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

**I. Title of USI Evaluation**:

USI Evaluation for Modifications to Beam Line 16B VISION Secondary Shutter Deceleration Switches.

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

It is proposed to modify two of the secondary shutter position indicator switches (deceleration switches) mounted on the Beamline 16B VISION secondary shutter. Specifically, it is proposed to:

1. Change the mounting locations of the deceleration switches from inside of the secondary shutter cavity to the side of the secondary shutter cavity; and

2. Change the type of switch used from the existing Honeywell Model 3HT1 switch to a Honeywell GL Series Model GLAA07A1B switch which is compatible with the proposed mounting scheme.

The existing mounting arrangement has been operationally problematic, very difficult to service and has caused significant instrument downtime. Alignment of the deceleration switches is difficult and slight misalignment can lead to the deceleration switches being damaged by the secondary shutter movable block. Figure 1 shows the lower deceleration switch and shows some bending of the mounting bracket that has been caused by slight misalignment. The proposed modifications are designed to provide a more robust and reliable switch arrangement that will additionally be more convenient to service.

The two secondary shutter deceleration switches are designed to actuate when the secondary shutter nears its end of travel towards the open or closed position. The switches are mounted such that it is actuated by shutter block as it nears end of travel in either the open or closed direction. The switches provide a signal to a PPS PLC that then sends a control signal to the servo drive power electronics to slow down the rate of travel of the secondary shutter for the purpose of preventing damage to shutter components. Because of their functionality, these switches are referred to as “deceleration switches.”

The deceleration switches are interfaced with PPS PLCs that control the speed of the secondary shutter drive mechanism. The deceleration switches provide no safety function and are designed to help protect equipment. In other neutron beamlines, the PPS does not control the movement of the secondary shutters but rather interfaces with non-PPS non-safety related control systems. As described below, the PPS safety function related to the secondary shutter is to control access into the instrument areas based on the secondary shutter open/closed status. For convenience, shutter movement control was integrated into the PPS logic for this beamline.

The secondary shutter is integrated with the Personnel Protection System to prevent excessive radiation exposure to personnel for routine access to the BL 16B sample or detector cave. When access to the cave is desired personnel first close the secondary shutter using the secondary shutter controls located in the IPPS local panel. An electric DC servo motor screw drive located on the secondary shutter moves the Inconel shutter block vertically up to block the neutrons (see Figure 3). The position of the shutter block is determined by redundant sets IPPS position

monitoring switches, two for the open position and two for the closed position (See Figures 1 and 2). The safety functionality of Secondary Shutters and PPS monitoring and control of Secondary Shutter position are addressed in the FSAD-NF in sections 3.3.8.3.1 *Target Personnel Protection System*, 3.3.8.3.2 *Instrument Personnel Protection System*, 3.3.13.2, *Neutron Beamline Components*, and 3.3.13.4 *Shutters*. With beam on target and BL 16 Primary Shutter in the open position, the PPS provides the credited safety function of controlling access into BL 16B instrument areas. The secondary shutter must be in the closed position in order for the PPS to allow access into the instrument areas. The PPS prevents access into the instrument areas unless the secondary shutter is closed. If the secondary shutter moves out of the closed position with access allowed into the instrument areas, a signal is sent to close the primary shutter and if the primary shutter fails to close within the requisite time, a trip signal is generated to shut off beam on target. These credited and essential functions of the PPS rely on dedicated redundant Open and Closed shutter position switches mounted at the top (Closed) and bottom (Open) of the secondary shutter cavity as shown in Figures 1 and 2. The PPS Open and Closed position switches are separate and distinct from the deceleration switches described above. The safety related PPS Open and Closed position switches are not affected by the proposed modifications to the deceleration switches.

As shown in Figure 3, when the secondary shutter is in the up position, the Inconel shield plug blocks the neutron beam. When the secondary shutter is in the down position, it rests on kinematic mounts for precise positioning with the opening aligned with the beam path to allow the neutron beam to pass.

