# NSTX Upgrade Project Overview

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General Atomics
INEL
Johns Hopkins U
LANL
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Lodestar
MIT
Nova Photonics
New York U
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**Ron Strykowsky**

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ENEA, Frascati
CEA, Cadarache
IPP, Jülich
IPP, Garching
ASCR, Czech Rep
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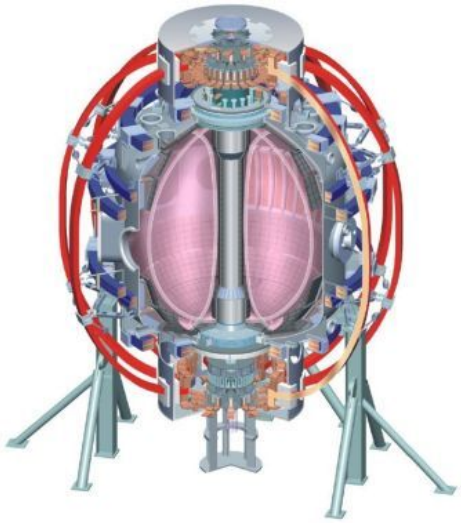
## FY 2012 Field Work Proposal Presentation

Germantown, March 11-12, 2010



# Project Scope

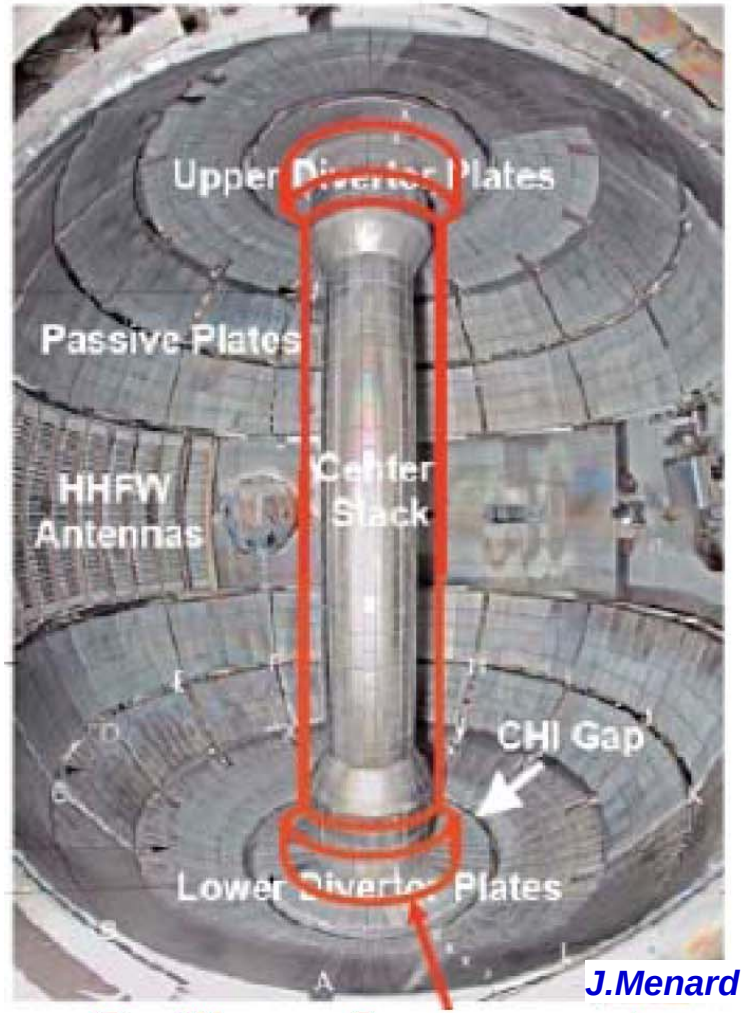
## 1) Upgrade centerstack

- New center core; TF bundle, PF1A & B, casing
- Structural improvements
- Electrical Power Systems
- Centerstack Diagnostics
- Auxiliary systems

## 2) Install a second neutral beam line

- Disassemble, decontaminate & refurbish an existing TFTR beamline
- Relocate pump duct, 22 racks and numerous diagnostics
- 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)

