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:	keV beam line of the Upgraded Injector Test Facility (UITF)		
Location:	Test Lab High Bay Area, room 1127-1129	**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:	Center for Injectors and Sources, Accel. Div.	**Date:**	2/4/2019
Document Owner(s):	Matthew 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).

The purpose of this OSP is to describe in detail the procedures for safely operating the keV region of the UITF.

The UITF can function as a gun test stand (this OSP). But when beam is accelerated to an energy that exceeds the potential energy applied to the gun, the UITF is considered an operational accelerator (beyond this OSP).

For the purposes of hazard assessment, FSAD Rev. 8* considers all the hazards associated with the UITF and specifies required mitigations. Gun Test Stand Operations are governed by this OSP that addresses the relevant hazards and 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 another OSP that addresses the relevant hazards and mitigations associated with both operation as a Gun Test Stand and as an operational accelerator as specific 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.

UITF operation with keV beam

There are two modes of operation:

1. Tune beam (pulsed) at voltage up to 450 kV (average current typically 100 nA)
2. CW beam administratively limited to 3 mA when using the 450kV power supply and 30 mA when using the 225kV supply. Note, the 225 kV power supply is limited to 3 kW power which means the maximum beam current that can be produced scales with gun voltage. For example, to deliver 30 mA beam current, the gun voltage must be set to 100 kV. At 225 kV, the maximum current will be 13.3 mA (Power = 3kW = 30mA x 100kV = 225kV x 13.3mA).

UITF gun high voltage conditioning

When a new photogun is constructed, it must be *high voltage conditioned*, which describes the first application of high voltage to the cathode electrode. During this process, an electron beam is NOT intentionally produced via photoemission, but field emitters can generate electrons that strike the anode and vacuum chamber walls and this produces x-ray radiation.

Although the photogun and keV beamline reside in Cave1 (see Figure 1), the affected area for both procedures is the entire UITF enclosure because Cave 1 and Cave 2 form a common space. The region above Cave1 where the electronics racks are located is accessible during these procedures, and therefore this area is also an affected region.

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

UITF is located in the High Bay Area of the Test Lab. Figure 1 shows the UITF lay out and identifies Caves 1 & 2, which are convenient designations referencing old and new test areas, respectively. Figures 1 and 2 show the labyrinth, which is the main access to UITF. Figure 3 shows UITF with concrete shielding over the roof of Cave 1. Electronics racks are located above Cave1. In Figure 3, for illustration purposes only, the roof of Cave2 is shown removed.

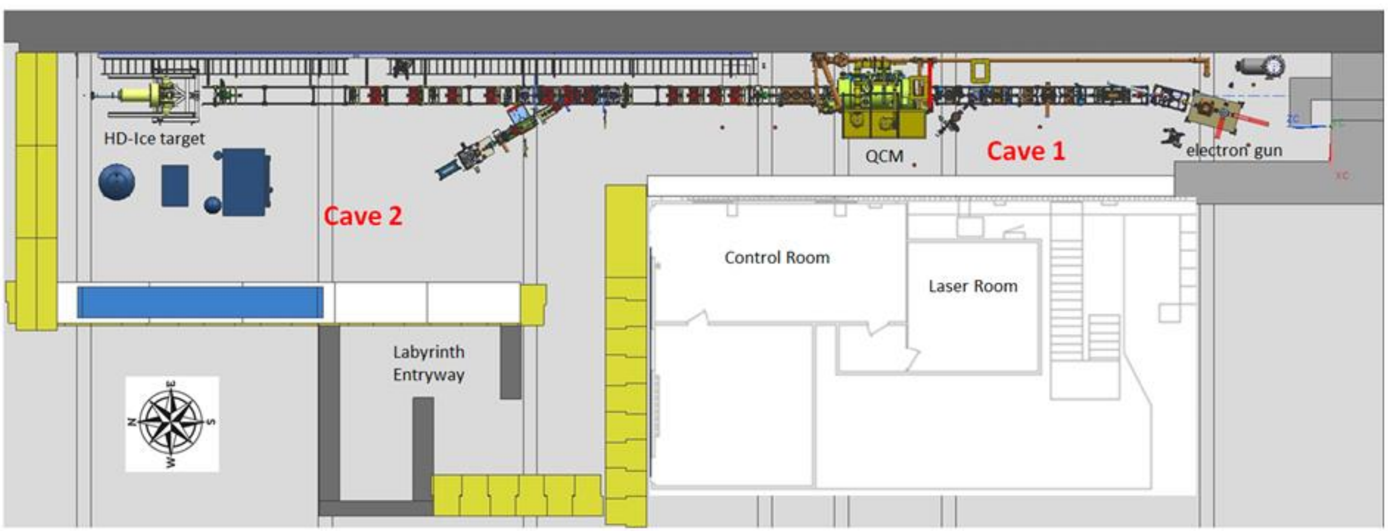

Figure 1 UITF beamline layout showing the two Caves. The photogun and keV beamline reside in Cave 1

