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Jefferson Lab
Thomas Jefferson National Accelerator Facility

Operational Safety Procedure Review and Approval Form # 94834
(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:	***ENP-20-94834-OSP***		
Issue Date:	***2/11/2020***		
Expiration Date:	***3/11/2023***		
Title:	***Transferring (loading/removing) targets to/from the HDice IBC in cave-2 of the UITF***		
Location: (where work is being performed) Building Floor Plans	***58 - Test Lab - 1127***	Location Detail: (specifics about where in the selected location(s) the work is being performed)	***NE corner of Bldg 58, UITF area***
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):		***3*** ***1***
Reason:	This document is written to mitigate hazard issues that are : ***Determined to have an unmitigated Risk code of 3 or 4***		
Owning Organization:	***PHALLB***		
Document Owner(s):	***Sandorfi, Andy (sandorfi@jlab.org)*** Primary		

Supplemental Technical Validations

Cryogenic Material - Gas or Liquid (Jonathan Creel, Kelly Dixon)
Lead
Aerial Work Platforms (Scissor/Aerial Lifts, Boom Trucks) (Joe Thomas, Mark Loewus)
Cranes & Hoists - Ordinary or Pre-Engineered (Bob Sperlazza, Mark Loewus)
ODH 0 and 1 (Imani Burton, Jennifer Williams)
Radiological Controlled Area (David Hamlette, Keith Welch)
Static Magnetic Fields >5G: Fringe, High, & Quench Effect (Imani Burton, Jennifer Williams)
Scaffolding (Bert Manzlak, George Perry)
ESH&Q Liasion (Bert Manzlak)

Document History

Revision	Reason for revision or update	Serial number of superseded document

Lessons Learned	Lessons Learned relating to the hazard issues noted above have been reviewed.
Comments for reviewers/approvers:	***02/03/2020 The revisions include the following: • S 5.3: Bert Manzlak's title is revised • S 7.1, p 4: added "or equivalent as determined in discussions with George Perry" to the specifications for the Leading Edge Self-Retractable lanyard. • S 7.1, p 4: to the required list of safety equipment for HDice staff, added: "Hard hats are required whenever working under the open cave-2 roof." • S 8, p 4: a second administrative control has been added: "A pre-use inspection of the NE scaffolding must be carried out each day before work begins that involves access to the cave-2 roof. A dated green inspection tag will be affixed to the scaffold to indicate that the inspection is current. (Inspections will be coordinated through Bert Manzlak.)" • S 9.1, p 4: Following George Perry's suggestion, expanded Rigger training to include: "Ladder Safety, SAF-307, and Tube & Coupler Scaffold training, SAF-303B" • S 12.2, p 5 bottom (just before the "Pre-Rigging requirements"): at George Perry's request, deleted the sentence, "As such, the safety-related equipment and procedures for this rigging operation are in common with OSP 87551". • S 12.2, p6, "Installation of the Work Platform": This section has been rewritten to match George Perry's specifications.***

Attachments

Procedure: ***OSP HDice IBC_target_transfer_Feb3'20.pdf***

THA: ***THA - HDice target transfer_Dec162019.pdf***

Additional Files:

Review Signatures

Person : Perry, George (gperry) **Reasoning:** Fall Protection	**Signed** on 2/4/2020 10:51:11 AM by George Perry (gperry@jlab.org)
Subject Matter Expert : Cryogenic Material - Gas or Liquid	**Signed** on 2/5/2020 4:36:35 PM by Kelly Dixon (kdixon@jlab.org)
Subject Matter Expert : Hazardous Metals->Lead	**Signed** on 2/10/2020 2:33:33 PM by Jennifer Williams (jennifer@jlab.org)
Subject Matter Expert : Material Handling Equipment->Aerial Work Platforms (Scissor/Aerial Lifts-> Boom Trucks)	**Signed** on 2/4/2020 7:44:49 AM by Mark Loewus (loewus@jlab.org)
Subject Matter Expert : Material Handling Equipment->Cranes & Hoists - Ordinary or Pre-Engineered	**Signed** on 2/4/2020 7:44:57 AM by Mark Loewus (loewus@jlab.org)
Subject Matter Expert : Oxygen Deficiency Hazards (ODH)->ODH 0 and 1	**Signed** on 2/10/2020 2:33:33 PM by Jennifer Williams (jennifer@jlab.org)
Subject Matter Expert : Radiation - Ionizing->Radiological Controlled Area	**Signed** on 2/5/2020 2:57:06 PM by Keith Welch (welch@jlab.org)
Subject Matter Expert : Static Magnetic Fields >5G: Fringe-> High-> & Quench Effect	**Signed** on 2/10/2020 2:33:33 PM by Jennifer Williams (jennifer@jlab.org)
Subject Matter Expert : Working at Elevations->Scaffolding	**Signed** on 2/4/2020 2:11:55 PM by Bert Manzlak (manzlak@jlab.org)

Approval Signatures

Division Safety Officer : PHALLB	**Signed** on 2/11/2020 7:23:30 AM by Ed Folts (folts@jlab.org)
ESH&Q Division Liasion : PHALLB	**Signed** on 2/10/2020 2:34:36 PM by Bert Manzlak (manzlak@jlab.org)
Org Manager : PHALLB	**Signed** on 2/10/2020 2:35:30 PM by Marco Battaglieri (battagli@jlab.org)
Safety Warden : Test Lab - 1127	**Signed** on 2/10/2020 4:18:09 PM by Matthew Poelker (poelker@jlab.org)

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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 For Word Doc

Title:	Transferring (loading/removing) targets to/from the HDice IBC in cave-2 of the UITF		
Location:	TestLab bldg. 58, UITF, cave-2	**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**	3
		Highest Risk Code after Mitigation (N, 1, or 2):	1
Owning Organization:	Physics	**Date:**	Dec 16, 2019
Document Owner(s):	A.M. Sandorfi		

DEFINE THE SCOPE OF WORK

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

This OSP describes the process of loading and removing solid targets from the HDice In-Beam-Cryostat (IBC) located in cave-2 of the UITF. Other operations are required before this activity can begin:

- The IBC should be cold and running at temperatures below 1 K within cave-2. If the target to be transferred is polarized, the super-conducting magnets within the IBC should be energized. Procedures for reaching these conditions are covered by **OSP 80380**.
- The shielding tiles on the roof of cave-2 should have been removed. Procedures for reaching this condition are covered by **OSP 87551**.

