

# Accelerator Readiness Review Plan of Action Revision 5



A U.S. Department of Energy Multilaboratory Project

SPALLATION NEUTRON SOURCE  
Argonne National Laboratory • Brookhaven National Laboratory • Thomas Jefferson National Accelerator Facility • Lawrence Berkeley National Laboratory • Los Alamos National Laboratory • Oak Ridge National Laboratory

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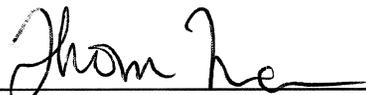
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Thom Mason  
Associate Laboratory Director

11 Aug, 2004

Date



Norbert Holtkamp  
Director,  
Accelerator Systems Division

10/Aug/04

Date



Ian Anderson  
Director,  
Experimental Facilities Division

11 August 04

Date



George Dodson  
Operations Manager,  
Accelerator Systems Division

10/Aug/04

Date



John Forester  
Operations Manager,  
Experimental Facilities Division

10/aug 104

Date



Les Price  
SNS DOE Project Manager

11 Aug. 2004

Date

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**ACRONYMS**

ARR	Accelerator Readiness Review
ASE	Accelerator Safety Envelope
CASE	Commissioning Accelerator Safety Envelope
CCL	Coupled Cavity Linac
CPP	Commissioning Program Plan
CD	Critical Decision
DOE	Department of Energy
DTL	Drift Tube Linac
FSAD	Final Safety Assessment Document
HEBT	High Energy Beam Transport
PFSAD	Preliminary Final Safety Assessment Document
PSAD	Preliminary Safety Assessment Document
RTBT	Ring to Target Beam Transport
SAD	Safety Assessment Document
SCL	Superconducting Linac
SNS	Spallation Neutron Source

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## 1. INTRODUCTION

The Spallation Neutron Source (SNS) commissioning, from Front End to Critical Decision 4 (CD-4), the end of the construction project, and the transition to operations, will take place under the Department of Energy (DOE) Accelerator Safety Order, DOE Order 420.2 B.

According to the guidance for DOE Order 420.2A, “The basis of DOE approval of Accelerator facility activities remains the contractor submission of Safety Assessment Documents (SAD), an Accelerator Safety Envelope (ASE) and Accelerator Readiness Review (ARR) reports, with subsequent DOE review and approval of the ASE.” In addition, the SNS Project Execution Plan requires DOE review and approval of the final SAD (FSAD).

The role of the DOE Field Office is specified in the draft guidance for DOE Order 420.2A. In Section II.A.3 under Accelerator Readiness Review it is stated that: “The role of DOE Field Offices (Operations/Area/Site Offices) in the ARR process is to: ‘Request the contractor to prepare a proposed ARR Plan of Action and submit it to DOE for acceptance.’”

This document contains the Plan of Action for the SNS readiness review process. The dates listed in this document are the anticipated schedule dates based on the current SNS baseline project schedule. These dates depend critically on beneficial occupancy dates for conventional facility construction and delivery dates from vendors and partner laboratories. During the fabrication, testing and installation, some changes to these dates may occur. As changes to the SNS project baseline schedule occur, the dates in the Plan of Action will be adjusted.

The specific dates are shown in Appendix A of this document in Microsoft Project Gantt Chart format.

### 1.1 DESCRIPTION OF THE ARR PROCESS

Facility Description: The SNS baseline design is for a ~1GeV, 1.4 MW pulsed H<sup>+</sup>/Proton beam directed to a target that is the source of secondary neutron beams used for scientific research.

Location: Oak Ridge, Tennessee

Program Considerations: The installation schedule requires commissioning tests for modules of the facility at the same time other modules are being installed. Furthermore, experimental beamlines become available sequentially for users.

Type of Accelerator Readiness Review: "Phased." The SNS Readiness Review Plan of Action is presented to the DOE for commissioning in modules. These modules are:

1. Front End (FE)
2. Drift Tube Linac Tank 1 (DTL)
3. Drift Tube Linac Tanks 2-3 (DTL)
4. Drift Tube Linac Tanks 4-6 (DTL) and Coupled Cavity Linac Modules 1-3(CCL)
5. Coupled Cavity Linac Module 4 and Superconducting Linac (SCL)
6. High Energy Beam Transport (HEBT)-Ring to Target Beam Transport (RTBT) to Extraction Dump
7. HEBT-Ring to RTBT to Target and Instruments

Reason for Selection of Type of ARR: Readiness is achieved by using the ARR process at the appropriate times in the project to maximize safety and readiness confidence and to minimize the time to project completion.

