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Revision Log

Purpose/Scope

The purpose of this Assessment is to comprehensively and qualitatively assess the risk from fire within the National Synchrotron Light Source (NSLS) to ensure DOE fire safety objectives are met. DOE fire protection criteria are outlined in DOE Order 420.1. The Fire Protection Assessment includes identifying the risks from fire and related hazards (direct flame impingement, hot gases, smoke migration, fire-fighting water damage, etc.). A Fire Hazard Analysis (FHA), required for the NSLS Facility Safety Assessment Document, is incorporated into this Assessment.

Summary

The planned use of the NSLS Facility is described in the "Occupancy and Associated Fire Hazards" section below. These descriptions are based on field surveys, a review of the planned and completed installations, and discussions with NSLS project staff. This assessment and FHA demonstrates the achievement of a reasonable and equivalent level of fire safety that meets DOE improved risk objectives.

Recommendations:

1) Improve the fire barrier for the North East center located stairs in the Phase II addition. The duct that passes through the stairwell's interior needs to be enclosed to isolate it from the stairwell. This is a low priority action and should be funded through the Activity Data Sheet system as part of a large project.

2) Continue to pursue Activity Data Sheet funding for the fire alarm smoke detector replacement to ensure increased alarm system stability and reliability of pre-signal logic. (ADS AA1D0056)

3) A lightning protection system is recommended for Building 725 based upon the expected lightning stroke frequency and the tolerable lightning stroke frequency from NFPA 780 2006 appendix L. These calculations are included in Appendix A of this FHA. An Activity Data Sheet has been submitted to address this lightning protection issue.

Analysis

0. Scope

The Assessment and Analysis of the NSLS Facility (Bldg. 725) is divided into five fire areas: 1) the LINAC/Control Room, 2) The Experimental Floor area including the Vacuum Ultraviolet (VUV) Ring, 3) the X-Ray Ring, 4) the Power Supply and RF Area, and 5) the office/support areas. This Assessment and FHA are based on information supplied by the NSLS staff, a review of the facility, and a review of construction drawings and specifications.

1.0 Location:

The NSLS Facility is located in the central-east region of Brookhaven National Laboratory (BNL). BNL is a 5,000-acre site owned by the Department of Energy and operated by Brookhaven Science Associates. BNL is located in Upton, New York. The NSLS hosts 2,300 researchers per year and supports over 1,100 different experiments annually. Detailed information on the NSLS can be obtained from the NSLS Home Page

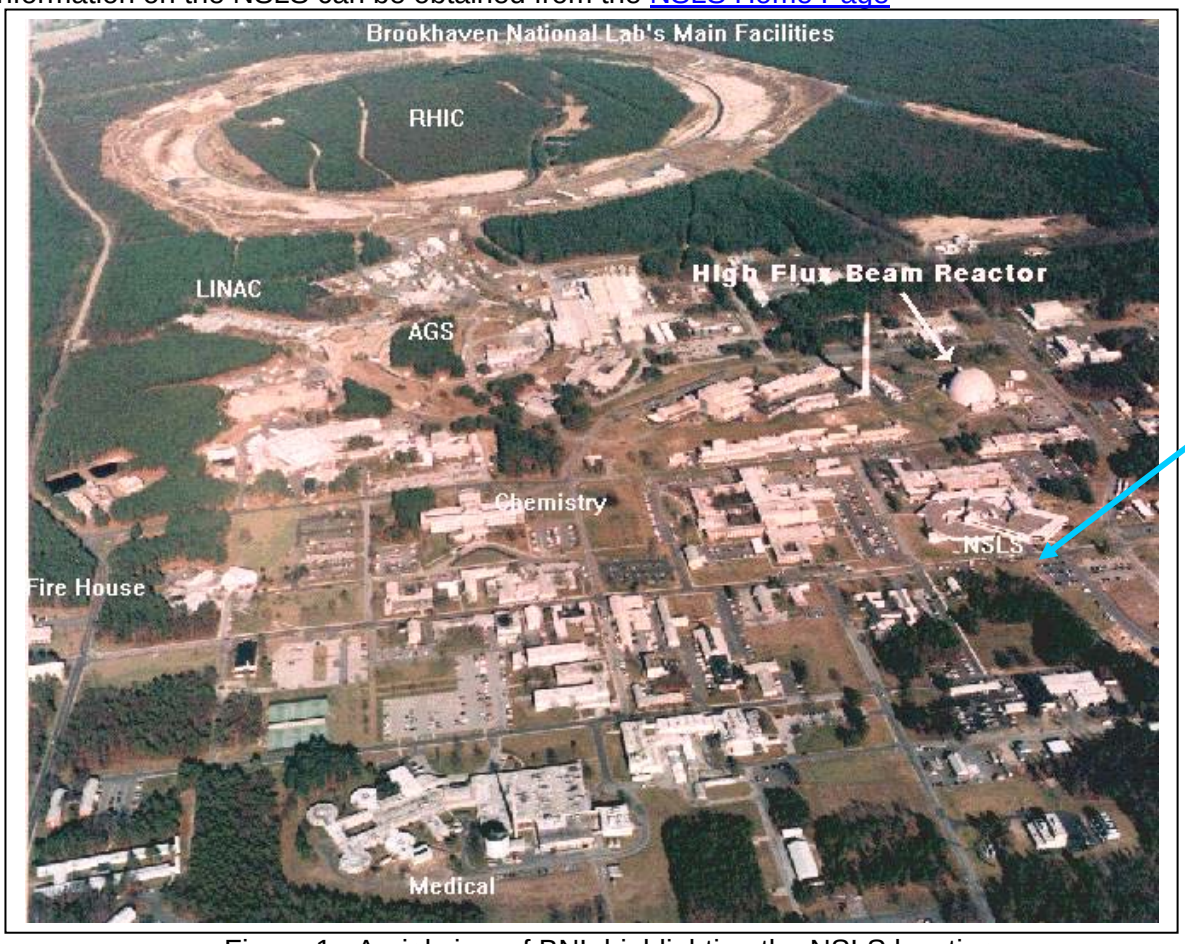

Figure 1: Aerial view of BNL highlighting the NSLS location.

