Power Upgrade Project Plans

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Accelerator Advisory Committee

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Outline

- Background
- Scope of the SNS power upgrade
- Upgrade plan
- Cost and Schedule
- Summary

Power Upgrade Project (PUP) Mission Need Affirmed in DOE 20-Year Plan

- PUP proposal ranked a “Very High Mid-Term Priority” in the DOE November 2004 Study, “Facilities for the Future of Science, A TwentyYear Outlook”
- Double total beam power facilitates:
  - Higher speed, better resolution, and additional capability for experiments on the performance threshold
  - Provides headroom for powering a Second Target Station without compromising the existing target station
  - Provides additional operating margin in the linac to improve overall reliability

SNS power upgrade path

- Mission need statement (CD-0) approved November 23, 2004
  - "… enable practical study of smaller samples and real-time studies at shorter time scales"
  - "Many technical margins have been built into SNS systems to facilitate a power upgrade to >2 MW"
- Power Upgrade Project was formed as a Major Item of Equipment (MIE) project to fulfill this mission need
- Doubling of power achieved by 30% increase in beam energy and 60% increase in beam current
- Major elements of the power upgrade include:
  - Addition of high-beta cryomodules and associated RF power systems
  - Ion source and target upgrades

SNS power upgrade scope

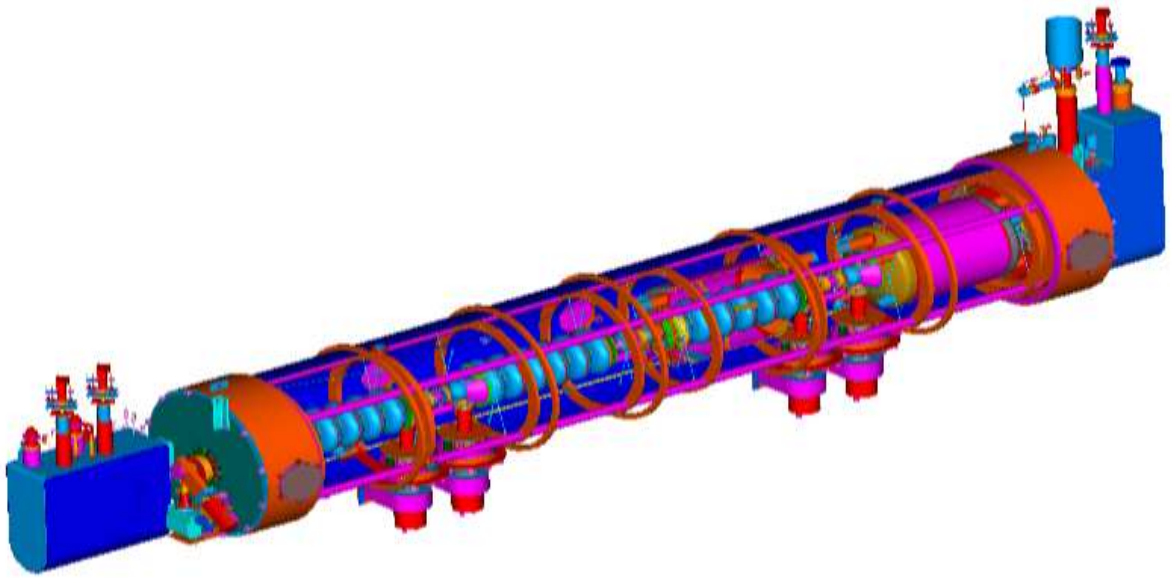
- SNS is currently capable of beam power > 1 MW (design power = 1.4 MW)
- Power upgrade goal is 3 MW
- Proven technology, designs are complete, SC linac successfully commissioned and operated for > 2 years
  - Options for production of cryomodules have been studied and more than one viable path exists
- Scope also includes enhancements needed in other key areas (target, ion source, …)
  - These activities include some R&D elements and have more lead time than the linac upgrade itself
  - Schedule logic overlays linac long lead procurements with target, ion source R&D

