10 ELECTRICAL ENGINEERING

10.1 Design Criteria

10.1.1 Codes and Standards

The latest edition of the codes, standards, orders, and guides referred to in this section will be followed, with a reference point of August 2008 being the anticipated design completion date. 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."

10.1.2 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

10.1.3 Codes, Standards, and Guides

Building Code of New York State (NYSBC) – 2002 Edition
National Electrical Code, NFPA 70, 2008.
Standard for Electrical Safety in the Workplace, NFPA 70E, 2004
National Fire Alarm Code, NFPA 72, 2002
Life Safety Code, NFPA 101, 2006
Emergency and Standby Power Systems, NFPA 110, 2005
29 CFR 1910, Occupational Safety and Health Standards
29 CFR 1926, Safety and Health Regulations for Construction
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

10.2 SITE UTILITIES

10.2.1 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. Existing utilities around the perimeter of the site that are active will remain, while utilities that cross the site and are abandoned will be removed where they cross under the footprint of the building.

10.2.2 Building 603 Substation Expansion:

The Building 603 campus substation will be expanded to include a fourth transformer (Transformer #0) to support the NSLS-II project. Plans and specifications associated with this work and modifications within

Building 603 will be provided in a separate package to allow early construction to begin in advance of the NSLS-II building package.

The existing 69 kV substation yard will be modified to allow the new equipment to be installed. 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. The exterior of Building 603 adjacent to the Transformer #0 will be sprayed with an exterior grade fire proofing material.

Within Building 603, the existing walls around the storage room will be removed and a new 275 ft2 addition with a roll-up door will be provided to house the relocated supplies. Existing utilities above the proposed location of the new switchgear line-up will be rerouted.

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.

A new 1200 A outgoing breaker will be provided in one of the empty cells in the Bus #2 switchgear to provide redundant service to the NSLS-II Project.

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.

10.2.3 Campus Distribution:

Two 1000 A feeders will be provided to serve the NSLS-II Project. The primary feeder will originate at the Bus #0 switchgear in Building 603. An alternate for a back-up feeder will be included which will originate at the Bus #2 switchgear.

Each feeder will consisting of two sets of 3-1/C, 1000 kcmil, 15 kV, MV-105, 133% EPR copper conductors and will be routed through a new manhole and duct bank system from Building 603 south along North Sixth Street, and west along Brookhaven Avenue to the NSLS-II site. The duct bank will be a 6-way 6 in. concrete encased duct bank.

The manhole and duct bank portion of this work will be included in the Building 603 substation upgrade package. The feeder cables will be included in the NSLS-II building package.

10.2.4 NSLS-II Site Distribution:

The site distribution system will be configured in a primary selective scheme with all unit-substations connected to the primary feeder.

A 6-way 6 in. concrete-encased duct bank will be routed from a manhole at Brookhaven Avenue to a manhole in the infield of the Ring Building via the basement utility room. A 6-way 6 in. duct bank will then be routed around the infield interconnecting all the unit-substations. Each 1000 A feeder consisting of two sets of 3-1/c, 1000 kcmil, 15 kV, MV-105, 133% EPR copper conductors will be routed to the “A” and “B” switches receptively of each unit-substation.

One unit-substation will be located at each Service Building #1 through #5 and at the Linac / Booster Building. Two unit-substations will be located between the Cryo Plant and the RF Building..

Each unit-substation will consist of primary switchgear, a 13,800-480Y/277 V, oil-filled substation type transformer, and a secondary air terminal section. The primary switchgear 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 2000 or 2500 kVA transformer will be triple rated 55˚ OA, 65˚ OA, and 65˚ FA. A duct bank and secondary feeder will be extended from the secondary air terminal cabinet to the 480 V switchgear located in the main electrical room of each service building. In lieu of a secondary air terminal cabinet, the unit-substations serving the Cryo Plant and RF Building will include outdoor walk-in 480Y/277 volt switchgear for distribution of feeders to loads within the Cryo Plant and RF Building.

An outgoing 480 V feeder in two 4 in. ducts (minimum one spare) will be provided from switchgear #2 to the process cooling tower facility on the north side of Brookhaven Avenue.

10.2.5 Voice/Data:

A new four-way 4 in. concrete-encased ductbank will be provided from existing manhole MH-84 to the BDF room in the Operations 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-85 and 84.

