ACCELERATOR OPERATIONS DIRECTIVES

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Jefferson Lab

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Preface

This document provides directives for Accelerator Division personnel and others who operate and maintain the Thomas Jefferson National Accelerator Facility (Jefferson Lab) CEBAF (Continuous Electron Beam Accelerator) accelerator and the associated beam-delivery systems.

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 accelerator 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 accelerator operations.

Chapter 3: Accelerator Operations
Specifies directives for how the accelerator programs are carried out, including the safety responsibilities of the control room staff and the role of safety organizations.

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

Appendix A: PD Shift Plan
A sample of the template used to create the Program Deputy Shift Plan, which provides specific instructions for the control room staff.

Appendix B: PD Weekly Summary
A sample of the template used to create the Program Deputy Weekly Summary.

Appendix C: Crew Chief Shift Log
A sample of the template used to create the Crew Chief Shift Log, which summarizes the activity at the end of each shift.

Appendix D: Test Plan Worksheet
A sample of the template used to create test plans, which must be completed by anyone testing specific accelerator operating parameters and gathering test data.

Appendix E: CEBAF Accelerator Repair Flow Chart
The CEBAF repair and repair escalation process in a flow chart format.

Appendix F: ATLis Maintenance Tasks
A sample of the template used for accelerator work plan submission, review, and approval.

Appendix G: AOD Release Memo and Change Summary
The memo used to release the AOD, including the associated change summary.

This document has been approved by:

Arne Freyberger, Director of Accelerator Operations — 2017-10-16 Date

Acronyms & Abbreviations

ABIL	Accelerator Bypassed-Interlock Log
AOD	Accelerator Operations Directives
APEL	Accelerator-Physics Experiment Liaison
ARM	Assigned Radiation Monitor
ASE	Accelerator Safety Envelope
ASRWP	ARM Standing Radiation Work Permit
ATLis	Accelerator Task List
BCM	Beam Current Monitor
BLA	Beam Loss Accounting System
BLM	Beam Loss Monitor
BOOM	Beam Operations Objective Monitor
BPM	Beam Position Monitor
BELS	Beam Envelope Limiting System
B-Team	Beam Transport Team
CARM	Controlled Area Radiation Monitor
CATS	Corrective Action Tracking System
CEBAF	Continuous Electron Beam Accelerator Facility
CED	CEBAF Element Database
CHL	Central Helium Liquefier
COO	Experimental Hall Conduct of Operations document
CW	Continuous Wave Beam
DOE	Department of Energy
DSO	Division Safety Officer
ELog	Electronic Logbook (formerly *Daily Activity Log*)
EPICS	Experimental Physics and Industrial Control System
ES&H	Environment, Safety and Health
ESH&Q	Environment, Safety, Health and Quality
FSAD	Final Safety Assessment Document
FSD	Fast Shutdown
HRA	High Radiation Area

IC	Incident Commander
IIC	Internal Incident Commander
IOC	Input/Output Controller
ISM	Integrated Safety Management
ISMS	Integrated Safety Management System
JLab	Jefferson Lab
LERF	Low Energy Recirculation Facility
LOD	LERF Operations Directives
MCC	Machine Control Center
MPS	Machine Protection System
MUX	Multiplexer
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
RBM	Radiation Boundary Monitor
RA	Radiation Area
RAC	Repair Assessment Committee
RCD	Radiation Control Department
RMA	Radioactive Materials Area
RWP	Radiation Work Permit
SME	Subject Matter Expert
SAD	Scheduled Accelerator Down
SSO	Safety System Operator
SRT	System Readiness Tool
TAC	Technical Advisory Committee
TOSP	Temporary Operational Safety Procedure
USI	Unreviewed Safety Issue
VESDA	Very Early Smoke Detection Apparatus

1 Program Control

Program control is the development and management of the CEBAF accelerator program carried out by the control room staff in the Machine Control Center (MCC).

This chapter describes how safety and work planning are integrated into accelerator 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 the personnel involved in defining, conducting, and scheduling the program.

1.1 Program Safety

Safety is integrated into all facets of CEBAF accelerator 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 CEBAF accelerator 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 accelerator 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 accelerator program is developed using a structured approval/scheduling process, which is summarized in the following paragraphs.

Groups of collaborating experimenters submit experiment proposals to the Program Advisory Committee (PAC) (see Figure 1-1, below). The PAC, which

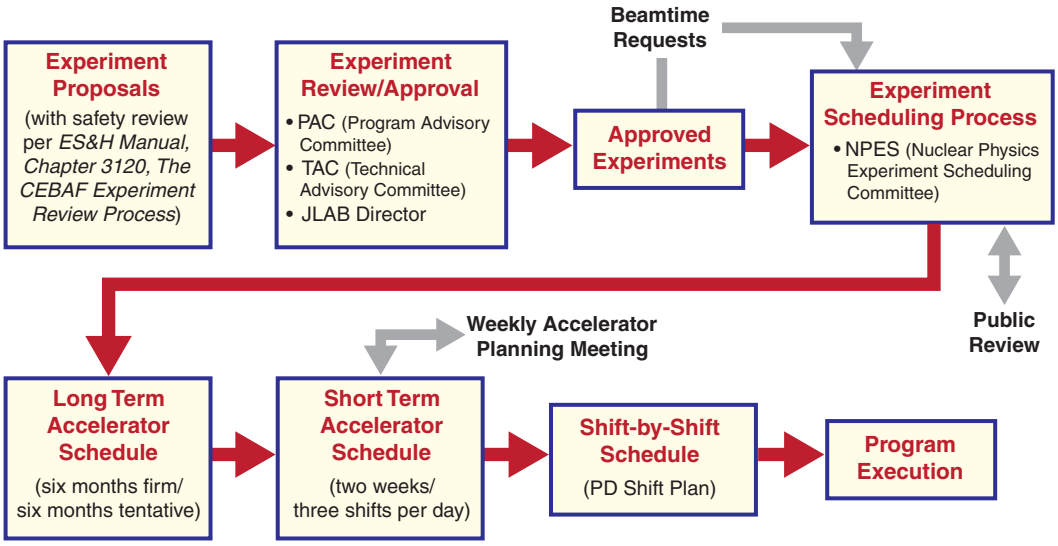


Figure 1-1: Experiment Approval/Scheduling Process Defines Accelerator Program Scope

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 3120, The CEBAF Experiment 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 Laboratory Director, meets at least twice per year to consider beamtime requests and then subsequently publishes a new CEBAF operations schedule for a 15-month period (six months firm, six months tentative, three months loosely defined). When scheduling, 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. The finalized schedule is referred to as the *CEBAF Long Term Schedule* (http://www.jlab.org/exp_prog/experiment_schedule/) (see Section 1.4.1 on page 1-14).

During operations the *CEBAF Long Term Schedule*, which shows activities in one-day increments, is further refined to become the *CEBAF Short Term Schedule* (http://accboard.acc.jlab.org/) (see Section 1.4.2 on page 1-17), which shows a two-week period of eight-hour shifts and is posted on the whiteboard in the MCC Conference Room. The Program Deputy (see Section 1.3.1 on page 1-11) develops and maintains the short term schedule based on input from the experimenters (JLab users and Physics Division staff) and Operations, including Engineering support staff. The short term schedule is discussed at the Weekly Summary Meeting (see Section 1.5 on page 1-18), where feedback and comments are incorporated as appropriate.

The Program Deputy communicates the scope and details of the final, shift-by-shift plan to the control room staff via the *PD Shift Plan* (https://accweb.acc.jlab.org/apps/pd/shift-plans) (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.

During periods of Scheduled Accelerator Down (SAD), the *SAD Calendar* supplants the *PD Shift Plan* as the document that communicates scheduled activities, and the SAD Program Deputy provides a PD Shift Plan when the MCC Control Room is staffed.

1.1.2 Program Hazard Analysis

As required by *DOE Order 420.2C, Safety of Accelerator Facilities,* two documents address the hazards associated with CEBAF accelerator operations: the *JLab Final Safety Assessment Document* (FSAD) and the *JLab Accelerator Safety Envelope* (ASE).

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 1.1.2.1 on page 1-4).

1.1.2.1 Unreviewed Safety Issues (USIs)

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 1.1.3.1 on page 1-5). 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*.

1.1.3 Program Hazard Controls

1.1.3.1 Credited Controls

The accelerator 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 1-3) 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 operators) is required to conduct accelerator operations within these controls (see Section 3.1.1.1 on page 3-2 and Section 3.1.1.4 on page 3-7). 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* is followed (see Section 1.1.2.1 on page 1-4).

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 CEBAF accelerator 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
  - Doors, gates, fences, and other barriers
  - Beam dump cooling building design
  - Nitrogen gas supply orifices
- **Active Engineered Controls**
  - Personnel Safety System (PSS) access controls
  - PSS beam containment controls
  - ODH System controls
- **Administrative Controls**
  - JLab experiment review process
  - CEBAF Operations staffing – Sweep and Controlled Access
  - CEBAF Operations staffing with beam to Faraday Cup #2
  - CEBAF Operations staffing with beam to 0R08
  - CEBAF Operations staffing with beam beyond 0R08

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 3.4.5.6 on page 3-31).

1.1.3.2 Additional Safety Controls

While the credited controls specified by the FSAD address worker safety, public safety, and environmental safety, CEBAF 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.
- **Max Juice** – An active engineered system that turns off the accelerated beam when the beam current reaches a user-specified threshold for a specific destination. The system accommodates multiple, simultaneous beam destinations and is intended to trip the beam before reaching beam current limits.
- **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 3.4.1.1 on page 3-18).
- **Operational Restrictions** – A listing of administrative limits and operating parameters for specific accelerator systems or areas (see Section 3.4.5.6 on page 3-31).
- **Beam Test Plans** – Formal plans that are submitted when a system expert wishes to test specific accelerator operating parameters or gather test data during normal accelerator operations (see Section 3.4.3.2 on page 3-24). Beam test plans require thorough prejob planning, hazard analysis, and a standard review/approval process.
- **CEBAF-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 accelerator operations are maintained in a binder in the MCC Control Room. These documents are reviewed by all operators and Crew Chiefs.

1.1.4 Program Execution Within Controls

The MCC shift crew executes the approved accelerator program as authorized in Section 1.2 on page 1-10 and within the controls established in Section 1.1.3 on page 1-5. 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 *Accelerator Operations Directives*.

Prior to executing the program, the shift crew achieves a state of readiness as follows.

- **Training and Qualification** – The oncoming Crew Chief and operators have the required training and are shown as a Crew Chief or operator on the list posted on the MCC Information Bulletin Board (see Section 3.1.1 on page 3-1).
- **Preshift Reading** – The oncoming Crew Chief and operators read and understand the following before assuming responsibility for CEBAF operations:
  - *PD Shift Plan* (see Section 1.4.3 on page 1-17)
  - *Electronic Logbook* (*ELog*) entries since last on shift (see Section 3.4.5.1 on page 3-30)
  - Accelerator-specific OSPs/TOSPs (see Section 1.1.3 on page 1-5)
  - Experiment-specific binders
- **Shift-Turnover Meetings** – The oncoming Crew Chief and operators participate in their respective shift-turnover meeting (see Section 3.4.2.3 on page 3-22) 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 and operators assume responsibility immediately following the shift-turnover meeting.
- **Stamp In** – The oncoming Crew Chief and operators complete all required fields in the *Crew Chief Stamp* or *Operator Stamp*, respectively, for each on-duty shift.

1.1.5 Program Feedback and Continuous Improvement

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

- **Electronic Logbook (*ELog*)** – As a time-based repository for information associated with program execution, the *ELog* (https://logbooks.jlab.org/book/elog) (see Section 3.4.5.1 on page 3-30) 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.
- **Downtime Reporting** – The Downtime Manager (see Section 4.2.10 on page 4-14) is used by the control room staff to record downtime event information, which is used for failure analysis and reporting.

- **Operations Problem Reports (OPS-PR)** – The OPS-PR system (see Section 3.4.5.4 on page 3-31) 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 hall scheduled to receive beam (see Section 1.5 on page 1-18), and other staff as determined by the Program Deputy. 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. During SAD periods, this meeting is held only as needed.
- **Daily Summary Meeting** – The Program Deputy runs the Daily Summary Meeting, which is held workdays at 0800 (see Section 1.5 on page 1-18). The focus of the meeting is to report on the previous 24 hours of operations and communicate the plan for upcoming operations. The Program Deputy presents the following, all of which are also available in the *ELog*:
  - Crew Chief Shift Logs – Written summaries for each shift that summarize operations, identify problems, and show time-accounting data (see Section 1.4.3 on page 1-17).
  - Time-Accounting Bar Graphs – Bar graphs that show the number of hours of beam delivered to the intended destinations for a 24-hour period.
  - Fast Shutdown (FSD) Graphs – Graphs that show the number and type of machine-protection system faults on a 24-hour time scale.

  A broad variety of personnel attend this meeting, including all interested experiment representatives, support staff, and managers. Useful discussion is encouraged. Time is set aside at the end of the meeting to discuss safety-related topics.

  During SAD periods, the SAD Program Deputy runs the meeting and presents the following:
  - PD Summary – A written summary, authored by the SAD Program Deputy, that describes significant maintenance and development activities for the previous 24-hour period.
  - ATLis Work Map – A graphic depiction of scheduled maintenance activities for the coming day.
  - SAD Calendar – A maintenance/activity schedule, maintained by the Operability Group, for the coming day/weeks.
- **Weekly Summary Meeting** – Held Wednesdays at 1330, this meeting summarizes the accelerator performance for the preceding week and looks ahead at the schedule for the upcoming week (see Section 1.5 on page 1-18). The Program Deputy presents the *PD Weekly Summary* (see Appendix B on page B-1) and the weekly time-accounting bar graph. The Operability Group presents the *Lost Time Report* (see Section 4.2.10.1 on page 4-14), Geographic Integrators present either a written, oral, or no report (depending on the scheduled program), and the Experiment Run Coordinators each present their *Run Coordinator Weekly Summary* (http://opweb.acc.jlab.org/internal/ops/ops_webpage/run_coord/

runcoord_form.php?action=main), which summarizes their hall's operations for the preceding week and addresses upcoming activities. This meeting is typically not held during SAD periods.

- **Machine Status Briefing** – The Machine Status Briefing is prepared weekly by the MCC Operations Deputy Group Leader and presented to the oncoming shift personnel at the MCC group meeting. The purpose of the report is to discuss lessons learned during the run period and identify areas that will require additional scrutiny by the oncoming shift crews.
- **Program Deputy Feedback Form** – Following a Program Deputy's tenure (see Section 1.3.1 on page 1-11), he/she is asked to complete the *Program Deputy Feedback Form*, a document that requests candid feedback and observations from the two-week period.
- **MCC Operations Procedure Revisions** – When an accelerator operator discovers an error or something that is unclear in a task-specific procedure, the operator must generate an Operations Problem Report (OPS-PR) or mark up a copy of the procedure and place it in the Procedure Markups bin in the control room, along with contact information. The MCC Documentation Coordinator (see Section 3.1.1.10 on page 3-14) then works with the Technical Custodian (i.e., the assigned subject matter expert) to make appropriate changes.
- **Repair Assessment Reporting (RAR)** – When the Repair Assessment Committee determines that a detailed investigation of a repair event could potentially improve accelerator availability through lessons learned, an investigation team is appointed (see Section 4.2.8 on page 4-12). The resulting report focuses on the root causes of the problem, any plans for correcting these problems, and lessons learned.
- **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 CEBAF accelerator within the safety envelopes listed in the *JLab Accelerator Safety Envelope* (ASE) (see Section 1.1.2 on page 1-3). 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

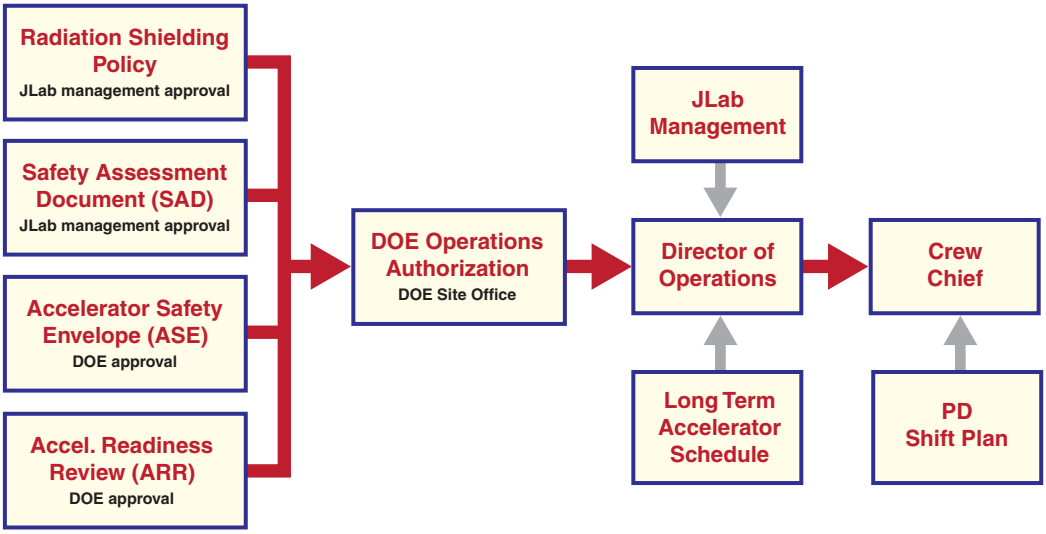


Figure 1-2: Accelerator Program Authorization

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 DOE. With these required documents in place, an Accelerator Readiness Review verified that all conditions for safe operations had been met, and DOE subsequently authorized CEBAF operations. A copy of the DOE letter authorizing CEBAF operations is posted on the MCC Information Bulletin Board.

The accelerator 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 *CEBAF Long Term Schedule* (see Section 1.1.1 on page 1-2). The Director of Accelerator Operations authorizes the Crew Chief to carry out the accelerator program as specified in the *PD Shift Plan* (see Section 1.1.1 on page 1-2). Before beam is run following an accelerator shutdown, the Director of Accelerator Operations makes a *Beam Authorization* entry in the *ELog*, authorizing beam to specific areas of the accelerator. During shutdown periods, the *SAD Calendar* generally supplants the *PD Shift Plan* as the document that communicates scheduled program activities.

1.3 Personnel and Responsibilities

The key personnel involved in defining, scheduling, and authorizing the accelerator program (see Section 1.1.1 on page 1-2) include the JLab Director, the Program Advisory Committee, the Technical Advisory Committee, the Nuclear Physics Experiment Scheduling (NPES) Committee, the Director of Accelerator Operations and the Program Deputy. The responsibilities of the Program Deputy are specified in the following section;

the responsibilities of the other key personnel are described in the appropriate committee charters and elsewhere.

1.3.1 Program Deputy

Program Deputies are staff appointed by the Director of Accelerator Operations to serve for a two-week period. During his or her tenure, the Program Deputy is responsible for all shifts of the CEBAF accelerator program. The Program Deputy conducts the Daily Summary Meeting and is expected to communicate with all shifts on a daily basis.

Program Deputy responsibilities are as follows:

- Meet with the Director of Accelerator Operations during the week preceding assumption of the Program Deputy responsibilities. At this meeting the Director of Accelerator Operations will provide an update on the medium-term operating priorities and a set of high-level goals to be achieved during the period.
- Meet with the MCC Documentation Coordinator (see Section 3.1.1.10 on page 3-14) during the week preceding assumption of the Program Deputy responsibilities. The MCC Documentation Coordinator will provide a briefing concerning Program Deputy information tools and provide a copy of the PD Help File, a compilation of useful PD-specific information.
- Publish a detailed accelerator program/schedule for each shift (the *PD Shift Plan*) and make it available to the members of the control room staff no later than the start of the shift. The *PD Shift Plan* must be created using the on-line *PD Shift Plan* form (see Appendix A on page A-1).
- Provide an alternate program (see Section 1.4.4 on page 1-17) when the scheduled accelerator program cannot be carried out. The alternate program shall maximize the use of available accelerator 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 Operations leadership.
- Schedule beam test plans as appropriate to support the accelerator program. The ranking supplied by the Beam Test Plan Review Team shall be considered when scheduling beam test plans. Beam test plans scheduled to be performed during a specific shift must be listed in the *PD Shift Plan* for that shift. After a test plan is performed, the test plan's Principal Investigator (see Section 3.4.3.2 on page 3-24) should be scheduled for a brief presentation at the Daily Summary Meeting (see Section 1.5 on page 1-18).
- Monitor the ongoing accelerator program to assure that the scheduled accelerator program is being carried out successfully.
- Request from Accelerator Division management any resources required to support the scheduled accelerator program.
- Conduct a daily meeting with the Experiment Run Coordinator for each experiment scheduled to receive beam that day or the following day (the Program Deputy 0745 Meeting, see Section 1.5 on page 1-18). This meeting shall serve as a routine means of exchanging information concerning the operating schedule, accelerator performance, or any other concerns that affect the scheduled program. The meeting generally occurs at 0745 in the conference area of the MCC Control Room on workdays

(weekends at 0830, as necessary). During scheduled accelerator shutdowns, accelerator technical staff attend this meeting and discuss maintenance progress.

- Conduct the summary meeting each workday morning (the Daily Summary Meeting, see Section 1.5 on page 1-18), where the Crew Chief Shift Summaries for the previous 24 hours (or weekend) are presented, develop any necessary short-term schedule modifications, and ensure that the appropriate laboratory resources are coordinated as necessary to keep the accelerator program on schedule.
- Conduct a weekly summary meeting (Weekly Summary Meeting, see Section 1.5 on page 1-18) to define the short-term operating schedule (see Section 1.4.2 on page 1-17) for the upcoming two-week period. The schedule must be posted on the MCC conference room scheduling white board and kept as up to date as possible (images of the scheduling whiteboard, updated at five-minute intervals, are available online at http://accboard.acc.jlab.org/).
- Prepare and present, at the Weekly Summary Meeting, a weekly summary report (the PD Weekly Summary) describing progress toward stated program goals, major maintenance concerns, and issues to be addressed in the coming week. The PD Weekly Summary must be created using the PD Weekly Summary template (see Appendix B on page B-1).
- Coordinate the presentation of the Run Coordinator Weekly Summaries at the Weekly Summary Meeting. The Experiment Run Coordinator for each experiment hall receiving beam shall prepare and present a report using the standard template (see http://opweb.acc.jlab.org/internal/ops/ops_webpage/run_coord/runcoord_form.php?action=main). The Program Deputy is responsible for making sure that the run coordinators are aware of this requirement in advance of the meeting (preferably the day before the meeting).
- Review with the Operability Group (see Section 4.1.1 on page 4-2) all maintenance activities that could affect accelerator operation.
- Complete the *Program Deputy Feedback Form* following the two-week Program Deputy tenure. This form requests candid feedback and observations from the two-week period.

