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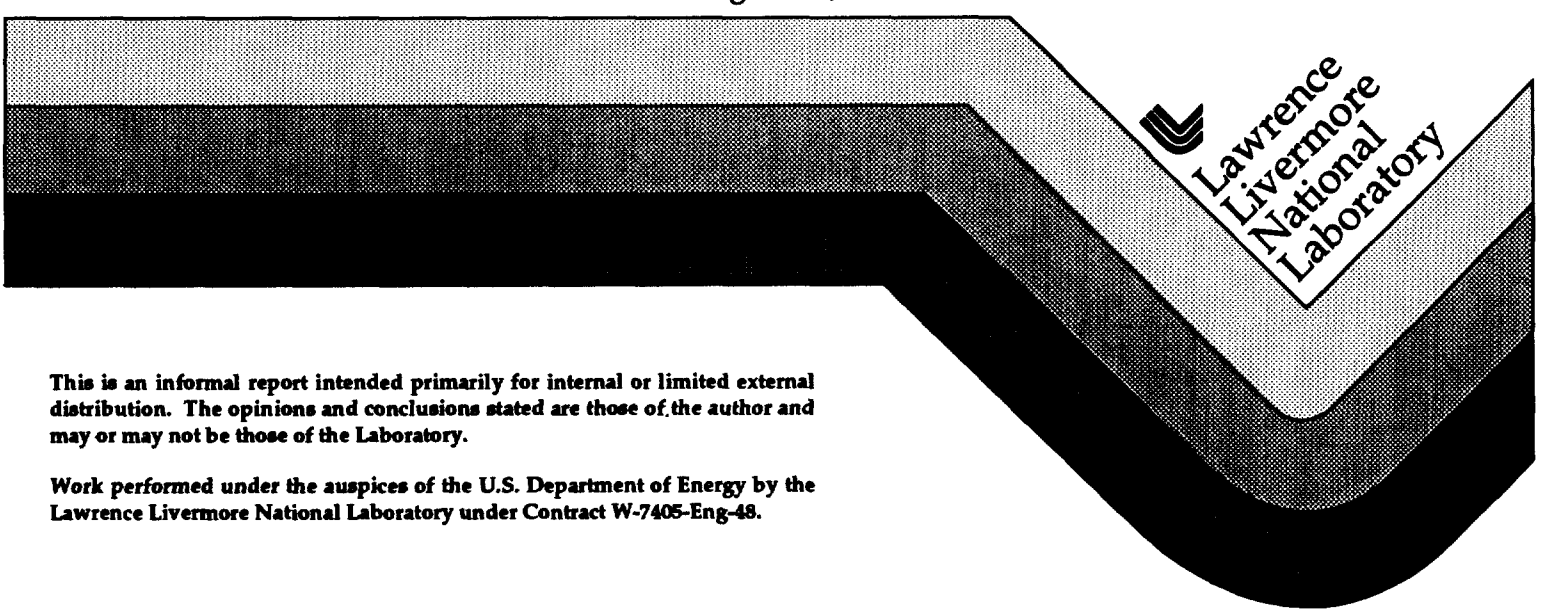
National Ignition Facility
SubSystem Design Requirements
NIF Site Improvements
SSDR 1.2.1

P. Kempel
J. Hands

August 19, 1996



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August 19, 1996

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Contents

1.0 Scope

This Subsystem Design Requirements (SSDR) document establishes the performance, design, and verification requirements associated with the NIF Project Site at Lawrence Livermore National Laboratory (LLNL) at Livermore, California. It identifies generic design conditions for all NIF Project facilities, including siting requirements associated with natural phenomena, and contains specific requirements for furnishing site-related infrastructure utilities and services to the NIF Project conventional facilities and experimental hardware systems.

Three candidate sites were identified as potential locations for the NIF Project. However, LLNL has been identified by DOE as the preferred site because of closely related laser experimentation underway at LLNL, the ability to use existing interrelated infrastructure, and other reasons. Selection of a site other than LLNL will entail the acquisition of site improvements and infrastructure additional to those described in this document. This SSDR addresses only the improvements associated with the NIF Project site located at LLNL, including new work and relocation or demolition of existing facilities that interfere with the construction of new facilities. If the Record of Decision for the PEIS on Stockpile Stewardship and Management were to select another site, this SSDR would be revised to reflect the charactersistics of the selected site.

Other facilities and infrastructure needed to support operation of the NIF, such as those listed below, are existing and available at the LLNL site, and are not included in this SSDR.

- Office Building.
- Target Receiving and Inspection.
- General Assembly Building.
- Electro-Mechanical Shop.
- Warehousing and General Storage.
- Shipping and Receiving.
- General Stores.
- Medical Facilities.
- Cafeteria services.
- Service Station and Garage.
- Fire Station.
- Security and Badging Services.

2.0 Applicable Documents

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

In addition to those identified in Section 3.2, the following DOE Orders generally apply to the acquisition of NIF conventional facilities:

- DOE 151.1, Emergency Management System.
- DOE 420.1, Facility Safety.
- DOE 430.1, Life Cycle Asset Management.
- DOE 440.1, Worker Protection Management for DOE Federal and Contractor Empolyees.
- DOE N 441.1, Radiological Protection for DOE Activities.
- DOE P 450.1.
- DOE 451.1, National Environmental Policy Act Compliance Program.
- DOE 460.1, Packaging and Transportation Safety.
- DOE 470.1, Safeguards and Security Program.
- DOE 471.1, Identification and Protection of Unclassified Controlled Nuclear Information (9/25/).
- DOE 471.2, Information Security Program.
- DOE M 471.2-1, Manual for Classified Matter Protection and Control (9/26/95).
- DOE 1360.2.B, Unclassified Computer Security (5/18/92).

3.0 System Requirements and Verification

3.1 System Description

The NIF Project construction site is located on approximately six acres of mostly vacant land in the northeast quadrant of the LLNL complex. The site improvements comprise the Laser and Target Area Building (LTAB) and Optics Assembly Building (OAB), which are separately addressed in SSDRs 1.2.2.1 and 1.2.2.3, respectively; and the necessary utilities, services, equipment, and facilities to support the Project, including a Service Equipment Building (SEB), which are described in this document.

The conventional facilities work comprising the NIF Site Improvements provides the NIF Project infrastructure for a complete functioning facility, including but not limited to the following:

- Site development and preparation, including surveying, demolition, and locating underground utilities.
- Earthwork, including excavation, solid waste disposal, dewatering, shoring, and backfilling.
- Paving and surfacing for walks, roads and parking areas.
- Piped underground utilities, including city water for potable use and fire protection, cooling water, heating water, sanitary and industrial wastes, stormwater drainage, and process gases.
- Industrial equipment associated with the conventional building utilities, such as boilers, refrigeration chillers, and air compressors, and a building enclosure to house them.

- Electric power and lighting, communication, and alarm systems.
- Security provisions, including physical protection systems and alarms.
- Landscaping and irrigation systems.

3.1.1 Demolition and Relocation

The work described below is more fully characterized in the construction drawings and specifications, which interpret the design requirements, provide information for bidding purposes, and give directions for demolition, relocation, and inspection.

