DRAFT

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LERF Operations Directives

Revision 1b1
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Jefferson Lab

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Preface

This document, the LERF Operations Directives (LOD), provides directives for Accelerator Division personnel and others who operate and maintain the Thomas Jefferson National Accelerator Facility (Jefferson Lab) LERF (Low Energy Recirculator Facility) accelerator and the associated beam-delivery and lasing systems.

Presently there are two accelerators on the JLab accelerator site: the LERF, and the Continuous Electron Beam Accelerator Facility (CEBAF). Each accelerator can be operated independently; however, both draw power, cryogens, and low-conductivity water from the same sources. Shift crews for both accelerators are members of the Accelerator Operations Group. CEBAF operations are covered by a separate document, the Accelerator Operations Directives (AOD) (http://opsntsrv.acc.jlab.org/ops_docs/online_document_files/ACC_online_files/accel_ops_directives.pdf).

The LERF electron accelerator is tightly integrated with "post acceleration" systems that allow the facility to act as a free electron laser (FEL). This gives the LERF a broad range of capabilities, including optical interaction studies, nuclear physics target interactions, and isotope production. When operated as an FEL, the LERF produces laser light that can leave the accelerator vault through an optical control room, where it can be directed to a series of user labs.

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

Chapter 1: Program Control
Describes how safety is integrated into execution of the LERF program and establishes how the program is defined and executed.

Chapter 2: Configuration Management
Outlines how configuration management standards and work practices are applied as part of LERF operations.

Chapter 3: LERF Operations
Specifies directives for how the LERF program is carried out, including the safety responsibilities of the control room staff and the role of safety organizations.

Chapter 4: Maintenance & Tracking
Describes the planning, scheduling, and coordinating of maintenance activities to maintain and improve LERF availability.

Appendix A: LERF Repair Flow Chart
The LERF repair and repair escalation process in a flow chart format.

Appendix B: LOD Release Memo
The memo used to release the LOD, including the associated change summary and review cycle.

This document has been approved by:

DRAFT

Arne Freyberger, Director of Accelerator Operations — Date 1/16/15

Acronyms & Abbreviations

ABIL	Accelerator Bypassed-Interlock Log
AOD	Accelerator Operations Directives
APEL	Accelerator-Physics Experiment Liaison
ARM	Assigned Radiation Monitor
ARR	Accelerator Readiness Review
ASE	Accelerator Safety Envelope
ATLis	Accelerator Task List
BCM	Beam Current Monitor
BLM	Beam Loss Monitor
BPM	Beam Position Monitor
B-Team	Beam Transport Team
CA	Channel Access
CARM	Controlled Area Radiation Monitor
CATS	Corrective Action Tracking System
CEBAF	Continuous Electron Beam Accelerator Facility
CHL	Central Helium Liquefier
COO	Conduct of Operations document
DOE	Department of Energy
DSO	Division Safety Officer
EC	Emergency Coordinator
EPICS	Experimental Physics and Industrial Control System
ES&H	Environment, Safety and Health
ESAD	Experiment Safety Assessment Document
ESH&Q	Environment, Safety, Health and Quality
FEL	Free Electron Laser
FSAD	Final Safety Assessment Document
FSD	Fast Shutdown
HCO	Hot Checkout
HRA	High Radiation Area
IIC	Internal Incident Commander

IOC	Input/Output Controller
IR	Infrared
ISM	Integrated Safety Management
ISMS	Integrated Safety Management System
JLab	Jefferson Lab
LED	LERF Element Database
LERF	Low Energy Recirculator Facility
LOD	LERF Operations Directives
LOSP	Laser Operational Safety Procedure
LPSS	Laser Personnel Safety System
LSOS	LERF Scientist on Shift
MCC	Machine Control Center
MPS	Machine Protection System
NPES	Nuclear Physics Experiment Scheduling Committee
ODH	Oxygen Deficiency Hazard
OSP	Operational Safety Procedure
OPS-PR	Operations Problem Report
PAC	Program Advisory Committee
PD	Program Deputy
PSS	Personnel Safety System
RA	Radiation Area
RAC	Repair Assessment Committee
RCD	Radiation Control Department
RF	Radio Frequency
RSAD	Radiation Safety Assessment Document
RWP	Radiation Work Permit
SME	Subject Matter Expert
SAD	Scheduled Accelerator Down
SRF	Superconducting Radio Frequency
SSO	Safety System Operator
TAC	Technical Advisory Committee
THz	Terahertz
TOSP	Temporary Operational Safety Procedure
USI	Unreviewed Safety Issue
UV	Ultraviolet

1 Program Control

Program control is the development and management of the LERF program carried out by the control room staff. This chapter describes how safety and work planning are integrated into LERF program development and execution, how the accelerator program is authorized, the various meetings and schedules that define the program, and the roles and responsibilities of personnel involved in defining, conducting, and scheduling the program.

1.1 Program Safety

Safety is integrated into all facets of LERF program planning and execution as defined in the *JLab Integrated Safety Management 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. The seven ISM guiding principles are listed below; more details are found in the *JLab Integrated Safety Management System Program Description.*

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

An overarching component of the safety program—and also one of the seven guiding principles listed above—is the requirement to maintain balanced priorities. It is JLab policy that no activity—including the execution of the accelerator program—is so urgent or important that standards for environmental protection, safety, or health are compromised; in other words, *safety first*. In this spirit, all JLab employees, subcontractors, and users are empowered to—without reprisal—stop any work that endangers people, the environment, property, or quality. This “stop work” policy is an expectation and responsibility for all JLab employees, subcontractors, and users and is documented in the *ES&H Manual, Section 3330, Stop-Work and Re-Start for Safety Program.*

In addition to the seven guiding principles, there are five core safety management functions that are integrated into planning and performing all work activity that could adversely affect workers, the public, or the environment. These core functions are as follows:

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

The LERF program is planned and executed using a structured framework of administrative tools, policies, and procedures, all of which contribute to overall program safety and consistency. The following subsections describe program safety in terms of the five ISM core functions and define how the various tools, policies, and procedures contribute to the safe execution of the program and also provide opportunities for continuous feedback and improvement.

The LERF program is supported by various maintenance activities, both scheduled and unscheduled. These maintenance activities also incorporate the integrated safety management principles described above. Maintenance work is guided by the policies established in the *ES&H Manual* and described in Chapter 4 on page 4-1 of this document.

1.1.1 Program Scope

The scope of the LERF program is developed using a structured approval/ scheduling process, which is summarized in the following paragraphs and illustrated in Figure 1-1, below. There are two paths that lead to approval and eventual execution of a LERF experiment. Nuclear Physics experiment proposals follow the traditional path of a typical physics experiment; outside-funded

ventures are funneled through a different management review track. Both paths include the same safety review process.

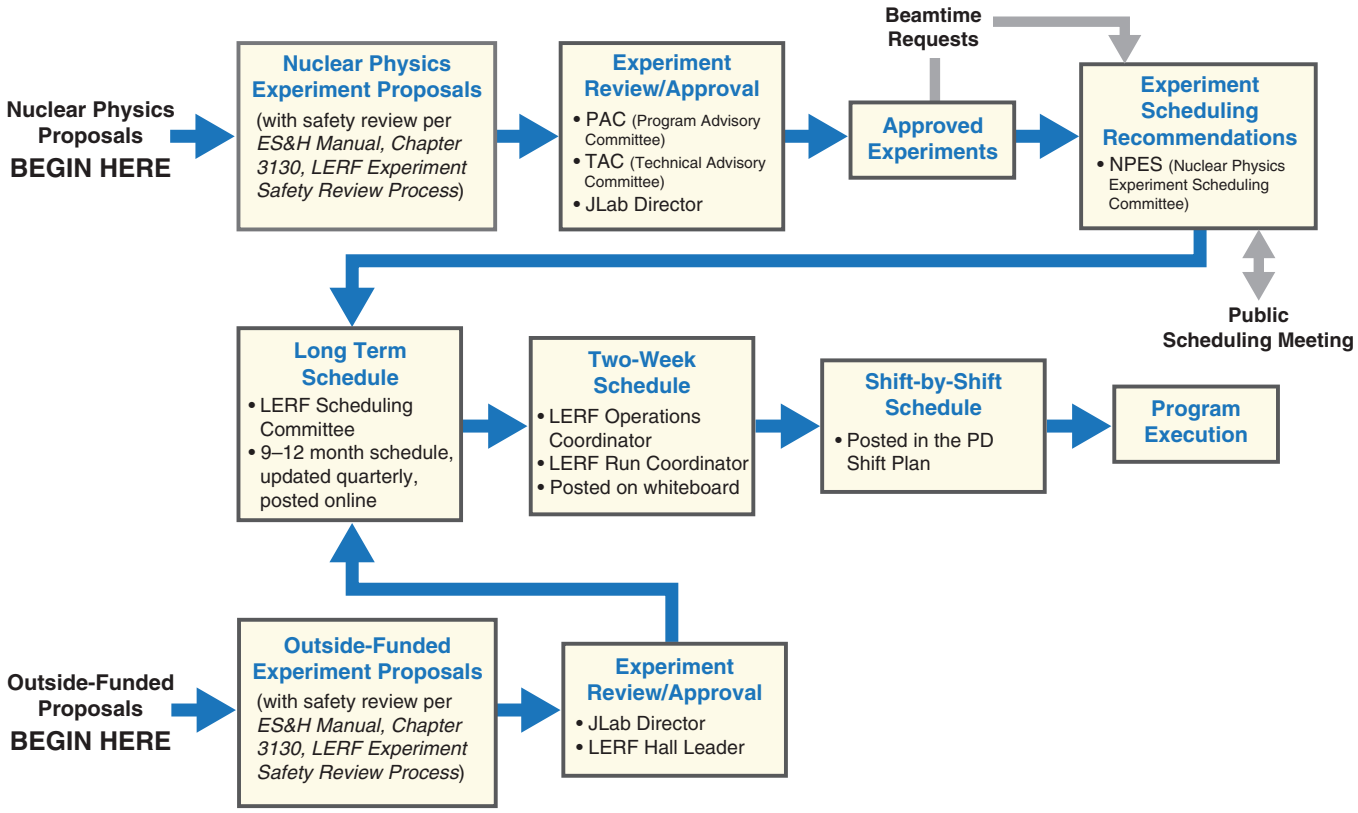


Figure 1-1: Experiment Approval/Scheduling Process Defines LERF Program Scope

1.1.1.1 Nuclear Physics Experiment Proposals

Groups of collaborating experimenters submit experiment proposals to the Program Advisory Committee (PAC) (see Figure 1-1). 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, Section 3130, The LERF 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 and then subsequently makes recommendations to the LERF Scheduling Committee (see Section 1.1.1.3

on page 1-4). NPES takes into account a wide range of factors such as scientific priorities, budget and manpower constraints, accelerator performance capabilities, experiment staging space requirements, radiation budgets, and accelerator development opportunities required to meet future program goals. The proposed schedule is then published for review and comment, and an open meeting of users and staff is held to gather feedback and make any necessary adjustments.

1.1.1.2 Outside-Funded Experiment Proposals

Experiments with outside funding will be considered for approval by the Jefferson Lab Director and the LERF Hall Leader. Each experiment proposal is reviewed for its effect on the environment, safety, and health using the review process defined in the *ES&H Manual, Section 3130, The LERF Experiment Safety Review Process*. Approved experiments are passed to the LERF Scheduling Committee for inclusion in the *LERF Long Term Schedule*.

1.1.1.3 Final Program Development

The LERF Scheduling Committee considers all approved experiment proposals, both nuclear physics and outside-funded, and generates the *LERF Long Term Schedule* (see Section 1.4.1 on page 1-16), which is posted online. The committee is appointed by the Director of Accelerator Operations and includes the LERF Hall Leader, the LERF Operations Coordinator and representatives from Engineering, Operability, and Operations management. The committee meets quarterly and publishes a nine-month schedule of LERF operations. The committee bases their scheduling decisions on a broad range of factors including experiment priority and infrastructure and staffing availability.

During operations, the *LERF Long Term Schedule*, which shows activities in one-day increments, is further refined to become the *LERF Short Term Schedule* (http://lerfboard.acc.jlab.org/) (see Section 1.4.2 on page 1-16), which shows a two-week period and is posted on the whiteboard in the LERF Conference Room. The LERF Run Coordinator (see Section 1.3.6 on page 1-14) consults with the LERF Operations Coordinator to develop and maintain the short term schedule. During running, the short term schedule is discussed at the LERF 0830 Daily Summary Meeting (see Section 1.5 on page 1-17), where feedback and comments are incorporated as appropriate.

The LERF Run Coordinator communicates the scope and details of the final plan to the control room staff via a LERF section in the *PD Shift Plan* (http://opweb.acc.jlab.org/CSUEApps/bta03/pd_shiftplan_history.php) (see Section 1.4.3 on page 1-17). The control room staff executes the specified program, working toward the defined goals while remaining within the established program scope.

1.1.2 Program Hazard Analysis

The potential hazards associated with executing the LERF program are analyzed as two distinct segments: 1.) the hazards associated with operating the LERF electron accelerator and its FEL lasing systems, and 2.) the hazards associated with each specific experiment that will use the LERF beam. The LERF accelerator and lasing systems operate under blanket approval, within specific operating constraints as described in Section 1.1.2.1, below. Each approved experiment,

however, must undergo a separate, thorough hazard analysis as described in Section 1.1.2.2 on page 1-5.

1.1.2.1 LERF Accelerator Hazard Analysis

As required by *DOE Order 420.2C, Safety of Accelerator Facilities,* two documents address the hazards associated with LERF accelerator 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)*. Planned and authorized variations beyond the boundaries of the ASE must be reviewed and approved by the DOE Site Office using the same process as for unreviewed safety issues (USIs) (see Section 1.1.3 on page 1-6).

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

1.1.2.2 LERF Experiment Hazard Analysis

Each LERF experiment must follow the experiment review process defined in the *ES&H Manual, Section 3130, LERF Experiment Safety Review Process.* This process specifies that an *Experiment Safety Assessment Document* (ESAD) and a *Conduct of Operations* document (COO) must be approved and in place before an experiment can run. 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.

1.1.3 Unreviewed Safety Issues

An unreviewed safety issue (USI) is an accelerator safety issue that presents a significant safety risk and was not previously identified, analyzed, and already mitigated as documented in the FSAD (see Section 1.1.2 on page 1-4). 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* (https://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 or ASE, 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*.

1.1.4 Program Hazard Controls

1.1.4.1 Credited Controls

The LERF program is conducted using credited controls to eliminate, control, or mitigate the accelerator-specific identified hazards. Credited controls are specified in the ASE (see Section 1.1.2 on page 1-4) and 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. The control room staff (i.e., the Crew Chief and LERF Operator) is required to conduct accelerator operations within these controls (see Section 3.2.1.1 on page 3-2 and Section 3.2.1.3 on page 3-5). Any proposed exception must be formally preapproved by the DOE site office and then authorized by the Director of Accelerator Operations before implementation. If a credited control is altered in any way, the *Unreviewed Safety Issue (USI) Procedure* must be followed (see Section 1.1.3 on page 1-6).

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

NOTE: The ASE specifies credited controls; the following list is for reference only.

- **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
  - LERF experiment review process
  - LERF Operations Staffing with Electron Beam ON

The Safety and Operations Envelopes – The ASE specifies the credited controls, which ensure that the accelerator safety risks are within acceptable limits. These controls are collectively referred to as the Safety Envelope. A second set of more stringent controls known as the Operations Envelope is used to provide assurance that the Safety Envelope is not exceeded. Variations of operating parameters outside the Operations Envelope, but within the Safety Envelope, are not treated as a DOE reportable occurrence but can cause administrative actions to be taken by JLab management. Operations Envelope limits are specified by Operations leadership and are listed in the Operational Restrictions (see Section 3.5.5.4 on page 3-25).

1.1.4.2 Additional Safety Controls

While the credited controls specified by the FSAD address worker safety, public safety, and environmental safety, LERF 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 LERF 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 (see Section 3.5.1.1 on page 3-17).
- **Operational Restrictions** – A listing of administrative limits and operating parameters for specific accelerator systems or areas (see Section 3.5.5.4 on page 3-25).
- **Beam Test Plans** – Formal plans that are submitted when a system expert wishes to test specific LERF operating parameters or gather test data during normal LERF operations (see Section 3.5.3.2 on page 3-23). Beam test plans require thorough prejob planning, hazard analysis, and a standard review/approval process.
- **LERF-Specific Operational Safety Procedures (OSPs) and Temporary Operational Safety Procedures (TOSPs)** – OSPs and TOSPs are developed when a task involves unusual safety hazards that are not fully addressed in the *ES&H Manual* or where the hazard has unique operational features such as tasks involving multiple work groups (see *ES&H Manual, Section 3310, Standard Operating Procedures and Operational Safety Procedures*). Copies of specific OSPs and TOSPs that pertain to LERF operations are maintained in a binder in the MCC control room. These documents are reviewed by all LERF Operators and Crew Chiefs.

