

FERMILAB CONTROLLED ACCESS TRAINING

Note: The hyperlinks below will take you to streaming video segments of the Controlled Access video. If you would prefer to view portions of the video with a stand-alone player rather than your web browser, click [here](#).

1. Purpose and Definitions

A controlled access is a means by which two or more people may safely enter an interlocked enclosure. A controlled access is typically used instead of a supervised access when it is desired to quickly resume operation after an access. Because a controlled access does not involve a full radiation survey, configuration control, or searching and securing the enclosure, it minimizes disruption to accelerator operations.

Personnel entering enclosures under controlled access conditions are subject to increased hazards due to a reduction in the level of sophistication of several safety measures. Because of this, personnel making controlled accesses must have additional training in order to know what safeguards have been reduced and to understand the procedures necessary to ensure their safety.

The conditions for supervised access and controlled access differ as follows:

Supervised Access: A radiation survey has been completed and documented since particle beams were accelerated or transported through the beam enclosure and the survey results have been appended to the appropriate Radiological Work Permit (RWP). The radiation and electrical safety system interlocks have been dropped to prevent energizing of exposed electrical bus and to prevent particle beam transport. Power supplies for beamline components that have exposed electrical connections have been locked off.

Controlled Access: The radiation and electrical safety system enclosure interlocks are active and monitoring the status of the enclosure. The controlled access key, when issued to persons making an access, prevents electrical power to exposed bus and prevents beam from entering the enclosure. A documented radiation survey has not been performed, so no survey data are appended to the RWP, and individuals making the controlled access must measure the radiation levels in the areas through which they travel or at which they work.

The change from controlled access to supervised access is made under the exclusive control of the Accelerator Division (AD) Operations Department through the Crew Chief in the Main Control Room (MCR), following consultation between the Operations Department Head, the AD Operations Coordinator, and the AD Radiation Safety Officer (RSO). No other individual is authorized to make this change.

Three conditions must be met before the Operations Department may change a beam enclosure status from controlled access to supervised access:

- A radiation survey has been performed by the AD Radiation Safety Group, or personnel specifically trained to perform an “initial entry survey” (for those enclosures requiring a survey). In those enclosures requiring a supervised access RWP, the RWP and initial entry survey results must have been revised since the last

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time the proton beam was in the area or determined to still reflect current conditions.

- The safety system must be “broken” (interlocks are dropped), requiring a search and secure before beam can be re-enabled.
- The operators must perform configuration control for the enclosure by locking off power supplies for beamline components that have exposed electrical connections. This is done based on the configuration control list provided by the AD ES&H Department and kept in the MCR.

If the safety system is inadvertently broken during a controlled access, the Crew Chief must choose between one of the following options:

Option 1 - The Crew Chief in consultation with the AD Operations Department Head and the RSO or his/her designee may elect to make the transition to supervised access. In this case, the operators perform configuration control and the AD Radiation Safety Group performs a radiation survey of the enclosure and updates the RWP, if appropriate.

Option 2 - The Crew Chief may elect to re-secure the enclosure. The Crew Chief may choose to order a search and secure immediately or wait until the access has been concluded. The enclosure shall be secured no later than the end of the shift unless the oncoming shift assumes responsibility, in which case search and secure must commence within two hours of the shift start. Entrants must continue to follow controlled access rules.

2. Qualification for Controlled Accesses

To ensure that controlled accesses can be conducted safely and reliably, the following procedures have been implemented:

- A. Before issuing enclosure keys, either directly or via remote key tree, MCR personnel will verify by using the key logger or TRAIN database that the entrants have the required training. The qualification requirements are:
 - a. At a minimum, prospective entrants must have completed, and be up-to-date in, Radiological Worker--Classroom (FN000470/CR), Radiological Worker--Practical Factors (FN000471/OJ), and Fermilab Controlled Access (FN000311) training courses. In addition, the entrant may need to be qualified in Lockout/Tagout (LOTO) Level 2 (FN000212), depending on the nature of the planned work activities and where they are to be performed (see paragraphs 3.B and 5.C). Fermilab Controlled Access training must be renewed annually by either attending the classroom session again or taking the “challenge exam” version of the course. Both versions of the course require the trainee to pass an examination covering essential course information. Both Radiological Worker courses and (if applicable) LOTO Level 2 require requalification every two years, again either by repeating the class or taking a challenge exam.
 - b. Additional requirements may be imposed in certain cases, such as training and medical qualification for oxygen deficiency hazard (ODH) areas and area-specific hazard training for some experimental enclosures.

