SNS-OPM-ATT 2.B-10.a.
Unreviewed Safety Issue (USI) Evaluation Form

I. Title of USI Evaluation:

USI Evaluation for Beam Line 1A USANS for Low Power Alignment Testing and Interim Shielding Configuration

II. Description of Proposed Activity (or discovered condition):

SNS Beam Line 1 uses a primary shutter designed to deliver beam to two neutron beamlines; Beamline 1A (USANS) and beamline 1B (NOMAD). Presently, beam is delivered to NOMAD as an approved operating instrument. Beam to the USANS beamline is blocked by a Temporary Beam Stop installed in its T0 chopper location.

It is proposed to install the USANS T0 chopper in place of the Temporary Beam Stop and to install the beamline configuration controlled shielding in order to perform low power alignment testing of instrument components within the USANS instrument enclosure. The basic USANS enclosure structure (e.g. walls, entry doors, etc.) is complete but work remains to install and certify the full PPS system and to complete component and infrastructure installation inside the enclosure. Beam line shielding will be installed per the approved drawing package (SING 201A50G8U8701A001) and under configuration control up to the instrument enclosure. Low Power Alignment Testing is planned for early February 2014 during the beginning of the upcoming run cycle. Upon completion of the alignment testing, a new interim shielding configuration that retains the USANS T0 chopper is proposed rather than returning the shielding to its present configuration.

Because of the close proximity of Beamline1B to the 1A Premonochromator, the NOMAD detector tank enclosure and sample room are expected to experience elevated dose rates by allowing beam to pass beyond the USANS T0 chopper location.

Details of the proposed activities and associated hazards and controls are evaluated below. Figures are presented in the Appendix for convenience of presentation.

1. Present BL 1B Configuration

The USANS Temporary Beam Stop consists of ~ 0.46 m long steel insert (in beam direction) with a 1/8 inch Aluminum plate with 0.88 inch of B_4C surrounded with beamline shielding [1]. The NOMAD neutronics analysis [2] evaluated radiological impacts of operating Beamline 1 with the NOMAD instrument operational and the Temporary Beam Stop installed in the USANS T0 chopper location. Figure 1 shows the Temporary Beam Stop installed in the USANS T0 cavity location.

2. Proposed Low Power Alignment Testing Activities

Low power alignment testing is proposed that would require low power beam (< 30kW) be transported into the unfinished USANS instrument enclosure for a duration of about 24 hours of beam. Current plans are to perform the alignment testing at ~ 20 kW at 30 Hz. The low power alignment testing objectives include:

- Alignment of the reflected beam with respect to the centerline of the flight tube and
- Adjustment of both the horizontal and vertical focus of each of the 7 Premonochromator spines (independently and as an assembly).

Potentially high radiation fields may be created in both the USANS instrument enclosure and in the NOMAD instrument when delivering beam past the T0 chopper as detailed in the USANS neutronics analysis [3].

Figures 2 and 3 show the basic layout of the USANS instrument with the USANS beamline shielding removed for clarity. The incident neutron beam travels down the flight tube to the Premonochromator. The Premonochromator scatters neutrons with the desired energy and bandwidth towards the USANS instrument enclosure. Neutrons not scattered by the Premonochromator continue in a straight flight path and are absorbed in a beam stop located behind the Premonochromator. Neutron interactions within the Premonochromator potentially create intense scattered neutron and gamma radiation when the USANS T0 chopper is parked in the open position which leads to elevated radiation in both the USANS instrument enclosure and NOMAD Tank Enclosure and to a lesser extent, the NOMAD Sample Room as detailed in Reference [3]. The USANS T0 chopper will be purposely parked in the open (white beam) position for the Low Power Alignment Testing activities.

Figures 2 and 3 also show the location of the Sample Shutter which drives horizontally in and out of the scatter beam from the Premonochromator to block beam into the instrument enclosure. The Sample Shutter design is shown in Figure 4. Ultimately, the USANS Sample Shutter position will be monitored by the PPS. The PPS will allow personnel entry into the USANS PPS controlled access area with the Sample Shutter closed and Primary Shutter open. This feature will not be installed for activities evaluated in this USI Evaluation. With the Sample Shutter in the open position, beam is allowed to pass into the enclosure. For the Alignment Testing, a neutron detector and beamstop will be placed in the neutron beam within the enclosure.

2.1 Potential Hazards Associated With Low Power Alignment Testing

2.1.1 Excessive radiation exposure of personnel in BL 1A enclosure - The maximum potential dose rate within the enclosure occurs with the USANS T0 chopper in the open position with the Sample Shutter open. Maximum potential dose rates within the USANS instrument enclosure are located in-beam where the flight tube enters the enclosure (see Figure 2). Predicted maximum dose rates [3, 9] are summarized in Table 1 below.

Table 1. Maximum In-Beam Projected Dose Rates within the USANS Instrument Enclosure Assuming White Beam (T0 Chopper Open)

Power	Dose Rate (mrem/hr) Sample Shutter Open	Dose Rate (mrem/hr) Sample Shutter Closed
2 MW	3,750	20
1.4 MW	2,625	14
30 kW	56	0.3

2.1.2 Excessive Radiation Exposure within the NOMAD instrument - The NOMAD tank enclosure will experience elevated dose rates if the USANS T0 chopper is open. This potential condition will remain for the life of the USANS instrument and will not go away after completion of the proposed activities evaluated in this USI Evaluation. Long-term dose management strategies will be required to ensure radiological doses in the NOMAD Tank Enclosure are maintained ALARA. Predicted maximum dose rates [3] within the NOMAD instrument are found at a localized position at one corner within the NOMAD tank enclosure adjacent to the USANS Premonochromator. Table 2 presents predicted dose rates in the NOMAD Sample Room associated with the USANS T0 Chopper parked in the open position. Dose rates in the Sample Room with the T0 Chopper parked in the open position are below concern for this analysis and can be safely managed under the provisions of the ORNL Radiation Protection Program.

Table 2. Maximum Projected Dose Rates within the NOMAD Instrument Enclosure Assuming USANS T0 Chopper Open

Power	**Dose Rate (mrem/hr) Tank Enclosure**	**Dose Rate (mrem/hr) Sample Room**
2 MW	570	4
1.4 MW	399	2.8
30 kW	9	0.06

2.1.3 Potential dose rates outside of shielding and enclosures – The maximum dose rate at any location outside of the beamline shielding and instrument enclosures is less than ~ 10 mrem/hr @ 2 MW with white beam [3]. Fault Study measurements conducted in accordance with an approved Fault Study Plan will provide confirmatory measurements of dose rates in accessible areas outside of shielding and enclosures and will allow early identification of unexpected dose rates. The expected level of radiological hazard can be safely managed by the provisions of the ORNL Radiation Protection Program and will not be addressed further here.