1.3.2 SAD Program Deputy

During periods of scheduled accelerator down (SAD), the program focus shifts to maintenance/installation, significantly altering the role of the Program Deputy. Accordingly, the position title changes to “SAD Program Deputy” (SAD PD), and the position responsibilities are adjusted as follows.

SAD PD responsibilities:

- Meet, during the week preceding assumption of SAD PD responsibilities, with the Director of Accelerator Operations (for the overall accelerator plan), the Operability Group Leader (to discuss all planned maintenance activities), and the MCC Documentation Coordinator (to understand the communication tools and conventions used while SAD PD).
- Prepare the daily *PD Summary*, which summarizes maintenance/installation activities for the preceding day and is created using the Presenter tool.

- Prepare the *ATLis Work Map*, which lists accelerator-site work activities for each work day and is created using the ATLis Work Map tool.
- Conduct the summary meeting each workday morning (the Daily Summary Meeting, see Section 1.5 on page 1-18) and present the *PD Summary* for the previous 24 hours (or weekend), the *ATLis Work Map*, and the *SAD Calendar,* which outlines planned activities for the day and beyond.
- Create a detailed accelerator program/schedule (the *PD Shift Plan*) whenever the MCC Control Room will by staffed during a shift, and make it available to the members of the control room staff no later than the start of the shift. The *PD Shift Plan* must be created using the on-line *PD Shift Plan* form (see Appendix A on page A-1).
- Coordinate the presentation of Geographic Integrator reports at the Weekly Summary Meeting. This should be done in consultation with the Director of Accelerator Operations and the Engineering Liaison to determine the appropriate level of reporting. Depending on the scheduled program, a Geographic Integrator may present a written summary, a brief oral summary, or no summary at all.

1.3.3 Beam Transport Team (B-Team)

The Beam Transport Team (B-Team) is charged with ensuring that the CEBAF accelerator efficiently and consistently meets the near-term and long-term beam specifications of the nuclear physics 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 consists mostly of accelerator scientists, but also includes other technical experts and members of accelerator leadership. The B-Team Leader (see Section 1.3.3.1 on page 1-13) organizes the efforts of the team and collaborates with accelerator management and the Program Deputy. The team is called on to solve beam transport problems during accelerator running and also focus on future known beam transport issues and physics program requirements. B-Team members frequently write single-use procedures known as Beam Test Plans (see Section 3.4.3.2 on page 3-24) to execute a test or process in a way that is well thought out, reviewed, and approved in advance. The B-Team Leader evaluates Beam Test Plans and gives each plan an appropriate ranking, considering the technical and scientific merits of the plan, along with how it fits with the near- and long-term goals of the accelerator program.

1.3.3.1 B-Team Leader

The B-Team Leader is responsible for guiding and organizing the efforts of the B-Team and collaborating with Operations management and the Program Deputy to move the accelerator program forward. Specific responsibilities are as follows.

- Collaborate with the Director of Accelerator Operations to determine how best to utilize B-Team assets to support the planned accelerator program.
- Schedule regular B-Team meetings with a specific agenda, assign action items, and track action items to completion.
- Assign specific task responsibility to appropriate individuals and monitor progress of all tasks.

- Manage the Beam Test Plan system (see Section 3.4.3.2 on page 3-24) and assign appropriate rankings based on the relative importance of each plan as determined through discussion at B-Team meetings.
- Meet weekly with the Program Deputy to discuss relevant Beam Test Plans, their relative importance, and when they might best be executed. Any pertinent beam transport issues should also be discussed at this meeting.
- Attend the Weekly Summary Meeting and present the Beam Studies Report.

1.3.4 Accelerator-Physics Experiment Liaison (APEL)

An Accelerator-Physics Experiment Liaison (APEL) is an accelerator scientist who is appointed to serve as a liaison for all experiments in a specific experiment hall. Halls A, B, C and D all have an appointed APEL. The Director of Accelerator Operations appoints all APELs. Specific responsibilities are as follows.

- Collaborate with the user group for each experiment. This includes regularly attending collaboration meetings and proactively advancing known beam transport and beam quality issues.
- Develop and own the beam transport lattice for the hall line and integrate this with all standard operations tools.
- Work with the Operations Hall Liaison (see Section 3.1.1.9 on page 3-13) to develop control room procedures and operator training.
- Work with the Geographic Integrator for the hall to ensure that the hardware design and installation meets the experiment requirements.
- Participate in experiment commissioning activities.
- Regularly attend B-Team meetings.

1.4 Program Schedules

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

1.4.1 Long Term Schedule

The long term schedule is established by the NPES Committee (see Section 1.1.1 on page 1-2). The committee releases a new version of the long term schedule twice per year. Each schedule nominally covers a fifteen-month period—firm for the first six months scheduled, tentative for the following six months, and loosely defined for the final three months (see http://www.jlab.org/exp_prog/experiment_schedule/). The approximate dates for schedule release are as follows:

- End of May – covers the 15 months beginning September 1
- End of November – covers the 15 months beginning January 1

The schedule provides the planned activity for the accelerator and each experimental hall for each day during the scheduled period. The schedule provides details concerning the following:

- **Collaborative Checkout –** Collaborative checkout is performed after major shutdowns or experiment installations by hall and accelerator personnel working in cooperation to evaluate and adjust the beam quality

prior to scheduled physics beam delivery. Halls should be ready and locked at the beginning of the scheduled collaborative checkout period. If the beam conditions meet the requirements of the experimenters, the experiments may use the beam time for production operations.

- **Commissioning** – Commissioning is the period between installation of equipment and the actual operational use of that equipment, such as in an experiment. A commissioning period may include testing, debugging, reconfiguration, calibration, final testing, operator training, and other activities required to produce fully operational equipment and systems.
- **Date** – An activity starts at 0800 on the scheduled date and ends at 0800 the day after it is last shown on the schedule.
- **Development** – Accelerator Development (also known as machine development or beam development) is a period set aside for investigating and determining operating characteristics of accelerator equipment and systems. Approved Beam Test Plans are the vehicle for conducting these investigations (see Section 3.4.3.2 on page 3-24).
- **Deinstall** – Deinstall is the period assigned to an experimental hall for the removal of special equipment used for a particular experiment or a set of experiments. Operations may continue in other halls when one hall has a deinstall period.
- **Facility** – Facility Development is a scheduled period that is used to meet priority needs of the moment, including experiments, commissioning new equipment, and accelerator development. It is allocated by the NPES.
- **GeV/pass/Pol** – When the accelerator is scheduled for beam delivery, the energy per pass (GeV/pass) is specified (e.g., 2.2 GeV/pass) and whether or not the beam is to be polarized (indicated by a “p”).
- **GeV/μA** – The beam energy scheduled for each experimental hall is indicated in the table (e.g., 10.0 GeV). The beam current is also indicated.
- **Holiday** – The accelerator and experimental halls are “locked out” during holiday periods, and no work or operations can be scheduled without the approval of the Director of Accelerator Operations or an Experimental Hall Leader.
- **Install** – Installation is the period assigned to an experimental hall for installing additional or new equipment.
- **Maintenance** – Accelerator maintenance shift(s) generally occur as scheduled on the *CEBAF Long Term Schedule*.
- **Priority** – When a hall is designated as having priority, that hall will have the primary voice in decisions concerning beam quality and/or changes in accelerator operating conditions (this does not mean that the priority hall can demand changes that would affect planned beam conditions in the other halls without their consent). The priority designation provides guidance to the Program Deputy when developing the short term schedule and managing the program. Final authority for decisions about unplanned changes in accelerator operation will rest with laboratory management.

  NOTE: The NPES Committee has established additional guidelines regarding priority. These guidelines, which are available from the long term schedule (see http://www.jlab.org/exp_prog/experiment_schedule/), supersede the information contained in this document when in conflict.

The hall with priority has the right to:

- Require an immediate retune of the accelerator when beam quality is not acceptable. If the retune degrades the previously acceptable beam for one of the other, lower priority halls, then the retune will continue until the beam is acceptable to both the priority hall and the other halls that were receiving acceptable beam when the retune began.
- Insist that an energy change occur as scheduled.
- Obtain hall access as desired.
- Request beam delivery interruptions for experiment-related operations (e.g., Mott measurements of beam polarization or pulsed-beam operation for current monitor calibrations), even though such operations may halt beam delivery to all halls.

These interruptions are limited by a sum rule: the total time lost by a non-priority hall shall not exceed 2.5 hours in any 24-hour period. It is highly preferred that, whenever possible, such interruptions be scheduled at the Program Deputy 0745 Meeting (see Section 1.5 on page 1-18) and coordinated between hall personnel.

Non-priority halls can:

- Require that a retune of the accelerator take place within 2.5 hours of the desired time (the retune will typically occur at the earliest convenient break in the priority hall's schedule).
- Require access to their hall within one hour of the desired time (again, the access will typically occur at the earliest convenient break in the priority hall's schedule).
- Request that beam delivery interruptions for experiment-related operations that temporarily block normal beam delivery to all other halls occur within 2.5 hours of the desired time. Interruptions of this type require, at a minimum, 24 hours advance notification and coordination with the Program Deputy and the other halls.

- **Restore** – Restore is the period assigned to start up the accelerator and/or tune the beam to meet specifications for its next scheduled use. Three or more days of restore may be scheduled after a major shutdown or holiday period. One shift of restore is typically scheduled when a new beam setup is being tuned (longer periods may be scheduled for unusual setups). A period of beam restoration is typically scheduled after scheduled maintenance. Short periods of restore may be scheduled after a target or energy change in a hall. Restore may also be referred to as planned or scheduled tuning.
- **Shutdown** – Normally, major shutdowns are scheduled two times per year, one in the winter and the other in the summer. Major shutdowns typically last for at least one month and include the accelerator and all experimental halls. Extensive planned maintenance—and possibly installation of new equipment—is scheduled for the accelerator and the experimental halls during shutdown. The priority of shutdown activities is determined in advance. During these periods PSS recertification, RF testing, limited beam tests and other system activities may be scheduled as shutdown activities.

1.4.2 Short Term Schedule

The short term schedule, which provides a shift-by-shift schedule for a two-week period, is reviewed at the Weekly Summary Meeting (see Section 1.5 on page 1-18), and is based on the long term schedule prepared by the NPES Committee. The Weekly Summary Meeting is conducted by the Program Deputy, and the short term schedule is posted on the white board in the MCC conference room. Halls scheduled to receive beam during the upcoming two weeks are expected to be represented at this meeting. The short term schedule takes into account the status and near-term maintenance needs of the individual experimental halls and the accelerator. Refinements to the short term schedule can be made by the Program Deputy at any time as dictated by changing requirements. Changes to the short term schedule must be communicated to the Hall Run Coordinators and announced at the Daily Summary Meeting (see Section 1.5 on page 1-18). Images of the white board, taken at five-minute intervals, are posted at http://accboard.acc.jlab.org/.

1.4.3 Shift-by-Shift Schedule (the *PD Shift Plan*)

The Program Deputy provides the written program for each shift, the *PD Shift Plan*, to the control room staff no later than the start of the shift. The *PD Shift Plan* must be created using the web-based *PD Shift Plan* form whenever the control room is staffed (see Appendix A on page A-1). Time accounting information entered in the Scheduled Program tables is automatically ported to BOOM (an automated time-accounting program—see Section 3.4.5.3 on page 3-31) for use in comparing actual versus scheduled accelerator performance.

The *PD Shift Plan* includes specific information concerning the scheduled program for the shift, any parallel programs that are to be performed (parasitic monitoring and testing, etc.), any important notes that the control room staff needs to be aware of, a list of beam test plans to be performed during the shift (as applicable), and a listing of approved beam test plans that can be performed as part of an alternate program (including any instructions concerning the preferred order of performance). The Standing Orders section of the *PD Shift Plan* is maintained by Operations leadership personnel (not the Program Deputy) and is used to convey important operating information that shall be reviewed each shift by the control room staff.

1.4.4 Alternate Program

An alternate program is developed when it becomes impossible to carry out the scheduled accelerator program. The alternate program generally consists of preapproved beam test plans (see Section 3.4.3.2 on page 3-24) or maintenance activities and is based on the estimated length of the down time. The alternate program shall be developed in a timely manner by the Program Deputy in consultation with Operations leadership.

1.5 CEBAF Meetings

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

- **Shift-Turnover Meeting** – This meeting takes place in the MCC Control Room between the oncoming and off-going shifts and is primarily an exchange of information (see Section 3.4.2.3 on page 3-22).
- **Program Deputy 0745 Meeting** – This meeting takes place at 0745 on regular workdays (weekends as necessary) in the conference area of the MCC Control Room. The meeting is conducted by the Program Deputy and attended by Operations leadership and the Hall Run Coordinator for each hall scheduled to receive beam. The meeting shall provide a forum for exchanging information concerning the operating schedule, accelerator performance, or any other concerns that affect the scheduled program. During scheduled accelerator shutdowns, accelerator technical staff attend this meeting and discuss maintenance progress.
- **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 activities of the previous 24 hours (or since the previous meeting) are summarized. The meeting closes with an opportunity to discuss any safety-related topic raised by any attendee.
- **Weekly Summary Meeting** – This meeting, which is conducted by the Program Deputy, takes place in the MCC conference room on Wednesdays at 1330 during periods of accelerator running. The function of the meeting is to report on the previous week of CEBAF activities and review the CEBAF Short Term Schedule (Section 1.4.2 on page 1-17) for the upcoming two weeks. Accelerator personnel and physics experiment/hall representatives present operation summaries for the preceding week. The standing agenda is as follows:
    - PD Weekly Summary and availability graphs
    - Handoff to the new Program Deputy (if applicable)
    - New Program Deputy program and goals (if applicable)
    - Present the Short Term Schedule (scheduling white board)
    - System Repair Report (Operability)
    - Geographic Integrator Reports (if applicable)
    - Hall Run Coordinator Weekly Summaries
- **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, and submitted Beam Test Plans are evaluated and a priority assigned.
- **Accelerator Maintenance Meeting** – This meeting is held as needed by the Operability Group on Mondays at1330. The meeting focuses on scheduled maintenance activities (see Section 4.2.4 on page 4-6), system performance issues, and any lessons learned from past maintenance projects and activities.

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 CEBAF accelerator. 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 CEBAF Element Database (CED) (see http://ced.acc.jlab.org/), 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 CED is critical, making appropriate application of configuration management principles of paramount importance for accelerator operations.

2.1 The CEBAF Element Database (CED)

The CED 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 CED as the single, authoritative source for operating information. With the CED as the central information repository, changes are immediately available to all tools whenever an element in the CED is updated or a new element is added. From a configuration management perspective, the CED 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 CED are as follows:

- **Model-driven Accelerator Setup** – The element definitions and design values in the CED 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 CED, replacing most hand-generated screens and ensuring that the screens always match the installed operational configuration.
- **System Readiness 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 CED.
- **Songsheet Updates** – Quarterly reports generated by the CED are used to update the accelerator songsheets (scale drawings that show the installed beamline components).

The CED 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 CED Revision Process

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

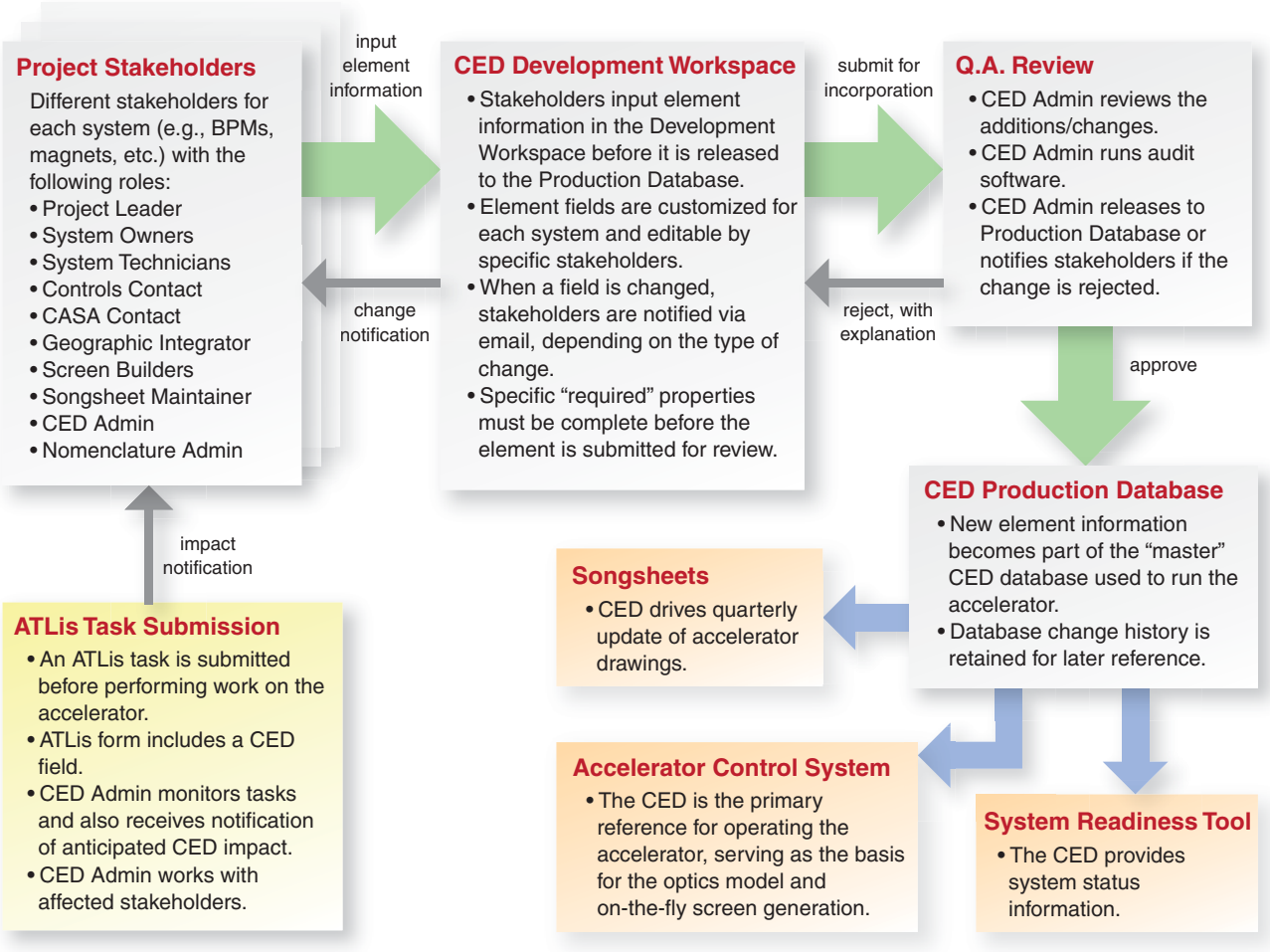


Figure 2-1: The CED Revision Process

2.1.2 Timely CED Updates

To accommodate the hot checkout process and accelerator operating requirements, CED 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 CED Administration before hot checkout begins. Populating a CED Development Workspace during the early stages of any project is a good practice that facilitates consistent nomenclature assignment and makes timely final approval/incorporation much easier.

2.1.3 Project Stakeholders

Elements in the CED 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 CED element has a set of associated fields, and each field has assigned write privileges, so that stakeholders can contribute their portion of the information. The Nomenclature Administrator has the final say with regard to element names. Others may contribute information, depending on the type of system and element. A CED Administrator helps facilitate the process and maintain CED standards.

An important by-product of the CED 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 CED Process

The ATLis work-planning tool (see Section 4.2.3 on page 4-6) provides a mechanism to help identify potential CED implications associated with planned work. The ATLis form includes a checkbox to indicate that the work will impact the information in the CED. If so, the CED Administrator is informed via email and works with the appropriate stakeholders to make sure that consistency between the installed equipment and the CED is maintained.

2.1.5 The CED Development Workspace

System Stakeholders prepare updates or new elements in a development workspace; they do not directly edit the CED 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 can be 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 CED Administrator (see Section 2.1.6 on page 2-3).

2.1.6 CED Quality Assurance Review

Before changes are merged from the development workspace into the production database, a CED Administrator reviews the proposed changes to verify that they

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

2.1.7 The CED Production Database

The production version of the CED database is the official repository for CEBAF element information, storing the present accelerator configuration and serving as the primary reference for the software tools that operate the CEBAF accelerator. This includes element nomenclature designations, where the CED 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 maintains consistency between the installed equipment and the information contained in the CED. 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 CED 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 Accelerator Operations

Accelerator operations refers to the activities associated with operating the CEBAF accelerator in order to carry out the scheduled program. CEBAF operations are conducted in or directed from the MCC by qualified staff as described in this chapter. During beam delivery to the experimental halls, there is close coordination between the MCC Control Room staff and the personnel staffing the respective experimental hall control rooms. Operations in the experimental hall control rooms are not covered by this document.

This chapter describes the roles and responsibilities of the control room staff and others involved with program execution, provides protocol for critical event response, and lists directives that govern specific aspects of the conduct of operations. A separate document, the *MCC Operations Manual* (see http://opsntsrv.acc.jlab.org/ops_docs/MCC_web_interface/interface_pages/administrative_docs.asp), establishes control room protocols that apply specifically to MCC Operations staff.

3.1 Personnel and Responsibilities

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

3.1.1 MCC Personnel and Responsibilities

The control room staff are those trained as Crew Chiefs, accelerator 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 accelerator 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 MCC Control Room staffing requirements for normal operations are described in Section 3.4.2.1 on page 3-20. The MCC Operations Group Leader posts a list of qualified Crew Chiefs, accelerator operators, ARMs, and SSOs on the MCC Information Bulletin Board.

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 3.1.1.8 on page 3-13).

