Target Fabrication
Tritium Facility

ORGANIZATION & REGULATION MANUAL
LLE INSTRUCTION 3100

SUBJECT: Target Fabrication Tritium Facility Organization and Regulation Manual

1. **Purpose:** To promulgate the policies, organization, regulations, and administrative procedures for operating the Target Fabrication Tritium Facility (TFAB).

2. **Promulgation:** The TFAB Organization and Regulation Manual is hereby promulgated.

3. **Approval:**

   [Signatures]

   David R. Harding  
   Target Fabrication Group Leader

   [Signatures]

   T. Craig Sangster  
   Experimental Division Director

   [Signatures]

   Walter T. Shmayda  
   Radiation Safety Officer

   [Signatures]

   Steven J. Loucks  
   Associate Director for Operations
Part I
Concept of Operations and Responsible Personnel

<table>
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1000 Tritium Laboratory Overview

The Target Fabrication Tritium Laboratory (Room 2838) houses several research systems that are used to handle tritium:

- Cryogenic Fill-Tube–Target Test Facility with DT (CFTF–DT): Conducts experiments that layer DT-filled National Ignition Facility (NIF)-scale capsules to determine the parameters required to field polar-drive experiments on the NIF.
- Isotope Separation System (ISS): Separates tritium from the other hydrogen isotopes to provide adjustable D–T ratios for LLE’s inertial confinement program.

1001 Tritium Laboratory Operations Overview

All aspects of tritium operations in Room 2838 will be under the direction and control of the Target Fabrication Tritium Laboratory Operations organization shown in Fig. I-1. This organization will control the tritium operations and will be responsible for the safety, design and execution of tritium-related experiments, data collection, and tritium monitoring.

![Diagram](image)

Fig. I-1. Organization of Target Fabrication Tritium Laboratory Operations.
The Tritium Laboratory Manager (TLM) is under the overall direction of the Target Fabrication Group Leader (GL). The Tritium Laboratory Manager, or person appointed by him/her, will review, track, schedule, and monitor all key tritium operations and maintenance actions.

Major equipment or systems placed out of commission will be tagged out in accordance with Section 4004 and logged in an Equipment Status Log maintained by the Tritium Laboratory Manager. The Tritium Laboratory Manager will inform the Target Fabrication Group Leader and the LLE Radiation Safety Officer of key equipment placed out of commission. The return of equipment and systems to commission after maintenance will be reported to the Target Fabrication Group Leader and LLE Radiation Safety Officer.

1002 Tritium Laboratory Manager

The Target Fabrication Tritium Laboratory Manager is responsible for the overall operation and operational readiness of the Tritium Systems. The Tritium Laboratory Manager reports to the Target Fabrication Group Leader and has the following specific responsibilities:

- Manage the Tritium Laboratory to ensure that it is fully ready to execute scheduled experiments approved by the Target Fabrication Group Leader.

- Direct Tritium Laboratory operations to ensure operations are conducted effectively and safely.

- Coordinate with System Engineering and the Radiation Safety Officer for the preparation and submission of written procedures covering tritium operations. Approve written change notices as required to clarify or amend these procedures.

- Manage and control all maintenance to ensure operational readiness.

- Make recommendations regarding the procurement of all Tritium Laboratory services, operating equipment spares and supplies, and system upgrade components.

- Be responsible for the overall system configuration control and management.

- Directly manage operator training and qualification and certify the qualification of the Tritium Laboratory Experimental Operators.

- Maintain a list of qualified Tritium Laboratory Operators.

- Analyze tritium system operations and performance.

- Approve any abnormal conditions, including directing the suspension of operations, if deemed necessary.

