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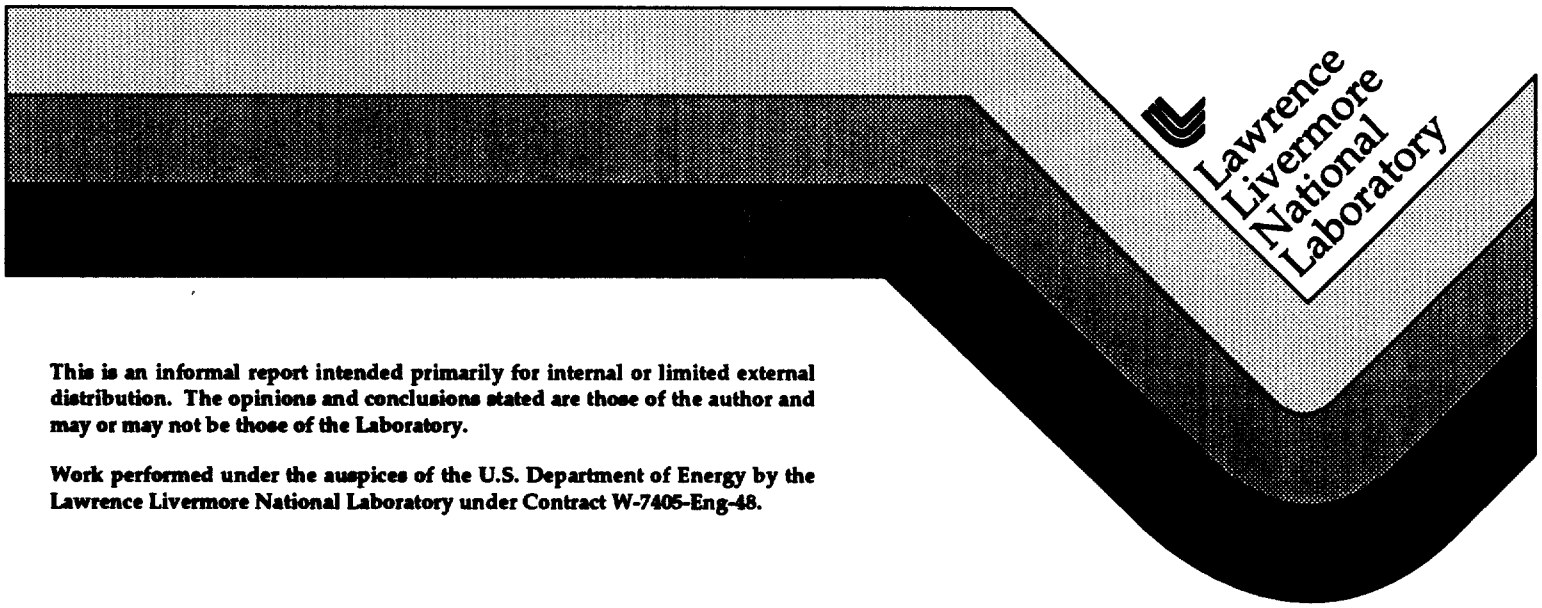
National Ignition Facility
SubSystem Design Requirements
Laser & Target Area Building (LTAB)
SSDR 1.2.2.1

P. Kempel

August 19, 1996



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National Ignition Facility
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August 19 1996

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List of Figures and Tables

1.0 Scope

This Subsystem Design Requirements (SSDR) document establishes the performance, design, and verification requirements for the conventional building systems and subsystems of the Laser and Target Area Building (LTAB), including those that house and support the operation of high-energy laser equipment and the operational flow of personnel and materials throughout the facility.

This SSDR addresses the following subsystems associated with the LTAB:

- Building structural systems for the Target Bay, Switchyards, Diagnostic Building, Decontamination Area, Laser Bays, Capacitor Bays and Operations Support Area; and the necessary space associated with building-support equipment.
- Architectural building features associated with housing the space and with the operational cleanliness of the functional operation of the facilities.
- Heating, Ventilating, and Air Conditioning (HVAC) systems for maintaining a clean and thermally stable ambient environment within the facilities.
- Plumbing systems that provide potable water and sanitary facilities for the occupants, plus stormwater drainage for transporting rainwater.
- Fire Protection systems that guard against fire damage to the facilities and their contents.
- Material handling systems for transporting personnel and heavy materials within the building areas.
- Mechanical process piping systems for liquids and gases that provide cooling and other service to experimental laser equipment and components.
- Electrical power and grounding systems that provide service and standby power to building and experimental equipment, including lighting distribution and communications systems for the facilities.
- Instrumentation and control systems that ensure the safe operation of conventional facilities systems, such as those listed above.

Detailed requirements for building subsystems that are not addressed in this document (such as specific sizes, locations, or capacities) are included in detail-level NIF Project Interface Control Documents (ICDs).

2.0 Applicable Documents

Consensus codes and standards, and reference documents applicable to LTAB subsystems are listed at the beginning of each discipline heading in Section 3.2.

3.0 System Requirements and Verification

3.1 System Definition

3.1.1 System Description

The Laser and Target Building (LTAB) subsystem consists of an integrated combination of building enclosures, supports, and utility subsystems that serve to sustain the operation of the NIF. The LTAB is the major structure of the complex, housing the NIF experimental hardware, control and diagnostic systems, and supporting equipment.

To accomplish this purpose, the LTAB arrangement consists of the functional areas listed below. Figure 3-1, LTAB Key Plan, provides a plan layout of these areas, consistent with operational requirements.

- Target Bay.
- Switchyards (two areas).
- Diagnostics Building.
- Decontamination Area (beneath the Diagnostics Building).
- Laser Bays (two areas).
- Capacitor Bays (four areas).
- Operations Support area.

The subsystems that comprise the LTAB subsystem are those structures, utility systems, and building components that serve the facility and certain experimental hardware needs. These LTAB subsystems are described in the following paragraphs.

3.1.1.1 Civil

Civil discipline is not applicable within the LTAB. For topographic, subsurface, and other siting data, generic design criteria, utility locations, and other information that contributes to the LTAB design, refer to SDR 001, Convention Facilities System Design Requirements, and SSDR 1.2.1, Site Improvements Subsystem Design Requirements.

3.1.1.2 Structural

Building structural systems consist of reinforced-concrete foundations and floor slabs and steel-framed superstructures for the Diagnostic Building, Decontamination Area, Laser Bays, Capacitor Bays, and Visitor Center. The Target Bay and Switchyards comprise a reinforced-concrete superstructure, which is enveloped in a steel-framed superstructure. Special foundation systems provide dimensional and vibrational stability for experimental apparatus, including thick, reinforced-concrete-mat foundations for laser support structures and equipment in the Laser Bays, and cast-in-place, reinforced-concrete foundations for the Target Bay and Target Chamber.

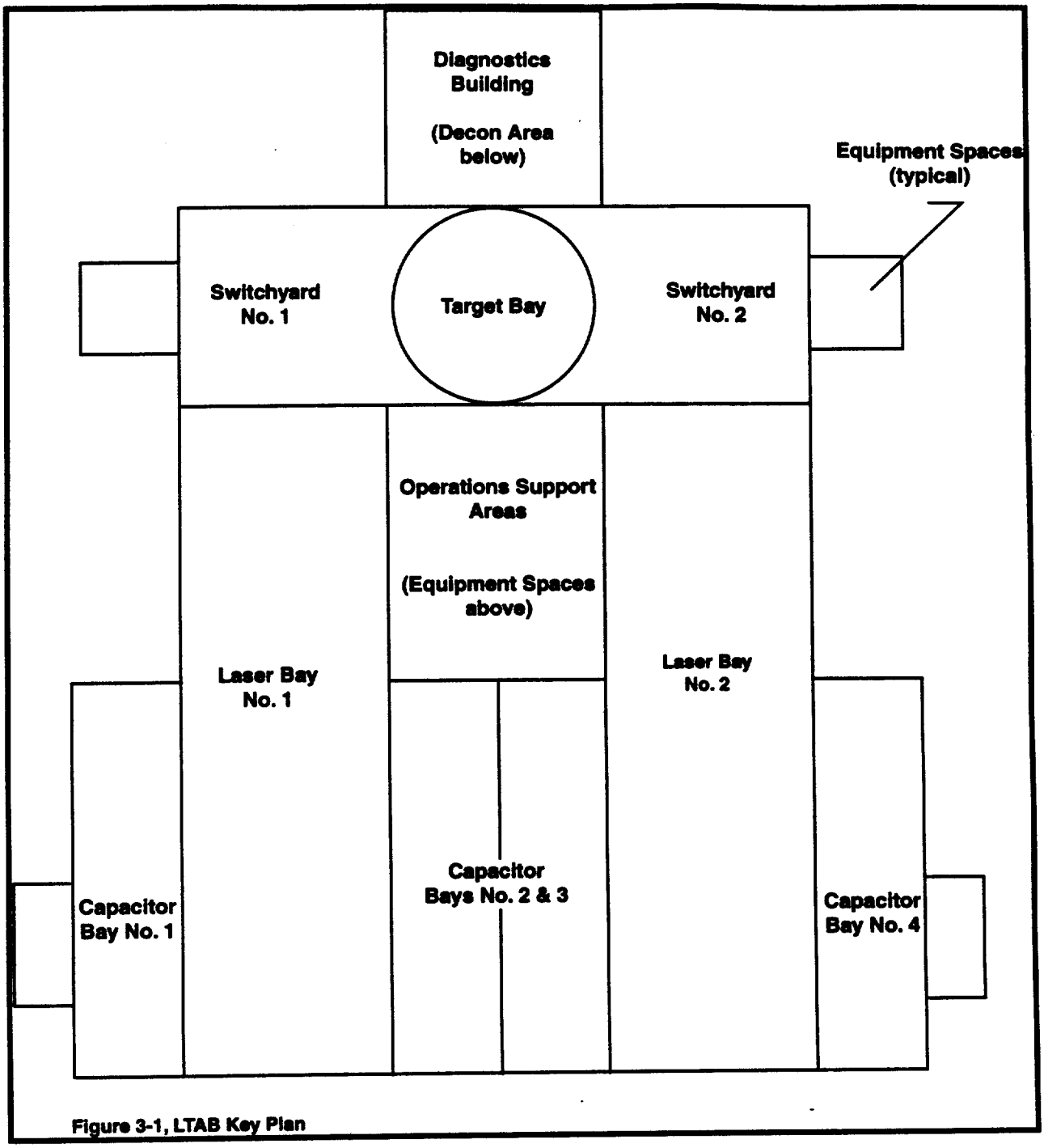

Figure 3-1, LTAB Key Plan

Concrete shielding is provided at strategic locations in the Target Bay structure, such as around penetrations associated with laser beam optics and diagnostics, and access door openings. The shielding provides protection against ionizing radiation that could be emitted from some NIF experiment operations.

