NSTX Upgrade Project Overview

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CompX
General Atomics
INEL
Johns Hopkins U
LANL
LLNL
Lodestar
MIT
Nova Photonics
New York U
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Think Tank, Inc.
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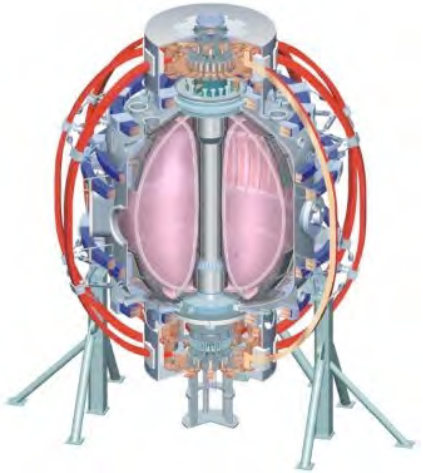
U Wisconsin

Ron Strykowsky

Princeton Plasma Physics Laboratory

NSTX Upgrade Project
Office of Science Review
LSB, B318
December 15-16, 2009



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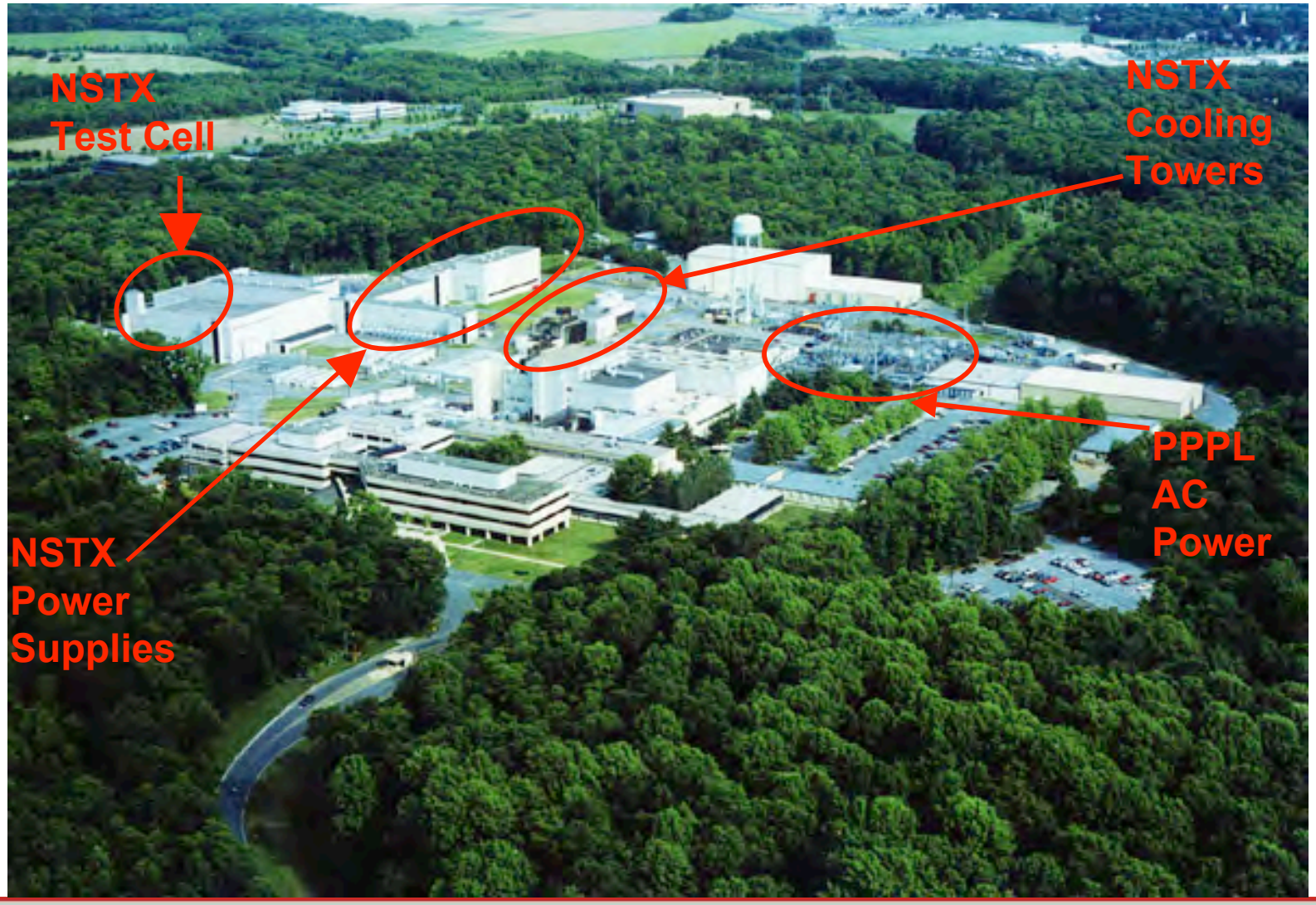
IPP, Jülich
IPP, Garching
ASCR, Czech Rep
U Quebec

