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SECTION 1
CONSTRUCTION SAFETY

1.1 INTRODUCTION

The purpose of this section is to assure that construction operations at Princeton Plasma Physics Laboratory (PPPL) are carried out in a manner that minimizes the risks of injuries to personnel and damage to property. This section addresses safety requirements for practices most commonly undertaken; however, it does not release workers from the safety requirements of the U.S. Department of Energy (DOE), Occupational Safety and Health Act (OSHA), and PPPL. This document does not specifically address all OSHA requirements and is not inclusive of other applicable parts of OSHA. The current version of the applicable Code of Federal Regulations (CFRs), including OSHA are available on the Internet. Consult with the ES&H Division on how to locate these requirements and their applicability for specific PPPL activities.

1.2 SCOPE

The provisions of this section apply during the construction, alteration, modifications, moving, or demolition of any building or structures, systems and components at PPPL, and are applicable to both Laboratory personnel and outside subcontractors.

1.3 DEFINITIONS

Construction Activities - Alterations, modifications, moving, demolition, or new installation of a building or structures, systems and components.

Construction Contractor – The subcontractor with primary responsibility for the execution of all construction work described within a construction procurement or authorization document.

Construction Manager - The PPPL employee who has project responsibility to ensure that construction activities are in compliance with OSHA, DOE, and PPPL standards.

Construction Safety Engineer - The PPPL employee or subcontract employee who verifies compliance by inspecting construction projects while in progress and reports to the Head of the ES&H Division. The need for an independent Construction Safety Engineer for a specific construction job or project will be determined on a case by case basis by Line Management in consultation with the ES&H Division Head and/or the ES&H and Infrastructure Department Head.

DOE - U.S. Department of Energy

Facility - A building, structure, area or room that is built, installed, or established to serve a particular purpose.

Subcontractor - A non-PPPL individual engaged in activities on site within the scope of this section.

Imminent Danger - A situation that has the immediate potential for death or serious injury to personnel.

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OSHA - Williams-Steiger Occupational Safety and Health Act.

1.4 RESPONSIBILITIES

1.4.1 Department Heads/Division Heads are responsible for ensuring the implementation of this section within their administrative areas.

1.4.2 Construction Managers are responsible for the direct implementation of this section. Specifically, they shall ensure that construction of all facilities is performed in accordance with required standards and shall:

A. Ensure that outside subcontractor personnel and/or PPPL employees are aware of, and perform work within, the requirements of this section.

B. Arrange, prior to construction, meetings of appropriate PPPL and subcontractor personnel to discuss and plan methods for carrying out the various construction activities. During construction, hold regular (e.g., daily) meetings with appropriate work supervisors, workers and the construction safety engineer to review planned work and associated safety issues and precautions.

C. Approve Job Hazard Analyses (JHAs) and ISM Plans prepared by construction contractors or others for construction activities.

D. Identify ES&H deficiencies and ensure that ES&H non-compliances are corrected.

E. Stop work immediately in areas where "imminent danger" exists.

F. Require that proper personal protective equipment is worn when necessary.

G. Ensure that contract specifications include adequate ES&H requirements.

H. Consult with the Fire Protection Engineer during design stages in those cases where existing fire protection systems may be impaired.

I. Conduct periodic inspections of construction sites.

J. Ensure that, upon discovery of an unsafe condition or work practice on a project site, the work is halted unless there is responsive action.

1.4.3 The Construction Safety Engineer, if determined to be needed, shall be responsible for assisting in the implementation of this section. Specifically, the Construction Safety Engineer shall:

A. Conduct regular inspections at the construction site to assure adequacy of ES&H compliance during construction activities. OSHA regulations 29CFR1910 and 1926 shall be used as the criteria for these inspections.

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B. Act as a source of information and provide guidance on the subject of construction safety.

