

# APS Upgrade Update



*Module assembly starting in Building 981*

**R. Hettel**

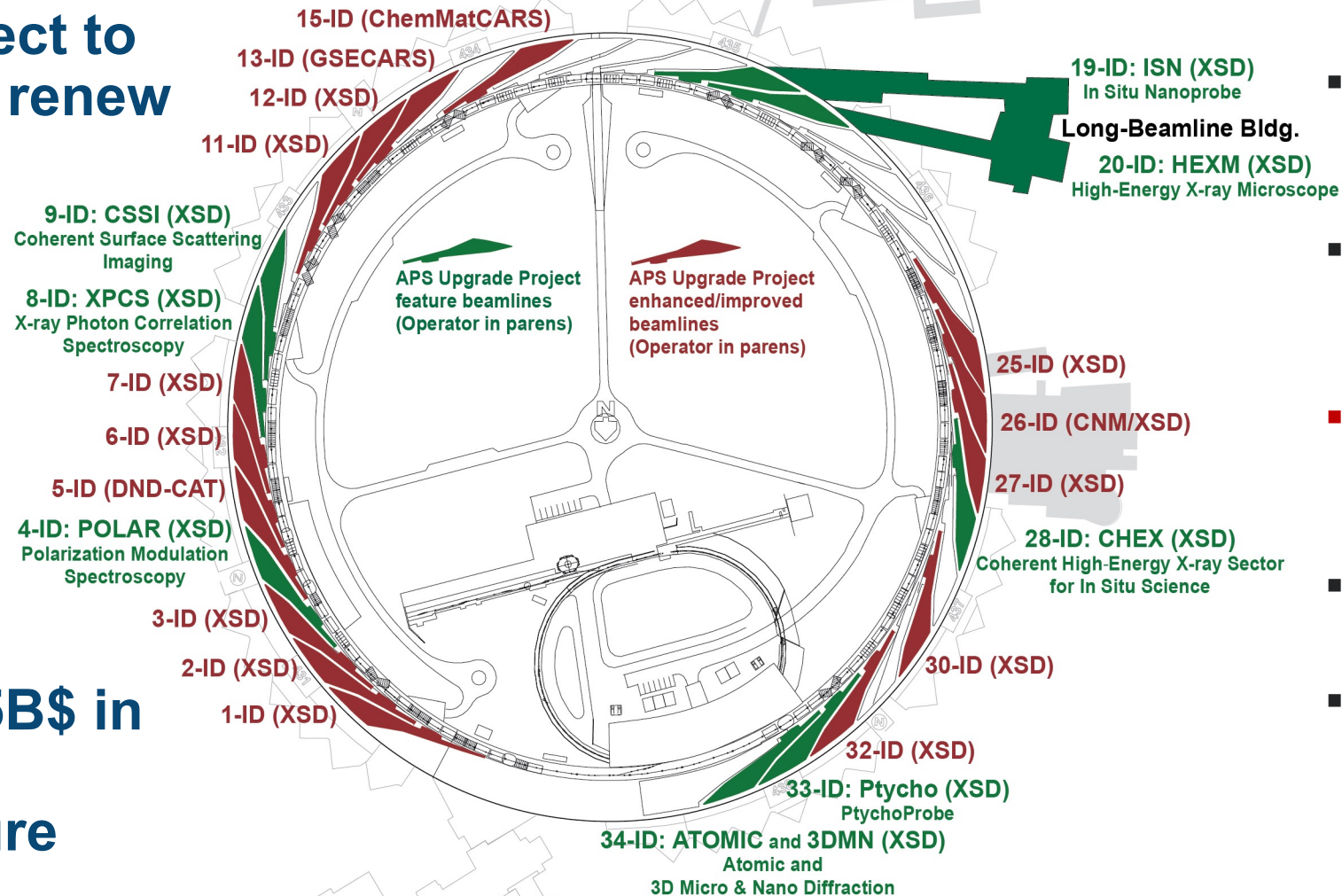
**APS User Organization Steering Committee/Partner User Council Meeting**

