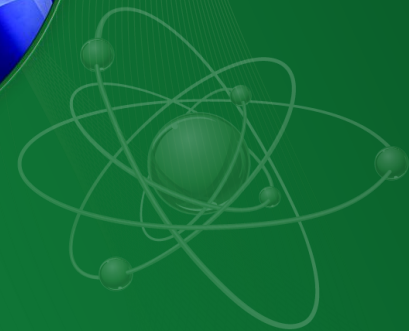
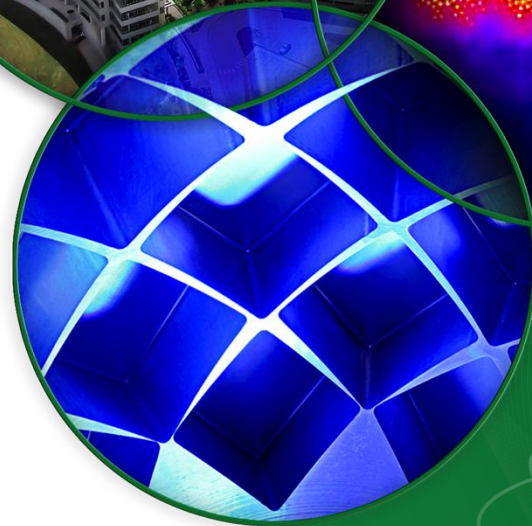
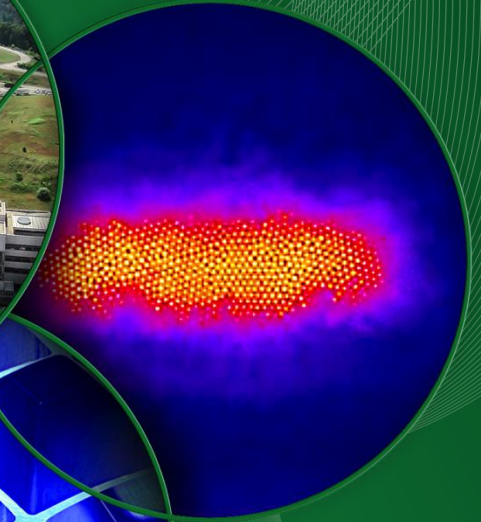


# The SNS Accelerator Improvement Program

George W. Dodson

Accelerator Advisory Committee  
March 24-26, 2015

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



# Requirements for an AIP Project

- DOE provides AIP funds to SNS for **additions, modifications, and improvements** to the research accelerator and ancillary equipment facilities to **maintain and improve the performance, reliability and efficiency of operations, and to provide new accelerator capabilities**. This definition encompasses all systems involved with the production and delivery of neutrons to the individual SNS beamlines.
- AIPs must result in a deliverable that can be identified and capitalized. The AIP deliverable must have an estimated cost greater than or equal to \$500,000, less than \$10,000,000 and a lifetime of at least 2 years. Fabrication of spares is not allowed in the AIP program (no spare Medium Beta Cryomodule).

# In the last AAC We presented a Plan for AIPs in FY 13-15 based on Sustainable 1.4MW Beam Operation

## HVCM Improvements (Pulse Length)

- Develop, Test and Deploy Cooling System Upgrade – **Prototype Completed, Fabrication Planning Underway**
- Complete Snubber/Gate Driver Deployment – **65% of Gate drivers and 30% Snubbers Installed**
- Develop, Test and Deploy New Controller – **Controller Developed, Tested and First Article Deployment Planned this Summer**

## Ion Source Improvements (Peak Current)

- Develop External Antenna Ion Source – **Successfully bench tested**

## Develop SRF Infrastructure and R&D for Cavity Gradient Improvement (Beam Energy)

- Complete Cryo Test Facility (2K) with VTA and HTA – **Completed**
- Plasma Processing
  - R&D with 3 Cell Cavity – **Completed**
  - R&D with 6 Cell Cavity – **Completed,**
  - R&D Work with HTA – **Underway**
  - R&D with offline Cryomodule – **planned for later in FY 2015**
  - In Situ Processing – **planned for later in FY 2016 and 2017**

# Sustainable 1.4MW Beam Operation - Continued

Design, Prototype, Fabricate and Test new DTL and CCL RF Coupler

- Prototype New DTL and CCL Couplers – Reduced urgency for new DTL,CCL Couplers resulted in lower priority– **Prototypes Completed**
- **New focus on RFQ Couplers**

Design, Fabricate and Install a new Primary Stripper Foil Mechanism

- Rebuilt and installed Spare PSF mechanism. Although far from perfect, it works well enough for a replacement to be a lower priority.
- The original has been rebuilt and bench-tested and is now the spare.

