Report of 1st Meeting of the NSLS-II Conventional Facilities Advisory Committee
18-19 October 2006

Present:
J. Hands, Sandia National Lab. (retired), Chairman
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The following is a report of the review conducted by the Conventional Facilities Advisory Committee for the NSLS-II Project. It is formatted according to the charge provided to the committee on October 18, 2006.

Preamble:
The committee welcomed the material that was prepared and presented at the meeting. It was satisfying to note the amount of detailed information contained within the review notebook and in the draft CDR prepared by HDR. Please congratulate your staff for their cooperation and hospitality. The specific comments that are provided are intended to enhance our mutual grasp of the scope of the NSLS II Project.

1. Is the scope of the project appropriate given the program objectives and constraints?

Generally the scope for Conventional Facilities is appropriate. The CF team may consider providing a more detailed design criteria document to the candidate A/E firms prior to placing a contract for design of the conventional facilities. The CDR in addition to the Design Criteria will allow the preliminary design to get underway promptly. The Brookhaven design standards should be included in the design criteria. The CDR drawing package could be enhanced by including more structural definition as drawings or narrative description.

2. Is the structure for managing this scope appropriate both by WBS and organizationally?

The WBS is adequate for CDR level. Organizationally, it is not clear how responsibilities match with the WBS accountabilities. When additional staff are identified, it may be easier to match roles and responsibilities to the WBS.

3. Is the CF team the right size and mix of skills to manage the project?

The general structure for the CF team could be adequate to manage the work. The resident staff of the NSLS-II CF group is making good use of BNL personnel from Plant Engineering, who are knowledgeable about site conditions and existing utilities. Much depends on how much work is assigned to the Construction Management contractor. When the team is described in reviews, it should include the administrative staff required to support the Brookhaven staff and the Construction Management office. The CM should be tasked with contractor outreach and cost validation as design proceeds to reduce risks. It is important in the contracts with the CM firm and in the PEP that ES&H accountabilities be carefully delineated. The CF team should consider adding a position to provide an integration function with the accelerator group. Such a position could report to an organization not affiliated with CF, but it should be a position which has authority to control the important interfaces between the conventional facilities and the accelerator and experimenter systems.

4. Does the procurement approach make sense or is there a better approach that should be used?

It is possible to make the procurement approach work, but there are significant risks that should be assessed immediately. For example, the schedule does not allow for the usual period of review for a $100M contract through the DOE chain of approvals. For the scheduled process to succeed, parallel reviews of draft documents, comment resolution and team work between NSLS II Project and DOE (prior to receiving final drawings and specifications) would be required. Multiple contracts issued by Brookhaven will complicate the procurement process, but three procurement specialists dedicated to the CF procurements should aid in mitigating the risk. At the next DOE review, the evaluation of the pros and cons of CM at Risk vs GC with Agent CM should be made available to the review team.

5. Have the right technical issues been identified and are they being adequately addressed?

Judging from the presentations, the correct technical issues are identified and are being addressed. Even though the project baseline is not established at the CDR phase, the project should consider instituting a change control process so that all team members are aware of the current baseline and who has authority to modify it. This would help to lock in the technical parameters for the project. There was no risk registry available for review, but the team should consider preparing one for CF since the design is planned to start in January. The CF team should assess the need to evaluate the site conditions with additional site characterization data before start of demolition of the existing buildings. In the period prior to the start of Preliminary Design, a computational fluid dynamics (CFD) analysis of the storage ring air flow and temperature distribution.

6. Are the cost and contingency commensurate with the scope and project risks at this stage of development?

During this review, the CF team was in the process of completing their bottoms-up estimates. When the cost estimates are compiled and reviewed, they should take into account the plan to phase construction of the accelerator ring. Requiring early access through beneficial occupancy of one section of the ring could significantly impact CF costs. It is recommended to decouple most of the CLOB from the ring construction to allow for the possibility to increase contingency if necessary. The project should consider increasing the escalation for conventional facilities since recent DOE projects have seen more than 3.5% annual increases. The escalation could become a bigger problem if the funding profile for the project does not match projected plan. Before the next DOE review, escalation impacts of the “notional” funding profile should be discussed with DOE. The impacts of this issue are so important that the CFAC would like to hear more on this issue following the DOE meeting in December. Specific contingency should be determined by the risks identified in the risk registry for Conventional Facilities.