3.1.1.1 Civil

Civil demolition and relocation work consists of the following:

- Determining the quality of existing shallow subsoil for use in the NIF construction as compacted backfill; processing and reusing it if suitable, disposing of it if not suitable.
- Removing approximately 400 feet of existing underground storm drain (42-in dia. concrete pipe) that passes through the NIF building site, and installing a new, rerouted, replacement storm drain.
- Removing approximately **TBD** sq yds of existing paved parking areas and walkways in the south portion of the NIF site to clear the construction area for new work.

3.1.1.2 Structural

Not applicable.

3.1.1.3 Architectural

Architectural demolition and relocation work consists of removing or relocating two small, modular-type buildings (5906 and 5927) in the north portion of the NIF site to clear the construction area for new work.

3.1.1.4 Mechanical

Mechanical demolition work consists of removal of the utility piping associated with modular buildings 5906 and 5927.

3.1.1.5 Electrical

Electrical demolition and relocation work consists of the following:

- An existing 13.8-kV overhead power line that interferes with new construction will be removed, including nine existing 13.8-kV power poles (PP-400 through PP-409) and associated overhead conductors.
- A new underground feeder in concrete-encased raceways will be installed to replace the overhead line. The new 13.8-kV circuit will provide power to four

existing transformers, now connected to the overhead line (T-1590, 1589, 1528 and 375), through two new sectionalizing switches.

- Existing 13.8-kV power manholes (MH) P-582 and associated underground ductbanks from existing manholes MH P-684 to MH P-581 will be removed. One new manhole and new underground ductbanks will be installed to ensure continuity of the 13.8-kV underground distribution system to existing facilities.
- Several existing lighting fixtures will be removed from Parking Lot F-7W with the paving demolition described in Section 3.1.1.1. Parking-lot lighting associated with new parking areas is described in Section 3.1.3.5.
- Electrical service wiring to modular buildings 5906 and 5927 will be removed.
- An existing underground communications ductbank that interferes with new construction will be removed.

3.1.2 Site Preparation

The work described below is more fully characterized in the construction drawings and specifications, which interpret the design requirements, provide information for bidding purposes, and give directions for preparing the site for construction and inspection of the results.

3.1.2.1 Civil

Site preparation consists of the clearing and preliminary grading of the NIF site area in readiness for construction of new facilities. It also includes the clearing, grading, and/or paving of laydown areas and areas for temporary construction offices, toilets, parking, storage buildings, and shops; and locating these contractor facilities for use during the construction period.

Grading includes the construction of appropriate slopes, swales, and retention areas to accommodate suitable drainage and runoff conditions for stormwater on the site.

3.1.2.2 Structural

Not applicable

3.1.2.3 Architectural

Not applicable, see Temporary Construction Facilities, Section 3.2.2.3.3.

3.1.2.4 Mechanical

Not applicable, see Temporary Construction Facilities, Section 3.2.2.3.4.

3.1.2.5 Electrical

Not applicable, see Temporary Construction Facilities, Section 3.2.2.3.5.

3.1.3 Roads, Parking, and Landscaping

The work described below is more fully characterized in the construction drawings and specifications, which interpret the design requirements, provide information for bidding purposes, and give directions for grading, paving, lighting, planting, irrigation, and inspection.

3.1.3.1 Civil

Personnel and vehicle access is provided to the Laser and Target Building (LTAB), Optics Assembly Building (OAB), and the SEB by paved roadways and walkways. Roadways are **TBD** ft wide with 50-ft turning radii, designed to accommodate service equipment vehicles and emergency vehicles, including fire trucks and ambulances.

Parking areas, including designs for handicapped person accessibility, are provided for approximately 150 cars in areas near the NIF buildings, including employees, visitors, and government personnel.

Setbacks for NIF facilities conform to LLNL site planning criteria for roads, buildings, pathways, and parking.

3.1.3.2 Structural

Not applicable

3.1.3.3 Landscape Architecture

Landscape improvements to the land incorporate the design philosophy and guidelines of LLNL's Landscape Master Plan and Design Guidelines. The elements of landscape design include plantings, irrigation, building-entry development, and outdoor areas for employee use. Landscaping is developed to esthetically organize the site, buildings, roadways, and flow of pedestrian traffic.

3.1.3.4 Mechanical

Mechanical work consists of providing a water supply source for landscape irrigation systems provided as part of the landscaping workscope. The potable water underground supply piping will be tapped to provide an irrigation source, which will include an isolation valve and backflow prevention.

3.1.3.5 Electrical

Street and parking lot lighting will be provided by metal lighting standards, coordinated with pavement configurations and landscaping, and arranged to provide **TBD** foot-candles of illumination at ground level for personnel safety and facility security.

3.1.4 Site Utilities

Site utilities work includes the installation of new, permanent, mechanical and electrical utilities and equipment, and a building enclosure—the SEB—to house the utility equipment and ancillaries, i.e., boilers, chillers, air compres-sors, pumps, electrical equipment, and control systems.

This work is briefly described below, and more fully characterized by the construction drawings and specifications, which interpret the utilities designs, provide information for bidding purposes, and give directions for construction, installation, testing, and inspection.

3.1.4.1 Civil

The civil construction associated with site utilities involves the excavation, backfill, compaction, and finish grading of trenches for underground utilities. This work is expected to be accomplished as part of the utilities installation.

3.1.4.2 Structural

The structural systems for the SEB consists of a reinforced-concrete foundation and floor slab, and steel-framed superstructure for a modular metal building.

3.1.4.3 Architectural

The SEB is an approximately **TBD** ft × **TBD** ft × **TBD** ft high, insulated, modular, metal building with space for installing and maintaining the NIF utilities equipment. The building is ventilated but unheated, contains a masonry firewall between the boilers and other equipment, personnel doors, windows, ventilating louvers, and an overhead roll-up door for material-handling-equipment access to the interior.

3.1.4.4 Mechanical

The following mechanical utilities are provided to or from the LTAB, OAB, and SEB:

- Potable water and fire protection water (CW/F).
- Chilled water.
- Heating hot water.
- Cooling tower water.
- Low-conductivity water (LCW).
- High-pressure natural gas.

- Compressed air.

Some utilities (CW/F, LCW, DIW, and high-pressure natural gas) are furnished from connections to existing underground utility piping located in Outer Loop Road. Others (cooling tower water, chilled water, and heating hot water) will be produced in the new SEB at the NIF site by equipment provided as part of the NIF Project work and piped underground to the LTAB and the OAB. Still others (nitrogen, argon) will be provided by other organizations within the NIF Project, and will be routed in common trenches with the utilities described in this SSDR.

CW/F is distributed at approximately 100 psig in typical 8-in piping with varying flowrates throughout the LLNL site in a street grid. Piping will be configured to furnish the flowrates (**TBD**) and static and residual pressures (**TBD**) necessary for the LTAB and the OAB, for both domestic use and fire protection. Separate connections are provided at the street for potable water and fire protection water.

LCW is distributed at approximately **TBD** psig throughout the LLNL site in a street grid. New underground piping will be connected to the existing grid, and routed to the LTAB to furnish the flowrates (**TBD**) and pressures (**TBD**) necessary for experiment systems.

