U.S. DEPARTMENT OF ENERGY | Office of Science

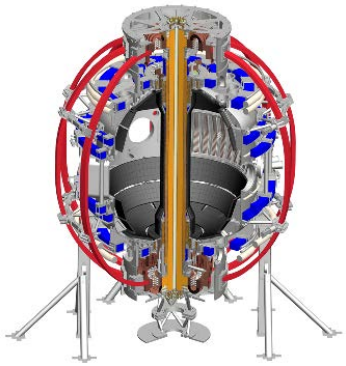
NSTX-U

Questions and Answers from PAC-37 Day 2

NSTX-U Team

NSTX-U PAC-37
PPPL
January 27, 2016

PPPL



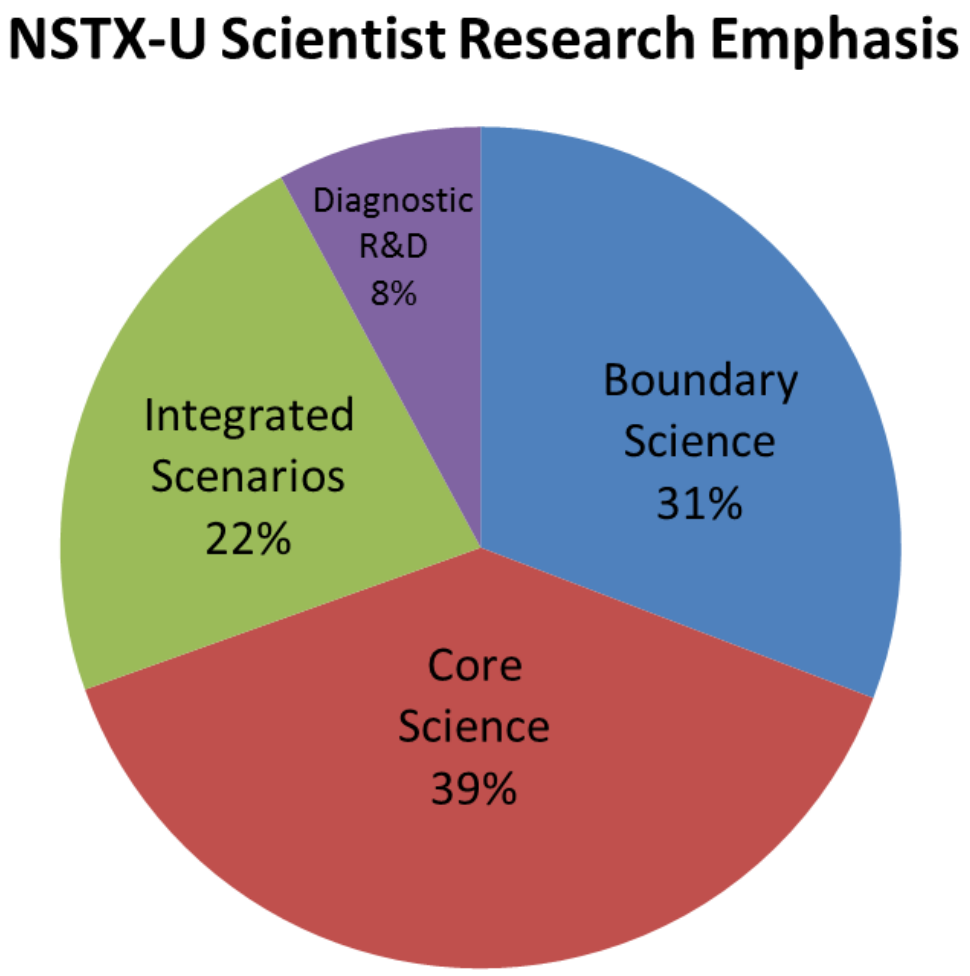
Questions from NSTX-U PAC-37 (Day 2)

1. What is the personnel allocation (FTE or headcount) by research group or topic?

2. What is the QC/QA and pre-testing plan for the solid high-Z tile row to be installed for the FY17 run? What will be done to verify both the materials and design in advance of installation of all the tiles?

