Fire Hazard Analysis
Building 923
Accelerator Department
Electronic Equipment Repair

Brookhaven National Laboratory

Prepared by:

R. Wheeler, PE,
Hughes Associates, Inc.
3610 Commerce Drive, Suite 817
Baltimore, MD 21227-1652

Project Review By: Signatures on File

M. Kretschmann PE, Fire Protection

Concurrence:

Department Chair

Date of Last Survey:
Date of Report: May 2007

CONFERRED WITH:

Joel Scott Accelerator Department
Michael Kretschmann, PE Fire Protection Engineering

TABLE OF CONTENTS

1.0 OVERVIEW AND RECOMMENDATIONS 1
1.1 Purpose and Methodology 1
1.2 Summary 3
1.3 Findings and Recommendations 4
1.3.1 New Findings and Recommendations 4
1.3.2 Outstanding Recommendations from Previous Reviews 6
2.0 SCOPE 6
3.0 LOCATION 6
4.0 CONSTRUCTION 6
4.1 Occupancy Classification 6
4.2 Construction Type 7
4.3 Passive Fire Protection 9
4.3.1 Fire Areas 9
5.0 FIRE PROTECTION 9
5.1 Automatic Fire Suppression Systems 9
5.1.1 Site Water Supply 9
5.1.2 Building Water Supply and Fire Department Connection 10
5.1.3 Sprinkler Systems 10
Photograph 2 – Wiring Attached to Sprinkler Piping 11
5.1.4 Fire Standpipe Systems 11
5.2 Fire Alarm Systems 11
5.2.1 Building Fire Alarm System 11
5.2.2 Site Fire Alarm System 11
5.3 Automatic Detection Systems 12
5.4 Fire Extinguishers 12
6.0 FIRE HAZARDS 12
6.1 Special Occupancies 12
6.1.1 Vital and Important Records Storage 12
6.1.2 Trailers and Portable Structures 12
6.1.3 Electrical Substations 13
6.1.4 Flammable Liquid and Gas Storage 13
6.1.5 Cables and Raceways 13
6.2 Housekeeping in Vital Areas 13
6.3 Building Materials 13
6.4 Exterior Exposure Hazards 13
6.4.1 Elements Outside of the Facility 14
6.4.2 Components of the Facility 14
6.5 Natural Phenomenon Hazard Exposure 15
6.5.1 Lightning Potential 15

6.5.2 Windstorm Potential 15
6.5.3 Brush Fire Potential 15
6.5.4 Earthquake Potential 15
6.5.5 Flooding Potential 15
6.6 Toxic Fire Potential 16
6.7 Biological Fire Potential 16
6.8 Radiation Fire Potential 16

7.0 PRE-FIRE AND EMERGENCY PLANNING 16

7.1 Protection of Essential Safety Class Systems 16
7.2 Protection of Vital Programs 16
7.3 Protection of High Value Property 16
7.4 Critical Process Equipment 16
7.5 Maximum Possible Fire Loss (MPFL) and Maximum Credible Fire Loss (MCFL) 16
7.5.1 MPFL Scenario 17
7.5.2 MPFL Calculation 17
7.5.3 MCFL Scenario 18
7.5.4 MPFL/MCFL Summary 18
7.6 Recovery Potential 18
7.7 BNL Fire/Rescue Group 18
7.8 Fire Apparatus Accessibility 19
7.9 Security Considerations Related to Fire Protection 19

8.0 LIFE SAFETY CONSIDERATIONS 19

8.1 Occupancy Load Factor and Calculations 19
8.2 Means of Egress 20
8.2.1 Number and Arrangement of Exits 20
8.2.2 Capacity of Exits 20
8.2.3 Travel Distance 20
8.2.4 Common Path of Travel 20
8.2.5 Dead Ends 20
8.2.6 Security Considerations Related to Fire Protection 20
8.2.7 Separation of Means of Egress 21
8.3 Exit Signs and Emergency Lighting 21
8.4 Exit Discharge 21
8.5 Barriers 21
8.5.1 Occupancy Separations 21
8.5.2 Incidental Use Areas 21
8.5.3 Separation of Means of Egress 21
8.5.4 Exit Access Corridors 21
8.5.5 Vertical Opening Barriers 22
8.5.6 Egress Stairways 22
8.6 Fire Protection Systems Required by Code 22
8.7 Operational Requirements that are Required by Code 22

9.0 REFERENCE DOCUMENTS 22

9.1 National Fire Protection Association 22
9.2 FM Global Loss Prevention Data Sheets 23

APPENDIX B - LIGHTNING RISK CALCULATION 1

APPENDIX C DETERMINATION OF WILDFIRE HAZARD SEVERITY USING NFPA 1144 1

1.0 OVERVIEW AND RECOMMENDATIONS

1.1 Purpose and Methodology

A Fire Hazard Analysis (FHA) was performed for Building 923, Accelerator Department Electronic Equipment Repair, at Brookhaven National Laboratory (BNL), Upton, NY. This report fulfills the requirement for documentation of an FHA as outlined in DOE Order 420.1, Facility Safety. This FHA assesses the risk from fire in Building 923 to ascertain whether the facility meets the objectives of DOE Order 420.1 and the Brookhaven National Laboratory (BNL) Fire Safety Program. The fundamental goal of the BNL Fire Safety Program is to control fire risks such that:

1. Public and employees are not unreasonably endangered by fire;
2. Vital Laboratory missions are maintained without significant interruption from fire;
3. Property losses are limited to less than $1 million dollars per occurrence, and lower when justified by cost-effective, risk reduction measures;
4. Damage to the environment is averted; and
5. The potential for occurrences of fires are avoided whenever economically feasible.

