BROOKHAVEN NATIONAL LABORATORY

SPILL PREVENTION CONTROL & COUNTERMEASURE PLAN (SPCC)

Facility & Operations Directorate
Energy & Utilities Division
Building 134C, 35 Brookhaven Avenue
Upton, New York 11973

Brookhaven National Laboratory is Operated by Brookhaven Science Associates for the US Department of Energy

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Spill Prevention Control and Countermeasures Plan (SPCC) Rule Cross-Reference

Final 2002 SPCC Rule (As Amended)	Description of Section	Corresponding BNL SPCC Plan Chapter/Section	Page
§ 112.7 - GENERAL REQUIREMENTS			
§ 112.7(a)	General requirements; discussion of facility's conformance with rule requirements; deviations from Plan requirements; facility characteristics that must be described in the Plan; spill reporting information in the Plan; emergency procedures.	Chapter 3 – In general	
§ 112.7(a)(1)	Discussion of facility's conformance with the requirements in this part.	Section 3.1 (Introduction)	3-1
§ 112.7(a)(2)	States that we must comply with all applicable requirements listed in this part and provides examples of sections that we can deviate from the requirements.	Revised Cross Reference will identify which sections were not applicable	iv
§ 112.7(a)(3)	Describe in your Plan the physical layout of the facility and include a facility diagram, which must mark the location and contents of each container. The facility diagram must include completely buried tanks that are otherwise exempted from the requirements of this part under §112.1(d)(4). The facility diagram must also include all transfer stations and connecting pipes. You must also address in your Plan:	Section 3.7 – Scope Section 3.10 – BNL Facilities Section 12.0 – Site Plans	3-3 3-12 12-1
§ 112.7(a)(3)(i)	The type of oil in each container and its storage capacity;	Section 3.9 – Product Storage, Capacity and Throughput Section 3.11 – Description of Storage Tanks Tables 1-5	3-10 3-12 3-13
§ 112.7(a)(3)(ii)	Discharge prevention measures including procedures for routine handling of products (loading, unloading, and facility transfers, etc.);	Section 3.14 – Product Transfers	3-19
§ 112.7(a)(3)(iii)	Discharge or drainage controls such as secondary containment around containers and other structures, equipment, and procedures for the control of discharge;	Section 3.13 – Facility Drainage and Effluent Treatment	3-19
§ 112.7(a)(3)(iv)	Countermeasures for discharge discovery, response, and cleanup (both the facility's capability and those that might be required of a contractor);	Section 8.0 – Spill Response Capability and Inventory of Oil Spill Clean-up Equipment	8-1
§ 112.7(a)(3)(v)	Methods of disposal of recovered materials in accordance with applicable legal requirements; and	Included in Brookhaven National Laboratory's Facility Response Plan (FRP)	**See Note #1**
§ 112.7(a)(3)(vi)	Contact list and phone numbers for the facility response coordinator, National Response Center, cleanup contractors with whom you have an agreement for response, and all appropriate Federal, State, and local agencies who must be contacted in case of a discharge as described in §112.1(b).	Included in Brookhaven National Laboratory's Facility Response Plan (FRP)	**See Note #1**
§ 112.7(a)(4)	Unless you have submitted a response plan under §112.20, provide information and procedures in your Plan to enable a person reporting a discharge as described in §112.1(b) to relate information on the exact address or location and phone number of the facility; the date and time of the discharge, the type of material discharged; estimates of the total quantity discharged; estimates of the quantity discharged as described in §112.1(b); the source of the discharge; a description of all affected media; the cause of the discharge; any damages or injuries caused by the discharge; actions being used to stop, remove, and mitigate the effects of the discharge; whether an evacuation may be needed; and, the names of individuals and/or organizations who have also been contacted.	Covered in Brookhaven National Laboratory's Facility Response Plan (FRP)	**See Note #1**
§ 112.7(a)(5)	Unless you have submitted a response plan under §112.20, organize portions of the Plan describing procedures you will use when a discharge occurs in a way that will make them readily usable in an emergency, and include appropriate supporting material as appendices.		
FAULT ANALYSIS			
§ 112.7(b)	Where experience indicates a reasonable potential for equipment failure (such as loading or unloading equipment, tank overflow, rupture, or leakage, or any other equipment known to be a source of a discharge), include in your Plan a prediction of the direction, rate of flow, and total quantity of oil which could be discharged from the facility as a result of each type of major equipment failure.	Section 3.8.3 – Worst Case Discharges Section 9.3.2 – Spill Scenarios FRP (Section 1.4.3.1 – Spill Scenarios)	3-8 9-9 34

Spill Prevention Control and Countermeasures Plan (SPCC) Rule Cross-Reference

Final 2002 SPCC Rule (As Amended)	Description of Section	Corresponding BNL SPCC Plan Chapter/Section	Page
SECONDARY CONTAINMENT			
§ 112.7(c)	Provide appropriate containment and/or diversionary structures or equipment to prevent a discharge as described in §112.1(b), except as provided in paragraph (k) of this section for qualified oil-filled operational equipment, and except as provided in §112.9(d)(3) for flowlines and intra-facility gathering lines at an oil production facility. The entire containment system, including walls and floor, must be capable of containing oil and must be constructed so that any discharge from a primary containment system, such as a tank, will not escape the containment system before cleanup occurs. In determining the method, design, and capacity for secondary containment, you need only to address the typical failure mode, and the most likely quantity of oil that would be discharged. Secondary containment may be either active or passive in design. At a minimum, you must use one of the following prevention systems or its equivalent:	Section 3.12 – Secondary Containment	3-13
§ 112.7(c)(1)(i)	Dikes, berms, or retaining walls sufficiently impervious to contain oil;		
§ 112.7(c)(1)(ii)	Curbing or drip pans;		
§ 112.7(c)(1)(iii)	Sumps and collection systems;	Not Applicable	
§ 112.7(c)(1)(iv)	Culverting, gutters, or other drainage systems;	Not Applicable	
§ 112.7(c)(1)(v)	Weirs, booms, or other barriers;	Not Applicable	
§ 112.7(c)(1)(vi)	Spill diversion ponds;	Section 3.12 – Secondary Containment (transformers only)	3-18
§ 112.7(c)(1)(vii)	Retention ponds; or	Section 8.0 – Spill Response Capability and Inventory of Oil Spill Clean-up Equipment	8-1
§ 112.7(c)(1)(viii)	Sorbent materials.	Not Applicable	
§ 112.7(c)(2)(i)	For offshore facilities: Curbing or drip pans; or	Not Applicable	
§ 112.7(c)(2)(ii)	Sumps and collection systems.	Not Applicable	
CONTINGENCY PLANNING			
§ 112.7(d)	Provided your Plan is certified by a licensed Professional Engineer under §112.3(d), or, in the case of a qualified facility that meets the criteria in §112.3(g), the relevant sections of your Plan are certified by a licensed Professional Engineer under §112.6(d), if you determine that the installation of any of the structures or pieces of equipment listed in paragraphs (c) and (h)(1) of this section, and §§112.8(c)(2), 112.8(c)(11), 112.9(c)(2), 112.10(c), 112.12(c)(2), 112.12(c)(11), 112.13(c)(2), and 112.14(c) to prevent a discharge as described in §112.1(b) from any onshore or offshore facility is not practicable, you must clearly explain in your Plan why such measures are not practicable; for bulk storage containers, conduct both periodic integrity testing of the containers and periodic integrity and leak testing of the valves and piping; and, unless you have submitted a response plan under §112.20, provide in your Plan the following:		
§ 112.7(d)(1)	An oil spill contingency plan following the provisions of part 109 of this chapter.	Covered in Brookhaven National Laboratory's Facility Response Plan (FRP)	**See Note #1**
§ 112.7(d)(2)	A written commitment of manpower, equipment, and materials required to expeditiously control and remove any quantity of oil discharged that may be harmful.	Section 2.0 – Statement of Management Approval	2-1
INSPECTIONS, TESTS, AND RECORDS			
§ 112.7(e)	Conduct inspections and tests required by this part in accordance with written procedures that you or the certifying engineer develop for the facility. You must keep these written procedures and a record of the inspections and tests, signed by the appropriate supervisor or inspector, with the SPCC Plan for a period of three years. Records of inspections and tests kept under usual and customary business practices will suffice for purposes of this paragraph.	Section 7.1 – Inspection Appendix 6 – EU-CSF-016 Daily Fuel Tank Storage Facility Inspection Appendix 8 - Sample F&O Inspection Checklists	7-1, 7-2

Spill Prevention Control and Countermeasures Plan (SPCC) Rule Cross-Reference

Final 2002 SPCC Rule (As Amended)	Description of Section	Corresponding BNL SPCC Plan Chapter/Section	Page
EMPLOYEE TRAINING AND DISCHARGE PREVENTION PROCEDURES			
§ 112.7(f)(1)	At a minimum, train your oil-handling personnel in the operation and maintenance of equipment to prevent discharges; discharge procedure protocols; applicable pollution control laws, rules, and regulations; general facility operations; and, the contents of the facility SPCC Plan.	Section 11 – Training FRP (Section 1.8.3 – General Training)	11-0 55
§ 112.7(f)(2)	Designate a person at each applicable facility who is accountable for discharge prevention and who reports to facility management.	Section 11 – Training FRP (Section 1.8.3 – General Training)	11-0 55
§ 112.7(f)(3)	Schedule and conduct discharge prevention briefings for your oil-handling personnel at least once a year to assure adequate understanding of the SPCC Plan for that facility. Such briefings must highlight and describe known discharges as described in §112.1(b) or failures, malfunctioning components, and any recently developed precautionary measures.	Section 11 – Training FRP (Section 1.8.3 – General Training)	11-0 55
SECURITY (EXCLUDING OIL PRODUCTION FACILITIES)			
§ 112.7(g)	Describe in your Plan how you secure and control access to the oil handling, processing and storage areas; secure master flow and drain valves; prevent unauthorized access to starter controls on oil pumps; secure out-of-service and loading/unloading connections of oil pipelines; and address the appropriateness of security lighting to both prevent acts of vandalism and assist in the discovery of oil discharges.	Section 3.14 – Product Transfer Section 10.0 – Security Appendix #2 Appendix #3	3-19 10-1
LOADING/UNLOADING (EXCLUDING OFFSHORE FACILITIES)			
§ 112.7(h)(1)	Where loading/unloading area drainage does not flow into a catchment basin or treatment facility designed to handle discharges, use a quick drainage system for tank car or tank truck loading and unloading areas. You must design any containment system to hold at least the maximum capacity of any single compartment of a tank car or tank truck loaded or unloaded at the facility.	Section 3.12 – Secondary Containment Section 5.0 – Status of Compliance with NYSDEC Regulations	3-13 5-1
§ 112.7(h)(2)	Provide an interlocked warning light or physical barrier system, warning signs, wheel chocks, or vehicle break interlock system in loading/unloading areas to prevent vehicles from departing before complete disconnection of flexible or fixed oil transfer lines.	Section 3.14 Product Transfer Appendix #2 Appendix #3	3-19
§ 112.7(h)(3)	Prior to filling and departure of any tank car or tank truck, closely inspect for discharges the lowermost drain and all outlets of such vehicles, and if necessary, ensure that they are tightened, adjusted, or replaced to prevent liquid discharge while in transit.		
BRITTLE FRACTURE EVALUATION			
§ 112.7(i)	If a field-constructed aboveground container undergoes a repair, alteration, reconstruction, or a change in service that might affect the risk of a discharge or failure due to brittle fracture or other catastrophe, or has discharged oil or failed due to brittle fracture failure or other catastrophe, evaluate the container for risk of discharge or failure due to brittle fracture or other catastrophe, and as necessary, take appropriate action.	Section 7.1 - Inspection	7-1
CONFORMANCE WITH STATE REQUIREMENTS			
§ 112.7(j)	In addition to the minimal prevention standards listed under this section, include in your Plan a complete discussion of conformance with the applicable requirements and other effective discharge prevention and containment procedures listed in this part or any applicable more stringent State rules, regulations, and guidelines.	Section 5.0 – Status of Compliance with NYSDEC Regulations	5-1

Spill Prevention Control and Countermeasures Plan (SPCC) Rule Cross-Reference

Final 2002 SPCC Rule (As Amended)	Description of Section	Corresponding BNL SPCC Plan Chapter/Section	Page
QUALIFIED OIL-FILLED OPERATIONAL EQUIPMENT			
§ 112.7(k)	The owner or operator of a facility with oil-filled operational equipment that meets the qualification criteria in paragraph (k)(1) of this sub-section may choose to implement for this qualified oil-filled operational equipment the alternate requirements as described in paragraph (k)(2) of this sub-section in lieu of general secondary containment required in paragraph (c) of this section.	Section 3.12 – Secondary Containment Appendix 12 – Spill History	3-13
§ 112.7(k)(1)	*Qualification Criteria – Reportable Discharge History*: The owner or operator of a facility that has had no single discharge as described in §112.1(b) from any oil-filled operational equipment exceeding 1,000 U.S. gallons or no two discharges as described in §112.1(b) from any oil-filled operational equipment each exceeding 42 U.S. gallons within any twelve month period in the three years prior to the SPCC Plan certification date, or since becoming subject to this part if the facility has been in operation for less than three years (other than oil discharges as described in §112.1(b) that are the result of natural disasters, acts of war or terrorism); and		
§ 112.7(k)(2)	*Alternative Requirements to General Secondary Containment.* If secondary containment is not provided for qualified oil-filled operational equipment pursuant to paragraph (c) of this section, the owner or operator of a facility with qualified oil-filled operational equipment must:		
§ 112.7(k)(2)(i)	Establish and document the facility procedures for inspections or a monitoring program to detect equipment failure and/or a discharge; and		
§ 112.7(k)(2)(ii)	Unless you have submitted a response plan under §112.20, provide in your Plan the following:		
§ 112.7(k)(2)(ii)(A)	An oil spill contingency plan following the provisions of part 109 of this chapter.		
§ 112.7(k)(2)(ii)(B)	A written commitment of manpower, equipment, and materials required to expeditiously control and remove any quantity of oil discharged that may be harmful.		
§ 112.8 – SPECIFIC REQUIREMENTS (ONSHORE FACILITIES)			
§ 112.8(a)	If you are the owner or operator of an onshore facility (excluding a production facility), you must: (a) Meet the general requirements for the Plan listed under §112.7, and the specific discharge prevention and containment procedures listed in this section.	See § 112.7 Above	
FACILITY DRAINAGE			
§ 112.8(b)(1)	Restrain drainage from diked storage areas by valves to prevent a discharge into the drainage system or facility effluent treatment system, except where facility systems are designed to control such discharge. You may empty diked areas by pumps or ejectors; however, you must manually activate these pumps or ejectors and must inspect the condition of the accumulation before starting, to ensure no oil will be discharged.	Section 3.12 – Secondary Containment Section 3.13 – Facility Drainage and Effluent Treatment Appendix #1	3-13 3-18
§ 112.8(b)(2)	Use valves of manual, open-and-closed design, for the drainage of diked areas. You may not use flapper-type drain valves to drain diked areas. If your facility drainage drains directly into a watercourse and not into an on-site wastewater treatment plant, you must inspect and may drain uncontaminated retained stormwater, as provided in paragraphs (c)(3)(ii), (iii), and (iv) of this section.		
§ 112.8(b)(3)	Design facility drainage systems from undiked areas with a potential for a discharge (such as where piping is located outside containment walls or where tank truck discharges may occur outside the loading area) to flow into ponds, lagoons, or catchment basins designed to retain oil or return it to the facility. You must not locate catchment basins in areas subject to periodic flooding.	Not Applicable	
§ 112.8(b)(4)	If facility drainage is not engineered as in paragraph (b)(3) of this section, equip the final discharge of all ditches inside the facility with a diversion system that would, in the event of an uncontrolled discharge, retain oil in the facility.	Not Applicable	

Spill Prevention Control and Countermeasures Plan (SPCC) Rule Cross-Reference

Final 2002 SPCC Rule (As Amended)	Description of Section	Corresponding BNL SPCC Plan Chapter/Section	Page
§ 112.8(b)(5)	Where drainage waters are treated in more than one treatment unit and such treatment is continuous, and pump transfer is needed, provide two "lift" pumps and permanently install at least one of the pumps. Whatever techniques you use, you must engineer facility drainage systems to prevent a discharge as described in §112.1(b) in case there is an equipment failure or human error at the facility.	Not Applicable	
BULK STORAGE CONTAINERS			
§ 112.8(c)(1)	Not use a container for the storage of oil unless its material and construction are compatible with the material stored and conditions of storage such as pressure and temperature.	Section 3.11 – Description of Storage Tanks Tables 1-6	3-12
§ 112.8(c)(2)	Construct all bulk storage container installations so that you provide a secondary means of containment for the entire capacity of the largest single container and sufficient freeboard to contain precipitation. You must ensure that diked areas are sufficiently impervious to contain discharged oil. Dikes, containment curbs, and pits are commonly employed for this purpose. You may also use an alternative system consisting of a drainage trench enclosure that must be arranged so that any discharge will terminate and be safely confined in a facility catchment basin or holding pond.	Section 3.12 – Secondary Containment	3-13
§ 112.8(c)(3)	Not allow drainage of uncontaminated rainwater from the diked area into a storm drain or discharge of an effluent into an open watercourse, lake, or pond, bypassing the facility treatment system unless you: (i) Normally keep the bypass valve sealed closed. (ii) Inspect the retained rainwater to ensure that its presence will not cause a discharge as described in §112.1(b). (iii) Open the bypass valve and reseal it following drainage under responsible supervision; and (iv) Keep adequate records of such events, for example, any records required under permits issued in accordance with §§122.41(j)(2) and 122.41(m)(3) of this chapter.	Section 3.13 – Facility Drainage and Effluent Treatment	3-18
§ 112.8(c)(4)	Protect any completely buried metallic storage tank installed on or after January 10, 1974 from corrosion by coatings or cathodic protection compatible with local soil conditions. You must regularly leak test such completely buried metallic storage tanks.	Section 3.12 – Secondary Containment Table 2	3-13
§ 112.8(c)(5)	Not use partially buried or bunkered metallic tanks for the storage of oil, unless you protect the buried section of the tank from corrosion. You must protect partially buried and bunkered tanks from corrosion by coatings or cathodic protection compatible with local soil conditions.	Not Applicable	
§ 112.8(c)(6)	Test or inspect each aboveground container for integrity on a regular schedule and whenever you make material repairs. You must determine, in accordance with industry standards, the appropriate qualifications for personnel performing tests and inspections, the frequency and type of testing and inspections, which take into account container size, configuration, and design (such as containers that are: shop-built, field-erected, skid-mounted, elevated, equipped with a liner, double-walled, or partially buried). Examples of these integrity tests include, but are not limited to: visual inspection, hydrostatic testing, radiographic testing, ultrasonic testing, acoustic emissions testing, or other systems of non-destructive testing. You must keep comparison records and you must also inspect the container's supports and foundations. In addition, you must frequently inspect the outside of the container for signs of deterioration, discharges, or accumulation of oil inside diked areas. Records of inspections and tests kept under usual and customary business practices satisfy the recordkeeping requirements of this paragraph.	Section 7.0 – Inspection and Maintenance of Equipment	7-1
§ 112.8(c)(7)	Control leakage through defective internal heating coils by monitoring the steam return and exhaust lines for contamination from internal heating coils that discharge into an open watercourse, or pass the steam return or exhaust lines through a settling tank, skimmer, or other separation or retention system.	Not Applicable	

Spill Prevention Control and Countermeasures Plan (SPCC) Rule Cross-Reference

Final 2002 SPCC Rule (As Amended)	Description of Section	Corresponding BNL SPCC Plan Chapter/Section	Page
§ 112.8(c)(8)	Engineer or update each container installation in accordance with good engineering practice to avoid discharges. You must provide at least one of the following devices: (i) High liquid level alarms with an audible or visual signal at a constantly attended operation or surveillance station. In smaller facilities an audible air vent may suffice. (ii) High liquid level pump cutoff devices set to stop flow at a predetermined container content level. (iii) Direct audible or code signal communication between the container gauger and the pumping station. (iv) A fast response system for determining the liquid level of each bulk storage container such as digital computers, telepulse, or direct vision gauges. If you use this alternative, a person must be present to monitor gauges and the overall filling of bulk storage containers. (v) You must regularly test liquid level sensing devices to ensure proper operation.	Section 3.11 – Description of Storage Tanks Section 5.0 – Status of Compliance with NYSDEC Regulations Tables 1 and 2	3-12 5-1
§ 112.8(c)(9)	Observe effluent treatment facilities frequently enough to detect possible system upsets that could cause a discharge as described in §112.1(b).	Not Applicable	
§ 112.8(c)(10)	Promptly correct visible discharges which result in a loss of oil from the container, including but not limited to seams, gaskets, piping, pumps, valves, rivets, and bolts. You must promptly remove any accumulations of oil in diked areas.	Section 7.1 – Inspection of Equipment	7-1
§ 112.8(c)(11)	Position or locate mobile or portable oil storage containers to prevent a discharge as described in §112.1(b). You must furnish a secondary means of containment, such as a dike or catchment basin, sufficient to contain the capacity of the largest single compartment or container with sufficient freeboard to contain precipitation.	Section 3.14 – Product Transfer	3-19
FACILITY TRANSFER OPERATIONS, PUMPING, AND FACILITY PROCESS			
§ 112.8(d)(1)	Provide buried piping that is installed or replaced on or after August 16, 2002, with a protective wrapping and coating. You must also cathodically protect such buried piping installations or otherwise satisfy the corrosion protection standards for piping in part 280 of this chapter or a State program approved under part 281 of this chapter. If a section of buried line is exposed for any reason, you must carefully inspect it for deterioration. If you find corrosion damage, you must undertake additional examination and corrective action as indicated by the magnitude of the damage.	Not Applicable	
§ 112.8(d)(2)	Cap or blank-flange the terminal connection at the transfer point and mark it as to origin when piping is not in service or is in standby service for an extended time.	Section 3.14 – Product Transfer Appendix #2 and #3	3-19
§ 112.8(d)(3)	Properly design pipe supports to minimize abrasion and corrosion and allow for expansion and contraction.	Section 3.11 – Description of Tanks	3-12
§ 112.8(d)(4)	Regularly inspect all aboveground valves, piping, and appurtenances. During the inspection you must assess the general condition of items, such as flange joints, expansion joints, valve glands and bodies, catch pans, pipeline supports, locking of valves, and metal surfaces. You must also conduct integrity and leak testing of buried piping at the time of installation, modification, construction, relocation, or replacement.	Section 7.1 – Inspection of Equipment Appendix #6	7-1
§ 112.8(d)(5)	Warn all vehicles entering the facility to be sure that no vehicle will endanger aboveground piping or other oil transfer operations.	Section 10.0 – Security	10-1

Note #1: BNL's Facility Response Plan (FRP) is included with the SPCC Plan. The FRP discusses response to minor as well as worst case discharge scenarios and is prepared in accordance with the requirements of 40 CFR Part 112.20.

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Managed by Brookhaven Science Associates
For the U.S Department of Energy

Mr. Michael D. Holland
Brookhaven Site Manager
U.S. Department of Energy
Upton, NY 11973

Subject: SPILL PREVENTION CONTROL AND COUNTERMEASURE PLAN

Dear Mr. Holland:

The undersigned Registered Professional Engineer is familiar with the requirements of Chapter 40 of the Code of Federal Regulations Part 112 (40 CFR 112) and has supervised examination of the facility. The undersigned Registered Professional Engineer attests that this Oil Spill Prevention, Control and Countermeasure Plan has bee prepared in accordance with good engineering practices including applicable industry standard, and in accordance with the requirements of Chapter 40 of the Code of Federal Regulations 40 CFR 112; that procedures have been established for required inspections and testing; and that the Plan is adequate for the facility.

William L. Chaloupka, P.E.

Name

[Signature and P.E. Stamp on File]

Signature

Manager, Utilities Complex

Title

March 2, 2011

Date

N.Y.S.P.E. #62038

P.E. Registration Number

2.0 STATEMENT OF MANAGEMENT APPROVAL

2.1 Issuing Authority

The Spill Prevention Control and Countermeasure (SPCC) Plan is prepared by Brookhaven National Laboratory's (BNL's) Facilities and Operations (F&O) Directorate, with assistance from the Environmental Protection Division (EPD), in accordance with 40 CFR Part 112.3(d).

This plan has been for reviewed and certified by a Professional Engineer licensed in the State of New York. By means of this Certification the engineer, having examined the facility and being familiar with the provisions of this plan, attests that the SPCC Plan has been prepared in accordance with good engineering practices. Such certification appears at the beginning of this document.

2.2 Periodic Update

The SPCC Plan will be periodically updated in accordance with 40 CFR Part 112.5.

1. Whenever there is a change in facility design, construction, operation or maintenance which materially affects the facilities potential for discharge of oil into or upon the waters of the United States or the adjoining shoreline.

2. A review and evaluation shall be completed once every five years from the date such facility becomes subject to this part. As a result of this review and evaluation, the plan shall be amended within six months to include more effective prevention and spill control technologies.

2.3 Organizational Responsibility

The Manager of the Energy and Utilities Division within the F&O Directorate is responsible for the periodic review and updating of the plan. He is also responsible for action in prevention, control, clean-up and remediation in the event of any spill covered by this plan.

The EPD Division Manager is responsible for ensuring timely regulatory guidance, technical assistance, and notifications to off-site regulatory agencies as required.

2.4 Implementation

The mission of Brookhaven National Laboratory, F&O Directorate, is to operate and maintain the physical plant of Brookhaven National Laboratory and the surrounding landscape; to administer the conventional construction program; to provide design, engineering and crafts services in support of the scientific efforts undertaken by the Laboratory, including the development and execution of policy regarding environmental planning and control of the physical plant. The F&O Directorate will comply with all

applicable BNL policies, DOE Orders, Federal, State, and local laws and regulations and applicable contracts and agreements. As such, any and all resources at my disposal as Manager of the Energy and Utilities Division are hereby committed to control the discharge of oil to the environment and remediate the results of such discharge.

[Signature on File]

E. T. Murphy
Manager – Energy & Utilities Division

March 2, 2011

Date

3.0 GENERAL INFORMATION

3.1 Introduction

The purpose of the Federal Water Pollution Control Act, as amended {sec. 2, Pub. L. 92-500, 86 Stat. 816, (33 USC 1251 et seq.)} is to prevent the discharge of oil into navigable waters and establish safeguards for containing discharges if they occur. This plan is prepared under the requirements of, and in accordance with, the following applicable sections of the Code of Federal Regulations (CFR).

- 40 CFR Part 109 Criteria for State, Local and Regional Oil Removal Contingency Plans
- 40 CFR Part 110 Discharge of Oil
- 40 CFR Part 112 Oil Pollution Prevention

These regulations were reviewed and this SPCC Plan was revised to include all applicable amendments as published in 74 FR 58784, November 2009.

The scope of this SPCC Plan includes Oil and Chemical releases but does not address prevention of radiation releases. These materials are addressed under other BNL policies, procedures, and programs.

The Oil Pollution Act of 1990 (OPA 90) mandates a Facility Response Plan (FRP) as an addition to the SPCC Plan. This document was initially prepared for BNL by Ecology and Environment, Inc., based on information available in the Coast Guard Navigation and Vessel Inspection Circular (NVIC) 7-92 and OPA 90. A copy of the Facility Response Plan was forwarded to the USEPA in February, 1993 and updated in accordance with the July 1994 amendments in February, 1995. The Facility Response Plan was revised in December 1999 to reflect changes in format and inclusion of additional information identified by the Environmental Protection Agency in August 2000 and again in September 2002. In 2006, the EPA completed a full review of BNL's FRP and performed a field inspection. Approval of the FRP was granted in September 2006 based upon the regulatory requirements set forth in the EPA's FRP rule (40 CFR Part 112). The FRP is currently being reviewed and updated (5-year review) and a copy of the updated plan (February 2011) will be forwarded to the USEPA and the NYSDEC under a separate cover.

Brookhaven National Laboratory (BNL) is a multi-disciplinary scientific research facility located in Brookhaven Township, Suffolk County, New York, at approximately the geographic center of Long Island. The nearest body of navigable water is approximately two (2) kilometers from the nearest oil or petroleum storage area. Therefore, the possibility of an oil spill into a navigable body of water is extremely remote. However, BNL is located in the deep recharge area of the sole source aquifer.

Long Island is a terminal moraine deposited by the glaciers at the end of the last ice age.

The composition of the soil is sand and gravel with some alluvial clay, and is extremely permeable. There are no surface water sources utilized for potable (drinking) water use. Long Island potable water is typically supplied from wells drilled into the underlying aquifer system. The area upon which the laboratory is located has been designated as the primary recharge area for the sole source aquifer and merits special protection. Therefore, this SPCC Plan has been prepared to provide pre-planned procedures to be initiated in the event of a casualty to an oil storage tank or associated piping to protect the sole source aquifer, as well as the possibility of oil migrating via the storm drainage or surface runoff to the headwaters and tributaries of the Peconic River.

3.2 Name and Location of Facility

BROOKHAVEN NATIONAL LABORATORY
SUFFOLK COUNTY
BROOKHAVEN TOWNSHIP
UPTON, LONG ISLAND, NEW YORK 11973

Longitude West 72 degrees 52 minutes 17 seconds
Latitude North 40 degrees 52 minutes 03 seconds

3.3 Name and Location of Owner and Operator of Facility

Owner:
U.S. DEPARTMENT OF ENERGY
BROOKHAVEN SITE OFFICE (BHSO)
53 BELL AVENUE, Building 464
UPTON, NEW YORK 11973
Attention: Mr. M. Holland, Brookhaven Site Manager

Operator of Facility:
BROOKHAVEN SCIENCE ASSOCIATES
DIRECTORS OFFICE
BROOKHAVEN NATIONAL LABORATORY
40 BROOKHAVEN AVENUE Building 460
UPTON, NEW YORK 11973
Attention: Dr. Sam Aronson, Director

3.4 Date of Initial Operation

BNL's oil storage facility became operational in 1948 when the Central Steam Facility (CSF) came on line to supply steam needs of the developing site. The first fuel oil tank was installed in January 1948. The site was classified as a Major Petroleum Facility (due to the volume of oil in storage) in 1978.

3.5 Purpose

The purpose of this plan is to:

1) Provide a comprehensive description of the on-site fuel oil storage areas including, but not limited to the following:

   A) List of applicable tanks
   B) Description of tanks (Age, Material, Size, Capacity)
   C) Containment provided for the tanks
   D) Overfill Protection

2) Provide a list of available on-site (BNL) resources for use to contain, control, and clean up any anticipated oil spill.

3) Provide a contingency plan for an oil spill of such magnitude that would require the use of additional (outside Contractor) resources.

3.6 Applicability

This SPCC Plan applies to all locations on the BNL site where oil or petroleum products may spill - resulting in a release of such quantities as to cause the discharge of said oil or petroleum products into or upon the navigable waters of the United States or adjoining shorelines. Application is without regard to whether the tanks or storage facilities are located above or below ground.

3.7 Scope

This Plan applies to all locations where oil or petroleum products are stored.

Specifically defined locations are locations where the storage of petroleum products exceeds 250 barrels (10,500 gallons), comprise approximately 98% of the consumable oil (gasoline, diesel, #2 and #6 fuel oil) stored on-site. These tanks are fully defined in Sections 3.9-3.11, Tables 1 and 2, and located on the attached site plans (Section 12), and are summarized below:

Facility	Capacity (Gals)
Building 610 - Central Steam Facility	2,300,000
Building 630 - Service Station	24,550
Building 651 - Site Equipment Fuel Storage	20,000
Building 423 - Staff Services Garage	16,000
Total Capacity	2,405,242

Generally included locations are locations where there is a need for petroleum products for building heat (#2 Fuel oil), Emergency Power (#2 Diesel fuel), or other miscellaneous petroleum needs (motor oil, waste oil, lube oil). The total quantities stored are less than

900 barrels, the tanks are scattered throughout the site, and there is no interconnecting piping. Delivery is by contract vendor or local transport. The point of consumption locations are summarized below:

Operation	Petroleum Product	No. of Locations	Total Capacity
Satellite heating systems	#2 Fuel oil	11	14,020 Gals.
Emergency Power supplies	#2 Diesel fuel	28	16,535 Gals.
Misc. Petroleum Storage	Motor/Waste/Lube Oil	8	7,230 Gals.

These 47 tanks, containing approximately 37,800 gallons (1.5% of the consumable petroleum storage) are listed for reference in Tables 3, 4, and 5.

These tanks are all 6,000 gallons or less and are scattered around the site. They are also described and located in the BNL Environmental Protection Division (EPD) Tank Database, available at Building 120, Upton, New York, 11973.

The notification and spill response sections are fully applicable, in all regards, to provide documentation, notification, and remediation in the event of an oil spill from these tanks.

Transformers

There are numerous power transformers (i.e., oil-filled equipment), installed either singularly or in groups (Substations), located throughout the site. Petroleum products, (mineral oil, Non-PCB) are used, but not consumed, as a dielectric and a coolant. Typically, the oil is placed in the transformer at the time of manufacture or, at the time of installation. The total oil involved is approximately 150,000 gallons.

Electrical equipment such as transformers and capacitors comprise approximately 6% of the aboveground oil storage capacity. With the exception of individual transformers containing greater than 600 gallons and/or consolidated into substations, the majority of this equipment is small, containing less than 100 gallons.

Over the last three years, less than 20 gallons of oil have been spilled from transformers. BNL's high voltage substations provide the greatest potential for large volume transformer spills. The largest transformer on the facility, containing 5,500 gallons is located adjacent to the CSF.

In the late 1990's several of the large electrical substations were upgraded and secondary containment was provided. Most of the other smaller transformers do not have secondary containment; however, these and the larger transformers discussed above are included in a routine inspection and maintenance program that would detect a failure and/or discharge.

The transformers are listed in Table 6, for reference. Additional information is available through the Facilities and Operations Maintenance Management System. A diagram of transformer and tank locations is provided as Exhibit F, Figure 3 in BNL's Facility Response Plan (BNL, 2011).

The written commitment of manpower, equipment, and materials to quickly control and remove any discharged oil that is included in this plan and BNL's FRP applies to this type of oil-filled equipment.

3.8 Site Geography

BNL is located at the geographical center of Long Island, New York. The site elevation varies from approximately 43 feet to 120 feet above sea level. The mean elevation in the developed section of the site is approximately 75 feet above sea level. The soil is composed mostly of sand and gravel deposited by glaciers at the end of the last ice age. There are no surface sources that are currently utilized for potable water on the island. BNL's potable and process water is obtained from wells by pumping from the underlying aquifer system. At BNL, the depth to water ranges from approximately 50 feet at the western portion of the site to approximately 8 feet in the vicinity of Sewage Treatment Plant (STP) at the eastern portion of the site. In most areas, the average depth to water is approximately 30 feet.

The site is served by a Sewage Treatment Plant (STP) with a rated capacity of 2,300,000 gallons per day (2.3 MGD) with an average flow of approximately 0.30 MGD. Treated effluent is discharged to the Peconic River. There is a current State Pollution Discharge Elimination System (SPDES) permit, number NY0005835, issued by the New York State Department of Environmental Conservation for the STP discharge. The Peconic River is the only free flowing water source on the site. The average flow is approximately 0.05 MGD above the discharge from the STP and approximately .55 MGD as measured ¼ mile below the outflow from the STP (Monitoring Station HM North). During periods of heavy rain, the up stream flow can crest at 2.0 MGD; conversely, during periods of drought, the stream is dry.

3.8.1 Surface Water

The terrain of the site is gently rolling, with elevations varying between 120 and 43 feet above sea level. The land lies on the western rim of the shallow Peconic River water shed. The marshy areas in the north and eastern sections of the site are part of the Peconic River headwaters. The Peconic River both recharges to, and receives water from the groundwater aquifer depending on the hydrological potential. In times of drought, the river typically recharges to groundwater (i.e., an influent stream) while with normal to above-normal precipitation, the river receives water from the aquifer (i.e., an effluent stream) thus the river on-site is classified as an intermittent river.

The largest source of water to the system is the BNL Sewage Treatment facility which contributes approximately 300,000 gallons per day (0.30 MGD). The discharge is in a permitted SPDES point (NY0005835). The facility was upgraded to secondary treatment with the addition of modular aeration and Ultra Violet Disinfection. The system also includes two (2) lined ponds to be used to divert the water flow from the river in the event of a petroleum release to the facility.

3.8.2 Storm Water Runoff

The developed areas on the BNL site require proper storm water management to minimize any adverse affects of parking area runoff, fertilizers and pesticides or inadvertent release of hazardous or toxic materials.

The site storm water runoff is channeled to several recharge basins generally located all around the periphery of the developed portion of the site. The storm water is collected in catch basins and/or diverted to culverts and conveyed to low lying areas, and/or drywells, and/or recharge basins. A small portion of the rainfall is collected in bermed areas around aboveground storage tanks and outdoor electrical transformer pads, which is diverted to the sanitary sewer system after inspection for visible sheen.

Ten major recharge sections serve the site, with the following designations: HN, HO, CSF, HWMF, HW, HX, HP, HS, SSSG, and HT. Each section is served by a recharge basin or low lying drainage area. Four of these areas (HN, HO, HS, & HT) have an effluent flow gauging and monitoring station. The stations are equipped with flow monitoring instrumentation consisting of either an H or Parshall Flume. The flowmeters are connected to a circular flow chart which continually monitors the discharge flow to the recharge area. The flow recording equipment is housed in a concrete block building which also contains an automatic refrigerated composite sampler. These samplers may be used to collect composite samples for compliance monitoring. Recharge basins HN, HO, HS, HT, CSF, HX, and HW are permitted point source discharges under the Laboratory SPDES Permit. Each is defined as a groundwater discharge. There are no surface water impacts associated with these basins. Consequently, releases of oil and other contaminants during fueling, other transfers or spills collected by these systems have no surface water impact.

<u>Recharge Basin HN</u> - Low Lying areas within the RHIC Ring

Recharge Basin HN consists of three basins located within the Relativistic Heavy Ion Collider (RHIC) ring. This recharge basin receives point discharges of secondary cooling water blowdown from the Alternate Gradient Synchrotron (AGS) and RHIC cooling towers. Storm water from the developed industrial areas is also directed to this recharge basin.

<u>Recharge Basin HO</u> - Excavated basin between the large Water Tower (Building 640) and the Waste Management Facility (WMF)

Recharge basin HO consists of two recharge basins that receive storm water from the surrounding industrial areas and two point discharges. The point discharges consist of once-through secondary cooling water from the AGS main magnet heat exchanger located in building 911 and once through cooling water from several large air handlers in building 901. The buildings in the developed industrial areas

consist mostly of offices and laboratories. The materials in storage in these areas is in storage cabinets and not exposed to storm water and are not considered potential point source discharges to ground water.

Recharge Basin HW - Low lying are a north of and along Weaver Drive

Recharge Basin HW receives storm water from the surrounding industrial areas. This area consists primarily of the NSLS-II construction site, the storage area adjacent to building 452, and the heavy machine shop, Building 479.

Recharge Basin HS - Excavated Basin South of East Princeton Avenue

Recharge Basin HS receives point discharge flow from the NSLS. Storm water drainage from the developed industrial area is also directed to this basin. The greatest risk of petroleum contamination is Building 630 – Service Station. This facility is an automotive service station operated by a contract operator providing gasoline and service to the sites general population. The potential for automotive fluids to be released to the environment arise from the activities performed during fueling of vehicles and during vehicle repair operations. The greatest potential release is that of the complete discharge of a transport tanker during fuel receiving operations.

Recharge Basin HP - Excavated basin at the corner of East Princeton Avenue and Rochester Street

Recharge Basin HP receives storm waters from the developed areas around buildings 493 and 494.

Recharge Basin HX - Excavated basin east of Upton and immediately north of Building 624

Basin HX receives filter backwash water from the Water Treatment Facility and rainfall runoff by sheet flow from adjacent developed areas.

Recharge Basin HT - Low lying area along the west side of west Fifth Ave between bldg. 930 and 919

Recharge basin HT receives storm water drainage from the developed areas northwest of the AGS and point discharge of cooling water blowdown from the Linear accelerator.

Central Steam Facility Outfall - Low lying area south of the large water tower Building 640

This area receives storm water drainage from the area surrounding the Central Steam facility and the Major Petroleum Facility storage areas. This area is bounded on the East Side by First Street. In general it consists of heavy growth

and dense vegetation and comprises about 360,000 square feet.

FHWMF Area Wetlands - Low lying area adjacent to the Hazardous Waste Management area

Receives water by sheet flow from the former hazardous waste management facility area.

SSSG Ground Surface

Storm water drainage from the developed areas surrounding the Site and Staff services garage (SSSG) discharge to ground surface via sheet flow in this area. There are also several catch basins along the roads in this area which also discharge to ground surfaces.

3.8.3 Worst Case Discharges

All fuel storage tanks at the Central Steam Facility are in containment areas sufficient to contain 110% of the contents of the largest tank within. Any discharge of product would require several failures to occur before a discharge could occur.

Tank Overflow

The following failures are required:

1. Failure of the High Level Alarm to notify the Engineers.
2. Failure of the High High Level Alarm to secure the pump.
3. Transfer or receiving in to a tank with insufficient capacity.
4. Failure of the Engineer to perform the required inspections and procedures as in EU-CSF-004; EU-CSF-009; EU-CSF-016.

Total Quantity Discharged:
Limited to the discharge of four trucks in the unloading facility or four hours transfer pumping, 30,000 gallons. This is easily contained in the bermed areas of all tanks.

Tank Leakage (non catastrophic failures)

The following failures are required:

1. Failure of a gasket, flange or joint.
2. Failure of the Engineer to perform the required inspections and procedures as in EU-CSF-004; EU-CSF-009; EU-CSF-016.

Total Quantity Discharged:
Limited to 24 hours of continued leakage, 24 Hours at 1,000 gallons per hour

(24,000 gallons). This is easily contained in the bermed areas of all tanks.

Tank or main fuel oil line rupture

The following failures are required:

1. Catastrophic condition such as a plane crash into the tank, and or into a fuel oil line.
2. Failure of containment. (Simple failure of the tank would confine the contents of the tank to the berm)

OR

1. Failure of a Fuel Oil Line outside the containment.
2. Failure of the Engineer to perform the required inspections and procedures as in EU-CSF-004; EU-CSF-009; EU-CSF-016.

Total Quantity Discharged:
The rapid discharge of the largest fuel oil tank, assuming it is full, is 600,000 gallons.

Flow Rate and Direction:
It may be assumed that such an event would attract the attention of the responsible engineers and actions to mitigate the event would begin immediately.

1. Discharge to the Sanitary Sewer system

   a. Given the rate of flow in the Sanitary Sewer system, it would require two (2) hours for the oil to reach the facility.
   b. Upon detection, the flow would be diverted to either of two 4,000,000 gallon holding ponds. Given a normal Sewer flow of 0.30 MGD, the discharge of 600,000 gallons (0.6MG), a rain event (1.0 MG), and one full pond, the capacity is sufficient for at least 2 days of operation.
   c. In the event that diversion is delayed, the Sewage Treatment facility has the following containment capacity within the operating system:

      Primary Clarifier – 29,000 gallons (Currently Out of Service)
      Modular Aeration Tank (one of two) - 185,800 gallons
      Secondary Clarifier Tank (one of two) - 2,050 gallons
      Sand filters (three acres) – 383,000 gallons would cover the sand to a depth of about 6 inches. The heavy #6 oil would be cooled by the sewage water and congeal on top of the sand filter media. The under drains in the sand filter beds would also form a “trap” to prevent oil, if it penetrated the beds, from reaching the Peconic River.

2. Discharge to the land surface in the vicinity of the Central Steam Facility

a. The area surrounding the tank farm is gently sloping towards the east. There are numerous small depressions and storm water catch basins to catch and contain some of the oil.
b. The nearest storm drain system is approximately 1,000 feet east of the fuel tanks. This system drains to the CSF Outfall drainage area (see Section 3.8.2). This area is sufficient to contain any possible discharge from the Fuel Storage Area. The vegetation would impede the flow of oil allowing it to cool and solidify. The natural depressions and gradual slope would further slow the flow of oil. Additionally, the area along First Street on the eastern side of this area (approximately 3,000 feet east of the Major Petroleum Facility) could be excavated and bermed to contain the spill.
c. Beyond First Street, is an additional flat area of approximately 150 acres where the oil could be contained.

In conclusion, there are no reasonable or foreseeable circumstances whereby an oil discharge could reach the surface waters.

3.9 Product Storage, Capacity and Throughput

The products stored at the site are petroleum fuels used for site operations only to generate steam and hot water for building heat and as fuel for cars, trucks, and heavy equipment.

Central Steam Facility - Building 610 - 2,300,000 Gallons
(Design Capacity - In-Service Tanks Only)

Tank Number	Design Capacity (Gals.)	Usual Product Stored	Present Use
3 (611C)	300,006	ASTM #6 Fuel Oil	In Service
4 (611D)	400,008	ASTM #6 Fuel Oil	In Service
5 (611E)	300,006	ASTM #2 Fuel Oil	In Service
6 (611F)	300,006	ASTM #2 Fuel Oil	In Service
9 (611G)	400,000	ASTM #6 Fuel Oil	In service
10 (611H)	600,000	ASTM #6 Fuel Oil	In service

Note: Tanks removed and so noted in the October 2007 SPCC Plan were deleted from this list.

For additional information, see Table 1

Throughput for the Central Steam Facility for Fiscal Year 2010 (October 1, 2009 to September 30, 2010) was as follows:

ASTM #6 Fuel Oil	465,178	Gallons
ASTM #2 Fuel Oil	79,532	Gallons
Total Fuel Throughput	544,710	Gallons FY 2010
Average Daily Throughput	1,490	Gallons per day

Site and Staff Services Garage - 36,000 gallons (Total capacity)

Tank No.	Capacity Gallons	Product Stored
Building 651		
1	5,000	ASTM Diesel Fuel Oil
2	10,000	ASTM Diesel Fuel Oil
3	5,000	ASTM Diesel Fuel Oil
Building 423		
1	8,000	Unleaded Gasoline
2	8,000	Unleaded Gasoline

For additional information, see Table 2

Throughput for the Site and Staff Services Garage Fiscal Year 2010 (October 1, 2009 to September 30, 2010) was as follows:

ASTM Diesel Fuel Oil	60,050	Gallons
Unleaded Gasoline	60,108	Gallons
Total Fuel Throughput	120,158	Gallons (FY 2010)
Average Daily Throughput	481	Gallons per day (250 work days per year)

Building 630 Service Station - 24,000 Gallons (Total capacity)

Tank No.	Capacity Gallons	Product Stored
1	8,000	Regular Gasoline
2	8,000	Premium Gasoline
3	8,000	Plus Gasoline

For additional information, see Table 2

Throughput for the Upton Service Station for Fiscal Year 2010 (October 1, 2009 to September 30, 2010) was as follows:

Unleaded Gasoline	145,281	Gallons
Average Daily Throughput	581	Gallons per day (250 work days per year)

3.10 Description of BNL Facilities

Brookhaven National Laboratory (BNL) is a multi-disciplinary scientific research facility located in Brookhaven Township, Suffolk County, New York State, at approximately the geographic center of Long Island. The entire property (5,300) acres is owned and operated by the U. S. Government and administered by the Department of Energy (DOE) through a long term contract to Brookhaven Science Associates (BSA). The facility is used to conduct research in many areas including the Biological Sciences, Particle Physics, Medical Research, Material Sciences, etc.

Central Steam Facility:

Provides steam for heating and process applications to the central site area. The boilers supply 125 psig. saturated steam to a district heating system comprising approximately 11 miles of supply and condensate return piping. The combined capacity of the plant is 475,000 pounds of steam per hour, with a winter peak load of 160,000 pounds of steam per hour and an average winter load of about 100,000 pounds of steam per hour.

Site and Staff Services Garage:

Provides for maintenance and service for the fleet of government owned and operated vehicles used on site. This fleet is composed of various passenger cars (Sedans), utility vehicles, (Pick up trucks and Panel trucks), heavy equipment, (Cranes, Dump trucks, bulldozers etc.) and Fire and Rescue equipment.

Building 630 Service Station:

This is an independently operated on-site service station that provides service for the employee's vehicles. In all ways, it operates as an independent service station. It is open 5 days per week.

3.11 Description of Storage Tanks

The following tables (Tables 1 to 6) provide a full detailed description and inventory of the petroleum storage and Electric Transformer capacity at Brookhaven National Laboratory.

Aboveground fuel oil storage tanks are constructed of steel or aluminum in accordance to general industry standards (API 650, Underwriters Laboratories, etc.) and are fitted with pressure and vacuum relief vents. The material and construction is compatible with this service. Piping supports are properly designed to minimize abrasion and corrosion and allow for expansion and contraction as required by CFR 112.8(d)(3).

Underground storage tanks at BNL are constructed of Fiberglass Reinforced Plastic (FRP) coated double-walled steel tanks in accordance with petroleum industry standards and are regulated by Federal and New York State UST regulations, 40 CFR Part 280 and

Table 1
PHYSICAL CHARACTERISTICS OF PETROLEUM BULK STORAGE TANKS
Brookhaven National Laboratory Central Steam Facility

Tank Number	Capacity Barrels	Product Stored	Service IN/OUT	Axis	Year Installed (Built)	Diameter (feet)	Height Length (feet)	Floor (ends)	Shell Thickness	Roof Thickness	Material	Tank Remote Level*	Tank Local Level*	Tank High Level*	Support Type*	Manufactuters Design Criteria & Notes*
3 (611C)	7143	#6 Oil	IN	Vertical	1964	40.00	32.00	1/4" Pl	0-16'H=1/4" 16-32'H=3/16"	3/16" Pl	ASTM-A283 Grade C	1	3,4,5	1,2	1	Buffalo Tank API Std.650
4 (611D)	9524	#6 Oil	IN	Vertical	1974	42.50	40.00	1/4" Pl	1/4" Pl	1/4" Pl	ASTM-A283 Grade C	1	3,4,5	1,2	1	Chicago Bridge API Std.650
5 (611E)	7143	#2 OIL	IN	Vertical	1983	38.00	35.50	1/4" Pl	1/4" Pl	3/16" Pl	A-283-C	1	3,4,5	1,2	1	Buffalo Tank API Std. 650
6 (611F)	7143	#2 OIL	IN	Vertical	1983	38.00	35.50	1/4" Pl	1/4" Pl	3/16" Pl	A-283-C	1	3,4,5	1,2	1	Buffalo Tank API Std. 650
9 (611G)	9330	#6 Oil	IN	Vertical	1989	48.00	30.00	1/4" Pl	1/4" Pl		SA-283-C	1	3,4,5	1,2	1	Pittsburg-Desmoines API 650
10 (611H)	14115	#6 Oil	IN	Vertical	1989	48.00	45.00	1/4" Pl	1/4" Pl-Ring 1 1/4" Pl-Ring 2-5		A-36 A-283-C	1	3,4,5	1,2	1	Pittsburg-Desmoines API 650

Capacity 54,398.00 BARRELS
2,284,716 GALLONS

*** Additional information are found on page 3-13 of this section**

Table 2
PHYSICAL CHARACTERISTICS OF PETROLEUM BULK STORAGE TANKS
Brookhaven National Laboratory Site, Staff and Contractor Service Stations

Tank Number	Capacity Barrels	Axis	Year Installed	Diameter (feet)	Length (feet)	Product Stored	Material	Tank Remote Level*	Tank Local Level*	Tank High Level*	Support Type*	Manufactuters Design Criteria & Notes*
Building 630 (Upton Service Station)												
630-06	190.48	Horizontal	1990	8.0'	21.30	Regular Gasoline	Steel	6	5	3	Buried	FRP Coated Double-Walled Steel Tank (STI-P3)
630-07	190.48	Horizontal	1990	8.0'	21.30	Premium Gasoline	Steel	6	5	3	Buried	FRP Coated Double-Walled Steel Tank (STI-P3)
630-08	190.48	Horizontal	1990	8.0'	21.30	Regular Gasoline	Steel	6	5	3	Buried	FRP Coated Double-Walled Steel Tank (STI-P3)
630-09	13.09	Horizontal	1990	4.0'	5.30	Waste Oil	Steel	6	5	3	Buried	FRP Coated Double-Walled Steel Tank (STI-P3)
Capacity:	584.53	BARRELS										
	24,550	GALLONS										
Building 651 Diesel Tank Farm												
651-02	238.09	Horizontal		7.0'	36'	Diesel Fuel	Steel	2	5	1	2	Above Ground
651-03	119.05	Horizontal		7.0'	17.5'	Diesel Fuel	Aluminum	2	5	1	2	Above Ground
651-04	119.05	Horizontal		7.0'	17.5'	Diesel Fuel	Aluminum	2	5	1	2	Above Ground
Capacity:	476.19	BARRELS										
	20,000	GALLONS										
Building 423 (Staff Services Motor Pool)												
423-06	190.48	Horizontal	1990	8.0'	21.33'	E-85	Steel	6	5	3	Buried	FRP Coated Double-Walled Steel Tank (STI-P3)
423-07	190.48	Horizontal	1990	8.0'	21.33'	Regular Gasoline	Steel	6	5	3	Buried	FRP Coated Double-Walled Steel Tank (STI-P3)
Capacity:	380.96	BARRELS										
	16,000	GALLONS										

*** Additional information are found on page 3-13 of this section**

Table 3
PHYSICAL CHARACTERISTICS OF PETROLEUM BULK STORAGE TANKS
#2 Fuel Oil – Satellite Heating Systems on BNL Site

Building Number	Building Address	BNL Tank Number	SCDHS Tank Number	Capacity (Gallons)	Year Purchased	Local Designation	Tank Material	Location
30	23 S. Upton Road	0030-04	530	4000	1996	SCAT Tank	Steel (Double-walled)	Above/Out
244	1 S. Upton Road	0244-09	925	1000	2004	Highland Tank	Steel (Double-walled)	Above/Out
321	W. Princeton Ave.	0321-03	924	1000	2003	Areo-Power Tank	Steel (Double-walled)	Above/Out
339	W. Princeton Ave.	0339-04	926	1000	2004	Highland Tank	Steel (Double-walled)	Above/Out
422	1 Upton Road	0422-05	238	1000	1994	SCAT Tank	Steel (Double-walled)	Above/Out
423	6 W. Princeton Ave.	0423-08	220	3000	1990	Motor Pool - Heating Oil Tank	FPR/STEEL (Double-walled)	Under/Out
526	12 N. Sixth St.	0526-04	247	270	1994	SCAT Tank	Steel (Double-walled)	Above/Out
526	12 N. Sixth St.	0526-14	883	1000	2003	Areo-Power Tank	Steel (Double-walled)	Above/Out
526	12 N. Sixth St.	0526-16	344	250	1994	SCAT Tank	Steel (Double-walled)	Above/Out
575	90 Fist St.	0575-09	845	500	2000	Heating Oil Tank	Steel (Double-walled)	Above/Out
630	14 Rochester St.	0630-13	943	1000	1994	SCAT Tank - Upton Service Station	Steel (Double-walled)	Above/Out
			Capacity:	**14020**	**Gallons**			
				334	**Barrels**			

Table 4
PHYSICAL CHARACTERISTICS OF PETROLEUM BULK STORAGE TANKS
Diesel Fuel for Emergency Power Supplies on BNL Site

Building Number	Building Address	BNL Tank Number	SCDHS Tank Number	Capacity (Gallons)	Year Installed	Tank Material	Location	Tank Notes
50	24 S. Upton Road	0050-02	843	1000	2000	FRP/STEEL (Double-walled)	Under/Out	Epoxy Coated
449	36 Morse Lane	0449-04	937	225	2006	Steel (Double-walled)	Above/Out	Tank in Generator Base
463	50 Bell Ave.	0463-19	941	400	2006	Steel (Double-walled)	Above/Out	Tank in Generator Base
488	11 Brookhaven Ave.	0488-05	938	100	2005	Steel (Double-walled)	Above/Out	Tank in Generator Base
490	30 Bell Ave.	0490-30	942	400	2006	Steel (Double-walled)	Above/Out	Tank in Generator Base
515	51 Brookhaven Ave.	0515-03	944	4000	2007	Steel (Double-walled)	Above/Out	Tank in Generator Base
555	33 Lewis Rd.	0555-14	952	225	2010	Steel (Double-walled)	Above/Out	Tank in Generator Base
575	90 First St.	0575-05	660	230	1997	Steel (Double-walled)	Above/Out	Tank in Generator Base
580	90 First St.	0580-02	659	140	1997	Steel (Double-walled)	Above/In	Tank in Generator Base
599	1 W. Brookhaven Ave.	0599-02	939	225	2006	Steel (Double-walled)	Above/Out	Tank in Generator Base
603	Rochester St.	0603-01	796	4000	1994	Steel (Double-walled)	Above/Out	SCAT Tank
614	W. Brookhaven Ave.	0614-05	---	500	2011	Steel (Double-walled)	Above/Out	Lube Cube Tank - Well House #4
618	20 Woods Road	0618-04	---	500	2011	Steel (Double-walled)	Above/Out	Lube Cube Tank - Well House #6
619	Past Woods Road	0619-04	---	500	2011	Steel (Double-walled)	Above/Out	Lube Cube Tank - Well House #7
635	East Fifth Avenue	0635-03	---	336	2011	Steel (Double-walled)	Above/Out	Tank in Generator Base
725	75 Brookhaven Ave.	0725-13	844	250	1992	Steel (Double-walled)	Above/Out	Lube Cube

Table 4
PHYSICAL CHARACTERISTICS OF PETROLEUM BULK STORAGE TANKS
Diesel Fuel for Emergency Power Supplies on BNL Site

Building Number	Building Address	BNL Tank Number	SCDHS Tank Number	Capacity (Gallons)	Year Installed	Tank Material	Location	Tank Notes
735	Brookhaven Ave.	0735-01	940	115	2006	Steel (Double-walled)	Above/Out	Tank in Generator Base
740	Brookhaven Ave.	740-01	---	450	2011	Steel (Double-walled)	Above/Out	Tank in Generator Base
740	Brookhaven Ave.	740-02	---	450	2011	Steel (Double-walled)	Above/Out	Tank in Generator Base
801	59 Rutherford Drive	0801-38	953	225	2010	Steel (Double-walled)	Above/In	Tank in Generator Base
912A	35 Lawrence Drive	0912A-05	946	3000	2008	Steel (Double-walled)	Above/Out	Lube Cube
1000P	Ring Road	1000P-03	576	300	1994	Steel (Double-walled)	Above/Out	Tank in Generator Base
1002A	Ring Road	1002A-01	570	300	1994	Steel (Double-walled)	Above/Out	Tank in Generator Base
1004A	Ring Road	1004A-01	568	300	1994	Steel (Double-walled)	Above/Out	Tank in Generator Base
1005S	Ring Road	1005S-01	396	500	1994	Steel (Double-walled)	Above/Out	Tank in Generator Base
1006A	Ring Road	1006A-01	575	300	1994	Steel (Double-walled)	Above/Out	Tank in Generator Base
1008A	Ring Road	1008A-01	572	300	1994	Steel (Double-walled)	Above/Out	Tank in Generator Base
1010A	Ring Road	1010A-01	571	300	1994	Steel (Double-walled)	Above/Out	Tank in Generator Base
1012A	Ring Road	1012A-01	569	300	1994	Steel (Double-walled)	Above/Out	Tank in Generator Base
			Capacity:	**16535**	**Gallons**			
				394	**Barrels**			

Table 5
PHYSICAL CHARACTERISTICS OF PETROLEUM BULK STORAGE TANKS
Miscellaneous Petroleum Tanks on BNL Site

Building Number	Building Address	BNL Tank Number	SCDHS Tank Number	Capacity (Gallons)	Year Installed	Tank Material	Location	Tank Notes
423	6 W. Princeton	0423-01	34	375	1998	Steel	Above/In	Waste Oil Tank
423	6 W. Princeton	0423-16	900	500	2003	Steel (Double-walled)	Above/Out	Motor Oil (Lube Cube)
423	6 W. Princeton	0423-17	901	500	2003	Steel (Double-walled)	Above/Out	Motor Oil (Lube Cube)
452	70 Bell Ave.	0452-02	49	275	1990	Steel	Above/In	Waste Oil Tank
630	14 Rochester Ave.	0630-12	902	280	2003	Steel (Double-walled)	Above/Out	Motor Oil (Lube Cube)
639	Temple Pl.	0639-02	951	1000	2009	Steel (Double-walled)	Above/Out	Bio-Diesel (Lube Cube)
911	35 Lawrence St.	0911-04	205	1100	1959	Steel	Above/In	Lube Oil (Generator)
928	35 Lawrence St.	0928-02	209	3200	1969	Steel	Above/In	Lube Oil (Generator)
			Capacity:	**7230**	**Gallons**			
				172	**Barrels**			

Table 6
Physical Characteristics of Power Transformers and Transformer Oil Storage Tanks on BNL Site

Equipment I.D. #	Description	Bldg. No.	Services	Fluid Type	KVA	Capacity (Gallons)	PCB ppm	Containment Type
030-TRNF619	TRANSFORMER, PADMOUNT	0030	Brookhaven Ctr.	OIL	500	223		P
050-TRNF519	TRANSFORMER, PADMOUNT	0050	Police Station	OIL	225	170		P
051-TRNF702	TRANSFORMER, PADMOUNT	0051	ERD	OIL	400	150		C1
097-TRNF513	TRANSFORMER, PADMOUNT	0652	Site Resources	RTE MP SILICONE	112.5	210	NA	P
098-TRNF714	TRANSFORMER, PADMOUNT	0098	Warehouse	ENVIRO TEMP FR3	400	145	Non-PCB	C3
120-TRNF641	TRANSFORMER, PADMOUNT	0120	ESH&Q	SILICON	400	190	NA	P
134-TRNF612	TRANSFORMER, PADMOUNT	134	MPO	SILICON	500	190	NA	P
153-TRNF232	TRANSFORMER, PADMOUNT	0153	Cavendish	OIL	500	170		C1
170-TRNF264	TRANSFORMER, PADMOUNT	0170	Compton	OIL	300	200		P
180-TRNF636	TRANSFORMER, PADMOUNT	0180	Fleming	SILICONE	400	190	NA	P
194-TRNF082	TRANSFORMER, PADMOUNT	0652	B652 Storage area	OIL	300	125	N/D	ASP
194-TRNF622	TRANSFORMER, PADMOUNT	13.8KV CABLE	179, 355, AND PIT 73	SILICON	13,500	165	NA	P
197-TRNF614	TRANSFORMER, PADMOUNT	0197	NNP	SILCONE	500	220	NA	P
197-TRNF615	TRANSFORMER, PADMOUNT	0197	NNP	SILCONE	500	220	NA	P
257-TRNF112	TRANSFORMER, PADMOUNT	0257	Guest Hse	OIL	400	145		P
317-TRNF250	TRANSFORMER, B PHASE	0317	RecCtr/Vault #1	OIL	50	39		V
317-TRNF336	TRANSFORMER, A PHASE	0317	Vault #1	OIL	50	39		V
317-TRNF337	TRANSFORMER, C PHASE	0317	Vault #1	OIL	50	39		V
318-TRNF606	TRANSFORMER, PADMOUNT	0452	B318 demo'd	OIL	500	270		P
318-TRNF625	TRANSFORMER, PADMOUNT	0134	B318 demo'd	SILICON	500	220	NA	P
324-TRNF251	TRANSFORMER, B PHASE	0325	Apt. #7	OIL	50			V
324-TRNF345	TRANSFORMER, C PHASE	0325	Apt. #7	OIL	50			V
324-TRNF346	TRANSFORMER, A PHASE	0325	Apt. #7	OIL	50			V
326-TRNF517	TRANSFORMER, PADMOUNT	0326	Site Maint.	OIL	300	168		P
327-TRNF252	TRANSFORMER, B PHASE	0327	Apt. #4	OIL	50			V

Table 6
Physical Characteristics of Power Transformers and Transformer Oil Storage Tanks on BNL Site

Equipment I.D. #	Description	Bldg. No.	Services	Fluid Type	KVA	Capacity (Gallons)	PCB ppm	Containment Type
327-TRNF347	TRANSFORMER, A PHASE	0327	Apt. #4	OIL	50			V
327-TRNF348	TRANSFORMER, C PHASE	0327	Apt. #4	OIL	50			V
327-TRNF708	TRANSFORMER, PADMOUNT	0327	Apt. #4	OIL	50			V
351-TRNF253	TRANSFORMER, B PHASE	0351	Apt. #6	OIL	50	45		V
351-TRNF349	TRANSFORMER, A PHASE	0351	Apt. #6	OIL	50	45		V
351-TRNF350	TRANSFORMER, C PHASE	0351	Apt. #6	OIL	50	45		V
356-TRNF217	TRANSFORMER, WEST	0356	SS Irrad Fac	OIL	50	33		V
356-TRNF352	TRANSFORMER, EAST	0356	SS Irrad Fac	OIL	50	33		V
362-TRNF254	TRANSFORMER, B PHASE	0362	Apt. #22	OIL	50	33		V
362-TRNF353	TRANSFORMER, A PHASE	0362	Apt. #22	OIL	50	33		V
362-TRNF354	TRANSFORMER, C PHASE	0362	Apt. #22	OIL	50	33		V
363-TRNF255	TRANSFORMER, B PHASE	0363	Laundry/Vault#6	OIL	50			V
364-TRNF553	TRANSFORMER, VSQ 2 PADMOUNT	0364	Apt. #40	OIL		590	Non-PCB	P
366-TRNF554	TRANSFORMER, VSQ 1, PADMOUNT	0366	Apt. #42	OIL		447		P
368-TRNF194	TRANSFORMER, PADMOUNT	0368-24	Cottage	OIL		93		P
368-TRNF195	TRANSFORMER, PADMOUNT	0368-27	Cottage	OIL		93		P
368-TRNF196	TRANSFORMER, PADMOUNT	0368-13	Cottage	OIL		93		P
368-TRNF197	TRANSFORMER, PADMOUNT	0368-18	Cottage	OIL		93		P
368-TRNF256	TRANSFORMER, PADMOUNT	0368-04	Cottage	OIL	50	50		P
368-TRNF257	TRANSFORMER, PADMOUNT	0368-06	Cottage	OIL		93		P
373-TRNF515	TRANSFORMER, PADMOUNT	0373	Childcare	OIL		717		P
400-TRNF705	TRANSFORMER, PADMOUNT	0400	RSF	OIL		395	Non-PCB	P
422-TRNF624	TRANSFORMER, PADMOUNT	0422	Site Resources	SILICON		160		C1
423-TRNF269	TRANSFORMER, B PHASE	0423	Motor Pool	OIL	50	35		C1
423-TRNF359	TRANSFORMER, A PHASE	0423	Motor Pool	OIL	50	35		C1
423-TRNF360	TRANSFORMER, C PHASE	0423	Motor Pool	OIL	50	35		C1
438-TRNF516	TRANSFORMER, PADMOUNT	0438	Sci. Educ.	OIL	220	156		P

Table 6
Physical Characteristics of Power Transformers and Transformer Oil Storage Tanks on BNL Site

Equipment I.D. #	Description	Bldg. No.	Services	Fluid Type	KVA	Capacity (Gallons)	PCB ppm	Containment Type
455-TRNF205	TRANSFORMER, SUBSTA., PADMOUNT	0455	Bulb House	OIL	150	100		P
459-TRNF240	TRANSFORMER, SUBSTATION	0459-FIRST-1-57	ITD	OIL	112.5	400		P
459-TRNF518	TRANSFORMER, PADMOUNT	0459	ITD	OIL	1000	400		P
461-TRNF244	TRANSFORMER, PADMOUNT	0461	Gym	OIL		155		C1
462-TRNF632	TRANSFORMER, PADMOUNT	0462	Hot Shop	SILICONE		190		P
463-TRNF068	TRANSFORMER, A PHASE SUB B	0463	BO	OIL		213		V
463-TRNF069	TRANSFORMER, B PHASE SUB B	0463	BO	oil		213		V
463-TRNF070	TRANSFORMER, C PHASE SUB B	0463	BO	OIL		213		V
463-TRNF073	TRANSFORMER, SUB E	0463	BO	OIL	13,800	213	7	C1
464-TRNF601	TRANSFORMER, PADMOUNT	0464	DOE	OIL	150	157		P
473-TRNF246	TRANSFORMER, SUBSTA., PADMOUNT	0473	EBeam Weld	OIL	150	100		P
479-TRNF550	TRANSFORMER, SUBSTATION	0479	HeavyMachine	R-TEMP	1500	362	N/D	C1
485-TRNF716	TRANSFORMER, PADMOUNT	0485	Scrap metal	SILICONE		188	NA	P
493-TRNF204	TRANSFORMER, PADMOUNT	0493	Video	OIL		122		C1
494-TRNF191	TRANSFORMER, PADMOUNT	0494	Storage	OIL		116		C1
515-TRNF713	TRANSFORMER, 515-5-TR	0515	BLUE GENE PROJECT	SILICONE	2500	404	N/D	C1
516-TRNF694	TRANSFORMER, PADMOUNT	0516	GW Pump/treat	SILICONE OIL		275		P
518-TRNF634	TRANSFORMER, PADMOUNT	0518	GW Pump/treat			190		P
519-TRNF635	TRANSFORMER, PADMOUNT	0519	GW Pump/treat			190		P
521-TRNF640	TRANSFORMER, PADMOUNT	0521	Air Sparge	MINERAL OIL		236		P
522-TRNF695	TRANSFORMER, PADMOUNT	0522	CNG Station	MINERAL OIL		213		P
528-TRNF633	TRANSFORMER, PADMOUNT	0528	EPD	SILICONE		153		C1
539-TRNF697	TRANSFORMER, PADMOUNT	0539	GW RecoverySouth	SILICONE		220		P

Table 6
Physical Characteristics of Power Transformers and Transformer Oil Storage Tanks on BNL Site

Equipment I.D. #	Description	Bldg. No.	Services	Fluid Type	KVA	Capacity (Gallons)	PCB ppm	Containment Type
560-TRNF613	TRANSFORMER, PADMOUNT	0560	MRI			268		P
598-TRNF188	TRANSFORMER, PADMOUNT	0598	GW Treatment	OIL		160		P
599-TRNF081	TRANSFORMER, PADMOUNT	0599	Firehouse	OIL		102		P
600-TRNF506	TRANSFORMER, SOUTH	0600	Chilled Water	OIL	7500	920	N/D	C3
600-TRNF507	TRANSFORMER, NORTH	0600	Chilled Water	OIL	7500	920	N/D	C3
603-TRNF166	TRANSFORMER	0603	69KV Substation	OIL	3750	541	N/D	C3
603-TRNF190	TRANSFORMER #1	0603	69KV Substation	OIL	26667	3,450	N/D	C3
603-TRNF602	TRANSFORMER #2	0603	69KV Substation	OIL	22400	4,795	N/D	C3
603-TRNF603	TRANSFORMER, STATION	0603	69KV Substation	OIL	1000	300	N/D	C3
603-TRNF639	TRANSFORMER #3	0603	69KV Substation	OIL	26670	5,500	N/D	C3
614-TRNF272	TRANSFORMER, WELL #4	0614	Well #4			105		INTAB
615-TRNF259	TRANSFORMER, PADMOUNT	ST0615		OIL		79		P
616-TRNF321	TRANSFORMER	ST0616		OIL	5000	1,160	N/D	C3
617-TRNF380	TRANSFORMER	ST0617		MINERAL OIL	20000	1,050	12	C3
618-TRNF273	TRANSFORMER, WELL #6	0618	Well #6			105		INTAB
619-TRNF696	TRANSFORMER, PADMOUNT	0619	WELL #7	R-TEMP FLUID		221		INTAB
624-TRNF662	TRANSFORMER	0624	Water Plant	SILICONE	750	269	N/D	C1
631-TRNF132	TRANSFORMER #4	0631	AGS 69KV Substation	OIL		3,950		C3
631-TRNF133	TRANSFORMER #5	0631	AGS 69KV Substation	OIL	20000	3,950	N/D	C3
631-TRNFOCB	TRANSFORMER	0631	AGS 69KV Substation	OIL	0	440	N/D	C3
631-TRNFOCB	TRANSFORMER	0631	AGS 69KV Substation	OIL	17220	440	N/D	C3
631-TRNFOCB	TRANSFORMER	0631	AGS 69KV Substation	OIL		363	N/D	C3
631-TRNFOCB	TRANSFORMER	0631	AGS 69KV Substation	OIL		372	N/D	C3
631-TRNF176	TRANSFORMER #6	0631	AGS 69KV Substation			3,745		C3
631-TRNF177	TRANSFORMER #7	0631		OIL		4,920		C3
634-TRNF221	TRANSFORMER, WELL #10 PADMOUNT	0634	Well #10			145		INTAB
635-TRNF222	TRANSFORMER, WELL #11 PADMOUNT	0635	Well #11			105		INTAB

Table 6
Physical Characteristics of Power Transformers and Transformer Oil Storage Tanks on BNL Site

Equipment I.D. #	Description	Bldg. No.	Services	Fluid Type	KVA	Capacity (Gallons)	PCB ppm	Containment Type
638-TRNF626	TRANSFORMER #8	0638	RHIC 69KV Switchgear	OIL	20000	5,480	N/D	C3
638-TRNF631	TRANSFORMER, PADMOUNT	0638	RHIC 69KV Switchgear	OIL	20000	4,920	N/D	C3
638-TRNF176	TRANSFORMER, PADMOUNT	0638	RHIC 69KV Switchgear	OIL	20000	3,745	N/D	C3
638-TRNF132	TRANSFORMER, PADMOUNT	0638	RHIC 69KV Switchgear	OIL	20000	3,950	N/D	C3
643-TRNF189	TRANSFORMER, 643 SUB. STATION	ST0643		OIL	2000	233	N/D	C1
645-TRNF628	TRANSFORMER, PADMOUNT	0645	Well Control Hse.	OIL		96		P
652-TRNF687	TRANSFORMER	652	Behind 452/Storage	OIL	225	194	N/D	ASP
652-TRNFSPARES	TRANSFORMER	652	Behind 452/Storage	OIL	225	163	N/D	ASP
652-TRNFSPARES	TRANSFORMER	652	Behind 452/Storage	OIL	225	168	N/D	ASP
652-TRNFSPARES	TRANSFORMER	652	Behind 452/Storage	OIL	225	100	N/D	ASP
652-TRNFSPARES	TRANSFORMER	652	Behind 452/Storage	OIL	750	307	N/D	ASP
652-TRNFSPARES	TRANSFORMER	652	Behind 452/Storage	OIL	300	280	N/D	ASP
652-TRNFSPARES	TRANSFORMER	652	Behind 452/Storage	OIL	500	280	N/D	ASP
652-TRNF	TRANSFORMER	652	Behind 452/Storage	OIL	113	175	N/D	ASP
652-TRNF	TRANSFORMER	652	Behind 452/Storage	OIL	300	210	N/D	ASP
661-TRNF693	TRANSFORMER	ST0661	BLDG-479, 518 & 519	OIL	5000	806	N/D	C3
670-TRNF698	TRANSFORMER, PADMOUNT	0670	Sr90 Treatment	SILICONE		245		P
681-TRNF715	TRANSFORMER, PADMOUNT	0681	NORTH GATE GAURD BOOTH	SILICONE		175		P
704-TRNF703	TRANSFORMER EAST	704		SILICONE	2500	531	N/D	C1
704-TRNF703	TRANSFORMER WEST	704		SILICONE	2500	531	N/D	C1
707A-551	TRANSFORMER	707A		R-TEMP	2400	167	N/D	C1
725-TRNF184	TRANSFORMER, #1	0725	NSLS	MINERAL OIL	2500	304	N/D	C1
725-TRNF185	TRANSFORMER, #3	0725	NSLS	MINERAL OIL	2500	304	N/D	C1
725-TRNF186	TRANSFORMER, #2	0725	NSLS	MINERAL OIL	2500	304	N/D	C1

Table 6
Physical Characteristics of Power Transformers and Transformer Oil Storage Tanks on BNL Site

Equipment I.D. #	Description	Bldg. No.	Services	Fluid Type	KVA	Capacity (Gallons)	PCB ppm	Containment Type
725-TRNF187	TRANSFORMER, #4	0725	NSLS	TYPE 1 OIL	2000	318	N/D	C1
725-SWITCH	SWITCH RECLOSER	0725	NSLS		0	30	N/D	C1
726-TRNF503	TRANSFORMER, PADMOUNT	0726	NSLS Support			98		C1
726-TRNF659	TRANSFORMER, PADMOUNT 728	0726	NSLS Support	SILICONE		178		C1
728-TRNF660	TRANSFORMER, PADMOUNT 726/727	0726	NSLS Office	SILICONE		223		C1
729-TRNF322	TRANSFORMER	0729	NSLS Lab	MINERAL OIL	1500	420	N/D	C1
735-TRNF709	TRANSFORMER	0735	CFN	OIL	2000	312	N/D	C1
735-TRNF710	TRANSFORMER	0735	CFN	OIL	2000	312	N/D	C1
750-TRNF607	TRANSFORMER	0750	HFBR/NEW EXTENSION	WYE OIL		192		C1
801-TRNF642	TRANSFORMER, PADMOUNT	0801	South	SILICONE	13,800	324		C1
817-TRNF605	TRANSFORMER, PADMOUNT	0817	B817	OIL		194	Non-PCB	P
820-TRNF100	TRANSFORMER	0820	ATF	MINERAL OIL	2000	600	N/D	C1
820-TRNF116	TRANSFORMER	0820	ATF	MINERAL OIL	500	394	N/D	C1
830-TRNF555	TRANSFORMER, PADMOUNT	0830	B830			226		P
832-TRNF608	TRANSFORMER, PADMOUNT	0832	NSLS II R&D	"R" TEMP		197		P
835-TRNF104	TRANSFORMER, #2	0835	Tower Crew	MINERAL OIL	500	200	18	C1
860-TRNF618	TRANSFORMER, SUBSTATION	0860	WM	MINERAL OIL	1500	420	N/D	C1
901-TRNF117	TRANSFORMER, NORTH	0901A	B901/CAD	MINERAL OIL	1000	157	N/D	C5
901-TRNF292	TRANSFORMER, SOUTH	0901A	B901/Alcove	MINERAL OIL	1000	229	12	C1
901-TRNF674	TRANSFORMER	0901A	B901/Alcove	SILICONE	2000	678	N/D	C1
902-TRNF024	TRANSFORMER, POWER CENTER #110	0902	Magnet Div.	MINERAL OIL	750	460	N/D	C2
902-TRNF025	TRANSFORMER, #116	0902	Magnet Div.	MINERAL OIL	2250	825	32	C4
902-TRNF026	TRANSFORMER, POWER CENTER #121	0902	Magnet Div.	MINERAL OIL	1250	668	17	C4
902-TRNF141	TRANSFORMER, SUB. STA. EAST	0902	Magnet Div.	MINERAL OIL	3750	1,482	11	C1
902-TRNF385	TRANSFORMER, PADMOUNT	0902	Magnet Div.			135		C1

Table 6
Physical Characteristics of Power Transformers and Transformer Oil Storage Tanks on BNL Site

Equipment I.D. #	Description	Bldg. No.	Services	Fluid Type	KVA	Capacity (Gallons)	PCB ppm	Containment Type
902-TRNF637	TRANSFORMER, SUBSTATION	0902	Magnet Div.	SILICONE	1500	420	N/D	C1
902-TRNF667	TRANSFORMER	0902	Magnet Div.	SILICONE	2500	563	N/D	C1
906-TRNF699	TRANSFORMER, PADMOUNT	0906	PET	R-TEMP	1000	235	NA	C1
911-TRNF643	TRANSFORMER A-2500	0911-FIRST-1-	CAD	SILICONE	2500	536		C1
911-TRNF644	TRANSFORMER SB1	0911	CAD	SILICONE	3500	491	N/D	C1
911-TRNF645	TRANSFORMER SB2	0911	CAD	SILICONE	3500	491	N/D	C1
912-TRNF171	TRANSFORMER, S/E EEBA, 5M	0912	AGS	OIL	3500	510	N/D	C4
912-TRNF172	TRANSFORMER, S/E EEBA, 6M	0912	AGS	OIL	3500	510	5	C4
912-TRNF392	TRANSFORMER, 911N	0912	AGS	OIL	3500	1,055	7	F1
912-TRNF611	TRANSFORMER, F3	0912A	AGS	OIL	2500	514	N/D	C4
912-TRNF646	TRANSFORMER, B	0912	AGS	SILICONE	2500	520	N/D	C4
912-TRNF647	TRANSFORMER, F2	0912A	AGS	SILICONE	2500	536	N/D	C4
912-TRNF648	TRANSFORMER, F1	0912A	AGS	SILICONE	2500	536	N/D	C4
912-TRNF649	TRANSFORMER, P1	0912	AGS	SILICONE	2500	536	N/D	C4
912-TRNF650	TRANSFORMER, P2	0912	AGS	SILICONE	2500	536	N/D	C4
912-TRNF651	TRANSFORMER, K1	0912	AGS	SILICONE	2500	536	N/D	C4
912-TRNF652	TRANSFORMER, 2K	0912	AGS	SILICONE	2500	536	N/D	C4
912-TRNF653	TRANSFORMER, G	0912	AGS	SILICONE	2500	536	N/D	C4
912-TRNF643	TRANSFORMER	912	AGS	SILICONE	3500	536	N/D	C4
912-TRNF663	TRANSFORMER, M1	0912	AGS	SILICONE	3500	536	N/D	C4
912-TRNF664	TRANSFORMER, M2	0912	AGS	SILICON	3500	536	N/D	C4
912-TRNF665	TRANSFORMER, M3	0912	AGS	SILICONE	3500	536	N/D	C4
912-TRNF673	TRANSFORMER, SUBSTATION C	0929	AGS	SILICONE	3500	520	N/D	C4
912-3K		912	AGS	OIL		800		C4
912-J-SUB	TRANSFORMER, SUBSTATION J	912	AGS	OIL	2500	450	N/D	C4
912-SPARE	TRANSFORMER	912	AGS	OIL	5300	3,045	N/D	C4
912-SPARE	TRANSFORMER	912	AGS	OIL	5300	3,045	N/D	C4

Table 6
Physical Characteristics of Power Transformers and Transformer Oil Storage Tanks on BNL Site

Equipment I.D. #	Description	Bldg. No.	Services	Fluid Type	KVA	Capacity (Gallons)	PCB ppm	Containment Type
912 Spares	TRANSFORMER	912A	AGS	Envirotemp FR3	varies	1,102	NA	ASP
913-TRNF030	TRANSFORMER, R	0913	AGS Tunnel	OIL	3500	309	N/D	C1
914-TRNF047	TRANSFORMER, D-2	0914	Booster Equip.	SILICONE	2500	555	N/D	C1
916-TRNF237	TRANSFORMER, PADMOUNT	0916	BLDG-916 WELL #2	OIL		122		INTAB
916-TRNF407	TRANSFORMER	0916	BLDG-916 WELL #2	OIL		122		INTAB
918-TRNF051	TRANSFORMER	918	AGS Warehouse	OIL	2500	831	18	C3
919-TRNF672	TRANSFORMER, SUBSTATION H1	0919	G2	SILICONE	3500	536	N/D	C1
919-TRNF680	TRANSFORMER, SUBSTATION H3	0919	G2/SULLAIR HELLIUM COMP	SILICONE OIL	2500	531	N/D	C1
919-TRNF681	TRANSFORMER, SUBSTATION H2	0919	G2	MINERAL OIL	3500	483	N/D	C1
925-TRNF386	TRANSFORMER	0925	Works Bldg.	OIL	750	218	N/D	C1
927-TRNF170	TRANSFORMER, N4	0927	N.Expt. Tunnel	MINERAL OIL	3500	510	6	C1
927-TRNF174	TRANSFORMER, N5 / N6	0927	N.Expt. Tunnel	MINERAL OIL	2800	420	20	C3
929-TRNF149	TRANSFORMER, MG	0929	RF Power Supply	MINERAL OIL	2500	550	5	C3
929-TRNF155	TRANSFORMER, RF	0929	RF Power Supply	MINERAL OIL	2500	550	10	C4
929-TRNF560	TRANSFORMER, RF-K	0929	RF Power Supply	MINERAL OIL	422	329	N/D	C3
929-TRNF561	TRANSFORMER, RF-KL	0929	RF Power Supply	MINERAL OIL	422	329	N/D	C3
929-TRNF562	TRANSFORMER, RF-IJ	0929	RF Power Supply	MINERAL OIL	422	329	N/D	C3
929-TRNF563	TRANSFORMER, RF-JK	0929	RF Power Supply	MINERAL OIL	422	329	N/D	C3
929-TRNF564	TRANSFORMER, RF-DE	0929	RF Power Supply	MINERAL OIL	422	329	N/D	C3
929-TRNF565	TRANSFORMER, RF-E	0929	RF Power Supply	MINERAL OIL	422	329	N/D	C3
929-TRNF566	TRANSFORMER, RF-D	0929	RF Power Supply	MINERAL OIL	422	329	N/D	C3
929-TRNF567	TRANSFORMER, RF-C	0929	RF Power Supply	MINERAL OIL	422	329	N/D	C3
929-TRNF568	TRANSFORMER, RF-B	0929	RF Power Supply	MINERAL OIL	422	329	N/D	C3
929-TRNF569	TRANSFORMER, RF-BC	0929	RF Power Supply	MINERAL OIL	422	329	N/D	C3
929-TRNF570	TRANSFORMER, RF-II	0929	RF Power Supply	MINERAL OIL	422	329	N/D	C3
929-TRNF666	TRANSFORMER	0929	RF Power Supply	ESSO UNIVOLT 52	422	644	N/D	C3

Table 6
Physical Characteristics of Power Transformers and Transformer Oil Storage Tanks on BNL Site

Equipment I.D. #	Description	Bldg. No.	Services	Fluid Type	KVA	Capacity (Gallons)	PCB ppm	Containment Type
929RF Test UNIT	TRANSFORMER	929	RF Power Supply	OIL	2000	467	N/D	C3
930-TRNF520	TRANSFORMER, BOOSTER BMMPS1	0930	200MeV LINAC	MINERAL OIL	600	400	N/D	C3
930-TRNF521	TRANSFORMER, BOOSTER BMMPS2	0930	200MeV LINAC	MINERAL OIL	600	400	N/D	C3
930-TRNF522	TRANSFORMER, BOOSTER BMMPS3	0930	200MeV LINAC	MINERAL OIL	600	400	N/D	C3
930-TRNF523	TRANSFORMER, BOOSTER BMMPS4	0930	200MeV LINAC	MINERAL OIL	600	400	N/D	C3
930-TRNF524	TRANSFORMER, BOOSTER BMMPS5	0930	200MeV LINAC	MINERAL OIL	1200	650	N/D	C3
930-TRNF525	TRANSFORMER, BOOSTER BMMPS6	0930	200MeV LINAC	MINERAL OIL	1200	650	N/D	C3
930-TRNF526	TRANSFORMER, BOOSTER BMMPS7	0930	200MeV LINAC	MINERAL OIL	1200	650	N/D	C3
930-TRNF527	TRANSFORMER, BOOSTER BMMPS8	0930	200MeV LINAC	MINERAL OIL	1200	650	N/D	C3
930-TRNF528	TRANSFORMER, BOOSTER BMMPS9	0930	200MeV LINAC	MINERAL OIL	600	400	N/D	C3
930-TRNF529	TRANSFORMER, BOOSTER BMMPS10	0930	200MeV LINAC	MINERAL OIL	600	400	N/D	C3
930-TRNF530	TRANSFORMER, BOOSTER BMMPS11	0930	200MeV LINAC	MINERAL OIL	600	400	N/D	C3
930-TRNF531	TRANSFORMER, BOOSTER BMMPS12	0930	200MeV LINAC	MINERAL OIL	600	400	N/D	C3
930-TRNF532	TRANSFORMER, BOOSTER BMMPS13	0930	200MeV LINAC	MINERAL OIL	600	400	N/D	C3
930-TRNF533	TRANSFORMER, BOOSTER BMMPS14	0930	200MeV LINAC	MINERAL OIL	600	400	N/D	C3
930-TRNF534	TRANSFORMER, BOOSTER BMMPS15	0930	200MeV LINAC	MINERAL OIL	600	400	N/D	C3
930-TRNF535	TRANSFORMER, BOOSTER BMMPS16	0930	200MeV LINAC	MINERAL OIL	600	400	N/D	C3
930-TRNF536	TRANSFORMER, BOOSTER BMMPS7	0930	200MeV LINAC	MINERAL OIL	1200	650	N/D	C3
930-TRNF537	TRANSFORMER, BOOSTER BMMPS18	0930	200MeV LINAC	MINERAL OIL	1200	400	N/D	C3

Table 6
Physical Characteristics of Power Transformers and Transformer Oil Storage Tanks on BNL Site

Equipment I.D. #	Description	Bldg. No.	Services	Fluid Type	KVA	Capacity (Gallons)	PCB ppm	Containment Type
930-TRNF538	TRANSFORMER, BOOSTER BMMPS19	0930	200MeV LINAC	MINERAL OIL	1200	400	N/D	C3
930-TRNF539	TRANSFORMER, BOOSTER BMMPS20	0930	200MeV LINAC	MINERAL OIL	1200	400	N/D	C3
930-TRNF540	TRANSFORMER, BOOSTER BMMPS21	0930	200MeV LINAC	MINERAL OIL	600	400	N/D	C3
930-TRNF541	TRANSFORMER, BOOSTER BMMPS22	0930	200MeV LINAC	MINERAL OIL	600	400	N/D	C3
930-TRNF542	TRANSFORMER, BOOSTER BMMPS23	0930	200MeV LINAC	MINERAL OIL	600	400	N/D	C3
930-TRNF543	TRANSFORMER, BOOSTER BMMPS24	0930	200MeV LINAC	MINERAL OIL	600	400	N/D	C3
930-TRNF544	TRANSFORMER, BOOSTER BMMPS25	0930	200MeV LINAC	MINERAL OIL	3600	450	N/D	C3
930-TRNF545	TRANSFORMER, BOOSTER BMMPS26	0930	200MeV LINAC	MINERAL OIL	1800	300	N/D	C3
930-TRNF546	TRANSFORMER, BOOSTER BMMPS27	0930	200MeV LINAC	MINERAL OIL	1800	300	N/D	C3
930-TRNF547	TRANSFORMER, BOOSTER BMMPS28	0930	200MeV LINAC	MINERAL OIL	1800	300	N/D	C3
930-TRNF548	TRANSFORMER, BOOSTER BMMPS29	0930	200MeV LINAC	MINERAL OIL	1800	300	N/D	C3
930-TRNF549	TRANSFORMER, BOOSTER BMMPS30	0930	200MeV LINAC	MINERAL OIL	3600	450	N/D	C3
930-TRNF654	TRANSFORMER, L3	0930	200MeV LINAC	SILICONE	2500	420	N/D	C3
930-TRNF655	TRANSFORMER, L2	0930	200MeV LINAC	SILICONE	2500	420	N/D	C3
930-TRNF656	TRANSFORMER, L1	0930	200MeV LINAC	SILICONE	2500	420	N/D	C3
930-TRNF	TRANSFORMER	0930	200MeV LINAC	OIL	3600	450	N/D	C3
930-TRNF	TRANSFORMER	0930	200MeV LINAC	OIL	1200	650	N/D	C3
930-TRNF	TRANSFORMER SPARES	0930	200MeV LINAC	OIL	600	400	N/D	C3
930-TRNF-629	TRANSFORMER	930	200MeV LINAC	OIL	1500	410	N/D	C3
930-TRNF-630	TRANSFORMER	930	200MeV LINAC	OIL	1500	410	N/D	C3

Table 6
Physical Characteristics of Power Transformers and Transformer Oil Storage Tanks on BNL Site

Equipment I.D. #	Description	Bldg. No.	Services	Fluid Type	KVA	Capacity (Gallons)	PCB ppm	Containment Type
930-145 TRNF SPARES	TRANSFORMER	930	200MeV LINAC	OIL	1500	282	6	C3
930 SPARE	TRANSFORMER	930	200MeV LINAC	OIL	3600	400	N/D	C3
930 SPARE	TRANSFORMER	930	200MeV LINAC	OIL	1200	650	N/D	C3
930 SPARE	TRANSFORMER	930	200MeV LINAC	OIL	2820	2,080	N/D	C3
933-TRNF045	TRANSFORMER, SUBTATION	0933	Riggers Shop	OIL	1000	190	42	C1
935-TRNF223	TRANSFORMER, PADMOUNT	0935	BNL Sci. Museum		300	125	Non-PCB	P
938-TRNF084	TRANSFORMER, PADMOUNT	0938	Rad. Effects Lab		300	115		P
939-TRNF079	TRANSFORMER, PADMOUNT	0939	EM. Ops.	OIL	1500	385		P
957-TRNF143	TRANSFORMER, BAF-2 / 1L	0957	NSRL	OIL	2500	550	2	P
957-TRNF144	TRANSFORMER, BAF-1 / 2L	0957	NSRL	OIL	2500	550	5	P
974-TRNF-701	TRANSFORMER	974	CAD Storage Warehouse	OIL	1500	280	Non-PCB	P
1000-TRNF405	TRANSFORMER, SUBSTATION 1000 P1	1000P	RHIC/1000P-LVCB630, 631, 632, 633	TYPE 1 OIL	3500	309	N/D	C1
1000-TRNF629	TRANSFORMER, SUBSTATION 1000 P2	0930	RHIC	MINERAL OIL	varies	410		C1
1000-TRNF630	TRANSFORMER, SUBSTATION 1000 P3	1000P	RHIC	MINERAL OIL	1500	410	N/D	C1
1000QP-TRNF-SPARE	TRANSFORMER SPARES	1000QP	RHIC	OIL	1500	410	N/D	C1
1002-TRNF400	TRANSFORMER, SUBSTATION 1002A	1002	RHIC	OIL	2500	288	N/D	C1
1002B-TRNF-400	TRANSFORMER	1002B	RHIC	OIL	2500	450	N/D	C1
1004-TRNF631	TRANSFORMER	1004	RHIC	OIL	2500	452	N/D	C1
1004-TRNF401	TRANSFORMER	1004A	RHIC	OIL	2500	288	N/D	C1, F1

Table 6
Physical Characteristics of Power Transformers and Transformer Oil Storage Tanks on BNL Site

Equipment I.D. #	Description	Bldg. No.	Services	Fluid Type	KVA	Capacity (Gallons)	PCB ppm	Containment Type
1004B-TRNF616	TRANSFORMER, SUBSTATION 1004B	1004B	RHIC	OIL	2500	375	N/D	C1,F1
1004B-TRNF617	TRANSFORMER, SUBSTATION 1004C	1004B	RHIC		2500	375	N/D	C1,F1
1005E-TRNF397	TRANSFORMER, E/POWER SUPPLY SUB. B	1005E	RHIC	OIL	2500	288	N/D	C3
1005H-TRNF283	TRANSFORMER	1005H	RHIC	OIL	12000	1,620	N/D	C3
1005H-TRNF284	TRANSFORMER	1005H	RHIC	OIL	12000	1,620	N/D	C3
1005H-TRNF398	TRANSFORMER, SUB.STA. #5H	1005H	RHIC	OIL	1500	225	11	C3
1005S-TRNF399	TRANSFORMER, SUB.STA. #5S	1005S	RHIC	OIL	1500	299	8	F1
1006-TRNF402	TRANSFORMER	1006A	RHIC	OIL	2500	288	N/D	F1
1006-TRNF676	TRANSFORMER, SUBSTATION 1006D	1006	RHIC	SILICONE	140	570	N/D	C1
1006-TRNF677	TRANSFORMER, SUBSTATION 1006E	1006	RHIC	SILICONE	140	570	N/D	C1
1006-TRNF678	TRANSFORMER, SUBSTATION 1006F	1006	RHIC	SILICONE	2800	1,550	N/D	C1
1006-TRNF679	TRANSFORMER, SUBSTATION 1006G	1006	RHIC	SILICONE	2800	1,550	N/D	C1
1008-TRNF403	TRANSFORMER	1008A	RHIC	OIL	2500	288	N/D	C1
1010A-TRNF609	TRANSFORMER, SUBSTATION 1010A	1010A	RHIC	OIL	2500	326	N/D	C1

Table 6
Physical Characteristics of Power Transformers and Transformer Oil Storage Tanks on BNL Site

Equipment I.D. #	Description	Bldg. No.	Services	Fluid Type	KVA	Capacity (Gallons)	PCB ppm	Containment Type
1012A-TRNF610	TRANSFORMER, SUBSTATION 1012A	1012A	RHIC	OIL	2500	326	N/D	C1
1101-TRNF604	TRANSFORMER	1101	CAD Warehouse	OIL	1000	157		C1

Total gallons on Site (Approximate): **149,962**

Transformer containment/suppression codes:

C1 = Concrete curb, gravel with soil base, and concrete pad.
C3 = Concrete curbs, concrete containment tank with valve and gravel. Valve is only opened after ECR inspection (semiannually).
C4 = Containment with geomenbrane liner.
C5 = weir connected to stormdrain - inspected semiannually by E/U and ECR.
D1 = deluge system
F1 - Firewall
INTB = Interior - basement location
INTAB = Interior location above basement.
P = Concrete pad only.
V = Sub-surface vault with an access hatch for inspections.
ASP = Asphalt surface (storage/not in-service)

General Notes:

1) BNL has a written SPCC and Facility Response Plan that has been prepared in accordance with sound industry practices and standards and with the Rule's requirements and has a management commitment to provide manpower, equipment and materials to quickly control and remove any quantity of oil discharged that may be harmful.

2) BNL's Energy and Utilites Division has a documented, semiannual transformer inspection and monitoring program whereby the units are checked for an equipment failure and/or a discharge of oil. The documentation for the above program is kept by the Facilites Operations Group for a minimum of five years.

6 NYCRR Part 613, respectively and are fitted with pressure and vacuum relief vents. As such, they are exempt from discussion with the SPCC Plan and should already satisfy the requirements of 112.8(c)(4). Failure of these tanks would have an impact on ground water but have no impact on surface water. The material and construction is compatible with this service.

Electric Transformers are constructed of steel and designed to general standards (National Fire Protection Association (NFPA) National Electric Code). As such they will withstand all but the most extreme conditions (Electrical failure and explosion). The material and construction is compatible with this service.

Notes are provided below for the Physical Characteristics of Fuel Oil Storage Tanks at BNL that are described in Tables 1 and 2:

TANK LEVEL
1. - Rosemount Model 5400 Radar Gauge
2. - Metritape resistive gauging system with remote read-out
3. - Automatic Tape Scale (Protectoseal model 12000 A or equal)
4. - Scale board with cable and float
5. - Manual sounding tape or stick
6. – Veeder-Root (TLS-350) – Automatic Tank Gauging System

TYPE SUPPORT
1. - Circular Ring
2. - (2) Piers with footings
3. - (3) Piers with footings
4. - (4) Piers with footings

HIGH LEVEL
1. - TRANSDATA Model 6699-40 Annunciator System with Model 6693-L Operation checkers
2. - Alarm from Rosemount Model 5400 Radar Gauge through a Programmable Logic Controller.
3. - PNEUMERACATOR Model LC [3 or 4] SA CL level indication system.
4. - OMNITEC / Electrolevel Indication System
5. - WARWICK TA201T Level Alarm with manual checker

3.12 Secondary Containment

All bulk oil storage at BNL is provided with some means of secondary containment to prevent discharges of oil into navigable waters of the United States and adjoining shorelines. Details on the types of secondary containment systems for these facilities are summarized further below.

BNL also has several pieces of oil-filled operating equipment (e.g., hydraulic and lubricating reservoirs, circuit breakers, transformers, and gear boxes) that are not considered bulk storage containers and are, therefore, not subject to the SPCC

requirements of 40 CFR 112.8, including the requirement to have sized secondary containment. Secondary containment for these types of oil-filled equipment is sometimes impracticable because of design and safety considerations and site configuration. In lieu of sized secondary containment, and in accordance with 40 CFR 112.7(k)(2), BNL has implemented the following alternative methods of control:

- A Facility Response Plan (FRP) is in place in accordance with 40 CFR 112.20 and includes details on BNL's oil spill response and removal plans that addresses the control, containment and recovery of an oil discharge in harmful quantities.
- A written commitment of resources is provided in Section 2.0 (Statement of Management Approval) of this plan that ensures that BNL is able to implement the FRP once a discharge has been detected.
- A robust inspection, maintenance and monitoring program exists at BNL that includes written procedures and processes that would help identify oil-filled equipment failures and/or discharges of oil. This program is detailed in Section 7.0 (Inspection and Maintenance of Equipment).

Central Steam Facility

The bulk oil storage tanks are contained in five (5) lined earthen berms. The berms are constructed as follows:

Tanks 3, 4, 5, 6, 9, and 10 are located in a bermed area in excess of 110% of the largest tank located in it. The lining for all bermed areas consists of a geosynthetic clay liner (GCL) and a layer of stone or gravel as overburden. The liner for tanks 3, 4, 9, and 10 is a Bentonite clay based product manufactured and marketed as ENVIRONMAT III. It consists of Bentonite clay sandwiched between two layers of polypropylene geotextile material. It is applied over a compacted earth base, with six (6) inch overlapping seams, extending to the top of the dike, and anchored in a trench. The material is overlaid with three (3) inches of round stone to act as a cover and to prevent UV deterioration to the polypropylene material.

The GCL liner for Tanks 5 and 6 is a Bentonite clay based product manufactured and marketed as CETCO Bentomat CLT. The Bentomat CLT is a GCL consisting of two non-woven geotextiles sandwiching a core of powdered bentonite. The Bentomat CLT has the added feature of a 20 mil high density polyethylene (HDPE) textured geomembrane adhered to one of the geotextiles. The geomembrane provides a greater puncture resistance than a conventional GCL and is less susceptible to installation damage. It is applied over a compacted earth base, with twelve (12) inch overlapping seams, extending over the top of the dike, and anchored in a trench. The GCL material is overlaid with twelve (12) inches of round stone to act as a cover and to prevent UV deterioration to the poly propylene material.

All of these berms have collection sumps. Although these are piped to the BNL Sanitary sewer, they are kept in a locked position and the key is kept in the supervisor's office. In practice, when the bottom of the berm is covered, provision is made to drain the water. A representative from the BNL Environmental Protection Division visually inspects the area, and if a visible sheen does not exist, permission is granted to manually drain the

berm. This procedure is detailed in the BNL F&O Directorate Policies and Procedures DF-ESH-009 (Draining Secondary Containments). A copy is enclosed as APPENDIX 1. Copies of the release authorizations are maintained at the Central Steam Facility and EPD.

As a continuing requirement of the Major Oil Storage Facility (MOSF) license a fully contained unloading area was constructed in 1995-6. Designed by Miatra Associates, PC, of Bridgewater, New Jersey and constructed by Gordon Environmental & Mechanical of Staten Island, New York, the facility consists of a 70 foot by 80 foot covered 4 bay truck area and an associated 24 foot by 70 foot pump area. Operation of this facility commenced in late December 1996, all transferring and receiving operations are consolidated in one central state of the art facility.

Fuel trucks enter the epoxy coated concrete unloading area and connect to the one of the four unloading stations using standard OPW/Evertite connections. The contents of the trucks are be pumped off, using the facilities pumps, and directed to the appropriate storage tank. The tank high-level alarm system is interconnected to the pumps so that any high level alarm will secure all receiving and transfer operations. The containment area is sufficient to contain the total contents of any one tank truck. The discharge from the containment area is directed to the sanitary sewer system, subject to the same procedures for release as the tank basins. Therefore, this facility complies with the provisions 40 CFR 112.7 (a) (3) (iii). During transfer, trucks are required to secure the engine, set the breaks and chock their wheels.

Other significant improvements are as follows:

1) All underground #6 Fuel Oil piping has been removed from service. Where necessary to cross roadways, the piping is installed in an access tunnel.
2) All #2 Fuel Oil piping not contained within the berm has been placed in a containment piping system with installed leak detection.
3) All Active Fuel Oil tanks have been inspected and repairs and up grades completed.
4) Tanks 3,4,5,6 have been cleaned, sandblasted and an epoxy coating/liner installed.
5) A double bottom with leak detection has been installed in Tanks 9 and 10.
6) Insulation has been installed on tanks 3, 4, 9 and 10 for conservation of energy.
7) Out of service tanks and piping systems have been cleaned decommissioned and removed.
8) New high level alarms have been installed on tanks 9 and 10.
9) Cathodic protection has been installed on tanks 3, 4, 5, 6, 9 and 10.

The complete Tank Testing Reports as performed by PCA Engineering of Hawthorne, New York are included as APPENDIX 10. The complete facility plans, previously submitted to and approved by the New York Department of Environmental Conservation are not included here. They are on file at F&O Directorate Offices.

Site and Staff Services Bulk Oil Storage

Building 651 - The three above ground diesel fuel tanks are enclosed within a 13-inch high concrete bermed area. This area was upgraded in November 2004 with sufficient volume to contain 110% of the largest tank plus 10% of the total volume of all other tanks contained in the bermed area. The project was approved by NYSDEC in June 2005 after a successful containment testing. A manually activated sump pump is used to facilitate draining accumulated rain water which is discharged to the sanitary sewer. The procedure is detailed in the BNL F&O Directorate Policies and Procedures DF-ESH-009 (Draining Secondary Containments). A copy is enclosed as APPENDIX 1. Copies of the release authorizations are maintained at the Building 326 and within EPD. There is secondary containment at the fuel filter and pump area. Therefore, this facility complies with the provisions 40 CFR 112.7 (a) (3) (iii).

In 1995 a project, constructed as Job No. 7858, was completed to upgrade this facility to meet Suffolk County Article 12 requirements. The unloading area was rebuilt with a covered 28 foot by 72 foot epoxy coated concrete containment area. The volume, approximately 8600 gallons, is sufficient for the largest anticipated fuel oil delivery truck. In practice, all fuel receiving (unloading) and transfer to the smaller site delivery tank truck is performed within this facility. The fuel lines connecting the unloading area with the tank farm are also secondarily contained. The facility is shown on the site plan (See Drawing 12.4). Complete details are available at the BNL F&O Directorate offices. The discharge from the containment area is pumped to the sanitary sewer system, subject to the same procedures for release as the tank basins. Therefore, this facility complies with the provisions 40 CFR 112.7 (a) (3) (iii). A permeability test was conducted in May 2005 determined that the permeability was acceptable at less than 10^{-7} cm /second.

Building 423 - The two (2) underground gasoline tanks were replaced in 1990 with fiberglass reinforced plastic (FRP) coated double wall steel tanks with integral leak detection and overfill protection in complete compliance with all provisions of Suffolk County Article 12. A representative of the county witnessed various stages of the installation of these tanks. In 2010, tank 423-06 was converted for the storage of E-85. As part of this conversion, the entire tank system was evaluated to ensure proper compatibility with E-85 fuel. Piping, valves, seals, sumps, dispenser, etc. were replaced as necessary. A representative from the New York State Department of Environmental Conservation witnessed and approved various stages of the upgrades to this tank.

The un-loading area is a hard surfaced (concrete) area immediately adjacent to and above the fill ports. The drainage system in the area consists of catch basins and dry wells. There is no direct discharge to any surface waters. The nearest surface water is in excess of 15,000 feet north of the location.

Given the intervening land contours, the porosity of the soil and the viscosity of the liquid received at this location, there exists no reasonable scenario that a discharge from this location could conceivably reach a surface water system. Therefore, this facility complies with the provisions 40 CFR 112.7 (a) (3) (iii)

Building 630 Service Station - The three (3) under ground gasoline tanks, used to refuel employee vehicles, were replaced in 1990 with FRP coated double wall steel tanks with integral leak detection and overfill protection in complete compliance with all provisions of Suffolk County Article 12. The underground waste oil tank was also replaced as part of this project with a double walled tank and piping. A representative of the county witnessed various stages of the installation of these tanks.

The un-loading area is a hard surfaced (concrete) area immediately adjacent to and above the fill ports. The drainage system in the area consists of catch basins storm sewers which direct the water to a ground water recharge basin south of West Princeton Avenue (HS). There is no direct discharge to any surface waters. The nearest surface water is in excess of 13,000 feet north of the location.

Considering the intervening land contours, the porosity of the soil and the viscosity of the liquid received at this location, there exists no reasonable scenario that a discharge from this location could conceivably reach a surface water system. Therefore, this facility complies with the provisions 40 CFR 112.7 (a) (3) (iii)

#2 Fuel Oil Satellite Heating Systems

Some BNL facilities have separate boilers and furnaces for building heating and hot water. Fuel oil for these systems is contained in 11 tanks for a total capacity of 14,020 gallons (Table 3). Ten of the eleven tanks are located outside, above ground, and are constructed of double-walled steel. One tank at Building 423 (Motor Pool) is located under ground and is a FRP coated double wall steel tank with integral leak detection and overfill protection in complete compliance with all provisions of Suffolk County Article 12. If precipitation is collected in the secondary containment systems, the water is inspected for a visible sheen and if none is present, disposed of to the sanitary sewer system.

Fuel oil is received at these locations on an as required basis. The delivery vehicle is via a contract vendor supplied 2,500-gallon tank truck as customarily used to deliver home heating fuel. The drainage system in these areas consists of catch basins dry wells and storm sewers that direct the water to ground water recharge basins. There is no direct discharge to any surface waters. Considering the intervening land contours, the porosity of the soil and the viscosity of the liquid received at these locations, there exists no reasonable scenario that a discharge could conceivably reach a surface water system. Therefore, this facility complies with the provisions 40 CFR 112.7 (a) (3) (iii)

Diesel Emergency Fuel Supplies

Fuel oil used for Emergency Power Generation is contained in 28 tanks for a total capacity of 16,535 gallons. Twenty-seven of these tanks are above ground and one is below ground. An underground storage tank is located at Building 50 and is a 1,000 gallon, FRP coated, double wall steel tank with integral leak detection and overfill protection in complete compliance with all provisions of Suffolk County Article 12. All remaining above ground tanks are designed with secondary containment systems and

fully comply with the provisions of Suffolk County Article 12.

Fuel oil is received at these locations on an as required basis. The deliver vehicle is via a BNL operated 1,500 gallon tank truck as customarily used to deliver home heating fuel. The drainage system in these areas consists of catch basins dry wells and storm sewers that direct the water to a ground water recharge basins. There is no direct discharge to any surface waters. Considering the intervening land contours, the porosity of the soil and the viscosity of the liquid received at these locations, there exists no reasonable scenario that a discharge could conceivably reach a surface water system. Therefore, this facility complies with the provisions 40 CFR 112.7 (a) (3) (iii)

Oil Filled Power Transformers

In 1991, BNL retained EBASCO Services, Inc. to conduct a comprehensive loss prevention survey of 100 substations containing a total of 315 transformers. The survey identified code-related deficiencies. Raytheon Engineers and Constructors provided Title I and Title II detail design services. One component of the Loss Prevention Project was the installation of dikes and containment around selected transformer installations. Installation began in the second quarter FY 95 with final completion in third quarter FY 1998. The containment provisions are as follows:

Item No. 1 Substations comprising one (1) transformer with less than 660 gallons of oil shall have an oil-collecting pit. (See definition below)

Item No. 2 Substations with multiple transformers whose total volume does not exceed 1320 gallons and where no individual transformer has a greater than 660 gallons of oil shall have an oil collecting pit.

The oil collecting pits are curbed areas filled with stone with no base slab, to collect any accidental discharge of oil from that piece of equipment. In the event of a spill, cleanup measures would require removal of the contaminated stone and/or soil and replacement of same.

Item No. 3 Substations comprising one (1) transformer with more than 660 gallons shall have an oil containment system, (see definition below)

Item No. 4 Substations with multiple transformers whose total volume exceeds 1320 gallons of oil shall have an oil containment system.

The oil containment systems shall be designed to collect and retain oil in order to prevent:

1) Its migration beyond the boundaries of the system and
2) The contamination of ground waters and/or navigable waters.

The systems shall include a concrete curbed perimeter and a sealed base slab forming a secondary oil containment retention pit. Where it is not feasible to provide a concrete

containment, a geomembrane liner containment is provided.

Containment recommendations are included in Table 6 of this report. The complete Loss Prevention report is on file with BNL F&O Directorate. Transformers are either filled at the factory or once at initial start up. There is no routine transferring operations at these locations. 40 CFR 112.7(a)(3) is not applicable.

3.13 Facility Drainage and Effluent Treatment

Central Steam Facility

The bermed areas for all the fuel oil tanks located at the Central Steam Facility are connected via locked post indicator valves to the sanitary sewer system. All heavy (#6) fuel tanks are equipped with both internal (coil) and external (tube and shell) heaters. The steam condensate is discharged to the bermed containment area. There is no recovery or direct discharge to any open water course, ditch, stream or dry tributary. Any accumulated rain water and steam fuel oil heating condensate is discharged to the sanitary sewer system once it is inspected and found to have no visible oil sheen. In accordance with BNL F&O Directorate Policies and Procedures DF-ESH-009 (Draining Secondary Containments) - APPENDIX 1, each inspection and manually activated discharge is documented and copies filed at CSF and EPD.

Site and Staff Services Garage

Building 651 Site Garage - The effluent from the bermed area is discharged to the sanitary sewer system. Prior to discharge, the water is inspected to ensure that there is no visible oil sheen. In accordance with BNL F&O Directorate Policies and Procedures DF-ESH-009 (Draining Secondary Containments) - APPENDIX 1, each inspection and manually activated discharge is documented and copies filed at Building 452 and EPD.

Building 423 Staff Services Garage and Building 630 Service Station - These underground tanks have containment sumps that do occasionally collect rainwater runoff from the surrounding paved areas. Monthly inspections of the sumps identify the presence of liquids. If discovered, arrangements are made with BNL's Water and Sewage Operating Engineers to pump out the water and discharge to the sanitary sewer system. Prior to discharge, the water is inspected to ensure that there is no visible oil sheen. In accordance with BNL F&O Directorate Policies and Procedures DF-ESH-009 (Draining Secondary Containments) - APPENDIX 1, each inspection and manually activated discharge is documented and copies filed at Building 452 and EPD.

3.14 Product Transfer

Central Steam Facility

Due to the high usage, extensive piping interconnections and multiple tanks containing the same product, the Central Steam Facility (CSF) receives fuel from a contract vendor and transfers it between tanks.

Receiving: Tank soundings are obtained everyday at midnight in order to determine the daily fuel consumption. The Supervisor - Central Steam Facility and the Manager, Utilities Group - Operation and Maintenance confer weekly to determine the delivery schedule for the following week. The vendor is then notified as to the weekly total requirement and the daily delivery schedule for the following week. The fuel oil is received at the CSF in accordance with the BNL F&O Directorate Policies and Procedures EU-CSF-009 (APPENDIX 2).

This procedure includes the requirements to assure the safe and accurate receipt of fuel from the delivery vehicle. They include such actions as:

1) Delegation of Responsibility.
2) Completion of Driver's Orientation Sheet (Instructing driver on BNL's Spill Prevention requirements).
3) Verification of product received.
4) Correct valve alignment to the intended-receiving tank.
5) Proper inspection of the tank truck to prevent leakage during transit.
6) Requirements that the vehicle is properly chocked while connected to the unloading hose.
7) Requirements and procedures to secure the facility when operations are concluded to prevent unauthorized personnel from entering the facility
8) Requirements to assure that all drain valves and other valves that could permit the discharge of oil to surface waters are properly locked and capped.

Transferring: Routine transferring between tanks to assure proper levels in the storage tanks is performed in accordance with F&O Directorate Policies and Procedures EU-CSF-004 (APPENDIX 3).

This procedure includes the requirements to assure the safe and accurate transfer of fuel between fuel oil storage tanks. They include such actions as:

1) Delegation of Responsibility.
2) Verification of product transferred.
3) Correct valve alignment to the intended-receiving tank.
4) Requirements and procedures to secure the facility when operations are concluded to prevent unauthorized personnel from entering the facility. The pump room shall be closed and locked.
5) Requirements to assure that all drain valves and other valves that could permit the discharge of oil to surface waters are properly locked and capped.

Site and Staff Services Garage

Building 423: Staff Services Garage - Fuel is transferred (received) from a commercial supplier in standard, compartmentalized, gasoline tank trucks. In general, fuel receiving is as follows:

1) The Staff Services Supervisor determines, via pumpage and tank soundings, the quantity of fuel required and orders it.

2) At the start of delivery, the tanks are again sounded to determine the amount on hand.

3) The tank truck is connected to the correct tank and the tank is filled by gravity.

4) The tanks are sounded at the completion of delivery and the product receipts are reconciled.

The tanks are fitted with high level alarms which are tested as per F&O Directorate Preventative Maintenance procedures.

Building 651: Site Maintenance Garage - Fuel is transferred (received) from a commercial supplier in standard, single compartment fuel tank trucks. The Supervisor, Heavy Equipment Shop, is responsible for the ordering and receiving of the fuel. In general, fuel receiving is as follows:

1) The Supervisor determines, via tank soundings, when approximately 2,000 gallons remains in the largest (10,000-gallon) tank. The minimum order, 3,500 gallons, is then placed.

2) At the start of delivery, the tank is again sounded to determine the amount on hand.

3) The tank truck is connected to the correct tank and the tank truck pump fills the tank.

4) The tank is sounded at the completion of delivery and the product receipt is reconciled.

Under normal conditions, only the single largest tank is in operation. The tanks have been fitted with high level alarms that are tested in accordance with F&O's PM system.

Building 423: Site Maintenance Garage – Is responsible for fueling various generators and mobile equipment on site. To accomplish this task, the Laboratory maintains a single delivery truck for transporting fuel from central storage areas to these remote locations. The vehicle is a 1997 Chevrolet chassis equipped with 1500 gallon two (2) compartment tank and associated pumping and metering equipment. The main tank (diesel) is 1100 gallons and the second (gasoline) tank is 400 gallons capacity. The operation, maintenance and repair are provided by the Staff Services garage in accordance with applicable Department of Transportation (DOT) requirements. The vehicle is licensed (Government License plate E-35181) and is available for off-site (Public Road) use if required. To minimize the possibility of a fuel release from reaching the surface waters or being discharged to ground water in the storm drain system the vehicle is parked within the fuel unloading containment area at Building 651 during idle periods

Building 630 Service Station - Fuel is transferred (received) from a commercial supplier in standard, compartmentalized, gasoline tank trucks. The station operator is responsible

for the ordering and receiving of the fuel. In general, fuel receiving is as follows:

1) Station operator determines, via pumpage and tank soundings, the quantity of fuel required and orders it

2) At the start of delivery, the tanks are again sounded to determine the amount on hand.

3) The tank truck is connected to the correct tank and the tank is filled by gravity via a fuel meter.

4) The tanks are sounded at the completion of delivery and the product receipts are reconciled.

The tanks are fitted with high level alarms which are tested periodically.

4.0 DISCUSSION OF OIL SPILL OCCURRENCES AND CORRECTIVE ACTION

When a spill of hazardous material occurs, Laboratory and contractor personnel are required to immediately notify the on-site Fire Rescue Group, whose members are trained to respond to such releases. The initial step in spill response is to contain and control any release and to notify additional response personnel (i.e., BNL environmental professionals, industrial hygienists, etc.). Environmental professionals reporting to the scene assess the spill for environmental impact and determine if it is reportable to regulatory agencies. Any release of petroleum products to soil must be reported to both NYSDEC and SCDHS, and any release impacting surface water must also be reported to the EPA National Response Center. In addition, a release of more than 5 gallons of petroleum product to impermeable surfaces or containment areas must be reported to NYSDEC and SCDHS. Spills of chemicals in quantities greater than the CERCLA-reportable limits must be reported to the EPA National Response Center, NYSDEC, and SCDHS. Remediation of the spill is conducted, as necessary, to prevent impacts to the environment, minimize human health exposures, and restore the site.

Complete information on BNL's oil spill reporting procedures is contained in Brookhaven National Laboratory's Standards Based Management System (SBMS) Subject Areas (available on the BNL Web Site) Occurrence Reporting and Processing System (ORPS) (APPENDIX 4) and Spill Response (APPENDIX 5).

During the period from January 1, 2006 to October 31, 2010, BNL experienced 44 spill incidents that were reported to regulatory agencies (None of the spills were greater than or equal to 10,000 gallons). New York State requires that any spill that impacts soil be reported within two hours of the time of discovery. Of the 44 spills only two (2) were related to the storage and transfer of petroleum. All other spills were related to failed mobile (e.g., motor oil, hydraulic oil, or antifreeze) or stationary equipment (e.g., working fluid releases such as cutting oils). The spills ranged in size from 1 cup to approximately 70 gallons.

All spills were either contained on impermeable surfaces or released on soil. None of the releases were deemed "reportable" per 40 CFR Part 110; that is none of the releases resulted in impacts to surface water, nor did they cause a violation of a surface water quality standard. There were neither long-term impacts to the environment nor any threats to surface waters resulting from these releases. BNL provides a summary of the reported incidents in annual site environmental reports. Description of the spills and their corrective actions during the past five (5) years are contained in APPENDIX 12.

5.0 STATUS OF COMPLIANCE WITH ENVIRONMENTAL PROTECTION ADMINISTRATION AND NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION REGULATIONS

Brookhaven National Laboratory (BNL) oil storage facilities, as defined by the Major Petroleum Facility (MPF) License and this SPCC Plan, are currently in substantial compliance with the requirements of NYSDEC and Federal regulator agencies. As part of the Department of Energy's (DOEs) commitment to environmental compliance, BNL actively identifies areas of potential noncompliance through routine inspections and maintenance and self-assessments.

New York State Department of Environmental Conservation (NYSDEC) Requirements:

1) Semi-annual testing of the MPF monitoring wells is completed.

2) Monthly monitoring of the MPF monitoring wells for free product is completed.

3) Inspection Certification of Secondary Containment Systems (every 5-years) - Secondary containment is complete for all fuel storage tanks covered by the MPF License. Divirka and Bartilucci completed an inspection and permeability testing of the containment berms in July 2006 (APPENDIX 11). Upgrades to the berm for Tanks 5/6 were necessary based on the results of testing in FY06. A Certification Report was prepared by D&B in September 2008 that documents actions taken to reconstruct Containment Basin 5/6. This report was approved by NYSDEC and is on file with the Facilities and Operations Directorate.

4) Overfill alarms have been installed on all active fuel storage tanks covered by the MPF License as per Suffolk County Article 12 (See below).

5) Double bottom containment and leak detection has been installed in the newest storage tanks (Tanks 9 and 10).

6) Cathodic (impressed current) protection has been installed on all fuel tanks at the Central Steam Facility. Monthly inspections and annual testing of these systems are completed.

Federal Requirements:

1) Five year revision of the SPCC Plan.

2) A Coast Guard plan is not required due to our remote location from navigable waters.

3) Facility Response Plan (FRP) and associated Emergency Response Action Plan (ERAP) has been updated and approved by EPA in FY06. These plans are currently undergoing a 5-year review and will be submitted to EPA for review/approval in February 2011. These plans are available under a separate cover.

Suffolk County Department of Health Services Requirements:

The Suffolk County Department of Health Services (SCDHS) has established regulations (Suffolk County Sanitary Code - Article 12) controlling the storage and handling of toxic and hazardous material in an effort to protect the ground water resources of the county. These regulations are among the most stringent in the country and specific requirements for storage which vary depending on factors such as, the location of the tank, the material stored in the tank, the tank storage capacity, and the date the tank was constructed.

On September 23, 1987, the Laboratory agreed to conform to the applicable environmental requirements of Article 6, 7, 10 and 12 of the Suffolk County Sanitary Code. The following is a list of the improvements required and their implementation.

Items Previously Completed:

Secondary Containment

Tanks 3, 4, 5, 6, 9, and 10 are located in a bermed area in excess of 110% of the largest tank located in it. The lining for all bermed areas consists of a geosynthetic clay liner (GCL) and a layer of stone or gravel as overburden. The liner for tanks 3, 4, 9, and 10 is a Bentonite clay based product manufactured and marketed as ENVIRONMAT III. It consists of Bentonite clay sandwiched between two layers of polypropylene goetextile material. It is applied over a compacted earth base, with six (6) inch overlapping seams, extending to the top of the dike, and anchored in a trench. The material is overlaid with three (3) inches of round stone to act as a cover and to prevent UV deterioration to the polypropylene material.

The GCL liner for Tanks 5 and 6 is a Bentonite clay based product manufactured and marketed as CETCO Bentomat CLT. The Bentomat CLT is a GCL consisting of two non-woven geotextiles sandwiching a core of powdered bentonite. The Bentomat CLT has the added feature of a 20 mil high density polyethylene (HDPE) textured geomembrane adhearded to one of the geotextiles. The geomembrane provides a greater puncture resistance than a conventional GCL and is less susceptible to installation damage. It is applied over a compacted earth base, with twelve (12) inch overlapping seams, extending over the top of the dike, and anchored in a trench. The GCL material is overlaid with twelve (12) inches of round stone to act as a cover and to prevent UV deterioration to the poly propylene material.

Overfill Protection: High Level Alarm

Overfill protection has been installed on all active tanks at the following locations:

Central Steam Facility Building 610 - Tanks 3, 4, 5, 6, 9, and 10 (See Table 1)

Site Maintenance Garage - Diesel Tanks 1, 2, and 3 (See Table 2)

These tanks have been equipped with a Transdata Model 6761 displacer probe and Model 6693

checker for use with a Model 6699 annunciator panel. This system activates both visible and audible alarm at predetermined level conditions to alert the operator of both High and High-High level conditions. Digital Petrotape™ level gauges were installed in FY06 and are manufactured by JOWA Consilium.

Additional overfill protection is installed as part of the fuel inventory system at the following locations:

Central Steam Facility Building 610 - Tanks 3, 4, 5, 6, 9, and 10 (See Table 1)

These tanks are equipped with METRITAPE level indicating systems which provide the operator with continuous indication of the level in the tanks. The systems are also configured with additional logic to provide additional high level alarms.

The following tanks are equipped with visual level indication:

Central Steam Facility Building 610 - Tanks 3, 4, 5, 6, 9, and 10 (See Table 1)

These tanks are provided with a float operated level indicating scale on the external surface of the tank. This provides the operator with an independent visual indication of the tank.

Underground Storage Tanks

There are eight (8) underground storage tanks at BNL that are used for the storage of petroleum products. All of these tanks and associated piping are double walled and equipped with approved overfill alarms, leak detection systems, and stage II vapor recovery system (as necessary).

As of FY08, BNL does not have any more single-walled tanks buried in the ground.

General Activities

The Laboratory has an ongoing program to maintain, inspect, upgrade and replace existing storage facilities and to meet with representatives of NYSDEC and SCDHS to ensure that the information provided for all registered storage facilities is accurate and that new or modified storage facilities are designed and reviewed for compliance with applicable petroleum bulk storage regulations.

In April 2010, due to a directive from the NYSDEC asserting their sole jurisdiction over petroleum storage at Major Oil Storage Facilities (MOSF), SCDHS notified BNL that they will cease permitting activities (review/approval for new construction and modifications, issuance of operating permits and registration requirement) at MOSF facilities. Therefore, all new construction and modifications to existing petroleum storage facilities will be reviewed and approved with representatives of the NYSDEC in accordance with 6 NYCRR Parts 613 and 614.

6.0 SPILL NOTIFICATION PROCEDURES

6.1 Introduction

It is the policy of Brookhaven National Laboratory (BNL) to require a positive attitude toward promptly reporting occurrences (including problems, concerns and adverse conditions) to the Department of Energy (DOE) and to other appropriate organizations, both external and internal as required by DOE Orders, Federal and State Regulations, and as further elaborated by BNL Standards Based Management System (SBMS) subject areas *Occurrence Reporting and Processing System* (ORPS) (APPENDIX 4) and *Spill Response* (APPENDIX 5).

6.2 Notification Procedures

In the event of an oil spill, the BNL Police Group and BNL's Fire Rescue Group are simultaneously notified by dialing extension 2222 or 911 from any on-site phone. From a cellular phone, call 631-344-2222. The Fire Rescue Group is assigned lead responsibility when responding to hazardous material or oil releases. The Incident Commander, typically the on-duty Captain, assesses the spill and determines the need for additional response personnel. If deemed necessary, the Incident Commander initiates the emergency response paging system. All Emergency Response personnel are available through the emergency response paging system, including the Qualified Individual, Facility and Operations supervisory staff, environmental compliance staff and others. Table 6-1 below lists some of the key emergency response personnel.

In the event of any accidental discharge that is > 100 gallons, BNL's Facility Response Plan (FRP) and associated Emergency Response Action Plan (ERAP) are used to guide the required emergency response, notifications, documentation, cleanup, and proper disposal of material. These plans were prepared in accordance with the requirements mandated by the Oil Pollution Act of 1990 and provide information necessary to respond to oil spills, especially worst case releases. Several controlled copies of these plans are available to members of BNL's emergency response organization.

Smaller spills are managed in accordance with the BNL subject area, *Spill Response*. This subject area identifies the responsibilities of all personnel who cause, discover, respond to, or clean up an unexpected release of oil, hazardous substances, radioactive materials, or other regulated pollutants. Environmental Protection Division (EPD) personnel make proper notifications to regulatory agencies and are responsible for the preparation of the Chemical and Oil Spill Reporting Form (APPENDIX 5) and coordination with the responsible agency to assure adequate notification and clean up effort.

Copies of spill reports, clean-up correspondence etc. are maintained by the Facilities and Operations Directorate and EPD.

EMERGENCY RESPONSE PERSONNEL BROOKHAVEN NATIONAL LABORATORY			
Title	**Name**	**Telephone[1]**	**Responsibility During Response Action**
1. Assistant Laboratory Director (F&O)	L. Bates	2222	Oversight of plant activities, including direction, coordination of containment, and remediation of spilled product.
2. Manager, Energy & Utilities (Qualified Individual)	E. Murphy	2222	
3. Manager, Utilities Complex	W. Chaloupka	2222	
4. Manager, Site Services Division	T. Lambertson	2222	
5. Supervisor - MPF	E. Simon	5327	Oversight of Major Petroleum Facility staff
6. Environmental Protection Division Regulatory Compliance Staff	J. Adams D. Bauer F. Craner S. Ferrone B. Hooda R. Lee P. Pohlot J. Remien K. Schwager J. Williams (one of ten)	2222	Assess release, determine notification requirements, and notify response personnel.
7. F&O Directorate Site Shift Supervisor	On Duty (one of five)	4284	F&O Support
8. Manager, Emergency Management	M. Pena	2222	Emergency Response Coordination
9. Public Affairs Office	M. Lynch	2222	Public Relations

[1] Telephone number that is initially used when the person is not on site. The Incident Commander initiates the emergency response paging system to request appropriate personnel assistance, including those listed above. All are available through the emergency response paging system.

7.0 INSPECTION AND MAINTENANCE OF EQUIPMENT

7.1 Inspection

As required by 40 CFR Part 112.7(e), routine inspections, maintenance, and record keeping for all tanks listed in Tables 1-5 are performed by oil storage facility owners in accordance with API 653 testing (or other appropriate industry standard), as required, to insure the integrity of the tanks and associated equipment. In addition, a monitoring program is in place for all oil-filled operating equipment to prevent or detect equipment failures and/or releases of oil. Records of all inspections are maintained at BNL for a minimum of five years.

In accordance with 40 CFR Part 112.8(c)(10), supervisors of these facilities will note any deficiencies that are reported during these inspections and take the necessary corrective actions. Evidence of leakage from tanks, piping, seams, gaskets, pumps, valves, etc, is reported immediately and remediated as appropriate. Maintenance requests are forwarded through the BNL Facility Operations Center (FOC) to assure proper accountability. See Section 7.2 for more details.

NOTE: A brittle fracture evaluation will be conducted when any field constructed aboveground tank undergoes repair, alteration, reconstruction or change in service that might affect the risk of a discharge or failure due to brittle fracture. A brittle fracture evaluation shall also be conducted if a facility fails or discharges oil due to brittle fracture or other catastrophe. Appropriate remedial action will be taken as necessary.

Details on inspections that are performed at the larger bulk storage facilities are provided below.

Building 610 - Central Steam Facility

BNL's Major Oil Storage Facility (MOSF) is inspected by Senior Stationary Engineers who are assigned to the facility 24 hours a day. The Senior Stationary Engineers monitor and record all tank levels and visually check the tank facility and all pumping operations every 2 hours (4 times every 8 hour shift). Once daily, a Senior Stationary Engineer will fill out a detailed inspection report during their visual inspection of the facility. The procedure is included as APPENDIX 6 (EU-CSF-016 Daily Fuel Tank Storage Facility Inspection).

The procedure requires that:

- Inspections are performed periodically
- Inspections are reviewed by management
- Inspections are written
- Inspection reports are retained for a period of three years.

In addition to the daily checks the following inspections are performed and documented for

all of the MOSF tanks:

- Monthly inspections of leak detection, high level, cathodic protection monitoring system and secondary containment. Example checklists for typical above and below ground storage tanks are provided in APPENDIX 8.
- Yearly cathodic protection testing.
- Five-year in-depth integrity inspections of the secondary containment systems (APPENDIX 11).
- In-depth integrity inspections of the tanks and associated piping are completed every ten years or when major material repairs are completed. This may include ultrasonic thickness measurements, holiday inspections, interior perimeter elevation surveys, and magnetic flux leakage floor scans. Copies of the latest Out-of-Service Tank Inspections are included in APPENDIX 10 for each of the tanks at the MOSF.

Site and Staff Services Facilities

Building 423 - Staff Services Garage (Motor Pool)

The Supervisor of BNL's Motor Pool is responsible for all operations at the facility. Routine inspections include the following:

- Daily inventory records for the purpose of detecting leaks. Records are kept for each tank (or battery of tanks) and include measurements of bottom water levels, sales, use, deliveries, inventory on hand and losses or gains. Readings of the fuel pump meters are taken daily and printouts from the tank gauging system are obtained twice per day (0830 and 1700). All reconciliation records are maintained at the facility.

- Weekly inspections of the tanks include the following:

  - Checking electronic overfill and leak detection panels to ensure that they are fully functional, including audible and visual alarms.
  - Checking leak detection system for traces of petroleum (Note: Printouts of the Automatic Tank Gauging (ATG) system checks are maintained to satisfy this requirement.

- Monthly inspections of the tanks include the following:

  - Checking that the tank is properly labeled and that the information is legible.
  - Ensuring that the tank is appropriately color-coded.
  - Inspection of the spill fill sump for spillage and condition of any exposed piping and monitoring probes contained within the sump.
  - Operability checks for the overfill alarm system (i.e., physically lift the ball valve to ensure that the alarms (audible and visual) are activated).
  - Ensure containment piping is opened at one end to allow leak/condensate to drain into the collection sump.
  - Check the dispensers for evidence of leaks.

- Check interstitial monitoring probe for signs of deterioration.

  An example checklist for the monthly inspections performed at this facility is included in APPENDIX 8.

- Yearly cathodic protection testing

Building 651 - Site Maintenance Aboveground Diesel Tank Farm

The Heavy Equipment Mechanic Operator (HEMO) Supervisor is responsible for all operations at this facility. Routine inspections include the following:

- Routine observations of the fuel transfer facility for leaks, drips or spills associated with fueling operations.
- Weekly tank soundings for inventory control.
- Monthly inspections of the condition of the tanks, piping, associated equipment, and secondary containment. An example Aboveground Storage Tank Monthly Visual Inspection Checklist is included in APPENDIX 8.
- Draining of accumulated rainwater in containment, as necessary.

Building 630 – Upton Service Station

The operator/manager of the Upton Service Station is responsible for all operations at his facility. Routine inspections for this facility are similar to those discussed for BNL's Staff Services Garage above. An example checklist for the monthly inspections performed at this facility is included in APPENDIX 8.

7.2 Maintenance

BNL inspection work orders and maintenance requests are processed through the FOC. The FOC utilizes a computerized maintenance management system, which insures that routine inspections are completed and proper response to any identified maintenance requirements. This system also allows for permanent equipment history to be generated and maintained. In most cases, the owners/operators of bulk storage facilities and other oil-filled equipment covered under this plan use this system as a tool to ensure routine inspections are completed. Work orders are automatically generated on a routine basis and distributed to the appropriate trade along with the necessary inspection checklist. A separate work order is generated if any deficiencies are identified during the inspection.

Work orders completed by BNL craft personnel are kept on file for a minimum of five years. A description of the Operations & Maintenance of the Maintenance Management Center (currently known as the FOC) and their responsibilities is detailed in procedure O&M-MMC-001 (APPENDIX 7). Although this procedure is dated June 2004, it is still the most current and in the process of being updated.

The Facility Operations Office handles all facility maintenance requirements. The F&O Directorate maintains a work force of 400 people including engineers, steamfitters,

electricians, sheet metal workers, insulation workers, heavy equipment mechanic operators, buildings and grounds workers, and stationary engineers. If there is a requirement for the services of an outside vendor, Contracts and Procurement issues the contract and the F&O Directorate insures that the work is properly completed. Members of the F&O Directorate handle contact administration.

8.0 SPILL RESPONSE CAPABILITY and INVENTORY OF OIL SPILL CLEAN UP EQUIPMENT

8.1 Equipment

Spill response equipment is maintained at several locations at BNL. Portable fuel transfer pumps, hand tools, and absorbent materials are available in a sea-land container located along Seventh Avenue adjacent to the fuel transfer facility. This equipment is collocated at the Major Petroleum Facility (MPF) for immediate response to spills. A spill response trailer used primarily for small, petroleum-related incidents is parked at the Site and Staff Services Garage (Building 326) and contains a small amount of absorbent materials for use during an oil spill incident. Heavy equipment and additional personnel for remedial work are available from BNL's Site Services Division. Additional absorbents are available from responding fire and rescue vehicles.

The estimated total absorbent recovery capability is 500 gallons, excluding the use of sand or soil. The total portable transfer pump capability at the MPF is approximately 4,500 bbls per day. BNL's fire department is staffed 24-hours a day and is responsible for providing first response resources for fire, medical, and hazardous material or oil spill incidents. Table 8-1 contains a representative list of generally available BNL equipment. BNL's Fire Rescue Group and Site Services Division, during inspection and testing, update the equipment lists, if necessary, or when any changes in equipment or supplies are made. A complete list of all equipment and supplies available at BNL for spill response is presented in Exhibit B of BNL's Facility Response Plan (FRP) (BNL, 2011), including the equipment capabilities of the Miller Environmental Group (MEG), BNL's Oil Spill Response Organization (OSRO).

An agreement was reached with MEG to provide response resources (personnel and equipment) for spills up to and including Worst Case Discharge (WCD) amounts occurring at BNL. MEG will respond within 1 to 6 hours of notification depending on the severity of the incident.

In addition to the equipment listed in Table 8-1, there are numerous communication systems available, including pagers, cellular phones, two-way radios, and conventional telephone systems.

