

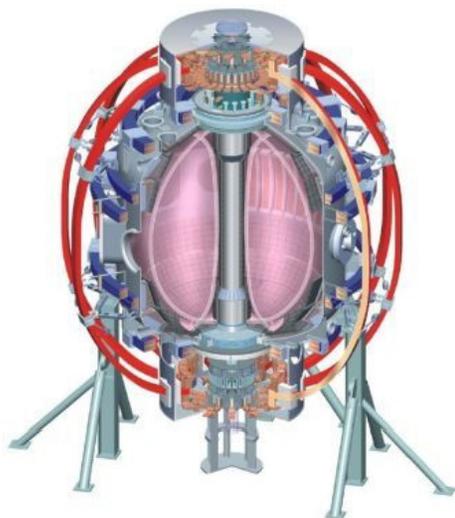
# NSTX Project

## Upgrade Project Overview

**Ron Strykowski**

**FY 2012 Field Work Proposal Presentation**  
**Germantown, March 11-12, 2010**

College W&M  
Colorado Sch Mines  
Columbia U  
CompX  
General Atomics  
INEL  
Johns Hopkins U  
LANL  
LLNL  
Lodestar  
MIT  
Nova Photonics  
New York U  
Old Dominion U  
ORNL  
PPPL  
PSI  
Princeton U  
Purdue U  
SNL  
Think Tank, Inc.  
UC Davis  
UC Irvine  
UCLA  
UCSD  
U Colorado  
U Illinois  
U Maryland  
U Rochester  
U Washington  
U Wisconsin



Culham Sci Ctr  
U St. Andrews  
York U  
Chubu U  
Fukui U  
Hiroshima U  
Hyogo U  
Kyoto U  
Kyushu U  
Kyushu Tokai U  
NIFS  
Niigata U  
U Tokyo  
JAEA  
Hebrew U  
Ioffe Inst  
RRC Kurchatov Inst  
TRINITI  
KBSI  
KAIST  
POSTECH  
ASIPP  
ENEA, Frascati  
CEA, Cadarache  
IPP, Jülich  
IPP, Garching  
ASCR, Czech Rep  
11

# Project Mission

## 1) Upgrade centerstack

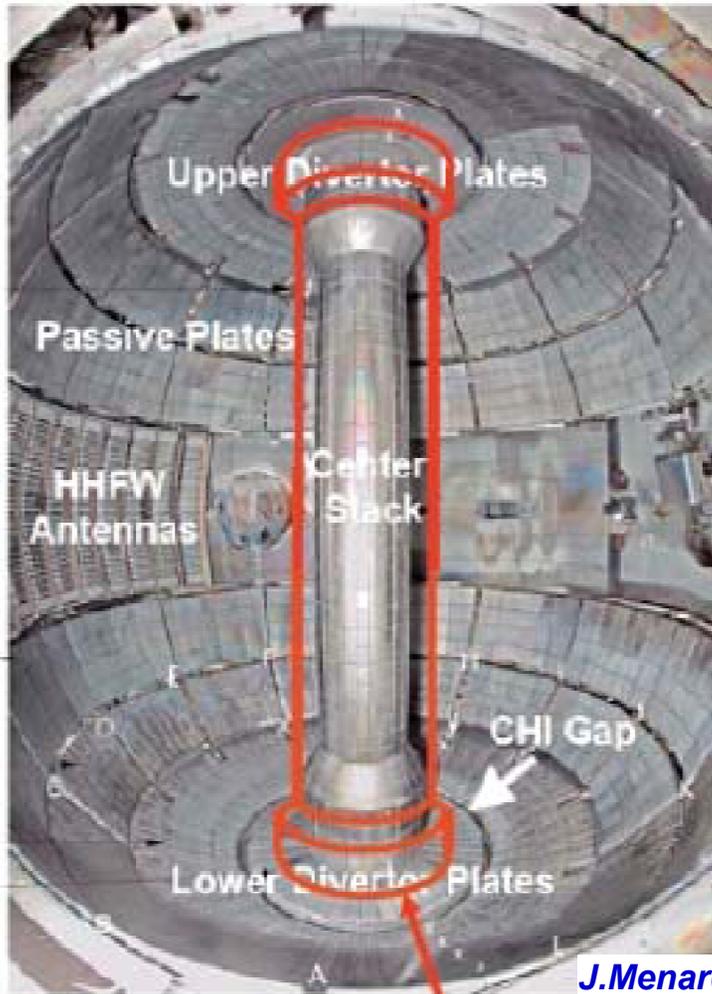
- New center core; TF bundle, PF1A & B, casing
- Structural improvements
- Electrical Power Systems
- Centerstack Diagnostics
- Auxiliary systems

