

# SAFETY OJT

This OJT provides you with a checklist, guideline, and record of your Operator II Safety training, and also introduces you to regular operational procedures as well as physical locations of equipment. **It is very important that you do not lose this document.** If you lose this document the training you have completed will have to be redone.

This training list has been successfully completed.

Department Head (Signature/Date) \_\_\_\_\_

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# Part 1: General Safety

## 1.1 Safety System

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### 1. Safety System Introduction

- \_\_\_\_\_ The electrical safety system (ESS) protects personnel from major electrical hazards in an enclosure
- \_\_\_\_\_ The critical device controller (CDC) system prevents beam from directly affecting personnel in an enclosure
- \_\_\_\_\_ The safety system has built-in redundancy
  - \_\_\_\_\_ The CDC and ESS permits both have separate A and B loops
  - \_\_\_\_\_ Most enclosure doors have two switches (one mechanical and one magnetic) to detect the status of the doors
  - \_\_\_\_\_ Each enclosure has two critical devices, or two ways to disable a single device, which can disable beam to an enclosure
  - \_\_\_\_\_ An enclosure's ESS permit status can be an input into a CDC permit
- \_\_\_\_\_ The safety system is designed to be fail-safe
  - \_\_\_\_\_ If a circuit fails, the failure results in a safe condition
  - \_\_\_\_\_ Loops and permits are active "HIGH" for proper operation, meaning that a supplied voltage must always be present to keep the permit good (for instance, if a wire is cut the permit is dropped)
- \_\_\_\_\_ Only the ESH&Q Interlock Group is authorized to work on the safety system

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## 2. Critical Device Controller System

- \_\_\_\_\_ Know that the CDC system protects personnel from the hazards of direct beam radiation
  - \_\_\_\_\_ CDCs provide a permit signal to the critical devices that allows those devices to be powered on
  - \_\_\_\_\_ This permit is obtained by turning on the CDC chassis after all the inputs are made up
  - \_\_\_\_\_ Energizing critical devices requires both an ESS permit and a CDC permit
  - \_\_\_\_\_ When the critical devices are powered on, it is possible to send beam to the enclosures protected by the CDC
- \_\_\_\_\_ Understand the purpose, function and location of the various CDC chassis
  - \_\_\_\_\_ Know where to find the parameters associated with each CDC
  - \_\_\_\_\_ Know how to interpret the digital status of a CDC
- \_\_\_\_\_ Know what types of devices are typically used as critical devices and how they inhibit or allow beam to enclosures
- \_\_\_\_\_ Know the critical devices for all enclosures
- \_\_\_\_\_ Know that if the CDC detects a critical device in an indeterminate state a critical device failure occurs
  - \_\_\_\_\_ Know the result of a critical device failure mode for each CDC

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## 3. Critical Device Work

- \_\_\_\_\_ Understand the procedure for issuing a critical device key [ADDP-OP-0400](#)
- \_\_\_\_\_ Know that only an RSO or designee can give approval to issue the critical device key for work on a critical device
- \_\_\_\_\_ Know that after work is done on a critical device and the critical device key is returned, a critical device test must be completed before beam can be sent beyond the device
- \_\_\_\_\_ Know in general what a critical device test entails and its purpose
  - \_\_\_\_\_ Know where to find specific test procedures for each CDC

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#### 4. ESS

- \_\_\_\_\_ The ESS permits power supplies in an enclosure to be energized
- \_\_\_\_\_ A device is interlocked to the ESS if it meets any of the three criteria listed below:
  - \_\_\_\_\_ It can deliver more than 50 V to its load
  - \_\_\_\_\_ It can deliver more than 50 A to its load
  - \_\_\_\_\_ It can store more than 1 J of energy
- \_\_\_\_\_ The ESS automatically “whoops” when all of its inputs are made up
  - \_\_\_\_\_ A “whoop” is an audible signal that is broadcast inside an enclosure, warning occupants that the ESS interlocks have been made up and power supplies can be turned on
- \_\_\_\_\_ The “A” circuit is the electrical hardwire loop through all the enclosure door switches
  - \_\_\_\_\_ Summed with the safety system ground fault circuit and the enclosure keys
- \_\_\_\_\_ The “B” circuit is the logic loop through all the enclosure interlock box sequence relays
  - \_\_\_\_\_ Summed with the emergency loop and the enclosure keys
  - \_\_\_\_\_ The emergency loop consists of pull-cords, scram-switches or large red crash buttons which will drop the inputs to the ESS for the enclosure

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#### 5. CDC vs. ESS

- \_\_\_\_\_ Know that multiple ESS permits can be inputs into a single CDC permit
- \_\_\_\_\_ Know that some enclosures are linked via CDC inputs, but do not share the same ESS
  - \_\_\_\_\_ These enclosures are linked for radiation safety, but not for electrical safety