The superstructures of both Laser Bays and Switchyard No. 2 include supports for 10-ton overhead traveling cranes.

These systems are more fully described in construction drawings and specifications, which interpret the structural and shielding designs, provide information for bidding purposes, and give directions for concrete construction, steel erection, inspection, and testing. The following configuration control drawings outline the scope of the LTAB:

Configuration Control Drawings

Drawing Number	**Title**
CFG - 200	Laser and Target Building Floor Plan at Level –33'-9"
CFG - 201	Laser and Target Building Floor Plan at Level 0'
CFG - 202	Laser and Target Building Floor Plan at Level 28'-0"
CFG - 203 & 204	Target Bay Floor Plans
CFG - 205	Diagnostics Building Floor Plans
CFG - 301 & 302	Laser and Target Building—Building Sections

3.1.1.3 Architectural

Target Bay – The Target Bay is an approximately 100-ft diam by 98-ft-tall, cylindrical, reinforced-concrete structure containing seven annular floors surrounding a Target Chamber pedestal, on which the Target Chamber will be constructed (see SDR 003). These spaces will house and support target positioning, imaging, and diagnostic equipment, and have special requirements for vibration and temperature control for facilitating optical component alignment. The walls, floors, and ceilings of the Target Bay are epoxy-coated concrete surfaces designed to maintain Class 100,000 cleanliness. Shielding doors provide personnel and equipment access to each level of the Target Bay from the Switchyards and the Diagnostics Building. The Target Bay contains approximately 39,250 sq ft of space (total) on all floors to provide access for installation, operation, and maintenance of laser and target sysem components.

Switchyards No. 1 and 2 – Each of the Switchyards is approximately 100 ft square by 90 ft high, forming reinforced-concrete structures adjacent to the north and south sides of the Target Bay. The Switchyards are high-bay open areas with low-dusting finishes to maintain a Class 100,000 cleanliness environment, in which five stories of optical switch components and beam transport structures will be installed (see SDR002). These spaces also have special requirements for vibration and temperature control to facilitate optical component alignment. Together, the Switchyards contain approximately 20,000 sq ft of

high-bay space to provide access for installation, operation, and maintenance of laser and target sysem components. Switchyard No. 2 has an overhead traveling crane (described in 3.1.1.7) for handling heavy equipment components.

The Target Bay, with Switchyards 1 and 2, forms an integrated reinforced-concrete structure containing these three main spaces. This structure is totally enclosed by a steel-framed, insulated metal building enclosure that provides an "environmental envelope" to ensure maintenance of the required thermal stability in these spaces. The enclosure building comprises standard industrial construction, with an insulated, EPDM (ethylene propylene diene monomer) roof and ordinary industrial finishes.

Diagnostics Building – The Diagnostics Building is a steel-framed, insulated, metal superstructure with reinforced-concrete floors and foundations, and low-dusting finishes to maintain a Class 100,000 cleanliness atmosphere. It is approximately 100 ft square and has four levels, one of which is the below-grade 63-ft-wide Decontamination Area described below. The Diagnostics Building contains approximately 36,000 sq ft of space (total) on all floors as follows:

Ground Floor Level (elev. –3.5′)

- Diagnostic repair.
- Machine shop.
- Outside user work space.
- Local control area.
- Men's and women's restroom areas.

Second Floor Level (elev. +17.5′)

- Unclassified local data acquisition.
- Target staging and cryo target assembly.
- Diagnostic staging and diagnostic storage areas.

This level incorporates special access features (1) to accommodate moving experimental target objects from outside the building through a 15-ft-wide corridor directly into the Target Bay, and (2) for storage of a Test Object Transport and Inspection Module – TOTIM (16′ × 10′).

Third Floor Level (elev. +29.5′)

- Classified local data acquisition.
- Short pulse laser.
- Long pulse laser.
- Optical components calibration.
- Diagnostic assembly/alignment and DC x-ray source areas.

Decontamination Area (elev. –33.5')

The below-grade level of the Diagnostics Building contains a 6300-sq-ft area with a hot cell and facilities for cleanup of potentially exposed personnel and contaminated equipment components.

Laser Bays – The two Laser Bays, along with the capacitor-equipment spaces between them (described below), form a steel-framed, insulated, metal superstructure with concrete floors and an insulated, EPDM roofing system. Each bay is approximately 440 ft long by 100 ft wide by approximately 50 ft (clear) high, and has low-dusting finishes to maintain a Class 100,000 cleanliness atmosphere for the laser equipment that will be housed in this space. Entry to these spaces is through airlocks from adjacent spaces, such as the Optics Assembly Building (OAB) and the entrance lobby.

Each bay has a special foundation (described in 3.1.1.2) at floor level to provide firm, vibration-free bearing for laser equipment supports (SDR002). Each bay has an overhead traveling crane (3.1.1.7) for handling equipment components in these spaces.

Capacitor Bays – Capacitor Bays No. 1 and 4 are steel-framed, insulated, metal structures with concrete floors and insulated, EPDM roofs, attached to the exterior sides of Laser Bays No. 1 and 2. Capacitor Bays No. 2 and 3 are inside the main structure, between the Laser Bays. Each of the Capacitor Bays is 50 ft wide by 250 ft long by approximately 28 ft high, and houses the capacitor banks, conductors, and raceways associated with the power system for laser flashlamps. Each of these 12,500-sq-ft spaces have ordinary industrial finishes.

Operations Support – The Operations Support spaces are housed within the larger high-bay structure, between the Laser Bays (see Fig. 3-1). These spaces include occupied areas on the main floor—the Master Oscillator Room (MOR), main control room, classified control room, computer room, strategy room, preamplifier module (PAM) maintenance area, and toilets—and normally unoccupied spaces above the main floor—mechanical equipment rooms, one of which extends the entire length of the Laser Bays over the occupied Operations Support area, and Capacitor Bays No. 2 and 3 on the main floor.

The main floor spaces total approximately 15,000 sq ft in an area 100 ft wide by 150 ft long by 28 ft high. The equipment spaces total approximately 45,000 sq ft in a space 100 ft wide by 440 ft long by approximately 36 ft high.

The architectural features of the LTAB are more fully described in construction drawings and specifications, which interpret the space designs, provide information for bidding purposes, and give directions for construction, installation, inspection, and testing. The following general arrangement drawings outline the space of the LTAB:

General Arrangement Drawings

Drawing Number	Title
GA202 - 01	General Arrangement Key Plan
GA202 - 02	General Arrangement Plans—Capacitor Bays
GA202 - 03	General Arrangement Plans—Laser Bay
GA202 - 04 thru 06	General Arrangement Plans—Switchyards
GA202 - 07	General Arrangement Plans—Target Bay
GA202 - 08	General Arrangement Plans—Operations Support
GA202 - 09	General Arrangement Plans—Diagnostics Building
GA202 - 10	General Arrangement Plans—Mechanical Rooms

3.1.1.4 Heating, Ventilating, and Air Conditioning (HVAC)

The LTAB HVAC systems are designed with the extensive use of Computational Fluid Dynamics in response to the experimenters' critical requirements for thermal stability, minimum vibration, cleanliness, and reliability during operation.

Tempered air is typically distributed at low velocities through round ducts with sound traps and long-radius elbows to minimize noise and vibrations. Rotating equipment is mounted with flexible connections to ductwork and appropriate vibration isolation to the building structure.

Hot water and chilled water supply to coils in air handling units is provided from boiler and chiller equipment located outside the LTAB and routed underground to the building. The equipment and underground piping is addressed in SSDR 1.2.1, NIF Site Improvements. Distribution piping to the coils is routed within the building to the mechanical spaces where the coils are located, and are configured to suppress hydraulic shock.

The systems controlling the ambient environment of each of the LTAB spaces are described in the paragraphs that follow.

Target Bay – Due to the potential for air activation during high-yield experiments, HVAC for the Target Bay is a self-contained system, isolated from other building HVAC systems, and maintained at positive pressure prior to these experiment "shots" and negative pressure immediately afterward to minimize the potential spread of radioactive contamination.

The Target Bay HVAC system achieves a Class 100,000 cleanliness environment by the use of HEPA filters in the air supply. The system includes four primary air handling units that circulate air through the Target Bay to maintain the required temperature. Each air handling unit consists of two fans, a cooling coil, sound traps, and filters.

The Target Bay system also includes two secondary make-up air handling units that control the relative humidity and provide the necessary air for ventilation and pressurization. Each make-up air handling unit consists of a fan, preheat coil, heating coil, humidifier, dehumidifier (cooling) coil, sound traps, and filters.

The Target Bay is served by an exhaust unit to maintain building pressurization and fresh air requirements, which discharges through an elevated release point equipped with an effluent monitoring station.

Laser Bays – The HVAC systems for Laser Bays No. 1 and 2 each consist of four primary air handling units maintaining a constant volume of circulating air. Each air handling unit has two fans, cooling coils, sound traps, and filters. The HVAC systems provides a Class 100,000 cleanliness environment in the Laser Bays.

Each primary air handling unit is associated with a secondary make-up air handling unit, which controls the required humidity and maintains the required ventilation and pressurization. Each make-up air handling unit consists of a fan, preheat coil, heating coil, humidifier, dehumidifier (cooling) coil, sound traps and filters.

Each air handler is also associated with an exhaust fan to maintain the proper balance of fresh air and pressurization of the space.

Switchyards – The HVAC systems for Switchyards No. 1 and 2 each consist of a primary air handling unit, a secondary make-up air handling unit, and an exhaust unit, similar to the equipment described for the Laser Bays, which maintain a Class 100,000 cleanliness environment in these spaces.

Diagnostics Building – Due to the need for several thermal zones in the Diagnostics Building, a zoned HVAC system is used to provide separate temperature controls for individual spaces in the building. The HVAC system comprises air handlers with chilled-water cooling and hot-water heating coils, variable-frequency drives for pressure compensation, and direct digital controls.