- Control access to the Tritium Laboratory.
1003  Tritium System Operator

The Tritium System Operator is the technician responsible for operation of the systems in the Tritium Laboratory. His/her specific responsibilities include the following:

- Operate the experimental systems that use tritium.
- Keep the Tritium Laboratory Manager informed as to system status and report any system abnormalities or failures that affect the performance of the systems.
- Collect and report data to the Tritium Laboratory Manager and the Target Fabrication Group Leader.
- Perform a weekly surface contamination survey of the laboratory and tritium stack monitoring.
Part II
Operational Organization and Personnel Relief

<table>
<thead>
<tr>
<th>Year</th>
<th>Title</th>
</tr>
</thead>
<tbody>
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<td>2001</td>
<td>List of Qualified Tritium System Operators</td>
</tr>
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<td>Pre-Operations Briefing</td>
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<td>2003</td>
<td>Tritium Laboratory Manager Day Orders</td>
</tr>
<tr>
<td>2004</td>
<td>Tritium Laboratory Manager Log</td>
</tr>
</tbody>
</table>

2001  List of Qualified Tritium System Operators

All personnel must complete the initial operator qualification specified in Part III of this manual. Only those who have completed the requisite qualification and have maintained operation proficiency may operate tritium-containing equipment in the Tritium Laboratory. The Tritium Laboratory Manager or a person designated by him/her will maintain a list of qualified personnel.

2002  Pre-Operations Briefing

Prior to the commencement of experiment operations, the Tritium Laboratory Manager and/or Target Fabrication Group Leader will conduct a briefing of key personnel. As a minimum, the following will be covered in this briefing:

- Status and readiness of the system
- Expected experimental requirements
- Review of problems experienced during previous operations

Personnel relief, if required because of two-shift operations or to accommodate individual personnel requirements, will be conducted in an orderly and controlled manner. Personnel must have the Tritium Laboratory Manager’s permission to be relieved and will not be relieved in the middle of a tritium operation. All personnel who are relieved of their duties will report their relief to the Tritium Laboratory Manager.
2003 Tritium Laboratory Manager Day Orders

The Tritium Laboratory Manager will prepare written directions for Tritium Laboratory operations that are made available to the Tritium System Operator(s) prior to each experiment. The following exemplify material to be included in these orders:

- Experimental/Operational plan for the day or the experiment
- Problems or special circumstances that warrant particular attention
- Administrative items of general interest to Tritium Laboratory operators

The orders will be read on a daily basis by all Tritium System Operators prior to conducting operations.

2004 Tritium Laboratory Manager Log

The Tritium Laboratory Manager will keep a chronological electronic log to document the operation of equipment involving tritium in the Tritium Laboratory. Each entry will be preceded by the date/time, and the log shall indicate the identity of the person operating the equipment along with the times of relief (if any) and laboratory securing. The following are required entries in this log:

- Commencement and completion of a particular process or experiment
- Significant problems or accomplishments
- Placing in or out of commission significant systems that affect the ability to perform operations
- Any incident that results in or could have resulted in personnel injury, significant material damage, or release of tritium above allowed limits
Part III
Personnel Training and Qualification

<table>
<thead>
<tr>
<th>3000</th>
<th>Personnel Training and Qualification Administration</th>
</tr>
</thead>
<tbody>
<tr>
<td>3001</td>
<td>Tritium System Operator Qualification Card</td>
</tr>
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<td>3002</td>
<td>Isotope Separation System Operator Qualification Card</td>
</tr>
<tr>
<td>3003</td>
<td>Gas Chromatograph Operator Qualification Card</td>
</tr>
</tbody>
</table>

3000 Personnel Training and Qualification Administration

All personnel assigned to operate tritium-related equipment in the Tritium Laboratory must complete the following formal documented qualification process:

- Complete requisite training and qualifications.
- Demonstrate a knowledge of organization and administrative procedures by satisfactorily completing an oral checkout from a qualified person.
- Demonstrate a knowledge of the technical system, subsystems, and equipment as well as associated applied engineering principles by satisfactorily completing an oral checkout from a qualified person.
- Complete operational training under instruction of a qualified person.
- Complete operational procedural requirements (practical factors) under the supervision of a qualified operator.
- Complete an oral examination by the Tritium Laboratory Manager after all other qualification card requirements are completed.

