Department of Energy
Fermi Site Office
Post Office Box 2000
Batavia, Illinois 60510

DIRECTOR'S OFFICE

JUN 8 2010

JUN 07 2010

Dr. Bruce L. Chrisman
Chief Operating Officer
Fermilab
P.O. Box 500
Batavia, IL 60510

Dear Dr. Chrisman:

SUBJECT: FERMI SITE OFFICE REPORT ON THE FERMILAB SAFE ELECTRICAL WORK PRACTICES ASSESSMENT

As part of our Oversight Program and Integrated Assessment Schedule, the Department of Energy, Fermi Site Office, conducted an assessment of Fermilab's Safe Electrical Work Practices. The on-site portion of this review occurred on February 22 - March 2, 2010. We want to thank Fermilab for the logistical and coordination efforts involved with completion of this review.

Enclosed is the final report for this assessment. A draft copy of this report was provided to Fermilab management and staff for review, comment, and a factual accuracy check. My staff has reviewed and addressed all comments and made the appropriate changes that resulted in the completion of the final report. The review identified two Level 2 and two Level 3 findings for a total of four Findings (definitions of the Finding levels are discussed below).

Please prepare and submit to me a proposed Corrective Action Plan (CAP) by July 16th, 2010, that addresses each of the four Findings. The CAP should be in the following format:

1. Finding: Restate the finding and its associated number.

2. Cause: State the cause of the finding (based on your analysis).

3. Corrective action(s): Present the individual action (or list of actions) that will be performed to address the finding and the estimated completion date for each corrective action. For Level 1 findings, a formal structured causal analysis shall also be completed and submitted as part of the CAP package. Level 2 findings require the identification of the apparent cause and additional causal analysis should be considered if the issue impacts more than one organization or activity, or if the issue is highly complex. Level 3 findings are similar to Opportunities for Improvement and do not require corrective actions; however, if no corrective actions are proposed, a sound justification for no action must be provided. Please ensure that the action(s) address the specific finding and its cause.

4. Deliverable(s): Provide a description of the deliverables to be submitted as evidence and closure for the action(s).

After an evaluation and determination that the completed action(s) will be effective in preventing recurrence, I will approve the CAP. Subsequently, my staff will track the status of all findings until closure.

If you have any questions or comments concerning the enclosed report or the CAP, please contact John Scott, of my staff, at extension 2250. Thank you.

Sincerely,

Mark E. Bollinger, Acting
Site Manager

Enclosure:
As Stated

cc: (Per John Scott)

N. Grossman
M. Michels
R. Ortgiesen
R. Dixon

Fermi Site Office (FSO) Oversight Program
Independent Assessment of
Electrical Safe Work Practices at
Fermi National Accelerator Laboratory (Fermilab)

I. INTRODUCTION

As part of FSO's Oversight Program, an independent assessment of Fermilab's electrical safe work practices was conducted February 22, 2010, through March 2, 2010. This independent assessment was conducted on behalf of FSO by Karl Moro of the Department of Energy (DOE), Office of Science-Chicago Office (SC-CH) Integrated Support Center. Ed Bucki was designated as the FSO Assessment Team Lead and assisted in the performance of this independent assessment.

FSO's Oversight Program is one of the means that supports FSO conformance with the Office of Science Line Management Oversight Program Description. This independent assessment followed FSO Procedure 2.3, and the results of this independent assessment are identified as Findings, Strengths, or Noteworthy Practices. These terms are defined as follows:

- Level 1 Finding* - These are issues of major significance that warrant a high level of attention on the part of line management. Typically these reflect a gap in addressing requirements or a systemic problem with implementing the requirements. If left uncorrected, this level of finding could negatively impact the adequacy of operations and/or accomplishment of the Office of Science (SC) mission.
- Level 2 Finding* - These are issues that represent a non-conformance and/or deviation with implementation of a requirement. Multiple issues at this level, when of a similar nature, may be rolled-up together into one or more Level 1 Findings.
- Level 3 Finding - These are issues where it is recognized that improvements can be gained in process, performance, or efficiency already established for meeting a requirement. This level of finding should also include minor deviations observed during oversight activities that have been promptly corrected on the spot and verified as completed.
- Strengths - A mature process or activity that has consistently demonstrated the ability to meet expectations, or a process or activity that efficiently and effectively facilitates and integrates processes, activities, and resources.

