LIVE FIRE RANGE

SAFETY ANALYSIS REPORT
STANDARD OPERATING PROCEDURES
OPERATIONAL SAFETY REQUIREMENTS

SAFEGUARDS AND SECURITY DIVISION

(Revision 11, February 2002)

Approved: _____
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I. INTRODUCTION AND GENERAL DESCRIPTION OF PROJECT

A. Overall Description

The Brookhaven National Laboratory (BNL) Live Fire Range (LFR) consists of a six- position, 91 meters (100-yard), baffled, bermed, outdoor small arms range and a grenade range. This facility will be used by BNL Police Group personnel to provide firearms and grenade training. The LFR may also be used by Federal and local law enforcement agencies and members of the Brookhaven Employees Recreation Association (BERA) Rifle and Pistol Club.

BNL personnel will operate the facility in compliance with DOE orders and Standard Procedures of Operation, (SPO 403, "Range Procedures", Attachment A) developed for the facility by the Safeguards and Security Division (SE). Weapons that will be used at the LFR include handguns; shotguns; submachine guns; rifles; grenade launchers; and smoke, gas, and stun grenades.

Design requirements for the LFR were developed by personnel from the BNL Plant Engineering Division (PE), Safety & Environmental Protection Division (SEP), and Safeguards and Security Division. As mandated by DOE Order 5480.4, the design of the LFR is in accordance with Army Regulation 385-63, "Safety Policies and Procedures for Firing Ammunition for Training, Target Practice, and Combat," dated 15 November 1983. Air Force Regulation 50-36, "Combat Arms Training and Maintenance Program Management," dated 15 March 1984, was also used as a reference. LFR updates and safety requirements comply with DOE STD-1091-96 and DOE Order 440.1A.

B. Location

BNL is located in Upton, Long Island, New York, approximately 97 kilometers (60 miles) east of New York City. The BNL site (Figure 1) consists of 404 hectares (5200 acres) bounded on the south by Interstate 495, on the north by Deer Leap Road, on the west by William Floyd Parkway, and on the east by North Street. The BNL Range is located on "Range" Road off First Street, approximately one-half mile north of Fifth Avenue, just north of the Sewage Treatment Plant, Building 575. It includes both a target shooting range and a grenade range (Figure 2).

C. Facility Rationale

BNL employs a protective force which is armed and subject to DOE firearms training and qualification standards. The level of risk associated with employment of armed personnel is inversely related to the level of training afforded those armed persons. The effectiveness of these armed persons in employing firearms is directly related to the level of training they receive.

Prior to construction of the LFR, the protective force trained at a partially baffled range at the same location. That range was judged to be unsafe. The principal purpose of the LFR is to provide safe small arms and grenade training and qualifications capabilities to BNL Police Group personnel. The small arms section of the range may also be used by members of the BNL Rifle & Pistol Club, as well as Federal and local law enforcement personnel for training, qualification, and competition.

