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January 30, 2006

Ms. Safety Director  
Sample Medical Corp.  
PO Box X  
Somewhere, CT

Re: NFPA 70E Hazard Assessment

Date of Visit

January 24, 2006

Scope & Purpose

Conduct an assessment for compliance with NFPA 70E – 2004 at Medical Company. Give a Management presentation on the requirements of NFPA 70E and OSHA 1910 subpart S. Report the findings and make recommendations.

Personnel Involved

Someone, Maintenance Manager  
Someone 2, Safety & Environmental Engineer  
Someone 3, Engineering Manager  
Someone 4, Electrical Project Technician  
Someone 5, Maintenance Technician  
Bill Shinn, e-Hazard Management LLC

Description of System

The location has eight substations with transformer ranging for 750 KVA to 3500 KVA. See Medical Corp. Drawings S-1, S-2 and E-3 for all substations except SWBD 6. The incoming voltage is 13.2 kV and the secondary voltage is 480/277 except SWBD 5 which is ungrounded. All high voltage work is contracted to a qualified contractor.

## **Analysis**

My analysis DID NOT include any exposure to hazards other than electric arc and shock. The results of my calculations using IEEE 1584-2002 Standard are attached in appendix A. I did not assess flash fire potentials, falls or any other hazards in this assessment. This is not a full hazard assessment of all tasks but this covers the most common tasks by operators and maintenance personnel. Other tasks are addressed in the 70E table and with training an average maintenance person can easily understand the PPE requirements. It is important that the notes in 70E Table 130.7(C)(9)(a) are not exceeded. I am recommending that you wear HRC level 4 protection for both level 3 and 4 exposures. See NFPA 70E Table 130.7(C)(10) for the detailed clothing requirements.

For **Switchboards SWBD 1, 2, 3, 4, 6, MCC SAP 40006499 and E-Beam Equipment** HRC 4 PPE is required for doing all tasks even with the doors closed as most of your equipment had air venting slots.

**SWBD 5** calculated  $64 \text{ cal/cm}^2$  of heat energy. This will cause permanent injury and is possibly lethal. I do not recommend doing any activities at this location with the power on. I recommend you have your engineering firm research a solution that would get the  $\text{cal/cm}^2$  below 40.

**SWBDs 7 and 8** calculated  $47 \text{ cal/cm}^2$  which is above HRC 4. I recommend you have your engineering firm propose a solution that would reduce the incident heat to below  $40 \text{ cal/cm}^2$ . SWBD 8 is currently de-energized.

Because of the high incident heat levels at all of the substation switchboards I strongly recommend you keep people out of these areas unless they have to do a task in the room. In other words don't use these rooms as a mini office, break area or home base for people.

### **HRC Level 2 Areas**

The 3000 ampere 3ML Busway and Panel Board MSB-7 will require wearing HRC 2 protection when energized parts are exposed.

### **HRC Level 1**

All other activities in the plant that require energized parts 50 volts or greater to be exposed will require HRC 1 protection. This includes voltage testing, troubleshooting, opening Mold Cabinets to check alarms, changing fuses, resetting circuit breakers and overloads. This would include

electricians, electrical engineers, electronic technicians, mold mechanics and tool room personnel. Note: If working on parts less than 50 volts but higher voltage is present in the enclosure you must protect yourself for the arc flash produced by the higher voltage.

Additional points,

1. Door fasteners **MUST** be fastened to operate switches safely and consider the doors closed. In Medical Corp, I observed most doors were closed properly. The enclosure has been tested to contain arc blast/flash to a low level but all fasteners must be in place.
2. Arc Flash Hazard Boundaries are listed in both feet and millimeters in Appendix A. For all 120/208/240V and 480V tasks down stream of the main Substation Switchboards you may use 4.0 feet as allowed in section 130.3(A). For the Substation Switchboards use the distance listed in Appendix A. All personnel within the Arc Flash Hazard Boundary must wear the required HRC level of PPE.
3. I observed your voltage rated gloves have never been tested. OSHA 1910.137 Table I-6 require gloves be dielectrically tested every 6 months. Contact me if you need help finding a test facility.

**Recommendations:**

1. Start wearing 100% cotton for performing electrical work. Do not allow the poly/cotton shirts you are currently wearing. You can not even wear poly/cotton under FR clothing as it will still melt. See NFPA 70E 130.7(C)(5).
2. You need to implement a “No Conductive Apparel” rule for persons performing electrical work with energy present per OSHA 1910.333(c)(8). This should include wearing safety glasses with plastic frames. Contact lenses should not be worn for electrical work as they will stick to the eye if exposed to an electrical arc flash.
3. When doing electrical work with the potential of an arc flash do not wear the hair or beard nets you currently have as they will melt to the person. Hair and beard nets that are Arc FR rated are available if FDA regulations do not allow removal for electrical tasks.