Once an individual completes a particular operation qualification, his/her name will be placed on the list of qualified personnel (2001), and the completed qualification card will be filed as a permanent record.
3001 Tritium System Operator Qualification Card

Name: ____________________________

Intent: Qualified for all Tritium System operations in Room 2838

Prerequisites: Radiation Worker Qualification; Electrical, Mechanical, Chemical, Beryllium, Laser, Liquid-Nitrogen Transfer, and Pressurized Gas Safety Training

Knowledge Requirements: Demonstrate knowledge of the following by satisfactorily completing an oral examination by a qualified individual:

<table>
<thead>
<tr>
<th>REQUIREMENT</th>
<th>QUALIFIED SIGNATURE/DATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Demonstrate knowledge of Tritium Operation Requirements, Personnel Relief, Procedural</td>
<td></td>
</tr>
<tr>
<td>Compliance, 2838 Room Access Restrictions, Maintenance and Tagout Protocol, General Safety,</td>
<td></td>
</tr>
<tr>
<td>Incident Reporting (TFORM, and LLE INST 6950)</td>
<td></td>
</tr>
<tr>
<td>2. Operation of the CFTF–DT System</td>
<td></td>
</tr>
<tr>
<td>4. Operation of the Isotope Separation System</td>
<td></td>
</tr>
<tr>
<td>5. Operation of the Stack Monitoring System</td>
<td></td>
</tr>
</tbody>
</table>

Practical Factors: Satisfactorily complete the following practical factors under the supervision of a qualified operator:

<table>
<thead>
<tr>
<th>REQUIREMENT</th>
<th>QUALIFIED SIGNATURE/DATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Demonstrate operation of CFTF–DT System</td>
<td></td>
</tr>
<tr>
<td>2. Demonstrate operation of Gas-Chromatography Mass</td>
<td></td>
</tr>
<tr>
<td>Spectrometry System</td>
<td></td>
</tr>
<tr>
<td>3. Demonstrate operation of Isotope Separation</td>
<td></td>
</tr>
<tr>
<td>System</td>
<td></td>
</tr>
<tr>
<td>4. Demonstrate operation of Stack Monitoring System</td>
<td></td>
</tr>
<tr>
<td>5. Replace He-gas cylinders</td>
<td></td>
</tr>
</tbody>
</table>
6. Refill LN2 Dewar

7. Refill cold-head compressor with helium

**Qualification Certification:** Satisfactorily complete a comprehensive oral examination covering all the knowledge and practical requirements of this qualification.

**EXAMINATION AND CERTIFICATION**

[Tritium Laboratory Manager]
3002  Isotope Separation System Operator Qualification Card

Name ______________________

Radiation Worker Certification: The above individual has satisfactorily completed all requirements to work with contaminated and activated materials and radiation sources and is in good standing as a radiation worker.

CERTIFICATION

/ __________________________
LLE Radiation Safety Officer

Practical Factors to operate the Isotope Separation System: Satisfactorily complete the following practical factors under the supervision of the Tritium Laboratory Manager:

<table>
<thead>
<tr>
<th>REQUIREMENT</th>
<th>QUALIFIED SIGNATURE/DATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Evacuate the storage bed secondary containments</td>
<td>________________________</td>
</tr>
<tr>
<td>2. Transfer gas from vessels to Pd and U beds</td>
<td>________________________</td>
</tr>
<tr>
<td>3. Shuffle gas between Pd and U beds</td>
<td>________________________</td>
</tr>
<tr>
<td>4. Evacuate the core system</td>
<td>________________________</td>
</tr>
<tr>
<td>5. Charge Pd/k column from gas vessels</td>
<td>________________________</td>
</tr>
<tr>
<td>6. Operate the separation columns</td>
<td>________________________</td>
</tr>
<tr>
<td>7. Recover tritium from the core system</td>
<td>________________________</td>
</tr>
<tr>
<td>8. Discharge raffinate from the mole sieve column</td>
<td>________________________</td>
</tr>
<tr>
<td>9. Remove helium from tritium gas</td>
<td>________________________</td>
</tr>
<tr>
<td>10. Vent the core system</td>
<td>________________________</td>
</tr>
<tr>
<td>11. Purge high tritium concentrations from the scroll pump</td>
<td>________________________</td>
</tr>
<tr>
<td>12. Operate the glovebox cleanup system</td>
<td>________________________</td>
</tr>
<tr>
<td>13. Operate the air lock</td>
<td>________________________</td>
</tr>
<tr>
<td>14. Activate the LN2 system</td>
<td>________________________</td>
</tr>
<tr>
<td>15. Load D₂ on the Pd/k coil</td>
<td>________________________</td>
</tr>
</tbody>
</table>

