Person: Welch, Keith (welch@jlab.org)
Org: RADCN

Status: PROCESSED
Saved: 1/23/2020 9:05:53 AM
Submitted: 1/23/2020 9:05:53 AM

Jefferson Lab
Thomas Jefferson National Accelerator Facility

Operational Safety Procedure Review and Approval Form # 95834
(See ES&H Manual Chapter 3310 Appendix T1 Operational Safety Procedure (OSP) and Temporary OSP Procedure for Instructions)

Type:	***OSP***	Click for OSP/TOSP Procedure Form Click for LOSP Procedure Form Click for LTT-Individual Information Click for LTT-Group Information	
Serial Number:	***ESH-20-95834-OSP***		
Issue Date:	***1/28/2020***		
Expiration Date:	***12/28/2020***		
Title:	***Isotope production target preparation, handling, analysis, and packaging***		
Location: (where work is being performed) Building Floor Plans	***18 - Low Energy Recirculator Facility (LERF) Floor 1***	Location Detail: (specifics about where in the selected location(s) the work is being performed)	***LERF Vault***
Risk Classification: (See ES&H Manual Chapter 3210 Appendix T3 Risk Code Assignment)	Without mitigation measures (3 or 4): With mitigation measures in place (N, 1, or 2):		***2*** ***1***
Reason:	This document is written to mitigate hazard issues that are : ***New/previously unrecognized Hazard Issue***		
Owning Organization:	***RADCN***		
Document Owner(s):	***Hamlette, David (hamlette@jlab.org)*** Primary ***Stavola, Adam (astav@jlab.org)*** ***Welch, Keith (welch@jlab.org)***		

Supplemental Technical Validations

Hazardous Material Transport - On or Off Site (Christian Whalen, Jennifer Williams)
ODH 0 and 1 (Imani Burton, Jennifer Williams)
Radiological Controlled Area (David Hamlette, Keith Welch)
Radiologically Contaminated Area (David Hamlette, Keith Welch)
Storage & Handling of Radioactive Materials (David Hamlette, Keith Welch)

Other Hazards:
gallium (Jennifer Williams)

Document History

Revision	Reason for revision or update	Serial number of superseded document

0	*New*	

Lessons Learned	Lessons Learned relating to the hazard issues noted above have been reviewed.
Comments for reviewers/approvers:	

Attachments

Procedure: ***Procedure-Isotope_OSP2019_r3-2.pdf***

THA: ***THA-Isotope_THA_R1.pdf***

Additional Files:

Review Signatures

Additional Authorization : Associate Director - ESH&Q	**Signed** on 1/23/2020 3:06:09 PM by Bob May (may@jlab.org)
Person : Subject Matter Expert : gallium	**Signed** on 1/23/2020 9:55:45 AM by Jennifer Williams (jennifer@jlab.org)
Subject Matter Expert : Hazardous Material Transport - On or Off Site	**Signed** on 1/23/2020 9:55:45 AM by Jennifer Williams (jennifer@jlab.org)
Subject Matter Expert : Oxygen Deficiency Hazards (ODH)->ODH 0 and 1	**Signed** on 1/23/2020 9:55:45 AM by Jennifer Williams (jennifer@jlab.org)
Subject Matter Expert : Radiation - Ionizing->Radiological Controlled Area	**Signed** on 1/23/2020 9:05:53 AM by David Hamlette (hamlette@jlab.org)
Subject Matter Expert : Radiation - Ionizing->Radiologically Contaminated Area	**Signed** on 1/23/2020 9:05:53 AM by David Hamlette (hamlette@jlab.org)
Subject Matter Expert : Radiation - Ionizing->Storage & Handling of Radioactive Materials	**Signed** on 1/23/2020 9:05:53 AM by David Hamlette (hamlette@jlab.org)

Approval Signatures

Division Safety Officer : RADCN	**Signed** on 1/23/2020 3:06:09 PM by Bob May (may@jlab.org)
Org Manager : RADCN	**Signed** on 1/23/2020 3:06:09 PM by Bob May (may@jlab.org)
Safety Warden : Low Energy Recirculator Facility (LERF) Floor 1	**Signed** on 1/28/2020 3:05:55 PM by Tina Menefee (menefee@jlab.org)

fa

Jefferson Lab
Thomas Jefferson National Accelerator Facility

Operational Safety Procedure Form

(See ES&H Manual Chapter 3310 Appendix T1 Operational Safety Procedure (OSP) and Temporary OSP Procedure for instructions.)