Table 8-1
Spill Response Equipment
Brookhaven National Laboratory

Operations and Maintenance: Heavy Equipment Inventory

Number of Units	Make	Type/Model	Operational Status
1	Caterpillar (D7)	Dozer	Active
1	John Deere (JD 450-C)	Dozer	Active
3	Kawasaki, Clark, and Volvo	Payloaders	Active
2	John Deere	Payloaders	Active
2	Caterpillar	Payloaders	Active
3		Dumpsters	Active
2		Load Lugger Trucks	Active
7		Dump trucks	Active
2	Volvo	Backhoe	Active
1	New Holland	Backhoe	Active
2	Honda	Generators (5-50 kilowatt)	Active
3	New Holland	Skidsteers	Active
3	Bobcat	Skidsteers	Active
1	Vacmaster System 4000	Vacuum System	Active

Major Oil Storage Facility: Response Equipment Inventory

Transfer Pumps

Make	Model	Capacity	Operational Status
LeRoi	Air-driven double diaphragm (90 psig)	2,000 gph at 150-foot head	Active
LeRoi	Air-driven double diaphragm (90 psig)	2,000 gph at 150-foot head	Active
LeRoi	Air-driven double diaphragm (90 psig)	2,000 gph at 150-foot head	Active
LeRoi	Air-driven double diaphragm (90 psig)	2,000 gph at 150-foot head	Active

Key:
psig = Pounds per square inch gauge gph = Gallons per hour

Table 8-1 (continued)
Spill Response Equipment
Brookhaven National Laboratory

Transfer Hose

Number	Length	Type	Service
4	25 feet	3-inch wire reinforced	Oil
3	20 feet	3-inch wire reinforced	Oil
3	25 feet	2-inch wire reinforced	Oil
1	20 feet	2-inch wire reinforced	Oil

Absorbents

Number	Package	Type
3	30-gallon pails	Loose absorbent material
1	50-pound bag	Loose absorbent material
6	Bundle (200 sheets)	Absorbent pads

Hard Boom: 1000 feet of hard boom to be deployed as necessary

Fire Rescue: Emergency Response Equipment Inventory

Number	**Equipment**	**Summary of Supplies Available (See Note Below)**
2	Haz-Mat Trailers	HazMat Level 'A', 'B', & 'C' capability. Up to Large Size Spill capability. Hand tools, spark resistant shovels, wrenches, standard and over-pack drums, acid and base absorbents, plastic sheet goods, absorbents (pads, loose, socks – multiple quantities of all), personal protective equipment, etc, decon equipment, chlorine kits.
1	Rescue Unit	HazMat Level 'B'and 'C' capability. Up to Moderate size spill capability. Extrication and technical rescue equipment. Hand tools, spark resistant shovels, wrenches, acid and base absorbents, mercury kit, plastic sheet goods, absorbents (pads, loose, socks), personal protective equipment, mass casualty emergency medical supplies, metering and monitoring equipment, APR/PAPR's, SCBA's.
1	Ambulance	BLS Capability. Emergency medical supplies, resuscitation equipment, emergency life support.
1	Class 'A' Engine	1500-gallon per minute pump, foam mixer, ladders, portable extinguishers, fire hose with assorted nozzles, hand tools.

Table 8-1 (continued) Spill Response Equipment Brookhaven National Laboratory		
Fire Rescue: Emergency Response Equipment Inventory (Continued)		
Number	**Equipment**	**Summary of Supplies Available (See Note Below)**
1	Command Vehicle	Communications and computer capabilities. Internet and Intranet capability.
1	Ladder/ Pumper	2000 GPM pump with 95' bucket/ladder. Foam capability, assorted fire equipment.
1	EMS Kubota	4x4 vehicle with BLS EMS equipment.
NOTE:	A complete list of all Fire Rescue equipment and supplies available at BNL for spill response is presented in Appendix B of the Facility Response Plan.	

8.2 On-site Personnel

The primary BNL Emergency Response Organization (ERO) is composed of BNL's Police and Fire Rescue Group, and Emergency Management. On-site personnel available on a 24-hour basis for immediate deployment include the following:

- Safeguards and Security: Six to eight personnel, including a supervisor;
- Fire/Rescue: Six to eight personnel, including a fire captain;
- Site Shift Supervisor: One Facility & Operations Directorate representative; and
- Senior Stationary Engineer: Two Major Petroleum Facility staff.

During off-hours, additional ERO support will be requested to respond, if necessary. The Emergency Management Division maintains a list of additional contact names and phone numbers. All ERO personnel are available through the emergency response paging system, including the Qualified Individual, Facility & Operations supervisory staff, environmental compliance staff and others. Table 6-1 in Section 6 (Spill Notification Procedures) lists some of the key emergency response personnel.

In addition to BNL personnel, the Miller Environmental Group, a registered Oil Spill Response Organization for the Port of New York, is contracted to provide additional mitigation in a Medium- or Worst-Case Discharge.

BNL's FRP provides a complete list of the BNL ERO by category and all available response personnel along with each person's responsibility and training. The FRP also includes evidence of the most current contract/agreement BNL has with MEG.

9.0 GROUNDWATER CONTINGENCY PLAN

9.1 Introduction

Section 9.2 describes the hydrogeologic parameters for the aquifer system underlying the Major Petroleum Facility (MPF), the Upton Service Station (Building 630), and the Staff Services Garage areas (Buildings 321 and 423), and Section 9.3 outlines monitoring strategies, contingency measures and reporting requirements under NYSDEC regulations and DOE directives.

9.2 Hydrogeological Parameters

9.2.1 Water Table Elevations and Groundwater Flow Directions

In the BNL region, groundwater flow directions and velocities are routinely assessed by measuring water table elevations in approximately 700 onsite and offsite wells. Water table maps are published annually in the *BNL Groundwater Status Report*. Groundwater flow directions vary across the BNL site. In general, groundwater in the northeast and northwest sections of the site flows eastward toward the Peconic River. In the central and western portions of the site, groundwater flow is south; while in the southeastern sections of the site groundwater flows to the southeast (see Drawing 12.5). The horizontal direction of groundwater flow at BNL is locally influenced by active supply wells; recharge basins and natural hydrogeological conditions. Pumping wells locally depress the water table, while active recharge basins produce local groundwater mounding conditions.

<u>Major Petroleum Facility</u>: Eight wells are used to monitor groundwater quality in the MPF area; these include upgradient well 076-25 and downgradient wells 076-16, 076-17, 076-18, 076-19, 076-378, 076-379, and 076-380 (Table 1). The water table elevation map prepared for the MPF area is presented as Drawing 12.2. The water table measurements used to prepare this map were acquired in June 2009 (Table 2). The direction of groundwater flow in the MPF area is predominantly to the south - southwest, and the depth to groundwater is approximately 32 feet below the ground surface.

<u>Upton Service Station</u>: Four wells are used to monitor groundwater quality in the service station area; these include upgradient well 085-235, and downgradient wells 085-17, 085-236, and 085-237 (Table 3). The water table elevation map prepared for the Upton Service Station area is presented as Drawing 12.2. The water table measurements used to prepare this map were acquired in June 2009 (Table 4). The direction of groundwater flow in the Service Station area is generally to the southeast, and the depth to groundwater is approximately 37 feet below the ground surface.

Table 1: Location of MPF Downgradient Monitoring Wells Relative to Storage Tanks

MPF Tank Berm Areas	Downgradient Monitoring Wells	Distance & Direction of Wells from Tank Area
Tank 4	076-16, 076-17, 076-378	100 feet South
Tank 9	076-16, 076-17, 076-378	200 feet South
Tank 10	076-16, 076-17, 076-378	300 feet South
Tanks 5 and 6	076-18, 076-19, 076-379	100 feet South
Tank 3	076-380 076-18, 076-19, 076-379	125 feet South 400 feet South

Note 1: Tanks 1 and 2 were removed from service, cleaned and demolished/removed December 1996.
Note 2: Tanks 7, 8, 21, and 22 were cleaned in September 1997 and demolished/removed November 1997.
Note 3: Tanks 11, 12, 18, 19, and 20 were demolished/removed May 2006.

Table 2: June 2009 Water Table Measurements in the MPF Area

Well ID	Date Measured	Measuring Point Elevation (MSL)	Depth to Water*	Water Table Elevation (MSL)
075-49	6-24-09	88.67	44.31	44.36
076-04	6-23-09	78.12	33.89	44.23
076-10	6-24-09	79.48	35.67	43.81
076-11	6-24-09	80.31	36.13	44.18
076-16	6-24-09	82.50	38.51	43.99
076-17	NM	81.52	--	--
076-18	6-24-09	77.26	33.25	44.01
076-19	6-24-09	77.83	33.81	44.02
076-20	6-24-09	79.37	35.01	44.36
076-22	6-24-09	80.37	36.47	43.90
076-24	6-23-09	77.53	33.10	44.43
076-25	6-24-09	80.48	36.02	44.46
076-183	6-24-09	79.75	36.04	43.71
076-185	6-24-09	76.66	32.91	43.75
076-317	6-24-09	80.77	36.34	44.43
076-378	6-24-09	78.53	34.54	43.99
076-379	NM	78.36	--	--
076-380	6-24-09	75.90	31.70	44.20

*: Depth to water (in feet) from a well's measuring point – typically located 2 feet above ground surface.
MSL: Mean Sea Level.
NM: Water level not measured during this time period.

Table 3: Location of Upton Service Station Downgradient Monitoring Wells Relative to Storage Tanks

Area Designation	Downgradient Monitoring Wells	Distance & Direction of Well from Tank Area
Gasoline USTs	085-236 and 085-237	15 feet Southeast
Station Building and Pump Islands	085-17	115 feet Southeast

Table 4: June 2009 Water Table Measurements in the Upton Service Station Area

Well ID	Date Measured	Measuring Point Elevation (MSL)	Depth to Water*	Water Table Elevation (MSL)
085-16	6-26-09	82.92	39.51	43.41
085-17	6-26-09	82.60	39.23	43.37
085-69	6-25-09	68.70	25.41	43.29
085-98	6-22-09	83.24	39.70	43.54
085-160	6-25-09	83.56	39.98	43.58
085-161	6-26-09	80.94	37.31	43.63
085-162	6-22-09	84.79	41.34	43.45
085-163	6-26-09	80.76	37.33	43.43
085-235	6-26-09	79.71	36.27	43.44
085-236	6-26-09	79.95	36.55	43.40
085-237	6-26-09	79.64	36.26	43.38
095-87	6-26-09	73.72	30.82	42.90

*: Depth to water (in feet) from a well's measuring point – typically located 2 feet above ground surface.
MSL: Mean Sea Level.

Staff Services Garage: Three wells are used to monitor groundwater quality in the Staff Services Garage area; including upgradient well 102-08 and downgradient wells 102-05 and 102-05 (Table 5). The water table elevation map prepared for the Staff Services Garage area is presented as Drawing 12.2. The water table measurements used to prepare this map were acquired in June 2009 (Table 6). The direction of groundwater flow in this area is generally to the south, and the depth to groundwater is approximately 50 feet below the ground surface.

9.2.2 Hydraulic Gradients

Major Petroleum Facility: The hydraulic gradient for the MPF area was determined using wells 076-24 and 076-183 which, for June 2009, showed a range in water table elevations of 44.43 feet MSL to 43.71 feet MSL, respectively. The distance between the two wells is approximately 680 feet. The hydraulic gradient utilized for groundwater velocity calculations is 0.001 ft/ft, which translates to a one-foot drop in water table elevation over a horizontal distance of approximately 840 feet.

Table 5: Location of Staff Services Garage Downgradient Monitoring Wells Relative to Storage Tanks

Area Designation	Downgradient Monitoring Wells	Distance & Direction of Well from Tank Area
Gasoline USTs and Pump Island	102-05 and 102-06	30 feet South

Table 6: June 2009 Water Table Measurements in the Staff Services Garage Area

Well ID	Date Measured	Measuring Point Elevation (MSL)	Depth to Water*	Water Table Elevation (MSL)
102-01	6-24-09	85.61	43.37	42.24
102-05	NM	Note 1	--	--
102-06	NM	93.49	--	--
102-08	6-24-09	95.54	51.96	43.58
102-10	NM	92.70	--	--
102-11	NM	93.09	--	--
102-12	6-24-09	93.28	50.80	42.48
102-13	NM	93.69	--	--

Note 1: Well needs to be resurveyed
*: Depth to water (in feet) from a well's measuring point – located slightly below ground surface for flush mount wells.
MSL: Mean Sea Level.
NM: Water level not measured during this time period.

Upton Service Station: The hydraulic gradient in the Service Station area is calculated using the water table elevation data of June 2009 from wells 085-160 and 095-87, which ranged from 43.58 feet MSL to 42.90 feet MSL, respectively. The distance between the two wells is approximately 780 feet. The hydraulic gradient utilized for groundwater velocity calculations is 0.0009 ft/ft.

Staff Services Garage: The hydraulic gradient in the Staff Services Garage area is calculated using the water table elevation data of June 2009 from wells 093-02 (located near the Brookhaven Center) and 102-12, which ranged from 43.59 feet MSL to 42.24 feet MSL, respectively. The distance between the two wells is approximately 900 feet. The hydraulic gradient utilized for groundwater velocity calculations is 0.0015 ft/ft.

9.2.3 Porosity

Soil samples collected during the installation of monitoring wells in the three petroleum storage areas indicate that the shallow Upper Glacial aquifer is primarily coarse in texture and has been classified as either SW (well graded) or SP (poorly graded) sand under the Unified Soil Classification System (see Appendix 9 for well construction and geologic logs). Although the unconsolidated nature of the aquifer sediments precludes direct measurement of porosity, specific yield tests conducted by the USGS at BNL resulted in an

estimated total porosity of 0.33 and an effective porosity of 0.24 (Warren et al., 1968).

9.2.4 Anisotropy

At the BNL site, USGS studies of the hydraulic characteristics of the Upper Glacial aquifer indicate that horizontal permeability exceed vertical permeability by a factor of 4 to 17 (Warren et al., 1968). Examination of sample logs from shallow wells in the BNL area indicates the coarse, poorly stratified character to the aquifer materials (Scorca et al., 1999). Based on this observation, aquifer anisotropy is anticipated to trend towards the lower known values. For purposes of estimation of vertical permeability in the area of the MPF, horizontal permeability is estimated to be four times greater than vertical permeability.

9.2.5 Horizontal Permeability

At the BNL site, three full-scale aquifer pumping tests have been performed to assess the hydraulic characteristics of the Upper Glacial aquifer. The first test, conducted by the USGS in 1951, was conducted at former BNL Supply Well #2 (Well S-6456), a middle Upper Glacial aquifer well located approximately 4,000 feet west of the MPF. The second and third tests were performed near BNL's former Hazardous Waste Management Facility (HWMF) during groundwater contamination studies (H2M/Roux Associates, 1985; CDM Federal, 1995). In all three cases, the estimated transmissivity (T) of the Upper Glacial aquifer was generally consistent, ranging from 188,000 gpd/ft to 190,000 gpd/ft, for an approximate conductivity (K) value of 175 ft/day.

9.2.6 Vertical Permeability

Vertical permeability values for the BNL site were evaluated during a 1951 USGS test of the Upper Glacial aquifer properties (Warren *et al*., 1968). During the USGS study, vertical permeability was calculated to be 45 ft/day from pumping test data, to as low as 10 ft/day using infiltration test data. Considering the similar near surface sedimentology in the three petroleum storage areas, the vertical permeability values for the three areas should compare favorably.

9.2.7 Groundwater Velocities

<u>Major Petroleum Facility</u>: Average groundwater velocities in the MPF area were calculated from the measured hydraulic gradient (0.001 ft/ft) in June 2009, the calculated hydraulic conductivity (175 ft/day), and the effective porosity (0.24) defined by the USGS (Warren *et al*., 1968). The resulting horizontal groundwater velocity in the MPF area during June 2009 was estimated to be 0.75 ft/day.

<u>Upton Service Station</u>: Average groundwater velocities in the Service Station area were calculated from the measured hydraulic gradient (0.0009 ft/ft) in June

2009, the calculated hydraulic conductivity (175 ft/day), and the effective porosity (0.24) defined by the USGS (Warren *et al*., 1968). The resulting horizontal groundwater velocity in the Gasoline Station area during June 2009 was estimated to be 0.67 ft/day.

Staff Services Garage: Average groundwater velocities in the Staff Services Garage area were calculated from the measured hydraulic gradient (0.0015 ft/ft) in June 2009, the calculated hydraulic conductivity (175 ft/day), and the effective porosity (0.24) defined by the USGS (Warren *et al*., 1968). The resulting horizontal groundwater velocity in the Staff Services Garage area during June 2009 was estimated to be 1.1 ft/day.

9.2.8 Petroleum Product Velocities

The length of time required for the various petroleum products to contact groundwater in the event of a spill is dependent on a number of variables, including:

- Sedimentology and thickness of the unsaturated zone above the water table;
- Product density and viscosity;
- Soil moisture storage (upper few inches/ft below grade);
- Antecedent moisture in the unsaturated zone; and
- Attenuating capacity of unsaturated zone sediments.

Predictions of contaminant migration through the unsaturated zone (vadose zone) are highly problematic, being largely controlled by antecedent moisture conditions that vary appreciably according to natural variations in precipitation and evaporation. For purposes of estimating travel time from land surface to the water table, velocities are usually based on vertical hydraulic conductivities and porosity (saturated, steady state flow conditions), and assume that contaminant migration moves vertically downward as a discrete wetting front.

This calculation, therefore, would potentially represent a minimum travel time of infiltration to the aquifer, and does not account for changes in sediment permeability and the contaminant's capacity for sorption and retardation as it migrates through the unsaturated zone.

Presently, the MPF stores only No. 2 and No. 6 fuel oil (see Section 3). Groundwater contaminants from these products can travel both as free product and in dissolved form with advective groundwater flow. The need to monitor for both forms of transport is reflected in the annual *BNL Environmental Monitoring Plan* which requires monthly sampling for free product, as well as semi-annual sampling for dissolved compounds.

The Upton Service Station and Staff Services Garage store unleaded gasoline in underground storage tanks (USTs). Groundwater contaminants from these

products can travel both as free product and in dissolved form with advective groundwater flow. Because these storage tanks meet Suffolk County Article 12 requirements for secondary containment, high level alarms and leak detection, monthly testing for free product on the water table is not needed. Furthermore, potential product loss at the diesel AST and associated off loading area would be mitigated by sealed secondary containment structures. However, the need to conduct a limited (confirmatory) monitoring program for both forms of transport is reflected in the annual *BNL Environmental Monitoring Plan*, which specifies semi-annual sampling for free product and volatile organic compounds in the wells downgradient of the UST areas.

Specific product travel times to groundwater must be modeled according to specific parameters that would be quantified at the time of a significant spill. Several of these parameters, particularly those which relate to antecedent soil moisture conditions, would be difficult to evaluate below existing containment systems. Spills in those areas and possible impacts to groundwater would primarily be assessed via the site groundwater monitoring program. Accidental spills outside of the tank containment areas (e.g., from above ground pipelines or transfer operations), though considered less likely and more immediately visible, would be evaluated through modeling and/or empirical techniques.

9.3 Contingency Plan

9.3.1 Groundwater Monitoring Plan

Major Petroleum Facility: Eight wells are used as observation points for groundwater monitoring as required by the MPF license; these include Well 076-25 as an upgradient well, and Wells 076-16, 076-17, 076-18, 076-19, 076-378, 076-379, and 076-380 as downgradient wells. The eight wells are constructed with 15 to 20 foot long screens that straddle the water table (see Appendix 9 for well construction logs).

The downgradient monitoring wells for the MPF are positioned to monitor potential spills from the petroleum storage tanks, all of which have bermed containment systems. Distance references from the tanks to the downgradient groundwater monitoring wells are provided in Table 4.

As required by the MPF license, the eight groundwater monitoring wells at the MPF are sampled monthly for free product. Additionally, groundwater samples are collected semi-annually (once in the spring and again in the fall), and analyzed using EPA 624 for Volatile Organic Compounds (including MTBE) and EPA Method 625 for Polynuclear Aromatic, Base Neutral, and Acid Extractable Compounds. Parameter lists are subject to change, based on annual MPF license conditions.

Upton Service Station: Groundwater quality in the Service Station area is monitored by one upgradient (085-235) and three downgradient wells (085-17, 085-236 and 085-237). Locations of these wells are shown on Drawing 12.3. The wells were installed with either 15- or 20-foot screens that straddle the water table (see Appendix 9 for well construction logs). The USTs and associated piping systems were designed, installed and are tested in accordance with Suffolk County Article 12 requirements. The wells were installed to evaluate possible historical releases and to ensure that potential leakage from the present USTs and/or distribution lines will be detected in the event of a tank alarm and/or containment system failure. Because the tanks meet Suffolk County Article 12 requirements for secondary containment, overfill protection, and leak detection, monthly testing for free product on the water table is not needed. However, the need to conduct a limited (confirmatory) monitoring program for both free product and dissolved contamination is reflected in the annual *BNL Environmental Monitoring Plan*, which specifies semi-annual measurements for free product and analysis for volatile organic compounds (including MTBE) using EPA Method 524. BNL may also periodically test groundwater samples for SVOCs using EPA Method 625.

Staff Services Garage: Groundwater quality in the Staff Services Garage area is monitored by two downgradient wells (102-05 and 102-06). These wells were installed downgradient of the gasoline UST and pump island areas (see Drawing 12.4). The wells were installed with either 15- or 20-foot screens that straddle the water table (see Appendix 9 for well construction logs). The USTs and associated piping systems were designed, installed and are tested in accordance with Suffolk County Article 12 requirements. The wells were installed to evaluate possible historical releases and to ensure that potential leakage from the present USTs and/or distribution lines will be detected in the event of a tank alarm and/or containment system failure. Because the tanks meet Suffolk County Article 12 requirements for secondary containment, overfill protection, and leak detection, monthly testing for free product on the water table is not needed. However, the need to conduct a limited (confirmatory) monitoring program for both free product and dissolved contamination is reflected in the annual *BNL Environmental Monitoring Plan*, which specifies semiannual measurements for free product and analysis for volatile organic compounds (including MTBE) using EPA Method 524 analysis. BNL may also periodically test groundwater samples for SVOCs using EPA Method 625.

9.3.2 Spill Scenarios

Major Petroleum Facility: Possible spills in the MPF area might be classified into four basic categories; major or minor spills inside the bermed containment areas, and major or minor spills outside the bermed containment areas. Major spills outside of the containment areas are not considered a likely occurrence since most spills in this area would be limited to line losses or transfer mishaps. Line losses should be immediately recognizable and resolvable in a relatively short period of

time. In 1997, potential impacts to the environment by transfer losses were reduced by the construction of a centralized fuel transfer station, which has sealed secondary containment areas.

It is assumed that most spills of consequence would occur within the bermed containment areas. The berm area for Tank 3 is bentonite lined, and the balance of the bermed areas are lined with Enviromat(R) - a combination geosynthetic and clay liner. These containment systems would prevent petroleum product from entering the soils with the exception of the unlined underside of the tanks that are supported by concrete ringwalls. Outside of a complete dislodgement of a tank from its foundation, leakage through the containment system would primarily be limited to the liner-ring wall interface.

The most probable spill scenario in the contained tanks areas would be leakage from the base of a tank. (Note: Tanks 9 and 10 have double bottoms.) If sizable, leakage from the base of a tank would be evident through noticeably rapid changes in product level in the tank. Otherwise, minor leakage might continue unabated until aquifer impacts were realized in the groundwater monitoring wells. Since antecedent moisture in the vadose zone beneath the tanks is constrained to a large extent by the liner system, a certain volume from these minor leaks would be stored in the unsaturated soils, until field capacity is reached.

A worst case scenario in terms of the most rapid migration of contaminants to the water table and traveling as a free phase or via advective groundwater flow to the MPF monitoring well network, assumes a catastrophic tank failure, resulting in a major spill and rapid attainment of field capacity in the vadose zone beneath the ruptured tank. Under those circumstances, minimal contaminant travel times to the groundwater monitoring network could be estimated using the hydrogeological parameters defined in Section 9.2 and the distances specified in Table 1. These data could also be used to support groundwater modeling studies of a given spill situation which would also incorporate site-specific information relative to product characteristics and environmental conditions at the time of the incident.

Upton Service Station and Staff Services Garage: The USTs were designed and installed according to Suffolk County Article 12 requirements. While it is unlikely that a significant release would go undetected by leak detection systems or bypass the secondary containment controls, failure of these systems could occur. Outside of a complete failure of an UST, the most probable spill scenario would be minor leakage. A sizable leak would be evident through noticeably rapid changes in product level in the tank. Minor leakage might continue unabated until aquifer impacts were realized in the groundwater monitoring wells. Since antecedent moisture in the vadose zone beneath the tanks is constrained to a large extent by the paved roadways overlying the tank areas, a certain volume from these minor leaks would be stored in the unsaturated soils, until field capacity is reached.

A worst case scenario in terms of the most rapid migration of contaminants to the water table and traveling as a free phase or via advective groundwater flow to the monitoring wells located downgradient of the UST areas, assumes a catastrophic tank failure, a major spill and rapid attainment of field capacity in the vadose zone beneath the ruptured tank or distribution lines. Under those circumstances, minimal contaminant travel times to the groundwater monitoring network could be estimated using the hydrogeological parameters defined in Section 9.2 and the distances from the release points to the wells (Tables 3 and 5).

These data could also be used to support groundwater modeling studies of a given spill situation which would also incorporate site-specific information relative to product characteristics and environmental conditions at the time of the incident.

9.3.3 Contingency Measures and Reporting Requirements

Emergency spill response for all spills of reportable quantities at BNL requires immediate NYSDEC Spill Unit notification (see Section 6.0) and also triggers specific response actions pursuant to DOE Order 231.1A, *Environment, Safety and Health Reporting*. This order directs BNL personnel to implement corrective actions in accordance with BNL's *Occurrence Reporting and Processing System* (Appendix 4). In addition to documenting how the spill occurred, clean-up procedures and future preventive measures to be implemented, reporting requirements are specified in this procedure.

Small spills in the form of unrecognizable tank leaks that become apparent only by the observation of free product or dissolved constituents in groundwater monitoring wells will be handled by direct notification of the NYSDEC Spill Unit. Complete information on oil spill reporting is contained in the *Occurrence Reporting and Processing System* (Appendix 4) and *Spill Response* (Appendix 5). Additional actions related to the detection of unexpected levels of contamination in the aquifer are defined in the BNL *Groundwater Protection Contingency Plan* (BNL procedure EM-SOP-309). The NYSDEC may also require expanded monitoring and additional groundwater investigations in conjunction with the Federal Facilities Agreement. At the same time, BNL would make an independent evaluation of the cause, impacts, and remedies required as the result of the incident.

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Scorca, M.P., Dorsch, W., and Paquette, D.E., 1999. Stratigraphy and Hydrologic Conditions at the Brookhaven National Laboratory and Vicinity, Suffolk County, New York, 1994-1997. U.S. Geological Survey Water Resources Investigations Report 99-4089.

10.0 SECURITY

10.1 Site Security

Security at the BNL site is maintained 24 hours per day by a response trained staff of armed Security Police Officers (SPO). Patrols are continuous throughout the site. Patrols are in radio contact with their headquarters and the duty sergeant and would request assistance as required.

Access of persons and vehicles is controlled at the site gates by security personnel. Access is controlled by examination of identity documents and/or BNL issued vehicle stickers. In addition, vehicle data for all vehicles entering the site is recorded.

10.2 Oil Storage Security

BNL's Facilities and Operations (F&O) Directorate provides 24 hour management coverage using a Site Shift Supervisor. The Site shift Supervisor has overall charge of all F&O facilities during the off hours. He is responsible to make rounds of F&O equipment, investigate unusual occurrences as reported by the SPO, alert BNL management as required, and mobilize F&O forces in response to an environmental emergency.

Aboveground piping and associated transfer operations are protected from vehicular traffic through design (i.e., installed far enough away from traffic) and/or by the use of curbing, bollards, etc. In addition, all oil storage facilities have adequate lighting that will assist in the discovery of discharges occurring during hours of darkness, both by operating personnel and by the SPO.

Additional details on oil storage security are provided below.

Building 610 - Central Steam Facility Oil Storage:

The Central Steam Facility (CSF) is staffed by at least two (2) employees 24 hours per day. The area is neither alarmed nor fenced, but is checked regularly (every two hours) by the engineers on duty. Additionally, the SPO patrol the area every two (2) hours on a random basis.

The unloading facilities are equipped with one way check valves to prevent product from accidentally flowing out if the connection is accidentally severed. Additionally, a ball valve is fitted immediately before the actual truck/transfer interface and a plug (OPW or Evertite) is inserted into the line after it is disconnected. All tank drains are fitted with locked valves and additionally capped, plugged or fitted with blank flanges as appropriate.

Fuel Oil receiving and transferring procedure are covered in BNL F&O Policies and Procedures EU-CSF-009 (APPENDIX 2) and EU-CSF-004 (APPENDIX 3) These procedures include the requirements to assure the safe transfer of fuel and the

requirements to secure the facility when active operations cease. They include such actions as:

1) Requirements and procedures to secure the facility when operations are concluded to prevent unauthorized personnel from entering the facility

2) Requirements to assure that all drain valves and other valves that could permit the discharge of oil to surface waters are properly locked and capped.

Site and Staff Services Oil Storage:

Building 423 – Motor Pool (Site Maintenance Garage)

The Station is secured at the close of business, 1700 hours. All power is secured to the pumps preventing the discharge of any product. The tank fills are secured with pad locks and there are no additional drains to be blanked.

Building 651 – Diesel Tank Farm

The area around the tanks is completely enclosed with a six foot high chain link fence which is secured during the off hours. The unloading facilities are equipped with one way check valve to prevent product from flowing out if the connection is accidentally severed. Additionally, a ball valve is fitted immediately before the actual truck/transfer interface and a plug (OPW or Evertite) is inserted into the line after it is disconnected. All tank drains are fitted with locked valves and additionally capped, plugged or fitted with blank flanges as appropriate. All power is secured to the pumps preventing the discharge of any product.

Building 630 - Upton Service Station

The Station is secured at the close of business, 1800 hours. All power is secured to the pumps precluding the discharge of any product. The tank fills are secured with pad locks and there are no additional drains to be blanked.

Heating and Emergency Generator Satellite Tanks

There are no loading/unloading facilities associated with these types of tanks. The individual tank fills are secured with pad locks when not in use and any additional drains associated with these types of tanks are blanked off, preventing the discharge of any product.

11.0 TRAINING

11.1 General Training Requirements (Oil-Handlers)

At a minimum and in accordance with the requirements of CFR 40 112.7(f), the following general training requirements are implemented at Brookhaven National Laboratory (BNL):

- Oil-handling personnel at BNL are trained in the operation and maintenance of equipment to prevent discharges; discharge procedure protocols; applicable pollution control laws, rules and regulations; general facility operations; and, the contents of BNL's SPCC Plan. This information is provided through a web-based training module that was developed specifically to address these requirements (TQ-SPCC). Initial training is provided to all identified oil-handling personnel prior to assuming their oil-related duties and may not be waived based on prior experience. A requalification requirement of three (3) years was determined to be adequate for this training module unless a significant change to BNL's SPCC Program is made.

- The Manager of the Energy and Utilities Division within the F&O Directorate has overall responsibility and is accountable for discharge prevention at BNL, maintains a controlled copy of the SPCC Plan, and regularly reports to facility management. However, first-line supervisors, department/division training coordinators, and subject matter experts within BNL's Environmental, Safety and Health Directorate provide support in ensuring that oil-handling personnel are properly identified and trained.

- An annual discharge prevention briefing is coordinated through BNL's Environmental Protection Division to assure adequate understanding of the SPCC Plan. At a minimum, this briefing highlights and describes recent discharges or failures, malfunctioning components, changes in equipment or procedures, and any recently developed precautionary measures.

11.2 All Employees

In addition to the specific training provided to oil-handlers, BNL has an extensive training program to keep all employees informed of the key safety and environmental issues that concern themselves and their environment. At a minimum, all new employees are required to take the following two web-based training courses that are applicable to the requirements outlined in this plan:

- Emergency Planning & Response (GE-EMERGPLAN) – This course was developed to inform employees of the proper actions to take in an emergency situation, which includes what to do in the event of a hazardous material release or spill.

- Environmental Protection (GE-ENV-GET) – This course focuses on defining the employee's role and responsibility in BNL's commitment to the preservation and protection of the environment including proper spill response procedures. Specifically, a discussion is included on the prevention, identification, mitigation, and proper notification of spills.

11.3 Emergency Response Organization

BNL's Fire Rescue and Security personnel and members of the Emergency Response Organization (ERO), which are non-uniformed BNL employees who respond to emergencies when requested and provide environmental, health and safety expertise to mitigate an event, receive additional training to ensure they are familiar with the proper spill response, notification, cleanup, and record keeping requirements required by this document and other related plans. Specific training/exercise programs include, but are not limited to:

National Preparedness for Response Program

BNL utilizes the National Preparedness for Response Exercise Program (PREP) to satisfy the requirements of Section 4202(a) of the Oil Pollution Act of 1990 (OPA 90). PREP was developed to provide a mechanism for compliance with the exercise requirements of OPA 90, while being economically feasible for the government and industry to adopt and sustain. As such, BNL ensures compliance with PREP in accordance with the standard set forth in this program. While the PREP program is a voluntary program, BNL recognizes the importance of response preparedness and will adhere to the guidelines to continually improve its response capabilities. An overview of BNL's required PREP exercises and purpose is provided below.

Qualified Individual Notification Exercise (Quarterly)

The purpose of this exercise is to ensure that the Qualified Individual (QI), or designee as indicated in BNL's Facility Response Plan (FRP), can be reached in a spill response emergency.

Equipment Deployment Exercises

The purpose of this exercise is to validate that spill response equipment (e.g., hard containment boom, pumps) is appropriate for the operating environment in which it is intended to be used and that operating personnel are trained and capable of its deployment and operation.

Annual Spill Management Team Tabletop Exercise (SMTTX)

This exercise is designed to ensure that BNL's emergency response organization and F&O Directorate management understands the rules and regulations pertaining to the use and storage of petroleum products, are familiar with the Laboratory's FRP, and are able to use it effectively to conduct a spill response. Attendees of this exercise include Fire Rescue and Security personnel, Environmental, Safety and Health Representatives, F&O Directorate personnel, and Community Relations.

Facility Emergency Procedures Exercise
This exercise tests BNL's emergency procedures to ensure personnel knowledge of actions to be taken to mitigate a spill. This exercise typically involves one or more of the emergency procedures for spill mitigation.

Environmental Protection Division Spill Response Team

Members of BNL's Environmental Protection Division (EPD) spill/emergency response team are responsible for implementing the procedure titled, "*Oil/Chemical Spill Emergency Response at BNL*" (RC-SOP-202) and are required to take several additional training courses to ensure they are familiar with their roles, responsibilities, and actions when responding to unexpected releases of oil, hazardous substances, or radioactive materials. At a minimum, the following additional training courses are required: Incident Command Training Course (TQ-EP-015), Emergency Response Drill/Exercise (EM-EP-117), Hazardous Waste Generator Training (HP-RCRIGEN3), NIMS IS-700 Training (EM-IS-700), and Spill Response Team Training Course (ES-SRT). Descriptive information about any of the courses listed above can be provided upon request.

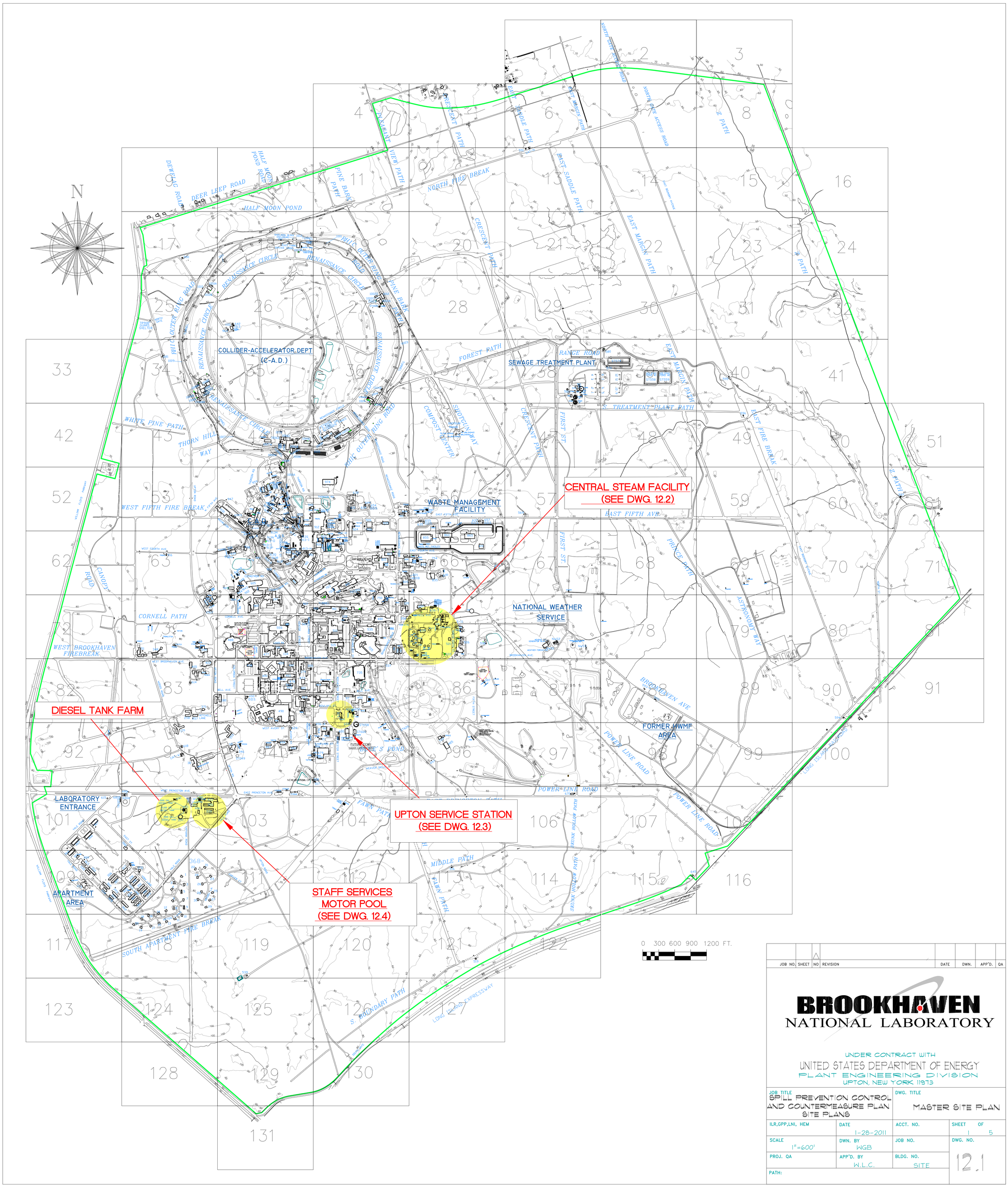
11.4 Documentation of Records

Each department/division documents personnel training with information regarding job duties, tasks, descriptive information about the course, and attendance records including those training records associated with satisfying SPCC requirements. In some cases, departments or divisions accomplish this documentation through coordination with the BNL Training Office. For each registered training course, BNL training documentation includes pertinent, descriptive information about the course, the recommended class size, expatriation date or frequency with which the course should be repeated by trainees, and equipment.

Each department/division must keep records of training attendance for required general training, on-the-job training, and recommended training. This documentation will be kept by BNL for five years, or for the period specified by the DOE or by applicable regulatory requirements. Individual training records and information about training courses may be viewed at http://training.bnl.gov/ or are kept on file by the department/division training coordinator.

12.0 SITE PLANS

Dwg. No.	Title
12.1	Brookhaven National Laboratory Site Master Plan with Grid Reference numbers
12.2	Grid Reference 76 - Central Steam Facility Building 610 and Tank Farm
12.3	Grid Reference 85 -Upton Service Station Building 630
12.4	Grid Reference 102 - Site and Staff Services Garages Building 423 and 651
12.5	Brookhaven National Laboratory Site Plan with Groundwater Contour Lines
12.6	Balance of Plant Satellite Fuel Storage Facilities
12.7	13.8 kV Electrical Transformer Locations
12.8	2.4 kV Electrical Transformer Locations

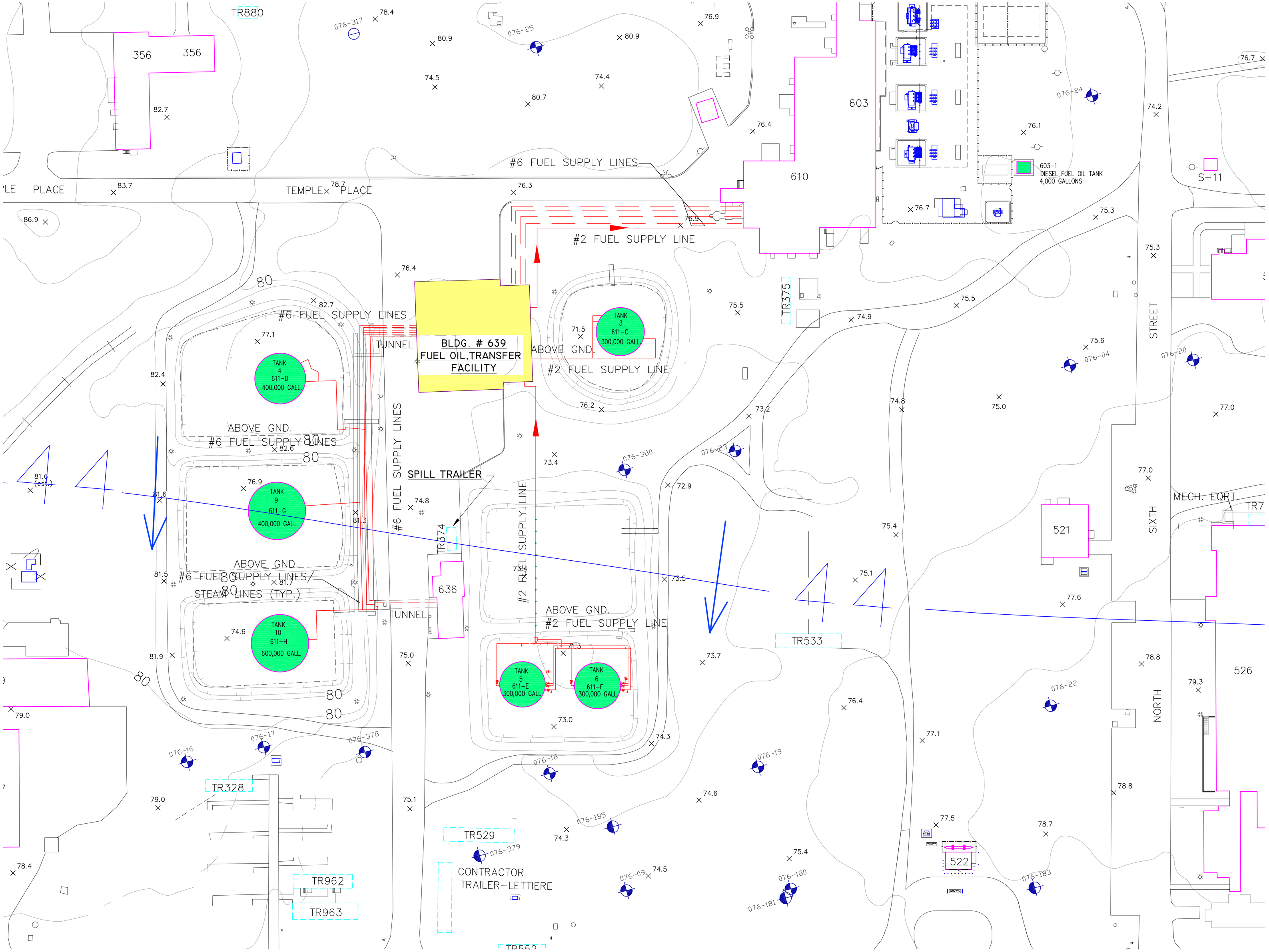


JOB NO.	SHEET	NO	REVISION	DATE	DWN.	APP'D.	QA

BROOKHAVEN
NATIONAL LABORATORY

UNDER CONTRACT WITH
UNITED STATES DEPARTMENT OF ENERGY
PLANT ENGINEERING DIVISION
UPTON, NEW YORK 11973

JOB TITLE: SPILL PREVENTION CONTROL AND COUNTERMEASURE PLAN SITE PLANS		DWG. TITLE: MASTER SITE PLAN	
ILR,GPP,LNI, HEM	DATE: 1-28-2011	ACCT. NO.	SHEET 1 OF 5
SCALE: 1"=600'	DWN. BY: WGB	JOB NO.	DWG. NO. 12.1
PROJ. QA	APP'D. BY: W.L.C.	BLDG. NO.: SITE	
PATH:			



GROUNDWATER CONTOUR MAP
JUNE 2009
PREPARED BY: D. PAQUETTE

LEGEND

WELL LOCATION

076-04 Grid No.-Well No.

Line of Equal Water Table ElevationJune 2009

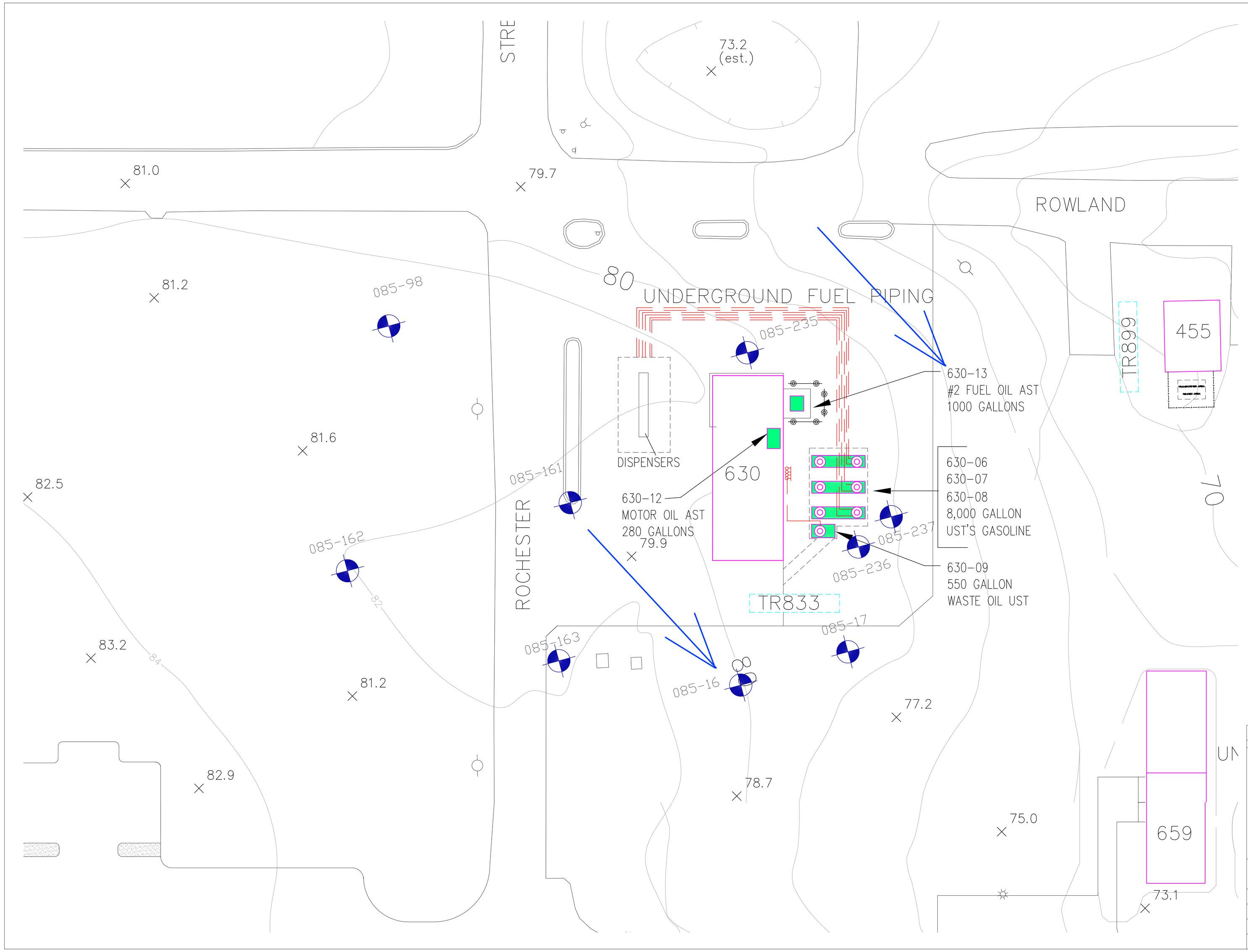
General Groundwater Flow Direction

JOB NO.	SHEET	NO	REVISION	DATE	DWN.	APP'D.	QA

BROOKHAVEN NATIONAL LABORATORY

UNDER CONTRACT WITH
UNITED STATES DEPARTMENT OF ENERGY
FACILITIES & OPERATIONS, MODERNIZATION PROJECT OFFICE
UPTON, NEW YORK 11973

JOB TITLE: SPILL PREVENTION CONTROL AND COUNTERMEASURE PLAN SITE PLANS		DWG. TITLE: GRID REFERENCE 75 & 76 CENTRAL STEAM FACILITY BUILDING 610 & TANK FARM	
ILR,GPP,LNI, HEM	DATE 01/31/11	ACCT. NO.	SHEET 1 OF 1
SCALE 1"=40'-0"	DWN. BY WGB / REV'D BY	JOB NO.	DWG. NO. 12.2
ESHQ RISK LEVEL	APP'D. BY WLC	BLDG. NO. SITE	
PATH:			



N

GROUNDWATER CONTOUR MAP
JUNE 2009
PREPARED BY: D. PAQUETTE

LEGEND

WELL LOCATION

085-16 Grid No.- Well No.

Line of Equal Water Table Elevation June 2009

General Groundwater Flow Direction

AST- ABOVEGROUND STORAGE TANK

UST- UNDERGROUND STORAGE TANK

JOB NO.	SHEET	NO	REVISION	DATE	DWN.	APP'D.	QA

BROOKHAVEN NATIONAL LABORATORY

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UPTON, NEW YORK 11973

JOB TITLE: SPILL PREVENTION CONTROL AND COUNTERMEASURE PLAN SITE PLANS		DWG. TITLE: GRID REFERENCE 85 SERVICE STATION BUILDING 630	
ILR,GPP,LNI, HEM	DATE 01/31/11	ACCT. NO.	SHEET 1 OF 1
SCALE 1"=20'-0"	DWN. BY WGB / REV'D BY	JOB NO.	DWG. NO. 12.3
ESHQ RISK LEVEL	APP'D. BY WLC	BLDG. NO. SITE	
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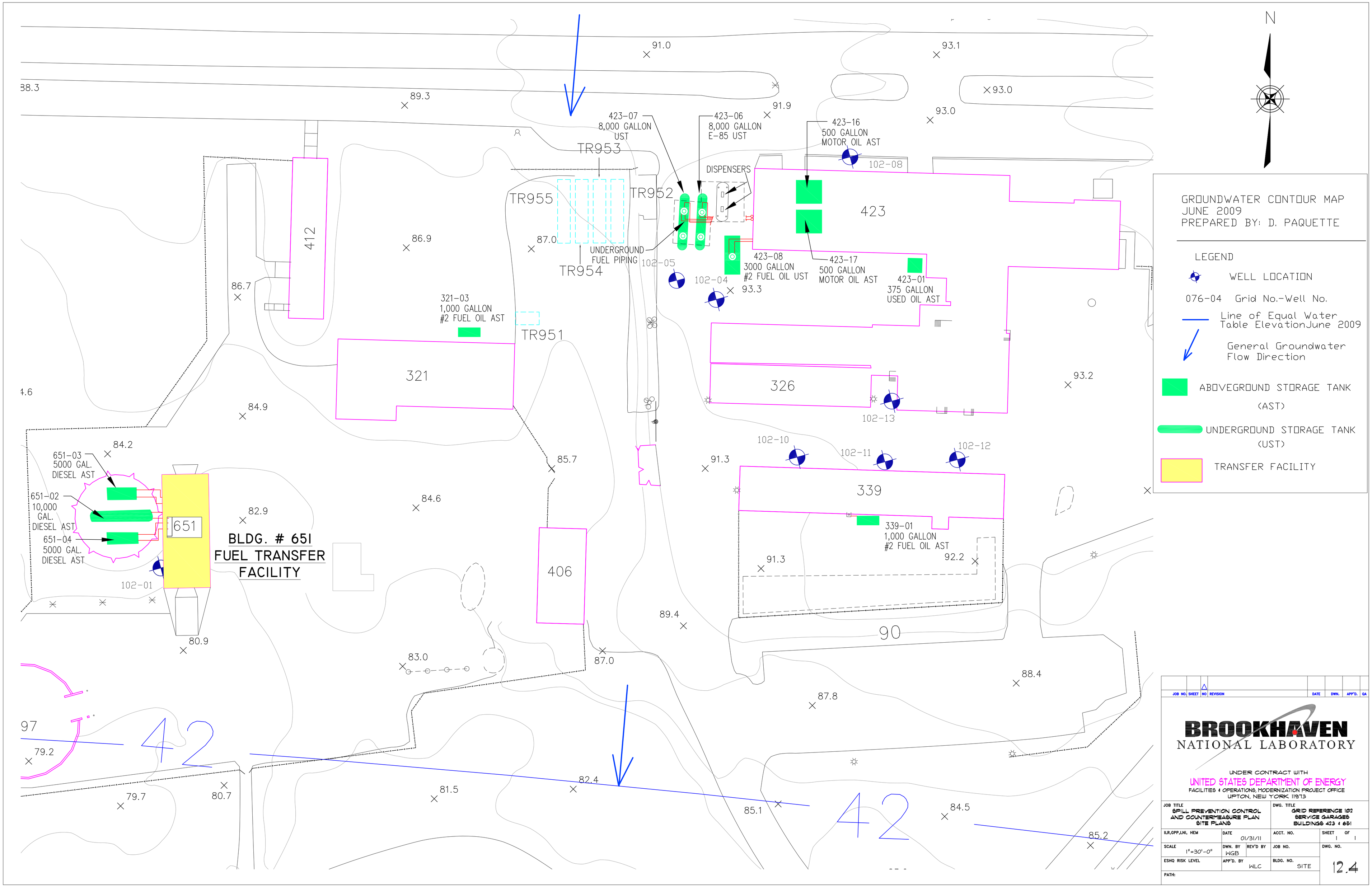
N
GROUNDWATER CONTOUR MAP
JUNE 2009
PREPARED BY: D. PAQUETTE
LEGEND
WELL LOCATION
076-04 Grid No.-Well No.
Line of Equal Water Table ElevationJune 2009
General Groundwater Flow Direction
ABOVEGROUND STORAGE TANK (AST)
UNDERGROUND STORAGE TANK (UST)
TRANSFER FACILITY
423-07
8,000 GALLON
UST
423-06
8,000 GALLON
E-85 UST
423-16
500 GALLON
MOTOR OIL AST
DISPENSERS
TR953
TR952
TR955
TR954
TR951
UNDERGROUND
FUEL PIPING
423-08
3000 GALLON
#2 FUEL OIL UST
423-17
500 GALLON
MOTOR OIL AST
423-01
375 GALLON
USED OIL AST
321-03
1,000 GALLON
#2 FUEL OIL AST
102-08
102-05
102-04
102-13
102-10
102-11
102-12
102-01
423
412
321
326
339
406
90
651
651-03
5000 GAL.
DIESEL AST
651-02
10,000
GAL.
DIESEL AST
651-04
5000 GAL.
DIESEL AST
BLDG. # 651
FUEL TRANSFER
FACILITY
339-01
1,000 GALLON
#2 FUEL OIL AST
42
42
91.0
93.1
93.0
91.9
93.0
89.3
86.9
87.0
86.7
93.3
93.2
84.9
84.2
85.7
91.3
84.6
82.9
91.3
92.2
89.4
80.9
83.0
87.0
88.4
87.8
79.2
79.7
80.7
81.5
82.4
85.1
84.5
85.2
JOB NO. SHEET NO REVISION DATE DWN. APP'D. QA
BROOKHAVEN
NATIONAL LABORATORY
UNDER CONTRACT WITH
UNITED STATES DEPARTMENT OF ENERGY
FACILITIES & OPERATIONS, MODERNIZATION PROJECT OFFICE
UPTON, NEW YORK 11973
JOB TITLE
SPILL PREVENTION CONTROL
AND COUNTERMEASURE PLAN
SITE PLANS
DWG. TITLE
GRID REFERENCE 102
SERVICE GARAGES
BUILDINGS 423 & 651
ILR,GPP,LNI, HEM
DATE 01/31/11
ACCT. NO.
SHEET 1 OF 1
SCALE 1"=30'-0"
DWN. BY WGB
REV'D BY
JOB NO.
DWG. NO.
ESHQ RISK LEVEL
APP'D. BY WLC
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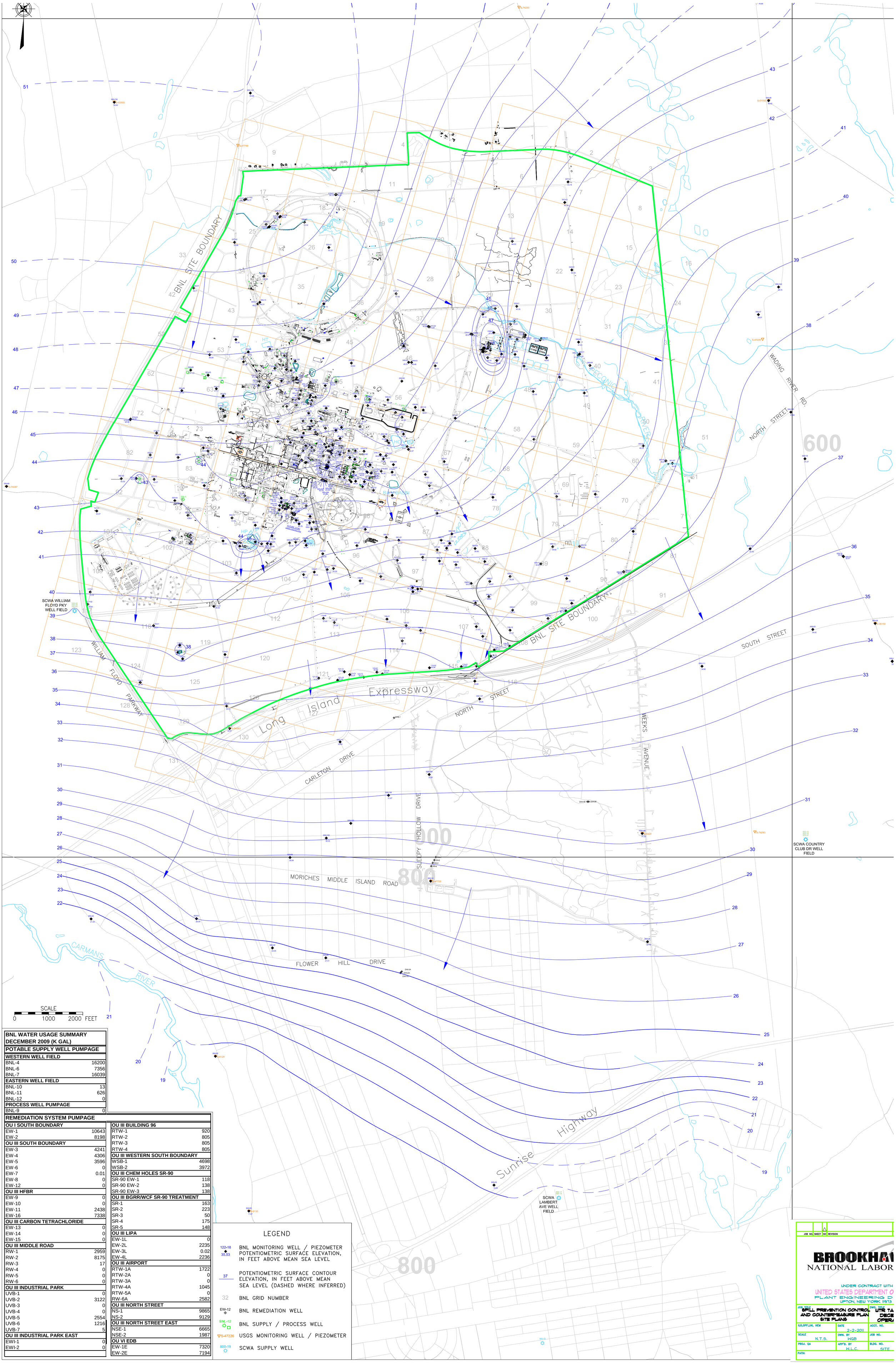

BNL WATER USAGE SUMMARY DECEMBER 2009 (K GAL)	
POTABLE SUPPLY WELL PUMPAGE	
WESTERN WELL FIELD	
BNL-4	16200
BNL-6	7356
BNL-7	16039
EASTERN WELL FIELD	
BNL-10	13
BNL-11	626
BNL-12	0
PROCESS WELL PUMPAGE	
BNL-9	0

REMEDIATION SYSTEM PUMPAGE	
OU I SOUTH BOUNDARY	
EW-1	10643
EW-2	8198
OU III SOUTH BOUNDARY	
EW-3	4241
EW-4	4306
EW-5	3596
EW-6	0
EW-7	0.01
EW-8	0
EW-12	0
OU III HFBR	
EW-9	0
EW-10	0
EW-11	2438
EW-16	7338
OU III CARBON TETRACHLORIDE	
EW-13	0
EW-14	0
EW-15	0
OU III MIDDLE ROAD	
RW-1	2959
RW-2	8175
RW-3	17
RW-4	0
RW-5	0
RW-6	0
OU III INDUSTRIAL PARK	
UVB-1	0
UVB-2	3122
UVB-3	0
UVB-4	0
UVB-5	2554
UVB-6	1216
UVB-7	5
OU III INDUSTRIAL PARK EAST	
EWI-1	0
EWI-2	0

OU III BUILDING 96	
RTW-1	920
RTW-2	805
RTW-3	805
RTW-4	805
OU III WESTERN SOUTH BOUNDARY	
WSB-1	4698
WSB-2	3972
OU III CHEM HOLES SR-90	
SR-90 EW-1	118
SR-90 EW-2	138
SR-90 EW-3	138
OU III BGRR/WCF SR-90 TREATMENT	
SR-1	163
SR-2	223
SR-3	50
SR-4	175
SR-5	148
OU III LIPA	
EW-1L	0
EW-2L	2235
EW-3L	0.02
EW-4L	2236
OU III AIRPORT	
RTW-1A	1722
RTW-2A	0
RTW-3A	0
RTW-4A	1045
RTW-5A	0
RW-6A	2582
OU III NORTH STREET	
NS-1	9865
NS-2	9129
OU III NORTH STREET EAST	
NSE-1	6665
NSE-2	1987
OU VI EDB	
EW-1E	7320
EW-2E	7194

LEGEND

- 122-18 / 35.53 — BNL MONITORING WELL / PIEZOMETER POTENTIOMETRIC SURFACE ELEVATION, IN FEET ABOVE MEAN SEA LEVEL
- 37 — POTENTIOMETRIC SURFACE CONTOUR ELEVATION, IN FEET ABOVE MEAN SEA LEVEL (DASHED WHERE INFERRED)
- 32 — BNL GRID NUMBER
- EW-12 — BNL REMEDIATION WELL
- BNL-12 — BNL SUPPLY / PROCESS WELL
- S-47226 — USGS MONITORING WELL / PIEZOMETER
- 800-19 — SCWA SUPPLY WELL

BROOKHAVEN NATIONAL LABORATORY
ENVIRONMENTAL PROTECTION DIVISION

TITLE: WATER-TABLE CONTOURS OF THE SHALLOW GLACIAL ZONE JUNE 22–26, 2009
2009 BNL GROUNDWATER STATUS REPORT

DWN: AJZ	VS:HS.: –	DATE: 06/14/1
CHKD: JEB	APPD: WRD	REV.: –
FIGURE NO.: 2–2		

BROOKHAVEN NATIONAL LABOR
UNDER CONTRACT WITH UNITED STATES DEPARTMENT O
PLANT ENGINEERING D
UPTON, NEW YORK 1973

JOB TITLE: SPILL PREVENTION CONTROL AND COUNTERMEASURE PLAN SITE PLANS		DWG. TITLE: WTR TA DECE OPERA
H.R.,GPP,LNI, HEM	DATE 2-2-2011	ACCT. NO.
SCALE N.T.S.	DWN. BY WGB	JOB NO.
PROJ. QA	APP'D. BY W.L.C.	BLDG. NO. SITE
PATH:		

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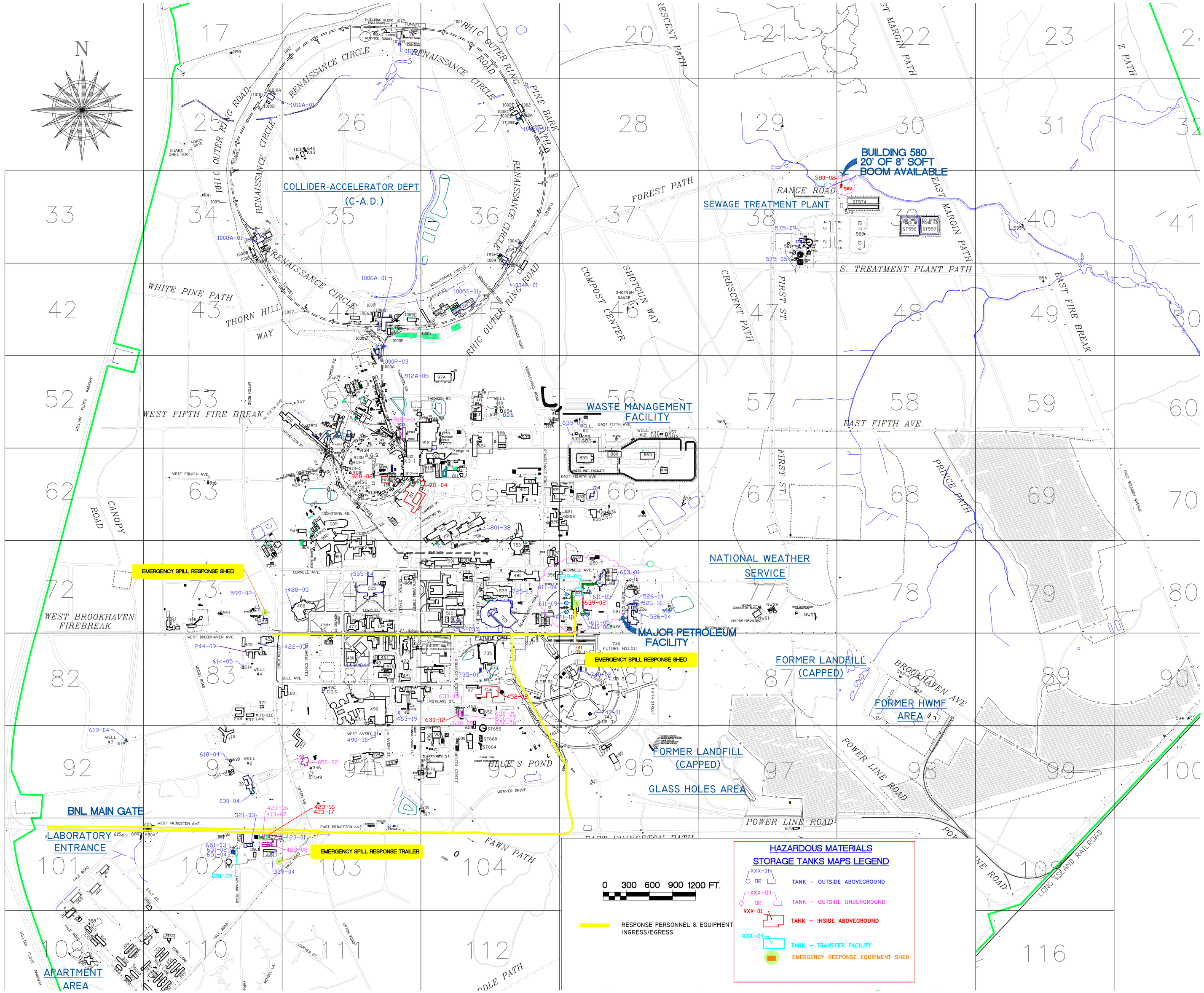

NOTES:

1. REFER TO ATTACHED TABLES 1-5 FOR TANK CONTENT AND CAPACITIES

JOB NO.	SHEET	NO	REVISION	DATE	DWN.	APP'D.	QA

BROOKHAVEN NATIONAL LABORATORY

UNDER CONTRACT WITH
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FACILITIES & OPERATIONS, MODERNIZATION PROJECT OFFICE
UPTON, NEW YORK 11973

JOB TITLE: FUEL OIL STORAGE TANKS		DWG. TITLE: BALANCE OF PLANT TANK LOCATIONS	
ILR,GPP,LNI, HEM	DATE: 1/23/12	ACCT. NO.	SHEET 1 OF 1
SCALE	DWN. BY: WCB / REV'D BY	JOB NO.	DWG. NO.
ESHQ RISK LEVEL	APP'D. BY: WLC	BLDG. NO.: SITE	12.6
PATH:			

NOTES:

1. REFER TO TABLE 6 FOR TANK CONTENT AND CAPACITIES

JOB NO.	SHEET	NO	REVISION	DATE	DWN.	APP'D.	QA

BROOKHAVEN NATIONAL LABORATORY

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FACILITIES & OPERATIONS, MODERNIZATION PROJECT OFFICE
UPTON, NEW YORK 11973

JOB TITLE: UTILITY SYSTEM MAP		DWG. TITLE: 13.8kV ELECTRICAL TRANSFORMER LOCATIONS	
ILR,GPP,LNI, HEM	DATE: 01/31/11	ACCT. NO.	SHEET 1 OF 1
SCALE	DWN. BY: WGB / REV'D BY	JOB NO.	DWG. NO.
ESHQ RISK LEVEL	APP'D. BY: WLC	BLDG. NO.: SITE	12.7
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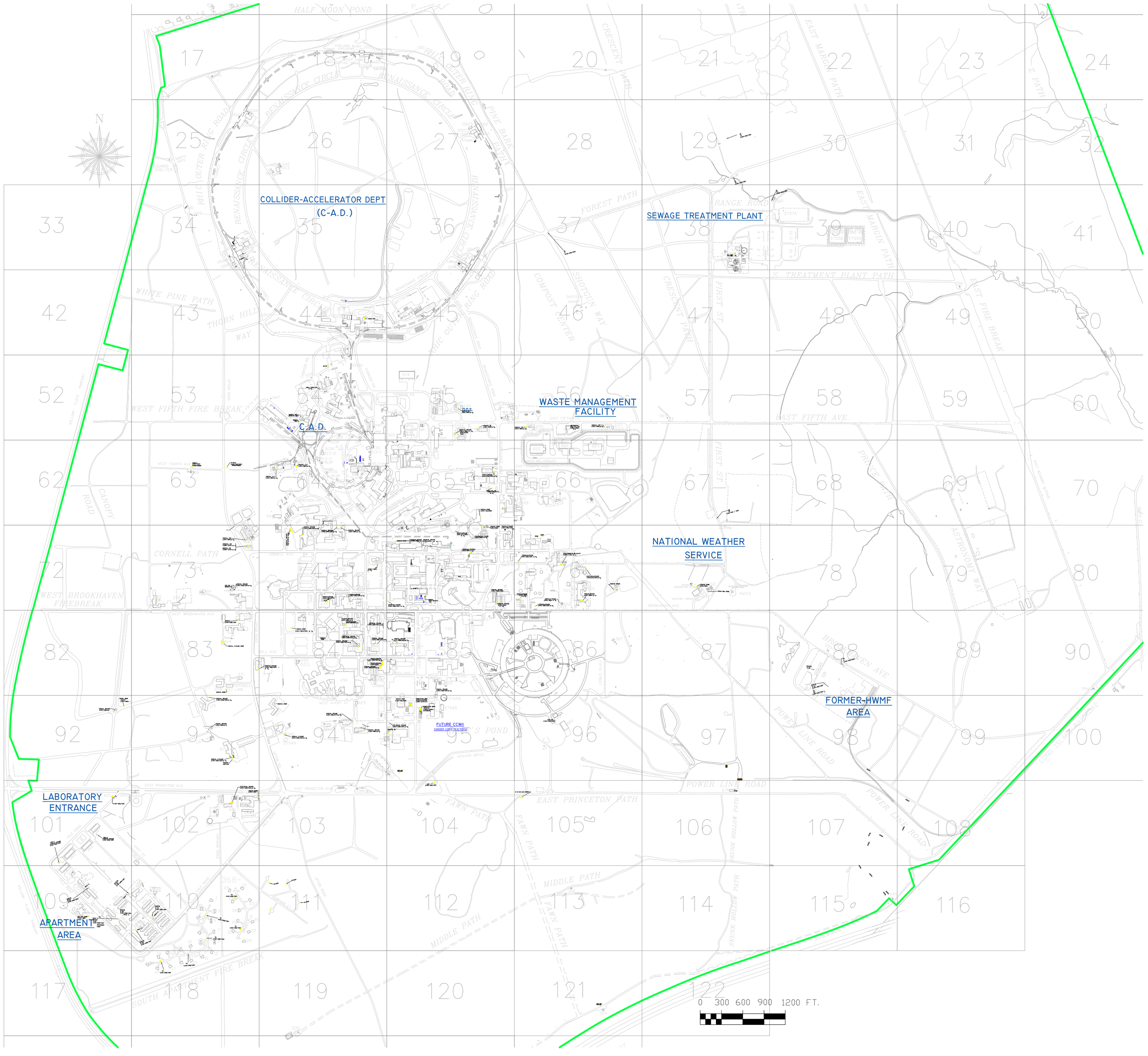

NOTES:

1. REFER TO TABLE 6 FOR TANK CONTENT AND CAPACITIES

JOB NO.	SHEET	NO	REVISION	DATE	DWN.	APP'D.	QA
		A					

BROOKHAVEN NATIONAL LABORATORY

UNDER CONTRACT WITH
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FACILITIES & OPERATIONS, MODERNIZATION PROJECT OFFICE
UPTON, NEW YORK 11973

JOB TITLE: UTILITY SYSTEM MAP		DWG. TITLE: 2.4kV ELECTRICAL TRANSFORMER LOCATIONS	
ILR,GPP,LNI, HEM	DATE: 01/31/11	ACCT. NO.	SHEET 1 OF 1
SCALE	DWN. BY: WGB / REV'D BY	JOB NO.	DWG. NO.
ESHQ RISK LEVEL	APP'D. BY: WLC	BLDG. NO.: SITE	12.8
PATH:			

APPENDIX 1

DRAINING SECONDARY CONTAINMENTS

1.0 PURPOSE

To provide a standard procedure for authorization, method, and documentation of draining bermed areas.

2.0 SCOPE

2.1 Applies to Energy & Utilities Central Steam Facility engineers responsible for operation and surveillance of the Central Steam Facility Tank Farm.

Applies to Site Resources Division personnel responsible for the site fuel oil tank farm, remote fuel tank storage areas, and outdoor oil filled transformer yard secondary containment berms.

2.2 Any BNL craftsman or outside contractor required to work inside the bermed areas will notify the responsible authority of the water condition within the bermed area prior to the commencement of work.

3.0 POLICY

3.1 This procedure will be followed at all times when a bermed area requires draining into the sanitary system. (Bermed areas require draining whenever enough water has accumulated in the containment that compromises its ability to contain the full amount of product in the tank.)

3.2 The Authorization Form/Discharge Documentation (Attachment EU-ESH-009A) or other similar form as supplied by the EPD Representative, will be filled out and filed whenever a bermed area is drained to the sanitary system.

3.2.1 The upper portion of the form (the authorization) will be filled out completely and signed before draining the bermed area.

This procedure was last printed on 3/1/2011 9:51:00 AM. Once printed, this file is no longer an official copy. Before using a printed copy, verify that it is the most current version by checking the document revision on the F&O Procedures Webpage.

3.2.2 The lower portion of the form (the discharge documentation), will be filled out by the cognizant supervisor upon completion of the task.

3.3 Central Steam Facility Additional Policy - The responsible authority will store the key for the bermed area drain valves.

3.4 Drainage of precipitation from within the diked area will be controlled in a manner that will prevent any toxic or hazardous material from entering the ground, groundwaters, or surface waters.

4.0 REFERENCES

4.1 6NYCRR Part 613 Handling and Storage of Petroleum - 613.3(c) (6) Secondary Containment System for Above Ground Tanks

4.2 Suffolk County Sanitary Code - Article 12 "Toxic and Hazardous Materials Storage and Handling Controls" (latest version), Section 1211, "Outdoor Above Ground Storage Facilities"

4.3 Standards for the Administration of Article 12 "Toxic and Hazardous Materials Storage and Handling Controls" of the Suffolk County Sanitary Code, Section 3 (latest version), Secondary Containment System for Above Ground Tanks

5.0 DEFINITIONS

5.1 **CSF:** Central Steam Facility

5.2 **ECR:** Environmental Compliance Representative

5.3 **EPD:** Environmental Protection Division

5.4 **FSR:** Facility Support Representative

5.5 **PIV:** Post Indicator Valve

5.6 **RA:** Responsible Authority - First line supervisor or his designee, General Supervisor, F&O SR Manager or Facility Project Manager (FPM), Complex Facility Manager (CFM) Manager, F&O E&U Manager, in that order.

6.0 PROCEDURE

6.1 Prerequisites

None

6.2 Precautions

None

6.3 Berm Inspection (All Locations)

- The determination of need to discharge rainwater from a tank berm is made by the RA. (Based upon remaining available volume in containment.) Use formula:

  Volume (empty) – Volume (rainwater) = Remaining Capacity

  Volume (empty) = $3.14r^2h$ (where h = height of containment in feet)

  Volume (rainwater) = $3.14r^2h$ (where h = height of rainwater in feet)

  Remaining Capacity (cubic feet) x 7.48 = Remaining Capacity (gallons)

  Gallons of Remaining Capacity must be 125% of Tank Capacity

- The RA contacts the EPD representative to perform the inspection of the berm area.
- The RA or his designee accompanies the EPD representative (ECR, FSR, or other designated EPD representative) on the inspection of the berm area.
- The EPD representative performs the inspection or sample and signs the discharge permit if the water does not have a visible sheen. If a sheen is present the ECR will provide direction to the responsible personnel for rectification.

6.4 Draining the Berm at the CSF

The RA assigns the responsible engineer, writes his name on the form, and gives him the key to the PIV.

- The engineer notes the time/date the valve is opened on the form, opens the valve, and monitors the draining operation.
- When the draining operation is complete, the responsible engineer closes and locks the valve.
- The RA will sign the time/date that the key was returned and that the discharge has been completed.
- The RA will file the form in the dedicated binder.
- The RA will keep a copy of each discharge form in a dedicated binder and submit a copy of the discharge form to EPD for all locations.

6.5 Draining Fuel Oil Tank/Chip Storage Berms at Locations other than the CSF

- Discharge water into the sanitary system in a controlled manner, via a submersible pump, in accordance with Suffolk County Department of Health Services Standards and in accordance with NYS Department of Environmental Conservation Requirements.
- The RA will keep a copy of each discharge form in a dedicated binder and submit a copy of the discharge form to EPD for all locations.

6.6 Draining the Berm for Outdoor Oil Filled Transformer

- The RA assigns the responsible tower line person (TLP), writes his name on the form, and gives him the key to the PIV (if required).
- The TLP notes the time/date the valve is opened on the form, opens the valve, and monitors the draining operation.
- When the draining operation is complete, the responsible engineer closes the valve and locks it.
- The RA will sign the time/date that the key was returned and that the discharge has been completed.
- The RA will file the form in the dedicated binder.
- The RA will keep a copy of each discharge form in a dedicated binder and submit a copy of the discharge form to EPD for all locations.

7.0 ATTACHMENTS

7.1 DF-ESH-009A, Authorization Form - Discharge of Rainwater from Bermed Areas

AUTHORIZATION FORM

DISCHARGE OF RAINWATER FROM BERMED AREAS AT BROOKHAVEN NATIONAL LABORATORY

Berm Inspection:			
Requested By:		Date:	
Inspected By:		Date:	
Berm Location / Tank #			

STATEMENT OF INSPECTION: Based on an inspection of the above tank berm, I certify that there is no visible oil sheen on the surface of the water collected within this berm. Authorization is hereby given to discharge this water to the sanitary sewer system, in accordance with the provision of our SPDES permit.

Signature:		Date:	

NOTE: The discharge must be performed within 24 hours of approval and inspection.

DISCHARGE DOCUMENTATION			
Responsible Worker:		Date:	
Supervisor:			
Time Valve Open:		Closed:	
Time Key Returned:			

Original: Shop File
Copy: R. Lee, Building 120

APPENDIX 2

Receiving Fuel Oil at the Central Steam Facility

1.0 PURPOSE

To provide a procedure for receiving fuel oil at the Central Steam Facility.

This procedure must be followed as written.

2.0 SCOPE

This procedure is to be followed by the stationary engineers at the Central Steam Facility when receiving fuel oil by tank truck.

3.0 POLICY

The stationary engineers will be responsible for the implementation of this procedure. Any changes or deviations from this procedure must first be approved by the responsible authority of the Central Steam Facility.

4.0 REFERENCES

4.1 Oil & Chemical Spill Prevention and Countermeasure Plan

4.2 SBMS Spill Response Subject Area

4.3 Oil Pollution Response Plan

4.4 EP-ES&H-105, Personal Protective Equipment

4.5 F&O Personal Protective Equipment (PPE) Webpage

5.0 DEFINITIONS

5.1 **Responsible authority**: First line supervisor, general supervising engineer, superintendent, deputy manager (E&U), and manager (E&U), in that order.

5.2 **Responsible engineer**: Senior stationary engineer whose assignment is to receive fuel oil.

6.0 PROCEDURE

6.1 Prerequisites

6.1.1 None.

6.2 Precautions

6.2.1 Use appropriate personal protective equipment (PPE) per F&O Personal Protective Equipment (PPE) Webpage.

6.3 Immediately upon arrival of the fuel truck, the responsible engineer will:

- Consult the Driver's Orientation Sheet (located in the Fuel Transfer Building Pump Room to determine whether the driver has completed the Central Steam Facility – Major Storage Facility Orientation (Attachment 7.2)). For those drivers that have not completed the orientation, instruct them in the BNL spill prevention requirements and have them read, complete the required form, and sign it. Place the completed form in the file and add their names to the Driver's Orientation Sheet.
- Obtain from the driver any and all documentation applicable to the product being delivered, including, but not limited to: weight receipts, bill of lading, or terminal invoices.
    - If a driver does not have a BNL weight slip, direct him to the scale, and instruct him in proper use of the scale.
- Consult with the responsible authority for the Central Steam Facility to determine which tank the load is to be delivered to.
- Obtain, with the aid of the truck driver, a representative sample of the product (by use of a suitable indicator) and determine if water is present.
- If water is present, consult with the responsible authority for further action, as the presence of water can result in rejection of the load.

6.4 Evaluation of the sample by Stationary Engineer: Take the representative sample, perform the following evaluation, and record the information on the Fuel Oil Receiving Report.

- Use the standard hydrometers to observe the API number and temperature of the product of every delivery. Convert to standard temperature and specific gravity.
- Note any unusual characteristics (for example, suspended solids, color, smell).
- If the evaluation is satisfactory, proceed to commence unloading. If not satisfactory, consult with the responsible authority.

6.5 Preparing to off-load: Prior to actual discharge, the responsible engineer will:

- Direct the fuel truck driver to the desired unloading station.
- Inspect tank truck and all drains and outlets for leakage. Instruct driver to tighten, adjust, and replace all leaking fittings so as to prevent leakage during transit. Note any/all deficiencies on the receiving report.
- Instruct driver to lock brakes, turn off engine, chock wheels, and attach bonding cable prior to connecting the discharge hose.
- Supervise connection of tank truck to BNL unloading station.
- Walk the fuel fill line and check valve lineup to correct tank.
- Obtain actual sounding of tank before discharge to determine amount of fuel in tank. Do not use previously written soundings.
- Check duplex strainer or filter assembly to ensure that clean, correctly sized strainers, or filters are installed and the strainer is ready to receive oil (for example, tops secure, vents closed, drains closed, gage connections open).
- Commence discharge of the product.

6.6 During the discharge operation, the responsible engineer will:

- Standby in the immediate vicinity and monitor the operation to ensure compliance with all safety requirements.
- Monitor cleanliness of strainer by watching pressure differential across strainer. If differential is greater than 25 psid, change flow over to standby strainer and clean the dirty one. Three strainers will be considered a maximum for a normal delivery.
- Be alert for leaky hoses, fittings, strainer housings, and truck pump glands. Be prepared to take necessary corrective action.

- Supervise clearing of fuel lines, securing pump, and disconnecting hoses as required at completion of discharge.
- Inspect tank truck and all drains and outlets for leakage. Instruct driver to tighten, adjust, and replace any/all leaking fittings so as to prevent leakage during transit. Note any/all deficiencies on the receiving report.

6.7 After discharge is complete, the responsible engineer will:

- Instruct truck driver to weigh out and return with weight slip to Central Steam Facility for paper work processing.
- Walk the fill line and secure the fill station.
- Take final sounding of tank.
- Record all information on the Fuel Oil Receiving Report (Attachment 7.1), fuel oil logs books, delivery receipts, and weekly log sheet as required.
- Sign and date the trucker's weight slip and fill in any supporting data that is required.
- On BNL weight slips record corrected API, gallons received, and what tank the fuel went into.

6.8 Non-operational status/un-manned operation. When active operations cease and receiving or transferring operations are complete, the responsible engineer must:

- Ensure all valves are secured (closed).
- Ensure all pumps are secured (off).
- Ensure that the Pump control room is closed and locked.
- Inspect all fuel oil tank drain valves, water draw off valves, and any other valve that may permit direct outward flow of the tanks contents. All such valves must be:
    - Securely closed,
    - Locked, and
    - Fitted with a blank flange, cap, or plug as appropriate.

7.0 ATTACHMENTS

7.1 EU-CSF-009A, Fuel Oil Receiving Report.

7.2 EU-CSF-009B, Central Steam Facility - Major Oil Storage Facility Orientation

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Central Steam Facility - Fuel Oil Receiving Report

Date:	Vendor:	Vendor Ticket #:
	Trucker:	Trucker Manifest #:
	Place of Origin:	
	Product: ☐ #6 Oil ☐ Other (Specify):	
	1 Pint Sample Taken: ☐ Yes ☐ No	
	Oil Received To: ☐ Burn Tank ☐ Other (Specify):	
	API as Received _____@ _____°F	
	API _____ @ 60°F = _____ lbs/gal	API By: ☐ Vendor ☐ Test

AMOUNT RECEIVED	
By Weight	**By Meter** (From Vendor)
Weight In:	Start:
Weight Out:	Stop:
Weight of Oil Received:	Gallons @ _____ °F = _____
API: lbs/gal	Gallons @ 60°F = _____
Gallons Received:	
By Tank Sounding	
Tank Number:	
Start:	
Stop:	
Gallons Received:	

_____
Engineer

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Central Steam Facility – Major Oil Storage Facility Orientation

Purpose:

To familiarize fuel oil delivery personnel with the operational requirements for the safe and environmentally proactive requirements of fuel oil transfer at Brookhaven National Laboratory.

Background:

Brookhaven National Laboratory is located in the Pine Barrens region of Long Island. The area is the central recharge area for the islands ground water, the only source of potable (drinking) water for the Island residents. Any chemical spill, oil or otherwise, that may impact the quality of that drinking water supply must be reported to the regulatory agencies (New York State Department of Environmental Conservation and the Suffolk Count Department of Health Services) and remediated immediately. As a "good neighbor", BNL takes its responsibilities seriously and we expect our contractors and their employees to do the same.

Responsibility and Accountability:

1. **The FUEL TRANSFER FACILITY is a SPILL CONTAINMENT AREA**

   The Fuel Transfer and Receiving Building is a containment area capable of holding in excess of 8,000-gallons of liquid. A leak within this area is not considered a reportable discharge, as it will not impact the environment. Any spill will have to be cleaned up to the satisfaction of BNL, but it is the most preferable place for it to happen. To minimize the probability of a spill, BNL will pump off all trailers to minimize the pressures in the transfer hose and reduce the potential from an oil spray from a ruptured hose or gasket.

2. **Drivers are responsible for any/all spills associated with their vehicle**

   It is you, the driver's responsibility, to clean ALL oil spills associated with your actions, inactions or omissions during the unloading operations. That includes all truck, engine, transmission and trailer leaks and drips. This especially includes any drips associated with connecting and disconnecting of the discharge hose. There are oil pads, wipes and drip pans provided to eliminate any oil spill potential. Persistent leaking vehicles will be banned from the site until repairs are completed.

3. **Do not move any vehicle with an active leak**

   Do not make a bad situation worse. If you, the driver, cannot repair the leak, it is your responsibility to call your company office to arrange a repair crew. The BNL Police have the authority to detain any vehicle on government property that may pose a threat to persons or the environment.

4. **Report all spills to the Senior Stationary Engineers**

   The Senior Stationary Engineers will assist you with any reasonable spill remediation or mitigation requirements. Oil pads and drip pans are available as required. In the event any spill will require additional notification, they will do so.

5. **For Emergencies: Dial 2222 on the local telephone**

   For emergency assistance (medical, fire, major oil spill, accident), the telephone number on the local (BNL) phone is 2222. If you are using a cell phone, it is 344-2222. This will call the BNL Fire Rescue Group and the BNL Police Group. The location is Building 639 – Fuel Transfer Building.

Central Steam Facility – Major Oil Storage Facility Orientation

6. **Turn off your engine – set your brakes**

   Turn off your engine to prevent exhaust fumes from collecting in the building. Set your brakes to prevent the truck/trailer from rolling.

7. **Chock your wheels**

   BNL provides one set of chocks at each unloading station for this purpose.

8. **Dial 4028 to contact the Senior Stationary Engineers - Central Steam Facility**

   Dial 4028 using the house phone located in the fuel transfer pump room (or 631-344-4028 using a cell phone) to announce your arrival. A Senior Stationary Engineer will come out to assist and direct in the fuel transfer.

9. **Apply ground clamp**

   When positioned at the correct unloading station as directed by the Senior Stationary Engineer, connect the ground wire to dissipate any static electric energy that may be present.

10. **Place drip pans as appropriate**

    Use BNL supplied drip pans under any and all hose connections to contain any drips from residual fuel in the hose or fitting.

11. **When instructed - connect hose to trailer**

    Operational requirements periodically change. The Senior Stationary Engineers will direct you to the correct unloading station. Just because you have been at a particular station "forever" does not mean you will be there today or tomorrow.

12. **Open trailer vents and drops**

    When properly connected, open trailer vents to prevent a tank collapse (implosion) and the drops to allow product to flow to the transfer pump.

Certification:

By my signature, I certify that:

- I have read the above training information and understand the information presented.
- The BNL representative has answered any questions I have regarding this information.
- I will, to the best of my ability, comply with the above instructions.

Signature:_____ Date:_____

Name: (Print):_____

The original will be kept on file at the Central Steam Facility. If requested, the driver shall be given a copy of this document.

APPENDIX 3

Transferring Fuel Oil at the Central Steam Facility

1.0 PURPOSE

To provide guidelines for transferring fuel oil at the Energy & Utilities Division, Central Steam Facility.

This procedure must be followed as written.

2.0 SCOPE

This guideline will be followed by the Stationary Engineers when required to transfer fuel oil in the Central Steam Facility Tank Farm (Major Oil Storage Facility).

3.0 POLICY

The Stationary Engineers are responsible for the implementation of this procedure. Any changes or deviations from this procedure must first be approved by the responsible authority of the facility.

4.0 REFERENCES

4.1 Spill Prevention Control and Counter Measures (SPCC Plan)

4.2 SBMS Subject Area Spill Response

4.3 DF-ESH-105, Personal Protective Equipment Issuance

4.4 F&O ESHT&Q Personal Protective Equipment Web Page

5.0 DEFINITIONS

5.1 **Engineer:** The Senior Stationary Engineer assigned to transfer oil.

5.2 Responsible Authority: First line supervisor, general supervisor, superintendent, Manager (EU) in that order.

6.0 PROCEDURE

6.1 Prerequisites

None

6.2 Precautions

6.2.1 Use appropriate personal protective equipment as indicated in DF-ESH-105, Personal Protective Equipment Issuance and the F&O ESHT&Q Personal Protective Equipment Web Page.

6.3 After receiving orders to transfer oil from the responsible authority, the engineer performing the transfer will:

- Ascertain the quantity of oil to be transferred, the origin and destination of the oil, and any specific instructions concerning pumps and piping to be used.
- The engineer will inspect the pipelines involved, checking to see that the necessary transfer valves are open to the proper tanks and closed to any other tanks.
- Inspect all fuel oil tank drain valves, water draw off valves, and any other valve that may permit direct outward flow of the tank's contents. All such valves will be:
    - Securely closed,
    - Locked, and
    - Fitted with a blank flange, cap, or plug as appropriate
- The engineer will sound all tanks involved in the transfer to ensure that the proper amount of oil is in each tank and that there is sufficient room in the tank to be filled. In the event that the soundings are incorrect by five percent, or that there is not sufficient room available in the receiving tank, notify the responsible authority.

- The engineers will use strainers of the type and mesh designated by the responsible authority.

6.4 During the transfer of oil, the engineer will perform frequent inspections of the process to ensure the integrity of the transfer system, these inspections will include:

- The engineer being alert for any leaks in the transfer system and being prepared to take the necessary corrective action in accordance with the SBMS Subject Area Spill Response.

- The engineer closely monitoring the pump operation. Excessive heat, vibration, or noise will be noted and corrective action taken.

- The engineer will observe the pressure differential across the strainer, if it exceeds 25 psi, they will change flow over to the strainer and clean the dirty one.

6.5 After completion of the transfer, the engineer will:

- Secure all pumps and valves used for the transfer and realign any processes secured due to the transfer.

- Take soundings of all tanks involved and determine gallons transferred.

- Enter the information in the appropriate tank log books, the engineer's log, and the fuel oil transfer slip.

- If the respective tank soundings reveal a difference of more than 5 percent oil transferred, notify the responsible authority.

6.6 Continuation of the transfer to the next shift:

- The relieving shift engineers will be notified as to the transfer quantity, the tanks, pumps, and the piping being used. In addition, the relieving shift will take soundings and inspect the transfer system immediately upon assuming the watch.
- The relieving shift engineers will complete the transfer operation in accordance with the previous described procedure.

6.7 Non-operational status/un-manned operation: When active operations cease, and receiving or transferring operations are complete, the responsible engineer will:

- Assure all valves in Transfer Facility Building 639 are secured (closed)
- Assure all pumps are secured (off)
- Pump control room is closed and locked
- Inspect all fuel oil tank drain valves, water draw off valves, and any other valve that may permit direct outward flow of the tank's contents. All such valves will be:
    - Securely closed
    - Locked, and
    - Fitted with a blank flange, cap , or plug as appropriate

7.0 ATTACHMENTS

None

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APPENDIX 4

SUBJECT AREA CONTENT

Management System: Quality Management

Subject Area: Occurrence Reporting and Processing System (ORPS)

VIEW/PRINT ALL (No Exhibits and Forms)

Effective Date: **Apr 30, 2009** (Rev 2.8) Periodic Review Due: **Apr 30, 2014**	Subject Matter Expert: Edward Sierra	Management System Steward: Roy Lebel

Introduction

This subject area provides the procedures for implementing the Occurrence Reporting Program Description and identifies the process for staff and management who perform specific duties related to the discovery, response, notification, investigation, and reporting of occurrences to BNL and DOE management.

All staff are required to appropriately report abnormal events or conditions that they perceive may

- Endanger the health and safety of staff or the public;
- Have an adverse effect on the environment;
- Seriously impact the operations and intended purpose of BNL facilities;
- Result in loss or damage of property; or
- Adversely affect national security or the security interest of DOE or BNL.

When an abnormal event or condition is reported to a Department Chair/Division Manager, it is subsequently relayed to an Event Categorizer who determines if the event or condition meets the criteria for a reportable occurrence. The Occurrence Category drives a graded approach to the level of follow-up actions required for internal and external notifications, occurrence investigation and analysis, and occurrence reporting. After a reportable occurrence is categorized and appropriate notifications are made, it is evaluated to assess its significance and programmatic impact, causal factors, generic implications, and the need for and implementation of corrective actions. The information identified in this process forms the basis for the Final Occurrence Report. This information also assists in improving policies and procedures and communicating lessons learned.

Contents

Section	Overview of Content (see section for full process)

1. Event Discovery	• Report event to appropriate staff.
2. Immediate Event Response and Categorization	• Initiate mitigation efforts to establish a safe, controlled condition. • Contact Event Categorizer. • Categorize event. • Make required notifications. • Initiate follow-up activities.
3. Occurrence Notifications	• Notify appropriate staff. • Complete and transmit forms. • Make required internal notifications and ATS entry.
4. Occurrence Investigation and Reporting	• Conduct fact-finding. • Initiate additional investigations, if needed. • Perform causal analysis. • Develop corrective actions. • Review and approve Update or Final Report. • Close actions in ATS.
5. Report Follow-up and Action Closeout	• Notify ORPS Office as corrective actions are completed. • ORPS Office closes actions in ATS and ORPS databases.

Definitions

Exhibits

Causal Analysis Tree
Instructions for Completing an Occurrence Report
Occurrence Reporting Model
Occurrence Reporting Process Flowchart

Forms

ORPS Occurrence Report Form
ORPS Prompt Notification Form

Training Requirements and Reporting Obligations

This subject area does not contain training requirements.

This subject area contains reporting obligations. See the section on Occurrence Notifications for more information.

External/Internal Requirements

Requirement Number	Requirement Title
10 CFR 830, Subpart A	Energy, Nuclear Safety Management, Quality Assurance Requirements
10 CFR 851	Worker Safety and Health Program
ISO 14001	International Organization for Standardization - Environmental Management System
M 231.1-2	CRD - Occurrence Reporting & Processing of Operations Information
O 226.1A	Implementation of Department of Energy Oversight Policy
O 414.1C	Quality Assurance
O 470.2B	CRD - Independent Oversight and Performance Assurance Program
O 5480.19, Change 2	Conduct of Operations Requirements for DOE Facilities
OHSAS 18001	Occupational Health and Safety Management Specifications
P 450.7	Environment, Safety and Health (ESH) Goals

References

Assessment Tracking System (ATS) website (*Limited Access)

DOE G231.1-2, Occurrence Reporting Causal Analysis Guide

ES&H Standard 1.2.1, Corrective Action Tracking Program

Emergency Preparedness Subject Area

Event Categorizer's Procedure, Occurrence Reporting and Processing System (ORPS), Quality Management Office

Event/Issue Summary Form

Event/Issues Management Subject Area

Investigation of Incidents, Accidents, and Injuries Subject Area

Lessons Learned Subject Area

Occurrence Reporting Program Description

Price-Anderson Amendments Act Compliance Validation and Noncompliance Reporting Program Description

Radiological Awareness Reports, Radiological Control Procedures

Spill Response Subject Area

* Access Limited to BNL Staff and Authorized non-BNL Staff.

Standards of Performance

All staff and guests shall carry out appropriate emergency responses and off-normal event follow-up activities.

All staff and guests shall promptly report accidents, injuries, ES&H deficiencies, emergencies, and off-normal events in accordance with procedures.

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PROCEDURE: EVENT DISCOVERY

Management System: Quality Management

Subject Area: Occurrence Reporting and Processing System (ORPS)

1. Event Discovery

Effective Date: **Apr 30, 2009**	Subject Matter Expert: Edward Sierra	Management System Steward: Roy Lebel

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Applicability

This information applies to BNL staff and non-BNL staff who discover an abnormal event or condition.

Required Procedure

All staff must appropriately report abnormal events or conditions that they perceive may endanger the health and safety of staff or the public, have an adverse effect on the environment, seriously impact the operations and intended purpose of BNL facilities, result in loss or damage of property, or adversely affect national security or the security interests of DOE or BNL. See the Definitions section for the definition of events or conditions as they apply to this subject area.

Refer to the Occurrence Reporting Process Flow Chart exhibit for an overview of this procedure.

Step 1	If the event or condition may involve classified or sensitive information, or incidents of security concern, immediately call the BNL Security Manager on extension 7759 during normal business hours or on extension 2238 after hours.
Step 2	If the event or condition is perceived as an emergency, activate an appropriate alarm and/or call extension 2222 or 911. Follow the procedures in the Emergency Response - All Staff section of the Emergency Preparedness Subject Area. See also the Spill Response Subject Area for emergencies involving hazardous materials.
Step 3	Report the event or condition to your supervisor as soon as practical (if unavailable, to the next higher level of management) or ES&H Coordinator who will notify the Department Chair/Division Manager as appropriate. **Note:** If the appropriate contact is not known, call extension 2238 (or 2222) and request that the appropriate Department Chair/Division Manager be informed of the event or condition.

References

Emergency Preparedness Subject Area

Spill Response Subject Area

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Questions/Comments Disclaimer

https://sbms.bnl.gov/sbmsearch/subjarea/74/74_pro1.cfm

PROCEDURE: IMMEDIATE EVENT RESPONSE AND CATEGORIZATION

Management System: Quality Management

Subject Area: Occurrence Reporting and Processing System (ORPS)

2. Immediate Event Response and Categorization

Effective Date: **Apr 30, 2009**	Subject Matter Expert: Edward Sierra	Management System Steward: Roy Lebel

Applicability

This information applies to Department Chairs/Division Managers (and their designees) responsible for the timely identification and immediate response to abnormal events or conditions and the Event Categorizers responsible for categorizing reportable events.

Required Procedure

Department Chairs/Division Managers are responsible for ensuring the appropriate event response and for providing the necessary information to the Event Categorizer for a categorization determination.

All staff must follow the appropriate security procedures when dealing with classified information or incidents of security concern.

Refer to the Occurrence Reporting Process Flow Chart exhibit for an overview of this procedure.

Step 1	The Department Chair/Division Manager ensures that appropriate event response mitigation efforts are initiated to stabilize and/or establish a safe, controlled condition.
Step 2	The Department Chair/Division Manager contacts the Event Categorizer via extension 1234 (631-344-1234) or 631-433-0443 as soon as practical, but allowing enough time so that a determination of reportability will take place within two hours of the event or condition discovery. **Note:** If needed, call extension 2238 (or 2222) and request assistance in contacting the Event Categorizer.

Step 3	The Department Chair/Division Manager and Event Categorizer discuss the event and related information.
Step 4	The Event Categorizer determines if the event meets the criteria for a reportable occurrence or Significance Category BNL (SCBNL) in accordance with the Quality Management Office's Event Categorizer's Procedure. **Note:** If needed, the Deputy Director for Operations is the final authority on categorization decisions.
Step 5	If the event or condition is determined not to be reportable, the Department Chair/Division Manager initiates appropriate follow-up activities. See the Investigation of Incidents, Accidents, and Injuries, Spill Response, Radiological Control Procedures, the section Identifying, Classifying, and Reporting a Nonconformance in the Event/Issues Management Subject Area, and/or Lessons Learned Subject Areas, and the Price-Anderson Amendments Act Compliance Validation and Noncompliance Reporting Program Description, as appropriate.
Step 6	If the Event Categorizer determines that the event is SCBNL the Event Owner proceeds directly to step 3 in the section Analyzing Event/Issues in the Event/Issues Management Subject Area and refers to the exhibit Risk Significance Level of Event/Issues in the same subject area for requirements. **Note:** If the event is not SCBNL and no further action is required by referenced subject areas, then event management is at the discretion of the BNL manager.
Step 7	Upon declaration of a SCBNL the ORPS Office initiates internal communications (DDO, Public Affairs, Event Categorizer team, PAAA Coordinator, Subject Matter Experts, etc.) and opens an Assessment Tracking System (ATS) entry to track completion of the Event/Issue Summary Form and resultant corrective actions. The Event/Issue Summary Form is due within 45 calendar days of categorization.
Step 8	If the event or condition is determined to be reportable, the Department Chair/Division Manager notifies the ORPS Reporting Facility Manager (Facility Manager).
Step 9	The Facility Manager, working with the Department Chair/Division Manager, makes the appropriate notifications to meet the occurrence reporting requirements. See the Occurrence Notifications section.
Step 10	The Facility Manager assigns responsibilities for follow-up activities (see following sections of this subject area) to appropriate line managers.

References

Assessment Tracking System (ATS) Website (*Limited Access)

Event Categorizer's Procedure, Occurrence Reporting and Processing System (ORPS), Quality Management Office

Event/Issue Summary Form

Event/Issues Management Subject Area

Investigation of Incidents, Accidents, and Injuries Subject Area

Lessons Learned Subject Area

Price-Anderson Amendments Act Compliance Validation and Noncompliance Reporting Program Description

Radiological Awareness Reports, Radiological Control Procedures

Spill Response Subject Area

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https://sbms.bnl.gov/sbmsearch/subjarea/74/74_pro2.cfm

PROCEDURE: OCCURRENCE NOTIFICATIONS

Management System: Quality Management

Subject Area: Occurrence Reporting and Processing System (ORPS)

3. Occurrence Notifications

Effective Date: **Apr 30, 2009**	Subject Matter Expert: Edward Sierra	Management System Steward: Roy Lebel

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Applicability

This information applies to ORPS Reporting Facility Managers and their designees, Event Categorizers, and the BNL ORPS Office responsible for occurrence notifications.

Note: ORPS Reporting Facility Managers (and their designees) are hereafter referred to as "the Facility Manager."

Required Procedure

Notification Reports must be submitted to DOE (via the ORPS online system) before the close of the next business day from the time of categorization (not to exceed 80 hours). Short Form Reports must be submitted to DOE (via the ORPS online system) no later than two business days after categorization of the occurrence. The Facility Manager initiates timely internal and external occurrence notifications as appropriate.

All staff follow the appropriate security procedures when dealing with classified information or incidents of security concern.

Refer to the Occurrence Reporting Process Flow Chart exhibit for an overview of this procedure.

Step 1	If the event or condition is categorized as an Operational Emergency, the BNL emergency response staff makes all necessary notifications.
Step 2	If the event or condition is categorized as a Significance Category 1, Recurring, Significance Category 2, 3, or 4, Occurrence, the Facility Manager orally notifies the Deputy Director for Operations (DDO) and the DOE Facility Representative. **Note:** The Facility Manager documents the notification of the DOE Facility Representative in field 27 of the Occurrence Report.

Step 3	(a) If the event or condition is categorized as a Significance Category 1 Occurrence, the Facility Manager makes arrangements with the DOE Facility Representative to e-mail (doehqeoc@oem.doe.gov) an ORPS Prompt Notification Form (within two (2) hours after categorization) of the reportable occurrence to the DOE Emergency Operations Center (EOC), and follow up with a phone call (EOC phone: 202-586-8100 or 8500) to ensure receipt of the e-mail. *Or* (b) Specific Significance Category 2, 3, and 4 Occurrences require Prompt Notification to the DOE Headquarters Emergency Operations Center as directed by the Event Categorizer. If the event or condition is categorized as a Recurring, 2, 3, or 4 Occurrence, go to step 4.
Step 4	The Facility Manager prepares and transmits the written Notification Report or Short Form for Significance Category 4 Occurrences on the Occurrence Reporting and Processing System (ORPS) database. Notification Reports are due before the close of the next business day from the time of categorization (not to exceed 80 hours). Short Form Reports are due no later than two business days after categorization. **Note**: The ORPS Occurrence Report form may be used as an aid in preparing reports. **Note**: The Facility Manager may delegate the actual writing of the Notification Report or Short Form to another involved individual or Department/Division, but the Facility Manager must approve it and submit it as the report originator. **Note:** The Short Form satisfies all of the written reporting requirements of a Significance Category 4 Occurrence.
Step 5	The Facility Manager notifies the ORPS Office that the Notification Report or Short Form has been transmitted (e-mail notification is acceptable).
Step 6	Upon transmission of the Notification Report or Short Form, the ORPS Office initiates internal communications (DDO, Public Affairs, Event Categorizer team, PAAA Coordinator, Subject Matter Experts, etc.) and opens an Assessment Tracking System (ATS) entry to track the Final Report due date (not applicable for Significance Category 4, Short Form Occurrences) or Short Form corrective actions.

References

Assessment Tracking System (ATS) Website (*Limited Access)

* Access Limited to BNL Staff and Authorized Non-BNL Staff.

The only official copy of this file is the one on-line in SBMS.

Before using a printed copy, verify that it is the most current version by checking the *effective date*.

PROCEDURE: OCCURRENCE INVESTIGATION AND REPORTING

Management System: Quality Management

Subject Area: Occurrence Reporting and Processing System (ORPS)

4. Occurrence Investigation and Reporting

Effective Date: **Apr 30, 2009**	Subject Matter Expert: Edward Sierra	Management System Steward: Roy Lebel

Applicability

This information applies to Department Chairs/Division Managers, ORPS Reporting Facility Managers and their designees, the BNL ORPS Office, and the Deputy Director for Operations involved in the investigation, analysis, and reporting of an occurrence.

Note: ORPS Reporting Facility Managers (and their designees) are hereafter referred to as "the Facility Manager."

Required Procedure

The Facility Manager ensures that the appropriate occurrence investigations and analyses are completed and that ORPS reports are submitted to DOE (via the ORPS online system) within 45 calendar days of the occurrence categorization. The investigations and follow-up actions are determined using a graded approach commensurate with the Occurrence Category. The Deputy Director for Operations approves and transmits all ORPS Update and Final Reports.

All staff must follow the appropriate security procedures when dealing with classified information or incidents of security concern.

Refer to the Occurrence Reporting Process Flow Chart exhibit for an overview of this procedure.

Step 1	The assigned Manager initiates investigations of the occurrence with a fact-finding meeting (see the Event/Issues Management Subject Area for information on conducting fact-finding).
Step 2	Determine if additional information/investigation is required.

Step 3	If additional information is required, initiate additional investigations as appropriate (see the Investigation of Incidents, Accidents, and Injuries Subject Area or contact the Independent Oversight Office if an independent investigation is warranted).
Step 4	Identify similar past occurrences to identify trends or potential Lab-level issues or recurrent conditions. The ORPS Office can assist in the effort.
Step 5	Perform a causal analysis using the graded approach as defined in the Occurrence Reporting Model. Identify the cause(s) of the event or condition (including the root cause, as required) using the codes provided in the exhibit Causal Analysis Tree (see the Event/Issues Management Subject Area for information on causal analysis).
Step 6	Develop corrective actions using the graded approach as defined in the Occurrence Reporting Model that address the apparent cause(s), at a minimum, and also address root cause, if appropriate. Determine target completion dates and identify actionees for the corrective actions (see the section Developing Corrective Actions in the Event/Issues Management Subject Area). **Note:** For occurrences resulting in a Type A or B accident investigation, all causes (direct, contributing, and root) identified in the accident investigation report, as well as the corrective actions developed in response to the judgments of need, must be included in the Final Report.
Step 7	Identify and process lessons learned using procedures in the Lessons Learned Subject Area.
Step 8	When satisfied with the investigation and proposed corrective actions, the Facility Manager enters the Occurrence Update or Final Report into the ORPS database ("SAVE" *but do not* "SUBMIT" the report) for approval by the Deputy Director for Operations (DDO) within 40 calendar days from time of categorization. See the Instructions for Completing an Occurrence Report exhibit. **Note**: The ORPS Occurrence Report form may be used as an aid in preparing reports. **Note:** All reports containing classified information or Unclassified Controlled Nuclear Information (UCNI) will be submitted in hard copy in accordance with established security requirements. An unclassified, nonsensitive version will be submitted through the ORPS database.
Step 9	The Facility Manager notifies the ORPS Coordinator who then notifies the DDO that the draft Update or Final Report is available on the ORPS for his review, approval, and submission.
Step 10	The DDO reviews the draft Update or Final Report.
Step 11	If the DDO does not find the draft Update or Final Report satisfactory: 1. The DDO identifies the items that need to be addressed and notifies (via email) the Facility Manager and the ORPS Office. 2. The Facility Manager addresses the concerns and revises the Update or Final Report on ORPS by repeating Steps 8 and 9.

Step 12	The DDO approves the Update or Final Report and transmits the report through ORPS to DOE within 45 calendar days of categorization. The Facility Manager is responsible for maintaining the record copies of any investigation-related materials.
Step 13	The DDO notifies the ORPS Coordinator that the Update or Final Report was transmitted.
Step 14	The ORPS Coordinator notifies the Facility Manager that the Update or Final Report was transmitted.
Step 15	The ORPS Office closes the reporting action and enters corrective actions into the Assessment Tracking System (ATS).

Guidelines

The Facility Manager may delegate authorship of the Update or Final Report to another involved individual or Department/Division, but the Facility Manager must approve and forward it to the Deputy Director for Operations.

If an Update Report is appropriate, follow the internal approval process described in steps 8-14 above. Update Reports may be required to

- Correct information in the Notification Report;
- Add significant and new information;
- Report status of an ongoing investigation;
- Recategorize the event (e.g., downgrade a Significance Category 1 Occurrence to a Significance Category 2 Occurrence or upgrade a Significance Category 2 to a Significance Category 1 Occurrence); or
- Provide reason for delay in issuing the Final Report.

References

Assessment Tracking System (ATS) website (*Limited Access)

Event/Issues Management Subject Area

Investigation of Incidents, Accidents, and Injuries Subject Area

Lessons Learned Subject Area

* Access Limited to BNL Staff and Authorized Guests.

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PROCEDURE: REPORT FOLLOW-UP AND ACTION CLOSEOUT

Management System: Quality Management

Subject Area: Occurrence Reporting and Processing System (ORPS)

5. Report Follow-up and Action Closeout

Effective Date: **Apr 30, 2009**	Subject Matter Expert: Edward Sierra	Management System Steward: Roy Lebel

Applicability

This information applies to (1) ORPS Reporting Facility Managers and their designees responsible for occurrence reporting follow-up actions, including the timely completion of corrective actions, and (2) the ORPS Office responsible for keeping the status of Final Report corrective actions current on the BNL Assessment Tracking System (ATS) and ORPS databases.

Note: ORPS Reporting Facility Managers (and their designees) are hereafter referred to as "the Facility Manager."

Required Procedure

The Facility Manager ensures that Final Report follow-up actions are completed when due. The ORPS Office keeps the status of Final Report corrective actions current on the ATS and ORPS databases.

All staff follow the appropriate security procedures when dealing with classified information or incidents of security concern.

Refer to the Occurrence Reporting Process Flow Chart exhibit for an overview of this procedure.

Step 1	If the Final Report is not approved by either the DOE Facility Representative or the DOE Program Manager: 1. The ORPS Office notifies the Facility Manager and the Deputy Director for Operations (DDO) of the rejection, along with the DOE explanation for the disapproval. 2. The ORPS Office enters the report revision due date into the ATS. 3. The Facility Manager resolves the issues of rejection and revises the report on the ORPS database. The revised report must be internally reviewed and approved, and re-entered into the ORPS database within 21 calendar days of the rejection

	(follow the internal review and approval procedures beginning with step 8 in the section Occurrence Investigation and Reporting of this subject area).
Step 2	The Facility Manager informs the ORPS Office as corrective actions are closed by completing and submitting a Close Action form located on the ATS.
Step 3	The Facility Manager may revise a corrective action and/or due date of same by completing and submitting a Create/Update Action form on the ATS. **Note:** For Significance Category 2 and higher reports, the Facility Representative must approve any changes made to the corrective actions.
Step 4	The ORPS Office closes actions in the ATS and ORPS databases as they are completed.
Step 5	When the last corrective action is completed, the ORPS Office closes the occurrence in the ATS database.

References

Assessment Tracking System (ATS) Web Site *

* Access limited to BNL staff and authorized non-BNL staff.

The only official copy of this file is the one on-line in SBMS.

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DEFINITIONS

Standards-Based Management System (SBMS)

BROOKHAVEN NATIONAL LABORATORY

Definition: Occurrence Reporting and Processing System (ORPS)

Term	Definition
apparent cause	The most probable cause(s) that explains why the causal factor happened, that can be reasonably identified, that local or facility management has the control to fix, and for which effective recommendations for corrective action(s) to remedy the problem can be generated, if necessary.
causal factor	An event or condition that either caused the occurrence under investigation or contributed to the unwanted result. If it were not for this event or condition, the unwanted result would not have occurred or would have been less severe.
condition	Any as-found state, whether or not resulting from an event, that may have adverse safety, health, quality assurance, security, operational or environmental implications. A condition is usually programmatic in nature; for example, an error in analysis or calculation; an anomaly associated with design or performance; or an item indicating a weakness in the management process are all conditions.
contributing cause(s)	A cause that contributed to an occurrence but, by itself, would not have caused the occurrence. For example, in the case of a leak, a contributing cause could be lack of adequate operator training in leak detection and response, resulting in a more severe event than would have otherwise occurred. In the case of a system misalignment, a contributing cause could be excessive distractions to the operators during shift change, resulting in less-than-adequate attention to important details during system alignment.
critique	A review of an event conducted by all involved parties for the purpose of fact-finding and identifying lessons learned. A critique is a convened meeting held as soon as possible after the event to identify what happened, but not to assign blame or find fault. A critique may or may not include the identification of action items and recommendations. The results of a critique are also used to determine if further investigation is warranted.
direct cause	The cause that directly resulted in the occurrence. For example, in the case of a leak, the direct cause could have been the problem in the component or equipment that leaked. In the case of a system misalignment, the direct cause could have been operator error in the alignment.
event	Something significant and real-time that happens (e.g., pipe break, valve failure, loss of power, environmental spill, earthquake, tornado, flood).
facility manager	That individual, or designee, with direct line responsibility for operation of a facility or group of related facilities, including authority to direct physical changes to the facility. A Facility Manager could also be responsible for a program or activity.
final report	A documented evaluation of an event or condition that is prepared in sufficient detail to enable the reader to assess its significance, consequences, or implications and to evaluate the actions being proposed or employed to correct the condition or to avoid recurrence. Final Reports must be submitted to DOE no later than 45 calendar days after initial categorization. DOE Guide 231.1-1, Occurrence Reporting and

	Performance Analysis Guide gives instructions for filling out an occurrence report.
incidents of security concern	Incidents of safeguards and security concern are events that, at the time of occurrence, have yet to be determined to be a violation of law, but that are of such concern to the safeguards and security program as to warrant immediate review, inquiry, and subsequent assessment and reporting.
lessons learned	A "good work practice" or innovative approach that is identified and shared, or an adverse work practice or experience that is shared to avoid recurrence. Lesson learned is text that documents changes in activities or procedures made because of an event considered significant enough to become part of the corporate memory. This event may have either a positive or negative connotation.
notification report	The initial documented report, to the Department of Energy, of an event or condition that meets the reporting criteria defined in DOE Manual 231.1-2.
occurrence	One or more (i.e., recurring) events or conditions that adversely affect, or may adversely affect, DOE (including NNSA) or contractor personnel, the public, property, the environment, or the DOE mission. Events or conditions meeting the criteria threshold identified in DOE M 231.1-2, or determined to be recurring through performance analysis, are occurrences.
occurrence investigation	An investigation conducted according to site-specific procedures and/or when determined by DOE that a Type A or B is required by DOE procedures.
operational emergencies	As defined in DOE O 151.1, *Comprehensive Emergency Management System*, they are the most serious occurrences and require an increased alert status for on-site personnel and, in specified cases, for off-site authorities. DOE O 151.1A provides the prompt notification requirements, definitions, criteria, and classifications of operational emergencies and appropriate responses. Written Occurrence Reports must be completed in accordance with DOE Manual 231.1-2, Occurrence Reporting and Processing of Operations Information.
prompt notification	Timely reporting of the occurrence to the DOE Field Office and the DOE Headquarters Operations Center as required by the Significance Category and the reporting criteria of the occurrence.
report originator	It is the person who originated the report. This is the person who gathers the information and is most knowledgeable about the event. If ORPS is being used, the name of the transmitter will automatically appear in this field when the report is uploaded. If there is not a signed hard copy Final Report on file, the report must be transmitted by the Facility Manager or designee.
reportable occurrence	Events or conditions to be reported in accordance with the criteria defined in DOE M 231.1-2.
root cause	The most basic cause(s) that explains why the apparent cause happened, that can reasonably be identified, that senior management has the control to fix, and for which effective recommendations for corrective action(s) to remedy the problem, prevent specific recurrence of the problem, and preclude occurrence of similar problems can be generated, if necessary.
short form reports	A Short Form Report, as described in DOE Guide 231.1-1, must be prepared and submitted for all Significance Category 4 occurrences no later than 2 business after categorization of the occurrence. This report will satisfy all of the written reporting requirements for these occurrences.

update report	Prepared and issued when intermediate reporting is required: (1) to supply additional information as it becomes available prior to issuance of the Final Report; (2) any change in categorization is documented in an Update Report which is to be submitted before the close of the next business day from the time of recategorization (not to exceed 80 hours); (3) upon request of DOE; or (4) and when the Final Report canot be completed within 45 calendar days, an Update Report is submitted giving a detailed explanation for the delay and the estimated date for submittal of the Final Report.

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APPENDIX 5

SUBJECT AREA CONTENT

Management System: Environmental Management System

Subject Area: Spill Response

VIEW/PRINT ALL (No Exhibits and Forms)

Effective Date: **Oct 16, 2007** (Rev 3.8) Periodic Review Due: **Oct 16, 2012**	Subject Matter Expert: Jeffrey Williams	Management System Steward: George Goode II

Introduction

Various environmental regulations and DOE Orders require the prompt reporting and remediation of unexpected releases of oil, hazardous substances, radioactive materials, or other regulated pollutants that have the potential for impacting the environment. Reporting releases may also be required as a condition of an environmental permit whenever the permit-authorized limits of an environmental release have been exceeded. Failure to promptly report and remediate a known or suspected release of oil, hazardous substances, radioactive materials, or other regulated pollutants to the environment could result in greater damage to the environment, and unnecessarily risk exposure to people.

This subject area identifies the responsibilities of all personnel who cause, discover, respond to, or clean up an unexpected release of oil, hazardous substances, radioactive materials, or other regulated pollutants. A manager's responsibilities to report permit limit exceedances are also defined for those facilities or operations subject to an environmental permit issued by the Environmental Protection Agency, the New York State Department of Environmental Conservation, or any other agency.

Contents

Section	Overview of Content (see section for full process)
1. Notification and Response Requirements for Unexpected Releases of Oil, Hazardous Substances, or Radioactive Materials	• Determine if release could result in exposure to personnel. • Report release. • Assess spill and notify staff to assist in cleanup. • Notify regulatory agencies, if required, and Director's Office and DOE. • Call Occurrence Categorizer.

2. Notification Requirements for Exceedances or Potential Exceedances of Regulatory Permit Release Limits	• Notify Environmental Protection and Emergency Planning Team, and management. • Complete ORPS Occurrence Report. • Notify regulatory agencies, Director's Office, and DOE.
3. Cleanup of Spills	• Clean up spill. • Ensure that waste is managed and waste control forms are completed.

Definitions

Exhibits

Spill Response Subject Area Flowchart

Forms

Chemical and Oil Spill Reporting Form

Training Requirements and Reporting Obligations

This subject area contains training requirements. See the Training and Qualifications Web Site.

This subject area contains the following reporting obligations in case of release of oil, hazardous substances, or radioactive materials:

- Environmental & Waste Management Services Division (ES) informs the Director's Office and the DOE Brookhaven Site Office (BHSO), as necessary.
- Environmental Compliance Group personnel notify the DOE-BHSO, the Director's Office, and off-site regulatory agencies, as necessary.

See the sections Notification and Response Requirements for Unexpected Releases of Oil, Hazardous Substances, or Radioactive Materials and Notification Requirements for Exceedances or Potential Exceedances of Regulatory Permit Release Limits of this subject area.

External/Internal Requirements

Requirement Number	Requirement Title
10 CFR 830, Subpart A	Energy, Nuclear Safety Management, Quality Assurance Requirements
29 CFR 1910.120	Emergency Response to Hazardous Substance Releases
40 CFR 110.6	Discharge of Oil
40 CFR 112	Protection of Environment/Oil Pollution Prevention

40 CFR 300	Protection of the Environment/National Oil and Hazardous Substances Pollution Contingency Plan
40 CFR 302.6	Notification Requirements under CERCLA and Title III of the Superfund Amendments and Reauthorization Act of 1986
40 CFR 355	Protection of the Environment/Emergency Planning and Notification
40 CFR 68	Chemical Accident Prevention Provisions
6 NYCRR 596-599	New York State Department of Environmental Conservation, "Hazardous Substance Bulk Storage Regulations,"
6 NYCRR 610	New York State Navigation Law - Article 12 Oil Spill Control and Compensation Act
6 NYCRR 611-614	New York State Department of Environmental Conservation, Storage and Handling of Petroleum/Petroleum Clean-up and Removal
6 NYCRR 750	State Pollutant Discharge Elimination System (SPDES) Permits
EO 13423	Strengthening Federal Environmental, Energy, and Transportation Management
O 151.1C	Comprehensive Emergency Management System
O 414.1C	Quality Assurance
O 430.2B	Departmental Energy, Renewable Energy and Transportation Management
O 450.1A	Environmental Protection Program
Suffolk County Sanitary Code - Article 12	Toxic and Hazardous Materials Storage and Handling Controls

References

BNL Online Inventory Catalog

Hazardous Waste Management Subject Area

Industrial Waste Subject Area

Mixed Waste Management Subject Area

Occurrence Reporting and Processing System (ORPS) Subject Area

PCB Management Subject Area

Radioactive Waste Management Subject Area

Training and Qualifications Web Site

Work Planning and Control for Experiments and Operations Subject Area

Standards of Performance

All staff and guests shall comply with applicable Laboratory policies, standards, and procedures, unless a formal variance is obtained.

All staff and guests shall promptly report accidents, injuries, ES&H deficiencies, emergencies, and off-normal events in accordance with procedures.

All staff and users shall identify, evaluate, and control hazards in order to ensure that work is conducted safely and in a manner that protects the environment and the public.

All staff and users shall ensure that they are trained and qualified to carry out their assigned responsibilities, and shall inform their supervisor if they are assigned to perform work for which they are not properly trained or qualified.

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PROCEDURE: NOTIFICATION AND RESPONSE REQUIREMENTS FOR UNEXPECTED RELEASES OF OIL, HAZARDOUS SUBSTANCES, OR RADIOACTIVE MATERIALS

Management System: Environmental Management System

Subject Area: Spill Response

1. Notification and Response Requirements for Unexpected Releases of Oil, Hazardous Substances, or Radioactive Materials

Effective Date: **Oct 16, 2007**	Subject Matter Expert: Jeffrey Williams	Management System Steward: George Goode II

Applicability

This information applies to BNL staff who have caused or become aware of any release of oil, hazardous substances, or radioactive materials; their immediate supervisors/line management; and all responders to the scene of the release.

Required Procedure

Refer to the Spill Response Subject Area Flowchart for an overview of this procedure.

Step 1	If a release occurs, staff determines if the spill response requires outside assistance. If a release occurs during routine operations and staff determines that the release has not caused an impact to soil, a waterway, or air, and will not result in exposure to personnel, then staff do not have to call for outside assistance provided that all of the following conditions are met: • The spill is onto an impermeable surface; • The material spilled is not a highly toxic or highly volatile material like methylene chloride; • The person responding to the spill has appropriate training and materials to clean up the spill; • The volume spilled is less than five gallons (petroleum-based products); • The spill is cleaned up immediately.

	Examples include gram-quantity spills of dilute acids onto a workbench or floor where personnel working with the acids have neutralizing agents at their disposal, or incidental spills of cutting fluids onto the floor in a machine shop and personnel have sorbent pads available in the shop's spill kit. Releases that meet any of the following criteria must be reported to Fire/Rescue (F/R) for outside assistance by calling extension 911 or 2222: • Unexpected releases of oil, hazardous substances, or radioactive materials thought or known to have entered a sink or drain; • Unexpected releases of oil, hazardous substances, and radioactive materials known or suspected to have impacted the environment. (Something spilled directly to the soil or a waterway must be reported. Even a few drops spilled to the soil or a waterway must be reported); • Any hazardous material spill where the staff member's actions would result in exposures to chemicals above established safety limits; • Spills where the staff member believes that he/she possesses neither appropriate equipment nor training to mitigate the incident; • Airborne releases of hazardous materials or spills that result or are likely to result in an uncontrolled release of the hazardous material. **Warning:** Packaging for Speedy Dry, Oil-Dri, and other clay absorbent products now contain warnings that they are **not** to be used to absorb any kind of vegetable oil, turpentine, hydrofluoric fluids, or biodiesel fuel (including ethanol). All of these fluids release heat as they evaporate. Because clay is a natural insulator, when piled up or placed in a container after absorbing any of these fluids, heat may not be able to dissipate. Cases have been reported in which these products, after absorbing one of the listed fluids, contacted other combustible waste materials with low flash points and ignited, resulting in fires.
Step 2	Staff aware of a known release requiring outside assistance immediately **call extension 911 or 2222 (631-344-2222)**, which simultaneously notifies Safeguards & Security and F/R that a release of oil, hazardous substances, or radioactive materials has occurred. **Note:** Staff reporting a release may take other actions as appropriate and within the scope of his or her training (e.g., completion of a Hazmat First Responder Operations level course) to secure the area, keep the released material from spreading, and assist any injured personnel. See the Training and Qualifications Web site.
Step 3	Staff aware of a suspected or probable release of a hazardous substance, oil, or radioactive material from a storage tank determined by any of the following means immediately notify their supervisor and their Environmental Compliance Representative or the Environmental & Waste Management Services Environmental Compliance group at 631-872-8796 or 631-872-8800: • Test, sampling, or monitoring results from a release detection method that indicate a release may have occurred; • Unusual operating conditions such as the erratic behavior of product-dispensing equipment, the sudden loss of product from a storage tank, an unexpected presence of water in a tank, or the physical presence of a hazardous substance or

	an unusual level of vapors on a site that are of unknown origin; • Impacts in the surrounding area, such as evidence of hazardous substances, oil, or resulting vapors in soils, basements, sewer and utility lines, and nearby surface waters; • Any other conditions or indications of a suspected release.
Step 4	Staff reporting the release provide the following information (if known) when calling 911 or 2222: • Name, Department/Division affiliation, and phone number; • Location and time of the release; • Material released (if known); • Approximate quantity released; • Brief description of the incident and actions already taken; • Names of other personnel notified/responding to the incident. Staff should evacuate the area as necessary and relocate to a safe area. After reporting the release, staff should await the arrival of F/R first responders and provide additional information regarding the release as requested. **Note:** For spills of polychlorinated biphenyls (PCBs) or materials suspected to contain PCBs that occur outdoors, follow this procedure. For spills of PCBs occurring indoors, refer to the PCB Spill/ Fire Response, Reporting and Cleanup section in the PCB Management Subject Area.
Step 5	Staff aware of a release notify the appropriate Department/Division management of the release as soon as possible.
Step 6	In accordance with the BNL Emergency Plan, the Incident Commander (IC) and the Emergency Response Organization (ERO) assess the nature and extent of the spill and notify additional personnel, as appropriate, to assist with the cleanup of spilled materials. Environmental & Waste Management Services (ES), Plant Engineering, Radiological Control, and Safety & Health Services personnel may be called upon to do the following: • Identify the spilled material if not yet known; • Support efforts to contain materials spilled; • Minimize impacts to the environment; • Assist in the recovery and disposal of spilled products; • Clean up materials and contaminated soils; • Provide expertise regarding the packaging of wastes to control costs associated with shipping and disposal. **Note**: Several memoranda of agreement exist with many outside agencies to obtain necessary resources to supplement BNL in the mitigation and cleanup of spills. **Note**: The spill must be handled in accordance with the Incident Command System (ICS), including the assignment of the F/R incident response number for tracking.
Step 7	When the emergency situation ends, cleanup may commence based on the type of incident. The IC hands over command and control of the incident to the appropriate

	individuals for cleanup. In most circumstances, Plant Engineering personnel supported by ES coordinate the cleanup efforts. Organizations causing and/or otherwise responsible for releases of oil or hazardous substances are responsible for all financial obligations associated with the spill response including all spill response and remedial activities, waste management and disposal activities, and other costs associated with remediation/restoration of the spill site. See Section Cleanup of Spills of this subject area for further details.
Step 8	ES determines if notifications to off-site regulatory agencies are required and makes notifications as appropriate. ES completes the Chemical and Oil Spill Reporting Form.
Step 9	ES informs the Director's Office and the DOE Brookhaven Site Office (BHSO), as necessary.
Step 10	The organization responsible for the release contacts the Occurrence Categorizer at 631-433-0443 as soon as practical, but allows enough time so that a determination of reportability can take place within two hours of the spill. Refer to the Occurrence Reporting and Processing System (ORPS) Subject Area for details. **Note:** Call extension 2238 (or 2222) to request assistance in contacting the Occurrence Categorizer.

Guidelines

Each Department/Division should keep a spill response kit appropriate to the materials they have in stock. The kit should include, but not be limited to, sorbent pads and socks compatible with materials likely to be spilled, neutralizing agents, barrier tape, and protective gloves. Various spill kit items that may be purchased are identified as stock items in the BNL Online Inventory Catalog. The locations of spill kits along with information on the types of materials present, their intended uses, and instructions on their use should be clearly posted or otherwise distributed to staff who should know how to use the spill kits.

Small leaks (a couple of drops) of automotive fluids onto impervious surfaces like asphalt and concrete do not have to be reported.

If there is any doubt about what to do when a spill occurs, call 911 or 2222.

References

BNL Online Inventory Catalog

Occurrence Reporting and Processing System (ORPS) Subject Area

PCB Management Subject Area

Training and Qualifications Web Site

PROCEDURE: NOTIFICATION REQUIREMENTS FOR EXCEEDANCES OR POTENTIAL EXCEEDANCES OF REGULATORY PERMIT RELEASE LIMITS

Management System: Environmental Management System

Subject Area: Spill Response

2. Notification Requirements for Exceedances or Potential Exceedances of Regulatory Permit Release Limits

Effective Date: **Oct 16, 2007**	Subject Matter Expert: Jeffrey Williams	Management System Steward: George Goode II

| SBMS Home Page | Top of Subject Area | Instructions | Definitions |

Applicability

This information applies to staff and managers of facilities or operations that possess environmental permits with authorized release limits.

Required Procedure

This procedure does not apply to permit limit exceedances that are ordinarily reported to regulatory agencies through routine reports.

Step 1	Staff or facility managers who become aware that an authorized permit release limit has been or may be exceeded immediately take appropriate actions to stop the release, and notify the Environmental Compliance Group in the Environmental & Waste Management Services Division (ES), the organization's ES&H coordinator, and the organization's Environmental Compliance Representative (ECR). Provide the following information to the ES Environmental Compliance Group, the ES&H Coordinator, and the ECR: • Name, department/division affiliation, and phone number; • Location and the time exceedance was discovered; • Permit number and permit limit exceeded; • Brief description of the incident and corrective actions already taken; • Names of other personnel notified/responding to the incident. **Note:** This procedure does not apply to permit limit exceedances that are ordinarily

	reported to regulatory agencies through routine reports, such as the Monthly Discharge and Monitoring Report.
Step 2	Staff reporting an exceedance or potential exceedance notify appropriate department/division management of the incident as soon as possible.
Step 3	The Occurrence Categorizer, assisted by the Department Chair/Division Manager, the ES Environmental Compliance Group, the ES&H Coordinator, and the ECR, categorizes the occurrence. The Facility Manager completes an ORPS Occurrence Report, as necessary. See the Occurrence Reporting and Processing System (ORPS) Subject Area for information.
Step 4	Environmental Compliance Group personnel who are contacted about an exceedance, or a potential exceedance of an authorized release limit, notify the DOE Brookhaven Site Office (BHSO), the Director's Office, and off-site regulatory agencies, as necessary.
Step 5	Environmental Compliance Group personnel provide support in controlling, containing, and minimizing the impacts of the release to the facility and environment.

References

Occurrence Reporting and Processing System (ORPS) Subject Area

https://sbms.bnl.gov/sbmsearch/subjarea/26/26_pro2.cfm

PROCEDURE: CLEANUP OF SPILLS

Management System: Environmental Management System

Subject Area: Spill Response

3. Cleanup of Spills

Effective Date: **Oct 16, 2007**	Subject Matter Expert: Jeffrey Williams	Management System Steward: George Goode II

| SBMS Home Page | Top of Subject Area | Instructions | Definitions |

Applicability

This information applies to the Incident Commander (IC) who, after determining that the emergency is over, coordinates the cleanup of the spill. This information also applies to the personnel cleaning up the spill and the organization responsible for the spill.

Required Procedure

Step 1	The Incident Commander (IC) commences the cleanup of the spill by assembling the appropriate personnel and equipment.
Step 2	The IC determines the method of cleanup. See the Work Planning and Control for Experiments and Operations Subject Area.
Step 3	Personnel clean up the spill, placing the waste in the appropriate containers. See the following subject areas for information: • Hazardous Waste Management • Mixed Waste Management • Radioactive Waste Management • PCB Management
Step 4	The organization responsible for the spill does the following: • Adds the incident response number on the Waste Control Form and containers; • Places the required waste label on the container holding the waste.
Step 5	The organization responsible for the spill manages all waste in accordance with the following subject areas:

	• Hazardous Waste Management • Radioactive Waste Management • Industrial Waste • Mixed Waste Management
Step 6	The organization responsible for the spill ensures that the waste is moved to the appropriate storage area.
Step 7	The organization responsible for the spill processes the Waste Control Form, ensuring that the incident response number is on the form, and provides the Environmental & Waste Management Services Division with the numbers of Waste Control Forms for the wastes generated.

