JLAB Shielding Policy for Ionizing Radiation

General Requirements

Shielding design shall limit exposure to ionizing radiation to values consistent with Jefferson's Lab's low hazard, non-nuclear facility designation. Shielding must follow JLab Shielding Design Criteria listed below and implement the ALARA principle to minimize worker and public exposure to ionizing radiation. Permanent or temporary shielding shall be implemented as necessary to mitigate radiation exposure from

- sources of prompt radiation generated by accelerator operation, around accelerator component test stands and any other Radiation Generating Devices at JLab,
- activated accelerator components, activated utilities such as air or cooling water
- radiation sources and any other radioactive material on site.

Ionizing radiation shielding design shall:

- Incorporate permanent shielding to the maximum extent practicable.
- Comply with requirements in JLab Shielding Design Criteria for normal operation and credible accident scenarios
- Specify required amounts and configuration of shielding materials such as earth, concrete or steel, alone or in combination. When required, labyrinths, mazes and penetrations through the shielding shall be designed to provide equivalent level of radiation protection.
- Be validated by initial radiation surveys and subsequently checked for proper configuration at regular intervals.
- Be documented in as-built drawings.
- Be improved, or the operating power shall be reduced, whenever Radiation Control Department (RCD) determines that the shielding configuration does not provide the required attenuation value.
- Be reviewed for the specific planned activity and approved by RCD before the radiation source is present in the area being shielded.

Configuration Management

All shielding affecting personnel radiation safety shall be subject to configuration controls. All shielding identified in the Accelerator Safety Envelope shall meet configuration management requirements specified for a Level 1 CM system in the Conduct of Engineering Manual. The Accelerator Safety Envelope has specific requirements regarding periodic evaluation of shielding integrity.

Earth shielding shall be periodically evaluated to ensure integrity. Excavation around accelerator areas incorporating earth shielding shall be controlled through written authorizations (i.e. Dig Permit). Shielding that can be altered by non-destructive means ("moveable shielding") shall be appropriately identified by labeling/signs, and be periodically inspected. The design and installation of moveable shielding shall be approved by RCD. For moveable shielding, preparation of the design package, configuration control and periodic inspections shall be described in a specific RCD procedure.

Temporary Shielding

The use of temporary shielding should be limited to situations in which the radiation source is of a temporary nature or where the use of permanent shielding is infeasible. Configuration management for temporary shielding shall be conducted using the same procedures that apply to other moveable shielding. Temporary shielding shall meet the design criteria specified in this document.

Appropriate administrative configuration controls defined in the procedure should be used to ensure that the temporary shielding is adequate and remains in place as long as needed. This may include the use of physical barriers and administrative lockout devices.

Shielding Design Criteria

Shielding against ionizing radiation must be designed to specifications that will ensure compliance with radiation exposure limits listed in the JLab ES&H Manual, RadCon (Radiation Control) Supplement. Accelerator shielding design considerations must include both normal accelerator operation and accident conditions. Radiation shielding shall be designed to satisfy all the conditions listed below.

1. Normal operation with continuous beam within the allowed beam power limits in specific areas :

    a) Integrated equivalent dose in occupied Radiological Controlled Areas (RCA) will not exceed 2.5 mSv (250 mrem) per year.
    b) Integrated equivalent dose in occupied areas other than RCAs will not exceed 1.0 mSv (100 mrem) per year.
    c) Integrated equivalent dose at JLab site boundary will not exceed 0.1 mSv (10 mrem) per year.
    d) Levels of radionuclides in the groundwater will not exceed the limits in the current VPDES permit.

Note 1: Use of appropriate occupancy factors is applicable in a), b) and c) above.

Note 2: Shielding calculations for normal operation are based on beam losses that are expected and predictable. The variable magnitude and duration of beam loss in different experiments are regulated by limits imposed on the “radiation budget”. These limits are specified by RCD in the Radiation Safety Analysis Document (RSAD) for each experiment.

2. Maximum credible accident scenario

This scenario is defined as mis-steering or loss of control of the electron beam under conditions corresponding to the upper limit of the beam power possible in a specific area. Under such conditions the integrated equivalent dose per occurrence will not exceed 150 mSv (15 rem).