Qualification Certification: Satisfactorily demonstrated the knowledge and completed the practical evolutions required to operate the Isotope Separation System.

EXAMINATION AND CERTIFICATION

/ __________________________
LLE Radiation Safety Officer
3003  Gas Chromatograph Operator Qualification Card

Name __________________________

Radiation Worker Certification:  The above individual has satisfactorily completed all requirements to work with contaminated and activated materials and radiation sources and is in good standing as a radiation worker.

CERTIFICATION

__________________________________________ /
LLE Radiation Safety Officer

Practical Factors to operate the Gas Chromatographic (GC) System:  Satisfactorily complete the following practical factors under the supervision of the Tritium Laboratory Manager:

REQUIREMENT                    QUALIFIED SIGNATURE/DATE
1.  Prepare the GC for gas analysis  ____________________________ /
2.  Activate the GC cleanup system  ____________________________ /
3.  Demonstrate H₂/D₂ separation and analysis  ____________________ /
4.  Compile an analysis report  ____________________________ /
5.  Demonstrate H₂/D₂/T₂ separation and analysis  ____________________ /
6.  Operate the GC cleanup system  ____________________________ /

Qualification Certification:  Satisfactorily demonstrated the knowledge and completed the practical evolutions required to operate the Isotope Separation System.

EXAMINATION AND CERTIFICATION

__________________________________________ /
LLE Radiation Safety Officer

III-5
Part IV
Standard Operating Procedures

<table>
<thead>
<tr>
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<th>Description</th>
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</thead>
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<td>Procedural Compliance</td>
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<tr>
<td>4001</td>
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</tr>
<tr>
<td>4002</td>
<td>Control of Maintenance</td>
</tr>
<tr>
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</tr>
<tr>
<td>4004</td>
<td>Tagout/Lockout</td>
</tr>
<tr>
<td>4005</td>
<td>Safety</td>
</tr>
</tbody>
</table>

4000 Procedural Compliance

Protection from personal exposure to hazardous as well as the need to avoid the potential for significant equipment damage or release of tritium to the environment dictates the need for formal compliance with approved operational procedures. Formal procedural compliance means:

- Only formally approved written procedures will be used to conduct tritium operations.
- If an error or omission that prevents continuing is noted in an Operation Procedure, the system will be placed in a safe state and the operation will be halted until a formal written change to the procedure is approved by the Tritium Laboratory Manager.
- The System Operation Procedures will be referenced as required during operations. For Tritium Operations, the applicable procedures will be open and used as a checklist by the Tritium System Operators. For all other evolutions, e.g., system preoperational checks and startup, system shutdown, and maintenance operations, the procedure will be referenced as frequently as necessary to ensure compliance with the procedural requirements.

4001 Tritium Laboratory Access and Personal Protection Equipment

To ensure the safe and proper operation of the laboratory, the following will be enforced:

- Access will be restricted to qualified operators and managers and will be controlled by an ID Card Reader at the entrance to Room 2838.
- A laboratory coat will be worn when inside the Tritium Laboratory.
- Operators will not be distracted during tritium operations.
- Gloves will be worn when performing operations inside of glove boxes.
- Arm protectors will be worn when the need arises.
4002 Control of Maintenance

Maintenance must be controlled to ensure the readiness of the Tritium Laboratory to conduct operations. Accordingly, the following procedures will be followed:

- The approval of the Tritium Laboratory Manager must be obtained prior to performing maintenance on or removing a system, subsystem, diagnostic, or equipment from service that is required to support operations.
- The Tritium Laboratory Manager will maintain an Equipment Status Log to document systems, subsystems, diagnostics, or equipment placed out of commission or in reduced status.
- Corrective and preventive maintenance will be scheduled by the Tritium Laboratory Manager in consonance with the laboratory’s operating schedule.
- The completion of maintenance and the restoration of systems, subsystems, or equipment to service will be reported to the Tritium Laboratory Manager.

