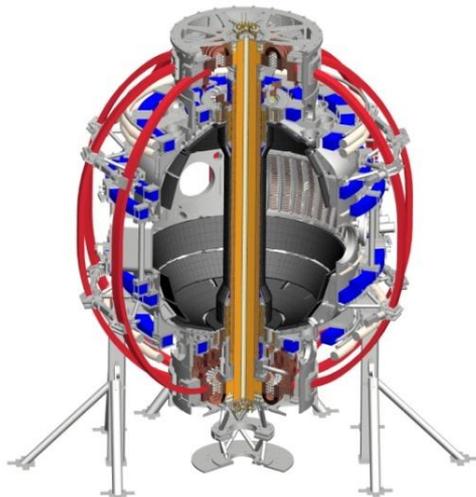


# NSTX-U 5 year plan text finalization

**J. Menard**

**5YP Update Meeting  
B318  
March 28, 2013**

*Coll of Wm & Mary  
Columbia U  
CompX  
General Atomics  
FIU  
INL  
Johns Hopkins U  
LANL  
LLNL  
Lodestar  
MIT  
Lehigh U  
Nova Photonics  
Old Dominion  
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*

# Schedule

- Most likely 5YP review dates remain the week of May 20
  - Expect dry-runs in 2<sup>nd</sup> half of April, first week of May

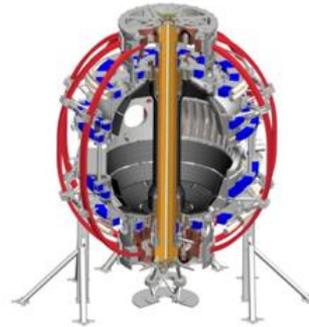
## **Due dates for your chapter text:**

- March 30 (this Saturday!)
  - Post updated chapter text for Jon/Stan/Masa to review.
  - E-mail us informing us that you've posted a version for comment.
- April 7/8: Jon's final comments will be returned back to chapter authors – Stan/Masa will also provide feedback
  - JM on travel to UK next week
- April 15: Final chapter text due for final formatting and posting for review panel
  - As usual, please post Word files and PDF

# Final Formatting

- Use the template
- Follow the guidelines distributed in template last year 
- Conformity is good for this document
- **If all else fails, make it look like Chapter 1**

## *Chapter 1 (update the #)*



## **Chapter title goes here**

### **1.1 Level 1 – Main section heading – 20 pt bold**

#### **1.1.1 Level 2 - 16 pt bold**

##### **1.1.1.1 Level 3 – 12 pt bold (14pt also ok)**

##### **1.1.1.1.1 Level 4 – 12 pt bold (don't use more levels than this!)**

Guidance for the formatting of your chapter:

- Chapter number font: Bold Italic 32pt
- Chapter title font: Bold 28pt
- Replace the figures above with something representative of your chapter
- Text font: Times New Roman
- Text font size: 12pt
- Text spacing: 1.15 using the Word line-spacing option
- Section heading fonts: see examples above
- Figure captions: 10pt italic, number according to the sub-section figure is in – see examples below. Put the Figure and caption in a single text-box – do not “group” them.
- References: Put at end of each chapter, “References” section heading should be in 16pt bold-face. See end of this template file for referencing style.

# Timelines

- Make your end-of chapter timelines consistent with the baseline and incremental timelines shown in Chapter 1 (and in slides that follow)
- 2 choices:
  - Have one timeline which is nominally base funding plan, and label incremental items as “(incremental)” or “(increm.)”
  - Or have two timelines – one for base, one for incremental plan
    - Probably only use this choice if the two plans are quite different for you
- 1 specific request for M&P chapter:
  - At end of PFC section, show graphics of PFC conversion sequencing for both the base and incremental plans, and describe (briefly) the steps, and rationale for the steps, in the text for each budget case

# 10 year plan tools with 5YP incremental funding (March 2013)

1.1 × (FY2012 + 2.5% inflation)

2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
------	------	------	------	------	------	------	------	------	------

