

**U ITF**

**O perations D irectives**

**Draft**

**October 31, 2016**



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**Preface**

This document, the UITF Operations Directives (UOD), provides directives for operation and maintenance of Thomas Jefferson National Accelerator Facility’s (Jefferson Lab’s) Upgraded Injector Test Facility (UITF).

The UITF is a **TEST** facility for R&D in accelerators, detectors for experimental nuclear and particle physics and experiments which can use the facility’s electron beam.

The CIS director has the authority and responsibility to authorize who can operate UITF. Operation in this context means any powering of UITF components which can or have the potential to generate radiation (HV, Lasers, RF and electron beam). *In order to be authorized, all persons should have read this document and non-CIS personnel should have acquired hands-on training.*

As a Test Facility, UITF does not require CEBAF/LERF type Operators and SSOs.

This document consists of the following sections. Each chapter describes the personnel and their responsibilities for UITF operations and the applicable directives.

##### Chapter 1: [Program Control](#_bookmark9)

Describes how safety is integrated into execution of the UITF program and establishes how the program is defined and executed.

##### Chapter 2: [Configuration Management](#_bookmark147)

Outlines how configuration management standards and work practices are applied as part of UITF operations.

##### Chapter 3: [UITF Operations](#_bookmark169)

Specifies directives for how the UITF program is carried out, including the safety responsibilities of the control room staff and the role of safety organizations.

##### Chapter 4: [Maintenance & Tracking](#_bookmark373)

Describes the planning, scheduling, and coordinating of maintenance activities to maintain and improve UITF availability.

##### Appendix A: [UITF Repair Flow Chart](#_bookmark455)

The UITF repair and repair escalation process in a flow chart format.

##### Appendix B: [UOD Release Memo](#_bookmark458)

The memo used to release the UOD, including the associated change summary and review cycle.

This document has been approved by:

Matthew B. Poelker

Director, Center for Injectors and Sources Date: October 15, 2016

August 31,2016 Preface



**Acronyms & Abbreviations**

ARM Assigned Radiation Monitor

BCM Beam Current Monitor

BLM Beam Loss Monitor

BPM Beam Position Monitor

CARM Controlled Area Radiation Monitor

CHL Central Helium Liquefier

COO Conduct of Operations document DOE Department of Energy

DSO Division Safety Officer

EPICS Experimental Physics and Industrial Control System

ERR Experimental Readiness Review

ESAD Experiment Safety Assessment Document ESH&Q Environment, Safety, Health and Quality

FSD Fast Shutdown

IOC Input/Output Controller

ISM Integrated Safety Management

JLab Jefferson Lab

PI Principal Investigator

LOSP Laser Operational Safety Procedure LPSS Laser Personnel Safety System

MPS Machine Protection System

ODH Oxygen Deficiency Hazard

OSP Operational Safety Procedure OPS-PR Operations Problem Report

PSS Personnel Safety System

RCD Radiation Control Department RF Radio Frequency

RSAD Radiation Safety Assessment Document RWP Radiation Work Permit

SRF Superconducting Radio Frequency

TOSP Temporary Operational Safety Procedure

UED UITF Element Database

UITF Upgraded Injector Test Facility UOD UITF Operations Directives

USI Unreviewed Safety Issue

August 31,2016 Acronyms & Abbreviations



**1**

**Program Control**

CIS develops, controls and manages the UITF program. This chapter describes how safety and work planning are integrated into UITF program development and execution, how the program is authorized, and the roles and responsibilities of personnel involved in defining, conducting, and scheduling the program.

## Program Safety

All facets of UITF program planning and execution integrate safety as defined in the *JLab Integrated Safety Manage**ment System Program Description*.

The JLab safety program establishes integrated safety management (ISM) practices that guide worker actions, from the development of safety directives to work performance. Below are seven ISM guiding principles. Refer to *JLab Integrated Safety Management System Program Description* for additional information.

* + 1. Line management responsibility for safety
    2. Clear roles and responsibilities
    3. Competence commensurate with responsibilities
    4. Balanced priorities
    5. Identification of safety standards and requirements
    6. Hazard controls tailored to work being performed
    7. Operations authorization

It is Jlab’s policy not to compromise safety and health of personnel and environment regardless of the urgency or importance of any activity. All JLab employees, subcontractors, and users have the power to stop any work that endangers people, the environment, property, or quality without any fear of reprisal. *ES&H Manual, Section 3330, Stop-Work and Re-Start for Safety Program* documents this ‘stop work policy’*.*

In addition to the seven guiding principles, there are five core safety management functions to ensure the safety of workers, the public and the environment. These are:

1. Define the scope of work
2. Analyze the hazards
3. Develop and implement controls
4. Perform work within controls
5. Provide feedback for continuous improvement

A structured framework of administrative tools, policies, and procedures guide the safety and consistency of UITF’s program planning and execution. ISM principles and the policies established in the *ES&H Manual* and described in [Chapter 4](#_bookmark372) of this document guide scheduled and unscheduled maintenance activities at UITF.

### Program Scope

There are two broadly definable programs at UITF. These are i) accelerator related programs, e.g. improvements to the Lab’s injectors for stringent beam control for parity experiments, testing accelerator components such as the ¼ cryomodule, beam diagnostic equipment and testing concepts for future accelerators such as JLEIC and ii) nuclear physics related programs, e.g. testing and preparing equipment for nuclear physics experiments such as the HDIce target, executing experiments that can be done with a 10 MeV electron beam, such as the bubble chamber experiment and testing detectors for nuclear physics experiments.

UITF as a ***test facility, and not a user facility***, rarely will host a Nuclear Physics experiment. However, outside the normal activities of the CIS group, i.e. activities targeted to R&D of electron sources, opportunities exit to test critical components for experimental physics and the accelerator. For these non-CIS activities, the UITF program follows a structured process commensurate with the complexity of the activity.

