Minutes of the Joint Meeting of the APSUO Steering Committee and Partner User Council
Argonne National Laboratory
August 24, 2010

APSUO Steering Committee members in attendance: D. Brown, P. Eng, P. Focia, P. Fuoss, J. Kropf, A. Sandy, R. Suter, D. Tiede,

Partner User Council members/alternates in attendance: A. Allen, W. Anderson, G. Bunker, R. Gordon, T. Irving, A. Joachimiak, D. Keane, L. Keefe, D. Mao, J. Maser, S. Sutton

APS Attendees: M. Beno, M. Borland, L. Gades, R. Gerig, J. M. Gibson, D. Haeffner, D. Mancini, D. Mills, W. Ruzicka, S. Strasser, L. Young

Welcome—J. M. Gibson

Budget: Gibson reviewed the status of the FY2011 budget. Due to the upcoming Congressional elections, a continuing resolution is anticipated. Despite the possibility for a tight budget, the Department of Energy (DOE) and Argonne management are committed to seeing the APS Upgrade go forward. In addition, due to a budget carryover, the APS anticipates being able to maintain operations.

APS Update—D. Mills
Note: The details of Mills' presentation are found at
http://www.aps.anl.gov/About/Committees/APS_Users_Organization/Meetings/2010/20100824_mills.pdf
Highlights follow:

Personnel Changes: Walter Lowe is leaving the APS to return to the Washington, D.C. area. He will be working at DOE in the Scientific User Facilities Division of Basic Energy Sciences (BES) and will be involved with the operations of the BES light sources. Secondly, a search committee has been charged with conducting an international search for a new APS director. Recommendations may be sent to the search committee (trossett@anl.gov). Finally, interviews cointinue for the Argonne Distinguished Fellow for Life Sciences at the Advanced Photon Source.

Industrial use at APS: The APS will begin a pilot program to increase industrial use during the next cycle. The program was being organized by W. Lowe; for the time being, Dennis Mills and Susan Strasser will oversee the pilot

Biosciences: Several APS and Bioscience staff will discuss APS-U with NIH and BER Program Managers during late August highlighting the opportunities that APS-U will afford the life sciences community.

Accelerator performance: Performance continues to excel. The machine ran with almost 99% availability and 100 hours mean time between faults (MTBF).

Congratulations: The APS congratulates Ken Sidorowicz on winning the UChicago Argonne Outstanding Service Award.

Budget: Proposed House and Senate budgets are approximately flat, lower than the FY2011 BES budget request. Funding priorities include full funding for construction activities (NSLS-II, APS-U, and LCLS-II) and near-optimal operations of Scientific User Facilities. BES will defer funding for new research, if necessary. For Argonne specifically, E. Isaacs anticipates a flat budget at least for the first few months of FY2011. As Gibson mentioned, Congress is likely to pass a continuing resolution due to the November elections. In addition, Congress is concerned about reducing federal deficits.

APS Upgrade: Since CD-0 was awarded on 4/22/10, APS staff have been moving forward to develop the Conceptual Design Report (CDR). The draft will be subjected to a series of reviews over the next several months. The triennial University of Chicago review (August 30-31) will be used as an opportunity to obtain feedback on a priority list of beamlines to be included. Subsequently, the draft CDR will be reviewed by the APS Scientific Advisory Committee (SAC), which will also review and prioritize these beamline/ beamline upgrades on the basis of scientific and user impact. Following these reviews, the APS plans to make a draft available to Users upon request and will solicit user input through APSUO, PUC, and/or Life Science Council representatives.

XIS/LSS Cross-Cut Review: The review will be held Oct 6. During the review, presentations will include a summary of the liquid surface scattering workshop and a series of science talks on x-ray interface science and liquid surface scattering. Both the October 6 Cross-Cut Review and a subsequent open forum discussion held by the APS SAC on October 7 will be open to the public.

Workshop: The Workshop on Evolution and Control of Complexity: Key Experiments Using Sources of Hard X-rays will be held at APS/ANL from October 11-13.

APS Upgrade: Overview and Status—D. Mancini

Timeline: The APS Upgrade Project began in early 2008 with a medium-term beamline proposal solicitation. The project reached a major milestone in April 2010, when DOE awarded the project CD-0 status, the "Approval of Mission Need."