The HDice dump solenoid is also de-energized in this procedure. The operation of this solenoid is described in **OSP 95104**.

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

Operations:

- Riggers move the HDice *Work Platform* into place, spanning the opening in the roof tiles of cave-2. (This Work Platform is stored on the roof of the UITF labyrinth when not in use.)
- The IBC is disconnected from the beamline and cranked into its vertical orientation.
- The cold HDice Transfer Cryostat (*TC*) is wheeled on its transportation cart from the HDice Lab to the UITF. It either contains a solid HD target (for *target loading*) or is empty and ready to receive one from the IBC (for *target extraction*). The cold TC must be lifted from its cart with the North 25-ton crane of bldg. 58. This can start either just outside the cave-2 shielding wall, lifting the TC over the walls of the UITF and down onto the IBC, or (in the most likely scenario) the TC can be rolled on its cart through the labyrinth into cave-2 and lifted up through the opening in the roof.
- The TC is positioned with its gate valve mated to the IBC gate valve. Three stabilizing chains are attached between the TC and points on the UITF roof, and the TC is leveled.
- The space between the gate valves is evacuated, and the gate valves are opened. The helium tube of the TC is lowered into the IBC to either deposit an HD target in the IBC or extract one from the IBC.
- The TC helium tube is withdrawn back into the TC vacuum space, the TC and IBC gate valves are closed, the TC is disconnected from the IBC and the stabilizing chains are removed.
- The TC is lifted off of the IBC, lowered onto its transportation cart, and wheeled back to the HDice Lab, where extracted targets are transferred to the Production dewar for recovery of the HD gas. (The target cell is surveyed by RadCon prior to removal and storage.)

- The IBC is rotated back to its horizontal position.

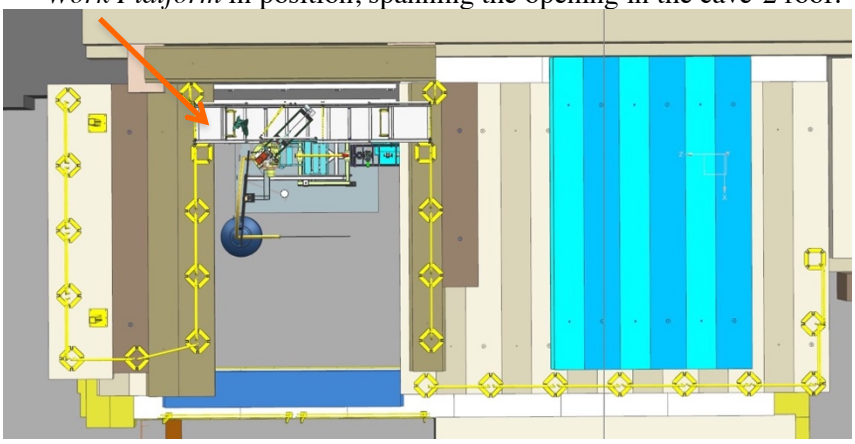
Riggers remove the *Work Platform* and return it to its storage location on top of the UITF Labyrinth. (This concludes the tasks of this OSP, after which the roof tiles can be replaced, following OSP 87551.)

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

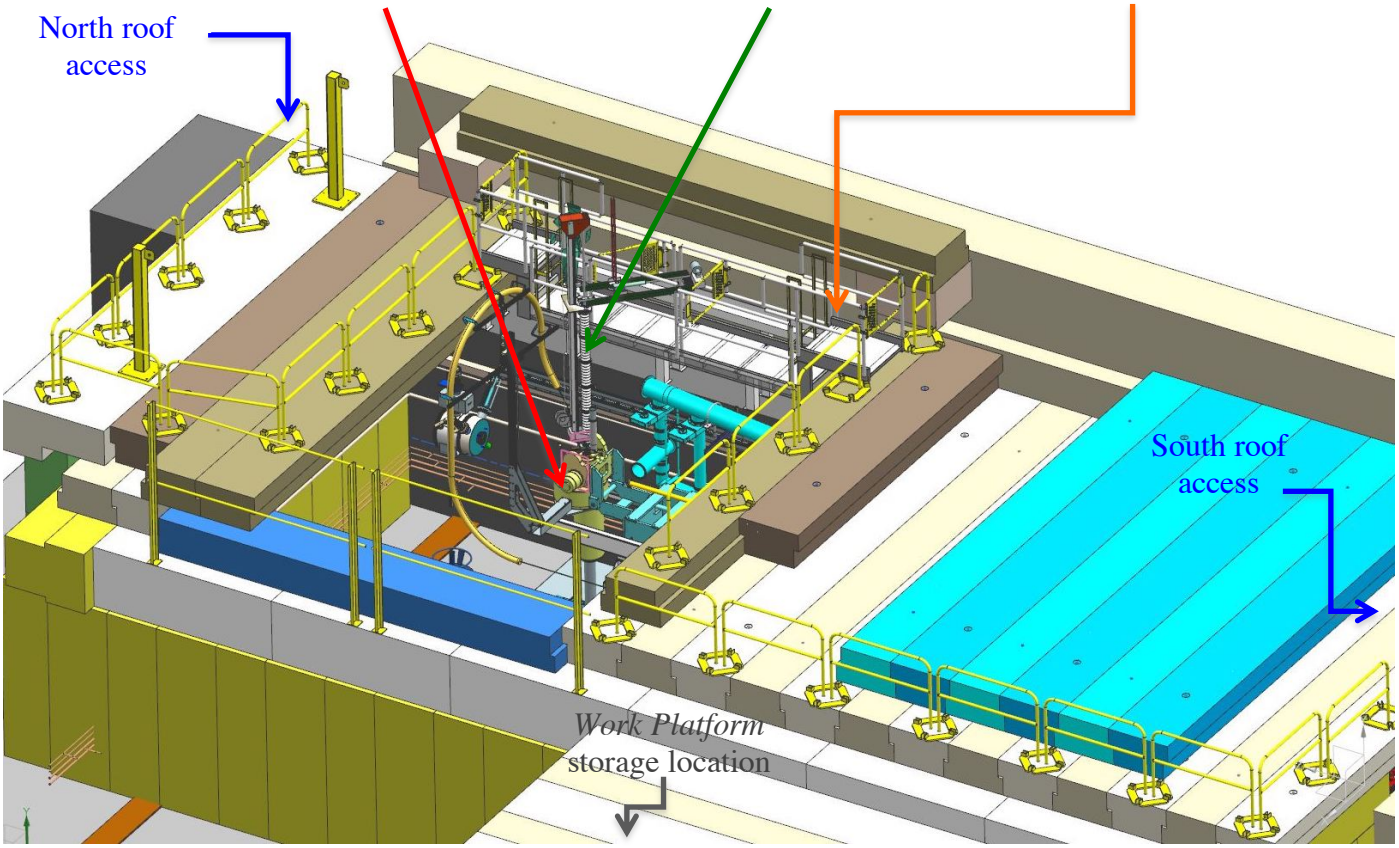
Operations take place in and on cave-2 of the UITF, located to the East side of area 1128 of bldg. 58.

