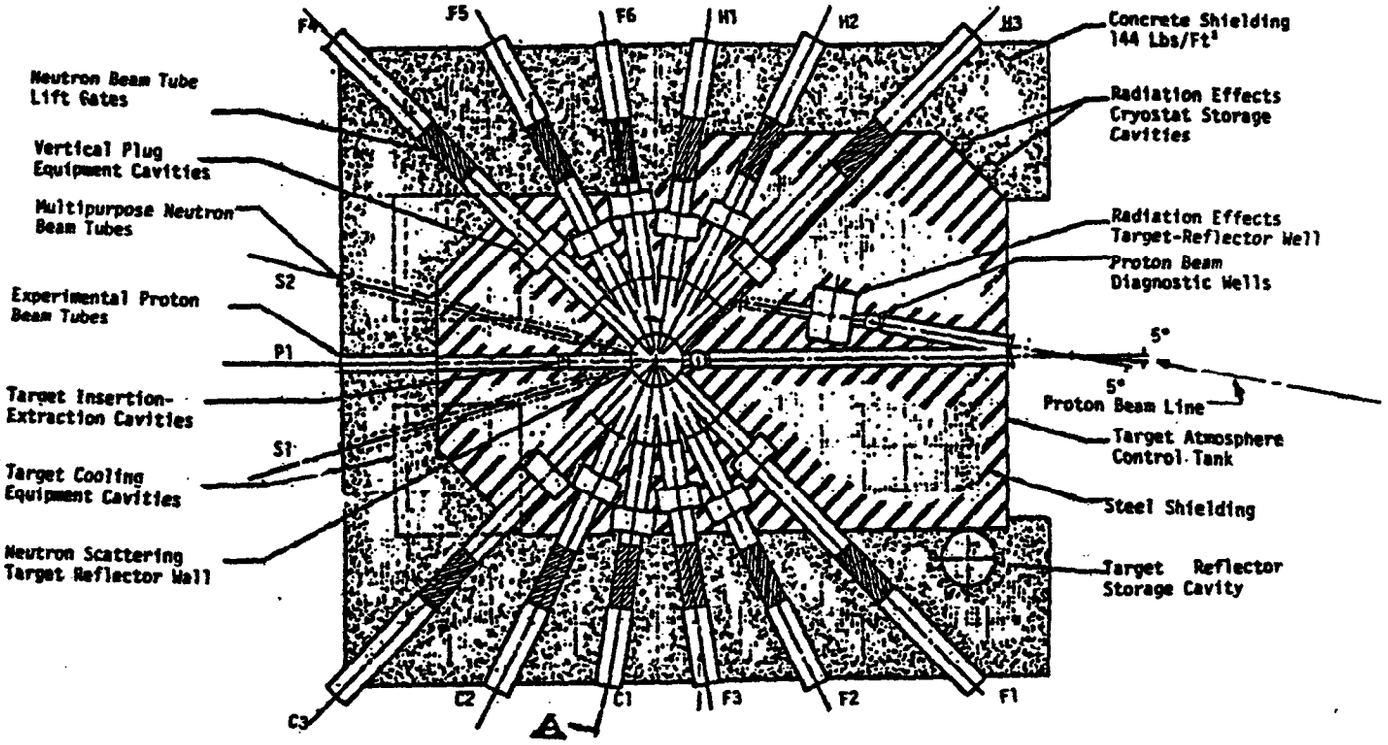

Fig. I-A.1. IPNS-I biological shield layout.

B. The SNS Project, J. T. Hyman, RL

1. General

My intention is to give an overview of the present Spallation Neutron Source (SNS) project in a very general way. Many of the team leaders responsible for the various parts of the machine and experimental facilities are here in person, and it would be most presumptuous of me to go into detail.

You will no doubt remember that just prior to the ICANS-II meeting at Rutherford (July 11-14, 1978), the NIMROD facility had been closed down. Since then, considerable efforts have been under way to strip down the old machine, and to dispose of unwanted material and equipment. This is being offered to universities, schools, or sold as scrap. A firm specializing in reclamation is dismantling the old rotating power supply and associated transformer/rectifier equipment and is still going to pay us a worthwhile sum!

