Advanced Photon Source Upgrade Project

Preliminary Design Report

September 2017

Chapter 9: Environment, Safety, and Quality Assurance

Document Number : APSU-2.01-RPT-002
ICMS Content ID : APSU_1705610

Table of Contents

List of Tables

Acronyms and Abbreviations

ACL	Acceptance Criteria Listing
ALARA	As Low As Reasonably Achievable
APS	Advanced Photon Source
APS-U	Advanced Photon Source Upgrade
Argonne	Argonne National Laboratory
ASE	Accelerator Safety Envelope
ASO	Argonne Site Office
BSDRSC	Beamline Safety Design Review Steering Committee
CAS	Contractor Assurance System
DOE	U.S. Department of Energy
EMS	Environmental Management System
HA	Hazard Analysis
HAR	Hazards Analysis Report
ISMS	Integrated Safety Management System
ISO	International Organization for Standardization
LMS	Laboratory Management System
MBA	Multi-Bend Achromat
MCI	Maximum Credible Incident
NEPA	National Environmental Policy Act
NFPA	National Fire Protection Association
ODH	Oxygen-deficiency Hazard
OHSAS	Occupational Health and Safety Assessment Series
PDR	Preliminary Design Report
PPE	Personal Protective Equipment
QA	Quality Assurance
SAD	Safety Assessment Document
SC	Office of Science
UBC	Universal Building Code

UChicago	UChicago Argonne LLC
WSHP	Worker Safety and Health Program

9 Environment, Safety, and Quality Assurance

9-1 Introduction and Overview

Argonne is committed to the protection of workers, visitors, the public and the environment. Consistent with the prime contract requirements, the UChicago Argonne, LLC, as operator of Argonne National Laboratory, maintains a Worker Safety and Health Program (WSHP), an Integrated Safety Management System (ISMS), and an Environmental Management System (EMS). Argonne also maintains certifications to three internationally recognized standards, including International Organization for Standardization (ISO) 14001:2015 *Environmental Management Systems*; ISO 9001:2015 *Quality Management Systems*; and Occupational Health and Safety Assessment Series (OHSAS) 18001:2007 *Occupational Health and Safety Systems.* These independent certifications support a robust Contractor Assurance System (CAS), enabling reasonable assurance to the UChicago Argonne, LLC and the U.S. Department of Energy (DOE) that objectives are accomplished and systems and controls are effective and efficient.

Argonne's policy, consistent with 48 CFR 970.5223-1, *Integration of Environment, Safety, and Health into Work Planning and Execution* [1], and DOE P 450.4A, *Integrated Safety Management Policy* [2] is integration of ES&H protection into all levels of management and work practices. In this way the Laboratory's daily, and overall, mission is accomplished protecting workers, the public, and the environment. To achieve this Argonne has developed and implemented three interrelated programs, Worker Safety and Health Program (WSHP), Integrated Safety Management System (ISMS), and the Environmental Management System (EMS). The WSHP, ISMS, and EMS description documents communicate the policies and procedures that together comprise the functional WSHP and ISMS at Argonne in compliance with 10 CFR 851 [3] and DOE P 450.4A [2]. The WSHP and ISMS description documents are implemented by the policies and procedures of the Laboratory-wide documents. The implementation of each of this suite of protective systems is through the Laboratory Management System (LMS) policies and procedures for all work conducted at Argonne. Subcontractors are required to abide by the same requirements, which are flowed down through contractual mechanisms and the verification of compliance and implementation is described in the LMS procedures.

Argonne Environment, Safety, Health and Quality Assurance policies apply to all employees, subcontractors, users, research visitors, students, and suppliers at all levels. These fundamental aspects of the overall Argonne ESH and QA policies are contained in the Laboratory Management System (LMS) as LMS-POL-1, *Safety and Health* [4]; LMS-POL-2, *Environmental Policy* [5]; and LMS-POL-9, *Quality Policy* [6]. Argonne's commitment to ES&H is also described in policies for specific topical areas including LMS-POL-35, *Radiological, Nuclear, and Accelerator Safety* [7]; LMS-POL-4, *Emergency Management Planning* [8]; LMS-POL-6, *Traffic Safety* [9]; LMS-POL-8, *Aviation Management and Safety* [10]; LMS- POL-10, *Working Alone* [11]; and LMS-POL-69, *Electrical Safety* [12].

In this Preliminary Design Report (PDR) Laboratory-wide implementing policies and procedures, are collectively referred to as the "ESH and QA program". The policies and procedures are placed in

prescribed formats and associated with essential functions, by core process, within Argonne through the Laboratory Management System (LMS). Policies and procedures related to the ESH and QA program are contained in the ESH core process.

9-2 Preliminary Hazard Methodology and Analysis

The potential hazards associated with the operation of the Advanced Photon source (APS) facility and generic x-ray beamlines have been addressed in the *Advanced Photon Source Safety Assessment Document (SAD)* [13]. The APS SAD will be revised during the project execution phase, and prior to commissioning, to reflect implementation of the APS Upgrade Project by incorporating information from this PDR and the APS Upgrade Project Hazards Analysis Report (HAR).

