Jefferson Lab
Thomas Jefferson National Accelerator Facility

Operational Safety Procedure Form

(See ES&H Manual Chapter 3310 Appendix T1 Operational Safety Procedure (OSP) and Temporary OSP Procedure for instructions.)

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Title:	UITF Cave2 ceiling roof tile removal		
Location:	Upgraded Injector Test Facility (UITF) located in the Test Lab High Bay Area, rooms 1125 – 1127	**Type:**	[X] **OSP** ☐ **TOSP**
Risk Classification (per Task Hazard Analysis attached) (See *ESH&Q Manual Chapter 3210 Appendix T3 Risk Code Assignment*.)		**Highest Risk Code Before Mitigation**	3
		Highest Risk Code after Mitigation (N, 1, or 2):	1
Owning Organization:	Accelerator Division	**Date:**	June 12, 2019
Document Owner(s):	Matt Poelker		

DEFINE THE SCOPE OF WORK

1. Purpose of the Procedure – Describe in detail the reason for the procedure (what is being done and why).

By design, there are sources of ionizing radiation inside the Upgraded Injector Test Facility (UITF) enclosure. The Cave2 concrete roof tiles protect personnel outside the UITF enclosure from being exposed to harmful levels of ionizing radiation, but these roof tiles are also designed to be removed to permit installation or removal of large equipment such as the HDIce polarized target and the Quarter Cryomodule (QCM). This OSP describes the steps that must be taken to ensure there is no possibility of generating ionizing radiation inside UITF enclosure when the Cave2 roof tiles are temporarily removed.

This OSP also describes the procedure for safely removing and re-installing ceiling tiles, and addressing the necessary aspects of fall protection.

The UITF can function as a gun test stand, when beam energy does not exceed the bias voltage applied to the photogun. Or it can operate as an accelerator, when beam is accelerated to an energy that exceeds the potential energy applied to the gun. For the purposes of hazard assessment, FSAD Rev. 8* considers all the hazards associated with the UITF and specifies required mitigations. Hazards associated with operation of the UITF as an accelerator require the use of credited controls. Those credited controls are identified in the FSAD Rev. 8 and incorporated into the UITF Accelerator Safety Envelope (ASE). The requirements for operating the UITF as an accelerator are incorporated in other OSPs that address the relevant hazards and mitigations associated with both operation as a Gun Test Stand and as an operational accelerator as specified in the ASE.

* Final Safety Assessment Document Rev 8 https://jlabdoc.jlab.org/docushare/dsweb/Get/Document-160467/FSAD%20Rev8%2011%202018%20with%20signature.pdf

2. Scope – include all operations, people, and/or areas that the procedure will affect.

As stated above, the Cave2 roof tiles are designed to be removed to permit the installation and removal of large equipment at UITF. Figure 1 shows an example - the installation of the HDIce polarized target which will be used at Hall B pending successful tests at UITF. The QCM is another large device that will eventually be removed from the UITF enclosure via the removable roof at Cave2.


Figure 1: (left) the HDIce target "in-beam-cryostat" being craned into the UITF enclosure through a hole in the Cave2 rooftop, (right) workers testing the fit-up of cryogenic plumbing on the the HDIce target – notice the absence of the Cave2 roof tiles above the HDIce target.

The roof tiles represent an essential "credited control" that protect personnel outside the UITF enclosure from being exposed to harmful levels of ionizing radiation produced when energetic electrons strike materials. Inside the UITF, energetic electrons are produced by a dc high voltage photogun operating at bias voltage up to 450 kV, and these electrons can be accelerated to MeV energy using the QCM. In addition to the intentionally-produced electron beam from the photogun and accelerated by the QCM, energetic field-emitted electrons can be produced by the photogun, the buncher and the QCM and this inadvertent energetic electron beam can also produce ionizing radiation. When Cave2 roof tiles are removed, steps must be taken to ensure there is no possibility of producing ionizing radiation inside UITF. Specifically, the following devices must be de-energized and locked out in accordance with approved Jefferson Lab Lock, Tag and Try policy:

- the photogun DC high voltage power supply
- the "cathode power supply" that permits operation of the high power amplifier and klystrons that drive the QCM
- the high power solid state amplifier that powers the 748.5 MHz buncher cavity

This OSP describes the steps that must be taken to ensure no ionizing radiation can be produced inside the UITF enclosure when Cave2 roof tiles are removed, and the steps that must be taken before UITF operations can resume once the roof tiles are replaced.

In addition, this OSP addresses the important aspects of fall-protection during tile removal and re-installation.

3. Description of the Facility – include building, floor plans and layout of the experiment or operation.

Global description of UITF composed of Cave 1 and Cave 2:

The location of UITF is the High Bay Area of the Test Lab building 58. Figures 2, 3 and 4 show the UITF layout and identify Caves 1 & 2, which are convenient designations referencing old and new test areas, respectively. The removable ceiling tiles are located at Cave2.

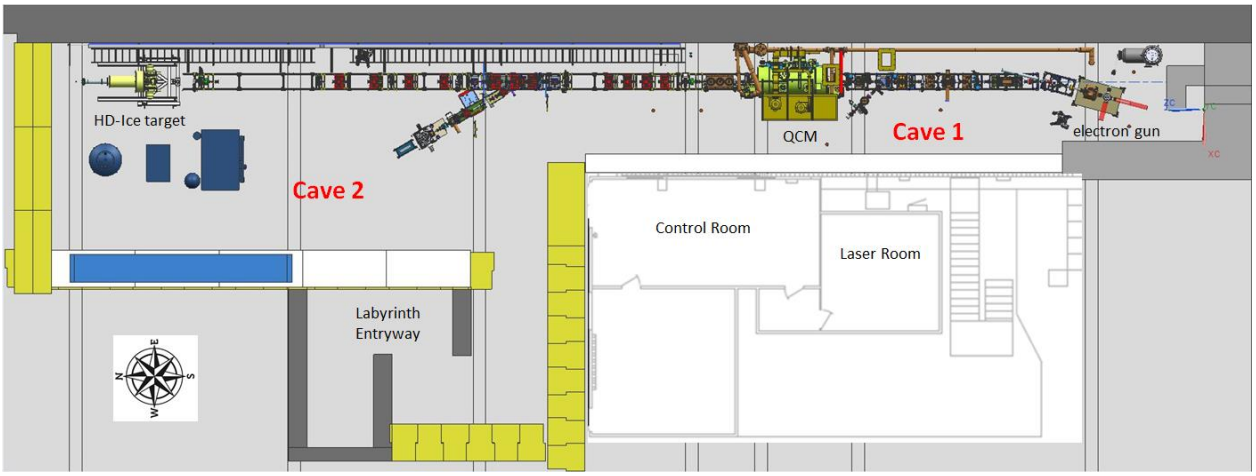


Figure 2: UITF enclosure composed of two "Caves". Ceiling tiles above Cave2 can be removed to install or remove large equipment at the UITF enclosure.

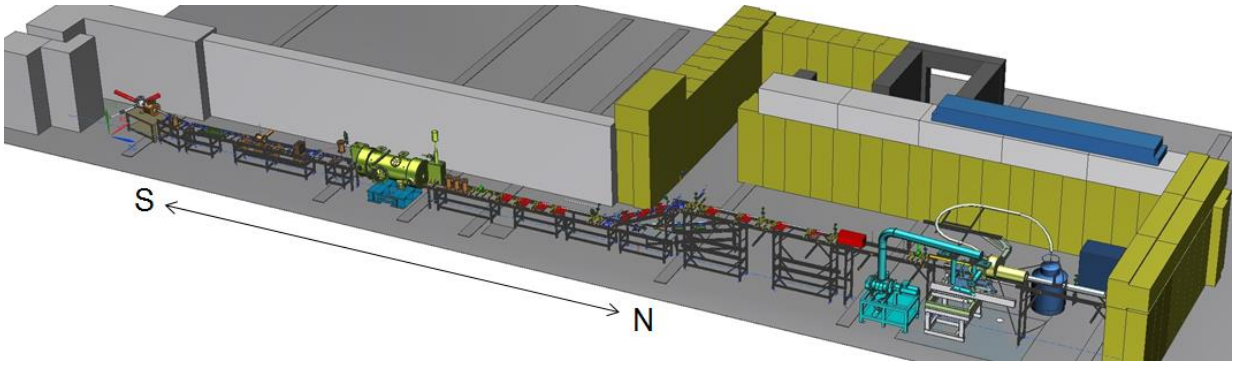


Figure 3: UITF layout showing the main entrance/exit via a labyrinth that leads to the high bay area of the Test Lab High Bay at building 58. The gun high voltage power supply is located inside Cave1, near the photogun at the southern-most location of the UITF enclosure.