A new cooling tower system provides condenser water to the NIF chillers for use in space cooling at the LTAB and OAB, and for nitrogen vaporization. The cooling tower is selected to serve the facility for a minimum 30-year service life. Initial fill and make-up water supply is provided by the CW/F supply system.

Water-cooled chillers will provide the necessary space cooling for the air-conditioning systems of LTAB and OAB. Chillers are sized for proportions of the load capacity; one chiller will always be available on standby.

Both chilled water for cooling and hot water for heating will be pumped from the SEB to cooling and heating coils in the LTAB and OAB. Flow through the coils is regulated to satisfy load requirements by two-way valves in the LTAB and OAB HVAC systems.

Each of the pumps listed below (several of each will be provided) will circulate water in the HVAC chilled-water and hot-water systems. In each system, one or more pumps run during peak loads; at least one other provides redundancy and standby capacity.

- Primary chilled water.
- Secondary chilled water.
- Condenser water (cooling tower water).
- Boiler circulating.
- Heating hot water.

Natural gas at 5 psig is provided from the site-wide utility system for use in the NIF boiler plant. Connections to the site main and at the building entrance have isolation valves. A seismic valve, a listed gas meter and regulator, bypass for the gas meter, and

shut-off valves downstream of the meter/regulator assembly are provided at the point of use. Low-pressure natural gas is supplied to the boilers in the SEB.

Two natural-gas-fired hot water boilers are provided to furnish space heating capacity for the air-conditioning systems of LTAB and OAB, and will be controlled by the building HVAC demands. Each boiler is sized at 65% of the total heating load; there are no standby boilers.

High-quality compressed air is supplied to the LTAB and OAB by three rotary screw, oil-free compressors equipped with air dryers, prefilters, and final filters. Each compressor is sized for approximately 50% of the total estimated load; two will operate at maximum capacity and one provides redundancy and standby capacity. The compressors will be controlled to automatically lead-lag the machines.

3.1.4.5 Electrical

Power—Electrical utility work consists of transformers, underground power distribution system to feed buildings, street and parking lot lighting, and power and lighting for the SEB, utility equipment, and cooling tower facilities.

Detailed description of the equipment, number, size, and location of manholes, ductbanks, sectionalizing switches, transformers, and generators is **TBD** as the design is firmly established.

Grounding—Grounding systems are provided for all buildings and equipment, consisting of grounding grids composed of #4/0 AWG, soft-drawn bare copper (SDBC) at 12.5-ft centers each way, cast into the floor slabs, with 10-ft-long, copper-clad, ground rods spaced at intervals around the perimeters of the grids. Electrical equipment and the main structural steel elements of buildings are connected to the ground grids.

Telecommunications—A common underground ductbank system for both classified and unclassified wiring are provided to serve the facilities on site.

Fire Alarm and Evacuation Voice Alarm—Underground raceways are provided for distribution of alarm-initiating, signaling, line circuits, and communication circuits. The Fire Alarm and Evacuation Voice Alarm circuits may be part of the telecommunications ductbank system.

Remote control, signaling, and power-limited circuits—Underground raceways are provided for distribution of Class 1, Class 2, and Class 3 remote control, signaling, and power-limited circuits. The raceway system may be part of the telecommunications ductbank system.

3.2 System Characteristics and Verification

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 used for design guidance in meeting per-formance criteria established in this requirements document.

3.2.1 General Siting Design Criteria

Many requirements identified in this section are applicable to a generic site. However, the specific criteria related to natural phenomena, environmental characteristics, and the use of existing utilities, facilities, and infrastructure are applicable only to the LLNL site. The information and criteria provided in this section shall be used in the design of all conventional facilities, buildings, sitework, and utilities, as applicable.

The work shall comply with codes, standards, guides, and regulatory requirements listed within these criteria and referenced documents, which shall be considered minimum standards.

3.2.1.1 Design Lifetime

All new construction shall be designed for at least a 30-yr lifetime. Systems or portions of systems for which a 30-yr life is impractical shall be designed for ease of replacement (i.e., timely, reasonable cost, and consistent with NIF availability requirements established in *Functional Requirements and Primary Criteria*, L-15983). Replacement includes removal, refurbishment, and reinstallation of original equipment, as well as the installation of new replacement equipment.

3.2.1.2 Human Factors

Consideration should be given to human factors engineering in the design, testing, operations, and maintainenance of conventional facilities to identify appropriate interfaces between personnel and facilities where human performance is a determinant in achieving system performance. The IEEE *Guide for the Application of Human Factors Engineering to Systems, Equipment, and Facilities of Nuclear Power Generating Stations* (IEEE Std 1023) may be used as guidance for engineers and managers to define interfaces between personnel and equipment, facilities, software, or documentation, and to identify plant design aspects to consider.

3.2.1.3 Probability of Natural Phenomena

The annual probability of seismic events exceeding specified levels (see Section 3.2.1.10) is 1×10^{-3}. The annual probability of wind-related events exceeding specified levels (see

Section 3.2.1.11) is 2×10^{-2}. The annual probability of flood-related events exceeding specified levels (see Section 3.2.1.12) is 5×10^{-4}.

3.2.1.4 Maximum Fire Loss

The maximum possible fire loss at the NIF shall not exceed $150 million in one fire. When the maximum credible fire loss could exceed $50 million in one fire, a redundant fire protection system shall be provided such that, despite failure of the primary system, the loss will be limited to $50 million. This redundancy may be provided by on-site fire-fighting forces responding to automatic alarms, in addition to automatic fire-suppression systems.

3.2.1.5 Reliability, Availability, and Maintainability (RAM)

Normal operating hours at the NIF include continuous LTAB operation, 24 hrs/day, 353 days/yr.

All NIF systems shall be sufficiently reliable to be available for three-shift operation of the NIF at least 256 days each year (72% availability).

Scheduled maintenance shall not preclude full-function operation of the NIF more than 69 days each year. Unscheduled maintenance shall not preclude full-function operation more than 28 days each year. Of these totals for all NIF systems, scheduled maintenance of conventional facilities systems are assumed to be performed within the 69 days, and are alloted 2.3 days/yr for unscheduled maintenance.

Adjustment of the RAM allocations for conventional facilities systems will result from refinement of the *NIF Project RAM Analysis*, NIF-0000159. Results (**TBD**) of the analysis shall be accommodated in the systems designs.

3.2.1.6 Recovery from System Failures

Recovery provisions shall be made in the design of conventional facilities systems for any failure that exceeds an annual occurrence probability of 5×10^{-4}, where timely recovery is necessary to meet NIF mission goals. As a design goal, normal operations should be restored in the time intervals associated with a potential system failure as follows:

- Rapid recovery—less than 24 hrs after any event that has an expected annual frequency of more than 1.0.
- Normal recovery—less than one week after any event that has an expected annual frequency of more than 10^{-2}.
- Extended recovery—less than three months after any event that has an expected annual frequency of between 10^{-2} and 5×10^{-4}.
- Non-recovery—any event that has an expected annual frequency less than 5×10^{-4} may require major reconstruction.

3.2.1.7 Facility Staffing

The completed facility will have an operating staff as outlined in the NIF Staffing Plan—a total of 267 personnel operating the facility 3 shifts a day, 7 days a week. The LTAB and OAB shall be capable of accommodating up to 50 visitors in a single group, which may involve many hundreds during an open house or conference event; up to 20 daily; and up to 5,000 annually.