References

Hazardous Waste Management Subject Area

Industrial Waste Subject Area

Mixed Waste Management Subject Area

PCB Management Subject Area

Radioactive Waste Management Subject Area

Work Planning and Control for Experiments and Operations Subject Area

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DEFINITIONS

Standards-Based Management System (SBMS)

BROOKHAVEN NATIONAL LABORATORY

Definition: Spill Response

Term	Definition
hazardous substance	Any element, compound, mixture, solution, or substance specifically designated by the Environmental Protection Agency (EPA) under section 102 of the Comprehensive Environmental Response Compensation and Liability Act (CERCLA). Any substance designated under section 311 of the Clean Water Act (CWA). Any toxic pollutant designated under section 307(a) of the CWA. Any hazardous air pollutant designated under section 112 of the Clean Air Act. Any listed or characteristic hazardous waste designated under section 3001 of the Resource Conservation Recovery Act. Any imminently hazardous chemical, substance or mixture that EPA has taken action on pursuant to section 7 of the Toxic Substance Control Act. Any substance or chemical listed in Section 597.2 of the New York State Code of Rules and Regulations.
oil	Vegetable oil, synthetic oil, or any kind or form of petroleum including fuel oil, engine oil, lubricating oil, sludge, oil refuse, and oil mixed with other wastes/materials.
radioactive material	Any material, equipment, or system component determined to be contaminated or suspected of being contaminated. Radioactive material also includes activated material, sealed and unsealed sources, and material that emits radiation.
release	Any unauthorized spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or disposing directly or indirectly of oil, hazardous substances, radioactive materials, or any other substance which results in the formation of a hazardous substance upon release so that the substance or any related constituent thereof, or any degradation product of such a substance or of a related constituent thereof, may enter the environment.
spill or spillage	Any escape of a hazardous substance or oil from the containers employed in the normal course of storage, transfer, processing, or use.
storage tank	An aboveground tank, an underground tank, or a non-stationary tank, and any associated piping, lines, dikes, curbs, transfer stations, and ancillary equipment.

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One of ten national laboratories overseen and primarily funded by the Office of Science of the U.S. Department of Energy (DOE), Brookhaven National Laboratory conducts research in the physical, biomedical, and environmental sciences, as well as in energy technologies and national security. Brookhaven Lab also builds and operates major scientific facilities available to university, industry and government researchers. Brookhaven is operated and managed for DOE's Office of Science by Brookhaven Science Associates, a limited-liability company founded by Stony Brook University, the largest academic user of Laboratory facilities, and Battelle, a nonprofit, applied science and technology organization.

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APPENDIX 6

DAILY FUEL TANK STORAGE FACILITY INSPECTION

1.0 PURPOSE

To provide guidelines for inspection of the Central Steam Facility fuel storage tanks and ancillary equipment.

This procedure must be followed as written.

2.0 SCOPE

The Senior Stationary Engineers (SSEs) are responsible for the implementation of this procedure.

3.0 POLICY

The Senior Stationary Engineers will follow this procedure when required to inspect the fuel storage area and ancillary equipment.

4.0 REFERENCES

4.1 Oil & Chemical Spill Prevention Control and Countermeasure (SPCC) Plan

4.2 SBMS Spill Response Subject Area

4.3 EP-ES&H-105, Personal Protective Equipment

4.4 F&O Personal Protective Equipment (PPE) Webpage

5.0 DEFINITIONS

5.1 **Responsible authority**: First line supervisor, deputy manager EU, and manager EU, in that order.

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5.2 Responsible engineer: Senior stationary engineer assigned to perform the inspection.

6.0 PROCEDURE

6.1 Prerequisites:

None.

6.2 Precautions:

Use appropriate personal protective equipment (PPE) per the F&O Personal Protective Equipment (PPE) Webpage.

6.3 Visual Inspections

- Perform visual inspection four times per shift (every two hours).
- At start of shift, record fuel tank levels in the logbook.
- Walk through all fuel storage, receiving, and transferring areas.
- Be alert for unusual conditions, leaks, drips, etc.
- Report leaks or oil spills to the Fire Rescue Group (x2222) immediately.
- Report any suspicious persons to Security (x2238).

6.4 Written Inspections

- Complete the Daily Tank Storage and Ancillary Equipment Inspection Sheet (Attachment 7.1).
- Perform inspection as directed by Central Steam Facility supervisor or his designee (usually at 1600 hours).
- Sign and date inspection sheet.
- Perform inspection and note exceptions, observations, and comments as per the inspection sheet.
- Be alert for any conditions that may comprise the integrity of the fuel tanks, piping system, or containment.
- Are all manholes secure, all bolts in and tight?

- Are all fuel oil tank drain valves, water draw off valves, or any other valves that may permit the outflow of the tank's contents closed, locked, and blanked or capped?
- Are piping and supports secure and in good repair?
- Are all PIVs closed and locked?
- If any spills or leaks are observed, immediately notify the Fire Rescue Group (x2222).
- Report any suspicious persons to Security (x2238).

6.5 Supervisory Review

- The Central Steam Facility lead man or supervisor will review all daily reports.
- Lead man or supervisor will initiate appropriate work orders to correct deficiencies.
- Central Steam Facility supervisor will periodically review selected reports.

6.6 Record Keeping

- Completed reports will be retained at the Central Steam Facility as part of the SPCC Plan.
- Completed reports will be retained for a period of three years.

7.0 ATTACHMENTS

7.1 EU-CSF-0016A, Central Steam Facility Daily Tank Storage and Ancillary Equipment Inspection Sheet

CENTRAL STEAM FACILITY DAILY TANK STORAGE AND ANCILLARY EQUIPMENT INSPECTION SHEET

Signature _____ Date and Time of Inspection _____

Area	Potential Problems	Area Status		Observations and Comments
		OK	UNSAT	
TANK 3 (611C) BERM	EROSION/OIL WATER			
PIPES, VALVES, TANK	LEAKS, CORROSION			
HEATERS	LEAKS			
FITTINGS AND GAGES	LEAKS / DAMAGED			
LIGHTING	BURNED OUT BULBS			
LEVEL INDICATION	STICKING, BROKEN			
SIGNAGE	FADED, TORN, ILLEGIBLE			
TANK 4 (611D) BERM	EROSION/OIL WATER			
PIPES, VALVES, TANK	LEAKS, CORROSION			
HEATERS	LEAKS			
FITTINGS AND GAGES	LEAKS / DAMAGED			
LIGHTING	BURNED OUT BULBS			
LEVEL INDICATION	STICKING, BROKEN			
SIGNAGE	FADED, TORN, ILLEGIBLE			
TANK 9 (611G) BERM	EROSION/OIL WATER			
PIPES, VALVES, TANK	LEAKS, CORROSION			
HEATERS	LEAKS			
FITTINGS AND GAGES	LEAKS / DAMAGED			
LIGHTING	BURNED OUT BULBS			
LEVEL INDICATION	STICKING, BROKEN			
SIGNAGE	FADED, TORN, ILLEGIBLE			
TANK 10 (611H) BERM	EROSION/OIL WATER			
PIPES, VALVES, TANK	LEAKS, CORROSION			
HEATERS	LEAKS			
FITTINGS AND GAGES	LEAKS / DAMAGED			
LIGHTING	BURNED OUT BULBS			
LEVEL INDICATION	STICKING, BROKEN			
SIGNAGE	FADED, TORN, ILLEGIBLE			

Area	Potential Problems	Area Status		Observations and Comments
		OK	UNSAT	
TANK 5 (611E) BERM	EROSION/OIL WATER			
PIPES, VALVES, TANK	LEAKS, CORROSION			
FITTINGS AND GAGES	LEAKS / DAMAGED			
LIGHTING	BURNED OUT BULBS			
LEVEL INDICATION	STICKING, BROKEN			
SIGNAGE	FADED, TORN, ILLEGIBLE			
TANK 6 (611F) BERM	EROSION/OIL WATER			
PIPES, VALVES, TANK	LEAKS, CORROSION			
FITTINGS AND GAGES	LEAKS / DAMAGED			
LIGHTING	BURNED OUT BULBS			
LEVEL INDICATION	STICKING, BROKEN			
SIGNAGE	FADED, TORN, ILLEGIBLE			

FUEL TRANSFER FACILITY BUILDING 639				
PUMPS	LEAKS, DRIPS			
STRAINERS	LEAKS, DRIPS			
VALVES	LEAKS, DRIPS			
OUTSIDE LIGHTING	CONDITION			
INSIDE LIGHTING	CONDITION			
DOORS	CONDITION			
WINDOWS	CONDITION			
UNLOADING AREA	CLEAN, NO OIL			
BOOM	CONDITION			
TELEPHONES	OPERATION RINGERS			
LEVEL CONTROL AUTOMATION	NOTE ANY ANOMALIES			
LIGHTING EXTERIOR OF BUILDING 610	LIGHTS NOT WORKING			

NOTE: THIS REPORTS CONSTITUTES A DAILY REVIEW OF THE GENERAL TANK FARM INTEGRITY. ANY COMMENTS WHICH AFFECT THE TANK FARM INTEGRITY SHOULD BE NOTED BELOW.

Leadman Signature _____ Supervisor _____

(Daily Signature) (Spot Check)

APPENDIX 7

Operations and Maintenance (O&M) is a division of Plant Engineering. O&M supports the scientific mission of Brookhaven National Laboratory through its responsibility for the maintenance and operation of the site. These maintenance and operating activities include buildings, installed equipment, grounds, roads and paved surfaces, site utilities and the utilities distribution systems. The scientific divisions are responsible for the maintenance, repair, and replacement of their scientific equipment.

The primary mission of Brookhaven National Laboratory is to conduct major scientific research and development programs. These programs and scientific personnel are located in approximately 3.7 million square feet in over 389 buildings on the 5,200 acre site.

The O&M Division is committed to maintain and service the site so it may be effectively and safely utilized to perform its scientific mission. In support of this commitment, modern maintenance programs and management controls have been established. This procedure describes the programs, controls, and the associated administrative procedures.

This procedure:

- Will serve as the training vehicle for employees new to the organization,
- Will serve as the reference document for those who use the services of the O&M division,
- Will serve as the baseline reference for future improvements in the administration of the maintenance effort,
- Will identify the risks associated with by-passing certain procedural steps, and
- Informs all in the O&M division of each other's administrative responsibilities.

The Superintendent of the Maintenance Management Center (MMC) is responsible for the distribution and maintenance of this procedure. All changes or additions must be submitted to the MMC Superintendent and approved by the Manager of the O&M Division.

1.0 PURPOSE

To establish set policies for daily operation of the Maintenance Management Center (MMC).

2.0 SCOPE

The MMC shop policies are for all employees working in the Maintenance Management Group.

3.0 POLICY

Written policies shall be established for each functional group in order to provide clear direction to all personnel on policy related issues. The Superintendent of MMC will be responsible for implementation of these policies.

4.0 REFERENCES

4.1 Employee Handbook

4.2 Supervisor's Personnel Manual

4.3 ESH Standards (Traffic Safety)

4.4 Traffic Safety Enforcement Memo, dated April 8, 2004, from P. Chaudhari

4.5 Maintenance Management Center Organizational Chart.

5.0 DEFINITIONS

None.

6.0 PROCEDURES

6.1 **Prerequisites:** None.

6.2 **Precautions:** None.

6.3 **Vacation Requests and Scheduling:** Use of accrued vacation time is subject to the shop's workload. Personnel shall endeavor to coordinate vacation schedules so that no more than one person of any discipline (e.g., Elec. P/E, Arch. P/E, Mech. P/E, Facility Inspector, Facility Office Asst.) are scheduled for concurrent vacation. In all cases, as much notice as possible should be given for vacation requests. It is the responsibility of the individual to ensure that his/her accrued vacation leave is 24 days or less as of September 25. Emergency or short notice requests will be handled on a case-by-case basis.

6.4 **Sick Leave:** Use sick leave for the purpose of being absent from work due to illness or injury. Personnel shall notify their immediate or second line supervisor prior to 0900 on the day of illness or injury. The 2468 voicemail is not to be used for the purpose of sick leave notification.

6.5 **Doctor Visits:** Arrange for doctor's and dentist's appointments outside of normal working hours. When it's impossible to do so, every effort should be made to minimize the impact to the work day.

6.5.1 Non-exempt employees: No more than eight hours each calendar year, minimum of one hour and a maximum of four hours each absence.

6.5.2 Exempt employees: No more than eight hours each calendar year, minimum of two hours or four hours each absence.

6.6 **Safety Policy:** When investigating, inspecting, or checking job status, honor all standing safety warnings and policy as dictated by BNL. Follow safety rules and guidelines of the Laboratory at all times. Personnel Protective Equipment (PPE) (e.g., ear protection, safety glasses, etc.) is available upon request. The burden of determining safety requirements lies with the individual. Film badges will be worn in all radiation areas.

6.7 **Issued Gear:** Lab issued gear (e.g., shoes, glasses, rain gear) will be issued to personnel consistent with Plant Engineering policy.

6.8 **Telephone Use:** As stated in the BNL Employee Handbook, "Telephone service is provided for the conduct of official business. Use of government-provided services for personal business is prohibited by law and may result in suspension or dismissal." However, personal use of the telephone shall be kept to a minimum and consistent with whatever personal situation has developed. In the event of an emergency and to ensure timely receipt of a message, it is recommended that personnel advise family to call 2468.

6.9 **Pagers:** Employees issued pagers shall have them on their person and turned on whenever they are away from the MMC office area. If a pager is suspected of not operating properly, it shall be turned in to the immediate supervisor for repair or replacement.

6.10 **Use of Government Vehicles:** Government vehicles are for work related activities only. When duties require the use of a vehicle to perform an inspection or investigation, every attempt shall be made to coordinate the trip with the other personnel. A drop-off system should be employed if it is expected that the length of a trip will exceed one hour. Vehicle logs will be filled out prior to removing the keys from the logbook. Smoking is prohibited in all Laboratory vehicles. All New York State laws will be enforced on BNL site. These laws could include: speed limits, stop lights, stop signs, parking, use of a cell phone while driving, right-of-way, yield to pedestrians, etc. For further guidance on traffic safety, refer to SBMS on Traffic Safety.

6.11 **Traffic Violations:** If an employee receives a traffic violation ticket, a cover letter must be attached and signed by a supervisor or division head. The cover letter and ticket must be returned to the O&M Administrative Office after it is signed by the appropriate supervisor. The O&M Office will return it to the Maintenance Management Superintendent and he will initial it next to the supervisor's signature and forward to the Safeguards & Security Division.

6.12 **Computer Security and Care:** Integrity of computer hardware and software is the responsibility of the assigned employee. Backups of local hard drive history data shall be performed monthly. Dust covers are to be in place during non-work hours and on periods of leave. Computers are not for personal use. Each user is responsible to ensure only authorized copies of software are used on their computer. For more guidance on computer administration, refer to the Employee's Handbook.

6.13 **Stock Material Withdrawal:** All office related supplies withdrawn from the stock system shall be approved by the Superintendent of MMC or his designee.

6.14 Maintenance Management provides maintenance data in:

- Job estimating
- Labor utilization
- Labor performance
- Overall labor productivity
- Vendor performance evaluation
- Customer service analysis
- Customer requests
- PM and predictive maintenance effectiveness
- Work order status
- Work order costing
- Work order prioritization
- Backlog summary and analysis
- Equipment downtime and cause analysis
- Maintenance budgets variance
- Maintenance budget requirements
- Equipment repair procedures
- Planning and scheduling effectiveness
- Overall maintenance effectiveness
- DOE condition assessment program (CAS)
- Fire alarm testing program
- Site key plans
- Tier I inspection process

The following personnel perform these activities:

- Superintendent Maintenance Management
- General Supervisor Maintenance Management
- Assistant Staff Specialist
- Facility Inspector

7.0 ATTACHMENTS

None.

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APPENDIX 8

Aboveground Storage Tank Monthly Visual Inspection Checklist
1,000 Gallon Highland Tank

BNL Tank ID No: **244-09** Date of Inspection: _____

Please complete the following checklist for the aboveground storage tank(s) in this storage area. This inspection must be conducted **monthly**, and records must be kept for five years. Copies of these inspection records should be made available upon the request of regulatory agencies. Please check each item as Satisfactory (S) or Unsatisfactory (U). For each unsatisfactory, a corrective action must be noted in the comments/corrective actions column and tracked to completion (Include any additional work orders created to address the identified issue).

Condition of Tank(s)	S	U	Comments/Corrective Actions
The exterior of the tank (including exterior coating and insulation) is in good condition, free of corrosion, cracks, blisters, or other sign of deterioration.			
There is no evidence of leakage from the tank.			
There is no evidence of leakage around pipe penetrations or other connections.			
Level gauge/site glass is fully functional and clear.			
The tank is labeled with the BNL/SCDHS Registered Tank Label. All applicable sections of the label have been completed and are legible. Mandatory fields include BNL Tank No., SCDHS Tank No., Design and Working Volumes, and Material Stored.			
The tank is properly color coded (green hexagon).			
Secondary Containment			
The secondary containment is in good condition, free of accumulated liquid (e.g., fuel oil, water) and shows no signs of leakage.			
Piping and Associated Equipment			
All piping, pumps, valves, fittings, seals, valve stems etc. are in good condition, show no signs of corrosion or deterioration and are not leaking.			
Piping is adequately supported with no evidence of sags.			
Fill/spill box is free of accumulated liquid and in good repair.			

Name of Inspector: _____

Signature: _____

Aboveground Storage Tank Monthly Visual Inspection Checklist
4,000 Gallon SCAT Tank

BNL Tank ID No: **603-01** Date of Inspection: _____

Please complete the following checklist for the aboveground storage tank(s) in this storage area. This inspection must be conducted **monthly**, and records must be kept for five years. Copies of these inspection records should be made available upon the request of regulatory agencies. Please check each item as Satisfactory (S) or Unsatisfactory (U). For each unsatisfactory, a corrective action must be noted in the comments/corrective actions column and tracked to completion (Include any additional work orders created to address the identified issue).

NOTE: Coordinate testing of high-level and leak detection alarms with Central Steam Facility (CSF) Engineers to ensure that remote alarm system in Building 610 is operational.

Condition of Tank(s)	S	U	Comments/Corrective Actions
The exterior of the tank (including exterior coating and insulation) is in good condition, free of corrosion, cracks, blisters, or other sign of deterioration.			
There is no evidence of leakage from the tank.			
There is no evidence of leakage around pipe penetrations or other connections.			
The high level alarm is fully functional, including audible and visual alarms (**both local and remote alarm in Building 610**). This must be demonstrated by lifting the test lever on the top of the tank to ensure operability.			
The tank is labeled with the BNL/SCDHS Registered Tank Label. All applicable sections of the label have been completed and are legible. Mandatory fields include BNL Tank No., SCDHS Tank No., Design and Working Volumes, and Material Stored.			
The tank is properly color coded (yellow hexagon).			
Secondary Containment			
The secondary containment is in good condition, free of accumulated liquid (e.g., fuel oil, water) and shows no signs of leakage.			
The secondary containment leak sensor is fully functional including visual and audible alarms (**both local and remote alarm in Building 610**). This must be demonstrated by pulling the sensor out of the containment and placing it in a cup of water to ensure operability.			
Piping and Associated Equipment			
All piping, pumps, valves, fittings, seals, valve stems etc. are in good condition, show no signs of corrosion or deterioration and are not leaking.			
Piping is adequately supported with no evidence of sags.			
Fill/spill box is free of accumulated liquid and in good repair.			

Name of Inspector: _____

Signature: _____

Aboveground Storage Tank Monthly Visual Inspection Checklist
4,000 gallon SCAT Tank

BNL Tank ID No: **30-04** Date of Inspection: _____

Please complete the following checklist for the aboveground storage tank(s) in this storage area. This inspection must be conducted **monthly**, and records must be kept for five years. Copies of these inspection records should be made available upon the request of regulatory agencies. Please check each item as Satisfactory (S) or Unsatisfactory (U). For each unsatisfactory, a corrective action must be noted in the comments/corrective actions column and tracked to completion (Include any additional work orders created to address the identified issue).

Condition of Tank(s)	S	U	Comments/Corrective Actions
The exterior of the tank (including exterior coating and insulation) is in good condition, free of corrosion, cracks, blisters, or other sign of deterioration.			
There is no evidence of leakage from the tank.			
There is no evidence of leakage around pipe penetrations or other connections.			
The high level alarm is fully functional, including audible and visual alarms.			
The tank is labeled with the BNL/SCDHS Registered Tank Label. All applicable sections of the label have been completed and are legible. Mandatory fields include BNL Tank No., SCDHS Tank No., Design and Working Volumes, and Material Stored.			
The tank is properly color coded (green hexagon).			
Secondary Containment			
The secondary containment is in good condition, free of accumulated liquid (e.g., fuel oil, water) and shows no signs of leakage.			
Piping and Associated Equipment			
All pumps, valves, fittings, seals, valve stems etc. are in good condition, show no signs of corrosion or deterioration and are not leaking.			
Piping is adequately supported with no evidence of sags.			
External pipe coatings (if provided) are sound with no peeling, blisters or rust evident.			
Fill/spill box is free of accumulated liquid and in good repair.			

Name of Inspector: _____

Signature: _____

Building 651 (Diesel Tank Farm)
Aboveground Storage Tank Monthly Visual Inspection Checklist

BNL Tank ID No(s): **651-01, 02, 03, and 04** Date of Inspection: _____

Building # **651**

Please complete the following checklist for the aboveground storage tank(s) in this storage area. This inspection must be conducted **monthly**, and records must be kept for five years. Copies of these inspection records should be made available upon the request of regulatory agencies. Please check each item as Satisfactory (S), Unsatisfactory (U), or Not Applicable (NA). For each unsatisfactory, a corrective action should be noted and the date of repair entered in the comments/corrective actions column.

NOTE: Identify which tank a deficiency applies to in the comments section.

Condition of Tank(s)	S	U	NA	Comments/Corrective Actions
The exterior of the tank (including exterior coating and insulation) is in good condition, free of corrosion, cracks, blisters, or other sign of deterioration.				
There is no evidence of leakage from the tank.				
There is no evidence of leakage around pipe penetrations or other connections.				
The high level alarm (both high and high-high) is fully functional, including audible and visual alarms.				
The tank is labeled with the BNL/SCDHS Registered Tank Label. All applicable sections of the label have been completed and are legible. Mandatory fields include BNL Tank No., SCDHS Tank No., Volume, and Material Stored.				
Secondary Containment				
The secondary containment for the tanks and transfer facility is in good condition, free of accumulated liquid (e.g., fuel oil, water) and shows no signs of leakage. **NOTE:** Contact the F&O Environmental Compliance Representative to coordinate the inspection and subsequent pump out of water from containment areas.				
There are no signs of spillage in the storage area.				
Piping and Associated Equipment				
All pumps, valves, fittings, seals, valve stems etc. are in good condition, show no signs of corrosion or deterioration and are not leaking.				
Piping is adequately supported with no evidence of sags.				
Piping, pumps, valves are labeled with contents.				
External pipe coatings (if provided) are sound with no peeling, blisters or rust evident.				
Fill boxes/containment areas are free of accumulated liquid and in good repair.				

Name of Inspector: _____ Signature: _____

Brookhaven National Laboratory - Upton Service Station

Monthly Inspection Checklist

Date of Inspection: _____

This inspection must be conducted monthly, and records must be kept for five years. Please check each item as Satisfactory (S), Unsatisfactory (U), or Not Applicable (NA). For each unsatisfactory, a corrective action must be noted and the date of repair entered in the comments column. ***Note: Identify which tank a deficiency applies to in the comments section.***

General	630-06			630-07			630-08			630-09		
	S	U	NA	S	U	NA	S	U	NA	S	U	NA
Tank label present (Tank #'s and product name).												
Fill cap is properly color-coded.												
Condition of manhole cover and caps: Sufficiently sealed to avoid water intrusion.												
Main alarm panel is properly labeled and fully operational.												
Note any comments/corrective actions and scheduled O&M performed this month:												
Sump and Piping	S	U	NA	S	U	NA	S	U	NA	S	U	NA
Manway or fill spill sump condition: No accumulated water and/or product, evidence of leakage.												
Exposed valves, pumps, piping, fittings, clamps, seals are in good condition, show no signs of corrosion or deterioration and are not leaking.												
Rubber test boots opened at sump end to allow free flow of product back to sump in the event of a piping leak.												
Sump probe properly placed within two inches of bottom.												
Note any comments/corrective actions and scheduled O&M performed this month:												
Overfill and Leak Detection Probes	S	U	NA	S	U	NA	S	U	NA	S	U	NA
Overfill alarm is functioning properly: Float device manually activated to demonstrate audible and visual alarm components.												
Exposed portion of interstitial leak detection probe is in good condition, properly attached and sealed to the riser, and water is not entering the sump.												
Note any comments/corrective actions and scheduled O&M performed this month:												
Dispensers	S	U	NA	S	U	NA	S	U	NA	S	U	NA
No evidence of leaks, shear valve is present and in good condition.												
Secondary piping test boot opened to allow free drainage back to tank sump for any leaks that may occur within the dispenser.												
Dispenser sump pan is in good condition. No seepage between and underneath concrete fill material.												
Note any comments/corrective actions and scheduled O&M performed this month:												

Name of Inspector: _____ Signature: _____

Weekly testing of the tanks electronic overfill and leak detection panels must be performed to ensure that they are fully functional, including audible and visual alarms. Initial and date each box weekly to document successful completion of tests. Please note any deficiencies/corrective actions above.

Week #1 [ ] Week #2 [ ] Week #3 [ ] Week #4 [ ]

Brookhaven National Laboratory – Motor Pool (Gasoline Tanks)

Monthly Inspection Checklist

Date of Inspection: _____

This inspection must be conducted monthly, and records must be kept for five years. Please check each item as Satisfactory (S), Unsatisfactory (U), or Not Applicable (NA). For each unsatisfactory, a corrective action should be noted and the date of repair entered in the comments column. ***Note: Identify which tank a deficiency applies to in the comments section.***

General	423-06			423-07		
	S	U	NA	S	U	NA
Tank label present (Tank #'s and product name).						
Fill cap is properly color-coded.						
Condition of manhole cover and caps: Sufficiently sealed to avoid water intrusion.						
Main alarm panel is properly labeled and fully operational.						
Note any comments/corrective actions and scheduled O&M performed this month:						

Sump and Piping	S	U	NA	S	U	NA
Manway or fill spill sump condition: No accumulated water and/or product, evidence of leakage.						
Exposed valves, pumps, piping, fittings, clamps, seals are in good condition, show no signs of corrosion or deterioration and are not leaking.						
Rubber test boots opened at sump end to allow free flow of product back to sump in the event of a piping leak.						
Sump probe properly placed within two inches of bottom.						
Note any comments/corrective actions and scheduled O&M performed this month:						

Overfill and Leak Detection Probes	S	U	NA	S	U	NA
Overfill alarm is functioning properly: Float device manually activated to demonstrate audible and visual alarm components.						
Exposed portion of interstitial leak detection probe is in good condition, properly attached and sealed to the riser, and water is not entering the sump.						
Note any comments/corrective actions and scheduled O&M performed this month:						

Dispensers	S	U	NA	S	U	NA
No evidence of leaks, shear valve is present and in good condition.						
Secondary piping test boot opened to allow free drainage back to tank sump for any leaks that may occur within the dispenser.						
Dispenser sump pan is in good condition. No seepage between and underneath concrete fill material.						
Note any comments/corrective actions and scheduled O&M performed this month:						

Name of Inspector: _____ Signature: _____

Weekly testing of the tanks electronic overfill and leak detection panels must be performed to ensure that they are fully functional, including audible and visual alarms. Initial and date each box weekly to document successful completion of tests. Please note any deficiencies/corrective actions above.

Week #1 [ ] Week #2 [ ] Week #3 [ ] Week #4 [ ]

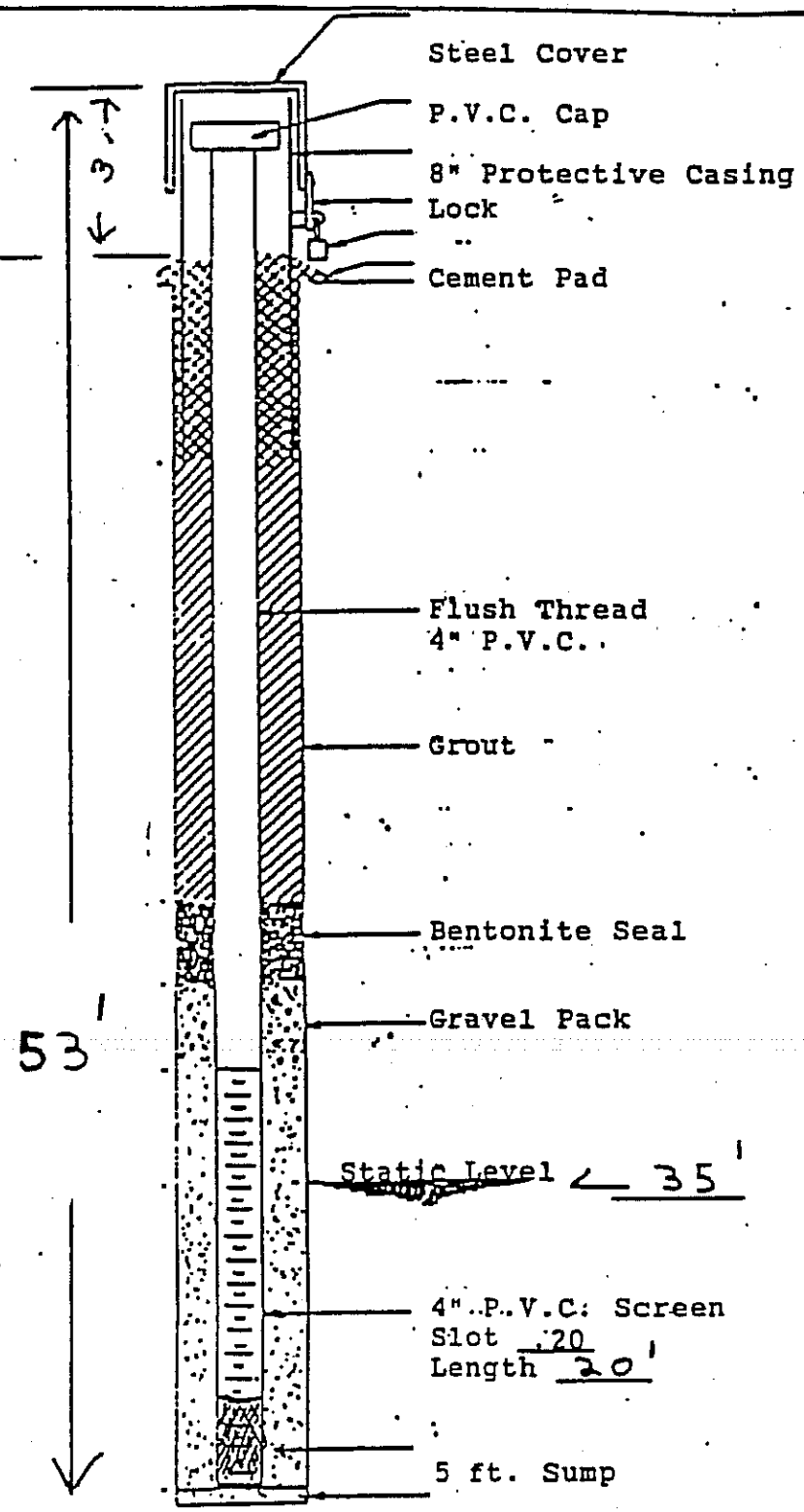
APPENDIX 9

R & L WELL DRILLING

581-6076
31 UNION AVENUE ISLIP, N.Y. 11751

WELL # 76-16

TOTAL DEPTH 53'



CONSULTING GROUND WATER GEOLOGISTS
ROUX ASSOCIATES INC

GEOLOGIC LOG

Study No. 13001 Date 6/30/89
Project Brookhaven National Lab
Client R & L Drilling
Page 1 of 3
Logged By E. Beacon
Well No. 76-16
Loc. Brookhaven National Lab
M.P. Elevation
Drilling Started 6/30/89 Ended 6/30/89
Driller R & L Drilling
Type Of Rig Stardrill 100/Hollow Stem Auger

WELL DATA
Hole Diam. (in.) 10
Final Depth (ft.) 50
Casing Diam. (in.) 4
Casing Length (ft.)
Screen Setting (ft.)
Screen Slot & Type 020 20
Well Status

G W READINGS(1)

Date	DTW MP(2)	Elev.W.T.

SAMPLER
Type split spoon
Hammer 140 lb.
Fall in.

DEVELOPMENT

OVM	SAMPLE No.	Rec.	Depth (ft.)	Blows/6"	Strata Change & Gen. Desc.	Depth (ft.)	SAMPLE DESCRIPTION
2.2-4.5		1.5	0-2				Top 0.9 dark brown, medium and fine SAND, trace gravel and silt, grass, roots, layer of coal? Bottom 0.6 light brown orange, medium SAND, some fine sand, little coarse sand, trace coarse gravel, trace silt.
2.2		1.3	5-7			5	Top 0.8 same as bottom above. Bottom 0.5 tan to light tan, medium and coarse SAND, trace gravel, trace fine sand.
2.2		0.85	10-12			10	Top 0.5 tan to light brown, medium and coarse SAND, trace fine and coarse gravel, trace very coarse and fine sand. Bottom 0.35 light tan to buff coarse SAND, some medium trace gravel, some darker laminae.
2.2		0.9	15-17			15	Tan to pinkish very coarse SAND, and fine GRAVEL, trace coarse gravel little coarse sand.

REMARKS: (1) in feet relative to a common datum
(2) from top of PVC casing

CONSULTING GROUND WATER GEOLOGISTS
ROUX ASSOCIATES INC

GEOLOGIC LOG

Study No. 13001 Date 6/30/89
Project Brookhaven National Lab
Client R & L Drilling
Page 2 Of 3
Logged By E. Beacon
Well No. 76-16
Loc. Brookhaven National Lab
M.P. Elevation
Drilling Started 6/30/89 Ended 6/30/89
Driller R & L Drilling
Type Of Rig Hollow Stem Auger

WELL DATA
Hole Diam. (in.)
Final Depth (ft.)
Casing Diam. (in.)
Casing Length (ft.)
Screen Setting (ft.)
Screen Slot & Type
Well Status

G W READINGS(1)

Date	DTW MP(2)	Elev.W.T.

SAMPLER
Type
Hammer lb.
Fall in.

DEVELOPMENT

OVM	SAMPLE No.	Rec.	Depth (ft.)	Blows/6"	Strata Change & Gen. Desc.	Depth (ft.)	SAMPLE DESCRIPTION
2.2		1.0	20-22				Same as above; some iron staining.
2.2		1.0	25-27			25	Light tan, very coarse SAND, some coarse sand, trace to little fine gravel, trace coarse gravel.
2.2		0.8	30-32			30	Top 0.1 light tan, very coarse SAND, and fine GRAVEL. Bottom 0.7 light tan, coarse SAND, some dark laminae well sorted, trace medium and fine sand.
2.2		1.2	35-37			35	Tan to pinkish tan, very coarse SAND, little to some fine gravel, trace coarse gravel, wet.

REMARKS: (1) in feet relative to a common datum
(2) from top of PVC casing

CONSULTING GROUND WATER GEOLOGISTS
ROUX ASSOCIATES INC

GEOLOGIC LOG

Study No. 13001 Date 6/30/89
Project Brookhaven National Lab
Client R & L Drilling
Page 3 of 3
Logged By E. Beacon
Well No. 76-16
Loc. Brookhaven National Lab
M.P. Elevation
Drilling Started 6/30/89 Ended 6/30/89
Driller R & L Drilling
Type Of Rig

WELL DATA

Hole Diam. (in.)
Final Depth (ft.)
Casing Diam. (in.)
Casing Length (ft.)
Screen Setting (ft.)
Screen Slot & Type
Well Status

G W READINGS(1)

Date	DTW MP(2)	Elev.W.T.

SAMPLER

Type
Hammer lb.
Fall in.

DEVELOPMENT

OVM	SAMPLE No.	Rec.	Depth (ft.)	Blows/6"	Strata Change & Gen. Desc.	Depth (ft.)	SAMPLE DESCRIPTION
0.0		1.0	40–42				Light brown, very coarse SAND, some coarse sand, trace to little fine gravel, wet.
		NR	45–47			45	
0.0		0.2	50–52			50	Tan to pink tan, very coarse SAND, and fine GRAVEL, little coarse gravel. Wet.
							B.O.B

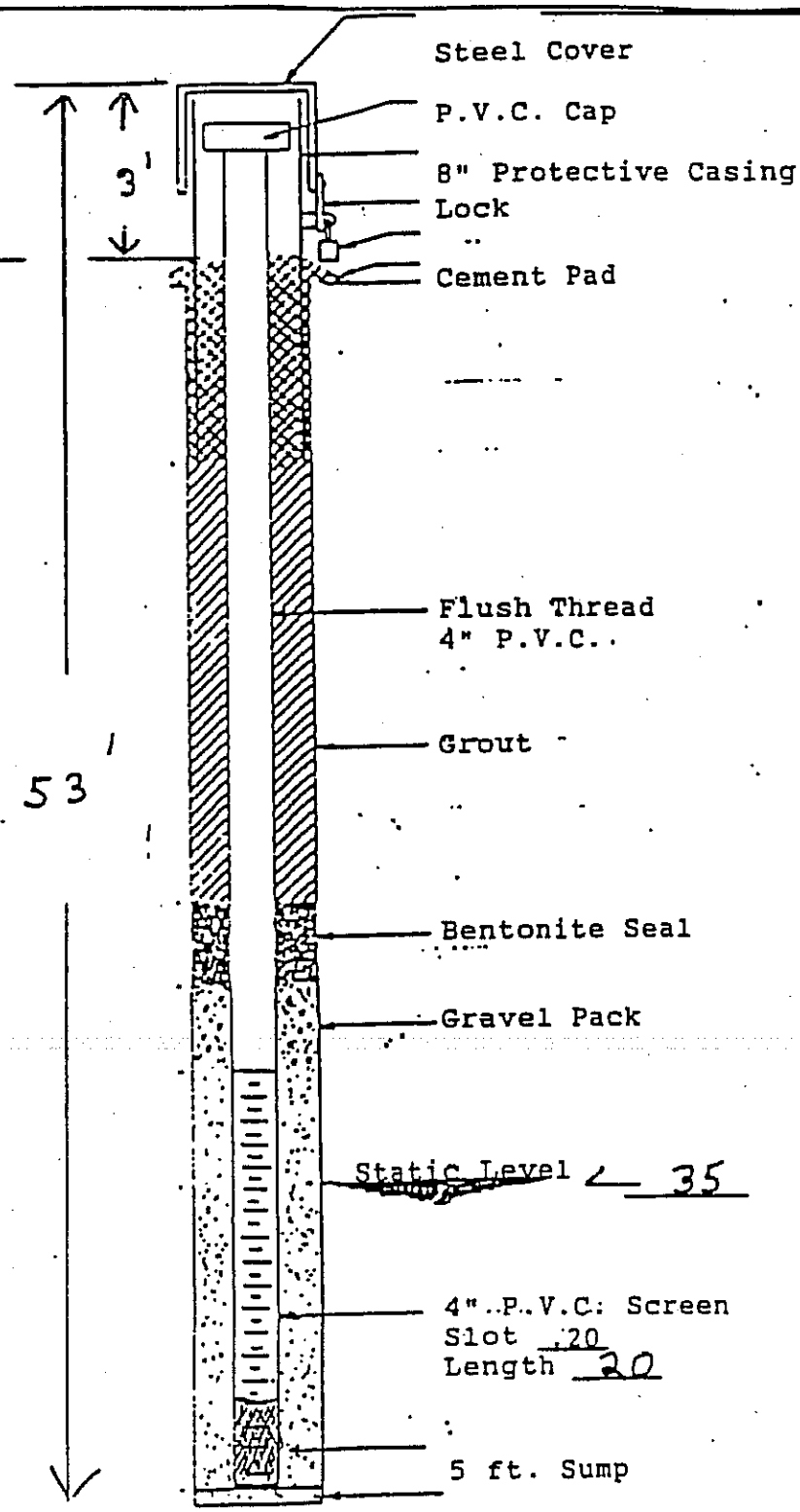
REMARKS: (1) in feet relative to a common datum
(2) from top of PVC casing

R & L WELL DRILLING

581-6076
31 UNION AVENUE ISLIP, N.Y. 11751

WELL # 76 - 17

TOTAL DEPTH 53



CONSULTING GROUND WATER GEOLOGISTS
ROUX ASSOCIATES INC

GEOLOGIC LOG

Study No. 13001 Date 7/6/89
Project BNL
Client R & L Drilling
Page 1 of 2
Logged By E. Beacon
Well No. 76-17
Loc. BNL
M.P. Elevation
Drilling Started 7/6/89 Ended 7/6/89
Driller R & L
Type Of Rig Stardrill 100Hollow stem auger

WELL DATA

Hole Diam. (in.) 10
Final Depth (ft.) 50
Casing Diam. (in.) 4
Casing Length (ft.)
Screen Setting (ft.)
Screen Slot & Type 020 20ft
Well Status

G W READINGS(1)

Date	DTW MP(2)	Elev.W.T

SAMPLER

Type split spoon
Hammer 140 lb.
Fall in.

DEVELOPMENT

OVM* ppm	SAMPLE No.	Rec.	Depth (ft.)	Blows/6"	Strata Change & Gen. Desc.	Depth (ft.)	SAMPLE DESCRIPTION
2.2		2.0	0-2'			0	Top 0.3 organic material: grass, leaves. Bottom 1.7 orange-brown coarse and medium SAND, little fine s little silt & clay, little fine grave cohesive.
2.2		1.0	5-7'			5	Top 0.5 same as bottom above except trace coarse gravel. Bottom 0.5 tan-brown, coarse & medium SAND, little fine gravel, trace coarse gravel.
2.2		1.0	10-12'			10	Light brown, coarse and medium SAND trace very coarse sand, trace fine sand, trace fine and coarse gravel.
2.2		0.35	15-17'			15	Tan to light tan, coarse SAND, trace very coarse and medium sand, trace fine gravel.
2.2		1.2	20-22'			20	Top 0.8 tan to light brown, coarse sand little very coarse sand, trace medium sand, trace coarse gravel. Bottom 0.4 pink-tan, very coarse SAND and GRAVEL, little coarse sand.
2.2		1.2	25-27'			25	Top 0.8 light tan to buff, very coarse and coarse sand trace coarse gravel; Bottom 0.4 light brown coarse SAND, sc very coarse sand, some darker laminae.

REMARKS: (1) in feet relative to a common datum
(2) from top of PVC casing

Background measured 2.2 to 4.5 ppm

CONSULTING GROUND WATER GEOLOGISTS
ROUX ASSOCIATES INC

GEOLOGIC LOG

Study No. 13001 Date 7/6/89
Project Brookhaven National Lab
Client R & L Drilling
Page 2 of 2
Logged By E. Beacon
Well No. 76-17
Loc. Brookhaven National Lab
M.P. Elevation
Drilling Started 7/6/89 Ended 7/6/89
Driller R & L Drilling
Type Of Rig Hollow Stem Auger

WELL DATA
Hole Diam. (in.)
Final Depth (ft.)
Casing Diam. (in.)
Casing Length (ft.)
Screen Setting (ft.)
Screen Slot & Type
Well Status

G W READINGS(1)

Date	DTW MP(2)	Elev. W.T.

SAMPLER
Type
Hammer lb.
Fall in.

DEVELOPMENT

OVM	SAMPLE No.	Rec.	Depth (ft.)	Blows/6"	Strata Change & Gen. Desc.	Depth (ft.)	SAMPLE DESCRIPTION
0-2.2		1.4	30-32			30	Top 0.3 tan, coarse and very coarse SAND, little fine gravel, trace coarse gravel. Middle 0.5 light tan to buff coarse and very coarse SAND, some fine gravel. Bottom 0.6 orange - pink brown, very coarse SAND, some coarse sand, little to some fine gravel, trace coarse gravel.
0-2.2		1.5	35-37			35	Top 1.3 tan, coarse and very coarse SAND, some fine gravel. Bottom 0.3 tan, very coarse SAND, some fine gravel, some fine gravel, darker laminae, wet.
0-2.2		.05	40-42			40	Tan, very coarse and coarse SAND, some fine gravel, wet.
		NR	45-47			45	No recovery.
0-2.2		0.15	50-52			50	Fine and coarse GRAVEL, some very coarse sand, little coarse sand.
							B.O.B

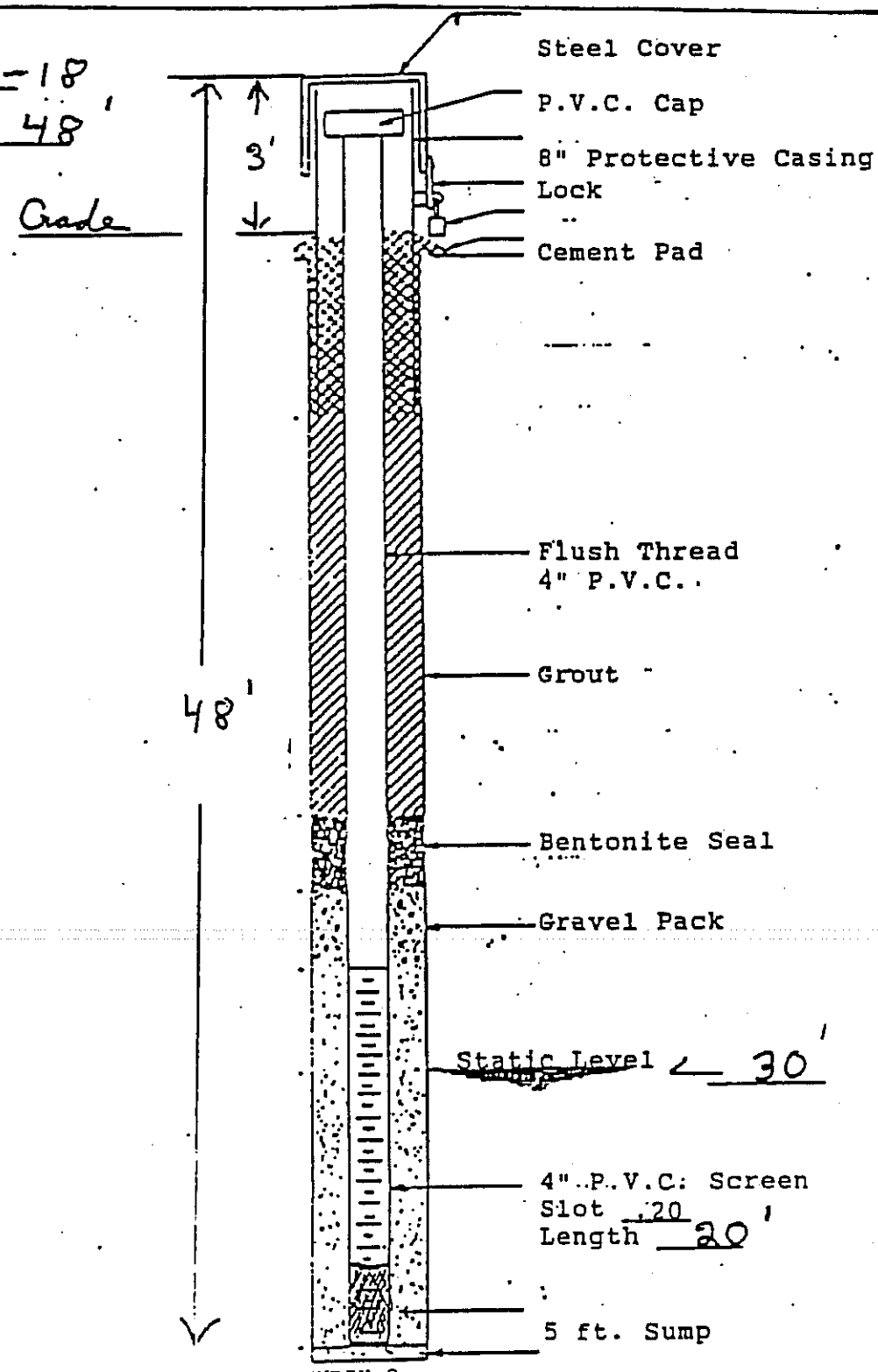
REMARKS: (1) in feet relative to a common datum
(2) from top of PVC casing

R & L WELL DRILLING

581-6076
31 UNION AVENUE ISLIP, N.Y. 11751

WELL # 76-18

TOTAL DEPTH 48'



CONSULTING GROUND WATER GEOLOGISTS
ROUX ASSOCIATES INC

GEOLOGIC LOG

Study No. 13001 Date 6/28/89
Project Brookhaven National Lab
Client R & L Drilling
Page 1 Of 3
Logged By Ellen Beacon
Well No. 76-18
Loc. BNL
M.P. Elevation
Drilling Started 6/28/89 Ended 6/28/89
Driller R & L Drilling
Type Of Rig Stardrill 100 Hollow Stem Auger

WELL DATA

Hole Diam. (in.) 10
Final Depth (ft.) 45
Casing Diam. (in.) 4
Casing Length (ft.) 25
Screen Setting (ft.) 25-45
Screen Slot & Type 020
Well Status Complete

G W READINGS(1)

Date	DTW MP(2)	Elev.W.T.

SAMPLER

Type split spoon
Hammer 140 lb.
Fall in.

DEVELOPMENT

OVM*	SAMPLE No.	Rec.	Depth (ft.)	Blows/6"	Strata Change & Gen. Desc.	Depth (ft.)	SAMPLE DESCRIPTION
2.2		2.0	0-2				Top 0.6 dark brown to black, medium SAND, little fine and coarse sand, trace gravel roots. Bottom 1.4 dark orange - brown, coarse to fine SAND mostly medium sand, trace to little gravel, trace silt, poorly sorted some roots. Slate chips.
2.2		0.6	5-7			5	Top 0.05 orange. Brown to tan, coarse SAND, little very coarse, trace gravel, trace fine sand.
0.0		0.7	10-12			10	Top 0.4 orange to light brown, coarse SAND, some very coarse sand, little medium, trace gravel. Bottom 0.3 fine GRAVEL, and very coarse SAND, little coarse gravel.
0.0		1.3	15-17			15	Top 0.6 light tan, coarse SAND, well sorted, trace very coarse sand. Bottom 0.7 dark tan very coarse SAND, some coarse gravel, little medium sand, large piece of coal (?)

REMARKS: (1) in feet relative to a common datum *Background 2.2 ppm
(2) from top of PVC casing

CONSULTING GROUND WATER GEOLOGISTS
ROUX ASSOCIATES INC

GEOLOGIC LOG

Study No. 13001 Date 6/28/89
Project Brookhaven National Lab
Client R & L Drilling
Page 2 of 3
Logged By E. Beacon
Well No. 76-18
Loc.
M.P. Elevation
Drilling Started Ended
Driller R& L Drilling
Type Of Rig

WELL DATA
Hole Diam. (in.)
Final Depth (ft.)
Casing Diam. (in.)
Casing Length (ft.)
Screen Setting (ft.)
Screen Slot & Type
Well Status

G W READINGS(1)

Date	DTW MP (2)	Elev. W.T.

SAMPLER
Type
Hammer lb.
Fall in.

DEVELOPMENT

OVM ppm	SAMPLE No.	Rec.	Depth (ft.)	Blows/6"	Strata Change & Gen. Desc.	Depth (ft.)	SAMPLE DESCRIPTION
0-2.2		1.25	20-22				Top 0.3 orangy tan, very coarse SAND little fine gravel, trace coarse gravel. Bottom 0.95 light tan, coarse and very coarse SAND, some dark laminae, trace coarse gravel, fairly sorted. Subangular to subrounded.
						22	
0-2.2		1.1	25-27			25	Top 0.3 tan, very coarse and coarse SAND, trace to little fine gravel. Bottom 0.8 tan to light tan, well sorted coarse SAND, trace very coarse sand to fine gravel.
0-2.2		1.15	30-32			30	Pink - brown, very coarse SAND, some fine gravel, some coarse sand. WET
2.2		0.6	35-37			35	Pink - brown very coarse SAND, and fine GRAVEL, trace to little coarse gravel, WET.

REMARKS: (1) in feet relative to a common datum
(2) from top of PVC casing

CONSULTING GROUND WATER GEOLOGISTS
ROUX ASSOCIATES INC

GEOLOGIC LOG

Study No. 13001 Date 6/28/89
Project Brookhaven National Lab
Client R & L Drilling
Page 3 of 3
Logged By E. Beacon
Well No. 76-18
Loc. Brookhaven National Lab
M.P. Elevation
Drilling Started 6/28/89 Ended 6/28/89
Driller R & L Drilling
Type Of Rig

WELL DATA

Hole Diam. (in.)
Final Depth (ft.)
Casing Diam. (in.)
Casing Length (ft.)
Screen Setting (ft.)
Screen Slot & Type
Well Status

G W READINGS(1)

Date	DTW MP(2)	Elev.W.T.

SAMPLER

Type
Hammer lb.
Fall in.

DEVELOPMENT

OVM ppm	SAMPLE No.	Rec.	Depth (ft.)	Blows/6"	Strata Change & Gen. Desc.	Depth (ft.)	SAMPLE DESCRIPTION
0.0		0.1	40–42 (sample not collected)			40	(Large rock stuck in spoon) Tan, very coarse SAND and fine GRAVEL. Wet.
0.0		0.3	45–47			45	Light tan to pink tan, fine and coarse GRAVEL, and very coarse SAND.
						47	B.O.B

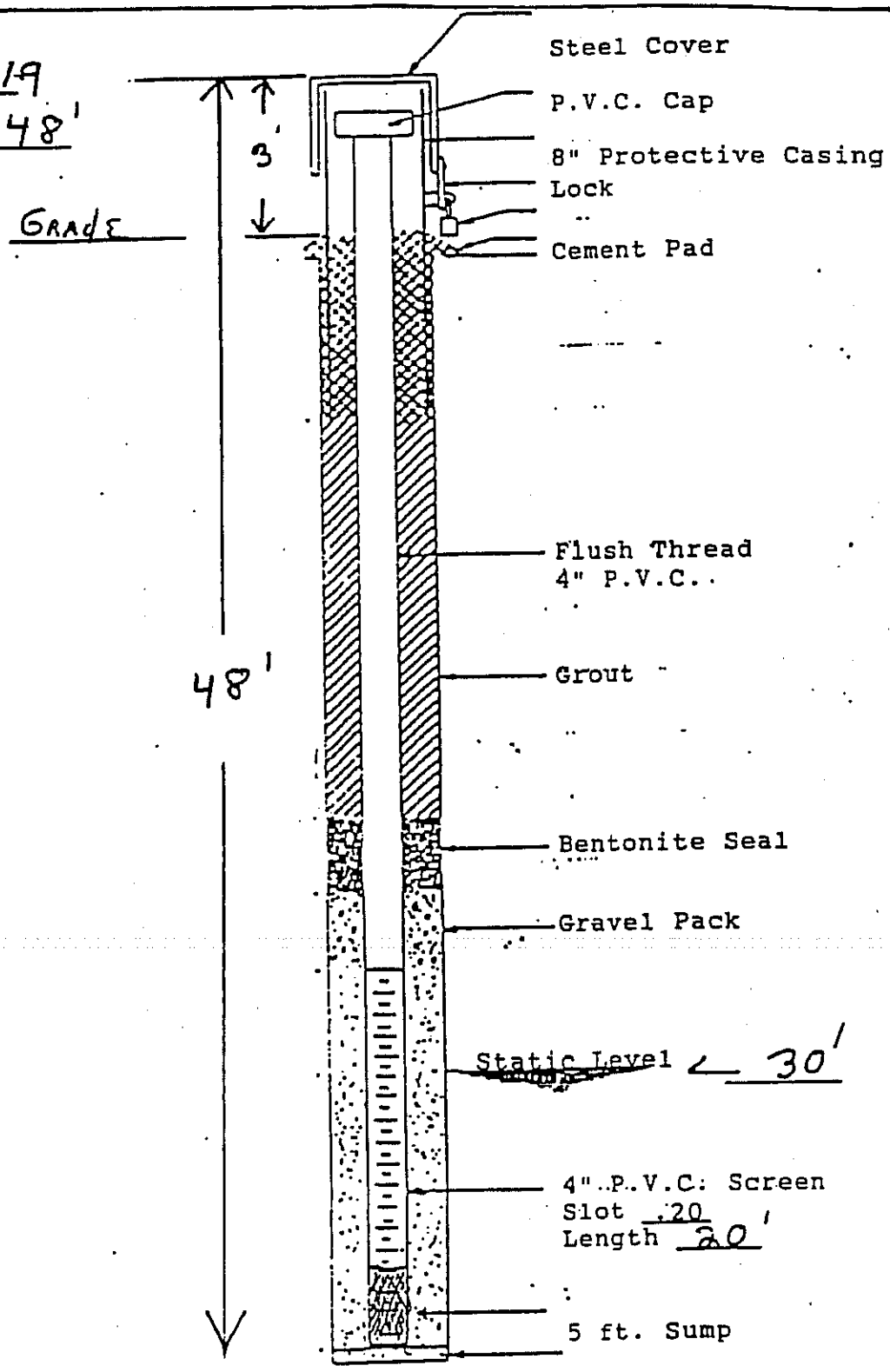
REMARKS: (1) in feet relative to a common datum
(2) from top of PVC casing

R & L WELL DRILLING

581-6076
31 UNION AVENUE ISLIP, N.Y. 11751

WELL # 76-19

TOTAL DEPTH 48'



CONSULTING GROUND WATER GEOLOGISTS
ROUX ASSOCIATES INC

GEOLOGIC LOG

WELL DATA

[illegible] 13291 [illegible] 6/29/89 [illegible] 10
[illegible] Brookhaven National Lab [illegible] 45

Client: R & L Drilling
Page: 1 Of 3
Logged By: E. Beacon
Well No.: 76-19
Loc.: Brookhaven National Lab
M.P. Elevation:
Drilling Started: 6/29/89 Ended: 6/29/89
Driller: R & L
Type Of Rig: Stardrill 100/Hollow Stem Auger

Casing Diam. (in.): 4
Casing Length (ft.): 25
Screen Setting (ft.): 20
Screen Slot & Type: 020
Well Status:

G W READINGS(1)

Date	Data Measured	G.W.T.

SAMPLER

Type: split spoon
Hammer: 140 lb.
Fall: in.

DEVELOPMENT

OVM ppm	SAMPLE No.	Rec.	Depth (ft.)	Blows/6"	Strata Change & Gen. Desc.	Depth (ft.)	SAMPLE DESCRIPTION
2.2		1.9	0-2			2	Top 0.3 dark, organic soil leaves roots. Middle 0.6 dark brown to black, medium SAND, little fine and coarse sand, trace fine gravel, roots Bottom 0.9 light to medium brown medium sand, some coarse, some fines trace silt, trace fine gravel, roots
2.2		0.8	5-7			5	Top 0.5 same as bottom above. Bottom 0.3 tan coarse and medium SAND, little fine sand, trace to little gravel (fine & coarse).
0-2.2		1.4	10-12			10	Light brown, medium and coarse SAND, trace fine sand, trace gravel (fine and coarse).
.2-4.5		1.2	15-17			15	Top 0.5 same as above. Bottom 0.7 tan to light buff coarse SAND, some very coarse sand trace to little fine and coarse gravel.

REMARKS: (1) in feet relative to a common datum
(2) from top of PVC casing Background OVM

2.2-4.5

CONSULTING GROUND WATER GEOLOGISTS
ROUX ASSOCIATES INC

GEOLOGIC LOG

Client: R & L Drilling
Page 2 of 3
Logged By
Well No. 76-19
Loc.
M.P. Elevation
Drilling Started Ended
Driller R & L Drilling
Type Of Rig

WELL DATA
Casing Diam. (in.)
Casing Length (ft.)
Screen Setting (ft.)
Screen Slot & Type
Well Status

G W READINGS(1)

SAMPLER
Type
Hammer lb.
Fall in.

DEVELOPMENT

OVM	SAMPLE No.	Rec.	Depth (ft.)	Blows/6"	Strata Change & Gen. Desc.	Depth (ft.)	SAMPLE DESCRIPTION
2.2		0.8	20-22				Light tan, very coarse SAND, some coarse gravel, little to some coarse SAND.
2.2		1.0	25-27			25	Top 0.6 light tan with some darker laminae, coarse and very coarse SAND, some fine gravel. Bottom 0.4 tan, very coarse SAND, some fine gravel; moist.
2.2		1.0	30-32			30	Tan pinkish tan, very coarse SAND, some fine gravel, trace to little coarse gravel, wet.
2.2 4.5		0.85	35-37			35	Same as above except trace coarse gravel.

REMARKS: (1) in feet relative to a common datum
(2) from top of PVC casing

CONSULTING GROUND WATER GEOLOGISTS
ROUX ASSOCIATES INC

GEOLOGIC LOG

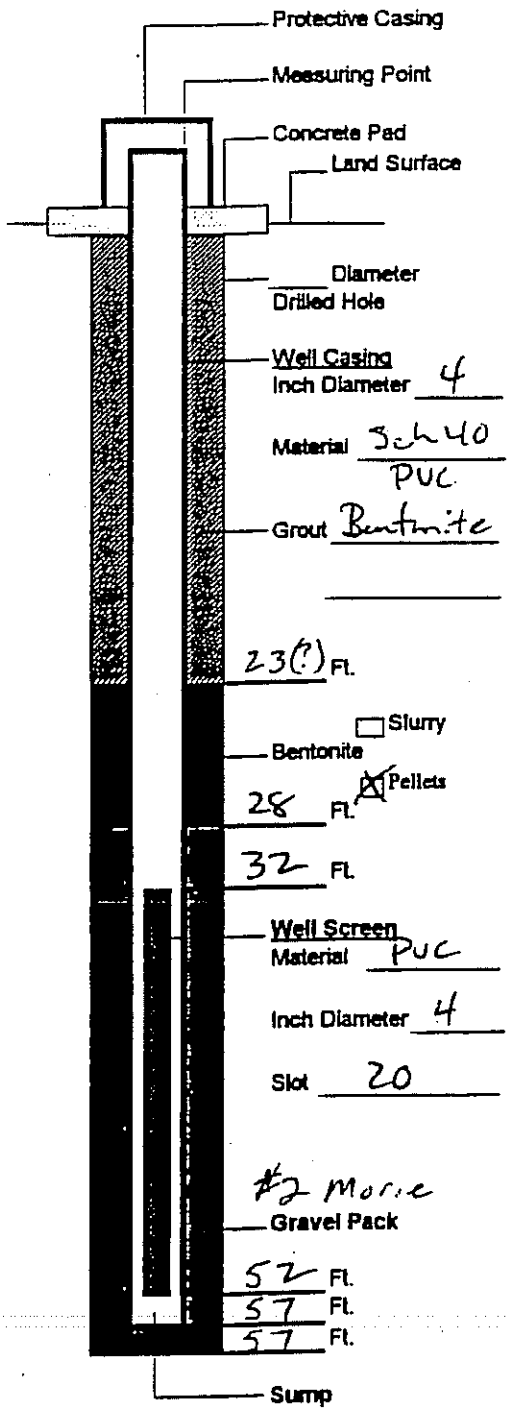
	WELL DATA	G W READINGS(1)
Client R & L Drilling	Casing Diam. (in.)	
Page 3 of 3	Casing Length (ft.)	
Logged By E. Beacon	Screen Setting (ft.)	
Well No. 76-19	Screen Slot & Type	
Loc.	Well Status	
M.P. Elevation	**SAMPLER**	**DEVELOPMENT**
Drilling Started Ended	Type	
Driller R & L Drilling	Hammer lb.	
Type Of Rig	Fall in.	

OVM	SAMPLE No.	Rec.	Depth (ft.)	Blows/6"	Strata Change & Gen. Desc.	Depth (ft.)	SAMPLE DESCRIPTION
2.2 4.5		0.15	40–42				Light tan, very coarse SAND, and fine GRAVEL. Wet.
		NR	45–47			45	
							B.O.B.

REMARKS: (1) in feet relative to a common datum
(2) from top of PVC casing

D Laquette 1/4/94

MONITORING WELL CONSTRUCTION LOG



Note:
All Depths in Feet Below or Above Land Surface

Well No. 76-25

NYSDEC Permit No.

Project OU IV RI/FS

Surveyor _____ Survey Date _____

Land Surface Elevation

Measuring Point Elevation

BNL Northing

BNL Easting

Installation Date 2/26/93

Drilling Contractor R&L

Drilling Method Hollow Stem Auger

Drilling Fluid

Fluid Loss During Drilling _____ Gallons

Development Technique (s) and Date(s)

Water Removed During Development _____ Gallons

Static Depth to Water 37 Feet below M.P.

Pumping Depth tp Water _____ Feet below M.P.

Pumping Duration

Yield _____ GPM _____ Date _____

Specific Capacity _____ GPM/Ft.

Well Purpose

Hydrogeologist J. DeFranco

Company Name CDM Federal

M FEDERAL PROGRAMS CORPORATION

BORING NUMBER **76-25S** SHEET 1 OF 2

PROJECT Brookhaven National Laboratories

LOCATION Upton, New York

CONTRACT NUMBER Operable Unit IV

LOGGED BY J. DeFranco

ORDINATES N 100,780.1 E 101,705.9

FACE ELEVATION 78.8 DATUM MSL

SAMPLE INFORMATION						STRATA	DESCRIPTION	WELL CONSTRUCTION DETAIL	ELEVATION FEET
TH T	LAB SAMPLE	SAMPLE TYPE	BLOW COUNTS	Recovery %	HNu (ppm)				
							TOP SOIL	Cement Backfill	
5		X	3-6-5	33	0		Fine SAND with medium gravel, well sorted, 2.5Y 7/3 pale yellow	100% Pure Bentonite Seal (2'-23')	75
10		X	6-15-25	72	0		As above with medium to coarse SAND with gravel	Schedule 40 PVC 4" Pipe	70
15		X	12-12-15	67	0		Medium to very coarse quartz SAND with trace fine gravel, well sorted, subround to subangular, 2.5Y 7/3 pale yellow		65
20		X	5-7-9	61	0		Coarse to very coarse quartz, minor garnet SAND with fine gravel, moderately sorted, subrounded-subangular, 7.5YR 7/4 pink	Bentonite Pellets (23'-28') ?	60
25		X	7-7-20	56	0		Medium to coarse quartz minor garnet SAND with fine gravel, well sorted, subround to subangular, 7.5YR 7/4 pink		55
30		X	15-20-23	56	0		Same as above	No. 2 Morie Gravel Pack (28'-57')	50
								Slot width 0.02"	45

LLING CONTRACTOR R&L

DRILLING METHOD Hollow stem auger

DRILLING EQUIPMENT

DRILLING STARTED 2/26/93 ENDED 2/26/93

REMARKS Saturated at 37.0 feet; OVA and Bicron used to screen split spoons.

See key sheet for symbols and abbreviations used above.

CDM FEDERAL PROGRAMS CORPORATION

BORING NUMBER **76-25S** SHEET 2 OF 2

PROJECT **Brookhaven National Laboratories**

LOCATION **Upton, New York**

CONTRACT NUMBER **Operable Unit IV**

COORDINATES **N 100,780.1 E 101,705.9**

SURFACE ELEVATION **78.8** DATUM **MSL**

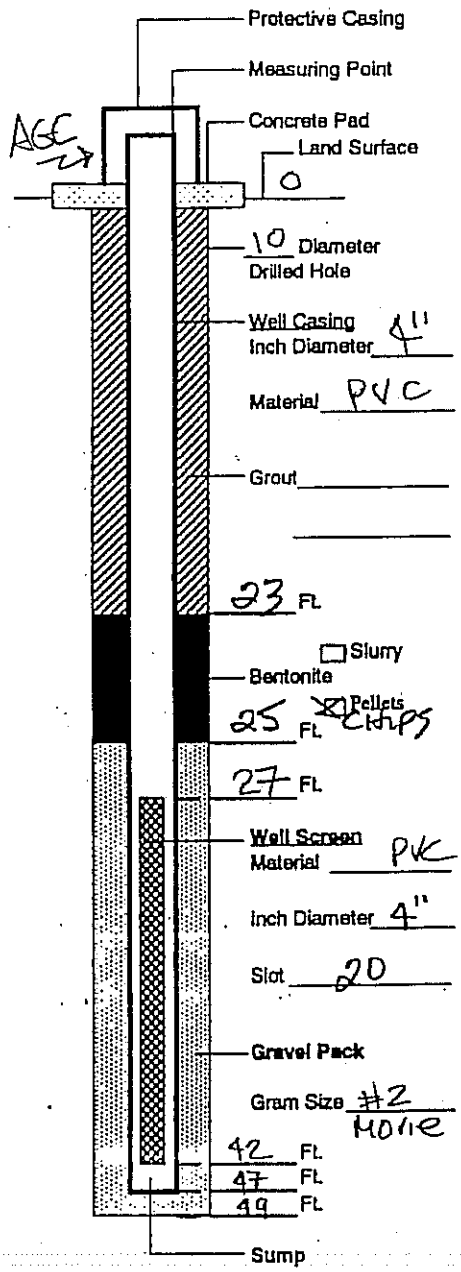
LOGGED BY **J. DeFranco**

SAMPLE INFORMATION						STRATA	DESCRIPTION	WELL CONSTRUCTION DETAIL	ELEVATION FEET
DEPTH FEET	LAB SAMPLE	SAMPLE TYPE	BLOW COUNTS	Recovery %	HNu (ppm)				
			12-15-20	78	0		Medium to coarse quartz SAND with rare fine gravel, moderately sorted, subround to subangular, 10YR 7/4 very pale brown	DTW (37.0')	40
40			9-18-14	22	0		Medium quartz SAND with fine gravel (10%), well sorted subround to subangular, color as above	Screen interval (32'-52')	35
45			3-7-10	44	0		Medium to very coarse quartz SAND and GRAVEL (40%), poorly sorted, subround to subangular, 10YR 8/4 very pale brown		30
50			10-20-35	61	0		Medium to coarse quartz minor garnet SAND with fine gravel (10%), well sorted, subround to subangular, color as above	Sump (52'-57')	
55									

Bottom of 76-25S at 57.0 feet

ATTACHMENT 3 BNL 076-378

MONITORING WELL CONSTRUCTION LOG



Note:
All Depths In Feet Below or Above Land Surface

Well No. MPF-02

NYSDEC Permit No. S-115929 T

Project 9409 Contract 11106

Surveyor _____ Survey Date _____

Land Surface Elevation _____

Measuring Point Elevation _____

BNL Northing _____

BNL Easting _____

Installation Date 1/3/2000

Drilling Contractor AQUIFER DRILLING & TESTING

Drilling Method HSA 6"

Drilling Fluid N/A

Fluid Loss During Drilling _____ Gallons

Development Technique (s) and Date(s) _____

Water Removed During Development _____ Gallons

Static Depth to Water _____ Feet below M.P.

Pumping Depth to Water _____ Feet below M.P.

Pumping Duration _____

Yield _____ GPM _____ Date _____

Specific Capacity _____ GPM/FL

Well Purpose Groundwater Monitoring

Hydrogeologist AD SILVER

Company Name AQUIFER DRILLING

ATTACHMENT 4

GEOLOGIC LOG

076-378

Well No. MPF-02	**BORE HOLE DATA**
Location: Major Petroleum Facility	Hole Diameter (inches): 6" HSA (10-12")
M.P. Elevation (1):	Total Depth(2): 47'
Project: 9409 Contract 11106	**SAMPLER**
Date: 1/3/2000	Type: 2" split spoon
Page 1 of 2	Hammer: 140# / 30" pounds
Logged By: A Silver	Fall: inches
Company: Aquifer Drilling	**REMARKS** first 5 ft excavated by hand.
Drilling Started: 1/3/2000 Ended: 1/3/2000	
Driller: S. Miller / J Philbin	
Type of Rig: Ft Mobile B-61	

OVM-PPM	SAMPLE No.	Rec.	Depth (ft.)	Blows/6"	Strata Change & Gen. Desc.	Depth (ft.)	SAMPLE DESCRIPTION
—	1.	100%	5/7	18/16/15/14		5	Very Pale Brown (10YR 7/4) fine sand trace gravel.
—	2.	95%	10/12	19/20/18/19		10	Yellowish brown (10YR 5/6) fine sand some silt trace gravel.
—	3.	100%	15/17	16/18/15/14		15	Greyish brown (10YR 5/2) fine sand and silt.
—	4.	85%	20/22	18/15/14/17		20	Very Pale brown (10YR 7/4) fine sand trace gravel
—	5	90%	25/27	18/16/16/16		25	"
—	6.	90%	30/32	18/23/29/23		30	"
—	7.		35/37	17/19/17/22		35	"
—	8.		40/42			40	

Remarks: (1) from measuring point located on top of well casing
(2) All depths in feet below land surface.

ATTACHMENT 4

GEOLOGIC LOG

076-378

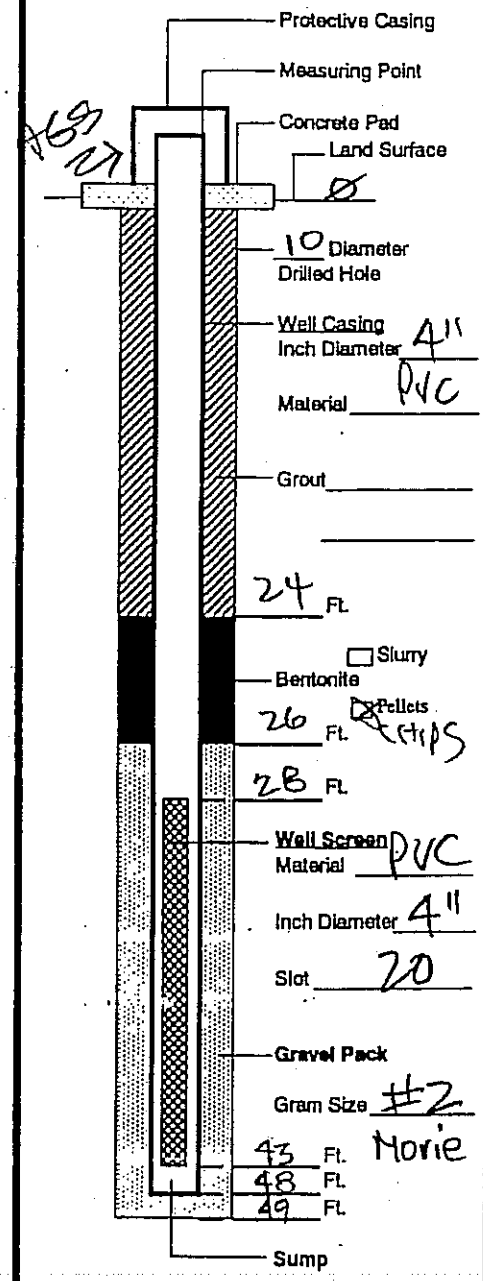
Well No. MPF-02	BORE HOLE DATA
Location: Major Petrol Facil	Hole Diameter (inches): Same as previous page
M.P. Elevation (1):	Total Depth(2):
Project: 9409 Contract 11106	SAMPLER
Date: 1/3/2000	Type:
Page 2 of 2	Hammer: pounds
Logged By: Silver	Fall: inches
Company: Aquifer Drilling	REMARKS
Drilling Started: 1/3/00 Ended: 1/3/00	
Driller: S. Miller / J. Phelbin	
Type of Rig: Mobile B-61	

OVM-PPM	SAMPLE No.	Rec.	Depth (ft.)	Blows/6"	Strata Change & Gen. Desc.	Depth (ft.)	SAMPLE DESCRIPTION
—	9.	85%	45/47	18/15/12/14		45	Very Pale Brown (10YR 7/4) fine sand trace gravel.
—	10	85%	50/52	16/19/20/22		50	"
			page 2 of 2.				

Remarks: (1) from measuring point located on top of well casing
(2) All depths in feet below land surface.

ATTACHMENT 3 BNL 076-379

MONITORING WELL CONSTRUCTION LOG



Note:
All Depths In Feet Below or Above Land Surface

48.0

Well No. MDF-03 076-379

NYSDEC Permit No. S-115930

Project 9909 Contract 11106

Surveyor _____ Survey Date _____

Land Surface Elevation _____

Measuring Point Elevation _____

BNL Northing _____

BNL Easting _____

Installation Date 1/3/2000

Drilling Contractor AQUIFER DRILLING

Drilling Method HSA 6"

Drilling Fluid N/A

Fluid Loss During Drilling _____ Gallons

Development Technique (s) and Date(s) _____

Water Removed During Development _____ Gallons

Static Depth to Water _____ Feet below M.P.

Pumping Depth to Water _____ Feet below M.P.

Pumping Duration _____

Yield _____ GPM _____ Date _____

Specific Capacity _____ GPM/Ft.

Well Purpose Monitor GW

Hydrogeologist A SILVER

Company Name AQUIFER DRILLING

ATTACHMENT 4

GEOLOGIC LOG

~~076-9~~ 076-379

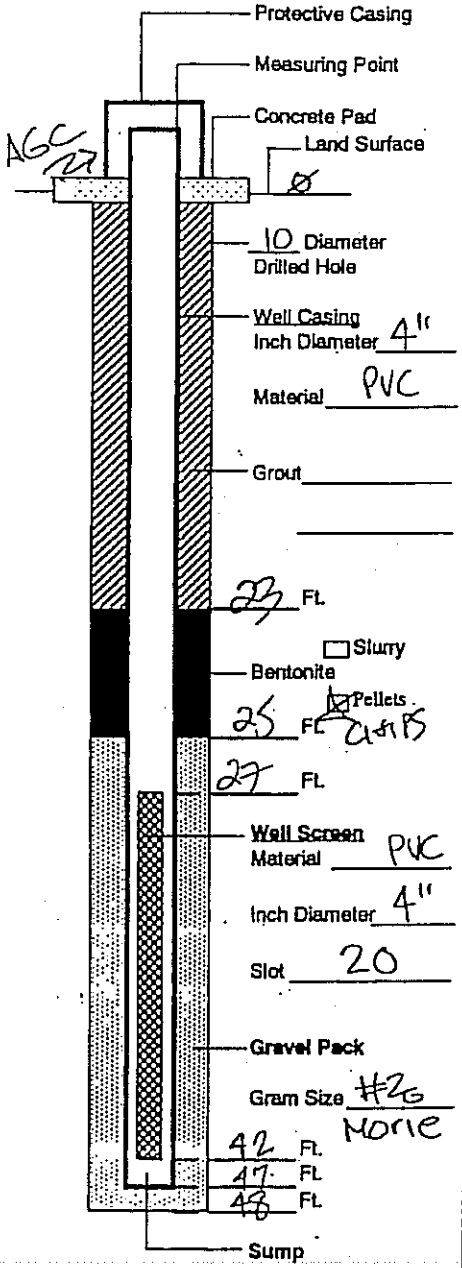
Well No. MPF-03	**BORE HOLE DATA**
Location: Major Petroleum Facility	Hole Diameter (inches): HSA 6" (10"-12")
M.P. Elevation (1):	Total Depth(2): 48
Project: 9409 Contract 11106	**SAMPLER**
Date: 1/3/2000	Type: 2" Split Spoon
Page 1 of 1	Hammer: 140/30 pounds
Logged By: A.D. Silver	Fall: inches
Company: Aquifer Drilling/Testing	**REMARKS** 5 ft hand excavated
Drilling Started: 1/3/2000 Ended: 1/3/00	
Driller: S. Miller / J Philbin	
Type of Rig: Mobile B-61	

OVM-PPM	SAMPLE No.	Rec.	Depth (ft.)	Blows/6"	Strata Change & Gen. Desc.	Depth (ft.)	SAMPLE DESCRIPTION
	1.	90%	5/7	18/17/18/18		5	Yellow (10YR 7/6) fine sand trace gravel
	2.	85%	10/12	17/18/16/14		10	"
	3.	88%	15/17	16/15/14/19		15	"
	4.	85%	20/22	19/21/23/20		20	"
	5.	85%	25/27	18/16/15/15		25	"
	6.	85%	30/32	19/21/20/26		30	"
	7.	80%	35/37	20/20/23/20		35	Yellowish brown (10YR 5/4) fine to medium sand trace gravel
	8.	80%	40/42	21/18/19/17		40	"
	9.	80%	45/47	26/18/19/22		45	"
	10.	80%	50/52	19/23/20/20		50	"

Remarks: (1) from measuring point located on top of well casing
(2) All depths in feet below land surface.

ATTACHMENT 3 BNL 076-380

MONITORING WELL CONSTRUCTION LOG



Note:
All Depths in Feet Below or Above Land Surface

47.5

Well No. MYF-01 076-380

NYSDEC Permit No. S-115928 T

Project 9408 Contract 111016

Surveyor _____ Survey Date _____

Land Surface Elevation _____

Measuring Point Elevation _____

BNL Northing _____

BNL Easting _____

Installation Date 1/4/2000

Drilling Contractor ~~AQUIFER DRILLING & TESTING~~

Drilling Method HSA 6¼

Drilling Fluid N/A

Fluid Loss During Drilling _____ Gallons

Development Technique (s) and Date(s) _____

Water Removed During Development _____ Gallons

Static Depth to Water _____ Feet below M.P.

Pumping Depth to Water _____ Feet below M.P.

Pumping Duration _____

Yield _____ GPM _____ Date _____

Specific Capacity _____ GPM/Ft.

Well Purpose Monitor GW

Hydrogeologist A.D. SILVER

Company Name AQUIFER DRILLING & TESTING

ATTACHMENT 4

076-380

GEOLOGIC LOG

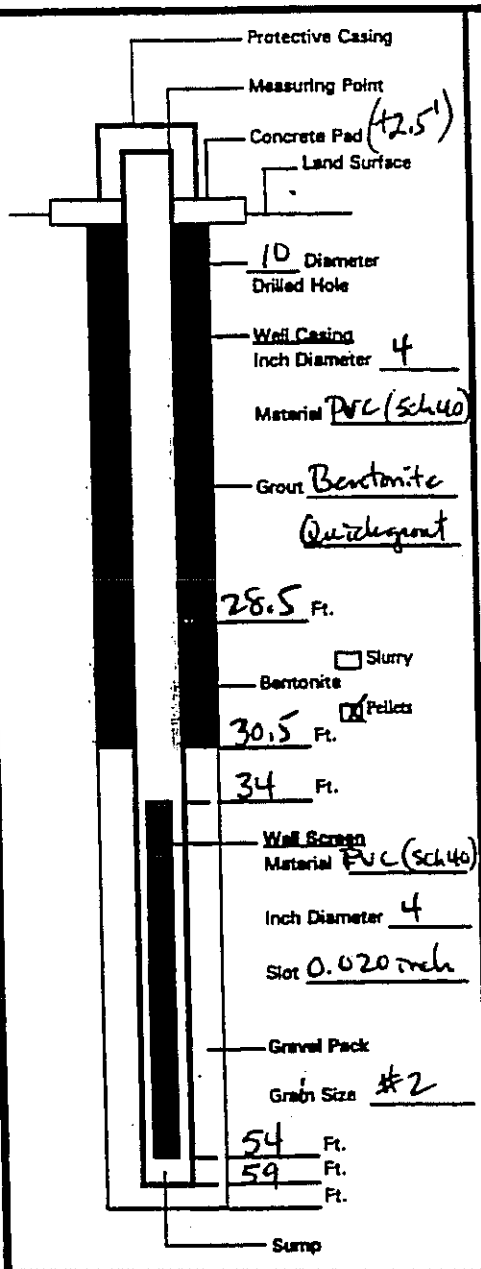
Well No. MPF-01	**BORE HOLE DATA**
Location: MAJ. PETROL. FAC.	Hole Diameter (inches): 6" HSA
M.P. Elevation (1):	Total Depth(2): 47
Project: 9409 Contract 11106	**SAMPLER**
Date: 1/4/2000	Type: 2" Split Spoon
Page 1 of 1	Hammer: 140#/30" pounds
Logged By: AD SILVER	Fall: inches
Company: AQUIFER DRILLING	**REMARKS**
Drilling Started: 1/4/2000 Ended: 1/4/2000	first 5 ft hand excavated
Driller: S. MILLER / J. Philbin	
Type of Rig: Mobile B-61	

OVM-PPM	SAMPLE No.	Rec.	Depth (ft.)	Blows/6"	Strata Change & Gen. Desc.	Depth (ft.)	SAMPLE DESCRIPTION
–	1.	90%	5/7	11/12/10/10	v. fine sand trace gravel	5	Yellowish brown (10YR 5/6) v. fine sand and silt trace gravel.
–	2.	85%	10/12	15/14/18/16		10	Light yellowish brown (10YR 6/4) fine sand trace gravel.
–	3.	85%	15/17	16/15/16/16	fine sand ~~trace gr.~~ ↓ unimodal	15	
–	4.	80%	20/22	18/13/12/15		20	"
–	5.	85%	25/27	19/15/14/14		25	"
–	6.	70%	30/32	22/20/20/20		30	"
–	7.	85%	35/37	17/21/24/23		35	"
–	8.	80%	40/42	20/23/23/20		40	"
–	9.	80%	45/47	18/18/20/16	same as above + med. sized sand [illegible]	45	color lightens about some medium grain sized sand increase

Remarks: (1) from measuring point located on top of well casing
(2) All depths in feet below land surface.

085-16

MONITORING WELL CONSTRUCTION LOG



Note:
All Depths in Feet Below or Above Land Surface

Well No. 85-16 (SEP-03)

NYSDEC Permit No. S-108906

Project Building 630

Surveyor J. DeSantis Survey Date

Land Surface Elevation

Measuring Point Elevation

BNL Northing

BNL Easting

Installation Date 7-8-96

Drilling Contractor LaFrambaise

Drilling Method HSA

Drilling Fluid

Fluid Loss During Drilling Gallons

Development Technique (s) and Date(s) Submersible pump 7-9-96

Water Removed During Development 840 Gallons

Static Depth to Water 42.7 Feet below M.P.

Pumping Depth to Water Feet below M.P.

Pumping Duration

Yield GPM Date

Specific Capacity GPM/Ft.

Well Purpose Monitoring Building 630 gasoline USTs

Hydrogeologist M. King

Company Name LaFrambaise

01-26-97

085-16

GEOLOGIC LOG

Well No. SEP-3 S108906
Location: BLDG 630
M.P. Elevation (ft):
Project: CONTRACT NO. 816499
Date: 7/8/96
Page 1 of 2
Logged By: M. K. KING
Company: LAFRAMBOISE WELL DRILLING
Drilling Started: 7/3/96 Ended: 7/8/93
Driller: J. MICHAUD
Type of Rig: FAILING F-10 HSA

BORE HOLE DATA
Hole Diameter (inches): 10 (6.25" HSA)
Total Depth (ft): 60

SAMPLER
Type: 2" x 24" SPLIT SPOON
Hammer: 140 pounds
Fall: 30 inches

REMARKS

OVM-PPM	SAMPLE No.	Rec.	Depth (ft.)	Blows/6"	Strata Change & Gen. Desc.	Depth (ft.)	SAMPLE DESCRIPTION
						1'	FINE SANDY LOAM
					AUGER	11'	FINE TO MEDIUM SAND SILTY WITH MEDIUM GRAVEL (10%) BROWN
BKD					AUGER		FINE TO MEDIUM SAND WITH 10% SMALL TO MEDIUM GRAVEL LIGHT BROWN CLEAN DAMP
BKD	1	23"	33'-35'	15/30/44/55			
BKD	2	20"	38'-40'	20/33/16/17			
						40'	

GEOLOGIC LOG

Well No. SEP-3 S108906

Location: BLDG 630

M.P. Elevation (ft):

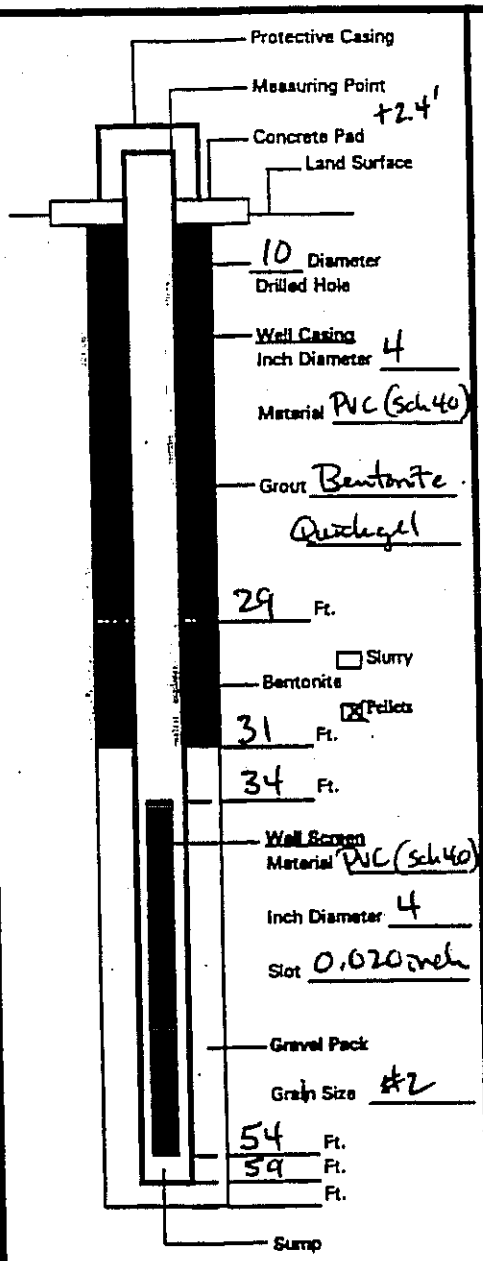
Page 2 of 2

REMARKS

OVM-PPM	SAMPLE No.	Rec.	Depth (ft.)	Blows/6"	Strata Change & Gen. Desc.	Depth (ft.)	SAMPLE DESCRIPTION
BKD	3	19"	43'~45	24/15/11/12			SUB ANGULAR TO WELL ROUNDED BROWN TO GRAY (QUARTZ) WET
BKD	4	14"	48'~50'	19/25/33/27			
BKD	5	21"	53'~55'	40/49/27/46			
BKD	6	18"	58'~60'	14/13/12/13			BOH

085-17

MONITORING WELL CONSTRUCTION LOG



Note:
All Depths in Feet Below or Above Land Surface

Well No. 85-17 (SEP-04)

NYSDEC Permit No. S-108905

Project Building 630

Surveyor J. DeSantis Survey Date

Land Surface Elevation

Measuring Point Elevation

BNL Northing

BNL Easting

Installation Date 7-2-96

Drilling Contractor LaFramboise

Drilling Method HSA

Drilling Fluid

Fluid Loss During Drilling Gallons

Development Technique (s) and Date(s) Submersible pump 7-9-96

Water Removed During Development 900 Gallons

Static Depth to Water 42.38 Feet below M.P.

Pumping Depth to Water Feet below M.P.

Pumping Duration

Yield GPM Date

Specific Capacity GPM/Ft.

Well Purpose Monitoring Building 630 gasoline USTs

Hydrogeologist M. King

Company Name LaFramboise

01-26-97

085-17

GEOLOGIC LOG

Well No. SEP-4 S108905
Location: BLDG 630
M.P. Elevation (ft):
Project: CONTRACT NO. 816499
Date: 7/2/96
Page 1 of 2
Logged By: M. K. KING
Company: LAFRAMBOISE WELL DRILLING
Drilling Started: 7/2/96 Ended: 7/2/96
Driller: J. MISHAWD
Type of Rig: FAILING F-10 HSA

BORE HOLE DATA
Hole Diameter (inches): 10 (6.25" HSA)
Total Depth (ft): 60

SAMPLER
Type: 2"X12" SPLIT SPOON
Hammer: 140 pounds
Fall: 30 inches

REMARKS

OVM-PPM	SAMPLE No.	Rec.	Depth (ft.)	Blows/6"	Strata Change & Gen. Desc.	Depth (ft.)	SAMPLE DESCRIPTION
					AUGER	12'	FINE TO MEDIUM SAND SILTY WITH MEDIUM TO COARSE GRAVEL (20%) BROWN
BKD							FINE TO MEDIUM SAND WITH 10% SMALL TO MEDIUM GRAVEL LIGHT BROWN
BKD	1	23"	28'~30'	8/13/40/71		28'	FINE TO MEDIUM SAND WITH OCCASIONAL GRAVEL < 10% GRAY (QUARTZ)
BKD	2	21"	33'~35'	14/19/26/30		33'	FINE TO MEDIUM SAND LIGHT BROWN MOIST
BKD	3	18"	38'~40'	17/28/32/39		38'	FINE TO MEDIUM SAND WITH OCCASIONAL SMALL GRAVEL BROWN MOIST

GEOLOGIC LOG

Well No. SEP-4 S108905

Location: BL04 L30

M.P. Elevation (ft):

Page 2 of 2

REMARKS

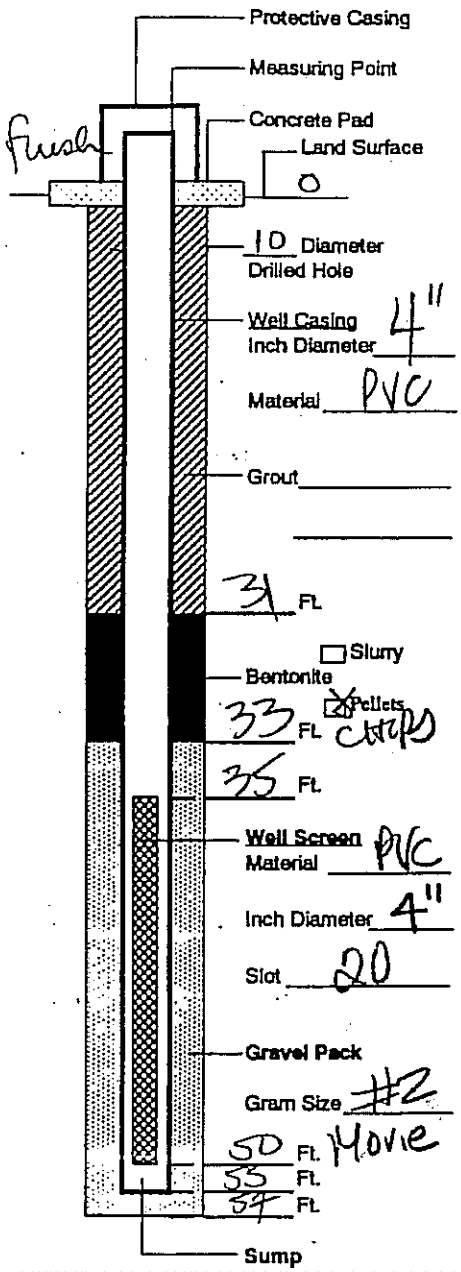
OVM-PPM	SAMPLE No.	Rec.	Depth (ft.)	Blows/6"	Strata Change & Gen. Desc.	Depth (ft.)	SAMPLE DESCRIPTION
BKD	4	23"	43'~45'	9/15/20/27		43'	
							MEDIUM TO COARSE SAND AND GRAVEL BROWN WET
BKD	5	18"	48'~50'	11/13/15/19			
BKD	6	24"	53'~55	15/16/16/20		53'	
							FINE TO MEDIUM SAND WITH MEDIUM TO COARSE GRAVEL 50% BROWN
BKD	7	21"	58'~60'	12/14/18/20		60'	
							BOH

Remarks: (1) from measuring point located on top of well casing

ATTACHMENT 3

MONITORING WELL CONSTRUCTION LOG

BNL 085-235



Note:
All Depths in Feet Below or Above Land Surface

Well No. SS-01 085-235

NYSDEC Permit No. S-115931 T

Project 9409 Contract 11106

Surveyor _____ Survey Date _____

Land Surface Elevation _____

Measuring Point Elevation _____

BNL Northing _____

BNL Easting _____

Installation Date 1/5/2000

Drilling Contractor AQUIFER DRILLING/TESTING

Drilling Method HSA 6"

Drilling Fluid N/A

Fluid Loss During Drilling _____ Gallons

Development Technique (s) and Date(s) _____

Water Removed During Development _____ Gallons

Static Depth to Water _____ Feet below M.P.

Pumping Depth to Water _____ Feet below M.P.

Pumping Duration _____

Yield _____ GPM _____ Date _____

Specific Capacity _____ GPM/Ft.

Well Purpose MONITOR GW

Hydrogeologist A. SILVER

Company Name AQUIFER DRILL

54.05

31/150 pellets

ATTACHMENT 4

GEOLOGIC LOG

085-235

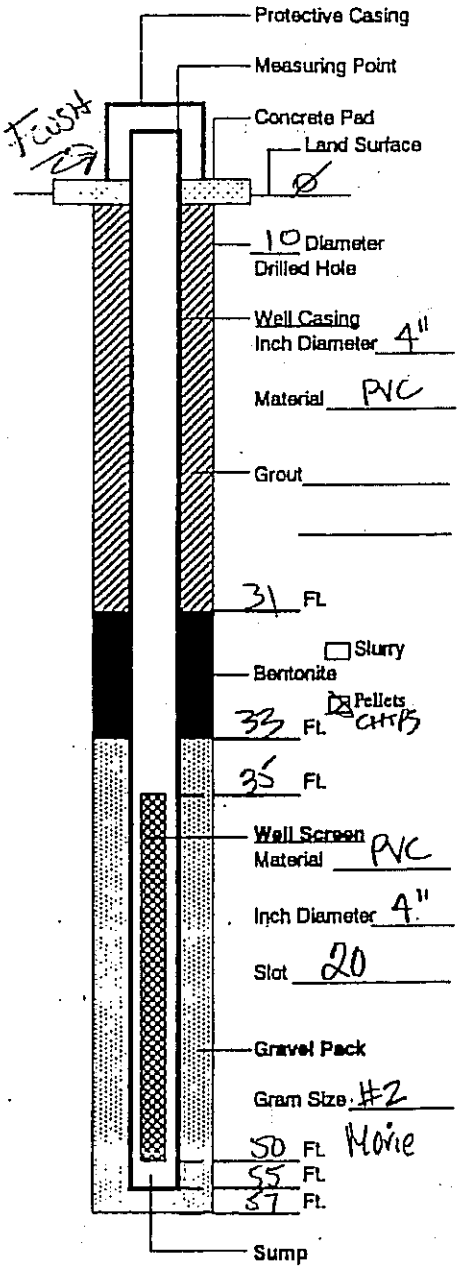
Well No. SS-01	BORE HOLE DATA
Location: Service Station	Hole Diameter (inches): 6" (10")
M.P. Elevation (1):	Total Depth(2): 55
Project: 9409 Contract #11106	SAMPLER
Date: 1/5/2000	Type: 2" Split Spoon
Page 1 of 1	Hammer: 140#/30" pounds
Logged By: AD SILVER	Fall: inches
Company: AQUIFER DRILLING	REMARKS first 5ft hand excavated - obstruction at 5ft. Moved hole EAST.
Drilling Started: 1/5/2000 Ended: -	
Driller: S MILLER / J. Philbin	
Type of Rig: Mobile B61	

OVM-PPM	SAMPLE No.	Rec.	Depth (ft.)	Blows/6"	Strata Change & Gen. Desc.	Depth (ft.)	SAMPLE DESCRIPTION
—	1.	80%	5/7	18/16/19/16		5	0-5ft cuttings Brownish Yellow 10YR6/6 fine sand trace gravel
						6	Very dark grey/dark brown (10YR 3/2) stained vf. to fine sand trace gravel.
—	2	85%	10/12	19/19/21/20		10	Strong dark brown (7.5YR5/8) fine to med. sand trace gravel.
—	3.	80%	15/17	18/23/22/23		15	Light yellowish brown (10YR 6/4) vf and fine sand trace gravel.
—	4.	85%	20/22	19/21/23/20			
—	5.	80%	25/27	16/17/19/20		20	"
—	6.	80%	30/32	18/18/15/16		25	"
—	7	85%	35/37	18/17/18/22		30	"
—	8	85%	40/42	20/19/25/26		35	"
—	9	85%	45/47	24/20/15/15		40	"
—	10	80%	50/52	19/23/17/20		45	"
—	11	80%	55/57	18/20/16/11		50	"
						55	

Remarks: (1) from measuring point located on top of well casing
(2) All depths in feet below land surface.

ATTACHMENT 3 BNL 085-236

MONITORING WELL CONSTRUCTION LOG



Note:
All Depths In Feet Below or Above Land Surface

Well No. SS-02 085-236

NYSDEC Permit No. S-115932 T

Project 9409 Contract 11106

Surveyor _____ Survey Date _____

Land Surface Elevation _____

Measuring Point Elevation _____

BNL Northing _____

BNL Easting _____

Installation Date 1/5/2000

Drilling Contractor AQUIFER DRILLING & TESTING

Drilling Method HOLLOW STEM AUGER 6"

Drilling Fluid N/A

Fluid Loss During Drilling _____ Gallons

Development Technique (s) and Date(s) _____

Water Removed During Development _____ Gallons

Static Depth to Water _____ Feet below M.P.

Pumping Depth to Water _____ Feet below M.P.

Pumping Duration _____

Yield _____ GPM _____ Date _____

Specific Capacity _____ GPM/FL

Well Purpose GW Monitoring

Hydrogeologist A D SILVER

Company Name AQUIFER DRILLING

res mounted flush casing after station vehicle drove over fresh pour!

54.9

ATTACHMENT 4

GEOLOGIC LOG

085-236

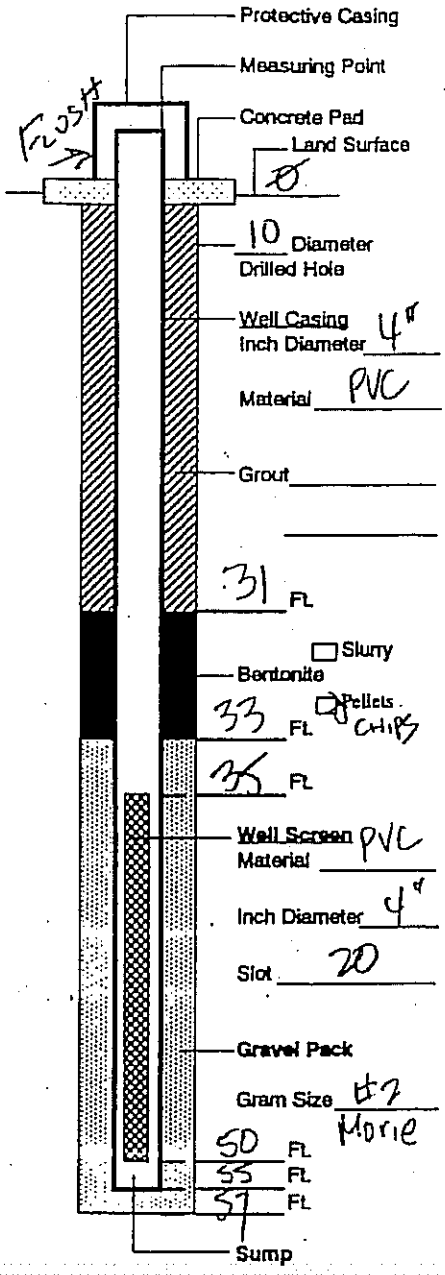
Well No. SS-02	**BORE HOLE DATA**
Location: Service Station	Hole Diameter (inches): 6" HSA (10")
M.P. Elevation (1):	Total Depth(2): 55
Project: 9409 Contract 11106	**SAMPLER**
Date: 1/5/2000	Type: 2" split spoon
Page 1 of 1	Hammer: 140# / 30" pounds
Logged By: A.D. SILVER	Fall: inches
Company: ARVIEER DRILLING	**REMARKS** 0-5 ft excavated by hand
Drilling Started: 1/5/00 Ended: 1/5/2000	
Driller: SILVER / J. Philbin	
Type of Rig: Mobile B-61	

OVM-PPM	SAMPLE No.	Rec.	Depth (ft.)	Blows/6"	Strata Change & Gen. Desc.	Depth (ft.)	SAMPLE DESCRIPTION
					0.5/1.0 P-stone		0.5/1.0 ft. P-stone backfill
Ø	1.	90%	5/7	16/13/15/14	1.0/4.0 fine sand		4.5/5.0 ft. STAINED Very dark brown (10YR 2/2) v.f. to fine sand, trace gravel.
						5	DARK yellowish brown (10YR 4/4) v.f. to fine sand trace gravel, trace silt.
—	2.	80%	10/12	18/18/16/16			
						10	Very pale brown (10YR 7/3) v.f. to fine sand trace gravel.
—	3.	85%	15/17	19/16/13/11			
—	4.	80%	20/22	22/15/17/18		15	s.a.a.
—	5.	80%	25/27	20/18/19/15		20	s.a.a.
—	6.	80%	30/32	18/16/19/18		25	"
—	7.	80%	35/37	22/24/16/16		30	"
—	8.	90%	40/42	20/18/19/18		35	"
—	9.	85%	45/47	18/17/17/23		40	"
—	10.	75%	50/52	20/23/24/22		45	"
—	11.	75%	55/57	19/19/21/18		50	"
						55	

Remarks: (1) from measuring point located on top of well casing
(2) All depths in feet below land surface.

ATTACHMENT 3 BNL 085-237

MONITORING WELL CONSTRUCTION LOG



Note:
All Depths in Feet Below or Above Land Surface

Well No. SS-03

NYSDEC Permit No. S-115933T

Project 9409 Contract 11106

Surveyor _____ Survey Date _____

Land Surface Elevation _____

Measuring Point Elevation _____

BNL Northing _____

BNL Easting _____

Installation Date 1/4/2006

Drilling Contractor AQUIFER DRILLING TESTING

Drilling Method HSA

Drilling Fluid N/A

Fluid Loss During Drilling _____ Gallons

Development Technique (s) and Date(s) _____

Water Removed During Development _____ Gallons

Static Depth to Water _____ Feet below M.P.

Pumping Depth to Water _____ Feet below M.P.

Pumping Duration _____

Yield _____ GPM _____ Date _____

Specific Capacity _____ GPM/Ft.

Well Purpose MONITORING

Hydrogeologist A.D. SILVER

Company Name AQUIFER DRILLING

SA.1

ATTACHMENT 4

GEOLOGIC LOG 085-237

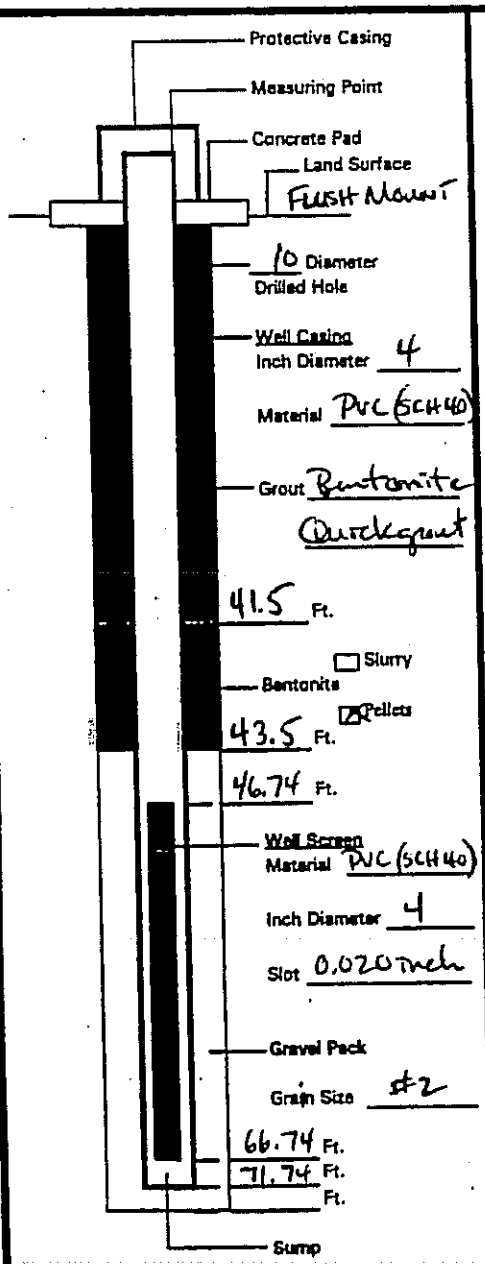
Well No. SS-03	**BORE HOLE DATA**
Location: Service Station	Hole Diameter (inches): 6" HSA (10")
M.P. Elevation (1):	Total Depth(2): 55
Project: 9409 Contract 11106	**SAMPLER**
Date: 1/4/00	Type: 2" Split Spoon
Page 1 of	Hammer: 140#/30" pounds
Logged By: AD Silver	Fall: inches
Company: Aquifer Drilling	**REMARKS** hand auger first 5 ft
Drilling Started: 1/4/2000 Ended:	
Driller: S. Miller / J. Philbin	
Type of Rig: Mobile B-61	

OVM-PPM	SAMPLE No.	Rec.	Depth (ft.)	Blows/6"	Strata Change & Gen. Desc.	Depth (ft.)	SAMPLE DESCRIPTION
Ø	1.	80%	5/7	25/23/18/16	No Units OVM-	5	0-4ft P-stone backfill 4-5ft yellowish Brown (10yR 5/6) fine sand some silt trace gravel. @5ft stained dark brown to black (10yR 2/2; 2/1)
—	2.	85%	10/12	18/16/19/20	(color change @ 10ft to 10yR5/6)	10	Yellowish brown fine sand trace silt and gravel (10yR 5/6) DAMP
—	3.	80%	15/17	17/17/18/17			
—	4.	80%	20/22	18/20/16/15		15	"
—	5.	85%	25/27	15/17/16/14		20	"
	6.	80%	30/32	18/18/15/15		25	"
—	7.	80%	35/37	17/19/16/17		30	Yellowish brown fine sand (10yR5/6) trace gravel. DAMP
—	8.	80%	40/42	19/24/23/22		35	color Δ to very pale brown (10yR 7/4) very fine to fine sand trace gravel - DAMP.
—	9.	80%	45/47	17/21/21/23		40	same "
—	10.	75%	50/52	18/25/20/24		45	"
—	11.	75%	55/57	20/23/23/22		50	"
						55	"

Remarks: (1) from measuring point located on top of well casing
(2) All depths in feet below land surface.

102-05

MONITORING WELL CONSTRUCTION LOG



Note:
All Depths in Feet Below or Above Land Surface

Well No. 102-05 (SEP-01)

NYSDEC Permit No. S-108907

Project BUILDING 423

Surveyor J. DeSantis Survey Date

Land Surface Elevation

Measuring Point Elevation

BNL Northing

BNL Easting

Installation Date 6-27-96

Drilling Contractor LaFramboise

Drilling Method HSA

Drilling Fluid

Fluid Loss During Drilling Gallons

Development Technique (s) and Date(s) Submersible Pump 7-9-96

Water Removed During Development 840 Gallons

Static Depth to Water 53.26 Feet below M.P.

Pumping Depth to Water Feet below M.P.

Pumping Duration

Yield GPM Date

Specific Capacity GPM/Ft.

Well Purpose Monitoring Building 423 gasoline USTs

Hydrogeologist M. King

Company Name LaFramboise

01-26-99

102-05

GEOLOGIC LOG

Well No. SEP-1 S108907	BORE HOLE DATA
Location: BLDG 423	Hole Diameter (inches): 10" (6.25 INCH HSA)
M.P. Elevation (1):	Total Depth (2): 75'
Project: CONTRACT NO. 816499	SAMPLER
Date: 6/27/96	Type: 2" x 24" SPLIT SPOON
Page 1 of 2	Hammer: 140 pounds
Logged By: M.K. KING	Fall: 30 inches
Company: LAFRAMBOISE WELL DRL	REMARKS
Drilling Started: 6/26/96 Ended: 6/27/96	
Driller: J. MICHAUD	
Type of Rig: FAILING F-10 HSA	

OVM-PPM	SAMPLE No.	Rec.	Depth (ft.)	Blows/6"	Strata Change & Gen. Desc.	Depth (ft.)	SAMPLE DESCRIPTION
			5"				ASPHALT
BKD					AUGER	8.0'	SILTY, FINE SAND WITH GRAVEL, BLACK (FILL)
BKD					AUGER	13.0'	ORGANIC SILT AND CLAY, BLACK
BKD					AUGER	16.0'	FINE SANDY SILT SOME CLAY, BROWN
BKD					AUGER		FINE TO MEDIUM SAND TRACE OF SILT AND OCCASIONAL SMALL GRAVEL, BROWN

GEOLOGIC LOG

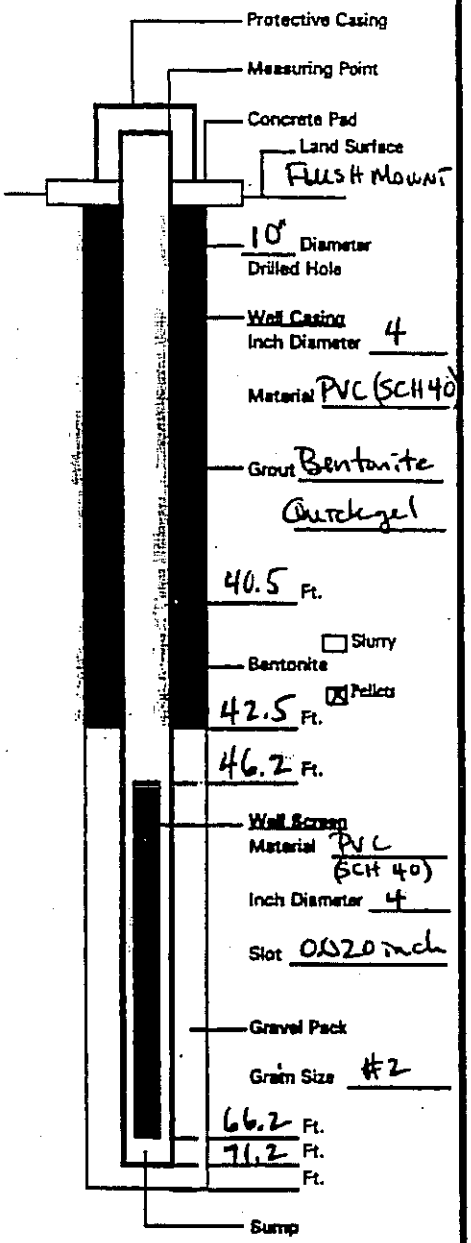
Well No. SEP-1 S108907
Location: BLDG 423
M.P. Elevation (ft):
Page 2 of 2

REMARKS

OVM-PPM	SAMPLE No.	Rec.	Depth (ft.)	Blows/6"	Strata Change & Gen. Desc.	Depth (ft.)	SAMPLE DESCRIPTION
BKD	1	0	28'-30'	4/7/10/9	AUGER		
						30.0'	NO RECV'D GRAVEL PLUG
BKD	2	14"	30'-32'	8/11/10/12	TRANSITION TO GRAY QUARTZ 40%		MEDIUM TO COARSE SAND LIGHT BROWN W/LENSES OF DARK BROWN FINE SAND.
	3	18"	33'-35	10/14/16/12			
BKD	4	22"	38'-40'	11/11/14/15	INTRUSIVE SMALL COBBLES		
BKD	5	15"	43-45	15/20/24/37	GRAVEL DECREASE 85% SAND 15% GRAVEL		
BKD	6	10"	48'-50'	18/22/27/34	GRAVEL INCREASE 60% SAND 40% GRAVEL		
BKD	7	23"	53'-55'	11/13/17/22			
					53.8 V/SWL	53.0'	FINE THROUGH COARSE SAND W/MEDIUM TO COARSE GRAVEL GRAY WET
BKD	8	20"	58'-60'	8/9/10/13			
BKD	9	11"	63'-65'	21/24/29/37			
						63.0'	COARSE SAND W/MEDIUM GRAVEL. SILTY. WET, GRAY
BKD	10		68'-70'	22/23/34/42			
						68.0'	MEDIUM TO COARSE SAND W/COARSE GRAVEL (10%) BROWNISH GRAY WET
						75.0'	BOH

102-06

MONITORING WELL CONSTRUCTION LOG



Note:
All Depths in Feet Below or Above Land Surface

Well No. 102-06 (SEP-02)

NYSDEC Permit No. S-108908

Project BUILDING 423

Surveyor J. De Santis Survey Date

Land Surface Elevation

Measuring Point Elevation

BNL Northing

BNL Easting

Installation Date 6-26-96

Drilling Contractor LaFramboise

Drilling Method HSA

Drilling Fluid

Fluid Loss During Drilling Gallons

Development Technique (s) and Date(s) Submersible pump 7-9-96

Water Removed During Development 900 Gallons

Static Depth to Water 53.38 Feet below M.P.

Pumping Depth to Water Feet below M.P.

Pumping Duration

Yield GPM Date

Specific Capacity GPM/Ft.

Well Purpose Monitoring Building 423 gasoline USTs

Hydrogeologist M. King

Company Name LaFramboise

D Lynthe 01-26-97

102-06

GEOLOGIC LOG

Well No. SEP-2 S108908
Location: BLDG 423
M.P. Elevation (ft):
Project: CONTRACT NO. 816499
Date: 6/27/96
Page 1 of 2
Logged By: M.K. KING
Company: LAFRAMBOISE WELL DRILLING
Drilling Started: 6/27/96 Ended: 6/27/96
Driller: J. MICHAUD
Type of Rig: FAILING F-10 HSA

BORE HOLE DATA
Hole Diameter (inches): 10" (6.25" HSA)
Total Depth (ft): 75'

SAMPLER
Type: 2" x 24" SPLIT SPOON
Hammer: 140 pounds
Fall: 30 inches

REMARKS

OVM-PPM	SAMPLE No.	Rec.	Depth (ft.)	Blows/6"	Strata Change & Gen. Desc.	Depth (ft.)	SAMPLE DESCRIPTION
						.3	ASPHALT
						2'	SANDY LOAM BLACK
					AUGER	12'	SILTY CLAY WITH FINE SAND BLACK
BKD					AUGER	38'	SILTY FINE SAND W/TRACE OF MICA BROWN
BKD	1	23"	38'-40'	9/11/12/10			MEDIUM TO COARSE SAND W/MEDIUM

GEOLOGIC LOG

Well No. SEP-2 S108908
Location: BLDG 423
M.P. Elevation (1):
Page 2 of 2

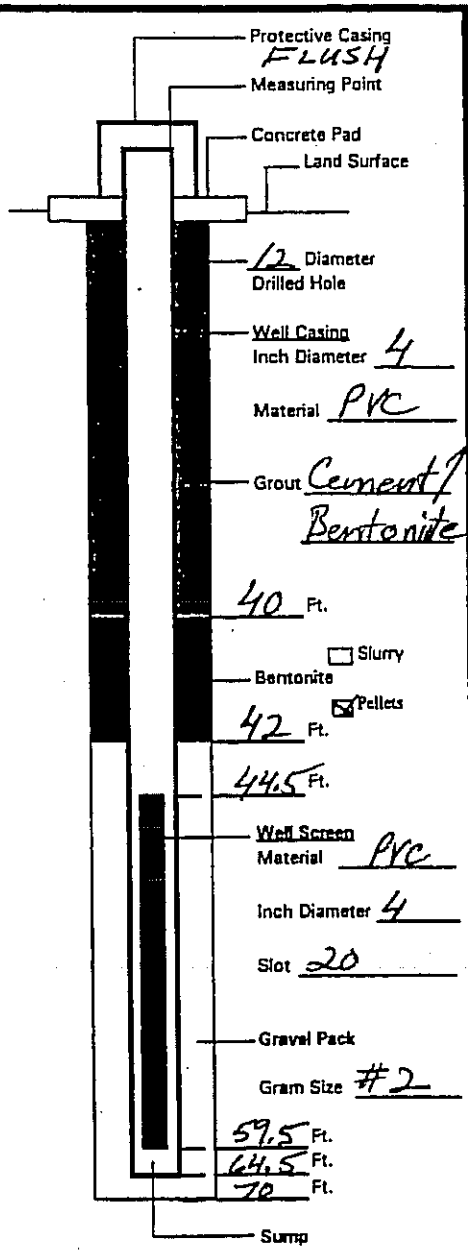
REMARKS

OVM-PPM	SAMPLE No.	Rec.	Depth (ft.)	Blows/6"	Strata Change & Gen. Desc.	Depth (ft.)	SAMPLE DESCRIPTION
BKD	2	19"	43'~45'	13/17/17/21			BROWN, DAMP
BKD	3	16"	48'~50'	15/17/20/23		48'	
BKD	4	19"	53'~55	14/18/24/27		53'	FINE TO MEDIUM SAND, LIGHT BROWN W/LENSES OF DARK BROWN FINE SAND
BKD	5	11"	58'~60'	17/17/15/12	53.1' V/SWL	58'	FINE TO MEDIUM SAND WITH OCCASIONAL GRAVEL (5%) BROWN WET
BKD	6	20"	63'~65'	6/7/15/23		63'	MEDIUM TO COARSE SAND SOME GRAVEL (10%) LIGHT BROWN WET
BKD	7	22"	68'~70'	29/33/32/25		68'	MEDIUM TO COARSE SAND W/SMALL GRAVEL LIGHT BROWN CLEAN WET
	8	2"	73'~75'	21/28/33/36		73'	MEDIUM TO COARSE SAND W/LARGE GRAVEL LIGHT BROWN TO GRAY WET
							COARSE SAND AND GRAVEL GRAY WET

Remarks: (1) from

MONITORING WELL CONSTRUCTION LOG

BNL 102-10



Note:
All Depths in Feet
Below or Above
Land Surface

Well No. MW-MTP-03

NYSDEC Permit No. S 113303

Project BNL-9167 On-Site

Surveyor _____ Survey Date _____

Land Surface Elevation _____

Measuring Point Elevation _____

BNL Northing _____

BNL Easting _____

Installation Date 01-06-99

Drilling Contractor Delta

Drilling Method HSA

Drilling Fluid None - Water used to hold heave below water table

Fluid Loss During Drilling ~150 Gallons

Development Technique (s) and Date(s) ——

Water Removed During Development _____ Gallons

Static Depth to Water ~50 ft b/s Feet below M.P.

Pumping Depth to Water _____ Feet below M.P.

Pumping Duration _____

Yield _____ GPM _____ Date _____

Specific Capacity _____ GPM/Ft.

Well Purpose Monitor GW quality downgradient of Motor Pool Area

Hydrogeologist Vince Glasser

Company Name Delta

DELTA WELL & PUMP CO, INC

97 UNION AVENUE, PO BOX 1309, RONKONKOMA, NY 11779

BNL 102-10

Pg 1 of 2

CORING LOG

Job Name: BNL- OnSite

Job Location: Brookhaven

Reference Point:

Date Started: 01-05-99 Completed: 01-06-99

Job No: BNL-9167

Well No: MW-MTP-03

DEC No: S-113303

SWL:

Driller: Brian Devine

SAMPLE core or flume	#	actual depth	length	BLOWS Post Hole / Hand Auger				FORMATION
		0-4.5						Fill: Sand, f-m, some gravel, f-m,
			PID=	trace (<2 ppm)				some silt & organic matter (roots), piece
								of wire, trace clay, 10YR-3-3/2 Sl. moist.
	1	5-7	1.0	4	3	2	2	Fill: Coal slag - crumbly & dry some
								organic matter, light 10YR-2-2/1 Dry
	2	10-12	1.8	5	6	10	12	Top 0.8 ft: Fill: Sand, vf-f, some silt
								& organic matter, some stones (1") 10YR-3-3/2
								sl. moist.
								Bottom 1.0 ft: Sand, vf-m, trace gravel f,
								some dk minerals - variably colored
								10YR-6-6/6 → 6/8 → 7/3, Dry fine laminae
	3	15-17	1.2	8	9	9	9	Sand, f-m, trace gravel f., w/ fine, darker
								horizontal banding, some dk minerals
								10YR-7-7/2 Dry
	4	20-22	1.7	8	14	14	14	Sand, vf-f, trace to some silt w/ 4
								stringers of "sugar" sand 10YR-5-5/3, Dry
	5	25-27	1.4	5	5	7	10	Sand ("Sugar") mostly m., trace to some
			PID=	120 ppm				gravel, f., trace to some dk minerals
								10YR-7-7/3, solvent odor, Wet @ ~20 ft
	6	30-32	1.3	8	8	17	12	Sand, m-c, some gravel, f-m, stones
			PID =	0 ppm				(1/4-3/4") rounded wh. qtz. 10YR-8-8/2 Dry
	7	35-37	1.1	15	21	11	14	Sand, mostly m, trace to some gravel,
			PID =	0 ppm				f-m, trace stones (1/4-1/2") trace dk
								minerals 10YR-8-8/2 Dry
	8	40-42		15	22	31	36	Sand, m-c, trace to some gravel f-m,
			PID =	150 ppm				trace stones (1/4") & dk minerals 10YR-7-7/4 Dry
	9	45-47		5	7	21	14	Same, slightly less gravel 10YR-7-7/2 to 7/3 Dry

* Use DHH for sample 5 on

DELTA WELL & PUMP CO, INC

97 UNION AVENUE, PO BOX 1309, RONKONKOMA, NY 11779

BNL - 102-10

Pg. 2 of 2

CORING LOG

Name BNL-On-Site GW Monitoring RHIC, AGS, BLIP, MRR & MTP Areas

Job No BNL-9167

Location Brookhaven

Well No MW-MTP-03

DEC No S-113303

Ance Point

SWL

Started 01/05/99 Completed 01/06/99

Driller Brian Devine

Helper Pat Fay

SAMPLE #	actual depth	length	BLOWS				FORMATION
10	50-52	1.3	12	15	9	20	~~Sa~~ Upper 0.7 ft: Sand, m, 10YR-7-7/4, trace dk minerals
		MR=>30ppm					Middle 0.2 ft: Silty Sand vf-m, some organic matter
							roots, old wood (charcoal-like), 10YR-3-3/3,
							Bottom 0.4 ft Sand, m-c, trace to some gravel, fine
							to med, some sm. stones (1/4-3/4"d), 10YR-7-7/4
							WET @ ~50 ft bls (also some dk minerals)
11	55-57	0.7	9	8	10	10	Same as bottom portion above w/ more stone
							(up to 1 1/2"d), stone in spoon tip, ~~#~~ 10YR-7-7/4 WET
12	60-62	0.3	5	5	6	7	Wash? Same as above
13	65-67	0.5	5	4	7	4	Same as above
							Drill to 70 ft bls
							END BORING

Prepared for:

Brookhaven National Laboratories
70 Bell Avenue, Building 134C
Upton, NY 11973

Out-of-Service Inspection of Tank No. 3 located at the Brookhaven National Laboratory Upton, New York Facility on November 5, 2003

Prepared by:

PCA Engineering, Inc.
430 Montclair Avenue
P.O. Box 196
Pompton Lakes, NJ 07442

PCA Job No. 23089

February 18, 2004

PHASE I REPORT

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API-653 Section 2.3

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I. INTRODUCTION AND BACKGROUND

On November 5, 2003, PCA Engineering, Inc. personnel performed an Internal Out-of-Service Inspection of Tank No. 3 located at the Brookhaven National Laboratory, Upton, New York Terminal.

The Brookhaven National Laboratory, Upton, New York Facility Registration Number for New York State is 01-1700. The inspection of Tank No. 3 conforms to Section 6NYCRR, Part 613.6 "Handling and Storage of Petroleum", New York State Department of Conservation.

The inspection performed is in compliance with the API 653 Standard.

An Industrial Scientific Model ATX-612 was used for vapor monitoring prior to and during entry. Prior to entry, the oxygen content was found to be 20.9% and the lower flammability level (LFL) 0%. These are considered non-hazardous and the interior inspection proceeded. All product lines were checked and found to be blinded or locked out.

PCA personnel on site were all currently trained in Hazardous Entry and Confined Space Entry.

SITE DESCRIPTION

Tank No. 3 is a welded, above ground, upright, cylindrical storage tank measuring 40 feet in diameter by 32 feet in height. The tank was erected in 1964 and has a product capacity of 7,143 barrels. The primary product stored on site is fuel oil of various grades.

The tank floor is fabricated of 16 lap welded carbon steel plates, provided with a poly-urea coating. The tank shell is arranged in 6 butt-welded courses, with 4 plates per course. The tank fixed roof, as well as the shell, is insulated with an aluminum jacketed insulation.

The tank is located within an earthen dike secondary containment area. The dike area has a bentonite mixed soil lining system, as indicated on BNL supplied drawings.

TEST PROCEDURES

The following is a list of the tests performed and their procedures involved in the inspection of Tank No. 3:

A) Ultrasonic Thickness Measurements

To obtain the residual metal thickness readings, either a Cygnus Model 3 or Cygnus Model 4 Ultrasonic Digital Thickness Gauge, with a 2.25 MHz transducer

TEST PROCEDURES (Cont'd)

was used. The Cygnus Model 3 has a resolution of +/- 0.002 inch; the Cygnus Model 4 has a resolution of +/- 0.005 inch, accuracy allowing for use on steel plate/piping materials used in storage tanks. The calibration of the instrument is confirmed prior to and during testing using a steel step block. The couplant used was Sonotech UT-X and/or motor oil.

A minimum of five (5) ultrasonic thickness readings were taken at each floor plate, with five (5) additional readings taken adjacent to the floor/shell joint on approximately 2 foot intervals. A W. R. Thorpe Pit Gauge was available to measure any pit depths, with readings taken at the point of deepest penetration. All ultrasonic thickness readings and pitted areas are noted on the enclosed data tables. The arrangement of the floor plates is shown on the enclosed PCA drawings.

A minimum of five (5) ultrasonic thickness readings were taken at each plate of the lower course of shell plates and each plate adjacent to the internal vertical ladder ascending to the roof, with readings tabulated on the enclosed data tables. The arrangement of the shell appurtenances is shown on the enclosed PCA drawings.

TEST PROCEDURES (Cont'd)

As an appurtenance survey, ultrasonic thickness measurements were taken on principle pipe penetrations and their API plates within the lower course of shell plates.

Ultrasonic thickness readings of the insulated roof were taken at a limited area within reach of the internal ladder.

B) Holiday Inspection (High Voltage Spark Test)

The epoxy coating of the tank floor was tested for overall integrity using a Tinker & Rasor Model AP/W Holiday Detector. The holiday tester operates on the principle of applying a fixed amount of high voltage electrical potential to the coated floor through a conductive silicon rubber brush.

With the instrument grounded to any area of bare steel electrically continuous with the floor, any holiday or defect in the epoxy would allow passage of current to the steel floor plates, thus completing the circuit. This would energize an audible signal indicating to the operator the location of any defect in the coating.

C) Interior Perimeter Elevation Survey

The interior survey is based on an assumed datum of 10 feet, as shown on the "Interior Elevation Survey", with measurements shown clockwise or counter-clockwise around the tank. Cross sections are taken at various intervals around the tank, as shown on the drawing.

The interior elevation survey is helpful in evaluating the condition of the floor plates. Low spots are areas of drastic grade changes, as indicated on the drawing, are potential areas of excessive stresses in the floor plates, and indications of possible loss of sub-structure support. Elevation cross sections are helpful to analyze this data.

D) Magnetic Flux Leakage Floor Scan

The tank floor was inspected using a Magnetic Flux Leakage Floor Scan (MFL and/or MFE).

The Magnetic Flux Leakage floor scanner operates using permanent rare-earth magnets to bring a section of the steel floor plate to magnetic saturation. A defect, located on front or back surfaces, causes a

scattering of the magnetic "lines of force" or flux. Sensors located between the magnets detect this flux leakage and display the result on a display screen.

MFL/MFE inspection is a qualitative inspection tool, which primarily detects plate cross-sectional volume loss (as opposed to remaining thickness) and correlates this as an amplitude display.

An observed significant indication is evaluated by the technicians using ultrasonic equipment for quantitative classification.

The Magnetic Flux Leakage Scan covers the majority of the tank floor plate, with the exception of the areas within 4 to 6 inches of the lap welds, corner welds, lap patches, columns, etc. Any additional areas not scanned are marked on the tank floor drawing.

II. SUMMARY OF FINDINGS

Upon completion of the inspections conducted on Tank No. 3, the following results were obtained:

Ultrasonic Thickness Inspection

The residual plate metal thickness measurements ranged as follows:

Floor:	.240″ to .255″	
Shell:	.230″ to .245″	(1st Course)
	.245″ to .245″	(2nd Course)
	.155″ to .180″	(3rd Course)
	.170″ to .175″	(4th Course)
Roof:	.180″ to .190″	

Holiday Inspection

The high voltage holiday test of the poly-urea film coating disclosed no indications of openings in the coating during the test. The final coating thickness ranged from 55 to 70 mils.

II. SUMMARY OF FINDINGS (Cont'd)

Interior Perimeter Elevation Survey

The perimeter elevations (shell settlement) indicate a maximum differential of 0.05 feet (0.60 inches). The settlement is considered planar tilt, with the maximum out-of-plane deflection of 0.022 feet (0.26 inch). The maximum permissible out-of-plane deflection per API 653, B.3.2 is 0.035 feet (0.42 inch).

There are no visible indications of tank shell or floor stress, or recent/active displacement of fill material from around or under the tank. This information, in conjunction with the tank's age (40 years +/-), would indicate the tank has reached its maximum settlement with no changes in deflections anticipated, based on current operational procedures and site conditions.

The internal cross section elevation results disclosed edge settlement with a typical radius of 3 feet. The maximum edge settlement observed was 1.08 inches, which is within 75% of the allowable settlement as noted in API 653, Figure B-10 and Figure B-11. Settlement between 75 and 100 percent of allowable requires further inspection, while settlement in excess of the allowable requires repair or engineering evaluation.

II. SUMMARY OF FINDINGS (Cont'd)

The pitch of the cone down floor was approximately 0.4 inches in 10 feet.

Edge settlement (or roll-off) typically occurs when the tank shell settles sharply around the periphery, resulting in deformation of the bottom plate near the shell-to-bottom corner junction.

Magnetic Flux Leakage Floor Scan

The magnetic flux leakage floor scan disclosed no significant indications beyond the 40% threshold setting of the scanner.

III. DISCUSSION

Deficiencies were limited to exterior paint loss on various shell attachments.

IV. TEST DATA

CORROSION SURVEY FIELD DATA TABLE

OWNER: Brookhaven National Labs
STRUCTURE: Tank No. 3
DATE OBTAINED: November 5, 2003
SURVEYED BY: K. Northern

PCA JOB NO. 23089

Ultrasonic Thickness Measurements
Tank Floor - In Inches

	1	2	3	4	5
Plate No. 1	0.245	0.250	0.250	0.245	0.250
	0.255	0.250	0.255	0.250	0.250
Plate No. 2	0.250	0.245	0.250	0.245	0.245
	0.250	0.255	0.245	0.250	0.245
Plate No. 3	0.245	0.250	0.245	0.250	0.240
	0.250	0.250	0.245	0.250	0.250
Plate No. 4	0.250	0.245	0.250	0.245	0.245
Plate No. 5	0.250	0.245	0.255	0.250	0.250
	0.245	0.250	0.245	0.250	0.240
Plate No. 6	0.245	0.250	0.250	0.245	0.245
	0.250	0.245	0.250	0.245	0.245
Plate No. 7	0.240	0.245	0.245	0.250	0.240
Plate No. 8	0.250	0.255	0.250	0.250	0.245
	0.250	0.245	0.255	0.250	0.250

minimum	0.240
average	0.248
maximum	0.255
std. dev.	0.003477

CORROSION SURVEY FIELD DATA TABLE

PCA JOB NO. 23089

OWNER: Brookhaven National Labs
STRUCTURE: Tank No. 3
DATE OBTAINED: November 5, 2003
SURVEYED BY: K. Northern

Ultrasonic Thickness Measurements
Tank Floor - In Inches

	1	2	3	4	5
Plate No. 9	0.250 0.245	0.245 0.250	0.245 0.245	0.250 0.250	0.250 0.250
Plate No. 10	0.250	0.245	0.250	0.245	0.250
Plate No. 11	0.245 0.250	0.250 0.245	0.245 0.245	0.250 0.245	0.245 0.250
Plate No. 12	0.250	0.245	0.250	0.245	0.250
Plate No. 13	0.250 0.245	0.255	0.250	0.245	0.250
Plate No. 14	0.245 0.250	0.250 0.240	0.245 0.240	0.250 0.245	0.245 0.240
Plate No. 15	0.250 0.245	0.245 0.250	0.250 0.245	0.245 0.250	0.250 0.245
Plate No. 16	0.245 0.245	0.250 0.250	0.250 0.250	0.255 0.255	0.250 0.250

CORROSION SURVEY FIELD DATA TABLE

OWNER: Brookhaven National Laboratory
STRUCTURE: Tank No. 3
DATE OBTAINED: November 5, 2003
SURVEYED BY: K. Northern

PCA JOB NO. 23089

Ultrasonic Thickness Measurements
Tank Shell - In Inches

	1	2	3	4	5
Plate No. 1	0.240	0.245	0.245	0.245	0.245
Plate No. 2	0.245	0.245	0.245	0.245	0.240
Plate No. 3	0.235	0.235	0.235	0.235	0.235
Plate No. 4	0.235	0.235	0.235	0.230	0.235
Plate No. 5	0.235	0.235	0.235	0.240	0.240
Plate No.6	0.235	0.235	0.235	0.235	0.235
Shell Wall Profile					
Course No. 1	0.240	0.245	0.245	0.245	0.245
Course No. 2	0.245	0.245	0.245	0.245	0.245
Course No. 3	0.155	0.155	0.175	0.175	0.180
Course No. 4	0.170	0.170	0.175	0.175	0.175

minimum	0.230
average	0.239
maximum	0.245
std. dev.	0.028566

CORROSION SURVEY FIELD DATA TABLE

OWNER: Brookhaven National Laboratory
STRUCTURE: Tank No. 3
DATE OBTAINED: November 5, 203
SURVEYED BY: K. Northern

PCA JOB NO. 23089

Appurtenance Survey
In Inches

	Top	Side	Bottom	Side
24" Manway	0.370	0.370	0.360	0.360
6" FIU/Return	0.430	0.428	0.420	0.428
3" Water Draw Off	0.230	0.225	0.225	0.220
6" Low Suction	0.420	0.445	0.465	0.420
4" High Suction	0.225	0.215	0.225	0.215
Blank	0.430	0.425	0.425	0.425
2" Steam	0.195	0.2	0.2	0.195
2" Steam	0.200	0.205	0.210	0.215

CORROSION SURVEY FIELD DATA TABLE

OWNER: Brookhaven National Labs
STRUCTURE: Tank No. 3
DATE OBTAINED: November 5, 2003
SURVEYED BY: K. Northern

PCA JOB NO. 23089

Ultrasonic Thickness Measurements
Tank Roof - In Inches

1	2	3	4	5
0.185	0.180	0.185	0.190	0.185

minimum	0.180
average	0.185
maximum	0.190
std. dev.	0.003536

Note: Ultrasonic Thickness Measurments of the roof were taken from the top of the internal ladder. There was no external access.

