13 CONVENTIONAL FACILITIES

13.1 CONVENTIONAL FACILITIES OVERVIEW

13.1.1 Introduction

The NSLS-II conventional facilities will provide the structures and systems necessary to enable installation and operation of the accelerator and experimental beamlines. The conventional facilities must be designed and constructed to enable the world-leading performance objectives of the project mission. Furthermore, the conventional facilities must be constructed on an aggressive schedule that enables installation of the accelerator systems and experimental beamlines in accordance with the project schedule goals. Lastly, the conventional facilities must meet the functional and aesthetic goals of creating an economically vibrant research facility that achieves technical excellence and is adaptable to the varied and changing requirements of the user community. This chapter describes the scope and design considerations for the NSLS-II conventional facilities.

13.1.2 Project Goals

The goals of the conventional facilities portion of the project support the overall goals of the NSLS-II project. These goals provide the guiding principals for conceptual design of the conventional facilities.

- World-class scientific capability
- Promote collaborative interaction
- Flexible building capability
- Economic construction and operation
- Sustainable design
- Section of the Ring Building available for accelerator installation by July 2010
- Ring Building beneficial occupancy by September 2011

13.1.3 Project Description

The NSLS-II conventional facilities will be designed to support the needs of the technical construction portion of the project. The selected site is the southeast corner of the intersection of Brookhaven Avenue and Groves Street. The existing NSLS building is diagonally across the intersection and the new Center for Functional Nanomaterials (CFN) is across Groves Street to the west.

The conventional facilities will consist of a Ring Building to house the accelerator and associated beamlines, a Central Lab Office Building (CLOB), up to four Lab Office Buildings (LOB), a Linac and RF Building with an associated service building, and four two story service buildings containing mechanical and electrical equipment. Additionally, the overall building complex is being planned to include a Guest House and the Joint Photon Sciences Institute Building. Both buildings are considered future construction and are not included in the Program or Cost of the NSLS-II project.

An architectural rendering of NSLS-II is shown in Figure 13.1.1. Figure 13.1.2 indicates the floor plan of the base scope NSLS-II complex and Figure 13.1.3 shows the complex with added conference center and LOB's 2, 3 & 4. The approximate gross area for each of these buildings is shown in Table 13.1.1. The building program is discussed more fully in Sections 13.4 and 13.5.

Table 13.1.1 NSLS-II Gross Area.

Building Component	Gross Area (ft^2)
Central Lab Office Building	52,748
Conference Center (optional)	15,000
Ring Building	244,663
Service buildings	32,000
Linac & RF Buildings	21,000
Lab Office Buildings (33,000 ft^2 optional)	44,000
Total NSLS-II	**409,411**

Figure 13.1.1 Architectural rendering of NSLS-II.

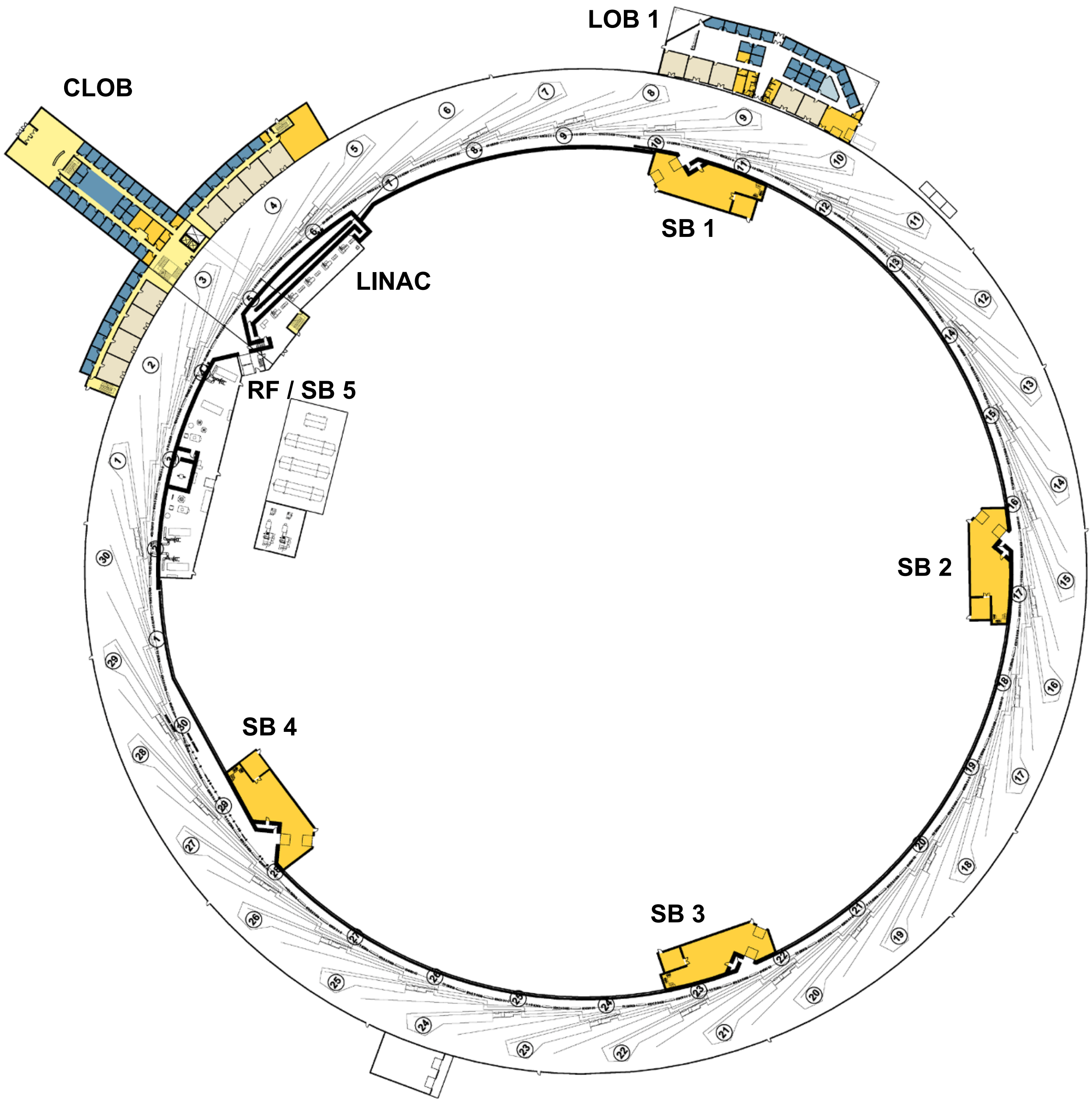

Figure 13.1.2 NSLS-II Complex Layout – First Floor Plan, base scope.

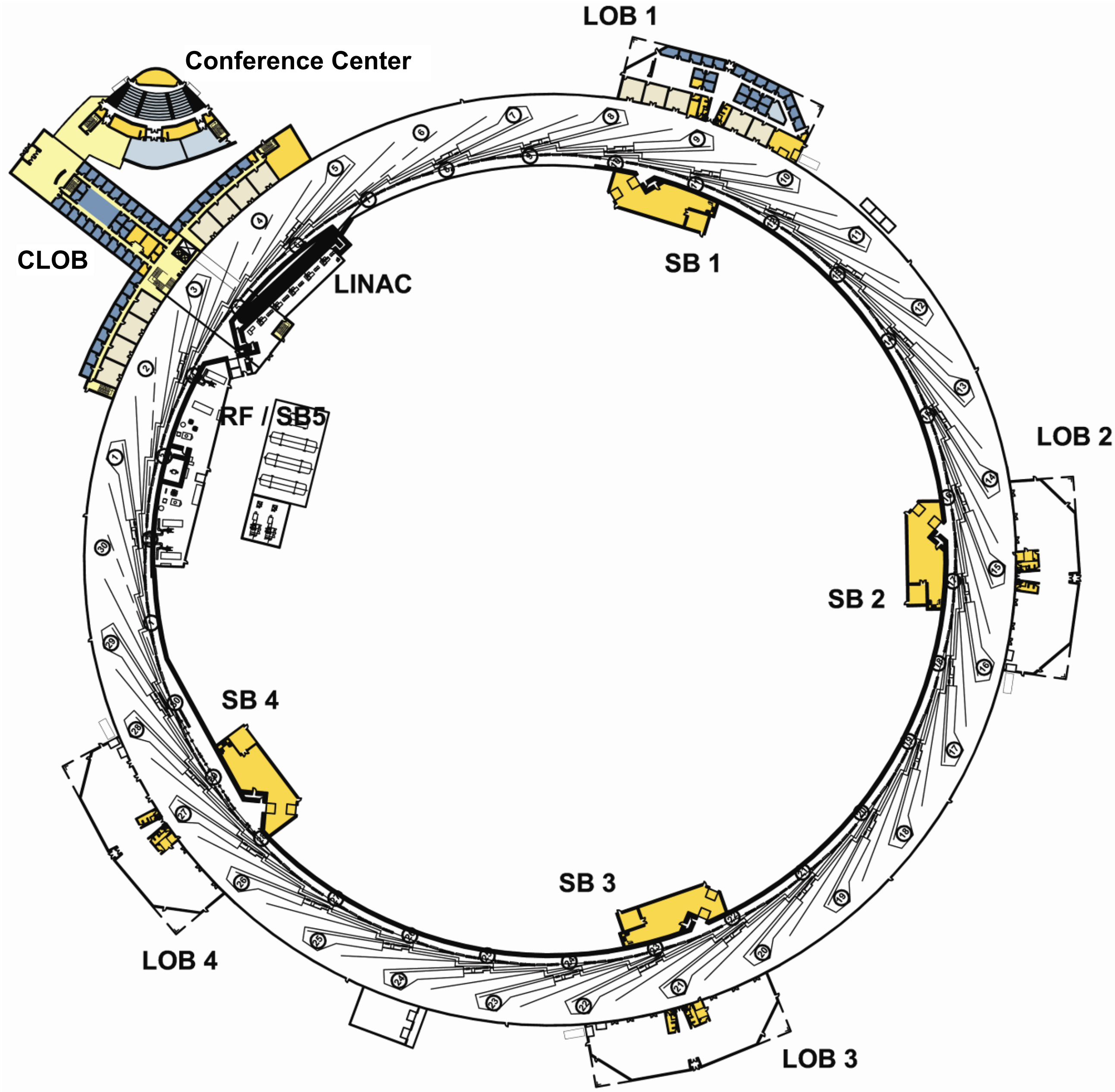

Figure 13.1.3 NSLS-II Complex Layout – First Floor Plan, with optional conference center and "warm shelled" LOBs 2, 3, and 4.

13.2 SITE ANALYSIS

13.2.1 Building Site Alternatives

13.2.1.1 Site Analysis Criteria

Five potential building sites were evaluated for the NSLS-II facility on the BNL campus. A site analysis has been prepared for each potential site. Evaluation criteria include:

- Overall campus planning – does placing the facility on the site promote the BNL master plan and enhance the overall character of the campus.
- Proximity to the Center for Functional Nanomaterials – is the site relatively near to CFN to facilitate collaborative research between the two facilities.
- Proximity to the existing NSLS facility – is the site relatively near the NSLS building to facilitate the transition of science from one to the other, and the potential reuse of the NSLS building for related programs.
- Technical suitability – does the site exhibit favorable ambient characteristics with regard to vibration, noise, traffic, electromagnetic or radiofrequency interference, or other characteristics that might detract from facility performance.
- Expansion capability – does the site promote expansion of lab/office space and allow for the extension of beamlines up to a length of 600 meters.
- Utility availability – are site utilities accessible to the site.
- Impact on existing facilities/infrastructure – does utilizing the site require operational or costly impacts on existing facilities and infrastructure.
- Environmental protection – does the site require negative environmental impacts to construct or operate.

A map of the potential sites is shown in Figure 13.2.1 and the evaluation matrix for each site is tabulated in Table 13.2.1.

Figure 13.2.1 Proposed site locations on the BNL campus with possible long beamlines.

Site 1: Southeast corner of Brookhaven Avenue and Groves Street
Site 2: Southwest corner of East Fifth Avenue and First Street
Site 3: Blue's Pond location, north of East Princeton Avenue
Site 4: South of East Princeton Avenue at Fawn Path
Site 5: East of William Floyd Parkway between Nineteenth Street and Upton Road

Table 13.2.1 Site analysis scoring matrix.

Criteria	**Campus Planning**		**Vibration Characteristics**		**Proximity to NSLS, CFN, Other**		**Technical Suitability**		**Expansion Capability**		**Utility Availability**		**Impact on Existing Facilities**		**Environmental Concerns**		**EMI / RFI Characteristics**		**TOTAL WEIGHTED SCORE**
Weight	3		3		2		2		3		1		2		2		1		
Score	Raw	Weighted	Raw	Weighted	Raw	Weighted	Raw	Weighted	Raw	Weighted	Raw	Weighted	Raw	Weighted	Raw	Weighted	Raw	Weighted	
Site 1	5	15	4	12	5	10	5	10	5	15	4	4	4	8	4	8	3	3	**85**
Site 2	3	9	3	9	3	6	3	6	5	15	3	3	4	8	4	8	3	3	**67**
Site 3	1	3	3	9	1	2	3	6	4	12	4	4	3	6	1	2	3	3	**47**
Site 4	1	3	4	12	1	2	2	4	5	15	1	1	5	10	2	4	5	5	**56**
Site 5	0	0	4	12	0	0	1	2	5	15	2	2	5	10	1	2	4	4	**47**

Note: Criteria weighting is on a scale of 1 to 3, with 3 being "Very Important" and 1 being "Somewhat Important." Raw Score is on a scale of 0 to 5, with 5 being "Strongly Meets Criteria" and 0 being "Does Not Meet Criteria." The Weighted Score is the product of those two values. The Total Weighted Score for each site is the cumulative value of all weighted scores for that location.

13.2.1.2 Alternative Site Analysis

Positive and negative attributes of each site are listed below.

13.2.1.2.1 Site 1 – Southeast of Intersection of Groves St. and Brookhaven Ave.

Positive Factors

- Location highly promotes BNL site master plan and development plan for Brookhaven Avenue.
- Pre-design survey indicates site has favorable vibration characteristics.
- Highly proximate to both the existing NSLS and CFN.
- Site is generally level, which should minimize need for off-site fill material.
- Site is only partially treed, which reduces clearing costs and environmental impacts.
- Undeveloped space on east and south sides of site will allow for installation of beamlines up to 600 m long.
- Utility mains with sufficient capacity for NSLS-II are available near the site.
- No identified environmental issues.
- A NEPA Environmental Assessment has been completed for the site and a Finding of No Significant Impact declared by DOE.
- Pre-design survey indicated favorable background EMI conditions. Requires relocation or remediation of power feeder along Seventh Street south of Brookhaven Avenue.

Negative Factors:

- Site requires completion of BNL shipping/receiving relocation project prior to construction.

13.2.1.2.2 Site 2 – Southwest of Intersection of East Fifth Ave. and First St.

Positive Factors

- There are no existing buildings on the site, so no demolition would be necessary.
- There is room for future beam extensions of up to 600 m.

Negative Factors

- Location is in relative proximity to Brookhaven Avenue, but it does not promote the BNL site master plan.
- The site is far from NSLS and CFN.
- The site is heavily wooded, has rolling grade, and major tree clearing and earthwork would be required.
- More access roads and infrastructure would have to be brought to the site.
- The site is located nearer to the weather station with potential EMI concerns caused by the Doppler radar.

13.2.1.2.3 Site 3 – The Blue's Pond Location, North of East Princeton Ave.

Positive Factors

- The site is close to NSLS and CFN, although not as conveniently situated as Site 1.
- There are no existing buildings on the site, so no demolition would be necessary.
- There is room for future beam extensions of up to 600 m.
- The site is located near Chilled Water Storage.
- The site is slightly farther from the Doppler radar than Site 1.

Negative Factors

- Location is in relative proximity to Brookhaven Avenue, but it does not promote the BNL site master plan.
- The site is wooded with rolling grade, and extensive tree clearing and earthwork would be required.
- Future long beams would have to extend over East Princeton Ave.
- More access roads and infrastructure would have to be brought to the site.
- Environmental impact: Existing Blue's Pond – a natural feature would have to be removed.

13.2.1.2.4 Site 4 – South of East Princeton Ave at Fawn Path

Positive Factors

- There are no existing buildings on the site so no demolition will be necessary.
- There is room for future beam extensions of up to 600 m.
- No identified environmental issues.

Negative Factors

- The site is very remote, at the southern edge of the BNL Campus.
- Proximity to Long Island Expressway could cause increased vibration impacts.
- The site is far from NSLS and CFN.
- The site is moderately wooded and some tree clearing would be required.
- More access roads and infrastructure would have to be brought to the site.

13.2.1.2.5 Site 5 – East of William Floyd Parkway, between Nineteenth St. and Upton Rd.

Positive Factors

- There are no existing buildings on the site so no demolition will be necessary.

Negative Factors

- The site is very remote, far from NSLS and CFN at the western end of Brookhaven Ave., and it does not promote the campus master plan.
- The site is very heavily wooded and major tree clearing would be required.
- There are minimal options for future beam extensions and additional tree clearing would be required.

13.2.2 Selected Site Analysis

Based upon the above analysis, Site 1 has the highest ranking of the 5 sites and is therefore the preferred building site. The location for the proposed NSLS-II site is based upon several criteria and includes the ability to comply with environmental requirements; the ability to meet research mission objectives; the physical proximity to collaborative BNL research facilities in the new Center for Functional Nanomaterials (CFN) and the existing NSLS, constructability factors related to site conditions; economic factors affecting project cost; conformance with BNL strategic planning goals and the ability to support future expansion and long beam lines. The site selected for construction of the NSLS-II meets all of the criteria indicated above and is superior to all alternative locations. The site design will respond to these criteria. The NSLS-II site plan at the selected site is shown in Figure 13.2.2.

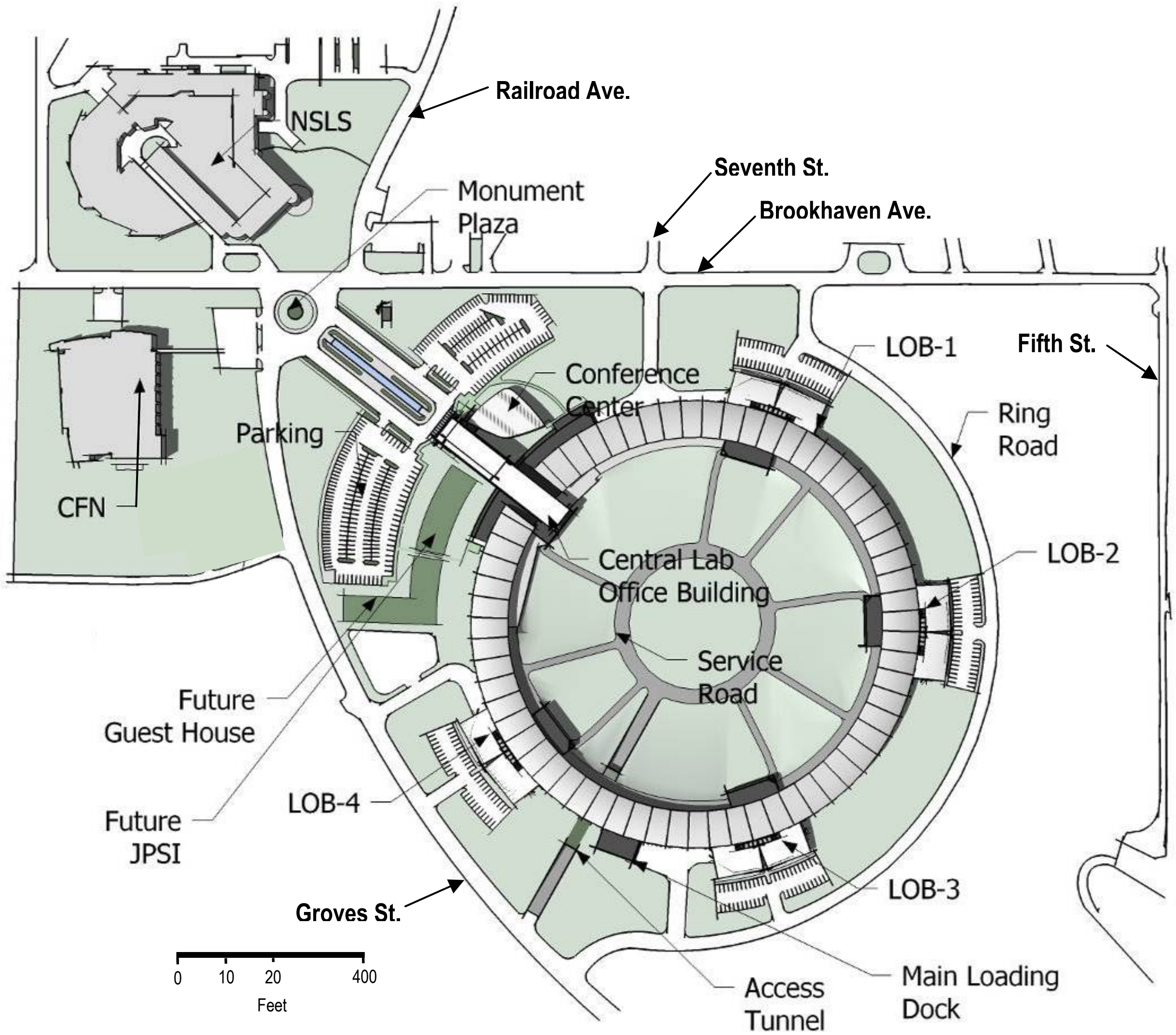

Figure 13.2.2 NSLS-II Site Plan.

13.2.2.1 Campus Planning

The site is a 50 acre parcel located at the intersection of Brookhaven Avenue and Groves Street on the BNL campus. Current master planning envisions Brookhaven Avenue becoming the primary east–west arterial street through the campus. Parcels adjacent to Brookhaven Avenue are considered preferred sites for current and future building projects, including NSLS-II. The architectural vocabulary along this axis will transform in character from a traditional masonry aesthetic in the west to an advanced technology image in the east.

The preferred site is located at a strategic location along Brookhaven Avenue consistent with the campus master plan. Together with CFN, NSLS-II will form a science focal point along Brookhaven Avenue emphasizing the site's commitment to new facilities promoting leading-edge science.

Locating NSLS-II in this parcel will allow for the future addition of extended beamlines of up to 600 m long. These may project eastward along Brookhaven Avenue, to the southeast, or to the south. This site allows for many future options.

13.2.2.2 Adjacencies

The adjacencies that NSLS-II will leverage at the preferred site are highly advantageous. The existing NSLS is diagonally located across Brookhaven Avenue, which will promote ease of interaction between the buildings, particularly during the science transition phase when both accelerators are operating. It will also simplify the relocation of equipment and staff between the two facilities. Additionally, the preferred site is directly across Groves Street from CFN. This adjacency will provide an unparalleled opportunity for collaborative research between two of the nation's premier science facilities.

13.2.2.3 Access, Traffic, Parking

The preferred site is bounded by Brookhaven Avenue on the north, Groves Street on the west and Fifth Street on the east. This configuration will provide easy access to all parts of the facility. The main entrance of the Central Lab Office Building will face the intersection of Brookhaven and Groves. Traffic into the primary facility parking lot will be from either of these roads, and a drop-off loop will be provided to the main entrance of the facility.

A Loop Road will be constructed around the outer perimeter of the building site. It will have access points from Brookhaven Avenue and Groves Street. The Loop Road will serve each of the Lab Office Buildings and also serve as the main service road around the site.

Each of the Lab Office Buildings will have an entrance serving the occupants of that building. Parking will be provided within convenient walking distance. Bicycle racks will also be provided near each building entrance.

Service vehicles will access the center of the Ring Building via a tunnel under the Ring Building. The tunnel will allow emergency vehicles as well as delivery of large equipment to enter the center of the ring. It will comply with NYDOT requirements and be 20 ft wide by 14 ft deep in height. The ramps in and out will have a slope not steeper than 12:1.

Pedestrian traffic will be accommodated by sidewalks between NSLS-II, CFN, and the existing NSLS buildings. Covered walkways or enclosed passages are envisioned between the Central Lab Office Building and both the Joint Photon Sciences Institute and the Guest House.

13.2.2.4 Vibration Survey

A pre-design vibration survey of the preferred building site was conducted by Colin Gordon Associates on June 14, 2006, with supplemental data collected on August 31 and September 1 [13.1]. The purpose of the survey was to evaluate the ability of the proposed NSLS-II building to meet the stated vibration criteria on the preferred building site. The site demonstrated no particular vibration characteristics that would adversely affect the performance of the NSLS-II scientific equipment. The results indicate that the preferred site is a "quiet" site vibrationally. A minimum 100 ft setback will be used between the building and both Brookhaven Avenue and Groves Street to minimize the vibration impact of passing traffic. Specific vibration criteria for the NSLS-II building are described in Section 13.3 Functional Requirements of this document.

13.2.2.4.1 Experimental Hall

Data were collected in mid-afternoon at six locations on the NSLS-II site and processed to obtain one-third octave band velocity spectra. The results indicate that the preferred site will easily meet vibration criteria VC-E but does not meet NIST-A criteria below a frequency of 5 Hz. It is believed that the low-frequency component which exceeds NIST-A is due to traffic, probably on the Long Island Expressway.

It is anticipated that the heavy floor slab of NSLS-II will reduce the amplitude at most frequencies, yielding a more favorable comparison to the criteria. Additional data was therefore taken on the floor slab of the nearby, partially constructed Center for Functional Nanomaterials in the late evening hours. The analysis indicates that the slab of CFN will meet NIST-A criteria during the nighttime hours. These data are thought to be representative of the eventual nighttime performance of the Experimental Hall in NSLS-II.

13.2.2.4.2 Accelerator Tunnel

To evaluate the Accelerator Tunnel, the survey data were transformed to displacement Power Spectral Density (PSD) spectra. This is the desired format for the storage ring vibration criteria. When calculated over the range of 4 to 50 Hz, the calculated R values do not meet the stated criteria of R less than 25 nm. However, it was noted that the data below 6 or 7 Hz was contaminated by system noise due to an instrument cable. If the criteria are modified slightly to calculate R from 6 to 50 Hz or from 8 to 50 Hz, and thereby eliminate the questionable data, the R values do generally meet the stated criteria of less than 25 nm.

Supplemental data collected in the CFN microscopy lab again validates the hypothesis that the heavy building slab will make a significant difference in the vibration data. Measurements taken at 7:30 pm and at 11:40 pm both yielded results that met the RMS amplitude criteria for NSLS-II of 25 nm. Again, it is anticipated that the improvement in vibration results due to the floor slab at CFN will translate to improvements in the NSLS-II data.

Overall, the vibration study indicates that following the installation of the floor slab for the Accelerator Tunnel and the Experimental Hall, which will significantly stiffen the site, the vibration environment will be comparable to that of other world-leading light source facilities.

13.2.2.5 EMI/RFI Survey

Pre-design electromagnetic interference surveys were conducted on June 14th and September 19th, 2006 by VitaTech Engineering, LLC [13.2]. Several types of measurements were taken to characterize the site:

- AC Extremely Low Frequency Electromagnetic Interference (ELF EMI)
- DC Electromagnetic Interference
- Radiofrequency Interference (RFI)

The site demonstrated no ambient electromagnetic or radio frequency interference that would adversely affect the performance of the NSLS-II scientific equipment. The nearby NWS Doppler radar facility does not appear to have a problematic effect with respect to RFI.

The site is generally undeveloped and therefore should be relatively free of large electromagnetic fields above the ambient background. Buried electrical power feeders running east-west along Brookhaven Avenue and north-south along Seventh Street are sources of EMI that need to be considered. The 100 ft building setback from Brookhaven Avenue will allow fields to largely decay without impacting the building performance. The feeder along Seventh Street will need to be relocated away from the building footprint.

13.2.2.5.1 AC ELF Electromagnetic Interference

AC ELF EMI fields are substantial along Brookhaven Avenue, due to the existing underground electrical feeders, ranging up to 3.36 mG. These flux densities drop off rapidly south of Brookhaven to approximately 0.1 mG at the 100 ft setback line and drop further to essentially zero beyond that point. Likewise, flux density peaks at approximately 0.4 mG above the buried electrical power lines at Seventh Street but drop off very rapidly to the east. As a point of reference, flux densities of up to 0.3 mG are acceptable for high-accuracy instruments such as TEMs, SEMs, and E-beam writers, which will be used in CFN.

13.2.2.5.2 DC Electromagnetic Interference

DC Electromagnetic Interference is caused by ferromagnetic masses in motion, typically objects such as elevators, trains, cars, buses, etc. There is a potential for DC EMI due to traffic along Brookhaven Avenue to the north of the site and along Fifth Avenue to the east. Analysis by VitaTech [13.2] indicates that between 40 ft and 130 ft south of Brookhaven, the DC fields will be such that instrumentation with dB/dt differential DC EMI resultant RMS thresholds between 1 mG and 0.1 mG will meet specification. Between 130 ft and 200 ft, instruments with a threshold of 0.1 mG to 0.01 mG will meet specification (197 ft is the predicted 0.01 mG isoline). Similar separation distances will apply to north–south traffic along Fifth Street.

13.2.2.5.3 Radiofrequency Interference

The RFI site measurements indicated very low electric field strength across a range of frequencies from 100 kHz to 18 GHz. The NEXRAD Doppler weather radar that is located only 2200 ft away operates at a frequency of 2877 MHz. The existing NSLS has experienced RFI impacts from the NEXRAD radar and has installed RF shielding around select laboratory and research areas to reduce the problem. A similar remediation approach will be used at NSLS-II if needed; shielding will be provided at the hutches based on scientific requirements rather than general shielding of the building.

Electric field strength RF levels were recorded on September 19, 2006 by VitaTech Engineering [13.2] at a point approximately in the center of the proposed NSLS-II site. Data over a broad spectrum of frequencies indicated elevated RF levels at a number of frequencies from various sources including the NEXRAD radar. In all cases, the electric field strength RF levels were below 1V/m, which is the typical threshold for scientific instrumentation.

13.2.2.6 Geotechnical Survey

A geotechnical survey of the preferred site was conducted in July of 2006 [13.3]. The explorations included 12 cone penetrometer test (CPT) soundings and four test borings. The results indicate that 2 to 12 in. of topsoil overlays medium dense and very dense sand, with pockets of fill in some locations near buildings and roadways. The sand deposit will work well for spread footings, and the existing fill material is generally suitable for use around the site and under the floor if compacted properly. Differential settlement is estimated to be less than 0.75 in. with footings designed for 2.5 tons psf and at least 3 ft wide.

Soils at the site are classified as Site Class D, “Stiff Soil Profile,” in accordance with the New York State Building Code. Specific data relating to the subsurface conditions are described in Section 13.3, Functional Requirements.

13.2.2.7 Topographical Survey

A topographical survey was conducted in June of 2006. The survey indicates that the preferred site is relatively flat and well suited for the NSLS-II building. Site elevation does vary from 10 ft above the Experimental Floor elevation to 6 ft below the finished floor; however, most of the site is near the proposed floor elevation. The level grade will minimize the requirement for cut and fill operations and will work to the benefit of potential future long beam lines extending up to 600 m onto the adjacent grounds.

13.2.2.8 Existing Site Utilities

Site utilities consist of electric, chilled water, steam, potable water, sanitary and storm sewer, and dry compressed air. Electrical power is wheeled to the site at 69 kV by the local electrical utility company (LIPA). This tie line has sufficient capacity for the NSLS-II loads. The other utilities are generated at BNL’s central utility plants and distributed underground for use throughout the site. The distribution systems for these utilities are of sufficient capacity to serve the NSLS-II complex; however, additional generating capacity is required for chilled water and cooling tower water. Additional chiller capacity and cooling tower capacity will be added at the existing central utility plant. A separate cooling tower system for process water cooling will be located near NSLS-II.

The most significant impact NSLS-II will have on the current BNL utility infrastructure is the central chilled water system, which is currently at maximum capacity and does not have spare capacity to meet the additional load of NSLS-II. As part of the NSLS-II project, additional chilled water capacity will be added to the existing central chilled water plant. Expanding the central chilled water plant in lieu of constructing dedicated local capacity provides advantages in reliability and reduced cost to the project [13.4].