Nuclear Physics experiments and major test installations such as HDIce follow the traditional path of a typical physics experiment. Figure 1 illustrates the process. The path for other activities depends on the scale, with small scale (< 2 FTE weeks?) tests requiring only the approval of CIS director.

**Nuclear Physics Experiments & Major Test Installations BEGIN HERE**

**Nuclear Physics Experiment Proposals**

(with safety review per *ES&H Manual, Chapter xxxx, Experiment Safety Review Process*)

**Experiment Review/Approval**

* PAC (Program Advisory Committee)
* TAC (Technical Advisory Committee)
* JLab Director

**Beamtime Requests**

**Approved ExperimentsInstallations**

**Experiment Scheduling Recommendations**

* NPES (Nuclear Physics Experiment Scheduling Committee

**Review/Approval**

* + (Jlab Director)\*
  + Accelerator Division
  + CIS Director

**Approved Installations**

with safety review per *ES&H Manual, Chapter xxxx, Safety Review Process*)

**Schedule**

* Determined by CIS director and the PI of the proposal

**Non-CIS & Outside funded projects**

**BEGIN HERE**

**Program Execution**

r

**Figure 1:** Approval/Scheduling Process for Nuclear Physics experiments and test installations at UITF

(\*) Projects whose requirements impact lab resources, as determined by Accelerator Division and the CIS Director, will require Jlab Director’s approval

##### Nuclear Physics Experiment Proposals

Groups of collaborating experimenters submit experiment proposals to the Program Advisory Committee (PAC) (see Figure [1).](#_bookmark20) The PAC, which consists of distinguished members of the worldwide physics community who are not JLab employees, reviews all experiment proposals, judging the scientific merit, technical feasibility, and the manpower requirements before making a recommendation to the Jefferson Lab Director. Each experiment proposal is also reviewed for its effect on the environment, safety, and health using the review process defined in the *ES&H Manual,* *Experiment Safety Review Process*. A second committee, the Technical Advisory Committee (TAC), also evaluates each experiment proposal and makes a recommendation to the Jefferson Lab Director based on the technical aspects of the proposal. The Jefferson Lab Director makes the decision to grant beam time.

Approved experiments can make formal beamtime requests using the standard  *Beam Request* form and the *Radiation Budget* form. These forms are submitted to the Nuclear Physics Experiment Scheduling Committee (NPES) for consideration, along with a one-page summary of the scientific goals of the experiment. NPES, which consists of key JLab employees appointed by the Jefferson Lab Director, meets at least twice per year to consider beamtime requests. NPES takes into account a wide range of factors such as budget and manpower constraints, UITF performance capabilities, experiment staging space requirements and radiation budgets required to meet program goals.

##### Major Test Installations for approved Experiment Proposals

##### Major test installations, e.g. HD-Ice follow the Physics Division’s process for conducting the tests. These may include an ESAD, RSAD, COO and ERR.

##### Outside-Funded Experiment Proposals

Experiments with outside funding, normally tests of equipment with electron beam, will be considered for approval by Jefferson Lab Director , the Associate Director for Accelerators and the CIS Director. Each proposal is reviewed for its effect on the environment, safety, and health using the review process. The CIS Director will schedule approved experiments in consultation with the PI of the project and the Lab leadership.

##### 1.1.1.4 CIS activities

##### UITF is test facility for developing electron sources for Jefferson Lab’s Nuclear Physics Experiments and future lab’s research interests. CIS director has the authority and responsibility for the scheduling and executing these activities.

##### 1.1.1.5 Program Development for non-CIS activities

The CIS Director appoints a coordinator for each approved non-CIS project. The UITF coordinator will liaise with the PI and/or the project’s run coordinator to develop overall and shift-by-shift run plans.

### Program Hazard Analysis

The potential hazards associated with executing the UITF program are analyzed as two distinct segments: 1.) the hazards associated with operating the UITF and 2.) the hazards associated with each non-CIS activity that will use the UITF beam.. Physics installations that use the UITF beam will follow the Physics Division processes for hazard analyses and reviews. For all other activities, CIS director has the authority and responsibility to require hazard analyses and mitigations measures and safety reviews.

### 1.1.2.1 UITF Hazard Analysis

As required by *DOE Order 420.2C, Safety of Accelerator Facilities,* two documents address the hazards associated with UITF operations: the *JLab Final Safety Assessment Document* (FSAD) and the *JLab Accelerator Safety Envelope* (ASE). Laser safety is addressed by the *ES&H Manual, Section 6410, Laser Safety Program.*

**JLab Final Safety Assessment Document (FSAD)** – The FSAD analyzes and identifies hazards and associated on-site and off-site impact to workers, the public, and the environment from normal accelerator operations and credible accidents. The FSAD provides descriptions of engineered controls (e.g., interlocks and physical barriers) and administrative measures (e.g., training and documentation) used to eliminate, control, or mitigate the hazards from accelerator operation.

The Department of Energy (DOE) has designated JLab as a “Low-hazard, Non- Nuclear Accelerator Facility.” This designation means that the hazards at Jefferson Lab have the potential for no more than minor on-site and negligible off-site impacts to people or the environment.

**JLab Accelerator Safety Envelope (ASE)** – The ASE defines the physical and administrative bounding conditions for safe operations based on the safety analysis documented in the FSAD. When operations are performed within the boundaries of the ASE, the facility staff, facility users, general public, and environment are protected. Variations beyond the boundaries of the ASE are treated as reportable occurrences and are reported using the process defined in the *ES&H Manual, Section 5300, Occurrence Reporting to Department of Energy (DOE)*.

**Laser Safety** – The *ES&H Manual, Section 6410, Laser Safety Program* addresses mitigation of the hazards associated with operating the UITF.