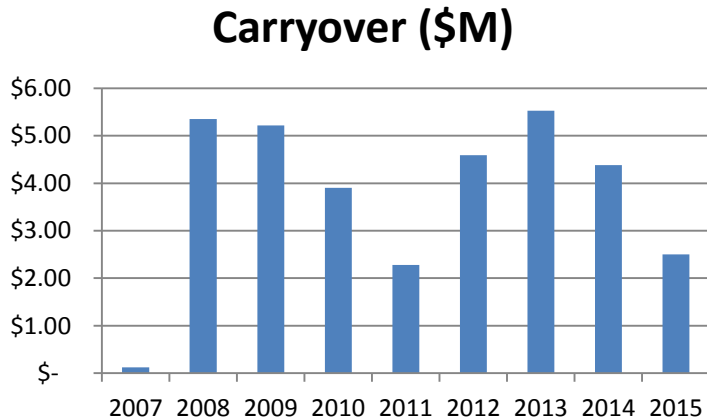
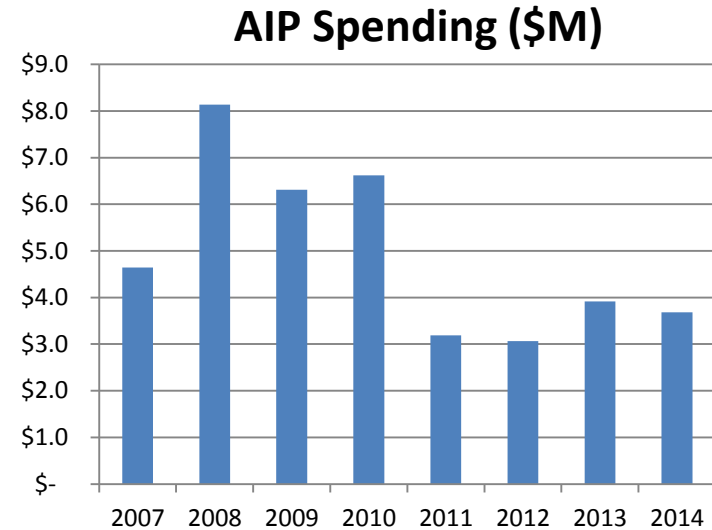
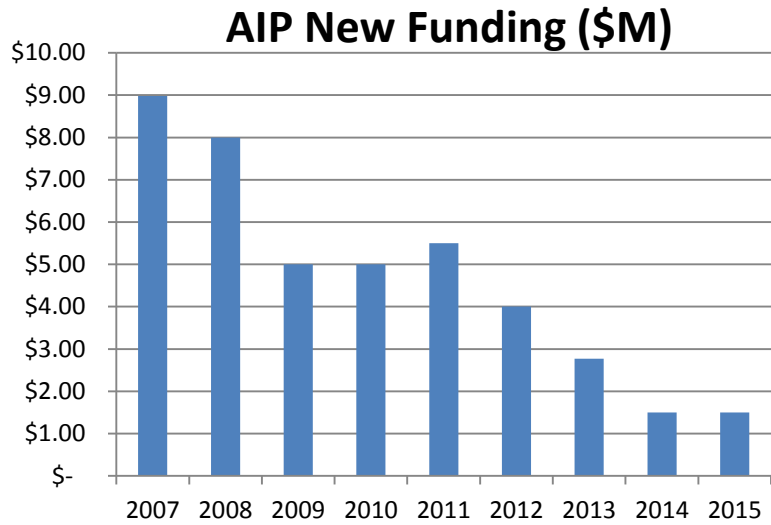
# What Additions, Have been Built since FY 2013 or are Planned using AIP Funding?

- Cryogenic Test Facility – Completed in FY2014
  - Vertical Test Apparatus, Horizontal Test Apparatus, LHe Filling Station
- Integrated Test Stand Facility – Underway (RFQ was RF Tested)
  - Test Stand for RFQ, LEBT, Ion Source, Beam Instrumentation, Neutron Moderators development
- Small Scale Chemistry for Cavity Processing – Planned (Almost ready to start )
  - Small scale chemical preparation of SRF Components
- Full Scale Chemistry System – Planned
  - Large scale chemical preparation for development of new cavities
- In-Situ Plasma Processing System – Planned (R&D Ongoing)
  - Essential for Sustainable Operation, Gradient Recovery

# What Modifications and Improvements Have been Built since FY2013 or are Planned Using AIP Funding?

- New HVCM Controller – **Underway**
  - New Controller for Pulse Flattening, Improved Diagnostics, COTS Package
- Warm Linac Vacuum Upgrade – **Underway**
  - Replace Ion Pumps with large Turbopumps more suited to large accelerating structures with many “O” Rings
- HVCM Cooling System Upgrade – **Planned (Prototype built, tested)**
  - Upgrade cooling to eliminate component overheating and oil degradation
- Machine Protection System Upgrade – **Planned (Design Document Written)**
  - Replace obsolescent components and improve performance
- Beam Instrumentation Infrastructure Improvement – **Planned**
  - Replace obsolescent components and improve performance
- Warm Linac Magnet Power Supply and Controller Upgrade – **New**
  - Replace obsolescent components, standardize power supplies and controllers for MEBT, DTL and CCL
- New DTL and CCL RF Couplers – **Planned (Prototypes built, tested)**