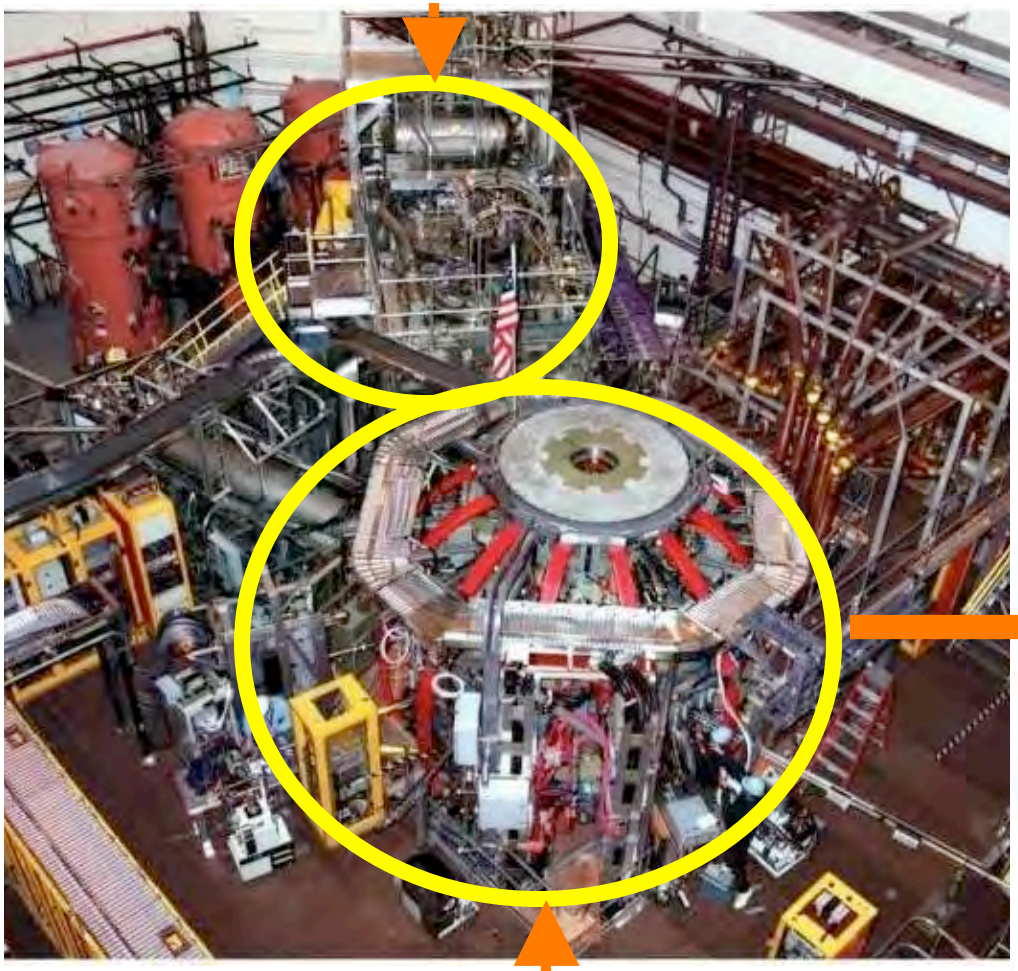
Princeton Plasma Physics Laboratory

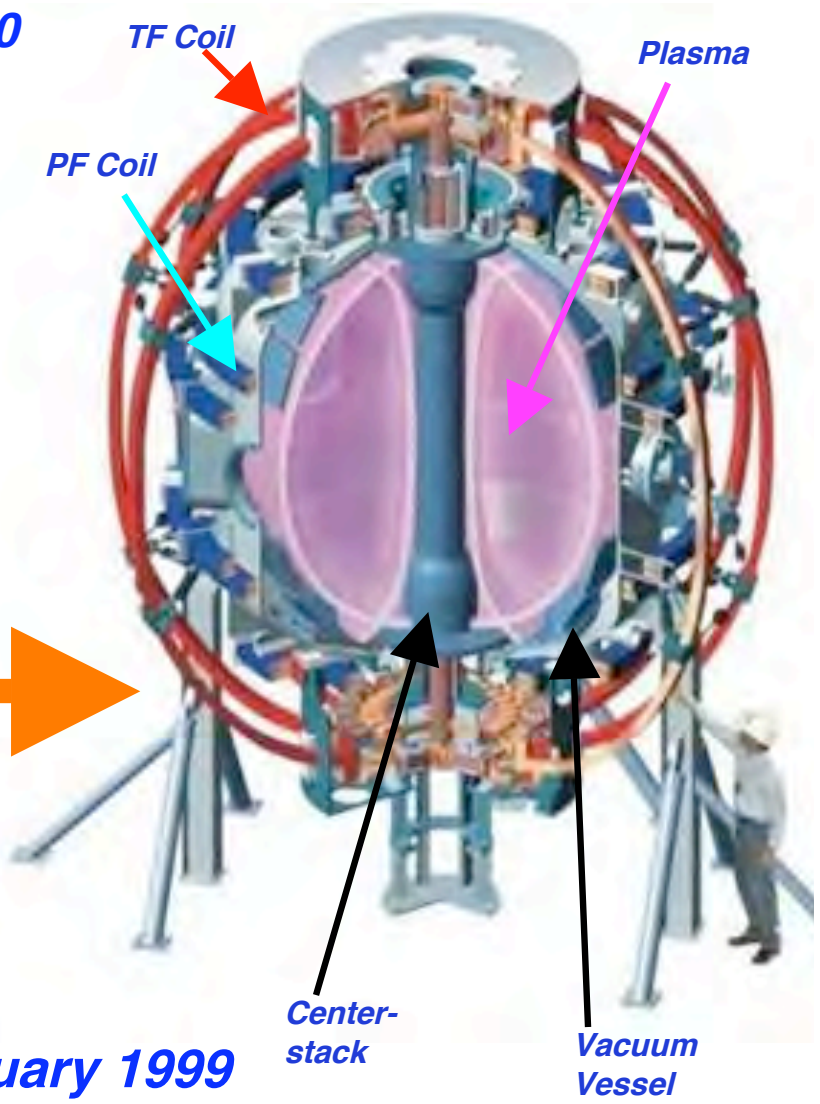
88 acres, total budget = $100M, 480 employees



National Spherical Torus Experiment – NSTX

Neutral Beam #1 operating since Sept 2000





NSTX Device operating since February 1999

NSTX Upgrade Project

Program Physics Goals

1) Better understand causes of ST transport and scaling to next step devices

2) Address ST start-up, sustainment and boundary issues

Project Mission

1) Double field and current

Upgrade centerstack to enable operations at

- Toroidal magnetic field of up to 1 Tesla (presently 0.55 Tesla)
- Plasma current up to 2 Mega-amp (presently 1 Mega-amp)

2) Double neutral beam power & more tangential injection

Install a second neutral beam line

- Beams tangent to radii 130cm, 120cm and 109.4cm
- Configure NB1 and NB2 so they can operate together or separately

