Collider-Accelerator Department

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managed by Brookhaven Science Associates
for the U.S. Department of Energy

October 28, 2002

Mr. Frank C. Kornegay
ES&H Manager
SNS Department
Oak Ridge National Laboratory
701 Scarboro Road
Oak Ridge, TN 37830

Dear Mr. Kornegay:

The ARR Team has completed its verification of open items referenced in our report to you of October 25, 2002. We find that all pre-start items are either closed or are included in a control room checklist that must be completed and signed off prior to commissioning with beam. We recommend that you and DOE authorize permission for the routine transport of H^- from the Front End to the beam stop, subject to the completion of the SNS OPM 6.E checklist.

The enclosed signature page will be completed as soon as practicable. Until that time, the ARR Team members have authorized their signature verbally.

Please let me know if you have any questions.

Very truly yours,

Edward T. Lessard

Edward T. Lessard
Associate Chair for ES&H/Q.A.

Enclosure

Copy to:
G. Dodson (SNS)
N. Holtkamp (SNS)
L. Price (DOE at SNS)
L. Radcliff (DOE at SNS)
D. Fitzgerald (LANL) - ARR Team Member
A. Etkin (BNL) - ARR Team Member
M. Vance (ORNL) - ARR Team Member
W. Ruzicka (ANL) – ARR Team Member
D. Werbeck (LANL) – ARR Team Member
R. Mau (FNAL) – ARR Team Member

Signature Page

A team, consisting of the personnel listed below, was charged by the SNS ES&H Manager on September 9, 2002 to perform an Accelerator Readiness Review (ARR) of the commissioning of the Front End and klystron gallery with H^- up to 2.5 MeV. The purpose of this review was to ensure that the required administrative controls and engineered safeguards committed in previous reviews to commission these facilities safely have been provided by the SNS Project.

This review was conducted in compliance with the provisions of DOE Order 420.2, *Safety of Accelerator Facilities.*

Team member signatures below denote concurrence that the SNS Project has completed the actions needed to address all open pre-commissioning issues listed in our report of October 25, 2002. We recommend authorization for the transport of H^- from the source to the Front End beam stop, subject to the completion of the SNS OPM 6.E Checklist.

Edward Lessard (BNL) Edward T Lessard

Daniel Fitzgerald (LANL) _____

Asher Etkin (BNL) _____

Mark Vance (ORNL) _____

William Ruzicka (ANL) _____

Richard Werbeck (LANL) _____

Robert Mau (FNAL) _____

Spallation Neutron Source

Accelerator Readiness Review
Front End and Klystron Gallery Commissioning

October 25, 2002

Signature Page

A team, consisting of the personnel listed below, was charged by the ES&H Manager of the SNS Project on September 9, 2002 to perform an Accelerator Readiness Review (ARR) of the Front End, Linac and klystron gallery. This independent review was charged with evaluating documentation, procedures, training records, operating plans, and hardware readiness. As the Linac hardware was not in place at the time of the review, the ARR focused on the Front End and klystron gallery.

This review was conducted in compliance with the provisions of DOE Order 420.2A, *Safety of Accelerator Facilities*.

Team member signatures below denote concurrence with conclusions and recommendations identified in this report.

Edward Lessard (BNL) _____

Daniel Fitzgerald (LANL) _____

Asher Etkin (BNL) _____

Mark Vance (ORNL) _____

William Ruzicka (ANL) _____

Richard Werbeck (LANL) _____

Robert Mau (FNAL) _____

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3. SNS Presentations at Opening Meeting on October 14, 2002
4. ARR Evaluation Reports by ARR Team Members
5. ARR Close Out Meeting Presentation to SNS on October 17, 2002

Executive Summary

The Accelerator Readiness Review Team for the start-up of the Front End and klystron gallery was appointed by the SNS ES&H Manager on September 9, 2002 (see Appendix 1). The ARR Team performed an Accelerator Readiness Review (ARR) of the Front End and klystron gallery from October 14 through October 17, 2002. This review evaluated relevant documentation, procedures, training records, operating plans, and hardware readiness.

A *Plan of Action* describing the ARR approach for the review is attached as Appendix 2 and was prepared, in compliance with the Implementation Guide for DOE Order 420.2A, Safety of Accelerator Facilities.

The ARR process started shortly after the appointment of the Team with documentation being made available through the use of the internet. An opening presentation was made by SNS staff and management (Appendix 3) and a tour of the facility was made on October 14, 2002. The ARR Committee then began the evaluation of the facility through document review, interviews, and facility inspections. Appendix 4 provides a series of summary reports outlining the results of these reviews.

It is the consensus of the ARR Team that the SNS Project management has conducted a comprehensive review and all provisions of the SAD necessary for Front End and klystron gallery commissioning are being addressed. Adequate controls and policies will be in place to extract beam from the source and transport beam safely to the Front End beam stop. A number of procedures and actions have not been completed at the time of this review that will need to be in place prior to the start of commissioning. This Team will monitor progress in completing these items and will recommend approval once all issues have been closed.

Introduction

Background

When completed in fiscal year (FY) 2006, the Spallation Neutron Source (SNS) will be the world's foremost neutron scattering facility. The facility will provide important scientific capabilities for basic research in many fields including materials science, life sciences, chemistry, solid state and nuclear physics, earth and environmental sciences, and engineering sciences. The design calls for a beam of negatively charged hydrogen ions (H^-) to be generated and accelerated to an energy of one billion electron volts (1 GeV) using a linear accelerator (LINAC). The H^- beam is transported to an accumulator Ring where it is injected after stripping away the electrons to leave the desired protons. In the Ring, the protons are bunched into short (under one microsecond) pulses 60 times per second. Finally, the proton beam is directed onto a liquid mercury target, where pulses of neutrons are created through spallation reactions of the protons with the mercury nuclei. Inside the Target Building, the emerging neutrons are slowed, or moderated, and channeled through beam lines to instrumented experimental areas where users carry out their research.

The SNS Project is being carried out as a multi-laboratory partnership, led by the SNS Project Office in Oak Ridge, Tennessee. The partner laboratories include: Argonne National Laboratory (ANL), Brookhaven National Laboratory (BNL), Los Alamos National Laboratory (LANL), Lawrence Berkeley National Laboratory (LBNL), Thomas Jefferson National Accelerator Facility (TJNAF), and Oak Ridge National Laboratory (ORNL). This collaborative approach is being used to take advantage of the best expertise available in different technical areas and to make the most efficient use of Department of Energy (DOE) resources.

Organization

The SNS Commissioning Program Plan (SNS 100000000-PN0004-R00) describes administrative and technical safety systems to be in place for commissioning. The SNS Accelerator Systems Division (ASD) is composed of approximately 120 physicists, engineers and technicians available to support the effective and efficient commissioning of each accelerator system.

ASD has established a Commissioning Team structure consisting of Managers for each major technical area, drawing team resources from the Accelerator System Division. This structure will provide day-to-day and weekly coordination of commissioning activities.

Each of the ASD technical groups will provide technical leads and specialists to supervise commissioning work, under the guidance and direction of the Commissioning Team. The SNS Environmental Safety and Health (ES&H) Manager will provide guidance and advice pertaining to SNS adherence to ORNL, DOE and Federal regulations.

Purpose of Commissioning

The commissioning of an accelerator is a critical step in the transition from the fabrication and installation phases to the operational phase. Accelerator commissioning not only includes a sequence of accelerator physics measurements in order to characterize the actual operational parameters of the accelerator systems, but it also includes a buildup of the operating organization and the formal conduct of operations procedures used to routinely run the facility. The information gained from commissioning studies and from the organizational maturity is used to endorse the operation of those systems or to serve as a basis by which to modify the systems.

ARR Team

Members of the ARR team and their primary responsibilities are listed below. A more detailed breakdown of the scope of each team member's work is provided in Appendix 2.

Name	**Affiliation**	**Primary Responsibility**
E. Lessard (Chair)	BNL	Radiological & Environmental Protection
D. Fitzgerald	LANL	Shielding
A. Etkin	BNL	Interlock Safety
M. Vance	ORNL	Training & Quality
W. Ruzicka	ANL	Experimental Operations
D. Werbeck	LANL	Fire Protection & Life Safety
R. Mau	FNAL	Accelerator Operations

L. Radcliff from the local Area Office of the DOE participated as a team member in the review. George Dodson, Operations Manager for the SNS Accelerator Systems Division, was the primary point of contact for the ARR team.

Conclusions

It is the consensus of the ARR Team that the SNS Project has conducted a comprehensive review and all provisions of the SAD necessary for this phase have been incorporated into facility and SNS Project practice. Adequate controls and policies will be in place to transport beam safely from the source to the Front End beam stop. ARR Evaluation Reports were prepared by each ARR team member and are attached in Appendix 4. At the time of this review a number of procedures and actions have not been completed that will need to be in place prior to the start of commissioning. The ARR Evaluation Reports identify a number of pre and post start issues that will need to be addressed by SNS management. SNS management is well aware of the open issues.

Brief summaries of principal topic areas are provided as follows.

Topic: Safety Assessment Document and Commissioning Plan

The SAD for the FELK is complete. A commissioning plan detailing the commissioning from Front End to CD-4 has been written.

Topic: Conduct of Operations and Operational Procedures

SNS has developed procedures and reviewed procedures; however, not all procedures that are required for Front End commissioning have been verified and approved. Some procedures in the OPM on the web are not approved. Procedures for dealing with off normal and emergency situations have been prepared and approved for use, but the local emergency response procedure has not been approved.

A review of the operations organization indicates that planned staffing for the commissioning of the Front End is adequate. Additionally, the R2A2s for the Division Director and Group Leaders exist and were reviewed. The R2A2s for the ASD Director and the Group Leaders should be reviewed again to ensure operations related roles, responsibilities, authorities and accountabilities are clearly described.

Topic: Radiation Shielding

The planned shielding and personnel barriers for the Front End will provide adequate protection to personnel from exposure to radiation during the commissioning. When the recommended measures have been developed and implemented, control of the shielding configuration will meet requirements during the course of Front End commissioning.

Topic: Lock Out / Tag Out

SNS has a written and signed off LOTO procedure. SNS also has a working hot procedure, but it is currently not signed off. There is some indication that the LOTO procedure has not been implemented uniformly in the field. People are being trained and training is being documented.

Topic: Fire Protection and Life Safety

Although the fire detection and fire protection systems for the Front-End and Klystron buildings will meet the requirements set forth by SNS, they are not yet complete and transferred to ORNL and ASD.

Topic: Environmental Management and Waste Management

Although only a part of the environmental record was sampled, it appears that all environmental documentation and permits are ready for commissioning. The

waste management plan is under development and the facility intends on complying with DOE Order 435.1 at the onset of generation of radioactive waste.

Topic: Quality Assurance, Self Assessment, Document Control

This is not currently a significant quality-affecting issue. There is no objective evidence to indicate that the Laboratory or SNS are overly concerned about this issue. It is anticipated to become more significant as SNS moves into accelerator commissioning and operations. Team members familiar with the SBMS have concluded that current SNS activities are conducted, in most cases, in agreement with current SBMS management system and subject areas.

The project currently has no defined system for use by management and staff to guide them in assessing their own activities. The independent assessment procedure provides no coverage for these types of activities. There are no defined systems for identifying and analyzing problems and issues, or for sharing the resultant lessons learned in an institutionalized fashion.

The current document control system has the potential to fulfill the needs of project management and staff, but must be updated to be more consistent and practiced in a more disciplined fashion if it is to be effective for near-future commissioning and operations activities. No consistent review of procedures by the SNS quality organization has occurred, although these reviews are mandated in SNS-QA-02, Procedure Development Procedure. This observation pertinent to quality review is really not the main issue. The procedure review process must be revisited to ensure that the right personnel are reviewing operating documents. Current evidence of approval on these documents shows that ASD-level and SNS project-level personnel are the approvers. This issue should be revisited to determine whether (a) the appropriate level of expertise at the right point in the management chain is reviewing and approving operating documents, and (b) the appropriate ESH, quality, and expertise set is brought into the procedure review process on a consistent basis.

An associated issue concerns the meaning of a document's existence on the SNS document web site. Documents were found on the web that are approved, unapproved, and in draft, but not labeled as draft. The first assumption of the reviewers was that these documents were all approved and current based on the fact that they were present on the web site. This is not the case, and the criteria for including procedures at this site are indeterminate at this time.

Topic: Interlock Plan

There is a large amount of work to be completed on a very tight schedule. Much of this work is of a critical nature and the ARR Team is concerned that there is not sufficient effort available.

There is a need to review the adequacy of the proposed critical devices and security implication of the proposed network interfaces.

Topic: Accelerator Safety Envelope

It is the consensus of the ARR Team that all relevant provisions of the ASE necessary for Front End commissioning are being addressed. Adequate controls and policies will be in place to transport beam safely from the ion source to the Front End beam stop. A number of actions associated with the ASE have not been completed at the time of this review that will need to be in place prior to the start of commissioning.

Topic: Maintenance Plan

The manual maintenance management program is adequate for Front End start up.

However, a maintenance plan for the Front End and DTL systems needs to be developed prior to the next commissioning module (DTL). The maintenance plan/procedures need then to be added to the general SNS procedure system and be kept current. The barcode Equipment Tracking system should continue to be used and the Computer Management System should be implemented as soon as is possible. Front End system engineers must ensure a robust maintenance program is in place until the procedures and automatic trending and tracking system is operational. Group Leaders and management should determine if the system engineers have the time and the focus to ensure a strong maintenance plan is in place and is on going, until the more automatic system comes fully on line. A routine self-assessment of the manual system by QA would be appropriate.

Topic: Work and Worker Safety

Although safety is a true value that is not to be compromised at SNS, the SNS ES&H program is not fully followed at the facility. Completeness of JHAs and strict adherence to safety procedures need to become part of the safety culture at SNS.

Topic: Internal SNS Evaluations

No unresolved action items from either internal or external reviews were identified that apply to systems needed for the Front End commissioning.

The systems involved in the Front End commissioning are relatively few, and operation of the overall Front End has already been demonstrated at LBNL. Thus, implementation of a process to identify, evaluate and resolve findings is not a prerequisite to the commissioning. However, the system complexity and associated risks increase significantly for the commissioning of the portions of the accelerator complex that follow the Front End. For this reason, prior to beginning the commissioning of the DTL, SNS should implement a robust process to identify, evaluate and resolve findings and make its use a requirement for all action items that result from external and internal reviews. In general, we recommend that this requirement should apply, in a value-added

approach, to action items from all project reviews including, for example, equipment design reviews.

Topic: Unreviewed Safety Issue Process

We conclude that with a properly finished USID procedure and process, the Front End start up could proceed. The fact that no USIDs have yet been performed on any Front End equipment or processes does not alter the above conclusion.

Recommendations

Appendix 4 contains recommendations organized by topic. There are pre-start recommendations and post-start recommendations.

Topic: Safety Assessment Document and Commissioning Plan

Topic: Conduct of Operations and Operational Procedures

Topic: Radiation Shielding

Topic: Lock Out / Tag Out

Topic: Fire Protection and Life Safety

Topic: Environmental Management and Waste Management

Topic: Quality Assurance, Self Assessment, Document Control

Topic: Interlock Plan Front End

Topic: Interlock Plan – Post Front End and Klystron Gallery Commissioning

Topic: Accelerator Safety Envelope

Topic: Maintenance Plan

Topic: Work and Worker Safety

Topic: Internal SNS Evaluations

Topic: Unreviewed Safety Issue Process

Appendix 1
ARR Team Appointment Letter dated 9/9/02 from SNS ES&H Manager

OAK RIDGE NATIONAL LABORATORY
MANAGED BY UT-BATTELLE FOR THE U.S. DEPARTMENT OF ENERGY

Frank C. Kornegay

ES&H Manager
701 Scarboro Road
Oak Ridge, TN 37830
Phone: 865-574-6588
Fax: 865-241-6587
E:mail: kornegayfc@ornl.gov

September 9, 2002

Mr. Edward T. Lessard
Building 911B
PO Box 5000
Upton, NY 11973-5000

Dear Dr. Lessard:

The Spallation Neutron Source (SNS) Accelerator Safety Review Committee, which you chair, has provided excellent input to the SNS. Your contributions have been incorporated in the accelerator safety documentation as well as in the facility design and operating plans.

The SNS is currently installing technical components in the Front End, Linac, and klystron gallery. In accordance with the DOE Accelerator Safety Order 420.2A, SNS will conduct an independent review of the Projects readiness to commission the accelerator. After consultation with the Department of Energy Project Office, I am requesting that the SNS Accelerator Safety Review Committee, supplemented by additional expertise, serve as the independent Accelerator Readiness Review team for the SNS.

The independent review will evaluate documentation, procedures, training records, and operating plans. The committee will provide SNS with findings and observations, and will identify those items that must be corrected prior to commissioning and other items that can be resolved on an agreed-upon schedule.

To minimize the costs and burden of travel, we anticipate that much of the review can be accomplished with the use of video and telephone links. Any travel required will be reimbursed by the SNS Project.

Your participation in this critical review is greatly appreciated.

Sincerely,

Frank C Kornegay

Frank C. Kornegay

cc: G. W. Dodson
M. P. Giannella
R. M. Harrington
N. R. Holtkamp
S. P. McKenzie
L. K. Price, DOE-ORO

Appendix 2
The ARR Plan of Action for the Phase I Review

Front End, Linac and Klystron (FELK)

Accelerator Readiness Review – Plan of Action

Objective: The objective of this review is to evaluate the preparation at the Spallation Neutron Source for FELK commissioning and to assure that the facility is prepared to operate in a safe and environmentally acceptable manner. The Accelerator Readiness Review (ARR) process will verify that necessary programs have been developed, that appropriate personnel have been assigned and trained, that operations and relevant procedures have been approved, and that safety significant systems and controls are in place. The ARR shall be performed consistent with the requirements of DOE Order 420.2A. It should be noted that the ARR process is not designed to evaluate the adequacy of the SAD, but rather is intended to confirm satisfactory closure of commitments made in the SAD and associated documents.

Methodology: The ARR Team shall verify that operational and ESH program commitments and requirements have been satisfactorily addressed through review of documents, interviews with responsible personnel and facility walk-down. The programmatic areas to be evaluated and responsibilities of each team member are defined in Table I below. Each team member will provide a brief summary of their review for inclusion into the SNS ARR file.

SNS internal reviews for FELK were performed at the SNS facilities. These evaluations are an important adjunct to the ARR process - closure of findings associated with these internal reviews will be verified during the ARR.

Scope: The purpose of this review will be to verify that the engineered safeguards, administrative controls, and procedures necessary for proton commissioning of FELK have been provided as committed in the revised SAD. In particular, the Review team will focus on:

Scope of review

1. Resolution of prior SNS internal reviews
2. Status of interlock system installation and testing
3. Operational procedures for proton operation
4. Operator or system specialist training & qualification
5. Safety assessment commitments for:
   - shielding
   - critical devices
   - access control
   - radiation monitoring
6. The commissioning & fault study plan
7. The ASE for FELK

Schedule: The onsite ARR will be conducted October 14 through 17, 2002. A closeout meeting with SNS management and DOE representatives will be held on October 17th at noon. Preliminary work will be performed via phone interviews in the weeks prior to the site visit.