The SNS Design Anticipated a Power Upgrade

- Room for more linac (increase energy from 1.0 to 1.3 GeV)
- Ring supports 1.3 GeV (magnets, power supplies, cabling, physics)
- Permanent target systems designed to 2 MW (bulk shield 4 MW)

Cryomodule and RF System Scope

- Nine (9) additional HB cryomodules
  - Installed in existing positions (slots) in linac tunnel
- 36 RF systems including klystrons, transmitters, modulators, and controls
- Final energy of 1.3 GeV will be achieved with flexibility by requiring that PUP cavities have gradient of ≥ 15.6 MV/m
  - Some cavities used for energy feedback
  - Some cavities used as online spares in case of component failure



Ring Scope

- Most of the RING Systems were designed for 1.3 GeV, but some changes are required:
  - Injection chicane
    - Two new dipoles + associated power supplies
  - Injection region vacuum
    - New chambers
    - New stripper foil mechanism
  - Extraction kickers (add two)
  - Ring injection dump upgrade

Ion Source Scope

- New ion source and LEBT required to increase RFQ output current from 38 to 59 mA

- PUP requirements will be met by combining a low-emittance, high-current ion source with LEBT that causes minimal emittance growth
  - Both of these elements have been demonstrated as individual components, but not as a combined system

- R&D program is focused on developing this equipment
  - Progress on several options was presented by Martin Stockli

Target Scope

- New (Mark-2) target (≥2 MW) with small Hg-filled channels eliminated to extend cavitation damage erosion lifetime
- R&D to support implementation of Mark-2 target and conceptual design for Mark-3 target with gas injection to mitigate cavitation damage (See Riemer presentation)
- Redesigned inner reflector plug (IRP) & Proton Beam Window (PBW)
- Target facilities upgrade

SNS Power Upgrade Parameters

Primary Scope Issues	Initial SNS Capability	Upgrade
Kinetic energy (GeV)	1.0	1.3
Nine (9) additional high-beta cryomodules	12	21
Thirty-six (36) new RF systems	81	117
New, higher power target	≥ 1 MW	≥ 2 MW
RFQ output peak current (mA)	38	59

SNS Power Upgrade Plan Was Revised Following June 2007 DOE Review

- Following the June 2007 Review of the PUP project and in consideration of budget constraints, DOE decided to:
  - Delay the start of PUP until 2010
  - Break the project into several elements based partly on their readiness to proceed
    - The newly defined Power Upgrade Project (PUP) includes only the beam energy upgrade portion
    - Beam current increase and target improvements will be accomplished through R&D activities and Accelerator Improvement Projects (AIPs)
- Conceptual design for this newly defined Power Upgrade Project (PUP) completed
  - Project will be started in 2010 and completed in 2013
- Net result of PUP + R&D + AIPs will be a doubling of the SNS beam power by 2013