3.2.1.8 Plant Modifications and Upgrades

Where reasonably feasible, conventional facilities designs shall preserve the capability for future NIF upgrades. In particular, consideration shall be given to the potential for adding a second target chamber that would be accessible to all laser beams and associated facilities, including diagnostics.

3.2.1.9 Site Soil Conditions

All NIF conventional facilities, including earthwork, paving, utilities, buildings, and equipment, shall be designed in consideration of the subsurface conditions at the NIF site, which are characterized in *Geotechnical Investigation **Draft** Report*, National Ignition Facility, Livermore, CA (Klienfelder, Inc., 4/26/96).

3.2.1.10 Seismic Criteria

Seismic design provisions for NIF are based on information in the *NIF Functional Requirements and Primary Criteria*, DOE-STD-1020-94, the Uniform Building Code (UBC), and certain NIF correspondence on the subject. Discussion and recommendations regarding seismic provisions for NIF are contained in correspondence NIF-LLNL-96-164 and D&CdwcW96-064mmb, and form the basis for the requirements summarized below. In the event of conflicting information, the requirements provided below shall govern.

Recovery Time—The requirement in the NIF Functional Requirements and Primary Criteria for a maximum recovery time of 3 months dictates the use of Performance Category (PC) 2 seismic design and evaluation criteria, as a minimum. An evaluation of the PC2 seismic design criteria, discussed in DOE-STD-1020-94, indicates both quantitative and qualitative consistency with a 3-month recovery requirement.

Design and Evaluation of NIF Conventional Facilities Structures Supporting Special Equipment—Seismic design of structures that support experimental equipment (i.e., Laser Bays No. 1 and 2 mat foundations, Target Building, and Switchyards No. 1 and 2) should be performed using PC2 criteria, as given in DOE-STD-1020-94, and augmented by dynamic analysis. Response spectrum analysis is the recommended analysis approach. The seismic demand computed for the design of these structures should allow for ductile, or inelastic, response. Guidelines for the amount of ductile response are provided in DOE-STD-1020-94 and the Uniform Building Code, in which the Rw

factors are defined for different structural types. Determination of maximum permanent displacements are to be made and compared to allowable permanent displacements (**TBD**). If maximum permanent displacements exceed allowable limits, adjustments to Rw factors are to be made until permanent displacements are within allowable limits. All three directions of input (100% in two horizontal directions and 100% in the vertical direction) should be considered when computing the seismic demand, and the results should be combined with an appropriate technique, such as the square-root-sum-of-the-squares (SRSS). For design, the seismic capacity should be computed according to the appropriate design codes.

Design and Evaluation of NIF Conventional Facility Structures—Seismic design of conventional facility structures (e.g. Laser Bays, Capacitor Bays, Switchyard weather enclosure, Diagnostics Building, OAB, SEB, and conventional systems equipment) should be performed using PC2 criteria given in DOE-STD-1020-94. Dynamic analysis is not a requirement unless stiffness, weight, or vertical irregularities require it. Ductile, or inelastic, response is permitted when computing the seismic demand and guidelines for the amount of ductile response are provided in DOE-STD-1020-94 and the UBC. For design, the seismic capacity should be computed according to the appropriate design codes.

Seismic Anchor Motion—DOE-STD-1020-94 does not explicitly address relative seismic anchor motion (SAM) for PC2 structures. Since the effects of SAM are important for distributed systems and equipment that span between different structures, SAM should be considered for the design and evaluation of conventional facilities structures and for systems and equipment located above experimental equipment. Restriction of the amount of SAM shall be specified as appropriate, based on computed amounts of perm-anent seismic displacements.

Seismic Importance Factor = 1.25.

Peak Seismic Ground Acceleration—The peak horizontal ground acceleration is 0.57g simultaneously in each of two orthogonal directions. The peak vertical ground acceleration is also 0.57g.

3.2.1.11 Wind Criteria

Wind design shall meet the requirements for a PC2 facility according to DOE-STD-1020-94. The NIF conventional facilities shall be designed in accordance with ANSI A58.1 (currently ASCE 7-93) for a wind speed of 72 miles per hour, exposure 'C' and an importance factor (I) of 1.07 (I = 1.15 per UBC '94). Wind forces may act from any horizontal direction.

Structural frames and building exteriors shall maintain their integrity and shall prevent breaching during design basis wind events.

3.2.1.12 Flood Criteria

According to DOE-STD-1020-94, the PC2 classification requires that consideration be given in facility designs for the 2,000-yr flood to ensure that NIF perfromance goals are not compromised. A flood hazard curve has not been developed for the Livermore site, but the major flooding threat for the NIF derives from excessive rainfall leading to overflow of the Arroyo Las Positas drainage. This condition is expected to result in sheet flow across the site at a probable depth of no more than one foot.

A flood hazard study for another facility at LLNL serves as the basis for estimating the flood criteria for the NIF (A. C. Boissonade, *Precipitation and Flood Level for B-332*, Fission Energy and Systems Safety Program, SANT95-068/AB). The NIF conventional facilities shall be designed to withstand these levels of precipitation without adverse impact to performance goals.

Duration	**Precipitation (inches)**
5 minutes	0.57
10 minutes	0.76
15 minutes	0.94
30 minutes	1.25
1 hour	1.73
2 hours	2.49
3 hours	3.12
6 hours	4.09
12 hours	5.13
24 hours	6.18
36 hours	7.52
48 hours	8.51
60 hours	9.00
72 hours	9.46

3.2.1.13 Weather Conditions

Outdoor conditions 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
- Annual Precipitation **TBD**

3.2.1.14 Environmental Protection

Design of the NIF site and conventional facilities shall be performed in accordance with the following standards:

- DOE Order 420.1, Facility Safety.
- DOE Order 440.1, Worker Protection for DOE Federal and Contractor Employees.
- DOE Order 5400.1, General Environmental Protection Program.
- Executive Orders 11988 and 11990, Floodplain and Wetlands Management.
- Endangered Species Act.
- American Indian Religious Freedom Act.
- National Archeological and Historic Preservation Act.

Consideration shall be given in NIF site designs to the consequential effects of construction and operation upon the surrounding ecosystems and environmentally sensitive areas.

Development, modification, or occupancy of existing flood plains, wetlands, and endangered species' habitat shall be avoided wherever practical alternatives exist.

If cultural, religious, or burial sites are encountered in the NIF construction, they shall not be disturbed without the consultation of appropriate interested and recognized organizations.

3.2.1.15 Decontamination and Decommissioning (D&D)

Consideration shall be given in the NIF site designs to simplifying the potential decontamination, decommissioning, or re-use of those facilities in which radioactive or other hazardous materials are used. Design features that may facilitate later D&D shall be identified as required by the NIF D&D Plan, to be prepared based on Title I design, and DOE Order 5820.2A, Radioactive Waste Management

3.2.1.16 Construction Safety

Provisions shall be made in construction documents for adherance to site-specific safety/work plans, meeting the requirements of LLNL's Safety, Accident Prevention, and Fire Protection Plan and Title 10, Code of Federal Regulations, Part 1926, OSHA requirements for construction safety.

