Agenda

- 8:00-9:00 Tour of facility
- 9:00-9:20 Welcome, an overview of NCSX, and Introductions (Phil Heitzenroeder)
- 9:20-11:00 Presentations (questions welcome at any time) (Steve Raftopoulos & Paul Goranson)
  - Cryostat and Cooling of Stellarator
  - LN2 Supply
  - LN2 Distribution/Control to magnets
- 11:00-12:00 Discussions (let's yield the floor to the experts)
- 12:00-1:00 Lunch
- 1:00- approx. 3:00 Summary & Discussion of Possible Ongoing Work

NCSX Cryogenic Systems
Peer Review/Workshop
April 23, 2008

Steve Raftopoulos
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Goals of this review

- **We have been charged to bring the design of the NCSX Cryogenic Systems to a level of greater maturity/lower risk.**

- **Our goal is to be at the Preliminary Design Review (PDR) level by the end of August 2008. That's only ~4 months!!!**

- ***This peer review is the starting point of this effort. Goals:***
  - ***To gain expert opinions concerning the Cryostat, LN2 distribution system, cool-down and methods proposed for both coil cooling and cool-down.***
  - ***To develop the framework for Statements of Work to provide NCSX with technical support for this effort with participants such as you.***

Specific tasks which we need to complete by August

Bringing the systems to Preliminary Design level requires:

- **Systems requirements defined.**
- **Analyses (thermal, mechanical, etc) necessary to support current elements of design and indicate changes are not necessary.**
- **Interfaces defined.**
- **ES&H requirements defined – Show that implementation of this design (through Installation & Operation) conforms with all PPPL, DOE, State and Local ES&H directives.**
- **Models/Drawings – Sufficient to support developmental design and analytical evaluation of the inherent ability of the design to attain the required performance. Drawings shall be sufficient to develop manufacturing & construction/installation approaches and cost estimates.**
- **FMEA/Risk Analyses – Failure Modes and Effects Analysis completed at the component and function level.**
- **Manufacturability – Design's manufacturability has been validated.**
- **Constructability – Demonstrate that design can be constructed/installed.**
- **Operations – Demonstrate confidence that the design will function reliably when placed into service.**
- **Cost/Schedule – Develop cost & schedule estimate with high level of confidence.**

Scope & status of the NCSX cryogenics system elements

- Design of the Cryostat for the NCSX Stellarator
  - Baseline design developed through PDR in '05.
- Design & analysis of the Cooling System (LN_2 and/or GN_2 distribution) that cools contents of the Cryostat (initial cool-down & during operation)
  - Currently pre-conceptual.
- Design of the magnet LN2 distribution system.
  - PDR scheduled for June 3.
- Design of the LN_2 supply system.
  - Currently pre-conceptual.

Salient Issues

- Can we successfully operate with a cryostat that is constructed with a modular, panelized design and has 125+ penetrations?
  - Seals between panels & at ports are of particular concern.
- Recommendations for effectively (and evenly) cooling the contents of the cryostat to minimize thermal stresses?
- Have we adequately addressed the LN_2 distribution system & flow balancing of LN_2 through the multiple coil cooling passages?
- Are there any obvious things that we've missed?
- Are there any safety related items & Code requirements that you would pass onto us?

Areas where we feel we need expert support

- It is our intention to seek formal agreements for technical support. The tentative list below is our current thoughts as we begin this review. We hope to refine it based on our discussions and review our refined thoughts with all of you this afternoon with more specific details:

SOW 1 - Cryostat and GN2 cryostat cooling

- Develop new or validate current concepts.
- Develop concepts for panels and penetrations into viable designs.
- Design cooling system that includes the hardware and the process for cooling the contents of the cryostat per the requirements.
- Establish cost estimates for fabrication.

SOW 2 for the LN2 distribution and control

- Verify current and perform additional flow calculations.
- Develop controls logic.
- Develop flow diagrams & schematics.
- Specify components.

- Go to Talks

What are we asking for? (end of day)

- Today (Move to closing discussion)
  - Give us candid critique of our current design plan(s)
- Immediate Future
  - Are you interested in possibly being involved in follow-on work ? Alternatively, can you point us to resources that may be experts in the areas needed.
    - Please let us know if you have questions on contractual arrangements that might be possible for this phase.
  - Even if you do not participate in the engineering/design follow-on work, would you be willing to participate in future design reviews or technical discussions?
- Not-so-Near Future
  - Fabrication. We will need to openly compete the fabrication contract(s). Please let us know if you'd be interested in receiving a Request for Quotation when it is issued.