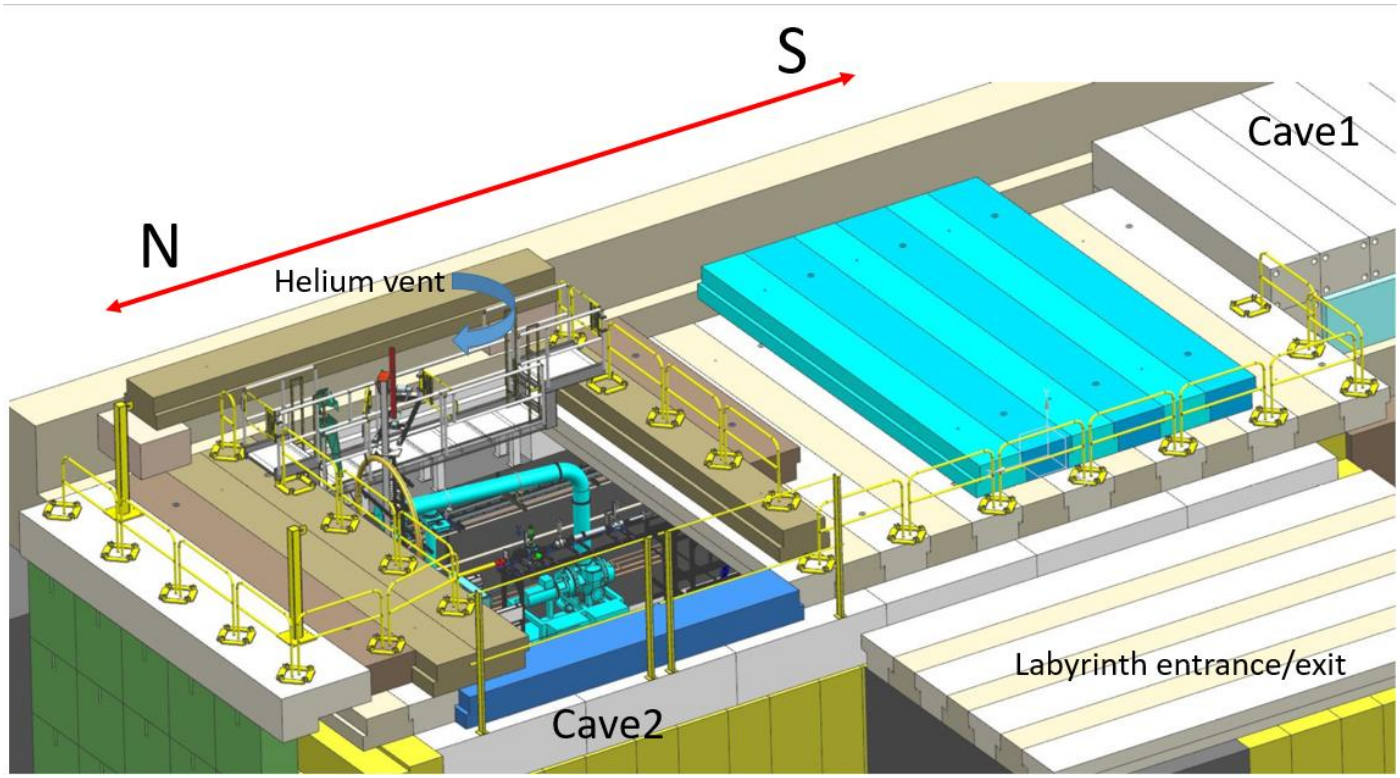


Figure 4: UITF showing the Cave2 rooftop: the ceiling tiles near the helium exhaust vent of Cave2 can be removed, as shown. Electronics racks are located above Cave 1, including RF power supplies relevant to this OSP, although the racks are not shown in the figure.

Location of devices that must be de-energized and locked out, to prevent the generation of ionizing radiation when Cave2 roof tiles are removed

The photogun resides in Cave1, at the southern-most end of the UITF enclosure. A high voltage power supply resides next to the photogun inside an SF6 pressure vessel - high voltage is applied to the cathode electrode of the photogun using a high voltage cable. Figure 5 shows the photogun at Cave1 and the electrical breaker panel from which the dc high voltage power supply is energized. This breaker panel is located on the west wall of the UITF enclosure approximately 2 m from the photogun. A voltage verification unit is part of the gun high voltage power supply AC circuit.