2.2 Controls to Protect Against Excessive Exposure within the BL 1A Enclosure During Low Power Alignment Testing

2.2.1 PPS Trap Key Entry Control

PPS Trap Keys are interlocked with the instrument Primary Shutters and must be in place to open the Primary Shutter. There are two types of Primary Shutter Trap Keys; S-keys and U-keys. Each trapped key is locked in position and can only be removed when the corresponding shutter is closed. For both the S-Key and U-key, the Primary Shutter must be closed in order to remove the trapped key. When the key is removed, the shutter control system will not open the shutter until the trapped key is reinserted and rotated to the "trapped" (horizontal) position and an OPEN command is given. The important distinction between the two key types is that with the U-Key removed from the Primary Shutter control, the PPS system monitors the status of the PPS Shutter Closed position switches and trips the proton beam if the switches change state to "not closed." The S-key does not provide this particular protective feature.

The analysis below is based on the use of the S-key because S-key mechanisms are presently available in-house and have been installed. Figure 5 depicts the S-key trap key exchange. The S_a Trap key must be released from the Primary Shutter Control position in order to release the J_z keys required to open the USANS enclosure door locks. Figure 6 shows a photo of one of the installed PPS J_z Trap Key door lock mechanism.

The U-key components have been ordered from the vendor but are not expected to be available in time for use for the proposed activities described in this evaluation. Should the U-key components arrive prior to initiation of the proposed activities, the use of the U-key in lieu of the S-key is acceptable and is bounded by the analysis below.

- PPS Trap Key required to unlock either of the two BL 1A enclosure entry doors to the USANS instrument enclosure
- PPS requires BL 1 Primary Shutter be closed to release Trap Key
- PPS prevents opening of the BL 1 Primary Shutter w/ Trap Key removed.
- Dose rates in the BL 1A enclosure with the primary shutter closed are negligible.
- Vulnerability – although the S-key cannot be released unless the shutter is closed (as indicated by the PPS position switches); the S-key does not protect against the unlikely scenario of the primary shutter drifting out of the closed into the open position after S-key has been released. This is highly unlikely and has never occurred during the life of SNS. The primary shutter is equipped with rod lockers specifically designed to hold the primary shutter closed in the event that hydraulic pressure holding the shutter closed is lost as described in the FSAD-NF. If hydraulic pressure to the shutter is lost and the rod locker failed, the shutter could potentially move into the open position by gravity. In such an instance, no automatic protective feature would actuate. Vulnerability to this scenario is mitigated by the other controls as listed below. (Note: If the U-key is used, no such vulnerability exits as the PPS provides a beam trip if the Primary Shutter drifts out of the Closed position during operations with use of the U-key.)

2.2.2 Sample Shutter Closed Prior to Entry

- PPS group will control movement of the sample shutter, only accessible from the temporary PPS cart. Access to the control computer will be password protected.
- PPS group will test, confirm and document the operability of the Sample Shutter “open” and “closed” position indicator switches.
- The maximum projected dose rate in the enclosure with the primary shutter open and sample shutter closed is 20 mrem/hr (assuming 2 MW white beam, see Table 1).

2.2.3 RWP Required for all Entries

- RWP requires alarming dosimeters for each person entering area; alarming dosimeters warn individuals to leave area upon alarm prior to receipt of excessive dose.
- Rad Worker training ensure personnel leave area upon alarming of dosimeter
- RWP requires RCT survey of area prior to entry.

- Alarming dosimeters provide sufficient warning to alert personnel to leave prior to receiving significant dose. For example, it would take an exposure of over 1 hour in the worst-case beam (3,750 mrem/hr, see Table 1) to approach the annual 10 CFR 835 annual personnel dose limit of 5 Rem.

2.2.4 Limit Power to $P \leq 30$ kW

- The accelerator operators will limit power during the Alignment Testing to 30 kW or less. The power limitation for the alignment testing will be clearly communicated to the accelerator operators.
- DG-535 will be set to limit beam rep rate and beam pulse width appropriately to limit beam power to 30 kW or less and will be under RS Hold to prevent unauthorized change to set points. DG-535 will provide a backup layer of control to the administrative control of beam power by the accelerator operators; however, DG-535 is not a credited or safety rated device.
- Limiting power to 30 kW limits the predicted maximum potential in beam dose within the enclosure to 56 mrem/hr with the T0 chopper and sample shutter open, see Table 1).

2.2.5 Fault Study Measurements (Low Power) – Radiological surveys will be conducted at low power $P < 30$ kW in accordance with an approved Fault Study Plan. The Fault Study will provide confirmatory measurements of dose rates within the enclosure and will allow early identification of unexpected dose rates. The RSO will modify Radiological Postings and Controls as needed. Power is limited to 30 kW for the Low Power Alignment Testing configuration.

2.2.6 Limited Duration of Low Power Alignment Testing

The planned duration is ~ 24 hours of beam time. The limited duration of the activity ensures the identified controls receive high attention and minimized chances of errors.

2.3 Controls to Protect Against Excessive Personnel Exposure in NOMAD Tank Enclosure During Low Power Alignment Testing

2.3.1 Radiological Posting and Control Per SBMS and 10 CFR 835 – The RSO will post and control access to the NOMAD tank enclosure area prior to opening of BL 1 shutter with beam.

2.3.2 Limit Power to $P < 30$ kW

- The accelerator operators will limit power during the Alignment Testing to 30 kW or less. The power limitation for the alignment testing will be clearly communicated to the accelerator operators.
- DG-535 will be set to limit beam rep rate and beam pulse width appropriately to limit beam power to 30 kW or less and will be under RS Hold to prevent unauthorized change to set points.
- Limiting power to 30 kW limits the maximum potential dose rate within the enclosure to 9 mrem/hr (primary shutter, T0 chopper open, see Table 2)

2.3.3 Fault Study Measurement (Low Power) - Radiological surveys will be conducted at low power P < 30 kW in accordance with an approved Fault Study Plan. The Fault Study will provide confirmatory measurements of dose rates within the enclosure and will allow early identification of unexpected dose rates. The RSO will modify Radiological Postings and Controls as needed based on Fault Study radiation measurements. Power is limited to 30 kW for the Low Power Alignment Testing configuration.

3 Interim Shielding Configuration - Upon completion of the low power alignment testing, it is proposed to leave the USANS T0 chopper in place rather than return to the present configuration that relies on the Temporary Beam Stop to block the beam. The following configuration is proposed to provide layered protection to control radiation levels associated with leaving the USANS T0 chopper installed:

- Sample Shutter Locked Closed
- Redundant Beam Plug Installed

With the above configuration in place, the access controls to the USANS enclosure will be removed (the Trap Key door lock mechanisms removed and requirement for RWP for entry removed) and workers will be provided free access to continue installation activities within the enclosure. It is proposed to run with this configuration until instrument construction is complete and authorization to run full power beam to instrument enclosure obtained. Duration is currently expected to be less than 8 months.

The USANS T0 chopper will purposely be rotated to the OPEN position with beam during initial high power operations for the purposes of Fault Study radiation survey measurements of the Interim Shielding Configuration. Upon completion of the Fault Study radiation survey measurements, the USANS T0 chopper will be rotated to the CLOSED position and leads to the drive mechanism will be disconnected and placed under RS Hold.

The maximum predicted dose rates in the USANS enclosure in the Interim Shielding Configuration are less than 1 mrem/hr [8] regardless of the T0 chopper position due to the effectiveness of the shielding provided by both the Sample Shutter and the Redundant Beam Plug.

