Fermilab

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August 16, 2005

Dr. Joanna M. Livengood
Site Manager
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U. S. Department of Energy
P. O. Box 2000
Batavia, Illinois 60510

Dear Dr. Livengood,

Subject: Energized Electrical Work Review Action Plan

Reference: Letter, Livengood to Brown, dated July 27, 2005, same subject

Attached for your review and approval is the plan developed in response to the DOE Energized Electrical Work Review. The plan was reviewed in draft by your staff. All actions will be complete by January 20, 2006. There are no interim milestones.

If you have any questions regarding this plan, please contact Mary Logue, at x-6329.

Sincerely,

Gerald C. Brown
Associate Director for Operations Support

Cc: B. Chrisman, w/o encl.
W. Griffing, w/encl.
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ESH File: Electrical Safety

Energized Electrical Work Review Report
Action Plan in Response to Recommendations
08/16/2005

Recommendation #1: *Fermilab should ensure that its electrical safety program includes NFPA 70E as a mandatory standard.*

Response: Fermilab's Work Smart Set of standards includes the National Fire Protection Association (NFPA) standards, which includes NFPA70E. FESHM 5042, "AC Electrical Power Distribution Safety", refers to NFPA 70E as a required standard. FESHM 5040, "Fermilabs' Electrical Safety Program", which summarizes Fermilab's electrical safety program, will be revised to specifically include NFPA70E.

Planned Action:

1. Revise FESHM 5040, "Fermilab Electrical Safety Program" to include NFPA 70E as a required standard.

Recommendation #2: *Fermilab should establish 50 VAC as the threshold for identifying systems that are required to be de-energized in order to work safely.*

Response: The policy establishing 50 VAC as the threshold for identifying systems that are required to be de-energized in order to work safely was clarified in a memo on June 17, 2005. It will be incorporated into FESHM 5042, "AC Electrical Power Distribution Safety". All employees who may be affected by these changes will be informed of the changes to the FESHM chapter.

Planned Action:

1. Revise FESHM 5042, "AC Electrical Power Distribution Safety" to incorporate 50 VAC as the threshold for identifying systems required to be de-energized to work safely.
2. Communicate changes to all affected employees

Recommendation #3: *Fermilab should avoid using ambiguous words like "generally" in defining policy on energized work.*

Response: The policy regarding energized work was clarified in a memo on June 17, 2005. It will be incorporated into FESHM. See Recommendation #2.

Planned Action: See Recommendation #2.

Recommendation #4: *Fermilab should use the more appropriate description of "energized [electrical] work" in place of the phrase "hot work."*

Response: The various references to "hot work" in FESHM 5000 chapter series will be replaced with the term "energized electrical work.

Planned Action:

1. Review, and revise as necessary the FESHM 5000 chapter series associated with electrical safety to replace the term "hot work", with a more appropriate description of "energized electrical work".

Recommendation #5: *Fermilab should discontinue the practice of energized manipulative work.*

Response: The policy regarding energized work was clarified in a memo on June 17, 2005. It will be incorporated into FESHM. See Recommendation #2.

Planned Action: See Recommendation #2.

Recommendation #6: *Fermilab should have a program to ensure voltage-rated gloves and live line tool (hot stick) testing is current.*

Response: Fermilab does have a program for ensuring voltage-rated gloves and live line tool testing; however, it is in need of better coordination and oversight. Fermilab will revise its program to ensure testing is current. Oversight of the program will take place as part of the Fermilab Tripartite Assessment program.

Planned Action:

1. Revise program for ensuring voltage-rated gloves and live line tools have testing that is current.

Recommendation #7: *Fermilab should use an EHAWP for diagnostics, testing or zero voltage checks.*

Response: As stated in the report, NFPA70E exempts documenting the analysis process for diagnostics, testing, or zero voltage checks. The review team stated that employees were conducting the appropriate analysis for these activities, and recommended documenting the process. Fermilab views this recommendation as truly a suggestion, and not a gap in the program. As such, this suggestion will need some time to review and examine the impact of imposing a requirement for such documentation. A white paper, examining the positive and negative aspects of this suggestion will be developed and submitted to Laboratory Management with recommendations for any further action.

Planned Action:

1. Develop a white paper, identifying any recommendation for further action on documenting the analysis process for diagnostics, testing, or zero voltage tests.

