



STANFORD UNIVERSITY

SLAC National Accelerator Laboratory

Operated by Stanford University for the U.S. Department of Energy



DOE Order 420.2D, Safety of Accelerator Facilities (9/09/2022)

Site Compliance Plan (Rev. 0, 5/01/2023)

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Introduction

The DOE Order 420.2 D, Safety of Accelerator Facilities, was signed on September 9th, 2022. This represents a move from the revision C to D and is the first revision in 12 years. The SLAC Site Compliance Plan outlines the implementation milestones and target completion dates in the table below. It is DOE’s expectation that SLAC is in compliance with meeting the 420.2D requirements within 9 months of the site’s initial implementation plan, (in this case this Site Compliance Plan) if possible. To this end, the third column denotes one of three choices: NA for the section of the Contract Requirements document (CRD) that is not applicable; In compliance by date, signifying SLAC meets the section of the CRD; and In Compliance with approved changes, which denotes action that will occur in the next nine months to meet DOE SLAC Site Office (SSO) expectations.

This Site Compliance Plan (SCP):

- a) corresponds with the version of the DOE Order on Safety of Accelerator Facilities listed in the Prime Contract,
b) states how the Laboratory complies with applicable requirements as tailored to the risks at the Laboratory,
c) identifies CRD sections that do not apply, and
d) documents DOE-approved methods of compliance for applicable requirements and that there are no recurring deliverables\*.

Impact on the Contract:

Under the SCP, sections of the CRD are incorporated into the Contract as-is, unless the SCP indicates that a section or portion thereof is inapplicable, or the section has been changed. Thus, for example, if “In compliance” is listed next to a CRD section, that section is incorporated into the Contract as-is. However, where an SCP indicates that a section or portion thereof is inapplicable, the section or portion thereof is excluded from the Contract. In addition, where a section or portion thereof is applicable, but changes to the section have been agreed by the Parties, the section, as modified by the Parties, shall be incorporated into the Contract. The SCP also memorializes the Parties’ agreement on how SLAC will comply with sections of the CRD (whether or not modified).

In addition to the requirements set forth in this CRD, Attachment 2, Definitions, to DOE O 420.2D, Safety of Accelerators, is referenced in and made a part of this CRD and provides definitions and information applicable to contracts in which this CRD is inserted. The requirements in this CRD apply to all accelerators and their operations<sup>1</sup> and all facilities that transition into operating accelerators.

\*Deliverables: Data delivered to DOE or other external agency (e.g., recurring reporting)



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**Attachment 1 – Contractor Requirements Document (CRD)**

CRD §	Requirements from CRD, Attachment 1	Compliance Status with 420.2.D	Method of Compliance	Deliverables* (managed through SLACTrak)			
				Item	Frequency	Due Date(s)	Recipient (e.g., SSO)
1.	EXEMPTIONS/EQUIVALENCIES. Requests for exemptions and equivalencies not listed below must be processed in accordance with DOE O 251.1, Departmental Directives Program, current version. The contractor must establish a periodic onsite validation process to ensure accelerators and devices granted exemptions or equivalencies provided in section 1 of this CRD continue to be operated under the conditions of the approved exemption or equivalency.	In Compliance	No exemptions or equivalencies are being requested per DOE Order 251.1.  A periodic onsite validation process will be established for accelerators and devices granted exemptions or equivalencies under CRD Section 1. The process will be documented in the Radiation Generating Devices (RGD) Program Manual FO-035 (by July 31, 2023). The RGD program is reviewed as part of the triennial self-assessment of SLAC Radiation Protection Program (RPP).  The majority of the compliance to the Order is found in the following document: <b>Conduct of Accelerator Facility Operations, (CAFO): CACM-2019-059-R002</b> , Effective Date June 15, 2021.	n/a	n/a	n/a	n/a
	Exemption. Devices operated in accordance with 10 Code of Federal Regulations (CFR) Part 34, Licenses for Industrial Radiography and Radiation Safety Requirements for Industrial Radiographic Operations, are exempt from requirements in section 2 of this CRD.	In Compliance	Radiography operations and density gauge operations at SLAC are exempt from requirements in section 2. SLAC reviews the licenses for all radiograph and density gauge operations onsite. Update RGD program manual by 7/31/2023.	n/a	n/a	n/a	n/a
1.b	Exemption. NNSA nuclear weapons designed. Neutron Generators are exempt from requirements in section 2.b of this CRD.	NA	NA: SLAC is an Office of Science laboratory and in as much does not work with NNSA nuclear weapons designed Neutron Generators	n/a	n/a	n/a	n/a
1.c	Equivalency. The following equivalencies are approved for requirements in section 2.a.(1) and 2.a.(2) of this CRD. (1) Devices operated in accordance with American National Standards Institute/Health Physics Society (ANSI/HPS) N43.2-2021, Radiation Safety for X-Ray Diffraction and Fluorescence Analysis Equipment; (2) Devices operated in accordance with ANSI/HPS N43.3-2008, General Radiation	In Compliance	SLAC does not plan to seek equivalencies under this section.  Instead, devices in the 1.c category are managed under the SLAC Radiological Control Manual (RCM) and Radiation Generating Devices (RGD) programs, which comply with 10 CFR Part 835, Occupational Radiation Protection regulation.	n/a	n/a	n/a	n/a

