UCOR
an AECOM-led partnership with Jacobs

PERFORMANCE DOCUMENT COVER PAGE

NOTE: If the following document is printed, this cover page must be attached to the front and the required information filled in below.

Date Printed: _____

Dates Checked:	**Rev. No.**

Document Number: _____ **Revision Number:** _____

Title: _____

Person Checking Revision Number: _____

The attached document was printed from the online Performance Document System. The user must check that the hard copy revision number matches the revision number of the controlled document in the online Performance Document System. For future use, confirm the revision number's accuracy online and record dates that the revision number was checked.

Section Below Completed by the Performance Document Group Only

Document Type: ☒ Administrative ☐ Technical Emergency
☐ Standard Practice ☐ Alarm Response

Required Review Date: 1/16/23 Date Required Review Completed: _____

Document Status: ☐ Maintain As Is ☐ Revise ☐ Delete

If "Maintain As Is," Next Required Review Date: _____

If "Revise" or "Delete," Due Date: _____

UCOR
an AECOM-led partnership with Jacobs

OWNER: Engineering	**PPD-DE-1035**	**REVISION: 1**
SUBJECT MATTER AREA: Engineering	**PREPARER: Kraig Oldfield**	**Page 1 of 35**
PROGRAM DESCRIPTION	**CONCURRENCE/DATE:**	**Linda B. Raulston 11/21/19 [Approval Signature on File]**
TITLE: ENGINEERING PROGRAM DESCRIPTION	**APPROVED BY/DATE:**	**James R. Fadeley 11/21/19 [Approval Signature on File]**
USQD ☒ UCD ☐ CAT X ☐ EXEMPT ☐	**EFFECTIVE DATE:**	**1/16/20**
USQD/UCD/CAT X No: USQD-MS-PPDDE1035-1556	**REQUIRED REVIEW DATE:**	**1/16/23**
Exhibit L Mandatory Contractor Document: No ☒ Yes ☐	**If an Interim Document, Expiration Date:**	

PURPOSE 2
SCOPE....2
EXPECTATIONS AND STRATEGY 2
REQUIREMENTS 2
ROLES, RESPONSIBILITIES, Programs, Products and Processes 2
A. UCOR Engineering Program Roles and Responsibilities 2
B. UCOR Engineering Document Preparation, Review, and Approval Responsibilities 7
C. UCOR General Engineering Products 9
D. UCOR Engineering Interfaces with Other UCOR Programs....18
E. UCOR Engineering Integration with Other UCOR Processes....20
F. UCOR Engineering Committees and Review Boards 21
G. UCOR Engineering Programs and Procedures 23
Attachment A ACRONYMS 25
Attachment B DESIGN REVIEWS....27

This document is approved for public release per review by:

Peter Kortman 11/6/19
UCOR Classification Date
Information and Control Office

REVISION LOG			
Revision	Effective Date	Description of Changes	Pages Affected
1	1/16/20	Intent change. Removed references to PROC-DE-1014 and replaced with PROC-DE-1012. Revised the entire document to align with current organization and programs.	All
0	11/1/17	Initial release.	All

PURPOSE

The purpose of this document is to define the URS | CH2M Oak Ridge LLC (UCOR, an AECOM-led partnership with Jacobs) Engineering Department's roles, responsibilities, authorities, products, programs and processes for efficient and disciplined conduct of engineering and technical support.

The role of UCOR Engineering has evolved from the engineering work involved in Decontamination and Decommissioning (D&D) and Surveillance and Maintenance (S&M) into the engineering efforts involved in operations and maintenance and new design. These types of changes have necessitated the creation of this Engineering Program Description to summarize the tools, processes, committees, products, and expectations of engineering work at UCOR.

The Engineering Organization at UCOR requires a high standard of engineering work from its members. Whether the members are direct UCOR employees, staff augmentation employees, subcontracted personnel (under Subcontract Blanket Agreement, Requisition for Offsite Services, or Professional Services Agreement), the Engineering Department requires that engineering work products be accurate, logical, and error free. The engineering work product or deliverable must be able to be supported, defended, and validated. To that end, the following document describes the various aspects of the UCOR Engineering Program.

SCOPE

This program description applies to all UCOR engineering disciplines and entities performing engineering or engineering supervised work for UCOR. The Engineering organization chart can be found on the UCOR Intranet under *Organizational Chart*.

EXPECTATIONS AND STRATEGY

It is the expectation of the Chief Engineer that all engineers read and abide by the programs, procedures, and expectations described in this document.

REQUIREMENTS

The guidance to Engineering staff provided herein is for the efficient and disciplined conduct of engineering and technical support. Specific orders, standards, contractual requirements, and procedures that regulate the many engineering activities and engineering products are specified in the sections below.

ROLES, RESPONSIBILITIES, PROGRAMS, PRODUCTS AND PROCESSES

A. UCOR Engineering Program Roles and Responsibilities

1. UCOR Chief Engineer

a. The UCOR Chief Engineer is the head of the engineering department. The UCOR Chief Engineer is responsible for establishing and maintaining UCOR wide engineering programs; developing and supporting engineering requirements; and managing UCOR wide engineering resources.

b. The UCOR Chief Engineer is the ultimate design authority on any design change or design issue. The UCOR Chief Engineer delegates design authority to Project Engineers (PEs), Engineering Managers or other engineers as appropriate.

c. The UCOR Chief Engineer has responsibility for the assignment of Preparers, Checkers, and Reviewers in the preparation and approval of engineering documents. This authority is delegated to the PEs in most cases.

d. The UCOR Chief Engineer convenes Decision Panels for Code of Record (COR) purposes in accordance with PROC-DE-1032, *Preparation and Maintenance of UCOR Code of Record (COR) Documentation*; convenes Change Control Boards in accordance with UCOR-4122, *Configuration Management Program Description for URS | CH2M Oak Ridge LLC, Oak Ridge, Tennessee*; and appoints team members and chairs the Engineering Review Boards (ERBs) in accordance with PROC-NS-1018, *Backfit Analysis Process*.

e. The UCOR Chief Engineer is responsible for the ensuring that engineers and technicians under the Chief Engineer's authority have the proper training and qualifications to perform work in their area of assignment.

f. The UCOR Chief Engineer develops the training and qualification requirements for all engineering positions and conducts oral boards as needed to ensure that the engineers occupying the designated positions are qualified for their positions.

g. The UCOR Chief Engineer is responsible for assigning Project Engineering Managers.

h. More specific Chief Engineer responsibilities are delineated in the engineering procedures listed in Section G.1 of this document.

