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Date: October 02, 2008

To: H. Weerts Director, HEP

Subject: *Track Imaging Cherenkov, TrICE Experiment Safety Review Report*

Participants: K. Byrum (HEP), G. Drake (HEP), M. Furlan (EQO), J. Grant (EQO), R. Talaga (HEP), R. Wagner (HEP), K. Wood (HEP)

September 26, 2008, members from the HEP Division Safety Review Committee and ANL Subject Matter Experts conducted an experiment safety review of the TrICE facility.

The site location of the experiment behind Building 366 southeast of Building 325 includes a movable trailer leased from an outside vendor with both electrical and electronic equipment connecting, and supporting the TrICE telescope.

Pending the official report from EQO, and with the exception of some minor National Electrical Code concerns which are fairly standard in commercial industry but not directly applicable for the TrICE R&D facility; there were no life safety findings that would impede the approval for the operations described in the ANLHEP_644, TrICE_092208 scope of work document. The HEP Division grants authorization and approval to operate the TrICE experiment provided that the minor issues, NEC code violations are addressed by 12/31/08.

For reference, see the following comments from M. Furlan and J. Grant; ANL Subject Experts.

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TRICE Comments

1. Rigid Nonmetallic Conduit (RNC)

a. Securing and Supporting requirements. NEC 352.30 (A) requires the conduit to be secured within 3 feet of each outlet box, junction box, device box, conduit body, or other conduit termination. The larger pipe's clean out needs support following this requirement.

b. Support of Rigid Nonmetallic Conduit. NEC table 352.30(B) requires ½-1 inch RNC to have a maximum spacing of 3 feet between supports, 1 ¼- 2 inch RNC have a maximum spacing of 5 feet between supports, 2 ½ - 3 inch RNC have a maximum spacing of 6 feet between supports and 3 ½ - 5 inch RNC have a maximum spacing of 7 feet between supports.

c. The plumbing pipe is not being used according to its listing. NEC 110.3(B) Installation and Use, requires that a product be installed per its listing requirements. I will as the day to day AHJ allow this installation due to the nature of the wiring.

d. Bushings. NEC 352.46 requires a bushing on a conduit to have a bushing installed to protect the wire from abrasion unless the box, fitting or enclosure provides equivalent protection.

e. Securing and Supporting. NEC 300.11(B) Raceways Used as Means of Support. The raceways can not support other raceways unless they are identified for that purpose. I recommend that a unistrut is staked to the ground and the pipes be secured to that unistrut. The pipes on top of one another need to be ran along side each other.

I suggest that the pipes be run along side of one another with a piece of unistrut underneath staked to the ground. Then the conduits need to be secured to the unistrut at the appropriate intervals.