Fiber optic cable 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 a new 4-way 4” duct bank from MH-84 to the BDF.

10.2.6 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. Pole mounted full cut-off fixtures will be provided to comply with LEED and Dark-sky requirements. The street lights will be circuited to building lighting panels via the building low-voltage lighting control panels.

10.3 Interior Power Distribution

10.3.1 Service Building Power Distribution:

A 3000 or 4000 amp, 480Y/277 V, 3-phase, 4-wire switchgear will be located in each of the five service building main electrical rooms. 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 Y/277 V distribution panels will be located in the mechanical rooms on both levels to serve lighting and mechanical equipment. Receptacle panels will be located adjacent to each mechanical panel to serve receptacles and other 120 V equipment.

Electrical power loads are shown in Table 10.1 at the end of this section.

10.3.2 Tunnel and Tunnel Mezzanine Power Distribution:

Most of the equipment that supports the storage ring is located on the mezzanine above the tunnel and operates at 120 or 208 V. Power to this equipment will be distributed on a per cell basis with 6 cells served by

each of the five Service Building switchgear line-ups (each cell serves two beamlines). A separate 480Y277 V feeder will serve one distribution panel at each cell. This panel will in turn sub-feed five 208Y120 V panels via separate transformers. A separate transformer and double section panel will be provided for each of the three single magnet power supply racks. A fourth transformer and double section panel will be provided to serve the vacuum instrument racks. A fifth transformer will serve Experimental Hall equipment.

To reduce arc-flash hazard, transformer sizes will be limited and remote controlled electrically operated molded case circuit breakers will be provided in the 480Y/277 V panel.

Future branch circuits can be routed from the panels to the racks in conduit or cable tray supported by a support grid mounted above the Mezzanine.

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

10.3.3 Experimental Hall Power Distribution:

A fifth transformer and single section panel will be provided at the tunnel mezzanine to serve Experimental Hall equipment. These panels will sub-feed two single section panels at the mezzanine level, one above each ratchet wall to serve equipment associated with that beamline.

Future branch circuits can drop out of these panels and be routed across the Experimental Hall on a support grid to equipment located along the beamline. Distribution panels for future beamlines between LOB2 thru LOB 4 will be provided with future beamlines.

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

10.3.4 Injection Building Power Distribution:

One 3000 A switchgear line-up will be located in the mechanical / service room. This switchgear will be dedicated to Linac and Booster equipment within the Injection Building.

10.3.5 RF Building/Cryo Plant Power Distribution:

Two 3000 A outdoor walk-in switchgear line-ups will be located at each unit-substation in the electric yard between the RF Building and the Cryo Plant. One line-up will serve loads within the RF Building. The second line-up will serve loads associated with the Cryo Plant.

10.3.6 Lab Office Building Power Distribution:

Each Lab Office Building will be provided with a 480Y/277 V panel fed directly from the switchgear in the associated service building. These panels will sub-feed two additional panels, one in each third of the building. These panels will serve lighting and mechanical equipment within the Lab Office Building, and sub-feed 208Y/120 V panels to serve receptacles in the labs 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.

10.3.7 Emergency Power:

Because of the building’s large size, two generators will be provided, one each at Service Building #2 and at the 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 operation 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, smoke exhaust fans, 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.

10.3.8 Uninterruptible Power Supply (UPS):

A UPS will be provided to support the Control Room and Computer Room. The preliminary size is 30 kVA.

If uninterruptible power is required for a specific piece of lab or experimental equipment, point-of-use UPS units will be provided by the users.

10.3.9 Voltage Utilization:

- Site distribution – 13,800 V, 3-phase, grounded wye distribution system.
- 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.

10.3.10 Voltage Drop:

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

10.3.11 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.

10.3.12 Arc-Flash Hazard Analysis:

An arc-flash hazard analysis will be performed during design to compare different distribution system configurations and again during construction using installed component characteristics to determine actual incident energy levels and recommended boundary information and PPE category.

10.4 Grounding

10.4.1 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 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.

10.4.2 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.

Ground fault protection will be provided at the switchgear main and all feeder breakers.

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.

10.4.3 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. Reference grounds within the hutches will be connected to the beamline's single point ground.