An important result of the current APS SAD was the establishment of the safety envelope for the components of the APS. In the operating range of the APS, the maximum radiation dose rate increases as particle beam power increases in each of the injector components. For this reason, the safety envelope for injector components has been defined in terms of maximum beam power. The safety envelope for the storage ring in injection mode is also defined in terms of maximum beam power. In stored-beam mode, the storage ring safety envelope is related to loss of the entire beam, and is therefore defined in terms of the maximum stored energy in the beam, measured in joules. Storage ring radiation and shielding assessment is covered in detail in section 4-3.12.4. The safety envelope for the beamlines is defined differently as it requires a set of controls to be in effect to ensure that radiation exposures inside Building 400, and outside beamline enclosures, are maintained As Low As Reasonably Achievable (ALARA). The safety envelopes are based on parameters used in calculating the consequences of a maximum credible incident (MCI) for each component type of the APS. The MCIs and their consequences are discussed in Chapter 4 of the current APS SAD. The Accelerator Safety Envelope (ASE) is provided in Chapter 5 of the APS SAD.

The hazard analysis process for the APS Upgrade Project involved development of a PHAR, and a HAR, documenting the study of potential hazards–including radiation, energy sources, hazardous materials, and natural phenomena, associated with the intended modifications to the APS facility as a result of the Upgrade. Hazard categories from the APS Upgrade are the same as those addressed in the APS SAD. Hazard analyses are based on a bounding-event approach in which the most severe case of each hazard category is analyzed to identify worst-case outcome. If the outcome is bounded in the existing SAD Hazard Analysis (HA), then it adequately addresses the hazard and the only planned change in the SAD will be descriptive text. Outcomes that are not bounded in the existing SAD HA will require that a new event analysis be developed including a determination of the initiating occurrence, possible detection or mitigation methods, potential added safety features to prevent or mitigate the event, probability of occurrence, and possible consequences. Initial review has not identified any new analyses which are likely to result in consequences beyond those evaluated in the currently approved SAD.

Table 9.1 summarizes the potential hazards that may result from the APS Upgrade Project, including the procedures and equipment used to control the hazard and reduce the risk levels to ensure safe operation. The HAR will provide a more detailed discussion of the hazard analyses. The potential hazards include (1) ionizing radiation, (2) non-ionizing radiation, (3) chemicals, (4) cryogenics, (5) electrical hazards, (6) fire, (7) magnetic fields, (8) oxygen deficiency, (9) noxious gases, (10) mechanical hazards, and (11) vacuum and pressure.

Table 9.2 provides a summary of the hazards analyzed in the PHAR; their probability level, as described in Table 9.3; and their consequence level, as described in Table 9.4. Table 9.5 provides an overall risk matrix, with resultant risk levels given in Table 9.6. The last column in Table 9.2

Table 9.1. APS-U Project Hazards and Associated Controls

Hazard	Associated Controls
Ionizing Radiation	
Accelerator Systems	Shielding, Access Control and Interlock System, procedures, training, Argonne Radiation Protection Program (radiological surveys, dosimetry, posting, & labeling)
X-ray Beamlines	Shielding, Personnel Safety System, procedures, training, Argonne Radiation Protection Program (radiological surveys, dosimetry, posting, & labeling)
Nonionizing Radiation	
Radio-frequency	Shielding, interlock system, field surveys, posting & labeling, personal protective equipment (PPE), procedures, training, standards
Laser	Shielding, interlock system, permit process, posting & labeling, work procedures, training, standards
Visible/UV Light	Shielding, optics, PPE, procedures, training, standards
Chemical	Designated storage areas, ventilation hoods, APS Chemical Hygiene Plan, Material Safety Data Sheets, Chemical Management System, satellite waste-accumulation areas, posting & labeling, PPE, procedures, training, standards
Cryogenic	Containment design, oxygen-deficiency hazard (ODH) monitors, ventilation, PPE, procedures, training, standards
Electrical	Barrier design, interlocks, equipment inspection, hot work permit process, posting & labeling, PPE, procedures, training, standards, equipment
Equipment Removal and Assembly Installation	Work planning & control process, posting & labeling, pre-job briefings, practice on mockups, PPE, procedures, training, standards
Fire	Barriers, detectors (smoke & heat), alarms, sprinkler system, ventilation, emergency egress routes, Fire Department, limitations on combustibles, flammable liquid storage cabinets, open-flame permits, procedures, training, evacuation drills, standards
Magnetic Fields	Field surveys, posting & labeling, procedures, training, standards
Oxygen Deficiency	Ventilation, ODH monitors, alarms, confined-space entry permit, posting & labeling, procedures, training, standards
Noxious Gases	Ventilation, procedures, training, standards
Mechanical	Design, barriers (machine guards), equipment inspection, posting & labeling, PPE, training, standards
Vacuum and Pressure	Design, pressure relief devices, monitors/gauges, flow & pressure control devices, posting & labeling, PPE, training, standards

corresponds to the risk levels shown in Table 9.6.