Experimental Safety Review for TrICE

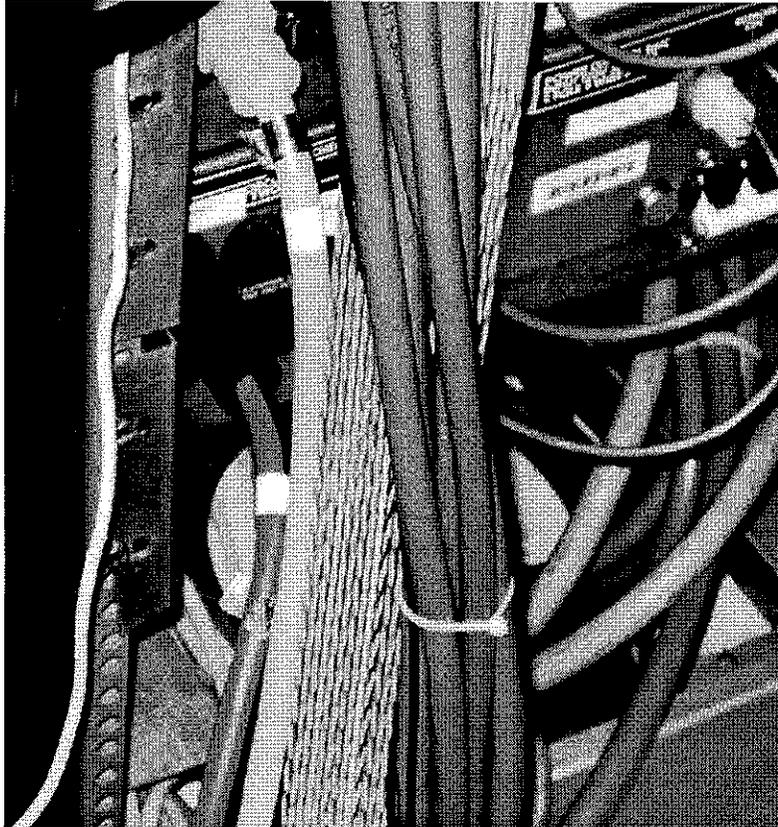
1. Extension cords
 - a. Extension cords are covered in the ES&H manual in section 9.3.4:
 - i. **90 Days.** Temporary electrical power and lighting installations will be permitted for a period not to exceed 90 days for holiday decorative lighting and similar purposes.
 - ii. **Emergencies and Tests.** Temporary electrical power and lighting installations will be permitted during emergencies and for tests, experiments, and developmental work.
 - iii. **Extension cords** must not be:
 1. Attached to building surfaces;
 2. Run through building walls, ceilings, doorways, or windows;
 3. Concealed behind building walls, ceilings, or floors;
 4. Used as a substitute for fixed wiring of a structure;
 - b. Applicable sections of the National Electric Code, NFPA 70 2008 edition in Article 400, **Flexible Cords and Cables** are:
 - i. 400.7 **Uses Permitted (A)(6)** Connection of utilization equipment to facilitate frequent interchange
 - ii. 400.8 **Uses Not Permitted (1)** As a substitute for the fixed wiring of a structure.
 - iii. 400.14 **Protection from Damage** Flexible cords and cables shall be protected by bushings or fittings where passing through holes in covers, outlet boxes or similar enclosures. In industrial establishments where the conditions of maintenance and supervision ensure that only qualified persons service the installation, flexible cords and cables shall be permitted to be installed in aboveground raceways that are no longer than 15 m (50 ft) to protect the flexible cord or cable from physical damage.
 - c. A case could be made for allowing extension cords as used in the TrICE trailer, as this is developmental work that requires frequent interchange. If allowed, the following changes are recommended:
 - i. Bushings or fittings to protect the cords at the point they enter and leave the raceway to the telescope.
 - ii. Method of locking out the trailer end of the cords.
 - d. The power supplies currently in use would have to be altered to connect them to permanent wiring, and the alterations could introduce a greater hazard than what is being mitigated by eliminating the extension cords.
2. Liquidtight Flexible Metal Conduit, and attachment plug used to run power at the telescope.
 - a. Applicable section of the National Electrical Code, NFPA 70 2008 edition in Article 350, **Liquidtight Flexible Metal Conduit: Type LFMC (A) Securely Fastened.** LFMC shall be securely fastened in place by an approved means within 300 mm (12 in.) of each box,

cabinet, conduit body, or other conduit termination and shall be supported and secured at intervals not to exceed 1.4 m (4 1/2 ft). *Exception No. 2:* Where flexibility is necessary after installation, lengths shall not exceed the following: (1) 900 mm (3 ft) for metric designators 16 through 35 (trade sizes ½ through 1 ¼).