4. The draft of your Written Electrical Safety Program is very good overall. I suggest you add requirement to use a GFCI with all 120 volt hand tools and extension cords. Also add the requirement for an Energized Work Permit as explained in NFPA 70E article 130. In Scope I suggest applying the document to contractors in addition to employees.

5. Implement the use of Class 0, 1 kV voltage rated gloves with leather protector gloves for activities 50 volts to 600 volts. Use Class 2, 17 kV voltage rated gloves in the E-Beam high voltage compartment. OSHA 1910.335(a)(1)(i) A six month testing program will also need to be implemented. OSHA 1910.137. Wearing Class 0 gloves with the leather protectors will provide 50 to 70 cal/cm<sup>2</sup> arc protection for the hands. When no shock protection is required but arc protection is needed you can still wear the voltage rated gloves or you can wear an all leather work glove (see NFPA 70E 130.7(13)(c) FPN). The all leather work glove will provide protection for HRC Levels 1 and 2. Of course you could also wear a FR rated glove such as the Carbtex glove when shock protection is not needed.
6. Start using 1000 volt rated insulated tools as required by OSHA 1910.335(a)(2)(i).
7. As mentioned above, I strongly recommend you get your engineering firm to recommend ways to reduce the incident energy to below 40 cal/cm<sup>2</sup> at SWBD 5, 7 and 8. E-Hazard Management can help you with this if your local firm can't help on this.
8. Relocate the pipe storage at SWBD 4.
9. Remove the desk and chair at SWBD 6.
10. At the Mold Press panels adding a lexan guard between the I/O panels and the control transformer would significantly reduce the probability of an arc flash.
11. In the Tool Room the mold being worked on needs to be electrically bonded to the power supply to prevent electrical shocks. This can be accomplished by using a welding return clamp on the mold that is bonded to the incoming electrical supply ground conductor to the heater controller.
12. You need to bond all welding tables to the building steel to reduce the possibility of electrical shock as required by ANSI Z49.1.
13. At SWBD 1 there is a major issues with working clearance between the Federal Pacific 13 kV switchgear and the 480 volt Switchboard. Consider removing the spare 13.2 kV switch compartment to obtain the required 42 inch minimum clearance.
14. My PPE Recommendations for 70E at Medical Corp are as follows, see NFPA 70E table 130.7(C)(10) for reference:

A. At all substation Switch Boards HRC level 4 will be required to do any task with the 480 volt parts energized.

B. Operating field disconnect switches and circuit breakers with the cover closed wearing your current work uniform is permissible.

C. All energized work and testing activities at the 3000 ampere Busway 3ML and Panel Board MSB-7 must be performed in HRC level 2.

D. All other tasks exposing energized parts above 50 volts will require HRC level 1. HRC 1 and 2 will require a Class E hard hat and non-metallic frame safety glasses in addition to FR garments. Hearing protection shall be ear canal inserts and can be foam.

E. For your application I would recommend shirts, pants and coveralls made from Indura Ultrasoft material when selecting future FR clothing. For HRC 1 you could wear 5.5 oz Indura Ultrasoft long sleeve shirts that are rated  $5 \text{ cal/cm}^2$ , either untreated denim blue jeans or Indura Ultrasoft pants. Another option would be a coverall

F. For your electricians I recommend the  $5 \text{ cal/cm}^2$  shirt mentioned in E above worn over a 100% cotton short sleeve T-shirt or a 7.5 oz Indura Ultrasoft shirt rated  $8 \text{ cal/cm}^2$  and  $11 \text{ cal/cm}^2$  Ultrasoft pants. For an arc rated face shield look at the  $10 \text{ cal/cm}^2$  face shields sold by Paulson or Salisbury.

G. Use NFPA 70E Table 130.7(C)(9)(a) to determine use of Voltage-rated gloves and tools.

15. I recommend you provide OSHA 1910.332 and NFPA 70E based training to all your employees as soon as the Electrical Written Program is complete. NFPA 70E requires three levels of training for employees:

- a. Affected training for those exposed to potential hazards but not operating equipment. This is usually machine operators clerical and management people. It takes approximately 1 hour per class.
- b. Task Specific Training for those performing specific electrical tasks. This training is specific to tasks performed. Time length will vary.

- c. Qualified training which is for electricians, electronic technicians and multi-skilled maintenance workers who perform electrical tasks. An eight hour module is available for low voltage.

Again e-Hazard Management, LLC can provide customized training meeting NFPA 70E and OSHA requirements.

I enjoyed my visit to Medical Corp and thank you for your hospitality. After you have read this report please contact me at 812-453-9160 for discussion.

Sincerely,

A handwritten signature in black ink, appearing to read "W. K. Shinn". The signature is written in a cursive style with a large, sweeping initial "W".

William K. Shinn