Recommendation #8: *Fermilab is encouraged to implement the use of the comprehensive method developed by the TD to aid in the performance of arc flash incident energy calculations throughout the Laboratory.*

Response: This recommendation was identified as an action in the Electrical Safety Performance Improvement Plan submitted to DOE in May 2004. An ad hoc group of the Electrical Safety Subcommittee was assigned this action. The group prepared a model single line drawing from a recent new construction activity. This was submitted to the ESS for review. The ESS reviewed the proposed template, documented guidelines and parameters of the program, and submitted it to Laboratory management for acceptance. The Technical Division has implemented, and essentially completed the drawings and arc flash calculations for the buildings under its purview. Sitewide implementation is expected to begin shortly.

Planned Action:

1. Begin implementation of program to calculate arc flash incident energy throughout the Laboratory.

Recommendation #9: *Fermilab should review the application of FR apparel and PPE to make sure that it is appropriate to the hazard level.*

Response: The wearing of the PPE that is appropriate for the hazard level will be addressed by implementing NFPA 70E training, as discussed in Recommendation #12. Implementation of the program to produce single line electrical drawings, as discussed in Recommendation #8, will make calculating the arc flash incident energy easier. That also will assist in identifying the appropriate level of PPE. Indeed, some groups, such as FESS are already performing this calculation when developing their hazard analyses.

Planned Action: See Recommendation #8 and #12.

Recommendation #10: *Fermilab should consider prohibiting the use of the Wiggy by subcontractor and in-house personnel.*

Response: Fermilab views this recommendation as truly a suggestion, and not a gap in the program. Initial research into the topic was unsuccessful. As such, this suggestion will need some time to review. This recommendation will be reviewed by the Electrical Safety Subcommittee. Additional information will be sought from the Review Team members to glean information that supports this recommendation. A white paper will be developed and submitted to Laboratory Management with recommendations for any further action.

Planned Action:

1. Research industry history on the catastrophic failure of solenoid voltage testers.
2. Develop white paper, along with recommendations for further action to Laboratory Management.

Recommendation #11: *Fermilab should discontinue the practice of using non-contact voltage testers for zero voltage checks if meters are commercially available that are "IEC CAT-III" rated for the voltages and conditions to be tested.*

Response: FESHM 5120, "Fermilab Energy Control Program" will be reviewed against the Lockout/Tagout requirements found in NFPA 70E. Along with other possible changes, the chapter will be revised to discontinue the use of non-voltage testers for zero voltage checks if meters are commercially available that are "IEC CAT-III" rated for the voltages and conditions to be tested.

Planned Action:

1. Review and revise FESHM 5120, "Fermilab Energy Control Program".

Recommendation #12: *Fermilab should establish a schedule for completing its corporate level NFPA 70E training.*

Response: The Electrical Safety Subcommittee and the ESH Section have identified who is considered a "qualified" worker, and who is required to be formally trained in NFPA 70E. A vendor to provide NFPA 70E training has been selected, and contracts are being put in place. It is anticipated that the training will begin before the next fiscal year, with substantial completion of the training (>90% completion) during FY2006.

Planned Action:

1. The Individual Training Needs Analysis (ITNA) will be revised to include the requirement for qualified workers, task managers, and construction coordinators to receive NFPA 70E training.
2. A schedule for conducting NFPA 70E training to qualified workers will be established.

Recommendation #13: *Fermilab should establish unqualified person training requirements and revise ITNA so as to allow supervisors to map any required training for the applicable employees.*

Response: Unqualified workers receive electrical safety training as part of New Employee Orientation (NEO). This course is required of all employees. This course includes electrical safety, including the requirements established in NFPA 70E. In

accordance with Recommendation #25, NEO will be revised to include information about signage and respect of work zone boundaries.

Action Plan:

1. Revise New Employee Orientation.

Recommendation #14: *Fermilab should modify its training as it relates to responding to electrical contact incidents by first promoting working de-energized; and if work must be performed energized, that during work planning and pre-job briefings workers be trained on how and where to remove the source of electricity.*

Response: This will be addressed as part of the training for qualified workers. See Recommendation #12.

Action Plan: See Recommendation #12.

Recommendation #15: *Fermilab should ensure that all ES&H training courses with electrical safety considerations appropriately reflect Laboratory policy on the performance of energized electrical work and/or the requirements of NFPA 70E.*

Response: ES&H training courses with electrical safety consideration have been reviewed to assure they appropriately reflect Laboratory policy.