Figure 1
Location Map of Brookhaven National Laboratory

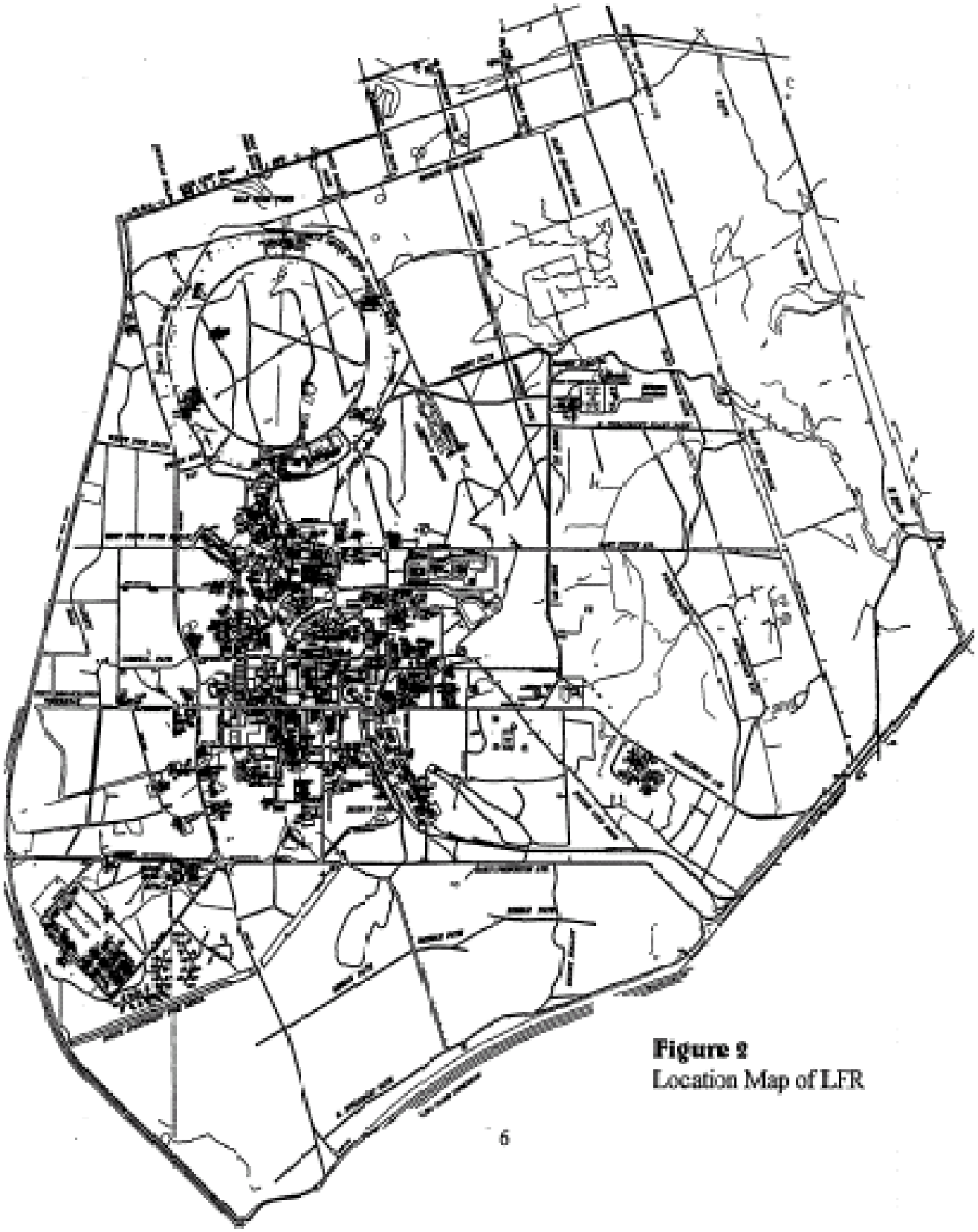


Figure 2
Location Map of LFR

II. SUMMARY SAFETY ANALYSIS

A. General

As mandated by DOE Order 5480.4, the design of the LFR is in accordance with Army Regulation 385-63, "Safety Policies and Procedures for Firing Ammunition for Training, Target Practice, and Combat," dated 15 November 1983. Air Force Regulation 50-36, "Combat Arms Training and Maintenance Program Management," dated 15 March 1984, was also used as a reference. Updates and safety concerns follow DOE Order 44.1A, “Worker Protection and Management for DOE Federal and Contractor Employees.

B. Safety Features

The primary safety features of the LFR are the backstop berms with affixed "eyebrow" ricochet catchers, side berms, and a series of baffles constructed to provide assurance that projectiles fired remain within the facility.

C. Risk Analysis

The risks associated with operation of the LFR on both the small arms and grenade sections can be characterized as weapons related and non-weapons related. There are no unusual non-weapons related risks associated with operation of this facility. This report provides an analysis, in detail, of all identified weapons-related risks.

The risks identified are:

1. Injury to individuals, both on-site and off-site, resulting from being struck by a projectile fired from a small arms weapon, grenade launcher, or grenade detonation.

2. Hearing damage to shooters and observers resulting from exposure to the sound of gunfire or grenade detonations.

3. Eye damage to shooters and observers resulting from malfunctioning weapons or ammunition. Spent casings ejected from autoloading weapons present an eye and burn hazard.

4. Mechanical hazards associated with operation of different types of weapons, e.g., burns, pinched fingers, bruised shoulders.

5. Exposure to lead by users of the LFR.

D. Conclusion

Based on the DOE Guide l5l.1-1, “Hazards Surveys and Hazards Assessments”, dated 8/21/97 evaluation of potential general risks at the LFR would be rated as a low hazard level facility. The associated safety analysis, review, and approval procedures are the basis for this safety analysis report. The low hazard rating is a reduction from the original SAR submitted. It is believed that the low rating is more appropriate, as other DOE site ranges, with similar specifications and use, also have a rating of low. It must also be noted that SPO III Training does not occur on our range. The low rating is commensurate with the risks associated with training and utilization activities. This has been approved by the BNL ES&H Committee.

Based on an analysis of the risks and risk management features and procedures associated with the LFR, there is sufficient assurance the LFR can be operated safely.

III. SITE DESCRIPTION

A. Site Location

The LFR is located in the northeast quadrant of the Laboratory (Figure 2). The LFR is approximately 183 meters (200 yards) south east of the normally unoccupied Chlorine House (Building 580), and northeast of the Sewage Treatment Plant (Buildings 575 and 579). No other buildings or facilities are located within 305 meters (1000 feet) of the LFR. The LFR has been designated Building 574.

B. Security

The LFR is located on BNL and is bermed, posted, and fenced. Keys to the gates of the LFR are controlled by the BNL Police Group.

IV. FACILITY DESCRIPTION

A. General Description

The small arms section of the LFR consists of a six position, 91 meters (100-yard), baffled, firing range with covered firing lines. The grenade section of the LFR contains a throwing pit.

B. Component Descriptions

Although, as indicated in Figure 3, BNL controls a heavily wooded area 1433 meters (4700 feet) east of the range backstop, 1341 meters (4400 feet) north to the property line, and 4400 feet south to a biology field, the principal objective of the design of the LFR was to contain all direct-fire projectiles within the confines of the LFR. To accomplish this objective, the design incorporates a series of horizontal and vertical baffles, berms, and backstop berms containing "eyebrow" ricochet catchers.

Figure 3
Impact Zone

C. LFR Description (Figure 4)

Significant construction features of the LFR are:

1. Small Arms Section

The small arms section of the LFR is 131 meters (429') long and 39 meters (129') wide and consists of nine firing lines: 91 meters (100 yards), 46 meters (50 yards), 32 meters (35 yards), 23 meters (25 yards), 14 meters (15 yards), 9 meters (10 yards), 6 meters (7 yards), 5 meters (5 yards), and 3 meters (3 yards). All firing positions are covered by horizontal roof baffles. Additional vertical baffles are positioned so that, when viewed from each firing line position, each baffle overlaps the succeeding baffle. The LFR is enclosed with 2 meters (6') chain link fencing, and the north, south, and east sides, bermed to a height of 4.5 meters (14' 9"). The backstop berm is 4.5 meters (14' 9") high, 44 meters (129' 2") wide, and 14 meters (45' 9") deep at the base pyramiding to 1.37 meters (4' 6") at the top. An "eyebrow" ricochet catcher is affixed to the top of the berm the full width of the berm.