10.4.4 Telecommunication grounding:

Telecommunication grounding will be provided in accordance with EIA/TIA 607 including providing a ground conductor in all telecommunication cable trays.

10.4.5 Lightning protection:

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

10.4.6 Cathodic protection:

Cathodic protection will not be provided.

10.5 RFI and ELF EMI Mitigation

No specific provisions are needed to mitigate radio frequency interference or extremely low frequency (60 Hz) electromagnetic fields.

10.6 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.

10.7 Radiation Protection

Conduit penetrations in to the tunnel will be limited in quantity and located only through the tunnel roof or the service building labyrinth. All penetrations will include an off-set to eliminate line of sight through the roof concrete. Spare penetrations will be provided for future use

10.8 Exterior Lighting

Exterior illumination levels will be as indicated in DOE/IES standards, LEED 2.2 SS Credit 8 and Dark-sky requirements.

Parking lots, loop and interior roadways will be lit by 175 watt metal halide full cut-off fixtures mounted on 20 foot aluminum poles.

Walkways will be lit by 100 watt metal halide cut-off fixtures mounted on 12 foot aluminum poles and 50 watt metal halide bollards.

Building mounted exterior lighting will be provided at entrances and exits and at the loading dock. Equipment yards will be lighted with spill light from the adjacent access drive fixtures and by 100 watt metal halide full cut-off fixtures mounted on 12 foot aluminum poles.

No architectural/façade lighting will be provided.

Site lighting will be circuited to building panels and controlled by photocell to provide on/off operation.

10.9 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.

Fluorescent lamps for troffers and pendant type fixtures will be a combination of T5 28 watt, T5HO 54 watt and T8, 32 watt lamps with a color temperature of 4100K with a CRI of at least 75. The T5 and T5HO lamps are provided to maximize energy conservation by using the highest efficiency lamps in the highest efficiency fixtures.

Fluorescent ballasts for T5, T5HO and T8 lamps and compact fluorescent lamps will 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.

Footcandle levels will be in accordance with DOE standards where applicable and with the IES Handbook for other spaces:

- Storage Ring Tunnel: 30 FC.
- Mezzanine: 30 FC.
- Experimental Hall: 30 FC.
- LINAC: 30 FC.
- Booster Ring Tunnel: 30 FC.
- Booster/LINAC Support Building: 30 FC.
- RF Building: 30 FC.
- Laboratories: 50-75 FC general with 75 FC on work surfaces.
- Offices: 30-50 FC general with 50 FC on work surfaces.
- Operations Center: 50 FC.
- Conference rooms: 30 FC.
- Attended support spaces: 30 FC.
- Unattended support spaces: 15 FC.
- Corridors, Stairs: 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.

Fixture types are tentatively defined as follows:

- Tunnel: Surface mounted enclosed and gasketed.
- Mezzanine: 2-lamp industrial fluorescent with 10% uplight.
- Experimental Hall: 250 watt metal halide with glass reflectors. Because of the restrike time of metal halide fixtures, wall mounted fluorescent fixtures will be provided on the outside wall for egress lighting.
- Laboratories: Pendant mounted direct/indirect fixtures with a single row of T5HO lamps.
- Enclosed offices: Recessed volumetric type fluorescent troffers with ribbed acrylic lens under each T5 lamp.
- Open office areas: Recessed volumetric type fluorescent troffers with ribbed acrylic lens under each T5 lamp.
- Conference rooms: Pendant mounted direct/indirect fixtures with a single row of T5HO lamps.
- Support spaces: Recessed volumetric type fluorescent troffers with ribbed acrylic lens under each T5 lamp.
- Corridors: Recessed volumetric type fluorescent troffers with ribbed acrylic lens under each T5 lamp.
- Stairs: Direct/indirect fluorescent wall brackets.
- Restrooms: Recessed linear fluorescent wall washers mounted along the back and front walls.
- Mechanical/electrical equipment rooms: 2-lamp industrial fluorescent with 10% uplight.
- Telephone/communication rooms: 2-lamp industrial fluorescent with 10% uplight.

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

10.10 Special Systems

10.10.1 Fire Alarm System:

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.