The maximum predicted dose rate in the NOMAD tank enclosure with the USANS T0 chopper parked open is ~ 570 mrem/hr. The maximum predicted dose rate is reduced to 78 mrem/hr with the T0 chopper rotating normally [3]. Parking the T0 chopper closed will eliminate the thermal neutron component from the beam incident and associated dose rates would be significantly lower than 78 mrem/hr [7].

Control over the T0 chopper position is considered a prudent measure because expected dose rates in the NOMAD tank enclosure are lowered with the T0 chopper closed; however, because the T0 chopper is designed to rotate freely, this analysis evaluates the T0 chopper remaining in the OPEN position as a bounding condition and ensures controls are in place to protect individuals when entering the NOMAD tank enclosure with the T0 chopper open.

3.1 Potential Hazards Associated with the Interim Shielding Configuration

3.1.1 Excessive radiation exposure of personnel in BL 1A Enclosure – The maximum potential radiation levels in the BL 1A enclosure are the same as those identified in Table 1.

3.1.2 Excessive Radiation Exposure within the NOMAD instrument – The maximum potential radiation levels in the BL 1A enclosure are the same as those identified in Table 2.

3.1.3 Potential dose rates outside of shielding and enclosures – Potential radiation hazards are identical to those identified in Section I.2.1.3. The maximum dose rate at any location outside of the beamline shielding and instrument enclosures is less than ~ 10 mrem/hr @ 2 MW with white beam. This level of radiological hazard is safely managed by the provisions of the ORNL Radiation Protection Program and will not be addressed further here.

3.2 Controls to Protect Against Excessive Exposure within the BL 1A Enclosure With The Interim Shielding Configuration

3.2.1 **Sample Shutter Closed with Power Lead Locked Under RS Hold**

- Sample Shutter will be placed in Closed position
- Leads to Sample Shutter disconnected from power source, locked out under RS Hold.
- Visual verification that shutter is closed (visual observation by looking into beam tube) and sign-off completion of this step by procedure
- PPS group will test, confirm and document the operability of the Sample Shutter "open" and "closed" position indicator switches.

3.2.2 **Redundant Beam Plug Installed Under Configuration Control** – A Redundant Beam Plug will be installed in the flight path where the beam enters the USANS enclosure (see Figure 7). The Redundant Beam Plug will be locked as configuration controlled shielding. The Redundant Beam Plug design (~ 6 inches of steel) provides similar radiological protection to individuals in the USANS enclosure as is provided by the Sample Shutter [4]. That is, the Redundant Beam Plug is capable of sufficiently mitigating radiation levels for a 2 MW white beam with the Sample Shutter in the open position and therefore provides a redundant layer of protection. The estimated dose rates in the enclosure with both the Sample Shutter and the Redundant Shutter in place are less than 1 mrem/hr.

3.2.3 **Fault Study Measurements** (Low and High Power) - After the Sample Shutter has been closed and locked per Section I.3.2.1 above and the Redundant Beam Plug has been installed under configuration control per Section I.3.2.2, high power (P ~ 400kW to ~1 MW as desired) USANS

Fault Study measurements may be conducted in accordance with an approved Fault Study Plan. Fault Study radiation survey measurements may be conducted with the USANS T0 Chopper rotated to the OPEN position in order to obtain confirmatory measurements of dose rates at low and high powers within the USANS enclosure, the NOMAD enclosure and other areas of interest and will allow early identification of unexpected dose rates. Fault Study measurements will provide the RSO with measured survey data to ensure radiological controls and postings remain appropriate.

3.3 Controls to Protect Against Excessive Personnel Exposure in NOMAD Tank Enclosure For The Interim Shielding Configuration

3.3.1 **Radiological Posting and Control Per SBMS and 10 CFR 835** – The RSO will post and control access to the NOMAD tank enclosure area prior to opening of BL 1 shutter with beam in the Interim Shielding Configuration.

3.3.2 **Fault Study Measurements** (Low and High Power) - After the Sample Shutter has been closed and locked per Section I.3.2.1 above and the Redundant Beam Plug has been installed under configuration control per Section I.3.2.2, high power (P ~ 400kW to ~1 MW as desired) USANS Fault Study measurements may be conducted in accordance with an approved Fault Study Plan. Fault Study radiation survey measurements may be conducted with the USANS T0 Chopper rotated to the OPEN position in order to obtain confirmatory measurements of dose rates at low and high powers within the USANS enclosure, the NOMAD enclosure and other areas of interest and will allow early identification of unexpected dose rates. Fault Study measurements will provide the RSO with measured survey data to ensure radiological controls and postings remain appropriate.

3.3.3 USANS T0 Chopper Closed with Leads Locked Under RS Hold – As a prudent measure, the USANS Chopper will be parked in the closed position with drive leads disconnected and placed under RS Hold upon completion of the high power Fault Study radiation survey measurements. For the purposes of this USI Evaluation, the USANS T0 Chopper is assumed to fail in the open position.

II.5 Testing and System Certification

The USANS PPS Trap Key functionality and the Sample Shutter PPS position monitoring switches (“open” and “closed”) indications will be tested and verified functional prior to use. The functionality of DG-535 will be verified prior to use to control power levels associated with the Low Power Alignment Testing.

II.6 Planned Future Modifications

Construction on the USANS instrument and instrument enclosure will continue once the approved Interim Shielding Configuration is established. Upon completion of construction/installation activities, USANS will undergo an IRR for commissioning. Current plans are to hold the commissioning IRR in the spring of 2014.

II.7 References

1. Email from Steve Howard to David Freeman, “RE: Temporary Beam Stop”, January 22, 2014, 1:51 PM
2. Shielding Calculations for NOMAD Beamline, SNS 106100200- DA0035-R00, August 2010.
3. Shielding Calculations for TOF-USANS Beamline, SING201A-50-CA0002, January 2014.
4. Email from Franz Gallmeier to David Freeman, “RE: Beam Plug Drawing”, January 31, 2014.
5. Spallation Neutron Source Final Safety Assessment Document For Proton Facilities, SNS 102030103-ES0018-R02, December 2010.
6. Spallation Neutron Source Final Safety Assessment Document For Neutron Facilities, SNS 102030102-ES0016-R03, September 2011.
7. Email from Franz Gallmeier to David Freeman, “USANS Dose Rates”, January 22, 2014, 1:16 PM.
8. Email from Franz Gallmeier to David Freeman, “USANS Shielding”, January 13, 2014.
9. Email from Igor Remec to David Freeman, “Re: Updated in beam dose rate estimate accounting for uncertainties in Bragg scattering”, January 24, 2014.

III. Does the proposed activity or discovered condition affect information presented in the FSAD-NF or FSAD-PF, e.g. regarding equipment, administrative controls, or safety analyses. If so specify the applicable FSAD and relevant sections.

No, the proposed Low Power Alignment Testing and subsequent Interim Shielding Configuration are bounded by the existing analysis presented in the FSADs. The use of PPS Trap Keys to control radiological hazards is discussed in Section 3.2.3 *Accelerator Safety System* and Section 4.2.1.2 *Moveable Shielding* of the FSAD-PF [5]. The Instrument PPS (IPPS) is addressed in Sections 3.3.8.3.2, 5.2.18, and 7.8 of the FSAD-NF [6]. No FSAD revisions are needed to support the proposed activities.