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- B. Normally, only Fermilab employees and users (as defined in chapter 1080 of the Fermilab ES&H Manual) are eligible to make controlled accesses. With the exception of contract technicians, who work closely with Lab employees and under a Fermilab supervisor for a significant period of time, subcontractor personnel are prohibited from becoming controlled access-qualified. Untrained visitors or workers (e.g., subcontractors) may be permitted to make an escorted controlled access if approved by the appropriate Senior Safety Officer and the RSO. In this case, the unqualified individual must receive a safety briefing from the RSO. Unqualified personnel must be escorted during the entire access. Although the untrained person must have his/her own enclosure key, he/she does not operate the interlock enter boxes. Only the qualified escorts may do this. Therefore, although there must be one qualified escort for each unqualified person, a minimum of two qualified people are required to make the access. An untrained person must be escorted for the entire time he/she has possession of the enclosure key. Escorts are responsible for ensuring that unqualified entrants observe all safety requirements. The individual or organization on whose behalf the requested access is being made is responsible for providing the necessary escorts.

3. Potential Hazards

There are potential hazards associated with controlled accesses. However, following the correct procedures can minimize or eliminate these hazards.

- A. Direct Beam-On Radiation: **If a person is in a beam enclosure during beam-on conditions, he or she is in immediate danger of receiving a large acute radiation exposure. When a key is removed from the key tree to allow access, the beam is inhibited in a fail-safe manner by several devices.** As long as you bring a key(s) to the enclosure(s) you are going to enter, you are protected from this hazard. However, if you enter an interlocked enclosure without a controlled access key for that area, then the beam could be turned on. If beam is lost by scraping a beam pipe or striking a magnet, the radiation levels could cause an acute exposure in excess of 450 rads. An acute exposure of 450 rads will cause death within 30 days to 50% of those so exposed.
- B. Electrocution: **Although the electrical safety system is intended to protect entrants from exposed electrical hazards, it depends upon numerous electrical and mechanical components that are not immune to failure. Reliance on the safety system alone is unsafe and does not satisfy LOTO requirements.** Prior to controlled access into the accelerator and external beamline enclosures, the electrical safety system permit is removed, which disables power to exposed conductors with hazardous voltages and/or currents. The power supplies connected to components with exposed electrical connections are normally shut off by the electrical safety system when the controlled access keys are removed from the key tree. Components with no exposed electrical connections normally remain energized.

Therefore, you must make certain that power has been locked off to any component you work on or may come in contact with. If you are in an enclosure and have not locked out components you are working on, you could be electrocuted! The individual doing the work is responsible for ensuring that the component is locked with his or her lock and danger-tagged in accordance with LOTO procedures. You must supply your own locks for this purpose. These locks are

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available from the stockroom. Prior to performing LOTO, the individual must have completed LOTO Level 2 training. (Note that LOTO is also required for working on beamline components under supervised access conditions. The configuration control performed by the Operations Department does not satisfy LOTO requirements because those locks are not applied by the people exposed to the hazard. They are merely an extra layer of safety.) Individuals who must operate circuit breakers in order to remove power from components they plan to work on and use test equipment to verify absence of energy before beginning work must also have Electrical Safety in the Workplace (NFPA 70E) training and wear appropriate clothing and protective equipment. Cardiopulmonary resuscitation (CPR) training is also required if the potential exposure is 277/480 V or above.