Click

Title:	Isotope production target preparation, handling, analysis, and packaging		
Location:	Building 18 (LERF Vault)	**Type:**	☒ OSP ☐ TOSP
Risk Classification (per Task Hazard Analysis attached) (See *ESH&Q Manual Chapter 3210 Appendix T3 Risk Code Assignment*.)		**Highest Risk Code Before Mitigation**	2
		Highest Risk Code after Mitigation (N, 1, or 2):	1
Owning Organization:	Radiation Control Department	**Date:**	11/6/19
Document Owner(s):	David Hamlette, Adam Stavola, Keith Welch		

DEFINE THE SCOPE OF WORK

1. Purpose of the Procedure – Describe in detail the reason for the procedure (what is being done and why).

The purpose of this Operational Safety Procedure (OSP) is to set forth the steps to remove, analyze, and package the post-irradiated gallium for off-site shipping to Virginia Commonwealth University

2. Scope – include all operations, people, and/or areas that the procedure will affect.

Although the Radiation Control Department (RCD) staff will be primarily responsible for execution of this OSP, several LERF personnel will be involved in the set-up/preparation for the isotope run. The LERF vault will be used exclusively for the purpose of completing the isotope run. There will be a Job-specific radiation work permit (RWP) that will outline all of the tasks associated with this OSP.

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

The LERF vault is normally a radiologically controlled area. During the isotope run, the control room will be manned by operators to facilitate taking the machine to Beam permit. Initial access to the vault post-irradiation will be performed by RCTs. Radiation, high radiation, and contamination areas are expected and will be assessed upon initial entry

ANALYZE THE HAZARDS and IMPLEMENT CONTROLS

4. Hazards identified on written Task Hazard Analysis

Refer to attached Task Hazard Analysis Work Sheet for details and mitigation. The following lists the hazards.

1. Ionizing Radiation
    a. Radiation areas
    b. High Radiation areas
    c. Contamination areas
2. Oxygen Deficiency
3. Corrosive hazard (gallium)

5. Authority and Responsibility:

4.
5.
5.1 Who has authority to implement/terminate

Keith Welch – Radiation Control Department Manager

5.2 Who is responsible for key tasks

David Hamlette and Adam Stavola – Radiation Control Department personnel

5.3 Who analyzes the special or unusual hazards including elevated work, chemicals, gases, fire or sparks (See ES&H Manual Chapter 3210 Appendix T1 Work Planning, Control, and Authorization Procedure)

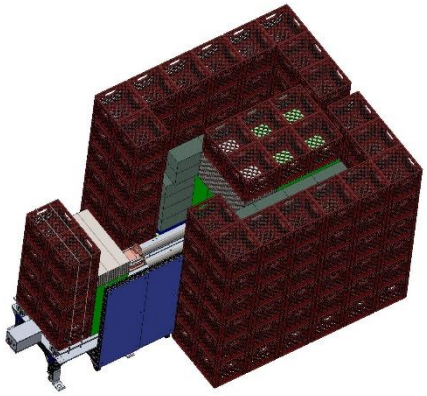
Division Safety Officers and certain Subject Matter Experts as indicated on the signature page.
Ionizing Radiation – Keith Welch
Oxygen Deficiency – J. William
Fire – Tim Minga

6. Personal and Environmental Hazard Controls Including:

5
6

6.1 Shielding

The 1X dump associated with the isotope experiment consists of a combination of S2 steel blocks, steel plates, cinder blocks and water filled cubitainers. The engineered design has been reviewed by the SCMB and is documented in the Radiation Control Shielding design database (Isotope Project Target Shielding). There will also be a shadow shield put in place to mitigate the significant residual dose rates upon entry to perform the removal and packaging of the gallium crucible.



1X Target Shielding

Movable shadow shield

The target shielding has been designed to provide the necessary shielding during the isotope run. Additionally, it provides a remote actuated access to the target apparatus for crucible removal and serves as a decay bunker for radiator once gallium is packaged.

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

N/A

6.3 Interlocks

During the isotope production run, access control interlocks will be invoked. The SSG group shall ensure that proper certifications have been performed, and up to date, prior to commencement of beam operations.

6.4 Monitoring systems

The LERF rapid access system function will be disabled during the isotope irradiation, however the actual unit (base and probes) will be used for diagnostic purposes. Controlled area radiation monitors in the LERF gallery will continue to be operational.

Continuous radiological air monitoring will be conducted during the experiment.