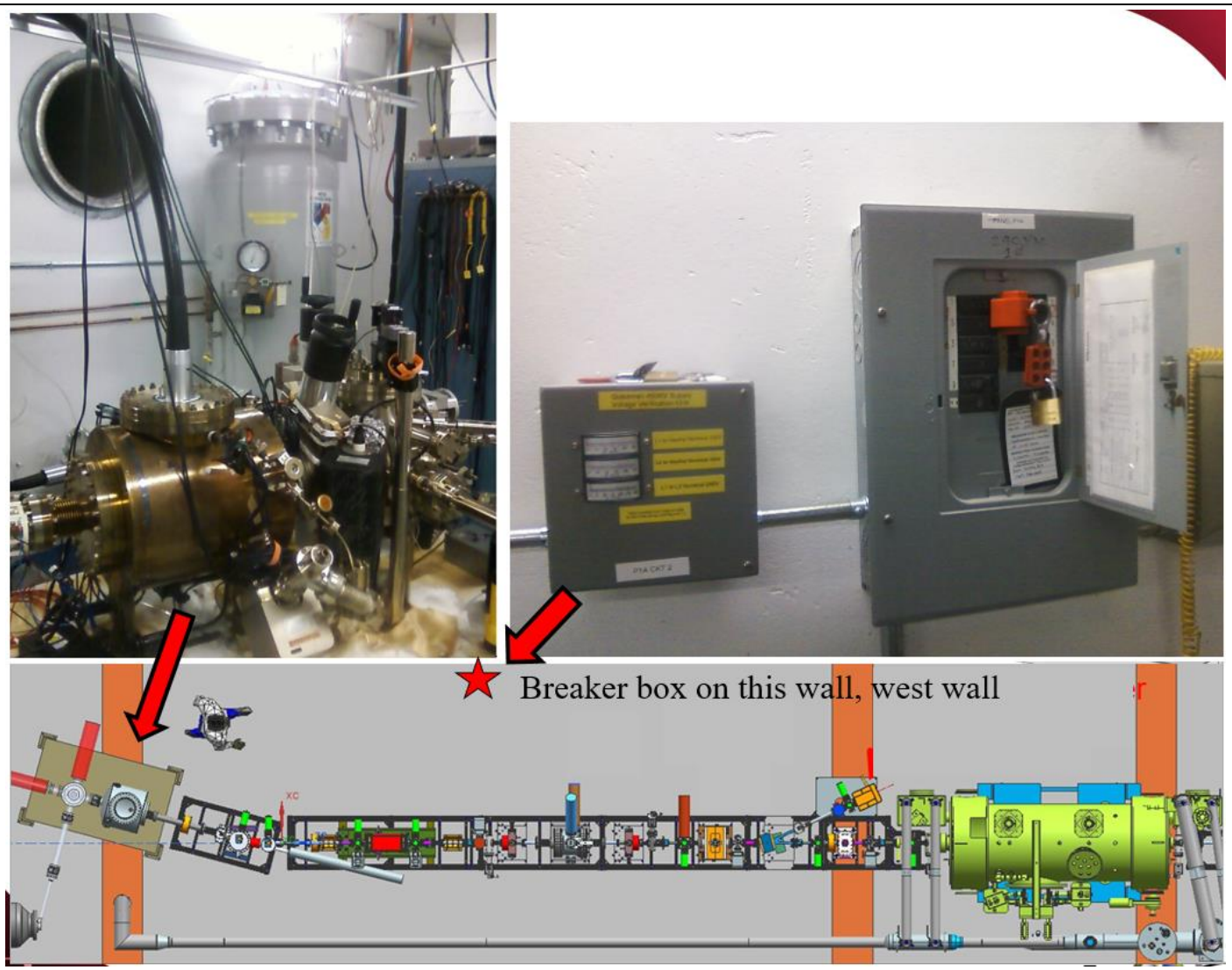


Figure 5: The schematic layout of the photogun and the keV beamline located inside Cave 1 of the UITF enclosure. Top right image shows the voltage verification unit associated with the gun high voltage epower supply, and the breaker panel where the AC circuit for the gun high voltage power supply resides.

The RF sources that drive the QCM and the buncher cavity are located on the rooftop of Cave1, near electronics rack ITF14 (see Figure 6). The buncher is powered using a 7 kW solid state amplifier and the QCM derives power from a "cathode power supply" composed of a high power amplifier and two klystrons. These devices can be de-energized and locked out by disconnecting the large "welding receptacle" power cords from AC power sources as described below.

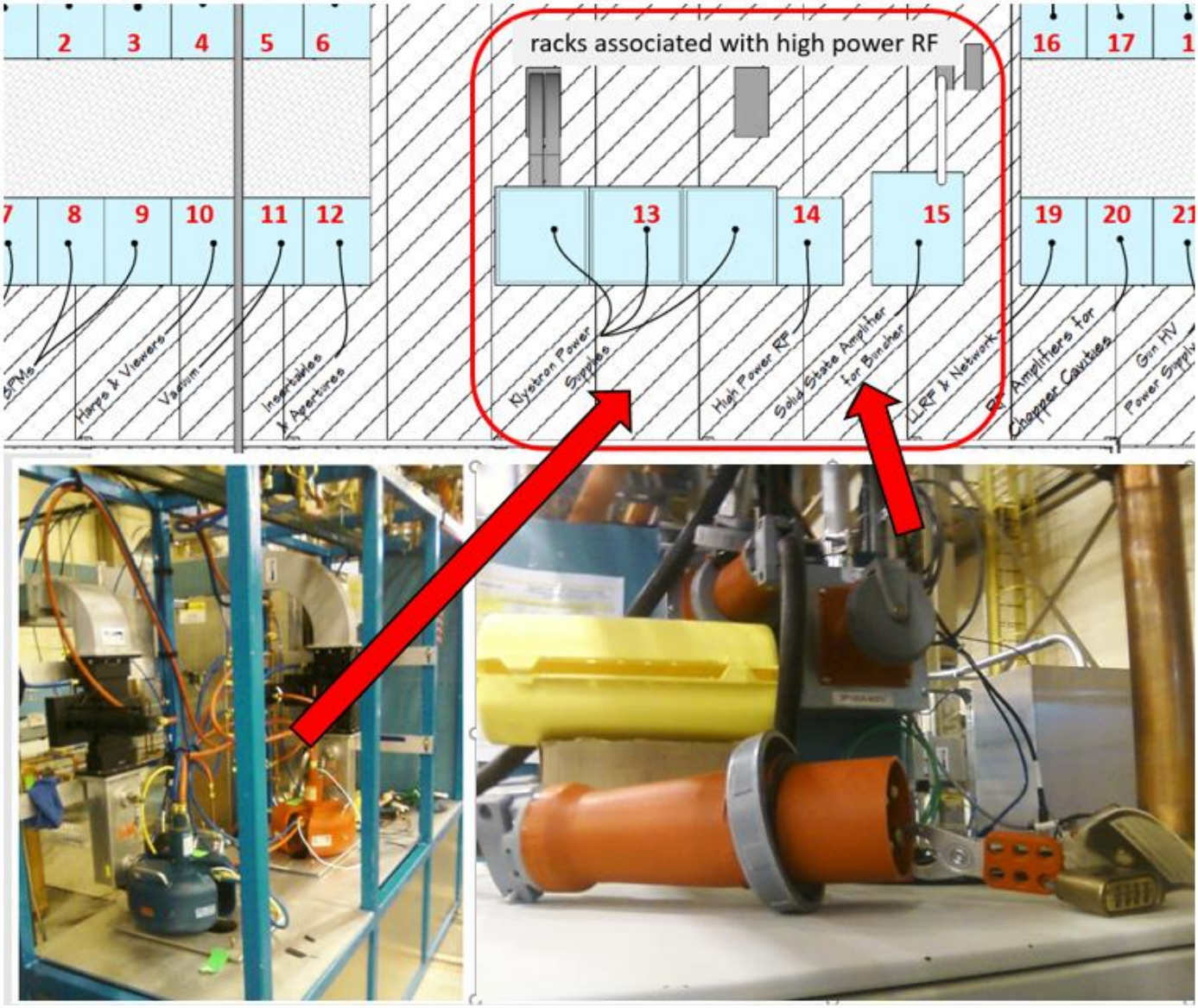


Figure 6: A schematic of the electronics racks located above Cave1. The red border on the diagram shows the location of the racks associated with high power RF. There are two "welding receptacle" power cords that must be disconnected from AC power sources and locked out using approved LTT receptacles to prevent operation of the QCM and buncher cavity. These are the only rf sources associated with ionizing radiation at UITF. The photo bottom (right) shows only one of the power cords "locked out" with an approved device.

ANALYZE THE HAZARDS and IMPLEMENT CONTROLS

4. Hazards identified on written Task Hazard Analysis

Refer to attached Task Hazard Analysis Work Sheet for details and mitigation. The following lists the hazards addressed in this OSP:

1. Ionizing Radiation

2. Electrical
3. Fall Protection

Other hazards exist at the UITF, e.g., ODH, SF6, rf non-ionizing radiation, laser, etc., but these are described in other OSPs.

5. Authority and Responsibility:

5.1 Who has authority to implement/terminate

- **Facility Manager** – This responsibility is assigned by the Accelerator Division Associate Director. This individual has ownership of the facility and has overall responsibility for safe configuration and operation of the facility. Matt Poelker is the present UITF Facility Manager, but others in the Center for Injectors and Sources could be assigned this designation too.

- **UITF Operator:** UITF Operators are people familiar with electron beam generation, delivery and acceleration. Presently UITF Operators are members of the Center for Injectors and Sources, and the Operations Department.

5.1 Who is responsible for key tasks

- **Facility Manager** coordinates the installation and removal of large equipment though the Cave2 roof. The Facility Manager is responsible radiation producing devices are locked-out in advance of modifications to the UITF shielding, including the Cave2 roof. Logbook entries must be submitted documenting LTT of key devices.

- **UITF Operators** may assist with locking out these devices, in consultation with the Facility Manager.

- **RF System Operators** are members of the Engineering Division familiar with RF control systems and power amplifiers. They assist the Principal Investigators in the execution of tests and the changing of RF system configurations. They must have a thorough understanding of the configuration and operation of the PSS and MPS systems, as well as the configuration of the MPS and RF systems required for the execution of the planned experiments. They are responsible for safe operation of rf equipment and they have the authority to stop any experiment if they feel that there is unnecessary potential to damage equipment or if there is an elevated level of risk of injury.