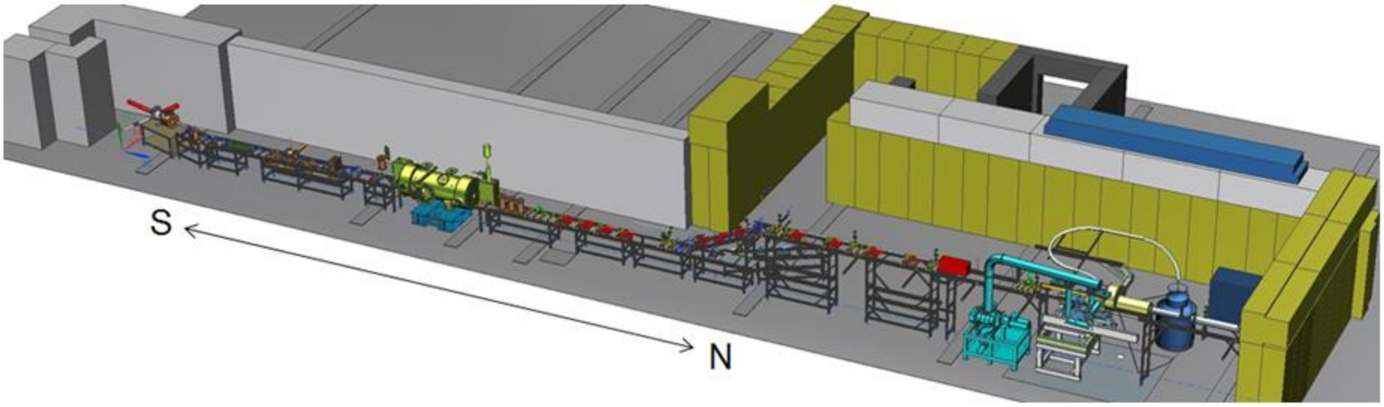

Figure 2 UITF layout showing the exit to main entrance through labyrinth towards the high bay area

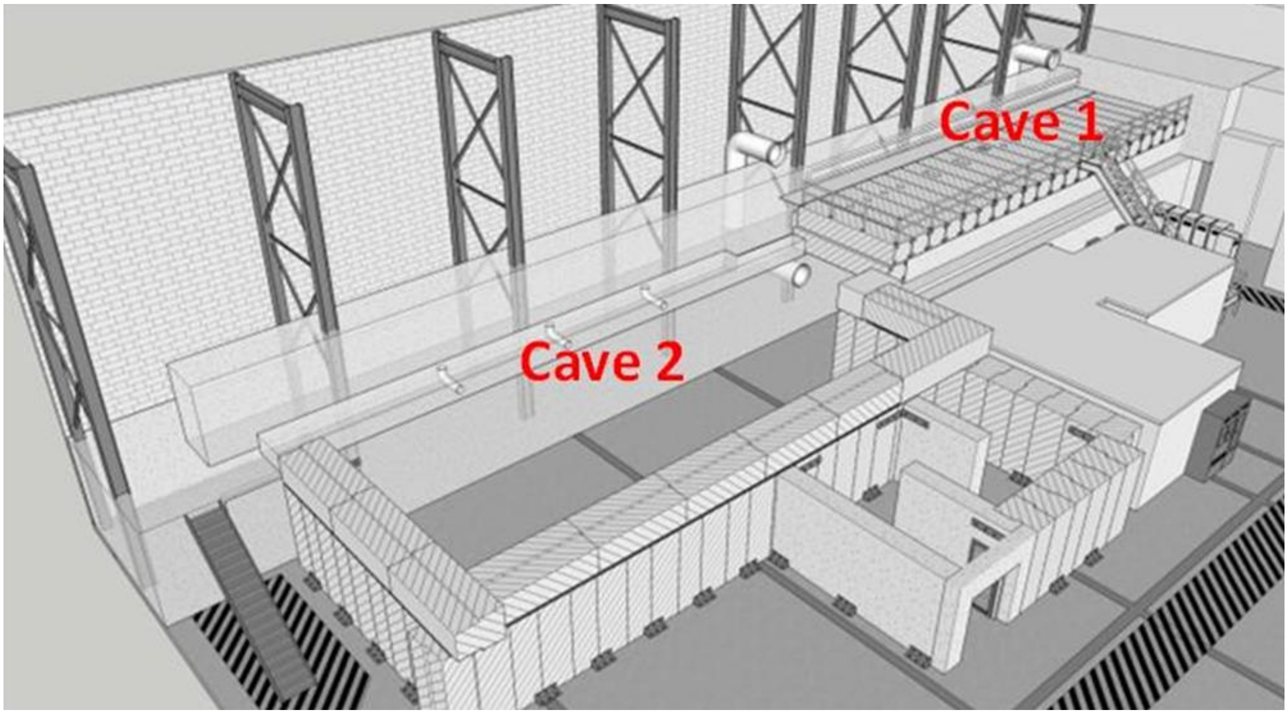

Figure 3 UITF layout showing the main entrance Labyrinth and shielded roof of Cave 1

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.