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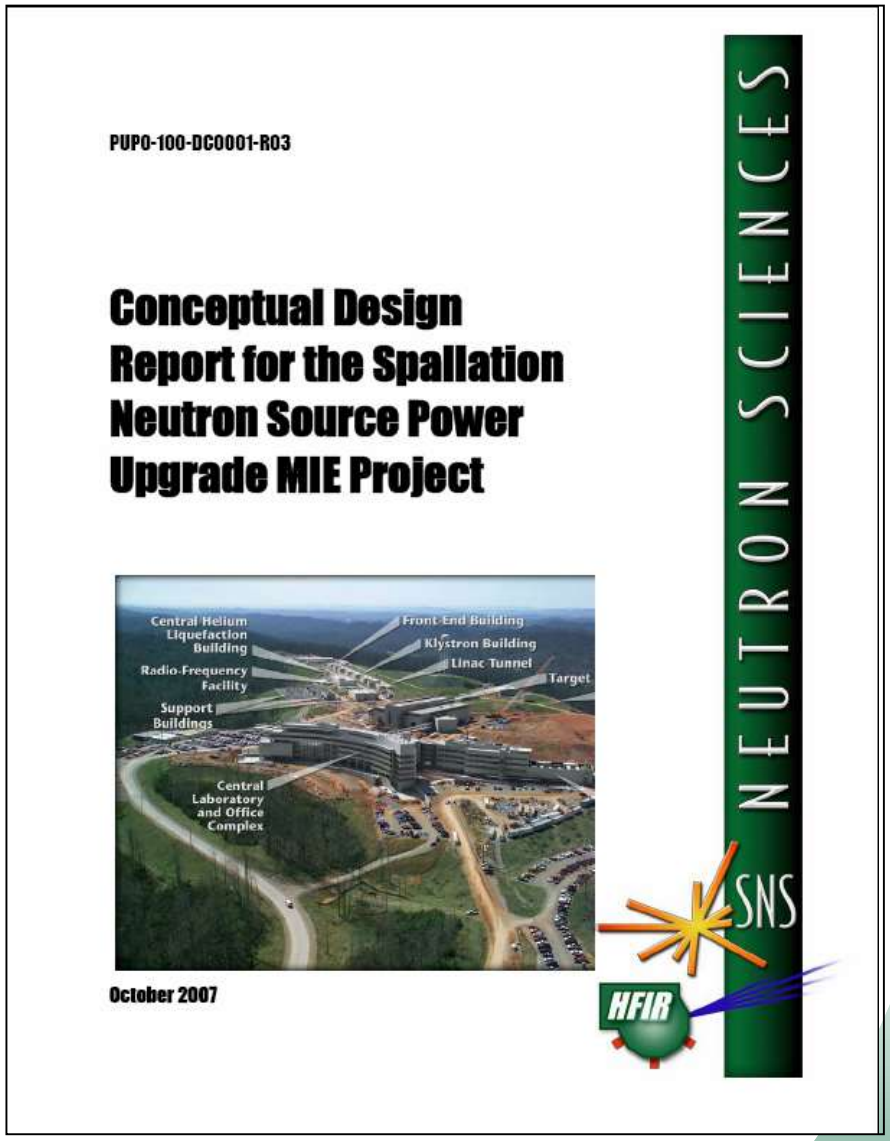
PUP project scope

R&D & AIPs funded with SNS operating budget

PUP Status

- Scope of newly constituted PUP is documented in the SNS Power Upgrade Project Conceptual Design Report (CDR rev 3)
  - Scope for beam current and target upgrades documented in June 2007 PUP CDR (CDR rev 2)
- Project Execution Plan, cost estimate, safety documentation, risk assessment, and CDR submitted to DOE for Critical Decision-1
  - Approval expected this year
- Delay in start of PUP + recent progress on SNS Second Target Station (STS) provides the opportunity to better integrate PUP with STS concepts