Existing sanitary sewers are located parallel to and south of Brookhaven Avenue (6 in. VTP) and parallel to and west of Seventh Street (10 in. VTP). The system along Brookhaven Avenue can remain as is and the northerly and easterly Lab Office Buildings can be connected to this sewer line. The system along Seventh Street, which extends further south parallel to and east of Groves Street, must be relocated, as it conflicts with the proposed NSLS-II construction.

Preferred access and routing of utilities is along Brookhaven Avenue. Utilities along Brookhaven have adequate capacity and connection here enables routing of these utilities through a common utility vault or basement beneath the Ring Building floor and into the interior of the ring. This approach provides good access for maintenance while minimizing the effects of noise and vibration, compared to running utilities through the building.

13.2.2.9 Existing Facilities

BNL has an on-going program to remove excess facilities and consolidate operations from WW-II vintage wood structures into more permanent buildings. Consistent with this program, there is a project underway to relocate BNL warehousing, shipping, and receiving operations from the WW-II era buildings at the western edge of the proposed NSLS-II site. BNL will remove buildings and structures associated with these operations prior to construction of NSLS-II.

13.3 Functional Requirements

13.3.1 Codes and Standards

The latest edition of the codes, standards, orders, and guides referred to in this section will be followed. All work will be in accordance with BNL's Implementation Plan for DOE 413.3, "Program and Project Management for the Acquisition of Capital Assets."

13.3.1.1 DOE Orders

DOE O5480.4 – Environmental Protection, Safety and Health Protection Standards
DOE O413.3A – Program and Project Management for the Acquisition of Capital Assets
DOE O414.1C – Quality Assurance
DOE O420.1B – Facility Safety
DOE O420.2B – Safety of Accelerator Facilities

13.3.1.2 Codes, Standards, and Guides

Building Code of New York State (NYSBC) – 2002 Edition
Building Code Requirements for Structural Concrete (ACI 318-99)
Specification for Structural Steel Buildings – Allowable Stress Design and Plastic Design, 1989 Edition
BNL Standards Based Management System Subject Areas
New York State and Suffolk County Department of Health Codes
American Concrete Institute
American National Standards Institute
ANSI 117.1 Accessible and Useable Buildings and Facilities
American Society of Mechanical Engineers
American Society for Testing Materials Standards
American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE) Design Guidelines
ASHRAE Standard 90.1-2001 Energy Standards for Buildings Except Low-Rise Residential Buildings
American Water Works Association
American Welding Society
ANSI/ASHRAE Standard 62-2001 Ventilation for Acceptable Indoor Air Quality
ANSI/AIHA Z9.5-1992 Standards for Laboratory Ventilation
ANSI/ASHRAE 110-1985 Method of Testing Performance of Laboratory Fume Hoods
Factory Mutual
ICEA Insulated Cable Engineering Association
Industrial Control Standards (NEMA)
IEEE Institute for Electrical and Electronic Engineers
IEEE C2-1997 National Electric Safety Code (NESC)
IES Illuminating Engineers Society
Mechanical Code of New York State
National Institute of Standards and Technology
National Electrical Code (NFPA 70 2005)
Standard for Electrical Safety in the Workplace (NFPA 70E)
National Fire Protection Association (NFPA) Standards
Sheet Metal and Air Conditioning Contractors' National Association (SMACNA) Standards for Ductwork Design
Occupational Safety and Health Administration (OSHA)

Underwriters Laboratory
New York State Plumbing Code - 2002 Edition
New York State Fire Prevention Code - 2002 Edition
Energy Conservation Code of New York State - 2002 Edition
Americans with Disabilities Act Accessibility Guideline (ADAAG)
Leadership in Energy and Environmental Design (LEED) 2.2
LEED for Labs

13.3.2 Code Analysis

A Preliminary Life Safety Code Analysis has been prepared and is available as a Technical Reference [13.5].

13.3.3 Site/Civil

13.3.3.1 Existing Conditions

A current topographical survey was conducted in June 2006. The survey drawing identifies 1 ft contours and major surface features. It will be the basis for the site/civil design.

The proposed construction site is relatively level with mostly open field previously used as recreational fields. As indicated on Figure 13.3.1, there are warehouse buildings on the western edge of the site that are in the process of being removed under a separate BNL project (see section 13.2.2.9). There are some trees in the developed footprint that will require removal. Additionally, there is a railroad spur running parallel to Groves Street that enters the site from the south that will be cut back to a point outside the developed footprint of the facility. This rail spur will be available for use during construction for delivery of bulk materials if needed. The tree removal and cut back of the railroad spur are part of the NSLS-II site preparation work.

Site storm drainage is available along the western edge of the site however, consistent with sustainable design principles, on-site recharge will be maximized with only overflow conditions going to the existing storm drainage system.

13.3.3.2 Site Utilities

The following site utilities are available at or near the site and will used for the NSLS-II facility:

- Potable water
- Sanitary sewer
- Storm drain
- Chilled water
- Steam and condensate
- Compressed air
- Electrical power
- Telephone/data
- Fire alarm

13.3.3.2.1 Potable Water

Existing potable water lines are located around the perimeter of the site as follows:

- Along the north side of Brookhaven Avenue (12 in. and 10 in. TRANS [“Trans.”])
- Parallel to and west of Seventh Street (8 in. Trans.) and extending south beyond the NSLS-II site

- Parallel to and east of Groves Street (8 in. Trans.)

The 8 in. line west of Seventh Street will need to be relocated around the footprint of the building. Connection of fire protection water and domestic water for the NSLS-II loop system will be from the relocated 8 in. line west of Seventh Street and the 12 in. line at Brookhaven Avenue and North Sixth Street.

13.3.3.2.2 Sanitary

Existing sanitary sewer lines are adjacent to the site on two sides. A six in. VTP line parallels Brookhaven Avenue on the north of the site and a 10 in. VTP west of Seventh Street meets with the 6 in. line at MH-163. The sanitary line then crosses Brookhaven to a 20 in. VTP line. The NSLS-II will connect to the 6 in. line from the CLOB and one LOB. The remaining services will be routed to a new underground pumping station and pumped into the 10 in. VTP line.

13.3.3.2.3 Storm Water

Storm water drainage will be provided for on site. Retention ponds will be utilized to the maximum extent practicable as encouraged by the LEED standard. Any excess storm water will utilize existing drainage structures.

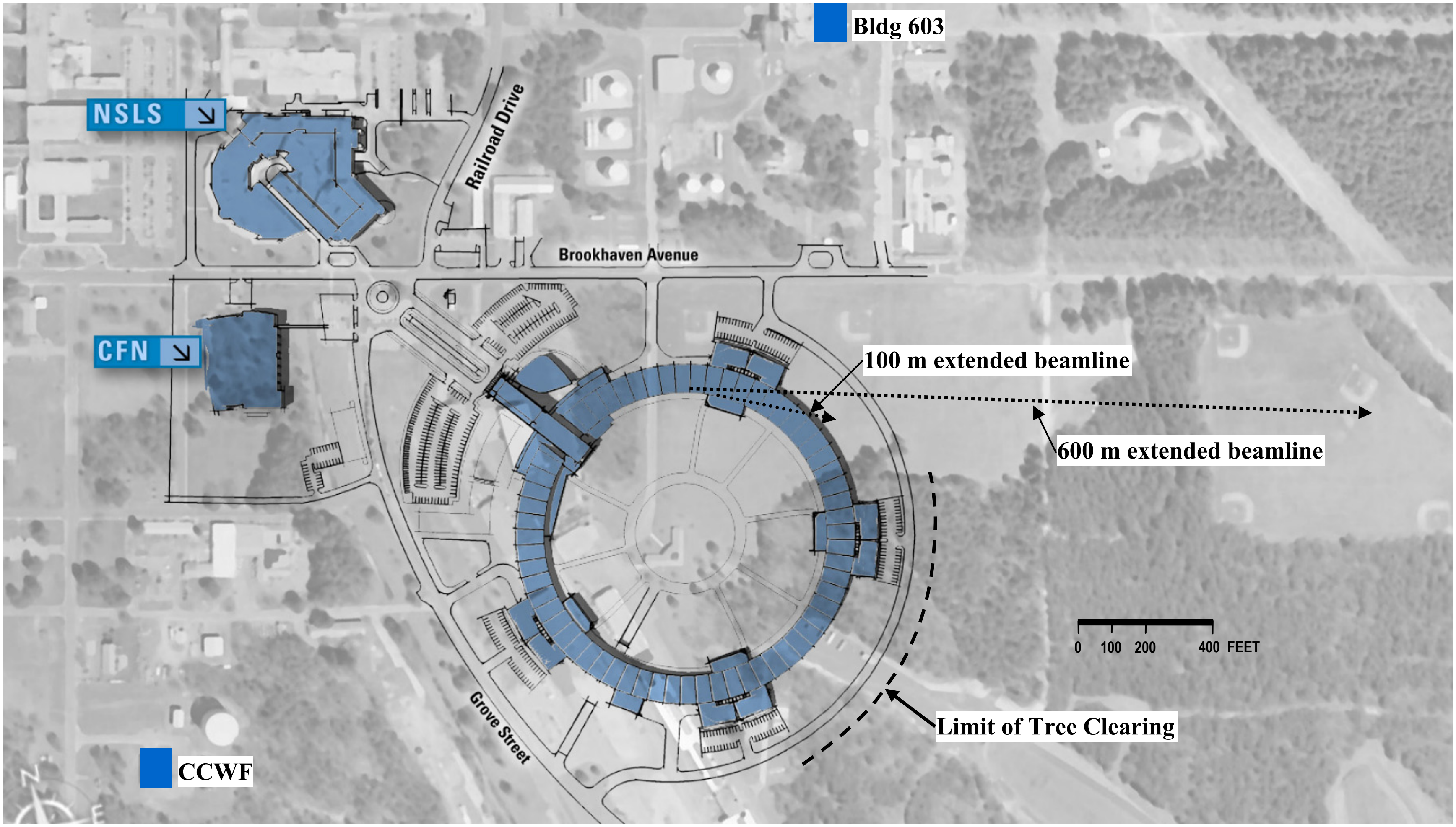

Figure 13.3.1 Proposed construction site for NSLS-II, showing existing conditions, including the limit of tree clearing required, and the locations of the BNL Central Chilled Water Facility (CCWF) and the Bldg 603 Electrical Substation that will supply chilled water and electrical power, respectively, to NSLS-II. Examples of possible extra long beamlines, extending outside the Ring Building, with lengths of 100 m and 600 m are also shown.

13.3.3.2.4 Chilled Water

Chilled water is a sitewide distributed utility. The NSLS-II project will tie into existing site chilled water at Rochester Street. A 24 in. chilled water supply and return header will be routed underground to the Ring Building and pass under the ring through the traffic access tunnel.

13.3.3.2.5 Steam & Condensate

A 10 in. steam line and a 4 in. condensate line are located just north of Brookhaven Avenue. The NSLS-II system will connect to these lines at MH-47.

13.3.3.2.6 Compressed Air

Compressed air is a sitewide distributed utility. The NSLS-II project will tie into existing site compressed air at Brookhaven Avenue. A 3 in. compressed air line will be routed underground to the Ring Building and pass under the ring through the traffic access tunnel.

13.3.3.2.7 Electrical Power

For a description of electrical site utilities, see Section 13.3.8, Electrical Engineering.

13.3.3.2.8 Telephone / Data

For a description of telephone and data utilities, see Section 13.3.8.14.2, Telephone and Data Communications.

13.3.3.2.9 Fire Alarm

For a description of fire alarms, see Section 13.3.8.14.1, Fire Alarm System.

13.3.4 Architecture

13.3.4.1 Building Envelope

The building envelope will be designed to meet at a minimum the prescriptive requirements of the Energy Conservation Code of New York (ECCNY). Brookhaven National Laboratory is located in Climate Zone 11B of the ECCNY. The thermal design parameters for envelope elements are dependent on the ratio of fenestration to overall wall area. The Ring Building has a window-wall ratio of less than 10 % and the LOBs and the CLOB have window-wall ratios greater than 10%. This ratio affects the prescriptive requirements of the ECCNY, as shown in Tables 13.3.1 and 13.3.2. Window to wall ratios of 0 to 10% are considered low fenestration area buildings and ratios or 25 to 40% are high fenestration area buildings.

Table 13.3.1 R-Values for High Fenestration Area Buildings – ECCNY

Building Component	Prescriptive R-Value
Exterior wall	R-11
Exterior wall below grade	R-11
Glazing	R-2 (U=0.5)
Roof (continuous insulation)	R-24
Slab on grade edge	R-8

Table 13.3.2 R-Values for Low Fenestration Area Buildings – ECCNY

Building Component	Prescriptive R-Value
Exterior wall	R-11
Exterior wall below grade	R-11
Glazing	No requirement
Roof (continuous insulation)	R-19
Slab on grade edge	No requirement

More stringent criteria will be used in most locations as required to meet the temperature stability performance of the building and to help achieve sustainability (LEED) goals. Targeted design R-values for wall and roofing systems are significantly higher than the prescriptive values shown above:

- Target R-value for Exterior wall system R-20
- Target R-value for Roofing system R-30

13.3.4.2 Building Occupancy

NSLS-II will be in operation 24 hours a day, 7 days a week; however, occupied hours for most staff are 8:00 AM to 5:00 PM. The overall building will be classified, per the Building Code of New York State, as a Business (“B”) Occupancy. The anticipated populations of the various areas are shown in Table 13.3.3:

Table 13.3.3 Building Office Capacity

Building	Population
Central Lab Office Building	190
Ring Tunnel	0
Lab Office Building 1	30
Lab Office Building 2	30
Lab Office Building 3	30
Lab Office Building 4	30
Linac Building	0
RF Building	0

13.3.4.3 Parking

Parking will be provided for the Central Lab Office Building and for each of the four Lab Office Buildings. Each LOB will have one parking space for each occupant and 10 additional spaces for visitors. The CLOB will provide one parking space for each employee plus 80 visitor spaces to accommodate day-to-day visitors and seminar participants. Parking for the future JPSI and Guest House is allocated for future paving. A drop-off loop will be provided to the entrance of the CLOB. Each parking lot will be barrier free and provide the required number of ADA-compliant parking spaces to meet current LEED requirements. Requirements for parking spaces are as shown in Table 13.3.4.

Table 13.3.4 Parking Requirements.

Building	Parking Spaces
Central Lab Office Building	280
Future JPSI*	*120*
Future Guest House*	*52*
Lab Office Building 1	40
Lab Office Building 2	40
Lab Office Building 3	40
Lab Office Building 4	40
Total	612
*Not part of NSLS-II Project	

13.3.4.4 Vibration Criteria

The vibration limits of the Experimental Hall are those criteria associated with the user-supplied research instruments, which are not well defined at this time. Therefore, the vibration requirements of this space will be established to meet general vibration criteria for similar physical science research centers. The vibration requirements of the vast majority of research equipment available today would be satisfied by a floor meeting vibration criterion VC-E or the more stringent NIST-A. The NIST-A criterion is more stringent than VC-E at frequencies less than 20 Hz. A minimum target of VC-E will be established for the Experimental Hall.

The vibration requirements for the accelerator tunnel have been provided in a much different manner. The storage ring is most sensitive to frequencies in the range of 4 to 50 Hz. The criterion for the storage ring vibration is defined in terms of R, the area beneath the power spectral density (PSD) spectrum $\Delta(f)$, between cutoff frequencies f_1 and f_2. The RMS amplitude, R, is to be less than 25 nm. R is defined as

$$R = \sqrt{\sum_{f_1=4}^{f_2=50} \Delta(f) \times \delta f}$$

where $\Delta(f)$ is the displacement power spectral density spectrum (in units such as m^2/Hz, where the frequency term in the denominator is the measurement bandwidth) and δf is the frequency resolution of the spectrum, 0.25 Hz. The lower and upper bounds of the summation are 4 and 50 Hz, respectively. Frequency components outside this range may be neglected.

13.3.4.5 Noise Criteria

The facility will have two primary groups of noise sources: 1) the facility's mechanical systems, such as air handlers, and 2) the user-provided research equipment. The noise control associated with the first group is within the purview of the NSLS-II design team, but the ability to mitigate noise associated with the second group is somewhat limited. It can be anticipated via passive room noise control measures incorporated into the design, but it cannot be controlled via mechanical constraints such as airflow velocities, fan selection, or silencers, concepts typically employed for the first group.

Studies carried out during the design of the Advanced Photon Source determined that final operational room noise in the Experimental Hall would be a mix of sound from both groups of sources, and that NC-60 to NC-65 would be achievable from a combination of mechanical system noise control measures on the proposed air handling system and room absorption incorporated into walls and ceiling. This is the noise range found in many industrial cleanrooms. In the absence of absorptive material, the noise at APS was predicted to be on the order of NC-70. NSLS-II will utilize absorptive material and appropriate mechanical system design to achieve NC 60-65.Noise Criteria (NC) level guidelines for other spaces in the facility will be as shown in Table 13.3.5.

Table 13.3.5 Acoustic Noise Criteria.

Space Type	Noise Criteria (NC) Level
Office	35–40
Laboratory	45–50
Conference rooms	30
Interaction space	40
Common use areas	40–45
Accelerator tunnel	None
Experimental Hall	60–65
Mechanical / electrical rooms	Per OSHA
Seminar room	30

13.3.4.6 EMI / RFI Criteria

No universal EMI/RFI design criteria has been established for the NSLS-II facility, although individual beamlines or experiments may have specific requirements. Shielding, if required will be the responsibility of the researcher at the individual beamline or laboratory.

13.3.5 Functional Program

Adjacencies of the various functional areas within the NSLS-II complex have been established through detailed discussions with the user groups. These groups include the Accelerator Team, the Experimental Team, Facilities Engineering, Environmental Safety & Health, Maintenance, and Management.

The Ring Building and LOBs will be divided into four Control Areas to safely accommodate a range of chemicals and hazardous gases that may be used within NSLS-II. These CAs are as follows:

- CA 1 –Ring Building and the Linac/RF Building
- CA 2 –Lab Office Building 1
- CA 3 –Lab Office Building 2
- CA 4 –Lab Office Buildings 3 and 4

The Central Lab Office Building will be considered a second fire area zone. It will be separated from the Ring Building by fire wall construction meeting the New York State Building Code Section 707. This allows the CLOB to have an additional four control areas on its first floor separate from those in the Ring Building and LOBs.

The control areas will be separated from each other with a fire-rated barrier wall. There will also be storage rooms located near LOB 1 that are classified as H Occupancies for Hazardous Chemical and Gases that exceed the quantities allowed by the Building Code of New York State under “B” occupancy. The amount of gas and chemicals allowed per control area is provided in Tables 13.3.6 and 13.3.7.

Table 13.3.6 Allowed Quantities of Hazardous Gas.

Gas Type	Allowed Storage	Allowed Usage
Flammable	2,000 ft^3	2,000 ft^3
Pyrophoric	100 ft^3	20 ft^3
Highly toxic	40 ft^3 (in approved cabinets)	40 ft^3
Toxic	1,620 ft^3	1,620 ft^3
Oxidizing	3,000 ft^3	3,000 ft^3

Note: Quantities include all allowed increases for building automatic sprinkler system.

Table 13.3.7 Allowed Quantities of Hazardous Chemicals.

Gas Type	Allowed Storage	Allowed Usage
Flammable Class 1-B	240 gal	120 gal
Flammable Class 1-C	360 gal	180 gal
Combined Flammables	480 gal	240 gal
Water Reactive Class 1	No Limit	No Limit
Water Reactive Class 2	20 gal	10 gal
Oxidizer Class 1	800 gal	400 gal
Oxidizer Class 2	20 gal	50 gal
Oxidizer Class 3	4 gal	0.5 gal

Note: Quantities include all allowed increases for building automatic sprinkler system.

Relationships between the areas will meet the requirements outlined in the following sections.

13.3.5.1 Ring Tunnel

- Requires access from the Ring Building infield for tunnel equipment installation.
- Shielding is required on the inboard, outboard, and top of the ring tunnel. This can be achieved with high-density concrete, normal weight concrete, or soil. This can also be achieved with a combination of materials.
- Access from tunnel to active beamlines is not a requirement but may be desirable in some applications.
- Storage ring and booster ring power supplies will be located on the tunnel mezzanine directly above the ring tunnel.
- Easy access from the CLOB control room to the ring tunnel is desirable.
- Access from the Experimental Floor to the ring mezzanine will be from stairs or ships ladders running parallel to the interior ring tunnel ratchet wall at locations where there is no active beam line.
- Walls of the ring tunnel must provide radiation shielding from the rest of the facility.

13.3.5.2 Experimental Hall and Access Corridor

- The Experimental Hall will have 30 sectors (a sector includes a straight section and the adjacent bending magnet) and must accommodate 25 to 30 60 m insertion device beamlines and hutches and another 25 to 30 bending magnet beamlines..
- The Experimental Hall must be able to accommodate future beamlines that will extend outside the building.
- Floor height with respect to the tunnel must allow beamlines to be 1.4 meters above the finished floor in the Experimental Hall. The floor must be constructed to limit differential settlement, as the beamlines must be maintained at 1.4 meters along their entire length.
- The Experimental Hall must have line-of-sight portals into the tunnel for beamline set-up.
- A perimeter access corridor for equipment and personnel access to the beamlines is required. A continuous trench drain between the access corridor and the Experimental Floor is provided for water removal, in lieu of floor drains in the Experimental Floor.
- Beamlines must have easy access to nearby LOBs and CLOB.
- The access corridor should provide space for informal interaction between researchers.

13.3.5.3 Central Lab Office Building

- The CLOB needs a seminar room for approximately 400 people and adjacent breakout rooms.
- It should provide visitors viewing gallery overlooking the Experimental Floor.

- The control room, operators' offices, small conference room, and computer room should be grouped together on the second floor with easy access to the RF/LINAC and Ring Tunnel areas.
- Provision for future enclosed access should be provided to both the Joint Photon Sciences Institute building and the Guest House.
- HVAC for the CLOB will be by penthouse air handling units.
- The CLOB should have an entry lobby for displays and a reception area for new users and guests.

13.3.5.4 Lab Office Buildings

- Laboratory space and offices should be near to their respective beamlines.
- Each LOB needs an entrance and parking lot to accommodate 40 cars.
- Individual laboratories in the LOBs should have access to the Experimental Hall through double doors.
- Informal interaction space should be provided in each LOB, as well as a conference room.
- Laboratory space within a LOB will be shared by all six sectors using the LOB.
- Laboratories will require chemicals and gases to be delivered to them. Provision for delivery and storage of these materials is required. A high hazard storage area is provided in LOB-1.
- LOBs must be configured to allow for future expansion requiring additional labs and offices.
- Each LOB will have an at-grade loading area.
- Each LOB will have a gas bottle storage area.
- HVAC for the LOBs will be air handling units in each LOB mechanical room.
- Each LOB will have at least one HEPA-filtered laboratory fume hood for working with nanomaterials.

13.3.5.5 Service Buildings

- Service buildings will house mechanical and electrical equipment supporting the Ring Building and must therefore be equally spaced around the interior side of Ring Building.
- Service buildings require access for large equipment moves.
- Access to the ring tunnel for both equipment and personnel will be provided through the service buildings from both the tunnel mezzanine and the Ring Building infield.
- Service buildings must be located so utilities can be easily and efficiently routed to them.

13.3.5.6 Linac/RF Buildings

- The Linac /RF Building must be adjacent to the ring tunnel.
- The Linac area must be shielded due to radiation during linac operation.
- The Linac area floor should be elevated to enable Linac to Booster alignment
- The RF area must have a shielded test area
- The RF area must have a small cryo equipment enclosure nearby (but separate for vibration isolation) and concrete pad for associated Helium storage tanks

13.3.6 Structural Engineering

13.3.6.1 Codes and Standards

Refer to Section 13.3.1, Codes and Standards..

13.3.6.2 Soil Conditions

13.3.6.2.1 Laboratory Testing

A geotechnical study of the proposed NSLS-II building site was performed which included 16 grain size distribution analyses on soil samples recovered from the test borings [13.3].

13.3.6.2.2 Subsurface Conditions

The subsurface explorations encountered up to 6 ft of fill overlying a sand deposit that extends to more than 100 ft deep. Subsurface conditions consist of topsoil lying above a layer of fill which is over a thick layer of stratified sand.

Topsoil ranging in thickness from 2 to 12 in. was encountered in borings drilled in landscaped areas. Topsoil was not encountered in borings drilled in paved/developed areas.

Each of the borings encountered fill ranging in thickness from 3.3 to 7 ft. This fill is characterized as silty sand. Several explorations experienced refusals, indicating buried objects within the fill.

A layer of stratified sand, sand with silt, and sand with gravel was encountered below the fill in all of the borings and CPT soundings. The sand is light brown to brown, with density ranging from medium dense to very dense.

Subsurface explorations were terminated within the sand at maximum depths of about 100 ft. A 1999 report on the stratigraphy and hydrogeologic conditions at the lab prepared by the United States Geologic Survey refers to the sand as the "Upper Glacial Aquifer," and states that the thickness at BNL is about 185 ft. Confining clay units and additional sand and gravel aquifers overlie bedrock, which reportedly occurs at a depth of about 1,500 ft.

The depth to groundwater appears to range from about 23 to 37 ft below ground surface, depending on the location at the site. This is based on the boring and CPT observations, as well as data collected in 2003 for CFN.

Soils at the site are classified as Site Class D, a "Stiff Soil Profile," in accordance with Table 1615.1.1 of the New York State Building Code. This class is based on the shear wave velocity measurements in the CPT soundings and SPT N-Values in the test borings. The soils are not considered susceptible to liquefaction.

It is recommended that foundations be designed as spread footing foundations with slab-on-grade floors. Fill should be removed below footings so they bear directly on the sand deposits. Recommended bearing pressure is 2.5 tons psf on footings at least 3 ft wide.

The site contours indicate that the Experimental Hall floor will range from 9 ft below grade to 6 ft above grade. Floors are well above groundwater levels encountered in the explorations. It is recommended that the slab-on-grade floors bear on a minimum of 6 in. of compacted structural fill placed over the natural sand deposit or suitable existing fill that has been compacted. Adequate densification should be accomplished using a heavy roller for both the native sand as well as the structural fill. This will provide a base for the Experimental Hall floor and should yield a low differential settlement when combined with the floor slab design.

13.3.6.3 Building Design Loads

The building structure will be designed based on the following building load conditions.

Table 13.3.8 Live Loads

Location	Load (psf)
Laboratories	125
Experimental Hall	250 (to be confirmed in final design)
Ring Tunnel	250 (to be confirmed in final design)
Tunnel mezzanine	125
Ring Building access corridor	125 (or wheel loads from fork lift trucks)
Corridors	100
Stairs and lobbies	100
Offices	100 (includes 20 psf for partitions)
Light storage areas	125
Mechanical rooms	150 (or actual weight of equipment)

Table 13.3.9 Building Snow Loads

Factor	Value
Ground snow load Pg	45
Snow importance factor I	1.1 for Central Lab Office Building and Conference Center
	1.0 for all other buildings
Snow exposure factor Ce	0.9 for Ring Building
	1.0 for all other buildings
Thermal Factor Ct	1.0
Design snow load	30 psf (min) + Drift where applicable

Table 13.3.10 Building Wind Loads

Factor	Value
Basic wind speed (3-sec gust)	110 mph
Wind load importance factor	1.15 for Central Lab Office Building and Conference Center
	1.00 for all other buildings
Wind exposure	B

Table 13.3.11 Building Earthquake Loads

Factor	Value
Short-period acceleration Ss	0.25 g
1 sec period acceleration S1	0.08
Site Class	C
Seismic Use Group	II for Central Lab Office Building and Conference Center
	I for all other buildings
Seismic Design Category	B
Seismic Importance Factor IE	1.25 for Central Lab Office Building
	1.00 for all other buildings

13.3.7 Mechanical Engineering

13.3.7.1 Codes and Standards

Refer to Section 13.3.1, Codes and Standards.

13.3.7.2 Mechanical Systems

The NSLS-II facility will require the following mechanical systems:

Table 13.3.12 Mechanical Systems.

Mechanical Utility	Central Lab Office Bldg	Experimental Hall	Tunnel Mezzanine	Service Bldg	Linac / RF	Lab Office Buildings
HVAC	■	■	■	■	■	■
General exhaust	■	■	■	■		■
Chilled water	■	■		■	■	■
Process Cooling Tower water		F		■		
Steam and condensate	■			■		■
Heating water	■			■	■	■

F= Future

13.3.7.3 Outdoor Design Conditions

Outdoor design conditions are based on the 2005 American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE) Fundamentals Handbook. Data are for LaGuardia Airport, New York and is the same criteria used for the adjacent CFN building on the BNL campus.

Elevation: 82 Ft

Weather Data – Summer:

Design Dry Bulb: 95°F
Design Wet Bulb: 76°F

Weather Data – Winter:

Design Dry Bulb: 0°F
Wind Speed: 15 mph

13.3.7.4 Indoor Design Conditions

Office Space

Cooling: 75 deg F +/- 5 deg F; 50 % RH ±10 % RH
Heating: 72 deg F +/- 5 deg F; 30 % RH ±10 % RH

Laboratory Space

Cooling: 75 deg F +/- 5 deg F; 50 % RH ±10 % RH
Heating: 72 deg F +/- 5 deg F; 30 % RH +/-10 % RH

Ring Tunnel

Cooling: 78 deg F +/- 0.18 deg F; 50 % RH ±10 % RH
Heating: 78 deg F +/- 0.18 deg F; 30 % RH ±10 % RH

Experimental Hall

Cooling: 75°F ±1°F; 50% RH ±10% RH
Heating: 75°F ±1°F; 30% RH ±10% RH

Linac Building

Cooling: 75°F ±1°F; 50% RH ±10% RH
Heating: 72°F ±1°F; 30% RH ±10% RH

RF Building

Cooling: 75°F ±1°F; 50% RH ±10% RH
Heating: 72°F ±1°F; 30% RH ±10% RH

13.3.7.5 Facility Cooling Load

Cooling loads for the facility can be broken down between loads cooled by the HVAC air cooling systems and the process cooling water systems, as shown in Table 13.3.13.

Table 13.3.13 Estimated Cooling Load.

	Heat Rejection to HVAC Units (Tons)	Heat Rejection to Process Cooling Water (Tons)
Ring tunnel	98	281
RF Building	160	238
Linac Building	6	10
Cryo Building	10	138
Tunnel mezzanine	374	267
Experimental Hall	1156	0
Lab Office Buildings	237	0
Central Lab Office Building	170	0
Total Load	**2211**	**934**

13.3.7.6 Existing Utilities

Sitewide utilities are distributed throughout the BNL campus and will be used for the NSLS-II facility. These utilities are available as follows:

Table 13.3.14 Existing Utilities.

Utility	Pressure (psig)	Temperature (F)
Potable water	60-70	N/A
Chilled water supply	60-100	45
Chilled water return	40	57
Steam	125	353
Compressed air	100	N/A
Sanitary sewer	N/A	N/A

13.3.7.7 Ventilation

- Outside air will be supplied to all spaces in accordance with the requirements of ASHRAE Standard 62.1-2004.
- Supply air for dry laboratories will be sized to meet the HVAC thermal load.

- Wet laboratories airflow will be once through, 100% exhausted. Supply air will be determined to meet the worst case of the following:
    - Fume hood or other exhaust requirements
    - Thermal load of the space
    - Minimum of twelve air changes per hour
- Supply air to the ring tunnel will be designed to meet the temperature stability requirements, but not less than six air changes per hour.
- The experimental hall's air flow requirements will be based on the temperature stability requirements of the space, but not less than six air changes per hour.
- Locker and shower rooms will receive twelve air changes per hour and will be 100% exhausted.

13.3.7.8 Chemical Fume Hoods

Chemical fume hoods will be designed for a maximum airflow based upon a 100 fpm air velocity with the sash open to 18 in. height. The Laboratory HVAC system will be a constant volume design utilizing air valves. Fume hoods identified for nanomaterials research will be provided with bag-in bag-out HEPA filtration rated at 99.9995% efficiency, with gel seal type filter housing. At least one such hood will be furnished for each LOB. Wet laboratories will also be provided with ventilated chemical storage cabinets integral to the fume hood.

13.3.7.9 Radioisotope Fume Hoods (if required)

Radioisotope fume hoods will be designed for a maximum airflow based upon a 100 fpm air velocity with the sash open to 18 in. height. They will have bag-in-bag-out HEPA filtration equipment on the exhaust.

13.3.7.10 Bio-Safety Cabinets

The need for these is yet to be determined.

