

**Report from the Low Level RF Review Committee
Of the Spallation Neutron Source
September 27, 2002**

Introduction

A review of the Low Level RF systems for the Spallation Neutron Source was held on September 27, 2002 at the SNS Office in Oak Ridge, Tennessee. The committee membership was: D. Boussard (CERN), B. Chase (FNAL), H. Edwards (FNAL), R. Jameson (LANL), R. Kustom (ANL), D. Proch (DESY), R. Siemann (SLAC, Chair), C. Swanson (Alpha Cad), D. Teytelman (SLAC), M. Thout (LANL), and R. Uršič (Instrumentation Technologies).

This report will give the committee responses to the charge.

1. Assess the status of the LANL and LBNL RF control systems.

LANL – There is uncertainty about the status of this system that arises from

- Incomplete/inadequate test & simulation of the FRCM functions
- Board level issues such as layout & crosstalk
- Feedback design that is not optimal
- Lack of system integration, documentation, and demonstration of functionality

LBNL – There is a good level of confidence that the systems that would meet requirements

- This design uses an incremental approach with an existing stable platform
- The present system can be extended to a larger one that meets requirements

2. Given the status of the RF control systems, is the delivery schedule required by the Integrated Project Schedule achievable? If not, what should be done to correct this situation?

Some of the earlier dates in the Integrated Project Schedule such as the delivery of the first system for the DTL will not be met. To be able to meet the overall schedule we recommend that there should be a project-wide approach that includes the following

- Bringing together the resources of all the SNS partner labs with oversight and responsibility at ORNL
- Reviewing of technical requirements including phase and amplitude specifications, modes of operation, auxiliary functions, maintenance, reliability, etc
- Using the additional people that have recently been made available at LANL and LBNL
- Outsourcing appropriate work to industry.

3a. Would reduced functionality improve the probability of on-time delivery?

Yes

3b. Do the existing hardware and software implementations accommodate simplification?

This question applies to the LANL board. It could accommodate simplification.

3c. Is it realistic to reduce functionality now and restore it at a later date?

Yes

3d. If so, which functions could be deleted without compromising performance during commissioning?

This should be addressed as part of review of technical requirements recommended in the response to #2 above.

4. Are the hardware and software development and testing methodologies appropriate for the short and long term performance and schedule requirements? Are the methodologies

consistent with the requirement that the system be operated, maintained and modified by ORNL staff?

LANL

The developments and testing methodologies are not appropriate for performance and schedule requirements. The reasons include inadequate simulation and testing, the choice of a low level programming language, and a board layout that is untested to date. The methodologies are not consistent with operation, maintenance, and modification by the ORNL staff. It is uncertain whether the system is reliable or maintainable, and ORNL staff will have to be brought into the development and trained.

LBNL

The development and testing methodologies are appropriate. They include simulation and testing and the use of a high level programming language. The methodologies are not consistent with operation, maintenance, and modification by the ORNL staff. It is uncertain because the board functionality must grow, and ORNL staff will have to be brought into the development and trained.

5. Are the staffing level and skill set sufficient, and is the project management structure appropriate to the task?

We are recommending an integrated effort managed by ORNL. The top level of the project management must have skills in RF and high frequency digital design, RTL design, RF field control and system integration, and there must be adequate, full-committed resources.

We have some observations about LANL and LBNL that do not apply if this integrated approach is followed.

- LANL - There has been a recent reorganization and additional manpower assigned, but the answer to this question in the charge is uncertain.
- LBNL - There must be additional manpower if there are additional responsibilities.

6. The LBNL RF control system is being modified to provide a backup system for the commissioning of the RFQ. Is this system upgradeable to meet the commissioning and operational requirements of the DTL, CCL and SCL?

The present system, appropriately upgraded, can meet the commissioning and operational requirements for the DTL, CCL and SCL.

7. Given that parallel development efforts are not sustainable for very long, how should the SNS Project proceed with the development of the RF control system in order to maximize the probability of success?

We responded to this in the second item of the charge, and that response is repeated here.

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Milestones

It was requested that the committee identify milestones that can be used to track progress. Each of the laboratories presented milestones. These were

- LANL – *i)* A plan for addressing this problem in 4 to 5 weeks, and *ii)* A first board to support DTL commissioning in 6 months
- LBNL – *i)* An operating RFQ system by the end of October, and *ii)* A second system for DTL by the end of January.

Appropriate milestones change with an integrated, project-wide approach we are recommending. In that case we recommend as milestones

- A plan for integrating the LLRF across the SNS project by the end of October
- System test first with a model cavity & then integrated system test with a superconducting cavity at Jefferson Lab by January.