A report addressed to Frank Kornegay, SNS ESH Manager, with recommendations and conclusions will be prepared at the completion of the review and finalized by October 24th.

ARR Team Members: Members of the ARR team and their primary responsibilities are listed below. A more detailed breakdown of the scope of each team member's work is provided in Table I.

Name	Affiliation	Primary Responsibility	Phone Number	Email Address
E. Lessard (Chair)	BNL	Radiological & Environmental Protection	631-344-4250	lessard@bnl.gov
D. Fitzgerald	LANL	Shielding	505-667-1549	fitzg@lanl.gov
A. Etkin	BNL	Interlock Safety	631-344-7200	etkin@bnl.gov
M. Vance	ORNL	Training & Quality	865-574-6545	vancemc@ornl.gov
W. Ruzicka	ANL	Experimental Operations	630-252-6834	wruzicka@anl.gov
D. Werbeck	LANL	Fire Protection & Life Safety	505-	
R. Mau	FNAL	Accelerator Operations	630-840-4429	mau@fnal.gov

L. Radcliff from the local Area Office of the DOE will participate as a team member in the review and will provide DOE oversight of the process and findings.

George Dodson, Operations Manager for the SNS Accelerator Systems Division, will be the primary point of contact for the ARR team.

Table I

FELK ARR Assignments[1]

	Lessard	Werbeck	Fitzgerald	Etkin	Vance	Ruzicka	Mau
Safety Assessment Document	X	a	a	a	a	a	a
Commissioning Plan	X	a	a	a	a	a	a
Internal SNS Evaluations	a	a	X	a	a	X	a
Conduct of Operations	X (R2A2s)	a	X (radiological control)	a	a	a	X
Interlock Plan	a	-	-	X	-	a	a
Maintenance Plan	a	X (fire protection, LOTO and life safety)	X (shielding and configuration control)	a	a	X	X (LOTO)
Training	a	X (worker and worker safety)	a	a	a	a	X (operator training)
Operational Procedures	a	a	a	a	a	X (USI process, maintenance procedures)	X
Commissioning Accelerator Safety Envelope	X	X	a	a	a	a	X
Quality Assurance Plan	a	a	a	a	X (self-assessment and document control)	a	a
Environmental Issues	X	-	-	-	-	-	-
Interviews	x	x	x	x	x	x	x
Field Verification	x	x	x	x	x	x	x

The DOE participant will attend and partake in all portions of the review as desired.

[1] An "X" indicates that the designated individual has primary responsibility for evaluation of the programmatic area or a specific topic in that programmatic area. An "a" indicates that the individual has a secondary responsibility in that programmatic area.

Appendix 3
SNS Presentations at Opening Meeting on October 14, 2002

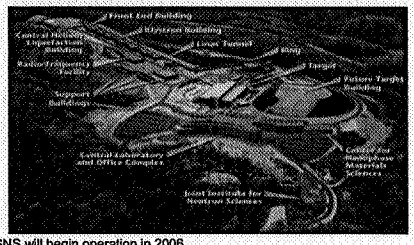
Accelerator Readiness Review

The Spallation Neutron Source: Project Update

Norbert Holtkamp
Accelerator Systems Division
Division Director

October 14, 2002

The Spallation Neutron Source



- The SNS will begin operation in 2006
- At 1.4 MW it will be ~8x ISIS, the world's leading pulsed spallation source
- The peak thermal neutron flux will be ~50-100x ILL
- SNS will be the world's leading facility for neutron scattering
- It will be a short drive from HFIR, a reactor source with a flux comparable to the ILL

SNS - Guiding Principles

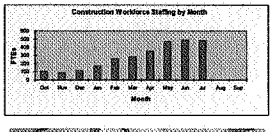
- SNS will provide high availability, high reliability operation of the world's most powerful pulsed neutron source (cf white paper)
- It will operate as a User Facility to support peer reviewed research on a Best-in-Class suite of instruments
  - Research conducted at SNS will be at the forefront of biology, chemistry, condensed matter physics, materials science and engineering
- SNS will have the capability to advance the state of the art in spallation neutron source technology. This includes:
  - R&D in accelerators, target, and instruments to keep SNS at the forefront
  - Planned enhancement of SNS performance through upgrades of the complex and ongoing instrument development as part of the normal operating life of the facility

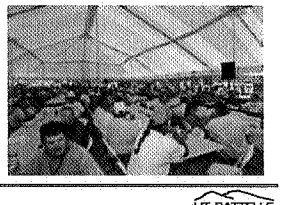
Cost Baseline

WBS	Description	May Baseline, $M		August Baseline* $M	
1.2	Project Support	75.7		75.7	
1.3	Front End Systems	21.0		21.1	
1.4	Linac Systems	292.1		293.9	
1.5	Ring & Transfer Systems	150.9		151.2	
1.6	Target Systems	101.9		103.2	
1.7	Instrument Systems	63.4		63.3	
1.8	Conventional Facilities	323.6		343.9	
1.9	Integrated Control Systems	59.5		59.8	
	BAC	1,088.1		1,111.9	
	Contingency	104.6	21.0%	80.8	21.0%
	TEC	1,192.7		1,192.7	
	R&D	101.2		101.2	
	Pre-Operations	117.8		117.8	
	TPC	1,411.7		1,411.7	

*Rev. 349.
**Reflects 5% reservation for commitments and awards.'
Additional potential PCRs totaling ~$7 M.

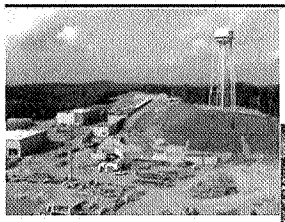
SNS Construction

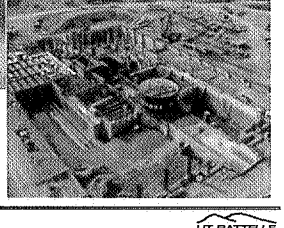




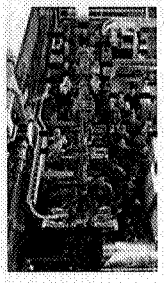
>1.3M safe hours!

SNS Construction

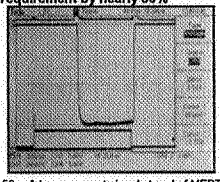




LBNL Highlights

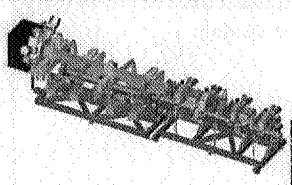


- All baseline MEBT-subsystems commissioned, (except choppers)
- Substantial participation of Partner Labs staff
- All major nominal Front-End beam parameters achieved
- Front End delivered to SNS-ORNL on schedule, by July 15
- Ion-Source and LEBT demonstrated high reliability
  - Supported 2 months of MEBT commissioning with one single antenna
- RFQ transmission well above 80% assumed in design
- Front-End beam current exceeds requirement by nearly 30%

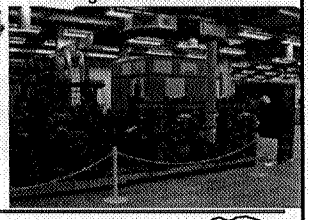


50-mA beam current signal at end of MEBT

FES System Installation on the Site



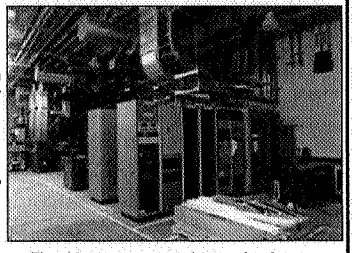
- Front end installed on the site
- Electrical checks are ongoing
- Vacuum checks are ongoing
- Klystron, transmitter and waveguides are installed



- Begin FES recommissioning October 29, 2002
- Requires RF System availability by October 15

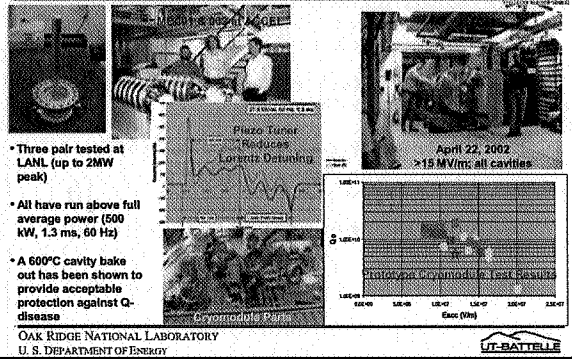
LANL: RFQ & DTL High-Power RF Equipment are Being Accepted, Delivered & Installed

- Marconi now producing 2.5-MW, 402.5-MHz klystrons. They are doing well. Nr. 5 acceptance tested.
- RFQ/DTL/CCL/MEBT klystron transmitter production nearly complete. All warm ones at ORNL.
- Converter modulator substations, SCR controllers, control racks being delivered
- Attention being given to:
  - Converter Modulator HV assembly production schedule
  - LLRF System



First klystrons, transmitters, circulators, loads, waveguide installed at SNS site

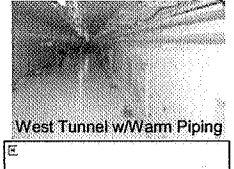
JLab Highlights



- Three pair tested at LANL (up to 2MW peak)
- All have run above full average power (500 kW, 1.3 ms, 60 Hz)
- A 600°C cavity bake out has been shown to provide acceptable protection against Q-disease

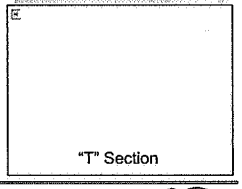
Cryo Installation on the Site

- Cryo line fabrication and installation is going very well.
- Compressors are in place.
- Cold Box has had several delays. Should be on site middle of October.



West Tunnel w/Warm Piping

Cold Compressors in the CHL



"T" Section

Summary

- ARR is crucial to be able to start up October 28.
- I am glad to see a strong team assessing the project and the program.
- I confident that you will help us to get things in place before October 28th.
- I want to thank George Dodson and the Operations Team as well as our ESH support plus everybody else for doing this work.

SNS Accelerator Readiness Review

Plans for Commissioning

of

SNS Accelerator Systems

G. Dodson

Operations Manager

Accelerator Systems Division

October 14, 2002

Topics

- Administrative and ES&H Plans
- Organization and Resources for commissioning
- Physics Plans for commissioning

Commission the entire facility, including Target, under Accelerator Safety Order DOE O 420.2A

Documents, etc. required by DOE O 420.2A for the Commissioning Accelerator Readiness Review Process:

- **Readiness Plan of Action for the SNS Readiness Review Process – Accepted by DOE**
- **SNS Commissioning Program Plan – Accepted by DOE**
- **ASD Technical Commissioning Plan***
- **An approved Safety Assessment Document – Approved by DOE**

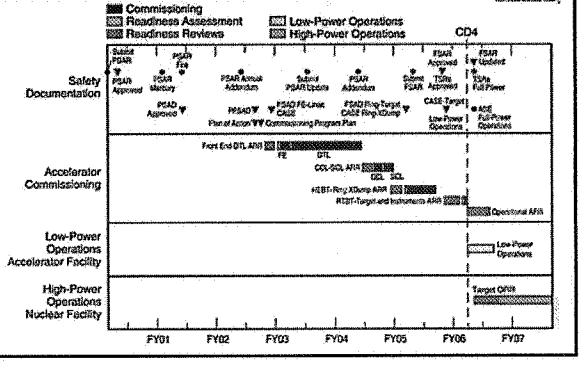
(* Not required under 420.2A – had been part of the Commissioning Program Plan)

Commission the entire facility, including Target, under Accelerator Safety Order DOE O 420.2A

Documents, etc. required by DOE O 420.2A for the Commissioning Accelerator Readiness Review Process:

- **An Accelerator Safety Envelope (ASE in FSAD)**
- **Written Operations Procedures (in the SNS-OPM)**
- **Training, Qualification and Certification Requirements (in the SNS ASD Training Manual)**
- **Shielding Policy (SNS ES&H Plan, Section 3)**
- **Internal Safety Review System (In ES&H Plan)**

SNS Project Commissioning



Commissioning Planning

- **Commissioning will take place as systems become available after Installation and Testing**
- **Readiness Plan of Action for entire readiness verification process**
- **ARRs by Module**
  - **Front End and DTL**
  - **CCL and SCL**
  - **HEBT- Ring - RTBT to Extraction Dump**
  - **Ring - RTBT to Target and Instruments**
- **Commissioning Readiness Assessments System by system**
- **Approval Authority: As defined in the August, 2001 Guidance for DOE O 420.2A, approval authority is at the field office level**
- **Commissioning will be done, in general, at reduced duty cycle and power levels, hardware limited. The power levels will be less than what is shown in the Commissioning Accelerator Operational Envelope.**

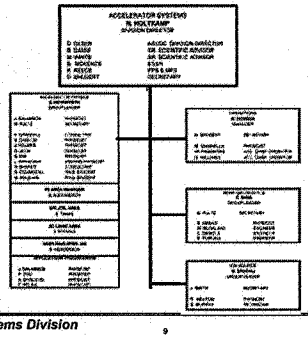
Operational Accelerator Readiness Review and Operational Readiness Review

- At the end of commissioning studies we will have demonstrated end-to-end operation of the SNS accelerator facilities including the target. Beam transport, stability, injection, extraction, losses and neutronics will have been measured at a proton flux consistent with the CD-4 (end of project) requirement.
- Safety Systems Certified :
  - Personnel Protection System (PPS)
  - Target Protection System (TPS)
- Machine Protection System (MPS) demonstrated
- The Operational ARR is scheduled to be complete on 30-Mar-06.
- During commissioning and low power operation we will maintain a Target radionuclide inventory below the Category 3 threshold for a Nuclear Facility per DOE-STD1027-92.
- The Target ORR is scheduled to be complete on 1-July-06

Installation and Commissioning Planning

- Installation Testing and Commissioning have been planned in an integrated manner, adapted to the known requirements of the systems and flexible enough to adapt to additional requirements as they become apparent.
- Interleave commissioning with installation schedule. Run installation on a 4-day 10-hour shift schedule
- Overnight shifts of processing and commissioning with
  - Thursday PM to Monday AM for dedicated commissioning
- Schedule, dedicated blocks of time with breaks as needed to repair equipment and evaluate data

ASD Organization for Commissioning



Organization for Commissioning

- Commissioning Organization - ASD
  - Commissioning Area Managers
    - A. Aleksandrov - Front End
    - E. Tanke - DTL-CCL
    - J. Stovall - SCL
    - S. Henderson - HEBT-Ring-RTBT
    - Develop and manage the ASD Technical Commissioning Plan
  - Accelerator Physics, Operations, Physicists and Engineers
  - Teams hold video conferences on a rotating schedule and as needed
- Goal of commissioning: deliver a beam to the target capable of satisfying CD-4 (Project Completion) requirements.

Commissioning Teams

Commissioning Teams	Front End	DTL-CCL	SCL	HEBT-Ring-RTBT	RTBT-Target
Accelerator Operations	Dodson Giannella Coordinator Operators(3)	Dodson Giannella Coordinator Operators(3)	Dodson Giannella Coordinator Operators(3)	Dodson Giannella Coordinator Operators(3)	Dodson Giannella Coordinator Operators(3)
Accelerator Physics	Henderson Galambos	Henderson Galambos	Henderson Galambos	Henderson Galambos	Henderson Galambos
Area Manager	Aleksandrov	Aleksandrov	Aleksandrov	Aleksandrov	Aleksandrov
	Tanke	Tanke	Tanke	Ring Area Manager TBD	Ring Area Manager TBD
	Danilov	Danilov	Danilov	Tanke	Tanke
	Stovall	Stovall	Stovall	Danilov	Danilov
	Jeon	Jeon	Jeon	Stovall	Stovall
	Chu	Chu	Chu	Jeon	Jeon
	Kim	Kim	Kim	Chu	Chu
	Kravchuk	Kravchuk	Kravchuk	Kim	Kim
				Kravchuk	Kravchuk
				Holmes	Holmes
				Shishlo	Shishlo
				Pelaia	Pelaia
				Ring Postdoc	Ring Postdoc
ES&H	Mckenzie	Mckenzie	Mckenzie	Mckenzie	Mckenzie
Ion Source Group	3	3	3	3	3
Electrical Systems Group	13	13	13	13	13
RF Group	16	16	16	16	16
Cryomodule Group	6	6	6	6	6
Cryogenics Group	12	12	12	12	12
Mechanical Group	29	29	29	29	29
Diagnostics Group	5	5	5	5	5
Controls Group	6	6	6	6	6
Partner Laboratories	TBD	TBD	TBD	TBD	TBD

Operators in Training Program

Operations Group:
Dodson, George
Giannella, Mario
Passmore, Shane
Accelerator Physics Group:
Aleksandrov, Sasha
Chu, Paul
Danilov, Slava
Galambos, John
Henderson, Stuart
Jeon, Dong-o
Kim, Sang-ho
Kravchuk, Leonid
Stovall, Jim
Tanke, Eugene

Ion Source Group:
Gibson, Paul
Morton, Rob
Murray, Syd
Stockli, Martin
Welton, Rob
ES&H:
McKenzie, Sam
Others:
Williams, Derrick

Technical Commissioning Plan

- The Technical Commissioning Plan includes a sequence of activities which take the system from testing through commissioning, including:
  - Subsystem Testing
  - Vertical Integration
  - Horizontal Integration
  - Beam Commissioning
- The Commissioning Teams, section by section, have compiled a list of these commissioning activities
- Each activity will have a short ~1 page summary adapted from a standard format which describes the the activity and lists requirements (beam parameters, equipment, software, people etc.)
- At the conclusion of the activities for a section, the beam will be commissioned and meet the CD-4 goals.