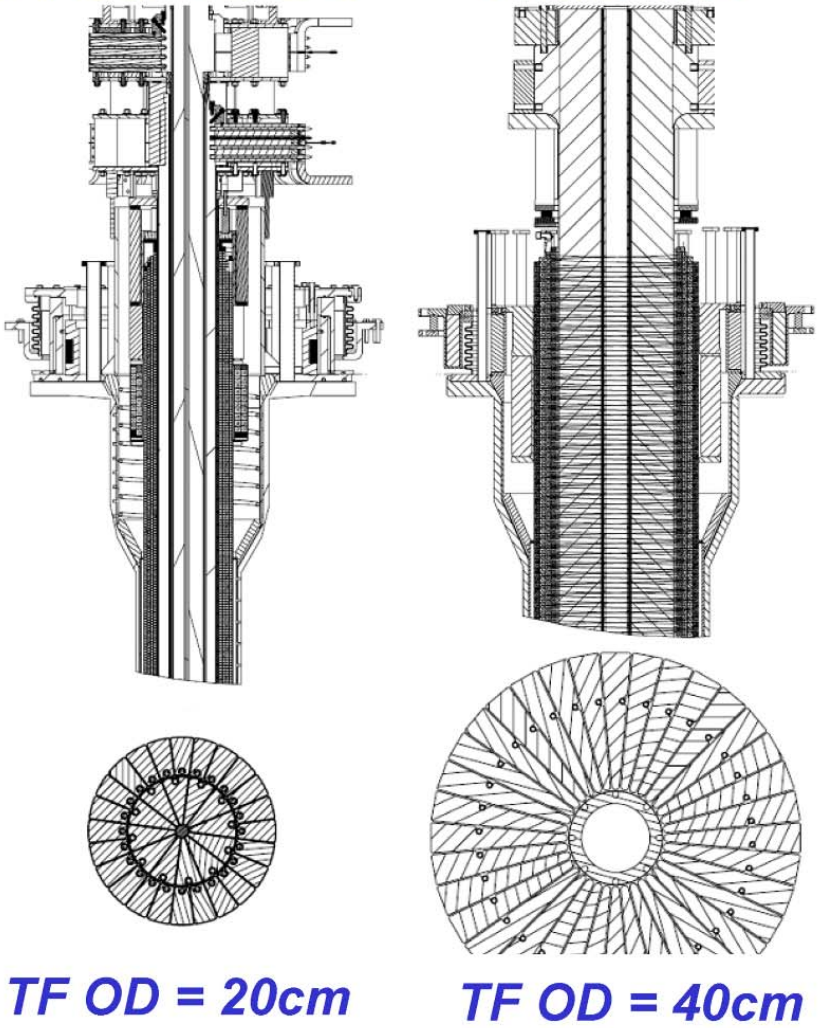
# Centerstack Upgrade Scope *(cont)*
## *CS Present and New*