Table 9.2. APS-U Risk Determination Summary

Hazard (Off-Normal)	**Probability Level**	**Consequence Level**	**Risk Level**
Ionizing Radiation			
Accelerator Systems	Low	Low	Extremely low
X-ray Beam-lines	Low	Medium	Low
Nonionizing Radiation	Extremely low	Low	Extremely low
Chemical	Medium	Low	Low
Cryogenic	Low	Low	Extremely low
Electrical	Low	Medium	Low
Equipment Removal	Medium	Low	Low
Equipment Assembly and Installation	Low	Medium	Low
Fire	Medium	Low	Low
Magnetic Fields	Low	Low	Extremely low
Oxygen Deficiency	Extremely low	Medium	Extremely low
Noxious Gases			
Accelerator Systems	Medium	Low	Low
X-ray Beam-lines	Low	Medium	Low
Mechanical	Medium	Low	Low
Vacuum and Pressure	Medium	Low	Low

Table 9.3. Hazard Probability Rating Levels

Category	Estimated Occurrance (per year)	Range of Probability	Description
High	$>10^{-1}$		Event is likely to occur several times during the life of the facility or operation.
Medium	10^{-2} to 10^{-1}		Event may occur during the life of the facility or operation.
Low	10^{-4} to 10^{-2}		Occurrence is unlikely or the event is not expected to occur, but may occur during the life of the facility or operation.
Extremely Low	10^{-6} to 10^{-4}		Occurrence is extremely unlikely or the event is not expected to occur during the life of the facility or operation. Events are limiting faults considered in design.
Incredible	$<10^{-6}$		Probability of occurrence is so small that a reasonable scenario is inconceivable. These events are not considered in the design or SAD accident analysis.

Table 9.4. Hazard Consequence Rating Levels

Consequence Level	Maximum Consequence
High	Serious impact on-site or off-site. May cause deaths or loss of the facility/operation. Major impact on the environment.
Medium	Major impact on-site or off-site. May cause deaths, severe injuries, or severe occupational illness to personnel or major damage to a facility/operation or minor impact on the environment. Facility is capable of returning to operation.
Low	Minor on-site impact with negligible off- site impact. May cause minor injury or minor occupational illness or minor impact on the environment.
Extremely Low	Will not result in a significant injury or occupational illness or cause a significant impact on the environment.

Table 9.5. Overall Risk Matrix

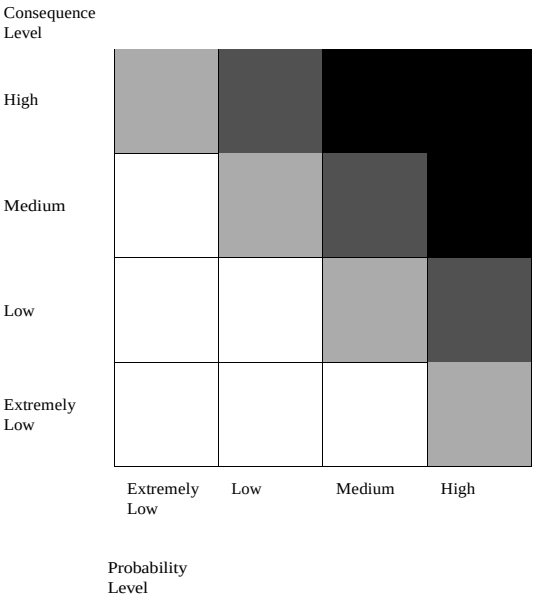
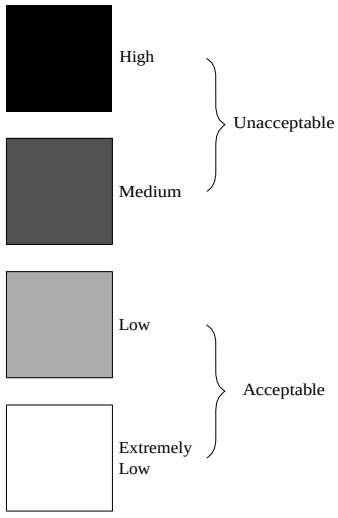


Table 9.6. Hazards Risk Determination Based on Hazards Risk Matrix



9-3 Environmental Protection

The National Environmental Policy Act of 1969 (NEPA) established a national environmental policy that promotes consideration of environmental factors in federal or federally sponsored projects. NEPA requires that the environmental impacts of proposed actions with potentially significant effects be considered in an environmental assessment or environmental impact statement. DOE has promulgated regulations in 10 CFR Part 1021, *Department Of Energy: National Environmental Policy Act Implementing Procedures* [14], which list classes of actions that ordinarily require those levels of documentation or that are categorically excluded from further NEPA review. In accordance with the DOE requirements, the environmental impact of the construction and operation of the APS facility was addressed by an environmental assessment document that led to a Finding of No Significant Impact [15]. This document was later revised to address addition of the Center for Nanoscale Materials, as a separate building adjoining the APS, and a Biosafety Level 3 facility on an APS beamline [16]. The revised environmental assessment was issued in June 2003. In addition to these documents, the DOE Argonne Site Office has issued specific categorical exclusions related to APS operations. One such categorical exclusion, ASO-CX-216, applies to Building 401A, constructed in 2007.