Upgrade Outage

1.5 → 2 MA, 1s → 5s

Metallic PFCs, 5s → 10-20s

New center-stack

Start-up and Ramp-up

Upgraded CHI for ~0.5MA ●

0.5-1 MA CHI ●

up to 1 MA plasma gun ●

Extend NBI duration to 10-20s and/or implement 2-4 MW off-axis EBW H&CD ●

1 MW ECH/EBW ●

2 MW ●

Boundary Physics

Lower divertor cryo-pump ●

Divertor Thomson ●

Upper divertor cryo-pump ●

Materials and PFCs

High-Z tile row on lower OBD ●

High-Z first-wall + lower OBD tiles ●

High-Z PFC diagnostics ●

All high-Z PFCs ●

Hot high-Z FW PFCs using bake-out system ●

Liquid metals / lithium

Li granule injector ●

Upward LITER ●

LLD using bakeable cryo-baffle ●

Flowing Li divertor or limiter module ●

Full toroidal flowing Li lower OBD ●

MHD

MGI disruption mitigation ●

Partial NCC ●

Enhanced MHD sensors ●

NCC SPA upgrade ●

Full NCC ●

Transport & Turbulence

●  $\delta B$  polarimetry

● High  $k_\theta$

● DBS, PCI, or other intermediate-k

Waves and Energetic Particles

● 1 coil AE antenna

HHFW limiter upgrade ●

● 4 coil AE antenna

●

● HHFW straps to excite EHO

High-power AE antenna ●

● Neutron-collimator, fusion source profile array

Scenarios and Control

● Snowflake ●  $\bar{n}_e$  ● Divertor  $P_{rad}$

Establish control of:

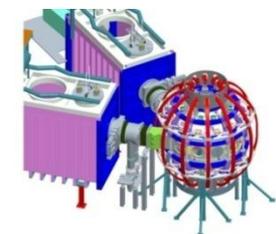
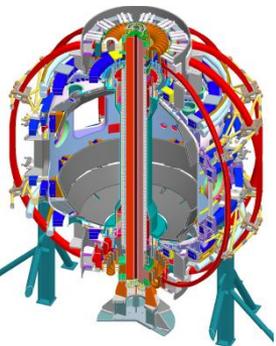
● Rotation ●

●  $q_{min}$  ●

Control integration, optimization ●

● Control integration, optimization with long-pulse and full metal wall

Inform U.S. next-step conceptual design including aspect ratio and divertor optimization



2nd NBI

# 5 year plan tools with 5YP base funding (March 2013)

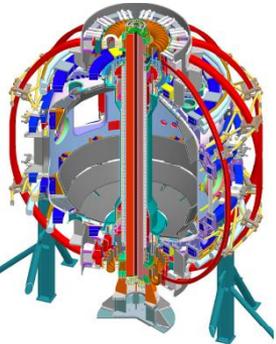
(FY2012 + 2.5% inflation)

2014	2015	2016	2017	2018
------	------	------	------	------

Upgrade Outage

1.5 → 2 MA, 1s → 5s

New center-stack



Start-up and Ramp-up

Upgraded CHI for ~0.5MA ●

up to 0.5 MA plasma gun ●

1 MW ECH/EBW ●

Boundary Physics

Lower divertor cryo-pump ●

High-Z PFC diagnostics ●

Materials and PFCs

High-Z tile row on lower OBD ●

High-Z tile row on cryo-baffle ●

Full high-Z lower OBD ●

Liquid metals / lithium

Li granule injector ●

Upward LITER ●

LLD using bakeable cryo-baffle ●

MHD

MGI disruption mitigation ●

Partial NCC ●

Enhanced MHD sensors ●

Transport & Turbulence

●  $\delta B$  polarimetry

● High  $k_{\theta}$

Waves and Energetic Particles

● Neutron-collimator, fusion source profile ●

● 1 coil AE antenna ●

● 4 coil AE antenna

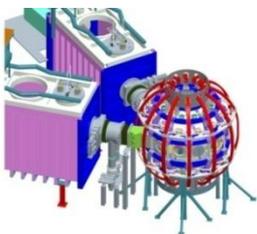
Scenarios and Control

● Establish control of:  
● Snowflake ●  $\bar{n}_e$  ● Divertor  $P_{rad}$  ●

● Rotation ●

●  $q_{min}$

- Cryo-pump, high-Z tile row on cryo-baffle, and partial NCC would be installed in-vessel during ~1 year outage between FY2016 and FY2017
  - NSTX-U would operate 1<sup>st</sup> half of FY2016 and 2<sup>nd</sup> half of FY2017