Going forward, the anticipated timeline is as follows:

- CD-1 end of FY2011
- CD-2 end of FY2012: preliminary design complete
    - CD-3a (early procurements of long-lead items)
- CD-3 end of FY2013: Formal acquisition
- CD-4 end of FY2017: completion

The APS is currently preparing documentation for CD-1. This includes the Conceptual Design Report (CDR), cost estimate and schedule range, project controls, and a preliminary hazard analysis. The CDR will undergo three major revisions.

- Work is currently under way on Revision 0. An early draft was completed in June 2010. Review comments from APS management and the APS-U steering committee were tabulated and provided to authors, who revised their chapters.
- Revision 1 (to be completed January/February 2011) will incorporate further technical review, detailed cost estimates, and strategic and logistical adjustments.
- Revision 2 (to be completed March 2011) will be presented at the DOE Review for CD1. The DOE Review will be followed by a Lehman review.

User Involvement: There are several ways in which Users can stay informed and provide input:

- Attend the APS Monthly Operations Meeting
- Attend the APS-U Monthly Meeting (10:30-11:30, last Friday of the month)
- Provide feedback through the discussion forums on the APS website .
- Provide input via the APS-U Steering Committee (D. Mills, Chair)
- Contact relevant theme leaders
    - Linda Young (Ultrafast Dynamics)
    - Chris Jacobsen (Imaging and Coherence)
    - Steve Heald (High Resolution Spectroscopy)
    - Jonathan Lang (Extreme Conditions)
    - Paul Zschack (Interfaces in Complex Systems)
    - Stefan Vogt (Proteins to Organisms)

Discussion:

In the discussion that followed, a user asked whether there are constraints on what interruptions to operations might be considered. Partner users with home institutions, for example, are very concerned about the impact on operations. Mancini responded that the goal is to have no impact on operations. Decisions will be made based on costs, schedule, and the importance of avoiding any unplanned outages. The worst-case impact would be no worse than when there have been budget constraints (e.g. ,no more than 750 hours in one year).

APS Upgrade: Experimental Facilities—Dean Haeffner

Current Status: The CDR first draft is finished and is several hundred pages in length. The draft includes bottom-up costing prepared by P. Den Hartog's group, as well as approximately 10 pages from each beamline involved. The draft is a work in progress, expected to undergo considerable revision.

A roadmap is being prepared, in parallel to the CDR. Haeffner thanked everyone for the considerable feedback provided on the first version of the roadmap, completed in January. All in all, Users provided 54 pages of comments. A revised should be ready for comment at the next SAC meeting.

Technical Developments: Since the last APSUO/PUC meeting, there have been several technical developments.

- Symmetry constraints for long straight sections (LSS) have been relaxed, allowing for much more flexibility in placement.
- Revolver undulators
    - Success at other facilities has led to their consideration.
    - They allow for flexibility in ID selection, generally allowing shorter period use while still having full spectral coverage
    - Are especially useful for canted beamlines
    - Because revolver undulators alleviate some storage ring impedance issues, they could negate the need for some LSS, e.g. LSS requested for spectral reasons.
    - Not fully reflected in the CDR draft
- Superconducting undulator chamber size
    - Approximately 1 m more than device length
    - Placement in the upstream portion of a straight section can preclude BM usage.
- Crab cavity placement for SPX
    - 6DS/8US scheme probably will not work; the proposed single sector for SPX beamlines (canted) is not viable.
    - Other possibilities include:
        - 6US/8US two sector solution
        - 6DS/7DS short one-sector solution; no canting possible
        - Variants of the above with 7/8, or entirely new sectors
    - This is a fairly recent development, not fully reflected in CDR draft, and APS personnel are still working through the consequences.
    - Current beamline programs on BM beamlines between crab cavities will need to be moved; 7BM and 8BM relocations are now part of the upgrade.

Non-Technical Developments: There have been several non-technical developments as well.