2.0 Construction

The NSLS Facility has been constructed in several phases, with 123,644 sq. ft. for the first floor and 38,512 sq. ft. for the second floor. Similar construction has been used in each phase. The floors are poured concrete. Exterior walls are insulated metal panels. The wall panels are UL listed under the large-scale room corner test and do not require sprinkler protection (i.e., considered non-combustible). The roof is an insulated metal deck assembly. Originally it was

constructed following a Factory Mutual Class I built-up tar roof system. Recent roof replacements have been fully nailed to the deck (also considered non-combustible). Exposed metal frames support the structure, except in the perimeter. The perimeter of the facility has a two-story office mezzanine constructed of poured concrete on metal deck. With the anticipation of a third floor in the original Phase I design, the office area's steel work has a 2-hour fire rating.

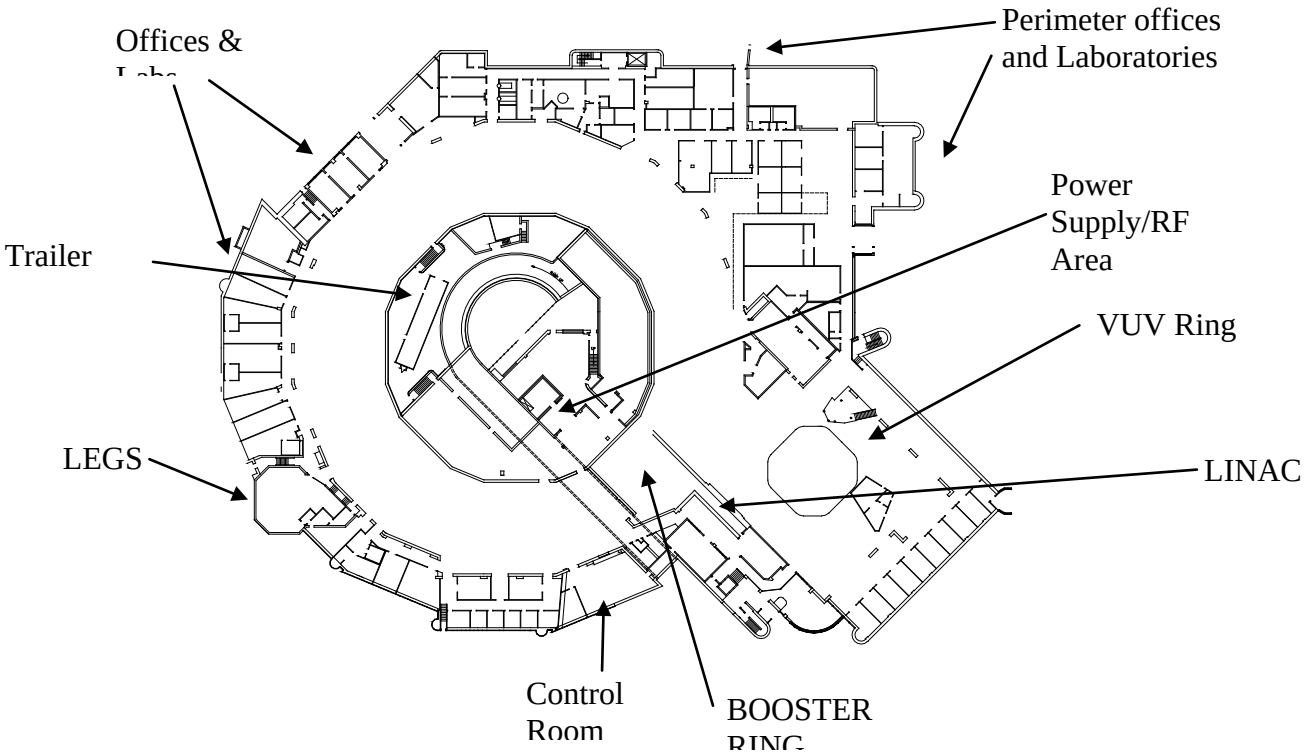

Figure 2: Diagram of NSLS experimental floor.

