

Interpretation by the Laboratory Electrical Safety Committee – June 2005

BNL Line Crew - 3

Work in Manholes

The Laboratory Electrical Safety Committee finds that the BNL Line Crew can safely perform housekeeping work (e.g.: inspection, and clearing drains) not involving contact with energized cables in manholes which contain energized cables, and clothing to protect against the effect of arc flash is not required while performing this work (although work planning and Division procedures may require certain personal protective equipment).

This document, read in conjunction with other referenced documents, forms the basis of an NFPA 70E arc flash hazard analysis.

Discussion

In Interpretation “BNL Line Crew - 1,” the Laboratory Electrical Safety Committee (LESC), acting as the Authority Having Jurisdiction, has determined that BNL Line Crew work can follow power transmission and distribution rules in activities approved by the LESL. That is, in selected areas of work, the LESL chooses to have the Line Crew follow OSHA 29CFR1910.269 *Electric power generation, transmission and distribution* and the National Electrical Safety Code (NESC) when dealing with transmission and distribution systems rather than 29CFR1910 Subpart S - *Electrical*.

Electrical Manholes

One work area addressed exclusively by the BNL line crew is maintenance of electrical manholes used for power distribution on site, referred to as utility manholes. Other workers may enter communication manholes containing only low-voltage telephone cables or fiber optics, and yet other workers may enter below-grade spaces containing components of the steam distribution system.

Manhole Configuration

The utility manholes are constructed in conformance with provisions of 1910.269 and the NESC. BNL utility manholes contain 13.8 kV, 2400 volt, and 480 volt circuits. Each duct-bank has an exposed copper ground wire installed in the duct-bank and through the manhole along with the cables. Individual cables that are spliced in the manhole have a drain wire from their shields connected to the exposed ground wire.

Workers may enter Electrical Manholes where Energized Cables are in service

Interpretation by the Laboratory Electrical Safety Committee – June 2005

The NESC expects utility workers to enter manholes with energized circuits. This is illustrated by the the Exception to Article 443 - Work on Energized Lines and Equipment, Para. K - Attendant on Surface, which provides the following [underscore added]:

"While electric supply personnel are in a manhole, an employee shall be available on the surface in the immediate vicinity to render assistance from the surface. This shall not preclude the employee on the surface from entering the manhole to provide short-term assistance.

EXCEPTION: This shall not preclude a qualified employee, working alone, from entering a manhole where energized cables or equipment are in service, for the purpose of inspection, housekeeping, taking readings, or similar work if such work can be performed safely."

OSHA 1910.269(t)(3)(iii) provides further confirmation that utility workers are expected to enter manholes along with energized circuits, as follows [underscore added]:

For the purpose of inspection, housekeeping, taking readings, or similar work, an employee working alone may enter, for brief periods of time, a manhole where energized cables or equipment are in service, if the employer can demonstrate that the employee will be protected from all electrical hazards.

Note that, despite the two above references, no member of the BNL Line Crew may enter a manhole without the presence of a qualified worker in attendance at the surface dedicated to monitoring the worker within the manhole.

Need for BNL Line Crew to Enter Electrical Manholes

There is a need to enter electrical manholes throughout the BNL site. The necessary work includes checking the manhole for water and pumping it out if necessary, inspecting the sump (French drain) and cleaning it, inspecting the cables for adequate support and leakage of oil or compound. One important task is determining the duct-bank pathway for marking on-grade, so that construction activities avoid the marked area and therefore avoid electrical penetrating accidents. This task requires a Line Crew worker to enter a manhole to clamp onto a ground cable that goes into a duct-bank. Aside from applying the clamp, the ground cable is not physically disturbed in this process. The duct-bank pathway is then determined at ground level by a "toning" process, which uses an electronic detector to follow a test tone placed onto the ground cable.

Engineering for Protection from Hazards in Electrical Manholes

Protection for workers is provided by, in descending order, engineering solutions, procedures

Interpretation by the Laboratory Electrical Safety Committee – June 2005

(including training), and finally through use of personal protective equipment. Regarding engineering solutions, the electrical manholes are all constructed and outfitted in accordance with requirements found in the Section 32 - *Underground conduit systems*, of the NESC, and cables are installed in accordance with Section 34 - *Cable in underground structures*.

Procedures for Protection from Hazards in Electrical Manholes

Entry into manholes is preceded by job risk assessments, job planning, and tailgate or toolbox meetings. Further, BNL does not permit any manipulation of an energized cable within a manhole during these tasks.