Personnel allocation (head-count) sorted by research area of emphasis / Science Group

- ~290 NSTX-U scientists in total
- Assign single label to each scientist
  - Boundary
  - Core
  - Scenarios
  - Diagnostic R&D



What is the QC/QA and pre-testing plan for the solid high-Z tile row to be installed? What will be done to verify both material and design? (Jaworski/Tresemer)

- The first high-Z tile row is an experimental set
  - Establish operational experience with high-Z
  - Verify engineering design methodology
  - Also a “trial by ~~fire~~ plasma” test of PPPL procurement, QA, and technical staff

- Quality control and verifications are being carried out in three main areas
  - Material specification
  - Fabrication dimensional controls
  - Installation procedures

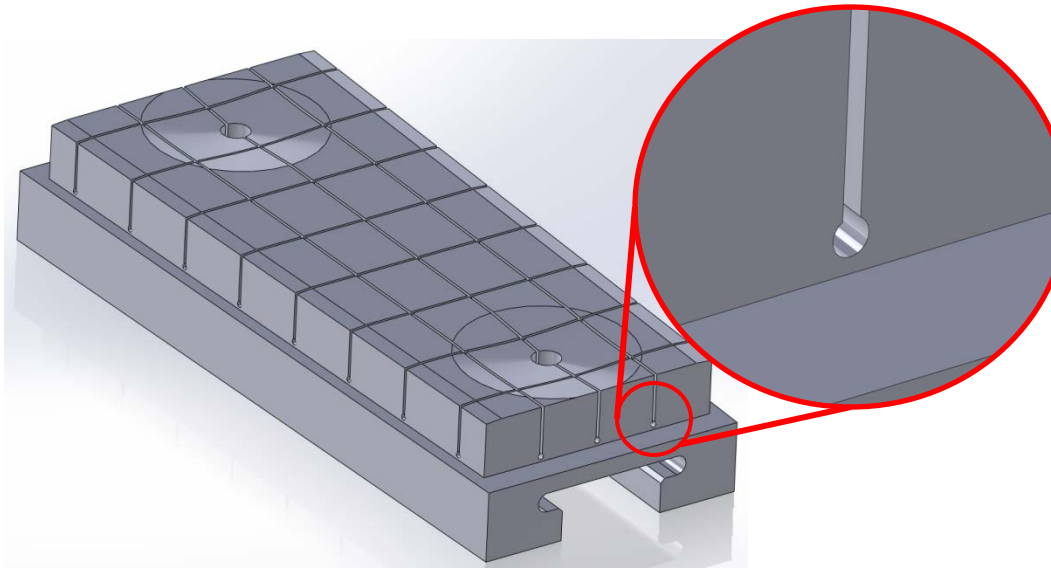
Material specification (trust, but verify)

- Numerous discussions with C-Mod engineering staff on TZM specifications in use for past 20+ years
- Rather than provide unique minimum requirements of our own creation, we have specified the use of an ASTM standard
  - ASTM B386 for molybdenum
  - Alloy type 363 (TZM, vacuum arc-cast, stress-relieved)
  - Provides specifications on composition, UTS, yield strength, elongation (mech. properties in transverse direction), and softening temperature minimum
  - Grain orientation specified in procurement specification
- Procured material currently under test at PPPL
  - S. Jurczynski performing tensile tests to verify ASTM spec
  - Will be testing with XRF analyzer to verify composition

Fabrication will be verified by PPPL QA

- Quality Assurance examination of fabricated parts a normal part of PPPL procurement process

- QA will be asked to verify critical features of final drawings
  - T-bar shaft
  - Chamfer geometry (including dish-pan)
  - Confirm round at base of castellations