1.1.5 Program Execution Within Controls

Under the direction of the Crew Chief, the LERF Operator executes the approved accelerator program as authorized in Section 1.2 on page 1-11 and within the controls established in Section 1.1.4 on page 1-6. All others requiring access to the LERF control system must meet the requirements specified in Section 3.5.1 on page 3-16. Program details are specified in the *PD Shift Plan*, and when special tests are necessary, system experts provide task details in the form of a *Beam Test Plan* (http://opsweb.acc.jlab.org/CSUEApps/atlis/atlis.php?want_beam_testplan=1). All activities are conducted in accordance with this document, the *LERF Operations Directives*.

Prior to executing the program, the shift crew achieves a state of readiness as follows. An FEL Laser Operator is required when the LERF is operating as an FEL.

- **Training and Qualification** – The oncoming Crew Chief, LERF Operator, and FEL Laser Operator have the required training and are shown as a Crew Chief, LERF Operator, or FEL Laser Operator on the list posted on the MCC Information Bulletin Board (see Section 3.2.1 on page 3-2).
- **Preshift Reading** – The oncoming Crew Chief, LERF Operator, and FEL Laser Operator read and understand the following before assuming responsibility for LERF operations:
  - *PD Shift Plan* (see Section 1.4.3 on page 1-17)
  - *LERF Logbook* (*LERFLog*) entries since last on shift (see Section 3.5.5.1 on page 3-24)

- *LERF Shift Log* for the preceding shift of operations (see Section 3.2.1.1 on page 3-2)
- LERF-specific OSPs/TOSPs (see Section 1.1.4.2 on page 1-7)
- Experiment-specific binders

- **Shift-Turnover Meetings** – The oncoming Crew Chief, LERF Operator, and FEL Laser Operator participate in their respective shift-turnover meeting (see Section 3.5.2.3 on page 3-21) at the beginning of each shift. This meeting serves as a prejob briefing, where the ongoing accelerator program and any off-normal conditions are discussed. The oncoming Crew Chief, LERF Operator, and FEL Laser Operator assume responsibility immediately following the shift-turnover meeting. When shifts do not overlap, the preshift reading described above takes the place of the shift-turnover meeting.
- **Stamp In** – The oncoming Crew Chief, LERF Operator, and FEL Laser Operator complete all required fields in the *Crew Chief Stamp* or *LERF Operator Stamp,* and *FEL Laser Operator Stamp*, respectively, for each on-duty shift.

1.1.6 Program Feedback and Continuous Improvement

Feedback and continuous improvement are integrated throughout the process of developing and then executing the LERF 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:

- **LERFLog** – As a time-based repository for information associated with program execution, the *LERFLog* (https://logbooks.jlab.org/book/elog) (see Section 3.5.5.1 on page 3-24) 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 (see Section 3.5.5.3 on page 3-25) 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.
- **Program Deputy/Halls Meeting** – Held workdays at 0745 (weekends as necessary), this meeting brings together the Program Deputy, the Experiment Run Coordinators for each CEBAF hall scheduled to receive beam (see Section 1.5 on page 1-17), the LERF Run Coordinator (when the LERF is operating) and key maintenance, operations, operability, and support staff, including Optics-on-call and the Day Shift Crew Chief. At this meeting the run coordinators provide feedback on the previous 24 hours of operations, and those assembled make any necessary adjustments to the program for the next 24 hours of operations.
- **CEBAF Daily Summary Meeting** – The CEBAF Program Deputy runs the Daily Summary Meeting, which is held workdays at 0800 (see

Section 1.5 on page 1-17). The focus of the meeting is to report on the previous 24 hours of CEBAF operations and communicate the plan for upcoming operations. The LERF Run Coordinator is expected to attend this meeting and briefly summarize LERF operations and any issues that may be facing the LERF in the coming shifts.

- **LERF Daily Summary Meeting** – The LERF Run Coordinator runs the LERF Daily Summary Meeting, which is held workdays at 0830 (see Section 1.5 on page 1-17). The focus of the meeting is to report on the previous 24 hours of LERF operations and communicate the plan for upcoming operations.
- **LERF Operations Procedure Revisions** – When an accelerator operator discovers an error or something that is unclear in a task-specific procedure, the operator provides a marked copy of the procedure to the LERF Documentation Coordinator (see Section 3.2.1.12 on page 3-13) or clearly describes the procedure problem in an OPS-PR. The LERF Documentation Coordinator then works with the Technical Custodian (i.e., the assigned subject matter expert) to make an appropriate change.
- **Corrective Action Tracking System (CATS)** – The lab-wide CATS system (https://mis.jlab.org/ehs/) 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.

1.2 Program Authorization

The DOE Site Office has authorized JLab to perform routine operations of the LERF accelerator within the safety envelopes listed in the *JLab Accelerator Safety Envelope* (ASE) (see Section 1.1.2 on page 1-4). Before granting operations authorization, the DOE carried out a rigorous review process (see Figure 1-2, below) as specified in *DOE Order 420.2C, Safety of Accelerator Facilities*. To meet the review requirements, JLab prepared a

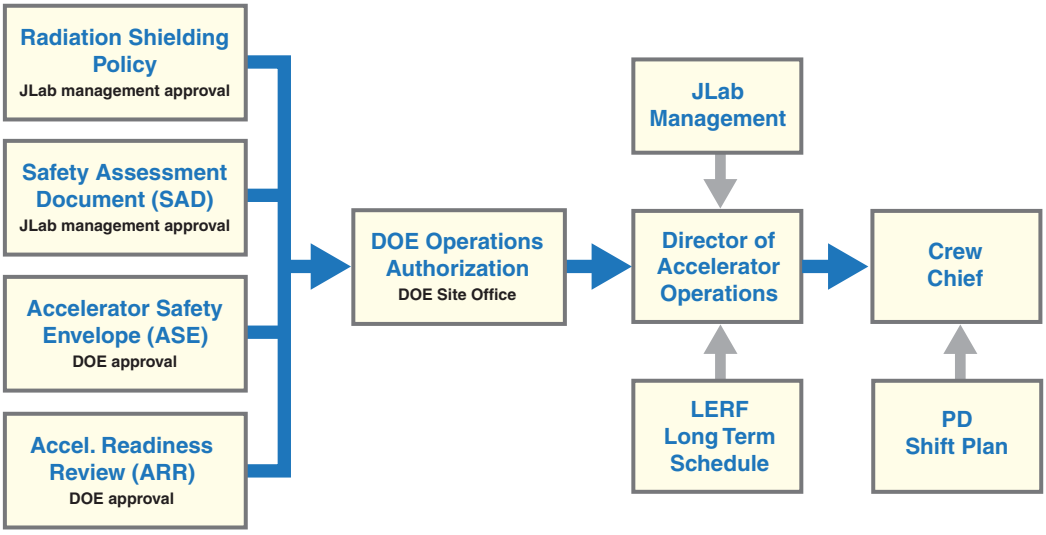


Figure 1-2: LERF Program Authorization

Radiation Shielding Policy and a *Safety Assessment Document* that conformed to DOE standards; these documents were approved by JLab management. JLab also prepared an *Accelerator Safety Envelope* document, which was approved by the DOE. With these required documents in place, an Accelerator Readiness Review verified that all conditions for safe operations had been met, and the DOE subsequently authorized LERF operations. A copy of the DOE letter authorizing LERF operations is posted on the MCC Information Bulletin Board.

The LERF program, which is developed by the Director of Accelerator Operations in consultation with JLab senior management, is designed to meet the goals established in the *LERF Long Term Schedule* (see Section 1.4.1 on page 1-16). The Director of Accelerator Operations authorizes the Crew Chief to carry out the LERF program as specified in the *PD Shift Plan* (see Section 1.4.3 on page 1-17). Before beam is run following an accelerator shutdown, the Director of Accelerator Operations makes a *Beam Authorization* entry in the *LERFLog*, authorizing beam to specific areas of the LERF. Before lasing following an accelerator shutdown, the Director of Accelerator Operations makes a *Lasing Authorization* entry in the *LERFLog*, authorizing lasing and power as appropriate in the LERF beamlines.

1.3 Personnel and Responsibilities

The key personnel involved in defining, scheduling, authorizing the LERF 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.

1.3.1 Director of Accelerator Operations

The Director of Accelerator Operations provides LERF operations oversight, including participating in program development and scheduling, and authorizing beam and lasing operations. Director of Accelerator Operations responsibilities include the following:

- Appoint members of the LERF Scheduling Committee.
- Develop the *LERF Long Term Schedule* in consultation with the LERF Scheduling Committee (see Section 1.2 on page 1-11).
- Approve deviations from the *LERF Long Term Schedule.*
- Authorize LERF operations by making appropriate *Beam and Lasing Authorization* entries in the *LERFLog* (see Section 1.2 on page 1-11). These entries define acceptable beam destinations, describe any operating constraints, and specify whether or not lasing is approved.
- 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 (see Section 1.3.6 on page 1-14).
- Appoint LERF Run Coordinators (see Section 1.3.6 on page 1-14).
- Appoint the LERF Accelerator-Physics Experiment Liaison (APEL) (see Section 1.3.8 on page 1-16).
- Appoint the LERF Geographic Integrator (see Section 1.3.6 on page 1-14).

1.3.2 LERF Hall Leader

The LERF Hall Leader coordinates with a variety of internal stakeholders and outside entities to ensure that the LERF facility best accommodates potential users and the operating program is well defined and supported with appropriate resources. LERF Hall Leader responsibilities include the following:

- Serve as the designated spokesman for the facility.
- Set high-level programmatic goals and priorities in consultation with JLab Management and present those goals and priorities to the LERF Scheduling Committee.
- Serve as a member of the LERF Scheduling Committee.
- Work directly with the Jefferson Lab Director to approve potential outside-funded experiments and then the LERF Experiment Scheduling Committee (see Section 1.1.1.3 on page 1-4) to find the best fit for available beam time.
- 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. This includes working directly with the Experiment Lead Scientist to address all safety and technical requirements for the experiment.
- Refer to the Radcon group for special review any potential outside-funded experiment with requirements that fall outside the normal facility operating envelope. Fixed-target experiments requiring energies above 20 MeV or isotope production are examples of this type of experiment.

- Verify that all outside-funded experiments have completed the LERF Experiment Safety Review Process before scheduling beam time.
- Present the appropriate safety documents for potential experiments to the Division Safety Officer (DSO) before moving to the design phase of the Experiment Review Process.
- Maintain programmatic balance for the LERF by prioritizing activities and working with the various stakeholders.

1.3.3 Experiment Lead Scientist

Each proposed LERF experiment is required to have an associated Experiment Lead Scientist, who supplies all of the experiment-specific information necessary for the design and safety review process. The Experiment Lead Scientist is often a non-JLab employee. LERF Experiment Lead Scientist responsibilities are as follows:

- Work with experiment representatives and the LERF Hall Leader to conduct a thorough design and safety analysis of all experiment equipment and proposed operating conditions, especially those unique to the experiment.
- Work with the LERF Hall Leader 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, LERF Experiment Safety Review Process.* This includes preparing and submitting the final ESAD and COO for the experiment.
- Organize the experiment collaboration to fabricate any new experimental apparatus and develop the work control documents for reviewing, installing, commissioning, and operating the apparatus.
- Work with the LERF Work 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.

1.3.4 Laser System Supervisor

The Laser System Supervisor oversees all facets of LERF lasing operations. This includes operating the LERF as an FEL and any laser operations in the user laboratories. The Laser System Supervisor is appointed by the LERF Hall Leader and the appointed is approved by the Laser Safety Officer. Responsibilities are as follows:

- Develop Laser Operational Safety Procedures (LOSPs) as defined in the *ES&H Manual, Section 6410, Laser Safety Program* for the LERF Optical Control Room and each LERF User Lab.
- Participate in the safety review process as defined in *ES&H Manual, Section 3130, LERF Experiment Safety Review Process.*
- Participate in training FEL Laser Operators.
- Post a list of qualified FEL Laser Operators on the MCC Information Bulletin Board.
- Schedule a FEL Laser Operator to work each shift of LERF operations as required to meet staffing requirements (see Section 1.4.1 on page 1-16).

- Ensure that, with regard to laser operations, each experiment's design, safety analysis, installation, documentation, and user training are appropriate and fully implemented before the experiment begins.
- Serve as a resource for laser-related questions from experiment collaborations.

1.3.5 LERF Operations Coordinator

The LERF Operations Coordinator organizes execution of the scheduled LERF program and addresses associated operational issues. This role requires a high level of familiarity with all aspects of the LERF program, including technical details of LERF accelerator operations and planned experiments. LERF Operations Coordinator responsibilities are as follows:

- Serve as a member of the LERF Scheduling Committee.
- Organize execution of the LERF program as specified by the *LERF Longterm Schedule* (see Section 1.4.1 on page 1-16), and when deviations from the schedule are required, work with LERF and Accelerator management to redefine the program.
- Meet with each LERF Run Coordinator during the week preceding their two-week tenure and provide a briefing that includes the standards for performing the position duties and details of what to expect during upcoming running, including any known issues. Continue this communication throughout the LERF Run Coordinator's tenure.
- Attend the CEBAF 0800 Daily Summary Meeting and the LERF 0830 Daily Summary Meeting.
- During LERF shutdown periods, organize and run the 0830 Daily Summary Meeting as needed to continue progress toward the next period of scheduled running and update the *LERF Short Term Schedule* (whiteboard) as appropriate.
- Approve submitted ATLis tasks and Beam Test Plans.
- Maintain records for each experiment in an electronic database, including safety documentation such as the COO, ESAD, and LOSP as applicable.

1.3.6 LERF Run Coordinator

LERF Run Coordinators are staff appointed by the Director of Accelerator Operations to serve for a two-week period during LERF running. During his or her tenure, the LERF Run Coordinator is responsible for all shifts of the LERF program and is expected to communicate with each shift on a daily basis to direct the scheduled program. The LERF Run Coordinator also keeps others informed of the program status by attending the CEBAF 0800 Daily Summary Meeting and commenting as appropriate, and also conducting the LERF 0830 Daily Summary Meeting. LERF Run Coordinator responsibilities are as follows:

- Meet with the LERF Operations Coordinator during the week preceding assumption of the LERF Run Coordinator responsibilities. The LERF Operations Coordinator will provide an update on the medium-term operating priorities and a set of high-level goals to be achieved during the period and also talk about the standards for performing the position duties and details of what to expect during upcoming running, including any known issues.

- Maintain the *LERF Short Term Schedule* (see Section 1.4.1 on page 1-16), which is the plan for the upcoming two weeks of LERF operations and is posted on the whiteboard in the conference area of the LERF. This schedule is also made available online using a camera system.
- Publish a plan for each shift of scheduled running and make it available to the members of the control room staff no later than the start of the shift. The plan must be submitted using the standard electronic tool, which incorporates the instructions as a separate section within the *CEBAF PD Shift Plan*.
- Provide an alternate program (see Section 1.4.4 on page 1-17) when the scheduled LERF program cannot be carried out. The alternate program should maximize the use of available LERF time through the execution of approved beam test plans and/or by addressing pending maintenance issues. The alternate program shall be developed in consultation with LERF leadership.
- Schedule beam test plans as appropriate to support the LERF program.
- Monitor the ongoing LERF program to assure that the scheduled program is being carried out successfully.
- Request from Accelerator Division management any resources required to support the scheduled LERF program.
- Attend the CEBAF Program Deputy 0745 Meeting held in the MCC Control Room each workday to answer questions and comment on the status of the LERF run to the Program Deputy.
- Attend the CEBAF Daily Summary Meeting at 0800 each workday in the MCC Conference Room. The LERF Shift Summaries for the previous 24 hours (or weekend) will appear as part of the standard set of information presented by the Program Deputy at the meeting. When the LERF information is presented, voice any significant program accomplishments or address any issues holding back the program, especially if the appropriate stakeholders are present at the meeting.
- Conduct the LERF Daily Summary Meeting at 0830 each workday morning (see Section 1.5 on page 1-17) and present the shift summaries for the previous 24 hours (or weekend). Develop any necessary short-term schedule modifications and update the *LERF Short Term Schedule* (whiteboard) accordingly.
- Attend the CEBAF Weekly Summary Meeting, which typically takes place during CEBAF running at 1330 in the MCC Conference Room.
- Review with the Operability Group (see Section 4.1.1 on page 4-1) all maintenance activities that could affect LERF or CEBAF operations.

1.3.7 Beam Transport Team (B-Team)

The Beam Transport Team (B-Team) is responsible for ensuring that the LERF efficiently and consistently meets the near-term and long-term beam specifications of the LERF program. This includes long-range planning to meet the beam requirements for specific experiments and also the commissioning of new or altered beam transport systems as they are brought online.

The B-Team also supports CEBAF operations and is lead by the B-Team Leader, who is responsible for guiding and organizing the efforts of the B-Team and collaborating with Operations and LERF management to move the LERF program

forward. The B-Team is called on to solve beam transport problems during LERF running and also to focus on future known beam transport issues and program requirements. B-Team members frequently write single-use procedures known as Beam Test Plans (see Section 3.5.3.2 on page 3-23) to execute a test or process in a way that is well thought out, reviewed, and approved in advance.