**28 July 2021**

# APS-U Project Scope

815M\$ project to update and renew the facility

Re-uses 1.5B\$ in existing infrastructure

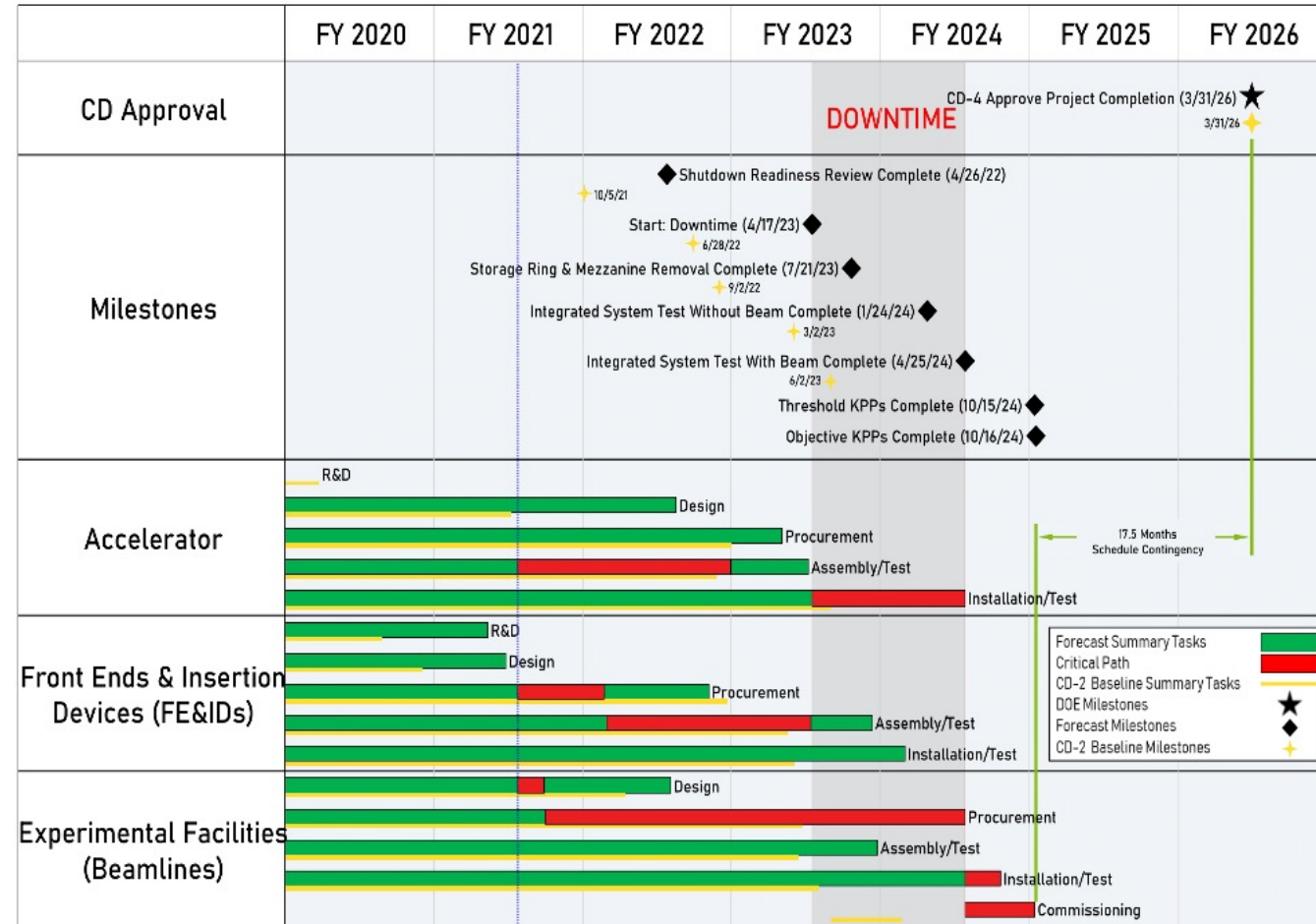


- New storage ring, **42 pm** emittance @ 6 GeV, 200 mA
- New and updated insertion devices, including SCUs
- Combined result in **brightness increases of up to 500x**
- **9 new feature beamlines + Long Beamline Building**
- 15 enhanced and improved beamlines
- Exploit high performance computing, AI



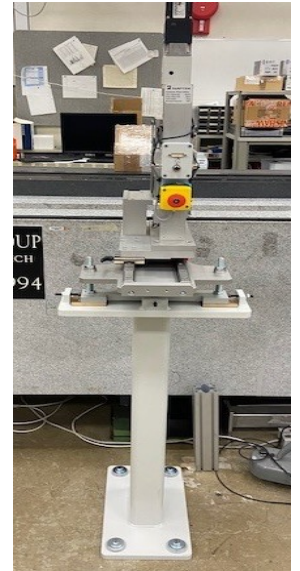
# COVID and the APS Upgrade

- Project is 53% complete by cost and 72% by cost+obligations. Cumulative CPI 0.98, SPI 0.96 (June EVMS).
- Downtime starts April 2023. No change in TPC and CD-4. Downtime duration remains 1 year.
- 18 months schedule contingency; 84.5M cost contingency remains (BAC).
- Argonne continues in Limited Operations Plus mode. 35-40 APS-U staff working with onsite testing and proximity badges for tracing. Planning for new (hybrid) working continues.