2. Project Engineering Managers (PEMs)

a. The Project Engineering Manager serves as the senior engineering member of the project team coordinating and providing direction for project related engineering activities.

b. The PEM provides direction for project related engineering and technology development, including alternative studies and risk mitigation.

c. The PEM reviews and monitors engineering project work authorizations and provides input to the appropriate project control account managers for engineering activities.

d. The PEM is accountable to the Area Project Manager for day-to-day direction of project engineering execution.

e. The PEM is accountable to the Chief Engineer for functional direction relative to project execution, strategies, estimates, and schedules as well as exercising design authority for the project.

f. The PEM assigns engineering tasks and priorities to the Project Engineers, Field Support Engineers, and System Engineers

g. The PEM develops engineering staffing plans for the project and serves as the cost account manager for engineering control accounts

h. The PEM is also authorized to perform the following:

- Approve engineering scope, cost, and schedule estimates
- Approve resource loading into project schedules
- Request technical agency resource support for modification
- Serves on the project Safety Basis Review Board (SBRB) and approves Safety Basis Documents

3. UCOR Project Engineers (PEs)

a. UCOR PEs have general engineering and engineering management responsibility for the scope of their respective project(s).

b. UCOR PEs provide engineering support to the Area Project Manager, Facility Managers (FMs), Project Managers (PMs), PEMs, and the Chief Engineer.

c. UCOR PEs assign and oversee engineering resources to cover the need for engineering deliverables, including but not limited to, design criteria, scopes of work, calculations, specifications, and Design Change Notices (DCNs). The PEs also ensure that system engineering reviews are performed as required.

d. UCOR PEs ensure that system engineering reviews (System Health Reporting) are performed as required.

e. UCOR PEs ensure participation of appropriate technical functional agencies in the design and review process, and meet costs, schedule, and technical commitments.

f. UCOR PEs have the responsibility to determine the need for documenting a change to an existing Structure, System or Component (SSC) and for the degree of documentation that is necessary based on the nature of the change and function of the system, structure, or component.

g. UCOR PEs assign the engineering document Preparer, Checker, and Reviewer(s) for the preparation of engineering documents.

h. The UCOR PEs are accountable to the PEM for:

- Technical adequacy of design, functional direction relative to project execution, and resource management
- Direction relative to project execution strategies, estimates, and schedules
- For day-to-day direction of project execution responsibilities and adherence to scope, cost, and schedule baselines

i. UCOR PEs have the following authorities:

- Approve engineering deliverables
- Assign design tasks and priorities to System Engineers (SEs) and Cognizant System Engineers (CSEs)

4. UCOR System Engineers (SEs)

a. The UCOR SE is responsible for providing technical support to the FM in the areas of operations, maintenance, inspections and tests, and configuration management (CM) for assigned systems and components. These responsibilities ensure that the integrity of a facility's safety basis (SB) is maintained. The system engineer should also be familiar with and understand the SB requirements for their assigned system. Engineering Program, UCOR-4144, *System Engineer Program Description for URS | CH2M Oak Ridge LLC, Oak Ridge, Tennessee*, implements the requirements of DOE-O-420.1C, and delineates the UCOR SE's responsibilities and qualification/training requirements.

b. The UCOR Chief Engineer is responsible for selection and assignment of the System Engineers.

c. The SE has the following responsibilities:

- Support the PM and PEM in the establishment of project and engineering execution strategies
- Control and maintenance of the technical baseline of the operating facility
- Providing and concurring with operational and technical requirements and standards for project definition and initiation documents
- Development and maintenance of design outputs
- Reviewing and concurring with design outputs for alignment with inputs
- Assisting in the decision making process to achieve defendable decisions through structured alternative evaluations
- Identifying and monitoring Preventive Maintenance and Corrective Maintenance for assigned systems
- Provide input into the development of spare parts requirements
- Review new/revised safety documentation to identify surveillance test requirements and Post Maintenance requirements.

5. UCOR Cognizant System Engineers (CSEs)

a. UCOR Cognizant System Engineers (CSEs) are assigned to Safety Significant (SS) / Safety Class (SC) SSCs as defined in safety basis documentation and appointed by the UCOR Chief Engineer.

b. The UCOR CSE is a subset of the SE role and considered an expert in the area of assignment.

c. The responsibilities of the CSE are the same as the SE with the following additional responsibilities:

- Representing the system in SBRB reviews
- Supporting the key elements of the Configuration Management Program for their assigned system
- Maintaining a constant awareness of the UCOR List of Active Safety Systems (LASS) and List of Design Features (LDF) (UCOR-4107) and identifying needed changes to the System Engineering Subject Matter Expert (SME)
- Supporting determination of start-up readiness
- Providing technical assistance in resolving potential inadequacies in documented safety analyses (PISA) for assigned systems and components
- Serving as a member of the Change Control Board (CCB) whenever a change is involved with assigned systems
- Preparing Engineering Operability Evaluations (EOEs) to establish the basis of system operability when the potential exists to challenge the operability of a system

6. UCOR Field Support Engineers (FSE)

a. UCOR FSEs in the Engineering Department, which are not specifically assigned as PEs, SEs, or CEs, are assigned areas of responsibility by their associated PE or by the Chief Engineer.

b. UCOR FSEs are the primary engineering interface with day-to-day project field activities.

c. UCOR FSEs engage the operational and supporting craft personnel to provide engineering assistance to field operations and maintenance work.

d. All FSEs are responsible for the following:

- Attending field walkdown for scoping corrective maintenance activities
- Attend the Plan of the Day meetings and identify where engineering needs to be engaged in the field
- Observe shop fabrication work as appropriate

- Represent engineering at operational meetings
- Periodically shadow operator rounds to become familiar with operating facilities
- Support design modifications
- Ensure field work is implemented correctly per designs and adequately implements design requirements

B. UCOR Engineering Document Preparation, Review, and Approval Responsibilities

1. The Engineering Document Preparer

a. The Preparer must be knowledgeable and qualified in the area of assignment, or under the mentorship of an engineer with the necessary knowledge and experience.

b. The Preparer must prepare accurate, reliable, and well supported calculations, analyses, specifications, descriptions, engineering reports, DCNs, and/or other documents.

c. The Preparer's work product must be complete and accurate.

d. The Preparer must include reasonable and defensible assumptions in design work. These assumptions should be verified with acknowledgement of their impact on the design.

e. The Preparer must be concise and accurate when communicating in both verbal and written communication.

f. The Preparer may collaborate with the checker or reviewer(s) during the preparation of the document; however the collaboration should not constitute the majority of the work product, such that the checker and/or reviewers can maintain independence from the preparation.

g. The Preparer must address all comments received from Checkers and/or Reviewers, incorporate the viable comments, and resolve all comments satisfactorily with the Checkers and/or Reviewers.

h. The Preparer should ask SMEs and more experienced personnel for assistance when needed.

2. The Engineering Document Checker

a. The Checker must check (review) the facts, assumptions and assertions of the engineering document for accuracy, reasonableness, and thoroughness. The checker's responsibility can range from a simple review of the preparer's work to a complete verification of the document by an alternate approach.

b. The Checker assumes the responsibility for technical accuracy of the engineering document.

c. The Checker must be knowledgeable in the subject area and technically competent for the assigned review. (Checkers need to have adequate knowledge or experience such that they could have prepared the document.)

d. The Checker must be a different person from the Preparer.

e. The Checker must be independent from the preparation of the document. Therefore, the Checker must not have prepared or helped significantly with the preparation of the document.

f. The Checker must submit written comments or suggestions to the document Preparer. If there are no comments or suggestions, the Checker must provide this status in writing to the Preparer.

g. The Checker must reconcile any comments or differences in opinion with the Preparer. If the difference of opinion cannot be reconciled between the Checker and Preparer, then the Differing Professional Opinion (DPO) Process, PROC-CT-1515, may be pursued.