---

* All findings must be addressed by the Laboratory. Level 1 Findings require the performance of a structured causal analysis to determine causal factors and the identification of the root cause. The causal analysis for Level 1 Findings also requires an extent of condition determination to prevent recurrence. Level 2 Findings require, at a minimum, identification of the apparent cause.

Noteworthy Practices – A positive observation, based on objective assessment data, of a particular practice, procedure, process, or system considered so unique or innovative enough that the entire Department might find it beneficial. Mere compliance with mandatory requirements is not considered to be a noteworthy practice.

The focus of this procedure is to contribute toward meeting the following objectives:

- Maintaining operational awareness for the FSO Manager
- Assessing compliance with Federal, State, and local laws and with contract provisions
- Assessing implementation of Fermilab's Integrated Safety Management (ISM) System and Environmental Management System (EMS)
- Providing FSO with a knowledge base with which to evaluate Fermilab's self-assessment reports
- Establishing a level of confidence in the Fermilab systems that are used to achieve the performance measures established in the contract

The scope of this independent assessment was to evaluate Fermilab compliance with electrical safety requirements set forth by National Fire Protection Association (NFPA) 70E, *Standard for Electrical Safety in the Workplace*, and determine the effectiveness of Laboratory actions taken to address the "Recommendations" identified during the May 2005 SC Energized Electrical Work Assessment, as applicable. Though the emphasis of this independent assessment was centered on conformance with the requirements of NFPA 70E (as were applicable in the course of conducting this independent assessment), conformance with corresponding requirements of the Occupational Safety and Health Act (OSHA) were also evaluated as necessary.

This independent assessment focused on the content of Laboratory-wide electrical safety program requirements contained in the Fermilab Environment, Safety and Health Manual (FESHM), and implementation of those requirements within Fermilab's Accelerator Division (AD), and Facilities Engineering Services Section (FESS). A Criteria and Review Approach Document (CRAD) was prepared to establish the objectives of this independent assessment, and criteria by which Fermilab would be evaluated. Each of the criteria was supplemented with lines of inquiry. The CRAD is attached.

II. APPLICABLE STANDARDS AND INTERNAL FERMILAB POLICIES, PROGRAMS, AND SYSTEMS

The Fermilab Work Smart Standards and its DOE Management and Operating Contract Clause, List B, were the set of regulatory requirements that were used to assess Fermilab's compliance status during this independent assessment. Specific standards applicable to this independent assessment include:

- NFPA 70E, *Standard for Electrical Safety in the Workplace*
- 29 Code of Federal Regulations Subpart 1910, *Occupational Safety and Health Standards for General Industry*

- FESHM 5040, *Fermilab Electrical Safety Program*

III. DISCUSSION OF RESULTS

Per FESHM 1030, *Environment, Safety and Health (ES&H) Organizations and Responsibilities*, the Electrical Safety Subcommittee (ESS) is responsible for the overall specification and content of the Fermilab Electrical Safety Program. The ESS recommends guidelines and general procedures for the safe operation and maintenance of electrical systems. These guidelines are intended to ensure the protection of personnel and property from the hazards inherent in the improper or careless use of electricity. The ESS is a standing subcommittee of the Laboratory Safety Committee.

The foundation of the Fermilab Electrical Safety Program is established by FESHM 5040. FESHM 5040 notes that electrically-related work at Fermilab will be conducted in accordance with applicable OSHA requirements, NFPA 70, *National Electrical Code*, NFPA 70E, NFPA 79, *Electrical Standard for Industrial Machinery*, and the *National Electrical Safety Code*.

FESHM 5040 is supplemented by: FESHM 5120, *Fermilab Energy Control Program (Lockout/Tagout)*; FESHM 5041, Electrical Utilization Equipment Safety; FESHM 5042, *AC Electrical Power Distribution Safety – For Systems Operating Between 50 and 600 VAC Nominal*; FESHM 5043, *Management and Use of Cable Tray Systems*; FESHM 5044, *Protection Against Exposed Electrical Bus*; FESHM 5045, *High Voltage Coaxial Connectors*; FESHM 5046, *Low Voltage, High Current Power Distribution Systems*; FESHM 5047, *Interruptible and Uninterruptible AC Power Back-Up Systems*; and FESHM 5048, *Hazard Mitigation for Electrical Workers – Work Practices and Selection and Use of Protective Clothing and Personal Protective Equipment*. In these FESHM documents the various roles and responsibilities of Fermilab staff, and all Laboratory-wide expectations and implementing requirements for performing this safe electrical work are defined.