# Technical Progress – Front Ends and Insertion Devices

- 8 out of 19 HHL GRID support from TruStone received. Sixteen out of 18 HHL first collimator assemblies received from MDC.
- Testing of the first article phase shifter from Danfysik has started at APS in MM1.
- The procurements of components for the production SCU is underway.
- Assembly of cold mass for the 1<sup>st</sup> SCU unit is underway. The assembled cold mass consisting of LHe tank, beam chamber, magnet core was completed and alignment has started.
- Keller's SCU core #4 was rejected and a new one will be produced. Keller is evaluating machining the cores #4 and #5 to a new design without the footed poles.



1<sup>st</sup> article Phase Shifter in MM1



Cold mass with LHe tank, two sets of magnets and beam chamber for 1<sup>st</sup> SCU



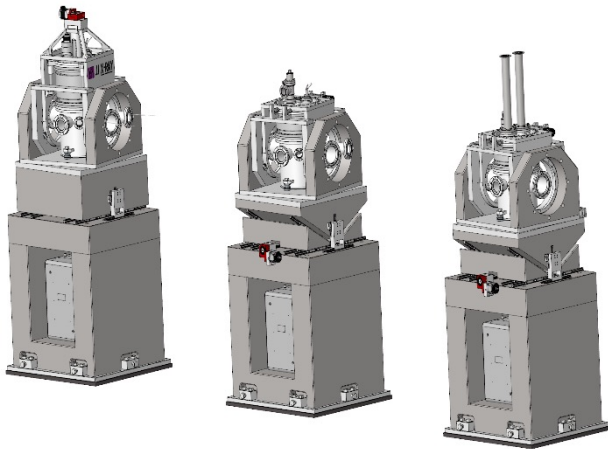
Cold vacuum chamber being machined for 2<sup>nd</sup> SCU



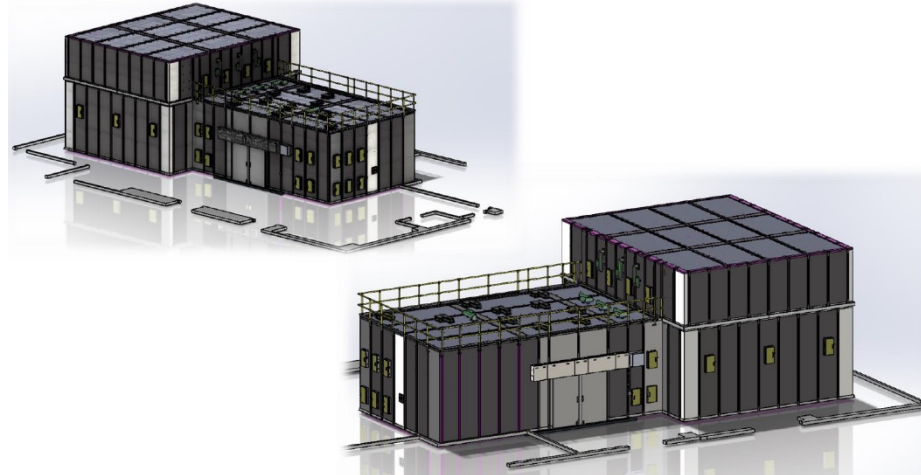
Completed assembly of IDFE LPPS table assembly prepared for storage in 981