This FHA is an evaluation of the fire hazards (1) that expose Building 923 and (2) that are inherent in the building or operations. The adequacy of the fire safety features in the building and the degree of compliance of the facility with specific fire safety provisions in DOE orders, and related engineering codes and standards, were determined. The results of the analyses are presented in terms of the fire hazards present, the potential extent of fire damage, and the impact on employee and public safety.

The general approach taken to complete this evaluation involved the identification of fire hazards in the building and the fire protection features required to mitigate the adverse consequences of a fire. A determination was made as to the adequacy of the existing fire protection features to effectively control the fire hazards. Concerns for the protection of safety systems, critical processes, and life safety of building occupants from fire were essential considerations in the analysis. Compliance was determined by a comparison of existing conditions found during the site visits with current code requirements. Where conflicting requirements were found the more conservative requirements were used in this evaluation.

Maximum Possible Fire Loss (MPFL) and Maximum Credible Fire Loss (MCFL) potentials were also evaluated. The MPFL, as defined in DOE Order 420.1, is the value of property within a fire area, unless a fire hazard analysis demonstrates a lesser (or greater) loss potential, assuming the failure of both automatic fire suppression systems and manual fire fighting efforts. The MCFL, as defined in DOE Standard 1066-99 Fire Protection Criteria, is the value of property within a fire area, unless a fire hazard analysis demonstrates a lesser (or greater) loss potential. This assumes that all installed fire protection systems function as designed, and the effect of emergency response is omitted except for post-fire actions. Both MPFL and MCFL fire

loss estimates are to include the replacement cost of equipment and property and any applicable decontamination and cleanup costs.

The MPFL scenario was based on a qualitative consideration of several factors; the potential to reach flashover conditions based on combustible loading and the geometry of the space(s) under consideration; adequacy of passive protection features; and continuity of combustibles.

The MCFL scenario is one in which automatic suppression systems function as designed. Since properly designed and installed sprinkler systems should limit the fire growth and/or damage to the design area of the system, this floor area is used in the determination of MCFL potentials when protected by automatic sprinkler systems. Without sprinkler protection the MCFL is the same as the postulated MPFL for that area.

MPFL and MCFL potentials were determined based on an average dollar density of the building replacement value divided by the floor area of the building. Building values were obtained from 2004 replacement costs. The content and equipment value were calculated based on the following assumptions:

- An average of $\$20/ft^2$ for content and equipment value within non-laboratory/support areas.
- An average of $\$100/ft^2$ for content and equipment value within the electronic equipment areas of the building.

The above cost assumptions are considered adequately conservative to address the requirement to include decontamination and cleanup costs.

A qualitative assessment of the risk presented by conditions found to be deficient was also performed and is included in Section 8, Recommendations. This assessment was made by assignment of a risk assessment code (RAC). The RAC methodology is used in a number of industries as a tool to qualitatively prioritize deficiencies and corrective actions and is derived as follows:

1. Hazard Severity. An assessment of the worst potential consequence, defined by degree of occupational injury, illness or property damage which is likely to occur as a result of the deficiency. Hazard severity categories shall be assigned by roman numerals according to the following criteria:

a. Category I. May cause death, permanent total disability, or loss of a facility/asset.

b. Category II. May cause permanent partial disability, temporary total disability in excess of 90 days (severe injury or severe occupational illness), or major property damage.

c. Category III. May cause minor injury, occupational illness, or property damage.

d. Category IV. Presents minimal threat to personnel safety or health, or property, but is still in violation of a standard.

2. Mishap Probability. The probability that a hazard will result in a mishap or loss, based on an assessment of such factors as location, exposure (cycles or hours of operation), affected populations, experience, or previously established statistical information. Mishap probability shall be assigned an English alphabet symbol according to the following criteria:

a. Subcategory A. Likely to occur immediately or within a short period of time. Expected to occur frequently to an individual item or person or continuously to a fleet, inventory or group.

b. Subcategory B. Probably will occur in time. Expected to occur several times to an individual item or person or frequently to a fleet, inventory or group.

c. Subcategory C. May occur in time. Can reasonably be expected to occur some time to an individual item or person or several times to a fleet, inventory or group.

d. Subcategory D. Unlikely to occur.

3. Risk Assessment Code. Using the matrix shown below, the RAC is expressed as a single Arabic number that is used to help determine hazard abatement priorities.

Hazard Severity	Mishap Probability			
	A	B	C	D
I	1	1	2	3
II	1	2	3	4
III	2	3	4	5
IV	3	4	5	6

RAC Definitions

1-Critical
2-Serious
3-Moderate
4-Minor
5 & 6-Negligible

1.2 Summary

This Fire Hazards Analysis (FHA) has been performed to comprehensively assess the risk from fire in Building 923, Electronic Equipment Repair. The FHA includes an analysis of the fire and life safety features of the facility to determine the level of compliance with DOE Order 420.1 Fire Protection objectives.

Based on the analysis, it has been determined that Building 923 is in general compliance with DOE Order 420.1 Fire Protection objectives. The following recommendations are the result of this evaluation.

1.3 Findings and Recommendations

1.3.1 New Findings and Recommendations

Finding: Wiring was observed attached to the sprinkler piping in the hallway as shown in Photograph 1.

Hazard Severity	IV
Mishap Probability	D
Risk Assessment Code	6

Recommendation HAI-06-923-01: Remove the wiring from the sprinkler system piping [NFPA 25, Section 5.2.2.2] (See Section 5.1.3).

Photograph #1, Wiring on Sprinkler Piping

Finding: An exposed wood stud structure is located on the north end of the building (See Section 6.3)

Hazard Severity	III
Mishap Probability	C
Risk Assessment Code	4

Recommendation HAI-06-923-02: Remove the exposed wood stud addition on the north end of the building (See Section 6.3).