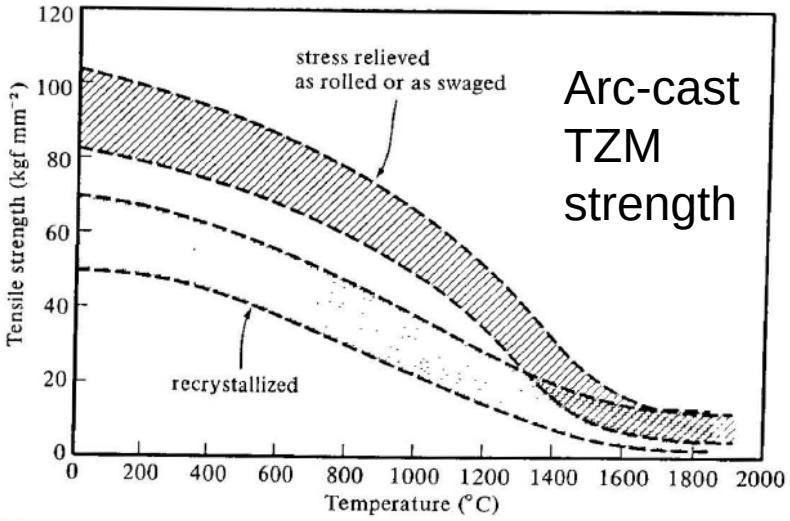
In-vessel Installation Procedure (IP) will specify tile-to-tile positioning

- Machine technicians install PFCs to IP specifications
  - Previously utilized for NSTX-U CS tiles
  - Extensive shimming expected (designed in) to accommodate uncertainty in outer divertor structure

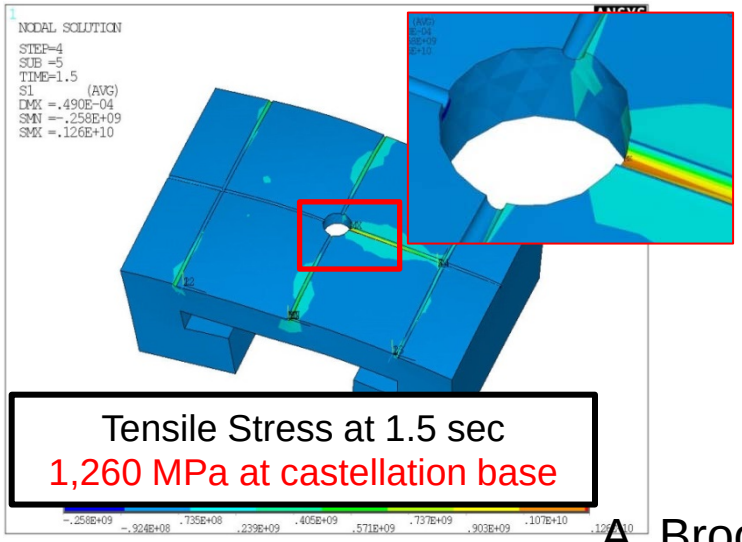
- Installation will be aided by precision installation tool
  - Inter-tile nominal gap is 0.030” (0.76mm), current plan for tolerancing +0”/-0.025” (0.64mm)
  - Inter-tile vertical tolerance alignment to within 0.005” (0.127mm)
  - Vertical misalignment spec. subject to change pending current analysis (PDR CHIT resolution)

Post-mortem analysis will verify performance after first run-year

- Most likely point of failure determined through extensive thermo-mechanical analysis
  - Castellation base results in stress concentration
  - Opening force along T-bar spine
  - Grain orientation specified that this is a longitudinal stress (maximum strength)
- Extra tiles procured so that a subset can be destructively examined post-run
- These experimental tiles are an engineering (and procurement) test for the cryo-pump divertor PFCs



Briggs, J., *High Temp.-High Press.* **3** (1971) p. 363-409.



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