*J.Menard*

***Outline of new center-stack (CS)***

***Present CS*** ***New CS***



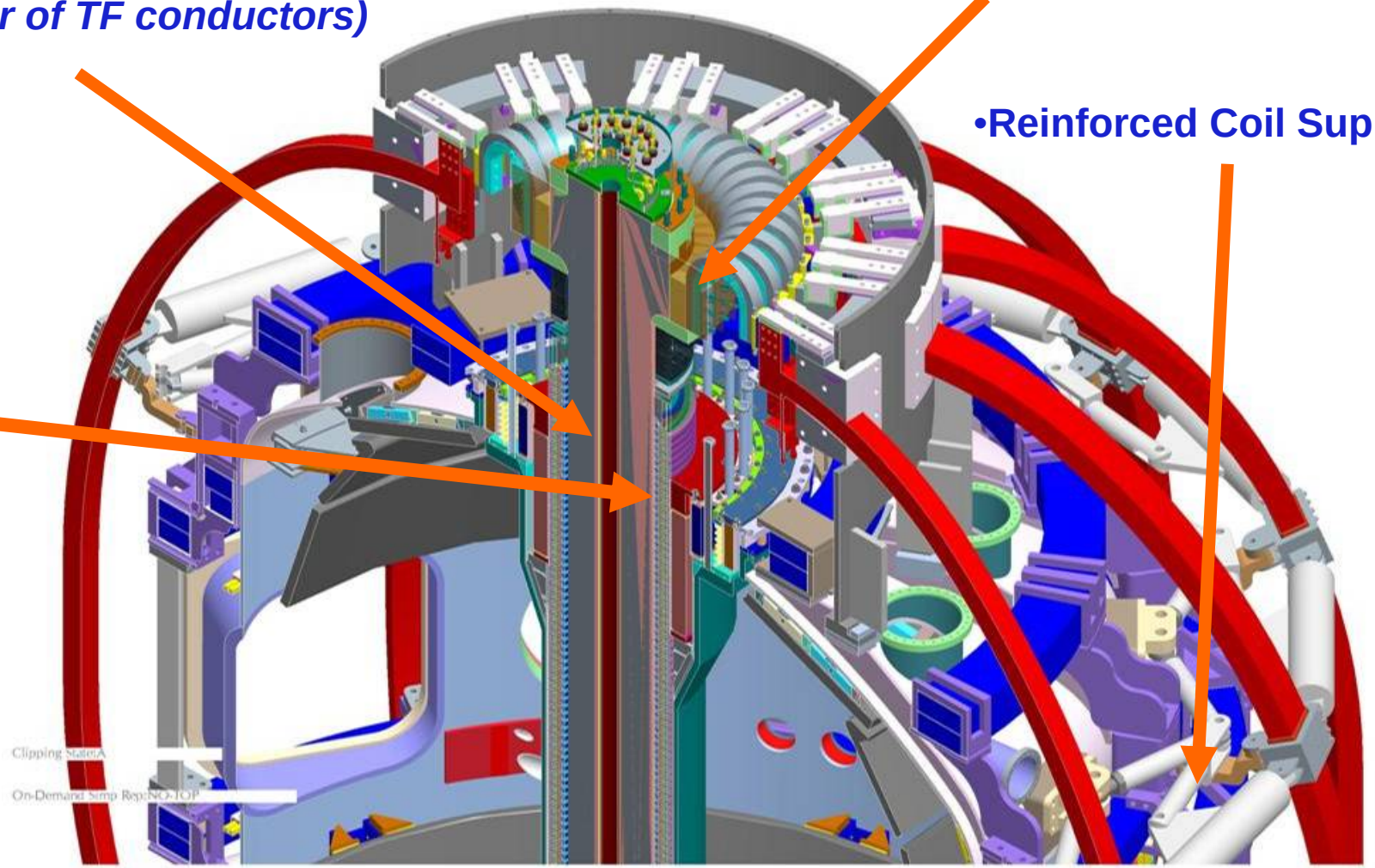
***TF OD = 20cm*** ***TF OD = 40cm***

- ***TF Bundle contains 36 identical conductors with one-layer joint design vs two conductors types***
- ***Bolted joints located at further radius hence lower joint current density and lower magnetic field at joint***