- **The Radiation Control Department (RCD)** insures that all radiation safety requirements, e.g. shielding configuration and postings, are met for specific operating modes of UITF.

- **Mechanical Installation Group** performs rigging tasks that include movement of the ceiling tiles using the Test Lab overhead crane

5.2 Who analyzes the special or unusual hazards including elevated work, chemicals, gases, fire or sparks (See ES&H Manual Chapter 3210 Appendix T1 Work Planning, Control, and Authorization Procedure)

Subject Matter Experts (SME's) will include but are not limited to the following individuals or their

designees:

- Jerry Kowal - Safety Systems Group Leader – PSS, MPS and ODH Monitoring
- Rick Nelson – RF Safety
- Keith Welch – Radiation Control Department
- Harry Fanning – Accelerator Division Safety Officer
- Laser Safety – Bert Manzlack
- Matt Poelker – Safety Warden
- Jennifer Williams – Industrial Hygiene
- Todd Kujawa – Electrical
- George Perry – Fall Protection

6. Personal and Environmental Hazard Controls Including:

6.1 Shielding

The Radiation Control Department (RCD) has recommended and evaluated the shielding at UITF necessary to mitigate radiation hazards. An assessment by the Radiation Control Department (RCD) indicates the UITF enclosure is adequately configured with sufficient shielding to mitigate radiation hazards. The shielding calculations can be found in JLAB-TN-18-020, "Radiation Safety Aspects of the Upgraded Injector Test Facility" by Vashek Vylet

But when the Cave2 roof tiles are removed, the shielding is inadequate, and the sources of ionizing radiation must be de-energized and locked out.

6.2 Barriers (magnetic, hearing, elevated or crane work, etc.)

As mentioned above, some of the ceiling tiles above Cave2 are designed to be removed to permit installation/removal of large equipment like the HDIce target and the QCM. These ceiling tiles are located near a helium vent described in Section 6.5 Ventilation. There is a grating installed near this vent to prevent personnel from entering the UITF enclosure (see Figure 7, although in this photograph, the grating barrier is not installed, photograph will be updated). When the roof tiles are removed for installation/removal of equipment, the grating must also be removed. The grating is an essential configuration-control device and must be re-installed before UITF is operated in any mode that can generate radiation.

Figure 7: the grating at the Cave2 helium vent that prevents entry into the UITF enclosure. Attached signage designates the grating as UITF credited control that must be in place before operating UITF as an accelerator. The grating is secured in-place using locks provided by RCD, and only RCD can remove these locks.

There is laser light within an interlocked enclosure near the photogun inside Cave1, the so-called laser hutch. If the interlocked laser hutch is opened, a shutter located inside the adjacent Laser Room closes, thereby extinguishing light inside the UITF enclosure. Per approved LSOP: ACC-17-64784-LOSP, it is permissible to open the laser hutch to align optical elements and to fine tune the trajectory of the laser light into the photogun using an independent eye-safe alignment laser, even when the ceiling tiles at Cave2 have been removed.

6.3 Interlocks

There are many interlocked devices at UITF. The ionizing-radiation producing devices are interlocked via a Personnel Safety System (PSS) that monitors doorway access points to the UITF enclosure, the configuration of high power rf electronics racks, radiation monitors (i.e., CARMS) located outside the enclosure, and other devices and conditions. The PSS will turn OFF radiation sources when unsafe conditions are detected but this assumes the UITF enclosure is properly configured, with all required shielding in place including the Cave2 roof tiles relevant to this OSP.

<u>There are no interlocks associated with the Cave2 roof tiles</u>, or the grating barrier at the helium vent, and that is why the ionizing-radiation producing devices must be locked out.

6.4 Monitoring systems

There are three monitoring systems related to safety at the UITF: the CARM radiation monitors mentioned above, an ODH monitoring system that is also part of the PSS which alarms when the oxygen level in the

UITF enclosure drops below 19.5%, and the third monitoring system relates to the pressure within the SF6 tank that houses the Glassman gun high voltage power supply. SF6 is an asphyxiant and powerful greenhouse gas.

The ODH and SF6 monitoring systems are unaffected by Cave2 roof tile removal. They remain effective monitoring systems even when radiation shielding is temporarily reconfigured. These systems are described in dedicated documents: https://misportal.jlab.org/railsForms/oxygen_deficiency_reviews/74180/edit https://wiki.jlab.org/ciswiki/images/a/ab/UITF_SF6_assessment.pdf

CARMs located around the UITF enclosure are used to measure radiation levels outside the UITF enclosure. These radiation detectors are part of the PSS and will trip OFF the photogun high voltage power supply and high power RF delivered to the QCM and buncher cavity when high radiation levels are detected. They monitor radiation levels all the time but only when the PSS is engaged do they trip OFF the ionizing radiation producing devices.

There are two CARM probes that monitor radiation inside the UITF enclosure that are not part of the PSS. Rather they are part of the "Rapid Access" system. Radiation levels measured by these CARMs are displayed on a control box located inside the UITF Control Room. These CARMs monitor radiation levels all the time but they do not trip OFF the ionizing radiation producing devices.

Finally, and related to this OSP, the PSS does NOT monitor the configuration of the Cave2 roof tiles. As a result, it is possible to sweep the UITF and engage the PSS while the roof tiles are removed, setting the PSS to RUN mode which enables operation of ionizing-radiation producing devices like the photogun and high power RF QCM and buncher. That is why these device must be de-energized and locked out.

6.5 Ventilation

Cryogenic gasses and fluids can be delivered to the QCM from the CTF refrigerator, gaseous N2, gaseous He, liquid helium (LHe) and liquid nitrogen (LN2). In addition, gaseous nitrogen "boil off" is provided to the UITF. An assessment of ODH concerns has determined that there is adequate ventilation at UITF to warrant an ODH0 rating for elevations below 9'. For a full description of ODH hazards, please see the approved ODH assessment found at:
https://misportal.jlab.org/railsForms/oxygen_deficiency_reviews/74180/edit

There is a passive 5.6 m^2 vent beneath the raised roof of Cave 2 (Figure 8) to vent lighter than air cryogens into the high bay area in the unlikely event of an equipment failure of experimental targets (e.g. HD-Ice). The removable roof tiles pertinent to this OSP are located at this passive helium vent.

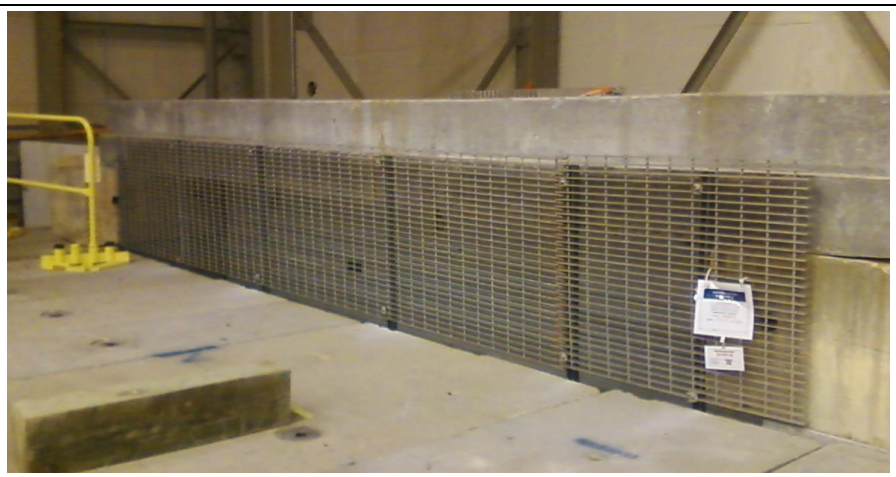


Figure 8: (top) the 5.6 m^2 helium vent, for lighter than air cryogenic gases to escape, as viewed from the top of Cave2 roof, (bottom) the helium vent as viewed from inside the UITF enclosure.