3. The Engineering Document Reviewer (including Interdisciplinary Reviewer)

NOTE: The assignment of reviewer resources is at the discretion of the PE. A reviewer may not always be assigned to review a document.

a. The Reviewer must check (review) the facts, assumptions, and assertions of the engineering document for accuracy, reasonableness, and thoroughness.

b. The Reviewer must be knowledgeable in the subject area of the assigned review.

c. The Reviewer must be a different person from the Preparer.

d. The Reviewer must be independent from the preparation of the document. Therefore, the Reviewer must not have prepared or helped significantly with the preparation of the document.

e. The Reviewer must submit written comments or suggestions to the document Preparer. If there are no comments or suggestions, the Reviewer must provide this status in writing to the Preparer.

f. The Reviewer must reconcile any comments or differences in opinion with the Preparer. If the difference of opinion cannot be reconciled between the checker and preparer, then the DPO Process, PROC-CT-1515, may be pursued.

4. Engineering Document Approver

a. The Approver must review and approve the engineering document after the Preparer has reconciled and incorporated previous review comments.

b. The Approver should be a person in a management position; however the Chief Engineer has the authority to assign approval authority to other qualified individuals as necessary. If no other approval authority has been designated, then the Chief Engineer acts as the final Engineering approval authority.

c. The Approver and the Preparer can be the same person, as long as an independent Checker or Reviewer (a different person) has performed the proper independent review.

d. The Approver's signature indicates that the proper engineering processes were followed, and that to the best of their knowledge, the document is accurate and complete.

e. The Approver and the Checker/Reviewer cannot be the same person.

C. UCOR General Engineering Products

1. Design Change Notices (DCNs)

a. DCNs are prepared in accordance with PROC-DE-1008, *Design Change Notice (DCN), Engineering Instructions (EIs), and Equivalency Evaluations (EEs)*, which defines the standard work processes and requirements for the preparation, review, implementation, disposition, and control of DCNs.

b. DCNs are documents prepared by Engineering to capture configuration changes to a system, structure, or component. DCNs can document revisions of approved engineering design documents (e.g., drawing, specification), or they can document an Engineering decision. A DCN may be generated to address as found or required changes. DCNs are documented on Form-743a.

c. In accordance with PROC-DE-1008, the PE has the responsibility to determine the need for a DCN and for the degree of documentation that is necessary based on the nature of the change and function of the system, structure, or components. The PE assigns responsibility for preparation and review of the DCN.

d. When preparing the DCN it is important that the design criteria/requirements and the rationale for the change are described, and that the verification or post-modification testing (also referred to as post-maintenance testing) is adequately described to ensure the modification is installed correctly and the equipment performs as expected.

2. Engineering Calculations

a. An engineering calculation is any type of mathematical computation in which the results are used in a design, study, report, evaluation, cost estimates, or work activity that is performed or used by personnel working on UCOR projects.

b. Engineering calculations must be orderly, complete, and accurate. They must be defensible and sufficiently clear to permit verification by an independent individual with enough knowledge on the subject or calculation to be able to discern correctness, completeness, and adequate justification.

c. The assumptions involved in a calculation must be verified. If unverified assumptions are used in the design output, then the design output must be annotated appropriately for unverified assumptions.

d. PROC-DE-0704, *Project Calculations*, provides the method and format for preparing, checking, approving, and revising project calculations. PROC-DE-0704 outlines the process for using an alternate calculation method for checking calculation accuracy.

e. Software designed for use in calculations must be validated and verified. Sufficient sample calculations, representative of the scope of the conditions in the calculation, must be provided to demonstrate the adequacy of the software. This verification and validation is performed in accordance with Software Quality Assurance process as described in PPD-IT-6007, *Software Quality Assurance Program*, and PROC-IT-6008, *Application Lifecycle Management*.

f. Nuclear Criticality Safety calculations are developed in accordance with PROC-NS-1005, *Nuclear Criticality Safety Evaluations and Calculations.*

3. Engineering Drawings

a. PROC-DE-0705, *Design Drawings*, provides the requirements for preparation, review, approval, and control of drawings prepared by and for UCOR. The drawing categories addressed by this procedure include figures, engineering sketches, and project drawings.

b. Engineering drawings must conform to procedural requirements, and the technical content must be consistent with design requirements and accurate.

c. PROC-DE-0705 applies to all drawings and sketches prepared and controlled by UCOR Engineering; all subcontractor drawings prepared in a staff augmentation role; and all drawings prepared for UCOR by a subcontractor in a non-staff augmentation role.

d. PROC-OR-1014, *OOCE Project Drawings*, controls the process for engineering drawings for UCOR Oak Ridge National Laboratory (ORNL) Operations and Cleanup Enterprise (OOCE).

4. Engineering Specifications

a. A specification is any technical description that details the aspects of the object/equipment/system. The specification forms the basis of the criteria from which the object/equipment/system is acquired or installed. These aspects may be performance related, dimensional related, material composition related, or describe any other aspect of the item. In order for the specification to be useful, the specification must be accurate, complete, and as specific as possible with respect to make, model, form, fit and function.

b. For more information on the preparation, review, approval, and control of project-specific standard performance and technical specifications, refer to PROC-DE-1007, *Specifications*. This procedure is generally used in specification writing for the supply chain management process.

c. In addition to the specifications discussed above, the engineer may also be requested to develop material specifications to support requisitions for material and services. PROC-PR-1200, *Requisition Process for Materials and Services*, describes the supply chain management process for such actions.

d. For capital projects or General Plant Projects involving major renovations, construction specifications may be developed by UCOR staff or subcontractors. PROC-DE-1007 covers this specification process.

5. Scopes of Work

a. PROC-DE-1010, *Scopes of Work*, is the procedure that defines the requirements for the preparation, review, approval, and control of technical Scopes of Work. Guidance on preparing Formal and Limited Scopes of Work is provided in PROC-DE-1010.

b. Technical Scopes of Work are often required for procurement documents like Requests for Proposals (RFPs) or other purchasing vehicles. Scopes of Work are used to convey technical project requirements that are typically for construction, fabrication, or field services and are included in procurement packages, work releases, etc. The UCOR engineer should be as technically accurate and precise as possible when submitting Scopes of Work for procurement purposes.

c. Section D.3 of this document describes the supply chain management process. Scopes of Work are one of the engineering products that may be needed in the supply chain management process.

6. Requirements Documents

a. Certain new large scale designs or changes to existing designs will require the preparation of a requirements document. PROC-DE-1033, *Development of UCOR Requirements Documentation*, guides the preparer to the correct vehicle to capture the requirements. Some of the noted requirements documentation vehicles are: COR, Design Criteria Document, Specification, Calculations, Procedures, DCN, and Scopes of Work.

b. Some projects may require a Design Criteria document be prepared based on general guidance in PROC-DE-1033, *Development of UCOR Requirements Documentation*, and specific guidance in PROC-DE-1016, *Design Criteria.* PROC-DE-1016 provides direction to capture the system and project requirements and develop them into design criteria.

7. Other Engineering Documents

a. Other Engineering Documents include, but are not limited to, Engineering Reports, Evaluations, Inspection Reports, Engineering Studies, and Test Plans.

b. An Engineering Report is a common method to document engineering results. The Engineering Document Cover page is Form-136. The format and contents for the Engineering Report are not specified by procedure, but the Form-136 requires the Checker and Approver signatures.