- C. **Residual Radioactivity: During a controlled access, the enclosure has not been surveyed and posted for radioactivity before you enter. During a controlled access, you are the person who has to do the radiation survey in the area where you are working.** After the proton beam strikes an object, the object becomes radioactive. Past experience as to the residual radioactivity level must not be relied upon. Experience has shown that it only takes a beam loss for a short period of time for high levels of residual radioactivity to be present shortly after the beam is turned off. Local radiation level postings are not to be relied upon, as they might not be accurate. The log survey meter (LSM) is the only reliable means of determining radiation levels during a controlled access. It is also important to remember that contamination surveys have not been performed, and one must follow all hold points specified on the RWP. The appropriate protective clothing must be worn when working on beamline elements, when the beam pipe is going to be opened up, or when any disassembly work is required.

Individuals making accesses to beam enclosures (**during both controlled and supervised accesses**) and other posted radiological areas must wear dosimetry specified by the RWP. In order to ensure that the 100-mrem-per-week local control limit is not exceeded, these individuals must keep daily pocket dosimeter records for the accesses. Accrued dose must be submitted on a weekly basis for tracking, either to the individual's local ES&H organization or to the web-based tracking system. This should be done as early in the work week as practical to assist Radiation Safety in dose tracking. This is especially important during scheduled shutdowns. Prior RSO approval must be obtained before the weekly exposure limit of 100 mrem may be exceeded.

- D. **Removable Radioactivity: Comprehensive contamination surveys are not routinely done in preparation for controlled accesses, increasing the possibility of ingesting or inhaling radioactive material.** Small quantities of radioactive material (in the form of dust, metal grindings, etc.) are hazardous if ingested, inhaled, or injected into the body. This is because the material, a source of radiation, may stay in the body for a long period of time, giving a large dose to a localized area of the body. Therefore, you are not permitted to smoke, eat, or drink in any beam enclosures. If you get some radioactive material on your hands, these actions could cause it to be internalized. All posted signs and instructions regarding contaminated areas and protective clothing requirements are to be obeyed. The controlled access RWP will specify the protective clothing requirements for the type of work to be performed.
- E. **Oxygen Deficiency Hazard: Certain areas of the accelerator and extraction beamlines are classified as ODH areas due to the large quantities of inert gases contained in the cryogenic systems.** If these gases were to leak, they could reduce

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oxygen levels to less than life-supporting. ODH procedures are to be followed in these areas at all times.

- F. High Magnetic Fields: **During a controlled access, some electromagnets may remain energized with potential exposure of personnel to magnetic fields.** Components that, when energized, may produce magnetic field strengths above the action level for individuals with cardiac pacemakers may be found in various locations and are posted “Danger: Magnetic Field Hazard.”

4. Warning Devices

If you find yourself in an enclosure during a controlled access and hear a loud whooping sound or verbal warning message, take immediate action.

The warning sound can be generated as a result of several scenarios:

- An electrical permit is about to be issued.
- Oxygen levels have dropped below 18 percent.
- Interlocks are being tested.
- A search and secure of an adjacent enclosure is taking place.

You must always treat these audible warnings as real and follow the instructions presented in this training.

If you hear a warning sound or message, pull the crash cord or push the crash button, if they are available in your area. Then hurry to the nearest exit and open the door or gate without using the controlled access procedure. This will drop the interlocks for that area, preventing beam from being transported to the enclosure. Then exit the enclosure.

If there are no crash cords or buttons in the area you are in, go immediately to the nearest exit and open the door or gate without using the controlled access procedure.

Do not stop at a telephone in the enclosure to call and report the warning. Leave the enclosure immediately and call the MCR from a telephone outside the enclosure to report what happened.

5. Controlled Access Rules

Employees who violate the rules below are subject to disciplinary action. The exact punishment for the offense would be determined by management based upon circumstances and the severity of the incident. Experimenters who violate the rules may lose their authorization to make controlled accesses. Additional restrictions on the use of laboratory facilities may be made at the discretion of Fermilab management. Employee disciplinary measures, including termination, are possible. **The rules are:**

- A. Read and sign the RWP for the enclosure to be accessed, if an RWP exists (experimental halls generally do not have RWPs). You must do this each time you obtain a key, even if you have made an access earlier in the day. The reason for this is that RWPs are not static documents. Entrants may recognize conditions during an access (e.g., items K and L, below) that can result in the RWP being altered. Different requirements may then apply to subsequent accesses.

