Unreviewed Safety Issue Determination (USID)

Title of USID:

USID for DTL4-6/CCL1-3 Commissioning

Description of USID (use attachments if necessary):
Low power commissioning of LINAC through CCL-3

Title and Date of Relevant SAD: ***SNS FSAD for FELK* (August 2002)**

USID Criteria:

1. Could the change increase the probability of occurrence of an accident previously evaluated in the authorization basis? Yes _____ No ✓
   Justification: _____ **See Attachment.**_____
   _____
   _____
   _____
2. Could the change increase the consequences of an accident previously evaluated in the authorization basis? Yes _____ No ✓
   Justification: _____ **See Attachment**._____
   _____
   _____
   _____
3. Could the change increase the probability of occurrence of a malfunction of equipment important to safety previously evaluated in the authorization basis? Yes _____ No ✓
   Justification: _____ **See Attachment**._____
   _____
   _____
   _____
4. Could the change increase the consequences of a malfunction of malfunction of equipment important to safety previously evaluated in the authorization basis? Yes _____ No ✓
   Justification: _____ **See Attachment**._____
   _____
   _____
   _____
5. Could the change create the possibility of a different type of accident than any previously evaluated in the authorization basis? Yes _____ No ✓
   Justification: _____ **See Attachment.**_____
   _____
   _____
   _____
6. Could the change increase the possibility of a different type of malfunction on equipment important to safety than any previously evaluated in the authorization basis? Yes ____ No ✓
   Justification: _____ **See Attachment**._____
   _____

7. Could the change reduce the margin of safety as defined in the Accelerator Safety Envelope?
   Yes _____ No ✓
   Justification: _____ **See Attachment.**

SNS Division Director or ES&H Division Coordinator must initial all items. Leave no blanks:

ITEM	APPLIES	DOES NOT APPLY
Decision to not revise the current SAD and/or ASE at this time:	✓	
The hazard associated with the proposed work or event is covered within an existing SAD and/or ASE (i.e., it has been determined not to be a USI).	✓	
SAD Title and Date: *SNS FSAD for FELK* (August 2002).		
This Form and attachments, if necessary, shall be used to document the USI until the next revision of the appropriate SAD.	✓	
Decision to submit a revised SAD and/or ASE to the SNS ESH Accelerator Safety Review Committee:		✓ **(configuration not expected to be repeated)**
The hazard associated with the proposed work is not appropriately included in an SAD (i.e., it has been determined to be an USI).		✓

R. M. Harrington RMHarrington 8/19/2004
Preparer Date

S. P. McKenzie Scott P McKenzie 8/19/04
Independent Reviewer Date

Approvals:

Jim D. Hedden for NH 8/20/04
Signature of the SNS Division Director Date

FC Gonzalez 19 August, 2004
Signature of SNS ES&H Manager Date

Attachment to USID for DTL4-6/CCL1-3 Commissioning
Answers to Questions 1—7 of USID Form Referenced in Procedure OPM 2.B-10

1. *Could the change increase the probability of occurrence of an accident previously evaluated in the authorization basis?*

Evaluation: No. The probability of occurrence of accidents previously evaluated in the FSAD-FELK will not be increased. The planned commissioning will be conducted with equivalent administrative control, Machine Protection System and the other controls presented and evaluated in the FSAD-FELK. The commissioning is to be conducted at low beam power (between about 5 and 320 W) by limiting the effective pulse length to 50 μs and frequency to 1 Hz. Operating so far below the ultimate design capacity of the machine will not lead to a greater frequency of accidents overpowering the beam stop because, in addition to administrative controls and training planned for commissioning, the Machine Protection System (MPS) and EPICS controls have been reconfigured to make it highly unlikely for operators to inadvertently set the beam rep rate or pulse duration to higher than the desired range.