Examples from Front End Recommissioning

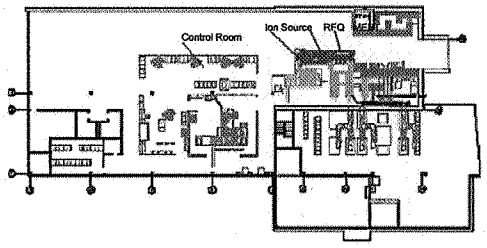
RFQ recommissioning
Beam transport to BCM1
RFQ transmission vs. proinjector voltage
Input match from LEBT to RFQ
LEBT steering
LEBT chopper effectivness
Chop symmetry at low chop voltage
RFQ transmission vs. duttation
Beam transport through MEBT
Beam transport to BPM2
Phase set of rebuncher 1
Beam transport to BPM3
Correction of voltage/phase set of rebuncher 1
Q1-Q4 quad setting correction
Phase set of rebuncher 2
Beam transport to BPM4
Correction of voltage/phase set of rebuncher 2
Beam transport to BPM5
Phase set of rebuncher 3
Q5-Q10 quad setting correction
Transmission measurement
Beam transport to BPM6
Phase set of rebuncher 4
Beam transport to the beam dump

Example of Commissioning Form

1.2.6 FES COMMISSIONING FORM 14-sep-2001

Major Category:	Commissioning
Sub-Category:	Beam transport through MEBT
Sub-System (e.g. beam emittance, or BPM etc.):	
Objective:	Set optimal phase of rebuncher cavity #2
Requested by:	A. Aleksandrov
Date Proposed:	09/25/01
Estimated Time to Complete:	.5 shifts
Estimated Manpower to Complete:	
Priority/Order:	1
Basic Equipment Needs (e.g. which diagnostics):	BPM3 ; cavity #2 controls
Special Equipment Needs:	
Software/Application needs:	BPM2 / Tool_3_26.m
Input Beam Requirements:	20mA, 20μs, 1Hz unchopped beam
Other prerequisites:	cavity #2 is tuned to resonance, RF power at calculated nominal level
Correlations Sought:	BPM3 sum signal vs. phase of cavity #2; BPM3 phase vs. phase of cavity #2;
Procedure:	Measure BPM3 sum signal. Establish maximum signal amplitude varying phase of cavity#2. Measure BPM3 phase. Establish maximum signal amplitude varying phase of cavity#2 then shift cavity phase by 90 degrees.
Supporting Computations:	PARMILA
Problems Expected:	
Comments:	

Front End and Front End Building Control Room

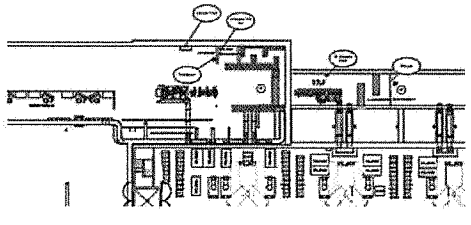


Front End Re-commissioning

- Front End re-commissioning takes place in the Front End Control Room in the Front End building using the MEBT in-line diagnostics and the slit-collector and beam dump located in the space at DTL section 1. This commissioning will use PPS Phase 0.
- We are scheduled for dedicated Front End commissioning from 29-Oct-02 to 31-Dec-02.
- Remove instrumentation/dump to make way for DTL tank 1 installation.
- Continue Front End studies as needed using the Diagnostic Plate downstream of DTL tank 1.

DTL Tank 3 Processing and Integrated Testing

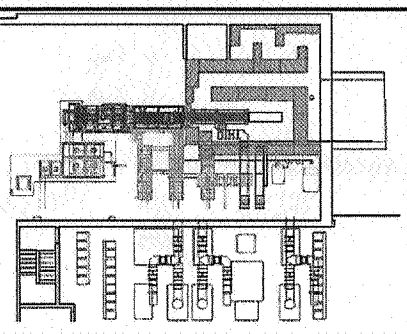
PPS Phase 0 – Tank 3 alone could be a RGD (ORNL)



DTL Commissioning

- Following Front End Commissioning DTL Tank 1 and the Diagnostic Plate/Dump will be installed in a shielded enclosure in place of of tank 2. By the end of tank 1 commissioning tanks 3,4,5,6 will have been installed.
- Commissioning is scheduled from 22-May-03 to 1-Apr-04

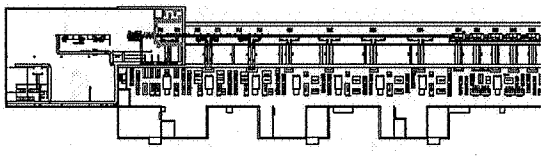
DTL Tank 1 Commissioning into Diagnostic Plate



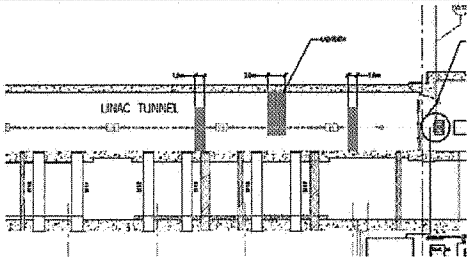
DTL Commissioning

- The Diagnostic Plate/Dump will be removed and tanks 2 through 6 will be commissioned with built in Faraday cups and wire scanners and diagnostics in CCL Module 1.
- Commissioning is scheduled from 22-May-03 to 1-Apr-04

Front End, DTL and CCL



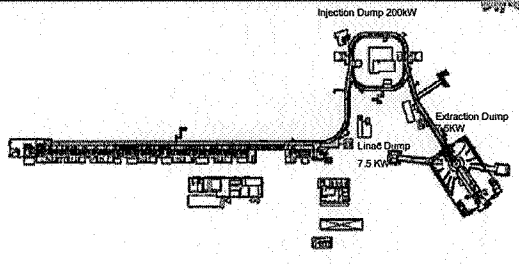
End of Linac Shielding for DTL and CCL Modules 1-3 Commissioning - PPS Phase 1



CCL - SCL Commissioning

- The CCL installation will be complete by the end of DTL commissioning.
- CCL modules 1-3 will be commissioned using Faraday cups, and a final beam dump immediately downstream of the CCL. Module 4 will be commissioned with the SCL into the Linac dump. CCL Commissioning is scheduled from 17-May-04 to 18-Aug-04.
- The SCL will be commissioned into the Linac beam dump. This requires beam transport magnetics, diagnostics and vacuum to the Linac beam dump.
- Commission the SCL from 1-Oct-04 to 21-Dec-04

SCL-HEBT-Ring-RTBT-Target and Instruments



HEBT- Ring - RTBT to Extraction Dump Commissioning

- Commission HEBT into the Ring Injection Dump
  - Measure beam transport parameters, energy corrector, energy spreader etc.
- Commission Ring into Extraction Dump
  - Ring injection painting and stripping
  - Lattice functions, Tunes, Closed orbit corrections etc.
  - Stored beam dynamics, Ring RF-beam interaction
  - Extraction
- Commissioning of the HEBT-Ring-RTBT to the Extraction Dump will take place from 22-Dec-04 to 17-Jun-05

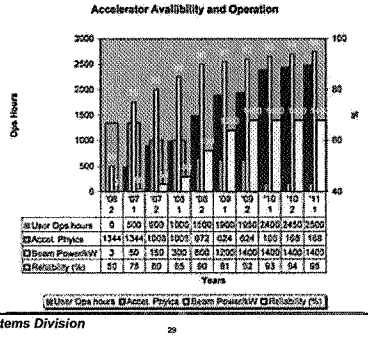
RTBT to Target and Instrument Commissioning

- The extracted beam will already have been commissioned to the extraction dump as a part of HEBT-Ring-RTBT commissioning.
- Target commissioning occurs at low intensity. Measure RTBT optical functions to the Target.
- Verify the operation of the Target and neutronics to an Instrument. Commission to CD-4 requirements.
- Commission the RTBT to the Target is scheduled from 1-Dec-05 to 30-Dec-05

Low Power Operation, ORR

- During Low Power Operation:
  - maintain a target radionuclide inventory below the Category 3 threshold
  - develop a beam with the capability of operating at higher average power levels.
  - Conduct Operational ARR, complete by 12-May-06
- The ORR is scheduled to be complete on 1-July-06. Following the ORR the Target will be part of a Nuclear Facility.
- Following the ORR we will proceed with Accelerator power ramp-up consistent with the ASD Beam Loss Policy, Accelerator Physics Studies, Target, Instrument and radiation safety studies.

Plan for Power and Availability Ramp Up



Accelerator Readiness Review

Front-End Commissioning Plans

A.V.Aleksandrov,

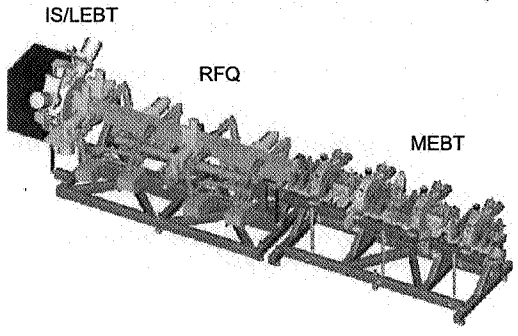
SNS Oak Ridge, Front End commissioning area manager

October 14-16, 2002

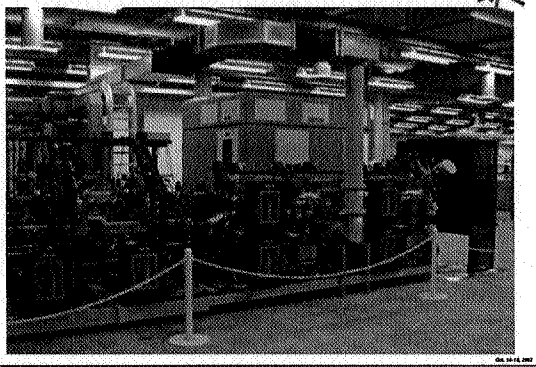
Outline

- Front End commissioning goals
- People, schedule
- Software development
- Commissioning Plan
  - Commissioning sequence

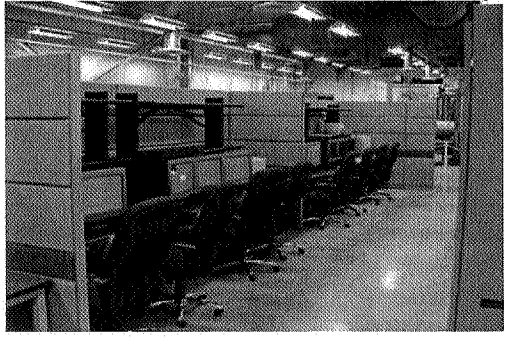
Front End Layout



Front End in the FE building

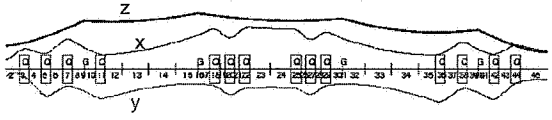


Temporary control room in the FE building



MEBT beam parameters

Design MEBT beam envelope



MEBT output beam parameters

(to be fulfilled simultaneously)

	Operation	Commissioning (LBNL)
Energy [MeV]	2.5	2.5 (2.5)
Current [mA]	38	25 – 38 (50)
Pulse length [ms]	1.0	.2 – 1.0 (1.0)
Duty factor [%]	6	1.5 – 6 (3-6)

Goals

- Provide beam acceleration in RFQ to design energy with acceptable transmission and design output emittances
- Transport beam from RFQ exit to DTL entrance
  - losses < 1% in the MEBT
- Provide proper beam time structure
  - Tune LEBT chopper, MEBT chopper
- Satisfy MEBT/DTL matching conditions
  - Provide design values of output r.m.s. Twiss parameters
    - Verify tuning procedures
    - Map output beam characteristics vs. tune, current

  (Fine tune will be done during DTL commissioning, in several iterations)
- Test all systems under full beam power

(items shown in blue can be done only during commissioning when diagnostics box is attached to the MEBT exit)

Schedule

- Equipment installation and check up: 03 June 02 – 25 Sep 02
  - Tests cables, polarities, AC, utilities, ...
- Test and RF conditioning: 26 Sep 02 – 28 Oct 02
  - Test noise floor, RF stability, vacuum, X-rays,...
  - Run integration test (MPS, timing, controls, ...)
- Commissioning: 29 Oct 02 – 31Dec 02

People

- To be able to support 3 shifts/day operation:
  - Operators (2 per shift): 19 total available
    - ***Operations Group:*** G. Dodson, M. Giannella, S. Passmore,
    - ***Accelerator Physics Group:*** A. Aleksandrov, P.Chu, V. Danilov, J.Galambos, S.Henderson, D.Jeon, S.Kim, L.Kravchuk, J.Stovall, E.Tanke
    - ***Ion Source Group:*** P. Gibson, R.Morton, S.Murray, M.Stockli, R.Welton
    - ***ES&H:*** S. McKenzie
  - Technical support: available on call
  - Help from the partner labs is available remotely or in person if needed

Training

- General training: safety, first aid, hazards, etc.
- Course of 13 lectures (with quiz) on individual systems
- Introductory practical course on application software
- Involvement in the test/conditioning procedures
- 4 people worked at least 1 week as operators during FES commissioning at Berkeley

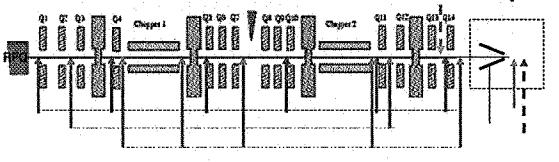
Operator Training

Accelerator Operator Training Lectures for Front-end Commissioning

Lecture Series: Introduction and Principles of Operation:

1	Ion Source (pdf) (ppt)	Martin Stockli	August 9, 2002
2	RFQ (pdf) (ppt)	Sasha Alexandrov	August 16, 2002
3	MPS (pdf) (ppt)	Coles Sibley	August 23, 2002
4	PPS (pdf) (ppt)	Paul Wright	August 30, 2002
5	Diagnostics	Saeed Assadi	September 6, 2002
6	RF Systems	David Anderson or Ray Fuja	September 13, 2002
7	MEBT Optics and Operation	Sasha Alexandrov	September 20, 2002
8	Control System	Dave Gurd	September 27, 2002
9	Chopper Operation	?	?
10	Commissioning Sequence and Algorithms	Sasha Alexandrov	?
11	Vacuum System	Peter Ladd?	?
12	Application Programs	John Galambos	?
13	Facilities	?	?

MEBT Diagnostics



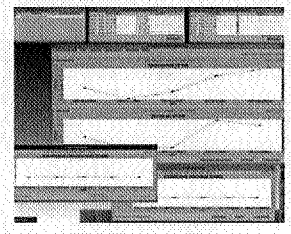
- Beam position and phase monitors – 6, vertical and horizontal
- Beam current monitors (toroids) – 2
- Beam profile monitors (wire scanners) – 5 ,vertical and horizontal
- Transverse emittance (slit & collector) - 1 (2)
- Bunch longitudinal shape (fast Faraday cup) –(1), R&D

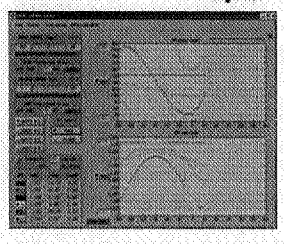
  Laser wire

Commissioning algorithms and software

- **General control software: controls group**
  - **EPICS**
- **Diagnostic software: diagnostics group**
  - **Drivers, low level processing, smart devices,..**
- **High level applications and data management: application software group + controls group + diagnostics group**
  - **Data bases, high level programming infrastructure,...**
- **Commissioning algorithms : accelerator physics group + application software group**
  - **Steering, rebuncher voltage and phase, quad tuning,...**
- **Support software: data collection and visualization: application software group**

Examples of control software





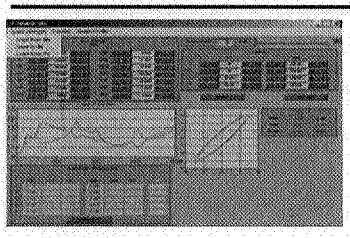
Orbit Correction App *(T. Pelaia)*

MEBT RF Setting app
(A.Aleksandrov and V. Alexandrov)

Software test at LBNL

- Start commissioning with original software used at LBNL, incorporate modifications later on (being developed in parallel).
- Software tested during commissioning at Berkeley:
  - EPICS control screens for individual systems
  - Internal IOC drivers
  - Application software:
    - Trajectory correction
    - Trajectory on line model
    - Rebunchers phase and amplitude setting
    - Beam profile on line model
    - Transverse profile tuning algorithm
    - Various data acquisition and analysis routines for system performance evaluation (jitter, noise, correlations, etc.)

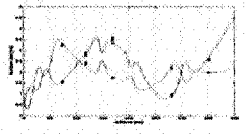
On line TRACE-3D model



Model needs "tuning":

-Quad proximity effect

-input Twiss parameters



After tuning model predictions are in good agreement with measurements

PARMILA on line model is being developed

Commissioning Plan – prioritized task list

Extended and modified based on LBNL experience

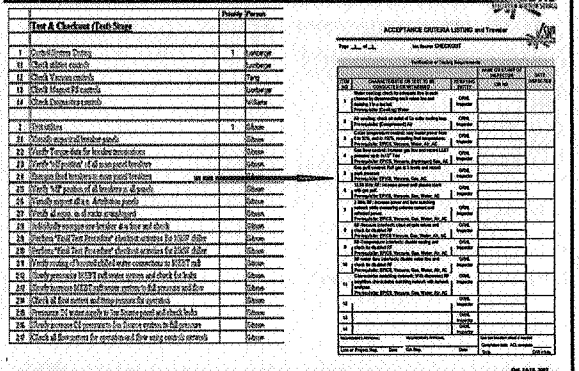
	Test stage
	Conditioning stage
	Commissioning stage
1	Ion source is ready
	Short unchopped pulse 20mA, .01ms, 1Hz or manual, D-plate
1.1	**RFQ recommissioning**
1.1.1	Beam transport to BCM1
1.2	**Beam transport through MEBT**
1.2.1	Beam transport to BPM2
1.3	**MEBT tuning and beam characterization**
1.3.1	Q1-Q4 quad setting correction
1.4	**Choppers commissioning**
1.4.1	LEBT chopper effectiveness
1.5	**High power beam test**
	Short unchopped pulse 38mA, .01ms - 1ms, 1Hz-60Hz, beam dump
1.5.1	RFQ amplitude stability vs. beam loading

- Task list
- Sequence and priority
- Procedure description
- Duration estimate
- Equipment list
- Software list
- Integration with support plans (diagnostics, RF, control,MPS, PPS etc.)
- Beam parameters

FES COMMISSIONING FORM (example)

- **Major Category:** Commissioning
- **Sub-Category:** RFQ recommissioning
- **Objective:** Establish optimum preinjector voltage
- **Requested by:** J. Staples
- **Date Proposed:** 09/25/01
- **Estimated Time to Complete:** 2 hours
- **Estimated Manpower to Complete:** 2 operators
- **Priority/Order:** 1
- **Basic Equipment Needs (e.g. which diagnostics):** BCM1, IS energy control
- **Special Equipment Needs:**
- **Software/Application needs:** BCM1, IS control / Tool_3_12.m
- **Input Beam Requirements:** 20mA, 20Os, 1Hz unchopped beam
- **Other prerequisites:** MEBT quads are powered in accordance with "Reb. off" set point. Reb. cavities are off. Beam stop is at MEBT exit.
- **Correlations Sought:** Transmission through RFQ vs. Injection energy
- **Procedure:** Thread beam through RFQ to BCM1. Operate RFQ at full gradient. Vary injection voltage from ion source in the range 55- 70kV. Observe BCM1 current. Compare with reference curve. Set source voltage to maximum of transmission
- **Supporting Computations:** PARMTEQ, TOUTATIS
- **Problems Expected:** If BCM1 is not available from EPICS then oscilloscope can be used to measure transformer output signal directly.

Test plan (> tasks)



Commissioning Plan – changes and additions

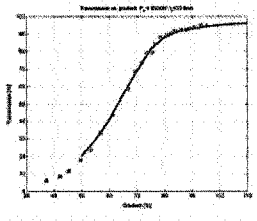
- Reduce amount of time for beam transport through the MEBT
- Add time for "rebunchers off" operation mode at early stage of the commissioning
- Include dedicated diagnostics commissioning shifts
- Add laser wire experiments
- Add "Beam In Gap" experiment
- Add "Round Beam Optics" experiment
- Add "Fast Faraday Cup" experiment

} Not must have but desirable

Many procedures are much better clarified and supporting software tools will be provided: emittance measurements, phase scans, BPM SVD analysis, etc.