1.4.4 Each Construction Contractor must prepare a written Integrated Safety Management (ISM) Plan (construction project safety and health plan) that implements the requirements of items A-G below for the construction work under their responsibility and obtain approval of the plan by the Construction Manager prior to commencement of any work covered by the plan. In the plan, the contractor must designate the individual(s) responsible for its on-site implementation, specify qualifications for those individuals, and provide a list of those project activities for which subsequent job hazard analyses are to be performed (see item A). The level of detail within the ISM Plan should be commensurate with the size, complexity and risk level of the construction project. In addition, the Construction Contractor must:

A. Prepare and have approved by the Construction Manager job hazard analyses (JHAs) in accordance with PPPL procedure ESH-004 prior to commencement of affected work. The JHAs must identity foreseeable hazards and protective measures, and address further hazards revealed by any supplemental information provided by the Construction Manager.
B. Provide (for approval by the Construction Manager) drawings and/or other documentation of protective measures for which applicable OSHA standards require preparation by a Professional Engineer or other qualified individual (these should be included in the ISM Plan).
C. Identify for approval by the Construction Manager competent persons for activities as required by applicable OSHA standards (these should be included in the ISM Plan).
D. Ensure workers are aware of foreseeable hazards and the protective measures as defined by the JHAs, and require that workers acknowledge being so informed.
E. Ensure that workers not following the safe work practices are subject to the Construction Contractor's disciplinary process.
F. Maintain a designated representative onsite during all active construction that is knowledgeable of the associated hazards and has the authority to act on behalf of the Construction Contractor; and that makes frequent and regular inspections of the construction worksite to identify and correct any instances of noncompliance with project safety and health requirements.
G. Instruct workers to report to the Construction Contractor's designated representative, hazards not previously identified or evaluated. If immediate corrective action is not possible or the hazard falls outside the project scope, the Construction Contractor must immediately notify affected workers, post appropriate warning signs, modify the appropriate JHAs, implement needed interim control measures, and notify the Construction Manager of the action taken. The Construction Contractor or the designated representative must stop work in the affected area until appropriate protective measures are established.

1.4.5 All PPPL employees and Subcontract Personnel shall comply with the requirements (Parts 1.5 and 1.6) of this section.

1.5 REQUIREMENTS

1.5.1 Standards - Construction or alteration of facilities shall be carried out within the provisions of OSHA, PPPL standards, DOE orders, state of New Jersey building codes, i.e.,

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Building Officials and Code Administrators (BOCA), and all other applicable codes as specified in the building industry. Where standards are in conflict, the standard providing the greater protection shall be followed.

1.5.2 Special Hazards Briefing - The nature of the PPPL research program occasionally presents special hazards (radiation, cryogenics, etc.) which must be controlled if construction activity will take place in close proximity to these hazard.

1.5.3 Inspections - Regularly scheduled safety inspections shall be conducted by the Construction Manager, Construction Safety Engineer, and Construction Contractor's designated representative. Periodic safety inspections may also be conducted by others (e.g., ES&H Division personnel, the Industrial Hygienist, Management Safety Walkthrough teams, etc.).

1.5.4 Personal Protective Equipment (OSHA 1926.95-1926.107) –Safety equipment which meets OSHA standards including safety shoes, hard hats, safety glasses, hearing protection devices, respirators, lifelines, lanyards, etc., as are appropriate to the hazards encountered, shall be provided and used by job personnel. The Industrial Hygienist and/or the Construction Safety Engineer are available to advise on appropriate equipment. Hard hats shall be worn whenever there is possible danger of head injury from impact, falling or flying objects, or from electrical shock and burns. Personal protective equipment shall be provided to subcontractors, or subcontractors must assure that their staff provides their own equipment.

1.5.5 Access - When work levels are above or below grade, a safe means of access and egress shall be provided.

1.5.6 Subcontractor Training Requirements - All subcontractors at PPPL shall comply with the Subcontractor Training Requirement, Policy No. P-028.

1.5.7 Construction Tools and Equipment - All such items must meet OSHA, ANSI, and other standards, as publicized in the industry.

1.6 PRACTICES/PROCEDURES

1.6.1 Ladders (OSHA 1926.1050, 1926.1051, and 1926.1053) - Ladder feet shall be placed on a substantial base, and the area around the top and bottom of the ladder shall be kept clear. Portable ladders shall be used at such a pitch that the horizontal distance from the top support to the foot of the ladder is one quarter of the working length of the ladder (the length along the ladder between the foot and top support). Ladders shall be tied, blocked, or otherwise secured to prevent displacement when used as access to other levels. Metal ladders shall not be used in areas where they may come into contact with energized electrical conductors.