Discussion for frequency of attempted beam enclosure access while beam on. The presence of cryogenic helium in the tunnel during DTL4-6/CCL1-3 commissioning creates the possibility of a scenario in which a worker in the extreme west end of the SCL tunnel would need to evacuate through the commissioning enclosure to escape a large-scale accidental helium release or a serious fire. This does not increase the previously evaluated probability of occurrence of scenarios involving attempted beam access with beam "on", because the FSAD-FELK hazard analysis (Table 4.3.1-1) places these types of scenario in the Anticipated Medium frequency category (frequency range between 10^{-2} and 10^{-1} per year).

The probability of a serious helium release during the one month commissioning period has been estimated at about 0.005 (John Jankovic, E-mail dated 8/3/2004), which is within the Anticipated-Medium frequency category, even if the commissioning were repeated for each of 12 consecutive months. The frequency of beam enclosure access for fire/smoke evacuation would be expected to be lower than for cryogenic evacuations because there is a lower probability of a serious fire occurrence and because the SNS accelerator tunnel is outfitted with a very early warning smoke detection system to notify occupants during the early stages of a fire. Therefore, the FSAD-FELK hazard analysis (Table 4.3.1-1) adequately addresses prompt radiation hazard associated with possible use of the beam enclosure as part of a potential evacuation path. [Note: Potential use of the commissioning enclosure as part of a worker evacuation path is not an ALARA issue because the residual radiation level inside the enclosure immediately after beam cut-off has been estimated at about 100 mrem/h in the aisle opposite the beam stop; thus, a worker entering and walking through the enclosure for evacuation purposes could expect to receive a dose of less than 1 mrem.]

For the proposed DTL4-6/CCL1-3 commissioning, the PPS will control access to the east end of the enclosure as shown on Figure 1, below, and as follows (per P.A. Wright, E-mail dated 8/3/2004):

1. Two PPS gates will be installed, one on each side of the labyrinth. Redundant limit switches on the gates will be tied to the nearest downstream beam shutdown station (BSS) (opening the

either gate will appear to the PPS as a pressed E stop button). This will shut down beam and RF operations in both segments.

2. A tri-color stack light will be installed at the cold section gate to inform workers of the status of the tunnel in the warm section. There will not be a similar light in the warm section.
3. The intent is that the gates remain closed at all times and are never used except for emergency exit (or possibly an admin controlled entry for cryo valve operation/ repair). The gates are not locked, but do have tamper indicators so the sweep team can verify that the gates have not been opened, allowing someone to go into the space between the labyrinth gates.
4. The wiring for the gate switches and stack light are temporary, it will not be installed in conduit. We will design a wiring harness to allow the BSS cabling to be plugged into the new devices. When we have finished the run, we will simply unplug the temporary harness and reconnect the two BSSs.

