OAK RIDGE National Laboratory

Proton Power Upgrade (PPU) Update

Presented to the
Basic Energy Sciences Advisory Committee

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ORNL is managed by UT-Battelle LLC for the US Department of Energy

U.S. DEPARTMENT OF ENERGY

Project motivation: Key science drivers

- PPU science drivers respond to grand challenges identified in DOE workshop reports
  - Non-equilibrium processes in active soft matter
  - Complex and dynamic biological systems
  - Highly entangled quantum states of matter
  - Liquid-solid reactions
  - Proton transfer processes
  - Chemical reactions at interfaces
  - Materials for extreme conditions
  - Interfacial science under non-equilibrium conditions
- PPU and the Second Target Station (STS) will ensure US researchers access to leading neutron science capabilities in the US

Machine design concept

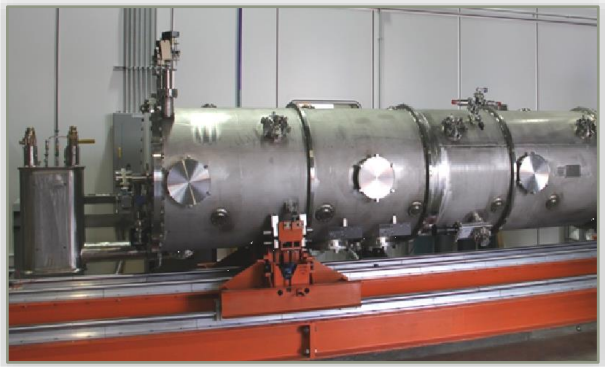
- PPU doubles SNS proton beam capability from 1.4 MW to 2.8 MW
  - 2 MW to First Target Station (FTS), 0.8 MW to STS
  - 30% energy increase, 50% current increase
  - Largely an extension of existing accelerator technology
  - Leverages built-in upgrade provisions

Key performance parameter	Threshold	Objective
Beam power on target (MW)	1.7	2.0
Beam energy (GeV)	1.25	1.3
Target operation without failure (hours)	1250 × 1.7 MW	1250 × 2.0 MW
Stored beam in ring (ppp)	1.6×10^{14} at 1.25 GeV	2.24×10^{14} at 1.3 GeV
Number of installed PPU cryomodules	6	7

Space in tunnel for new cryomodules

Project scope

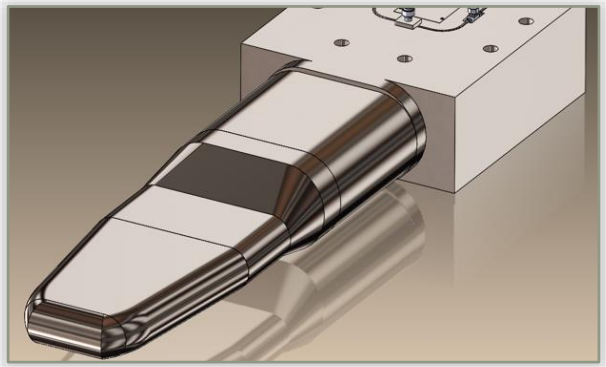
Superconducting linac (with JLab): 7 cryomodules



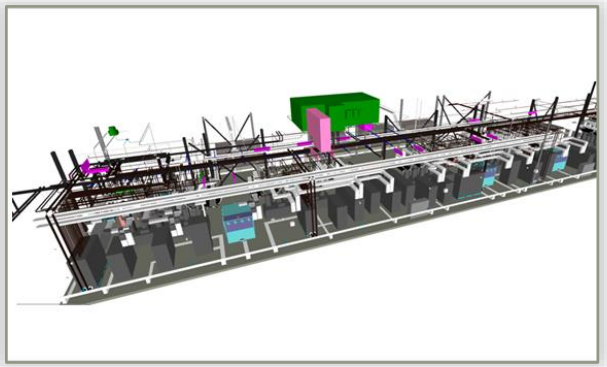
Ring (with FNAL): Injection, extraction

RF: Upgrade existing linac RF, RF for new cryomodules

Basis for WBS structure



Target: 2 MW target vessel, support system upgrades



Conventional facilities: Klystron gallery, transfer line stub for STS

PPU timeline
CD plans are dependent on funding availability

- PPU will minimize user impact, with only one extended outage in 2023
- As PPU installs equipment, beam power will gradually be increased
- TPC estimate at CD-3a is $239M