1.3.8 LERF Accelerator-Physics Experiment Liaison (APEL)

The LERF Accelerator-Physics Experiment Liaison (APEL) is an accelerator scientist who is appointed by the Director of Accelerator Operations to serve as a liaison for the LERF program. Specific responsibilities are as follows.

- Collaborate with the Experiment Lead Scientist for each experiment. This includes regularly attending any collaboration meetings and proactively advancing known beam transport and beam quality issues.
- Develop and own the beam transport lattice for the LERF and integrate this with all standard operations tools.
- Work with the Operations LERF Liaison (see Section 3.2.1.11 on page 3-12) to develop control room procedures and operator training.
- Work with the LERF Geographic Integrator (see Section 4.1.3 on page 4-3) to ensure that the hardware design and installation meets the experiment requirements.
- Participate in experiment commissioning activities.
- Regularly attend B-Team meetings.
- Maintain LERF Scientist on Shift (LSOS) training qualifications for the LERF (see Section 3.2.1.6 on page 3-10).
- Review new experiment proposals and provide input to the TAC as part of the experiment approval process (see Section 1.1.1.1 on page 1-3).

1.4 Program Schedules

Published accelerator program schedules include long term schedules, short term schedules, and shift-by-shift schedules.

1.4.1 LERF Long Term Schedule

The *LERF Long Term Schedule* is developed by the LERF Scheduling Committee (see Section 1.1.1.3 on page 1-4) and covers a nine-month period. Activities shown on the schedule but beyond the nine-month period are considered tentative. The committee meets quarterly and subsequently releases an updated schedule, which is available online at URL TBD.

1.4.2 LERF Short Term Schedule (LERF Whiteboard)

The short term schedule, which provides a shift-by-shift schedule for a two-week period, is posted on the white board in the LERF conference area. Images of the white board are available online at URL TBD. The schedule is a shift-by-shift refinement of the *LERF Long Term Schedule* (see Section 1.4.1 on page 1-16).

During scheduled running, the LERF Run Coordinator maintains the schedule. During shutdowns, the LERF Operations Coordinator updates the schedule as appropriate. Changes to the schedule can be made at any time but should be announced at the LERF 0830 Daily Summary meeting.

1.4.3 Shift-by-Shift Schedule (the *LERF Run Coordinator Shift Plan*)

The LERF Run Coordinator provides the written program for each shift to the control room staff no later than the start of the shift. The shift plan must be created using the web-based Presenter tool, which inserts the information into the CEBAF *PD Shift Plan* as a separate section. The intended program must be described in enough detail for the Crew Chief and LERF Operator to execute the plan.

1.4.4 Alternate Program

An alternate program may be executed when it becomes impossible to carry out the scheduled LERF program. The alternate program can consist of preapproved beam test plans (see Section 3.5.3.2 on page 3-23) or maintenance activities and should be determined in consultation with the LERF Run Coordinator.

1.5 LERF Meetings

Meetings are necessary to plan, schedule, and coordinate activities and to disseminate important information. Meetings that address LERF operations, maintenance, and support include:

- **Shift-Turnover Meeting** – This meeting takes place in the control room between the oncoming and off-going shifts when shifts overlap and is primarily an exchange of information (see Section 3.5.2.3 on page 3-21). Preshift reading substitutes for this meeting when shifts do not overlap,
- **Program Deputy 0745 Meeting** – This meeting takes place at 0745 on regular workdays (weekends at 0830, as necessary) in the conference area of the MCC control room. The meeting is conducted by the Program Deputy and attended by Operations leadership, the Hall Run Coordinator for each hall scheduled to receive beam, and the LERF Run Coordinator. The meeting provides a forum for exchanging information concerning the operating schedule, accelerator performance, or any other concerns that affect the scheduled program.
- **CEBAF 0800 Daily Summary Meeting** – This meeting takes place at 0800 on regular workdays in the MCC conference room and is conducted by the Program Deputy. The CEBAF activities of the previous 24 hours (or since the previous meeting) are summarized. When the LERF is running, the LERF shift summaries appear as part of the information shown, and the LERF Run Coordinator should make appropriate comment from the audience.
- **LERF 0830 Daily Summary Meeting** – This meeting takes place at 0830 on regular workdays in the LERF conference area and is conducted by the LERF Run Coordinator. The LERF activities of the previous 24 hours (or since the previous meeting) are summarized and the plan for upcoming running is discussed.
- **B-Team Meeting** – This meeting takes place in the MCC conference room on Tuesdays at 1330 and is conducted by the B-Team Leader. Pertinent beam transport issues are discussed, including those relevant to the LERF.

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 LERF 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 the accelerator, however, requires a single, definitive, up-to-date source of operating information for beamline elements. This central repository for the accelerator is the LERF Element Database (LED), 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 LED is critical, making appropriate application of configuration management principles of paramount importance for accelerator operations.

2.1 The LERF Element Database (LED)

The LED is the central element-specific information repository used to operate the accelerator. 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 LED as the single, authoritative source for operating information. With the LED as the central information repository, changes ripple immediately through all tools whenever an element in the LED is updated or a new element is added. From a configuration management perspective, the LED is key for establishing and maintaining consistency between the physical accelerator configuration and the tools used to operate it.

Some specific tools that rely on the LED are as follows:

- **Model-driven Accelerator Setup** – The element definitions and design values in the LED are used to create setpoint files, which can be scaled using modeling

software and then uploaded to the accelerator control system for design-based setups.

- **On-the-fly Control Screens** – On-the-fly screens pull information directly from the LED, replacing most hand-generated screens and ensuring that the screens always match the installed operational configuration.
- **Hot Checkout Tool** – Following a scheduled accelerator shutdown, element readiness is verified by system owners before beam operations can commence. A web-based interface pulls element information directly from the LED.

The LED also automatically creates a change history whenever element data is revised. Read-only historical save points provide snapshots of machine operating conditions for later reference.

2.1.1 The LED Revision Process

A well-defined revision control process is critical for maintaining the integrity of the LED. This includes defining roles and responsibilities and providing appropriate communication tools. Figure 2-1, below, provides an overview of the process.

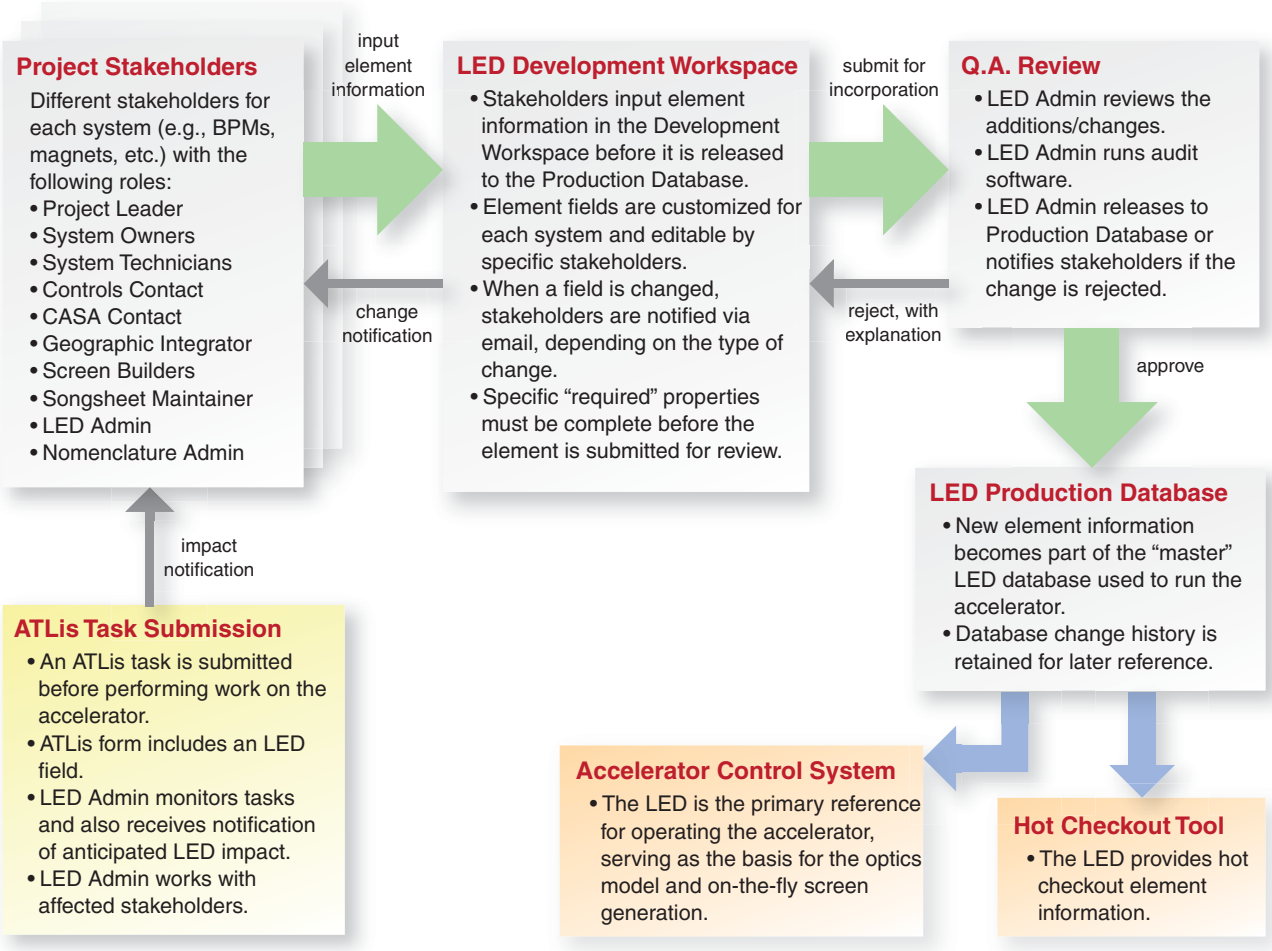


Figure 2-1: The LED Revision Process

2.1.2 Timely LED Updates

To accommodate the hot checkout process and accelerator operating requirements, LED updates must be incorporated in the production database in order to support hot checkout activities and the scheduled program. This means that the changes must have already passed the quality review and been incorporated in the production database by LED Administration before hot checkout begins. Populating the LED Development Workspace during the early stages of any project is a good practice that will make timely final approval/ incorporation much easier.

2.1.3 Project Stakeholders

Elements in the LED 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 2-1 on page 2-2. Each LED 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 LED Administrator helps facilitate the process and maintain LED standards.

An important by-product of the LED 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.

2.1.4 ATLis as Part of the LED Process

The ATLis work-planning tool (see Section 4.2.2 on page 4-5) provides a mechanism to help identify potential LED implications associated with planned work. All ATLis tasks are routed to an LED Administrator, who reviews each task to identify possible LED impact. In addition, the ATLis form includes a question that asks if the work will impact the information in the LED. If so, the LED Administrator is informed via email and works with the appropriate stakeholders to make sure that consistency between the installed equipment and the LED is maintained.

2.1.5 The LED Development Workspace

System Stakeholders prepare updates or new elements in a development workspace; they do not directly edit the production LED production database (see Section 2.1.7 on page 2-4). 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 LED Administrator (see section 2.1.6 on page 4).

2.1.6 LED Quality Assurance Review

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

2.1.7 The LED Production Database

The production version of the LED database is the gold standard for LERF element information, storing the present accelerator configuration and serving as the primary reference for the software tools that operate the LERF facility. This includes element nomenclature designations, where the LED is considered the authoritative reference, with the final designations being approved by the Nomenclature Administrator.

The configuration management process described in Figure 2-1 on page 2-2 is the focal point for maintaining consistency between the installed equipment and the information contained in the LED. It is critical that all System Stakeholders contribute their portion of the element information when a new element is added and continue to update the information as they make changes in the field. Additionally, the LED automatically creates a series of read-only historical snapshots as element changes are made. This feature provides a means for understanding past configurations should the need arise.

3 LERF Operations

LERF operations refers to the activities associated with operating the LERF accelerator and the associated lasing systems in order to carry out the scheduled program. This chapter describes the roles and responsibilities of the control room staff and others involved with LERF program execution, provides protocol for critical event response, and lists directives that govern specific aspects of the conduct of operations.

3.1 LERF Operations Overview

LERF accelerator operations are conducted from either the MCC Control Room or the LERF Control Room (but not both) by qualified staff as described in this chapter. The Crew Chief determines which control room will be used to conduct LERF operations and provides program oversight, including managing the available control room staff. The LERF Operator controls and monitors the LERF 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 LERF Operator when making control system changes that will affect the electron beam. Whenever the LERF produces laser light to the LERF Optical Control Room, a FEL Laser Operator must be on duty in the LERF. Some experiments may require the presence of staff in the LERF user labs; however, user lab operations are covered by the Conduct of Operations (COO) for each specific experiment. Each experiment will have its own ESAD and COO (see Section 1.1.2.2 on page 1-5). These directives do not apply to the Gun Test Stand, which is also located in the LERF building.

Staffing requirements for a variety of operating conditions are described in Section 3.5.2.1 on page 3-19. Exceptions to the staffing requirements require authorization from the Director of Accelerator Operations. A "Hot Standby" mode (i.e., Beam Off/*Power Permit*) provides operating flexibility that can be used to keep the LERF "warm" overnight, avoiding a time-consuming cold start in the morning when the LERF is not running 24/7.

The two-week LERF program is defined by the LERF Run Coordinator and communicated to the on-shift crew via the LERF section of the *PD Shift Plan*. Deviations from the scheduled program are managed through the Crew Chief, who coordinates with the LERF Run Coordinator and others.

Critical event response for the accelerator site, including the LERF, is directed by the Crew Chief, who can call on the combined control room staff of both the LERF and

CEBAF, depending on the circumstances. Critical event response is described in Section 3.4 on page 3-13.

3.2 Personnel and Responsibilities

The personnel involved in accelerator operations include the control room staff and support staff.

3.2.1 Control Room Personnel and Responsibilities

The control room staff are those trained as Crew Chiefs, LERF Operators, FEL Laser Operators, Assigned Radiation Monitors (ARMs), and Safety System Operators (SSOs). The control room staff also includes the physicists, engineers, experimenters, and others who operate the LERF controls to commission new hardware or software, diagnose problems, and perform specific experiments, test plans, or beam studies. The control room staff, regardless of group or institutional affiliation, must comply with the directives specified herein.

The LERF staffing requirements for normal operations are described in Section 3.5.2.1 on page 3-19. The MCC Operations Group Leader posts a list of LERF-qualified Crew Chiefs, LERF Operators, ARMs, and SSOs on the MCC Information Bulletin Board. The LERF Laser System Supervisor posts a list of qualified FEL Laser Operators, also on the MCC Information Bulletin Board. The LERF Hall Leader posts a list of those qualified as a LERF Scientist on Shift (LSOS) (see Section 3.2.1.6 on page 3-10).

In addition to the normal Operations control room staff required for beam operations, an Accelerator-Site Security Guard must also be present on the accelerator site. The Accelerator-Site Security Guard is responsible for performing specific duties related to accelerator operations (see Section 3.2.1.10 on page 3-12).

3.2.1.1 Crew Chief

NOTE: Unless otherwise specified, the term Crew Chief is used throughout this document to refer to the *on-duty* Crew Chief. Under certain circumstances, staffing requirements may allow for the Crew Chief to be on-call, rather than on site. The Crew Chief On-Call role is described in the *Accelerator Operations Directives*.

The Crew Chief provides oversight responsibility for both the LERF and CEBAF accelerators. During LERF running, the Crew Chief determines which control room will be used for LERF operations (either the LERF or the MCC) and assigns LERF Operator, and LERF SSO duties (FEL Laser Operator responsibilities are assigned by the LERF Laser System Supervisor). The Crew Chief helps guide LERF program execution, even when the program is executed from the LERF Control Room. The Crew Chief is empowered to, based on overall CEBAF and LERF program priorities, maximize utilization of available control room manpower. This may mean redirecting the LERF Operator to perform duties

unrelated to the LERF but in the best interests of the overall JLab program. A summary of the Crew Chief's LERF-related responsibilities follows; other Crew Chief responsibilities are listed in the *Accelerator Operations Directives*.