6.6 Other (Electrical, ODH, Trip, Ladder) (Attach related Temporary Work Permits or Safety Reviews as appropriate.)

The roof tops of the UITF enclosure are (obviously) elevated, and therefore there exists a fall hazard. The Cave1 roof top includes permanent railings with toe boards – as such, Cave1 can be accessed at any time without fall protection.

Cave2 frequently serves as storage for a variety of objects, such as cryomodules and crane spreader bars. When the yellow guard rails are properly positioned around the perimeter of the Cave2 rooftop (see Figure 9, below), the Cave2 rooftop can be accessed without fall protection.

During Cave2 ceiling tile removal, some of the yellow guard rails must be moved and re-positioned. During Cave2 ceiling tile removal, the fall protection described below is required.

Figure 9, configurable, moveable, modular safety railings are positioned around the perimeter of the Cave2 roof top under normal conditions. With these railings in place, no fall protection is required. Railings at the north end of the Cave2 rooftop include toeboards to reduce the risk of items falling from the roof to the walkway below. Additional fixed railing on the west side of the rooftop serves to reduce the fall hazard during roof tile removal. One of the posts for securing the horizontal lifeline is shown in the figure to right.

7. List of Safety Equipment:

7.1 List of Safety Equipment:

1. Appropriate fall protection during roof tile removal and during removal/installation of large devices into UITF enclosure, described below in Section 12
2. Fall warning signs, Keep Out Signs
3. ODH status sign near the helium vent, on top of Cave2

7.2 Special Tools:

1. Fall protection harnesses, lanyards
2. Horizontal lifeline
3. Appropriate hoist ring lifting fixtures that attach to the ceiling tiles that are to be moved
4. The crane bridle used to lift the roof tiles
5. Moveable and fixed railings around the perimeter of the Cave2 roof top, and on either side of the opening formed by removal of ceiling tiles
6. Commercial tool used to move the bases of the moveable railings (optional, but recommended)

8. Associated Administrative Controls

- Radiation Control Department staff are responsible for:
  - Configuration control of moveable shielding
  - Determining and posting the appropriate radiological control signage, boundaries and barricades

- Center for Injectors and Sources (CIS) staff are responsible for:
  - Work coordination between various groups (high power RF, SRF for cryomodule storage, Rigging, RCD)
  - Locking out the devices described below
  - Seeking RCD approval to operate the UITF facility after re-installing roof tiles and barrier at the helium vent

- Placing fall-warning and Keep-out signs on the Cave2 rooftop

- Rigging staff who use the Building 58 Test Lab High Bay overhead crane are responsible for safe lifting of cryomodules, ceiling tiles and large devices
  - Making sure the area is clear of personnel
  - Posting appropriate warning signage
  - Using required fall protection

*Administrative controls includes: Authority/responsibility, Procedures, Postings, and PPE

9. Training

9.1 What are the Training Requirements (See List of Training Skills)

1. Trained in Lock, Tag and Try (for those locking out the radiation producing devices, typically UITF Operators), SAF104
2. Electrical Safety Awareness: Classes, Modes, etc., SAF603A
3. Trained in Material Handling - Rigging, Cranes, and Hoists
4. Fall Protection training: SAF 202, SAF 202A, and SAF202B

DEVELOP THE PROCEDURE

10. Operating Guidelines

UITF Operator Requirements

In addition to the LTT training, the UITF operator must:

1. Read and understand this OSP

11. Notification of Affected Personnel (who, how, and when include building manager, safety warden, and area coordinator)

Safety: UITF Safety Warden, Matt Poelker 269-7357, cell. 757-897-9408
UITF Facility Manager: Matthew Poelker, office 269-7357, cell. 757-897-9408

12. List the Steps Required to Execute the Procedure: from start to finish.

Steps 1 through 4 describe the overall process of tile removal, as it pertains to eliminating the hazard of ionizing radiation. A detailed description of the tile removal process with respect to rigging and fall protection follows thereafter.

Steps related to eliminating the hazard of ionizing radiation:

Step 1: Set a schedule for roof tile removal and replacement. The Facility Manager will coordinate tasks with relevant parties and ensure tasks and schedule information is made widely available. Groups involved include:

a) Engineering or Physics staff trained in crane operations and rigging (e.g., Walter Kellner or Neil Wilson),
b) SRF Institute staff responsible for moving the cryomodules stored on top of Cave2 (e.g., John Fischer). The cryomodules must be removed and temporarily stored elsewhere.
c) The group responsible for the large device that is being installed or removed from the UITF enclosure (e.g., HDIce project leader Andy Sandorfi, or the SRF Institute responsible for installing/removing the QCM)
d) The high power RF group (e.g., Rick Nelson or David Gelhaar) must be informed that AC power will be removed from the cathode power supply and solid state amplifier for the duration of the roof tile work
e) The UITF Operator whose task it is to lock out the ionizing radiation producing devices

f) The Accelerator and Physics Division Safety Officers

Step 2: In advance of Cave2 roof tile removal, and with the UITF PSS system configured OPEN;

a) Lock out the photogun high voltage power supply. Inside Cave1, near the photogun, apply the approved LTT device to the labeled circuit breaker as shown in Figure 10 (left). Panel P1A, circuits 2/4, 30A, 240 VAC one-phase power. There is a schematic taped to the inside of the breaker box door panel that identifies this circuit.
b) Lock out the high power rf cathode power supply and solid state amplifier. Above Cave1, remove both AC power cords from the 480 VAC welding receptacles and place the connectors in approved LTT lock boxes, as shown in Figure 10 (right)
c) Log the status of ionizing-radiation sources at UITF as being locked-out using UITFLog electronic logbook, and email this entry to members of Radiation Control Group (e.g., David Hamlette).

Figure 10: (left) apply the lock at the gun high voltage breaker panel circuit as shown, (right) remove the large welding receptacle connectors from the 480 VAC outlets and enclose the connectors in approved LTT lock boxes (only one of the welding receptacle connectors is locked out in the photo).

Step 3: With the ionizing radiation sources locked out, and with permission of Facility Manager:

a) Remove the Cryomodules and other relevant items – if present – from the Cave2 roof top, store them elsewhere
b) The helium vent aluminum grating is designed to remain in place during the ceiling tile removal process, but if deemed "in the way", contact RCD to remove the RCD locks and move grating to the top of the vent tile for storage.
c) Log the condition of UITFLog: Beam Authorization Rescinded.
d) Move the fall protection guard rails from the ceiling tiles that will be removed – at this point, fall protection must now be worn, see specific task details below.
e) Move the ceiling tiles and perform the task, i.e., remove or install the large device at UITF through the opening in the Cave2 rooftop
f) Replace the roof tiles
g) Replace the grating at the helium vent, if the grating was removed. RCD to re-attach locks and signage, and submit UITFLog documenting RCD actions.