Photograph #2, Rear Structure

Finding: Two pine trees are located on the north side of the building and pose an unnecessary exposure to the building (Photograph #4) (See Section 6.4.1.1).

Hazard Severity	III
Mishap Probability	C
Risk Assessment Code	4

Recommendation HAI-06-923-03: Remove the pine trees.

Photograph #3, Pine Trees

The following is a summary of recommendations and their relative priority.

Rec.No.	Recommendation	RAC
HAI-07-923-1	Remove the wiring from the sprinkler system piping	6
HAI-07-923-2	Remove the exposed wood stud addition on the north end of the building	4
HAI-07-923-3	Remove the pine trees at the north end of the building	4

1.3.2 Outstanding Recommendations from Previous Reviews

There are no outstanding recommendations from previous reviews.

2.0 SCOPE

This FHA is based on information supplied by the Accelerator Department staff, a survey of the facility conducted on May 3, 2007, and a review of available drawings.

The following codes and standards were utilized for this evaluation:

The Building Code of New York State 2002 Edition (BCNYS)

International Code Council (ICC), International Building Code (IBC) 2003 Edition;

ICC, International Fire Code (IFC) 2003 Edition;

National Fire Protection Association (NFPA) Codes, Standards, and Recommended Practices – See Section 9 (Reference Documents) of this report for a complete list.

Factory Mutual Property Loss Prevention Data Sheets – See Section 9 (Reference Documents) of this report for a complete list.

3.0 LOCATION

Building 923 is located in the central west 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.

4.0 CONSTRUCTION

4.1 Occupancy Classification

The building contains general offices of the AGS Survey Group; a small calibration lab; and instrument repair rooms. The following occupancy classifications are based on LSC and BCNYS criteria:

Use	LSC Occupancy Classification	BCNYS Group Classification
Offices	Existing business	Group B

Calibration lab	Existing business	Group B
Electronic equipment repair rooms	Existing business	Group B
Building service mechanical or electrical equipment rooms	Classified as part of the predominant occupancy	Incidental use area

4.2 Construction Type

Building 923 is a one-story building constructed of insulated metal panels on steel frame. A wood frame addition is located on the north end of the building which connects to a small room used for the storage of electronic equipment. This addition is sided with asbestos transite panels. With the exception of the north addition, the overall building is classified as unprotected and noncombustible construction; BCNYS Type IIB and NFPA Type II (000).

The building consists of two "wings" approximately 30 feet wide by 165 feet long connected by an enclosed walkway in the middle. The wings of the building have peaked roofs with a height of approximately 15 feet with 10 foot eaves (Photograph 1).

Photograph 4 – View of South End of Building 923 from Parking Lot

Life Safety Code

The LSC does not specify a minimum construction type for existing business [§39.1.6] occupancies. Thus, the existing construction complies with LSC requirements.

Building Code of New York State

Section 503 and Table 503 of the BCNYS contain criteria for the allowable height and area of buildings based on their occupancies and construction type. Section 506 and 507 of the IBC contain allowable area increases based on the location of the building and sprinkler protection, if provided.

The BCNYS also permits an increase in allowable areas for buildings that have more than 25 percent of their perimeter on a public way or open space having a minimum width of 20 feet [IBC, 506.2]. The area increase due to frontage is determined in accordance with the following equation:

$$If = 100[F/P - 0.25] W/30, \text{ where:}$$

If = Area increase due to frontage.

F = Building perimeter which fronts on a public way or open space having 20 feet open minimum width (feet).

P = Perimeter of entire building (feet).

W = Width of public way or open space (feet). The width (W) must be at least 20 feet and W/30 cannot exceed 1.0. (Exception; W/30 cannot exceed 2.0 in accordance with IBC 506.2.1, Exception). Where the value of W varies along the perimeter of the building, the allowable area calculation shall be based on the weighted average of each portion of exterior wall and open space where the value of W is between 20 and 30 feet.

Building 923 adjoins public ways or open spaces exceeding 20 feet on all sides of the building. The west side adjoins an open space of approximately 35 feet. The other three sides adjoin open spaces with a minimum of approximately 50 feet. Therefore, the allowable frontage increase is 106 percent. The applicable height and area limitations for a Group B occupancy in a Type II B structure is:

Base Height	55 ft 4 stories
Base Area (ft^2)	23,000
Street Frontage Increase(ft^2)	24,380
Increased Area (ft^2)	47,380

1 The maximum allowable areas include an increase for 106% open perimeter/street frontage.

The building area is approximately 11,500 gross square feet and complies with the allowable height and area limitations of the BCNYS and the IBC.

4.3 Passive Fire Protection

Passive fire protection features include fire-resistive construction, fire doors, fire windows, and fire and smoke dampers. The features are provided to limit fire spread and damage from the area of fire origin to other portions of the building.

4.3.1 Fire Areas

The building is not subdivided and is considered a single fire area. A fire area is defined as a portion of a building that is bounded by a combination of fire-resistive walls and floor/ceiling assemblies, and/or exterior walls. In DOE facilities, fire areas are typically provided for property protection. The Implementation Guide for DOE Order 420.1 requires credited fire areas to be separated from the remainder of the building by a minimum of 2-hour fire barriers (walls and horizontal assemblies). Fire areas may also be provided for compliance with building code limitations for building additions.

5.0 FIRE PROTECTION

Existing fire protection systems that provide protection to full or segmented portions of this facility can be classified in four categories; Automatic Fire Suppression Systems, Fire Alarm, Automatic Detection Systems, and Fire Extinguishers. The following is a description of the existing installed systems in the building.

5.1 Automatic Fire Suppression Systems

5.1.1 Site Water Supply

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 300,000 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 gallons per minute (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. [**Need to verify**: The distribution system in the vicinity of Building 923 has a static supply pressure of 58 pounds per square inch (PSI) at low elevated tank levels. The water supply system in the area can supply about 3,200 GPM at 20 PSI (based on the Water Distribution Model Analysis developed by the Fire Protection Engineering Group during the summer of 2004.)]