The Fermilab Electrical Safety Program was found to be consistent with NFPA 70E requirements, but for one exception. FESHM 5040 notes that working inside the limited approach boundary is "normally limited to only qualified persons." The ambiguity of this statement could be construed to mean it is permissible to have unqualified persons crossing the limited approach boundary. It was explained that this was written by ESS to account for an NFPA 70E allowance to bring unqualified persons beyond the limited approach boundary. However, NFPA 70E, 130.2(D)(2) states that this can only occur when there is a need for an unqualified person to cross the limited approach boundary. It then adds that the qualified person advise the unqualified person of the possible hazards, and then continuously escort that unqualified person while inside the limited approach boundary. FESHM 5040 fails to qualify its own requirement by not noting the specific NFPA 70E conditions under which an unqualified person may cross a limited approach boundary. (**See Finding F-1**) A recommendation to clarify ambiguous language, such as the word "generally" was made during the May 2005 SC Energized Electrical Work Assessment. The Laboratory's response was to only search out and eliminate use of the word "generally".

It was commonly stated during interviews with Fermilab staff and subcontractors that with the exception of diagnostic type work on energized parts and circuits, manipulative work involving energized parts and circuits is prohibited. Those interviewed added there was a process established to perform manipulative work

involving energized parts and circuits. FESHM 5042 requires that when manipulative work involving energized parts and circuits is to be performed, an Electrical Hazard Analysis/Work Permit is to be completed. This Permit is to include the justification for performing any manipulative work involving energized parts and circuits, and approved prior to initiating the work. Approvals on the Permit include the Division/Section Electrical Coordinator, the Division/Section Head, and the Fermilab Directorate.

The Fermilab Chief Operating Officer indicated that in the past several years he could only recall four Permits having come forward to him requesting his approval. He said with one known exception, there is no known need to perform manipulative work on energized parts and circuits. He stated that in nearly all cases any needed work can be rescheduled for another time, or if it truly has to be done, then it will be done later, but done de-energized. The exception he mentioned involved uninterruptible power supplies (UPS) systems. Putting a UPS system in a safe electrical condition creates an exposure to a serious electrical hazard if done incorrectly. He indicated he has twice approved this work be done energized, but that it was done in accordance with an established procedure created for that task, and in accordance with NFPA 70E requirements.

Using the NFPA 70E definitions for qualified and unqualified (referred to in FESHM as non-qualified) person; Fermilab has developed two training courses. Course FN000385/CR, *Electrical Safety in the Workplace*, provides qualified persons with the needed knowledge of the Fermilab Electrical Safety Program requirements and the hazards associated with the work they are expected to perform. Course FN000387/CR, *Electrical Safety Orientation – Lockout/Tagout (LOTO) and Electrical Safety in the Workplace*, provides all employees with knowledge of the Fermilab hazardous energy control requirements, and provides unqualified persons with a basic understanding of the Fermilab Electrical Safety Program and the electrical type hazards they might encounter in the workplace.

The determination for attending either of these courses is established by completion of an Individual Training Needs Assessment (ITNA). A series of questions are answered by an employee's supervisor through the ITNA process to determine the training needs for that employee. Supervisors are required to perform annual ITNA reviews; it is here that supervisors can see any training not completed.

Based on the work an employee is expected to perform, it is here where they are identified as either a qualified or unqualified person. FN000387/CR is presented at least every other Monday as part of the New Employee Orientation (NEO). NEO may be presented more frequently as hiring is increased. FN000387/CR is a one-time course intended for all persons who'll be on-site for at least 30 calendar days in a calendar year. If a person doesn't attend the NEO, the FN000387/CR course can be taken on-line.

FN000385/CR is presented on an as needed basis when sufficient numbers of attendees are identified. At the time of this assessment 10 employees were shown in Fermilab's training database (TRAIN) as "Past Due" to take FN000385/CR. Of these 10, only 2 were actually past due for taking the renewal training. Renewal training is required every 3 years through an on-line course and test. The renewal course might be taught in-person as the need arises. The remaining employees included 6 new employees awaiting the next presentation of FN000385/CR, and 2

others identified by their ITNA that had not yet taken the training. Time constraints during this assessment did not permit follow up to determine if supervisors of these employees are prohibiting these individual from doing any energized electrical work until the training is completed.

ITNA includes a question which identifies those employees working on 277 volts and 480 volts. These individuals are also required to take cardio-pulmonary resuscitation and automated external defibrillator training. This course is taught monthly. TRAIN shows 16 employees as "Past Due"; 8 of which have not taken the training.

