


NCSX Modular Coils

Plans and Progress

Winding R&D



James H. Chrzanowski
November 27, 2002

Agenda

- Discuss the plans/goals of the winding development program
- Discuss the program's progress to date
- Discuss how we're doing business
- Discuss how safety is being incorporated in our daily planning and work activities

Plans/Goals

- Through the use of design, testing and prototyping, develop a sound plan for the fabrication of the NCSX Modular coils.
 - Selection of epoxy resin
 - Development of VPI plan
 - Development of manufacturing process plan
 - Design/fabrication of coil manufacturing tooling and equipment
 - Study of tolerance control (Keystone test)
 - Wind and VPI a prototype coil

Documentation

- Generated three Work Planning Forms (WP's)... **WP# 1016, 1018 and 1019**
- Generated a NEPA for the R&D activities **NEPA #1283** (approved)
- Generated a SOW for the Winding Development Activities **# NCSX-SOW-142-01-00** (Out for review)

VPI Plan

- *Vacuum-Pressure-Impregnation*
- Presently developing a VPI plan for impregnating modular coils. Includes:
 - Epoxy selection
 - Design of test specimens- property studies
 - Gather equipment for performing tests
 - Design/develop mold for Modular coils VPI
 - Design an epoxy delivery system

Epoxy Selection

- The project has selected **CTD-101K** as the resin system for impregnating the Modular coils (*Composite Tech. Dev. Co.*)
- Establishing test requirements for determining material properties
- Design of test samples
- Establish a contract with an outside consultant to support test activities

Epoxy Characterization

Epoxy performance
(cure cycle, viscosity, etc.)



Viscosity Measurements



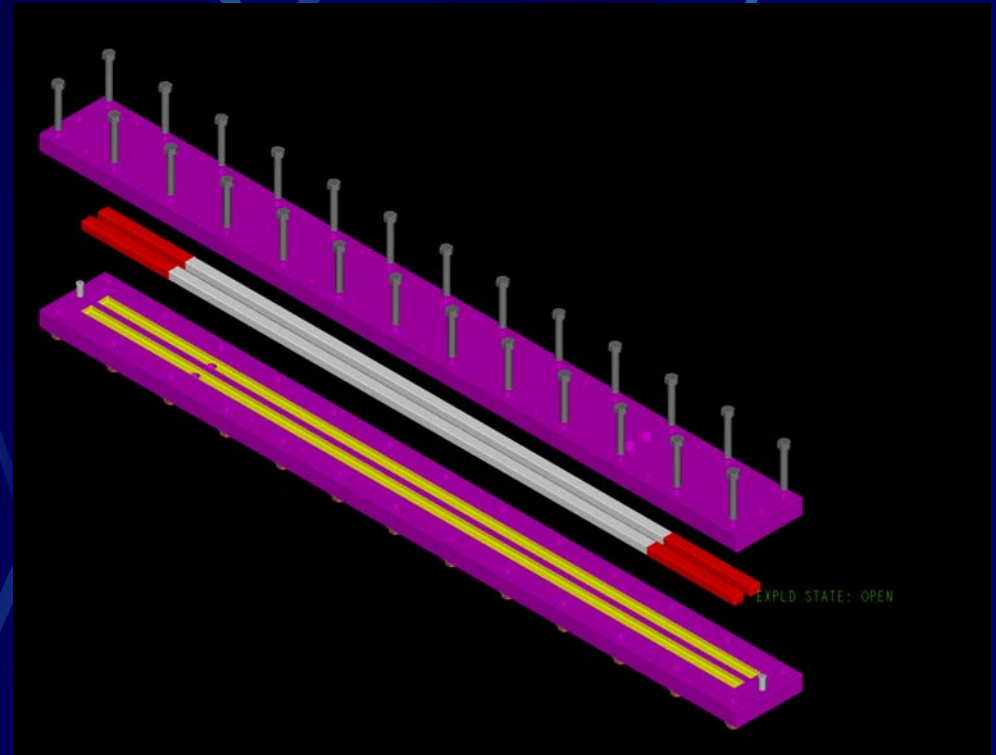
R&D Equipment



- **Vacuum oven** for performing VPI trials
 - Existing oven at PPPL
 - Reconditioned with new controls
- **Viscometers** and small oven available