OSHA 1910.269 contains requirements for entering confined spaces, and 1910.269 Appendix A-5 provides a flow chart for “Application of Sections 1910.146 and 1910.269 to Permit-Required Confined Spaces. These issues are dealt with as part of PM Job Plan MH-003. In addition to checking the confined space of the manhole with a four-gas meter, this procedure requires a person entering a manhole to pump out standing water if necessary, and to verify there are NO obvious signs of cable leakage or deterioration. This requirement agrees with requirements in OSHA para. 1910.269(t)(7), which states:

"Defective cables." Where a cable in a manhole has one or more abnormalities that could lead to or be an indication of an impending fault, the defective cable shall be deenergized before any employee may work in the manhole, except when service load conditions and a lack of feasible alternatives require that the cable remain energized. In that case, employees may enter the manhole provided they are protected from the possible effects of a failure by shields or other devices that are capable of containing the adverse effects of a fault in the joint.

Note: Abnormalities such as oil or compound leaking from cable or joints, broken cable sheaths or joint sleeves, hot localized surface temperatures of cables or joints, or joints that are swollen beyond normal tolerance are presumed to lead to or be an indication of an impending fault. “

Both the NESC and OSHA recognize the need to secure the area around a manhole opened for access. In general, an additional person is required as noted in the NESC para. 443 K - *Attendant on Surface*, which states:

“While electric supply personnel are in a manhole, an employee shall be available on the surface in the immediate vicinity to render assistance from the surface. This shall not preclude the employee on the surface from entering the manhole to provide short-term assistance.”

OSHA addresses this topic in para. 1910.269(t)(3) - *Attendants for manholes*:

Interpretation by the Laboratory Electrical Safety Committee – June 2005

“1910.269(t)(3)(i) While work is being performed in a manhole containing energized electric equipment, an employee with first aid and CPR training meeting paragraph (b)(1) of this section shall be available on the surface in the immediate vicinity to render emergency assistance.

1910.269(t)(3)(ii) Occasionally, the employee on the surface may briefly enter a manhole to provide assistance, other than emergency.

OSHA additionally requires that the surface attendant may not enter the manhole if a hazard exists because of traffic patterns in the area of the opening used for entry, or if there is reason to believe that a hazard may exist in the enclosed space.

Finally, all BNL line crew workers have their own personal radio which uses a common communications channel. This arrangement follows the requirement in OSHA para. 1910.269(t)(3)(iv), which states:

Reliable communications, through two-way radios or other equivalent means, shall be maintained among all employees involved in the job.

Personal Protective Equipment as Protection from Hazards in Electrical Manholes

On May 13, 2005, Plant Engineering completed a job risk assessment (JRA) for work by the line crew in performing maintenance work in manholes. The assumptions included these workers dressed as would line workers in neighboring utilities (Keyspan, Con Ed) while doing similar work, as confirmed during discussions with a representative of the DOE Office of Science (SC) Energized Electrical Work Review team visiting BNL during the week of April 18, 2005.

The NESC, in Article 420 I - *Clothing*, provides only that:

"Employees shall wear clothing suitable for the assigned tasks and the work environment. When working in the vicinity of energized lines or equipment, employees should avoid wearing exposed metal articles."

The Laboratory Electrical Safety Committee believes that work in electrical manholes by the Line Crew does not require clothing to protect against the effects of arc flash, and that work planning should result in determining the appropriate personal protective equipment for each task. The LESC notes that Division procedures, possibly based on a Job Hazard Analysis, may require certain personal protective equipment.

Conclusion

Interpretation by the Laboratory Electrical Safety Committee – June 2005

The LESC recognizes that work requirements applying to electrical work throughout the balance of the Laboratory are performed under different rules (1910.331-360). When work is performed by the Line Crew on equipment exclusively under their control, they follow power transmission and distribution rules. These modified requirements do not grant license to work in an uncontrolled manner. Rather, they acknowledge that work practices under the OSHA 1910.269 and the National Electrical Safety Code are more appropriate for the utility-like work of the Line Crew. Job planning, job risk assessments, and tailgate or toolbox meetings are still required before work on components of BNL's utility systems.

The LESC, as the Laboratory Authority Having Jurisdiction in electrical matters, and having thoroughly considered all issues related to this matter, concludes that the BNL Line Crew can safely perform housekeeping work (inspection, and clearing drains) in manholes which contain energized cables, and clothing to protect against the effect of arc flash is not required while performing this work (although work planning and Division procedures may require certain personal protective equipment).

The LESC believes that this document provides the *necessary and sufficient* review regarding this issue. This record of decision is *necessary* to support the unique work practices to be used solely by the Line Crew. It is *sufficient* to provide this required documentation without necessitating changes to BNL electrical safety standards. Including these work practices in BNL open documents could lead to misinterpretation by the unique workforce, with the likely result of unqualified persons performing unsafe practices on experimental equipment.