Though no energized work was witnessed, interviewees who perform such work stated they wear the required personal protective equipment (PPE). The required PPE mentioned included safety glasses, hearing protection, arc-rated face shields, flame-resistant clothing (shirts, pants, coveralls, and jackets), voltage rated gloves, and flash suits. Those interviewed understood the need for this PPE, its availability, and correctly described the work situations when they are required to be worn. Those interviewed also properly described the Laboratory policy for performing energized electrical work, as well as correctly stating how they would go about performing such tasks.

Approximately 6 months prior to this assessment, FESS established hazard assessments that cover approximately 80% of their electrical work-related activities. The hazard assessments include recognition of needed PPE and other such precautions and information to accomplish the work. The remaining work is allowed to be conducted through a "mental hazard analysis" when FESS supervision determines an employee possesses the needed skills and experience to perform such work. The hazard assessments are maintained in a database, and are generated as needed as part of electrically-related work orders. FESS employees stated they have the opportunity when assigned a work order with or without a hazard assessment to raise questions pertaining to their safety. Likewise, the hazard assessments allow for employee feedback.

Both AD and FESS have established written lockout/tagout (LOTO) procedures for specific hazardous energy control activities. Discussions with AD and FESS employees found that scheduled evaluations of these written LOTO procedures are not always occurring in accordance with FESHM 5120. **(See Finding F-2)** FESHM 5120 calls for each division/section to perform and document inspections at least annually to assure each written LOTO procedure continues to be implemented properly in accordance with the Fermilab Energy Control Program. Specifically FESHM 5120 calls for each written LOTO procedure to be:

- Reviewed by a designated knowledgeable employee and revised or corrected as necessary;
- Each written LOTO procedure be reviewed with all employees authorized to perform the procedure, including that each authorized employee understands the procedure and is familiar with his/her responsibilities under the procedure; and

- There be observation of a sampling of authorized employees performing the written LOTO procedure and discuss the implementation with all other authorized employees present and any inadequacies or potential improvements identified to the procedure or its performance noted and corrected.

FESS stated that they do not have a supervisor present on off-shifts. As such, they are not ensuring all employees authorized to use written LOTO procedures are reviewing those documents, or determining if those same employees are familiar with their responsibilities under the written LOTO procedures. An AD supervisor acknowledged not having reviewed each written LOTO procedure for over a year. Likewise, other AD employees acknowledged not having reviewed the written LOTO procedures in over a year. Follow-up by the AD Senior Safety Officer determined that 8 AD employees had not completed their written LOTO procedure training during the last annual review cycle.

Efforts are underway by all the Fermilab divisions/sections to have completed sets of single line electrical drawings (SLEDs). In August 2006, the ESS had developed a *Standard Conventions for the Fermilab Electrical AC Power Distribution System* to assist in this effort. At the time of this assessment all SLEDs had not been completed. FESS is identified as the "clearinghouse" for all the division/section SLEDs. Unfortunately, all the division/section SLEDs are not all compatible electronically; hence it cannot be ensured that all the needed details will transfer electronically to FESS. The AD Electrical Coordinator demonstrated how they maintain their SLEDs up-to-date. The AD Electrical Coordinator starts revisions with hand written markings on the existing SLEDs. The marked up SLED is then handed over to other AD employees responsible for updating SLEDs using CAD. Likewise the AD Electrical Coordinator demonstrated a similar process for updating panel schedules to reflect new and upgraded electrical installations.

FESS has assisted the Fermilab Computing Division (CD) by obtaining an engineering subcontractor to perform their SLEDs, arc-flash calculations, and provide labeling of electric distribution equipment to reflect arc-flash calculations and PPE needs. Besides CD, only the Technical Division is reported to have taken on performing arc-flash calculations, and providing labeling of electric distribution equipment. A FESS employee indicated that there is now an "informal policy" in place for all new Fermilab construction projects calling for documentation of installation details necessary for performing future arc-flash calculations. FESS management was not aware of any such policy.