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## 6. Safety System Display

- \_\_\_ Know how to use the CDC subpages
  - \_\_\_ Check the status of the critical device permits
- \_\_\_ Know how to use the tunnel doors pages
  - \_\_\_ Which tunnel doors are open
  - \_\_\_ Which location in a tunnel dropped the interlocks
  - \_\_\_ Which scram switches are pulled
- \_\_\_ Know how to use the keys pages
  - \_\_\_ Which keys are missing from a key tree
  - \_\_\_ Which keys are present in the key tree but unturned
- \_\_\_ Know how to use the ESS subpages
- \_\_\_ Know how to use the Diagnostics pages
  - \_\_\_ Check the status of the rad monitors
  - \_\_\_ Check the status of the safety system UPSs
  - \_\_\_ Check the status of the audio permit

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## 7. Accesses

- \_\_\_ Know the requirements for controlled access
  - \_\_\_ Beam is off
  - \_\_\_ Power supplies are off
  - \_\_\_ CDC is disabled
  - \_\_\_ Necessary LOTO has been performed
  - \_\_\_ Keys issued
- \_\_\_ Know the requirements for supervised access
  - \_\_\_ Controlled access requirements met
  - \_\_\_ Radiation survey completed and posted
  - \_\_\_ Configuration control lockout performed
  - \_\_\_ Interlocks dropped
- \_\_\_ Know the requirements for open access
- \_\_\_ Be aware of the requirements for power-on access

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## 8. Search and Secure

- \_\_\_\_\_ Understand that the primary purpose of the search and secure is to clear the enclosure of all personnel
- \_\_\_\_\_ Understand the General Search and Secure Procedure [ADDP-OP-0200](#)
- \_\_\_\_\_ Be familiar with material covered in any enclosure specific search and secure training
  - \_\_\_\_\_ Search and secure maps

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## 9. Remote Experiment Controlled Access

- \_\_\_\_\_ Understand the role of a Controlled Access Leader (CAL) and how to check if a CAL is qualified via the [Controlled Access Leaders webpage](#)
  - \_\_\_\_\_ Know who the Controlled Access Coordinator is for a specific area
  - \_\_\_\_\_ Understand that only people approved by the Controlled Access Coordinator can enter that enclosure
- \_\_\_\_\_ Understand that there are experimenter access restrictions for the following areas:
  - \_\_\_\_\_ MTest
  - \_\_\_\_\_ MCenter
  - \_\_\_\_\_ MTA
  - \_\_\_\_\_ NM4
  - \_\_\_\_\_ MC-1

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## 10. Interlocked Radiation Detectors

- \_\_\_\_\_ Know where interlocked detectors are normally located and what they protect
- \_\_\_\_\_ Know what types of interlocked detectors are used and the differences between them
- \_\_\_\_\_ Know how to use the interlocked radiation detector MUX display, RadMon
  - \_\_\_\_\_ Determine the MUX ID number, type of detector, detector location, and counts registered on detector
  - \_\_\_\_\_ Obtain information for calculating dose rates
  - \_\_\_\_\_ Know the locations of the reset buttons
- \_\_\_\_\_ Know how to respond to rad trips
- \_\_\_\_\_ Know the location and lock combination of the spare chipmunk and scarecrow cabinet
  - \_\_\_\_\_ Know how to find the location of a chipmunk or scarecrow using the interlocked detectors red book
- \_\_\_\_\_ Know how to replace a chipmunk following steps outlined in Radiation Detector Change Procedure [ADSP-10-0101](#)
  - \_\_\_\_\_ Know which detector type we are not allowed to change
- \_\_\_\_\_ Know that TLMs utilize an ArCO<sub>2</sub> mix
  - \_\_\_\_\_ Know how to change out the bottles
- \_\_\_\_\_ Know that there are ACNET readbacks for each of the interlocked radiation detectors
  - \_\_\_\_\_ Find these parameters on page D106
  - \_\_\_\_\_ Know that all of these devices are datalogged

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## 11. Coasting Beam Valves

- \_\_\_\_\_ Know which machines have coasting beam valves
- \_\_\_\_\_ Know that coasting beam valves protect personnel in adjacent enclosures from radiation hazards due to stored beam
- \_\_\_\_\_ Know what conditions will cause coasting beam valves to close
- \_\_\_\_\_ Use the Coasting Beam subpage of the Safety System display to check the status of the coasting beam permit

## 1.2 Keys

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### 1. Key Distribution

- \_\_\_ Verify access type and entry key
- \_\_\_ Log out a key to an individual
  - \_\_\_ Many keys have special restrictions and approval requirements (some keys, such as the AC master key, may not be issued to non-operations personnel)
- \_\_\_ Verify an individual's training by the following methods, if necessary:
  - \_\_\_ TRAIN database
  - \_\_\_ Class verification cards
  - \_\_\_ Contacting ESH&Q
  - \_\_\_ CAL qualification list
- \_\_\_ Know that any key not in the key logger database must be logged out in the MCR Elog

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### 2. Key Logger

- \_\_\_ Know how to use the key logger computer at the Duty Assistant's desk to perform the following functions:
  - \_\_\_ Log keys in and out
  - \_\_\_ Read outstanding keys list
  - \_\_\_ View transaction log
  - \_\_\_ Know how to restart the key logger if it dies
  - \_\_\_ Know how to update the key logger training database