Work Platform stored on UITF Labyrinth:

Work Platform in position, spanning the opening in the cave-2 roof:



Vertical IBC in cave-2 with TC mounted on top, next to the Work Platform:



ANALYZE THE HAZARDS and IMPLEMENT CONTROLS

4. Hazards identified on written Task Hazard Analysis

Hazards:

(A) Riggers:

- Fall protection during the moving of the *Work Platform*, either from its storage location on the roof of the Labyrinth to the opening in the cave-2 roof, or during its return to its storage position.

(B) HDice staff:

- Lifting a cryostat containing liquid helium (LHe) and liquid nitrogen (LN2) with a crane;
- Cold He and N2 gas venting from the Transfer Cryostat;
- Handling lead shielding bricks;
- Magnetic fields from the TC and IBC magnets.
- Material that has become activated by exposure to the UITF beams.

Notes:

- Radiation Safety: All UITF sources of ionizing radiation will have been de-energized and locked out as part of OSP 87551, which is a necessary prerequisite for this OSP. The only remaining potential radiological hazard is a target activated by the UITF beam. In the case of target extraction, an initial survey by RadCon will precede the tasks of this OSP and will determine if the work can proceed.
- ODH: Since the roof tiles have been removed prior to this procedure, cave-2 reverts to ODH-0 for this OSP;

Fall protection: Once the Riggers have installed the *Work Platform,* the cave-2 roof is accessed either from a scaffold on the North side or from stairs on the South side. These points of roof access, and the roof perimeter are all enclosed by railings, in accord with OSP 87551. The Catwalk is constructed with railings along its perimeter. Thus, fall protection is NOT required by HDice staff to access the *Work Platform*.

5. Authority and Responsibility:

5.1 Who has authority to implement/terminate

X. Wei, A. Sandorfi, M. Lowry, C. Hanretty

5.2 Who is responsible for key tasks

C. Hanretty, X. Wei, A. Sandorfi

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)

- ODH Assessment: carried out by Will Oren & Hari Areti; approved by Chris Perry https://wiki.jlab.org/ciswiki/index.php/File:UITF_ODH_Assessment.pdf ;
- ODH Review 74180: signed by Jennifer Williams, and Tim Michalski https://misportal.jlab.org/railsForms/oxygen_deficiency_reviews/74180/edit ; effective: 03/07/2018 – 02/12/2021
- Structural Analysis of the UITF *Work Platform*: reviewed by T. Renzo https://wiki.jlab.org/ciswiki/images/1/1e/Catwalk_engineering_calculations_from_Tom_Renzo.pdf
- Fall Protection during elevated work: Georgy Perry
- Lead handling: Jennifer Williams
- Radiation Control: Keith Welch
- UITF Safety Wardens: Matt Poelker
- Accelerator Division Safety Officer: Harry Fanning
- Physics Division ES&H Liason: Bert Manzlack

6. Personal and Environmental Hazard Controls Including:

6.1 Shielding

- Issues involving UITF shielding are extensively discussed in OSP 87551, whose procedures must precede this OSP, and in JLab-TN-18-020.
- Lead shielding around the beam pipe immediately upstream of the IBC (not to exceed 10 bricks, 26 lbs each) will be partially removed to allow the beam pipe to be removed. This is discussed in Section 12.4 .

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

- Elevated work: railings will have been installed completely around the perimeter of the cave-2 roof as part of OSP 87551 which must necessarily precede this OSP.
- Magnetic fields: a beacon will be operating in cave-2 when the IBC super-conducting magnets and/or the Dump Solenoid are energized. Lines marking the 5 gauss limits will be indicated on the cave-2 floor.

6.3 Interlocks

NA

6.4 Monitoring systems

HDice IBC operations monitoring, following OSP 80380

6.5 Ventilation

NA

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

NA

7. List of Safety Equipment:

7.1 List of Safety Equipment:

- For Riggers: Appropriate fall protection during installation and during removal of the *Work Platform*. Keep out signage while the *Work Platform* is being rigged into place or stored;
  DBI-Sala 30' Leading Edge Self-Retractable lanyard (Model #3504500, or equivalent as determined in discussions with George Perry).
- For HDice staff: Cryo (or Welding) gloves and safety glasses for handling cryogens when refilling TC levels, as needed, and for moving lead shielding bricks (not to exceed ten 26-lb bricks);
  Hard hats are required whenever working under the open cave-2 roof.

