

## Record of Decision for Remaining APS-U Project Beamline Design Reviews

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## Change History

<b>Rev #</b>	<b>Revision Date</b>	<b>Sections Affected</b>	<b>Description of Change</b>
0	3/18/2021	All	Original release

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# Record of Decision

## Remaining APS-U Project Beamline Design Reviews

### 1. Introduction and Background

The APS Upgrade (APS-U) Project defined various requirements for technical design reviews in the APS-U Design Completion Definition Document and Design Review Guidelines (APSU\_1436539). This process was intended to ensure effective reviews across the Project and to provide a means of measuring project design completion so that the Project could provide evidence that DOE Critical Decision (CD) milestones were met.

The Project requirements were in line with revision 9 of the APS Design Reviews document (APS\_000031) and BSDRSC reviews are included for all Radiation Safety System (RSS) components after the Project final design review for the instrument.

The APS-U Project conducts Conceptual (CDR), Preliminary (PDR), and Final Design (FDR) Reviews on all Project scope, with consistent requirements. Revision 10 of APS Design Reviews introduced the newly formed Photon Sciences Design Review Committee (PDRC) and more standard requirements for design reviews. Since August 2019, APS-U has routed all technical design reviews through the PDRC.

The remaining review effort for the beamlines substantially consists of radiation safety reviews. This Record of Decision presents the APS-U plans for what documentation it will produce to complete the radiation safety reviews for the beamlines.

As part of the Upgrade, there are various levels of work on all beamlines. Due to do-no-harm requirements, all beamlines will be updated in aspect and a radiation safety review will be required. The task of reviewing 50+ beamlines over a period of a year is too large for both the design team and the review team. To ensure that the beamlines are reviewed properly, a graded approach is recommended to accomplish these tasks.

This document details a proposal for conducting design reviews to satisfy both the APS-U Project requirements and APS requirements.

### 2. Documentation

The science case and beamline high level designs are documented in CDRs, PDRs, and FDRs submitted for DOE OPA reviews and Director's Reviews.

The Project has generated technical documents that are reviewed and approved through the DMS/ICMS document management system. When changes occur, the documents are revised and routed for review and approval to maintain configuration control. Every feature and enhancement beamline has a Functional Requirements Document (FRED). All the feature beamlines have a Photon Delivery (PD) system Engineering Specification Document (ESD), an Optics ESD, and multiple instrument ESDs depending on the beamline. An Interface Control Document (ICD) that covers the beamline interface to front end insertion device is also completed. In addition, a general beamline ICD will be used for all the feature beamline and

major enhancements to address the various interfaces. All the above-mentioned documents are routed in ICMS workflow and are reviewed and approved.

For the PDRC beamline FDR, the Project plans to submit a design review package consisting of the beamline FRED, ESDs, ICDs, and thermal reports of all RSS components. In addition, a beamline layout along with synchrotron and Bremsstrahlung ray tracings will also be provided. A beamline Component Reference Table (CRT) will list all beamline components and will provide the alignment information, water setpoints, and reference to drawing packages. The beamline PD ESD will include references to all the assembly drawings as well. A portfolio review file will be created with the above-mentioned documents so a complete package can be submitted to the PDRC. This is a typical case for a new feature beamline. A graded approach will be used as discussed below for additional types of beamline design changes.

### **3. Design Reviews**

At the current time, all optics-like mirrors and monochromators are independently reviewed by the PDRC, then procured. These are typically built to specification, where a vendor will provide drawings and models as part of the procurement contract. The models will be submitted and archived in PDMLINK or VAULT, depending on the type of drawing provided. The beamline layout will be updated with the actual optics drawing prior to commissioning of the beamline. The beamline instruments are also reviewed independently by the PDRC. For feature beamlines, a Project-level Final Design Review was conducted with external reviewers.

Based on the levels of reviews already having taken place, it is prudent to use a graded approach and focus on safety-related reviews, especially radiation safety.