## 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)

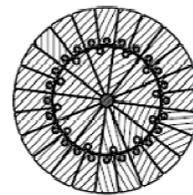
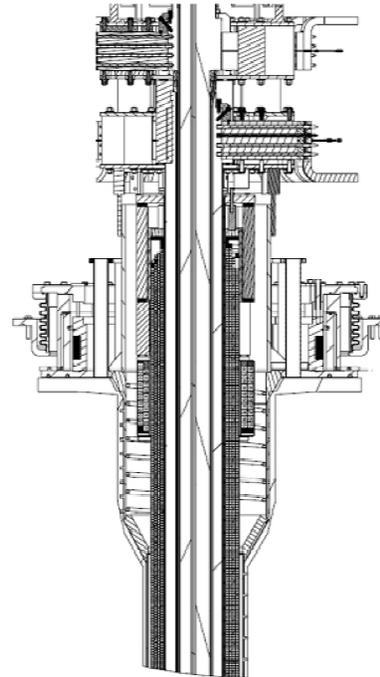
# Centerstack Upgrade Scope *(cont)*

## *CS Present and New*



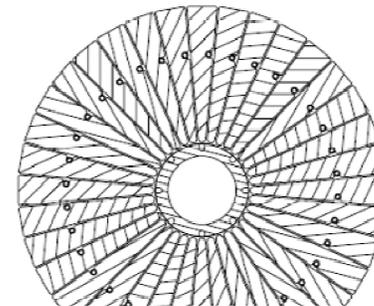
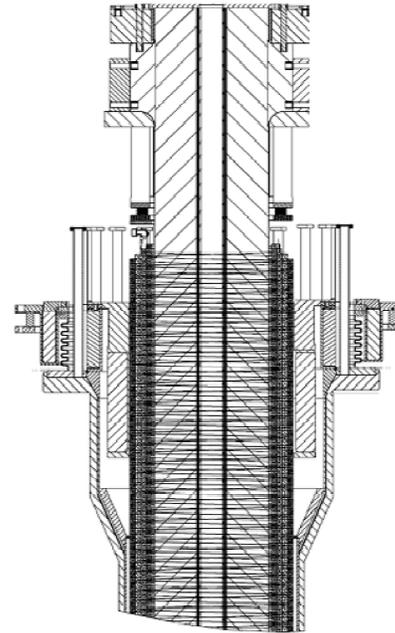
**Outline of new center-stack (CS)**