2. Grenade Section

The grenade section of the LFR is an open rectangular parcel enclosed by a 2 meters (6') chain link fence on its north and west sides. The only entrance is at the west side. The south berm, which also forms the northern boundary of the small arms section of the LFR, is 131 meters (429') long x 4.5 meters (14' 9") high. The east berm (rear) is 14 meters (45' 9") wide x 4.5 meters (14' 9") high and is affixed with an "eyebrow" ricochet catcher.

3. Baffles (Figure 5)

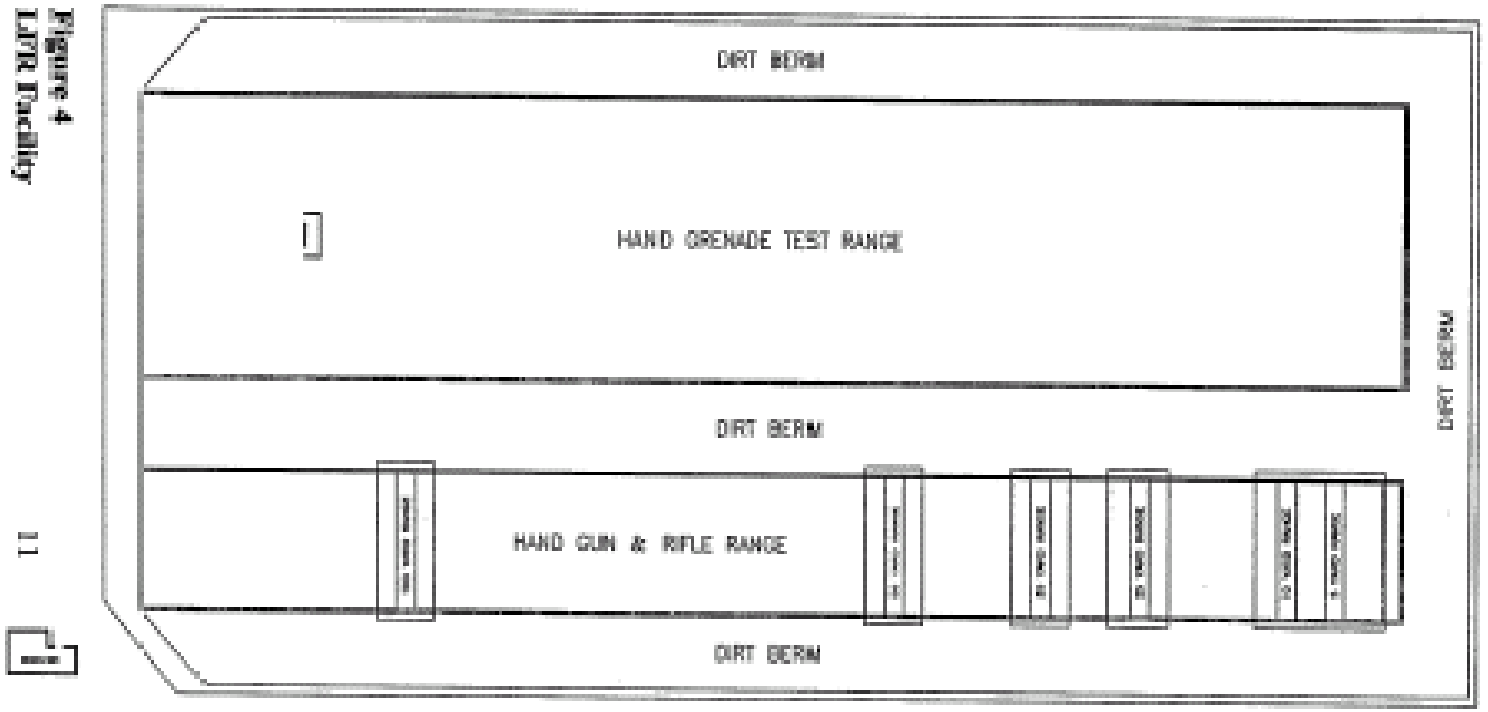
The impact area described in paragraph IV.B above is sufficient for handling rounds that may ricochet from the range; however, it is not adequate for direct-fire rounds. Thus, all firing positions are covered by horizontal roof baffles and, with the exception of the 3 meters (3-yard) position, have additional vertical baffles located in front of each firing position. The vertical baffles are positioned so that, when viewed from each firing line position, each baffle overlaps the succeeding baffle which will impede projectiles from leaving the LFR.

Baffle construction is based upon the standards contained in Air Force Regulation 50-36, those followed in constructing the Argonne National Laboratory range, and tests conducted at BNL (Attachment C). All horizontal and vertical baffles are sheathed in 2 cm (3/4") plywood with a 9 cm (3-1/2") cavity filled with pea gravel.

4. "Eyebrow" Ricochet Catchers (Figure 6)

The rear berms of both the small arms and grenade sections of the LFR contain "eyebrow" ricochet catchers. The "eyebrows" are 3 meters (9') wide, 1.5 meters (5') of which extends toward the shooters. The outer edge of the "eyebrow" (toward the shooters) rises to a 60° angle.