Frost Proof Fire hydrants are provided within 300 ft. of the 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.

5.1.2 Building Water Supply and Fire Department Connection

Building 923 has one 6 inch ductile sprinkler lead-ins connected to an 8 inch main along Rutherford Drive which supplies the sprinkler system riser located in the south end of the building.

The sprinkler system riser is provided with a Fire Department Connection (FDC). The FDC is located on the south side of the building. The nearest hydrant is less than 100 feet from the fire department connection as required by code. The two 2 ½ inch outlets on the FDCs conform to National Standard Thread couplings standard. The piping between the Fire Department Connections and the supply side of the Alarm Check Valve Assembly is 4 inch. The pipe connects to the discharge side of the Alarm Check Valves.

5.1.3 Sprinkler Systems

5.1.3.1 Alarm Check Valve Assembly

The sprinkler system has a 4-inch Model E Alarm Check Valve assembly manufactured by the Reliable Sprinkler Company. The alarm check valve is UL and FM listed and provides the required alarm signals for flow activation to the building fire alarm panel.

5.1.3.2 Wet Pipe Sprinkler System Sizing Method

Automatic sprinkler protection is provided throughout the building. According to the hydraulic data plate attached to the riser the system design criteria is 0.15 gpm/ft^2 over a design area of 2,500 ft^2. The calculated system demand is listed as 473 gpm at a pressure of 45 psi at the base of the riser.

Wiring was observed attached to the sprinkler piping in the hallway as shown in Photograph 1 (**Recommendation HAI-06-923-01**).

Photograph 1 – Wiring Attached to Sprinkler Piping

5.1.4 Fire Standpipe Systems

A standpipe system is not provided in the building, nor is one required.

5.2 Fire Alarm Systems

The facility has a fire alarm system that is connected to the Site Fire Alarm system. The two systems are as follows.

5.2.1 Building Fire Alarm System

The building fire alarm system is a conventional, hard-wired type and consists of a Gamewell model series FlexAlarm Fire Alarm Control Panel (FACP). Manual pull stations are provided at all exits as required. The system also includes spot type heat detectors that are installed in one of the electronic repair rooms in the east wing of the building. The system also monitors waterflow and valve tamper switches for the sprinkler system.

The building fire alarm system transmits (via telephone line/modem technology) alarm, trouble, and supervisory signals, on a per zone and type of device basis, to the central Site Fire Alarm System located in the on-site Fire House (refer to Section 5.2.2 of this analysis report for information on the Site Fire Alarm System).

A manual fire alarm system is required in accordance with the Building Code of the State of New York (BCSNY), 2002 edition, Section 907.2.2.

Alarm notification is provided by audible alarm bell/gong appliances installed generally in public corridors. Some of the bell/gong appliances include an integral strobe for visual alarm notification. Based on observations the coverage is not adequate.

5.2.2 Site Fire Alarm System

Brookhaven National Laboratory provides central fire alarm station coverage using a fault tolerant sever infrastructure based multiplexed Site Fire Alarm System. The system is an Andover Continuum; installed in 2005 (Andover is a part of Simplex Grinnell). The system complies with the requirements of NFPA 72 defined as a Style 6 Class “A” System.

Two mirrored servers are located in separate buildings. If the lead server fails the system automatically switches over to the working server. The Site Fire Alarm System operates on a fault tolerant high speed Ethernet infrastructure that utilizes network switches and fiber wiring between each of the major components.

The Site Fire Alarm System monitors fire alarm panels located throughout BNL by uses the existing site telephone cable plant. RS232 signals are sent via full duplex line drivers. Each fire alarm panel has two channels connected to the Site Fire Alarm System. The panels are divided into 9 communication "loops." It is currently monitoring 9,700 points. Response time from

alarm at the panel to alarm indication at the Central Station is less than 82 seconds, which is within the 90 seconds allowed by NFPA 72.

The main console is at the Firehouse, Bldg. 599. This station monitors all fire alarm signals, trouble and communication status alarms. A satellite 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. A second satellite station is provided at AGS Main Control Room, Bldg. 911, and receives only the fire alarm signals from the RHIC/AGS accelerator buildings.

5.3 Automatic Detection Systems

Spot type (old dome style) heat detectors are installed in one electronic repair room of the building.

5.4 Fire Extinguishers

Portable fire extinguishers are required in existing business occupancies [§39.3.5]. Multipurpose ABC fire extinguishers are provided throughout the building. The location and placement of portable fire extinguishers is in accordance with NFPA 10, *Standard for Portable Fire Extinguishers*.

6.0 FIRE HAZARDS

Fire hazard potentials are classified into four major categories; Building Materials, Special Occupancies, Exterior Hazard Exposure, and Natural Hazard Exposure. The following is an evaluation of Building 923 for each category.

6.1 Special Occupancies

6.1.1 Vital and Important Records Storage

There are no vital or important records stored within Building 923. Vital records are those records which are essential to the mission 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 significant extra expense.

6.1.2 Trailers and Portable Structures

There are no trailers or portable structures associated with Building 923. However, there is an electronic equipment storage room on the north side of the building that is attached to Building 923 by a wood frame construction walkway (Photograph #2). In addition, there is a portable storage unit located on the west side of the building, between Building 923 and Building 918.

Photograph #2 – Wood frame structure at north end of Building 923

6.1.3 Electrical Substations

There are no electrical substations or transformers located in close proximity to the building.

6.1.4 Flammable Liquid and Gas Storage

Flammable liquid or gas storage areas were not observed at the time of this survey.

