

**TO: A VONHALLE**  
**FROM: C NEUMEYER**  
**SUBJECT: GROUNDING OF MACHINE COMPONENTS DURING ACCESS**

This memo presents recommendations for safe practices related to the grounding of the NSTX machine which should be incorporated into appropriate NSTX operating procedures. In addition, the implementation of an additional ground switch inside the NSTX test cell for the inner and outer vacuum vessel sections is recommended.

#### *Introduction*

The Safety Disconnect Switches (SDSs) located in the Field Coil Power Conversion (FCPC) Building provide a ground for the NSTX magnets and also, via the Coaxial Helicity Injection (CHI) SDS, a ground for the inner and outer vacuum vessel which form the CHI electrodes.

The Safety Lockout Device (SLD) ensures that the SDS line switches are open, and ground switches are closed. This is accomplished by electrical interlocks which monitor the position of the line and ground switches as well as by the venting of the compressed air which actuates same.

Although the SLD and SDS systems, and the way that they are used, have proven reliable in the past, there are some issues which need to be addressed. These relate in part to the unusual nature of the CHI system which requires the electrical isolation of the vessel parts which allows the use of the resistive bakeout of the center stack casing, along with the fact that, during various test activities the normal function of the SLD and SDS has to be replaced by interim isolation and grounding. This includes not only the testing which takes place at FCPC but also that which takes place in the test cell, requiring frequent connection and disconnection of the grounds.

#### *Recommendations*

- 1) Whenever the CHI system is not in use, 4/0 single point grounds shall be placed from the ring buses, which connect to the inner and outer vacuum vessel sections, to ground, until such time that a suitable grounding switch is installed to serve this purpose within the NSTX test cell. These ground connections shall be tagged in the name of a Chief Operating Engineer (COE);

- 2) A suitable grounding switch, which grounds the inner and outer vacuum vessel sections, shall be designed and installed in the NSTX test cell. The switch shall be interlocked with the test cell access control system, and the CHI power supply permissive, and shall be able to withstand the prospective CHI power supply short circuit current;
- 3) An improved facility (e.g. bus links) should be incorporated for the purpose of opening the inner and outer vacuum vessel connections at the ring bus to the cables leading out to the SDS and other components. The frequent lifting of the ground cables during vacuum vessel hipot is not good practice;
- 4) Any and all NSTX magnet coil and bus bar terminals which are not enclosed and are easily accessible, shall be covered with insulating boots;
- 5) Controlled access shall not begin, even if the SLD has been vented, until grounds are in place on the inner and outer vacuum vessel sections either by method 1) or 2) above;
- 6) Free access shall not begin until 4/0 grounds are placed from each terminal of each NSTX coil to ground at the bus bars interface with the flexible connectors connecting to the Power Cable Termination Structure (PCTS), along with the vessel grounds in place either by method 1) or 2) above. These ground connections shall be tagged in the name of the COE;
- 7) Under no circumstances shall the flex connectors which connect the bus bars with the PCTS be removed without the grounds, 6) above, in place.

### *Summary*

Because of CHI the inner and outer vacuum vessel sections, along with all components electrically in common, are floating unless some measure is taken to ground them. The CHI SDS accomplishes this purpose, but it is a remote ground subject to frequent disconnection due to test and needs to be supplemented by a local grounding feature. The same is true of the magnets, but, assuming that there are no exposed terminals present, they present less of a risk of personnel contact than do the aforementioned parts. To prevent the passage of hazardous potential from FCPC to the NSTX Test Cell and vice-versa, grounds should be placed on all of the bus bars during non-operating times (free access), especially to cover situations where testing may be underway which compromises the normal safety functions of the SLD and SDS.

The above recommendations are more or less in line with current practice. However they need to be formally included in the appropriate procedures and training of personnel.

In case any of the above points are considered controversial, we can meet to review them and discuss alternatives.

cc: E Baker      W Blanchard      R Camp      G Pearson      D O'Neill  
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