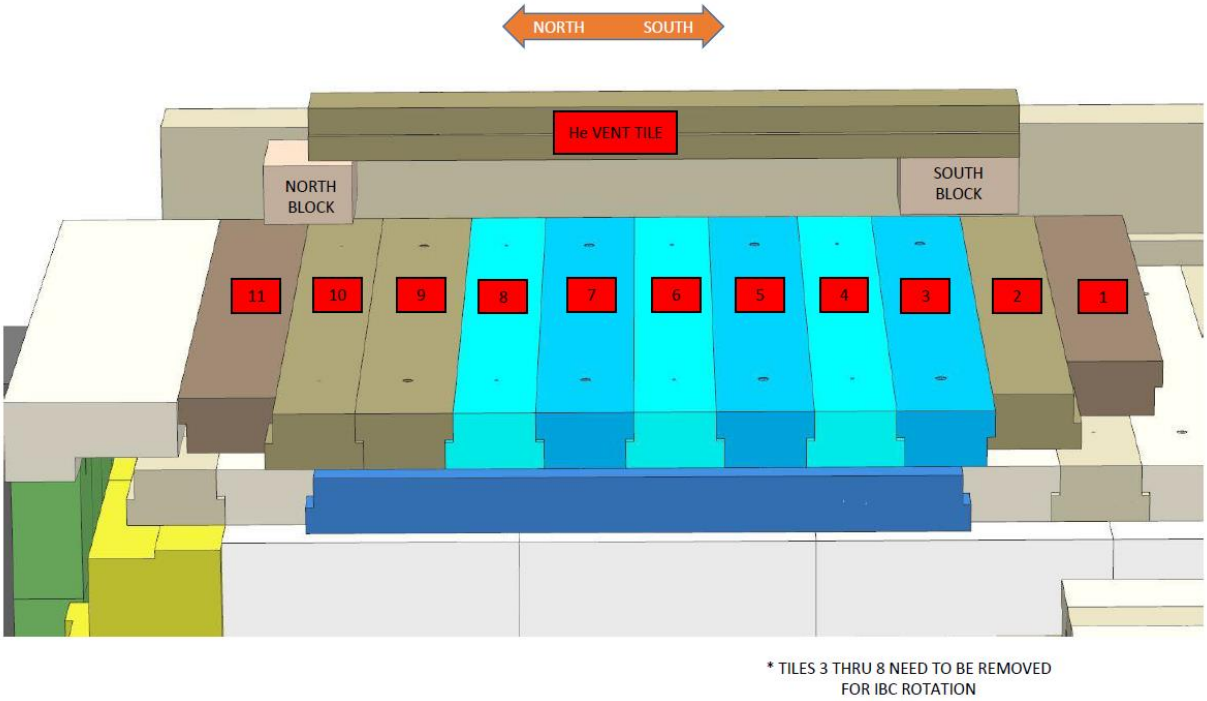
h) Replace the fall protection fencing around the perimeter of the Cave2 rooftop.
i) Replace the cryomodules and other items, if they were present on the Cave2 rooftop

Step 4: Return to Normal UITF operations

a) The Facility Manager and/or UITF Operator must verify that the Cave2 roof tiles have been properly re-installed. Also verify the helium vent grating barrier is in place and properly configured to restrict access to the UITF enclosure.
b) Log the status of UITF Cave2 roof tiles and barrier at the helium vent, using UITFLog electronic logbook, and email this entry to members of Radiation Control Group (e.g., David Hamlette).
c) Remove locks from the photogun high voltage power supply and the high power RF sources and make another UITFLog electronic logbook entry stating that ionizing radiation sources can now be energized per approved OSPs. Beam Authorization Approved.

Specific steps related to Rigging and Fall Protection:

Figure 11 shows the roof tile layout of Cave2. Six roof tiles are moved/relocated to the southern-most section of the Cave2 rooftop, tiles 3 – 8, starting with roof tile #3 and ending with roof tile #8, in sequential ascending order. Note the presence of moveable and fixed fall protection. The moveable yellow guard rail extends around the perimeter of the Cave2 rooftop. Note also the presence of fixed fall protection at the location of the elevated roof tiles (west side). This combination of fixed and moveable railing eliminates the fall hazard from the west side of the roof top. The main fall hazard associated with this task is the opening into the UITF enclosure created by the removal of ceiling tiles. After the ceiling tiles have been removed, additional yellow guard rails are placed along tiles #2 and #9, running east/west. The presence of moveable yellow guard rails on tiles 2 and 9, adequately addresses the potential fall hazard associated with the missing roof tiles.



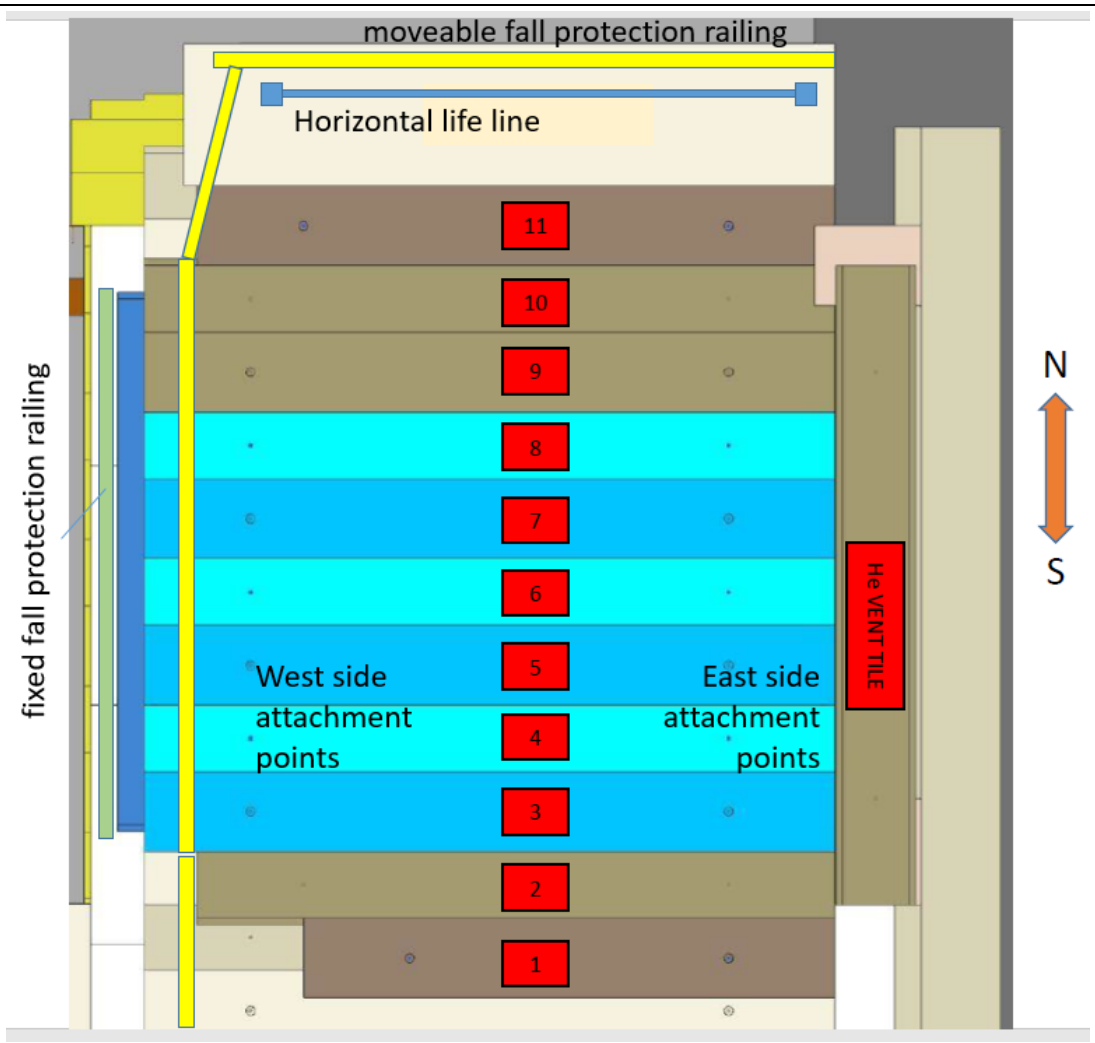


Figure 11: (top) side view of the Cave2 rooftop at UITF, (bottom) top view of the Cave2 rooftop with ceiling tiles numbered and showing the outline of moveable yellow guard rails, and the fixed railing, and the horizontal lifeline. Roof tiles 3 – 8 are moved and re-located.