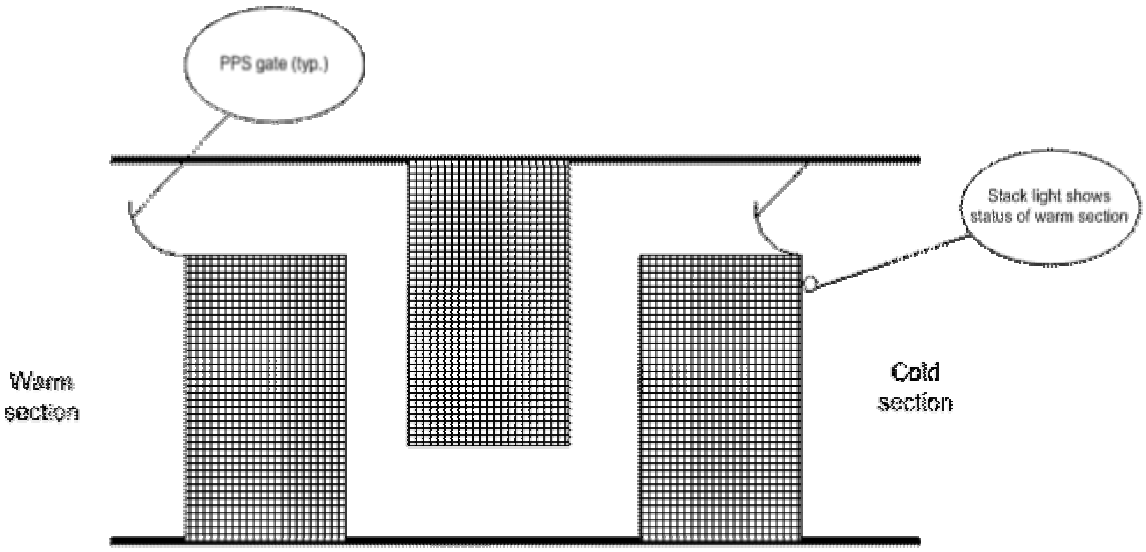

Figure 1 PPS Enclosure Access Control for DTL4-6/CCL1-3 Commissioning (east end shown)

2. *Could the change increase the consequences of an accident previously evaluated in the authorization basis?*

Evaluation: No. As discussed below, potential radiation exposure consequences for accidents that could occur during this stage of commissioning are bounded by the accident evaluations presented in the FSAD-FELK.

Discussion for consideration of the thickness of DTL3 commissioning beam enclosure. The concrete block labyrinth at the East end of the commissioning beam enclosure provides less shielding than the soil berm evaluated in the FSAD-FELK for beam accidents. However, this does not increase consequences of accidents because beam control accidents during commissioning are lower in consequences than the linac beam control accidents evaluated in the FSAD-FELK. Two factors account for the anticipated greater safety margin: (1) the commissioning limits on rep rate and pulse length hold beam power to a factor of about 900 below the design level for the linac with corresponding lower consequences for potential beam

spill accidents (versus the full beam spill accidents presented in the FSAD-FELK), and (2) the shielding provided is adequate for both routine and accident conditions. Shielding for DTL4-6/CCL1-3 commissioning is designed to yield at the maximum planned commissioning beam power a radiation dose rate of 0.25 mrem/h in continuously or frequently occupied locations outside the enclosure. Higher levels will be allowed in certain non-occupied or infrequently occupied areas outside the enclosure in accordance with radiological posting and access control requirements. The worst case unmitigated beam spill associated with the planned commissioning is estimated (Irina Popova, E-mail dated 7/29/2004) to increase dose outside the enclosure to a level not exceeding 1 rem/h, compared to the ~20 rem/hour worst case outside the berm presented in the FSAD-FELK for HEBT beam spills. The MPS would be expected to cut off the beam very rapidly in such an event, but, failing that, the PPS chipmunk-based interlock would interrupt the beam before significant worker dose accumulated in accessible locations.

Discussion for consideration of the presence of workers in the tunnel during beam-on commissioning operations. Workers will be located inside the tunnel, but outside the DTL-4-6/CCL1-3 commissioning enclosure but they are not at risk for greater accident consequences. The shielding limits possible accident initiated external radiation exposures (see discussion in the previous paragraph) and the planned low intensity and limited duration of beam stop irradiation limits the potential for an accident generating a significant airborne source term of radioactive material. The planned total amount of proton beam produced during commissioning , not expected to exceed an integral total of approximately 32 kW*hours, results in modest buildup of activation and spallation products. The beam stop cooling water will be replaced during the commissioning run as needed to maintain the radionuclide concentration below the drinking water standard. Credible beam overheating and water spill accidents could not generate source terms that would cause excessive worker internal (i.e., inhalation) exposures.

The inherent limitation of the amount of radioactivity that can build up in the beam stop and coolant during the planned approximately one month of low-beam-power commissioning protects workers from potential accident airborne source terms even though the full tunnel ventilation system will not be installed at the time of the proposed commissioning. Additional defense in depth against overheating the beam stop and possible airborne source term generation is provided by MPS monitoring and beam cut-off should excessive beam onto the beam stop occur (see response to Question 1, above).