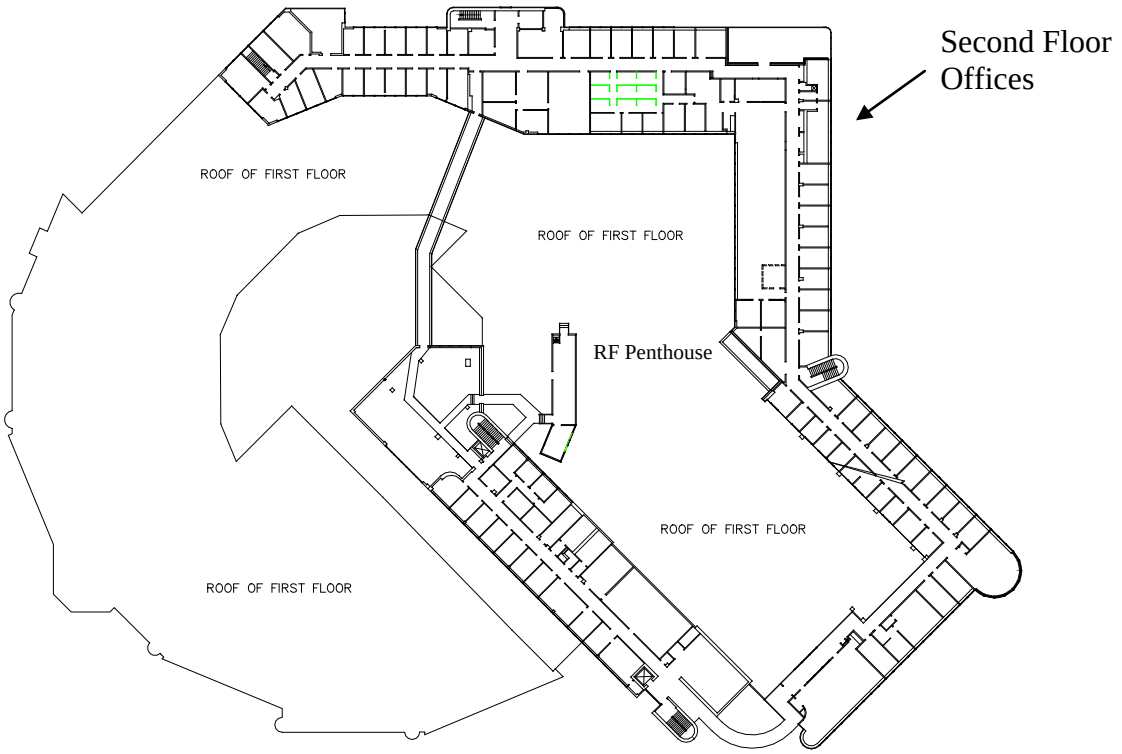

Figure 3: Diagram of NSLS second floor offices.

2.1 Fire Barriers

For protection of the occupants during egress, the stairways are required to be 1-hour fire rated enclosures by the NFPA Life Safety Code. The North East center stair has ductwork that violates the protected space within the stairwell (see Recommendation # 1). The stairway enclosure provides an adequate smoke barrier, but does not meet fire barrier requirements. This is a minor deviation due to the low combustible loading in the area and the sprinkler protection provided. It does not warrant immediate corrective work. A proposal has been made to include the work in existing life safety funding requests within the Activity Data Sheet system.

To protect the facility from an electrical transformer fire in the center courtyard, fire barriers are present along the transformer yard's south wall and at the doorways located at both ends of the walkway across the courtyard. A deluge sprinkler system is provided over the transformers for equipment protection, but also reduces damage to the walkway. The interior of the RF area's exterior wall and air dampers are fire rated. The design followed Factory Mutual Loss Prevention Data Sheet 5-4.

Each mechanical equipment room has a one-hour fire rated barrier.

The NSLS Control Room is isolated from the adjacent experimental area by a one-hour fire rated enclosure. The protection includes a fire shutter on the window between the X-ray floor and the Control Room.

For the original building construction, the main lobby was provided with fire rated shutters on a second floor mezzanine that overlooked the lobby. In addition, the adjacent office was provided with fire rated shutters for the window that looked over to the mezzanine. With Phase II construction, the second floor mezzanine was extended as a walkway around the lobby providing pedestrian access to the new second floor office wing. The fire shutters were removed or bolted in place to prevent inadvertent operation in the pedestrian walk way. To provide protection in accordance with the Life Safety Code, the new atrium created by the Phase II construction required that the doorways on the walkway be provided with smoke barriers (fusible links on door closures).

From the Phase II addition to the NSLS, a second floor corridor overlooks the VUV ring. The panes of glass in this section of corridor have wire glass in steel frames. With the presence of sprinklers on both sides of the viewing glass, the fire separation is considered adequate.

Portions of the exterior insulated metal panel (manufactured by A.H. Robins) were enclosed inside the building with the Phase II and Phase III additions. Due to their UL Large Scale Room Corner ratings, flame spread was considered adequate for interior finishes. The only area where an improvement was made was a Phase II arrangement where the second floor corridor overlooks the VUV floor. Fire rated gypsum board was directly screwed to the panels to afford a thermal barrier improving flame spread ratings and fire barrier ratings.

2.2 Windstorm Damage Potential

The insulated metal decks are designed to withstand local windstorms as per New York State Building Code and Factory Mutual I-90 rating (local terrain is considered a type "C"). The newly reinsulated areas of the roof are fully nailed and also comply with the preceding windstorm ratings.

2.3 Lightning Potential

The lightning damage potential for Building 725 is a concern based on an NFPA 780 Annex L "Lightning Risk Assessment" calculation. The expected lightning frequency (Nd) of 0.0133 is greater than the tolerable lightning frequency (Nc) of 0.0002 (calculations are shown in Appendix A of this document).

3.0 Occupancy and Associated Fire Hazards

The NSLS is an accelerator facility. Bunches of electrons, generated by an electron gun, are accelerated through a LINAC and a booster synchrotron. They are injected into the VUV Storage Ring and the X-Ray Storage Ring. High intensity synchrotron light is generated from these rings. The electron accelerators have typical accelerator sub-systems, such as RF systems, power supplies, transport beam lines using warm magnets, and vacuum systems. Beam lines are used to transport the synchrotron light to experimental stations. Experiments are set up around the accelerator rings to study the interaction of matter with the synchrotron beam. All experiments are reviewed and hazards controlled by the NSLS experimental review process.