The secondary shutter screw drive is also equipped with beyond-end-of-travel switches that provide indication that the secondary shutter has traveled beyond its intended range of travel in the up or down direction. The beyond-end-of-travel switches are interfaced with the PPS PLC that shuts off the drive upon actuation of the beyond-end-of-travel switches to protect the equipment. The beyond-end-of-travel switches serve no credited safety function and are not affected by the proposed modifications to the deceleration switches.

The deceleration switches are presently mounted inside of the secondary shutter cavity in close proximity to the redundant PPS Open and Close position switches that provide the credited safety function as shown in Figures 1 and 2. Figure 1 show the lower deceleration position switch and the lower redundant PPS Open position switches that provide the credited safety function. Figure 2 shows the upper switches. As the shutter moves from the up to down position, it first contacts the deceleration switch, sending a signal to the PPS controller to slow the rate of travel. When the shutter is in the down (Open) position, it sits on and depresses the redundant PPS credited safety position switches.

It is proposed to remove the existing deceleration switches (Honeywell Model 3HT1) and their mounting brackets and to replace the switches with Honeywell GL Series Model GLAA07A1B switches mounted to on the side of the secondary shutter cavity as shown in Figure 4. Mounting the deceleration switches on the side of the shutter cavity will allow for ease of access and adjustment and the new type of switch is appropriate for the side mounting configuration and will be not require as precise alignment as the existing switches due to the design of the actuating arm.

Spec sheets for the existing and proposed new switches are provided in the Appendix. A

summary of characteristics follows:

- Honeywell Model 3HT1 rated at 3 A @ 250 V and rated to temperature of 538 C
- Honeywell GL Series Model GLAA07A1B rated at 1 to 100 mA and 50 V and rated to temperature of 85C

The specifications for the new switch have been reviewed and determined to be electrically compatible with the circuitry [1]. The existing wiring will be used with the new switches. The wiring will be moved from the Normally Open contacts of the existing switches to the Normally Open contacts of the new switches. The wiring diagram (provided in Appendix) will not be changed and no changes will be required to the PPS PLC logic.

It should be noted that the redundant PPS Open and Close position switches that provide the credited safety functionality are firmly mounted in a vertical orientation (see Figures 1 and 2) within the secondary shutter cavity housing and are not susceptible to similar dres as has been experienced with the deceleration switches which were mounted horizontally on the interior mounting bracket.

**Inspection and Post Maintenance Testing**

A DataStream Work Request and associated Work Order have been created to perform the installation and testing of the proposed deceleration limit switches. Work Order 1356890 is the work control task for performing this work. An associated electronic modification request, EMOD, has also been generated to track and define the work as it progresses through the engineering process.

A Level 1 work order (1361464) contains requirements for inspection and post maintenance testing or the new switches after they are installed. This work order contains the following requirements that must be completed before the IPPS is returned to service:

Inspection

- Verify new deceleration switches are installed and mounted securely
- Verify deceleration switches are correctly wired to IPPS PLC inputs
- Verify existing PPS end of travel switches and separate wiring harness has not been impacted by repair activities

Post Maintenance Testing

- Restore IPPS power and verify shutter goes full travel open and closed and the PPS end switches correctly indicate the open and closed status
- Verify the shutter engages the new deceleration switches and the motor drive slows down at the end of shutter travel both open and closed
- Cycle the shutter ten times open/ closed
- When the shielding is re-stacked cycle the shutter five times while checking end of travel and deceleration switch status to ensure that the shutter/ shutter wiring was not damaged after the shielding was installed.