Support staff for operations includes an MCC Documentation Coordinator, who is responsible for maintaining documentation that is used by the control room staff for accelerator operations, maintenance, and troubleshooting (see Section 3.1.1.10 on page 3-14).

3.1.1.1 Crew Chief

NOTE: Unless otherwise specified, the term Crew Chief is used throughout this document to refer to the *on-duty* Crew Chief. Separate sections specify the responsibilities of the Crew Chief On-Call (see Section 3.1.1.2 on page 3-5) and the Crew Chief In-Training (see Section 3.1.1.3 on page 3-6).

The Crew Chief has immediate responsibility for the safe and efficient operation of the CEBAF accelerator and its subsystems. This includes immediate oversight of program execution, control room staff, and all control room activities, including the delivery of high quality beam to carry out the experimental nuclear physics program as well as other accelerator studies and system commissioning plans. The Crew Chief must ensure that the accelerator is operated in compliance with the *Accelerator Safety Envelope* (ASE) and other applicable JLab policies/procedures (including this document) and is responsible for understanding all workplace hazards, safety procedures, and the rules and requirements governing day-to-day accelerator operations.

The Crew Chief must be technically competent in the area of electron beam transport dynamics and understand the operational aspects of all systems associated with the CEBAF accelerator, including the Personnel Safety System (PSS), the electron source, RF, magnets, beam diagnostics, control system software, vacuum, beam dumps, CHL, and supporting infrastructure.

The Crew Chief's responsibilities include safety, program coordination, supervision, control room staff training, and the record-keeping activities associated with these responsibilities (see Section 3.4.5 on page 3-29). The oncoming Crew Chief assumes responsibility for control room activities immediately after the Crew Chief shift turn-over meeting (see Section 3.4.2.3 on page 3-22). A summary of the Crew Chief's responsibilities follows:

Safety:

- Coordinate the response 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 Section 3.3, Critical Event Response, on page 3-15.
- Be aware of the operational state of all accelerator systems within the accelerator site at all times. This includes knowing the operational status of the LERF.
- Know the intended delivery points for all CEBAF beams and the approximate average beam currents and beam energies.
- Verify, before running beam to any accelerator segment, that a current *Beam Operations Authorization* entry (see Section 1.2 on page 1-10) has been made in the *ELog*, permitting beam delivery to that segment.

- Ensure that the operational and safety envelopes for the CEBAF accelerator, as specified in the *Operational Restrictions* (see Section 3.4.5.6 on page 3-31) and the *Accelerator Safety Envelope,* are not exceeded.
- Lower the PSS state to the appropriate level if minimum staffing levels cannot be met as defined in Section 3.4.2.1 on page 3-20. If the reduction in staffing can be anticipated, the PSS state should be lowered before the reduction occurs.
- Understand and coordinate an appropriate response to all PSS and Machine Protection System (MPS) faults.
- Control or directly supervise the operation of devices that interface to the PSS such as gun high-voltage controls, beam stoppers, RF systems, and magnet box supplies (see Section 3.1.1.5 on page 3-9).
- Verify that, before leaving the accelerator in the DOWN state (see Section 3.4.2.1 on page 3-20) and the control room unstaffed, the PSS state for all areas of the CEBAF accelerator and experimental halls (with the permission of the appropriate hall shift leader) is changed to Restricted Access.
- Verify that, before the MCC Control Room is left unattended, the status of the LERF meets at least one of the following criteria:
  - the LERF PSS state is Restricted Access, *or*
  - the LERF staffing levels meet the minimum documented requirements.
- Ensure that FSD masking is properly configured to protect accelerator and experiment-specific components.
- Ensure that accelerator operations are conducted in accordance with all current information in the *ELog* (see Section 3.4.5.1 on page 3-30), *PD Shift Plan* (see Section 1.4.3 on page 1-17), and *PSS Log* (see Section 3.4.5.7 on page 3-31).
- Read and understand all approved accelerator-specific OSPs and TOSPs, and be familiar with all items posted on the MCC Information Bulletin Board (e.g., Occurrence Reports, shift schedules, important memos, etc.).
- Assign ARM and SSO responsibilities. The Crew Chief must not serve as an ARM.
- Review and sign off on radiation surveys performed and verify that these surveys meet the established Radiation Control Department (RCD) standards.
- Allow appropriate access to keys in the Keywatcher System (see Section 3.4.4.8 on page 3-28).
- Act as PSS Test Director during PSS certifications as assigned by the MCC Operations Group Leader.

Program coordination:

- Coordinate the activities of all control room staff, including on-duty operators and others who are operating accelerator controls (see Section 3.1.1 on page 3-1).
- Understand all responsibilities specified in this document, the *Accelerator Operations Directives,* and in the *MCC Operations Manual* (see http://opsntsrv.acc.jlab.org/ops_docs/MCC_web_interface/interface_pages/

administrative_docs.asp), a separate document that establishes control room protocol.

- Understand the information in the *PD Shift Plan* (see Section 1.4.3 on page 1-17) and the *ELogs* (see Section 3.4.5.1 on page 3-30). These must be read before the start of the shift. If a *PD Shift Plan* is not available, the Program Deputy must be contacted for verbal instructions until a shift plan is posted.
- Read all 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 experiment-specific binders (see Section 3.1.1.9 on page 3-13) before the start of each new experiment or when new information is added to the binders.
- Complete all information fields in the *Crew Chief Stamp* and, after completing the Crew Chief shift turn-over meeting (see Section 3.4.2.3 on page 3-22), stamp in as Crew Chief at the beginning of each on-duty shift.
- Carry out the program defined by the *PD Shift Plan*.
- Notify the Program Deputy when the primary accelerator program cannot be carried out and the anticipated interruption is longer than one hour (see Appendix E on page E-1).
- Execute the designated alternate program(s) to make effective use of the facility when it becomes impossible to carry out the scheduled accelerator program.
- Follow the repair escalation process defined in Section 4.2.5.2 on page 4-8.
- Assist with the coordination and prioritization of immediate maintenance activities by maintenance crews (see Section 4.2.5 on page 4-8). This includes reviewing and approving ATLis tasks (see Section 4.2.3 on page 4-6) that address immediate maintenance, if those tasks have not already been reviewed and approved through the normal process.
- Close any Operations Problem Reports (OPS-PRs; see Section 3.4.5.4 on page 3-31) completed during the shift.
- Complete all sections of the *Crew Chief Shift Log* (see Appendix C on page C-1) and post it to the *ELog*. This includes noting the major reasons for no beam during a shift (assuming beam delivery was scheduled), recording the amount of down time associated with each event, and noting any problems that require attention.
- Inform the users (those scheduled to receive beam) when beam cannot be delivered according to the scheduled program per the guidelines in Section 3.4.6 on page 3-32. This notification shall include an estimate of the length of the down time.
- 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 Procedure Markups bin in the control room, along with contact information (see Section 3.4.3 on page 3-24).
- Dismiss anyone from the control room who is being disruptive or interfering with scheduled operations (see Section 3.4.2.4 on page 3-23).
- Be responsible for accurate end-of-shift time accounting numbers in the beam time accounting database (see Section 3.4.5.3 on page 3-31) and the final version of the *Crew Chief Shift Log*. This includes conferring with the

experiment hall shift leaders concerning any time accounting discrepancies for the shift and hand editing the database, if in error.

- Pass Crew Chief responsibility to an oncoming Crew Chief or Crew Chief On-Call. If no oncoming Crew Chief or Crew Chief On-Call is available, continue to serve as the Crew Chief until relieved or other arrangements are made with the MCC Operations Group Leader.
- Serve as Crew Chief On-Call during all scheduled, unscheduled, or short-notice accelerator shutdown periods if serving as the Crew Chief during the final shift before the shutdown, unless other arrangements are made or until relieved by another Crew Chief.

Supervision and training:

- Remain in the control room, except for brief periods for activities such as field troubleshooting and emergency response. When away from the control room, the Crew Chief must carry the Crew Chief cellular phone or an MCC handheld radio to maintain contact with the on-duty crew. The Crew Chief must not leave the accelerator site.
- Supervise the on-duty operators.
- Coordinate operator task assignments for the on-duty shift.
- Ensure that accurate shift records are kept (see Section 3.4.5 on page 3-29).
- Ensure that the operator and Crew Chief shift-turnover meetings occur promptly and are properly conducted (see Section 3.4.2.3 on page 3-22).
- Provide feedback to the MCC Operations Group Leader concerning operator performance.
- Participate in the annual performance assessment process for operators as specified by the MCC Operations Group Leader.
- Coordinate the on-duty training and qualification of operators and Crew Chiefs In-Training (see Section 3.1.1.3 on page 3-6) as directed by the MCC Operations Group Leader.
- Oversee the stamped-in Crew Chief In-Training (see Section 3.1.1.3 on page 3-6), and as time permits, assist with operating the accelerator.

3.1.1.2 Crew Chief On-Call

When the MCC Control Room is 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. In the event of an unscheduled or short-notice accelerator shutdown, the Crew Chief assumes the responsibility of the Crew Chief On-Call until relieved by another Crew Chief. A summary of Crew Chief On-Call responsibilities is as follows:

- Carry the Crew Chief cell phone at all times and respond to all calls.
- Staff—or arrange the required staffing for—the control room to support the program requirements.
- Remain within a 50-mile radius of JLab.
- Stamp in as Crew Chief at the beginning of the on-duty period and make an *ELog* entry that provides appropriate contact information.

- Coordinate the response to incidents that occur within the accelerator site and respond as specified in the *ES&H Manual, Operational Safety Procedures* (OSPs), *Temporary Operational Safety Procedures* (TOSPs), and *Emergency Procedures.* Respond in person (i.e., come to JLab) for safety-related events and critical hardware/software failures within the accelerator site boundary. Non-emergency events such as equipment outages or requests for support may be coordinated by phone.
- Notify the Operability Manager in the event of a critical accelerator equipment failure or power outage.
- Print copies of Accelerator Systems On-Call lists and Operations Staff Phone list and keep them available for quick reference.
- Contact the MCC Operations Group Leader if Crew Chief On-Call responsibilities cannot be fulfilled because of illness, a family emergency, or other circumstances. The MCC Operations Group Leader will arrange for replacement Crew Chief On-Call coverage.
- Contact the MCC Operations Group Leader and the Accelerator-Site Security Guard if the Crew Chief On-Call coverage is transferred to another qualified Crew Chief outside of the published on-line schedule.
- Document on-call activities in the *ELog.* Log entries shall be made as soon as is practical.
- Attend the scheduled Daily Summary Meetings and the Weekly Summary Meeting.
- Provide control room support—or arrange support for—activities such as tunnel sweeps, test plans, equipment repair, or equipment checkout.
- Know the scheduled CEBAF and LERF operations programs and the present PSS status for CEBAF and the LERF.
- Ensure that the Crew Chief cell phone is passed directly to the next scheduled Crew Chief On-Call so that these devices are never unattended.
- Return the Crew Chief cell phone to the on-duty Crew Chief no later than 0800 on the day that accelerator operations are scheduled to resume.

3.1.1.3 Crew Chief In-Training

As part of qualifying as a Crew Chief, a qualified accelerator operator must serve as a Crew Chief In-Training for a period of time to be determined by the MCC Operations Group Leader. Under the guidance of the On-Duty Crew Chief, the Crew Chief In-Training gains valuable hands-on experience performing the Crew Chief duties described in Section 3.1.1.1 on page 3-2. Throughout the training period, the job performance of the Crew Chief In-Training is evaluated by Operations leadership and Crew Chiefs. The On-Duty Crew Chief can, at any time during a shift, assume full Crew Chief responsibilities and request that the Crew Chief In-Training resume operator responsibilities. Crew Chief In-Training responsibilities are as follows:

- Receive authorization from the MCC Operations Group Leader to serve as a Crew Chief In-Training.
- Receive approval from the On-Duty Crew Chief before stamping in as the Crew Chief In-Training.
- Determine, in consultation with the On-Duty Crew Chief, the specific shifts that the Crew Chief In-Training will stamp in. This determination is at the

discretion of the On-Duty Crew Chief and must be made no later than the day before the shift is to occur.

- Under the guidance of the On-Duty Crew Chief, perform all Crew Chief duties as described in Section 3.1.1.1 on page 3-2. These duties are to include all delegation and coordination responsibilities.
- Keep the On-Duty Crew Chief informed of all actions that affect accelerator operation and shift activities.
- Relinquish Crew Chief responsibilities at any time as requested by the On-Duty Crew Chief, and resume the responsibilities of an accelerator operator (see Section 3.1.1.4 on page 3-7).

3.1.1.4 Accelerator Operators

NOTE: Unless otherwise specified, the term operator is used throughout this document to refer to the *on-duty* operators. A qualified Crew Chief signed in as an operator assumes the operator role and all operator responsibilities.

The accelerator operators control and monitor the accelerator systems to deliver the beams required for the scheduled and alternate accelerator programs. On-duty accelerator operators are supervised and directed by the Crew Chief. The Crew Chief can assign on-duty accelerator operators to assist other staff as needed. The oncoming operators assume on-duty responsibility immediately after the shift turn-over meeting (see Section 3.4.2.3 on page 3-22). A summary of 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 Section 3.3, Critical Event Response, on page 3-15.
- Read and understand all approved accelerator-specific OSPs and TOSPs, and be familiar with all items posted on the MCC Information Bulletin Board (e.g., Occurrence Reports, shift schedules, important memos, etc.).
- Know the intended delivery points for all beams and the approximate average beam currents and beam energies.
- Ensure that the operational and safety envelopes for the CEBAF accelerator, as specified in the *Operational Restrictions* (see Section 3.4.5.6 on page 3-31) and the *Accelerator Safety Envelope,* are not exceeded.
- Understand and respond appropriately to all PSS and MPS faults.
- Before beam operation, search and secure all required PSS segments using the steps specified in the *PSS Sweep Procedure* and *Service Building Sweep Procedure* (see http://opsntsrv.acc.jlab.org/ops_docs/MCC_web_interface/interface_pages/operating_procedures.asp).
- Place the PSS in an appropriate state if minimum staffing levels cannot be met as defined in Section 3.4.2.1 on page 3-20.

Program Execution:

- Understand all responsibilities specified in this document, the *Accelerator Operations Directives,* and in the *MCC Operations Manual* (see http://opsntsrv.acc.jlab.org/ops_docs/MCC_web_interface/interface_pages/administrative_docs.asp), a separate document that establishes control room protocol.
- Remain in the control room, except for brief periods for activities such as field troubleshooting and emergency response or as otherwise authorized by the Crew Chief. Operators must not leave the accelerator site as defined in Section 3.4.2.1 on page 3-20. Before leaving the control room, operators must have Crew Chief approval and, if the tasks they are performing are important to the accelerator program, delegate those tasks to another operator or the Crew Chief. When away from the MCC, operators must carry a cell phone or MCC handheld radio so that they can be contacted from the control room.
- Read and understand the information in the *PD Shift Plan* (see Section 1.4.3 on page 1-17) and the *ELog* (see Section 3.4.5.1 on page 3-30). These must have been read before the start of the shift.
- Read and understand the experiment-specific binders (see Section 3.1.1.9 on page 3-13) before the start of each new experiment or when new information is added to the binders.
- Read all 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 *Operator Stamp* and, after completing the shift turn-over meeting (see Section 3.4.2.3 on page 3-22), stamp in as an operator at the beginning of each on-duty shift.
- 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 beam parameters according to approved procedures to optimize performance.
- Immediately notify the Crew Chief of changes and events that occur during operations. Examples of events that must be communicated are as follows:
  - Changes in operating conditions (e.g., beam current, beam energy, target changes, raster changes, FSD masking)
  - Transitions from tune-mode to CW beam operation
  - Requests for PSS state changes
  - Equipment failures or off-normal events
  - Recurring beam trips
  - Emergencies
  - Non-routine communications with non-MCC personnel
- Respond to beam-user requests for changes to beam specifications.
- Coordinate with the Crew Chief to keep beam users informed during program interruptions per the guidelines established in Section 3.4.6 on page 3-32.
- Coordinate with the Crew Chief to follow the repair escalation process defined in Section 4.2.5.2 on page 4-8.

- Conduct and participate in operator shift-turnover meetings (see Section 3.4.2.3 on page 3-22).
- Make downtime entries and initiate OPS-PRs as appropriate (see Section 3.4.5 on page 3-29).
- 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 Procedure Markups bin in the control room, along with contact information (see Section 3.4.3 on page 3-24).
- Perform record-keeping duties (see Section 3.4.5 on page 3-29).
- Serve as a mentor to new operators and support the Crew Chief in performing his/her mentor duties. This responsibility may require working with the Crew Chief to ensure that new operators are given sufficient opportunity to transport beam.
- If qualified and authorized, perform repair procedures when necessary and work with repair personnel as assigned to gain insight into system operation and repair.

3.1.1.5 Safety System Operators (SSOs)

CEBAF 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. Accelerator operators and Crew Chiefs 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. This section describes general and CEBAF-specific SSO duties.

Whenever one or more PSS segments are in a PSS state higher than Restricted Access, a Designated SSO must be on shift. The Designated SSO retains primary responsibility for PSS operation throughout the shift; however, other SSOs may operate the PSS console as needed. All PSS state changes must have Crew Chief approval.

At the beginning of the shift, the Designated SSO receives a PSS status passdown from the outgoing Designated SSO, and at the end of the shift, provides passdown to the next Designated SSO. The passdown must include the details of any ongoing access, including the area of the access, the reason for the access, and any special radiological considerations.

An SSO must monitor all controlled accesses, including all personnel entering and exiting the beam enclosures. An SSO's responsibility for an access ends when everyone has exited the access area *or* when responsibility for monitoring the access is transferred to another SSO.

To qualify as an SSO, a candidate must pass a written and practical test that demonstrates the candidate's ability to operate the safety system console and associated systems and perform sweeps of the various tunnel segments to the satisfaction of the Safety System Group Leader. The Safety System Group Leader notifies the Operations Group Leader and updates the training database when a candidate qualifies as an SSO. SSOs must requalify every two years.

Duties and responsibilities:

- Using the Public Address System, announce that a sweep sequence is about to start and announce machine state changes. These announcements are made in accordance with the steps outlined in the *PSS Sweep Procedure* (see http://opsntsrv.acc.jlab.org/ops_docs/online_document_files/MCC_online_files/PSS_sweep_procedure.pdf).
- Monitor the safety system console during the tunnel sweep sequence.
- Operate beam stoppers associated with the PSS.
- Verify that all personnel admitted into the accelerator enclosures during a sweep or controlled access have exited the beam enclosure *and* the access room before changing the machine state to “Power Permit” or “Beam Permit”.
- Notify the Crew Chief before making a PSS state change.
- Make PSS state changes at the request of the Crew Chief to meet the scheduled program.
- Ensure that a radiation survey of any PSS segment that has received beam or has a C-100 cryomodule that has produced gradient has been completed in accordance with the *General Access RWP.* The single exception is the injector segment, which does not require a radiation survey after receiving beam if the beam energy did not exceed 10 MeV.
- Ensure that a radiation survey is completed per the *General Access RWP* before allowing entry into any PSS segment that has received beam or in which a C-100 cryomodule has produced gradient. Exceptions to this requirement are specified in the *General Access RWP.*
- Ensure that an ARM is the first person to enter the accelerator tunnel for any access requiring a radiation survey. Do not allow entry of additional personnel without notifying the ARM.
- Monitor the PSS during personnel entry and exit while in Controlled Access. Follow procedures outlined in the *PSS Controlled Access Procedure* (see http://opsntsrv.acc.jlab.org/ops_docs/online_document_files/MCC_online_files/PSS_controlled_access_proc.pdf).
- Determine the identity of all entrants during a controlled access, their intended destination, and the purpose of the access.
- Verify that individuals requesting entry to the tunnel are carrying the proper radiological badging prior to allowing entry.
- Verbally check the current oxygen deficiency hazard (ODH) training status of individuals requesting entry to the tunnel.
- Be familiar with the tunnel radiation conditions *before* allowing access to the tunnel and inform people entering the tunnel of any hot spots, contaminated areas, High Radiation Areas (HRAs), or postings in the vicinity of their work. If the area includes an HRA, entrants must be informed of its location and the SSO must verify that a radiation watch is on duty before allowing access.
- Verbally verify that individuals exiting the beam enclosure under Controlled Access are not removing any potentially radiologically activated material that has been in the beam enclosure during beam operations.

- Ensure that the conditions for special sweeps are met. Such sweeps, which can be performed only as detailed in the *PSS Sweep Procedure* (see http://opsntsrv.acc.jlab.org/ops_docs/online_document_files/MCC_online_files/PSS_sweep_procedure.pdf), allow a qualified sweep team to rearm, without a complete radiation survey, a PSS segment that has lowered to Restricted Access.
- Keep accurate records of the PSS in the *PSS Log* (see Section 3.4.5.7 on page 3-31).
- Promptly notify the Crew Chief of any emergency or abnormal situations.
- Notify the Safety System Group Leader if the SSO and the Crew Chief disagree about a PSS issue and resolve the issue before proceeding.

3.1.1.6 Assigned Radiation Monitor (ARM)

Assigned Radiation Monitors (ARMs) are specially trained operators who provide supplemental radiological control support. The specific duties and tasks that an ARM can perform are defined by the *ARM Standing Radiation Work Permit* (ASRWP) and all other applicable Radiation Work Permits (RWPs) as specified by the Radiation Control Department (RCD). In general, the primary function of an ARM is to serve as a radiological escort for Controlled Access entries into the beam enclosure. More-complex radiological control tasks are reserved for members of the RCD.

The RCD prescribes and administers ARM training as defined in the *Radiation Control Manual*, which is a supplement to the *ES&H Manual* (https://www.jlab.org/ehs/ehsmanual/RadCon/index.html). Accelerator operators and Crew Chiefs must qualify as ARMs for all areas of the CEBAF accelerator, the experiment halls, and the LERF. Training consists of a classroom (theory) portion, followed by separate “practical” training, where the ARM-in-training demonstrates familiarity with specific Radiologically Controlled areas and Radiological areas (e.g., Radiation, High Radiation, and Contamination areas within the CEBAF accelerator, individual experiment halls, service buildings, and the LERF).

One ARM-trained operator on each shift is designated as the ARM for that shift. The ARM does not necessarily have to be an operator on shift but must be available to perform ARM duties. The Crew Chief must not serve as the ARM but can use discretion regarding how to deploy available ARM-trained operators.