6.5 Ventilation

There will be no changes to any ventilation system. Area ventilation system identified in, or associated with LERF, are based on the ODH analysis for the facility.

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

7. List of Safety Equipment:

7.1 List of Safety Equipment:

1. Personal protective equipment for target removal will be defined in the Radiation Work Permit.

7.2 Special Tools:

- Extension tongs to remove crucible from test apparatus
- Transfer tray to be used during movement of crucible from test apparatus to lead pig
- Equipment cart with lead bricks for additional ALARA measures
- Rod for hands-off smear surveys

8. Associated Administrative Controls

- Job-specific RWP
- Radiological Posting

9. Training

6.
7.
8.
9.
9.1 What are the Training Requirements (See List of Training Skills)

Personnel who access the LERF vault during the isotope production run must have the following training:
- SAF 100 – ES&H Orientation
- SAF 103 – Oxygen Deficiency Hazard
- SAF 801T/P– Rad worker I
- SAF801kd – General Access RWP
- SAF 802 T/P – Rad worker II (for access to the target hutch after irradiation)
- Read and sign this OSP

DEVELOP THE PROCEDURE

10. Operating Guidelines

The Isotope run target handling is governed by this Operational Safety Procedure, which will provide step-by-step instructions, as well as a backout procedure in the event of an unexpected outcome.

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

Radiation: Radiation Control Department Manager – Keith Welch 757-876-5342
LERF Isotope PI: Kevin Jordan 757-876-1742, Radiation Control Department Field Operations Manager: David Hamlette 757-876-1743

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

NOTE: For procedural steps requiring two people, P1 is used to designate actions for the first individual and P2 is used to designate actions for the second individual. Steps without the P1 or P2 designation may be performed by either individual. A third person is expected to perform the analytical preparation prior to or concurrent with the crucible removal. The RAL Manager (or designee) should approve the use of ISOCS for analyzing the shielded crucible.

12.0 Loading Crucible

12.0.a Don PPE; Lab coat, safety goggles & Nitrile (11 mil minimum thickness) Gloves

12.0.b Lay down protective barrier in the fume hood in lab 1, ensure fume hood is on, and lower the sash as much as practical for splash protection.

12.0.c Heat the Gallium in a water bath (glass beaker) on a hot plate to 30 to 40 C, set crucible on hot plate as well to raise temperature to >30C (if exceed 44C, then use tongs to handle beaker.)

12.0.d Set crucible on a scale & zero scale

12.0.e Place ~50 grams of Gallium in crucible and record the weight

12.0.f Screw Graphite plug into the end of the crucible. Place in a plastic case with gallium/corrosive label.

12.0.g Store filled crucible on LCW stabilized copper plate until ready for use (preferably the target cooling raft in the hutch).

NOTE: If gallium is spilled, cleanup with spill pads and return used pads to ES&H for disposal. Properly dispose of gloves per ES&H requirements.

After preparation, the crucible is installed in the 1X irradiation hut by LERF staff.

12.1 Post-Irradiation Crucible Removal and Packaging

All shipping container components and packing labels, counting equipment, transport cart, smears, bags and PPE should be prepared and staged prior to irradiation. Ensure the transport cart is prepared with herculite covering and loaded with: (1) shipping pig, (2) tongs, (3) bags, (4) modified smears (5) tape and (6) extra PPE.

12.1.a P1 and P2: Approach the isotope shield from the South end (accessible side) with appropriate survey meters. P2 should remain out of the immediate area and document survey results as P1 performs general area surveys around the isotope shield (radiation and contamination). Perform field checks on general area smears, then send for lab counting.

12.1.b P1: Move the portable shield to the access-side of the isotope shield structure. P1 also moves the transport cart adjacent to the portable shield. Ensure the lid is removed from the shipping pig and positioned adjacent to the pig.

12.1.c P1: Move to the downstream side of the isotope shield structure and open the shield hutch using the remote controls. Once open, P1 visually inspects the crucible for any signs of failure. If there are any indications of rupture or leakage, take a photograph and close the shield. Report back to the Principle Investigator.

12.1.d P1: Take radiation measurements, including contamination surveys on the crucible with the modified smears. P2: Document the measurement results. If the radiation measurements are greater than 1R/hr whole-body or contamination results are greater than 1E+06 dpm/100cm^2, P1 shall close the shield and alert the RCM for further direction.

12.1.e P1: While positioned behind the portable shield, use the tongs to release the crucible restraints (clasps). **Release the rear clasp first**, then the side clasp. Ensure the clasp handles are swung as far open as possible.