These documents provide the bounding environmental protection analyses for APS construction and operation. All present APS operations and experimental activities are within these analyzed boundaries. The APS Upgrade Project has been evaluated as required by the evaluation process described in LMS-PROC-11, *National Environmental Policy Act Implementation* [17]. An environmental review form, ANL-985-770 was prepared and submitted to the DOE Argonne Site Office and received approval as a Categorical Exclusion as ASO-CX-337 on March 7, 2017.

The removal of the existing storage ring will involve nearly 1900 tons of material, which will be processed through the Argonne waste management program. Planning for the disposition of the materials, and the disposition pathways has occurred with finalization as the Project proceeds. All disposition paths will adhere to the current DOE environmental policy at the time of generation. The newly approved Argonne Radiological Protection Program Technical Basis Document, RS-TBD-003 *Clearance Protocol for Potentially Activated Material* [41] will provide a methodology to allow recycling of materials and reduce the land disposal burdens of cost and impact for a large volume of material.

Given the proposed accelerator systems and beamline modifications described in this PDR, the environmental impacts of APS operations with those modifications installed are highly likely to remain within those bounded by the existing documentation.

9-3.1 ESH Management

The APS Upgrade Project is committed to planning and execution in a manner that preserves the safety of the workers, the public and the environment. Consistent with this goal a dedicated ESH position has been created and is being staffed through a matrixed agreement from the Laboratory ESH organization. This brings the needed subject matter expertise to the project, and allows for depth of support to be tapped as needed through the central organization along with ensuring uninterrupted support moving forward. The following sections describe how ES&H will be managed for Project design; work activities involving removal, installation, and modifications; and initial commissioning of the new multi-bend achromat (MBA) lattice storage ring. General emergency planning during these activities is also addressed.

9-3.2 APS-U Project Safety Design

The design and development of the APS Upgrade Project and its technical components involves an iterative review process. The safety of the design, and effects of the operation of the technical components, are addressed in the perspective development of the APS Upgrade. The process began with the identification and evaluation of hazards, development of controls or alternative mechanisms addressing identified hazards and, where necessary, a revision of design ensuring the hazards are eliminated or appropriately mitigated. The safety review and revision process will continue as designs progress and become more detailed. This is the same process was used for the original APS Project.

9-3.2.1 Codes and Standards

DOE 10 CFR 851, *Worker Safety and Health Program* [3], requires the incorporation of specified codes and standards into contractors WSHPs. These, in turn, are implemented by a variety of Argonne safety requirements documents, such as the Argonne LMS procedures associated with the safety and health core process. The APS design review process includes determining whether the appropriate codes and standards have been applied. Codes and standards of note that apply to the APS Upgrade Project include the following:

- ANSI Z136.1, Safe Use of Lasers (2000) (as implemented via Argonne Procedure LMS-PROC-285, Laser Safety [18]);
- National Fire Protection Association (NFPA) 70, National Electrical Code (as implemented via Environment, Safety and Health Manual ESH-9.1, General Electrical Safety [19]);
- NFPA 70E, Standard for Electrical Safety in the Workplace (as implemented via Environment, Safety and Health Manual ESH-9.2, Electrical Worker Safety [20]); and
- American Society of Mechanical Engineers Boiler and Pressure Vessel Code, Sections I through XII Including Applicable Code Cases (as implemented via Argonne Procedure LMS-PROC-313 Pressure Systems Safety [21].)

Any new building construction will be designed and reviewed consistent with the procedures in place at the time of design and approval with the codes, standards and procedures utilized consistent with the Argonne Facilities Design Guide [22] revision in place at the time of design.

9-3.2.2 Design Reviews

The *APS Design Review Procedure*, AP&P 3.1.01 [23], is being followed by the APS Upgrade Project. This procedure defines a uniform approach for the APS staff when designs are being reviewed. The procedure applies to designs for new projects or modifications to existing APS systems, including mechanical, pressure, cryogenic, electrical, electronic, software, safety, and shielding systems. This same procedure is applied to designs brought to the APS from external parties, e.g., partner users. In this case, the review focuses on safety, although recommendations regarding technical issues may be included in the report. APS management uses a graded approach to determine the appropriate level of formality to be applied to design reviews. Any improvements or modifications to an APS safety system must follow a formal review process.

The x-ray beamline review process is currently managed by the Beamline Safety Design Review Steering Committee (BSDRSC). From the outset, the safety of the beamline components has been evaluated as the components are designed. When assembled, the beamline components are inspected by the Beamline Commissioning Readiness Review Team and the appropriate APS safety committees. Comments and guidance from each of these reviews provide input to the iterative process of safety design and procedures improvement.

The BSDRSC conducts its evaluation in a systematic manner, using the expertise of the committee members as well as the committee advisors. The initial safety analysis for each beamline is prepared by the group managing that beamline. The estimated effect of each hazard is evaluated by the BSDRSC with regard to its potential impact on personnel and on operation of the facility.

Design of any new building construction will be in accordance with the Argonne procedures for design and approval of designs for new construction in place at the time of design commencement.