- Discussions have continued with non-XSD beamlines about possible relocation, particularly to free up ports for long beamlines.
- Discussions have begun with non-XSD beamlines about possible partnering opportunities (e.g., via canting).
- Cost estimates have led to reevaluation of scope for some beamlines.
- A few experimental capabilities were unintentionally left out of the previous roadmap, and we are now finding locations for them.
- There are not enough open ports for all of the proposals.

Beamline Proposals: Haeffner presented a detailed presentation of specific beamline proposals.

- Ultrafast Dynamics
    - Short Pulse X-ray (SPX) facility (7-ID, 7-BM)
        - Multiplexed operation with three independent beamlines, four independent end stations
    - Laser initiated time-resolved spectroscopy and WAXS/SAXS
        - Currently at 11-ID, possible move to 6-ID
- Imaging and Coherence:
    - Long, wide-field imaging beamline
    - Sector 32 cant/upgrade
    - Next Generation Microprobes (2-ID)
    - Cryonanoprobe
    - XPCS (8-ID)
    - High Energy Tomography
    - Fuel Spray Beamline
- High Resolution Spectroscopy
    - Canted undulator at 20-ID (or alternate)
    - Coordinated upgrades to sectors 3, 9, 30
        - 9-ID dedicated to RIXS
        - HERIX and NRS at 3-ID and 30-ID
    - Catalysis facility at 9-BM
- Extreme Conditions
    - High magnetic field scattering (6-ID or 11-ID)
    - High pressure studies (16-ID)
    - High energy scattering (1-ID)
        - Upgrade and cant to address high user demand
        - Add a superconducting undulator
        - Increase capacity for industrial use
    - High field/pressure magnetic spectroscopy (4-ID)

- Interfaces in Complex Systems
    - X-ray interface science
        - Enhanced tunability for ID and BM beamline(s)
        - Specialized end-stations available offline
        - Environmental cells that can be attached to general diffractometers
    - Liquid surface scattering
    - Expand resonant interface scattering (33-ID)
    - Microbeam and 3D diffraction (34-ID)
- Proteins to Organisms
    - Bionanoprobe II (21-ID or new canted ID elsewhere)
    - Enhanced SAXS/WAXS (new BM or newly canted, upgraded 5-ID)
    - Microfocus MX beamline (19-ID)
    - Enhanced time-resolved MX beamline

Optics: The APS Upgrade will necessitate a general optics upgrade. APS proposes to increase stored beam to 150 mA and upgrade all beamlines to be capable of operation at 200 mA. This will require high heat load components: stops, shutters, slits, windows, monos, mirrors, etc. For ID beamlines, shorter period undulators often provide higher brilliance with lower power.

APS-U will necessitate several optics development efforts.

- Focusing optics (micro-, submicron-, and nano-focusing)
    - Many types of optics currently in use will continue to be used: Kirkpatrick-Baez (KB) mirrors, refractive lenses, zone plates, multilayer Laue lenses (MLL)
    - The upgrade steering committee is currently evaluating needs.
- Precision motion/stability
- Requests to upgrade optics, deposition, and metrology facilities
    - Upgrade large deposition system
    - Upgrade rotary deposition system
    - Large area ellipsometer
    - High resolution, large field-of-view SEM
    - Pulsed laser deposition (PLD) system
    - CMP pitch polisher
    - High-precision x-ray diffractometer for crystal orientation
    - Bruker D2 CRYSO system for crystal miscut measurement
    - Ultrasonic mill for non-destructive cleaning of crystal and mirror surfaces
    - Ultrahigh-resolution double-crystal diffraction and imaging system
    - High resolution slope measurement tool
    - High resolution laser Fizeau interferometer with advanced stitching capability
    - Metrology atomic force microscope

Detectors: Detector development requests have included:

- Pilatus-like pixel array detectors
- Analog pixel array detectors
- Large area detectors
- Multi-strip or pixel detector for HERIX
- Fluorescence detectors faster than current silicon drift detectors
- Crystal-based spectrometer for time-resolved XAFS
- Streak cameras with ~1-10 ps time resolution

XSD-ODG currently plans to focus on two main areas of development:

- Improved readout speed and time resolution of area detectors and diode arrays
- Improved detection efficiency for x-rays with energy >20 KeV

Detectors that are, or will be, available commercially have also been requested.