7. Is the schedule realistic and supportive of project objectives?

The schedule does not show any planned usage of float by the Conventional Facilities processes from 2007-2010. Considering the risks associated with this work, the team should consider what its approach to using float will be during this period when the CF work is on the critical path. The CF team may want to review the durations for Preliminary and Final Designs which are currently included in the total time for each design phase. The CF schedule appears to be aggressive. Thorough integration of the CF, accelerator and experimenter systems schedules is necessary to demonstrate critical links. The Title I design schedule should allow time for a detailed programming and integration effort.

8. Are there specific actions that should be taken between now and the next DOE review?

In addition to the suggestions above, the following recommendations are made. There should be some MOU outlining the Lab accountabilities and agreements in the moving of activities and demolition of buildings on the proposed project site. It is proposed to have rotating equipment in service buildings attached to the ring inner wall. The structural implications of the vibration criteria should be evaluated with a structural vibration consultant familiar with rotating equipment. Evaluate the risk of multiple prime contractors on site at the same time on safety, coordination, interfaces, etc. Delineate roles and responsibilities in the draft Project Execution Plan. Before the next review, ensure that the drawings and other documentation agree on exactly what is in and out of the current project baseline. For the project in general, it is important that those team members who have not worked on a line item be thoroughly trained.

ADDENDUM

The following is an addendum to the report of the 1st Meeting of the NSLS-II Conventional Facilities Advisory Committee. It contains additional comments by M. Kirshenbaum (ANL).

General Comments:

Based on my review of the project documents and the presentation there are four primary areas that need to be addressed in greater detail; these are schedule, temperature stability, design criteria, and vibration mitigation.

Schedule:

The schedule for Title I and Title II appear to be very tight and should be amended to reflect some time for the requisite design reviews and float. While the conceptual design does appear to begin to address programming of the facility there seems to be insufficient detail that would allow the A/E to immediately begin Title I design. The Title I design schedule should allow time for a detailed programming and integration effort.

Integration is a process that coordinates and ensures that the technical needs of the machine and those identifiable for the future beam lines are incorporated into the conventional facility design. The goal is for the design of the facility and the machine to fit as seamlessly as possible. The NSLS should assign one or more individuals to this task and clearly define their job description and level of responsibility.

Since there is some time between the end of the conceptual design and the beginning of Title I the Project should utilize this time to their advantage. In addition to beginning the integration work during this interval some studies could be conducted to substantiate the efficacy of some of the unique design elements in the conceptual design. These should include a computational fluid dynamic analysis of the storage ring air flow and temperature distribution and an analysis of the vibration transmission from the infield service building to the storage ring.

Temperature Stability:

Temperature stability is required for both the storage ring and beam lines. Given the small size of the NSLS beam the criteria for this stability is very strict especially when the size of the air conditioned spaces is taken into account. During the presentation some examples of temperature stability in individual laboratories were presented to illustrate the current level of control now being achieved. While these levels of control are better than those specified for the NSLS storage ring, consideration should be given to the fact that the storage ring is a much larger space to control and that control will be from multiple sources instead of a single source. There are also interface issues between the experiment hall and storage ring tunnel that must be considered.

The current plan, to maintain the storage ring at an elevated temperature (85 F) during operation while the surrounding experiment hall is maintained at a lower (75 F) temperature, may create some operational challenges. The air temperature has been set to match that of the DI water cooling the storage ring components. The DI water will not be chilled but cooled only through an evaporative cooling process with the lowest achievable summer temperature being 85 F. This plan is being driven primarily by two objectives. The first is to save capital cost associated with chilling the DI cooling water and the second is to save future operating cost associated with those chillers.

To accommodate the maintenance activities the tunnel temperature is planed to be lowered to 75 F during each maintenance period thus further complicating tunnel temperature control.

While these are laudable goals there is some risk inherent with this approach.

- First the heat transfer and temperature control will have one additional source to contend with. Maintaining a lower storage ring temperature, identical to the experiment hall, would surround the tunnel with a space at an equivalent stable temperature, eliminating one heat transfer path. It also benefits the experiment hall, particularly at the ratchet wall interface with the beam lines by eliminating a heat source for the first optics enclosures (FOE). The possibility of forcing all FOE's to require air conditioning and temperature control could place an added cost to the construction of each beam line and this should be evaluated with regard to the "total cost" of building the light source.

- An area of greater concern, that needs further consideration, is the impact of the periodic changes in tunnel temperature that will occur during the facility maintenance periods. How long will it take to lower space temperature and more importantly how long will it take to raise the temperature back to operating set points and achieve stability? One complicating factor that should be given careful (computational) analysis is the impact of cooling the tunnel while the storage ring components are maintained by the DI water at a mean temperature of 85 F. In this condition the beam line will act as a large radiator and convector, so space cooling and chiller capacity must be included to cool this space and reject this heat during maintenance periods. Was this accounted for in the sizing of the chilled water plant and if so would not the plant capacity requirements be closer to those of a facility with a chilled DI water system and storage ring operating at 75 F? Additionally, it is not clear what source of heat will be used to maintain the DI water operating temperature of 85 F when the magnets and other components are de-energized.