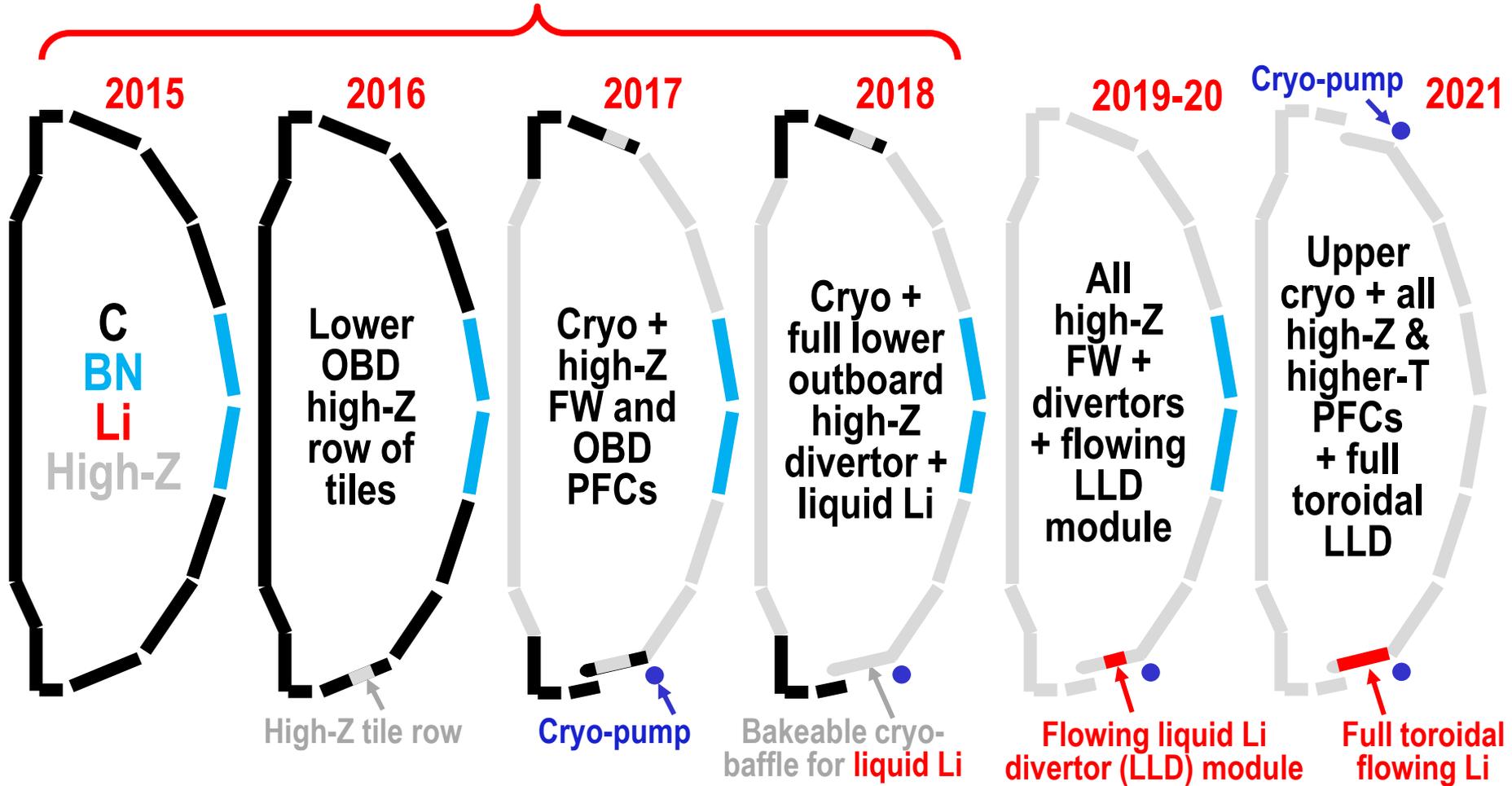


2nd NBI

# NSTX-U internal component staging supports goal to assess compatibility of high $\tau_E$ and $\beta + 100\%$ NICD with metallic PFCs