Action Plan: Action Complete.

Recommendation #17: *Fermilab should ensure the implementation of NFPA 70E by subcontractors.*

Response: Although the subcontractor terms and conditions do not specifically require NFPA 70E, it does identify the "NFPA standards, as applicable". In Fermilab's interpretation, this included NFPA 70E. However, given that this is a standard with wide-ranging implications, it is wise to specifically identify it in construction subcontracts. The ES&H procedure used to review subcontractor ES&H plans will be revised to include a review of NFPA compliance. Task managers and construction coordinators will be instructed to observe the subcontractor performance for compliance with NFPA 70E. Finally ES&H oversight personnel will include NFPA 70E compliance in their oversight inspections.

Action Plan:

1. Requirements for construction subcontractors to follow NFPA 70E will be incorporated into FL-3.
2. Procedures to review subcontractor ES&H plans will be revised to include verification of NFPA 70E compliance.
3. Communication will be issued to task managers/construction coordinators to verify compliance with NFPA 70E through HA preparation, review, and acceptance.

Recommendation #18: *Fermilab should more clearly define the training and experience requirements for approval of Task Managers and Construction Coordinators. Persons with oversight of electrical work should be trained in electrical safety and NFPA 70E. Training should be recurring.*

Response: Acting on a recommendation of the Subcontractor Safety Subcommittee, the Associate Director for Operations Support tasked various technical subcommittees to define the training and experience required for task managers and construction coordinators. This was begun in May 2005, and work is ongoing. It is recognized that task managers and electrical coordinators who oversee electrical work will be required to take NFPA 70E training. This will enable them to provide adequate oversight of subcontracted electrical work.

Action Plan:

See Recommendation #12.

Recommendation #19: *Fermilab should ensure that subcontractor electricians are formally trained in NFPA 70E requirements. The training should include appropriate use, care and testing of PPE.*

Response: Currently fixed price construction subcontracts require subcontractors to assure their employees are trained for the work they will be performing at Fermilab. Subcontractors are required to maintain, and at Fermilab request, present safety training records. The Fermilab ES&H Manual chapters for subcontracted construction work requires the verification of certain training such as confined space, respiratory protection, oxygen deficiency hazards, and radiation safety (the last two being Fermilab-provided). Those chapters will be revised to include NFPA 70E training. For fixed priced contracts, the responsibility to review training will rest with the construction coordinator. For Time and Materials contracts, the responsibilities to review training have been assigned to the T&M Office. The local IBEW union recently held NFPA 70E training for electricians (at the request of Fermilab and Argonne National Laboratory electrical subcontractors). A Fermilab task manager attended this training for evaluation purposes. Task managers and construction coordinators will be apprised of these revisions. ES&H personnel will spot check this effort through their oversight inspections.

Action Plan:

1. Revise FESHM 7010 and 7011 to include the requirement to review NFPA 70E training when the work involves electrical work.
2. Issue a communication to task managers and construction coordinators reminding them to review NFPA 70E training records for their projects.
3. Issue an instruction to ES&H personnel to review NFPA 70E training records as part of their inspection process.

Recommendation #20: *Fermilab should require subcontractor electricians to wear appropriate all-cotton clothing, with long sleeve shirts and long pants as a minimum when performing energized electrical work.*

Response: NFPA 70E requires all-cotton clothing with long sleeve shirts and long pants as a minimum when conducting energized electrical work. The action plan for Recommendation #17 specifically includes compliance with NFPA 70E in the subcontract. This would include a requirement for appropriate clothing. As a side note, the review team found electricians to be wearing appropriate clothing.

Action Plan: See Recommendation #17.

Recommendation #21: *Fermilab should ensure that contractors wear appropriate PPE for all tasks.*

Response: The requirement that subcontractor employers provide PPE that is appropriate for the job is present in the terms and conditions of their contracts with Fermilab. Identification of work-specific PPE is performed during the job planning stage, and documented in the hazard analysis. Employees are reminded about possessing and wearing PPE during Subcontractor Orientation that every subcontractor is required to take. Task managers and construction coordinators meet with subcontractors before starting new tasks to review the hazard analysis, including what PPE will be used. Finally, task managers, construction coordinators, and ES&H oversight personnel periodically inspect work activities for compliance with hazard analyses.