CORROSION SURVEY FIELD DATA TABLE

OWNER: Brookhaven National Laboratory
STRUCTURE: Tank No. 3
DATE OBTAINED: November 5, 2003
SURVEYED BY: K. Northern

Elevation Survey

PCA JOB NO. 23089

	Shell	1'	2'	3'	4'	5'	10'	Center
A	10.00	9.96	9.96	9.99	9.99	10.00	10.11	10.06
B	10.01	9.99	9.96	9.99	9.99	9.99	9.99	
C	10.02	9.99	9.97	9.97	9.99	9.99	10.06	
D	10.00	10.01	9.98	9.98	9.95	9.94	10.07	
E	9.99	9.99	9.97	9.95	9.97	10.01	10.13	
F	9.99	9.95	9.89	9.89	9.90	9.89	9.91	
G	9.99	9.93	9.90	9.89	9.92	9.92	9.98	
H	10.00	9.98	9.98	9.96	9.98	9.98	10.06	

API 653 INSPECTION - DATA EVALUATION

GENERAL INFORMATION

Customer: Brookhaven National Laboratory Job No.: 23089 Date: 11/5/2003

Tank No.: 3
Diameter: 40 feet
Height: 32 feet
Safe Fill: 285,925 gal.
Capacity: 300,810 gal.
Product: Fuel Oil

Cathodic Protection?: y
Leak Detection?: n
Thick FilmCoating?: y
Thin Film Coating?: n

Erected: 1/1/1964
Date Last- Inspected:
Cleaned:
Painted:
Lined:
Strapped:

	Quantities:
Floor plts:	16
Roof plts:	N/A
Shell crs:	4
Plts/Crs:	6

	PlateThickness (in)					
	Original	General	Delta	Minimum	Material	Riveted?
Floor Plates:			0.000			
Sketch Plates:			0.000			
Annular Plates:			0.000			
Shell - 1st course:	0.245	0.237	0.008	0.230	Unknown	
2nd course:	0.245	0.245	0.000	0.245	Unknown	
3rd course:	0.180	0.167	0.013	0.155	Unknown	
4th course:	0.175	0.172	0.003	0.170	Unknown	
5th course:			0.000			
6th course:			0.000			
7th course:			0.000			
8th course:			0.000			
Roof:			0.000			

1st Crse Avg Shell Thickness (in)	
1st	0.235
2nd	0.235
Min Thick	0.230
4th	0.235
5th	0.235

	Pitting Depth (in)			
	Max Int.	Avg Int.	Max Ext.	Avg Ext.
Floor Plates:	0.006	0.004	0.010	0.008
Shell - 1st course:	0.020	0.010	N/A	N/A
Roof:	0.008	0.006	N/A	N/A

Containment Area:

Steel?
Diameter feet
Height feet

Containme bbl
110% Cap

Earthen? y
Length 80 feet
Width 80 feet
Height 5 feet
Containment 5,760 bbl
110% Cap 330,891 Insufficent Containment if tank is filled to capcity

Calculated Safe Fill (based on capacity of containment) = 23.15 feet
Readjust Facility Safe Fill to Calculated Safe Fill

COMMENTS:

PCA ENGINEERING, INC.

BOTTOM PLATE TOPOGRAPHY

Tank:	3	No of Sections:	8	Elevation @ Center of Tank:	10.06 ft	Allowable Roll-Off	
Diameter:	40	Max Chord Length:	15.70 ft	Average Pitch:	-0.04 in/ft	in 1'	0.33 in
				Overall Differential Settlement	0.36 in	in 2'	0.70 in
						in 3'	1.07 in

	AXIS 1		AXIS 2		AXIS 3		AXIS 4		AXIS 5		AXIS 6	
Spacing	Field Data	Roll-Off	Field Data	Roll-Off	Field Data	Roll-Off	Field Data	Roll-Off	Field Data	Roll-Off	Field Data	Roll-Off
Shell	10.00		10.01		10.02		10.00		9.99		9.99	
1'	9.96	0.48	9.99	0.24	9.99	0.36	10.01	0.12	9.99	0.00	9.95	0.48
2'	9.96	0.48	9.96	0.60	9.97	0.60	9.98	0.24	9.97	0.24	9.89	1.20
3'	9.99	0.12	9.97	0.48	9.97	0.60	9.98	0.24	9.95	0.48	9.89	1.20
5'	10.00		9.99		9.99		9.94		10.01		9.89	
10'	10.11		10.09		10.06		10.07		10.13		9.91	
20'												
30'												
40'												
50'												
60'												
70'												
80'												
90'												
Settlement	0		-0.01		-0.02		0.00		0.01		0.01	

	AXIS 7		AXIS 8		AXIS 9		AXIS 10		AXIS 11		AXIS 12	
Spacing	Field Data	Roll-Off	Field Data	Roll-Off	Field Data	Roll-Off	Field Data	Roll-Off	Field Data	Roll-Off	Field Data	Roll-Off
Shell	9.99		10.00									
1'	9.93	0.72	9.98	0.24		0.00		0.00		0.00		0.00
2'	9.90	1.08	9.98	0.24		0.00		0.00		0.00		0.00
3'	9.89	1.20	9.96	0.48		0.00		0.00		0.00		0.00
5'	9.92		9.98									
10'	9.98		10.06									
20'												
30'												
40'												
50'												
60'												
70'												
80'												
90'												
Settlement	0.01		0.00									

PCA ENGINEERING,INC.

TANK SHELL EVALUATION API 653 SECTION 2.3

Tank: 3

Date: 11/5/2003

Diameter: 40 feet
Height: 32 feet
t_1(avg.): 0.234 inches
t_2: 0.230 inches

Field data: 0.235
0.235
0.230
0.235
0.235
t_1= 0.234

Thickness Determination:

$L=3.7(D*t_2)^{1/2}$

Where: L= the maximum vertical length, in inches, over which hoop streees are assumed to "average out" around local discontinuities
D= tank diameter, in feet
t_2= the least thickness, in inches, in area of corrosion, exclusive of pits

L= 11.22266 inches

Minimum Thickness Calculation for Welded Tank Shell:

Course No. 1

t_{min}= **2.6DHG/SE** = **0.138 inches**

Where:
t_{min}= the minimum acceptable thickness, in inches, as calculated from the above formula; however, t_{min} shall not be less than 0.1 inch for tank course
D= nominal diameter of tank, in feet
H= Height, in feet, from the bottom of length *L* for the most severely corroded area in each shell course to the maximum design liquid level
G= highest specific gravity of the contents (including water, if hydtsted)
S= maximum allowable stress in psi; use the smaller of 0.80Y or 0.426T for bottom and second course; use the smaller of 0.88Y or 0.472T for all other courses
Y= specified minimum yield strength of the plate; 30,000 psi if unknown
T= the smaller of the specified minimum tensile strength of the plate or 80,000 psi; use 55,000 psi if unknown
E= original joint efficiency for the tank. use E=0.7 if unknown, E=1.0 when evaluating the retirement thickness in a corroded plate, when away from welds or joints by at least the greater of 1 inch or twice the plate thickness
NOTE: For riveted tanks see section 653.2.3.4; see section 653.2.3.3 for complete explanation

D =	40 feet	G =	1.0	Y =	30,000 psi
H =	32 feet	S =	23,430 psi	T =	55,000 psi
				E =	1.0

Then, per API653 section 2.3.3.1:

If:	a:	t_1	>=	t_{min}
		0.234	>=	**0.138**
and				
	b:	t_2	>=	60% t_{min}
		0.230	>=	**0.083**

THEREFORE, NO ACTION IS REQUIRED

Maximum Safe Fill Height = 52.82 feet **Adjusted Safe Fill Height**

$(t_2SE/2.6DG)+1$

PCA ENGINEERING, INC.

Courses

Tank: 3

Date: 11/5/2003

Diameter:	40	Yield:	23,430
Height:	32	Joint Efficiency:	1.0
Number of Courses:	4	Specific Gravity:	1.00

MINIMUM THICKNESS per each SHELL COURSE

	Height (TOC)	Minimum Thickness	
Course 1	8	0.138	OK
Course 2	16	0.102	OK
Course 3	24	0.067	OK
Course 4	32	0.031	OK
Course 5			
Course 6			
Course 7			
Course 8			

TANK BOTTOM EVALUATION - API 653 SECTION 2.4

Tank: 3 Date: 11/5/2003

Minimum Thickness for Tank Bottom Plate (API 4.4.7):

$$MRT = (\text{minimum of } RT_{bc} \text{ or } RT_{ip}) - O_r(StP_r + UP_r)$$

Where:

MRT = minimum remaining thickness at the end of interval O_r
This value must meet the requirments of Table 6-1
and sections 4.4.7.4 and 4.4.8

O_r = in-service interval (years to next inspection) not to exceed that allowed by 4.2.2 (normally 10 years)

RT_{bc} = minimum remaining thickness from bottom side corrosion, after repairs

RT_{ip} = minimum remaining thickness from internal corrosion after repairs

StP_r = maximum internal pitting rate, in inches per year; StP_r = 0 if tank bottom is internally lined.

UP_r = maximum underside pitting rate, in inches per year; UP_r = 0 if tank bottom is cathodically protected.

T_a	=	0.000 inch	RT_{bc}	=	-0.010	UP_r	=	0.000 in/yr
UP_m	=	0.010 inch	RT_{ip}	=	-0.006	StP_r	=	0.000 in/yr
StP_m	=	0.006 inch	O_r	=	10.0 years			

Solve for: MRT = -0.010 inch

Or = #DIV/0! years where MRT = 0.050
NOTE: see API 653 table 6-1

Then if:

MRT > 0.050

THEREFORE, REPAIRS ARE REQUIRED

TANK SETTLMENT EVALUATION - API 653 APPENDIX B

Tank: 3

Date: 11/5/2003

Diameter: 40 feet
Sections: 8

Arc (L): 15.71 feet
Yield(Y): 30000 psi
(E): 29000000 psi
Height(H): 32 feet

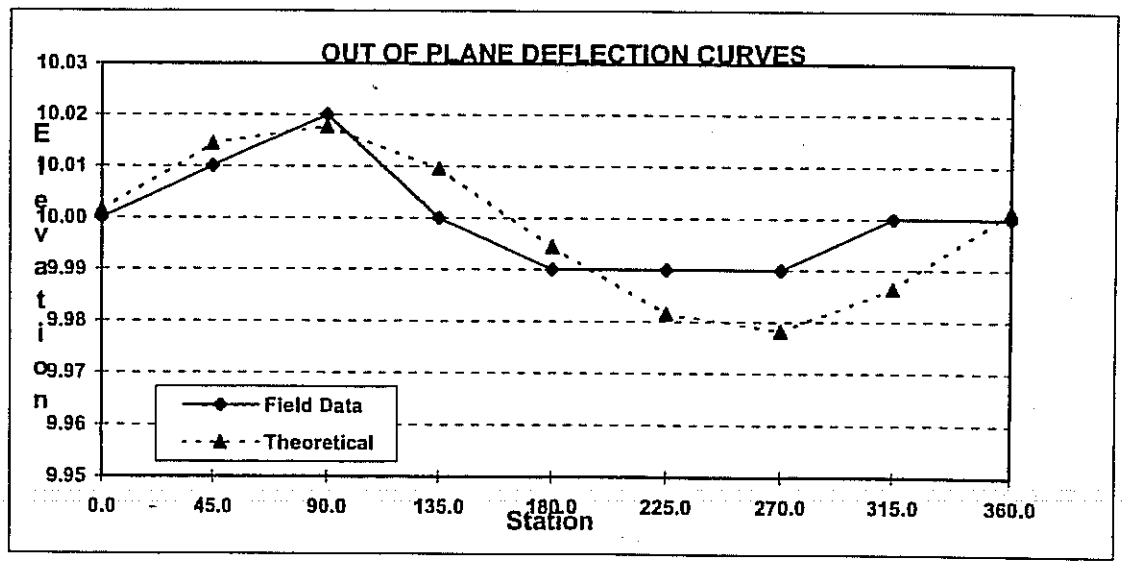
Maximum Permissible Out-of-Plane Deflection:

$S<=(L^2*Y*11)/(2(E*H)$

Where:
S= deflection, in feet (out-of-plane distortion)
L= arc length, between measurement pts, in feet
Y= yield strength, in psi
E= Young's modulus, in psi
H= tank height, in feet

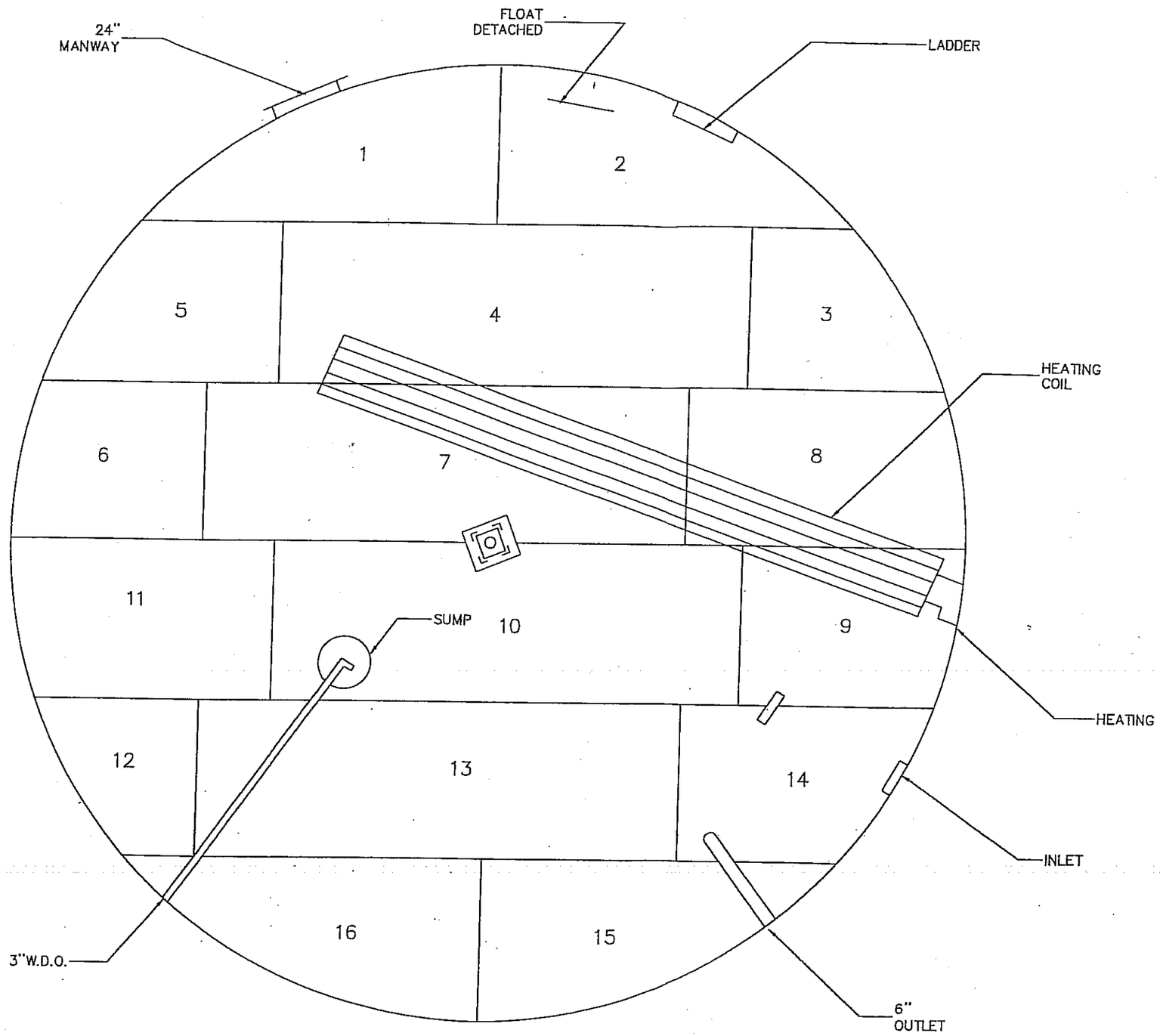
S<= 0.043871 feet

Degrees	Station	Field Data	Theoretical	Delta(U_i)	Deflection(S_i)
0.0	0.0	10.00	10.001	-0.001	-0.0060
45.0	15.7	10.01	10.014	-0.004	-0.0048
90.0	31.4	10.02	10.018	0.002	0.0092
135.0	47.1	10.00	10.009	-0.009	-0.0084
180.0	62.8	9.99	9.995	-0.005	-0.0040
225.0	78.5	9.99	9.982	0.008	0.0048
270.0	94.2	9.99	9.978	0.012	0.0008
315.0	110.0	10.00	9.987	0.013	0.0084
360.0	125.7	10.00	10.001	-0.001	-0.0060



THEN, SINCE THE MAXIMUM Si <= S NO ACTION IS REQUIRED

PCA ENGINEERING, INC.



FLOOR PLAN

GENERAL NOTES:

TANK No. 3

LEGEND

PCA ENGINEERING, INC.
430 Montclair Ave. Pompton Lakes, NJ.
TEL. (973) 616-4501

BROOKHAVEN NATIONAL LABS
BLDG 452
P.O. BOX 5000
UPTON, NY 11973-5000

PROJECT LOCATION:

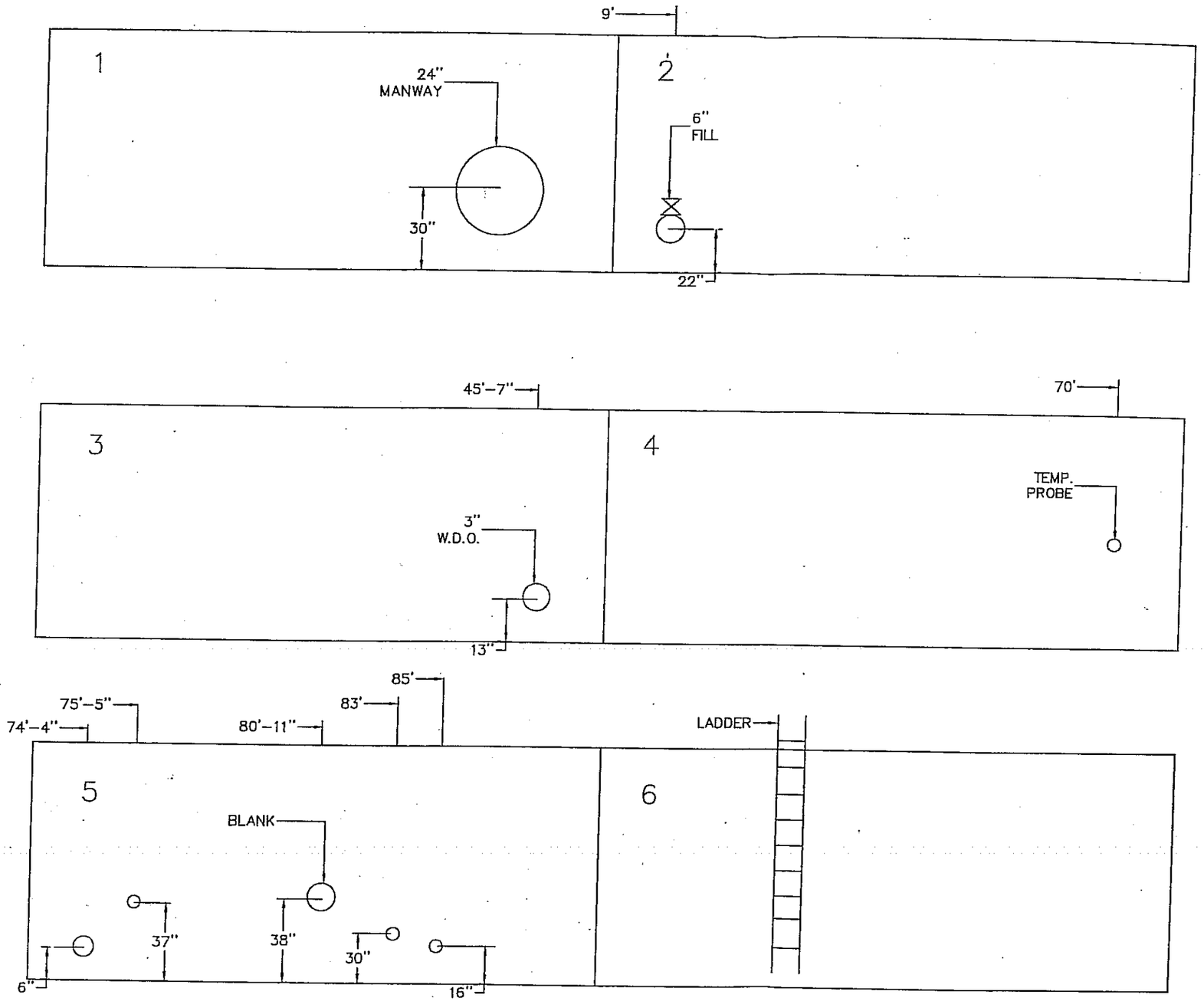
BROOKHAVEN NATIONAL LABS

UPTON, NY

DRAWING TITLE:

OUT-OF-SERVICE INSPECTION OF TANK No.3

CHECKED BY:		DRAWN BY:	A.U.Z.
SCALE:	N.T.S.	DATE:	1-27-04
DRAWING No.:	BW-23089-10	REV.	0



1st COURES SHELL PLATE CONFIGURATION

GENERAL NOTES:

TANK No. 3

LEGEND

PCA ENGINEERING, INC.
430 Montclair Ave. Pompton Lakes, NJ.
TEL. (973) 616-4501

BROOKHAVEN NATIONAL LABS
BLDG 452
P.O. BOX 5000
UPTON, NY 11973-5000

PROJECT LOCATION:

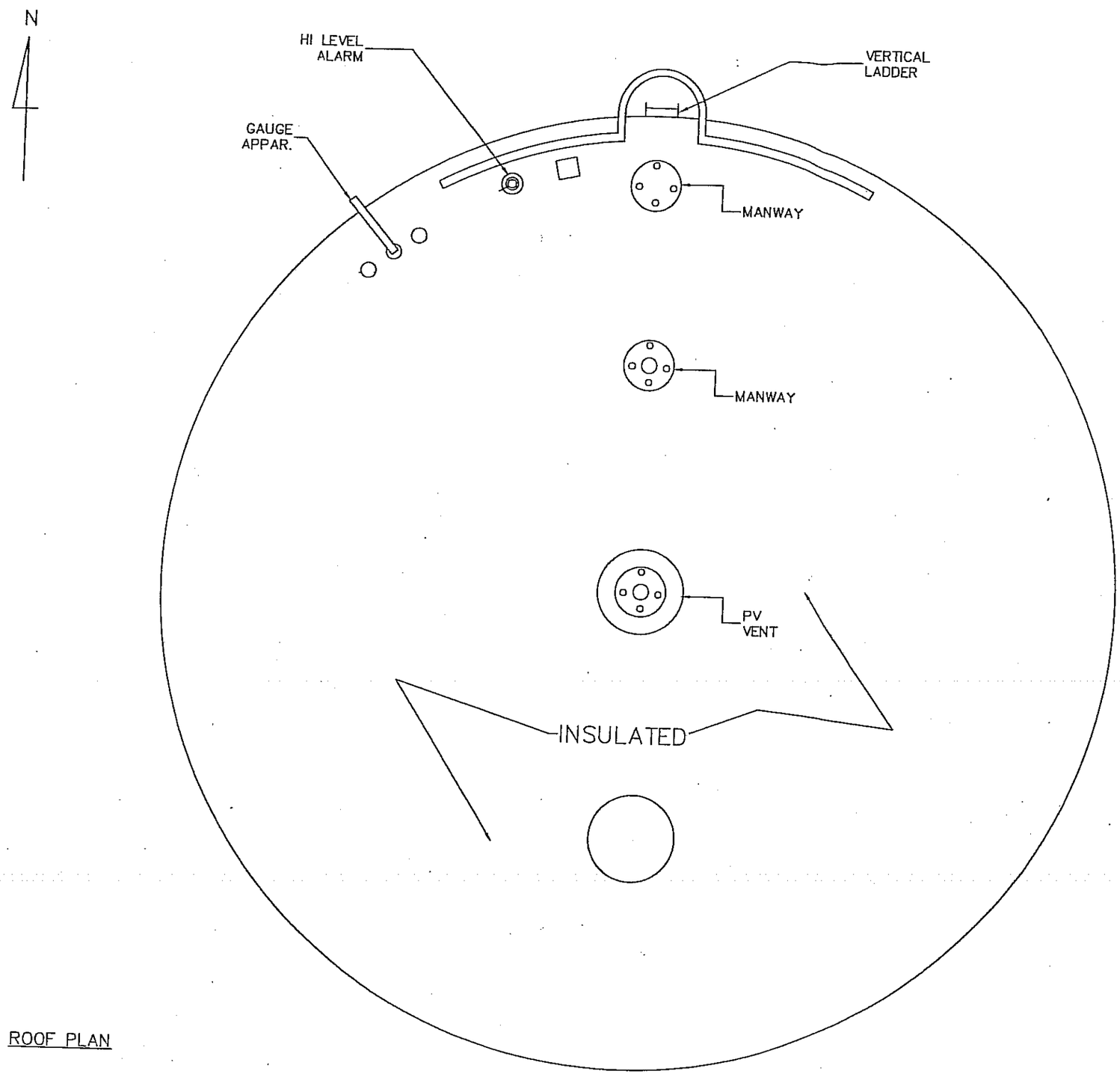
BROOKHAVEN NATIONAL LABS

UPTON, NY

DRAWING TITLE:

OUT-OF-SERVICE INSPECTION
OF TANK No.3

CHECKED BY:	R	DRAWN BY:	A.U.Z.
SCALE:	N.T.S.	DATE:	1-27-04
DRAWING No.:	BW-23089-11	REV.	0



ROOF PLAN

GENERAL NOTES:

TANK No. 3

LEGEND

PCA ENGINEERING, INC.
430 Montclair Ave. Pompton Lakes, NJ.
TEL. (973) 616-4501

BROOKHAVEN NATIONAL LABS
BLDG 452
P.O. BOX 5000
UPTON, NY 11973-5000

PROJECT LOCATION:

BROOKHAVEN NATIONAL LABS

UPTON, NY

DRAWING TITLE:

OUT-OF-SERVICE INSPECTION
OF TANK No.3

CHECKED BY:	wlc	DRAWN BY:	A.U.Z.
SCALE:	N.T.S.	DATE:	1-27-04
DRAWING No.:	BW-23089-12	REV.	0

V. API 653 CHECKLIST

API 653

TANK OUT-OF-SERVICE INSPECTION CHECKLIST

OVERVIEW

OK	Check that tank has been cleaned, is gas free, and safe for entry
OK	Check that the tank is completely isolated from product lines, all electrical power, and steam lines
OK	Check that roof is adequately supported, including fixed roof structure and floating roof legs
OK	Check for presence of falling object hazards, such as corroded-through roof rafters, asphalt stalactites, and trapped hydrocarbons in unopened or plugged equipment or appurtenances, ledges, etc.
OK	Inspect for slipping hazards on the bottom and roof decks
OK	Inspect structural welds on accessways and clips
OK	Check surfaces needing inspection for a heavy-scale buildup and check weld seams and oily surfaces where welding is to be done. Note areas needing more cleaning, including blasting

Remarks: _____

TANK EXTERIOR

NA	Inspect appurtenances opened during cleaning such as lower floating swing sheave assemblies, nozzle interiors (after removal of valves)
OK	Hammer test or ultrasonically test the roof
NA	Enter and inspect the floating roof pontoon compartments

Remarks: _____

BOTTOM INTERIOR SURFACE

OK	Using a flashlight held close to and parallel to the bottom plates, and using the bottom plate layout as a guide, visually inspect and hammer test the entire bottom
*NA	Measure the depth of pitting and describe the pitting appearance (sharp edged, lake type, dense, scattered, etc.)
NA	Mark areas requiring patching or further inspection
NA	Mark locations for turning coupons for inspection
OK	Inspect all welds for corrosion and leaks, particularly the shell-to-bottom weld
OK	Inspect sketch plates for corrosion
NA	Locate and mark voids under the bottom
OK	Record bottom data on a layout sketch using the existing bottom plates as a grid. List the number and sizes of patches required
NA	Vacuum test the bottom lap welds

NA	Hammer test or ultrasonically examine any slightly discolored spots or damp areas
OK	Check for reinforcing pads under all bottom attached clips, brackets and supports
NA	Inspect floating roof leg pads for pitting or cutting, and excessive dimpling (indicating excessive loading)
OK	Check the column bases of fixed roof supports for adequate pads and restraining clips
NA	In earthquake zones 3 and 4, check that roof supports are not welded down to the tank, but are only restrained from horizontal movement
NA	Check area beneath swing line cable for indications of cable cutting or dragging
NA	Mark old oil and air test connection for removal and patching
NA	Identify and report low areas on the bottom that do not drain adequately
OK	Inspect coating for holes, disbonding, deterioration, and discoloration

Remarks: * The floor is coated with a polyurea coating.

SHELL SEAMS AND PLATES

NA	On cone up bottoms, closely inspect and gauge the depth of metal loss on the lower 2 to 4 inches of the shell (area of standing water)
OK	Measure the depth of pitting on each course
NA	Inspect and estimate the amount of metal loss on the heads of rivets and bolts
NA	Inspect shell-to-bottom riveted lap joints
NA	Inspect for vertical grooving damage from seal assembly protrusions
OK	Inspect existing protective coatings for damage, deterioration, and disbonding
NA	Check for areas of rubbing (indicating too much pressure by the seal assembly shoes or inadequate annular space)
OK	Visually inspect the shell plates and seams for indications of leakage
NA	If the shell has riveted or bolted seams, record the leak locations by film or chart in case the locations are lost during surface preparation for painting
NA	Measure annular space at 40-foot intervals
OK	Survey the shell to check for roundness and plumb

Remarks:

SHELL-MOUNTED OVERFLOWS

NA	Inspect overflow for corrosion and adequate screening
NA	Check location of overflow that it is not above any tank valves or equipment

Remarks: _____

ROOF INTERIOR SURFACE

General

OK	Visually inspect the underside surface of the roof plates for holes, scale buildup, and pitting
NA	Hammer test or ultrasonically examine to check for thin areas, particularly in the vapor space of floating roofs and at edge of roof on cone roof tank
OK	Check all clips, brackets, braces, etc., welded to the roof deck plate for welded reinforcing pads and see that they have not broken free
OK	If no pad is present, penetrant test for cracking of the weld or deck plate
OK	Inspect the protective coating for breaks, disbondment, and deterioration

Remarks: _____

Fixed Roof Support Structure

OK	Inspect the support columns for thinning in the upper two feet
NA	On API columns (two channels welded together) check for corrosion scale breaking the tack welds, unless the joint between the channels is completely seal welded
OK	Check that the reinforcing pad on the bottom is seal welded to the tank bottom with horizontal movement restraining clips welded to the pad
OK	Determine if pipe column supports are concrete filled or open pipe. If open pipe, check for a drain opening in the bottom of the pipe
OK	Inspect and gauge rafters for thinning, particularly near the center of the roof. Report metal loss
OK	Check for loose or twisted rafters
OK	Inspect girders for thinning and check that they are attached securely to the top of the columns
OK	Report if the columns have cross bracing in the area between the low pump out and top of the shell (for future internal floating roof installation)
OK	Inspect and report presence of any roof-mounted swing line bumpers
OK	Photograph the roof structure if no rafter layout drawing exists

Remarks:

FIXED ROOF APPURTENANCES

Inspection and Light Hatches

OK	Inspect the hatches for corrosion, paint and coating failures, holes, and cover sealing
NA	On loose covers, check for a safety chain in good condition
OK	On light hatches over 30 inches across, check for safety rods
OK	Inspect the condition of the gaskets on bolted or latched down hatch covers

Remarks:

Staging Support Connection

OK	Inspect the condition of the staging support for corrosion

Remarks:

Breathers and Vents

NA	Inspect and service the breather
NA	Inspect screens on vents and breathers

Remarks:

Emergency P/V Hatches

NA	Inspect and service pressure/vacuum hatches (setting should be high enough to prevent chattering of breather during normal operation. See breather manufacturer's guide
NA	Inspect liquid seal hatches for corrosion and proper liquid level in the seal

Remarks:

Sample Hatch

OK	Inspect sample hatch for corrosion
OK	Check that the cover operates properly
OK	If the tank has no gaugewell, check for a hold off distance marker and check measurement

Remarks: _____

FLOATING ROOF

Roof Deck

NA Hammer test the area between roof rim and shell. (If access for hammer testing is inadequate, measure the distance from the bottom edge of the roof to the corroded area and then hammer test from inside the pontoon)

NA In sour water service, clean and test all deck plate weld seams for cracking unless the lower laps have been seal welded

NA Check that either the roof drain is open or the drain plug in the roof is open in case of unexpected rain

NA On flat bottomed and cone down bottom roof decks, check for a vapor dam around the periphery of the roof. The dam should be continuous without break to prevent escape of vapors to the seal area from under the center of the roof

Remarks: _____

Floating Roof Pontoons

NA Visually inspect each pontoon for liquid leakage

NA Run a light wire through the gooseneck vents on locked down inspection hatch covers to make sure they are open

NA Inspect lockdown latches on each cover

NA Check and report if each pontoon is:

- _____ Vapor tight (bulkhead seal welded on one side on bottom, sides and top
- _____ Liquid tight (seal welded on bottom and sides only) or
- _____ Unacceptable (minimum acceptable condition is liquid tight)

Remarks: _____

Floating Roof Cutouts

NA Inspect underside of cutouts for mechanical damage

NA Inspect welds for cracks

NA Inspect plate for thinning, pitting, and erosion

NA Measure mixer cutouts and record plate thickness for future mixer installation or replacement
Plate thickness: _____

Remarks: _____

Floating Roof Supports

NA	Inspect fixed low and removable high floating roof legs for thinning
NA	Inspect for notching at bottom of legs for drainage
NA	Inspect for leg buckling or bellying at bottom
NA	Inspect pin hole in roof guide for tears
NA	Check plumb of all legs
NA	Inspect for adequate reinforcing gussets on all legs through a single portion of the roof
NA	Inspect the area around the roof legs for cracking if there is no internal reinforcing pad or if the topside pad is not welded to the deck plate on the underside
NA	Inspect the sealing system on the two-position legs and the vapor plugs in the fixed low leg for deterioration of the gaskets
NA	On the shell mounted roof supports, check for adequate clearance based on the maximum floating roof movement as determined by the position of the roof relative to the gaugewell and/or counter rotational device

Remarks:

FLOATING ROOF SEAL ASSEMBLIES

Primary Shoe Assembly

NA	Remove four sections of foam log (foam filled seals) for inspection, on 90° locations
NA	Inspect hanger attachment to roof rim for thinning, bending, broken welds, and wear of pin holes
NA	Inspect clips welded to roof rim for thinning
NA	Shoes: Inspect for thinning and holes in shoes
NA	Inspect for bimetal bolts, clips, and attachments
NA	Seal fabric: Inspect for deterioration, stiffening, holes, and tears in fabric
NA	Measure length of fabric from top of shore to roof rim, and check against maximum anticipated annular space as roof operated
NA	Inspect any modification of shoes over shell nozzles, mixers, etc., for clearance
NA	Inspect shoes for damage caused by striking shell nozzles, mixers, etc.

Remarks:

Primary Toroidal Assembly

NA	Inspect seal fabric for wear, deterioration, holes, and tears
NA	Inspect hold down system for buckling or bending
NA	Inspect foam for liquid absorption and deterioration

Remarks:

Rim Mounted Secondaries

NA Inspect the rim-mounted bolting bar for corrosion and broken welds
Measure and chart seal-to-shell gaps
Visually inspect seal from below, looking for holes as evident by light
NA Inspect fabric for deterioration and stiffness
NA Inspect for mechanical damage, corrosion, and wear on tip in contact with shell
NA Inspect for contact with obstructions above top of shell

Remarks:

FLOATING ROOF APPURTENANCES

Roof Manways

NA Inspect walls of manways for pitting and thinning
NA On tanks with interface autogauges, check seal around gauge tape cable and guide wires through manway cover
NA Inspect cover gasket and bolts

Remarks:

Rim Vent

NA Check rim vent for pitting and holes
NA Check vent for condition of screen
NA On floating roof tanks where the environmental rules require closing off the vent, check the vent piping for corrosion at the pipe-to-rim joint and check that the blinding is adequate

Remarks:

Vacuum Breaker, Breather Type

NA Service and check operation of breather valve
NA Check that nozzle pipe projects no more than 1/2 inch below roof deck
NA Inspect reinforcing pad and pad weld

Remarks:

Vacuum Breaker, Mechanical Type

NA Inspect the stem for thinning. Measure how far the vacuum breaker cover is raised off the pipe when the roof is resting on high or low legs
On high legs: _____
On low legs: _____

Remarks: _____

Roof Drains: Open Systems, Including Emergency Drains

NA Check liquid level inside open roof drains for adequate freeboard. Report if there is insufficient distance between liquid level and top of drain

NA If tank comes under Air Quality Monitoring District rules, inspect the roof drain vapor plug

NA If emergency drain is not at the center of the roof, check that there are at least three emergency drains

Remarks: _____

Closed Drain Systems: Drain Basins

NA Inspect for thinning and pitting

NA Inspect protective coating (topside)

NA Inspect basin cover or screen for corrosion

NA Test operation of check valve

NA Check for presence of check valve where bottom of basin is below product level

NA Inspect drain basin(s) to roof deck welds for cracking

NA Check drain basin(s) outlet pipe for adequate reinforcement to roof deck (including reinforcing pad)

Remarks: _____

Closed Drain Systems: Fixed Drain Line on Tank Bottom

NA Hammer test fixed drain line on tank bottom for thinning and scale/debris plugging

NA Inspect supports and reinforcing pads for weld failures and corrosion

NA Check that pipe is guided, not rigidly locked to supports, to avoid tearing of tank bottom plate

Remarks: _____

Closed Drain Systems: Flexible Pipe Drain

NA	Inspect for damage to exterior of pipe
NA	Check for obstructions that pipe could catch on
NA	Inspect shields to protect pipe from snagging
NA	Inspect results of hydrotest on flexible roof drain system

Remarks: _____

Closed Drain Systems: Articulated Joint Drain

NA	Hammer test rigid pipe in flexible joint system for thinning and scale debris plugging
NA	Inspect system for signs of bending or strain
NA	Inspect results of system hydrotest
NA	Inspect landing leg and pad

Remarks: _____

Autogauge System and Alarms

NA	Check freedom of movement of tape through autogauge tape guide
NA	Inspect sheaves for freedom of movement
NA	Test operation checker
NA	Inspect tape and tape cable for twisting and fraying
OK	Test the tape's freedom of movement through guide sheaves and tape guide pipe
NA	On open-top tanks, check that gate tapes with cables have no more than one foot of tape exposed with float at lowest point
OK	Check float for leakage
OK	Test float guide wire anchors for spring action by pulling on wire and releasing
NA	Inspect floatwells in floating roofs for thinning and pitting of walls just above the liquid level
*(1)OK	Check that the autogauge tape is firmly attached to the float
NA	Inspect the tape cable and float guide wire fabric seals through the floatwell cover
OK	Inspect the bottom guide wire attachment clip; inspect for a temporary weighted bar instead of a permanent welded down clip
OK	Inspect board-type autogauges indicators for legibility and freedom of movement of indicator
NA	Measure and record these distances to determine if seal damage will occur if tank is run over:
_____	From shell top angle to underside of tape guide system
_____	From liquid level on floating top to top of secondary seal
NA	Identify floating roofs where the tape is connected directly to the roof
OK	Overfill alarm: Inspect tank overfill prevention alarm switches for proper operation

Remarks: *(1) Float is detached form autogauge

COMMON TANK APPURTENANCES

Gauge Well

NA	Inspect gauge well pipe for thinning at about two-thirds distance above the bottom: look for thinning at the edge of the slots
NA	Check for corrosion on the pipe joint. Check that sample cords, weights, thermometers, etc., have been removed from pipe
NA	Check for cone at bottom end of pipe about one foot above the bottom
NA	Check condition of well washer pipe and that its flared end is directed at the near side of the hold-off pad
NA	Check that the supports for the gaugewell are welded to pad or to shell and not directly to bottom plate
NA	Check operation of gaugewell cover
NA	Check presence of a hold-off distance marker in well pipe and record hold-off distance
	Hold-Off Distance
NA	Identify and report size and pipe schedule, and whether pipe is solid or slotted. Report slot size
NA	Check that the hold-off distance plate is seal welded to the bottom and that any gaugewell supports are welded to the plate and not directly to the bottom
NA	Inspect vapor control float and cable
NA	Check for presence and condition of gaugewell washer
NA	Check for bull plug or plate blind on gaugewell washer valve
NA	Inspect gaugewell guide in floating roof for pitting and thinning
NA	Inspect the guide rollers and sliding plates for freedom of movement
NA	Inspect condition of gaugewell pipe seal system
NA	On black oil and diesel services: if gaugewell is also used for sampling, check for presence of a thief- and gauge-type hatch to avoid spillage
NA	Visually inspect inside of pipe for pipe weld protrusions which could catch or damage vapor control float

Remarks:

Sampling Systems: Roof Sample Hatches

NA	Inspect roof mounted sample hatches for reinforcing pads and cracking
NA	Inspect cover for operation
NA	For tanks complying with Air Quality Monitoring District rules, inspect sample hatch covers for adequate sealing
NA	Check horizontal alignment of internal floating roof sample hatches under fixed roof hatches
NA	Inspect the sealing system on the internal floating roof sample hatch cover
NA	Inspect floating roof sample hatch cover recoil reel and rope

Remarks:

Shell Nozzles

OK	Inspect shell nozzles for thinning and pitting
NA	Inspect hot tap nozzles for trimming of holes
OK	Identify type of shell nozzles
OK	Identify and describe internal piping, including elbow up and elbow down types

Remarks:

For Nozzles Extended into the Tank

OK	Inspect pipe support pads welded to tank bottom
OK	Inspect to see that pipe is free to move along support without strain or tearing action on bottom plate
OK	Inspect nozzle valves for packing leaks and damaged flange faces
OK	Inspect heater steam nozzle flanges and valves for wire cutting
NA	Report which nozzles have thermal pressure relief bosses and valves
NA	In internal elbow-down fill line nozzles, inspect the wear plate on the tank bottom
NA	On elbow-up fill lines in floating roof tanks, check that opening is directed against underside of roof, not against vapor space. Inspect impact area for erosion

Remarks:

Diffusers and Air Rolling Systems

NA	Inspect diffuser pipe for erosion and thinning
NA	Check holes in diffuser for excessive wear and enlargement
NA	Inspect diffuser supports for damage and corrosion
NA	Check that diffuser supports restrain, not anchor, longitudinal line movement
NA	Inspect air spiders on bottom of lube oil tanks for plugging and damaged or broken threaded joints

Remarks:

Swing Lines

NA	Inspect flexible joint for cracks and leaks
NA	Scribe the flexible joint across the two moving faces and rise end of swingline to check the joint's freedom of movement, indicated by separation of scribe marks

NA Check that flexible joints over six inches are supported
NA Inspect the swing pipe for deep pitting and weld corrosion
NA Loosen the vent plugs in the pontoons and listen for a vacuum. Lack of a vacuum indicates a leaking pontoon
NA Check the results of air test on pontoons during repairs
NA Inspect the pontoons for pitting
NA Inspect the pull-down cable connections to the swing
NA Inspect the condition of the bottom-mounted support, fixed roof limiting bumper, or shell mounted limiting bumper of wood condition, weld and bolt corrosion, and seal welding to bottom or shell
NA Inspect safety hold-down chain for corrosion and weak links
NA Check that there is a welded reinforcing pad where the chain connects to the bottom
NA If the floating swing in a floating or internal floating roof does not have a limiting device preventing the swing from exceeding 60 degrees, measure and calculate the maximum angle possible with the roof on overflow
_____ Maximum angle on overflow
(If the calculated angle exceeds 65 degrees, recommend installation of a limiting bracket)
NA Inspect pull down cable for fraying
NA Inspect for three cable clamps where cable attaches to end of swingline (single-reeved) or to roof assembly (double-reeved). Inspect sheaves for freedom of movement
NA Inspect winch operation and check the height indicator for legibility and accuracy
NA Inspect bottom-mounted sheave assembly at end of pontoon for freedom of rotation of sheave
NA Inspect shell mounted lower sheave assembly for freedom of rotation of sheave, corrosion thinning, and pitting of sheave housing
NA Inspect upper sheave assembly for freedom of movement of sheave
NA Inspect the cable counterbalance assembly for corrosion and freedom of operation

Remarks: _____

_____

Manway Heater Racks

NA Inspect the manway heater racks for broken welds and bending of the sliding rails
NA Measure and record the length of the heater and length of the track

Remarks: _____

_____

Mixer Wear Plates and Deflector Stands

NA Inspect bottom and shell plates and deflector stands
NA Inspect for erosion and corrosion on the wear plates. Inspect for rigidity, structural soundness, corrosion, and erosion of deck plates and reinforcing pads that are seal welded to the bottom under the deflector stand legs

NA Measure for propeller clearance between the bottom of deflector stand and roof when the roof is on low legs

Remarks:

ACCESS STRUCTURES

Handrails

OK Identify and report type (steel pipe, galvanized pipe, square tube, angle) and size of handrails
OK Inspect for pitting and holes, paint failure
OK Inspect attachment welds
OK Identify cold joints and sharp edges. Inspect the handrails and midrails
NA Inspect safety drop bar (or safety chain) for corrosion, functioning and length
NA Inspect the handrail between the rolling ladder and the gauging platform for a hazardous opening when the floating roof is at its lowest level

Remarks:

Platform Frame

NA Inspect frame for corrosion and paint failure
NA Inspect the attachment of frame to supports and supports to tank; for corrosion and weld failure
NA Check reinforcing pads where supports are attached to shell or roof
NA Inspect the surface that deck plate or grating rests on, for thinning and holes
OK Check that flat-surface to flat-surface junctures are seal welded

Remarks:

Deck Plate and Grating

NA Inspect deck plate for corrosion-caused thinning or holes (not drain holes) and paint failure
NA Inspect plate-to-frame weld for rust scale buildup
NA Inspect grating for corrosion-caused thinning of bars and failure of welds
NA Check grating tie-down clips. Where grating has been retrofitted to replace plate, measure the rise of the step below and above the grating surface and compare with other risers on the stairway

Remarks: Roof xxx of paint and insulation subjected to severe corrosion

Stairway Stringers

NA Inspect spiral stairway stringers for corrosion, paint failure, and weld failure. Inspect attachment of stairway treads to stringer

NA Inspect stairway supports to shell welds and reinforcing pads

NA Inspect steel support attachment to concrete base for corrosion

Remarks: _____

Rolling Ladder

NA Inspect rolling ladder stringers for corrosion

NA Identify and inspect ladder fixed rungs (square bar, round bar, angles) for weld attachment to stringers and corrosion, particularly where angle rungs are welded to stringers

NA Check for wear and corrosion where rolling ladder attaches to gauging platform

NA Inspect pivot bar for wear and secureness

NA Inspect operation of self-leveling stairway treads

NA Inspect for corrosion and wear on moving parts

NA Inspect rolling ladder wheels for freedom of movement, flat spots, and wear on axle

NA Inspect alignment of rolling ladder with roof rack

NA Inspect top surface of rolling ladder track for wear by wheels to assure at least 18 inches of unworn track (track long enough)

NA Inspect rolling ladder track welds for corrosion

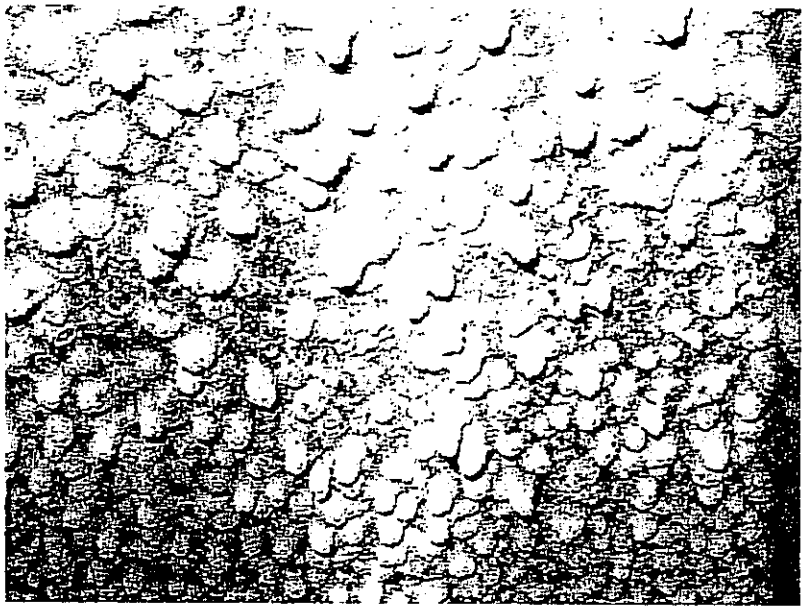
NA Inspect track supports on roof for reinforcing pads seal welded to deck plate

NA Check, by dimensioning, the maximum angle of the rolling ladder when the roof is on low legs
Maximum angle: _____

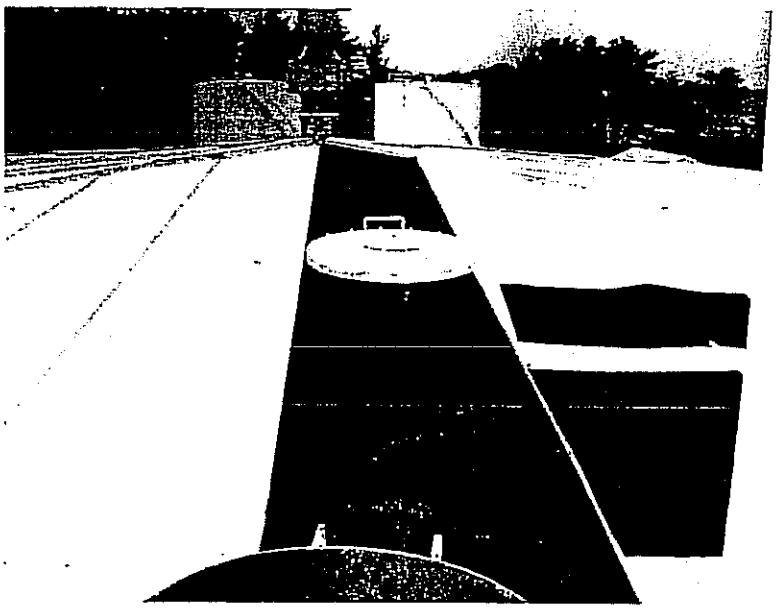
NA If rolling ladder track extends to within five feet of the edge of the roof on the far side, check for a handrail on the top of the shell on that side

Remarks: _____

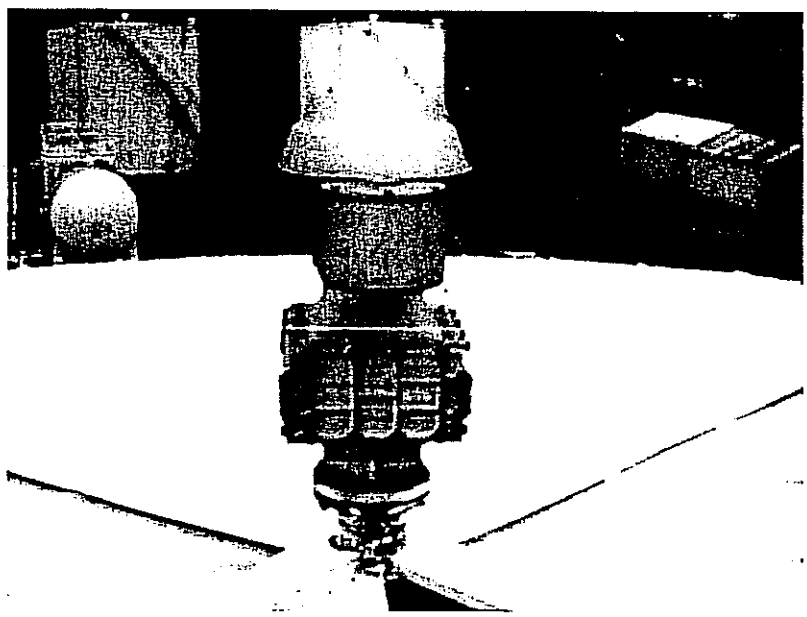
VI. PHOTOGRAPHS



PB050021.JPG
11/5/2003
Tank No.3 Roof Underside



PB050015.JPG
11/5/2003
Tank No.3 Roof Over View



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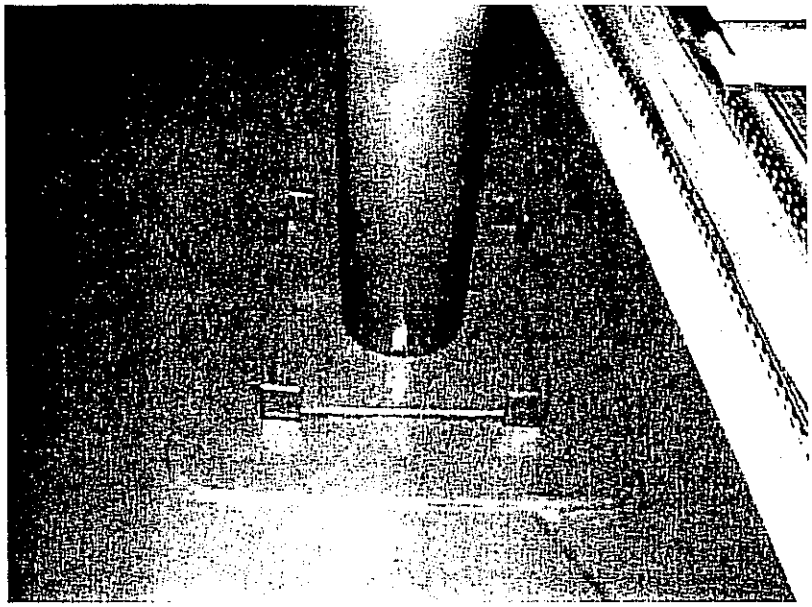
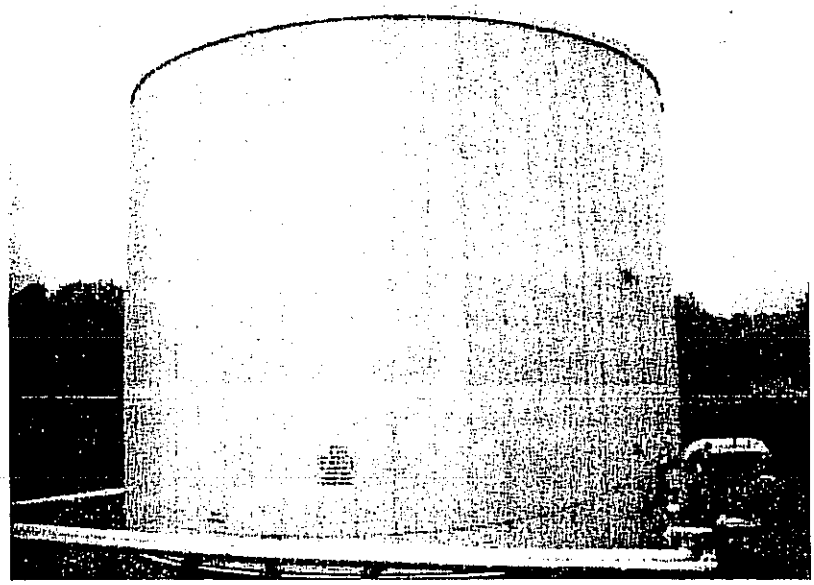
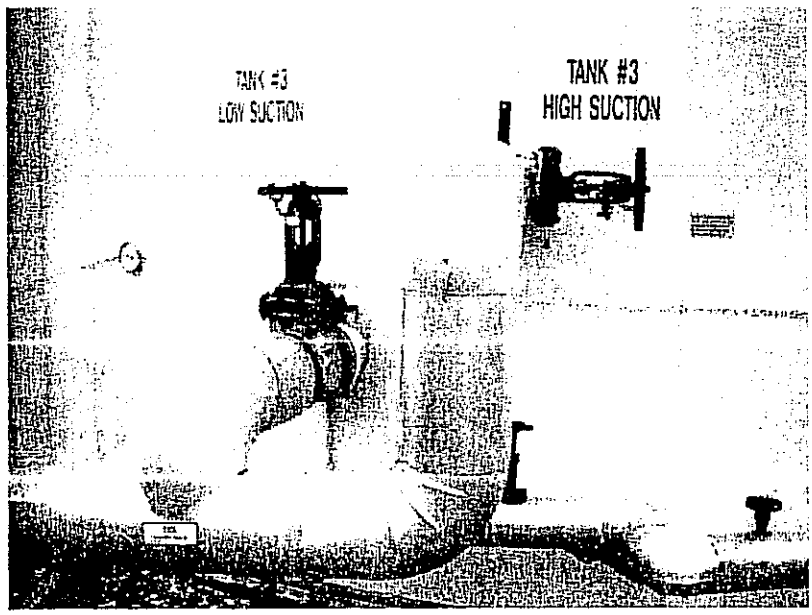
Tank No.3 High Level Alarm



PB050010.JPG
11/5/2003
Tank No.3 Roof Support



PB050001.JPG
11/5/2003
Tank No.3 Over View



PB050002.JPG
11/5/2003
Tank No.3 Piping

VII. RECOMMENDATIONS

As a result of the findings disclosed in the inspection of Tank No. 3, PCA Engineering, Inc. makes the following recommendations:

- Restore exterior paint coating as needed.

The maximum interval until the next internal inspection would be 7 years based on the attached calculation, Suffolk County/New York Department of Environmental Conservation Regulations, the available data, and assumes completion of above repairs, operation under the same service and operating conditions. This does not preclude regular in-service inspection by terminal personnel and qualified inspector, and it is not a guarantee of future performance.

All repairs should be completed per API 650, 653 and other applicable Standards. An inspection of all repairs should be performed prior to return to service.

Based on the extent of the inspections performed on Tank No. 3, the test results indicate no substantial corrosion or defects above and beyond that noted, as of the test date of November 5, 2003. This is not to be construed as an expressed or implied warranty of future performance.

Brookhaven National Laboratory

Tank No. 3
November 5, 2003
PCA Job No. 23089

Kenneth Northern

KENNETH NORTHERN
PCA ENGINEERING, INC.

W M Kent

WILLIAM M. KENT
PCA ENGINEERING, INC.
API Certification No. 297

STATE OF NEW YORK
DANIEL R. KOGUT
069049
LICENSED PROFESSIONAL ENGINEER

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WMK:mm

Notwithstanding anything contained in this report, nothing herein shall be construed as a representation, warranty or guarantee, either expressed or implied, regarding the future structural integrity or future life expectancy of any of the items tested. This report and any analysis provided is in all respects subject to and shall be interpreted within the limitations and parameters of the test procedures performed. In the event testing is performed using a sampling procedure, this report and any analysis shall be limited to those areas actually tested and the type of test conducted, and the customer is cautioned not to extrapolate the results of the test samples.

Prepared for:

Brookhaven National Laboratory
Building 452, P. O. Box 5000
Upton, NY 11973-5000

Out-of-Service Inspection of Tank No. 4 located at the Brookhaven National Laboratory Upton, New York Terminal on May 15, June 2 and July 29, 2003

Prepared by:

PCA Engineering, Inc.
430 Montclair Avenue
P.O. Box 196
Pompton Lakes, NJ 07442

PCA Job No. 23089

September 9, 2003

PHASE I REPORT

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API-653 Section 2.3

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SITE DESCRIPTION

Tank No. 4 is a welded, above ground, upright, cylindrical storage tank measuring 42.5 feet in diameter by 40 feet in height. The tank was erected in 1974 and has a product capacity of 400,000 gallons. The product content during the last period of service was fuel oil.

The tank floor is fabricated of 19 lap welded carbon steel plates. The tank shell is arranged in 5 butt-welded courses, with 5 plates per course. The tank fixed roof is fabricated of 20 lap-welded plates arranged in a cone configuration.

The tank is located within an earthen dike secondary containment area. The dike area has a bentonite mixed soil lining system, as indicated on BNL supplied drawings.

TEST PROCEDURES

The following is a list of the tests performed and their procedures involved in the inspection of Tank No. 4:

A) Ultrasonic Thickness Measurements

To obtain the residual metal thickness readings, either a Cygnus Model 3 or Cygnus Model 4 Ultrasonic Digital Thickness Gauge, with a 2.25 MHz transducer was used. The Cygnus Model 3 has a resolution of +/-

TEST PROCEDURES (Cont'd)

0.002 inch; the Cygnus Model 4 has a resolution of +/- 0.005 inch, accuracy allowing for use on steel plate/piping materials used in storage tanks. The calibration of the instrument is confirmed prior to and during testing using a steel step block. The couplant used was Sonotech UT-X and/or motor oil.

A minimum of five (5) ultrasonic thickness readings were taken at each floor plate, with five (5) additional readings taken adjacent to the floor/shell joint on approximately 2 foot intervals. A W. R. Thorpe Pit Gauge was available to measure any pit depths, with readings taken at the point of deepest penetration. All ultrasonic thickness readings and pitted areas are noted on the enclosed data tables. The arrangement of the floor plates is shown on the enclosed PCA drawings.

A minimum of five (5) ultrasonic thickness readings were taken at each plate of the lower course of shell plates and each plate adjacent to the spiral stairway ascending to the roof, with readings tabulated on the enclosed data tables. The arrangement of the shell appurtenances is shown on the enclosed PCA drawings.

TEST PROCEDURES (Cont'd)

As an appurtenance survey, ultrasonic thickness measurements were taken on principle pipe penetrations and their API plates within the lower course of shell plates.

Ultrasonic thickness readings of the roof were taken at a minimum of five (5) readings per plate.

B) Holiday Inspection (Low Voltage Sponge Test)

The epoxy coating of the tank floor was tested for overall integrity using a Tinker & Rasor Model M/1 Sponge Tester. The sponge tester operates on the principle of applying a fixed amount of D.C. current (67.5 volts) to the epoxy coated floor through a water saturated sponge.

With the instrument grounded to any area of bare steel electrically continuous with the floor, any holiday or defect in the epoxy would allow passage of water to the steel floor plates, thus completing the circuit. This would energize the buzzer, indicating to the operator the location of any defect in the epoxy coating.

C) Holiday Inspection (High Voltage Spark Test)

The epoxy coating of the tank floor was tested for overall integrity using a Tinker & Rasor Model AP/W Holiday Detector. The holiday tester operates on the principle of applying a fixed amount of high voltage electrical potential to the coated floor through a conductive silicon rubber brush.

With the instrument grounded to any area of bare steel electrically continuous with the floor, any holiday or defect in the epoxy would allow passage of current to the steel floor plates, thus completing the circuit. This would energize an audible signal indicating to the operator the location of any defect in the coating.

D) Interior Perimeter Elevation Survey

The interior survey is based on an assumed datum of 10 feet, as shown on the "Interior Elevation Survey", with measurements shown clockwise or counter-clockwise around the tank. Cross sections are taken at various intervals around the tank, as shown on the drawing.

The interior elevation survey is helpful in evaluating the condition of the floor plates. Low spots are areas of drastic grade changes, as indicated on the drawing, are potential areas of excessive stresses in the floor plates, and indications of possible loss of sub-structure support. Elevation cross sections are helpful to analyze this data.

E) Magnetic Flux Leakage Floor Scan

The tank floor was inspected using a Magnetic Flux Leakage Floor Scan (MFL and/or MFE).

The Magnetic Flux Leakage floor scanner operates using permanent rare-earth magnets to bring a section of the steel floor plate to magnetic saturation. A defect, located on front or back surfaces, causes a scattering of the magnetic "lines of force" or flux. Sensors located between the magnets detect this flux leakage and display the result on a display screen.

TEST PROCEDURES (Cont'd)

MFL/MFE inspection is a qualitative inspection tool, which primarily detects plate cross-sectional volume loss (as opposed to remaining thickness) and correlates this as an amplitude display.

An observed significant indication is evaluated by the technicians using ultrasonic equipment for quantitative classification.

The Magnetic Flux Leakage Scan covers the majority of the tank floor plate, with the exception of the areas within 4 to 6 inches of the lap welds, corner welds, lap patches, columns, etc. Any additional areas not scanned are marked on the tank floor drawing.

II. SUMMARY OF FINDINGS

Upon completion of the inspections conducted on Tank No. 4, the following results were obtained:

Ultrasonic Thickness Inspection

The residual plate metal thickness measurements ranged as follows:

Floor:	.213" to .268"
Shell:	.233" to .270" (1st Course)

Holiday Inspection

The initial inspection included an evaluation of the existing thin film floor coating system. The coating was found to be in poor condition, with multiple holidays and visible indications of blistering and/or delamination. Areas of rust/primer bleed-through were also evident.

The follow-up high voltage holiday test of the new coating system disclosed several indications, which were immediately repaired. There were no holidays remaining. The final coating thickness ranged from 50 to 60 mils.

II. SUMMARY OF FINDINGS (Cont'd)

Interior Perimeter Elevation Survey

The perimeter elevations (shell settlement) indicate a maximum differential of 0.01 feet (0.12 inches). The settlement is considered planar tilt, with the maximum out-of-plane deflection of 0.01 feet (0.12 inch). The maximum permissible out-of-plane deflection per API 653, B.3.2 is 0.04 feet (0.48 inch).

There are no visible indications of tank shell or floor stress, or recent/active displacement of fill material from around or under the tank. This information, in conjunction with the tank's age (29 years +/-), would indicate the tank has reached its maximum settlement with no changes in deflections anticipated, based on current operational procedures and site conditions.

The internal cross section elevation results disclosed edge settlement with a typical radius of 3 feet. The maximum edge settlement observed was 1.65 inches, which is within 75% of the allowable settlement as noted in API 653, Figure B-10 and Figure B-11. Settlement between 75 and 100 percent of allowable requires further inspection, while settlement in excess of the allowable requires repair or engineering evaluation.

II. SUMMARY OF FINDINGS (Cont'd)

The pitch of the cone down floor was approximately 3.7 inches in 10 feet.

Edge settlement (or roll-off) typically occurs when the tank shell settles sharply around the periphery, resulting in deformation of the bottom plate near the shell-to-bottom corner junction.

Magnetic Flux Leakage Floor Scan

The magnetic flux leakage floor scan disclosed no significant indications. The indications noted were confirmed and reviewed by ultrasonic B-scan, with no indications greater than 0.050 inch in depth.

III. DISCUSSION

As a result of the inspection performed, the following deficiencies were observed:

- Top surface pitting was measured between 0.010 inch and 0.060 inch, with bottom surface pitting measured between 0.010 inch and 0.020 inch.
- The existing floor coating was removed and replaced following the initial inspection. The coating system applied was PCS-355 manufactured by Polyurea Coating Systems. The coating is a two-part spray applied material designed as a tank lining. The coating was applied by Gombert Painting, Inc. of Deer Park, New York. PCA Engineering, Inc. conducted a post application holiday test of the new coating on July 29, 2003.

IV. TEST DATA

CORROSION SURVEY FIELD DATA TABLE

OWNER: Brookhaven National Labs
STRUCTURE: Tank No. 4
DATE OBTAINED: June 2, 2003
SURVEYED BY: P. Seastrand

Ultrasonic Thickness Measurements
Tank Floor - In Inches

PCA JOB NO. 23089

	1	2	3	4	5
Plate No. 1	0.246	0.254	0.252	0.253	0.252
	0.246	0.253	0.251	0.251	0.256
Plate No. 2	0.262	0.262	0.261	0.262	0.258
	0.258	0.264	0.256	0.258	0.266
Plate No. 3	0.250	0.251	0.261	0.259	0.257
	0.265	0.258	0.262	0.262	0.265
Plate No. 4	0.256	0.258	0.258	0.252	0.248
	0.256	0.256	0.249	0.246	0.248
Plate No. 5	0.259	0.251	0.253	0.256	0.249
	0.253	0.250	0.243	0.257	0.240
Plate No. 6	0.236	0.242	0.239	0.244	0.243
	0.245	0.246	0.265	0.237	0.240
Plate No. 7	0.253	0.260	0.260	0.255	0.260
Plate No. 8	0.249	0.248	0.246	0.254	0.244
	0.260	0.240	0.217	0.248	0.247

minimum	0.213
average	0.250
maximum	0.268
std. dev.	0.009231

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CORROSION SURVEY FIELD DATA TABLE

OWNER: Brookhaven National Labs
STRUCTURE: Tank No. 4
DATE OBTAINED: June 2, 2003
SURVEYED BY: P. Seastrand

PCA JOB NO. 23089

Ultrasonic Thickness Measurements
Tank Floor - In Inches

		1	2	3	4	5
Plate N o. 9		0.234	0.245	0.244	0.245	0.250
		0.249	0.251	0.250	0.240	0.250
Plate No. 10		0.255	0.252	0.248	0.256	0.260
Sump	Shell	0.309	0.310	0.305	0.305	
	Floor	0.355	0.360	0.360	0.355	
Plate No. 11		0.255	0.249	0.250	0.248	0.252
		0.242	0.252	0.260	0.235	0.248
Plate No. 12		0.230	0.241	0.213	0.241	0.244
		0.244	0.244	0.246	0.246	0.242
Plate No. 13		0.267	0.268	0.266	0.265	0.264
Plate No. 14		0.262	0.262	0.257	0.257	0.253
		0.255	0.252	0.254	0.255	0.257
Plate No. 15		0.246	0.248	0.244	0.245	0.245
		0.246	0.245	0.242	0.237	0.238

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CORROSION SURVEY FIELD DATA TABLE

OWNER: Brookhaven National Labs
STRUCTURE: Tank No. 4
DATE OBTAINED: June 2, 2003
SURVEYED BY: P. Seastrand

PCA JOB NO. 23089

Ultrasonic Thickness Measurements
Tank Floor - In Inches

	1	2	3	4	5
Plate No. 16	0.243	0.245	0.244	0.250	0.248
	0.244	0.246	0.254	0.248	0.248
Plate No. 17	0.244	0.258	0.252	0.260	0.263
	0.266	0.261	0.264	0.265	0.265
Plate No. 18	0.243	0.246	0.246	0.248	0.248
	0.248	0.242	0.232	0.231	0.247
Plate No. 19	0.242	0.240	0.225	0.239	0.244
	0.237	0.244	0.248	0.245	0.250

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CORROSION SURVEY FIELD DATA TABLE

OWNER: Brookhaven National Labs
STRUCTURE: Tank No. 4
DATE OBTAINED: June 2, 2003
SURVEYED BY: P. Seastrand

PCA JOB NO. 23089

Ultrasonic Thickness Measurements
Tank Shell - In Inches

1	2	3	4	5
0.242	0.245	0.264	0.260	0.257
0.254	0.259	0.261	0.260	0.240
0.268	0.270	0.263	0.265	0.260
0.255	0.254	0.253	0.252	0.253
0.233	0.238	0.236	0.238	0.239

minimum	0.233
average	0.253
maximum	0.270
std. dev.	0.010872

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CORROSION SURVEY FIELD DATA TABLE

OWNER: Brookhaven National Labs
STRUCTURE: Tank No. 4
DATE OBTAINED: June 2, 2003
SURVEYED BY: P. Seastrand

Appurtenance Survey
Tank Shell - In Inches

PCA JOB NO. 23089

	Top	Side	Bottom	Side
24" manway	0.535	0.540	0.520	0.530
4" fill / return	0.325	0.325	0.335	0.330
2" steam	0.215	0.225	0.215	0.220
2" steam	0.215	0.210	0.215	0.220
8" high suction	0.430	0.425	0.445	0.450
8" low suction	0.440	0.450	0.445	0.450
4" water draw-off	0.330	0.335	0.330	0.330
3" blank	0.250	0.245	0.255	0.240
4" blank	0.285	0.305	0.315	0.310

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CORROSION SURVEY FIELD DATA TABLE

OWNER: Brookhaven National Labs
STRUCTURE: Tank No. 4
DATE OBTAINED: June 2, 2003
SURVEYED BY: P. Seastrand

Elevation Survey

PCA JOB NO. 23089

	Shell	1'	2'	3'	4'	5'	10'	Center
A	10.00	9.83	9.70	9.65	9.63	9.64	9.54	9.26
B	10.00	9.82	9.68	9.62	9.56	9.50	9.37	
C	9.99	9.85	9.78	9.75	9.65	9.58	9.54	
D	9.99	9.89	9.76	9.71	9.79	9.68	9.45	
E	10.00	9.87	9.80	9.75	9.75	9.70	9.47	
F	10.00	9.88	9.83	9.78	9.75	9.73	9.54	
G	10.00	9.86	9.80	9.76	9.73	9.70	9.42	
H	10.00	9.89	9.79	9.73	9.70	9.70	9.47	
A	10.00							

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API 653 INSPECTION - DATA EVALUATION

GENERAL INFORMATION

Customer: **Brookhaven National Labs** Job No.: 23089 Date: 6/2/03

Tank No.: 4
Diameter: 42.5 feet
Height: 40 feet
Safe Fill: feet
Capacity: 10,214 bbl
Product: Fuel Oil

Cathodic Protection?: n
Leak Detection?: n
Thick FilmCoating?: n
Thin Film Coating?: n

Erected: 1/1/74
Date Last Inspected
Cleaned:
Painted:
Lined:
Strapped:

	Quantities:
Floor plts:	19
Roof plts:	20
Shell crs:	5
Plts/Crs:	5

1st Crse Avg Shell Thickness (in)	
1st	0.238
2nd	0.236
Min Thick	0.233
4th	0.238
5th	0.239

	PlateThickness (in)					
	Original	General	Delta	Minimum	Material	Riveted?
Floor Plates:	0.268	0.250	0.018	0.213	Unknown	n
Sketch Plates:			0.000			
Annular Plates:			0.000			
Shell - 1st course:	0.270	0.253	0.017	0.233	Unknown	n
2nd course:			0.000			
3rd course:			0.000			
4th course:			0.000			
5th course:			0.000			
6th course:			0.000			
7th course:			0.000			
8th course:			0.000			
Roof:			0.000			

	Pitting Depth (in)			
	Max Int.	Avg Int.	Max Ext.	Avg Ext.
Floor Plates:	0.060	0.010	0.050	0.025
Shell - 1st course:				
Roof:				

Containment Area:

Steel?
Diameter feet
Height feet

Containment bbl
110% Cap

Earthen?
Length feet
Width feet
Height feet
Containment bbl
110% Cap

Calculated Safe Fill (based on capacity of containment) = 0.00 feet
Therefore, containment is sufficient if current Safe Fill is maintained

COMMENTS: The tank shell and roof are insulated, limiting access for thickness gauging.

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BOTTOM PLATE TOPOGRAPHY

Tank:	10	No of Sections:	8	Elevation @ Center of Tank:	9.35 ft
Diameter:	42	Max Chord Length:	16.49 ft	Average Pitch:	0.37 in/ft
				Overall Differential Settlement	0.12 in

Allowable Roll-Off	
in 1'	0.74 in
in 2'	1.11 in
in 3'	1.48 in

	AXIS 1		AXIS 2		AXIS 3		AXIS 4		AXIS 5		AXIS 6	
Spacing	Field Data	Roll-Off	Field Data	Roll-Off	Field Data	Roll-Off	Field Data	Roll-Off	Field Data	Roll-Off	Field Data	Roll-Off
Shell	10.00		10.01		10.00		10.00		10.00		10.00	
1'	9.90	1.20	9.95	0.72	9.93	0.84	9.98	0.24	9.93	0.84	9.92	0.96
2'	9.82	2.16	9.84	2.04	9.88	1.44	9.94	0.72	9.86	1.68	9.86	1.68
3'	9.77	2.76	9.80	2.52	9.82	2.16	9.91	1.08	9.80	2.40	9.80	2.40
5'	9.65		9.72		9.72		9.85		9.68		9.70	
10'	9.59		9.59		9.54		9.64		9.56		9.53	
20'	9.34		9.31		9.40		9.37		9.28		9.27	
30'												
40'												
50'												
60'												
70'												
80'												
90'												
Settlement	0		-0.01		0.00		0.00		0.00		0.00	

	AXIS 7		AXIS 8		AXIS 9		AXIS 10		AXIS 11		AXIS 12	
Spacing	Field Data	Roll-Off	Field Data	Roll-Off	Field Data	Roll-Off	Field Data	Roll-Off	Field Data	Roll-Off	Field Data	Roll-Off
Shell	10.00		10.00									
1'	9.95	0.60	9.91	1.08		0.00		0.00		0.00		0.00
2'	9.89	1.32	9.84	1.92		0.00		0.00		0.00		0.00
3'	9.85	1.80	9.78	2.64		0.00		0.00		0.00		0.00
5'	9.80		9.67									
10'	9.66		9.55									
20'	9.29		9.23									
30'												
40'												
50'												
60'												
70'												
80'												
90'												
Settlement	0.00		0.00									

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TANK SHELL EVALUATION API 653 SECTION 2.3

Tank: 10 Date: 6/2/03

Diameter: 42 feet
Height: 45 feet
t_1(avg.): 0.237 inches
t_2: 0.233 inches

Field data:
0.238
0.236
0.233
0.238
0.239
t_1= 0.237

Thickness Determination:

$L=3.7(D*t_2)^{1/2}$

Where: L= the maximum vertical length, in inches, over which hoop streees are assumed to "average out" around local discontinuities
D= tank diameter, in feet
t_2= the least thickness, in inches, in area of corrosion, exclusive of pits

L= 11.57456 inches

Minimum Thickness Calculation for Welded Tank Shell:

Course No. 1

t_{min}= **2.6DHG/SE** = **0.205 inches**

Where:
t_{min}= the minimum acceptable thickness, in inches, as calculated from the above formula; however, t_{min} shall not be less than 0.1 inch for tank course
D= nominal diameter of tank, in feet
H= Height, in feet, from the bottom of length *L* for the most severely corroded area in each shell course to the maximum design liquid level
G= highest specific gravity of the contents (including water, if hydtsted)
S= maximum allowable stress in psi; use the smaller of 0.80Y or 0.426T for bottom and second course; use the smaller of 0.88Y or 0.472T for all other courses
Y= specified minimum yield strength of the plate; 30,000 psi if unknown
T= the smaller of the specified minimum tensile strength of the plate or 80,000 psi; use 55,000 psi if unknown
E= original joint efficiency for the tank. use E=0.7 if unknown, E=1.0 when evaluating the retirement thickness in a corroded plate, when away from welds or joints by at least the greater of 1 inch or twice the plate thickness

NOTE: For riveted tanks see section 653.2.3.4; see section 653.2.3.3 for complete explanation

D =	42 feet	G =	1.0	Y =	30,000 psi
H =	45 feet	S =	23,430 psi	T =	55,000 psi
				E =	1.0

Then, per API653 section 2.3.3.1:

If:	a:	t_1	>=	t_{min}
		0.237	>=	**0.205**
and				
	b:	t_2	>=	60% t_{min}
		0.233	>=	**0.123**

THEREFORE, NO ACTION IS REQUIRED

Maximum Safe Fill Height = **50.99** feet **Tank can be filled to capacity**
$(t_2SE/2.6DG)$ +1 **Provided Containment Capacity is Sufficient**

PCA ENGINEERING, INC.

Courses

Tank: **10** Date: **6/2/03**

Diameter:	42	Yield:	23,430
Height:	45	Joint Efficiency:	1.0
Number of Courses:	5	Specific Gravity:	1.00

MINIMUM THICKNESS per each SHELL COURSE

	Height (TOC)	Minimum Thickness	
Course 1	9	0.205	**OK**
Course 2	18	0.163	**OK**
Course 3	27	0.121	**OK**
Course 4	36	0.079	**OK**
Course 5	45	0.037	**OK**

TANK BOTTOM EVALUATION - API 653 SECTION 2.4

Tank: 4 Date: 6/2/03

Minimum Thickness for Tank Bottom Plate (API 4.4.7):

$$MRT = (\text{minimum of } RT_{bc} \text{ or } RT_{ip}) - O_r(StP_r + UP_r)$$

Where:

MRT = minimum remaining thickness at the end of interval O_r
This value must meet the requirments of Table 6-1
and sections 4.4.7.4 and 4.4.8

O_r = in-service interval (years to next inspection) not to exceed that allowed by 4.2.2 (normally 10 years)

RT_{bc} = minimum remaining thickness from bottom side corrosion, after repairs

RT_{ip} = minimum remaining thickness from internal corrosion after repairs

StP_r = maximum internal pitting rate, in inches per year; $StP_r = 0$ if tank bottom is internally lined.

UP_r = maximum underside pitting rate, in inches per year; $UP_r = 0$ if tank bottom is cathodically protected.

T_o	=	0.268 inch	RT_{bc}	=	0.218	UP_r	=	0.0017 in/yr
UP_m	=	0.050 inch	RT_{ip}	=	0.208	StP_r	=	0.0020 in/yr
StP_m	=	0.060 inch	O_r	=	10.0 years			

Solve for: MRT = 0.171 inch

Or = 28.9 years where MRT = 0.100

NOTE: see API 653 table 6-1

Then if:

MRT > 0.100

THEREFORE, NO ACTION IS REQUIRED

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TANK SETTLMENT EVALUATION - API 653 APPENDIX B

Tank: 10

Date: 6/2/03

Diameter: 42 feet
Sections: 8

Arc (L): 16.49 feet
Yield(Y): 30000 psi
(E): 29000000 psi
Height(H): 45 feet

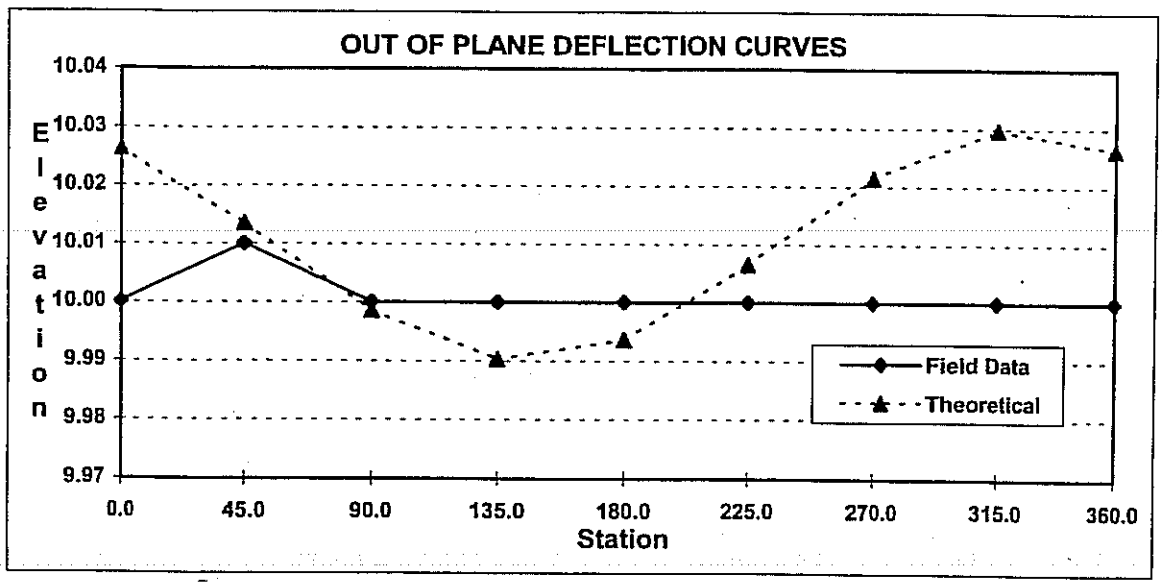
Maximum Permissible Out-of-Plane Deflection:

$S<=(L^2*Y*11)/(2(E*H)$

Where:
S= deflection, in feet (out-of-plane distortion)
L= arc length, between measurement pts, in feet
Y= yield strength, in psi
E= Young's modulus, in psi
H= tank height, in feet

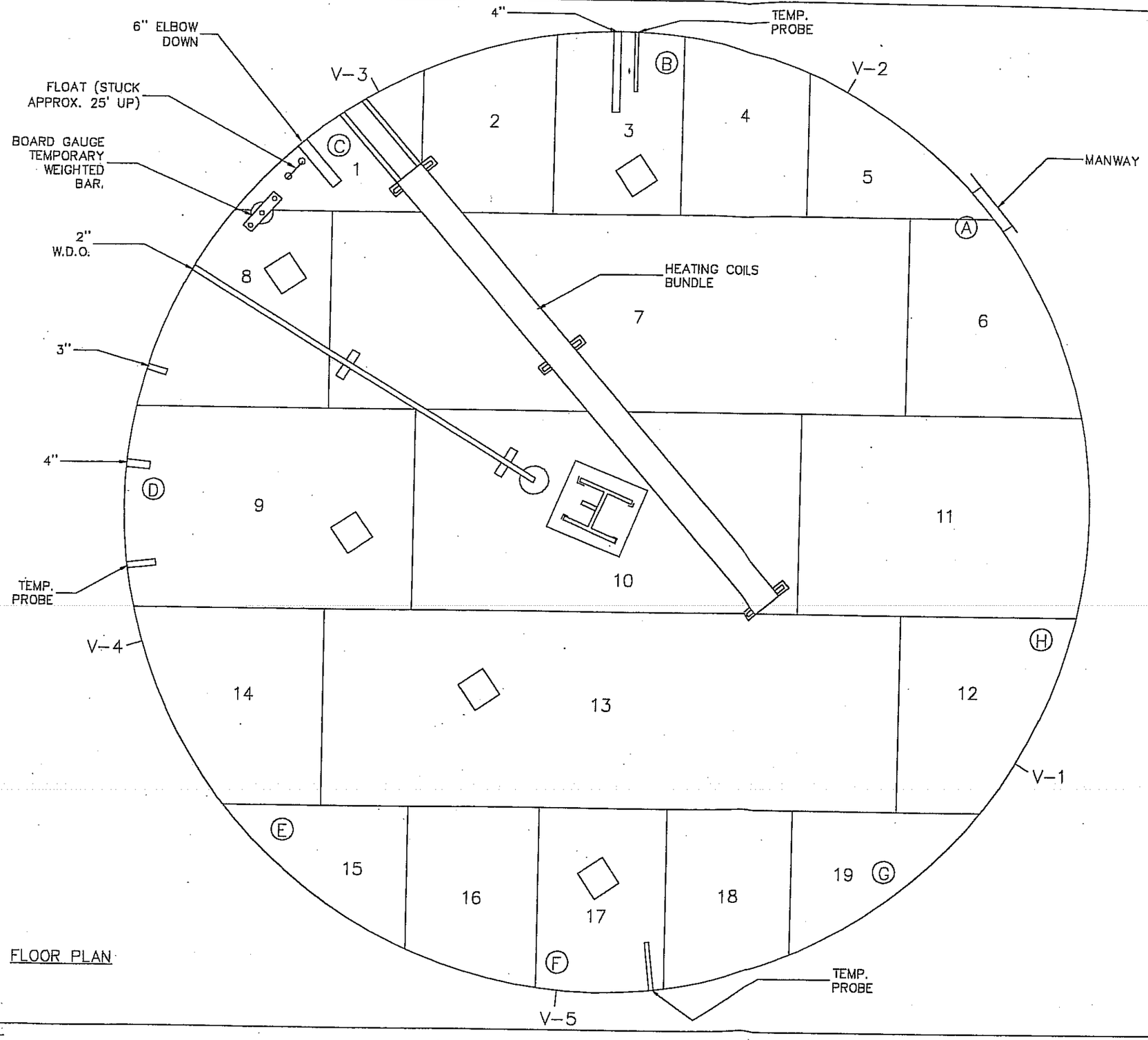
S<= 0.034395 feet

Degrees	Station	Field Data	Theoretical	Delta(U_i)	Deflection(S_i)
0.0	0.0	10.00	10.026	-0.026	-0.0098
45.0	16.5	10.01	10.013	-0.003	0.0090
90.0	33.0	10.00	9.999	0.001	-0.0016
135.0	49.5	10.00	9.990	0.010	0.0058
180.0	66.0	10.00	9.994	0.006	0.0048
225.0	82.5	10.00	10.007	-0.007	0.0010
270.0	99.0	10.00	10.021	-0.021	-0.0034
315.0	115.5	10.00	10.030	-0.030	-0.0058
360.0	131.9	10.00	10.026	-0.026	-0.0098



THEN, SINCE THE MAXIMUM Si <= S NO ACTION IS REQUIRED

PCA ENGINEERING, INC.



FLOOR PLAN

GENERAL NOTES:

TANK No. 4

LEGEND

1 – FLOOR PLATE No.

PCA ENGINEERING, INC.
430 Montclair Ave. Pompton Lakes, NJ.
TEL. (973) 616-4501

BROOKHAVEN NATIONAL LABS
FISCAL DIVISION BLDG 134B
P.O. BOX 5000
UPTON, NY

PROJECT LOCATION:
BROOKHAVEN NATIONAL LABS
BROOKHAVEN AVENUE
UPTON, NY

DRAWING TITLE:
TANK INSPECTION
TANK No. 4

CHECKED BY:	P.S.	DRAWN BY:	A.U.Z.
SCALE:	N.T.S.	DATE:	6-13-03
DRAWING No.:	BW-23089-01	REV.	0

V. API 653 CHECKLIST

API 653

TANK OUT-OF-SERVICE INSPECTION CHECKLIST

OVERVIEW

OK	Check that tank has been cleaned, is gas free, and safe for entry
OK	Check that the tank is completely isolated from product lines, all electrical power, and steam lines
OK	Check that roof is adequately supported, including fixed roof structure and floating roof legs
OK	Check for presence of falling object hazards, such as corroded-through roof rafters, asphalt stalactites, and trapped hydrocarbons in unopened or plugged equipment or appurtenances, ledges, etc.
OK	Inspect for slipping hazards on the bottom and roof decks
OK	Inspect structural welds on accessways and clips
OK	Check surfaces needing inspection for a heavy-scale buildup and check weld seams and oily surfaces where welding is to be done. Note areas needing more cleaning, including blasting

Remarks: _____

TANK EXTERIOR

N/A	Inspect appurtenances opened during cleaning such as lower floating swing sheave assemblies, nozzle interiors (after removal of valves)
N/A	Hammer test or ultrasonically test the roof
N/A	Enter and inspect the floating roof pontoon compartments

Remarks: _____

BOTTOM INTERIOR SURFACE

OK	Using a flashlight held close to and parallel to the bottom plates, and using the bottom plate layout as a guide, visually inspect and hammer test the entire bottom
OK	Measure the depth of pitting and describe the pitting appearance (sharp edged, lake type, dense, scattered, etc.)
OK	Mark areas requiring patching or further inspection
OK	Mark locations for turning coupons for inspection
*	Inspect all welds for corrosion and leaks, particularly the shell-to-bottom weld
OK	Inspect sketch plates for corrosion
OK	Locate and mark voids under the bottom
OK	Record bottom data on a layout sketch using the existing bottom plates as a grid. List the number and sizes of patches required
*	Vacuum test the bottom lap welds

OK	Hammer test or ultrasonically examine any slightly discolored spots or damp areas
OK	Check for reinforcing pads under all bottom attached clips, brackets and supports
N/A	Inspect floating roof leg pads for pitting or cutting, and excessive dimpling (indicating excessive loading)
OK	Check the column bases of fixed roof supports for adequate pads and restraining clips
N/A	In earthquake zones 3 and 4, check that roof supports are not welded down to the tank, but are only restrained from horizontal movement
N/A	Check area beneath swing line cable for indications of cable cutting or dragging
N/A	Mark old oil and air test connection for removal and patching
OK	Identify and report low areas on the bottom that do not drain adequately
OK	Inspect coating for holes, disbonding, deterioration, and discoloration

Remarks: *tank floor is coated

SHELL SEAMS AND PLATES

OK	On cone up bottoms, closely inspect and gauge the depth of metal loss on the lower 2 to 4 inches of the shell (area of standing water)
OK	Measure the depth of pitting on each course
N/A	Inspect and estimate the amount of metal loss on the heads of rivets and bolts
N/A	Inspect shell-to-bottom riveted lap joints
N/A	Inspect for vertical grooving damage from seal assembly protrusions
OK	Inspect existing protective coatings for damage, deterioration, and disbonding
N/A	Check for areas of rubbing (indicating too much pressure by the seal assembly shoes or inadequate annular space)
*	Visually inspect the shell plates and seams for indications of leakage
N/A	If the shell has riveted or bolted seams, record the leak locations by film or chart in case the locations are lost during surface preparation for painting
N/A	Measure annular space at 40-foot intervals
OK	Survey the shell to check for roundness and plumb

Remarks: *the tank has an insulating jacket

SHELL-MOUNTED OVERFLOWS

N/A	Inspect overflow for corrosion and adequate screening
N/A	Check location of overflow that it is not above any tank valves or equipment

Remarks: _____

ROOF INTERIOR SURFACE

General

OK	Visually inspect the underside surface of the roof plates for holes, scale buildup, and pitting
N/A	Hammer test or ultrasonically examine to check for thin areas, particularly in the vapor space of floating roofs and at edge of roof on cone roof tank
N/A	Check all clips, brackets, braces, etc., welded to the roof deck plate for welded reinforcing pads and see that they have not broken free
N/A	If no pad is present, penetrant test for cracking of the weld or deck plate
N/A	Inspect the protective coating for breaks, disbondment, and deterioration

Remarks: _____

Fixed Roof Support Structure

OK	Inspect the support columns for thinning in the upper two feet
N/A	On API columns (two channels welded together) check for corrosion scale breaking the tack welds, unless the joint between the channels is completely seal welded
OK	Check that the reinforcing pad on the bottom is seal welded to the tank bottom with horizontal movement restraining clips welded to the pad
N/A	Determine if pipe column supports are concrete filled or open pipe. If open pipe, check for a drain opening in the bottom of the pipe
OK	Inspect and gauge rafters for thinning, particularly near the center of the roof. Report metal loss
OK	Check for loose or twisted rafters
OK	Inspect girders for thinning and check that they are attached securely to the top of the columns
N/A	Report if the columns have cross bracing in the area between the low pump out and top of the shell (for future internal floating roof installation)
N/A	Inspect and report presence of any roof-mounted swing line bumpers
OK	Photograph the roof structure if no rafter layout drawing exists

Remarks:

FIXED ROOF APPURTENANCES

Inspection and Light Hatches

OK	Inspect the hatches for corrosion, paint and coating failures, holes, and cover sealing
OK	On loose covers, check for a safety chain in good condition
N/A	On light hatches over 30 inches across, check for safety rods
OK	Inspect the condition of the gaskets on bolted or latched down hatch covers

Remarks:

Staging Support Connection

*	Inspect the condition of the staging support for corrosion

Remarks: *minor paint failure

Breathers and Vents

OK	Inspect and service the breather
OK	Inspect screens on vents and breathers

Remarks:

Emergency P/V Hatches

OK	Inspect and service pressure/vacuum hatches (setting should be high enough to prevent chattering of breather during normal operation. See breather manufacturer's guide
N/A	Inspect liquid seal hatches for corrosion and proper liquid level in the sea

Remarks:

Sample Hatch

OK	Inspect sample hatch for corrosion
OK	Check that the cover operates properly
OK	If the tank has no gaugewell, check for a hold off distance marker and check measurement

Remarks: _____

FLOATING ROOF

Roof Deck

N/A Hammer test the area between roof rim and shell. (If access for hammer testing is inadequate, measure the distance from the bottom edge of the roof to the corroded area and then hammer test from inside the pontoon)

N/A In sour water service, clean and test all deck plate weld seams for cracking unless the lower laps have been seal welded

N/A Check that either the roof drain is open or the drain plug in the roof is open in case of unexpected rain

N/A On flat bottomed and cone down bottom roof decks, check for a vapor dam around the periphery of the roof. The dam should be continuous without break to prevent escape of vapors to the seal area from under the center of the roof

Remarks: _____

Floating Roof Pontoons

N/A Visually inspect each pontoon for liquid leakage

N/A Run a light wire through the gooseneck vents on locked down inspection hatch covers to make sure they are open

N/A Inspect lockdown latches on each cover

N/A Check and report if each pontoon is:

- _____ Vapor tight (bulkhead seal welded on one side on bottom, sides and top
- _____ Liquid tight (seal welded on bottom and sides only) or
- _____ Unacceptable (minimum acceptable condition is liquid tight)

Remarks: _____

Floating Roof Cutouts

N/A Inspect underside of cutouts for mechanical damage

N/A Inspect welds for cracks

N/A Inspect plate for thinning, pitting, and erosion

N/A Measure mixer cutouts and record plate thickness for future mixer installation or replacement
Plate thickness: _____

Remarks: _____

Floating Roof Supports

N/A	Inspect fixed low and removable high floating roof legs for thinning
N/A	Inspect for notching at bottom of legs for drainage
N/A	Inspect for leg buckling or bellying at bottom
N/A	Inspect pin hole in roof guide for tears
N/A	Check plumb of all legs
N/A	Inspect for adequate reinforcing gussets on all legs through a single portion of the roof
N/A	Inspect the area around the roof legs for cracking if there is no internal reinforcing pad or if the topside pad is not welded to the deck plate on the underside
N/A	Inspect the sealing system on the two-position legs and the vapor plugs in the fixed low leg for deterioration of the gaskets
N/A	On the shell mounted roof supports, check for adequate clearance based on the maximum floating roof movement as determined by the position of the roof relative to the gaugewell and/or counter rotational device

Remarks: _____

FLOATING ROOF SEAL ASSEMBLIES

Primary Shoe Assembly

N/A	Remove four sections of foam log (foam filled seals) for inspection, on 90° locations
N/A	Inspect hanger attachment to roof rim for thinning, bending, broken welds, and wear of pin holes
N/A	Inspect clips welded to roof rim for thinning
N/A	Shoes: Inspect for thinning and holes in shoes
N/A	Inspect for bimetal bolts, clips, and attachments
N/A	Seal fabric: Inspect for deterioration, stiffening, holes, and tears in fabric
N/A	Measure length of fabric from top of shore to roof rim, and check against maximum anticipated annular space as roof operated
N/A	Inspect any modification of shoes over shell nozzles, mixers, etc., for clearance
N/A	Inspect shoes for damage caused by striking shell nozzles, mixers, etc.

Remarks: _____

Primary Toroidal Assembly

N/A	Inspect seal fabric for wear, deterioration, holes, and tears
N/A	Inspect hold down system for buckling or bending
N/A	Inspect foam for liquid absorption and deterioration

Remarks: _____

Rim Mounted Secondaries

N/A	Inspect the rim-mounted bolting bar for corrosion and broken welds
N/A	Measure and chart seal-to-shell gaps
N/A	Visually inspect seal from below, looking for holes as evident by light
N/A	Inspect fabric for deterioration and stiffness
N/A	Inspect for mechanical damage, corrosion, and wear on tip in contact with shell
N/A	Inspect for contact with obstructions above top of shell

Remarks: _____

FLOATING ROOF APPURTENANCES

Roof Manways

N/A	Inspect walls of manways for pitting and thinning
N/A	On tanks with interface autogauges, check seal around gauge tape cable and guide wires through manway cover
N/A	Inspect cover gasket and bolts

Remarks: _____

Rim Vent

N/A	Check rim vent for pitting and holes
N/A	Check vent for condition of screen
N/A	On floating roof tanks where the environmental rules require closing off the vent, check the vent piping for corrosion at the pipe-to-rim joint and check that the blinding is adequate

Remarks: _____

Vacuum Breaker, Breather Type

N/A	Service and check operation of breather valve
N/A	Check that nozzle pipe projects no more than 1/2 inch below roof deck
N/A	Inspect reinforcing pad and pad weld

Remarks: _____

Vacuum Breaker, Mechanical Type

N/A	Inspect the stem for thinning. Measure how far the vacuum breaker cover is raised off the pipe when the roof is resting on high or low legs On high legs: _____ On low legs: _____

Remarks: _____

_____

Roof Drains: Open Systems, Including Emergency Drains

N/A Check liquid level inside open roof drains for adequate freeboard. Report if there is insufficient distance between liquid level and top of drain

N/A If tank comes under Air Quality Monitoring District rules, inspect the roof drain vapor plug

N/A If emergency drain is not at the center of the roof, check that there are at least three emergency drains

Remarks: _____

_____

Closed Drain Systems: Drain Basins

N/A Inspect for thinning and pitting

N/A Inspect protective coating (topside)

N/A Inspect basin cover or screen for corrosion

N/A Test operation of check valve

N/A Check for presence of check valve where bottom of basin is below product level

N/A Inspect drain basin(s) to roof deck welds for cracking

N/A Check drain basin(s) outlet pipe for adequate reinforcement to roof deck (including reinforcing pad)

Remarks: _____

_____

Closed Drain Systems: Fixed Drain Line on Tank Bottom

N/A Hammer test fixed drain line on tank bottom for thinning and scale/ debris plugging

N/A Inspect supports and reinforcing pads for weld failures and corrosion

N/A Check that pipe is guided, not rigidly locked to supports, to avoid tearing of tank bottom plate

Remarks: _____

_____

Closed Drain Systems: Flexible Pipe Drain

N/A Inspect for damage to exterior of pipe

N/A Check for obstructions that pipe could catch on

N/A Inspect shields to protect pipe from snagging

N/A Inspect results of hydrotest on flexible roof drain system

Remarks: _____

_____

Closed Drain Systems: Articulated Joint Drain

N/A	Hammer test rigid pipe in flexible joint system for thinning and scale debris plugging
N/A	Inspect system for signs of bending or strain
N/A	Inspect results of system hydrotest
N/A	Inspect landing leg and pad

Remarks:

Autogauge System and Alarms

OK	Check freedom of movement of tape through autogauge tape guide
OK	Inspect sheaves for freedom of movement
*	Test operation checker
OK	Inspect tape and tape cable for twisting and fraying
OK	Test the tape's freedom of movement through guide sheaves and tape guide pipe
N/A	On open-top tanks, check that gate tapes with cables have no more than one foot of tape exposed with float at lowest point
OK	Check float for leakage
OK	Test float guide wire anchors for spring action by pulling on wire and releasing
N/A	Inspect floatwells in floating roofs for thinning and pitting of walls just above the liquid level
OK	Check that the autogauge tape is firmly attached to the float
N/A	Inspect the tape cable and float guide wire fabric seals through the floatwell cover
OK	Inspect the bottom guide wire attachment clip; inspect for a temporary weighted bar instead of a permanent welded down clip
OK	Inspect board-type autogauges indicators for legibility and freedom of movement of indicator
N/A	Measure and record these distances to determine if seal damage will occur if tape is run over:
	From shell top angle to underside of tape guide system
	From liquid level on floating top to top of secondary seal
N/A	Identify floating roofs where the tape is connected directly to the roof
OK	Overfill alarm: Inspect tank overfill prevention alarm switches for proper operation

Remarks: *the auto gauge is not accurate; however, it has been supplemented by a board type gauge.

COMMON TANK APPURTENANCES

Gauge Well

N/A	Inspect gauge well pipe for thinning at about two-thirds distance above the bottom: look for thinning at the edge of the slots
N/A	Check for corrosion on the pipe joint. Check that sample cords, weights, thermometers, etc., have been removed from pipe
N/A	Check for cone at bottom end of pipe about one foot above the bottom

N/A	Check condition of well washer pipe and that its flared end is directed at the near side of the hold-off pad
N/A	Check that the supports for the gaugewell are welded to pad or to shell and not directly to bottom plate
N/A	Check operation of gaugewell cover
N/A	Check presence of a hold-off distance marker in well pipe and record hold-off distance _____ Hold-Off Distance
N/A	Identify and report size and pipe schedule, and whether pipe is solid or slotted. Report slot size
N/A	Check that the hold-off distance plate is seal welded to the bottom and that any gaugewell supports are welded to the plate and not directly to the bottom
N/A	Inspect vapor control float and cable
N/A	Check for presence and condition of gaugewell washer
N/A	Check for bull plug or plate blind on gaugewell washer valve
N/A	Inspect gaugewell guide in floating roof for pitting and thinning
N/A	Inspect the guide rollers and sliding plates for freedom of movement
N/A	Inspect condition of gaugewell pipe seal system
N/A	On black oil and diesel services: if gaugewell is also used for sampling, check for presence of a thief- and gauge-type hatch to avoid spillage
N/A	Visually inspect inside of pipe for pipe weld protrusions which could catch or damage vapor control float

Remarks: _____

_____

Sampling Systems: Roof Sample Hatches

OK	Inspect roof mounted sample hatches for reinforcing pads and cracking
OK	Inspect cover for operation
N/A	For tanks complying with Air Quality Monitoring District rules, inspect sample hatch covers for adequate sealing
N/A	Check horizontal alignment of internal floating roof sample hatches under fixed roof hatches
N/A	Inspect the sealing system on the internal floating roof sample hatch cover
N/A	Inspect floating roof sample hatch cover recoil reel and rope

Remarks: _____

_____

Shell Nozzles

OK	Inspect shell nozzles for thinning and pitting
OK	Inspect hot tap nozzles for trimming of holes
OK	Identify type of shell nozzles
OK	Identify and describe internal piping, including elbow up and elbow down types

Remarks: _____

_____

For Nozzles Extended into the Tank

OK	Inspect pipe support pads welded to tank bottom
OK	Inspect to see that pipe is free to move along support without strain or tearing action on bottom plate
OK	Inspect nozzle valves for packing leaks and damaged flange faces
OK	Inspect heater steam nozzle flanges and valves for wire cutting
OK	Report which nozzles have thermal pressure relief bosses and valves
N/A	In internal elbow-down fill line nozzles, inspect the wear plate on the tank bottom
N/A	On elbow-up fill lines in floating roof tanks, check that opening is directed against underside of roof, not against vapor space. Inspect impact area for erosion

Remarks: _____

_____

Diffusers and Air Rolling Systems

N/A	Inspect diffuser pipe for erosion and thinning
N/A	Check holes in diffuser for excessive wear and enlargement
N/A	Inspect diffuser supports for damage and corrosion
N/A	Check that diffuser supports restrain, not anchor, longitudinal line movement
N/A	Inspect air spiders on bottom of lube oil tanks for plugging and damaged or broken threaded joints

Remarks: _____

_____

Swing Lines

N/A	Inspect flexible joint for cracks and leaks
N/A	Scribe the flexible joint across the two moving faces and rise end of swingline to check the joint's freedom of movement, indicated by separation of scribe marks
N/A	Check that flexible joints over six inches are supported
N/A	Inspect the swing pipe for deep pitting and weld corrosion
N/A	Loosen the vent plugs in the pontoons and listen for a vacuum. Lack of a vacuum indicates a leaking pontoon
N/A	Check the results of air test on pontoons during repairs
N/A	Inspect the pontoons for pitting
N/A	Inspect the pull-down cable connections to the swing
N/A	Inspect the condition of the bottom-mounted support, fixed roof limiting bumper, or shell mounted limiting bumper of wood condition, weld and bolt corrosion, and seal welding to bottom or shell
N/A	Inspect safety hold-down chain for corrosion and weak links
N/A	Check that there is a welded reinforcing pad where the chain connects to the bottom
N/A	If the floating swing in a floating or internal floating roof does not have a limiting device preventing the swing from exceeding 60 degrees, measure and calculate the maximum angle possible with the roof on overflow

_____ Maximum angle on overflow

(If the calculated angle exceeds 65 degrees, recommend installation of a limiting bracket)

N/A Inspect pull down cable for fraying

N/A Inspect for three cable clamps where cable attaches to end of swingline (single-reeved) or to roof assembly (double-reeved).

Inspect sheaves for freedom of movement

N/A Inspect winch operation and check the height indicator for legibility and accuracy

N/A Inspect bottom-mounted sheave assembly at end of pontoon for freedom of rotation of sheave

N/A Inspect shell mounted lower sheave assembly for freedom of rotation of sheave, corrosion thinning, and pitting of sheave housing

N/A Inspect upper sheave assembly for freedom of movement of sheave

N/A Inspect the cable counterbalance assembly for corrosion and freedom of operation

Remarks: _____

Manway Heater Racks

N/A Inspect the manway heater racks for broken welds and bending of the sliding rails

N/A Measure and record the length of the heater and length of the track

Remarks: _____

Mixer Wear Plates and Deflector Stands

N/A Inspect bottom and shell plates and deflector stands

N/A Inspect for erosion and corrosion on the wear plates. Inspect for rigidity, structural soundness, corrosion, and erosion of deck plates and reinforcing pads that are seal welded to the bottom under the deflector stand legs

N/A Measure for propeller clearance between the bottom of deflector stand and roof when the roof is on low legs

Remarks: _____

ACCESS STRUCTURES

Handrails

* Identify and report type (steel pipe, galvanized pipe, square tube, angle) and size of handrails

OK Inspect for pitting and holes, pain failure

OK Inspect attachment welds

OK Identify cold joints and sharp edges. Inspect the handrails and midrails

OK Inspect safety drop bar (or safety chain) for corrosion, functioning and length

N/A Inspect the handrail between the rolling ladder and the gauging platform for a hazardous opening when the floating roof is at its lowest level

Remarks: *2½" steel angle

Platform Frame

OK Inspect frame for corrosion and paint failure
* Inspect the attachment of frame to supports and supports to tank; for corrosion and weld failure
OK Check reinforcing pads where supports are attached to shell or roof
OK Inspect the surface that deck plate or grating rests on, for thinning and holes
OK Check that flat-surface to flat-surface junctures are seal welded

Remarks: *minor paint failure

Deck Plate and Grating

OK Inspect deck plate for corrosion-caused thinning or holes (not drain holes) and paint failure
OK Inspect plate-to-frame weld for rust scale buildup
OK Inspect grating for corrosion-caused thinning of bars and failure of welds
OK Check grating tie-down clips. Where grating has been retrofitted to replace plate, measure the rise of the step below and above the grating surface and compare with other risers on the stairway

Remarks:

Stairway Stringers

OK Inspect spiral stairway stringers for corrosion, paint failure, and weld failure. Inspect attachment of stairway treads to stringer
OK Inspect stairway supports to shell welds and reinforcing pads
N/A Inspect steel support attachment to concrete base for corrosion

Remarks:

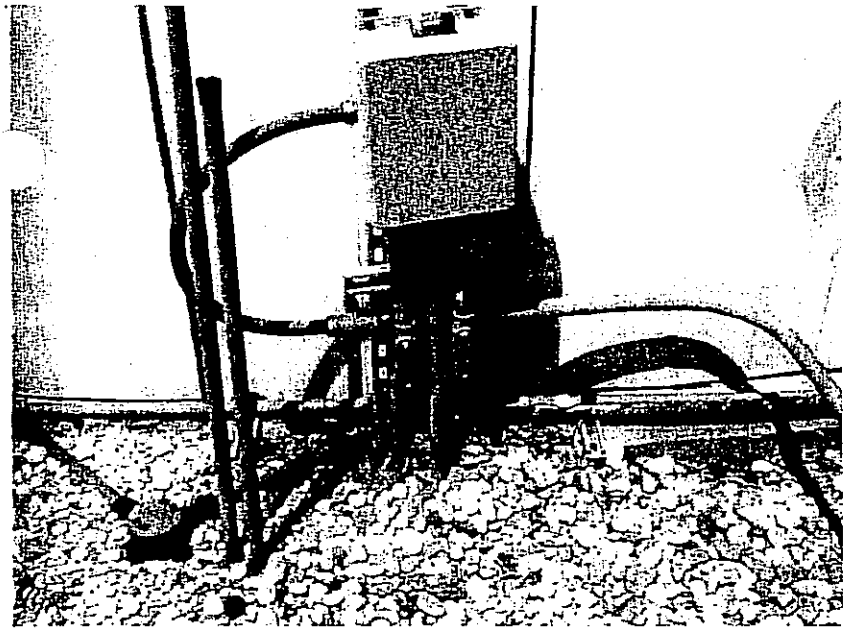
Rolling Ladder

N/A Inspect rolling ladder stringers for corrosion
N/A Identify and inspect ladder fixed rungs (square bar, round bar, angles) for weld attachment to stringers and corrosion, particularly where angle rungs are welded to stringers
N/A Check for wear and corrosion where rolling ladder attaches to gauging platform
N/A Inspect pivot bar for wear and secureness

N/A	Inspect operation of self-leveling stairway treads
N/A	Inspect for corrosion and wear on moving parts
N/A	Inspect rolling ladder wheels for freedom of movement, flat spots, and wear on axle
N/A	Inspect alignment of rolling ladder with roof rack
N/A	Inspect top surface of rolling ladder track for wear by wheels to assure at least 18 inches of unworn track (track long enough)
N/A	Inspect rolling ladder track welds for corrosion
N/A	Inspect track supports on roof for reinforcing pads seal welded to deck plate
N/A	Check, by dimensioning, the maximum angle of the rolling ladder when the roof is on low legs Maximum angle: _____
N/A	If rolling ladder track extends to within five feet of the edge of the roof on the far side, check for a handrail on the top of the shell on that side

Remarks: _____

VI. PHOTOGRAPHS



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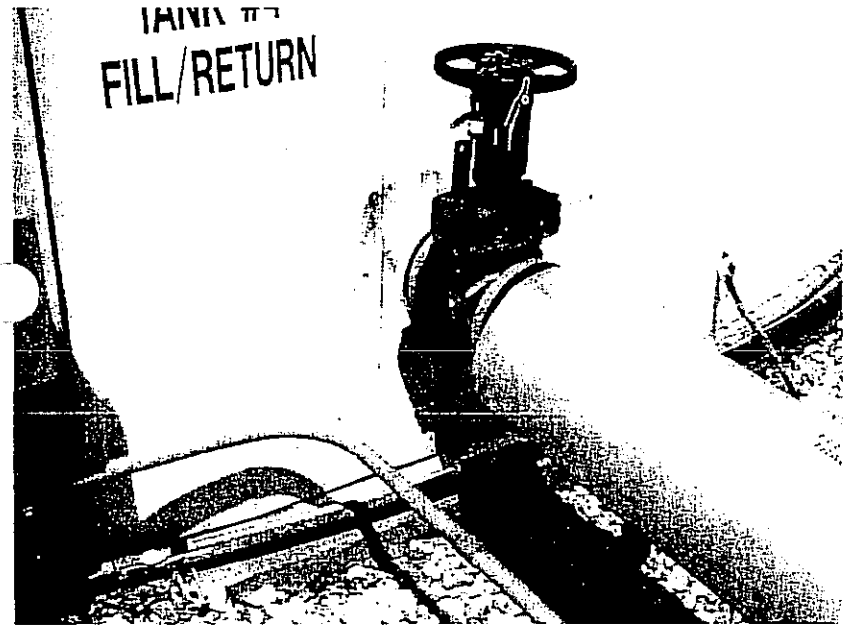
Tank No. 4 - cathodic protection junction box



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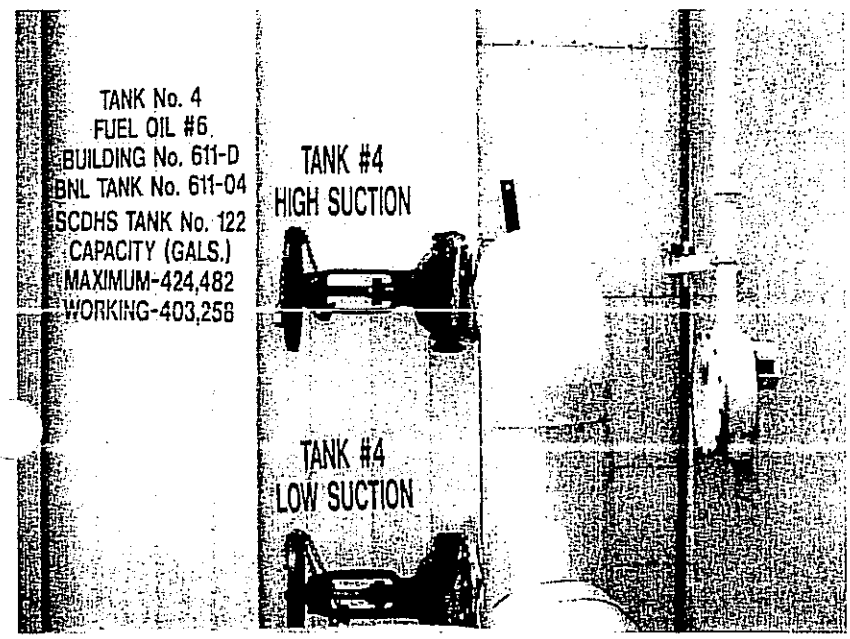
Fill / return line



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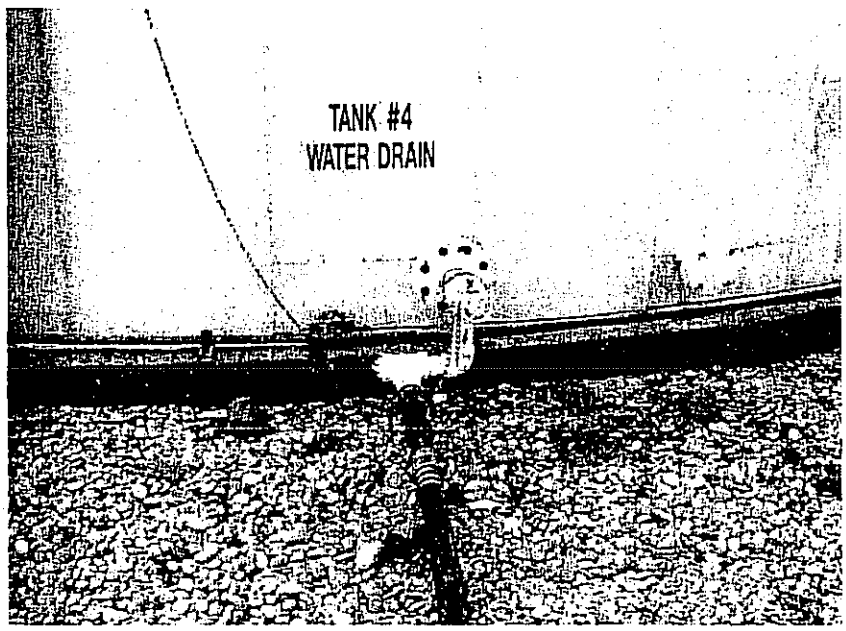
High and low suction

P5150089.JPG
5/15/03
Auto gauge



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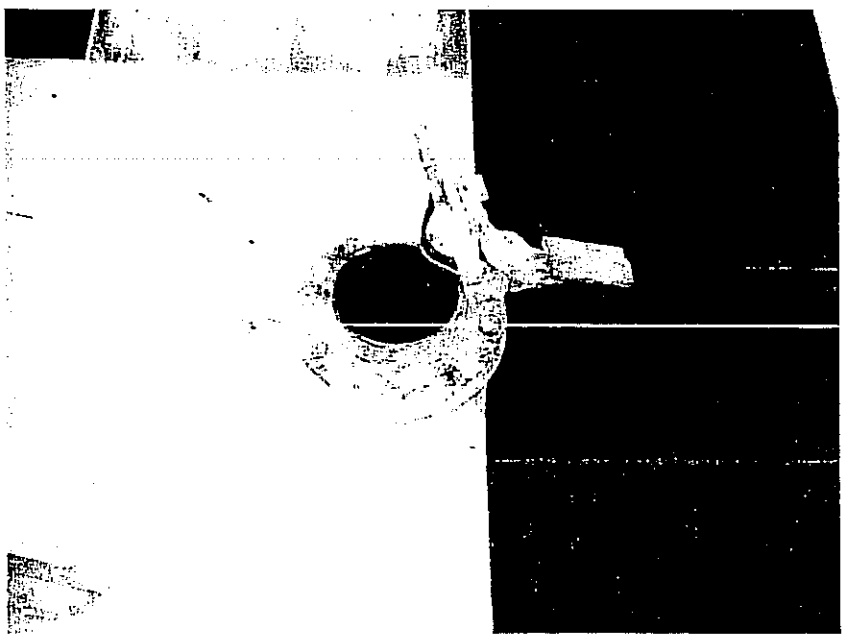
Water draw-off



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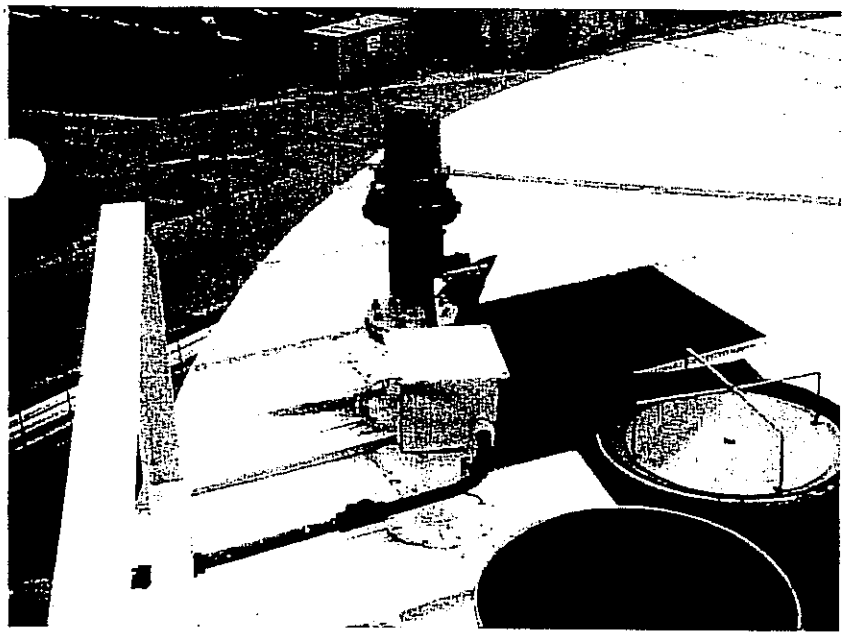
Sample hatch



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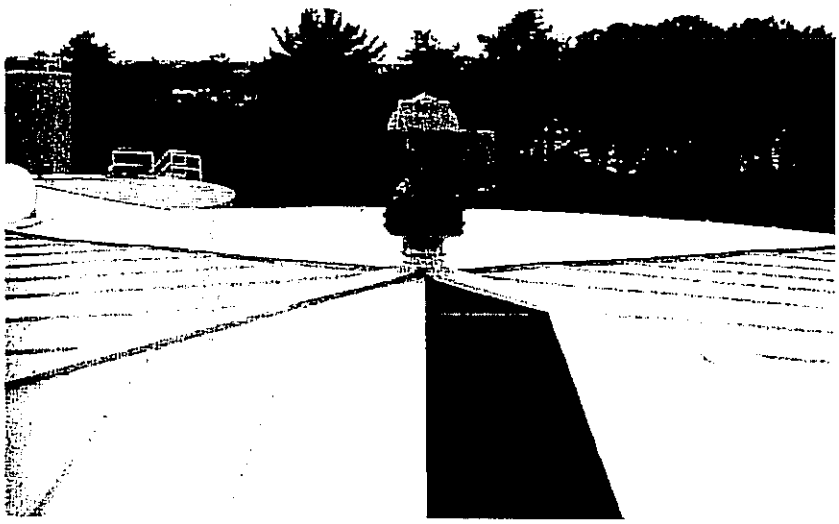
High level / overfill alarm



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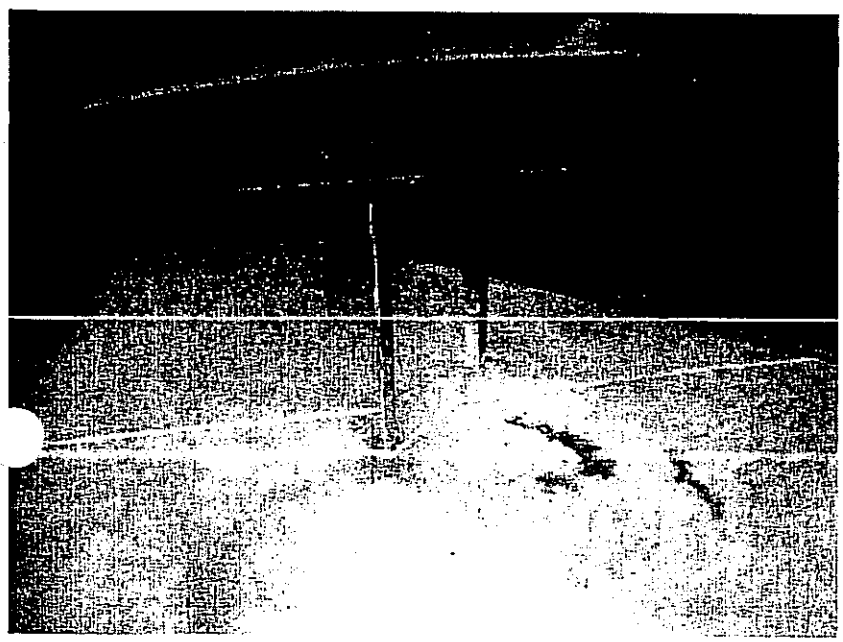
Pressure/vacuum vent with flame arrestor



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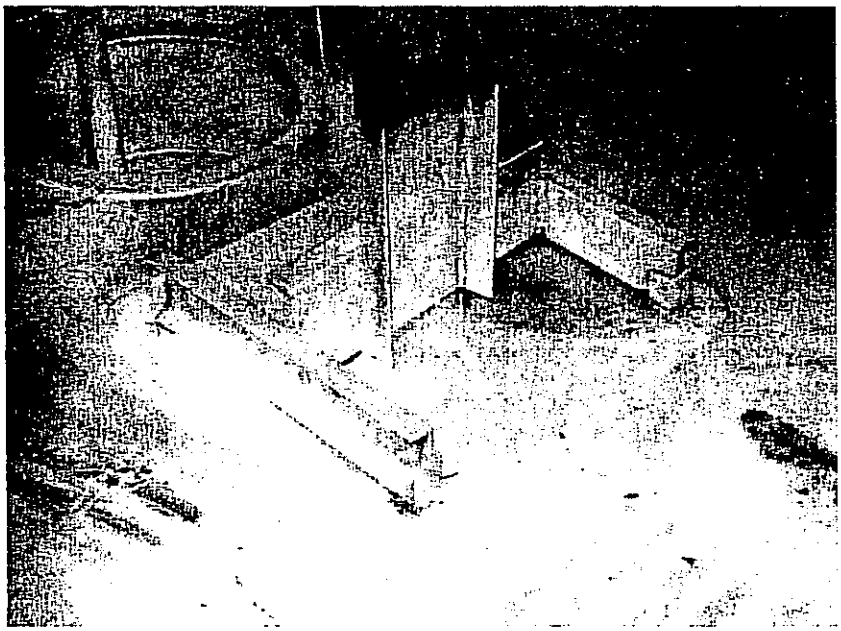
6/2/03
Heating coils



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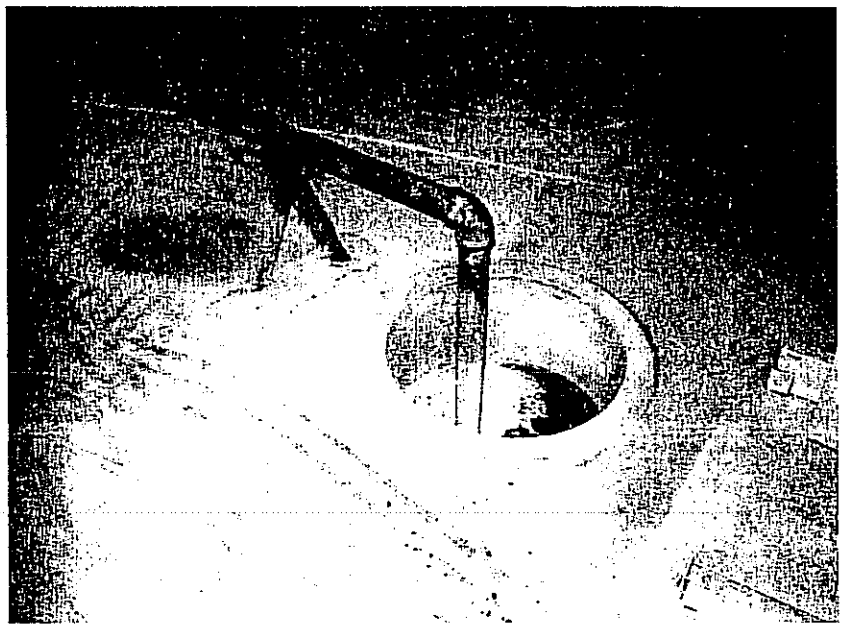
6/2/03
Center column



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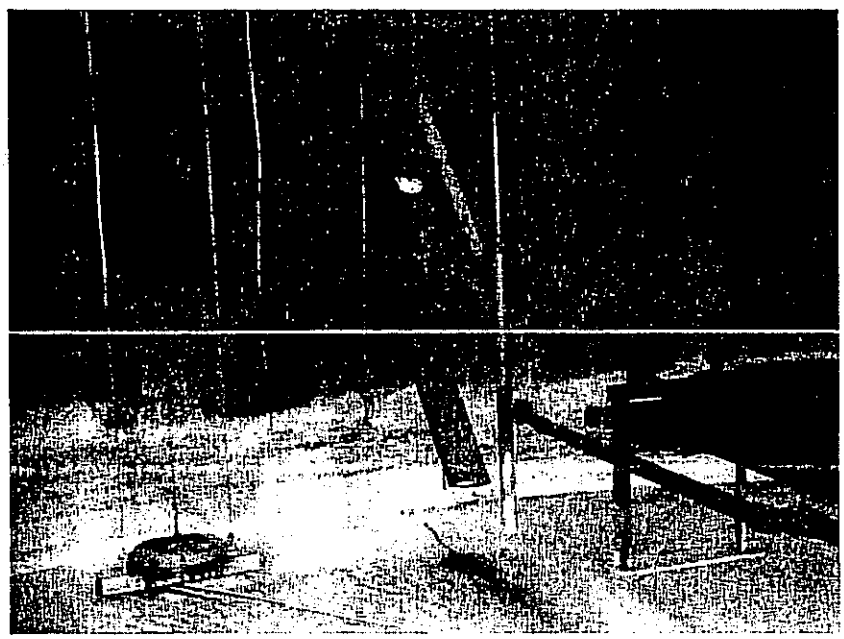
Water draw-off



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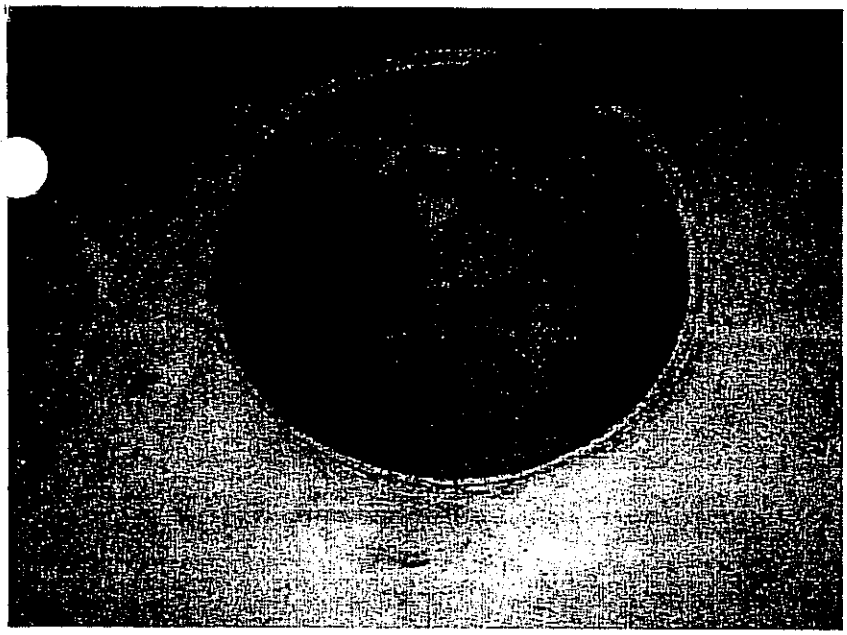
6/2/03
Gauging float



P6020019.JPG
6/2/03
Sump

VII. RECOMMENDATIONS

As a result of the findings disclosed in the inspection of Tank No. 4, PCA Engineering, Inc. makes the following recommendations:

- Monitor tank return-to-service filling on an hourly basis until full working head is attained and allow for a 24-hour static period.

The maximum interval until the next internal inspection would be 7 years based on the attached calculation, Suffolk County/New York Department of Environmental Conservation Regulations, the available data, and assumes completion of above repairs, operation under the same service and operating conditions. This does not preclude regular in-service inspection by terminal personnel and qualified inspector, and it is not a guarantee of future performance.

All repairs should be completed per API 650, 653 and other applicable Standards. An inspection of all repairs should be performed prior to return to service.

VII. RECOMMENDATIONS (Cont'd)

Based on the extent of the inspections performed on Tank No. 4, the test results indicate no substantial corrosion or defects above and beyond that noted, as of the test date of June 2, 2003. This is not to be construed as an expressed or implied warranty of future performance.

Brookhaven National Laboratory
Tank No. 4
June 2, 2003
PCA Job No. 23089

Peter Seastrand

PETER SEASTRAND
PCA ENGINEERING, INC.

WILLIAM M. KENT
PCA ENGINEERING, INC.
API Certification No. 297

STATE OF NEW YORK
DANIEL R. KOGUT
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LICENSED PROFESSIONAL ENGINEER

DANIEL KOGUT
PCA ENGINEERING, INC.
NY P.E. No. 069049

PS:lms

Notwithstanding anything contained in this report, nothing herein shall be construed as a representation, warranty or guarantee, either expressed or implied, regarding the future structural integrity or future life expectancy of any of the items tested. This report and any analysis provided is in all respects subject to and shall be interpreted within the limitations and parameters of the test procedures performed. In the event testing is performed using a sampling procedure, this report and any analysis shall be limited to those areas actually tested and the type of test conducted, and the customer is cautioned not to extrapolate the results of the test samples.

Prepared for:

Brookhaven National Laboratories
70 Bell Avenue, Building 134C
Upton, NY 11973

Out-of-Service Inspection of Tank No. 5 located at the Brookhaven National Laboratory Upton, New York Facility on October 27 & November 5, 2003

Prepared by:

PCA Engineering, Inc.
430 Montclair Avenue
P.O. Box 196
Pompton Lakes, NJ 07442

PCA Job No. 23089

February 13, 2004

PHASE I REPORT

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API-653 Section 2.3

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VII. RECOMMENDATIONS

I. INTRODUCTION AND BACKGROUND

On October 27, 2003 and November 5, 2003, PCA Engineering, Inc. personnel performed an Internal Out-of-Service Inspection on Tank No. 5 located at the Brookhaven National Laboratory, Upton, New York Terminal.

The Brookhaven National Laboratory, Upton, New York Facility Registration Number for New York State is 01-1700. The inspection of Tank No. 5 conforms to Section 6NYCRR, Part 613.6 "Handling and Storage of Petroleum", New York State Department of Conservation.

The inspection performed is in compliance with the API 653 Standard.

An Industrial Scientific Model ATX-6 was used for vapor monitoring prior to and during entry. Prior to entry, the oxygen content was found to be 20.9% and the lower flammability level (LFL) 0%. These are considered non-hazardous and the interior inspection proceeded. All product lines were checked and found to be blinded or locked out.

PCA personnel on site were all currently trained in Hazardous Entry and Confined Space Entry training.

SITE DESCRIPTION

Tank No. 5 is a welded, above ground, upright, cylindrical storage tank measuring 38 feet in diameter by 35 feet in height. The tank was erected in 1983 and has a product capacity of 7,200 barrels. The product content during the last period of service was No. 2 fuel oil.

The tank floor is fabricated of 11 lap welded carbon steel plates. The tank shell is arranged in 4 butt-welded courses, with 5 plates per course. The tank fixed roof is fabricated of 18 lap welded plates arranged in a cone configuration.

The tank is located within an earthen dike secondary containment area. The dike area has a bentonite mixed soil lining system, as indicated on BNL supplied drawings.

TEST PROCEDURES

The following is a list of the tests performed and their procedures involved in the inspection of Tank No. 5:

A) Ultrasonic Thickness Measurements

To obtain the residual metal thickness readings, either a Cygnus Model 3 or Cygnus Model 4 Ultrasonic Digital Thickness Gauge, with a 2.25 MHz transducer was used. The Cygnus Model 3 has a resolution of +/- 0.002 inch; the Cygnus Model 4 has a resolution of +/- 0.005 inch, accuracy allowing for use on steel plate/piping materials used in storage tanks. The calibration of the instrument is confirmed prior to and during testing using a steel step block. The couplant used was Sonotech UT-X and/or motor oil.

A minimum of five (5) ultrasonic thickness readings were taken at each floor plate, with five (5) additional readings taken adjacent to the floor/shell joint on approximately 2 foot intervals. A W. R. Thorpe Pit Gauge was available to measure any pit depths, with readings taken at the point of deepest penetration. All ultrasonic thickness readings and pitted areas are noted on the enclosed data tables. The arrangement of the floor plates is shown on the enclosed PCA drawings.

TEST PROCEDURES (Cont'd)

A minimum of five (5) ultrasonic thickness readings were taken at each plate of the lower course of shell plates and each plate adjacent to the spiral stairway ascending to the roof, with readings tabulated on the enclosed data tables. The arrangement of the shell appurtenances is shown on the enclosed PCA drawings.

As an appurtenance survey, ultrasonic thickness measurements were taken on principle pipe penetrations and their API plates within the lower course of shell plates.

Ultrasonic thickness readings of the roof were taken at a minimum of five (5) readings per plate.

B) Holiday Inspection (Spark Test)

The epoxy coating of the tank floor was tested for overall integrity using a Tinker & Rasor Model M/1 Sponge Tester. The sponge tester operates on the principle of applying a fixed amount of D.C. current (67.5 volts) to the epoxy coated floor through a water saturated sponge.

TEST PROCEDURES (Cont'd)

With the instrument grounded to any area of bare steel electrically continuous with the floor, any holiday or defect in the epoxy would allow passage of water to the steel floor plates, thus completing the circuit. This would energize the buzzer, indicating to the operator the location of any defect in the epoxy coating.

C) Interior Perimeter Elevation Survey

The interior survey is based on an assumed datum of 10 feet, as shown on the "Interior Elevation Survey", with measurements shown clockwise or counter-clockwise around the tank. Cross sections are taken at various intervals around the tank, as shown on the drawing.

The interior elevation survey is helpful in evaluating the condition of the floor plates. Low spots are areas of drastic grade changes, as indicated on the drawing, are potential areas of excessive stresses in the floor plates, and indications of possible loss of sub-structure support. Elevation cross sections are helpful to analyze this data.

D) Magnetic Flux Leakage Floor Scan

The tank floor was inspected using a Magnetic Flux Leakage Floor Scan (MFL and/or MFE).

The Magnetic Flux Leakage floor scanner operates using permanent rare-earth magnets to bring a section of the steel floor plate to magnetic saturation. A defect, located on front or back surfaces, causes a scattering of the magnetic "lines of force" or flux. Sensors located between the magnets detect this flux leakage and display the result on a display screen.

MFL/MFE inspection is a qualitative inspection tool, which primarily detects plate cross-sectional volume loss (as opposed to remaining thickness) and correlates this as an amplitude display.

An observed significant indication is evaluated by the technicians using ultrasonic equipment for quantitative classification.

The Magnetic Flux Leakage Scan covers the majority of the tank floor plate, with the exception of the areas within 4 to 6 inches of the lap welds, corner welds, lap patches, columns, etc. Any additional areas not scanned are marked on the tank floor drawing.