13.3.7.11 Building Pressurization

- The NSLS-II building will be maintained at a positive pressure to minimize infiltration of outside air into the facility. Specific areas within the facility will have pressurization that is positive or negative with respect to this building baseline pressure.
- The ring tunnel will be maintained at a positive pressure with respect to the building baseline pressure.
- Laboratories will be maintained at a negative pressure with respect to their surrounding corridors or adjacent spaces.
- Experimental hutches on the beamline floor may be positive or negative to the experimental floor depending on specific requirements of each experiment. An ESH review will be performed for each beamline experiment to determine the appropriate air balance for the application.
- Toilets, locker rooms, and showers will be maintained at a negative pressure with respect to their adjacent corridors.

13.3.7.12 Supply Air Filtration

All air handling units will have 30% pre-filters. Air handling units serving the ring tunnel, experimental areas, and laboratories will have 95% final filters upstream of the cooling coils. Special filtration requirements for experimental hutches are not included in the base construction.

13.3.7.13 Vibration Isolation

Vibration isolation will be required for some mechanical equipment in order to meet the vibration requirements of the accelerator and beamline experiments. Rotating equipment such as air-handling units, pumps, fans, compressors, etc., are of particular concern and will be isolated. Additionally, large ductwork and piping systems will also require isolation. Specific strategies for isolation are included in the vibration consultants' report [13.1]

13.3.7.14 Process Systems

Process systems are those systems that are provided primarily to support the experimental equipment rather than the building itself. The NSLS-II accelerator, beamlines, and laboratories will require the following Process systems.

Table 13.3.15 Process Systems.

Process System	Central Lab Office Bldg	Experimental Hall	Tunnel Mezzanine	Service Bldg	Linac / RF	Lab Office Buildings
Gaseous nitrogen	■	■	■			■
Liquid nitrogen		■			■	
Compressed air	■	■		■		■
DI water - consumable	■					■
DI water make-up				■		
Process cooling water - Cu		■	■			
Process cooling water - Al			■			

13.3.7.15 Plumbing Systems

The NSLS-II facility will require the following plumbing systems:

- Domestic cold water
- Domestic hot water
- Sanitary sewer
- Tempered water (for emergency eye wash and shower)

These services will be distributed within the CLOB, the LOBs, the Experimental Hall, and the Linac and RF Buildings.

13.3.7.16 Fire Protection Systems

All of the NSLS-II buildings will be protected by wet pipe automatic fire sprinkler systems. Fire detection and alarms will be provided as described in the Electrical section of this document. The NSLS-II facility will require the following fire protection systems:

- Fire water
- Automatic fire sprinklers

13.3.8 Electrical Engineering

13.3.8.1 Codes and Standards

Refer to Section 13.3.1, Codes and Standards.

13.3.8.2 Utilization Voltages

- 13,800 V, 3-phase, 3-wire, grounded wye, 60 Hz:
  - site distribution
- 480Y/277 V, 3-phase, 4-wire, 60 Hz:
  - lighting
  - motors greater than or equal to ½ HP
  - selected pieces of equipment
- 208Y/120 V, 3-phase, 4-wire, 60 Hz:
  - receptacles
  - motors less than ½ HP
  - selected pieces of equipment

13.3.8.3 Utilities

13.3.8.3.1 Relocation and/or Demolition of Existing Utilities

The extent of electric and communication utilities to be relocated and/or demolished shall be based on a utility survey and the final building footprint. In general, all existing utilities under the building footprint shall be relocated if active or removed if inactive. Inactive utilities outside the footprint may be abandoned in place.

13.3.8.3.2 Power

Building 603 Substation Expansion

The existing campus substation at Building 603 located near the intersection of Cornell Avenue and North Sixth Street, has adequate 69 kV power capacity but does not have adequate transformation capacity to 13.8 kV to serve the currently estimated loads of the NSLS-II project, and will require upgrading. Upgrades of additional 66 kV/13.8 kV transformers and related switchgear are required.

The existing substation yard includes 69 kV overhead structure with two incoming utility lines, three 20.0/26.7/29.9 MVA 66.0/13.8 kV transformers, and space for one additional transformer. Inside Building 603 are the 15 kV metal-clad switchgear lineups for Bus 1, Bus 2, and Bus 3.

The upgrade shall include modifying the existing 69 kV support structure, and providing a new 69 kV SF6 breaker, and a 20.0/26.7/29.9 MVA 66.0/13.8 kV transformer, 2000 A 15 kV overhead busway, and 15 kV SF6 metal-clad switchgear within Building 603, to be designated Bus 0. A new fire separation wall shall be provided between the existing transformer #3 and the new transformer.

There is not adequate space within Building 603 to house the new switchgear. Therefore, the building will require modification and expansion to house the new gear.

The new switchgear shall include a main breaker, three tie breakers to connect to Bus 1, Bus 2, and Bus 3, one outgoing breaker to feed the NSLS-II project.A new tie breaker at each of the existing Bus 1, Bus 2, and Bus 3 switchgear lineups will connect to Bus 0.Each new breaker shall be provided with relaying, metering, and communication for remote monitoring and control.

Campus Distribution

The existing campus manhole and ductbank system has two spare 5 in. ducts between Building 603 and the NSLS-II site which can be utilized to route a new 800A 15 kV feeder from the Bus 0 switchgear to manhole MH-E5 via manholes MH-E1, E2, E3, E4, and E5 along North Sixth Street. The feeder shall consist of two sets of 3-1/c, 1000 kcmil, 15 kV, 100% EPR copper conductors. A redundant feeder may be provided in the future. This future feeder will require a new ductbank to be installed.

13.3.8.3.3 Telephone and Data Communications

Copper service is available at Building 537 at the northwest corner of the NSLS-II site. New cable may be routed in the existing ductbank to manhole MH-84 via MH-85. A new four-way 4 in. ductbank will be provided from MH-84 to the NSLS-II BDF (building distribution frame) within the CLOB.

Fiber service is available at Building 515 near the intersection of Brookhaven Ave and Rochester Street New cable may be routed in the existing manhole and ductbank system from Building 515 to the existing manhole MH-84 at the NSLS-II site via manholes MH-14B, 14H, 87, 86, and 85. The new cable may share the same new four-way 4 in. ductbank with the copper service cable from MH-84 to the NSLS-II BDF.

13.3.8.3.4 Street Lighting

Street lighting will be provided along Brookhaven Avenue and Groves Street from their intersection to the last vehicle entry point into the site.

13.3.8.4 Normal Power Distribution

The on-site normal power distribution system shall be configured in a primary selective scheme which will be fully utilized once the future redundant feeder is provided.

An eight-way 5 in. concrete-encased ductbank will be provided between MH-E5 and a new manhole within the Ring Building. Infield from this manhole, a six-way 5 in. concrete-encased ductbank will be provided clockwise and counterclockwise around the infield to each substation. Two sets of 3-1/c, 1000 kcmil, 15 kV, 100% EPR copper conductors will be provided from MH-5E to the “A” switch of each substation. A 480 V feeder utilizing one active and one spare 4 in. duct will be provided from Switchgear #1 to the process cooling tower facility on the north side of Brookhaven Avenue via MH-E5B, E5A, E5, and E4.

The feeder shall have the capacity to support 6000 kVA of additional load at the RF Building, which would be required if the storage ring were upgraded in the future to operate at an energy of 3.6 GeV. At this time, installation of supporting infrastructure shall be limited to the 15 kV primary feeder. All associated substations, switchgear, and distribution needed for operation at 3.6 GeV would be provided in the future.

Each substation shall include an outdoor metal enclosed switchgear close coupled to a 13,800-480Y/277 V 2000, 2500, or 3000 kVA oil-filled substation type transformer with a secondary air terminal section. The primary switchgear shall consist of two key-interlocked duplex load interrupter switches in series with one set of fuses. Each transformer shall be triple rated 55˚ OA, 65˚ OA, and 65˚ FA. A ductbank and secondary feeder shall be extended to 480 V switchgear located in the electrical room of each service building.

13.3.8.5 Emergency Power Distribution

Two on-site diesel generators will provide emergency and optional standby power during interruptions of the normal power distribution system. Each generator shall be provided with a weatherproof, reach-in, sound attenuated enclosure.

Fuel oil storage capacity shall provide 12 hour full-load operation and may be stored in a double wall, sub-base fuel tank with remote alarm panel. The fuel storage system shall comply with Suffolk County DHS Article 12 requirements.

Emergency power shall be provided to the following loads:

- Egress and exit lighting

- Fire alarm system
- Fire suppression system
- Selected exhaust and make-up systems
- Selected HVAC controls
- Mechanical control system

Standby power shall be provided to the following loads:

- Telecommunication system
- Security system
- Sump pumps, sewage ejectors, etc.
- Selected lab equipment

The intent is to limit the amount of laboratory equipment on generator power to that equipment which is necessary to prevent equipment damage or the loss of an experiment that will take several days to reproduce.

13.3.8.6 Uninterruptible Power

An Uninterruptible Power Supply system shall be provided to backup equipment associated with the control room. At this time, there are no other requirements for a central UPS system. If uninterruptible power is required, it will be provided by the user via point-of-use UPS units.

13.3.8.7 Design Loads

13.3.8.7.1 Equipment Loads

For initial planning, the following estimated loads have been used. However, as the machine design is refined and/or the equipment list is developed, the most current information available and/or the manufacturer's published data for the selected equipment or best approximation from similar equipment will be used.

Accelerator Tunnel and Tunnel Mezzanine

- Single magnet circuits
  - Total demand load = 2220 kW (74 kW/cell x 30 cells)
  - Each cell shall be served by approximately:
    30 – 3-phase, 208 V circuits
    20 – 1-phase, 208 V circuits
    20 – 1-phase, 120 V circuits
  - All loads are located in the mezzanine above the tunnel. Ten equipment racks will be located at 30 equally distributed locations.
  - Panel boards serving this rack-mounted equipment may be surface mounted on the mezzanine wall.
- Ring-wide power supplies (locations will be defined during the preliminary design phase)
  - One 480 kW, 480 V, 3-phase load
  - One 100 kW, 480 V, 3-phase load
  - One 10 kW, 480 volt, 3 phase load. Location will be defined during the preliminary design phase.
- Transfer line magnet power supplies (locations will be defined during the preliminary design phase)
  - Linac to booster ring: 30 – 3-phase, 208 V circuits
  - Booster to storage ring: 70 – 3-phase, 208 V circuits
- Insertion devices
  Currently undefined. Assume low power consumption.

- Vacuum instrumentation
  - Total demand load = 300 kVA (10 kW/cell x 30 cells)
  - Mostly 120 and 208 V, some 480 V
  - All loads are located in the mezzanine above the tunnel.
- Tunnel instrumentation
  - Total demand load = 300 kVA (10 kW/cell x 30 cells)
  - Mostly 120 and 208 V, some 480 V
  - All loads are located in the tunnel. Generally for portable equipment.
- Tunnel power and signal support
  Separate power and signal cable trays shall be provided within the tunnel throughout its entire length as well as above the racks at the mezzanine level. Additional tray shall be provided from the mezzanine to the control room.

Experimental Hall

- Total demand load = 2850 kW (75 to 95 kW/sector x 30 sectors)
- Equipment loads will generally be 120 and/or 208 V.
- Panel boards serving Experimental Hall equipment may be surface mounted on the adjacent walkway wall.

Linac/RF Building

- Linac RF system: 20 kW
- Booster RF system: 160 kW, 480 V, 3-phase
- RF transmitter: 700 kW, 480 V, 3-phase
- Cryogenic plant: 500 kW, 480 V, 3-phase

Central Lab Office Building

- Lab equipment: 25 VA per net square ft connected
- Office equipment: 5 VA per net square ft connected

Lab Office Buildings

- Lab equipment: 25 VA per net square ft connected
- Office equipment: 5 VA per net square ft connected

13.3.8.7.2 Demand Factors

A 1.0 demand factor will be used at electrical distribution equipment serving tunnel and Experimental Hall equipment. NEC code demand factors will be used at all other locations.

13.3.8.7.3 Spare Capacity

- Branch circuit panels and distribution panels serving tunnel equipment will provide 10% spare capacity.
- Branch circuit panels serving Experimental Hall equipment will provide 25% spare capacity.
- Branch circuit panels serving labs within the LOBs will provide approximately 50% spare capacity.
- Other panels and switchgear will provide approximately 25% spare capacity.

13.3.8.8 Grounding

13.3.8.8.1 Grounding Electrode System

- The grounding electrode system shall consist of underground metal piping, building steel, a 250 kcmil bare copper Ufer ground embedded in the concrete foundation around the perimeter of the building with cross-connecting conductors at approximately 100 ft spacing under the Ring Building, and the ground rods associated with the lightning protection system.
- The 250 kcmil concrete embedded conductor shall be exothermically welded to the foundation rebar at 20 ft increments.
- All underground connections shall be exothermically welded.
- The ground grid shall be designed to provide <5 ohms of resistance to earth.

13.3.8.8.2 Power System Safety Grounding

- The power system safety grounding shall be in accordance with the NEC and IEEE 142 Grounding of Industrial and Commercial Power Systems.
- The Building 603 substation upgrade and each of the NSLS-II unit substations shall be grounded in accordance with IEEE 80 AC Substation Grounding.
- Lab equipment shall be grounded in accordance with IEEE 1100 Powering and Grounding Electronic Equipment.
- A separate green insulated equipment grounding conductor shall be provided in all feeder and branch circuits.
- Branch circuits serving sensitive electronic equipment shall be provided with a green with yellow strips isolated equipment grounding conductor in addition to the green equipment grounding conductor.

13.3.8.8.3 Instrument Reference Grounding

Provide one instrument reference ground bus at each beamline to be used by users only for the purpose of grounding sensitive electronic and/or communication circuits. The bus shall be connected directly to the grounding electrode system and bonded to the local transformer(s) which provide power to that beamline equipment. It shall be considered the beamline’s single point ground for all user equipment.

13.3.8.8.4 Static Dissipation Grounding

Selected labs may require static dissipative flooring and/or bench tops. Verify requirements and provide grounding as necessary.

13.3.8.8.5 RF Shield Grounding

If a shield is required to attenuate nearby radar emissions, the shield shall be bonded and grounded as recommended by the shielding consultant.

13.3.8.8.6 Telephone and Data Communication Grounding

Telephone and data communication grounding shall be provided in accordance with EIA/TIA 607.

13.3.8.8.7 Lightning Protection

A complete lightning protection system shall be provided in accordance with NFPA 780 and UL 96A.

13.3.8.8.8 Cathodic Protection

Typically, cathodic protection has not been provided on other campus projects. Therefore, it is assumed that it will not be required at the NSLS-II project. However, this requirement should be verified with the recommendations contained in the soils report.

13.3.8.9 ELF EMI and RFI Mitigation

At this time, there is no requirement to mitigate magnetic fields produced by electrical/mechanical distribution equipment which could effect sensitive lab equipment.

Similarly, there is no identified requirement to mitigate radio frequency interference from lighting fixtures, adjustable frequency drives, or other mechanical/electrical equipment that operate at higher frequencies.

There will be provision to shield the experimental floor from RFI generated by the RF cavities. Local shielding will be provided in the accelerator tunnel in these areas. Any additional shielding will be provided on an as-needed basis as part of the experimental apparatus. Most hutches have inherent EMI/RFI shielding by nature of their construction.

13.3.8.10 Vibration Isolation

At this time, vibration isolation of electrical equipment will include upgraded spring isolators on the generators, neoprene pads under transformers, and prohibiting the use of any conduit under or within vibration isolation slabs.

13.3.8.11 Radiation Protection

Conduit penetrations in to the tunnel shall be limited in quantity and located only through the tunnel ceiling. All penetrations shall include offsets that prevent line-of-sight through the high-density concrete. Spare penetrations shall be provided for future use.

Refer to Chapter 17, Radiation Safety and Shielding, for information regarding shielding material and thickness requirements.

13.3.8.12 Exterior Lighting

- Exterior lighting shall be provided along the interior and exterior roadways, parking lots, walkways, and building exits. Illumination levels shall be in accordance with DOE and IES standards.
- Fixtures shall be full cut-off type using metal halide light sources at a mounting height generally not exceeding 20 ft.
- Exterior lighting controls shall provide photocell on, photocell off controls with the ability to turn off the lights at a selectable time of day.
- The exterior lighting system shall comply with LEED Sustainable Site Credit #8 - Light Pollution Reduction and ASHRAE 90.1.

13.3.8.13 Interior Lighting

- Interior lighting shall be provided primarily from fluorescent sources. Incandescent lighting may be provided in labs where very low-level lighting is required or where RF interference may be a concern. Metal halide may be considered in the Experimental Hall.
- Fluorescent lamps shall be T8, 32 W, 4100K with a minimum CRI of 75. Fluorescent ballast for T8s and compact lamps shall have a minimum ballast factor of 0.85 and a total harmonic distortion of <10%.

- Exit lights shall be LED type.
- Occupancy sensors shall control lighting in all spaces other than lab and experimental areas. Offices, storage, and similar spaces shall be provided with override off switches at the door. Lab and experimental areas shall be provided with a low-voltage control system with local on/off override switches.
- Photo sensors shall be provided in perimeter offices and other spaces with natural lighting.
- Interior illumination levels shall be in accordance with DOE and IES standards. Egress and exit lighting shall comply with the New York State Building Code (NYSBC) and NFPA.
- The interior lighting system power consumption shall comply with ASHRAE 90.1 limitations.

13.3.8.14 Special Systems

13.3.8.14.1 Fire Alarm System

- A complete manual and automatic, supervised, fire detection, and voice evacuation system shall be provided. It shall be a non-coded, addressable, microprocessor-based fire alarm system with initiating devices, notification appliances, and monitoring and control devices. Initiating and appliance circuits shall be Class B. The fire alarm system shall be in accordance with DOE and NY State Code requirements.
- Smoke detection shall be provided in labs in the CLOB and the LOBs, throughout the Experimental Hall and tunnel, electrical rooms (including switchgear rooms in the service buildings), telephone and data communications rooms, and in elevator lobbies, shaft, and machine room. Consideration should be given to the use of air sampling detectors. Provisions shall be provided for connecting future smoke detectors located within the future experimental hutches. Smoke detectors in elevator lobbies, shaft, and machine room shall initiate elevator recall. Duct smoke detectors shall be provided in air handling systems as required by NYSBC and NFPA 90A.
- Heat detectors shall de-energize elevator power in accordance with ANSI 17.1 Elevator Code.
- The fire alarm control panel shall be located at the CLOB main entrance.
- Common alarm and trouble signals will be transmitted via dedicated fiber optic cable to the campus fire alarm system.
- The fire alarm system shall match campus standards.

13.3.8.14.2 Telephone and Data Communication Systems

- A complete pathways, spaces, and structured cabling distribution system shall be provided and consist of telecommunication rooms, plywood backboards, racks, cabinets, cable tray, conduit, back boxes, copper cable, fiber optic cable, connectors, cover plates, termination blocks, cross connect cables, patch panels, and all necessary accessories and shall be provided in accordance with applicable EIA/TIA standards.
- Cable tray shall be provided in LOB corridors and above the walkway around the Experimental Hall. Conduit shall be provided between the cable tray and each outlet or raceway.
- Each voice/data outlet shall be provided with one Cat 6 voice jack and one Cat 6 data jack.
- Each data outlet shall be provided with one Cat 6 data jack.

13.3.8.14.3 Security System

- The security system shall consist of an access control system only. Intrusion detection and CCTV systems are not required.
- Card readers shall be located at each building entrance, at each corridor entrance to a lab, at each entrance to the Experimental Hall, at each entrance to the tunnel, and at each entrance to other selected spaces.
- To match campus standards, security equipment components (card readers, controllers, locks, door contacts, etc.) will be owner furnished, contractor installed. Security system cabling and raceways shall be contractor provided and installed. Door exiting devices, power transfer hinges, etc. shall be coordinated with the door schedule.

13.3.9 Sustainable Design & LEED

The goal for the NSLS-II facility is to incorporate a wide range of sustainable strategies and objectives throughout the design and construction process while meeting the functional requirements of an advanced technology facility and creating a workplace that is environmentally friendly, energy-efficient, and both healthy and pleasant to be in. The NSLS-II facility will be designed to achieve a minimum LEED Certification Level of LEED Certified and higher if possible.

13.4 PROGRAM

13.4.1 Building Program

NSLS-II will have distinct components that make up the final building plan. They are the Ring Building, the Central Lab Office Building, the Lab Office Buildings, the Service Buildings, and the Linac/RF Buildings. Each of these buildings has separate space and utility requirements.

13.4.1.1 Definitions

Net Square Feet (NSF): The sum of all areas that are required to meet general or specific functional needs. NSF is calculated based on the interior dimensions of the rooms and spaces.

Gross Square Feet (GSF): The total area of all spaces in the building including wall thicknesses. GSF is calculated based on the exterior face of the building spaces and includes non-assignable spaces such as building circulation, mechanical/electrical rooms, restrooms, janitor closets, and the area of interior and exterior walls.

Building Efficiency: Building efficiency is calculated as the ratio of NSF/GSF.

Table 13.4.1 Summary Program of Spaces.

Space Description	NSF	GSF
Central Lab Office Building	36,900	52,748
Conference Center*	13,440*	15,000*
Ring Building	228,118	244,663
Service Buildings	28,696	32,000
Linac & RF Buildings	15,862	21,000
Lab Office Buildings* (4 @ 11,000 GSF ea.)	30,480*	44,000*
Total Square Feet	**353,496**	**409,411**
Building Efficiency: 86%		

* 15,000 GSF Conference Center and 33,000 GSF of Lab Office Building space are optional and not in base scope

13.4.2 Ring Building

The Ring Building, shown in Figure 13.1.2, will consist of four space components, the ring tunnel, the tunnel mezzanine, the Experimental Hall, and the access corridor.

The ring tunnel, housing the booster ring and the storage ring, occupies the inner most area of the Ring Building. The beamlines used by the experimental stations extend tangentially from the ring at select locations. The Experimental Hall is designed to accommodate beamlines that are approximately 60 m long from the center of the straight section to the end of the beamline. Outboard of the Experimental Hall will be the access corridor.

Above the ring tunnel is the tunnel mezzanine. Power supplies for the accelerator will be located on the tunnel mezzanine with electrical power feeds dropping through the floor into the tunnel.

Beyond the ring tunnel is the experimental floor. The experimental floor is the space where the beamlines and hutches for the experiments are located. The floor in this area will be designed to reduce transmission of vibration and prevent differential settlement of the floor which can be detrimental to the performance of the beamlines.

The outermost ring of the Ring Building is the access corridor which is approximately 10 ft wide and designed for fork truck and pedestrian traffic. This will be a continuous aisle that runs the circumference of the Ring Building. It is from this aisle that the CLOB and LOBs will be accessed.

Table 13.4.2 Ring Building Program of Spaces.

Space Number	Room Name	Size NSF	No. of Spaces	Total NSF	GSF	Notes
RB-101	Ring tunnel	34,824	1	34,824		
RB-102	Experimental Hall/Access corridor	143,820	1	143,820		
RB-103	Tunnel mezzanine	46,624	1	46,624		
RB-104	Loading dock	2400	1	2,400		
RB-105	Hazardous materials storage	450	1	450		Located near LOB 1
	Ring Building		**5**	**228,118**	**244,663**	
	Efficiency: 93%					

13.4.3 Central Lab Office Building

The Central Lab Office Building will be a three-story structure that serves as the focal point of the facility. Figures 13.4.1, 13.4.2, and 13.4.3 show the floor plans for the first, second, and third floors, respectively, of the CLOB. It will include an entry lobby for reception and displays, administrative offices, offices for operating staff, and workshop and lab space to support NSLS-II operations staff and users. It will include approximately 160 enclosed offices and 30 open plan offices. There will also be a director’s suite with director’s office and conference room..

The CLOB will have provision for connection to an optional separate Conference Center that can accommodate 400 occupants utilizing ground floor and mezzanine seating areas. The Conference Center will include lobby display areas and toilet facilities for seminar attendees.

The CLOB will also have 3 breakout/conference rooms on the second floor that can be accessed from the optional Conference Center mezzanine lobby area to serve as breakout rooms or used as conference rooms if the Conference Center is not constructed.

Incorporated into the CLOB is space equivalent to one Lab Office Building to serve user and NSLS-II staff beamlines in the CLOB area. Approximately 20 of the enclosed offices and 10 of the open plan offices will be for this staff. Eight laboratories will be available to support NSLS-II staff requirements and/or beamlines in the area.

The CLOB will contain the accelerator control room with associated conference and computer rooms and a viewing gallery located on the second level to view the Experimental Floor.

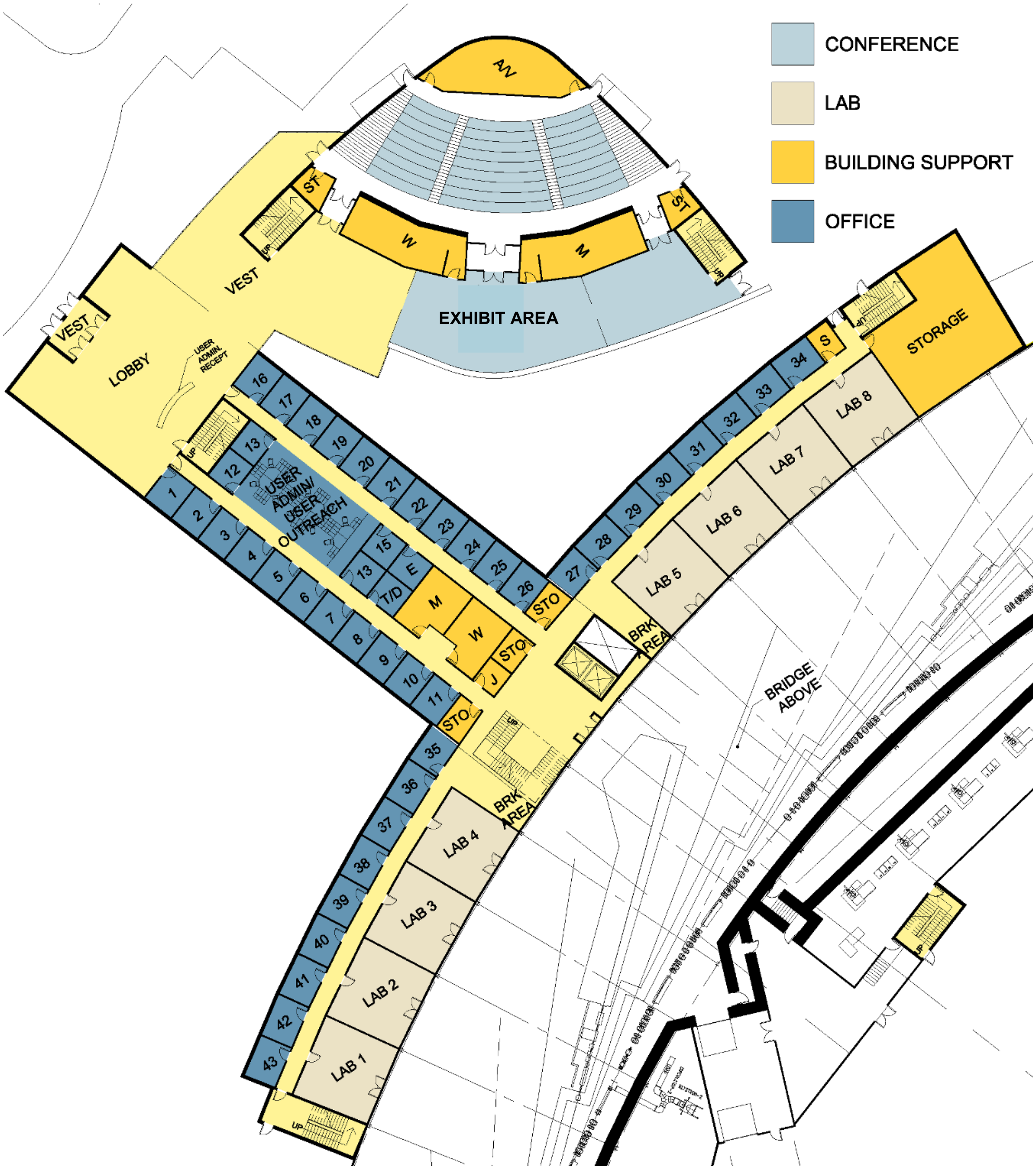

Figure 13.4.1 CLOB 1st Floor Plan.

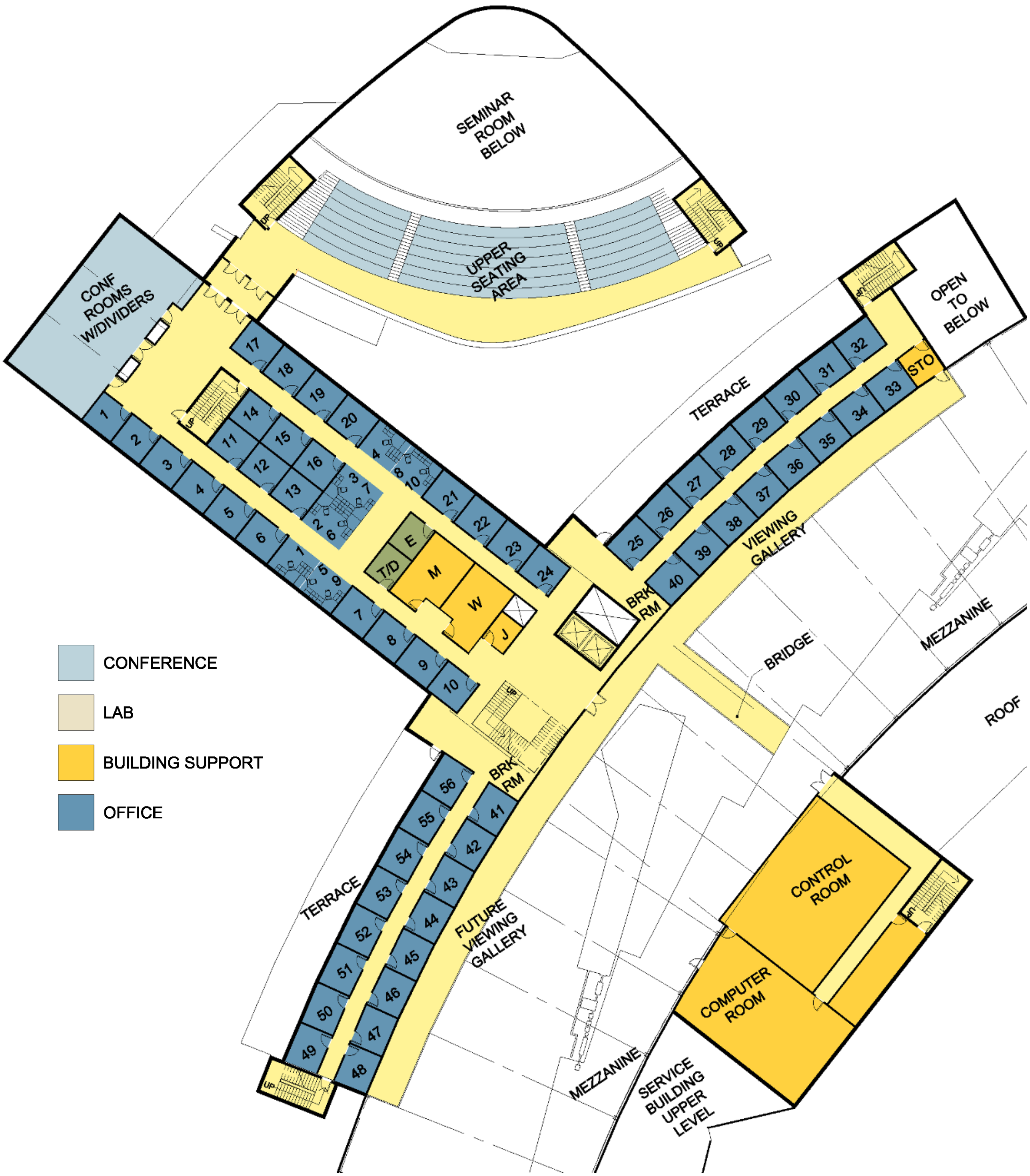

Figure 13.4.2 CLOB 2nd Floor Plan.

Figure 13.4.3 CLOB 3rd Floor Plan.

Table 13.4.3 Central Lab Office Building Program of Spaces.