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### 3. Enclosure Keys

- \_\_\_ Know the purposes of the various enclosure keys found in the MCR key tree
  - \_\_\_ Enter keys for any enclosure
  - \_\_\_ Reset keys for any enclosure
  - \_\_\_ Linac penetration key
- \_\_\_ Know when it is appropriate to issue enclosure keys
- \_\_\_ Know which enclosure keys require a confined space permit

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#### 4. Remote Key Trees

- \_\_\_\_\_ Know how the various remote key trees are used throughout AD
- \_\_\_\_\_ Know from which key trees we issue keys remotely
  - \_\_\_\_\_ MTest
  - \_\_\_\_\_ MCenter
  - \_\_\_\_\_ NM4
  - \_\_\_\_\_ NML Cave/FAST/ESB
  - \_\_\_\_\_ CMTF Cave/PIP2IT
  - \_\_\_\_\_ MC-1

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#### 5. Non-Enclosure Keys

- \_\_\_\_\_ Know the uses of various keys found around the MCR
- \_\_\_\_\_ Know that certain keys require extra permission and who to contact
  - \_\_\_\_\_ What special requirements, if any, are necessary to check each key out
- \_\_\_\_\_ MCR key tree keys
  - \_\_\_\_\_ Operator storage room
  - \_\_\_\_\_ AC3 ODH building
  - \_\_\_\_\_ AC4 service building
  - \_\_\_\_\_ Refrigerator building access
  - \_\_\_\_\_ AP0 service building key
  - \_\_\_\_\_ Booster GMPS Bypass, Booster Hipot Enable, and Booster 13.8 kV lockout keys

\_\_\_\_ Crew chief cabinet keys

- \_\_\_\_ MCR Halon Panel Trouble Silence
- \_\_\_\_ MI PS
- \_\_\_\_ FIRUS Room
- \_\_\_\_ AP0 Vault Access
- \_\_\_\_ AP0 Vault Cooling Water Cage
- \_\_\_\_ HEP
- \_\_\_\_ Critical Device
- \_\_\_\_ Flammable Storage Cabinet
- \_\_\_\_ Linac QPS
- \_\_\_\_ Emergency Generator
- \_\_\_\_ Radiation Area Fence Access
- \_\_\_\_ Confined Space Keys
- \_\_\_\_ C0 Assembly Building RHF Key
- \_\_\_\_ MI-40 Absorber Room
- \_\_\_\_ Configuration Control Keys

\_\_\_\_ Master key rings

- \_\_\_\_ ACM
- \_\_\_\_ CUB keys (A5AA15 and A5AA24, or ID)
- \_\_\_\_ EXP and EAD

\_\_\_\_ External Beamlines keys

- \_\_\_\_ M4A, NS20, and P1 (Ops keys)
- \_\_\_\_ EAD0
- \_\_\_\_ M1 (rad fence key and TSB)
- \_\_\_\_ EXP

## 1.3 Radiation Safety

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### 1. Radiation Hazards

- \_\_\_ Understand the different possible sources of radiation exposure at Fermilab
  - \_\_\_ Activated tunnel components (e.g. magnets)
  - \_\_\_ Transferable contamination (e.g. radioactive dust)
  - \_\_\_ X-ray sources (septa at full voltage or Linac RF stations at full gradient)

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### 2. ALARA

- \_\_\_ Know how to use ALARA, As Low As Reasonably Achievable, to minimize radiation exposure
  - \_\_\_ Minimize time exposed to radiation
  - \_\_\_ Maximize distance from radiation
  - \_\_\_ Use shielding when possible

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### 3. Units of Radiation Measurement

- \_\_\_ Roentgen (R)
  - \_\_\_ Defined for gamma rays and x-rays in open air only
  - \_\_\_ A measure of a radiation field, not its effects on people
  - \_\_\_ Log survey meters (LSMs) and wallflowers read out in mR/hr
- \_\_\_ Radiation absorbed dose (rad)
  - \_\_\_ Applies to all types of radiation and all types of materials
  - \_\_\_ Does not account for potential effects on human body due to different types of radiation
- \_\_\_ Roentgen equivalent man (rem)
  - \_\_\_ A unit for measuring all types of radiation, taking into account the effects that different radiation types have on the body
  - \_\_\_ Used as a legal unit for exposure reports
- \_\_\_ Understand that for beta and gamma radiation, the dose equivalent (rem) is the same as the absorbed dose (rad)

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#### 4. Radiation Areas

\_\_\_\_\_ Radiation area definitions can be found in the Fermilab Radiological Worker Training and are defined by *Occupational Radiation Protection Program* (10 C.F.R. §835)

\_\_\_\_\_ A Radiation Area is an area accessible to individuals in which radiation levels could result in an individual receiving a dose to the whole body in excess of 5 mrem in 1 hour at 30 cm

\_\_\_\_\_ A High Radiation Area is an area accessible to individuals in which radiation levels could result in an individual receiving a dose to the whole body in excess of 100 mrem in 1 hour at 30 cm

\_\_\_\_\_ A Very High Radiation Area is an area accessible to individuals in which radiation levels could result in a person receiving an absorbed dose in excess of 500 rads in 1 hour at 1 m from a radiation source or from any surface that the radiation penetrates