The process outlined below addresses "Fall Protection" and specific aspects of Material Handling associated with this job, with general aspects of Material Handling covered by basic Rigging and Crane Operation training. The work will be performed using a minimum 3 person crew: Crane operator, the North Side Worker who will attach crane bridle to hoist rings on each ceiling tile being moved, and South Side Worker working from the "safe side" of the moveable yellow guard rails who will remove the crane bridle from the hoist rings once each tile has been relocated to the southern side of the rooftop.

Each roof tile weighs 19,000 pounds (9.5 tons) and has two attachment points located on the east and west sides: threaded 1 ½"-6 NC tapped holes that accept hoist rings rated for lifting 24,000 pounds (12 tons). Figure 12 shows the hoist ring and bridle configuration:

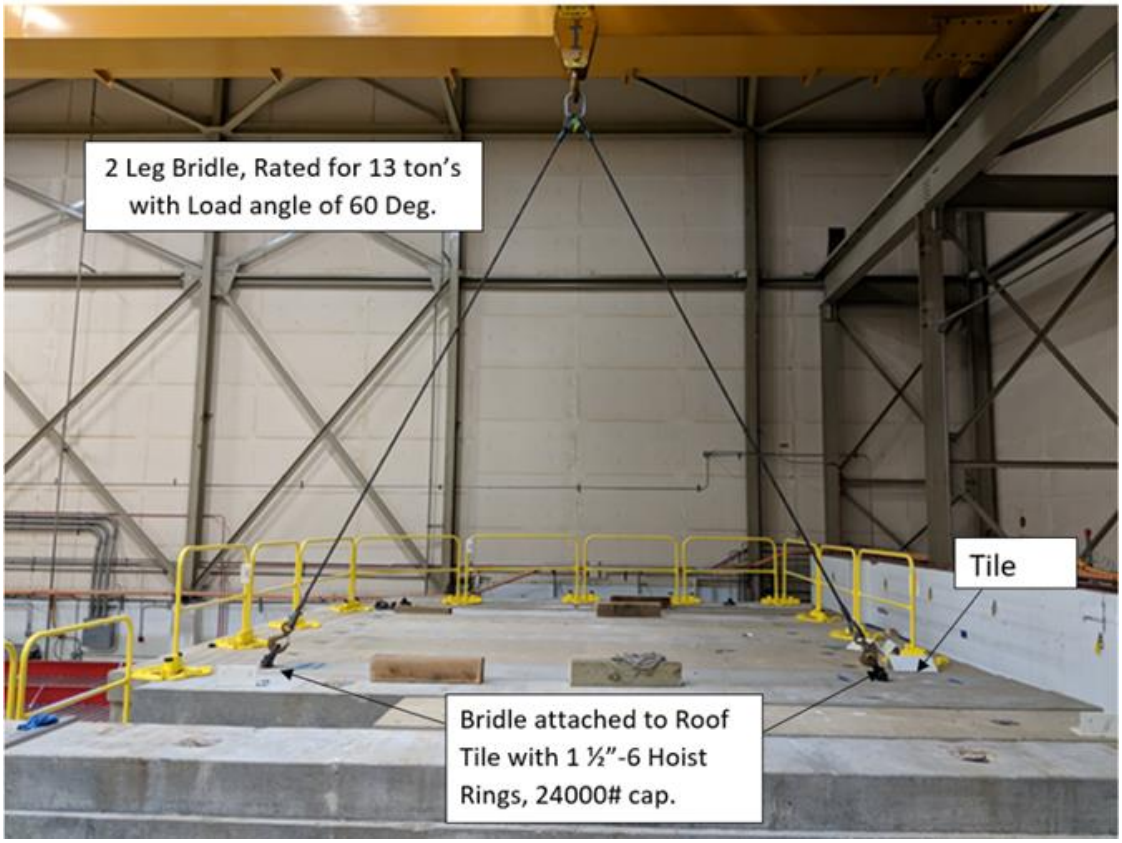


Figure 12: configuration and specifications of the crane lifting bridle and the roof tile hoist rings

Pre-Job Preparations:

1. Install permanent guardrail on specified portion of UITF roof's west edge.
2. Install new stairway/platform on both north and south ends of UITF roof for personnel access and egress. Stairway/platform on north end should also address the guarding of an unprotected edge near the top of the existing stairwell.
3. Install new horizontal lifeline atop shielding block along north edge of UITF roof. If DBI Sala horizontal lifeline #7602020 is used, and if posts onto which lifeline is connected are designed for fall arrest of only one person, remove one of the two O-Rings from the lifeline.
4. Place signage on lifeline post regarding max. capacity (limitation on how many persons may tie-off to lifeline & to use O-Ring).

Removing Ceiling Tiles (see Figure 13):

5. Post signage for passersby to 'Keep Out' during crane activities and movement of ceiling tiles.
6. Stage modular guardrail, to be used at roof opening's north edge, in an accessible area which will not interfere with movement of ceiling tiles.
7. Install modular guardrail (in an east-west direction) along the southern portion of the high roof, to protect

the Crane Operator and South Side Worker from falls through the roof opening created after the first ceiling tile is moved.

8. North Side Worker to use DBI Sala Self Retractable Lanyard (#3504500) to connect to O-Ring on horizontal lifeline. Use of horizontal lifeline must be under direction of a qualified person.
9. Upon completion of ceiling tile removal, North Side Worker moves modular guardrail from its staged area into position protecting against falls from the opening's northern edge.
10. North Side Worker moves SRL to the eastern-most position on horizontal lifeline, unhooks from the lanyard, and exits roof via the new northern stairway/platform (not shown in Figure 13).