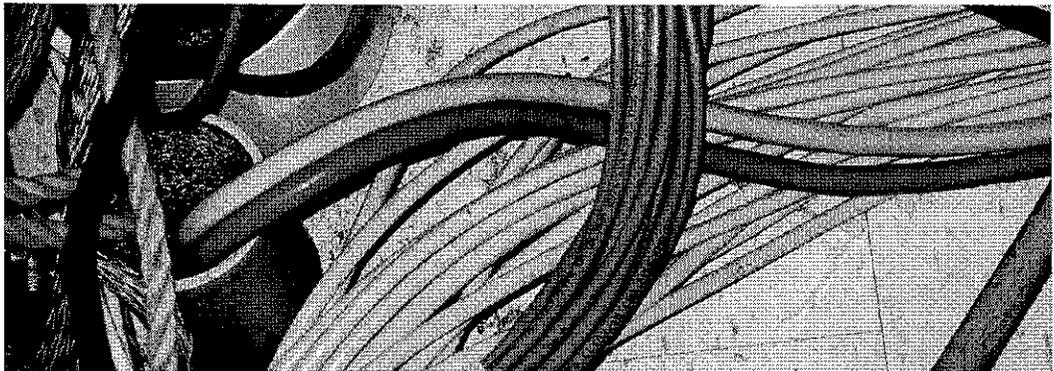
- b. The attachment plug used is not listed for use with LFMC.
 - c. Again, a case could be made for allowing this wiring method as necessary to prevent rodent damage to energized conductors. If allowed the following is recommended.
 - i. The LFMC should be secured according to the section of the NEC copied above.
 - ii. Since the attachment plug was not intended to be used with LFMC it must be evaluated to ensure that makes a secure connection to the LFMC to prevent it from being accidentally pulled loose and exposing energized conductors.
3. Relocatable Power Tap zip-tied to the telescope framework in the tent.
- a. RPTs are also covered in section 9.3.4 of the ES&H manual:
 - i. Do not attach RPT's to any structure or rack where tools are needed for removal.
 - ii. Do not use outdoors or in wet locations
 - b. The RPT in the tent seems to be damaged.
 - c. If allowed to be used in an outdoor location, obtain a new, undamaged RPT and attach it in an approved fashion.

Pictures:

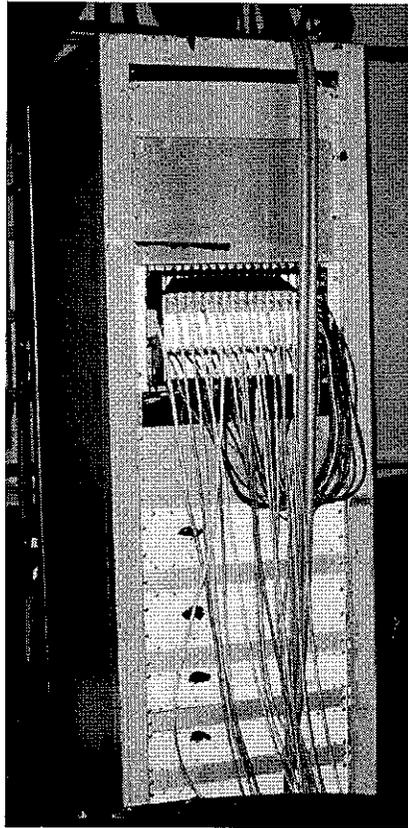
Extension Cords



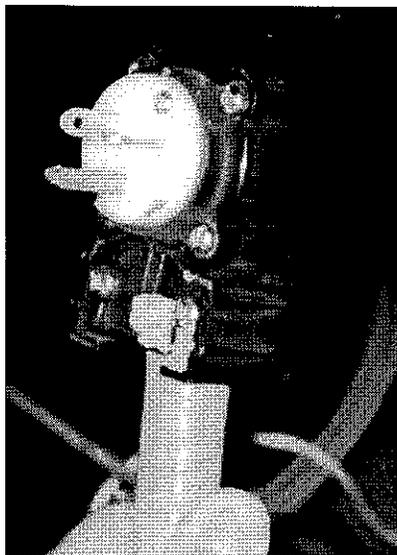
Extension Cords enter Raceway to Tent



Liquidtight Flexible Metal Conduit



Attachment Plug on LFMC



RPT