Offices are provided for administrative support, engineering support, and use by experimenters. There are also several conference rooms and seminar rooms located throughout the facility. Laboratories are present for sample preparation. These labs are classified as existing general industry for Life Safety Code Occupancy classification, and as Group B based on the New York State Building Code classification (BCNYS 304.1). The quantities of flammable and combustible liquids within all the laboratory units do not exceed NFPA 45 limitations for NFPA Class B laboratory units with automatic sprinkler protection. The majority of the labs within the facility would be classified as Class C or D based upon these same NFPA 45 quantities. (See tables 3.0 and 3.0.1)

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Table 3.0: Maximum Quantities of Flammable and Combustible Liquids in Sprinklered Laboratory Units [NFPA 45, Table 10.1.1]

Laboratory Unit Fire Hazard Class	Flammable and Combustible Liquid Class	***Excluding* Quantities in Storage Cabinets or Safety Cans**		***Including* Quantities in Storage Cabinets or Safety Cans**	
		Max. quantity per 100 ft^2 of Laboratory Unit (gal) (L)	**Max. quantity per Laboratory Unit (gal) (L)**	**Max. quantity per 100 ft^2 of Laboratory Unit (gal) (L)**	**Max. quantity per Laboratory Unit (gal) (L)**
A	I	10 (38)	600 (2270)	20 (76)	1200 (4540)
	I, II, and IIIA	20 (76)	800 (3028)	40 (150)	1600 (6060)
B	I	5 (20)	300 (1136)	10 (38)	600 (2270)
	I, II, and IIIA	10 (38)	400 (1515)	20 (76)	800 (3028)
C	I	2 (7.5)	150 (570)	4 (15)	300 (1136)
	I, II, and IIIA	4 (15)	200 (757)	8 (30)	400 (1515)
D	I	1 (4)	75 (284)	2 (7.5)	150 (570)
	I, II, and IIIA	1 (4)	75 (284)	2 (7.5)	150 (570)

Table 3.0.1
Sprinklered Laboratory Unit Size and Separation Requirements [NFPA 45, Table 5.1.1]

Laboratory Unit Classification	Area of Lab Unit	Fire Separation Requirement
A	**≤ 10,000 sq ft**	**2 hours**
	> 10,000 sq ft	**Labs of this classification and size are not permitted**
B	**≤ 10,000 sq ft**	**1 hour**
	> 10,000 sq ft	**Labs of this classification and size are not permitted**
C	**Any size**	**No requirement**
D	**Any size**	**No requirement**

3.1 Control Areas and BCNYS provisions:

Small quantities of hazardous materials are used, handled and stored in laboratories and other spaces on the experimental floor areas of the building. For the purposes of determining compliance with hazardous materials exempt quantities, the BCNYS defines a *control area* as an area within a building that is enclosed by fire walls, fire barriers, and/or exterior walls (i.e., a fire area). The BCNYS regulates the amounts of hazardous materials that are permitted to be stored and used in each control area (i.e., exempt quantities or exempt amounts). (See tables 3.1.0 and 3.1.1) Any hazardous material quantity that exceeds the exempt quantities per control area requires the area to be classified as a Group H (high hazard) area. The fire resistance requirements for any of these areas becomes more restrictive. At the time of this survey, the total quantity of flammable liquid storage within the NSLS facility is below the threshold allowed for even a single control area. Although the experimental floor encompasses much of the first floor of the building, three other control areas on the first floor can be defined to reduce the potential for exceeding the limits allowed by the BCNYS even further.

Table 3.1.0 — Control Area Criteria by Floor Level [from BCNYS Table 414.2.2]

Floor Level		**Percent of allowable exempt quantities per control area**	**Number of allowable control areas per floor**	**Fire resistance rating of fire barriers (hours)**
Above grade	2	75	3	1
	1	100	4	1
Below grade	Basement	75	3	1

Table 3.1.1 — Maximum Allowable Quantities of Flammable Liquids Per Control Area and Per Floor Level [from BCNYS Table 307.7(1)]

Floor level/ Hazardous material	Maximum number of control areas permitted per floor level	Exempt quantity per control area for storage	Exempt quantity per control area in open use
		With Automatic Sprinklers	
Second Floor (75%)	3		
Class IA		90 gal	15 gal
Class IB		180 gal	45 gal
Class IC		270 gal	45 gal
Combination Class I		360 gal	45 gal
First Floor (100%)	4		
Class IA		120 gal	60 gal
Class IB		240 gal	120 gal
Class IC		360 gal	180 gal
Combination Class I		480 gal	240 gal

Allowable increases for sprinkler protection and approved storage have been applied.

3.2 Compressed Gas Storage

Storage of all hazardous compressed gases is located outside Bldg 725 on the northwest side. Incompatible gases are segregated by either 20 feet or by ¼" metal plates. These plates serve as the 30-minute fire separation as required by NFPA 55 (7.1.6.2.1). Use of gases within the building is controlled by the experimental review process, with emphasis on reducing quantities of gases within the facility. There are gas handling cabinets located at several beamlines to further reduce the potential for gas release to the experimental floor area.

3.3 Hazardous Waste Storage

The hazardous waste storage shed is a commercially built standalone building located to the northwest of Bldg. 725. This structure is equipped with lighting and heat, and has its own secondary containment under the floor of the unit. This structure presents no significant fire hazard to building 725.