After discussion with the ESS Chairperson, FESS, and the ES&H Section, it was learned there were never any other commitments made than just performing SLEDs. Regardless, it was expressed by some they believe there is also a need to perform arc-flash calculations, and labeling of electrical distribution equipment. Though AD has established a process of updating their SLEDs, there is no formal path forward for managing and sustaining the effectiveness of the Laboratory-wide initiative for documenting SLEDs, performing flash protection boundary calculations, and providing precautionary labeling of electrical distribution equipment. (**See Finding F-3**)

The work performed by subcontractors was examined to determine compliance with Fermilab electrical safety requirements. Subcontractors are generally not included in Fermilab electrical safety training other than what is provided through

NEO. Contracts that include the performance of electrical work make reference to conformance with 10 CFR 851, *Worker Safety and Health Rule*, which includes conformance with NFPA 70 and 70E. Fermilab requires all subcontractors performing electrical work to demonstrate completion of NFPA 70E training. Discussions with the foreman of the long term time and materials electrical subcontractor working at Fermilab indicated that he only brings in journeyman electricians who have completed the NFPA 70E training provided by the local IBEW. The AD Senior Safety Officer (who presents the FN000385/CR course) and the AD Electrical Coordinator attended the local IBEW NFPA 70E training and found it to be exceptional. Visits to 2 of the on-going jobs underway by the long term time and materials electrical subcontractor found that 2 of the 4 electricians present to be in possession of the card provided at completion of the training. When questioned, the 2 missing the card provided at completion of the IBEW NFPA 70E training, indicated they had completed the training but had forgot to bring in their cards that day. FESHM 7010, *ES&H Program for Construction – Fixed Price*, and FESHM 7011, *ES&H Program for Construction – Time and Materials Activities (Other Than Fixed Price)*, both require construction coordinators and task managers to verify completion of subcontractor training. This has typically not been done by the task managers interviewed. Discussions with a FESS construction coordinator indicated that he did not have time to make such verifications. (**See Finding F-4**)

IV. CONCLUSIONS

Though this assessment only covered AD and FESS, and only involved a limited portion of those Fermilab employees potentially exposed to energized electrical parts and circuits, this assessment found that Fermilab has established a site-wide program for the implementation of NFPA 70E. The 4 findings identified by this assessment can best be described as primarily administrative issues. Implementation of corrective actions to address these findings and prevent their recurrence will prove beneficial in making a highly effective electrical safety program. The Laboratory should utilize the results of this assessment and determine if corrective actions need to be applied to other areas of the Laboratory that were not included with the scope of this assessment.

V. FINDINGS, STRENGTHS, AND NOTEWORTHY PRACTICES

Findings

F-1 FESHM 5040 fails to qualify its own requirement by not noting the specific NFPA 70E conditions under which an unqualified person may cross a limited approach boundary. (Level 2 Finding)

F-2 Annual Division/Section inspections of required written LOTO procedures are not always occurring in accordance with FESHM 5120. (Level 2 Finding)

F-3 There is no formal path forward for managing and sustaining the effectiveness of the Laboratory-wide initiative for documenting single line electrical drawings, performing flash protection boundary calculations, and providing precautionary labeling of electrical distribution equipment. (Level 3 Finding)

F-4 Verification of subcontractor credentials that demonstrate having completed recognized NFPA 70E training is not always occurring. (Level 3 Finding)

Strengths

No strengths were recognized during this independent assessment.

Noteworthy Practice

No noteworthy practices were recognized during this independent assessment.

VI. PERSONNEL INTERVIEW

R. Alber	S. Dixon	B. Wickenberg
J. Anderson	B. Falconer	J. Holm
A. Auersch	R. Foutch	L. Huitt
D. Baird	M. Geelhoed	T. Kanyok
B. Benson	T. Gibbs	J. Kofran
R. Bies	G. Gilbert	G. Mitchell
M. Bonkalski	D. Hellberg	S. Moua
J. Brown	J. Reid	J. Niehoff
J. Cassidy	B. Shull	R. Ortgiesen
B. Chrisman	D. Sigmon	J. Pathiyil
R. Coll	B. Van Duzen	J. Ranson
P. Czarapata	R. White	W. Wittaniemi

VII. DOCUMENTS REVIEWED

- *ES&H Section Construction Audit Procedure*, Environment, Safety and Health Section, No Date
- *Internal Assessment the Actions Taken in Response to the June 2005 Department of Energy Office of Science Review of Fermilab Energized Electrical Work*, Environment, Safety and Health Section, June 2006
- Fermilab Today, *Safety Tip of the Week – Insulating Gloves*, April 3, 2006
- Fermilab Today, *Electrical Glove Testing Due*, October 2, 2006
- FESHM 1030, *Environment, Safety and Health (ES&H) Organizations and Responsibilities*
- FESHM 2050, *Building Manager Program*
- FESHM 5120, *Fermilab Energy Control Program (Lockout/Tagout)*
- FESHM 5040, *Fermilab Electrical Safety Program*
- FESHM 5041, *Electrical Utilization Equipment Safety*
- FESHM 5042, *AC Electrical Power Distribution Safety – For Systems Operating Between 50 and 600 VAC Nominal*
- FESHM 5044, *Protection Against Exposed Electrical Bus*
- FESHM 5048, *Hazard Mitigation for Electrical Workers – Work Practices and Selection and Use of Protective Clothing and Personal Protective Equipment*

