Chapter 1: General Policy and Responsibilities

ESH: Threshold Review Form

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Use this form in conjunction with the ESH: Project Review Procedure (SLAC-I-720-0A24C-001) for project / process applicability determination and threshold review.

Review the scope of work in the context of the lower limit thresholds below. Complete this form **only** if the work exceeds these thresholds.

Lower Limit Thresholds

1. Researcher/ requester has experience with the activity and is comfortable with the perceived risk
    1. Recognized hazard(s) and existing mitigations
    2. Limited scope
    3. Applicable standard operating procedures (SOPs) – activity within the scope of existing SOPs
    4. No “deviation from the standard model”
2. Not facility related – not attached to the building, et cetera
3. No new and/or “unusual” equipment involved
4. Does not involve change/modification of or impact to a shared utility or shared area
5. Supervisor concurs that the proposed activity is within the “standard model” for the individual

Project Information

Project/Experiment Name	FACET Experimental Program	**Location/ Bldg**	001 FACET area of Sector 19/20
Requester	Keith Jobe	**Phone #**	2084
Responsible Person	Christine Clarke	**Phone #**	5746
Requester's Department Head	Carsten Hast	**Phone #**	8556
ES&H Coordinator	Joe Kenny	**Phone #**	2201

Statement of Work

This hazard analysis and threshold review has been developed to address the hazards associated with a "generic beamline experiment" conducted at FACET. Most of the experimental programs anticipated to operate at FACET are completely addressed by this analysis.

The experiments which are addressed by this analysis meet all of the following criteria:

- The experimental apparatus is a) positioned outside the beam path or b) consists of a target material less than 2% of a radiation length[1].
- No gas, chemicals or hazardous materials are used in the experiment except for nitrogen in venting and purging. Incidental quantities of ethyl or propyl alcohols are permitted in the accelerator enclosure for cleaning of vacuum components.
- Remotely operated motion control systems operate slowly or include guards protecting personnel from pinch hazards.
- Maintenance and adjustments of the experiment (including target changes) is accomplished without the use of cranes or the lifting of heavy components.
- Class IV lasers are not used.

Experiments which fail to meet all of the above criteria (e.g.: the Plasma Wakefield Experiment) will undergo additional hazard analysis and review.

Any change in an experiment prompts a new hazard analysis and review. This includes new samples, new equipment or new procedures.

Currently approved experiments are listed below. These are provided as examples of "generic experiments".

[1] 2% radiation length for Silicon is approximately 2 mm, for YAG is approximately 0.7 mm.

E-201 Dielectric Wakefield Studies at FACET

A continuation and extension of an FFTB experimental program. The experimental program consists of passing the beam near a dielectric material and parameterizing the breakdown threshold with the next phase being measuring the energy gain or loss of the beam.

A holder with samples of dielectric tubes in various geometries (cylindrical, planar) is inserted in the vacuum chamber on vacuum compatible motorized stages provided by ARD Test Facilities. The beam is passed through the sample and the bunch compression (peak current) is increased until breakdown in the sample is observed by visible flashes in the structures (as viewed by a SLAC provided camera, CCD or sCMOS). The beam wakefield makes Cerenkov radiation in the dielectric samples which will be coupled out of the vacuum chamber to THz detectors brought by the experiments (pyroelectric, Golay cell).

Within the vacuum chamber, there are Newport vacuum compatible stages- 1 long linear stage for 50mm movement and 1 5 axis stage. These are remotely controlled via an XPS controller in the Klystron Gallery. These stages and actuators are rated at 10^{-6} Torr. All stages and motion controls are provided by SLAC ARD Test Facilities.

E-202 Ultrafast Magnetic Switching at FACET

A continuation and extension of a FFTB experimental program. The experiment consists of passing a beam through a thin sample/target. The sample is studied offline to understand how magnetization changes in a magnetic sample on ultrafast time scales with little or no energy deposition in the material.

The vacuum chamber will be inserted in the beam line on the experimental table and a manipulator loaded with samples will be installed on top of it. The motorized manipulator will bring the samples in the path of the electron beam for exposure to single or multiple electron bunches. After the exposure of all samples, the manipulator will be removed and new samples will be loaded for another round of exposures.

The samples are moved in and out of the beam using a motion controller directed by commands given from outside the tunnel via an Ethernet cable. A camera will be used to provide visual feedback. Sample motion will be synchronized with the electron beam trigger.