IV. Does the proposed activity or discovered condition affect any of the requirements of the ASE. If so, list the affected sections

The proposed Alignment Testing and subsequent Interim Shielding Configuration do not affect any of the requirements of the ASE. Relevant ASE requirements for neutron beam lines regarding the successful completion of an Instrument Readiness Review and PPS control applicable to the operational configuration will be met. No ASE changes are needed to support the proposed activities.

> **ASE Section 2.4** states "*Installed Beamlines (i.e. those that have successfully completed an Instrument Readiness Review for the applicable operational configuration) shall be allowed to open their Primary Shutter during beam operation to the Target.*"

An IRR for the applicable operational configuration will be completed prior to opening Primary Shutter to Beam Line 1 with beam.

> **ASE Section 3.2.1** states *"Operability - Those portions of the PPS and PPS-interlocked Area Radiation Monitor systems required to support the applicable operational configuration shall be operable during operations with beam."*

The PPS Trap Key entry control for BL 1A enclosure provides the appropriate PPS control, as approved by ISSC (and RSC as appropriate), to support the operational configuration associated with proposed beam tests.

> **ASE Section 3.2.2.2** states *"Operations with beam to areas with a non-operable PPS shall be prohibited and controlled in accordance with the appropriate lockup of PPS critical beam production or transport devices."*

There are no areas to be potentially entered associated with the Interim Shielding Configuration because the beam is closely contained within passive configuration controlled shielding installed immediately adjacent to or directly in the beam. The USANS Sample Shutter will be locked in the closed position under an RS Hold. The USANS Sample Shutter serves as the primary designated PPS controlled beam transport device to allow entry into PPS controlled enclosure areas in the USANS final completed operational configuration.

V. USI Evaluation Criteria:

1. Could the change significantly increase the probability of occurrence of an accident previously evaluated in the FSADs? Yes __ No_x_

Justification:

a. Low Power Alignment Testing: The proposed Low Power Alignment Testing involves delivering low power beam past the USANS T0 chopper location to the shielded Pre-Monochromator that 1) scatters neutrons into the USANS instrument enclosure and 2) scatters radiation into the NOMAD tank enclosure. Relevant accident scenarios include excessive radiation exposure while accessing the USANS and/or NOMAD enclosures while the beam is on and excessive radiation exposure due to inadvertent removal of installed massive beam line shielding.

The probability of excessive radiation exposure due to personnel entry into the USANS instrument detector tank enclosures while the beam is on is minimized to insignificant levels by the layers of control identified in Section I.2.2 above. Each of the following controls are capable of independently mitigating the accident scenario:

- PPS Trap Key Entry Control for USANS Instrument Enclosure
- Sample Shutter Closed Prior to Entry
- RWP Required for All Entries
- Limit Power to P < 30 kW

The combination of the 4 controls listed above is more than sufficient to reduce the probability of excessive exposure to insignificant levels. Fault study measurements will be conducted to confirm predicted dose rates and to identify any unexpected conditions. In addition, the limited duration of the alignment activities (~ 24 hours of low power beam time) ensures controls receive high attention and minimize the chances of unforeseen errors associated with the use of a non-standard beam line configuration.

The probability of excessive radiation exposure due to personnel entry into the NOMAD tank enclosures during the proposed alignment testing activities are minimized to insignificant levels by the layers of control identified in Section I.2.3 above. The worst case predicted accident dose rate is 570 mrem/hr. Areas with dose rates of this magnitude are routinely controlled at ORNL under the provision of SBMS Radiological Safety Program. The following controls are capable of independently mitigating the accident scenario:

- Radiological Posting and Control Per SBMS and 10 CFR 835
- Limit Power to P < 30 kW

In addition, Fault Study measurements conducted in accordance with an approved Fault Study Plan will provide confirmatory measurements of dose rates within the enclosure and will allow early identification of unexpected dose rates. The RSO will have the opportunity to modify Radiological Postings and Controls as needed based on Fault Study measurements to ensure compliance with SBMS and 10 CFR 835.

The 1A beamline shielding is massive like the beamline shielding for other instruments and will be configuration controlled in same fashion as used for all of the other beamlines. The probability of inadvertent removal of the configuration controlled, massive beamline shielding is not increased above that which already exits with other SNS beamline shielding.

b. Interim Shielding Configuration: The proposed Interim Shielding Configuration involves leaving the USANS T0 chopper installed and controlling the potential for excessive radiological exposures in the USANS instrument enclosure using shielding under RS Hold configuration control.

The probability of excessive radiation exposure due to unrestricted personnel access to the USANS instrument enclosures while the beam is on is minimized to insignificant levels by the layers of control identified in Section I.3.2 above. The following controls are capable of independently mitigating the accident scenario:

- Sample Shutter Locked Closed With Power Leads Locked Under Configuration Control
- Redundant Beam Plug Installed Under Configuration Control

There is no credible failure mechanism for the Sample Shutter once it has been visually verified to be closed and locking the power leads under RS Hold configuration control. The Sample Shutter moves in the horizontal plane only (i.e. does not rotate) and is driven by a screw drive assembly. There is no way to jolt or passively move the Sample Shutter without rotating the screw drive assembly.

Because there is not credible way for the Sample Shutter to open once closed and power to the drive system locked out (under RS Hold configuration control) and because the redundant shield plug will be installed and controlled as configuration controlled shielding, the probability of an excessive exposure accident within the USANS enclosure is not significant.

The passive nature of the Sample Shutter and Redundant Beam Plug; the limited duration of the Interim Shielding Configuration minimize the chances of an unforeseen error associated with the use of a non-standard beam line configuration.

Fault study measurements will be conducted to confirm predicted dose rates at low (P < 30 kw) and high powers (P ~ 400 kW to ~ 1 MW) and to identify any unexpected conditions. Fault Study measurements for the Interim Shielding Configuration will be conducted with the USANS T0 Chopper rotated to the OPEN position in order to confirm the projected worst case dose rates as described in Section I.3.2. Fault study radiation survey measurements, as described above, will characterize dose rates associated with a T0 Chopper and allow the RSO to ensure radiological postings and controls are appropriate for T0 Chopper open conditions.

Closing T0 chopper is considered a prudent measure because it reduces dose rates in the NOMAD tank enclosure to levels well below those anticipated for routine operations (i.e. USANS T0 Chopper rotating normally). The T0 chopper is designed to rotate freely. In absence of an analysis to the contrary, it is assumed to fail open for the purposes of this evaluation.

The potential for elevated dose rates within the NOMAD instrument persists with the Interim Shielding Configuration because the source of the radiation is beam scattering in the region adjacent to the NOMAD instrument where shielding is relatively thin due to geometric restrictions. Dose rates within the NOMAD instrument are unaffected by the Sample Shutter position or the Redundant Shield Plug in the USANS Instrument.