4.0 Critical Process Equipment

The following table lists the systems that are present in the facilities, their values (including development costs) and their expected replacement values (without salvage).

NSLS 2008 Costs (Table 4.0)

Location	System	Total Cost ($k, 2008)	Estimated Replacement Cost ($k, 2008; Material & labor, less engineering)
Building			
	Phase I Construction	59,600	47,680 (80%)
	Phase II Construction	37,800	30,240 (80%)
	Structural Biology	2,600	2,080 (80%)
	Miscellaneous	137,200	123,480(90%)
	Sub Total:	237,200	203,480
Beam lines	VUV& X-Ray	324,800	292,320 (90%)
	Total:	$562,000k	**$495,800k**

Within the facilities of the NSLS, critical process parts have identified by the Department. Critical process parts are those items essential to the operations of the accelerator that require a long lead-time for replacement. These spares are stored in a separate building, not subject to a common incident.

4.1 Special Occupancies

Special occupancies include electronic data processing and vital/important records. The special occupancies of NSLS are expanded upon in sections 4.1.1 and 4.1.2, below.

4.1.1 Electronic Data Processing

For the operations of the accelerator, there is a computer room and equipment on the second floor. While the equipment is not high value, the programs and parameters are essential to the operations of the NSLS. Data and programs are backed up and protected in another fire area.

Similarly, all engineering drawings produced by the NSLS Design Room are backed up in either electronic or microfiche format. These backups are stored in another building.

Users of the experimental beam lines collect data from their experiments. Loss of one beamline's data is not vital to DOE's overall science programs. Users are responsible for protecting their own data.

4.1.2 Vital and Important Records Storage

Vital records are those records that are essential to the mission of an important program and which, if lost, could not be reproduced or obtained elsewhere. Important records are those records possessing a high value to the mission of an important program but which, if lost, could be reproduced or reconstructed with difficulty or extra expense.

The following NSLS documents have been named as vital: NSLS Safety Assessment Document, NSLS Accelerator Safety Envelope, NSLS Environmental Assessment, as well as the signed original NSLS agreements between the NSLS and Participating Research Teams, including Memoranda of Understanding among PRT members.

Based on the above definition, the data collected from the experiments are not considered vital records within the context of DOE definitions.

Data and programs related to the operations of the NSLS machine are considered vital. Data and programs are backed up and kept in a separate fire area.

4.2 Unique Fire Hazards

Unique fire hazards include; trailers, cooling towers, flammable liquid and gas storage, cable trays, housekeeping in vital areas, and highly combustible building materials. The unique fire hazards at the NSLS Facility are expanded upon in sections 4.2.1 through 4.2.6, below.

4.2.1 Trailers

There is one trailer currently stored at the NSLS. This trailer is located 200 feet east of the northeast corner of Bldg. 725. It was used to house a superconducting magnet providing backup power for the VUV Ring in case of brief power dips. This system is no longer in use. It is all metal construction and sufficiently isolated from the main building to not pose a fire hazard to the NSLS operations.

A non-combustible, trailer-like structure is located on the roof of the main facility. It is used for RF equipment. The structure is provided with smoke detection and sprinkler protection. It does not pose a fire exposure to any other facility equipment.

4.2.2 Cooling Towers

Roof mounted cooling towers are provided for this facility's HVAC system and several experimental processes (magnet cooling, power supply cooling). The cooling towers are standard industrial towers, constructed of all metal, and are not a fire concern.

4.2.3 Flammable Liquid & Gas Storage

Use of flammable liquids follows the BNL Subject Area on Fire Safety.

Experiments are monitored for the quantities that they bring in via the experimental review process. The use of flammables is tracked and monitored by the NSLS safety staff. Flammable Liquid lockers are spaced around the facility and are inventoried. Routine inspection of the experimental floor (Tier I inspections) provides close oversight of flammable liquid storage.

The use of flammable gases follows BNL Subject Area on Fire Safety. Several beam lines use combustible gases in small quantities. Routine use is monitored by Tier I inspections and through Experiment Review.

4.2.4 Cable Trays

The accelerator operation relies heavily on the use of cable trays for the distribution of power and signals. The original NSLS installations predated the National Electrical Code requirements for flammability. Installations did not always separate high voltage, low voltage, control, power, and signaling cables. A continuing effort is underway to segregate cables in accordance with NEC requirements throughout the NSLS. The cabling is located in conduits, raceways and cable trays. With the exception of the LINAC radiation shielding enclosure and the X-ray Ring, all areas are protected by automatic sprinkler protection and accessible for manual fire fighting efforts. The majority of the areas are provided with smoke detection, which provides early warning of a fire. The resultant level of protection meets the intent of the Factory Mutual Data Sheet on cable tray protection for non-FM listed cables.

4.2.5 Housekeeping in Vital Areas

For this high value facility, good housekeeping and control of combustibles is achieved. The experiment review process screens beam line activities for compliance with this goal. The NSLS self-inspection program (Tier I) monitors routine aspects. The BNL Plan Review Process screens conventional construction operations.

4.2.6 Highly Combustible Building Materials

The building's exterior insulated walls are constructed using an Underwriter's Laboratory insulated wall panel, listed for construction not needing sprinkler protection.

One hutch along the X4 beam line uses polystyrene insulation in the construction (predated the review processes). The polystyrene insulation is in tight contact with the metal skin of the 15 ft. by 20 ft. structure. The presence of automatic sprinkler protection above the hutch, the non-combustible contents, and the lack of ignition sources in the hutch reduce the current level of risk to an acceptable status. Previous hutches of polystyrene have been removed when experimental beam line construction allowed their replacement.