E-203 Smith Purcell Radiation Studies at FACET.

The purpose of the experiment is to determine the time profile of electron bunches which are a few fs long. This is achieved by measuring the spectral distribution of the radiation emitted when the bunch passes close to the surface of a metallic grating. The radiation is, typically, in the mid to far infrared part of the spectrum and is measured by an array of detectors that are at ambient temperature and pressure.

This experiment is a continuation and extension of an End Station A experimental program.

There are three different gratings with periods of 0.05, 0.25 and 0.5mm, respectively, and a ‘blank’ (flat piece of metal with no periodic structure) will be inserted sequentially near the beam path. The typical separation between grating surface and beam will be 2mm. The output from about 100 bunches will be counted for each grating/blank combination. A set of optical filters whose transmission characteristics match the range of wavelengths produced by each grating, will be inserted in front of the detectors every time there is a grating change.

The grating and filter changing mechanisms will be under remote control by the experimenters. All motors are low voltage (24V DC), which will be provided by our own UL-listed power supply. This is the same arrangement as used previously at ESA.

Threshold Review

Broad Thresholds	**Determination (Yes or No)**	**Comments/Clarification/Qualifiers**
a. Some or all of the activity's characteristics having possible safety consequences are new to the responsible organization.	**no**	
b. The proposed activity represents a significant change of scope of the existing operation.	Yes	This is a new program at SLAC. All experiments are either a continuation of a prior experiment or have similar experimental protocols. However, conducting the experiments in this facility is new to SLAC.
c. The proposed activity introduces hazards not previously analyzed and for which there are no institutional protocols and procedures to mitigate them (e.g. hazards not addressed in the SLAC ESH Manual).	**No**	
d. The proposed activity represents a significant change in the hazard of operation.	**Yes**	**The introduction of materials into the beam will be evaluated by RP.**
e. The proposed activity is sufficiently complex that a review would be prudent.	**No**	
f. The proposed activity triggers Building. Inspection Office (BIO) requirements* or is required by DOE Order (e.g. DOE 423) or Stanford Institutional Review Boards. *BIO Review triggers are listed at the end of this	**No**	

form.		

Note: *if, based on review, the determination is "yes" on one or more of the broad thresholds then the experiment/project must be referred to one or both of the external review processes.*

Hazard Characterization and Mitigation Approach

Item #	Aspect of Experiment/Project	Hazard(s) Description	Mitigation Approach
Class II or IIIa Lasers	HeNe class IIIa lasers are commonly used for alignement.		The use of the laser will be minimized to reduce potential exposure. Eye and skin exposure and direct viewing of the laser beam will be avoided.
Class IIIb and Class IV Lasers	No high-power lasers are involved in this phase of the experimental program.		None required. Use of Class IV Lasers is not addressed in this analysis. Experiments requiring the use of a Class IV laser must have this hazard separately analyzed. Written approval from the SLAC laser safety officer (LSO) will be given prior to the operation of a Class 3b or Class 4 laser.
Work in Radiological Environments	All	All experimental programs are conducted in the accelerator enclosure. The potential for radiological activation exists. Experimenters are required to be SLAC-qualified radiation workers and follow SLAC protocols.	Local management and oversight of experimental programs by Test Facilities group. All workers must be SLAC Radiation Workers (RWT-I). Experiments will be supported by SLAC RPFO. Removal of equipment will follow standard RPFO procedures

Generation of prompt radiation through the introduction of experimental devices	Beam targets and apparatus can be positioned into the beam.	Increase of radiation levels in Klystron Gallery	Experiments will be reviewed by Radiation Physics and controlled in the BAS. Key systems are interlocked to SLAC MPS system to avoid beam interception while beamline is not clear. There will be procedures in place to avoid undesired beam interception. Radiation detectors along Sector 20 beamline (two pairs of LIONs) will trip off beam through Beam Containment System. Additional radiation detectors will be placed in the area and will trip off the beam through Beam Containment System if this is an outcome of the Radiation Physics review.
Vacuum chamber Pressure System	Pressure/vacuum chamber.		Vacuum Chambers will be inspected by a member of the PSWG post-installation. Vacuum Chambers will be included in pressure system database if deemed applicable on inspection.
Nitrogen gas - ODH	Used as a purge gas for venting beamline systems	Potential exists to turn accelerator enclosure into a ODH environment	The volume of nitrogen required to turn area into an ODH environment is greater than that contained in a six-pack of gas bottles or a single Dewar of liquid nitrogen. The air flow required to bring air to a safe equilibrium is very low. The air flow at FACET is high when the hatches are raised. Occupancy of the linac housing is not possible without raising the hatches as Linac housing lighting cannot be turned on until the hatches are raised.