7.2 Special Tools:

For Riggers, when moving the *Work Platform*:

1. Fall-protection Harnesses and Lanyards
2. Horizontal lifeline.
3. Appropriate slings for lifting.

8. Associated Administrative Controls

1. Staff who use the Building 58 Test Lab High Bay overhead crane to lift the *Work Platform* or the *Transfer Cryostat* are responsible for:
   - Making sure the area is clear of personnel
   - Posting appropriate warning signage
2. A pre-use inspection of the NE scaffolding must be carried out each day before work begins that involves access to the cave-2 roof. A dated *green inspection tag* will be affixed to the scaffold to indicate that the inspection is current. (Inspections will be coordinated through Bert Manzlak.)

9. Training

9.1 What are the Training Requirements (See List of Training Skills)

Rigger-specific training:

- SAF-403, SAF-702M - Training in Material Handling - Rigging, Cranes, and Hoists

• Ladder Safety, SAF-307, and Tube & Coupler Scaffold training, SAF-303B
• Fall Protection training: SAF-202, SAF-202A, and SAF-202B

HDice staff:
• ODH / SAF-103 ;
• Compressed gas / ES&H 6150 ;
• Ladder Safety / SAF-307; and Tube & Coupler scaffold training / SAF-303B
• Crane Operation and Rigging / SAF-403
• Lead Worker Safety Awareness / SAF-136

DEVELOP THE PROCEDURE

10. Operating Guidelines

HDice Staff:
- Read and understand the HDice IBC OPS manual: https://www.jlab.org/Hall-B/HDIce/manuals/inbeam04.pdf
  A detailed description of the IBC is given in *Nucl. Inst. Meth. Phys. Res.* ***A815*** *(2016) 31.*
- Read and understand the HDice TC OPS manual: https://www.jlab.org/Hall-B/HDIce/manuals/transfer05a.pdf
  A detailed description of the TC is given in *Nucl. Inst. Meth. Phys. Res.* ***A737*** *(2014) 107.*

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

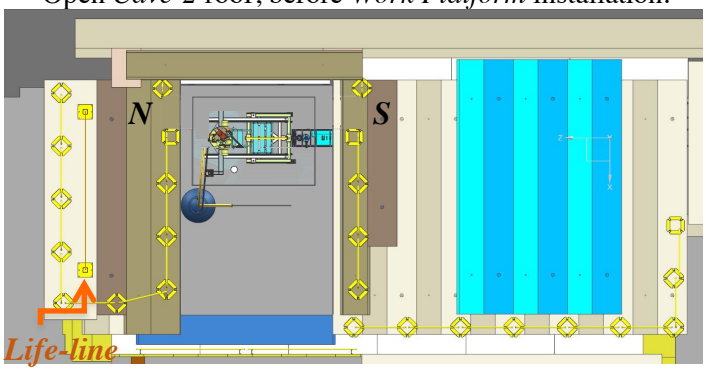
Prior to the start and when the work has been fully completed, notify the following:
Building 58 manager: Phil Denny (x 7752);
UITF Safety Warden: Matt Poelker (x 7357)
HDice: A. Sandorfi (x 5457), X. Wei (x 5266)

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

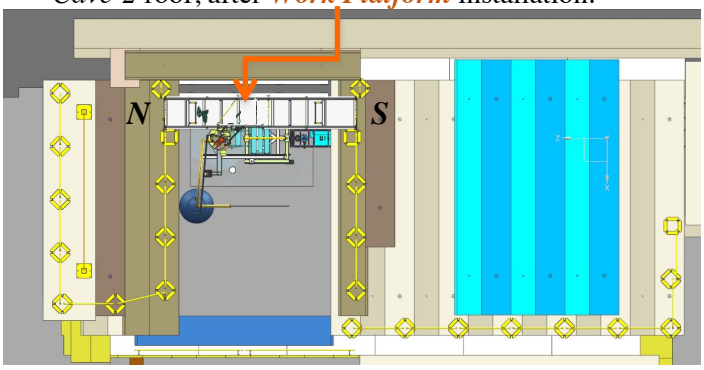
12.1 When extracting a target that has been exposed to beam, RadCon will survey the outside of the IBC to determine if the extraction can proceed.

12.2 Riggers move the HDice *Work Platform* into place, spanning the opening in the roof tiles of cave-2:
This work begins after the completion of OSP 87551. The HDice *Work Platform* is stored on the roof of the UITF Labyrinth. The configuration of the cave-2 roof, after the relocation of the roof shielding tiles (under OSP 87551), is illustrated in the left-hand panel of the figure below. (Six shielding tiles, shown here in blue, have been relocated onto the south portion of the cave-2 roof, exposing the equipment on the cave floor.)
The only fall hazards at this point are associated with the gaps in the yellow guard rails which will accept the ends of the *Work* Platform (at the N and S ends of the opening in the cave-2 roof, as indicated in the figures). The installed *Work Platform* is illustrated in the right panel of the figure.

Open *Cave-2* roof, before *Work Platform* installation:



Cave-2 roof, after ***Work Platform*** installation:



The process outlined below addresses "Fall Protection" and specific aspects of Material Handling associated with this job, with general aspects of Material Handling covered by basic Rigging and Crane Operation training. The work will be performed using a minimum 3 person crew: *Crane operator*, a *North Side Worker*, and a *South Side Worker*. This *Work Platform* installation will immediately follow the work of OSP 87551 which removes the six concrete shielding tiles to expose the top of cave-2.