- Contracts with universities, other labs, industry
- Pilatus pixel array detectors
    - Eiger PAD with 75 μm pixels, up to 10 kHz frame rates
    - 2M in vacuum
    - CdTe sensor
    - Various sizes
- Other area detectors
    - Cornell/ADSC Mixed-mode pixel array detector
    - High-speed cameras coupled to scintillators
    - A-Si flat panel
- Strip detector for HERIX
- Fluorescence detectors
    - Silicon drift diodes (SDD) in custom configurations
    - Multi-element Ge detectors
    - Crystal-based detectors, e.g. wavelength dispersive x-ray spectrometer
- Fast scintillator point detectors

In addition, expansion of the Detector Pool has been recommended:

- Expand inventory of commercial items
- Procure custom or non-commercial items
- Expand services as needed (e.g. evaluation, characterization of detectors)

User Involvement: Users wishing to provide input should contact the Upgrade Steering Committee, the Beamline theme leaders/members, or APS/APS-U management.

- Steering committee: D. Mills, R. Gerig, G. Srajer, J. Maclean, M. Borland, T. Irving (PUC), P. Fuoss and D. Tiede (APSUO), R. Fischetti (Life Sciences Council Chair), D. Neumann (SAC Member)

- Beamline theme leaders/members: L. Young, C. Jacobsen, S. Heald, J. Lang, P. Zschack, S. Vogt
- APS/APS-U Mgmt: D. Mancini, D. Haeffner, M. Ramanathan, M. Beno

Discussion: A summary of the discussion follows.

- Question: We are unsure how well higher current will work for all beamlines. Will there be an opportunity for studies in advance?
    - Answer: Yes.
- Question: Is the APS considering partnering with industry for detector development?
    - Answer: Yes, partnering is encouraged. The XSD Optics and Detector Group (ODG) does some of this already and certainly has it in mind. Anyone with ideas is welcome to help people get together in collaborations. Also, Users are encouraged to suggest topics for APS to recommend for DOE to consider for SBIR funding in support of APS-U.
- Question: We have a concern about computing resources. For example, with a large number of more advanced detectors, the amount of data may become problematic.
    - Answer: The CDR currently has a discussion of IT capabilities, including centralized archival storage and improvement of network capabilities. This may be done as part of APS-U or operations spending.

APS Upgrade: Accelerator Issues—Michael Borland

APS accelerator upgrades serve mission requirements. The goals of APS-U, for the accelerator, are to:

- Address the need for increased beamline capacity (e.g. LSS and cants)
- Improve beam stability for more demanding experiments
- Increase brightness and flux for 10~100 keV
- Support time-resolved studies at a few PS scale

Lattice and Beam Dynamics: Long Straight Sections (LSS) can be implemented at APS by removing the Q2 magnets on either side of the LSS, removing the adjacent correctors and BPMs, and sliding other components away from the ID. This solution increases the space available for the ID from 4.8 m to 7.7 m. Even though this is the most cost-effective option for LSS implementation, it will still be difficult to afford more than eight LSS.

Constraints on new lattices include:

- Maximum Beta functions
- Beta functions at IDs
- Magnet strengths will be limited by current power supplies

- Sufficient chromaticity to stabilize the beam
- Sufficient dynamic aperture for good injection efficiency
- Sufficient momentum aperture for good Touschek lifetime
- Emittance no more than 10% higher than present

Traditionally, only symmetric placement of LSS was considered viable, however this constraint increases the cost of the overall project. Recently, accelerator staff developed multi-objective genetic algorithms to design lattices with reduced symmetry. Thus far, three basic lattices have been developed. Borland presented a comparison of APS today with these theoretical lattices. A new lattice would be likely to have comparable emittance. Work continues on higher chromaticity solutions for the test lattices.