# Centerstack Upgrade Scope *(con't)*

## Outer TF, Vessel, Umbrella Structure, Reinforcements

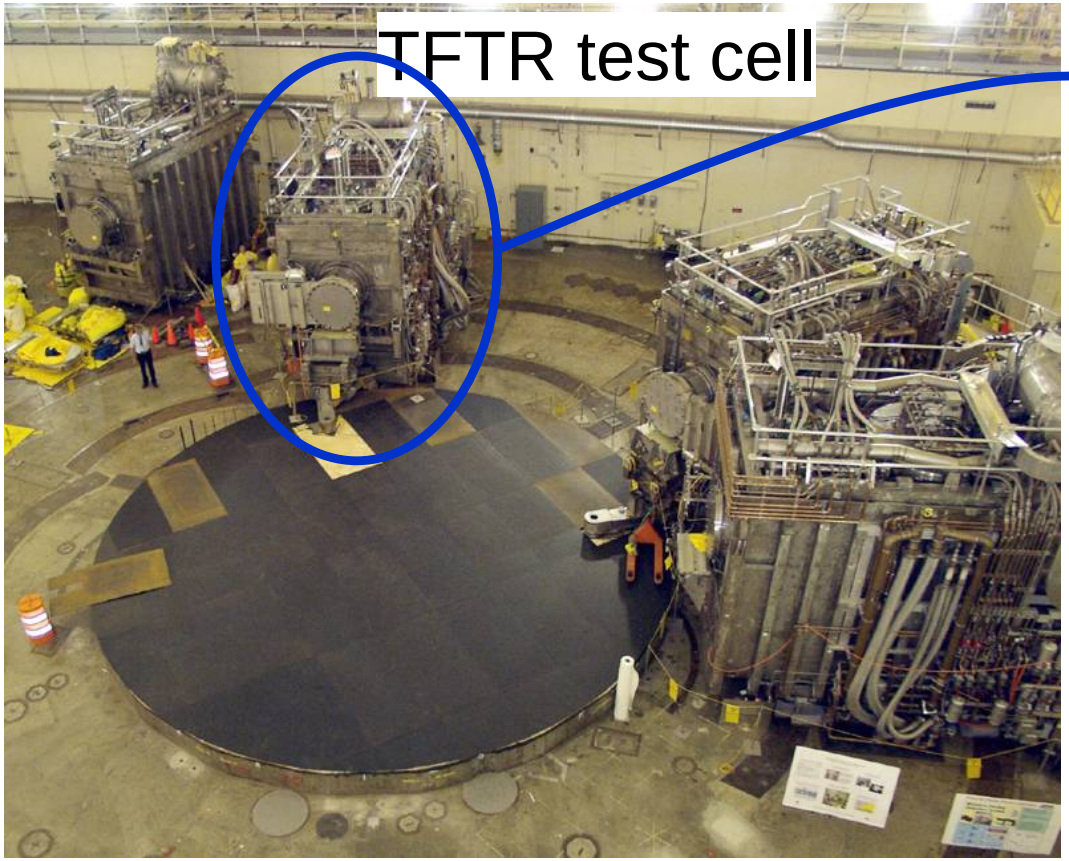
- **Simpler Inner TF design** *(single layer of TF conductors)*
- **Improved Joint Design**
- **Reinforced Coil Supports**
- **OH coil wound on TF**