If a ladder is to provide the only means of access or exit from a working area for 25 or more employees, or simultaneous two-way traffic is expected, a double-cleat ladder shall be installed. Cleats shall be inset into the edges of the side rails a minimum of one-half inch, or filler blocks shall be used on the rails between the cleats. The cleat shall be secured to each rail with three or more 10d common wire nails or other fasteners of equivalent strength. Cleats shall be uniformly spaced, 12 inches center-to-center. Two-inch by four-inch lumber shall be used for side and mid-rails of double cleat ladders up to 12 feet in length; two-inch by six-inch lumber for double cleat ladders from 12 to 24 feet in length. Double cleat ladders shall not exceed 24 feet in length.

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Ladders shall be installed so they extend at least 36 inches above the upper level walking or working surface, or the ladder shall be secured at its top to a rigid support that will not deflect and provisions shall be made for adequate hand-holds, when used as access to other levels. Ladders shall be inspected prior to use and defective ladders shall be withdrawn from service immediately.

1.6.2 Scaffolds (OSHA 1926.450-1926-452) - Scaffolds shall be erected on sound, rigid footings. Scaffolds and components shall be capable of supporting, without failure, its own weight and at least four times the maximum intended load. "Standard railing" with intermediate rail and toe-boards shall be installed on all open sides and ends of platforms more than 10 feet above the adjacent floor or ground level. Scaffold working platforms shall be a minimum of 18 inches in width. All planking shall be scaffold grade as recognized by grading rules for the species of wood used. Scaffold planks shall extend over end supports not less than six inches nor more than 12 inches, and secured from movement. All scaffolding and accessories shall have any defective parts immediately replaced or repaired.

Scaffold components manufactured by different manufacturers shall not be intermixed unless the components fit together without force and the scaffold's structural integrity is maintained by the user. Scaffold components manufactured by different manufacturers shall not be modified in order to intermix them unless a competent person determines the resulting scaffold is structurally sound. Scaffold components made of dissimilar metals shall not be used together unless Industrial Hygiene, in consultation with a structural engineer, has determined that galvanic action will not reduce the strength of any component to a level below the 4:1 factor (see ESHD 5008 Section 9).

1.6.3 Ramps and Runways (OSHA 1926.451e) - Ramps and runways used by workers shall be not less than 18 inches in width. Ramps and runways used for wheelbarrows shall be not less than 36 inches in width. Ramps and runways with more than a 12.5 degree incline plane shall have cleats not more than 14 inches apart. Ramps and runways more than four feet above the adjacent ground shall have a standard railing. Ramps and runways shall be capable of supporting, without failure, at least four times the maximum load.

1.6.4 Floor Openings, Open Sides, Hatchways, Etc. (OSHA 1926.500 -1926.502) - All floor openings shall be guarded by a "standard railing." Railing shall be provided on all exposed sides, except entrances to a ramp, stairway, or fixed ladder. Every open-sided floor or platform six feet or more above the adjacent floor or ground level shall be guarded by a standard railing with toe-boards on all open sides except where there is an entrance to a ramp, stairway, or fixed ladder.

1.6.5 Air Tools (OSHA 1926.300 - 1926.305) - Pneumatic power tools shall be connected to the air-supply hose in a positive manner to prevent accidental disconnection. Safety clips or retainers shall be securely installed and maintained on pneumatic impact tools to prevent attachments from being accidentally expelled. The manufacturer's safe operating pressure for all fittings shall not be exceeded.

1.6.6 Electrical - Electrical work shall be in compliance with the National Electrical Code (NEC). Ground Fault Circuit Interrupters shall be utilized where specified in Article 305 of the NEC. The noncurrent-carrying metal parts of plug-connected or portable equipment shall be grounded even when double insulated equipment is used. Extension cords shall be the three-wire

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type. Flexible cords shall be used only in continuous lengths without splices. Worn or frayed cords shall not be used. Exposed lamps for temporary lighting shall be guarded by approved lamp guards. Receptacles shall be of approved, dead-front type with a contact for extending ground continuity and shall be so designed and constructed that the plug may be pulled out without leaving any live parts exposed to accidental contact. Where different voltages, frequencies, or types of current (ac or dc) are to be supplied by portable cords, the receptacles shall be marked and designed so that attachment plugs are not interchangeable. Each motor and appliance disconnect and each feeder or branch circuit shall be legibly marked at the point where it originates to indicate its purpose.