**Present CS**



**TF OD = 20cm**

**New CS**



**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)*

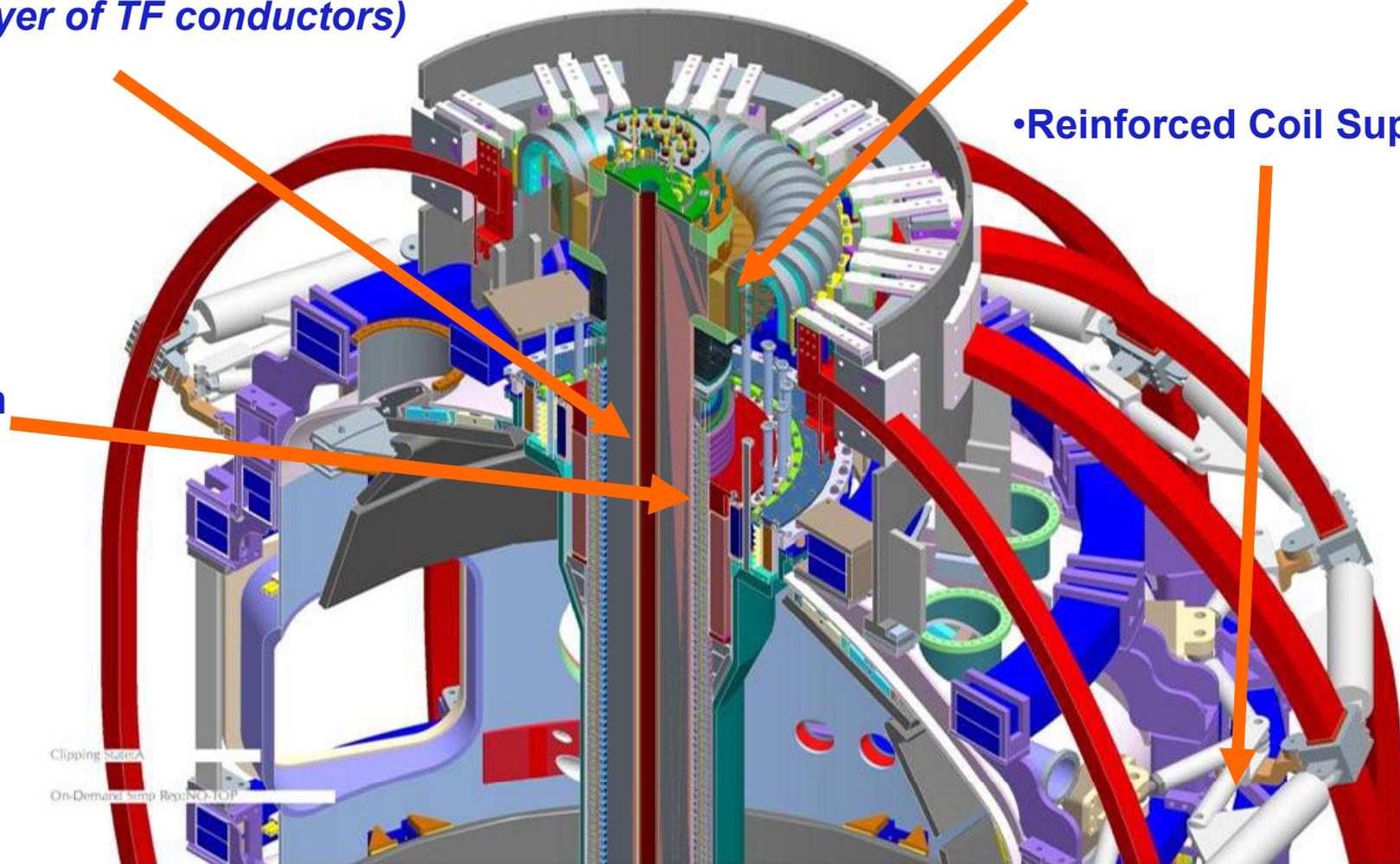
Outer TF, Vessel, Umbrella Structure, Reinforcements