\_\_\_\_\_ A Contamination Area is an area where there is a transferable radiation hazard

\_\_\_\_\_ Know why you should not eat, smoke, or drink in a radiation area

\_\_\_\_\_ Know who is responsible for the radiation survey in a controlled access

\_\_\_\_\_ At 100 mR/hr at 1 foot, call the MCR crew chief before any work is performed

\_\_\_\_\_ At 500 mR/hr at 1 foot, leave an area immediately

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#### 5. Annual Dose Limits

\_\_\_\_\_ Know the FNAL whole body radiation dose limit (Administrative Control Level)

\_\_\_\_\_ 1.5 rem in 1 year

\_\_\_\_\_ 100 mrem in 1 week

\_\_\_\_\_ Know that a full body dose of 450 rem will be lethal within 1 month for 50% of the population

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## 6. Personal Dosimetry and Survey Instruments

\_\_\_\_\_ Know when each of the following it is used, what types of radiation it detects, and how levels are measured and recorded:

- \_\_\_\_\_ Dosimetry badge
- \_\_\_\_\_ Self-reading pocket dosimeter
- \_\_\_\_\_ LSM

\_\_\_\_\_ Know that your self-reading pocket dosimeter dose is entered once a week via a web link emailed to you

\_\_\_\_\_ Know how to check an LSM prior to its use

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## 7. Radiation Surveying

\_\_\_\_\_ When leaving a radiation area, be able to properly use survey equipment

- \_\_\_\_\_ Frisker
- \_\_\_\_\_ Wallflower

\_\_\_\_\_ Know that a person and personal clothing is considered contaminated if they are 100 counts/minute above background as measured by a frisker

\_\_\_\_\_ Know how to properly respond to a person found contaminated as outlined in the Radioactive Contaminated Person emergency response procedures (ERPs) (ADDP-OP-0015 and ADDP-OP-0016)

\_\_\_\_\_ Know that waste items and protective clothing are considered contaminated if they are 50 counts/minute above background as measured by a frisker

\_\_\_\_\_ Know how the radioactivity class system works for contaminated items

- \_\_\_\_\_ Class 1: 50 counts/minute on contact to 1 mR/hr at 1 ft
- \_\_\_\_\_ Class 2: 1 mR/hr to 10 mR/hr
- \_\_\_\_\_ Class 3: 10 mR/hr to 100 mR/hr
- \_\_\_\_\_ Class 4: 100 mR/hr to 1000 mR/hr
- \_\_\_\_\_ Class 5: > 1000 mR/hr

\_\_\_\_\_ Know how to dispose of waste found to be contaminated

- \_\_\_\_\_ Radioactive Waste Disposal Procedure [ADSP-10-0201](#)
- \_\_\_\_\_ Temporary Waste Storage Cabinet Procedure [ADDP-OP-0301](#)

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## 8. Radiological Work Permits

- \_\_\_\_\_ Know that Radiological Work Permits (RWPs) are used to control access into radiation areas
  - \_\_\_\_\_ Know how often an RWP must be reviewed
  - \_\_\_\_\_ Understand that a supplemental RWP may be required for work in radiation areas
- \_\_\_\_\_ Know how RWPs are used and what information they contain
  - \_\_\_\_\_ Type of access
  - \_\_\_\_\_ Dosimetry requirements
  - \_\_\_\_\_ Portable survey meter requirements
  - \_\_\_\_\_ Additional instructions
  - \_\_\_\_\_ Protective clothing requirements
  - \_\_\_\_\_ Interpreting survey maps and sheets
- \_\_\_\_\_ Know where the Enclosure RWPs can be found
  - \_\_\_\_\_ [ES&H Online RWP webpage](#)
  - \_\_\_\_\_ RWP Binders

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## 9. Radiation Fenced Area

- \_\_\_\_\_ Understand the steps necessary to access a Radiation Fenced Area [ADDP-OP-0403](#)

## 1.4 Cryogenic and ODH Safety

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### 1. ODH Area Entry

Be familiar with the requirements for entering ODH areas:

- \_\_\_ A0 compressor room
- \_\_\_ B0/BA compressor building
- \_\_\_ Meson Cryo Central building
- \_\_\_ M02 – M05
- \_\_\_ Lab B compressor room
- \_\_\_ NML Cave and refrigerator room
- \_\_\_ HAB cryo platform
- \_\_\_ CMTF compressor building and high bay pit
- \_\_\_ MC-1 refrigerator room

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### 2. ODH Tasks

- \_\_\_ Know how to check an escape pack
  - \_\_\_ Ocenco EEBD
  - \_\_\_ Elsa packs
- \_\_\_ Know how to check and recalibrate a portable oxygen monitor
- \_\_\_ Know how to don an escape pack
- \_\_\_ Know how to determine if someone is ODH qualified