1.6.7 Illumination (OSHA 1926.56) - Construction areas, aisles, stairs, ramps, runways, corridors, offices, shops, and storage areas where work is in progress shall be lighted with either natural or artificial illumination. Illumination for work areas shall comply with OSHA 1926.56.

1.6.8 Housekeeping (OSHA 1926.25, 1926.252) - During the course of construction, alteration, or repairs, form and scrap lumber with protruding nails and all other debris shall be kept cleared from work areas, passageways, and stairs in and around buildings and structures. Combustible scrap and debris shall be removed at regular intervals during the course of construction so as to keep areas neat and orderly. Containers shall be provided for the collection and separation of waste, trash, oily and used rags, and other refuse. An enclosed chute shall be used whenever materials are to be dropped more than 20 feet to any exterior point. When debris is dropped through holes in the floor without the use of chutes, the area where the material is dropped shall be enclosed with barricades not less than 42 inches high and not less than six feet back from the projected opening. Signs warning of the hazard of falling materials shall be posted at each level. Removal shall not be permitted in this lower area until debris handling ceases above.

1.6.9 Compressed Gas Cylinders - Valve protection caps shall be in place when compressed gas cylinders are transported, moved, or stored unless secured in welding carts. Cylinder valves shall be closed when work is finished and when cylinders are empty or are moved. Compressed gas cylinders shall be properly secured at all times. Cylinders shall be kept at a safe distance or shielded from welding or cutting operations. Cylinders shall not be placed where they can come in contact with an electrical circuit. All regulators shall be in proper working order before being put to use.

1.6.10 Temporary Heating - Subcontractors using temporary heating units [salamanders, stoves, liquid petroleum gas (LPG) heaters, or portable fuel oil heaters] are responsible for their safe operation. All heating devices shall be Underwriters Laboratory (UL) listed or Factory Mutual (FM) approved. All precautions necessary shall be provided by the subcontractor, including fire watches, adequate fire extinguishers, proper storage of fuel, periodic maintenance, etc. Only electric heating units may be used in the vicinity of electrical apparatus; all other energy sources are strictly prohibited.

1.6.11 Fire Protection - Fire extinguishers of a type and number appropriate to the hazards present shall be provided by the contractor unless work is being performed in areas already adequately protected by existing PPPL fire extinguishers. These extinguishers shall be readily accessible at all times. The number, type, and location of the extinguishers will be determined in accordance with NFPA codes. Where work involves welding, oxyacetylene cutting, or exposure to other open flames, the provisions of Subpart J of Part 1926, OSHA, shall apply. The contractor may not impair fire alarms, water supply, or other fire protection systems without

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advance approval from the Fire Protection Engineer and Emergency Services Unit (ESU) personnel. Fire hydrants may be used only with the approval of the Fire Protection Engineer and ESU personnel. The introduction of combustibles on the site should be limited to reduce the risk of fire to property or delay to the project. All supplies of flammable liquids that are brought into buildings must be in Underwriters Laboratory (UL) labeled safety cans. Flammable liquids are to be dispensed and used in accordance with paragraph 1910.106 of OSHA. If the construction includes installation of automatic sprinkler protection, the installation shall be completed, tested, and placed in service before occupying the space.

Additionally, to minimize the risk and impact of fire during construction, line management shall ensure that compliance with the following requirements is achieved:

A. NFPA 241, "Safeguarding Construction, Alterations, and Demolition Operations"

B. OSHA 1926, Safety and Health Regulations for Construction."

C. Access is always maintained to the site for Emergency Response vehicles.

D. The site/project is provided with two-way communications for the purpose of emergency notification.

E. The site/project is secured against unauthorized entry.

F. Welding, cutting, and open flame work is performed in a designated area whenever possible.

G. When water is available, the site/project is provided with an adequate supply (including an adequate number of fire hydrants strategically located at the site) for fire fighting capability.

H. Projects involving multiple level buildings are provided with dry standpipe systems. (The limitations of the ESU shall be considered when determining the need for dry standpipes in multiple level buildings during construction.)

I. Construction site safety inspections are conducted weekly, documented, and any unsafe conditions identified and tracked until corrected.