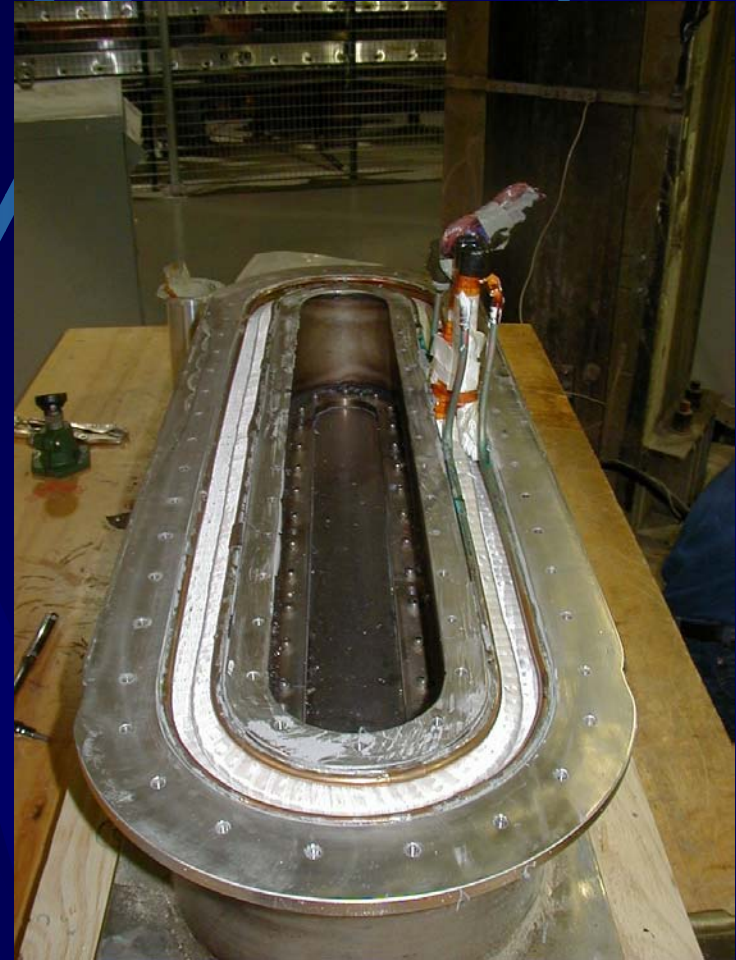
Tensile Specimens

- Designed mold for tensile specimens
- Being fabricated
- VPI (2) insulated copper rope samples week of December 2nd.



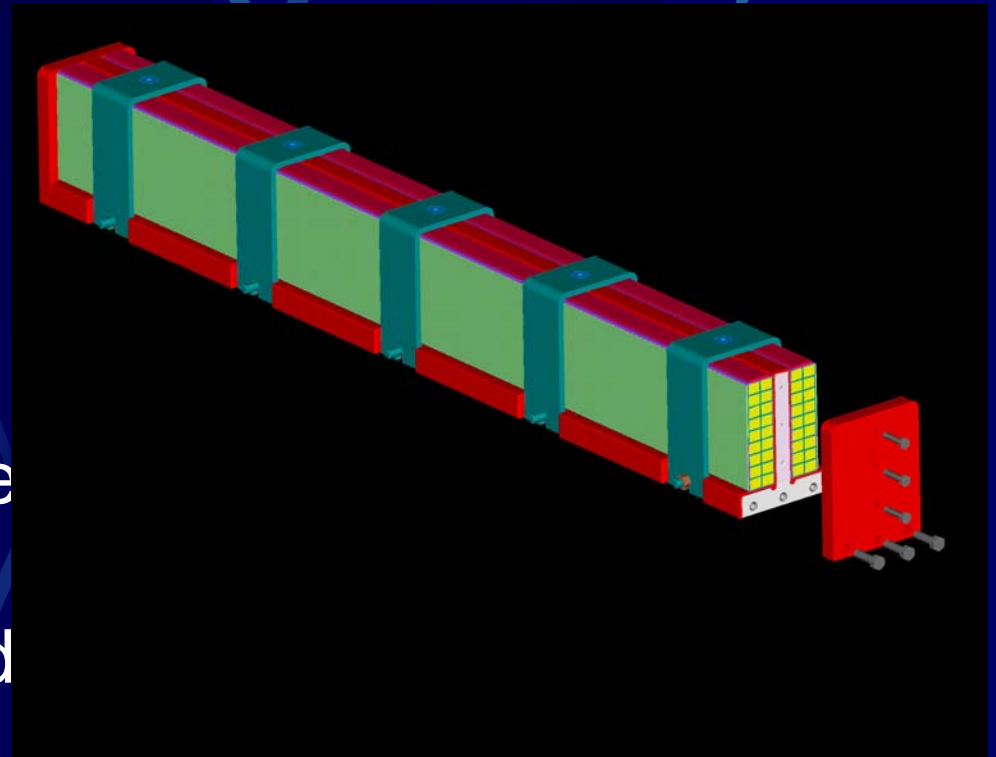
Univ. of Tenn. Coil

- Coil fabricated by UT using similar conductor & insulation as NCSX & QPS
- PPPL will prep and VPI canned coil
- VPI week of December 9th.
- Additional coils may be fabricated & VPI'd at PPPL
- VPI experience will be gained



