Similar to the Linac Draft SAD, the *blue italicized* text provides description of the content for that section. The green text is proposed wording. Of course, a title page with approvals and a revision control page is needed.

**Section 1. Introduction** *[These words are directly from the BNL Tandem ASE and can used verbatim.]*

This Accelerator Safety Envelope (ASE) defines the Credited Controls that are established for the Linac accelerator facility to ensure safe operations and to minimize potential accelerator-related risks to the public, workers, and environment.

Any condition that results in loss of Credited Control safety function or beam operation outside of operating limits and requirements, defined in sections 2, 3, and 4 of this ASE, must be managed as an ASE Violation.

Upon discovery of an ASE violation event, facility management will stop any activities impacted by the affected system, place the system in a safe and stable condition, and implement occurrence reporting requirements.

Any proposed modification to the facility or discovered condition that impacts the Credited Controls defined here must undergo an Unreviewed Safety Issue (USI) evaluation.

The USI process provides the framework for evaluation of issues and events that may impact the ASE and/or SAD (Safety Assessment Document) and to determine if Credited Control integrity is maintained.

**Section 2. Credited Controls**

**Passive Credited Controls**

Shielding

*Requirement:* *[The text here should come directly from the text in the SAD.]*

**During [state the condition under which the shielding must be installed, e.g., beam operations or beam operations is possible], shielding must be installed in its proper configuration. Shielding consists of steel, concrete walls, concrete plug doors, concrete blocks, and berm per [state what describes the shielding requirements so it is ambiguous whether a current condition meets the shielding requirements or not.]**

*Basis/Context:* *[The text here should come directly from the text in the SAD.]*

This control protects personnel from radiation resulting from beam operation and fault conditions. Elevated radiation may occur when [describe accident conditions]. Beam containment elements include [describe elements of the shielding package, e.g., beam shielding, adjacent shielding, berms]. Shielding elements at the facility are managed under Fermilab’s Configuration Management Program to ensure that shielding elements are properly placed and that changes to the configuration of these elements must undergo USI evaluation, review, and approval by the Radiation Safety Committee [or appropriate organization at Fermilab] before they can be implemented. The configuration of shielding elements is documented with pictures or drawings and the appropriate inspection procedure to validate the configuration of each element.

Fencing

*Requirement:* *[The text here should come directly from the text in the SAD.]*

**During [state the condition under which the fencing must be intact, e.g., beam operations or beam operations is possible] fencing must be installed in its proper configuration. Fencing consists of [describe the fencing requirements [state what describes the fencing requirements so it is ambiguous whether a current condition meets the fencing requirements or not].**

*Basis/Context: [The text here should come directly from the text in the SAD.]*

This control protects personnel from radiation resulting from beam operation and fault conditions. Elevated radiation may occur when [describe accident conditions]. The fencing prevents personnel from accessing areas that may have elevated radiation levels. Fencing at the facility is managed under Fermilab’s Configuration Management Program to ensure that fencing is placed and that changes to the fencing must undergo USI evaluation, review, and approval by the Radiation Safety Committee [or appropriate organization at Fermilab] before they can be implemented. The configuration of fencing is documented with pictures or drawings and the appropriate inspection procedure to validate the configuration of the fencing.

**Active Engineered Credited Controls**

RSIS and Associated Detectors

*Requirement****:*** *[The text here should come directly from the text in the SAD.]*

**During [state the condition under which the RSIS must be functioning e.g., beam operations or beam operations is possible], the RSIS must prevent entry to the [describe the areas isolated by the RSIS]. [If there are different areas that must be isolated under different operating conditions, give each one a separate paragraph. For example, first paragraph, During X, the RSIS must prevent entry to Y; second paragraph, During Z, the RSIS must prevent entry to W; third paragraph, During V, the RSIS must prevent entry to U.]**

**During [state the condition under which the associated detectors must be functioning e.g., beam operations or beam operations is possible], radiation detectors as specified in [state the document that lists the detectors that must be operating, or list the detectors here. The objective is that it is unambiguous what the detector status has to be (which have to be operable and what their setpoints are) to be in compliance with the ASE.]**

*Basis/Context: [The text here should come directly from the text in the SAD.]*

The safety analysis identifies the use of radiation monitors to provide indication that radiation levels are higher than expected. The settings of these detectors have been established based on analysis to alarm if abnormal conditions occur.

Fluorinert Filter:

*Requirement:**[The text here should come directly from the text in the SAD.]*

**Whenever Fluorinert that has been exposed to radiation is in the system and the Fluorinert is being circulated, the vendor provided filter for collection of Fluorinert decomposition products shall be in the system and shall not be expended as indicated by the filter life indicator. [These are possible words. Fermilab should confirm this is the appropriate requirement for this filter.]**

*Basis/Context: [The text here should come directly from the text in the SAD.]*

When Flourinert is exposed to radiation, decomposition can produce small amounts of [enter gas 1] and [enter gas 2]. These gases have a regulatory breathing air concentration limit of [X] and [Y] respectively. A proprietary filter provided by the Flourinert vendor is installed in the system to capture these hazardous gases. This filter must be functioning any time Fluorinert that has been exposed to radiation is in the system and being circulated.

**Administrative Credited Controls**

Authorization Operating Document:

*Requirement: [The text here should come directly from the text in the SAD.]*

**During beam operations [can this be made more definitive? When something is energized, when some measurement reads X or higher? When beam operations are not inhibited by any controls?] of the Linac segment of the Fermilab Main Accelerator, an approved Linac Beam Permit & Running Condition shall have been issued prior to Linac beam operations. The Beam Permit & Running Condition document shall be approved by [list the positions required to approve this document.]**

*Basis/Context[The text here should come directly from the text in the SAD.]:*

To summarize the bounding conditions for safe operation of the Linac, and to provide explicit approval for operations of the Linac. The limitations specified in this authorizing document ensure that assumptions used in the analysis to ensure safe operations are valid.