3.2.1.17 Emergency Preparedness

Conventional facilities designs shall be performed in consideration of potential emergencies from within and outside the NIF, as outlined in the *LLNL Emergency Plan*, LLNL 1993a, and the *Emergency Preparedness and Response Plan for Laser Programs*, L-15409. Facility designs shall incorporate features to accommodate relevant provisions of these plans and/or shall not preclude compliance of the facilities with the plans.

3.2.2 Site System Performance and Physical Characteristics

3.2.2.1 Demolition and Relocation

3.2.2.1.1 Civil

The existing topsoil shall be sampled to determine its suitability for reuse, including appropriate processing for reuse, as backfill in the permanent construction of NIF conventional facilities. Stockpiling and reuse, or removal from the site, shall be provided for in the design of the work.

An existing stormwater drain line (42-in. dia concrete pipe) traverses the NIF site where new construction is contemplated. The interfering portion of the existing line shall be relocated and reconnected to restore the flow of stormwater in the line.

Existing paved parking areas and walkways in the south portion of the NIF site (north of existing building 571) interfere with planned construction, and shall be removed to clear the construction area for new work. Replacement of 62 paved parking spaces shall be provided west of building 571.

3.2.2.1.2 Structural

Not applicable

3.2.2.1.3 Architectural

Two small, modular-type buildings (5906 and 5927) in the north portion of the NIF site interfere with planned construction, and shall be removed to clear the construction area for new work.

3.2.2.1.4 Mechanical

Utility piping associated with the modular buildings described in Section 3.2.2.1.3 shall be removed.

3.2.2.1.5 Electrical

The existing 13.8-kV overhead power line, now providing power to four existing transformers (T-1590, 1589, 1528 and 375), interferes with the construction of new facilities of the NIF Project and shall be removed, including nine existing 13.8-kV power poles (PP-400 through PP-409) and associated overhead conductors.

A new 13.8-kV underground feeder shall be installed through two new sectionalizing switches to replace the overhead line and provide power to the four existing transformers.

Existing 13.8-kV power manholes (MH) P-582 and associated underground ductbanks from existing MH P-684 to existing MH P-581 shall be abandoned. One new manhole and new underground ductbanks shall be installed to ensure continuity of the existing 13.8-kV underground distribution system.

Several existing lighting fixtures that interfere with new construction shall also be removed from Parking Lot F-7W. New parking-lot lighting shall be provided as described in Section 3.2.2.4.5.

Electrical service associated with the modular buildings described in Section 3.2.2.1.3 shall be removed.

3.2.2.1.6 Verification of Demolition and Relocation

Not applicable to demolition. For relocation installations, refer to Section 4.0, Quality Assurance.

3.2.2.2 Site Preparation

3.2.2.2.1 Civil

The NIF site area shall be cleared and graded in preparation for construction of new facilities, including the grading of laydown areas and areas for temporary construction offices, toilets, parking, storage buildings, and shops. Grading shall include the establishment of appropriate slopes, swales, and retention areas to accommodate suitable drainage and runoff conditions for stormwater on the site.

3.2.2.2.2 Structural

Not applicable.

3.2.2.2.3 Architectural

Not applicable.

3.2.2.2.4 Mechanical

Not applicable.

3.2.2.2.5 Electrical

Not Applicable

3.2.2.2.6 Verification of Site Preparation

Refer to Section 4.0, Quality Assurance.

3.2.2.3 Temporary Construction Facilities

3.2.2.3.1 Civil

Provisions shall be made in the construction plans for installation (prior to permanent construction) and removal (after permanent construction) of the following temporary facilities:

- Paved or unpaved staging/laydown areas for bulk commodities of construction materials, such as piping, wiring, structural and reinforcing steel, aggregates, special equipment, etc.
- Storage areas for fabricated items awaiting installation, such as re-steel cages, ductwork, mechanical and electrical equipment, transformers, special equipment, etc.
- Parking areas for construction workers' autos, construction trucks, cranes, and other equipment.
- Paved or unpaved construction access roadways.
- Stormwater drainage.
- Security fencing.

3.2.2.3.2 Structural

Not applicable.

3.2.2.3.3 Architectural

Provisions shall be made in the construction plans for installation (prior to permanent construction) and removal (after permanent construction) of the following temporary buildings or enclosures:

- Toilet and lunchroom facilities for construction personnel.
- Office facilities for contractors' management, inspection, and clerical personnel.
- Storage facilities for equipment (including NIF special equipment) and components that must be preserved indoors.
- Shop facilities for on-site fabrication of items to be incorporated in the permanent construction, and for calibrating inspection devices.
- Garage facilities for inspection and servicing of construction vehicles and equipment.

3.2.2.3.4 Mechanical

Provisions shall be made in the construction plans for installation (prior to permanent construction) and removal (after permanent construction) of temporary utility piping necessary to support the facilities described in Section 3.2.2.3.3.

3.2.2.3.5 Electrical

Provisions shall be made in the construction plans for installation (prior to permanent construction) and removal (after permanent construction) of the following temporary services:

- Power and lighting for temporary construction facilities.
- Telephones for contractor offices.
- Site security, fire, and evacuation alarms.

3.2.2.3.6 Verification of Temporary Construction Facilities

Refer to Section 4.0, Quality Assurance.

3.2.2.4 Roads, Parking, and Landscaping

3.2.2.4.1 Civil

Civil designs for NIF permanent conventional facilities shall be performed in accordance with the following standards:

- American Society of Civil Engineers.
- American Association of State Highway Transportation Officials.
- LLNL Facilities Standards.

Grading and Drainage—Paved areas shall be designed in accordance with the following:

- Longitudinal and transverse slopes shall be limited to 4% max in the direction of parking and 6% perpendicular to parking.
- Paved areas shall be graded at a min 1.5% slope.
- Concentrated flow at paved swales shall be graded at a min 1% slope or, if less, concrete curb-and-gutters or valley gutters shall be used.
- The min slope of concrete gutters shall be 0.5%.
- Surface drainage in landscape areas shall have a min 2% slope.
- An underground drainage system shall be provided when proper surface drainage slopes cannot be established.

Paving—Personnel and vehicle access shall be provided to the LTAB, OAB, and SEB by paved roadways and walkways. Roadway widths shall be **TBD** ft wide with a minimum turning radius of 50 ft, and shall be configured to accommodate service equipment vehicles and emergency vehicles, including fire trucks and ambulances.

Parking areas, including pavement and curb designs for handicapped person accessibility, shall be provided for approximately 150 personnel in areas near the NIF buildings, including employees, visitors, and government personnel. Parking shall be located away from HVAC air intake structures, to prevent entrainment of automobile exhaust gases.

Dumpster locations and access for garbage trucks shall be provided. Three dumpsters (1-garbage, 1-paper recycle, and 1-cardboard recycle) are required. The truck, which lifts dumpsters with front forks, requires a 50-ft turning radius or adequate back-up space.

Paved areas shall be designed to CALTRANS H20 traffic loads, with pavement thickness based on subgrade strength (R-Value TBD from soil test) and the number of heavy trucks (**TBD**) and the number of fork lifts (**TBD**). Two-in. asphaltic concrete over six-in. aggregate base shall be the minimum for parking areas and two-in. asphaltic concrete over eight-in. aggregate base for road ways.