RFQ recommissioning

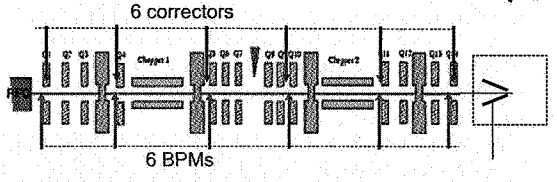
- Full RFQ commissioning is done at Berkeley using diagnostics box at RFQ exit
- Recommissioning at Oak Ridge: measurement of transmission vs. RF power.
  - Reduced power beam, allowed to be lost in the MEBT



Measured RFQ transmission vs. RF power

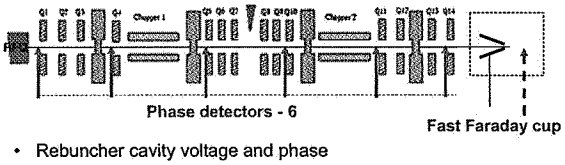
(J. Staples et al., Berkeley)

Beam transport through MEBT



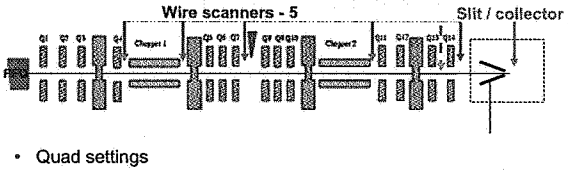
- Reduced power beam to prevent damage from lost beam.
- Step-by-step steering
- Beam based mechanical alignment if needed

Tuning of Longitudinal Focusing



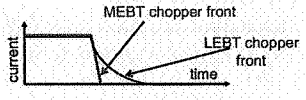
- Rebuncher cavity voltage and phase
  - phase scans,
  - BPM sum signal,
  - fast Faraday cup at MEBT exit
- Validate tuning algorithms to be able restore set point without diagnostic box at end

Tuning of Transverse Focusing

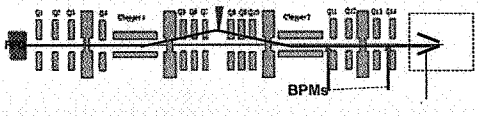


- Quad settings
  - profile measurements,
  - Twiss parameters at MEBT exit
- Map output Twiss parameters vs. tune, beam current
- Validate tuning algorithms to be able restore set point without diagnostic box at MEBT exit

Chopper tuning



- Synchronize pulse timing
- Position chopper target edge
- Measure beam extinction ratio
- Establish 1800 phase advance between chopper and antichopper



High power beam test

- RF system stability under beam load
- Temperature stability
- Vacuum stability
- Radiation levels

- Chopper targets have not been tested yet under high power
- Almost last window of opportunity for full power operation until 2006

To provide beam sufficient for commissioning of the rest of the machine up to CD-4 requirements is the first priority.

Summary

- Commissioning team is formed and being trained
- FES Commissioning plan has been developed
- Commissioning software is being developed
- Experience of LBNL commissioning is incorporated

People, hardware, software and plan are adequate to FES commissioning goals and schedule

ARR , October 14 - 17, 2002

DTL TESTING AND COMMISSIONING PLAN

Eugène Tanke

DTL-CCL commissioning area manager, SNS/ORNL

G.Dodson, M.Giannella, D.Jeon (SNS/ORNL), S.Nath, M.Plum, R.Shafer, J.Stovall (LANL) L.Kravchuk (INR)

Outline for testing has been defined

- Debug & integrate all accelerator subsystems (PPS, MPS, RF, diagnostics, controls, cooling, vacuum, etc.) through:
  - "Vertical" testing (individual test of each subsystem)
  - "Horizontal" testing (testing across subsystems)
  - Testing with beam
- Electronic logbook on the web (Tom Pelaia, Mario Giannella, Jeff Patton, Brad Horn)
  - http://snsapp1.sns.ornl.gov:8888/Logbook/WebObjects/Logbook.woa

Initial detailed list of tests has been defined.....

vertical testing

	DTL TANK (V-testing)	Priority	Person
	Test & Checkout, System Test Stage		
1	GLOBAL CONTROLS (GC)		D.Gurd
1.1	Test LLRF controls	1	D.Jeon
1.2	Test HPRF controls	1	D.Gurd
1.3	Test RCCS controls	1	S.Joseph
1.4	Test Magnets/PS controls	1	S.Nath
1.5	Test interlock controls	1	C.Sibley
1.6	Test timing system	1	D.Gurd
1.7	Test MPS	1	C.Sibley
2	VACUUM		P. Ladd
2.1	Base Vacuum	1	P. Ladd
3	RCCS	1	M.Hechler
3.1	RCCS flowtest	1	A.Bhchawat
4	RF	1	R.Fuja
4.1	Overshot RF tuning	1	Y. Kang
4.2	HVDM interface	1	S.Anderson
4.3	LLRF crosscal	1	R.Ma
4.4	HPRF crosscal (low load)	1	M.McCarthy
4.5	RF reference line	1	R.Ma
5	MAGNETS		T.Hunter
5.1	Check PMQ magnet systems	1	T.Hunter
5.2	Check Dipole Corrector magnet systems	1	T.Hunter
6	PS		K.Zeller
6.1	Calorate power supply current	1	K. Zeller
7	DIAGNOSTICS	1	S.Assadi
7.01	Calorate BPMs through test points	1	C.Deibele
7.02	Calorate BCMs through test points	1	C.Deibele
7.03	Calorate FCs through test points	1	S.Assadi
7.04	Calorate wire scanners through test points	1	W.Blokland
7.05	Calorations for phase of selected BPMs	2	C.Deibele
7.06	BCM cross talk with Dipole Corr. operational	2	C.Deibele
7.07	BPM cross talk with Dipole Corr. operational	2	C.Deibele
7.08	FC cross talk with Dipole Corr. operational	2	S.Assadi
7.09	Wire scanner noise floor with Dipole Corr. operational	2	W.Blokland
7.10	BLM	2	S.Assadi
8	PPS		P.Wright
8.1	PPS interlocks	1	P.Wright
9	EHS		S.McKenzie
9.1	Monitoring of radiation levels	1	D.Gregory
10	Application programs		J.Galambos

....contacts for these tests have been identified...

horizontal testing

	DTL TANK (H-testing)	Priority	Person
	Test & Checkout, Conditioning Stage		
1	GLOBAL CONTROLS (GC)		D.Gurd
1.1	Test LLRF controls	1	D.Jeon
1.2	Test HPRF controls	1	D.Gurd
1.3	Test RCCS controls	1	S.Joseph
1.4	Test Magnets/PS controls	1	S.Nath
1.5	Test interlock controls	1	C.Sibley
1.6	Test timing system	1	D.Gurd
1.7	Test MPS	1	C.Sibley
2	VACUUM		P. Ladd
2.1	Base Vacuum	1	P. Ladd
3	RCCS	1	M.Hechler
3.1	RCCS flow test	1	D.Richard
4	RF		R.Fuja
4.01	RF leads geometry check		F. Kang
4.02	DTL klystron vs. RF power	1	F. Kang P.Ladd
4.03	DTL klystron vs. duty factor	1	F. Kang P.Ladd
4.04	DTL frequency vs. duty factor	1	F. Kang
4.05	Field flatness vs. average power	1	F. Kang
4.06	DTL rf amplitude loop stability measurement	1	F. Kang
4.07	DTL phase loop stability measurement	1	F. Kang
4.08	DTL cavity vacuum vs. RF power	1	F. Kang
4.09	DTL conditioning	1	R.Fuja
4.10	DTL cavity frequency vs. duty factor	1	F. Kang
4.11	SYNCH checkout	1	S.Anderson
4.12	LLRF crosscal		R.Ma
4.13	HPRF (with LLRF,RCCS and SC)		M.McCarthy
4.14	RF reference line		R.Ma
5	MAGNETS		T.Hunter
5.1	Check Dipole Corrector magnet systems with RF on	1	T.Hunter
6	PS		K.Zeller
6.1	Calorate power supply current	1	K. Zeller
7	DIAGNOSTICS		S.Assadi
7.1	BCM cross talk with RF (DC) operational	2	C.Deibele
7.2	BPM cross talk with RF (DC) operational	2	C.Deibele
7.3	FC cross talk with RF (DC) operational	2	S.Assadi
7.4	Wire scanner noise floor with RF (DC) operational	2	W.Blokland
7.5	BLM		
8	PPS		P.Wright
8.1	PPS interlocks	1	P.Wright
9	EHS		S.McKenzie
9.1	Monitoring of radiation levels	1	D.Gregory
10	Application programs		J.Galambos

....labor loaded duration estimates for testing will be reviewed.....

testing with beam

	DTL TANK (Equipment test with beam)	Priority	Person
	Test & Checkout, Commissioning Stage		
1	PPS		P.Wright
1.1	PPS interlocks	1	P.Wright
2	RF		R.Fuja
2.1	DTL RF power as a f(beamloading)	1	Y. Kang
3	DIAGNOSTICS		S.Assad
3.1	BCM response	2	C.Delbele
3.2	BPM response	2	C.Delbele
3.3	FC response	2	S.Assadi
3.4	Wire scanner response	2	W.Blokland
3.5	BLM	2	S.Assadi
4	MPS		C.Sibley
4.1	MPS interlocks	1	C.Sibley
5	EHS		S.McKenzie
5.1	Monitoring of radiation levels	1	D.Gregory
6	Application programs		J.Galambos
6.1	Steering algorithm	1	T.Pelaia

...and detailed test descriptions are being reviewed and/or prepared (including for D-plate).

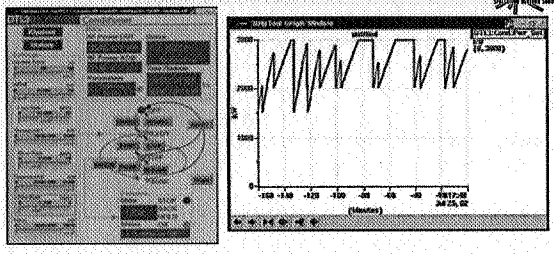
RF conditioning plans for DTL tanks established

- **DTL Tank Conditioning Procedure* , L.Kravchuk and E.Tanke**
- Prepared with feedback from J.Stovall, J.Billen, L.Young (all LANL), Y.Kang, R.Fuja, D.Jeon, M.Giannella and G.Dodson (all SNS/ORNL), S.Vasyuchenko (SNS/INR)

This procedure describes possible scenarios for raising the RF power level during the DTL Tank conditioning and is based on the experience at the INR DTL (five tanks) as well as experience of other DTL conditioning has been taken into account (FNAL, CERN, KEK, LANL etc).

*SNS-NOTE-OP-72

RF conditioning will have computer support



Carl Lionberger (LBNL), Eric Snow (student at ORNL), Ernest Williams, Pam Gurd (ORNL controls), John Galambos, Eugène Tanke (AP/ORNL)

DTL Testing and Commissioning Plan supports the IPS

- The DTL system testing spans > 11 months:
  - It will start prior to DTL tank 1 installation and will need to be completed before DTL tanks 2-6 commissioning starts.
  - DTL tanks 2-6 testing runs in parallel to DTL tank 1 commissioning
- DTL commissioning starting dates :
  - DTL tanks 1 22-May-2003
  - DTL tanks 2-6 1-Dec-2003
- Beam ready for CCL : 1-Apr-2004

Beam Commissioning Goals Support CD-4 Demonstration (no change)

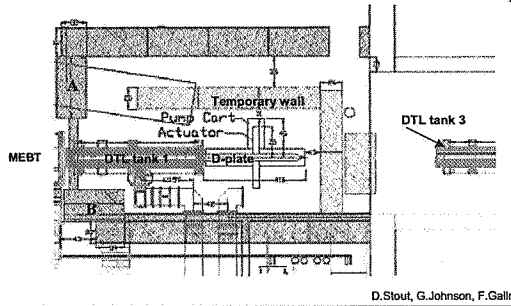
- CD-4 requirement = $1*10^{13}$ ppp on target
- Primary goal = $2*10^{13}$ ppp to the CCL @ 87 MeV
  - Develop/validate tuning procedures
  - Characterize beam(s) and their properties
  - Achieve maximum average beam power (limited by "beam stop" used)
- Secondary Commissioning Goals are Aimed at Achieving Production Beam Levels
  - Independently demonstrate production beam parameters
  - Achieve maximum peak current possible
  - Measure pulse to pulse jitter in beam parameters (e.g. beam centroid)
  - Quantify beam loss

DTL, CCL Commissioning overview is on the web

http://www.sns.gov/projectinfo/operations/commissioning.htm

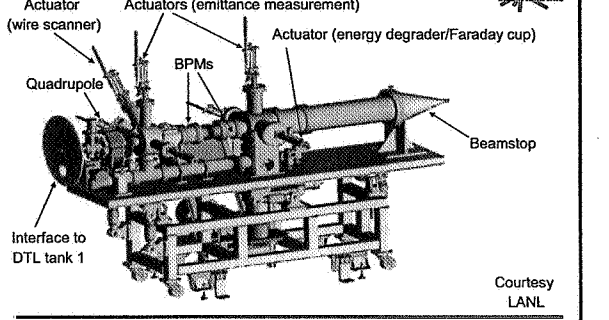
Major Category : DTL Tank 2-6
Sub-Category : Beam sub-category for DTL Tank 2
Sub-System : Beam profiles
Objective: To obtain beam profiles vs. quad scan and to validate transverse matching condition
Requested by : Jim Stovall (LANL) and Dong-o Jeon (SNS)
Date Proposed : January 2004
Estimated Time to Complete : 3 shifts
Estimated Manpower to Complete : 9 man-shifts
Priority/Order: high / 3
Basic Equipment Needs : Fully functioning components up to and including DTL Tank 2
Special Equipment Needs : None
Software/Application needs : Graphics display of beam profile and analysis
Input Beam Requirements : Beam up to 50micros pulse, up to full current,max 10Hz
Other prerequisites : None
Correlations Sought : Beam profiles vs. MEBT matching quad scans
Procedure: Measuring beam profile while varying MEBT matching quads
Supporting Computations : None
Problems Expected :
Comments:
Date Completed LANL: **Date Completed ORNL:**
Results:
Problems encountered:

Tunnel has been Extended to Enclose Tank 1 A Temporary Wall will Protect Workers



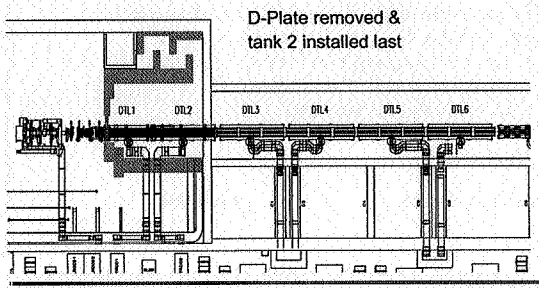
D.Stout, G.Johnson, F.Gallmeier

D-plate to be installed in the tunnel before the end of 2002



Courtesy LANL

DTL Tanks 3-6 Installed in Parallel with Tank 1 Commissioning



Significant progress in loading DTL data in the Global Database

- Beam line devices are all in
  -magnet data (correctors, PMQs), RF cavities, global coordinates
- Equipment initiated, advances as equipment arrives
  -racks, magnets (PMQs) all done
  -RF, RCCS, vacuum under way
- Web based user interface to database reports
- But much more still to be done....

Jeff Patton

Application software being interfaced to Global Controls (GC)

- DTL diagnostics will use same or similar software as for FE
- Algorithms for commissioning exist for
  - RF amplitude&phase setting (matlab)
  - Transverse matching, based on WS and emittance measurement (DTL tank1), (matlab)
    (John Galambos, Dong-o Jeon are interfacing these to GC using JAVA)
  - Steering (same as for FE, already interfaced to GC; Tom Pelaia)
- Virtual Accelerator
  - Interface between Process Variables (PVs) and TRACE3D
  - Tests underway for DTL tank 1 with D-plate (Paul Chu, Andrei Shishlo)

Sufficient resources for beam commissioning planned

Commissioning Teams	Front End	DTL-CCL	SCL	HEBT-Ring-RTBT	RTBT-Target
Accelerator Operations	Dodson Gioiella Coordinator Operators(3)	Dodson Gioiella Coordinator Operators(3)	Dodson Gioiella Coordinator Operators(3)	Dodson Gioiella Coordinator Operators(3)	Dodson Gioiella Coordinator Operators(3)
Accelerator Physics	Henderson Galambos Aleksandrov Tanke Danilov Stovall Jeon Chu Kim Kravchuk	Henderson Galambos Aleksandrov Tanke Danilov Stovall Jeon Chu Kim Kravchuk	Henderson Galambos Aleksandrov Tanke Danilov Stovall Jeon Chu Kim Kravchuk	Henderson Galambos Aleksandrov Beng Area Manager TBD Tanke Danilov Stovall Jeon Chu Kim Kravchuk Holmes Shishlo Pelaia Ring Postdoc	Henderson Galambos Aleksandrov Beng Area Manager TBD Tanke Danilov Stovall Jeon Chu Kim Kravchuk Holmes Shishlo Pelaia Ring Postdoc
Ekker	Mckenzie	Mckenzie	Mckenzie	Mckenzie	Mckenzie
Ion Source Group	3	3	3	3	3
Electrical Systems Group	13	13	13	13	13
RF Group	16	16	16	16	16
Cryomodule Group	6	6	6	6	6
Cryoplant Group	12	12	12	12	12
Mechanical Group	29	29	29	29	29
Diagnostics Group	6	6	6	6	6
Controls Group	6	6	6	6	6
Partner Laboratories	TBD	TBD	TBD	TBD	TBD

Some on-going and planned activities

- DTL tank1 cold model tuning optimization (ongoing)

-design field distribution and field distribution stability, Craig Deibele, Sasha Vasyuchenko (ASD) & Jim Billen, Jim Stovall (LANL)

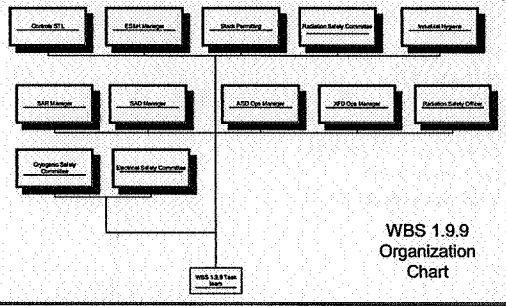
- Updating the test and commissioning plans (ongoing)
- Simulations using measured fields (planned)

-using measured accelerating field distribution

Spallation Neutron Source
Personnel Protection System

Paul Wright
Protection Systems Team Leader

October 14, 2002

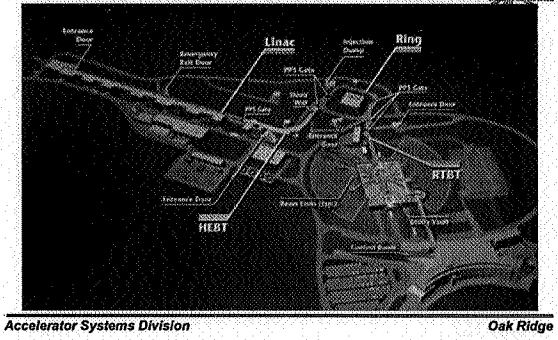


WBS 1.9.9
Organization
Chart

PPS Highlights

- Modeled after systems installed at CEBAF and APS
- Executed in accordance with the requirements contained in the the ANSI/ ISA standard S84.01
- Provides protection against prompt radiation from accelerator operations
- Based on SNS standard programmable logic controllers
- Divided into segments to facilitate maintenance and testing

Overview



PPS Safety Functions

- Prevent beam operation in segments not cleared of personnel (beam containment)
- Prevent RF klystron operation and energizing of exposed electrical conductors in segments not cleared of personnel
- Shut off beam if personnel enter an operating segment
- Shut off RF klystrons and de-energize exposed electrical conductors if personnel enter an operating segment

PPS Safety Functions

- Shut off beam if equipment faults cause radiation levels in occupied areas to increase over normal levels
- Support administrative actions to clear personnel from segments before beam operation
- Warn personnel located in segments before beam operation

Critical Devices

- Beam Cutoff
  - -65 KV High Voltage for the Ion Source
  - RF to the RFQ
  - Ion Source Plasma RF (alternative to –65 KV)
- Beam Containment
  - Dipole magnets in the HEBT
  - Lambertson Dipole
  - RTBT dipole magnet DH13

Controlled Devices

- -65 KV High voltage power supply
  - Redundantly controlled by 480 VAC PPS contactors
- RF Plasma Sources for Ion Source
  - Redundantly controlled by 480 VAC PPS contactors
- RF Klystrons
  - Redundantly controlled by:
    - Interlock on 2100 VAC circuit breaker for high voltage modulator
    - RF transmitter interface

Controlled Devices

- HEBT and Lambertson dipole magnet power supplies
  - Redundantly controlled by:
    - 480 VAC PPS contactors
    - Power supply interfaces
- Other magnet power supplies
  - Power supply interface
    or
  - Common PPS AC contactor for multiple small power supplies
- RTBT dipole magnet DH13 power supply
  - AC & DC disconnects provided by Target Protection System with an interface to PPS for status and control

PPS Operating Modes

Mode	Features
Restricted Access	Personnel access to segment controlled by operator, radiation work permit badge reader, or both. Hazardous operations in segment not permitted.
Search	Personnel access to segment controlled by operator. Only search personnel allowed in segment. Personnel will be required to carry an exchange key while in the segment. Hazardous operations in segment not permitted.
Controlled Access	Personnel access to segment controlled by operator. Access limited to trained personnel. Personnel will be required to carry an exchange key while in the segment. Hazardous operations in segment not permitted.