4003 Equipment Status Log

The Tritium Laboratory Manager will maintain an Equipment Status Log that documents the current out-of-commission status and/or material deficiency of systems, subsystems, or equipment and the completion of required preoperational tests and inspections prior to resuming operation. This log will be maintained electronically in an Excel spreadsheet, as follows:

*Out-of-Commission (OOC)/Material Deficiency List:* This list will be maintained in an Excel spreadsheet as a chronological listing of systems, subsystems, or equipment placed out of commission or noted to have a material deficiency. This list will be maintained in the following format:

<table>
<thead>
<tr>
<th>Time/Date Placed OOC</th>
<th>System, Diagnostic, or Equipment</th>
<th>Tagout (if required)</th>
<th>Post Test</th>
<th>Time/Date Restored</th>
<th>GL/TLM Initials</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Enter Next Number</td>
<td>Date Cleared</td>
<td>Enter Y/N</td>
<td>Date Completed</td>
</tr>
</tbody>
</table>

Before restoring a system, diagnostic, or equipment and signing the time/date restored block, the Tritium Laboratory Manager will ensure that both the tagout and post-test requirements, as applicable, are completed.

The OOC/Material Deficiency List will be reviewed weekly to ascertain new items and update those that have been corrected.
4004 Tagout/Lockout

To ensure personnel safety and prevent equipment damage, positive procedures are required to prevent the inadvertent operation of systems or equipment placed out of commission for maintenance. Of particular concern is the risk of electrical shock, release of the stored energy from pressurized compressible fluids, or the release of toxic chemicals or tritium. As a facility becomes larger and more people become involved in the operation and maintenance of the same systems and equipment, reliance on a “single” cognizant person for his or her safety can no longer be assumed. Accordingly, it becomes increasingly likely that a circuit breaker, switch, or valve will be inadvertently operated by an operator who is unaware of a system’s maintenance status. Such actions can result in the personal injury or death (e.g., electrocution or entrapment by rotating equipment) of personnel performing maintenance or in the destruction of equipment (e.g., starting a pump without oil). Accordingly, formal procedures are required to prevent the inadvertent operation of systems or equipment placed out of commission for maintenance.

As used in this procedure, a “tagout” is defined as the placement of a tag on a breaker, switch, control device, or valve that states that it should not be operated. “Lockout” is defined as the installation of a physical barrier to operation such as a lock or the removal of a connecting link to prevent operation of the component being worked on.

The following policies apply to utilizing the tagout/lockout procedures described herein:

- Each supervisor and maintenance technician will evaluate each maintenance action with respect to safety and the need to utilize these tagout/lockout procedures. If there is a risk of someone inadvertently operating a system opened for maintenance, appropriate breakers, switches, control devices, and/or valves will be tagged in the safe position by a red “DANGER DO NOT OPERATE” tag (see Fig. IV.1) or will be physically locked to preclude operation. The Tritium Laboratory Manager will be responsible for ensuring that these tagout/lockout procedures are used when appropriate prior to allowing maintenance to take place.

- Breakers, switches, valves, etc., that are tagged will be verified by personal inspection to be in the appropriate position prior to hanging a “DANGER DO NOT OPERATE” tag. These tags will be securely affixed to the actual breaker, switch, or valve in a manner that ensures their visibility to anyone who might operate it. After the tag is affixed, it will be signed by the person hanging it. Breakers and switches will be verified by observing their position relative to local on/off markings. Valves will be verified either by position indicators or physically verifying the valve by turning in the direction of the desired position.