Figure 4
LIFR Facility



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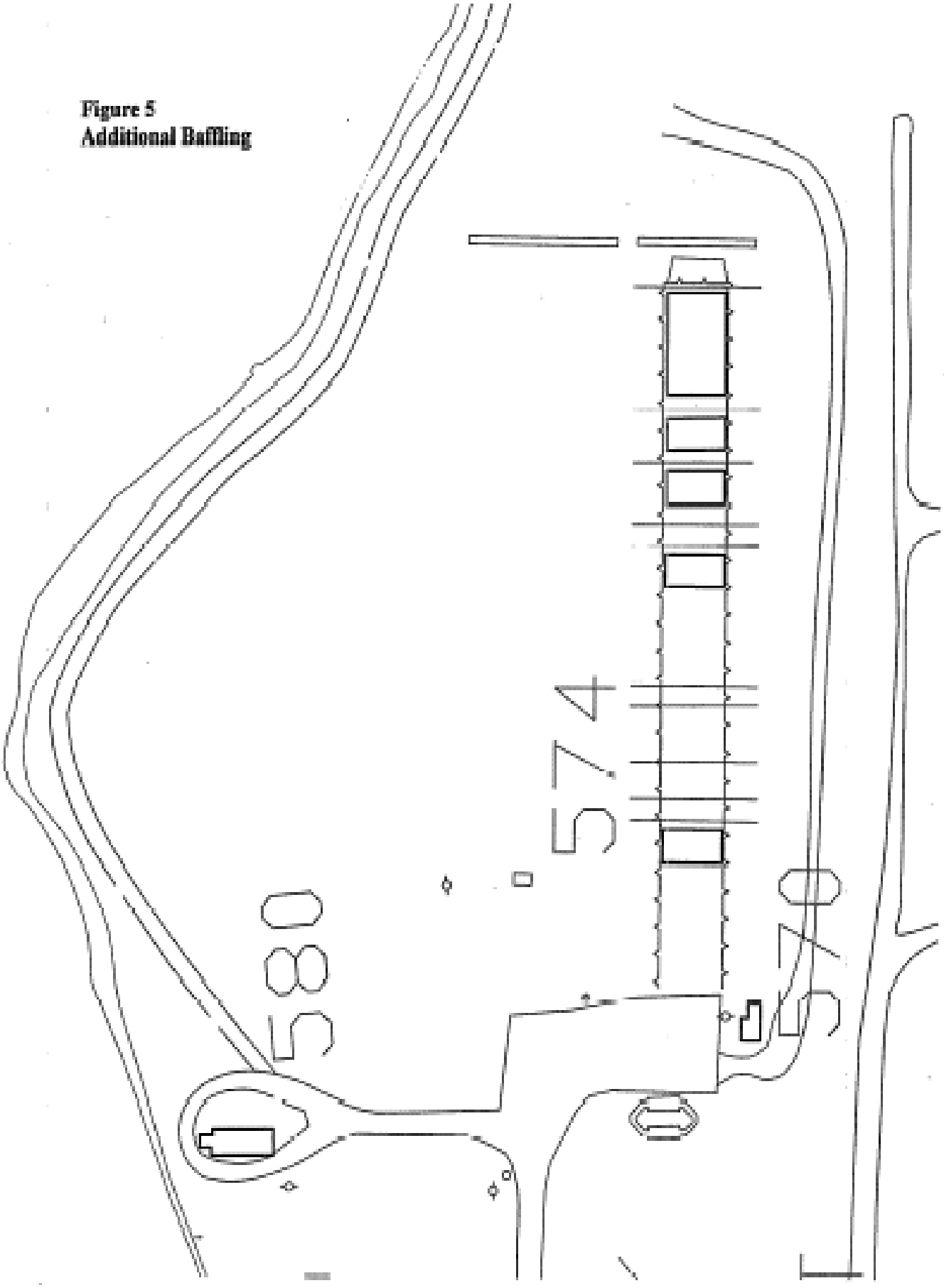
BROOKHAVEN
NATIONAL LABORATORY