Setbacks for NIF facilities shall conform to LLNL site planning criteria for roads, buildings, pathways, and parking.

Storm and Sanitary Sewer Lines—Roof drains, overflow drains and interior down spouts from buildings shall be connected to site storm drain.

The storm water calculation shall be based on a 25-year frequency curve as shown in LLNL Plant Engineering Standard PEL-C-02440, using the rational method. A portion of an existing 42-in cast-in-place concrete storm drain pipe that interferes with the LTAB is to be rerouted (see Section 3.2.2.1.1).

Sanitary sewer pipelines shall be designed in accordance with the following:

- Minimum line size: 6-in. dia.
- Designed velocity: min 2 fps flowing at half depth.
- Sewers to have straight runs between manholes spaced every 400 ft max (if manholes are needed).
- Clean-outs shall be used for changes indirection of minor sewer laterals and building connections.
- Sanitary discharge quantities shall be based on fixture units.

3.2.2.4.2 Structural

Not applicable

3.2.2.4.3 Landscape Architecture

Landscaping improvements shall be provided for the NIF site according to the design philosophy and guidelines of LLNL's Landscape Master Plan and Design Guidelines. Landscape designs shall include, but not be limited to lawns, plantings, entry development, outdoor areas for employee use, and screening. Landscape designs shall esthetically organize the site, buildings, roadways, and the flow of pedestrian traffic. Consideration shall be given to landscape designs along xeriscape principles.

Landscape improvements shall include underground irrigation system(s) for lawn areas, trees, shrubs, and other plantings, and appropriate drainage system(s).

3.2.2.4.4 Mechanical

A source of supply shall be provided for irrigation of landscape plantings and lawn areas from the underground CW/F piping, including code-required isolation valves and backflow prevention.

3.2.2.4.5 Electrical

Street and parking lot lighting shall be provided, using fixtures with high-pressure sodium (HID) lamps controlled by photocells. Lighting levels shall be according to Illuminating Engineering Society (IES) Standards, and shall ensure adequacy to meet LLNL security lighting requirements.

3.2.2.4.6 Verification of Roads, Parking, and Landscaping

Refer to Section 4.0, Quality Assurance.

3.2.2.5 Site Utilities

3.2.2.5.1 Civil

Civil designs for utility systems shall be performed in accordance with applicable standards associated with the following:

- American Society of Civil Engineers, ANSI/ASCE.
- American Association of State Highway Transportation Officials.
- Uniform Federal Accessibility Standard FED STD 975.

Earthwork shall be accomplished in consideration of subsurface conditions at the NIF site (see Section 3.2.1.9).

3.2.2.5.2 Structural

Analysis procedures, designs, and material strength allowables shall meet the requirements of Section 3.2.1.10 and the following codes and standards:

- Uniform Building Code, ICBO.
- American Concrete Institute (ACI) 318-93.
- American Society of Civil Engineers, ANSI/ASCE 7-88, Code Require-ments for Minimum Design Loads for Buildings.
- ACI 301-84, Specifications for Structural Concrete for Buildings.
- American Welding Society (AWS) D1.1, Structural Welding Code.
- American Institute of Steel Construction (AISC), Specifications for Design, fabrication and Erection of Structural Steel for Buildings, 9th edition.
- American Association of State Highway Transportation Officials, specifications.

- DOE-STD-1020-94, Natural Phenomena Hazards Design and Evaluation Criteria for DOE Facilities.
- NIF-LLNL-94-554, D&CdwcW96-064mmb, and NIF-LLNL-96-164 (correspondence regarding seismic input).

All civil catch basins, electrical and mechanical manholes, transformer pulling handholes, vaults, boxes, and similar structures shall be traffic rated. Structures requiring internal personnel access shall be designed for single-person entry and shall incorporate spring-assist doors or hatches where appropriate. Walls shall be designed to resist lateral earth pressure of 40 psf, plus the pressure due to AASHTO H-20 wheel loading located two feet away from the structure.

Sealed or water-tight doors and hatches shall be used to minimize water, dust, and dirt infiltration. All covers and hatches in traffic areas shall be designed for AASHTO H-20 wheel loads, and in other locations designed for a live load of 100 psf.

Reinforced-concrete slab-on-grade and foundations for the SEB shall be designed to support a floor live load of **TBD** psf. Seismic, wind loads, and other design characteristics are addressed in Section 3.2.1.

All major equipment and pumps in the SEB shall be appropriately anchored to raised reinforced-concrete foundations or pads extending above floor level, with exterior foundations extending sufficiently above surrounding grade to prevent accumulation of dirt and debris.

3.2.2.5.3 Architectural

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

- International Council of Building Officials, UBC.
- National Fire Protection Assn., NFPA 101, Life Safety Code.

The primary use occupancy classification shall be "industrial" (NFPA 4-1.9). The size of the SEB shall accommodate the following NIF conventional facilities support equipment, as well as their ancillaries and associated controls, and shall contain adequate space for maintenance access to all components:

- Hot water boilers.
- Chillers.
- Air compressors.
- Pumps.
- Electrical equipment.

The building enclosure shall consist of an (insulated **TBD**) metal building with exposed, painted, structural members inside, and organic-coated, metal siding panels outside. Roofing may be organic-coated, standing seam, metal panels. Windows shall be

provided to allow natural light where permitted by code. The SEB shall be esthetically compatible with the architectural designs of the OAB and LTAB.

Personnel access shall be provided to the SEB by at least two personnel doors located according to the applicable codes. Equipment access shall be provided by at least one electrically operated, overhead, roll-up door, size **TBD**. The threshold configuration shall permit the use of fork lifts and other material handling vehicles.

Interior (fire)walls shall be provided as required by code, to separate the boilers and their ancillaries from electrical and mechanical equipment spaces.

3.2.2.5.4 Mechanical

Mechanical and HVAC designs for utilities, equipment, and the SEB shall be performed in accordance with the following standards:

- American Society of Heating, Refrigeration, and Air Conditioning Engineers, ASHRAE Guide, and associated standards.
- AMCA—Air Movement and Control Association.
- ARI—Air-Conditioning and Refrigeration Institute.
- Energy Conservation standards, 10CFR 435 & 436.
- Factory Mutual Standards.
- NEC—National Electrical Code.
- National Fire Protection Assn. Standards.
- LLNL Facilities Standards.
- Uniform Building Code, ICBO.
- Uniform Mechanical Code, ICBO.
- Uniform Plumbing Code, ICBO.

Note: Process gases not addressed in this SSDR document are also being provided by the NIF Project. This "by-others" process gas piping may be routed underground in a common trench with the conventional-facilities utility piping described below.

Service Equipment Building—The SEB shall be ventilated by thermostatically controlled exhaust fans and appropriate inlet louvers with back-draft dampers. Heating and cooling are not required.

Chilled Water—Chilled water for building space cooling shall be provided by a chiller plant located in the SEB. Chilled water shall be supplied to building HVAC systems and returned to the chiller plant at the proper temperatures to meet space cooling demands. Piping shall be routed underground in a common trench with other utilities serving the LTAB and OAB.