6.1.5 Cables and Raceways

There are no cable trays associated with the building.

6.2 Housekeeping in Vital Areas

Good housekeeping and control of combustibles was observed during this survey.

6.3 Building Materials

The addition on the north end of the building is constructed of exposed wood studs (Photograph #2) (**Recommendation HAI-06-923-02**).

6.4 Exterior Exposure Hazards

Any exterior structure, area or piece of equipment that is subject to harmful effects from, or can cause harmful effects to this facility is defined as an exterior exposure. Exterior exposures can be categorized as: elements outside of the facility, and as components of the facility.

6.4.1 Elements Outside of the Facility

The following is a summary of fire exposures to Building 923. All exposures are evaluated using FM Data Sheet 1-20 "Protection against Exterior Fire Exposure." These exposures do not present an undue hazard to Building 923.

6.4.1.1 North Exposures

Exposures to the North are minimal. Building 922 is located approximately 50 feet away. Two pine trees are located on the north side of the building and pose an unnecessary exposure to the building (Photograph #4) (**See Recommendation HAI-06-923-03**).

6.4.1.2 South Exposures

There are no exposures to the South.

6.4.1.3 East Exposures

Exposures to the East are minimal. Two waste storage tanks are located approximately 100 feet away. The tanks are located in a diked area.

6.4.1.4 West Exposures

A portable storage unit is located approximately 15 feet to the west, between Building 923 and Building 918. Due to sloping terrain, the roof line of the storage unit is slightly higher than the floor elevation of Building 923.

Photograph #3 – Trees at the north end of Building 923

6.4.2 Components of the Facility

The facility is considered one fire area, with no internal separation.

6.5 Natural Phenomenon Hazard Exposure

Natural Hazards can be classified in five hazard categories: lightning, windstorm, wild fire, earthquake and flooding. The following is an evaluation for each category.

6.5.1 Lightning Potential

Following the Risk Assessment methodology the expected lightning frequency (Nd) of 0.00019 is less than the tolerable lightning frequency (Nc) of 0.0002 (calculations shown in appendix B of this report), therefore a lightning protection system is not required.

6.5.2 Windstorm Potential

The Long Island area basic wind speed (3-second gust) is 120 MPH based on Factory Mutual Data Sheet 1-28 and BCNYS figure 1609.4. The ground roughness exposure category for the Building 923 area is 'Exposure B." Based on the calculations this building should have roof assemblies classified as "Class 90" rated assemblies. The roof appears to be in good condition.

6.5.3 Brush Fire Potential

An analysis was completed consistent with the requirements and guidelines of NFPA 1144 *Protection of Life and Property from Wildfire* (2002) to determine the wildfire risk to Building 923. The risk assessment was conducted in accordance with the Wildfire Hazard Severity Form checklist of NFPA 1144. The checklist is a summary of typical desirable characteristics found in various wildfire hazards analyses. Elements include emergency response ingress and egress, type of vegetation, topography, building construction and roofing materials, available fire protection, and utilities.

Based on the analysis, the hazard from wildfire to Building 923 is "LOW". Specifics of the Wildfire Hazard Severity Analysis are shown in Appendix C of this report. However, two pine trees located at the north end of the building present an exposure (Photograph 4).

6.5.4 Earthquake Potential

The seismic damage potential for this facility is classified as low based on a Natural Hazards analysis produced for the BNL campus titled "DOE Accelerator Order 5480.25 Implementation Plane for Brookhaven National Laboratory National Phenomena Hazards Evaluation" dated April 1994. A low seismic classification means that the buildings and fire protection systems are not required to comply with seismic design standards.

6.5.5 Flooding Potential

Flood potential from bodies of water overflowing their normal levees is low for the BNL area. The flooding potential for this facility was classified as low in a Natural Hazards Analysis report produced for the BNL site, dated April 1994, titled "DOE Accelerator Order 5480.25 Implementation Plane for Brookhaven National Laboratory National Phenomena Hazards Evaluation."

There does not appear to be a flooding concern for Building 923 due to the surrounding terrain.

6.6 Toxic Fire Potential

There are no known toxic materials present in the building that present a release potential due to fire.

6.7 Biological Fire Potential

There are no known biological materials present in the building that present a release potential due to fire.

6.8 Radiation Fire Potential

There is a small calibration source located in a room in the calibration lab in the northwest area of the building. However, the source is sealed and is in a non-dispersible form.

7.0 PRE-FIRE AND EMERGENCY PLANNING

The BNL Fire Department maintains an adequate pre-fire plan book for this facility (http://intranet.bnl.gov/emergencyservices/runcards/main_i.asp). The pre-plan was reviewed as part of this analysis.

7.1 Protection of Essential Safety Class Systems

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

7.2 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 in this report, are required for this facility.

7.3 Protection of High Value Property

There is no high value equipment located within Building 923. High value equipment is generally regarded as any single item that is valued at $1 million or more, or where the loss of a single item could result in a loss of program continuity of greater than six months.

7.4 Critical Process Equipment

The is no critical process equipment located within Building 923

7.5 Maximum Possible Fire Loss (MPFL) and Maximum Credible Fire Loss (MCFL)

The MPFL, as defined in DOE Order 420.1, is the value of property within a fire area, unless a fire hazard analysis demonstrates a lesser (or greater) loss potential, assuming the failure of

both automatic fire suppression systems and manual fire fighting efforts. The fire loss estimate includes the replacement cost of equipment and property and any applicable decontamination and cleanup costs.

In accordance with the BNL Fire Safety Program, protection is required for facilities having an MPFL in excess of established thresholds as follows:

- When the MPFL exceeds $1 million an automatic sprinkler system designed in accordance with applicable NFPA standards is required;
- When the MPFL exceeds $25 million, a redundant fire protection system is required such that, despite the failure of the primary fire protection system, the loss will be limited to $25 million; and
- When the MPFL exceeds $50 million, a redundant fire protection system and a 3-hour fire resistance rated barrier are required to limit the MPFL to $50 million.