•Simpler Inner TF design  
*(single layer of TF conductors)*

•Improved Joint Design

•Reinforced Coil Supports

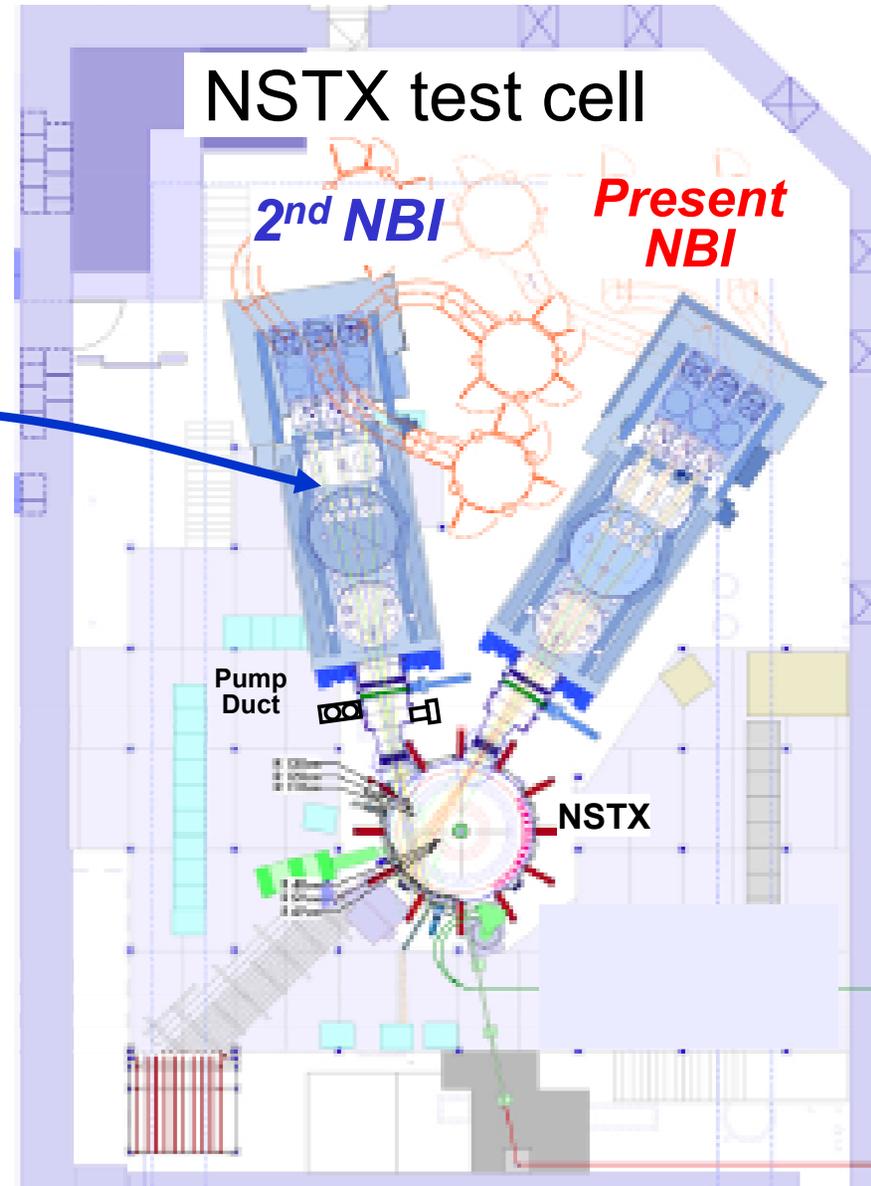
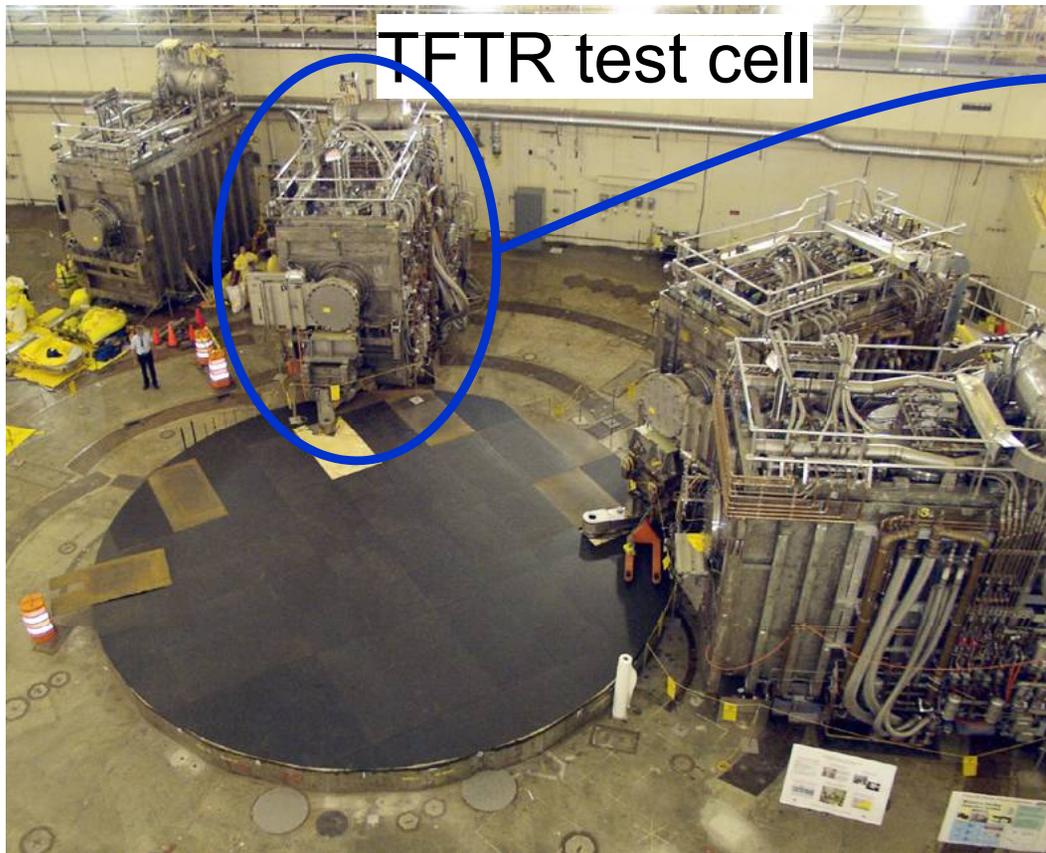
•OH coil  
wound on  
TF



