User Policies and Procedures for the Irradiation Test Area

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A collection of user procedures related to conducting an experiment in the Irradiation Test Area. Additional information available at ita.fnal.gov.

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Definitions

MTA: MeV Test Area, referring to the beam enclosure and service building as well as the beam line. This is the name to use in communications with the Main Control Room. This space was previously known as the MuCool Test Area with the same MTA acronym.

ITA: Irradiation Test Area, referring to the shielded experimental cave at the end of the MTA beam line as well as the program of user test experiments taking place at the facility. Experiments involve studying the effects of radiation on materials in the MTA beam. Experimental activities in the MTA facilities are overseen by the ITA coordinator.

Counting House: Refers to one half of the service building located adjacent to the entrance to the beam enclosure on the surface in the parking lot. This room was previously known as the MuCool, or MTA, Refrigeration Room and housed cryogenic equipment for the

previous experiment. The room has been refurbished to serve as a counting house for experiments. It is connected to the beam enclosure through a series of penetrations. This building is divided in half by a set of double doors, the other half of the building being the Compressor Room.

Figure 1: Annotated aerial view showing beam alcove, experiment hall, and counting house approximately as situated in the grass-covered berm. Beam direction and path are indicated by the cyan arrow and dotted line.

TSW Process

Experimenters must have an approved Technical Scope of Work (TSW), which describes the test experiment in detail. A TSW is a written plan put in place to establish a clear understanding of how an experiment will practically function and each party's roles and responsibilities. Please note that this is not a guarantee of beam time. This is not an official contract. The TSW makes sure all parties understand what is expected. See https://programplanning.fnal.gov/tsw_orc/.

The preparation and consideration of a TSW for each irradiation effort helps the facility be flexible and meet the goal of equal access to test beams for all detector tests with relatively low

bureaucratic overhead and a guarantee of safety, coordination and oversight. The TSW is signed by the experiment spokesperson and acknowledged by Fermilab division heads and associate directors. The scope of work is not considered proprietary information and is publicly released.

The spokesperson is the experiment's official contact and is responsible for forwarding all relevant information to the rest of the group, arranging for their training and getting the necessary approvals for the experiment to run. If a test beam is part of a larger experiment, the spokesperson listed on the test beam *should not* be the experiment's spokes, unless they are directly involved in the running of the test beam.
In order to fill out the TSW, you must have a Fermilab ID number and a Services account. Please obtain an ID first then start the TSW from here. All ITA experiments are considered "Beam TSW".

Note that the ITA nominally delivers 12 hours of beam per week for one experimental run. For more details on the beam delivery go here.

The purpose of the facility is to study the effects of radiation damage on materials and detector components, this is NOT an isotope production facility and any radionuclides produced are incidental to the radiation effects studies. To ensure this, samples placed in the beam path must be carefully catalogued and long-term storage and use plans for the samples are required. This information will help determine whether the experiment can be approved for beam use and how best to schedule the experiment with other requests. **Please address the following questions explicitly when filling out the experimental request in the TSW:**

1. What are the quantity, dimensions, and material composition of each sample to be placed in the beam path?
2. What are the required fluence for each sample?
3. What are the plans for the samples after the ITA run is complete?
    1. How long is on-site storage required for (and at what temperature)?
    2. Is time at FTBF also needed?
    3. Will samples eventually be shipped offsite and if so approximately when, where, and for what purpose?
        1. Provide shipping address and radioactive materials license for destination institution and Radiation Safety contact.
4. Please identify any facility infrastructure needed for your experiment.
5. Please identify hazards associated with your experiment. The current Safety Assessment Document for the facility is viewable here. All hazards associated with an experiment must be covered by this document.
6. The ITA requires coordination with the Radiation Safety Operations department for the installation and removal of samples in the beam enclosure, and a cool-off period is necessary after irradiation. See here for a typical weeks schedule at the ITA. If the nature of your experiment requires a different schedule, please discuss when filling out the TSW and requesting time.

The TSW will be reviewed by the ITA coordinator, assigned RSO, and beam line physicist to ensure the experiment can be accommodated by the facility safely and calculate expected

sample activations. After approval from the ITA coordinator it will be submitted to receive signatures from the Office of the CIO, Office of the CRO, AD Head, PPD Head, ESH Head, and the SRSO.

