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CRRT Guideline for the Restart of APS Beamlines After the APS-U Shutdown

Changes made in this revision:

Original version

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1. INTRODUCTION

Purpose

The APS-U Project is a major change to the infrastructure of the APS, with the replacement of the storage ring, front ends, and most insertion devices. Many APS beamlines will also undergo significant changes, either as part of the APS-U or through simultaneous APS Operations or Collaborative Access Team (CAT) activities. However, it should be noted that much of the existing beamline infrastructure will be retained. Regardless of the degree of changes during the Dark Period, all beamlines are required to go through a restart process that ensures the beamline has met all requirements for operations and is ready for commissioning. This document describes the restart requirements and processes that are the responsibility of the PSC Commissioning Readiness Review Team (CRRT).

The task of restarting the APS beamlines is a somewhat different task than bringing up beamlines at a greenfield facility. The great majority of APS beamlines will be ready for commissioning at the end of the APS-U Dark Period, with a large user community eager to conduct experiments after the lengthy pause due to APS-U construction. The efficient restart of beamlines presents a considerable logistical challenge and the process described in this document is designed to explain and help address that challenge.

The APS restart process for beamlines after the APS-U dark period will ensure that both new and existing beamline components and systems meet all APS requirements for beamline operations, and that initial operations with beam are carried out in a manner that is safe for personnel and minimizes any potential damage to equipment. This document gives a general description of the restart process and the requirements for initiation of beamline operations. For every beamline, specific commissioning procedures will be developed based on the general concepts described here.

Definitions

The term “commissioning” is used in many, often contradictory, ways by the accelerator and beamline community. For the purposes of the restart of APS beamlines, the following definitions will be used:

- Check Out – Verification of the installed design and testing of beamline components, equipment, and systems without the x-ray beam.
- Ops Commissioning – Bringing first beam into a beamline, adjustments to beam position through storage-ring steering, and shielding verification of shielded enclosures and shielded transport. Ops Commissioning is the responsibility of the CRRT, working with Health Physics (HP), Floor Coordinators, and beamline staff.
- Technical Commissioning – Testing of beamline components, equipment, and systems using the x-ray beam. Technical Commissioning includes alignment of x-ray optical systems. Technical Commissioning is the responsibility of the beamline staff.

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- Scientific Commissioning – Early experiments using the beamline that are designed to test, debug, and characterize the various beamline systems. Often these experiments will have enhanced support by beamline scientists and the beamline capability may be limited to a subset of its full functionality. Scientific Commissioning is the responsibility of the beamline staff and may, or may not, include outside users.

This document is written primarily for an audience of people familiar with APS nomenclature, acronyms, abbreviations, and commonly used terms are not defined in the text. Definitions for such terms are given in Appendix A.

2. Pre-beam Requirements for APS Beamlines to Receive Authorization for Ops Commissioning

Prior to an APS beamline being enabled for initial operations (i.e., Ops Commissioning), a series of conditions must be met for every beamline. These conditions are listed here and will be elaborated upon below:

- The beamline FDR or Beamline Upgrade Final Design (BUFD) approved by the Deputy Associate Laboratory Director for Operations based on a review by the PSC Design Review Committee, with all relevant recommendations appropriately resolved and closed out
- The Front End for the beamline is operational
- At least one insertion device (ID) for the beamline operational (ID beamlines only)
- Completion of installation of the beamline components and systems relevant to Ops Commissioning
- Completion of survey and alignment of the beamline RSS components
- PSS & BLEPS for the beamline operational
- All relevant RSS components for the beamline tagged and logged into the appropriate tracking system by the Experimental Facilities Operations Group (EFOG).
- Check Out of the beamline components and systems complete to the point that it is ready for Ops Commissioning
- Beamline specific CRRT procedure for Ops Commissioning is approved

When these conditions are met, the CRRT chair (or designate) will request authorization from the Director of Ops for PSC for the relevant parts of the beamline to be brought “on-line” for the purposes of Ops Commissioning. The form of this request is a memo circulated in ICMS.

