Rick Hance

Engineering Note

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Project: D0 Upgrade - Central Tracking Solenoid Installation
Doc. No: H941109A

Subject: DZERO Solenoid Energization Project -- Description/Status/Standards

This note is the root document for the project which entails the electrical aspects of the D0 Central Tracking Solenoid installation. It contains the project description, task list/status/assignment, documentation list, documentation control policy and design review policy.

The Rev Date shown above is also the revision number of this document. Contact Rick Hance for the most recent version. Rick Hance can be contacted by phone, pager or EMAIL as follows:

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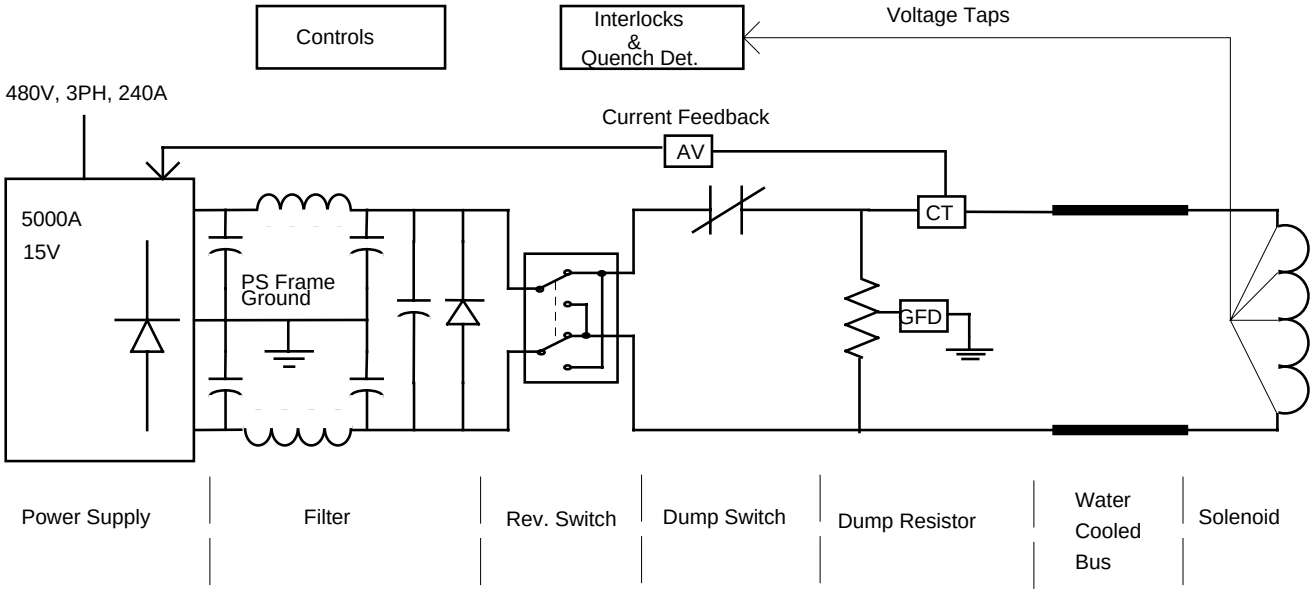
Project Description:

This project includes all aspects of the design, procurement, installation, documentation and commissioning of the following systems pertaining to the superconducting solenoid of the DZERO Central Tracking System upgrade: AC distribution , DC power supply, ripple filter, dump switch and protection resistor, reversing switch, water cooled DC bus work, quench detection, interlocks and interface to controls.

The parent document for this project is FERMILAB-TM-1886, May 13, 1994; "Conceptual Design of a 2 Tesla Superconducting Solenoid for the Fermilab D0 Detector Upgrade"; Chapter 10 DC Energization circuit. The reference conceptually defines the power system for the new DZERO tracking solenoid. The sketch below shows the functional parts of this project. The current status of each functional part is listed beginning on page 2.



Status Narrative:

As of September 13, 1999 the project is completed and operational with the solenoid installed in the calorimeter bore in the Dzero Assembly Pit. A single point failure analysis was completed as was an electrical safety review and a comprehensive system validation procedure. This included validating all circuits, operation to and including 5000A, calibration, reversing, quench simulation etc. The system was first successfully energized and tested in September of 1998. Field mapping of the solenoid has been occurring in the evenings for the last 5 weeks (Aug/Sep 99) and is scheduled to be completed within the next two days.

- All of the major components have been installed and documented. This includes the power supply, power supply filter, reversing switch, dump switch, dump resistor, AC distribution, cooling water pipes, DC interconnection bus-bars and solenoid bus; and the controls rack containing PLC and NIM crates with their associated cooling systems and power supplies.
- Wiring from all of the controls modules and all of the NIM modules to the end rack is completed and documented.
- Wiring from the endrack to the various external components (power supply, reversing switch, dump switch, current transductor, etc.) within the power supply room is completed and documented.
- Temperature interlocks and temperature readout sensors on the power components and system bus are completed and documented.
- The quench detection & protection system designs, absolute value current measuring system, ground fault detector system and dump switch controls have been designed, reviewed, implemented in printed circuits, bench tested, produced, installed, and documented.
- The power supply voltage limiter circuit (for adjusting charge rate) has been designed and implemented and documented.
- Programming of the operator's DMACS control system is finished and documented; including the process control user screens and all of the monitoring routines. Quench data logging has been programmed (Dan Markley) and tested.
- The low conductivity chilled water (LCW) & condensation control scheme has been designed, implemented (programmed and wired), and documented.
- The "Initial validation and test procedure" has been written and the validation and testing has been performed.
- All documentation is 100% up-to-date and available on the internet web site for viewing and printing.