8. Design Reviews

a. A major milestone in the development of a large scope engineering design is the Design Review. The Design Review ensures that the design requirements are addressed in accordance with PROC-DE-1016, *Design Criteria*, and ensures the design criteria meet the design requirements.

b. Depending on the contractual arrangements, the Design Review may take the form of a 30/60/90 review, a Critical Decision (CD) milestone review (CD-1, CD-2, CD-3 and CD-4 reviews as laid out in DOE-O-413.3B change 1), conceptual/preliminary/final review, a constructability review, or any one of many other forms for review. For more information on design reviews, see Attachment B of this document.

9. Specialty Engineering Products and Programs

a. **Arc Flash Models/Calculations:** Arc Flash (AF) analyses are performed to determine if an AF hazard exists. The AF hazard calculation is used to determine the appropriate protective measures used inside the AF boundary. PROC-DE-1023, *Preparation and Maintenance of Arc Flash (AF) Hazard Analyses for AC and DC Electrical Systems*, defines the creation, execution, revision, approval, control, and distribution of AF hazard analysis and AF labels. Only trained and competent electrical engineers perform AF Calculations.

b. Lockout/Tagout (LO/TO) Permits: Lockout/Tagout Permits (Form-194) are prepared to protect personnel from the unexpected release of hazardous energy. PROC-EH-2002, *Hazardous Energy Control (Lockout/Tagout)* is the governing procedure on hazardous energy control (LO/TO). In some cases electrical engineers are required to provide LO/TO isolation points for maintenance activities and in some cases they required to investigate systems or components in an abandoned/historical LO/TO situation. Engineering's input to the LO/TO process is critical to personnel safety so extreme care should be taken to validate the engineering input.

c. Excavation/Trenching Permits: Excavation and Trenching work processes are described in PROC-FO-1004, *Excavation /Trenching Permitting*. The Excavation Permit, Form-147, is not an engineering controlled form, but does require an engineering review and engineering signatures. There are engineering responsibilities embedded in the excavation/trenching work processes. PROC-FO-1004 should be followed closely with respect to engineering responsibilities for engineering personnel preparing the permits and conducting excavation and trenching work.

d. Ground Penetration Permitting: Ground penetration work processes are described in PROC-FO-3037, *Ground Penetration Permitting*. The Ground Penetration Permit, Form-3446, is not an engineering controlled form, but does require an engineering review and engineering signatures. There are engineering responsibilities embedded in the ground penetration work processes. PROC-FO-3037 should be followed closely with respect to engineering responsibilities for engineering personnel preparing the permits and conducting ground penetration work.

e. Penetration Permitting: Penetration work processes are described in PROC-FO-1072, *Penetration Permitting*. The Penetration Permit, Form-3129, is not an engineering controlled form, but does require an engineering review and engineering signatures. There are engineering responsibilities embedded in the penetration work processes. PROC-FO-1072 should be followed closely with respect to engineering responsibilities for engineering personnel preparing the permits and conducting penetration work.

f. Work Releases (WRs) on Blanket Agreements: A WR is a document used to identify and authorize funding for a scope of work under a subcontract blanket agreement. In this process, a Form-204, Work Release Form, is used alone or with attachments to initiate a specific task(s) under an existing subcontract blanket agreement. In some cases, the engineer must prepare a WR and/or a technical evaluation for certain scopes of work. The procedures and forms that guide this type of work are: PROC-PR-1200, PROC-OS-1005, Form-204, and PROC-DE-1010.

g. Non-Nationally Recognized Testing Laboratory (NRTL) Evaluations: While the UCOR procurement program is very specific that only NRTL equipment be purchased, when NRTL products are not available, non-NRTL equipment must be evaluated for use at a UCOR facility. This non-NRTL evaluation process is described in PPD-EH-2009, PROC-DE-1021, Form-2988, and Form-2988a instructions.

h. Commercial Grade Dedication (CGD): CGD is an acceptance process performed in accordance with PROC-DE-1018, *Evaluation and Approval Process for Dedicating Commercial Grade Items and Services*, to provide reasonable assurance that a commercial grade item or service will successfully perform its intended safety function and, in this respect, is deemed equivalent to an item or services provided under the requirements of NQA-1.

- PROC-DE-1018 provides a process for the CGD of new and replacement commercial grade items or services, or utilization of existing items for use in SS/SC applications at UCOR as part of ongoing configuration management activities. This procedure must be used for all UCOR managed Hazard Category 2 or 3 nuclear facilities when commercial grade items or services are procured for use as CM Level 1 configured items (CI), or for services that affect CIs from suppliers that do not have an approved NQA-1 certification.

- If the item being procured for the safety system is not Like for Like, then an Engineering Evaluation (EE) or a commercial grade dedication must be pursued.

- PROC-DE-1021, *Material Requisition Package Requirements*, establishes the level of rigor and identifies the engineering process and controls necessary to provide the appropriate level of assurance for requisitions for equipment and materials used in UCOR projects or operated facilities. This procedure identifies the process required for material requisition of a commercial grade item for level 1 and 2 acquisitions with special requirements.

i. Backfit Analysis (BFA): PROC-NS-1018, *Backfit Analysis Process*, establishes the responsibilities, requirements, specific guidelines, and methodology for conducting a BFA. The BFA process is intended to be a qualitative evaluation tool to determine if an existing SSC can be reasonably expected to perform its proposed new safety function(s).

- The BFA Process is used to evaluate new or revised SC or SS requirements for an existing SSC and determine if the SSC is capable of adequately performing its new safety function, or if additional modifications or other compensatory measures are needed to provide adequate assurance that the SSC can perform its intended safety function. It is used when the functional classification of an existing SSC is upgraded to SC or SS.

- UCOR Engineers working on this analysis are expected to have a good working knowledge of the SSC. The resulting analysis must be reasonably supported and justified, and support the assurance that the SSCs in question will be capable of meeting all of their required safety functions.

j. Engineering Operability Evaluations (EOE): A safety system is defined as operable if the system, subsystem, train, component, or device is capable of performing its specified safety function(s). When an active Safety System or design feature is suspected of not being capable of performing its safety function, then an operability evaluation must occur. PROC-DE-1013, *Engineering Operability Evaluations*, describes the process under which the engineer provides an EOE to the FM for an adverse condition with respect to a piece of safety equipment or a safety system that is suspected of inoperability.

- PROC-FO-515, *Facility Management*, guides the facility manager with respect to operability and functional determinations. The engineer's input to this process is through the EOE via PROC-DE-1013, *Engineering Operability Evaluations*, and Form-713, Engineering Operability Evaluation (EOE) Instructions. It should be noted that the Chief Engineer or their designee must review the EOE before it can be finalized.

k. System Descriptions (SDs): SDs are developed as part of the System Engineering Program. They are intended to serve as comprehensive reference handbooks for SEs to enable technical and configuration management, and knowledge to support the FM as prescribed by DOE-O-420.1C. They are not design basis documents and they are not intended to provide analytical input for calculations and analyses.