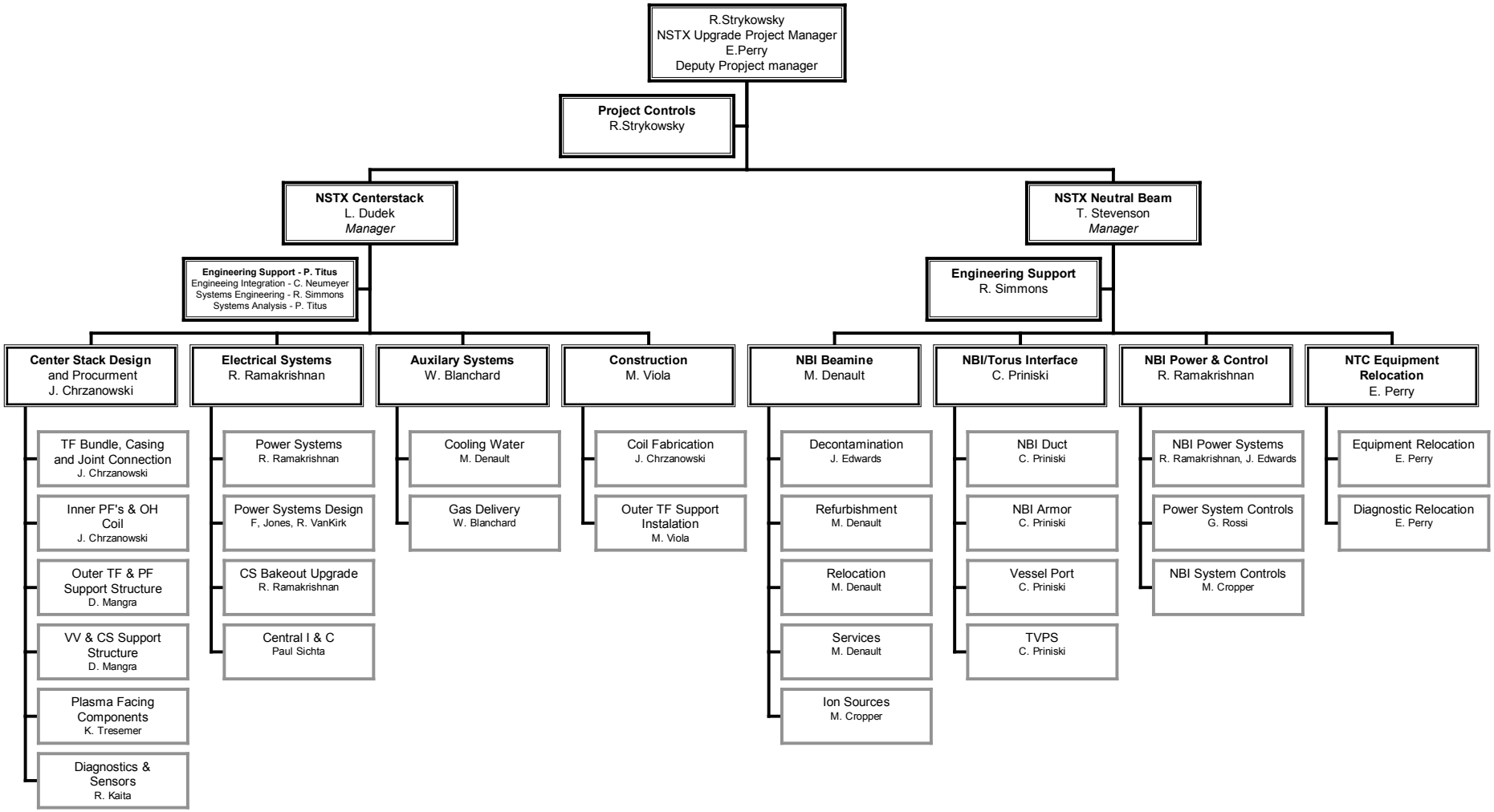
NSTX Upgrade Cost & Schedule

	TPC ($M)	
	Unconstrained	Constrained
Cost Range	$77 - $94M	$81 - $98M
Schedule	48 months FY12/FY13 shutdown	60 months FY13/14 shutdown
	CD-4 May 2014	CD-4 May 2015

- *Most of the required funding is re-directed from the base program*
- *$13-$30M incremental funding required*

NSTX Upgrade Project Organization

NSTX UPGRAGE PROJECT ORGANIZATION



General Requirements Documents

- General Requirements Documents (GRDs) were generated and approved early in the conceptual design process
  - One GRD for the centerstack
  - Another GRD for the second neutral beamline
- Design philosophy for the centerstack
  - Very conservative design (to handle maximum output from power supplies)
  - Re-evaluating approach by transferring risk from structural supports alone TO a DCPS + supports. No loss in physics capabilities.
- Design philosophy for the second neutral beamline (NB2)
  - Provide a beamline with the same characteristics as the first beamline on NSTX
  - Assume that internal copper parts need to be re-made until it is proven that they can be sufficiently decontaminated

Centerstack Upgrade Scope

- Inner TF bundle
- TF Flex bus
- OH coil

Center stack

- Inner PF coils
- Enhance outer TF supports
- Enhance PF supports
- Reinforce umbrella structure
- New umbrella lids
- Power systems re-configuration