Accelerator operators performing radiological control tasks 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 RCD during assigned ARM-related tasks but remains under the direction of the Crew Chief and is still considered an accelerator operator. Any problems or concerns the ARM identifies shall be referred to the RCD for resolution. At the completion of the task, the ARM reports the results to the Crew Chief and resumes previous responsibilities.

When an ARM task carries through a Crew Chief shift change, the Crew Chief informs the oncoming Crew Chief. If an ARM task carries through the operator shift change (which occurs one hour after the Crew Chief shift change), the oncoming ARM can relieve the outgoing ARM but only after they discuss the task details.

The following is a general list of ARM responsibilities and examples of tasks reserved for RCD personnel. Additional detail is provided in the ASRWP and other applicable RWPs, and when in conflict, the ASRWP and other relevant RWPs supersede this document. Questions about any radiological control task should be referred to the Radiation Control Field Operations Coordinator (876-1743).

ARM responsibilities:

- Read, understand, and sign the ASRWP and other applicable RWPs as specified by the RCD.
- During Controlled Access entries to the accelerator enclosure, escort personnel to the job location and remain with the escorted personnel until their work is complete or until relieved by another ARM or member of the RCD. This responsibility includes performing a radiation survey to verify safe radiological conditions along the access route and at the site of the planned work.
- At the direction of the Crew Chief, acknowledge alarms on Controlled Area Radiation Monitors (CARMs) and make appropriate logbook entries.
- Notify the RCD if a CARM alarms more than once per shift.
- Upon request of the Crew Chief, investigate the cause of safety system interlock trips caused by CARMs. This generally means taking radiation measurements and comparing the results with CARM data to determine if the conditions causing the CARM interlock trip are still present.
- Monitor workplace activity for adherence to radiation safety requirements.
- Stop work activities that do not conform to approved procedures or do not conform to good work practice.
- Be observant of the proper use of dosimetry when in a radiological area, and correct any misuse.
- Perform source checks of MCC Control Room radiation survey equipment, and document the results in the *Source Check Logbook* (see Section 3.4.5.9 on page 3-32).

ARMs must not:

- Be a part of a work crew for any activity they monitor.
- Serve as a radiological escort into any controlled area for which they have not been approved by the RCD.
- Approve the release of water or air from potentially activated systems.
- Relocate Radiation Boundary Monitors (RBMs), CARMs or CARM probes, reset CARM trip levels, take failed CARMs or RBMs out of service, or modify CARMs or RBMs in any way.
- Evaluate sample analysis results, dosimetry results, or RBM data to determine compliance with state or federal (legal) requirements.
- Release activated material from Radiologically Controlled Areas (RCAs).
- Release any potentially activated item for unrestricted use.
- Approve shielding design or verify conformance to the design.

ARMS may, *when specifically authorized and directed by a qualified Radiological Control Technician AND with the concurrence of the Crew Chief*:

- Post or modify a radiological area or boundary.
- Perform radiation surveys for unescorted entry.

3.1.1.7 Non-MCC Control Room Staff

Occasionally, accelerator physicists, engineers, experimenters, accelerator operators in-training, and others operate the accelerator controls to commission new hardware or software, diagnose problems, or perform experiments. 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. Anyone working at the operator consoles in the MCC must have the approval of the Crew Chief (see Section 3.1.1.4 on page 3-7) and, if making control system changes that will affect beam, meet the criteria outlined in Section 3.4.1.3 on page 3-19.

3.1.1.8 Accelerator-Site Security Guard

When performing specific duties that are related to accelerator operations (see Section 3.4.2.1 on page 3-20), the Accelerator-Site Security Guard staffing the entry-gate guard post is considered to be an MCC 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 entering the accelerator site.
- Ensure that anyone entering the accelerator site has the appropriate authorization and training or is accompanied by a trained escort.

3.1.1.9 Operations Hall Liaisons

Each physics hall has an accelerator operator or Crew Chief assigned as an Operations Hall Liaison. The Operations Hall Liaison helps to facilitate information exchange between the experimenters and the MCC Operations Group, both in advance of and during actual experiments. Since each experiment generally has unique operating requirements and associated personnel who are not familiar with normal operating procedures, the Operations Hall Liaison serves as a valuable link to help identify potential problems before they occur and educate both the experimenter and fellow operators. To simplify the information exchange process, standard forms have been developed as tools to be used when gathering the information. These forms are collected for each experiment and placed in the applicable experiment binder.

The experiment binders (one for each hall) are located in the MCC Control Room and include a specific section for each upcoming experiment as well as applicable ES&H information. The Operations Hall Liaison is responsible for adding the completed *Physics/MCC Experiment Planner Form*, the *Operations Hall Liaison Check List,* and any other important experiment-specific information to the binder,

prior to the start of the experiment. All operators and Crew Chiefs shall familiarize themselves with this information before the start of an experiment.

3.1.1.10 MCC Documentation Coordinator

The MCC Documentation Coordinator works with system experts to develop appropriate accelerator operating and troubleshooting procedures for use in the MCC Control Room. The MCC Documentation Coordinator maintains these documents in an on-line document delivery system and coordinates the inclusion 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 in the MCC Control Room (see Section 3.4.3.1 on page 3-24).
- 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 procedures, troubleshooting procedures.
- Meets with the oncoming Program Deputy during the week preceding the new Program Deputy's tenure to brief the Program Deputy on the use of the appropriate information tools. Also maintains the PD Help File, a compilation of useful PD-specific information.

3.2 Training

Crew Chiefs and 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.

New operators are assigned an on-shift mentor—someone with significant operating experience who helps guide them through the process of becoming a competent operator. Each new operator must successfully pass a structured training curriculum to become a qualified operator.

Before becoming a Crew Chief, a candidate must first serve as a Crew Chief In-Training (see Section 3.1.1.3 on page 3-6) for a period of time as determined by the MCC Operations Group Leader. Each Crew Chief In-Training is assigned an experienced Crew Chief as a mentor. The training includes supervised on-shift performance of Crew Chief responsibilities and demonstrated competence of key accelerator operating concepts.

Training tools for operators and Crew Chiefs include the following.

- Self-paced, on-line training
- On-the-job training
- Mentoring for new operators and Crew Chiefs In-Training.
- Formal classroom training conducted by system experts during off-shift time (on-line videos of past presentations are generally available)
- Lessons-learned and information presented during group meetings
- Simulators

- Operating procedures, troubleshooting guides, and other controlled documentation
- Outside (non-JLab) courses

The MCC Operations Group Leader determines who is a qualified MCC operator or Crew Chief and can suspend or terminate such qualifications at his/her discretion. The MCC Operations Group Leader maintains a list of qualified and authorized MCC operators and Crew Chiefs and 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.

3.3 Critical Event Response

On-duty MCC Control Room staff 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 also 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 this document.

3.3.1 Safety Envelope Violations

The ASE (see Section 1.1.2 on page 1-3) specifies the Safety Envelope, a set of physical and administrative conditions within which CEBAF and its experiments must operate (see Section 1.1.3.1 on page 1-5). The Safety Envelope establishes engineered and administrative controls, including limits for CEBAF operations staffing, experiment hall 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 EH&S Reporting Officer, the Director of Accelerator Operations, the Program Deputy, 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.

3.3.2 Operations Envelope and Operational Restriction Violations

The Operations Envelope provides administrative assurance that the Safety Envelope for these controls is not exceeded (see Section 1.1.3.1 on page 1-5). 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 energy and beam current maximums, beam dump

power limitations, experiment target limits, and target and beam dump raster sizes (see Section 3.4.5.6 on page 3-31). 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 Program Deputy, 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.

3.3.3 Personnel Safety System (PSS) Malfunctions

The PSS is designed to protect personnel during accelerator operations, relying on administrative, hardware, and software controls. 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 1.1.2.1 on page 1-4) must be followed.

If the Safety System Group Leader determines that the PSS did not function correctly, the occurrence reporting process described in Section 3.3.1 on page 3-15 shall be followed.

3.3.4 Beam Envelope Limit System (BELS) Malfunctions

The Beam Envelope Limit System (BELS) is designed to ensure that the CEBAF accelerator does not exceed its operations and safety beam power envelopes. This system measures the beam energy and current for each endstation and the beam switchyard, combines the results, and alerts the control room staff well in advance of any shutdown action. If necessary, however, the BELS has the ability to turn off beam before the operations limit is exceeded.

If, during accelerator operations, a malfunction of the BELS system is perceived, beam delivery to the affected segment shall cease immediately, and the Crew Chief shall report the perceived malfunction to the Safety System Group Leader for resolution. Beam operations shall not resume until direct approval is given to the Crew Chief by the Director of Accelerator Operations.

3.3.5 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 target motion, 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 accelerator in less than 100 µs. MPS subsystems include beam loss monitors (BLMs), the beam loss accounting (BLA) system, 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 Crew Chief shall report the observed or perceived malfunction to the Safety System Group on-call contact for resolution. Beam operations can resume after the system is repaired and verified as operational by the Crew Chief or with the approval of the Director of Accelerator Operations.

3.3.6 Beam-Strike Events

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

- An acute loss of beamline vacuum caused by beam strike. Vacuum loss is considered to be acute whenever supplemental vacuum pumping equipment is required to restore beamline vacuum.
- A radiation level detected during a beamline survey exceeds 1.0 R/hour on contact, except downstream of physics targets, at beam dumplettes, or when associated with beamline components activated by cryomodule field emission.
- Physical damage to beamline components has been caused by beam strike. This includes physical damage to components such as beam pipe, beam dumps, magnets, BPMs, targets, and insertable devices like harps and viewers. Radiation damage to components such as viewer cameras or IOCs is not considered to be caused by beam strike.

If a beam-strike event occurs, the beam shall immediately be turned off (if not already off) and the appropriate staff notified. This includes the Program Deputy, system maintenance personnel, and all 4-hour escalation contacts (see Section 4.2.8 on page 4-12). The control room staff 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 MCC Crew Chief by the Director of Accelerator Operations.

The Repair Assessment Committee (RAC) shall investigate all beam-strike events and prepare and distribute a written report as described in Section 4.2.5.2 on page 4-8.

3.3.7 Emergency Response

Crew Chiefs and operators are first responders for a variety of emergency situations within the accelerator site safety fence and play a critical role in emergency communication and coordination. When responding to emergencies on the accelerator site, the Crew Chief directs the response, either personally assuming the role of Internal Incident Commander (IIC) or assigning an operator to serve in that capacity. The IIC remains in charge at the site of the emergency until the emergency concludes or an external agency's Incident Commander (IC) arrives on site. The IC assumes overall control of the incident, and the IIC remains on the scene and assists the IC until the event concludes or until relieved by another Crew Chief or operator or by a member of the Emergency Management Team.

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
- Flood
- Injury
- ODH alarm
- Power outage
- Radiation event
- Spill
- Tornado
- Weather emergency

3.4 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 CEBAF accelerator.

3.4.1 Control System Interaction

The accelerator 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.

3.4.1.1 Accelerator Control System Access

Authorization to manipulate CEBAF accelerator system process variables is controlled by the Crew Chief through the use of the channel access security protocol. The control room staff can open 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. 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 3.4.1.3 on page 3-19); however, upon request, the Crew Chief can use discretion to temporarily grant channel access to others so long as the activity will not affect ongoing beam transport. Such changes can be made from the field but only with Crew Chief permission.

3.4.1.2 Crew Chief and Operator Control System Interaction

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

- Complete and pass the required training for Crew Chiefs and 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 operators.

- Be physically present in the MCC 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 Crew Chief before changing any accelerator system process variable during beam operations.

3.4.1.3 Control System Interaction Affecting Beam Transport by Others

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

- 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 channel access for areas where beam is being transported.
- Have explained to the Crew Chief, in advance, the anticipated changes and been given Crew Chief approval. The Crew Chief will open channel access as appropriate for the task.
- Be physically present in the MCC Control Room and working from an accelerator computer console when making control system changes.

3.4.2 Shift Protocol

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

3.4.2.1 Staffing Requirements for Operations

The *JLab Accelerator Safety Envelope* (ASE) defines the Safety Envelope for CEBAF 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 CEBAF are defined here, in this document. Figure 3-1, below, illustrates the Beam-On destinations and the associated staffing requirements as defined in Table 3-1, also below.

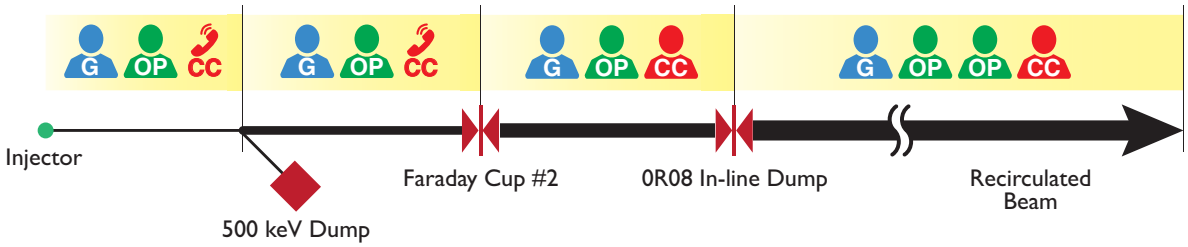


Figure 3-1: Beam-On Destinations with Associated Staffing

Table 3-1: Minimum Staffing Requirements for CEBAF Operations

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

				Beam On			
		Accel. Off	Beam Off	500 keV	FC#2	0R08	Recirculated
Minimum Staffing	Security Guard	•	•	•	•	•	•
	Crew Chief On-Call	•	•	•	•		
	One Operator		•[1]	•[2]	•[2]	•[2]	
	Crew Chief (on-site)					•[2]	•[3]
	Two Operators						•[3]
PSS State	Injector	Restricted	≤Power Permit	Beam Permit	Beam Permit	Beam Permit	Beam Permit
	North Linac	Restricted	Any	≤Power Permit	Beam Permit	Beam Permit	Beam Permit
	S. Linac, BSY, Any Hall	Restricted	Any	Any	Any	Any	Any
Devices	FC#2		Locked In[4]	Locked In[4]	Locked In[4]		
	0R08 In-line Dump					Locked In[4]	

[1] Either the operator or the Crew Chief On-call must be on the accelerator site.
[2] Either the Crew Chief or the operator must be in the MCC.
[3] Either the Crew Chief or *an* operator must be in the MCC.
[4] Inserted into beamline, verified, and configuration managed (i.e., locked in place).

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

- 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 3.1.1.8 on page 3-13). This definition is expanded to include the TEDF building if an 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 CEBAF accelerator is operated solely from the MCC Control Room.
- Most accelerator operators and Crew Chiefs are qualified SSOs (see Section 3.1.1.5 on page 3-9).
- A qualified SSO must be in the MCC whenever
  - The injector PSS segment is in Beam Permit,
  - Any PSS segment is in Sweep Mode,
  - Any PSS segment is in Sweep Complete Mode, or
  - Any PSS segment is in Controlled Access.
- Most accelerator operators are trained as ARMs and can provide ARM coverage (see Section 3.1.1.6 on page 3-11). While serving as an ARM, the operator is still under the direction of the Crew Chief and, for staffing purposes, is still considered to be an operator.
- Crew Chiefs are also qualified accelerator operators.
- When two Crew Chiefs are assigned to work a shift, one of the Crew Chiefs shall assume the responsibilities of an operator and adhere to the operator shift schedule. The shift schedule (see Section 3.4.2.2 on page 3-22) designates who will serve as the acting Crew Chief.
- Exceptions to any of the staffing requirements specified in Table 3-1 on page 3-20 require authorization from the Director of Accelerator Operations.
- Whenever the Crew Chief leaves the MCC, they must carry the Crew Chief cellular phone or an MCC handheld radio so they can be contacted by the control room (see Section 3.1.1.1 on page 3-2).
- Whenever operators leave the MCC, they must carry their cell phone or an MCC handheld radio so the control room can contact them (see Section 3.1.1.4 on page 3-7).
- Whenever the Crew Chief must leave the site, the accelerator state may need to be lowered as outlined in Table 3-1 on page 3-20.
- Accelerator operators can leave the control room with the approval of the Crew Chief. Before leaving the control room, accelerator operators must delegate the tasks they were performing to another operator or to the Crew Chief if the tasks are important to the immediate accelerator program.
- Whenever control room staff changes occur for any reason, the oncoming staff member(s) 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 an on-duty operator.

3.4.2.2 Shift Schedules

During scheduled beam delivery, the accelerator systems are typically operated 24 hours a day on a rotating-shift basis. The MCC Operations Group Leader is responsible for scheduling Crew Chief and operator shift assignments and posting the schedule on the MCC Information Bulletin Board. The MCC Operations Group Leader can change control room staffing assignments at any time as long as the staffing requirements established in Section 3.4.2.1 on page 3-20 are met.

3.4.2.3 Shift-Turnover Meetings

There are two standard shift-turnover (passdown) meetings: one for Crew Chiefs and one for operators. The shift-turnover meetings are held at the end of each shift so that the off-going control room crew can transfer information to the oncoming control room crew. Formal transfer of operator or Crew Chief responsibility takes place at the conclusion of the respective shift-turnover meeting, not when an 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.

The shift-turnover meetings are held in the control room 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 Program Deputy, 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 *ELog* to acknowledge (1) having been briefed on the accelerator program and the status of the accelerator systems and crew members, and (2) taking over the Crew Chief responsibilities from the departing crew.

Figure 3-2 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
- Beam authorization changes
- Alarm handler masking configuration and active alarms
- Any open downtime entries
- System Readiness Tool equipment downgrades or exceptions
- Ongoing hardware or software issues
- Recent OPS-PRs
- Hall(s) status
- The PSS state
- Present beam conditions and beam delivery specifications
- A quick summary of how the accelerator has been performing
- Ongoing beam quality issues
- Any ongoing beam test plans

Figure 3-2: Outline for a Typical Shift-Turnover Meeting Agenda

3.4.2.4 Control Room Conduct

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

- Crew Chief and operators performing their assigned tasks.
- Program Deputy.
- Accelerator Operations Department staff.
- Technical staff whose assistance has been requested by the control room staff or by 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.

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 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.

3.4.3 Control Room Procedures

In order to carry out the CEBAF accelerator 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

3.4.3.1 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 MCC Documentation Coordinator (see Section 3.1.1.10 on page 3-14). 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 via the MCC Documentation Index 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.
- If a procedure is found to be ineffective or in error, the operator or Crew Chief must generate an Operations Problem Report (OPS-PR) or mark up a copy of the procedure and place it in the Procedure Markups bin in the control room, along with contact information.
- When requested, Crew Chiefs and operators are responsible for reviewing and critiquing draft procedures for accuracy before the procedure is released for general use.

3.4.3.2 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. 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 (for an example, see Appendix D on page D-1).

Once submitted by the author, each beam test plan is electronically routed for review by the MCC Group Leader and the B-Team Leader (see Section 1.3.3.1 on page 1-13). The B-Team leader prioritizes the reviewed beam test plans based on their relevance to the long- and short-term accelerator programs, giving each a ranking that is used by the Program Deputy, who schedules execution of beam test plans via the *Program Deputy Shift Plan* (see Section 1.3.3.1 on page 1-13). Before a beam test plan is executed, it must be receive final approval from the Crew Chief.

Circumstances may dictate that a beam test plan be written and executed within a short time frame. To accommodate such work, the beam test plan review/approval process can be shortened to require only review/approval by the Crew Chief.

3.4.4 Control Room Equipment

Accelerator operations equipment consists of console equipment, fire alarm equipment, radiation-monitoring equipment, portable oxygen monitors, communications equipment, computer workstations, printers, a video wall, key control equipment, and U.S. Government-owned vehicles.

3.4.4.1 Equipment Calibration

Radiation monitoring equipment is maintained, tested, and calibrated by the Radiation Control Department in accordance with the *Radiological Control Manual*. Portable oxygen monitoring equipment is maintained, tested, and calibrated by Industrial Health staff in accordance with the manufacturer's instructions. Other equipment used in connection with accelerator operations to make measurements of critical beam properties and accelerator subsystem performance must be maintained and kept calibrated by system owners. Any equipment found to be out of calibration must be removed from service, an appropriate OPS-PR form submitted, and the incident noted in the *Crew Chief Shift Log*.

3.4.4.2 PSS Console Equipment

Personnel Safety System (PSS) control equipment for the accelerator, beam switchyard, experimental halls, and LERF is located in the MCC Control Room.

The PSS controls are to be operated by qualified SSOs, and Safety System Group technical staff. The PSS monitors display the accelerator PSS state and radiation monitor status.

The PSS systems include the following:

- Access controls
- Safety interlocks
- ODH monitors
- Certain radiation monitors
- Video switcher (control room)
- Video MUX controller (control room)
- Large format video displays

The Safety System Group maintains a public address system that is used to announce changes in the PSS status.

3.4.4.3 Fire Alarm Equipment

Smoke detectors, heat detectors, very early smoke detection apparatus (VESDA), and manual pull stations distributed throughout the accelerator complex can activate a fire alarm. A fire alarm status monitor is located in the PSS control console in the MCC Control Room. The fire alarm control panels for the accelerator site fire alarm system are located in the following buildings:

- MCC (Building 85), Room 105 (the equipment room, located between the control room and the conference room).
- BSY Service Building (Building 98)
- Hall D Counting House (Building 202) (inside the front entrance)
- LERF (Building 18) (inside the double doors at the front entrance).

Also located in the MCC, Room 105, are the local annunciator panels for the accelerator and end stations, the manual controls for the smoke removal system, and communications equipment for the Newport News Fire Department.

The Facilities Management Department is responsible for inspection, maintenance, and testing of the fire alarm system. Before any portion of the fire alarm system is disabled, approval from the Facilities Management Fire Protection Engineer is required in accordance with the requirements of the Jefferson Lab Fire Protection Program, notification must be placed on the alarm monitoring station of the PSS console, and the Crew Chief must be informed.

3.4.4.4 Radiation Monitoring Equipment

Radiation monitoring equipment (i.e., survey meters) is used by the ARMs and the RCD staff for radiation surveys during accelerator operations and on initial entry into the beam enclosure tunnel after shutdown of operations. The RCD stocks the MCC Control Room with one or more survey meters, the required forms, and the survey logbook. Survey meters are checked for functionality by the ARM before use. Other instruments are kept by the RCD and may be made available if their use is indicated.