7.5.1 MPFL Scenario

A single MPFL scenario is considered for Building 923 which has a fire area of approximately 11,500 square feet.

7.5.2 MPFL Calculation

The building has a replacement value of approximately $2 million. The building value was obtained from 2004 replacement costs. The average dollar density of the building is the replacement value divided by the floor area of the building ($2,000,000/11,500 ft^2 = $174/$ft^2$ ($175/$ft^2$)).

The content and equipment value is calculated based on the following assumptions:

- An average of $20/$ft^2$ for content and equipment value within predominantly office/support areas.
- An average of $100/$ft^2$ for content and equipment value within the electronic repair or storage areas of the building.

For the purpose of this evaluation it is assumed that 70 percent of the building is occupied by office space and the remaining contains electronic repair or storage. The estimated MPFL is:

	Area (ft^2)	Factor ($/$ft^2$)	Estimate
Building	11,500	175	$2,012,500
Contents, office	8,050	20	$161,000
Contents, electronics	3,450	100	$345,000
		Total	$2,518,500

7.5.3 MCFL Scenario

The MCFL, as defined in DOE Standard 1066-99 Fire Protection Criteria, is the value of property within a fire area, unless a fire hazard analysis demonstrates a lesser (or greater) loss potential. This assumes that all installed fire protection systems function as designed, and the effect of emergency response is omitted except for post-fire actions.

The maximum credible fire scenario is one in which automatic suppression systems function as designed. The sprinkler system for this building has a design area of 2,500 ft^2. Since properly designed and installed sprinkler systems should limit the fire growth and/or damage to the design area this floor area was used in the determination of MCFL potentials when protected by automatic sprinkler systems. Without sprinkler protection the MCFL is the same as the postulated MPFL for that area.

For the purpose of this evaluation it is assumed that the MCFL occurs in an electronics repair or storage area of the building, which represents the higher content cost density. The estimated MCFL is:

	Area (ft^2)	Factor ($/$ft^2$)	Estimate
Building	2,500	175	$437,500
Contents, electronics	2,500	100	$250,000
		Total	$687,500

7.5.4 MPFL/MCFL Summary

The MPFL estimate of $2.5 million exceeds the threshold at which automatic sprinkler protection is required. Sprinkler protection is required so that the MCFL is limited to $1 million. The building is provided with sprinkler protection throughout and therefore complies with the MPFL and MCFL loss criteria.

7.6 Recovery Potential

Operations and contents within the building can be readily provided elsewhere.

7.7 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, and (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 3200 people. Minimums of two members per shift hold New York State "Emergency Medical Technician - D" certifications ("D" is for defibrillation). Normally all five

firefighters have EMT status. The Group operates a New York State Certified Basic Life Support ambulance. Medivac services are available to BNL via the Suffolk County Police Department. Additionally the Fire/Rescue Group has two 1500 GPM "Class A" Pumpers, 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 Building 923 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 Stonybrook University.

7.8 Fire Apparatus Accessibility

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

7.9 Security Considerations Related to Fire Protection

There are no security restrictions for this facility that would hamper fire department response to an emergency.

8.0 LIFE SAFETY CONSIDERATIONS

Life safety considerations for this facility include means of egress consisting of exit access, exits and exit discharge, exit signage, and emergency lighting. This building is required to comply with state building codes and NFPA 101, the Life Safety Code (LSC). The requirements of both the 2002 edition of the Building Code of New York State (BCNYS) and the 2006 edition of the LSC have been applied to this analysis. It should be noted that the BCNYS is not intended to apply to existing structures. Appendix K of the BCNYS addresses alterations to existing structures.

8.1 Occupancy Load Factor and Calculations

The occupant load for code purposes is calculated based on applicable occupant load factors specified in LSC Table 7.3.1.2. An occupant load factor of 100 sq ft per person was applied to the entire building. The calculated occupant load is therefore 115 persons (11,500 ft^2/100 ft^2/person).

8.2 Means of Egress

8.2.1 Number and Arrangement of Exits

The LSC requires that a floor with an occupant load of 500 or fewer persons must have a minimum of two means of egress [§7.4.1.1]. Additional exits may be required for compliance with exit capacity or arrangement of exits criteria.

The building is provided with five exit doors that discharge directly to the exterior; one door at the north and south ends of the east portion, one door at the south end of the west portion; and two doors from the connecting hallway.

8.2.2 Capacity of Exits

The egress capacity provided from a floor or portion thereof must be sufficient to accommodate the occupant load. The egress capacity for an egress component is based on the width of the component. For stairways, the factor of 0.3 in. of stair width per person is applied. For doors, ramps, corridors, and other level components, the factor of 0.2 in. of width per person is applied.

The egress widths of the existing doors are each approximately 34 inches clear width. Each of the doors has an egress capacity of 170 persons. The aggregate capacity of these five exits is approximately 850 persons which clearly exceeds the calculated occupant load of 115 persons.

8.2.3 Travel Distance

The exit access travel distance is the distance from an occupiable point to the nearest exit or exit enclosure. The maximum exit access travel distances for a business occupancy protected throughout by an automatic sprinkler system is 200 feet [LSC §39.2.6].

The building is in compliance with exit access travel distance limitations.

8.2.4 Common Path of Travel

The maximum allowable common path of travel for business occupancies is 75 ft. The building is in compliance with the common path of travel distance limitations.

8.2.5 Dead Ends

Dead-end corridors must not exceed 50 ft in business occupancies [LSC §39.2.5.2]. The building is in compliance with dead end travel distance limitations.