**References**

1. Email from Aaron Coleman to Paul Wright, "RE: draft USI for BL 16B deceleration switch", January 30, 2014, 5:01 pm.
2. Email from Aaron Coleman to George Dodson and Paul Wright, "RE: draft USI for BL 16B deceleration switch", February 3, 2014, 3:43 pm.
3. Drawings:
    a. SING216B20M8U8716A231_R04
    b. SING216B20M8U8716A350_R00
    c. SING216B20M8U8716A438_R01
    d. SING216B20M8U8716A439_R01
    e. 109090201-R8U-8700-A719_R00

**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 modifications to the deceleration switches do not affect information presented in the FSADs. The deceleration feature of the secondary shutter is a non-safety function designed to prevent damage to the shutter components that is not addressed in the FSADs. The safety functionality of Secondary Shutters and PPS monitoring and control of Secondary Shutter position are addressed in the FSAD-NF in sections 3.3.8.3.1 *Target Personnel Protection System*, 3.3.8.3.2 *Instrument Personnel Protection System*, 3.3.13.2, *Neutron Beamline Components*, and 3.3.13.4 *Shutters*. No FSAD revisions are needed to support the proposed modification of the deceleration switches because safety is not impacted.

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

The proposed modifications to the deceleration switches do not affect any of the requirements of the ASE. ASE requirements for the PPS are provided in ASE Section 3.2 Personnel Protection System. No ASE revisions are needed to support the proposed modification of the non-safety related deceleration switches.

**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**:

   The proposed modifications to the BL 16B deceleration switches will have no impact on the probability of occurrence of FSAD evaluated accidents. The deceleration switches serve no safety related function. The proposed modifications to the deceleration switches have no impact on the safety functions associated with the BL 16B secondary shutter.

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

   **Justification**: The proposed modifications to the BL 16B deceleration switches will have no impact on the consequences of FSAD evaluated accidents. The deceleration switches serve no safety related function. Consequences of accidents related to the secondary shutter, that is, potential excessive radiological exposure to individuals entering the BL 16B instrument areas are unchanged by the proposed modification to the deceleration switches. The proposed modifications to the deceleration switches have no impact on the safety functions associated with the BL 16B secondary shutter.

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**: The proposed modifications to the BL 16B deceleration switches will not increase the probability of occurrence of a malfunction of equipment important to safety as evaluated in the FSADs. The decelerations switches interface with the PPS PLC and are physically located in the same general vicinity as the PPS redundant OPEN and CLOSED position indicator switches that serve a credited safety function of protecting individuals from excessive radiation exposure when entering the BL 16B instrument.

   The deceleration switches serve no safety related function; however they do directly interface with the PPS PLC. The deceleration switches are electrically passive components and do not have any self-contained energy storage or power generating components, which could adversely affect the operation of the PLC system [1].

   Identified potential failure modes of the deceleration switches are discussed below:

   1. One or both deceleration switch fails in the closed position. This failure mode would impact the desired control of the secondary shutter movement; however, will not impact the credited safety function of the secondary shutter which is based on the redundant OPEN and CLOSED PPS position monitoring switches. The redundant OPEN and CLOSED PPS position monitoring switches and associated PPS PLC logic that executes the credited safety functionality will be unaffected by this failure mode.

   2. One or both deceleration switch fails in the open position. This failure mode would impact the desired control of the secondary shutter movement; however, will not impact the credited safety function of the secondary shutter which is based on the redundant OPEN and CLOSED PPS position monitoring switches. The redundant OPEN and CLOSED PPS position monitoring switches and associated PPS PLC logic that executes the credited safety functionality would be unaffected by this failure mode.

   3. One or both deceleration switch mechanism becomes damaged (e.g. badly bent, torn off mounts, shorted to ground, etc.). This failure mode most likely would lead to a persistent “always open” or “always closed” conditions as was addressed in items 1 and 2 above. If the switch mechanism becomes dislodged or torn from its mounts it most likely would fall downward from its position and dangle or fall from its wiring cable. The probability that such an event could lead to potential interferences with the safety functionality of the redundant PPS Open or Closed position monitoring switches is reduced by the proposed relocation of switches to outside of secondary shutter cavity because the new mounting positions are further removed from the redundant PPS safety credited switches and are mounted on a different face of the secondary shutter cavity (see Figures 1, 2, and 3). Should the switches become damaged such that one or both legs become shorted to ground the PPS input module would be protected from any significant damage because the input module has short circuit protection [1, 2]. The wiring configuration for the deceleration switches is

such that the switches are wired as a current sourcing output type in which the current is short circuit protected out to the field device [1].