Staffing:

*Requirement: [The text here should come directly from the text in the SAD.]*

**During beam operations [same comment as above] to the Linac segment of the Fermilab Main Accelerator, the following staffing shall be in place during applicable beam operation:**

* **At least one member of the AD Operations Department who has achieved the rank of Operator II or higher shall be on shift.**
* **At least one member of the AD Operations Department shall be present in the Main Control Room (MCR).**

*Basis/Context: [The text here should come directly from the text in the SAD.]:*

To ensure operations within bounding conditions specified in Operation Authorization Document, and to disable beam operation to the Linac and initiate an immediate response in the event of a determined ASE violation.

Bounding Parameters:

*Requirement: [The text here should come directly from the text in the SAD.]*

**During beam operations [same comment as above] to the Linac segment of the Fermilab Main Accelerator, The Linac segment will be operated within the following parameters:**

| Mode | Intensity | Energy |
| --- | --- | --- |
| Full Operation | **1.77e19 protons/hr** | **400 MeV** |

**These parameters are further specified in the Operation Authorization Document.**

**Linac intensity is monitored via: L:RF3INT**

*Basis/Context: [The text here should come directly from the text in the SAD.]:*

Linac lower level penetrations up to NTF are interlocked to 50 mrem outside the beamline enclosure with Chipmunks by the transmission lines for tanks 1-5. Using scaling criteria 1, the Chipmunk trip point scaled to a 500 mrem accident condition results in a factor of 10. The current operating limit is 6.7 x 1017 protons/hour. Scaling up by 10 sets the Linac ASE to 6.7 x 1018 protons/hour up to NTF.

Linac upper level downstream waveguide penetration limit is 10 mrem/hour for 3.54 x 1017 protons/hour. The Chipmunks at the lower level penetrations for the transmission lines for tanks 6-9 were adjusted down to trip at 10 mrem. The calculated dose at the upper level penetrations is similar to the dose at the lower level penetrations allowing the lower level penetration Chipmunks to also protect the upper level waveguide penetrations. Using scaling criteria 1, the Chipmunk trip point scaled to a 500 mrem accident condition results in a factor of 50. The current operating limit is 3.54 x 1017 protons/hour. Scaling up by 50 sets the Linac ASE to 1.77 x 1019 protons/hour after NTF.

**Section 3. Configuration Management for Credited Controls** *[The text here should come directly from the text in the SAD. As noted by strikethrough text, some modification to what is in the draft SAD will be needed. Whatever ends up in the SAD, should end up here.]*

To ensure the integrity of the Credited Controls during accelerator operation, several methods of Configuration Management are in place.

* Excavation within the “Excavation Waiver Prohibited Zone” around the accelerator are required to go through the JULIE process. Part of the JULIE process includes ES&H Division Radiation Safety personnel review to determine if required shielding may be impacted.
* Required movable and penetration shielding is posted and/or locked and/or bolted in place where applicable.
* Components that are part of the Radiation Safety Interlock System (RSIS) are labeled.
* Surveillance is performed, as specified in Section 8.

~~If shielding or fencing is planned to be removed, the assigned Radiation Safety Officer (RSO) is responsible for ensuring the affected segment of the Fermilab Main Accelerator is locked off in a safe state, using RSO Configuration Control locks.~~ [This probably should be deleted. Any deviation from the ASE requirements should be approved via the USI process.]

~~If any Credited Control is not in place, either planned or discovered, the assigned RSO is responsible for ensuring the affected segment of the Fermilab Main Accelerator is locked off in a safe state, using RSO Configuration Control locks.~~ [This probably should be deleted. Any deviation from the ASE requirements should be approved via the USI process.]

Removal of Credited Controls (i.e., rescinding Operation Authorization Documents, removing shielding or fencing, etc.) during maintenance periods is common, and the assigned RSO is responsible for ensuring the affected segment of the Fermilab Main Accelerator is locked off in a safe state, using RSO Configuration Control locks.

The ES&H Division Radiation Physics Operations and Accelerator Safety Departments utilize a Configuration Control Log to track instances of placing affected segment of the Fermilab Main Accelerator in a Configuration Controlled off state. This Log keeps track of reasons why the affected segment of the Fermilab Main Accelerator was locked off, what must be done prior to resuming operations, and confirmation that conditions are back in place and confirmed before operations are permitted to resume.

**Section 4. Required Calibration, Testing, Maintenance, and Inspection Schedules for Engineered Credited Controls** *[The text here should come directly from the text in the SAD. The introductory paragraph shown here is from the BNL Tandem SAD/ASE. This paragraph was not included in the Linac draft SAD, but perhaps should have been, or at least something similar. Fermilab should determine if such an introductory paragraph is appropriate, and if so, include an accurate one identically in both the SAD and this ASE. Also, note that maintenance requirements for ODH components was inadvertently included in the Linac draft SAD. ODH does not apply to Linac and that maintenance requirement was removed here and should be removed from the SAD.]*

The schedules below are defined to meet radiological control manual requirements. Listed are the maximum certification intervals allowed, including the extension allowed to accommodate the facility operating schedule. Systems are certified when the functionality is confirmed in accordance with the testing procedures. This includes the ACS and ODH systems.

* **Operation of all RSIS components shall be tested at an interval annually not to exceed 12 months.**
* **Area radiation monitors must be functionally tested and calibrated as an interval, not to exceed 12 months.**
* **All shielding shall be inspected at an interval not to exceed 12 months.**
* **All Fluorinert Filters shall be inspected at an interval not to exceed XX months.**
* **All fencing shall be inspected at an interval not to exceed 12 months.**