NSLS-II Accelerator Systems Advisory Committee (ASAC)
Report of the sixth meeting, October 22 and 23rd, 2009.

Committee Members Present :

G. Decker, APS,
W. Decking, DESY
D. Einfeld, ALBA
P. Elleaume, ESRF, Chair
J. Galayda, SLAC
C. Steier, LBNL/ALS

Members Absent :

J.M. Filhol, SOLEIL
R.P. Walker, DLS
D. Rubin, Cornell

Introduction

The committee is pleased by the excellent quality of the technical work as well as the good quality of the presentations. The committee acknowledges that an enormous amount of thinking and progress has been made by the project in many technical areas.

Here is the reply of the Committee to the charge.

Review recent progress and near-term plans in Accelerator Systems in terms of technical, cost, and schedule performance

The committee is pleased to see that most of the magnet contracts are finalized and good progress is made on the vacuum chamber. It takes note of the fact that the Linac contract will be the next priority followed by the Booster contract. The Booster contract is on the critical path and the committee is worried about the complexity of this contract in terms of the responsibilities shared between BNL and the contractor and the possible delays in both the negotiation and the execution of such a contract.
In view of the documentation presented, the committee finds it difficult to make a clear statement on the cost but does not see any important problems on the horizon.
The committee sees a strong maturity in many technical areas and is pleased by the efficient use of the ARRA money to speed up the completion of the building infrastructure.
The committee recommends that the project keeps on watching the ratio of spending versus earned value, particularly in view of the recent negative trend. The committee recognizes that the management is aware of this and has started appropriate action.

Review the plans for beam position monitor systems and comment on the advisability of an in-house development regarding technical performance, cost, and schedule

The Beam Position Monitoring (BPM) for a synchrotron light source is probably one of (or) the most essential and delicate diagnostics. For the past four years, nearly all new projects world wide have selected the so called Libera Electronics manufactured by Instrumentation Technologies in Slovenia. The system performs reliably in many facilities and is mature . However, the Libera electronics is based on some out-of-date components selected 10 years ago and the company is reluctant to make it evolve at an acceptable cost for NSLS. The company also keeps aggressive intellectual property rights on the firmware which prevents future evolutions under customer initiative. Under these circumstances, the committee understands the desire of the project to develop in-house its own BPM electronics. The committee recognizes that an alternative to the Libera electronics can be developed but will need time and resources to achieve similar or better performance. It is the opinion of the committee that the project probably has the time to develop a new system if highly skilled and motivated people embark immediately on the project. It was reported that a project team has already started. The committee does not believe that a definitive choice between Libera and an in-house development can be made by December 2009. The committee recommends the development of a fully detailed specification and the establishment of a schedule with clearly defined milestones including testing on an appropriate, operational electron storage ring. The committee recommends to get advice and involvement of a few world experts having extensive experience with digital based beam position electronics or similar FPGA applications. Concerning the BPM buttons, the committee recommends that calculations of the high frequency RF power deposited in the button geometry should be performed using electromagnetic codes as GDFIDL, to have an accurate estimate of the heating of the button.

Review the overall machine protection system and the integration of personal protection system, beam containment and top-off safety measures

The committee is pleased to see the present status of development of the Personal Protection System (PPS) as well as the thinking already taking place concerrning a Beam Containment System (BCS). On many existing facilities, a BCS had to be implemented on the fly after completion of the facility. NSLS II has a unique opportunity to integrate it from the early stage of the project. We also note that much effort is still needed in this direction.
The recommendation of the committee is to keep the BCS as flexible and as simple as possible and functionally independent of the PPS. As reported during the presentation, the committee takes note of the reported high dose predicted under abnormal conditions at various places along the accelerator complex. These predicted losses must be considered as worst cases as they assume a point-like beam dump. Due to the limited shielding thickness, the issue is particularly severe outside the booster tunnel in case of an obstacle in the electron beam path close to full energy. The committee recommends to establish a detailed and clear commissioning plan of the injector systems taking into account that trial and error tuning techniques like they have often been employed in the past in a number of facilties might not be consistent with ALARA principles given the relatively thin booster shielding. Instead deterministic tuning techniques making full use of all available beam diagnostics should be developed in advance. Emphasis should be placed on educating the commissioning and future operations crew to the radiological protection issues.
The initial top-off safety studies make good use of strategies and methods developed at other 3rd generation light sources. Good progress is visible, however, the simulation needs to be refined with denser phase space and a finer simultaneous scan of all magnet parameters. The committee feels very strongly that the case of a magnet mis-setting cannot be considered as a low probability event. Initial thoughts
concerning a top-off interlock system as part of the PPS system were also shown. They look adequate but need significant further elaboration. Particularly the time response requirements need to be clarified soon, since they might have significant impact on the layout of the top-off part of the PPS systems.