Pre-Rigging requirements:

1. Stairways (either permanent or a temporary scaffold) are in place on the north and south ends of the cave-2 roof to provide egress.
2. A DBI Sala horizontal lifeline #7602020 has been installed on the north side of the cave-2 roof (as indicated in the above figures), with signage on the lifeline post regarding max. capacity (limitation on how many persons may tie-off to lifeline & to use O-Ring).
3. Signage has been posted for passersby to 'Keep Out' during crane activities.
4. North Side Worker to use DBI Sala Self Retractable Lanyard (#3504500) to connect to O-Ring on horizontal lifeline. Use of horizontal lifeline must be under direction of a qualified person.

Installation of the Work Platform:

1. The North and South Workers access the top of the UITF Labyrinth. This will be facilitated by installation of a new stairway access from the cave2 roof down to the top of the Labyrinth, and enclosing the Labyrinth roof with guardrails.
2. Using standard rigging equipment, they attach straps to the *Work Platform*.
3. While standing in the southern-most area of the cave2 roof, adjacent to cave1, the Crane Operator uses the Bldg. 58 North 25-ton crane to move the Work Platform from the Labyrinth to span the cave2 roof opening.
4. The South Worker connects his lanyard to a hoist ring in the concrete ceiling tiles, and guides the load with a tag line during transport of the Work Platform.
5. The North Worker uses the NE stair/scaffold to access the north end of the cave2 roof, and connects his lanyard to the DBI Sala horizontal lifeline #7602020. Use of this lifeline is limited to work that takes place north of the opening in the cave2 roof.
6. The North and South Workers position/re-position the guardrails around the roof opening in order to accept placement of the Work Platform.
7. The *Work Platform* is lowered into place, guided by the North and South Workers. Upon conclusion of the Work Platform installation, the Workers may disconnect their lanyards.

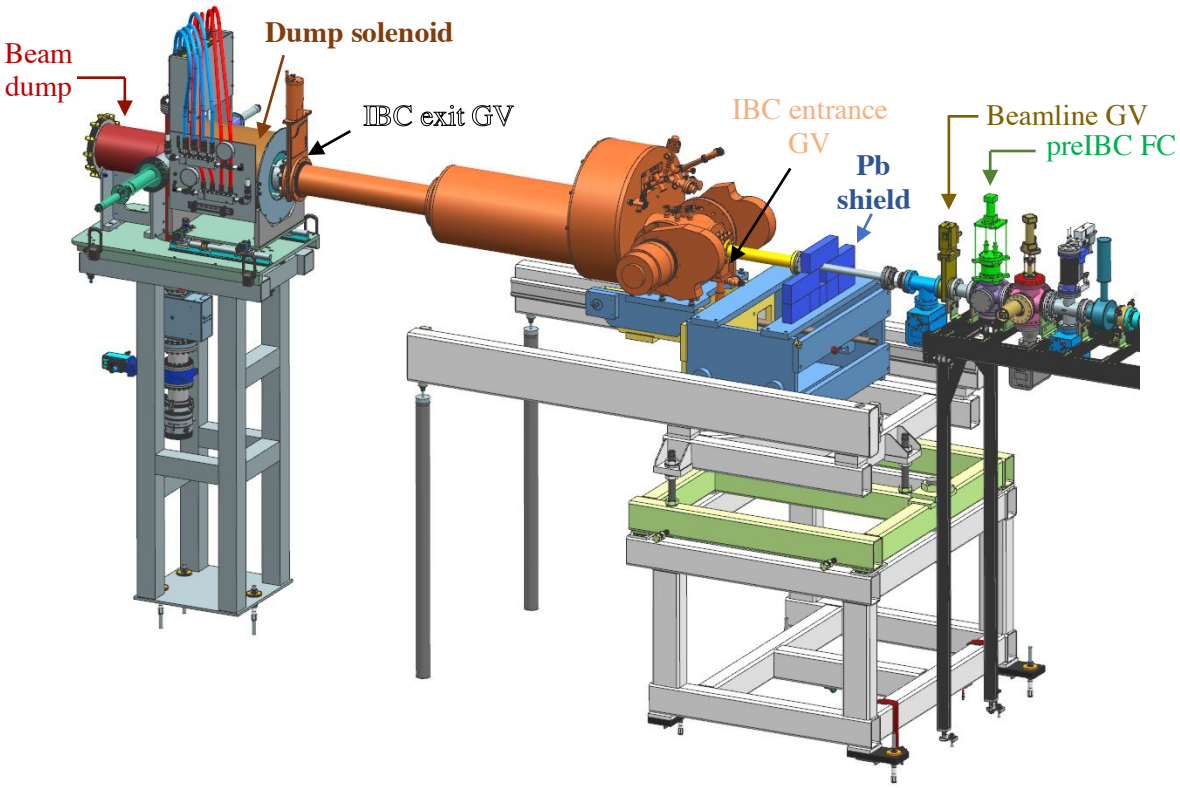
Removal and Storage of the Work Platform:
Such work will immediately precede the work of OSP 87551 which replaces the six concrete shielding tiles to complete the enclosure of cave-2. The same *Pre-Rigging requirements* will be followed (as listed above). The removal and storage of the *Work Platform* follows the steps for *Installation* (as above), but in reverse.

12.3 HDice work to prepare the TC for target handling:

- Cool the HDice Transfer Cryostat (TC) in the HDice Lab, following the procedures detailed in https://www.jlab.org/Hall-B/HDIce/manuals/transfer05a.pdf;
- In preparation for target loading into the IBC in cave-2, an HD target (either unpolarized or polarized) will have been moved into the TC from the Production Cryostat (PD) within the HDice Lab.
- For target extraction from the IBC, the TC will have been cooled but has no target, and the PD in the HDice Lab is cold (operating at 2K) and also has no target (since the extracted target will ultimately be transferred to the PD for recovery of the HD gas).
- Before moving the TC to the UITF, verify in the HDice Lab that the TC liquid helium level (LHe) is full, the liquid nitrogen level (LN2) is full, and that the LN2 auxiliary shutter volume is at least ½ full.