Safety Training

Everyone will need:

- MTA Hazard Awareness: Individuals performing work in the MTA bean enclosure or counting house must complete Hazard Awareness training. This training is required for anyone entering the facility, but it can be taken online.
- New Employee/User Orientation Training: This training should have been completed in order to obtain a Fermilab ID badge. Follow the instructions here to take the training online. It includes:
    - GERT: If you do not need to access the beamline enclosure, then General Employee Radiation Training is adequate. This training is required for anyone entering the facility.
    - Electrical Safety Orientation: This training is to expose unqualified employees to the hazards and consequences of an electrical incident and steps to take to protect themselves from the hazard. This training is required for anyone entering the facility.

Everyone entering the beamline enclosure will need:

- Radiological Worker: If you need to make any access to the ITA experimental hall, then you will need both parts of Radiological Worker Training. You must be over 18 years of age. A dosimetry badge can be obtained by filling out the information in the website http://www-esh.fnal.gov/pls/default/tld_requests.html, then picking up the dosimeter in the Communications Center on the Wilson Hall ground floor (next to the ID Office). The spokesperson or an ITA coordinator can sign for any permissions on these forms.
    - You must take the 1.5 hour online Radiological - Worker Classroom (Virtual) course every two years.
    - You must also take the 2-hour Radiological Worker - Practical Factors class in person every two years. Schedule this as early as possible.
- Controlled Access: Radiological workers who require entrance to enclosures under controlled access conditions will also need Controlled Access training. This course must be retaken yearly.

Installation

When arriving at the facility for installation the ITA coordinator will orient you to the service building and beam enclosure as required. All users involved in the installation will have completed the MTA Hazard Awareness training and Radiological Worker training. There are electronics racks available to users in both the counting house and beam enclosure. ITA staff will overview the procedure for loading samples into the materials box depending on the nature of the test. If motion tables, cooling or other infrastructure is required it will be demonstrated.

There is a set of generic cables that run between the counting house and enclosure that are available in patch panels for users. **If your experiment requires additional cables to pull through the penetrations, contact the ITA Coordinator**. **DO NOT ATTEMPT TO INSTALL NEW CABLING OR TAMPER WITH PENETRATION SHIELDING**.

Users will prepare their installation in the electronics racks first and pre-stage any samples in the materials box for installation in the beam. A time will be arranged with the Radiation Control Technicians (RCTs) to move the materials into the shielding cave. **Users are not permitted to access any equipment in the shielding cave or front porch without the presence of an RCT.**

To enter the counting house door requires an AC4 key which may be checked out from the MCR. Only one AC4 key for the outer door is needed for the party. The experimenter who checks out the AC4 key must return it to the MCR themselves, they may not pass it on to anyone else. The owner of the key should remain present during installation activities.

Operational Readiness Clearance (ORC)

Each time an approved test beam experiment sets up in the beamline it must obtain an Operational Readiness Clearance (ORC) before the apparatus can be operated with beam. This consists of an inspection of the equipment (in the beam enclosure) by a committee including the AD Division Safety Officer, assigned RSOs, and other SMEs as needed.

This review takes place after an experiment is completely installed and connected to all equipment as it is intended to operate. Equipment CANNOT be turned on until the ORC has been completed. After the ORC the experiment must be approved by the review committee and then signatures are obtained by the ITA coordinator, Accelerator Division Safety Officer, RPO Department Head , Accelerator Division Operations Department Head, and Accelerator Division Head. This process may take some time and beam cannot be requested until complete. Additional information on the ORC process for the facility is available here and FESHM 2005.

Weekly Schedule

A nominal week at the ITA consists of one experimental group. If you have scheduling constraints or the nature of your proposed experiment requires a different schedule, please discuss with the ITA coordinator when requesting beam time and setting up the TSW. To view the current schedule go here. This calendar will reflect the planned installation day, beam day, and sample retrieval day for a given experiment based on their needs determined in the TSW, accelerator conditions, and RCT/SME coverage.

