JPARC Materials and Life Science Facility Technical Advisory Committee (N-TAC)

Report on the Fourth Meeting

Held at JAEA Tokai Site
Nov. 14 – 16, 2005

Executive Summary and Main Recommendations

As before, the JSNS Project staff continued to impress the Committee by the quality of the engineering and science that supports the Joint Project. The progress in the construction is now highly visible and most impressive. Although they have to cope with an extremely tight budget the construction management team of the Joint Project appear to have full control over their expenditures and commitments and are dedicated to success.

N-TAC was under the impression that the transition from the old JAERI to the new JSNS structure had been accomplished in a smooth way with only small difficulties for the Joint Project. We also wish to acknowledge the appointment of a dedicated advisory committee for the muon part of the project, M-TAC, which relieved N-TAC of some of its responsibilities in a field where it was not very well represented.

The JSNS Project is rapidly approaching its commissioning period. Except for some details the design of the target station is complete and manufacturing is in an advanced state. This leaves little room for technical changes and most of the Committee's comments therefore relate to questions of testing, commissioning and future maintenance planning.

The Team continued to improve details of the design, complying, where possible, with the advice and recommendations given by the N-TAC in their earlier meetings. This resulted in some clear improvements in the overall safety and performance expectation of the systems. Unfortunately, due to extreme budget constraints there remain some areas, such as the shutters with their inserts and the beam line between the muon and neutron targets, where alignment and maintenance will be very difficult and carries a risk that radiation exposure to service personnel may be high.

The most important areas, where the N-TAC feels that there is some urgency for continued action include:

- ***The work on the pressure wave/cavitation erosion mitigation***: Results of Doppler Laser Accelerometer measurements carried out at WNR in Los Alamos did not seem to support the p^4-law in cavitation damage potential.

Given the fact that the Project prepares to use this technique to monitor cavitation load on the target shell, this requires urgent attention. Either the p^4 law needs to be confirmed or the laser doppler technique needs to be refined

- ***The pump concept to be used in the mercury loop*:** While the N-TAC clearly favours early loop testing with water, which can be accomplished with the gear pump now under procurement, there remains an operational risk in the long term use of this pump. We therefore recommend planning and preparing for a transition to an EM-pump as early as possible after the loop testing phase.

- ***Beam footprint on the target*:** There seems to exist a possibility that the beam can be focused to four times its nominal peak current density on the target window. Apart from strongly enhancing the cavitation problem this might also lead to a common mode failure of all target containment shells, which is not acceptable. The Project is strongly advised to search for a solution that makes such focusing impossible at full power.

- ***Alignment and maintenance procedures of shutters an their inserts*:** The procedure proposed for replacement and alignment of the shutters and their inserts is complex, possibly not very reliable and carries the risk of undesirable radiation exposure of personnel, if carried out when the facility has been operational for some time. Much of this complexity seems to be a consequence of severe budget constraints.

- ***Schedule/duration of the licensing procedure*:** The Committee was informed that in Japan early, i.e. pre-procedural interaction with the licensing authorities to optimize the process is not possible, in contrast to common practice in other countries. While this is clearly a delicate issue, the N-TAC feels that it might be worth while for the Project and Laboratory Management to try and initiate such interaction in view of the novelty of the present project. This might help to shorten the time needed for the actual licensing process considerably.

1. Introductory remarks

The N-TAC Committee, comprising the members

Dr. Günter S. BAUER (Chair)	Forschungszentrum Juelich GmbH, Germany
Dr. Timothy A. BROOME	ISIS, Rutherford Appleton Laboratory, UK
Dr. John M. CARPENTER	Argonne National Laboratory, USA
Mr. Hajo HEYCK	Paul Scherrer Institute, CH
Prof. Hiroaki KURISHITA	Tohoku University, Japan
Dr. Thomas J. MCMANAMY	SNS Project Oak Ridge, USA

was invited to hold its fourth meeting on November 14 to 16, 2005, at the Tokai site of JAEA, Ibaraki Prefecture.

As before, the Committee felt very well received and preparations by the Project Team were excellent. We wish to express our sincere gratitude to the Project Management and its supporting organizing team for a smooth and effective meeting and the confidence put in us as an Advisory Team. The presentations on the technical status given were well prepared and were complemented by an informative visit to the construction site, which demonstrated most impressively the rapid progress the overall Project is making.

