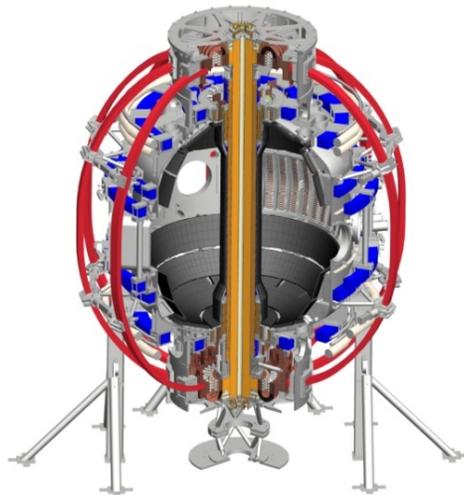


# NSTXU NBI Upgrade Overview

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**Princeton Plasma Physics Laboratory  
NSTX Upgrade Project  
Office of Science Review  
PPPL LSB – 318  
May 2-3, 2012**

*Coll of Wm & Mary  
Columbia U  
CompX  
General Atomics  
FIU  
INL  
Johns Hopkins U  
LANL  
LLNL  
Lodestar  
MIT  
Lehigh U  
Nova Photonics  
ORNL  
PPPL  
Princeton U  
Purdue U  
SNL  
Think Tank, Inc.  
UC Davis  
UC Irvine  
UCLA  
UCSD  
U Colorado  
U Illinois  
U Maryland  
U Rochester  
U Tennessee  
U Tulsa  
U Washington  
U Wisconsin  
X Science LLC*



*Culham Sci Ctr  
York U  
Chubu U  
Fukui U  
Hiroshima U  
Hyogo U  
Kyoto U  
Kyushu U  
Kyushu Tokai U  
NIFS  
Niigata U  
U Tokyo  
JAEA  
Inst for Nucl Res, Kiev  
Ioffe Inst  
TRINITI  
Chonbuk Natl U  
NFRI  
KAIST  
POSTECH  
Seoul Natl U  
ASIPP  
CIEMAT  
FOM Inst DIFFER  
ENEA, Frascati  
CEA, Cadarache  
IPP, Jülich  
IPP, Garching  
ASCR, Czech Rep*

# NSTXU NBI Overview: Introduction

- Neutral Beam Injection Upgrade Project status:
  - GRD met, FDR successful, CD3 approved
  - Finish and release drawings, specifications, Statements of Work (SOW), requisitions
  - Ramp up purchases, procurements, Tech Shop Work Orders, Open orders
  - Develop JHAs, Installation Procedures, and Work Control Packages for NTC
  - Engage field crews in approved work with hazard controls and proper PPE
  - Status Reporting:
    - Each Job stasured by CAM to Project Office and ADEI on monthly basis
    - Field work reviewed and planned weekly at Rollover meeting
    - Daily coordination at Plan of Day meeting and at 8:30 meeting
- NBI Job Performance Overview
- NSTXU General Arrangement model
  - Ongoing refinement to maintain configuration and avoid interferences
  - Approval required by Construction Manager
- Job Progress
- Conclusion & Questions

# GRD Requirements for NBI Design

- Disassemble & evaluate a TFTR BL* ✓
- Decon a TFTR DT BL* ✓
- Refurbish BL* ✓
- Lift BL over wall – Clearance OK* ✓
- Add second NBI & Services in NTC* ✓
- Connect Power & Controls* ✓
- Aim wider (modify VV)* ✓
- Rearrange NTC to fit* ✓
- Capability to run either or both* ✓
- NBI Power x 2 for NSTXU* ✓