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- B. Obtain a controlled access key for the area to be entered and maintain control of the key until you return it. Keys for most AD enclosures are located at the MCR. Other keys are located at remote key trees near the enclosure entrances.
- C. Perform LOTO in accordance with Fermilab ES&H Manual Chapter 5120, *Fermilab Energy Control Program (Lockout/Tagout)*. For all accesses into the Booster, any part of the Tevatron, Main Injector, MiniBooNE (MI-12A or B), or the interlocked areas underground at NuMI (MI-65), you must also apply a lock(s) to the appropriate group lock box(es) in the MCR. For this reason, LOTO Level 2 training is required to obtain an access key for any of these enclosures.
- D. Know how to use a LSM and use one to check radiation levels in the area where you are working.
- E. Wear protective clothing specified in the RWP for the enclosure to be entered and the type of work to be performed. For large jobs extending over long periods of time (such as magnet changes), the task leader may request a job-specific RWP. In these cases, Radiation Safety may survey the work area in question and write a RWP solely for the job. Clothing requirements and other RWP requirements may be relaxed for the job. Requirements for work in the remainder of the enclosure would be dictated by the normal controlled access RWP.
- F. Never enter a beam enclosure alone. A controlled access is a hazardous work activity that requires application of the two-person rule. At least two people are required to enter the enclosure for a proper controlled access, even if the entry will be brief and only in the immediate area beyond the gate.
- G. Have the key physically on your person while in an interlocked enclosure.
- H. **Never permit entry to another person who does not have a key for the area entered, even if you have one. Thus, you are responsible for checking everyone who makes the controlled access with you. Each person entering an interlocked enclosure must physically display his/her key to other personnel participating in the access.**
- I. **If you should discover that you or another person has somehow entered an enclosure without the correct key (or you have otherwise departed from the controlled access procedures in a manner that could lead to a safety concern), immediately exit the enclosure without using the controlled access procedure, thereby dropping the interlocks. Then call the MCR and report the circumstances. Dropping the interlocks if a person is found to have entered an enclosure on controlled access without the proper key (or other departures from the procedure) will force a search and secure to be performed before running beam in the enclosure. This is necessary since the integrity of the controlled access process has been compromised and even if the access participants think they have accounted for all personnel after it is discovered that an individual has entered without the proper key.**
- J. Never give the key to another individual, even if you know he/she is qualified to make controlled accesses. The key is assigned to you alone.

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- K. Inform the Crew Chief if you plan to work in any radiological area where the exposure rate exceeds **100 mR/hr** at one foot. You must receive permission from the RSO or designee prior to beginning work.
- L. Immediately leave the area, check closely for contamination, and inform the Crew Chief if exposure rates have increased drastically (compared to levels previously posted) and are greater than **500 mR/hr** at one foot. The Crew Chief shall call the RSO or designee to determine subsequent action.
- M. Follow the ODH area entry requirements (training, medical clearance, escape pack, and personal oxygen monitor) if they are required for the area.
- N. During a controlled access to repair a problem, make the repair and complete the access as rapidly as possible. During shutdown periods, the accelerator may be off for several days. This typically affords more time in which to make controlled accesses. However, because the number of keys available is limited, and because several work groups may need to access the same enclosure, accesses should always be done expeditiously.

In fixed-target experimental halls, controlled accesses during accelerator operation have typically been limited to one hour in duration. This is because of operational considerations and the potential for prompt radiation (for example, due to muons from upstream). On shutdown days, Operations and the RSO will review the time limit for controlled accesses. With the concurrence of both, the time limit may be waived.

- O. **Personally** return the key to the MCR or remote key tree as soon as the controlled access has been completed. **Keys used to make controlled accesses should never be taken home overnight or removed from the Fermilab site.** If you placed a LOTO lock on a group lock box in the MCR, remove it at this time.