Monday: Users arrive, complete any onsite training required and install the experiment. The ITA Coordinator will arrange a time between users and RCTs for the RCTs to insert samples into

the shielding cave. An ORC (Operational Readiness Clearance) review is typically held in the afternoon after installation is complete.

Tuesday: After all issues from the ORC have been addressed and signatures collected, beam can be requested. Beam irradiations are nominally up to 12 hours. Users can monitor the experiment from the ITA counting house or remotely depending on their setup. Beam time may adjust subject to any downtimes to the accelerator complex. **At present beam will be delivered during the day subject to expert operator availability. No controlled accesses are permitted without RSO approval.**

Wednesdays are frequently a maintenance day for the accelerator.

Friday: After the beam run is complete, there is a cool-down period before the enclosure may be entered to retrieve samples. Nominally sample retrieval will be done on Fridays by the RCTs in coordination with the user. Samples will be placed in the freezer in the ITA counting house for storage until the activity has decreased. It will be possible to cool samples in the beam enclosure via a vortex chiller upon request. If samples need to be retrieved sooner for any reason, please make note when requesting beam time and setting up the TSW so RCT availability can be planned.

Requesting Beam

Once an experiment has an approved ORC, the experimental group may request beam from the Main Control Room (MCR) (x3721). The MCR will not send beam until this request has been made. This is done in coordination with the beam line physicist to coordinate times when experts are available to steer the beam. To streamline communication with the MCR the experiment will appoint one person (experiment representative), nominally the experiment spokesperson or a designate, to handle all communications. If the experiment choses to handle the data collection responsibilities in shifts they will identify to the MCR when a shift change has occurred and there is a new contact.

There are two options for where a user may be located while beam is being sent. This location will be specified in the ORC documentation and approved by the ITA coordinator.

- ITA Counting House – For experiments with active samples requiring monitoring of cooling, power, active data collection from the samples users will be stations in the ITA counting house (x3101)
- Remote – For experiments with passive samples with little monitoring required beyond the total fluence delivered by the accelerator to the samples, users may be remotely located.

When making a request for beam the experimental representative must communicate the following information to the MCR:

- Identify the experiment they represent (TXXXX). The ITA Coordinator will tell the MCR which experiments have been approved to make a request.

- Identify their name, location and contact number
- Specify they are requesting beam to the MTA
- Request a target fluence and any additional requests (i.e., specification on beam spot size, pulse pattern, etc.)

During the beam run the MCR may contact the experiment representative to relay information on beam conditions. The experimental representative may contact the MCR to request any changes in operating conditions or when the beam request is complete. The beamline physicist will provide a method for the experiment to count and monitor the integrated dose delivered to the experiment that meets the needs of the group. The experiment representative will communicate to the MCR when beam should be stopped at the conclusion of their run.

During the beam run, no controlled accesses are permitted without Radiation Safety Officer approval. Due to the high radiation environment in the hall, accesses are discouraged until the irradiation is complete and the hall has cooled off and been configured for supervised access**. If a controlled access is required, the user will contact the ITA coordinator who will communicate the request to the MCR.**

Enclosure Access

Access to the MTA beam enclosure requires the relevant safety training discussed above. Users may check out enclosure Enter keys from the MCR for the MTA enclosure. Each user making an enclosure access must have their own unique enclosure Enter key and read and sign the appropriate Radiological Work Permit (RWP). It is possible to read and sign the RWP online (https://esh-rwp.fnal.gov) or in the MCR. Any PPE required for enclosure access, as specified on the RWP, is located in a cabinet in the counting house located adjacent to the beam enclosure access point. A set of pocket dosimeters and a charging station is also available in the counting house. To enter the outer door to the vestibule area before opening the beam enclosure door requires an AC4 key which may be checked out from the MCR. Only one AC4 key for the outer door is needed for the party. The experimenter who checks out the AC4 key must return it to the MCR themselves, they may not pass it on to anyone else. The owner of the key should remain present during installation activities.

There is NO open access at MTA, meaning there is never a time where access to the hall is permitted without the above training and enclosure Enter key requirements. User access for installation and retrieval will take place when the enclosure is configured in a supervised access state, which means that enclosure interlocks have been disabled, a radiation survey has been performed in the enclosure, and the Accelerator Division Operations Department have converted the enclosure to this status.