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

Key Plans	Weapons Range Facility
PLANT ID	574

Figure 5
Additional Baffling



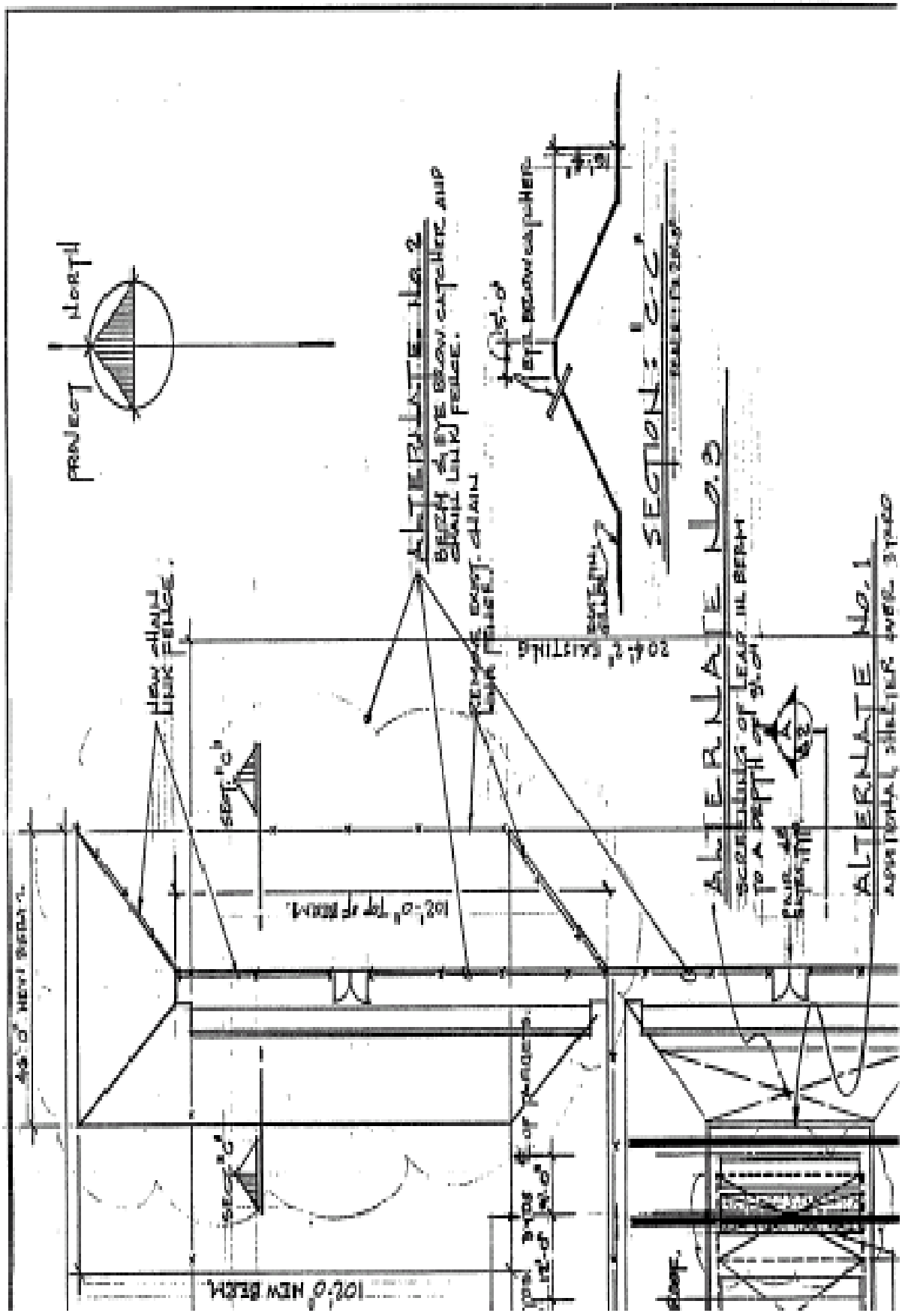


Figure 6
Eyebrow – LFR

5. Grenade Throwing Pit (Figure 7)

The grenade throwing pit is a rectangular structure 4 meters (13') long x 1.68 meters (5' 6") wide x 1.42 meters (4' 8") high and is constructed of 15 cm (6") x 15 cm (6") rough sawn, pressure treated timber with two 36" openings at each end of the western long side to provide entry for the thrower and instructor. The pit is constructed on a reinforced 15 cm (6") concrete slab sloping downward toward the front and sloping from each of the sides into a smaller pit .60 meters (2') square and .60 cm (2') 20 cm (8") deep in the front center of the throwing pit wall. The smaller pit is designed so that an accidentally dropped grenade will roll into it and prevent serious injury to the participants. A fire extinguisher, approved by the BNL Fire/Rescue Group, is maintained at the LFR in the event of a grass fire.

6. Turning Target System

The turning target system is powered by hard wire and remotely controlled to expose and conceal targets on command.

The hard wire system is 117 VAC, 20 amps, and is connected to the range power supply via underground cable. The power supply has an on/off switch located in the electrical panel mounted on the fence at the entrance to the range.

In addition to the built-in Air Space Armor Plate Assembly which protects the down range target system, the system is also protected against damage and the remote possibility of causing a ricochet by a 81 cm (32") high x 20 cm (8") wide railroad tie barrier located between the shooters and the system. To further eliminate ricochet possibility, the metal posts to the turning mechanisms are covered with wood and the target frames constructed of wood.

7. Warning Devices

The range is equipped with a halyard mounted on a light pole. A red warning flag is displayed on this pole when the range is used during daylight hours. For nighttime firing, a flashing red beacon will be illuminated as a warning that the range is in use. A "Range in Use" sign is displayed when firing is occurring.

V. ACCIDENT ANALYSIS

A. Introduction

There is some degree of risk inherent in all firearms handling. The potential for an accidental discharge, for example, always exists. Experience has shown that these risks can be effectively managed by application of the following:

1. Range design which incorporates proven safety features.

2. Employment of competent range training and safety personnel.

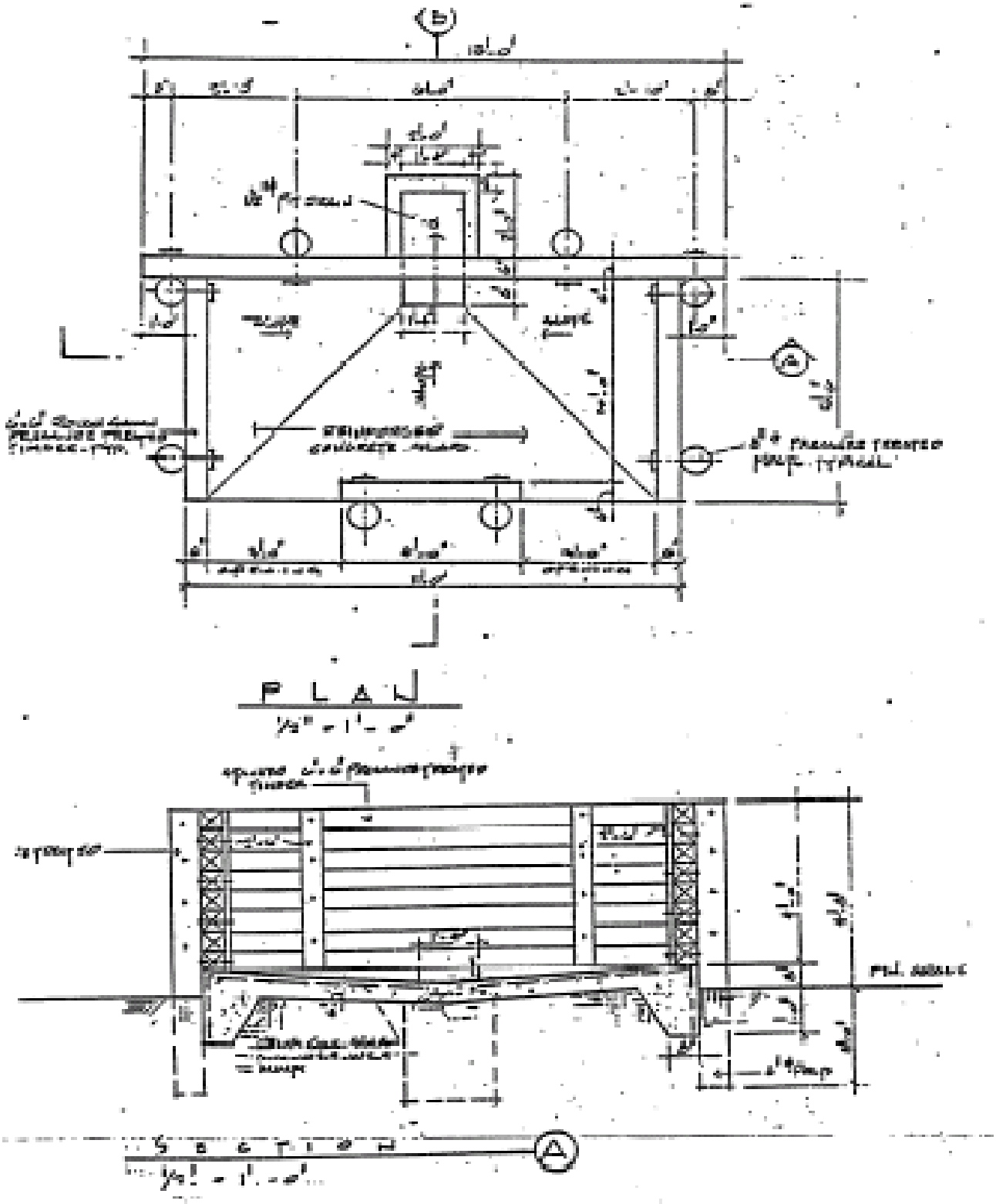


Figure 7
Grenade Pit

3. Strict compliance with a concise and complete set of Standard Procedures of Operation (SPOs).

4. Thorough firearms and grenade familiarization and training in applicable portions of the SPO prior to live-fire training.

5. Safety consciousness and mature conduct on the part of all personnel involved in range activities.

The SAR (both for the target and grenade sections) and the operating procedures for the facility reflect each of these considerations.

This SAR addresses only those hazards associated with range operation that are firearms related. Safety concerns such as falls, burns, cuts, etc., are only analyzed as they relate to weapons operations.

B. Identified Risks and Risk Management Methods

1. Injury Resulting from Projectile

a. Small Arms Section

The projectiles from types of firearms that will be fired at the LFR have the potential to cause an injury or death. The population at risk from a firearm discharge are those persons within the maximum range of that weapon.

The M-16 and similar weapons have the greatest maximum range of the weapons proposed for use at the LFR. The population potentially at risk during firing at the LFR, excluding any mitigating factors such as the backstop, berms, baffles, etc., is that group of people within range of the M-16 from the firing line. This group includes the users of the LFR, the BNL site population, and an off-site population surrounding the Laboratory.

Projected use of the LFR is approximately 100,000 rounds per year. These rounds will be properly aimed, intentional discharges. These will impact on the backstop and be contained within the facility, posing no further risk. The possibility of ricochet hazards will be minimized by the vertical baffles, berms, "eyebrow" ricochet catcher, the impact area described in paragraph IV.B, and proper maintenance of the backstop according to operational safety requirements. Lead buildup or rocks observed in this area will be removed as necessary. To eliminate lead leaching into ground water, in August 1989, the soil of the rear berm was sifted to one foot depth and lead waste disposed of by the SEP Hazardous Waste Section. The amount of lead waste has been reduced and is now disposed of as “recyclables”. This procedure is repeated annually. (See Attachment B, OSR #1)

The backstop, "eyebrow" ricochet catcher, side berms, and baffle system provide high assurance that projectiles will not escape the facility, either directly or by ricochet, if loaded weapons are not allowed to point outside of the horizontal and vertical limits of the protection afforded by these

features. The Range Instructor and all users of the range share in the responsibility of ensuring that no loaded weapon is ever allowed to point in a direction such that, if a discharge were to occur, the projectile would not be contained within the range.