Although no new buildings are necessary for the SNS, there are a considerable number of significant alterations and additions to be done. Among these alterations is the new control center due for completion in July. The layout of the SNS Facility is illustrated in Fig. I-B.1.

2. 70-MeV Linac

Modifications to upgrade the 70-MeV Linac from the original 1 Hz to the required 50 Hz operation for the SNS are progressing. A prototype modulator has been run and rf fed into tank 4. The rf valves are able to deliver the required power, but more work has to be done on increasing the ratings of rf parasitic suppression and to overcome heating problems in the driver anode blocking capacitors. The rf stages are identical for all four tanks.

An H^- ion source assembly has been designed and most parts are being manufactured. Tests are expected to start in July. The source is of the cesium-activated Penning type and is expected to be happiest running at a fixed-duty cycle. A HEDS chopper, which is a modified old 15 MeV HEDS chopper, is being proposed for short-pulse injection studies. Additional shielding for the Linac has been specified. The basic design of the 70-MeV transport line has been done, and work is being carried out on improvements to the beam diagnostics.

3. Synchrotron Ring

Minor changes have been made to the magnet lattice and the location of most of the correction elements has been specified (orbit-correction dipoles, trim quadrupoles, skew quadrupoles, octupoles, etc.)

Orders have been placed for 20 trim quadrupoles, 20 doublet quadrupoles (the first of these magnets are due for delivery about now). We are about to go out to tender for the 10 large bending magnets. The design of the remaining singlet quadrupoles is well advanced. A magnet-measurement system, based on one of the GEC 4070 control computers and using the GRACES control language interpreter/compiler, has been set up.

All of the capacitors for the main power supply have been received from Daresbury (from NINA). A new dc bias supply is to be purchased. An ac makeup supply has been decided upon, but whether the synchrotron will be locked to the mains (which vary in frequency as it does in the U.S.) or run at fixed frequency still is something of an open question. The problem

area we have is the difficulty in maintaining accurate phasing of a number of rotating high-speed choppers in the neutron beam lines. The power supplies for the trim quadrupoles have been specified.

The ceramic vacuum vessel sections are on order and the design of the furnace for joining the sections is progressing. This work will be carried out in R4, which is the old converter building of the NIMROD PS. Much of the pumping equipment has already been delivered.

The high power rf system has been completely redesigned to take account of the characteristics of available ferrite. There will now be six two-gap cavities instead of the four three-gap ones as originally proposed. We are now in the process of evaluating tenders for the ferrite.

Development work is under way on a prototype cavity bias supply, and the system design for the control (phase and amplitude) for the six rf cavities has been completed. Hardware development of the low-power rf system is under way including a prototype primary frequency generator, machine-timing system, rf phase detectors, etc. Considerable thought is being given to the design of the rf shield and a number of measurements are planned on such things as flanges, bellows, etc.

A beam-position monitor for use in the ring and based on a ferrite or mu-metal cored induction coil has been designed and a prototype has been built and is being tested.

Control of beam losses in the ring is very important, and we are aiming to localize the losses to a few restricted regions. From injection up to 100-MeV the losses (as high as 50%) will be localized on a specially designed collector system. The predominant loss at higher energies will be on the septum of the extraction magnet.

The extraction system has been designed and from it the orientation of the synchrotron lattice decided. Experimental work is proceeding on magnetic measurements on an experimental ferrite kicker magnet driven from a test facility employing an artificial live and triggered spark gap. The final pulser will use high-voltage cables as the PFN and have a co-axial thyratron switch (design now well advanced).

4. External Proton Beam and Target Station

The External Proton Beam (EPB) has been designed and will use a total of 64 magnets (63 of these quadrupole and bending magnets, are available, from NIMROD, together with the necessary power supplies).

A preliminary design for a pion-therapy facility has been completed and is being costed prior to presentation to the Medical Research Council for funds (about now). An additional wide-aperture quadruple will be needed. The pion target will reduce the main target intensity by 10% and the facility will be mounted on top of the EPB shield.

The physics design of the target station is nearing completion, and some engineering proposals have been sketched for the arrangement of the shuttered holes. Eighteen holes at nominally 13° (giving 5 ft. between centers at the outside of the shield) are proposed.