The radiation monitoring system includes controlled-area radiation monitors (CARMs) located at appropriate locations throughout the beam enclosures and boundary monitors for perimeter monitoring. Monitored device status is communicated via EPICS on the Radiation Monitor Commander screen, and radiation alarms and warnings are annunciated through the Alarm Handler. A separate, audible, analog alarm annunciates radiation alarms independently from the EPICS system. Only RCD staff can change monitoring device setpoints. Operations staff (ARMs) can reset instruments under the direction of the RCD.

3.4.4.5 Oxygen Deficiency Hazard (ODH)

The *Cryogenic Safety* chapter of the Jefferson Lab *ES&H Manual* establishes policies and procedures for controlling cryogens at Jefferson Lab. Fundamental policies discussed in the chapter include: the requirement for attendance at ODH training prior to entry into an ODH area, establishment of a series of ODH areas (ODH0, ODH1, ODH2, ODH3, and ODH4) with increasing restrictions for entry based on increasing risk, installation of a fixed oxygen monitoring system, and the

availability of personal oxygen monitors. Personal oxygen monitors and five-minute escape packs are available in the MCC, CHL, and LERF control rooms.

The oxygen monitoring system status is communicated via EPICS, and ODH alarms and warnings are annunciated through the Alarm Handler. A separate, audible, analog system annunciates ODH alarms independently from EPICS. Accelerator operators are trained to monitor the ODH system, quickly identify the location of an alarming sensor, and read the indicated oxygen percentage.

3.4.4.6 Communications Equipment

The control room is the communications center for the accelerator complex. Communications equipment includes telephones, cellular telephones, the public address system, two-way radios, pagers, and texting devices.

Control Room Telephones: The control room telephones at the Crew Chief and operator consoles (extensions 7045, 7046, 7047, 7048, 7049) are reserved for the control room staff. These telephones are equipped with a caller identifier, which displays a name and telephone number for calls from offices or the location and telephone number for calls from work areas.

Extension 7050 is located at the safety system console; its use shall be limited to communications with the SSO. This telephone is also equipped with a caller identifier. This information can be used to help direct an emergency response team to the area of an emergency. Extension 7879 is also located at the safety system console and is for general use by the control room staff.

Other telephones for general use are located at the Principal Investigator console (7877, 7878), the Program Deputy console (7997), behind the equipment racks (7044), and in the computing area (5977, 5978, 5979, 5980).

Cellular Telephones: There are two cell phones associated with Operations: the Crew Chief cell phone (630-7050) and the Program Deputy cell phone (876-7997). During machine operations, the Crew Chief cell phone is left on and placed in a battery charger at the Crew Chief console. The Crew Chief must carry the cell phone when not in the control room. The Program Deputy cell phone is either kept on and carried by the Program Deputy at all times during scheduled accelerator running, or forwarded to the Program Deputy's personal phone. During non-operation periods, the Crew Chief cell phone is left on and carried by the Crew Chief On-Call at all times.

Public Address System: The public address system shall be used to announce changes in the PSS state and for urgent communications. It is not to be used in lieu of telephones, radios, and pagers, without Crew Chief authorization. The public address system can broadcast to the entire site, only the end stations and the accelerator, or only the LERF.

Operations Two-Way Radios: There are four handheld radios and a base station for use by the on-duty crew. One of these radios is dedicated for use by the Crew Chief and is stored in a charger on the Crew Chief work station. All radios transmit and receive on three channels; the channel/frequency assignments are shown in Table 3-2. It is important to note that these radios are the same as those

carried by Newport News Fire and Rescue and transmit using the same radio network.

Table 3-2: Operations Two-Way Radio Frequencies

Channel	User	User
Channel 1	JLab Security	Used and monitored by JLab Security Guards
Channel 2	Fire/Life/ Safety	JLab EH&S personnel
Channel 3	Cmd & Ctrl	MCC Operations personnel

Repeaters are installed to allow radio use above and below ground, in the tunnel and the halls.

The radios are stored in battery chargers in the control room when not in use. They can be borrowed by asking the Crew Chief.

Pagers or Texting Devices: Many Jefferson Lab employees are equipped with pagers or texting devices. The Jefferson Lab telephone listing includes pager/ device numbers for individuals. Also, individual pager numbers are listed in the Jefferson Lab computer database entitled “JList”.

Signals received above ground are rebroadcast in the tunnel, allowing messages to reach staff in the injector area, the linacs, the beam switchyard, the arcs, the LERF and Halls A, B, C, and D.

3.4.4.7 Control Room Equipment

The computer workstations, laser printer (mccx02), and other equipment in the control room are for work-related use by the control room staff and others engaged in conducting the scheduled accelerator program. The Crew Chief has the authority to restrict the use of control room equipment as needed.

Maintenance of the computer equipment is the responsibility of the Accelerator System Administration Group. The associated maintenance tasks include performing regular data back-ups, keeping records of software applications, maintaining the software documentation, acquiring and installing new software and updates, and arranging for hardware maintenance as needed. The MCC Administrative Assistant is responsible for maintaining appropriate laser printer supply inventories.

3.4.4.8 Key Control

Keywatcher System – Key control is accomplished through the Keywatcher system located in the MCC Control Room. Each key in this system is fitted with a Smartkey key ring that works in conjunction with the Keywatcher to allow access only to users with the proper access codes. The Keywatcher will record an access history for each key and user, allowing keys to be traced. It is the responsibility of the MCC Operations Group Leader to authorize new key users and keep the database up to date.

The Keywatcher system is equipped with a battery backup that should last for 24 hours in the event of a power failure. As standard procedure, however, if a power outage occurs and it is believed that the outage will be longer than 12 hours *and*

the emergency backup generator is not functional, the emergency key release procedure shall be followed by a Crew Chief (thus avoiding having the keys be inaccessible). The keys must remain in the care of a Crew Chief until power is restored and the keys can be returned to the Keywatcher.

Crew Chief Safe – The Crew Chief safe is located adjacent to the Keywatcher system in the MCC Control Room. A key, which is accessible via the Keywatcher system, is required to unlock the safe. Access to this key is limited to Crew Chiefs. The Crew Chief safe is used to control sensitive items.

3.4.4.9 U.S. Government Vehicles

There are various government vehicles on site that are available for use. The guidelines for their use are in the JLab *Administrative Manual, Section 301*. The Crew Chief controls the use of an electric cart that is reserved for use by control room staff.

3.4.5 Record Keeping

Accurate record keeping is an essential part of accelerator operations and is required for both administrative and technical reasons. Accelerator operations record-keeping utilizes a broad range of tools, including logs of specific activities (e.g., *ELog, PSS Log, Radiation Survey Log),* time accounting tools (BOOM), and problem-reporting tools (OPS-PR).

Many of these record-keeping tools are electronic and built on top of databases that facilitate data analysis, information flow, and linking of associated data. A system failure during operations, for example, would be documented using a problem report (an OPS-PR), which would appear in the *ELog* and might also be linked to other associated logbook entries. During the process of generating the OPS-PR, the operator may be presented with repair information if the failure is a common problem. The OPS-PR is automatically routed via email to the system owner and others who have asked to receive the system-specific information. As progress is made toward solving the problem, the OPS-PR status can be updated, reassigned to someone else, or even turned into an ATLis task (see Section 4.2.3 on page 4-6) if associated maintenance is required. In the future, the data can be mined to look for trends and problem solutions.

The primary tool for making log entries in the control room is JELI, a computer interface that will write to any of the logs and permits flexible entry linking and category selection. Log entries can also be made using a web-based interface.

Requests for additional record-keeping support by the control room staff shall be directed to the MCC Operations Group Leader.

The Crew Chief is responsible for on-shift record keeping. The on-duty crew members contribute to the record-keeping activities for the duration of the shift. The Crew Chief must review these records frequently to ensure that entries clearly and accurately describe shift activities.

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 and writing the correct entry nearby. Initial all corrections and indicate the time and date of the correction. Paper logbooks to be used in the event of a failure of the electronic

versions of either the *ELog* or the *PSS Log* are kept in the fireproof safe in the control room. Whenever paper logbook entries are made, the entries must be scanned into the electronic version of the log as soon as possible.

3.4.5.1 Electronic Logbook (ELog)

The *Electronic Logbook*, which is commonly referred to as the *ELog*, is an electronic sequential record of accelerator-related activities. Entries are made manually by control room staff and others associated with accelerator operations, or automatically, based on time, specific conditions, or some other type of trigger.

There are two basic types of log entries: routine and non-routine. Routine entries occur during the course of operations, tend to follow a standard format, and convey routine information.

Typical routine log entries during operations include the following:

- Crew Chief Sign In (the Crew Chief Stamp)
- Operator Sign In (the Operator Stamp)
- Control Room Staff Changes
- Calls for Expert Help
- Downtime Entries (using the Downtime Manager)
- OPS-PRs
- Crew Chief Shift Summaries
- Time Accounting Summaries
- Program Deputy Summaries

Non-routine log entries describe specific events as they unfold. During operations, the control room staff has primary responsibility for making non-routine entries to serve as a complete record of events. Each entry must provide sufficient detail to describe the event or link to other entries that provide such detail. Log entries should include the following details.

- Who – the names of specific individuals or groups involved if such information is important to understanding the event.
- What – a description of what happened. Links to other log entries should be provided as necessary.
- Where – the location of the event or the accelerator system(s) affected.
- When – the time stamp on the entry may not be sufficient. It may be appropriate to include a timeline of when specific parts of the event occurred.
- Why – if there is a discernable cause for the event, it should be included.

3.4.5.2 Other Electronic Logbooks

In addition to the *ELog*, there are several other computer-based logbooks that are maintained to record specific information; for example, CLOG (CHL), HALOG (Hall A), HBLOG (Hall B), HCLOG (Hall C), HDLOG (Hall D), RADLOG (Radcon), and LERFLOG (LERF). When making a *ELog* entry, the author should consider whether it is appropriate to include the same entry into one or more of the other computer-based logs.

3.4.5.3 Beam Operations Objective Monitor

The *Beam Operations Objective Monitor* (BOOM) is an electronic time accounting system that monitors electron beam delivery from the CEBAF accelerator to specific objective points according to a set of predefined states. The information gathered is used to track beam availability to the experimental halls and the overall beam delivery history of the accelerator. The Crew Chief is required to verify that the beam objectives for each shift are consistent with the scheduled accelerator program provided by the Program Deputy and change the BOOM state to reflect the actual accelerator state throughout the shift.

3.4.5.4 Operations Problem Reports (OPS-PRs)

The Operations Problem Report (OPS-PR) system is an electronic tool used by the MCC 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 4.2.9 on page 4-13).

3.4.5.5 Downtime Manager

The Downtime Manager is used to document program interruptions. Crew Chiefs and operators capture appropriate information as a system downtime event unfolds, including the associated system and component and the nature of the failure (see Section 4.2.10 on page 4-14).

3.4.5.6 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 1.1.2 on page 1-3). Operations leadership is responsible for the accelerator-specific thresholds; Hall leadership is responsible for the hall-specific thresholds. These restrictions include but are not limited to the following:

- Energy restrictions
- Current limits
- Power limitations for dumps
- Beam raster information (targets and dumps)

The Crew Chief must be aware of all limits established in the Operational Restrictions. Violations of the Operational Restrictions must be addressed as described in Section 3.3.2 on page 3-15.

3.4.5.7 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.

3.4.5.8 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 3.1.1.6 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.

3.4.5.9 Radiation Source Check Logbook

The *Radiation Source Check Logbook* is a record of instrument response checks of radiological instruments used by control room personnel to perform radiation surveys. Using the radiation source located in the control room, Radcon and ARM-trained personnel verify survey instrument responses on a routine basis. The results are recorded in the *Radiation Source Check Logbook*.

3.4.6 Informing Users of Accelerator Program Interruptions

When scheduled beam delivery is interrupted, it is important for the MCC Control Room staff to keep experimenters informed regarding the anticipated length of the interruption. When a program interruption exceeds five minutes, the MCC crew begins a downtime entry, which is visible at the top of the *ELog*. After ten minutes, the MCC crew must contact the hall shift leaders whose halls were receiving beam and inform them of the nature of the problem and, if possible, an estimated time to recover. As a general rule, follow-up calls to the halls 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 experimenters so that they can plan accordingly. During such interruptions, the frequency of follow-up calls shall be determined in consultation with the hall shift leaders (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 CEBAF accelerator to maintain and improve availability. Examples of accelerator 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

Accelerator maintenance tasks can be divided into three categories: immediate, scheduled, and standby. These maintenance categories are defined in Section 4.2.4 on page 4-6.

New projects or system changes can significantly impact accelerator operations and thus require a structured, often cross-divisional, approach to planning, execution, and implementation. Operations reviews, which directly address Operations-centric concerns, are an integral part of this process as described in Section 4.2.2 on page 4-5.

Accelerator improvements are realized by systematically collecting accelerator performance information (i.e., tracking), then dedicating resources to improve performance.

4.1 Personnel and Responsibilities

Maintenance and project oversight for CEBAF is the responsibility of the Operability Group of the Accelerator Operations Department. Maintenance and project activities are supported by the Jefferson Lab system support groups and subcontractors, who perform the maintenance tasks. Approved accelerator 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 the operability of the CEBAF accelerator. The following are the general responsibilities of this group:

- Identify immediate CEBAF maintenance needs based on the experiences of the 24 hours prior to the Program Deputy 0745 Meeting (see Section 1.5 on page 1-18) or as conditions arise.
- Attend the Daily Summary (0800) Meeting (see Section 1.5 on page 1-18).
- Follow up on action items initiated at the Daily Summary Meeting.
- Assist in planning and scheduling CEBAF maintenance days, scheduled accelerator downs (i.e., long-term off times), system hot checkout, and start-up activities.
- Review and integrate CEBAF accelerator projects into the existing Nuclear Physics program, optimizing the integration plan to provide continuity between pre- and post-project operations.
- Provide direction for scheduled accelerator down (SAD) daily activities at the Daily Summary Meeting by leading the planning, coordination, and execution of SAD tasks.
- Conduct the weekly Accelerator Maintenance Meeting as needed. This meeting is used to plan, schedule, and coordinate upcoming maintenance and project activities (see Section 1.5 on page 1-18).
- Develop and maintain the *SAD Calendar* (https://accweb.acc.jlab.org/calendar/), which presents the overview plan of activities for current or upcoming accelerator shutdowns.
- Assist the Program Deputy with developing and maintaining the *ATLis Work Map* (https://accweb.acc.jlab.org/workmap/), an electronic map of the accelerator that shows the major tasks for each maintenance day and identifies potential safety concerns.
- Review and approve all ATLis tasks for scheduled and standby maintenance (see Section 4.2.3 on page 4-6), checking each task for completeness, proper coordination, safety, and schedule and then monitoring the task during execution.
- Apprise the Program Deputy of proposed CEBAF maintenance tasks and the potential impact on machine operability.
- Create reports on CEBAF 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 CEBAF accelerator availability or capabilities, and track those projects to conclusion.
- Collaborate with the Engineering Liaison in planning and guiding System Hot Checkout activities (see Section 4.2.6.1 on page 4-10).
- Participate in the demonstration and testing of new equipment and systems as they move from development to operational running.
- Solicit feedback from ATLis users for improvements to ATLis. Work with software engineers to implement such improvements.

4.1.2 Geographic Integrators

Geographic Integrators are appointed by the Director of Accelerator Operations and serve as owners of discrete geographic areas of the CEBAF accelerator and experiment halls. The Engineering Liaison serves as the primary communication point for all Geographic Integrators. Geographic Integrator responsibilities are as follows:

- Be knowledgeable about systems within the geographic area.
- Work with system owners and experts to ensure consistency between the CED (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 4.2.6.1 on page 4-10).
- Identify potential problems affecting performance or schedule and communicate such problems to Operations management and the Engineering Liaison.
- Identify projects that will improve accelerator system function, maintainability, reliability, or safety and communicate these possibilities to the Engineering Liaison and Operations management.
- Facilitate integration of activities within the geographic area.
- Attend the 0800 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.
- Present a brief status update for the geographic area at the Weekly Summary Meeting (see Section 1.5 on page 1-18) as required. This may be a written report, a brief oral summary, or no summary at all, depending on the scheduled program and guidance from the Program Deputy.
- Attend the weekly B-Team Meeting (see Section 1.5 on page 1-18) as requested and report any limitations within the geographic area that will affect the physics program. Evaluate and facilitate any new B-Team initiatives in the geographic area.

4.1.3 Accelerator Support Groups

Individual Accelerator Support Groups oversee all aspects of each accelerator system (e.g., SRF, RF, DC Power, I&C) to assure system performance in support of the scheduled accelerator operations program. Each Accelerator Support Group has the following operations-specific responsibilities.

- Implement a working system that meets the required operating specifications.
- Monitor and maintain system performance during accelerator operations.
- Maintain a high degree of system reliability in support of scheduled accelerator running.
- Assist Geographic Integrators (see Section 4.1.2 on page 4-3) with the planning, management, and execution of accelerator projects.
- Ensure that the element data contained in the CED matches the existing system configuration, and incorporate any CED changes in a timely manner (see Section 2.1.1 on page 2-2).

- Provide timely on-call system support during accelerator running through an organized on-call support effort that shares the responsibility among qualified technical support personnel. The Web On-call system (see Section 4.2.5.1 on page 4-8) 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 needed to provide system support.
- Support hot checkout activities as required before each accelerator run period.
- Plan system maintenance as required to maintain/improve system reliability.
- Maintain an appropriate spares level to support accelerator operations.
- Plan system upgrades to meet the performance requirements of the upcoming scheduled accelerator 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 4.2.3 on page 4-6).

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 1.1.2.1 on page 1-4). 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:

- Accelerator 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 safety equipment in the experimental areas (e.g., the CEBAF halls).
- 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 Operations Project-Review Process

Effectively integrating new projects or significant system changes with ongoing and scheduled accelerator operations is a complex challenge. The system design/fabrication organizations at JLab have detailed project development processes that already include reviews; however, the Operations-integration process is sufficiently complicated to require its own structured project reviews. These reviews place emphasis on Operations-centric concerns such as specifications, implementation schedule, training, documentation, operator interfaces, and demonstrated system performance.

The Director of Accelerator Operations requests and schedules Operations reviews. Not all projects will require a full complement of Operations reviews; rather, a graded approach is used, depending on the complexity and potential impact to accelerator operations. Section 4.2.2.1, below, lists potential Operations reviews and the minimum agenda for each review.

4.2.2.1 Operations Reviews

The Director of Accelerator Operations schedules each review, sets the agenda, and works with project leadership to invite the appropriate participants. Each review includes, at the minimum, the following items, which are to be supplied by the Project Leader or Task Leader. Operations may request additional information as needed.

Operations Design Review

- Preliminary overall project schedule
- High-level system specification
- Budget outline (including labor and procurements)

Operations Project-Status Review

NOTE: There may be more than one Operations Project-Status Review, as determined by the Director of Accelerator Operations.

- Project schedule, including progress to date
- Final system specification

Transition-to-Operations Review

- Final implementation plan, including a detailed schedule, planned functional testing, CED integration progress, and intended delivery of associated items at system turnover to Operations
- Training plan for affected maintenance and Operations personnel
- Documentation plan, including Operations procedures and training materials

Full-Functionality Acceptance Review

- Completion status of all items associated with the project, including hardware, software, screens, technician and Operations training, and documentation
- Hardware and software demonstration

4.2.3 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 (see example in Appendix F on page F-1). Through ATLis, accelerator personnel electronically submit tasks and provide the required supporting information, including task details, the potential impact to accelerator 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 Operability Group or the Crew Chief for after-hours immediate maintenance. Following completion, the task and any appended comments remain in the database to provide work history and lessons learned information.

4.2.4 Maintenance Categories

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

- Immediate
- Scheduled
- Standby

4.2.4.1 Immediate Maintenance

Immediate maintenance consists of repairs to correct conditions that impede the scheduled 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 4.2.5 on page 4-8. When the need for repair is first recognized, a Downtime Manager event is started to track repairs as the event unfolds. Entries must also be made in the appropriate computer-based logs (e.g., *ELog or SLOG*) 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 4.2.3 on page 4-6). If the task has not already been reviewed and approved by Operability, the Crew Chief must review and approve the task.

When 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, to discuss the work plan and conduct a pre-job briefing. Work coordination is a vital part of the repair process.

After the repair effort is complete, an appropriate *ELog* entry must be made by maintenance personnel, summarizing the repair, any known causes, and any lessons learned, and the associated ATLis task(s) updated. If any components were downgraded during the repair, their status should be reviewed and upgraded to Ready as appropriate.

4.2.4.2 Scheduled Maintenance

Scheduled maintenance consists of activities that are planned in advance using the ATLis work planning system (see Section 4.2.3 on page 4-6) and reviewed and approved by the Operability Group.

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

As work is completed, the ATLis task must be updated and an *ELog* entry made (see Section 3.4.5.1 on page 3-30) using the *ELog* posting link found on the ATLis task page.

4.2.4.3 Standby Maintenance

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

Maintenance tasks performed during an unscheduled downtime period include:

- Correction of the problem(s) that caused the program interruption (see Immediate maintenance, Section 4.2.4.1 on page 4-6).
- Scheduled maintenance that can be performed ahead of schedule (see Section 4.2.4.2 on page 4-7).

In the event of an unscheduled accelerator down time, the Program Deputy develops an alternate program in accordance with the repair escalation process (see Section 4.2.5.2 on page 4-8). Depending on the duration of the down, the Operability Manager proposes appropriate maintenance tasks, choosing from already-approved ATLis tasks (see Section 4.2.3 on page 4-6) and advising the Program Deputy and appropriate JLab leadership of the potential impact to operations. The Program Deputy is authorized to, at any time, curtail or cancel tasks that may threaten the scheduled program.

4.2.5 CEBAF Repair Protocol

Accelerator repairs are made whenever hardware or software problems interrupt the primary CEBAF program. During lengthy repairs, the Crew Chief shall consult with the Program Deputy to optimize use of the time by performing an alternate accelerator program (see Section 1.4.4 on page 1-17).