Mock-up lattices can be tested by turning off existing magnets to simulate magnet removal. Using this method, accelerator personnel have tested two lattices:

- 8RLSS (random LSS) mock-up lattice
    - Normal injection efficiency and lifetime
    - Necessary to steer the beam to the center of the sextupoles
    - Implication: cannot have significant steering of the beam to compensate for misaligned beamlines
        - Must to realign 37 beamlines (23 IDs, 14 BMs); Borland recommend that if this lattice is chosen, realignment work should start as soon as possible.
- 8RLSS+SPX+RHB mock-up lattice
    - Normal injection efficiency
    - Lifetime is significantly reduced (5 hours at 100 mA).
    - Study of this lattice continues.

Long taper development will be required as part of LSS implementation; LSS increase effective vertical impedance, while longer linear tapers reduce impedance. The new tapers will use "accelerator real-estate."

Beam Stabilization: APS has fallen behind in beam stability. Stability is important; in fact, better stability is like a brightness upgrade. APS-U targets a two- to four-fold improvement. Components required include:

- BPM electronics
    - Benefit: two-fold reduction in AC noise floor
- Storage ring vacuum chamber microwave mode dampers
    - Benefit: doubles the number of available vertical BPMs for feedback
- Real time feedback system upgrade
    - Double the number of BPMs interfaced to the system
    - Double the number of fast steering correctors
    - Benefit: improve AC stability four-fold
    - Benefit: improve feedforward system that mitigates top-up disturbance

- Front-end x-ray BPMs
    - Hard x-ray GRID XBPM system based on x-ray fluorescence, immune to soft BM radiation background
    - Benefit: expect a two-fold improvement in long-term stability
    - An in-air prototype is currently being tested at 35-ID.
- Tunnel temperature regulation
    - Currently, the air temperature is typically maintained within 1.2^{o}F. This causes a 10~15 micron motion of accelerator components relative to the floor.
    - Benefit: A two-fold reduction in air temperature variation gives a two-fold reduction in long-term drift.
- BPM position sensing
    - BPMs move over time, for example, with temperature variations. Monitoring the positions of BPMs can allow for correction.
    - Benefit: two-fold improvement in long-term stability

Insertion Devices: There have been requests for 22 devices as part of APS-U. Several undulator types are being considered:

- Planar HPM
- Planar revolver HPM
- Planar in-vacuum HPM
- SC planar (APS-U R&D)
- APPLE
- IEX (non-APS-U R&D)

Borland reviewed present performance at 100mA with planar undulators, compared to anticipated APS-U performance at 150mA, with canted standard straight sections (SSS) vs. canted LSS vs. non-canted SSS. Borland noted the need to carefully optimize IDs for specific beamline needs and beam conditions.

Accelerator personnel are prototyping a Superconducting Undulator (SCU) with a 16mm period, targeting ~20keV first harmonic, but which also gives good performance for the 3rd and 5th harmonic. The R&D plan is as follows:

- Installation of a short prototype to address critical issues
- Measurement of beam-induced heating in various operation modes
- Validation of cryogenic design concept
- Development and verification of methods for building and tuning devices
- Development of magnetic measurement techniques
- Characterize long term stability
- Investigate failure scenarios

Short Pulse X_rays
Accelerator personnel are exploring Zholents' Transverse RF Chirp Concept as a mechanism for providing short-pulse x-rays (A. Zholents et al., NIM A 425, 385, 1999). The predicted pulse duration is 1-3.5 picoseconds. Applications include:

- Addresses a weakness of storage rings and an area of significant interest
- Spatial encoding of time information in a pump-probe experiment
- Coherent imaging with a large vertical spot size

The scope of the SPX project includes:

- Two cryomodules, each with eight superconducting cavity cells (eg. 6-ID upstream and 8-ID upstream)
- Cryoplant for the 2K operation of cavities
- High-power RF system delivering ~6.5 kW/cell
- Low-level RF system delivering high power and great stability
- Diagnostics
- Ongoing R&D program and the installation in the ring of a test system

Higher Current: APS is currently capable of 150mA operation in 24 and 324 bunch modes. The long term goal of 200 mA operation requires upgrades to the RF couplers, HOM dampers, and controls to improve stability for four-klystron operation. Even 150mA operation requires beamline and front-end (FE) upgrades.

Front Ends: 24 FE installations have been proposed for APS-U. High heat load R&D is essential to define limits of existing and future FE designs.