There will be five (5) fire alarm control panels. The fire alarm control panels will be located adjacent to the exterior doors of the service buildings. The panels will be Grinnell/Simplex model 4100U fire alarm panels. The panels will be connected together by fiber cabling. Seven (7) remote fire alarm annunciation panels will be located. at the main entrance of the operations building, adjacent to the truck dock by each of the Laboratory Office Buildings, at the exterior door where future Laboratory Office Buildings will be connected, and at the Linac. The remote fire alarm annunciation panels will be connected to the fire alarm panel via fiber cable. A central fire alarm annunciation workstation will be located in the control room in the operations building.

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 each lab 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.

An air sampling smoke detection system will be provided throughout the Tunnel and Experimental Hall including the Tunnel Mezzanine. Each air sampling system can cover up to 20,000 sf. Therefore each Pentant will be provided with one air sampling system in the Tunnel and three air sampling systems in the Experimental Hall. The air sampling system will be Fenwal Protection System model AnaLaser-II.

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.

Wet sprinkler valves assemblies, sprinkler/standpipe water 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 facility. A minimum of two indicating circuits will be provided in each area with devices connected alternately. A visual device will be located on the exterior of the building adjacent to each entrance where a fire alarm control panel is located to guide the Fire Department to the activated panel.

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 fiber optic cable to the campus fire alarm system.

10.10.2 Telecommunication System (Voice, Data and Video):

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 Operations Building. The BDF room will also serve as the Intermediate Distribution Frame room for the Operations Building.

One IDF will be located in each Service Building and in each Lab Office Building. The Service Building IDF will serve outlets in that Service Building and in the adjacent Experimental Hall. The Lab Office Building IDF will serve outlets in the associated lab office areas.

Cable tray will be provided above the Mezzanine to interconnect the BDF with all the IDF’s. This tray will carry backbone cables and station cables serving the Experimental Hall.

Cable tray will be provided at lab and office corridors to route station cables to outlets in the lab office areas.

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.

10.10.3 Security System:

The security system will consist of a card reader access control system with limited security camera feed to the Security Center at Building 50.

Card readers will be located at each building entrance, and at each entrance to other selected spaces such as the control room, control computer room and electrical switchgear rooms.

CCTV systems will be provided for limited property protection areas such as the control room and control computer room. 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.

Table 10.1 Electrical Loads.

	Equip. kW	VA/SF	SF	kVA	df	kVA / Pentant	Total kVA
Storage Ring Equipment: (uniform load)							
Storage Ring	3211.9						
Insertion Devices	204.0						
Experimental Hall Equipment:							
Beam Lines	401.8				200% spare		805
Lab Office Buildings: (5 LOBs)							
Lighting		2	20000	40	1.0	40	200
Mechanical		5	20000	100	1.0	100	500
Receptacles		3	12800	38	0.6	23	115
Labs		25	2880	72	0.6	43	215
25% Spare						52	260
						258	1290
Experimental Hall and Service Buildings:							
Lighting		2	64000	128	1.0	128	640
Mechanical		6	64000	384	1.0	384	1920
Receptacles		1	64000	64	0.6	38	190
25% Spare						138	690
Storage Ring Point loads:						688	3440
Storage Ring Equipment (point load):							
SR Dipole (assumed at Sector #2)	460.0						
RF, Cryo Plant, Injection Loads:							
Linac Equipment:							
Source	11.6						
LINAC	29.6						
LINAC RF	200.0						
Booster Ring Equipment:							
Booster Ring LEBT	51.8						
Booster Ring Booster	1075.0						
Booster Ring HEBT	70.8						
Booster RF	170.0						
Linac, Booster Ring :							
Lighting		2	32000	64	1.0		64
Mechanical		6	32000	192	1.0		192
Receptacles		1	32000	32	0.6		19.2
25% Spare							69
RF Building Equipment:							344
Main Ring RF	2850.0						
Cryogenic Plant	500.0						
RF Controls and Diagnostics	40.0						
RF, Cryo Plant :							
Lighting		2	8000	16	1.0		16
Mechanical		6	8000	48	1.0		48
Receptacles		1	8000	8	0.6		4.8
25% Spare							17
							86
			Building Lighting, Misc Receptacle, Mechanical and Spare =				5963
Total Equipment Load	9276.5						9277
Loads for 3 GeV Energy Level					Total Building Load (kVA) =		15,239