### 1.1.2.2 UITF non-CIS Activity Hazard Analysis

Each Nuclear Physics experiment and major installation must follow the experiment review process defined by the Physics Division. This process specifies that an Experiment Safety Assessment Document (ESAD) and a Conduct of Operations document (COO) must be approved and in place before beam delivery. The ESAD addresses safety issues and activities for the experiment, while the COO describes the operational parameters for the experiment (e.g., duration, beam energy, beam current) and any required configuration changes to hardware or software. These two documents work together to address and communicate safety and operational information unique to each specific experiment

### Unreviewed Safety Issues

An unreviewed safety issue (USI) is a safety issue that presents a significant safety risk and was not previously identified, analyzed, and already mitigated as documented in the FSAD. The word “unreviewed” in the term USI does *not necessarily* mean that hazards and controls were not properly reviewed; rather, it refers to hazards associated with a particular configuration or activity that may be new or different than those previously identified, analyzed, and mitigated as documented in the FSAD. A USI can result from either of the following:

* Discovery of a potential hazard that may not have been fully addressed in the development of the FSAD and ASE, including the discovery of errors or omissions in the hazard analysis.
* A proposed accelerator configuration or operational change that is beyond the scope of the hazard analysis in the FSAD.

It is important to note that the USI process does NOT apply to standard industrial hazards, unless the hazard could directly impact accelerator safety.

If a USI is suspected, either as the result of a proposed modification or due to unexpected circumstances, then the JLab *Unreviewed Safety Issue (USI) Procedure* (ht[tps:/](https://jlabdoc.jlab.org/docushare/dsweb/Get/Document-16644/USI%20Procedure.doc)/jlabdoc.jlab.org/docushare/dsweb/Get/Document-16644/ USI%20Procedure.doc) is followed. If an activity is *potentially* outside of either the analysis or the set of controls documented in the FSAD, then the review process is performed. All personnel must immediately report any potential USI to their supervisor, the owner of the affected system, and the Accelerator Division Safety Officer. If a significant safety hazard is suspected, the supervisor ensures the immediate termination of the suspect activity and follows the notification sequence described in the *Unreviewed Safety Issue (USI) Procedure*.

### Program Hazard Controls

##### Credited Controls

The UITF program is conducted using credited controls to eliminate, control, or mitigate the identified hazards. Credited controls are described in brief in the following paragraphs. A credited control is determined through hazard evaluation to be essential for safe operation directly related to the protection of personnel or the environment. Credited controls are assigned a higher degree of operational assurance than other controls. If a credited control is altered in any way, the *Unreviewed Safety Issue (USI) Procedure* must be followed.

Credited controls used during UITF operations fall into two categories: engineered controls and administrative controls. Engineered controls are identified as either active or passive controls. The credited controls for UITF operations are as follows:

##### Passive Engineered Controls

Permanent shielding, including labyrinths

Movable shielding

Nitrogen gas supply orifices

##### Active Engineered Controls

Personnel Safety System (PSS) level controls

PSS critical devices

PSS access controls

PSS sweep procedures

PSS interlocks

PSS multiple safety functions

PSS alarm and warning devices

PSS ODH monitoring and alerts

##### Administrative Controls

Locked doors and gates

UITF Nuclear Physics experiment and major installation review process

##### Additional Safety Controls

While the credited controls specified by the FSAD address worker safety, public safety, and environmental safety, UITF Operations uses other additional safety controls to provide an added safety margin and to help protect against property damage (i.e., damage to the accelerator) arising from accelerator operations.

These controls provide additional layers of protection to mitigate potential problems before the credited controls even come into play. Examples of these additional safety controls are as follows:

* + - * + **Machine Protection System (MPS)** – An active engineered system designed to turn off the beam whenever an off-normal condition is detected and before significant damage to the accelerator can occur or a credited- control threshold is reached. There are a variety of inputs to this fast shutdown system such as vacuum valves, RF systems, beam loss monitors, beam current monitors, beam dumps, and target motion devices.
        + **Laser Operational Safety Procedures (LOSPs)** – As specified by the *ES&H Manual, Section 6410, Laser Safety Program*, each Class 3B or Class 4 laser must have an associated LOSP that covers the piece of

equipment and the area where it is located. Depending on the scheduled operating program, there may be a separate LOSP for the UITF Optical Control Room and each user lab.

* + - * + **Channel Access Security** – An active engineered system that establishes a security protocol limiting the ability of individuals to access electronic process variables used to control the accelerator.

### Program Execution Within Controls

As a Test Facility, UITF does not routinely operate 24/7 and most of the operations take place during work hours and occasionally may extend a few hours past the normal work hours. All CIS related operations are conducted by CIS staff under the authority of the CIS Director.

Non-CIS activities such as testing equipment either for Physics experiments or for accelerator system follow the following regulations.

* **Training and Qualification** – The crew operating UITF would have been authorized by CIS Director to operate the facility. CIS Director will appoint a Coordinator.
* **Pre-shift Preparedness** – The coordinator and the crew will have an operational plan for the day,
* **UITF Logbook**: All pertinent operations will be recorded in the UITF logbook.
* **Test procedures**; The PI of the tests and the CIS coordinator will work together to ensure that all documents such as OSPs and TOSPs are in place and are readily available.

### Program Feedback and Continuous Improvement

Feedback and continuous improvement are integrated throughout the process of developing and then executing the UITF program. A variety of communication tools provide opportunities for specific lessons learned and general feedback to flow back into the system, resulting in improvements based on experience. Some feedback channels provide information that can be used immediately, while others gather data that can be used later for trend analysis and future planning.