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	<p>Safety Standard for Installations Using Non-Medical X-Ray and Sealed Gamma-Ray Sources, Energies up to 10 MeV;</p> <p>(3) Devices operated in accordance with ANSI/HPS N43.5-2005, Radiological Safety Standard for the Design of Radiographic and Radioscopic NonMedical X-Ray Equipment Below 1 MeV (Reaffirmed 2013);</p> <p>(4) Neutron generators operated below 600 keV in accordance with National Council on Radiation Protection and Measurements (NCRP) Report 72- 1983, Radiation Protection and Measurement of Low-Voltage Neutron Generators; and</p> <p>(5) Devices operated at or below 10 MeV in accordance with NCRP Report 144- 2003, Radiation Protection for Particle Accelerator Facilities, and/or ANSI- HPS N43.1-2011, Radiation Safety for the Design and Operation of Particle Accelerators.</p>						
<b>1.d</b>	Contractors who manage accelerators and their operations with the potential for inadvertent criticality must implement a DOE-approved criticality safety program in accordance with DOE O 420.1, Facility Safety, current version, in addition to the requirements of this CRD. This requirement cannot be exempted under the provisions of section 3.c. of DOE O 420.2D, Safety of Accelerators, or this CRD.	NA	Accelerator operations and current experimental programs at SLAC do not involve, use, or produce a sufficient inventory of fissionable material to create the potential for inadvertent criticality.	n/a	n/a	n/a	n/a
<b>2.</b>	<b>PROGRAM ELEMENTS</b>						
<b>2.a.</b>	<p>a. Contractors that manage accelerators and their operations under this CRD must establish the following program elements prior to commissioning and routine operations:</p> <p>(1) A safety analysis or analysis of postulated worst-case accident for every accelerator</p>	In Compliance by 9/21/23	Per O420.2D section 2.a and DOE O420.2D Implementation Plan, FAQ #8, the approved SLAC Integrated Safety Management Program and SLAC Radiation Protection Program (RPP) are used to satisfy requirements for 2.a.(1) and 2.a.(2) for devices operated at or below 10 MeV.	n/a	n/a	n/a	n/a