One set of acoustical panels is located along the X1 beam line. These panels contain an expanded plastic material, mostly polyurethane. The plastic is encapsulated by 5/8-inch sheet rock on both sides in this fully sprinklered facility. This is not considered an unacceptable arrangement per Factory Mutual Data Sheets on Expanded Plastics.

No significant amounts of exposed polystyrene insulation or other highly combustible building materials are used in other areas of construction or operations at the NSLS.

Borated polyethylene shielding is used around the front ends of several hutches for neutron shielding. Although the polyethylene is not "fire retardant", the quantities are limited to small shielding areas away from ignition sources. The risk is minimal.

5.0 Fire Protection/Suppression Features

5.1 Site Water System

BNL has a combination domestic and fire protection water supply system. The system is supplied by several deep wells and is stabilized by two elevated water storage tanks (one 1 million gallon and one 350,000 gallon capacity). The wells have electric primary drivers and a limited number have backup internal combustion drivers. The system can sustain three days of domestic supply and a maximum fire demand (4,000 gpm for 4 hours) for BNL with two of the system's largest pumps out and one storage tank unavailable. The piping distribution network is well gridded. The distribution system in the area of the NSLS Facility has a static supply pressure of 65 psi. The combination domestic and fire water supply system can supply 1,378 gpm at 60 psi (based on test results from a 8/18/97 test). Computer modeling of the site's system, with physical proofing of the model, confirms that this supply is adequate for the automatic sprinkler system in the building.

Given the high value of the facility, the reliability of water supplies was improved by providing adequate supplies from the north of the facility and from the south. A set of Post Indicator Valves (PIV) allows the isolation of the north and south feeds prior to entering the facility.

Fire hydrants are provided within 300 ft. of each facility. Frost proof hydrants are needed since the frost line extends to 4 feet below the surface in the winter. BNL and the local Suffolk County Fire Departments use National Standard Thread couplings.

BNL's Plant Engineering Division maintains the water supply system. BNL's Fire/Rescue Group conducts valve inspections on the distribution system to ensure reliability of firefighting water supplies.

5.2 BNL Fire/Rescue Group

The BNL Fire/Rescue Group is a full time, paid department. Minimum staffing is five firefighters and one officer per shift. The firefighters are trained to meet Firefighter Level III by International Fire Service Training Association standard, National Fire Protection Association (NFPA) Fire Fighter Level II standard, (NFPA) Hazardous Material Technician Level, and they are Suffolk County Certified Confined Space Rescuers.

The BNL Fire/Rescue Group also provides emergency medical services to an on-site population of 2700 people. A minimum of two members per shift hold New York State "Emergency Medical Technician - D" certifications ("D" is for defibrillation). Normally at least four firefighters have EMT status. The Group operates a New York State Certified Basic Life Support ambulance. Medevac services are available to BNL via the Suffolk County Police Department.

Additionally the Fire/Rescue Group has two 1500 gpm "Class A" Pumpers, a brush truck, one Rescue Vehicle for initial hazardous material incident response and heavy rescue operation, and one Incident Command Vehicle.

The single Fire Station is located on the west side of the BNL Site. Response time to the most remote section of the BNL Site is less than eight minutes. Response time to the NSLS Facility is estimated at 5 minutes.

BNL participates in the Suffolk County Mutual Aid Agreement. This allows the resources from over 130 departments to assist BNL. BNL is also a member of the Town of Brookhaven Foam Bank. BNL has a mutual aid agreement for hazardous material incidents with the Town of Brookhaven and Stony Brook University.

5.3 Site Fire Alarm System

Brookhaven National Laboratory provides central fire alarm station coverage by an Underwriter Laboratory listed multiplexed Site Fire Alarm System. The system complies with the requirements of NFPA 72 for a Style 7D System.

The main console is at the Firehouse, Bldg. 599. This station monitors all fire alarm signals, trouble and communication status alarms. A secondary alarm monitoring system station is provided at Safeguards and Security, Bldg. 50, and receives only the fire alarm signals. If the Firehouse does not acknowledge an alarm within 90 seconds, the satellite station at Bldg. 50 will receive an audible indication to handle the alarm.

Internal to NSLS Bldg. 725, the fire alarm panels have a remote annunciator in the Control Room. All fire alarms display on the remote annunciator. Due to the desire by the NSLS to avoid disrupting beam line operations, fire alarm bells do not automatically ring throughout the facility. All alarms are immediately transmitted to Fire/Rescue for response. However, internal building alarms are delayed for smoke detection as allowed by NFPA 72 (pre-signal feature of Chapter 1-5.4.10). Control Room Operators must press a delay button to allow the bells to remain silent past the prescribed one minute count down time. NSLS Operations Coordinators are dispatched to the alarming zone to determine the nature of the alarm and inform responding Fire/Rescue personnel. Alarm signals from sprinklers, manual fire alarm boxes and two or more smoke detectors on one alarm zone actuate the building bells immediately. Duct Smoke detections are supervisory alarm signals (allowed by NFPA 72) and do not ring fire alarm bells, yet still summon the fire department.

5.4 Fire Extinguishers

Fire extinguishers installed throughout the facilities in accordance with NFPA 10. While hose stations are provided around the facility, they are not provided with hose. They are intended for Fire/Rescue Group use only and do not provide credit for reducing fire extinguisher placement.