The probability of excessive radiation exposure due to personnel entry into the NOMAD tank enclosures with the Interim Shielding Configuration are minimized to insignificant levels by the layers of control identified in Section I.3.3 above. The worst case predicted dose rate (USANS T0 Chopper open) is 570 mrem/hr. The unmitigated consequence of inadvertent exposure at this rate for an entire 8 hour work day is below the 5 Rem annual dose limit of 10 CFR 835 and does not require a credited control per the SNS section of credited controls policy as described in the FSAD-NF [6]. Areas with dose rates of this magnitude are routinely controlled at ORNL under the provision of SBMS Radiological Safety. Therefore, the primary control to protect against overexposures, as identified in Section 3.3, is:

- Radiological Posting and Control Per SBMS and 10 CFR 835

In addition, Fault Study measurements conducted in accordance with an approved Fault Study Plan will provide confirmatory measurements of dose rates within the enclosure and will allow early identification of unexpected dose rates. The RSO will have the opportunity to modify Radiological Postings and Controls as needed based on Fault Study measurements to ensure compliance with SBMS and 10 CFR 835.

The massive instrument beamline shielding will be controlled in same fashion as used for all of the other beamlines. The probability of inadvertent removal of the configuration controlled massive beamline shielding is not increased above that which already exits with other SNS beamline shielding.

2. Could the change significantly increase the consequences of an accident previously evaluated in the FSADs? Yes__ No _x_

   Justification: Consequences of accidents previously evaluated in the FSADs are not increased. Consequences associated with accidental exposure in the USANS and NOMAD enclosures are orders of magnitude lower than those assumed in the FSAD-NF. Section 7.8 of the FSAD-NF assumes localized instrument beam dose rates on the order of 1,000 Rem/hr. Localized worst-case accident dose rate estimates associated with the Low Power Alignment Testing and the Interim Shielding Configuration are less than 2 R/hr at 2 MW. Consequences associated with inadvertent removal of beamline shielding are similar to those associated with the inadvertent removal of shielding at other beamlines.

3. Could the change significantly increase the probability of occurrence of a malfunction of equipment important to safety previously evaluated in the FSADs?

   Yes__ No _x_

   Justification: No, the probability of occurrence of a malfunction of equipment important to safety previously evaluated in the FSADs is not significantly increased by the proposed Low Power Alignment Testing or the Interim Shielding Configuration. The use of PPS interlocked trap keys for entry and RS Hold on devices such as the Sample Shutter and configuration control of shielding are commonly used mechanisms at SNS to control similar and greater radiological hazards and are described in the FSAD. The probability of a malfunction or failure of equipment important to safety in not significantly different from other applications of the same controls.

4. Could the change significantly increase the consequences of a malfunction of equipment important to safety previously evaluated in the FSADs?

   Yes__ No _x_

   Justification: Consequences of malfunction of equipment important to safety as evaluated in the FSADs are not increased. Consequences associated with malfunction of equipment leading to accidental exposure in the USANS and NOMAD enclosures are orders of magnitude lower than those assumed in the FSAD-NF. Section 7.8 of the FSAD-NF assumes localized instrument beam dose rates on the order of 1,000 Rem/hr. Localized worst-case accident dose rate estimates associated with the Low Power Alignment Testing and the Interim Shielding Configuration are less than 2 R/hr at 2 MW. Consequences associated with inadvertent removal of beam line shielding are similar to those associated with the inadvertent removal of shielding at other beam lines.

5. Could the change create the possibility of a different type of accident than any previously evaluated in the FSADs that would have potentially significant safety consequences?

   Yes__ No _x_

   Justification: The proposed Low Power Alignment Testing and the Interim Shielding Configuration do not create the possibility of a different type of accident than those evaluated in the FSADs that would have potentially significant safety consequences. No new types of accidents are created by the proposed activities; the basic accident scenarios associated with neutron beamlines remains excessive radiation exposure due to inadvertent exposure to prompt beam or beam-induced radiation.

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

   Yes__ No _x_

   Justification: No, the proposed Low Power Alignment Testing and Interim Shielding Configuration do not increase the possibility of a different type of malfunction of equipment important to safety than any previously evaluated in the FSADs. Equipment important to safety for this activity includes the trap key system and placement and configuration control of shielding. No new types of malfunctions are introduced; these equipment items are used across the SNS site to control similar and greater magnitudes of radiological hazards. Potential malfunctions (e.g. loss of control of shielding configuration or malfunction of PPS trap key system) are unchanged.

VI. USI Determination: A USI is determined to exist if the answer to any of the 6 questions above (Section V) is "Yes." If the answer to all 6 questions is "No", then no USI exists.

a. Does the proposed activity (or discovered condition) constitute a USI?

__ Yes – DOE approval required

_x_ No – Proposed activity may be implemented with appropriate internal review.

[signature] 2/5/2014

David Freeman, Qualified Preparer — Date

[signature] Feb 5, 2014

Mike Harrington, Qualified Reviewer — Date

[signature] 2/5/14

Paul Wright, PTS Team Leader — Date

[signature] Feb 5 2014

Don Gregory, SNS Radiation Safety Officer — Date

[signature] 2/5/2014

Ken Herwig, Instrumentation Projects & Dev. Mgr. — Date

[signature] 2-5-14

Glen Johns, Accelerator Operations Manager — Date

Approvals:

[signature] FEB-05-2014

Kevin Jones, RAD Division Director and SNS Operations Manager — Date

Appendix A. Figures

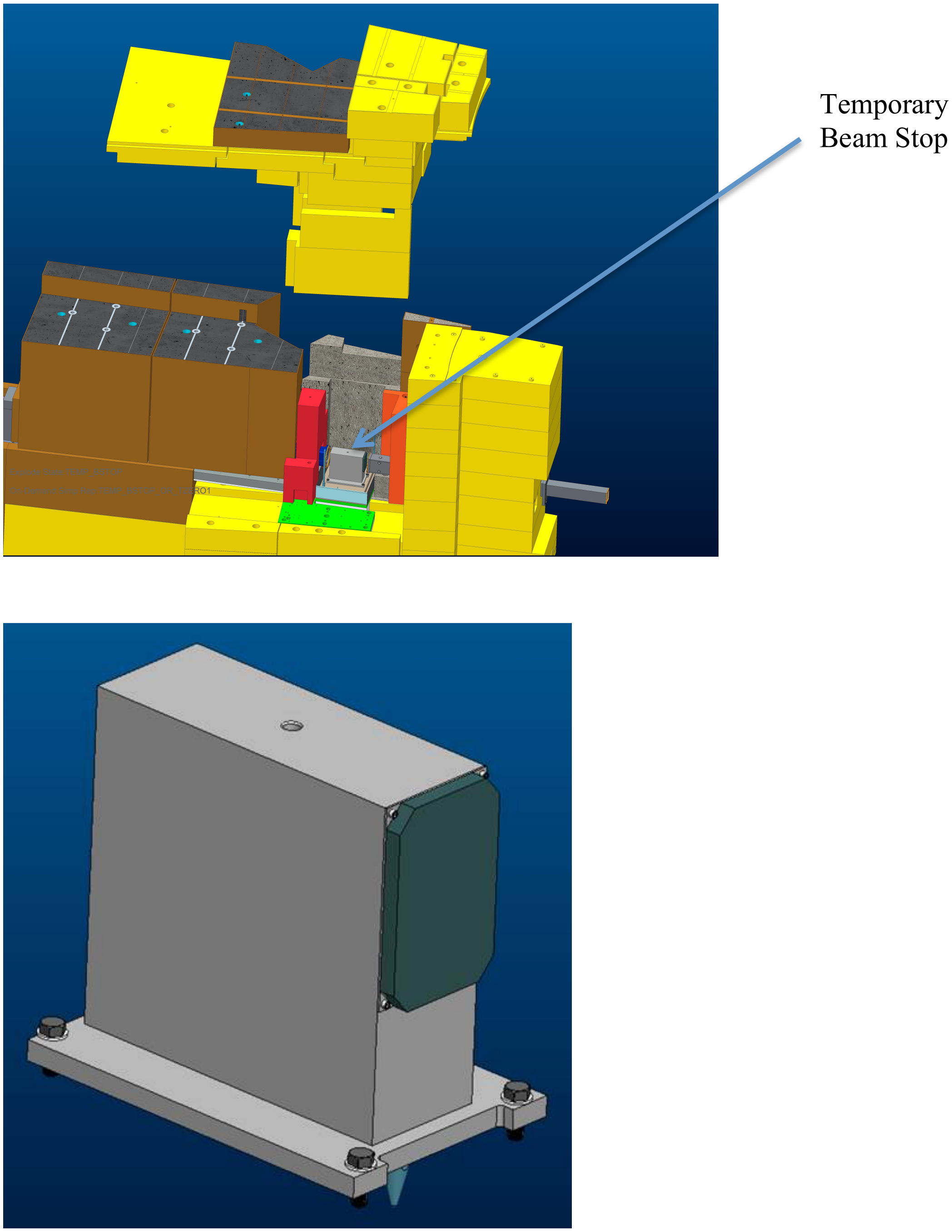

Figure 1. Temporary Beam Stop Currently Installed In USANS T0 Chopper Location

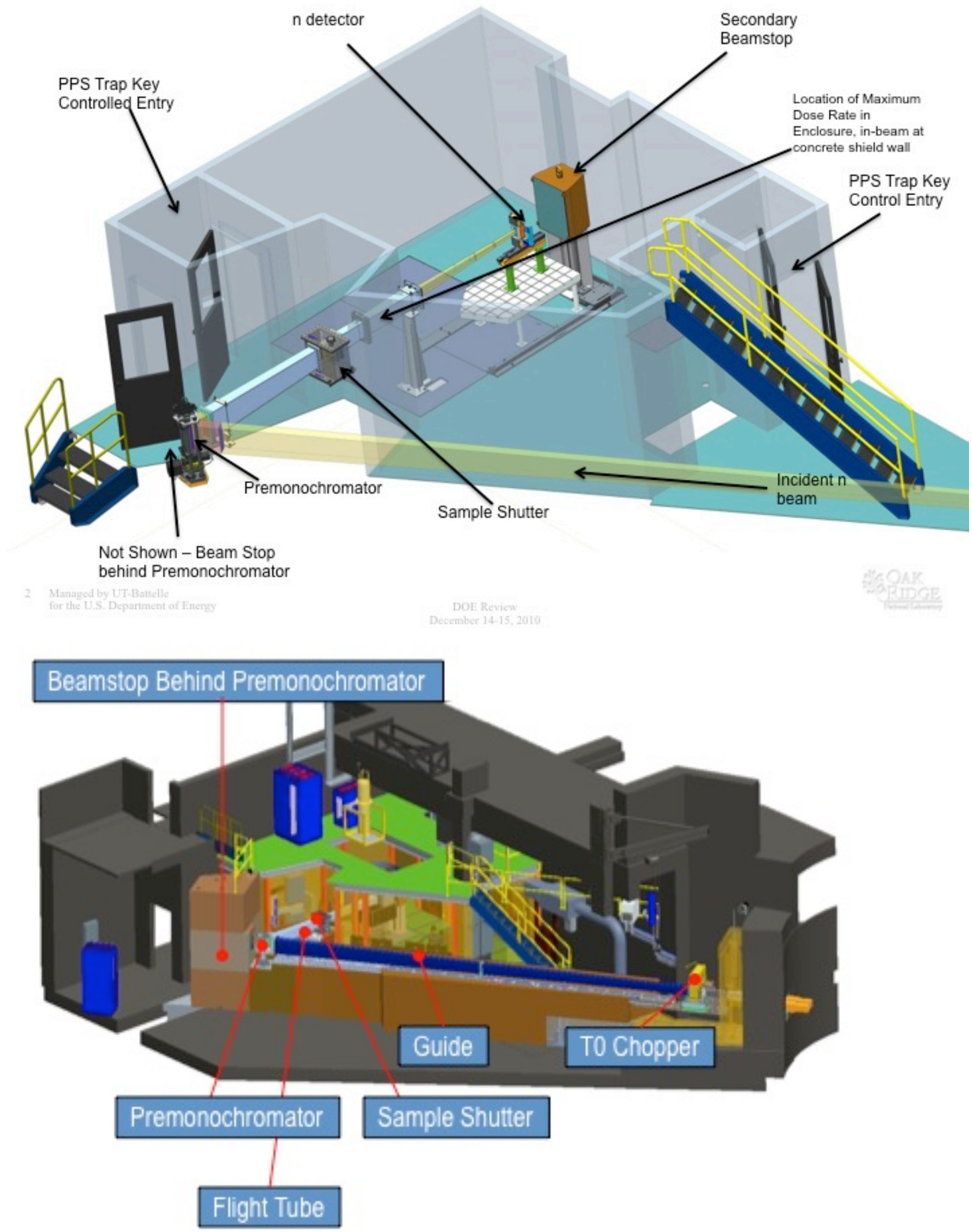

Figure 2. Depiction of BL 1A Beam Arrangement (Beamline Shielding is removed for clarity)