*NSTX Beamline 1*

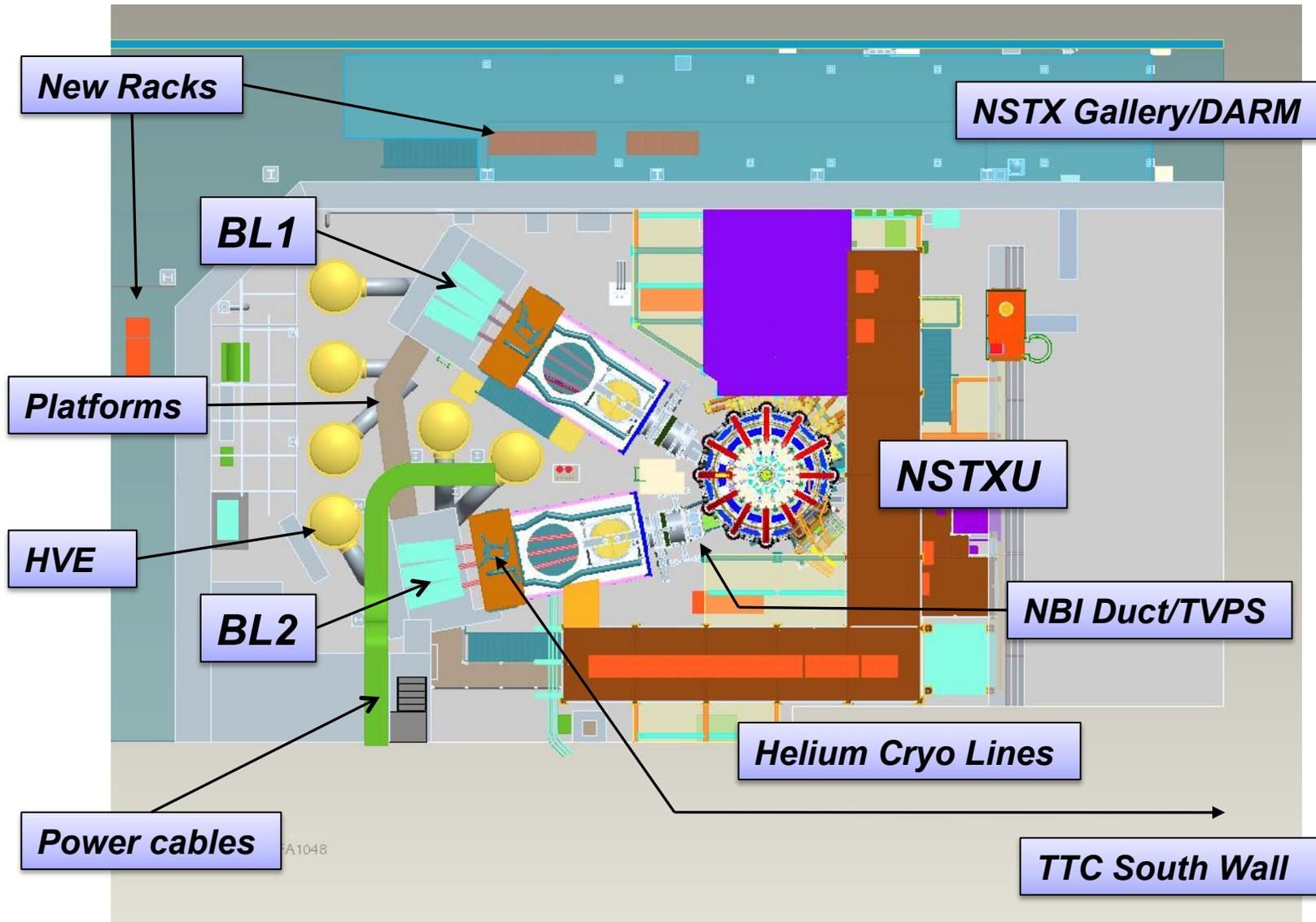
**SAME**

# NSTXU NBI Job Performance

NSTXU NBI Project Cost (all k\$)	Control Account Manager	NBI BAC	NBI EAC	Planned Value (BCWS)	Earned Value (BCWP)	Actual Cost (ACWP)	CPI	SPI
Job: 2420 - 2nd NBI Sources*	Cropper	1094	63	99	99	63	1.57	1.00
Job: 2425 - BL Relocation	Atnafu	1803	1767	301	272	265	1.03	0.90
Job: 2430 - 2nd NBI Decontamination*	Stevenson	2057	2070	2057	2057	2070	0.99	1.00
Job: 2440 - 2nd NBI Beamline	Cropper	2589	2375	1019	962	687	1.40	0.94
Job: 2450 - 2nd NBI Services	Denault	4516	4623	416	699	680	1.03	1.68
Job: 2460 - 2nd NBI Armor	Tresemmer	700	714	392	585	572	1.02	1.49
Job: 2470 - 2nd NBI Power	Ramakrishnan	3335	3265	260	724	442	1.64	2.78
Job: 2475 - 2nd NBI Controls	Cropper	2089	1902	248	887	785	1.13	3.58
Job: 2480 - 2nd NBI/TVPS Duct	Denault	1952	2198	462	547	571	0.96	1.18
Job: 2485 - Vacuum Pumping System	Blanchard	388	420	90	133	219	0.61	1.48
Job: 2490 - NTC Equipt Relocations	Perry	3615	3219	767	1335	939	1.42	1.74
Job: 7300 - NB2 Management	Stevenson	1364	1383	533	533	466	1.14	1.00
Job: 7400 - Health Physics Support	Stevenson	2507	2087	1172	1172	752	1.56	1.00
Total NBI Upgrade BL2		28009	26086	7816	10005	8511	1.18	1.28

\* Job completed

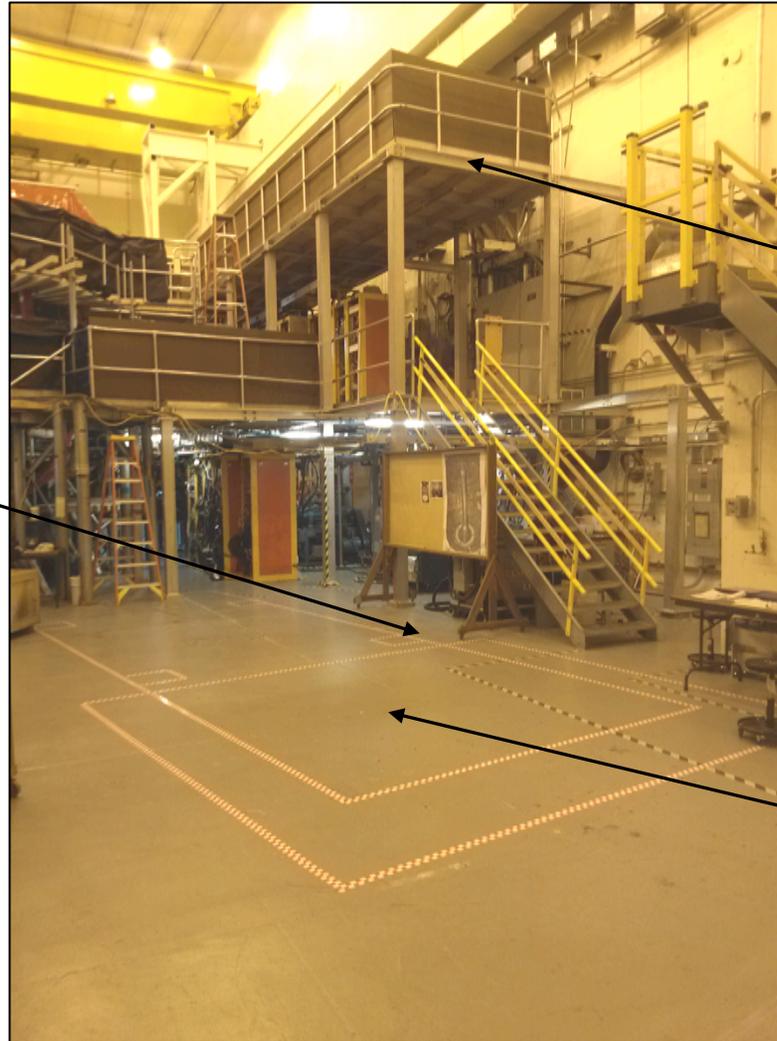
# NSTXU Test Cell General Arrangement



## NTC space allocation for NBI footprint successful...

2450  
2490

- *Water systems piping will run from Pump Room to MER*
- *Penetrations will be made in NTC floor near BL2*
- *Survey and routing details in progress...*
- *Floor scanning planned next*
- *Subcontract installation is planned next year*



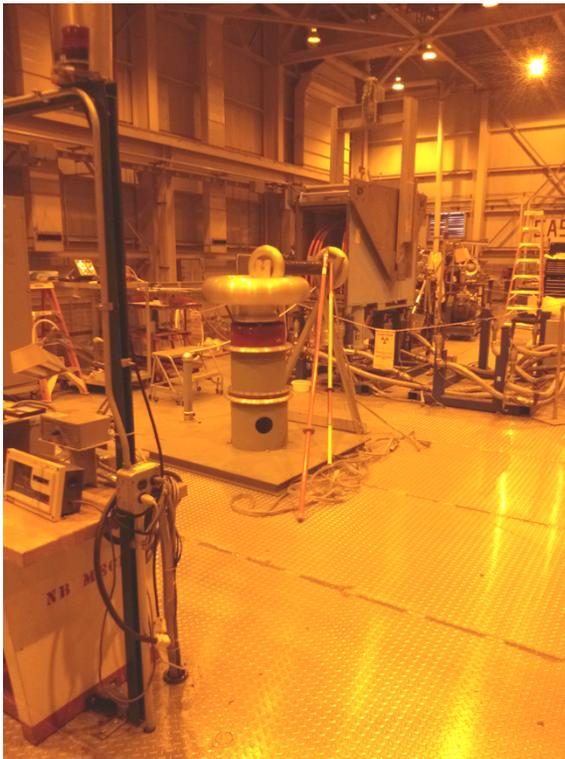
- *New platform installations*
- *Stairs will move...*
- *More to come...*