II. SUMMARY OF FINDINGS

Upon completion of the inspections conducted on Tank No. 5, the following results were obtained:

Ultrasonic Thickness Inspection

The residual plate metal thickness measurements ranged as follows:

Floor:	.248″ to .268″	
Shell:	.252″ to .268″	(1st Course)
	.258″ to .264″	(2nd Course)
	.248″ to .256″	(3rd Course)
	.252″ to .256″	(4th Course)
Roof:	.164″ to .200″	

Holiday Inspection

The original epoxy floor coating system was evaluated by a holiday test (low voltage). It was found to be in poor condition, with general porosity across the surfaces.

Addendum: A subsequent holiday inspection was performed on November 5, 2003. The newly applied poly-urea coating was inspected for holidays and no discontinuities were observed. A copy of the letter report is attached in the data section of the report.

SUMMARY OF FINDINGS (Cont'd)

Interior Perimeter Elevation Survey

The perimeter elevations (shell settlement) indicate a maximum differential of 0.36 feet (4.32 inches). The settlement is considered planar tilt, with the maximum out-of-plane deflection of 0.01 feet (0.12 inch). The maximum permissible out-of-plane deflection per API 653, B.3.2 is 0.04 feet (0.48 inch).

There are no visible indications of tank shell or floor stress, or recent/active displacement of fill material from around or under the tank. This information, in conjunction with the tank's age (20 years +/-), would indicate the tank has reached its maximum settlement with no changes in deflections anticipated, based on current operational procedures and site conditions.

The internal cross section elevation results disclosed edge settlement with a typical radius of 3 feet. The maximum edge settlement observed was 1.92 inches, which is within 75% of the allowable settlement as noted in API 653, Figure B-10 and Figure B-11. Settlement between 75 and 100 percent of allowable requires further inspection, while settlement in excess of the allowable requires repair or engineering evaluation.

Magnetic Flux Leakage Floor Scan

Results of the magnetic flux scan of the tank floor revealed no areas of repeatable indications.

III. DISCUSSION

As a result of the inspection performed, the following deficiencies were observed:

Interior

- There is no seal welded wear plate under the elbow down fill line.
- The gauge well pipe is not secured to the floor.
- The integrity of the epoxy floor coating has been compromised.

Exterior

- The spiral stairway steps are not fully welded to the shell; moisture intrusion/scaling is evident.
- Overall paint failure of the roof top coat was evident.

On November 5, 2003 an inspection was performed on Tank No.5. The following results were obtained:

- A recently applied poly-urea coating was installed on the tank floor and up three (3) feet of the tank shell. The poly-urea film coating was tested with a spark tester, determining that there were no discontinuities in the coating.
- The spiral stairway steps were fully seal welded to the tank shell.

III. DISCUSSION (Cont'd)

- The still well pipe has been secured to the shell.
- A seal welded wear plate has been installed under the elbow down fill line.

IV. TEST DATA

CORROSION SURVEY FIELD DATA TABLE

OWNER: Brookhaven National Labs
STRUCTURE: Tank No. 5
DATE OBTAINED: June 11, 2002
SURVEYED BY: W. Kent

Ultrasonic Thickness Measurements
Tank Floor - In Inches

PCA JOB NO. 22213

	1	2	3	4	5
Plate No. 1	0.262	0.256	0.260	0.260	0.260
	0.260	0.258	0.256	0.254	
Plate No. 2	0.264	0.260	0.256	0.260	0.260
	0.262	0.262	0.260	0.262	
Plate No. 3	0.268	0.266	0.268	0.264	0.268
	0.264	0.264	0.268	0.264	
Plate No. 4	0.252	0.252	0.252	0.252	0.256
	0.256	0.258	0.254	0.256	
Plate No. 5	0.252	0.256	0.254	0.254	0.256
	0.254	0.260	0.252	0.256	
Plate No. 6	0.260	0.258	0.262	0.256	0.256
Plate No. 7	0.256	0.258	0.252	0.260	0.260
	0.254	0.256	0.260	0.256	
Plate No. 8	0.252	0.260	0.260	0.256	0.254
	0.252	0.256	0.248	0.252	

minimum	0.248
average	0.259
maximum	0.268

CORROSION SURVEY FIELD DATA TABLE

OWNER: Brookhaven National Labs
STRUCTURE: Tank No. 5
DATE OBTAINED: June 11, 2002
SURVEYED BY: W. Kent

PCA JOB NO. 22213

Ultrasonic Thickness Measurements
Tank Floor - In Inches

		1	2	3	4	5
Sump	Floor	0.396	0.396	0.394	0.392	0.392
	Wall	0.380	0.380	0.382	0.380	0.382
Plate No. 9		0.260	0.264	0.264	0.262	0.264
		0.264	0.266	0.262	0.264	
Plate No. 10		0.260	0.264	0.260	0.260	0.264
		0.260	0.260	0.264	0.260	
Plate No. 11		0.260	0.264	0.258	0.262	0.264
		0.264	0.264	0.264	0.262	

CORROSION SURVEY FIELD DATA TABLE

OWNER: Brookhaven National Labs
STRUCTURE: Tank No. 5
DATE OBTAINED: June 11, 2002
SURVEYED BY: W. Kent

PCA JOB NO. 22213

Ultrasonic Thickness Measurements
Tank Shell - In Inches

	1	2	3	4	5
Plate No. 1	0.260	0.260	0.262	0.260	0.260
Plate No. 2	0.264	0.262	0.260	0.260	0.262
Plate No. 3	0.268	0.268	0.264	0.264	0.264
Plate No. 4	0.260	0.258	0.260	0.254	0.254
Plate No. 5	0.258	0.258	0.254	0.252	0.252

minimum	0.252
average	0.260
maximum	0.268

Shell Wall Profile

Course No. 1	0.262	0.264	0.264	0.260	0.260
Course No. 2	0.264	0.260	0.264	0.260	0.258
Course No. 3	0.252	0.256	0.256	0.252	0.248
Course No. 4	0.252	0.252	0.256	0.256	0.252

CORROSION SURVEY FIELD DATA TABLE

OWNER: Brookhaven National Labs
STRUCTURE: Tank No. 5
DATE OBTAINED: June 11, 2002
SURVEYED BY: W. Kent

PCA JOB NO. 22213

Appurtenance Survey
In Inches

	Top	Side	Bottom	Side
24" Manway	0.316	0.312	0.312	0.316
API	0.322	0.320	0.224	0.322
3" Inlet	0.308	0.304	0.312	0.312
API	0.312	0.316	0.316	0.312
3" Shell Nozzle	0.308	0.308	0.292	0.292
API	0.316	0.316	0.318	0.320
4" Nozzle	0.340	0.340	0.348	0.340
API	0.322	0.322	0.320	0.324
3" Nozzle	0.300	0.296	0.308	0.298
API	0.312	0.316	0.316	0.312
4" Water Draw-Off	0.336	0.336	0.344	0.336
API	0.320	0.320	0.324	0.320
2" Return	0.202	0.210	0.212	0.206

CORROSION SURVEY FIELD DATA TABLE

OWNER: Brookhaven National Labs
STRUCTURE: Tank No. 5
DATE OBTAINED: June 11, 2002
SURVEYED BY: W. Kent

PCA JOB NO. 22213

Appurtenance Survey
In Inches

	Top	Side	Bottom	Side
6" Upper Suction	0.440	0.444	0.444	0.440
API	0.316	0.312	0.316	0.320
6" Lower Suction	0.440	0.436	0.440	0.434
API	0.312	0.314	0.312	0.320
4" Nozzle	0.360	0.358	0.364	0.360
API	0.320	0.320	0.322	0.320

CORROSION SURVEY FIELD DATA TABLE

OWNER: Brookhaven National Labs
STRUCTURE: Tank No. 5
DATE OBTAINED: June 11, 2002
SURVEYED BY: W. Kent

Ultrasonic Thickness Measurements
Tank Roof - In Inches

PCA JOB NO. 22213

	1	2	3	4	5
Plate No. 1	0.188	0.184	0.186	0.186	0.188
Plate No. 2	0.188	0.184	0.192	0.188	0.192
Plate No. 3	0.188	0.192	0.192	0.188	0.190
Plate No. 4	0.184	0.184	0.184	0.184	0.186
Plate No. 5	0.188	0.184	0.188	0.186	0.188
Plate No. 6	0.188	0.184	0.188	0.186	0.188
Plate No. 7	0.168	0.164	0.172	0.168	0.168
Plate No. 8	0.188	0.172	0.170	0.180	0.176
Plate No. 9	0.188	0.184	0.190	0.188	0.188
Plate No. 10	0.192	0.192	0.192	0.192	0.192
Plate No. 11	0.176	0.176	0.184	0.178	0.184
Plate No. 12	0.178	0.178	0.184	0.184	0.178
Plate No. 13	0.188	0.184	0.184	0.188	0.184
Plate No. 14	0.186	0.188	0.188	0.190	0.186
Plate No. 15	0.188	0.188	0.192	0.188	0.188
Plate No. 16	0.192	0.192	0.190	0.192	0.190
Plate No. 17	0.196	0.200	0.200	0.196	0.196
Plate No. 18	0.196	0.196	0.200	0.196	0.196

minimum	0.164
average	0.186
maximum	0.200

CORROSION SURVEY FIELD DATA TABLE

OWNER: Brookhaven National Labs
STRUCTURE: Tank No. 5
DATE OBTAINED: June 11, 2002
SURVEYED BY: W. Kent

Elevation Survey

PCA JOB NO. 22213

	Shell	1'	2'	3'	4'	5'	10'	Center
A	10.00	9.97	9.91	9.83	9.81	9.80	9.75	9.71
B	9.95	9.90	9.84	9.80	9.78	9.75	9.78	
C	9.81	9.81	9.79	9.76	9.80	9.82	9.76	
D	9.64	9.66	9.69	9.73	9.75	9.74	9.75	
E	9.56	9.55	9.56	9.57	9.54	9.59	9.63	
F	9.59	9.58	9.59	9.61	9.65	93.68	9.71	
G	9.73	9.69	9.67	9.68	9.68	9.67	9.63	
H	9.91	9.85	9.80	9.75	9.73	9.71	9.73	
A	10.00							

API 653 INSPECTION - DATA EVALUATION

GENERAL INFORMATION

Customer: Brookhaven National Labs Job No.: 22213 Date: 6/11/02

Tank No.: 5
Diameter: 38 feet
Height: 35.5 feet
Safe Fill: _ feet
Capacity: 7,247 bbl
Product: No. 2 Fuel Oil

Cathodic Protection?: y
Leak Detection?: n
Thick FilmCoating?: n
Thin Film Coating?: y

Erected: 1/1/84
Date Last- Inspected: 5/1/96
Cleaned:
Painted:
Lined:
Strapped:

	Quantities:
Floor plts:	11
Roof plts:	18
Shell crs:	4
Plts/Crs:	5

1st Crse Avg Shell Thickness (in)	
1st	0.258
2nd	0.258
Min Thick	0.252
4th	0.254
5th	0.252

	PlateThickness (in)					
	Original	General	Delta	Minimum	Material	Riveted?
Floor Plates:	0.268	0.259	0.009	0.248	Unknown	n
Sketch Plates:			0.000			
Annular Plates:			0.000			
Shell - 1st course:	0.268	0.260	0.008	0.252	Unknown	n
2nd course:	0.264	0.261	0.003	0.258	Unknown	n
3rd course:	0.256	0.253	0.003	0.248	Unknown	n
4th course:	0.256	0.254	0.002	0.252	Unknown	n
5th course:			0.000			
6th course:			0.000			
7th course:			0.000			
8th course:			0.000			
Roof:	0.200	0.186	0.014	0.164	Unknown	n

	Pitting Depth (in)			
	Max Int.	Avg Int.	Max Ext.	Avg Ext.
Floor Plates:	0.007	0.005	0.009	0.008
Shell - 1st course:	0.006	0.005	0.005	0.004
Roof:	0.009	0.007	0.006	0.005

Containment Area:

Steel? _____
Diameter _____ feet
Height _____ feet

Containm _____ bbl
110% Cap _____

Earthen? y
Length 135 feet
Width 97 feet
Height 5 feet
Containment 11,786 bbl
110% Cap 7,972 Sufficient Containment if tank is filled to capcity

Calculated Safe Fill (based on capacity of containment) 52.48 feet
Therefore, containment is sufficient if current Safe Fill is maintained

COMMENTS:

PCA ENGINEERING, INC.

BOTTOM PLATE TOPOGRAPHY

Tank: 5
Diameter: 38

No of Sections: 8
Max Chord Length: 14.92 ft

Elevation @ Center of Tank: 9.71 ft
Average Pitch: 0.04 in/ft
Overall Differential Settlement 5.28 in

Allowable Roll-Off	
in 1'	0.41 in
in 2'	0.78 in
in 3'	1.15 in

Spacing	AXIS 1		AXIS 2		AXIS 3		AXIS 4		AXIS 5		AXIS 6	
	Field Data	Roll-Off	Field Data	Roll-Off	Field Data	Roll-Off	Field Data	Roll-Off	Field Data	Roll-Off	Field Data	Roll-Off
Shell	10.00		9.95		9.81		9.64		9.56		9.59	
1'	9.97	0.36	9.90	0.60	9.81	0.00	9.66	0.24	9.55	0.12	9.58	0.12
2'	9.91	1.08	9.84	1.32	9.79	0.24	9.69	0.60	9.56	0.00	9.59	0.00
3'	9.83	2.04	9.80	1.80	9.76	0.60	9.73	1.08	9.57	0.12	9.61	0.24
5'	9.80		9.75		9.82		9.74		9.59		9.68	
10'	9.75		9.78		9.76		9.75		9.63		9.71	
20'												
30'												
40'												
50'												
60'												
70'												
80'												
90'												
Settlement	0		0.05		0.19		0.36		0.44		0.41	

Spacing	AXIS 7		AXIS 8		AXIS 9		AXIS 10		AXIS 11		AXIS 12	
	Field Data	Roll-Off	Field Data	Roll-Off	Field Data	Roll-Off	Field Data	Roll-Off	Field Data	Roll-Off	Field Data	Roll-Off
Shell	9.73		9.91									
1'	9.69	0.48	9.85	0.72		0.00		0.00		0.00		0.00
2'	9.67	0.72	9.80	1.32		0.00		0.00		0.00		0.00
3'	9.68	0.60	9.75	1.92		0.00		0.00		0.00		0.00
5'	9.67		9.71									
10'	9.63		9.73									
20'												
30'												
40'												
50'												
60'												
70'												
80'												
90'												
Settlement	0.27		0.09									

PCA ENGINEERING,INC.

TANK SHELL EVALUATION API 653 SECTION 2.3

Tank: 5 Date: 6/11/02

Diameter: 38 feet
Height: 35.5 feet
t_1(avg.): 0.255 inches
t_2: 0.252 inches

Field data:
0.258
0.258
0.252
0.254
0.252
t_1= 0.255

Thickness Determination:

$L=3.7(D*t_2)^{1/2}$

Where: L= the maximum vertical length, in inches, over which hoop streees are assumed to "average out" around local discontinuities

D= tank diameter, in feet

t_2= the least thickness, in inches, in area of corrosion, exclusive of pits

L= 11.44969 inches

Minimum Thickness Calculation for Welded Tank Shell:

Course No. 1

t_{min}= **2.6DHG/SE** = **0.145 inches**

Where:

t_{min}= the minimum acceptable thickness, in inches, as calculated from the above formula; however, t_{min} shall not be less than 0.1 inch for tank course

D= nominal diameter of tank, in feet

H= Height, in feet, from the bottom of length *L* for the most severely corroded area in each shell course to the maximum design liquid level

G= highest specific gravity of the contents (including water, if hydtsted)

S= maximum allowable stress in psi; use the smaller of 0.80Y or 0.426T for bottom and second course; use the smaller of 0.88Y or 0.472T for all other courses

Y= specified minimum yield strength of the plate; 30,000 psi if unknown

T= the smaller of the specified minimum tensile strength of the plate or 80,000 psi; use 55,000 psi if unknown

E= original joint efficiency for the tank. use E=0.7 if unknown, E=1.0 when evaluating the retirement thickness in a corroded plate, when away from welds or joints by at least the greater of 1 inch or twice the plate thickness

NOTE: For riveted tanks see section 653.2.3.4; see section 653.2.3.3 for complete explanation

D =	38 feet	G =	1.0	Y =	30,000 psi
H =	35.5 feet	S =	23,430 psi	T =	55,000 psi
				E =	1.0

Then, per API653 section 2.3.3.1:

If:	a:	t_1	>=	t_{min}
		0.255	>=	**0.145**
and				
	b:	t_2	>=	60% t_{min}
		0.252	>=	**0.087**

THEREFORE, NO ACTION IS REQUIRED

Maximum Safe Fill Height = 60.76 feet
(t_2SE/2.6DG) +1

Tank can be filled to capacity
Provided Containment Capacity is Sufficient

PCA ENGINEERING, INC.

Courses

Tank: 5

Date: 6/11/02

Diameter:	38	Yield:	23,430
Height:	35.5	Joint Efficiency:	1.0
Number of Courses:	4	Specific Gravity:	1.00

MINIMUM THICKNESS per each SHELL COURSE

	Height (TOC)	Minimum Thickness	
Course 1	8.875	0.145	OK
Course 2	17.75	0.108	OK
Course 3	26.625	0.071	OK
Course 4	35.5	0.033	OK

TANK BOTTOM EVALUATION - API 653 SECTION 2.4

Tank: 5 Date: 6/11/02

Minimum Thickness for Tank Bottom Plate (API 2.4.7):

$$MRT = (\text{minimum of } RT_{bc} \text{ or } RT_{ip}) - O_r(\ StP_r + UP_r\ )$$

Where:

MRT = minimum remaining thickness at the end of interval O_r
This value must meet the requirments of Table 4-1
and sections 2.4.7.4 and 2.4.8

O_r = in-service interval (years to next inspection) not to exceed that allowed by 4.2.2 (normally 10 years)

RT_{bc} = minimum remaining thickness from bottom side corrosion, after repairs

RT_{ip} = minimum remaining thickness from internal corrosion after repairs

StP_r = maximum internal pitting rate, in inches per year; StP_r = 0 if tank bottom is internally lined.

UP_r = maximum underside pitting rate, in inches per year; UP_r = 0 if tank bottom is cathodically protected.

T_o	=	0.268 inch	RT_{bc}	=	0.259	UP_r	=	0.000 in/yr
UP_m	=	0.009 inch	RT_{ip}	=	0.261	StP_r	=	0.0004 in/yr
StP_m	=	0.007 inch	O_r	=	10.0 years			

Solve for: MRT = 0.255 inch

Or = 419.0 years where MRT = 0.100
NOTE: see API 653 table 4-1

Then if:

MRT > 0.100

THEREFORE, NO ACTION IS REQUIRED

PCA ENGINEERING, INC.

TANK SETTLMENT EVALUATION - API 653 APPENDIX B

Tank: 5

Date: 6/11/02

Diameter: 38 feet
Sections: 8

Arc (L): 14.92 feet
Yield(Y): 30000 psi
(E): 29000000 psi
Height(H): 35.5 feet

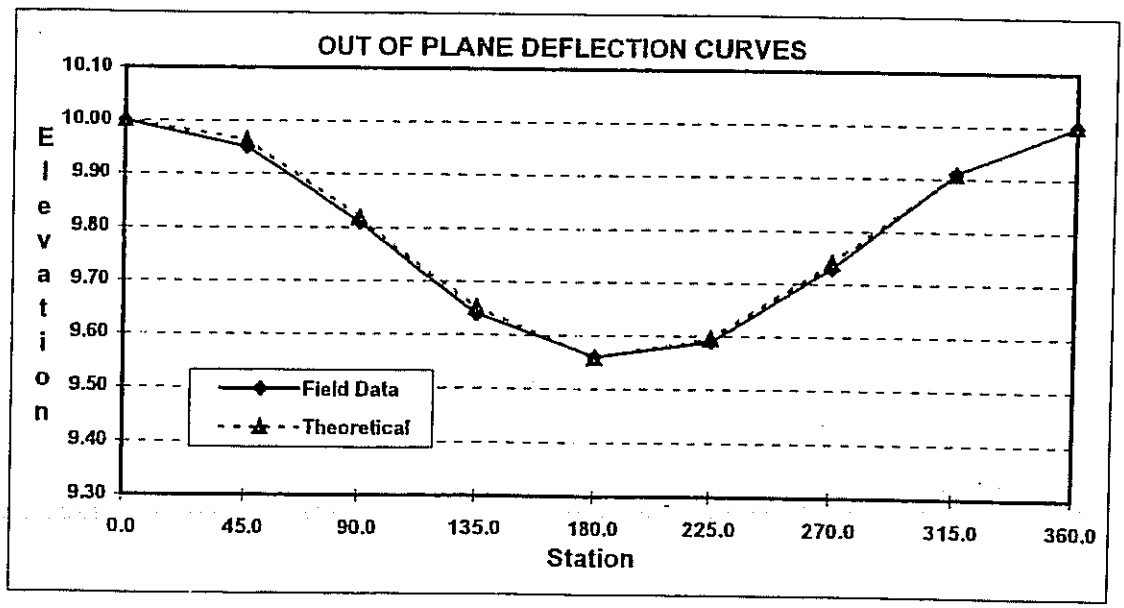
Maximum Permissible Out-of-Plane Deflection:

$S<=(L^2*Y*11)/(2(E*H)$

Where:
S= deflection, in feet (out-of-plane distortion)
L= arc length, between measurement pts, in feet
Y= yield strength, in psi
E= Young's modulus, in psi
H= tank height, in feet

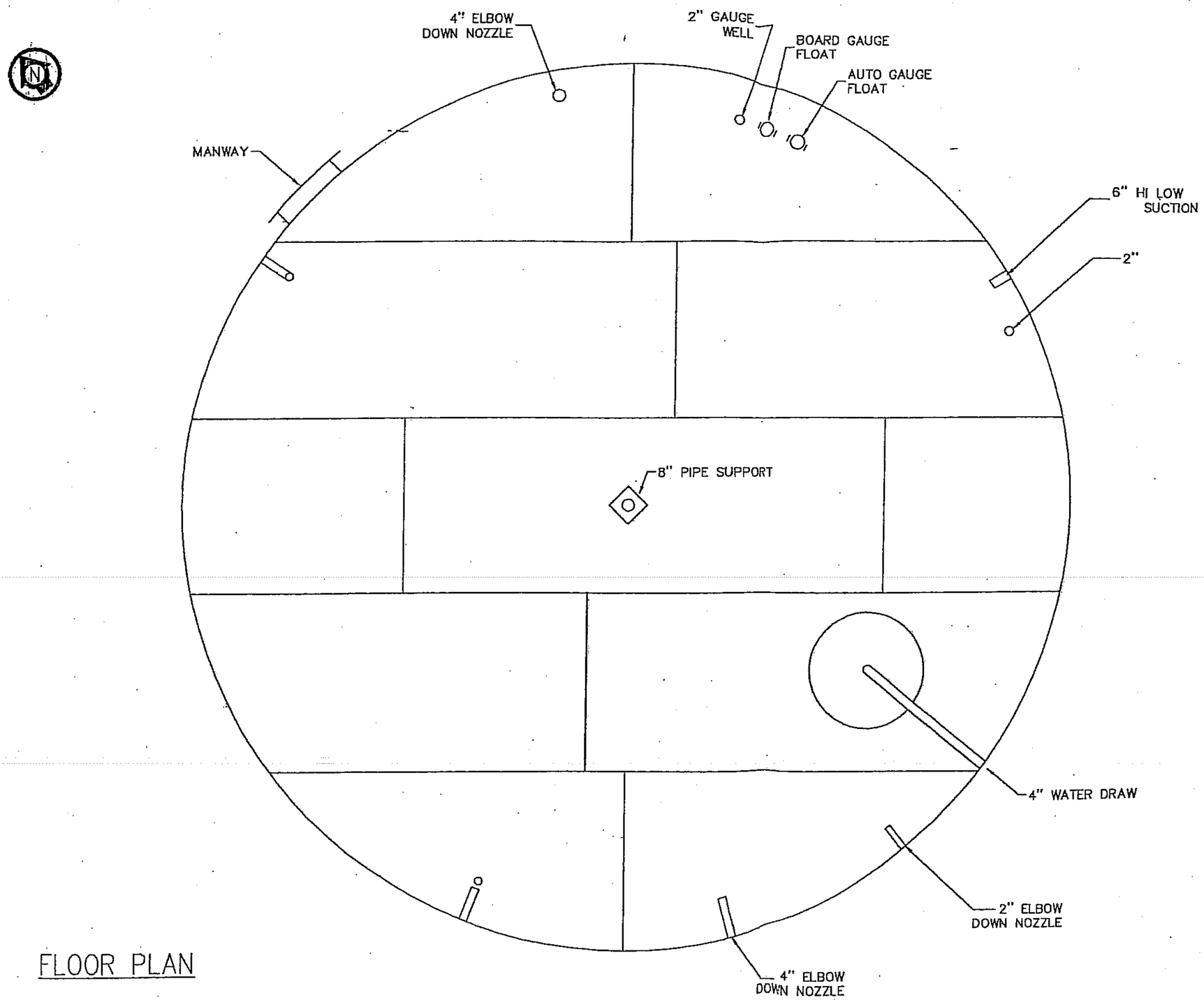
S<= 0.03569 feet

Degrees	Station	Field Data	Theoretical	Delta(U_i)	Deflection(S_i)
0.0	0.0	10.00	10.002	-0.002	0.0051
45.0	14.9	9.95	9.964	-0.014	-0.0090
90.0	29.8	9.81	9.819	-0.009	0.0036
135.0	44.8	9.64	9.651	-0.011	-0.0072
180.0	59.7	9.56	9.558	0.002	0.0099
225.0	74.6	9.59	9.596	-0.006	-0.0010
270.0	89.5	9.73	9.741	-0.011	-0.0086
315.0	104.5	9.91	9.909	0.001	0.0072
360.0	119.4	10.00	10.002	-0.002	0.0051



THEN, SINCE THE MAXIMUM Si <= S NO ACTION IS REQUIRED

PCA ENGINEERING, INC.



FLOOR PLAN

GENERAL NOTES:
38' DIA. X 35'-6"H.

LEGEND:

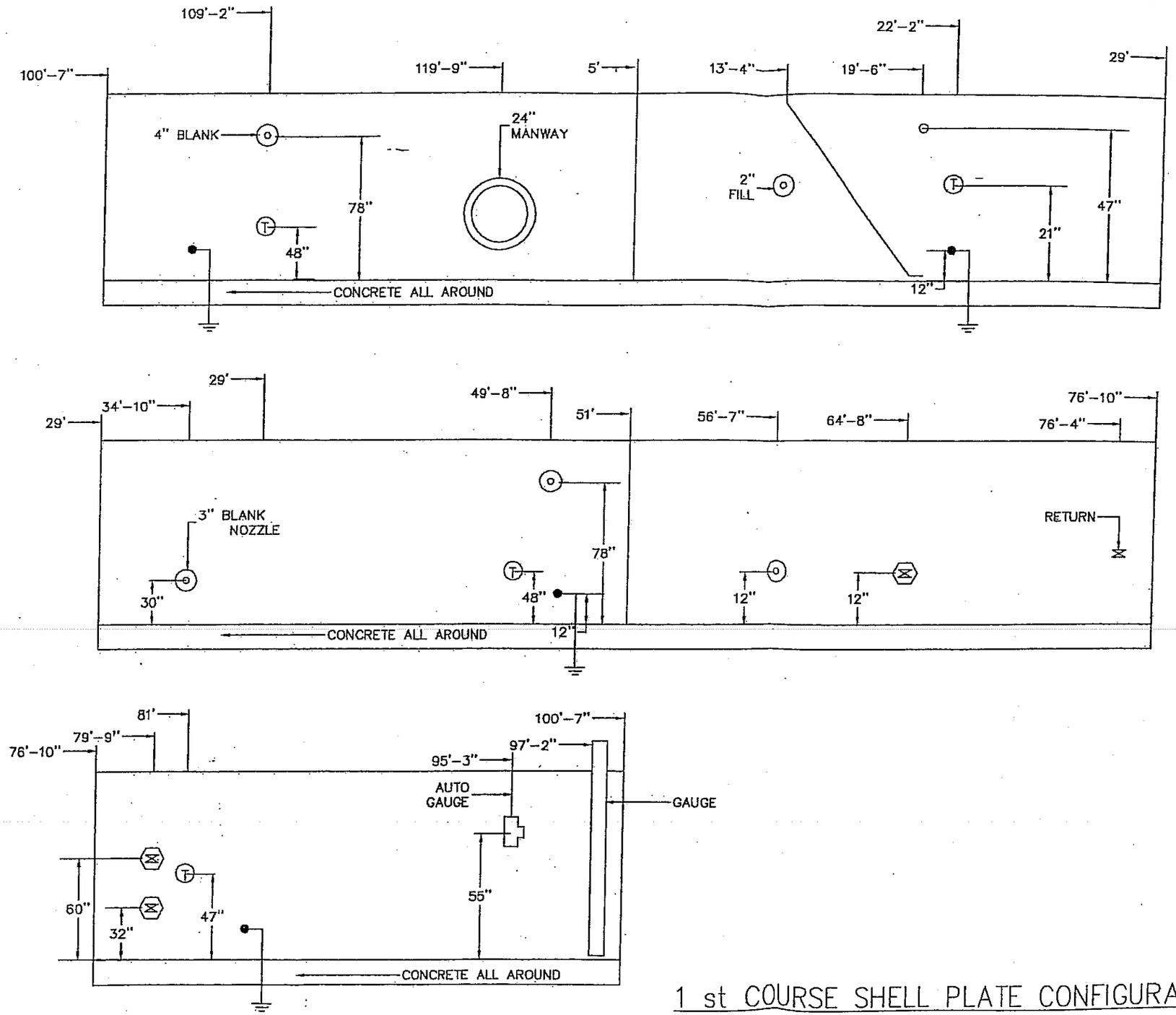
PCA ENGINEERING, INC.
430 Montclair Ave. Pompton Lakes, NJ.
TEL. (973) 616-4501

BROOKHAVEN NATIONAL LAB.
FUEL TRANSFER FACILITY
UPTON, NY.

PROJECT LOCATION:
BROOKHAVEN NATIONAL LAB.
FUEL TRANSFER FACILITY
UPTON, NY.

DRAWING TITLE:
TANK INSPECTION
TANK No. 5

CHECKED BY:	WJL	DRAWN BY:	A.U.Z.
SCALE:	N.T.S.	DATE:	7-9-02
DRAWING No.:	BW-22213-01	REV.	0



1 st COURSE SHELL PLATE CONFIGURATION

GENERAL NOTES:
TANK No. 5
38' DIA. X 35'-6" H.

LEGEND:

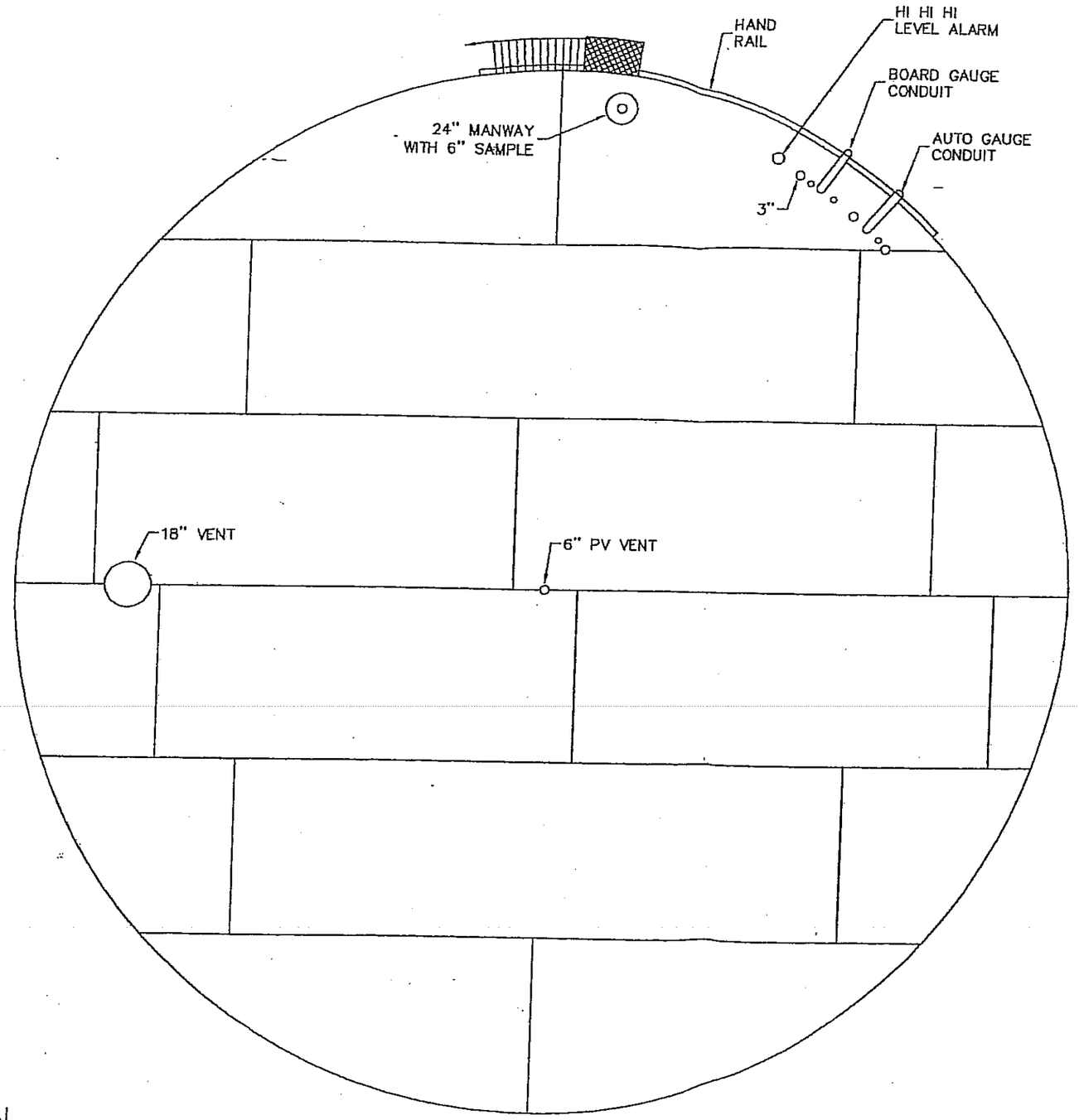
PCA ENGINEERING, INC.
430 Montclair Ave. Pompton Lakes, NJ.
TEL. (973) 616-4501

BROOKHAVEN NATIONAL LAB.
FUEL TRANSFER FACILITY
UPTON, NY.

PROJECT LOCATION:
BROOKHAVEN NATIONAL LAB.
FUEL TRANSFER FACILITY
UPTON, NY.

DRAWING TITLE:
TANK INSPECTION
TANK No. 5

CHECKED BY:	WIC	DRAWN BY:	A.U.Z.
SCALE:	N.T.S.	DATE:	7-10-02
DRAWING No.:	BW-22213-02	REV.	0



ROOF PLAN

GENERAL NOTES:
TANK No. 5
38' DIA. X 35'-6" H.

LEGEND:

PCA ENGINEERING, INC
177 Royal Ave. Hawthorne, N.J. U.S.A.
TEL. (201) 427-8540

BROOKHAVEN NATIONAL LAB.
FUEL TRANSFER FACILITY
UPTON, NY.

PROJECT LOCATION:
BROOKHAVEN NATIONAL LAB.
FUEL TRANSFER FACILITY
UPTON, NY.

DRAWING TITLE:
TANK INSPECTION
TANK No. 5

CHECKED BY:	WJC	DRAWN BY:	A.U.Z.
SCALE:	N.T.S.	DATE:	7-9-02
DRAWING No.:	BW-22213-03	REV.	0

V. API 653 CHECKLIST

API 653

TANK OUT-OF-SERVICE INSPECTION CHECKLIST

OVERVIEW

OK	Check that tank has been cleaned, is gas free, and safe for entry
OK	Check that the tank is completely isolated from product lines, all electrical power, and steam lines
OK	Check that roof is adequately supported, including fixed roof structure and floating roof legs
OK	Check for presence of falling object hazards, such as corroded-through roof rafters, asphalt stalactites, and trapped hydrocarbons in unopened or plugged equipment or appurtenances, ledges, etc.
OK	Inspect for slipping hazards on the bottom and roof decks
OK	Inspect structural welds on accessways and clips
OK	Check surfaces needing inspection for a heavy-scale buildup and check weld seams and oily surfaces where welding is to be done. Note areas needing more cleaning, including blasting

Remarks: _____

_____

TANK EXTERIOR

OK	Inspect appurtenances opened during cleaning such as lower floating swing sheave assemblies, nozzle interiors (after removal of valves)
OK	Hammer test or ultrasonically test the roof
N/A	Enter and inspect the floating roof pontoon compartments

Remarks: _____

_____

BOTTOM INTERIOR SURFACE

*	Using a flashlight held close to and parallel to the bottom plates, and using the bottom plate layout as a guide, visually inspect and hammer test the entire bottom
OK	Measure the depth of pitting and describe the pitting appearance (sharp edged, lake type, dense, scattered, etc.)
N/A	Mark areas requiring patching or further inspection
N/A	Mark locations for turning coupons for inspection
OK	Inspect all welds for corrosion and leaks, particularly the shell-to-bottom weld
OK	Inspect sketch plates for corrosion
N/A	Locate and mark voids under the bottom
OK	Record bottom data on a layout sketch using the existing bottom plates as a grid. List the number and sizes of patches required
N/A	Vacuum test the bottom lap welds

OK	Hammer test or ultrasonically examine any slightly discolored spots or damp areas
OK	Check for reinforcing pads under all bottom attached clips, brackets and supports
N/A	Inspect floating roof leg pads for pitting or cutting, and excessive dimpling (indicating excessive loading)
N/A	Check the column bases of fixed roof supports for adequate pads and restraining clips
OK	In earthquake zones 3 and 4, check that roof supports are not welded down to the tank, but are only restrained from horizontal movement
N/A	Check area beneath swing line cable for indications of cable cutting or dragging
OK	Mark old oil and air test connection for removal and patching
OK	Identify and report low areas on the bottom that do not drain adequately
OK	Inspect coating for holes, disbonding, deterioration, and discoloration

Remarks: *hammer testing was not performed due to presence of epoxy thin Film lines

SHELL SEAMS AND PLATES

OK	On cone up bottoms, closely inspect and gauge the depth of metal loss on the lower 2 to 4 inches of the shell (area of standing water)
OK	Measure the depth of pitting on each course
OK	Inspect and estimate the amount of metal loss on the heads of rivets and bolts
N/A	Inspect shell-to-bottom riveted lap joints
N/A	Inspect for vertical grooving damage from seal assembly protrusions
OK	Inspect existing protective coatings for damage, deterioration, and disbonding
N/A	Check for areas of rubbing (indicating too much pressure by the seal assembly shoes or inadequate annular space)
N/A	Visually inspect the shell plates and seams for indications of leakage
N/A	If the shell has riveted or bolted seams, record the leak locations by film or chart in case the locations are lost during surface preparation for painting
N/A	Measure annular space at 40-foot intervals
OK	Survey the shell to check for roundness and plumb

Remarks:

SHELL-MOUNTED OVERFLOWS

N/A	Inspect overflow for corrosion and adequate screening
N/A	Check location of overflow that it is not above any tank valves or equipment

Remarks: _____

_____

ROOF INTERIOR SURFACE

General

OK	Visually inspect the underside surface of the roof plates for holes, scale buildup, and pitting
OK	Hammer test or ultrasonically examine to check for thin areas, particularly in the vapor space of floating roofs and at edge of roof on cone roof tank
OK	Check all clips, brackets, braces, etc., welded to the roof deck plate for welded reinforcing pads and see that they have not broken free
N/A	If no pad is present, penetrant test for cracking of the weld or deck plate
OK	Inspect the protective coating for breaks, disbondment, and deterioration

Remarks: _____

_____

Fixed Roof Support Structure

OK	Inspect the support columns for thinning in the upper two feet
N/A	On API columns (two channels welded together) check for corrosion scale breaking the tack welds, unless the joint between the channels is completely seal welded
OK	Check that the reinforcing pad on the bottom is seal welded to the tank bottom with horizontal movement restraining clips welded to the pad
OK	Determine if pipe column supports are concrete filled or open pipe. If open pipe, check for a drain opening in the bottom of the pipe
OK	Inspect and gauge rafters for thinning, particularly near the center of the roof. Report metal loss
OK	Check for loose or twisted rafters
OK	Inspect girders for thinning and check that they are attached securely to the top of the columns
N/A	Report if the columns have cross bracing in the area between the low pump out and top of the shell (for future internal floating roof installation)
N/A	Inspect and report presence of any roof-mounted swing line bumpers
OK	Photograph the roof structure if no rafter layout drawing exists

Remarks: _____

FIXED ROOF APPURTENANCES

Inspection and Light Hatches

OK	Inspect the hatches for corrosion, paint and coating failures, holes, and cover sealing
OK	On loose covers, check for a safety chain in good condition
OK	On light hatches over 30 inches across, check for safety rods
OK	Inspect the condition of the gaskets on bolted or latched down hatch covers

Remarks: _____

Staging Support Connection

N/A	Inspect the condition of the staging support for corrosion

Remarks: _____

Breathers and Vents

N/A	Inspect and service the breather
OK	Inspect screens on vents and breathers

Remarks: _____

Emergency P/V Hatches

N/A	Inspect and service pressure/vacuum hatches (setting should be high enough to prevent chattering of breather during normal operation. See breather manufacturer's guide
N/A	Inspect liquid seal hatches for corrosion and proper liquid level in the sea

Remarks: _____

Sample Hatch

OK	Inspect sample hatch for corrosion
OK	Check that the cover operates properly
N/A	If the tank has no gaugewell, check for a hold off distance marker and check measurement

Remarks: _____

_____

FLOATING ROOF

Roof Deck

N/A Hammer test the area between roof rim and shell. (If access for hammer testing is inadequate, measure the distance from the bottom edge of the roof to the corroded area and then hammer test from inside the pontoon)

N/A In sour water service, clean and test all deck plate weld seams for cracking unless the lower laps have been seal welded

N/A Check that either the roof drain is open or the drain plug in the roof is open in case of unexpected rain

N/A On flat bottomed and cone down bottom roof decks, check for a vapor dam around the periphery of the roof. The dam should be continuous without break to prevent escape of vapors to the seal area from under the center of the roof

Remarks: _____

_____

Floating Roof Pontoons

N/A Visually inspect each pontoon for liquid leakage

N/A Run a light wire through the gooseneck vents on locked down inspection hatch covers to make sure they are open

N/A Inspect lockdown latches on each cover

N/A Check and report if each pontoon is:

- _____ Vapor tight (bulkhead seal welded on one side on bottom, sides and top
- _____ Liquid tight (seal welded on bottom and sides only) or
- _____ Unacceptable (minimum acceptable condition is liquid tight)

Remarks: _____

_____

Floating Roof Cutouts

N/A Inspect underside of cutouts for mechanical damage

N/A Inspect welds for cracks

N/A Inspect plate for thinning, pitting, and erosion

N/A Measure mixer cutouts and record plate thickness for future mixer installation or replacement

Plate thickness: _____

Remarks: _____

_____

Floating Roof Supports

N/A	Inspect fixed low and removable high floating roof legs for thinning
N/A	Inspect for notching at bottom of legs for drainage
N/A	Inspect for leg buckling or bellying at bottom
N/A	Inspect pin hole in roof guide for tears
N/A	Check plumb of all legs
N/A	Inspect for adequate reinforcing gussets on all legs through a single portion of the roof
N/A	Inspect the area around the roof legs for cracking if there is no internal reinforcing pad or if the topside pad is not welded to the deck plate on the underside
N/A	Inspect the sealing system on the two-position legs and the vapor plugs in the fixed low leg for deterioration of the gaskets
N/A	On the shell mounted roof supports, check for adequate clearance based on the maximum floating roof movement as determined by the position of the roof relative to the gaugewell and/or counter rotational device

Remarks: _____

FLOATING ROOF SEAL ASSEMBLIES

Primary Shoe Assembly

N/A	Remove four sections of foam log (foam filled seals) for inspection, on 90° locations
N/A	Inspect hanger attachment to roof rim for thinning, bending, broken welds, and wear of pin holes
N/A	Inspect clips welded to roof rim for thinning
N/A	Shoes: Inspect for thinning and holes in shoes
N/A	Inspect for bimetal bolts, clips, and attachments
N/A	Seal fabric: Inspect for deterioration, stiffening, holes, and tears in fabric
N/A	Measure length of fabric from top of shore to roof rim, and check against maximum anticipated annular space as roof operated
N/A	Inspect any modification of shoes over shell nozzles, mixers, etc., for clearance
N/A	Inspect shoes for damage caused by striking shell nozzles, mixers, etc.

Remarks: _____

Primary Toroidal Assembly

N/A	Inspect seal fabric for wear, deterioration, holes, and tears
N/A	Inspect hold down system for buckling or bending
N/A	Inspect foam for liquid absorption and deterioration

Remarks: _____

Rim Mounted Secondaries

N/A	Inspect the rim-mounted bolting bar for corrosion and broken welds
N/A	Measure and chart seal-to-shell gaps
N/A	Visually inspect seal from below, looking for holes as evident by light
N/A	Inspect fabric for deterioration and stiffness
N/A	Inspect for mechanical damage, corrosion, and wear on tip in contact with shell
N/A	Inspect for contact with obstructions above top of shell

Remarks: _____

_____

FLOATING ROOF APPURTENANCES

Roof Manways

N/A	Inspect walls of manways for pitting and thinning
N/A	On tanks with interface autogauges, check seal around gauge tape cable and guide wires through manway cover
N/A	Inspect cover gasket and bolts

Remarks: _____

_____

Rim Vent

N/A	Check rim vent for pitting and holes
N/A	Check vent for condition of screen
N/A	On floating roof tanks where the environmental rules require closing off the vent, check the vent piping for corrosion at the pipe-to-rim joint and check that the blinding is adequate

Remarks: _____

_____

Vacuum Breaker, Breather Type

N/A	Service and check operation of breather valve
N/A	Check that nozzle pipe projects no more than 1/2 inch below roof deck
N/A	Inspect reinforcing pad and pad weld

Remarks: _____

_____

Vacuum Breaker, Mechanical Type

N/A	Inspect the stem for thinning. Measure how far the vacuum breaker cover is raised off the pipe when the roof is resting on high or low legs On high legs: _____ On low legs: _____

Remarks: _____

_____

Roof Drains: Open Systems, Including Emergency Drains

N/A	Check liquid level inside open roof drains for adequate freeboard. Report if there is insufficient distance between liquid level and top of drain
N/A	If tank comes under Air Quality Monitoring District rules, inspect the roof drain vapor plug
N/A	If emergency drain is not at the center of the roof, check that there are at least three emergency drains

Remarks: _____

_____

Closed Drain Systems: Drain Basins

N/A	Inspect for thinning and pitting
N/A	Inspect protective coating (topside)
N/A	Inspect basin cover or screen for corrosion
N/A	Test operation of check valve
N/A	Check for presence of check valve where bottom of basin is below product level
N/A	Inspect drain basin(s) to roof deck welds for cracking
N/A	Check drain basin(s) outlet pipe for adequate reinforcement to roof deck (including reinforcing pad)

Remarks: _____

_____

Closed Drain Systems: Fixed Drain Line on Tank Bottom

N/A	Hammer test fixed drain line on tank bottom for thinning and scale/ debris plugging
N/A	Inspect supports and reinforcing pads for weld failures and corrosion
N/A	Check that pipe is guided, not rigidly locked to supports, to avoid tearing of tank bottom plate

Remarks: _____

_____

Closed Drain Systems: Flexible Pipe Drain

N/A	Inspect for damage to exterior of pipe
N/A	Check for obstructions that pipe could catch on
N/A	Inspect shields to protect pipe from snagging
N/A	Inspect results of hydrotest on flexible roof drain system

Remarks: _____

_____

Closed Drain Systems: Articulated Joint Drain

N/A	Hammer test rigid pipe in flexible joint system for thinning and scale debris plugging
N/A	Inspect system for signs of bending or strain
N/A	Inspect results of system hydrotest
N/A	Inspect landing leg and pad

Remarks: _____

_____

Autogauge System and Alarms

OK	Check freedom of movement of tape through autogauge tape guide
OK	Inspect sheaves for freedom of movement
OK	Test operation checker
OK	Inspect tape and tape cable for twisting and fraying
OK	Test the tape's freedom of movement through guide sheaves and tape guide pipe
N/A	On open-top tanks, check that gate tapes with cables have no more than one foot of tape exposed with float at lowest point
OK	Check float for leakage
OK	Test float guide wire anchors for spring action by pulling on wire and releasing
N/A	Inspect floatwells in floating roofs for thinning and pitting of walls just above the liquid level
OK	Check that the autogauge tape is firmly attached to the float
OK	Inspect the tape cable and float guide wire fabric seals through the floatwell cover
OK	Inspect the bottom guide wire attachment clip; inspect for a temporary weighted bar instead of a permanent welded down clip
OK	Inspect board-type autogauges indicators for legibility and freedom of movement of indicator
N/A	Measure and record these distances to determine if seal damage will occur if tape is run over:
_____	From shell top angle to underside of tape guide system
_____	From liquid level on floating top to top of secondary seal
N/A	Identify floating roofs where the tape is connected directly to the roof
OK	Overfill alarm: Inspect tank overfill prevention alarm switches for proper operation

Remarks: _____

_____

COMMON TANK APPURTENANCES

Gauge Well

OK	Inspect gauge well pipe for thinning at about two-thirds distance above the bottom: look for thinning at the edge of the slots
OK	Check for corrosion on the pipe joint. Check that sample cords, weights, thermometers, etc., have been removed from pipe
OK	Check for cone at bottom end of pipe about one foot above the bottom

OK	Check condition of well washer pipe and that its flared end is directed at the near side of the hold-off pad
*1	Check that the supports for the gaugewell are welded to pad or to shell and not directly to bottom plate
OK	Check operation of gaugewell cover
N/A	Check presence of a hold-off distance marker in well pipe and record hold-off distance Hold-Off Distance _____
*2	Identify and report size and pipe schedule, and whether pipe is solid or slotted. Report slot size
N/A	Check that the hold-off distance plate is seal welded to the bottom and that any gaugewell supports are welded to the plate and not directly to the bottom
N/A	Inspect vapor control float and cable
N/A	Check for presence and condition of gaugewell washer
N/A	Check for bull plug or plate blind on gaugewell washer valve
OK	Inspect gaugewell guide in floating roof for pitting and thinning
OK	Inspect the guide rollers and sliding plates for freedom of movement
OK	Inspect condition of gaugewell pipe seal system
OK	On black oil and diesel services: if gaugewell is also used for sampling, check for presence of a thief- and gauge-type hatch to avoid spillage
OK	Visually inspect inside of pipe for pipe weld protrusions which could catch or damage vapor control float

Remarks: *1 pipe is not secured to the floor; *2 2" Sch. 40 pipe with 1" diameter slots

Sampling Systems: Roof Sample Hatches

OK	Inspect roof mounted sample hatches for reinforcing pads and cracking
OK	Inspect cover for operation
OK	For tanks complying with Air Quality Monitoring District rules, inspect sample hatch covers for adequate sealing
N/A	Check horizontal alignment of internal floating roof sample hatches under fixed roof hatches
OK	Inspect the sealing system on the internal floating roof sample hatch cover
N/A	Inspect floating roof sample hatch cover recoil reel and rope

Remarks:

Shell Nozzles

OK	Inspect shell nozzles for thinning and pitting
N/A	Inspect hot tap nozzles for trimming of holes
OK	Identify type of shell nozzles
OK	Identify and describe internal piping, including elbow up and elbow down types

Remarks:

For Nozzles Extended into the Tank

N/A	Inspect pipe support pads welded to tank bottom
N/A	Inspect to see that pipe is free to move along support without strain or tearing action on bottom plate
OK	Inspect nozzle valves for packing leaks and damaged flange faces
N/A	Inspect heater steam nozzle flanges and valves for wire cutting
N/A	Report which nozzles have thermal pressure relief bosses and valves
OK –	In internal elbow-down fill line nozzles, inspect the wear plate on the tank bottom
OK	On elbow-up fill lines in floating roof tanks, check that opening is directed against underside of roof, not against vapor space. Inspect impact area for erosion

Remarks: _____

_____

Diffusers and Air Rolling Systems

N/A	Inspect diffuser pipe for erosion and thinning
N/A	Check holes in diffuser for excessive wear and enlargement
N/A	Inspect diffuser supports for damage and corrosion
N/A	Check that diffuser supports restrain, not anchor, longitudinal line movement
N/A	Inspect air spiders on bottom of lube oil tanks for plugging and damaged or broken threaded joints

Remarks: _____

_____

Swing Lines

N/A	Inspect flexible joint for cracks and leaks
N/A	Scribe the flexible joint across the two moving faces and rise end of swingline to check the joint's freedom of movement, indicated by separation of scribe marks
N/A	Check that flexible joints over six inches are supported
N/A	Inspect the swing pipe for deep pitting and weld corrosion
N/A	Loosen the vent plugs in the pontoons and listen for a vacuum. Lack of a vacuum indicates a leaking pontoon
N/A	Check the results of air test on pontoons during repairs
N/A	Inspect the pontoons for pitting
N/A	Inspect the pull-down cable connections to the swing
N/A	Inspect the condition of the bottom-mounted support, fixed roof limiting bumper, or shell mounted limiting bumper of wood condition, weld and bolt corrosion, and seal welding to bottom or shell
N/A	Inspect safety hold-down chain for corrosion and weak links
N/A	Check that there is a welded reinforcing pad where the chain connects to the bottom
N/A	If the floating swing in a floating or internal floating roof does not have a limiting device preventing the swing from exceeding 60 degrees, measure and calculate the maximum angle possible with the roof on overflow

_____ Maximum angle on overflow

(If the calculated angle exceeds 65 degrees, recommend installation of a limiting bracket)

N/A Inspect pull down cable for fraying

N/A Inspect for three cable clamps where cable attaches to end of swingline (single-reeved) or to roof assembly (double-reeved). Inspect sheaves for freedom of movement

N/A Inspect winch operation and check the height indicator for legibility and accuracy

N/A Inspect bottom-mounted sheave assembly at end of pontoon for freedom of rotation of sheave

N/A Inspect shell mounted lower sheave assembly for freedom of rotation of sheave, corrosion thinning, and pitting of sheave housing

N/A Inspect upper sheave assembly for freedom of movement of sheave

N/A Inspect the cable counterbalance assembly for corrosion and freedom of operation

Remarks: _____

_____

Manway Heater Racks

N/A Inspect the manway heater racks for broken welds and bending of the sliding rails

N/A Measure and record the length of the heater and length of the track

Remarks: _____

_____

Mixer Wear Plates and Deflector Stands

N/A Inspect bottom and shell plates and deflector stands

N/A Inspect for erosion and corrosion on the wear plates. Inspect for rigidity, structural soundness, corrosion, and erosion of deck plates and reinforcing pads that are seal welded to the bottom under the deflector stand legs

N/A Measure for propeller clearance between the bottom of deflector stand and roof when the roof is on low legs

Remarks: _____

_____

ACCESS STRUCTURES

Handrails

OK Identify and report type (steel pipe, galvanized pipe, square tube, angle) and size of handrails

OK Inspect for pitting and holes, pain failure

OK Inspect attachment welds

OK Identify cold joints and sharp edges. Inspect the handrails and midrails

OK Inspect safety drop bar (or safety chain) for corrosion, functioning and length

N/A Inspect the handrail between the rolling ladder and the gauging platform for a hazardous opening when the floating roof is at its lowest level

Remarks:

Platform Frame

N/A Inspect frame for corrosion and paint failure
N/A Inspect the attachment of frame to supports and supports to tank; for corrosion and weld failure
N/A Check reinforcing pads where supports are attached to shell or roof
N/A Inspect the surface that deck plate or grating rests on, for thinning and holes
N/A Check that flat-surface to flat-surface junctures are seal welded

Remarks:

Deck Plate and Grating

N/A Inspect deck plate for corrosion-caused thinning or holes (not drain holes) and paint failure
N/A Inspect plate-to-frame weld for rust scale buildup
N/A Inspect grating for corrosion-caused thinning of bars and failure of welds
N/A Check grating tie-down clips. Where grating has been retrofitted to replace plate, measure the rise of the step below and above the grating surface and compare with other risers on the stairway

Remarks:

Stairway Stringers

Inspect spiral stairway stringers for corrosion, paint failure, and weld failure. Inspect attachment of stairway treads to stringer
* Inspect stairway supports to shell welds and reinforcing pads
Inspect steel support attachment to concrete base for corrosion

Remarks: spiral stairway steps are not fully welded to the shell; water intrusion has resulted in minor scaling/straining; see photographs

Rolling Ladder

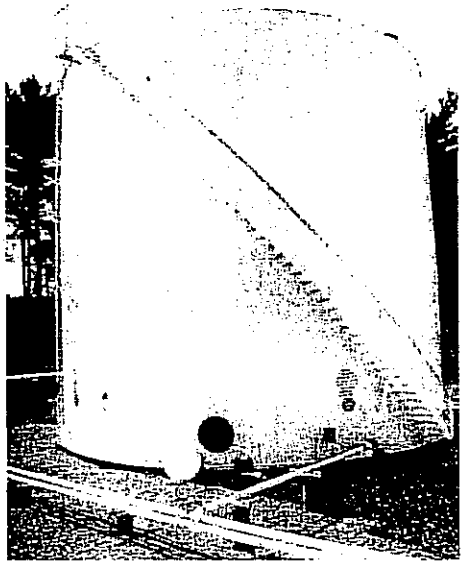
N/A Inspect rolling ladder stringers for corrosion
N/A Identify and inspect ladder fixed rungs (square bar, round bar, angles) for weld attachment to stringers and corrosion, particularly where angle rungs are welded to stringers
N/A Check for wear and corrosion where rolling ladder attaches to gauging platform
N/A Inspect pivot bar for wear and secureness

N/A	Inspect operation of self-leveling stairway treads
N/A	Inspect for corrosion and wear on moving parts
N/A	Inspect rolling ladder wheels for freedom of movement, flat spots, and wear on axle
N/A	Inspect alignment of rolling ladder with roof rack
N/A	Inspect top surface of rolling ladder track for wear by wheels to assure at least 18 inches of unworn track (track long enough)
N/A	Inspect rolling ladder track welds for corrosion
N/A –	Inspect track supports on roof for reinforcing pads seal welded to deck plate
N/A	Check, by dimensioning, the maximum angle of the rolling ladder when the roof is on low legs Maximum angle: _____
N/A	If rolling ladder track extends to within five feet of the edge of the roof on the far side, check for a handrail on the top of the shell on that side

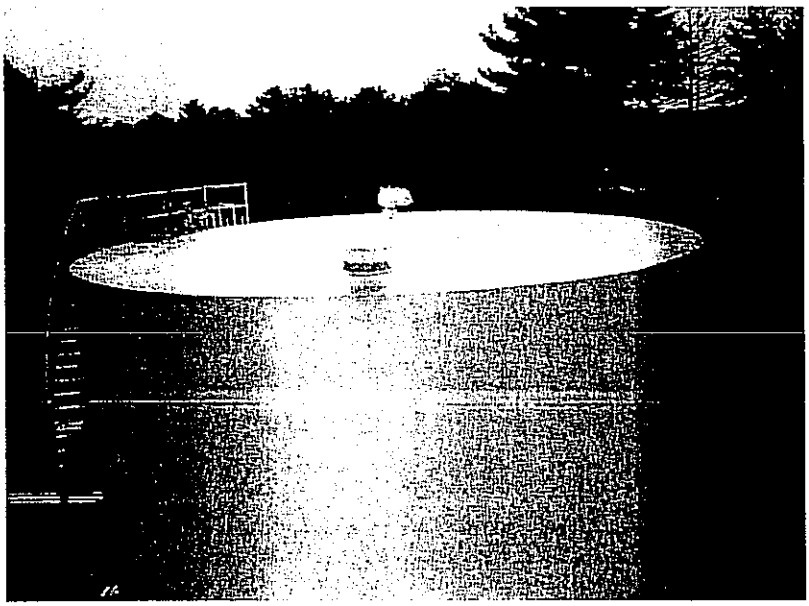
Remarks: _____

_____

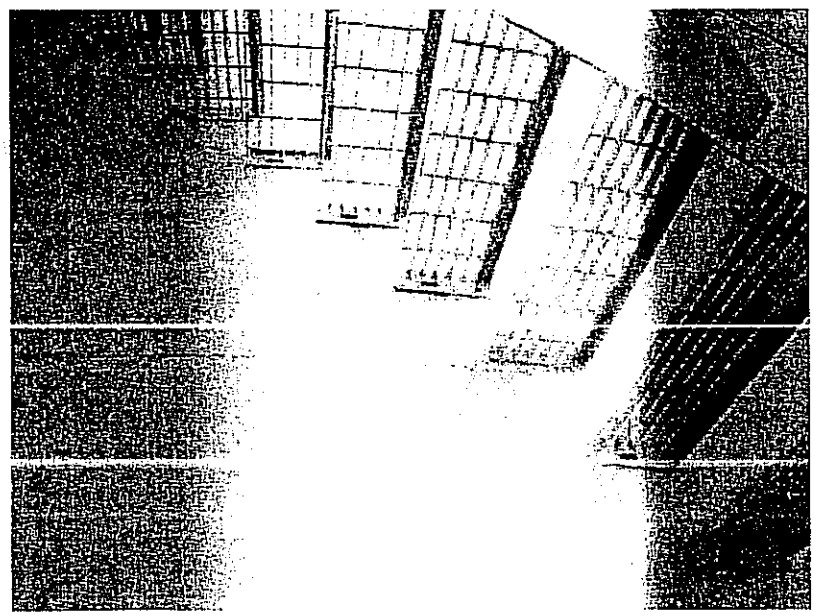
VI. PHOTOGRAPHS



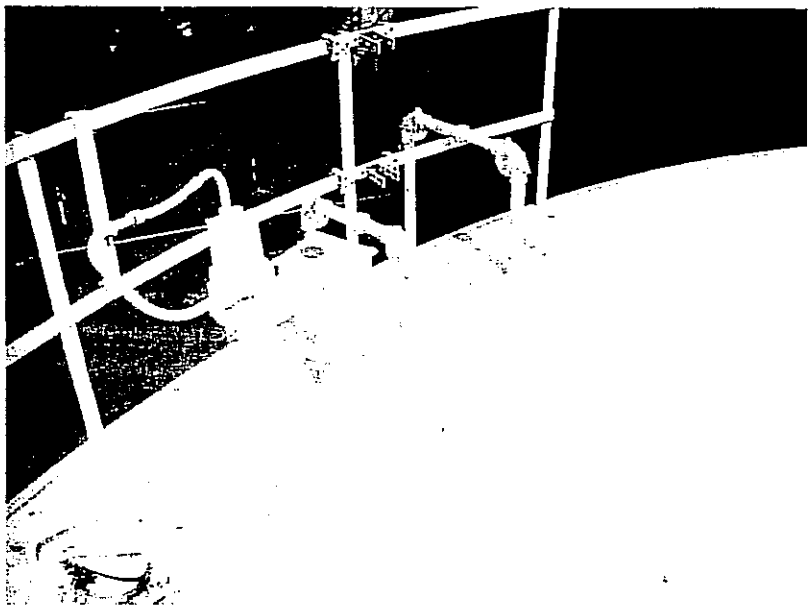
P6110002.JPG
6/11/2002
Tank No. 5 - overview



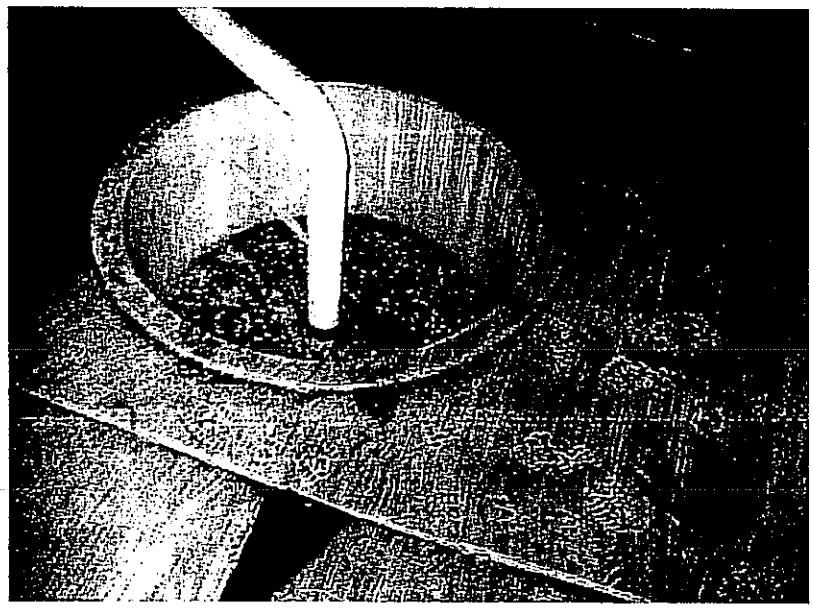
P6110003.JPG
6/11/2002
Roof overview



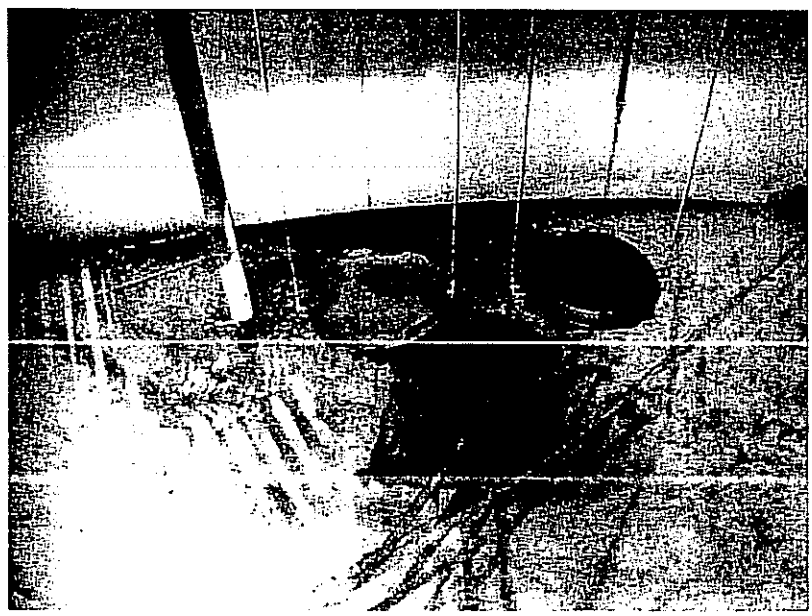
P6110004.JPG
6/11/2002
Minor paint failure/scaling of stairway



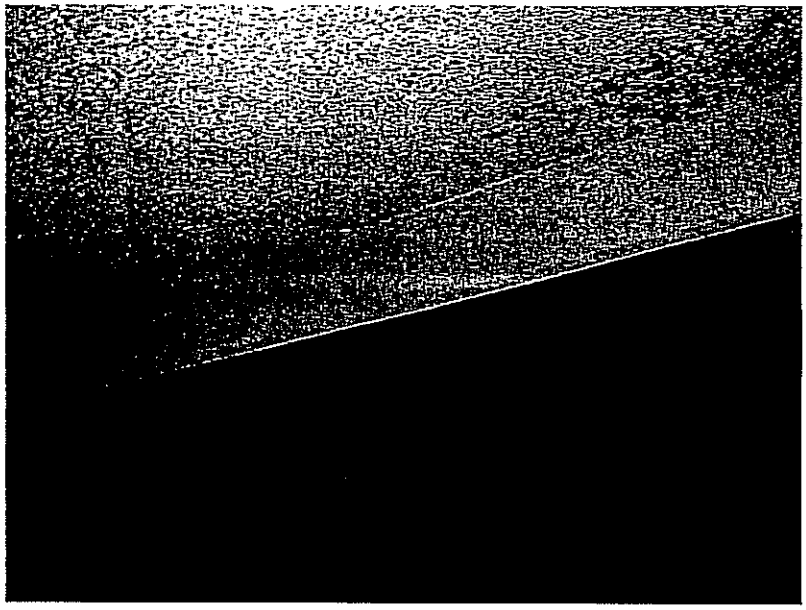
P6110015.JPG
6/11/2002
Roof attachment



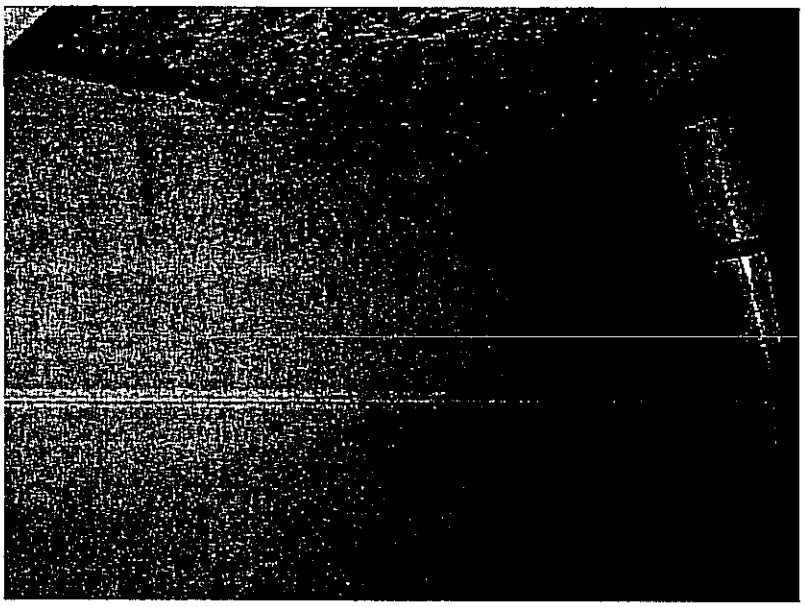
P6110007.JPG
6/11/2002
Sump



P6110010.JPG
6/11/2002
Gauge float

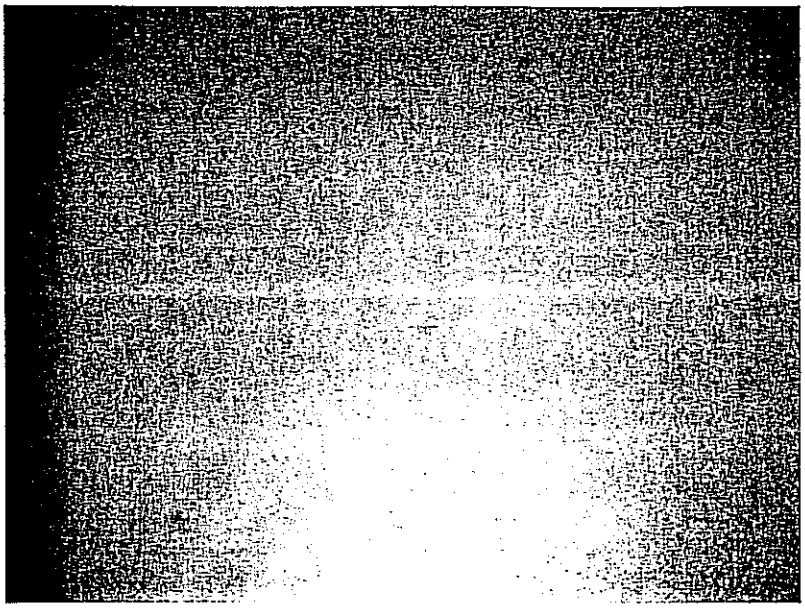


P6110017.JPG
6/11/2002
Roof underside



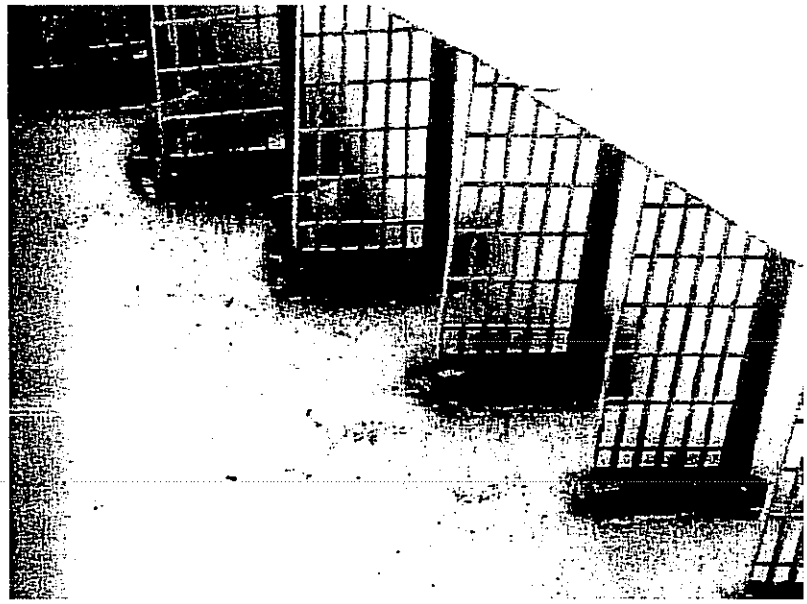
P6110018.JPG
6/11/2002
Roof underside

UPDATED PHOTOGRAPHS



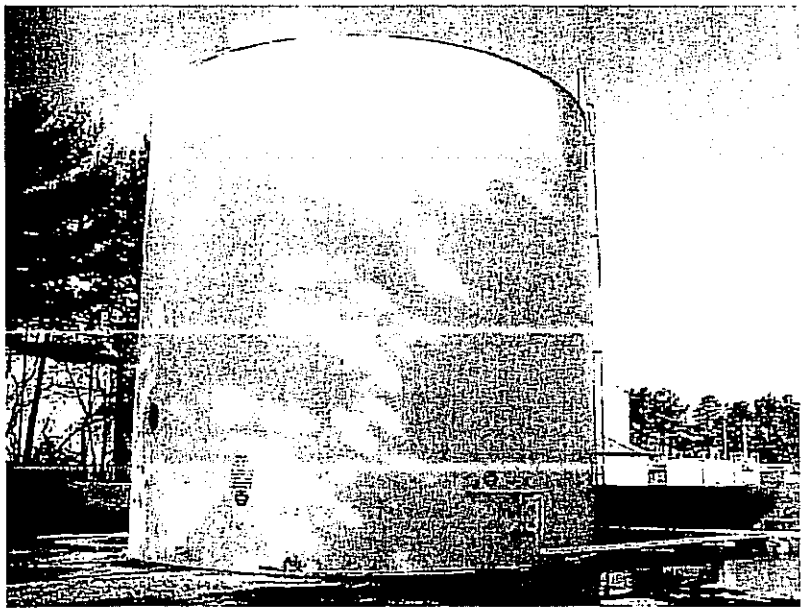
MVC-014L.JPG

Floor Coating



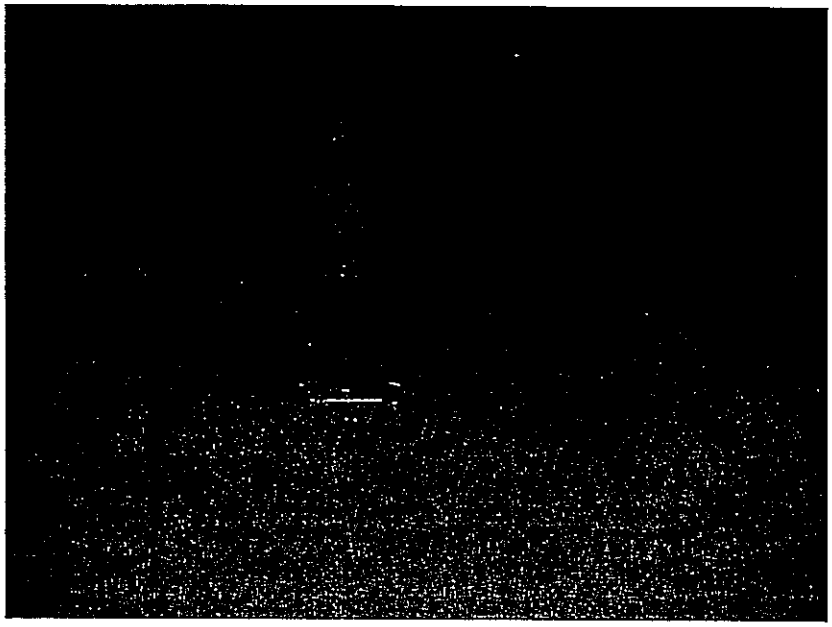
MVC-018L.JPG

Repaired Seal Welded Spiral Stairs



AMVC-015L.JPG

Over View



MVC-010L.JPG

Center Column

VII. RECOMMENDATIONS

As a result of the findings disclosed in the inspection of Tank No. 5, PCA Engineering, Inc. makes the following recommendations:

- Restore paint coating as needed to the roof and exterior piping.

The maximum interval until the next internal inspection would be 7 years based on the attached calculation, Suffolk County Regulations, the available data, and assumes completion of above repairs, operation under the same service and operating conditions. This does not preclude regular in-service inspection by terminal personnel and qualified inspector, and it is not a guarantee of future performance. The inspection/service interval can be substantially improved through the addition of cathodic protection corrosion control and/or an internal floor coating system, per applicable standards.

All repairs should be completed per API 650, 653 and other applicable Standards. An inspection of all repairs should be performed prior to return to service.

VII. RECOMMENDATIONS (Cont'd)

Based on the extent of the inspections performed on Tank No. 5, the test results indicate no substantial corrosion or defects above and beyond that noted, as of the test date of October 27, 2003 and November 5, 2003. This is not to be construed as an expressed or implied warranty of future performance.

Brookhaven National Laboratory
Tank No. 5
October 27, 2003 and November 5, 2003
PCA Job No. 23089

KENNETH NORTHERN
PCA ENGINEERING, INC.

WILLIAM M. KENT
PCA ENGINEERING, INC.
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NY P.E. No. 069049

WMK:mm

Notwithstanding anything contained in this report, nothing herein shall be construed as a representation, warranty or guarantee, either expressed or implied, regarding the future structural integrity or future life expectancy of any of the items tested. This report and any analysis provided is in all respects subject to and shall be interpreted within the limitations and parameters of the test procedures performed. In the event testing is performed using a sampling procedure, this report and any analysis shall be limited to those areas actually tested and the type of test conducted, and the customer is cautioned <u>not</u> to extrapolate the results of the test samples.

Prepared for:

Brookhaven National Laboratories
70 Bell Avenue, Building 134C
Upton, NY 11973

Out-of-Service Inspection of Tank No. 6 located at the Brookhaven National Laboratory Upton, New York Facility on October 27 & November 5, 2003

Prepared by:

PCA Engineering, Inc.
430 Montclair Avenue
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Pompton Lakes, NJ 07442

PCA Job No. 23089

February 13, 2004

PHASE I REPORT

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API-653 Section 2.3

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VII. RECOMMENDATIONS

I. INTRODUCTION AND BACKGROUND

On October 27, 2003 and November 5, 2003, PCA Engineering, Inc. personnel performed an Internal Out-of-Service Inspection on Tank No. 6 located at the Brookhaven National Laboratory, Upton, New York Terminal.

The Brookhaven National Laboratory, Upton, New York Facility Registration Number for New York State is 01-1700. The inspection of Tank No. 6 conforms to Section 6NYCRR, Part 613.6 "Handling and Storage of Petroleum", New York State Department of Conservation.

The inspection performed is in compliance with the API 653 Standard.

An Industrial Scientific Model ATX-6 was used for vapor monitoring prior to and during entry. Prior to entry, the oxygen content was found to be 20.9% and the lower flammability level (LFL) 0%. These are considered non-hazardous and the interior inspection proceeded. All product lines were checked and found to be blinded or locked out.

PCA personnel on site were all currently trained in Hazardous Entry and Confined Space Entry training.

SITE DESCRIPTION

Tank No. 6 is a welded, above ground, upright, insulated (shell) cylindrical storage tank measuring 38 feet in diameter by 35 feet in height. The tank was erected in 1983 and has a product capacity of 7,200 barrels. The product content during the last period of service was No. 2 fuel oil.

The tank floor is fabricated of 11 lap welded carbon steel plates. The tank shell is arranged in 4 butt-welded courses, with 5 plates per course. The tank fixed roof is fabricated of 18 lap welded plates arranged in a cone configuration.

The tank is located within an earthen dike secondary containment area. The dike area has a bentonite mixed soil lining system, as indicated on BNL supplied drawings.

TEST PROCEDURES

The following is a list of the tests performed and their procedures involved in the inspection of Tank No. 6:

A) Ultrasonic Thickness Measurements

To obtain the residual metal thickness readings, either a Cygnus Model 3 or Cygnus Model 4 Ultrasonic Digital Thickness Gauge, with a 2.25 MHz transducer was used. The Cygnus Model 3 has a resolution of +/- 0.002 inch; the Cygnus Model 4 has a resolution of +/- 0.005 inch, accuracy allowing for use on steel plate/piping materials used in storage tanks. The calibration of the instrument is confirmed prior to and during testing using a steel step block. The couplant used was Sonotech UT-X and/or motor oil.

A minimum of five (5) ultrasonic thickness readings were taken at each floor plate, with five (5) additional readings taken adjacent to the floor/shell joint on approximately 2 foot intervals. A. W. R. Thorpe Pit Gauge was available to measure any pit depths, with readings taken at the point of deepest penetration. All ultrasonic thickness readings and pitted areas are noted on the enclosed data tables. The arrangement of the floor plates is shown on the enclosed PCA drawings.

TEST PROCEDURES (Cont'd)

A minimum of five (5) ultrasonic thickness readings were taken at each plate of the lower course of shell plates and each plate adjacent to the spiral stairway ascending to the roof, with readings tabulated on the enclosed data tables. The arrangement of the shell appurtenances is shown on the enclosed PCA drawings.

As an appurtenance survey, ultrasonic thickness measurements were taken on principle pipe penetrations and their API plates within the lower course of shell plates.

Ultrasonic thickness readings of the roof were taken at a minimum of five (5) readings per plate.

B) Holiday Inspection

The epoxy coating of the tank floor was tested for overall integrity using a Tinker & Rasor Model M/1 Sponge Tester. The sponge tester operates on the principle of applying a fixed amount of D.C. current (67.5 volts) to the epoxy coated floor through a water saturated sponge.

With the instrument grounded to any area of bare steel electrically continuous with the floor, any holiday or defect in the epoxy would allow passage of water to the steel floor plates, thus completing the circuit. This would energize the buzzer, indicating to the operator the location of any defect in the epoxy coating.

C) Interior Perimeter Elevation Survey

The interior survey is based on an assumed datum of 10 feet, as shown on the "Interior Elevation Survey", with measurements shown clockwise or counter-clockwise around the tank. Cross sections are taken at various intervals around the tank, as shown on the drawing.

The interior elevation survey is helpful in evaluating the condition of the floor plates. Low spots are areas of drastic grade changes, as indicated on the drawing, are potential areas of excessive stresses in the floor plates, and indications of possible loss of sub-structure support. Elevation cross sections are helpful to analyze this data.

II. SUMMARY OF FINDINGS

Upon completion of the inspections conducted on Tank No. 6, the following results were obtained:

Ultrasonic Thickness Inspection

The residual plate metal thickness measurements ranged as follows:

Floor:	.248" to .270"	
Shell:	.250" to .270"	(1st Course)
	.260" to .270"	(2nd Course)
	.255" to .260"	(3rd Course)
	.250" to .255"	(4th Course)
Roof:	.175" to .200"	

Holiday Inspection

The original epoxy floor coating system was evaluated by a holiday test (low voltage). It was found to be in poor condition, with general porosity across the surfaces.

Addendum: A subsequent holiday inspection was performed on November 5, 2003. The newly applied poly-urea coating was inspected for holidays and no discontinuities were observed. A copy of the letter report is attached in the data section of the report.

II. SUMMARY OF FINDINGS (Cont'd)

Interior Perimeter Elevation Survey

The perimeter elevations (shell settlement) indicate a maximum differential of 0.36 feet (4.32 inches). The settlement is considered planar tilt, with the maximum out-of-plane deflection of 0.01 feet (0.12 inch). The maximum permissible out-of-plane deflection per API 653, B.3.2 is 0.04 feet (0.48 inch).

There are no visible indications of tank shell or floor stress, or recent/active displacement of fill material from around or under the tank. This information, in conjunction with the tank's age (20 years +/-), would indicate the tank has reached its maximum settlement with no changes in deflections anticipated, based on current operational procedures and site conditions.

The internal cross section elevation results disclosed edge settlement with a typical radius of 3 feet. The maximum edge settlement observed was 1.92 inches, which is within 75% of the allowable settlement as noted in API 653, Figure B-10 and Figure B-11. Settlement between 75 and 100 percent of allowable requires further inspection, while settlement in excess of the allowable requires repair or engineering evaluation.

II. SUMMARY OF FINDINGS (Cont'd)

The pitch of the cone down floor was approximately 0.4 inches in 10 feet.

Edge settlement (or roll-off) typically occurs when the tank shell settles sharply around the periphery, resulting in deformation of the bottom plate near the shell-to-bottom corner junction.

Magnetic Flux Leakage Floor Scan

Results of the magnetic flux scan of the tank floor revealed no areas of repeatable indications.

III. DISCUSSION

As a result of the inspection performed, the following deficiencies were observed:

Interior

- The integrity of the epoxy floor coating has been compromised with numerous holidays.
- There is no seal welded wear plate under the elbow down fill line.
- The still well pipe is not secured to the floor.

Exterior

- The spiral stairway steps are not fully welded to the shell; moisture intrusion/scaling is evident.
- Overall paint failure of the roof top coat was evident.
- The roof vent was observed to be corroded (see photographs).

On November 5, 2003 an inspection was performed on Tank No.6. The following results were obtained:

- A recently applied poly-urea coating was installed on the tank floor and up three (3) feet of the tank shell. The poly-urea film coating was tested with a spark tester, determining that there were no discontinuities in the coating.

III. **DISCUSSION** (Cont'd)

- The spiral stairway steps were fully seal welded to the tank shell.
- A seal welded wear plate has been installed under the elbow down fill line.
- The still well pipe is secured to the shell.

IV. TEST DATA

CORROSION SURVEY FIELD DATA TABLE

OWNER: Brookhaven National Labs
STRUCTURE: Tank No. 6
DATE OBTAINED: October 27, 2003
SURVEYED BY: W. Kent

PCA JOB NO. 22213

Ultrasonic Thickness Measurements
Tank Floor - In Inches

	1	2	3	4	5
Plate No. 1	0.256	0.254	0.258	0.260	0.258
	0.254	0.256	0.260	0.256	
Plate No. 2	0.256	0.256	0.260	0.256	0.254
	0.252	0.258	0.256	0.256	
Plate No. 3	0.266	0.268	0.264	0.266	0.264
	0.268	0.266	0.268	0.264	
Plate No. 4	0.260	0.262	0.268	0.260	0.260
	0.256	0.256	0.260	0.262	
Plate No. 5	0.252	0.252	0.254	0.256	0.257
	0.254	0.252	0.254	0.252	
Plate No. 6	0.264	0.258	0.260	0.258	0.256
Plate No. 7	0.260	0.260	0.260	0.260	0.260
	0.252	0.256	0.258	0.260	0.258

minimum	0.248
average	0.258
maximum	0.270
std. dev.	0.005194

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CORROSION SURVEY FIELD DATA TABLE

OWNER: Brookhaven National Labs
STRUCTURE: Tank No. 6
DATE OBTAINED: October 27, 2003
SURVEYED BY: W. M. Kent

PCA JOB NO. 23089

Ultrasonic Thickness Measurements
Tank Floor - In Inches

	1	2	3	4	5
Plate No. 8	0.260	0.260	0.260	0.258	0.260
	0.256	0.260	0.256	0.260	0.256
Plate No. 9	0.270	0.264	0.267	0.264	0.268
	0.264	0.266	0.268	0.268	0.264
Plate No. 10	0.256	0.256	0.256	0.254	0.256
	0.258	0.256	0.254	0.256	0.256
Plate No. 11	0.252	0.254	0.252	0.252	0.248
	0.248	0.248	0.252	0.248	0.248
SUMP	0.390	0.388	0.398	0.388	0.382
	0.384	0.382			

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1-800-666-PCA1

CORROSION SURVEY FIELD DATA TABLE

OWNER: Brookhaven National Labs
STRUCTURE: Tank No. 6
DATE OBTAINED: October 27, 2003
SURVEYED BY: W. M. Kent

PCA JOB NO. 23089

Ultrasonic Thickness Measurements
Tank Shell - In Inches

	1	2	3	4	5
Plate No. 1	0.250	0.255	0.250	0.255	0.255
Plate No. 2	0.255	0.260	0.255	0.260	0.255
Plate No. 3	0.260	0.260	0.265	0.260	0.260
Plate No. 4	0.255	0.260	0.255	0.260	0.255
Plate No. 5	0.270	0.270	0.270	0.265	0.270

minimum	0.250
average	0.259
maximum	0.270
std. dev.	0.006007

Shell Wall Profile

Course No. 1	0.255	0.260	0.255	0.255	0.260
Course No. 2	0.265	0.270	0.265	0.260	0.265
Course No. 3	0.255	0.255	0.260	0.255	0.255
Course No. 4	0.255	0.250	0.255	0.255	0.250

PCA ENGINEERING, INC.
1-800-666-PCA1

CORROSION SURVEY FIELD DATA TABLE

OWNER: Brookhaven National Labs
STRUCTURE: Tank No. 6
DATE OBTAINED: October 27, 2003
SURVEYED BY: W. M. Kent

PCA JOB NO. 23089

Appurtenance Survey
In Inches

	Top	Side	Bottom	Side
24" Manway	0.320	0.325	0.320	0.325
API	0.320	0.320	0.320	0.325
3" Inlet	0.330	0.270	0.295	0.300
API	0.320	0.320	0.325	0.320
3" Blank Nozzle	0.305	0.305	0.310	0.315
API	0.320	0.315	0.320	0.320
4" Blank Nozzle	0.340	0.340	0.345	0.340
API	0.320	0.325	0.320	0.320
3" Blank Nozzle	0.330	0.320	0.315	0.310
API	0.320	0.320	0.320	0.315
4" Water Draw-Off	0.340	0.350	0.345	0.340
API	0.320	0.315	0.320	0.320
2" Return	0.205	0.200	0.200	0.268

PCA ENGINEERING, INC.
1-800-666-PCA1

CORROSION SURVEY FIELD DATA TABLE

OWNER: Brookhaven National Labs
STRUCTURE: Tank No. 6
DATE OBTAINED: October 27, 2003
SURVEYED BY: W. Kent

PCA JOB NO. 22213

Appurtenance Survey
In Inches

	Top	Side	Bottom	Side
6" Upper Suction	0.430	0.425	0.430	0.430
API	0.320	0.325	0.320	0.320
6" Lower Suction	0.440	0.440	0.440	0.440
API	0.315	0.310	0.315	0.315
4" Nozzle	0.320	0.320	0.315	0.315
API	0.320	0.320	0.320	0.315

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1-800-666-PCA1

CORROSION SURVEY FIELD DATA TABLE

OWNER: Brookhaven National Labs
STRUCTURE: Tank No. 6
DATE OBTAINED: October 27, 2003
SURVEYED BY: W. M. Kent

PCA JOB NO. 23089

Ultrasonic Thickness Measurements
Tank Roof - In Inches

	1	2	3	4	5
Plate No. 1	0.200	0.195	0.190	0.190	0.195
Plate No. 2	0.190	0.185	0.190	0.185	0.190
Plate No. 3	0.180	0.185	0.185	0.190	0.185
Plate No. 4	0.185	0.190	0.180	0.195	0.190
Plate No. 5	0.190	0.185	0.185	0.190	0.190
Plate No. 6	0.185	0.190	0.190	0.185	0.185
Plate No. 7	0.190	0.185	0.185	0.190	0.185
Plate No. 8	0.180	0.180	0.185	0.185	0.185
Plate No. 9	0.185	0.185	0.180	0.190	0.190
Plate No. 10	0.190	0.180	0.195	0.180	0.185
Plate No. 11	0.185	0.175	0.180	0.185	0.180
Plate No. 12	0.185	0.190	0.185	0.190	0.180
Plate No. 13	0.190	0.185	0.190	0.185	0.180
Plate No. 14	0.180	0.185	0.185	0.190	0.185
Plate No. 15	0.185	0.190	0.190	0.185	0.190
Plate No. 16	0.180	0.185	0.185	0.180	0.185
Plate No. 17	0.185	0.190	0.185	0.180	0.185
Plate No. 18	0.180	0.190	0.190	0.180	0.190

minimum	0.175
average	0.186
maximum	0.200
std. dev.	0.004454

PCA ENGINEERING, INC.
1-800-666-PCA1

CORROSION SURVEY FIELD DATA TABLE

OWNER: Brookhaven National Labs
STRUCTURE: Tank No.6
DATE OBTAINED: October 27, 2003
SURVEYED BY: W. M. Kent

Elevation Survey

PCA JOB NO. 23089

	Shell	1'	2'	3'	4'	5'	10'	20'	Center
A	10.00	10.01	9.91	9.95	9.96	9.97	9.88		9.84
B	9.99	10.00	10.00	9.99	10.00	9.99	9.93		
C	9.81	9.82	9.81	9.79	9.79	9.78	9.82		
D	9.68	9.70	9.68	9.70	9.73	9.77	9.86		
E	9.61	9.61	9.65	9.67	9.66	9.63	9.71		
F	9.65	9.63	9.64	9.63	9.67	9.71	9.80		
G	9.73	9.78	9.80	9.80	9.82	9.80	9.83		
H	9.89	9.91	9.91	9.92	9.90	9.88	9.86		
A	10.00								

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1-800-666-PCA1

API 653 INSPECTION - DATA EVALUATION

GENERAL INFORMATION

Customer: Brookhaven National Labs

Job No.: 23089

Date: 10/27/2003

Tank No.: 6
Diameter: 38 feet
Height: 35 feet
Safe Fill: – feet
Capacity: 7,145 bbl
Product: lo. 2 fuel oil

Cathodic Protection?: y
Leak Detection?: n
Thick FilmCoating?: n
Thin Film Coating?: y

Erected: 1/1/1984
Date Last- Inspected: Jun-02
Cleaned:
Painted:
Lined:
Strapped:

	Quantities:
Floor plts:	11
Roof plts:	18
Shell crs:	4
Plts/Crs:	5

1st Crse Avg Shell Thickness (in)	
1st	0.250
2nd	0.255
Min Thick	0.250
4th	0.255
5th	0.255

	PlateThickness (in)					
	Original	General	Delta	Minimum	Material	Riveted?
Floor Plates:	0.270	0.258	0.012	0.248	Unknown	n
Sketch Plates:			0.000			
Annular Plates:			0.000			
Shell - 1st course:	0.270	0.259	0.011	0.250	Unknown	n
2nd course:	0.270	0.265	0.005	0.260	Unknown	n
3rd course:	0.260	0.256	0.004	0.255	Unknown	n
4th course:	0.255	0.253	0.002	0.250	Unknown	n
5th course:			0.000		Unknown	n
6th course:			0.000			
7th course:			0.000			
8th course:			0.000			
Roof:	0.200	0.186	0.014	0.175	Unknown	n

	Pitting Depth (in)			
	Max Int.	Avg Int.	Max Ext.	Avg Ext.
Floor Plates:	0.020	0.010	0.025	0.015
Shell - 1st course:	0.006	0.004	0.005	0.004
Roof:	0.010	0.008	0.006	0.005

Containment Area:

Steel?
Diameter feet
Height feet

Containme bbl
110% Cap

Earthen? y
Length 135 feet
Width 97 feet
Height 5 feet
Containment 11,786 bbl
110% Cap 7,972 Sufficient Containment if tank is filled to capcity

Calculated Safe Fill (based on capacity of containment) = 52.48 feet
Therefore, containment is sufficient if current Safe Fill is maintained

COMMENTS:

PCA ENGINEERING, INC.

BOTTOM PLATE TOPOGRAPHY

Tank: 6
Diameter: 38

No of Sections: 8
Max Chord Length: 14.92 ft

Elevation @ Center of Tank: 9.84 ft
Average Pitch: -0.03 in/ft
Overall Differential Settlement 4.68 in

Allowable Roll-Off	
in 1'	0.34 in
in 2'	0.71 in
in 3'	1.08 in

	AXIS 1		AXIS 2		AXIS 3		AXIS 4		AXIS 5		AXIS 6	
Spacing	Field Data	Roll-Off	Field Data	Roll-Off	Field Data	Roll-Off	Field Data	Roll-Off	Field Data	Roll-Off	Field Data	Roll-Off
Shell	10.00		9.99		9.81		9.68		9.61		9.65	
1'	10.01	0.12	10.00	0.12	9.82	0.12	9.70	0.24	9.61	0.00	9.63	0.24
2'	9.91	1.08	10.00	0.12	9.81	0.00	9.68	0.00	9.65	0.48	9.64	0.12
3'	9.95	0.60	9.99	0.00	9.79	0.24	9.70	0.24	9.67	0.72	9.63	0.24
5'	9.97		9.99		9.78		9.77		9.63		9.71	
10'	9.88		9.93		9.82		9.86		9.71		9.80	
20'												
30'												
40'												
50'												
60'												
70'												
80'												
90'												
Settlement	0		0.01		0.19		0.32		0.39		0.35	

	AXIS 7		AXIS 8		AXIS 9		AXIS 10		AXIS 11		AXIS 12	
Spacing	Field Data	Roll-Off	Field Data	Roll-Off	Field Data	Roll-Off	Field Data	Roll-Off	Field Data	Roll-Off	Field Data	Roll-Off
Shell	9.73		9.89									
1'	9.78	0.60	9.91	0.24		0.00		0.00		0.00		0.00
2'	9.80	0.84	9.91	0.24		0.00		0.00		0.00		0.00
3'	9.80	0.84	9.92	0.36		0.00		0.00		0.00		0.00
5'	9.80		9.88									
10'	9.83		9.86									
20'												
30'												
40'												
50'												
60'												
70'												
80'												
90'												
Settlement	0.27		0.11									

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TANK SHELL EVALUATION API 653 SECTION 2.3

Tank: 6 Date: 10/27/2003

Diameter: 38 feet
Height: 35 feet
t_1(avg.): 0.253 inches
t_2: 0.250 inches

Field data: 0.250
0.255
0.250
0.255
0.255
t_1= 0.253

Thickness Determination:

$L=3.7(D*t_2)^{1/2}$

Where: L= the maximum vertical length, in inches, over which hoop streees are assumed to "average out" around local discontinuities
D= tank diameter, in feet
t_2= the least thickness, in inches, in area of corrosion, exclusive of pits

L= 11.40417 inches

Minimum Thickness Calculation for Welded Tank Shell:

Course No. 1

t_{min}= **2.6DHG/SE** = **0.143 inches**

Where:
t_{min}= the minimum acceptable thickness, in inches, as calculated from the above formula; however, t_{min} shall not be less than 0.1 inch for tank course
D= nominal diameter of tank, in feet
H= Height, in feet, from the bottom of length *L* for the most severely corroded area in each shell course to the maximum design liquid level
G= highest specific gravity of the contents (including water, if hydtsted)
S= maximum allowable stress in psi; use the smaller of 0.80Y or 0.426T for bottom and second course; use the smaller of 0.88Y or 0.472T for all other courses
Y= specified minimum yield strength of the plate; 30,000 psi if unknown
T= the smaller of the specified minimum tensile strength of the plate or 80,000 psi; use 55,000 psi if unknown
E= original joint efficiency for the tank. use E=0.7 if unknown, E=1.0 when evaluating the retirement thickness in a corroded plate, when away from welds or joints by at least the greater of 1 inch or twice the plate thickness

NOTE: For riveted tanks see section 653.2.3.4; see section 653.2.3.3 for complete explanation

D =	38 feet	G =	1.0	Y =	30,000 psi
H =	35 feet	S =	23,430 psi	T =	55,000 psi
				E =	1.0

Then, per API653 section 2.3.3.1:

	If:	a:	t_1	>=	t_{min}
			0.253	>=	**0.143**
	and				
		b:	t_2	>=	60% t_{min}
			0.250	>=	**0.086**

THEREFORE, NO ACTION IS REQUIRED

Maximum Safe Fill Height = **60.29** feet **Tank can be filled to capacity**
(t_2SE/2.6DG) +1 **Provided Containment Capacity is Sufficient**

PCA ENGINEERING, INC.

Tank: 6

Date: **10/27/2003**

Diameter:	38	Yield:	23,430
Height:	35	Joint Efficiency:	1.0
Number of Courses:	4	Specific Gravity:	1.00

MINIMUM THICKNESS per each SHELL COURSE

	Height (TOC)	Minimum Thickness	
Course 1	8.75	0.143	**OK**
Course 2	17.5	0.106	**OK**
Course 3	26.25	0.070	**OK**
Course 4	35	0.033	**OK**
Course 5			
Course 6			
Course 7			
Course 8			

TANK BOTTOM EVALUATION - API 653 SECTION 2.4

Tank: 6 Date: **10/27/2003**

Minimum Thickness for Tank Bottom Plate (API 4.4.7):

$$MRT = (\text{minimum of } RT_{bc} \text{ or } RT_{ip}) - O_r(StP_r + UP_r)$$

Where:

MRT = minimum remaining thickness at the end of interval O_r
This value must meet the requirments of Table 6-1
and sections 4.4.7.4 and 4.4.8

O_r = in-service interval (years to next inspection) not to exceed that allowed by 4.2.2 (normally 10 years)

RT_{bc} = minimum remaining thickness from bottom side corrosion, after repairs

RT_{ip} = minimum remaining thickness from internal corrosion after repairs

StP_r = maximum internal pitting rate, in inches per year; StP_r = 0 if tank bottom is internally lined.

UP_r = maximum underside pitting rate, in inches per year; UP_r = 0 if tank bottom is cathodically protected.

T_o	=	0.270 inch	RT_{bc} =	0.245		UP_r	=	0.000 in/yr
UP_m	=	0.025 inch	RT_{ip} =	0.250		StP_r	=	0.0010 in/yr
StP_m	=	0.020 inch	O_r =	10.0 years				

Solve for: MRT = 0.235 inch

Or = 143.7 years where MRT = 0.100
NOTE: see API 653 table 6-1

Then if:

MRT > 0.100

THEREFORE, NO ACTION IS REQUIRED

PCA ENGINEERING, INC.

TANK SETTLMENT EVALUATION - API 653 APPENDIX B

Tank: 6

Date: 10/27/2003

Diameter: 38 feet
Sections: 8

Arc (L): 14.92 feet
Yield(Y): 30000 psi
(E): 29000000 psi
Height(H): 35 feet

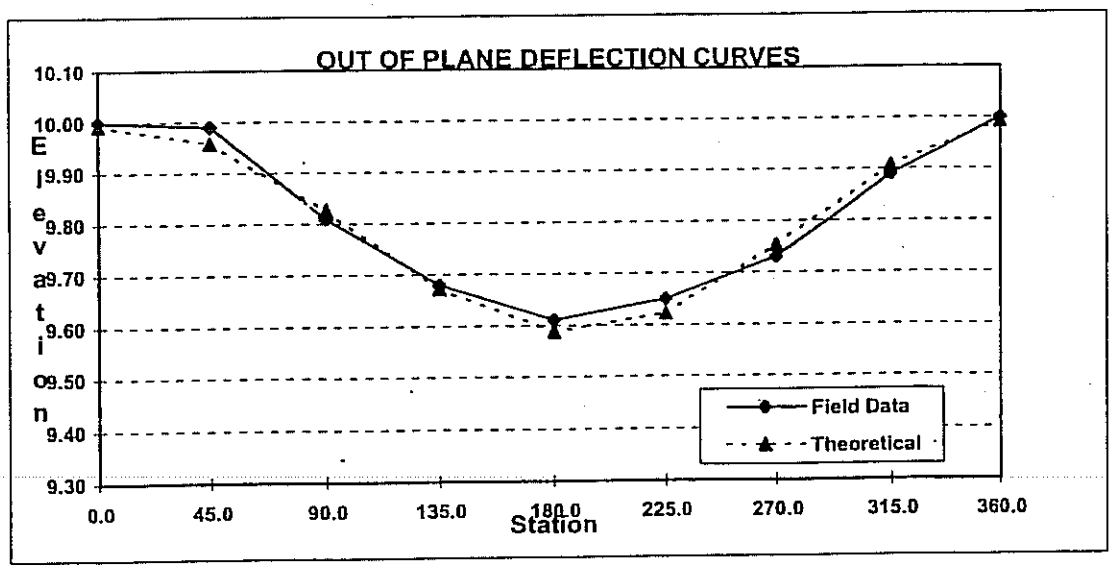
Maximum Permissible Out-of-Plane Deflection:

$S<=(L^2*Y*11)/(2(E*H)$

Where:
S= deflection, in feet (out-of-plane distortion)
L= arc length, between measurement pts, in feet
Y= yield strength, in psi
E= Young's modulus, in psi
H= tank height, in feet

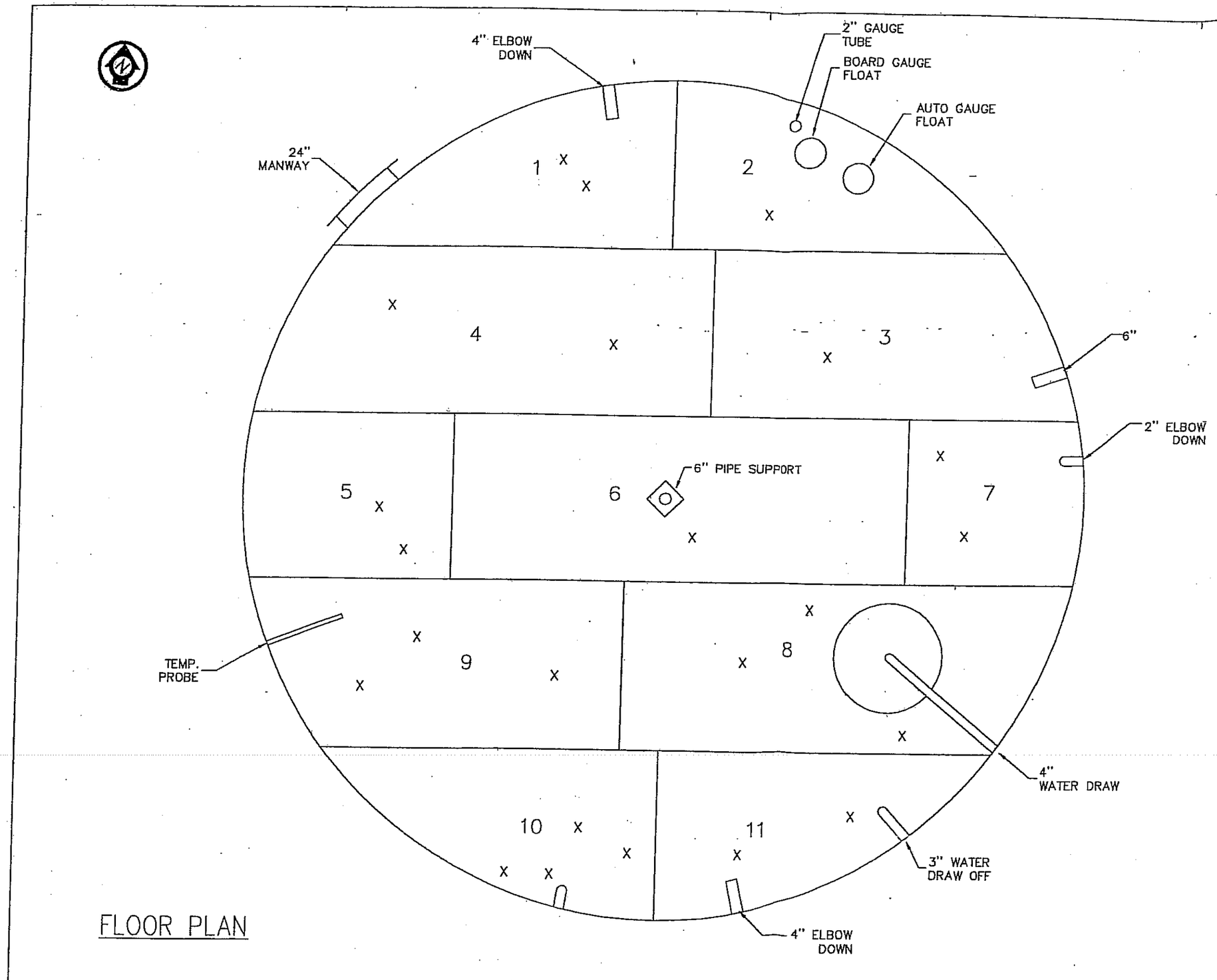
S<= 0.0362 feet

Degrees	Station	Field Data	Theoretical	Delta(U_i)	Deflection(S_i)
0.0	0.0	10.00	9.992	0.008	0.0009
45.0	14.9	9.99	9.958	0.032	0.0358
90.0	29.8	9.81	9.826	-0.016	0.0354
135.0	44.8	9.68	9.672	0.008	0.0044
180.0	59.7	9.61	9.588	0.022	0.0041
225.0	74.6	9.65	9.622	0.028	0.0292
270.0	89.5	9.73	9.754	-0.024	0.0296
315.0	104.5	9.89	9.908	-0.018	0.0094
360.0	119.4	10.00	9.992	0.008	0.0009



THEN, SINCE THE MAXIMUM Si <= S NO ACTION IS REQUIRED

PCA ENGINEERING, INC.



FLOOR PLAN

GENERAL NOTES:

TANK No. 6
38' DIA. X 35'-6" H.

LEGEND:

X – HOLIDAY LOCATIONS

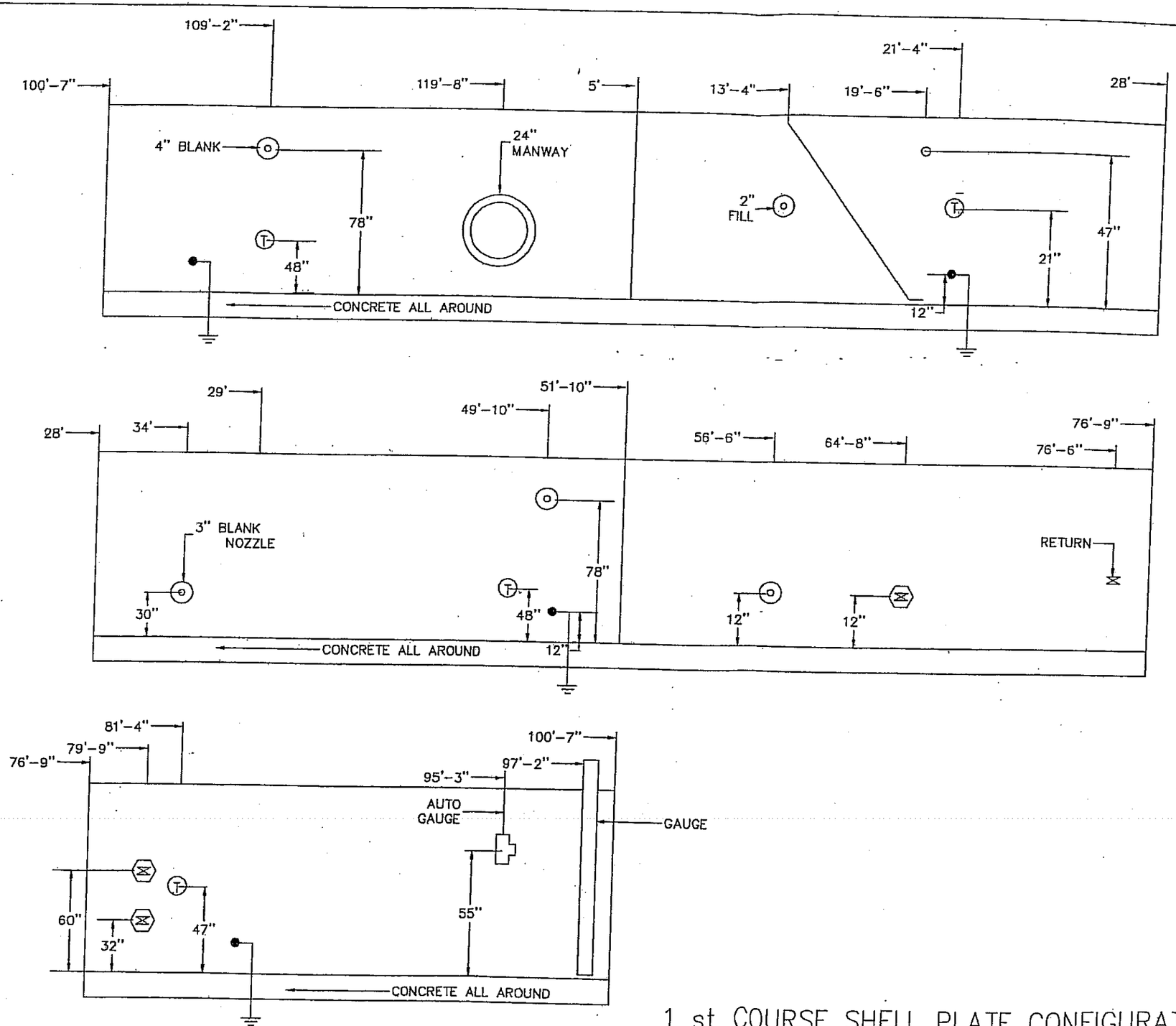
PCA ENGINEERING, INC.
177 Royal Ave. Hawthorne, N.J. U.S.A.
TEL. (201) 427-8540

BROOKHAVEN NATIONAL LAB.
FUEL TRANSFER FACILITY
UPTON, NY.

PROJECT LOCATION:
BROOKHAVEN NATIONAL LAB.
FUEL TRANSFER FACILITY
UPTON, NY.

DRAWING TITLE:
OUT-OF-SERVICETANK INSPECTION
TANK No. 6

CHECKED BY:	UL	DRAWN BY:	A.U.Z.
SCALE:	N.T.S.	DATE:	11-21-03
DRAWING No.:	BW-23089-04	REV.	0



1 st COURSE SHELL PLATE CONFIGURATION

GENERAL NOTES:
TANK No.6
38' DIA. X 35'-6" H.

LEGEND:

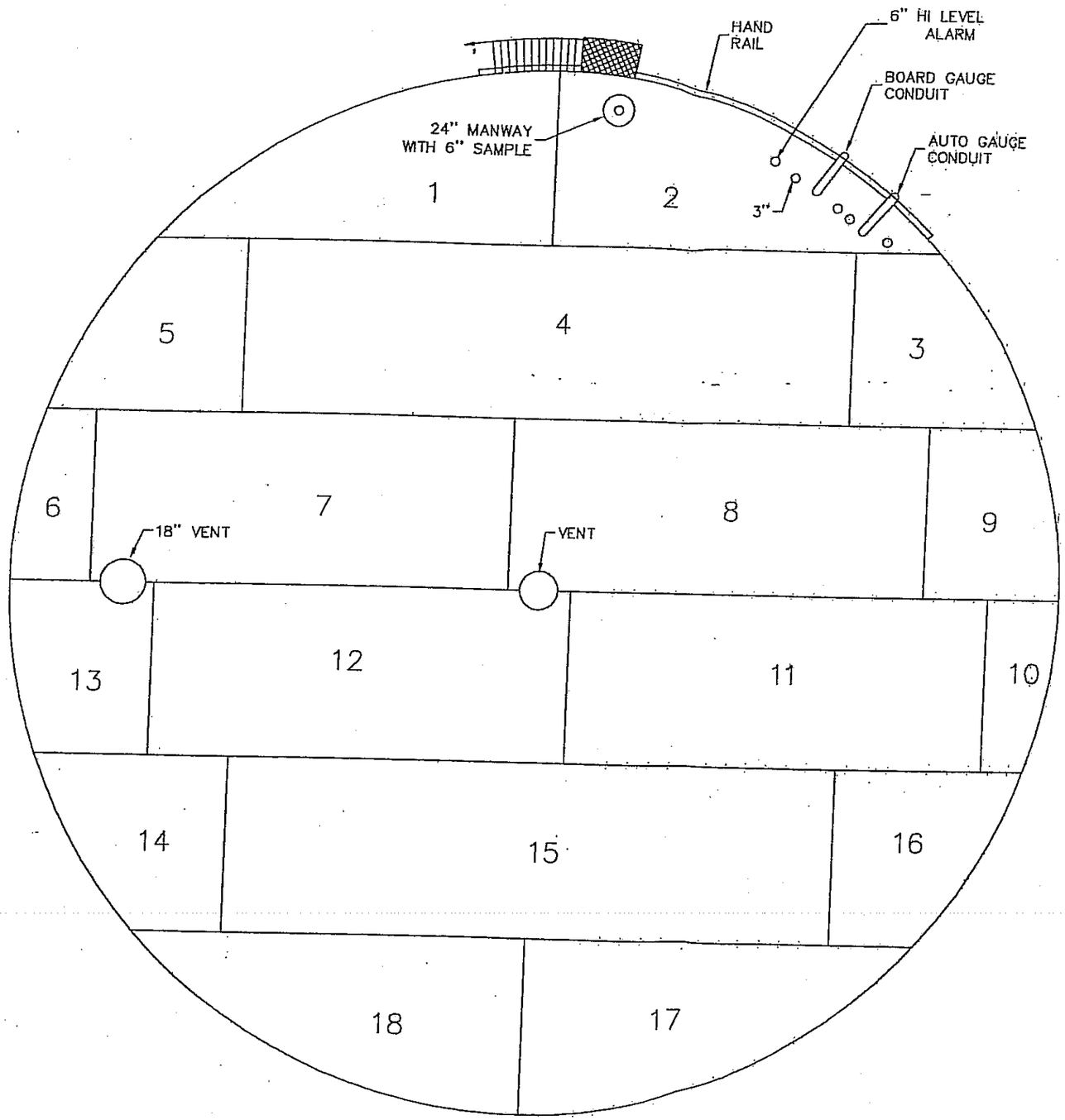
PCA ENGINEERING, INC.
430 Montclair Ave. Pompton Lakes, NJ.
TEL. (973) 616-4501

BROOKHAVEN NATIONAL LAB.
FUEL TRANSFER FACILITY
UPTON, NY.

PROJECT LOCATION:
BROOKHAVEN NATIONAL LAB.
FUEL TRANSFER FACILITY
UPTON, NY.

DRAWING TITLE:
TANK INSPECTION
TANK No. 6

CHECKED BY:	WK	DRAWN BY:	A.U.Z.
SCALE:	N.T.S.	DATE:	11-21-03
DRAWING No.:	BW-23089-05	REV.	0



ROOF PLAN

GENERAL NOTES:
TANK No. 6
38' DIA. X 35'-6" H.

LEGEND:

PCA ENGINEERING, INC.
430 Montclair Ave. Pompton Lakes, NJ.
TEL. (973) 616-4501

BROOKHAVEN NATIONAL LAB.
FUEL TRANSFER FACILITY
UPTON, NY.

PROJECT LOCATION:
BROOKHAVEN NATIONAL LAB.
FUEL TRANSFER FACILITY
UPTON, NY.

DRAWING TITLE:
TANK INSPECTION
TANK No. 6

CHECKED BY: WV	DRAWN BY: AEC
SCALE: N.T.S.	DATE: 11-21-03
DRAWING No.: BW-23089-06	REV. 0

V. API 653 CHECKLIST

API 653

TANK OUT-OF-SERVICE INSPECTION CHECKLIST

OVERVIEW

OK	Check that tank has been cleaned, is gas free, and safe for entry
OK	Check that the tank is completely isolated from product lines, all electrical power, and steam lines
OK	Check that roof is adequately supported, including fixed roof structure and floating roof legs
OK	Check for presence of falling object hazards, such as corroded-through roof rafters, asphalt stalactites, and trapped hydrocarbons in unopened or plugged equipment or appurtenances, ledges, etc.
OK	Inspect for slipping hazards on the bottom and roof decks
OK	Inspect structural welds on accessways and clips
OK	Check surfaces needing inspection for a heavy-scale buildup and check weld seams and oily surfaces where welding is to be done. Note areas needing more cleaning, including blasting

Remarks: _____

_____

TANK EXTERIOR

OK	Inspect appurtenances opened during cleaning such as lower floating swing sheave assemblies, nozzle interiors (after removal of valves)
OK	Hammer test or ultrasonically test the roof
N/A	Enter and inspect the floating roof pontoon compartments

Remarks: _____

_____

BOTTOM INTERIOR SURFACE

*	Using a flashlight held close to and parallel to the bottom plates, and using the bottom plate layout as a guide, visually inspect and hammer test the entire bottom
OK	Measure the depth of pitting and describe the pitting appearance (sharp edged, lake type, dense, scattered, etc.)
N/A	Mark areas requiring patching or further inspection
N/A	Mark locations for turning coupons for inspection
OK	Inspect all welds for corrosion and leaks, particularly the shell-to-bottom weld
OK	Inspect sketch plates for corrosion
N/A	Locate and mark voids under the bottom
OK	Record bottom data on a layout sketch using the existing bottom plates as a grid. List the number and sizes of patches required
N/A	Vacuum test the bottom lap welds

OK	Hammer test or ultrasonically examine any slightly discolored spots or damp areas
OK	Check for reinforcing pads under all bottom attached clips, brackets and supports
N/A	Inspect floating roof leg pads for pitting or cutting, and excessive dimpling (indicating excessive loading)
N/A	Check the column bases of fixed roof supports for adequate pads and restraining clips
OK	In earthquake zones 3 and 4, check that roof supports are not welded down to the tank, but are only restrained from horizontal movement
N/A	Check area beneath swing line cable for indications of cable cutting or dragging
OK	Mark old oil and air test connection for removal and patching
OK	Identify and report low areas on the bottom that do not drain adequately
OK	Inspect coating for holes, disbonding, deterioration, and discoloration

Remarks: *hammer testing was not performed due to presence of epoxy thin Film lines

SHELL SEAMS AND PLATES

OK	On cone up bottoms, closely inspect and gauge the depth of metal loss on the lower 2 to 4 inches of the shell (area of standing water)
OK	Measure the depth of pitting on each course
OK	Inspect and estimate the amount of metal loss on the heads of rivets and bolts
N/A	Inspect shell-to-bottom riveted lap joints
N/A	Inspect for vertical grooving damage from seal assembly protrusions
OK	Inspect existing protective coatings for damage, deterioration, and disbonding
N/A	Check for areas of rubbing (indicating too much pressure by the seal assembly shoes or inadequate annular space)
N/A	Visually inspect the shell plates and seams for indications of leakage
N/A	If the shell has riveted or bolted seams, record the leak locations by film or chart in case the locations are lost during surface preparation for painting
N/A	Measure annular space at 40-foot intervals
OK	Survey the shell to check for roundness and plumb

Remarks:

SHELL-MOUNTED OVERFLOWS

N/A	Inspect overflow for corrosion and adequate screening
N/A	Check location of overflow that it is not above any tank valves or equipment

Remarks: _____

ROOF INTERIOR SURFACE

General

OK	Visually inspect the underside surface of the roof plates for holes, scale buildup, and pitting
OK	Hammer test or ultrasonically examine to check for thin areas, particularly in the vapor space of floating roofs and at edge of roof on cone roof tank
OK	Check all clips, brackets, braces, etc., welded to the roof deck plate for welded reinforcing pads and see that they have not broken free
N/A	If no pad is present, penetrant test for cracking of the weld or deck plate
OK	Inspect the protective coating for breaks, disbondment, and deterioration

Remarks: _____

Fixed Roof Support Structure

OK	Inspect the support columns for thinning in the upper two feet
N/A	On API columns (two channels welded together) check for corrosion scale breaking the tack welds, unless the joint between the channels is completely seal welded
OK	Check that the reinforcing pad on the bottom is seal welded to the tank bottom with horizontal movement restraining clips welded to the pad
OK	Determine if pipe column supports are concrete filled or open pipe. If open pipe, check for a drain opening in the bottom of the pipe
OK	Inspect and gauge rafters for thinning, particularly near the center of the roof. Report metal loss
OK	Check for loose or twisted rafters
OK	Inspect girders for thinning and check that they are attached securely to the top of the columns
N/A	Report if the columns have cross bracing in the area between the low pump out and top of the shell (for future internal floating roof installation)
N/A	Inspect and report presence of any roof-mounted swing line bumpers
OK	Photograph the roof structure if no rafter layout drawing exists

Remarks: _____

FIXED ROOF APPURTENANCES

Inspection and Light Hatches

OK	Inspect the hatches for corrosion, paint and coating failures, holes, and cover sealing
OK	On loose covers, check for a safety chain in good condition
OK	On light hatches over 30 inches across, check for safety rods
OK	Inspect the condition of the gaskets on bolted or latched down hatch covers

Remarks: _____

Staging Support Connection

N/A	Inspect the condition of the staging support for corrosion

Remarks: _____

Breathers and Vents

N/A	Inspect and service the breather
OK	Inspect screens on vents and breathers

Remarks: _____

Emergency P/V Hatches

N/A	Inspect and service pressure/vacuum hatches (setting should be high enough to prevent chattering of breather during normal operation. See breather manufacturer's guide
N/A	Inspect liquid seal hatches for corrosion and proper liquid level in the sea

Remarks: _____

Sample Hatch

OK	Inspect sample hatch for corrosion
OK	Check that the cover operates properly
N/A	If the tank has no gaugewell, check for a hold off distance marker and check measurement

Remarks: _____

FLOATING ROOF

Roof Deck

N/A – Hammer test the area between roof rim and shell. (If access for hammer testing is inadequate, measure the distance from the bottom edge of the roof to the corroded area and then hammer test from inside the pontoon)

N/A In sour water service, clean and test all deck plate weld seams for cracking unless the lower laps have been seal welded

N/A Check that either the roof drain is open or the drain plug in the roof is open in case of unexpected rain

N/A On flat bottomed and cone down bottom roof decks, check for a vapor dam around the periphery of the roof. The dam should be continuous without break to prevent escape of vapors to the seal area from under the center of the roof

Remarks: _____

Floating Roof Pontoons

N/A Visually inspect each pontoon for liquid leakage

N/A Run a light wire through the gooseneck vents on locked down inspection hatch covers to make sure they are open

N/A Inspect lockdown latches on each cover

N/A Check and report if each pontoon is:

- _____ Vapor tight (bulkhead seal welded on one side on bottom, sides and top
- _____ Liquid tight (seal welded on bottom and sides only) or
- _____ Unacceptable (minimum acceptable condition is liquid tight)

Remarks: _____

Floating Roof Cutouts

N/A Inspect underside of cutouts for mechanical damage

N/A Inspect welds for cracks

N/A Inspect plate for thinning, pitting, and erosion

N/A Measure mixer cutouts and record plate thickness for future mixer installation or replacement

Plate thickness: _____

Remarks: _____

Floating Roof Supports

N/A	Inspect fixed low and removable high floating roof legs for thinning
N/A	Inspect for notching at bottom of legs for drainage
N/A	Inspect for leg buckling or bellying at bottom
N/A	Inspect pin hole in roof guide for tears
N/A	Check plumb of all legs
N/A	Inspect for adequate reinforcing gussets on all legs through a single portion of the roof
N/A	Inspect the area around the roof legs for cracking if there is no internal reinforcing pad or if the topside pad is not welded to the deck plate on the underside
N/A	Inspect the sealing system on the two-position legs and the vapor plugs in the fixed low leg for deterioration of the gaskets
N/A	On the shell mounted roof supports, check for adequate clearance based on the maximum floating roof movement as determined by the position of the roof relative to the gaugewell and/or counter rotational device

Remarks: _____

FLOATING ROOF SEAL ASSEMBLIES

Primary Shoe Assembly

N/A	Remove four sections of foam log (foam filled seals) for inspection, on 90° locations
N/A	Inspect hanger attachment to roof rim for thinning, bending, broken welds, and wear of pin holes
N/A	Inspect clips welded to roof rim for thinning
N/A	Shoes: Inspect for thinning and holes in shoes
N/A	Inspect for bimetal bolts, clips, and attachments
N/A	Seal fabric: Inspect for deterioration, stiffening, holes, and tears in fabric
N/A	Measure length of fabric from top of shore to roof rim, and check against maximum anticipated annular space as roof operated
N/A	Inspect any modification of shoes over shell nozzles, mixers, etc., for clearance
N/A	Inspect shoes for damage caused by striking shell nozzles, mixers, etc.