12.1.f P1: Position the tongs on the crucible, ensuring the grippers engage completely around the crucible. Grasp the crucible with the tongs, keeping the handles firmly closed. Carefully lift the crucible off the raft and position it above the rolling cart. Take contact and 30 cm dose rates on the crucible, then place it in the shipping pig with the graphite plug facing up. Place the tongs in a poly bag.

12.1.g P1: Secure the shipping pig lid using the clasps. P2: Close the shield hut using the remote control. Place the locking hasp on the drive chain and lock with an RCG-1 lock.

12.1.h Carefully move the cart to the counting area and position the shield/cart into the counting configuration. Take contact and 30 cm radiation measurements of the shielded crucible. Record the readings on a survey form.

12.2 Crucible Analysis (ISOCS)

Note: The ISOCS system should be configured in advance by the RAL Manager. The configuration includes background sources in the area and QC checks prior to the crucible analysis. If the system is not configured, users should contact the RAL Manager prior to analysis.

12.2.a With the crucible and shield in position, open the Gamma Acquisition and Analysis software. Select the "A_1" button to run the "Ga_Cu_Analysis" analysis sequence.

12.2.b A sample report is printed on the screen once the count is complete. Select "Export to Report to PDF" from the "File" Menu. Save the report to M:\radcon\RAL\Gamma Spec\ISOCS_Measurements\2019_IsotopeProduction

12.2.c Review the sample results, spectrum, and report for anomalies.

12.3 Crucible Analysis (Dose Rate)

Note: This step should only be performed if the ISOCS system is unusable and should be performed concurrent with loading crucible into the shipping shield.

12.3.a Refer to the 30 cm radiation survey data taken in step 12.1.h. Dose-to-activity values are estimated from simulation results for 1kW with 34 hours of irradiation and 10 hours of decay in accordance with the following table:

Table 1
Isotopic Dose Rate to Activity Conversions at 30 cm (DC_s)
($mCi \cdot mR^{-1} \cdot h$)

Cu64	Cu67	Ga67	Ga72	Zn69m	Ga68
0.155	0.022	0.624	0.011	0.006	0.042

12.3.b Calculate the isotopic activity using the expected simulated dose rates and simulated isotopic concentrations as follows:

$$A_i = DC_s \cdot \dot{D}_m$$

Where A is the isotopic activity for each isotope in the final form (i), DC is the dose rate to activity conversion from the simulation (s), and $\dot{D}$ is the measured (m) dose rate.

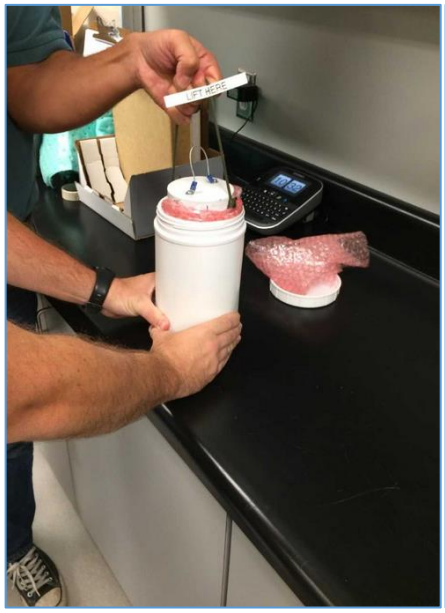
12.4 Packaging Instructions

Note: General RCD shipping responsibilities, surveys and shipping preparations are provided in RCD procedure HPP-OPS-001.

Caution: The assembled inner container weighs approximately 18 pounds; packaging operations that require lifting the shield should be performed by two personnel.

12.4.a Ensure the "**LIFT HERE**" label is affixed to the paracord handle on the crucible shield. Ensure the clasps are closed and affix the prepared "**CAUTION: OPEN IN HOT CELL**" label around the shield so that the clasps are covered.