Examples of feedback and continuous improvement tools used during program development and execution are as follows:

* **UITFLog** – As a time-based repository for information associated with program execution, the *UITFLog* provides a way to document events and can also be searched and sorted for useful information by system experts and other JLab employees with password privileges. Log entries can also be sorted by type, which includes downtime, tune, and OPS-PR entries.
* **Operations Problem Reports (OPS-PR)** – The OPS-PR system provides system owners with specific information about system failures and a mechanism for communicating when the problems are fixed and how they were repaired. The resulting data can be used for trend analysis.
* **Corrective Action Tracking System (CATS)** – The lab-wide CATS system tracks action items that arise from the various inspections, assessments, and audits.
* **DOE/JLab Hotlines/Web Sites** – Telephone hotline numbers for addressing issues such as waste, fraud, abuse, management, and safety concerns are posted on the DOE information bulletin board in the MCC. Such issues shall always be addressed first through the normal supervisory chain, but if results are unsatisfactory or there is fear of retribution, the hotlines provide other avenues of recourse.

## Personnel and Responsibilities

The key personnel involved in defining, scheduling, authorizing the UITF program and planning for safe operations are described in the following section. Responsibilities of the other personnel are described in the appropriate committee charters and elsewhere.

Responsibilities may be delegated to other responsible parties as appropriate.

### CIS Director

The CIS Director provides UITF operations oversight, including participating in program development and scheduling, and authorizing beam operations. CIS Director’s responsibilities include the following:

* + - * Authorizing who can operate UITF i.e. UITF Operator
      * For non-CIS activities appoint a coordinator to liaise with the PI or the PI’s Designee.
      * Develop the *UITF Schedule* for tests that span multiple days or multiple tests than can occur over the same time period
      * Approve deviations from the *UITF Schedule.*
      * Authorize resumption of beam operations as appropriate following critical events such as Safety Envelope violations, Operations Envelope and Operational Restrictions violations, Personnel Safety System malfunctions, Machine Protection System malfunctions, and beam-strike events.

### UITF Coordinator

For non-CIS activities, the UITF Coordinator works with the PI or PI’s designee and with a variety of internal stakeholders and outside entities to ensure that the UITF facility best accommodates potential users and the operating program is well defined and supported with appropriate resources. Serve as the designated spokesman for the facility.

* + - * Meet with representatives of potential outside-funded experiments to determine if their requirements are in line with the capabilities of the facility and help move appropriate experiments through the approval and scheduling process.
      * Refer to the Radcon group for special review any potential outside-funded experiment with requirements that fall outside the normal facility operating envelope.
      * Verify that all outside-funded experiments have completed the UITF Safety Review Process before scheduling beam time.
      * Present the appropriate safety documents for potential experiments to the Division Safety Officer (DSO) prior to the Experiment Review Process.

### Experiment PI

Each proposed non-CIS activity at UITF is required to have an associated Principal Investigator, who supplies all of activity-specific information necessary for any design and safety review process. The PI could be lab employee or a non-JLab person. The PI’s responsibilities are as follows:

* + - * Work with the UITF Coordinator to conduct a design and safety analysis of all experiment equipment and proposed operating conditions.
      * Work with the UITF Coordinator to guide the experiment through all phases of the readiness and safety review process, including primary responsibility for completion of the steps defined in *ES&H Manual, Section 3130, UITF Experiment Safety Review Process.* This includes preparing and submitting the final ESAD and COO for the experiment*.*
      * Work with the UITF Coordinator to safely install any new experiment equipment.
      * At the conclusion of the experiment organize the decommissioning of any equipment that is to be removed and arrange for removal.

## Program Schedules

### CIS Activities Schedule

These activities are scheduled by the CIS Director or his designee.

### Non-CIS Activities Schedule

These activities are scheduled by the CIS Director and the PI of the experiment or major installation.

* + 1. **Shift-by-Shift Schedule**

For CIS activities, these are determined by the CIS director in consultation with the CIS staff. For non-CIS activities, the CIS director, the UITF Coordinator and the PI will meet and determine the shift-by-shift schedule.. The shift plan must be entered in the UITF Logbook.



**2**

**Configuration**

**Management**

According to DOE-STD-1073, *DOE Standard, Configuration Management*, the basic objectives of a configuration management system are to

* establish consistency among design requirements, physical configuration, and documentation, and
* maintain this consistency for the life of the facility, especially when changes are made.

Configuration management standards and work practices are already in place for the systems and equipment that make up the UITF facility. These standards, which are maintained by the specific organizations, also apply to new systems that are designed, fabricated, and then installed in the accelerator. Successful operation of UITF, however, requires a single, definitive, up-to-date source of operating information for beamline elements. This central repository for the accelerator is the UITF Element Database (UED), which serves as the information source for such tools as model-driven accelerator setup, on-demand control screens, and element-by-element hot checkout.

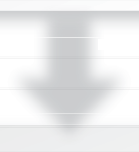
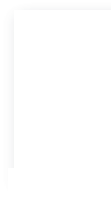
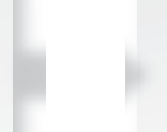
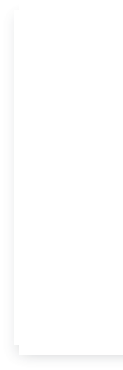
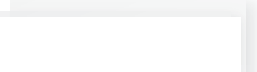
Consistency between the installed equipment configuration and the information contained in the UED is critical, making appropriate application of configuration management principles of paramount importance for accelerator operations.

## The UITF Element Database (UED)

The UED is the central element-specific information repository used to operate UITF. All beamline elements that affect beam operations are included in the database, with the information for each type of element tailored to match the specific function. Operations-critical tools pull element information from the database, relying on the UED as the single, authoritative source for operating information. With the UED as the central information repository, changes ripple immediately through all tools whenever an element in the UED is updated or a new element is added. From a configuration management perspective, the UED is key for establishing and maintaining consistency between the physical accelerator configuration and the tools used to operate it

### The UED Revision Process

A well-defined revision control process is critical for maintaining the integrity of the UED. This includes defining roles and responsibilities and providing appropriate communication tools. [Figure](#_bookmark157) 2, below, provides an overview of the process.