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### 3. Oxygen Monitoring

- \_\_\_ Know why oxygen heads are placed both at the bottom and top of ODH enclosures
- \_\_\_ Know how to read different styles of local ODH chassis
- \_\_\_ Know how to read oxygen levels on ACNET
- \_\_\_ Know that portable oxygen monitors and fixed oxygen monitors alarm at 19.5%
  - \_\_\_ Know that barometric pressure and age of the monitor can affect oxygen readings
- \_\_\_ Know the protocol for changing an oxygen head
  - \_\_\_ Know where spares can be found and what to do with old heads

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### 4. Gas Bottles

- \_\_\_ Know how to properly change out a high-pressure gas bottle
- \_\_\_ Know that gas bottles should always be secured in place
- \_\_\_ Know that bottles need to be secured when transported
  - \_\_\_ AD/Ops vans are not a proper way to transport bottles
- \_\_\_ Know the importance of the screw cap on top that protects the gas valve when the bottle is being stored
- \_\_\_ Watch the operations movie on gas bottles

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### 5. Confined Space Access

- \_\_\_ Know the definition of a confined space
- \_\_\_ Know the procedure used to access a confined space

## 1.5 Fire Safety

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### 1. Flammable Gas Safety

\_\_\_\_\_ Know that the purpose of the flammable gas system is to supply a flammable gas mixture to fixed-target and other experiments for use in their detectors

\_\_\_\_\_ Know that the common flammable gases in use include hydrogen, methane, ethane, and isobutene

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### 2. Flammable Storage Cabinet

\_\_\_\_\_ Know what is stored in the flammable storage cabinet

\_\_\_\_\_ Know how it protects personnel and areas from hazards

\_\_\_\_\_ Know how to access the AD/Ops flammable storage cabinet

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### 3. Fire Extinguisher Usage

\_\_\_\_\_ Know the different types of fire extinguishers used around the lab

\_\_\_\_\_ Understand that you are not required to put out a fire with an extinguisher if you do not feel safe doing so

## 1.6 Waste Handling and Disposal

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### 1. Temporary Waste Storage Cabinet

\_\_\_\_\_ Be able to use the temporary waste storage cabinet flow chart and classification lists to classify waste types

\_\_\_\_\_ Know whom to call if you are not sure what type of waste you have

\_\_\_\_\_ Identify the proper shelf to store a particular type of waste

\_\_\_\_\_ Be able to follow the procedure for storing waste on any shelf

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### 2. Spills

\_\_\_\_\_ Know how to properly respond to spills of various materials using the ERP flow charts (ADDP-OP-0017 and ADDP-OP-0018).

## 1.7 Emergency Response

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### 1. Generic Emergency Response

- \_\_\_ Know what to in case of an emergency
  - \_\_\_ Dial x3131
  - \_\_\_ Remove personnel or contain the hazard if you can do so without endangering yourself or others
  - \_\_\_ Prevent others from being exposed to the hazard

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### 2. Emergency Response Binder

- \_\_\_ Know the locations of Emergency Response Binders
- \_\_\_ Have a general idea of when the binder should be used
- \_\_\_ Know how to follow the flow charts
- \_\_\_ Know what personnel should respond to emergencies
- \_\_\_ Know that the crew chief responds to real emergencies

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### 3. ODH and Cryo Emergency Response

- \_\_\_ Know how to follow and where to find the relevant ERP flow charts for the following ODH and cryogenic emergency situations:
  - \_\_\_ ODH Investigation ERP (ADDP-OP-0013 and ADDP-OP-0014)
  - \_\_\_ Cryogenic ERP (ADDP-OP-0003 and ADDP-OP-0004)

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### 4. FIRUS Response

- \_\_\_ Know where to find and how to follow the relevant ERP flow charts to respond to the FIRUS alarms
  - \_\_\_ Fire in the footprint area (ADDP-OP-0007 and ADDP-OP-0008)
  - \_\_\_ Fire outside the footprint area (ADDP-OP-0009 and ADDP-OP-0010)
  - \_\_\_ AP0 airborne radiation alarm (ADDP-OP-0001 and ADDP-OP-0002)
  - \_\_\_ Utility alarms (CUB 300 tank fill system low conductivity, etc.)

Trainer	Date
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## 5. Audio System

\_\_\_\_\_ Know how to respond if you hear the ESS “whooping” the audible warning when you are in an enclosure

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## 6. Beam-On Incident

\_\_\_\_\_ Know how to respond to beam on accident using the ERP flow charts (ADDP-OP-0005 and ADDP-OP-0006)

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## 7. Chain of Command

\_\_\_\_\_ Know the chain of command in any emergency as outlined in the Accelerator Division Emergency Plan, [ADSP-02-0401](#), from highest to lowest in command

- \_\_\_\_\_ Incident Commander
- \_\_\_\_\_ Division Head or alternate
- \_\_\_\_\_ Division Safety Officer (Equivalent to ESH&Q Department Head)
- \_\_\_\_\_ MCR Crew Chief
- \_\_\_\_\_ Emergency Warden