The fourth meeting of N-TAC was called at a point in time when the Project was approaching its integration phase. Numerous items had already been delivered or were in various stages of manufacturing. This put the main emphasis in the present meeting on safety, commissioning and maintenance issues. The Committee refrained from highlighting advices and recommendations in the report because experience shows that all comments are taken very seriously by the Project Team As always, we offer our comments fully in the spirit of helpfulness.

Once again the Committee was pleased to note that the comments and recommendations of the earlier N-TAC meetings have been studied very thoroughly by the Project Team and, where deemed appropriate, they have been adopted and changes were made to the designs or procedures. The Project team are shifting the focus of their work more and more towards testing, commissioning and operational safety issues while they continue to have a watchful eye on the manufacturing and quality assurance issues.

A detailed report of the Committee's findings and comments was given at the closeout session of the meeting and the presentation material was handed over to the Project to allow immediate action without waiting for this report to be completed.

The structure of the report roughly follows the agenda for the presentations, although in some cases safety issues were included in the chapters dealing with the respective sub-systems.

2. Mercury Target and Target System

Pressure wave effects

The Committee is greatly impressed with the progress the JAEA team has made in understanding the cavitation/erosion/fatigue/bubble-mitigation phenomena and encourages further work in the multi-laboratory collaboration, which has been very productive.

The innovative concept of plasma surface treatments by carburizing and then nitriding of *annealed* 316L significantly improved its fatigue bending strength but not for *20%CW* 316L, indicating that effects of microstructures of 316ss might be important. The effects of microstructures of 316ss should be investigated further.

Detrimental effects of stagnant mercury on fatigue bending strength of 20%CW SUS316ss were found to be significant. Similarly to the above comment these detrimental effects of mercury should be thoroughly examined by using 316L with differently controlled microstructures to extend the lifetime of target vessel.

Theoretical and experimental evidence is growing that there might be beneficial effects of bubbles on pressure wave mitigation. In addition to the need to more thoroughly examine and optimize the effects, development of a bubbler that enables to generate bubbles with controlled size and volume fraction is required. Several methods of fabricating a multi-bore bubbler by sintering or drilling holes are under discussion. One of the N-TAC members has brought up an alternative concept which the Project might consider trying:

> The method is based on powder metallurgy with W powder and very fine Cu fibres (~10 ? m in diameter and of suitable length). It exploits the facts that W and Cu have significantly different thermal expansion coefficient and will not form any reaction layers even at high temperatures, and that Cu is very ductile and hard to break. The fine Cu fibres are carefully arranged in the desired suitable grid pattern and the space between them is filled with W powder in a HIP capsule. The capsule containing the W powder and Cu fibres is degassed and vacuum-sealed, followed by HIPing around 1000~1050 °C, slightly below the melting point of Cu (1083 °C). The W powder and Cu fibres are in good contact at the HIPing temperature, whereas cooling from the HIPing temperature to ambient temperature should lead to the formation of gaps along the Cu fibres due to the much larger thermal shrinkage of Cu than that of W. This would make it possible to pull out the fibres and thus introduce micron-size channels into the HIPed W compact. In order to produce optimized bubblers, effects of the diameters and spacing of the Cu fibres, HIPing temperature and pressure and cooling rate after HIPing should be examined.

As before, the Committee would like to stress the importance of an aggressive approach to finding a solution to the pressure wave problem. In particular there seem to be some indications of inconsistencies, which require urgent resolution:

> (1) While the Committee was pleased to learn about another successful measurement campaign at WNR in Los Alamos and is anxious to learn more about details of the outcome, we are alarmed by the fact that preliminary

results indicate that the Laser Doppler Vibrometer did not support the p^4-law. Solving this issue is of great importance because it indicates one of two possibilities: Either the p^4-law is not generally valid or the LDV technique in its present form is inappropriate for characterising the scale of cavitation damage. Both options would be of great impact on the ongoing work!

(2) Bubble injection in MIMTIM caused a rise in peak pressure which is not consistent with WNR measurements and also not expected. A possible explanation of an impact pressure through a gas layer has been offered by the Team, but there is no conclusive evidence yet. The Committee wishes to encourage aggressive pursuit of the proposed tests to solve this issue!