- PROC-DE-1012, *Preparation and Control of System Descriptions*, defines the requirements for preparation, review, approval, issue, and revision of SDs for active safety systems. This document is to be followed for the preparation and revision of all SDs for the Active Safety Systems listed in UCOR-4107, *UCOR List of Active Safety Systems (LASS) and List of Design Features (LDF)*, and for UCOR managed facilities.

l. Troubleshooting: Troubleshooting is a systematic approach to problem solving where the problem solver uses the skills of examination and analysis to diagnose a problem. Engineers are often involved in troubleshooting equipment malfunctions especially when the equipment is complex. Complex troubleshooting results are typically documented in an Engineering Report, but other documentation vehicles may be appropriate. There are many approaches to troubleshooting, but the following guidance represents best practice in this area:

- Document the as-found condition of the equipment as accurately as possible,
- Take pictures of the as found condition of the equipment if possible,
- Get eyewitness testimony of the malfunction or problem if possible,
- When analyzing/diagnosing, try to change only one aspect (position, component, condition) at a time (so that one can determine cause and effect),

- Make careful notes of the condition of the problem with the one changed aspect,
- Avoid mind-set tendencies like “we have seen this before,” but rather approach the problem as a new problem before jumping to conclusions,
- Watch the performance of the equipment after each item has been repaired or replaced, so that “normal” performance can be ascertained. If possible test the equipment for operability after each “fix.”

10. Configuration Management (CM)

a. UCOR-4122, *Configuration Management Program for URS | CH2M Oak Ridge, LLC, Oak Ridge, Tennessee*, documents the UCOR CM program. This document identifies the necessary elements from DOE-STD-1073-2003 and implements them in a UCOR tailored program, as required by the UCOR/DOE contract.

b. PROC-NS-1016, *Configuration Management Plans for Nuclear and Non-Nuclear Facilities*, describes how to write a CM Plan that adheres to UCOR-4122 CM Program requirements.

c. When a change to a configured item is being planned, a change package is assembled (normally a DCN). The change package must go through a technical, management, and Unreviewed Safety Question (USQ) review. The change package preparation guidance is found in UCOR-4122 and in the appropriate CM Plan for the project.

d. The project specific CM Plans establish the project level CM requirements and the project level CDs and CIs.

11. Welding

a. Welding Operations at UCOR facilities are controlled by Engineering. PROC-DE-1031, *Welding Procedure*, contains the requirements and responsibilities for controlling welding, brazing, braze welding, and bonding. UCOR welding activities must be in compliance with DOE orders, engineering specifications and industry codes and standards.

b. The responsibilities of a Project Weld Engineer (PWE) are delineated in PROC-DE-1031. One of the key responsibilities of the PWE is weld inspections. It is paramount that the PWE be qualified and certified to perform the weld inspections in accordance with the governing codes and standards.

12. System Health Reporting

a. System Health Reporting is the process of monitoring and trending in a system or project area so that the responsible individual knows and can quantify the health (status or wellbeing) of the system/project.

b. PROC-DE-1038, *System Health Report*, describes steps for preparing, reviewing, approving, issuing, and maintaining System Health Reports (SHR) on an annual basis to determine the continued operability, availability, maintainability, configuration control, material condition, aging degradation issues, and overall health of site systems using a graded approach. Systems or project areas selected provide analysis to verify their ability to perform their credited and or mission function.

c. The Chief Engineer approves the systems to be assessed; assigns SEs and CSEs; determines the need for SHRs to be presented to Senior Management; and approves SHRs. Any engineer that is assigned engineering responsibilities for a system, project, or facility, should be prepared to assess the health of the system, project, or facility when requested by the Chief Engineer. The engineer should also be cognizant of the preventive maintenance/predictive maintenance and be aware that the correct maintenance is being performed. The SHR is also used to identify and document actions required to be completed in order to maintain system performance at an acceptable level.

13. Installed Process Instrumentation (IPI)

a. The IPI Program applies to UCOR maintained and operated process instrumentation that have Technical Safety Requirements (TSRs) associated with them, or that have industry procurement or regulatory requirements. The IPI program utilizes a graded approach by categorizing IPI as either Category 1, 2 or 3. IPI devices used to take measurements or readings that satisfy regulatory requirements are required to be treated as calibrated IPI, regardless of functional classification. IPI devices used exclusively for reference data collection/monitoring may be treated as GS for calibration control purposes. IPI functionally classified as GS does not require recalibration or accountability of use, except as noted above. Installed instruments not used to control a TSR or not specified as IPI should be controlled and calibrated through the preventive maintenance program. This list excludes radiological protection instruments and fire protection instruments, as they have separate management programs.

b. PPD-DE-1036, *UCOR Installed Process Instrumentation (IPI) Program Description*, defines the requirements and responsibilities for the control of UCOR maintained and operated IPI used to support SSCs for UCOR at the ORNL.

c. The responsibilities of UCOR Maintenance, UCOR Engineering, and UCOR Maintenance Instrument and Calibration (I&C) Supervisor are delineated in PPD-DE-1036. Their responsibilities include classification of IPI, Control of IPI, and procurement of new or replacement IPI.

D. UCOR Engineering Interfaces with Other UCOR Programs

1. Work Control

a. Engineers participating in work at UCOR facilities must be aware of the various standards and restrictions that apply to certain types of work. PROC-FS-1001, *Integrated Work Control Program*, applies to work control at UCOR facilities. Some of the more prominent work control areas for engineering involvement are:

- Participating in the development of Job Hazard Analysis
- Identification and control (special handling) of hazardous, radiological, and other controlled items
- STOP Work: Each engineer is empowered to order an immediate "stop work" in accordance with PROC-EH-2018, *Stop Work*, when assessing an operation or process that has the potential to seriously jeopardize safety, health, or the environment, or has imminent life-threatening implications.
- Post Maintenance Testing
- Work scope identification

2. Nuclear Safety

a. The USQ Determination is a key review that affects many Engineering products. The purpose of the USQ review is to determine whether proposed changes are adequately evaluated relative to the SB documents, and whether those changes require prior DOE approval before the changes are made. PROC-NS-1001, *Unreviewed Safety Question Determinations for Nuclear Category 2&3 Facilities*, establishes the process for USQ determinations and provides the review and approval requirements for USQ determination documents.

b. 10 Code of Federal Regulations (CFR) 830, Section 203(d) requires "The contractor responsible for a Hazard Category 1, 2, or 3 DOE nuclear facility must implement the DOE approved process in situations where there is a:

- Temporary or permanent change in the facility as described in the existing Documented Safety Analysis (DSA),
- Temporary or permanent change in the procedures as described in the existing DSA,
- Test or experiment not described in the existing DSA, (or)
- PISA because the analysis potentially may not be bounding or may be otherwise inadequate."

c. PROC-NS-1008, *Unreviewed Change Determinations for Radiological and Non-Nuclear Facilities*, describes the evaluation process for changes and/or as-found conditions for less-than nuclear Hazard Category 3 facilities and activities to determine whether the changes and/or as-found conditions are within the approved SB.