- *BL footprint surveyed*
- *Source Platform*
- *Access platform*
- *HVE locations next...*

# NSTXU NBI Sources: complete

2420

No NBI Ops in FY11 due to TF fault so BL1 sources still OK allowing use of 3 spares for BL2



**ION SOURCE HIPOT TEST STAND**



**3 TESTED ION SOURCES FOR BL2**

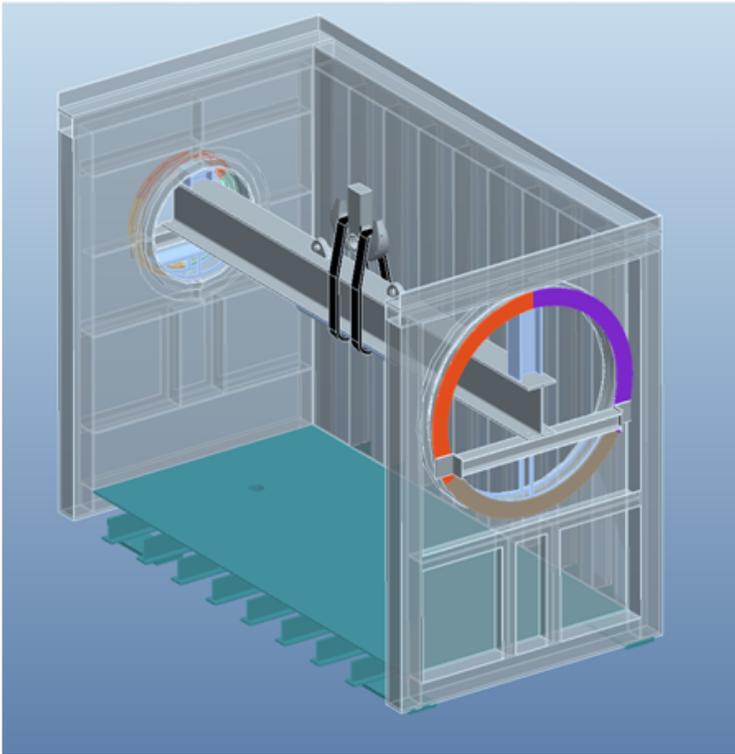
## BL Relocation preparations are underway...

2425

- Complete relocation schedule developed
  - Box
  - Lid
  - 90 inch Flange
  - Source Platform
  - Magnet & Stand
  - Ion Dump
  - Calorimeter
  - High Voltage Enclosures
- SE Door conduit removed
- SE Door Ducts removed
- SE Door Duct bypasses installed
- SE Shield Lintel removal procedure
- BL Box modifications completed
- BL Lift fixture designed and approved
- Relocation procedure using air castors
  - Beam box and Lid
- Moving day planned later this summer...



## BL Lift fixture fabrication in RESA Shop – in progress



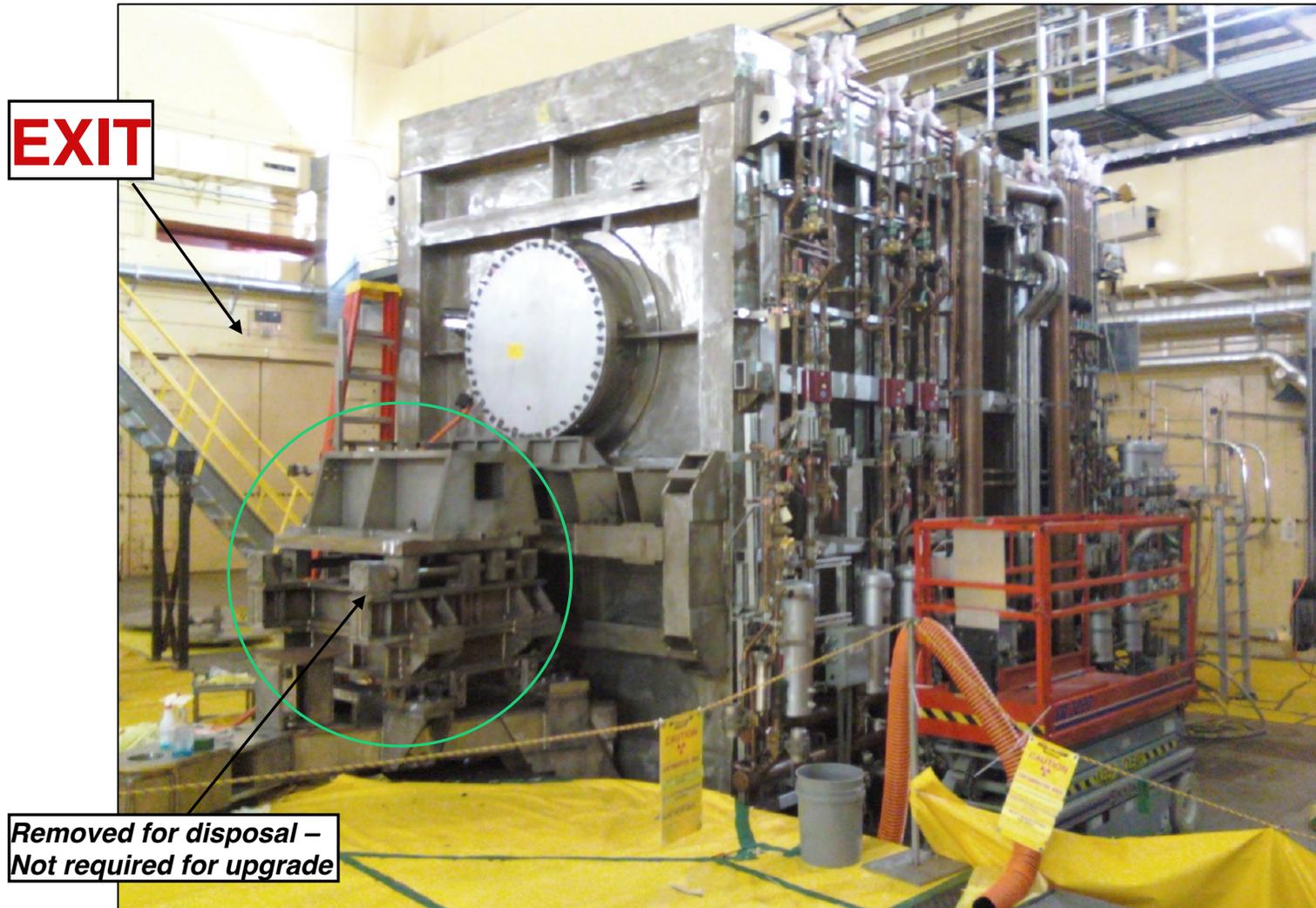
*Reentrant hook lift fixture design for better clearance over the NTC South Shield Wall*