Centerstack Upgrade

- Plan is to fabricate inner TF bundle in-house
- Estimates are based on the actual costs of designing, fabricating and installing the current centerstack
- Base estimates are conservative
  - Opportunities for reducing costs
  - Value engineering studies to optimize the design with DCPS while still meeting the physics objectives
- Contingency based on uncertainties and risks defined in each individual job estimate

Second Neutral Beam Scope

- Disassemble and evaluate an existing TFTR beamline
- Decontaminate
- Refurbish for reuse
- Relocate pump duct, 22 racks and numerous diagnostics to make room in the NSTX Test Cell
- Install new port on vacuum vessel to accommodate NB2
- Move NB2 to the NSTX Test Cell
- Services being re-configured (power, water, cryo and controls)

Neutral Beam #2

- Estimates are based on the actual costs of designing, refurbishing and installing NSTX Neutral Beam #1
- Decontamination estimates are based on actual experience with TFTR neutral beams
  - Goal to reduce to acceptable levels
- Estimates are conservative
  - Includes costs for making new parts that might be able to be decontaminated for reuse
  - Opportunities for reducing costs whenever decontamination succeeds
- Contingency based on uncertainties and risks defined in each individual job estimate

Ready for CD-1

- Successful technical peer review in June for Neutral Beam #2
- Successful technical peer review in August for new Center stack
- Successful Independent CDR October 28-29th
- OFES Review December 15th–16th
- Documentation specified by DOE Order 413.3 prepared.

Charge Questions

1) Is the selected approach to upgrade the NSTX device technically sound?.
   - The Technical solutions meet the NSTX Physics requirements
   - Technical challenges are well understood for this stage of the project
   - "Bundling" both upgrades is the most cost effective and efficient approach for meeting the GRD while minimizing impact to the operations plan. Separation into two project would have significant impacts to cost and the NSTX research program schedule.

2) Based on the current stage of project, have all the appropriate project risks been identified?
   - The risks identified at CD-0, such as the design for the TF flex joint, are being addressed and retired.
   - A Risk Registry has been prepared and implemented for tracking all identified risks.
   - A project review recommendation log tracks all open chits & recommendations from formal reviews.

Charge Questions

3) Is the proposed cost and schedule range, including contingency, realistic and reasonable?
   - The work scope is complete, well organized with clear assignment of responsibilities.
   - Estimates based upon a standardized and disciplined process
   - A well detailed resource loaded schedule exists and provides the basis for all cost and schedules
   - A well detailed risk registry has been developed and implemented
   - The contingency methodology incorporates estimate uncertainty as well as risk and provides a credible CD-1 cost range.
   - Both the unconstrained and constrained case's staffing needs are well identified and achievable.
   - The project has been responsive in addressing both programmatic mission goals (base case) as well as anticipated funding guidance (constrained case).
   - The project is poised to initiate and effectively manage the preliminary design phase of the project.
   - Opportunities for cost reduction are being pursued.

4) Given the current stage of the project, is the project's management structure and team appropriate, and are the plans to support the next phase of the project sufficient?
   - As part of performing the conceptual design, we have brought on additional talent that will be needed for the next phase of the project.
   - The project organization brings together individuals with proven project leadership coupled with experienced technical experts in the fields of analysis, design, magnets, power systems, NB systems, I&C, construction.
   - Staffing plans, both near term and long ranges, are understood and currently being met.
   - Dialog and communications with DOE is open and routine (i.e. IPT, weekly mtgs)
   - PU provides a constructive external oversight role (i.e. readiness reviews)

Charge Questions

5) Has the project satisfied the documentation requirements for CD-1 as required by DOE Order 413.3 A?
   - Conceptual Design Review Successful
   - Detailed basis of estimate for a project cost range
   - Conceptual design report
   - Acquisition Strategy
   - Preliminary PEP
   - Federal Project Director appointed
   - Long Lead procurement identified
   - Integrated Safety Management (ISM) in place
   - ES&H Documents in place
   - QA/QC System in place

6) Are Environmental, Safety and Health aspects being properly addressed given the project's current stage of development?
   - Preliminary Hazard Analysis is based on current plans using the hazard analysis summary in the NSTX Safety Assessment Document.
   - Compliance with occupational radiation exposure regulation (10CFR835) and DOE-approved PPPL Radiation Protection Program will be assured with PPPL Health Physics Division support.
   - Nonradiological hazards (e.g., electrical, fire, magnetic fields, RF, lithium, etc.) are expected to be comparable to present NSTX operations.