9-3.2.3 Natural Phenomena Hazards Mitigation

The current design of the APS has been identified in the *Code of Record Report for Argonne National Laboratory* [24] as being designed and constructed in accordance with *Uniform Building Code 1991 edition* [25] which addressed mitigation of hazards posed by natural phenomena. The bulk of the APS Upgrade Project will utilize the current structures without major modifications by changing the content of the structure for the operation of the accelerator, thus the design and construction assumptions for the current structure continue to be valid to the APS Upgrade Project:

- Seismic risk at Argonne at the time of the current APS structure design and construction was defined by the *Universal Building Code, 1991 edition*(UBC)[25], the code of record, was considered low with Argonne residing in Zone 0, and construction was completed meeting the minimum seismic requirements of the UBC-1991 Chapter 23.
- Wind-loading requirements for the buildings (per the UBC) are specified in the structural design, calculations, and specifications, and are similarly specified for all building exterior enclosure systems consistent with the requirements of UBC-1991 Chapter 23. Tornado shelters are designated per Argonne guidelines at interior protected locations within the APS buildings.
- Flooding is not considered to be a likely hazard because the APS is not in a flood zone, is on high ground, and has few subsurface areas, which all have dedicated sump pumps coupled with 25 years in operation in which record rain events have occurred without issue.

Any new building construction would be designed and constructed in accordance with the Argonne Facilities Design Guide, [22] current edition at the time of design and approval with interfaces to grandfathered portions of the building in accordance with the applicable code, standard or procedure in place at the time of the design approval.

- Lightning protection and grounding have been included in the design for the entire APS facility, per IBC, NFPA, and National Electrical Code requirements.
- New construction that may be included will be designed and constructed in accordance with the current approved Argonne Facilities Design Guide and interfaces meeting the requirements needed when interfacing with systems and structures installed to a differing code of record or as approved by the relevant authority having jurisdiction.

9-3.3 Equipment Removal and Assembly/Installation

APS Upgrade Project management recognizes that equipment removal and assembly/installation activities can directly and indirectly pose significant hazards. Thus, management will ensure that APS Upgrade Project activities and associated hazards are evaluated prior to commencement for each phase of work utilizing a locally approved procedure as required by the then current revision of Laboratory-Wide Argonne Procedure LMS-PROC-200, *Local Work Planning and Control Implementing Procedures* [26]. While the current APS is operational all work conducted must interface with and will utilize the most current revision of the APS Procedure 3.1.124, *Work Planning and Control at the APS* [27]. For the installation or modification of equipment it is preferred that a procedure and hazard analysis be developed that incorporates the hazard controls, the relevant PPE, QA procedures and processes that must be followed and equipment needed to allow for maximum repeatability and consistency. Coordination of removal and installation will be accomplished in conjunction with safety staff to allow review of the overlapping tasks to ensure that any precautions needed due to concurrent activities are addressed and adequately flowed down to the workers and subcontractors involved in the work. Storage ring removal and other infrastructure modifications will be performed over an extended period forecast to last about one year utilizing multiple work shifts. It is possible for beamline installations or modifications to be carried out during operating periods if the work is being performed outboard of the storage ring ratchet wall, with the beamline safety and photon shutters fully closed and utilizing the properly developed work control documents and procedures.

Work involving suppliers and subcontractors will be conducted in accordance with the Argonne procedures LMS-PROC-123, *Contractor Safety* [28], and LMS-PROC-221, *Technical Representative and Contractor ESH Representative* [29]. Contractual mechanisms flow down the ESH and QA program requirements, and verification of compliance is accomplished by a combination the assigned technical representative and the APS Upgrade Project safety and QA staff.

9-3.4 Operations

This PDR document section addresses the ES&H aspects of the APS Upgrade Project and does not address how operations will be conducted once the Upgrade modifications are completed. Accelerator facility operation requires a high degree of flexibility for the effective execution of unique and complex research and development programs. Concurrently, these activities must be conducted in a safe and environmentally sound manner. The *Advanced Photon Source Conduct of Operations Manual* [30] was prepared in accordance with DOE O 5480.19 Change 2, *Conduct of Operations Requirements for DOE Facilities* [31]. The APS manual implements the 18 chapters of DOE O 5480.19 Change 2 in sequence and supplements the requirements of the Order with Argonne site procedures where applicable. As required by the Order, within the APS organization a graded approach is to be followed in determining which of the chapters or elements of chapters are applicable to any activity or unit. This means that the elements of the chapters are applied to each activity at a level of detail that is commensurate with the operational importance of the activity and its potential environmental, safety, and/or health impact.

For example, initial operation of the storage ring following Upgrade modifications will be conducted the same way as the machine studies that precede the start of each operations run. Machine studies are covered in the *APS Conduct of Operations Manual* [30], *Chapter 2, Shift Routines and Operating Practices.*

Since the approval of the *APS Conduct of Operations Manual*[30], DOE O 5480.19 [31] has been replaced by DOE O 422.1, *Conduct of Operations* [32]. While DOE O 422.1 is directly applicable to nuclear facilities it is only applicable to accelerators when designated by the DOE Field Element Manager. The DOE Argonne Site Office Manager has not designated this directive to apply to the APS as of preparation of this PDR section, thus APS management has decided to continue to use the existing *APS Conduct of Operations Manual* [30]. At the time DOE O 422.1 [32] is made applicable to the APS, a revision to the current *Conduct of Operations Manual* will be prepared and submitted to DOE to comply with the directive. It is anticipated that the applicability of the directive will become applicable for the APS Upgrade prior to the completion of the Upgrade, thus it is planned that the *Conduct of Operations Manual* will be updated to meet the new design parameters of the upgrade, the expectations for operations and to meet the current DOE Directive, DOE O 422.1 Chg2, or successor revision.