Space Number	Room Name	Size NSF	No. of Spaces	Total NSF	GSF	Notes
CB-101	Private office	110	160	17,600		
CB-102	Open office	90	30	2,700		
CB-103	Director's office	240	1	240		
CB-104	Director's conference room	200	1	200		
CB-105	Storage	480	1	480		
CB-106	Breakout/ conf. rooms	500	3	1,500		
CB-107	Lobby	2,400	1	2,400		
CB-108	Break / kitchenette room	200	2	400		
CB-109	Control conference room	240	1	240		
CB-110	Control room	1,600	1	1,600		
CB-111	Computer room	800	1	800		
CB-112	Toilet room and shower	350	6	2,100		
CB-113	Viewing gallery	1,600	1	1,600		
CB-114	Laboratories (16 modules)	240	16	3,840		8 double-module labs
CB-116	Stock room	1,200	1	1,200		
CB-117	Auditorium, 1st floor	3,900	1	3,900		Not in Base Scope
CB-118	Auditorium, mezzanine	5,200	1	5,200		Not in Base Scope
CB-129	Exhibit breakout	3,340	1	3,340		Not in Base Scope
CB-120	Toilet rooms	400	2	800		Not in Base Scope
CB-121	AV room	200	1	200		Not in Base Scope
	Central Lab Office Bldg		**226**	**38,900**		
	Conference Center		**6**	**13,440**		Not in Base Scope
	Building Total		**232**	**50,340**		
	Efficiency – CLOB: 70%				**52,748**	
	Efficiency – Conference: 90%				**15,000**	
	Efficiency – Combined: 74%				**67,748**	

13.4.4 Lab Office Buildings

There will be a maximum of four single-story Lab Office Buildings. These will include 22 enclosed offices and eight open-plan offices. Each LOB will also have 10 laboratory modules plus interaction areas, conference rooms, and storage. The floor plan for LOB 1 is indicated on Figure 13.4.4.

Figure 13.4.4 LOB 1 floor plan.

Table 13.4.4 Lab Office Buildings Program of Spaces.

Space Number	Room Name	Size NSF	No. of Spaces	Total NSF	GSF	Notes
	Lab Office Building				**55,000**	Building Target GSF
LOB-101	Private office	110	22	2,420		
LOB-102	Flexible office space	90	8	720		
LOB-103	Laboratory module	240	10	2,400		5 double-module labs
LOB-104	Storage	480	1	480		.
LOB-105	Conference room	200	1	200		
LOB-106	Lobby & interaction space	500	1	500		
LOB-107	Break room	200	1	200		
LOB-108	Loading/staging	200	1	200		
LOB-109	Toilet/shower	250	2	500		
LOB -110	Mechanical penthouse	0	0	0		Not currently included in program.
			45	**7,620**		
	4 Lab Office Buildings		**180**	**30,480**		
	Efficiency: 69%				**44,000**	

13.4.5 Laboratory Design

Each LOB will have five laboratories, which will be shared with all the beamlines associated with that particular LOB. These labs are based on a 12 ft wide and 20 ft long lab planning module with each lab being two modules wide. A typical laboratory layout is shown in Figure 13.4.5. These labs will have access to the Experimental Hall through recessed double doors 6 ft wide (two 3 ft wide leaves). The labs will be accessed from the LOB by a single recessed 3 ft wide door.

At least two labs in each LOB will be wet labs, either chemistry or biology, which will require a fume hood. At least one of these hoods will be HEPA filtered in each LOB. Additionally, each LOB will have the capability to provide at least one HEPA filtered fume hood designated for nanomaterials work. The other labs will be dry labs with cabinetry and equipment but no fume hoods. These labs may be equipped with elephant trunk exhausts or glove boxes as needed by the laboratory type. Two of the labs within each LOB may be designed to be upgradeable to an H5 Occupancy in the future, where Hazardous Production Materials (HPM) are used (per the New York State Building Code).

Chemistry wet labs will include ventilated chemical storage cabinets (possibly incorporated into the fume hood base). Each wet laboratory will also be furnished with a safety shower/eyewash station. Floor drains will not be provided in laboratory space though a sump pit may be provided to collect liquids and allow testing prior to pumping to sanitary waste.

These same general requirements will apply to the eight laboratories located in the Central Lab Office Building. Two of the labs in the CLOB will be wet labs, either chemistry or biology, which will require a fume hood. At least one of these hoods will be HEPA filtered.

Other types of labs will be accommodated either in JPSI or elsewhere at BNL:

- X-ray source/crystal polishing (located in JPSI)
- Metrology lab (located in BNL Instrumentation Division)
- Sample characterization labs (located in JPSI and LOBs)
- Electronics labs (located in JPSI and LOBs)
- Magnet characterization lab (located in BNL Building 832)
- Ultra high vacuum lab (located in BNL Building 905)

Since the LOB labs are going to be shared labs, it is necessary to make the labs as generic as possible while still serving the requirements of the research being performed.

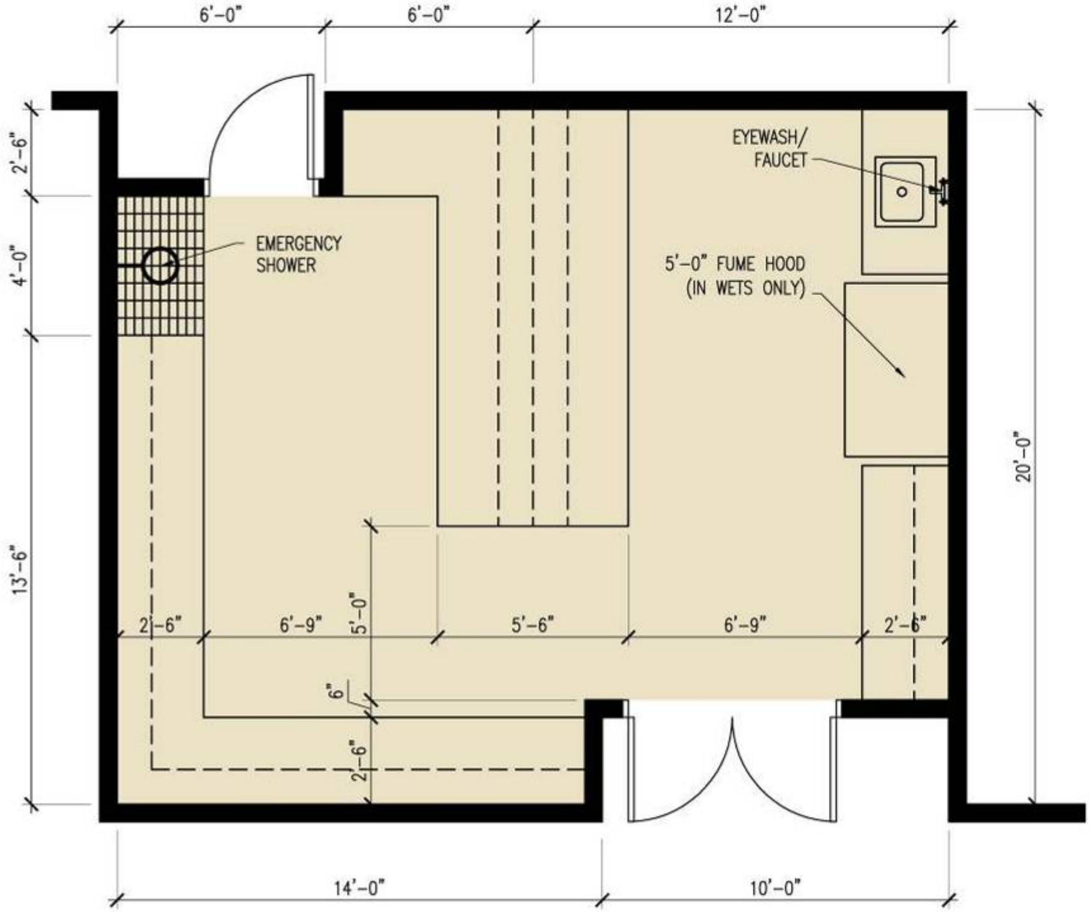

Figure 13.4.5 Typical laboratory layout.

13.4.6 Service Buildings

There will be five two-story service buildings and one single-story service building, located within the Linac/RF Building. These buildings will house the mechanical and electrical equipment to service the experimental floor, the ring tunnel, and the ring mezzanine. The Service Building 1st floor (see Figure 13.4.6) will provide personnel access to the ring tunnel through a labyrinth, and equipment access to the ring tunnel at two of these service buildings through a shielded door. The Service Building 2nd floor (see Figure 13.4.6) will house air handlers for the experimental floor area and will provide equipment access to the ring mezzanine via an at grade roll-up door.

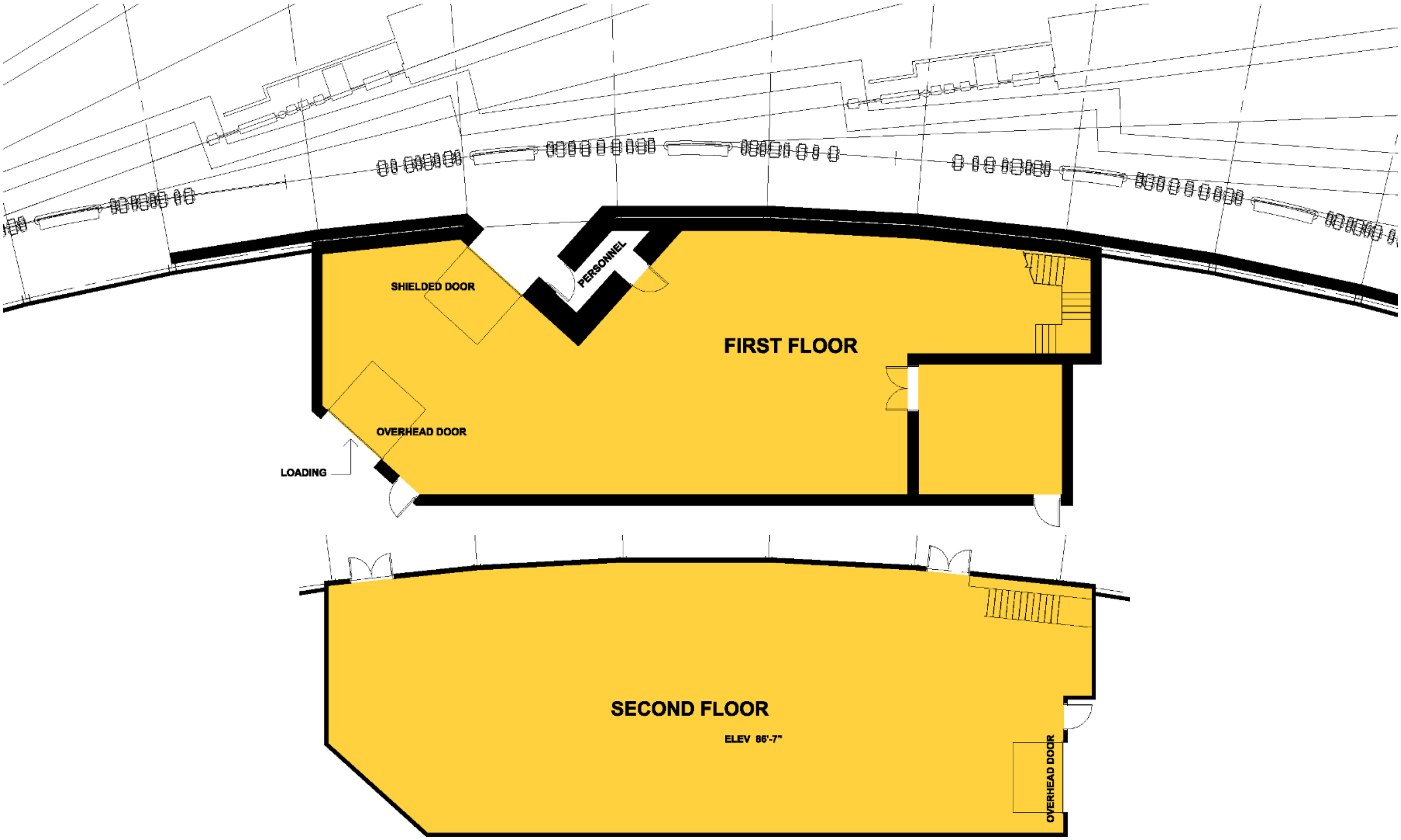

Figure 13.4.6 Service Building. Top figure shows first floor and bottom figure shows second floor.

Table 13.4.5 Service Buildings Program of Spaces.

Space Number	Room Name	Size NSF	No. of Spaces	Total NSF	GSF	Notes
	Service Buildings				**20,000**	Building Target GSF
SB-101	Mech./Elect. equip. room, lower level	3,277	4	13,108		
SB-201	Mech./Elect. equip. room, upper level	3,897	4	15,588		
			8	**28,696**		
	Efficiency: 90%				**32,000**	

13.4.7 Linac/RF Buildings

The Linac/RF Building consists of five spaces for the Linac and RF equipment and a single story Service Building. The space will be located on the opposite side of the ring from the Central Lab Office Building and will be accessed from the Central Lab Office Building via a bridge. The Linac area finished floor will be approximately 5 ft higher than the experimental floor to enable Linac alignment with the booster Ring. The RF area will include a concrete shielded RF cavity test enclosure. Above the RF area will be a second floor service area to provide space for mechanical and electrical equipment equivalent to that provided in Service Building SB1 – SB4. Figures 13.4.7 and 13.4.8 show the Linac and RF area floor plans, respectively.

Table 13.4.6 Linac and RF Buildings Program of Spaces.

Space Number	Room Name	Size NSF	No. of Spaces	Total NSF	GSF	Notes
	Linac and RF Buildings				12,900	Building Target GSF
LB-101	Linac Room	1,730	1	1,730		
LB-102	Klystron Galley	2,216	1	2,216		
LB-103	Service Building	6,150	1	6,150		
LB-104	RF Cavities	5,340	1	5,340		
LB-105	RF Testing	426	1	426		
	Linac and RF Buildings		**5**	**15,862**		
	Efficiency: 76%				**21,000**	

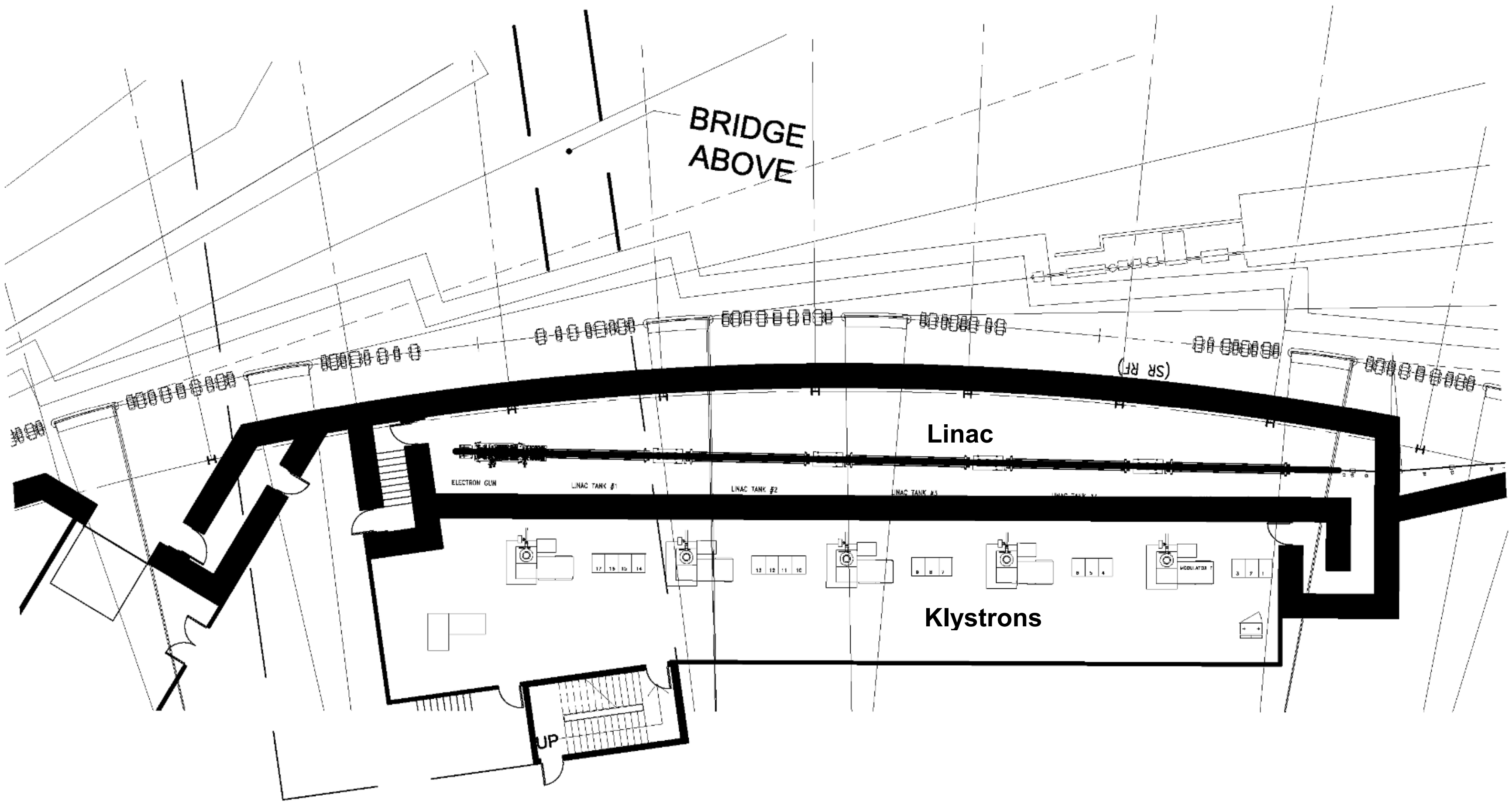

Figure 13.4.7 Linac area.

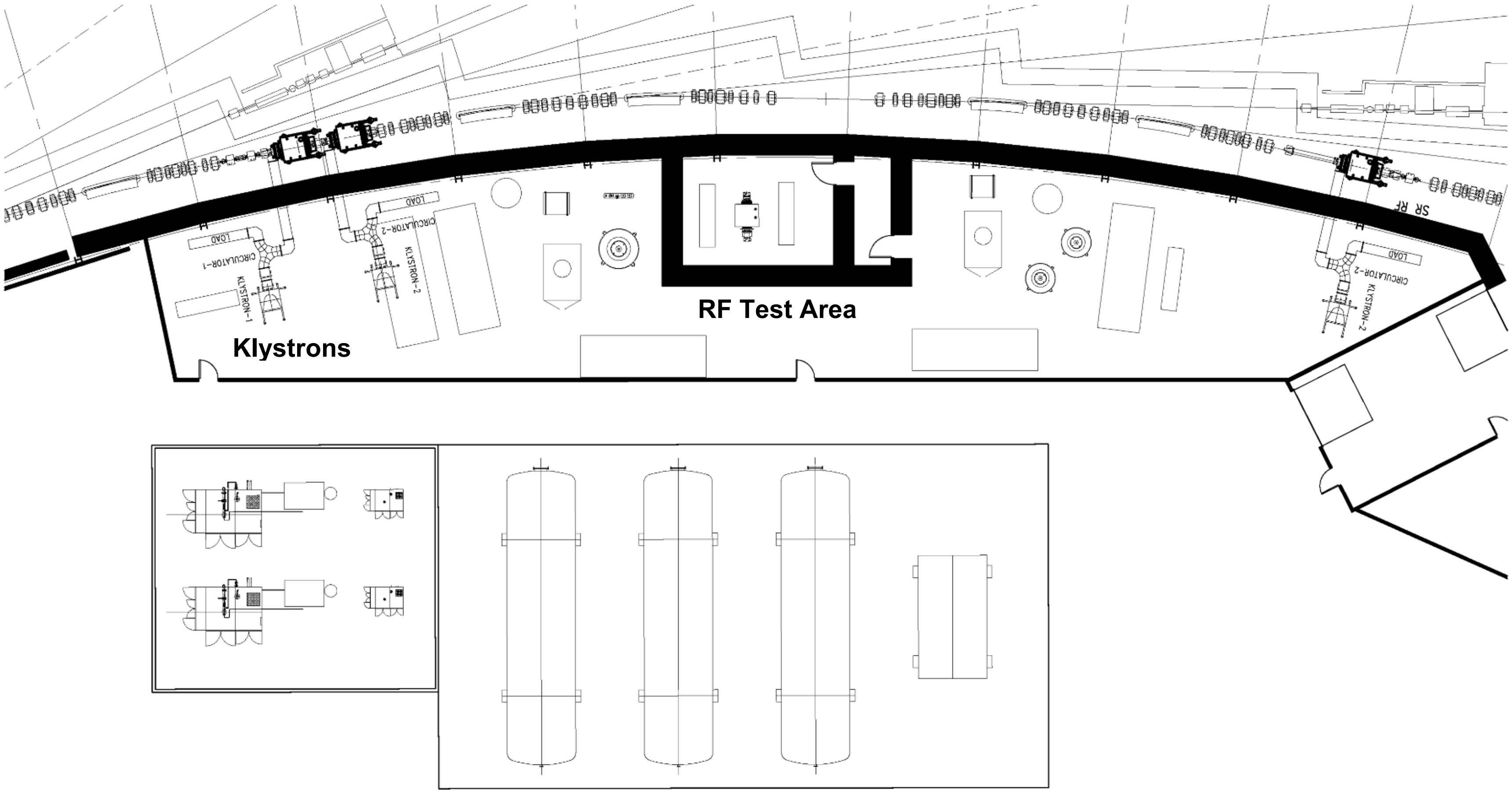

Figure 13.4.8 RF area.

13.4.8 Circulation

Entry points into the Ring Building are provided around the circumference of the building both from the outside and the inside of the ring. The main entrance to the Ring Building will be from the Central Lab Office Building. Other entrances to the complex are available from the LOBs and from the service buildings. Within the three-story CLOB, two elevators will provide vertical transportation.

When the accelerator is operating, access to the ring tunnel is not allowed, for safety reasons. Doors into the ring tunnel will be interlocked with the accelerator to prevent entry into the tunnel when the beam is operating.

Primary circulation within the Ring Building will be provided by the access corridor that circumscribes the outside of the building. It will provide for both pedestrian and vehicular (bicycle, forklift, etc.) traffic. The access corridor will have points of entry from each LOB and from each laboratory within the LOBs. If future beamlines are extended across the access corridor, provision will be made at that time for an elevated bridge across the beamline sized for all anticipated traffic.

Control room personnel require ready access to the tunnel mezzanine and the ring tunnel itself. A pedestrian bridge will be provided from the CLOB second floor across the Experimental Hall to the tunnel mezzanine. Entrance to the accelerator tunnel will be via the service buildings. Stairs in the service buildings will provide circulation between the mezzanine level and the tunnel level. Personnel will access the accelerator tunnel through a personnel labyrinth on the first level. Entry into the Ring Building from the LOBs, service buildings, and the CLOB will be restricted by card-reader controlled access.

13.4.9 Building Floor Elevations

The floor elevation for the Ring Building (experimental floor) is the functional baseline for the elevations of the adjoining buildings and spaces. This elevation is set to balance cut and fill on the site while also minimizing the need for engineered fill. The floor elevations for the components are given in Table 13.4.7.

Table 13.4.7 Building Floor Elevations.

Building Component	Floor Elevation
Experimental floor and access corridor	+ 73 ft
Ring tunnel	+ 74 ft 4 in.
Tunnel mezzanine	+ 86 ft 7 in.
Lab Office Building	+ 73 ft
Central Lab Office Building	--
First floor	+73 ft
Second floor	+ 88 ft
Third floor	+103 ft
Service buildings	--
Ring tunnel access	+ 74 ft 4 in.
Upper level	+ 86 ft 7 in.
Linac Building	+ 78 ft
RF Building	+ 74 ft 4 in.

13.4.9 Building Cross Sections

Figure 13.4.9-13.4.14 show typical cross-sections through the Ring Building and adjoining structures as follows: Figure 13.4.9 – in-between LOBs and MERs; Figure 13.4.10 – at the location of a LOB and MER; Figure 13.4.11 – at the location of the center of the CLOB; Figure 13.4.12 – to the side of the CLOB; Figure 13.4.13 – at the RF building; and Figure 13.4.14 – at the Linac building and experimental hall.

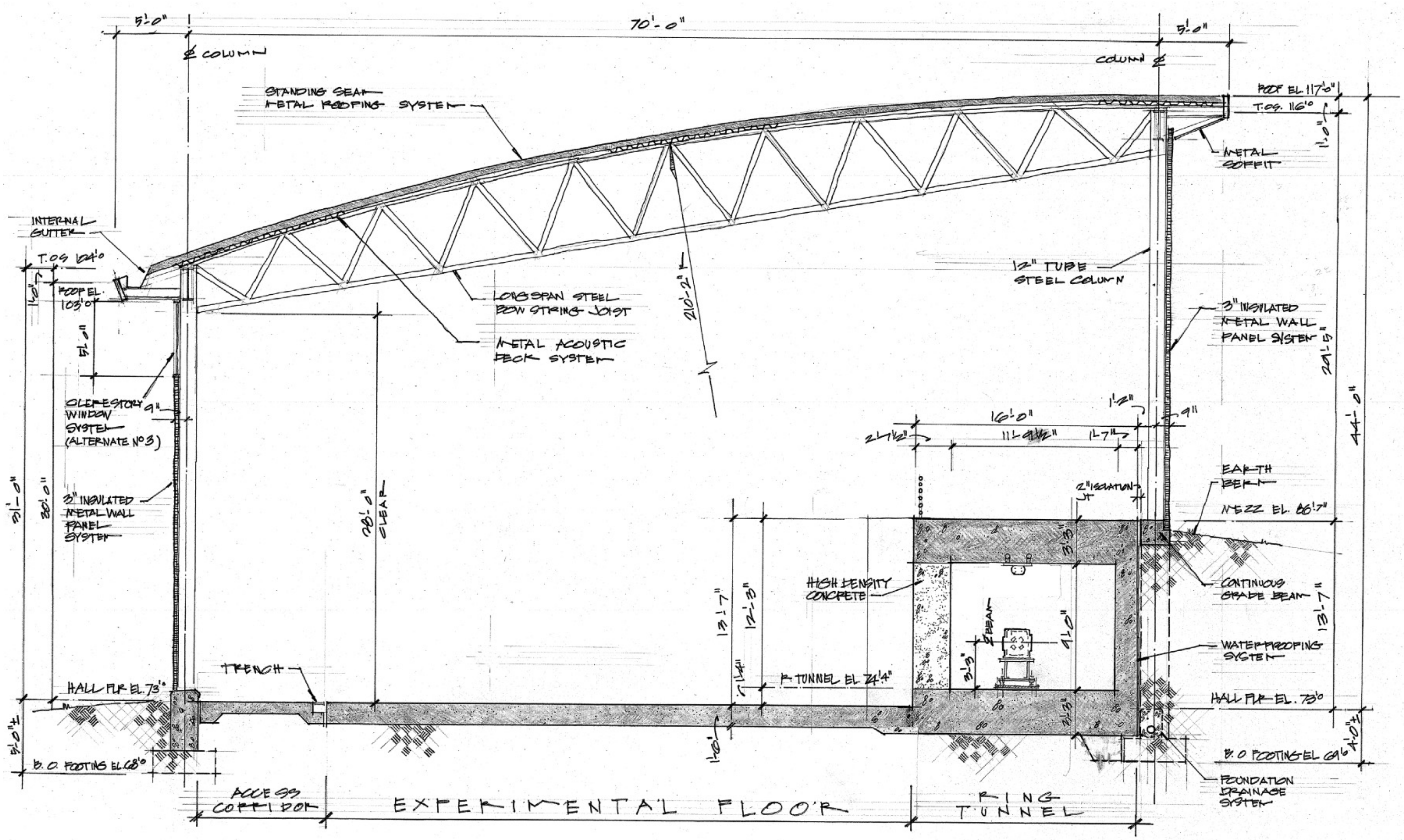

Figure 13.4.9 Cross-section through Ring Building in-between LOBs and MERs.

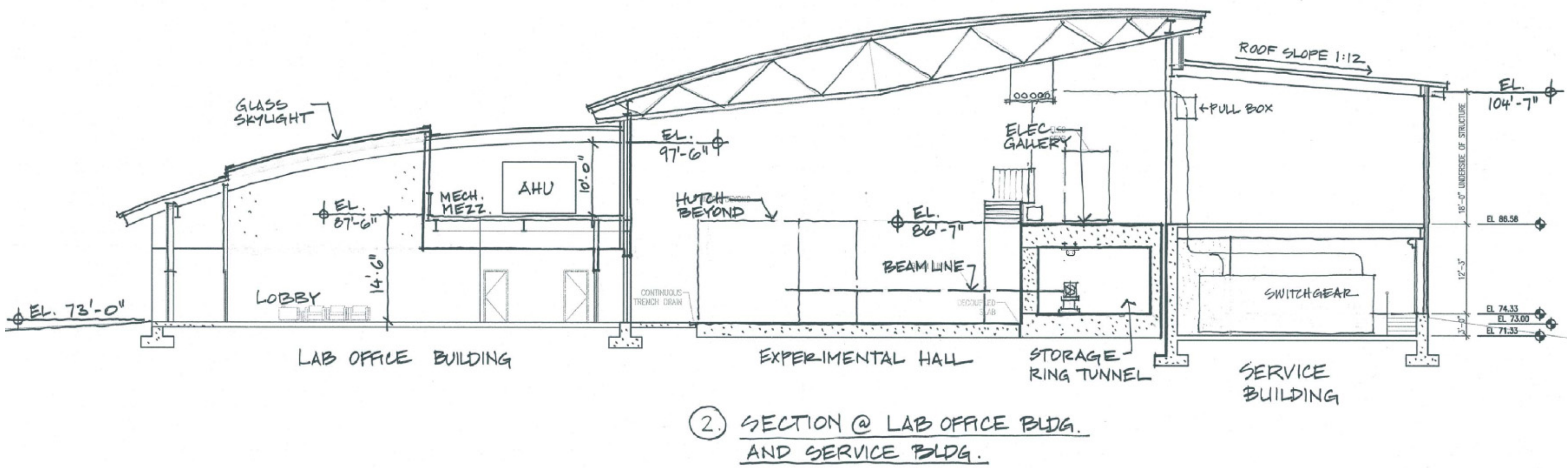

Figure 13.4.10 Cross-section through Ring Building in vicinity of an LOB and MER.

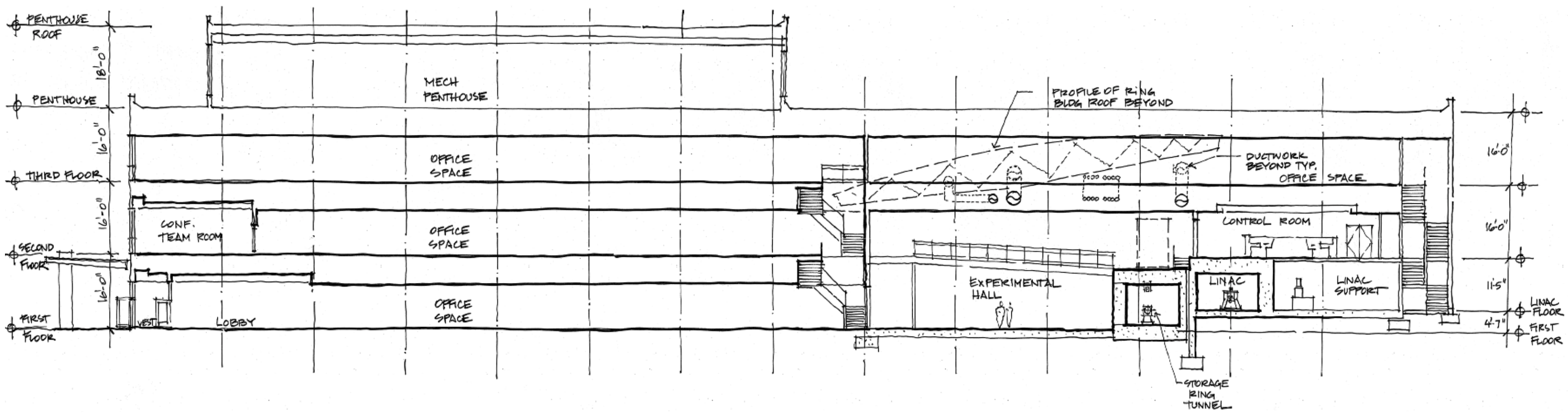

Figure 13.4.11 Cross-section of Ring Building through center of CLOB and MER.