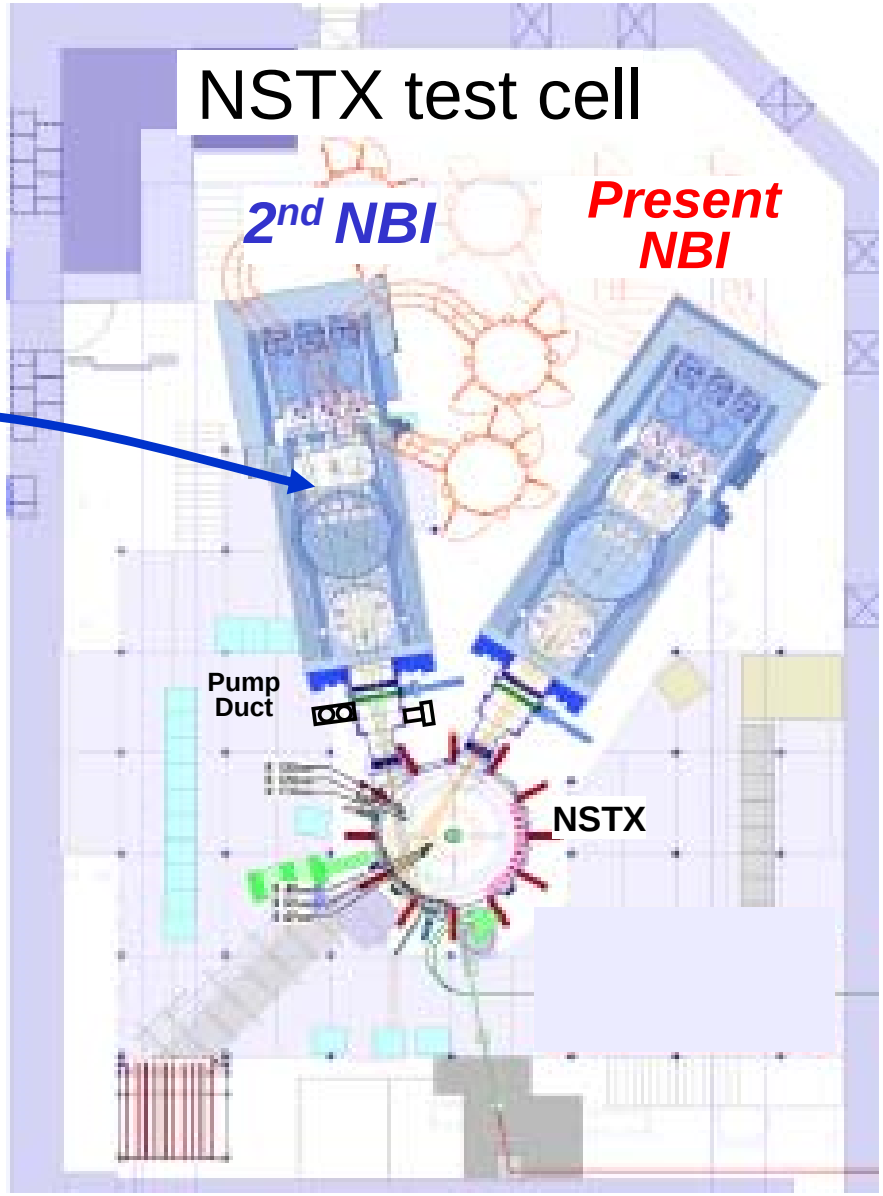


# Second Neutral Beam Scope

## *A TFTR Neutral Beamline will be Moved to the NSTX Test Cell*

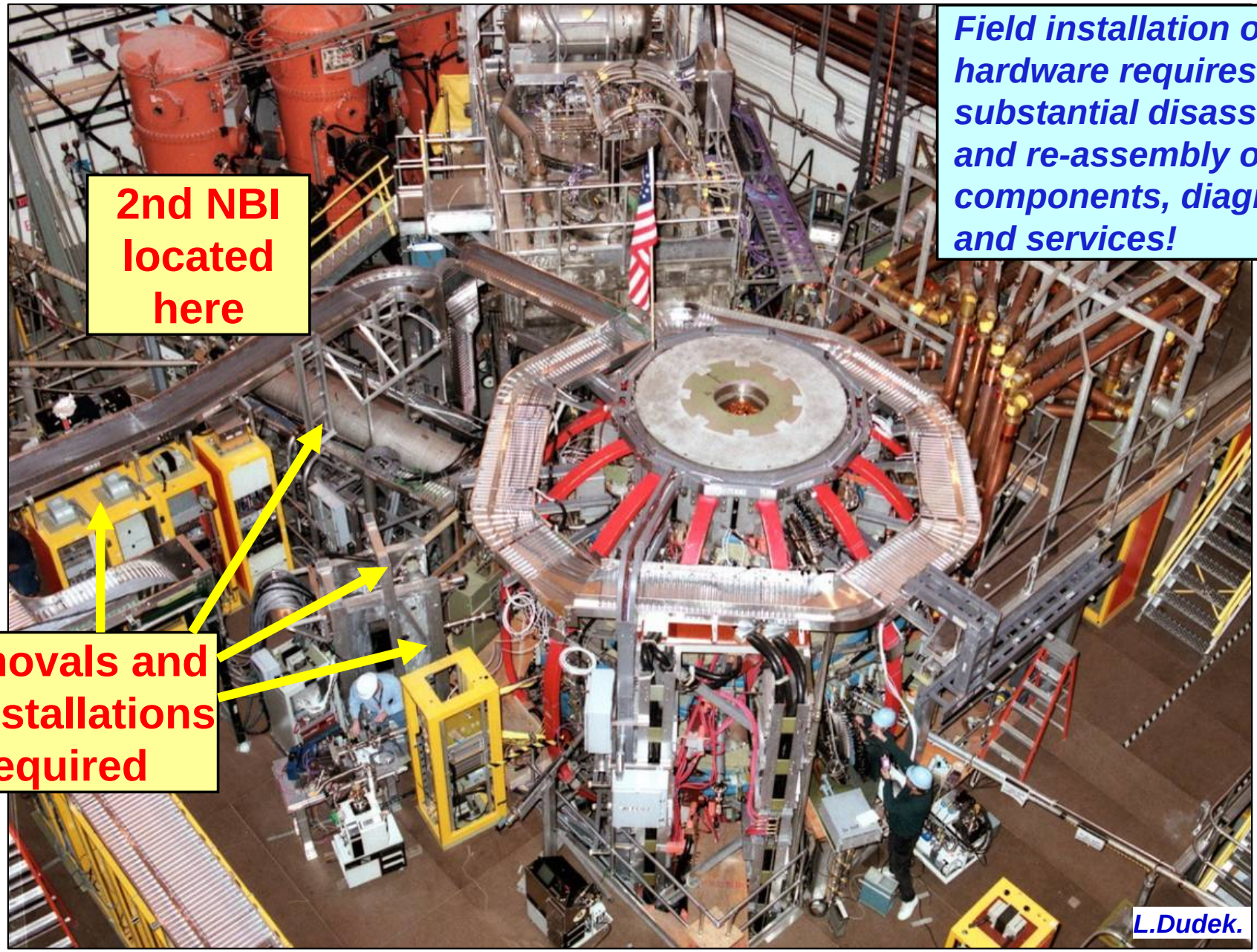
- PPPL has extensive experience operating, maintaining, refurbishing NBI
- NBI is well understood and has provided reliable heating to high β values in NSTX