Elaboration of conditions

Relevant scope of the beamline – Often in the beamline commissioning process, segments of the beamline are brought on-line sequentially, with significant time lapses between activities. Hence, the heavy use of the word “relevant” in the Ops Commissioning Readiness Requirements. The list above can be applied to portion of a beamline if the CRRT Chair deems this appropriate. An example of this is the common practice of only enabling the FOE at low

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power to allow for alignment of beamline optics. In such a circumstance, open FDR recommendations applying to the non-operational segment of the beamline may be acceptable, and the verifications of beamline work completion may also be specified as being for a limited portion of the beamline. Any verification memos or other correspondence should be explicitly clear on the beamline scope being verified. Authorization memos will clearly specify to the EFOG group which portions of the beamline can take beam during any phase of commissioning.

Beamline FDR or FDR Update – Work on APS beamlines during the APS-U dark period varies tremendously in extent and impact. Some beamlines are essentially being totally rebuilt, whereas many others have minimal modifications. Regardless of the amount of beamline work during the dark period, all APS beamlines are required to submit a Final Design Report (FDR) or a Beamline Upgrade Final Design (BUFD). An FDR should follow the APS requirements for such documents [APS_2013651]. An BUFD template has been developed for beamlines with relatively minor changes for the APS-U and is available from the APS PDRC. From the point of view of the CRRT, the key things in the FDR or the BUFD are:

- Beamline bremsstrahlung and synchrotron ray-traces for the new APS-U source,
- Heat-load calculations considerations for critical components, and
- Descriptions of changes to any beamline shielding or RSS-related component.
- Sufficient documentation on changed RSS components to meet configuration management requirements as reviewed by the PDRC.

The FDR is reviewed and approved by the PDRC, often with actionable Recommendations. All Recommendations related to relevant scope will need to be appropriately resolved and closed prior to authorization for Ops Commissioning. The chair of the PDRC will be asked by the CRRT Chair to confirm the approval the beamline FDR or FDR-U, and the status of any Recommendations.

Beamline installation and checkout – Prior to the authorization for Ops Commissioning, the completion of installation and checkout of the beamline components and systems required for basic beamline operations will be verified. Generally, this will include RSS components, transport, and major optical systems in the beamline. End station instrumentation (e.g., diffractometers, sample motion systems, local focusing optics, detectors) are not required for Ops Commissioning and are not required to be installed and checked out as part of this process.

The verification of installation has several aspects.

- The beamline lead scientist and beamline engineer (if one has been designated) will be asked to confirm that all relevant components and systems have been installed per the approved configuration and are operational. This includes all mechanical, water, and vacuum work that may have been done by various groups.
- The survey and alignment (S&A) group will confirm that all S&A tasks are complete.
- The SI group will confirm that all relevant PSS & BLEPS are operational and verified. If there are any exceptions to final PSS & BLEPS configurations, these will be explicitly noted with justification in the request for authorization. The justification will identify the

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controls used to mitigate the equipment damage risk if the BLEPS configuration is not in place. PSS configurations must prevent access to beamline enclosures when beam is present in all situations.

Tagging and Documentation of RSS Components – The APS Floor Coordinators within the EFOG have policies and procedures for the tagging of RSS Components and related documentation. The CRRT Chair will verify with the Beamline Critical Component System Manager (CCSM) that all relevant RSS components have been tagged and that the Configuration Control Component List is posted.

CRRT Beamline Specific Commissioning Procedure – The specific CRRT beamline Ops Commissioning procedure is a document prepared by the CRRT with step-by-step directions for the Ops Commissioning of the beamline in question accounting for unique aspects of the beamline. These procedures go through approval in ICMS and are archived there. Any eTravelers required by those procedures will be captured as a record in the APS eTraveler system.

3. Additional Requirements Prior to Beginnings Ops Commissioning

The specific CRRT Ops Commissioning Procedure developed for each beamline has a checklist that requires completion prior to the beamline being brought “on-line”. Often, some of these tasks are completed immediately prior to the Ops Commissioning and are confirmed in the pre-beam CRRT walk through. The checklist will vary somewhat dependent upon the individual aspects of the beamline, but will generally include the following:

- Confirm the beamline front end is operational and ready to receive beam.
- Confirm PSS is operational and the beamline is set to “global on-line”.
- Confirmation by the Floor Coordinator that a Configuration Control Components List is posted and that all required tags are in place. In particular, seals on enclosure labyrinths will be checked.
- Enable any IDs to be used during shielding verification. During Ops Commissioning, control of this ID will normally be restricted to the Floor Coordinators. Set the gap limits to the appropriate values for the ensuing activity. A control screen (via EPICS) should be available at the beamline and checked for functionality. (ID beamlines only.)
- Verify the dimensions and locations of any temporary shielding (if any) as indicated in the documentation approved by the PDRC.
- Visual check of the shielding integrity of the beamline. Particular attention will be paid to enclosure doors, labyrinths, and seams. Enclosure doors will be tested to ensure smooth operation.
- Visual check of RSS components to confirm that all components are secured in place with no obvious displacement from their appropriate positions, all transport vacuum valves are in an “open” position, and that all the moveable parts shutters are in their correct positions. Verify that any required cooling water for both permanent and temporary components is circulating properly.