4. Deceleration switch wiring damaged (severed, shorted to ground, etc.). The existing wiring will be used with the proposed modification in the deceleration switches. The probability of the wiring being damaged by the moving secondary shutter is reduced because the switch mounting locations have been moved from inside of the secondary shutter cavity to the side of the cavity away from the moving components (see Figures 3 and 4). Damage to the deceleration switch wiring would likely lead to either a persistent "open" or "closed" signal or being sent to the PPS PLC controller. This failure mode would impact the desired control of the secondary shutter movement; however, will not impact the credited safety function of the secondary shutter which is based on the redundant OPEN and CLOSED PPS position monitoring switches. The redundant OPEN and CLOSED PPS position monitoring switches and associated PPS PLC logic that executes the credited safety functionality would be unaffected by this failure mode. Should one or both of the deceleration switch wires become shorted to ground the input module would be protected from any significant damage because the PPS input module has short circuit protection [1]. The wiring configuration for the deceleration switches is such that the switches are wired as a current sourcing output type in which the current is short circuit protected out to the field device [1].

Overall, the proposed modifications to the decelerations switches will not increase the probability of a malfunction of the PPS safety credited functionality with regard to the secondary shutter. The probability of the deceleration switches becoming dislodged and potentially impacting the safety functionality of the redundant PPS OPEN and CLOSED position switches is decreased by the proposed mounting location on the side of the secondary shutter cavity.

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 affected by the proposed modifications to the deceleration switches. Consequences associated with malfunction of the PPS equipment leading to accidental exposure in the BL 16B instrument remain unchanged and are not affected by the proposed changes to the deceleration switches. Potential malfunctions of the deceleration switches have no impact on safety.

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 modifications to the deceleration switches do not create the possibility of a different type of accident with potentially significant consequences. The deceleration switches perform no safety related functions. Failure the deceleration switches could potentially lead to equipment damage, but do not create the possibility any accident with significant safety consequences. The proposed mounting of the deceleration switches further remove them away from the redundant OPEN and CLOSED PPS position monitoring switches that provide the credited safety functionality making them less likely to have an unforeseen potential interference with their safety related functionality.

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 modifications to the deceleration switches do not increase the possibility of a different type of malfunction of equipment important to safety than those evaluated in the FSADs. Failure the deceleration switches could potentially lead to equipment damage, but do not introduce a different type of malfunction to the PPS safety functionality associated with the secondary shutter. Potential malfunctions of the deceleration switches have no impact on safety.

**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.

David Freeman, Qualified Preparer — Feb 3, 2014 — Date

Mike Harrington, Qualified Reviewer — 2/3/2014 — Date

Paul Wright, PTS Team Leader — 2/4/14 — Date

Bobby Cross, SNS Instrument Operation Manager — 2.4.2014 — Date

**Approvals:**

Kevin Jones, RAD Division Director and SNS Operations Manager — 02.04.2014 — Date