2425

*Lift fixture fabrication in RESA Tech Shop*

## BL2 Box refurbishment – ready for external cleaning and move

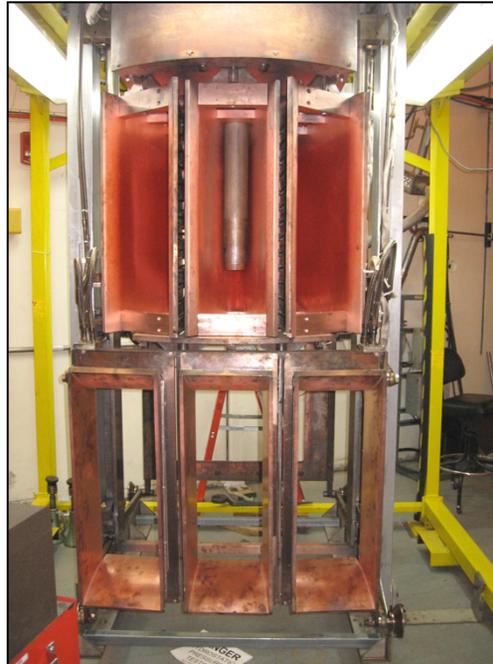


2425  
2440



Ion Dump Replacement -

- Fabrication complete
- Machining complete
- Manifold complete
- Brazing complete
- Leakchecking complete
- Thermocouples next...



Calorimeter Upgrade –

- Parts fabrication well along
- Double bellows installation in progress
- Double drive system ordered and received
- External support structure work order in shop



# Penetrations for water systems, power cabling, and cryogenic services

2450  
2470



*Power cabling & trays  
through shield block  
section of wall*

*LHe cryo line penetrations*

# Cryogenics Line LN and LHe piping fabrication in progress in NBI shop



*BL2 LN Manifold Vent line*



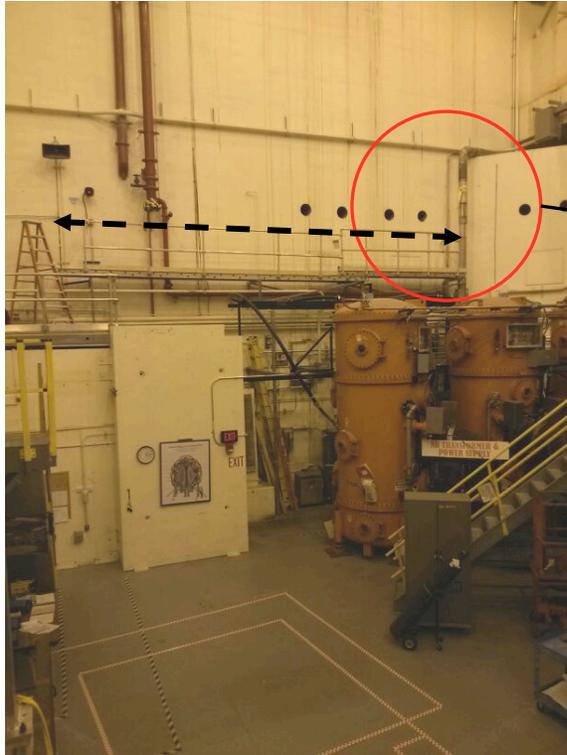
*Vacuum jacket*

*Insulated pipe*

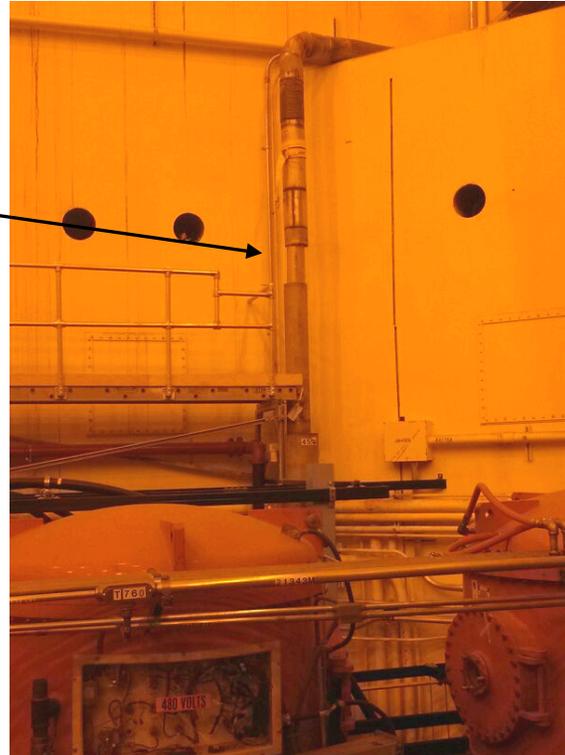
2450

# Liquid Nitrogen manifold vent installation in NTC in progress...

2450



*NTC North Wall & Catwalk*



*Cut into existing LN vent line*

- Extend existing LN System service for BL2
- Connects to BL1 now
- Build scaffold catwalk to access
- Cut into system
- Tee for BL2
- Piping supply and vent lines on North and West wall
- Connections to BL2 LN manifolds & LHe deWar
- LHe lines will connect to existing system in TFTR TC with penetrations into NTC...