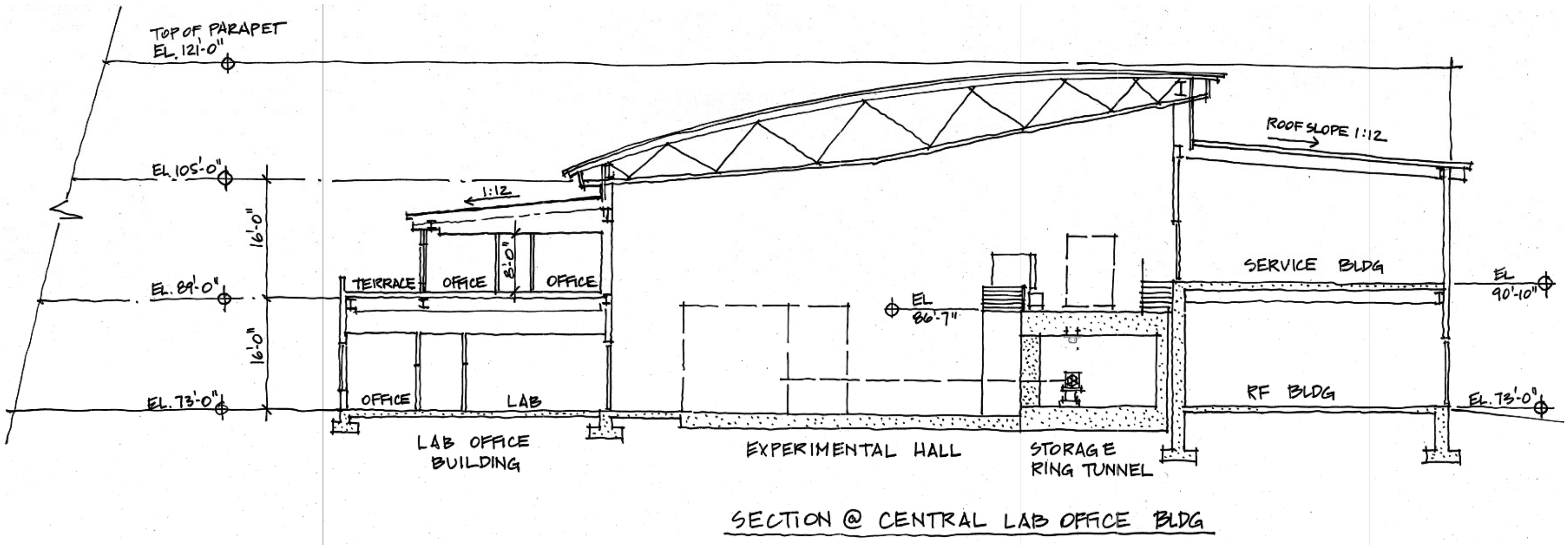

Figure 13.4.12 Cross-section of Ring Building through side of CLOB, showing second floor offices above LOB 1, which is integrated into the CLOB.

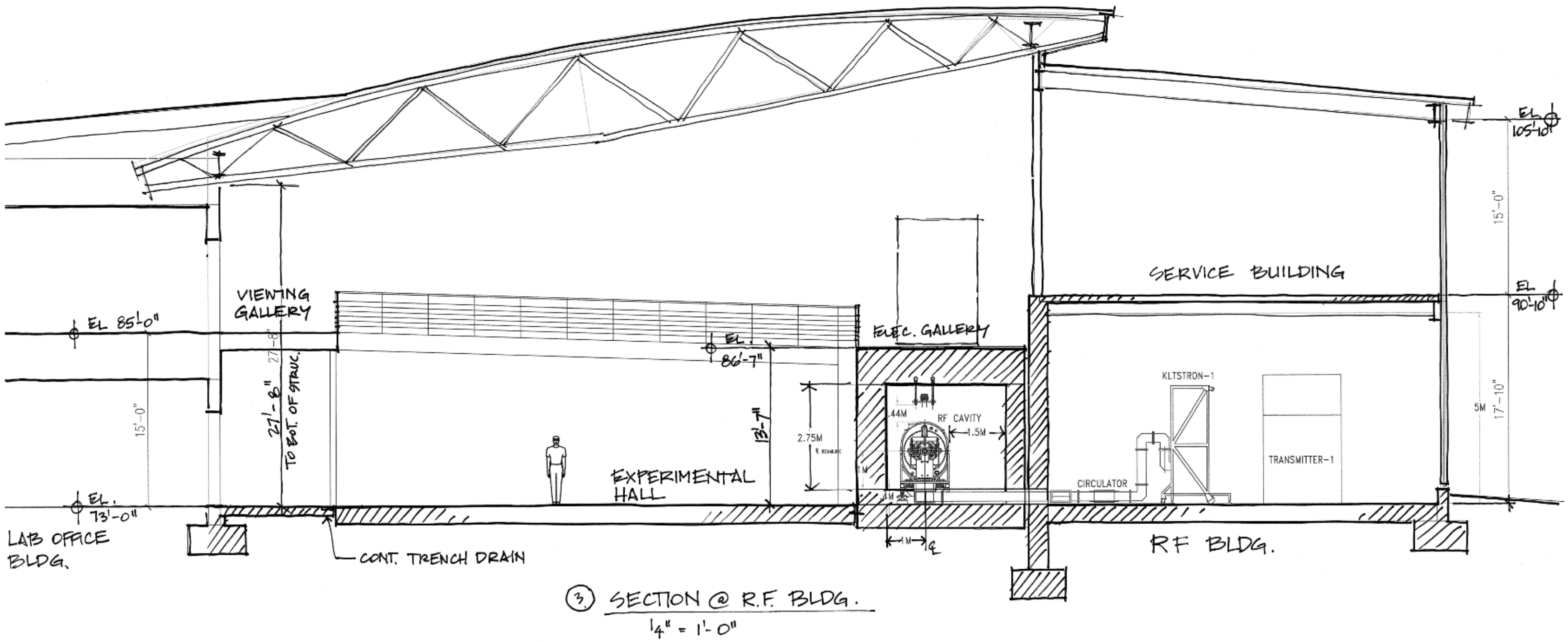

Figure 13.4.13 Cross-section through Ring Building in vicinity of RF building.

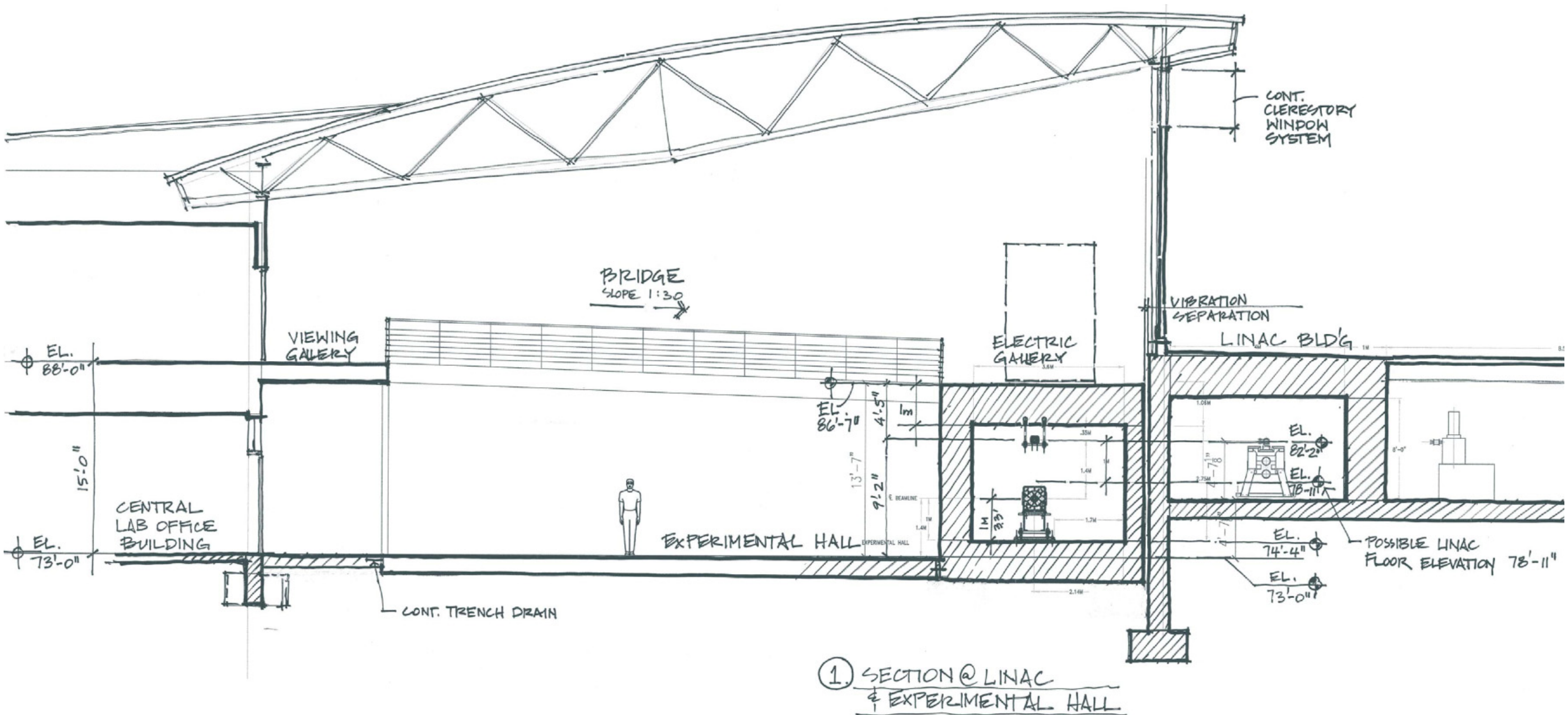

Figure 13.4.14 Cross-section through Ring Building in vicinity of Linac Building. The bridge from the CLOB to the electrical gallery on the tunnel mezzanine is also shown.

13.5 Scope and Conceptual Design

13.5.1 Improvements to Land (WBS 1.6.3.2)

Improvements to land includes removal of existing structures, pavement, abandoned utilities, rail spur, and unsuitable fill, then re-grading and installation of new paving, drainage, site lighting, and landscaping. This WBS element will consist of two work packages:

- WBS 1.6.3.2.1 – Site Preparation which will encompass site clearing, cutting to grade, removal of unsuitable fill, routing of utilities, and build-up and compaction to grade with suitable fill;
- WBS 1.6.3.2.2 – Site Restoration, which will be included in the Ring Building contract and will include the installation of all new paving, drainage, site lighting, and landscaping.

13.5.1.1 Existing Structures

Removal of the existing building foundations will be required as part of the NSLS-II site work. Additionally, any underground utilities serving these buildings will also be removed back to the utility mains.

13.5.1.2 Pavement

Removal of existing pavement will be required for Railroad Street and Seventh Street. Both roadways will be removed to a point that enables tie-in to new roads and parking areas constructed as part of the project.

13.5.1.3 Abandoned Utilities

Existing site utility systems that are not being used or have been abandoned in place will be removed as part of the NSLS-II project. The site plan identifies several underground utility pipes that will be removed back to an approved location and terminated.

13.5.1.4 Railway Spur

The existing railway spur that runs parallel to Groves Street will be removed to a point south of the building site. Approximately 500 ft of track will be removed.

13.5.1.5 Site Work

Site clearing will be required to remove trees to the west of Seventh Street and in the southeast corner of the site. The geotechnical report indicates a one foot layer of topsoil above sand, gravel, and silt. The topsoil will be removed for construction and retained for berm construction and replacement topsoil. Any other unsuitable fill identified by the geotechnical report will also be removed and replaced by material from the on-site borrow pit. Final site grading will level the site to the elevations shown on the site plan.

13.5.1.6 Paving

New paving for NSLS-II will include:

- Curbed drive and entrances from Brookhaven Avenue and Groves Street
- Curbed drop-off loop for the CLOB
- Parking (uncurbed) for the CLOB
- Ring Road (uncurbed) around the outer perimeter of the NSLS-II site

- Access to the Loop Road from Groves Street, Brookhaven Avenue
- Parking (uncurbed) for each of the LOBs
- Truck access to the main loading dock and loading platforms at each LOB
- Access tunnel under the Ring Building into the infield area
- Service road (uncurbed) around the infield including drives to each service building
- Campus sidewalks

13.5.1.7 Storm Water

Storm water drainage from buildings and paved areas will be collected in retention basins to the extent possible as encouraged by the LEED guidelines. Basins will be constructed both outside the Ring Building perimeter and within the infield of the Ring Building. Collected storm water will be disposed of onsite with percolation beds or will be discharged into existing drainage structures which will be enlarged as needed to meet 100 year storm criteria. Special drainage accommodation will be required for the access tunnel under the Ring Building.

13.5.1.8 Landscaping

After construction, the site will be reseeded and landscaping will be provided for the LOBs and the CLOB. The landscape design will enhance streetscapes and pedestrian circulation routes, and create buffers to screen unsightly views such as service yards. A building sign and landscaping elements will be used to screen the existing small communications building that will remain near the corner of Brookhaven Avenue and Groves Street.

13.5.1.9 Erosion and Sedimentation Control

Erosion and sedimentation control systems will be installed and utilized for the duration of the construction phase of the project. Silt fencing and stabilized construction entrances will be installed prior to the commencement of construction activities. Disturbed areas within the construction site will be stabilized as soon as practical and subsequently maintained with appropriate methods to minimize erosion of exposed earth. Temporary seeding, mulching, or crushed stone will be used to achieve stabilization.

13.5.2 Central Lab Office Building (WBS 1.6.3.3)

13.5.2.1 Architectural Concepts

The Central Lab Office Building will serve as the front door to the NSLS-II complex. It is envisioned to be a three-story building that will interface with the future Guest House and Joint Photon Sciences Institute buildings planned for the site. The building will house the Director’s office, a conference center, control room and office space, and will incorporate a lab office complex serving users for six sectors.

13.5.2.1.1 Alternatives – Building Configuration

- Two story building without integral LOB
- Three story building without integral LOB
- Three story building with integral LOB

13.5.2.1.2 Selected Concept – Three-Story Building with Integral LOB

The selected concept consists of a three story building that overlaps the Ring Building radially to provide a strong entrance to the facility as well as a connection across the Ring Building for easy access to the Accelerator Tunnel and Tunnel Mezzanine.

13.5.2.1.3 Future Expansion

It is not envisioned that the CLOB will expand in the future. The design does not provide for future expansion horizontally or vertically. However, connectivity to future adjacent buildings is envisioned. It is anticipated that the Lab Office Building area may expand in the future to accommodate future beamlines. In this case, the LOB portion of the Central Lab Office Building will expand horizontally, which allows the labs and offices to be on the same level as the Experimental Hall.

13.5.2.2 Space Program

The first floor will consist of the lobby with space for displays, a user reception area, staff offices and labs, user group labs and offices, shower facilities, loading area, stock room, and an access point for the future conference center. The second floor includes additional staff offices, breakout/conference rooms, a viewing gallery overlooking the Experimental Hall, a bridge across the Experimental Hall, and the control center inboard of the Ring Building that includes the control room, computer room, conference room, and kitchenette. The third floor will house the director's suite and continues with staff office space and a viewing space/terrace overlooking the inside of the ring.

The future conference center will be located on the first floor of the complex as a semi-attached space with its own identity. It will consist of a 400-person sloped-floor auditorium with exhibit space in the lobby and full audiovisual capabilities. Three breakout conference rooms will be provided on the second floor to support seminar activities. It will be located directly off the open, two-story lobby atrium where social events can be hosted.

13.5.2.3 Circulation

The primary point of entry will be the main entrance and lobby that will draw in pedestrian traffic from the parking lot and drop-off loop. Sidewalks are envisioned for pedestrian traffic to and from the adjacent future JPSI and Guest House buildings. Interaction areas will be incorporated adjacent to key circulation areas of the building. The building also provides primary entrance into the Experimental Hall. A bridge accessed from the second floor will span across the Experimental Hall and provide access to the control room as well as the accelerator tunnel, tunnel mezzanine, Linac and RF Building. Two elevators will provide vertical circulation within the building.

13.5.2.4 Quality of Life

Building orientation, sustainable materials, and the use of natural light will be integrated into the design to promote a comfortable and productive environment. Unlike the Ring Building, the Central Lab Office Building's envelope will consist of large areas of glass, allowing for visual transparency and providing an inviting front door to the NSLS-II complex. The lobby will be a space for informal interaction and social events. A shower facility will be provided to encourage exercise in off hours, which is a highly valued benefit for many employees and accommodates the 24/7 nature of NSLS-II operations, as well as support LEED sustainable design objectives.

13.5.2.5 Foundations

Building foundations are expected to be spread footings for columns and continuous strip footings for walls based on a similar foundation system used for the CFN Building in the immediate vicinity.

13.5.2.6 Building Superstructure

The Central Lab Office Building will be a three-story structure. All levels will be braced structural steel frames. The third level will include a Vierendeel truss structure to span across the Experimental Hall.

The second and third floor construction will typically consist of 20 GA – 2 in. thick composite steel deck with 3 in. lightweight concrete topping (total slab thickness = 5 in.) supported on a framework of steel beams and girders.

The roof will be comprised of structural steel framing or open web steel joists supporting 20 GA – 1 ½ in. thick steel roof deck.

13.5.2.7 Building Construction

The exterior of the CLOB will be constructed of an insulated metal wall panel and stud system. The system will be comprised of 2 in. insulated metal panels, exterior sheathing, air barrier, 6 in. metal studs, fiberglass batt insulation, and interior gypsum board. The minimum thermal resistance of the system will be R-20.

The roof of the CLOB will be a flat TPO membrane roofing system that meets current LEED requirements and the energy code minimum R-value.

The curtain wall windows at the CLOB will consist of 1 in. clear tempered insulated glass with a low-E coating in a thermally broken aluminum frame. The thermal transmission value for the glazing will be a U value of 0.30 in the summer and 0.30 in the winter. The visible light transmission will be 69% and the shading coefficient will be a maximum of 0.44.

The exterior doors will be curtain wall aluminum insulated doors to match the windows, or insulated hollow metal doors and frames.

13.5.2.8 Interior Finishes

The CLOB will have gypsum board walls with wood doors and hollow metal frames. The offices will have a side light or interior window to allow natural light into the interior spaces. The interior finishes are as follows:

- Floor finishes office area and conference rooms – carpet tile
- Floor finishes laboratories, control room, and computer room– sheet linoleum
- Floor finishes lobby – porcelain ceramic tile
- Exterior walls - painted
- Interior walls offices and labs – painted
- Interior walls conference rooms – paint or wall coverings
- Ceiling system – suspended acoustical tiles and grid
- Doors – wood, stained
- Door frames – painted

13.5.3 Ring Building (WBS 1.6.3.4)

13.5.3.1 Architectural Concepts

The Ring Building is the scientific and visual focal point for the NSLS-II facility. The halo-shaped building will dominate the site by its sheer breadth (937 ft in diameter), although its height (approx. 30 ft) is not proportionally commanding.

13.5.3.1.1 Future Expansion

The Ring Building is designed for future expansion by the addition of LOBs or support buildings to its outer or inner periphery. It is also possible that future beamlines will be added with a length of up to 600 m, which will extend substantially beyond the limits of the building. The facility is being designed to allow these long beamlines to be installed in the future with minimal impact on the current building. Accommodation for the long beamlines will be made when and if they are required.

13.5.3.1.2 Space Program

Within the Ring Building is the linac module, the RF module, the ring tunnel, the tunnel mezzanine, and the Experimental Hall. Service buildings connected to the inboard side of the Ring Building will provide HVAC, mechanical, and electrical services to the building components.

13.5.3.2 Circulation

The access corridor around the outside perimeter of the Ring Building provides the primary circulation route for the building. It will be designed to handle both pedestrian and forklift traffic. The corridor will provide access to the CLOB, all of the LOBs, individual laboratories within the LOBs, and the adjacent Experimental Hall. Stairs from the Experimental Hall will provide access to the tunnel mezzanine and the service buildings. The pedestrian bridge spanning the Experimental Hall will allow operators to conveniently walk between the control room and the tunnel mezzanine. Stairs within the service building will provide a means of accessing the ring tunnel from the tunnel mezzanine level.

Egress from the Experimental Hall will be through the four LOBs, the CLOB, across the tunnel mezzanine and through the service buildings, or through intermediate emergency exit doors spaced around the exterior perimeter of the Ring Building.

13.5.3.3 Quality of Life

Although the focus of the Ring Building is the enhancement of scientific inquiry, it is desirable to make the space an environment that researchers will enjoy occupying. Comfort facilities for the Ring Building are provided in the CLOB and in the four LOBs within a reasonable distance from all beamlines. As an add-alternate, natural lighting will be brought into the space via perimeter windows. Exterior shading will prevent direct sunlight from impacting experimental performance.

13.5.3.4 Foundations

The foundations for the walls along the outside perimeter of the Ring Building will consist of spread footings for columns and continuous strip footings for walls. The walls on the inboard side of the ring will have spread footings with concrete piers to the height of the tunnel roof and a concrete ring beam tying the piers together at the top.

13.5.3.5 Building Superstructure

13.5.3.5.1 Experimental Hall

The building structure will be a braced steel frame with a curved roof supported by steel joists and 72'-0" trusses or joist girders spanning radially. The roof structure will be supported by columns spaced along the inner and outer perimeters at a maximum spacing of 24'-0". The roof deck will be 20 GA – 1 ½ in. thick steel deck.

The Experimental Hall will have 18 in. thick reinforced concrete slab, poured in place over compacted sub-grade and a vapor barrier. This slab will be poured against and tied to the tunnel foundation wall with rebar dowels to prevent differential settlement. Isolated from this slab, will be the 8 in. reinforced concrete access corridor slab, poured over compacted sub-grade near the outer perimeter and designed for fork lift truck wheel loads.

13.5.3.5.2 Ring Tunnel

Within the Ring Building is the ring tunnel that houses the booster ring and accelerator ring. The exterior wall of the tunnel (inboard) will be a minimum of 0.5 m thick standard weight concrete with no less than 1 m of earth bermed against the wall. In locations where the exterior wall of the tunnel is not bermed, for instance adjacent to service buildings or the linac building, the wall will be 1 m thick standard weight concrete to provide adequate radiation shielding. The interior tunnel wall (ratchet wall) will be constructed of 0.8 m of high-density concrete for the entire height of the wall. The tunnel roof slab will be approximately 1 m thick standard weight concrete, designed to support the electrical gear above. In areas where potential radiation is increased due to transition, injection, or beam stop areas, thicknesses will be increased as indicated in Chapter 17, Radiation Safety and Shielding. The tunnel floor slab will be a 1 m thick standard weight reinforced concrete slab-on-grade poured in place over compacted sub-grade and a vapor barrier. The ring tunnel floor will not be vibrationally isolated from the Experimental Hall floor.

The interior shield wall of the tunnel or "ratchet wall" is currently planned to be constructed of pre-cast high-density concrete panels that will be procured as early as possible in the project. This provides potential advantages in reduction of schedule risk as well as possible cost savings to the project. The precast sections will be designed to be assembled from a few standardized panel sizes, to ease installation. The panels will be sized to be readily handled and transported by truck or rail or may be pre-cast on site prior to installation.

13.5.3.5.3 Service Buildings

Five service buildings along the inner perimeter of the Ring Building will be two-story structures with concrete exterior walls at the lower level supporting a braced steel frame for the second floor above. The concrete side walls will be designed for lateral earth pressure from the berms.

The second floor construction will typically consist of 20 GA – 2 in. thick composite steel deck with 3 in. lightweight concrete topping (total slab thickness = 5 in.) supported on framework of steel beams and girders.

The roof will be constructed of structural steel framing or open web steel joists supporting 20 GA – 1 ½ in. thick steel roof deck.

The first floor construction will consist of 6 in. thick slab on grade reinforced with 6x6 – W2.9 x W2.9 WWF over 6 in. of compacted granular fill and a vapor barrier. Final design of the first floor will be consistent with vibration mitigation needs of the facility.

Each service building will have a personnel labyrinth from the lower level into the ring tunnel. Additionally, an opening will be provided for installation of a large shield door (super door) for tunnel access for girders and other large assemblies as part of the technical facilities.

13.5.3.5.4 Linac Building

The Linac Building consists of the linac room and the klystron gallery.

The klystron gallery is a single-story structure with framed/braced structural steel construction. The roof will consist of a 20 GA - 1 ½ in. thick steel roof deck supported on structural steel beams and girders.

The linac room requires shielded walls and roof consisting of 1 m thick concrete. A personnel labyrinth will be proved at each end of the room for access.

The floor construction of both spaces will consist of 6 in. thick slab on grade reinforced with 6x6 – W2.9 x W2.9 WWF over 6 in. of compacted granular fill and a vapor barrier.

13.5.3.5.5 RF Building

This is a two-story structure with the RF area on the lower level and a mechanical/electrical equipment room above. It will have framed/braced structural steel construction. The roof will consist of a 20 GA 1 ½ in. thick steel roof deck supported on structural steel beams and girders.

The RF test room walls and roof will have radiation shielding consisting of 1 m thick concrete and a personnel labyrinth into the space will be provided.

The floor construction will consist of 6 in. thick slab on grade reinforced with 6x6 – W2.9 x W2.9 WWF over 6 in. of compacted granular fill and a vapor barrier.

13.5.3.5.6 Access Tunnel

There will be an access tunnel 20 ft wide and 14 ft high (clear height) that will go under the Ring Building for service vehicles. The tunnel retaining walls will be approximately 18 in. thick reinforced concrete walls and will also support the tunnel roof/Experimental Hall floor, which will consist of eight continuous one-way reinforced concrete slabs supported on concrete beams spanning between the tunnel walls.

13.5.3.6 Lateral Load Resisting System

Lateral loads will be mainly resisted by braced frames wherever possible, otherwise by moment frames where bracing location would become architecturally prohibitive.

13.5.3.7 Building Construction

13.5.3.7.1 Experimental Hall

The Ring Building exterior walls will be comprised of a built-up metal wall panel system with insulating batts and interior metal liner panel. The minimum thermal resistance of the system will be R-20.

The roof of the Ring Building will be a curved standing seamed metal roof system. The system will be comprised of the standing seamed roof over R30 rigid insulation, gypsum board sheathing, and structural metal roof deck.

The optional clerestory windows at the Ring Building will consist of 1 in. clear tempered insulated glass with a low-E coating in a thermally broken aluminum frame. The thermal transmission value for the glazing will be a U value of 0.30 in the summer and 0.30 in the winter. The visible light transmission will be 69% and the shading coefficient will be a maximum of 0.44. Clerestory windows will be an additive alternate but are not in the base scope.

The exterior doors of the Ring Building will be insulated hollow metal doors and hollow metal frames.

Acoustical treatments will line the ceiling and walls to maintain an acceptable noise level in the Experimental Hall.

13.5.3.7.2 Ring Tunnel

The ring tunnel will be constructed of poured in place or pre-cast concrete as described above in the Building Superstructure section.

13.5.3.7.3 Service Buildings

The service buildings' lower level will be constructed of poured in place concrete walls with a soil berm to the height of the second level. The second level exterior walls will be a built-up metal wall panel system with insulating batts and interior metal liner panel. The minimum thermal resistance of the system will be R-20.

The roof of the service buildings will be a TPO membrane roofing system. It will consist of a standing seamed roof over R30 rigid insulation, gypsum board sheathing, and structural metal roof deck.

The exterior doors of the service buildings will be insulated hollow metal doors and hollow metal frames.

Each service building will be provided with a 10 ft x 10 ft opening that may be filled with concrete block as portable shielding, or be used for a superdoor (borolated polyethelene-filled steel door) installation. The superdoors are not included in the conventional facilities portion of the project.

13.5.3.7.4 Linac and RF Buildings

The exterior walls of the Linac and RF Buildings will be 3 in. insulated metal wall panels, on a steel girt system. The minimum thermal resistance of the system will be R-20. Interior walls shared with the ring tunnel will be concrete of sufficient thickness to provide adequate radiation shielding.

The roof of these buildings will be a TPO membrane roofing system. It will consist of a standing seamed roof over R30 rigid insulation, gypsum board sheathing, and structural metal roof deck. In specific locations over the linac and the RF test room, shielding with 1 m thick concrete roof will be required.

The exterior doors of the Linac and RF Buildings will be insulated hollow metal doors and hollow metal frames.

13.5.3.8 Interior Finishes

13.5.3.8.1 Experimental Hall

The Experimental Hall will have the following interior finishes:

- Floor finishes – sealed concrete
- Exterior walls – factory-finished wall panels
- Interior walls – factory finished steel or concrete or gypsum board walls – painted
- Acoustic treatment on ceiling and walls
- Steel – painted
- Roof Structure – painted
- Doors – painted

13.5.3.8.2 Ring Tunnel

The ring tunnel will have the following finishes:

- Floor finishes – sealed concrete
- Interior and exterior concrete walls – painted
- Concrete roof structure – painted

13.5.3.8.3 Service Buildings

The service buildings will have the following finishes:

- Floor finishes – Sealed concrete
- Exterior wall – Factory-finished wall panels
- Interior and exterior concrete walls – painted
- Steel – painted
- Doors and frames– painted or factory finished.

13.5.3.8.4 Linac and RF Buildings

The Linac and RF Buildings will have the following finishes:

- Floor finishes – Sealed concrete
- Exterior wall – Factory-finished wall panels
- Interior walls – factory-finished steel or concrete or gypsum board walls – painted
- Steel – painted
- Roof Structure – painted
- Doors – painted

13.5.4 Lab Office Buildings (WBS 1.6.3.5)

13.5.4.1 Architectural Concepts

Five LOBs will be spaced around the exterior of the Ring Building. Four will be independent modules and one will be incorporated into the CLOB. The LOBs will be the primary entrance for many researchers. A focus on interactive spaces will provide an environment where collaboration is encouraged.

13.5.4.1.1 Alternatives – Building Configuration

Single-story buildings – Single-story buildings with labs along the Ring Building access corridor and offices and other spaces outboard of the labs. Ground level entrance from adjacent parking provides convenient access for research staff and visitors. This is the preferred alternative.

Two-story buildings – Two-story buildings with labs along Ring Building access corridor and offices above the labs on the second level. This alternative was not selected because of difficult circulation between labs and offices, and each LOB would require stairs and an elevator to meet ADA requirements.

Integral long beamlines – This concept was a single-story LOB design with integral beamline hutches built into the LOB to accommodate potential long beamlines. This configuration was not selected because the beamlines caused discontinuities in the LOB floor plan and because of the uncertainty of needing 100 m beamlines. Additionally, the LOB size had to increase to accommodate the hutches, adding cost to the conventional facilities.

13.5.4.1.2 Future Expansion

The five Lab Office Buildings are being designed with the intent of future expansion. Each LOB is being initially programmed to support six sectors, with one insertion device and one bending magnet beamline per sector. If additional beamlines are added by canting insertion device beamlines, the LOBs will need to expand to support these. The LOBs are designed to expand horizontally along the outside of the Ring Building as future need demands. Services to any expansion, including HVAC, plumbing, power, etc. will be added at the time of the expansion. They are not included in the initial scope of the project.

13.5.4.2 Space Program

Each LOB will contain 30 offices, 10 laboratory modules, a conference room, storage, a kitchenette, and a loading platform. The intent of the Lab Office Buildings is to provide support space for experimentation that is close to the beamlines. Each LOB will support six sectors in the Experimental Hall. The LOB will provide five offices for each supported sector. The five laboratories will be shared by all six sectors to minimize duplication of space requirements and lab equipment. Each laboratory will have direct access to the Experimental Hall access corridor via double doors for moving equipment between them.

13.5.4.3 Circulation

Each Lab Office Building will be one story high and have a parking lot adjacent to the building and an exterior entrance that will be the primary entrance for most researchers and visitors. Direct access to the Experimental Hall will be provided from the lobby/interaction area and will be a secure entrance. Equipment and materials will be brought into the building from a loading platform that will also allow equipment to be conveniently moved into the Experimental Hall. Pedestrian traffic to other LOBs or to the CLOB will be via the access corridor around the perimeter of the Ring Building.