Safety:

- Assume the role of Internal Incident Commander (IIC) when responding to ES&H emergencies on the accelerator site, including the LERF facility. The Crew Chief is expected to transfer the IIC responsibility to a member of the Emergency Management Team as soon as appropriate and then offer his/her services to the IIC.
- Coordinate LERF critical event response as described in Section 3.4 on page 3-13.
- Be aware at all times of the PSS status of the LERF.
- Verify, before running beam to any LERF accelerator segment, that a valid *Beam Operations Authorization* entry (see Section 1.2 on page 1-11) has been made in the *LERFLog*.
- Verify, before operating the LERF as an FEL, that a valid *Lasing Operations Authorization* entry (see Section 1.2 on page 1-11) has been made in the *LERFLog* and an FEL Laser Operator is on duty.
- Ensure that the operational and safety envelopes for the LERF, as specified in the *Operational Restrictions* (see Section 3.5.5.4 on page 3-25) and the *Accelerator Safety Envelope,* are not exceeded.
- Verify that the LERF PSS state is lowered to the appropriate level if minimum staffing levels cannot be met as defined in Section 3.5.2.1 on page 3-19.
- Ensure that a Radcon Checklist has been completed before allowing RF or beam operations in the LERF if it as been in Restricted Access for longer than 24 hours.
- Verify that, before leaving the LERF in the Beam OFF state (see Section 3.5.2.1 on page 3-19) and the LERF and MCC control rooms unstaffed, the PSS state for the LERF is changed to Restricted Access.
- Verify that the LERF staffing levels meet the minimum requirements specified in Section 3.5.2.1 on page 3-19.
- Ensure that LERF operations are conducted in accordance with all current information in the *LERFLog* (see Section 3.5.5.1 on page 3-24), *PD Shift Plan* (see Section 1.4.3 on page 1-17), *PSS Log* (see Section 3.5.5.5 on page 3-25), and *Operational Restrictions* (see Section 3.5.5.4 on page 3-25).
- Read and understand all approved LERF-specific OSPs and TOSPs.
- Assign LERF ARM and SSO responsibilities. The Crew Chief must not serve as an ARM.
- Review and sign off on LERF radiation surveys performed during on-duty shifts and verify that these surveys meet the established Radiation Control Department (RCD) standards.

Program coordination:

- Determine which control room will be used for LERF operations, either the LERF Control Room or the MCC Control Room. The LERF Operator will conduct operations from the designated control room.
- Assign LERF Operator duty.
- Verify that an FEL Laser Operator is on duty if the LERF program calls for operating the LERF as an FEL.
- Coordinate the activities of all control room staff, including on-duty operators and others who are operating LERF controls from the MCC Control Room. When LERF operations are conducted from the LERF Control Room, the LERF Operator assumes this responsibility.
- Direct the utilization of available control room manpower based on the overall CEBAF and LERF program priorities. This may mean having the LERF Operator perform duties unrelated to the LERF but in the best interests of the overall JLab program.
- Understand all responsibilities specified in this document, the *LERF Operations Directives*.
- Understand the LERF-specific information in the *PD Shift Plan* (see Section 1.4.3 on page 1-17) and the *LERFLog* (see Section 3.5.5.1 on page 3-24). These must be read before the start of the shift. If the LERF-specific portion of the *PD Shift Plan* is not available and LERF operations are scheduled per the *LERF Short Term Schedule* (see Section 1.4.2 on page 1-16), the LERF Run Coordinator must be contacted for verbal instructions until a shift plan is posted.
- Read all LERF-specific beam test plans listed in the *PD Shift Plan* that are to be performed during the on-duty shift and be aware of other beam test plans that have been approved.
- Read and understand the LERF experiment-specific binders (see Section 3.2.1.11 on page 3-12) before the start of each new experiment or when new information is added to the binders.
- Complete all LERF-specific information fields in the *Crew Chief Stamp* and, after completing the Crew Chief shift turn-over meeting (see Section 3.5.2.3 on page 3-21), stamp in as Crew Chief at the beginning of each on-duty shift.
- Oversee execution of the LERF program defined by LERF-specific section of the *PD Shift Plan*.
- Notify the LERF Run Coordinator when the primary program cannot be carried out and the anticipated interruption is longer than one hour (see Appendix A on page A-1).
- Oversee execution of the designated alternate program(s) to make effective use of the LERF facility when it becomes impossible to carry out the scheduled program.
- Follow the repair escalation process defined in Section 4.2.4.2 on page 4-7.
- Assist with the coordination and prioritization of immediate maintenance activities by maintenance crews (see Section 4.2.3.1 on page 4-6). This includes reviewing and approving ATLis tasks (see Section 4.2.2 on page 4-5) that address immediate maintenance, if those tasks have not already been reviewed and approved through the normal process.

- Close any LERF-related Operations Problem Reports (OPS-PRs; see Section 3.5.5.3 on page 3-25) completed during the shift.
- Dismiss anyone from the MCC Control Room who is being disruptive or interfering with scheduled operations (see Section 3.5.2.4 on page 3-22). When LERF operations are conducted from the LERF Control Room, the LERF Operator assumes this responsibility.
- Provide supervisory oversight of the LERF Operator.

3.2.1.2 Crew Chief On-Call

When neither the LERF nor CEBAF have a scheduled operations program (i.e., the control rooms are not staffed), a qualified Crew Chief is designated as the Crew Chief On-Call and is on duty 24 hours a day during the assigned period. The Crew Chief On-Call can be contacted at all times via the Crew Chief cell phone (630-7050). An on-line schedule of Crew Chief On-Call assignments is maintained at http://opweb.acc.jlab.org/internal/OPS/batphonepss.html and posted in the Guard House. Crew Chief On-Call responsibilities are defined in the *Accelerator Operations Directives*.

3.2.1.3 LERF Operator

The LERF Operator controls and monitors the LERF acceleration systems to deliver the beam required for the scheduled and alternate LERF programs. The on-duty LERF Operator is supervised and directed by the Crew Chief, who, based on overall JLab priorities or emergency situations, may choose to redirect the LERF Operator to other, non-related duties at any time, provided the LERF is first placed in a safe state (Beam Off/Power Permit or lower; see Section 3.5.2.1 on page 3-19). LERF operations can be conducted from either the MCC Control Room or the LERF Control Room; however, when the Crew Chief is absent from either control room, the LERF Operator assumes a more prominent role for oversight of the LERF program and control room staff. All LERF control system manipulation that could affect electron beam must take place in the presence of the LERF Operator (i.e., in the same control room), who can open channel access privileges to qualified staff as appropriate. The LERF Operator cannot serve simultaneously as a CEBAF operator. When there is more than one LERF Operator on shift, the Crew Chief designates a lead operator. A summary of LERF Operator responsibilities follows:

Safety:

- Promptly notify the Crew Chief of emergency situations such as any incident involving personal injury, fire alarms, explosions, low-oxygen alarms, or vehicular accidents.
- Respond to incidents that occur within the accelerator site as specified in the *ES&H Manual, Operational Safety Procedures* (OSPs)*, Temporary Operational Safety Procedures* (TOSPs)*,* and *Emergency Procedures*, and as described in Section 3.4 on page 3-13.
- Read and understand all approved LERF-specific OSPs and TOSPs.
- Know the intended delivery points for all LERF beams and the approximate average beam currents and beam energies.

- Verify that, before leaving the LERF in the Beam OFF state (see Section 3.5.2.1 on page 3-19) and the LERF and MCC control rooms unstaffed, the PSS state for the LERF is changed to Restricted Access.
- Verify that the LERF staffing levels meet the minimum requirements specified in Section 3.5.2.1 on page 3-19.
- Ensure that LERF operations are conducted in accordance with all current information in the *LERFLog* (see Section 3.5.5.1 on page 3-24), *PD Shift Plan* (see Section 1.4.3 on page 1-17), *PSS Log* (see Section 3.5.5.5 on page 3-25), and *Operational Restrictions* (see Section 3.5.5.4 on page 3-25).
- Ensure that a Radcon Checklist has been completed before allowing beam operations in the LERF if it as been in Restricted Access for longer than 24 hours.
- Verify, before running beam in the LERF accelerator, that a valid *Beam Operations Authorization* entry (see Section 1.2 on page 1-11) has been made in the *LERFLog*.
- Verify, before operating the LERF as an FEL, that a valid *Lasing Operations Authorization* entry (see Section 1.2 on page 1-11) has been made in the *LERFLog* and an FEL Laser Operator is on duty in the LERF.
- Ensure that FSD masking is properly configured to protect LERF accelerator and experiment-specific components.
- Control or directly supervise the operation of devices that interface to the LERF PSS such as gun high-voltage controls, beam stoppers, RF systems, and magnet box supplies.
- Ensure that the operational and safety envelopes for the LERF, as specified in the *Operational Restrictions* (see Section 3.5.5.4 on page 3-25) and the *Accelerator Safety Envelope,* are not exceeded.
- 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 LERF beam enclosure before electron beam operation.
- Verify that the LERF PSS is placed in an appropriate state if minimum staffing levels cannot be met as defined in Section 3.5.2.1 on page 3-19.

Program Execution:

- Dismiss anyone from the LERF Control Room who is being disruptive or interfering with scheduled operations (see Section 3.5.2.4 on page 3-22).
- Coordinate the activities of all LERF control room staff, including others who are operating LERF controls from the LERF Control Room. When LERF operations are conducted from the MCC Control Room, the Crew Chief assumes this responsibility.
- Maintain close communication with the FEL Laser Operator if the scheduled program includes lasing.
- Carry out the program defined in the LERF-specific information in the *PD Shift Plan* (see Section 1.4.3 on page 1-17).
- Work with the Laser Operator to optimize lasing when the LERF is operated as an FEL.

- Keep the Crew Chief informed of the program status, providing updates for all significant program or machine status changes.
- Notify the Crew Chief when the primary program cannot be carried out and the anticipated interruption is longer than one hour (see Appendix A on page A-1).
- Contact appropriate on-call personnel in response to problems with the LERF accelerator or lasing system.
- Understand all responsibilities specified in this document, the *LERF Operations Directives*.
- Remain in the control room during on-duty shifts, except for brief periods for activities such as field troubleshooting and emergency response. The LERF Operator must not leave the accelerator site. When away from the control room, the LERF Operator must carry a cell phone or an MCC handheld radio so that they can be contacted from the MCC Control Room. When operating from the LERF Control Room, the LERF Operator must contact the Crew Chief before leaving the control room.
- Open channel access as needed for qualified individuals (see Section 3.5.1.4 on page 3-17) and oversee their manipulation of the control system, which must take place in the presence of the LERF Operator if such changes could affect electron beam transport.
- Read and understand the LERF-specific information in the *PD Shift Plan* (see Section 1.4.3 on page 1-17) and the *LERFLog* (see Section 3.5.5.1 on page 3-24). These must have been read before the start of the shift.
- Read and understand the LERF experiment-specific binders (see Section 3.2.1.11 on page 3-12) before the start of each new experiment or when new information is added to the binders.
- Read all LERF beam test plans listed in the *PD Shift Plan* that are to be performed during the on-duty shift.
- Complete all information fields in the *LERF Operator Stamp* and stamp in as the LERF Operator at the beginning of each on-duty shift. An operator cannot serve as the LERF Operator and as a CEBAF operator simultaneously. The most recent stamp-in indicates the present role.
- 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.
- Respond to beam-user requests for changes to beam specifications.
- Follow the repair escalation process defined in Section 4.2.4.2 on page 4-7.
- Conduct and participate in shift-turnover meetings with the oncoming LERF Operator and FEL Laser Operator for succeeding shifts (see Section 3.5.2.3 on page 3-21). If there is no succeeding shift crew, preshift reading will facilitate program continuity.
- If the LERF will not be operated on the succeeding shift, follow the appropriate shutdown procedure at the end of the shift and document the shutdown in the *LERFLog*.
- Make downtime entries and initiate OPS-PRs as appropriate (see Section 3.5.5 on page 3-24).

- Complete all sections of the *LERF Shift Log* and post it to the *LERFLog*. This includes noting the major reasons for no beam during a shift (assuming beam delivery was scheduled) and noting any problems that require attention.
- Inform the users (those scheduled to receive beam or laser light) when beam or light cannot be delivered according to the scheduled program per the guidelines in Section 3.5.6 on page 3-26. This notification shall include an estimate of the length of the down time and may be redundant with notification from the Crew Chief.
- Follow established written operating and troubleshooting procedures. If a procedure is ineffective, an Operations Problem Report (OPS-PR) must be generated or a copy of the procedure marked up and placed in the bin in the Procedure Markups bin in the MCC Control Room, along with contact information (see Section 3.5.3 on page 3-23).
- Perform record-keeping duties (see Section 3.5.5 on page 3-24), and ensure that accurate shift records are kept.
- If qualified and authorized, perform repair procedures when necessary and work with repair personnel as assigned to gain insight into system operation and repair.
- Close any LERF-related Operations Problem Reports (OPS-PRs; see Section 3.5.5.3 on page 3-25) completed during the shift.

3.2.1.4 LERF Hot-Standby Operator

A LERF Hot-Standby Operator is authorized to perform a limited subset of the regular duties of a LERF Operator during periods when the LERF PSS system state is *Power Permit* or lower. A LERF Hot-Standby Operator can simultaneously serve as a CEBAF Operator. A summary of LERF Hot-Standby Operator responsibilities follows:

- Complete all information fields in the *LERF Operator Stamp* and stamp in as LERF Hot-Standby Operator at the beginning of each on-duty shift.
- Verify that a LERF SSO (see Section 3.2.1.7 on page 3-11) is available in the MCC control room or on-call. The LERF Hot-Standby Operator *will not* change the state of the PSS to a higher state (e.g., from *Power Permit* to *Beam Permit*) and must contact the on-call SSO whenever a state change occurs (there are absolutely no restrictions on the use of the LERF PSS Crash button for emergencies).
- Read and understand all approved LERF-specific OSPs and TOSPs.
- Verify that the LERF staffing levels meet the minimum requirements specified in Section 3.5.2.1 on page 3-19.
- Control the operation of devices that interface with the Personnel Safety System (PSS) (e.g., gun high-voltage controls, beam stoppers, RF HPAs and magnet box supplies).
- Respond to emergencies by calling the Crew Chief or Crew Chief On-Call (a Crew Chief always carries the on-call phone during shutdowns; see Section 3.2.1.2 on page 3-5).

- Verify that the PSS state for the LERF is changed to *Restricted Access* before the LERF is left unattended (i.e., not staffed per the guidelines established in Section 3.5.2.1 on page 3-19).
- Ensure that a shift-turnover meeting occurs with any on-coming LERF Operator or LERF Hot-Standby Operator, or if there is no on-coming LERF Operator, inform the Crew Chief or Crew Chief On-Call that the LERF will not be staffed.
- Ensure that accurate and timely log entries are made in the appropriate log books. A final, end-of-shift *LERFLog* entry must be made that summarizes the activities performed during the shift.

3.2.1.5 FEL Laser Operator

The FEL Laser Operator controls the production and transport of laser light to the User Labs when the LERF is operating as an FEL. FEL Laser Operator responsibilities are as follows:

- Complete all information fields in the *FEL Laser Operator Stamp* and stamp in as the FEL Laser Operator at the beginning of each on-duty shift. The FEL Laser Operator can serve simultaneously as the LERF Operator.
- Remain within the LERF building whenever laser light can be delivered to one or more User Lab. If the Laser Operator must leave the building, the Laser Personnel Safety System (LPSS) must be locked in a condition that will prevent inadvertent delivery of laser light to a User Lab.
- Perform sweeps of the Optical Control Room and User Labs and arm the LPSS before operating the LERF as an FEL.
- Know and follow the Laser Operational Safety Procedure (LOSP) for the LERF and each user lab.
- Verify, before operating the LERF as an FEL that a valid *Laser Operations Authorization* entry (see Section 1.2 on page 1-11) has been made in the *LERFLog*.
- Read and understand all approved LERF-specific LOSPs, OSPs, and TOSPs.
- Read and understand the LERF-specific information in the *PD Shift Plan* (see Section 1.4.3 on page 1-17) and the *LERFLog* (see Section 3.5.5.1 on page 3-24). These must have been read before the start of the shift.
- Read and understand the LERF experiment-specific binders (see Section 3.2.1.11 on page 3-12) before the start of each new experiment or when new information is added to the binders.
- Understand all responsibilities specified in this document, the *LERF Operations Directives*.
- Configure the machine protection system (MPS) appropriately for the optical beam dump that will be used.
- Verify that all lasers are directed into an appropriate beam dump at a power level that does not exceed that specified in the COO.
- Establish and maintain the requested laser light conditions to the User Labs as specified in the applicable Laser Operational Safety Procedure.
- Maintain close communication with the LERF Operator, especially if the LERF Operator is operating from the MCC Control Room.
- Follow all instructions from the Crew Chief.

- Work directly with laser light users to meet the goals for the scheduled program.
- Request changes to the electron beam setup of the LERF accelerator as necessary to establish the desired lasing parameters. Such requests are made to the LERF Operator.
- Operate the Laser Personnel Safety System.
- Participate in shift-turnover meetings with the oncoming LERF Operator and FEL Laser Operator for succeeding shifts (see Section 3.5.2.3 on page 3-21). If there is no succeeding shift crew, preshift reading will facilitate program continuity.
- Provide laser-specific shift information to the LERF Operator for inclusion in the *LERF Shift Log*.
- Inform the LERF Operator when laser light cannot be delivered according to the scheduled program and provide an estimate of the length of the down time. The LERF Operator will notify the users and the Crew Chief.