The 50+ beamlines that are covered by the Project require different levels of reviews. All beamlines will require a radiation safety recertification review. For this review, the minimum set of documentation will be beamline layout, Bremsstrahlung and synchrotron ray tracings, and a Component Reference Table (CRT). In addition, the assembly level drawings of all Radiation Safety System (RSS) components will be required. For all RSS components operating with white or pink beam, a thermal simulation of the capability will be documented, reviewed, approved, and archived in DMS/ICMS prior to the RSS review above.

The following list is based on a graded approach to review based on the type of beamline as listed in Appendix A and Appendix B.

- *Feature Beamlines:*

Feature beamlines are brand new beamlines built after dismantling existing beamlines or built out in a new location. As shown in the Appendix table, feature beamline Photon Delivery (PD) systems were previously reviewed and approved by an external committee. In addition, individual components like optics and other instrument systems have been reviewed by the PDRC. Going forward, Final Design Reviews routed through the PDRC shall cover a safety review, with a focus on RSS components, Personnel Safety System (PSS) search paths and egress issues for life safety.

- *Major Enhancements:*

A major enhancement beamline is a class of beamline where an upgrade is taking place on an existing beamline. A major enhancement mainly involves a change to the layout of a beamline. While the optics for these enhancement beamlines have been reviewed, changes in geometry of the beamline require that the PD system is reviewed. A beamline FRED and ESD will be documented for this type of beamline design change, similar to FRED and ESD documentation for a feature beamline. Like the feature beamline, the review will once again focus of the safety aspects like RSS components, PSS search paths and egress issues for life safety.

- *Enhancements:*

An enhancement beamline is a class of beamline where an upgrade is taking place on an existing beamline. The enhancement is typically limited to instrument upgrades, in which case, they are reviewed by the PDRC prior to contract award. Depending on the extent of the instrument upgrade, for example, a beamline FRED and ESD may exist for the type of enhancement. The beamline PD system remains the same. However, the front end exit table and the insertion device (ID) will be different than what is currently in operation at the APS. Therefore, all RSS component thermal simulations will be repeated at the APS-U Storage Ring (SR) operating envelope, documented and approved in DMS/ICMS. The beamline layout drawings will be updated, and ray tracings revised based on source, front end exit table and instrument configuration changes. The beamline Component Reference Table will be generated, and RSS components assembly drawings will be included in the overall design package. In cases where assembly drawings are not available, every effort will be made to generate required documentation. A PDRC review package will be generated with the above-mentioned documents, and a PDRC FDR for the beamline will be limited to RSS components.

- *Do-No-Harm Beamlines:*

All insertion device beamlines, which are not categorized as feature or enhancement beamlines, next default to this category. This does not include Collaborative Access Team (CAT) beamlines, which are performing upgrades on their own. In such cases the Project team will assist the CAT beamline by providing guidance on formats and templates for beamline layouts and Bremsstrahlung/ synchrotron ray tracings.

The beamline PD system remains the same as installed for Do-No-Harm beamlines. However, the front-end exit table and the insertion device will be different than is currently in operation at the APS. Therefore, all RSS component thermal simulations will be repeated at the APS-U SR operating envelope, documented and approved in DMS/ICMS. Similar to enhancement beamlines, the beamline layout will be updated, and ray tracings revised based on source, front end exit table and instrument configuration changes. The beamline Component Reference Table will be generated and RSS components assembly drawings will be included in the overall design package. In cases where assembly drawings are not available, every effort will be made to generate required documentation. A PDRC review package will be generated with the above-mentioned documents, and a PDRC FDR for the beamline will be limited to RSS components.

- *Bending Magnet Beamlines:*

With the exception of 4 bending magnet (BM) beamlines (5-BM, 13-BM, 14-BM, and 16-BM), where they currently operate multiple branches, the remaining bending magnet beamlines require only a realignment of the beamline to the new source. This involves a translation and a rotation of the beamline. The beamline layout drawings will be updated, and ray tracings revised based on source, front end exit table and instrument configuration changes. In most cases, the enclosure guillotines will be manufactured new. The beamline Component Reference Table will be generated, and RSS components assembly drawings will be included in the overall design package. In cases where assembly drawings are not available, every effort will be made to generate required documentation. A PDRC review package will be generated with the above-mentioned documents, and a PDRC FDR for the beamline will be limited to RSS components and the impact of the shift of the beamline.