Decontamination Area – The HVAC system for the bottom floor of the Diagnostics Building consists of air handlers with chilled-water cooling and hot-water heating coils, variable-frequency drives for pressure compensation, and direct digital controls. The system includes a dedicated exhaust fan that discharges to an elevated stack equipped with a stack-effluent environmental monitoring station. The supply and exhaust systems are controlled to maintain a negative pressure in the Decontamination Area.

Capacitor Bays – Each of the four Capacitor Bays is served by a dedicated air handling unit consisting of a supply fan, cooling coil, heating coil, and filters. The air handling units circulate air through the spaces to maintain temperatures in the required range.

Operations Support Areas – Each of the zoned areas is served by dedicated air handling units consisting of supply fans, cooling and heating coils, filters, sound traps,

direct digital controls, and variable-frequency drives. Dedicated exhaust fans and make-up air handling units are also used to provide the required exhaust and recirculated air to maintain proper temperatures and cleanliness environment (Class 100,000 in the MOR and PAM maintenance areas only).

These systems are more fully described in the construction drawings and specifications, which interpret the HVAC and HVAC-Controls designs, provide information for bidding purposes, and give directions for fabrication, installation, inspection, testing, and balancing.

3.1.1.5 Plumbing

Plumbing systems for the LTAB consist of domestic cold water (potable water), sanitary waste, suspect waste (potentially contaminated waste), and stormwater drains. These systems serving the building are described in the paragraphs below.

The domestic cold water system is available on site (underground) at approximately 100 psig, reduced to 80 psi at the building, then distributed in the building to serve low-flow fixture-unit requirements. In addition to sanitary fixtures, the system also serves and includes emergency eye-wash fountains and safety showers, laboratory sinks, and hose bibbs. Connections may also be provided for process requirements (see 3.1.1.8).

The sanitary soil/waste and vent system in the LTAB provides a minimum flow velocity of 2 ft/s in accordance with local codes. Traps are provided with integral trap primers. The interior sanitary waste piping is routed and connected to the fixture units in the building.

Potentially contaminated waste from the Decontamination Area of the Diagnostics Building is collected in fixtures and floor drains and routed to a retention tank system in accordance with Laboratory requirements published in *LLNL Guidelines for Retention Tank Systems*.

The stormwater drain system consists of roof drains, overflow drains, and associated piping to convey the water to the exterior of the building. The roof drains and overflows prevent flooding of the roof over 2 inches. Piping is designed for the maximum design rainfall of 4 in/hr, routed to the site storm drain system in accordance with local plumbing codes.

These systems are more fully described in construction drawings and specifications, which interpret the plumbing designs, provide information for bidding purposes, and give directions for construction, installation, inspection, and testing.

3.1.1.6 Fire Protection

The LTAB fire suppression systems consist of automatic wet-pipe sprinkler systems, gaseous dispersion systems, and portable fire extinguishers. The sprinkler system designs and densities are based on NFPA Ordinary Hazard Group 2 occupancy.

Fire Protection water supply is provided by connection to the site water system loop through three supply lines, one on each side of the Laser Bays and one serving the Target Bay and Switchyards. Service connections include backflow prevention, flow detector alarms, valve supervision, fire department connections, and inspector's test and drain valves. System risers are located inside the building. Standpipes are combined with the sprinkler systems and located in each stair shaft with a hose connection at each floor and on the roof.

The Target Bay and Decontamination Area (lowest levels) serve as their own collection reservoirs for discharge water from fire suppression heads there, and will hold volumes equal to the design flows from sprinklers for 20 minutes, plus the manual fire-fighting flow rate. This facilitates collection and retention of potentially contaminated water in these areas for treatment and disposal.

The Control Rooms (2) and the Master Oscillator Room in the Operations Support area are provided with CO_2 fire suppression systems below the raised floors, which are designed to activate and to initiate alarms by thermal detectors.

These systems are more fully described in construction drawings and specifications, which interpret the fire protection and control system designs, provide information for bidding purposes, and give directions for construction, installation, inspection, and testing.

3.1.1.7 Material Handling

3.1.1.7.1 Cranes

Three cranes are provided in the LTAB—one in each Laser Bay, and one in Switchyard No. 2—for the initial installation of laser beamline components and long-term operations and maintenance use. All cranes will be designed, installed, and tested in accordance with applicable safety standards and have similar physical and performance characteristics as follows:

Overhead cranes for the LTAB are 10-ton-capacity, electrically operated, double-girder bridge cranes with under-running trolley-and-hoist assemblies, safety hooks, and dynamic controls with inching capability. Cranes are operated from remote radio-control stations at floor level.

3.1.1.7.2 Monorails and Hoists

Monorails and hoists are provided at **TBD** strategic locations in the LTAB spaces to facilitate the installation and maintenance of building-related equipment components. Manually operated, under-running trolleys with electrically operated hoists have **TBD**-ton capacities and safety hooks. Hoists are operated from push-button pendant controls.

A **TBD**-capacity overhead monorail (no hoist) is provided for potential future use along the center of the 15-ft-wide corridor on the second level of the Diagnostics Building.

3.1.1.7.3 Elevators

Five elevators are provided in the LTAB:

- One (each) in Switchyards 1 and 2, which also serve the Target Bay and Laser Bays.
- One in the Diagnostics Building—for transporting equipment and personnel between floors and platform levels.
- One near the main entrance to the LTAB, serving a catwalk level to the Operations Support Area.
- One in the Operations Support Area.

The Switchyard elevators are electrically operated, push-button-controlled, traction-type freight elevators with 10,000 lbs capacity. These elevators are located where the Target Bay, Switchyards, and Laser Bays intersect, and serve seven landings, including the Laser Bay floor and all levels of the Switchyard and Target Bay platforms.

The Diagnostics Building elevator is an electrically operated, push-button-controlled, traction-type freight elevator with **TBD** lbs capacity. It is located at the east wall of the building, adjacent to the Target Bay, and serves four landings.

The main-entrance elevator is an electrically operated, push-button-controlled, personnel elevator with **TBD** lbs capacity, and serves two landings. It is located at the outside wall of Laser Bay No. 1, near the main entrance, providing an overhead catwalk route to the Operations Support Area.

The Operations Support elevator is an electrically operated, push-button-controlled, personnel elevator with **TBD** lbs capacity, and serves two landings. It is located near the west stairs in the Operations Support Area.

These systems are more fully described in construction drawings and specifications, which interpret the crane, hoist, and elevator designs, provide information for bidding purposes, and give directions for construction, installation, inspection, and performance testing.

3.1.1.8 Mechanical Process Piping

The mechanical process piping systems for operations use in the LTAB include the following:

- Nitrogen (building blockouts only, for future installations).
- Argon (building blockouts only, for future installations).
- Process Water (from the domestic cold water supply—see 3.1.1.5).
- Low-Conductivity Cooling Water (building blockouts, for future).
- Deionized Cooling Water (building blockouts, for future).
- Compressed Air (from the facility supply system).

Process water is provided for operations use by distribution piping to isolation valves and appropriate backflow preventers at strategic locations in the facility. Supplies (size and location **TBD**) are connected water lines described in 3.1.1.5.

High-quality compressed air for instrumentation and operations use is supplied by compressors located on site (see SSDR 1.2.1). Compressed air piping is routed in the building to conventional-facilities instrument and equipment locations. Valved and capped piping stubs (size and location **TBD**) are provided at strategic locations for future operations use.

All other mechanical process piping will be provided by the NIF Project through blockouts installed in the LTAB foundation walls and floor slabs at **TBD** locations in the LTAB spaces.

These systems are more fully described in the construction drawings and specifications, which interpret the blockout and piping designs, provide information for bidding purposes, and give directions for construction, installation, inspection, and testing.

3.1.1.9 Electrical

Electrical work consists of building power distribution, lighting, communications, fire detection and alarms, evacuation voice/alarm, security system, grounding, and lightning protection systems. Detail description **TBD** after design is established.

These systems are more fully described in the construction drawings and specifications, which interpret the electrical distribution system designs, provide information for bidding purposes, and give directions for construction, installation, inspection, and testing.

3.1.1.10 Instrumentation and Controls

Instrumentation and controls (I&C) for conventional-facilities mechanical and electrical systems **TBD** as design is established. I&C for special equipment and operations use is provided by the NIF Project.

These systems are more fully described in the construction drawings and specifications, which interpret the instrumentation and controls designs, provide information for bidding purposes, and give directions for construction, installation, inspection, and testing.

3.2 System Characteristics and Verification

Generic design criteria for NIF conventional facilities (design lifetime, performance class, reliability, seismic and wind criteria, ALARA shielding, quality assurance, etc.) are identified in NIF-SDR001, *Conventional Facilities System Design Requirements* and NIF–SSDR 1.2.1, *NIF Site Improvements*. The design of subsystems addressed in this SSDR document shall comply with the general criteria established in these documents in addition to those specifically identified in this section.

Certain quantitative and qualitative system or subsystem design attributes emerge from this or other SSDR(s) and may be identified in lower-level Interface Control Documents (ICDs). In cases where the SSDR and ICD are silent in regard to essential subsystem design criteria, and unless otherwise specifically stated herein, DOE Order 6430.1A, General Design Criteria, dated 4/6/89, is to be utilized for design guidance in meeting performance criteria established in this requirements document.

3.2.1 Performance and Physical Characteristics

3.2.1.1 Civil

(Not applicable. Refer to SDR001 and SSDR 1.2.1, *Site Improvements Subsystem Design Requirements*, for topographic and subsurface data, siting information, utility locations, etc.)

3.2.1.2 Structural

Structural designs for the LTAB shall be performed in accordance with the following standards:

General

- International Council of Building Officials, UBC.
- LLNL Special Requirements for Structural Design.
- DOE Order 6430.1A, General Design Criteria.
- DOE STD 1020-94, Natural Phenomena Hazards Design.

Design

- American Society of Civil Engineers, ANSI/ASCE 7-88, Code Requirements for Min. Design Loads for Buildings.

Concrete

- American Concrete Institute, ANSI/ACI-318.

Steel

- American Institute of Steel Construction, AISC Manual M011.

3.2.1.2.1 Structure Loads

Structure floor loading and other characteristics associated with operational requirements for LTAB structures are listed in Table 3-1.