3. Supply Chain Management (Procurement)

a. Engineering provides support for the supply chain management processes. These processes include preparing scopes of work, purchase orders, input to RFPs, preparation of technical specifications, and other support as requested. Some engineers are also qualified as Material and Services Request approvers. Engineers must also specify the required codes and standards for equipment that is ordered to comply with industrial codes and standards.

b. The RFP is the first step in attaining the engineering and construction support needed to fulfill certain engineering (and other) requirements. PROC-DE-1010, *Scopes of Work*, PROC-DE-1021, *Material Requisition Package Requirements*, and PROC-PR-1200, *Requisition Process for Materials and Services*, are procedures that apply to RFP related processes.

c. An RFP is a document that is sent to potential suppliers/subcontractors asking for a quote or proposal to meet the requirements specified in the RFP. For that reason, the RFP must have correct and accurate descriptions of the requirements for the needed materials or services; and it must have criteria under which the response proposal will be judged. If engineering is involved in the RFP, then the engineer will most likely be relied upon to define the Scope of Work (Exhibit D) and work with procurement to develop the other exhibits, such as Exhibits B (Special Conditions), E (Technical Specifications), F (Drawing List and Drawings), and I (Subcontract Submittal Requirements Summary). Other engineering assistance in the RFP process may also be required.

d. Specifications in the support of Supply Chain Management are detailed in Section C.4 of this document.

4. Quality Assurance (QA) Program

a. UCOR Engineers are responsible for knowing the UCOR QA requirements and for performing engineering work in accordance with the QA requirements at the site. UCOR-4141, *URS | CH2M Oak Ridge LLC Quality Assurance Program Plan, Oak Ridge, Tennessee*, explains the practices and processes that make UCOR a DOE NQA-1 contractor. It is expected that all engineers be familiar with and comply with these processes. Engineers also play a role in resolving issues documented on nonconformance reports. Some of the more important quality assurance processes to engineering work are:

- Qualification of Personnel
- QA in Supply Chain Management
- Corrective Action Program
- Document Control
- Work Control
- Design and Change Control
- Assessments

5. Fire Protection

a. The UCOR Fire Protection Program (FPP) addresses facility fire safety requirements for design, construction, operation, management, decontamination, decommissioning, and demolition of DOE facilities. The FPP is implemented and maintained through a combination of engineered fire protection systems, procedures, work control processes, emergency response services, and UCOR safety oversight responsibilities. PPD-FP-2001, *Fire Protection Program Description*, describes the UCOR FPP in detail.

b. The UCOR Engineer is expected to know that new UCOR facilities, modifications to existing buildings, relocatable structures, and all newly installed or modified fire protection systems and features are required to conform to governing fire protection requirements (e.g., CFR, DOE, and the National Fire Protection Association codes and standards). Design packages that include fire safety issues or fire protection features are required to be reviewed by a UCOR Fire Protection Engineer.

6. Training and Qualification

a. All engineers will be assigned a Training Position Description (TPD) to specify the training and qualification that must be in place for that engineer to occupy a certain job title or engineering role. The Chief Engineer determines which TPDs are assigned to individual engineers.

b. PROC-TC-0702, *Training Program*, describes the UCOR Training program's processes and requirements. In addition, the LEARN database on the UCOR intranet houses the training requirements for all UCOR workers. Required Reading, Computer Based Training, and classroom training courses are listed in the individual's training page. Due dates are listed for uncompleted training, and completed training can be viewed and printed.

c. It is expected that the engineer will complete the training that is assigned by the required due date. For classroom training, it is expected that the engineer will show up to the classroom on time and prepared for class.

E. UCOR Engineering Integration with Other UCOR Processes

1. Integrated Safety Management System (ISMS) Processes: Preparers of engineering documents should consider the ISMS processes, as described in PPD-EH-1400, *Integrated Safety Management System Program Description*, so that safe practices are incorporated in the design and operation of projects and facilities.

2. Environmental Compliance and Protection: UCOR engineers must have an awareness of state and federal mandated environmental compliance requirements when preparing new designs, preparing DCNs, or providing engineering support to UCOR operations. UCOR-4088, *Environmental Compliance and Protection Awareness Handbook Oak Ridge, Tennessee*, provides an overview of the environmental related laws, regulations, policies, and procedures. PPD-EC-1747, *Environmental Compliance and Protection Program*, provides more detailed information on environmental compliance.

3. **Personnel Safety Practices:** UCOR engineers must be cognizant of the UCOR safety standards and requirements. An overview of these safety requirements are located in UCOR-4087, *Safety and Health Handbook, Oak Ridge, Tennessee*. PPD-EH-1745, *Worker Health and Safety Program*, provides a more comprehensive description of UCOR health and safety requirements and processes. These standards must be kept in mind not only for day-to-day outdoor and office work, but also when designing equipment or facilities.

4. **Human Performance Improvement (HPI):** HPI is a field of study that aims to improve safety and reliability of systems, equipment, activities, and processes by studying the human interaction with these processes, and eliminating or reducing the error likely precursors or conditions. The implementation of HPI is the proactive identification of error precursors (those work conditions known to increase the average error rate) and the selection of appropriate tools to reduce the frequency of errors and/or reduce the severity of an error's consequences. UCOR engineers must be aware of HPI influencers and prepare design taking HPI under consideration.

   a. UCOR-4666, *UCOR Human Performance Improvement Implementation Plan Oak Ridge, Tennessee*, delineates activities that will be performed to effectively implement the principles, concepts, and tools of HPI.

   b. The UCOR Safety Handbook, UCOR-4087, lists common error precursors and HPI work control tools that can be utilized to effectively reduce errors. It is expected that UCOR engineers will utilize the HPI error mitigative tools when working out in the field and during the design process.

5. **Safety Conscious Work Environment (SCWE):** UCOR engineers work in a SCWE. This is an environment where the individual is empowered to raise safety questions without fear of retaliation; knows that management wants to hear and willingly listens to concerns; and knows that issues are managed through constructive and timely processes. If a UCOR engineer encounters an unsafe situation either in nuclear safety or personnel safety, the engineer is empowered to stop work, raise the concern to management, and understand that no retaliation or reprisal will result.

F. UCOR Engineering Committees and Review Boards

1. Project Review Committee (PRC)

   a. The mission of the PRC is to provide critical reviews of facility/project operations and key controlling performance documents to ensure those activities, when executed as planned, will maintain the facility in a safe compliant state and protect the workforce, surrounding facilities, and the public.

   b. The PRC, charter, scope of work, and committee composition is described in PROC-FO-515, *Facility Management*, and also in CHT-UCOR-102, *UCOR Project Review Committee.*

   c. UCOR engineers should be aware of the PRC charter and provide source material to the PRC for review upon request. In some cases, the UCOR engineer may be included as a PRC member.

2. Engineering Review Board (ERB)

a. The ERB acts as an oversight committee for engineering issues and as an approval authority for the backfit analysis process. The ERB is described in CHT-UCOR-238, *Engineering Review Board (ERB) Charter*, and PROC-NS-1018, *Backfit Analysis Process.* In the case of backfit analysis, the ERB meets to review the technical content, the rigor of the analysis, and the technical conclusion of the analysis. ERB roles and responsibilities are further defined in PROC-NS-1018.