Should there be a reduced operation of the 4 bending magnet beamlines named above (5-BM, 13-BM, 14-BM, and 16-BM) or there are configuration changes greater than identified above, a more extensive review of the entire PD system will be warranted.

The diagnostic and beam size monitor beamlines at 35-BM and 38-AM, respectively, are considered part of the accelerator system. A separate Record of Decision will document the graded approach for design reviews related to these beamlines.

Appendix A – Insertion Device Beamlines

Sector	Affiliation	Category	Description of Work Needed	Enclosures	HL Mirrors	Mono	Focusing KB	Focusing CRL	Instruments	Thermal	RSS Comp.	Sector
1		M. Enhancement	New monochromator - FOE reconfigured due to horizontal bounce			SPEC			F	R	LS	1
2		M. Enhancement	Modified for full cant and new monochromator for one branch			SPEC*	SPEC		F*	R	LS	2
3		Enhancement	New KB mirrors otherwise no change				SPEC*			C	L	3
4		Feature	APSU New beamline	P	SPEC	SPEC	SPEC	SPEC	F	R	PD only	4
5	DND	Enhancement	FOE with new replacement mirror and replacement monochromator		Reuse	Reuse				C	L	5
6		M. Enhancement	Modified for canting - Reconfigure FOE					SPEC		R	LS	6
7		M. Enhancement	Reconfigured FOE for new HL mirror first, and instrument		SPEC*		SPEC		F*	R	LS	7
8		Feature	APSU New beamline	P	SPEC	SPEC	SPEC*	SPEC	F	R	PD only	8
9		Feature	APSU New beamline	P	SPEC	SPEC	SPEC*	SPEC	F	R	PD only	9
10	MR	DoNoHarm	No change							C	L	10
11		M. Enhancement	Modified for canting - Reconfigure FOE and new monochromator			SPEC		SPEC		R	LS	11
12		Enhancement	Enclosure modification, CRL and instrument	P				SPEC	F	C	L	12
13	GSECCARS	Enhancement	Need custom FE Exit table and beamline optics repolish and instrument support				SPEC*			C	L	13
14	BIOCARS	DoNoHarm	Need custom FE Exit table due to floor, Chopper							C	L	14
15	CHEMMATCARS	Enhancement	CHEMMAT redesigning for canting, APSU provided monochromatic mirrors	ToDo						ToDo	ToDo	15
16	HP(XSD)	DoNoHarm	HP planning to redo beamline - Already canted							C	L	16
17	IMCA	DoNoHarm	No change							C	L	17
18	BIO	DoNoHarm	No change							C	L	18
19		Feature	APSU New beamline	P	SPEC	SPEC	SPEC		F	R	PD only	19
20		Feature	APSU New beamline	P		SPEC			F	R	PD only	20
21	LS	DoNoHarm	No change							C	L	21
22	SER	DoNoHarm	SER planning for canting of beamline							ToDo	ToDo	22
23	GMCA(XSD)	DoNoHarm	No change							C	L	23
24	NE	DoNoHarm	No change							C	L	24
25		Feature	Done	Done	Done	Done			F*	R	L	25
26	CNM	Enhancement	Swap mirrors and monochromator and upgrade instrument		Done	Done			F	C	L	26
27		Enhancement	Instrument upgrade						F	C	L	27
28		Feature	APSU New beamline	P		SPEC		SPEC	F	C	PD only	28
29		DoNoHarm	No change							C	L	29
30		Enhancement	New HR secondary monochromator							C	L	30
31	LILY/XSD	DoNoHarm	Redo Beamline by APS							ToDo	ToDo	31
32		M. Enhancement	Modified for canting - Redo beamline and instrument	P			SPEC		F	R	LS	32
33		Feature	APSU New beamline	P	SPEC	SPEC*			F	R	PD only	33
34		Feature	APSU New beamline	P	SPEC	SPEC*	SPEC		F	R	PD only	34
35	DCS	DoNoHarm	No change							C	L	35
			<i>Blank box on the reviews means nothing is needed or is not applicable</i>									
		Done	<i>Components received or in the process of receiving</i>									
		P	<i>Built to Spec - Need final approval prior to fabrication</i>									
		SPEC	<i>Built to Specifications - Completed</i>									
		SPEC*	<i>Built to Specifications - Review Scheduled</i>									
		F	<i>Final Design review complete</i>									
		F*	<i>Final Design review scheduled</i>									
		C	<i>Need to check thermal of RSS beam stops and masks</i>									
		R	<i>Need a report of thermal calculations for RSS to be reviewed and approved</i>									
		L	<i>Limited scope to layout and ray tracings, and provide RSS component list</i>									
		LS	<i>Upgrades in place - PDRC to review safety aspects only, ray tracings and Component list</i>									
		PD only	<i>New Beamline - Will submit a complete portfolio of FRED/ESD. Final review to address safety issues only with emphasis on RSS</i>									
		ToDo	<i>Not APSU Scope but will require PDRC to review</i>									