## **2. PREPARATION FOR COMMISSIONING**

DOE Order 420.2A contains a list of requirements for the ARR process. This list includes a SAD and an ASE. Adequate training and qualification of personnel, written procedures, an internal safety review system, and a shielding policy must also be demonstrated.

The FSAD review and ARRs are held by the contractor, with review committees of independent experts, as specified in the guidance for DOE Order 420.2A. There will be a DOE observer at each of these reviews. There will also be a formal closeout of each review with the DOE Project Office. The DOE Project Manager authorizes the contractor to proceed with commissioning of each module.

The Preliminary Safety Assessment Document (PSAD) was approved in October 2001. A revision, the Preliminary Final Safety Assessment Document (PFSAD), was submitted for independent review in January 2002. The report from the independent review of the PFSAD concluded that the document was

adequate to cover the commissioning of the Front End and Linac modules. The FSAD for the Front End and Linac was submitted to DOE and approved in August 2002. The FSAD and ASE was presented once for the first three modules and will evolve and again for each successive module at the appropriate readiness review.

A Plan of Action was submitted to DOE prior to the ARR for the Front End module. Feedback from the Front End module ARR process was incorporated into this revised Plan of Action.

A commissioning program plan (CPP) was also approved by DOE in August 2002.

### **3. ACCELERATOR AND EXPERIMENTAL SYSTEMS**

The ARR process for the Front End module was preceded by review and approval of the FSAD for the Front End and Linac commissioning modules. This FSAD included the Commissioning Accelerator Safety Envelope (CASE) (Rev. 1) for the Front End and Linac.

The ARR process for the HEBT-Ring-RTBT to Extraction Dump will be preceded by a review of the FSAD for the HEBT-Ring-RTBT to Target and Instruments module. This FSAD will include the CASE (Rev. 2) for the HEBT-Ring-RTBT to Extraction Dump. The CASE (Rev. 3) for Target and Instruments will be reviewed prior to the ARR for RTBT to Target and Instruments and will be incorporated into the FSAD at that time.

The following review and commissioning sequence will be followed for each module. It will be described in detail below for the first module consisting of the Front End.

The Front End ARR was conducted by an independent ARR team, with a DOE observer, over a period of approximately seven weeks. The first five weeks of the review period were devoted to preparation of review materials and construction of an ARR web site to allow easy remote access by the reviewers. We intend to build on this documentation, which will shorten the preparation period for subsequent ARRs. The ARR team site visit closeout ended with a "punch list" of items which were to be completed prior to a recommendation for turn on approval.

Following the ARR team site visit closeout, the “punch list” items were addressed and a final ARR team closeout was held. This closeout ended with a recommendation to the DOE Project Manager for authorization to proceed, which was granted on October 30, 2002.

DTL Tank 1 commissioning followed an activity sequence similar to the one which was followed the Front End module, but including Lessons Learned from the Front End ARR. Specifically, prior to the commencement of DTL Tank 1 ARR, a formal declaration of “readiness to Commission DTL Tank 1” was made by the Project. This occurred on August 11, 2003. The formal contractor ARR site visit and review took place from August 12-14, 2003. Following the site visit, a formal ARR closeout took place to close out “punch list” and other items listed as “to be completed prior to commissioning” in the ARR site visit. The closeout took place on August 21, 2003. The committee recommended to the DOE Project Manager that authorization to proceed should be granted. DOE permission to proceed was granted on August 26, 2003.