3. Safety Basis Review Board (SBRB)

a. The SBRB is charted and sponsored by the UCOR President and Chief Executive Office. The SBRB ensures implementation of 10 CFR 830 subpart B, DOE orders, and UCOR contractual policies and procedures related to nuclear safety programs at UCOR sites. The UCOR SBRB reviews and assesses the various SB documents and related material associated with nuclear facility safety, facility safety, and hazardous material safety. For more information on the purpose, mission, charter and responsibilities of the SBRB, refer to CHT-UCOR-211, *Safety Basis Review Board.*

b. The following additional procedures document roles for the SBRB:

- PROC-NS-1001, *Unreviewed Safety Question Determinations for Nuclear Category 2 & 3 Facilities,*
- PROC-NS-1002, *Safety Documentation for Hazard Category 2 & 3 Nuclear Facilities,*
- PROC-NS-1008, *Unreviewed Change Determinations for Radiological and Non-Nuclear Facilities,*
- PROC-NS-1009, *Safety Documentation for Radiological and Non-Nuclear Facilities,*
- PROC-NS-1017, *Implementation Verification Review Process*

4. Change Control Board (CCB)

a. The mission of the CCB is to provide management oversight of recommended changes to Active Safety Systems, DFs, and other SSCs managed under CM and the associated CIs at the project level. For further details on the change management of CIs, see UCOR-4122, *Configuration Management Program for URS | CH2M Oak Ridge LLC, Oak Ridge, Tennessee,* and the individual Project specific CM Plans. (The three project specific CM Plans are: UCOR-4104, UCOR-4781, and UCOR-4082.)

b. The CCB must meet the requirements for technical and management reviews described in UCOR-4122 and the project specific CM Plans.

5. Code of Record (COR) Decision Panel

a. The Decision Panel for the COR is described in PROC-DE-1032, *Preparation and Maintenance of UCOR Code of Record (COR) Documentation*. The Decision Panel's purpose is to evaluate the technical, cost, and benefit information associated with modifications to facilities that already have a COR document. The Decision Panel has the authority to decide if the modification should proceed (cost/benefit/funding analysis); if the COR should be changed to accommodate the physical modification; and if updates in codes and standards are warranted for inclusion in the COR.

b. The membership of the Decision Panel is decided by the Chief Engineer. More information about the Decision Panel is contained in Section E of PROC-DE-1032.

G. UCOR Engineering Programs and Procedures

1. The following are UCOR Engineering relevant procedures and program documents:

- UCOR-4000, *Document Preparation Guide for URS | CH2M Oak Ridge LLC, Oak Ridge, Tennessee*
- UCOR-4122, *Configuration Management Program Description for URS | CH2M Oak Ridge LLC, Oak Ridge, Tennessee*
- UCOR-4141, *URS | CH2M Oak Ridge LLC Quality Assurance Program Plan, Oak Ridge, Tennessee*
- CHT-UCOR-211, *Safety Basis Review Board*
- PPD-EC-1747, *Environmental Compliance and Protection Program*
- PPD-EH-1400, *Integrated Safety Management System Description*
- PPD-EH-1745, *Worker Safety and Health Program*
- PPD-EH-2009, *Electrical Safety Program*
- PPD-FO-1035, *Maintenance Management Program*
- PPD-FO-1036, *Conduct of Operations Program Description*
- PPD-IH-5140, *Hazard Communication*
- PPD-IT-6007, *Software Quality Assurance Program*
- PPD-RP-4000, *Radiation Protection Program Description for URS | CH2M Oak Ridge LLC, Oak Ridge, Tennessee*
- PPD-WM-2400, *UCOR Waste Management Program Plan*
- PROC-CT-1515, *Differing Professional Opinion Process*
- PROC-DE-0704, *Project Calculations*
- PROC-DE-0705, *Design Drawings*
- PROC-DE-1007, *Specifications*
- PROC-DE-1008, *Design Change Notices (DCNs), Engineering Instructions (EIs) and Equivalency Evaluations (EEs)*
- PROC-DE-1010, *Scopes of Work*
- PROC-DE-1012, *Preparation and Control of System Descriptions*
- PROC-DE-1013, *Engineering Operability Evaluations*
- PROC-DE-1015, *Update and Control of the Lists of Active Safety Systems (LASS) and Design Features (LDF)*
- PROC-DE-1016, *Design Criteria*

- PROC-DE-1018, *Evaluation and Approval Process for Dedicating Commercial Grade Items and Services*
- PROC-DE-1021, *Material Requisition Package Requirements*
- PROC-DE-1022, *Control of Measuring and Test Equipment*
- PROC-DE-1023, *Preparation and Maintenance of Arc Flash (AF) Hazard Analyses for AC and DC Electrical Systems*
- PROC-DE-1027, *UCOR Structural Inspections*
- PROC-DE-1031, *Welding Procedure*
- PROC-DE-1032, *Preparation and Maintenance of UCOR Code of Record (COR) Documentation*
- PROC-DE-1033, *Development of UCOR Requirements Documentation*
- PROC-EH-2002, *Hazardous Energy Control (Lockout/Tagout)*
- PROC-EH-2018, *Stop Work*
- PROC-FO-1004, *Excavation/Trenching Permitting*
- PROC-FO-1008, *Hoisting and Rigging Operations*
- PROC-FO-1009, *Qualification and Performance as Competent Person Rigger and Crane Signal Person*
- PROC-FO-1041, *Crane Operator Certification/Qualification*
- PROC-FO-1072, *Penetration Permitting*
- PROC-FO-3033, *Airgap for Hazardous Energy Isolations*
- PROC-FO-3037, *Ground Penetration Permitting*
- PROC-FP-2001, *Fire Protection Program Procedure*
- PROC-FS-1001, *Integrated Work Control Program*
- PROC-IT-6008, *Application Lifecycle Management*
- PROC-NS-1001, *Unreviewed Safety Question Determinations for Nuclear Hazard Category 2 & 3 Facilities*
- PROC-NS-1002, *Safety Documentation for Hazard Category 2 & 3 Nuclear Facilities*
- PROC-NS-1008, *Unreviewed Change Determinations for Radiological and Non-Nuclear Facilities*
- PROC-NS-1009, *Safety Documentation for Radiological and Non-Nuclear Facilities*
- PROC-NS-1016, *Configuration Management Plans for Nuclear and Non-Nuclear Facilities*
- PROC-NS-1017, *Implementation Verification Review Process*
- PROC-NS-1018, *Backfit Analysis Process*
- PROC-OS-1001, *Records Management, Including Document Control*
- PROC-OS-1004, *Document Numbering and Issuance*
- PROC-PQ-1445, *Suspect/Counterfeit Items*
- PROC-RP-4554, *Transportation and Hazardous and Radiological Material*

Attachment A
ACRONYMS

AF	Arc Flash
BFA	Backfit Analysis
CCB	Change Control Board
CD	Critical Decision
CSE	Cognizant System Engineer
CFR	Code of Federal Regulations
CGD	Commercial Grade Dedication
CI	Configured Items
CM	Configuration Management
COR	Code of Record
D&D	Decontamination and Decommissioning
DCN	Design Change Notice
DOE	U.S. Department of Energy
DPO	Differing Professional Opinion
DSA	Documented Safety Analysis
EE	Equivalency Evaluations
EOE	Engineering Operability Evaluations
ERB	Engineering Review Board
ETTP	East Tennessee Technology Park
FPP	Fire Protection Program
FM	Facility Manager
FSE	Field Support Engineer
HPI	Human Performance Improvement
I&C	Instrument and Control
IPI	Installed Process Instrumentation
ISMS	Integrated Safety Management System
LO/TO	Lockout/Tagout
NQA-1	American Society of Mechanical Engineers National Quality Assurance Certification
NRTL	Nationally Recognized Testing Laboratory
ORNL	Oak Ridge National Laboratory
PE	Project Engineer
PEM	Project Engineering Manager
PISA	Potentially Inadequacies in Documented Safety Analyses
PM	Project Manager
PRC	Project Review Committee
PWE	Project Weld Engineer
QA	Quality Assurance
RFP	Request for Proposal
S&M	Surveillance and Maintenance
SB	Safety Basis
SBRB	Safety Basis Review Board
SC	Safety Class
SCWE	Safety Conscious Work Environment
SD	System Descriptions
SE	System Engineer
SHR	System Health Report