1. Ionizing Radiation
2. Laser non-ionizing Radiation
3. RF Non-ionizing Radiation
4. Magnetic Fields

5. Oxygen Deficiency
6. Electrical
7. Pressure / Vacuum
8. SF6 toxicity

5. Authority and Responsibility:

5.1 Who has authority to implement/terminate

Matthew Poelker

5.2 Who is responsible for key tasks

Matthew Poelker

5.3 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)

Ionizing Radiation – Keith Welch
Laser non-ionizing radiation – B. Manzlak, J. Williams
RF Non-ionizing radiation – J. Williams
Oxygen Deficiency – J. Williams
Electrical – T. Kujawa
Lead – M. Brown
SF6 toxicity – J. Williams
Fire – Ed Douberly
Safety Warden – J. Hansknecht
Pressure / Vacuum – W. Oren

5.4 What are the Training Requirements (See http://www.jlab.org/div_dept/train/poc.pdf)

UITF Operators must have the following Training

- SAF 100 – ES&H Orientation
- SAF 1140 – Laser Orientation
- SAF603A – Electrical Safety Awareness: Classes, Modes, etc.
- SAF 103 – Oxygen Deficiency Hazard
- SAF 104 – Lock, Tag and Try
- SAF 801– Rad worker
- SAF130AU – Pressure Systems Safety Awareness for Users
- SAF136 – Lead Worker Safety Awareness
- Read and sign this OSP

6. Personal and Environmental Hazard Controls Including:

6.1 Shielding

The keV beam line is operated in tune mode or CW mode. Tune mode beam is a pulsed beam at 60 Hz providing an average beam current of 100 nA. In CW mode, the average beam current can be up to 3 milliamps when using the 450 kV power supply and 30 mA when using the 225 kV power supply. During gun high voltage conditioning short-duration bursts of x-ray radiation can be produced by field emission at ~ uA levels when electrons strike the photogun anode and the photogun vacuum chamber walls.

Of the two walls in Cave 1, the east wall (see Figure 1) is many meters thick and is an effective radiation barrier. The west wall is 36” thick. The concrete roof of Cave 1 is 30” thick. There is 3.5” iron shielding below the roof penetrations leading to the electronics racks (Figure 4 below).

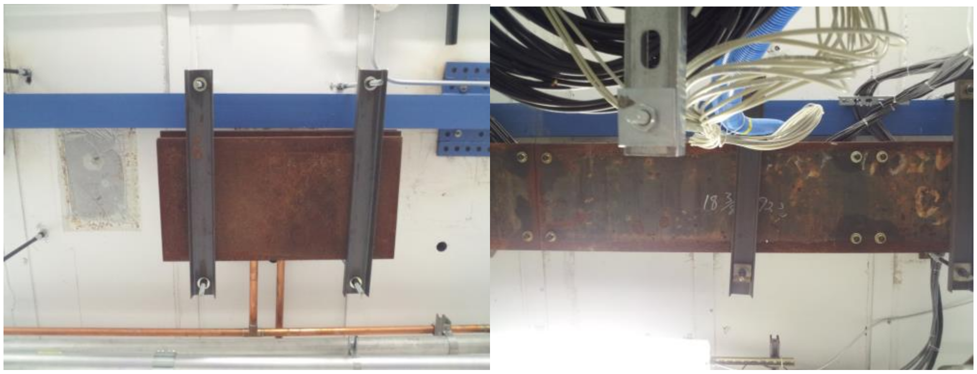

Figure 4 Steel plates covering penetrations in Cave 1. Cables pass through the penetrations linking the electronics racks and beamline elements

The keV beam termination points are apertures, beam dumps and Faraday cups in Cave 1. Local shielding will be employed at these beam termination points to mitigate radiation hazards.

The main entrance labyrinth and the south access labyrinth prevent line of sight exposure to x-ray radiation.

An assessment by the Radiation Control Department (RCD) indicates Cave1 is adequately configured with sufficient shielding to mitigate radiation hazards.

The top of the UITF Cave1 roof is accessible during keV beam operations but the area is considered a Radiologically Controlled Area, with signage provided by RCD indicating access restrictions and dosimeter requirements. Signage will be posted at the bottom of the stairs leading to the Cave1 roof (see Figure 5, left). After UITF operations are complete, access to the UITF Cave1 roof is unrestricted (See Figure 5, right).

Figure 5 (left) During UITF operations, the top of UITF Cave1 roof is a Radiologically Controlled Area and dosimetry is required to access the roof. (right) access is unrestricted when UITF operations are complete.

During initial beam commissioning and at agreed current levels delivered from the photogun, RCD will conduct radiation surveys of accessible areas outside the UITF enclosure to verify shielding effectiveness and establish final operational limits, alarm thresholds, and postings.

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

Some of the ceiling tiles above Cave2 are designed to be removable to permit installation/removal of large equipment like the HDIce target and the quarter cryomodule. 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 6). 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 in place before UITF is operated in any mode that can generate radiation. The grating must be confirmed in-place during the Pre-Sweep process.