- The tag(s) shall be removed when maintenance is completed and the system or equipment is ready to be restored to service or operated for testing.

- Under no circumstances will a breaker, switch, or valve that is tagged by a “DANGER DO NOT OPERATE” tag be operated.
• Particular attention must be paid to systems or equipment that either has more than one source of power or is remotely controlled.

• All electrical power systems containing >24 V will be de-energized prior to performing maintenance, unless the procedures for working on energized components are employed. Tags will be used for protection on systems with voltages from 120 to <440 V. Physical lockout will be used for protection on systems with a voltage of ≥440 V.

A Tagout Log consisting of a tagout index and individual tagout sheets will be maintained by the Tritium Laboratory Manager and will be administered as follows:

• The Out-of-Commission/Material Deficiency List will serve a dual purpose as the tagout index. When a tagout is indicated as necessary, a sequential tagout number will be assigned and entered in the space provided.

• An individual tagout sheet (Fig. IV-1) will be filled out for each individual system, subsystem, diagnostic, or equipment that requires a tagout. After the tagout sheet is completed by the maintenance person, the adequacy of the tagout coverage will be verified by the Tritium Laboratory Manager who will indicate his/her authorization by signing the tagout sheet.
Once the tagout is authorized, the maintenance person will install the tags, and when all tags are installed, he/she will sign the tagout sheet; maintenance may then be started.

When maintenance and required preoperational inspections are completed, the maintenance person will remove the tags that were hung to support the maintenance. All tags removed will be delivered to the Tritium Laboratory Manager and the maintenance person will sign the tagout sheet to indicate the tags have been removed.

The Tritium Laboratory Manager will check that all tags listed on the tagout sheet have been returned. He/she will then remove the respective tagout sheet from the active section of the tagout log and place it in the inactive section of the log. If no Post Test is required, the Tritium Laboratory Manager will also update the OOC List by indicating the date the equipment was restored to service.

When a Post Test is completed after removal of the tags, the maintenance person will review the results with the Tritium Laboratory Manager and certify that the equipment may be restored to service. The Tritium Laboratory Manager will then update the OOC List by indicating the date the equipment was restored to service.

A weekly audit of the Tagout Log will be conducted as follows:

- Check the OOC List/Tagout Index against the Active Tagout Sheets to ensure they agree.
- For all Active Tagout Sheets, verify by visual inspection that all associated tags are in place, the component is in the proper position, and the tag is properly completed and signed. Any deficiencies must be resolved by preparing new tagouts/tags as required.
- Upon completion of the audit, the OOC List/Tagout Index will be recopied to list only the active items. All Inactive Tagout Sheets and associated tags should then be archived.

4005 Safety

The safe operation of the Tritium Laboratory is of paramount importance and will not be jeopardized. It is the responsibility of all personnel to follow applicable safety procedures. The failure to follow established safety procedures may result in appropriate disciplinary action up to and including dismissal. Since general and specific safety precautions, procedures, laws, and regulations exist from several authoritative sources (e.g., University Environmental Health and Safety procedures, state and local electrical and mechanical codes, NYS laser and radiation safety regulations, etc.), they will not be enumerated here.

The Tritium Laboratory Manager has the overall responsibility for the safe operation of the Tritium Laboratory under the general guidance and oversight of the Laboratory Safety Officer and the functional area safety officers (Chemical, Electrical, Laser, and Radiological). If a question arises with respect to safety, it should be resolved by
referring to an authoritative reference before proceeding. Should situations arise where procedures are unknown or there are questions of interpretation, the appropriate functional area safety officer should be consulted before proceeding. These situations and questions will also be brought to the attention of the Laboratory Safety Officer before proceeding.