Safety conscious shooters and control of the range by a trained RI, in accordance with strict standard operating procedures, are the primary safeguards against a projectile leaving the LFR. All users of the LFR receive training on safe operation of weapons and the safety procedures employed at the LFR prior to any live firing. A trained RI shall be present and in command at all times the LFR is in use. These safeguards, supplemented by the bullet containment system at the LFR, provide a high level of assurance that projectiles will not leave the facility.

The risk of injury to users within the LFR is mitigated by the safety training received by all users of the facility and by control of the facility by a trained RI in accordance with strict procedures at all times the LFR is in use.

The possibility of ricochets presents both an on-site and off-site risk. This hazard has been addressed at the LFR by the construction of a baffle system, earth berms, and backstop with ricochet "eyebrow" catcher and by posting the impact area. Each of these structures serves to intercept and contain ricochets. All metal structures erected forward of the firing line have been sheathed in wood to minimize the possibility of a ricochet.

A possibility exists that a person might climb the berm surrounding the LFR and enter the danger area when firing is taking place, exposing the person to the risk of injury by a projectile fired before that person's presence is observed. This risk is mitigated by the fencing and warning signs posted around the perimeter of the berm. Added warning of the danger is given by the display of a red warning flag during daylight hours and a flashing red beacon at nighttime when live-fire is in progress. Additionally, shooting will not be permitted at the LFR if visibility does not allow shooters to clearly identify their targets. Lighting shall be used to supplement existing light when necessary to meet this standard.

b. Grenade Range

There are no "offensive" hand grenades used at BNL. Stun grenades are used; thus, there is a low probability for projectile injury from fuse housing, striker, and loose debris on the ground. The persons potentially at risk during stun grenade training, excluding mitigating factors such as the grenade pit, fence, berms, and one-on-one instruction, are the Range Instructor and the trainee. Another potential for projectile injury, excluding mitigating factors such as the backstop affixed with an "eyebrow" ricochet catcher, berm, fencing, and one-on-one instruction, is the use of grenade launchers for smoke and gas. Those potentially at risk during this training are the RI, the trainee, and trespassers within 400 meters (404 yards). The potential hazard from the use of smoke and gas grenades will be mitigated by conducting training only when wind direction is away from users and observers.

The grenade pit, berms, "eyebrow" ricochet catcher, and fencing, provide high assurance that projectiles will not escape the facility nor injure those utilizing the range if launchers are not permitted to point outside of the horizontal and vertical limits of the protection afforded by these

features. The RI and users share in the responsibility for ensuring that a loaded launcher is never pointed in a direction other than the target.

A possibility exists that a person might climb the berm surrounding the grenade section of the LFR and enter the danger area when firing is taking place, exposing the person to the risk of injury by a projectile fired before that person's presence is observed. This risk is mitigated by the fencing and warning signs posted around the perimeter of the range. Added warning of the danger is given by the display of a red warning flag during daylight hours and a flashing red beacon at nighttime when live fire is in progress. Additionally, grenade training will not be permitted at the grenade range if visibility does not allow trainees to clearly identify the target areas. Lighting shall be used to supplement existing light when necessary to meet this standard.

Prior safety training in the proper use of grenades and launchers; strict control by a RI; one-to-one instruction; and the grenade pit, berms, "eyebrow" ricochet catcher and fencing provide high assurance that projectiles will not escape the facility nor injure those using the grenade range.

2. Hearing Loss

A loud report occurs with many types of grenade and small arms fire. Continued exposure to such noise can result in long-term hearing impairment. Sound-barrier hearing protectors are available at the range. The RI shall ensure that hearing protectors are used by all persons in the area when firing is taking place. Security personnel are given auditory tests by the BNL Occupational Medicine Clinic annually, as hearing loss associated with exposure to grenade and gunfire is normally a slow process which takes place over a lengthy period. The testing provides notice of any problem developing in this area, and, depending on the results of these tests, appropriate measures shall be taken.

3. Eye Damage

Projectile particles from stun grenades and spent casings ejected from firearms and other eye hazards can be encountered during normal range operation. In addition, a weapon or ammunition malfunction may subject a shooter's eyes to hot gases, burning powder, or metal fragments. Approved safety glasses are available through the BNL Safety Equipment Program. The RI shall ensure that eye protection is worn by all personnel on the firing line or grenade pit any time firing is taking place.

4. Mechanical Hazards

During live fire, weapon barrels and smoke grenades can cause burns. Ejected cartridges are also capable of causing burns if they come in contact with the skin. The RI shall ensure that all users of the LFR are briefed on these hazards. The RI shall also caution shooters to button loose fitting collars to prevent an ejected cartridge case from lodging against the skin.

5. Lead Exposure

Exposure to lead fumes generated during live fire can be harmful to the health of users of the LFR. Monitoring of shooter breathing zone exposure to lead shall be conducted semi-annually by

BNL's SEP Division as stated in DOE STD 1091-96. DOE STD 1910.1025 and OSHA standards are used to verify that lead exposures are below occupational exposure limits. Appropriate steps shall be taken to minimize exposure to lead, depending upon testing results. Additionally, all RI are tested annually by the Occupational Medicine Clinic for the concentration of lead within their blood. RI's whose blood lead level exceeds established standards will be temporarily prohibited from firing until subsequent testing indicates a satisfactory reduction in lead level. If excessive levels are detected, the cause will be evaluated and corrective action identified and taken. After range use personnel shall wash their hands prior to eating, drinking or smoking.