- While capital and operating cost were the basis for advocating the warmer DI water and storage ring temperatures it is not clear how significant a savings would result. During the presentation, a cost for chiller capacity of $2800 per ton of cooling was noted. While this may be true for an overall installation, once a plant general layout has been established, additional capacity can often be obtained not by adding chillers but by increasing the size of those already planned. The cost differential incurred by increasing unit size will be substantially less than that used during the presentation. When elimination of the separate cooling towers, pumps, controls, and piping distribution required by the 85 F system is factored into the economic analysis the capital cost savings may not be significant. A thorough economic analysis should be conducted but only after an operating scenario for the storage ring temperature change-over is fully coordinated with the intended storage ring design and careful consideration of alignment and start up issues.

Design Criteria:

While some criteria is provided for the conventional facilities design there is insufficient information to establish overall limiting parameters that can affect system performance and the economics of the construction. For instance, air and water velocity and pressure drop limits must be established as these will affect the size of the piping and ductwork and can have a large economic impact if too conservative an approach is used. In particular parameters must be set for the minimum acceptable density for temperature control zones, electrical outlets, and electrical circuits on a per area or space basis. Also, the specification for the DI water system needs further definition; dissolved oxygen content, pH, and TOC, levels to name a few, should be clearly defined. Pipe material specification for DI water needs further examination with consideration given to the cost effectiveness of low grade (304 L) thin wall (schedule 5 and 10) mechanically coupled stainless steel as alternates. A complete review of the level of detail of the criteria should be conducted and all the criteria arranged and placed in a single location for convenient access. Ideally this information should be provided to the firms bidding the A/E contract since it will help in defining the level of effort required during design.

While a balance must be achieved between cost and operating performance with regard to ductwork and pipe sizing, the impression given during the presentations seemed to imply that very low velocities (and subsequently) large duct and pipe sizes would be used. The limits of such velocities should be clearly defined. With regard to piping systems too low a velocity can present as many or more problems as too high a velocity. Also, it should be cautioned that over sizing and expending extra cost to stiffen and enlarge ductwork to reduce vibration will in most cases have a negligible affect on the vibration transmitted to the building, storage ring components, and beam lines. Given the low energy level of the ductwork with respect to the robustness of the building structure a more cost effective approach is to properly isolate the ductwork from the structure.

Vibration Mitigation:

The significance of vibration transmission can not be over emphasized. The conceptual design report places the majority of the rotating equipment in buildings in the infield directly adjacent to the storage ring. While slab thickness and fill along with isolation of the two structures is being employed for vibration mitigation, questions arise due to the extremely close proximity of the two slabs. Experience at the Advanced Photon Source (APS) has shown that even equipment provided with vibration isolation and isolated slabs provides insufficient attenuation when imbalances develop as rotating equipment begins to age. While the isolation of slabs impedes the transmission of vibration, the earth below still provides a path for it. The greater the distance between the slabs the greater the level of dampening obtained. At the APS the rotating equipment is located at the outfield experiment hall wall as far as possible from the storage ring. When equipment has become unbalanced the effects are limited to only those beam line hutches at the furthest extremity of the beam line thereby mitigating impact to the overall facility operation. With the NSLS design equipment vibration will directly impact the storage ring which may pose a global problem for the facility and could impact multiple beam line performances.

Mitigation methods could be employed using large inertia bases with more sophisticated vibration isolation technology or consideration could be given to pulling the infield service building in toward the center of the infield, increasing the distance between the buildings. This "gap" between the buildings may not need to be excessive and should be explored. As an alternative, locating rotating equipment on the infield side of the service building in addition to isolating those portions of the slab would increase the vibration path by the width of the service building. Economic considerations would govern the methodology used.

The slab thickness being proposed for the storage ring appears to be excessive. This thickness is being proposed for two reasons; to provide extra vibration mitigation and as a means of adjusting elevation of the storage ring beam line. The cost impact of the slab thickness will be large and should be given greater consideration. With regard to increasing the entire storage ring slab in order to adjust the elevation of the beam line consideration should be given to thickening only that portion of the slab under the girder assemblies thereby achieving the elevation adjustment and minimizing the amount of concrete required.