Other routes to bubble injection such as decompression of mercury with dissolved gas should be kept under consideration.

Target hull design and manufacturing

In response to comments made at the last N-TAC meeting details of the target design have been reconsidered by the MLF-Team. An important result is the reduction of the gap width between the liquid metal container and the outer protection hull from 8 to 5 mm. Together with pressurization of the helium in the interspace to 0.3 MPa this will suppress boiling of mercury even if the beam is not switched off immediately after a major leak in the liquid metal target container, although the temperature will rise as high as 440°C. The margin is still very narrow, though!

The mixing of technologies of wire-cutting and bolted design for the different target vessel sections is considered to introduce a risk that is difficult to control. The case presented requires solving two sets of problems—it seems better to solve only one. The Committee suggests considering using wire cutting for manufacture of all target sections.

In this context the question was raised, as to whether casting has been considered as a method to construct the parts of the mercury vessel?

Detrimental effects of stagnant mercury on fatigue bending strength of 20%CW SUS316ss were found to be significant and its degradation rate against the number of cycles became more significant with increasing frequency. Fracture surfaces of 20%CW SUS316ss tested in stagnant mercury exhibited quite a different pattern from that tested in the air. In view of superposition of other possible detrimental effects of irradiation, the available data of which is very limited, effects of microstructures on mitigation of the detrimental effects should be thoroughly examined by using 316L with differently controlled microstructures to extend the lifetime of target vessel.

The use of all metal seals on the main target flange (and hence high sealing forces) is likely to result in damage to the fixed flange on the long run. After several target changes it may well be impossible to produce an adequate seal. (This effect has been seen at ISIS.) There does not appear to be a method to replace this flange.

The Committee recommends that the design of the fixed flange be changed so that it can be replaced when required

The Committee would like to stress the importance of considering the effect of temperature changes on the arrangement for sealing the mercury pipes.

A remaining concern which was discussed briefly is the very large size of the target shell that needs to be exchanged regularly. This is a substantial cost factor which could be reduced if the target can be re-designed in a way that a smaller part needs to be exchanged. A preliminary concept put forward by the project team (M. Teshgigawara) would foresee a horizontal coupling flange similar to the system implemented at the US-SNS. While it is rather late in the procurement phase of JSNS, such a simplification, if possible with minimal changes to the target trolley, would certainly be very beneficial. *The target design team is encouraged to explore possibilities to implement such a concept under the proviso that no schedule delay is introduced*. Since the basic outer dimensions of the overall target module would remain the same, transition to such a new design might even be possible after the commissioning phase of the Project.

As an alternative option to reduce the large size and heavy weight of the target shielding cask the Committee recommends investigation of the possibility of separating the hot front part of the target cell from the bulky spool piece and flange right inside the maintenance cell, e.g. by using a hacksaw. This would allow transport of the larger part with much less shielding.

Target loop and control system

Despite extensive discussions and testing there is still an open question as to what type of pump should be used in the mercury loop. The current planning still leans towards a gear pump and progress is being made in modifying its design such that leakage can be reduced. The combination of W base/Ni base was found to be the best choice among the four combinations of materials for the gear pump seals. Since material properties are well known to strongly depend on its composition, each composition of W base and Ni base should be specified precisely.

Nevertheless, the Committee feels that a permanent magnet EM pump looks a better choice than the gear pump for the mercury circuit. One drawback might be that the testing of the loop with water during the commissioning process will be impossible with an EM-pump. It might, therefore, be a good compromise to equip the loop with a gear pump initially but make sure that the design allows transition to an EM-pump at a later stage. An added benefit of this concept would be that it allows the Project some more time to optimize the design and test the EM-pump off line. Otherwise, a centrifugal pump might be worth considering, if the available space is sufficient.

The interlock systems for the target should include mercury temperature. More diversity and redundancy in the instrumentation is required in the mercury loop – for example flow both on inlet and outlet and more pressure measurements.

The Committee was alarmed by the information that the full power beam can be focused to give 4 times the normal current density. This is a serious safety issue,

since in this case there might be a common mode failure of all shells of target shroud simultaneously. The Committee recommends the Project find ways to limit the peak current density on the target by hardware.

The only way to measure tritium reliably is to bubble a gas sample through water and count the tritium with liquid scintillator. Such a system should be considered to measure the efficiency of the tritium absorbers.