8.2.6 Security Considerations Related to Fire Protection

There are no security restrictions of building features that would adversely affect fire protection.

8.2.7 Separation of Means of Egress

Where two exits or exit access doors are required, they must be located at a distance from one another not less than one-half the length of the maximum overall diagonal dimension of the building or area served [LSC §7.5.1.3.2; BCNYS §]. The building complies with the separation of means of egress criteria as required by the BCNYS and LSC in all areas.

8.3 Exit Signs and Emergency Lighting

Exit signage is required in accordance with Section 7.10 of the LSC. Exit signs should be placed in corridors and in rooms required to have at least two means of egress. The building is in general compliance with the requirement for exit signage.

Emergency lighting is not required for this building. However, battery powered emergency lighting units are provided in the building.

8.4 Exit Discharge

Exits are required to terminate directly at a public way or at an exterior exit discharge. All of the exits discharge to the exterior of the building and lead to a public way.

8.5 Barriers

8.5.1 Occupancy Separations

8.5.2 Incidental Use Areas

Incidental use areas or hazardous areas are considered those spaces that pose a relatively higher hazard than the predominant occupancy of the area in which they are located. Such spaces are not necessarily classified as high-hazard (Group H) occupancies. Hazardous areas include general storage rooms, boiler or furnace rooms, and maintenance shops. The LSC requires hazardous areas to be separated from adjoining areas by a 1-hour fire resistance-rated barrier without windows or protected by automatic fire suppression systems [LSC §8.7.1.1]. Rooms with severe hazards such as maintenance shops with woodworking and painting are required to have both fire barrier enclosure and automatic fire suppression.

The building is protected throughout by an automatic sprinkler system and is in compliance with this requirement.

8.5.3 Separation of Means of Egress

8.5.4 Exit Access Corridors

Fire resistance-rated corridor walls are not required in existing business occupancies [LSC §39.3.6]. In addition, the building is protected throughout by an automatic sprinkler system; therefore rated corridor walls are not required.

8.5.5 Vertical Opening Barriers

8.5.6 Egress Stairways

There are no egress stairs in the building.

8.6 Fire Protection Systems Required by Code

Automatic sprinkler protection is provided throughout the building. There are no other fire protection systems required by code.

8.7 Operational Requirements that are Required by Code

When performed, cutting and welding operations in the building are required to be conducted in accordance with NFPA 51B**,** *Standard for Fire Prevention during Welding, Cutting, and Other Hot Work,* 2003 Edition.

There are no other fire protection related operational requirements required by code.

9.0 REFERENCE DOCUMENTS

9.1 National Fire Protection Association

NFPA 10, *Standard for Portable Fire Extinguishers*, 2002 Edition

NFPA 13, *Standard for the Installation of Sprinkler Systems*, 2002 Edition

NFPA 25, Inspection, Testing and Maintenance of Water Based Fire Suppression Systems, 2002 Edition.

NFPA 30, *Flammable and Combustible Liquids Code*, 2003 Edition

NFPA 51B**,** *Standard for Fire Prevention during Welding, Cutting, and Other Hot Work*, 2003 Edition

NFPA 70, *National Electrical Code*®, 2005 Edition

NFPA 72®, *National Fire Alarm Code*®, 2002 Edition

NFPA 80, *Standard for Fire Doors and Fire Windows*, 1999 Edition

NFPA 101®, *Life Safety Code*®, 2006 Edition

NFPA 780, *Standard for the Installation of Lightning Protection Systems*, 2004 Edition

NFPA 1144, *Standard for Protection of Life and Property from Wildfire*, 2002 Edition

9.2 FM Global Loss Prevention Data Sheets

None

APPENDIX B - LIGHTNING RISK CALCULATION

The expected lightning frequency (Nd) is **0.00019** and the tolerable lightning frequency (Nc) is **0.0002**. Based on NFPA 780, If Nc > Nd, a lightning protection system is not required.

EXPECTED LIGHTNING STROKE FREQUENCY FROM NFPA 780 ANNEX L

$$N_d = (N_g)(A_e)(C_1)(10^{-6})$$

N_d = **0.0019** = yearly average flash density in the region where the structure is located

(N_g) = **2.0** = the yearly lightning strike frequency to the structure

(C_1) = **0.25** = the environmental coefficient

(A_e) = **3,824** = the equivalent collective area of the structure in square meters from calculation below

Length (L)	**170**	Feet
Width (W)	**75**	Feet
Height (H)	**15**	Feet

0.25

Figure H.4.2(a) Results **3,824** sq. meters

Figure H.4.2(b) Results **591** sq. meters

Table H.4.3 Determination of Environmental Coefficient C_1

Relative Structure Location	C_1
Structure located within a space containing structures or trees of the same height or taller within a distance of $3H$	0.25
Structure surrounded by smaller structures within a distance of $3H$	0.5
Isolated structure, no other structures located within a distance of $3H$	1
Isolated structure on a hilltop	2

Assume

0.25

Figure H.4.2(a) Calculation of the equivalent collective area for a rectangular structure.

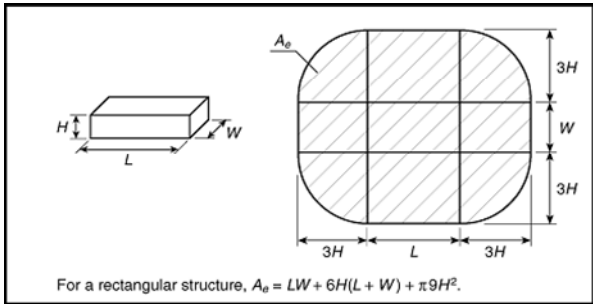
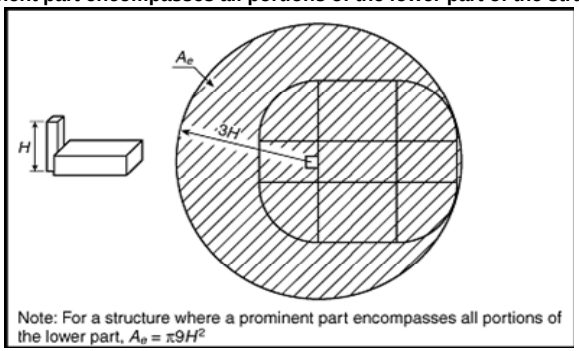


Figure H.4.2(b) Calculation of the equivalent collective area for a structure where a prominent part encompasses all portions of the lower part of the structure.