- FESHM 7010, *ES&H Program for Construction – Fixed Price*
- FESHM 7011, *ES&H Program for Construction – Time & Materials Activities (Other Than Fixed Price)*
- Office of Science, *Energized Electrical Work Review*, Fermi National Accelerator Laboratory, June 13-17, 2005
- Tripartite Assessment (DRAFT), *Compliance Assessment for FESHM 5048*, Facilities Engineering Services Section, January 2005
- Tripartite Assessment, *NFPA 70E* Self-Assessment Report, Accelerator Division, March 2008
- Tripartite Assessment, *Compliance with NFPA 70E-2004 and FESHM 5048 for UPS Systems and Compliance with NFPA 70E-2004 for Electronic Cabinets Utilization Equipment* Self-Assessment Report, Computing Division, April 2005
- Tripartite Assessment, *NFPA 70E Implementation Within TD* Self-Assessment Report, Technical Division, April 2005
- PowerPoint Slides for Fermilab Training Course FN000385/CR, *Electrical Safety in the Workplace*, No Date
- PowerPoint Slides for Fermilab Training Course FN000387/CR, *Electrical Safety Orientation – Lockout/Tagout (LOTO) and Electrical Safety in the Workplace*, No Date
- TRAIN Tickler Report for Fermilab Training Course FN000385/CR – *Electrical Safety in the Workplace*, Past Due as of February 22, 2010
- Example Work Order WO443213, *NUMSB – Check & Repair Light Out Over Personnel Door*, Facilities Engineering Services Section, November 2009
- Example Work Order WO451082, *Air Compressor Inspection – Quarterly*, Facilities Engineering Services Section, February 2010
- Example Work Order WO451273, *FCP – Replace Motor – PM*, Facilities Engineering Services Section, February 2010
- Fermilab Electrical Safety Subcommittee, *Standard Conventions for the Fermilab Electrical AC Power Distribution System*, Reviewed and Approved by the Electrical Safety Subcommittee, August 7, 2006

VIII. WORK OBSERVATIONS

- Industrial Building 4, Chemical Cleaning Equipment Electrical Install
- Main Injector Building 14, Service Building Electrical Install
- Main Injector Building 39, Kicker Room Electrical Install

Energized Electrical Safety Assessment, February 22-25, 2010

Objective: Management has established an effective electrical safety program to ensure conformance with the requirements established by 10 CFR 851 for the performance of energized electrical work.

Criteria	Laboratory Documents and Records	Observations
The Laboratory has established an electrical safety program based on the hazards and risks involving the work being performed. This program provides management and employee awareness of the potential hazards associated with electrical energy as part of the work performed, and promotes self-discipline for employees who might direct or perform work on or near exposed energized electrical conductors or circuit parts. This program identifies appropriate safety principles and controls based on work performed.	*The Laboratory should enter their management system documents that describe how the Laboratory satisfies the criteria and the records that demonstrate effective implementation.*	

Conclusions – *Provide an overall (on-balance) summary statement regarding the extent to which the Laboratory is satisfying the above objective and criteria.*

Strengths –

-
-

Weaknesses –

•   •
Findings / Recommendations –   •   •

Documents and Records Reviewed:

-
-

Persons Interviewed:

-
-

Supplemental Lines of Inquiry:

1. Does the program establish controls for working on or near live parts operating at 50 volts or more or where an electrical hazard exists before work is started?
2. Does the Laboratory's utilize a hazard/risk evaluation process before work is started on or near live parts operating at 50 volts or more or where an electrical hazard exists?
3. Does the Laboratory require job briefings be held before starting each job with all employees involved that covers the hazards associated with the work, the procedures to be followed, any special precautions, the energy source controls, and the personal protective equipment required?
4. Does the program establish appropriate safe work practices before any person approaches exposed live parts within the Limited Approach Boundary by using shock hazard analysis and flash hazard analysis?
5. Does the program require that live parts an employee might be exposed to be put in an electrically safe work condition before the employee works on or near them?
6. Does the Laboratory permit work on electrical conductors or circuit parts not put in an electrically safe work condition?