3.2.1.2.2 Radiation Shielding

Radiation shielding designs for the LTAB shall meet the applicable requirements of the following standards:

- DOE Order 5400.5, Radiation Protection of the Public and the Environment.
- DOE Order 420.1, Facility Safety.
- DOE Order N441.1, Radiation Protection for Occupational Workers.
- Title 10, Code of Federal Regulations, Part 20 (Standards for Protection Against Radiation).
- Title 10, Code of Federal Regulations, Part 835 (Occupational Radiation Protection).

The ALARA principle (as low as reasonably achievable) shall be used in the design to eliminate unnecessary radiation doses to LTAB workers, collocated employees, and visitors from both routine and off-normal operations. A shielding design goal for the maximum radiation dose to an individual worker shall be one-tenth (or lower, based on ALARA) of the occupational external dose limits specified in 10CFR835.

The source term for the NIF is 4.3×10^{20} neutrons/yr (1200 MJ/yr), emitted isotropically at the center of the 10-m-diam Target Chamber. Prompt dose limits in the areas in and around the LTAB are identified in Table 3-2.
Recommended material for shielding is reinforced concrete conforming with the requirements of ANSI/ACI-318 (may be coincident with structural elements of the building).

3.2.1.2.3 Verification of Structural Design

Refer to Section 4.0, Quality Assurance.

Table 3-1 – Structure Loads

Building Area	Floor Live Load	Deflection	Vibration	Noise
Target Bay	TBD psf TBD concent.	TBD	$<1 \times 10^{-10} g^2$ Hz from 1 to 200 Hz (Note 1)	(Note 2)
Switchyards	TBD psf TBD concent.	TBD	$<1 \times 10^{-10} g^2$ Hz from 1 to 200 Hz (Note 1)	(Note 2)
Diagnostic Building	TBD psf TBD concent. all floors	TBD	TBD	TBD
Decontamin. Area	TBD psf TBD concent.	TBD	N/A	N/A
Laser Bays: Floors Fdn Slab	TBD psf TBD concent. TBD psf	TBD	$<1 \times 10^{-10} g^2$ Hz from 1 to 200 Hz (Note 1)	(Note 2)
Capacitor Bays	TBD psf TBD concent.	TBD	$<1 \times 10^{-10} g^2$Hz from 1-200Hz (Note 1)	
Visitor Center	100 psf 2000 lb concent.	TBD	N/A?	N/A
Operations Support Area	100 psf 2000 lb concent.	TBD	PAMMA & MOR (Note 1 & 3). Others N/A	(Note 2)

Notes:

N/A = not applicable

1. Building structures shall incorporate design features to reduce the transmission of vibrations to laser components, switchyard optics, the target chamber and other components.
2. Building structures shall incorporate design features to reduce noise transmission to laser components, switchyard optics, the target chamber and other components.
3. PreAmplifier Module Maintenance Area (PAMMA): $<1 \times 10^{-6} g^2$ Hz, from 1 to 200 Hz
   Master Oscillator Room (MOR): $<1 \times 10^{-8} g^2$ Hz, from 1 to 200 Hz

Table 3-2 – Radiation Dose Limits for the NIF

Building Area	Prompt Radiation Dose Limitations (taking into account ALARA principles)
Target Bay	Exclusion area—no personnel occupancy during experiment shots
Switchyards	Exclusion area—no personnel occupancy during experiment shots
Diagnostics Building	≤30 mrem/yr
Decontamination Area	≤30 mrem/yr
Laser Bays	Exclusion area—no personnel occupancy during experiment shots
Capacitor Bays	Exclusion area—no personnel occupancy during experiment shots
Operations Support Areas	≤30 mrem/yr
Equipment Spaceswith personnel access	≤30 mrem/yr
Outside Areas Aroundthe LTAB	≤50 mrem/yr
Site Boundary	≤0.2 mrem/yr

3.2.1.3 Architectural

Architectural designs for the LTAB shall be performed in accordance with the following standards:

- International Council of Building Officials, UBC.
- National Fire Protection Assn, NFPA 101, Life Safety Code.
- Uniform Federal Accessibility Standard FED STD 975.
- DOE Order 5632.1C, Protection of Safeguards and Security Interests.
- PHY 96055.PDF, Security Requirements, NIF Classified Control Room.

3.2.1.3.1 Functional Space Requirements

Functional space requirements and other characteristics associated with operational requirements are listed in Table 3-3. Appropriate toilet facilities shall be provided for all "business" occupancies in accordance with the Uniform Plumbing Code. Cleanliness classifications are not "clean room" requirements per se (e.g., particle monitoring equipment not required, etc.), but they are intended to approach those characterized in Federal Standard 209D.

Table 3-3 – Space Requirements

Building Area	Approx. Net Floor Area	Approx. Room Height	Occupancy Class	Cleanliness Classification
Target Bay	39,000 (7 levels)	Levels Vary	Industrial	100,000 clean zone
Switchyards	20,000 (2 spaces)	90'	Industrial	100,000 clean zone
Diagnostic Building (see Note)	36,000 (4 levels)	Levels Vary	Industrial, Business	N/A (see Note)
Decontamination Area	6300 incl above	32'	Industrial	100,000 clean zone
Laser Bays	90,000 (2 bays)	51'	Industrial	100,000 clean zone
Capacitor Bays	50,000 (4 bays)	28'	Industrial	N/A (see Note)
Visitor Center	TBD	TBD	Business	N/A (see note)
Operations Support Area	15,000	15'	Business	100,000 clean zone

Note:
N/A = Special cleanliness not applicable; ordinary industrial/business "good housekeeping" applies to these spaces.

Ground Floor Level (elev. –3.5')

- Diagnostic repair: 50' × 50'
- Machine Shop: 50' × 50'
- Outside User Work Space: 50' × 30'
- Local Control Area: 44' × 20'
- Men's/Women's restrooms: 22' × 15' each

Second Floor Level (elev. +17.5')

- Unclassified Local Data Acquisition: 35' × 30'
- Target Staging and Cryo Target Assembly: 40' × 28'
- Diagnostic Staging: 20' × 30'
- Diagnostic Storage: 20' × 30'

Diagnostics Building spaces comprising approximately 36,000 sq ft shall be provided as follows. Room sizes are approximate.

The second floor level shall incorporate access features to accommodate moving experimental target objects from outside the building, through a 15-foot-wide corridor, directly into the Target Bay, and also for storage of a Test Object Transport and Inspection Module (TOTIM): 16' × 10'

Third Floor Level (elev. +29.5')

- Classified Local Data Acquisition: 35' × 30'
- Short Pulse Laser: 30' × 20'
- Long Pulse Laser: 30' × 20'
- Optical Components Calibration: 30' × 20'
- Diagnostic Assembly/Alignment: 30' × 20'
- DC X-Ray Source: 30' × 20'

Decontamination Area (elev. –33.5')

The below-grade level of the Diagnostics Building shall include a 6300-sq-ft area with a hot cell and facilities for cleanup of potentially radioactively exposed personnel and contaminated equipment components.

3.2.1.3.2 Access and Egress

Building spaces, corridors, stairways, exits, and exit paths shall meet the requirements for their construction and occupancy classifications, as established in the reference code documents, including requirements for handicapped access to the main-entry elevator and overhead catwalk route to the Operations Support Area.

Primary use occupancy classification shall be "Industrial," per the life safety code (NFPA 101, 4-1.9). Secondary use shall be "Business" (NFPA 101, 4-1.8).

In order to maintain the differential atmospheric pressures required in LTAB spaces, access for personnel and equipment to the LTAB from the building exterior or from adjacent buildings (i.e., OAB and Diagnostics Building) shall be through airlock spaces. Access between LTAB spaces that have differing ambient pressures shall also be through airlock spaces, such as stairwells, elevators, or vestibules.

Personnel access to and egress from security-classified spaces shall be through single-door security portals, in accordance with PHY 96055.PDF and LLNL security practices. Construction materials and installations associated with classified spaces, including floors, walls, ceilings, doors, vents, sound transmission, telephones, and alarms shall meet the requirements for an Alarmed Limited Area within a surrounding Controlled Area.

3.2.1.3.3 Building Interior and Exterior Finishes

All interior building spaces designated as "clean zone" spaces shall have durable, sealed, surface finishes that do not chalk, slough, or otherwise give off particles, and

shall be compatible with maintaining the environment of spaces with cleanliness classifications listed in Table 3-2.

Interior spaces for "business" occupancy shall have surface finishes **TBD.**

Airlock spaces **TBD.**

All exterior building surfaces shall be **TBD.**

3.2.1.3.4 Miscellaneous Metals

Stairs, handrails, grating, expansion joints... **TBD.**

3.2.1.3.5 Wood and Plastic

Carpentry, countertops, shelving, laminates... **TBD.**

3.2.1.3.6 Thermal and Moisture Control

Insulation, vapor barriers, fireproofing, roof membranes, flashing... **TBD.**

3.2.1.3.7 Doors and Windows

Entrance, personnel, overhead, roll-up doors... **TBD.**

3.2.1.3.8 Architectural Specialties

Toilet partitions, accessories, chalkboards, fire extinguisher cabinets, signs...**TBD.**

3.2.1.3.9 Miscellaneous Special Equipment

Dock levelers, bumpers, fume hoods, sound and vibration control...**TBD.**

3.2.1.3.10 Verification of Architectural Design

Refer to Section 4.0, Quality Assurance.

3.2.1.4 Heating, Ventilating, and Air Conditioning

HVAC designs for the LTAB shall be performed in accordance with the following standards:

- American Society of Heating, Refrigeration, and Air Conditioning Engineers, ASHRAE Guide, and associated standards.
- Airborne Particulate Cleanliness Classes, FED STD 209E.
- ACGIH Industrial Standard Ventilation Manual.
- AMCA - Air Movement and Control Association.
- ANSI/AIHA Standard Z 9.5, Laboratory Ventilation.
- ANSI/ASME N510 Nuclear Air-Cleaning Handbook.
- ARI - Air-Conditioning and Refrigeration Institute.
- DOE Order 5400.5, Radiation Protection of the Public and Environment.
- Energy Conservation Standards, 10CFR 435 & 436.
- Standards for Emission of Radionuclides from DOE Facilities, 40CFR 61.
- Factory Mutual Standards.
- NEC - National Electrical Code.
- National Fire Protection Assn Standards.
- LLNL Facilities Standards.
- LLNL Health and Safety Manual.
- SMACNA - Sheet Metal and Air-Conditioning Contractors Nat'l Ass'n.
- Uniform Building Code, ICBO.
- Uniform Mechanical Code, ICBO.
- Uniform Plumbing Code, ICBO.