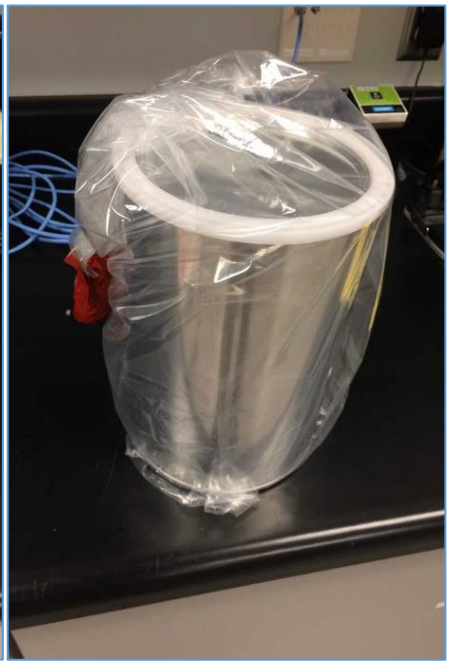
12.4.b Using the paracord handle, lower the shield into the plastic container. Add bubble packaging, as needed, to ensure a tight fit.



12.4.c Seal the top of the container with several wraps of electrical tape, place the container in the mesh transport bag. Ensure the steel canister has the absorbent padding installed, and lower the container into the steel canister. Once in the canister, add bubble packaging to ensure a tight fit and seal the container using the lid and lid locking ring.

12.4.d Place the sealed steel canister into the inner plastic bag (min 0.002 mil). J-Seal the bag.





12.4.e Prepare the shipping box by removing the lower foam insert and placing it into a plastic bag (min 0.003 mil). Place the insert with bag into the box.

12.4f Place the package (steel canister in the inner bag) into the lower foam insert in the shipping box. Ensure the canister registers completely into the insert. Place the upper foam insert over the container and ensure that it completely engages the canister. J-seal the bag.

12.4.g Place a copy of the Package Opening Instructions in the box. Close the shipping box lid, close the clasps and attach a tamper seal. **Caution: use care to ensure that the lid retainer wire does not get caught in the lid track.**

12.4.h Use RCD procedure HPP-OPS-001 to complete shipping preparations.

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

During step 12.1, back out procedure involves placing the crucible within the shielding hutch, ensuring equipment is stored in a safe condition, and closing the shielding hutch. Adequate time should be allowed for the isotopes of concern to decay.

14. Special environmental control requirements:

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

Gallium

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

None

14.3 Abatement steps (secondary containment or special packaging requirements)

Type A package with secondary containments for shipping

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

See Emergency Response Guideline:
https://jeffersonlab.sharepoint.com/sites/IsotopeProductionDocuments/Shared%20Documents/Safety%20documents/Isotope%20ERG.pdf.pdf?csf=1&e=g4jFOa&CT=1579725008503&OR=OWA-NT&CID=3d891fcd-336f-60da-21cc-d741f9493b16

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

- CARM probe calibrations performed annually by RadCon
- Portable survey meter calibrations performed semi-annually by RadCon
- ISOCS calibration for the measurement geometry performed on a case basis by RadCon.

17. Inspection Schedules

- Shielding configuration inspection semi-annually, performed by RadCon

18. References/Associated/Relevant Documentation

HPP-OPS-001, Shipping and Receiving of Radioactive Material
RWP-2019-J013
Emergency Response Guideline for Isotope Experiment

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

Submit Procedure for Review and Approval (See ES&H Manual Chapter 3310 Appendix T1 OSP & TOSP Instructions – Section 4.2 Submit Draft Procedure for Initial Review):

- Convert this document to .pdf
- Open electronic cover sheet: https://mis.jlab.org/mis/apps/mis_forms/operational_safety_procedure_form.cfm
- Complete the form
- Upload the pdf document and associated Task Hazard Analysis (also in .pdf format)

Distribution: Copies to Affected Area, Authors, Division Safety Officer
Expiration: Forward to ESH&Q Document Control

Form Revision Summary

Revision 1.5 – 04/11/18 – Training section moved from section 5 Authority and Responsibility to section 9 Training
Revision 1.4 – 06/20/16 – Repositioned "Scope of Work" to clarify processes
Qualifying Periodic Review – 02/19/14 – No substantive changes required
Revision 1.3 – 11/27/13 – Added "Owning Organization" to more accurately reflect laboratory operations.
Revision 1.2 – 09/15/12 – Update form to conform to electronic review.
Revision 1.1 – 04/03/12 – Risk Code 0 switched to N to be consistent with 3210 T3 Risk Code Assignment.
Revision 1.0 – 12/01/11 – Added reasoning for OSP to aid in appropriate review determination.
Revision 0.0 – 10/05/09 – Updated to reflect current laboratory operations

ISSUING AUTHORITY	FORM TECHNICAL POINT-OF-CONTACT	APPROVAL DATE	REVIEW DATE	REV.
ESH&Q Division	Harry Fanning	04/11/18	04/11/21	1.5

This document is controlled as an on line file. It may be printed but the print copy is not a controlled document. It is the user's responsibility to ensure that the document is the same revision as the current on line file. This copy was printed on 1/31/2020.