VI. QUALITY ASSURANCE

Design requirements for the safety systems installed at the LFR were established based upon the capabilities of the weapons to be used at the facility. The baffle system (Figure 5) was designed and constructed in accordance with Air Force Regulation 50-36, the Argonne National Laboratory range construction specifications, and baffle design tests conducted at BNL (Attachment C).

The LFR will be maintained in a fully functional and safe condition through inspections by the RI prior to each live-fire use and through prompt maintenance of any defects found. This will be supplemented by periodic inspections by the Range Master verifying that the facility's safety features continue to conform with design requirements.

Current operating procedures for the range shall be distributed to all RIs, with additional instruction and familiarization as appropriate, by the Range Master (RM) and Training Unit (TU). No changes in these procedures shall take place unless approved by the BNL Firearms Safety Committee. Final approval is by Management of the Safeguards and Security Division.

Firearms qualifications and certification records of all BNL security personnel will be maintained by the Training Unit, which will ensure that such qualifications and certifications are kept current, commensurate with each individual's duties and authority.

VII. CONDUCT OF OPERATIONS

A. LFR Management

The LFR will be operated by the BNL Police Group. Overall responsibility for range operations rests with the Range Master (RM). The RM shall review and approve or disapprove all lesson plans for training proposed for the LFR. Operating procedures for the LFR shall be reviewed and approved by the BNL Firearms Safety Committee.

All BNL use of the LFR will be under the direct control of the BNL RI. The primary duty of the RI is to ensure the safe conduct of all activity at the LFR. The full range of duties and qualifications of the RI are detailed in the Range Procedure.

As mandated in Firearms Safety Standard 1091-96, BNL has formed a Firearms Safety Committee to advise management on issues related to the safe conduct of activities involving firearms. All firearms-related activities at BNL are subject to review by this committee.

B. Safety Review System

The BNL Firearms Safety Committee shall, at least annually inspect armories, ranges, cleaning facilities, and any other firearms associated facilities. The Committee will review, evaluate and approve changes to firearms related safety analysis reports, policies, lesson plans and operating procedures. The committee will assist Laboratory management in providing safe firearms activities. Additionally, all firearms operations are subject to review by BNL and DOE safety and security organizations.

C. Inspection Program

The RI shall inspect the LFR for hazards and potential hazards prior to each live-fire use of the facility. Any hazards or potential hazards noted shall be documented and reported without delay to the RM. No live-fire use of the facility shall take place until such problems have been corrected.

D. Procedures

The LFR shall be utilized in accordance with an approved Standard Procedures of Operations (SPO-403 Range Procedures, Attachment A). The SPO, and any revisions, shall be subject to review and approval by the BNL Firearms Safety Committee prior to implementation.

A RI shall be present and in control when the LFR is being utilized. Firearms that may be used by the BNL Police and other Law Enforcement Agencies will include .38 handguns, 9mm handguns, shotguns, MP-5s (both semi-automatic and fully automatic 9mm), M-16's or AR-15's (223), and G3S1 (or equivalent) sniper rifles (7.62 NATO or 5.56 NATO caliber). Other weapons with capabilities not exceeding those listed above may also be used. Hand grenades (stun, gas, and smoke) may be used at the grenade range. No ammunition is stored at or near the LFR.

BERA, is not permitted to use the grenade range. At the small arms section of the LFR, BERA, Federal and non-federal organizations are not permitted use of turning targets.

Prior to the implementation of any new training or evaluation method involving firearms and non-routine tactical operations, a training risk analysis shall be completed and approved by the Firearms Safety Committee.

The throwing pit is utilized only for training with practice and stun grenades. Prior to live grenade training, each trainee must successfully complete a safety course for handling, throwing, and disposing of live grenades. Upon completion of this course, the trainee is instructed (one-on-one) in throwing practice grenades at a cone located approximately 35m from the pit.

The grenade range is also used for training with grenade launchers, utilizing both smoke and gas. This course of training commences with classroom instruction in familiarization and safe use of the launcher. At the range, the trainee is instructed (also one-on-one) in the proper use of the launcher.

E. Emergency Planning

BNL maintains a staff of trained Emergency Medical Technicians (EMT) 24 hours per day. Communication with emergency services can be made from the range via telephone and portable radio. Normal response time by BNL EMT's will be under five minutes. BNL has developed, and exercised, Standard Operating Procedure 403 Range Procedures, which outlines actions for quickly handling, treating, and evacuating injured personnel. This plan shall be drilled annually. In addition to indicating specific procedure to be followed, it also stipulates that all SE RI are cardiopulmonary resuscitation (CPR)/first aid trained and retrained annually. First aid training includes treatment of trauma and gunshot wounds. A First Aid Trauma Kit is stored in the Range Shed. Its contents have been reviewed and approved by the BNL Fire Rescue Group and the BNL Designated Physician. Its contents are inventoried monthly.

VIII. REFERENCES

1. Army Regulation No. 385-63, "Safety Policies and Procedures for Firing Ammunition for Training, Target Practice, and Combat," 15 November 1983.

2. Air Force Regulation 50-36, "Combat Arms Training and Maintenance Program Management," 15 March 1984.

3. "DOE Live-Fire Range (LFR) Final Safety Analysis Report," Sandia National Laboratories, Albuquerque, New Mexico, March 1983.

4. "Argonne National Laboratory Firearms Training Facility Safety Analysis Report," Argonne National Laboratory, Argonne, Illinois, October 1987.

5. DOE Standard 1091-96, "Firearms Safety," February 1996.

6. DOE Order 440.1 "Worker Protection Management for DOE Federal and Contractor Employers," 9/30/95.