PPS Operating Modes

Mode	Features
Controlled Access—Magnets Energized	Personnel access to segment controlled by operator. Access limited to trained personnel. Personnel will be required to carry an exchange key while in the segment. Exposed energized conductors may be energized. RF or beam operations in segment not permitted.
Power Permit	No personnel access permitted. RF klystron operation, energized exposed conductors allowed. No beam operation in segment.
Beam Permit	No personnel access permitted. Full operation allowed.

PPS Beam Containment Modes

Mode	Operating Equipment	Beam Containment Mechanisms
Ion Source Conditioning	Ion Source	RF to RFQ 65 KV or Plasma RF supply
LINAC Tuning	Front End, LINAC, and LINAC Dump	First Dipole Magnet in HEBT Second through Eighth Dipole Magnets in HEBT
Ring Tuning	Front End, LINAC, LINAC Dump, Ring, RTBT, Injection and Extraction Dump	RTBT Dipole Magnet (RTBT.DH13) Lambertson Dipole

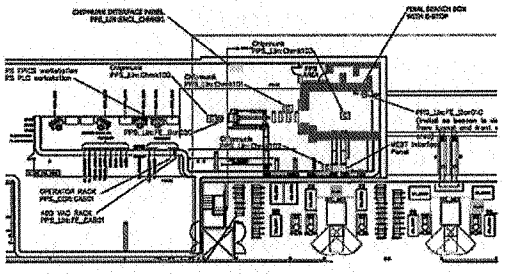
PPS Beam Containment Modes

Mode	Operating Equipment	Beam Containment Mechanisms
Full Operation	Front End, LINAC, LINAC Dump, Ring, RTBT, Injection and Extraction Dump, Target and Beam Lines	Mercury Target Beam Line Shutters

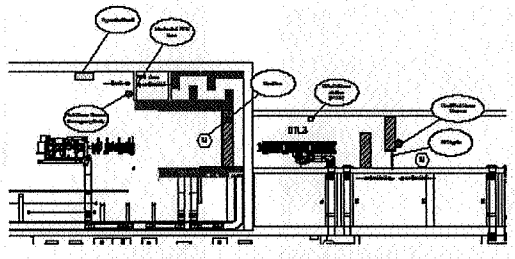
PPS Phases

- The PPS is being implemented in phases
  - Phase 0- Front End and DTL tank 1
  - Phase 1- LINAC segment
  - Phase 2- LINAC & HEBT segments
  - Phase 3- Entire Accelerator
  - Phase 4- Target and Instruments
- *Even the phases have phases*
  - 0.0a- Ion Source Only
  - 0.0- Front End (Ion Source & RFQ)
  - 0.1- Front End and DTL tank 1

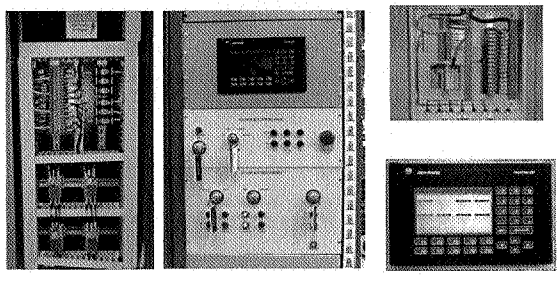
Phase 0 Overview



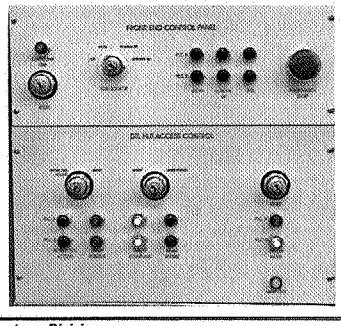
DTL 3 PPS



Phase 0 Controls



Operator Controls



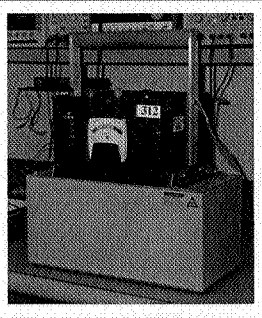
Warning Devices

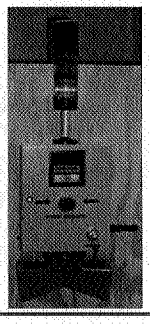
- Beam shutdown stations located every 100 feet
- Tunnel lights dim prior to beam operation
- Public Address system in tunnels

Radiation Detection

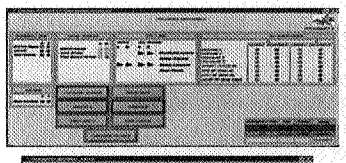
- Based Fermi Lab style "Chipmunks"
- Units will be installed outside the shielding
- Units may be applied non-redundantly or redundantly depending on potential radiation levels
- Outputs will be used to shut off beam
- Pulse signals will be sent to the operator interface for display, trending and archiving

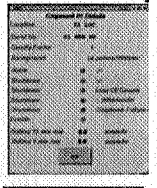
PPS Devices

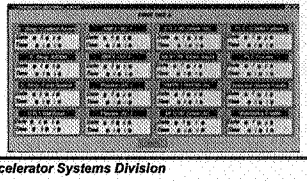


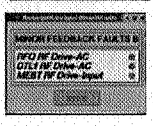


EPICS Screens

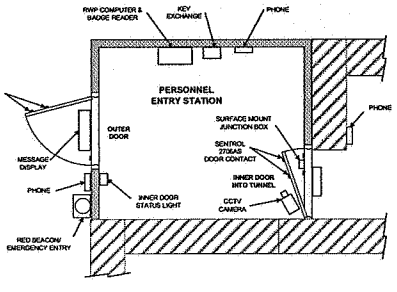




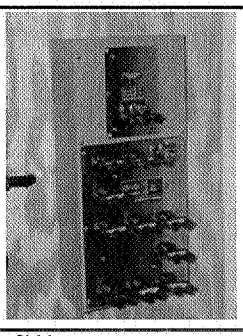




PPS Entry Station



Exchange Keys



Safety Life Cycle

- Analyze hazards
- Apply passive or administrative controls
- Determine active safety functions and performance levels
- Develop safety specifications
- Develop conceptual design and verify adherence to specifications
- Detailed design
- Installation, test and acceptance test
- Pre-startup safety review
- Operations, maintenance and periodic testing

Policy on HA and Risk Minimization and Acceptance Given in the SNS SAD

- Purpose:
  - –Understand Risks
  - –Eliminate or Mitigate Risks
  - –Designate Safety Significant Equipment
- Methods:
  - –conservative consequences and frequencies
  - –qualitative analysis supplemented by quantitative analysis where necessary to understand the hazard's consequence(s)

When to Designate a System "Safety Significant"

- The Safety Significant Designation is Awarded When:
  - –Unmitigated risk includes serious injury or death
  - –AND
  - –Multiple, reliable layers of defense-in-depth do not exist.
- Philosophy: The Safety Significant System gives us something to "hang our hat on," but
  - –Desired situation is to have a Safety Significant system plus defense-in-depth -- I.e., non-safety-related systems and administrative actions/training.

Guidance of ISA-84.01 Requires Assignment of SIL Levels to Safety Significant PPS Features

- Policy for Assigning SIL Levels is Documented:
  - –"SNS Personnel Protection System Safety Basis and Basis for Selection of PPS SIL Levels," SNS-102030103-ES0005-R00 (Rev 01 currently being processed).
- Realistic fatality threats without much (non-safety-related) defense-in-depth require SIL-2
- Injury threats or low probability fatality threats with effective (non-safety-related) defense in depth require SIL-1.

Appropriate SIL Levels Have Been Assigned to Essential PPS Features

- Tunnel Access Control: SIL-2
  - –Related sweep support and pre-beam warnings: SIL-1
- Beam Confinement: SIL-2
- RF Klystron Control: SIL-2
- Exposed Electrical Conductors Control: SIL-1
- Occupied area Radiation Area Integrity Control (ALARA): no-SIL
  - –Can set SIL-1 or SIL-2 if need arises.

Hazard Analysis & Safety Functions

- Contains information on hazard analysis results
- Contains safety functions and safety integrity level requirements

Safety Requirements Specification

- Developed in accordance with ISA S84 requirements
- Contains basic system requirements
  - Requirements from hazard analysis
  - Safety Functions
    - Process inputs
    - Process outputs
    - Relation of inputs to outputs
    - Manual shutdown
    - Response time
    - HMI
    - Reset
  - Required SIL
  - Diagnostic requirements
  - Maintenance and testing requirements

Software Safety Requirements Specification

- General Requirements
  - Safety Functions
  - PLC specification
  - Network Architecture
  - Programmer restrictions
- Fault detection and response
  - PLC faults
  - Equipment faults (feedback)
- Inter-PLC I/O
- Inputs from field devices
  - Key switches
  - Position switches
- Program formats
- Operating Logic
  - Operating Modes
  - Personnel Entry Doors
  - Sweep Logic
  - Beam Permit Logic
- Logic is represented by a combination of flowcharts and Boolean logic diagrams

Programmable Logic Controllers

- Redundant programmable logic controllers (PLCs) for each segment
- Uses the SNS standard PLC
- Input and output circuits are designed to be fail safe (energized to enable, de-energize to disable)
- Signal and control cabling, along with the PLC network cable, will be routed in separate wireways from other cabling
- A common functional software requirements document will be prepared- the logic for each PLC is developed by separate engineers
- Production PLC programming is rigorously controlled in accordance with the software configuration control procedure

Safety vs. Non-Safety PLCs

- Reviewed safety PLCs during initial design phases
  - High diagnostic
  - 1oo3 redundancy
- Concentrated on Moore high diagnostic safety PLC
  - Very high claimed dangerous undetected failure rate
  - Impressive reliability calculations available from vendor
- Vender performed estimate for SNS accelerator PPS
  - Roughly three times the cost of the SNS standard PLC (1oo2)
  - Vendor architecture did not lend itself to highly distributed system like SNS
  - Redundant system would not normally use different programs

SNS Standard PLC

- Allen Bradley ControlLogix family of PLCs
- Pros
  - Up to date design with several networking options
    - ControlNet
    - EtherNet
    - DeviceNet
  - EPICS driver developed for SNS project
  - Broad usage at SNS provides many knowledgeable staff members to help with design/ programming issue
  - Product availability and support expected to continue for many years

SNS Standard PLC

- Cons
  - New product has more software revisions (firmware and programming software)
  - Reliability data available, but not based on extensive product history
  - Only basic failure data available, not dangerous undetected failure rates

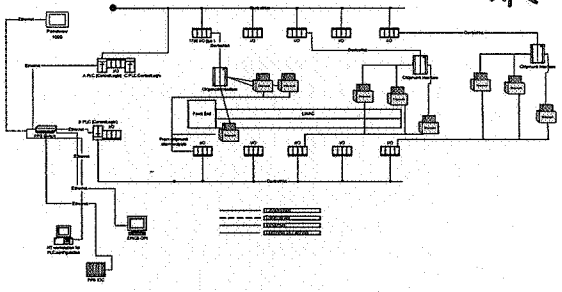
PLC Power Supplies

- Standard Design uses four 24 VDC power supplies
  - System A supply
  - System B supply
  - Chipmunk power supply (C)
  - Interposing relays power supply (D)
- Power supplies are never interconnected
- Intersystem connections are separated by interposing relays

PLC Network Considerations

- Confronted by a number of possibilities when designing the PLC network Architecture
- ControlLogix has several networking options
  - ControlNet, Ethernet, DeviceNet, Remote I/O, Data Highway
- Standardized on the following:
  - ControlNet for remote I/O chassis data transfer
    - Deterministic, passive network over coax or fiber
  - Ethernet for communications with EPICS and PLC based HMI
  - DeviceNet for connection to field mounted I/O (low speed DAS)

Phase I PLC Networks



Programming Issues

- RSLogix software organizes programs as follows:
  - Project
    - Tasks (Continuous or Periodic)
      - Programs (scheduled or unscheduled)
        - » Routines (called from mainprogram via subroutine calls)
- Issues related to program segmentation
  - Should programs be segmented
  - If segmented, should be divided into separate Tasks, Programs or Routines

Programming Issues

- SNS is segmenting functions into separate routines:
  - GSV (Get System Values) to determine loss of communications and existence of forces
  - Keyswitch logic- provides defined logic outputs regardless of switch type (BBM or MBB) and detects switch malfunction
  - Feedback faults- determines that controlled device is not in assigned state
  - Radiation alarm processing- From Chipmunks
  - Main logic routine- sweep logic and logic for controlled devices
  - First out logic- captures first input to drop sweep and timestamps (sent to EPICS
  - Pulse test logic- Tests output module to determine if capable shutting off controlled device (without shutting off the device)

Programming Issues

- Internal vs. programmer provided diagnostics
  - Watchdog logic to ensure complete program execution
  - Watchdog timers
  - Loss of communications routines
  - Force detection
  - Program Checksum
- Programming languages
  - RSLogix software provides ability to program in ladder logic or function block
    - Function block primarily intended for analog control, but basic digital blocks can be used to perform PPS logic
    - SNS is programming one PLC with ladder logic and the other with function block

EPICS Security

- PLC communicates status to EPICS
- EPICS CIP driver modified such that EPICS cannot write to PLC
- VX operating system modified to prevent external log in
- Separate Ethernet port on IOC separates accelerator VLAN from PPS LAN
- Testing will be performed to demonstrate system integrity in the event of VLAN malfunction or hacking attempt

Radiation System PLC

- ControlLogix family allows multiple PLC processors in a chassis
- Separate PLC processor provided in A system chassis to process pulse inputs from Chipmunks
- Processor communicates with AB Panelview interface to allow radiation safety officers to enter Chipmunk data
  - Setpoints, serial number, location, quality factor, background pulse rate
- PLC summarizes Chipmunk status and provides single digital output to A PLC (does not communicate over backplane)

PLC program testing

- What constitutes an acceptable level of program testing at each implementation stage

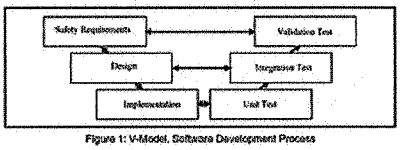


Figure 1: V-Model, Software Development Process

http://www.exida.com/articles/soft61508.pdf

PPS Software QA

- PPS PLC software
  - Level 1 configuration control item
  - A programmer only works on one system, not both systems
  - PLC logic is developed/ modified only in accordance with an approved logic specification (level 1 document)
  - Re-certification is required after logic modifications
  - PLC logic is maintained on master CD-ROMs maintained by the PPS group. CDs will be rigorously controlled.