3. Moderators

Fabrication of the moderators and their cryogenic supply lines is a very complex process. The discussions showed that this had been accounted for well by the design team and that very detailed procedures were established which allowed the manufacturing process of the prototype coupled cold moderator to be completed successfully. A comprehensive program for testing and examination is in place and should be carried out with great scrutiny. The company entrusted with this task seems to be fully up to the job and have the appropriate staff with the necessary skills. Since the need to manufacture such moderators will be recurring during the life time of the facility, it will be important to have a very thorough documentation of all manufacturing parameters and of all experience that accrued during the process (also attempts that failed!). This is sometimes difficult to obtain from industry, but the team should insist on it.

Fabrication of an actual AIC decoupler with a curved shape is expected to be achieved by HIPing of AIC-Al5083 and machining. However, the gap between the AIC and Al5083 before HIPing should be very small to suppress any deformation of the AIC during HIPing to a negligible level. We recommend post-fabrication ultrasound examinations of the products.

4. Shutters

Alignment of Shutter Inserts

The proposed alignment process for JSNS shutter inserts is very complicated and time consuming. Also aligning the inserts after the source has been in operation for some time will expose the staff carrying out the work to radiation dose. These disadvantages have to be balanced with the potential increase in neutron flux at the instrument.

Simulations for the NOBORU instrument show that rotation of the shutter over the range available only changes the integrated intensity at the sample position by about 4%. However, based on experience (at ISIS) misalignment of a shutter insert containing a neutron guide section can lead to significant losses of neutron flux. The Committee recommends that only shutters containing guides should be adjusted.

The collimation in the shutter insert should be made slightly oversize so that if there is a small misalignment the view of the moderator, defined by the fixed collimation in the neutron beam path, is not obstructed as this will result in background. The same

can be done for a guide section in the shutter with only a small loss in neutron intensity.

Sufficient survey datums in the floor of the MFL must remain accessible after the installation of the instruments to allow future alignment of the instruments taking into account that datums will be buried as the instrument installation proceeds. New survey datums may well have to be provided.

Shutters – Mechanical Alignment

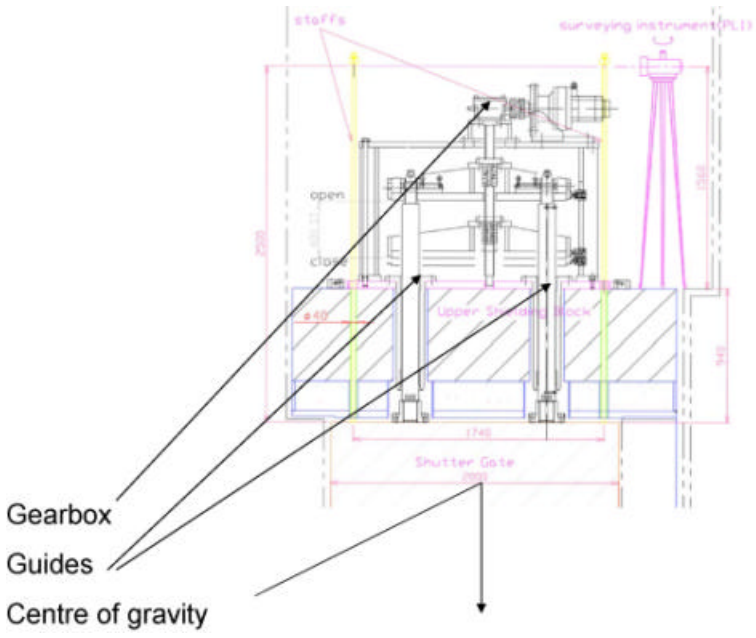
There is restricted space around the shutter lifting mechanisms and restricted access to the mechanical components.

The Committee recommends that a simple mock-up of the area is constructed to test whether there is sufficient access for the work required at installation, maintenance and shutter removal.

The clearance between the shutter and the interstitial blocks is 20 mm. There seems to be nothing to prevent the shutter from touching the blocks particularly when the shutter twists from the torque reaction when the motor is started.

The Committee recommends that the possibility of adding a simple guide system be considered.