3.2.1.6 LERF Scientist on Shift (LSOS)

A LERF Scientist on Shift (LSOS) is a qualified individual who requires access to the LERF control system during beam operations in order to help execute the LERF program. An LSOS works closely with and remains under the direction of the LERF Operator if changing accelerator parameters, or the FEL Laser Operator if adjusting laser light.

NOTE: On occasion, others who are solving specific problems at the request of the LERF Operator may need access to the control system. They can be granted access for a limited time period under the direct supervision of the LERF Operator but are not considered to be an LSOS, because they are solving a specific problem and not executing the LERF program.

A summary of LSOS responsibilities follows:

- Complete and pass the required training as specified by the MCC Operations Group Leader.
- Be approved by the Director of Accelerator Operations and added to the list of those qualified to have LERF channel access for areas where beam is being transported.
- Understand all responsibilities specified in this document, the *LERF Operations Directives*.
- Have explained to the LERF Operator, in advance, the anticipated work and been given LERF Operator approval. The LERF Operator will open channel access as appropriate for the task. As work progresses, the LERF Operator must be kept informed. If maintenance is required, requests must be made through the LERF Operator. Laser light delivery system adjustment can only be made under direction of the FEL Laser Operator.
- Be physically present in the same control room as the LERF Operator (or FEL Laser Operator for light delivery adjustment) and working from an accelerator computer console when making control system changes. An LSOS can serve simultaneously as the LERF Operator.
- Follow the directions of the LERF Operator or FEL Laser Operator as appropriate.

- Help train the on-shift crew by explaining tasks and providing hands-on training. Whenever possible, the LSOS should explain or demonstrate how to perform a task and then let the on-shift crew gain hands-on experience under supervision.
- Make a *LERFLog* entry describing the anticipated work before work begins, and continue to make log entries describing progress as appropriate.
- Ensure that the operational and safety envelopes for the LERF, as specified in the *Operational Restrictions* (see Section 3.5.5.4 on page 3-25) and the *Accelerator Safety Envelope,* are not exceeded.
- Ensure that LERF operations are conducted in accordance with all current information in the *LERFLog* (see Section 3.5.5.1 on page 3-24), *PD Shift Plan* (see Section 1.4.3 on page 1-17), *PSS Log* (see Section 3.5.5.5 on page 3-25), and *Operational Restrictions* (see Section 3.5.5.4 on page 3-25).
- Know the intended delivery points for all LERF beams and the approximate average beam currents and beam energies.
- Ensure that FSD masking is properly configured to protect LERF accelerator and experiment-specific components.
- Verify, before operating the LERF as an FEL, that a valid *Lasing Operations Authorization* entry (see Section 1.2 on page 1-11) has been made in the *LERFLog* and a FEL Laser Operator is on duty in the LERF.

3.2.1.7 Safety System Operator (SSO)

SSOs are responsible for operating the Personnel Safety System (PSS) for the JLab accelerators in a manner that keeps personnel safe. There are two separate PSS systems within the accelerator site: one for the CEBAF accelerator and experiment halls, and the other for the LERF. Both are operated from the PSS console in the MCC Control Room. CEBAF operators, Crew Chiefs, and the LERF Operator qualify to operate both systems and may do so concurrently. Other personnel may be trained to operate only the LERF PSS and are referred to as LERF SSOs. SSO duties are described in more detail in the *Accelerator Operations Directives*. LERF-specific SSO responsibilities are as follows:

- Notify the LERF Operator and/or the Crew Chief before making a LERF PSS state change.
- Know the drive laser bypass mode for the LERF vault .

3.2.1.8 Assigned Radiation Monitor (ARM)

Accelerator operators and the LERF Operator must qualify as ARMs for all areas of the CEBAF accelerator, the experiment halls, and the LERF. One ARM-trained person on each shift is designated as the ARM for that shift. The Crew Chief must not serve as an ARM. The ARM does not necessarily have to be an operator on shift as long as he/she is available on call.

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 LERF).

Accelerator operators performing radiological control tasks while on shift must not be assigned another task for the duration of the radiological task and must not leave the accelerator site. The ARM functions as a member of the Radiation Control Department (RCD) during assigned ARM-related tasks, but remains under the direction of the Crew Chief and is still considered a CEBAF accelerator operator or LERF Operator. Any problems or concerns the ARM identifies shall be referred to the RCD for resolution. At the completion of the task(s), the ARM reports the results to the Crew Chief and resumes previous responsibilities. ARM duties are described in more detail in the *Accelerator Operations Directives*.

3.2.1.9 Non-LERF Control Room Staff

Occasionally, staff other than the LERF Operator, Laser Operator, or Crew Chief may need to access the LERF control system. LSOSs, accelerator physicists, engineers, experimenters, operators in-training, and others may need to operate the accelerator controls to commission new hardware or software, diagnose problems, or perform experiments. All of these people, regardless of group or institutional affiliation, must comply with the directives specified in this document as well as any direct instruction from the Crew Chief or LERF Operator. Anyone working at the operator consoles in the MCC or LERF must have the approval of the Crew Chief or the LERF Operator, and if making control system changes that will affect beam, meet the criteria outlined in Section 3.5.1.4 on page 3-17.

3.2.1.10 Accelerator-Site Security Guard

When performing specific duties that are related to accelerator operations (see Section 3.5.2.1 on page 3-19), the Accelerator-Site Security Guard staffing the entry-gate guard post is considered to be an MCC/LERF staff member. The guard post located at the main accelerator site entrance is considered to be within the boundary of the accelerator site (i.e., “within the site safety fence”). The operations-related responsibilities of the Accelerator-Site Security Guard are as follows:

- Contact appropriate on-call personnel in response to alarms or emergency situations.
- Contact the rover guard when assistance is required.
- Direct emergency vehicles that are entering the accelerator site.
- Ensure that anyone entering the accelerator site has the appropriate authorization and training or is accompanied by a trained escort.

3.2.1.11 Operations LERF Liaison

An accelerator operator or Crew Chief is assigned as the Operations LERF Liaison in order to serve as a link between the experimenters and the Operations Group. A summary of the Operations LERF Liaison responsibilities follows:

- Helps to facilitate information exchange between the LERF organization and the MCC Operations Group, both in advance of and during actual experiments.
- Remains engaged with the LERF organization, attending planning meetings and proactively seeking out information and bringing that information back to the MCC Operations Group.

- Maintains the LERF experiment-specific binders and updates them before the start of each experiment. There are two identical binders for each experiment: one in the MCC, and the other in the LERF control room. Original documents are placed in the MCC binder, and copies of those documents are placed in the LERF binder.

3.2.1.12 LERF Documentation Coordinator

The LERF Documentation Coordinator works with system experts to develop appropriate accelerator operating and troubleshooting procedures used to operate the LERF. The LERF Documentation Coordinator maintains these documents and coordinates the addition of new documents and revisions to existing documents. A summary of responsibilities is as follows:

- Works with subject matter experts (SMEs) to develop detailed accelerator operating and troubleshooting procedures used to opeate the LERF (see Section 3.5.3.1 on page 3-23).
- Edits the content and format of new procedures to conform with established document control and format standards.
- Maintains an electronic document index and delivery system that permits on-line viewing and use of documents as well as on-demand printed copies.
- Maintains standard document-creation templates used for authoring operating and troubleshooting procedures.

3.3 Training

Crew Chiefs and LERF Operators are trained to a level of competence that allows for safe accelerator operations and maximized operating efficiency. This includes understanding basic accelerator operating concepts, key operational aspects of all systems, and attaining/maintaining a level of competence that contributes to efficient operations. Each new operator must successfully pass a structured training curriculum to become a qualified operator.

The MCC Operations Group Leader determines who is a qualified Crew Chief, LERF Operator, or MCC Operator and can suspend or terminate such qualifications at his/her discretion. The MCC Operations Group Leader maintains a list of qualified and authorized Crew Chiefs, LERF Operators, and MCC operators posts this list on the MCC Control Room bulletin board. If some portion of an operator or Crew Chief's training expires, his/her control room staff qualifications are not nullified but task assignments may be impacted until the training is retaken.

3.4 Critical Event Response

On-duty LERF shift crews are in a unique position to identify and act on critical problems that could potentially harm personnel, property, or the environment. Crew Chiefs and operators serve as first responders for a variety of emergencies within the accelerator site safety fence. Although the nature of such problems and events can vary widely, the basic responses to the most common critical events are described or referenced in the following sections.

3.4.1 Safety Envelope Violations

The ASE (see Section 1.1.2 on page 1-4) specifies the Safety Envelope, a set of physical and administrative conditions within which the LERF and its experiments must operate. The Safety Envelope establishes engineered and administrative controls, including limits for LERF operations staffing and Personnel Safety System (PSS) functionality. Variations beyond the conditions specified in the Safety Envelope are treated as reportable occurrences. For guidance concerning what constitutes a Safety Envelope violation, refer to the ASE.

If the Safety Envelope is violated during accelerator operations, beam must be terminated and the investigation process followed as specified in the *ES&H Manual, Section 5200, Event Investigation and Causal Analysis Process* (this process includes DOE notification). The Director of Accelerator Operations, the LERF Operations Coordinator, the LERF Run Coordinator, the MCC Group Leader, 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 to the Crew Chief.

3.4.2 Operations Envelope and Operational Restriction Violations

The Operations Envelope provides administrative assurance that the Safety Envelope for these controls is not exceeded (see Section 1.1.4.1 on page 1-6). The Operational Restrictions web page (http://opsweb.acc.jlab.org/internal/ops/ops_webpage/restrictions/ops_restrictions.html) specifies beam-related Operations Envelope limits for destinations and devices. Variations outside the Operations Envelope, but within the Safety Envelope, are not treated as a DOE-reportable occurrence but require specific administrative action as described below.

The Operational Restrictions also establish the thresholds for accelerator operation, including beam current maximums, beam dump power limitations, experiment target limits, and target and beam dump raster sizes (see Section 3.5.5.4 on page 3-25). 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 LERF Operations Coordinator, the LERF Run Coordinator, the MCC Group Leader, 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 to the Crew Chief.

3.4.3 Personnel Safety System (PSS) Malfunctions

The PSS is designed to protect personnel during accelerator operations. If, during accelerator operations, a malfunction of the PSS is perceived, beam delivery shall be terminated immediately. The Crew Chief 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 to the Crew Chief by the Director of Accelerator Operations.

If the Safety System Group Leader determines that a previously unidentified hazard exists, the USI process (see Section 1.1.3 on page 1-6) must be followed.

If the Safety System Group Leader determines that the PSS did not function correctly, the occurrence reporting process described in Section 3.4.1 on page 3-14 shall be followed.

3.4.4 Laser Personnel Safety System (LPSS) Malfunctions

The LPSS is designed to protect personnel during accelerator operations. If, during accelerator operations, a malfunction of the LPSS is perceived, laser operations shall be terminated immediately. The Crew Chief shall report the perceived malfunction to the Laser System Supervisor for resolution.

If, on investigation, the Laser System Supervisor determines that the LPSS operated as designed and such operation does not pose a previously undetected personnel hazard, then laser operations may resume after direct approval is given to the Crew Chief by the Director of Accelerator Operations.

If the Laser System Supervisor determines that a previously unidentified hazard exists, the USI process (see Section 1.1.3 on page 1-6) must be followed.

If the Laser System Supervisor determines that the LPSS did not function correctly, the occurrence reporting process described in Section 3.4.1 on page 3-14 shall be followed.

3.4.5 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 LERF 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 LERF Operator must notify the Crew Chief who must report the observed or perceived malfunction to the Safety System Group on-call contact for resolution. Beam operations shall not resume until the system is repaired and verified and direct approval is given to the Crew Chief by the Director of Accelerator Operations.

3.4.6 Electron-Beam-Strike and Laser-Strike Events

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

- An acute loss of beamline vacuum caused by an electron beam or laser 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 downstream of physics targets or at beam dumplettes.
- Physical damage to beamline components has been caused by a beam or laser 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- or laser-strike event occurs, the beam shall immediately be turned off (if not already off) and the appropriate staff notified. This includes the LERF Run Coordinator, system maintenance personnel, and all 4-hour escalation contacts (see Section 4.2.4.2 on page 4-7). The LERF Operator shall immediately begin post-event analysis and make appropriate log entries to capture the circumstances and chronology of the event. Beam operations shall not resume until direct approval is given to the Crew Chief by the Director of Accelerator Operations.

3.4.7 Emergency Response

Crew Chiefs and operators (including the LERF Operator) are first responders for a variety of emergency situations within the accelerator site safety fence and also play a critical role in emergency communication and coordination. When responding to emergencies on the accelerator site, the Crew Chief assumes the role of Internal Incident Commander (IIC) until relieved (see Section 3.2.1.1 on page 3-2). Emergency response is guided by written procedures, which are located in the *Emergency Response Binder* in the MCC 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

3.5 Directives

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

3.5.1 Control System Interaction

The LERF 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.

3.5.1.1 LERF Control System Access

Authorization to manipulate LERF accelerator system process variables is controlled by the LERF Operator and Crew Chief through the use of the channel access (CA) security protocol. The control room staff can open LERF 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 Crew Chief or LERF 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 and other authorized personnel (see Section 3.5.1.4 on page 3-17); however, upon request, the Crew Chief or LERF Operator can use discretion to temporarily grant channel access to others so long as the activity will not affect ongoing electron beam transport. Such changes can be made from the field but only with Crew Chief or LERF Operator permission.

The Central Helium Liquefier (CHL) control room, which is located in the CHL building, is staffed by CHL operators. These CHL operators have unlimited channel access for cryogenic process variables.

3.5.1.2 Crew Chief and LERF Operator Control System Interaction

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

- Complete and pass the required training for Crew Chiefs and LERF Operators as specified by the MCC Operations Group Leader.
- Be approved by the Director of Accelerator Operations and added to the list of qualified CEBAF Crew Chiefs and LERF Operators.
- Be physically present in the MCC Control Room or LERF Control Room and working from an accelerator computer console when making control system changes during beam operations.
- When not on shift, obtain authorization from the LERF Operator before changing any accelerator system process variable during beam operations.

3.5.1.3 FEL Laser Operator Control System Interaction

FEL Laser Operators have channel access that is limited to process variables required to adjust laser light production systems. They must meet the following requirements.

- Complete training and be added to the list of qualified FEL Laser Operators by the LERF Laser System Supervisor. This list is posted on the MCC Information Bulletin Board.
- Be physically present in the LERF and working from a LERF computer console when making control system changes during beam operations.

3.5.1.4 Control System Interaction Affecting Beam Transport by Others

Personnel other than LERF Operators and Crew Chiefs who, when beam is present in the LERF 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 LERF 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 LERF Operator because they are solving a specific problem and not executing the LERF program.

- Complete and pass the required LSOS training as specified by the MCC Operations Group Leader (see Section 3.2.1.6 on page 3-10).
- Be approved by the Director of Accelerator Operations and added to the list of those qualified to have LERF channel access for areas where beam is being transported.
- Have explained to the LERF Operator, in advance, the anticipated changes and been given LERF Operator approval. The LERF Operator will open channel access as appropriate for the task.
- Be physically present in the same control room as the LERF Operator and working from an accelerator computer console when making control system changes.

3.5.2 Shift Protocol

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

3.5.2.1 Staffing Requirements for Operations

The *JLab Accelerator Safety Envelope* (ASE) defines the Safety Envelope for LERF operations and establishes minimum staffing requirements to remain within that Safety Envelope. The Operations Envelope is a second, generally more stringent, limit within which operations must be conducted. The Operations Envelope serves as an administrative control to prevent the Safety Envelope from being exceeded. The ASE specifies that the Operations Envelope staffing requirements for LERF operations are defined here, in this document. Table 3-1, below, and the paragraphs that follow describe those staffing requirements.

Table 3-1: Minimum Staffing Requirements for LERF Operations

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

LERF Operating Condition	LERF PSS State	Minimum Required Staffing
• **Beam OFF**	• *Restricted Access*	• Crew Chief (on call) • Accelerator-Site Security Guard (on site)
• **Beam OFF**	• *Controlled Access, Sweep Mode, Sweep Complete Mode*	• Crew Chief (on call) • LERF SSO (in MCC) • Accelerator-Site Security Guard (on site)
• **Beam OFF**	• *Power Permit*	• Crew Chief (on call) • LERF Operator or LERF Hot-Standby Operator (in MCC or LERF) • Accelerator-Site Security Guard (on site) **NOTE:** The LERF Operator or LERF Hot-Standby Operator is not required if the Crew Chief is in the designated control room (MCC or LERF).
• **Beam ON (accelerator only)**	• *Beam Permit*	• Crew Chief (in MCC, LERF, or on site) • LERF Operator (in designated control room, either MCC or LERF) • Accelerator-Site Security Guard (on site)
• **Beam ON (lasing to Optical Control Room)**	• *Beam Permit*	• Crew Chief (in MCC, LERF, or on site) • LERF Operator (in designated control room, either MCC or LERF) • FEL Laser Operator (in LERF) • Accelerator-Site Security Guard (on site)

The staffing requirements shown in Table 3-1 address the possible LERF operating conditions; other constraints and conventions are as follows:

- Beam ON is defined as the LERF 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).
- The accelerator site is defined as the area bounded by the accelerator site safety fence and includes the guard post, which is always staffed by an Accelerator-Site Security Guard (see Section 3.2.1.10 on page 3-12). This definition is expanded to include the TEDF building if a LERF Operator must make a brief visit to the TEDF to acquire a critical spare part or test equipment required to continue the scheduled accelerator program.