Figure 6: the grating at the Cave2 helium vent that prevents entry into the UITF enclosure

Besides the grating at the helium vent, other barriers at UITF include:

1. Vacuum windows: The UITF beam line is under vacuum. If work involves thin windows (which is not anticipated), there will be signage warning personnel entering UITF that hearing protection is mandatory for entrance. Hearing protection will be available in well-marked containers.
2. Magnetic Fields: The magnets at UITF can be energized when the UITF is OPEN but these magnets have fields that drop off to less than 5 gauss within a few inches from the magnet. If there are cases where the field is > 5 gauss at a foot or more, there will be barriers to prevent personnel from exposure to the magnetic field.
3. The magnets have electrical terminals which are either insulated or have protective covers to prevent accidental contact.
4. The doors to UITF represent barriers, these are described below in Section 6.3 Interlocks

6.3 Interlocks

The UITF's Personnel Safety System (PSS) ensures that personnel cannot access the test caves when prompt radiation hazards are possible, and will turn OFF radiation sources when unacceptable radiation levels are detected outside the enclosure. Radiation exposure is prevented through both administrative (sweep procedures, locked gates, postings) and engineered means (interlocks, radiation monitoring, etc.). UITF (see Figure7) is a completely enclosed area. No one is allowed inside the enclosure during beam operations, or gun high voltage conditioning, or when high power RF is applied to the buncher or the SRF quarter cryomodule. Figures 8 and 9 show the two entry/exit ways to and from the UITF, the run safe box, signage along with the warning beacons.

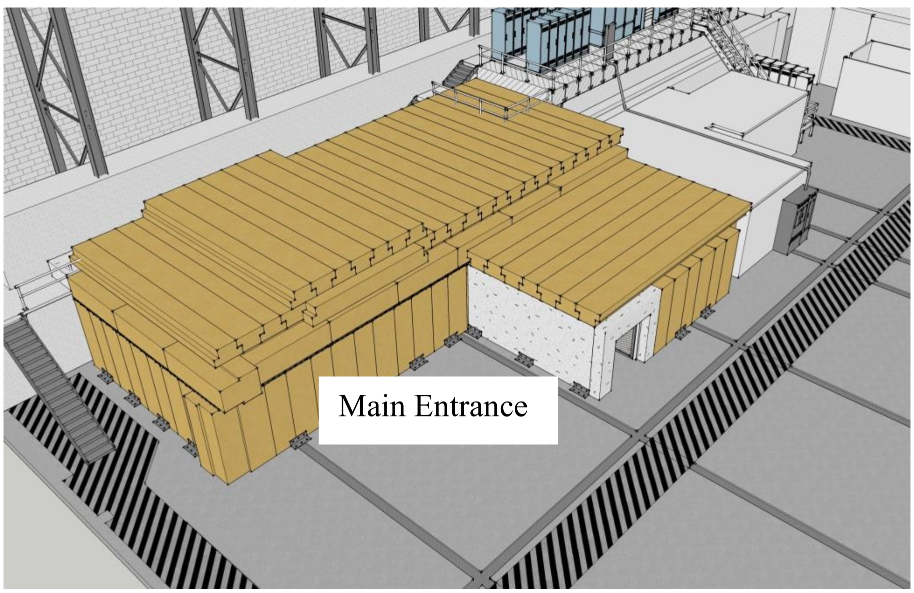

Figure 7 UITF With concrete shielding in place

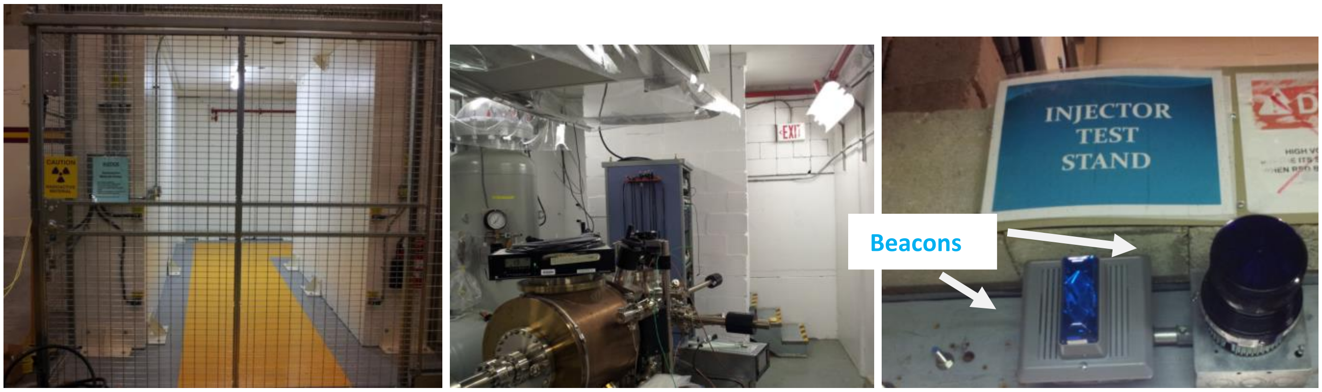

Figure 8 (Left) Main entrance/exit from high bay area through the labyrinth of UITF (Middle), Secondary exit into the high bay from the southern-most location of the keV section. Both doors have Personnel Safety System interlocks and emergency exit switches on the nearby walls (Right). Beacons exist at both entrance/exit ways

Figure 9 (Left) Exit into high bay from Cave 1 near the electron gun (Middle) Run/Safe Box (Right) Crash Switch for exit. Run/Safe Boxes and Crash switches are at both the entrance/exit ways

There are four PSS states: OPEN, SWEEP, READY and RUN. READY state is the safe state, when doors are open and the UITF enclosure can be occupied by personnel. The RUN state issues "permits" to RF sources, the Gun High Voltage power supply and PSS laser shutters. "Permits" allow these devices to be energized.