Nitrogen Gas	Used for purging of vacuum chambers	Classical hazards. A source of nitrogen needs to be identified.	A procedure has been developed and will be followed for nitrogen use in FACET housing. Handling of high-pressure bottles or 6-packs must be done by qualified personnel (Course #170).
Helium Gas	Used for leak detection in accelerator enclosure	Material handling: carrying bottle into enclosure. Classical gas hazards.	Small aluminum gas bottles (approximate weight: 30 lbs) will be used. Handling of high-pressure bottles or 6-packs must be done by qualified personnel (Course #170)
Occupational injury	Accelerator enclosure is approximately 40 feet below grade level	Stairs and physical injury	Recognize hazard.
Medical emergency	Accelerator enclosure is approximately 40 feet below grade level	Normal medical or occupational emergency	Phones in tunnel will have distinct numbers so security and EMS can respond appropriately knowing that it is a subterranean call. A plan will be developed with the SLAC Emergency Management Coordinator to address emergency response issues in the FACET area of the accelerator enclosure. Identified measures will be implemented.
Pressure Safety	Pressurization of a vacuum chamber	Significant overpressure may result in hardware failure / injury	Vacuum protocols, including use of pressure relief valves when backfilling with N2, will be followed.
Conventional	Experiments will overload support tables	Hardware failure / injury	None required. Tables are built and anchored for a load of 7244 lbs. All installations are reviewed by ESH Coordinator.
Work in Hot Environments		Ambient temperatures in the Linac housing can exceed 90° F (32° C).	Work/rest and hydration regimens will be determined before each shift and enforced continuously to assure compliance with the American Conference of Governmental Industrial Hygienists threshold limit value. Water will be available in the FACET User Trailer (B244).
Experimental instrumentation	Electrical Safety of Experimental Equipment	Electrical Safety	All equipment will be NRTL approved or pass SLAC EEIP inspection before first usage

Pinch Hazard	Locally or remotely controlled moving parts	Parts could move without warning when experimenters are by the equipment potentially causing injury	All movement will be sufficiently slow that the experimenters can move away safely or the pinch hazard will be guarded. Notices warning of the possibility of remotely moving parts are posted where applicable.
Reaching experiments on the tables	Experimental tables are over 4' from the floor. They are 4' wide. Reaching the equipment on the table will be difficult for many Users.	Users will need to stand on something in order to extend their reach across the table. Floor space on the north side of the beamline is taken up by the cover to a waveguide.	16" tall platforms will be used to access the tables from the aisle (south) side. This extends the reach of the Users across the table. The platforms will be placed against the tunnel wall so there is no gap to trap a foot. The waveguide cover on the north side will be converted to a raised walking surface.
Standing on tables	Experimental tables may be classified as an Elevated Work Surface if the drop to the floor is greater than 4 feet.	Users may need to stand on the tables which is over 4 feet from the floor of the linac tunnel.	When a User needs to climb onto the table, they must have the 16" platform in the immediate area. This reduces the potential to fall to below 4 feet.
Overhead hazards	Features on the tunnel ceiling pose bump hazards		Where ever possible, such features will be removed. If removal is not possible, feature will be wrapped in foam. Bump caps and hard hats are available for use.
Cranes	No cranes are involved in this phase of the experimental program.		None required. Experiments requiring the use of a crane must have this hazard separately analyzed.
Radio frequency (RF) non-ionizing electromagnetic radiation (NIR).	No sources of NIR are involved in this phase of the experimental program.		None required. Experiments involving NIR must have this hazard separately analyzed.

Applicability Determination Based on Review	Yes	No
Experiment/project can be designated a *work* activity? *(Note: if no then please indicate below which (or both) review process applies)*		XX
Conventional Construction Project Review Process applicable?		XX
Experimental Review Process applicable?	XX	

Responsible Person			
	Print Name	Signature	Date
ESH Coordinator			
	Print Name	Signature	Date

Building or Area Manager			
	Print Name	Signature	Date
Requester's Department Head			
	Print Name	Signature	Date