- For staffing purposes, the “MCC” includes only the MCC Control Room (Room 104), the rest rooms (Rooms 120 and 121), and the kitchenette (Room 119), all located in Building 85. The “LERF” includes the LERF Control Room (Room 206), the user labs (Rooms 208–213), the rest rooms (Rooms 203 and 204), and the conference/break area (Room 202).
- The LERF accelerator can be operated from either the LERF Control Room or the MCC Control Room, but not both. The Crew Chief designates which control room will be used for LERF operations. When operations transfer from one control room to the other, the LERF must drop to *Power Permit* or a lower state, if the staffing levels in Table 3-1 on page 3-19 are not met during the transition.
- The FEL Laser Operator must be in the LERF whenever the LERF operates as an FEL. The laser shutter must be closed if the Laser Operator leaves the LERF and the Crew Chief and LERF Operator must be notified.
- The stamped-in LERF Operator cannot also serve as a CEBAF Operator but can simultaneously serve as the FEL Laser Operator. The Crew Chief, however, can serve as Crew Chief for both the LERF and CEBAF simultaneously. A LERF Hot-Standby Operator can simultaneously serve as a CEBAF Operator.
- During LERF beam operations, those making control system changes that will affect electron beam transport must do so in the presence of the LERF Operator (see Section 3.5.1.4 on page 3-17).
- All LERF Operators and Crew Chiefs are qualified SSOs (see Section 3.2.1.7 on page 3-11).
- A qualified SSO must be in the MCC whenever the LERF PSS is
  - In *Sweep Mode*,
  - In *Sweep Complete Mod*e, or
  - In *Controlled Access*.
- All LERF Operators are trained as ARMs and can provide ARM coverage (see Section 3.2.1.8 on page 3-11). While serving as an ARM, the LERF Operator is still under the direction of the Crew Chief and, for staffing purposes, is still considered to be the LERF Operator.
- Exceptions to any of the staffing requirements specified in Table 3-1 on page 3-19 require authorization from the Director of Accelerator Operations.
- Whenever the Crew Chief leaves the MCC or the LERF, they must carry the Crew Chief cellular phone or an MCC handheld radio so they can be contacted by the control room.
- Whenever the LERF Operator leaves the designated control room (i.e., LERF or MCC), they must carry their cell phone or an MCC handheld radio so they can be contacted.
- Whenever the Crew Chief must leave the site, the LERF state may need to be lowered as outlined in Table 3-1 on page 3-19.
- Whenever LERF Operator changes occur for any reason, the oncoming staff member must receive a summary of the shift activities, receive task assignments from the Crew Chief, familiarize themselves with the information in the various logs, and stamp in as the LERF Operator.

3.5.2.2 Shift Schedules

During scheduled LERF beam delivery, the MCC Operations Group Leader is responsible for scheduling Crew Chief and LERF Operator shift assignments and posting the schedule on the MCC Information Bulletin Board. The MCC Operations Group Leader may, at his/her discretion, change control room staffing assignments at any time as long as the staffing requirements established in Section 3.5.2.1 on page 3-19 are met. To support LERF lasing operations, the LERF Operations Cooridinator is responsible for scheduling FEL Laser Operator shift assignments and posting the schedule on the MCC Information Bulletin Board and may also change staffing assignments at any time.

3.5.2.3 Shift-Turnover Meeting

There are two standard shift-turnover meetings: one for Crew Chiefs and one for LERF Operators/Laser Operators. 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. Formal transfer of operator or Crew Chief responsibility takes place at the conclusion of the respective shift-turnover meeting, not when a LERF Operator or Laser Operator or Crew Chief stamps in. Oncoming operators must not make control system changes until after the shift-turnover meeting, unless specifically requested to do so by the on-duty Crew Chief. When shifts do not overlap, preshift reading described in Section 1.1.5 on page 1-8 takes the place of the shift-turnover meeting.

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

The shift-turnover meeting shall not be interrupted by telephone calls, pages, or by anyone outside the Accelerator Operations Department, except when the safety of personnel or the integrity of the facility are in jeopardy. Attendance by anyone other than the members of the two affected shifts, the LERF Run Coordinator, and Operations Department leadership is discouraged.

At the start of each shift, the oncoming Crew Chief and operators are required to sign in by completing the Crew Chief or operator stamp in the *LERFLog* to acknowledge (1) having been briefed on the LERF program and the status of the accelerator systems and crew members, and (2) taking over the Crew Chief responsibilities from the departing crew.

Figure 3-1 defines the agenda for a typical shift-turnover meeting. Formal transfer of authority takes place at the conclusion of the meeting.

Typical Shift-Turnover Meeting Agenda

Discuss the following as appropriate:

- SSO, ARM, and safety issues
- Alarm handler masking configuration and active alarms
- Any open downtime entries
- Ongoing hardware or software issues
- Recent OPS-PRs
- User Lab(s) status
- The PSS state
- Present beam conditions and beam delivery specifications
- A quick summary of how the LERF has been performing
- Ongoing beam quality issues
- Any ongoing beam test plans

Figure 3-1: Outline for a Typical Shift-Turnover Meeting Agenda

3.5.2.4 Control Room Conduct

Control Room Access: Access to the LERF Control Room or MCC Control Room is limited to the control room staff and others engaged in support of the scheduled program. The following are the only people normally allowed in the main operator console area:

- Crew Chief and operators performing their assigned tasks.
- FEL Laser Operator in the LERF Control Room.
- LERF Run Coordinator.
- Program Deputy.
- Accelerator Operations Department staff.
- Technical staff whose assistance has been requested by the control room staff or by the LERF Run Coordinator or the Program Deputy.
- Physics personnel and others conducting tests or experiments that have been scheduled in advance.
- Others, with the permission of the Crew Chief or LERF Operator.

Distractions: Distractions such as electronic devices, electronic media, or printed matter that do not relate to accelerator operations are not permitted in the control room without permission from the MCC Operations Group Leader. The Crew Chief or the LERF Operator has the right and responsibility to require anyone deemed to be a distraction to leave the control room.

Outgoing Telephone Calls: Staff shall limit outgoing telephone calls from the control room to official calls that pertain to current accelerator operations. Staff shall keep telephone conversations brief, professional, and formal.

3.5.3 Control Room Procedures

In order to carry out the LERF program, the control room staff adheres to general guidelines, basic operating principles, and specific task-related written procedures such as the following:

- Operating procedures
- Troubleshooting procedures
- Test plans

3.5.3.1 Operating Procedures and Troubleshooting Guides

Operating procedures and troubleshooting guides are written using standard templates. The technical content is kept up to date by system experts, who are designated as technical custodians. The document creation and revision process is coordinated by the LERF Documentation Coordinator (see Section 3.2.1.12 on page 3-13). Operating procedures and troubleshooting guides serve different purposes as follows:

- **Operating Procedures –** Operating procedures are used to perform specific control room tasks in a standardized manner to achieve well defined results.
- **Troubleshooting Guides** – Troubleshooting guides are used to diagnose, and then correct, common problems in specific accelerator systems. Starting from a list of possible fault symptoms, troubleshooting guides route the user through a series of checks to diagnose the problem and then provide specific corrective action or defer to on-call help.

The following guidelines apply to both operating procedures and troubleshooting guides:

- Operating procedures and troubleshooting guides (and other pertinent documents) are accessible in an electronic format. These documents can be used on-line or in a printed form. When there is any uncertainty regarding the most up-to-date version of a document (on-line vs. printed), the on-line version is always considered to be the standard. All procedures, whether printed or on-line, will include appropriate document control information on each page, including the page number (X of X), the revision number and date, and the document title.
- LERF Operators are responsible for noting errors in operating procedures. If an error is found, an OPS-PR shall be completed to record the problem and, if suggested changes are extensive, a marked copy of the procedure shall be provided to the LERF Documentation Coordinator.
- When requested, Crew Chiefs and LERF Operators are responsible for reviewing and critiquing draft procedures for accuracy before the procedure is released for general use.

3.5.3.2 Beam Test Plans

Beam test plans are procedures written by system experts to test specific accelerator operating parameters and to gather test data. Test plans are written and submitted using an on-line form that is a part of the web-based ATLis work planning system (see Section 4.2.2 on page 4-5). The form is used to provide the specific test steps, along with a variety of other critical information such as a

backout plan, any safety considerations, test conditions required, and contact persons. Once submitted by the author, each beam test plan is electronically routed for review by key personnel. The test plan can either be approved for execution or rejected for revision.

The LERF Operations Coordinator and LERF Hall Leader evaluate all LERF test plans and give guidance to the LERF Run Coordinator as to when each test plan should be scheduled. The LERF Run Coordinator lists scheduled test plans for each shift in the PD Shift Plan.

3.5.4 Control Room Equipment

Control room equipment consists of console equipment, fire alarm equipment, radiation-monitoring equipment, portable oxygen monitors, communications equipment, computer workstations, printers, video monitors, key control equipment, and U.S. Government-owned vehicles. Details of the equipment available to control room staff are covered in the *Accelerator Operations Directives*.

3.5.5 Record Keeping

Accurate record keeping is an essential part of LERF operations and is required for both administrative and technical reasons. LERF operations record-keeping documents include the *LERFLog*, the *GunLog*, the *LERF Shift Log*, completed Beam Test Plan summaries, and various data gathering and checklist logs. Requests for additional record keeping by the control room staff should be directed to the LERF Operations Coordinator.

The LERF Operator is responsible for on-shift record keeping. The LERF Operator must enter and review these records frequently to ensure that entries clearly and accurately describe shift activities. During normal operations, at least one entry per hour should be made, in addition to stamping in at the beginning of the shift. Even during periods of steady running or when the LERF is down because of a maintenance issue, routine entries are important to communicate status, even if the entry simply says, “No change in status.”

Paper log books are to be used in the event of a failure of electronic logs such as the *LERFLog*. Handwritten entries in any paper log must not be erased or covered over. Corrections to log entries must not obscure the incorrect entry. Corrections are made by drawing a single line through the incorrect entry, writing the correct entry nearby, and initialing and indicating the time and date of the correction.

3.5.5.1 LERFLog

The *LERFLog* is the sequential record of the events occurring during the operation of the LERF. 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 *LERFLog* is a computer based electronic log book which can be accessed from the ELOG home page. When a Crew Chief, LERF Operator, or FEL Laser Operator stamps in, the stamp appears as a *LERFLog* entry.

3.5.5.2 Completed Work Control Documents and Equipment Configurations

For each LERF experiment, the completed work control documents and new equipment designs are stored in an electronic repository. The DSO sends the approved experiment documentation to the LERF Hall Leader, who places them in the document repository, along with the documented machine configuration used for the experiment. The LERF Operations Coordinator also maintains documentation that describes the present LERF configuration in an electronic repository.

3.5.5.3 Operations Problem Reports (OPS-PRs)

The Operations Problem Report (OPS-PR) system is an electronic tool used by the control room staff to notify the "owners" of systems when those systems do not function properly. OPS-PR reports shall include sufficient descriptive information and detail to allow the appropriate individual(s) to properly diagnose and correct the problem (see Section 4.2.8 on page 4-12).

3.5.5.4 Operational Restrictions

The Operational Restrictions are a set of maximum operating thresholds that are maintained in a limited-access database. Some limits are specified as Operations Envelope limits (see Section 1.1.4.1 on page 1-6). These restrictions include but are not limited to the following:

- Energy restrictions
- Current limits
- Power limitations for dumps

The Crew Chief and LERF Operator must be aware of all limits established in the Operational Restrictions. Violations of the Operational Restrictions must be addressed as described in Section 3.4.2 on page 3-14.

3.5.5.5 PSS Log

The *PSS Log* is used to record (1) personnel entries and exits under controlled access conditions, (2) changes in accelerator state, and (3) information about Safety System equipment failures.

3.5.5.6 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 an accelerator enclosure is required, with the exceptions noted in Section 3.2.1.8 on page 3-11.

These sheets must be filled out in pen, signed, and dated by the survey team. The Crew Chief must review the survey for completeness and sign it. 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;

however, the results of the latest survey of each area must remain in the binder at all times.

3.5.6 Informing Users of LERF Program Interruptions

When scheduled beam delivery is interrupted, it is important to keep users informed regarding the anticipated length of the interruption. When a program interruption exceeds five minutes, the LERF Operator must contact the on-shift user representative and inform them of the nature of the problem and, if possible, an estimated time to recover. As a general rule, follow-up calls shall be placed every 60 minutes, until the problem is resolved. When critical repair-related information is learned, it shall be communicated immediately, without observing the 60-minute interval. If a problem has a known, lengthy duration (e.g., a CHL trip), that information shall be communicated to the users so that they can plan accordingly. During such interruptions, the frequency of follow-up calls shall be determined in consultation with the users (e.g., call again in two hours, or call ~one hour before beam delivery will resume).

4 Maintenance & Tracking

Maintenance refers to work performed on the hardware or software of the LERF to maintain and improve availability. Examples of LERF 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

LERF maintenance tasks can be divided into three categories: immediate, scheduled, and standby. These maintenance categories are defined in Section 4.2.3 on page 4-5.

Projects are major installations that 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.

4.1 Personnel and Responsibilities

Maintenance and project oversight for LERF is a shared responsibility between the Operability Group of the Accelerator Operations Department and the LERF Work Coordinator. The LERF Work Coordinator handles day-to-day task scheduling and oversight in close coordination with the Operability Group, who help maintain appropriate balance between LERF and CEBAF priorities. Maintenance and project activities are supported by the Jefferson Lab system support groups and subcontractors, who perform maintenance tasks for both the LERF and CEBAF. Approved repairs are performed by authorized personnel.

4.1.1 Operability Group

The Operability Manager heads the Operability Group, a group within the Accelerator Operations Department with responsibility for operability of the

CEBAF accelerator and the close coordination of LERF operability activities. The following are the LERF-specific responsibilities for this group:

- Meet with the LERF Work Coordinator at least weekly or as needed to coordinate LERF work activities.
- Serve as a backup reviewer/approver for LERF-specific ATLis tasks for scheduled and standby maintenance (see Section 4.2.2 on page 4-5).
- Mediate scheduling and resource conflicts when LERF operability issues conflict with CEBAF operability issues and serve as the final authority when such conflicts arise.
- Assist with developing and maintaining the LERF portion of the *SAD Calendar* (https://accweb.acc.jlab.org/calendar/), which presents the overview plan of activities for current or upcoming LERF and CEBAF shutdowns.

4.1.2 LERF Work Coordinator

The LERF Work Coordinator responsibilities encompass the LERF facility and include coordination and scheduling of all maintenance and installation activities. The LERF Work Coordinator works hand in hand with the Operability Group to balance CEBAF and LERF work priorities and scheduling.

LERF Work Coordinator responsibilities are as follows:

- Serve as the primary contact for work to be performed in the LERF.
- Coordinate and schedule the safe and efficient installation of equipment in the LERF, including new experiment equipment and accelerator system modifications or upgrades.
- Maintain equipment documentation and work control documents in a central electronic repository.
- Identify immediate LERF maintenance needs based on the experiences of the 24 hours of LERF running and present recommended maintenance items at the LERF 0830 Daily Summary Meeting (see Section 1.5 on page 1-17).
- Attend the Program Deputy 0745 Meeting (see Section 1.5 on page 1-17) at 0745 on regular workdays.
- Attend the CEBAF 0800 Daily Summary Meeting (see Section 1.5 on page 1-17).
- Attend the LERF 0830 Daily Summary Meeting (see Section 1.5 on page 1-17).
- Attend the CEBAF Weekly Summary Meeting, typically held on Wednesdays at 1330 in the MCC Conference Room.
- Follow up on action items initiated at the Daily Summary Meetings or Weekly Summary Meeting.
- Assist in planning and scheduling LERF maintenance days, scheduled LERF downs (i.e., long-term off times), and system hot checkout and start-up activities.
- Meet with the Operability Manager at least once a week to coordinate planned work and identify potential conflicts. When there is a conflict between LERF and CEBAF activities, the Operability Manager determines

the path forward in consultation with the LERF Work Coordinator and other stakeholders.