*T. Stevenson, et al.*

# Value engineering and practical design approaches in collaboration with Physics are key in constraining cost



# Progress to Date

- CD-0 Approved February 2009
- The NSTX Upgrade Project organization formally established under the Associate Director for Engineering and Infrastructure.
- Successful technical conceptual peer reviews.
- Bottoms-up cost and schedule estimate prepared
- Successful Independent CDR October 28-29th
- CD-1 Documentation Prepared in compliance with DOE Order 413.3
- Successful OFES (Lehman) Review December 15th–16th
- Value engineering has resulted in ~$5M cost reductions in the cil support design /installation and NBI decontamination & refurbishment
- Successful technical preliminary design peer review held March 3rd for Neutral Beam #2

# Plans for 2010

- Aiming for CD-1 Approval by March 31st
- Preliminary Design
  - FMEA analysis
  - Complete NBI Decontamination
  - R&D Activities (joint test, OH braze testing)
  - Update GRD for CS
  - CS Preliminary Design Peer review May 2010
  - Updated CD-2 Estimates May 2010
  - Project comprehensive PDR June 2010
- Office of science review July 2010
  - Apply for CD-2 July 2010
  - CD-2 Approval August 2010
  - Begin Final Design after CD-2 approval

# Plans for 2011

- CS and NBI final design and analysis
- CS and NBI Final Peer reviews mid-FY 2011
- Final Design Review 3rd quarter FY 2011
- OFES (Lehman review) 4th quarter FY 2011
- CD-3 Approval Late FY 2011
  - ***(authorization to buy hardware procurements)***
- **Complete Inner TF Fabrication (conductor machining, friction stir weld leads, procure OH conductor)**
- Begin NBI refurbishment

# Plans for 2012

- **Begin TF/OH final assembly**
- CS tile procurement
- NBI major procurements (duct, vessel cap, bellows, tiles)
- NBI Services
- Beamline relocation preparations (fixtures, procedures)
- Removal procedures and re-installation design
- Complete FY12 operations campaign and begin outage
- Start Diagnostics removals

# NSTX Upgrade Project Plan

- **The project is currently working toward developing a firm CD-2 cost and schedule baseline to be vetted by a OFES (Lehman) review this fiscal year.**
- **Out year plans, beyond FY 2012, are a function of the ongoing preliminary design (including value engineering), the final base cost estimate, contingency analysis, and funding profile guidance provided by OFES.**
- **Various scenarios have been developed which bracket the project cost, schedule and NSTX Programmatic implications;**
  1. ***An unconstrained case – lowest total project cost, 2 yr outage in FY12&13, FY2014 Operations, requires incremental funding in FY10,11,12.***
  2. ***Flat funding with increment case - FY11 & 12 (FWP guidance), Incremental funding during the outage (CD-1 plan), operations in FY 2015.***
  3. ***Flat budget case - requires no incremental funding, separates scope into two phases, full capability operations in FY2016.***

# Summary

- The project has a mature and well thought through design approach. *"The project design is well advanced of what is required at this stage of the project."* (1)
- The project technical, cost and schedule has been vetted by technical peer reviews, an independent CDR and OFES (Lehman) review. *"Approach to upgrading the NSTX is technically sound".* (1)
- The project is being managed as a major PPPL project. "The NSTX Upgrade project organization has been established and key management positions are filled with experienced staff members." (1)
- Cost and schedule estimates can be supported by the NSTX Program *"At this stage of the project, the proposed schedule estimate, including contingency appears reasonable."* (1)
- The NSTX-U Project is a significant upgrade that can be constructed within existing program funding levels, HOWEVER, incremental funding during this budget period will reduce the total TPC AND accelerate CD-4.

***(1) OFES (Lehman) Review December 16, 2009***