9-3.5 Emergency Planning

The APS participates in the Argonne Comprehensive Emergency Management Plan and has developed local area emergency plans for all APS buildings. The emergency management program incorporates documentation, including maps with designated tornado shelters and fire rally points; assignment of area emergency response responsibilities; and periodic drill requirements. The APS Upgrade Project modifications will be incorporated into the emergency management program as the modifications are implemented. It is not anticipated that there will need to be significant changes to the plans or the risk evaluations as a result of the upgrade project.

9-4 Quality Assurance

The Quality Assurance (QA) requirements for the APS Upgrade Project originate from DOE O 413.3B, *Program and Project Management for the Acquisition of Capital Assets* [33], which requires the APS Upgrade Project to address the QA criteria in 10 CFR 830 Subpart A, *Quality Assurance Requirements* [34], and DOE O 414.1D, *Quality Assurance* [35].

Attachment 1 of DOE O 414.1D [35] requires the APS Upgrade Project to develop a QA program that implements the ten DOE QA criteria, suspect/counterfeit item prevention, and safety software QA, will be implemented using a graded approach. The ten DOE QA criteria are as follows:

1. Quality Program
2. Qualification and Training
3. Quality Improvement
4. Documents and Records
5. Work Processes
6. Design
7. Procurement
8. Inspection and Acceptance Testing
9. Management Assessment
10. Independent Assessment

The APS Upgrade Project is also required to implement the QA requirements contained in the Argonne Laboratory Management System, which has been certified in accordance with ISO 9001:2008, *Quality Management Systems Requirements* [36].

Argonne LMS-POL-9, *Quality Policy of the Argonne Laboratory Management System* [6], requires the APS Upgrade Project to pursue continual improvement in both products and services, and in relationships internally and with its customers, and to be committed to the following principals:

- Provide exceptional products and services in support of our mission, customer requirements, and our country;
- Provide an environment through empowerment, training, and recognition that will challenge and reward our employees; and
- Maintain a safe and healthy work environment for our employees and for anyone who may be affected by our organization.

The APS Upgrade Project has committed to implement the Argonne *Quality Policy* [6] by developing and maintaining a project QA plan that implements the DOE and Argonne requirements, and ensures that safety and quality are given the highest priority. The plan is designed to implement the requirements contained in DOE O 414.1D [35], using the process-based approach in ISO/TC 176/SC 2/N 544R3, *Guidance on the Concept and Use of the Process Approach for Management Systems*. Using this approach ensures the APS Upgrade Project has a QA program that implements the QA requirements using a value-added approach that makes effective use of resources, while providing consistent and measurable results.

The APS Upgrade Project will utilize the procedures in the Argonne QA program for the imple-

mentation of the following requirements:

- Evaluation and monitoring of commercial suppliers
- Inspection and testing of purchased products
- Prevention of counterfeit items
- Control of nonconforming items and services
- Correction and prevention of quality issues
- Performing assessments of the project QA plan

The APS U project QA coordinator will also perform evaluation and monitoring of work being performed by other DOE Laboratories (Partner Laboratories). The oversight will consist of a gap analysis performed by the Project QA coordinator to identify any weaknesses in the quality assurance programs of the partner laboratories. If necessary, additional requirements to address the weaknesses identified by the gap analysis will be included in the Memorandum of Understanding between the Laboratories. The QA coordinator will monitor the Memorandum of Understating between the Laboratories and their performance through product acceptance.

9-4.1 Material Handling and Acceptance

The APS Upgrade Project will perform work in a manner consistent with Argonne's ISMS, WSHP and EMS. Workers will be trained and will utilize approved procedures, drawings, and instructions. Controls will be developed and applied ensuring that work performed will achieve final expectations. APS Upgrade planning documents and written plans will be utilized to assist Project personnel in identifying any environmental, safety, security or quality issues prior to performing work.

Records of work that require component or subsystem identification will be retained. Tags, inspection sheets, and records of results must be protected, and traceability measures applied. Work processes that require certified or licensed workers will include written confirmation the task was performed by the appropriate staff.

Workers will be made aware of requirements for handling, storage, and identification of quality information ensuring their understanding that completed items, systems and components must be protected in a manner deemed appropriate, as determined prior to the start of work. Special work instructions will be created for critical components or systems, as needed.

Vendor and supplier documents will be reviewed by the APS Upgrade staff directly affiliated with the acquisition of an item or service. The QA coordinator will review all procurement documents, including related drawings and specifications to determine the appropriate quality actions to be performed in accordance with the appropriate graded approach. Vendor-supplied QA questionnaires and supporting documents will be evaluated to determine supplier qualifications. Records of inspection and nonconformance will be reviewed by the technical lead, the APS Upgrade procurement group, and the QA coordinator to determine final acceptance.