3. *Could the change increase the probability of occurrence of a malfunction of equipment important to safety previously evaluated in the authorization basis?*

<u>Evaluation</u>: No. Prior to the proposed commissioning, the Personnel Protection System will be certified as a fully functional, SIL-2 safety significant interlock system as described in the FSAD-FELK. Commissioning operations will not cause the PPS to fail because they are within the envelope evaluated in the FSAD-FELK.

For certain helium release scenarios the FSAD-FELK hazard evaluation credits automatic actuation of the tunnel emergency ventilation (smoke exhaust) system to confine the oxygen deficiency hazard to the tunnel. It could be argued that installing a shielding labyrinth in the

tunnel after CCL4 could inhibit the flow of air exhausted by the emergency ventilation system. However, each of the three walls has a floor-to-ceiling doorway opening such that the labyrinth does not impose enough flow resistance to significantly inhibit the flow of air exhausted from the tunnel by the emergency ventilation blowers.

4. *Could the change increase the consequences of a malfunction of equipment important to safety previously evaluated in the authorization basis?*

Evaluation: No. Consequences of PPS malfunction are not increased over those evaluated in the FSAD-FELK. The configuration and activities planned for commissioning are entirely enveloped by the FSAD-FELK because of the shielding provided and the lower beam power levels to be utilized during commissioning (see response to Question 2, above).

5. *Could the change create the possibility of a different type of accident than any previously evaluated in the authorization basis?*

Evaluation: No. The commissioning exercises the linac through CCL3 in a similar, but less intense manner, than planned and analyzed in the FSAD-FELK for routine operation. No different type of accident has been identified.

6. *Could the change increase the possibility of a different type of malfunction of equipment important to safety than any previously evaluated in the authorization basis?*

Evaluation: No. The Personnel Protection System is being certified as a fully functional, SIL-2 safety significant interlock system for the DTL4-6/CCL1-3 commissioning. The safety functions and configuration are conceptually identical to that presented in the FSAD-FELK.

7. *Could the change reduce the margin of safety as defined in the Accelerator Safety Envelope?*

Evaluation: No. The proposed commissioning activities will be in full compliance with the CASE as presented in the FSAD-FELK (see Table 1, below). Therefore the commissioning will not reduce the margin of safety as defined in the approved CASE (see Table 5.1.1-1, FSAD-FELK).

Table 1: Commissioning Accelerator Safety Envelope (CASE) Compliance for DTL-4-6/CCL1-3 Commissioning

CASE Section	CASE Requirement	Implementing Document	Compliance Documentation
Introduction			
1.1	In the event of a variation beyond the boundaries described in Sections 2, 3, and 4, SNS Accelerator Systems Division staff shall make notifications according to the requirements of an approved occurrence reporting procedure.	OPM 2.B-1 *Operational Envelopes and ASEs*	Logbook documents parameter limit violations during beam operations.
1.2	The method used by the SNS for change control of the ASE shall be documented in an approved operations procedure	OPM 2.B-1 *Operational Envelopes and ASEs*	
1.3	Modifications to the ASE involving change to a bounding condition or an unreviewed safety issue (USI) shall be approved by the DOE prior to implementation.	OPM 2.B-1 *Operational Envelopes and ASEs*	OPM 2.B-10 *Procedure for Documenting Unreviewed Safety Issue Determination* specifies record keeping for USIDs
Safety Limits			
2.1	Less than 1 rem/y to any worker, unless an extended ALARA goal is approved in accordance with ORNL procedures prior to the worker exceeding this dose. Approved methods for personnel dosimetry are described in Section 4.2.2.5	OPM 2.B-1 *Operational Envelopes and ASEs*	ORNL central HP records. Individual radworker exposures > 300 mrem and non-radworker exposures > 0 reported to division radiation control officer (DRCO).
2.2	Less than 100 mrem/y at any location routinely occupied by workers or members of the public without personal dosimetry as verified through the use of retrospective dose measurements as described in Section 4.2.2.1.	OPM 2.B-1 *Operational Envelopes and ASEs*	OPM 2.H-6.3, *Passive Area Monitoring of Occupied Controlled Areas* specifies required TLD data retention.
2.3	The maximally exposed off-site individual shall not receive an annual radiation dose in excess of the following limits due to SNS activities, as evaluated in accordance with ORNL procedures for environmental compliance: 10 mrem/y (radionuclide release), 25 mrem/y (all pathways).	OPM 2.B-1 *Operationals Envelopes and ASEs*	Air concentrations in the tunnel have been calculated (G. Dodson E_mail dated 8/03/2004) and are a small fraction of applicable 10 CFR 835 DACs for workers. After atmospheric transport to off-site locations, the doses to members of the public are below the level of concern that would require monitoring of atmospheric releases.
Experimental and Operational Limitations			
3.1	The PPS (i.e., portions required to support the applicable operational configuration) shall be functional during operations with beam.	OPM 2.B-1 *Operational Envelopes and ASEs*	OPM 3.A-7 T*est and Certification of the PPS* requires issuance of certification report that certifies PPS operability.
3.2	Positive means shall be applied to ensure that individuals entering the tunnel have received tunnel access training or are escorted by a trained individual.	OPM-3.A-3 *Access Procedures* OPM-3.A-4 *Sweep Procedures*	A proximity card access control device at tunnel entry verifies each non-escorted person has Enclosure Training when the PPS is in service. Note: radiation safety hold tag(s) applied in LO/TO type system to prevent production of ionizing radiation