# Technical Progress – Experimental Systems

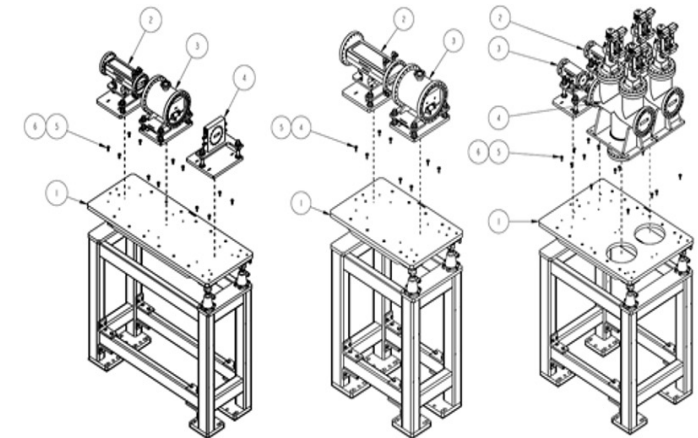
- The Horizontal Double Crystal Monochromators for 5 of the feature beamlines was awarded to IDT, England.
- For the XPCS small angle instrument, vendors have been chosen for the flight path and the motion system.
- The CSSI beamline grand tube procurement has been initiated with bids due back in September 2021.
- Final design by JJ Xray for the single-crystal monochromators and tunable double crystal monochromator (DCM) have been sent to Argonne for approval.
- For the large 20-ID-E enclosure in the LBB the preliminary manufacturing design package was submitted by Caratelli to be approved by ANL.
- Assembly level drawings were completed for ASL beamline shutters and mask.



Renderings from JJ Xray for the three SCM for the CHEX beamlines



Rendering and drawings presented by vendor for Argonne approval for 20-ID-E enclosure.



Assembly drawings provided for technicians to start assembly of 25-ID beamline components

# Technical Progress – Experimental Systems (LBB)

- Steel structure installation has been completed.
- Installation of the roof deck is complete.
- ISN concrete hutch walls and ceilings have been poured.
- AML masonry walls have been installed, as well as the steel catwalk to the future mezzanine level access from HEXM enclosure ceiling.
- Mechanical rough in work is ongoing in the Mezzanine level of the Experimental Hall.



*Concrete ISN enclosure walls and roof complete*



*Site Photo from June 30, 2021*



*Steel Structure of the LBB and the corridors*



*AML masonry walls with the catwalk to HEXM*

# Technical Progress – Accelerator

## Magnets

- >1000 out of 1321 ring magnets received.

## Power Supply Systems

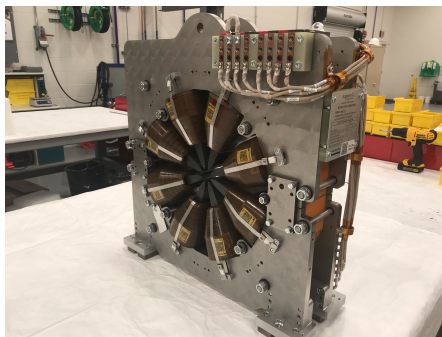
- 282 out of 1030 unipolar power supplies received
- All 1,255 bipolar supplies received.

## Vacuum System

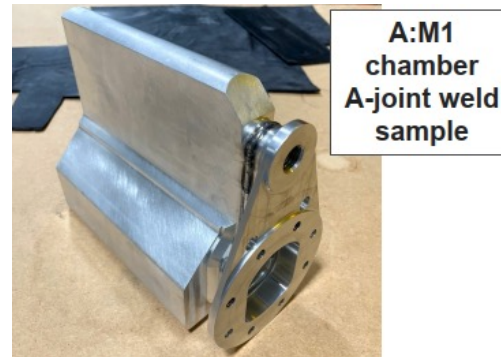
- All 105 M1 formed extrusions completed and delivered to a final machining vendor in the Chicago area.
- NEG-coating of copper chambers underway.
- Many many other vacuum components, BPMs, etc. in process.



Unipolar power supply converter cabinets and the units under test in elevated-temperature room.



Magnet #1000



A:M1 chamber A-joint weld sample



Quick-Seal ConFlat Chain Clamps from VACOM  
1040 of 1920 delivered



# Technical Progress – Accelerator (cont.)

## Bunch Lengthening System

- The bunch lengthening system (BLS) cavity is presently staged for high-pressure water cleaning.
- This clean room work will be completed next month, and the system will then be moved back to the rf cold testing area.

## Injection

- All piece-parts for the stripline kicker first-article are in hand. The high voltage (HV) test stand at BNL is now up and running.
- Horizontal pulsed septum, BTS line and diagnostics in design.