DTL Tanks 2-3 commissioning followed an activity sequence similar to the one which was followed the DTL Tank 1, but including Lessons Learned from the DTL Tank 1 ARR. Specifically, prior to the commencement of DTL Tank 2-3 ARR, a formal declaration of “readiness to Commission DTL Tanks 2-3” was made by the Project. This occurred on March 29, 2004. The formal contractor ARR site visit and review took place from March 30-April 1, 2004. Following the site visit, a formal ARR closeout took place to close out “punch list” and other items listed as “to be completed prior to commissioning” in the ARR site visit. The closeout took place on April 7, 2004. The committee recommended to the DOE Project Manager that authorization to proceed should be granted. DOE permission to proceed was granted on April 8, 2004.

DTL Tanks 4-6 and CCL Modules 1-3 commissioning will follow the same ARR activity sequence as was followed the DTL Tanks 2-3 module. Specifically, prior to the commencement of DTL Tanks 4-6 and CCL Modules 1-3 commissioning activities, a formal declaration of readiness will be made and a formal contractor ARR site visit and review will take place. Following the site visit, a formal ARR closeout will take place to close out any “punch list” or other items listed as “to be completed prior to commissioning” in the ARR site visit. This process will be followed for the other modules, which consist of:

- CCL Module 4 and the SCL

- HEBT-Ring-RTBT to Extraction Dump
- HEBT-Ring-RTBT to Target and Instruments

Following RTBT to Target commissioning, CD-4 performance criteria will be achieved using sufficient instrument capability. Additionally, the low power operations safety envelopes for the Accelerator, Target, and Instruments will have been approved. Commissioning of completed Instruments will begin during the low power operation period (following CD-4) when sufficient beam power becomes available.

An ARR for routine operation will take place after CD-4.