5.5 Fire Department Standpipe

Fire department standpipes are provided on the perimeter of the X-Ray Ring, VUV Ring and in the stairwells. All other areas are accessible by fire department hose lines from the exterior of the facility. Hose stations around the experimental floor were provided with water flow switches. Some have been disconnected. These were a preliminary design feature to allow local experimental hutches to be provided with sprinkler protection. This design was not feasible and they remain unused.

5.6 Fire Detection and Suppression

Smoke detection is provided for the X-Ray Ring, X-Ray experimental floor (activates pre-action sprinklers), VUV Ring (activates pre-action sprinklers), control room (activates pre-action sprinklers), second floor computer (activates pre-action sprinklers), and the RF power supply area (activates pre-action sprinklers). Smoke detection was installed in these areas due to the high importance of the electronics.

During a fire alarm system upgrade to accommodate the pre-signal feature for the alarm bells, an incompatibility with the smoke detection for the building was discovered. To allow the circuits to distinguish from one smoke detector in alarm and a manual fire alarm box in alarm, an in-line resistor was installed in each circuit. The manufacturer's representative assisted in the selection of the resistor to ensure proper functioning, however they will not officially approve the modification. This deviates from the Underwriter's Laboratory approved arrangement. However the impact of fault will be a smoke detector acting as a manual box (ringing the bells instead of the pre-signal). Corrective action has been requested via the ESH Planning System by submitting an Activity Data Sheet for the $250,000 to replace the building smoke detection (see Recommendation #2 above; ADS AA1D0056)).

Elevator lobbies are provided with smoke detection to facilitate elevator recall in compliance with ANSI elevator safety codes.

Duct smoke detection is provided in the air-handling units as per chapter 4 of NFPA 90. However the alarm signals are treated as supervisory alarms and not fire alarms. This is permitted by NFPA 72, but is not a standard configuration at BNL. This is intended to reduce the false alarm potential of the facility causing occupant evacuation.

The X-ray/RF Power Supply Equipment area is provided with smoke detection in compliance with NFPA 72. However past fire experience with this area shows that the detection is not very effective. Air handling equipment, power supply vent fans, and the ceiling space congested with utility services hamper smoke movement. Due to the important nature of this electrical equipment to NSLS operations, an improved smoke detection system was recommended. Two Highly Sensitivity Smoke Detection systems were installed with both being located in the X-ray/RF Power Supply area. These systems alarm at both the Firehouse and locally on the NSLS alarm detection panels.

6.0. Fire Protection Special Topics

6.1 Fire Protection of Vital Programs

The operations associated with this facility are not considered to be a DOE vital program. Therefore, no special fire protection precautions, beyond those that are generically described above, are required for this facility.

6.2 Fire Protection of High Value Property

There are no individual systems or components that are considered high value (i.e., exceeding $1 million each).

6.3 Protection of Essential Safety Class Systems

There are no essential safety class systems associated with this non-nuclear facility.

7.0 Fire Loss Potentials

Fire loss potentials are classified into two major categories; the maximum possible fire loss and the recovery potential. The loss potentials for the NSLS Facility are expanded upon in sections 7.1 and 7.2, below.

7.1 Maximum Possible Fire Loss (MPFL)

The Maximum Possible Fire Loss (MPFL) for the NSLS Facility is estimated to be in excess of $30 million. MPFL estimates are based on a fire in which active fire suppression systems fail (sprinklers, clean agent fire suppression, manual interior fire fighting efforts). While the value of the facility is in excess of $400 million dollars, continuity of combustibles is lacking. The facility is non-combustible, the interior structures are predominately non-combustible, contents do not contain many combustibles. Combustibles primarily consist of localized material. Cable trays with combustible cables represent one of the far-reaching combustible materials. However, cables are slow burning and do not produce much heat. They will produce heavy smoke conditions and leave corrosive particulate. Clean up will be extensive and detailed. Clean up will represent most of the cost in recovering from this large building fire.

7.2 Recovery Potential

It is unforeseeable that a credible fire in Building 725 would result in a shutdown of the accelerator(s) for an excessive period of time (greater than 6 months). Special process spares are in place to provide replacements for long lead items. Computer files (for the accelerators and for vital records) are backed up and stored in another fire area away from the Computer Room. Engineering drawings are backed up and stored in another building (see Section 4.1.1).

8.0 Security Considerations Related to Fire Protection

The facility has security measures to restrict access, including card readers. Provisions have been made for Fire/Rescue access via card reader programming, provision of master key, or installation of interlocked crash doors. Radiation security barriers comply with the Life Safety Code for egress.

9.0 Exposure Fire Potential

The NSLS Facility is located in the eastern part of BNL. To the north is Bldg. 535, a one story with basement masonry walled building. Established roadways provided engineered features that help protect the facility from a potential wildland fire and exposure fires from other facilities. The roof systems are UL Listed will not ignite from the anticipated burning brands produced in a brush fire.

The electrical sub station in the courtyard of Bldg. 725 has been analyzed against Factory Mutual Data Sheet 5-4 on fire protection from electrical substations. The installed fire protection is adequate to minimize the damage to the building in the event of a transformer fire.

No other facilities pose a fire exposure to the NSLS.

10.0. Environmental Impact Due to a Fire (Including Water Runoff)

Toxic, biological, and radiation incidents resulting from a fire, including water runoff, are analyzed in sections 10.1 through 10.3, below. The NSLS reviews experiments in accordance with NSLS ES&H Policies and Requirements Manual, "Experimental Safety Review" to identify these type of safety concerns and implement appropriate controls.