CASE Section	CASE Requirement	Implementing Document	Compliance Documentation
			when PPS not in service.
3.3	Beam power to the target shall not exceed 2 MW, averaged over any 24-h period	OPM 2.B-1 *Operational Envelopes and ASEs*	EPICS archives data on beam power.
3.4	Loss monitoring results and radiation survey results shall be used to maintain beam loss ALARA as defined in an approved operations procedure	OPM-2.H-17.2 *Procedure for Trending Beam Loss and Radiological Monitoring Data*	OPM 2.H-17.2 specifies loss monitoring record keeping requirement. RCT Supervisor records surveys on "web survey" or "E-log"
3.5	Radiological area classifications and postings shall be in accord with approved ORNL or SNS policy requirements.	SBMS, Radiation Control Technicians	Survey performed (and filed) when/if radiological area posting(s) changed.
3.6	During operations with beam, area radiation monitors that are interfaced with the PPS shall be within their calibration date.	OPM-2.H-18 *Chipmunk Radiation Monitors*	PPS leader keeps records of chipmunk calibrations.
3.7	During operations with beam, the locations of area radiation monitors interfaced with the PPS shall be configuration controlled.	OPM 2.H-18.3 *Chipmunk Radiation Monitors*	PPS leader keeps signed originals of authorization forms to place/remove chipmunks.
3.8	Compensatory action shall be taken if neither fire detection nor fire protection is available to an accelerator building that is > 4000 sq ft interior floor area. Compensatory measures may include, but are not limited to, minimizing ignition sources, providing a fire watch, or providing temporary detection or suppression measures	OPM 2.B-1 *Operational Envelopes and ASEs* OPM 2.J-2 *Fire Safety*	Commissioning Checklist, plus supervised circuits annunciated at ORNL Fire Command Center.
3.9	If an ODH is present in the LINAC, then personnel entering the tunnel shall be trained in ODH/cryogenic hazard avoidance or escorted by a trained individual, and oxygen deficiency alarm and automatic initiation of LINAC Tunnel smoke exhaust blowers must be functional.	Linac ODH system integration tests (ASD_IC-P57) and *ODH Alarm System Certification Procedure for the Linac Tunnel* (OPM 2.N-2.1.1).	See item 3.2 – access controlled using proximity card system. Tunnel access training upgrade for ODH hazards will be complete before helium introduced into tunnel. OPM 2.N-2.1.1 has been performed and the ODH alarm system is now tested and certified.
3.10	If an ODH is present in the CHL Building, then the automatic oxygen deficiency alarm and warning features must be functional, and personnel entering the CHL shall be trained in cryogenic and ODH avoidance or escorted by a trained individual.	CHL ODH system integration tests have been performed and the *ODH Alarm System Certification Procedure for the CHL* (OPM 2.N-2.1.2) is being developed.	Access being controlled by locked doors and signage, with restriction of building access to trained individuals. Certification records will be retained per OPM 2.N-2.1.2.