PPS Software QA

- PLC firmware
  - A master listing will be maintained of the firmware versions in each PLC device
  - Before any firmware is upgraded, a cross check is performed to ensure that other firmware levels are compatible or upgraded as necessary
  - Re-certification is required after firmware updates
- RS-Logix windows computer tied to PPS Ethernet system
  - Located in an area where access is controlled (control room)
  - Strict password control, computer can only be accessed by approved personnel
  - Used to program and interrogate PLC logic only, not used for operator display

PPS Software QA

- PPS EPICS screens
  - EPICS screens prepared in accordance with approved specification (level 2 document, approved by PPS group leader & ASD operations)
  - Displays/ functions tested after implementation/ modification in accordance with written specification

420.2A Draft Guidance Checklist

- Unsupervised Occupancy- Doors always locked
- Two person rule- Enforced via administrative procedure
- Access control mechanisms- Will have CCTV cameras at entry doors, may have plant badge reader control tied to RWP system
- Interlock functions selected after careful safety analysis

420.2A Draft Guidance Checklist

- PLC based interlock system
  - Operability validated via certification
  - Modular design (5 segments)
  - Redundant systems for SIL 2 safety functions
  - External links to PLC designed to allow data communications without jeopardizing PLC operability
- Staff Resources- Dedicated Controls team for safety systems

420.2A Draft Guidance Checklist

- Technical Design
  - Inputs and outputs designed to be fail-safe for the most likely failure modes
  - SIL 2 interlocks designed to protect against single failures
  - System components located in locked enclosures, PPS cable run in separate conduits or tray with dividers
  - Two critical devices are used to prevent beam production/ transport
  - The status of each controlled device is monitored by the PPS and action taken to shut off beam when a controlled device is detected in an unsafe state
  - The PPS controls will not be used as routine shutdown devices

420.2A Draft Guidance Checklist

- Technical Design (continued)
  - PPS covered by ASD configuration control policy, strict control over safety related devices associated with the PPS
  - Modular design allows maintenance/ modifications without affecting other segments
  - System designed to allow complete functional testing in a timely manner
  - Documented findings and responses to the preliminary and final design review

420.2A Draft Guidance Checklist

- Personnel Exclusion Areas
  - Beam shutdown stations provided every 100 feet in tunnels
  - All personnel doors have panic bars for emergency exit, devices provided for emergency entry (interlocked to beam)
  - Message displays at entrance doors alert workers to tunnel status, all doors have red beacons
  - PLC supervised search required for high radiation areas prior to beam permit
  - Audible and visual alarms are provided in the tunnel prior to power or beam permit
  - Search required after access violation
  - Controlled access mode provided to allow access without subsequent search, including "magnets on" mode

420.2A Draft Guidance Checklist

- Testing of Interlocks
  - Planned re-certification interval is 6 to 12 months
  - Procedures will require post-modification or maintenance testing appropriate to the change or repair
  - Written certification procedures will be used for certification testing
  - No crossties between inputs to A & B systems allow independent testing of redundant systems
  - Certification testing will include final test to observe proper shutdown of operating critical devices (i.e. operating power supply shuts off upon removal of PPS permissive)

420.2A Draft Guidance Checklist

- System Documentation
  - Only approved drawings and documents are used to establish the PPS configuration
  - The configuration control plan will describe the methods used to maintain control over PPS documentation
  - Certification procedures will require records maintenance of completed certifications

420.2A Draft Guidance Checklist

- Administrative Control
  - The PPS configuration will be controlled in accordance with the ASD configuration control procedure
  - Procedure developed for bypassing of PPS interlocks
  - Maintenance procedures will be prepared to address repair work on the PPS
    - Work performed only by authorized personnel
    - Post-modification testing/ re-certification required prior to a return to service

Oxygen Deficiency Hazard (ODH) System

- Protects against hazards from inert gases in LINAC and Central Helium Liquefier (CHL)
- Cryogenic and warm helium in LINAC
- Cryogenic & warm helium and cryogenic nitrogen in CHL
- Large inventory of helium able to reduce oxygen content to hazardous levels throughout entire accelerator
- ODH system will be provided to address these hazards

ODH System

- LINAC ODH system will consist of fixed oxygen sensors in the LINAC tunnel tied to area visual and audible alarms in the tunnel and visual alarms at all entrances to the LINAC/ HEBT
- Passive ventilation is provided via the emergency ventilation system (EVS) any time the LINAC can be accessed
- Active ventilation is provided for the LINAC tunnel. Normally this will be manually controlled by the operator, but can start automatically
- System status, alarms and controls are provided in the control room

ODH System

- CHL ODH system consists of fixed oxygen sensors with audible and visual alarms
- Passive ventilation is provided in the warm compressor area (warm gas only)
- Adequate passive ventilation is not available in the cold box area
- Liquid nitrogen used in the cold box represents a hazard in the pit area of the building
- Redundant oxygen sensors are provided in the cold box area due to lack of other layers of protection

Change Control

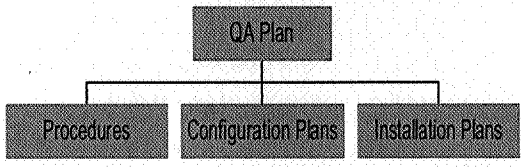
John Mashburn
ASD Quality Assurance Representative

October 15, 2002

CONTENTS

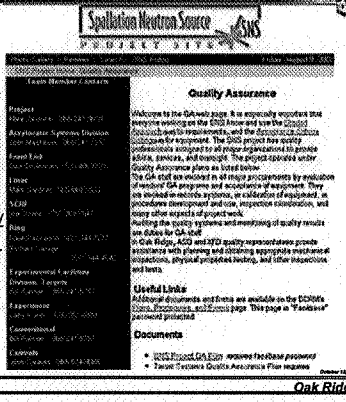
- Quality Assurance Web Site
- QA Staff and Organization
- SNS QA Plan
- SNS Procedures
- Changes in Procurements
- Configuration Management
- Installation Plan

Change Process



SNS Quality Assurance Web Page: Key to information such as procedures, forms, contacts

http://www.sns.gov/projectinfo/qa/qahome.htm



- The **ASD Quality Assurance Representative (QAR)**, JOHN MASHBURN, reports directly to the SNS Quality Manager and Supports the ASD Director
- **PARTNER LABS** have QARs who report to their STL and are obligated to support the SNS QA program and Quality Manager
- A **METROLOGY LAB** is maintained by QA in the RATS building to make reliable part dimensional verifications readily available (room 52-next to John Mashburn's office)

- The SNS project operates under a quality assurance program that complies with **DOE order O 414.1A**
- The program is described in the "Spallation Neutron Source Quality Assurance Plan, SNS-QA-P01," Rev.2, which is on the web at the QA homepage under "Project Information:"
  http://www.sns.gov/projectinfo/
- The SNS QA plan has been approved by DOE

QA Program Requirement for Change Control

Criterion 6—Design

- **Changes**—Design changes, including project change orders, field changes, and nonconforming items designated "use-as-is" or "repair," shall be controlled by measures commensurate with those applied to the original design. Temporary modifications will have a level of control similar to the design of permanent modifications if they affect a quality level 1 or 2 system.
- **Configuration management**—Systems will be implemented to control designs and to inform facility operators of the current configuration of equipment in the facility.

SNS MANAGEMENT SYSTEMS PROCEDURES

The SNS project has a **MINIMUM NUMBER** of management procedures, including QA procedures

The procedures are **EASY TO FIND-** just use the web!
http://www-internal.sns.gov/dcrm/procedures.htm#procedures

The procedures are **EASY TO USE**

- The process steps are given as one-page colored flowcharts in most cases

QA AUDITS check compliance with the procedures and their effectiveness by looking at results

Changes in Procurements

Supplier-Requested Deviations

The Offeror may propose deviations from the specifications, drawings, or other technical requirements of this procurement. Where time is a consideration, the Offeror may communicate the proposed deviation directly to the engineer or technical lead, with a copy to the Company's buyer. The engineer or technical lead will evaluate the technical aspects and recommend to the buyer, who will communicate acceptance or disapproval to the Offeror. The request should identify the affected items, drawing/specification number & revision number, a description of the proposed deviation, and the justification for it. (source: procedure SNS-QA-P05)

Changes in Procurements

Nonconformances

The Company expects to receive equipment items, components, materials, software, and documentation that conform to all codes, standards, specifications, and procedures in the Agreement. The Seller may use its own nonconformance program to identify, report, and recommend disposition of all nonconformances, but dispositions that would leave any remaining nonconformity must be submitted to the Company for approval. The request should identify the affected item(s) by name and serial number, citing the drawing/specification number & revision number containing the specific requirement that has not been met. It should state the number of nonconforming items being reported. The request should include a description of the nonconformity, identifying requirement(s) not met. The supplier may attach a description of the cause, and a corrective actions plan and schedule if pertinent.

Note: The issuance and acceptance of such a request in no way limits or affects the warranty provision of the Agreement. Such a request shall not establish a precedent or obligation to accept existing or future items not conforming to all provisions of the Agreement. (source: SNS-QA-P05)

Configuration Management

CONFIGURATION MANAGEMENT PLAN (CMP)

The SNS CMP outlines the process and procedure for managing the approved project baselines for the technical design basis, cost, and schedule.

Management and control of the technical requirements and design parameters for SNS involve critical issues and constitute the majority of coverage provided in the CMP. Management of the entire project technical baseline (CCB Level 3) is the responsibility of the deputy project director. The CMP also delineates how the SNS change control system will work to administer and record changes to all three project baselines.

Configuration Management

BASELINE CHANGE CONTROL RESPONSIBILITY AND PROCESS

The baseline change manager provides administrative control and support for processing all SNS project change requests (PCRs). SNS uses a Web-based electronic process that begins upon submission of draft PCRs and continues through various reviews to the final approval of the PCRs. Baseline change proposals (BCPs), which require DOE review and approval, are processed outside the electronic system. Each subproject has its own change process coordinator, who interfaces with the Project Office's baseline change manager.

The project controls manager is responsible for implementing approved cost and schedule baseline changes to the official SNS project baseline documents and files.

The project director, his direct reports, and the senior team leaders (STLs) are responsible for implementing all approved baseline technical/design basis changes to the official SNS project technical baseline documents and supporting technical design documents and files at all locations.

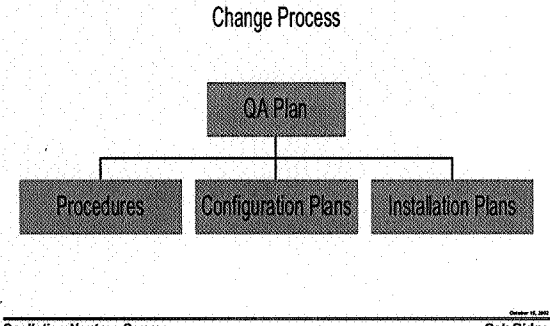
Installation Plan Change Control

- It is ASD policy that all installation of technical components and subsystems, as well as their associated conditioning and testing without beam be performed in accordance with formal, signed documentation.
- In the environment of an accelerator installation where field changes are frequently necessary to make first-article hardware work, ASD Installation must implement a process to efficiently handle and control these changes.

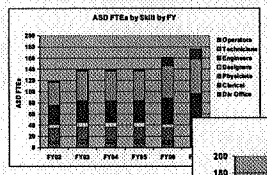
Installation Plan Change Control

- The initial release of all installation packages (i.e., drawings, specifications, procedures) will be transmitted with an SNS Accelerator Division—Document Transmittal form signed by the appropriate Group Leader (Fig. 7). After that initial formal release, up to six field changes may be made to the documents through sketches and formal logbook entries. After the sixth change, a Document Change Notice per the *Project Controls Manual* will be initiated and the document formally revised (Fig. 8).
- The exception to this field configuration control policy is ES&H. If a document change affects an ES&H requirement or changes the risk level inherent in a design or its implementation, the original documentation will be revised and formally reviewed and approved before its re-release.

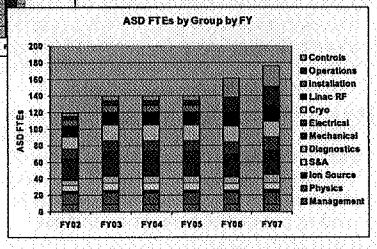
SNS Change Control



ASD Staff Ramp-Up



- In FY03 about 140 FTEs, plus students, post docs, and some visitors will be funded in the ASD work packages. In addition 3 LANL COS will be working at ORNL.



- In FY01-06 ~700 FTEy are supported by either pre-ops, field-coordination, or installation budgets
- LI Controls FTEs are counted by Dave Gurd
- In FY07 176 FTEs will be supported by operations

Commissioning Teams	Front End	DTL-CCL	SCL	HEBT-Ring-RTBT	RTBT-Target
Accelerator Operations	Dodson	Dodson	Dodson	Dodson	Dodson
	Gianella	Gianella	Gianella	Gianella	Gianella
	Coordinator	Coordinator	Coordinator	Coordinator	Coordinator
	Operators(3)	Operators(3)	Operators(3)	Operators(3)	Operators(3)
Accelerator Physics	Henderson	Henderson	Henderson	Henderson	Henderson
	Galambos	Galambos	Galambos	Galambos	Galambos
Red + Area Manager	Aleksandrov	Aleksandrov	Aleksandrov	Aleksandrov	Aleksandrov
	Tanke	Tanke	Tanke	Ring Area Manager TBD	Ring Area Manager TBD
	Danilov	Danilov	Danilov	Tanke	Tanke
	Stovall	Stovall	Stovall	Danilov	Danilov
	Jeon	Jeon	Jeon	Stovall	Stovall
	Cho	Cho	Cho	Jeon	Jeon
	Kim	Kim	Kim	Cho	Cho
	Kravchuk	Kravchuk	Kravchuk	Kim	Kim
				Kravchuk	Kravchuk
				Holmes	Holmes
				Shishlo	Shishlo
				Palais	Palais
				Ring Postdoc	Ring Postdoc
ES&H	Mckenzie	Mckenzie	Mckenzie	Mckenzie	Mckenzie
Ion Source Group	3	3	3	3	3
Electrical Systems Group	13	13	13	13	13
RF Group	16	16	16	16	16
Cryomodule Group	6	6	6	6	6
Cryogenics Group	12	12	12	12	12
Mechanical Group	29	29	29	29	29
Diagnostics Group	8	8	8	8	8
Controls Group	6	6	6	6	6
Partner Laboratories	TBD	TBD	TBD	TBD	TBD

Appendix 4
ARR Evaluation Reports

ARR Evaluation Form

Topic: Safety Assessment Document and Commissioning Plan

Date: 10/16/02

I. Evaluation Criteria:

A Safety Assessment Document (SAD) exists, has been reviewed by an appropriate ES&H Committee as an independent safety review, and the comments and recommendations resulting from that review have been adequately addressed by management.

Management has documented its conclusions that the activity analyzed in the SAD is an accurate evaluation of the ES&H consequences of undertaking the activity, and that the mitigated risks of the activity to employees, the public, and the environment are acceptably low.

A commissioning plan detailing the administrative and technical safety systems which are required for commissioning has been written.

II. Records Reviewed:

Spallation Neutron Source, Final Safety Assessment Document for the Front End, Linac and Klystron, August 2002, 102030103-ES0008-R00

Spallation Neutron Source Commissioning Program Plan, July 2002, SNS 100000000-PN0004-R00

III. Interview Conducted:

None.

IV. Sites Visited:

None.

V. Discussion of Results:

The SAD for FELK was reviewed by an independent safety review committee (ASRC) in two stages. Comments and recommendations were appended to the SAD and adequately addressed.

The SAD is approved by line management and approved by DOE.

VI. Conclusion:

The SAD for the FELK is complete.

A commissioning plan detailing the commissioning from Front End to CD-4 has been written.

VII. Recommendation

None.

Reviewer: E. Lessard

ARR Evaluation Form

Topic: Conduct of Operations and Operational Procedures

Date: 10/16/02

I. Evaluation Criteria:

Do they have a conduct of operations matrix?

Are procedures necessary for safe operation of the activity developed, reviewed, verified (by performance where applicable), and approved?

Is a procedure control system established, which defines the processes for procedure preparation, review, approval, verification, distribution and training, and are these processes kept current?

Is maintenance involving the safety aspects of Front End commissioning being reviewed and have maintenance procedures been identified, developed, reviewed, verified, and approved?

Are procedures for safety-related operations and maintenance kept current?

Are procedures to deal with off-normal and emergency situations prepared and approved for use?

II. Records Reviewed:

SNS Operations Procedure Manual

III. Interview Conducted:

Mario Giannella

IV. Sites Visited:

701 Scarboro

V. Discussion of Results:

SNS does not have a conduct of operations matrixed to DOE 5480.19. SNS has many procedures that could be matrixed into a conduct of operations. We discussed authorization to start up and procedures that are part of conduct of operations.

We discussed remote operation abilities.

VI. Conclusion:

SNS has developed procedures and reviewed procedures; however, not all procedures that are required for Front End commissioning have been verified and approved. Thus, training is also not completed. Some procedures in the OPM on the web are not approved. Procedures for dealing with off normal and emergency situations have been prepared and approved for use, but local the emergency response procedure has not been approved.

A review of the operations organization indicates that planned staffing for the commissioning of the Front End is adequate. Additionally, the R2A2s for the Division Director and Group Leaders exist and were reviewed.

VII. Recommendation

The following key operational procedures must be reviewed and approved, and training completed, before Front End commissioning. These procedures must have a tracking sheet showing both the technical reviewer and QA reviewer signatures prior to authorizing:

1.A-1 Authorization
1.B-1 SNS Documents for Operation
1.B-2 Logbook Keeping
SNS-OPM Section 2 – Safety -All facets of Safety (LOTO, hazards, Radiation, Electrical, guidelines, etc.)
4.B-2 Training and Qualification Plan
5.A-1 Local Emergency Plan
5.B-4 Emergency procedures to be implemented by CCR operators
6.A-1. SNS Operations Organization & Administration
6.A-2. Operating Practices
6.A-3. Activities in Control Rooms
6.A-4.1. Chief Operator Authorization to Modify Procedures
6.A-5. Shift Turnover
6.K-1. Trouble Reporting
8.A.1 Ion Source Procedure
A.1 OPM Acronyms
A.2 More General Acronyms
SNS-OPM Appendix M. – Maps

A Conduct of Operations matrix should be completed after the Front End commissioning but prior to the next commissioning module. A full conduct of operations matrix is not needed for turning on the front end; however, two areas need addressing:

1. No remote operations.
2. Signed off operations start up lists need to be completed for equipment installed for the Front End. For examples, see SNS Form 13 and SNS Form 17.

The R2A2s for the ASD Director and the Group Leaders should be reviewed to ensure operations related roles, responsibilities, authorities and accountabilities are clearly described.

Reviewers: Bob Mau and Ed Lessard

ARR Evaluation Form

Topic: Radiation Shielding

Date: 16 October 2002

I. Evaluation Criteria:
   a. Is the shielding design, implementation and control in accordance with 10 CFR Part 835, *Occupational Radiation Protection*, the guidance in DOE Order 420.2A, *Safety of Accelerator Procedures*, and ORNL-RP-110, *ORNL Radiological Control Policy and Radiological Protection Procedures*.
   b. Do the shielding design, implementation and control meet the commitments in the Safety Assessment Document?

II. Records Reviewed:
   a. *Radiation Shielding and Barriers*, SNS-OPM 2.H-6 and subsections contained therein.
   b. Spallation Neutron Source Radiation Safety Committee Charter.
   c. SNS/AP Technical Note 07, *Accelerator physics model of expected beam loss along the SNS accelerator facility during normal operation.*
   d. Report of the Spallation Neutron Source Project Neutronics and Shielding Design Calculations External Review Committee.

III. Interviews Conducted:
   a. George Dodson and Don Gregory, tour of Front End, linac tunnel and klystron gallery, 15 October.
   b. George Dodson (interview conducted jointly with Bill Ruzicka and Mark Vance), 15 October.
   c. Franz Gallmeier, Don Gregory and Irina Popova, 16 October.

IV. Sites Visited: SNS Front End, linac tunnel and klystron gallery, 15 October

V. Radiation Shielding

   a. Discussion of Results

Requirements for radiation shielding are contained in subsections of Section 2.H of the Operations Procedures Manual. Design objectives for limits on prompt radiation for both normal operations and fault conditions are suitably conservative. Specifications for review of shielding design, configuration control and requirements for radiation barriers are clearly stated. However, the criteria for shielding and the objectives for control of radiation levels in occupied areas are scattered through a few procedures rather than being located in a single document. Further, the detailed criteria are in a somewhat puzzling location, the subsection on review of shielding design. This lack of centralization leads to a somewhat confusing array of requirements and, in at least one case, results in an apparent contradiction. In the Radiation Safety Policy (SNS-OPM 2.H-5) the design objective for prompt radiation

limits in continuously occupied areas is stated to be less than 0.25 mrem/hour and ALARA. However, the limit is stated as 0.5 mrem/hour in the procedure on Review of SNS Shielding Design (SNS-OPM 2.H-7.4).