Input element information

**Stakeholders** Different stakeholders for each system (e.g., BPMs,

magnets, etc.) with the

following roles:

* System Owners
* System Technicians
* Controls Contact
* CASA Contact
* Songsheet Maintainer
* UED Admin
* Nomenclature Admin

Change Notification

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or

**UED Development Workspace** Stakeholders input element information in the Development

•

•

or

Workspace before it is released

to the Production Database. Element fields are customized for each system and editable by specific stakeholders.

•

When a field is changed, stakeholders are notified via email, depending on the type of change.

* + Specific “required” properties must be complete before the element is submitted for review.

submit for incorporation

Reject with explanation

reject, with

tion

h

explana

**Q.A. Review**

UED Admin reviews the

•

•

•

additions/changes. UED Admin runs audit software.

UED Admin releases to Production Database or notifies stakeholders if the change is rejected.

Approve

a

approv

.

**UED Production Database**

* New element information becomes part of the “master” UED database used to run UITF
* Database change history is retained for later reference.

**Figure 2:** The UED Revision Process

### Project Stakeholders

Elements in the UED are organized by system (e.g., BPMs, magnets, RF, vacuum), and each system has a different group of stakeholders. The various stakeholders are listed in Figure 2. Each UED element has a set of associated fields, and each field has assigned write privileges, so that stakeholders can contribute their portion of the information. Specific “required” fields are assigned only to the Project Lead. The Nomenclature Administrator has the final say with regard to element names. Others contribute various information, depending on the type of system and element. An UED Administrator helps facilitate the process and maintain UED standards.

An important by-product of the UED revision process is improved communication between stakeholders. As element changes are made, the various stakeholders are notified, providing them with information that can be used in their planning process.

### The UED Development Workspace

System Stakeholders prepare updates or new elements in a development workspace; they do not directly edit the production UED production database. Within that workspace, each element can have a variety of fields that are editable by specific stakeholders. Each element has “required” fields that must be completed before the element is submitted for incorporation in the production database. However, during the development phase, the workspace can be quite freeform, allowing stakeholders to add and remove fields and even proceed without a final element designator. As element field changes are made, automatic notifications are sent, depending on the type of change. After the information in the development workspace is complete, a request to merge the information with the production database is made, and the request is considered by a UED Administrator.

### UED Quality Assurance Review

Before changes are merged from the development workspace into the production database, an UED Administrator reviews the proposed changes to verify that they are valid and also runs audit software that determines if the information meets UED requirements. If problems are identified, the UED Administrator notifies the person who submitted the proposed changes and discusses how to correct the issues. After all criteria are met, the UED Administrator releases the changes to the UED production database and stakeholders are notified. This review process ensures the integrity of the element data contained in the UED production database.



**3**

**UITF Operations**

UITF operations refers to the activities associated with operating the UITF. This chapter describes the roles and responsibilities of the operating staff and others involved with UITF program execution, provides protocol for critical event response, and lists directives that govern specific aspects of the conduct of operations.

## UITF Operations Overview

UITF operations are conducted from the UITF Control Room by authorized staff. The UITF Operator controls and monitors the UITF beam acceleration systems. Other qualified individuals can be granted access to the control system (i.e., “channel access”) but must be in the presence of the UITF Operator when making control system changes that will affect the electron beam.

Critical event response for the UITF, is directed by the UITF Coordinator.

## Personnel and Responsibilities

The personnel involved in UITF operations include the UITF Operator and support staff.

### Control Room Personnel and Responsibilities

##### UITF Operator

The UITF operator is responsible for UITF program execution, The UITF Operator controls and monitors the UITF to deliver the beam required for the scheduled UITF programs.

* + - * + Be aware at all times of the PSS status of the UITF..
        + Ensure that the operational and safety envelopes for the UITF are not exceeded.
        + Verify that, before leaving the UITF in the Beam OFF state, the PSS state for the UITF is changed to Restricted Access.
        + Read and understand all approved UITF-specific OSPs and TOSPs.
        + ACT as an ARM.
        + Review and sign off on UITF radiation surveys performed during on-duty shifts and verify that these surveys meet the established Radiation Control Department (RCD) standards.
        + Read and understand all approved UITF-specific OSPs and TOSPs.
        + Know the intended delivery points for all UITF beams and the approximate average beam currents and beam energies.
        + Ensure that FSD masking is properly configured to protect UITF accelerator and experiment-specific components.
        + Control or directly supervise the operation of devices that interface to the UITF PSS such as gun high-voltage controls, beam stoppers, RF systems, and magnet box supplies.
        + Ensure that the appropriate Machine Protection Systems (MPS) are used during beam operations.
        + Understand and respond appropriately to all PSS, LPSS, and MPS faults.
        + Using the procedures specified in the *PSS Users Manual,* search and secure the UITF beam enclosure before electron beam operation*.*
        + Close any UITF-related Operations Problem Reports (OPS-PRs)

Program coordination:

* + - * + Coordinate the activities of the PI or PI’s designee.
        + Understand all responsibilities specified in this document, the *UITF Operations Directives*.
        + Understand the UITF-specific information in the shift plan.
        + Read and understand the experiment-specific information.

Program execution:

* + - * + Open channel access as needed for qualified individuals.
        + Read all UITF beam plans listed in theShift Plan
        + Monitor beam quality to ensure that the beam specifications meet the program goals.
        + Monitor the performance of operating accelerator systems.
        + Measure and adjust accelerator and electron beam parameters according to approved procedures to optimize performance.
        + In case of critical system failure, bring UITF to restricted access and perform radiation survey if there was beam operation.

##### Assigned Radiation Monitor (ARM)

UITF Operators must qualify as ARMs.