1.6.12 Excavating and Trenching (OSHA 1926.650-1926.652) – Before starting any excavation that will penetrate the ground to a depth greater than 12 inches, a digging permit must be obtained in accordance with Procedure ENG-024 to determine if there are any known underground utilities in the area. National Environmental Policy Act (NEPA) review and certification from the NEPA Compliance Manager will also be required prior to commencing excavation, as per Procedure ESH-014. Permits shall be located and protected at the excavation site. The walls and faces of all excavations and trenches five feet or more in depth, or in which employees are exposed to danger from unstable earth, shall be guarded by proper shoring, sloping of ground, or some other equivalent means in accordance with Tables P-1 and P-2 of OSHA, Part 1926. Trench shoring, when required, shall be installed from above or from the open end of the trench in a manner that provides protection for the workers during the installation process, and it shall be removed in the reverse manner to provide equal protection. Excavated or

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other material shall be stored and retained at least two feet from the edge of excavations which employees may be required to enter. Periodic inspections of excavations shall be made by the Construction Manager, Construction Field Engineer, Construction Safety Engineer, and Construction Contractor's designated representative for evidence of possible cave-ins or slides. When either of these are apparent, all work in the excavation shall cease until the necessary precautions have been taken to safeguard the employees. Trenches more than four-feet deep shall have ladders or steps located no more than 25 feet distant from where personnel are required to work. Adequate signs, barricades, and/or flagpersons shall be placed when necessary to provide protection where work is being performed on or adjacent to streets. The flagpersons shall be provided with and shall wear a red or orange warning garment while flagging. Garments worn at night shall be equipped with reflectorized material.

1.6.13 Excavating Equipment - All equipment and vehicles in use shall be checked by the operator at the beginning of each shift to assure that all parts, equipment, and accessories affecting safe operation are free from defects and in a safe operating condition. No one shall operate equipment in reverse unless one of the following conditions is met:

A) The vehicle has a reverse signal alarm which is audible above the surrounding noise level, and/or

B) A separate observer has been assigned to signal that it is safe to do so.

Bulldozer and scraper blades, endloader buckets, dump bodies, and similar equipment shall be either fully lowered or blocked when repaired or when not in use. When unattended, all excavating equipment shall have motors stopped, brakes set, and keys removed.

1.6.14 Motor Vehicles - All PPPL and subcontractor employee vehicles are subject to the PPPL traffic regulations. Automobile accidents involving PPPL or subcontractor employee vehicles on site shall be reported to PPPL Security (x2536, x2883).

1.6.15 Mobile Cranes - The operator shall comply with the manufacturer's specifications, limitations, and the requirements listed in Procedure ENG-021. Rated load capacities, boom angles, recommended operating speeds, and special hazard warnings or instructions shall be posted on all equipment and be visible from the operator's station. Outriggers shall be deployed on stable footings in accordance with the manufacturer's recommendations when lifts are in progress. Equipment shall be inspected daily by the operator and all safety deficiencies corrected before use. Accessible areas within the swing radius of the revolving super structure shall be barricaded when the crane is operating near construction personnel. Except where electrical distribution and transmission lines have been de-energized and visibly grounded at point of work, or where insulating barriers are provided, no part of a crane or its load shall be operated within 10 feet of a line rated at 50 kV or below. For lines rated over 50 kV, increase the distance 4" for every 10kV above 50 kV or see 29CFR 1910.333(c)(3)(iii) for exceptions. Loads shall be properly rigged and balanced before they are set in motion.

1.6.16 Signs and Barriers - Signs requiring the wearing of safety hard hats shall be placed at approaches to construction sites. Warning signs and barricades shall be placed on approaches to all areas where hazardous conditions exist as the result of construction activities.

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1.6.17 Explosives - Explosives are banned from the site unless specifically authorized by the ES&H Executive Board, with the exception of Hilti Guns operated by qualified personnel.

1.6.18 Emergency Medical Treatment - For emergencies requiring immediate assistance, dial 3333 on PPPL telephones. On all other telephones dial 243-3333. Stay on the telephone until all required information is given to an appropriate party.

1.6.19 Control for hazardous waste/materials shall be in accordance to Procedure EWM-001.

1.6.20 All other requirements of OSHA 1926 and 1910 shall be enforced.

1.7 REFERENCES

10 CFR Part 851, Worker Safety and Health Program

29 CFR 1926 and 29 CFR 1910, Safety and Health Regulations for Construction, OSHA

DOE Order 440.1, Worker Protection Management for DOE Federal and Contractor Employees

ES&HD-5008, Section 2, Electrical Safety

ES&HD-5008, Section 5, Fire Protection

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