7. Does the Laboratory have administrative requirements established for work on energized electrical conductors or circuit parts?
8. Are requirements established to ensure test instruments and equipment is rated for the circuits and equipment it will be connected, designed for the environments it is expected to be used, and handled and maintained in manner that will not lessen its designed performance?
9. Are electrical safety performance expectations communicated to subcontractors and visitors?

Criteria and Review Approach Document for Fermi National Accelerator Laboratory

Energized Electrical Safety Assessment, February 22-25, 2010

Objective: The Laboratory's training of employees, subcontractors, and visitors is effective at communicating the performance expectations established by Fermilab's electrical safety program requirements.		
Criteria	Laboratory Documents and Records	Observations
Training is provided to all employees who face a risk of electrical hazard that is not reduced to a safe level by the electrical installation requirements of the National Electrical Code. Employees understand the specific hazards associated with electrical energy, with safety-related work practices and procedural requirements as necessary to provide protection from the electrical hazards associated with their respective job, and they can identify and understand the relationship between electrical hazards and possible injury.	*The Laboratory should enter their management system documents that describe how the Laboratory satisfies the criteria and the records that demonstrate effective implementation.*	
Conclusions – *Provide an overall (on-balance) summary statement regarding the extent to which the Laboratory is satisfying the above objective and criteria.* Strengths – • • Weaknesses –		

•   •
Findings / Recommendations –   •   •

Documents and Records Reviewed:

-
-

Persons Interviewed:

-
-

Supplemental Lines of Inquiry:

1. Has the Laboratory established training for both qualified and unqualified persons?
2. Is electrical safety training provided as classroom or on-the-job, or a combination of both?
3. Is risk utilized to determine the degree of training provided to employees?
4. Are unqualified persons trained in and familiar with any electrical hazards of their workplace and any associated safe work practices necessary to their duties?
5. Are qualified persons trained and knowledgeable of the construction and operation of equipment or a specific work method, and possess the knowledge to recognize and avoid the electrical hazards that might be present with respect to that equipment or work method?
6. Are qualified persons trained in and familiar with the proper use of special precautionary techniques, personal protective equipment, including arc-flash, insulating and shielding materials, and insulated tools and equipment?
7. Are qualified persons working within the limited approach boundary of exposed live parts operating at 50 volts or more additionally trained in:

- The skills and techniques necessary to distinguish exposed energized parts from other parts of electrical equipment;
- The skills and techniques to determine the nominal voltage of exposed live parts;
- The approach distances and corresponding voltages to which they may be exposed; and
- The decision-making process necessary to determine the degree and extent of the hazard and the personnel protective equipment and job planning necessary to perform the task safely?

8. Are all persons who could be exposed to energized electrical conductors or circuit parts trained to understand the established hazardous energy control procedure as applicable to their duties?
9. Are all persons working on or near exposed energized electrical conductors or circuit parts trained in methods of release of victims from contact with exposed energized electrical conductors or circuit parts?
10. If warranted by their duties, are persons regularly instructed in methods of first-aid and emergency procedures?
11. What are the qualification requirements for subcontractors?

Energized Electrical Safety Assessment, February 22-25, 2010

Objective: Work is carried out by qualified personnel using approved procedures, instructions, and equipment under administrative, technical, and ES&H controls to achieve a planned end result.

Criteria	Laboratory Documents and Records	Observations
Procedures to prevent electrical related injuries require employees to completely remove the source of electrical energy by eliminating the possibility of its reappearance by identifying all possible sources of electricity and the disconnecting means of each source. Furthermore, these procedures call for use of protective clothing and personal protective equipment, visually verifying to the extent possible that these hazards have been eliminated and then tested to verify the absence of voltage, that applicable energy control practices are utilized, and finally that conductors and parts that might become energized while performing work be grounded.	*The Laboratory should enter their management system documents that describe how the Laboratory satisfies the criteria and the records that demonstrate effective implementation.*	

Conclusions – *Provide an overall (on-balance) summary statement regarding the extent to which the Laboratory is satisfying the above objective and criteria.*

Strengths –

-

• Weaknesses – • •
Findings / Recommendations – • •

Documents and Records Reviewed:

•

•

Persons Interviewed:

•

•

Supplemental Lines of Inquiry:

1. Has the Laboratory established protective clothing and personal protective equipment requirements for work on or near exposed energized electrical conductors or circuit parts?
2. Are current as-built diagrammatic drawings available to employees to trace all possible sources of electricity and their disconnecting means?
3. Are circuit labels legible on electrical panel schedules and do they correctly identify existing circuits?
4. Does the Laboratory require the visual inspection of a disconnecting means (if possible) to ensure a physical break in all conductors?
5. Does the Laboratory require use of approved voltage testing device for zero-voltage checks phase-to-ground for each conductor, and phase-to-phase between each conductor of a disconnecting means? (Taking these measurements is to be considered working on or near exposed live parts.)