Any access that requires reaching into or manipulating equipment inside the shielding cave or the front porch must have a Radiation Control Technician present. Activities involving the electronics racks or other areas of the experimental hall are permitted without RCT coverage.

When the enclosure is configured to send beam the interlock systems are activated, and access is only possible in a controlled access. **There is currently no controlled access without RSO approval** due to the potential for high radiation fields**.** Users are strongly encouraged to avoid controlled accesses during the beam run. If a situation comes up that requires an access the experimental leader will contact the ITA coordinator. The ITA coordinator will communicate the access request to the MCR and iit will be coordinated with the RSO and may be subject to RCT availability if the proposed access involves operations in the front porch/cave. It is very difficult to arrange such an access outside normal business hours.

End of Run

At the end of your run there will be a cool-off period after which the beam enclosure will be surveyed and configured for supervised access. We ask that you uninstall equipment or make arrangements with the facility for storage. Please return all tools and cables. **All equipment leaving the beam enclosure must be surveyed.** Equipment and samples located in shielding cave and/or beam path will be removed by RCTs and stored accordingly as outlined here.

At the end of the year, we ask that users write a 1-page report about their test beam run and results. We will be in touch to collect those reports. We are also very interested to see what results you achieved and are happy to hear about publications. We may display posters around the facility as well.

Storage of Samples

After materials are irradiated in the beam, they will follow a storage path outlined in the decision tree in Figure 2. For each beam run, a cool-off period will be determined by the RSO before RCTs and users can access the enclosure and retrieve samples.
Most samples will move into a freezer located in the ITA counting house for further cooling. This freezer has lead curtain shielding and is locked by the RSO. Radiation levels outside the freezer will be maintained under 0.05 mR/hr at one foot to provide unlimited occupancy for users. When a sample is sufficiently cooled, arrangements can be made for transportation to FTBF, another suitable on-site location, or transportation offsite according to the plans set in the TSW.