Product acceptance will be performed using established Acceptance Criteria Listings (ACLs) as described in LMS-PROC-49, *Receipt Inspection* [37]. The ACLs will be established prior to the start of work or construction. Nonconformances with a specific requirement will be documented and evaluated in accordance with LMS-PROC-3, *Control of Nonconforming Products and Services*

[38].

Inspection and acceptance testing will be planned and documented in accordance with LMS-PROC-49, *Receipt Inspection* [37], and AQO-QA-8.1, *Source Verification* [39], as applicable. Technical staff, with support from the Project QA coordinator, is responsible for the generation of an acceptance strategy prior to the acquisition of items and services for the APS Upgrade Project. The ACL will define the inspection and verification requirements needed to be satisfied to render the item or service safe, acceptable, or usable.

As noted on the applicable ACL some inspections of items will be performed using calibrated measuring and monitoring devices traceable to known and accepted reference standards such as those of the National Institute of Standards and Technology. When required calibration will be performed in accordance with LMS-PROC-50, *Control and Calibration of Measuring and Test Equipment* [40], and APS Procedure 3.1.113, *Control of APS Measuring and Test Equipment* [41]. While these procedures are not required for all acquisitions, they may be applied at the requestor's discretion.

9-4.2 Quality Management

The purpose of the *APS Upgrade Quality Plan* is to describe, document, and communicate the APS Upgrade Project's QMS and the systematic approach for ensuring that quality is achieved. The APS Upgrade Project QMS described in this Quality Plan will meet the requirements of DOE O 414.1D [35] and P 450.4A [2], the international standard ISO 9001 [36], and the *Argonne National Laboratory Quality Assurance Program Plan* [42]. The *APS Upgrade Quality Plan* describes the QMS and defines authorities, interrelationships and responsibilities of the personnel performing within the system.

The APS–U Quality Plan will be used in parallel with the *APS Upgrade Project Execution Plan* for conducting work activities in a manner that produces a high-quality, mission-compliant facility while protecting workers, the environment, and the general public. The following are the significant aspects of this Quality Plan:

- Quality management, verification and overview of activities demonstrating the completeness and appropriateness of achieved quality;
- Assurance a quality activity is performed to specified process requirements;
- Assurance an item, facility, or work product performs its designed function;
- Application of an appropriate graded approach to each activity; and
- Assurance that all levels of APS Upgrade Project management are responsible and accountable for the production of high-quality items and services for the Upgrade.

Outside contributors, specifically vendors and contractors, will also be required to adhere to APS Upgrade quality expectations. Requirements will be established, documented and conveyed in purchasing and contract documents. In accordance with the graded approach, vendors'or subcontractors'quality assurance/quality control plans, procedures, and processes may be reviewed and approved prior to commencement of work activities when deemed necessary.

References

[1] U.S. Government. *Code of Federal Regulations 48 CFR 970.5223-1.* Number Integration of Environment, Safety, and Health into Work Planning and Execution. Washington, DC, 2010.

[2] U.S. Department of Energy. *DOE P 450.4A.* Number Integrated Safety Management Policy. Washington, DC, 2011.

[3] U.S. Government. *Code of Federal Regulations 10 CFR 851, Worker Safety and Health Program.* Washington, DC, 2012.

[4] Argonne National Laboratory. *Laboratory-Wide Argonne Policy LMS-POL-1.* Number Rev. 5, Safety and Health. Argonne, IL, 2015.

[5] Argonne National Laboratory. *Laboratory-Wide Argonne Policy LMS-POL-2.* Number Rev. 5, Environmental Policy. Argonne, IL, 2015.

[6] Argonne National Laboratory. *Laboratory-Wide Argonne Policy LMS-POL-9.* Number Rev. 5, Quality Policy. Argonne, IL, 2015.

[7] Argonne National Laboratory. *Laboratory-Wide Argonne Policy LMS-POL-35.* Number Rev. 1, Radiological, Nuclear, and Accelerator Safety. Argonne, IL, 2016.

[8] Argonne National Laboratory. *Laboratory-Wide Argonne Policy LMS-POL-4.* Number Rev. 3, Emergency Management Planning. Argonne, IL, 2016.

[9] Argonne National Laboratory. *Laboratory-Wide Argonne Policy LMS-POL-6.* Number Rev. 10, Traffic Safety. Argonne, IL, 2017.

[10] Argonne National Laboratory. *Laboratory-Wide Argonne Policy LMS-POL-8.* Number Rev. 2, Aviation Management and Safety. Argonne, IL, 2015.

[11] Argonne National Laboratory. *Laboratory-Wide Argonne Policy LMS-POL-10.* Number Rev. 2, Working Alone. Argonne, IL, 2013.

[12] Argonne National Laboratory. *Laboratory-Wide Argonne Policy LMS-POL-69.* Number Rev. 1, Electrical Safety. Argonne, IL, 2017.

[13] Argonne National Laboratory. *Advanced Photon Source Safety Assessment Document APS 3.1.2.1.0.* Number Rev. 4. Argonne, IL, 2012.