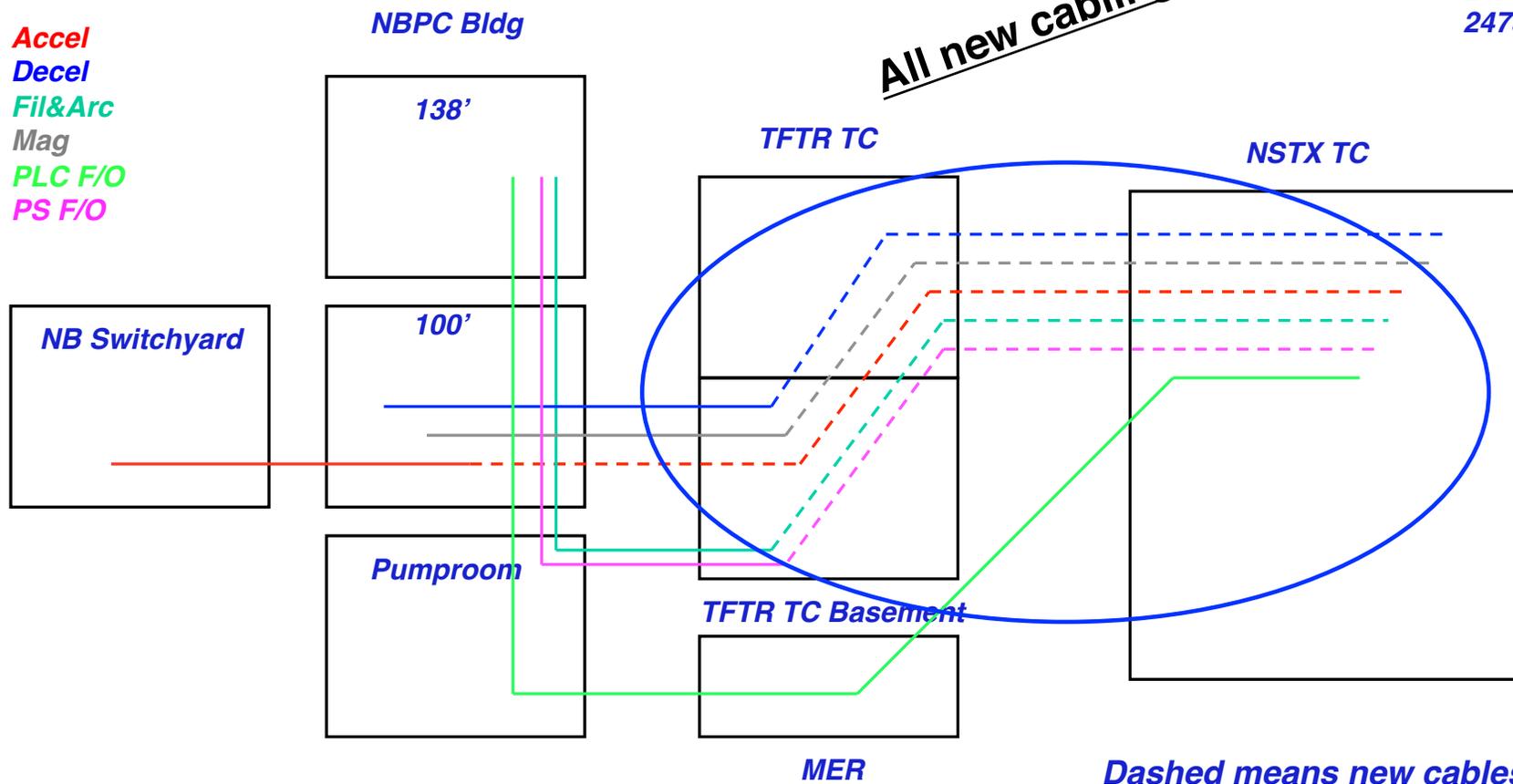
# NSTXU NBI Power & Controls - Road Map

*Routing, Penetrations, Installation Procedures revised for improved penetration locations*

*All new cabling on order or here*

2470  
2475

- Accel
- Decel
- Fil&Arc
- Mag
- PLC F/O
- PS F/O

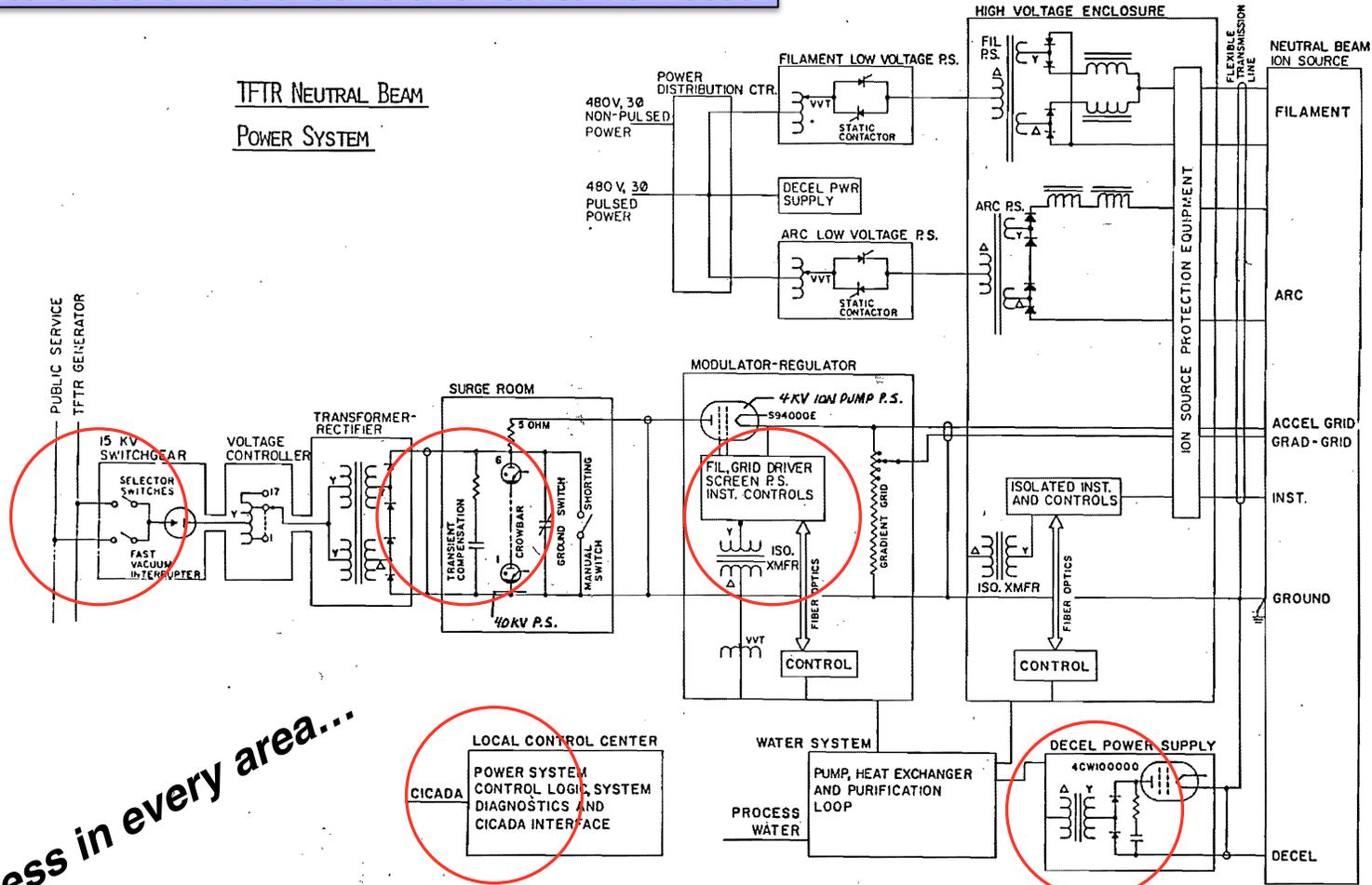


# NSTXU NBI Power & Controls - One Line Diagram

2475

**Update electronics & control circuits as noted**

TFTR NEUTRAL BEAM  
POWER SYSTEM



Progress in every area...