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## 8. Safety Envelope

- \_\_\_\_\_ Know what the safety envelope is
- \_\_\_\_\_ Know how to respond to violations of the safety envelope as outlined in the Response to Violations of the Accelerator Safety Envelope document, [ADSP-02-0101](#).
- \_\_\_\_\_ Know the responsibilities of the AD Head, AD/Ops Department Head, and crew chief regarding the safety envelope
- \_\_\_\_\_ Know how the beam operational limit differs from the accelerator safety envelope (ASE) limit
- \_\_\_\_\_ Know how to respond to excursions above the operational limit as outlined in the Response to Excursions above the Accelerator Operating Limits document, [ADSP-02-0102](#)
- \_\_\_\_\_ Know who must be informed if the operational limit is exceeded by more than 5%
- \_\_\_\_\_ Know who must be informed if the ASE limit is exceeded
  - \_\_\_\_\_ What must occur before accelerator operations are resumed
  - \_\_\_\_\_ How to expediently disable and remove beam to an area
- \_\_\_\_\_ Know how the beam budget monitor (BBM) on console 104 can be used as a guide to see how close each machine or beamline is to approaching the beam operational and safety envelopes
- \_\_\_\_\_ Know how to calculate the beam operational and ASE limits with the help of the limit sheets
- \_\_\_\_\_ Know how to properly gather data after an expected violation

Trainer	Date
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## 9. Safety Alert Monitors (SAM)

\_\_\_\_\_ Know what the SAM modules are used for around the laboratory

\_\_\_\_\_ Know when the monthly testing occurs

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## 10. Tornado Warning

\_\_\_\_\_ Know how to properly respond to a tornado warning as outlined in the ERP flow chart (ADDP-OP-0019)

\_\_\_\_\_ Know how the Tornado Enable and Tornado Disable buttons work on the paging system box

\_\_\_\_\_ Know the tornado shelter locations for various Accelerator Division areas

Trainer	Date
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## 11. Emergency Response Kits

\_\_\_\_\_ Know what can be found in the emergency response kits in each of the AD/Ops vehicles

\_\_\_\_\_ Emergency Response procedure binder

\_\_\_\_\_ Emergency Response Area Maps binder

\_\_\_\_\_ Emergency PPE

## 1.8 Safety Documentation

Trainer	Date
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### 1. Miscellaneous Documentation

\_\_\_\_\_ Be able to find the following documents either physically or online, and have a basic understanding of what is contained in each:

\_\_\_\_\_ ADDPs, ADSPs, and ADAPs

\_\_\_\_\_ Blank and used electrical lock-out forms binders (for switching off 13.8 kV and configuration control lockout)

\_\_\_\_\_ Search and secure procedures

\_\_\_\_\_ Power outage book

\_\_\_\_\_ Hot item book

## Part 2: Electrical Safety

### 2.1 General Electrical Safety Training

Trainer	Date
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#### 1. NFPA-70E Electrical Safety and Arc Flash Training

\_\_\_\_\_ Know that operators must complete the following electrical safety training courses before they are qualified to perform any breaker manipulation

\_\_\_\_\_ Fermilab NFPA-70E

\_\_\_\_\_ Accelerator Operations Departmental NFPA-70E

\_\_\_\_\_ Understand the hazard risk categories and know the proper PPE for each

\_\_\_\_\_ Hazard risk categories that operators normally encounter

\_\_\_\_\_ Know the shock protection boundaries

\_\_\_\_\_ Understand arc flash hazards

\_\_\_\_\_ Be aware of the safety training videos

Trainer	Date
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#### 2. Lock Out Tag Out (LOTO)

\_\_\_\_\_ GENERAL LOTO: Know what conditions must be met, who is qualified to follow the procedure, and have a basic understanding of the General LOTO procedure

\_\_\_\_\_ WRITTEN LOTO: Know what requirements are needed to follow a written LOTO procedure and who is qualified

\_\_\_\_\_ Know what a Job Lock Box is and how they are sometimes used during machine shutdowns

\_\_\_\_\_ Be familiar with the proper use of locks and tags including what color lock and what type of tag (caution or danger) should be used in a particular situation

\_\_\_\_\_ Know who must give written approval before a LOTO lock is removed by anyone other than the person who applied the lock

Trainer	Date
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### 3. Power Supply Diagnosis

Know that operators do not work on most of the power supplies found on site, but rather are limited to troubleshooting or modular replacement. However, you may be asked to assist a qualified power supply technician.

- \_\_\_\_\_ Know that operators do not work on energized equipment
- \_\_\_\_\_ Know that power supplies may have multiple sources of power present, and if so, a written LOTO procedure is required
- \_\_\_\_\_ Know that the two person rule is in effect when working on supplies
- \_\_\_\_\_ Know how to safely use the appropriate voltmeter to verify voltages at test points
- \_\_\_\_\_ Know how to verify that a power supply is de-energized
- \_\_\_\_\_ Know that specialized equipment may require additional specific LOTO training

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### 4. Ground and Insulating Sticks

Know the differences between the various types of grounding and insulating sticks listed below, and know under what circumstances each is used.