= input required

TOLERABLE LIGHTNING FREQUENCY FROM NFPA 780 APPENDIX L

$$N_c = \frac{1.5 \times 10^{-3}}{C}$$

where $C = (C_2)(C_3)(C_4)(C_5)$.

N_c = **0.0002**

= input required

Assume **1.0**

C_2 — Structural Coefficients			
	Roof		
Structure	Metal	Nonmetallic	Flammable
Metal	0.5	1.0	2.0
Nonmetallic	1.0	1.0	2.5
Flammable	2.0	2.5	3.0

Assume **2.0**

Structure Contents	C_3
Low value and nonflammable	0.5
Standard value and nonflammable	1.0
High value, moderate flammability	2.0
Exceptional value, flammable, computer or electronics	3.0
Exceptional value, irreplaceable cultural items	4.0

Assume **1.0**

Structure Occupancy	C_4
Unoccupied	0.5
Normally Occupied	1.0
Difficult to evacuate or risk of panic	3.0

Assume **5.0**

Lightning Consequence	C_5
Continuity of facility services not required, no environmental impact	1.0
Continuity of facility services required, no environmental impact	5.0
Consequences to the environment	10.0

APPENDIX C
DETERMINATION OF WILDFIRE HAZARD SEVERITY USING NFPA 1144.

ELEMENT	POINTS
A. Means of Access	
1. Ingress and egress	
a. Two or more roads in/out	**0**√
b. One road in/out	7
2. Road width	
a. >= 24 ft	0
b. >= 20 ft and < 24 ft	**2**√
c. < 20 ft	4
3. All-season road condition	
a. Surfaced road, grade <5%	**0**√
b. Surfaced road, grade > 5%	2
c. Non-surface road, grade < 5%	2
d. Non-surface road, grade > 5%	5
e. Other than all-season	7
4. Fire Service Access	
a. <= 300 ft with turnaround	**0**√
b. > 300 ft with turnaround	2
c. < 300 ft with no turnaround	4
d. >= 300 ft with no turnaround	5
5. Street Signs	
a. Present	**0**√
b. Not present	5
B. Vegetation (Fuel Models)	
1. Characteristics of predominate vegetation within 300 ft.	
a. Light (e.g., grasses, forbs, sawgrassess, and tundra) NFDRS Fuel Models A,C,L,N,S, and T	5
b. Medium (e.g. light brush and small trees) NFDRS Fuel Models D,E,F,H,P,Q, and U	**10**√
c. Heavy (e.g. dense brush, timber, and hardwoods) NFDRS Fuel Models B,G, and O	20
d. Slash (e.g. timber harvesting residue) NFDRS Fuel Models J,K, and L	25
2. Defensible space	
a. More than 100 ft of vegetation treatment from the structures	1
b. 71 ft to 100 ft of vegetation treatment from the structures	
c. 30 ft to 70 ft of vegetation treatment from the structures	**10**√
d. < 30 ft of vegetation treatment from the structures	25
C. Topography Within 300 of Structures	
1. Slope < 9%	**1**√
2. Slope 10% to 20 %	4
3. Slope 21% to 30%	7

4.	Slope 31% to 40%	8
5.	Slope > 41%	10

D. Additional Rating Factors

1.	Topographical features that adversely affect wildland fire behavior	0-5 [**0**√]
2.	Areas with a history of higher fire occurrence than surrounding areas due to special situations	0-5 [**0**√]
3.	Areas that are periodically exposed to unusually severe fire weather and strong dry winds.	0-5 [**0**√]
4.	Separation of adjacent structures that can contribute to fire spread	0-5 [**0**√]

E. Roofing Assembly

1.	Class A roof	0
2.	Class B roof	**3**√
3.	Class C roof	15
4.	Nonrated	25

F. Building Construction

1.	Materials		
	a.	Noncombustible/fire-resistive siding, eaves, and deck	**0**√
	b.	Noncombustible/fire-resistive siding and combustible deck	5
	c.	Combustible siding and deck	10
2.	Building setback relative to slopes of 30% or more		
	a.	>= 30 ft to slope	1
	b.	< 30 ft to slope	5

G. Available Fire Protection

1.	Water source availability		
	a.	Pressurized water source availability	
		500 gpm hydrants <= 1000ft apart	**0**√
		250 gpm hydrants <= 1000ft apart	1
	b.	Nonpressurized water source availability	
		>= 250 gpm continuous for 2 hours	3
		< 250 gpm continuous for 2 hours	5
	c.	Water unavailable	10
2.	Organized response resources		
	a.	Station <= 5 miles from structure	**1**√
	b.	Station > 5 miles from structure	3
3.	Fixed fire protection		
	a.	NFPA 13	**0**√
	b.	None	5

H. Placement of Gas and Electric Utilities

1.	Both underground	**0**√
2.	One underground, one aboveground	3
3.	Both aboveground	5

I. Total **18**

Hazard Assessment	Total Points
Low hazard	**< 40**
Moderate hazard	40-69
High hazard	70-112
Extreme hazard	> 112

A Wildfire Severity Level of 32 = A LOW Hazard