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

- The Crew Chief notifies the affected user(s) as to the nature and anticipated duration of the problem (see Section 3.4.6 on page 3-32).
- The Crew Chief immediately notifies the Program Deputy if the program interruption is anticipated to be longer than one hour.
- The Crew Chief immediately notifies the 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 protocol established by the Web On-Call tool (see Section 4.2.5.1 on page 4-8).
- The Crew Chief or an operator opens a Downtime Manager 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 4.2.5.2 on page 4-8).
- If the repair takes longer than eight hours or spans two or more shifts worked by repair personnel, then the component must be downgraded in the System Readiness Tool, either by the technician or the Crew Chief (see Section 4.2.6.3 on page 4-11).

4.2.5.1 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. CEBAF 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.

4.2.5.2 Repair Escalation

When, after following the repair protocol described in Section 4.2.5 on page 4-8, 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 E on page E-1 for a flow chart of this process.

- Before any repairs are deferred and the scheduled program altered as a result, the Director of Accelerator Operations and the Operability Manager must be notified.
- 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 must record the details of the repair escalation in the *ELog*.

- 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 E on page E-1 about the problem and the present repair work status. The Crew Chief must record the details of these calls in the *ELog*.
- If a repair lasts longer than eight hours or spans two or more shifts worked by repair personnel, the technician or the Crew Chief downgrades the readiness status of the components in the System Readiness Tool (see Section 4.2.6.3 on page 4-11).

4.2.6 System Readiness

Whether or not a system is ready to support the accelerator program is referred to as system readiness. Because the CEBAF accelerator has many complex, interdependent systems, it is important to transition to a higher state of readiness in an organized, prescribed fashion, and then continue to know the readiness state of every system during accelerator running. Each system has three possible states of readiness as follows.

- **Off** – No planned operations.
- **Hot Checkout** – The transition from Off to Running using a pre-defined process. When the hot checkout process is complete, system experts have confirmed that their systems are ready to support 24/7 operations.
- **Running** – Engineering turnover to Operations is complete and components are in a state that supports scheduled operations. Component failures during running are addressed using the CEBAF repair protocol (see Section 4.2.5 on page 4-8).

Figure 4-1, below, shows how system readiness flows through the hot checkout process and integrates with the CEBAF repair protocol during running. Additional hot checkout and running details are provided in the following sections.

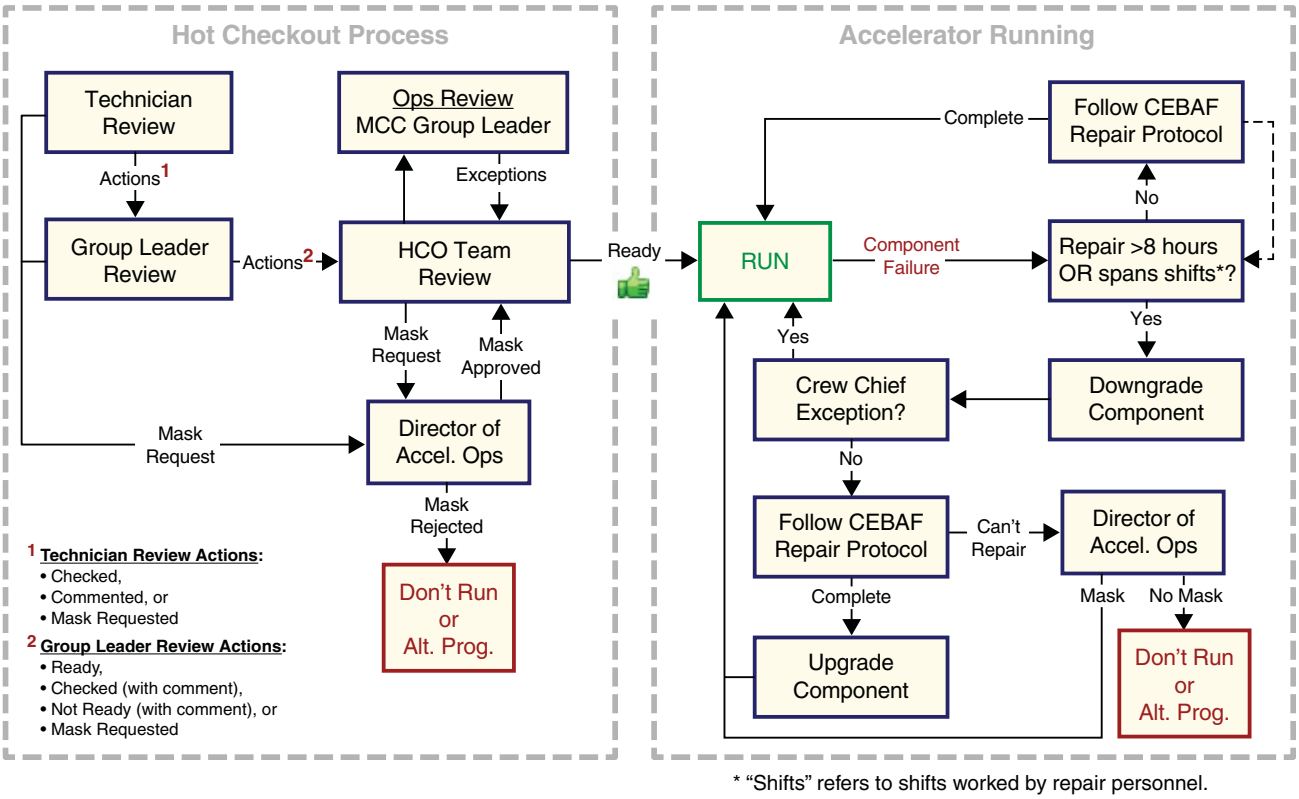


Figure 4-1: System Readiness During Hot Checkout and Accelerator Running

The readiness status of any individual component can be "downgraded" at any time, by anybody, if a component is reconfigured, modified, or potentially compromised. Group Leaders and the Hot Checkout Team routinely downgrade components before any scheduled run period. The responsible group(s) receives email notification that the hot checkout process will need to be repeated.

4.2.6.1 System Hot Checkout

System hot checkout 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. 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 System Readiness Tool is a database-driven web tool that supports a consistent, prescribed hot checkout process. The tool is used to track and communicate progress toward system readiness.

System Owners populate the System Readiness Tool with readiness checklists and checkout procedures that are detailed and repeatable. As shown in Figure 4-1 on page 10, technicians execute the documented process for each system by changing the status to Checked, adding a comment to explain why the system is not ready, or making a mask request. Mask requests can be made at any point during the hot checkout process, and if approved by the Director of Accelerator Operations, hide the readiness state of the component for the duration of the upcoming running. Group Leaders perform a second level of readiness verification, changing the status to Ready, Checked (with a comment added), Not Ready (with a comment added), or making a mask request.

As the period of planned running approaches, the Hot Checkout Team (see Section 4.2.6.2 on page 4-11) meets to evaluate the status of all systems. If a system is not ready at the beginning of the scheduled run period but is not required until later, the MCC Group Leader can grant an "exception," which does not delay the planned running and indicates that the component will be repaired prior to its being needed during the scheduled run. After all systems reach a sufficient state of readiness, the Hot Checkout Team completes the hot checkout process by making the final approvals in the System Readiness Tool and an *ELog* entry verifying that all required systems are ready to support 24/7 operations.

4.2.6.2 Hot Checkout Team

The Hot Checkout Team is responsible for coordinating hot checkout activities and is appointed by the Director of Accelerator Operations. The team includes representatives from each of the following groups: Engineering, Operability, and Operations. The Engineering Liaison is the Hot Checkout Team Leader. Hot Checkout Team responsibilities are as follows:

- Oversee the System Readiness Tool and coordinate functional changes as necessary.
- Ensure that all systems required for upcoming operations are included in the System Readiness Tool.
- Determine which components will be downgraded, and downgrade those components at the beginning of a shutdown.
- Monitor ATLis tasks and downgrade components as necessary.
- Report on readiness progress at the Daily Summary Meeting and the Weekly Summary Meeting during hot checkout periods.
- Track system readiness and keep the Director of Accelerator Operations apprised of potential readiness problems.
- Make an ELog entry verifying that all required systems are ready to support 24/7 operations before scheduled accelerator operations. The entry should include all component masks and exceptions in effect.

4.2.6.3 System Readiness During Running

During scheduled running, it is important to be able to determine the readiness state of all systems required to support the run program. When a component fails, the CEBAF repair protocol is followed (see Section 4.2.5 on page 4-8) and the system readiness state is tracked as shown in Figure 4-1 on page 10. If the repair progresses quickly, there is no need to downgrade the component; however, if the repair takes longer than eight hours or spans two shifts worked by repair

personnel, then the component must be downgraded in the System Readiness Tool, either by a technician or the Crew Chief.

The Crew Chief is authorized to issue an "exception" for any short-term component failure that does not halt the scheduled program and will be repaired on a maintenance day during the run period. Each exception must have an accompanying comment in the System Readiness Tool to explain the rationale for the exception and any associated limitations that the non-operational component may cause. If the failed component will be non-operational for an extended period of time, the Director of Accelerator Operations can review and mask the component.

4.2.7 Bypassing System Interlocks

Interlocks constrain the operation of equipment in some fashion, either electronically or mechanically, and prevent equipment from being placed in an unintended state. The process for intentionally bypassing an interlock is specified in *ES&H Manual, Section 6112, Interlock Bypass Program.* A listing of bypassed interlocks is maintained in the *Accelerator Bypassed-Interlock Log* (http://opsweb.acc.jlab.org/abil/pro/).

It should be noted that the process for bypassing interlocks associated with the Personnel Safety System is specified in a separate document, the *PSS Configuration Management Procedure* (https://jlabdoc.jlab.org/docushare/dsweb/Get/Document-110171/PSS%20Config%20Mgmt%20Proc%201.pdf).

4.2.8 Repair Assessment Reporting

The Repair Assessment Committee (RAC) oversees the investigation of accelerator repair events and determines if a detailed investigation of a repair event could potentially improve accelerator availability through the lessons learned. 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 accelerator availability using the lessons learned.

Details of the repair assessment reporting process are contained in a separate document, *Accelerator Repair Assessment Reporting* (http://opsntsrv.acc.jlab.org/ops_docs/online_document_files/ACC_online_files/repair_escalation_reporting.pdf), 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. Past reports, reports in progress, and resulting action items are available through the *RAR Database* (http://opsweb.acc.jlab.org/CSUEApps/rerdb/). The template used to write a Repair Assessment Report is shown in Figure 4-2, 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 documents; 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 4-2: Repair Assessment Report Template

4.2.9 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 4.2.3 on page 4-6) 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 OPS-PRs appear as *ELog* 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 *ELog* 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.

4.2.10 CEBAF Reliability and Downtime Tracking

When the accelerator cannot meet the scheduled program, the on-duty control room crew uses the Downtime Manager (https://accweb.acc.jlab.org/dtm/) to record the interruption as a system downtime event. As each event unfolds, the crew captures appropriate information, including the associated system and component and the nature of the failure. The goal is to document downtime events with sufficient detail to generate reports and perform later analysis, which will be used to direct decision making such as resource allocation, equipment design changes, training, spares purchases, system upgrades, and improvements to beam transport processes. The Operability Group is responsible for defining the Downtime Manager requirements and function and also analyzing the resulting data.

Each system downtime event covers a discrete time period during which the program was interrupted. If multiple system failures occur in parallel during that time period, those incidents become part of the same event, which begins with the initial program interruption and ends when the scheduled program resumes. Events also include instances when a program interruption is caused by a beam quality issue. If no known hardware component is the cause, then the incident is assigned to “beam transport.”

4.2.10.1 Accelerator System Repair Reports

The Operability Group uses data from the Downtime Manager and other information sources to compile reports, which are used as a means to raise the level of accelerator downtime awareness, and ultimately, to improve overall accelerator availability. These reports are presented at the Weekly Summary

Meeting (see Section 1.5 on page 1-18) and also distributed via email. The standard reports are as follows.

- *Weekly Accelerator System Repair Report* – The report covers the preceding week (Tuesday 2400 through Tuesday 2400) and shows total repair time and specific repair information for the top repair events during the week.
- *Monthly Availability Report* – The report provides a monthly compilation of downtime information, including accelerator performance metrics, a listing of significant repair events, and repairs broken down by system category, with the associated trending and failure information.
- *Annual Accelerator System Repair Report* – A histogram that displays the total annual repair hours per system, subdivided by monthly totals.

Individuals can also use the Downtime Manager as an on-line data analysis tool to better identify system-performance and failure-mode trends.

Appendix A PD Shift Plan

General Description:

Program Deputy Shift Plans are created using a web-based, database-driven interface. See https://accweb.acc.jlab.org/apps/pd/shift-plans

Figure A-1: Program Deputy Shift Plan Example, p. 1

Program Deputy Shift Plans

Shift Plans | LERF Programs | PD Assignments | Help | Login (Auto)

Shift Plan for DAY Shift April 01, 2017 (Saturday)

Program Deputy Doe, John
Last Updated 17-04-01 06:45

Accelerator Program

Scheduled Program	Number of Hours
Beam Delivery for Physics	6
Accelerator Configuration Change (ACC)	0
Accelerator Restoration	0
Accelerator Beam Studies	2
Accelerator SAD (Off)	0

Physics Program

Scheduled Program	Number of Hours	Hall with Priority	Experiment
Hall A	6		Commissioning
Hall B	0		
Hall C	0		
Hall D	6	✔	GlueX

Program Deputy Instructions

New Instructions in the Last 24 Hours:

Contact SRF Vacuum On-call if there is an opportunity for a SL access.

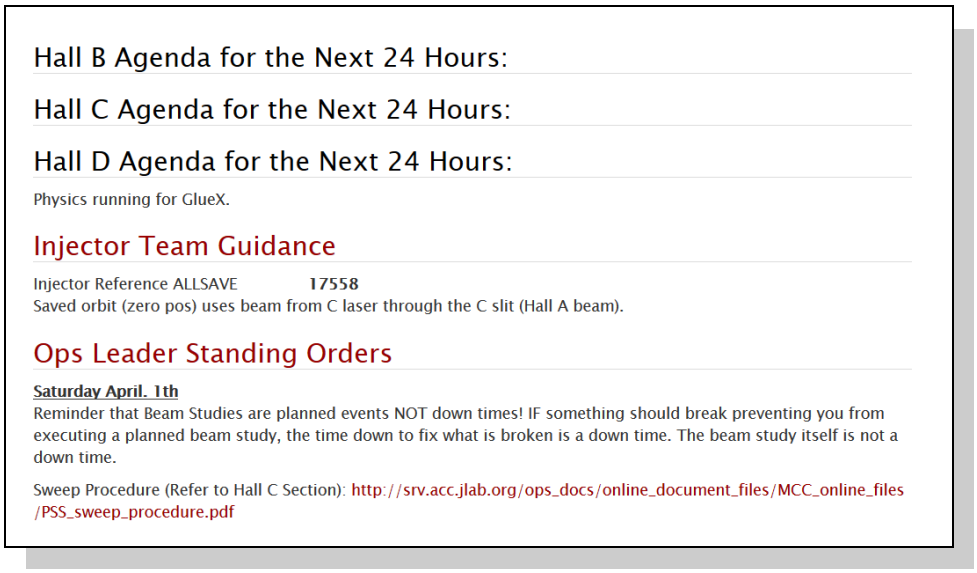
Instructions Older than 24 Hours:

Lock energy to Hall A.

Important Elog Entries (including entry number):

3466871 14:11 smith BLM-BLA Correlations

Figure A-2: Program Deputy Shift Plan Example, p. 2



Hall B Agenda for the Next 24 Hours:

Hall C Agenda for the Next 24 Hours:

Hall D Agenda for the Next 24 Hours:

Physics running for GlueX.

Injector Team Guidance

Injector Reference ALLSAVE **17558**
Saved orbit (zero pos) uses beam from C laser through the C slit (Hall A beam).

Ops Leader Standing Orders

Saturday April. 1th
Reminder that Beam Studies are planned events NOT down times! IF something should break preventing you from executing a planned beam study, the time down to fix what is broken is a down time. The beam study itself is not a down time.

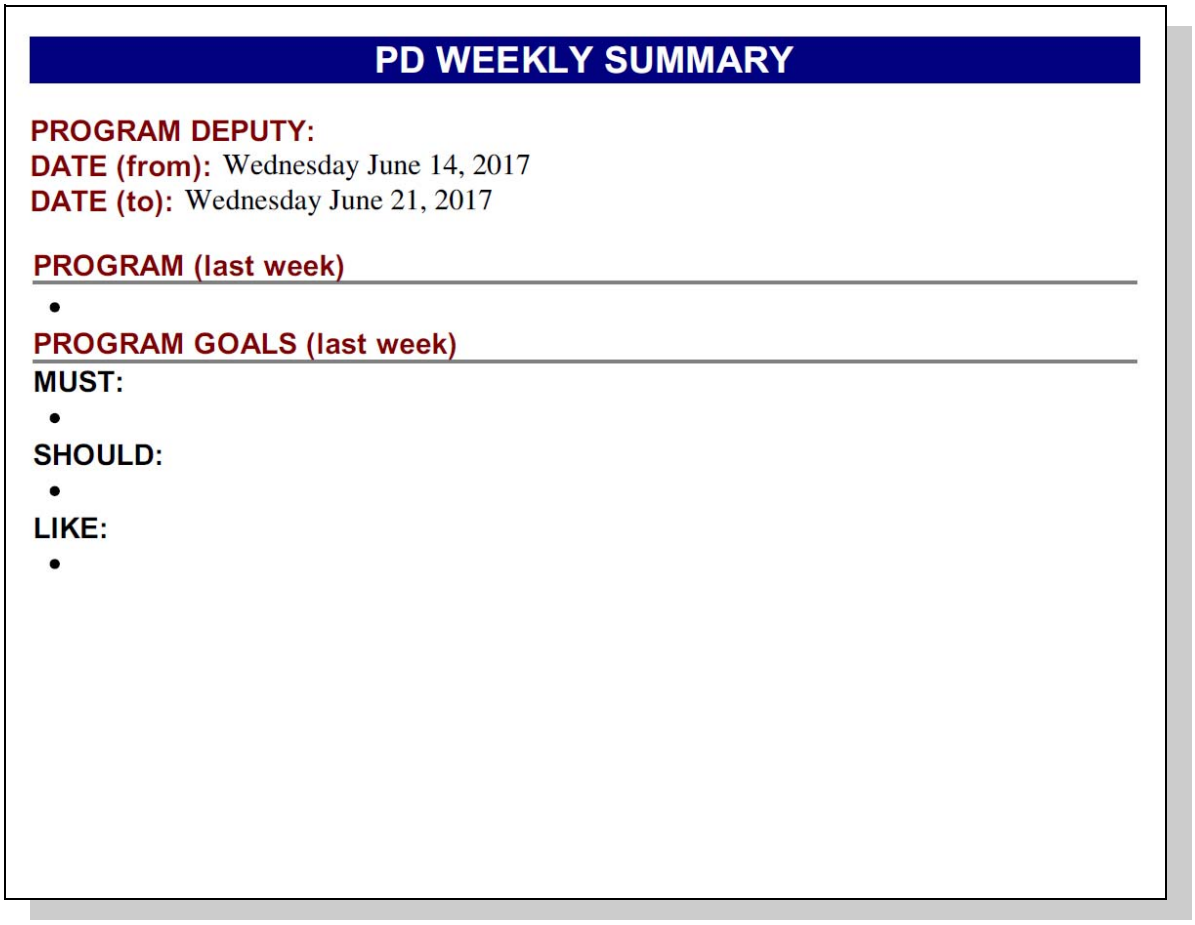
Sweep Procedure (Refer to Hall C Section): http://srv.acc.jlab.org/ops_docs/online_document_files/MCC_online_files/PSS_sweep_procedure.pdf

Appendix B PD Weekly Summary

General Description:

The PD Weekly Summary is presented by the Program Deputy at the Weekly Scheduling Meeting. The summary provides information on operations for the preceding week and describes anticipated goals and activities for the upcoming week of accelerator operations. Detailed information regarding beam availability, the duration of accesses, sources of lost time, and other statistical breakdowns is provided by other parties. See https://accweb.acc.jlab.org/presenter/pd-menu

Figure B-1: Program Deputy Weekly Summary Template, p. 1



PD WEEKLY SUMMARY

PROGRAM DEPUTY:
DATE (from): Wednesday June 14, 2017
DATE (to): Wednesday June 21, 2017

PROGRAM (last week)

•

PROGRAM GOALS (last week)

MUST:

•

SHOULD:

•

LIKE:

•

Figure B-2: Program Deputy Weekly Summary Template, p.2

PD WEEKLY SUMMARY

AVAILABILITY SUMMARY

Table 1: Beam to Halls for the Preceding Week (*)

(Wednesday 07:00 - Wednesday 07:00)

	PD Scheduled (hours)	Actual Hall Program (hours)	Accelerator Availability (%)	Acceptable Beam in Use (%)	Hall Availability (%)
Hall A					
Hall B					
Hall C					
Hall D					

Table 2: Accelerator-Specific Activities for the Preceding Week (*)

(Wednesday 07:00 - Wednesday 07:00)

	PD Scheduled (hours)	Actual (hours)
Acc. Beam Studies		
Acc. Restoration		
Acc. Config. Change		
Sched. Acc. Off		

Figure B-3: Program Deputy Weekly Summary Template, p. 3

PD WEEKLY SUMMARY

Table 3: Access Times for the Preceding Week (*)
(in hours, Wednesday 07:00 - Wednesday 07:00)

	Hall A	Hall B	Hall C	Hall D	Accel.
PCC - Planned Configuration Change	0.0	0.0	0.0	0.0	0.0
Repair/Investigate	0.0	0.0	0.0	0.0	0.0
Opportunistic	0.0	0.0	0.0	0.0	0.0
Other	0.0	0.0	0.0	0.0	0.0
Total Access Time	0.0	0.0	0.0	0.0	0.0

NOTE: The values in Table 3 are based on numbers from the PSS log book.