There are radiation monitors – referred to as CARMs – that are interlocked to the PSS system. CARMs are primarily used to detect radiation outside the UITF enclosure but one or more CARMs may be located inside the UITF enclosure. CARM placement is determined by the RCD. When CARMs detect unacceptable levels of radiation in Run state, the PSS will drop to READY state, removing all the permits.

In OPEN state, the main entrance/exit will be in use. The secondary exit door can be used as needed, but is primarily considered an emergency exit. The main and secondary entrance/exit doors are part of the PSS, with magnetic locks that engage and prevent entry when the UITF enclosure is swept and the PSS is set to the Run state. The PSS will turn OFF radiation sources when door interlocks are breached.

Additional details related to the PSS interlocks:

There are signals warning about potential prompt radiation:

- a Magenta Beacon is active as soon as UITF PSS Controller is switched to SWEEP State and stays ON for all higher States
- 30s siren is turned ON, when UITF is about to switch to RUN State. This means the RUN State is delayed by 30s while the warning siren sounds

In addition, when a CARM is tripped, it drops the UITF PSS Controller from RUN State to READY (safe) and there are latched audible and visual alarm indicators in the UITF Control Room. The audible alarm can be silenced when RESET pushbutton is pressed once. If the cause of alarm is not present anymore, then the RESET pushbutton, when pressed 2nd time, will clear the visual alarm. It is not necessary to clear the latched alarms to return to RUN State as long as there is no active CARM trip. Trip of the CARMs will trigger radiation alarm (audible and visual) at the UITF Control Room independently of the PSS State.

6.4 Monitoring systems

There are three monitoring systems. One is the PSS, explained above, which provides access control to the UITF and protects personnel from prompt ionizing radiation associated with UITF operation. The second is the ODH system, which alarms when the oxygen level in the UITF enclosure drops below 19.5%. The third monitoring system relates to the pressure within the SF6 tank that houses the Glassman gun high voltage power supply. There is a digital pressure gauge that monitors SF6 pressure, and can be configured to “alarm” when pressure falls below a User specified level. The alarm is a Yellow LED that illuminates at the SF6 tank. The alarm is also an EPICS signal. The alarm is triggered when pressure drops from 60 to 58 psi. Finally, there is an Ashcroft pressure switch that will shut off the Glassman HV power supply when SF6 pressure falls below 45psi.

6.5 Ventilation

There are two fans on the east wall of Cave 1 (Figure 10). In addition, there are three 0.15 m (6”) diameter vent holes on the west wall near the ceiling and two 0.3m x 0.3m (12”x12”) square vents. These square vent holes have chimneys attached to them on the ceiling. The height of the chimneys is about 7 ft. which will mitigate any hazard in the unusual event of cryogenic gas release in Cave 1. The existence of these fans is included for completeness of information, however the ODH assessment of UITF does not take credit for the existence of these fans. The ODH and SF6 toxicity assessments are attached to this document.