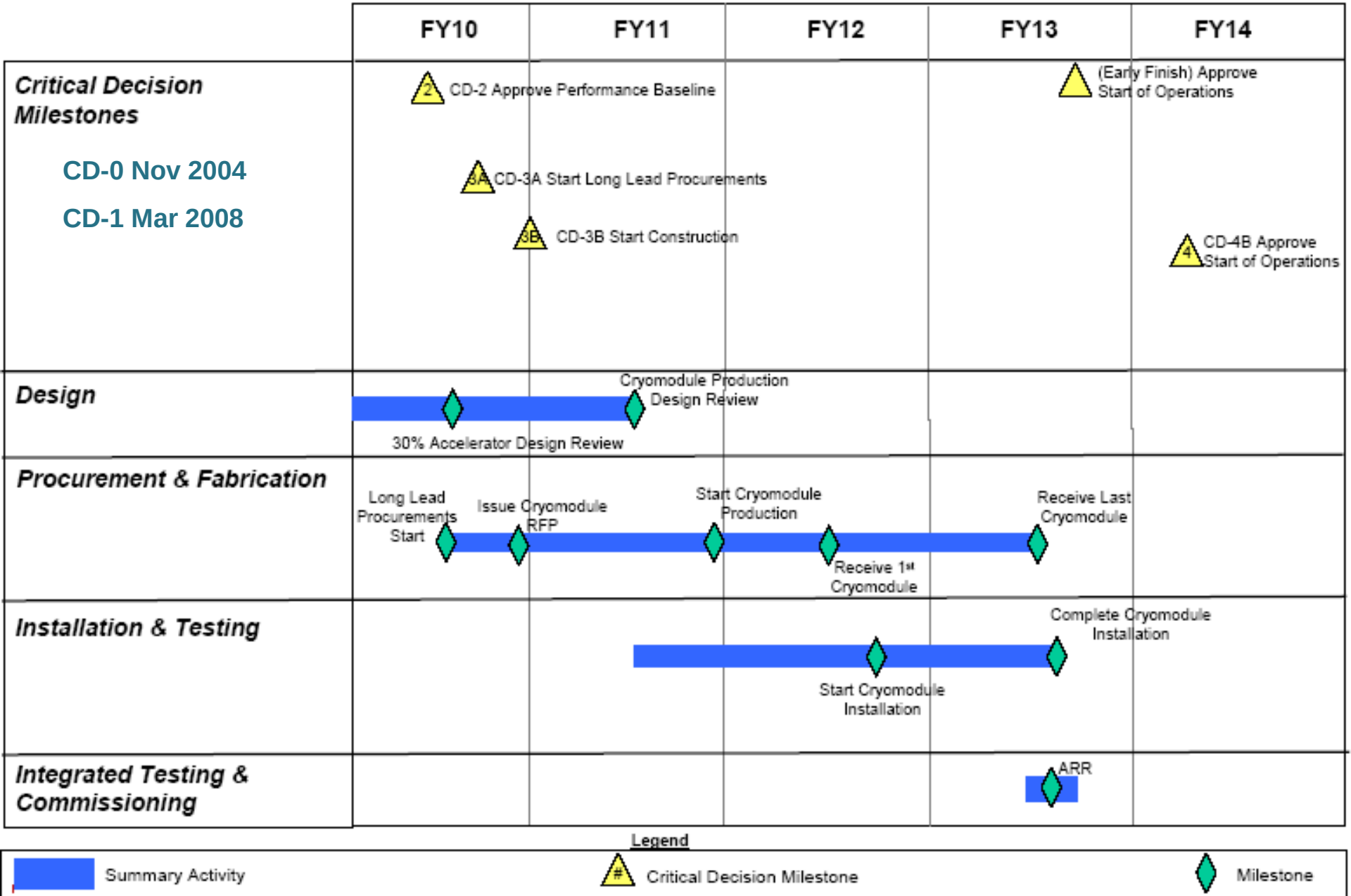
Cost Estimate for SNS power upgrade

Funding Needs ($M)