Remarks: _____

Primary Toroidal Assembly

N/A	Inspect seal fabric for wear, deterioration, holes, and tears
N/A	Inspect hold down system for buckling or bending
N/A	Inspect foam for liquid absorption and deterioration

Remarks: _____

Rim Mounted Secondaries

N/A Inspect the rim-mounted bolting bar for corrosion and broken welds
N/A Measure and chart seal-to-shell gaps
N/A Visually inspect seal from below, looking for holes as evident by light
N/A Inspect fabric for deterioration and stiffness
N/A Inspect for mechanical damage, corrosion, and wear on tip in contact with shell
N/A Inspect for contact with obstructions above top of shell

Remarks: _____

FLOATING ROOF APPURTENANCES

Roof Manways

N/A Inspect walls of manways for pitting and thinning
N/A On tanks with interface autogauges, check seal around gauge tape cable and guide wires through manway cover
N/A Inspect cover gasket and bolts

Remarks: _____

Rim Vent

N/A Check rim vent for pitting and holes
N/A Check vent for condition of screen
N/A On floating roof tanks where the environmental rules require closing off the vent, check the vent piping for corrosion at the pipe-to-rim joint and check that the blinding is adequate

Remarks: _____

Vacuum Breaker, Breather Type

N/A Service and check operation of breather valve
N/A Check that nozzle pipe projects no more than 1/2 inch below roof deck
N/A Inspect reinforcing pad and pad weld

Remarks: _____

Vacuum Breaker, Mechanical Type

N/A Inspect the stem for thinning. Measure how far the vacuum breaker cover is raised off the pipe when the roof is resting on high or low legs
On high legs: _____
On low legs: _____

Remarks: _____

_____

Roof Drains: Open Systems, Including Emergency Drains

N/A	Check liquid level inside open roof drains for adequate freeboard. Report if there is insufficient distance between liquid level and top of drain
N/A	If tank comes under Air Quality Monitoring District rules, inspect the roof drain vapor plug
N/A	If emergency drain is not at the center of the roof, check that there are at least three emergency drains

Remarks: _____

_____

Closed Drain Systems: Drain Basins

N/A	Inspect for thinning and pitting
N/A	Inspect protective coating (topside)
N/A	Inspect basin cover or screen for corrosion
N/A	Test operation of check valve
N/A	Check for presence of check valve where bottom of basin is below product level
N/A	Inspect drain basin(s) to roof deck welds for cracking
N/A	Check drain basin(s) outlet pipe for adequate reinforcement to roof deck (including reinforcing pad)

Remarks: _____

_____

Closed Drain Systems: Fixed Drain Line on Tank Bottom

N/A	Hammer test fixed drain line on tank bottom for thinning and scale/ debris plugging
N/A	Inspect supports and reinforcing pads for weld failures and corrosion
N/A	Check that pipe is guided, not rigidly locked to supports, to avoid tearing of tank bottom plate

Remarks: _____

_____

Closed Drain Systems: Flexible Pipe Drain

N/A	Inspect for damage to exterior of pipe
N/A	Check for obstructions that pipe could catch on
N/A	Inspect shields to protect pipe from snagging
N/A	Inspect results of hydrotest on flexible roof drain system

Remarks: _____

_____

Closed Drain Systems: Articulated Joint Drain

N/A	Hammer test rigid pipe in flexible joint system for thinning and scale debris plugging
N/A	Inspect system for signs of bending or strain
N/A	Inspect results of system hydrotest
N/A	Inspect landing leg and pad

Remarks: _____

Autogauge System and Alarms

OK	Check freedom of movement of tape through autogauge tape guide
OK	Inspect sheaves for freedom of movement
OK	Test operation checker
OK	Inspect tape and tape cable for twisting and fraying
OK	Test the tape's freedom of movement through guide sheaves and tape guide pipe
N/A	On open-top tanks, check that gate tapes with cables have no more than one foot of tape exposed with float at lowest point
OK	Check float for leakage
OK	Test float guide wire anchors for spring action by pulling on wire and releasing
N/A	Inspect floatwells in floating roofs for thinning and pitting of walls just above the liquid level
OK	Check that the autogauge tape is firmly attached to the float
OK	Inspect the tape cable and float guide wire fabric seals through the floatwell cover
OK	Inspect the bottom guide wire attachment clip; inspect for a temporary weighted bar instead of a permanent welded down clip
OK	Inspect board-type autogauges indicators for legibility and freedom of movement of indicator
N/A	Measure and record these distances to determine if seal damage will occur if tape is run over:
_____	From shell top angle to underside of tape guide system
_____	From liquid level on floating top to top of secondary seal
N/A	Identify floating roofs where the tape is connected directly to the roof
OK	Overfill alarm: Inspect tank overfill prevention alarm switches for proper operation

Remarks: _____

COMMON TANK APPURTENANCES

Gauge Well

OK	Inspect gauge well pipe for thinning at about two-thirds distance above the bottom: look for thinning at the edge of the slots
OK	Check for corrosion on the pipe joint. Check that sample cords, weights, thermometers, etc., have been removed from pipe
OK	Check for cone at bottom end of pipe about one foot above the bottom

OK	Check condition of well washer pipe and that its flared end is directed at the near side of the hold-off pad
OK	Check that the supports for the gaugewell are welded to pad or to shell and not directly to bottom plate
OK	Check operation of gaugewell cover
N/A	Check presence of a hold-off distance marker in well pipe and record hold-off distance
_____	Hold-Off Distance
*1	Identify and report size and pipe schedule, and whether pipe is solid or slotted. Report slot size
N/A	Check that the hold-off distance plate is seal welded to the bottom and that any gaugewell supports are welded to the plate and not directly to the bottom
N/A	Inspect vapor control float and cable
N/A	Check for presence and condition of gaugewell washer
N/A	Check for bull plug or plate blind on gaugewell washer valve
OK	Inspect gaugewell guide in floating roof for pitting and thinning
OK	Inspect the guide rollers and sliding plates for freedom of movement
OK	Inspect condition of gaugewell pipe seal system
OK	On black oil and diesel services: if gaugewell is also used for sampling, check for presence of a thief- and gauge-type hatch to avoid spillage
OK	Visually inspect inside of pipe for pipe weld protrusions which could catch or damage vapor control float

Remarks:*2 2" Sch. 40 pipe with 1" diameter slots

Sampling Systems: Roof Sample Hatches

OK	Inspect roof mounted sample hatches for reinforcing pads and cracking
OK	Inspect cover for operation
OK	For tanks complying with Air Quality Monitoring District rules, inspect sample hatch covers for adequate sealing
N/A	Check horizontal alignment of internal floating roof sample hatches under fixed roof hatches
OK	Inspect the sealing system on the internal floating roof sample hatch cover
N/A	Inspect floating roof sample hatch cover recoil reel and rope

Remarks:

Shell Nozzles

OK	Inspect shell nozzles for thinning and pitting
N/A	Inspect hot tap nozzles for trimming of holes
OK	Identify type of shell nozzles
OK	Identify and describe internal piping, including elbow up and elbow down types

Remarks:

For Nozzles Extended into the Tank

N/A	Inspect pipe support pads welded to tank bottom
N/A	Inspect to see that pipe is free to move along support without strain or tearing action on bottom plate
OK	Inspect nozzle valves for packing leaks and damaged flange faces
N/A	Inspect heater steam nozzle flanges and valves for wire cutting
N/A	Report which nozzles have thermal pressure relief bosses and valves
OK	In internal elbow-down fill line nozzles, inspect the wear plate on the tank bottom
OK	On elbow-up fill lines in floating roof tanks, check that opening is directed against underside of roof, not against vapor space. Inspect impact area for erosion

Remarks: _____

_____

Diffusers and Air Rolling Systems

N/A	Inspect diffuser pipe for erosion and thinning
N/A	Check holes in diffuser for excessive wear and enlargement
N/A	Inspect diffuser supports for damage and corrosion
N/A	Check that diffuser supports restrain, not anchor, longitudinal line movement
N/A	Inspect air spiders on bottom of lube oil tanks for plugging and damaged or broken threaded joints

Remarks: _____

_____

Swing Lines

N/A	Inspect flexible joint for cracks and leaks
N/A	Scribe the flexible joint across the two moving faces and rise end of swingline to check the joint's freedom of movement, indicated by separation of scribe marks
N/A	Check that flexible joints over six inches are supported
N/A	Inspect the swing pipe for deep pitting and weld corrosion
N/A	Loosen the vent plugs in the pontoons and listen for a vacuum. Lack of a vacuum indicates a leaking pontoon
N/A	Check the results of air test on pontoons during repairs
N/A	Inspect the pontoons for pitting
N/A	Inspect the pull-down cable connections to the swing
N/A	Inspect the condition of the bottom-mounted support, fixed roof limiting bumper, or shell mounted limiting bumper of wood condition, weld and bolt corrosion, and seal welding to bottom or shell
N/A	Inspect safety hold-down chain for corrosion and weak links
N/A	Check that there is a welded reinforcing pad where the chain connects to the bottom
N/A	If the floating swing in a floating or internal floating roof does not have a limiting device preventing the swing from exceeding 60 degrees, measure and calculate the maximum angle possible with the roof on overflow

_____ Maximum angle on overflow

(If the calculated angle exceeds 65 degrees, recommend installation of a limiting bracket)

N/A Inspect pull down cable for fraying

N/A Inspect for three cable clamps where cable attaches to end of swingline (single-reeved) or to roof assembly (double-reeved). Inspect sheaves for freedom of movement

N/A Inspect winch operation and check the height indicator for legibility and accuracy

N/A Inspect bottom-mounted sheave assembly at end of pontoon for freedom of rotation of sheave

N/A Inspect shell mounted lower sheave assembly for freedom of rotation of sheave, corrosion thinning, and pitting of sheave housing

N/A Inspect upper sheave assembly for freedom of movement of sheave

N/A Inspect the cable counterbalance assembly for corrosion and freedom of operation

Remarks: _____

_____

Manway Heater Racks

N/A Inspect the manway heater racks for broken welds and bending of the sliding rails

N/A Measure and record the length of the heater and length of the track

Remarks: _____

_____

Mixer Wear Plates and Deflector Stands

N/A Inspect bottom and shell plates and deflector stands

N/A Inspect for erosion and corrosion on the wear plates. Inspect for rigidity, structural soundness, corrosion, and erosion of deck plates and reinforcing pads that are seal welded to the bottom under the deflector stand legs

N/A Measure for propeller clearance between the bottom of deflector stand and roof when the roof is on low legs

Remarks: _____

_____

ACCESS STRUCTURES

Handrails

OK Identify and report type (steel pipe, galvanized pipe, square tube, angle) and size of handrails

OK Inspect for pitting and holes, pain failure

OK Inspect attachment welds

OK Identify cold joints and sharp edges. Inspect the handrails and midrails

OK Inspect safety drop bar (or safety chain) for corrosion, functioning and length

N/A Inspect the handrail between the rolling ladder and the gauging platform for a hazardous opening when the floating roof is at its lowest level

Remarks:

Platform Frame

N/A Inspect frame for corrosion and paint failure
N/A Inspect the attachment of frame to supports and supports to tank; for corrosion and weld failure
N/A Check reinforcing pads where supports are attached to shell or roof
N/A Inspect the surface that deck plate or grating rests on, for thinning and holes
N/A Check that flat-surface to flat-surface junctures are seal welded

Remarks:

Deck Plate and Grating

N/A Inspect deck plate for corrosion-caused thinning or holes (not drain holes) and paint failure
N/A Inspect plate-to-frame weld for rust scale buildup
N/A Inspect grating for corrosion-caused thinning of bars and failure of welds
N/A Check grating tie-down clips. Where grating has been retrofitted to replace plate, measure the rise of the step below and above the grating surface and compare with other risers on the stairway

Remarks:

Stairway Stringers

OK Inspect spiral stairway stringers for corrosion, paint failure, and weld failure. Inspect attachment of stairway treads to stringer
* Inspect stairway supports to shell welds and reinforcing pads
N/A Inspect steel support attachment to concrete base for corrosion

Remarks: spiral stairway steps are not fully welded to the shell; water intrusion has resulted in minor scaling/straining; see photographs. (repair completed)

Rolling Ladder

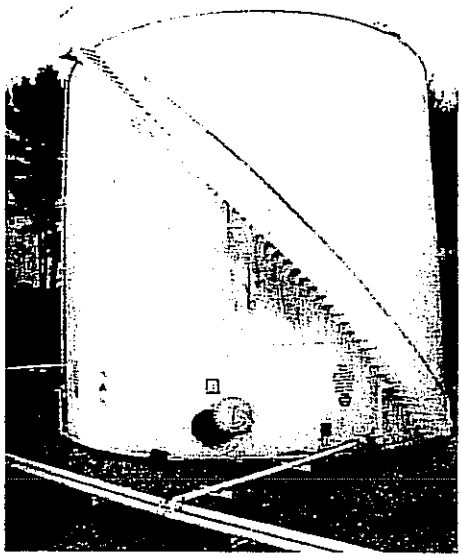
N/A Inspect rolling ladder stringers for corrosion
N/A Identify and inspect ladder fixed rungs (square bar, round bar, angles) for weld attachment to stringers and corrosion, particularly where angle rungs are welded to stringers
N/A Check for wear and corrosion where rolling ladder attaches to gauging platform
N/A Inspect pivot bar for wear and secureness

N/A	Inspect operation of self-leveling stairway treads
N/A	Inspect for corrosion and wear on moving parts
N/A	Inspect rolling ladder wheels for freedom of movement, flat spots, and wear on axle
N/A	Inspect alignment of rolling ladder with roof rack
N/A	Inspect top surface of rolling ladder track for wear by wheels to assure at least 18 inches of unworn track (track long enough)
N/A	Inspect rolling ladder track welds for corrosion
N/A	Inspect track supports on roof for reinforcing pads seal welded to deck plate
N/A	Check, by dimensioning, the maximum angle of the rolling ladder when the roof is on low legs Maximum angle: _____
N/A	If rolling ladder track extends to within five feet of the edge of the roof on the far side, check for a handrail on the top of the shell on that side

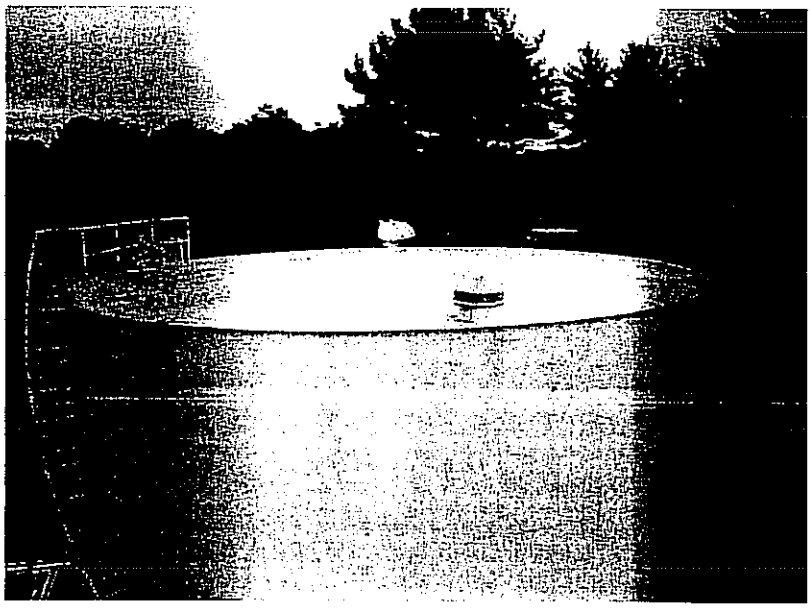
Remarks: _____

_____

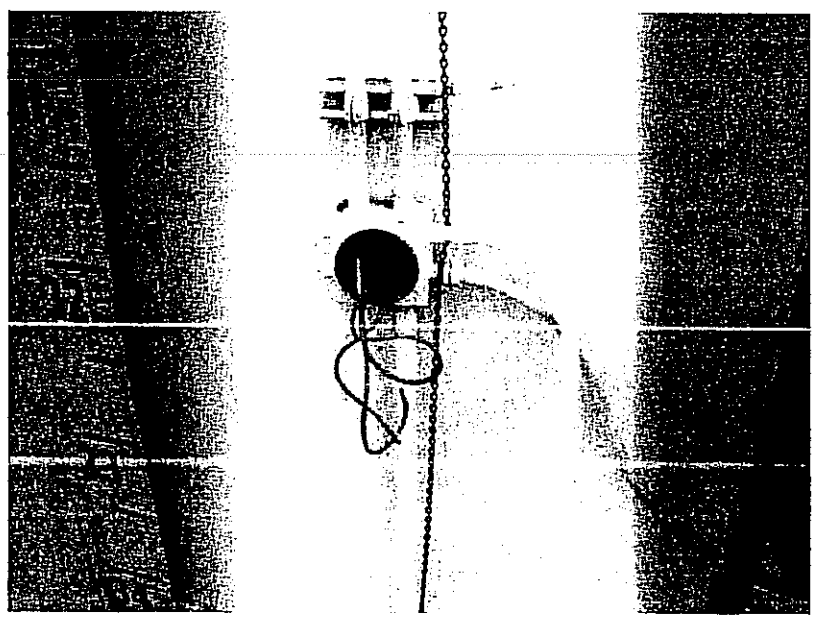
VI. PHOTOGRAPHS



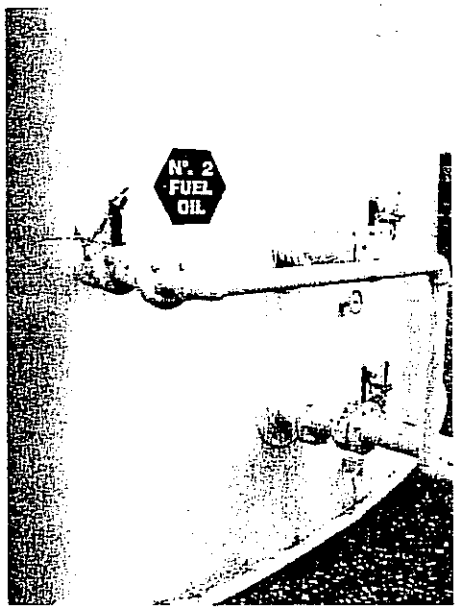
PA270003.JPG
10/27/2003
Tank No. 6 - overview



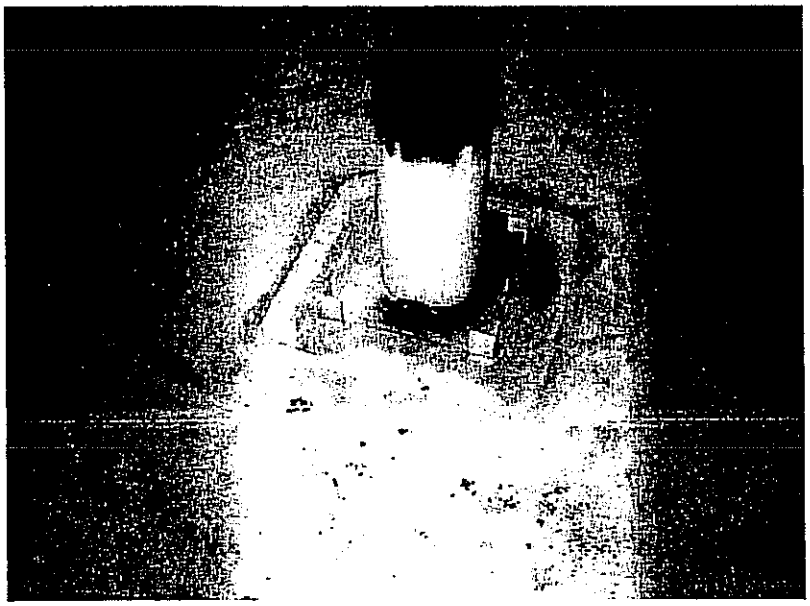
PA270027.JPG
10/27/2003
Roof overview



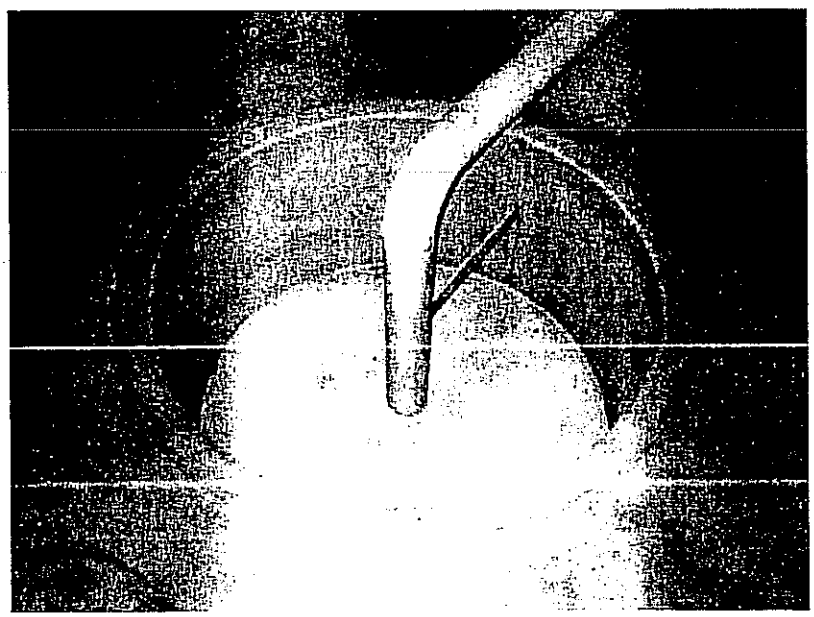
PA270005.JPG
10/27/2003
Incomplete electrical connection



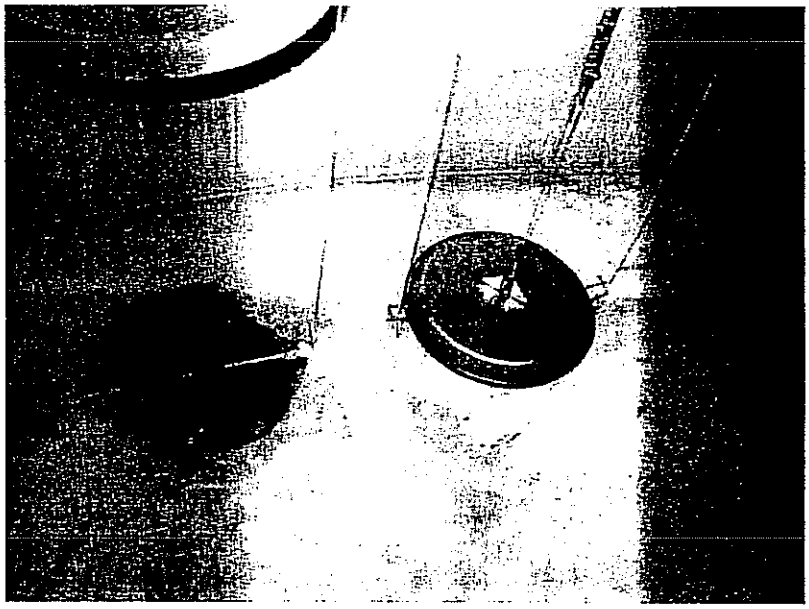
PA270007.JPG
10/27/2003
Shell nozzles



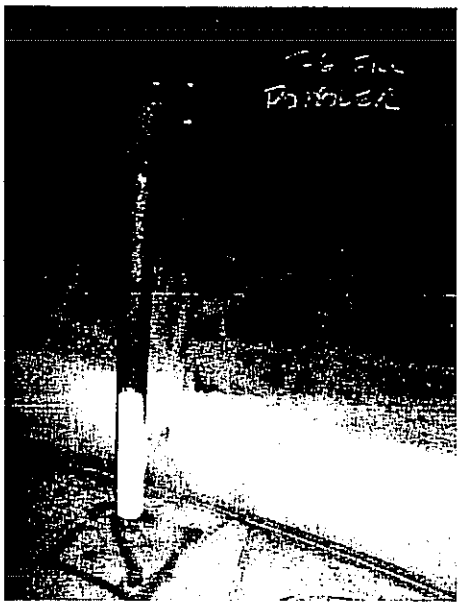
PA270008.JPG
10/27/2003
Typical holiday



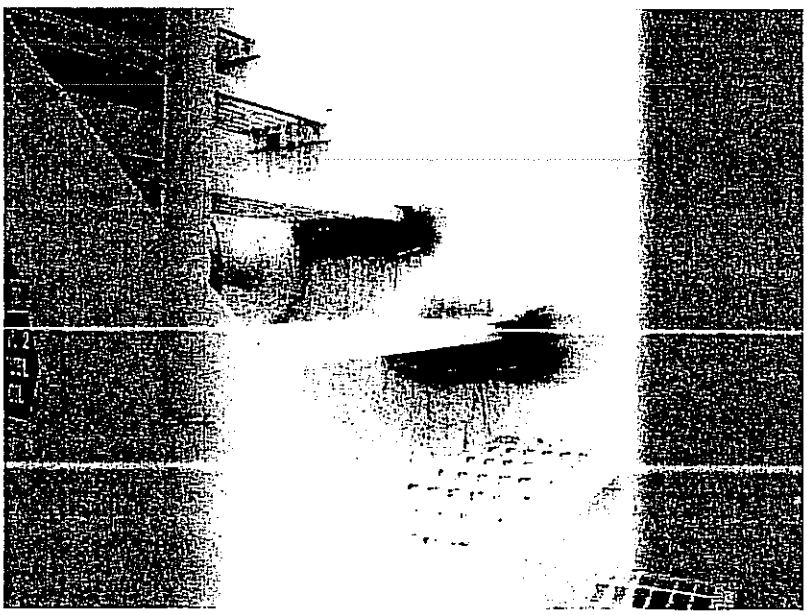
PA270009.JPG
10/27/2003
Sump



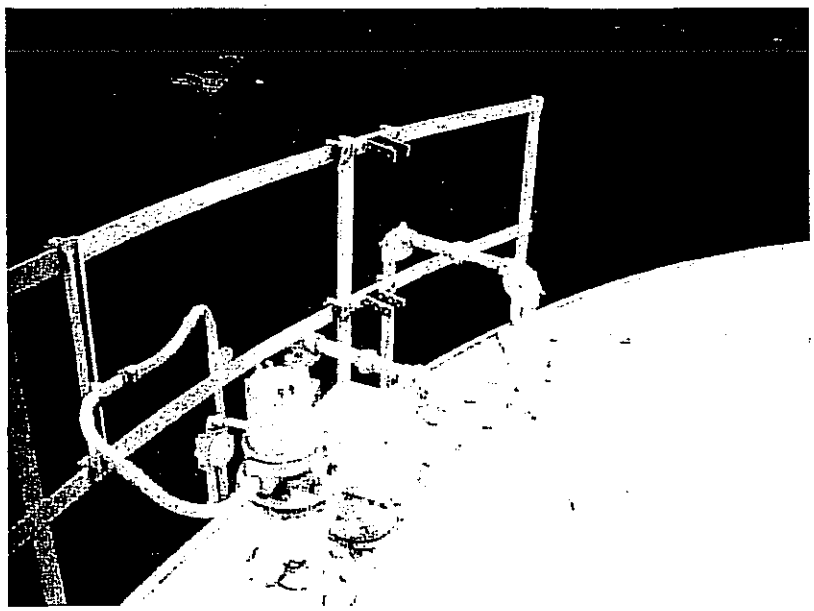
PA270010.JPG
10/27/2003
Gauge float



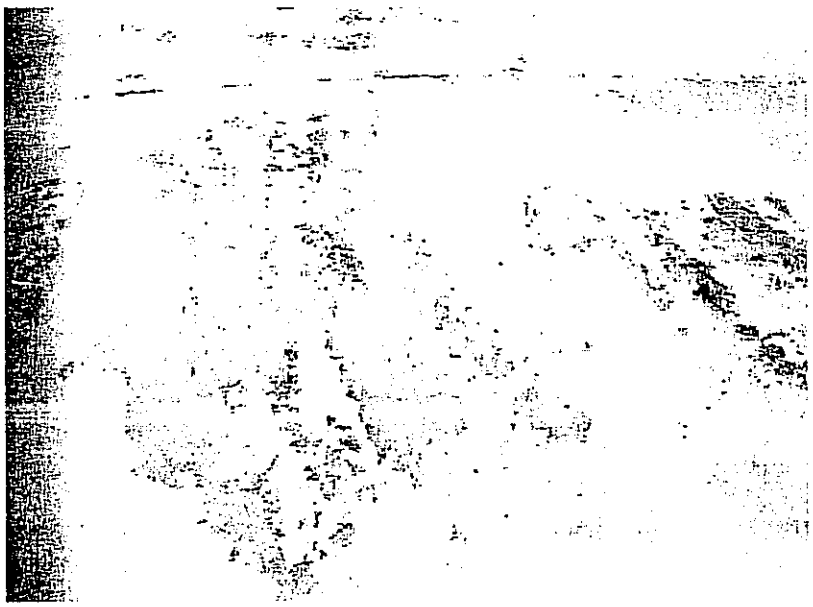
PA270011.JPG
10/27/2003
Typical elbow down product line



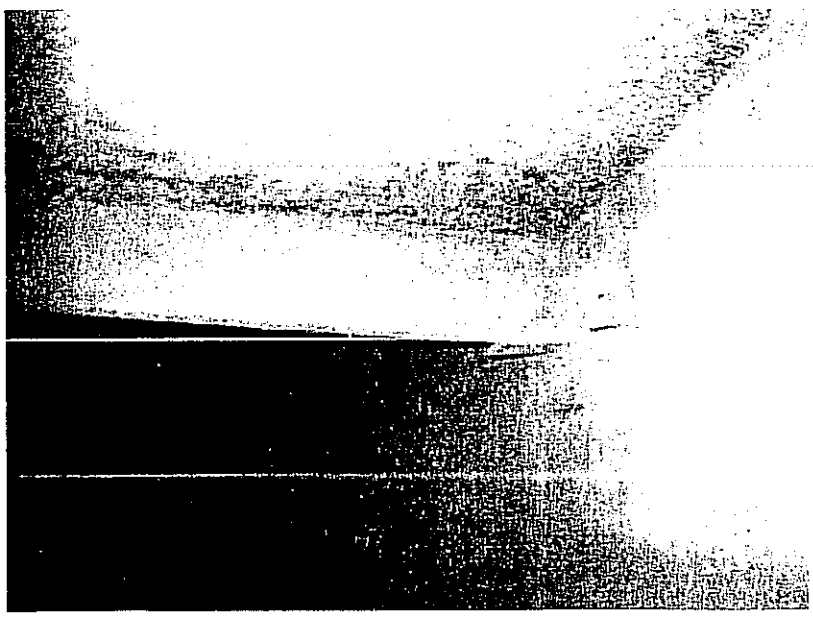
PA270017.JPG
10/27/2003
Work in progress - spiral stairway repairs



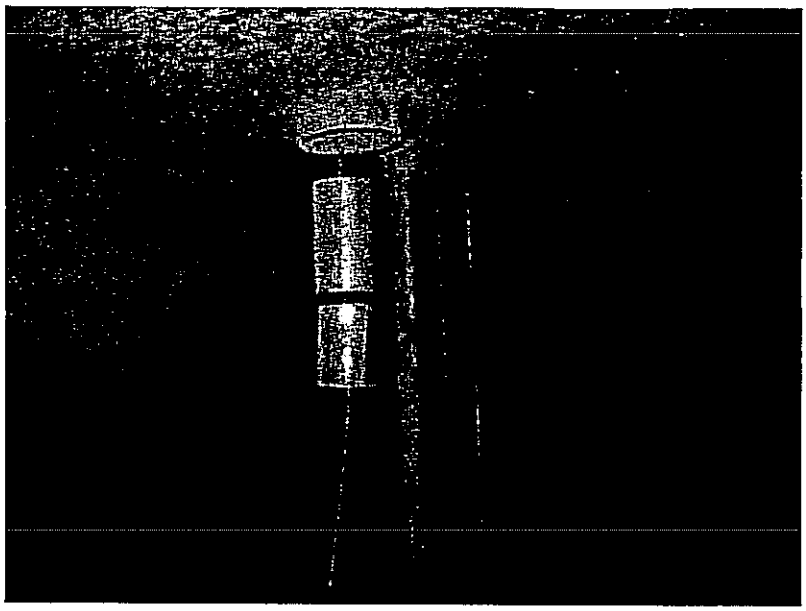
PA270019.JPG
10/27/2003
Roof paint coating failure



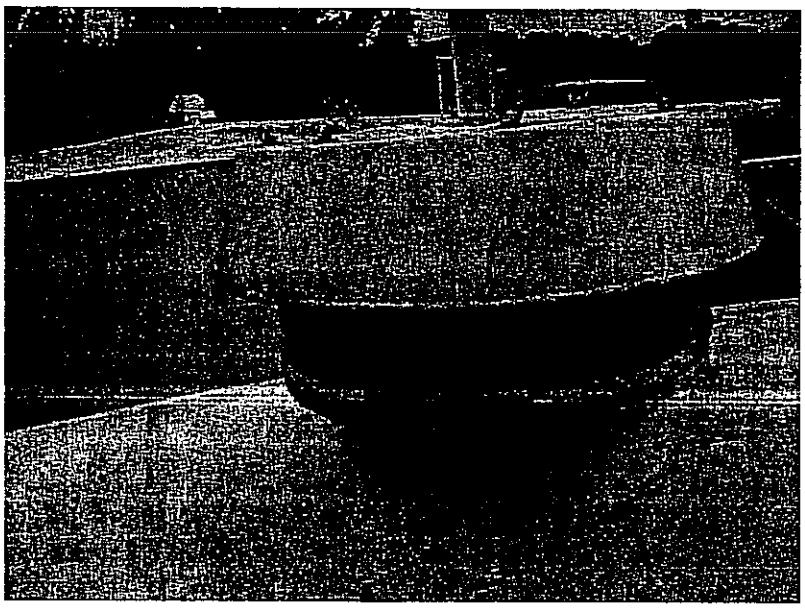
PA270020.JPG
10/27/2003
Roof paint coating failure



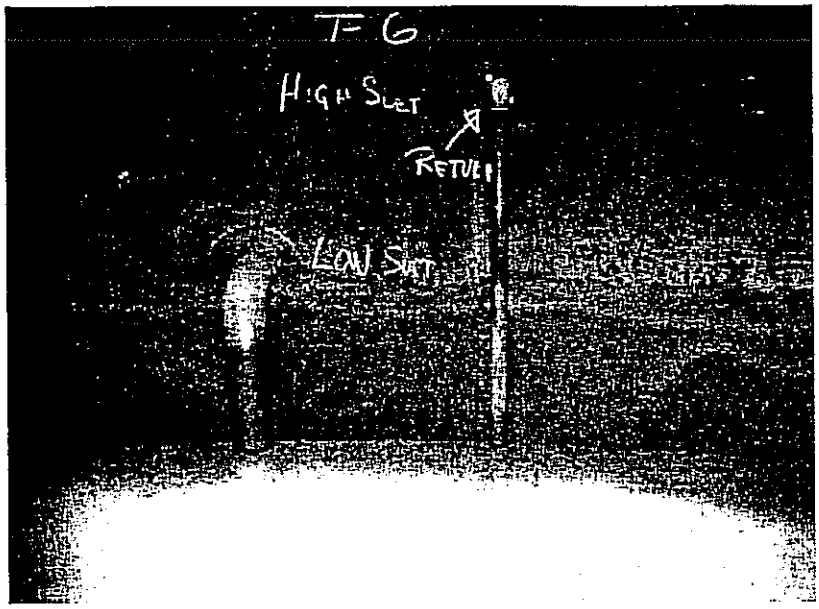
PA270021.JPG
10/27/2003
Roof underside



PA270022.JPG
10/27/2003
Roof underside

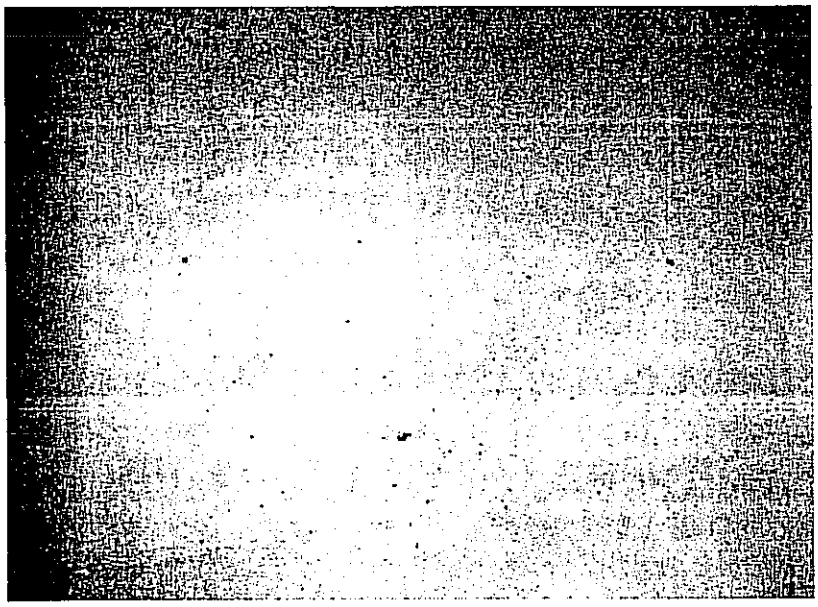


PA270024.JPG
10/27/2003
Corroded roof vent



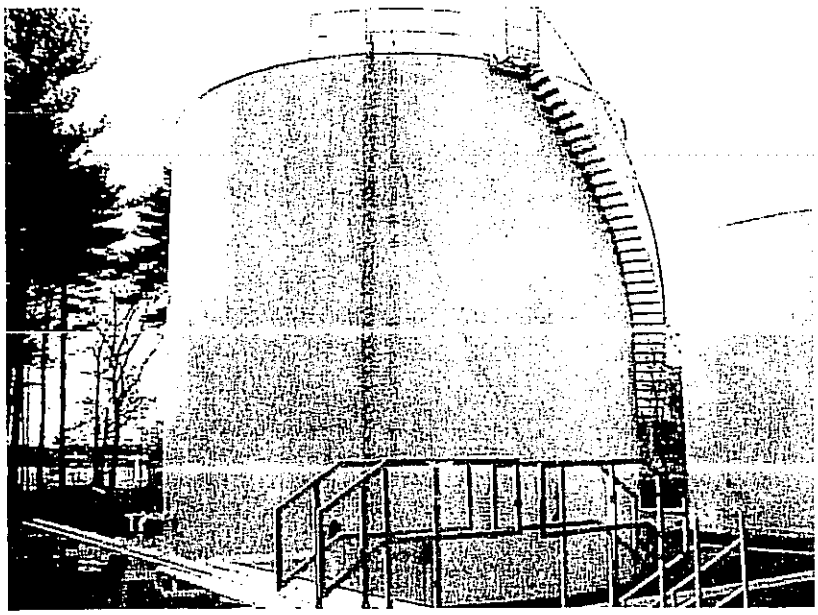
AMVC-011L.JPG

High Suction Return Line



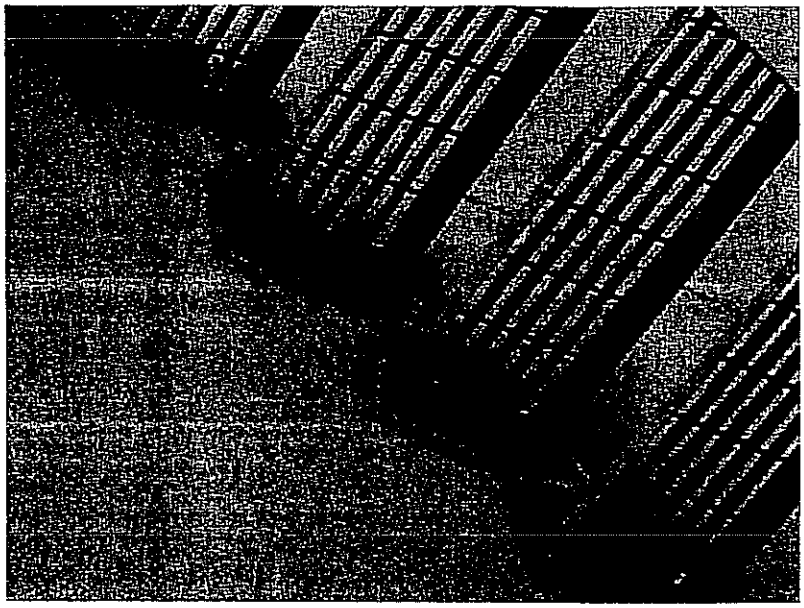
AMVC-012L.JPG

Floor Coating



AMVC-001L.JPG

Over View



AMVC-002L.JPG

Repaired Seal Welded Spiral Stairs

AMVC-007L.JPG

Center Column

VII. RECOMMENDATIONS

As a result of the findings disclosed in the inspection of Tank No. 6, PCA Engineering, Inc. makes the following recommendations:

- Restore paint coating as needed to the roof and exterior piping.
- Replace corroded roof vent.

The maximum interval until the next internal inspection would be 7 years based on the attached calculation, Suffolk County Regulations, the available data, and assumes completion of above repairs, operation under the same service and operating conditions. This does not preclude regular in-service inspection by terminal personnel and qualified inspector, and it is not a guarantee of future performance. The inspection/service interval can be substantially improved through the addition of cathodic protection corrosion control and/or an internal floor coating system, per applicable standards.

All repairs should be completed per API 650, 653 and other applicable Standards. An inspection of all repairs should be performed prior to return to service.

VII. RECOMMENDATIONS (Cont'd)

Based on the extent of the inspections performed on Tank No. 6, the test results indicate no substantial corrosion or defects above and beyond that noted, as of the test dates of October 27, 2003 and November 5, 2003. This is not to be construed as an expressed or implied warranty of future performance.

Brookhaven National Laboratory
Tank No. 6
October 27, 2003 and November 5, 2003
PCA Job No. 23089

KENNETH NORTHERN
PCA ENGINEERING, INC.

WILLIAM M. KENT
PCA ENGINEERING, INC.
API Certification No. 297

STATE OF NEW YORK
DANIEL R. KOGUT
069049
LICENSED PROFESSIONAL ENGINEER

DANIEL KOGUT
PCA Engineering, INC.
NY P.E. No. 069049

WMK:mm

Notwithstanding anything contained in this report, nothing herein shall be construed as a representation, warranty or guarantee, either expressed or implied, regarding the future structural integrity or future life expectancy of any of the items tested. This report and any analysis provided is in all respects subject to and shall be interpreted within the limitations and parameters of the test procedures performed. In the event testing is performed using a sampling procedure, this report and any analysis shall be limited to those areas actually tested and the type of test conducted, and the customer is cautioned not to extrapolate the results of the test samples.

Prepared for:

Brookhaven National Laboratories
70 Bell Avenue, Building 134C
Upton, NY 11973

Out-of-Service Inspection of Tank No. 9 located at the Brookhaven National Laboratory Upton, New York Facility on October 28, 2003

Prepared by:

PCA Engineering, Inc.
430 Montclair Avenue
P.O. Box 196
Pompton Lakes, NJ 07442

PCA Job No. 23089

February 13, 2004

PHASE I REPORT

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API-653 Section 2.3

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VII. RECOMMENDATIONS

I. INTRODUCTION AND BACKGROUND

On October 28, 2003, PCA Engineering, Inc. personnel performed an Internal Out-of-Service Inspection on Tank No. 9 located at the Brookhaven National Laboratory, Upton, New York Terminal.

The Brookhaven National Laboratory, Upton, New York Facility Registration Number for New York State is 01-1700. The inspection of Tank No. 9 conforms to Section 6NYCRR, Part 613.6 "Handling and Storage of Petroleum", New York State Department of Conservation.

The inspection performed is in compliance with the API 653 Standard.

An Industrial Scientific Model ATX-6 was used for vapor monitoring prior to and during entry. Prior to entry, the oxygen content was found to be 20.9% and the lower flammability level (LFL) 0%. These are considered non-hazardous and the interior inspection proceeded. All product lines were checked and found to be blinded or locked out.

PCA personnel on site were all currently trained in Hazardous Entry and Confined Space Entry.

SITE DESCRIPTION

Tank No. 9 is a welded, above ground, upright, cylindrical storage tank measuring 48 feet in diameter by 30 feet in height. The tank was erected in 1986 and has a product capacity of 9,700 barrels. The product content during the last period of service was No. 6 fuel oil.

The tank floor is fabricated of 19 lap welded carbon steel plates. The tank shell is arranged in 4 butt-welded courses, with 5 plates per course. The tank roof is provided with a fixed roof supported by a single column. The exterior of the tank is insulated.

The tank is located within an earthen dike secondary containment area. The dike area has a bentonite mixed soil lining system, as indicated on BNL supplied drawings.

TEST PROCEDURES

The following is a list of the tests performed and their procedures involved in the inspection of Tank No. 9:

TEST PROCEDURES (Cont'd)

A) Ultrasonic Thickness Measurements

To obtain the residual metal thickness readings, either a Cygnus Model 3 or Cygnus Model 4 Ultrasonic Digital Thickness Gauge, with a 2.25 MHz transducer was used. The Cygnus Model 3 has a resolution of +/- 0.002 inch; the Cygnus Model 4 has a resolution of +/- 0.005 inch, accuracy allowing for use on steel plate/piping materials used in storage tanks. The calibration of the instrument is confirmed prior to and during testing using a steel step block. The couplant used was Sonotech UT-X and/or motor oil.

A minimum of five (5) ultrasonic thickness readings were taken at each floor plate, with five (5) additional readings taken adjacent to the floor/shell joint on approximately 2 foot intervals. A W. R. Thorpe Pit Gauge was available to measure any pit depths, with readings taken at the point of deepest penetration. All ultrasonic thickness readings and pitted areas are noted on the enclosed data tables. The arrangement of the floor plates is shown on the enclosed PCA drawings.

TEST PROCEDURES (Cont'd)

A minimum of five (5) ultrasonic thickness readings were taken at each plate of the lower course of shell plates, with readings tabulated on the enclosed data tables. The arrangement of the shell appurtenances is shown on the enclosed PCA drawings.

As an appurtenance survey, ultrasonic thickness measurements were taken on principle pipe penetrations and their API plates within the lower course of shell plates.

Lack of access to the insulated roof and upper shell surfaces did not allow any thickness testing.

B) Holiday Inspection (High Voltage Spark Test)

The freshly applied polyurea floor coating system was tested for overall integrity using a Tinker & Rasor Model AP/W Holiday Detector. The holiday tester operates on the principle of applying a fixed amount of high voltage electrical potential to the coated floor through a conductive silicon rubber brush.

TEST PROCEDURES (Cont'd)

With the instrument grounded to any area of bare steel electrically continuous with the floor, any holiday or defect in the epoxy would allow passage of current to the steel floor plates, thus completing the circuit. This would energize an audible signal indicating to the operator the location of any defect in the coating.

C) Interior Perimeter Elevation Survey

The interior survey is based on an assumed datum of 10 feet, as shown on the "Interior Elevation Survey", with measurements shown clockwise or counter-clockwise around the tank. Cross sections are taken at various intervals around the tank, as shown on the drawing.

The interior elevation survey is helpful in evaluating the condition of the floor plates. Low spots are areas of drastic grade changes, as indicated on the drawing, are potential areas of excessive stresses in the floor plates, and indications of possible loss of sub-structure support. Elevation cross sections are helpful to analyze this data.

TEST PROCEDURES (Cont'd)

D) Magnetic Flux Leakage Floor Scan

The tank floor was inspected using a Magnetic Flux Leakage Floor Scan (MFL and/or MFE).

The Magnetic Flux Leakage floor scanner operates using permanent rare-earth magnets to bring a section of the steel floor plate to magnetic saturation. A defect, located on front or back surfaces, causes a scattering of the magnetic "lines of force" or flux. Sensors located between the magnets detect this flux leakage and display the result on a display screen.

MFL/MFE inspection is a qualitative inspection tool, which primarily detects plate cross-sectional volume loss (as opposed to remaining thickness) and correlates this as an amplitude display.

An observed significant indication is evaluated by the technicians using ultrasonic equipment for quantitative classification.

The Magnetic Flux Leakage Scan covers the majority of the tank floor plate, with the exception of the areas within 4 to 6 inches of the lap welds, corner welds, lap patches, columns, etc. Any additional areas not scanned are marked on the tank floor drawing.

II. SUMMARY OF FINDINGS

Upon completion of the inspections conducted on Tank No. 9, the following results were obtained:

Ultrasonic Thickness Inspection

The residual plate metal thickness measurements ranged as follows:

Floor:	.370″ to .390″
Shell:	.230″ to .255″ (1st Course)

Holiday Inspection

Results of the holiday inspection indicated satisfactory conditions throughout the entire floor surface, with no indications observed.

Dry film thickness measurements were determined to range from 48 to 67 mils.

Interior Perimeter Elevation Survey

The perimeter elevations (shell settlement) indicate a maximum differential of 0.08 feet (0.96 inches). The settlement is considered planar tilt, with the maximum out-of-plane deflection of 0.05 feet (0.60 inch). The maximum permissible out-of-plane deflection per API 653, B.3.2 is 0.08 feet (0.96 inch).

II. **SUMMARY OF FINDINGS** (Cont'd)

There are no visible indications of tank shell or floor stress, or recent/active displacement of fill material from around or under the tank. This information, in conjunction with the tank's age (17 years +/-), would indicate the tank has reached its maximum settlement with no changes in deflections anticipated, based on current operational procedures and site conditions.

The internal cross section elevation results disclosed edge settlement with a typical radius of 3 feet. The maximum edge settlement observed was 1.77 inches, which is within 75% of the allowable settlement as noted in API 653, Figure B-10 and Figure B-11. Settlement between 75 and 100 percent of allowable requires further inspection, while settlement in excess of the allowable requires repair or engineering evaluation.

The pitch of the cone down floor was approximately 0.9 inches in 10 feet.

Edge settlement (or roll-off) typically occurs when the tank shell settles sharply around the periphery, resulting in deformation of the bottom plate near the shell-to-bottom corner junction.

II. SUMMARY OF FINDINGS (Cont'd)

Magnetic Flux Leakage Floor Scan

Results of the magnetic flux scan of the tank floor revealed no indications beyond the 40% threshold limit of the scanner.

III. DISCUSSION

Following application of the new floor liner, we find the interior in satisfactory condition overall.

Deficiencies are limited to isolated locations of minor paint deterioration on the exterior lower shell surfaces.

IV. TEST DATA

CORROSION SURVEY FIELD DATA TABLE

OWNER: Brookhaven National Labs
STRUCTURE: Tank No. 9
DATE OBTAINED: October 28, 2003
SURVEYED BY: W. M. Kent

PCA JOB NO. 23089

Ultrasonic Thickness Measurements
Tank Floor - In Inches

	1	2	3	4	5
Plate No. 1	0.380	0.375	0.380	0.375	0.380
	0.390	0.385	0.390	0.390	0.385
Plate No. 2	0.375	0.375	0.380	0.375	0.375
	0.380	0.375	0.380	0.380	0.375
Plate No. 3	0.375	0.380	0.375	0.375	0.380
	0.375	0.370	0.375	0.380	0.375
Plate No. 4	0.380	0.375	0.380	0.370	0.375
	0.38	0.380	0.380	0.375	0.380
Plate No. 5	0.385	0.380	0.375	0.380	0.375
	0.380	0.375	0.385	0.380	0.375
Plate No. 6	0.375	0.380	0.375	0.380	0.380
	0.375	0.380	0.375	0.375	0.380
Plate No. 7	0.380	0.375	0.380	0.370	0.380
	0.375	0.380	0.375	0.380	0.375
Plate No. 8	0.370	0.375	0.375	0.370	0.375
	0.370	0.375	0.375	0.370	0.375

minimum	0.370
average	0.378
maximum	0.390
std. dev.	0.003599

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CORROSION SURVEY FIELD DATA TABLE

OWNER: Brookhaven National Labs
STRUCTURE: Tank No. 9
DATE OBTAINED: October 28, 2003
SURVEYED BY: W. M. Kent

PCA JOB NO. 23089

Ultrasonic Thickness Measurements
Tank Floor - In Inches

		1	2	3	4	5
Plate No. 9		0.380	0.375	0.380	0.375	0.380
Plate No. 10		0.375	0.380	0.375	0.370	0.380
Sump	Shell	0.370	0.375	0.370		
	Floor	0.370	0.370	0.370		
Plate No. 11		0.380	0.385	0.380	0.380	0.375
Plate No. 12		0.380	0.375	0.375	0.380	0.380
Plate No. 13		0.375	0.380	0.375	0.385	0.375
		0.380	0.375	0.380	0.375	0.380
Plate No. 14		0.380	0.375	0.380	0.375	0.380
		0.375	0.375	0.375	0.380	0.375
Plate No. 15		0.375	0.380	0.375	0.380	0.375
		0.380	0.380	0.380	0.375	0.380
Plate No. 16		0.380	0.375	0.380	0.375	0.380
		0.375	0.375	0.375	0.375	0.375

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CORROSION SURVEY FIELD DATA TABLE

OWNER: Brookhaven National Labs
STRUCTURE: Tank No. 9
DATE OBTAINED: October 28, 2003
SURVEYED BY: W. M. Kent

PCA JOB NO. 23089

Ultrasonic Thickness Measurements
Tank Floor - In Inches

	1	2	3	4	5
Plate No. 17	0.375	0.380	0.375	0.380	0.375
	0.380	0.380	0.385	0.375	0.375
Plate No. 18	0.380	0.375	0.380	0.375	0.380
	0.375	0.375	0.380	0.375	0.380
Plate No. 19	0.375	0.380	0.375	0.380	0.375
	0.380	0.380	0.375	0.380	0.375

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CORROSION SURVEY FIELD DATA TABLE

OWNER: Brookhaven National Labs
STRUCTURE: Tank No. 9
DATE OBTAINED: October 28, 2003
SURVEYED BY: W. M. Kent

PCA JOB NO. 23089

Ultrasonic Thickness Measurements
Tank Shell - In Inches

	1	2	3	4	5
Plate No. 1	0.230	0.235	0.230	0.230	0.230
Plate No. 2	0.240	0.245	0.240	0.245	0.240
Plate No. 3	0.245	0.240	0.245	0.240	0.240
Plate No. 4	0.230	0.230	0.235	0.230	0.235
Plate No. 5	0.250	0.255	0.250	0.250	0.255

minimum	0.230
average	0.240
maximum	0.255
std. dev.	0.008226

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CORROSION SURVEY FIELD DATA TABLE

OWNER: Brookhaven National Labs
STRUCTURE: Tank No. 9
DATE OBTAINED: October 28, 2003
SURVEYED BY: W. M. Kent

PCA JOB NO. 23089

Appurtenance Survey
Tank Shell - In Inches

	Top	Side	Bottom	Side
24" manway	0.520	0.520	0.525	0.520
API	0.255	0.250	0.255	0.250
2" heating supply	0.205	0.210	0.205	0.205
2" heating return	0.210	0.205	0.205	0.205
2" heating supply	0.200	0.205	0.210	0.205
2" heating return	0.210	0.205	0.205	0.210
3" blank nozzle	0.285	0.280	0.285	0.285
4" blank nozzle	0.320	0.335	0.330	0.330
4" fill/return	0.335	0.340	0.335	0.335
6" high suction	0.455	0.450	0.455	0.450
6" low suction	0.445	0.450	0.455	0.450
2" heating supply	0.210	0.215	0.210	0.210
2" heating return	0.205	0.210	0.210	0.205
4" water draw off	0.420	0.430	0.425	0.420

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CORROSION SURVEY FIELD DATA TABLE

OWNER: Brookhaven National Labs
STRUCTURE: Tank No. 9
DATE OBTAINED: October 28, 2003
SURVEYED BY: W. M. Kent

Elevation Survey

PCA JOB NO. 23089

	Shell	1'	2'	3'	4'	5'	10'	20'	Center
A	10.00	9.95	9.88	9.83	9.77	9.71	9.60	9.79	9.80
B	10.02	10.00	9.99	9.94	9.96	9.94	9.64	9.96	
C	10.04	9.97	9.91	9.87	9.87	9.86	9.79	9.93	
D	9.96	9.97	9.97	9.89	9.78	9.79	9.61	9.80	
E	9.98	9.96	9.95	9.91	9.83	9.80	9.60	9.82	
F	9.99	9.98	9.91	9.92	9.86	9.83	9.71	9.80	
G	9.96	9.90	9.90	9.89	9.87	9.85	9.68	9.45	
H	9.96	9.91	9.81	9.87	9.82	9.82	9.65	9.34	
A	10.00								

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API 653 INSPECTION - DATA EVALUATION

GENERAL INFORMATION

Customer: **Brookhaven National Labs** Job No.: 23089 Date: 10/28/03

Tank No.: 9
Diameter: 48 feet
Height: 30 feet
Safe Fill: feet
Capacity: 9,772 bbl
Product: No. 6 fuel oil

Cathodic Protection?: y
Leak Detection?: y
Thick FilmCoating?: y
Thin Film Coating?: n

Erected: 01/01/86
Date Last Inspected
Cleaned:
Painted:
Lined:
Strapped:

	Quantities:
Floor plts:	19
Roof plts:	0
Shell crs:	4
Plts/Crs:	5

1st Crse Avg Shell Thickness (in)	
1st	0.230
2nd	0.235
3rd	0.230
4th	0.230
5th	0.230

	PlateThickness (in)					
	Original	General	Delta	Minimum	Material	Riveted?
Floor Plates:	0.390	0.378	0.012	0.370	Unknown	n
Sketch Plates:			0.000			
Annular Plates:			0.000			
Shell - 1st course:	0.255	0.240	0.015	0.230	Unknown	n
2nd course:			0.000			
3rd course:			0.000			
4th course:			0.000			
5th course:			0.000			
6th course:			0.000			
7th course:			0.000			
8th course:			0.000			
Roof:			0.000			

	Pitting Depth (in)			
	Max Int.	Avg Int.	Max Ext.	Avg Ext.
Floor Plates:	0.020	0.010	0.020	0.010
Shell - 1st course:	0.006	0.005	0.005	0.004
Roof:	0.000	0.000	0.000	0.000

Containment Area:

Steel?
Diameter feet
Height feet

Containment bbl
110% Cap

Earthen? y
Length 110 feet
Width 112 feet
Height 5 feet
Containment 11,088 bbl
110% Cap 10,749 Sufficient Containment if tank is filled to capcity

Calculated Safe Fill (based on capacity of containment) : 30.95 feet
Therefore, containment is sufficient if current Safe Fill is maintained

COMMENTS:

gauging.

PCA ENGINEERING, INC.

BOTTOM PLATE TOPOGRAPHY

Tank:	9	No of Sections:	8	Elevation @ Center of Tank:	9.80 ft	Allowable Roll-Off		
Diameter:	48	Max Chord Length:	18.84 ft	Average Pitch:	0.09 in/ft	in 1'	0.46 in	
				Overall Differential Settlement	0.96 in	in 2'	0.83 in	
						in 3'	1.20 in	

	AXIS 1		AXIS 2		AXIS 3		AXIS 4		AXIS 5		AXIS 6	
Spacing	Field Data	Roll-Off	Field Data	Roll-Off	Field Data	Roll-Off	Field Data	Roll-Off	Field Data	Roll-Off	Field Data	Roll-Off
Shell	10.00		10.02		10.04		9.96		9.98		9.99	
1'	9.95	0.60	10.00	0.24	9.97	0.84	9.97	0.12	9.96	0.24	9.98	0.12
2'	9.88	1.44	9.99	0.36	9.91	1.56	9.97	0.12	9.95	0.36	9.91	0.96
3'	9.83	2.04	9.94	0.96	9.87	2.04	9.89	0.84	9.91	0.84	9.92	0.84
5'	9.71		9.94		9.86		9.79		9.80		9.83	
10'	9.60		9.64		9.79		9.61		9.60		9.71	
20'	9.79		9.96		9.93		9.80		9.82		9.80	
30'												
40'												
50'												
60'												
70'												
80'												
90'												
Settlement	0		-0.02		-0.04		0.04		0.02		0.01	

	AXIS 7		AXIS 8		AXIS 9		AXIS 10		AXIS 11		AXIS 12	
Spacing	Field Data	Roll-Off	Field Data	Roll-Off	Field Data	Roll-Off	Field Data	Roll-Off	Field Data	Roll-Off	Field Data	Roll-Off
Shell	9.96		9.96									
1'	9.90	0.72	9.91	0.60		0.00		0.00		0.00		0.00
2'	9.90	0.72	9.81	1.80		0.00		0.00		0.00		0.00
3'	9.89	0.84	9.87	1.08		0.00		0.00		0.00		0.00
5'	9.85		9.82									
10'	9.68		9.65									
20'	9.45		9.34									
30'												
40'												
50'												
60'												
70'												
80'												
90'												
Settlement	0.04		0.04									

PCA ENGINEERING INC.

TANK SHELL EVALUATION API 653 SECTION 2.3

Tank: 9

Date: 10/28/03

Diameter: 48 feet
Height: 30 feet
t_1(avg.): 0.231 inches
t_2: 0.230 inches

Field data:
0.230
0.235
0.230
0.230
0.230
t_1= 0.231

Thickness Determination:

$L=3.7(D*t_2)^{1/2}$

Where: L= the maximum vertical length, in inches, over which hoop streees are assumed to "average out" around local discontinuities
D= tank diameter, in feet
t_2= the least thickness, in inches, in area of corrosion, exclusive of pits

L= 12.2938 inches

Minimum Thickness Calculation for Welded Tank Shell:

Course No. 1

t_{min}= **2.6DHG/SE** = **0.154 inches**

Where:
t_{min}= the minimum acceptable thickness, in inches, as calculated from the above formula; however, t_{min} shall not be less than 0.1 inch for tank course
D= nominal diameter of tank, in feet
H= Height, in feet, from the bottom of length *L* for the most severely corroded area in each shell course to the maximum design liquid level
G= highest specific gravity of the contents (including water, if hydtsted)
S= maximum allowable stress in psi; use the smaller of 0.80Y or 0.426T for bottom and second course; use the smaller of 0.88Y or 0.472T for all other courses
Y= specified minimum yield strength of the plate; 30,000 psi if unknown
T= the smaller of the specified minimum tensile strength of the plate or 80,000 psi; use 55,000 psi if unknown
E= original joint efficiency for the tank. use E=0.7 if unknown, E=1.0 when evaluating the retirement thickness in a corroded plate, when away from welds or joints by at least the greater of 1 inch or twice the plate thickness

NOTE: For riveted tanks see section 653.2.3.4; see section 653.2.3.3 for complete explanation

D =	48 feet	G =	1.0	Y =	30,000 psi
H =	30 feet	S =	23,430 psi	T =	55,000 psi
				E =	1.0

Then, per API653 section 2.3.3.1:

If: a: t_1 >= t_{min}
0.231 >= **0.154**

and

b: t_2 >= 60% t_{min}
0.230 >= **0.093**

THEREFORE, NO ACTION IS REQUIRED

Maximum Safe Fill Height = **44.18** feet
(t_2SE/2.6DG) +1

Tank can be filled to capacity
Provided Containment Capacity is Sufficient

PCA ENGINEERING, INC.

Courses

Tank: **9** Date: **10/28/03**

Diameter:	48	Yield:	23,430
Height:	30	Joint Efficiency:	1.0
Number of Courses:	4	Specific Gravity:	1.00

MINIMUM THICKNESS per each SHELL COURSE

	Height (TOC)	Minimum Thickness	
Course 1	7.5	0.154	**OK**

TANK BOTTOM EVALUATION - API 653 SECTION 2.4

Tank: 9 Date: 10/28/03

Minimum Thickness for Tank Bottom Plate (API 4.4.7):

$$MRT = (\text{minimum of } RT_{bc} \text{ or } RT_{ip}) - O_r(StP_r + UP_r)$$

Where:

MRT = minimum remaining thickness at the end of interval O_r
This value must meet the requirments of Table 6-1
and sections 4.4.7.4 and 4.4.8

O_r = in-service interval (years to next inspection) not to exceed that allowed by 4.2.2 (normally 10 years)

RT_{bc} = minimum remaining thickness from bottom side corrosion, after repairs

RT_{ip} = minimum remaining thickness from internal corrosion after repairs

StP_r = maximum internal pitting rate, in inches per year; StP_r = 0 if tank bottom is internally lined.

UP_r = maximum underside pitting rate, in inches per year; UP_r = 0 if tank bottom is cathodically protected.

T_o	=	0.390 inch	RT_{bc}	=	0.370	UP_r	=	0.0005 in/yr
UP_m	=	0.020 inch	RT_{ip}	=	0.370	StP_r	=	0.0005 in/yr
StP_m	=	0.020 inch	O_r	=	10.0 years			

Solve for: MRT = 0.360 inch

Or = 320.0 years where MRT = 0.050
NOTE: see API 653 table 6-1

Then if:

MRT > 0.050

THEREFORE, NO ACTION IS REQUIRED

PCA ENGINEERING, INC.

TANK SETTLMENT EVALUATION - API 653 APPENDIX B

Tank: 9

Date: 10/28/03

Diameter: 48 feet
Sections: 8

Arc (L): 18.85 feet
Yield(Y): 30000 psi
(E): 29000000 psi
Height(H): 30 feet

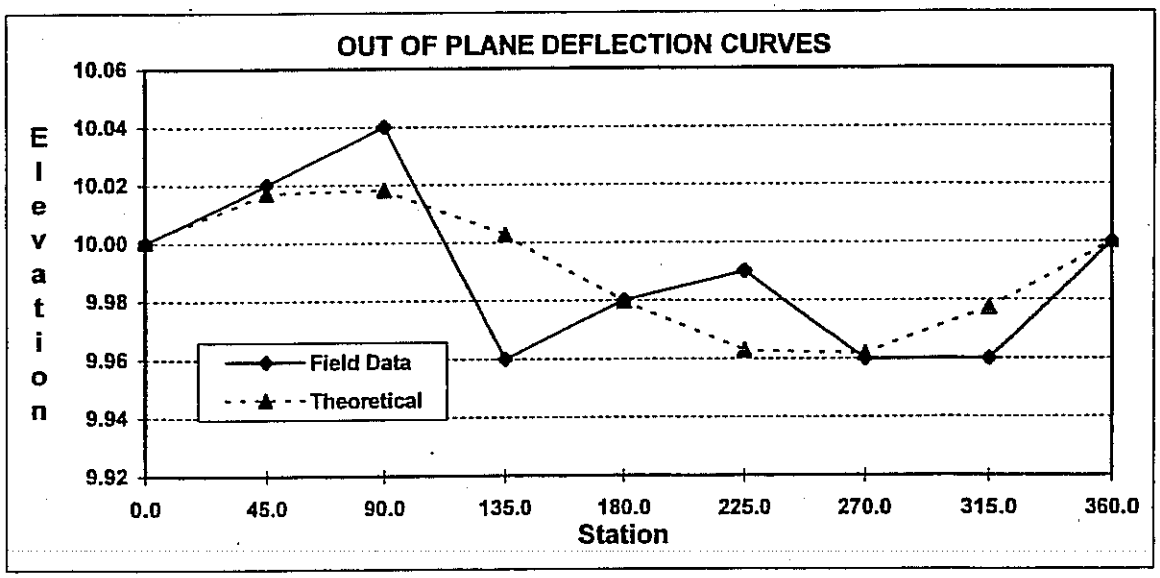
Maximum Permissible Out-of-Plane Deflection:

$S<=(L^2*Y*11)/(2(E*H)$

Where:
S= deflection, in feet (out-of-plane distortion)
L= arc length, between measurement pts, in feet
Y= yield strength, in psi
E= Young's modulus, in psi
H= tank height, in feet

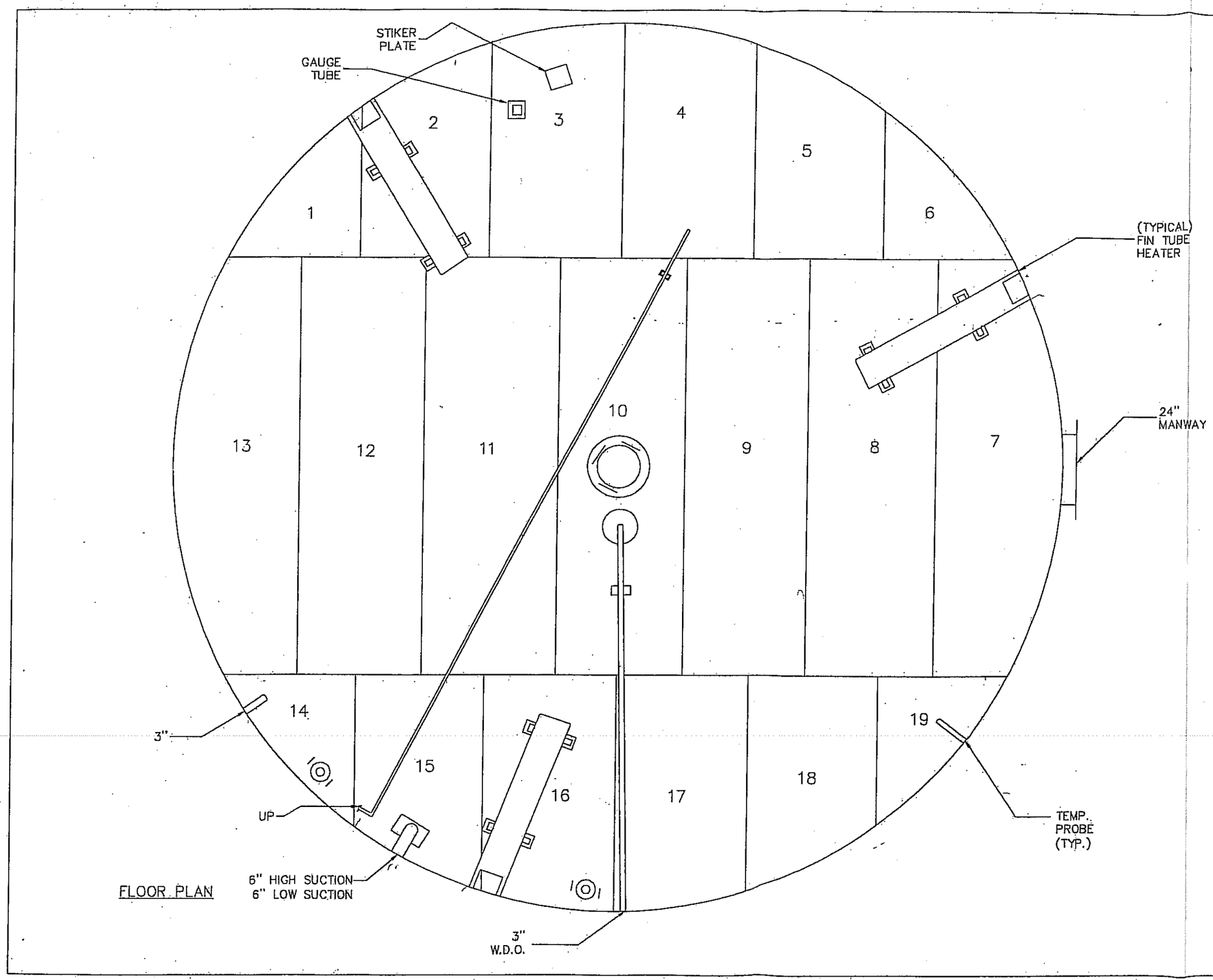
S<= 0.067386 feet

Degrees	Station	Field Data	Theoretical	Delta(U_i)	Deflection(S_i)
0.0	0.0	10.00	10.000	0.000	0.0070
45.0	18.8	10.02	10.017	0.003	-0.0080
90.0	37.7	10.04	10.018	0.022	0.0417
135.0	56.5	9.96	10.003	-0.043	-0.0537
180.0	75.4	9.98	9.980	0.000	0.0080
225.0	94.2	9.99	9.963	0.027	0.0280
270.0	113.1	9.96	9.962	-0.002	-0.0067
315.0	131.9	9.96	9.977	-0.017	-0.0163
360.0	150.8	10.00	10.000	0.000	0.0070



THEN, SINCE THE MAXIMUM Si <= S NO ACTION IS REQUIRED

PCA ENGINEERING, INC.



FLOOR PLAN

GENERAL NOTES:

TANK No. 9
48' DIA. X 32' H.

LEGEND

1 – FLOOR PLATE No.

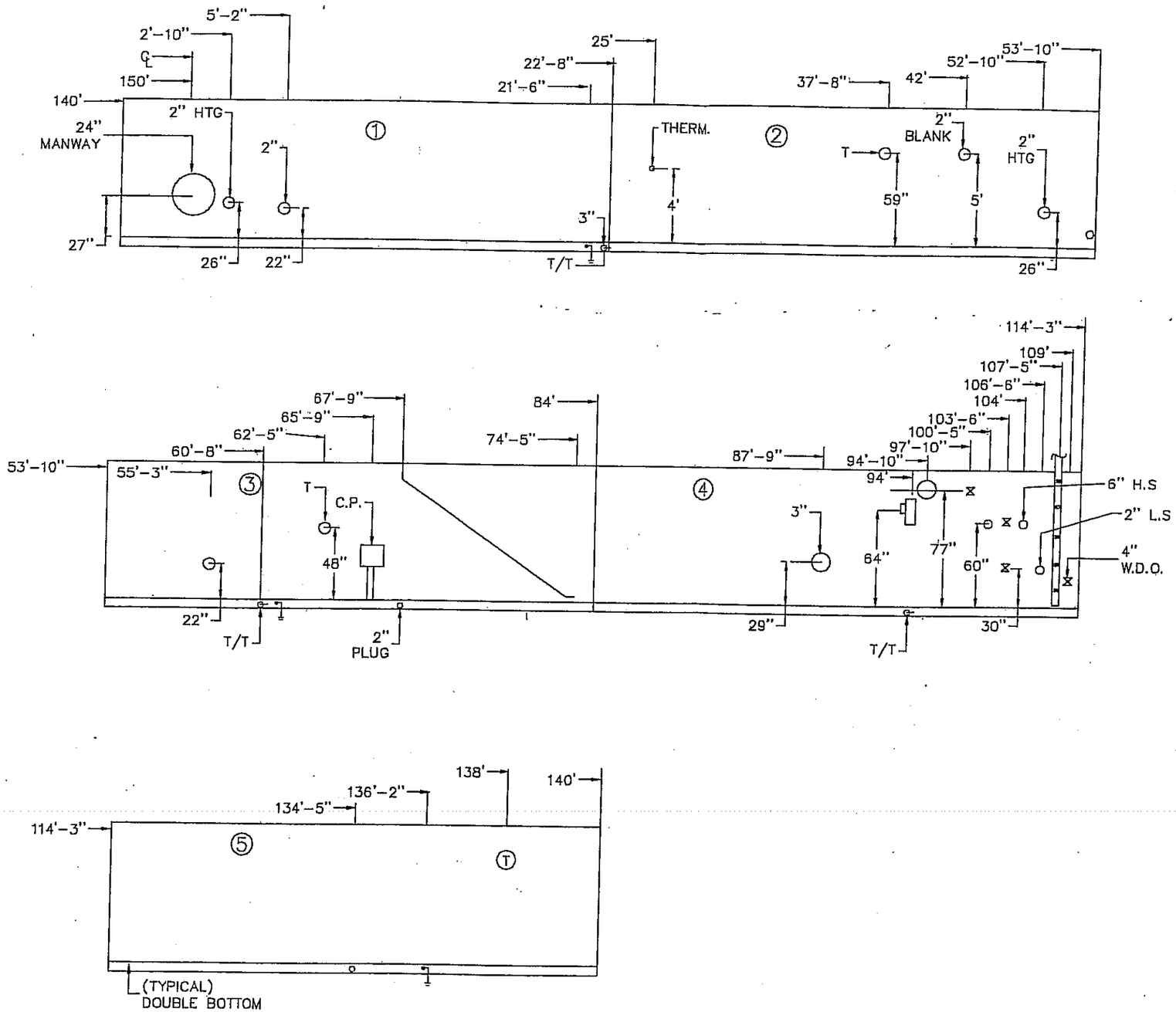
PCA ENGINEERING, INC.
430 Montclair Ave. Pompton Lakes, NJ.
TEL. (973) 616-4501

BROOKHAVEN NATIONAL LABS
FISCAL DIVISION BLDG 134B
P.O. BOX 5000
UPTON, NY

PROJECT LOCATION:
BROOKHAVEN NATIONAL LABS
BROOKHAVEN AVENUE
UPTON, NY

DRAWING TITLE:
OUT-OF-SERVICE TANK INSPECTION
TANK No. 9

CHECKED BY:	WL	DRAWN BY:	A.U.Z.
SCALE:	N.T.S.	DATE:	11-21-03
DRAWING No.:	BW-23089-07	REV.	0



1st COURSE SHELL PLATE CONFIGURATION

GENERAL NOTES:

TANK No. 9
48' DIA. X 32' H.

LEGEND

①– SHELL PLATE No.

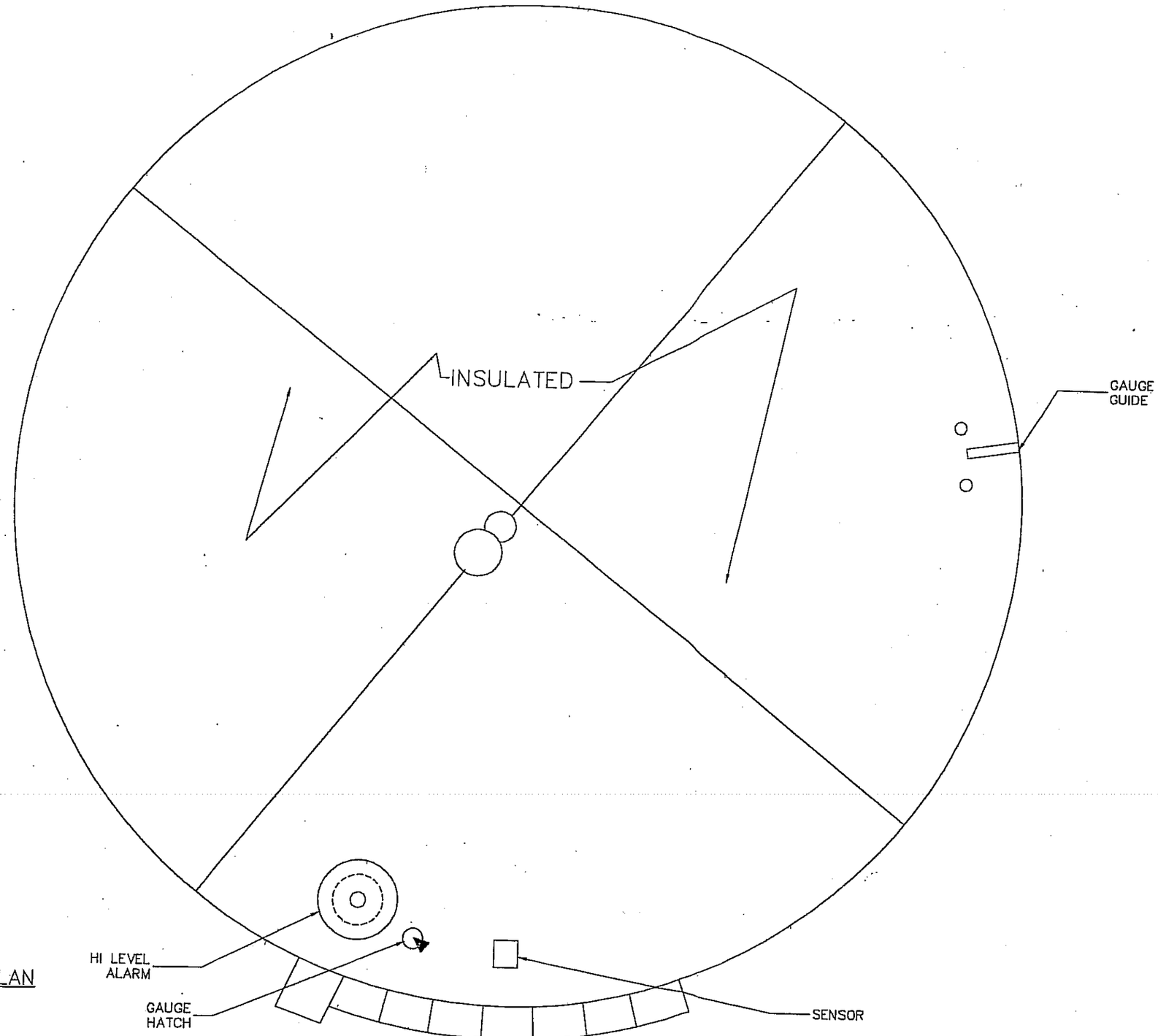
PCA ENGINEERING, INC.
430 Montclair Ave. Pompton Lakes, NJ.
TEL. (973) 616-4501

BROOKHAVEN NATIONAL LABS
FISCAL DIVISION BLDG 134B
P.O. BOX 5000
UPTON, NY

PROJECT LOCATION:
BROOKHAVEN NATIONAL LABS
BROOKHAVEN AVENUE
UPTON, NY

DRAWING TITLE:
OUT-OF-SERVICE TANK INSPECTION
TANK No. 9

CHECKED BY:	DRAWN BY: A.U.Z.
SCALE: N.T.S.	DATE: 11-21-03
DRAWING No.: BW-23089-08	REV. 0



ROOF PLAN

GENERAL NOTES:

TANK No. 9
48' DIA. X 32' H.

LEGEND

PCA ENGINEERING, INC.
430 Montclair Ave. Pompton Lakes, NJ.
TEL. (973) 616-4501

BROOKHAVEN NATIONAL LABS
FISCAL DIVISION BLDG 134B
P.O. BOX 5000
UPTON, NY

PROJECT LOCATION:
BROOKHAVEN NATIONAL LABS
BROOKHAVEN AVENUE
UPTON, NY

DRAWING TITLE:
OUT-OF-SERVICE TANK INSPECTION
TANK No. 9

CHECKED BY:	WL	DRAWN BY:	A.U.Z.
SCALE:	N.T.S.	DATE:	11-21-03
DRAWING No.:	BW-23089-09	REV.	0

V. API 653 CHECKLIST

API 653

TANK OUT-OF-SERVICE INSPECTION CHECKLIST

OVERVIEW

OK	Check that tank has been cleaned, is gas free, and safe for entry
OK	Check that the tank is completely isolated from product lines, all electrical power, and steam lines
OK	Check that roof is adequately supported, including fixed roof structure and floating roof legs
OK	Check for presence of falling object hazards, such as corroded-through roof rafters, asphalt stalactites, and trapped hydrocarbons in unopened or plugged equipment or appurtenances, ledges, etc.
OK	Inspect for slipping hazards on the bottom and roof decks
OK	Inspect structural welds on accessways and clips
OK	Check surfaces needing inspection for a heavy-scale buildup and check weld seams and oily surfaces where welding is to be done. Note areas needing more cleaning, including blasting

Remarks: _____

TANK EXTERIOR

OK	Inspect appurtenances opened during cleaning such as lower floating swing sheave assemblies, nozzle interiors (after removal of valves)
OK	Hammer test or ultrasonically test the roof
N/A	Enter and inspect the floating roof pontoon compartments

Remarks: _____

BOTTOM INTERIOR SURFACE

*	Using a flashlight held close to and parallel to the bottom plates, and using the bottom plate layout as a guide, visually inspect and hammer test the entire bottom
OK	Measure the depth of pitting and describe the pitting appearance (sharp edged, lake type, dense, scattered, etc.)
N/A	Mark areas requiring patching or further inspection
N/A	Mark locations for turning coupons for inspection
OK	Inspect all welds for corrosion and leaks, particularly the shell-to-bottom weld
OK	Inspect sketch plates for corrosion
N/A	Locate and mark voids under the bottom
OK	Record bottom data on a layout sketch using the existing bottom plates as a grid. List the number and sizes of patches required
N/A	Vacuum test the bottom lap welds

OK	Hammer test or ultrasonically examine any slightly discolored spots or damp areas
OK	Check for reinforcing pads under all bottom attached clips, brackets and supports
N/A	Inspect floating roof leg pads for pitting or cutting, and excessive dimpling (indicating excessive loading)
OK	Check the column bases of fixed roof supports for adequate pads and restraining clips
N/A	In earthquake zones 3 and 4, check that roof supports are not welded down to the tank, but are only restrained from horizontal movement
N/A	Check area beneath swing line cable for indications of cable cutting or dragging
OK	Mark old oil and air test connection for removal and patching
OK	Identify and report low areas on the bottom that do not drain adequately
OK	Inspect coating for holes, disbonding, deterioration, and discoloration

Remarks: *hammer testing was not performed due to the presence of floor coating.

SHELL SEAMS AND PLATES

OK	On cone up bottoms, closely inspect and gauge the depth of metal loss on the lower 2 to 4 inches of the shell (area of standing water)
OK	Measure the depth of pitting on each course
OK	Inspect and estimate the amount of metal loss on the heads of rivets and bolts
N/A	Inspect shell-to-bottom riveted lap joints
N/A	Inspect for vertical grooving damage from seal assembly protrusions
OK	Inspect existing protective coatings for damage, deterioration, and disbonding
N/A	Check for areas of rubbing (indicating too much pressure by the seal assembly shoes or inadequate annular space)
N/A	Visually inspect the shell plates and seams for indications of leakage
N/A	If the shell has riveted or bolted seams, record the leak locations by film or chart in case the locations are lost during surface preparation for painting
N/A	Measure annular space at 40-foot intervals
OK	Survey the shell to check for roundness and plumb

Remarks:

SHELL-MOUNTED OVERFLOWS

N/A	Inspect overflow for corrosion and adequate screening
N/A	Check location of overflow that it is not above any tank valves or equipment

Remarks: _____

ROOF INTERIOR SURFACE

General

OK	Visually inspect the underside surface of the roof plates for holes, scale buildup, and pitting
OK	Hammer test or ultrasonically examine to check for thin areas, particularly in the vapor space of floating roofs and at edge of roof on cone roof tank
OK	Check all clips, brackets, braces, etc., welded to the roof deck plate for welded reinforcing pads and see that they have not broken free
N/A	If no pad is present, penetrant test for cracking of the weld or deck plate
OK	Inspect the protective coating for breaks, disbondment, and deterioration

Remarks: _____

Fixed Roof Support Structure

OK	Inspect the support columns for thinning in the upper two feet
N/A	On API columns (two channels welded together) check for corrosion scale breaking the tack welds, unless the joint between the channels is completely seal welded
OK	Check that the reinforcing pad on the bottom is seal welded to the tank bottom with horizontal movement restraining clips welded to the pad
OK	Determine if pipe column supports are concrete filled or open pipe. If open pipe, check for a drain opening in the bottom of the pipe
OK	Inspect and gauge rafters for thinning, particularly near the center of the roof. Report metal loss
OK	Check for loose or twisted rafters
OK	Inspect girders for thinning and check that they are attached securely to the top of the columns
N/A	Report if the columns have cross bracing in the area between the low pump out and top of the shell (for future internal floating roof installation)
N/A	Inspect and report presence of any roof-mounted swing line bumpers
OK	Photograph the roof structure if no rafter layout drawing exists

Remarks:

FIXED ROOF APPURTENANCES

Inspection and Light Hatches

OK	Inspect the hatches for corrosion, paint and coating failures, holes, and cover sealing
OK	On loose covers, check for a safety chain in good condition
OK	On light hatches over 30 inches across, check for safety rods
OK	Inspect the condition of the gaskets on bolted or latched down hatch covers

Remarks:

Staging Support Connection

N/A	Inspect the condition of the staging support for corrosion

Remarks:

Breathers and Vents

N/A	Inspect and service the breather
OK	Inspect screens on vents and breathers

Remarks: Center vent corroded

Emergency P/V Hatches

N/A	Inspect and service pressure/vacuum hatches (setting should be high enough to prevent chattering of breather during normal operation. See breather manufacturer's guide
N/A	Inspect liquid seal hatches for corrosion and proper liquid level in the sea

Remarks:

Sample Hatch

OK	Inspect sample hatch for corrosion
OK	Check that the cover operates properly
N/A	If the tank has no gaugewell, check for a hold off distance marker and check measurement

Remarks: _____

FLOATING ROOF

Roof Deck

N/A Hammer test the area between roof rim and shell. (If access for hammer testing is inadequate, measure the distance from the bottom edge of the roof to the corroded area and then hammer test from inside the pontoon)

N/A In sour water service, clean and test all deck plate weld seams for cracking unless the lower laps have been seal welded

N/A Check that either the roof drain is open or the drain plug in the roof is open in case of unexpected rain

N/A On flat bottomed and cone down bottom roof decks, check for a vapor dam around the periphery of the roof. The dam should be continuous without break to prevent escape of vapors to the seal area from under the center of the roof

Remarks: _____

Floating Roof Pontoons

N/A Visually inspect each pontoon for liquid leakage

N/A Run a light wire through the gooseneck vents on locked down inspection hatch covers to make sure they are open

N/A Inspect lockdown latches on each cover

N/A Check and report if each pontoon is:

- _____ Vapor tight (bulkhead seal welded on one side on bottom, sides and top
- _____ Liquid tight (seal welded on bottom and sides only) or
- _____ Unacceptable (minimum acceptable condition is liquid tight)

Remarks: _____

Floating Roof Cutouts

N/A Inspect underside of cutouts for mechanical damage

N/A Inspect welds for cracks

N/A Inspect plate for thinning, pitting, and erosion

N/A Measure mixer cutouts and record plate thickness for future mixer installation or replacement
Plate thickness: _____

Remarks: _____

Floating Roof Supports

N/A	Inspect fixed low and removable high floating roof legs for thinning
N/A	Inspect for notching at bottom of legs for drainage
N/A	Inspect for leg buckling or bellying at bottom
N/A	Inspect pin hole in roof guide for tears
N/A	Check plumb of all legs
N/A	Inspect for adequate reinforcing gussets on all legs through a single portion of the roof
N/A	Inspect the area around the roof legs for cracking if there is no internal reinforcing pad or if the topside pad is not welded to the deck plate on the underside
N/A	Inspect the sealing system on the two-position legs and the vapor plugs in the fixed low leg for deterioration of the gaskets
N/A	On the shell mounted roof supports, check for adequate clearance based on the maximum floating roof movement as determined by the position of the roof relative to the gaugewell and/or counter rotational device

Remarks: _____

FLOATING ROOF SEAL ASSEMBLIES

Primary Shoe Assembly

N/A	Remove four sections of foam log (foam filled seals) for inspection, on 90° locations
N/A	Inspect hanger attachment to roof rim for thinning, bending, broken welds, and wear of pin holes
N/A	Inspect clips welded to roof rim for thinning
N/A	Shoes: Inspect for thinning and holes in shoes
N/A	Inspect for bimetal bolts, clips, and attachments
N/A	Seal fabric: Inspect for deterioration, stiffening, holes, and tears in fabric
N/A	Measure length of fabric from top of shore to roof rim, and check against maximum anticipated annular space as roof operated
N/A	Inspect any modification of shoes over shell nozzles, mixers, etc., for clearance
N/A	Inspect shoes for damage caused by striking shell nozzles, mixers, etc.

Remarks: _____

Primary Toroidal Assembly

N/A	Inspect seal fabric for wear, deterioration, holes, and tears
N/A	Inspect hold down system for buckling or bending
N/A	Inspect foam for liquid absorption and deterioration

Remarks: _____

Rim Mounted Secondaries

N/A Inspect the rim-mounted bolting bar for corrosion and broken welds
N/A Measure and chart seal-to-shell gaps
N/A Visually inspect seal from below, looking for holes as evident by light
N/A Inspect fabric for deterioration and stiffness
N/A Inspect for mechanical damage, corrosion, and wear on tip in contact with shell
N/A Inspect for contact with obstructions above top of shell

Remarks: _____

FLOATING ROOF APPURTENANCES

Roof Manways

N/A Inspect walls of manways for pitting and thinning
N/A On tanks with interface autogauges, check seal around gauge tape cable and guide wires through manway cover
N/A Inspect cover gasket and bolts

Remarks: _____

Rim Vent

N/A Check rim vent for pitting and holes
N/A Check vent for condition of screen
N/A On floating roof tanks where the environmental rules require closing off the vent, check the vent piping for corrosion at the pipe-to-rim joint and check that the blinding is adequate

Remarks: _____

Vacuum Breaker, Breather Type

N/A Service and check operation of breather valve
N/A Check that nozzle pipe projects no more than 1/2 inch below roof deck
N/A Inspect reinforcing pad and pad weld

Remarks: _____

Vacuum Breaker, Mechanical Type

N/A Inspect the stem for thinning. Measure how far the vacuum breaker cover is raised off the pipe when the roof is resting on high or low legs
On high legs: _____
On low legs: _____

Remarks:

Roof Drains: Open Systems, Including Emergency Drains

N/A	Check liquid level inside open roof drains for adequate freeboard. Report if there is insufficient distance between liquid level and top of drain
N/A	If tank comes under Air Quality Monitoring District rules, inspect the roof drain vapor plug
N/A	If emergency drain is not at the center of the roof, check that there are at least three emergency drains

Remarks:

Closed Drain Systems: Drain Basins

N/A	Inspect for thinning and pitting
N/A	Inspect protective coating (topside)
N/A	Inspect basin cover or screen for corrosion
N/A	Test operation of check valve
N/A	Check for presence of check valve where bottom of basin is below product level
N/A	Inspect drain basin(s) to roof deck welds for cracking
N/A	Check drain basin(s) outlet pipe for adequate reinforcement to roof deck (including reinforcing pad)

Remarks:

Closed Drain Systems: Fixed Drain Line on Tank Bottom

N/A	Hammer test fixed drain line on tank bottom for thinning and scale/ debris plugging
N/A	Inspect supports and reinforcing pads for weld failures and corrosion
N/A	Check that pipe is guided, not rigidly locked to supports, to avoid tearing of tank bottom plate

Remarks:

Closed Drain Systems: Flexible Pipe Drain

N/A	Inspect for damage to exterior of pipe
N/A	Check for obstructions that pipe could catch on
N/A	Inspect shields to protect pipe from snagging
N/A	Inspect results of hydrotest on flexible roof drain system

Remarks:

Closed Drain Systems: Articulated Joint Drain

N/A	Hammer test rigid pipe in flexible joint system for thinning and scale debris plugging
N/A	Inspect system for signs of bending or strain
N/A	Inspect results of system hydrotest
N/A	Inspect landing leg and pad

Remarks: _____

Autogauge System and Alarms

OK	Check freedom of movement of tape through autogauge tape guide
OK	Inspect sheaves for freedom of movement
OK	Test operation checker
OK	Inspect tape and tape cable for twisting and fraying
OK	Test the tape's freedom of movement through guide sheaves and tape guide pipe
N/A	On open-top tanks, check that gate tapes with cables have no more than one foot of tape exposed with float at lowest point
OK	Check float for leakage
OK	Test float guide wire anchors for spring action by pulling on wire and releasing
N/A	Inspect floatwells in floating roofs for thinning and pitting of walls just above the liquid level
OK	Check that the autogauge tape is firmly attached to the float
OK	Inspect the tape cable and float guide wire fabric seals through the floatwell cover
OK	Inspect the bottom guide wire attachment clip; inspect for a temporary weighted bar instead of a permanent welded down clip
OK	Inspect board-type autogauges indicators for legibility and freedom of movement of indicator
N/A	Measure and record these distances to determine if seal damage will occur if tape is run over:
	_____ From shell top angle to underside of tape guide system
	_____ From liquid level on floating top to top of secondary seal
N/A	Identify floating roofs where the tape is connected directly to the roof
OK	Overfill alarm: Inspect tank overfill prevention alarm switches for proper operation

Remarks: _____

COMMON TANK APPURTENANCES

Gauge Well

OK	Inspect gauge well pipe for thinning at about two-thirds distance above the bottom: look for thinning at the edge of the slots
OK	Check for corrosion on the pipe joint. Check that sample cords, weights, thermometers, etc., have been removed from pipe
OK	Check for cone at bottom end of pipe about one foot above the bottom

OK	Check condition of well washer pipe and that its flared end is directed at the near side of the hold-off pad
OK	Check that the supports for the gaugewell are welded to pad or to shell and not directly to bottom plate
OK	Check operation of gaugewell cover
N/A	Check presence of a hold-off distance marker in well pipe and record hold-off distance _____ Hold-Off Distance
OK	Identify and report size and pipe schedule, and whether pipe is solid or slotted. Report slot size
N/A	Check that the hold-off distance plate is seal welded to the bottom and that any gaugewell supports are welded to the plate and not directly to the bottom
N/A	Inspect vapor control float and cable
N/A	Check for presence and condition of gaugewell washer
N/A	Check for bull plug or plate blind on gaugewell washer valve
OK	Inspect gaugewell guide in floating roof for pitting and thinning
OK	Inspect the guide rollers and sliding plates for freedom of movement
OK	Inspect condition of gaugewell pipe seal system
OK	On black oil and diesel services: if gaugewell is also used for sampling, check for presence of a thief- and gauge-type hatch to avoid spillage
OK	Visually inspect inside of pipe for pipe weld protrusions which could catch or damage vapor control float

Remarks: _____

_____

Sampling Systems: Roof Sample Hatches

OK	Inspect roof mounted sample hatches for reinforcing pads and cracking
OK	Inspect cover for operation
OK	For tanks complying with Air Quality Monitoring District rules, inspect sample hatch covers for adequate sealing
N/A	Check horizontal alignment of internal floating roof sample hatches under fixed roof hatches
OK	Inspect the sealing system on the internal floating roof sample hatch Cover
N/A	Inspect floating roof sample hatch cover recoil reel and rope

Remarks: _____

_____

Shell Nozzles

OK	Inspect shell nozzles for thinning and pitting
N/A	Inspect hot tap nozzles for trimming of holes
OK	Identify type of shell nozzles
OK	Identify and describe internal piping, including elbow up and elbow down types

Remarks: _____

_____

For Nozzles Extended into the Tank

N/A	Inspect pipe support pads welded to tank bottom
N/A	Inspect to see that pipe is free to move along support without strain or tearing action on bottom plate
OK	Inspect nozzle valves for packing leaks and damaged flange faces
N/A	Inspect heater steam nozzle flanges and valves for wire cutting
N/A	Report which nozzles have thermal pressure relief bosses and valves
OK	In internal elbow-down fill line nozzles, inspect the wear plate on the tank bottom
OK	On elbow-up fill lines in floating roof tanks, check that opening is directed against underside of roof, not against vapor space. Inspect impact area for erosion

Remarks: _____

Diffusers and Air Rolling Systems.

N/A	Inspect diffuser pipe for erosion and thinning
N/A	Check holes in diffuser for excessive wear and enlargement
N/A	Inspect diffuser supports for damage and corrosion
N/A	Check that diffuser supports restrain, not anchor, longitudinal line movement
N/A	Inspect air spiders on bottom of lube oil tanks for plugging and damaged or broken threaded joints

Remarks: _____

Swing Lines

N/A	Inspect flexible joint for cracks and leaks
N/A	Scribe the flexible joint across the two moving faces and rise end of swingline to check the joint's freedom of movement, indicated by separation of scribe marks
N/A	Check that flexible joints over six inches are supported
N/A	Inspect the swing pipe for deep pitting and weld corrosion
N/A	Loosen the vent plugs in the pontoons and listen for a vacuum. Lack of a vacuum indicates a leaking pontoon
N/A	Check the results of air test on pontoons during repairs
N/A	Inspect the pontoons for pitting
N/A	Inspect the pull-down cable connections to the swing
N/A	Inspect the condition of the bottom-mounted support, fixed roof limiting bumper, or shell mounted limiting bumper of wood condition, weld and bolt corrosion, and seal welding to bottom or shell
N/A	Inspect safety hold-down chain for corrosion and weak links
N/A	Check that there is a welded reinforcing pad where the chain connects to the bottom
N/A	If the floating swing in a floating or internal floating roof does not have a limiting device preventing the swing from exceeding 60 degrees, measure and calculate the maximum angle possible with the roof on overflow
_____	Maximum angle on overflow

(If the calculated angle exceeds 65 degrees, recommend installation of a limiting bracket)

N/A Inspect pull down cable for fraying

N/A Inspect for three cable clamps where cable attaches to end of swingline (single-reeved) or to roof assembly (double-reeved). Inspect sheaves for freedom of movement

N/A Inspect winch operation and check the height indicator for legibility and accuracy

N/A Inspect bottom-mounted sheave assembly at end of pontoon for freedom of rotation of sheave

N/A Inspect shell mounted lower sheave assembly for freedom of rotation of sheave, corrosion thinning, and pitting of sheave housing

N/A Inspect upper sheave assembly for freedom of movement of sheave

N/A Inspect the cable counterbalance assembly for corrosion and freedom of operation

Remarks: _____

Manway Heater Racks

N/A Inspect the manway heater racks for broken welds and bending of the sliding rails

N/A Measure and record the length of the heater and length of the track

Remarks: _____

Mixer Wear Plates and Deflector Stands

N/A Inspect bottom and shell plates and deflector stands

N/A Inspect for erosion and corrosion on the wear plates. Inspect for rigidity, structural soundness, corrosion, and erosion of deck plates and reinforcing pads that are seal welded to the bottom under the deflector stand legs

N/A Measure for propeller clearance between the bottom of deflector stand and roof when the roof is on low legs

Remarks: _____

ACCESS STRUCTURES

Handrails

OK Identify and report type (steel pipe, galvanized pipe, square tube, angle) and size of handrails

OK Inspect for pitting and holes, pain failure

OK Inspect attachment welds

OK Identify cold joints and sharp edges. Inspect the handrails and midrails

OK Inspect safety drop bar (or safety chain) for corrosion, functioning and length

N/A Inspect the handrail between the rolling ladder and the gauging platform for a hazardous opening when the floating roof is at its lowest level

Remarks: *2½" painted carbon steel angle

Platform Frame

N/A Inspect frame for corrosion and paint failure
N/A Inspect the attachment of frame to supports and supports to tank; for corrosion and weld failure
N/A Check reinforcing pads where supports are attached to shell or roof
N/A Inspect the surface that deck plate or grating rests on, for thinning and holes
N/A Check that flat-surface to flat-surface junctures are seal welded

Remarks:

Deck Plate and Grating

N/A Inspect deck plate for corrosion-caused thinning or holes (not drain holes) and paint failure
N/A Inspect plate-to-frame weld for rust scale buildup
N/A Inspect grating for corrosion-caused thinning of bars and failure of welds
N/A Check grating tie-down clips. Where grating has been retrofitted to replace plate, measure the rise of the step below and above the grating surface and compare with other risers on the stairway

Remarks:

Stairway Stringers

OK Inspect spiral stairway stringers for corrosion, paint failure, and weld failure. Inspect attachment of stairway treads to stringer
OK Inspect stairway supports to shell welds and reinforcing pads
N/A Inspect steel support attachment to concrete base for corrosion

Remarks:

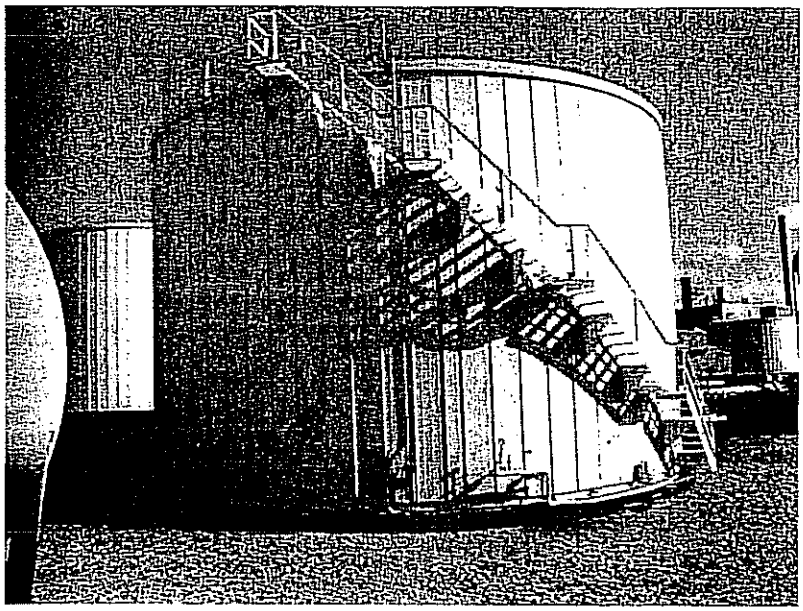
Rolling Ladder

N/A Inspect rolling ladder stringers for corrosion
N/A Identify and inspect ladder fixed rungs (square bar, round bar, angles) for weld attachment to stringers and corrosion, particularly where angle rungs are welded to stringers
N/A Check for wear and corrosion where rolling ladder attaches to gauging platform
N/A Inspect pivot bar for wear and secureness

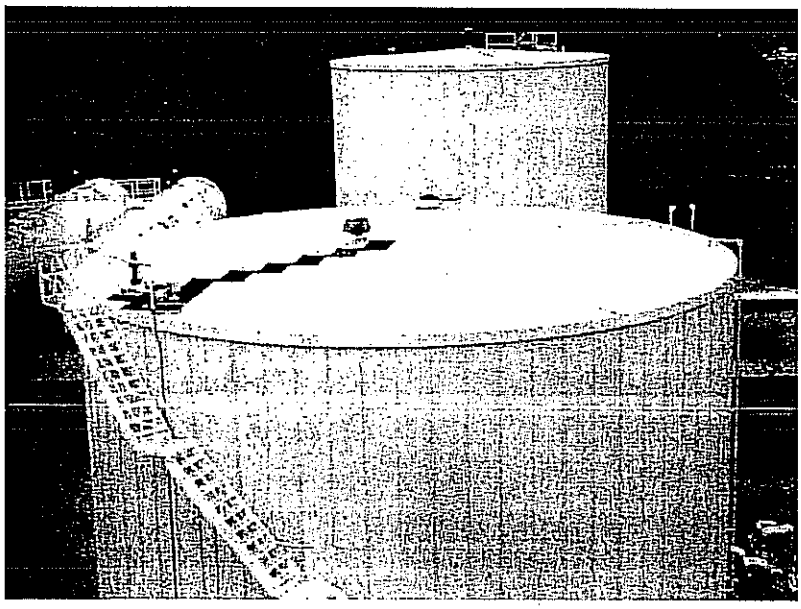
N/A	Inspect operation of self-leveling stairway treads
N/A	Inspect for corrosion and wear on moving parts
N/A	Inspect rolling ladder wheels for freedom of movement, flat spots, and wear on axle
N/A	Inspect alignment of rolling ladder with roof rack
N/A	Inspect top surface of rolling ladder track for wear by wheels to assure at least 18 inches of unworn track (track long enough)
N/A	Inspect rolling ladder track welds for corrosion
N/A	Inspect track supports on roof for reinforcing pads seal welded to deck plate
N/A	Check, by dimensioning, the maximum angle of the rolling ladder when the roof is on low legs Maximum angle: _____
N/A	If rolling ladder track extends to within five feet of the edge of the roof on the far side, check for a handrail on the top of the shell on that side

Remarks: _____

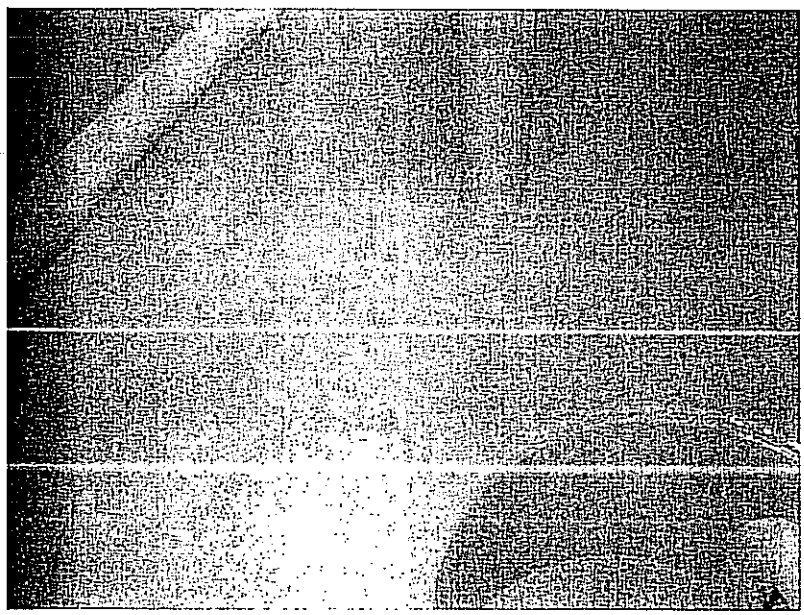
VI. PHOTOGRAPHS



PA280039.JPG
10/28/2003
Tank No. 9 - overview



PA280041.JPG
10/28/2003
Roof overview



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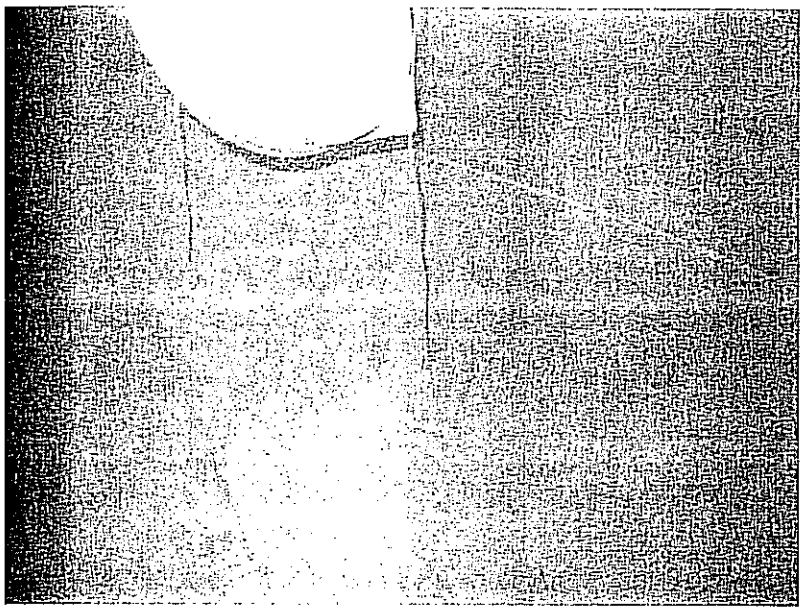
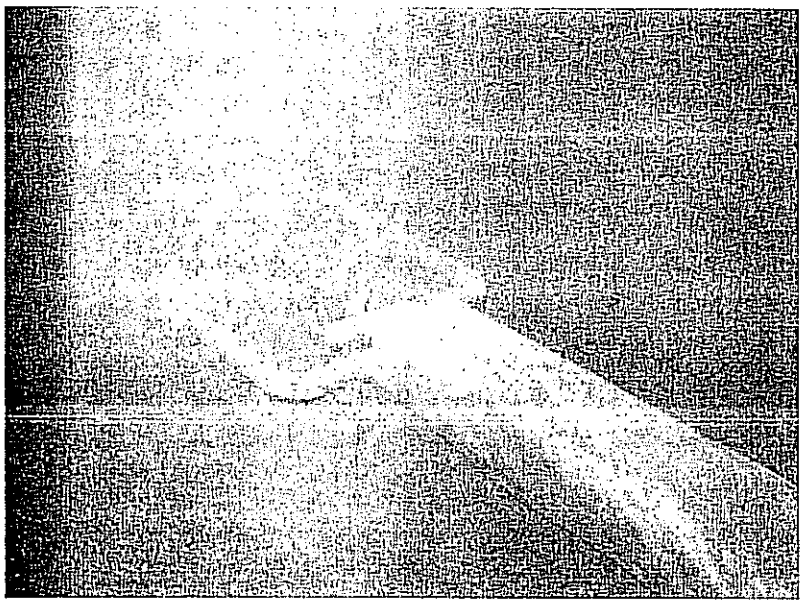
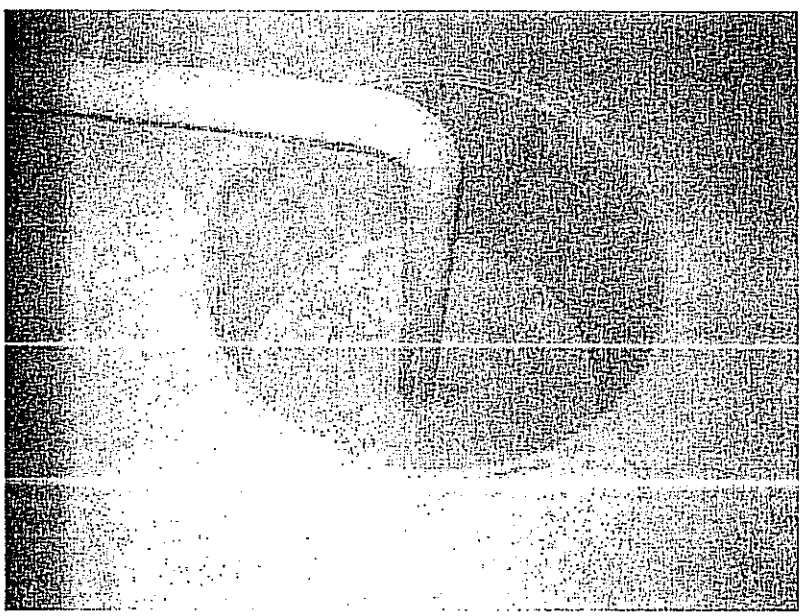
10/28/2003
Center column



PA280045.JPG
10/28/2003
Gauge float



PA280046.JPG
10/28/2003
Heating coils



PA280049.JPG
10/28/2003
Sump

VII. RECOMMENDATIONS

As a result of the findings disclosed in the inspection of Tank No. 9, PCA Engineering, Inc. makes the following recommendations:

- Restore paint coatings as needed.

The maximum interval until the next internal inspection would be 7 years based on the attached calculation, Suffolk County Regulations, the available data, and assumes completion of above repairs, operation under the same service and operating conditions. This does not preclude regular in-service inspection by terminal personnel and qualified inspector, and it is not a guarantee of future performance.

All repairs should be completed per API 650, 653 and other applicable Standards. An inspection of all repairs should be performed prior to return to service.

Based on the extent of the inspections performed on Tank No. 9, the test results indicate no substantial corrosion or defects above and beyond that noted, as of the test date of October 28, 2003. This is not to be construed as an expressed or implied warranty of future performance.

Brookhaven National Laboratory
Tank No. 9
October 28, 2003
PCA Job No. 23089

WILLIAM M. KENT
PCA ENGINEERING, INC.
API Certification No. 297

STATE OF NEW YORK
DANIEL R. KOGUT
069049
LICENSED PROFESSIONAL ENGINEER

DANIEL KOGUT
PCA ENGINEERING, INC.
NY P.E. No. 069049

WMK:mm

Notwithstanding anything contained in this report, nothing herein shall be construed as a representation, warranty or guarantee, either expressed or implied, regarding the future structural integrity or future life expectancy of any of the items tested. This report and any analysis provided is in all respects subject to and shall be interpreted within the limitations and parameters of the test procedures performed. In the event testing is performed using a sampling procedure, this report and any analysis shall be limited to those areas actually tested and the type of test conducted, and the customer is cautioned not to extrapolate the results of the test samples.

Prepared for:

Brookhaven National Laboratory
Building 452, P. O. Box 5000
Upton, NY 11973-5000

Out-of-Service Inspection of Tank No. 10 located at the Brookhaven National Laboratory Upton, New York Terminal on May 15, June 2 and July 29, 2003

Prepared by:

PCA Engineering, Inc.
430 Montclair Avenue
P.O. Box 196
Pompton Lakes, NJ 07442

PCA Job No. 23089

September 9, 2003

PHASE I REPORT

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API-653 Section 2.3

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VII. RECOMMENDATIONS

I. INTRODUCTION AND BACKGROUND

On May 15, June 2 and July 29, 2003, PCA Engineering, Inc. personnel performed an Internal Out-of-Service Inspection of Tank No. 10 located at the Brookhaven National Laboratory, Upton, New York Terminal.

The Brookhaven National Laboratory, Upton, New York Facility Registration Number for New York State is 01-1700. The inspection of Tank No. 10 conforms to Section 6NYCRR, Part 613.6 "Handling and Storage of Petroleum", New York State Department of Conservation.

The inspection performed is in compliance with the API 653 Standard.

An Industrial Scientific Model ATX-612 was used for vapor monitoring prior to and during entry. Prior to entry, the oxygen content was found to be 20.9% and the lower flammability level (LFL) 0%. These are considered non-hazardous and the interior inspection proceeded. All product lines were checked and found to be blinded or locked out.

PCA personnel on site were all currently trained in Hazardous Entry and Confined Space Entry.

SITE DESCRIPTION

Tank No. 10 is a welded, above ground, upright, cylindrical storage tank measuring 42 feet in diameter by 45 feet in height. The tank was erected in 1986 and has a product capacity of 14,286 barrels. The primary product stored on site is fuel oil of various grades.

The tank floor is fabricated of 19 lap welded carbon steel plates. The tank shell is arranged in 5 butt-welded courses, with 5 plates per course. The tank fixed roof is fabricated of 26 lap welded plates arranged in a cone configuration.

The tank is located within an earthen dike secondary containment area. The dike area has a bentonite mixed soil lining system, as indicated on BNL supplied drawings.

TEST PROCEDURES

The following is a list of the tests performed and their procedures involved in the inspection of Tank No. 10:

A) Ultrasonic Thickness Measurements

To obtain the residual metal thickness readings, either a Cygnus Model 3 or Cygnus Model 4 Ultrasonic Digital Thickness Gauge, with a 2.25 MHz transducer

TEST PROCEDURES (Cont'd)

was used. The Cygnus Model 3 has a resolution of +/- 0.002 inch; the Cygnus Model 4 has a resolution of +/- 0.005 inch, accuracy allowing for use on steel plate/piping materials used in storage tanks. The calibration of the instrument is confirmed prior to and during testing using a steel step block. The couplant used was Sonotech UT-X and/or motor oil.

A minimum of five (5) ultrasonic thickness readings were taken at each floor plate, with five (5) additional readings taken adjacent to the floor/shell joint on approximately 2 foot intervals. A W. R. Thorpe Pit Gauge was available to measure any pit depths, with readings taken at the point of deepest penetration. All ultrasonic thickness readings and pitted areas are noted on the enclosed data tables. The arrangement of the floor plates is shown on the enclosed PCA drawings.

A minimum of five (5) ultrasonic thickness readings were taken at each plate of the lower course of shell plates and each plate adjacent to the spiral stairway ascending to the roof, with readings tabulated on the enclosed data tables. The arrangement of the shell appurtenances is shown on the enclosed PCA drawings.

TEST PROCEDURES (Cont'd)

As an appurtenance survey, ultrasonic thickness measurements were taken on principle pipe penetrations and their API plates within the lower course of shell plates.

Ultrasonic thickness readings of the roof were taken at a minimum of five (5) readings per plate.

B) **Holiday Inspection (Low Voltage Sponge Test)**

The epoxy coating of the tank floor was tested for overall integrity using a Tinker & Rasor Model M/1 Sponge Tester. The sponge tester operates on the principle of applying a fixed amount of D.C. current (67.5 volts) to the epoxy coated floor through a water saturated sponge.

With the instrument grounded to any area of bare steel electrically continuous with the floor, any holiday or defect in the epoxy would allow passage of water to the steel floor plates, thus completing the circuit. This would energize the buzzer, indicating to the operator the location of any defect in the epoxy coating.

C) **Holiday Inspection (High Voltage Spark Test)**

The epoxy coating of the tank floor was tested for overall integrity using a Tinker & Rasor Model AP/W Holiday Detector. The holiday tester operates on the principle of applying a fixed amount of high voltage electrical potential to the coated floor through a conductive silicon rubber brush.

With the instrument grounded to any area of bare steel electrically continuous with the floor, any holiday or defect in the epoxy would allow passage of current to the steel floor plates, thus completing the circuit. This would energize an audible signal indicating to the operator the location of any defect in the coating.

D) **Interior Perimeter Elevation Survey**

The interior survey is based on an assumed datum of 10 feet, as shown on the "Interior Elevation Survey", with measurements shown clockwise or counter-clockwise around the tank. Cross sections are taken at various intervals around the tank, as shown on the drawing.

The interior elevation survey is helpful in evaluating the condition of the floor plates. Low spots are areas of drastic grade changes, as indicated on the drawing, are potential areas of excessive stresses in the floor plates, and indications of possible loss of sub-structure support. Elevation cross sections are helpful to analyze this data.

E) Magnetic Flux Leakage Floor Scan

The tank floor was inspected using a Magnetic Flux Leakage Floor Scan (MFL and/or MFE).

The Magnetic Flux Leakage floor scanner operates using permanent rare-earth magnets to bring a section of the steel floor plate to magnetic saturation. A defect, located on front or back surfaces, causes a scattering of the magnetic "lines of force" or flux. Sensors located between the magnets detect this flux leakage and display the result on a display screen.

TEST PROCEDURES (Cont'd)

MFL/MFE inspection is a qualitative inspection tool, which primarily detects plate cross-sectional volume loss (as opposed to remaining thickness) and correlates this as an amplitude display.

An observed significant indication is evaluated by the technicians using ultrasonic equipment for quantitative classification.

The Magnetic Flux Leakage Scan covers the majority of the tank floor plate, with the exception of the areas within 4 to 6 inches of the lap welds, corner welds, lap patches, columns, etc. Any additional areas not scanned are marked on the tank floor drawing.

II. SUMMARY OF FINDINGS

Upon completion of the inspections conducted on Tank No. 10, the following results were obtained:

Ultrasonic Thickness Inspection

The residual plate metal thickness measurements ranged as follows:

Floor:	.363" to .388"
Shell:	.235" to .250" (1st Course)

Holiday Inspection

The initial inspection included an evaluation of the existing thin film floor coating system. The coating was found to be in poor condition, with multiple holidays and visible indications of blistering and/or delamination. Areas of rust/primer bleed-through were also evident.

The follow-up high voltage holiday test of the new coating system disclosed several indications, which were immediately repaired. There were no holidays remaining. The final coating thickness ranged from 50 to 60 mils.

II. SUMMARY OF FINDINGS (Cont'd)

Interior Perimeter Elevation Survey

The perimeter elevations (shell settlement) indicate a maximum differential of 0.01 feet (0.12 inches). The settlement is considered planar tilt, with the maximum out-of-plane deflection of 0.007 feet (0.08 inch). The maximum permissible out-of-plane deflection per API 653, B.3.2 is 0.04 feet (0.48 inch).

There are no visible indications of tank shell or floor stress, or recent/active displacement of fill material from around or under the tank. This information, in conjunction with the tank's age (17 years +/-), would indicate the tank has reached its maximum settlement with no changes in deflections anticipated, based on current operational procedures and site conditions.

The internal cross section elevation results disclosed edge settlement with a typical radius of 3 feet. The maximum edge settlement observed was 2.94 inches, which is within 75% of the allowable settlement as noted in API 653, Figure B-10 and Figure B-11. Settlement between 75 and 100 percent of allowable requires further inspection, while settlement in excess of the allowable requires repair or engineering evaluation.

II. SUMMARY OF FINDINGS (Cont'd)

The pitch of the cone down floor was approximately 4.2 inches in 10 feet.

Edge settlement (or roll-off) typically occurs when the tank shell settles sharply around the periphery, resulting in deformation of the bottom plate near the shell-to-bottom corner junction.

Magnetic Flux Leakage Floor Scan

The magnetic flux leakage floor scan disclosed no significant indications. The indications noted were confirmed and reviewed by ultrasonic B-scan, with no indications greater than 0.050 inch in depth.

III. DISCUSSION

As a result of the inspection performed, the following deficiencies were observed:

Interior

- The integrity of the epoxy floor coating has been compromised.
- The auto gauge was found to be insufficient; however, it is supplemented by a board gauge.
- The existing floor coating was removed and replaced following the initial inspection. The coating system applied was PCS-355 manufactured by Polyurea Coating Systems. The coating is a two-part spray applied material designed as a tank lining. The coating was applied by Gombert Painting, Inc. of Deer Park, New York. PCA Engineering, Inc. conducted a post application holiday test of the new coating on July 29, 2003.

Exterior

- The tank rests on a concrete pad. The shell and roof were found to be insulated. The stairway and staging areas were found to have minor paint failure.

IV. TEST DATA

CORROSION SURVEY FIELD DATA TABLE

OWNER: Brookhaven National Labs
STRUCTURE: Tank No. 10
DATE OBTAINED: June 2, 2003
SURVEYED BY: P. Seastrand

PCA JOB NO. 23089

Ultrasonic Thickness Measurements
Tank Floor - In Inches

	1	2	3	4	5
Plate No. 1	0.371	0.370	0.370	0.371	0.365
	0.367	0.369	0.370	0.370	0.370
Plate No. 2	0.371	0.369	0.373	0.371	0.368
	0.369	0.368	0.369	0.370	0.372
Plate No. 3	0.386	0.383	0.384	0.385	0.380
	0.387	0.385	0.387	0.384	0.383
Plate No. 4	0.375	0.378	0.375	0.379	0.377
	0.375	0.375	0.378	0.374	0.377
Plate No. 5	0.377	0.378	0.378	0.377	0.380
	0.371	0.376	0.372	0.370	0.376
Plate No. 6	0.380	0.378	0.380	0.378	0.380
	0.379	0.377	0.378	0.371	0.370
Plate No. 7	0.375	0.372	0.372	0.369	0.372
	0.376	0.378	0.372	0.370	0.368
Plate No. 8	0.373	0.372	0.370	0.369	0.373

minimum	0.363
average	0.375
maximum	0.388
std. dev.	0.00528

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CORROSION SURVEY FIELD DATA TABLE

OWNER: Brookhaven National Labs
STRUCTURE: Tank No. 10
DATE OBTAINED: June 2, 2003
SURVEYED BY: P. Seastrand

PCA JOB NO. 23089

Ultrasonic Thickness Measurements
Tank Floor - In Inches

		1	2	3	4	5
Plate N o. 9		0.379	0.376	0.379	0.375	0.379
Plate No. 10		0.379	0.378	0.381	0.382	0.383
Sump	Shell	0.363	0.364	0.364	0.364	
	Floor	0.370	0.367	0.374	0.372	
Plate No. 11		0.368	0.376	0.378	0.375	0.377
Plate No. 12		0.371	0.370	0.364	0.372	0.369
Plate No. 13		0.369	0.366	0.373	0.369	0.373
		0.375	0.371	0.370	0.372	0.372
Plate No. 14		0.365	0.364	0.374	0.375	0.374
		0.370	0.375	0.374	0.369	0.363
Plate No. 15		0.377	0.380	0.375	0.378	0.378
		0.380	0.372	0.372	0.382	0.380
Plate No. 16		0.372	0.375	0.377	0.369	0.380
		0.370	0.374	0.375	0.371	0.370

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CORROSION SURVEY FIELD DATA TABLE

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STRUCTURE: Tank No. 10
DATE OBTAINED: June 2, 2003
SURVEYED BY: P. Seastrand

PCA JOB NO. 23089

Ultrasonic Thickness Measurements
Tank Floor - In Inches

	1	2	3	4	5
Plate No. 17	0.384	0.388	0.385	0.386	0.385
	0.382	0.381	0.368	0.372	0.380
Plate No. 18	0.374	0.374	0.373	0.375	0.373
	0.368	0.368	0.380	0.374	0.374
Plate No. 19	0.374	0.380	0.374	0.370	0.370
	0.371	0.368	0.375	0.374	0.369

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CORROSION SURVEY FIELD DATA TABLE

OWNER: Brookhaven National Labs
STRUCTURE: Tank No. 10
DATE OBTAINED: June 2, 2003
SURVEYED BY: P. Seastrand

PCA JOB NO. 23089

Ultrasonic Thickness Measurements
Tank Shell - In Inches

1	2	3	4	5
0.245	0.245	0.245	0.240	0.250
0.245	0.240	0.245	0.240	0.240
0.240	0.235	0.240	0.245	0.240
0.240	0.240	0.245	0.240	0.240
0.240	0.240	0.245	0.250	0.245

minimum	0.235
average	0.242
maximum	0.250
std. dev.	0.003571

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CORROSION SURVEY FIELD DATA TABLE

OWNER: Brookhaven National Labs
STRUCTURE: Tank No. 10
DATE OBTAINED: June 2, 2003
SURVEYED BY: P. Seastrand

PCA JOB NO. 23089

Appurtenance Survey
Tank Shell - In Inches

	Top	Side	Bottom	Side
24" manway	0.515	0.515	0.515	0.515
API	0.255	0.260	0.260	0.250
2" heating coils	0.195	0.195	0.195	0.195
2" heating coils	0.195	0.195	0.205	0.215
2" blank	0.215	0.215	0.210	0.210
2" heating coils	0.195	0.190	0.195	0.195
2" heating coils	0.195	0.195	0.200	0.205
6" blank	0.335	0.335	0.330	0.335
6" fill / return	0.330	0.325	0.335	0.325
8" high suction	0.440	0.440	0.430	0.435
8" low suction	0.445	0.435	0.430	0.440
2" steam	0.215	0.205	0.195	0.200
2" steam	0.215	0.210	0.215	0.205
4" water draw-off	0.325	0.330	0.320	0.335
3" blank	0.305	0.290	0.285	0.305

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CORROSION SURVEY FIELD DATA TABLE

OWNER: Brookhaven National Labs
STRUCTURE: Tank No. 10
DATE OBTAINED: June 2, 2003
SURVEYED BY: P. Seastrand

Elevation Survey

PCA JOB NO. 23089

	Shell	1'	2'	3'	4'	5'	10'	20'	Center
A	10.00	9.90	9.82	9.77	9.68	9.65	9.59	9.34	9.35
B	10.01	9.95	9.84	9.80	9.75	9.72	9.59	9.31	
C	10.00	9.93	9.88	9.82	9.76	9.72	9.54	9.40	
D	10.00	9.98	9.94	9.91	9.88	9.85	9.64	9.37	
E	10.00	9.93	9.86	9.80	9.72	9.68	9.56	9.28	
F	10.00	9.92	9.86	9.80	9.75	9.70	9.53	9.27	
G	10.00	9.95	9.89	9.85	9.82	9.80	9.66	9.29	
H	10.00	9.91	9.84	9.78	9.71	9.67	9.55	9.23	
A	10.00								

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API 653 INSPECTION - DATA EVALUATION

GENERAL INFORMATION

Customer: **Brookhaven National Labs** Job No.: 23089 Date: 6/2/03

Tank No.: 10 Erected: 1/1/86

Diameter: 42 feet Cathodic Protection?: n Date Last Inspected

Height: 45 feet Leak Detection?: n Cleaned:

Safe Fill: feet Thick FilmCoating?: n Painted:

Capacity: 11,222 bbl Thin Film Coating?: n Lined:

Product: Fuel Oil - various grades Strapped:

	Quantities:
Floor plts:	19
Roof plts:	26
Shell crs:	5
Plts/Crs:	5

1st Crse Avg Shell Thickness (in)	
1st	0.240
2nd	0.240
3rd	0.235
4th	0.245
5th	0.240

	PlateThickness (in)					
	Original	General	Delta	Minimum	Material	Riveted?
Floor Plates:	0.388	0.375	0.013	0.363	Unknown	n
Sketch Plates:			0.000			
Annular Plates:			0.000			
Shell - 1st course:	0.250	0.242	0.008	0.235	Unknown	n
2nd course:			0.000			
3rd course:			0.000			
4th course:			0.000			
5th course:			0.000			
6th course:			0.000			
7th course:			0.000			
8th course:			0.000			
Roof:			0.000			

	Pitting Depth (in)			
	Max Int.	Avg Int.	Max Ext.	Avg Ext.
Floor Plates:	0.060	0.020	0.020	0.010
Shell - 1st course:				
Roof:				

Containment Area:

Steel? Earthen?

Diameter feet Length feet

Height feet Width feet

Height feet

Containment bbl Containment bbl

110% Cap 110% Cap

Calculated Safe Fill (based on capacity of containment): 0.00 feet

Therefore, containment is sufficient if current Safe Fill is maintained

COMMENTS: The tank roof and shell are insulated, limiting access for thickness gauging.

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BOTTOM PLATE TOPOGRAPHY

Tank:	4	No of Sections:	8	Elevation @ Center of Tank:	9.26 ft	Allowable Roll-Off	
Diameter:	42.5	Max Chord Length:	16.68 ft	Average Pitch:	0.42 in/ft	in 1'	0.79 in
				Overall Differential Settlement	0.12 in	in 2'	1.16 in
						in 3'	1.53 in

	AXIS 1		AXIS 2		AXIS 3		AXIS 4		AXIS 5		AXIS 6	
Spacing	Field Data	Roll-Off	Field Data	Roll-Off	Field Data	Roll-Off	Field Data	Roll-Off	Field Data	Roll-Off	Field Data	Roll-Off
Shell	10.00		10.00		9.99		9.99		10.00		10.00	
1'	9.83	2.04	9.82	2.15	9.85	1.68	9.89	1.20	9.87	1.56	9.88	1.44
2'	9.70	3.60	9.68	3.84	9.78	2.52	9.76	2.76	9.80	2.40	9.83	2.04
3'	9.65	4.20	9.62	4.56	9.75	2.88	9.71	3.36	9.75	3.00	9.78	2.64
5'	9.64		9.50		9.58		9.68		9.70		9.73	
10'	9.54		9.37		9.54		9.45		9.47		9.54	
20'												
30'												
40'												
50'												
60'												
70'												
80'												
90'												
Settlement	0		0.00		0.01		0.01		0.00		0.00	

	AXIS 7		AXIS 8		AXIS 9		AXIS 10		AXIS 11		AXIS 12	
Spacing	Field Data	Roll-Off	Field Data	Roll-Off	Field Data	Roll-Off	Field Data	Roll-Off	Field Data	Roll-Off	Field Data	Roll-Off
Shell	10.00		10.00									
1'	9.86	1.68	9.89	1.32		0.00		0.00		0.00		0.00
2'	9.80	2.40	9.79	2.52		0.00		0.00		0.00		0.00
3'	9.76	2.88	9.73	3.24		0.00		0.00		0.00		0.00
5'	9.70		9.70									
10'	9.42		9.47									
20'												
30'												
40'												
50'												
60'												
70'												
80'												
90'												
Settlement	0.00		0.00									

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TANK SHELL EVALUATION API 653 SECTION 2.3

Tank: 10

Date: 6/2/03

Diameter: 42 feet
Height: 45 feet
t_1(avg.): 0.240 inches
t_2: 0.235 inches

Field data:
0.240
0.240
0.235
0.245
0.240
t_1= 0.240

Thickness Determination:

$L=3.7(D*t_2)^{1/2}$

Where: L= the maximum vertical length, in inches, over which hoop streees are assumed to "average out" around local discontinuities
D= tank diameter, in feet
t_2= the least thickness, in inches, in area of corrosion, exclusive of pits

L= 11.62413 inches

Minimum Thickness Calculation for Welded Tank Shell:
Course No. 1

t_{min}= 2.6DHG/SE = **0.205 inches**

Where:
t_{min}= the minimum acceptable thickness, in inches, as calculated from the above formula; however, t_{min} shall not be less than 0.1 inch for tank course
D= nominal diameter of tank, in feet
H= Height, in feet, from the bottom of length *L* for the most severely corroded area in each shell course to the maximum design liquid level
G= highest specific gravity of the contents (including water, if hydtsted)
S= maximum allowable stress in psi; use the smaller of 0.80Y or 0.426T for bottom and second course; use the smaller of 0.88Y or 0.472T for all other courses
Y= specified minimum yield strength of the plate; 30,000 psi if unknown
T= the smaller of the specified minimum tensile strength of the plate or 80,000 psi; use 55,000 psi if unknown
E= original joint efficiency for the tank. use E=0.7 if unknown, E=1.0 when evaluating the retirement thickness in a corroded plate, when away from welds or joints by at least the greater of 1 inch or twice the plate thickness
NOTE: For riveted tanks see section 653.2.3.4; see section 653.2.3.3 for complete explanation

D =	42 feet	G =	1.0	Y =	30,000 psi
H =	45 feet	S =	23,430 psi	T =	55,000 psi
				E =	1.0

Then, per API653 section 2.3.3.1:

If: a: t_1 >= t_{min}
0.240 >= **0.205**

and

b: t_2 >= 60% t_{min}
0.235 >= **0.123**

THEREFORE, NO ACTION IS REQUIRED

Maximum Safe Fill Height = **51.42** feet
(t_2SE/2.6DG) +1

Tank can be filled to capacity
Provided Containment Capacity is Sufficient

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Courses

Tank: 10 Date: 6/2/03

Diameter:	42	Yield:	23,430
Height:	45	Joint Efficiency:	1.0
Number of Courses:	5	Specific Gravity:	1.00

MINIMUM THICKNESS per each SHELL COURSE

	Height (TOC)	Minimum Thickness	
Course 1	9	0.205	**OK**
Course 2	18	0.163	**OK**
Course 3	27	0.121	**OK**
Course 4	36	0.079	**OK**
Course 5	45	0.037	**OK**

TANK BOTTOM EVALUATION - API 653 SECTION 2.4

Tank: **10** Date: **6/2/03**

Minimum Thickness for Tank Bottom Plate (API 4.4.7):

$$MRT = (\text{minimum of } RT_{bc} \text{ or } RT_{ip}) - O_r(StP_r + UP_r)$$

Where:

MRT = minimum remaining thickness at the end of interval O_r
This value must meet the requirments of Table 6-1
and sections 4.4.7.4 and 4.4.8

O_r = in-service interval (years to next inspection) not to exceed that allowed by 4.2.2 (normally 10 years)

RT_{bc} = minimum remaining thickness from bottom side corrosion, after repairs

RT_{ip} = minimum remaining thickness from internal corrosion after repairs

StP_r = maximum internal pitting rate, in inches per year; $StP_r = 0$ if tank bottom is internally lined.

UP_r = maximum underside pitting rate, in inches per year; $UP_r = 0$ if tank bottom is cathodically protected.

T_o	=	0.388 inch	RT_{bc}	=	0.368	UP_r	=	0.0011 in/yr
UP_m	=	0.020 inch	RT_{ip}	=	0.328	StP_r	=	0.0034 in/yr
StP_m	=	0.060 inch	O_r	=	10.0 years			

Solve for: MRT = 0.282 inch

Or = 49.6 years where MRT = 0.100
NOTE: see API 653 table 6-1

Then if:

MRT > 0.100

THEREFORE, NO ACTION IS REQUIRED

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TANK SETTLMENT EVALUATION - API 653 APPENDIX B

Tank: 4 Date: 6/2/03

Diameter: 42.5 feet
Sections: 8

Arc (L): 16.69 feet
Yield(Y): 30000 psi
(E): 29000000 psi
Height(H): 40 feet

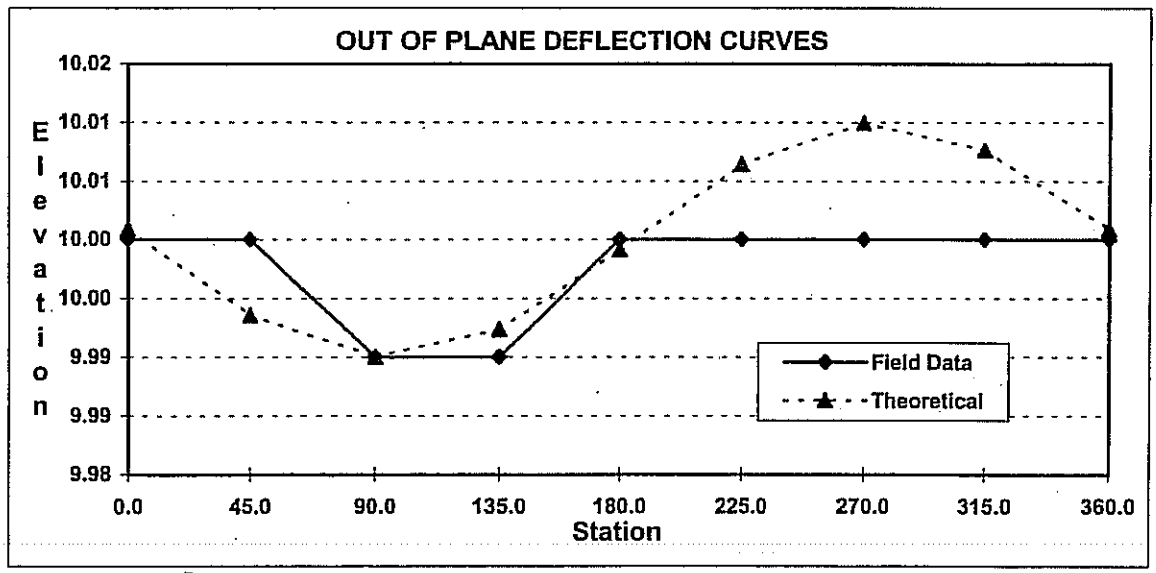
Maximum Permissible Out-of-Plane Deflection:

$S<=(L^2*Y*11)/(2(E*H)$

Where: S= deflection, in feet (out-of-plane distortion)
L= arc length, between measurement pts, in feet
Y= yield strength, in psi
E= Young's modulus, in psi
H= tank height, in feet

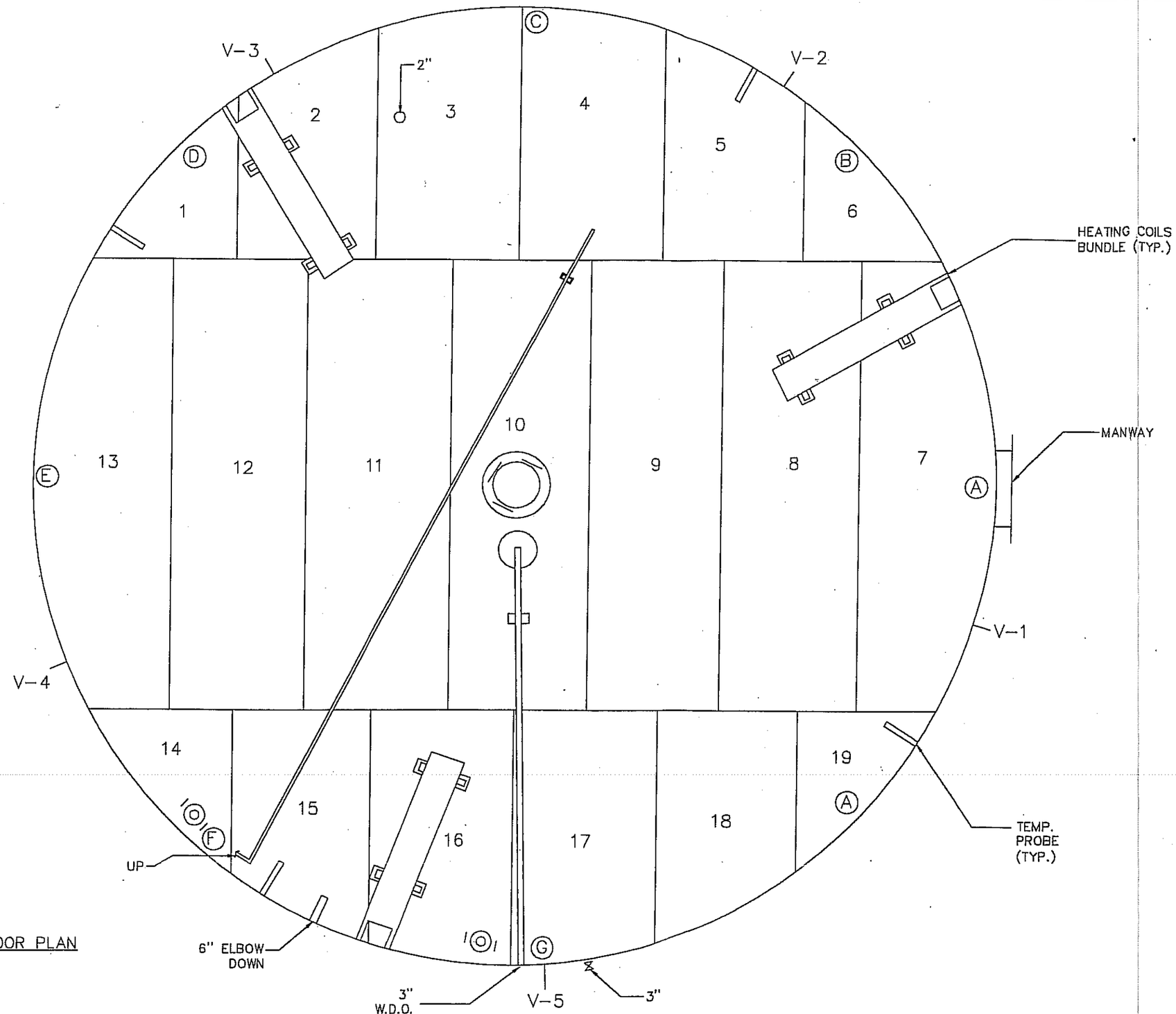
S<= 0.039621 feet

Degrees	Station	Field Data	Theoretical	Delta(U_i)	Deflection(S_i)
0.0	0.0	10.00	10.001	-0.001	-0.0003
45.0	16.7	10.00	9.994	0.006	0.0069
90.0	33.4	9.99	9.990	0.000	-0.0021
135.0	50.1	9.99	9.992	-0.002	-0.0028
180.0	66.8	10.00	9.999	0.001	0.0053
225.0	83.4	10.00	10.006	-0.006	-0.0019
270.0	100.1	10.00	10.010	-0.010	-0.0029
315.0	116.8	10.00	10.008	-0.008	-0.0022
360.0	133.5	10.00	10.001	-0.001	-0.0003



THEN, SINCE THE MAXIMUM Si <= S NO ACTION IS REQUIRED

PCA ENGINEERING, INC.



FLOOR PLAN

GENERAL NOTES:

TANK No. 10
48' DIA.

LEGEND

1 – FLOOR PLATE No.

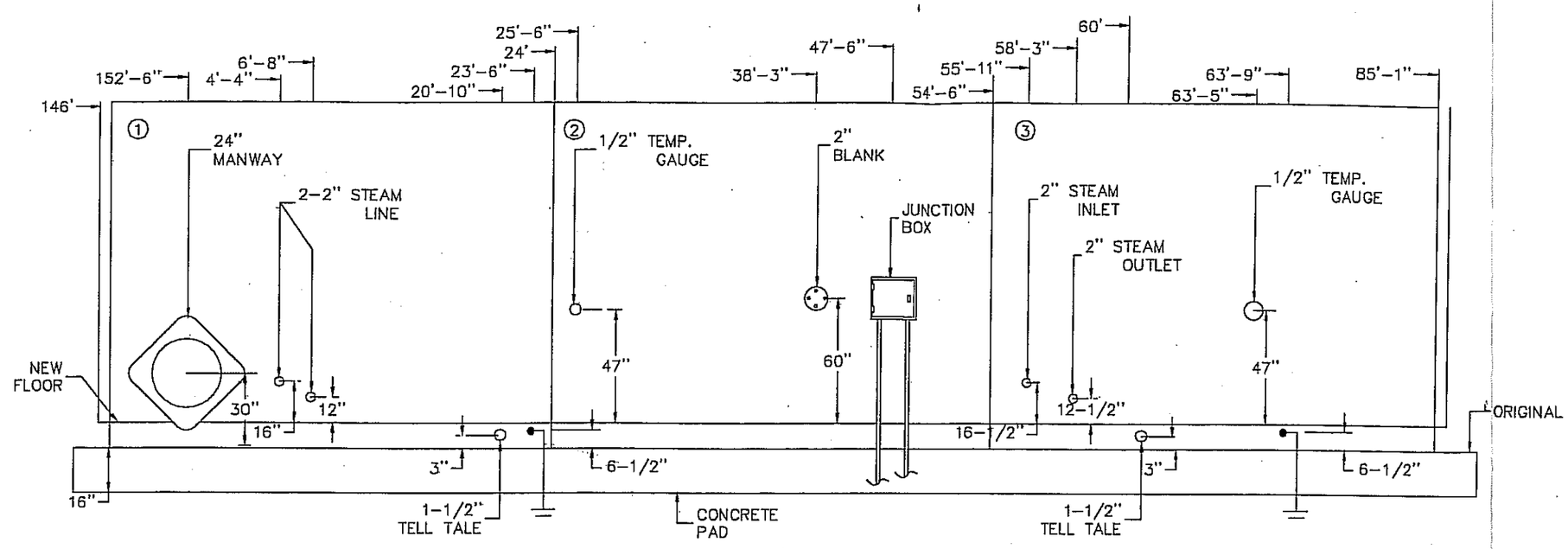
PCA ENGINEERING, INC.
430 Montclair Ave. Pompton Lakes, NJ.
TEL. (973) 616-4501

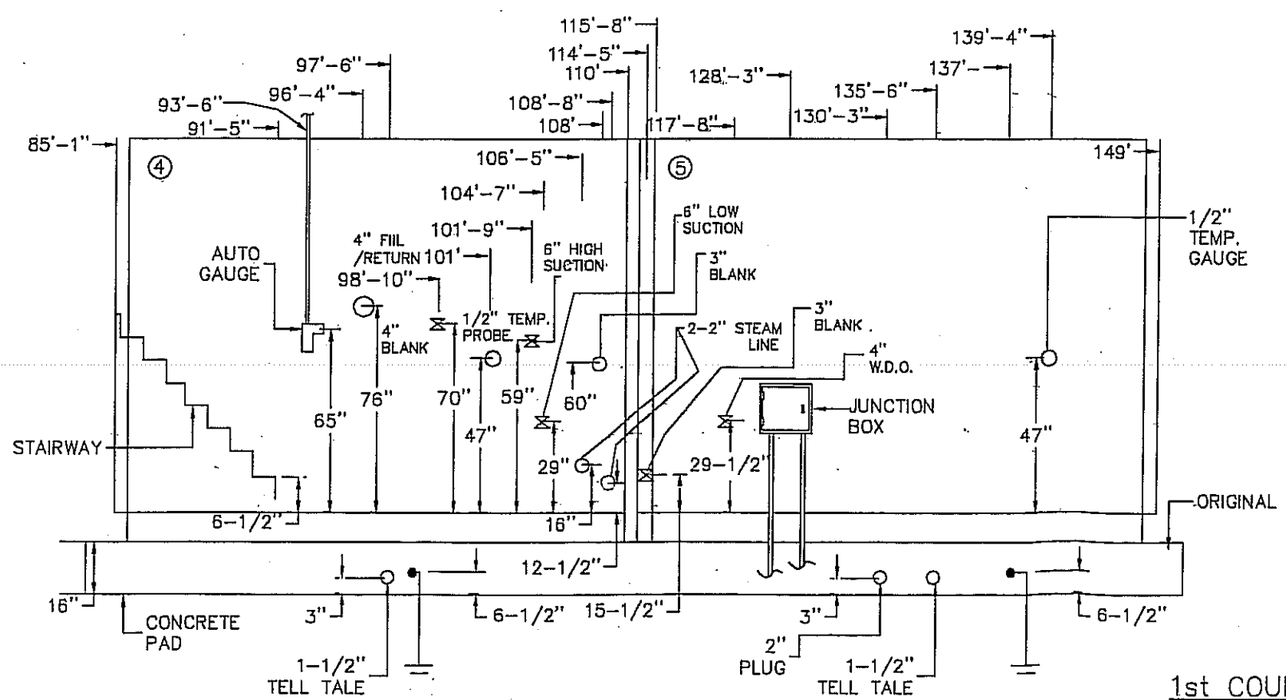
BROOKHAVEN NATIONAL LABS
FISCAL DIVISION BLBG 134B
P.O. BOX 5000
UPTON, NY

PROJECT LOCATION:
BROOKHAVEN NATIONAL LABS
BROOKHAVEN AVENUE
UPTON, NY

DRAWING TITLE:
TANK INSPECTION
TANK No. 10

CHECKED BY:	P.S.	DRAWN BY:	A.U.Z.
SCALE:	N.T.S.	DATE:	6-13-03
DRAWING No.:	BW-23089-02	REV.	0





1st COURSE SHELL PLATE CONFIGURATION

GENERAL NOTES:

TANK No. 10
48' DIA.