12.4 Beamline preparations:

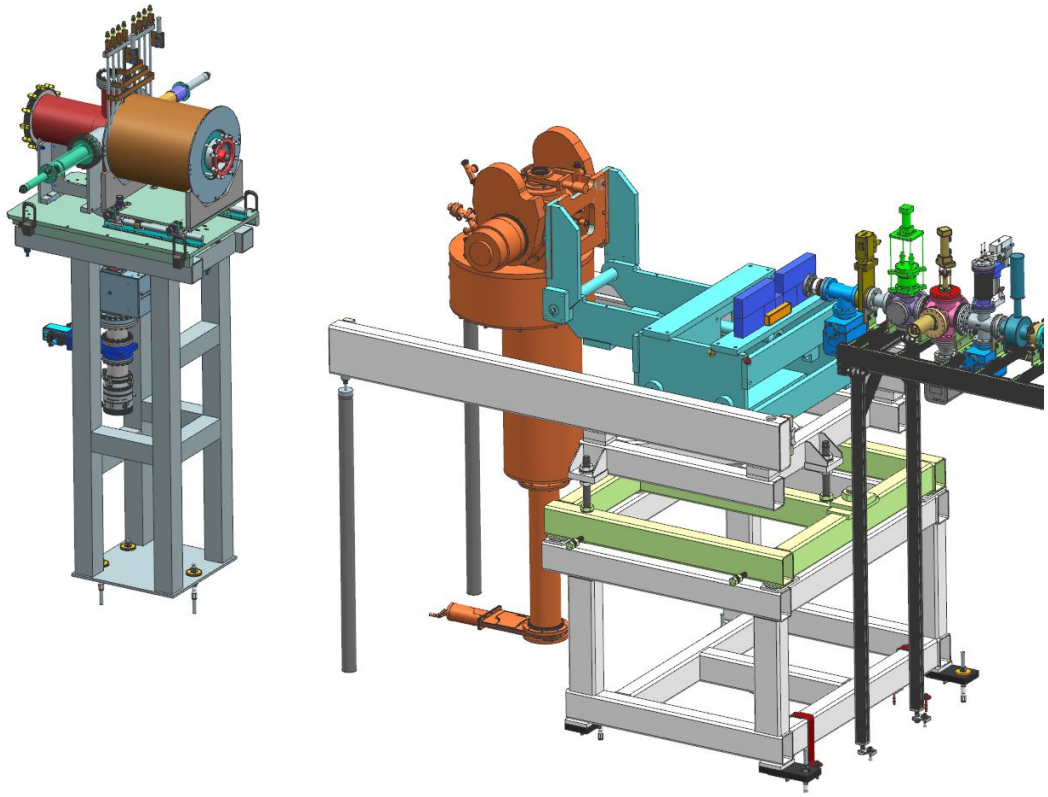
For reference, the main components of the HDice beam dump, the HDice IBC and the end of the cave-2 beamline are illustrated in the figure below. The following preparations must be made:



- The preIBC Faraday Cup is inserted;
- The beamline gate valve (GV) is closed;
- The dump solenoid is de-energized;
- The main *holding solenoid* field of the IBC is reduced to 32 A (~0.60 tesla);
- The *transfer solenoid* field of the IBC is reduced to 17A (~0.28 tesla peak)
- The IBC entrance gate valve is closed;
- The IBC exit gate valve is closed;
- The upstream **IBC lead shield**, which protects electronics close to the target (not to exceed 10 bricks, 26 lbs each) is partially removed to allow the upstream beam pipe to be disconnected;
- The **upstream beamline vacuum pipe connection** to the IBC is vented with N2 gas and removed;
- The dump solenoid slides back on its rails, exposing the connection to the IBC gate valve;
- The dump vacuum chamber is vented with N2 gas, and the ISO flange is disconnected from the gate valve;
- The IBC is rolled back 6" (upstream) on its cart;

12.5 IBC rotation:

- While monitoring the IBC pumping lines and instrumentation cables to avoid interferences, the IBC is rotated vertical. The final configuration is illustrated in the figure below:



12.6 Move the TC from the HDice Lab into cave-2 of the UITF

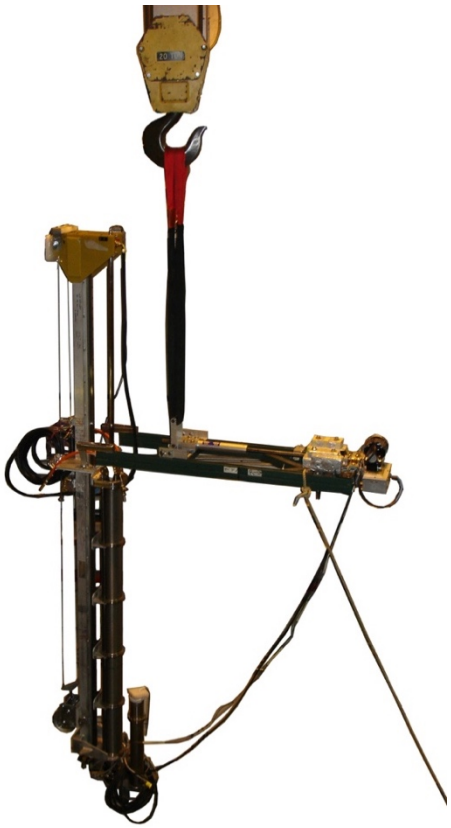
- The cold TC is rolled to the UITF with its instrumentation on its transportation cart (which holds the cryostat at a 30 degree incline to maintain cryogen levels), as shown in the figure below:

The TC on its cart is rolled into the TestLab, through the Labyrinth of the UITF and into cave-2, below the opening in the roof.