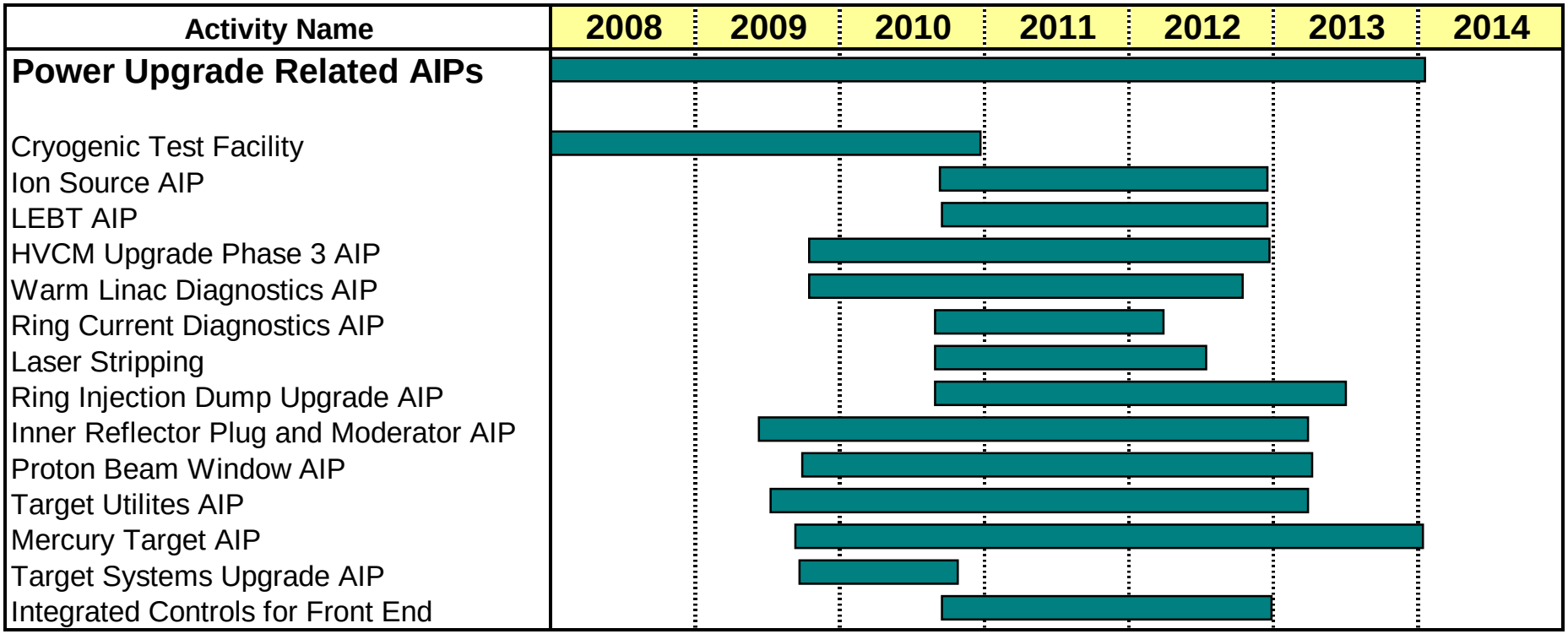
	Prior	FY08	FY09	FY10	FY11	FY12	FY13	Total
PUP	0.7	0.7	0.1	17.9	37.6	19.0	13.6	**90**
CU AIPs	0.0	0.9	3.8	8.5	26.8	19.6	4.4	**64**
Ops R&D	5.6	3.7	7.3	5.5	2.3	1.4	1.4	**27**
Total	**6.3**	**5.3**	**11.2**	**31.9**	**66.7**	**40.0**	**19.3**	**181**