13.5.4.4 Quality of Life

The Lab Office Buildings will be home to staff and visitors who frequently work long and irregular hours. The glass storefront exterior walls will bring natural light into the office space. The glass façade and the relatively small size of the LOBs will create a contrast to the massive form of the Ring Building and will break down the scale. Open space with comfortable seating will encourage cooperative interactions between research teams. Covered outdoor seating will provide additional space to unwind and interact. A kitchenette will include a sink, refrigerator, and microwave for preparing simple meals. Comfort facilities will include toilets and a shower in each LOB. The building materials and use of natural lighting will provide the Lab Office Buildings with a pleasant work environment.

13.5.4.5 Foundations

Foundations are expected to be spread footings for columns and continuous strip footings for walls, based on similar foundation system for the CFN Building in the immediate vicinity.

13.5.4.6 Building Superstructure

These are single-story structures with framed/braced structural steel construction. The roof will be a 20 GA 1 ½ in. thick steel roof deck supported on structural steel beams and girders. The use of steel beams/girders will provide better support for the mechanical roof top units.

The first floor construction will consist of 6 in. thick slab on grade reinforced with 6x6 – W2.9 x W2.9 WWF over 6 in. of compacted granular fill and a vapor barrier.

13.5.4.7 Building Construction

The exterior walls of the LOBs will be comprised of a 3 in. insulated metal wall and exterior metal stud system. The system will be comprised of the insulated metal panel, 6 in. exterior metal studs, and interior gypsum board. The minimum thermal resistance of the system will be R-24.

The roof of the LOBs will be a standing seamed metal roof system. The system will be comprised of the standing seamed roof over R30 rigid insulation, vapor barrier, and structural metal roof deck. There will be an AHU mezzanine within the roof space for air-handling equipment serving the LOB.

The curtain wall windows at the LOBs will consist of 1 in. clear tempered insulated glass with a low-E coating in a thermally broken aluminum frame. The thermal transmission value for the glazing will be a U value of 0.30 in the summer and 0.30 in the winter. The visible light transmission will be 69% and the shading coefficient will be a maximum of 0.44.

The exterior doors will be curtain wall aluminum insulated doors to match the windows or insulated hollow metal doors and frames.

13.5.4.8 Interior Finishes

The LOBs will have gypsum board walls with wood doors and hollow metal frames. The offices will have a side light or interior window to allow natural light into the interior spaces. The interior finishes of the LOBs are as follows:

- Floor finishes, office area and conference rooms – carpet tile
- Floor finishes, laboratories – sheet linoleum
- Floor finishes, lobby – porcelain ceramic tile
- Exterior walls - painted
- Interior walls, offices and labs – painted
- Interior walls, conference rooms – paint or wall coverings
- Ceiling system – suspended acoustical tiles and grid
- Doors – stained wood
- Door frames – painted

13.5.5 Structural Materials

This section covers structural materials for all buildings included in the NSLS-II scope. This includes work in WBS numbers 1.6.3.2 – Site Preparation, 1.6.3.3 – Central Lab Office Building, 1.6.3.4 – Ring Building, 1.6.3.5 – Lab Office Buildings, and miscellaneous structural materials for WBS 1.6.3.6 – Mechanical Utilities, and 1.6.3.9 – Electrical Utilities.

13.5.5.1 Concrete (normal weight, unless noted otherwise)

- Foundation and slab on grade: f'c = 4000 psi
- Piers, walls, grade beams, slabs and stairs on grade: f'c = 4000 psi
- Light weight concrete for Second Level Floor: f'c = 4000 psi
- High density concrete for radiation shielding: f'c = 4000 psi; density = 250 lb/ft^3 nominal

13.5.5.2 Reinforcing Steel

- Deformed: ASTM 615, Grade 60
- Welded wire fabric: ASTM A185

13.5.5.3 Structural Steel

- Wide flanges and tees: ASTM A992, Fy = 50 ksi
- Channels, angles and plates: ASTM A36, Fy = 36 ksi
- Steel pipes: ASTM A53, Type E or S, Grade B, Fy = 35 ksi
- Structural tubes: ASTM A500, Grade B, Fy = 46 ksi
- Anchor bolts: ASTM F1554, 3/4 in. dia. min.
- Bolts: ASTM A325, 7/8 in. dia. min.

13.5.6 Mechanical Utilities

This section includes all site mechanical utilities identified as WBS 1.6.3.6 as well as building mechanical utilities systems included as a part of WBS numbers, 1.6.3.3 – Central Lab Office Building, 1.6.3.4 – Ring Building, 1.6.3.5 – Lab Office Buildings.

13.5.6.1 Mechanical Systems

Mechanical HVAC and piping systems will be provided to meet the environmental control needs of NSLS-II. The following systems are included:

- General HVAC
- Accelerator tunnel HVAC
- Experimental Hall HVAC
- Linac and RF Buildings HVAC
- General exhaust – Experimental Hall
- General exhaust – Lab Office Buildings
- Chilled water
- Process Cooling Tower water
- Steam
- Condensate
- Heating water

Specific details of each of these systems are described below.

13.5.6.1.1 General HVAC

Scope/Major elements	Air handling units
	Ductwork and accessories
	Controls
Redundancy	No redundancy
Humidification type	Steam
Coverage	Central Lab Office Building
	Lab Office Buildings
	Service buildings
Materials of construction	
Plenum	Galvanized steel
Filters	30% pre-filters and 95% final filters
Coils	Copper
Ductwork and accessories	Galvanized steel, insulated

Air handling units serving the Central Lab Office Building and the Lab Office Buildings will be commercial grade units. They will have 2 in. double wall construction, galvanized steel interior liner, and stainless steel condensate drain pan. Air handling units will be located in enclosed penthouse or mezzanine areas on top of their respective buildings.

Air handling units will have return fan, relief air section, mixing section, 30 % pre-filters, 95% pre-filters upstream of coils, steam preheat coil, cooling coil, centrifugal fan, and humidifier.

All units will be installed in draw-through configuration providing good dehumidification and even air flow through the cooling coil.

Supply and return fans will be centrifugal, belt-driven and will have high efficiency airfoil blades and AMCA label. They will be dynamically balanced after installation on the job site. Air filters will be replaceable cartridge type with filter efficiencies based on NBS Atmospheric Dust Spot Method. Their sizes will be standardized 24 x 24 and 12 x 24 in. where possible. Supply and return fans of all air handling units will have Adjustable Frequency Drives. All air handling units will have economizer cycle controls.

13.5.6.1.2 Accelerator Tunnel HVAC

Scope/Major elements	Air handling units
	Ductwork and accessories
	Controls
Redundancy	No redundancy
Temperature control	±0.1 °C (±0.18 °F)
Humidification type	Steam
Coverage	Accelerator tunnel
Materials of Construction	
Plenum	Galvanized steel
Filters	30% pre-filters and 95% final filters
Coils	Copper
Ductwork and accessories	Galvanized steel, insulated

The building/accelerator tunnel HVAC systems consist of multiple air handling units located in the five service building Mechanical Equipment Rooms (MER), each servicing one fifth of the tunnel circumference. The tunnel supply and return ducts are shown in Figure 13.5.1 and the corresponding HVAC equipment in the MER is shown in Figure 13.5.2. The air handling units will have 2 in. double wall construction, galvanized steel interior liner, and stainless steel condensate drain pan. The AHU serving the tunnel will include a return fan, relief air section, outside air intake, 30% pre-filter, 95% final filter, steam preheat coil, cooling coil, supply fan, humidifiers, hot water reheat coil, and duct-mounted low heat density electric reheat coil for final accurate temperature control and an SCR controller. The supply and return fans will have Adjustable Frequency Drives (AFD) for future flexibility and to provide ease of adjustment during balancing. Air will be cooled to as low as 50°F for proper dehumidification, and reheated to required discharge temperature. Cooling temperature will be reset based upon tunnel relative humidity to maintain RH setpoint and save energy. Most of the reheat will be with hot water. The final discharge temperature will be controlled by electric reheat coils responding to duct sensors in the main supply duct. Tunnel sensors will reset the discharge temperature setpoint to maintain the tunnel section temperature.

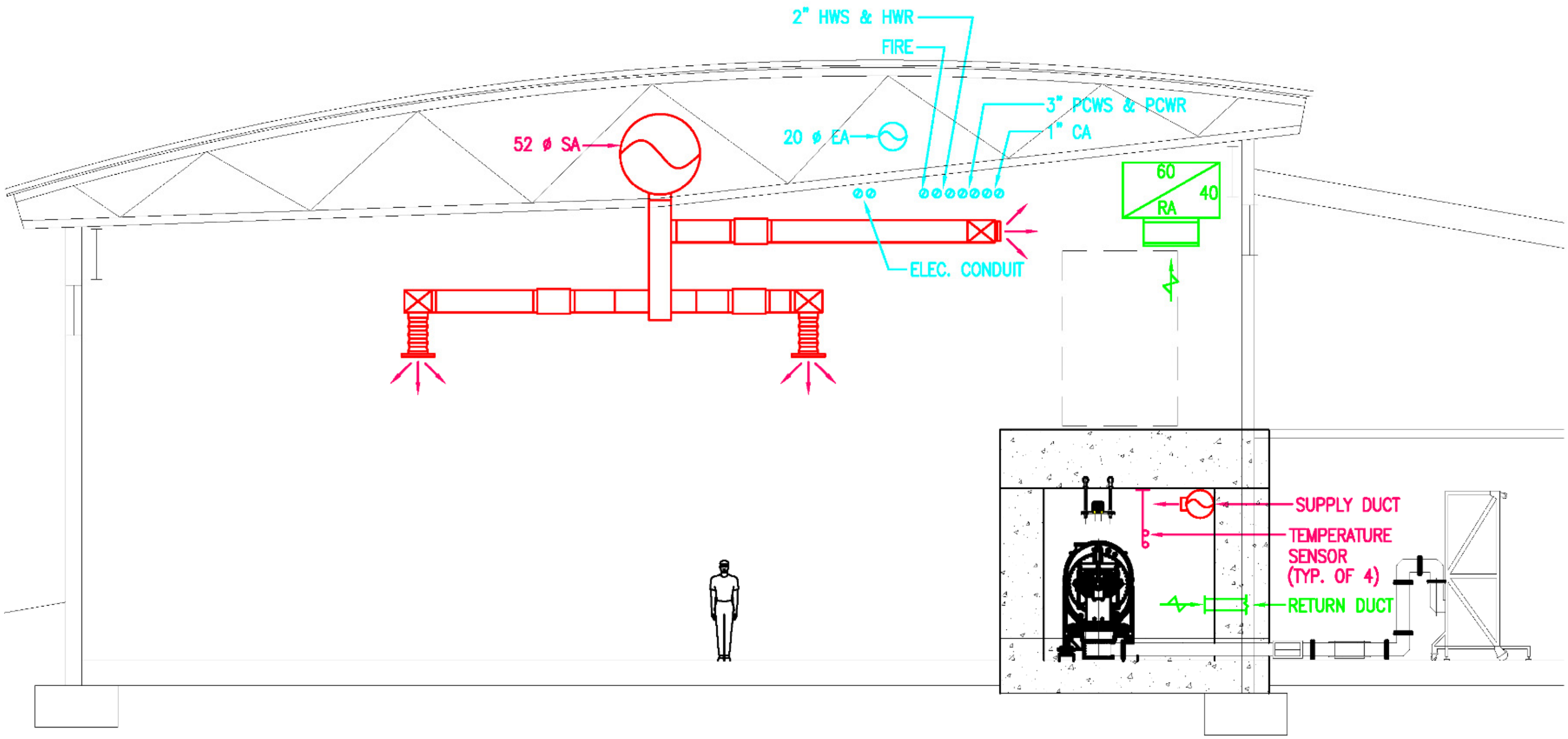

Figure 13.5.1 Cross-section view of Experimental Hall and storage ring tunnel HVAC supply and return ducts.

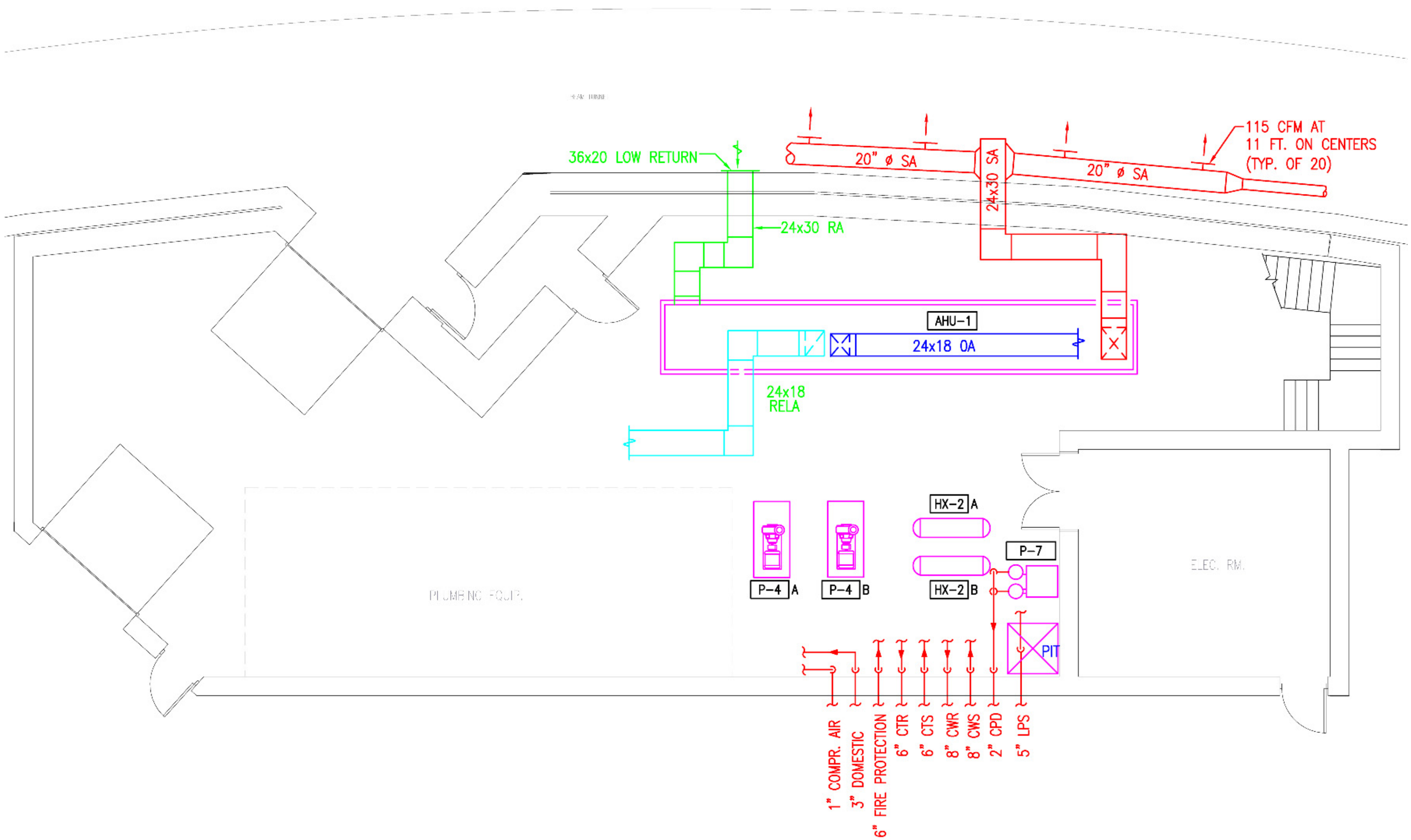

Figure 13.5.2 HVAC units servicing accelerator tunnel, located in lower level of MER.

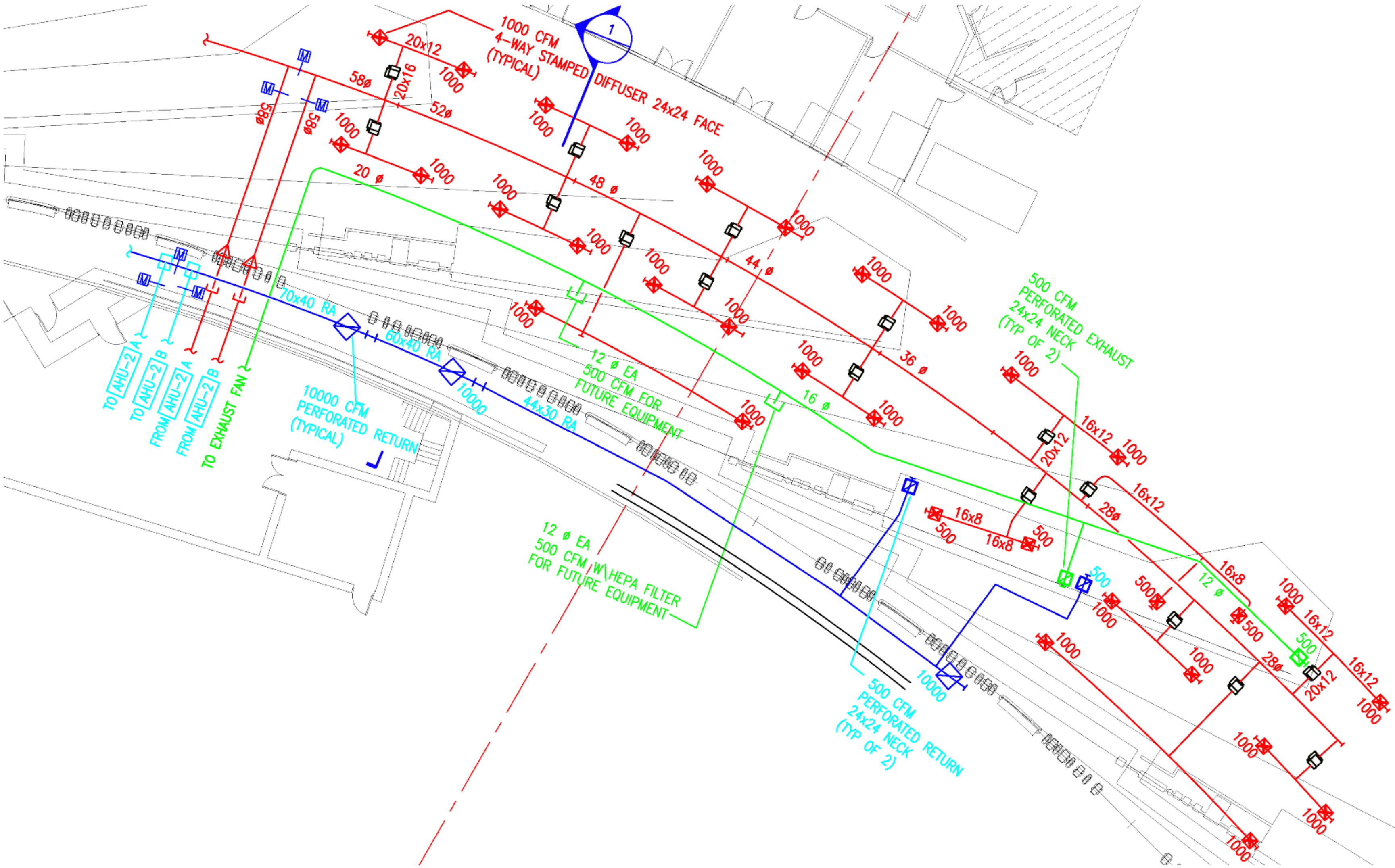

Figure 13.5.3 Floor plan layout of one half of HVAC supply and return ducts for Experimental Hall from AHU in one MER.

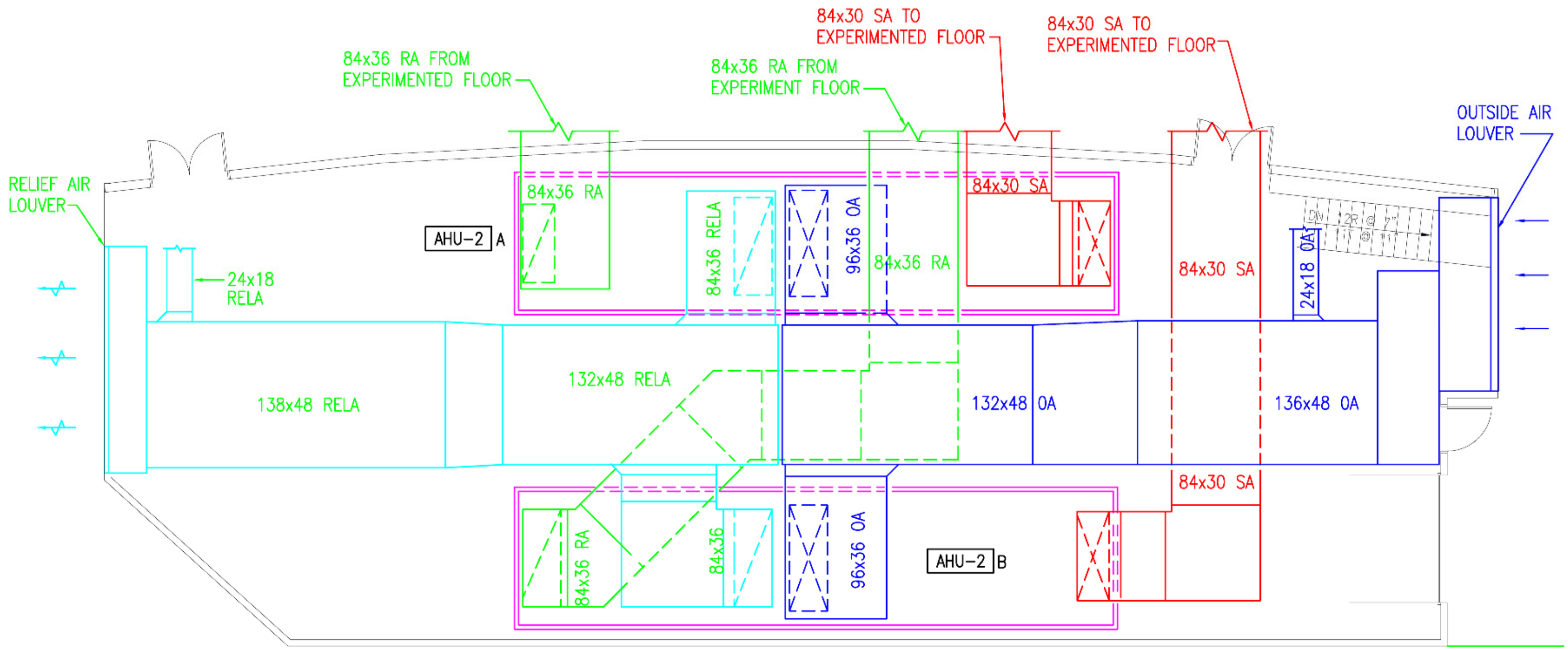

Figure 13.5.4 HVAC units servicing Experimental Hall, located in upper level of MER.

13.5.6.1.3 Experimental Hall HVAC

Scope/Major elements	Air handling units
	Ductwork and accessories
	Controls
Redundancy	No redundancy
Temperature control	±1.0 °F
Humidification type	Steam
Coverage	Experimental Hall
Materials of construction	
Plenum	Galvanized steel
Filters	30% pre-filters and 95% final filters
Coils	Copper
Ductwork and accessories	Galvanized steel, insulated

The Experimental Hall HVAC systems consist of multiple air handling units located in the five service building Mechanical Equipment Rooms (MER), each serving one fifth of the Experimental Hall. A radial cross-section view of the Experimental Hall supply and return ducts is shown in Figure 13.5.1 and the floor plan layout of one half of the HVAC supply, return, and exhaust ducts is shown in Figure 13.5.3. The corresponding HVAC equipment in the MER is shown in Figure 13.5.4.The AHUs will have 2 in. double-wall construction, galvanized steel interior liner, and stainless steel condensate drain pan. The potential for using heavier construction to minimize noise and vibration will be evaluated further in Title I design. The air-handling units will include return fan, relief air section, outside air intake, 30% panel filter, 95% pre-filter, steam preheat coil, cooling coil, supply fan, humidifiers, hot water reheat coil, and sound attenuators. The supply and return fans will have Adjustable Frequency Drives (AFD). Air will be cooled to as low as 50°F for proper dehumidification, and reheated to required discharge temperature. Temperature control in the Experimental Hall will be achieved using VAV boxes with hot water reheat coils.

The building/accelerator tunnel HVAC systems consist of multiple air handling units located in the five service building Mechanical Equipment Rooms (MER), each servicing one fifth of the tunnel circumference. The tunnel supply and return ducts are shown in Figure 13.5.1 and the corresponding HVAC equipment in the MER is shown in Figure 13.5.2.

13.5.6.1.4 Linac and RF Building HVAC

Scope/Major elements	Air handling units
	Ductwork and accessories
	Controls
Redundancy	No redundancy
Temperature control	±1.0°F
Humidification type	Steam
Coverage	Linac and RF Buildings
Materials of construction	
Plenum	Galvanized steel
Filters	30% pre-filters and 95% final filters
Coils	Copper
Ductwork and accessories	Galvanized steel, insulated

The Linac and RF buildings will be served by an air handling unit to provide fresh air ventilation and provide cooling to the space. The unit will be sized for 6 air changes per hour but will normally deliver two air changes per hour. Air handling units will have direct chilled water cooling.

13.5.6.1.5 General Exhaust – Experimental Hall

Scope/Major Elements	Exhaust fans
	Ductwork and accessories
Redundancy	N+1
Coverage	Experimental Hall - beamlines
	Hazardous material storage
	Other areas requiring exhaust
Materials of Construction	
Ductwork and accessories	Galvanized steel, insulated

Exhaust for the Experimental Hall will be provided by 10 exhaust fans – 2 in each service building. Each set of two fans will be tied together to provide full redundancy. Exhaust branches will have flow control devices to minimize balancing requirements as new loads are brought on line. This system will be available to provide general exhaust for the Experimental Hall, hutches, chemical storage cabinets, and specific equipment as needed. Other special exhaust requirements will be addressed individually as they are identified.

13.5.6.1.6 General Exhaust – Lab Office Buildings

Scope/Major elements	Exhaust fans, non-sparking
	Ductwork and accessories
Redundancy	N+1
Coverage	Laboratories with fume hoods
	Hazardous material storage
	Mechanical equipment rooms
	Toilets and showers
	Other areas requiring exhaust
Materials of construction	
Ductwork and accessories	Galvanized steel, insulated

Each Lab Office Building, including the CLOB, will be provided with an independent exhaust system. General exhaust mains and hood exhaust branches will have flow control devices to minimize balancing requirements during future changes. Exhaust fans will discharge the air at high velocity to prevent re-circulation. In each LOB, one of the laboratory exhausts will be HEPA filtered. Fume hood and hazardous materials storage cabinet exhaust systems will be segregated from toilet and general room exhaust systems.

13.5.6.1.7 Chilled Water

Scope/Major elements	Piping and accessories
Redundancy	Redundant chillers and pumps provided at the Central Utility Plant
Capacity	2400 ton peak load
Chilled water supply temperature	45°F
Chilled water return temperature	57°F
Differential pressure	35 psig
Piping velocity	4-6 FPS maximum
Coverage	Tunnel and Experimental Hall AHUs
	General air handing units – CLOB & LOB
Process cooling water heat exchangers	
Materials of construction	
Piping	Carbon steel, insulated
Valves	Butterfly or globe, carbon steel

The central chilled water system has primary pumps associated with each chiller in the central utility building and secondary pumps to circulate chilled water through the campus distribution system. The NSLS-II facility will be served by 24 in. chilled water supply and return fed by the campus distribution system. There will be no tertiary pumping in the building. Secondary chilled water pumps will have AFDs. Chilled water will enter NSLS-II and will be distributed underground in the interior annulus of the building and distributed underground to each service building. A flow meter will be located at the building entry point to monitor total chilled water flow to NSLS-II. Chilled water will serve air handling units, process cooling water heat exchangers, and miscellaneous cooling equipment. See Figure 13.5.5 for the location and routing of chilled water utilities to the site.

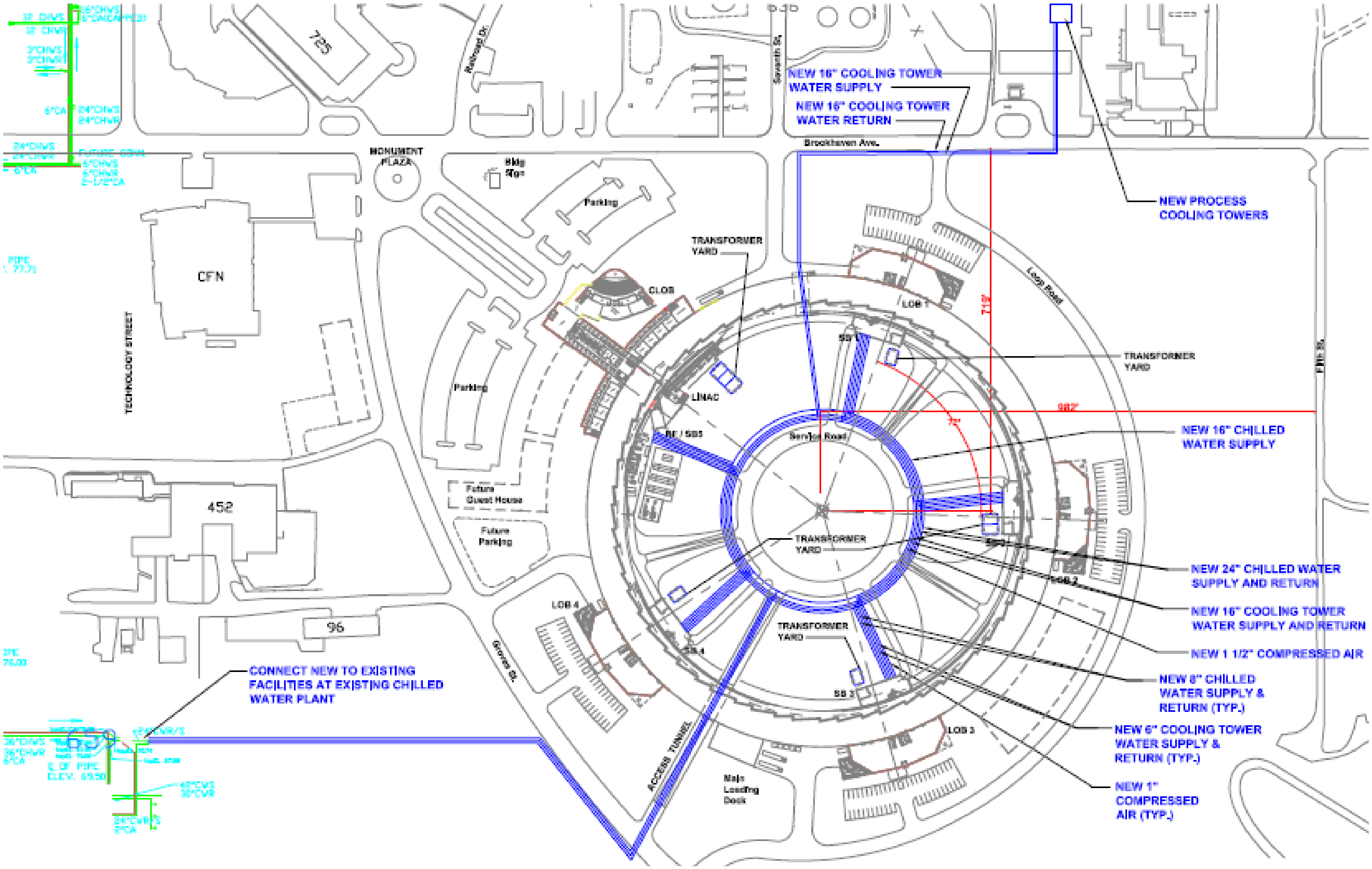

Figure 13.5.5 Chilled water utility plan.

13.5.6.1.8 Process Cooling Tower Water

Scope/Major Elements	Cooling towers
	Pumps
	Mechanical strainers/ side stream filtration
	Piping and accessories
Redundancy	N+1 tower cells and pumps
Capacity	2700 Ton peak load (three cells at 1350 ton each)
Tower water supply temperature	82°F
Tower water return temperature	97°F
Make-up source	Potable water
Coverage	Process cooling water system
Materials of Construction	Galvanized steel with "Baltibond" finish, PVC fill
Basins	Stainless steel
Fans	GRP
Piping	Carbon steel
Valves	Butterfly or globe, carbon steel
Pumps	Bronze impeller
	Carbon steel shaft
	Cast ion casing
Filters	Carbon steel shell and mesh
	Freeze protection, AFD for fans

The process cooling tower water system will provide primary cooling for the process cooling water system. This system will be designed to operate year-round. The process cooling water heat exchangers and piping systems are not part of conventional construction.