# Appendix A. Figures

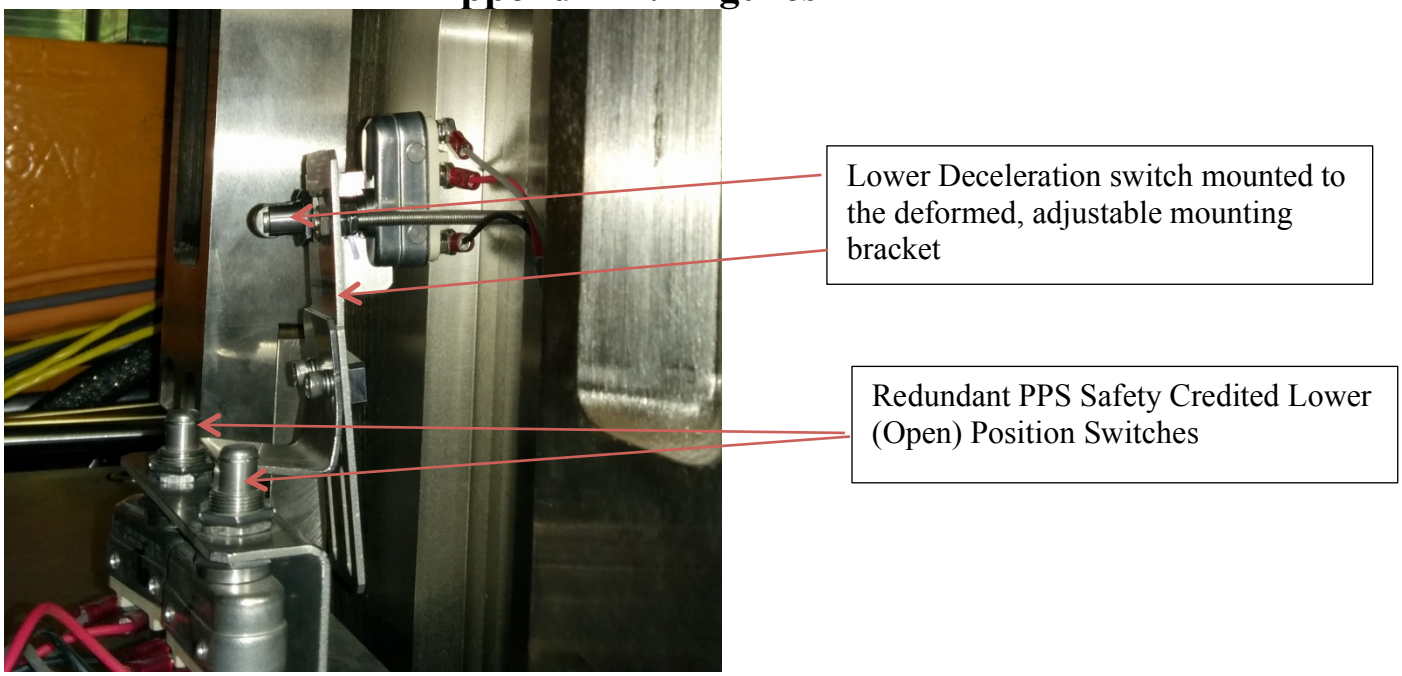


**Figure 1. Existing Switch Arrangement Showing the Redundant OPEN PPS and Lower Deceleration Switch** (Note that the mounting bracket for the "down" position deceleration switch has been deformed due to improper alignment causing improper operation of the switch.)