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				Item	Frequency	Due Date(s)	Recipient (e.g., SSO)
	<p>managed under this CRD;</p> <p>(2) Clearly defined roles and responsibilities for accelerator activities including those for training and procedures; and</p> <p>(3) A current listing/inventory of accelerators managed under this Order and exemptions or equivalencies to this Order.</p> <p>An approved Integrated Safety Management Program, in accordance with 48 CFR 970.5223-1, Integration of Environment, Safety, and Health into Work Planning and Execution, may be used to satisfy requirements for 2.a.(1) and 2.a.(2) above. Accelerators operated at or below 10 MeV that involve only unmodified commercially available equipment, including electron microscopes and ion implant devices, may use manufacturer documentation appropriately addressing the safety analysis, training, and procedures to satisfy requirements for 2.a.(1) and 2.a.(2), above, if the accelerator is maintained and operated according to the manufacturer recommendations.</p>		<p>SLAC devices operated at or below 10 MeV are classified as RGDs at SLAC, whose safe operations are governed under the SLAC RCM and RGD program manual (FO-035).</p> <p>The requirements 2.a.(1) and 2.a.(2) for RGDs can be satisfied by showing an appropriate crosswalk of the RCM and FO-035 with 10 CFR 835.</p> <p>Actions: 1) Perform cross-walk between RCM and RGD programs with 10 CFR 835 by May 15, 2023. 2) Review/Revise as needed, the FO-035, "Radiation Generating Devices Program Manual." by July 31, 2023, and 3) complete implementation by August 31, 2023.</p> <p>Devices that are not classified as RGDs are classified as accelerators at SLAC, which will be subject to the requirements 2.a.(1), 2.a.(2), 2.a.(3), and 2.b (i.e., SAD, ASE, USI and ARR).</p> <ul style="list-style-type: none"> <li>• 2.a.(1) At SLAC we have 4 ASE's and 6 SADs that address worst case accidents.</li> <li>• 2.a.(2) Between the CAFO and each of the Directorates existing DAFOs, the roles and responsibilities, training, and procedures are delineated and implemented.</li> <li>• 2.a.(3) Inventory of the accelerators is kept current in the CAFO.</li> </ul> <p>Action: The CAFO will be revised to incorporate some of the new requirements that 420.2D spells out, particularly on these program elements. Complete revision by September 21, 2023</p> <p>Both accelerators and RGDs are subject to the requirement 2.a.(3)</p> <p>Action: Inventory list of RGDs and accelerators will be updated as needed. The list of all RGDs is maintained by Radiation Protection Department (RPD) while the list of accelerators is maintained by SLAC.</p>				

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				Item	Frequency	Due Date(s)	Recipient (e.g., SSO)
			<p>Klystrons associated with accelerator operations (e.g., LAF, SPEAR3, ASTA and NLCTA) are not included in the RGD lists (action: update SADs to include Klystrons).</p> <p>Milestones and due dates:                      5/15/2023 - Complete Crosswalk                      7/31/2023 - Revise FO-031                      8/31/2023 - Complete impementation                      Revise CAFO by 9/21/23</p>				
<b>2.b.</b>	<p>Contractors that manage accelerators that operate above 10 MeV must establish the following program elements, in addition to the elements listed in section 2.a.(2) and 2.a.(3) of this CRD, prior to commissioning and routine operations:</p> <p>(1) A Safety Assessment Document (SAD) in lieu of the analysis required in 2.a.(1) above;                      (2) A DOE approved Accelerator Safety Envelope (ASE);                      (3) A DOE approved Unreviewed Safety Issue (USI) Process; and                      (4) An Accelerator Readiness Review (ARR) process.</p>	In Compliance by 9/21/23	<p>The CAFO will be reviewed and revised by 9/21/2023:</p> <ul style="list-style-type: none"> <li>Chapter 4: Hazard Analysis,</li> <li>Chapter 12: Unreviewed Safety Issues</li> </ul> <p>SLAC has established program elements in section 2b that correspond with 2.b.(1), (2), (3), and (4).</p>	n/a	n/a	n/a	n/a
<b>2.c.</b>	<p>Program elements must be periodically (interval not to exceed five years) reviewed and updated, as appropriate. The contractor must ensure the Contractor Assurance System includes processes to review the contractor accelerator safety program elements listed in this CRD.</p>	In Compliance	<p>CAFO, Chapter 13: Institutional Assessment Program as coordinated by Contractor Assurance System (CAS). Specifically: Refer in Integrated Assessment Schedule</p> <p>10 CFR 835 already requires triennial self-assessment of RPP which includes RGD program review. The RPP self-assessment schedule for FY22-FY24 is available in IAS.</p> <p>Accelerator and RGDs schedules of assessments were added to the IAS</p>	n/a	n/a	n/a	n/a
<b>2.d.</b>	<p>Accelerator Safety Envelope (ASE).                      (1) The ASE, and any updates or amendment to</p>	In Compliance	<p>ASEs for operating accelerators are in compliance; ASEs for non-operating accelerators will be reviewed and</p>	n/a	n/a	n/a	n/a