CASE Section	CASE Requirement	Implementing Document	Compliance Documentation
Engineered Safety Systems Requiring Calibration, Testing, Maintenance, and Inspection			
4.1	The PPS shall be functionally tested in accordance with requirements specified in an approved operations procedure.	OPM 3.A-7 T*est and Certification of the PPS*	Certification report documents performance of the procedure.
4.1.1	Functional tests shall be conducted prior to each commissioning module involving change(s) in shielding or access control.	OPM 3.A-7 T*est and Certification of the PPS*	Certification report documents performance of the procedure.
4.2	Fire detection/protection systems shall be tested periodically, in accordance with the applicable NFPA standards.	OPM 2.J-2 *Fire Safety,* ORNL SBMS: *Fire Protection, Prevention and Control*	ORNL Fire Department records periodic inspections in the Inspection, Test and Maintenance (ITM) database.
4.3	Area radiation monitors that are interfaced with the PPS shall undergo annual testing (not to exceed 15 months).	OPM-2.H-18 *Chipmunk Rad Monitors*	Chipmunks are tested quarterly (PPS leader keeps records). They are calibrated annually by the ORNL Radiation Instrumentation Calibration Program (RICP) group who keep the calibration records.
4.3.1	Monitors shall be tested to verify appropriate response following changes in configuration or arrangement.	OPM-2.H-18 *Chipmunk Rad Monitors*	PPS leader keeps records.
4.4	The oxygen monitoring system, including automatic initiation of the LINAC smoke exhaust fans shall undergo annual inspection and testing (not to exceed 15 months).	OPM-2.N-2.1.1 *Linac Tunnel ODH System Testing and Certification Procedure*	PPS leader keeps records.
Administrative Controls			
5.1	Minimum Main Control Room Staffing: When the beam is in operation, one chief operator and one operator shall be on duty, and one of the two must remain in the Main Control Room at all times.	OPM 2.B-1 *Operational Envelopes and ASEs*	Log books specify on-duty personnel during each beam-on shift.
5.2	Operations staff shall be trained and qualified on their safety, operational and emergency responsibilities. Records of training and qualification shall be maintained on the SNS Training Management System.	OPM 4 *Training and Qualification*	SNS Training Management System database.
5.3	Work planning and control shall comply with requirements specified in an approved operations procedure and the approved JHA procedure; applicable hazards shall be controlled, as specified, by approved SNS procedures, standards, directives, and guidance.	OPM 2.E-3 link to JHA procedure	JHAs posted at job site. Note: JHAs that take significant development effort are typically titled as procedures and retained for reuse.

CASE Section	CASE Requirement	Implementing Document	Compliance Documentation
5.4	Beam fault studies shall be performed in accordance with approved procedures.	2.H-16, *Fault Study Preparation Guidelines and Fault Study Procedure for Primary and Secondary Beam Areas*	Records retained per 2.H-16.
5.5	Work on energized electrical systems shall comply with working hot permits and the other controls in accordance with the requirements specified in an approved SNS operations procedure.	OPM 2.G-3 *Electrical Safety Working on or near or Working Hot Guidelines*	Individuals who do work on energized systems are required to be trained on and sign the applicable JHA
5.6	Permanent and movable shielding, as well as any barriers (e.g., fencing) shall be under configuration control, as defined in an approved operations procedure.	2.H-7. *Radiation Shielding and Barriers*	Reviews of significant changes documented by Radiation Safety Committee
5.7	Modification and review of the PPS shall be in accordance with the configuration control program documented in an approved operations procedure.	3.A-8.1, *Configuration Management Procedure for the PPS*	Screening of PPS changes done by Operations. PPS leader keeps record on all changes. Reviews of significant changes documented by Radiation Safety Committee