6. Does the Laboratory require after each zero-voltage check that the voltage detector be tested to determine if it's operating satisfactorily?
7. Has the Laboratory established a hazardous energy control program compliant with NFPA 70E and 29 CFR 1910 requirements?
8. Does the Laboratory require use of approved ground connecting devices (if possible) rated for the available fault duty between ground and the phase conductors or circuit parts before touching them?

Criteria and Review Approach Document for Fermi National Accelerator Laboratory

Energized Electrical Safety Assessment, February 22-25, 2010

Objective: Work involving energized conductors and circuits is allowable by management only when it has been determined that establishing an electrically safe working condition is infeasible.

Criteria	Laboratory Documents and Records	Observations
Work on energized conductors and circuits can occur only after all other opportunities for establishing an electrically safe work condition have been exhausted. Work on or near an energized conductor or circuit is performed by qualified employees. Laboratory management approves this increased risk of exposure.	*The Laboratory should enter their management system documents that describe how the Laboratory satisfies the criteria and the records that demonstrate effective implementation.*	

Conclusions – *Provide an overall (on-balance) summary statement regarding the extent to which the Laboratory is satisfying the above objective and criteria.*

Strengths –

-
-

Weaknesses –

-
-

Findings / Recommendations –

•
•

Documents and Records Reviewed:

-
-

Persons Interviewed:

-
-

Supplemental Lines of Inquiry:

1. Has work on energized conductors and circuits occurred? If yes, were these circumstances justified by the understanding that to do otherwise would create an increased or additional hazard, or because of equipment design or operational limitations made de-energizing the equipment infeasible?
2. In those circumstances where work on energized conductors and circuits have occurred, were written work permits prepared? Was it approved by Laboratory management?
3. Is testing, troubleshooting, voltage measuring, etc., of energized conductors and circuits allowed? If yes, under what controls can this occur?
4. Have Shock Hazard Analyzes been prepared across the Laboratory?
5. Have Flash Hazard Analyzes been prepared across the Laboratory?
6. Do Laboratory employee's posses knowledgeable and understanding of Limited, Restricted, and Prohibited Approach Boundaries?
7. Have employees who are exposed to electrical hazards been provided appropriate protective clothing and personal protective equipment?

Criteria and Review Approach Document for Fermi National Accelerator Laboratory

Energized Electrical Safety Assessment, February 22-25, 2010

Objective: An approve contractor assurance system exists, to promote continuous improvement.		
Criteria	Laboratory Documents and Records	Observations
Management systems have been institutionalized that will promote continuous improvement in the performance of electrical-related work to ensure compliance with 10 CFR 851 requirements.	*The Laboratory should enter their management system documents that describe how the Laboratory satisfies the criteria and the records that demonstrate effective implementation.*	
Conclusions – *Provide an overall (on-balance) summary statement regarding the extent to which the Laboratory is satisfying the above objective and criteria.* **Strengths** – • • **Weaknesses** – • •		
Findings / Recommendations – • •		

Documents and Records Reviewed:

-
-

Persons Interviewed:

-
-

Supplemental Lines of Inquiry:

1. Has the Laboratory conducted self-assessments and internal independent assessments of their energized electrical work program, and hazardous energy control program in the last three years to verify compliance with applicable requirements set forth by 10 CFR 851?
2. Have external assessments of the Laboratory's energized electrical work program, and hazardous energy control program been conducted in the last three years to verify compliance with applicable requirements set forth by 10 CFR 851?
3. Are corrective actions related to the Laboratory's energized electrical work program, and hazardous energy control program, tracked to closure? Are they verified as completed and effective? Is extent of condition evaluated?
4. Are lessons learned internal and external to the Laboratory energized electrical work communicated to employees?
5. Is there evidence of the Laboratory application of external lessons learned being put to use?
6. Is there evidence of the Laboratory generating lessons learned based on their own experiences, and sharing those with the DOE complex?