13.5.6.1.9 Steam

Scope/Major elements	Underground steam piping in conduit
	Pressure reducing valve (PRV)
	Hot water generator
	Humidifiers
	Piping and accessories
Redundancy	Dual PRV station
Capacity	17,000 lb/hr
Steam supply pressure in two stages	125 psig reduced to 15 psig in the service buildings
	125-50 psig; 50-15 psig
Coverage	AHUs in Ring Building, LOBs, and CLOB
	Hot water generator
Materials of Construction	
Piping	Carbon steel, insulated
Valves	Gate or globe, carbon steel
Heat exchanger	Carbon steel shell, copper tubes

Steam is available at the site from the Central Steam Plant at 125 psig and will be reduced to 15 psig at NSLS-II. The estimated peak steam load of the new building is 17,000 lbs/hr. The size of the underground steam supply into the building is 6 in. Steam flow will be measured for energy calculations. See Figure 13.5.6 for routing of steam and condensate utilities.

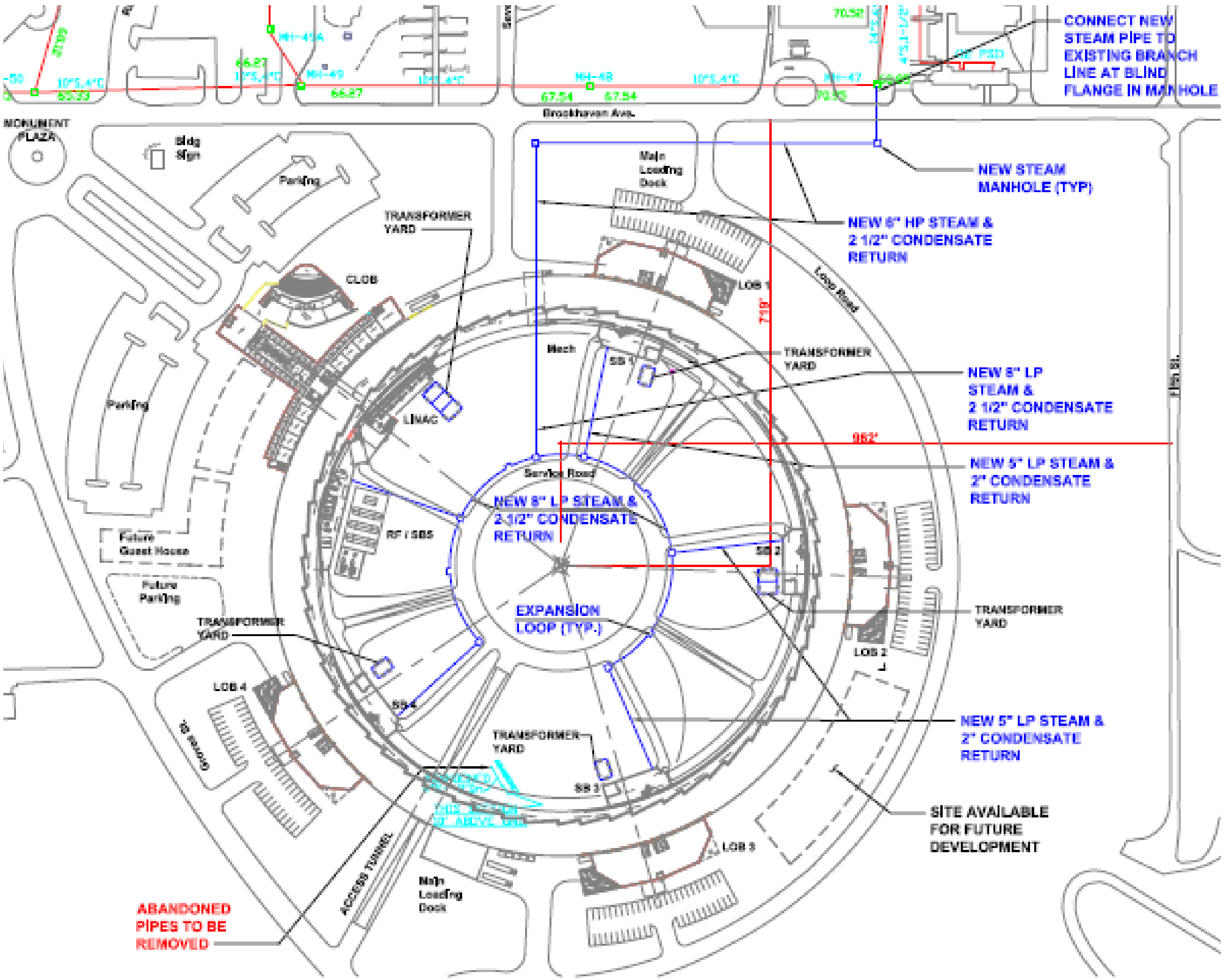

Figure 13.5.6 Steam Utility Plan.

13.5.6.1.10 Condensate

Scope/Major elements	Receivers
	Piping and accessories
Redundancy	Duplex pumping sets
Coverage	AHUs in Ring, LOBs, and CLOB
	Hot water generator
Materials of construction	
Piping	Sch. 80 carbon steel, insulated
Valves	Globe, carbon steel

The condensate will be collected in duplex receivers and returned to the Central Steam Plant via the site 40 psig pumped main in a 3 in. schedule 80 carrier pipe.

13.5.6.1.11 Heating Water

Scope/Major elements	Heat exchangers
	Pumps
	Piping and accessories
Redundancy	N+1 equipment
Capacity	
Heating water supply temperature	180°F
Heating water return temperature	160°F
Piping velocity	4-6 FPS maximum
Coverage	Tunnel and Experimental Hall AHUs
	CLOB and LOB
Service buildings	
Materials of construction	
Heat Exchanger	Copper tubes, carbon steel shell
Piping	Carbon steel, insulated
Valves	Butterfly or ball, carbon steel
Pumps	Bronze impeller
	Carbon steel shaft
	Steel Casing

Steam will be used to produce heating water in shell and tube heat exchangers located in the service buildings. Heating water will be distributed to the terminal re-heat coils.

13.5.6.2 Plumbing Systems

13.5.6.2.1 Potable Water

Scope/Major elements	Water heaters
	Piping and accessories
	Safety showers/ eye washes
Redundancy	Two mains, with multiple connection points to the site system will connect to form a looped system feeding the building.
Cold water supply temperature	Ambient
Hot water supply temperature	See Narrative below
Coverage	Experimental Hall
	CLOB
	LOB
Service buildings	
Materials of construction	
Piping	4 in. and over: Ductile iron, cement lined (buried)
	3 in. and under: Copper (above ground)
Valves	Ball, globe or gate, bronze
Pumps	Stainless steel impeller, shaft
	Mechanical seals
	Ductile iron casing
Tanks	Galvanized steel (storage)
	Stainless steel or glass lined (water heaters)
Remarks	Disinfected to code requirements

The existing potable water system along the north of the site along Brookhaven Avenue connects to a 12 in. line at North Sixth Street. The 8 in. line parallel to Seventh Street will be relocated away from the footprint of the NSLS-II buildings. A new 8 in. water line will be constructed under the parking lot to the west of the building footprint and reconnect to the Seventh Street line south of the site. See Figure 13.5.7 for location of potable tie-in points and routing of piping.

One tie-in will be installed in the 12 in. line at Brookhaven Avenue and North Sixth Street. The second tie-in will be to the 8 in. relocated line west of Seventh Street. These two 8 in. lines will feed the potable water loop in the Ring Building infield.

A section of the 8 in. water line east of Groves Street interferes with the proposed location of the future Guest House building footprint. This line will also need to be relocated for the Guest House to be constructed.

Potable water serving the facility will be used for both the domestic and laboratory plumbing fixtures and equipment. The available pressure is estimated at 60 PSI. All mains into the building will be protected by a backflow prevention device. Water filtration will be at point of use if needed.

Laboratory faucets will incorporate integral vacuum breakers, and make-ups to mechanical and laboratory equipment will be provided with appropriate backflow prevention devices.

Domestic hot water will be provided at each laboratory building MER and include a circulated piping system. Hot water will be produced by a storage type electric water heater. The hot water will be stored at 140°F and distributed to lavatories and laboratory fixtures at 120°F through a thermostatic mixing valve.

A tempered (85°F) water distribution piping system will be provided through a thermostatic mixing valve and used as the source for the emergency fixtures located throughout each laboratory building. The system will be circulated.

Type "L" copper tubing with wrought copper or cast brass fittings and solder joints will be the pipe material. The pipe joints will be formed with 95-5 tin-antimony solder or code approved "lead free" solder and flux having a chemical composition equal to or less than 0.2-percent lead. Piping 2 in. and smaller may be joined with fittings utilizing a copper crimping system such as the Rigid/Viega ProPress System. 2½ in. piping and over may be schedule 40 galvanized steel with threaded or mechanical couplings (Victaulic style connections). The piping will be insulated with fiberglass pipe insulation having an all service jacket and self-sealing lap.

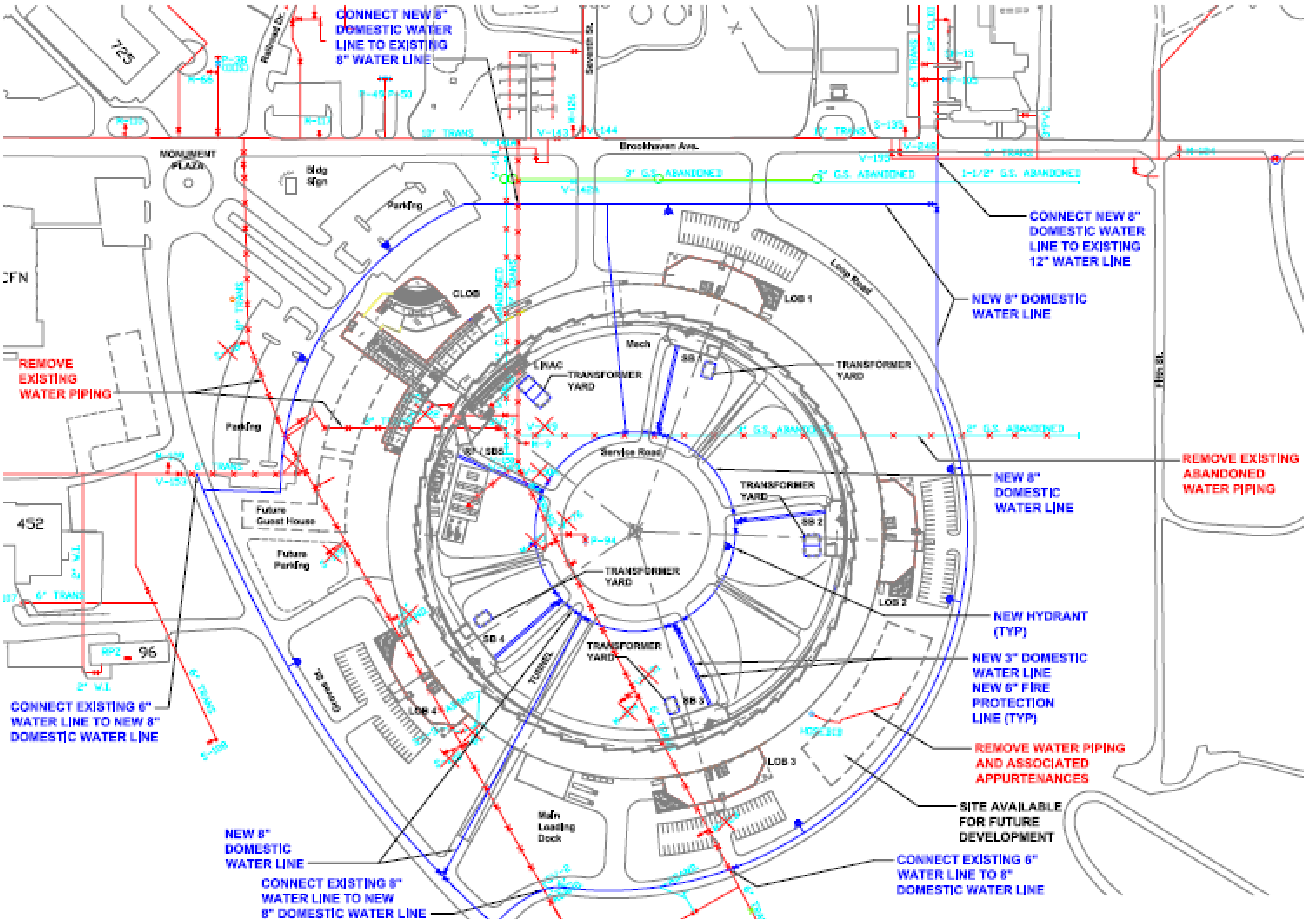

Figure 13.5.7 Potable Water Utility Plan.

13.5.6.2.2 Sanitary

A new 10 in. sanitary line will be constructed in the proposed parking lot to the west of the existing sewer. The new line would extend as a gravity line to just east of Groves Street and be located to the north of the future Guest House. The extension of the existing system to the south includes an underground pumping station, which is located in close proximity to the proposed layout of the outer ring road. The pumping station would be relocated to just to the east of Groves Street and a forced main would connect to the new 10 in. sanitary line. Construction would involve roughly 1000’ of 10 in. sanitary sewer, 2000’ of 6 in. sanitary sewer, 500 ft of 6 in. force main and one new underground pumping station.

13.5.6.3 Process Systems

Process systems will be provided to NSLS-II to meet the needs of the accelerator, beamlines, and laboratories. The following process systems are included:

- Nitrogen
- Liquid nitrogen
- Compressed air
- Deionized water
- Deionized water make-up (technical facilities)
- Process Cooling Water (technical facilities)

13.5.6.3.1 Nitrogen

Scope/Major elements	Site nitrogen skid, evaporator
	Piping and accessories
Redundancy	None
Supply pressure	100 psig
Coverage	Experimental Hall
	Central Lab Office Building
	Lab Office Buildings
Materials of construction	
Piping	Type L hard-drawn copper, oxygen cleaned
Valves	Ball, full port, brass, 3-piece, oxygen cleaned

The source for gaseous nitrogen will be vaporizers installed at the liquid nitrogen tank. Primary distribution will occur in the Ring Building. Secondary mains serving the lab/office buildings will be valved to permit isolation for maintenance and modifications. Branches serving individual laboratory modules will be valved.

Piping material will be type L copper tubing with wrought copper fittings and solder joints utilizing 95-5 tin-antimony solder.

The gaseous nitrogen distribution system will be designed to maintain a maximum pressure drop of 10-percent from the point of discharge to the farthest outlet.

13.5.6.3.2 Liquid Nitrogen

Scope/Major elements	Site nitrogen skid
	Piping and accessories
Redundancy	None
Coverage	Experimental Hall
	RF Building
Materials of construction	
Piping	Vacuum jacketed

Liquid nitrogen will be stored in a centrally located tank (location to be determined). Primary distribution will occur in the Ring Building with connection points available for beamline use. Filling stations will be provided at each lab/office building to permit dewars to be filled.

The piping distribution system will be through vacuum jacketed piping with either a dynamic or static vacuum. The piping shall contain an inner carrier tube and an exterior jacket. The annular space shall be under vacuum and have appropriate spacers. The system components (piping, fittings, valves, etc.) shall be products manufactured by, or provided by, a single manufacturer and not built up assemblies.

13.5.6.3.3 Compressed Air

Scope/Major elements	Filter / dryer skids
	Piping and Accessories
Redundancy	100 scfm oil free back-up compressor / dryer skid
Capacity	100 scfm
Supply pressure	100 psig from site system
	95 psig after regulator
Quality	Oil free
Moisture	-20°F dew point
Particulate	1 micron
Coverage	Experimental Hall
	Central Lab Office Building
	Lab Office Buildings
	Service buildings
Materials of construction	
Piping	Hard-drawn copper, brazed
Valves	Ball, full port, brass

The source for the laboratory compressed air will be the site wide 100 PSIG system. The site system is oil free, filtered, clean, and dried to minus 20°F dew point.

To assure clean, dry compressed air delivery to the laboratories, the incoming service will be provided with a 1 micron coalescing filter to collect moisture and/or particulates originating in the site distribution piping. The filter will be designed to remove all particulates 1 micron and larger, and 100% of liquid water. A pressure regulator will be installed downstream of the filter and set for a discharge pressure of 95 PSIG. Individual connection points for personnel use will be provided with a regulator set limiting the pressure to 30 psig.

Piping for the system will be Type L copper tubing (ASTM B819) with wrought copper fittings and brazed joints. All components including valves will be cleaned for oxygen service and capped and/or bagged by the manufacturer for delivery to the site for installation. Assembly will be with brazing filler alloy without the use of flux.

13.5.6.3.4 Deionized Water

Scope/Major elements	DI water
	Point-of-use systems
Redundancy	
Capacity	
Supply temperature	78 F
Supply pressure	
Make-up water source	Potable water make-up system
Coverage	Lab Office Buildings Laboratories
Water quality	
Resistivity	1 mega-ohm/cm (min)
Materials of construction	
Piping	Sch. 80 polypropylene
Tanks	GRP, stainless steel
Valves	Diaphragm or ball, polypropylene
Pumps	Stainless steel

Each Lab Office Building that requires DI water as a consumable will be provided with a separate point-of-use water system. The system will include polishing, storage, and distribution components. Point-of-use polishing units will be installed in the laboratory designated for “wet use” in each LOB.

13.5.6.3.5 Deionized Water Make-up

Scope/Major elements	Pre-treatment plant
	DI water plant
DI water polishing skid	
	Pumps
	Piping and accessories
Redundancy	N+1 equipment
Capacity	TBD
Supply temperature	Ambient
Make-up water source	Potable water
Coverage	Process cooling water systems
	Deionized water system
Water quality	
Resistivity	1 mega-ohm/cm (min)
Materials of Construction	
Piping	Sch. 80 polypropylene
Tanks	GRP, stainless steel
Valves	Diaphragm or ball, polypropylene
Pumps	Stainless steel

The deionized water make-up system provides deionized quality water to both the DI water system used as a consumable in laboratories and to the process cooling water systems. The deionized water make-up system is included in the Technical Construction portion of the NSLS-II project. It is discussed in the Conventional Facilities chapter of the CDR for coordination purposes.

13.5.6.3.6 Process Cooling Water

Scope/Major elements	Heat exchangers
	Pumps
Filters	
	Piping and Accessories

The Linac, Aluminum and Non-Aluminum Process Cooling Water systems are included in the Technical Construction portion of the NSLS-II project. They are discussed in the Conventional Facilities chapter of the CDR for coordination purposes.

The process cooling tower water system will reject the majority of the process loads captured by the process water systems. Chilled water will be used to finely control the cooling water temperature. Plate and frame heat exchangers located in the MER spaces will reject heat to both the process cooling tower water system and the chilled water system. Process cooling water piping will be distributed around the perimeter of the Ring Building. Chilled water piping will be insulated to prevent condensation at low supply water temperatures. Cooling tower water and process cooling water systems will not require insulation.

13.5.6.4 Fire Protection Systems

13.5.6.4.1 Fire Water

Scope/Major elements	Fire water main
	Hydrants
	Piping, sprinkler heads and accessories
Redundancy	System loop is fed from two connection points to the site system
Capacity	Per Code
Coverage	Entire NSLS-II complex
Hazard classifications	
Accelerator tunnel	See narrative
Experimental Hall	See narrative
Office / Public spaces	Light hazard
Utility areas	See narrative
Gas cabinets	See narrative
Chemical storage areas	Extra hazard (Group 2)
Fire hose allowance	Per NFPA 13
Fusible link rating	As required for application
Minimum supply pressure	Main: TBD
Materials of construction	
Piping	Ductile iron, cement lined (buried)
	Sch. 40 black steel (above ground)
Valves	Butterfly or OS&Y
Pumps	

Two 8 in. fire services with post indicator valves will be extended from the site water mains. The actual available pressure has not been verified at this time. Fire flow data will be obtained during design. Each service will be provided with an Underwriters Laboratory and Factory Mutual listed reduced pressure backflow prevention device. A single combined full size bypass with a normally closed valve will also be provided. An additional site main will be extended below the building through a basement utility vault to the ring interior and provide the supply to fire hydrants located within the enclosed area.

A sprinkler system will be designed to provide 100-percent protection of the facility. Where the piping installation will be subject to freezing temperatures, dry sprinklers will be employed.

Interior piping will be Schedule 40 steel pipe. No other piping material will be acceptable. The piping will be joined by welding, threaded fittings, or cut groove fittings and couplings. Pipe and fittings used in dry pipe portions of the system will be galvanized inside and outside.

Unless otherwise indicated, the entire sprinkler system will be designed as an Ordinary Group 1 Hazard occupancy with 0.15 GPM/SF density. The remote hydraulic area will be calculated at 2500 ft^2.

A fire standpipe system is not required for this facility based on the Building and Fire Codes of New York State. However, per BNL's standards, 2-1/2 in. fire department valves connected to the sprinkler mains will be installed in each of the stair towers. The 2-1/2 in. fire department valves will have 2-1/2 in. x 1-1/2 in. reducers. Additional fire department valves may be located as required to achieve additional coverage.

Fire hydrants will be located along the Loop Road outside of the Ring Building and along the Service Road inboard of the Ring Building at distances meeting DOE and code requirements and not more than 300 ft from all building entrances.

13.5.6.5 Automatic Temperature Controls

NSLS-II will have an automatic temperature control system serving all buildings within the complex. The system shall be compatible with the existing WebCTRL Energy Management System (EMCS) as manufactured by Automated Logic Corp. The system shall have calibrated precision instruments for all critical environmental control points. The system shall interface with the EPICS-based control system utilized for control of accelerator systems.

13.5.7 Electrical Utilities

This section includes all site Electrical Utilities identified as WBS 1.6.3.9 as well as building electrical utilities systems included as a part of WBS numbers, 1.6.3.3 – Central Lab Office Building, 1.6.3.4 – Ring Building, 1.6.3.5 – Lab Office Buildings. See Figure 13.5.4 for location of electrical utilities to the NSLS-II site.

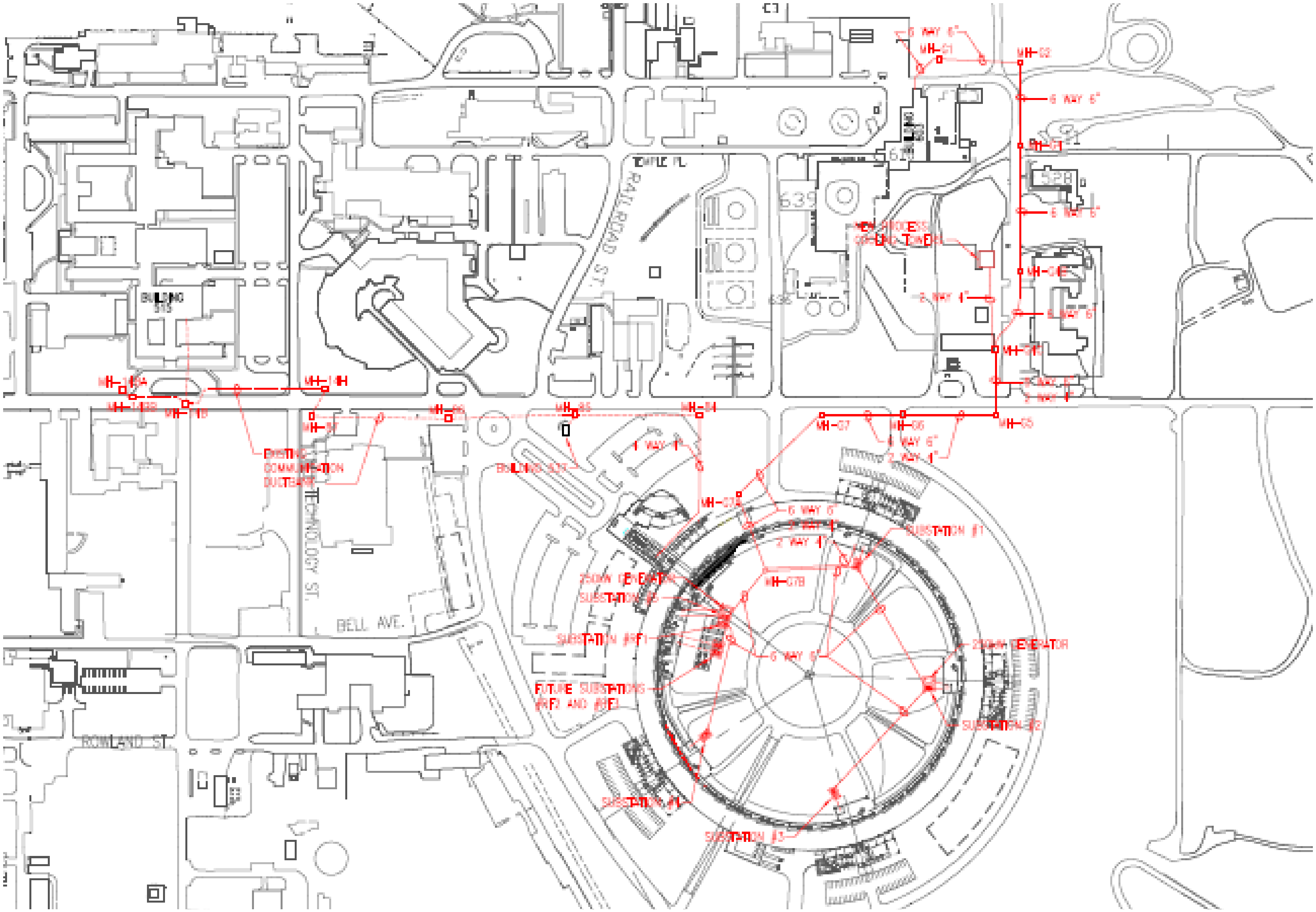

Figure 13.5.8 Electrical Site Utilities Plan

13.5.7.1 Site Utilities

13.5.7.1.1 Relocation and/or Demolition of Existing Utilities:

The scope of relocation and/or demolition of existing electric and communication utilities will be based on a utility survey and the final building footprint. At this time, it is assumed that existing utilities around the perimeter of the site are active and will remain, and that utilities across the site are abandoned and will be removed where they cross under the footprint of the building.

13.5.7.1.2 Power

Building 603, Campus Substation Expansion

The Building 603 campus substation will be expanded to include a fourth transformer to support the NSLS-II project.

The existing 69 kV substation yard will be modified to serve the new equipment. The two existing 69 kV potential transformers will be relocated. A new 69 kV SF6 breaker and a new 20.0/26.7/29.9 MVA, 66.0-13.8 kV transformer will be provided. A new fire separation wall will be provided between the existing transformer #3 and the new transformer.

Within Building 603, the existing walls around the storage room will be removed and a new 275 ft^2 addition with a roll-up door will be provided to house the relocated supplies.

The new Bus 0 15 kV SF6 metal-clad switchgear will be located over the existing cable trench and adjacent to the existing Bus 2 switchgear.

The Bus 0 switchgear will include a 2000 A main breaker, three 2000 A tie breakers to Bus 1, Bus 2, and Bus 3, one 1200 A outgoing breaker to feed the NSLS-II project, and three cells for future 1200 A outgoing breakers.

A new 2000 A tie breaker will be provided in each of the existing Bus 1, Bus 2, and Bus 3 switchgear lineups.

Modifications to existing switchgear will match their respective manufacturer’s standards.

2000 A, 15kV busway will be utilized between the new transformer and the new switchgear, and to interconnect the new switchgear to each of the existing lineups.

Campus Distribution

The primary distribution system will be configured in a primary selective scheme. However, only one feeder will be provided with the base construction. The second feeder and new ductbank from Building 603 to MH-5E will be provided as an alternate or at some time in the future.

A new 800 A feeder consisting of two sets of 3-1/C, 1000 kcmil, 15 kV, 100% EPR copper conductors will be routed through the existing manhole and ductbank system from the Bus 0 switchgear in Building 603, along North Sixth Street to existing manhole MH-E5 at the intersection of Brookhaven Avenue and North Sixth Street. 100% insulation is provided in order to utilize the existing 5 in. ducts.

NSLS-II Site Distribution

An eight-way 5 in. concrete-encased ductbank will be routed from manhole MH-E5 to a manhole in the infield of the Ring Building via the basement utility room. A six-way 5 in. ductbank will than be routed around the infield interconnecting all the substations. Three ducts will serve the “A” switches and three ducts will serve the “B” switches of the primary selective switchgear. An 800 A feeder consisting of two sets of 3-1/c, 1000 kcmil, 15 kV, 100% EPR copper conductors will be routed from MH-5E to the “A” switch of each substation. A 480 V feeder in two 4 in. ducts (minimum one spare) will be provided from switchgear #1 to the process cooling tower facility on the north side of Brookhaven Avenue via MH-E5B, E5A, E5, and E4.

One substation will be located at each service building 1 through 4. Two substations will be located at service building 5, which is associated with the Central Lab Office Building and the Linac and RF Buildings.

Each substation will consist of a primary switchgear, a 13,800-480Y/277 V, 2000, 2500, or 3000 kVA oil-filled substation type transformer, and a secondary air terminal section. The primary gear will be 15 kV outdoor, non-walk-in metal-enclosed switchgear with a key-interlocked duplex switch in series with one set of fuses. Each transformer will be triple rated 55˚ OA, 65˚ OA, and 65˚ FA. A ductbank and secondary feeder will be extended from the secondary air terminal cabinet to the switchgear located in the main electrical room of each service building.

13.5.7.1.3 Telephone and Data Communication

A new four-way 4 in. concrete-encased ductbank will be provided from existing manhole MH-84 to the BDF room in the Central Lab Office Building. The ductbank will be used for both copper and fiber optic cables.

Copper cables will be routed from Building 537 to the BDF via manholes MH-84 and 85.

Fiber optic cables will be routed from Building 515 near the intersection of Brookhaven Avenue and Rochester Street through existing ductbanks and manholes MH-14B, 14H, 87, 86, 85, and 84 and through the new four-way 4 in. ductbank from MH-84 to the BDF.

13.5.7.1.4 Street Lighting

New street lighting, matching the Brookhaven standard, will be provided along Brookhaven Avenue between Groves Street and the last vehicle entry point into the site, and along Groves Street between Brookhaven Avenue and its last vehicle entry point into the site. Lighting will also be provided in the parking lots, major pedestrian walkways, and the entrance to the CLOB.

The street lights will be circuited to building lighting panels via the building low-voltage lighting control panels.

13.5.7.2 Normal Power Distribution

13.5.7.2.1 Service Buildings Power Distribution

One 3000 A or 4000 A, 480Y/277 V, 3-phase, 4-wire switchgear will be located in each of the five service building main electrical rooms. A sixth switchgear will be located in the main electrical room of the service building associated with the Linac/RF Building. Each switchgear will include a main breaker section, and two or more distribution sections. The main sections will contain a drawout power air circuit breaker, CTs, digital meter with communication, and surge suppression equipment. Feeder devices in the distribution sections will also be drawout power air circuit breakers.

480 V distribution panels will be located in the mechanical rooms to serve mechanical equipment.

Lighting and receptacle panels will be located in the main electrical room to serve fixtures and devices within the service building.

13.5.7.2.2 Tunnel and Tunnel Mezzanine Power Distribution

Most of the equipment that supports the booster ring and storage ring is located on the mezzanine above the tunnel and operates at 208 V. With the large number of circuits, three double section 208Y/120 V branch circuit panelboards will be provided to serve the equipment racks housing the single magnet power supplies, vacuum instrumentation, tunnel instrumentation, and insertion devices. These panels will be located at each of the 30 cells around the Mezzanine, and served by a 112.5 kVA transformer located above the ratchet adjacent to the panels.

Power to the ring-wide power supplies will be provided by one or more dedicated 480Y/277 V panels fed directly from the switchgear. The panel location(s) will be verified during the design phase.

Power to the transfer line magnet power supplies will be provided by one or more 208Y/120 V panel(s) fed from the 480 V panel serving cell equipment or directly from the switchgear.

Empty cable tray will be provided through out the length of the tunnel and above the racks at the mezzanine level. Separate cable trays will be provided for power and signal. Tray locations will be coordinated with other utilities.

Lights and miscellaneous receptacles will be circuited to panels located in the adjacent service building.