There are several fixed points in the shutter support system. These need to be aligned very precisely to avoid damage and excessive wear in the lifting system. It is most important that the shutter hangs freely. There will be a torque reaction when the motor starts. It is not clear in which component this force is absorbed. There is a danger of high loads on the fixed points (either the gear box or the guides) which may not be acceptable.



The Committee recommends early operation of a prototype, or one of the production systems, to investigate the operability of the shutter system.

The crane capacity exceeds shutter weight considerably. Dedicated load cells and set points can prevent damage by collision of parts during shutter service.

5. Cryogenic system

The project has modified the control system design of the cryogenic system. No longer is control through the refrigerator, instead control is through the heater power. The driving measurement is the proton beam power, that is, system responses are keyed to proton beam power so as to maintain constant heat input to the hydrogen stream. While the new control philosophy is an improvement over the previous one, direct measurement of the moderator heating rather than an indirect one through proton beam power should at least be considered as a second, independent parameter. The cryogenic systems group has developed a control system model. The control system was shown to be able to handle anticipated operational variations. Simulations show that with actions taken within ~ 30-second response time (flow circuit period is 113 seconds) the system pressure remains within the desired control range for all cases treated, maximum steady power 0.1-1.0 MW. This looks good so far. Evaluations should continue to cover all situations that might conceivably occur.

The planning for the management of off-normal events in the cryogenic system is progressing well and is very comprehensive. More detail is continuously being added. Naturally, this is a task that will continue into the commissioning and even the operational phase as experience with the operation of the system accrues. A case currently missing from the list is, for example, that of mercury ingress into the helium volume or in contact with moderator components.

Perhaps a specialists group should subject this list and the analyses to a dedicated review.

The commissioning plan for the cryogenic system seems to cover the basic needs. The 100-kW beam power requirement for commissioning seems to delay the tests inordinately—a few kW should do for many purposes. The Committee recommends to determine what tests could be done earlier at lower power. Also consider what the instrument scientists need. The commissioning planning should continue under review.

6. Beam Line Alignment

The significant and ongoing settlement of the floor of the neutron target building remains a matter of concern. So far no saturation is observable and the effect must be expected to continue as more weight is added. Possibilities for adjusting the beam transport system exist but are extremely tedious. This may cause serious difficulties and possibly long schedule delays if major corrections are required. It would be highly desirable to introduce more flexibility in the beam transport line to accommodate such settlements since it is not obvious when, whether and where the phenomenon will come to a stand still.

7. Muon target

It was a good move to have a separate Technical Advisory Committee (M-TAC) for the muon facility. The comments and recommendations given by that Committee in their first meeting and as reported to N-TAC are supported in full.

One comment we would like to make relates to the extensive use of steel in the muon target area: Although access by personnel is not planned for maintenance and intervention purposes it might be a good idea to consider covering some of the surfaces exposed to high neutron flux by a less activating layer such as marble concrete to reduce dose levels when components must be pulled out. We realize, however, that it may now bee too late for such measures because construction has already progressed too far.

8. Safety design

As a general comment, the Committee is pleased to note that safety issues get adequate attention in the overall planning of the facility and procedure. Unfortunately we learned that it is not possible, in Japan, to involve the licensing authorities in the safety case before the licence is finally applied for. Such early contacts have proven very helpful in other projects elsewhere because they helped to establish good working relations and a level of mutual trust that made it possible to optimize the effort that went into the system safety design. In the absence of such contacts the Project has to work to rules and regulations which have almost inevitably been drawn up with different systems in mind and, in their combination may not be appropriate for a project like the JSNS. In particular, the time necessary for the authorities to acquaint themselves with the specifics of the project, to formulate their questions and the extra time it takes for the Project to generate the specific documentation may lead to delays in the licensing process. The Committee recommends that the Project and Laboratory Management should try to establish pre-licensing communication with the Authorities.

A variety of different issues were presented under the heading of “Safety Design”. In most cases the Committee’s remarks are incorporated under the respective systems and associated procedures. The following is just a concise summary of such remarks:

- The Concept of off gas system is adequate. The efficiency of the mercury filter should be monitored carefully to maintain the efficiency of the molecular sieve and the copper oxide bed.
- Interlock design should consider redundancy and diversity of signals and correct positions of detectors in the mercury loop to achieve fast reaction. For example, an inverter failure signal or a flow measurement at the pump outlet cannot detect a leak between the pump and target quickly. Furthermore, a diverse temperature signal could be provided to detect the loss of the heat sink.
- Contact of aluminium components with mercury should be prevented in case of malfunctions or leaks of the mercury system.