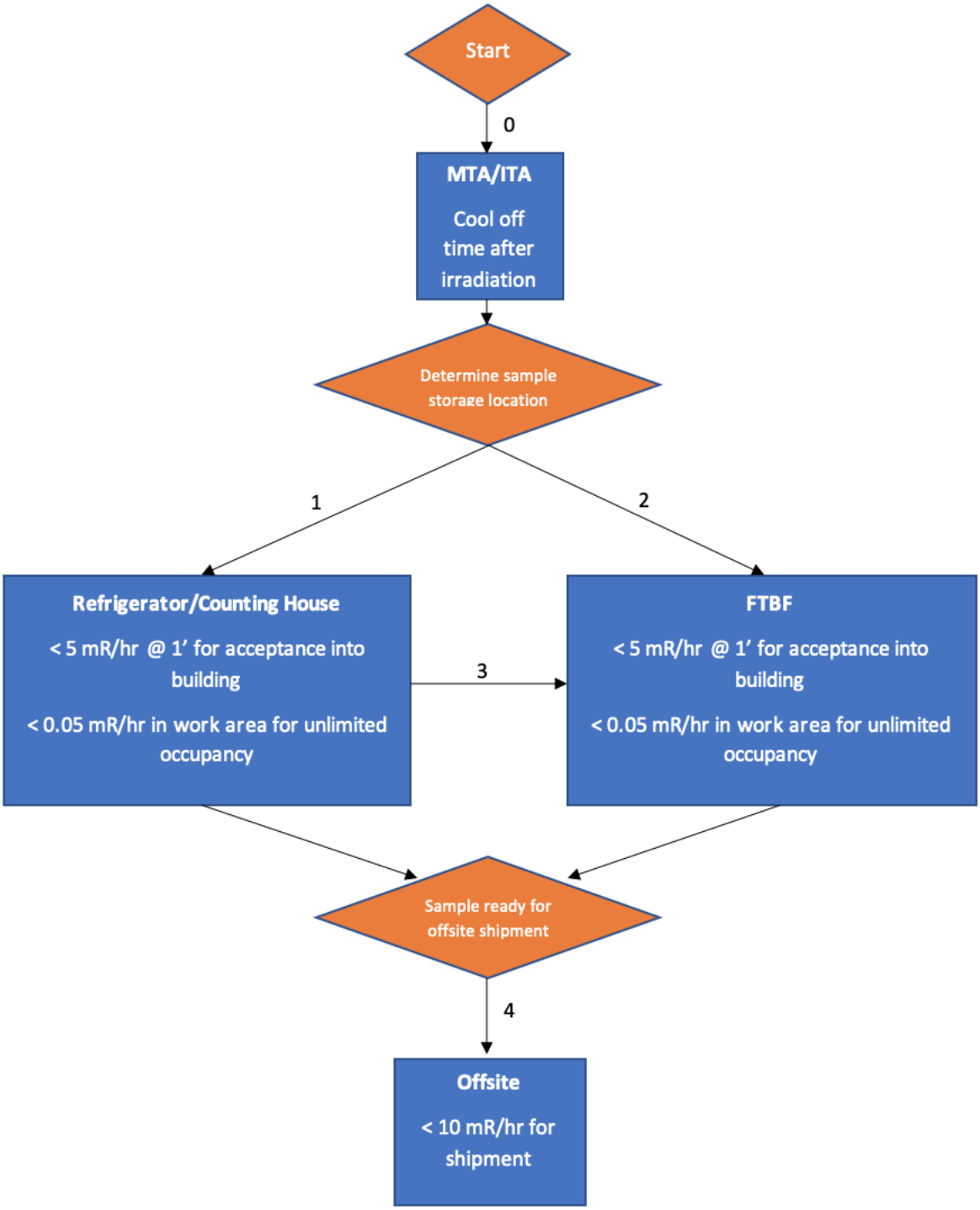

Figure 2: Flowchart showing movement of samples on and offsite. Path 0: Need TSW. TSW must include material composition, irradiation plan, activation products, radioactive materials license and which path equipment will be following after irradiation. Shipping costs back need to be considered. Path 1: Dose rate needs to be less then 5 mR/hr on the outside of the shielded freezer – dose rates need to be less than 0.05 mR/hr for unlimited occupancy in work area. Consideration for next incoming group. RCT coverage during removal of materials from shielding cave and storage in freezer. Path 2: Unshielded dose rate needs to be less then 5 mR/hr for acceptance directly into FTBF. All offices spaces need to be maintained at 0.05 mR/hr. RCT coverage during the removal of samples from the shielding cave and then standard MMR procedures followed to transport materials to FTBF. Path 3: Unshielded dose rate needs to be less then 5 mR/hr for acceptance into FTBF. All offices spaces need

to be maintained at 0.05 mR/hr. Additional freezer shielding may be needed. Standard MMR process is followed for transportation of materials to FTBF. Path 4: Dose rate needs to be less then 10 mR/hr to minimize both cost and DOT restrictions in shipping. Some institutions, depending on their radioactive materials license, may require isotope characterization if equipment is still radioactive. May need to store onsite until activation products have decayed away, if this is unknown. Shipping out of country will need more considerations.

Movement of Samples

After irradiated samples have cooled sufficiently in the counting house freezer, they may be retrieved for use on-site or shipment offsite. **Note that plans for the use of irradiated materials and destinations must have already been filed in the TSW requesting beam time at the ITA. Any change in plans must be discussed with the ITA coordinator and assigned RSO and included in a TSW addendum.** The sample storage freezer is under RSO control and cannot be opened without the presence of an RCT. For a sample to be used in a Radioactive Materials Area without occupancy restriction it must be under 0.05 mR/hr at one foot. For more details on radiation requirements see the section above on sample storage.

For transportation of materials onsite, please contact the ITA coordinator and assigned RSO to make arrangements and fill out a Material Move Request (MMR). This may require a few days lead time for approvals and scheduling of an RCT.

For transportation of materials offsite, please notify the ITA coordinator, assigned RSO, and Kathy Graden to initiate the shipment process. This will require identifying the receiving institution, radioactive material license, and a point of contact at the institution, **which must be supplied in the process of submitting the TSW.**
There will be a survey form that will follow irradiated samples around site as they are used and surveyed to maintain chain of custody and information on the sample. The form must be signed off by the SRSO/RSO/MTA staff before a sample is shipped offsite.