Remaining to do:

- Complete the final bus run into the collision hall when the detector is moved to its final position.
- Install and connect cables from end rack to crash buttons, and steel position sensor. These items are integrated already into controls and interlocks; but still need to be connected as the experiment's infrastructure construction proceeds.

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Task List/status/assignment:

Task	Status	Assignment
AC Distribution (480V, 350Amp)	Complete	Beverly, Hance
Power Supply (5000 Amp)	Complete	Hance, Jaskierny,Bell
Power Supply Regulator (charging voltage limiter)	Complete	Jaskierny, Hance
Filter (Differential & Common Mode)	Complete	Hance
Dump Switch	Complete	Jaskierny,Hance
Reversing Switch	Complete	Hance, Jaskierny
Dump Resistor	Complete	Jaskierny, Hance, Miller
Water Cooled DC Bus Work	Bus to pit finished, bus to hall partial. All pressure tested	Beverly, Hance
Controls	PLC program complete (TISOFT). User interface program complete (DMACS).	Hance
Quench Data Logging System	PLC routines complete	Markley
Interlocks	Complete & installed except for crash buttons and steel permit.	Jaskierny & Hance
Quench Detection	Complete	Jaskierny & Hance
ABS - Absolute Value Circuit	Complete	Jaskierny, Hance
CT - Current Transductor	Complete	Jaskierny
GFD - Ground Fault Detector	Complete	Jaskierny, Hance
Low Conductivity Water System	All plumbing complete & tested. Control system programmed and wired. Flow tests completed. LCW conductivity interlock installed.	Simon (plumb), Hance (control)

Documentation Policy:

Document Numbers - All documentation associated with this project must bear DZERO documentation control numbers. All documents must ultimately be kept in hard copy format at DZERO regardless of the methods used to create and maintain them. Rick Hance will issue numbers and be responsible for proper filing.

Engineering Notes - The root document for each device must be a DZERO Engineering Note which will contain the description of the device, a bill of materials, a list of all engineering changes and an index to all related documentation. Related documentation includes schematics and other documents which can not be conveniently incorporated directly into the Engineering Note.

In order to proceed with maximum efficiency, each individual designer must prepare the Engineering Note for each task or device for group review before commencing with the design. The Engineering note will describe the task and its interface particulars in enough detail such that the specification for each design can be reviewed and approved before actual design work begins. As the project proceeds, the designer is expected to "flesh out" the Engineering Note with the details of the design and installation such that the documentation and the hardware are finished at the same time.

Schematic Diagrams - D size sheets are preferred. This size sheet provides ample area for circuitry and will allow for reduction to B size for notebook placement and easy reproduction. If multisheet drawings are required, they must be hierarchical instead of flat with the top sheet being a functional block diagram which clearly depicts the routing of all nets between sheets. Separate sheets of multisheet drawings must be the same size. Drawings should be drawn per ANSI Y14 standards regarding title blocks, letter sizes and drafting practices. Title blocks may be ANSI standard or traditional Fermilab.

Documentation List:

The main design documents are listed below. These and most **detail** design and review documents are available on the WWW. See "http://www-d0.fnal.gov/~hance/solenoid.htm". A complete list of all related documents is maintained by R. Hance and available from him.

Document Number	Type	Description	Location
FERMILAB-TM-1886 May 13, 1994	Fermilab Technical Memo	Conceptual Design of a 2 Tesla Superconducting Solenoid for the Fermilab D0 Detector Upgrade	Fermilab Publications Office
3823.111-EN-418	D0 Engineering Note (Rev 1/19/99)	Specification for solenoid energization, controls, interlocks and quench protection	Hance Computer File H950116A with up-to-date copy in D0 note file and on www.
3823.111-EB-330052	D0 Schematic (Rev 10/1/98)	System shematic - hierarchical design- includes all components - 17 pages. Complete	Hance computer file with current copy in D0 flat files and on www
solctrls.mdb	Microsoft Access Database	Relational database of all controls wiring connected to the controls endrack	Hance computer file -- also published on web site.
D0_RICKH\C:\Ti\Ti555*.*	TISOFT Files	PLC control program. Ladder, I/O, variables, constants, coils, etc.	Hance computer file – copy on SCADA node and binaries uploaded to PLC
D0_CCRS2 Database TIA3	DMACS Database	SCADA node database for DMACS interface to PLC	D0_CCRS2 computer file. Managed by R. Hance
Dmacs-nt-server\S:\Wdmacs\Pic\D0\Dcontrol.odf & DC_*.odf	DMACS “odf” files	Process control screens (pictures) providing control and monitoring of solenoid energization. 24 Sceens.	Maintained by R. Hance on Dmacs-nt-server and routinely updated to development and view nodes.

Design Review Policy:

Designs at all levels will be reviewed by the appropriate people. A top level functional (conceptual) design review will be held whereby the overall design approach will be presented to the solenoid project managers. After the basic concept has been approved, the design of the individual components will be assigned to various people. These people will then develop a functional (conceptual) design for their component. The functional design will include a list of specifications to be met and a block diagram or single line drawing showing the approach to be taken . The functional designs will then be reviewed by peers ie. engineers with the participation of safety experts. Once these functional designs have been reviewed, the individual designers will proceed with the actual engineering, drafting and documentation of the final designs. The final designs will then be reviewed by peers before construction. Although this seems like an excess number of reviews, the reviews will only be as formal as is dictated by the complexity or uniqueness of the design. The review process is intended to ensure that proper specifications are developed, proper engineering is practiced, safety is observed, the final designs are validated; and proper documentation is produced.