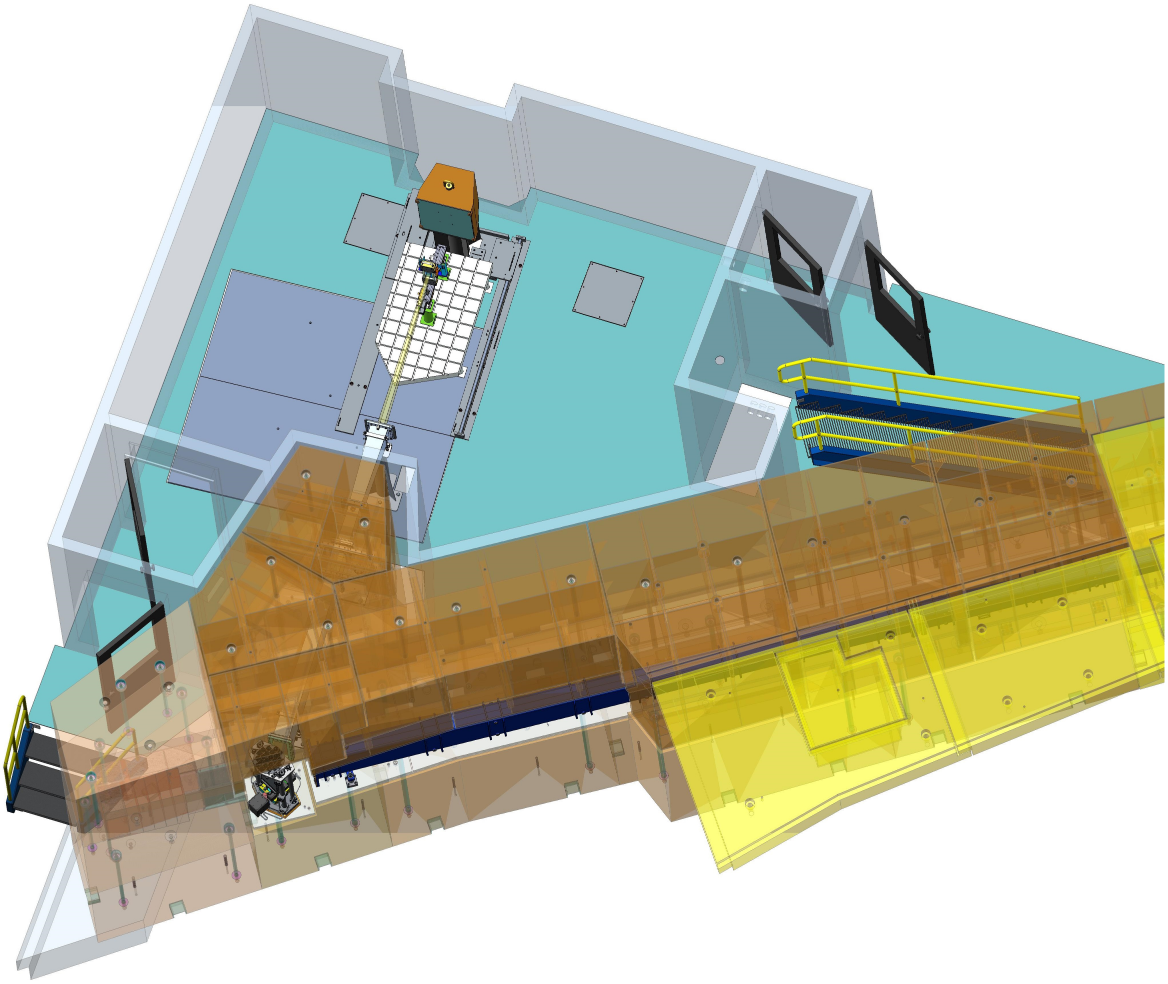

Figure 3. Depiction of Beamline 1 A Beam Arrangement with Beamline Shielding Shown

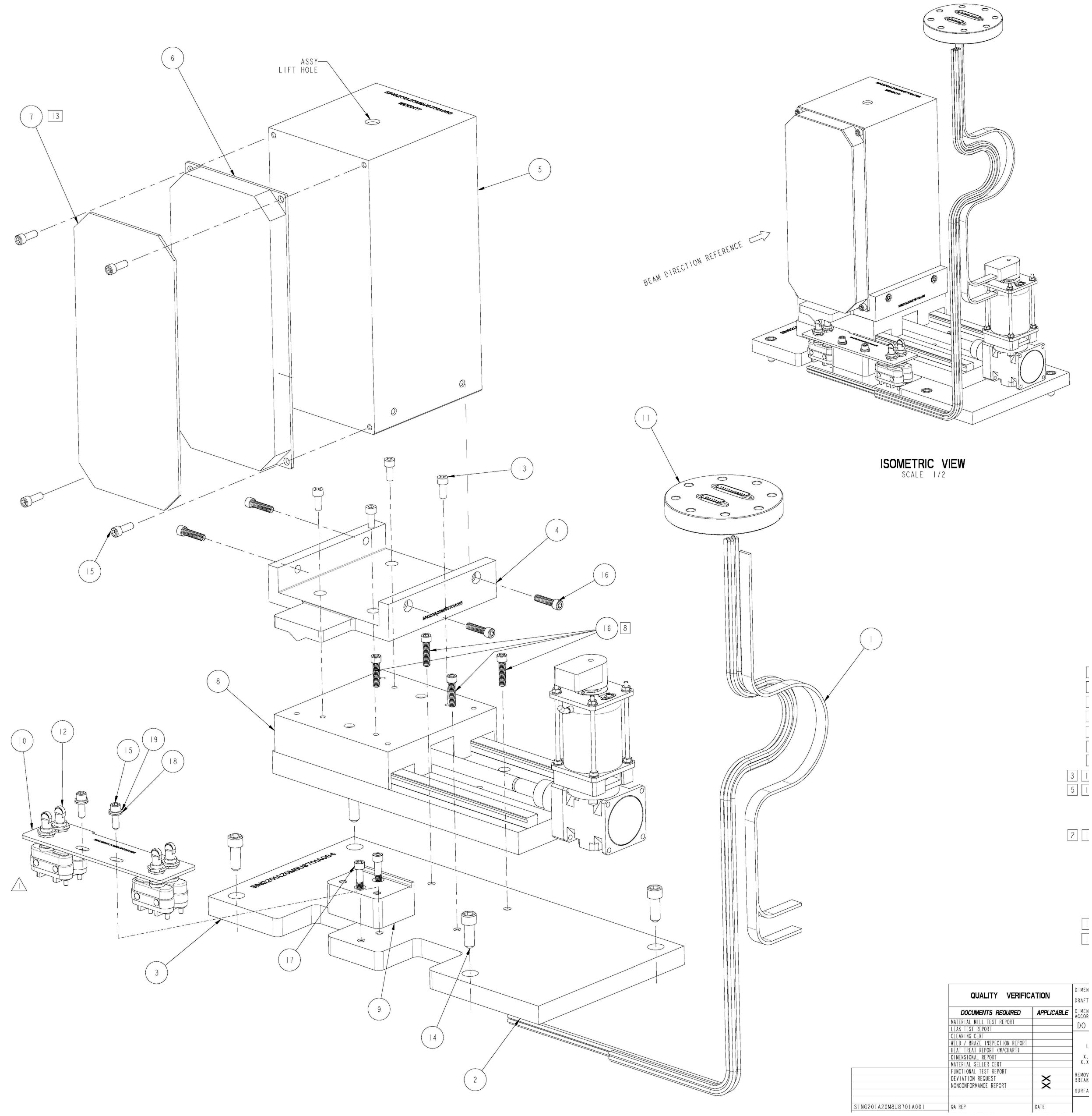

Figure 4. Sample Shutter (from drawing SING201A20M8U8701A081, Rev 1)