- \_\_\_\_\_ An insulating stick, sometimes called a hot stick, has no connection to ground and is used to manipulate devices that could potentially be at high potentials (like knife switches)
- \_\_\_\_\_ A soft ground stick is connected to ground through a bleeder resistor and is used to slowly discharge a device that may be at high potential and may contain stored energy
- \_\_\_\_\_ A hard ground stick has a direct connection to ground and may be used to quickly discharge a device that may be at high potential, but with relatively low stored energy

Trainer	Date
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## 5. Configuration Control Lockout

Know the general procedure and requirements for a configuration control lockout.

- \_\_\_\_\_ Understand that when a configuration control lockout or unlock is performed on any device, the corresponding check sheet must be with you and kept up to date.
- \_\_\_\_\_ Configuration control lock out does not meet personal LOTO requirements
- \_\_\_\_\_ Configuration control lock out is done to meet supervised access conditions and to provide an extra layer of protection from electrical hazards for personnel working in enclosures
- \_\_\_\_\_ The Crew Chief can authorize the removal of a configuration control lock for a secured enclosure
- \_\_\_\_\_ Only the Division Safety Officer can authorize the removal of a configuration control lock for an unsecured enclosure
- \_\_\_\_\_ Know how to find what PPE is required for performing a Configuration Control Lockout

## 2.2 Electrical Safety Walkaround

This section serves as an introduction to the written LOTO switch off procedures encountered by operators. Operators must complete additional annual training in order to be authorized to perform these LOTO procedures. The procedures are found on the Ops Required Reading webpage (<https://fermi-fmp2.fnal.gov/fmi/webd/OpReading>). **You are not qualified to perform the following tasks as a lead authorized employee until you receive final approval from the Operations Department Head or designee.**

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### 1. Booster LOTO Switch Off

- \_\_\_\_\_ Know the steps of the Booster GMPS LOTO procedure as defined in [ADSP-05-1212](#)
- \_\_\_\_\_ Be shown through the Booster LOTO procedure by an authorized person using the checklist
- \_\_\_\_\_ Know that manipulating the GMPS breakers are HRC-2 activities
- \_\_\_\_\_ Know which devices are de-energized by this switch off
  - \_\_\_\_\_ Know that GMPS is the only device de-energized by this switch off

Trainer	Date
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### 2. Main Injector LOTO Switch Off

- \_\_\_\_\_ Know the steps of the Main Injector LOTO procedure as defined in [ADSP-05-1214](#) and [ADSP-05-1210](#)
- \_\_\_\_\_ Be shown through the MI LOTO procedure by an authorized person using the checklist
- \_\_\_\_\_ Know that manipulating the house disconnects are HRC-0 activities
- \_\_\_\_\_ Know which devices are de-energized by this switch off
  - \_\_\_\_\_ Know that MOS 86 and 87 provide power to the main bend and quad magnets in the MI
  - \_\_\_\_\_ Know that MOS 89 powers the MI sextupoles, MI abort line, RR injection Lambertson, the P1, P2, M1, and P3 Line power supplies and some upstream NuMI supplies from I:LAM60 to E:QF112
  - \_\_\_\_\_ Know that the house power safety disconnect at MI-30 powers the RR-30 Line Lambertons and VBND magnets
  - \_\_\_\_\_ Know that the house power safety disconnect at MI-10 powers I:Q847, I:LAM10, and E:HV860

Trainer	Date
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### 3. F-Sector LOTO Switch Off

- \_\_\_\_\_ Know the steps of the F-Sector LOTO procedure as defined in [ADSP-05-1210](#)
- \_\_\_\_\_ Be shown through the F-Sector LOTO procedure by an authorized person using the checklist
- \_\_\_\_\_ Know which devices are de-energized by this switch off
  - \_\_\_\_\_ Know that MOS 89 powers the P1, P2, M1 and P3 Lines in F-Sector

Trainer	Date
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### 4. Transfer Hall LOTO Switch Off

- \_\_\_\_\_ Know the steps of the Transfer Hall LOTO procedure as defined in [ADSP-05-1210](#)
- \_\_\_\_\_ Be shown through the Transfer Hall LOTO procedure by an authorized person using the checklist
- \_\_\_\_\_ Know that if MOS 89 is on and has not been switched off then manipulating the yard breakers are HRC-2 activities
  - \_\_\_\_\_ Know that if MOS 89 is off the disconnects may be switched off without PPE as long as the operator locks up the MOS 89 key in the lockbox with his or her LOTO lock to ensure that this condition persists during the switch off activity
- \_\_\_\_\_ Know which devices are de-energized by this switch off
  - \_\_\_\_\_ Know that S:HP3DS and S:QP3 power the P3 Line elements in Transfer Hall

Trainer	Date
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### 5. NuMI MI-65 LOTO Switch Off

- \_\_\_\_\_ Know the steps of the NuMI MI-65 LOTO procedure as defined in [ADSP-05-1217](#)
- \_\_\_\_\_ Be shown through the NuMI MI-65 LOTO procedure by an authorized person using the checklist
- \_\_\_\_\_ Know that manipulating the control power disconnect is an HRC-0 activity
- \_\_\_\_\_ Know that NuMI bend and quad power supplies are de-energized by this switch off

Trainer	Date
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**6. MiniBooNE MI-12A/MI-12B LOTO Switch Off**