PUP cost range is $87M to $98M including 24% contingency

PUP Summary Schedule



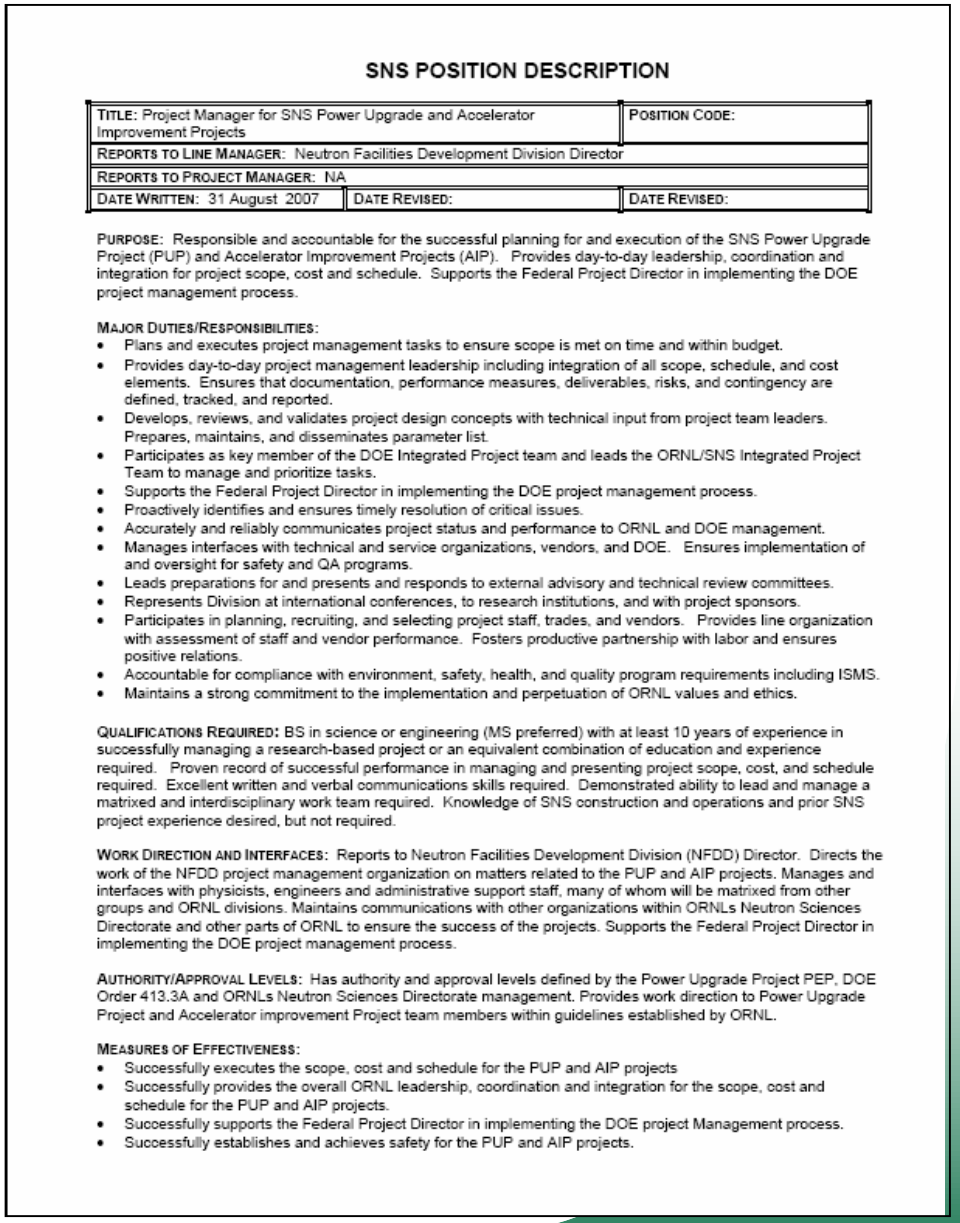
Schedule for power upgrade-related AIPs



Significant R&D efforts on mercury target and ion source are already underway

Hiring PUP Project Manager

- New ORNL Project Manager will be in-place soon
- Will manage AIPs for the next 1 ½ years and prepare for start of PUP in 2010
- Position posted in December 2007



SNS POSITION DESCRIPTION

TITLE: Project Manager for SNS Power Upgrade and Accelerator Improvement Projects		**POSITION CODE:**
REPORTS TO LINE MANAGER: Neutron Facilities Development Division Director		
REPORTS TO PROJECT MANAGER: NA		
DATE WRITTEN: 31 August 2007	**DATE REVISED:**	**DATE REVISED:**

PURPOSE: Responsible and accountable for the successful planning for and execution of the SNS Power Upgrade Project (PUP) and Accelerator Improvement Projects (AIP). Provides day-to-day leadership, coordination and integration for project scope, cost and schedule. Supports the Federal Project Director in implementing the DOE project management process.