Responsibilities and authorities for approval of shielding design are described differently in two separate documents that treat this subject. The first, the charter for the Radiation Safety Committee (RSC), states that the RSC is advisory to management and that the SNS Associate Laboratory Director shall determine the disposition of RSC recommendations. This line management responsibility for safety is in accordance with the principles of Integrated Safety Management. However, the procedure on Review of SNS Shielding Design (SNS-OPM 2.H-7.4) states that the SNS RSC and the SNS RSO approve shielding designs.

Shielding design is not a complex issue for Front End commissioning because radiation levels are expected, on the basis of experience at LBNL, to be less than about 100 mrem/hour. Looking ahead, shielding design will become a more important issue as the DTL and downstream portions of the beam delivery system are readied for commissioning. Extensive shielding design has been carried out for these areas, and the general design approach was reviewed by an external committee 20-21 September 2000. However, designs for specific areas have not received the reviews described in the procedure on Review of SNS Shielding Design (SNS-OPM 2.H-7.4).

b. Conclusion: The planned shielding and personnel barriers for the Front End will provide adequate protection to personnel from exposure to radiation during the commissioning.

c. Recommendations:
   i. Consolidate the criteria for shielding and the objectives for control of radiation levels in occupied areas in a central document to which other documents and procedures may refer.
   ii. Resolve discrepancies in the stated design objective for prompt radiation limits in continuously occupied areas.
   iii. Resolve the apparent mis-assignment of authority for approval of shielding design that appears in the procedure on Review of SNS Shielding Design (SNS-OPM 2.H-7.4) to bring this authority into agreement with the charter for the Radiation Safety Committee.
   iv. Review of shielding design is not a major concern for Front End commissioning because of the low radiation levels observed at Berkeley; however, reviews of the shielding design as described in the procedure on Review of SNS Shielding Design (SNS-OPM 2.H-7.4) must be carried out and documented before parts of the accelerator beyond the Front End can be declared ready for operation.

VI. Radiation Shielding Configuration Control

a. Discussion of Results

Shielding requirements are expected not to be complex for the commissioning of the Front End. During commissioning activities at LBNL, some lead shielding was installed to reduce x-ray emissions from two of the pre-bunchers. SNS plans to install this shielding and to shield the beam stop, where up to 100 mrem/hour is anticipated at commissioning beam intensities, using borated polyethylene. The objective is to keep radiation levels below 5 mrem/hour at 30 cm from radiation sources, thus qualifying the Front End as a controlled area.

Once the shielding is installed, the engineer in charge will certify that the shielding configuration is proper, and the RSO will also sign off on the shielding configuration. The shielding will be subject to configuration control under normal ORNL Radiation Control procedures. When commissioning begins, radiation levels will be measured in normal operation and under fault conditions. These measurements will provide the basis for any additional shielding and personnel exclusion measures that may be necessary.

b. Conclusion: When the recommended measures have been developed and implemented, control of the shielding configuration will meet requirements during the course of Front End commissioning.

c. Recommendations: two measures still must be taken to ensure control of the shielding configuration as conditions change during the course of commissioning.
   i. A procedure should be written to establish criteria under which a complete set of radiation surveys are required, e.g., when beam intensity is increased significantly or operating parameters that could affect radiation levels are changed significantly.
   ii. Similarly, a procedure should be written to establish criteria under which additional shielding and/or personnel exclusion measures will be implemented and the process for implementation.

Reviewer: Dan Fitzgerald

ARR Evaluation Form

Topic: Lock Out / Tag Out

Date: 10/16/02

I. Evaluation Criteria:

Does SNS have a lock out tag out (LOTO) Procedure?
Does SNS have a working hot procedure?
Has LOTO and working hot training been implemented in the field?

II. Records Reviewed

SNS 104070400-PR0007 l, Lockout Tagout of Hazardous Energy Sources (signed off)
SNS OPM2.G2, Electrical Safety Implementation Plan (not signed off)
SNS OPM2.G3, Electrical Safety Working Hot (not signed off)

III. Interviewed conducted:

Mario Giannella, Paul Gibson, Paul Holick, Rob Morton, Sam McKenzie

IV. Sites visited:

SNS Construction Site, Front End Building

V. Discussions of results

LOTO

SNS 104070400- PR0007-R1, Lockout Tagout of Hazardous Energy Sources, is approved and signed off. It appears reasonably complete.

SNS OPM2.G2, Electrical Safety Implementation Plan, is a procedure that has not been signed off. Therefore training on this procedure hasn't begun

Training data base was looked at, as well as a vertical slice through Ion Source Group. The training records of the Ion Source Group were complete. The over all data base for the whole division indicated few people had expired training.

WORKING HOT

- In talking to the experts, SNS will not be working hot.
- There needs to be a protocol to allow installation, verification and testing of new installations, commissioning, maintenance, and repair.

- There is a procedure, SNS OPM2.G3, Electrical Safety Working Hot, which has not been approved. The protocol of using JHAs for working hot seems to be the vehicle that SNS has chosen as an alternative safety system until the working hot procedure is authorized. For example, the Ion Source Group did a JHA on its power supplies, which addressed working hot issues.

SITE VISIT

The on site visit found that LOTO was not being implemented locally according to the written LOTO procedure. This was brought to the attention of the ASD ESH Coordinator and the SNS ESH Manager, who acted immediately to correct the issue and investigate the root cause.

VI. Conclusion

SNS has a written and signed off LOTO procedure. SNS also has a working hot procedure, but it is currently not signed off. There is some indication that the LOTO procedure has not been implemented completely in the field. People are being trained and training is being documented.

VII. Recommendations

A number of actions associated with LOTO have not been completed at the time of this review that will need to be in place prior to the start of commissioning. The Quality Assurance Program Manager at ORNL, who is a member of the ARR Team, will monitor progress in completing these items. Specifically, SNS must finish the procedure sign offs, and ensure that the appropriate personnel are trained in the following procedures:

SNS OPM2.G2 Electrical Safety Implementation Plan
SNS OPM2.G3 Electrical Safety Working Hot

Working hot should be prohibited until SNS OPM2.G3, Working Hot, is authorized and personnel are trained. If working hot situations become truly necessary, then a JHA must be written and followed.

Note: Working hot prohibition includes installation, verification and testing of a new installation, commissioning, maintenance, and repair.

SNS needs to develop a self-assessment program that routinely (quarterly is typical) verifies that workers in the field are following the SNS LOTO program. This is often a task assigned to QA.

Reviewers: Bob Mau - primary, Dick Werbeck

ARR Evaluation Form

Topic: Fire Protection and Life Safety

Date: 10/16/02

I. Evaluation Criteria:

SNS FSAD for FELK, Table 5.1.1 – 1, item 3.8 - Compensatory action shall be taken if neither fire detection nor fire protection is available to an accelerator building that is greater than 4000 square feet.

SNS FSAD for FELK, Table 5.1.1 – 1, item 4.2 - Fire detection/protection systems shall be tested periodically in accordance with applicable NFPA standards.

II. Records Reviewed:

SNS – OPM 2.B – 1, Section 5.1; SNS FSAD for the FELK; Preliminary Fire Hazards Analysis: FELK, HEBT Service Building and Part of HEBT Tunnel (NTSC Report No. 00-3006.001.001, Title II, Rev.0); SNS – OPM 2.J – 2, Section 5.

III. Interview Conducted:

Jim Eckroth, Sam McKenzie

IV. Sites Visited:

Front-End Building, Klystron Building

V. Discussion of Results:

The Front-End building has both a fire detection (VESDA) and fire protection (sprinkler) system. The Klystron building has a fire detection (VESDA) system and will have a fire protection system. Testing of the fire detection system began today and will be completely checked out by the end of the week (10/18/02). The fire protection system is fully checked out and operational in the Front-End building; once the Klystron building construction is complete, fire protection for that building will be implemented.

Operation of the fire detection/protection systems has not been formally transferred to ORNL. ASD has not accepted the systems as complete.

Maintenance and periodic testing of the fire detection and protection systems is to be carried out by ORNL as described in ORNL Facility Use Agreements. The FUA for the SNS is currently under development and not yet complete.

VI. Conclusion:

Although the fire detection and fire protection systems for the Front-End and Klystron buildings will meet the requirements set forth by SNS, they are not yet complete and transferred to ORNL and ASD.

VII. Recommendation

Before commissioning begins, ensure that:

1) Installation and acceptance testing of the fire detection and protection systems in the Front-End building are completed and approved by ASD.
2) Installation and acceptance testing of the fire detection system in the Klystron Building is completed and approved by ASD.
3) Because the SNS FUA is not complete, some formal agreement between ASD and the ORNL Fire Protection organization is developed and approved so that ORNL assumes responsibility for operating, maintaining and periodically testing the completed fire detection and protection systems.

Reviewer: Dick Werbeck

ARR Evaluation Form

Topic: Environmental Management and Waste Management

Date: 10/16/02

I. Evaluation Criteria:

SBMS Subject Area for Environmental Management and draft Subject Area for Waste Management

II. Records Reviewed (A sampling of available documents):

Spallation Neutron Source Environmental Impact Statement, DOE/EIS-0247

Record of Decision for Construction and Operation of the Spallation Neutron Source, Federal Register Vol. 64, No. 125, Wednesday, June 30, 1999 / Notices.

Mitigation Action Plan for the Spallation Neutron Source, October 1999 for DOE/EIS-0247

General Permit for Bank Stabilization Activities Associated with Road Construction, White Oak Creek, KFO 2000-015

General Permit for Minor Road Crossings at the Spallation Neutron Source Project, White Oak Creek, KFO 2000-014

Spallation Neutron Source Project – Department of the Army, Corps of Engineers Approval Letter, March 9, 2000

Water Quality Permit, Aquatic Resource Alteration, Permit Number 00-042, Tennessee Department of Environment and Conservation

Permit Application to Construct Two Natural Gas Fired Boilers, Oak Ridge National Laboratory, Spallation Neutron Source (SNS) Project, Letter From J. Malosh to Mr. Barry R. Stevens, August 23, 2001.

Construction Site Stormwater Control and Pollution Prevention Plan for the Spallation Neutron Source, 108020300-PN0001-R03, October 2, 2002

Spallation Neutron Source Preliminary Waste Management Plan, SNS 102030000-TR0002-R01, June 2002

III. Interview Conducted:

Frank Kornegay

IV. Sites Visited:

701 Scarboro

V. Discussion of Results:

Frank Kornegay is on the Steering Committee for the development of Subject Areas for SBMS and is well aware of the ORNL requirements for environmental management and waste management. The SNS project has internal operations procedures for notifications of environmental events. Frank has obtained the necessary NPDES permit for liquid effluents and intends to obtain the NESHAPS permit for airborne emission in 2004.

While Frank is highly organized and has made available all requested documents, it may serve the Project in the future to establish a set of authorization documents associated with environmental management at SNS on the web.

VI. Conclusion:

Although only a part of the environmental record was sampled, it appears that all environmental documentation and permits are ready for commissioning. The waste management plan is under development and the facility intends on complying with DOE Order 435.1 at the onset of generation of radioactive waste.

VII. Recommendations

None.

Reviewer: E. Lessard

ARR Evaluation Form

Topic: Quality Assurance, Self Assessment, Document Control

Date: 10/16/02

I. Evaluation Criteria:

SNS integration with ORNL SBMS

Self-assessment, self-identification of events and issues, reviewing and sharing results of events/issues

Document control, subject matter reviews, and document status tracking

II. Records Reviewed:

SNS QA plan, two 2001 internal audit reports, QA assessment statistical summary entitled Findings from QA Assessments

Various procedures from the Operating Procedures Manual, SNS QA plan, SNS-QA-PO2/Procedure Development Procedure

III. Interview Conducted:

John Mashburn, Mike Skonicki, George Dodson, Mario Giannella information provided during presentations on 10/14/02

IV. Sites Visited:

701 Scarboro

V. Discussion of Results:

During presentations and subsequent discussions, it was apparent that there are differences of opinion concerning whether SBMS currently applies or whether it will apply to future activities. No objective evidence has been found to indicate that the SNS project has received a waiver or an approved deviation request from ORNL management indicating that SNS is not required to meet the requirements of SBMS.

Two internal audit reports for 2001 were reviewed: The first dealt with Oak Ridge SNS document and records practices. The second was an assessment of the AE/CM, Knight Jacobs, project plans. In addition, three incident reports were reviewed: a headache ball failure at the site, an eyebolt failure on a dipole lift, and a grass fire at the site. The SNS independent assessment procedure (SNS-OPM 9.A-11) was also reviewed.

Document control and review requirements contained in the SNS QA plan were reviewed against current operating procedure review and approval practices. The Procedure Development Procedure indicates that quality personnel are to review all operating procedures. Procedures from the Operating Procedures Manual were reviewed for evidence of quality review and none was found.

VI. Conclusion:

This is not currently a significant quality-affecting issue. There is no objective evidence to indicate that the Laboratory or SNS are overly concerned about this issue. It is anticipated to become more significant as SNS moves into accelerator commissioning and operations. Team members familiar with the SBMS have concluded that current SNS activities are conducted, in most cases, in agreement with current SBMS management system and subject areas.

The project currently has no defined system for use by management and staff to guide them in assessing their own activities. The independent assessment procedure provides no coverage for these types of activities. There are no defined systems for identifying and analyzing problems and issues, or for sharing the resultant lessons learned in an institutionalized fashion.

The current document control system has the potential to fulfill the needs of project management and staff, but must be updated to be more consistent and practiced in a more disciplined fashion if it is to be effective for near-future commissioning and operations activities. No consistent review of procedures by the SNS quality organization has occurred, although these reviews are mandated in SNS-QA-02, Procedure Development Procedure. This observation pertinent to quality review is really not the main issue. The procedure review process must be revisited to ensure that the right personnel are reviewing operating documents. Current evidence of approval on these documents shows that ASD-level and SNS project-level personnel are the approvers. This issue should be revisited to determine whether (a) the appropriate level of expertise at the right point in the management chain is reviewing and approving operating documents, and (b) the appropriate ESH, quality, and expertise set is brought into the procedure review process on a consistent basis.

An associated issue concerns the meaning of a document's existence on the SNS document web site. Documents were found on the web that are approved, unapproved, and in draft, but not labeled as draft. The first assumption of the reviewers was that these documents were all approved and current based on the fact that they were present on the web site. This is not the case, and the criteria for including procedures at this site are indeterminate at this time.

VII. Recommendation

1. Proactive management consideration should be given to an effort to determine the current degree of alignment between the SNS quality plan and related systems and

processes and the management systems and subject areas described within the SBMS. This can be a part of the comprehensive organizational needs assessment directly related to the logical progression of overall programmatic emphasis from a construction to an operations perspective.

Three suggested areas for initial review:
- Performance (Self) assessment
- Critiques
- Lessons learned

2. Provide management and staff with an effective, easy-to-use, paper-light self assessment process whereby they may find and fix their own problems before they become significant. Provide management and staff with guidelines concerning a consistent method for reviewing problems, minimal documentation of the results, and appropriate sharing of lessons learned. Effective use of e-mail for these activities can enhance the development and deployment of a staff-friendly system.

3. Establish consistent management expectations concerning procedure development, content, and status tracking. Establish a consistent review procedure describing appropriate levels of review and approval by subject matter experts including quality personnel. Determine what level of management is actually needed to review and approve operating documents. Establish requirements for inclusion of documents on the division's web site. Consider establishing a development area for unapproved/in process operating and administrative documents so that only approved documents are included on the current procedures site. All of this can easily be included in one document.

Reviewer: Mark Vance

ARR Evaluation Form

Topic: Interlock Plan Front End

Date: October 16, 2002

I. Evaluation Criteria:

The results of testing conducted to confirm the readiness of the hardware to undertake the activity safely have been documented, evaluated to ensure adequacy, and meet quality assurance requirements.

The performance of the physical systems that provide assurance of the viability of the ASE and maintain the activity within the CASE, have been verified and records of appropriate system, tests, and calibrations exist and are current.

II. Records Reviewed:

SNS-OPM 3A-8.1 Configuration Management for the PPS
SNS-OPM 3A-8.2 Safety Requirements Specifications for the Accelerator Personnel Protection System
SNS-OPM 3A-8.3 PPS Interface Control Document
SNS-OPM 3A-8.4 PPS System Safety Basis and Basis for Selection of PPS Safety Integrity Levels
SNS-OPM 3A-8.5 PPS Software Safety Requirements Phase 0
SNS-OPM 2H-18.3 Chipmunk Radiation Monitors

III. Interview Conducted:

P. Wright – Protection System Team Leader
B. Stone – Protection System Engineer
W. Passmore – Accelerator Chief Operator

IV. Sites Visited:

SNS – Front End Building
PPS – Shop-Lab
701 Scarboro

V. Discussion of Results:

SNS-OPM 3A-8.5 is undergoing modification to conform to the needs of Front End commissioning. The certification test procedures for the PPS required for operation of the Front End is in a preliminary state and requires editing, review and approval prior to use. The transfer of detailed information about PPS operation to the person preparing the test procedure is a mix of formal documents and informal interaction that can complicate the preparation of the certification test procedures.

PPS equipment installation in the front end building is progressing reasonably given the reduced scope of the present ARR. Three chipmunks

have been received on loan from Brookhaven National Laboratory and need to be prepared for installation and checkout. The RF source for the RFQ is in a very preliminary state, which may interfere with final testing of the PPS.

Configuration control of the PPS hardware is reasonable. As built drawings have been prepared and are being signed. PPS housings are secured and labeled with warning signs. Technicians who work on enclosures shared with PPS equipment are trained by the PSG about their responsibilities. A secured storage for PPS test keys and spare keys is on order. Secure storage of the CD-R copy of the operating software and backups is presently undefined. The chipmunk placement is just starting.

VI. Conclusion:

There is a large amount of work to be completed on a very tight schedule. Much of this work is of a critical nature and I am concerned that there is not sufficient effort available.

VII. Recommendations:

The certification test procedures should be prepared sufficiently in advance to permit review and rehearsal prior to formal release and use.

A post startup critique of the certification test procedure preparation, execution and post execution review processes should be performed. This should be completed prior to commissioning of DTL-1.

Documentation of the installation and testing of the chipmunks is to be prepared prior to commissioning of Front End.

All system keys are accounted for and spares are in secure storage as per SNS-OPM 3A-8.1 prior to the start of PPS certification testing.

The secure location of the operating software CD-R and backups be determined and documented prior to the start of PPS certification testing.

Insure system description documents are approved prior to Front End commissioning.

Reviewer: Asher Etkin

ARR Evaluation Form

Topic: Interlock Plan – Post Front End and Klystron Gallery Commissioning

Date: October 16, 2002

I. Evaluation Criteria:

Radiation shutoff critical devices shall insure that the radiation level be reduced by disabling the device to a level that represents an acceptable hazard.

The PPS Data and control network shall be isolated from non-authorized personnel.