6. Generic Access Procedure

- A. Pre-planning: Before initiating a controlled access, you should carefully plan your activity. Determine where you will be working, what entrance to use in order to reach that location, and what enclosure key(s) you will need to obtain. Review the hazards associated with your job and complete a written Hazard Analysis if required by Fermilab policy for the type of work that you are going to perform. Determine any specific LOTO requirements and lock out any power supplies for beamline components on which you intend to work. Your supervisor should be involved in all phases of this planning process.
- B. Main Control Room: Read and sign the appropriate RWP(s) for the enclosure(s) you plan to access, if applicable. Obtain the correct key(s) for that enclosure(s). Obtain an LSM and perform the required functional tests. If required for the enclosure(s) you plan to access, sign out and check a personal oxygen monitor and obtain and inspect an escape pack. Obtain the radiation dosimetry specified in the RWP. If you will be entering the Booster, Tevatron, Main Injector, MiniBooNE (MI-12A or B), or NuMI MI-65 Enclosure, you must attach LOTO locks and tags to the appropriate group lock box or boxes.
- C. Tunnel entrance: Don the protective clothing specified in the RWP for the type of activity you are going to perform. Check the status of the interlocks on the panel next to the gate. If the interlocks are down, call the MCR. Before anyone inserts and turns a key in the interlock enter box, **the members of the party must physically display**

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their keys to each other. To begin the access, one entrant inserts his or her key into the exterior interlock enter box and turns and holds the key. Other members of the access party may now unlock the gate or door to the enclosure and pass through it. One of the other entrants then inserts a key in the interior interlock enter box and turns it. The person holding his or her key in the exterior enter box may now remove the key, enter the enclosure and close the gate or door. The person holding the key in the interior enter box can then remove it. Check the interlock system status panel again to verify that the access was successfully carried out without dropping the interlocks. If you encounter problems, call the MCR. Proceed with your work, remembering to survey your surroundings with the LSM.

- D. End of access: Exit enclosure by reversing the procedure in C above. Return key(s) and other items to the MCR. Remove any LOTO locks you placed on the group lockboxes in the MCR.

7. Tevatron Enclosure Access

- A. Although the Tevatron enclosure is a single continuous tunnel, it contains two separately interlocked zones. The area from E34 to F47 is called “F-Sector” and requires a red key. The area from F47 to A24 is called “Transfer Hall” and requires a blue key. The remainder of the ring (A24 to E34) is called “Tevatron A-E Sectors” and does not currently require controlled access.
- B. This configuration means that, if you intend to access more than one interlocked region, you need more than one key. You also need to read and sign more than one RWP, and you may need to place a lock on two or more of the group lock boxes in the Main Control Room.
- C. The gates at A24, E34, and F47 are only cored on one side, allowing use without a key in the other direction. This permits access to the exit stairwell beyond the gate in the event of an ODH situation or other emergency. In non-emergency situations, you must remember to do a controlled access through these gates.

8. Boundaries Between Interlock Systems

At locations where two enclosures or separate interlock zones meet, two different keys are needed to make a controlled access through the gate; one for the zone you are leaving and one for the zone you are entering. The key for the enclosure on the opposite side of the gate is needed to work each box.

Historically, some gates have needed both keys to operate each interlock enter box; however these older system are being replaced with the more modern system that requires only one key per enter box.

9. Access Control at AP-10 via Remote Key Tree

- A. When an access is desired, read and sign the local RWP by the key tree. LSMs are also staged in the area of the key tree.
- B. Call the MCR (ext. 3721) and report the names and ID numbers of the individuals making the access. MCR personnel must verify the entrants' training before allowing keys to be issued.

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- C. Stay on the phone with the MCR and, when the key tree door is released, open the key tree door and remove the keys needed. Inform MCR personnel of the entrants' ID and key numbers so the information can be recorded in the access log. **You must always leave one key in the key tree** in case emergency access to the enclosure is required.
- D. Before access, close the key tree door.
- E. After access, call the MCR to have the key tree door released. Place the keys back in the key tree, inform MCR personnel of which keys were returned, then close the key tree door.