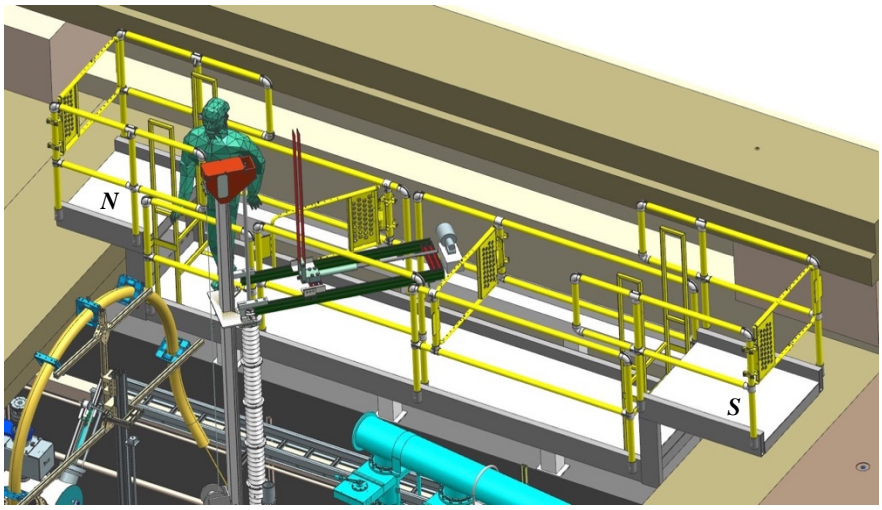
12.7 Lift the TC onto the IBC:

- During transfer operations a retractable arm that is integral to the TC is used to position it off-center from a hoist to eliminate mechanical interference from crane components. (The lifting point slides on rails and is positioned using a motor and lead screw. Lead counterweights are fixed on the free end of the lifting arm. When the TC is supported by a hoist and the lifting arm is extended, adjustments in the position of the lifting

point on the arm produce vertical movements of the TC. The large mechanical advantage provides a delicate control when docking the TC on the top of another cryostat.) This mechanism is inspected before each use. The TC with its counter-balanced arm is shown in the figure below.



- Using the above counter-balanced lifting fixture, the TC is raised with the North 25-ton crane, and positioned over the IBC with its gate valve mated to the IBC gate valve.
- Three stabilizing chains are attached between the TC and points on the UITF roof shielding, and the TC is leveled and secured. This operation requires access to the top of the TC, which is provided by the Work Platform.
- Initial access to the Work Platform will usually be via the stairs on the South side of the cave-2 roof. Once the TC is lowered and mated to the IBC, the arm of the TC lifting fixture extends across the Work Platform, which blocks egress for someone working on the North side of the TC arm, as shown below. With this arrangement, when required, the worker exits the roof via the North scaffold. (For this reason, Ladder training SAF-307 and Scaffold training SAF-303B are required.)



12.8 Loading or extracting an HD target:
- The space between the TC and IBC gate valves is evacuated, and the gate valves are opened. The helium tube of the TC is lowered into the IBC to either load an HD target into the IBC or extract one from the IBC.
- The TC helium tube is then withdrawn back into the TC vacuum space, the TC and IBC gate valves are closed, and the volume between them in vented with N2 gas.
  (The steps specific to target extraction or insertion are extensively detailed in separate check-sheets maintained by the HDice group.)

12.9 Returning the TC to its transportation cart
- The TC stabilizing chains are removed;
- The TC is lifted off of the IBC, lowered onto its transportation cart, and wheeled back through the UITF Labyrinth to the HDice Lab.

12.10 Recovering an extracted target and RadCon survey:
- In the HDice Lab, targets extracted from the IBC are cold transferred to the PD, a variable temperature cryostat, where they are slowly warmed to recover the HD gas.
- Target cells that have been exposed to the UITF beam are surveyed by RadCon prior to removal from the PD.

12.11 Return the IBC to horizontal orientation in preparation for UITF beam:
- In cave-2 the IBC is rotated back to the horizontal orientation, and the steps detailed in section 12.4 are reversed to prepare the IBC for UITF beam:
- The IBC is rolled forward 6" (downstream) on its cart
- The ISO flange on the dump is reconnected to the IBC gate valve, and the dump vacuum chamber is pumped.
- The dump solenoid slides forward on its rails, against the IBC gate valve
- The **upstream beamline vacuum pipe connection** to the IBC is reinstalled and pumped.
- The upstream **IBC lead shield** is reinstalled (< 10 bricks).
- When the dump vacuum has dropped below 1 e-6 mb, the IBC exit gate valve is opened;
- When the beamline vacuum has dropped below 1 e-6 mb, the IBC entrance gate valve is opened;
- The main *holding solenoid* field of the IBC is raised to 59 A (~1.10 tesla);
- The *transfer solenoid* field of the IBC is raised to 20A (~0.33 tesla peak)
- The dump solenoid is re-energized to 342 A (~0.25 tesla);
- The beamline gate valve may be opened when beam operations are ready to resume;
- When measurements are ready to resume with beam, the preIBC Faraday Cup may be withdrawn.

12.12 Storing the Work Platform:
- Riggers remove the *Work Platform* and return it to its storage location on top of the UITF Labyrinth, following the steps in 12.2 . (This concludes the tasks of this OSP, after which the roof tiles can be replaced, following OSP 87551.)

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

- For Rigging work, follow the steps in 12.2 to return the *Work Platform* to it's storage location.
- For HDice target related work, contact X. Wei (x 5266), A. Sandorfi (x 5457), M. Lowry (x 7432) or C. Hanretty (x 5023) to assess status before attempting any backout steps.