NBI NBPS One Line Diagram

X3

## NBI BL1 & BL2 Controls Racks installed in Gallery...

2475

- *Many controls hardware orders completed and received*
- *Many, many drawings completed and approved*
- *Salvage some controls from legacy equipment*
- *Add BL2 Thermocouple Scanner system*
- *Design power feeds to racks from existing AC Power infrastructure*
- *Reuse existing penetration...*



- *Cage and sliding gates installed*
- *Racks relocated*
- *Populate racks with hardware*
- *Chassis and rack wiring well along or completed...*
- *Awaiting BL cable tray installation in NTC and racks...*

## N4ABC Local Control Center upgrade and wiring in progress

2475



- ***New NI chassis and LabView adds BL operator control purview***
- ***Software upgrades designed and coded***
- ***Additional NI and computing interfaces provide timing and data transfer with NSTX central computing and eliminates CAMAC***
- ***Wiring changes in progress...***

# N4ABC High Voltage Power Supply controls modifications in progress...



*NBI Switchyard Disconnect Switch Remote Control*



*Mod/Reg Grad Grid Divider and Controls chassis modifications*

# Mod/Reg Grad Grid Divider fabrication and assembly in progress



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## M/R Power Supply reactivation started...

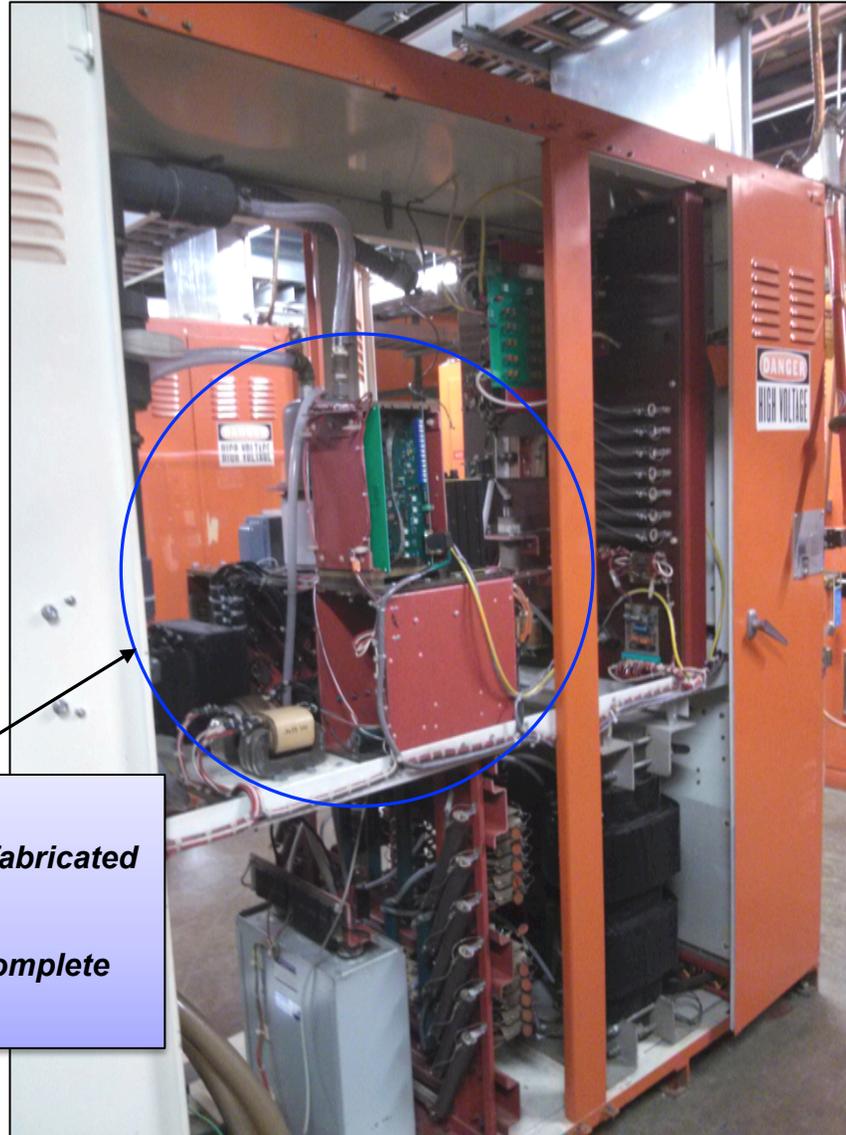
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**4ABC HVST  
installations  
in M/R  
completed**

## N4ABC Decel Power Supply controls update completed

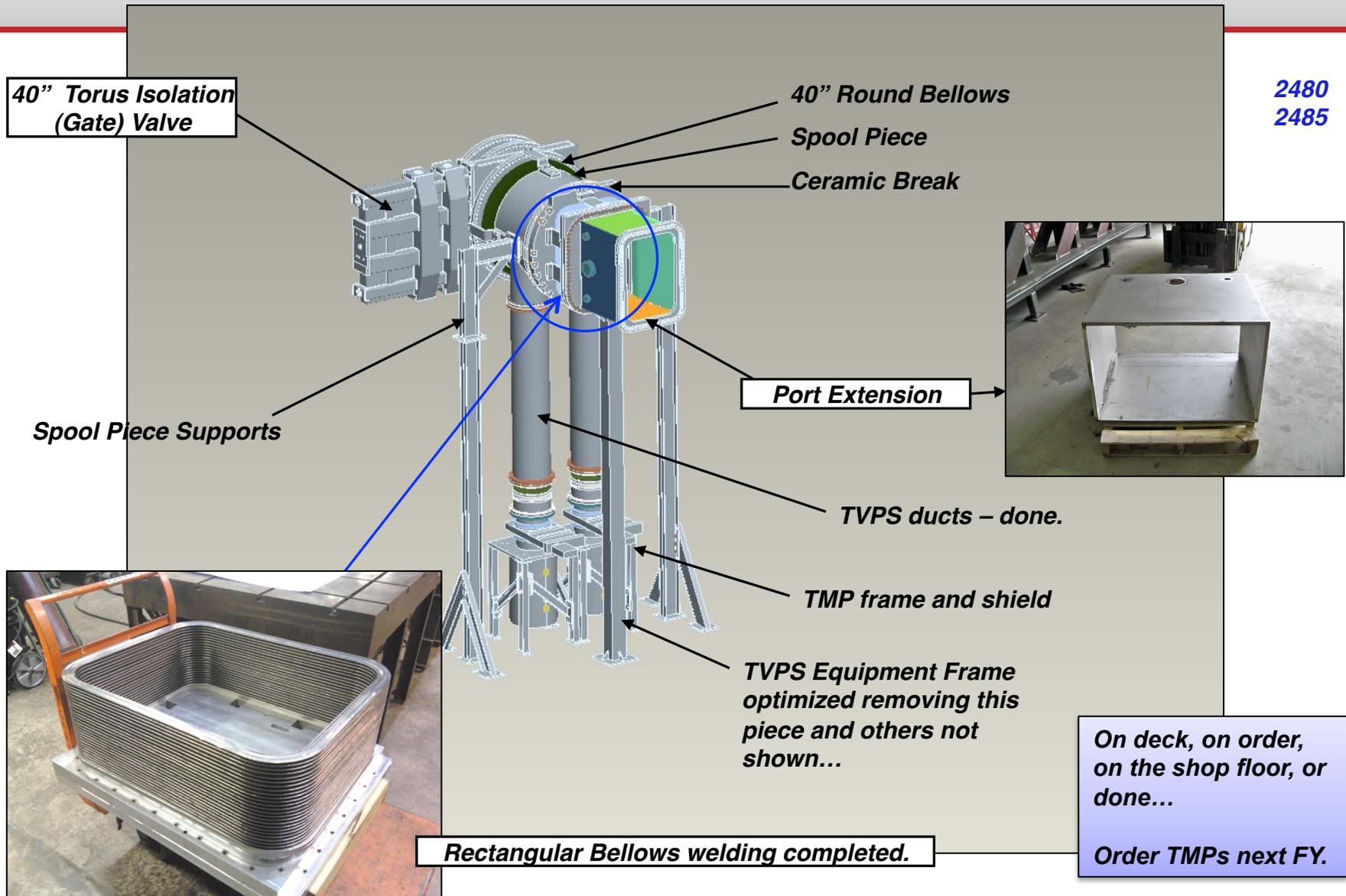
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- *New regulator design*
- *New printed circuit boards fabricated*
- *Installation complete 4ABC*
- *Associated modifications complete*
- *Ready for initial testing*