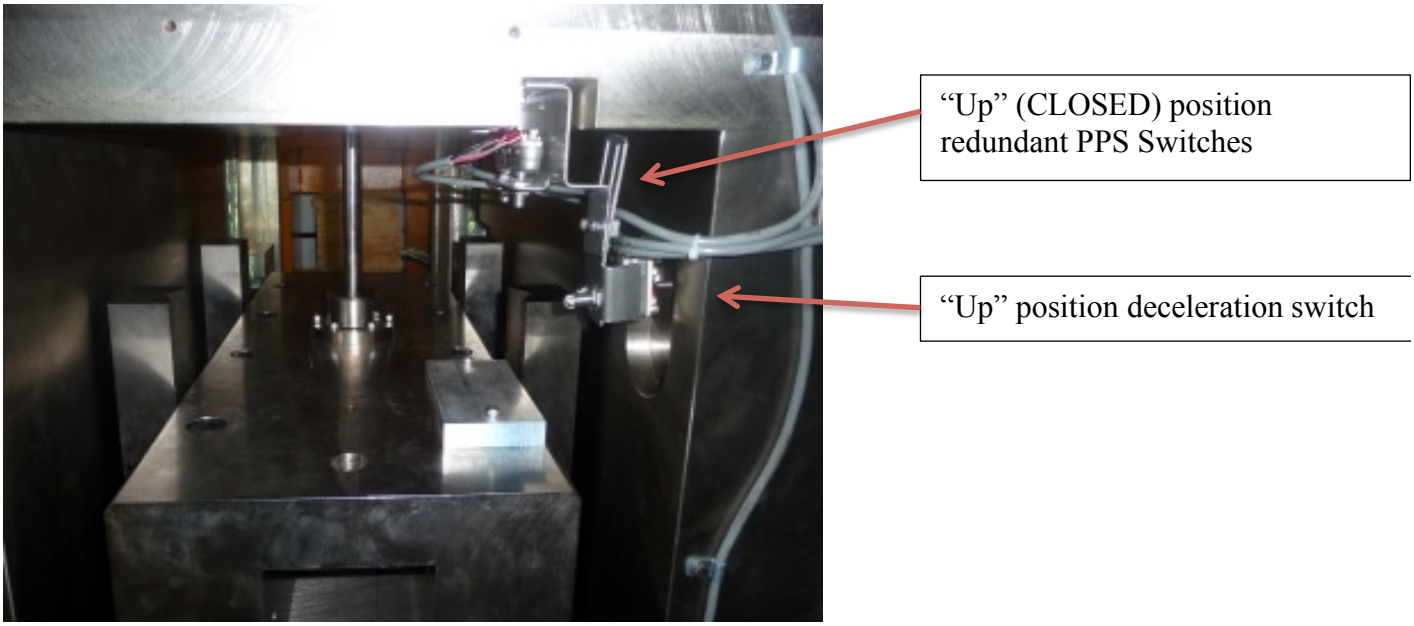


**Figure 2. Existing Switch Arrangement Showing the Redundant CLOSED PPS and Lower Deceleration Switch**

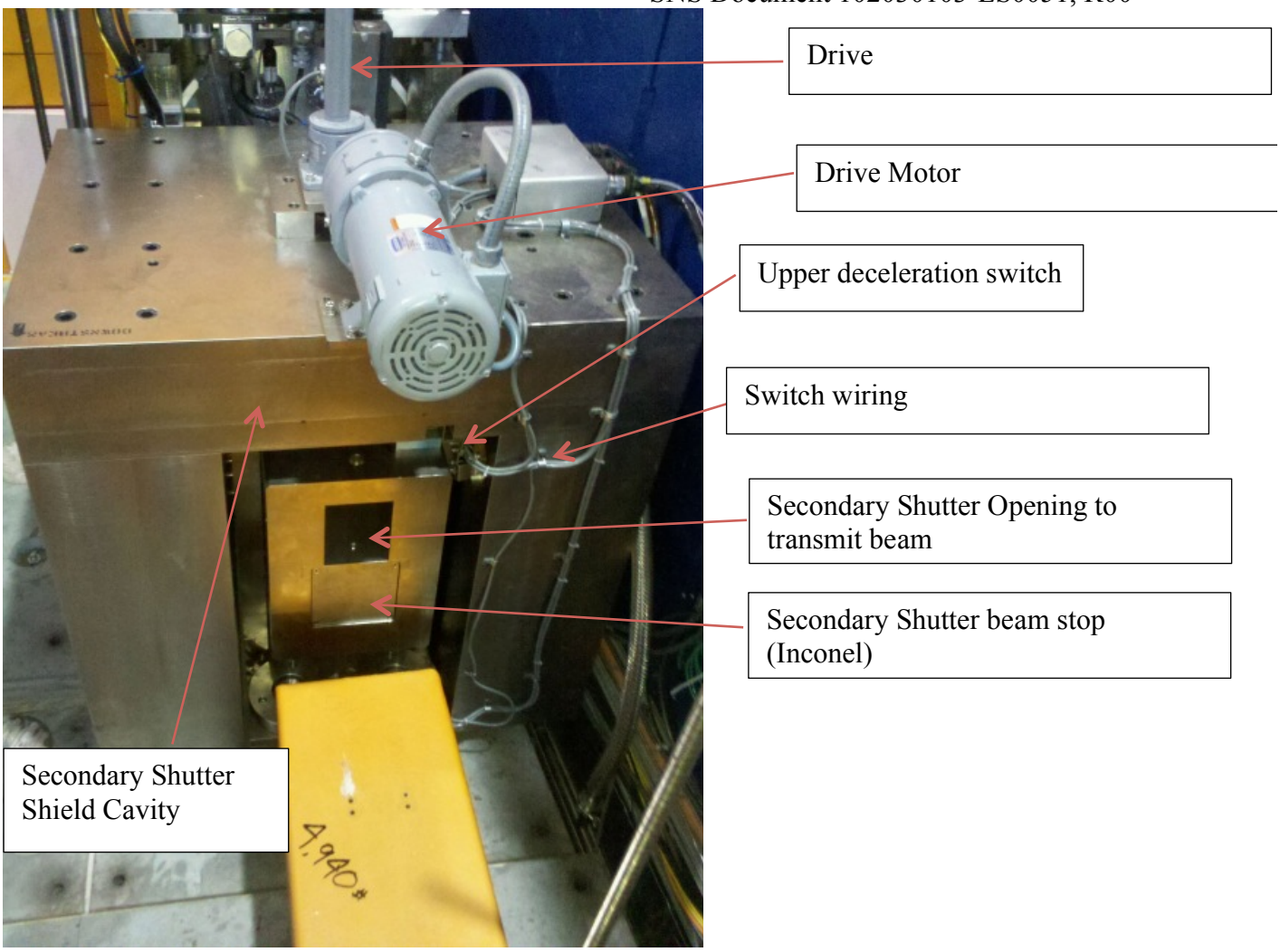