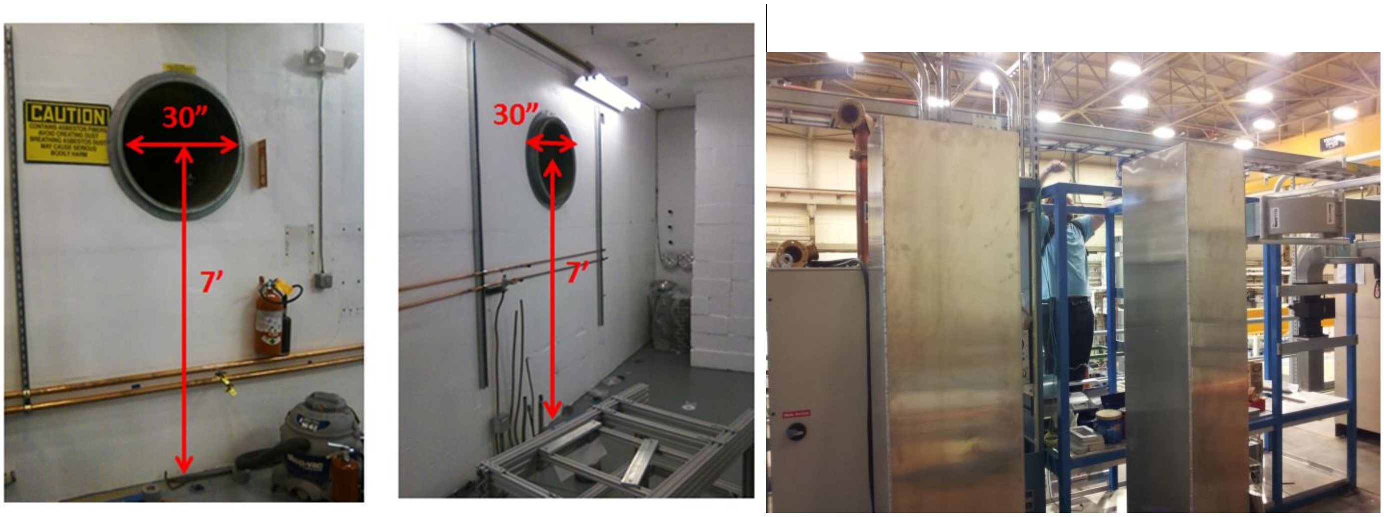

Figure 10 (Left) Fan with a capacity of 7400 CFM vents air into the high bay area, (middle) fan with a capacity of 4400 CFM vents air to outside the test lab, right two chimneys attached to the square vent holes in the ceiling of Cave 1

There is a passive 5.6 m^2 vent beneath the raised roof of Cave 2 (Figure 11) 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). As mentioned in Section 6.2 Barriers, there is a grating installed at the helium vent that prevents entry into the UITF enclosure.

Figure 11 (Left) Shielded elevated-roof section of Cave 2, which will be used for experimental targets, including cryogenic targets. (Right) 5.6 m^2 Vent area beneath the elevated roof section of Cave2, for lighter than air cryogenic gases to escape.

6.6 Pressure / Vacuum

The evacuated photogun and keV beamline is considered a Category 0 vacuum system, per Part 7 of the Pressure Safety Supplement. Specifically, the cross section of the vacuum system does not exceed 33 square inches, the relieving vacuum cannot exceed 15 psi, there are no cryogenic components, and there are no thin walled components that could rupture.

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

The manuals for photogun high voltage systems can be found at: https://wiki.jlab.org/ciswiki/index.php/ITF21 Manuals clearly state that the high voltage power supplies must be de-energized before work is performed, in accordance with JLab LTT policy.

A separate document describes laser-safety related concerns and procedures: LOSP (ACC-17-64784-LOSP)

The ODH assessment for the UITF is attached. This assessment can be found at: https://misportal.jlab.org/railsForms/oxygen_deficiency_reviews/74180/edit

See Section 5.3 above for a complete list of hazards.

7. List of Safety Equipment:

7.1 List of Safety Equipment:

1. Safety glasses when performing mechanical work, as needed
2. Gloves depending on mechanical or shielding work
3. Hard hats and/or steel toed boots depending on materials handling needs
4. Laser safety goggles, as required by LOSP (ACC-17-64784-LOSP)

7.2 Special Tools:

n/a

8. Associated Administrative Controls

- Safety Systems Group staff is responsible for:
  - PSS administrative and engineered controls
  - Training on access controls and sweep procedures

- Radiation Control Department staff is responsible for:
  - Maintenance and calibration of fixed interlocked and hand held radiation monitors
  - Placement of CARMs
  - Area and personnel dosimeters
  - Radiation surveys
  - Assigned Radiation Monitor Training (if needed)
  - Appropriate signage

- Center for Injectors and Sources (CIS) staff is responsible for:
  - LSS administrative controls
  - SF_6 Gas insulated HVPS administrative and engineered controls
  - Locking and Tagging the Faraday cup in front of the ¼ cryomodule for keV mode operation
  - Placement of BLMs and determining proper BLM settings that minimize radiation and optimize machin protection
  - Maintaining an up-to-date list of trained UITF Operators

The Faraday cup in front of the ¼ cryomodule is inserted and locked in place for all keV mode operations. The valve t the ¼ cryomodule is CLOSED and cannot be opened via EPICS (i.e., the compressed air line is NOT attached to the OPEN spigot of the valve mechanism)

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

- CIS personnel are responsible for safe operation of the UITF. This includes limiting beam power to fall within the identified operations and safety parameters.
- UITF's PSS logic manages the two door switches and the Run/Safe Boxes to provide an "Area Secure" signal to the PSS logic
- The HVPS control unit is interlocked to the PSS, it cannot be energized unless the PSS is in "Run" state, attained after the UITF enclosure has been swept.
- The laser shutter is interlocked to the PSS and LSS.
- The CARMs/radiation probes are interlocked to the PSS.
- High power RF (for buncher and ¼ cryomodule) is interlocked to the PSS

DEVELOP THE PROCEDURE

9. Operating Guidelines

The UITF's keV beam is operated under this Operational Safety Procedure, which addresses hazards associated with maintenance and operation and their mitigations through engineered and administrative controls. Fault conditions in the UITF can produce only local work area impacts.

Staffing

The UITF can be operated by a single trained and authorized user (typically the personnel conducting gun and/or beam studies). During keV beam operations, tests can happen in unattended mode, for example a long beam run to measure the photocathode charge lifetime.

UITF Operation

PSS state for the UITF is either: Open (open access), Sweep, Ready or Run. Ready state is an internal (logical) mode confirming that all interlocks are ready for transition to Run state.

A Laser Bypass mode of operation permits the PSS laser shutter to open while the PSS is in Ready state, to permit the alignment of the drive laser beam into the photogun vacuum chamber.