LEGEND

① – SHELL PLATE No.

PCA ENGINEERING, INC.
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UPTON, NY

PROJECT LOCATION:
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TANK INSPECTION
TANK No. 10

CHECKED BY:	PS	DRAWN BY:	A.U.Z.
SCALE:	N.T.S.	DATE:	6-13-03
DRAWING No.:	BW-23089-03	REV.	0

V. API 653 CHECKLIST

API 653

TANK OUT-OF-SERVICE INSPECTION CHECKLIST

OVERVIEW

OK	Check that tank has been cleaned, is gas free, and safe for entry
OK	Check that the tank is completely isolated from product lines, all electrical power, and steam lines
OK	Check that roof is adequately supported, including fixed roof structure and floating roof legs
OK	Check for presence of falling object hazards, such as corroded-through roof rafters, asphalt stalactites, and trapped hydrocarbons in unopened or plugged equipment or appurtenances, ledges, etc.
OK	Inspect for slipping hazards on the bottom and roof decks
OK	Inspect structural welds on accessways and clips
OK	Check surfaces needing inspection for a heavy-scale buildup and check weld seams and oily surfaces where welding is to be done. Note areas needing more cleaning, including blasting

Remarks: _____

TANK EXTERIOR

N/A	Inspect appurtenances opened during cleaning such as lower floating swing sheave assemblies, nozzle interiors (after removal of valves)
N/A	Hammer test or ultrasonically test the roof
N/A	Enter and inspect the floating roof pontoon compartments

Remarks: _____

BOTTOM INTERIOR SURFACE

OK	Using a flashlight held close to and parallel to the bottom plates, and using the bottom plate layout as a guide, visually inspect and hammer test the entire bottom
OK	Measure the depth of pitting and describe the pitting appearance (sharp edged, lake type, dense, scattered, etc.)
N/A	Mark areas requiring patching or further inspection
N/A	Mark locations for turning coupons for inspection
*	Inspect all welds for corrosion and leaks, particularly the shell-to-bottom weld
OK	Inspect sketch plates for corrosion
OK	Locate and mark voids under the bottom
OK	Record bottom data on a layout sketch using the existing bottom plates as a grid. List the number and sizes of patches required
*	Vacuum test the bottom lap welds

OK	Hammer test or ultrasonically examine any slightly discolored spots or damp areas
OK	Check for reinforcing pads under all bottom attached clips, brackets and supports
N/A	Inspect floating roof leg pads for pitting or cutting, and excessive dimpling (indicating excessive loading)
OK	Check the column bases of fixed roof supports for adequate pads and restraining clips
N/A	In earthquake zones 3 and 4, check that roof supports are not welded down to the tank, but are only restrained from horizontal movement
N/A	Check area beneath swing line cable for indications of cable cutting or dragging
N/A	Mark old oil and air test connection for removal and patching
OK	Identify and report low areas on the bottom that do not drain adequately
OK	Inspect coating for holes, disbonding, deterioration, and discoloration

Remarks: *tank floor is coated

SHELL SEAMS AND PLATES

OK	On cone up bottoms, closely inspect and gauge the depth of metal loss on the lower 2 to 4 inches of the shell (area of standing water)
OK	Measure the depth of pitting on each course
N/A	Inspect and estimate the amount of metal loss on the heads of rivets and bolts
N/A	Inspect shell-to-bottom riveted lap joints
N/A	Inspect for vertical grooving damage from seal assembly protrusions
OK	Inspect existing protective coatings for damage, deterioration, and disbonding
N/A	Check for areas of rubbing (indicating too much pressure by the seal assembly shoes or inadequate annular space)
*	Visually inspect the shell plates and seams for indications of leakage
N/A	If the shell has riveted or bolted seams, record the leak locations by film or chart in case the locations are lost during surface preparation for painting
N/A	Measure annular space at 40-foot intervals
OK	Survey the shell to check for roundness and plumb

Remarks: *the tank has an insulating jacket

SHELL-MOUNTED OVERFLOWS

N/A	Inspect overflow for corrosion and adequate screening
N/A	Check location of overflow that it is not above any tank valves or equipment

Remarks:

ROOF INTERIOR SURFACE

General

OK	Visually inspect the underside surface of the roof plates for holes, scale buildup, and pitting
N/A	Hammer test or ultrasonically examine to check for thin areas, particularly in the vapor space of floating roofs and at edge of roof on cone roof tank
N/A	Check all clips, brackets, braces, etc., welded to the roof deck plate for welded reinforcing pads and see that they have not broken free
N/A	If no pad is present, penetrant test for cracking of the weld or deck plate.
N/A	Inspect the protective coating for breaks, disbondment, and deterioration

Remarks:

Fixed Roof Support Structure

OK	Inspect the support columns for thinning in the upper two feet
OK	On API columns (two channels welded together) check for corrosion scale breaking the tack welds, unless the joint between the channels is completely seal welded
OK	Check that the reinforcing pad on the bottom is seal welded to the tank bottom with horizontal movement restraining clips welded to the pad
OK	Determine if pipe column supports are concrete filled or open pipe. If open pipe, check for a drain opening in the bottom of the pipe
OK	Inspect and gauge rafters for thinning, particularly near the center of the roof. Report metal loss
OK	Check for loose or twisted rafters
OK	Inspect girders for thinning and check that they are attached securely to the top of the columns
N/A	Report if the columns have cross bracing in the area between the low pump out and top of the shell (for future internal floating roof installation)
N/A	Inspect and report presence of any roof-mounted swing line bumpers
OK	Photograph the roof structure if no rafter layout drawing exists

Remarks:

FIXED ROOF APPURTENANCES

Inspection and Light Hatches

OK	Inspect the hatches for corrosion, paint and coating failures, holes, and cover sealing
OK	On loose covers, check for a safety chain in good condition
N/A	On light hatches over 30 inches across, check for safety rods
OK	Inspect the condition of the gaskets on bolted or latched down hatch covers

Remarks:

Staging Support Connection

*	Inspect the condition of the staging support for corrosion

Remarks: *minor corrosion

Breathers and Vents

OK	Inspect and service the breather
OK	Inspect screens on vents and breathers

Remarks:

Emergency P/V Hatches

OK	Inspect and service pressure/vacuum hatches (setting should be high enough to prevent chattering of breather during normal operation. See breather manufacturer's guide
N/A	Inspect liquid seal hatches for corrosion and proper liquid level in the sea

Remarks:

Sample Hatch

OK	Inspect sample hatch for corrosion
OK	Check that the cover operates properly
OK	If the tank has no gaugewell, check for a hold off distance marker and check measurement

Remarks: _____

FLOATING ROOF

Roof Deck

N/A Hammer test the area between roof rim and shell. (If access for hammer testing is inadequate, measure the distance from the bottom edge of the roof to the corroded area and then hammer test from inside the pontoon)

N/A In sour water service, clean and test all deck plate weld seams for cracking unless the lower laps have been seal welded

N/A Check that either the roof drain is open or the drain plug in the roof is open in case of unexpected rain

N/A On flat bottomed and cone down bottom roof decks, check for a vapor dam around the periphery of the roof. The dam should be continuous without break to prevent escape of vapors to the seal area from under the center of the roof

Remarks: _____

Floating Roof Pontoons

N/A Visually inspect each pontoon for liquid leakage

N/A Run a light wire through the gooseneck vents on locked down inspection hatch covers to make sure they are open

N/A Inspect lockdown latches on each cover

N/A Check and report if each pontoon is:

- _____ Vapor tight (bulkhead seal welded on one side on bottom, sides and top
- _____ Liquid tight (seal welded on bottom and sides only) or
- _____ Unacceptable (minimum acceptable condition is liquid tight)

Remarks: _____

Floating Roof Cutouts

N/A Inspect underside of cutouts for mechanical damage

N/A Inspect welds for cracks

N/A Inspect plate for thinning, pitting, and erosion

N/A Measure mixer cutouts and record plate thickness for future mixer installation or replacement
Plate thickness: _____

Remarks: _____

Floating Roof Supports

N/A	Inspect fixed low and removable high floating roof legs for thinning
N/A	Inspect for notching at bottom of legs for drainage
N/A	Inspect for leg buckling or bellying at bottom
N/A	Inspect pin hole in roof guide for tears
N/A	Check plumb of all legs
N/A	Inspect for adequate reinforcing gussets on all legs through a single portion of the roof
N/A	Inspect the area around the roof legs for cracking if there is no internal reinforcing pad or if the topside pad is not welded to the deck plate on the underside
N/A	Inspect the sealing system on the two-position legs and the vapor plugs in the fixed low leg for deterioration of the gaskets
N/A	On the shell mounted roof supports, check for adequate clearance based on the maximum floating roof movement as determined by the position of the roof relative to the gaugewell and/or counter rotational device

Remarks: _____

FLOATING ROOF SEAL ASSEMBLIES

Primary Shoe Assembly

N/A	Remove four sections of foam log (foam filled seals) for inspection, on 90° locations
N/A	Inspect hanger attachment to roof rim for thinning, bending, broken welds, and wear of pin holes
N/A	Inspect clips welded to roof rim for thinning
N/A	Shoes: Inspect for thinning and holes in shoes
N/A	Inspect for bimetal bolts, clips, and attachments
N/A	Seal fabric: Inspect for deterioration, stiffening, holes, and tears in fabric
N/A	Measure length of fabric from top of shore to roof rim, and check against maximum anticipated annular space as roof operated
N/A	Inspect any modification of shoes over shell nozzles, mixers, etc., for clearance
N/A	Inspect shoes for damage caused by striking shell nozzles, mixers, etc.

Remarks: _____

Primary Toroidal Assembly

N/A	Inspect seal fabric for wear, deterioration, holes, and tears
N/A	Inspect hold down system for buckling or bending
N/A	Inspect foam for liquid absorption and deterioration

Remarks: _____

Rim Mounted Secondaries

N/A	Inspect the rim-mounted bolting bar for corrosion and broken welds
N/A	Measure and chart seal-to-shell gaps
N/A	Visually inspect seal from below, looking for holes as evident by light
N/A	Inspect fabric for deterioration and stiffness
N/A	Inspect for mechanical damage, corrosion, and wear on tip in contact with shell
N/A	Inspect for contact with obstructions above top of shell

Remarks: _____

FLOATING ROOF APPURTENANCES

Roof Manways

N/A	Inspect walls of manways for pitting and thinning
N/A	On tanks with interface autogauges, check seal around gauge tape cable and guide wires through manway cover
N/A	Inspect cover gasket and bolts

Remarks: _____

Rim Vent

N/A	Check rim vent for pitting and holes
N/A	Check vent for condition of screen
N/A	On floating roof tanks where the environmental rules require closing off the vent, check the vent piping for corrosion at the pipe-to-rim joint and check that the blinding is adequate

Remarks: _____

Vacuum Breaker, Breather Type

N/A	Service and check operation of breather valve
N/A	Check that nozzle pipe projects no more than 1/2 inch below roof deck
N/A	Inspect reinforcing pad and pad weld

Remarks: _____

Vacuum Breaker, Mechanical Type

N/A	Inspect the stem for thinning. Measure how far the vacuum breaker cover is raised off the pipe when the roof is resting on high or low legs On high legs: _____ On low legs: _____

Remarks:

Roof Drains: Open Systems, Including Emergency Drains

N/A	Check liquid level inside open roof drains for adequate freeboard. Report if there is insufficient distance between liquid level and top of drain
N/A	If tank comes under Air Quality Monitoring District rules, inspect the roof drain vapor plug
N/A	If emergency drain is not at the center of the roof, check that there are at least three emergency drains

Remarks:

Closed Drain Systems: Drain Basins

N/A	Inspect for thinning and pitting
N/A	Inspect protective coating (topside)
N/A	Inspect basin cover or screen for corrosion
N/A	Test operation of check valve
N/A	Check for presence of check valve where bottom of basin is below product level
N/A	Inspect drain basin(s) to roof deck welds for cracking
N/A	Check drain basin(s) outlet pipe for adequate reinforcement to roof deck (including reinforcing pad)

Remarks:

Closed Drain Systems: Fixed Drain Line on Tank Bottom

N/A	Hammer test fixed drain line on tank bottom for thinning and scale/ debris plugging
N/A	Inspect supports and reinforcing pads for weld failures and corrosion
N/A	Check that pipe is guided, not rigidly locked to supports, to avoid tearing of tank bottom plate

Remarks:

Closed Drain Systems: Flexible Pipe Drain

N/A	Inspect for damage to exterior of pipe
N/A	Check for obstructions that pipe could catch on
N/A	Inspect shields to protect pipe from snagging
N/A	Inspect results of hydrotest on flexible roof drain system

Remarks:

Closed Drain Systems: Articulated Joint Drain

N/A	Hammer test rigid pipe in flexible joint system for thinning and scale debris plugging
N/A	Inspect system for signs of bending or strain
N/A	Inspect results of system hydrotest
N/A	Inspect landing leg and pad

Remarks:

Autogauge System and Alarms

OK	Check freedom of movement of tape through autogauge tape guide
OK	Inspect sheaves for freedom of movement
*	Test operation checker
OK	Inspect tape and tape cable for twisting and fraying
OK	Test the tape's freedom of movement through guide sheaves and tape guide pipe
N/A	On open-top tanks, check that gate tapes with cables have no more than one foot of tape exposed with float at lowest point
OK	Check float for leakage
OK	Test float guide wire anchors for spring action by pulling on wire and releasing
N/A	Inspect floatwells in floating roofs for thinning and pitting of walls just above the liquid level
OK	Check that the autogauge tape is firmly attached to the float
N/A	Inspect the tape cable and float guide wire fabric seals through the floatwell cover
OK	Inspect the bottom guide wire attachment clip; inspect for a temporary weighted bar instead of a permanent welded down clip
OK	Inspect board-type autogauges indicators for legibility and freedom of movement of indicator
N/A	Measure and record these distances to determine if seal damage will occur if tape is run over:
	_____ From shell top angle to underside of tape guide system
	_____ From liquid level on floating top to top of secondary seal
N/A	Identify floating roofs where the tape is connected directly to the roof
OK	Overfill alarm: Inspect tank overfill prevention alarm switches for proper operation

Remarks: *the auto gauge is not accurate; however, it has been supplemented by a board type gauge.

COMMON TANK APPURTENANCES

Gauge Well

N/A	Inspect gauge well pipe for thinning at about two-thirds distance above the bottom: look for thinning at the edge of the slots
N/A	Check for corrosion on the pipe joint. Check that sample cords, weights, thermometers, etc., have been removed from pipe
N/A	Check for cone at bottom end of pipe about one foot above the bottom

N/A	Check condition of well washer pipe and that its flared end is directed at the near side of the hold-off pad
N/A	Check that the supports for the gaugewell are welded to pad or to shell and not directly to bottom plate
N/A	Check operation of gaugewell cover
N/A	Check presence of a hold-off distance marker in well pipe and record hold-off distance
	Hold-Off Distance
N/A	Identify and report size and pipe schedule, and whether pipe is solid or slotted. Report slot size
N/A	Check that the hold-off distance plate is seal welded to the bottom and that any gaugewell supports are welded to the plate and not directly to the bottom
N/A	Inspect vapor control float and cable
N/A	Check for presence and condition of gaugewell washer
N/A	Check for bull plug or plate blind on gaugewell washer valve
N/A	Inspect gaugewell guide in floating roof for pitting and thinning
N/A	Inspect the guide rollers and sliding plates for freedom of movement
N/A	Inspect condition of gaugewell pipe seal system
N/A	On black oil and diesel services: if gaugewell is also used for sampling, check for presence of a thief- and gauge-type hatch to avoid spillage
N/A	Visually inspect inside of pipe for pipe weld protrusions which could catch or damage vapor control float

Remarks: _____

Sampling Systems: Roof Sample Hatches

OK	Inspect roof mounted sample hatches for reinforcing pads and cracking
OK	Inspect cover for operation
N/A	For tanks complying with Air Quality Monitoring District rules, inspect sample hatch covers for adequate sealing
N/A	Check horizontal alignment of internal floating roof sample hatches under fixed roof hatches
N/A	Inspect the sealing system on the internal floating roof sample hatch cover
N/A	Inspect floating roof sample hatch cover recoil reel and rope

Remarks: _____

Shell Nozzles

OK	Inspect shell nozzles for thinning and pitting
OK	Inspect hot tap nozzles for trimming of holes
OK	Identify type of shell nozzles
OK	Identify and describe internal piping, including elbow up and elbow down types

Remarks: _____

For Nozzles Extended into the Tank

OK	Inspect pipe support pads welded to tank bottom
OK	Inspect to see that pipe is free to move along support without strain or tearing action on bottom plate
OK	Inspect nozzle valves for packing leaks and damaged flange faces
OK	Inspect heater steam nozzle flanges and valves for wire cutting
OK	Report which nozzles have thermal pressure relief bosses and valves
N/A	In internal elbow-down fill line nozzles, inspect the wear plate on the tank bottom
N/A	On elbow-up fill lines in floating roof tanks, check that opening is directed against underside of roof, not against vapor space. Inspect impact area for erosion

Remarks: _____

_____

Diffusers and Air Rolling Systems

N/A	Inspect diffuser pipe for erosion and thinning
N/A	Check holes in diffuser for excessive wear and enlargement
N/A	Inspect diffuser supports for damage and corrosion
N/A	Check that diffuser supports restrain, not anchor, longitudinal line movement
N/A	Inspect air spiders on bottom of lube oil tanks for plugging and damaged or broken threaded joints

Remarks: _____

_____

Swing Lines

N/A	Inspect flexible joint for cracks and leaks
N/A	Scribe the flexible joint across the two moving faces and rise end of swingline to check the joint's freedom of movement, indicated by separation of scribe marks
N/A	Check that flexible joints over six inches are supported
N/A	Inspect the swing pipe for deep pitting and weld corrosion
N/A	Loosen the vent plugs in the pontoons and listen for a vacuum. Lack of a vacuum indicates a leaking pontoon
N/A	Check the results of air test on pontoons during repairs
N/A	Inspect the pontoons for pitting
N/A	Inspect the pull-down cable connections to the swing
N/A	Inspect the condition of the bottom-mounted support, fixed roof limiting bumper, or shell mounted limiting bumper of wood condition, weld and bolt corrosion, and seal welding to bottom or shell
N/A	Inspect safety hold-down chain for corrosion and weak links
N/A	Check that there is a welded reinforcing pad where the chain connects to the bottom
N/A	If the floating swing in a floating or internal floating roof does not have a limiting device preventing the swing from exceeding 60 degrees, measure and calculate the maximum angle possible with the roof on overflow

_____ Maximum angle on overflow

(If the calculated angle exceeds 65 degrees, recommend installation of a limiting bracket)

N/A Inspect pull down cable for fraying

N/A Inspect for three cable clamps where cable attaches to end of swingline (single-reeved) or to roof assembly (double-reeved). Inspect sheaves for freedom of movement

N/A Inspect winch operation and check the height indicator for legibility and accuracy

N/A Inspect bottom-mounted sheave assembly at end of pontoon for freedom of rotation of sheave

N/A Inspect shell mounted lower sheave assembly for freedom of rotation of sheave, corrosion thinning, and pitting of sheave housing

N/A Inspect upper sheave assembly for freedom of movement of sheave

N/A Inspect the cable counterbalance assembly for corrosion and freedom of operation

Remarks: _____

Manway Heater Racks

N/A Inspect the manway heater racks for broken welds and bending of the sliding rails

N/A Measure and record the length of the heater and length of the track

Remarks: _____

Mixer Wear Plates and Deflector Stands

N/A Inspect bottom and shell plates and deflector stands

N/A Inspect for erosion and corrosion on the wear plates. Inspect for rigidity, structural soundness, corrosion, and erosion of deck plates and reinforcing pads that are seal welded to the bottom under the deflector stand legs

N/A Measure for propeller clearance between the bottom of deflector stand and roof when the roof is on low legs

Remarks: _____

ACCESS STRUCTURES

Handrails

* Identify and report type (steel pipe, galvanized pipe, square tube, angle) and size of handrails

OK Inspect for pitting and holes, pain failure

OK Inspect attachment welds

OK Identify cold joints and sharp edges. Inspect the handrails and midrails

OK Inspect safety drop bar (or safety chain) for corrosion, functioning and length

N/A Inspect the handrail between the rolling ladder and the gauging platform for a hazardous opening when the floating roof is at its lowest level

Remarks: *2½" steel angle

Platform Frame

OK Inspect frame for corrosion and paint failure
* Inspect the attachment of frame to supports and supports to tank; for corrosion and weld failure
OK Check reinforcing pads where supports are attached to shell or roof
OK Inspect the surface that deck plate or grating rests on, for thinning and holes
OK Check that flat-surface to flat-surface junctures are seal welded

Remarks: *minor paint failure

Deck Plate and Grating

OK Inspect deck plate for corrosion-caused thinning or holes (not drain holes) and paint failure
OK Inspect plate-to-frame weld for rust scale buildup
OK Inspect grating for corrosion-caused thinning of bars and failure of welds
OK Check grating tie-down clips. Where grating has been retrofitted to replace plate, measure the rise of the step below and above the grating surface and compare with other risers on the stairway

Remarks:

Stairway Stringers

OK Inspect spiral stairway stringers for corrosion, paint failure, and weld failure. Inspect attachment of stairway treads to stringer
OK Inspect stairway supports to shell welds and reinforcing pads
N/A Inspect steel support attachment to concrete base for corrosion

Remarks:

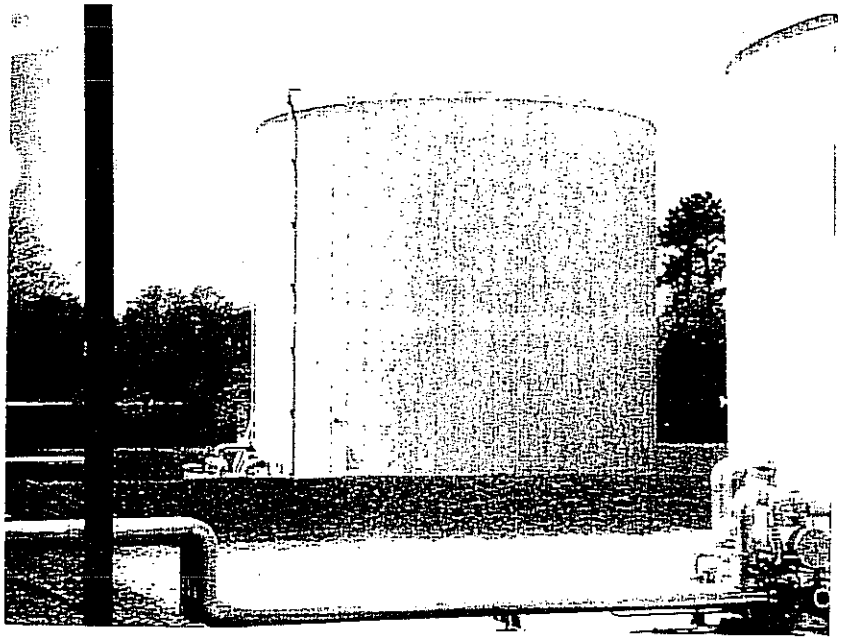
Rolling Ladder

N/A Inspect rolling ladder stringers for corrosion
N/A Identify and inspect ladder fixed rungs (square bar, round bar, angles) for weld attachment to stringers and corrosion, particularly where angle rungs are welded to stringers
N/A Check for wear and corrosion where rolling ladder attaches to gauging platform
N/A Inspect pivot bar for wear and secureness

N/A	Inspect operation of self-leveling stairway treads
N/A	Inspect for corrosion and wear on moving parts
N/A	Inspect rolling ladder wheels for freedom of movement, flat spots, and wear on axle
N/A	Inspect alignment of rolling ladder with roof rack
N/A	Inspect top surface of rolling ladder track for wear by wheels to assure at least 18 inches of unworn track (track long enough)
N/A	Inspect rolling ladder track welds for corrosion
N/A	Inspect track supports on roof for reinforcing pads seal welded to deck plate
N/A	Check, by dimensioning, the maximum angle of the rolling ladder when the roof is on low legs Maximum angle: _____
N/A	If rolling ladder track extends to within five feet of the edge of the roof on the far side, check for a handrail on the top of the shell on that side

Remarks: _____

VI. PHOTOGRAPHS



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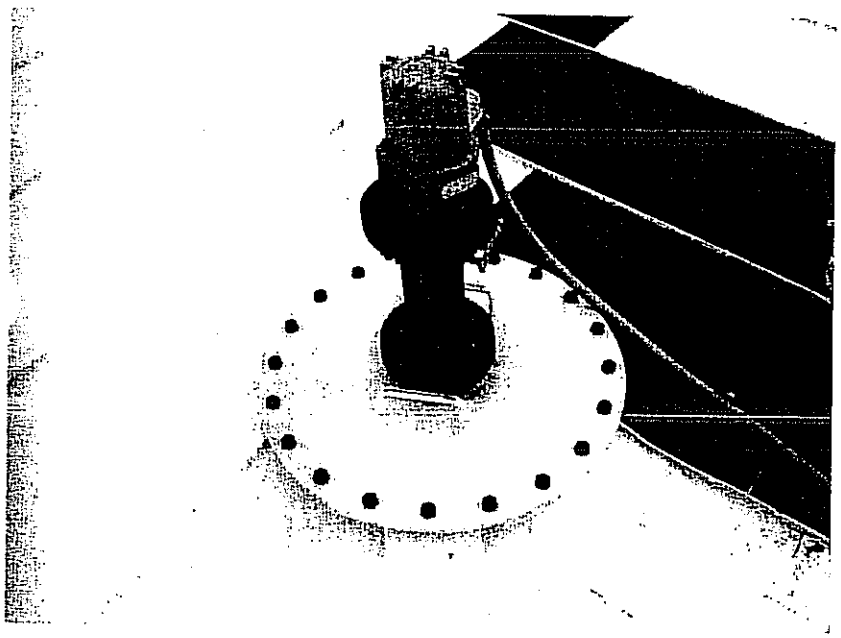
5/15/03
Tank No. 10 - overview



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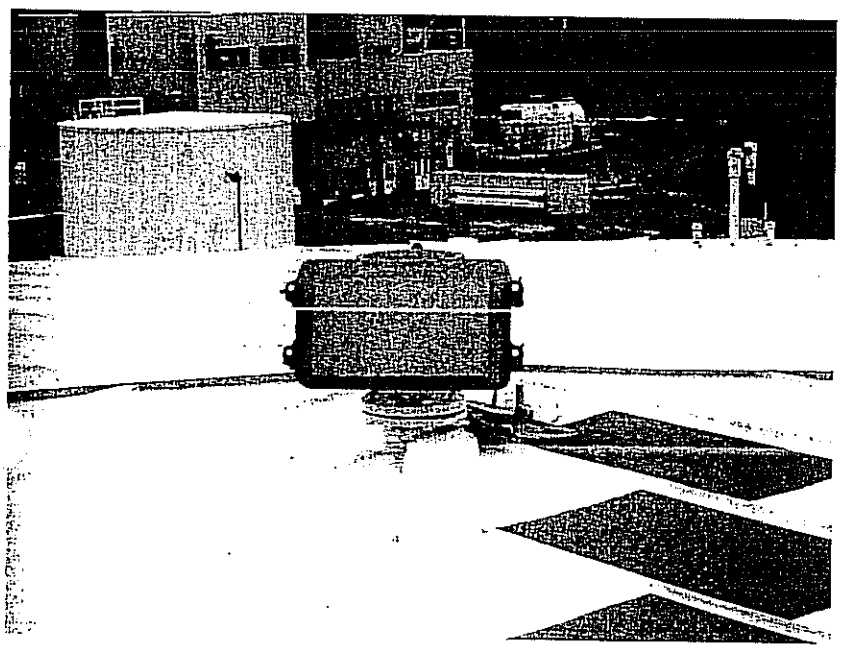
High level / overfill alarm



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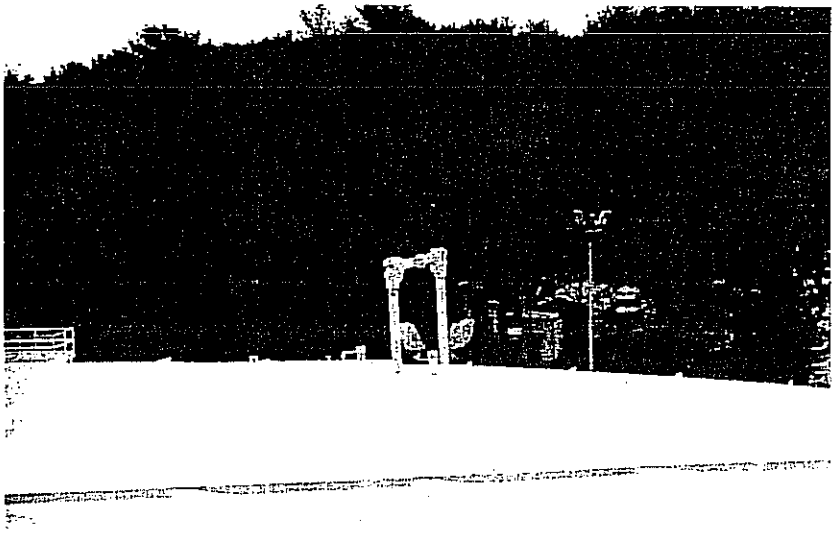
Flame arrestor



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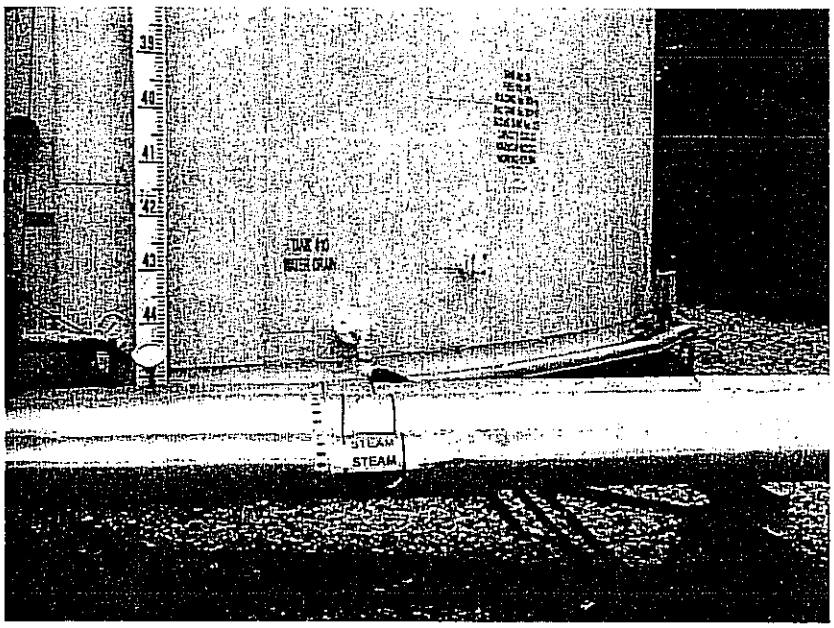
Gauge



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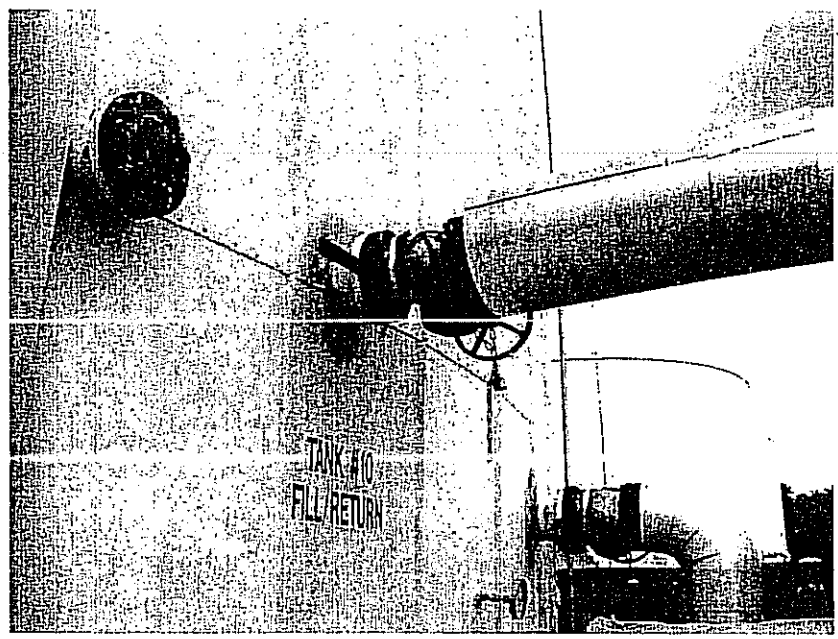
Water draw-off



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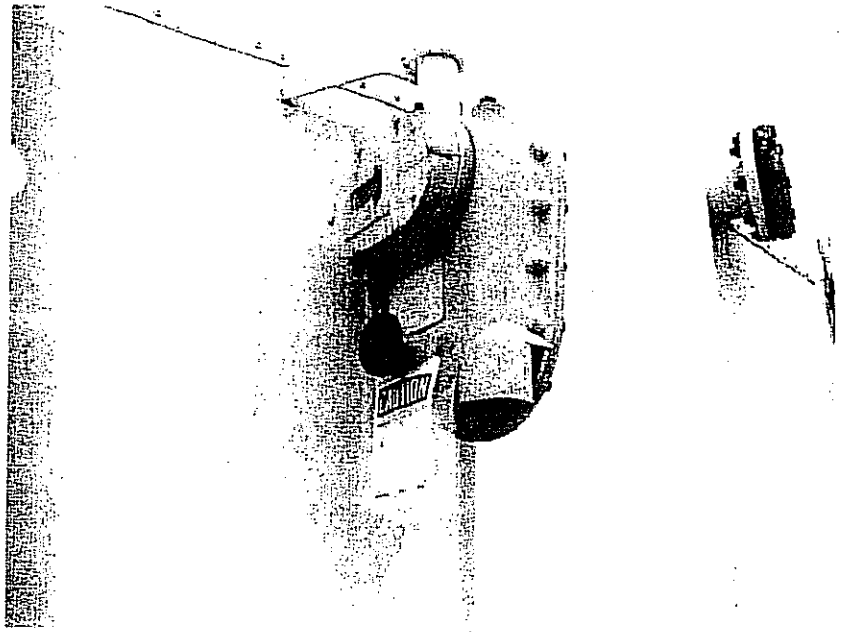
Fill / return line



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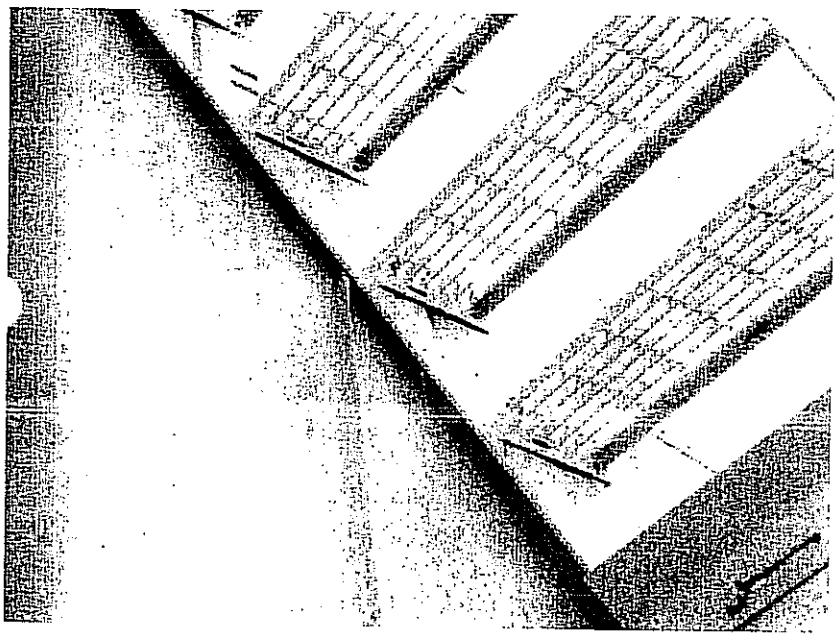
Auto gauge



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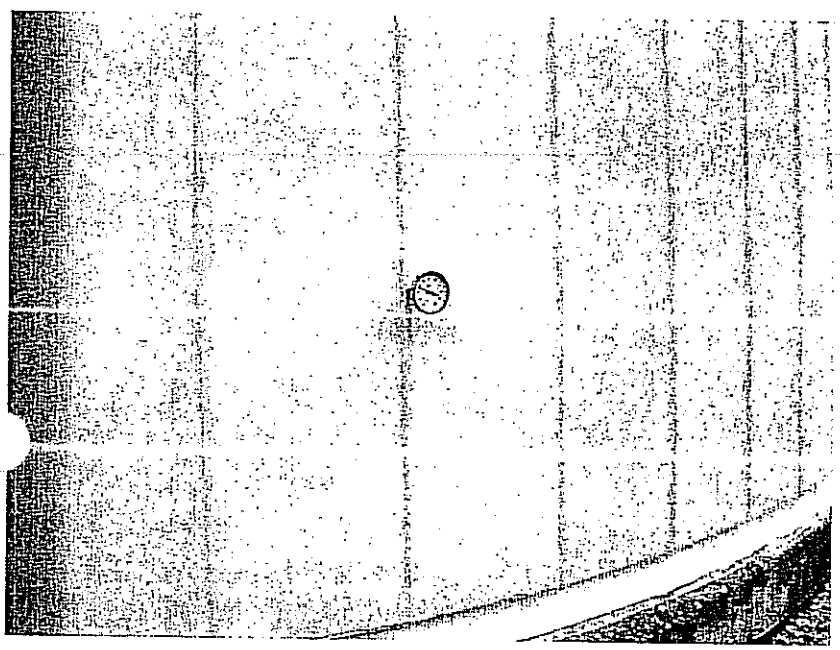
Stairway



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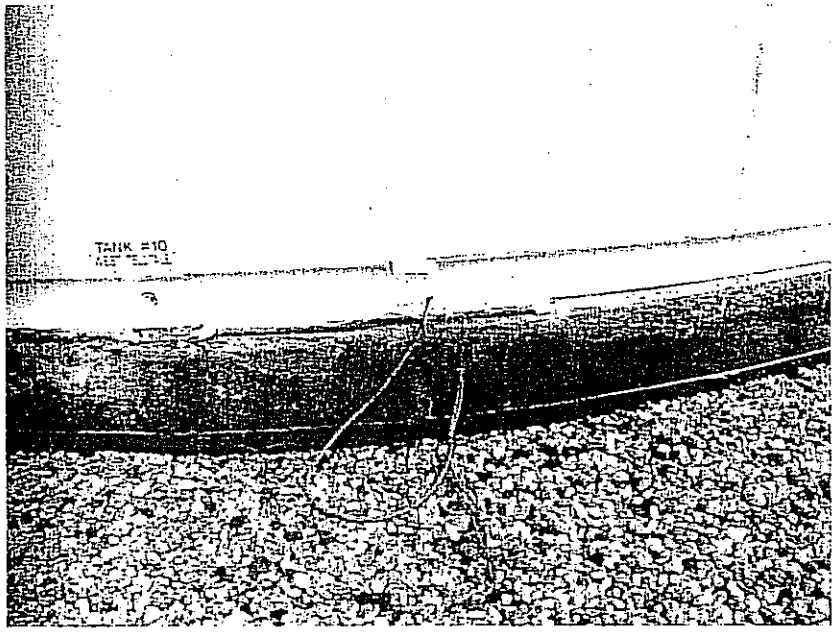
Temperature probe



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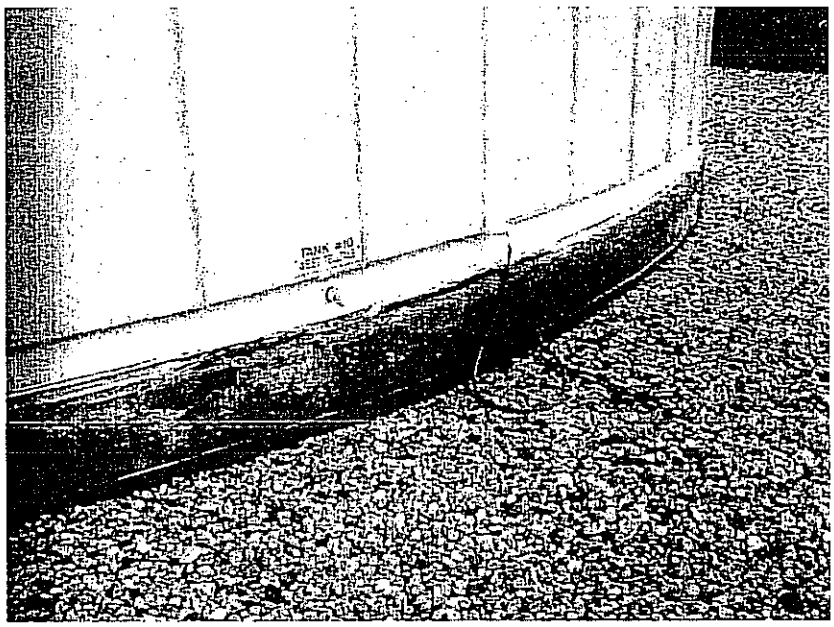
Ground lug



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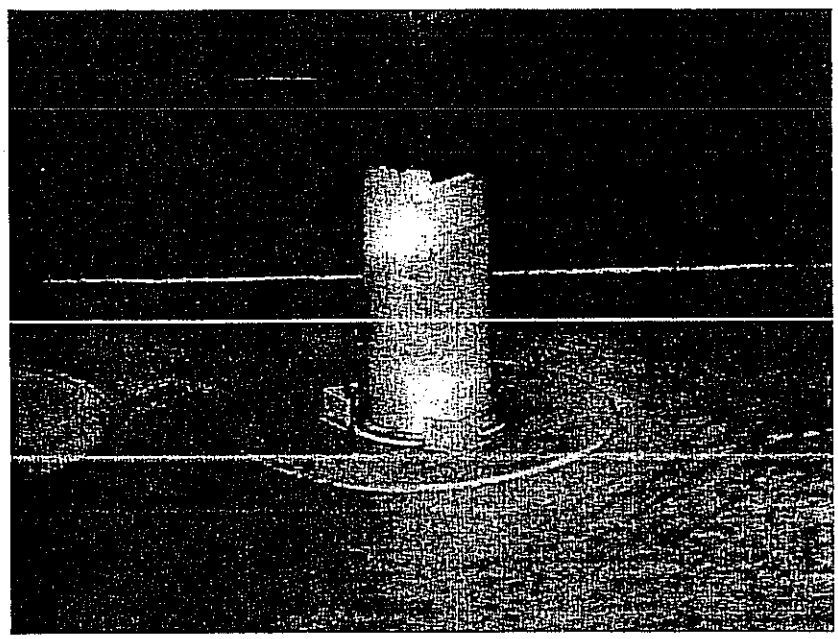
Tell tale



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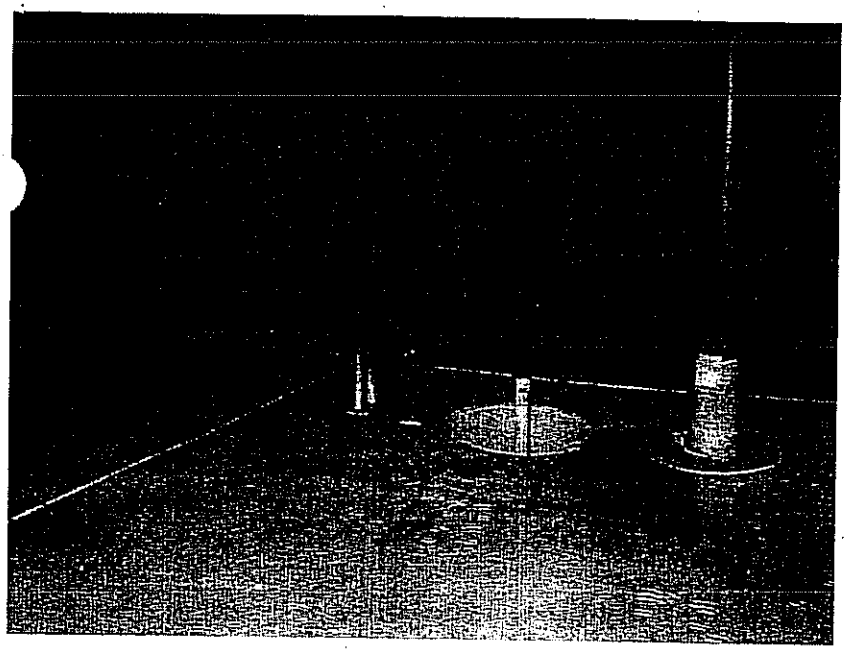
Center column



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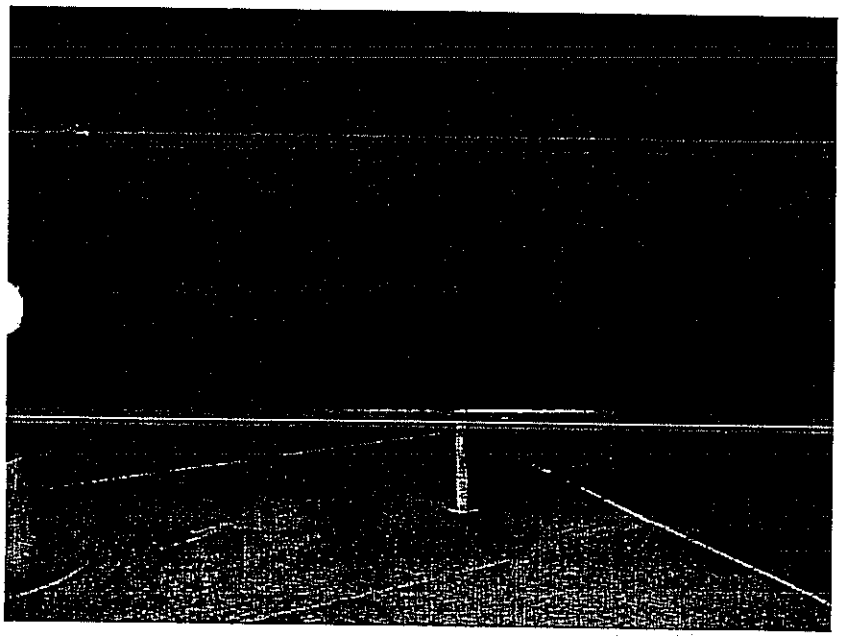
6/2/03
Water draw-off



P6020012.JPG
6/2/03
Heating coil

VII. RECOMMENDATIONS

As a result of the findings disclosed in the inspection of Tank No. 10, PCA Engineering, Inc. makes the following recommendations:

- Address and monitor minor corrosion activity along the spiral stair and other appurtenances.
- Monitor tank return-to-service filling on an hourly basis until full working head is attained and allow for a 24-hour static period.

The maximum interval until the next internal inspection would be 7 years based on the attached calculation, Suffolk County/New York Department of Environmental Conservation Regulations, the available data, and assumes completion of above repairs, operation under the same service and operating conditions. This does not preclude regular in-service inspection by terminal personnel and qualified inspector, and it is not a guarantee of future performance.

All repairs should be completed per API 650, 653 and other applicable Standards. An inspection of all repairs should be performed prior to return to service.

VII. RECOMMENDATIONS (Cont'd)

Based on the extent of the inspections performed on Tank No. 10, the test results indicate no substantial corrosion or defects above and beyond that noted, as of the test date of June 2, 2003. This is not to be construed as an expressed or implied warranty of future performance.

Brookhaven National Laboratory
Tank No. 10
June 2, 2003
PCA Job No. 23089

Peter Seastrand

PETER SEASTRAND
PCA ENGINEERING, INC.

WILLIAM M. KENT
PCA ENGINEERING, INC.
API Certification No. 297

STATE OF NEW YORK
DANIEL R. KOGUT
069049
LICENSED PROFESSIONAL ENGINEER

DANIEL KOGUT
PCA ENGINEERING, INC.
NY P.E. No. 069049

PS:lms

Notwithstanding anything contained in this report, nothing herein shall be construed as a representation, warranty or guarantee, either expressed or implied, regarding the future structural integrity or future life expectancy of any of the items tested. This report and any analysis provided is in all respects subject to and shall be interpreted within the limitations and parameters of the test procedures performed. In the event testing is performed using a sampling procedure, this report and any analysis shall be limited to those areas actually tested and the type of test conducted, and the customer is cautioned not to extrapolate the results of the test samples.

APPENDIX 11

BROOKHAVEN
NATIONAL LABORATORY

Major Petroleum Facility License No. 01-1700

Evaluation of Existing Secondary Containment Systems

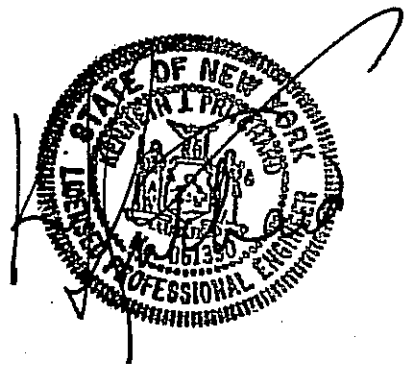
JULY 2006

BROOKHAVEN NATIONAL LABORATORY
BROOKHAVEN SCIENCE ASSOCIATES, LLC.
UPTON, NEW YORK

DVIRKA AND BARTILUCCI
CONSULTING ENGINEERS
A DIVISION OF WILLIAM F. COSULICH ASSOCIATES, P.C.

BROOKHAVEN NATIONAL LABORATORY
MAJOR PETROLEUM FACILITY
LICENSE NO. 01-1700

EVALUATION OF EXISTING SECONDARY CONTAINMENT SYSTEMS



PREPARED BY

DVIRKA AND BARTILUCCI
CONSULTING ENGINEERS

JULY 2006

EVALUATION OF EXISTING SECONDARY CONTAINMENT SYSTEMS BROOKHAVEN NATIONAL LABORATORY MAJOR PETROLEUM FACILITY

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INTRODUCTION

Brookhaven National Laboratory (BNL) is a multi-discipline research facility located on a 5,200-acre parcel in the Town of Brookhaven, Suffolk County, New York. The facility is owned by the U.S. Government, is administered by the Department of Energy (DOE) and is operated through a long-term contract with Brookhaven Science Associates. The facility is used to conduct research in many areas including, but not limited to, the Biological Sciences, Particle Physics, Medical Research and Material Sciences.

The facility includes a Central Steam Facility, which produces steam for heating and process applications. The Central Steam Facility (Building 610) is located at the eastern end of Temple Place between North Sixth Street and Seventh Street. The Central Steam Facility has a combined capacity of 475,000 pounds of steam per hour, with an average load of about 100,000 pounds of steam per hour.

Fuel oil for the Central Steam Facility is received and stored in the immediate vicinity of the Central Steam Facility in a series of aboveground storage tanks. Presently, 6 aboveground petroleum tanks ranging in size from 300,000 to 600,000 gallons are in place. The storage tanks are located in five distinct containment basins with a total maximum capacity of approximately 2.2 million gallons. At the time of the last evaluation of the secondary containment system in June 2001, a total of 11 tanks and six basins existed. Since that time, 5 tanks and one basin used for fuel oil and various research projects have been removed from service, disposed or demolished. Information on the 6 existing tanks is summarized in Table 1. The locations of storage basin and tanks are shown on the Site Plan contained in Appendix A.

The 6 tanks are the subject of a Major Petroleum Facility License No. 01-1700 issued by the New York State Department of Environmental Conservation. The Major Petroleum Facility Permit (6NYCRR Parts 610) applies to this facility because it has in-place storage capacity in excess of 400,000 gallons. The facility is also subject to 6NYCRR Parts 612 through 614 as a Petroleum Bulk Storage Facility.

Table 1

EXISTING STORAGE TANKS

Tank Number	SCDHS Tank No.	MOSF Registered Capacity (gallons)	Maximum Capacity (gallons)	Working Capacity (gallons)	Product Stored/Status
3 (611-03)	121	300,000	300,810	285,925	No. 6 Fuel Oil/In Use
4 (611-04)	122	420,000	424,482	403,258	No. 6 Fuel Oil/In Use
5 (611-05)	123	300,000	301,174	286,327	No. 2 Fuel Oil/In Use
6 (611-06)	124	300,000	301,174	286,237	No. 2 Fuel Oil/In Use
9 (611-09)	126	400,000	398,197	379,020	No. 6 Fuel Oil/In Use
10 (611-10)	125	600,000	601,242	571,914	No. 6 Fuel Oil/In Use

Note: Tanks 11, 12, 18, 19 and 20 have been removed.

In accordance with the requirements of the Major Petroleum Facility license, the integrity of the secondary containment system must have an in-depth evaluation conducted by a licensed Professional Engineer on a frequency not to exceed every 5 years.

PURPOSE

The purpose of this report is to present the methods, results and findings of an evaluation conducted by Dvirka and Bartilucci Consulting Engineers, of the containment integrity of each of the five containment basins. This evaluation includes a physical examination of the containment system and laboratory or in-place permeability testing of the geosynthetic clay liners (GCL) and soil bentonite liners in the basins to confirm containment integrity.

The results of this evaluation will also be presented in the context of the level of protection afforded by the containment systems to the underlying groundwater system.

EXISTING CONTAINMENT SYSTEMS

The 6 aboveground storage tanks associated with and located in proximity to the Central Steam Facility are arranged in five distinct containment basins. For the purpose of this report, the basins will be identified by the predominant or major tank(s) located within the basin. The basin identification is as follows:

Basin ID	Tanks Contained Within
Basin 3	Tank 3
Basin 4	Tank 4
Basin 5/6	Tanks 5 and 6
Basin 9	Tanks 9
Basin 10	Tank 10

Since the evaluation performed in 2001, a number of changes have been performed by BNL to clarify the storage capacity of this facility. These changes are as follows:

- At the time of the 2001 evaluation, Basin 4 provided containment for Tank 4 as well as Tanks 19 and 20. Tanks 19 and 20 each had a capacity of 60,000 gallons, but had never been piped or placed in service. Tanks 19 and 20 have been completely removed and only their support piers remain in place. The tanks were lifted from their support piers by a crane positioned outside of the basin, and were disposed of. This operation avoided the need for equipment to enter the footprint of the basin, and therefore avoided damage to the existing containment system.

- At the time of the 2001 evaluation, Basin 9 provided containment for Tank 9 as well as Tanks 11 and 18. Tanks 11 and 18 each had a capacity of 60,000 gallons, but had never been piped or placed in service. Tanks 11 and 18 have been completely removed and only their support piers remain in place. As with Tanks 19 and 20, the tanks were lifted from their support piers by a crane, positioned outside of the basin, and were disposed of. This operation avoided the need for equipment to enter the footprint of the basin, and therefore avoided damage to the existing containment system.

- At the time of the 2001 evaluation, Basin 12 provided containment for Tank 12. Basin 12 has been removed in its entirety. Tank 12 was cleaned of its contents and removed for disposal. *Piping associated with Tank 12 was cleaned of its contents and removed.* Basin 12 was filled with soil and regraded to blend in with the surrounding areas.

- Piping to Tanks 5 and 6 has been revised to take advantage of the new access (straighter pipe runs) provided by the abandonment of Basin 12. The revised piping within Basin 5/6 made use of existing pipe supports and therefore did not disturb the existing hydraulic barriers. *No equipment entered the basin to perform this work.*

- The drain manhole in Basin 3 was revised by BNL forces to provide for a more efficient drain structure. It is reported that the work involved the installation of a welded stainless steel sump as an insert into the existing precast concrete structure. The connection of the sump to the existing drain piping was performed within the precast structure, so as not to require ground disturbance. The integrity of the existing GCL hydraulic barrier was supplemented by overlaying two panels of CETCO CLT (geosynthetic clay liner with a 20 mil, textured HDPE geomembrane) over the existing GCL surface. The panels were overlapped approximately 2 feet in the center area straddling the drain manhole. Each panel extends as one piece from the tank foundation, across the basin floor and up the basin side slope to an anchor trench at the top of the slope. The overlap seam between the two panels and the interface at the drain manhole were enhanced with powdered bentonite.

  The CETCO CLT material was new material taken from a roll stored on-site (indoors) that was part of the Basin 4 repairs in 2001. The CLT panels were installed with the geomembrane side up. Photographs of this installation are attached in Appendix B.

The above modifications have clarified the storage capacity of this facility by maintaining only those tanks which are actually involved in the operation of the Central Steam Facility and are actively in service. As noted in prior evaluation of the MOSF, a number of tanks of various sizes had been installed in the MOSF containment basins to serve as storage capacity for various research projects conducted or to be conducted at BNL. Many of the ancillary tanks had never been placed in service and were effectively abandoned in place after construction.

In general, each of the five basins under consideration is an earthen bowl constructed with a mildly sloping floor for drainage and earthen berms forming side slopes around the periphery of the basin. Each basin is intended to provide a minimum of 110 percent containment volume of the largest tank within the basin while accounting for the displacement volume of the other tanks and/or structures within the basin. Each basin is constructed with a manual, normally locked closed, drain valve to permit removal of accumulated precipitation from the basin. The drain system for each basin is connected to the on-site sewage collection system. The removal of precipitation from the basins follows a prescribed protocol which is detailed in the Spill Prevention Control and Countermeasure Plan (SPCC) - Oil Pollution Response Plan, latest update December 15, 2000 which is specific to all of the tanks located at the BNL Facility.

In order to provide an effective containment vessel, the surface of each basin is treated or constructed to establish a low permeability hydraulic barrier intended to minimize percolation of spilled petroleum products into the underlying soils and, ultimately, the underlying groundwater system. In the event of a spill, the hydraulic barrier must be capable of substantially containing the petroleum products for a period of time sufficient to permit detection of the spill and implementation of remedial measures for removal and proper disposition of the petroleum products. New York State Department of Environmental Conservation (NYSDEC) has developed permeability guidelines which meet the requirements of the Petroleum Bulk Storage regulations. These guidelines are contained in the NYSDEC publication – Spill Prevention Operations Technology Series No. 10 (SPOTS-10).

The methods utilized to establish the hydraulic barrier in each of the five basins can be categorized as either in-situ methods or prefabricated geosynthetic methods. One of the basins

(5/6) was constructed utilizing the in-situ method. The remaining four basins (3, 4, 9 and 10), have been constructed utilizing prefabricated geosynthetic methods.

For the in-situ method, bentonite or sodium montmorillonite is incorporated into the prepared soil surface in order for the bentonite to occupy the voids of the soil. Bentonite is a naturally occurring, high swelling clay which has the capacity to free swell to approximately 16 times its dry volume when hydrated with water in an unconfined condition. When properly dispersed within a base soil, the fine bentonite particles will occupy the natural voids of the soil. In the presence of water, the bentonite will hydrate and swell to more completely occupy the voids of the soil. This reduction of the void volume of the amended base soil results in a reduction of the permeability of the soil. The change in permeability of the base soil can approach several orders of magnitude and render an otherwise permeable soil into an effective hydraulic barrier.

In the case of Basins 5/6, the bentonite was incorporated into the base soil by the rototilling method. The area of the basin would have been segmented into a grid pattern with each unit of the grid having a uniform area. A pre-established quantity of bentonite would be uniformly spread out over each grid unit and then mixed or incorporated into the soil using a rototiller to create an amended soil lift. The mixed soil would then be graded and compacted to establish a prepared lift of low permeability soil. A layer of protective soil or stone would be placed over the amended soil layer to provide a walking surface, protect the amended soil from erosion and the elements, and provide a nominal degree of confining pressure. The thickness of the soil-bentonite layer in Basins 5/6 is reported to be 9 inches thick as indicated in the Summary Report - Secondary Containment System prepared by ERM-Northeast, March 1987.

In the case of Basins 3, 4, 9 and 10, bentonite was applied to the surface of the basins in the form of a prefabricated geosynthetic clay liner (GCL). The GCL is comprised of two boundary or cover layers which sandwich a uniform layer of bentonite. The GCL is furnished as a "carpet" of material and is packaged on a roll to facilitate installation. The GCL that was installed was Enviromat, manufactured by the James Clem Corp. Basin 3 was lined with a version of Enviromat fabricated with a 4-ounce per square yard woven polypropylene geotextile

as the top cover, a paper scrim as the bottom cover and a water soluble adhesive mixed with the bentonite to bind the bentonite to the covers. The composite material had sufficient stiffness to permit handling and installation. Over time, the water soluble adhesive would break down, in the presence of water or precipitation, leaving a uniform layer of bentonite in place.

Basins 4, 9 and 10 were lined with a later version of Enviromat which was similar to that used in Basin 3 in all regards except that the bottom cover (paper scrim) was replaced by a 1-ounce per square yard spunlace, open weave polyester textile. In both versions, the sodium bentonite was distributed at a rate of approximately 1.0 pound per square foot. Each version had a fabricated thickness of 0.25 inch prior to hydration. Installation of each version of Enviromat required that a smooth, graded and compacted subgrade surface be prepared which was free of protrusions and rocks larger than 2 inches. Seams were prepared by overlapping adjacent panels by at least 6 inches. Penetrations of the GCL (e.g., tank foundations, pipe supports) would be sealed by bringing the GCL in close contact with the penetrating object by creating a boot, butt joint or toed in condition with the GCL and supplementing the contact with loose bentonite. When hydrated with water in the presence of confining pressure, the bentonite would swell to form a continuous, low permeability layer of bentonite. Product literature for Claymax (Enviromat experienced a name change to Claymax) states that the permeability of the product to water is 2×10^{-10} cm/sec. More typical representations of the impermeability of GCL materials suggest the permeability to water is on the order of 5×10^{-9} cm/sec. A copy of the product literature for Claymax is enclosed as Appendix C.

A protective layer of stone or gravel would be placed over the installed GCL to provide a confining overburden pressure, a walking surface and to protect the GCLs from exposure to the elements or incidental damage. GCL products have routinely been utilized in lieu of other low permeability soil methods for containment purposes.

In response to the 2001 evaluation of the MOSF containment basins, remedial repairs were performed in Basin 4 and minor repairs were performed in Basins 3, 5/6, 9 and 10. The remedial repairs in Basin 4 required the removal and replacement of a portion of the GCL which had been damaged. The minor repairs in the remaining basins involved improvements to select

penetrations of the GCL. All of the repairs were performed by BNL personnel with oversight by D&B personnel.

The repair program was documented in a report titled:

Brookhaven National Laboratory
Major Petroleum Facility
License No. 01-1700
Certification Report
Remedial Repairs to Secondary Containment Systems
February 2002
Dvirka and Bartilucci Consulting Engineers

The certification report is on file with the NYSDEC.

Given the replacement of a portion of the GCL in Basin 4, the hydraulic barrier now consists of a combination of GCL materials, namely, the original Claymax product in areas not requiring repair and a CETCO CLT product in areas which were remediated in 2001. A copy of the product literature for CETCO CLT is enclosed as Appendix C.

METHODS OF EVALUATION

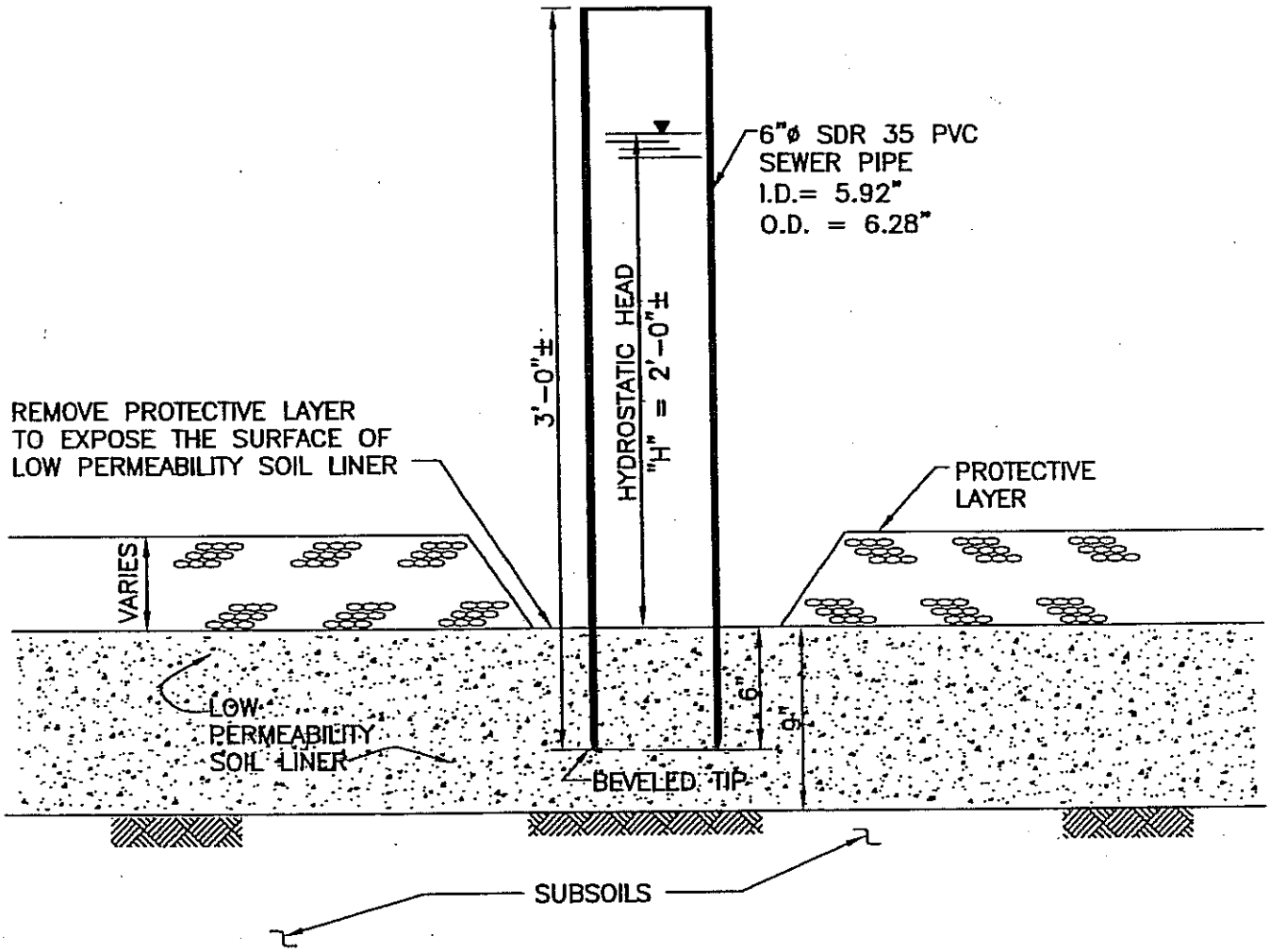
In order to establish the integrity of the five existing containment systems, three in-situ methods of permeability testing were employed to examine and/or test the low permeability hydraulic barriers. Two of the methods involved in-place testing and the third involved laboratory testing of coupon samples. Due to the distinct physical differences between a compacted, low permeability soil liner versus a prefabricated geosynthetic clay liner, the methods of evaluation must be unique to each.

The essence of the evaluation is intended to document the measure of impermeability or low permeability which exists and that the installed materials have not been damaged, disturbed or detrimentally impacted by service, the elements, modifications or construction activities, or by foreign substances.

The permeability of the soil liners was tested in place. Typical laboratory test methods for low permeability soils would involve the taking of an undisturbed sample with a Shelby tube, transporting the sample to a lab and subjecting the sample to test in a flexible wall permeameter. The flexible wall permeameter (ASTM D5084) offers a controlled environment for establishing the permeability of the sample under laminar flow conditions, controlled effective stress and flow in only one direction along the length of the sample. Unfortunately, the normal geometry and makeup of a secondary containment basin precludes access by a piece of heavy equipment suitable for pressing the Shelby tube into place without inflicting undue damage to the remainder of the hydraulic barrier. Due to these limitations, a percolation type permeability test was utilized to establish a measure of the in-place permeability. The percolation test was conducted by removing the stone or gravel protective layer to expose the top surface of the hydraulic barrier.

For Basin 5/6 percolation tubes was pressed or hammered into the surface of the soil in order to penetrate 6 inches. The percolation tube was constructed of a 3-foot length of 6-inch diameter PVC pipe as shown in Figure 1. The leading edge of the pipe was tapered on the outside to reduce resistance to penetration and minimize disturbance of the soil sample within the tube. After setting, the interface between the outside diameter of the pipe and the ground surface was tamped and sealed with powdered bentonite. No attempts were made to compact or remold the soil contained by the tube in an effort to simulate undisturbed conditions. A reference mark was established for measurement purposes. Tap water was poured into the pipe to create a hydrostatic head over the soil surface. The area of the test is equal to the cross-sectional area of the pipe. A sufficient quantity of water was placed into the tube to establish at least a two-foot column of water over the soil under initial conditions. Liquid level measurements were made of the water column to monitor the rate of percolation into the soil. These measurements were then used to determine the coefficient of permeability (also known as hydraulic conductivity).

In the case of Basins 3, 4, 9 and 10, the installed GCL is not conducive to performing an in-place percolation test using the 6-inch percolation tube method. The relative thinness of the material (1/4-inch) and the geotextile covers preclude the setting of a percolation tube into the material with any degree of certainty that an effective seal has been realized between the sample



IN-SITU PERMEABILITY
TEST APPARATUS
FOR SOIL/BENTONITE LINERS
N.T.S.

BROOKHAVEN NATIONAL LABORATORY
MAJOR PETROLEUM FACILITY

EVALUATION OF EXISTING
SECONDARY CONTAINMENT SYSTEMS

Dvirka and Bartilucci
Consulting Engineers
A Division of William F. Cosulich Associates, P.C.

FIGURE NO.1

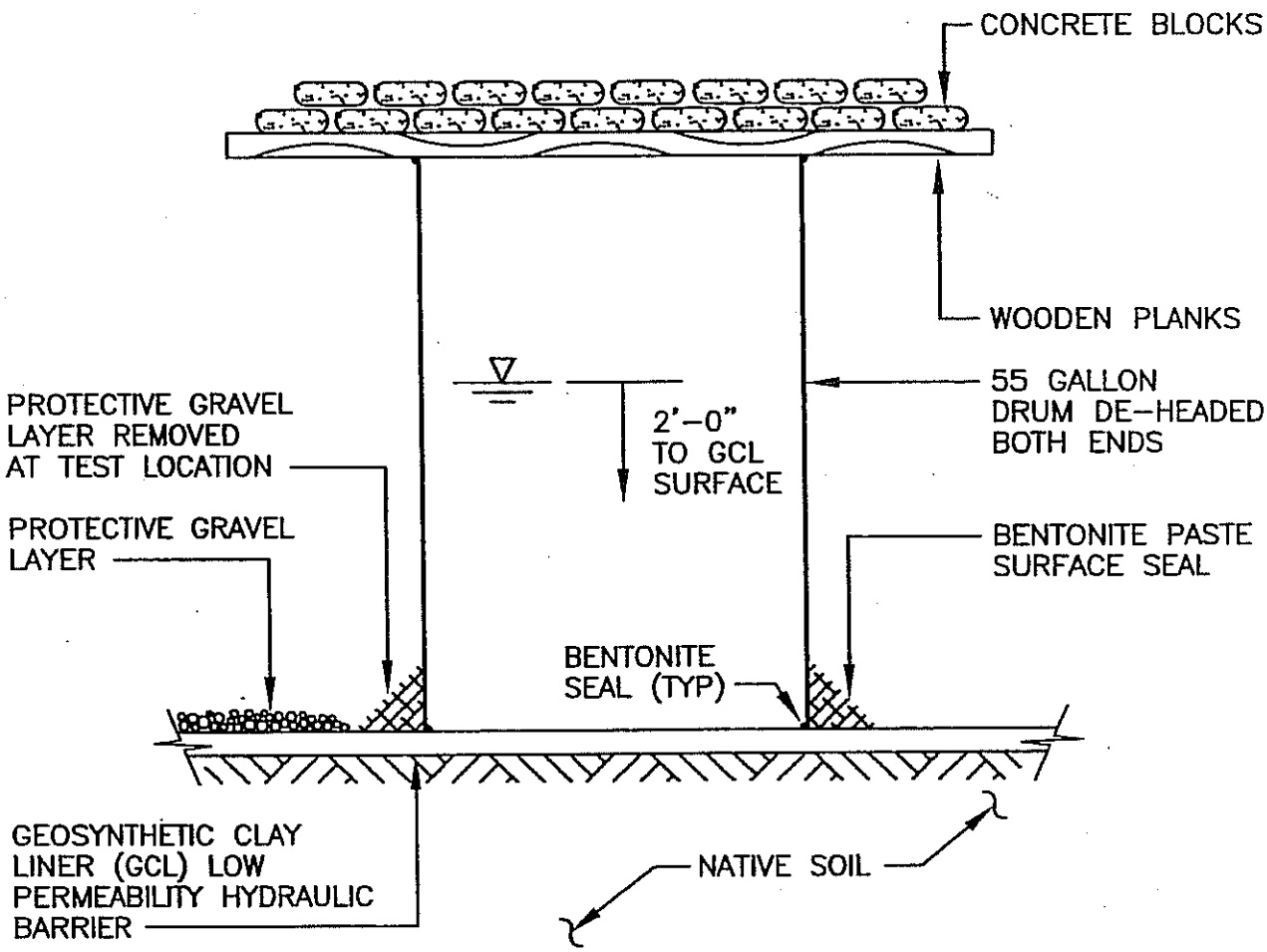
and the inside diameter of the tube. Therefore, an alternate field method of testing the integrity of the GCL was used. The test method devised was non-invasive so as not to damage or compromise the barrier. The test method is described as follows:

Arrangements were made with Brookhaven National Laboratory staff to have the GCL basins drained of any accumulated precipitation in accordance with standard facility protocols prior to commencing the test. Test locations were selected in the bottom area of the basin to be representative of the overall basin and the protective gravel layer was manually removed to expose the top surface of the GCL.

The test apparatus consisted of a clean 55-gallon drum deheaded both ends to serve as an infiltrometer or reservoir of water above the test specimen. The assembled test apparatus is shown in Figure 2. Prior to performing the test, the drum was placed in position and weighted down to form a dimple or impression in the GCL. This impression was coated with a bentonite and water paste and the lower end of the drum was set into the dimple and the paste. Additional bentonite paste was used to seal the lower exterior edge of the drum to the upper surface of the GCL. Minimal bentonite paste was used on the interior seal so as not to compromise the integrity of the test.

The top of the drum was then covered with boards and weighted down with concrete blocks to promote the seal at the GCL interface. Several inches of tap water was placed into the drum to fully hydrate the seals and the GCL sample area and confirm that test water was not being lost at the drum/GCL interface. The drum was then filled with tap water to a level of in-situ 24 inches above the GCL surface and the test begun. Measurements were then taken from the surface of the liquid within the drum to an established reference mark to determine the rate of decline of water with a measurement accuracy of 0.01 foot. Photographs of the typical test set-up are contained in Appendix D.

This test is comparable in nature to the permeability test performed in Basin 5/6 and is consistent with the methods described in the Petroleum Association for Conservation of the Canadian Environment (PACE) Report No. 79-2. In keeping with the PACE report, if after a



IN-SITU PERMEABILITY TEST APPARATUS FOR GEOSYNTHETIC CLAY LINERS

N.T.S.

BROOKHAVEN NATIONAL LABORATORY
MAJOR PETROLEUM FACILITY

EVALUATION OF EXISTING SECONDARY CONTAINMENT SYSTEMS

Dvirka and Bartilucci Consulting Engineers
A Division of William F. Cosulich Associates, P.C.

FIGURE No.2

30-minute test period there is no discernible change in fluid level, the permeability is assumed to be equal to or less than 1×10^{-6} cm/sec. When a change in fluid level was noted, the permeability value was estimated using graphical data developed by test procedures described in the PACE report or calculated using equations contained in ASTM D5084.

The in-situ testing of the GCL hydraulic barriers was pursued in an effort to avoid the taking of destructive samples. In the 1995 evaluation, sample coupons were removed and forwarded to a laboratory for testing of permeability and the mass of bentonite per unit area. The sample coupons were approximately 18 inches square. Repair patches were required and installed in order to remediate the disturbance to the hydraulic barrier. The installation of the repair patches is straight forward and should provide a comprehensive repair of the damage imparted by the taking of the coupons. The in-situ test method discussed above avoids the taking of sample coupons and, therefore, minimizes the disturbance to the as-constructed hydraulic barrier. As a safeguard, powdered bentonite and a repair patch was installed over the area of the in-situ test leaving the completed test area with a double layer of GCL.

The in-situ test protocol for the GCL was submitted on March 29, 2001, to the New York State Department of Environmental Conservation (NYSDEC) for consideration prior to proceeding with the 2001 evaluation and field tests. NYSDEC reviewed the protocol and provided a conditional approval of this procedure in correspondence dated April 11, 2001, see Appendix E.

Pursuant to the guidance offered by the NYSDEC, at least two permeability determinations were performed in each of the basins. In addition, NYSDEC requested that a seam in the GCL barrier be visually examined in each basin to document the condition of a typical seam. In keeping with the GCL manufacturer's recommendations, a typical seam should provide an overlap of adjacent GCL panels of approximately 6 inches.

As noted previously, a portion of Basin 4 was rehabilitated in 2001 by removing damaged areas of GCL and installing new GCL in its place. The replacement GCL, CETCO CLT, is a composite product consisting of a GCL plus a 20 mil, textured HDPE geomembrane

attached to one side. The material was installed with the geomembrane side up to take advantage of the puncture resistance of the geomembrane during the placement of the overlying gravel layer. When this material is exposed for examination and testing, it is the geomembrane surface which is accessible beneath the gravel layer.

The relative stiffness of the 20 mil geomembrane precludes the performance of an in-situ permeability test using the drum method. The geomembrane surface is not readily deformed and will not product an effective seal to the drum apparatus. In these areas of Basin 4, it was necessary to cut samples from the installed material to allow for laboratory testing. In two locations, 18-inch square samples were removed and sent to a laboratory for permeability testing as well as mass of bentonite per unit area measurements. Each sample location was repaired utilizing a GCL patch which overlapped the sample area by at least 12 inches. The overlap seam between the patch and the underlying GCL was enhanced with powdered bentonite.

A third permeability test was performed in-situ in Basin 4 to document the permeability of the older GCL product which remains in portions of the basin.

To further supplement the permeability determination, visual examination of the basins and the upper surface of the hydraulic barrier was also undertaken. For each location, the protective layer of stone was removed, the conditions noted, and the protective layer replaced. Particular attention was paid to conditions associated with penetrations of the hydraulic barrier, such as the tank foundations, pipe supports, walkway piers, etc. These visual examinations were intended to document that the hydraulic barrier remains in an undisturbed and undamaged state. Areas where the thickness of the protective layer was diminished were also noted. The visual examinations were noninvasive and nondestructive to the integrity of the hydraulic barrier. Permeability test sites and locations of visual examination are shown on Drawings 2 through 6 contained in Appendix G.

Field testing and basin examinations were conducted during the period June 27, 2006 through July 7, 2006.

TEST RESULTS

Three 6-inch diameter percolation tube tests were performed in Basin 5/6, but one was considered invalid. A total of seven 55-gallon drum infiltrometer tests were performed. Two locations within each of Basins 3, 9 and 10 were tested. A third test performed in Basin 9 was considered invalid. Two sample coupons were removed from Basin 4 to allow for laboratory testing, plus one in-situ drum test was performed in Basin 4.

After the in-situ test equipment was installed and a 2-foot column of water was established in the 6-inch diameter percolation tube or the 55-gallon drum, the drop in the liquid level was measured against time. Water level measurements were made using a Solinst Model 101 Water Level Meter with a measuring increment of 1/100 (0.01) foot. The drop was measured at an initial 30-minute interval and over an extended time period. Utilizing PACE criteria, the coefficient of permeability was determined at the first 30-minute interval and also for the average water level drop over the extended time period. The test results are summarized in Table 2.

In general, the in-situ test procedures may tend to overstate the permeability of the test specimen relative to the actual permeability or results obtained under laboratory conditions. The in-situ method for testing the GCL relies extensively on the seal created between the lower edge of the drum and the upper geotextile of the GCL. In addition, the drum does not penetrate through the test specimen and therefore does not provide a comprehensive lateral boundary layer to the test specimen. During the performance of the field tests, there were some observations that test water may have "wicked" laterally through the structure of the geotextile to the area outside of the test drum. This lateral migration of water would reveal itself as a lowering of water in the test chamber but would not represent water which has passed vertically through the GCL. Any diversion of test water away from the test specimen (area defined by the drum) would suggest that the specimen is more permeable than it actually is.

Table 2

IN-SITU PERMEABILITY TEST RESULTS

Location	Coefficient of Permeability (cm/sec) 30 minutes	Extended Period (Test Duration)
Basin 3		
Site 3A	4.34×10^{-8}	6.82×10^{-8} (1,200 minutes)
Site 3B	2.89×10^{-8}*	1.74×10^{-8} (1,395 minutes)
Basin 4		
Site 4A	N/A (LAB)	1.18×10^{-9} (114.1 hours)
Site 4B	N/A (LAB)	3.72×10^{-10} (115.1 hours)
Site 4C	2.89×10^{-8}*	2.31×10^{-8} (150 minutes)
Basin 5/6		
Site 5/6/A	Test Invalid[1]	
Site 5/6/B	2.31×10^{-7}*	5.78×10^{-8} (480 minutes)
Site 5/6/C	1.85×10^{-6}	1.06×10^{-6} (420 minutes)
Basin 9		
Site 9A	5.78×10^{-8}	2.48×10^{-8} (1,330 minutes)
Site 9B	Test Invalid[1]	
Site 9C	2.89×10^{-8}*	$1.45 \times 1-^{-8}$ (240 minutes)
Basin 10		
Site 10A	2.89×10^{-8}*	2.77×10^{-8} (1,445 minutes)
Site 10B	4.96×10^{-8}	2.65×10^{-8} (1,440 minutes)

[1]For details see evaluation discussion for Basin 5/6 and 9.

* No discernable drop in liquid level. Permeability is calculated using ½ of smallest increment on measuring device (0.01 foot). For calculation purposes, the drop is assumed to be 0.005 foot in 30 minutes.

In the case of the in-situ testing of the soil bentonite layer, similar circumstances exist at the interior surfaces of the test chamber (6" diameter pipe). If there is any channeling of flow at the interface between the sample and the pipe or an incomplete seal between the pipe and the soil, this flow would serve to suggest that the sample is more permeable than it actually is.

In an effort to address these possibilities, each in-situ test was run for the prescribed 30 minutes; then the test was permitted to continue for an extended period. The extension of the test period is helpful to verify that the test specimen was fully hydrated and also to provide corroborating data to the initial measurements. As noted above, any deficiencies in the test setup would be revealed as an overstatement of the permeability. If the rate of liquid level drop diminished over time, it can be concluded that test has more closely approached equilibrium.

Clearly, in-situ testing cannot approach the suggested levels of accuracy which are assumed in laboratory testing. In this light, the in-situ testing should be considered as providing an adequate approximation of the in-place permeability without imparting the damage to the hydraulic barrier necessary for the taking of destructive samples for laboratory analysis.

The field test data was used to determine the apparent permeability of the test specimen. In the case of the GCL barriers, the permeability was calculated in accordance with ASTM D5084 for the falling head conditions. In the case of the soil bentonite barriers, the permeability was also calculated for falling head conditions. In each case, the data should be viewed in the context that a reasonable approximation, albeit possibly overstated, of the permeability has been established.

Based upon past laboratory testing of GCL conducted in 1995 and a comparison with field tests indicate the field procedure is generally a conservative test. The following is a comparison of laboratory (1995) and field test (2001 and 2006) results:

Coefficient of Permeability (cm/sec)

	2006 In-situ Field Test	2001 In-situ Field Test	Laboratory Test
Basin 4	2.3×10^{-8}	$3.85 \times 10^{-7} - \leq 9 \times 10^{-7}$	1.40×10^{-7}
Basin 9	$2.9 \times 10^{-8} - 5.8 \times 10^{-8}$	$2.9 \times 10^{-7} - 1.7 \times 10^{-6}$	1.31×10^{-7}
Basin 10	$2.9 \times 10^{-8} - 4.9 \times 10^{-8}$	$9 \times 10^{-7} - 2.8 \times 10^{-6}$	1.01×10^{-7}

The requirements outlined in the NYSDEC SPOTS No. 10 publication notes an acceptable secondary containment water permeability of 1×10^{-6} cm/sec for No. 2 fuel oil and 1×10^{-5} cm/sec for No. 6 fuel oil in a high risk area. The BNL site is considered a high-risk area in the context of SPOTS 10 given the presence of the underlying sole-source aquifer. This high-risk area designation would apply to the majority of Long Island.

OBSERVATIONS AND FINDINGS

Test results and field observations generally indicate the tank storage facilities have a degree of impermeability that is consistent with the need to provide adequate secondary containment in the event of a tank failure.

As previously noted in Table 2, the field permeability test results of GCL and soil/bentonite liners ranged from 2.89×10^{-8} to 1.85×10^{-6} cm/sec. Product literature for GCL products used for basin construction suggest the permeability (hydraulic conductivity) to water is on the order of 5×10^{-9} cm/sec and past laboratory testing of the liners were on the order of 1×10^{-7} cm/sec. In general, a properly constructed GCL or soil/bentonite hydraulic barrier should not experience deterioration or damage under normal use unless it has been exposed to subsequent disturbance or displacement. In all basins the GCL and soil/bentonite materials were found to be hydrated and in acceptable condition with some exceptions.

Based upon evaluation of the field test method, initial GCL/bentonite product impermeability characteristics and past laboratory testing of GCL materials from the tank storage basins, the in-situ permeability tests serve to adequately document the order of magnitude of the in-situ permeability and can be considered conservative in nature. Findings of field

permeabilities in this range using the PACE test procedure are considered sufficient to afford appropriate barrier protection of the groundwater resource in the vicinity of the fuel storage tanks. This is predicated upon performance of proper basin maintenance.

In conjunction with the in-situ permeability testing, a series of non-destructive visual examinations was performed in each basin to document the physical integrity of the hydraulic barrier. Each visual examination required hand excavation of the overlying stone protective layer in order to expose the upper surface of the hydraulic barrier.

The locations for the performance of the visual examinations were selected as those areas of construction most likely to be deficient.

As with any liner system, the most likely locations for defects to exist in the continuity of the hydraulic barrier are at and around penetrations. During installation, each penetration must be individually addressed in order to effect an adequate seal at this interface. Typical penetration details for GCL installations involve bringing the GCL into contact with the penetrating object. The methods of achieving contact may involve a boot arrangement where the free edge of the GCL rides up the penetrating object; a butt arrangement where the free edge of the GCL intersects the exterior of the penetrating object; or an arrangement where the free edge of the GCL is let into a furrow or trench of bentonite around the penetrating object. In each arrangement, the contact between the GCL and the penetrating object is normally supplemented with powdered bentonite or a soil/bentonite mixture. The bentonite or soil/bentonite mixture is intended to bridge any irregularities in the fit of the GCL to the penetrating object.

In the case of penetrations of a soil/bentonite hydraulic barrier, the soil bentonite mixture would be placed against the penetrating object and compacted in place.

In general, a properly constructed GCL or soil/bentonite hydraulic barrier should not experience deterioration or damage under normal use unless it has been exposed to subsequent disturbance or displacement. In addition to penetration locations, visual examinations were performed at random "field" locations to assess the general condition of the hydraulic barrier.

As requested by NYSDEC, a GCL seam in each basin was unearthed and examined to document that proper overlaps were installed.

It should be noted that, during the field examination of the basins, a heavy rain event was experienced and all of the basins were noted to impound water until such time that the basin drains were opened.

The following is a summary of test results and field observations for each basin:

Basin No. 3

Stored Product: No. 6 Fuel Oil

Containment System: Enviromat (GCL), CETCO CLT (GCL)

Protective Layer: Stone on basin floor, crushed gravel on embankments

Number of Permeability Tests: 2 in situ

Number of Visual Observations: 13

Number of Seam Observations: 1

- The coefficient of permeability based upon field tests ranged from 2.89×10^{-8} to 4.34×10^{-8} cm/sec.
- At exposed locations the GCL membrane appeared in fair condition with some wear noted in the top fabric. The depth of stone layer above the membrane ranged from 4 to 5 inches. The top cover of the GCL was found to be intact and the bottom of the membrane (paper scrim) was found to have dissolved as was intended. The bentonite is no longer separate and distinct. Bentonite appears to have migrated to some extent and mixed with the underlying soils.
- On the southern top of slope of the embankment the membrane fabric lacks sufficient crushed gravel cover.
- Adequate overlap was observed at the GCL seam.
- The GCL membrane at pipe support piers was adequately sealed (2 locations).
- At the perimeter of the tank foundation, the GCL penetration was adequately sealed (4 locations).

- A portion of the hydraulic barrier in Basin 3 has been replaced by BNL personnel since 2001 as part of work to improve the drain manhole located in the southern area of the basin. The modifications to the manhole involved the installation of a cylindrical stainless steel sump into the precast concrete manhole and connection to existing drain piping. As a consequence of this work, the GCL local to the area of the drain manhole was disturbed, requiring removal and replacement. In order to ensure proper repair of the hydraulic barrier, BNL personnel installed new GCL materials, CETCO CLT, from rolls of new product which remained after the 2001 remedial repairs in Basin 4. The new material was installed on top of the existing GCL. Two panels were installed and each panel extended from the tank foundation, across the basin floor and up the embankment to an anchor trench located outside of the basin. Each panel overlapped the drain manhole, the panels were seamed to each other and the drain penetration was supplemented with powdered bentonite. Gravel cover was reinstalled on top of the new GCL materials. Photographs depicting this work are provided in Appendix B.

Basin No. 4

Stored Product: No. 6 Fuel Oil

Containment System: Enviromat (GCL), CETCO CLT (GCL)

Protective Layer: Stone on basin floor, crushed gravel on embankments

Number of Permeability Tests: 3 (2 – laboratory, 1 – in situ)

Number of Visual Observations: 13

Number of Seam Observations: 1

- Three permeability tests were performed using a combination of laboratory testing and in-situ testing. In the areas of Basin 4 that were remediated in 2001, coupon samples were obtained from two locations (Test Sites 4A and 4B) and were submitted for laboratory testing. The laboratory testing of the CETCO CLT samples included permeability (ASTM D5084 and D5887) and mass of bentonite per unit area (ASTM D5993). Copies of the test results are included as Appendix F. The results of this testing are as follows:

Sample	Permeability (cm/sec)	Mass of Bentonite per Unit Area (lbs/ft^2 @ 0% moisture)	
		Sample	Specifications
4A	1.18 x 10-9	0.97	0.75
4B	3.72 x 10-10	0.87	0.75

One in-situ permeability test was performed (Test Site 4C) in the area of Basin 4, which did not require remediation in 2001 (Enviromat). The in-situ testing indicated a permeability of 2.89×10^{-8} after 30 minutes (no discernable drop in liquid level, calculated using an assumed drop of 0.005 foot) and a permeability of 2.31×10^{-8} after 150 minutes.

- At the top of slope of the embankment, along the northwest, east/northeast and southeast perimeter of the basin, the GCL fabric is exposed in isolated areas and lacks sufficient gravel cover for protection. These areas are above the containment basin and should be considered general maintenance and housekeeping.

- Penetration details at the six locations (tank foundations and/or piers) were found to be acceptable.

- Tanks 19 and 20 have been removed from Basin 4, leaving the foundation piers in place and undisturbed. Tanks 19 and 20 had never been placed in service.

- The depth of stone covering the membrane was ±6-inch.

- Adequate overlap was observed at the GCL seam.

Basin No. 9

Stored Product: No. 6 Fuel Oil

Containment System: Enviromat (GCL)

Protective Layer: Stone on basin floor, crushed gravel on embankments

Number of Permeability Tests: 3 in situ (one considered invalid)

Number of Visual Observations: 18

Number of Seam Observations: 2

- The coefficient of permeability based upon field tests ranged from 2.89×10^{-8} to 5.78×10^{-8} cm/sec. A total of three tests were performed. One test (Site B) was not considered valid due to test equipment problem which precluded the ability to obtain an effective seal between the membrane and the test drum. The test site was relocated to a more suitable area (Site C) in close proximity to the non-valid test site.

- The top of the GCL fabric was observed to be in good condition. The GCL membrane was covered with 3 to 4 inches of gravel.

- At a number of locations along the top of the embankments, the GCL is exposed with some slight tearing. Stone should be replaced to cover and protect the exposed material as general maintenance and housekeeping.

- Tanks 11 and 18 have been removed from Basin 9, leaving the foundation piers in place and undisturbed. Tanks 11 and 18 had never been placed in service.

- Penetrations of the hydraulic barrier at tank foundation (5 locations), tank piers (3 locations) and pipe support piers (1 location) were found to be acceptable.

- In the area of the western toe of slope, between the two northernmost piers for Tank 11 (Tank 11 has been removed), the GCL was observed to be raised and the fabric abraded or torn. The cause of this condition is not known and should be evaluated.

- Adequate overlap was observed at the GCL seam (2 locations).

Basin No. 10

Stored Product: No. 6 Fuel Oil

Containment System: Enviromat (GCL)

Protective Layer: Stone on basin floor, crushed gravel on embankments

Number of Permeability Tests: 2 (in situ)

Number of Visual Observations: 17

Number of Seam Observations: 2

- The coefficient of permeability based upon field test ranged from 2.89×10^{-8} to 4.96×10^{-8} cm/sec.

- GCL that was exposed was observed to be in good condition with approximately 3 inches of stone cover.

- Penetrations of the hydraulic barrier at tank foundation (6 locations) and pipe support piers (3) locations found to be acceptable.

- As with the other GCL lined basins, there are a number of locations at the top of slope of the embankment where the GCL is exposed and lacks sufficient gravel cover. This condition should be corrected as general maintenance and housekeeping.

- Adequate overlap was observed at the GCL seam.

Basin No. 5/6

Stored Product: No. 2 Fuel Oil

Containment System: Soil/Bentonite

Protective Layer: Stone on basin floor, none on embankments

Number of Permeability Tests: 3 in situ (one considered invalid)

Number of Visual Observations: 25

- The coefficient of permeability based upon field tests was 2.31×10^{-7} to 1.85×10^{-6} cm/sec. The two tests were performed in the basin floor and one test in the side slope of the embankment.

- A moderate level of clay materials was evident around the permeability test sites and other observation points. It should be noted that a low permeability soil bentonite mixture requires only 5 to 10% bentonite depending on the gradation of the base soil.

- Piping revisions have been implemented within the footprint of the basin to re-route piping to Tanks 5 and 6. These revisions made use of existing pipe support piers (no new piers were constructed) and there is no suggestion of damage to the soil bentonite hydraulic barrier.

- Certain areas of the basin floor were noted to be soft or loose under the weight of foot traffic due to high levels of clay.

- There is no protective layer in place over the side slopes of the embankment. Light vegetation (grasses) has become established and should serve to diminish the potential for damage due to erosion or foot traffic.

IMPACTS TO GROUNDWATER

The key issue in discussing the results of the containment basin permeability tests is the potential impact to groundwater resulting from a petroleum product spill from any one of the 6 storage tanks in the vicinity of the Central Steam Facility. The travel time required for a petroleum product spill to reach the surface of the water table is of particular importance. Equally important is the time required for products to migrate through the floor materials within a particular basin.

The two fuel oils of concern for this facility will be No. 2 Fuel Oil and No. 6 Fuel Oil. As indicated in Table 1, these two petroleum products are the only two products stored in storage tanks located in the vicinity of the Central Steam Facility.

For the purpose of calculation, No. 2 Fuel Oil will be assumed to have a vertical migration or percolation rate of 1/2 the rate of water. No. 6 Fuel Oil will vertically migrate at a rate appreciably slower than No. 2 Fuel Oil.

The Summary Report prepared by ERM-Northeast for Secondary Containment System - Brookhaven National Laboratory, March 1987 (ERM Summary Report) indicated that the depth to groundwater in the area of Basins 5/6 was 32 feet and the native subsoils had a vertical permeability to water of 1×10^{-3} cm/sec. These values will be utilized for all five of the containment basins since all five are within close proximity to each other.

Two components of vertical percolation will be used to estimate the travel time necessary for a spill to permeate through the bottom of the containment system and the travel time necessary for a spill which has permeated the containment system to reach the underlying groundwater system.

All calculations will be predicated on water as the permeant, applied over the surface of the basin floor with a constant one-foot hydrostatic head above the upper surface of the hydraulic barrier. For purposes of calculating the gradient, the thickness of the GCL shall be taken as 0.25 inch or 0.021 foot and the thickness of the in-place soil/bentonite liner shall be taken as 9 inches or 0.75 foot. The attenuation capacity of the distinct containment systems will be calculated using the results of the in-situ permeability tests. For the purpose of this discussion, the highest (greatest) permeability measurement for each basin has been used in the calculations.

Table 3 presents the velocity of the liquid as water through the hydraulic barrier and the underlying soils and the travel times calculated for water to permeate the hydraulic barrier and reach the water table. The travel time required for No. 2 Fuel Oil is taken as twice the travel time required for water to reach the water table.

The velocity of water as a permeant through the hydraulic barrier is calculated from the flow rate of water through a unit area of the hydraulic barrier with a head (driving force) of 1 foot above the surface of the hydraulic barrier. The gradient across the GCL is calculated to be 51. The gradient across the 9-inch layer of soil bentonite is calculated to be 2.33.

The travel times presented in Table 3 should be considered conservative for the following reasons.

- The in-situ permeability test is a conservative approximation of the actual permeability for the reasons discussed previously.
- The in-situ permeability test does not account for the confining pressure exerted by the overlying protective stone which, by necessity, is removed in order to conduct the test.
- The thickness of the GCL is assumed to be 0.25 inch (0.02 foot) in all calculations of permeability, gradient and travel times. The literature suggests that the thickness of the GCL may swell as much as 60 percent under the confining stress of 6 inches of stone. If the GCL is assumed to swell 60 percent in thickness, it would increase the specimen length from 0.25 inch to 0.40 inch, increase the calculated permeability by approximately 60 percent, reduce the calculated gradient from 51 to 31 and increase the calculated travel time through the hydraulic barrier by approximately 70 percent.

  The hydrated thickness of the GCL cannot be adequately measured in the field. Therefore, the dry thickness of the GCL at 0.25 inch is used for calculation purposes.
- The greatest permeability calculated for each basin is used in the calculations to present a worst case.

The travel times to reach the groundwater table are calculated to be more than 26 days for a No. 2 fuel oil. Because of the higher viscosity, the travel time to groundwater for a No. 6 fuel oil would be significantly longer. In the case of Basin 5/6, the thickness of the soil bentonite layer at 9 inches yields a travel time for No. 2 fuel oil on the order of 200 days. All other basins contain No. 6 fuel oil. Therefore, sufficient time exists for BNL staff to initiate spill mitigation activities before the petroleum product spill would compromise the aquifer.

Table 3

BROOKHAVEN NATIONAL LABORATORY
SUMMARY OF VERTICAL PERCOLATION RATES

Basin No.	Barrier Type	Permeability (cm/sec)*	Hydraulic Barrier		Underlying Soils		Total Travel Time – Water (days)	Total Travel Time - No. 2 Fuel Oil (days)
			Velocity - Water (ft/day)	Travel Time - Water (days)	Velocity - Water (ft/day)	Travel Time - Water (days)		
3	GCL	6.82×10^{-8}	0.009	2.11	2.91	10.96	13.07	26.1
4	GCL	2.31×10^{-8}	0.003	6.23	2.91	10.96	17.19	34.4
5/6	Soil/Bentonite	1.06×10^{-6}	0.007	89.68	2.91	10.96	100.7	201.4
9	GCL	2.48×10^{-8}	0.004	5.81	2.91	10.96	16.77	33.5
10	GCL	2.77×10^{-8}	0.004	5.21	2.91	10.96	16.17	32.3

*For calculation purposes, highest permeability from each basin is used.

Table 3 (continued)

BROOKHAVEN NATIONAL LABORATORY
SUMMARY OF VERTICAL PERCOLATION RATES

Notes:

The travel time of water through the hydraulic barrier is calculated through a series of equations:

$q = kia$

where: q = flow rate (ft^3/sec)
k = permeability (cm/sec converted to ft/sec)
i = hydraulic gradient [(head of water and thickness of layer) ÷ thickness of layer], head of water assumed to be 1 foot, thickness of GCL equals 0.25 inch or 0.02 foot, thickness of soil/bentonite liner equals 9 inches or 0.75 foot.
a = area (a unit area of 1 ft^2 is used for calculation purposes)

Having calculated the flow rate (q), the velocity is calculated using the equation:

$v = q/a$

when: v = velocity (ft/sec converted to ft/day)
q = flow rate (ft^3/sec)
a = area (a unit area of 1 ft^2)

Having calculated the velocity (v), the travel time through the hydraulic barrier is calculated using the equation:

$T = t/v$

where: T = Travel time (days)
t = thickness of layer (ft)
v = velocity (ft/day)

CONCLUSIONS AND RECOMMENDATIONS

Basin Nos. 3, 4, 5/6, 9 and 10 were found to be in substantial compliance with secondary containment requirements. However, the following maintenance actions are recommended to assure the continued integrity of the basins:

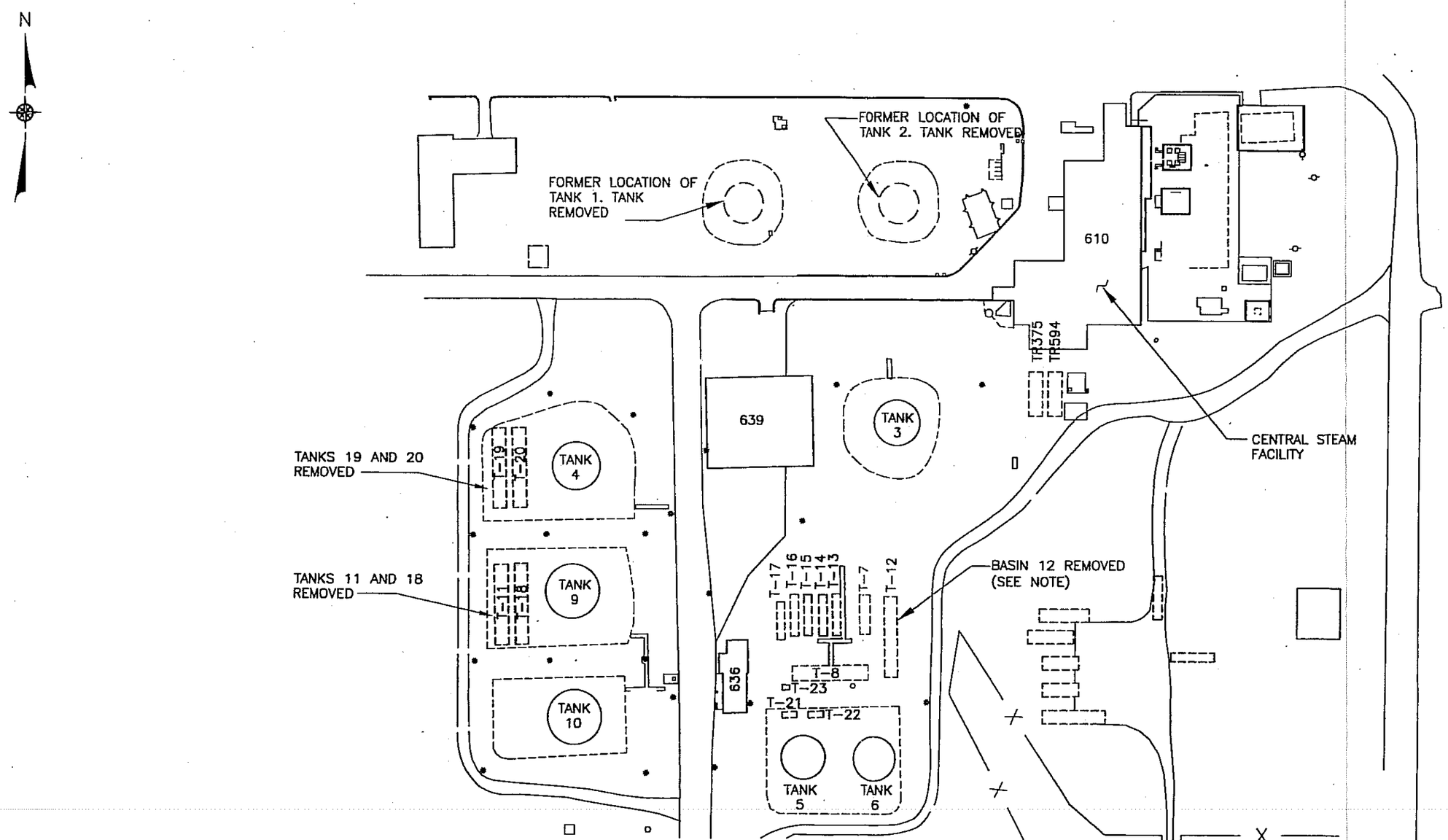
- Provide additional stone or crushed gravel on floor and/or embankment areas where GCL is exposed or the cover material is not sufficient to protect the GCL. Patch or replace GCL which has been ripped or damaged due to exposure, or lack of cover materials.
- Continue to conduct a control program to prevent the growth of vegetation which may produce roots that may penetrate the hydraulic barrier.

One area within Basin No. 9 was found to have potential deficiencies; therefore, the following is recommended:

- The exposed GCL in the northwest section of the basin requires further investigation to determine the cause of the GCL bulging. Repair or replace damaged GCL materials.

APPENDIX A

SITE PLAN



NOTE: TANKS 7,8,12,13,14,15,16,17,21,22 AND 23 HAVE BEEN REMOVED.
BASIN 12 HAS BEEN REMOVED

SCALE: 1"=100'

Dvirka and Bartilucci
CONSULTING ENGINEERS
A DIVISION OF WILLIAM F. COSULICH ASSOCIATES, P.C.

BROOKHAVEN NATIONAL LABORATORY
MAJOR PETROLEUM FACILITY

SITE PLAN

DRAWING NO. 1

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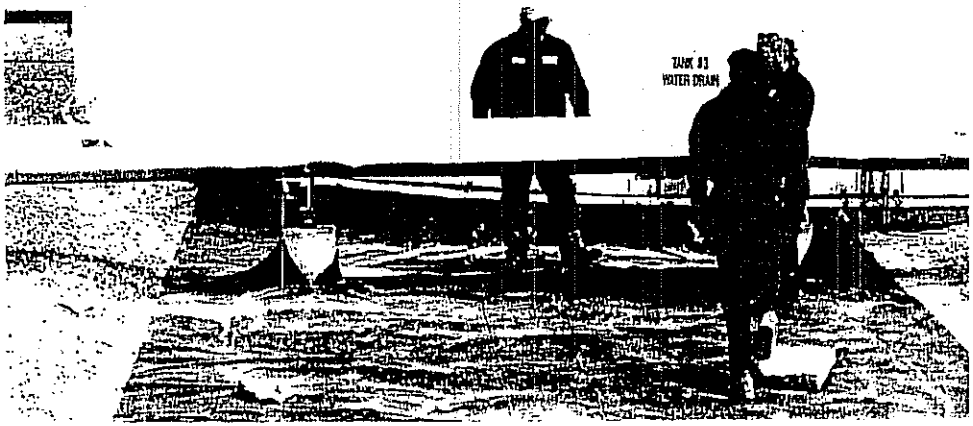
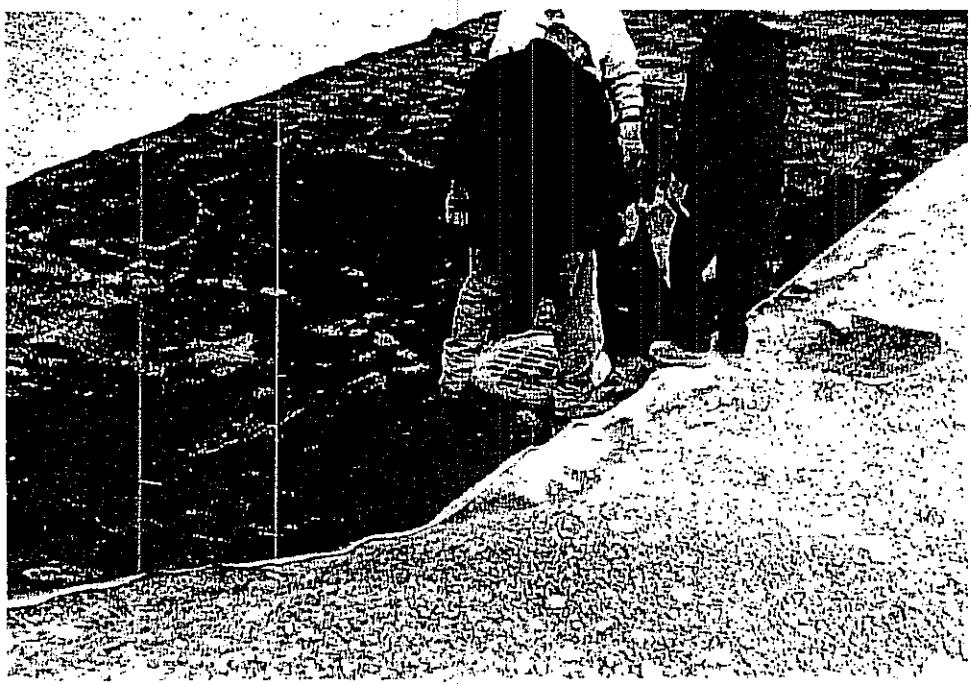
APPENDIX B

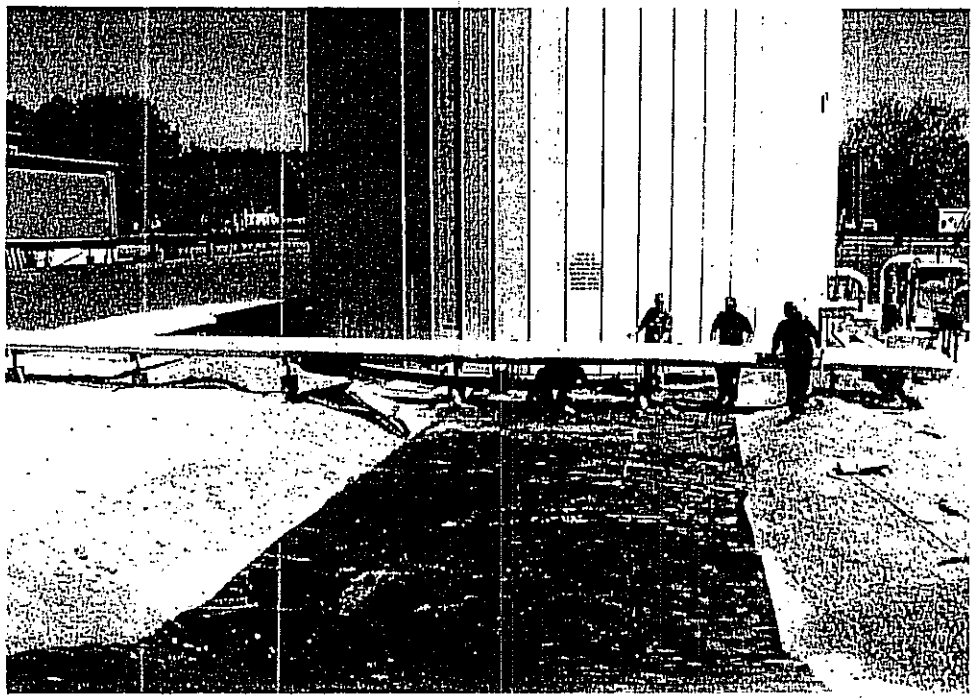
MODIFICATION OF BASIN 3 DRAIN MANHOLE

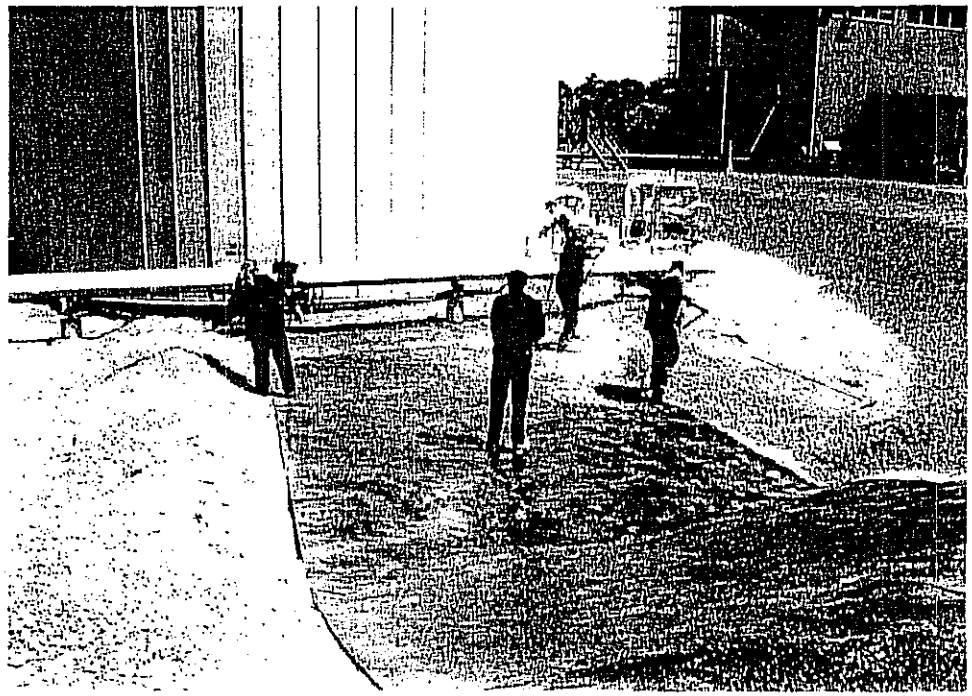
APPENDIX C

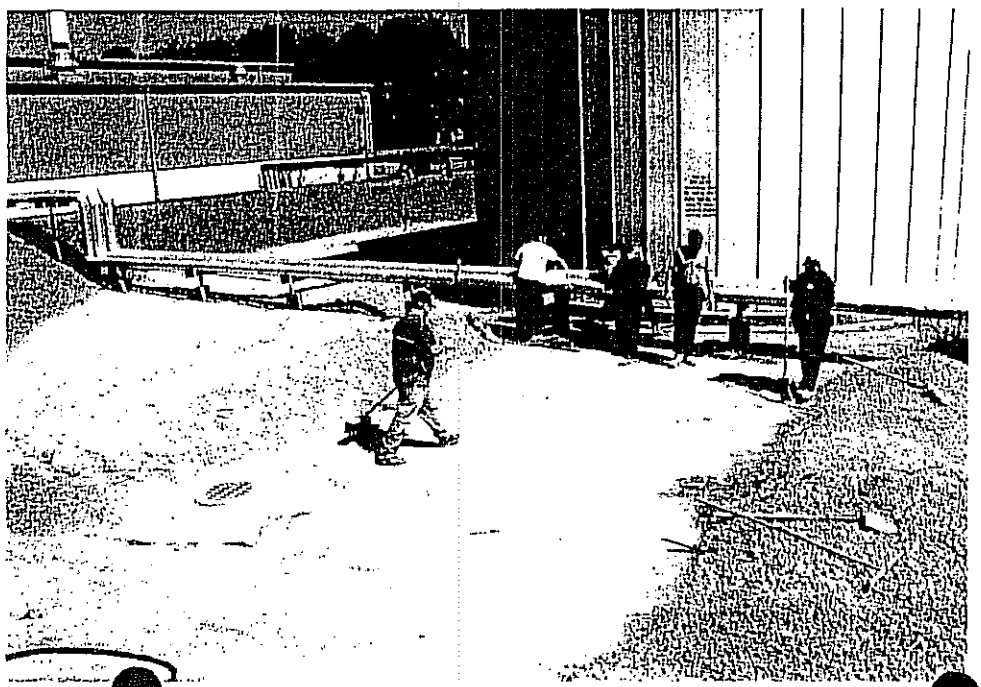
CLAYMAX AND CETCO CLT PRODUCT LITERATURE


TANK #3
WATER DRAIN

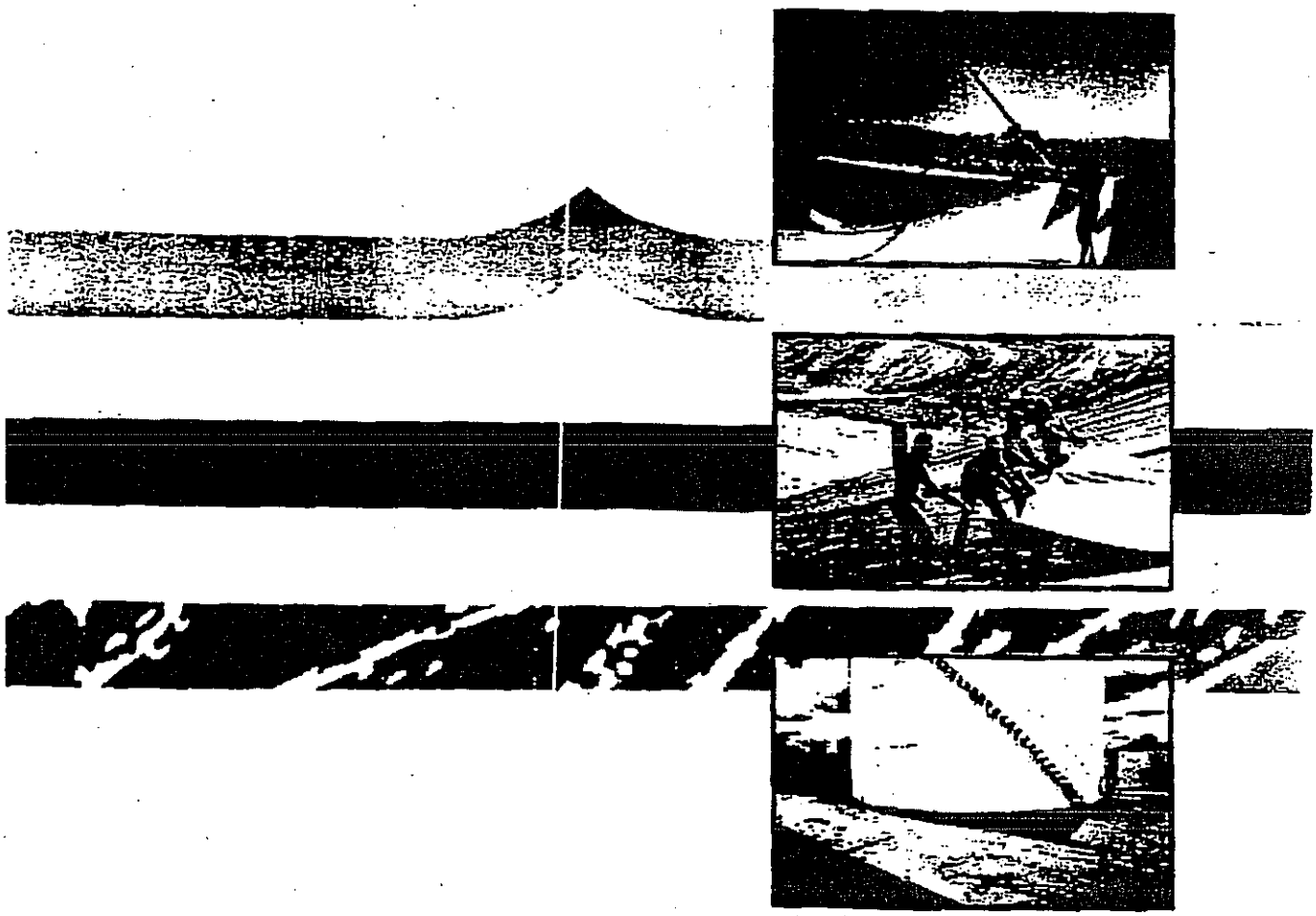








CLAYMAX®



CLAYMAX® IS THE STATE-OF-THE-ART GEOCOMPOSITE LINER FOR THE WATER AND WASTE CONTAINMENT INDUSTRY. CLAYMAX® . . . THE IMPERMEABLE BARRIER OF BENTONITE CLAY IN CARPET FORM.

CLAYMAX® liner is the optimum impermeable liner for the water and waste containment industry.

CLAYMAX® PRODUCT SPECIFICATION

Sodium Bentonite Content	1.0 lbs. per square foot
Thickness	¼ inch
Liner Dimensions	13.5 feet x 82 feet
Effective Area Covered	1059.5 square feet (assume 6" overlap along one side and one end)
Roll Weight/Unit	1130 lbs. (minimum)
Permeability Coefficient	2×10^{-10} cm per second @ 35' head pressure.

LABORATORY TEST DATA

Procedure—Six inches of silica sand covering CLAYMAX liner in a triaxial cell under thirty-five feet of water head pressure.

GROUP	PERMEANT	PERMEABILITY
Water	De-Aired Water	2×10^{-10} cm/sec.
Salt	Seawater	2×10^{-10} cm/sec.
Acid	Acetic Acid Phosphoric Acid	2×10^{-8} cm/sec. 2×10^{-9} cm/sec.
Calcium	Calcium Chloride	2×10^{-9} cm/sec.
Alcohol	Ethyl Alcohol	2×10^{-9} cm/sec.
Organics	Methylene Chloride	3×10^{-10} cm/sec.
Leachate	Sewage BOD>38,000 Paper Pulp Sludge	8×10^{-9} cm/sec. 2×10^{-10} cm/sec.
Hydrocarbons	Jet Fuel Diesel Fuel Unleaded Gasoline	8×10^{-10} cm/sec. 8×10^{-10} cm/sec. 2×10^{-10} cm/sec.
Pressure	100 foot Water Head	1×10^{-7} cm/sec.

Additional tests are available upon request.

The above test performance data were produced under laboratory conditions. The actual performance characteristics may vary. No performance warranty is express or implied.

PACKAGING AND SHIPPING

Roll Content	1107.0 square feet
Roll Weight	1135 lbs. (approx.) wrapped
Roll Size	14.5 feet long (PVC wrapped) x 18" diameter (approx.)

APPLICATIONS: Fresh water ponds, waste lagoons, municipal landfills/caps, tank farm containments, irrigation canals and earthen dams.

CLAYMAX® liner is a flexible polypropylene bentonite sandwich providing a uniform layer of clay in carpet form creating a cost-effective solution for any liquid containment sealing problem.

E.P.A. regulations for waste containment specify that lagoon/landfill liners be composed of a heavy plastic membrane layer (HDPE) on top of a thick layer of **compacted clay (3 feet minimum).** Because a single sheet of **CLAYMAX liner exceeds this requirement,** it has been specified and installed as "the clay layer" in several landfills in the United States and Europe.

CLAYMAX® liner is the state-of-the-art geocomposite liner that ingeniously combines the durability of woven polypropylene fabric with the impermeability of a pound-per-square-foot of an inert mineral, sodium bentonite (montmorillonite).

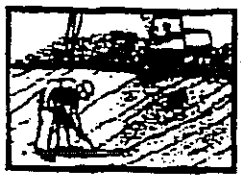
Sodium bentonite, the mineral component in CLAYMAX liner, is a high-swelling clay that swells to form a monolithic seal when hydrated with fresh water. The CLAYMAX liner has **self-sealing seams** and an overall **self-healing** ability if ripped or punctured. In its hydrated (swollen) state, the clay will swell up to 15 times its dry volume providing tremendous impermeability and a great resistance to all chemicals. In a typical installation, the ¼-inch CLAYMAX liner sheet will swell ½-to-1 inch resulting in the **equivalent permeability of 30 feet of compacted clay.**

EQUIPMENT REQUIRED: The CLAYMAX liner must be installed with the **stenciled polypropylene side up (facing the operator).** The polypropylene protects and supports the system on installation. The liner can either be pulled from a roll suspended at the top of a slope, or the free end may first be secured in a locking trench and the suspended roll can be backed down the slope and across the excavation by the supporting vehicle.

Suspending and unrolling CLAYMAX liner is facilitated by inserting a heavy-duty 3-inch diameter steel pipe through the 3½-inch roll core on which CLAYMAX liner is shipped. This pipe should be 16-18 feet long to accommodate the hoisting chains from the lifting vehicle (any type of vehicle with a fork or front-end bucket). A spreader bar is required to ensure roll clearance and to prevent damage to roll edges.

Quality control of CLAYMAX liner seams requires an on-site inspection of a uniform 6-inch overlap and supervision of backfilling to prevent aggregate from opening seams.

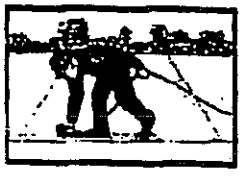
SITE PREPARATION: The pond, lagoon, tank farm enclosure or canal excavation depth should be determined to allow for a final addition of a minimum 6-8 inches of soil or aggregate cover material. The excavation should be well contoured with slopes that are at a maximum of three-to-one. Protrusions and rocks larger than 2 inches in diameter should be removed and the entire excavation should be compacted sufficiently to prevent ruts from installation vehicles. Compaction can be accomplished using either conventional rolling equipment or wheeled vehicles. Use of sheepsfoot rolling equipment is not recommended. A liner **locking trench (min. 18 inches deep)** must be provided at the top of all slopes.



ORIENTATION: When installing CLAYMAX liner, **all seams on slopes must be perpendicular to the excavation bottom.** This method prevents seam displacement during the backfill procedure. It is also important that the first CLAYMAX liner roll and all succeeding rolls be pulled tight to smooth out creases.

ANCHORING: All CLAYMAX liner sheets should be anchored to pressure-treated wooden 2 x 4's (or equivalent) and locked into trenches at the toe of all slopes, covered with fill and compacted to prevent slippage during installation. This trench should be at least 12 inches above the final contained liquid level and should be approximately **18 inches deep** and **18 inches back from the finished waterline.**

SEAMING: CLAYMAX liner seams are non-critical and self-seaming. CLAYMAX liner seams require a **simple 6-inch overlap** with long pins or nails every yard to allow for movement of CLAYMAX liner during ground subsidence. No adhesive or thermal welding is required. The hydrated bentonite will push through the woven polypropylene forming a monolithic seal with a permeability of no greater than 1×10^{-9} cm/sec.



REPAIRING: Irregular shapes, cuts or tears are **easily repaired** by covering the area with CLAYMAX liner to provide a 6-inch overlap on all sides. These repair pieces should be stapled or nailed in position until cover material has been placed.

COVERING: Cover material (minimum 6-8 inches of aggregate or backfill) should be applied as CLAYMAX liner sheets are placed to afford maximum protection. **Correctly installed, CLAYMAX liner is capable of supporting installation personnel and equipment.** Because it is not recommended for vehicles to operate directly on CLAYMAX liner without the support of a backfill, **cover material should always be pushed forward.** Cover material (other than aggregate) should be compacted after placement.

CLAYMAX® liner, the state-of-the-art geocomposite, can be used as a primary or secondary liner.

MATERIAL SPECIFICATIONS

Primary Backing (Typical Properties) — Polypropylene is nonbiodegradable and inert to most chemicals, acids and alkalis.

Color	Natural white
Filler Fiber	Nylon
Substrate	24 x 10 Delustered—even polypropylene, non-toxic, water permeable
Weight	4 oz. per square yard
Tensile Strength	78 lbs. per inch (minimum)
Grab Strength (ASTM D-1682)	Warp 95 lbs., Fill 70 lbs.
Mullen Burst Strength (ASTM D774)	250.25 lbs. per square inch
Puncture Strength (¼" mandril ASTM D3787 MOD.)	249 lbs.
Melting Point	329°F
Elongation (ASTM D-1682)	Warp 15%, Fill 18%
Shrinkage—Hot Water	Nil
Shrinkage—Dry (20 min. @ 270°F)	2%

Cover Fabric	100% seamless polyester; open weave allows for expansion of bentonite
Weight	1 oz. per square yard
Grab Strength	Warp 30 lbs., Fill 13.6 lbs.
Burst Strength	35 lbs. per square inch

Bentonite Sizing (Sodium Montmorillonite)	Specially graded, 6 mesh and 30 mesh granules
Mineralogical Composition	90% Montmorillonite (min.)

Adhesive	Water soluble, non-toxic
Storage	On dry ground, under roof or other protective covering

The manufacturer reserves the right to change product specifications and instructions/limitations without notice. Information contained herein supersedes previously printed material prior to 7/89.

JAMES CLEM

CORPORATION

contact

James Clem Corporation
444 North Michigan Avenue, Suite 1610
Chicago, IL 60611 USA

Phone: 312-321-6255
FAX: 312-321-6258
Telex: 343400

for your local distributor.

CLAYMAX Liner Inventory — Decorative Pond

Leachate Collection Pond (Secondary Liner)

CLAYMAX® LIQUID CONTAINMENT LINER

ADVANTAGES

Economical and easy to install
Minimal labor required
All seams are simple overlap seams
Liner can be cut and trimmed with a utility knife

GENERAL CHARACTERISTICS

Self-healing/Self-sealing
Natural sealant activated by water
Porous protection layers allowing quicker hydration
Water-soluble adhesive
Factory-uniform continuous bentonite layer
Minimum 1 lb. bentonite per sq. ft.
Totally flexible
Compatible for use with plastic liners and other multiple liner systems
Rolled goods for convenient storage
Standard sheet sizes: 13½' x 82' and custom lengths available
Relatively resistant to environmental and biological attack

INSTALLATION ADVANTAGES

Uncomplicated installation requiring:

No seam welding or sewing
No special equipment or cutting tools
No geotextile or other special protection

May be staked or nailed
Simple overlap seams
Accommodates complex configurations
No bentonite loss when cut or trimmed
Virtually no waste material

CAUTIONARY INSTRUCTIONS: CLAYMAX liner may be damaged by exposure to water turbulence or hazardous or toxic substances, hazardous or solid wastes, salt or other contaminants in water and should not be used for containment of these constituents without prior evaluation. CLAYMAX liner must be inspected for damage if exposed to any of those substances or conditions and, if damaged, must be repaired or replaced immediately. CLAYMAX liner must be installed in accordance with plan and specification requirements, prepared by a professional engineer.

All drawings are intended solely as a guide and for general information only.

All test performance data were produced under laboratory conditions and are not intended as a substitute for tests of the specific liquid or leachate that may come in contact with CLAYMAX liner. All test performance data are subject to James Clem Corporation's limitation of warranties. James Clem Corporation recommends that the purchaser perform site-specific tests of CLAYMAX liner.

LIMITATION OF WARRANTIES: James Clem Corporation warrants that CLAYMAX liner meets James Clem Corporation's specifications. James Clem Corporation disclaims any other warranties, express or implied, as to CLAYMAX liner, including all warranties of merchantability and fitness for any particular purpose. James Clem Corporation is not liable for any incidental or consequential damages of any kind. James Clem Corporation assumes no liability for CLAYMAX liner's performance or for injuries resulting from the use of CLAYMAX liner, including any liability resulting from the purchaser's engineering, design, construction and installation.

GENERAL INSTALLATION INFORMATION: CLAYMAX liner should never be installed in standing water.

Exposure to turbulent water may also cause damage.

If exposed to any of these substances or conditions, CLAYMAX liner must be inspected and, where necessary, immediately repaired or replaced.

If rainfall commences during installation or while under construction, cover with plastic sheeting to provide interim protection.

To insure its integrity, CLAYMAX liner must be protected by and remain buried under a minimum of 6" to 8" of backfill or aggregate. Backfill must be compacted with rubber-tired or conventional rolling equipment to an 85% Modified Proctor.

All illustrations are intended solely as a guide and are for general information only. Contact James Clem Corporation for:

- Containment installation instructions on slopes greater than 3 to 1.
- Installations where CLAYMAX liner must resist extreme hydrostatic pressure that may require a double layer of CLAYMAX liner.
- Temporary containment applications.
- Suitability for secondary containment applications.

Any unusual CLAYMAX liner installation procedures not covered in this brochure must be approved in writing by James Clem Corporation prior to the installation.

See James Clem Corporation's below-grade bentonite waterproofing catalog in Sweet's section 07100/CLE BuyLine 3527.

The information contained in this brochure supercedes all information printed prior to 7/89.

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Printed in the USA 8-89

BENTOMAT® "CLT" PANEL AND ROLL SPECIFICATIONS

STANDARD PANEL SPECIFICATIONS

PANEL DIMENSIONS*:	15-ft. (4.6 m) wide; 150-ft (45.7 m) long	
TOTAL PANEL AREA:	2,250-sq. ft. (209-sq. m)	
EFFECTIVE AREA:	2,145-sq. ft. (200-sq. m).	(Assumes 6-in. (150 mm) edge overlap and 2-ft. (600 mm) end overlap)

STANDARD ROLL SPECIFICATIONS

DIMENSIONS:	16-ft. (4.9 m) wide w/ core; 26-in. (660-mm) diameter
NOMINAL WEIGHT:	2950 lbs. (1340 kg)
CORE SIZE (I.D.):	4 in. (100 mm). Inner core plug measures 2.5 in. (63 mm)
PACKAGING:	6-mil (0.15 mm) U.V.-resistant polyethylene sleeve

STANDARD SHIPPING SPECIFICATIONS

SHIPMENT SIZE**:	15 rolls per truckload or container load
GRANULAR BENTONITE:	50-lb (23-kg) bags

UNLOADING AND HANDLING EQUIPMENT

CORE PIPE AND SPREADER BAR:	18-ft (5.5 m) long, 3 in. (75 mm) Nominal Pipe Size, XXH OR: Solid steel pipe OR: Stinger attachment for forklift
CHAINS OR STRAPS:	2 required; approximately 12-ft. (3.7 m) long each
EQUIPMENT:	Front end loader or forklift (typical)

*Custom widths/lengths available.

**The number of rolls per truckload may vary depending on actual mass of GCL rolls.

1500 W. Shure Drive • Arlington Heights, IL 60004 • USA • (847) 392-5800 • FAX (847) 577-5571
A wholly owned subsidiary of AMCOL International

The information and data contained herein are believed to be accurate and reliable. CETCO makes no warranty of any kind and accepts no responsibility for the results obtained through application of this information.

CETCO LINING TECHNOLOGIES

Certified Properties

BENTOMAT® "CLT" CERTIFIED PROPERTIES

MATERIAL PROPERTY	TEST METHOD	TEST FREQUENCY, ft2 (m2)	REQUIRED VALUES
Bentonite Swell Index[1]	ASTM D 5890	1 per 50 tonnes	24 mL/2g min.
Bentonite Fluid Loss[1]	ASTM D 5891	1 per 50 tonnes	18 mL max.
Bentonite Mass/Area[2]	ASTM D 5993	40,000 ft^2 (4,000 m^2)	0.75 lb/ft^2 (3.6 kg/m^2) min
GCL Grab Strength[3]	ASTM D 4632	200,000 ft^2 (20,000 m^2)	120 lbs (530 N) MARV
GCL Peel Strength[3]	ASTM D 4632	40,000 ft^2 (4,000 m^2)	15 lbs (65 N) min.
GCL Index Flux[4]	ASTM D 5887	Periodic	1×10^{-9} m^3/m^2/sec max.
Hydraulic Conductivity[4]	ASTM D 5887	Periodic	5×10^{-10} cm/sec max.
GCL Hydrated Internal Shear Strength[5]	ASTM D 5321	Periodic	500 psf (24 kPa) typical

Bentomat "CLT" is a reinforced GCL consisting of a layer of sodium bentonite between two geotextiles, which are needlepunched together and laminated to a 20-mil (0.5 mm) textured HDPE geomembrane.

Notes

1. Bentonite property tests performed at CETCO's bentonite processing facility before shipment to CETCO's GCL production facilities.
2. Bentonite mass/area reported at 0 percent moisture content.
3. All tensile testing is performed in the machine direction, with results as minimum average roll values unless otherwise indicated.
4. ASTM D5887 Index flux and hydraulic conductivity testing with deaired distilled/deionized water at 80 psi (551 kPa) cell pressure, 77 psi (531 kPa) headwater pressure and 75 psi (517 kPa) tailwater pressure. Reported value is equivalent to 95 gal/acre/day. This flux value is equivalent to a permeability of 5×10^{-10} cm/sec for typical GCL thickness. This flux value should not be used for equivalency calculations unless the gradients used represent field conditions. ASTM D 5887 testing is performed only on a periodic basis because the membrane is essentially impermeable.
5. Peak value measured at 200-psf (10 kPa) normal stress. Site-specific materials, GCL products, and test conditions must be used to verify internal and interface strength of the proposed design.