An HVAC system design that optimizes energy consumption and building life cycle costs shall be provided for the LTAB as a consequence of a comprehensive analysis of the building's energy conservation aspects.

3.2.1.4.1 Outdoor Design Conditions

Outdoor conditions for the LLNL preferred site shall be those listed for 1% ASHRAE Weather Data for Livermore, CA. The following outdoor environmental design conditions apply:

- Location: Livermore, CA
- Latitude/Longitude: 37.7° N, 122° W
- Elevation: 490 ft above MSL
- Summer: 100°F DB, 69°F WB
- Mean Daily Temp Range: 24°F
- Winter: 24°F
- Heating Degree Days: 3012

3.2.1.4.2 Indoor Design Conditions

Indoor design conditions for the LTAB HVAC systems are specified in Table 3-4.

Table 3-4 – Indoor HVAC Design Conditions

Building Space	Temperature (°F)	Relative Humidity (%)	Pressure (in. H_2O)	Cleanliness Classification
Target Bay, normal mode	68 ± 0.5	45 ± 15	+0 .05	100,000 clean zone
Target Bay, confinement mode	68 ± 0.5	45 ± 15	–0.05	100,000 clean zone
Switchyards	68 ± 0.5	45 ± 15	+0.05	100,000 clean zone
Diagnostic Building, Target Handling Area	68 ± 2	45 ± 15	–0.01	100,000 clean zone
Diagnostic Building, Decontamination Area	68 ± 2	45 ± 15	–0.01	100,000 clean zone
Diagnostic Building (other areas)	68 ± 2	45 ± 15	N/A	100,000 clean zone
Laser Bays	68 ± 0.5	45 ± 15	+0.05	100,000 clean zone
Capacitor Bays	70 ± 2	no min. 60 max.	+0.001	N/A
Operations Support Area	70 ± 2	45 ± 10	+0.01	100,000 clean zone
PAMMA	68 ± 0.5	45 ± 10	+0.01	
MOR	68 ± 0.5	45 ± 15	+0.05	

3.2.1.4.3 Ventilation Requirements

Generally, outside air make-up for ventilation shall be provided in accordance with ASHRAE Standard 62 to provide at least 20 cfm/person. Mechanical and electrical equipment spaces shall be ventilated to remove equipment heat loads and maintain air temperatures and pressurization specified in Table 3-4.

The target-handling area, deconatmination area, and other areas where checmicals are used in the Diagnostics Building shall be ventilated to provide at least 6 air changes/hr.

Restrooms shall be ventilated at 2 cfm/sq ft or 12 air changes/hr, whichever is greater.

3.2.1.4.4 Filtration Requirements

The HVAC systems shall be designed to provide filtered, temperature-controlled air to all parts of the LTAB. Area systems indicated in Table 3-4 to provide a 100,000 cleanliness class shall incorporate appropriate filters to attain that condition. The laser system to be installed in the LTAB spaces by the NIF Project will be slightly pressurized with a clean gas to prevent particle intrusion into the containment system enclosing the critical optical components within.

During normal operations, the Target Chamber vacuum roughing system shall be filtered (and shielded) to remove any activated particulates from the gas stream before being exhausted to an elevated release point. During maintenance mode, exhaust from the Target Chamber shall pass through HEPA filters before discharging through the elevated release point.

The exhaust system for the debris-shield cleaning station of the Decontamination Area of the Diagnostics Building shall include appropriate HEPA filters to remove potential radioactive contamination from the air prior to discharge through an elevated release point. The exhaust duct shall be fitted with an environmental monitoring station meeting the requirements of DOE Order 5400.5 and 40CFR 61, Subpart H, Standards for Emissions of Radionuclides for DOE Facilities. Maintenance provisions shall be included for safely changing out "dirty" filters in this system.

If the two HEPA-filtered exhaust systems are discharged through a common elevated release point, backflow prevention shall be provided for both systems.

3.2.1.4.5 Pressurization Requirements

To prevent activation of air in other building spaces, the Target Bay space is required to be negative relative to all other spaces following an experiment. Due to the potential for air activation during high-yield experiments, the Target Bay HVAC system is required to be isolated, self-contained, and capable of maintaining this negative pressure, including a separate exhaust system with HEPA and gaseous filters to remove potential radioactive contamination from the air prior to discharge through the stack described in 3.2.1.4.4.

3.2.1.4.6 Noise and Vibration Control

Air shall be distributed throughout the LTAB HVAC systems at low velocities through ductwork that provides for sound attenuation and minimizes noise and vibration.

The piping distribution system for hot- and chilled-water supply to coils in air handling units shall be configured to suppress hydraulic shock and minimize noise and vibration.

3.2.1.4.7 Seismic Equipment Anchoring

Rotating equipment shall be mounted within the building structure to resist seismic forces specified in SSDR 1.2.1, with appropriate vibration isolation and flexible duct connections to prevent building vibrations exceeding those specified in Table 3-1.

3.2.1.4.8 HVAC Controls

A direct digital control system shall be provided to regulate all functions of the LTAB HVAC systems. The control system shall be connected to the main control room and the LLNL site central monitoring system to indicate critical and important system failures.

3.2.1.4.9 Verification of HVAC Design

Refer to Section 4.0, Quality Assurance.

3.2.1.5 Plumbing

Plumbing system designs for the LTAB shall be performed in accordance with the Uniform Plumbing Code and the LLNL Facility Standards.

Plumbing systems shall be provided as necessary to service the electric water heaters, fixtures, and appliances in the Operations Support areas and Diagnostics Building and drainage of stormwater from all roof areas.

3.2.1.5.1 Potable Water

Domestic cold water from the site underground supply system, provided at approximately 100 psig, shall be reduced to 80 psi at the building and sized in accordance with the required fixture units. Low-flow fixtures shall be used, and the system design shall comply with Americans with Disabilities Act requirements. In addition to serving sanitary fixtures, the system shall include drinking fountains, emergency eyewash and safety showers, electric water heaters, laboratory sinks, and hose bibbs.

3.2.1.5.2 Sanitary Waste

A sanitary soil/waste and vent system shall be provided and sized on the basis of the fixture requirements and a minimum flow velocity of 2 ft/s, in accordance with LLNL Facility Standards and applicable local codes. Traps shall be provided with integral trap primers. The interior sanitary system shall be connected to the exterior underground sanitary sewer.

3.2.1.5.3 Suspect Waste

Potentially contaminated waste from the Decontamination Area of the Diagnostics Building shall be connected to a retention tank system. The retention system shall be designed in accordance with *Guidelines for Retention Tank Systems*, LLNL Environmental Protection Department, January 1996.

3.2.1.5.4 Stormwater Drains

A rainwater collection system shall be provided, consisting of roof drains, overflow drains, and associated piping to convey the water to the exterior of the building, and shall be designed to accommodate a maximum design rainfall of 4 in/hr. Each of the roof drains and the overflows shall consist of a strainer extending not less than four inches above the surface of the roof, having a minimum inlet area of 1.5 times the area of the pipe to which it is connected. Overflow drains shall prevent flooding of the roof over 2 inches. The stormwater piping shall be sloped at a minimum of 1/8 in/ft and routed to the LLNL site storm drainage system. The system shall be designed in accordance with LLNL Facility Standards and applicable local codes.

3.2.1.5.5 Verification of Plumbing Design

Refer to Section 4.0, Quality Assurance.

3.2.1.6 Fire Protection

3.2.1.6.1 General

Fire suppression system designs for the LTAB shall be performed in accordance with the following standards:

- National Fire Protection Assn (NFPA) Standards.
- Factory Mutual (FM) Standards.
- NFPA 75, Standard Fire Protection of Electronic Computer Data Processing Equipment.

System designs shall be based on NFPA "Ordinary Hazard, Group 2" occupancy.

Fire suppression systems for the LTAB spaces shall consist of automatic sprinkler systems and portable fire extinguishers, with gaseous suppression systems for control rooms with raised floors and high concentrations of electronics.

The sprinkler systems shall be wet-pipe type, with dry-pipe systems provided only in areas exposed to freezing. Minimum design density shall be based on NFPA Ordinary Hazard Group 2 occupancy. All sprinkler systems shall be black steel piping, designed and installed in accordance with NFPA 13. Sprinkler heads shall be the quick-response type.

The sprinkler system water supplies shall be served by connections to the NIF site's water system loop.

Service connections at the building shall include backflow prevention, flow detector alarms, valve supervision, Fire Department connections, inspector's tests and drains.

Discharge water from suppression system activation in the Target Bay and in the Decontamination Area shall be collected for required treatment and disposal, holding volumes equal to the design flow from the sprinklers for 20 minutes, plus the manual fire fighting flow rate.
Fire sprinkler system risers shall be located inside of the building, with standpipes combined with the sprinkler systems. Standpipe risers shall be located in each stair shaft with 2-inch hose connections at each floor landing and on the roof. Control valves shall be equipped with supervisory switches that alarm to a local fire alarm panel and to the remote central station. Water flow detectors shall be provided for each sprinkler system riser and each zone, and shall alarm to a local fire alarm panel and to the remote central station.

3.2.1.6.2 Verification of Fire Protection Design

Refer to Section 4.0, Quality Assurance.

3.2.1.7 Material Handling

Design of crane, hoist, and elevator equipment for the LTAB shall be performed in accordance with applicable standards of the following organizations:

- Crane Manufacturers Association of America (CMAA).
- American Gear Manufacturer's Association (AGMA).
- American Institure of Steel Construction (AISC).
- American National Standards Institute (ANSI).
- American Society for Testing and Materials (ASTM).
- American Society of Mechanical Engineers (ASME).
- American Welding Society (AWS).
- Anti-Friction Bearing Manufacturer's Association (AFBMA).
- Hoist Manufacturers Institute (HMI).
- Institute of Electrical and Electronics Engineers (IEEE).
- National Electrical Manufacturers Association (NEMA).
- National Elevator Industry, Inc. (NEII).
- National Fire Protection Association (NFPA).
- Underwriters Laboratory (UL).

3.2.1.7.1 Cranes

Three cranes are required in the LTAB—one in each Laser Bay and one in Switchyard No. 2. Cranes shall comply with CMAA-70 or 74, ASME HST M4, ANSI B30.2, B30.10, NEC Article 610, and AWS D14.1 requirements and shall have a 30-year design lifetime.

