Brookhaven National Laboratory
Potable Water Supply System
General Information

General Plant Description

The Brookhaven National Laboratory (BNL) Water Treatment Facility (WTF) is located on the western side of the Laboratory's Upton, New York site. The site is owned and operated by the Department of Energy (DOE) and is under the direct supervision of Brookhaven Science Associates. Originally constructed in 1960 with three rapid sand filters, the WTF has undergone a series of upgrade projects resulting in its present state that has been designed to meet the current and future water needs of the Laboratory.

The water supply system is the only source of potable water for the on site population of 3,500 people and the associated scientific research. It is comprised of the following components.

Potable Water Supply Wells

Six (6) electrically driven vertical turbine deep well pumps, with auxiliary drive engines, design rated at 1200 gpm each.

Well No.	4	6	7	10	11	12
Permit No.	W-1656	W-2210	W-2210	W-3156	W-3156	W-3389
Constructed	1960	1964	1964	1980	1981	1986
Design Capacity (gpm)	1200	1200	1200	1200	1200	1200
Total Depth (ft)	148.5	150	150	142	142	142
Depth of Water (ft)	46	52	52	48	48	48

Wells #4, #6, and #7, located west of Upton Road, supply water to the Water Treatment Facility. Wells #10, #11, and #12, located along First Street, discharge directly to the system.

Water Treatment Facility

Iron removal by oxidation and filtration – reduce iron concentration from 3-4 mg/Liter in the ground water to 0.03 mg/L in the finished water. The dissolved, soluble (ferrous) iron in the ground water must first be converted and oxidized to form insoluble ferric hydroxides that flocculate and settle.

The WTF consists of the following components and functions:

- Aeration Tank - To reduce carbon dioxide gas and aid in oxidation.
- Rapid Mix Tank – Addition and mixing of chemicals.
- Sodium hypochlorite - Disinfection and iron oxidation.
- Polymer –A coagulant to aid in the flocculation process.
- Lime – To raise the pH and soften the water.
- Retention (Flocculation) Tank – Provide retention time for the chemicals react and allow floc to form.
- Slow Mix Tank – Gentle mixing to aid in floc build-up.
- Rapid Sand Filter – Eight filter cells where the iron floc is removed by passing the water through a mixed media (Sand and Coal).
- Wet Well With Lift Pumps - Storage of filtered water prior to the aeration towers.
- Packed Aeration Tower – Volatile Organic Contaminants (VOC) removal by spraying the water down over "wiffle balls" while air flows upward through the water spray.
- Clear Well - Storage of finished water, final chlorination prior to distribution.
- High Service Pumps (4) - Supply water to distribution system.

Water Storage Tanks

300,000 Gallon Tank

Pittsburgh-Des Moines Steel Company built the cone-roof, ellipsoidal-bowl tank of riveted and welded construction for the Army in 1941. It is located on Upton Road next to Police Headquarters. The bowl is 40 feet in diameter. The tank is approximately 124 feet to the high water level.

1,000,000 Gallon Tank

The spheroidal roof, torus bowl tank, was built by Chicago Bridge & Iron in 1985. It is located near the center of the site, near the intersection of Cornell and North Sixth Street. The bowl is 75.5 feet in diameter. The bottom of the tank is 126 feet above land surface.

Carbon Filters

Carbon adsorption filters are installed on the three wells discharging to the distribution system. (Wells 10,11,12). These wells had concentrations of the VOC 1,1,1 Trichloroethane at about 3-4 parts per billion (ppb) above the drinking water standard of 5 ppb. Since October of 1996, the

raw water has been consistently below the drinking water standard and the filters are no longer required. However, they are maintained in active service to ensure a high water quality. The system consists of two 10-foot diameter pressure vessels, each loaded with approximately 20,000 pounds of activated carbon that can be operated in series or parallel flow. BNL operates the system in parallel to achieve a flow rate of 1, 000 gallons per minute. When the carbon is exhausted, it is replaced with new carbon and the spent product is returned to the manufacturer for thermal reactivation and reuse.

Distribution Piping

The site has approximately 45 miles of distribution pipe. It is a mix of Cast Iron (1940's), transite, plastic, and cement-lined ductile iron. All new construction is cement lined ductile iron pipe.

Potable Water Production

In 1998, production was 786,000,000 gallons or an average monthly production of 65,000,000 gallons (2.2 mgd). Monthly flow varies from 26,000,000 gallons (0.86 mgd) to over 120,000,000 gallons (4 mgd). The water is for domestic consumption, cooling tower makeup, and once through equipment cooling, including the AGS Main Magnet heat exchangers.