- Logging of openings and closings of instrument doors should be provided in addition to the logging of the shutters.
- Hot cell access with full mask and protection suit must provide communication means between workers and to the outside.
- Mock ups should be provided for testing and practicing hands on work in the hot cell to reduce duration of work and individual job doses.
- Crane safety should provide adequate interlocks or stoppers to prevent damaging equipment with heavy or bulky loads.

9. Entrance into hot cell

The impression given in the presentations at N-TAC 4 is that entry to the cell is now assumed to be possible although this is still expected to be a rare event. The analysis shows that entry could be possible with suitable protective measures under the conditions assumed. There remains a risk that the hazards may turn out to be higher than has been assumed in the analysis – for example if higher mercury spills occur or decontamination is not completely efficient

Mock-ups for those systems where entry is contemplated for maintenance or repair are very important to practice and reduce entry time.

The Committee believes that a contingency plan is required in case cell entry proves not to be possible.

Communication between staff in the Cell is likely to be essential and the face masks proposed make this very difficult.

- Is it possible to install temporary shielding around main hot spots before entry?
- Is entry required for routine maintenance as well as for breakdown (e.g. power manipulator)

10. Component maintenance

Maintenance Schedule of Primary Large Components by Remote Handling

The overall schedule appears well developed and has adequate shutdown time for anticipated maintenance. There are a few details which may warrant review as discussed below.

The Moderator/Reflector replacement time (14 days) is shorter then has been required by LANSCE or ISIS for equivalent operations. The LANSCE reflector plug replacement was on the order of 2 months and ISIS is currently 21 calendar days.

Since the JSNS is more similar to the LANSCE operation, and requires more remote handling consider increasing the schedule allowance to at least 20 days.

The replacement cycle for shutter inserts is more likely to be 2 per year as new instruments are installed. During the first few years the accelerator power levels will be low and the replacement frequency for the target and other components will be low.

Consider developing a schedule based on the anticipated power ramp up rate, which would allow more time for new instrument installation and not require as frequent target and component replacement

Maintenance of mercury circulation system and Target vessel exchange truck design update

The key maintenance operations have been identified and initial remote handling methods well defined. Failure rates for components were estimated from LWR data. It is worth noting, however, that the failure rates are likely to be significantly higher for new systems or new applications such as the mercury gear pump or heat exchanger. Also, failure rates for the crane and power manipulator systems were not included in the estimates and may be relatively high.

Mock-up testing for the pump handling has been started and this is extremely valuable and should be made as realistic as possible with demonstrations of all key handling operations. Such demonstrations on mock-ups and the later remote handling integrated testing in the hot cell should be video taped for future training of operators. If possible the mock-up testing should use cameras with viewing angles and lighting similar to what will be anticipated in the hot cell.

After a given remote handling operation has been successfully demonstrated all steps should be incorporated into a formal procedure. This with the video would be the basis for training of future operators.

There was no discussion of any preventative maintenance of the hot cell power manipulator or crane systems which are likely to be needed in the hot cell (greasing, inspections, etc). This could be a reason for regular entry into the cell. If so, an area should be defined and steps taken to ensure that entry is possible. Debris from pipe cutting should not be allowed to be generated in such an area.

There was no discussion of recovery methods for significant failures in the power manipulator or in cell crane systems. Possible failures should be identified (if that has not already been done) and recovery actions defined.

Development Status of Moderator-Reflector Remote Handling

The remote handling plan is well developed and has addressed the key issues. The design development is impressive and the concepts for moderator replacement and overall handling appear reasonable. A few detail comments are given below.

It appears that very tight fabrication tolerances on the moderator transfer line structure may be needed for the attachment tools to properly engage. Consider making two sets of attachment tools, with one used during fabrication and the other for installing the moderator and transfer line for the first and subsequent assemblies.

Further development of the cutting tool should be done to avoid the violent break seen in the demonstration. If small pieces are released into the hot cell it could make access difficult and there is a risk of damage to other components if debris is not contained.