Lower emittance: A lower-emittance lattice may be feasible (e.g. 1.5 nm effective emittance). This could have been an alternative to the LSS lattice. It may also be possible to integrate with the LSS lattice, but this will be difficult and might only be workable for 324 bunch mode. However, the effort may be worthwhile if there are applications for which low emittance could be useful.

Discussion:

- Question/Comment: IDs can be changed later, more easily than some other components. In addition, a period change can sometimes be accomplished without a complete hardware change. APS needs to make sure that the Front Ends are capable.
    - Answer: It is true that IDs can be changed later, but it isn't cheap. We are funded now to replace IDs, so we should take the opportunity. Front End capability is also being addressed as part of APS-U.

- Question: We are concerned about beam stability. What would be the limit for the predicted stability?
    - Answer: We think we are going to achieve 0.4 μm and 0.2 μrad in the vertical short term, 1 μm and 0.5 μrad long term (1 week) drift. This will be state of the art—as good as any facility in the world.

Argonne National Laboratory
August 24, 2010

APSUO Steering Committee members in attendance: D. Brown, P. Eng, P. Focia, P. Fuoss, J. Kropf, A. Sandy, R. Suter, D. Tiede

APS Attendee: S. Strasser

Approval of the Minutes: The minutes of the May 5, 2010, APSUO Steering Committee meeting were unanimously approved; the agenda was reviewed and reordered.

Election of a Vice-Chair:
Given that the Vice-Chair has traditionally assumed responsibility for the organization of the scientific sessions of the annual Users Meeting, then becomes APSUO Chair, Tiede and Fuoss agreed to briefly review these responsibilities prior to a call for nominations. Although a number of responsibilities are associated with the Chair role, it was agreed that the Chair could delegate many of these to other APSUO Steering Committee members.

Vice-Chair User Meeting Responsibilities:

- Meet, as requested, with the Chairs of other Argonne User Facilities (specifically CNM and EMC) to establish an appropriate level of involvement from each facility and develop an overall structure for the meeting.
- Ensure that Chairs for the following have been selected from the APSUO Steering Committee:
    - Nominating Committee
    - Poster Committee
    - Workshop Committee
    - Banquet/Social Events Committee
- Invite speakers (in conjunction with Chairs of other user organizations as appropriate), including Argonne Director, DOE Program Managers, "political" speaker, etc.
- Work with User Office(s) to develop an overall budget
- Work with Committee (Steering Committee plus other facility Chairs) to establish a theme, poster, website design, etc.

Chair Responsibilities:

- Chair Steering Committee meetings
- Serve as the APSUO Rep on the following:
    - SAC
    - Cross-cut Reviews
    - Partner User Proposal Review Committee
    - National User Facility Organization (NUFO)
    - APS-U Steering Committee

- Weekly Ops Meeting
- Monthly Ops Planning Committee

Following considerable discussion, the APSUO Steering Committee elected Peter Eng to serve as the next Vice Chair.

Decisions for 2010-2011:
Tiede agreed to assume some of the Chair responsibilities and delegate others. The list of APSUO representatives to the various Committees is as follows:

- SAC – David Tiede
- Cross-cut Reviews – David Tiede (or delegate on an ad hoc basis)
- Partner User Proposal Review Committee – Bob Suter
- National User Facility Organization (NUFO) – Dennis Brown (multi-year commitment); Pam Focia, alternate
- APS-U Steering Committee – Paul Fuoss (until May 2011), David Tiede, Peter Eng (beginning in May 2011)
- Weekly Ops Meeting – David Tiede; Jeremy Kropf, alternate
- Monthly Ops Planning Committee – David Tiede

Pamela Focia agreed to serve as the APS Workshop Chair for the 2010 Users Meeting.

New Business:
In other business, Paul Fuoss suggested that the APSUO Steering Committee look at the issue of the annual facility operating scheduling, indicating that a schedule that had shutdowns in August, December, and April could potentially be more favorable for users. Paul agreed to write several paragraphs of rationale for this suggestion and circulate them to the Steering Committee for comment before communicating further with the APS or the APS User community. Further discussion will take into consideration what sort of run cycle best serves the facility currently and during APS-U, as opposed to simply reflecting the historical pattern of operations.