Introduction

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SNS PPU Injection/Extraction Magnet Intermediate Review
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Project scope

- Oak Ridge National Laboratory (ORNL) is working on a Proton Power Upgrade (PPU) Project for the Spallation Neutron Source (SNS)
- Beam energy increases from 1.0 GeV to 1.3 GeV in steps
- Fermilab is doing three magnet designs for PPU:
  - Injection chicane dipole magnets – new design
  - Injection dump dipole magnets – new design
  - Extraction Lambertson magnet – modify existing magnet
- The designs are at three stages, so we ask that you look at each of them in context
Agenda (negotiable)

8:30 – Introduction (Dave)
8:45 – Chicane dipole design (John)
10:00 – Break
10:15 – Dump dipole status (John)
11:15 – Extraction Lambertson initial observations -- (Vladimir)
11:30 – Questions, open discussion
12:00 – Committee discussion, executive lunch
1:30 – Closeout
PPU-Ring Technical scope

- Re-evaluate injection dump power limit
- Install view screen

- Replace two chicane magnets
- Upgrade injection kicker power supplies
- Replace injection dump septum magnet
- Move chicane magnet #1 upstream ~32 cm
- Add WS to IDmp beamline

- Upgrade existing extraction kicker systems
- Replace shims in extraction septum magnet

- Upgrade water cooling system for the power supplies in the Ring service building
- Cooling fan kit for the main ring dipoles substation power transformers

- Neutronics and shielding calculations for RTBT to R2T2 tunnel stub
- PPS for stub

- Power limit system 2 MW
Ring injection scope detail (WBS P.4.2)

- Upgrade injection kicker power supplies (8 total)
- Move chicane #1 ~32 cm upstream
- Two new magnets Chicane #2 and Chicane #3
- New injection dump septum magnet
- Chicane #4 does not change

6.2 m
SNS 1.3 GeV injection requirements

- Closed orbit bump of about 100 mm
- Merge $H^-$ and circulating beams with zero relative angle
- Chicane #2 B-field at foil $0.21 \, T < B < 0.22 \, T$ and chicane #3 peak field $< 0.2 \, T$ for $H^0$ excited states
- Field tilt $[\arctan(By/Bz)] > 100 \, \text{mrad}$ to keep electrons off foil
- Direct stripped electrons down to electron catcher
- Direct $H^-$ and $H^0$ waste beams to IDmp beam line

Except for the chicane #2 and #3 field and tilt angle requirements, the PPU 1.3 GeV requirements are the same as the 1.0 GeV requirements
Ring injection

- Inj. Dump Septum (to be replaced)
- Chicane #4 (to remain)
- Chicane #3 (to be replaced)
- Chicane #2 (to be replaced)
- Chicane #1 (to be moved)
Ring Injection Zone
Extraction Lambertson Magnet (as of 2003)
Chicane Dipole Status

• A single design for the two magnets, one upside down, has been deemed acceptable
• Detailed tracking studies by ORNL have shown that the two chicane dipoles produced a field profile that meets the project needs
• Interfaces and potential interferences in the tunnel have been resolved through extensive measurements and modeling
• Detailed component drawings are in an advanced state
• Coil tooling models are ready for component drawings

• Would like to call this the 90% final review, so please look at the magnet in this light.
Dump Dipole Status

• The solid model is at an advanced state, with most mechanical, electrical, and plumbing issues resolved

• Detailed tracking studies completed in late January identified two issues that still need to be addressed by what we expect to be minor modifications to the core geometry

• We ask that you concentrate on the mechanical design, looking at magnetic design considerations to the extent possible, and treat this as a preliminary design review
Extraction Lambertson Magnet

• The STEP file from the CAD model of the existing magnet has been loaded and we are resolving orientation questions.

• While there is no design to review beyond the existing magnet, your thoughts on areas to pay attention to would be welcome.
Rough schedule for completing the designs

- Chicane drawings and tooling – late April
- Dump dipole – Final design review – July
- Extraction Lambertson – Final design review – July
- Component procurement readiness review – October
- Production readiness review – March 2021
1. Is the design of the chicane dipole magnets technically sound and sufficiently advanced to ensure success?

2. Is the mechanical design of the dump dipole magnet sufficiently mature to proceed to component drawings when the magnetic design is approved by the project?

3. Is the concept of reshimming the extraction Lambertson magnet realistic?