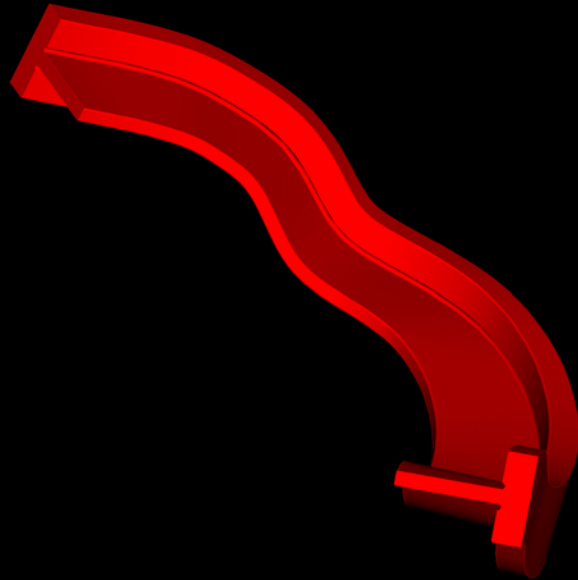
VPI Process Samples

- Straight tee section
- 36 copper insulated turns
- Develop mold installation process
- Gain VPI experience & confidence
- Tee being fabricated
- **VPI in January**



VPI Process Samples-II

More complex shapes
for VPI & mold trials

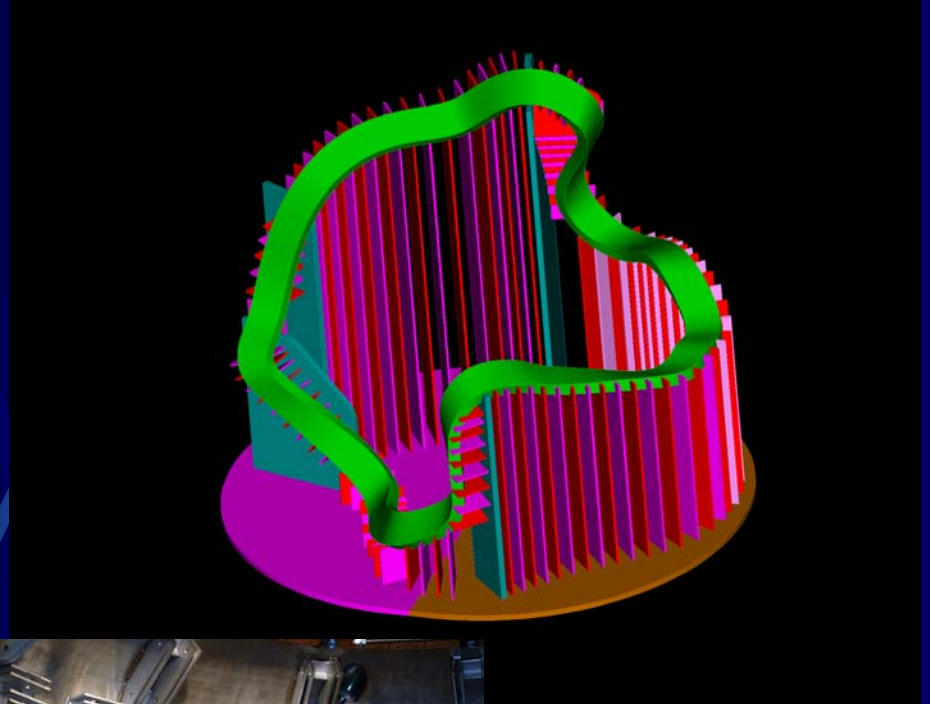


S.S. Cast specimens- RFQ
(del'y February)



Keystone Trials

- Winding form being designed
- Nine insulated turns using (4) conductor will be wound onto form
- “Faro” mechanical measuring arm will be used to measure tolerance build as a result of conductor keystoneing



Coil Fabrication Tooling

- Design tooling for winding modular coils
 - Autoclave (Vacuum oven to VPI modular coils) ..Design has begun (**FDR scheduled for January 31, 2003**)
 - Winding station
 - Automatic taping machine
 - Conductor payout system
 - Winding clamps
 - Coil handling equipment



The Way of Doing Business

- Weekly status meetings with all participants
- Open communication (exchange ideas)
- D-site work permits
- Pre & Post job briefs
- Procedures or travelers will be used
- Numerous peer reviews and brain storming sessions

Safety

- **Safety** is being incorporated in all aspects of the development program
- **Industrial Hygiene** is a member of the weekly design/status meetings
- Job Hazard Analysis (**JHA's**)
- Personnel protective equipment (**PPE's**) being used
- **Involvement** of all safety groups

Safety First



Warning signs

Chemical storage cabinets



Personnel protective equipment



Chemical eye wash station

Safety Summary

- Integrated Safety Management (ISM) is being used throughout R&D program
- Early safety involvement
- Use of JHA's
- Proper selection & use of PPE's
- Be aware of potential safety issues such as Confined Space, etc.

Near Term Milestones

● Peer Reviews

- Keystone plans.... Dec. 5, 2002
- Test plans- material properties.. Dec. 10, 2002
- VPI Winding Forms.. Dec. 10, 2002

● Activities

- VPI UT CoilDec. 11-17, 2002

● Design Reviews

- FDR- Autoclave ...Jan. 31, 2003
- PDR- Winding Facility... Jan. 31, 2003