[14] U.S. Government. *Code of Federal Regulations 10 CFR 1021.* Number In Department of Energy: National Environmental Policy Act Implementing Procedures. Washington, DC, 2011.

[15] U.S. Department of Energy. *Finding of No Significant Impact (FONSI), 7-GeV Advanced Photon Source.* Number DOE/EA-0389. Argonne National Laboratory, Washington, DC, 1990.

[16] U.S. Department of Energy. *Environmental Assessment for Enhanced Operations of the Advanced Photon Source at Argonne National Laboratory-East, Argonne, Illinois.* Number Number DOE/EA 1455. Washington, DC, 2003.

[17] Argonne National Laboratory. *Laboratory-Wide Argonne Procedure LMS-PROC-11.* Number Rev. 3, National Environmental Policy Act Implementation. Argonne, IL, 2013.

[18] Argonne National Laboratory. *Laboratory-Wide Argonne Procedure LMS-PROC-285.* Number Rev. 1, Laser Safety. Argonne, IL, 2013c.

[19] Argonne National Laboratory. *Environment, Safety, and Health Manual Section 9.1, ESH-9.1.* Number Rev. 10, General Electrical Safety. Argonne, IL, 2017.

[20] Argonne National Laboratory. *Environment, Safety, and Health Manual Section 9.2, ESH-9.2.* Number Rev. 10, Electrical Worker Safety. Argonne, IL, 2017.

[21] Argonne National Laboratory. *Laboratory-Wide Argonne Procedure LMS-PROC-313.* Number Rev. 0, Pressure Systems Safety. Argonne, IL, 2017.

[22] Argonne National Laboratory. *Facilities Design Guide, Revision 0, JSTD-128-W-T001.* Argonne, IL, 2016.

[23] Argonne National Laboratory. *Advanced Photon Source Procedure 3.1.01.* Number Rev. 8, APS Design Review. Argonne, IL, 2014.

[24] Argonne National Laboratory. *Code of Record Report for Argonne National Laboratory, Revision 4, JMLT-168-W-T001.* Argonne, IL, 2014.

[25] International Conference of Building Officials. *Universal Building Code, 1991 Edition.* Whittier, CA, 1991.

[26] Argonne National Laboratory. *Laboratory-Wide Argonne Procedure LMS-PROC-200.* Number Rev. 6, Local Work Planning and Control Implementing Procedures. Argonne, IL, 2016.

[27] Argonne National Laboratory. *Advanced Photon Source Procedure 3.1.124.* Number Rev. 0, Work Planning and Control at the APS. Argonne, IL, 2014.

[28] Argonne National Laboratory. *Laboratory-Wide Argonne Procedure LMS-PROC-123.* Number Rev. 6, Contractor Safety. Argonne, IL, 2016.

[29] Argonne National Laboratory. *Laboratory-Wide Argonne Procedure LMS-PROC-221.* Number Rev. 3, Technical Representative and Contractor ESH Representative. Argonne, IL, 2015.

[30] Argonne National Laboratory. *Advanced Photon Source Conduct of Operations Manual, APS-3.1.1.1.0.* Number Rev. 3. Argonne, IL, 2006.

[31] U.S. Department of Energy. *DOE O 5480.19.* Number Change 2, Conduct of Operations Requirements for DOE Facilities. Washington, DC, 2001.

[32] U.S. Department of Energy. *DOE O 422.1.* Number Change 2, Conduct of Operations. Washington, DC, 2014.

[33] U.S. Department of Energy. *DOE O 413.3B.* Number Program and Project Management for the Acquisition of Capital Assets. Washington, DC, 2010.

[34] U.S. Government. *Code of Federal Regulations 10 CFR 830.* Number Subpart A - Quality Assurance Requirements. Washington, DC, 2005.

[35] U.S. Department of Energy. *DOE O 414.1D.* Number Quality Assurance. Washington, DC, 2011.

[36] International Organization for Standardization. *ISO 9001.* Number Quality Management Systems - Requirements. Geneva, Switzerland, 2015.

[37] Argonne National Laboratory. *Laboratory-Wide Argonne Procedure LMS-PROC-49.* Number Rev. 4, Receipt Inspection. Argonne, IL, 2016.

[38] Argonne National Laboratory. *Laboratory-Wide Argonne Procedure LMS-PROC-3.* Number Rev. 6, Control of Nonconforming Products and Services. Argonne, IL, 2017.

[39] Argonne National Laboratory. *Laboratory-Wide Argonne Procedure AQO-QA-8.1.* Number Rev. 3, Source Verification. Argonne, IL, 2017.

[40] Argonne National Laboratory. *Laboratory-Wide Argonne Procedure LMS-PROC-50.* Number Rev. 5, Control and Calibration of Measuring and Test Equipment. Argonne, IL, 2016.

[41] Argonne National Laboratory. *Advanced Photon Source Procedure 3.1.113.* Number Rev. 6, Control of APS Measuring and Test Equipment. Argonne, IL, 2014.

[42] Argonne National Laboratory. *Argonne National Laboratory Quality Assurance Program Plan.* Number Rev. 8. Argonne, IL, 2016.