- Work directly with the Engineering Liaison and System Owners to plan upcoming LERF maintenance and system upgrades.
- Review and integrate LERF projects into the *LERF Long Term Schedule*, optimizing the integration plan to provide continuity between pre- and post-project operations.
- Add LERF maintenance tasks to the *SAD Calendar* (https://accweb.acc.jlab.org/calendar/), which presents the overview plan of activities for current or upcoming LERF and CEBAF shutdowns.
- Review and approve all LERF-specific ATLis tasks for scheduled and standby maintenance (see Section 4.2.2 on page 4-5), checking each task for completeness, proper coordination, safety, and schedule and then monitoring the task during execution.
- Apprise the LERF Run Coordinator of proposed LERF maintenance tasks and the potential impact on LERF operability.
- Create reports on LERF accelerator performance that include data on sources of downtime and system availability.
- Meet with support groups to identify major causes of downtime, recommend methods for improvement, review projects that will improve LERF availability or capabilities, and track those projects to conclusion.
- Collaborate with the Engineering Liaison in planning and guiding System Hot Checkout activities (see Section 4.2.7 on page 4-11).
- Participate in the demonstration and testing of new equipment and systems as they move from development to operational running.

4.1.3 LERF Geographic Integrator

The LERF Geographic Integrator helps coordinate system integration and readiness to meet the scheduled program. The Engineering Liaison serves as the primary communication point for the LERF Geographic Integrator. LERF Geographic Integrator responsibilities are as follows:

- Be knowledgeable about systems within the LERF.
- Work with system owners and experts to ensure consistency between the LED (see Section 2.1 on page 2-1), songsheets, and installed hardware.
- Facilitate interaction, communication, and cooperation between groups working on tasks that have shared components, systems, and resources.
- Track work progress leading up to and through the hot checkout process (see Section 4.2.7 on page 4-11).
- Identify potential problems affecting performance or schedule and communicate such problems to LERF management, Operations management, and the Engineering Liaison.
- Identify projects that will improve accelerator system function, maintainability, reliability, or safety and communicate these possibilities to the LERF management, Operations management, and the Engineering Liaison.
- Facilitate integration of activities within the LERF.

- Attend the LERF 0830 Daily Summary Meeting during machine operations and hot checkout and facilitate the diagnosis and repair of identified problems.
- Lead focus meetings to address any potential or existing issues.
- Attend the weekly B-Team Meeting (see Section 1.5 on page 1-17). Evaluate and facilitate any new LERF B-Team initiatives.

4.1.4 System Owners

System Owners oversee all aspects of a LERF system (e.g., SRF, RF, magnets, BPMs) to assure system performance in support of the scheduled program. System Owners have the following operations-specific responsibilities.

- Implement a working system that meets the required operating specifications and monitor and maintain system performance during accelerator operations.
- Maintain a high degree of system reliability in support of the scheduled program.
- Ensure that the element data contained in the LERF Element Database (LED) matches the existing system configuration, and incorporate any LED changes in a timely manner (see Section 2.1.1 on page 2-2).
- Provide timely on-call system support during LERF running, either personally or through an organized on-call support effort that shares the responsibility among qualified technical support personnel. The Web On-call system (see Section 4.2.4.1 on page 4-7) must be used to communicate appropriate on-call information to the control room staff.
- Provide written maintenance and troubleshooting documentation and appropriate training, including safety training, to personnel who may be contacted for on-call support.
- Support hot checkout activities as required before each LERF run period.
- Plan system maintenance as required to maintain system reliability.
- Recommend an appropriate spares level to support accelerator operations.
- Plan system upgrades to meet the performance requirements of the planned LERF program, and incorporate new technologies as they become available.

4.2 Directives

4.2.1 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. Completion

of the hazard analysis step is verified during submission of the ATLis task entry (see Section 4.2.2 on page 4-5).

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. Guidance on hazard assessment and work control document selection and development can be found in the *ES&H Manual, Chapter 3320, Temporary Work Permits.*

When planning or performing maintenance work, unreviewed safety issues (USIs) that might arise from the work must be identified and reported (see Section 1.1.3 on page 1-6). In general, the standard industrial hazards encountered during maintenance are addressed by the *ES&H Manual* or as described in the preceding paragraph; however, certain work may affect systems that act as credited controls used to mitigate the known hazards of accelerator operations as addressed in the DOE-approved FSAD and ASE documents. Such work includes, but is not limited to the following:

- LERF 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 listed in the ASE.

The *Unreviewed Safety Issue (USI) Procedure* (https://jlabdoc.jlab.org/docushare/dsweb/Get/Document-16644/USI%20Procedure.doc) provides additional guidance helpful in identifying USIs and specifies the steps required to address any USI.

4.2.2 ATLis Work Planning Tool

Maintenance and project tasks are submitted, approved, and then scheduled using ATLis (Accelerator Task List), a web-based work planning tool. Through ATLis, maintenance personnel electronically submit tasks and provide the required supporting information, including task details, the potential impact to LERF operations, task hazard identification and a hazard mitigation plan, a backout plan, and supporting documentation as attachments. Once submitted, a task is automatically routed via email to the appropriate parties for comment and approval. After approval, the task waits in the pending queue until the work is scheduled by the LERF Work Coordinator, who coordinates with the Operability Group. Following completion, the task and any appended comments remain in the database to provide work history and lessons learned information.

LERF-specific ATLis tasks are collected under a separate tab in the standard ATLis web interface.

4.2.3 Maintenance Categories

Maintenance tasks can be divided into three categories (described in the following sections):

- Immediate
- Scheduled
- Standby

4.2.3.1 Immediate Maintenance

Immediate maintenance consists of repairs to correct conditions that impede the scheduled LERF program or are identified as safety hazards.

Immediate maintenance repairs are requested by the Crew Chief at the time of the failure per the protocol established in Section 4.2.4 on page 4-7. The LERF Operator notifies the Crew Chief when immediate maintenance is needed, and the Crew Chief coordinates the maintenance response. Entries must be made in the appropriate computer-based logs (e.g., *LERFLog*) and include as much of the following information as possible:

- When the problem was first recognized
- When the problem was resolved
- When beam was re-established
- A thorough description of the problem

Repairs shall be performed by on-duty maintenance personnel whenever possible, but other staff, including ES&H and the Radiation Control Department staff, may be called in as needed to evaluate work conditions, provide support, or expedite the work.

Before work can proceed on an immediate maintenance task, the work must be covered by an ATLis task (see Section 4.2.2 on page 4-5). If the task has not already been reviewed and approved by the LERF Work Coordinator or Operability, the Crew Chief must review and approve the task.

If off-site personnel are called in to perform immediate maintenance, they must contact the Crew Chief when they arrive on site, either by phone or face-to-face contact. Work coordination is a vital part of the repair process.

4.2.3.2 Scheduled Maintenance

Scheduled maintenance consists of maintenance and project activities that are planned in advance using the ATLis work planning system (see Section 4.2.2 on page 4-5) and reviewed and approved by the LERF Work Coordinator.

The LERF Run Coordinator can, if necessary, curtail or cancel previously approved tasks at any time to protect the overall purpose and schedule of the program.

As each task is completed, the ATLis task must be closed and a *LERFLog* (see Section 3.5.5.1 on page 3-24) entry made using the *LERFLog* posting link found on the ATLis task page.

4.2.3.3 Standby Maintenance

During periods of unscheduled down time, standby maintenance (i.e., standby tasks) may be performed opportunistically, ahead of schedule.

Maintenance tasks performed during an unscheduled downtime period include:

- Correction of the problem(s) that caused the program interruption (see Immediate maintenance, Section 4.2.3.1 on page 4-6).
- Scheduled maintenance that can be performed ahead of schedule (see Section 4.2.3.2 on page 4-6).

In the event of an unscheduled LERF down time, the LERF Run Coordinator works with the LERF Operations Coordinator and LERF Work Coordinator to develop an alternate program. Depending on the duration of the down, the LERF Work Coordinator proposes appropriate maintenance tasks, choosing from already-approved ATLis tasks (see Section 4.2.2 on page 4-5) and advising the LERF Run Coordinator and appropriate JLab leadership of the potential impact to operations. The LERF Run Coordinator is authorized to, at any time, curtail or cancel tasks that may threaten the scheduled program.

4.2.4 LERF Repair Protocol

LERF repairs are made whenever hardware or software problems interrupt the scheduled program. During lengthy repairs, the Crew Chief or LERF Operator shall consult with the LERF Run Coordinator to determine if an alternate program is possible (see Section 1.4.4 on page 1-17).

The following guidelines describe the repair process; see Appendix A on page A-1 for a flow chart of this process.

- The LERF Operator notifies the affected user(s) as to the nature and anticipated duration of the problem (see Section 3.5.6 on page 3-26).
- The LERF Operator immediately notifies the Crew Chief and LERF Run Coordinator if the program interruption is anticipated to be longer than one hour.
- The Crew Chief immediately notifies the LERF Work Coordinator, Operability Manager, and Engineering Liaison if the program interruption is anticipated to be longer than four hours.
- The Crew Chief determines whether the problem can be corrected quickly by the control room staff or if on-call help is required. If on-call help is required, the Crew Chief uses the Operations on-call protocol.
- The LERF Operator opens a *LERFLog* entry and continues to add detail as the event progresses.
- If the problem is not solved two hours after *the original program interruption,* the Crew Chief initiates the repair escalation process (see Section 4.2.4.2 on page 4-7).

4.2.4.1 Call-in Lists

Call-in lists are used to summon support staff to carry out immediate repairs or to perform repairs that require specific expertise. Group Leaders are ultimately responsible for organizing their on-call response program and providing contact information for continuous 24/7 coverage. The on-call information must be supplied using the Web On-Call tool.

4.2.4.2 Repair Escalation

When, after following the repair protocol described in Section 4.2.4 on page 4-7, a problem cannot be solved by the control room staff and/or on-call help within two hours of the original program interruption, the Crew Chief initiates the repair escalation process described in this section.

The following guidelines must be followed in the event of a repair escalation; see Appendix A on page A-1 for a flow chart of this process.

- Two hours after *the original program interruption*, the Crew Chief notifies the designated escalation contacts that there is a problem, describes the problem, and reports the present repair work status. This is to occur even if on-call help has had only a portion of the two hours to correct the problem. The Crew Chief or LERF Operator must record the details of the repair escalation in the *LERFLog*.
- The escalation contacts can decide to provide additional resources, undertake an alternate course of action, or continue on the present course. In order to optimize its response and to make the best use of available personnel, a maintenance group can develop its own internal escalation policy to assure that the appropriate people are notified in a timely manner.
- Four hours after the original program interruption, the Crew Chief notifies the personnel specified in Appendix A on page A-1 about the problem and the present repair work status. The Crew Chief must record the details of these calls in the *LERFLog*.

4.2.5 Bypassing System Interlocks

Interlocks are present in many LERF 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 LERF 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 setpoints. 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* (http://www.jlab.org/accel/ssg/Pss/confinal1.pdf).

4.2.5.1 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” (see Section 4.2.5.2, below).

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 *Accelerator Bypassed-Interlock Log* (ABIL) 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, and a serial number. The serial number is generated when the ABIL entry is made. 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 who would be removing the bypass.

There are two exceptions to this requirement.

- **Exception #1** – Bypasses made by changing a software process variable require an ABIL entry but *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 (i.e., immediate maintenance; see Section 4.2.3.1) are also handled differently. If an interlock is bypassed during an immediate maintenance event, an Interlock Bypassed tag must be placed, but an ABIL entry *is not* required. This is intended to make immediate maintenance repairs more efficient. When each bypass is removed, the associated tag must be removed. In some instances, an alternative means or workaround may be found to resume the scheduled accelerator program, thus ending the immediate maintenance event. If an interlock bypass remains in place at the conclusion of the immediate maintenance event and the equipment is still "in-service", an ABIL entry must be made for each bypass still in place and the associated serial number must be written on the Interlock Bypassed tag.

4.2.5.2 Out-of-Service Equipment

Equipment is considered to be “out-of-service” when critical physical connections to the LERF have been removed. This is accomplished by, at a minimum, physically removing critical cabling that connects the system to the LERF. 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. If a tagged piece of equipment is installed in the accelerator (i.e., the interlock is still bypassed), the tag must remain in place and an *Accelerator Bypassed-Interlock Log* entry must be made. The serial number generated when the log entry is made must be recorded on the tag already attached to the equipment.

4.2.6 Repair Assessment Reporting

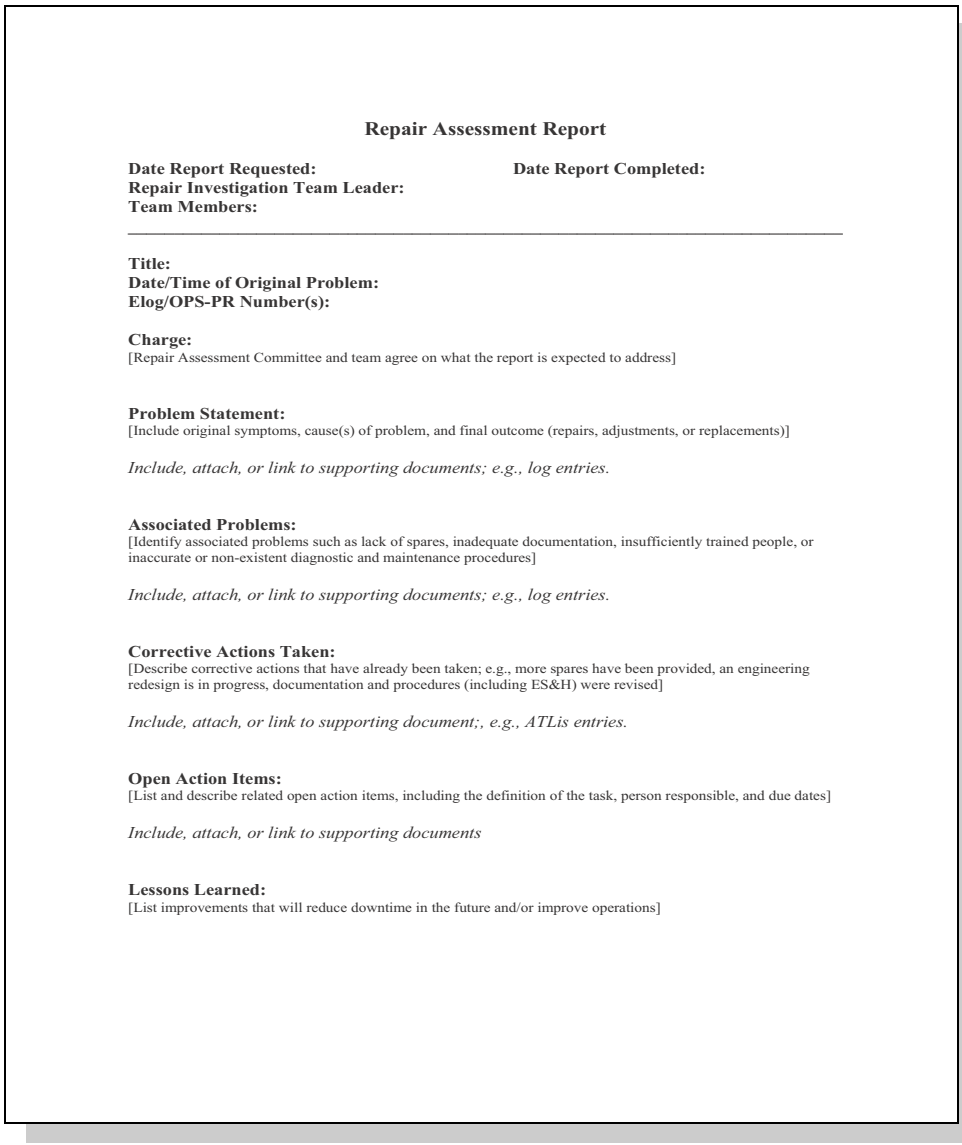
The LERF Operations Coordinator identifies repair events that should be considered for additional evaluation. The Repair Assessment Committee (RAC) determines if a detailed investigation of a repair event could potentially improve

LERF availability through the lessons learned and then oversees the investigation of such LERF repair events. If the RAC determines that additional investigation would be useful, they work with the appropriate managers to appoint a Repair Investigation Team, which is tasked with performing a detailed investigation and writing a Repair Assessment Report. The repair assessment process is not intended to place blame for problems on specific groups or individuals; rather, it serves as a mechanism to identify recurring problems, educate and draw on the knowledge of the entire Jefferson Lab staff and, ultimately, improve LERF availability using the lessons learned.

Details of the repair assessment reporting process are contained in a separate document, Accelerator Repair Assessment Reporting, which documents the repair assessment reporting process, establishes the criteria the RAC uses to evaluate events, and defines RAC and Repair Investigation Team responsibilities.

Repair Assessment Reports focus on the root causes of the problem, any plans for correcting these problems, and lessons learned. The report generally does not contain names of individuals; rather, it emphasizes technical or organizational

problems and constructive suggestions for improvements. The template used to write a Repair Assessment Report is shown in Figure 4-1, below.



Repair Assessment Report

Date Report Requested: **Date Report Completed:**
Repair Investigation Team Leader:
Team Members:

Title:
Date/Time of Original Problem:
Elog/OPS-PR Number(s):

Charge:
[Repair Assessment Committee and team agree on what the report is expected to address]

Problem Statement:
[Include original symptoms, cause(s) of problem, and final outcome (repairs, adjustments, or replacements)]

Include, attach, or link to supporting documents; e.g., log entries.

