8 Operational Safety Requirements

8.0 Operational Safety

Upon completion of the SPEAR3 upgrade, the accelerator will become operational and enter a period of commissioning before routine operations commence. At SLAC before any accelerator facility can operate, a Beam Authorization Sheet (BAS) is required to be in place. The BAS establishes the pre-running and running conditions that need to be met before beam can be put into the machine. This would include: checking the physical integrity of shielding, testing of Beam Containment Devices, testing and certifying the PPS system, identification of BCS settings, defining/limiting the maximum beam current and energy, and specifying any other operating conditions that may affect the safe operation of the accelerator. The BAS is issued and approved jointly by the cognizant Radiation Physicist for the facility and the SSRL Safety Office and concurred by the Accelerator Operations Manager. At every shift change, the Accelerator Operator on duty signs the BAS, thus noting and acknowledging any changes to the BAS.

The operation of SPEAR3 from a safety standpoint will not differ from SPEAR2. The BAS will be updated to reflect the change in shielding configurations, the addition of active beam containment devices, and other modifications as necessary.

During "run" cycles, maintenance of the beam falls under the responsibility of the Accelerator Operations Manager, whose task is to assure that the facility operates within specified parameters, that accelerator components remain functional, and that the facilities and infrastructure of the area are in good repair. During maintenance and shutdown periods, the Accelerator Engineering and Technical Services Manager is responsible for the accelerator and its components and infrastructure, and assures that work is performed in accordance with SLAC's ES&H regulations.

8.1 Accelerator Safety Envelope

The DOE Accelerator Safety Order (DOE O 420.2B, "Safety of Accelerator Facilities") allows for the safety envelope to be based on specific radiation levels or potential maximum exposures derived from extrapolation of empirical data and operational experience.[i] Correspondingly, shielding design and installation will limit integrated radiation dose under normal operating conditions, mis-steering conditions and accident conditions to those limits specified by SLAC in the *Radiation Safety Systems, Technical Basis Document.* This then constitutes the physical limits of the Accelerator Safety Envelope for prompt ionizing radiation at the SPEAR3 facility. Various administrative and engineered systems provide assurance that the safety envelope will not be exceeded. Refer to Table 8-1.

Table 8-1. Accelerator Safety Envelope - Limits for Shielding Design

Condition	Scenario	Limit	Beam Loss
Normal Operation	Injection	1 rem/y	Local + Distributed
Accident	Injection	25 rem/h; 3 rem/event	Maximum Credible Beam

To satisfy the physical limits defined in Table 1, SSRL has chosen the maximum power capability of the accelerator as the Safety Envelop boundary for all applications. In as much, no operator action can cause SPEAR3 to exceed the beam power limits of the Safety Envelope.

The nominal maximum operating conditions are:

- Injected Beam Power – 5 Watts
- Energy 3 GeV
- Maximum current 525 mA.

8.2 Accelerator Operations Envelope

Assurance of the safe conduct of operations within the boundaries of the safety envelope relies on both engineered safety systems and operational procedures to prevent or mitigate unwarranted conditions.

- Procedures are written to provide specific direction for operating systems and equipment during normal, abnormal and emergency conditions.
- Engineered safety systems are employed to assure systems operate within their pre-determined parameters or operating ranges.
- Commissioning time is given to validate local shielding at higher currents and energies as well as to assure proper calibration of engineering controls.
- Recognized hazards are mitigated through engineered and administrative controls at all times.

The nominal operating parameters for SPEAR3 are 3 GeV beam energy and 500 mA circulating current. Septum magnet aside, the upper limit on electron beam energy is 3.3 GeV. At this energy, the maximum circulating current is limited to 340 mA in order to maintain constant total power load on the vacuum chamber. Small energy and current variations (on the order of 1%) are possible at any operating point. For symmetry reasons, we assume SPEAR3 could be operated down to 2.7 GeV with up to 750 mA circulating current. Operation much further outside the ±10% energy range is technically complicated due to magnet field quality in the dipole magnets and RF limitations (at high energy). Scientifically, changes in the photon-beam energy spectrum and photon-beam fan-width render electron beam energies undesirable outside the ±10% energy range in the foreseeable future. Estimated annual beam loss is about 3.5×10^{15} electrons/year.

[i] Electron Beam Loss Estimates for SPEAR3 SSRL-ENG-NOTE-371– Corbett J., et al.