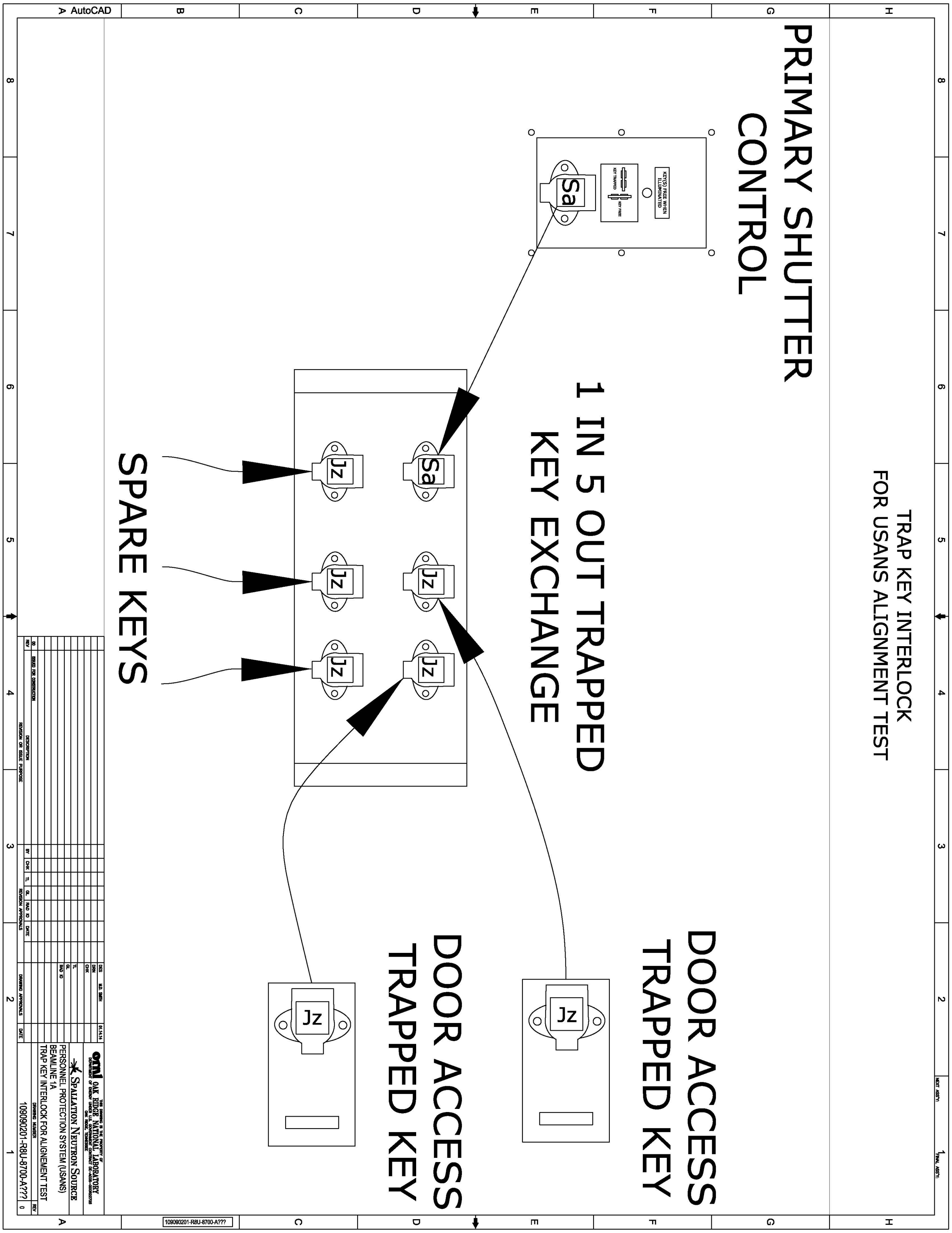

Figure 5. Schematic depiction of the PPS Trap Key Exchange Station

Figure 6. PPS Trap Key Door Lock Mechanism with Jz Key Installed on USANS Instrument Enclosure South Side Entry Door

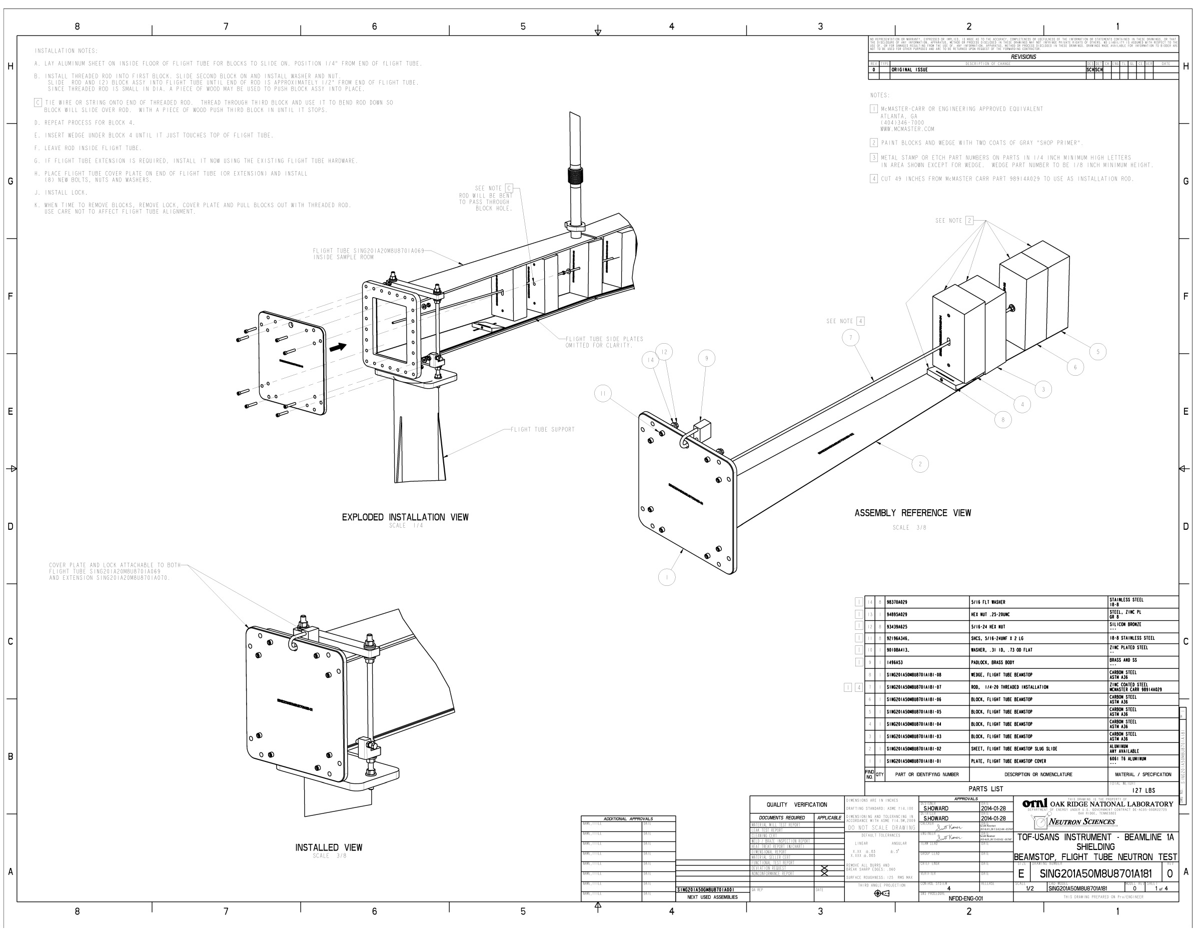

Figure 7. Redundant Shield Plug (SING 201A50M8U8701-R00)