The following policies apply to safety throughout the laboratory:

- No person will willfully operate, energize, or otherwise use any tool, system, or equipment that is known to have a safety defect.
- Only personnel who are specifically trained and qualified will perform system or equipment maintenance.
- No safety-related interlock, alarm, detector, or device will be overridden or disabled without the specific permission of the Laboratory Safety Officer.
- Safety incidents and potentially unsafe practices or conditions will be reported immediately to the Tritium Laboratory Manager who in turn will inform the Target Fabrication Group Leader, the appropriate functional safety officer, and the Laboratory Safety Officer.
- No person will intentionally allow him- or herself to be shocked by electricity, to inhale or eat hazardous chemicals or materials including radioactive material, to be exposed to laser radiation without appropriate protection, or to be exposed unnecessarily to nuclear radiation.
- Appropriate safety protective equipment shall be worn when required. This includes appropriate goggles when exposed to laser light; safety glasses, rubber gloves, and laboratory aprons when handling hazardous chemicals or cryogenic fluids; safety glasses when operating machine tools such as grinders, drills, lathes, milling machines, etc.; safety shields and rubber gloves when working on energized power sources; and safety harnesses when working aloft.
- Systems and equipment shall be tagged out in accordance with Section 4004 as required.
- Only personnel trained and certified to operate machine shop equipment by a full-time LLE machinist will operate such equipment.
- All personnel will comply with the electrical safety procedures detailed below.

Electrical Safety Procedures: Electrical or electronic equipment containing >24 V shall be de-energized prior to performing corrective maintenance. This does not apply to taking readings on, making adjustments to, or trouble shooting electrical or electronic equipment when by equipment or instrument probe design, the readings and adjustments can be made without risk of electrical shock. A risk of electrical shock exists if it is possible to inadvertently contact a live electrical circuit. If there is a risk of shock and it is necessary to take readings on or perform maintenance adjacent to energized components, the following procedures for working on energized equipment must be followed:
• Permission to work on energized equipment must be received by the cognizant Group Leader and the Laboratory Safety Officer or the Electrical Safety Officer.

• The equipment should be de-energized to the maximum extent possible.

• A minimum of two personnel must be present: one who is actually performing the maintenance and one who acts as a safety monitor.

• Insulating material should be laid out to the maximum extent practical to insulate the worker from ground and to protect against inadvertent contact with energized components.

• Approved insulated rubber gloves should be worn if practical.

• The safety monitor must be knowledgeable. As a minimum, he or she must know how to de-energize the equipment, be in a position to observe the worker, and be in a position to pull/push the worker free in the event he or she receives an electrical shock. Care should be exercised that the safety monitor is not shocked in the process of freeing a shock victim. To this end, a rope or belt or personal momentum should be used to free the victim.

• Someone qualified in CPR should be available in the laboratory.

• Insulated tools and instruments should be used.

• A voltage tester should be used to verify which circuits are energized and which are de-energized before commencing maintenance.
<table>
<thead>
<tr>
<th>Time/Date Placed OOC</th>
<th>System, Diagnostic, or Equipment</th>
<th>Tagout (if required)</th>
<th>Post Test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Enter Next No.</td>
<td>Date Cleared</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Enter Y/N</td>
<td>Date Completed</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Time/Date Restored</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>GL/TLM Initial Here</td>
</tr>
</tbody>
</table>

IV-8
Tagout Sheet

Tagout number: __________

System or equipment name: _____________________________________________

Reason for tagout: ___________________________________________________

Post Test: ____________________________________________________________

(provide brief description or enter “N/A”)

<table>
<thead>
<tr>
<th>Tag suffix (-A,-B,...)</th>
<th>Breaker, switch, or valve identification</th>
<th>Position</th>
<th>Tag Removed</th>
<th>Post Test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>O = open/off</td>
<td>S = shut</td>
<td></td>
</tr>
<tr>
<td></td>
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Tagout authorized by __________________________ / ________________________
(Tritium Laboratory Manager) (Time and Date)

Tags installed by __________________________ / ________________________
(signed after installing) (Installer) (Time and Date)

Tagout cleared by* __________________________ / ________________________
(signed when all tags removed) (Remover) (Time and Date)

Restored to Commission __________________________ / ________________________
(signed when post test is complete) (Tester) (Time and Date)

*Complete after removal and delivery of the removed tags to the Tritium Laboratory Manager.