Specific ARM training and qualifications are defined in the *Radiation Control Manual*, which is a supplement of the *ES&H Manual*. In general, however, ARM training consists of a classroom (theory) portion followed by separate “practical” training, where the ARM-in-training demonstrates the ability to survey specific radiologically controlled areas (e.g., the CEBAF accelerator, individual experiment halls, or the UITF).

## Critical Event Response

The nature of critical events can vary widely. the basic responses to the most common critical events are described or referenced in the following sections.

### Safety Envelope Violations

If the Safety Envelope is violated during UITF operations, beam must be terminated and the investigation process followed as specified in the *ES&H Manual, Section 5200, Event Investiga**tion and Causal Analysis Process.* The Director of Accelerator Operations, the the CIS Director, the Safety System Group Leader, and the Accelerator Division Safety Officer (DSO) must be notified as soon as possible.

Beam operations shall not resume until the Director of Accelerator Operations gives direct approval.

### Operations Envelope and Operational Restriction Violations

The Operations Envelope provides administrative assurance that the Safety Envelope for these controls is not exceeded.

The Operational Restrictions establish the thresholds for UITF operation, including beam current maximums, beam dump power limitations, experiment target limits, and target and beam dump raster sizes. Variations outside of the Operational Restrictions require specific administrative action as described below.

If an Operations Envelope or Operational Restriction violation occurs, beam must be terminated and the Director of Accelerator Operations, the CIS Director, and the Safety System Group Leader (for PSS-related violations) must be notified immediately. Beam operations shall not resume until the Director of Accelerator Operations gives direct approval.

### Personnel Safety System (PSS) Malfunctions

The PSS is designed to protect personnel during UITF operations. If, during operations, a malfunction of the PSS is perceived, beam delivery shall be terminated immediately. The UITF operatopr shall report the perceived malfunction to the Safety System Group Leader for resolution.

If, on investigation, the Safety System Group Leader determines that the PSS operated as designed and such operation does not pose a previously undetected

personnel hazard, then beam operations may resume after direct approval is given by the CIS Director..

If the Safety System Group Leader determines that a previously unidentified hazard exists, the USI process must be followed.

If the Safety System Group Leader determines that the PSS did not function correctly, the occurrence reporting process described in shall be followed.

### Machine Protection System (MPS) Malfunctions

The Machine Protection System (MPS) is a hardware-based system used to shut off the electron beam in cases where sustained beam, or energy directly related to the electron beam, could damage components. MPS inputs include variables such as beam loss and superconducting cavity arcs or quenches. The backbone of the MPS system is the Fast Shutdown system (FSD), which has the ability to shut off the beam from anywhere in the UITF in less than 40 µs. MPS subsystems include beam loss monitors (BLMs) and the FSD system.

If, during accelerator operations, a malfunction of the MPS is observed or perceived, beam delivery in the affected segment shall cease immediately, and the UITF Operator must report the observed or perceived malfunction for resolution to the appropriate CIS Staff. Beam operations shall not resume until the system is repaired and verified and direct approval is given the CIS Director.

### Electron-Beam-Strike Events

Although the MPS is designed to minimize the potential for beam-related and laser-related equipment damage, such events can still occur.

* An acute loss of beamline vacuum can be caused by an electron beam strike. Vacuum loss is considered to be acute whenever supplemental vacuum pumping equipment is required to restore beamline vacuum.
* A radiation level detected during a beamline survey exceeds 1.0 R/hour on contact, except at beam dumplettes where beam was intentionally directed.
* Physical damage to beamline components has been caused by a beam strike. This includes physical damage to components such as beam pipe, beam dumps, magnets, BPMs, targets, and insertable devices like harps and viewers. Radiation damage to components such as viewer cameras is not considered to be caused by beam strike.

If a beam strike event occurs, the beam shall immediately be turned off (if not already off) and the appropriate staff notified. Beam operations shall not resume until direct approval is given by the CIS Director.

### Emergency Response

The Crew UITF Operator assumes the role of Internal Incident Commander (IIC) until relieved. . Emergency response is guided by written procedures, which are located in the *Emergency Response Binder* in the Control Room. This binder contains site building maps and general emergency information as well as procedures for the following specific situations:

* 911 call (for a 911 call placed from within the accelerator site safety fence)
* Bomb threat
* Fire
* Injury
* ODH alarm
* Power outage
* Radiation event
* Spill
* Weather emergency

## Directives

This section specifies directives that shall be followed by all Control Room personnel and others engaged in the operation or oversight of components that are part of the UITF.

### Control System Interaction

The UITF is operated using EPICS (Experimental Physics and Industrial Control System), an open-source computer interface that reads and writes to process variables, which remotely control accelerator system components.

##### UITF Control System Access

Authorization to manipulate UITF accelerator system process variables is controlled by the UITF Operator through the use of the channel access (CA) security protocol. The control room staff can open UITF channel access for specific devices or an entire system to anyone with a valid operations computer system account; however, such requests must first be authorized by the UITF Operator. During maintenance periods, channel access is generally opened to anyone with a valid operations computer system account.

During beam operations, channel access is generally closed to everybody except control room staff. The UITF Operator can use discretion to temporarily grant channel access to others so long as the activity will not affect ongoing electron beam transport.

##### UITF Operator Control System Interaction

Only qualified UITF Operators have unlimited channel access to all UITF process variables at all times; however, these personnel must observe the following restrictions.

* + - * + Be approved by the CIS Director and added to the list of qualified UITF Operators.
        + Be physically present in the UITF Control Room and working from a UITF computer console when making control system changes during beam operations.

##### Control System Interaction Affecting Beam Transport by Others

Personnel other than UITF Operators who, when beam is present in the UITF accelerator, need to make control system changes that will affect beam transport, must meet the following requirements.