Associated Problems:
[Identify associated problems such as lack of spares, inadequate documentation, insufficiently trained people, or inaccurate or non-existent diagnostic and maintenance procedures]

Include, attach, or link to supporting documents; e.g., log entries.

Corrective Actions Taken:
[Describe corrective actions that have already been taken; e.g., more spares have been provided, an engineering redesign is in progress, documentation and procedures (including ES&H) were revised]

Include, attach, or link to supporting document;, e.g., ATLis entries.

Open Action Items:
[List and describe related open action items, including the definition of the task, person responsible, and due dates]

Include, attach, or link to supporting documents

Lessons Learned:
[List improvements that will reduce downtime in the future and/or improve operations]

Figure 4-1: Repair Assessment Report Template

4.2.7 System Hot Checkout

System hot checkout (HCO) is a period of scheduled, dedicated time, during which all accelerator systems are recovered, exercised, and made ready for beam operation prior to restoring beam. The hot checkout period is scheduled by the Director of Accelerator Operations.

Hot checkout ensures that systems and tools are verified as operational prior to operation of the accelerator. Simple stand-alone items (e.g., current readbacks) can be tested by individuals. More complex tools, however, often require interaction between *multiple* systems (e.g., the fast feedback system) and close coordination between two or more groups. The technicians responsible for accelerator system installation and maintenance and their managers must

participate in hot checkout activities to ensure that their systems are ready for beam operations.

The Hot Checkout Tool (HCO Tool) is a web-based interface that provides a uniform checkout process. The tool serves as a means to track and communicate progress toward system readiness.

System Owners populate the HCO Tool with readiness checklists and checkout procedures that are detailed and repeatable. As hot checkout progresses, technicians execute the documented process, verifying that individual system components are ready for operations before checking them off one by one in the HCO Tool. Group supervisors and managers then perform a second level of readiness verification, which signals that a system is ready for beam operations. If at any time a component is reconfigured, modified, or potentially compromised, anybody can use the HCO Tool to downgrade the readiness status of that component. The responsible group(s) receives email notification that the checkout process will need to be repeated.

All systems required to deliver beam to the intended destination must be signed off. Operations leadership can mask components that are not ready.

The LERF HCO Team is responsible for coordinating hot checkout activities. The LERF HCO Team is appointed by the Director of Accelerator Operations and includes a representative from each of the following groups: Engineering, Operability, and LERF Operations. The Engineering representative typically serves as the LERF HCO Team Leader. LERF Hot Checkout Team responsibilities are as follows:

- Determine which components will be downgraded, and downgrade those components at the beginning of the shutdown.
- Monitor submitted ATLis tasks and downgrade components as necessary.
- Track system readiness throughout the scheduled accelerator shutdown and keep the Director of Accelerator Operations apprised of potential readiness problems.
- Report on readiness progress at the LERF 0830 Daily Summary Meeting during hot checkout periods.
- Ensure that all systems required for upcoming accelerator operations are included in the HCO Tool.
- Oversee the HCO Tool and coordinate functional changes as necessary.

4.2.8 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, with all of the resulting information stored in a central database. OPS-PRs are tracked as an indicator of system performance. The goal of OPS-PR tracking is to monitor the frequency of problems, the potential trends, and the corrective actions taken as a result of the OPS-PRs.

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. After the problem is understood, the OPS-PR should be turned into an ATLis task (see Section 4.2.2 on page 4-5) if associated maintenance is required. When the problem is corrected, the OPS-PR assignee shall close the OPS-PR and associated ATLis task, which automatically emails the appropriate personnel. Responsibility for an open OPS-PR is *not* fulfilled by simply creating an associated ATLis task; rather, the OPS-PR is closed when the ATLis task addressing the problem has been *completed*.

All LERF OPS-PRs appear as *LERFLog* entries, with an associated status indicator flag. When the flag is red, the OPS-PR is still open; when green, the OPS-PR has been closed. Status can be updated directly from the *LERFLog* entry. The OPS-PR can be reassigned, recategorized, assigned to a specific individual, or closed, and comments can be added. The Problem Reporting Listing page collects all OPS-PRs on a single page and provides the means to filter and bulk manage OPS-PRs.

Appendix A LERF Repair Flow Chart

General Description:

The flow chart shown below outlines the process used to repair any problem that interrupts the performance of the primary LERF program. For additional detailed information on the repair or repair escalation process, refer to Section 4.2.4 on page 4-7.

Figure A-1: LERF Repair Flow Chart

Step	Event	Actions
1	**Original Repair Problem** (the program is interrupted)	• LERF Operator notifies the affected users as to the nature and anticipated duration of the problem. • LERF Operator notifies the Crew Chief and LERF Run Coordinator if the anticipated interruption is longer than one hour. • Crew Chief calls for on-call help or directs control room staff to attempt to solve the problem. • Crew Chief notifies the LERF Work Coordinator, the Operability Manager, and the Engineering Liaison if the anticipated interruption is longer than 4 hours. • Control room staff starts a downtime event.

2	**Repair Escalation (Level 1)**
	(2 hours after program interruption)
		• Crew Chief notifies the designated escalation contacts, along with the following:
		  • System Owner
		  • LERF Run Coordinator
		• Escalation contacts take appropriate action.

3	**Repair Escalation (Level 2)** (4 hours after program interruption)	• Crew Chief notifies the Operability Manager and the appropriate Department Head (or Deputy) of the on-going problem.

Appendix B LOD Release Memo

General Description:

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

Figure B-1: LOD Release Memo, p. 1

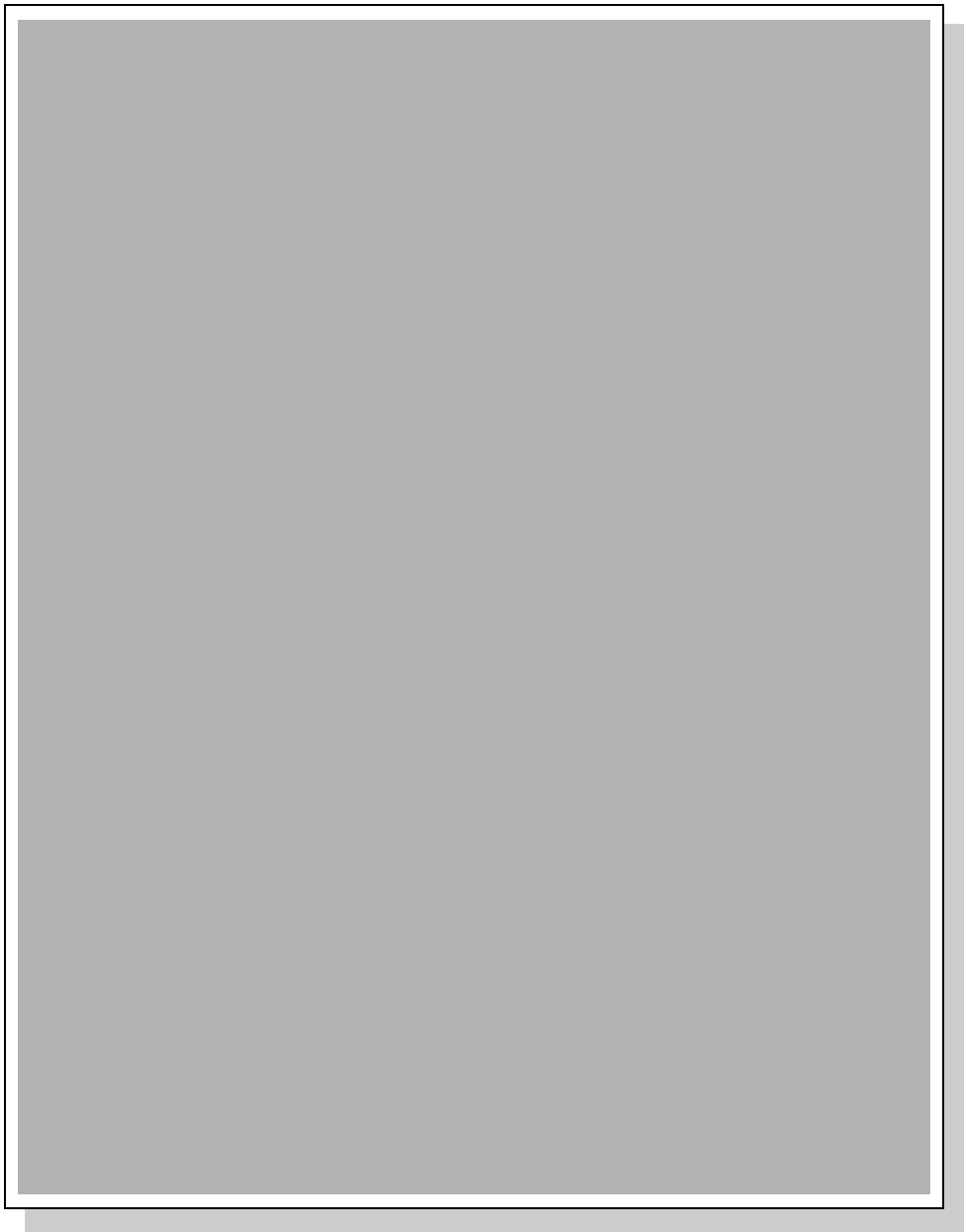


Figure B-2: LOD Release Memo, p. 2

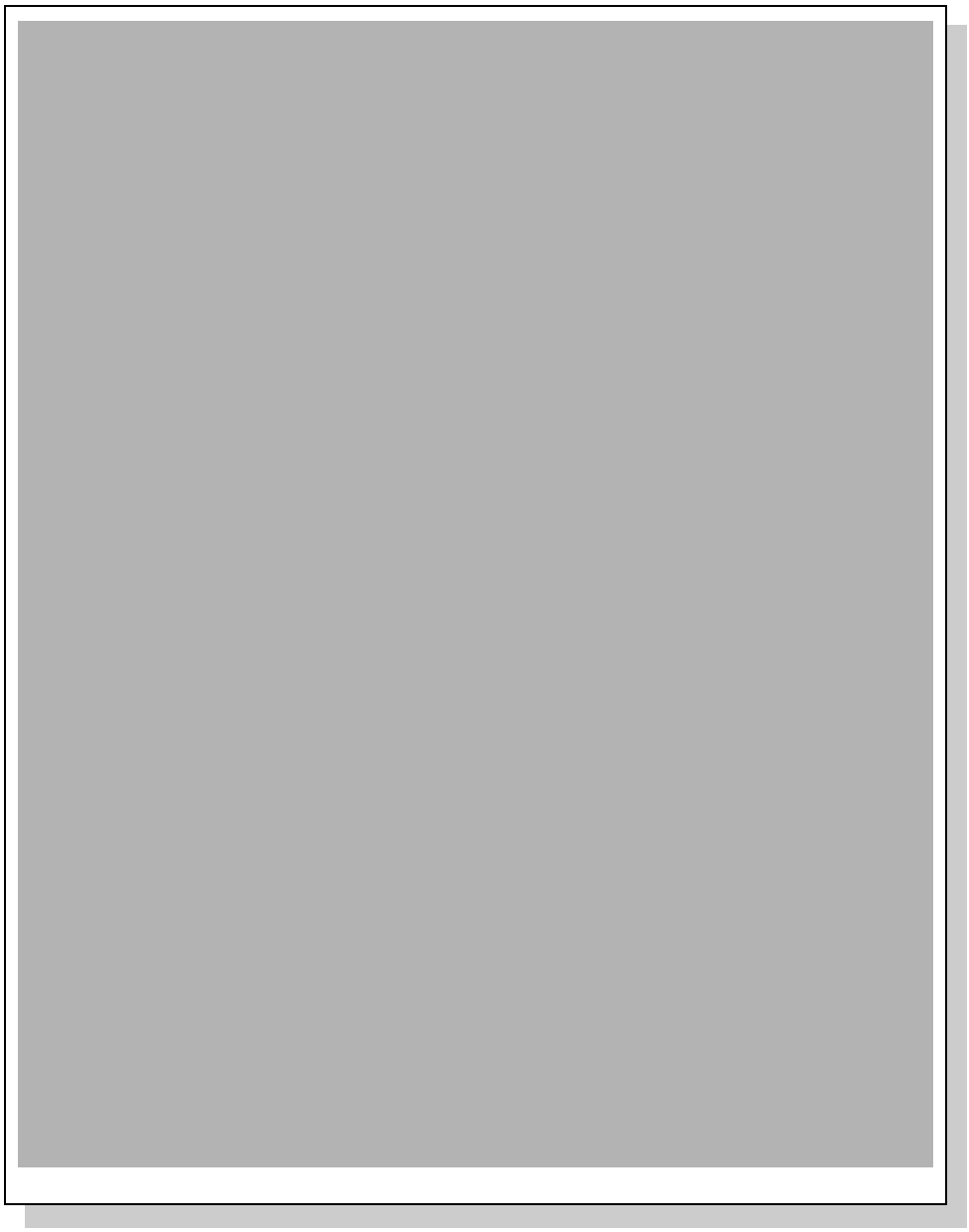
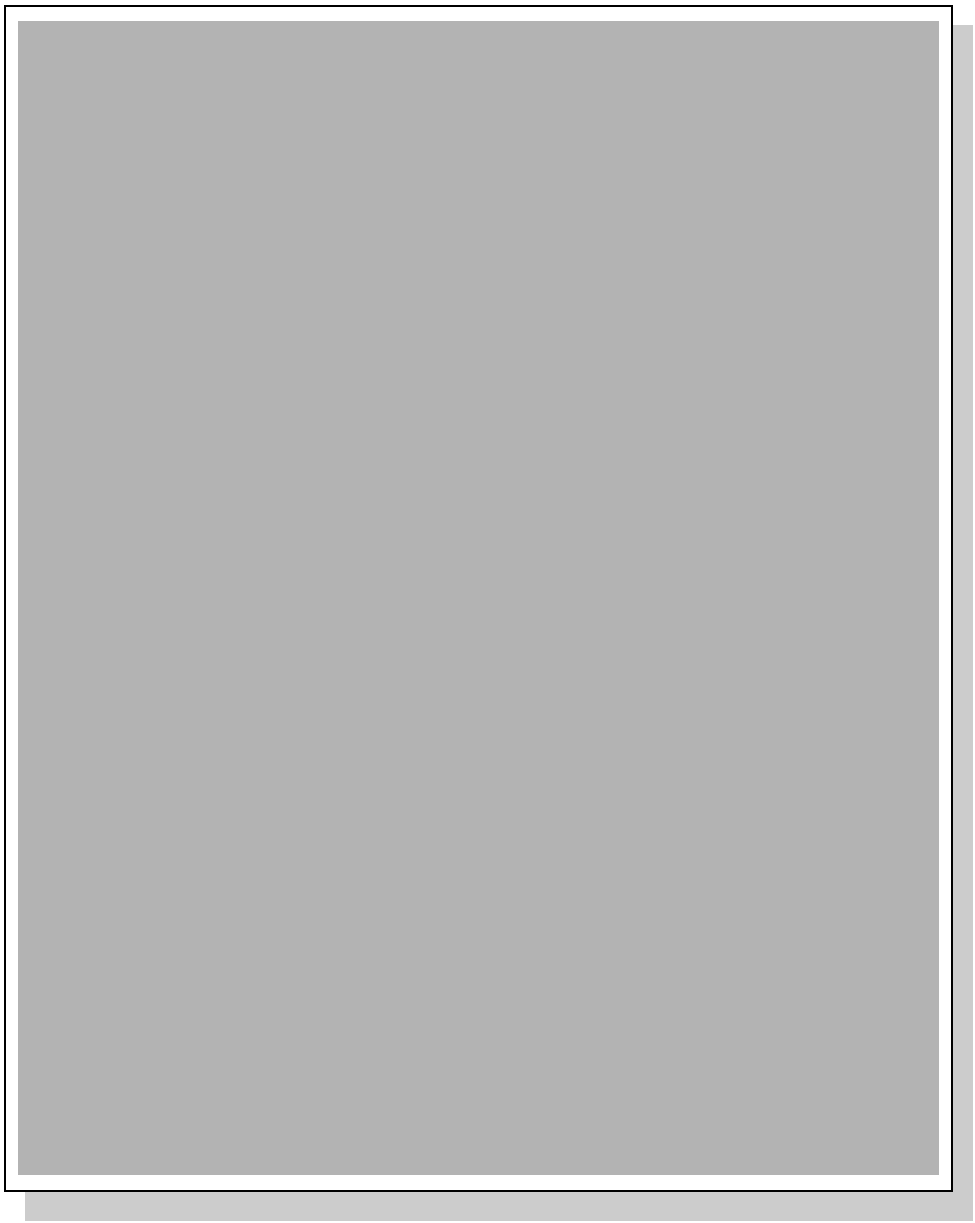


Figure B-3: LOD Release Memo, p. 3



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