TR 401bm
Revised 9/01

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A wholly owned subsidiary of AMCOL International

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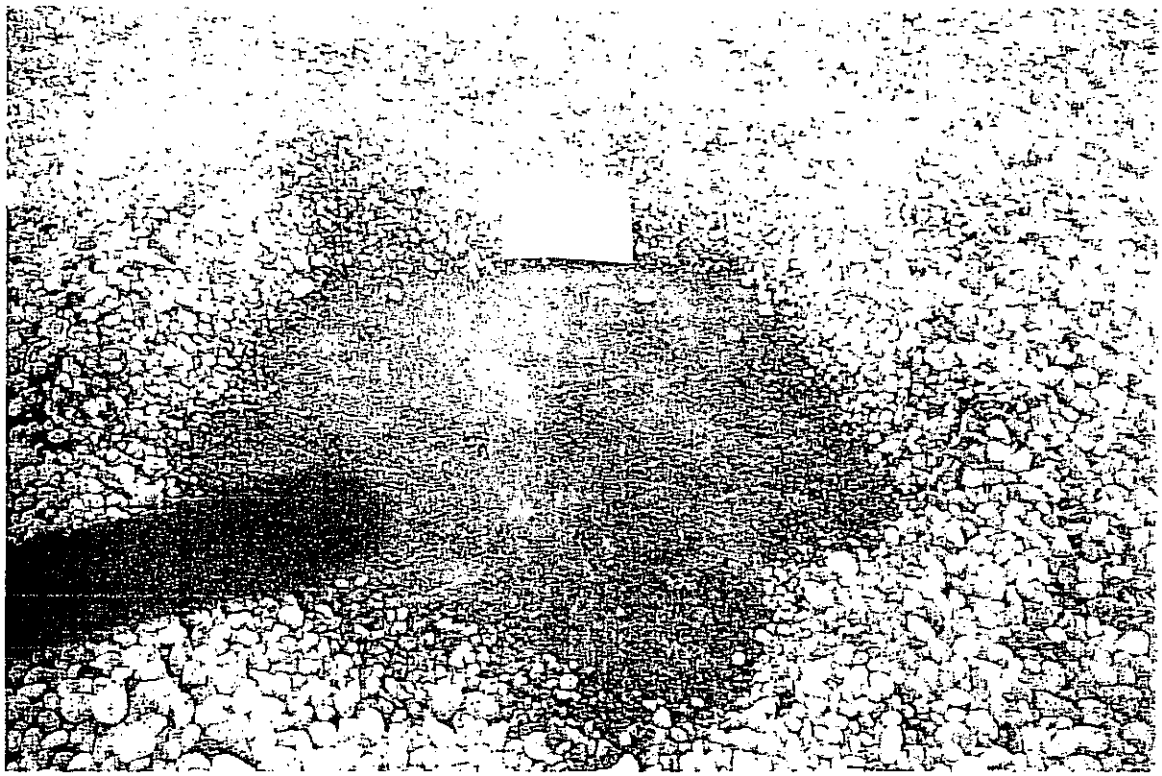
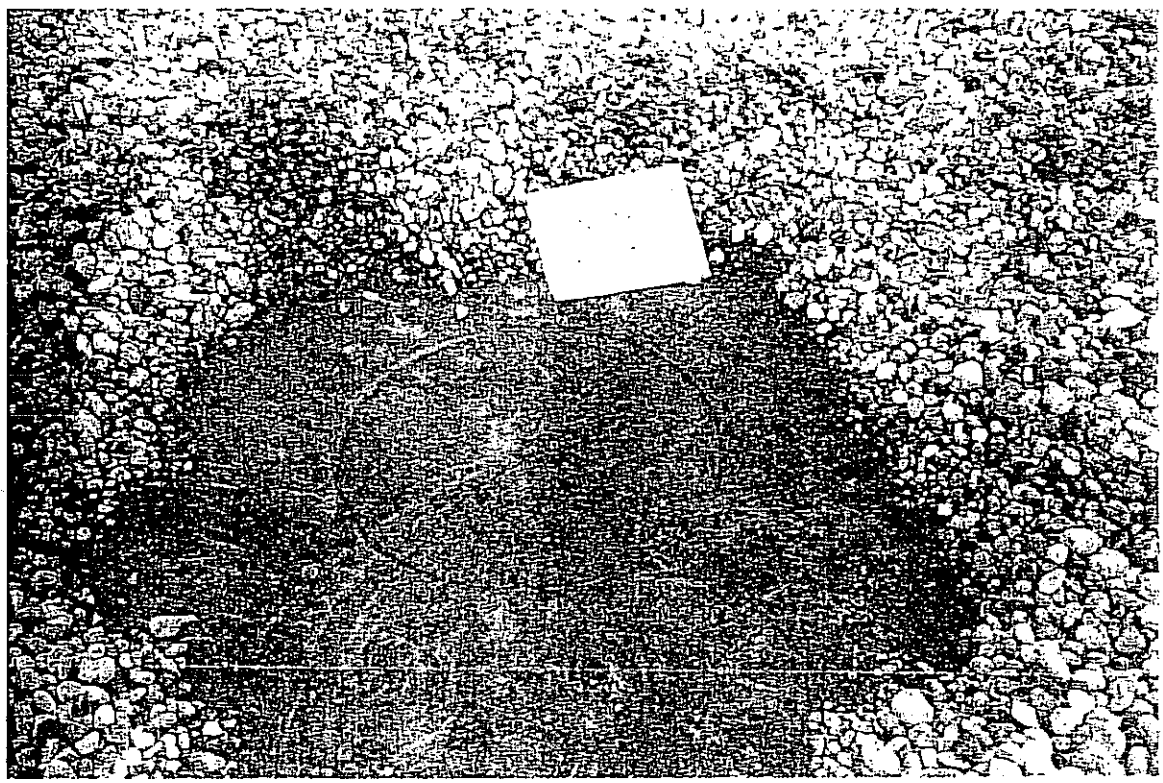
APPENDIX D

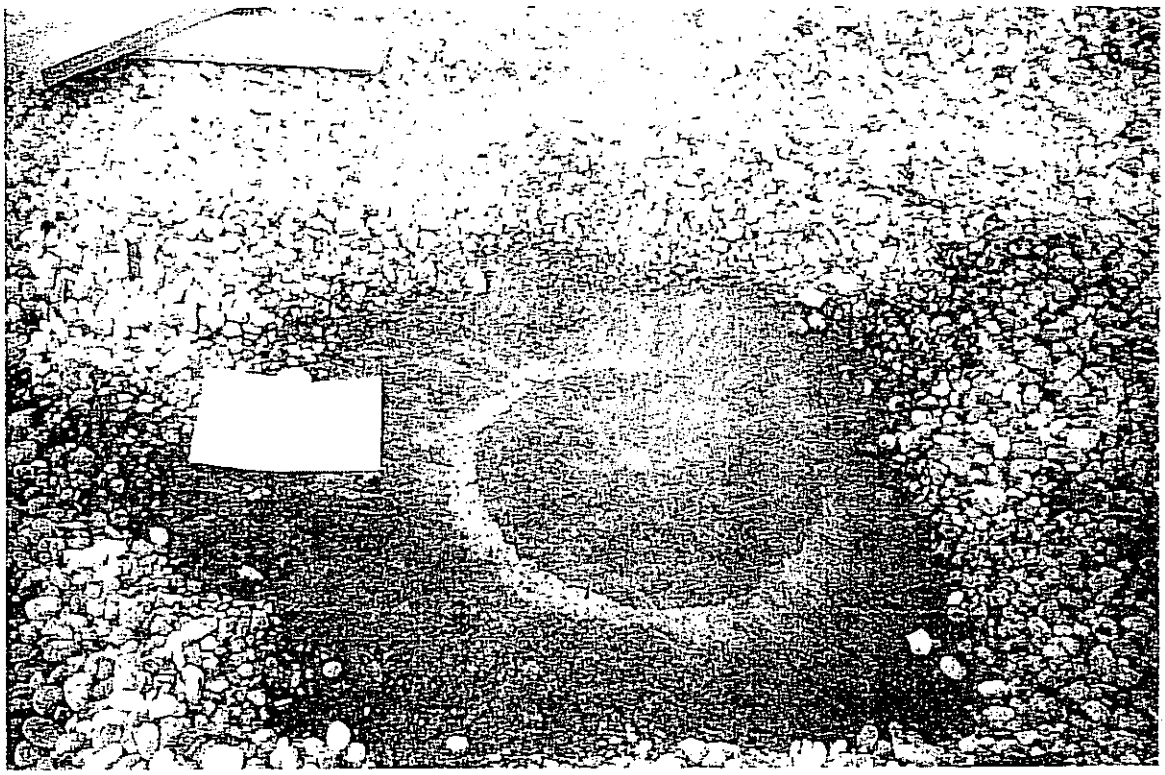
PHOTOGRAPHS OF TYPICAL TEST SET-UP



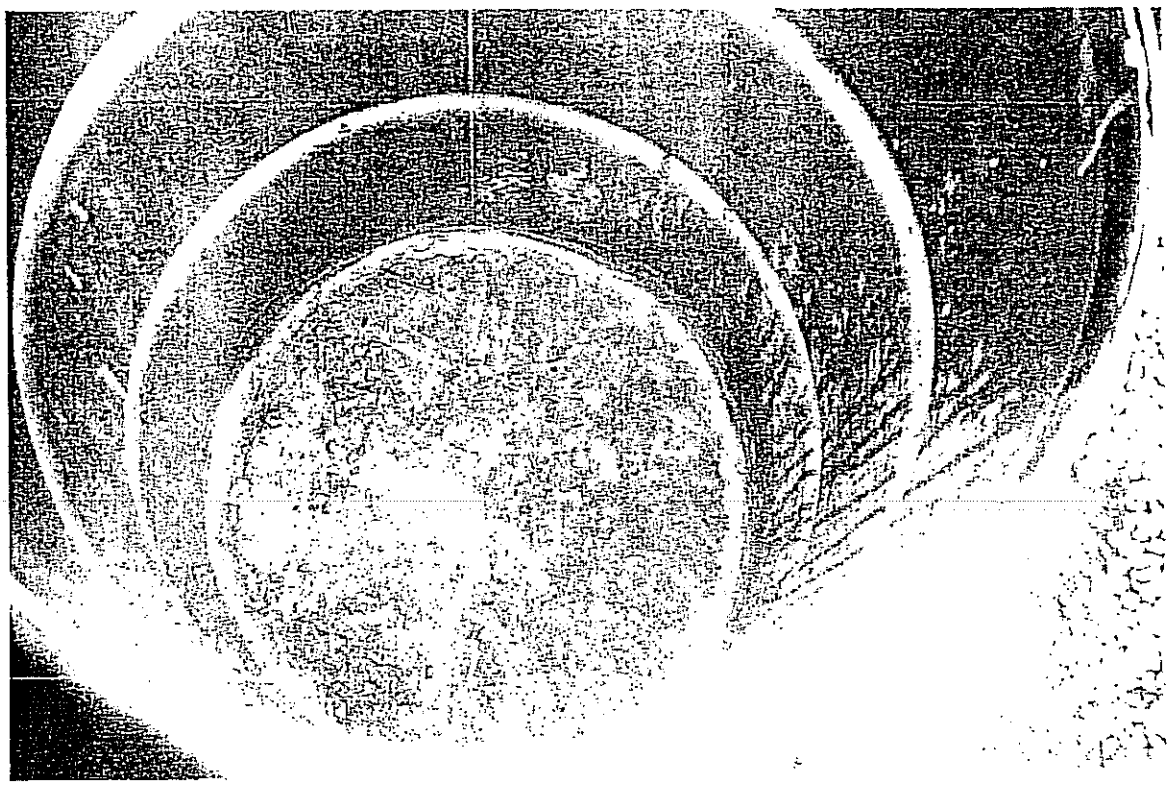
Step 1: Hand excavate area for in situ permeability test to expose upper surface of GCL.



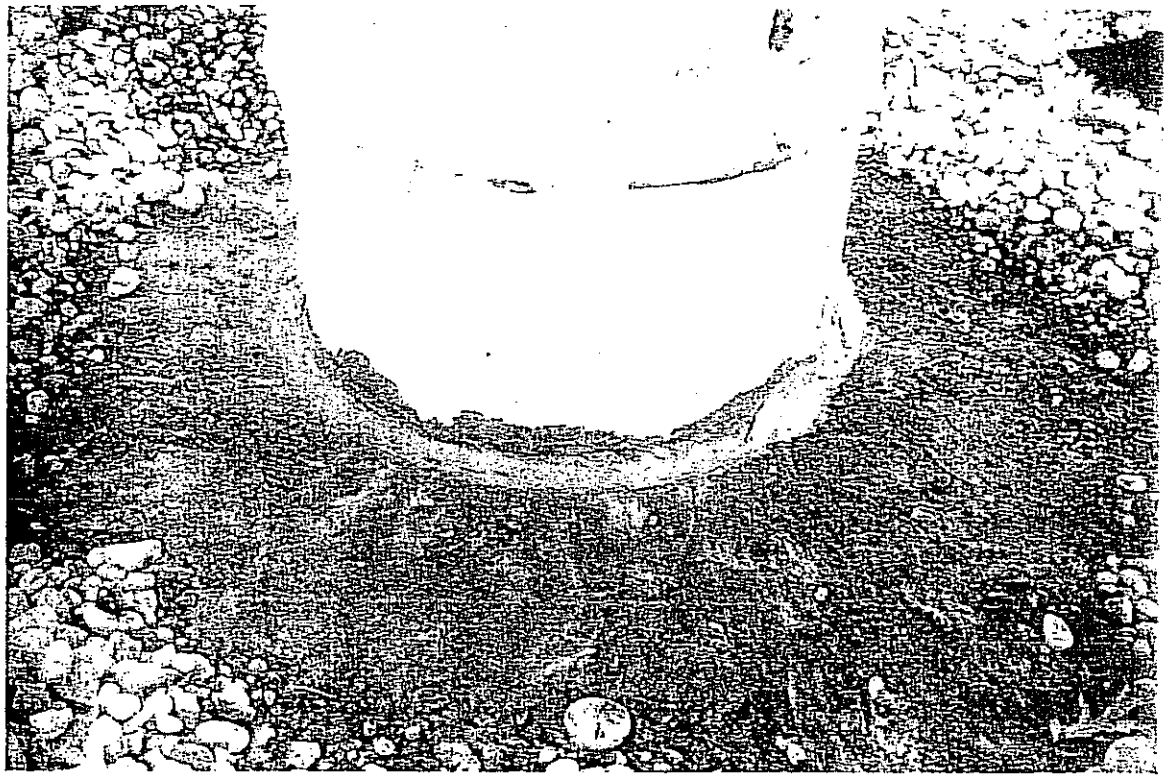
Step 2: Press edge of 55 gallon drum into the GCL to form a dimple in the upper surface of the GCL.



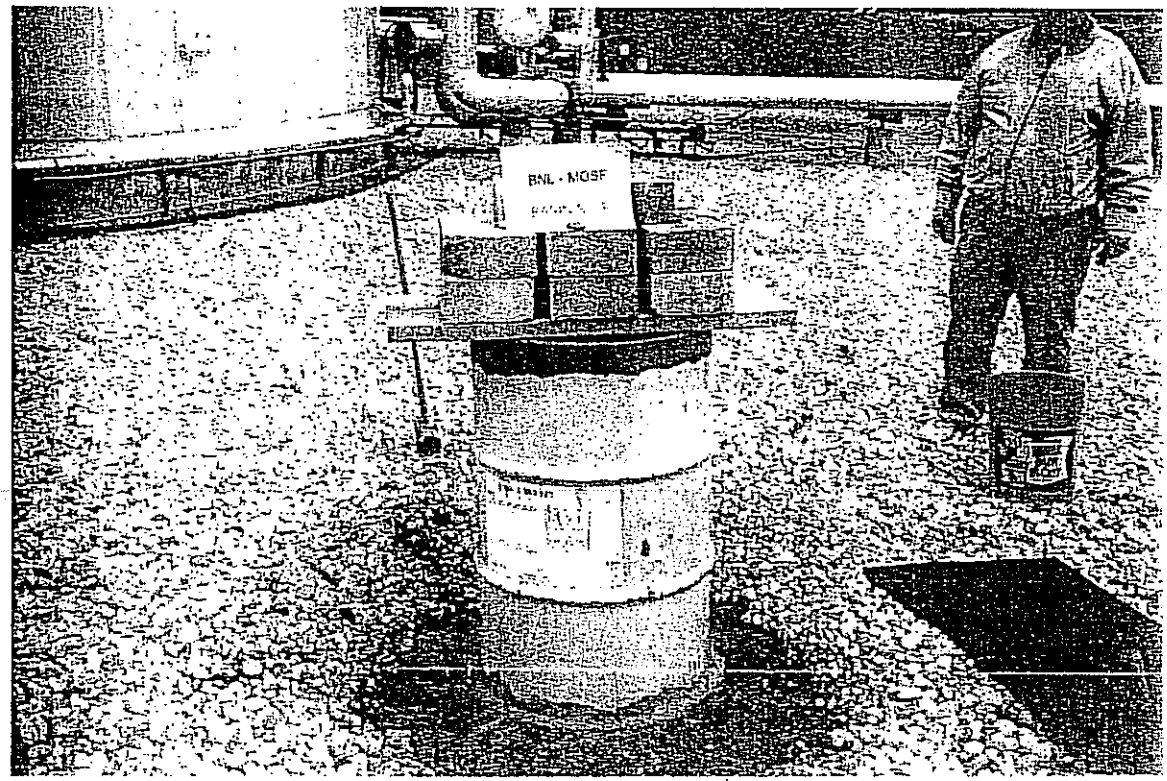
Step 3: Prepare a paste of powdered bentonite and water and lay a bead of paste into the dimple in the fabric of the GCL.



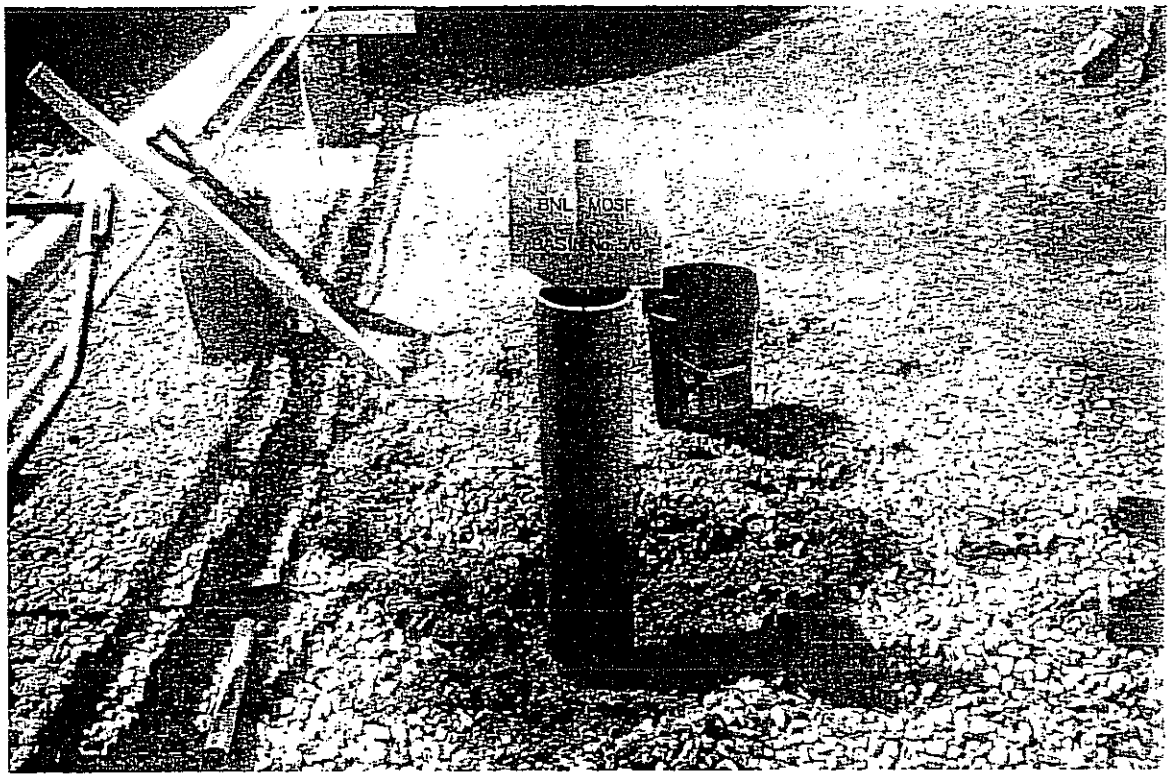
Step 4: Set 55 gallon drum into bentonite paste and trowel inside edge to create a seal using a minimal amount of the paste.



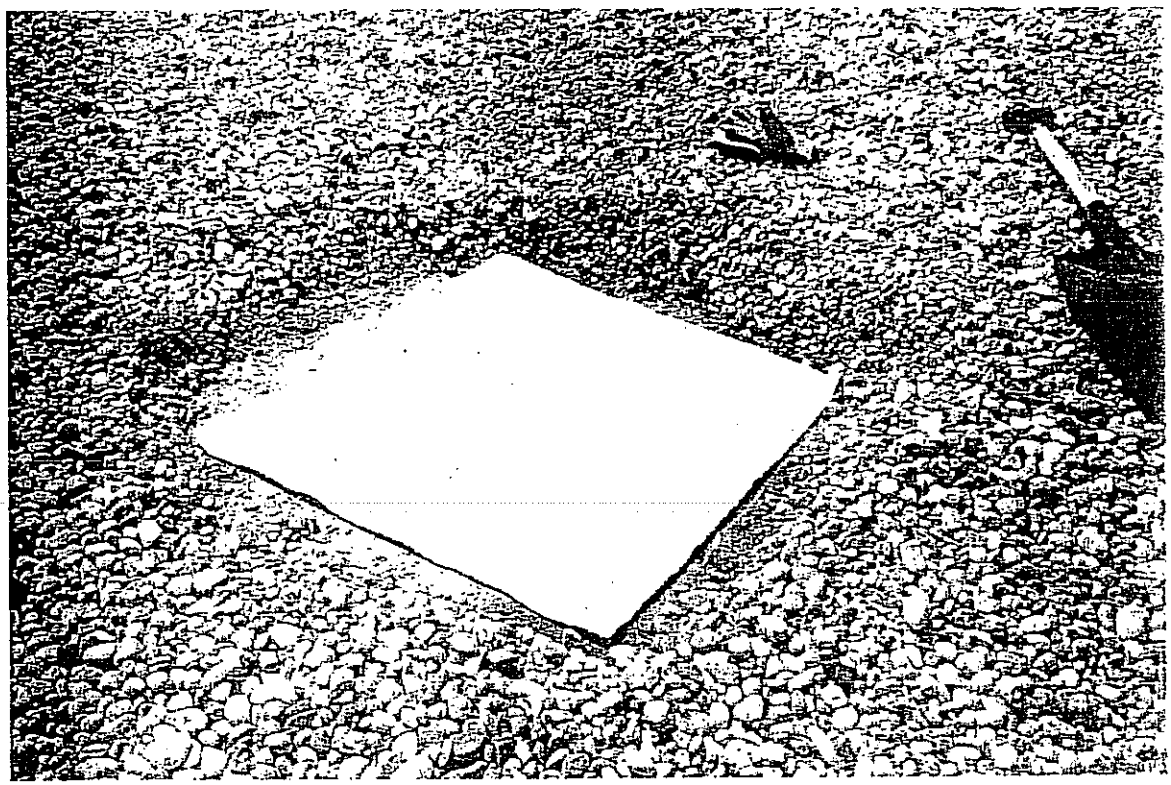
Step 5: Apply additional bentonite paste to the outer edge of the drum to create a seal.



Step 6: Set boards and weights on top of drum to apply downward pressure. Pour tap water into drum, allow test specimen to hydrate, then add water to 24 inches above surface of GCL. Measure drop in water level against time.



Typical test apparatus for the testing of the soil/bentonite low permeability hydraulic barriers in Basin 5/6 and Basin 12.



Typical example of the installation of powdered bentonite and a repair patch on the GCL after the performance of the in situ permeability test.

APPENDIX E

IN-SITU TEST PROTOCOL

Dvirka and Bartilucci
CONSULTING ENGINEERS
330 Crossways Park Drive, Woodbury, New York, 11797-2015
516-364-9890 • 718-460-3634 • Fax: 516-364-9045
e-mail: db-eng@worldnet.att.net

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Theodore S. Pytlar, Jr.

Associates
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David S. Glass, P.E.
William D. Merklin, P.E.
Michael Neuberger, P.E.
Brian M. Veith, P.E.
Charles J. Wachsmuth, P.E.

March 29, 2001

VIA FACSIMILE AND FIRST CLASS MAIL

Nick Acampora
NYSDEC
Division of Environmental Remediation – Spill Response
SUNY – Building 40
Stony Brook, NY 11790

Re: Brookhaven National Laboratory
Major Oil Storage Facility
NYSDEC Permit No. 01-1700
D&B No. 1903

Dear Mr. Acampora:

Dvirka and Bartilucci Consulting Engineers (D&B) has been retained by Brookhaven National Laboratory (BNL) to perform the 5-year evaluation of the secondary containment basins associated with its Major Oil Storage Facility (MOSF). This facility operates under NYSDEC Permit No. 01-1700 and currently consists of seven storage tanks located in six containment basins. D&B performed the previous evaluation of these six containment basins in 1995. Two additional basins (Containment Basins 1 and 2) addressed in 1995 have subsequently been removed from service due to the removal of the associated storage tanks and will not be considered in the upcoming evaluation.

For the purpose of discussion, the six containment basins which will be evaluated are as follows:

Tank Number	Containment Basin No.
3	3
4	4
5	5/6
6	5/6
9	9
10	10
12	Mini Tank Farm

In 1995, D&B documented that four of the subject containment basins (Nos. 3, 4, 9 and 10) were constructed with a geosynthetic clay liner (GCL) as the hydraulic barrier and the remaining two basins (Nos. 5/6 and the Mini Tank Farm) were constructed with a soil/bentonite blend as the hydraulic barrier. Confirmation of the permeability of these hydraulic barriers was addressed using laboratory procedures for the GCL (Nos. 4, 9 and 10) and in-place testing for the soil/bentonite blends. Destructive samples of the GCL were obtained by removing an 18-inch square from each basin. The samples were then subjected to laboratory permeability testing. The site of each destructive sample required that a repair or patch be installed to address the sampled area.

In the case of Containment Basin 3, it was found that the GCL used to construct the hydraulic barrier was an early version of Clay Max, which provided a geotextile on one side of the GCL and a paper scrim on the other side. The purpose of the paper scrim was to contain the bentonite core during shipping and installation. In accordance with the manufacturer's instructions, the GCL was installed with the paper scrim down, against the underlying soil subgrade. Over time, the paper scrim would deteriorate and place the bentonite core in direct contact with the soil subgrade.

The intended deterioration of the paper scrim resulted in a condition where a viable sample for laboratory testing could not be obtained and necessitated that an in-place permeability test be implemented. D&B devised an in-place test of the GCL in Containment Basin 3 as an adaptation of the in-place permeability testing method prescribed by the Petroleum Association for the Conservation of the Canadian Environment (PACE) Report No. 79-2. The details of this test method are described in the attached copy of Addendum 1, dated June 26, 1996, which was issued as a follow-up to the 1995 evaluation. This addendum is on file with the NYSDEC.

As you will note, the GCL test procedure was capable of documenting the in-place permeability down to a level of less than or equal to 1×10^{-6} cm/sec, utilizing the nomograph provided by the PACE Report No. 79-2 (Figure 4-11, copy attached). This level of definition is sufficient to satisfy the permeability guidelines offered by NYSDEC Spill Prevention Operations Technology Series (SPOTS) No. 10 for both the No. 2 and No. 6 Fuel Oil products which are stored by BNL.

Given that the in-place permeability test procedure for the GCL did not involve the taking of destructive samples, D&B would like to propose that this non-destructive method be utilized for all of the GCL testing in the upcoming evaluation. This approach should benefit the overall integrity of the containment basin by avoiding the need to make repairs to the hydraulic barrier. As a safeguard, D&B will install patch material over the area of each test to mitigate the potential that the test procedure may inadvertently compromise the hydraulic barrier in the area

of the test. In the event that a failing test is documented through these nondestructive procedures, a destructive sample will be taken for laboratory analysis to confirm the findings. As above, the site of the destructive sampling will be repaired with a patch of replacement material.

As per our previous telephone conversations, a minimum of two permeability tests will be conducted in the floor area for each containment basin. With your approval, these tests will be performed nondestructively unless conditions dictate that destructive sampling must be performed. Clearly, the intention of this proposal is to avoid the disturbance of the existing hydraulic barrier and the repairs necessitated by destructive sampling. The only disadvantage of nondestructive, in-place permeability testing is that the testing for the mass of bentonite per unit area of GCL cannot be performed. This parameter is not a condition of approval by NYSDEC and was performed in the 1995 evaluation as independent confirmation that the GCL was not compromised by its service. As noted in the 1995 evaluation, there was no significant deviation from the manufacturer's literature to suggest that the physical parameters of the GCL were altered by their use.

We trust that our proposal to use nondestructive methods to document the in-place permeability of the hydraulic barriers for the BNL facility will meet with your approval. Should you have any questions or concerns regarding this proposal, please feel free to contact this office directly in order that we may address your concerns as expeditiously as possible.

Upon receipt of your written position regarding this matter, we will proceed with the evaluation in order that BNL may comply with the prescribed timetable for this evaluation.

Very truly yours,

Edward J. Reilly

Edward J. Reilly

EJR/cmc
Enclosure
cc/encl.:
W. Chaloupka
R. Burns
♦1903\EJR01LTR-01.DOC(R01)

BROOKHAVEN NATIONAL LABORATORY
MAJOR OIL STORAGE FACILITY
PERMIT No. 01-1700
EVALUATION OF EXISTING
SECONDARY CONTAINMENT SYSTEMS

ADDENDUM No. 1
JUNE 26, 1996

Field examination of the eight (8) basins was performed by representatives of Dvirka and Bartilucci in late November and early December of 1995. Six of the eight basins (namely Basins 1, 2, 3, 4, 9 and 10) were found to be constructed with a Geosynthetic Clay Liner (GCL) as the hydraulic barrier. Basins 5/6 and 8/12 were found to be constructed with a soil/bentonite mixture as the hydraulic barrier.

As part of this effort, 18-inch square coupons of the installed GCL were removed from Basins 1, 2, 4, 9 and 10 for the purpose of laboratory permeability testing and mass of bentonite per unit area determinations. For each of these five basins, the nature of the GCL permitted viable samples or coupons to be retrieved and subjected to laboratory testing. In the case of Basin 3, it was discovered that the installed GCL was an earlier version of that installed in the other five basins. The distinction between these two versions is that the Basin 3 GCL was fabricated with a paper scrim on one side which was intended to dissolve or deteriorate over time to allow the bentonite core of the GCL to come in direct contact with the underlying soil. This intermixing of the bentonite core and the soil is consistent with the intent of the product. However, this mechanism prevents ready definition of the interface of the GCL and the soil for the purpose of removing a sample for laboratory testing. After careful examination of the coupon removed from Basin 3, it was determined that the sample could not be considered undisturbed or representative of the in-situ conditions. As a result, the sample was not subjected to laboratory testing for permeability or mass of bentonite per unit area determinations.

In response to these circumstances, an alternate method of testing the integrity of the Basin 3 hydraulic barrier was devised. The beginning of winter weather conditions prevented this alternate testing to take place in late December and was deferred until the Spring of 1996.

On March 29, 1996, representatives of Dvirka and Bartilucci conducted an in-situ permeability test of the installed GCL in Basin 3. The test method devised was non-invasive so as not to damage or compromise the barrier. The test method is described as follows:

Arrangements were made with Brookhaven National Laboratories to have Basin 3 drained of any accumulated precipitation in accordance with standard facility protocols prior to commencing the test. A test location was selected in the bottom area of the basin to be representative of the overall basin and the protective gravel layer was manually removed to expose the top surface of the GCL.

The test apparatus consisted of a clean 55-gallon drum deheaded both ends to serve as an infiltrometer or reservoir of water above the test specimen. The assembled test apparatus is shown in Figure No. 2 attached. Prior to performing the test, the drum was placed in position and weighted down to form a dimple or impression in the GCL. This impression was coated with a bentonite and water paste and the lower end of the drum was set into the paste. Additional bentonite paste was used to seal the lower edge of the drum to the surface of the GCL. Minimal bentonite paste was used on the interior seal so as not to compromise the integrity of the test.

The top of the drum was then covered with boards and weighted down with sand bags to promote the seal at the GCL interface. Several inches of water was placed into the drum to fully hydrate the seals and confirm that test water was not being lost at the drum/GCL interface. The drum was then filled to a level of 24 inches above the GCL surface and the test begun. Over a period of approximately 2 hours and 45 minutes, 29 measurement of the water surface were taken and no measurable drop was detected. Measurement accuracy is 0.01 feet.

The results of the test support the appropriateness of the test method and confirm that the test sample is the area inscribed by the open end of the drum. This test is comparable in nature to the permeameter test performed in Basins 5/6 and 8/12 and that prescribed by the Petroleum Association for Conservation of the Canadian Environment (PACE) Report No. 79-2 referenced in the ERM-Northeast report. In keeping with the PACE report, if after a 30-minute test period there is no discernible change in fluid level, the permeability is assumed to be equal to or less than 1×10^{-6} cm/sec. Given that the test was conducted for approximately 2 hours and 45 minutes (greater than 5 times that prescribed) and no discernible change in the liquid level could be measured, it can be concluded that the GCL exhibits a permeability equal to or less than 1×10^{-6} cm/sec. For the purpose of calculation, a permeability value of 1×10^{-6} cm/sec will be utilized. Based on the length of the test conducted with no discernible drop in liquid level, it is likely that the permeability is less than 1×10^{-6} cm/sec.

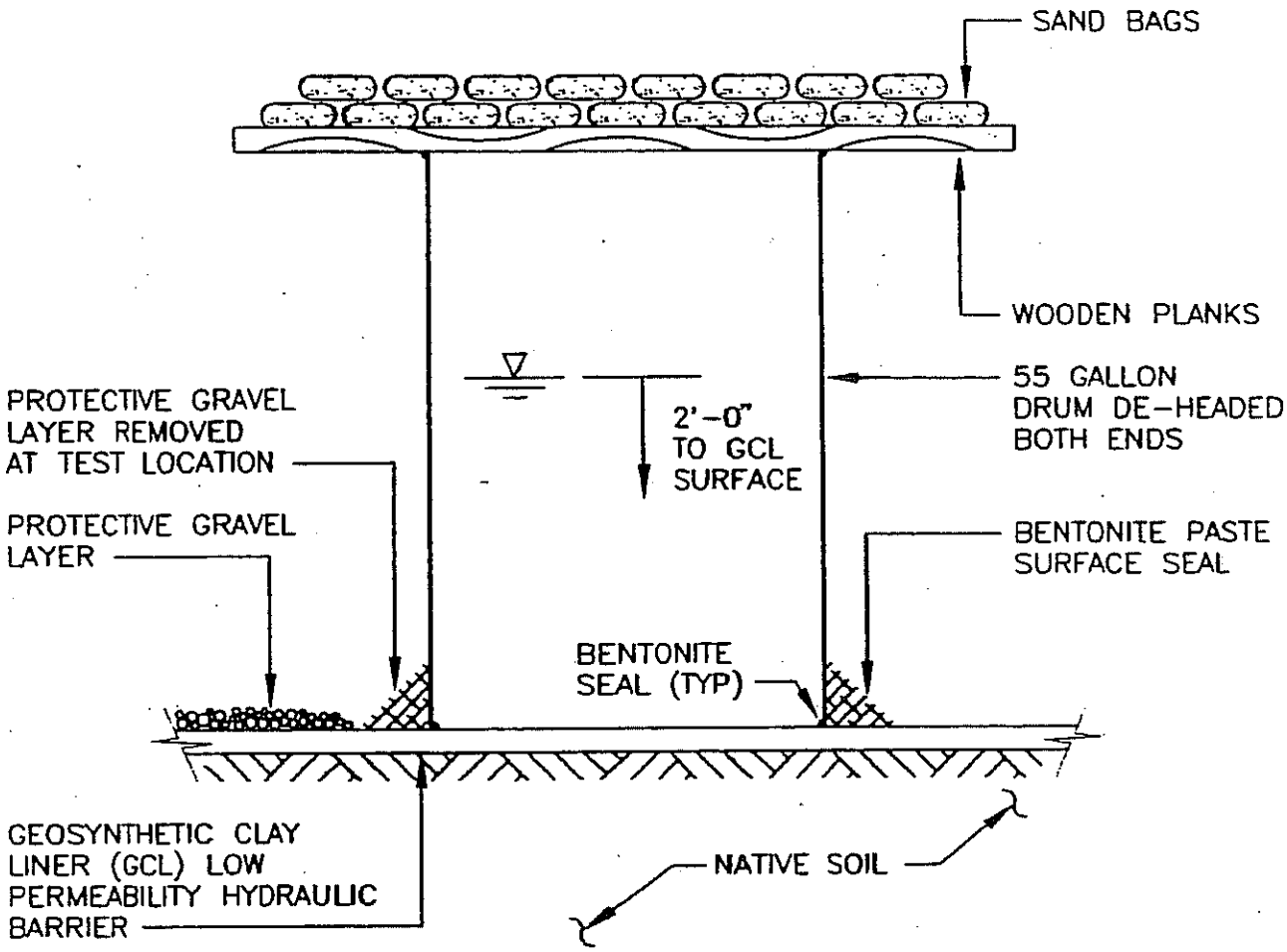
Given the makeup of the GCL installed in Basin 3, namely, the absence of a geosynthetic at the interface with the underlying soil, a representative sample for the determination of mass of bentonite per unit area is not available. Due to the intermixing of the bentonite core with the underlying soil there is no practical method to estimate this value in the field.

Table 2 (Page 21) of the December 1995 report has been revised to include the permeability value for Basin 3 and a copy is attached hereto.

Table 3 (Page 23) of the December 1995 report has been revised to reflect that the mass of bentonite per unit area for Basin 3 cannot be determined and a copy is attached hereto.

Table 5 (Page 26) of the December 1995 report has also been revised to reflect the data now available for Basin 3 and the resulting vertical percolation rates for water and No. 2 Fuel Oil. A copy of the revised Table 5 is attached hereto.

As can be seen by the test data for Basin 3, the in-place GCL provides a competent hydraulic barrier with a permeability less than or equal to 1×10^{-6} cm/sec. The top surface of the GCL in the test area was found to be intact and undisturbed. As with the other five basins constructed with GCL, the current hydraulic conductivity or permeability of the GCL has increased over time when compared to the manufacturer's literature but still provides for general compliance with the requirements for secondary containment. This level of containment is further enhanced by the fact that Tank 3 is utilized for the storage of ASTM No. 6 fuel oil which, due to its viscosity at ambient temperatures, is less likely to permeate the secondary containment system.



IN -SITU PERMEABILITY TEST BASIN NO.3

N.T.S.

BROOKHAVEN NATIONAL LABORATORY
MAJOR OIL STORAGE FACILITY
EVALUATION OF EXISTING
SECONDARY CONTAINMENT SYSTEMS

Dvirka and Bartilucci
Consulting Engineers
A Division of William F. Cosulich Associates, P.C.

FIGURE No.2

TABLE 2

BROOKHAVEN NATIONAL LABORATORY
MAJOR OIL STORAGE FACILITY

PERMEABILITY OF
GEOSYNTHETIC CLAY LINERS

Basin No.	Calculated Permeability
1	3.85×10^{-7} cm/sec
2	4.19×10^{-6} cm/sec
3	$\leq 1 \times 10^{-6}$ cm/sec
4	1.40×10^{-7} cm/sec
9	1.31×10^{-7} cm/sec
10	1.01×10^{-7} cm/sec

TABLE 3

BROOKHAVEN NATIONAL LABORATORY
MAJOR OIL STORAGE FACILITY

MASS/UNIT AREA
GEOSYNTHETIC CLAY LINERS

Basin No.	Mass/Unit Area (Dry)	Mass/Unit Area (corrected to 20% moisture)
1	0.87 lbs./sq. ft.	1.09 lbs./sq. ft.
2	0.81 lbs./sq. ft.	1.01 lbs./sq. ft.
3	N/A	N/A
4	1.07 lbs./sq. ft.	1.34 lbs./sq. ft.
9	0.67 lbs./sq. ft.	0.84 lbs./sq. ft.
10	0.81 lbs./sq. ft.	1.03 lbs./sq. ft.

N/A: Not Available, method of fabrication of the Geosynthetic Clay Liner in Basin 3 precludes a determination of the mass of bentonite per unit area.

TABLE 5

BROOKHAVEN NATIONAL LABORATORY

SUMMARY OF VERTICAL PERCOLATION RATES

Basin No.	Barrier Type	Permeability (cm/sec)	Hydraulic Barrier		Underlying Soils		Total Travel Time - Water (days)	Total Travel Time - No. 2 Fuel Oil (days)
			Velocity - Water (ft/day)	Travel Time - Water (days)	Velocity - Water (ft/day)	Travel Time - Water (days)		
1	GCL	3.85×10^{-7}	0.056	0.377	2.91	10.96	11.3	22.7
2	GCL	4.19×10^{-6}	0.606	0.035	2.91	10.96	10.9	21.9
3	GCL	$\leq 1 \times 10^{-6}$	0.145	0.145	2.91	10.96	11.11	22.2
4	GCL	1.40×10^{-7}	0.020	1.04	2.91	10.96	12.0	24.0
5/6	Soil/Bentonite							
	Test 1	2.87×10^{-7}	0.002	396	2.91	10.96	406.9	813.8
	Test 2	2.10×10^{-5}	0.139	5.41	2.91	10.96	16.4	32.7
	Test 5	6.25×10^{-7}	0.004	182	2.91	10.96	192.9	385.8
8/12	Soil/Bentonite							
	Test 3	1.11×10^{-4}	0.733	1.0	2.91	10.96	11.9	23.9
	Test 4	2.35×10^{-5}	0.155	4.83	2.91	10.96	15.8	31.6
9	GCL	1.31×10^{-7}	0.019	1.11	2.91	10.96	12.1	24.1
10	GCL	1.01×10^{-7}	0.015	1.44	2.91	10.96	12.4	24.8

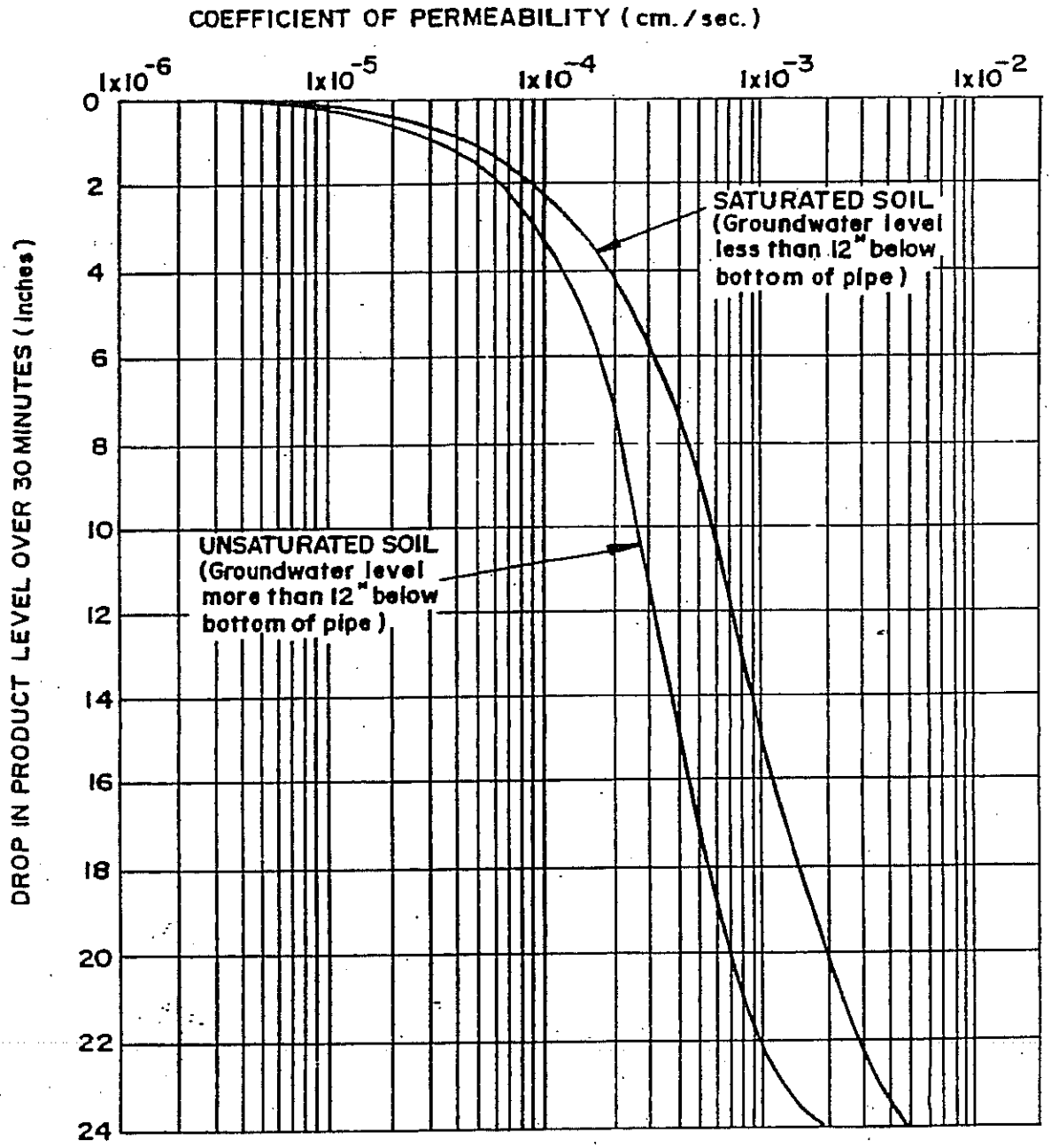


Figure 4·11 COEFFICIENT OF PERMEABILITY (34)

New York State Departme of Environmental Conserv. on
Division of Environmental Remediation, Region One
Spill Prevention and Response
Building 40 - SUNY, Stony Brook, New York 11790-2356
Phone: (631) 444-0320 • **FAX:** (631) 444-0328
Website: www.dec.state.ny.us

Erin M. Crotty
Commissioner

April 11, 2001

Dvirka and Bartilucci
330 Crossways Park Drive
Woodbury, NY 11797-2015

Attn: Mr. Edward Reilly

Re: MOSF #01-1700, Brookhaven National Laboratory, Upton.

Dear Mr. Reilly:

This office is in receipt of your March 29, 2001 permeability testing proposal for the secondary containment systems at the above referenced site. Based on review of the proposal, this office has no objection to you proceeding with the test method described provided that you adhere to the procedures outlined in the PACE Report 79-2, any applicable industry accepted procedures, and good engineering practice.

A report must then be prepared and submitted to this office for review and comment no later then 30 days after completion of the inspection. The report must include the results of the permeability testing, your findings of the physical condition of the containment area and liner, a diagram indicating the location of each test area, and any recommendations. In addition, a Professional Engineer must be review, certified and stamp the report with his/her seal.

Please contact me at least 5 days in advance of the work so a representative may be present. If you have any questions or comments regarding this matter, please call me at (631) 444-0322.

Sincerely,

Nick Acampora
Environmental Program Specialist II

cc: K. Gomez
W. Chaloupka, BNL

APPENDIX F

LABORATORY TESTING OF CETCO CLT – BASIN 4

geotechnics
.....GEOTECHNICAL AND GEOSYNTHETIC SERVICES

LABORATORY TEST REPORT

July 31, 2006

Mr. Edward J. Reilly
Dvirka and Bartilucci
330 Crossways Park Drive
Woodbury, New York 11797-2015

Project No.: L06163-01

GAI-LAP
Initials: MM #: 14-96
Date: 7-31-06

RE: LABORATORY TEST RESULTS
BENTOMAT CLT GCL
BROOKHAVEN NATIONAL LABORATORY
MAJOR OIL STORAGE FACILITY
SECONDARY CONTAINMENT – BASIN NO.4
D&B NO. 2540

Transmitted herein are the results of laboratory tests performed for Dvirka and Bartilucci as directed by Mr. Reilly on two samples of Bentomat CLT GCL with the textured geomembrane carrier that were submitted on July 11, 2006. The samples were approximately seventeen inches by seventeen inches and were packaged flat in individual plywood boxes.

We are pleased to be of service and trust that our efforts have contributed to the success of your project. Should you have any questions or if we may be of any further assistance, please do not hesitate to call.

Respectfully submitted,

Richard S. Lacey

Richard S. Lacey, P.E.
Laboratory Director

attachments: 8 Data Pages

geotechnics
INTEGRITY IN TESTING

CAVEAT

The tests were performed in general accordance with the procedures referenced on the data tables as well as industry practice on test specimens believed to be representative of the samples submitted. The test results are indicative only of the specimens that were actually evaluated. There were no sample remnants.

Geotechnics has no direct knowledge of the origin of the samples submitted, implies no position with regard to the disposition of the test results, i.e. pass/fail, and makes no claims as to the suitability of the material for its intended end use.

The test data and all associated project information provided shall be held in confidence and disclosed to other parties only with the authorization of the Client and Geotechnics.

The test data transmitted herein is considered integral with this report and is not to be reproduced except in whole and only with the authorization of the Client and Geotechnics.

GCL INDEX FLUX & PERMEABILITY TEST

ASTM D 5887
(SOP-G52)

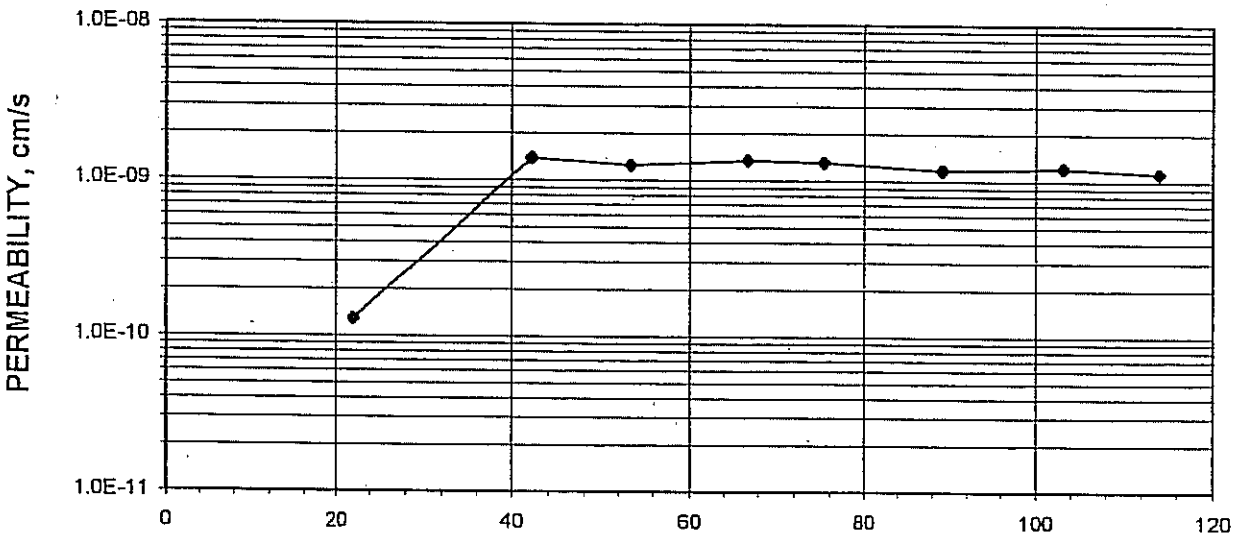
geotechnics
INTEGRITY IN TESTING

ab ID No.	L06163-01-01	Material	BENTOMAT CLT GCL
Client	DVIRKA & BARTILUCCI	Roll I.D.:	NA
Client Project	BROOKLYN NATIONAL D&R #2540	Lot No.:	NA
roject No.	L06163-01	Sample No.	4A

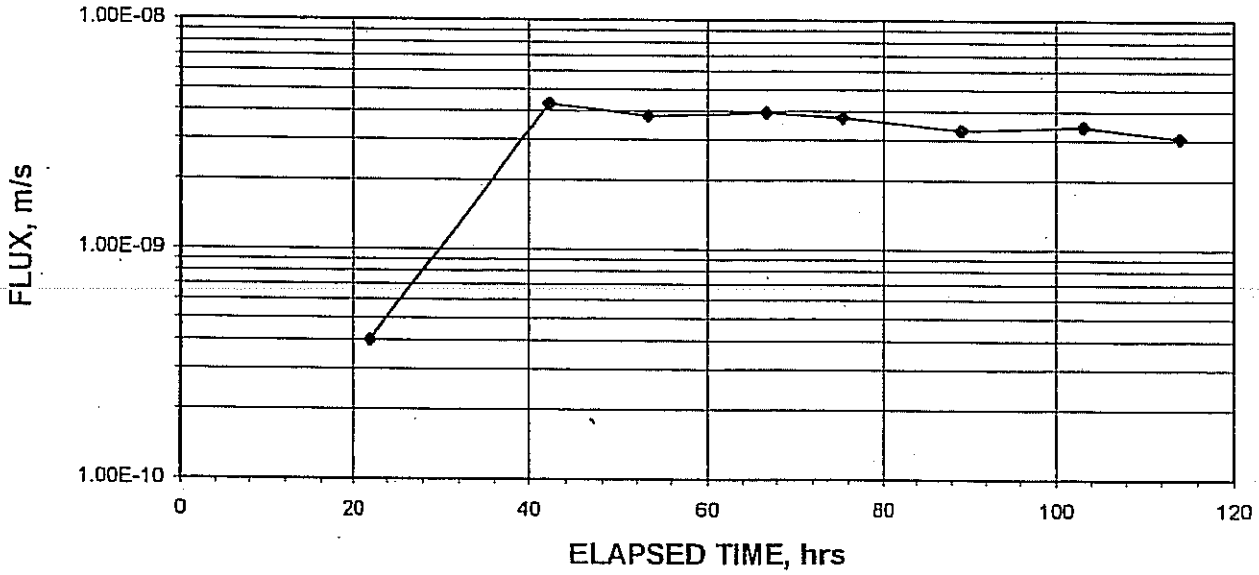
AVERAGE FLUX = 3.27E-09 m/s

AVERAGE PERMEABILITY = 1.18E-09 cm/s @ 20°C

PERMEABILITY VS. ELAPSED TIME



FLUX VS. ELAPSED TIME



Checked By: Date:

C:\MSOFFICE\Excel\Perms\July 2006\[163P2GCL.xls]Sheet1

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GCL INDEX FLUX & PERMEABILITY TEST

ASTM D 5887
(SOP-G52)

geotechnics
INTEGRITY IN TESTING

Lab ID No.	L06163-01-01	Tested by: JCM	Date: 07/12/06
Client	DVIRKA & BARTILUCCI		
Client Project	BROOKLYN NATIONAL D&R #2540	Checked by:	Date:
Project No.	L06163-01		
Material	BENTOMAT CLT GCL		
Roll I.D.:	NA		
Lot No.:	NA		
Sample No.	4A		
Permeant:	DEAIRED, DEIONIZED WATER		

SPECIMEN:	BEFORE TEST	AFTER TEST
Wt. of GCL (gm.) [2]	62.96	
Clay Component Thickness 1 (in.) [1]	0.141	0.178
Clay Component Thickness 2 (in.) [1]	0.159	0.214
Clay Component Thickness 3 (in.) [1]	0.154	0.225
Average Clay Component Thickness (in.)	na	0.206
Average Clay Component Thickness (mm)	na	**5.224**
Specimen Dia. (in)	4.000	4.000
Specimen Area (in.^{2})	12.57	12.57
Specimen Area (m^2)	0.00811	0.00811
Mass/Unit Area of GCL(gm./m^2) [2]	7,763	17,604
Mass/Unit Area of GCL(psf) [2]	1.59	3.60

*NOTES: 1) Direct visual measurement of exposed clay at specimen perimeter.
2) Includes weight of the textile carriers.

C:\MSOFFICE\Excel\Perms\July 2006\[163P2GCL.xls]Sheet1

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GCL INDEX FLUX & PERMEABILITY TEST

ASTM D 5887
(SOP-G52)

geotechnics
INTEGRITY IN TESTING

Lab No.	L06163-01-01
lient	DVIRKA &.BARTILUCCI
Client Project	BROOKLYN NATIONAL D&R #2540
Project No.	L06163-01
laterial	BENTOMAT CLT GCL
Roll I.D.:	NA
Sample No.	4A

Pressure Heads (Constant)		Final Sample Dimensions	
op Cap (psi)	75.0	Sample Length (cm), L	0.522
Bottom Cap (psi)	77.0	Sample Diameter (cm)	10.16
Cell (psi)	80.0	Sample Area (cm^2), A	**78.50**
Total Head (cm)	140.6	Inflow Burette Area (cm^2), a-in	0.875
		Outflow Burette Area (cm^2), a-out	0.875

AVERAGE FLUX = 3.27E-09 m/s
AVERAGE PERMEABILITY = 1.18E-09 cm/s @ 20oC

DATE (m-d-y)	ELAPSED TIME t (hr)	TOTAL INFLOW (cm^3)	TOTAL OUTFLOW (cm^3)	RATIO ΔIN / ΔOUT (3 readings)	TOTAL HEAD h (cm)	TEMP. (°C)	INCREMENTAL FLUX @ 20°C (m/sec)	INCREMENTAL PERMEABILITY @ 20°C (cm/sec)
07/15/06	0.0	0.0	0.0	NA	155.8	23.0	NA	NA
07/16/06	22.1	0.3	0.2	NA	155.2	22.0	4.01E-10	1.28E-10
07/17/06	42.3	2.9	2.5	1.16	149.6	22.2	4.30E-09	1.40E-09
07/17/06	53.4	4.1	3.7	1.09	146.9	22.5	3.80E-09	1.26E-09
07/18/06	66.9	5.7	5.1	1.08	143.5	22.1	3.95E-09	1.35E-09
07/18/06	75.3	6.7	5.9	1.18	141.4	22.0	3.75E-09	1.31E-09
07/19/06	89.2	7.9	7.3	1.00	138.5	22.1	3.32E-09	1.18E-09
07/19/06	103.1	9.2	8.7	0.89	135.4	23.0	3.44E-09	1.22E-09
07/20/06	114.1	10.2	9.6	1.00	133.2	22.0	3.07E-09	1.14E-09

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CONFORMANCE TEST RESULTS

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CLIENT: DVIRKA AND BARTILUCCI CONSULTING ENGINEERS
CLIENT PROJECT: BROOKHAVEN NATIONAL LABORATORY
MAJOR OIL STORAGE FACILITY
SECONDARY CONTAINMENT-BASIN NO. 4
CLIENT PROJ. NO.: 2540
PROJECT NO.: L06163-01
LAB ID NO.: L06163-01-01
MATERIAL: CETCO BENTOMAT CLT GCL
SAMPLE I.D. 4A

	SPECIMEN	TOTAL WT. AS REC'D grams	TOTAL WT. DRY grams	TOTAL WT. AS REC'D psf	TOTAL WT. DRY psf	WT. BACKING psf (1)	AS REC'D Bent Cont psf	DRY Bent Cont psf	MOISTURE CONTENT %	Bent Cont 12% m.c. psf
BENTONITE CONTENT ASTM D5993	1	78.6	60.8	1.56	1.21	0.200	1.36	1.01	35	1.13
	2	87.7	61.1	1.74	1.21	0.200	1.54	1.01	52	1.13
	3	71.6	56.2	1.42	1.11	0.200	1.22	0.91	33	1.02
	4	79.0	60.6	1.57	1.20	0.200	1.37	1.00	36	1.12
	5	79.5	57.4	1.58	1.14	0.200	1.38	0.94	47	1.05
							AVERAGE:	**0.97**	**41**	**1.09**

* NOTES:1) Weight of carrier (geotextile) provided by CETCO spec. info: .

CHECKED BY: BF DATE: 7-14-06

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GCL INDEX FLUX & PERMEABILITY TEST

ASTM D 5887
(SOP-G52)

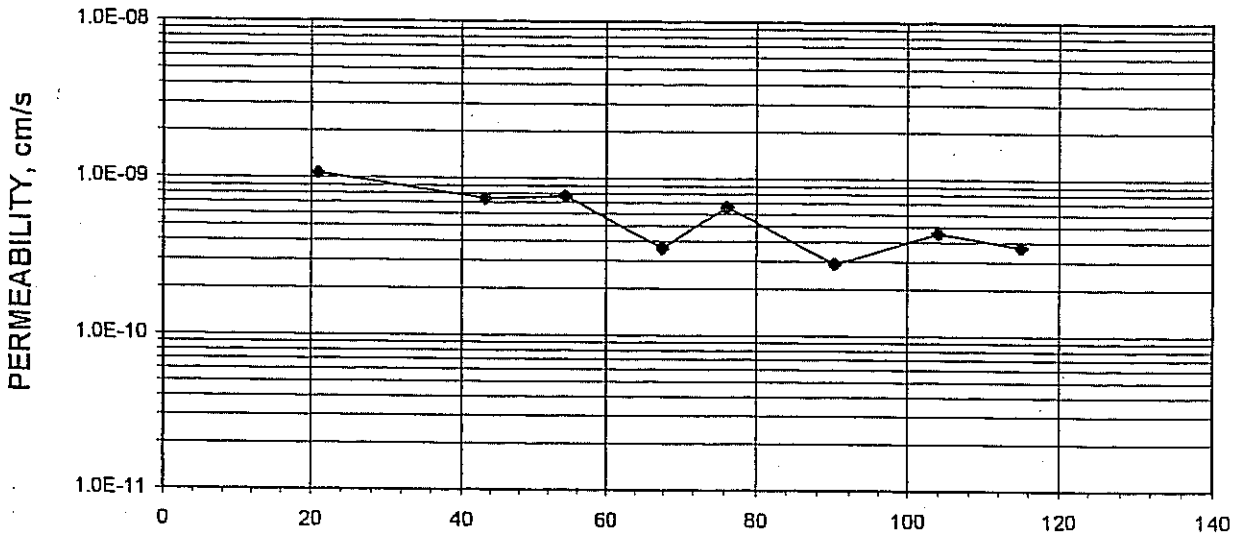
geotechnics
INTEGRITY IN TESTING

Lab ID No.	L06163-01-02	Material	BENTOMAT CLT GCL
Client	DVIRKA & BARTILUCCI	Roll I.D.:	NA
Client Project	BROOKLYN NATIONAL D&R #2540	Lot No.:	NA
Project No.	L06163-01	Sample No.	4B

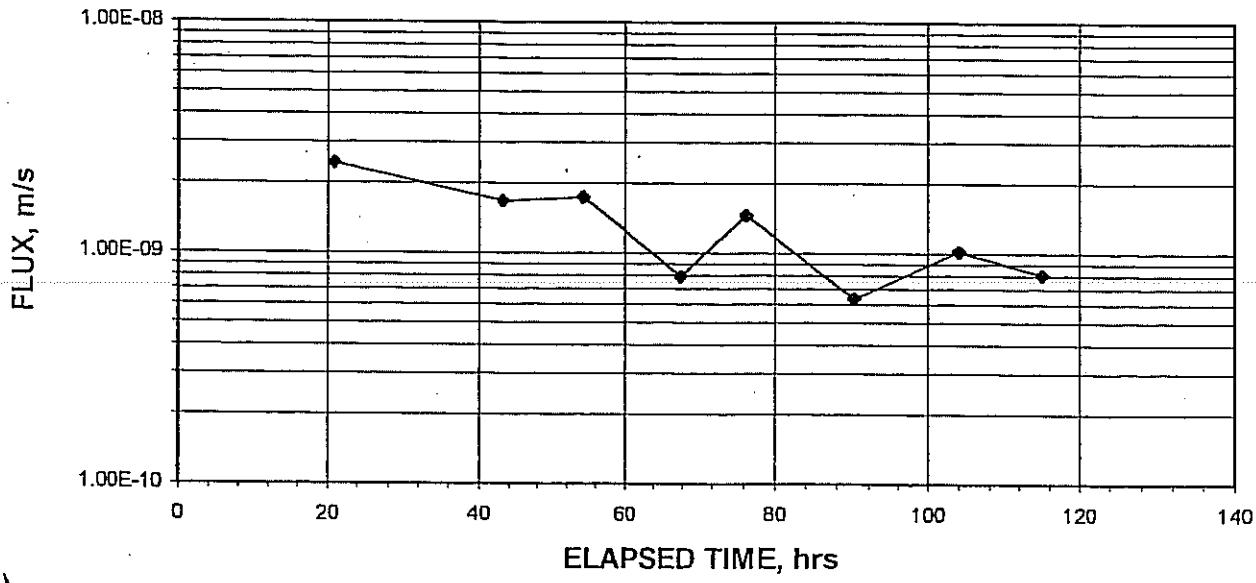
AVERAGE FLUX = 8.21E-10 m/s

AVERAGE PERMEABILITY = 3.72E-10 cm/s @ 20°C

PERMEABILITY VS. ELAPSED TIME



FLUX VS. ELAPSED TIME



Checked By: Date:

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GCL INDEX FLUX & PERMEABILITY TEST

ASTM D 5887
(SOP-G52)

geotechnics
INTEGRITY IN TESTING

Lab ID No.	L06163-01-02	Tested by: JCM	Date: 07/12/06
Client	DVIRKA & BARTILUCCI		
Client Project	BROOKLYN NATIONAL D&R #2540	Checked by:	Date:
Project No.	L06163-01		
Material	BENTOMAT CLT GCL		
Roll I.D.:	NA		
Lot No.:	NA		
Sample No.	4B		

Permeant: DEAIRED, DEIONIZED WATER

SPECIMEN:	BEFORE TEST	AFTER TEST
Wt. of GCL (gm.) [2]	70.21	
Clay Component Thickness 1 (in.) [1]	0.160	0.285
Clay Component Thickness 2 (in.) [1]	0.146	0.236
Clay Component Thickness 3 (in.) [1]	0.135	0.309
Average Clay Component Thickness (in.)	na	0.277
Average Clay Component Thickness (mm)	na	**7.027**
Specimen Dia. (in)	4.000	4.000
Specimen Area (in.^{2})	12.57	12.57
Specimen Area (m^2)	0.00811	0.00811
Mass/Unit Area of GCL(gm./m^2) [2]	8,657	19,632
Mass/Unit Area of GCL(psf) [2]	1.77	4.02

*NOTES: 1) Direct visual measurement of exposed clay at specimen perimeter.
2) Includes weight of the textile carriers.

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GCL INDEX FLUX & PERMEABILITY TEST

ASTM D 5887
(SOP-G52)

geotechnics
INTEGRITY IN TESTING

Lab ID No.	L06163-01-02
Client	DVIRKA & BARTILUCCI
Client Project	BROOKLYN NATIONAL D&R #2540
Project No.	L06163-01
Material	BENTOMAT CLT GCL
Roll I.D.:	NA
Sample No.	4B

Pressure Heads (Constant)

Top Cap (psi)	75.0
Bottom Cap (psi)	77.0
Cell (psi)	80.0
Total Head (cm)	140.6

Final Sample Dimensions

Sample Length (cm), L	0.703
Sample Diameter (cm)	10.16
Sample Area (cm^2), A	**78.50**
Inflow Burette Area (cm^2), a-in	0.891
Outflow Burette Area (cm^2), a-out	0.915

AVERAGE FLUX = 8.21E-10 m/s
AVERAGE PERMEABILITY = 3.72E-10 cm/s @ 20oC

DATE (m-d-y)	ELAPSED TIME t (hr)	TOTAL INFLOW (cm^3)	TOTAL OUTFLOW (cm^3)	RATIO ΔIN/ΔOUT (3 readings)	TOTAL HEAD h (cm)	TEMP. (°C)	INCREMENTAL FLUX @ 20°C (m/sec)	INCREMENTAL PERMEABILITY @ 20°C (cm/sec)
07/15/06	0.0	0.0	0.0	NA	155.3	23.0	NA	NA
07/16/06	21.0	2.6	0.3	NA	152.1	22.0	2.44E-09	1.07E-09
07/17/06	43.3	4.5	0.5	9.00	149.7	22.2	1.67E-09	7.44E-10
07/17/06	54.4	5.1	1.0	3.57	148.5	22.5	1.74E-09	7.71E-10
07/18/06	67.9	5.7	1.0	2.40	147.8	22.1	7.90E-10	3.61E-10
07/18/06	76.3	6.2	1.2	5.50	147.1	22.0	1.46E-09	6.65E-10
07/19/06	90.2	6.4	1.5	1.40	146.5	22.1	6.38E-10	2.88E-10
07/19/06	104.1	6.9	1.8	1.17	145.6	23.0	1.02E-09	4.56E-10
07/20/06	115.1	7.2	2.0	1.60	145.1	22.0	8.07E-10	3.71E-10

Checked By: Date:

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CONFORMANCE TEST RESULTS

geotechnics

CLIENT: DVIRKA AND BARTILUCCI CONSULTING ENGINEERS
CLIENT PROJECT: BROOKHAVEN NATIONAL LABORATORY
MAJOR OIL STORAGE FACILITY
SECONDARY CONTAINMENT-BASIN NO. 4
CLIENT PROJ. NO.: 2540
PROJECT NO.: L06163-01
LAB ID NO.: L06163-01-02
MATERIAL: CETCO BENTOMAT CLT GCL
SAMPLE I.D. 4B

	SPECIMEN	TOTAL WT. AS REC'D grams	TOTAL WT. DRY grams	TOTAL WT. AS REC'D psf	TOTAL WT. DRY psf	WT. BACKING psf (1)	AS REC'D Bent Cont psf	DRY Bent Cont psf	MOISTURE CONTENT %	Bent Cont 12% m.c. psf
BENTONITE CONTENT ASTM D5993	1	84.2	53.4	1.67	1.06	0.200	1.47	0.86	71	0.96
	2	73.6	47.9	1.46	0.95	0.200	1.26	0.75	68	0.84
	3	84.2	56.6	1.67	1.12	0.200	1.47	0.92	60	1.03
	4	85.8	57.7	1.70	1.14	0.200	1.50	0.94	59	1.06
	5	81.1	55.4	1.61	1.10	0.200	1.41	0.90	57	1.01
							AVERAGE:	0.87	63	0.98

* NOTES:1) Weight of carrier (geotextile) provided by CETCO spec. info: .

CHECKED BY: BF DATE: 7-14-06

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L06163-01-02

7/14/2006

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APPENDIX G

PERMEABILITY TEST SITES/LOCATIONS OF VISUAL EXAMINATION

NOTE:
LOCATION OF PIPE SUPPORT PIERS & LOCATION OF VISUAL OBSERVATIONS ARE APPROXIMATE.

TEST SITE 3A

Observations:
GCL fabric in fair to poor condition. Several abrasions noted on top layer of fabric. 4 to 5 inches of stone above fabric.

Test Results:
Date: June 29, 2006
Weather: Partly Cloudy
Temperature: 75°F

Time	Water Level(feet)
1:45 p.m.	1.34
2:15 p.m.	1.35
2:45 p.m.	1.38
3:15 p.m.	1.39
3:45 p.m.	1.40
4:00 p.m.	1.41

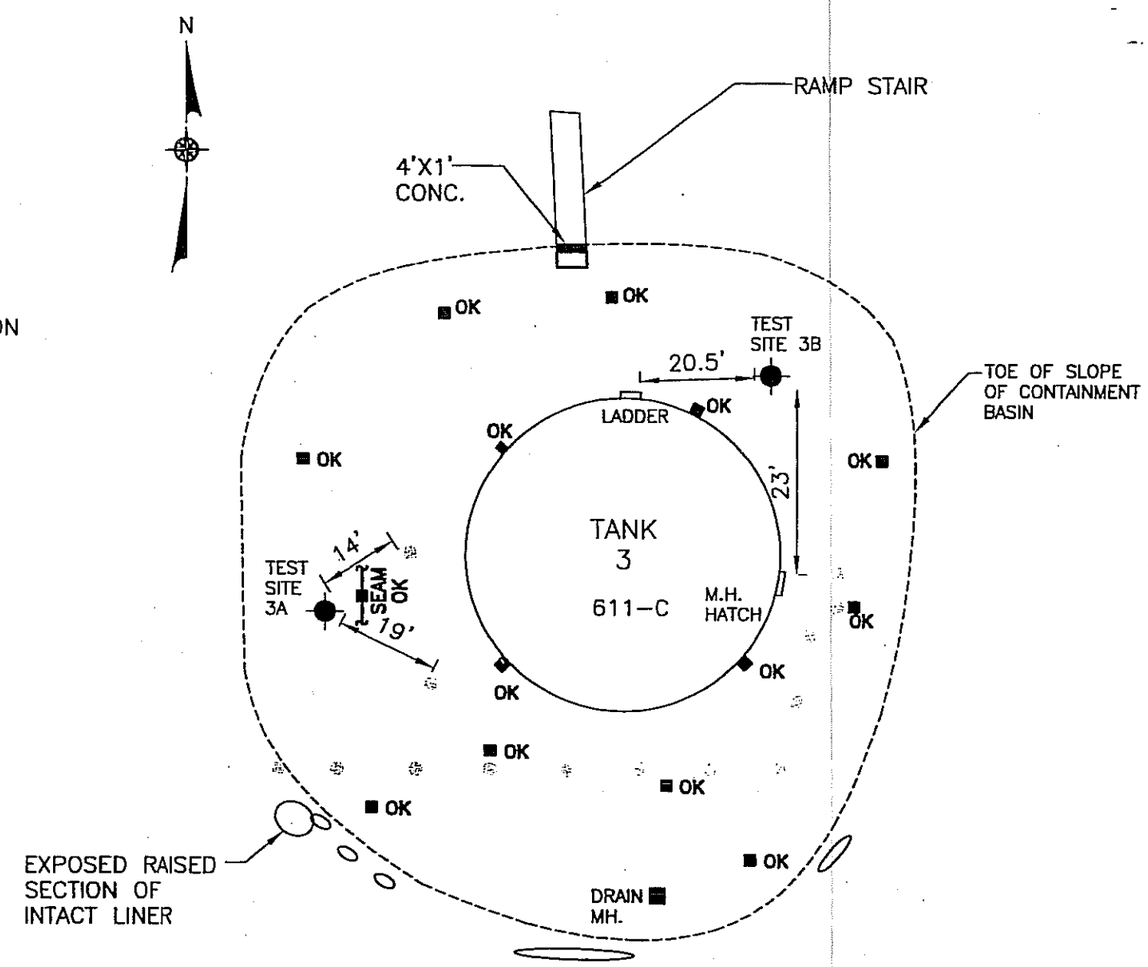
LEGEND
- 12"ø CONC. PIERS
- LOCATION OF VISUAL EXAMINATION
- PERMEABILITY TEST SITE
- LINER EXPOSED AT SURFACE AT TOP OF SLOPE

TEST SITE 3B

Observations:
GCL fabric in good condition. ± 5 inches of stone above fabric.

Test Results:
Date: June 29, 2006
Weather: Partly Cloudy
Temperature: 75°F

Time	Water Level(feet)
11:30 a.m.	1.31
12:00 p.m.	1.31
12:30 p.m.	1.31
1:00 p.m.	1.32
1:30 p.m.	1.32
2:00 p.m.	1.32
2:30 p.m.	1.33
3:00 p.m.	1.34



SOURCE: DVIRKA AND BARTILUCCI, EVALUATION OF EXISTING SECONDARY CONTAINMENT SYSTEMS, JUNE 2001

SCALE: 1"=20'

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CONSULTING ENGINEERS
A DIVISION OF WILLIAM F. COSULICH ASSOCIATES, P.C.

BROOKHAVEN NATIONAL LABORATORY
MAJOR PETROLEUM FACILITY

CONTAINMENT BASIN NO. 3

DRAWING NO. 2

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NOTES:
1. LOCATION OF PIPE SUPPORT PIERS & LOCATION OF VISUAL OBSERVATIONS ARE APPROXIMATE.

TEST SITE 4A

Observations:
GCL fabric in good condition.
± 6 inches of stone above GCL.

Test Results:
Date: June 27, 2006
Weather: Sunny
Temperature: 80°F

A sample of liner 1'–6"x1'–6" was cut out and sent for laboratory analysis. The sample area was patched with 3'–6"x3'–6" liner and bentonite powder.

TEST SITE 4B

Observations:
GCL fabric in good condition.
± 6 inches of stone above GCL.

Test Results:
Date: June 27, 2006
Weather: Sunny
Temperature: 80°F

A sample of liner 1'–6"x1'–6" was cut out and sent for laboratory analysis. The sample area was patched with 3'–6"x3'–6" liner and bentonite powder.

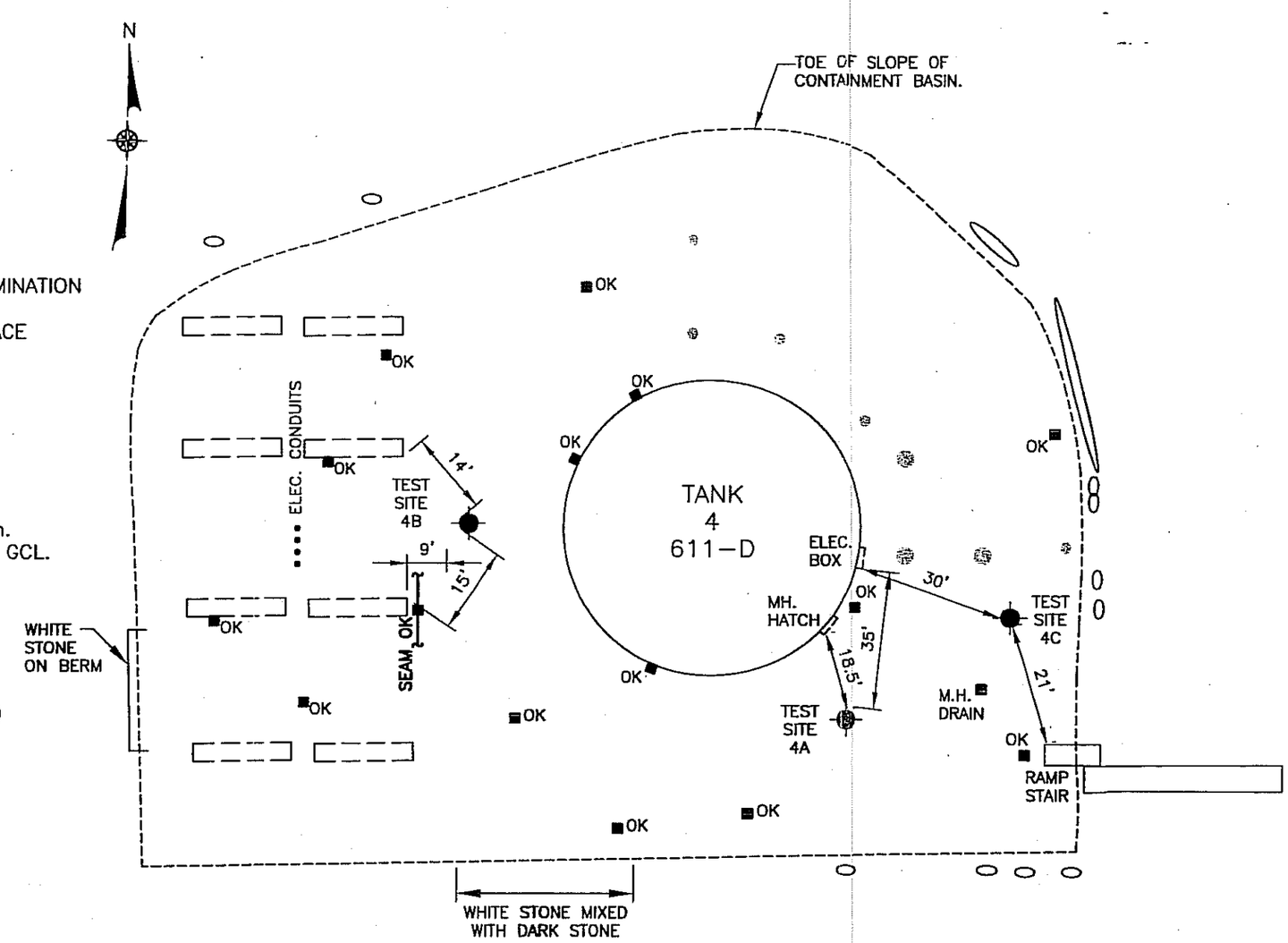
LEGEND
- 12"ø CONC. PIERS
- 3'ø CONC. PIERS
- LOCATION OF VISUAL EXAMINATION
- PERMEABILITY TEST SITE
- LINER EXPOSED AT SURFACE AT TOP OF SLOPE

TEST SITE 4C

Observations:
GCL fabric in good condition.
4 inches ± of stone above GCL.

Test Results:
Date: June 28, 2006
Weather: Sunny
Temperature: 80°F

Time	Water Level(feet)
11:30 a.m.	1.20
12:00 p.m.	1.20
12:30 p.m.	1.21
1:00 p.m.	1.21
1:30 p.m.	1.21
2:00 p.m.	1.21
2:30 p.m.	1.22
3:00 p.m.	1.23



SOURCE: DVIRKA AND BARTILUCCI, EVALUATION OF EXISTING SECONDARY CONTAINMENT SYSTEMS, JUNE 2001

SCALE: 1"=20'

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BROOKHAVEN NATIONAL LABORATORY
MAJOR PETROLEUM FACILITY

CONTAINMENT BASIN NO. 4

DRAWING NO. 3

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NOTES:
1. LOCATION OF PIPE SUPPORT PIERS & LOCATION OF VISUAL OBSERVATIONS ARE APPROXIMATE.

LEGEND
- 12"ø CONC. PIERS
- LOCATION OF VISUAL EXAMINATION
- PERMEABILITY TEST SITE (6'ø PIPE)

TEST SITE 5/6B

Observations:
Site was somewhat difficult to penetrate the 6-inch diameter test pipe into the basin floor. A moderate degree of clay was evident in and around test location.

Test Results:
Date: June 28, 2006
Weather: Rain/Overcast
Temperature: 80°F

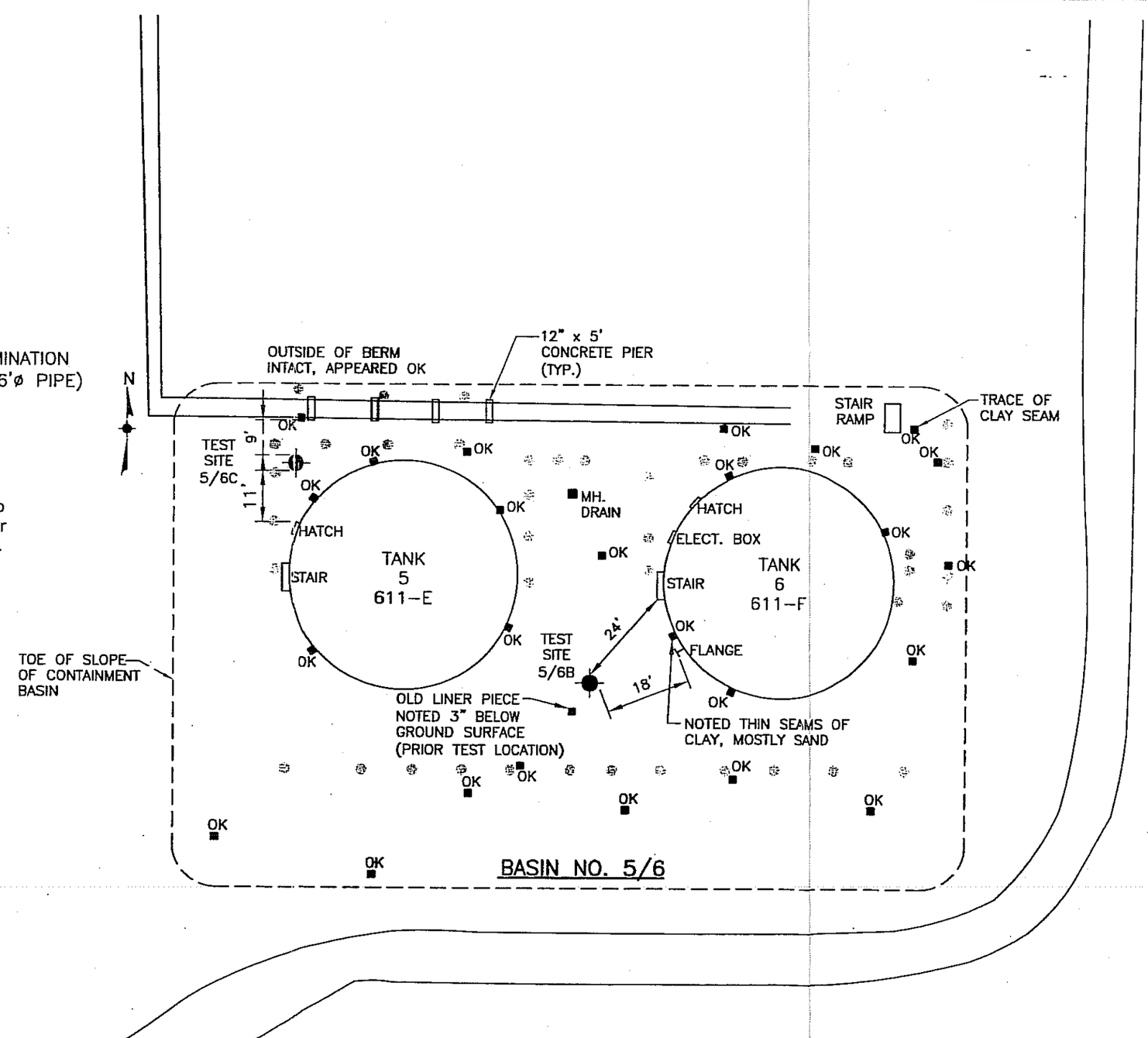
Time	Water Level(feet)
9:00 a.m.	1.39
10:00 a.m.	1.40
10:30 a.m.	1.39
11:00 a.m.	1.39
11:30 a.m.	1.39
12:00 p.m.	1.39
12:30 p.m.	1.39
1:00 p.m.	1.40

TEST SITE 5/6C

Observations:
Site was somewhat difficult to penetrate the 6-inch diameter test pipe into the basin floor. A moderate degree of clay was evident in and around test location.

Test Results:
Date: June 28, 2006
Weather: Rain/Overcast
Temperature: 80°F

Time	Water Level(feet)
10:00 a.m.	1.51
10:30 a.m.	1.53
11:00 a.m.	1.54
11:30 a.m.	1.55
12:00 p.m.	1.57
12:30 p.m.	1.58
1:00 p.m.	1.60



SCALE: 1"=20'

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A DIVISION OF WILLIAM F. COSULICH ASSOCIATES, P.C.

BROOKHAVEN NATIONAL LABORATORY
MAJOR PETROLEUM FACILITY

CONTAINMENT BASIN NO. 5 AND NO. 6

DRAWING NO. 4

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NOTES:

1. LOCATION OF PIPE SUPPORT PIERS & LOCATION OF VISUAL OBSERVATIONS ARE APPROXIMATE.

TEST SITE 9A

Observations:
GCL fabric is in good condition. 3 to 4 inches of stone cover over GCL.

Test Results:
Date: June 28, 2006
Weather: Light rain (a.m.), partly cloudy (p.m.)
Temperature: 80°F

Time	Water Level(feet)
1:20 p.m.	1.13
1:50 p.m.	1.14
2:20 p.m.	1.14
2:50 p.m.	1.15
3:50 p.m.	1.15
4:20 p.m.	1.15
4:50 p.m.	1.16
5:00 p.m.	1.16

TEST SITE 9B

Observations:
GCL fabric is in good condition. Test not valid due to leaky seal around test chamber. Moved to Site C.

Test Results:
Date: June 28, 2006
Weather: Partly Cloudy
Temperature: 80°F

Test chamber could not establish a seal to surface of GCL. Test abandoned.

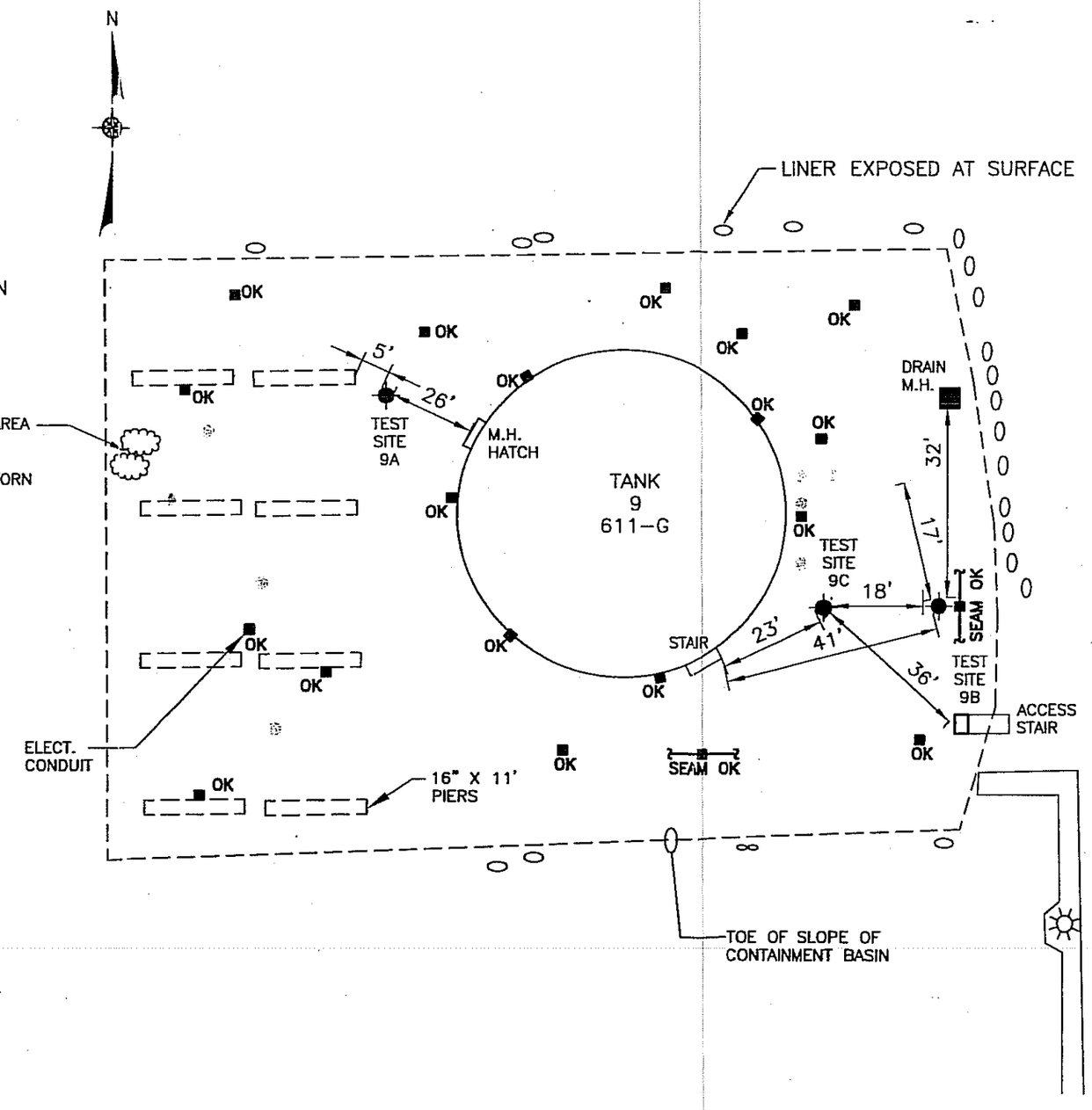
LEGEND
- 12"ø CONC. PIERS
- LOCATION OF VISUAL EXAMINATION
- PERMEABILITY TEST SITE
- AREA OF EXPOSED FABRIC AT TOP OF SLOPE

TEST SITE 9C

Observations:
GCL fabric is in good condition. 3 inches ± of gravel above GCL.

Test Results:
Date: June 30, 2006
Weather: Partly Cloudy
Temperature: 80°F

Time	Water Level(feet)
9:30 a.m.	1.31
10:00 a.m.	1.31
10:30 a.m.	1.32
11:00 a.m.	1.32
12:00 p.m.	1.33
1:00 p.m.	1.33
1:30 p.m.	1.33



SOURCE: DVIRKA AND BARTILUCCI, EVALUATION OF EXISTING SECONDARY CONTAINMENT SYSTEMS, JUNE 2001

SCALE: 1"=20'

Dvirka and Bartilucci CONSULTING ENGINEERS
A DIVISION OF WILLIAM F. COSULICH ASSOCIATES, P.C.

BROOKHAVEN NATIONAL LABORATORY
MAJOR PETROLEUM FACILITY

CONTAINMENT BASIN NO. 9

DRAWING NO. 5

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NOTES:

1. LOCATION OF PIPE SUPPORT PIERS & LOCATION OF VISUAL OBSERVATIONS ARE APPROXIMATE.

TEST SITE 10A

Observations:
GCL fabric in good condition.
±3 inches of stone above GCL.

Test Results:
Date: June 27, 2006
Weather: Sunny
Temperature: 80°F

Time	Water Level(feet)
2:25 p.m.	1.32
3:00 p.m.	1.33
3:30 p.m.	1.32
4:00 p.m.	1.32
5:00 p.m.	1.35

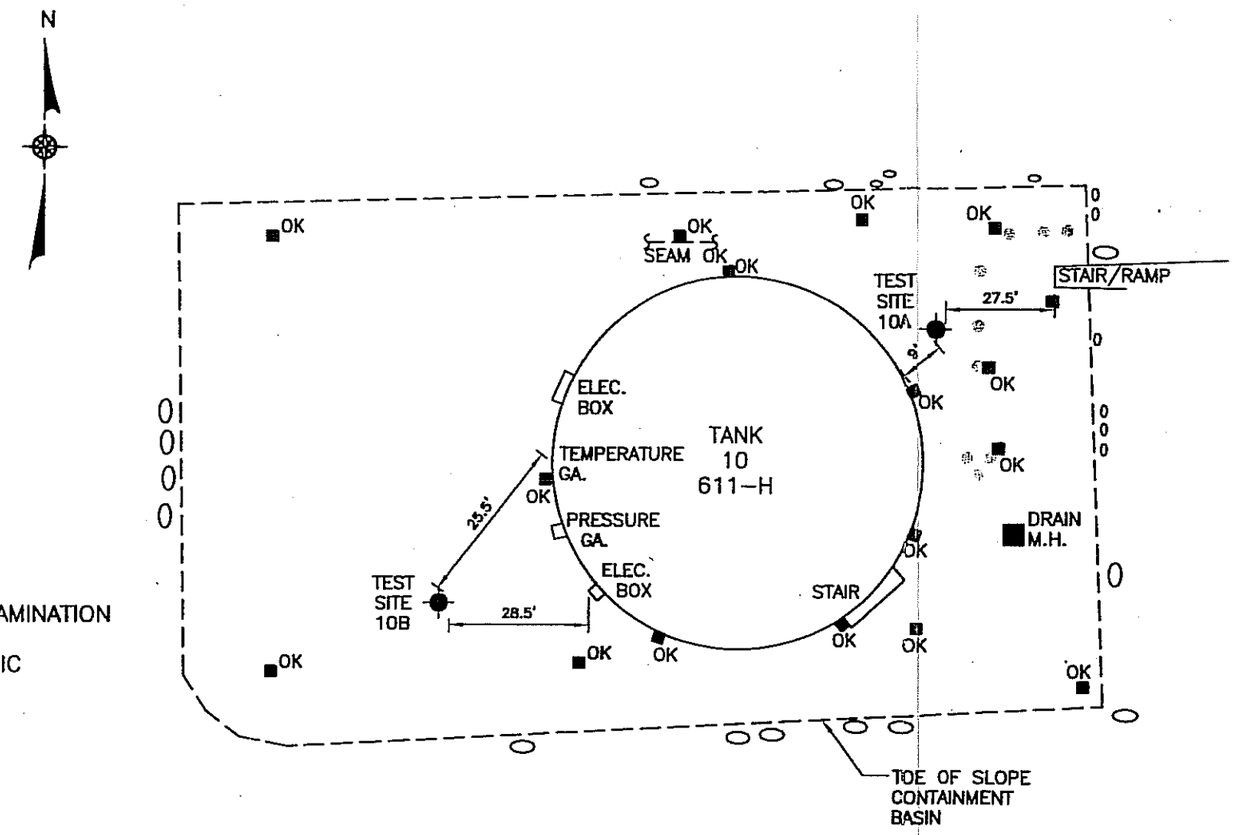
TEST SITE 10B

Observations:
GCL fabric is in good condition.
± 3 inches of stone above GCL.

Test Results:
Date: June 27, 2006
Weather: Sunny
Temperature: 80°F

Time	Water Level(feet)
2:30 p.m.	1.63
3:05 p.m.	1.64
3:30 p.m.	1.64
4:00 p.m.	1.64
5:00 p.m.	1.65

LEGEND
- 12"ø CONC. PIERS
- LOCATION OF VISUAL EXAMINATION
- PERMEABILITY TEST SITE
- AREA OF EXPOSED FABRIC AT TOP OF SLOPE



SCALE: 1"=20'

Dvirka and Bartilucci CONSULTING ENGINEERS
A DIVISION OF WILLIAM F. COSULICH ASSOCIATES, P.C.

BROOKHAVEN NATIONAL LABORATORY
MAJOR PETROLEUM FACILITY

CONTAINMENT BASIN NO. 10

DRAWING NO. 6

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APPENDIX 12

Table 3-7. Summary of Chemical and Oil Spill Reports.

Spill No. and Date	Material and Quantity	ORPS Report	Source/Cause and Corrective Actions
04-01 1/10/04	Transmission fluid 1 gal	No	A BNL employee notified Fire Rescue of a ~1 gal spill of transmission fluid from an employee vehicle in front of Bldg. 488. The spill was on pavement and partially on soil in the area of the parking space. Spill absorbent was placed on the affected areas and BNL's Plant Engineering (EP) personnel collected and containerized the spill absorbent, including the affected soil, for off-site disposal.
04-06 2/6/04	Ethylene glycol 1.0 gal	Yes* (CH-BNL-BNL-2004-0001)	On February 6, 2004, a BNL employee was westbound on Princeton Ave. (unpaved portion) after completing a sampling event. The employee slowed to ~ 25 mph and applied the brake to enter a sharp curve. Due to unseen ice on the roadway, the employee was unable to steer the vehicle and it slid directly into a tree resulting in a spill of ~ 1 gal of antifreeze. Spill absorbent was placed on the affected areas and EP personnel collected and containerized the spill absorbent for off-site disposal.
04-08 2/27/04	Unknown Oil 1 gal	No	BNL employees performing a weekly flow chart exchange at recharge basin HZ noticed a darkening of the soil in two areas. They stated that a crane had previously been parked over the area of the spill and therefore it is assumed to be the source. Although the exact material released is unknown, it is assumed to be a type of oil. EP personnel responded and removed contaminated soil for off-site disposal.
04-12 3/1/04	Engine Oil 0.5 gal	No	An empty 5-gal container with an open nozzle was found on the grass in front of Bldg. 919B. The manufacturer's label read "Black Bear Company Inc. Motor Oil." Grass and soil around the container had black stains. The contaminated grass and soil were excavated until no visible oil-stained soil and no residual petroleum odors remained. Approximately 2.5 ft^3 of soil was removed by EP personnel for off-site disposal.
04-14 3/8/04	Ethylene glycol 1 gal	Yes* (CH-BH-BNL-PE-2004-0001)	During repair of the heater block on the emergency generator for Bldg. 488, EP personnel reported a spill of ~ 1 gal (4 lb.) of a 50/50 mix of ethylene glycol and water onto the lower platform, concrete pad , and nearby soil. A deteriorated cooling system hose caused the spill. EP personnel used spill absorbent and containerized it along with the affected soil for off-site disposal.
04-17 3/23/04	Mineral Oil 2 gal	No	Near Bldg. 919, a primary bushing on a transformer (# 912-TRNF-170, 631-5-11) released ~ 2 gal of mineral oil onto the concrete pad and into the adjacent rocky soil. EP personnel discovered the spill during a routine inspection. They removed the contaminated soil and rock ballast, and containerized it for off-site disposal.
04-18 3/24/04	Mineral Oil 1 gal	No	During routine transformer inspection, a leaking gauge was discovered. EP personnel immediately repaired the leaking gauge fitting and put spill absorbent on the concrete below. They removed the stained rock along with the spill absorbent for off-site disposal.
04-19 3/23/04	Compressor Oil 10 gal	No	The refrigeration compressor in Bldg. 902 shut down. When Cryogenic Group personnel investigated, they discovered that a failed seal on the compressor had released ~ 10 gal of oil to the building. The room had been equipped with an angle iron berm to prevent the release of oil to the outdoors in the event of such an incident. The berm proved to be better than 95% effective, with some minor oil weeps evident along the building edge. These were resealed to prevent future releases. Cryogenic Group personnel applied several bags of spill absorbent, which was containerized for off-site disposal.
04-22 4/8/04	Transmission fluid 1 cup	No	A privately owned vehicle had transmission failure and released transmission fluid on the asphalt just east of the Upton/Cornell intersection. Due to the early morning traffic and for safety reasons, the vehicle was moved to the grassy soil beside the road. This resulted in a release of ~ 8 oz. of fluid. Spill absorbent was placed under the vehicle and on the affected soil. EP personnel cleaned the spill and collected all contaminated soil for off-site disposal.
04-24 4/26/04	Transformer Oil 19 gal	Yes* (CH-BH-BNL-PE-2004-0003)	During a rainstorm, an EP employee noticed an oily sheen on Bell Ave., south of Bldg. 452 and found two transformers knocked over. One transformer had lost all its contents (15 gal.) and the second transformer lost ~ 4 gal. Oil had crossed the road and entered the storm drain. Fire Rescue diked the storm drains and laid down oil absorbent, but an oil sheen was evident on the stormwater run-off channel adjacent to Groove St. Placing an oil absorbent boom across the channel prevented discharge to a wetland area south of Grove St. The booms were changed several times while the spill was remediated. Analysis of the oil showed it to be contaminated with PCBs. Cleanup was conducted following EPA requirements. Closeout of the incident is pending.
04-25 4/28/04	Cooling Water (Activated) 260 gal	No	The BLIP Target vessel contains ~ 300 gal of cooling water that routinely becomes activated through use. Due to localized Linac beam drift, a beam window flange on this vessel failed, allowing a ~ 260 gal release of cooling water to secondary containment (the outer vessel). The contained cooling water was pumped into US DOT-approved containers for proper off-site disposal. There were no measurable releases of cooling water to the environment and the spilled radionuclide inventory did not exceed CERCLA or State reportable quantities, so the spill to containment was deemed nonreportable to EPA and NYSDEC. Because the amount of water

Spill No. and Date	Material and Quantity	ORPS Report	Source/Cause and Corrective Actions
			spilled into secondary containment exceeded 5 gal, the spill was reportable to SCDHS.
04-26 5/6/04	Diesel fuel 0.5 gal	No	An environmental cleanup contractor rented a trailer-mounted diesel-powered centrifugal pump for the Peconic River cleanup project. The pump was staged on a grassy area near the worksite. An increase in daytime temperature caused expansion in the full fuel tank, releasing ~ 0.5 gal of fuel. The contractor put down adsorbent pads and a 5-gal container to capture the liquids coming from the fuel tank, but some had already contacted the grass below. The contractor removed the affected grass and any soil that had traces (odor or visual) of fuel. These materials were containerized and disposed of off-site.
04-28 5/8/04	Cooling Water (activated) 280 gal	No	See Spill No. 04-25 for details, as this spill was identical. Activated water was again removed from the secondary containment structure and transferred to DOT-approved containers for off-site disposal. After this incident and an extensive investigation, the cause of the beam drift was identified and additional equipment and safeguards have been put in place to prevent recurrence.
04-31 5/17/04	Ethylene Glycol 1 gal	Yes* (CH-BH-BNL-PE-2004-0004)	After turning onto S. Harvard St., the operator of a forklift (#109917) realized that a mechanical problem had occurred and stopped on the edge of the road across from Bldg. 479. Inspection revealed a failed water pump. About 1 gal of an ethylene glycol and water mix had been released to the roadway and nearby soil. Absorbent pads were immediately put under the forklift. The forklift was taken for repair and the affected soil was removed for off-site disposal.
04-32 5/20/04	Hydraulic Fluid 2 pints	No	An environmental contractor for the Peconic River cleanup was using an excavator to remove surface sediment from the riverbed. Failure of an o-ring on the hydraulic system of the excavator resulted in a loss of hydraulic fluid to a 20- x 5-ft. section of the riverbed. The excavator was immediately moved over the adjacent roadway onto plastic and absorbent material was placed below it to catch any leaking fluid. Sand bags were placed in the riverbed to prevent the introduction of more water to this section, and multiple absorbent booms were used to remove the 2 pints of fluid released. The booms were containerized for proper disposal. During a follow-up inspection by NYSDEC, the following conditions were placed on the restoration project work in the Peconic River. 1) To help prevent a release of petroleum from diesel/gasoline powered dewatering pumps, a secondary containment system was employed and properly maintained under all pumps at all times. 2) To help contain a release and prevent future impacts, an absorbent boom was pre-deployed at the downstream dewatering pump discharge point at all times and regularly inspected, maintained, and changed as necessary. 3) All proactive measures were to be implemented immediately, remain in place, and become part of the Spill Prevention Plan through to project completion.
04-35 6/1/04	Hydraulic Fluid 1 gal	No	A loose hose fitting from a hydraulic cylinder of a 30-ton Terex dump truck released ~ 1 gal of hydraulic fluid onto soil. Absorbent pads were immediately placed on the spill areas. The top layer of soil where the spill occurred was removed and placed on plastic sheeting. The soil was containerized for off-site disposal.
04-37 6/9/04	Hydraulic Fluid < 1gal	No	A vacuum pump has an exhaust leading out of the rear of building 1005E. An in-line mist eliminator is part of the system to capture any residual oil that accumulates during exhausting. The mist eliminator had become oversaturated during operations and released less than 1 gal of oil through the exhaust. The oil saturated the soil underneath the exhaust point. EP personnel remediated the area by collecting and containerizing the oily soil for off-site disposal.
04-43 7/1/04	Hydraulic Fluid 0.25 gal	No	A contractor-owned excavator struck a tree branch, rupturing a hydraulic line. Less than 0.25 gal of hydraulic fluid spilled onto the soil near Building 815. Absorbent pads were immediately placed on the spill area by Fire Rescue. The soil was removed by the contractor and placed in a 55-gal drum. BNL arranged for waste off-site disposal.
04-44 7/8/04	Diesel Fuel < 1 gal	No	A BNL employee walking in the area of the Peconic River cleanup noticed soil discoloration beneath the trailer carriage of a portable diesel generator that was being used by a contractor as a power source for the project. The employee alerted Fire Rescue to the apparent spill, which was probably caused by expansion of fuel in the generator tank after it had been filled. Contractor personnel dug out a 3- x 5-ft. area under the trailer carriage, removing all visibly contaminated soil. The waste was stored in large polyethylene bags and transported to a staging area for transfer to 55-gal drums. BNL arranged for off-site disposal.
04-45 7/12/04	Hydraulic Fluid < 0.5 cups	No	An excavator that had been used in the Peconic River cleanup was on the east firebreak road awaiting return to the leasing company. A BNL employee passing by noticed a small stained area in the sand near the base of the unit, and notified Fire Rescue. Absorbent pads were used to clean the excavator undercarriage stained from the leaking hydraulic line. The contaminated soil was shoveled into a 3-gal pail for proper off-site disposal. Contractor personnel said the excavator was to be returned to the leasing company later in the day.
04-48 7/20/04	Hydraulic Fluid 1 pint	No	During the Peconic River cleanup, a contractor-operated excavator released hydraulic fluid into ponded Peconic River water (in a dewatered area) and onto sediment. The spill was caused by the failure of a rubber o-ring on a hydraulic line. Booms were placed on the ponded water and

Spill No. and Date	Material and Quantity	ORPS Report	Source/Cause and Corrective Actions
			pads were put below the leaking hydraulic line. The o-ring was replaced after the line was fully drained. Pads, booms, and associated debris were bagged and repacked into drums for off-site disposal.
04-56 9/16/04	Fuel Oil 4 gal	No	During the planned removal of an Underground Storage Tank (UST) on the north side of Building T-87, several small holes were observed on the side of the tank. A Sanitary Engineer from SCDHS observed the tank's removal. It was set aside and the excavation was inspected. SCDHS provided oversight during the removal of contaminated soil, checking for contamination (sniff and water sheen) until clean soil was encountered. A total of ~ 4 yd^3 of soil was removed and disposed. SCDHS determined that all contaminated soil had been removed and that end point samples were not necessary. The excavation was backfilled.
04-57 9/17/04	Fuel Oil 65 gal	Yes* (CH-BH-BNL-PE-2004-0005)	During a planned UST removal on the south side of Building 244, at least one dime-sized hole was observed on the bottom of the tank. A SCDHS Sanitary Engineer observing the tank's removal also oversaw the removal of contaminated soil, checking it for contamination (sniff and water sheen) until the depth of the excavation (~ 15 ft) and proximity of the building made further soil removal unwise. One soil sample collected from the bottom of the excavation confirmed that not all of the contamination had been removed, but a Geoprobe investigation of the tank area showed no impacts above state and county action levels. A total of approximately 40 yd^3 of soil was removed from the excavation for off-site disposal.
04-58 9/24/04	Hydraulic Fluid < 1 pint	No	Hydraulic fluid was observed leaking from a manlift as it was parked along the railroad. Inspection of the unit revealed the hydraulic fluid was leaking from a twisted ¾-in. hydraulic line. Plastic was placed beneath the manlift and contractor personnel scraped up the contaminated soil beneath the manlift and along the railroad. Contaminated soil and absorbent rags that were used to clean the chassis of the manlift were placed in containers for off-site disposal. The damaged manlift was transported off site for repairs.
04-59 9/22/04	Fuel Oil 90 gal	Yes* (CH-BH-BNL-PE-2004-0005)	During a planned UST removal on the south side of Bldg. 339, significant contamination was discovered near the tank's fill and vent lines. In addition, at least one small hole was observed on the bottom of the tank. SCDHS and NYSDEC observed tank removal and inspected the excavation, examining the soil for contamination (sniff and water sheen) until the depth of the excavation (~ 14 ft) and proximity of the building prevented further soil from being removed. It appeared that clean soil was reached on the bottom and sidewalls of the excavation. To confirm this, three soil samples were collected and analyzed for volatile and semivolatile organic compounds. Analytical results showed remaining soils to be less than state and county action levels. In total, ~ 50 yd^3 of soil were removed and disposed of properly.
04-60 9/27/04	Oil/Degreaser < 1 cup	No	Oil sheen was observed on water run-off near buildings 326 and 423, the EP Heavy Equipment Mechanic Operator shop. The cause of oil sheen was determined to be residual oil (hydraulic or diesel) on the frame of the New Holland skid steer that was being washed down as part of a preventive maintenance action. The water runoff had made its way to the catch basin on the southeast corner of Bldg. 326 that discharges into the woods south of the building. Absorbent pads and an absorbent sock were used to contain contaminated runoff and absorb residual water/oil. The skid steer's oil, hydraulic, and coolant reservoirs where checked and there was not noticeable loss of fluids. Therefore, residual oils on the frame of the unit were seen as the likely source of the sheen. Remedial actions included using a wet vacuum to suction the small pool of water containing the residual oil and degreaser (Simple Green). The bottom of the catch basin was cleaned with absorbent pads and the contaminated soil at the point of discharge in the wooded area was manually excavated by EP personnel. Analytical results on soil samples showed no exceedance of county action levels. All contaminated absorbents and soils were disposed of off site.
04-64 10/12/04	Diesel Fuel ~ 1 pint	No	While EP personnel were preparing equipment for the winter, they discovered that one of the smaller farm tractors, primarily used for snow clearing, had leaked a small amount of diesel fuel on the ground. The date and time of the spill is unknown, but the cause of the leak was most likely from fuel in the tank expanding during the summer. The spill site was cleaned up immediately. Most of the contamination was concentrated in the grass and leaves below the tractor. Approximately 1 to 2 in. of impacted soil was removed as well. Contaminated material was collected for off-site disposal.
04-66 10/22/04	Ethylene Glycol solution 1 gal	Yes* (CH-BH-BNL-BNL-2004-0021)	A BNL employee was transferring a 5-gal plastic container of 50/50 ethylene glycol and water to a laboratory in Bldg. 815. The container was transported in the bed of a pick-up truck and in secondary containment. However, when the container was lifted by the handle it ruputured, releasing 1 gal of the glycol mixture. Most landed on the concrete pad and was contained with spill absorbent. A small quantity spilled onto the cab of the truck and onto the ground. It's estimated that < 1 lb (i.e., < 1/2 lb glycol) spilled onto soil. EP personnel cleaned up the material and containerized it for off-site disposal.
04-72	Engine Oil	No	Contractor workers noticed a fuel film on soil after their contract fuel company delivered fuel to

Spill No. and Date	Material and Quantity	ORPS Report	Source/Cause and Corrective Actions
12/10/04	2 – 3 quarts		their equipment. The contractor suspected the source was the departing fuel truck and stopped the truck at the corner of Brookhaven Ave. and Power Line Rd. He confirmed that the fuel delivery truck was leaking motor oil and immediately placed absorbent pads under the truck to capture any further drips. A light oil film was observed on the soil in several locations around the truck and a more substantial area (~2 x 3 ft) was observed on the soil adjacent to the truck. The contractor cleaned up the spill and BNL disposed of the contaminated material.
04-73 12/17/04	Oil/Water mixture 120 gal	No	On December 16, BNL staff drained and replenished the Citranox tank in the Central Cleaning facility. Approximately 275 gal of cleaning solution were transferred to the Coolant Recycling Facility for processing in the Water Eater. The operator of the Coolant Recycling Facility began processing the Citranox Solution to evaporate the water in solution at ~ 1530 hrs using the Water Eater autofill cycle, then left the facility. A considerable volume of tramp oil was already in the Water Eater tank from a batch of Blasocut 2000 Coolant that had been previously processed. As the Citronox was heated to 212 °F, the water in solution began to boil. The boiling liquid caused a water/oil foam to form and spill over the top of the tank. When this foam hit the cold steel floor in the building, it condensed, producing steam. After liquid in the tank dropped below the autofill low-level line, the pump automatically activated, causing more Citronox to be dispensed into the tank, repeating the cycle. Eventually, enough steam was produced to set off a heat detector that, in turn, activated an alarm in Building 479 to alert Fire Rescue. They immediately responded, as did the site supervisor on duty. When the door to Building 495 was opened, there was ~ 3 in. of oil/water on the floor. Power to the Water Eater tank was cut. All of the oil/water was fully contained within the building's secondary containment. Using a wet vacuum, workers recovered ~ 130 gal of oil/water and placed it in drums for off-site disposal.

*Release is reportable to DOE under the requirements of DOE Order 231.1A, Occurrence Reporting and Processing.

DOT = Department of Transportation
NYSDEC = New York State Department of Environmental Conservation
PCBs = PolyChlorinated Biphenyls
PE = Plant Engineering
PVC = PolyVinyl Chloride
SCDHS = Suffolk County Department of Health Services
STP = Sewage Treatment Plant
SU = Standard Units
UST = Underground Storage Tank

Table 3-7. Summary of Chemical and Oil Spill Reports.

Spill No. and Date	Material and Quantity	ORPS Report	Source/Cause and Corrective Actions
05-01 Jan 26	Solvent Mixture 1 gallon	Yes SC-CH-BH-BNL-BNL-2005-0001	The 490 Building Manager requested that plumbing work be performed in Room 907. For access to the work area, a researcher was asked to move a full, 1-gallon glass bottle of a solvent mixture containing Acetone (40%), Hexane (38%), Methylene Chloride (20%), Ethyl Acetate (1%), Ethanol (1%), and Porphyrin. The manager placed the container on a cart and during transport the cart hit a bump (possibly a door sill). The container fell to the floor and broke. The incident was reported to the fire and police groups and a cleanup response began. More than 90 percent of the mixture evaporated prior to the response team arrival. The small amount of liquid remaining was removed with absorbent pads. The pads, personal protective equipment, and broken glass container were placed in a plastic bucket and were properly disposed. The spill was reported to regulatory agencies, as > 1 pound of hexane was released to the air.
05-03 Feb 8	Hydraulic Fluid < 1 gallon	No	During repairs to the railroad siding, a hose failed on a backhoe and released hydraulic fluid to the railroad tracks, ballast, and ties. All visually impacted soils and ballast were removed for disposal. Waste was disposed at an approved disposal facility.
05-04 Mar 14	Hydraulic Fluid 1 pint	No	While working on the Peconic River cleanup, an Envirocon worker noticed a hydraulic leak from a Bobcat working on the temporary plastic mat road. Approximately 1 pint of hydraulic oil leaked from the plastic mat onto surrounding soil. The spill was immediately contained and cleaned up.
05-08 Mar 31	Human Excrement < 1 gal	No	Numerous 5-gallon plastic buckets in garbage bags were found on BNL property along a road adjacent to the BNL east boundary. The Emergency Services Division HAZMAT Team packaged the waste into DOT-approved containers (three 55-gal drums) and then transferred it to the Waste Management area. The containers were opened on April 7 by a BNL vendor (Onyx) and human excrement was found. The waste was re-packaged and disposed of as Regulated Medical Waste through the Medical Department.
05-10 April 12	Compressor Oil 2 ounces	No	A dewatering pump on the Peconic River remediation project blew compressor oil out of the discharge hose, to the plastic containment below and adjacent soil. The discharge was apparently due to failure of the compressor rings. The oil released to the containment pad and the affected soil was removed for proper disposal.
05-13 May 18	Diesel Fuel ½ gallon	No	Oil-stained grass was discovered in an area where a portable emergency generator had been parked, behind Bldg. 610. The stained area was approximately 2 ft in diameter. Diesel fuel is believed to have leaked from the fill cap of the generator fuel storage tank as a result of thermal expansion of the fuel. Buildings and Grounds personnel removed all visibly contaminated grass and underlying soil for off-site disposal.
05-17 Jun 20	Slaked Lime 15 pounds	No	BNL personnel discovered a white-chalky, alkaline solid material on soil along a concrete headwall near an on-site drinking water wellhouse and reported it to the Emergency Services Division as an unknown material spill. The material was collected and put in a plastic 15-gallon waste container. During this cleanup, samples were collected for chemical identification/ fingerprinting. Samples of similar material on site, including Quick Lime and Ice melt, were compared with the unknown substance using field fingerprinting methods: reaction with acids, precipitation of solids, and pH. Based on these tests (high pH and calcium content), the unknown material was identified as slaked lime (calcium hydroxide). It was characterized and sent off-site for disposal.
05-20 Aug 15	Motor Oil ½ cup	No	A locomotive owned and operated by New York & Atlantic Railway leaked motor oil on the tracks along Power Line Road, just before the Laboratory exit. The locomotive had recently dropped off a load of empty rail cars for BNL to use for transporting remediation waste. The leak was not discovered until after the locomotive left the site. Most of the leaked motor oil was on top of a railroad tie, although some spilled over onto the soil on either side. Spill absorbent was used to remediate the spill, and the impacted spoil and contaminated absorbent were removed and containerized for off-site disposal.
05-22 Aug 17	Ethylene Glycol 7 gallons	No	A radiator hose ruptured on the "Trackmobile" being used to transport rail cars in support of the Former Hazardous Waste Management Facility cleanup. The operator realized there was a problem and immediately stopped the vehicle and workers placed drip pans and absorbent material under the radiator. Impacted soils, gravel, and debris were removed and placed in a 55-gallon drum for off-site disposal.

Spill No. and Date	Material and Quantity	ORPS Report	Source/Cause and Corrective Actions
05-23 Oct 8	Hydraulic Fluid 5 gallons	No	As concrete blocks were being moved from Bldg. 912 to Bldg. 933 along E. Fifth Avenue, a hydraulic line burst, resulting in a spill of approximately 5 gallons of hydraulic oil along a 1-mile stretch of road. It was raining heavily throughout the day and there was evidence of discharge of the oil into two of the storm sewer drains near Bldg. 912. Fire and Rescue personnel were notified as soon as the spill was discovered. It was contained to the asphalt road and did not come into contact with the soil. Absorbents were placed along the spill areas and along the storm drains. Booms were also placed at the weir (SPDES Outfall #002) to prevent discharge into the recharge basins located near the RHIC Ring. Visual inspection of the weir leading to the recharge basins showed no evidence of discharge of oil into the environment. All contaminated absorbents were collected and disposed off site.
05-27 Nov 4	Gasoline < 1 gallon	No	During routine surveillance of BNL property along North Street, a BNL employee noticed a closed 10-gallon carboy on the east side of North Street approximately 250 yards north of the east gate. The carboy was about 2/3 full and contained what appeared to be waste engine oil. Another 250 yards north, he found an open 5-gallon pail filled with rainwater that had overflowed onto the ground below. The rain water in the pail had a visible sheen and a noticeable gasoline odor. Fire Rescue was notified and placed the 5-gallon pail in an overpak container with contaminated soil they recovered from below the container. The abandoned containers were transported to a waste storage area for characterization and disposal.
05-28 Nov 5	Floor Stripper 1 gallon	Yes SC-BHSO-BNL-PE-2005-0002	Weekend custodial staff dumped floor stripper into the courtyard of Bldg. 911. Stripper, which is highly caustic, was dumped on the bricks and migrated to the side gravel. A field pH reading on litmus paper showed a very high pH. Custodial staff and grounds crew cleaned up the spill and collected all waste for proper disposal.
05-32 Dec 12	Hydraulic Fluid < 1 gallon	No	During the planned decommissioning of an outdoor lift behind Bldg. 480, it was discovered that one of the hydraulic lines had rusted and leaked within the pit of the lift. The piping was removed and the line was capped. The accumulated debris at the bottom of the pit (leaves and sand) was discolored from the oil. The pit had a concrete floor and a drain to prevent water accumulation. All impacted material was removed and containerized for off-site disposal.
05-33 Dec 17	No. 6 Fuel Oil 20 gallons	Yes SC-BHSO-BNL-PE-2005-0003	At approximately 2:30 a.m., a Metro fuel oil tanker came on site to deliver a load of #6 fuel oil, but did not deliver the fuel. In the process, the tanker leaked oil in a trail that was discovered on the northbound William Floyd Parkway, through its route on BNL property and off site as it traveled southbound on William Floyd Parkway. On the parkway, as well as for most of its route on site, the tanker left one to two thin lines of #6 fuel along its route. Where the tanker slowed or stopped, it left a heavier deposit. This was particularly true at the entrance gate, weigh station, fuel transfer bay, and where the truck took corners. Most significantly, the truck leaked 20 to 25 gallons on the ground and in a catch basin shortly after it pulled out of the transfer bay. The roads, transfer bay, impacted soils, and drywell were cleaned and all spill residue was disposed of off site.

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DOT = Department of Transportation

Table 3-7. Summary of Chemical and Oil Spill Reports.

Spill No. and Date	Material and Quantity	ORPS Report	Source/Cause and Corrective Actions
06-09 07/18/06	Ethylene Glycol/Water 1 gallon	No	A Laboratory visitor was at the main gate trailer when the radiator in his vehicle failed, spilling approximately 1 gallon of antifreeze to the asphalt parking lot. Roads and Grounds personnel responded and cleaned up the release with speedy dry, and containerized the waste for off-site disposal.
06-10 07/19/06	Hydraulic Fluid 1 gallon	No	A front-end loader was being used to move a fallen tree off the north gate access road. As it was pushing the tree off the road, a branch ripped the hydraulic hose, releasing approximately 1 gallon of hydraulic fluid to the ground. The majority of the fluid leaked onto the road, but approximately 1 quart reached soil. Emergency Services applied speedy dry, Security closed off the road (at William Floyd Parkway), and Roads and Grounds staff cleaned up and containerized the spill debris for off-site disposal.
06-15 09/06/06	Ethylene Glycol/Water 2 gallons	No	During grading and application of recycled concrete aggregate on a dirt road (east of Buildings 610 and 528), a hose clamp broke on the dump truck radiator causing the hose to come loose and spill approximately 2 gallons of antifreeze to the ground. Roads and Ground personnel excavated and containerized the impacted soil for off-site disposal.
06-17 09/22/06	Diesel Fuel ½ gallon	No	A fuel line leak from BNL's Fire Brush truck occurred while Emergency Services personnel were practicing the use of equipment (the Brush Truck). Release was to sand. Emergency Services personnel removed most of affected sand and Roads and Grounds cleaned up residual material that was stained. The contaminated soil was placed into a plastic drum (10-gal) for off-site disposal.
06-21 09/27/06	Ethylene Glycol/Water 1 gallon	No	Upon exiting the vehicle, the driver of a BNL step van noticed it was leaking antifreeze and notified appropriate staff. Fire Rescue responded and applied speedy dry. The vehicle was towed away, and the material was containerized for off-site disposal.
06-24 10/26/06	Hydraulic Fluid ½ gallon	No	A tractor trailer being used to transport excavated soils for off-site disposal experienced a small leak of hydraulic fluid while dumping some of its payload on the ground. The prime contractor for the excavation project had spill equipment handy (i.e., absorbent pads) and was able to capture most of the leak. Some of the hydraulic fluid was released to the soil on the dirt road. The contractor's front-end loader was used to immediately clean up the impacted area and the material was placed on plastic for ultimate disposal. The impacted soil and absorbent pads (approximately 1/2 drum) were containerized and disposed of off-site.
06-25 11/20/06	Ethylene Glycol/Water 2 gallons	No	An unknown vehicle developed a leak of ethylene glycol after entering the site. The vehicle started leaking at the traffic light at Upton Road and Princeton Avenue, traveled to the Vehicle Monitoring Station turnaround area, turned around, and then left the site. BNL Fire Rescue personnel applied speedy dry to the spill and Roads and Grounds containerized the material for off-site disposal.

Notes:

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Table 3-7. Summary of Chemical and Oil Spill Reports.

Spill No. and Date	Material and Quantity	ORPS Report	Source/Cause and Corrective Actions
07-02 02/07/07	Ethylene Glycol/Water 1/2 gallon	No	A Laboratory vehicle leaked antifreeze onto the parking lot of Building 50. Speedy dry was used to absorb the fluid and the car was sent to the vehicle maintenance shop for repair. All wastes were containerized for off-site disposal.
07-03 04/20/07	Hydraulic Fluid 1 quart	No	While using a front-end loader to clear brush, a stump became wedged between the bucket and the ground, resulting in damage to a hydraulic hose. The loader was immediately secured and shut down. Impacted soils were removed and containerized for off-site disposal.
07-04 05/03/07	Hydraulic Fluid 1/2 cup	No	During retrieval of a roll-off trailer, a Town of Brookhaven vehicle spilled approximately 1/2 cup of hydraulic fluid to the ground. The spill was caused by an overfilled reservoir. The reservoir was drained to remove excess fluid, and the impacted soil was removed for off-site disposal.
07-05 05/17/07	Hydraulic Fluid 2 gallons	No	While mowing the lawn outside of Building 750, the lawn mower developed a leak from the valve spool. Examination of the valve spool showed that one of the hose fittings loosened due to vibration. The hose connection was repaired, and the impacted soils were excavated and containerized for off-site disposal.
07-06 05/18/07	Biobased Hydraulic Fluid 25 gallons	No	During examination of the vehicle lifts in Building 423, vehicle lift 2 was noted as not operating properly. Further examination by the repair contractor revealed a leak in the buried piping, and the piping was then repaired. The hydraulic fluid was vegetable oil-based; therefore, the New York State Department of Environmental Conservation did not require the remediation of the impacted soils.
07-07 06/03/07	Ethylene Glycol/Water 1 gallon	No	A privately operated limousine developed an antifreeze leak due to a failed water pump. The vehicle was towed from the BNL site for repair, and the spilled fluid was absorbed with speedy dry and containerized for off-site disposal.
07-08 06/06/07	Waste Engine Oil 3 gallons	No	A BNL employee brought a container of waste oil from home to dispose of at the local service station. The container was transferred from his personal vehicle to a laboratory pick-up truck. The container was not secured in the back of the truck, and it fell over and split open. The oil spilled into the back of the truck, out of the rear door, and onto pavement and soil. Speedy dry and sand were used to absorb the spilled oil. All contaminated media was collected and containerized for off-site disposal.
07-11 08/07/07	Ethylene Glycol/Water 1/2 gallon	No	The water pump in a BNL-operated vehicle failed, resulting in a release of antifreeze to the parking lot of Building 423. The vehicle was awaiting repair at the time of release. Speedy dry was used to remediate the release, which was later collected and containerized for off-site disposal.
07-13 08/29/07	Ethylene Glycol/Water 1/2 gallon	No	The lower radiator hose of a Laboratory vehicle failed, resulting in a release of antifreeze to the parking lot at Building 599. Speedy dry was used to absorb the spilled fluid, which was later collected for off-site disposal. The vehicle was sent to the vehicle maintenance shop for repair.
07-15 09/19/07	Hydraulic Fluid 30 gallons	No	During replacement of the elevator hydraulic system in Building 1005, a release of hydraulic fluid was discovered. The fluid was found in the interstitial space of the hydraulic cylinder and the exterior casing. The elevator casing was partially submerged in groundwater and the oil was found floating on the surface of the water. All oil was contained between the outside casing and the water. The oil was removed by pumping and by flooding the casing with water, causing the oil to spill out the top where it was collected. All oil and contaminated water was containerized for off-site disposal. The new hydraulic system includes a secondary containment sock to prevent future releases in the event of a casing leak.
07-17 10/22/07	Hydraulic Fluid 5 gallons	No	A new front-end loader leaked oil on the ground during its initial use. Examination of the unit showed that the hose connections at the control box were loose, probably due to vibration during shipping. The contaminated soils were containerized for off-site disposal.
07-19 12/10/07	Hydraulic Fluid 1 gallon	No	A hydraulic hose on the garbage truck failed resulting in a release of hydraulic oil to parking areas near Buildings 488 and 902. Due to wet weather, the oil flowed into a storm water catch basin and was discharged to a low-lying area near Building 904. The spill was remediated by using spill absorbents. All contaminated media was collected and containerized for off-site disposal.

Notes:

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Table 3-7. Summary of Chemical and Oil Spill Reports.

Spill No. and Date	Material and Quantity	ORPS Report	Source/Cause and Corrective Actions
08-01 01/16/08	Gasoline 1 quart	No	An abandoned pump inside a plastic tray was found in a remote area of the site. There was evidence of spillage to the soil around the tray. Approximately 50 pounds of soil was removed from the area and containerized for disposal.
08-02 01/28/08	Heat Transfer Oil 70 gallons	No	A helium compressor failed in Bldg. 902C resulting in spillage of heat exchange fluid to the containment area under the compressor and building floor. All spilled oil was contained within the building. Free liquids were recovered using pumps and absorbents. The remaining was recovered using speedy dry. All waste materials were containerized for off-site disposal.
08-04 04/28/08	Power Steering Fluid 1 quart	No	While performing work at the composting area, the power steering unit in a backhoe started to leak. A containment tray was placed beneath the unit immediately upon discovery, however some fluid was spilled to the soil. The impacted soil was removed for off-site disposal.
08-06 06/11/08	Hydraulic Fluid 13 gallons	Yes	The street sweeper developed a hydraulic leak while sweeping Upton Road. Upon discovery the unit was secured to prevent further leakage. The release impacted approximately 200 foot of road surface. Speedy dry was used to absorb the oil. The sweeper was transferred to the repair shop and impacted soils and speedy dry were collected and containerized for off-site disposal.
08-13 09/12/08	Motor Oil 5 gallons	No	A BNL vehicle was being pushed to the gasoline refueling station after running out of gas. While turning to enter the driveway to the station an unsecured 5 gallon container of motor oil fell out of the vehicle from behind the driver's seat. The container ruptured upon impact with the road. The container belonged to a BNL employee who was transporting it to the onsite service station for disposal. Impacted soils were cleaned up and speedy dry was used to absorb residual oil from the pavement.
08-14 10/06/08	Motor Oil/Hydraulic Oil Mixture 10 gallons	Yes	While mowing the lawn near Bldg. 703 the lawn mower tipped on its side due to the angle of the hill being mowed. Motor oil and hydraulic oil leaked from the vehicle as it lied on its side. All oil was contained on asphalt, but was reportable due to the volume released. Spilled ouil was absorbed on speedy dry and containerized for off-site disposal. There were no injuries resulting from this event.
08-15 10/13/08	Ethylene Glycol 1 gallon	No	The radiator hose on a dump truck failed resulting in the release of 1 gallon of coolant to soil and asphalt. Spill absorbents were used to remove residual liquid. All impacted soils and spill absorbents were collected and containerized for off-site disposal.
08-16 10/13/08	Sodium Hydroxide 1 - 2 gallons	Yes	During the late evening of October 13, 2008, a propane explosion occurred resulting in the demolition of Bldg. 637, potable well house 12. The falling debris caused extensive damage to the sodium hydroxide storage tank. Initial inspection of the tank revealed that the site gauge which was constructed of Tygon tubing, broke away from the tank and complete loss of all product was suspected. Once the debris field was cleared, inspection of the tank showed that the site gauge pinched back on itself therefore restricting loss of hydroxide to a couple of gallons or less. All spilled product was contained by the tank's secondary containment and there was no environmental release.
08-21 12/09/08	Hydraulic Oil 15 gallons	No	Hydraulic oil leaked from the elevator casing at Bldg 750. Upon inspection, the rubber hydraulic seal and fiber gasket were found to be faulty and were replaced. Approximately 15 gallons of oil was recovered from the elevator pit. Residual oil was cleaned using absorbents. All oil and absorbents were containerized for off-site disposal.

Notes:

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Table 3-7. Summary of Chemical and Oil Spill Reports.

Spill No. and Date	Material and Quantity	ORPS Report	Source/Cause and Corrective Actions
09-01 01/05/09	Hydraulic (vegetable) oil 70 gallons	No	One of the pistons associated with a vehicle lift at Bldg. 423 failed, resulting in the release of 70 gallons of oil to the containment beneath the lift. All oil was recovered and sent for disposal as "used oil." The oil is vegetable based and therefore not considered a hazardous material. The lift was replaced.
09-12 05/06/09	20% Ethylene Glycol Solution 1 gallon	No	During site preparation for the NSLS-II project, land graders unearthed an abandoned solar heat experiment that used ethylene glycol solutions as a heat transfer fluid. Polyethylene tubing was encountered by the graders and cut during the grading process, releasing approximately 1 gallon of glycol solution to the ground. An investigation ensued which revealed a complex arrangement of piping and tanks for storing solutions and studying the effects of the ground as a heat storage media. The piping systems were uncovered and the glycol solutions recovered. In total ~ 240 gallons of glycol was removed from the systems.
09-15 05/13/09	Hydraulic Oil 0.5 gallons	No	While mowing the lawn by Apartment #22, the driver noticed the mower was leaking hydraulic fluid. He stopped mowing and parked the vehicle on the pavement. Speedi-dri was used to absorb the oil from the pavement and visibly impacted soil was removed and containerized for off-site disposal.
09-16 05/19/09	Water/Diesel Fuel > 10 gallons	Yes	During site preparation of the NSLS-II project site, land graders unearthed a previously unidentified fuel storage tank. While the tank was mostly empty, residual diesel fuel and water was released to the soil due to the impact of the grader on the tank. The tank was removed from the ground and contaminated soils were excavated and containerized for offsite disposal. Examination of the tank showed several corrosion holes indicating that the contaminated soils were likely the result of past leakage.
09-18 05/29/09	Gasoline 4 gallons	No	After refueling, the gasoline tank on a BNL pick-up truck began to leak. The tank was pumped out and the gasoline reused in another vehicle. Approximately 4 gallons of gasoline leaked from the vehicle and onto the parking lot and adjacent soil before being discovered. Spill absorbents were used to recover the gasoline and impacted soils were removed for off-site disposal.
09-22 06/22/09	Transmission Fluid 2 gallons	No	A rubber transmission fluid line on a large lawnmower dislodged from its fitting, resulting in a release of 2 gallons of fluid to pavement and a small area of grass. Spill absorbents were used to recover the fluid from the asphalt and impacted soils were removed for off-site disposal.
09-24 07/22/09	Hydraulic Fluid 1 gallon	No	While clearing brush, a hydraulic line on a backhoe failed, resulting in the release of hydraulic oil to the ground. Spill absorbent pads were used to remove oil from the machine and impacted soils were excavated and containerized for off-site disposal. The backhoe was repaired prior to returning to service.
09-26 08/14/09	Hydraulic Fluid 1 gallon	No	While moving rail cars, a hydraulic fitting on a Track Mobil loosened, resulting in the release of ~1 gallon of hydraulic oil to the railroad tracks and rock ballast. Impacted rocks were removed and containerized for off-site disposal and the Track Mobil was repaired and returned to service.
09-28 09/17/09	Hydraulic Fluid 1 gallon	No	A hydraulic hose on a payloader failed, resulting in the release of 1 gallon of oil to soil. Impacted soil was excavated and containerized for off-site disposal. The payloader was returned to the heavy equipment shop for repairs.
09-29 10/19/09	Ethylene Glycol 1 gallon	No	A radiator hose on a BNL pickup truck failed, resulting in the release of 1 gallon of ethylene glycol solution to the ground. All spillage was contained on asphalt. Spill absorbent was used to clean up the release. All contaminated spill absorbent was collected and disposed of off site.
09-32 11/16/09	Diesel Fuel 5 – 6 gallons	No	A bulldozer had been parked at the compost area for a period of time. When inspected, diesel fuel was noticed leaking from the vehicle. The bulldozer was trailered and transported to the heavy equipment shop for repairs. Examination of the soil beneath the vehicle showed extensive contamination with diesel fuel. Approximately 3 – 4 cubic yards of contaminated soil were excavated and containerized for off-site disposal.
09-33 11/19/09	Hydraulic Fluid 60 gallons	No	During a retrofit of the elevator in Bldg. 725, oil was discovered in the casing enclosing the elevator ram. Miller Environmental Group, an EPA recognized Oil Spill Response Organization, was retained to clean the oil and any contaminated water from the elevator casing. Approximately 60 gallons of oil and 35 gallons of water were recovered. Once the casing was cleaned out, the elevator contractor completed installation of the new cylinder and ram. A small-diameter PVC monitoring device was installed to monitor for the presence of additional leakage.

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