Level 1 Milestone	Date	Comments
CD-0, mission need	January 2009	Approved
CD-1, cost range alternative selection	April 2018	Approved
CD-3a, long lead procurement	October 2018	Approved
CD-2, performance baseline	Q1 2020	
CD-3, start of construction	Q1 2021	
CD-4, project completion	Q3 2027	Early completion: Mid-2024

Recent progress

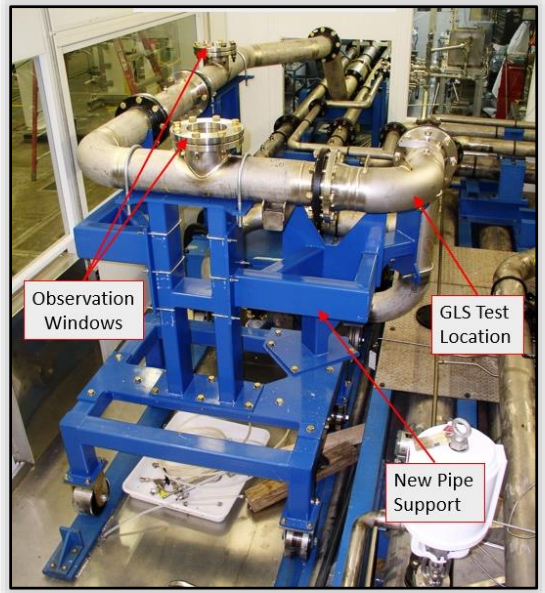
Accelerator systems

- Long lead procurement for superconducting cavities placed
- High power RF equipment design and testing under way

RF high voltage modulator undergoing heat test

Target systems

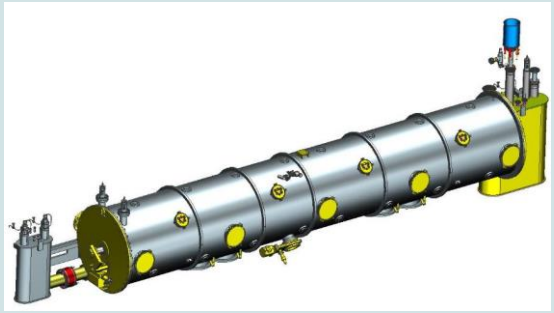
- Testing gas injection techniques to mitigate target damage
- Upgraded full-scale mercury Target Test Facility



Upgraded Target Test Facility

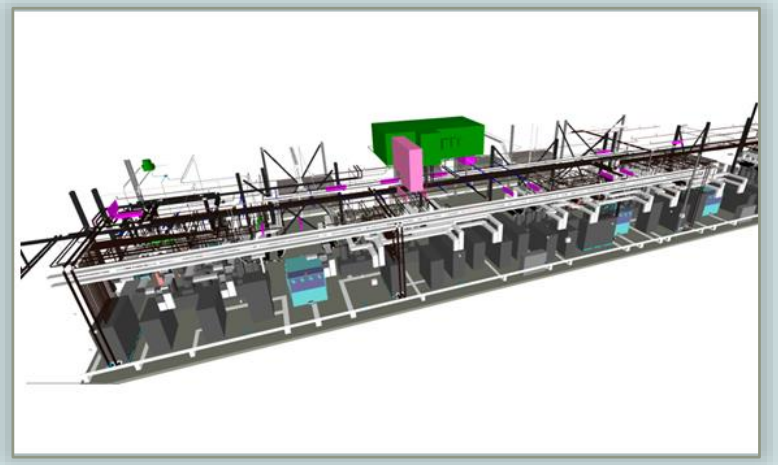
One year forecast

Finalize cryomodule and high power RF designs / initiate procurements



Finalize target gas injection development

Complete klystron gallery final design / initiate construction



Discussion

- SNS upgrades will enable researchers to address new scientific capabilities
- SNS upgrades are needed to maintain US leadership in neutron sciences
- PPU is largely based on existing accelerator technology
- We are implementing target gas injection capabilities to mitigate damage at high power
- We are partnering with other labs to leverage fabrication capabilities
- Favorable FY18 and FY19 budget allocations have helped advance the project
  - CD-3a approval for early cavity procurement
  - Pursuing CD-3b long lead approval to accelerate the early power ramp-up