**NOTE:** On occasion, those who are solving specific problems at the request of the UITF Operator may need access to the control system but may not meet the following criteria. They can be granted access for a limited time period under the direct supervision of the UITF Operator because they are solving a specific problem and not executing the UITF program.

* + - * + Be approved by the CIS Director and added to the list of those qualified to have UITF channel access for areas where beam is being transported.
        + Have explained to the UITF Operator, in advance, the anticipated changes and been given UITF Operator approval. The UITF Operator will open channel access as appropriate for the task.
        + Be physically present in the same control room as the UITF Operator and working from a UITF computer console when making control system changes.

### Shift Protocol

Shift protocol includes staffing requirements, shift schedules, and control room staff conduct.

##### Staffing Requirements for Operations

**Table 3:** Minimum Staffing Requirements for UITF Operations

**NOTE:** The paragraphs following this table provide information required to understand these staffing requirements.

|  |  |  |
| --- | --- | --- |
| **UITF Operating Condition** | **UITF PSS State** | **Minimum Required Staffing** |
| * **Beam OFF** | * *Restricted Access* | * None |
| * **Beam OFF** | * *Sweep Mode* | * UITF Operator * Another authorized UITF operator |
| * **Beam ON** | * *Beam Permit* | * UITF Operator |

UITF has only two PSS states: Restricted Access or Beam Permit

The staffing requirements shown in [Table](#_bookmark321) 3 address the possible UITF operating conditions; other constraints and conventions are as follows:

* + - * + Beam ON is defined as the UITF being in *Beam Permit*.
        + Beam OFF is defined as whenever the gun high-voltage power supply is not enabled (i.e., the power supply does not have a PSS permissive).
* All UITF Operators are trained as ARMs.
* Whenever the UITF Operator leaves the UITF control room during non-restricted access, the UITF Operator must carry a cell phone for contact.
* Whenever UITF Operator changes occur for any reason, the oncoming staff member must receive a summary of the shift activities, receive task assignments from the UITF Operator.

##### Shift-Turnover Meeting

Because it is a test facility, the need for a shift turnover meeting will be rare. The shift-turnover meetings are held at the end of each shift so that the off-going staff can transfer information to the oncoming staff.

The shift-turnover meetings are held in the UITF control room and usually last less than fifteen minutes.

### Control Room Equipment

The UITF control room equipment consists of console equipment, fire alarm equipment, radiation-monitoring equipment, portable oxygen monitors, communications equipment, computer workstations, printers, video monitors.

### Record Keeping

Accurate record keeping is an essential part of UITF operations and is required for both administrative and technical reasons. UITF operations record-keeping documents include the *UITFLog*. Requests for additional record keeping by the control room staff should be directed to the CIS Director..

The UITF Operator is responsible for on-shift record keeping. The UITF Operator must enter and review these records frequently to ensure that entries clearly and accurately describe shift activities.

##### UITFLog

The *UITFLog* is the sequential record of the events occurring during the operation of the UITF. All information must be entered promptly, since delays often lead to incomplete or inaccurate entries. All entries require the date, time and name of the person making the entry. The *UITFLog* is a computer based electronic log book which can be accessed from the ELOG home page.

##### PSS Log

The *PSS Log* is used to record (1) changes in UITF state, and (2) information about Safety System equipment failures.

##### Radiation Survey Log

Radiation surveys identify areas where activation of beamline hardware may require radiological work controls or access controls. A detailed radiation survey (see the *Radiological Control Manual*) must be performed any time entry into the UITF enclosure is required. These sheets must be filled out in pen, signed, and dated by the ARM. The original survey sheet must be scanned, the resulting image posted in the electronic *Radiation Survey Log*. and the original survey sheet placed in the Radiation Survey binder, which contains the most recent survey sheets. The Radiation Control Department is responsible for collecting previous survey records. The results of the latest survey of each area must remain in the binder at all times.



**4**

**Maintenance & Tracking**

Maintenance refers to work performed on the hardware or software of the UITF. Examples of UITF maintenance activities include:

* Making repairs after a failure
* Periodic replacement of high-wear parts
* Fixing inspection deficiencies
* Post-repair testing
* Calibration
* Alignment
* Equipment and software upgrades

As a test facility, the UITF maintenance tasks are expected to be carried out within the priorities for resources set by the laboratory management.

Any major installations may be performed either by JLab staff and/or contractors and require either cross-divisional coordination or extensive engineering effort in the planning and execution phases and during checkout.

## Personnel and Responsibilities

For CIS related tasks, maintenance of the UITF is the responsibility of CIS director. Maintenance and project oversight for non-CIS tasks is a shared responsibility between the CIS director and the project ‘s PI. For these tasks, the UITF Coordinator handles day-to-day task scheduling and oversight. Maintenance and project activities are supported by the Jefferson Lab system support groups and subcontractors, who perform maintenance tasks for both the UITF and CEBAF. Approved repairs are performed by authorized personnel.

### UITF Coordinator

The UITF Coordinator responsibilities encompass the UITF facility and include coordination and scheduling of all maintenance and non-CIS installation activities.

UITF Coordinator responsibilities are as follows:

* + - * Serve as the primary contact for work to be performed in the UITF.
      * Coordinate and schedule the safe and efficient installation of equipment in the UITF, including new experiment equipment and UITF system modifications or upgrades to accommodate the non-CIS projects.
      * Maintain equipment documentation and work control documents in a central electronic repository.
      * Participate in the demonstration and testing of new equipment and systems as they move from development to operational running.
      * Lead focus meetings to address any potential or existing issues.

### System Owners

System Owners oversee all aspects of a UITF system (e.g., SRF, RF, magnets, BPMs) to assure system performance in support of the scheduled program.

System Owners should ensure that the element data contained in the UITF Element Database (UED) matches the existing system configuration, and incorporate any UED changes in a timely manner.