The chiller plant shall have variable capacities for light and heavy cooling loads, and shall have sufficient standby capacity to satisfy cooling requirements while equipment is inoperable during maintenance or repair, such as may be provided by two 50%-

capacity chillers operating in lead-lag fashion, with one 50% capacity chiller on standby. Chillers shall not make use of ozone-depleting refrigerants.

Cooling Tower Water—Cooling water for the chiller condenser(s) shall be provided by a dedicated cooling tower plant located on the NIF site. The condenser-cooling water shall be pumped (underground) to the equipment in the SEB.

Cooling tower cells shall be designed for 69°F wet-bulb temperatures. Standby tower capacity shall be determined during preliminary design of space-cooling and chiller systems. Condenser water shall be supplied and returned to the chillers at the proper temperatures to satisfy equipment requirements.

Heating Hot Water—Hot water for building space heating shall be provided by a natural-gas-fired boiler plant located in the SEB. The heating hot water shall be supplied to the building HVAC systems and returned to boilers at the proper temperatures to satisfy space heating requirements. Two boilers shall be provided, each with 65% of the demand capacity, with no standby boiler.

Hot water piping shall be routed underground in a common trench with other utilities from the SEB serving the LTAB and OAB.

Potable Water—(CW/F) is available at approximately 80 psig in typical 8-in piping with varying flowrates throughout the LLNL site in a street grid. New underground piping for the NIF shall be configured to furnish the flowrates and static and residual pressures necessary for the domestic water systems in the LTAB and the OAB. The domestic water system shall be provided with isolation valves and backflow prevention in accordance with applicable portions of the UPC and LLNL Facilities Standards.

Separate LTAB and OAB connections and valving to an underground supply loop shall be provided for potable domestic water and for fire protection water.

Fire Protection Water—Water for fire protection sprinklers in the buildings shall be provided at 80 psig from the NIF underground loop to the LTAB, OAB, and SEB.

Low-Conductivity Water—LCW is available at aproximately **TBD** psig through the LLNL site in a street grid. New underground piping for the NIF shall be configured to furnish the flowrates and static pressures necessary for use in experiment systems in the LTAB (**TBD** gpm) and the OAB (**TBD** gpm). The LCW system shall be provided with isolation valves and backflow prevention in accordance with applicable portions of the LLNL Facilities Standards.

Natural Gas—Natural gas is available at 5 psig from the site-wide utility and shall be provided for use in the NIF boiler plant. Connections to the existing site main and at the new building entrance shall have an appropriate isolation valve and seismic valve. Connections at the point of use shall have the proper isolation valve, a listed gas meter,

regulator, and bypass, with shut-off valves downstream of the meter/regulator assembly. Low-pressure natural gas shall be furnished to the boilers.

Compressed Air—High-quality compressed air (**TBD** cfm) shall be supplied at 100 psig, underground to the LTAB and OAB from a compressor plant in the SEB. Piping shall be routed underground in a common trench with other utilities serving the LTAB and OAB.

The compressor plant shall have variable capacity for low and high demands, and shall have sufficient standby capacity to satisfy compressed air requirements while equipment is inoperable during maintenance or repair, such as may be provided by two 50%-capacity machines operating in lead-lag fashion, with one 50%-capacity machine on standby.

3.2.2.5.5 Electrical

The design of NIF Project electrical power systems shall, as a minimum, be accomplished in accordance with the requirements of the following LLNL Facilities Standards:

- Standby Power: PEL-E-16620.
- Pad Mounted Distribution Transformers: PEL-E-16322.
- Energy Metering: PEL-I-13300 Rev. C.
- Sectionalizing Switches: PEL-E-16494.
- Medium Voltage Power Cables: PEL-E-16121.
- Precast Concrete MHs for Medium-Voltage Systems: PEL-E-16119.
- Underground Ducts: PEL-E-16118.

Power—Primary power for the entire NIF Project shall be supplied from existing double-ended 13.8-kV Switchgear LGS57.

Two existing 1200-A circuit breakers (one from the North Bus and one from the South Bus) shall be used to form an open-tie loop circuit to provide primary (13.8 kV) power through sectionalizing switches to transformers feeding the following electrical loads:

- Chillers and pumps.
- Boilers and pumps.
- Compressors.
- Cooling Tower and pumps.
- Capacitor Bays #1, #2, #3 and #4.

Two existing 1200-A circuit breakers (one from the North Bus and one from the South Bus) shall be used to form an open-tie loop circuit to provide primary (13.8-kV) power through sectionalizing switches to transformers feeding all remaining NIF electrical loads.

The NIF 13.8-kV power distribution system shall be underground, using new man-holes and new concrete-encased ductbanks.

The utilization power system voltage and loads for the NIF Project, especially for the LTAB Building, shall be served by separate transformers, in order to isolate noisier loads from loads that are noise-sensitive. These separate systems and the loads they serve are as follows:

- 4160-V Chillers: Two transformers shall supply the chillers through 5-kV switchgear. Tie-breaker shall allow either transformer to supply all chillers.
- 480-V Chiller Pumps: Two transformers shall supply pump loads associated with the chillers through a 480-V power distribution center. Tie-breaker shall allow either transformer to supply all chiller pumps.

- LTAB: Outdoor transformers located around the building perimeter shall serve the following power requirements:

  HVAC loads: 13.8-kV/480-V transformers shall supply HVAC fan loads for the building. These loads split onto several Motor Control Centers.

  Lighting loads: 13.8-kV/480/277-V transformer(s) shall supply 277-V lighting loads.

  Utility loads: 13.8-kV/480-V transformer(s) shall supply power to 480-V Power Distribution Center(s). The 480-volt Power Distribution Center(s) supply power to dry-type 480/208-120-V transformers located in the building, which supply 208-120-V utility panelboards.

  Utility pulsed power: 13.8-kV/480-V transformer(s) supply 480-V Distribution Center(s). Capacitor bank modules will use this power directly. The 480-V Power Distribution Center(s) also supply power to dry-type 480/208-120-V transformers located in the building, which supply 208-120-V research panelboards for NIF Special Equipment that have embedded pulsed-power systems.

  Research Power: 13.8-kV/480-V transformer(s) shall supply 480-V Power Distribution Center(s). The 480-V Power Distribution Center(s) supply power to dry-type 480/208-120-V transformers located in the building, which supply 208-120-V research panelboards.

  Clean Power: Research power further isolated by dry-type transformers located near the load. Additional detail is provided in the *NIF Grounding and Shielding Plan*, L-17346-1 (NIF-LLNL-94-211).

  Voltage Quality: Power distribution voltage to NIF experimental equipment shall be maintained in compliance with ANSI C84.1, Electrical Power Systems and Equipment—Voltage Rating 60 Hz, Range A. Voltage excursions outside these limits shall not exceed Range B, and should be limited in extent, frequency, and duration. Corrective

measures for excursion events shall be undertaken as shown in Table 1 and Figure B1 of the standard.

- OAB Loads: 13.8-kV/480-277-V transformer(s) supply power to 480-277-V Power Distribution Center(s). The Power Distribution Center(s) supply power to building electrical systems.