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	the approved ASE, must be submitted to the DOE Field Element Manager for approval. (2) Any activity violating the ASE must be terminated immediately and be put in a safe and stable configuration. Affected operations must be terminated immediately and put in a safe and stable configuration for discovered conditions that create or reveal an ASE violation. The DOE Field Element Manager must approve the restart of any activity or affected operations after a DOE-mandated shutdown because of an ASE violation.		approved by SSO. The DOE-SSO Manager approves the restart of any activity or affected operations after a DOE-mandated shutdown because of an ASE violation.				
2.e.	Safety Assessment Document (SAD). The purpose of the SAD is to provide a description of the facility, an analysis of accelerator specific hazards, and necessary controls to eliminate or mitigate those hazards such that associated risks are clearly understood. All hazards at an accelerator fall within two categories: 1) hazards that are safely managed by other DOE approved applicable safety and health programs and/or processes; or 2) accelerator specific hazards that are analyzed and safely managed by the SAD and provisions of the ASE. The amount of detail provided, and the depth of analysis must be tailored to be commensurate with the magnitude and types of hazards present and the complexity of the facility. The SAD, which represents the technical basis for the bounding conditions and controls in the ASE, must be maintained so it reflects current hazards and controls. The contractor must notify the DOE Field Element Manager, or designee, when the SAD is revised and approved. The SAD must:	In Compliance	SADs for operating accelerators will be reviewed and updated by 9/30 to be in compliance with O 420.2.D SADs for non-operating accelerators will be reviewed and updated for the required ARR	n/a	n/a	n/a	n/a
2.e.(1)	Identify and analyze accelerator specific hazards and identify necessary controls to eliminate or mitigate hazards to workers, the public, and the	In Compliance	See (2) e above.	n/a	n/a	n/a	n/a

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	environment. Identify and analyze non-accelerator specific hazards which could serve as initiators or contributors to other evaluated accelerator accidents. Hazards from radiation and residual radioactivity associated with beam operations must be evaluated for onsite and offsite impacts from routine operations and credible accidents as appropriate. Analysis of radioactive material must consider direct radiation, contamination, and airborne dispersion as appropriate;						
2.e.(2)	Provide a description of uncontrolled risk (i.e., without mitigation) and risk with controls in place associated with accelerators and their operations;	In Compliance	See (2) e above.	n/a	n/a	n/a	n/a
2.e.(3)	Provide detailed descriptions of engineered controls (e.g., interlocks and physical barriers) and administrative measures (e.g., training, procedures) taken to eliminate or mitigate hazards to workers, the public, and the environment from accelerators and their operations; and	In Compliance	See (2) e above.	n/a	n/a	n/a	n/a
2.e.(4)	Include or reference a description of the accelerator and accelerator facility function, location, and management organization in addition to details of major accelerator and accelerator facility components and their operation.	In Compliance	See (2) e above.	n/a	n/a	n/a	n/a
f.	Unreviewed Safety Issue (USI) Process. The contractor must document how the USI Process is implemented and must identify how the requirements listed below are addressed. The site or facility USI Process must be submitted to the DOE Field Element Manager for approval.	In Compliance by 5/31/23	SLAC wil update CAFO Chapter 12: Unreviewed Safety Issues, and submit USI process to SSO for approval by 5/31/2023	n/a	n/a	n/a	n/a
f.(1)	The USI Process must evaluate proposed activities or discovered conditions that introduce new or previously unreviewed accelerator-specific hazards to ensure controls are in place to prevent or mitigate hazards as appropriate. The term “activities” includes modifications, temporary changes, permanent changes, and new activities.	In Compliance by 5/31/23	See f. above	n/a	n/a	n/a	n/a