The Laser Bay cranes shall each have a 42-ft hook height; the Switchyard No. 2 crane shall have a 90-ft-plus hook height. All cranes shall have the following characteristics:

Cranes shall have a 10-ton full-load capacity, with hoist lifting speeds variable up to 25 ft/minute, creep mode capability, and soft start-and-stop features. The bridge and trolley shall each include double-speed drives with traveling speeds of 20 ft/minute and 80 ft/minute and shall also include "inching" capability. All crane motions shall be controlled by a **TBD** type control station attached to **TBD** to control all crane operations over the entire bridge length. An emergency stop button shall be incorporated in the control station that will set all brakes, thus stopping all crane motions when depressed. Crane electrification shall be by festooned cable. Hoists shall include double-reeving cable with a true list capability. Hoist cables shall have a minimum 5:1 safety factor on ultimate rope strength. Hoists shall include a double braking system, activated when power to the brake is removed, and shall have emergency lowering capability, such that in the event of power failure the crane operator will have the capability of lowering a full-capacity load from any hook height.

Stainless steel drip pans shall be provided under motors, gear boxes, and other components where leakage of grease, oil, or other contaminants could occur. Drip pans shall be designed to facilitate easy removal and proper disposal of collected lubricants and contaminants.

Access ladders shall be provided to the bridges of all cranes, and maintenance platforms/catwalks with safety handrails shall be provided for servicing all components.

3.2.1.7.2 Monorails and Hoists

TBD monorails and hoists are required for the LTAB:

Laser Bays:	**TBD.**
Switchyards:	**TBD.**
Target Bay:	**TBD.**
Diagnostics Building:	One at second floor level, no hoist.
Capacitor Bays:	**TBD.**
Mechanical Equipment Spaces:	**TBD.**

3.2.1.7.3 Elevators

Five elevators are required in the LTAB—one in each Switchyard, one in the Diagnostics Building, one near the entrance in Laser Bay No. 1, and one in the Operations Support Area. All elevators shall be designed to operate in non-hazardous areas and shall have 30-year design lifetime. The safety device for lowering, stopping, and holding shall be 150% of rated load. The rated speed for each elevator shall be within 10% of specified speed, based on the full load in up direction and no load in down direction. The stopping accuracy shall be within ±1/4 inch. Elevators shall include a self-leveling feature to automatically level the car to the floor landings.

The Switchyard No. 1 freight elevator shall be electrically operated, traction-type, and shall have 10,000-lb capacity. The elevator speed shall be **TBD** ft/minute, and shall service seven landings. Each landing shall include a **TBD**-ft-wide by **TBD**-ft-high door. The elevator doors shall be power-operated, single-speed, bi-parting. Elevator cars shall be **TBD**-ft-wide by **TBD** ft deep clear inside, with **TBD** panels for each side and back wall.

The Switchyard No. 2 elevator shall be an electrically operated equipment lift, and shall have **TBD**-lb capacity. The lift speed shall be **TBD** ft/minute, and shall service seven landings. Each landing shall include a **TBD**-ft-wide by **TBD**-ft-high, electrically operated door. The lift car shall be **TBD**-ft-wide by **TBD** ft deep clear inside, with **TBD** panels for each side and back wall.

The Diagnostics Building freight elevator shall be an electrically operated, traction-type elevator and shall have **TBD**-lb capacity. The elevator speed shall be **TBD** ft/minute, and shall service four landings. Each landing will include a **TBD**-ft-wide by **TBD**-ft-high door. Elevator doors shall be power-operated, single-speed, bi-parting. The elevator car shall be **TBD** ft by **TBD** ft deep clear inside, with **TBD** panels for each side and back wall.

Both personnel elevators (Laser Bay and Operations Support Area) shall be hydraulically operated, traction-type elevators, and shall have **TBD**-lb capacity. The elevator speed shall be **TBD** ft/minute, and shall service two landings. Each landing shall include a **TBD**-ft-wide by **TBD**-ft-high door. The elevator doors shall be power-operated, single-speed, bi-parting. Elevator cars shall be **TBD**-ft-wide by **TBD** ft deep clear inside, with **TBD** panels for each side and back wall. Hydraulic power units shall be complete and self-contained.

3.2.1.7.4 Verification of Material Handling Equipment Design

Refer to Section 4.0, Quality Assurance.

3.2.1.8 Mechanical Process Piping Systems

Mechanical process piping systems for operations or experiment use, such as nitrogen and argon gases, domestic water, low-conductivity water (supply and return), deionized water, and compressed air, are not to be installed as part of the conventional LTAB construction, unless otherwise specifically described.

However, building penetration blockouts (only) shall be provided at **TBD** locations in the outside walls and adjacent floors of the Laser Bays for future installation of mechanical process piping by the NIF Project. Blockouts for future piping shall be (size, shape, and location **TBD**) and shall be filled with soft plugs (lean concrete or other suitable material).

3.2.1.8.1 City Water

Process water for operations use shall be provided from the domestic water supply system described in 3.2.1.5.1, to isolation valves and capped piping stubs (size, material and flow rate **TBD**) provided at **TBD** locations for future connection and installation by the NIF Project.

3.2.1.8.2 Compressed Air

Dry compressed air (**TBD** cfm) for conventional facilities instrumentation and controls and for operations use shall be provided throughout the LTAB at 100 psig, –40°F dewpoint, and filtration to 0.5 μm. Distribution piping (size and material **TBD**) shall be routed to meet building-related instrumentation and equipment requirements, and supplied to isolation valves and capped stubs at **TBD** locations in the **TBD** spaces, (size, material, and flow rate **TBD**) for operations use.

3.2.1.8.3 Verification of Mechanical Process Designs

Refer to Section 4.0, Quality Assurance.

3.2.1.9 Electrical

Electrical systems designs for the LTAB shall be performed in accordance with the following standards:

- National Electrical Code, NFPA 70.
- Edison Electric Institute (EEI).
- Illuminating Engineering Society (IES) Lighting Handbook.
- Institute of Electrical and Electronic Engineers (IEEE).
- Insulated Cable Engineers Association (ICEA).
- National Electrical Manufacturers Association (NEMA).
- Underwriters Laboratories (UL).
- Lighning Protection Institute (LPI).

- National Fire Protection Association (NFPA).
- LLNL Facility Standards.
- NIF Grounding Plan, L-17346.
- LLNL Procurement Specifications Plan, PSM-E-16490.

3.2.1.9.1 Normal Main Power Distribution

The system voltage and loads within the LTAB shall be served by separate systems that are divided to isolate noisier loads from loads that are sensitive to noise. These separate systems and the loads they serve are as follows:

- **HVAC loads:** Several 480-V motor control centers shall supply power to HVAC fan loads for the building.

- **Utility loads:** Separate 480-V power distribution center(s) shall be provided for the Target Bay and for the Laser Bays to supply the utility loads. These loads shall be distributed on 208/120-V utility panelboards throughout the building. Dry-type transformers shall be utilized to transform power from 480 V to 208/120 V. The utility panelboards serve general-purpose receptacles including the office/laboratory areas of the building.

- **Utility pulsed power:** Pulsed-power equipment shall be supplied from 480-V power distribution centers to separate, dedicated, dry-type, 480/208-120-V transformers.

- **Research power:** Separate 480-V power distribution centers shall be provided for the Laser Bay and for the Target Bays supply research power. The research power shall be distributed on 208/120V research panelboards within the various areas of the building. Dry-type transformers shall be utilized to transform power from 480 V to 208/120 V.

- **Clean power:** Further isolated research power shall be distributed from separate, isolation transformers at the load. Additional detail is provided in the *NIF Grounding and Shielding Plan*, L-17346-1 (NIF-LLNL-94-211).

Panelboards and dry-type transformers shall meet the minimum requirements of LLNL Facilities Standard PEL-E-16470 and PEL-E-7/C, respectively.

3.2.1.9.2 StandBy Power

Standby power will be provided by diesel generator(s) located on site (see SSDR 1.2.1) and meeting best available control technology (BACT). Standby power shall be distributed at 480 V, 3 phase and 120 V, single phase to those critical loads requiring reliable redundant power supply, such as:

- Emergency lights.

- Radiation monitoring system.
- Fire alarm system.
- Paging systems.
- Security systems.
- Target chamber area negative air pressure control ventilation fans.
- Cryogenic vacuum pumps.

Detailed description, number, size, and location of the electrical loads on standby power **TBD** as design is established.

Automatic transfer and bypass isolation switches and dry-type transformers to transform power from 480-V to 208/120-V shall be provided.

Standby Power shall meet the minimum requirement of LLNL Facilities Standard PEL-E-16620. Automatic transfer and bypass isolation switches shall meet the minimum requirement of LLNL Procurement Specifications PSM-E-16490.

3.2.1.9.3 Uninterruptible Power

Uninterruptible Power System(s) (UPS) shall be incorporated as an integral element on the following systems to maintain power until the standby power (generator) is on-line:

- Emergency egress lighting.
- Radiation monitoring system.
- Fire alarm panel.
- Security system.
- Emergency voice page and alarm system.

3.2.1.9.4 Lighting Distribution

Lighting loads: Separate 480/277-V Power Distribution Center(s) shall be provided for the Target Bay, and for the Laser Bays supply the 277-V lighting loads.

Lighting levels shall be consistent with IES Standards. Emergency wall-mounted battery lights shall be provided as required. Exit lights and a minimum number of room lights shall be on the standby power. High ceilings and exterior areas shall use HID fixtures. Exterior lights shall be provided with photocells. The outdoor fixtures shall use HPS type lamps.

3.2.1.9.5 Grounding

A #4/0 AWG soft drawn bare copper (SDBC) grounding ring, with 3/4-in by 10-ft copper clad ground rods at 25-ft ctrs shall be provided around the LTAB. A ground grid of #4/0 SDBC cables at 12.5-ft centers , both directions, shall be embedded in floor slabs throughout the building. The ground grid and all building structural supports

shall be bonded to the building ground loop with exothermic welds or bolted ground clamps.

Wall-mounted, visible ground bars shall be provided in the laboratory-type spaces.

Grounding shall meet the general guidelines of LLNL Facilities Standards PEL-E-16450 and the NIF Grounding Plan, L-17346, NIF-LLNL-94-211.