II. Records Reviewed:

SNS-OPM 3A-8.1 Configuration Management for the PPS
SNS-OPM 3A-8.2 Safety Requirements Specifications for the Accelerator Personnel Protection System
SNS-OPM 3A-8.3 PPS Interface Control Document
SNS-OPM 3A-8.4 PPS System Safety Basis and Basis for Selection of PPS Safety Integrity Levels
SNS-OPM 3A-8.5 PPS Software Safety Requirements Phase 0

III. Interview Conducted:

P. Wright – Protection System Team Leader
B. Stone – Protection System Engineer

IV. Sites Visited:

701 Scarboro

V. Discussion of Results:

The beam shutoff critical devices are the source 65 KV extraction supply, the RFQ RF and the Ion Source RF.
The RF shutoff critical devices are the output power amplifier HV and the RF drive to the final amplifier.
The present plan is to use a firewall to isolate PPS from the EPICS.
In addition there will be a password protected stand-alone PC attached to the data and control network during machine operation. This PC will have full access to the PPS.

VI. Conclusion:

There is a need to review the adequacy of the proposed critical devices and security implication of the proposed network interfaces.

VII. Recommendations:

The required beam intensity reduction factor should be determined.

Each of the beam shutoff devices should be evaluated against the established reduction requirement and the result documented. If direct measurements are made, transmission should be optimized.

The security of the firewall should be evaluated, tested and the results documented.

The desirability of having a PC attached to each PPS network should be justified. Alternative solutions should be considered that are more secure.

Reviewer: Asher Etkin

ARR Evaluation Form

Topic: Accelerator Safety Envelope

Date: 10/16/02

I. Evaluation Criteria:

The procedure that addresses the ASE-required equipment and systems must specify the minimum necessary system components and monitoring devices to allow operation. If these minimums are not met, actions are specified.

II. Records Reviewed:

SNS-OPM 2.B-1. Operational Envelopes and Accelerator Safety Envelopes, August 13, 2002

III. Interview Conducted:

George Dodson

IV. Sites Visited:

701 Scarboro

V. Discussion of Results:

We discussed with the Operations Manager the issue of operating limitations in the ASE being readily verifiable. The systems of interest were those that track beam intensity and beam losses. These systems were verified by examining the information that would normally be viewed by the operators. The issue of excess information in the current ASE procedure that relates to future commissioning modules was discussed. We reviewed the documentation requirements called for in the ASE procedure, locking out the accelerator when not manned by operations personnel, daily orders to operations personnel, the use of call down lists that identify support group contacts, the desire not to use jumpers on the PPS in order to energize beam line components for testing or maintenance when the accelerator is off, the use of the PA system and other communications devices, and a start up checklist for operations personnel that indicates to them that all items in the ASE have been completed prior to operations with beam.

All these issues have been addressed to some extent. For example, electronic logs have been proposed for daily orders to operators, but this electronic log is not ready yet. Another example of a system called out in the ASE but not yet complete is the communication system between an operator who might be investigating a problem on the klystron level and an operator in the Temporary Control Room (TCR).

VI. Conclusion:

It is the consensus of these ARR Team members that all relevant provisions of the ASE necessary for Front End commissioning are being addressed. Adequate controls and policies will be in place to transport beam safely from the ion source to the Front End beam stop. A number of actions associated with the ASE have not been completed at the time of this review that will need to be in place prior to the start of commissioning. The Quality Assurance Program Manager at ORNL, who is a member of the ARR Team, will monitor progress in completing these items.

VII. Recommendations:

The following shall be in place prior to commissioning:

A CASE procedure that identifies ASE requirements and operating limits, safety systems and individual responsibilities necessary for Front End commissioning only must be developed.

The operator response procedure that is used to respond to the differential current monitor alarms in the Front End must be in place. The current monitors must be installed and operating and interfaced with the EPICS systems. Setpoints corresponding to some fraction of the allowed beam loss, identified in the CASE for the Front End, must trigger alarms that alert operators to action.

Locking out the accelerator when not manned by operations personnel must be formalized and a system developed that does not involve the PPS.

Electronic logs or written logs must be set up to record daily orders and long term orders to operations personnel. Procedures for maintaining these logs current must be defined.

The use of call down lists that identify support group contacts must be completed.

The PA system is complete for Front End use; however, direct communications between operators in different parts of the Front End building must be in place prior to operations with beam.

A start up checklist for the on-duty operations personnel that indicates all items in the CASE have been completed prior to operations with beam must be in place. The items on this list must be approved by the Operations Manager prior to placing it in the TCR. Each item on the start up checklist in the TCR must be signed by the relevant responsible Group Leader or systems specialist. The on-duty Chief Operator must sign the completed checklist prior to beam.

Reviewers: Ed Lessard, Dick Werbeck and Bob Mau

ARR Evaluation Form

Topic: Maintenance Plan

Date: 10/26/02

I. Evaluation Criteria:

- Maintenance involving the safety aspects of Front End commissioning has been identified
- Maintenance procedures for safety systems have been developed, reviewed, verified, and approved
- Procedures for safety-related maintenance are kept current

II. Records Reviewed:

Computer Based Maintenance Management System

III. Interviews Conducted:

George Dodson, Mario Giannella and various on site personnel at the front end site.

IV. Sites Visited:

SNS Construction Site.

V. Discussion of Results:

The planned cradle-to-grave system for equipment tracking and maintenance is an impressive one. The described features, when implemented, should contribute to a superior maintenance program. The system will be based on bar coding of individual equipment, much of which has already been accomplished. Some particular features of the system include:

- Required maintenance items for the equipment and the schedule for performing them are available to maintenance personnel. Presumably, maintenance procedures will soon also be available.
- A job hazard analysis and LOTO instructions, if required, are available to workers.
- For each item of equipment, there will be a list of employees who are qualified to do specified maintenance.
- There is a capability for the maintenance worker to enter observations and notes.
- The system will include data on installation location, operating hours, PM logging, fault reporting and performance measurements.

The new bar-coding system with the Computer Management Maintenance System (CMMS) will track all equipment: 1) of a >$2000 value, 2) all safety systems, and 3) any

equipment designated by the lead engineer. This system will be a major tool, when fully implemented, in helping the accelerator run at a level of > 90% reliability. The SNS project has done well in evaluating several data tracking program vendors to find one that would work for them. If they had started the initial installations without these systems, then they would have significantly more problems down the road with tracking equipment and performing maintenance. The trending functions of the system should be very valuable to help ensure reliability. Also of note, is that the whole facility, including the target area, will use this system.

Unfortunately, this system will not be implemented for at least six months, too late for the Front End commissioning. In the interim, a more traditional maintenance approach will be used, in which the systems engineers and the group leaders will be responsible for ensuring that maintenance is performed. This is, in our opinion, an adequate interim approach. However, given the ambitious nature of the planned maintenance system, it may prove difficult to implement this system on schedule while conducting an aggressive program of accelerator commissioning.

We found no existing maintenance procedures and were told that maintenance lists do not yet exist. While this is understandable for equipment that is just being installed, it is important that maintenance procedures be established early in the life of the operation. The system engineers will ensure maintenance is done, and will have help from data entry personnel in entering equipment parameters and scheduled maintenance tasks, but this more human tracking approach should be closely monitored until the maintenance procedures are fully developed and the more automated system is operational.

SNS personnel ran the front end system with Berkeley personnel in California. SNS personnel then helped disassemble the system for transportation to Tennessee. Finally, SNS personnel re installed the front end at SNS. These are some of the same persons who will maintain and run the system at SNS. Since the front end team is already quite familiar with the front end equipment, the front end maintenance program, with proper oversight, should fall into place.

VI. Conclusion:

The manual maintenance management program is adequate for Front End start up.

VII. Recommendations:

- A maintenance plan for the Front End and DTL systems needs to be developed prior to the next commissioning module (DTL).
- The maintenance plan/procedures need then to be added to the general SNS procedure system and be kept current.
- The barcode Equipment Tracking system should continue to be used and the Computer Management System should be implemented as soon as is possible.
- Front End system engineers must ensure a robust maintenance program is in place until the procedures and automatic trending and tracking system are operational.

Group Leaders and management should determine if the system engineers have the time and the focus to ensure a strong maintenance plan is in place and is on going, until the more automatic system comes fully on line. A routine self-assessment of the manual system by QA would be appropriate.

Reviewers: M. Vance, D. Fitzgerald and W. Ruzicka

ARR Evaluation Form

Topic: Work and Worker Safety (see also "LOTO and Working Hot Review")

Date: 10/16/02

I. Evaluation Criteria:

SNS FSAD for FELK, Table 5.1.1 – 1, item 5.3 - Work planning and control shall comply with requirements specified in an approved operations procedure and the approved JHA procedure; applicable hazards shall be controlled, as specified, by approved SNS procedures, standards, directions and guidance.

II. Records Reviewed:

SNS – OPM 2.B – 1, Section 3.2; SNS FSAD for the FELK; SNS JHA Procedure; SNS JHA Manual

III. Interview Conducted:

Sam McKenzie, Paul Gibson, Rob Morton

IV. Sites Visited:

Front-End Building, Klystron Building

V. Discussion of Results:

The JHA process and procedure are the linchpins of ISM implementation at SNS. Because of the "bottoms-up" nature of JHA, consistency in how hazards are dealt with and mitigated could be a concern. A key to consistent implementation of JHA is the ES&H Coordinator for ASD. Line management needs to be an active proponent for the process.

Although workers are applying the JHA process to their work planning, follow-up on one operation carried out in the Front-End Building indicated that the safety of others in the vicinity of where the work was performed must be taken more into consideration. For example, during a site visit a primary hazard (cryogenic fluid) was covered adequately by a JHA, a secondary hazard (noise from exhausting cryogenic vapor) could have been dealt with more fully.

In another example, an approved SNS LOTO procedure exists, that everyone needs to understand "must be strictly followed." Field investigation indicated this is not presently the case. (See also the LOTO and Working Hot ARR Evaluation Form)

VI. Conclusion:

Although safety is a true value that is not to be compromised at SNS, the SNS ES&H program is not fully followed at the facility. Completeness of JHAs and strict adherence to safety procedures need to become part of the safety culture at SNS.

VII. Recommendation

Reinforce safety as a value at SNS. This should be a "top-down" exercise whole-heartedly led and endorsed by the SNS Director and all SNS line managers.

Reviewer: Dick Werbeck

ARR Evaluation Form

Topic: Internal SNS Evaluations

Date: 16 October 2002

I. Evaluation Criteria:
   a. Does the SNS project have a process implemented to identify, evaluate and resolve findings made by internal and external oversight and audit groups?
   b. Have previous findings by internal and external oversight and audit groups that are relevant to the Front End commissioning been completed satisfactorily or are corrective actions underway?

II. Records Reviewed:
   a. Front End Testing and Conditioning Tasks, SNS 00000000-0000-R00.
   b. Action Items Report for all open items in the Project Office Action Tracking System.
   c. Minutes of Radiation Safety Committee Meetings for 6 June 2001 and for 2002.
   d. Report of the Spallation Neutron Source Project Neutronics and Shielding Design Calculations External Review Committee.

III. Interviews Conducted:
   a. Suzanne Herron, 15 & 16 October
   b. Don Gregory, 15 & 16 October
   c. Mario Giannella, 15 & 16 October
   d. Franz Gallmeier and Irina Popova, 16 October

IV. Sites Visited: N/A

V. Discussion of Results: SNS has a database system implemented to capture, track and close out action items resulting from findings by external and internal reviews. This system is generally referred to as the Project Office Action Tracking System. It has been used to track findings that result from the semi-annual project reviews by DOE and, in fact, its use for this purpose is required. The system informs the responsible individual by email when a corrective action is assigned, and informs the approving official when the action is submitted for closure. Project office personnel remind responsible individuals of upcoming deadlines. However, there is no requirement established for tracking findings resulting from other external reviews or from internal reviews. This approach appears to be somewhat informal, with the result that the need for actions may go unrecognized. For example, there was no evidence of a system for tracking actions identified in minutes of the Radiation Safety Committee meetings. In another case, an external review of shielding design calculations in September 2000 resulted in thirteen recommendations, but there is no apparent tracking of responses to these recommendations. While some of the recommendations evidently have been addressed, there appeared to be no organizational impetus to resolve these issues.

VI. Conclusion: No unresolved action items from either internal or external reviews were identified that apply to systems needed for the Front End commissioning.

VII. Recommendation: The systems involved in the Front End commissioning are relatively few, and operation of the overall Front End has already been demonstrated at LBNL. Thus, implementation of a process to identify, evaluate and resolve findings is not a prerequisite to the commissioning. However, the system complexity and associated risks increase significantly for the commissioning of the portions of the accelerator complex that follow the Front End. For this reason, prior to beginning the commissioning of the DTL, SNS should implement a robust process to identify, evaluate and resolve findings and make its use a requirement for all action items that result from external and internal reviews. In general, we recommend that this requirement should apply, in a value-added approach, to action items from all project reviews including, for example, equipment design reviews.

Reviewers: Dan Fitzgerald, Bill Ruzicka

ARR Evaluation Form

Topic: Unreviewed Safety Issue Process

Date: 10/16/02

I. Evaluation Criteria:

SNS management requires a review to be made of the activity's conformance to applicable ES&H requirements.

II. Records Reviewed:

SNS Operations Procedure 2.B-10 titled "Procedure for documenting Unreviewed safety Issues."

USID, performed on the "Warm Helium Purge Lines in the SD Linac."

III. Interview Conducted:

M. Harrington, S. McKenzie, and P. Wright

IV. Sites Visited:

701 Scarboro

V. Discussion of Results:

SNS Operations Procedure 2.B-10 draft procedure has much of the standard USQ/USID verbiage and flow charts but lacks the requirements to ask the all important seven questions.

I was shown a preliminary USID, done on the "Warm Helium Purge Lines in the SD Linac." This evaluation answered all seven standard USQ/USID questions in the negative, so confirmed properly that this USID did not constitute an unreviewed safety issue and does not require an ASE change. This example shows that the USID process is about 90% mature, but it needs to be finalized. For example, the USID form referred to a SAR or BIO which does not apply, and it had not been fully signed off by all the proper authorities.

M. Harrington informed me that no Unreviewed Safety Issue Determinations had been performed on Front End equipment or processes.

VI. Conclusion:

Pursuant to this USID Issue, I conclude that with a properly finished USID procedure and process, the Front End start up could proceed. The fact that no USIDs have yet to be performed on any Front End equipment or processes, also leads me to the above conclusion.

VII. Recommendation

A USID procedure should be completed, reviewed, and approved by the proper authorities, prior to Front End startup.

Reviewer: W. Ruzicka

Appendix 5
ARR Close Out Meeting Presentation to SNS on October 17, 2002

Front End Accelerator Readiness Review, October 14 - 17, 2002

Close Out Meeting
October 17, 2002

E. Lessard (Chair), A. Etkin, D. Fitzgerald, R. Mau, W. Ruzicka, M. Vance, D. Werbeck

ARR Areas of Responsibility

Radiological Protection
Environmental Protection
Shielding
Interlock Safety
Quality
Fire Protection
Life Safety
Experimental Operations
Accelerator Operations

Laboratories Represented:

BNL
LANL
ORNL
ANL
FNAL

Purpose of Commissioning

- The commissioning of an accelerator is a critical step in the transition from the fabrication and installation phases to the operational phase
- Accelerator commissioning not only includes a sequence of accelerator physics measurements in order to characterize the actual operational parameters of the accelerator systems, but it also includes a buildup of the operating organization and the formal conduct of operations procedures used to routinely run the facility
- The information gained from commissioning studies and from the organizational maturity is used to endorse the operation of those systems or as a basis by which to modify the systems

Document Readiness - SAD and Commissioning Plan

- **SAD for FELK is complete**
- **Reviewed by an independent safety review**
- **Comments and recommendations adequately addressed**
- **Approved by line management**
- **Approved by DOE**
- **Line authority has approved the Commissioning Package**
- **Line has declared readiness for the ARR to commence**

Conclusion ++++++

Document Readiness – ESH Review

- SNS management has required a review to be made of the activity's conformance to applicable ES&H requirements
- Non-conformances have been identified and schedules and resources for achieving compliance have been established and approved by the appropriate level of management
- There is a process for reviewing changes to Front End commissioning for impacts on hardware, procedures, training and unreviewed safety issues
- Processes exist for evaluating the readiness of radiological control measures and other ES&H items applicable to Front End Commissioning
- A process exists to identify, evaluate, and resolve findings made by internal and external oversight and audit groups
- Previous findings made by internal and external oversight and audit groups, which are relevant to Front End Commissioning, have been satisfactorily completed or have corrective actions underway

CONCLUSION +/-

Document Readiness - Interlocks

- The results of testing conducted to confirm the readiness of hardware to undertake the activity safely have been documented, evaluated to ensure adequacy, and meet quality assurance requirements
- The performance of the physical systems that provide assurance of the viability of the ASE and that maintain the activity within the CASE, have been verified, and records of appropriate system, tests, and calibrations exist and are current

CONCLUSION +/-

Document Readiness - Maintenance

- Maintenance involving the safety aspects of Front End commissioning has been identified
- Maintenance procedures for safety systems have been developed, reviewed, verified, and approved
- Procedures for safety-related maintenance are kept current

CONCLUSION +/-

Document Readiness - Training

- Individual assignments, responsibilities, authorities, and reporting relationships are defined, documented, and included in training
- Qualifications or exceptions to specified areas of training based upon education or experience have been granted and documented
- These programs are documented and encompass the range of duties required to be performed in accordance with the SAD

CONCLUSION +/-

Document Readiness – Conduct of Operations

- Procedures necessary for safe operation of the activity have been developed, reviewed, verified and approved
- A procedure control system has been established, which defines the processes for procedure preparation, review, approval, verification, distribution and training, and processes are kept current
- Procedures to deal with off-normal and emergency situations have been prepared and are approved for use

CONCLUSION +/-

Documentation Readiness - CASE

- The procedure addressing the ASE-required equipment and systems specifies the minimum necessary system components and monitoring devices to allow operation
- When these minimums are not met, actions are specified

CONCLUSION +/-

Document Readiness - Quality Assurance

- Integration with SBMS
- Lessons learned
- Critiques
- Routine self assessment - internal assessments of operations procedures and processes

CONCLUSION +/-

Document Readiness - Environmental Management

- SBMS Subject Area for Environmental Management and draft Subject Area for Waste Management

Conclusion ++++

Hardware Readiness

- Equipment and systems having safety importance meet criteria described in the SAD and have been appropriately tested. This includes
  - Electrical systems
  - Shielding
  - Protection against credible fires
  - Beam transport
  - Personnel protection system
  - Fixed radiation monitoring equipment
  - Critical devices
- A program is in place to periodically reconfirm the status and operability of hardware systems that have safety importance

CONCLUSION +/-

Personnel Readiness

- Training and qualification programs have been established for general safety orientation, accelerator operations personnel, maintenance and support personnel, experimenters using the SNS, and emergency responders
- A process to periodically evaluate training program effectiveness has been established and documented and specifically includes the following considerations:
  - Training and qualification of personnel has been achieved
  - The numbers of trained and qualified operations, maintenance and support persons meet SAD and/or ASE requirements

CONCLUSION +/-

Conclusions

- It is the consensus of the ARR Team that the SNS Project management has conducted a comprehensive review and all provisions of the SAD necessary for Front End and klystron gallery commissioning are being addressed
- Adequate controls and policies will be in place to extract beam from the source and transport beam safely to the stop
- A number of procedures and actions have not been completed at the time of this review that will need to be in place prior to the start of commissioning
- This Team will monitor progress in completing these items and will recommend approval once all issues have been closed