**Figure 3. Secondary Shutter/Shield Cavity.**

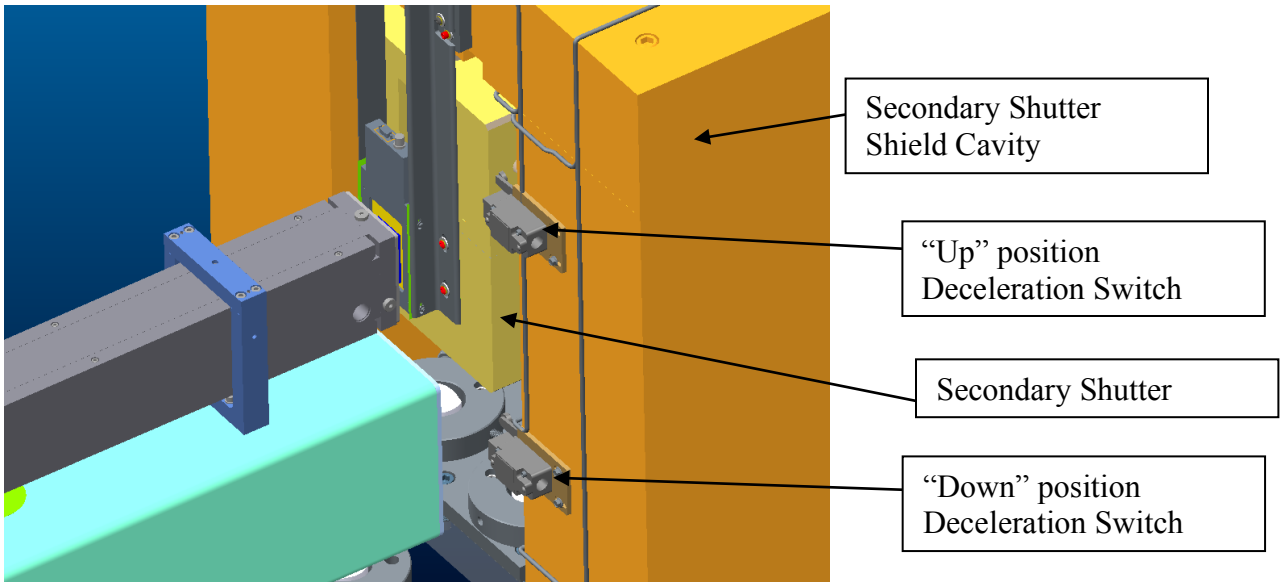


**Figure 4. Proposed Deceleration Switch Configuration and Location**