The inclusion of compliance NFPA70E specifically in the subcontract, as described in Recommendation #17, along with training for task managers, construction coordinators, and subcontractors, as described in Recommendations #12 and #19, will tighten up this facet of Fermilab's construction safety program.

Action Plan: See Recommendations, #12, #17, and #19.

Recommendation #22: *Fermilab should verify that:*

- *personal protective equipment used by subcontractors is properly maintained, inspected, and tested.*
- *each electrician is issued a personal pair of rubber insulating gloves properly sized for their hands. Properly sized gloves will result in improved dexterity and appropriate protection.*

- *appropriate gloves for the voltage are utilized to improve dexterity. Persons working on 480V maximum equipment do not require Class 2 gloves suitable for 17kV.*

Response: This recommendation is similar to Recommendation #21: subcontractors are required to provide their employees with appropriate PPE. The term "appropriate" also implies that the equipment is properly maintained, inspected and tested. Task managers and construction coordinators, by virtue of being trained in NFPA 70E, will understand PPE requirements, including maintenance and testing, and will be able to direct corrections in the field.

Action Plan: See Recommendations #12, #17, and #19.

Recommendation #23: *Fermilab should document that subcontractors have "stop work" authority.*

Response: All subcontractor employees are informed of their ability to stop work in Subcontractor Orientation. The subcontractor employees who were interviewed as part of the review all stated that they had stop work authority. Furthermore, the subcontractor is expected to describe their stop work authority in the ES&H Plan. The ESH-SEP procedure for reviewing subcontractor ES&H plans will be modified to include verification of subcontractor stop work authority

Action Plan:

1. Modify ESH-SEP procedure regarding the review of subcontractor ES&H plans to include subcontractor stop work authority.

Recommendation #24: *Fermilab should ensure that subcontractor employees are trained to recognize flash and approach boundaries in order to establish appropriate work zones.*

Response: Currently fixed price construction subcontracts require subcontractors to assure their employees are trained for the work they will be performing at Fermilab. Subcontractors are required to maintain, and at Fermilab request, present safety training records. The Fermilab ES&H Manual chapters for subcontracted construction work require the verification of certain training such as confined space, respiratory protection, oxygen deficiency hazards, and radiation safety (the last two being Fermilab-provided). Those chapters will be reviewed to include NFPA 70E training. Taking the training will address the hazard recognition issue in this recommendation. For fixed priced contracts, the responsibility to review training will rest with the construction coordinator. For Time and Materials contracts, the responsibilities to review training have been assigned to the T&M Office. The local IBEW union recently held NFPA 70E training for electricians (at

the request of Fermilab and Argonne National Laboratory electrical subcontractors). A Fermilab task manager attended this training for evaluation purposes. Task managers and construction coordinators will be apprised of these revisions. ES&H personnel will spot check this effort through their oversight inspections.

Action Plan: See Recommendation # 17 and #19.

Recommendation #25: *Fermilab should ensure that all personnel respect established work zone boundaries. Subcontract employees should be trained to recognize that attendants may be necessary when work zones are established in high-traffic areas.*

Response: In current Fermilab practice, establishment of work zone boundaries is addressed during the HA review and implementation. Subcontractors are encouraged to prevent violators from entering a restricted area. They will be encouraged to report violators to their Fermilab Point of Contact. The other side of this equation is to educate the working population at Fermilab to respect established boundaries. This will be accomplished through a revision of New Employee Orientation. Included will be information on signage and restrictions in entering work zones for construction sites. FermiToday will be used as a vehicle to communicate these requirements to current Fermilab employees.

Action Plan:

1. Revise New Employee Orientation.
2. Issue communication to current Fermilab employees.

Recommendation #26: *Subcontractor oversight personnel should ensure appropriate training and implementation of NFPA 70E lockout procedures.*

Response: With NFPA 70E training, as described in Recommendation #19, this recommendation will be satisfied. In addition, the ESH-SEP procedure for reviewing subcontractor ES&H plans will be modified to include verification that the subcontractor LOTO program is in compliance with NFPA 70E.

Action Plan:

1. Modify ESH-SEP procedure for reviewing subcontractor ES&H plans to verification of compliance of subcontractor LOTO program with NFPA 70E.