3.2.1.9.6 Lightning Protection

A lightning protection system connected to the building grounding system shall be provided in accordance with NFPA 780, LPI175 and UL96

3.2.1.9.7 Cathodic Protection

Cathodic protection shall be provided for all direct-buried metallic pipes.
Cathodic protection shall meet the minimum requirements of LLNL Facilities Standards PEL-M-02666.

3.2.1.9.8 Industrial Electronics

3.2.1.9.8.1 Telecommunications

The telecommunications system design and installation for the LTAB shall be performed in accordance with EIA/TIA-569 and EIA/TIA-568.

3.2.1.9.8.2 Fire Detection and Alarm

Fire detection and alarm systems for the LTAB shall be designed and installed according to the requirements of NFPA 72 and NFPA 70. Designs shall incorporate "intelligent" detection and actuation devices monitored by signalling line circuits. A Fireman's Fan Shutdown Panel shall be interfaced with the HVAC control system to allow manual override control of fans and dampers during emergencies.

3.2.1.9.8.3 Evacuation Voice Alarm

An evacuation Voice Alarm (EV/A) system shall be provided for the LTAB, with the design and installation conforming to NFPA 72 requirements for an EV/A System, NFPA 70, and ADA. The EV/A system shall function to override the building page system.

3.2.1.9.8.4 Building Page

The building page system for the LTAB shall be designed to function independently of the EV/A system, but the EV/A system shall override the building page. The instrumentation rack for the EV/A system shall be located in the classified control

room. As a minimum, the building page system shall be capable of "all-page" and "zone" paging in the following areas:

- Target Bay.
- Switchyard #1.
- Switchyard #2.
- Diagnostic Building.
- Decontamination Area .
- Laser Bays.
- Capacitor Bays.
- Operations Support areas.

3.2.1.9.8.5 Closed Circuit Television (CCTV)

Raceways shall be provided to support the installation of closed-circuit television in all conference rooms, breakrooms, ground floor lobby/waiting area, and **TBD**.

3.2.1.9.8.6 Security Alarm Systems

Raceway system(s) and equipment space to support installation of door interlocks and accesss control systems are required at all **TBD** spaces for a laser safety system. An access control system shall be provided by **TBD** for the Capacitor Bays, Laser Bays, MOR, Switchyards, and Target Bay.

A security access control system shall be provided by **TBD** for the Classified Control Room, including a balanced magnetic switch on the door and interior sensors to detect any penetration of the room, or movement within the alarmed area.

3.2.1.9.8.7 Oxygen Deficiency and Carbon Dioxide Monitoring

Separate systems shall be provided in the Laser Bays to monitor and alarm a deficiency of oxygen and the presence of excessive carbon dioxide. Sensors shall detect the existence of these conditions at **TBD** locations and shall activate audible and visual alarms locally, at the main control room, and at a central LLNL dispatch station.

3.2.1.9.9 Verification of Electrical Designs

Refer to Section 4.0, Quality Assurance.

3.2.1.10 Instrumentation & Controls

3.2.1.10.1 General

I&C for the LTAB shall be designed and installed based on the latest equipment with proven technology. The following LTAB systems shall be provided with I&C equipment: **TBD.**

3.2.1.10.2 Verification of I&C Design

Refer to Section 4.0, Quality Assurance.

3.3 Design and Construction

3.3.1 Civil

Not applicable

3.3.2 Structural

TBD – to be described after design is established by drawings and specifications

3.3.3 Architectural

TBD – to be described after design is established by drawings and specifications.

3.3.4 HVAC

TBD – to be described after design is established by drawings and specifications.

3.3.5 Plumbing

TBD – to be described after design is established by drawings and specifications.

3.3.6 Fire Protection

TBD – to be described after design is established by drawings and specifications.

3.3.7 Material Handling

TBD – to be described after design is established by drawings and specifications.

3.3.8 Mechanical Process Piping

TBD – to be described after design is established by drawings and specifications.

3.3.9 Electrical

TBD – to be described after design is established by drawings and specifications.

3.3.10 Instrumentation & Controls

TBD – to be described after design is established by drawings and specifications.

3.4 Logistics

TBD – to be described after CM has completed construction planning.

4.0 Quality Assurance Provisions

The quality of the LTAB and its subsystems is assured through the implementation of the NIF Project management system, which is described by procedural controls in the *Project Control Manual* and in planning documents such as the *Quality Assurance Program Plan, Project Execution Plan,* and *Configuration Management Plan.*

These controls address required performance of assurance measures, such as reviews, inspections, and assessments, to be included at every phase of work involved in the acquisition of the LTAB and its subsystems, including the requirement that each major participant in the Project establish its own QA Program (management system) covering its work on the Project.

The following paragraphs address aspects of the NIF QA Program for the LTAB and its subsystems.

4.1 Q-Levels (Quality Assurance Levels)

As part of the NIF QA Program provision to focus management attention commensurate with the importance of Project elements, each LTAB subsystem and its components was analyzed according to *NIF Procedure 1.6, Assignment of Q-Levels,* to establish its relative importance to Project success. The results of these analyses are characterized by the Q-Levels (quality assurance levels) identified in the Q-List **DRAFT**, Table 4.1-1. There are three Q-Levels in descending importance from one to three.

Table 4.1-1 **DRAFT** Q-list: LTAB

WBS Element number	**WBS element title**	**Assigned quality level**			**Why not Q-level 3 ?**
		1	**2**	**3**	
1.2.2	**Experimental Buildings**				
1.2.2.1	**LTAB**				
1.2.2.1.1	**Target Bay**				
1.2.2.1.1.2	Structural				
1.2.2.1.1.2.1	Foundation			x	
1.2.2.1.1.2.2	Concrete structures			x	
1.2.2.1.1.3	Mechanical				
1.2.2.1.1.3.1	HVAC systems				
	Exhaust fans			x	
	Primary Air Circulation Fans			x	
	Make-Up Air Fans			x	
	Cooling/Heating Water Control Valves			x	
	Local Digital Control System			x	
	Cooling/Heating Coils			x	
	Ducts			x	
	Filters			x	
1.2.2.1.1.3.2	Plumbing			x	
1.2.2.1.1.3.3	**Fire protection system**				
	Detectors		x		Failure or malfunction may result in fatalities and injuries in case of fire.
	Fire Control Panel		x		
	Fire Water Valves		x		
	Fire protection equipment		x		
1.2.2.1.1.3.4	**Seismic restraints**		x		Failure may result in fatalities and injuries
1.2.2.1.1.3.5	Mechanical specialities			x	
1.2.2.1.1.4	Electrical				
1.2.2.1.1.4.1	*Main distribution system*			x	
1.2.2.1.1.4.2	*Computers, diagnostics, instrumentation*			x	
1.2.2.1.1.4.3	*UPS*			x	
1.2.2.1.1.4.4	*Grounding*			x	

1.2.2.1.1.5	**Safety and security system**		x		Failure may result in fatalities and injuries
1.2.2.1.1.6	Telecommunication and data transfer system			x	
1.2.2.1.1.7	**Shielding**	x			Failure may result in fatalities and injuries and its design is unique to NIF
1.2.2.1.2	**Switchyards**				
1.2.2.1.2.2	Structural			x	
1.2.2.1.2.2.1	Foundations			x	
1.2.2.1.2.2.2	Concrete Structures			x	
1.2.2.1.2.3	Mechanical				
1.2.2.1.2.3.1	HVAC System			x	
	Exhaust fans			x	
	Primary Air Circulation Fans			x	
	Make-Up Air Fans			x	
	Cooling/Heating water control valves			x	
	Local Digital Control System			x	
	Cooling/Heating Coils			x	
	Filters			x	
1.2.2.1.2.3.2	Plumbing			x	
1.2.2.1.2.3.3	**Fire Protection System**				
	Detectors		x		Failure or malfunction may result in fatalities and injuries in case of fire.
	Fire control panel		x		
	Fire water valves		x		
	Fire protection equipmnet		x		
1.2.2.1.2.3.4	**Seismic restraint**		x		Failure may result in fatalities and injuries
1.2.2.1.2.3.5	Mechanical specialities			x	
1.2.2.1.2.4	Electrical				

1.2.2.1.2.4.1	Main distribution system			x	
1.2.2.1.2.4.2	Computers, diagnostics, and instrumentation			x	
1.2.2.1.2.4.3	UPS			x	
1.2.2.1.2.4.4	Grounding			x	
1.2.2.1.2.5	**Safety and security system**		x		Failure may result in fatalities and injuries
1.2.2.1.2.6	Telecommunication and data transfer system			x	
	Shielding	x			Failure may result in fatalities and injuries and its design is unique to NIF
1.2.2.1.3	**Diagnostic area**				
1.2.2.1.3.2	Structural				
1.2.2.1.3.2.1	Foundations			x	
1.2.2.1.3.2.2	Steel Structures			x	
1.2.2.1.3.3	Mechanical				
1.2.2.1.3.3.1	HVAC System				
	Exhaust fans			x	
	Primary Air Circulation Fans			x	
	Make-Up Air Fans			x	
	Chilled Water Control Valves			x	
	Local Digital Control System			x	
	Cooling/Heating Coils			x	
	Filters			x	
1.2.2.1.3.3.2	Plumbing			x	
1.2.2.1.3.3.3	Fire Protection				
	Detectors		x		Failure or malfunction may result in fatali- ties and injuries in case of fire.
	Fire control panel		x		
	Fire water valves		x		
	Fire protection equipmnet		x		
1.2.2.1.3.3.4	**Seismic restraint**		x		Failure may

					result in fatalities and injuries
1.2.2.1.3.3.5	Mechanical Specialities			x	
1.2.2.1.3.4	Electrical				
1.2.2.1.3.4.1	Main distribution system			x	
1.2.2.1.3.4.2	Computers, diagnostics, and instrumentation			x	
1.2.2.1.3.4.3	UPS			x	
1.2.2.1.3.4.4	Grounding			x	Elements of the grounding for the SCIF Control could become a Q-Level 2 if it is decided to add this room.
1.2.2.1.3.5	Safety and security system			x	
1.2.2.1.3.6	Telecommunication and data transfer system				
1.2.2.1.3.7	**Shielding**		x		Failure may result in fatalities and injuries and its design is unique to NIF
1.2.2.1.4	**Decontamination Area**				
1.2.2.1.4.2	Structural				
1.2.2.1.4.2.1	Foundations			x	
1.2.2.1.4.2.2	Steel Structures			x	
1.2.2.1.4.3	Mechanical				
1.2.2.1.4.3.1	HVAC System				
	Exhaust fans			x	
	Primary Air Circulation Fans (Have8 ; Need 7)			x	
	Make-Up Air Fans H90			x	
	Chilled Water Control Valves			x	
	Local Digital Control System			x	
	Cooling/Heating Coils			x	
	Filters			x	
1.2.2.1.4.3.2	Plumbing			x	
1.2.2.1.4.3.3	Fire Protection				
	Detectors		x		Failure or