MAJOR DUTIES/RESPONSIBILITIES:

- Plans and executes project management tasks to ensure scope is met on time and within budget.
- Provides day-to-day project management leadership including integration of all scope, schedule, and cost elements. Ensures that documentation, performance measures, deliverables, risks, and contingency are defined, tracked, and reported.
- Develops, reviews, and validates project design concepts with technical input from project team leaders. Prepares, maintains, and disseminates parameter list.
- Participates as key member of the DOE Integrated Project team and leads the ORNL/SNS Integrated Project Team to manage and prioritize tasks.
- Supports the Federal Project Director in implementing the DOE project management process.
- Proactively identifies and ensures timely resolution of critical issues.
- Accurately and reliably communicates project status and performance to ORNL and DOE management.
- Manages interfaces with technical and service organizations, vendors, and DOE. Ensures implementation of and oversight for safety and QA programs.
- Leads preparations for and presents and responds to external advisory and technical review committees.
- Represents Division at international conferences, to research institutions, and with project sponsors.
- Participates in planning, recruiting, and selecting project staff, trades, and vendors. Provides line organization with assessment of staff and vendor performance. Fosters productive partnership with labor and ensures positive relations.
- Accountable for compliance with environment, safety, health, and quality program requirements including ISMS.
- Maintains a strong commitment to the implementation and perpetuation of ORNL values and ethics.

QUALIFICATIONS REQUIRED: BS in science or engineering (MS preferred) with at least 10 years of experience in successfully managing a research-based project or an equivalent combination of education and experience required. Proven record of successful performance in managing and presenting project scope, cost, and schedule required. Excellent written and verbal communications skills required. Demonstrated ability to lead and manage a matrixed and interdisciplinary work team required. Knowledge of SNS construction and operations and prior SNS project experience desired, but not required.

WORK DIRECTION AND INTERFACES: Reports to Neutron Facilities Development Division (NFDD) Director. Directs the work of the NFDD project management organization on matters related to the PUP and AIP projects. Manages and interfaces with physicists, engineers and administrative support staff, many of whom will be matrixed from other groups and ORNL divisions. Maintains communications with other organizations within ORNLs Neutron Sciences Directorate and other parts of ORNL to ensure the success of the projects. Supports the Federal Project Director in implementing the DOE project management process.

AUTHORITY/APPROVAL LEVELS: Has authority and approval levels defined by the Power Upgrade Project PEP, DOE Order 413.3A and ORNLs Neutron Sciences Directorate management. Provides work direction to Power Upgrade Project and Accelerator improvement Project team members within guidelines established by ORNL.

MEASURES OF EFFECTIVENESS:

- Successfully executes the scope, cost and schedule for the PUP and AIP projects
- Successfully provides the overall ORNL leadership, coordination and integration for the scope, cost and schedule for the PUP and AIP projects.
- Successfully supports the Federal Project Director in implementing the DOE project Management process.
- Successfully establishes and achieves safety for the PUP and AIP projects.

Summary

- **Successful completion of the PUP MIE Project is a key element of the strategy to realize the full scientific potential of SNS**
  - **2x power upgrade will be realized in time to support STS**
  - **Plan to minimize disruption to SNS operation**
- **PUP Scope (beam energy upgrade) and Risks are well understood**
  - **Conceptual Design Report provides basis**
  - **CD-1 approval expected in 2008**
  - **Based on proven technology – leverages capability built into the existing complex**
  - **PUP cost range estimated to be $87M to $98M with a Dec 2013 completion**
  - **Will draw on expertise (technical and project management) developed in SNS construction, SING, etc.**
- **Beam current and target power handling upgrade funded through R&D and Accelerator Improvement Projects (AIPs)**
  - **Concerned about the risk/uncertainty associated with funding significant portions of the upgrade with operation funds**