## Incremental budget case

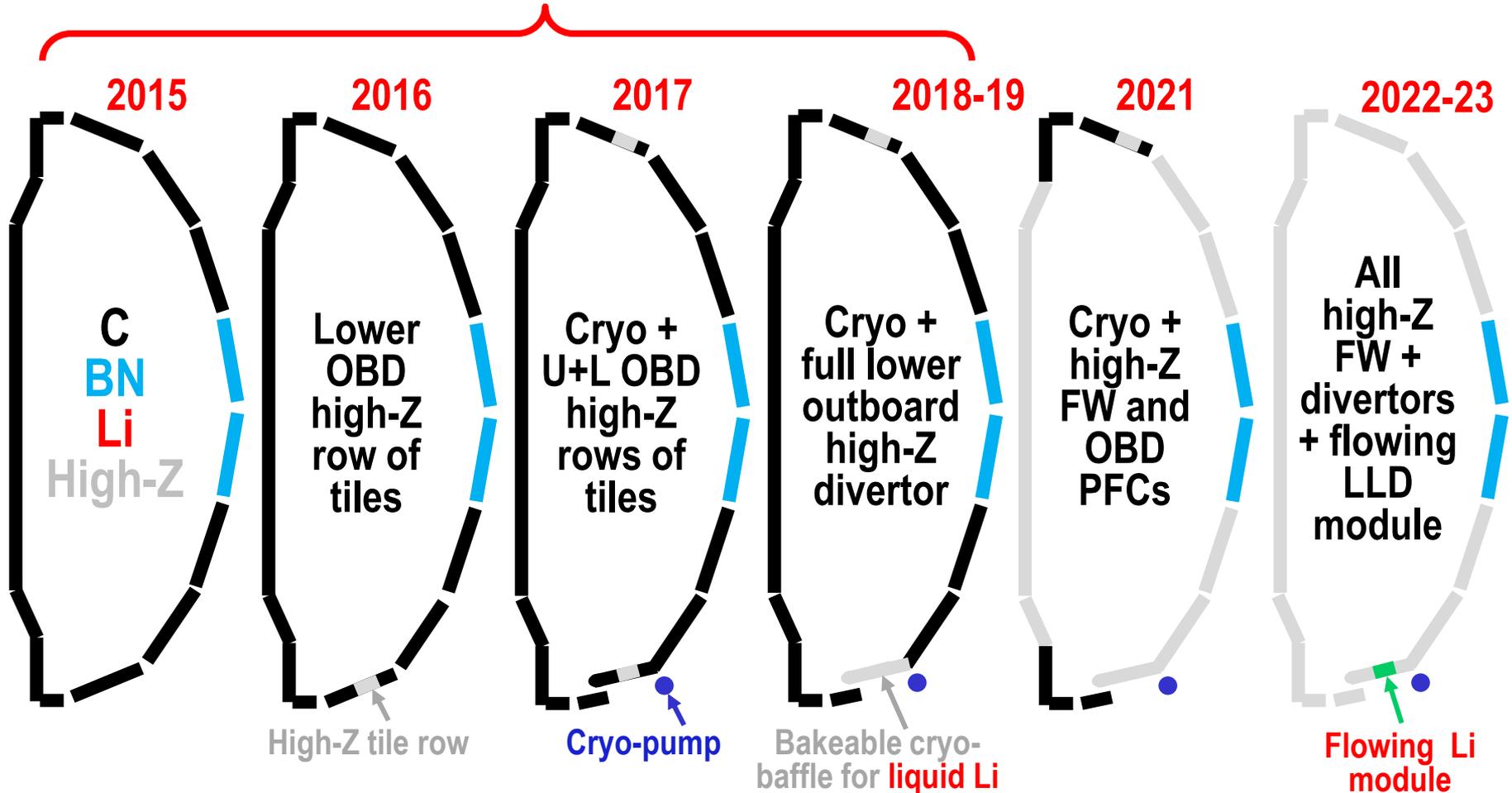
*Nominal 2014-18 5 year plan steps for implementation of cryo-pump + high-Z PFCs + LLD*



# NSTX-U internal component staging supports goal to assess compatibility of high $\tau_E$ and $\beta + 100\%$ NICD with metallic PFCs

Base budget case

Nominal 2014-18 5 year plan steps for implementation of cryo-pump + high-Z PFCs + LLD



# In your chapter, identify and mention the 1 or 2 strongest examples of world-leading science in the NSTX-U 5YP

## What is “world-leading” science?

**Example:** The criteria below were used in evaluating US facilities/programs in the recent (March 2013) “Report of the FESAC Subcommittee on the Prioritization of Proposed Scientific User Facilities for the Office of Science”

1. Addresses research needs identified in recent planning for at least 1 FES strategic goals: MFE, HEDLP, materials for fusion, basic plasma science
2. Resolves key scientific questions that are critical to development steps toward fusion power production
3. Creates opportunities for discoveries in plasma and fusion science
4. Provides unique capabilities
5. Enhances or maintains scientific leadership by the US
6. Provides cost effective approach to answering important scientific questions
7. Supports a broad community of researchers
8. Creates synergies through multi-disciplinary research

**Don't over-do it! But where it is strong, self-evident, and true, point it out...**

## One additional comment/request (post 5YP text completion)

- A key metric of the productivity and quality of our scientific research is publications
- Publication count was lower in 2012 ( $\Delta \sim -10$  papers)
  - Expect IAEA publications will make up for some of this in 2013, but...
- 2012 PRL count was: 1
  - Previous recent years: 3-6
- One can debate the merits, but PRL (and Science, Nature, ...) are often viewed as important indicators of scientific discoveries, innovation, and leadership
- We urge you to try to publish in one of the above prominent journals in the next year (and future years)