10.1 Toxic Incident

There are no known materials in the NSLS Facility that, if involved in a fire, would result in a significant quantity of toxic material being created and released.

Experimental areas may typically have:
- Small quantities of compressed research gases that are combustible or toxic;
- Compressed inert gases;
- Liquid cryogens;
- Various combustible solvents as well as caustic and acid solutions, in liter quantities, stored in cabinets.

In a slightly related topic, lead is used to line the interior of several hutches as well as other components throughout the facility. Lead sheets provide needed radiation shielding. In the event of a fire within one of the hutches (10 by 15 feet maximum), lead could be vaporized and dispersed. Fire preplans for the NSLS contain information and would lead to proper precautions and clean up. Dispersion outside of the facility is not practical due to the limited combustibles, the large interior space the hutches are in, and the presence of sprinklers between the hutches and the exterior of the building.

10.2 Biological Incident

BNL has an Institutional Biosafety Committee (IBC), which reviews materials of this type. The NSLS Experiment Review Coordinator includes the IBC in the experiment review process as needed. While biological matter is used in the experimental spaces of the NSLS, the hazard is low. Most work is done with harmless proteins. Occasional studies involve biosafety

precautions (BSL 2). For these experiments, the quantities of material studied are minute (microgram ranges) and present little risk to fire rescue personnel.

Materials are normally fixed and not readily dispersible, even under fire conditions. Other than pre-fire planning information, there are no fire issues related to biohazards at the NSLS.

10.3 Radiation Incident

Synchrotron radiation ceases when the machines are turned off and no electrons are stored in the rings. There are no significant environmental impacts in the event of a fire since the activated material is not present.

A number of VUV Ring shutters and shields are constructed of deplete Uranium. The VUV Ring is thus a Material Balance Area overseen by Isotopes & Special Materials. The Uranium in the shutters is fully encased in stainless steel. The shields and shutters do not have significant combustibles located around them. It is unlikely they will be exposed to a fire of such magnitude to cause a release.
Small “check sources” are located around the facility for radiation survey meters and for detector calibration. These are not considered a release potential. All sources are registered in the sealed source database managed by the BNL Radiological Control Division.

From time to time, various beamlines use microgram quantities of transuranics. These are managed through the NSLS Experiment Review System and are not considered a significant concern for release.

No other radioactive materials are used or stored in the NSLS.

11.0 Pre-fire and Emergency Planning

The BNL Fire Department maintains an adequate pre-fire plan book for this facility as part of the Firehouse Response Card System.

A Local Emergency Plan is maintained for the NSLS. It includes Control Room Operator actions to take with various alarms. Operator requirements are documented in NSLS procedures.

11.1 Fire Apparatus Accessibility

Fire apparatus accessibility is adequate for the main facility. Current parking lot configurations allow access by apparatus in the event of an emergency.

Access to the center courtyard and to the north avenue of the NSLS are via 10-ton bridges. While fire apparatus have weights up to 20 tons, structural engineers for the original construction have indicated that the occasional use by fire trucks (once every few years) does not endanger the structure.

12.0 Life Safety Considerations

DOE mandates the use of NFPA 101, the Life Safety Code. Major life safety considerations for this industrial facility include the following components: means of egress components and capacity, number and arrangement of the means of egress, travel distances to exits, discharge from the exits, and emergency lighting and marking of the means of egress.

The likelihood of a fast spreading fire is remote, given the nature of combustibles within the NSLS facility. Hence the facility is considered to be an “ordinary hazard industrial occupancy.” The only exception is the X-Ray Ring. The X-Ray Ring is an enclosure and is built to house the accelerator. As such it is appropriately classified as a “low hazard” “special purpose industrial occupancy.”

Travel distances to exits from points inside the building are within the 250-foot limit of Life Safety Code section 28-2.6.1 for sprinklered Industrial Occupancies. There is a clear path from the courtyard in the center of the building, over a ramped roadway, to the street ("public way").

Travel distances to exits from points inside the X-Ray Ring are within the 300 ft. limit of Life Safety Code Section 28-2.6.3 for unsprinklered “special purpose industrial occupancies”.

The nature of the accelerator facility is such that beamlines come out from the two accelerator rings. The length of the beam line creates a common path of travel. Where the beamlines are long and would exceed allowable common path of travel distances, alternate means of egress of have been provided. In several locations, “duck under” locations have been provided. Duck under locations are a path under the beam line. The height of the opening is more than 40 inches. Widths are more than 36 inches. Areas below the beamline are marked to help keep them clear. While these locations do not meet the strict interpretation of an exit path, they provide a second path out for the physically agile, mentally alert, person in this industrial occupancy. These beamline paths are not considered dead ends since dead ends are applied to paths involving corridors. Beamline paths are difficult to confuse with a normal corridor or any type of path leading to a second exit.

The permitted occupant load is based on floor area and on occupant load factors. The occupant load factor for General Industrial (and for Business) is 100 sq.ft. /person. There is no occupant load factor for “special purpose industrial” (the X-Ray Ring). Those areas are not normally occupied. The permitted occupant load for the building is 1,400 people, based on a conservative estimate that 5,200 of the building's 162,156 sq.ft. is tunnels and mechanical rooms.

Emergency power is provided to the lighting throughout the facility. Sodium lights used for emergency power are provided with incandescent elements to provide light during the restrike time. The emergency power source is an existing emergency generator located north of Bldg. 725. The generator is tested by Plant Engineering in accordance with NFPA 110.

Appendix A: Lightning Protection Calculations

Lightning Protection B0725.pdf...