TEST PLANS COMPLETED

-

SIGNIFICANT ACHIEVEMENTS

-

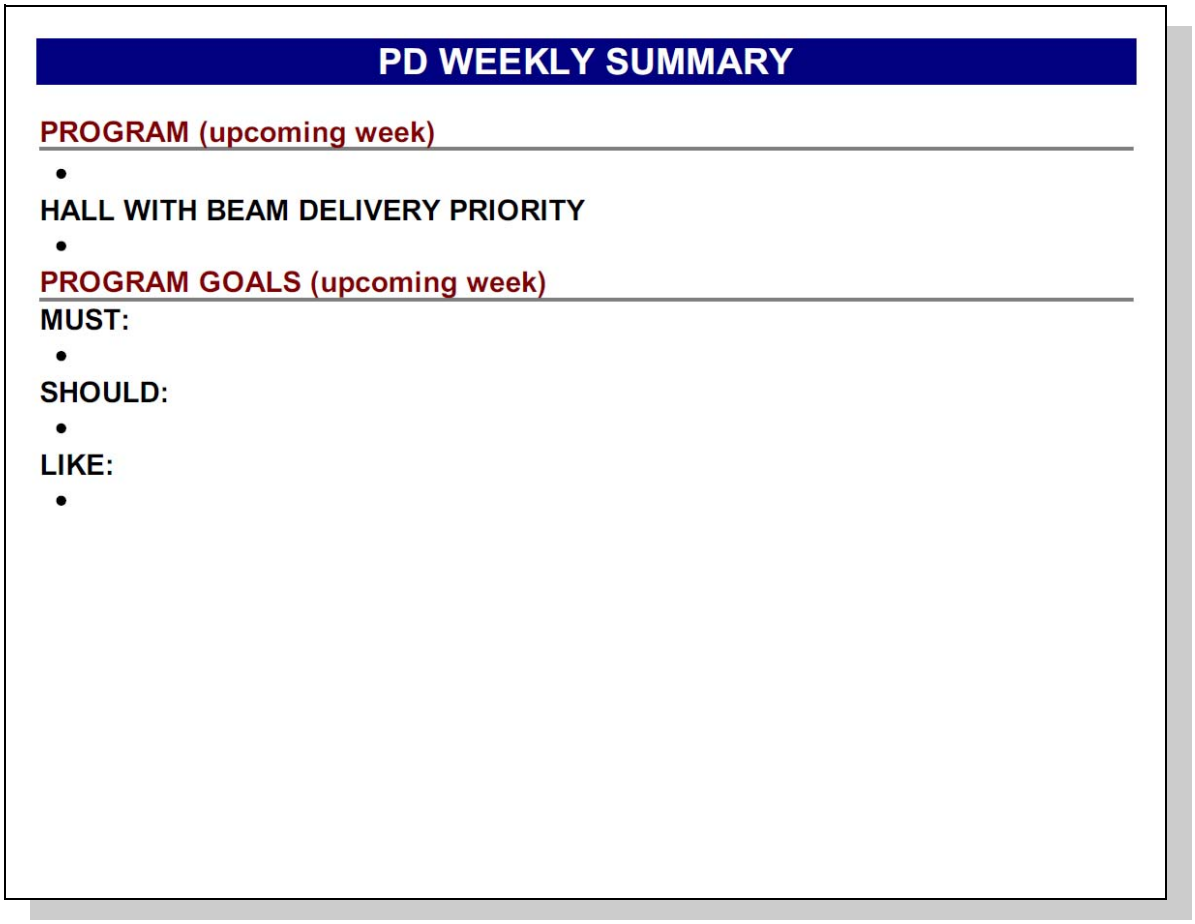
SIGNIFICANT MAINTENANCE/MACHINE DEVELOPMENT ACTIVITIES

-

SIGNIFICANT PROBLEMS PENDING

-

Figure B-4: Program Deputy Weekly Summary Template, p. 4



Appendix C Crew Chief Shift Log

General Description:

The Crew Chief Shift Log (often referred to as the Do Log) is filled out by the Crew Chief at the end of each shift. The completed log is presented by the Program Deputy at the Daily Summary Meeting and posted in the *ELog*. The shift log provides a summary of activity for the shift (including time accounting) and identifies problems that require attention and problems that were solved. See https://accweb.acc.jlab.org/presenter/cc-menu

Figure C-1: Crew Chief Shift Log Template (Do Log)

CEBAF SHIFT LOG

SHIFT SUMMARY

•

PROBLEMS REQUIRING ATTENTION

•

•

MAJOR REASONS FOR NO BEAM

•

DATE: Friday - March 06, 2017
SHIFT: Swing (1500-2300)
TEAM: Smith: Jones, George
PROGRAM: Hall A (1), Hall B(3), Hall D(5)

	Sched.	Actual	ABU	BANU
Hall A (-)	8.0	7.2	7.0	0.2
Hall B (Commis.)	8.0	6.6	6.2	0.4
Hall D (Detector)	8.0	6.4	4.0	2.4

logtemplate.fm

Appendix D Beam Test Plan

General Description:

A Beam Test Plan is submitted by anyone needing to test specific accelerator operating parameters and gather test data (see Section 3.4.3.2 on page 3-25). Beam Test Plans are created using a web-based, database-driven interface that can be accessed from the top of the *ELog* or http://opsweb.acc.jlab.org/CSUEApps/atlis/atlis.php?want_beam_testplan=1.

Figure D-1: Test Plan Worksheet Example, p. 1

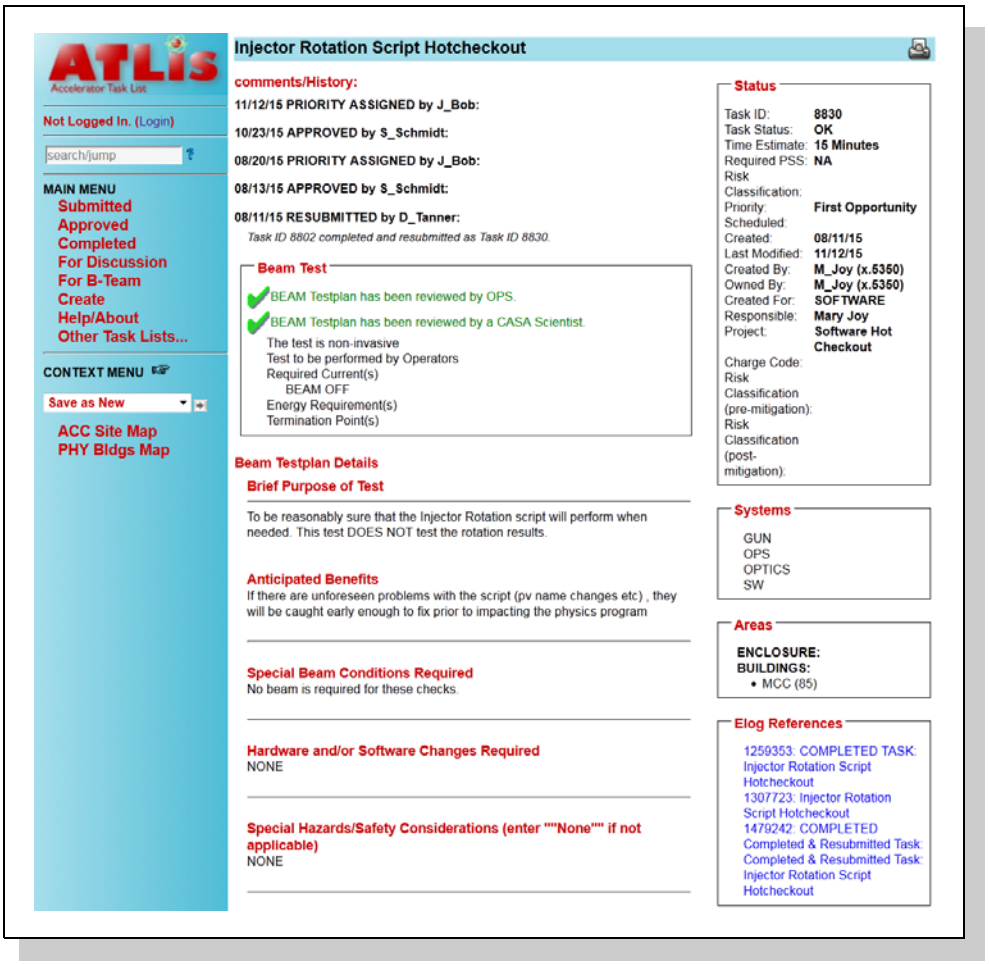
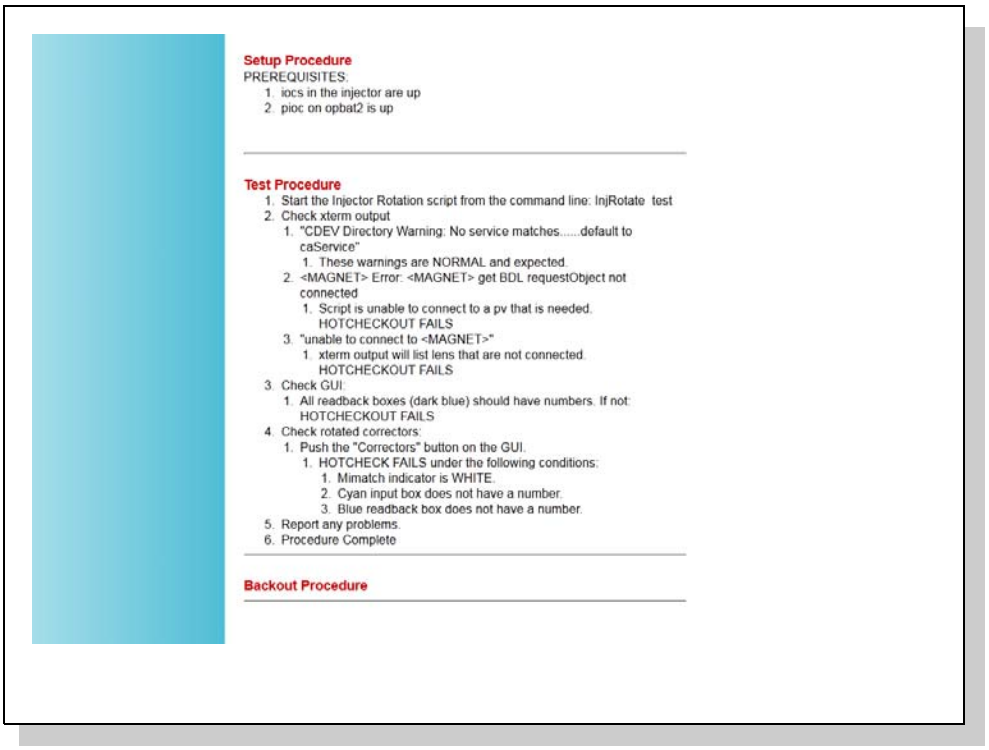


Figure D-2: Test Plan Worksheet Example, p. 2



Setup Procedure

PREREQUISITES:

1. iocs in the injector are up
2. pioc on opbat2 is up

Test Procedure

1. Start the Injector Rotation script from the command line: InjRotate test
2. Check xterm output
    1. "CDEV Directory Warning: No service matches.....default to caService"
        1. These warnings are NORMAL and expected.
    2. <MAGNET> Error: <MAGNET> get BDL requestObject not connected
        1. Script is unable to connect to a pv that is needed. HOTCHECKOUT FAILS
    3. "unable to connect to <MAGNET>"
        1. xterm output will list lens that are not connected. HOTCHECKOUT FAILS
3. Check GUI:
    1. All readback boxes (dark blue) should have numbers. If not: HOTCHECKOUT FAILS
4. Check rotated correctors:
    1. Push the "Correctors" button on the GUI.
        1. HOTCHECK FAILS under the following conditions:
            1. Mimatch indicator is WHITE.
            2. Cyan input box does not have a number.
            3. Blue readback box does not have a number.
5. Report any problems.
6. Procedure Complete

Backout Procedure

Appendix E CEBAF Repair Flow Chart

General Description:

The flow chart shown below outlines the process used to repair any problem that interrupts the primary CEBAF accelerator program. For additional detailed information on the repair or repair escalation process, refer to Section 4.2.5.2 on page 4-8.

Figure E-1: CEBAF Accelerator Repair Flow Chart

Step	Event	Actions
1	**Original Repair Problem** (the program is interrupted)	• Crew Chief notifies the experimental halls (see Section 3.4.6 on page 3-32). • Control room staff solves the problem or calls on-call help at Crew Chief's discretion. • Crew Chief notifies Program Deputy if anticipated interruption is longer than 1 hour. • Crew Chief notifies Operability Manager if anticipated interruption is longer than 4 hours. • Control room staff starts an OPS-PR. • The Technician or the Crew Chief downgrade the component(s) if the repair lasts longer than 8 hours or spans two shifts (see Section 4.2.6.3 on page 4-11). **NOTE:** Before repairs are deferred and the scheduled program altered, the Director of Accelerator Operations and the Operability Manager must be notified.

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

3	**Repair Escalation (Level 2)** (4 hours after program interruption)	• Crew Chief notifies the following:
		  • Director of Accelerator Operations
		  • Operability Manager
		  • Program Deputy
		  • Department Head (or Deputy)
		  • Engineering Liaison

4	**Repair Assessment Reporting**	• Repair Assessment Committee (RAC) determines if a detailed investigation is warranted and, if so, forms a Repair Investigation Team (see Section 4.2.8 on page 4-12). • Repair Investigation Team investigates the repair event and prepares a Repair Assessment Report that focuses on root causes, plans for improvements, and lessons learned.

Appendix F ATLis Maintenance Tasks

General Description:

An ATLis task is submitted by anybody wanting to perform work on an accelerator system (see Section 4.2.3 on page 4-6). ATLis tasks are created using a web-based, database-driven interface that can be accessed from the top of the *ELog* or http://opsweb.acc.jlab.org/CSUEApps/atlis/atlis.php?.

Figure F-1: ATLis Work Planning Template, p. 1

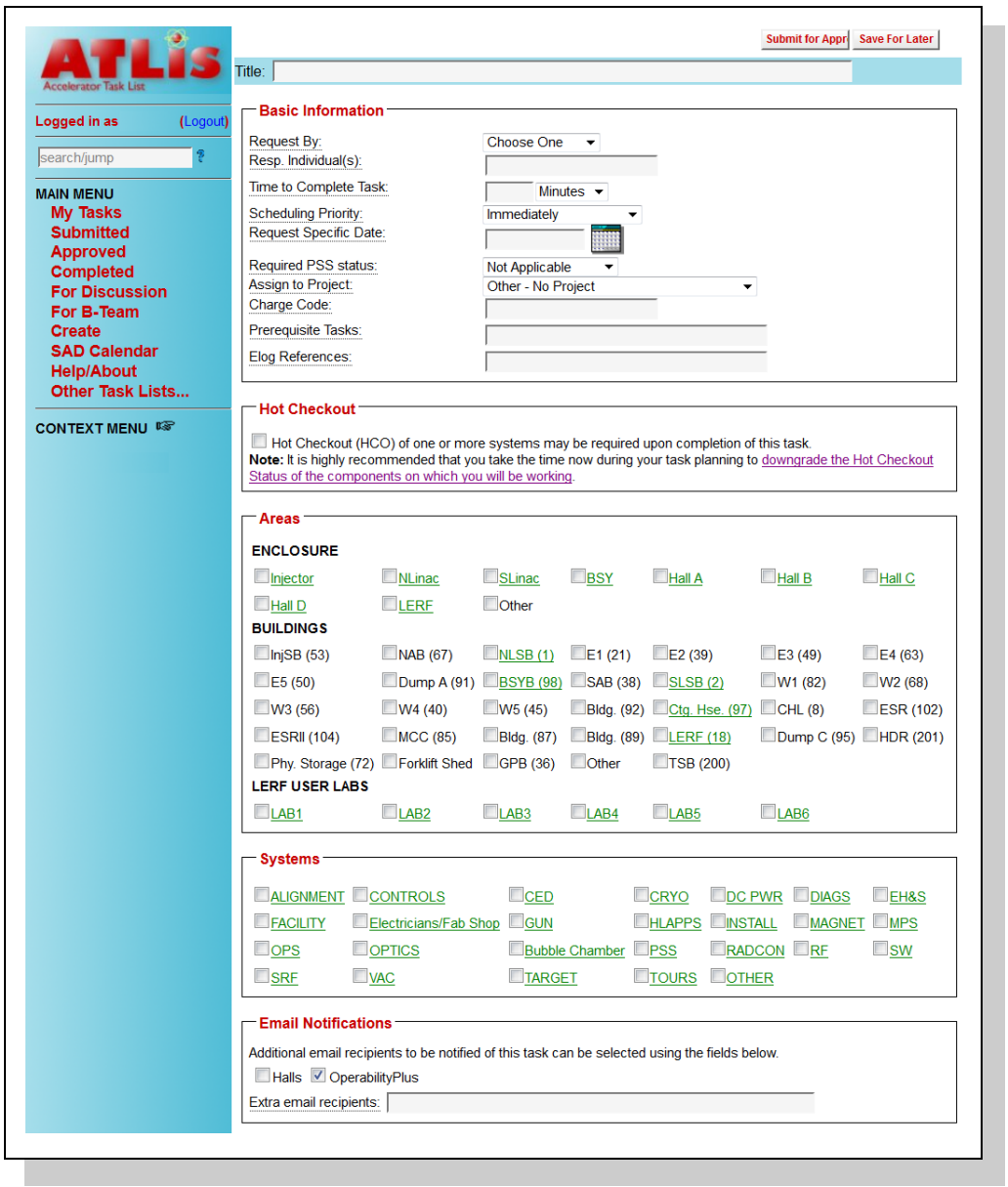
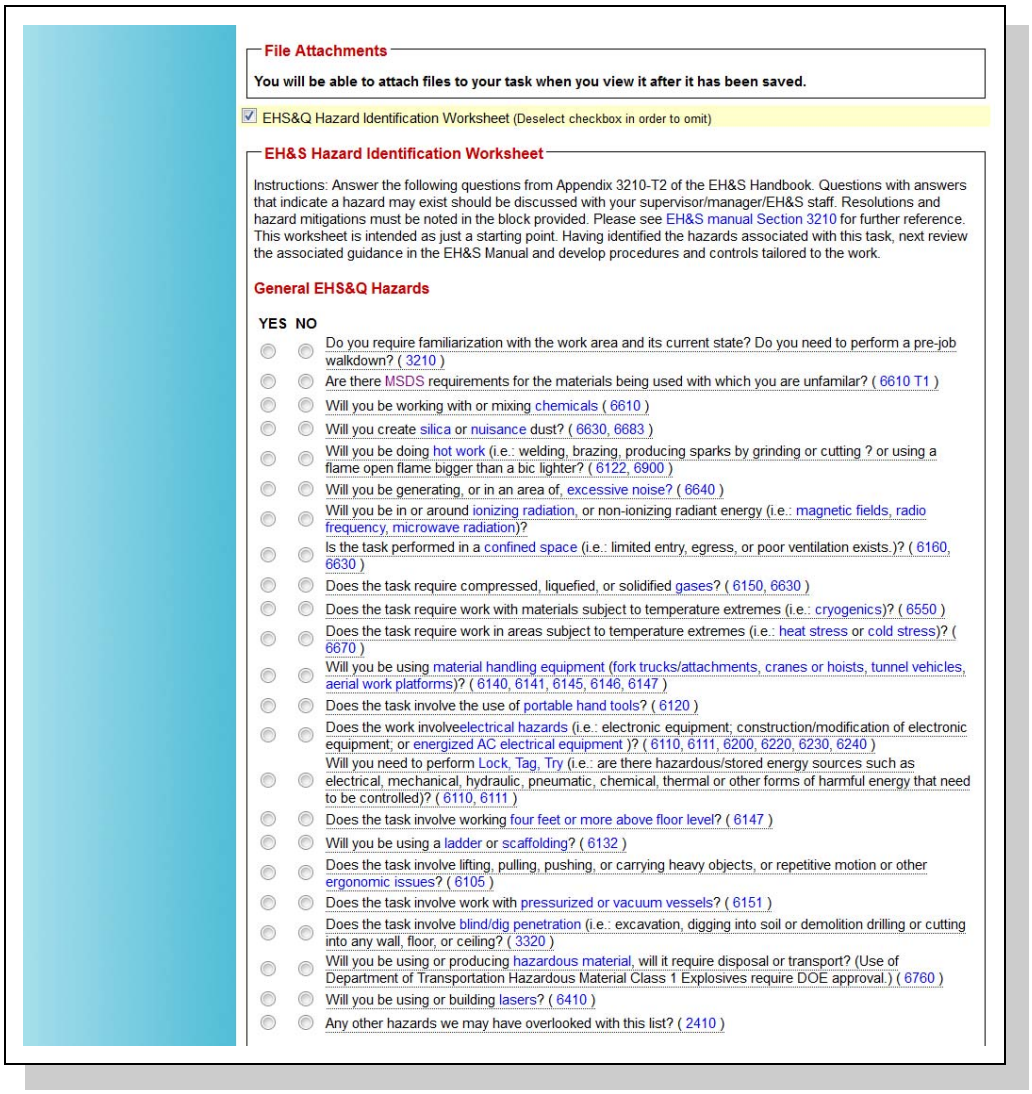


Figure F-2: ATLis Work Planning Template, p. 2



File Attachments

You will be able to attach files to your task when you view it after it has been saved.