Target plates are being developed by the Atomic Energy Research Establishment (AERE) Harwell under contract. Successful diffusion bonding and forming of target plates have been achieved (Zircalloy-2 clad, "Springfield" adjusted, uranium of different thickness plates) of sizes suitable for test on the Harwell linac.

Beryllium reflector blocks have been ordered as have 420 litres of D_2O (tritium < 1 Ci/ℓ). Work is continuing on the target cooling system. A detailed study of remote-handling problems associated with the target station has started. A model remote-handling cell is planned and remote master/slave manipulators ordered (the problems of need for remote handling elsewhere in the machine are being kept very much in mind).

5. Controls

The four GEC 4070 computers were delivered early in 1979 and are working well. The largest machine is in constant use for development of system software. Another is being used for the magnet-measurement system noted earlier. The other two machines are used to familiarize staff with GRACES and for development of equipment interfaces (CAMAC and a GP multiplex system). Prototypes of the data link CAMAC controllers are almost complete. The first software equipment/computer interface routines (data modules) are being written.

The importance of the control system should not (and isn't) being underestimated (perhaps my personal involvement in accelerator computer control systems makes me biased). However, the needs of the control system and a standardized approach are being written into all of the electrical equipment specifications.

6. Experimental Equipment

Although most of my comments have been related to the SNS itself, considerable work has been done on the experimental front (users). The first six instruments have reached the costing stage, scientific specifications have been agreed upon with the universities and financial approval will be sought in May. Design studies are continuing on other instruments, and it is planned to have 10-12 instruments available on day one (late 1982).

7. Overall

Sufficient information is now known about the availability of effort, money, and project requirements to make detailed overall planning a meaningful exercise. My personal view (and it is my personal view) is that 1982 is an achievable date if optimal use is made of the available manpower, no unnecessary work is done, and as much work as possible is "farmed out". Time alone will prove me right or wrong!

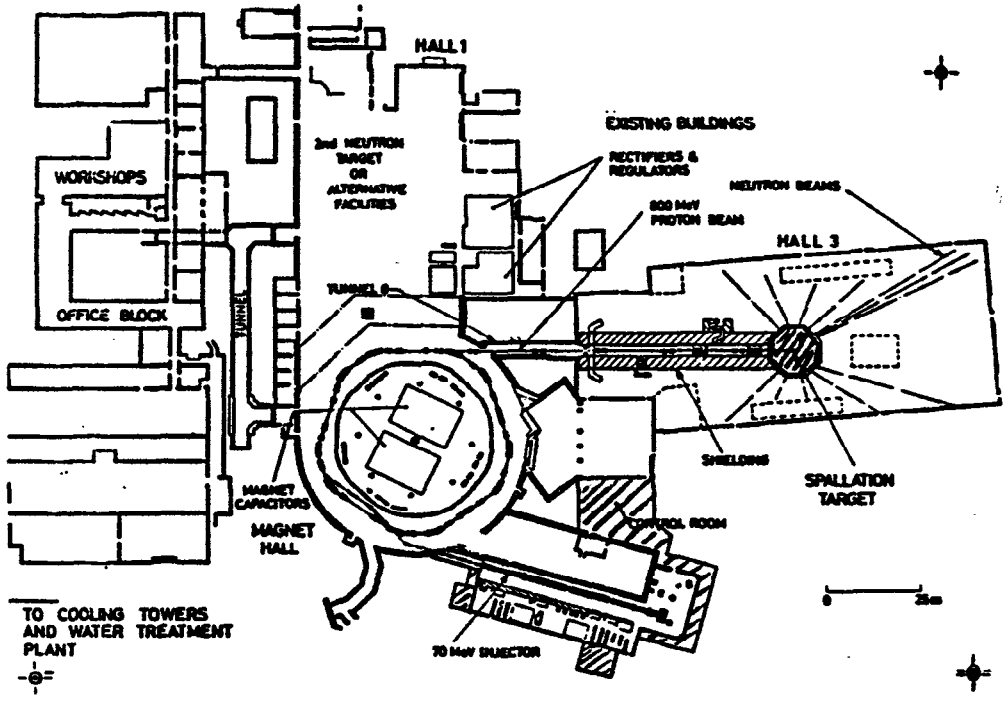

Fig. I-B.1. Layout of SNS facility. The magnet lattice is not up to date.