Comment on the Injection systems including the plan for the pulsed magnet facility and the procurement strategy for the booster

The committee welcomes the pulsed magnet facility. The committee is worried about the potential incompatibility between the pulsed magnet facility and low-noise magnetic measurement (dipoles, quadrupoles, insertion devices) which are planned in the same building.
The committee believes that the procurement strategy for the booster is reasonable but since we did not receive the details on the final split of responsibility between the project and the contractor we cannot make a more precise statement.

Review and comment on the NSLS-II power supply systems

The committee is very impressed by the technical design and the progress made for the power supply system. The strategy appears effective in terms of cost, maintainability and integration into the facility. The committee is unsure whether a 10 kHz update rate of the digital setpoint for the ramped booster power supplies is sufficient to correctly tune the booster at injection. The committee is pleased that the project team focuses on designing power supplies with a few ppm of current stability

Review the plans for production, assembly, and installation of accelerator systems

At this stage of the project, the installation schedule has been thought through and adequate consideration has been given to the installation. 18 months for girder preparation and installation in the ring tunnel looks adequate.

Review the plans for start-up, test, and commissioning of accelerator systems

The project is aware of the list of requirements to be fulfilled before the start of commissioning. No plan was presented for testing and commissioning so the committee cannot comment.

In addition to the response to the charge, the committee would like to make the following remarks concerning topics which were the subject of dedicated presentations:

Accelerator Systems Status

The Committee is worried about the importance of the technical modifications required for the RF vessel (needed to satisfy the new regulations) of the superconducting cavity. The committee is pleased to see that the project is collaborating with the SRRC (Taiwan) project which needs similar superconducting cavities and wonders if such collaboration could be extended to the Pohang Light Source who is also about to purchase superconducting cavities.

Progress on Injection Systems

The project appears to be well aware of the difficulties. The committee supports the proposed design of component to be compatible with a potential later upgrade for 2 Hz operation of the booster. The committee also strongly supports the proposed stacking option in the booster. More simulation effort should be carried out to further develop this option. The committee is disappointed to see that the pulsed sextupole approach for injection has been discontinued for a number of technical reasons. The committee agrees that the classical 4 kicker bump plus septum magnet is very mature and minimizes the risk but will probably not allow optimal stability of the stored beam during top-off. The committee recommends to keep the option of pulsed sextupole opene as a future upgrade path that would minimize the stored beam orbit distortion during top-off and continue the studies to resolve the technical issues at a lower level.

Insertion Devices

The committee takes note of a challenging development program of Insertion Devices (IDs). The committee recalls that the main design parameters (pole and magnet width, gap, period, magnetic design) of all IDs should be checked (and if necessary modified) through tracking studies including a realistic storage ring lattice by means of the kick map method. Concerning the multipole specifications of the IDs and damping wigglers, the committee recommends clarification of the transverse aperture over which they must be fulfilled as well as the magnetic gap range. It is important that the specifications (and therefore ultimately the performance) are not compromised due to schedule pressure. However, on the other hand, all specifications need to be clearly explained by accelerator physics requirements and pertinent simulations, since unnecessarily tight specifications can have substantial negative cost and schedule impact. Variable gap wigglers of similar field and period have been installed at the ALS and SPEAR in recent years and the specification documents for those newest devices could be used as guidance.

The committee recognizes the need of purchasing insertion devices from external vendors. The committee also recalls that the ID development effort will continue over many years and that it is important that the project develops the relevant technical expertise which is best realized by manufacturing, assembling and shimming some IDs in-house. In this respect, one must keep in mind that the time needed to develop the first in-vacuum undulator in house may be longer than the one needed by an experienced vendor. In this respect the committee is pleased to see the progress in the establishment of an ID magnetic measuring laboratory.

Beamline Front-End Systems

The issues are well understood and the proposed design of front-end components benefits from the experience developed at APS and elsewhere concerning high power front-ends. Efficient and simple designs of slits, photon shutters, and safety shutters have been proposed. The level of electron beam position interlock needed to protect the vacuum chamber in case of mis-steering must be revisited and clearly established. The committee is concerned about the difficulty to operate a machine reliably with the currently proposed interlock threshold of 0.5 mm. It should be checked to be consistent with the possible beam perturbations expected during top-off operation. Interlocking on both position and angle might be necessary.

The design of the front-end components and their control system must be made in order to avoid as much as possible having to dump the beam in the storage ring in case of failure of one front-end component. The committee recalled that an effective passive protection possible to avoid sending the electron beam inside a beamline hutch during top-off is to implement a permanent magnet steerer in the beamline front-end. The committee recommends to keep this option open by reserving the necessary space in the beamline front-end until the full studies of top-off safety are completed.

At future meetings, the committee would like to hear presentations on :

- Studies of the lattice with non-zero chromaticity
- Update on the EPU shimming
- progress on PPS ,BCS, and Top-off safety studies as well as interlocks
- High Level Applications
- Fast orbit feedback

The committee recommends the establishment of a document summarizing the main parameters of all accelerator components (lattice parameters, magnet and power supply, timing, vacuum chamber cross-section, …) including linac, transfer lines, booster and storage ring. The document should also be distributed to ASAC. Such a document has been compiled and was made available in other recent projects.