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f.(2)	The USI Process must evaluate USIs to determine if accelerator specific hazards associated with a proposed activity or discovered condition are adequately addressed by the current SAD and approved ASE. Any activity expected to exceed the bounding conditions of the ASE must be evaluated using the USI process. Once an USI has been appropriately reviewed, the issue becomes a Reviewed Safety Issue and may be considered as an addendum to the SAD.	In Compliance by 5/31/23	See f. above	n/a	n/a	n/a	n/a
f.(3)	DOE approval is required if the USI Process determines that a Reviewed Safety Issue introduces accelerator specific hazards that are not adequately addressed by the current SAD and approved ASE prior to implementation of the proposed activity.	In Compliance by 5/31/23	See f. above	n/a	n/a	n/a	n/a
f.(4)	DOE must be promptly notified upon discovery of conditions with the credible potential to introduce accelerator specific hazards that are not adequately addressed by the current SAD and approved ASE.	In Compliance by 5/31/23	See f. above	n/a	n/a	n/a	n/a
f.(5)	If conditions are discovered that introduce accelerator specific hazards that are not adequately addressed by the current SAD and approved ASE, impacted/affected operations must be suspended immediately and put in a safe and stable configuration. Discovered conditions must be addressed using DOE approved measures, as appropriate. DOE must provide written approval for resumption of impacted/affected operations.	In Compliance by 5/31/23	See f. above	n/a	n/a	n/a	n/a
g.	Accelerator Readiness Reviews (ARRs). ARR must be performed before DOE approval for commissioning and/or routine operation and as directed by the DOE Program Secretarial Officer, NNSA CSO1 for Safety, or a DOE Field Element Manager. A single ARR may be conducted prior to commissioning that addresses both commissioning and routine operations, with	In Compliance	Per CAFO Chapter 14, Accelerator Readiness Reviews (ARR) must be held before requesting DOE approval for initiating beam operations.	n/a	n/a	n/a	n/a

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	<p>agreement of the DOE Field Element Manager. As part of the ARR process, the contractor must demonstrate to the satisfaction of the DOE Field Element Manager that an appropriately comprehensive and independent ARR has been conducted, identified pre-start issues have been resolved, commissioning activities required for safe operations have been completed as appropriate, and the following processes are in place:</p> <p>(1) A Contractor Assurance System that maintains an internal assessment process;</p> <p>(2) A Configuration Management Program that addresses accelerator safety; and</p> <p>(3) Credited controls and appropriate administrative processes related to accelerator safety (e.g., training, procedures, etc.). The contractor must receive DOE Field Element Manager approval for:</p> <p>(4) The start of commissioning activities; and</p> <p>(5) The start of routine operations.</p>						
<b>h.</b>	Decommissioning Activities. Contractors who manage accelerators and their operations under this CRD must receive DOE Field Element Manager approval prior to the start of accelerator decommissioning activities.	In Compliance	Deactivation and Decommissioning per Project Management Program	n/a	n/a	n/a	n/a

(end CRD)

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## Attachment 2 – Definitions

This Attachment provides definitions of terms used in DOE O 420.2D, Safety of Accelerators, as well as information applicable to contracts in which the associated CRD (Attachment 1 to DOE O 420.2D, Safety of Accelerators) is inserted.