**APPENDIX A**

**PLAN OF ACTION  
GANTT CHART**

ID	Task Name	Duration	Start	Finish	Details	Reason for Step	99	2000	2001	2002	2003	2004	2005	2006	2007
							H2	H1	H2	H1	H2	H1	H2	H1	H2
1	<b>Plan of Action</b>	<b>1831 days</b>	<b>Jan 3 '00</b>	<b>Jan 4 '07</b>											
2															
3	<b>Preparation for Commissioning</b>	<b>206 days</b>	<b>Oct 1 '01</b>	<b>Jul 11 '02</b>											
4	PSAD Rev#0 Approved	0 days	Oct 1 '01	Oct 1 '01	Approved	SAD Required by DOE O 420.2A									
5	<b>PFSAD Development</b>	<b>10 days</b>	<b>Jan 18 '02</b>	<b>Jan 31 '02</b>		<b>SAD Required by DOE O 420.2A</b>									
6	PFSAD Issued	0 days	Jan 18 '02	Jan 18 '02	Issued for Review	SAD Required by DOE O 420.2A									
7	Conduct PFSAD Review	2 days	Jan 23 '02	Jan 24 '02	DOE Project Office observer	SAD Required by DOE O 420.2A									
8	Review Team Closeout	5 days	Jan 25 '02	Jan 31 '02	Closeout with DOE Project Manager; DOE Project Manager Authorization to Proceed	SAD Required by DOE O 420.2A DOE Approval Required in PEP									
9	<b>Plan of Action for Readiness Determination</b>	<b>5 days</b>	<b>Jun 10 '02</b>	<b>Jun 14 '02</b>	<b>DOE PM Acceptance and Feedback</b>	<b>Guidance for DOE 420.2A</b>									
10	<b>Submit Commissioning Program Plan</b>	<b>1 wk</b>	<b>Jul 5 '02</b>	<b>Jul 11 '02</b>	<b>Submit Commissioning Program Plan</b>	<b>Guidance for DOE 420.2A</b>									
11															
12	<b>Accelerator Systems</b>	<b>943 days</b>	<b>Oct 23 '01</b>	<b>May 31 '05</b>											
13	<b>FSAD for Front End and Linac ( Includes ASE (Rev#1) for Front End and</b>	<b>1 day</b>	<b>Oct 23 '01</b>	<b>Oct 23 '01</b>		<b>SAD Required by DOE O 420.2A</b>									
14	FSAD for Front End and Linac Closeout	1 day	Oct 23 '01	Oct 23 '01	Closeout with DOE Project Manager; DOE Project Manager Authorization to Proceed	SAD Required by DOE O 420.2A DOE Approval Required in PEP									
15	<b>ARR for Front End</b>	<b>33 days</b>	<b>Sep 16 '02</b>	<b>Oct 30 '02</b>		<b>ARR Required by DOE O 420.2A</b>									
16	Preparation for ARR for Front End	5 wks	Sep 16 '02	Oct 18 '02											
17	ARR for Front End	5 days	Oct 21 '02	Oct 25 '02	DOE Project Office observer, Committee turnover of punch list	ARR Required by DOE O 420.2A									
18	ARR Closeout	3 days	Oct 28 '02	Oct 30 '02	Contractor closeout of ARR punch list with DOE Project Manager; DOE Project Manager Authorization to Proceed	ARR Required by DOE O 420.2A									
19	<b>Commission Front End</b>	<b>46 days</b>	<b>Oct 29 '02</b>	<b>Dec 31 '02</b>		Commissioning									
20															
21	<b>ARR For DTL Tank 1</b>	<b>8 days</b>	<b>Aug 12 '03</b>	<b>Aug 21 '03</b>											
22	ARR for DTL Tank 1	3 days	Aug 12 '03	Aug 14 '03	DOE Project Office observer, Committee turnover of punch list	ARR Required by DOE O 420.2A									
23	ARR Closeout	3 days	Aug 19 '03	Aug 21 '03	Contractor closeout of ARR punch list with DOE Project Manager; DOE Project Manager Authorization to Proceed	ARR Required by DOE O 420.2A									
24	<b>Commission DTL Tank 1</b>	<b>41 days</b>	<b>Aug 22 '03</b>	<b>Oct 17 '03</b>		Commissioning									
25															
26	<b>ARR for DTL Tanks 2-3</b>	<b>8 days</b>	<b>Mar 29 '04</b>	<b>Apr 7 '04</b>											
27	ARR for DTL Tanks 2-3	4 days	Mar 29 '04	Apr 1 '04	DOE Project Office observer, Committee turnover of punch list	ARR Required by DOE O 420.2A									
28	ARR Closeout	3 days	Apr 5 '04	Apr 7 '04	Contractor closeout of ARR punch list with DOE Project Manager; DOE Project Manager Authorization to Proceed	ARR Required by DOE O 420.2A									
29	<b>Commission DTL Tanks 2-3</b>	<b>10 days</b>	<b>Apr 12 '04</b>	<b>Apr 23 '04</b>		Commissioning									
30															
31	<b>ARR for DTL Tanks 4-6 and CCL Modules 1-3</b>	<b>14 days</b>	<b>Aug 19 '04</b>	<b>Sep 7 '04</b>											
32	Conduct ARR for DTL Tanks 4-6 and CCL Modules 1-3	6 days	Aug 19 '04	Aug 26 '04	DOE Project Office observer, Committee turnover of punch list	ARR Required by DOE O 420.2A									
33	ARR Team Closeout	8 days	Aug 27 '04	Sep 7 '04	Contractor closeout of ARR punch list with DOE Project Manager; DOE Project Manager Authorization to Proceed	ARR Required by DOE O 420.2A									
34	<b>Commission DTL Tanks 4-6 and CCL Modules 1-3</b>	<b>26 days</b>	<b>Sep 10 '04</b>	<b>Oct 15 '04</b>		Commissioning									
35															
36	<b>ARR for CCL Module 4 and SCL</b>	<b>9 days</b>	<b>Feb 14 '05</b>	<b>Feb 24 '05</b>											
37	Conduct ARR for CCL Module 4 and SCL	3 days	Feb 14 '05	Feb 16 '05	DOE Project Office observer, Committee turnover of punch list	ARR Required by DOE O 420.2A									
38	ARR Team Closeout	4 days	Feb 21 '05	Feb 24 '05	Contractor closeout of ARR punch list with DOE Project Manager; DOE Project Manager Authorization to Proceed	ARR Required by DOE O 420.2A									
39	<b>Commission CCL Module 4 and SCL</b>	<b>58 days</b>	<b>Mar 11 '05</b>	<b>May 31 '05</b>		Commissioning									
40															
41	<b>Ring Systems</b>	<b>277 days</b>	<b>Oct 28 '04</b>	<b>Nov 18 '05</b>											