10. Access Control at Fermilab Test Beam Facility (FTBF)

- A. When a controlled access is desired, contact the designated Particle Physics Division (PPD) Controlled Access Leader (CAL), who will then call the MCR (ext. 3721) to identify the experimental hall to be accessed and report the names and ID numbers of the individuals making the access. MCR personnel must verify the entrants' training before allowing keys to be issued. The CAL will verify completion of any additional PPD-required training.
- B. If the beamline is operating at the time the access is requested, an operator will ensure that beam is removed from the enclosure to be accessed. After the operator has removed beam and unlocked the associated key tree door, the CAL may issue keys to the people making the access. The CAL will inform MCR personnel of the entrants' ID and key numbers so that the information can be recorded in the access log. The CAL also records this on a local log.
- C. **One key must remain in the key tree** in case emergency access to the enclosure is required.
- D. Before access, the CAL will close the key tree door.
- E. Entrants are not required to perform radiation surveys in fixed-target experimental halls, which are controlled areas rather than radiological areas. RWPs are not normally required for controlled access into these areas; however, if special circumstances dictate a need for one, the RSO would communicate this to MCR personnel, who would then inform entrants that review and signature of a RWP was required prior to key issuance.
- F. All personnel making a controlled access must wear their dosimetry badge. However, pocket dosimeters and protective clothing are usually not required for controlled accesses into fixed-target experimental halls.
- G. After the access, return keys to the CAL, who will complete the local access log, call the MCR to have the key tree door released, report which keys are being returned, place keys back in the key tree, and close the key tree door.

11. Access Control at NM4 via Remote Key Tree

- A. Call the MCR (ext. 3721) and report the names and ID numbers of the individuals making the access. MCR personnel must verify the entrants' training before allowing keys to be issued.

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- B. Stay on the phone with the MCR and, when the key tree door is released, open the key tree door and remove the keys needed. Inform MCR personnel of the entrants' ID and key numbers so the information can be recorded in the access log. **You must always leave one key in the key tree** in case emergency access to the enclosure is required.
- C. Entrants are not required to perform radiation surveys in fixed-target experimental halls, which are controlled areas rather than radiological areas. RWPs are not normally required for controlled access into these areas; however, if special circumstances dictate a need for one, the RSO would communicate this to MCR personnel, who would then inform entrants that review and signature of a RWP was required prior to key issuance.
- D. All personnel making controlled access must wear their dosimetry badge. However, pocket dosimeters and protective clothing are usually not required for controlled accesses into fixed-target experimental halls.
- E. Before access, close the key tree door.
- F. After access, call the MCR to have the key tree door released. Place the keys back in the key tree, inform MCR personnel of which keys were returned, then close the key tree door.

12. [Access Control at Advanced Superconducting Test Area \(ASTA\) located at NML via Remote Key Tree](#)

- A. Call the MCR (ext. 3721) and report the names and ID numbers of the individuals making the access. MCR personnel must verify the entrants' training before allowing keys to be issued.
- B. Stay on the phone with the MCR and, when the key tree door is released, open the key tree door and remove the keys needed. Inform MCR personnel of the entrants' ID and key numbers so the information can be recorded in the access log. **You must always leave one key in the key tree** in case emergency access to the enclosure is required.
- C. Before access, close the key tree door.
- D. After access, call the MCR to have the key tree door released. Place the keys back in the key tree, inform MCR personnel of which keys were returned, then close the key tree door.

13. [Critical Step Summary](#)

- A. Obtain or call for enclosure access key(s) from the MCR (ext. 3721).
- B. Sign RWP if required.
- C. Perform necessary LOTO before entry.
- D. Verify everyone on the controlled access has the correct enclosure entry key before entering the enclosure.
- E. **Never** permit entry to another person who does not have a key for the area entered.

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- F. Survey work area for radiological conditions.
- G. If you or another person has entered an enclosure without the correct key (or you have otherwise departed from the controlled access procedures in a manner that could lead to a safety concern), **immediately** exit the enclosure without using the controlled access procedure, thereby dropping the interlocks. Then call the MCR (ext. 3721) and report the circumstances.