Jefferson Lab
Thomas Jefferson National Accelerator Facility

Task Hazard Analysis (THA) Worksheet

(See ES&H Manual Chapter 3210 Appendix T1
Work Planning, Control, and Authorization Procedure)

Click For Word

Author:	David Hamlette	**Date:**	11/11/19	**Task #:** If applicable	

Complete all information. Use as many sheets as necessary

Task Title:	Isotope Production Run			**Task Location:**	LERF (building 18)
Division:	Accelerator	**Department:**	Operations	**Frequency of use:**	A few times per year
Lead Worker:	N/A				

Mitigation already in place:
Standard Protecting Measures
Work Control Documents

Ionizing Radiation Engineered Controls

- LERF beam operations/access controls managed by the personnel safety system (entry doors are interlocked)
- LERF vault protected by approved design shielding

Oxygen Deficiency Hazard

As a result of changes to LERF operations, specifically LCLS-II testing, a recent ODH reassessment was performed that considers the cryogenic nitrogen, helium and gaseous nitrogen load.

Sequence of Task Steps	Task Steps/Potential Hazards	Consequence Level	Probability Level	Risk Code (before mitigation)	Proposed Mitigation (Required for Risk Code >2)	Safety Procedures/ Practices/Controls/Training	Risk Code (after mitigation
1	Handling of target crucible/exposure to ionizing radiation	L	M	2	See "Mitigations already in place"	It is expected that post-irradiation levels will create high radiation and localized contamination areas. RadCon will perform initial entry surveys in accordance with RWP 2019-S002 for all entries during the experiment. RWP 2019-J013 is used in conjunction with this OSP to control target removal and packaging.	1

Jefferson Lab
Thomas Jefferson National Accelerator Facility

Task Hazard Analysis (THA) Worksheet

(See ES&H Manual Chapter 3210 Appendix T1
Work Planning, Control, and Authorization Procedure)

Sequence of Task Steps	Task Steps/Potential Hazards	Consequence Level	Probability Level	Risk Code (before mitigation)	Proposed Mitigation (Required for Risk Code >2)	Safety Procedures/ Practices/Controls/Training	Risk Code (after mitigation
2	Filling and handling of target crucible/potential exposure to corrosive gallium	L	M	2	Wear appropriate PPE (lab coat, safety glasses, gloves) as outlined in OSP, use surface coverings and absorbent materials.	No occupational exposure limits have been established for Gallium. This does not mean that this substance is not harmful. Follow this OSP and Emergency Response Guide for spills.	1
3	ODH	M	L	2	See "Mitigations already in place"	All personnel entering the area must have ODH training and follow procedures based on EH&S signage.	1

Highest Risk Code before Mitigation:	2	**Highest Risk Code after Mitigation:**	1

When completed, if the analysis indicates that the Risk Code before mitigation for any steps is "medium" or higher (RC≥3), then a formal Work Control Document (WCD) is developed for the task. Attach this completed Task Hazard Analysis Worksheet. Have the package reviewed and approved prior to beginning work. (See ES&H Manual Chapter 3310 Operational Safety Procedure Program.)

Jefferson Lab
Thomas Jefferson National Accelerator Facility

Task Hazard Analysis (THA) Worksheet

(See ES&H Manual Chapter 3210 Appendix T1
Work Planning, Control, and Authorization Procedure)

Form Revision Summary

Periodic Review – 08/29/18 – No changes per TPOC
Periodic Review – 08/13/15 – No changes per TPOC
Revision 0.1 – 06/19/12 - Triennial Review. Update to format.
Revision 0.0 – 10/05/09 – Written to document current laboratory operational procedure.

ISSUING AUTHORITY	TECHNICAL POINT-OF-CONTACT	APPROVAL DATE	REVIEW DATE	REV.
ESH&Q Division	Harry Fanning	08/29/18	08/29/21	0.1

This document is controlled as an on line file. It may be printed but the print copy is not a controlled document. It is the user's responsibility to ensure that the document is the same revision as the current on line file. This copy was printed on 1/31/2020.

By signing this page, you testify that you have read, understand, and agree to abide by the procedure specified in the above referenced work control document:

Serial Number: ESH-20-95834-OSP

Title: Isotope production target preparation, handling, analysis, and packaging

Name	Signature	Date