- Standby Power shall be provided by an outdoor diesel-generator(s) at 480 V for the entire NIF Facility. Standby power shall be available for the protection of life, health, and property, and for safeguards and security. Standby power shall be provided for such loads as emergency exit lighting, fire alarms and sensors, security systems, safety-related ventilation, radiation monitors, and effluent monitors and controls. Additional standby power shall be available to preserve experiment process continuity **TBD**.

  The diesel-generator installation shall include fuel storage sufficient for 12 hours continuous operation at full-load capacity.

Grounding—A grounding system shall be provided for all buildings, consisting, as a minimum, of a grounding grid of #4/0 AWG, soft-drawn bare copper (SDBC), with copper-clad, ground rods exothermically welded to it around the perimeter of the grid. In addition to other requirements within the LTAB and OAB (see SSDRs 1.2.2.1 and 1.2.2.3), the main structural steel elements of buildings, including the SEB, and electrical equipment shall be exothermically welded or bolted with ground clamps to #4/0 SDBC wires connected to the ground grid. The grounding system shall conform to requirements established in the *NIF Grounding and Shielding Plan*, L-17346-1 (NIF-LLNL-94-211).

Communications—Telecommunications for the LTAB and OAB shall be provided as follows:

- Ductbanks for all Industrial Electronics systems shall be in accordance with the LLNL underground duct standard. (for LLNL ref: PEL-E-16118).
- Fiber-optic cables shall be used for data transmission. Cables of classified and unclassified systems shall be installed in separate, dedicated ducts. Access to the duct bank is controlled by locking access covers and is limited to authorized maintenance personnel.
- Copper transmission media shall be installed to accommodate various alarm and signaling requirements in addition to fiber-optic cables. Copper transmission media and fiber-optic media shall be routed in separate ducts.

Alarms—Fire Alarm, remote control, signaling, and power-limited circuits:

To the greatest extent practical, and as allowed by applicable codes and standards, fire alarm, remote control, signaling, and power-limited circuits shall use transmission media installed as part of the telecom-munications system. Underground raceways for fire alarm, remote control, signaling, and power-limited circuits shall be designed and

installed per NFPA 70. Where underground raceways are part of a telecommunications ductbank, the LLNL underground duct standard shall apply.

- Underground raceways used for fire alarm, remote control, signaling, and power-limited circuits shall be dedicated and separate from telecommunications ducts when installed as part of a telecommunication ductbank.
- Within manholes, fire alarm, remote control, signaling, and power-limited circuits shall be bundled, tagged, and secured separately from both classified and unclassified telecommunications.

3.2.2.5.6 Verification of Site Utilities

Refer to Section 4.0, Quality Assurance.

3.3 Design and Construction

3.3.1 Civil

TBD—to be described after design is established by drawings and specifications. Note that construction verification should be covered by reference to Section 4.0, Quality Assurance

3.3.2 Structural

TBD—to be described after design is established by drawings and specifications. Note that construction verification should be covered by reference to Section 4.0, Quality Assurance.

3.3.3 Architectural

TBD—to be described after design is established by drawings and specifications. Note that construction verification should be covered by reference to Section 4.0, Quality Assurance.

3.3.4 Mechanical

TBD—to be described after design is established by drawings and specifications. Note that construction verification should be covered by reference to Section 4.0, Quality Assurance.

3.3.5 Electrical

TBD—to be described after design is established by drawings and specifications. Note that construction verification should be covered by reference to Section 4.0, Quality Assurance.

3.4 Logistics

TBD—to be described after CM has completed construction planning. This section should be very brief, discussing acquisition of Conventional Facilities in their entirety, and should make reference to the CM's planning and construction packaging documents.

4.0 Quality Assurance Provisions

The quality of Site Improvements subsystems is assured through the implemen-tation of the NIF Project management system, which is described by procedural controls in the *Project Control Manual* and various planning documents, such as the *Quality Assurance Program Plan, Project Execution Plan, Configuration Management Plan,* and others.

These controls address the performance of assurance measures, such as reviews, inspections, and assessments, to be performed at every phase of work involved in the acquisition of NIF sitework 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 certain aspects of the NIF QA Program for the Site Improvements subsystems.

4.1 Q-Levels (Quality Assurance Levels)

As part of the NIF QA Program provision to focus management attention commen-surate with the importance of Project elements, the Site Improvements subsystems were analyzed according to *NIF Procedure 1.6, Assignment of Q-Levels,* to establish their relative importance to Project success. The results of these analyses are characterized by the Q-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: Site Improvement

WBS element number	WBS element title	Assigned quality level			Why not quality Level 3?
		1	2	3	
1.2	**Site and Conventional Facilities**				
1.2.1	**Site Improvement**				
1.2.1.1	Demolition and relocation			x	
1.2.1.2	Site preparation			x	
1.2.1.3	Roads, Parking, Land scaping			x	
	Roads			x	
	Parking			x	
	Landscaping			x	
1.2.1.4	Site Utilities			x	
1.2.1.4.1	Sanitary drainage			x	
1.2.1.4.2	Storm drainage			x	
1.2.1.4.3	Mechanical Utility			x	
1.2.1.4.3.1	Water supply system			x	
	Main water valves			x	
	Metering system			x	
	Piping			x	
1.2.1.4.3.2	Fire water system				
	Fire hydrants			x	
	Fire water valves and piping			x	
1.2.1.4.3.3	Cooling Water System			x	
1.2.1.4.3.3.1	Chillers			x	
	Compressors			x	
	Condensers			x	
	Evaporators			x	
1.2.1.4.3.3.2	Cooling Tower			x	
	Cells			x	
	Fans			x	
	Pumps			x	
1.2.1.4.3.3.3	Circulating pumps				
	Chilled water			x	
	Condenser water			x	
1.2.1.4.3.4	Heating water system				
	Boiler			x	
	Circulating pumps			x	
1.2.1.4.3.5	Gas/Fuel system				
	Main line valves			x	
	Metering system			x	
	Piping			x	

1.2.1.4.4	Electrical				
1.2.1.4.4.1	Primary power system			x	
	Sectionizing switches			x	
	High voltage trasformers			x	
	switchboard			x	
	Motor control center			x	
	Starter switches			x	
	Low voltage transformers			x	
	Panelboards			x	
1.2.1.4.3.2	Outside lighting				
	Equipment			x	
	wiring & conduits			x	
1.2.1.4.3.3	Telecommunication and data transfer				
	Equiment			x	
	wiring & conduits			x	
1.2.1.4.3.4	Safety and security system			x	

4.2 Quality Requirements

The quality requirements for NIF Site Improvements 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 of this SSDR. These requirements appear as system characteristics in NIF Site subsystem drawings and specifications discussed in Section 3.1.

4.3 Quality Assurance Measures

4.3.1 Site Subsystems

Construction specifications associated with each of the Site subsystems 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 are identified in the specifications for Q-Level 1 and 2 components involved in Site Improvements.

4.3.2 Site Subsystem Design Verification

Design verification is accomplished through implementation of the Architect-Engineer's (AE's) 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 and fabrication drawings generated by suppliers 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 Site Subsystem Construction Verification

Construction verification is accomplished through implementation of the CM's inspection procedures of the CM QA Program. Verification of CM QA Program implementation and further verification of the fabrication 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

(Blank)

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. All requirements reassessed and updated, based on mid-Title I Development information.

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