The Laser Bypass key is not required in UITF Control Room to start the Sweep but RF and Gun permits are inhibited when Laser Bypass is active. In order to remove the Laser Bypass key from Laser Interface chassis, it must be switched to OFF position (no bypass). The use of the Laser Bypass key shall be documented in the UITF electronic logbook.

In order to start the Sweep, the UITF doors must be closed, all Crash switches reset and PSS must be in OPEN state. This is a starting condition for the SWEEP state. Only from this condition, when the state key is switched to Sweep position, will the PSS enter SWEEP state.

The sweep procedure is described in Section 11.

UITF Operator Requirements

In addition to the training listed in section 4.4, the UITF operator must:

1. Read and understand this OSP that includes PSS sweep procedures,
2. Receive the practical training on this OSP and on UITF operational procedures from system owner (Matthew Poelker or designee)
3. Perform walkthrough of the following areas: UITF control room and Cave 1 roof where the electronics racks are located.

Upon completion of training, the Operator's name will be posted as an Approved and Trained UITF Operator in the UITF Control Room, in the binder that includes relevant procedures like this OSP.

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

Safety: UITF Safety Warden, John Hansknecht 269-7097
UITF system owner: Matthew Poelker, office 269-7357, cell. 757-897-9408

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

keV beamline

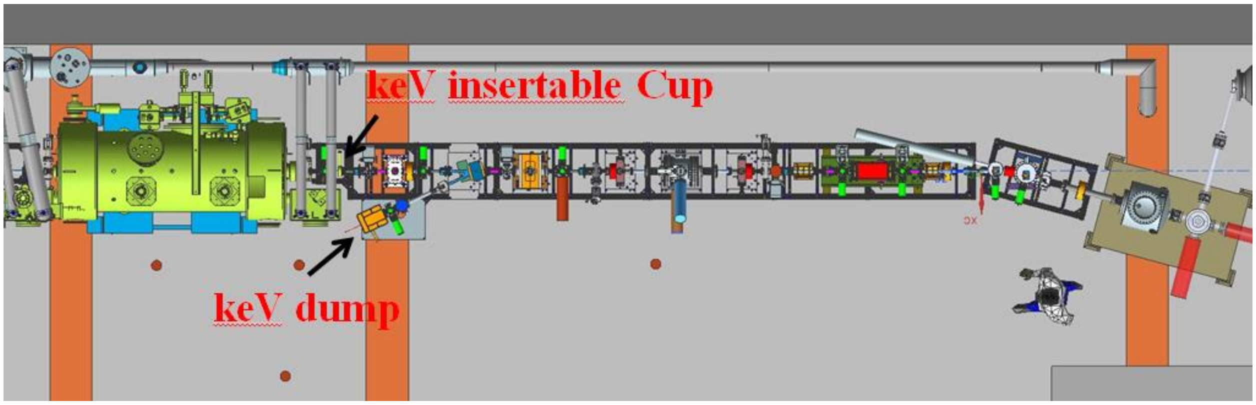

Figure 12 keV beam line top views. The figure shows the location of the 1/4 Cryomodule, the keV fixed dump, and the keV insertable Faraday Cup

The beam termination points such as the Faraday cup in front of the ¼ cryomodule, apertures and beam dump will have additional local shielding in compliance with Radiation Control Department's assessment.

During transport of the electron beam from the gun, whether in Tune mode or CW mode, there can be beam losses. This is especially true during initial commissioning with beam. The beam loss monitors (BLMs), will detect the beam losses and shutter the laser, terminating beam production. While this will protect the beam line from venting during CW operations, this can become a nuisance during beam tune up. The control system allows masking of the BLMs during Tune mode operations.

The PMTs have a built in diagnostic LED, which is used to verify their functionality. Placement and orientation of BLMs around the beam pipe will be decided by UITF operators, based on concerns for maximizing machine protection. The sensitivity of the BLM is set by adjustment of the high voltage applied to the PMT while intentionally steering low current beam into the beamline vacuum chamber wall, in a manner consistent with CEBAF procedures.

The RCD will post the roof of Cave1 as a Radiologically Controlled Area; radiation surveys will be requested upon initial beam production and at agreed current levels to verify shielding effectiveness and establish final operational limits, alarm thresholds, postings, etc. UITF operators will notify RCD prior to initiating a new test condition, e.g., when a new gun is high voltage conditioned, or when proceeding to a higher beam current than the prevailing agreed limit.

The following describes the operating procedures for keV beam line.