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- Check that all Be windows that are potentially exposed to white beam are protected from ozone generation. If windows are made from a different material, the CRRT chair will determine the appropriate measures to be taken.
- The area around the enclosures and transport subject to shielding verification should be cleared of any obstacles preventing ready access for radiation surveys. If any items are not moveable for some reason, the situation should be discussed with CRRT Chair and HP to reach an agreement on an acceptable solution.
- If white or pink beam is to be brought into air and any point, an ozone monitor will be set up in the enclosure to monitor ozone levels. If high levels of ozone are considered likely, an ozone removal system may be installed.
- The members of the CRRT Commissioning Team will consult with beamline staff and determine scattering conditions for each enclosure being tested. Depending on the configuration of the enclosure, existing beamline equipment (e.g., slits, filters, mirrors, monochromators) may be used as a scattering source, or standard CRRT scattering targets may be installed in the beam path. Generally, it is preferred to have scatterers in positions adjacent to doors or in positions where there is frequent scatter of the beam during normal operations.
- HP will rope off and post the specified Commissioning Area as required by HP procedures.
- Confirm all CCWPs for the beamline are closed and that an ESAF or BOA covering the Ops Commissioning work is approved and posted.

4. Suggested Beamline Capabilities

The following beamline functions are not required for Ops Commissioning, but are of considerable use in ensuring that Ops Commissioning is carried out in an efficient manner.

- ID control for the beamline staff with corresponding control screens. During Ops Commissioning, ID control is limited to the Floor Coordinators, but after initial low power shielding verification, control of the beamline is normally given to the beamline staff (with ID restrictions), for alignment of optics. Beamline ID control is required for this process to progress efficiently.
- Status screens for monitoring the vacuum of white beam components. Often during initial beam operations, outgassing can be significant and it is important to be able to monitor it at the beamline.
- Status screens for photon diagnostics at the beamline. In particular, it is necessary to monitor the storage-ring beam position monitors (bpm's) (both rf and x-ray), but any additional diagnostics the beamline has available can also considerably speed the process of steering the beam to the correct position.
- Motion Control checked out for relevant motions, monitors, detectors, flags, slits, etc. Significant delays occur during Ops Commissioning when these basic beamline functions are not available.

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5. Feedback and Improvement

If you are using this procedure and have comments or suggested improvements for it, please go to the [APS Policies and Procedures Comment Form](#)* to submit your input to a Procedure Administrator. If you are reviewing this procedure in workflow, your input must be entered in the comment box when you approve or reject the procedure.

Instructions for execution-time modifications to a policy/procedure can be found in the following document: Field Modification of APS Policy/Procedure ([APS_1408152](#)).

* <https://www.aps.anl.gov/Document-Central/APS-Policies-and-Procedures-Comment-Form>

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Appendix A – Nomenclature, Acronyms, and Abbreviations Used in the Document

APS	Advanced Photon Source
APS-U	Advanced Photon Source Upgrade
BLEPS	Beamline Equipment Protection System
BOA	Beamline Operations Approval Form
BUFD	Beamline Upgrade Final Design – The BUFD is used by the PDRC to document designs for beamlines for the APS-U installed storage ring. Typically, it is used in placed of a FDR for beamlines with minor modifications during the Dark Period.
CAT	Collaborative Access Team
CCSM	Critical Component System Manager
CRRT	Commissioning Readiness Review Team
Dark Period	The period of time between the cessation of APS operations with the original storage ring and the beginning of operations with the storage ring installed as part of the APS-U
ESAF	Experiment Safety Accessment Form
FDR	Final Design Report
FOE	First Optics Enclosure
HP	Health Physics
ICMS	Integrated Content Management System – ICMS is the main document management system for APS documents
ID	Insertion Device
PSC	Argonne Photon Sciences Directorate
PSS	Personal Safety System
RSS	Radiation Safety System
S&A	Survey and Alignment
SI	Safety Interlocks