1. Accelerator: A device and its components employing electrostatic or electromagnetic fields to impart kinetic energy to molecular, atomic, or sub-atomic particles and capable of creating a radiological area as defined by 10 CFR Part 835, Occupational Radiation Protection. Accelerator components include injectors, targets, beam dumps, detectors, experimental enclosures, accelerator enclosures, experimental areas, and experimental apparatus utilizing the accelerator. The accelerator also includes associated support and test facilities, equipment, systems, and utilities necessary to operate the accelerator or utilize the accelerated beam.
2. Accelerator Facility: The accelerator, plant, buildings, structures, and equipment supporting the accelerator and its operations that are under the direct control of the contractor.
3. Accelerator Operations: Activities within the accelerator facility that, over the lifecycle of the facility, support 1) production or utilization of accelerator beams; 2) research and experimental activities utilizing accelerator beams; 3) handling, storage and analysis of accelerator induced radioactive components and materials within the accelerator facility boundary; 4) receipt, preparation, assembly, inspection, and installation of samples into the accelerator beam; or 5) removal, disassembly, handling, analysis, and storage for radioactive dose minimization to meet the definition of ALARA in 10 CFR Part 835, Occupational Radiation Protection, or transportation requirements, and packaging of samples after use in the accelerator beam. Accelerator Operations excludes radioisotope processing activities that are not required to operate or maintain the accelerator.
4. Accelerator Readiness Review (ARR): A structured method for verifying that hardware, personnel, and procedures associated with commissioning or routine operations are ready to permit the activity to be undertaken safely.
5. Accelerator Safety Envelope (ASE): A documented set of verifiable physical and administrative requirements, bounding conditions, and credited controls that ensure safe operation and address accelerator specific hazards and risks.
6. Commissioning: A phase of an accelerator facility operation that is typically used to conduct initial beam testing and/or verify design specifications. Commissioning periods may be tailored to the needs of each facility and there may be great variations in their duration, breadth, and formality, but in all cases, the activities will be bounded by an ASE and preceded by an ARR and DOE approval.
7. Credited Controls: Controls determined through Safety Analysis to be essential for safe operation directly related to the protection of workers, the public, and the environment.
8. DOE Element: First-tier organizations at DOE/NNSA HQ and in the field as listed in the Correspondence Style Guide, Office of the Executive Secretariat.
9. DOE Field Element Manager: The manager having overall responsibility for a DOE field element including execution of oversight policy implementation. The Field Element Manager directs activities of DOE/NNSA field or site offices and has line accountability for all site program, project execution, and contract management.
10. DOE Program Secretarial Officer (PSO): An Assistant Secretary, Office Director, Head of Program Element, or NNSA Deputy Administrator to whom designated field offices directly report and who has overall landlord responsibilities for the assigned direct reporting elements.
11. Radiation: Ionizing radiation, including the accelerated particle beam and the radiation produced when the beam interacts with matter or changes direction. Radiation includes alpha particles, beta particles, gamma rays, X-rays, neutrons, high-speed electrons, highspeed protons, and other particles capable of producing ions.
12. Radioisotope Processing: Chemical, thermal, or physical actions taken to separate, isolate, refine, or enrich specific isotopes of a chemical element.
13. Residual Radioactivity: Radioactivity in structures, materials, soils, groundwater, and other media at a site resulting from the accelerator or accelerator



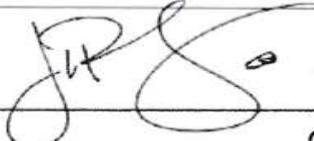

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- operations.
14. Reviewed Safety Issue: The outcome of the evaluation and determination phase of the USI Process.
  15. Risk: A quantitative or qualitative expression of possible harm, which considers both the probability that a hazard will cause harm and the amount of harm; or, alternatively, an estimate of the probability of occurrence of a hazard-related incident and the severity of the consequence associated with the incident.
  16. Safety Analysis: A documented process to systematically identify the hazards of a given operation; including a description and analyses of the adequacy of measures taken to eliminate, control, or mitigate the hazards and risks of normal operation; and identification and analyses of potential accidents and their associated risks.
  17. Safety Assessment Document (SAD): A document containing the results of a Safety Analysis for an accelerator or accelerator facility pertinent to understanding the risks to workers, the public, and the environment of operating the accelerator.
  18. Unreviewed Safety Issue (USI): An activity or discovered condition with accelerator specific hazards that have yet to be evaluated to determine if the activity or discovered condition introduces accelerator specific hazards that are not adequately addressed by the current SAD and approved ASE.
  19. USI Process: The process or methodology used to evaluate/review USIs to determine if the activity or discovered condition is adequately addressed by the current SAD and approved ASE.

**Approvals (Electronically sign and date)**

John Connolly	Deputy Director, Operations, SLAC	 5/1/2023	
Charina Rockwell	Director of Operations and Projects, SSO		CHARINA ROCKWELL Digitally signed by CHARINA ROCKWELL Date: 2023.05.05 07:22:00 -07'00'
Ernest Maune	Team Lead, Business System, SSO	<b>Ernest J. Maune</b>	Digitally signed by Ernest J. Maune Date: 2023.05.09 12:05:11 -07'00'
Hanley Lee	Head of Field Element, Manager, SSO	<b>Hanley Lee</b>	Digitally signed by Hanley Lee Date: 2023.05.09 14:24:55 -07'00'

Please return signed document to [Burtnett@SLAC.Stanford.edu](mailto:Burtnett@SLAC.Stanford.edu)



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**SLAC National Accelerator Laboratory**

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**DOE Order 420.2D, Safety of Accelerator Facilities (9/09/2022)**

**Site Compliance Plan (Rev. 0, 5/01/2023)**

**Revision History**

<b>Revision</b>	<b>Revision Date</b>	<b>Summary of Change(s)</b>
R0	5/01/2023	Original Release.