☑ EHS&Q Hazard Identification Worksheet (Deselect checkbox in order to omit)

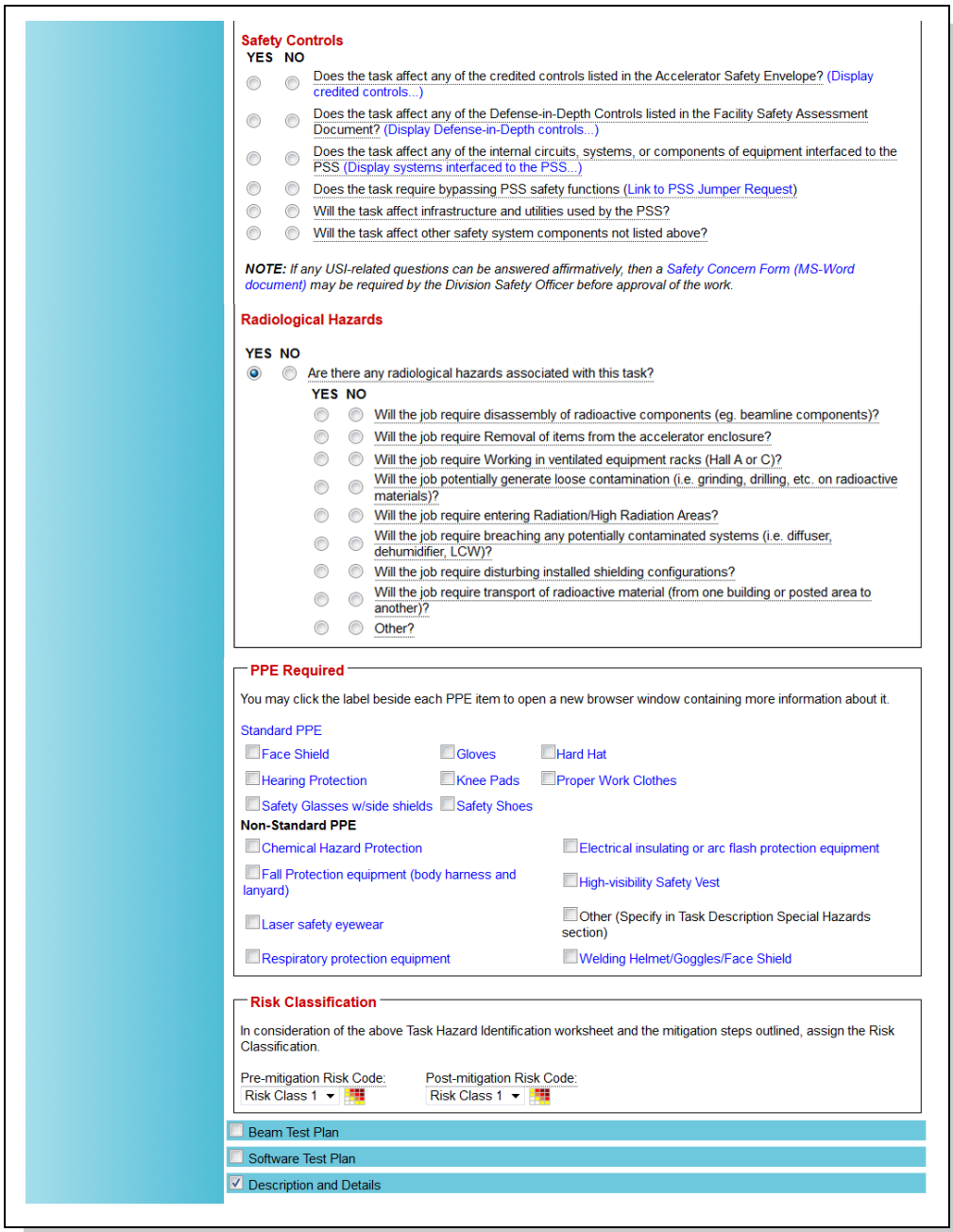
EH&S Hazard Identification Worksheet

Instructions: Answer the following questions from Appendix 3210-T2 of the EH&S Handbook. Questions with answers that indicate a hazard may exist should be discussed with your supervisor/manager/EH&S staff. Resolutions and hazard mitigations must be noted in the block provided. Please see EH&S manual Section 3210 for further reference. This worksheet is intended as just a starting point. Having identified the hazards associated with this task, next review the associated guidance in the EH&S Manual and develop procedures and controls tailored to the work.

General EHS&Q Hazards

YES	NO	
○	○	Do you require familiarization with the work area and its current state? Do you need to perform a pre-job walkdown? (3210)
○	○	Are there MSDS requirements for the materials being used with which you are unfamilar? (6610 T1)
○	○	Will you be working with or mixing chemicals (6610)
○	○	Will you create silica or nuisance dust? (6630, 6683)
○	○	Will you be doing hot work (i.e.: welding, brazing, producing sparks by grinding or cutting ? or using a flame open flame bigger than a bic lighter? (6122, 6900)
○	○	Will you be generating, or in an area of, excessive noise? (6640)
○	○	Will you be in or around ionizing radiation, or non-ionizing radiant energy (i.e.: magnetic fields, radio frequency, microwave radiation)?
○	○	Is the task performed in a confined space (i.e.: limited entry, egress, or poor ventilation exists.)? (6160, 6630)
○	○	Does the task require compressed, liquefied, or solidified gases? (6150, 6630)
○	○	Does the task require work with materials subject to temperature extremes (i.e.: cryogenics)? (6550)
○	○	Does the task require work in areas subject to temperature extremes (i.e.: heat stress or cold stress)? (6670)
○	○	Will you be using material handling equipment (fork trucks/attachments, cranes or hoists, tunnel vehicles, aerial work platforms)? (6140, 6141, 6145, 6146, 6147)
○	○	Does the task involve the use of portable hand tools? (6120)
○	○	Does the work involveelectrical hazards (i.e.: electronic equipment; construction/modification of electronic equipment; or energized AC electrical equipment)? (6110, 6111, 6200, 6220, 6230, 6240)
○	○	Will you need to perform Lock, Tag, Try (i.e.: are there hazardous/stored energy sources such as electrical, mechanical, hydraulic, pneumatic, chemical, thermal or other forms of harmful energy that need to be controlled)? (6110, 6111)
○	○	Does the task involve working four feet or more above floor level? (6147)
○	○	Will you be using a ladder or scaffolding? (6132)
○	○	Does the task involve lifting, pulling, pushing, or carrying heavy objects, or repetitive motion or other ergonomic issues? (6105)
○	○	Does the task involve work with pressurized or vacuum vessels? (6151)
○	○	Does the task involve blind/dig penetration (i.e.: excavation, digging into soil or demolition drilling or cutting into any wall, floor, or ceiling? (3320)
○	○	Will you be using or producing hazardous material, will it require disposal or transport? (Use of Department of Transportation Hazardous Material Class 1 Explosives require DOE approval.) (6760)
○	○	Will you be using or building lasers? (6410)
○	○	Any other hazards we may have overlooked with this list? (2410)

Figure F-3: ATLis Work Planning Template, p. 3



Safety Controls

YES NO

- Does the task affect any of the credited controls listed in the Accelerator Safety Envelope? (Display credited controls...)
- Does the task affect any of the Defense-in-Depth Controls listed in the Facility Safety Assessment Document? (Display Defense-in-Depth controls...)
- Does the task affect any of the internal circuits, systems, or components of equipment interfaced to the PSS (Display systems interfaced to the PSS...)
- Does the task require bypassing PSS safety functions (Link to PSS Jumper Request)
- Will the task affect infrastructure and utilities used by the PSS?
- Will the task affect other safety system components not listed above?

NOTE: *If any USI-related questions can be answered affirmatively, then a Safety Concern Form (MS-Word document) may be required by the Division Safety Officer before approval of the work.*

Radiological Hazards

YES NO

- Are there any radiological hazards associated with this task?

  YES NO

  - Will the job require disassembly of radioactive components (eg. beamline components)?
  - Will the job require Removal of items from the accelerator enclosure?
  - Will the job require Working in ventilated equipment racks (Hall A or C)?
  - Will the job potentially generate loose contamination (i.e. grinding, drilling, etc. on radioactive materials)?
  - Will the job require entering Radiation/High Radiation Areas?
  - Will the job require breaching any potentially contaminated systems (i.e. diffuser, dehumidifier, LCW)?
  - Will the job require disturbing installed shielding configurations?
  - Will the job require transport of radioactive material (from one building or posted area to another)?
  - Other?

PPE Required

You may click the label beside each PPE item to open a new browser window containing more information about it.

Standard PPE

- Face Shield
- Gloves
- Hard Hat
- Hearing Protection
- Knee Pads
- Proper Work Clothes
- Safety Glasses w/side shields
- Safety Shoes

Non-Standard PPE

- Chemical Hazard Protection
- Electrical insulating or arc flash protection equipment
- Fall Protection equipment (body harness and lanyard)
- High-visibility Safety Vest
- Laser safety eyewear
- Other (Specify in Task Description Special Hazards section)
- Respiratory protection equipment
- Welding Helmet/Goggles/Face Shield

Risk Classification

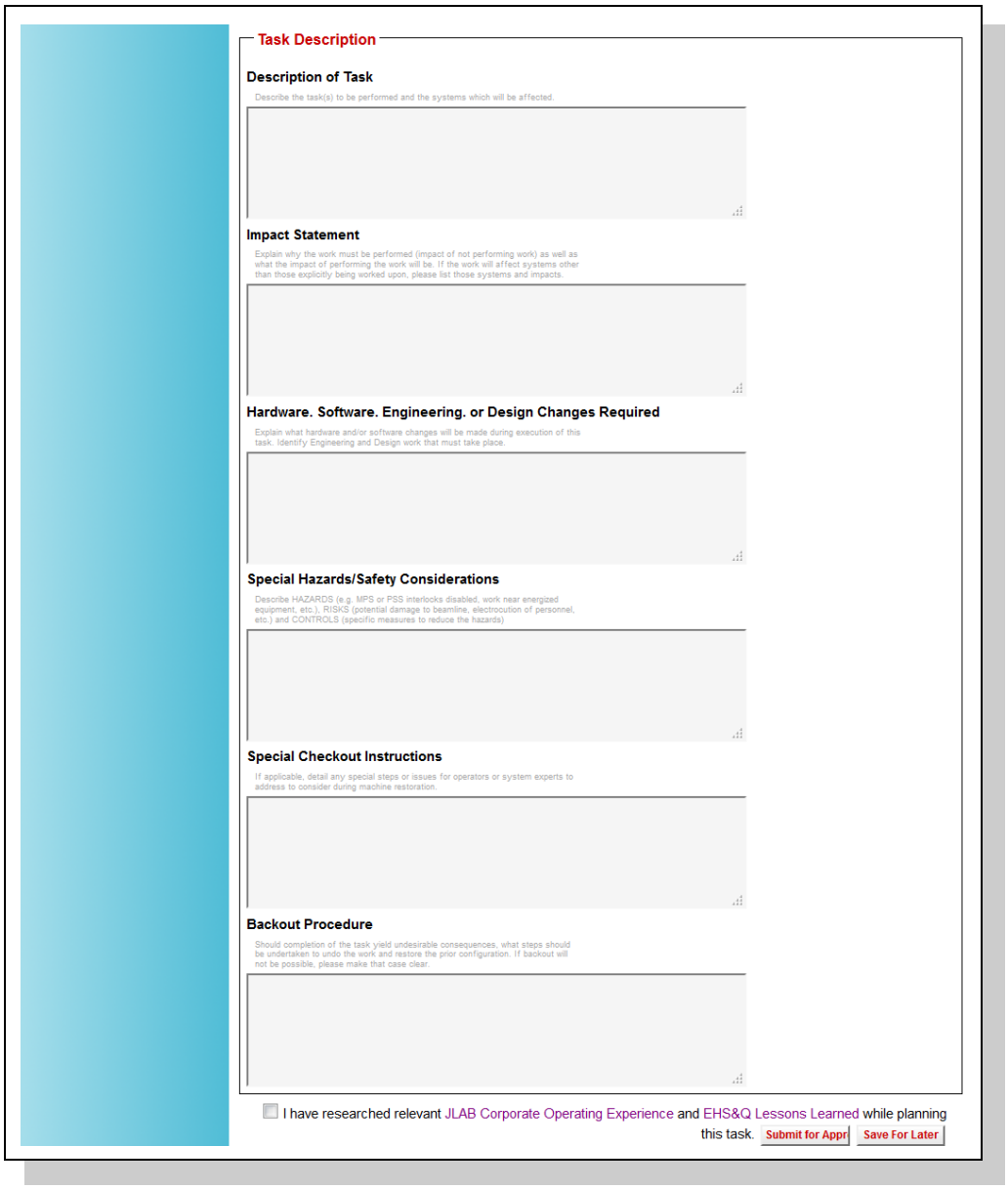
In consideration of the above Task Hazard Identification worksheet and the mitigation steps outlined, assign the Risk Classification.

Pre-mitigation Risk Code: Risk Class 1

Post-mitigation Risk Code: Risk Class 1

- Beam Test Plan
- Software Test Plan
- Description and Details

Figure F-4: ATLis Work Planning Template, p. 4

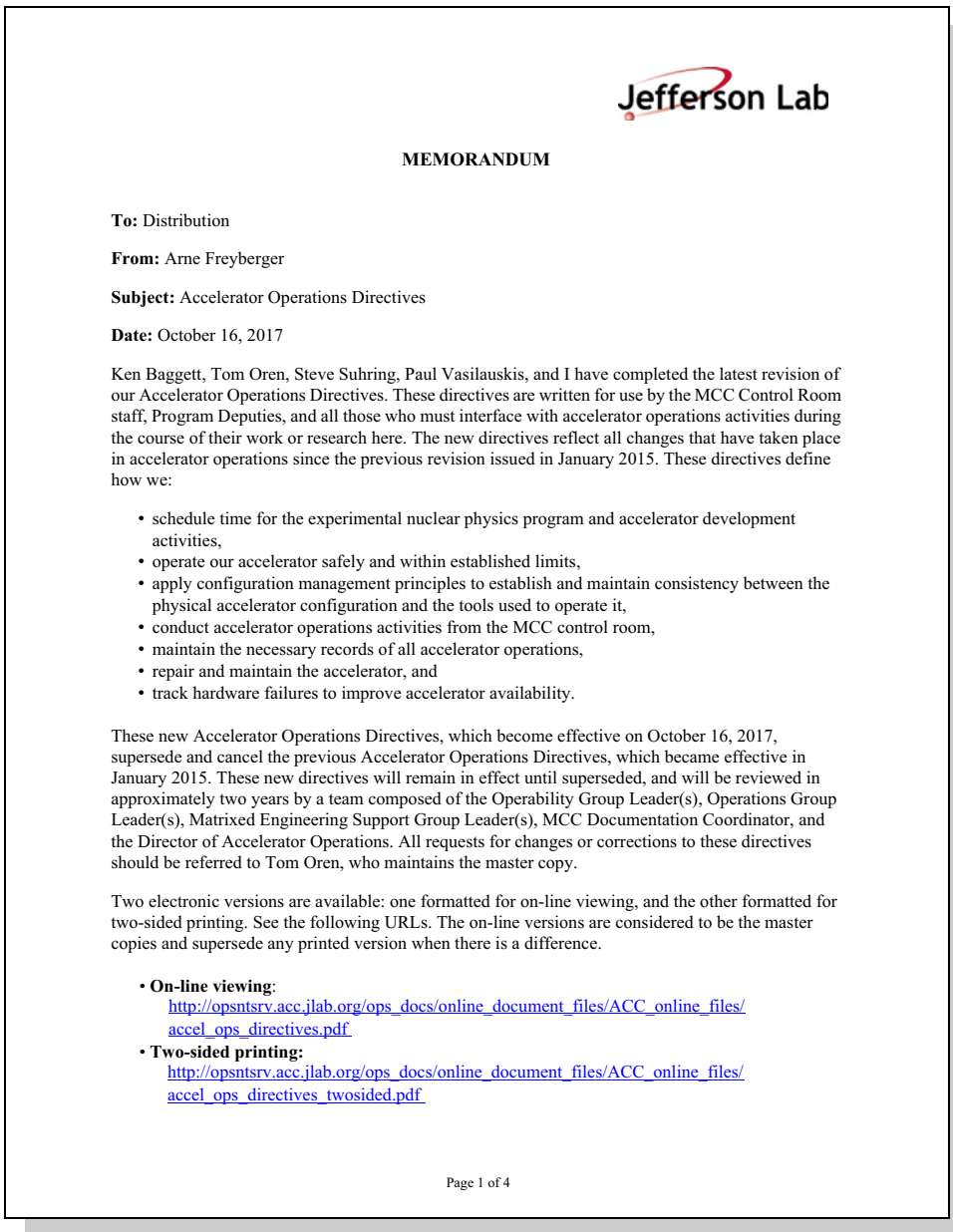


Appendix G AOD Release Memo

General Description:

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

Figure G-1: AOD Release Memo, p. 1



Jefferson Lab

MEMORANDUM

To: Distribution

From: Arne Freyberger

Subject: Accelerator Operations Directives

Date: October 16, 2017

Ken Baggett, Tom Oren, Steve Suhring, Paul Vasilauskis, and I have completed the latest revision of our Accelerator Operations Directives. These directives are written for use by the MCC Control Room staff, Program Deputies, and all those who must interface with accelerator operations activities during the course of their work or research here. The new directives reflect all changes that have taken place in accelerator operations since the previous revision issued in January 2015. These directives define how we:

- schedule time for the experimental nuclear physics program and accelerator development activities,
- operate our accelerator safely and within established limits,
- apply configuration management principles to establish and maintain consistency between the physical accelerator configuration and the tools used to operate it,
- conduct accelerator operations activities from the MCC control room,
- maintain the necessary records of all accelerator operations,
- repair and maintain the accelerator, and
- track hardware failures to improve accelerator availability.

These new Accelerator Operations Directives, which become effective on October 16, 2017, supersede and cancel the previous Accelerator Operations Directives, which became effective in January 2015. These new directives will remain in effect until superseded, and will be reviewed in approximately two years by a team composed of the Operability Group Leader(s), Operations Group Leader(s), Matrixed Engineering Support Group Leader(s), MCC Documentation Coordinator, and the Director of Accelerator Operations. All requests for changes or corrections to these directives should be referred to Tom Oren, who maintains the master copy.

Two electronic versions are available: one formatted for on-line viewing, and the other formatted for two-sided printing. See the following URLs. The on-line versions are considered to be the master copies and supersede any printed version when there is a difference.

- **On-line viewing**: http://opsntsrv.acc.jlab.org/ops_docs/online_document_files/ACC_online_files/accel_ops_directives.pdf
- **Two-sided printing:** http://opsntsrv.acc.jlab.org/ops_docs/online_document_files/ACC_online_files/accel_ops_directives_twosided.pdf

Page 1 of 4

Figure G-2: AOD Release Memo, p. 2

The following table summarizes what are considered to be the most significant changes made during this review cycle.

Table 1: 2017 AOD Revision Summary

Revision	AOD Section
SAD Program Deputy – Added a formal description of the SAD Program Deputy role, which is invoked during lengthy scheduled accelerator shutdowns. The Program Deputy role now applies specifically to accelerator running.	Section 1.3.2, p. 1-12
Long Term Schedule – Revised the dates of schedule release: end of May for 15 months beginning September 1; end of November for 15 months beginning January 1.	Section 1.4.1, p. 1-14
Songsheet Updates per CED – Songsheets will be updated per quarterly change reports generated by the CEBAF Element Database (CED).	Section 2.1, p. 2-1
Radcon Checklist – Removed the requirement for the Crew Chief to verify that a *Radcon Checklist* has been completed before sending beam to any portion of the accelerator or a hall that has been in Restricted Access for longer than 24 hours. In lieu of this requirement, the *Radcon Checklist* has been added to the Beam Authorization tool.	Section 3.1.1.1, p. 3-2
PSS Users Manual – Removed references to the *PSS Users Manual*, which, for sweep purposes, was replaced by the *PSS Sweep Procedure* and the *Service Building Sweep Procedure*.	Section 3.1.1.4, p. 3-7
ARM Responsibilities – Redefined the scope of ARM responsibilities. The primary function of an ARM is to serve as a radiological escort for Controlled Access entries into the beam enclosure. ARMs will no longer post or modify radiological areas or boundaries or perform radiation surveys for unescorted entry unless specifically authorized and directed by Radcon.	Section 3.1.1.6, p. 3-11
MPS Malfunctions – Director of Accelerator Operations approval is no longer required before resuming operations after MPS malfunctions are repaired; Crew Chief approval is sufficient.	Section 3.3.5, p. 3-16
Beam Strike Events – Beamline components activated to >1.0 R/hour by cryomodule field emission are now considered a "beam strike event." The Repair Assessment Committee investigates all beam strike events.	Section 3.3.6, p. 3-17
Internal Incident Commander – Defined the first-responder role that a Crew Chief or operator plays as the Internal Incident Commander (IIC) for on-site emergencies.	Section 3.3.7, p. 3-17
Staffing Requirements for Operations – Beam-on staffing levels are now tied to specific beam destinations: 500 keV, FC#2, 0R08, and recirculated beam. The staffing requirements are depicted using a graphical representation, along with a revised table format.	Section 3.4.2.1, p. 3-20
Accelerator Support Groups – Changed the section title to "Accelerator Support Groups" (previously "System Owners") and the text was changed to reflect the actual support structure.	Section 4.1.3, p. 4-3

Page 2 of 4

Figure G-3: AOD Release Memo, p. 3

Table 1: 2017 AOD Revision Summary

Revision	AOD Section
Operations Project-Review Process – Added a new section that defines a series of Operations-centric reviews intended to supplement other review processes already in place. These reviews are implemented using a graded approach, depending on the project complexity and potential impact to accelerator operations.	Section 4.2.2, p. 4-5
Immediate Maintenance ELog Entries – Reinforced the requirement for maintenance personnel to make an ELog entry describing the repair after it is completed.	Section 4.2.4.1, p. 4-6
Deferred Repairs – Before repairs are deferred and the program altered as a result, the Director of Accelerator Operations and the Operability Manager must be notified.	Section 4.2.5.2, p. 4-8
System Downgrades – If a repair lasts longer than eight hours or spans two or more shifts worked by repair personnel, the system's readiness should be downgraded in the System Readiness Tool.	Section 4.2.5.2, p. 4-8
System Readiness – Added a new section that describes how a system's "readiness" to support the scheduled accelerator program is tracked using the System Readiness Tool. Formerly this tracking tool was called the Hot Checkout Tool, and it's focus was post-shutdown system readiness leading up to a physics run. The functionality has been extended to track system readiness during accelerator running, and this new section describes that process as well as the hot checkout process.	Section 4.2.6, p. 4-9
Bypassing System Interlocks – Removed the specific details of this process, which are now described in the referenced *ES&H Manual* section.	Section 4.2.7, p. 4-12
System Repair Reports – Added detail describing the weekly, monthly, and annual system repair reports.	Section 4.2.10.1, p. 4-14
CEBAF Repair Flow – Added additional notifications at the two- and four-hour escalation points, and required notification of the Director of Accelerator Operations and Operability Manager if any repairs are deferred, thus altering the scheduled accelerator program.	Appendix E, p. E-1
"Daily Activity Log" to "ELog" – Changed all instances of "Daily Activity Log" to "Electronic Logbook (ELog)" to match commonly used terminology.	Many instances.

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Figure G-4: AOD Release Memo, p. 4

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