*NBPC 100' level*

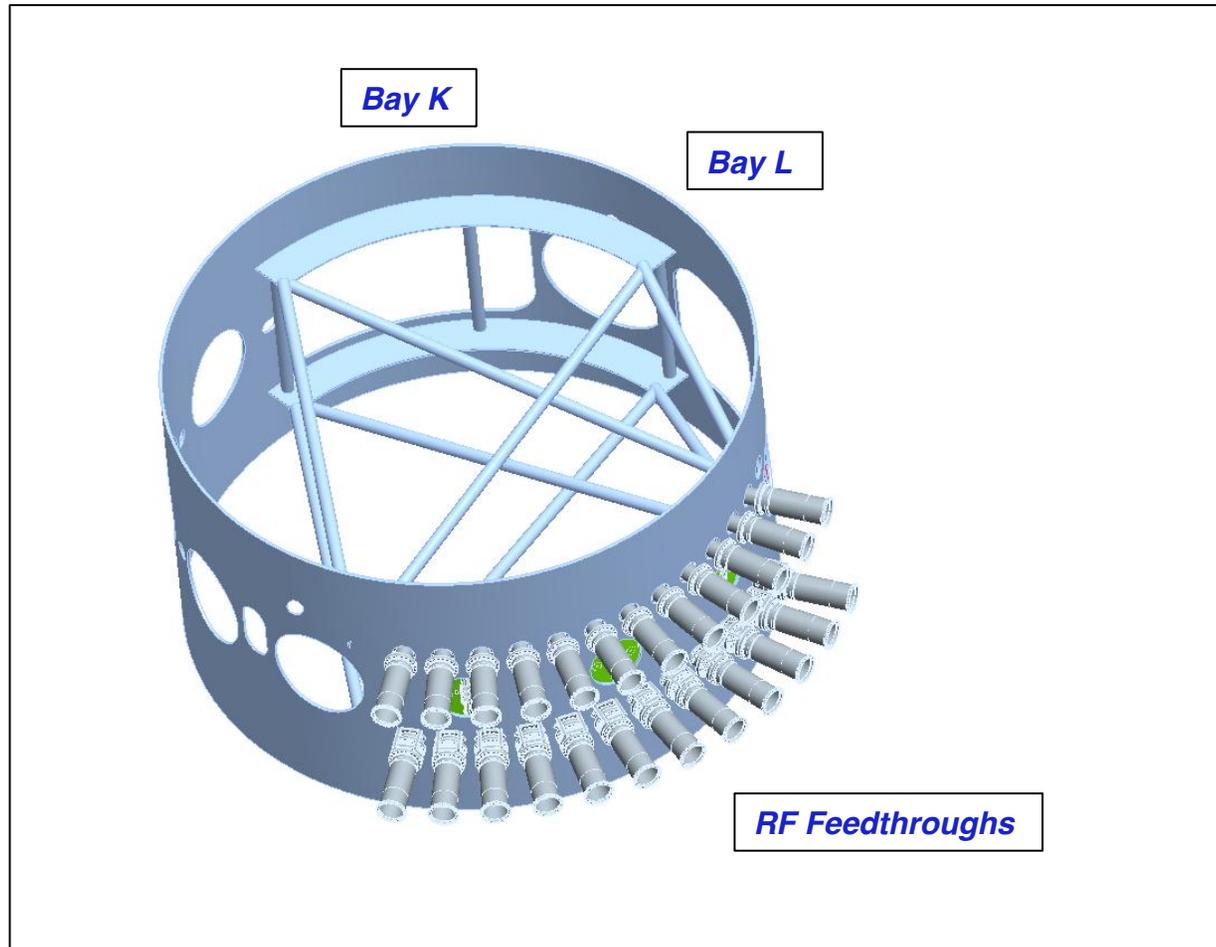
# NBI Duct and Torus Vacuum Pumping System (TVPS) progress...



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## VV Modification supports designed & fabrication in progress...

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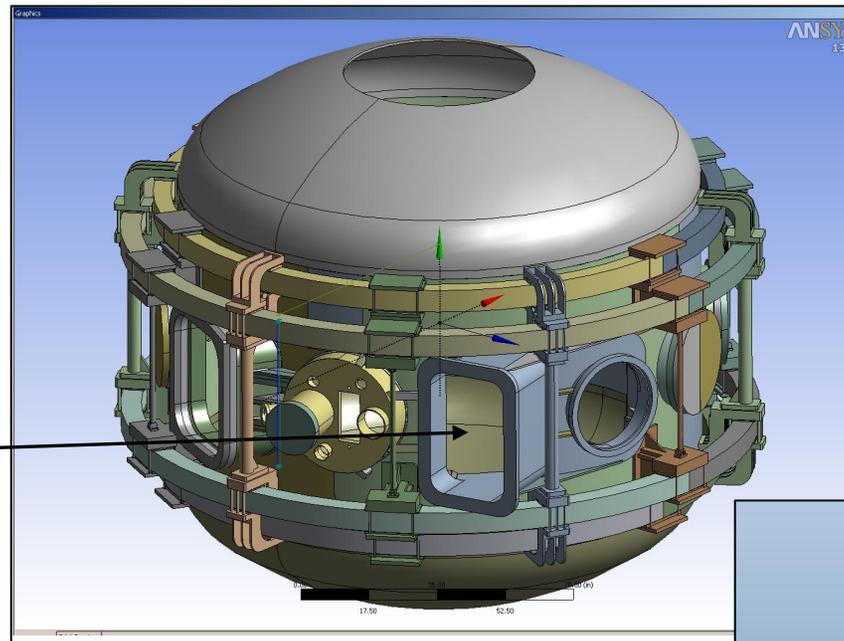