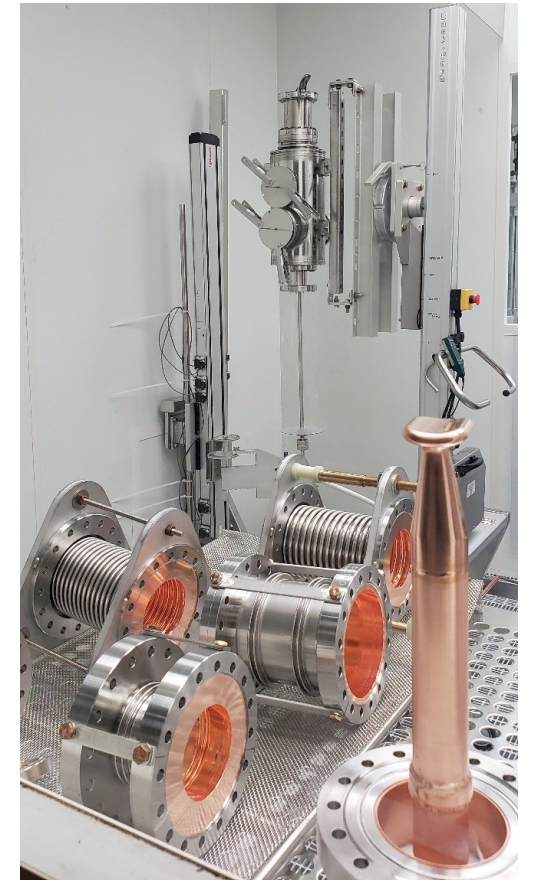
## Instrumentation and Controls

- Controls, diagnostics, timing/sync system, transverse and longitudinal feedback, fast orbit feedback in design and test.

## Radiation Safety

- PSS updates in progress.
- Radiation monitors and shielding design near completion.
- Top-up safety interlocks being defined.

First assembled  
high-voltage  
stripline injection  
kicker at BNL

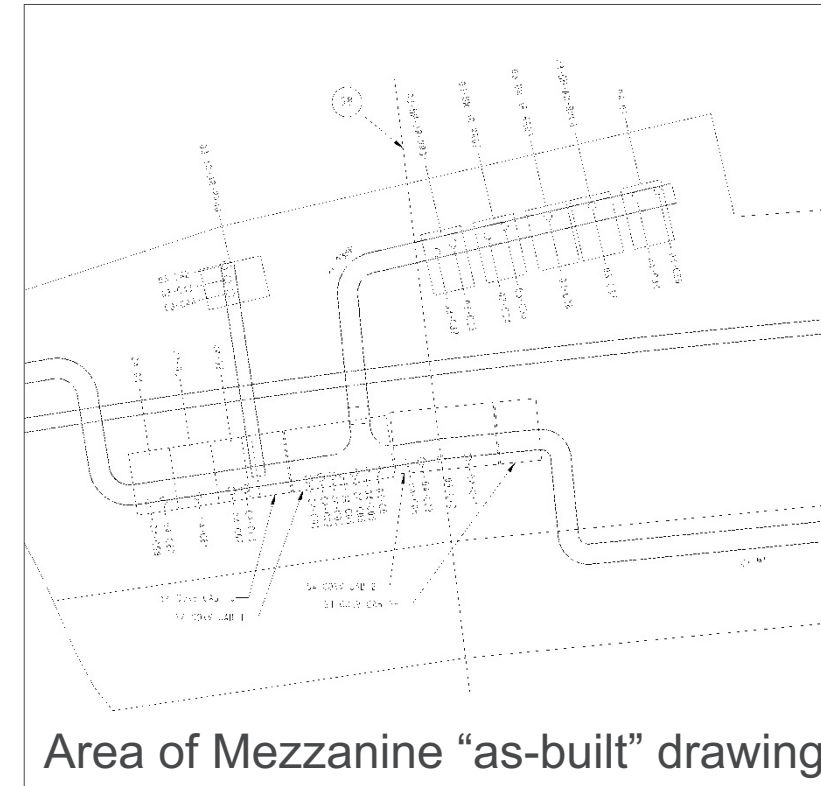


Bunch lengthening system  
clean room assembly.  
Background: BLS cavity  
assembly mounted vertically for  
high-pressure rinse.  
Foreground: copper-coated  
bellows and coupler