Procedure:

In the UITF

1. Insert Faraday cup at the entrance of ¼ Cryomodule. Lock and Tag the cup. Verify that the valve in front of the ¼ cryomodule is CLOSED and cannot be opened via EPICS (i.e., the compressed air line is NOT attached to the OPEN spigot of the valve)
2. The following is an overview of the PSS sweep. Use the complete detailed sweep procedure and map attached to this OSP. A copy will also be maintained in the Control Room. A Sweep procedure checklist will be used to remind the Operator to perform specific tasks, like verify the position of the Faraday Cup upstream of the ¼ cryomodule, locked in place.
   i) Inform occupants of the Cave1 roof of impending keV beam operations, alert them to the personal dosimeter requirement. Verify that the grate is properly installed at the Cave2 helium vent. Verify RCD signage is properly posted
   ii) Inform all occupants to leave the UITF enclosure
   iii) Close both doors
   iv) Go to control room and turn key to SWEEP
   v) Enter the enclosure through the back door, close door behind you upon entry. The back door locks Closed after 60 seconds from the time the PSS key is set to Sweep state.
   vi) Arm RunSafe Box601 in the hallway
   vii) Sweep the enclosure, walking all the way to the north wall of Cave2
   viii) Verify the Faraday Cup is locked in place, and the valve to the ¼ cryomodule is locked CLOSED
   ix) Arm RunSafe Box602 near labyrinth exit
   x) Exit through the labyrinth closing screen gate door completely
   xi) Return to control room, turn key to RUN to arm the Personnel Safety System. The Operator must complete the Sweep is 4 minutes, from the time the key is set to Sweep state. Based on experience, this is enough time.

In the Control Room

1. Turn ON the gun high voltage
2. Set up Viewer Limited Mode.
3. Load the nominal optics file and look for beam on viewers (viewer limited mode, very low duty factor), working from the gun to the dump, using steering magnets as necessary. Adjust solenoid fields to obtain the desired beam size along the beamline.
4. Turn on the BLMs, take beam to Tune Mode, 8uA
5. Steer the beam to deliberately cause beam loss and ensure that the BLMs detect the beam loss and shut off the beam.
   a. If BLMs do not respond as expected, increase the BLM voltage until they are sensitive to the intended beamloss.
6. Once the BLMs are responding as expected, establish beam to the Faraday cup.

7. Verify that the Beam Position Monitors are reading back
8. Establish buncher and chopper settings using Harps and viewers, until the Tune beam looks 'good' in the spectrometer line
9. Set CW beam current to 100 nA and ensure that the beam transports cleanly to the Faraday cup.
10. Turn beam on in tune mode and ensure clean transportation to Faraday cup.
11. Go to 100 nA CW mode
12. Increase the current in steps to the desired permissible beam current
13. Save the keV beamline settings

Shielding Verification: *Contact the Radiation Control Group to verify shielding. This is done by delivering beam to the dump, and RadCon making radiation measurements inside and outside the cave enclosure. This must happen each time a new higher current is produced by the photogun.*

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

At any time during UITF operations, the PSS can be brought to OPEN state, in case there is a need to access the enclosure or to conclude high voltage operations.

Returning the PSS to OPEN State in normal operating conditions

- Turn off the gun HVPS from the EPICS control screen
- Turn OFF the buncher RF from EPICS control screens
- Switch the key to OPEN state

13. Special environmental control requirements:

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

SF6 is used as an electrical insulating gas inside the pressurized (60 psi) high voltage power supply.

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

SF6 is a greenhouse gas that must be re-used to avoid releasing it into the atmosphere when there is a need to open the tanks, i.e. high voltage power supply maintenance. SF_6 is a powerful greenhouse gas, 23,900 times worse than CO_2.

13.3 Abatement steps (secondary containment or special packaging requirements)

https://wiki.jlab.org/ciswiki/index.php/SF$_6$_Inventory_and_Handling_Procedures

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

Returning the PSS to OPEN State in case of emergency or any other abnormal conditions

At any moment the PSS Safety Crash buttons can be depressed. This action will cut off the gun high voltage power supply, turn OFF high power RF, and will close the laser shutter if those systems are operational. It will also crash the sweep and will force unlock the doors.

Since ionizing radiation is present in the enclosure only when the gun is at high voltage, depressing any of the PSS RunSafe or Control Room crash buttons will restore the area to a safe level. NOTE: the emergency exit crash switch will only release the local door lock.

The following is a list of currently installed alarms:

1. ODH (blue strobe + buzzer)
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)

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

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 Cave1. 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 21%). 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.

Other emergency procedures not covered by alarms are:

a. Ventilation failure. Expected Response is to evacuate area immediately and convene at muster point.

b. Personnel inside UITF enclosure AND the doors are locked. **NOTE: This event should never occur if proper sweep procedures are followed.** Expected response is to proceed to the nearest Run/Safe Box and press the crash button. Each door has a local crash out button the will release its lock to allow exit. Opening the door will drop the PSS to OPEN state.

c. Electrical Power failure and in case of personnel trapped inside UITF enclosure. **Personnel Entrapment should never occur if proper sweep procedures are followed.** PSS system will unlock the doors (Electrical power maintains the locks, loss of power unlocks – fail/safe mode)

Notifications:
UITF Safety Warden, John Hansknecht 269-7097
UITF system owner: Matthew Poelker, office 269-7357, cell. 757-897-9408
ODH, Fire: Guard gate 269-5822
Other Emergencies: Guard gate 269-5822

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

16. Inspection Schedules

PSS certification will happen twice per year, scheduled by SSG

17. References/Associated/Relevant Documentation

Task Hazard Analysis
LOSP (ACC-17-64784-LOSP)
UITF ODH assessment
SF6 exposure assessment
UITF Sweep Procedure

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

Operations logbook (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 1.4 – 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	06/20/16	06/20/19	1.4

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