Maintenance of Shutters and Shutter Insert

In general the replacement operation appears to be complex with restricted access and viewing. Also, the access shown around the drive units did not include any secondary systems such as cable trays for the motor power cables, shutter control cables, or other utilities. Detailed planning should continue to confirm that sufficient access is possible for all operations considering both physical obstructions and radiation dose rates. Some further detail comments are given below.

The replacement planning should include measures for detecting contamination and controlling it if required.

It is likely that a gamma shield or cask will be needed to install a new insert into a shutter that has been activated.

The operation of lifting the gate for removal has the hazard of the gate interfering with the cask and the crane continuing to lift. A crane load cell should be used for this operation and there should be alignment features to guide the gate into the cask.

The step of engaging the shaft gripper on the shafts through the cask appears difficult and a mock-up of this operation would be useful in identifying any problems and developing solutions.

11. Commissioning

System Commissioning

The overall plan shows good integration of the testing of all major systems and should meet requirements.

Adding experienced remote handling technicians to the staff to participate in demonstration testing would be extremely valuable and should be done if at all possible within budget restrictions. This has been of great benefit at the SNS and numerous design improvements have been made as a result.

Off beam Integration Test and On Beam Study

The increased duration for the mercury testing is a good change and should allow identification of any problems with the pump and loop.

Experience at the SNS has been that initial water loop testing has taken on the order of two weeks to resolve problems with instrumentation, software, venting and cleaning of filters. In-line screen filters were installed for initial loops operation and in most cases they rapidly plugged with debris even though the piping had been cleaned. After initial operations these filters were removed. The testing also identified a large number of instrumentation problems and software control screen problems. Based on this experience it is recommended to increase the water test duration from 5 to 10 days.

Remote handling test durations do not appear to allow time for identification of design problems, developing solutions and retesting. The experience at the SNS has been that most remote handling tests have identified necessary changes and a repeat of the test after the changes are made.

Remote handling testing demonstrations appear to be only for a small number of operations and may not include operations which are not planned but may be needed due to system failures such as replacing valves. The Committee recommends developing a complete list of potential remote handling operations and either demonstrating all or make a **documented** decision that the risk is low enough to omit demonstration for some. If there is additional schedule contingency, a more complete set of remote handling demonstrations should be considered.

"As built" data will be needed for remote replacement of components and piping. This was crucial for the SNS built tooling fixtures for the pump and heat exchanger to be sure that replacement flange surfaces would mate with existing piping. "As built" dimensions were taken for each mercury pipe spool. We recommend a similar procedure for JSNS.

Consider a target change practice after the mercury loop test and before irradiation in order to evaluate mercury spills and overall mercury containment.

The on-beam testing has the potential to give valuable data on pressure pulse and cavitation effects and should be maintained. There has to be a method after this testing to make it impossible to produce a focused beam at high power levels.

Commissioning Plan for Cryogenic System and Moderator

The plans are well developed and appear to meet all requirements.

Commissioning Plan for Recovery Test

Good preliminary plans have been developed.

Leak checking and tightening or replacing seals will be difficult. There should be defined torque values for all bolts in the process systems and a data base to record that proper loads were used for each component during initial and subsequent assembly. If the leak test method is by pressure decay, it may be necessary to systematically re-torque all connections if the leak can not be located by other means.

12. Miscellaneous

Neutron scattering instruments

The Committee notes, with pleasure, the progress in funding instruments and the most impressive results from the microstrip detector development

Instrument Access control

Rather than limit access to the neutron instruments to one door it would be better to treat all possible entrances to the beam area in the same way. If it is physically possible for a user to enter through a hatch this will almost certainly happen so it is better to anticipate this and design the interlock system accordingly.

The weakest part of the proposed system is the human search so the shutter opening/beam available needs to be indicated very clearly – blue lighting is used at ISIS, a (very loud) audible warning siren is used at LANSCE.

There will be pressure to allow access to the instruments during shutter maintenance. Does the gamma dose rate from the target (with the shutter open) prevent this?

Control system recommendation:

A data base with all stored set points, alarm-and trip levels, control parameters and interlocks is very useful to store and restore the values in different test- and commissioning configurations. This increases the protection and safety of components and saves time in the commissioning process.

END OF THE REPORT

Waldshut, Jan. 28, 2006

Günter Bauer
on behalf of the Committee