- \_\_\_\_\_ Know the steps of the MiniBooNE MI-12A/MI-12B LOTO procedure as defined in [ADSP-05-1216](#)
- \_\_\_\_\_ Be shown through the MiniBooNE LOTO procedure by an authorized person using the checklist
- \_\_\_\_\_ Know that manipulating the breaker is an HRC-0 activity
- \_\_\_\_\_ Know that the major BNB bend and quad power supplies in MI-12A and MI-12B are de-energized by this switch off

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**7. Muon Pre-Target & Pre-Vault LOTO Switch Off**

- \_\_\_\_\_ Know the steps of the Pre-Target/Pre-Vault 480V LOTO procedure as defined in [ADSP-05-1218](#)
- \_\_\_\_\_ Be shown through the Pre-Target & Pre-Vault LOTO procedure by an authorized person using the checklist
- \_\_\_\_\_ Know that manipulating the power panel disconnects is an HRC-0 activity
- \_\_\_\_\_ Know that the major bend and quad power supplies in F23 and AP0 are de-energized by this switch off

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**8. Muon Transport LOTO Switch Off**

- \_\_\_\_\_ Know the steps of the Transport 480V LOTO procedure as defined in [ADSP-05-1219](#)
- \_\_\_\_\_ Be shown through the Transport LOTO procedure by an authorized person using the checklist
- \_\_\_\_\_ Know that manipulating the power panel disconnects is an HRC-0 activity
- \_\_\_\_\_ Know that the major bend and quad power supplies in F27 and AP0 are de-energized by this switch off

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## 9. Muon Delivery Ring LOTO Switch Off

- \_\_\_\_\_ Know the steps of the Delivery Ring 13.8kV and 480V LOTO procedure as defined in [ADSP-05-1220](#)
- \_\_\_\_\_ Be shown through the Delivery Ring LOTO procedure by an authorized person using the checklist
- \_\_\_\_\_ Know that manipulating the D:IB utility yard disconnect is an HRC-2 activity
- \_\_\_\_\_ Know that manipulating the power panel disconnects is an HRC-0 activity
- \_\_\_\_\_ Know that the major bend and quad power supplies in AP30, AP50, and AP10 are de-energized by this switch off

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## 10. Muon Extraction & Extraction Stub LOTO Switch Off

- \_\_\_\_\_ Know the steps of the Extraction Enclosure Including the Extraction Stub 480V LOTO procedure as defined in [ADSP-05-1221](#)
- \_\_\_\_\_ Be shown through the Extraction LOTO procedure by an authorized person using the checklist
- \_\_\_\_\_ Know that manipulating the power panel disconnects is an HRC-0 activity
- \_\_\_\_\_ Know that the major bend and quad power supplies in AP30 and MC-1 are de-energized by this switch off

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## 11. Muon M4 Enclosure LOTO Switch Off

- \_\_\_\_\_ Know the steps of the M4 Enclosure 480V LOTO procedure as defined in [ADSP-05-1222](#)
- \_\_\_\_\_ Be shown through the Extraction LOTO procedure by an authorized person using the checklist
- \_\_\_\_\_ Know that manipulating the power panel disconnects is an HRC-0 activity
- \_\_\_\_\_ Know that the major bend and quad power supplies in MC-1 are de-energized by this switch off

## Part 3: Laser Safety

### 3.1 Laser Safety for MCR Operators

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#### 1. Personnel Roles

Have a basic understanding of the rules and guidelines for laser safety and the Operations' role. Please refer to [FESHM 5062.1](#) for information.

\_\_\_\_\_ Laser safety officer (LSO)

\_\_\_\_\_ Qualified laser operator

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#### 2. Safety Signs and Labels

Be familiar with the typical appearance and use of laser safety signs and labels.

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#### 3. Laser Hazards

Be familiar with the classification of laser hazards. Your knowledge should include:

\_\_\_\_\_ Class 1, Class 2 and Class 3a

\_\_\_\_\_ Are low enough power to either not pose a hazard (Class 1), the blink reflex is sufficient for eye protection (Class 2) or the power density is low as to cause only a moderate hazard (Class 3a)

\_\_\_\_\_ Do not stare into the beam or point in the direction of other people or shiny objects

\_\_\_\_\_ Class 3b and Class 4

\_\_\_\_\_ Cause eye injury within the time it takes to blink, including specular reflection (Class 3b) and diffuse reflection (Class 4)

\_\_\_\_\_ Class 4 lasers can damage skin and ignite fires

\_\_\_\_\_ Class 4 lasers require a warning light or sound to alert others that the laser will be activated

\_\_\_\_\_ Requires PPE and laser operator training

\_\_\_\_\_ Lasers are classified according to their power with limits set as a function of wavelength

\_\_\_\_\_ Lasers can be of visible and invisible wavelengths

\_\_\_\_\_ Laser hazards can be reduced by enclosing the beam path in a locked or interlocked box or room

Trainer	Date
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#### 4. Operational Laser Areas

Be familiar with the operational areas where operators may encounter lasers:

- Linac laser notcher
- FAST Laser Lab
- MC-1
- MT6-2