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

Helium, Nitrogen, Lead

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

None

14.3 Abatement steps (secondary containment or special packaging requirements)

None

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

In case of the loss of building power, the HDice diesel generator will switch on within about 10 sec, and all pumps will auto-restart. The IBC controls are on UPS backup and will continue to monitor. Nonetheless, the status should be verified and a call should be made to one of the following:

M. Lowry (609 439 8288);
X. Wei (516 635 1957);
C. Hanretty (850 491 8382);
A. Sandorfi (631 332 1565).

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

None

17. Inspection Schedules

PSS-ODH system inspection schedule: https://jlabdoc.jlab.org/docushare/dsweb/View/Collection-10790

18. References/Associated/Relevant Documentation

- HDice IBC OPS manual: https://www.jlab.org/Hall-B/HDIce/manuals/inbeam04.pdf
- HDice TC OPS manual: https://www.jlab.org/Hall-B/HDIce/manuals/transfer05a.pdf

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

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

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

Author:	A.M. Sandorfi	Date:	Nov. 9, 2019	Task #: If applicable	

Complete all information. Use as many sheets as necessary

Task Title:	Transferring (loading/removing) targets to/from the HDice IBC in cave-2 of the UITF	Task Location:	TestLab bldg. 58, UITF, cave-2

Division:	Physics	Department:	Hall B	Frequency of use:	6 times per year

Lead Worker: A. Sandorfi, X. Wei – involves the removal of a few lead bricks (26 lb ea)

Mitigation already in place:
Standard Protecting Measures
Work Control Documents

- UITF ODH: https://wiki.jlab.org/ciswiki/index.php/File:UITF_ODH_Assessment.pdf ; https://misportal.jlab.org/railsForms/oxygen_deficiency_reviews/74180/edit ;
- PSS-ODH system operational: https://jlabdoc.jlab.org/docushare/dsweb/View/Collection-10790 ;
- UITF Cave-2 ceiling roof tile removal – OSP 87551, https://wiki.jlab.org/ciswiki/images/e/e4/UITF_Cave2_ceiling_roof_tile_removal_OSP.pdf
- HDice IBC Operations in cave-2 - manual: https://www.jlab.org/Hall-B/HDIce/manuals/InBeam01a.pdf ; OSP 80380, https://wiki.jlab.org/ciswiki/images/7/77/Cool_and_Operate_HDice_IBC_and_its_superconducting_magnets_in_cave2_of_UITF_ENP-18-80380-OSP.pdf
- HDice TC Operations manual: https://www.jlab.org/Hall-B/HDIce/manuals/transfer05a.pdf

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	When extracting a target that has been exposed to beam, RadCon will survey the outside of the IBC (Possible activated material in target cells. Note: unlikely due to low energy and planned low currents.)	M	EL	1		RanCon survey required	1

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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	Riggers move the HDice *Work Platform* into place. (A potential Fall Hazard into the opening of cave-2 is associated with gaps in the yellow guard rails that will accept the Work Platform. The Platform is needed for target transfer operations. Equipment damage could result if improperly rigged.)	M	EL	3	As part of OSP 87551, which precedes the activities of this OSP, a horizontal lifeline has been added to the North end of the cave-2 roof. The North Worker attaches to this lifeline using an approved Lanyard before approaching the North-side gap in the yellow guard rails, which will accept the North end of the Work Platform. The South Worker connects his lanyard to Hoist Rings in the concrete ceiling tiles before approaching the South gap in the guard rails.	Approved fall protection harnesses, lanyards and lifeline, all of which are inspected regularly. KEEP OUT signs are placed near fall hazards.	1
3	Prepare Transfer Cryostat (TC) for target handling. (If procedure is incorrectly executed, could result in loss of polarized target that took months to make, and/or damage to equipment.)	M	M	3		- ODH training / SAF-103 - Compressed gas training / ES&H 6150. - TC operations, as detailed in https://www.jlab.org/Hall-B/HDIce/manuals/transfer05a.pdf	1
4	Prepare beamline: disconnect IBC, partially remove lead shielding, de-energize dump solenoid. (Potential damage to equipment if improperly handled. Potential back and hand injury in moving lead. Electrical hazard.)	M	L	2		- ODH training / SAF-103. - Compressed gas training / ES&H 6150. - Lead Worker Safety Awareness training / SAF-136. - OSP 94612 for operation of the dump solenoid.	1

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
5	IBC rotation to vertical (Could result in damage to equipment.)	M	EL	1			1
6	Move the TC from the HDice Lab into cave-2 of the UITF. (Programmatic loss of target polarization if not carried out correctly.)	M	EL	1			1
7	Lift the TC onto the IBC. Requires egress from cave-2 roof via North scaffold. (Fall risk from scaffolding.)	M	EL	1		- Ladder Safety training SAF-307 and Scaffold training SAF-303B.	1
8	Load a target from the TC into the IBC, or extract a target from the IBC into the TC. (If procedure is incorrectly executed, could result in loss of polarized target that took months to make, and/or damage to equipment.)	M	M	3		- steps specific to target extraction or insertion are extensively detailed in separate check-sheets maintained by the HDice group.) - IBC operations, as detailed in https://www.jlab.org/Hall-B/HDIce/manuals/inbeam04.pdf	1
9	Lift the TC off the IBC and return it to its transportation cart. (Potential for fall from scaffolding.)	M	EL	1		- Ladder Safety training SAF-307 and Scaffold training SAF-303B.	1

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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
10	Recovering an extracted target and RadCon survey. (Possible activated material in target cells. Note: unlikely due to low energy and planned low currents.)	L	EL	1		RanCon survey required	1
11	Return the IBC to horizontal orientation in preparation for UITF beam. Restore lead shielding. Re-energize dump solenoid. (Could result in damage to equipment. Potential back and hand injury in moving lead. Electrical hazard.)	M	L	2		- ODH training / SAF-103. - Compressed gas training / ES&H 6150. - Lead Worker Safety Awareness training / SAF-136. - OSP 94612 for operation of the dump solenoid.	1
12	Riggers store the Work Platform. (Could damage equipment in cave-2 if improperly rigged and components fall.)	M	EL	1			1

Highest Risk Code before Mitigation:	3	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.)

Form Revision Summary

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 REQUIRED DATE	REV.
ESH&Q Division	Harry Fanning	06/19/12	06/19/15	0.1

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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: ENP-20-94834-OSP

Title: Transferring (loading/removing) targets to/from the HDice IBC in cave-2 of the UITF

Name	Signature	Date