## Directives

### Safety Guidelines for Maintenance Activities

Maintenance and project tasks are performed within the guidelines established by the Jefferson Lab *ES&H Manual, Section 3000, Planning for Safe Operations.*

Work control documents associated with these tasks include, but are not limited to, Standard Operating Procedures (SOPs), Fire Hazard Work Permits, Confined Space Work Permits, Electrical Service Work Permits, and Radiological Work Permits. Prior to performing work, the *ES&H Manual, Section 3210, Work Planning, Control, and Authorization Process* must be followed in order to properly plan the work, identify and analyze risks, and gain the required authorization.

If a hazard associated with a task is not addressed by the *ES&H Manual*, then the hazard is considered unusual, and specific written approval in the form of Operating Safety Procedures (OSPs) or Temporary Operating Safety Procedures (TOSPs) is required prior to beginning the work.

When planning or performing maintenance work, unreviewed safety issues (USIs) that might arise from the work must be identified and reported. In general, the standard industrial hazards encountered during maintenance are addressed by the *ES&H Manual.*  However, certain work may affect systems that act as credited controls used to mitigate the known hazards of UITF operations. Such work includes, but is not limited to the following:

* + - * UITF modifications that are not replacement-in-kind activities.
      * Change-out/replacement of safety equipment that is identified in the FSAD or ASE and not identical in form, fit, and function.
      * Changes to the safety systems and equipment.

The *Unreviewed Safety Issue (USI) Procedure* provides additional guidance helpful in identifying USIs and specifies the steps required to address any USI.

### Bypassing System Interlocks

Interlocks are present in many UITF systems and serve to protect personnel, equipment, or both. Interlocks constrain the operation of equipment in some fashion, either electronically or mechanically. Interlocks found in the UITF typically rely on some type of electronic transducer, sensor, switch or physical mechanism to keep equipment from being placed in an unsafe state. It can be difficult to determine whether or not a specific item should, in fact, be considered an interlock. For example, a water valve is not an interlock, but an associated sensor that detects water flow, temperature, pressure, or valve position and constrains the operation of equipment *is* part of an interlock for that equipment.

From time to time it may be necessary to bypass a system interlock. Bypassing can be accomplished in a variety of ways, including installing a physical wire or jumper, modifying software, or making a change in one or more process variables or set points. Specific steps must be taken whenever an interlock is bypassed; however, these steps differ depending on whether the equipment remains in service or is physically disconnected from the accelerator (i.e., out-of-service).

These two possibilities and the required steps are defined in the following sections. It should be noted that this directive does not apply to equipment associated with the Personnel Safety System, which is governed by a separate document, the *Jefferson Lab Personnel Safety System Configuration Control Policy.*

##### In-Service Equipment

Equipment is considered to be “in-service” when the physical, critical connections to the accelerator remain in place. In other words, the equipment remains in- service even if a switch (or switches) is thrown or a fuse is removed. Only actions like physically removing the equipment or disconnecting critical cabling change the status to “out-of-service”.

When an interlock is bypassed on an in-service system, the person performing the bypass must ensure that an appropriate entry is made in the *UITF Logbook* and also apply a standard Interlock Bypassed tag when the interlock is bypassed. This tag must include the name of the person installing the bypass, the date, the purpose, the location of the jumper., Each bypass requires a separate tag, and the tag must be placed in a location that is obvious to anybody who would be removing the bypass.

There are two exceptions to this requirement.

* + - * + **Exception #1** – Bypasses made by changing a software process variable *do not* require an Interlock Bypassed tag. Examples are masking a fast shutdown (FSD) node or bypassing an ODH head through software.
        + **Exception #2** – Bypasses made during repairs to correct conditions that impede the scheduled program.

##### Out-of-Service Equipment

Equipment is considered to be “out-of-service” when critical physical connections to the UITF have been removed. This is accomplished by, at a minimum, physically removing critical cabling that connects the system to the UITF. Equipment such as a box power supply may remain in place but be considered out-of-service after critical physical disconnects have been made. Equipment that has never been installed in the accelerator is also considered to be out-of-service.

Bypassed interlocks in out-of-service equipment must be identified by a tag*.* The person installing the bypass must fill out and apply a standard Interlock Bypassed tag when the interlock is bypassed. This tag must include the name of the person installing the bypass, the date, the purpose, and the location of the jumper (a serial number is not required for out-of-service equipment). The tag must remain attached to the equipment until the bypass is removed. Each bypass requires a separate tag, and the tag must be placed in a location that is obvious to anybody installing the equipment.

### OPS-PR Problem Reporting System

OPS-PR (Operations Problem Report) is an electronic tracking and reporting system for corrective action requests. OPS-PR entries are made using either the control screen interface or the web-based interface.

The OPS-PR initiator describes the problem and also selects from the lists of systems, groups, and regions to categorize the problem. For some common problems, guidance for a solution may be presented as the entry is made. Files can be attached, and the entry can also be associated with other similar entries. The electronic logbook(s) where the entry will appear can also be specified. When the entry is submitted, the system owner and other subscribed personnel automatically receive the entry via email; other recipients can also be entered. Once generated, an OPS-PR can be reassigned by the system owner and comments can be added as progress is made toward resolution.

**Appendix A**



**UOD Release Memo**

After each revision, the UOD is re-released under cover of the UOD Release Memo, which includes a brief change summary and a list of those receiving hard copies of the document.

**Figure A-1:** UOD Release Memo, p. 1



MEMORANDUM

**To:** Distribution

**From:** Matthew Poelker

**Subject:** UITF Operations Directives

**Date:** October 31,2016

These new UITF Operations Directives, dated October 31,2016, will remain in effect until superseded. The UITF Operations Directives will be reviewed in approximately three years by the CIS Director,

The URL for the UOD is:

https://wiki.jlab.org/ciswiki/index.php/UOD.pdf

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