# Second Neutral Beam Scope

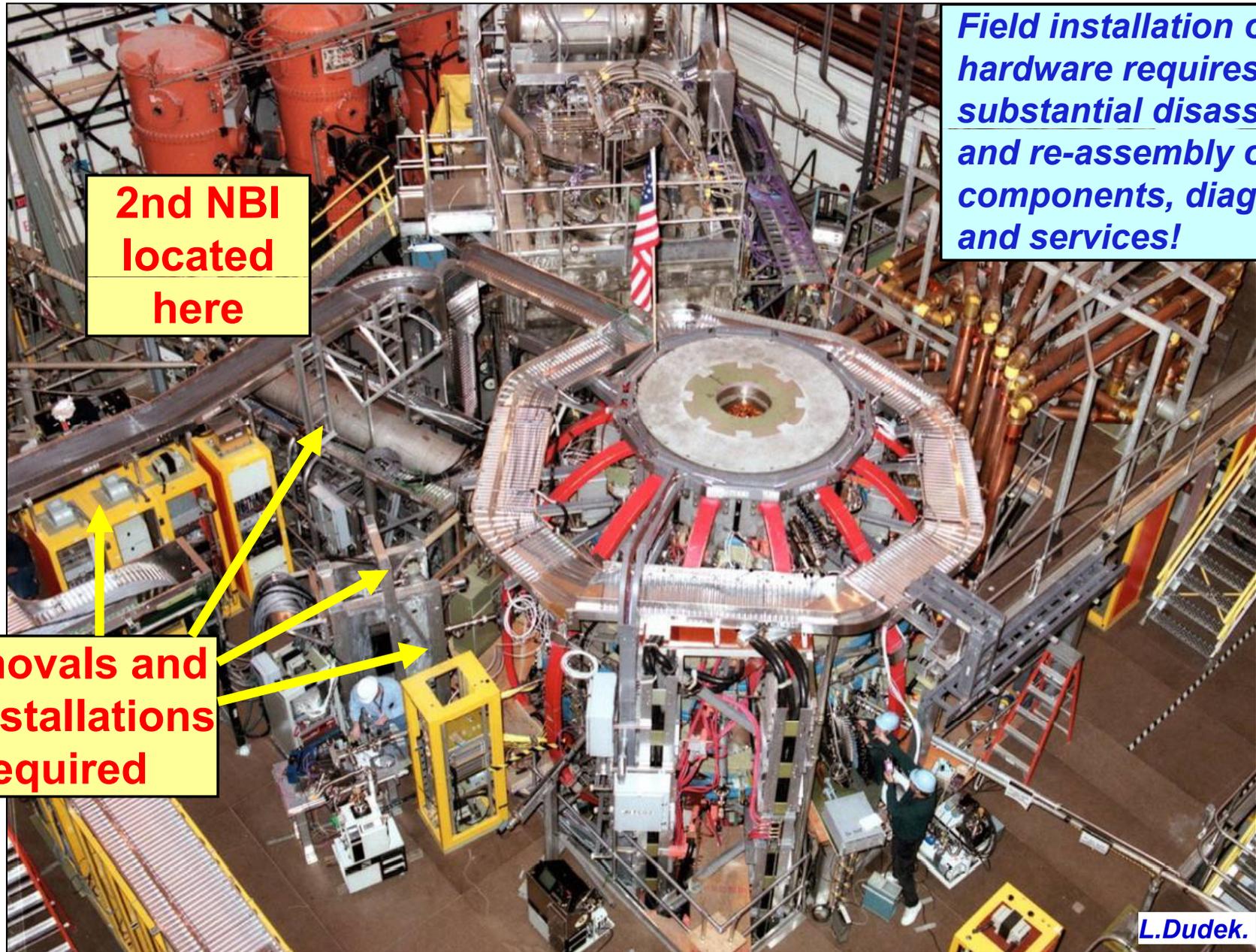
*A TFTR Neutral Beamline will be Moved to the NSTX Test Cell*

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



*T. Stevenson, et al.*

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



**2nd NBI  
located  
here**

**Removals and  
re-installations  
required**

*Field installation of new hardware requires substantial disassembly and re-assembly of existing components, diagnostics and services!*

L.Dudek.

# 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 28-29<sup>th</sup>
- CD-1 Documentation Prepared in compliance with DOE Order 413.3
- Successful OFES (Lehman) Review December 15<sup>th</sup>–16<sup>th</sup>
- 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 31<sup>st</sup>
- 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 3<sup>rd</sup> quarter FY 2011
- OFES (Lehman review) 4<sup>th</sup> 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.”* <sup>(1)</sup>
- 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”.* <sup>(1)</sup>
- 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.”* <sup>(1)</sup>
- 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.”* <sup>(1)</sup>
- 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.

<sup>(1)</sup> OFES (Lehman) Review December 16, 2009