Appendix B – Bending Magnet Beamlines

Sector	Affiliation	Status	Description of Work Needed	Beamline Layout	Type of Review	Sector
1		Active	Translate and Rotate whole beamline by 0.5mrad	AB together ends 36m, C 53-59 m	Limited to layout/Ray tracing and identified RSS components	1
2		Active	Translate and Rotate beamline in A enclosure	A ends 32m , B station 48-55 m	Limited to layout/Ray tracing and identified RSS components	2
5	DND	Active	Only one branch will go forward.	A, B together, C & D together ends at 61 m	<a href="#">Slightly expanded review than other beamlines due to changes</a>	5
6		Active	Translate and Rotate beamline in A enclosure	A,B together ends 37m	Limited to layout/Ray tracing and identified RSS components	6
7		Active	Translate and Rotate beamline in A enclosure	A, B together ends 38m	Limited to layout/Ray tracing and identified RSS components	7
8		Active	Translate and Rotate beamline in A enclosure	B station ends 55m	Limited to layout/Ray tracing and identified RSS components	8
9		Active	Translate and Rotate whole beamline by 0.5mrad	B, C together C station ends at 64m	Limited to layout/Ray tracing and identified RSS components	9
10	MR	Active	Translate and Rotate beamline in A enclosure	A,B together ends 32m	Limited to layout/Ray tracing and identified RSS components	10
11		Active	Translate and Rotate whole beamline by 0.5mrad	B station ends at 54 m	Limited to layout/Ray tracing and identified RSS components	11
12		Active	Translate and Rotate whole beamline by 0.5mrad	B station ends at 60 m	Limited to layout/Ray tracing and identified RSS components	12
13	GSECCARS	Active	CAT will design to use both branches	B,C & D together ends at 62 m	<a href="#">Slightly expanded review than other beamlines due to changes</a>	13
14	BIOCARS	Active	Delayed - Only one branch - Need plan	B,C & D together ends at 65 m	<a href="#">Slightly expanded review than other beamlines due to changes</a>	14
16	HP(XSD)	Active	Only one branch will go forward.	A, B together, C & D together ends at 52 m	<a href="#">Slightly expanded review than other beamlines due to changes</a>	16
17	IMCA	Inactive	Delayed - beamline has not no plans to operate	B station ends at 57 m	Limited to layout/Ray tracing and identified RSS components	17
19		Maybe	Translate and Rotate whole beamline by 0.5mrad	No B station C, D together D station ends at 54m	Limited to layout/Ray tracing and identified RSS components	19
20		Active	Translate and Rotate whole beamline by 0.5mrad	B station ends at 58 m	Limited to layout/Ray tracing and identified RSS components	20
23	GMCA(XSD)	Inactive	Delayed - beamline has not no plans to operate	A& B together B ends at 43m	Limited to layout/Ray tracing and identified RSS components	23
24	NE	Inactive	Delayed - beamline has not no plans to operate	A& B together B ends at 38m	Limited to layout/Ray tracing and identified RSS components	24
33		Active	Translate and Rotate whole beamline by 0.5mrad	A,B together C station ends at 56m	Limited to layout/Ray tracing and identified RSS components	33