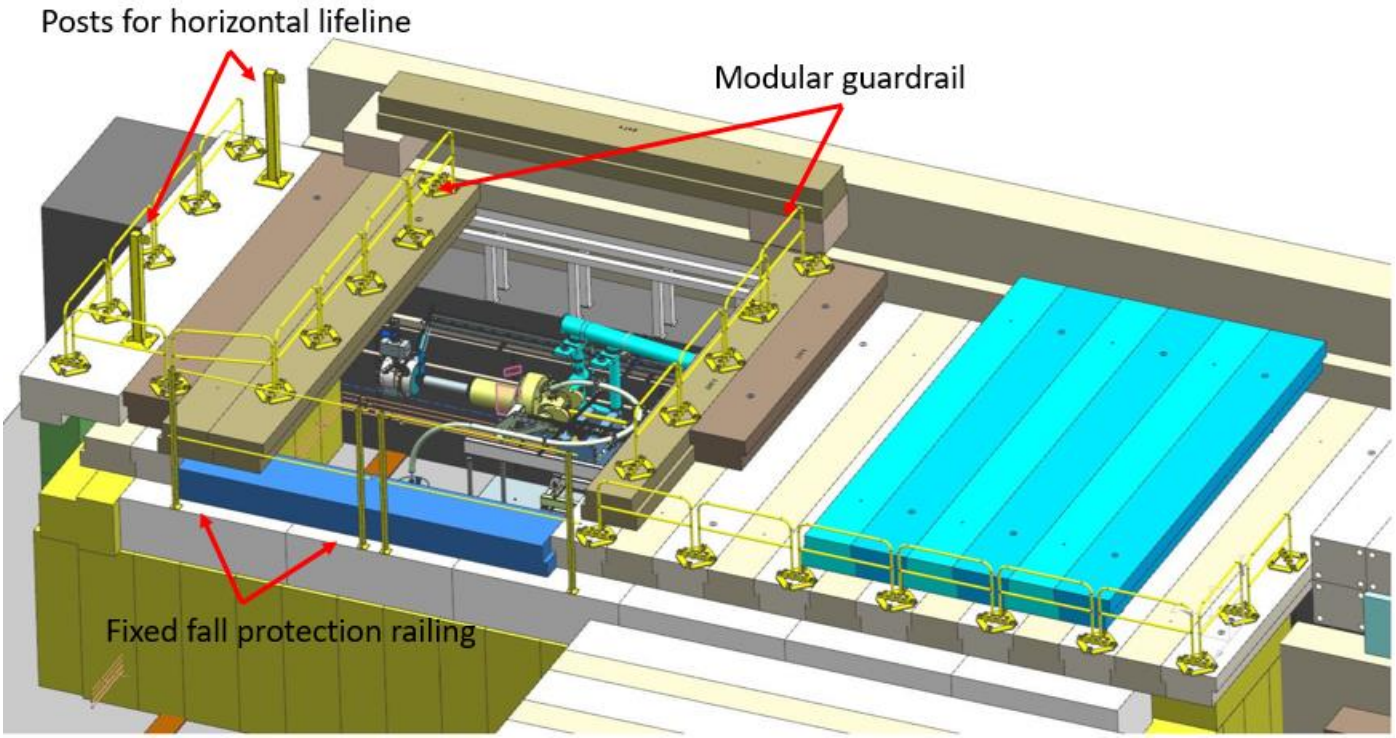


Figure 13: modular guardrail around the exposed edge of the Cave2 rooftop, and at both edges of the hole formed by roof tile removal. Fixed fall protection at the west-side of the opening. Posts at the north side of the rooftop are used to secure the horizontal lifeline. A stairway (not shown) provides path to exit the roof for North Side worker once ceiling tiles have been removed.

Replacing Ceiling Tiles:

11. Post signage, as necessary, for passersby to 'Keep Out' during crane activities and movement of ceiling tiles.
12. North Side Worker accesses the roof via new northern stairway/platform, and connects to SRL on horizontal lifeline. Use of horizontal lifeline must be under direction of a qualified person.
13. Modular guardrail on northern edge of roof opening is relocated to an out-of-the-way staging area.
14. Upon completion of ceiling tile replacement, relocate modular guardrail on southern end of high roof to a staging area.

15. Remove 'Keep Out' signage as necessary.

Note: Modular guardrail, installed at UITF roof opening created by ceiling tile removal, should include one section, on both north and south sides of opening, which can be relocated to allow installation of Physics Div. work platform, limiting the max. gap between railings of 4".

List of all required equipment:

- Wheeled-tool for moving the bases of the yellow guard rail (recommended, but optional)
- Two Leg Bridle, rated for 13 ton's with load angle of 60 degrees
- Bridle attached to Roof Tile with 1 ½"-6 NC Hoist Rings, 24000 pound capacity
- DBI-Sala 30' Leading Edge Self-Retractable lanyard (Model #3504500)
- DBI 20' horizontal lifeline (Model #7602020)

13. Back Out Procedure(s) i.e. steps necessary to restore the equipment/area to a safe level.

Follow the tile removal process in reverse order to replace the ceiling tiles. Then follow Step 4 listed above to verify and document that the tiles and helium vent grating are in place, and once again serve as approved shielding credited control. Electronic logbook entries document the status of shielding and ionizing-radiation sources throughout the process, the final entry denotes the procedure complete, and UITF operations can resume in accordance with approved OSPs.

14. Special environmental control requirements:

14.1 List materials, chemicals, gasses that could impact the environment (ensure these are considered when choosing Subject Mater Experts) and explore EMP-04 Project/Activity/Experiment Environmental Review below

There is SF6 inside the gun high voltage power supply pressure vessel, see section 15 below.

14.2 Environmental impacts (See EMP-04 Project/Activity/Experiment Environmental Review)

14.3 Abatement steps (secondary containment or special packaging requirements)

15. Unusual/Emergency Procedures (e.g., loss of power, spills, fire, etc.)

The following is a list of currently installed alarms:

1. ODH (blue strobe + buzzer), located at each door and in the Control Room
2. Fire (white strobe + high pitch)
3. SF6 pressure sensor on Glassman high voltage power supply SF6 tank
4. Potential prompt radiation (magenta strobe beacon and 30 second siren), located at each doorway and near the electronics racks on Cave 1 rooftop.

The expected response to any of the alarms is to evacuate the UITF enclosure immediately and proceed to the high bay area of the Test Lab

Return to normal operations occurs when alarms are cleared by the following personnel:

1. ODH cleared by SSG or CIS Staff

2. Fire cleared by Facilities Management
3. SF6 CIS staff, SF6 custodian, UITF Safety Warden responsibility
4. CARM alarms, contact RCD and follow their instructions

Comments regarding SF6 hazards: The 45 lbs of SF6 that resides inside the high voltage power supply vessel would occupy 3.2 cubic meters if it were instantaneously released, compared to 207 cubic meter volume of Cave 1. Since SF6 is about 5 times heavier than air, it will accumulate on the floor when released from the high voltage power supply vessel. It would reside within a layer less than 1" thick on the floor. However, if it fully mixed with air in Cave 1, the oxygen concentration would fall to ~ 20.5% which is not deemed hazardous (normal oxygen content of 20.8%). Accounting for the 4400 cfm exhaust fan, it will take ~ 45 minutes to remove all SF6 from the cave (assuming good mixing in the Cave). This time interval does not allow enough time for personnel to exceed the 8-hour exposure limit of 1000ppm. The estimated 8-hour average exposure concentration would be ~ 572ppm.

If the ventilation fan is not operating inside the UITF enclosure, the SF6 will remain along the floor. In this case, personnel are not allowed to work on the floor in case of known leaks.

The pressure vessel assessment of the high voltage power supply SF6 tank can be found in Docushare, Folder PS-ACC-17-001

Notifications:
UITF Safety Warden, Matthew Poelker, office 269-7357, cell. 757-897-9408
UITF system owner: Matthew Poelker, office 269-7357, cell. 757-897-9408
ODH, Fire: Guard gate 269-5822
Other Emergencies: Guard gate 269-5822

16. Instrument Calibration Requirements (e.g., safety system/device recertification, RF probe calibration)

Not applicable

17. Inspection Schedules

As dictated by EH&S, the following items will be inspected on regular basis:

- Lanyards and other types of fall protection
- Lifting fixtures, bridle
- Posts for horizontal lifeline, the lifeline

18. References/Associated/Relevant Documentation

- UITF ODH assessment found at:
  https://misportal.jlab.org/railsForms/oxygen_deficiency_reviews/74180/edit
- Fall Protection Systems, Chapter 6131 of the EH&S Manual:
  https://www.jlab.org/ehs/ehsmanual/manual/6131.html
- Material Handling Equipment Program - Rigging, Cranes, and Hoists, Chapter 6141 of the EH&S Manual
- JLAB-TN-18-020, "Radiation Safety Aspects of the Upgraded Injector Test Facility", Vashek Vylet

19. List of Records Generated (Include Location / Review and Approved procedure)

UITF Operations logbook, UITFLog (electronic)

Click
To Submit OSP
for Electronic Signatures

Distribution: Copies to Affected Area, Authors, Division Safety Officer
Expiration: Forward to ESH&Q Document Control

Form Revision Summary

Revision 1.5 – 04/11/18 – Training section moved from section 5 Authority and Responsibility to section 9 Training
Revision 1.4 – 06/20/16 – Repositioned "Scope of Work" to clarify processes
Qualifying Periodic Review – 02/19/14 – No substantive changes required
Revision 1.3 – 11/27/13 – Added "Owning Organization" to more accurately reflect laboratory operations.
Revision 1.2 – 09/15/12 – Update form to conform to electronic review.
Revision 1.1 – 04/03/12 – Risk Code 0 switched to N to be consistent with 3210 T3 Risk Code Assignment.
Revision 1.0 – 12/01/11 – Added reasoning for OSP to aid in appropriate review determination.
Revision 0.0 – 10/05/09 – Updated to reflect current laboratory operations

ISSUING AUTHORITY	FORM TECHNICAL POINT-OF-CONTACT	APPROVAL DATE	REVIEW DATE	REV.
ESH&Q Division	Harry Fanning	04/11/18	04/11/21	1.5

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