# Technical Progress – Removal & Installation

- Removal Planning
  - As-built/Installation drawing for the first Mezzanine double-sector complete.
  - Evaluation of Accelerator areas:
    - Evaluation of Zone F sectors.
    - Inventory of Utility Corridor penetrations.
    - 3D Scanning of more areas to incorporate into “as-builts.”
- Early installation efforts planned for the August APS shutdown:
  - Installation of Network Fiber continued.
  - EMI Cabinet installation and tie ins.
- Procedure testing in August APS maintenance shutdown period
  - Hazardous Energy Control/hazard physical separation procedure testing
    - Magnet separation from the hazard source.
    - Copper process water system separation from the hazard source.
  - Test installation of cable tray and PS cable pulls in tunnel.
- Full-sector mock-up in planning



Area of Mezzanine “as-built” drawing

# FY22 Goals

## Level 2 Milestones from Project Execution Plan (2018/19):

- Unipolar Power Supplies 50% received Oct-21
- Magnets M1-M2 67% received Oct-21
- Shutdown Readiness Review Complete Feb-22
- Receive All Unipolar Power Supply Controllers Components Mar-22
- Magnets M1-M2 100% received May-22
- Insertion Devices Procurement Complete May-22
- Ass'y / Test - Injection / Extraction Systems Complete (septum, kickers) May-22
- Magnets M1 & M2 Complete Jun-22
- Accelerator Procurement Complete Aug-22
- Accelerator Component/Sub-system Assembly & Testing Completed Sep-22

## Other FY22 goals:

- Complete design of all major components for the project
- Assemble the sector mock-up
- Complete installation and commissioning of 25-ID ASL beamline
- Complete contract awards for most beamline optics and detectors
- Complete weld development for the L-bend vacuum chamber
- Complete R&D for the superconducting undulator

# Major Outstanding Issues

- Manage COVID impact and all the disruptions it causes as best and safely as possible; ramp up on-site assembly work safely
- New beamline enclosure installations are being delayed due to COVID-19; working to mitigate this and the threat to the beamline completion schedule
- Define Radiation Protection system for top-up injection with beamline stoppers open (task team in place)
- Mitigate ~170 Ops-Project gaps identified in the Gap Workshop; prioritize and coordinate work with APS Operations so the facility as a whole is ready
- Finalize SAD and ASE; prepare for ARR (task team in place)
- Complete final designs on time (being carefully managed)
- Manage vendor contracts for timely deliveries to meet project schedule

# Notes / Upcoming Events

ANL EVMS Surveillance Review August 17<sup>th</sup> – 19<sup>th</sup>

ARR Status Review August 31-September 1

APS Operations Review September 8<sup>th</sup> – 10<sup>th</sup>

Director's Review September 28<sup>th</sup> – October 1<sup>st</sup>

- Charge parallel w/ IPR charge (converged).
- Draft list of reviewers in hand, reaching out for scheduling (list shared w/ program).

DOE OPA Project Review October 26<sup>th</sup> – 29<sup>th</sup>

# Safety First!

**back up**

# Gap Workshop Findings – Mitigation in Progress

1. Groups want to retain specific existing equipment.
2. The management of water flow and quality during the darktime needs to maintain the component operational effectiveness
3. Injector complex is commissioned when the SR is ready to receive charge.
4. RF test stand needs to operate during the darktime.
5. RF system readiness for the conditioning of SR RF Cavities is assured during darktime prior to system checkout with beam.
6. Management and R2A2s for the fully integrated PSC organization have been established.
7. SR is under appropriate vacuum prior to commissioning with beam. RF Section vacuum is maintained during dark time.
8. Beamline and experimental lab facilities activities including construction and overhaul are minimally impacted by APS-U activities during the dark time.
9. APS maintains and operates the injector complex during the darktime.
10. APS has executed a coordinated framework for facility readiness that includes installation, checkout and initial commissioning with and without beam for beamlines and the accelerator complex.
11. Specific APS system upgrades and infrastructure have been implemented that integrate with APS-U Project including RF, PAR shielding and some beamlines.
12. Power availability for the APS during and after the darktime is assured.
13. Control software is available to perform system checkout and initial commissioning of the Storage Ring
14. APS-U field replaceable components as well as cables in the cable plant are accurately depicted in CDB.
15. APS has a resource loaded preventative maintenance and spares program for the next 25 years.
16. Controls infrastructure provided to beamlines and the accelerator meets or exceed current capabilities.
17. Environmental conditions on the APS Experiment Hall floor are sufficient to meet worker needs and are adequate for a world class experimental program.
18. Critical requirements to interface APS-U funded systems into APS operations have been identified and implemented.