# AIP Funding and Spending FY 2007-2015



# Planned and Budgeted FY 2015 AIPs

Accelerator Improvement Projects	Total Project Cost	Costed & Committed FY14	Carryover from FY14	FY14 Carryover Rescheduled for FY15	FY15 New BA	FY 15 Total Scheduled BA	
AIP-25 Cryogenic Test Stand Facility	\$ 5,277,808	\$ 751,350	\$ 628,567		\$ -	\$ -	Completed in FY 2014
AIP-30 Integrated Test Stand Facility	\$ 2,246,748	\$ 1,357,176	\$ 803,229	\$ 803,229	\$ -	\$ 803,229	Underway
AIP-33 Small Scale Chemistry	\$ 2,623,000	\$ -	\$ -	\$ -	\$ 200,000	\$ 200,000	Underway
AIP-34 New HVCM Controller	\$ 2,000,000	\$ -	\$ 500,000	\$ 500,000	\$ 300,000	\$ 800,000	Underway
AIP-35 Warm Linac Vacuum	\$ 5,315,142	\$ 1,580,452	\$ 612,286	\$ 1,240,853	\$ 750,000	\$ 1,990,853	Underway
AIP 39 Machine Protection System Improvements	\$ 3,360,000	\$ -	\$ -	\$ -	\$ 250,000	\$ 250,000	Awaiting DOE Approval
AIP-36 HVCM Cooling Upgrade	\$ 1,189,000	\$ -	\$ -	\$ -	\$ -	\$ -	On Hold
AIP-37 Beam Instrumentation Infrastructure Improvements	\$ 2,000,000	\$ -	\$ -	\$ -	\$ -	\$ -	On Hold
AIP-38 DTL-CCL Couplers	\$ 1,030,000	\$ -	\$ -	\$ -	\$ -	\$ -	On Hold
AIP 42 Warm Linac Resonance Control System (RCCS) Upgrade	\$ 790,000	\$ -	\$ -	\$ -	\$ -	\$ -	On Hold
<b>Subtotal Accelerator Improvement (AIP)</b>		<b>\$ 3,688,978</b>	<b>2,544,082</b>	<b>\$ 2,544,082</b>	<b>\$ 1,500,000</b>	<b>\$ 4,044,082</b>	<b>\$ -</b>

We plan to spend most if not all of the \$4 M in AIP funds this FY with little or no carryover. The plan for FY16 will depend on funding levels in FY16.



# Notional AIP Spending Plan (Funding Based)

Accelerator Improvement Projects	Total Project Cost	FY 15 Scheduled BA	FY 16 Scheduled BA	FY 17 Scheduled BA	Cost at End of FY17	Status at End of FY17
AIP-30 Integrated Test Stand Facility	\$2,246,748	\$803,229	\$60,000	\$0	\$2,220,405	Complete
AIP-33 Small Scale Chemistry	\$2,623,000	\$200,000	\$800,000	\$800,000	\$1,800,000	Underway
AIP-34 New HVCM Controller	\$2,000,000	\$800,000	\$800,000		\$1,600,000	Underway
AIP-35 Warm Linac Vacuum	\$5,315,142	\$1,990,853	\$1,000,000	\$800,000	\$5,371,305	Complete
AIP 39 Machine Protection System Improvements	\$3,360,000	\$250,000	\$400,000	\$500,000	\$1,150,000	Underway
AIP-36 HVCM Cooling Upgrade	\$1,189,000	\$0	\$500,000	\$689,000	\$1,189,000	Complete
AIP-37 Beam Instrumentation Infrastructure Improvement	\$2,000,000	\$0	\$500,000	\$1,000,000	\$1,500,000	Underway
AIP-46 Plasma Processing	\$1,030,000	\$0	\$100,000	\$300,000	\$400,000	Underway
AIP 42 Warm Linac Resonance Control System (RCCS) Upgrade	\$790,000	\$0			\$0	On Hold
AIP Warm Linac Power Supply and Controller Upgrade	\$2,000,000	\$0	\$600,000	\$900,000	\$150,000	Underway
<b>NEW FY BA</b>		<b>\$1,500,000</b>	<b>\$5,000,000</b>	<b>\$5,000,000</b>		
<b>Subtotal Accelerator Improvement (AIP)</b>		<b>\$4,044,082</b>	<b>\$4,760,000</b>	<b>\$4,989,000</b>		

# Other Major Needs

- Spare Medium Beta Cryomodule (not an AIP) \$4M
- CCL Klystron Second Vendor Startup (not an AIP) \$2M
- Spare 402.5MHz Circulators (not an AIP) \$1M
- Replacement Remote Handling Robot Possibly and AIP \$7.5

# Summary

- We have an active AIP Process.
- AIPs have shifted over the years from “what we should have had at the end of the Project Phase” to what we need for sustainable operation
- This includes a recent emphasis on Obsolescence Mitigation.
- With an installed equipment base of ~\$700M, an AIP budget of \$1.5M/Year is not sustainable.