Operational Description Of The Water Treatment Facility

The WTF provides up to 6 million gallons per day (mgd), with an average flow of 2 mgd of high quality potable water to the BNL system. Water supply wells #4, #6, and #7 are rated at 1200 gallons per minute (gpm), and provide water that is relatively high in iron and manganese to the WTF. The WTF reduces these elements to acceptable levels prior to being discharged to the potable water system. Treated water is supplied by four high service pumps located at Building 621 (WTF Service Building). The well stations are equipped with flow meters and appropriate instrumentation so as to monitor, start, and stop pumps automatically in a pre-selected sequence, based on the water distribution system demand as measured in the two elevated water storage tanks and the WTF clearwell.

The WTF reduces the concentration of iron and manganese in the raw water by the process of aeration, oxidation/precipitation, flocculation, and filtration.

Sodium hypochlorite is injected at the well stations for oxidation and disinfection prior to actual treatment at the plant.

The ground water from the wells is pumped to the WTF aeration tank where air is injected through a perforated PVC piping system. This air stripes out the natural carbon dioxide of the water and reduces the amount of lime required for pH adjustment. This air is supplied to the aeration tank by one of three blowers located in the filter building.

The filter building contains the rapid mix tank where polymer is added as a flocculation aid, a retention tank to allow flocculation to occur, and a slow mix tank prior to entering the filters.

The water is conveyed by gravity through the inlet channel and into the eight dual media down flow filters. Each filter contains one-foot of sand media overlaid with two feet of anthracite coal media. The filtered water flows through the filter bottom nozzles into a plenum area under each filter, where it enters a common effluent channel for discharge to the clearwell. All eight filters are continuously operated, except during filter backwash when one unit is removed from service.

Backwashing (reverse flow) is initiated when the head loss across the filter has increased due to clogging of the media with iron floc. The insoluble iron and the backwash water is recharged to the ground.

The water flows by gravity to the wet well (80,000 gallons) where it is stored prior to pumping to the aeration towers. Four lift pumps (multi-stage vertical-turbine), rated at 1200 gpm supply water to the aeration towers. Each tower has a capacity of 2,400 gpm. Air is introduced at the bottom of the tower (counter flow) to remove any volatile organic compounds that may be present. The water then drains into the clearwell.

The clearwell holds treated water (300,000 gallons) prior to discharge by the high service pumps to the system. Sodium hypochlorite is again added to the treated water for disinfection at this point.

System Operation

The system is controlled as follows:

1. Changes in the storage tower levels activates the high service pumps.
2. Changes in the clearwell controls Wells 4, 6, and 7.
3. Wet well levels control the lift pumps.
4. High and low level limits lock out respective pumps.

Manpower

Six plant operators man the WTF eight-hours per day, five-days per week. After normal working hours and on weekends and holidays, an automatic alarm system monitors the plant. If an alarm condition occurs, a signal is automatically indicated at the Central Chilled Water Facility, which is manned continuously, and the appropriate operations personnel are contacted by the Site Shift Supervisor.

All plant operators hold NYS Department of Health 2A Community Water System Operator Certificates. Supervisory management personnel hold 1A Community Water System Operator Certificates.

Maintenance Schedule

Maintenance on the well is performed when a reduction in capacity is approximately 20% of operational flow. The well pump is pulled (disassembled and inspected) and repaired as required. The casing and well screen is chemically treated and redeveloped. Frequency of maintenance varies on usage and water quality.

Outages and Emergencies

All wells are driven by electric motors. In the event of a power failure, the wells are equipped with backup propane or diesel fueled engines. In the event of a power failure or water main break, the storage towers provide reserve capacity to maintain system pressure.

Support Documentation

Document	*Frequency*	*Responsibility*	*Document Stored*
Operating Log	Daily	Operator	624
Well Book	Daily	Operator	624
Health Department Report	Monthly	Supervisor	Supervisor's Office
Rounds Log	Daily	Operator	624
Plant Log	Daily	Operator	624
Charts	Daily	Operator	624
Alarm/ECI Log	Daily	Operator	624
Well Draw Down	Weekly	Operator	624
Test Results	Monthly	Supervisor	Supervisor's Office
Maintenance Work Orders	Monthly	Supervisor	MMC- Building 97