*Bracing to maintain VV integrity during cut and weld process for Bay K and Bay L installations*

# VV Bay JK Modification procedure and supports prepared

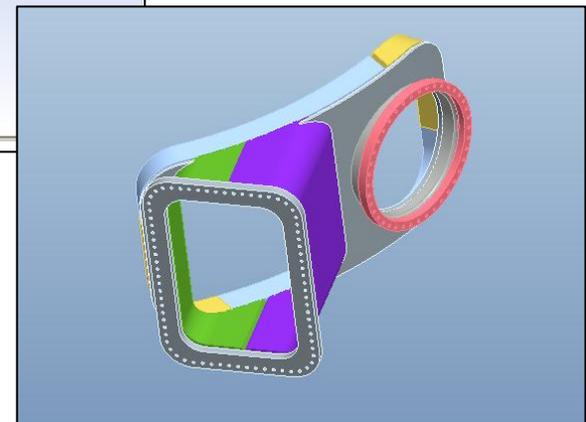
*Support VV, make cuts, attach weldment....*

2480



*New Bay K for BL2*

*Bay JK weldment on order & due in today....*



# NBI Armor support fabrication done and installation in progress...

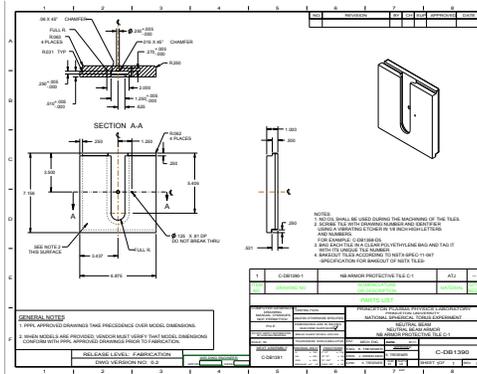
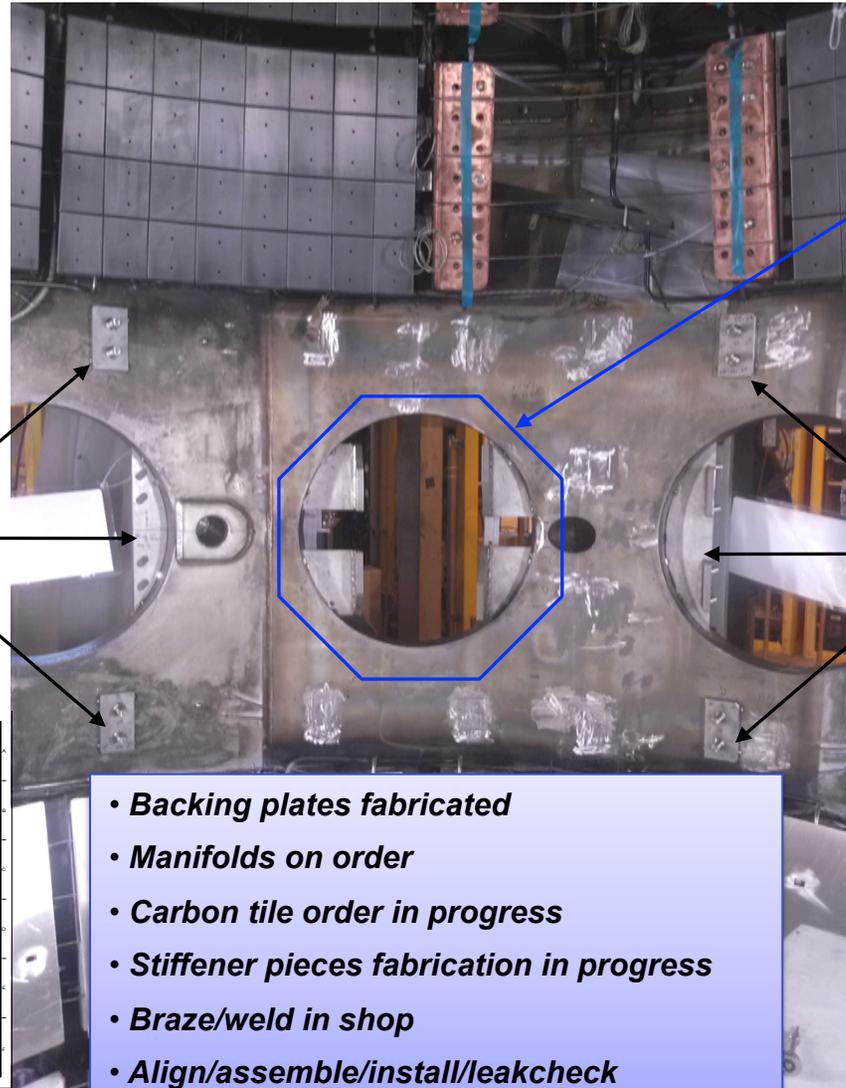
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*Supports aligned using metrology and tack welded in place to determine field fit changes...*

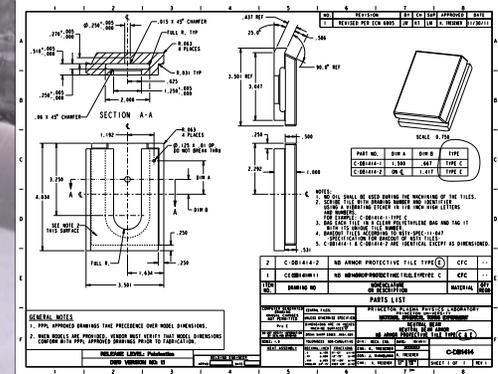
*Bay H supports need to be field fit and aligned using backing plates before final welding...*

OK

OK



- Backing plates fabricated
- Manifolds on order
- Carbon tile order in progress
- Stiffener pieces fabrication in progress
- Braze/weld in shop
- Align/assemble/install/leakcheck



## NSTXU NBI: Conclusion

NBI BL2 Upgrade GRD Requirements fully met by this design  
General Arrangement maintained by Construction Manager to avoid interferences  
BL refurbishment in progress – on pace for move later this year...  
HP support has been excellent  
Relocation to NTC - preparations underway for move later this year  
Services fabrication and installation has begun – water lines planned next FY  
Power - cables on order or received / Installation planned next FY  
Controls progress has been tremendous on BL and NBPS  
Floor space has been achieved by use of gallery and new platforms  
Duct procurements and shop work orders going strong  
VV modifications will begin next month – parts are here  
Armor support installation has started and armor fabrication progressing well  
Costs have tracked well to date – CPI and SPI greater than 1.1  
Schedule has been accelerated but still adequate for NBI activities – not critical path  
NSTXU NBI project is progressing on task, under cost, on time...