					malfunction may result in fatali-
	Fire control panel		x		ties and injuries in case of fire.
	Fire water valves		x		
	Fire protection equipmnet		x		
1.2.2.1.4.3.4	**Seismic restraint**		x		Failure may result in fatalities and injuries
1.2.2.1.4.3.5	Mechanical Specialities			x	
1.2.2.1.4.4	Electrical				
1.2.2.1.4.4.1	Main distribution system			x	
1.2.2.1.4.4.2	Computers, diagnostics, and instrumentation			x	
1.2.2.1.4.4.3	UPS			x	
1.2.2.1.4.4.4	Grounding			x	
1.2.2.1.4.5	**Safety and security system**		x		Failure may result in fatalities and injuries
1.2.2.1.4.6	Telecommunication and data transfer system			x	
1.2.2.1.4.7	**Shielding**	x			Failure may result in fatalities and injuries
					and its design is unique to NIF
1.2.2.1.5	**Laser Bays**				
1.2.2.1.5.2	Structural				
1.2.2.1.5.2.1	Foundations			x	
1.2.2.1.5.2.2	Steel Structures			x	
1.2.2.1.5.3	Mechanical				
1.2.2.1.5.3.1	HVAC System			x	
	Exhaust fans			x	
	Primary Air Circulation Fans			x	
	Make-Up Air Fans			x	
	Chilled Water Control Valves			x	
	Local Digital Control System			x	
	Cooling/Heating Coils H215			x	

	Filters			x	
1.2.2.1.5.3.2	Plumbing			x	
1.2.2.1.5.3.3	Fire Protection				
	Detectors		x		Failure or malfunction may result in fatali-
	Fire control panel		x		ties and injuries in case of fire.
	Fire water valves		x		
	Fire protection equipmnet		x		
1.2.2.1.5.3.4	Nitrogen Cooling System		x		System has a level 2 component
	Programmable logic controller			x	
	Nitrogen handling unit			x	
	Nitrogen Vaporizer			x	
	Nitrogen storage tank			x	
	Instrumentation		x		Failure may result in fatalities and injuries
1.2.2.1.5.3.5	Deionized water cooling system				
	Programmable logic controller			x	
	Heat Exchanger			x	
	Pumps and piping			x	
	Instrumentation and conrol valves			x	
1.2.2.1.5.3.6	**Seismic Restraints**		x		Failure may result in fatalities and injuries
1.2.2.1.5.3.7	Mechanical Speciallities			x	
1.2.2.1.5.4	Electrical				
1.2.2.1.5.4.1	Main distribution system			x	
1.2.2.1.5.4.2	Computers, diagnostics, and instrumentation			x	
1.2.2.1.5.4.3	UPS			x	
1.2.2.1.5.4.4	Grounding			x	
1.2.2.1.5.5	Safety and Security System			x	This assumes that all laser beams are contained in

					enclosures
1.2.2.1.5.6	Telecommunication and data transfer			x	
1.2.2.1.6	**Capacitor Bays**				
1.2.2.1.6.2	Structural				
1.2.2.1.6.2.1	Foundations			x	
1.2.2.1.6.2.2	Steel Structures			x	
1.2.2.1.6.3	Mechanical				
1.2.2.1.6.3.1	HVAC System				
	Exhaust fans			x	
	Primary Air Circulation Fans			x	
	Make-Up Air Fans			x	
	Chilled Water Control Valves			x	
	Local Digital Control System			x	
	Cooling/Heating Coils			x	
	Filters			x	
1.2.2.1.6.3.2	Plumbing			x	
1.2.2.1.6.3.3	Low-Conductivity Water (LCW) Cooling System				
	Programmable logic controller			x	
	Pumps and piping			x	
	Instrumentation and conrol valves			x	
1.2.2.1.6.3.4	Fire Protection				
	Detectors		x		Failure or malfunction may result in fatali-
	Fire Control Panel		x		ties and injuries in case of fire.
	Fire Water Valves		x		
	Fire protection equipmnet		x		
1.2.2.1.6.3.5	**Seismic Restraints**		x		Failure may result in fatalities and injuries
1.2.2.1.6.3.6	Mechanical specialities			x	
1.2.2.1.6.4	Electrical				
1.2.2.1.6.4.1	Main Power Distribution System			x	
1.2.2.1.6.4.2	Computers, Diagnostics, and Instrumentation			x	
1.2.2.1.6.4.3	UPS			x	

1.2.2.1.6.4.4	Grounding			x	
1.2.2.1.6.5	**Safety and Security Systems**			x	
1.2.2.1.6.6	Telecommunication and data transfer			x	
1.2.2.1.7	**Visitors' Center**				
1.2.2.1.7.2	Structural				
1.2.2.1.7.2.1	Foundations			x	
1.2.2.1.7.2.2	Steel Structures			x	
1.2.2.1.7.3	Mechanical				
1.2.2.1.7.3.1	HVAC System				
	Exhaust fans			x	
	Primary Air Circulation Fans			x	
	Make-Up Air Fans			x	
	Chilled Water Control Valves			x	
	Local Digital Control System			x	
	Cooling/Heating Coils			x	
	Filters			x	
1.2.2.1.7.3.2	Plumbing			x	
1.2.2.1.7.3.4	Fire Protection				
	Detectors		x		Failure or malfunction may result in fatali-
	Fire Control Panel		x		ties and injuries in case of fire.
	Fire Water Valves		x		
	Firefighting equipment		x		
1.2.2.1.7.3.5	**Seismic Restraints**		x		Failure may result in fatalities and injuries
1.2.2.1.7.3.6	Mechanical Specialities			x	
1.2.2.1.7.4	Electrical				
1.2.2.1.7.4.4	Main Power Distribution System			x	
1.2.2.1.7.4.1	Computers, Diagnostics, and Instrumentation			x	
1.2.2.1.7.4.2	UPS			x	
1.2.2.1.7.4.3	Grounding			x	
1.2.2.1.7.4.4	Safety and Security Systems			x	
1.2.2.1.7.5	Telecommunication and data transfer			x	
1.2.2.1.8	**Operations Support**				

1.2.2.1.8.2	Structural				
1.2.2.1.8.2.1	Foundations			x	
1.2.2.1.8.2.2	Concrete Structures			x	
1.2.2.1.8.2.3	Steel Structures			x	
1.2.2.1.8.3	Mechanical				
1.2.2.1.8.3.1	HVAC System				
	Exhaust fans			x	
	Primary Air Circulation Fans			x	
	Make-Up Air Fans			x	
	Chilled Water Control Valves			x	
	Local Digital Control System			x	
	Cooling/Heating Coils			x	
	Filters			x	
1.2.2.1.8.3.2	Plumbing			x	
1.2.2.1.8.3.3	**Fire Protection**				
	Detectors		x		Failure or malfunction may result in fatali-
	Fire Control Panel		x		ties and injuries in case of fire.
	Fire Water Valves		x		
	Firefighting equipment		x		
1.2.2.1.8.3.4	**Seismic Restraints**		x		Failure may result in fatalities and injuries
1.2.2.1.8.3.5	Mechanical Specialities			x	
1.2.2.1.8.4	Electrical				
1.2.2.1.8.4.1	Main Power Distribution System			x	
1.2.2.1.8.4.2	Computers, Diagnostics, and Instrumentation			x	
1.2.2.1.8.4.3	UPS			x	
1.2.2.1.8.4.4	Grounding			x	
1.2.2.1.8.5	Safety and Security Systems			x	
1.2.2.1.8.6	Telecommunication and data transfer			x	

4.2 Quality Requirements

The quality requirements for the LTAB and its subsystems are specified in the applicable codes and standards cited in this SSDR, and in relation to their Q-Levels may have additional attributes identified in the specific requirements in Section 3.2.1, Performance and Physical Characteristics. These requirements may appear as system characteristics in LTAB drawings and specifications to which the text refers in Section 3.1.1, System Description.

4.3 Quality Assurance Measures

4.3.1 LTAB Subsystems

Construction specifications associated with each of the LTAB subsystems shall contain provisions (such as inspections, documentation, certifications, and witnessed tests) for assuring that the specified quality is achieved and delivered to the NIF Project. Inspections, tests, and other QA provisions required by the codes and standards cited in the specifications shall be considered minimum requirements for Q-Level 3 components. Additional provisions for Q-Level 1 and 2 components in LTAB subsystems shall be specifically identified in their specifications.

4.3.2 Subsystem Design Verification

Design verification is accomplished through implementation of Project-approved Architect-Engineer (AE) design control procedures of the AE's QA Program, including review of all calculations, analyses, studies, drawings, and specifications produced by the AE, and all shop, fabrication, and erection drawings generated by suppliers and installers during construction. Verification of AE implementation of its QA Program is performed by NIF Project staff members in accordance with NIF Procedures 5.1, Design Review, and 10.1, Independent Assessments, of the *NIF Project Control Manual* (QA Program).

4.3.3 Subsystem Construction Verification

Construction verification is accomplished through implementation of Project-approved Construction Manager (CM) inspection procedures of the CM's QA Program. Verification of CM QA Program implementation and further verification of the fabrication, installation, and construction activity is performed by NIF Project staff members in accordance with NIF Procedures 7.3, Vendor Surveillance, and 10.1, Independent Assessments, of the *NIF Project Control Manual* (QA Program).

5.0 Notes

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6.0 Revision Record

Rev. letter	Date	Changed by	Description
A	3/25/96	Kempel	Complete reformat and rewrite of existing information. Lower-tier requirements moved to SSDRs. All requirements reassessed and updated, based on CDR and ACD information; flowdown tracking and verification methods established.
B	8/19/96	Kempel/Knawa	Complete reformat and rewrite of existing information. Generic requirements moved to Site Improvements SSDR. All requirements reassessed and updated, based on mid-Title I Development information.

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