13.5.7.2.3 Experimental Hall Power Distribution

Each beamline will be provided with one double section 208Y/120 V panelboard, served by a 75 kVA transformer and located at the mezzanine level at each of the 60 ratchets. Future branch circuits can drop out of the panel and be routed across the Experimental Hall on framing members to equipment located along the beamline.

Lights and miscellaneous receptacles will be circuited to panels located in the adjacent service building.

13.5.7.2.4 Linac/RF Building

A second switchgear will be located in the service building associated with the Linac/RF Building. This switchgear will be dedicated to equipment within the Linac and RF Buildings.

13.5.7.2.5 Central Lab Office Building Power Distribution

The Central Lab Office Building will be provided with an 800 A, 480Y/277 V panel fed directly from the switchgear in the associated service building. This panel will serve mechanical equipment and lighting and receptacle panels on each floor. Double section panels will serve the labs on the first floor.

Within each lab, two-compartment surface mounted raceway will be provided at bench tops and around the perimeter of the lab. Equipment in the center of the room will be served by surface-mounted raceways mounted on overhead ceiling mounted service carriers.

13.5.7.2.6 Lab Office Building Power Distribution

Each LOB will be provided with a 400 A, 480Y/277 V panel fed directly from the switchgear in the associated service building. This panel will serve mechanical equipment and lighting within the Lab Office Building, and will sub-feed two 208Y/120 V double section panels via a single 150 kVA transformer. The 208Y/120 V panels will serve devices in the lab and office areas.

Within each lab, two-compartment surface mounted raceway will be provided at bench tops and around the perimeter of the lab. Equipment in the center of the room will be served by surface-mounted raceways mounted on overhead ceiling-mounted service carriers.

13.5.7.3 Emergency Power

Because of the building's large size, two generators will be provided, one each at service building #2 and at the Linac/RF Building. The assumed size of each generator is 250 kW. A sub-base fuel tank in compliance with Suffolk County Article 12 will be provided with a 12-hour full load capacity. To reduce noise and vibration, a weatherproof, sound attenuated reach-in enclosure will be provided.

Two automatic transfer switches will be provided; one to serve code required emergency loads, and one to serve optional standby loads. The emergency loads include egress and exit lighting, the fire alarm system, fire suppression system, selected lab exhaust and make-up systems, and select HVAC control systems. The emergency loads will be reenergized within 10 seconds of sensing a power outage.

The optional standby loads are not defined, but will likely include selected laboratory equipment, one switched light fixture in each lab, and the communication and security systems. Optional standby loads may be delayed to limit motor starting kVA.

13.5.7.4 Uninterruptible Power Supply

A UPS will be provided to support the Control Room. The preliminary size is 30 kVA. If uninterruptible power is required for a specific piece of lab equipment, point-of-use UPS units will be provided by the users.

13.5.7.5 Voltage Utilization

- Building lighting - 277 V
- Motors 1/2 horsepower and larger - 480 V, 3-phase
- Motors less than 1/2 horsepower - 120 V
- Equipment – As required by nameplate, except special voltages and frequencies including 220 V, 230 V, 240 V, 380 V, DC, 50 Hz, 400 Hz, 415 Hz, etc. will require user provided point-of-use transformers and/or frequency converters.

13.5.7.6 Voltage Drop

Voltage drop will be limited to 2% in feeders and 3% in branch circuits.

13.5.7.7 Feeders and Branch Circuits

- All conductors will be copper installed in conduit. Conductors #3 and smaller will have THWN insulation. Conductors #2 and larger will have XHHW insulation.
- Conductors #10 AWG and smaller will be solid. Conductors #8 AWG and larger will be stranded. Minimum size conductors will be #12 AWG for branch circuits, #14 AWG for control wiring and #18 for signal cables.
- All feeder and branch circuit conductors will be provided with color coded insulation throughout their entire length.
- Separate neutral conductors will be provided for each receptacle circuit. Insulation of neutrals will be provided with three colored strips matching their associate phase conductors. Insulation of neutrals serving two or three pole circuits will be solid.
- All feeders and branch circuits will be provided with a green insulated equipment grounding conductor.
- All branch circuits serving sensitive electronic laboratory receptacles and equipment will be provided with a green with three yellow strips isolated equipment grounding conductors.
- Generally, conduit will be electrical metallic tubing with compression fittings. Conduit below grade will be concrete encased schedule 40 PVC. No conduit will be imbedded within slabs on or above grade.

13.5.7.8 Grounding

13.5.7.8.1 Grounding Electrode System

- The grounding electrode system will consist of underground metal piping, building steel, concrete encased 250 kcmil Ufer ground within all exterior wall foundations with direct buried cross connecting 250kcmil conductors 100 ft on center, and 10 ft ground rods spaced at approximately 100 ft on center around the perimeter.
- A 10 x 10 ft 250 kcmil ground grid will be provided at the Building 603 substation expansion, and at each unit substation transformer at the project site to reduce earth resistance and to limit step and touch potential.
- All underground connections will be exothermically welded.
- The ground grid shall be designed to provide <5 ohms of resistance to earth.
- A main ground bus will be located in the main electrical room at each service building. The grounding electrode conductors, interior metal pipe grounds, and the telecommunication ground will be connected to the main grounding bus.

13.5.7.8.2 Power System Grounding

- All power system grounding will be in accordance with the NEC.
- The secondary of each 13,800-480Y/277 V substation transformer will be grounded at the substation. The grounded neutral will be re-bonded at each switchgear main breaker.
- The generator neutral will be grounded at each generator. Four-pole automatic transfer switches will be provided.
- The secondary of each 480-208Y/120 V transformer will be connected to the nearest building steel via a local power system ground bus.
- A separate green insulated equipment grounding conductor will be provided in all feeders and branch circuits.
- Branch circuits serving sensitive electronic equipment will be provided with a green with yellow strips isolated equipment grounding conductor in addition to the green equipment grounding conductor.

13.5.7.8.3 Instrument Reference Ground

An instrument reference ground bus will be provided at each beamline to be used by users only for the purpose of grounding sensitive electronic communication circuits. The bus will be connected directly to the grounding electrode system and bonded to the local transformer(s) which provide power to that beamline equipment. The instrument reference ground bus will be considered the beamline's single point ground for all user equipment.

13.5.7.8.4 Electrostatic Dissipation

At this time, there are no known requirements for static dissipative flooring and/or bench tops.

13.5.7.8.5 RF Shield Grounding

Bonding plates will be provided in the RF shield at 100 foot increments and connected to the building counterpoise with #4/0 conductors.

13.5.7.8.6 Telephone and Data Communication Grounding

Telephone and data communication grounding will be provided in accordance with EIA/TIA 607.

13.5.7.8.7 Lightning Protection

A complete lightning protection system will be provided in accordance with NFPA 780 and UL 96A.

13.5.7.8.8 Cathodic Protection

It is assumed that no cathodic protection will be provided.

13.5.7.9 ELF EMI and RFI Mitigation

- No specific provisions have been incorporated to mitigate magnetic fields; however, routing of cables in and around laboratory spaces will be minimized, where feasible, to reduce fields in these areas.
- Further evaluation of planned RF cavity installations during subsequent design phases may identify local shielding requirements.

13.5.7.10 Vibration Isolation

The generators will be provided with spring isolators as recommended by the vibration consultant. All transformers will be mounted on neoprene pads. No conduit will be installed under or within vibration isolation slabs.

13.5.7.11 Radiation Protection

Conduit penetrations in to the tunnel will be limited in quantity and located only through the tunnel ceiling. All penetrations will include an off-set to eliminate line of sight through the high density concrete. See radiation protection section for additional detail.

Spare penetrations will be provided for future use.

13.5.7.12 Exterior Lighting

- Exterior illumination levels will be as indicated in DOE/IES standards.
- Parking lots and access drives will be lit by 175 W metal halide cut-off fixtures mounted on 20 ft aluminum poles.
- Walkways will be lit by 100 W metal halide cut-off fixtures mounted on 12 ft aluminum poles and 50 W metal halide bollards.
- Building-mounted exterior lighting will be provided at entrances and exits and at loading docks.
- No architectural/façade lighting will be provided.
- Site lighting will be circuited via low-voltage control panels with photocell on/off control.

13.5.7.13 Interior Lighting

- Lighting design will be accomplished with energy efficient fluorescent lamps and electronic ballasts. Downlights and accent lights will be provided by compact fluorescent lamps. Incandescent lamps will not be utilized except in selected labs where low level illumination is required or where electromagnetic interference may occur.
- Fluorescent lamps for troffers and pendant type fixtures will be T8, 32 W, 4100K with a CRI of at least 75.
- Fluorescent ballasts for T8 lamps shall be electronic type with a ballast factor of 0.85 minimum and total harmonic distortion of less than 10%.
- Compact fluorescent lamps will be used in downlights and wall wash fixtures.
- Exit lights will be LED type.

- Fluorescent fixtures in labs will be controlled by a low-voltage control system with low-voltage switches at the entrances.
- Occupancy sensors will be provided in enclosed offices and in open office areas, corridors, restrooms, and in support spaces.
- Photo sensors will be provided in perimeter offices and in spaces with natural lighting to de-energize lights when sufficient daylight is present.
- Footcandle levels will be in accordance with DOE standards where applicable and with the IES Handbook for other spaces:
  - Tunnel: 30 FC
  - Mezzanine: 30 FC
  - Experimental Hall (above beam-lines): 50 FC general illumination
  - Laboratories: 50-75 FC general with 75 FC on work surfaces
  - Offices: 30–50 FC general with 50 FC on work surfaces
  - Conference rooms: 30 FC
  - Attended support spaces: 30 FC
  - Unattended support spaces: 15 FC
  - Corridors: 10–15 FC
  - Restrooms: 10–15 FC general with 30 FC at the mirror/sink area
  - Mechanical/electrical equipment rooms: 15 FC
  - Telephone/communication rooms: 50 FC

Egress and exit lighting will be provided in accordance with NYSBC and NFPA 101

13.5.7.14 Special Systems

13.5.7.14.1 Fire Alarm

A complete manual and automatic, supervised, fire detection and voice evacuation system will be provided. It will be a non-coded, addressable, microprocessor-based fire alarm system with initiating devices, notification appliances, and monitoring and control devices. Initiating and appliance circuits will be Class B. The fire alarm system will be in accordance with DOE requirements and NFPA 72.

Manual stations will be programmable and located at all building exits, at all exit stairs, and at 300 foot intervals in egress corridors.

Photoelectric area smoke detectors will be located in all labs, through out the Tunnel and Experimental Hall, and in elevator lobbies, shaft and machine room. Provisions will be made for smoke detectors to be located within the future hutches. Smoke detectors in elevator lobbies, shaft and machine room will initiate elevator recall. Duct smoke detectors will be provided in air handling systems as required by NYSBC and NFPA 90A.

Heat detectors will be located adjacent to sprinkler heads in elevator shafts and machine room and will de-energize elevator power in accordance with ANSI 17.1, Elevator Code.

Post indicating valves, sprinkler flow and tamper switches, and pre-action and dry-pipe systems will be monitored.

Combination audio/visual and/or visual only devices will be provided throughout the corridor system, in each lab, and in most rooms other than single person offices. A minimum of two indicating circuits will be provided in each area with devices connected alternately.

The fire alarm control panel will be located at the main entrance of the Central Lab Office Building.

Notification appliance circuit power supplies will be distributed throughout the facility to provide power for the audible/visual appliances and to reduce voltage drop. The power supplies will be located in easily accessible locations.

Common alarm and trouble signals will be transmitted via dedicated fiber optic cable to the campus fire alarm system.

The fire alarm system will match campus standards.

13.5.7.14.2 Telephone and Data Communication System

A complete pathways, spaces, and structured cabling distribution system will be provided that consists of telecommunication rooms, plywood backboards, racks, cabinets, cable tray, conduit, back boxes, copper cable, fiber optic cable, connectors, cover plates, termination blocks, cross connect cables, patch panels, and all necessary accessories and will be provided in accordance with applicable EIA/TIA standards.

The Building Distribution Frame room will be located in the Central Lab Office Building. The BDF room will also serve as the Intermediate Distribution Frame room for the Central Lab Office Building, and the associated service building and sector of the tunnel and Experimental Hall.

Four 4 in. conduits will be routed from the BDF to Manhole MH-85 on the south side of Brookhaven Drive.

One IDF will be located in each Lab Office Building to serve its associated outlets.

Cable tray will be provided at lab and office corridors and around the Experimental Hall to route riser cable between the BDF and IDFs and to route station cables to outlets in the tunnel, Experimental Hall, and service building. Conduit will be provided between the cable tray and each outlet or raceway.

Each voice/data outlet will be provided with one Cat 6 voice jack and one Cat 6 data jack.

Each data outlet will be provided with one Cat 6 data jack.

Voice and data riser cabling will be provided from the BDF to each IDF. Voice riser cables will be multi unshielded twisted pairs, 24 gauge, solid copper and terminated on the terminal block in each closet. Data riser cabling will be 12 multi mode and 12 single mode fiber optic cables terminated at each end in a patch panel with a type SC connector. Voice will be terminated directly on rack-mounted termination panels. Patch panels will be mounted in 19 in. equipment racks.

Station cabling from each voice/data will consist of two four-pair Category 6 cables terminated at the devices and on the rack mounted telephone terminal blocks. Cables will be labeled at each device, terminal block, and patch panel.

13.5.7.14.3 Security System

The security system will consist of an access control system only. Intrusion detection and CCTV systems will not be provided.

Card readers will be located at each building entrance, at each corridor entrance to a lab, at each entrance to the Experimental Hall, at each entrance to the tunnel, and at each entrance to other selected spaces.

To match campus standards, security equipment components (card readers, controllers, locks, door contacts, etc.) will be owner furnished, contractor installed. Door exiting device, power transfer hinges, etc. will be coordinated with the door schedule. Security system cabling will be contractor installed and terminated by the owner.

13.5.8 Sustainable Design (LEED)

13.5.8.1 Approach

Sustainable design is an approach that addresses how design decisions will impact the natural environment, building occupants, construction methods and materials, and long term operations and maintenance. Incorporating sustainable design in new buildings is a DOE requirement that must be balanced with other program objectives such as cost, schedule, and technical performance. As such, sustainable design is an additional set of criteria on which design decisions for NSLS-II must be based.

The goal for the NSLS-II facility is to incorporate a wide range of sustainable strategies and objectives throughout the design and construction process while meeting the functional requirements of an advanced technology facility and creating a workplace that is environmentally friendly, energy-efficient, and both healthy and pleasant to be in. The NSLS-II facility will be designed to obtain a minimum of a LEED Certified Level as well as meet sustainable goals outlined in The Federal Leadership in High Performance and Sustainable Buildings Memorandum of Understanding (MOU).

LEED™ (Leadership in Energy and Environmental Design) is a voluntary, consensus-based national rating system developed by the U.S. Green Building Council that provides a complete framework for assessing building performance and meeting sustainability goals. Its current version, LEED Version 2.2 for New Construction and Major Renovations (NC) is being proposed for this project.

Consistent with the USGBC LEED program, the project team identified five key principles that will define and guide our sustainable approach. These principles will continue to be monitored throughout the design and construction and include the following:

- Site: Sustainable Site Design
- Water: Protecting and Conserving Water
- Energy: Designing for Energy Efficiency and Considering Alternative Energy Sources
- Materials: Optimizing the Environmental Life Cycle of Materials
- IEQ: Enhance Indoor Environmental Quality

The project will be evaluated against each LEED criteria. Those which receive either a ‘Prerequisite’ or ‘Credit’ marking result in a point score for certification:

Prerequisites: This category is based on minimum requirements and all must be met. No further points will be awarded unless the minimum is achieved. There are a total of seven Prerequisites.

Credits: Credits are evaluated and result in a point score. The total points possible under LEED-NC v.2.2 are 69 points.

The certifications levels are available as follows:

Table 13.5.1 LEED Certification Points.

Certification Level	Points Required
LEED Certified	26-32 Points
LEED Silver	33-38 Points
LEED Gold	39-51 Points
LEED Platinum	52-69 Points

13.5.8.2 Sustainable Site

Maximizing the benefit of the existing site can be accomplished though a number of sustainable measures, one of which is storm water management. The volume of storm water generated on the site depends on the area of impervious surfaces. To control the quantity of storm water run-off, detention ponds have been designed to capture excess and reduce the impact on the BNL site system.

The possibility of utilizing bio-retention ponds or pervious pavement to treat storm water runoffs is proposed. In addition to controlling quantity, these strategies help to promote infiltration, and capture and treat the storm water runoff.

Bicycle racks and other site amenities will be included to ensure compliance with as many LEED credits as possible. Other possible amenities include designated preferred parking for car/van pools and fuel efficient vehicles and showers for bikers.

13.5.8.3 Water: Protecting and Conserving Water

Implementing water efficiency measures can reduce potable water use, and often save building owners operating costs. In addition, sustainable water use protects natural water bodies from contamination. To reduce potable water consumption, no permanent irrigation will be provided for the NSLS-II site. The plantings will be native to the region and will require little or no additional water after new growth has been established.

Further, we believe that the use of water-conserving fixtures can, in aggregate, provide savings of 20 to 30% when compared to water usage requirements under the Energy Policy Act 1992. These types of fixtures will be considered for NSLS-II.

13.5.8.4 Energy: Designing for Energy Efficiency and Using Alternative Sources of Energy

The impact that energy use has on the environment is broad and long-lived. Almost every aspect of conventional energy use poses some threat to the natural environment. Instituting energy efficient strategies like daylighting, high energy efficiency equipment, EMS optimization, ENERGY STAR roof, and building commissioning will all contribute to a building which will perform at a higher level, ultimately reducing overall energy consumption and reducing operating and maintenance costs. To further meet the sustainable requirements outlined in the MOU we will establish a whole building performance target that takes into account the intended use, occupancy, operations, plug loads, other energy demands, and design to earn the Energy Star7 targets for new construction and major renovation where applicable.

This project will eliminate the use of ozone-depleting compounds during and after construction where alternative environmentally preferable products are available, consistent with either the Montreal Protocol and Title VI of the Clean Air Act Amendments of 1990, or equivalent overall air quality benefits that take into account life cycle impacts.

13.5.8.5 Materials: Optimizing the Environmental Life Cycle of Materials

Almost 70% of all energy invested in a building's construction is embodied in the materials themselves. Embodied energy is the energy required to extract, transport, process, install, recycle, or dispose of these materials. The project team will evaluate the environmental impact, resource efficiency, and performance of the proposed building materials. Non-toxic materials from local and renewable sources will be considered.

The material selection process will focus on life-cycle issues rather than solely on aesthetic or first cost. Use of recycled content materials and those that are manufactured regionally will be maximized. For all EPA designated products we will use products that meet or exceed EPA's recycle content recommendations.

Material recycling will be facilitated to reduce waste and conserve resources. The design will provide for an area dedicated to the separation, collection, and storage of materials for recycling by the building occupants.

A Construction Waste Management Plan will be required for this project. A minimum of 50% of construction, demolition, and land clearing waste will be recycled and/or salvaged to meet LEED requirements as well as goals included in the MOU agreement.

13.5.8.6 IEQ: Enhance Indoor Environmental Quality

The quality of the indoor environment has a significant impact on human health, productivity and quality of life. Sustainable indoor environments promote daylighting, natural ventilation, and interiors that are free of toxins. The result is an interior environment that safeguards occupant health, and reduces operating costs. We will comply with ASHRAE Standard 55–2004 and ASHRAE Standard 62.1-2004 Ventilation for Acceptable Indoor Air Quality. Other strategies will include CO_2 monitoring System, low VOC and non-toxic materials, as well as permanent air monitoring systems.

A large contributor to the quality of the indoor environment is the indoor air quality. An Indoor Air Quality (IAQ) Management Plan will be developed and implemented during construction and pre-occupancy.

After construction and prior to occupancy, a minimum 72-hour flush-out will be conducted with maximum outdoor air consistent with achieving relative humidity no greater than 60 percent. After occupancy, flush-out will continue as necessary to minimize exposure to contaminants from new building materials.

In addition to industry standard sustainable initiatives, the NSLS-II team will propose specific innovations in sustainability pertaining to IEQ and human comfort. These innovations include using furniture systems which follow the LEED for Commercial Interiors (LEED CI) Guidelines and meet the Greenguard Air Quality Certification.

13.5.8.7 LEED Status

In order to track the LEED prerequisites and credit point status of the project, a tracking spreadsheet has been developed that include the following information:

- LEED Prerequisite/Credit. Title and Intent of each prerequisite/credit taken directly from LEED. What the credit/prerequisite is meant to achieve.
- Requirement. Requirement necessary to meet LEED prerequisite or credit requirement, taken directly from LEED.
- LEED Points Available. Notes the number of points available for each LEED credit. If REQ'D appears in the column, this indicates a prerequisite for which there are no associated points.
- "Yes" / "Maybe?" / "No" Status
  "Yes" The credit can be achieved.
  "Maybe?" The credit will be pursued but there is not enough information at this time to assume it will be earned.
  "No" The credit is not achievable.
- Responsibility: Person or group of people responsible for preparation of documentation, calculation, and/or information research.
- Comment. Provides general comments regarding possible impacts to cost, schedule, design, etc.

Based on the Total Point Summary, the NSLS-II project is currently estimated to have 25 Yes and 22 Maybe points, as shown in Table 13.5.2. To meet the goal of a LEED Certified level, the project is required to have a minimum of 26 points. Thus, we aniticipate no difficulty in achieving LEED Certified Certification and depending on how many Maybe points we obtain, it is possible that we may achieve LEED Silver or LEED Gold Certification, in accordance with Table 13.5.1.

Table 13.5.2 NSLS-II Preliminary LEED Points.

Point Category	Score
Yes	25 points
Maybe	22 points
No	22 points
Total Possible	69 points

13.6 METHOD OF ACCOMPLISHMENT

13.6.1 Design

Title I and Title II design will be performed by an A/E firm under contract to BNL. The A/E firm will be competitively selected based on best technical qualifications for this project. The A/E firm will also optionally provide Title III support services for construction monitoring, start-up, and commissioning.

13.6.2 Construction

Conventional construction will involve construction of the NSLS-II complex of buildings and improvements to land and utilities including expansion of the existing Central Utility Building. These will be procured generally as a lump-sum competitively procured contract to a general contractor. Certain aspects of the site preparation work will be contracted as an early package to allow for required settling of earthworks prior to physical construction of the facility. Early procurement of the shield wall high density concrete will also mitigate schedule risk. Four construction packages are planned: site preparation; shield wall early procurement; the main Ring Building (and all associate structures and utilities); and expansion of the CCWF. The contractors will be selected based on an evaluated bid whereby the award is given to the firm meeting all technical, management, financial, past performance record, and safety qualifications for the project at the best value.

13.6.3 Quality Assurance

The project will be conducted in accordance with BNL's site-wide Quality Assurance Program (QAP) that applies to all work conducted at BNL. The BNL QAP conforms to the requirements of Department of Energy (DOE) Order 414.1, Quality Assurance, and 10CFR 830 Subpart A, Quality Assurance Requirements. BNL's QAP consists of the following ten criteria:

- Program
- Personnel Training and Qualification
- Quality Improvement
- Documents and Records
- Work Processes
- Design
- Procurement
- Inspection and Acceptance Testing
- Management Assessment
- Independent Assessment

BNL's approach to satisfying the requirements of these criteria are delineated in the BNL Quality Assurance Program Description within the BNL Standards-Based Management System (SBMS). The NSLS-II design, construction and operation are subject to the QAP. A key element of the QAP is the concept of

"Graded Approach", that is, applying an appropriate level of analysis, controls, and documentation commensurate with the potential to have an environmental, safety, health, radiological, or quality impact.

13.6.3.1 NSLS-II QA Plan

The NSLS-II QAP has been developed and addresses both the conventional and technical aspects of the project. This plan addresses project activities from design through construction, as well as commissioning and startup. The sections of the NSLS-II QAP applicable to conventional facilities address the basic design and construction of the building and utilities systems executed by the NSLS-II Conventional Facilities Division. Requirements of the NSLS-II QAP will flow down to contractors performing design and construction of conventional facilities.

13.6.4 Bid Strategy

The bid environment on Long Island is expected to remain very competitive for the next several years, a timeframe that includes the bid period for NSLS-II. The project team recognizes the challenge of this bid environment and of the rapidly escalating costs of concrete and steel, primary materials for the project, and has developed a bid strategy to deal with it. A base building package has been identified along with a series of additive alternates that may be constructed if within the overall project budget. Some of the items listed as add alternates are features that are highly desirable for a world-class research facility but not absolutely essential for basic operation. Other items are building components that can be constructed in phases as the experimental floor is filled with beamlines over the course of several years.

As a result of beamlines being phased in over a period of time, portions of the experimental floor will not be used initially and the LOBs supporting future beamlines will not be fully occupied. The user group requirements for these future beamlines are not known at this time. It has been decided that optional Lab Office Buildings 2, 3, and 4 could be constructed in a warm-shell configuration for future fit-out by the user groups as needs dictate. The construction would include finishes on exterior walls, electrical power, HVAC, plumbing and other essential services. The LOBs would be useable, but not be ready for final occupancy until the space is programmed with the final user groups.

13.6.4.1 NSLS-II Base Scope

The base scope consists of the following building components:

- Ring Building
- Central Lab Office Building
- Lab Office Building 1
- Linac and RF Buildings
- All five Service Buildings.

The base scope will include the Ring Road, the loop road, the access roads to the service buildings and parking lots for the CLOB and LOB 1.

The base scope will include a curved standing seamed roof over the Ring Building and LOBs. The full design includes two AHUs in each service building to serve the Experimental Hall. All HVAC and mechanical systems required for the ring tunnel from all five service buildings will be included in the base bid.

13.6.4.2 Bid Alternates

In addition to the items listed above, there are several building components that will be included as design alternates. These include but are not limited to the Conference Center and Exhibit areas, Lab office Buildings

2, 3, and 4 and associated systems, and parking. Table 13.6.1 identifies the proposed bid alternates for the project.

Table 13.6.1 Base Bid and Bid Alternate Components.

Building Component	Base Bid	Bid Alternate
Ring Building including ring tunnel, ring mezzanine, Experimental Floor, and access corridor.	■	
Central Lab Office Building and associated mechanical electrical and fire protection.	■	
Lab Office Building No. 1 and associated mechanical electrical and fire protection systems.	■	
RF Building and associated mechanical electrical and fire protection.	■	
Linac Building and associated mechanical electrical and fire protection.	■	
Service Buildings 1 through 5.	■	
All AHUs and duct work serving the Ring Tunnel from Service Buildings 1 through 5.	■	
All AHUs and ductwork serving the Experimental Floor and ring mezzanine from Service Buildings 1 through 5.	■	
Process utilities serving the Ring Building to be built out for all experimental areas.	■	
Ring Building curved standing seam roof.	■	
Road and parking curbing at building entrances only.	■	
Paving of Ring Road and parking for CLOB and LOB 1.	■	
Grass seeding of site.	■	
Alternate # 1 Conference Center.		■
Alternate # 2 Lab Office Buildings 2, 3 and 4.		■
Alternate # 3 Clerestory windows on Ring Building.		■
Alternate # 4 Ring Building sloped (not curved) standing seam roof (deduct).		■
Alternate # 5 Parking lots for LOBs 2, 3, and 4.		■
Alternate # 6 Finish layer of asphalt to parking lot and roads.		■
Alternate # 7 Provide trees and shrubs for landscaping as well as grass seeding.		■
Alternate # 8 TPO roof on Ring Building (deduct).		■
Alternate # 9 Preinsulated Metal Panel		■

13.6.5 Value Management

Value Management (VM) will be performed for this project as required under DOE Order 413.3A, “Program and Project Management for the Acquisition of Capital Assets.” An independent value management team will perform VM review during Title I design. A VM report will be provided to the NSLS-II Project Director and DOE/BHSO Federal Project Director for consideration and, where feasible, incorporation into project design documents.

The VM review will be a systematic review of the mature Title I design performed by an independent team of qualified consultants. The team will comprehensively review design elements and material selections with regard to their needed level of performance and quality. Alternate methods, elements and selections that meet the necessary performance and quality will be considered. The comparative first cost and life cycle cost of these alternatives will be determined and compared to the original design. A VM report will be prepared indicating alternatives considered, their respective costs and recommendations as to which alternatives should be implemented in the project design.

13.6.6 Commissioning

An important element in the ultimate success of the NSLS-II will be proper commissioning of the facilities systems and instruments. The extreme sensitivity of the storage ring and research beamlines requires that all systems and instruments achieve their maximum performance capability to fulfill the research mission. Additionally, any systems or equipment that can create environmental disturbance must be properly calibrated, balanced, tuned, or shielded to prevent detrimental impact to the research. During the Title I design phase, a detailed facility commissioning plan will be prepared to assure that appropriate commissioning requirements have been included in the NSLS-II design. The commissioning plan will:

- Present a schedule and sequence for start-up of building systems and instruments, including dependencies linked to the conventional or technical construction schedule.
- Identify safety approvals required prior to start-up
- Identify systems and instruments at the equipment level that will require commissioning.
- Identify references and sources of start-up procedures and performance, test and acceptance criteria for the instruments and equipment.
- Identify whether the equipment will be commissioned by BNL staff, contractor staff, vendor staff, or if the services of a specialty commissioning contractor are warranted.
- Identify the point at which equipment has been accepted and can be turned over to operations staff.
- Be updated during the Title II and Title III phases as appropriate to reflect changes in equipment selection and performance.

13.7 Conceptual Design Drawings

Conceptual design drawings of the NSLS-II site and buildings are provided in a separate volume of drawings. The drawings are organized into four sections:

- Site/civil engineering
- Architectural
- Mechanical engineering
- Electrical engineering

Drawing lists for each of these sections follows.

13.7.1 Site/Civil Concept Design Drawings

Site/civil drawings are identified in the drawing list below:

Table 13.7.1 Site/Civil Concept Design Drawing List.

Site / Civil Concept Drawings
Site Layout & Grading Plan
Sanitary Sewer Plan
Storm Sewer Plan
Potable Water Plan
Steam Plan
Chilled Water, Cooling Tower Water and Compressed Air Plan

13.7.2 Architectural Concept Design Drawings

Architectural drawings are identified in the drawing list below:

Table 13.7.2 Architectural Concept Design Drawing List.

Architectural Concept Drawings
Site Plan
Building View
Base Building Site Plan
Base Building Floor Plan
Building View
Building View
Building View
Overall NSLS-II Floor Plan
Ring Building Plan
Beamline Cluster (6 beamlines)
Central Lab Office Building (CLOB) - First Floor
Central Lab Office Building (CLOB) - Second Floor
Central Lab Office Building (CLOB) - Third Floor
Seminar/Exhibit Area Plan
Building View
Building View
Building View
Building View
Building View
Lab Office Building (LOB) - Full Build-out (LOB 1)
Lab Office Building (LOB) - Shell Build-out (LOBs 2, 3 and 4)
Building View
Service Building - Second Floor
Service Building - First Floor
Linac Building
RF Building
Typical Section at Ring Building
Section at Lab Office Building and Service Building
Section at Central Lab Office Building
Section at RF Building
Section at RF Building
Section at Linac and Experimental Hall

13.7.3 Mechanical Concept Design Drawings

Mechanical drawings are identified in the drawing list below:

Table 13.7.4 Mechanical Concept Design Drawing List.

Mechanical Drawings
Typical Experimental Floor - HVAC
Mechanical Section
Service Building – Lower Level – Mechanical Room
Service Building – Upper Level – Mechanical Room
RF Building – Upper Level - Mechanical Room
Typical Experimental Floor - Piping
Accelerator Tunnel AHU Control Diagram
Process Cooling - Condenser Water Diagram

13.7.4 Electrical Concept Design Drawings

Electrical drawings are identified in the drawing list below:

Table 13.7.5 Electrical Concept Design Drawing List.

Electrical Drawings
Site Electrical Plan
Building 603 Campus Substation Upgrade, Switch House And Yard Plan
Campus Substation And Site Distribution One-Line Diagram
Cluster #3 Electrical Floor Plan
Cluster#3 Normal Distribution One-Line Diagram

References

[13.1] BNL Site Vibration Study, 2006.
[13.2] VitaTech Engineering EMI/RFI Site Assessment Study, 2006.
[13.3] Geotechnical Report for NSLS-II site, 2006.
[13.4] BNL Chilled Water Alternatives Study, 2006.
[13.5] NSLS-II Preliminary Life Safety Code Review, 2006.