Attachment A
Acronyms
Page 2 of 2

SME	Subject Matter Expert
SS	Safety Significant
SSC	System Structure or Component
TPD	Training Position Description
TSR	Technical Safety Requirements
UCOR	URS | CH2M Oak Ridge LLC
USQ	Unreviewed Safety Question
WDO	Waste Disposition Organization
WR	Work Release

Attachment B
DESIGN REVIEWS

A major milestone in the development of a large scope engineering design is the occurrence of a **Design Review**. Depending on the contractual arrangements, the design review may take many forms. Some of the most common design review forms are:

1. 30/60/90 design review
2. Critical Decision (CD) milestone review (CD-1, CD-2, CD-3, and CD-4 reviews as laid out in DOE-O-413.3B change 1)
3. Conceptual/Preliminary/Final review
4. Title I, Title II, reviews
5. Constructability Reviews

DOE-O-413.3B change 1 counsels that the following objectives should be evaluated at the Critical Decision reviews:

- The design is of sufficient quality.
- Operational and functional objectives are met.
- Maintenance of costs are within the budget.
- Design is sufficient for the stage of the project, e.g., for final design, the design is biddable, constructible, and cost-effective.
- Interface compatibility exists.
- Final contract documents comply with the design criteria.
- A detailed, unbiased, analytical approach is given to all of the above items.

If the magnitude and the type of the project warrants it, UCOR engineers may be required to present design status at each of the above mentioned intervals (CD-1 through CD-4). Unless otherwise specified in the contract, the expectations for the engineering content for 30/60/90 milestones are required for most projects.

Design reviews may be completed in-house with internal resources, or by reviewers external to the project. In general, large UCOR design projects have a requirement for 30/60/90 design reviews. However there can be modifications on this rule to include variations of percent complete milestones and variations due to contractually obligated milestones. Each contract can be set up differently, but the 30/60/90 method is considered standard.

Another type of design review is a **constructability review**. During a constructability review, the constructability review team must evaluate the provided information and ensure that the design is constructible and biddable. It must ensure that the construction risks are eliminated or mitigated, and that construction cost and schedule estimates adequately reflect design, procurement, selected contracting methods, and site conditions.

Attachment B
DESIGN REVIEWS
Page 2 of 9

Summary of 30/60/90 Design Review Expectations

The expectations for the **30%** complete design review are as follows:

a. Listing of needed specifications.
b. Listing of needed calculations.
c. Listing of needed drawings.
d. Preliminary piping and instrumentation drawings (P&IDs) should be developed.
e. All revisions should be under change control.

The expectations for the **60%** complete design review are as follows:

a. An understandable and thoroughly developed specification of the deliverables.
b. Complete scope of work specifications.
c. Some quality, manufacture, and execution details may be TBD.
d. Unedited masters are unacceptable.
e. Most calculations are completed and in the approval process.
f. P&IDs should be at least 60% complete.

The expectations for the complete **90%** design review are as follows:

a. Design Agency's work is complete.
b. QA of work product checked.
c. Final quality drawings and documents are either sealed or ready to be sealed and the designer can support/defend the design.
d. Subcontractor's design should be final.

The following table (Table A) provides additional detail and examples of the 30/60/90 design review milestones.

Attachment B
DESIGN REVIEWS
Page 3 of 9

Table A - 30/60/90 Design Reviews

NOTE 1: The guidance provided below is for general understanding of 30/60/90 design reviews. The stated criteria at each level may be modified in the contract and tailored for project specifics.

NOTE 2: For the 100% complete milestone, the comments from the 90% design review should have been incorporated and the resulting documents should be ready for the Professional Engineer's stamp.

Discipline	Percent Design Review	Expectation What should be completed at each stage
Process/Systems	30%	The design and qualification codes, standards, criteria should be completed.
		Basic chemical and nuclear process systems: The process technology in the form of chemistries, nuclear criticality, process reactions, thermo-hydraulics of mixing or separation, feed stocks (incoming materials), output (products), phase change, reaction physics, etc. should be completed and verified either by exact replication of a successful process (same processes, same sizes, same environments), or by testing.
		Support systems and utilities: The design of support systems and utilities (cooling water, instrument air, steam supply, heat exchangers, etc.) need not be completed at this stage; however utility requirements should be identified and concepts for extension or provision of those utilities stated.
		Alternative studies must have been completed so that there is no risk of change in technology in favor of a more efficient process.
		The thermo-hydraulic designs (flows, equipment sizing) should be completed for the basic systems. A process flow diagram should be developed at this point. Preliminary sizing of major equipment items will be complete.
		Safety classification, and defense-in-depth and single-failure design should be completed for the Basic chemical and nuclear systems, and the containment-confinement system.
	60%	The design of support systems and utilities should be completed.
		The P&IDs should be completed for all systems.
		The line lists (pressures, temperatures, cycles) should be completed for all systems.
		Safety classification, and defense-in-depth and single-failure design should be completed for all systems.

Attachment B
DESIGN REVIEWS
Page 4 of 9

Discipline	Percent Design Review	Expectation What should be completed at each stage
Process/Systems	60%	All products and chemicals should be identified for safe hazard protection.
		Thermo-hydraulic design of utilities should be well underway. Utilities design should include calculations to support sizing and identification of tie-in points to existing utility systems as well as preliminary layouts piping, cables, etc. (i.e., drawings). Equipment selections to support the required unit operations or physio-chemical processes should be finalized. Preparation should begin for start-up testing plans and operating procedures.
	90%	The design calculations, analyses, reports, specifications, drawings should be completed, reviewed, and approved so that they are ready to be issued for use.
Geotechnical/Site Characterization	30%	The design and qualification codes, standards, criteria should be completed. Land-use of the facility, public exclusion zone, emergency response, etc. should have been approved.
		Local geology, meteorology, hydrology studies should be completed satisfactorily. Site characterization via borings, piezometers, test pits, or other means of subsurface analysis should be completed and all lab test results documented for use in design. This should include borrow sites for earthwork if soil is to be imported for subgrade construction.
		The design-basis magnitude of natural phenomena hazards should have been established and finalized.
		Seismicity should be completed in the form of hazards analysis and ground motions.
		Human-induced hazards should have been identified.
		Environmental impact studies and permits should be completed.
	60%	The site characterization should be completed. Calculations and specifications for specialty civil and structural work should be nearing completion.
	90%	All geotechnical work should be complete.

Attachment B
DESIGN REVIEWS
Page 5 of 9

Discipline	Percent Design Review	Expectation What should be completed at each stage
Plant Layout	30%	The design and qualification codes, standards, criteria should be completed. Preliminary Layout plot plans of buildings and major structures should be completed, with verification that processes can be accommodated, including future expansions.
		The conceptual 3D facility layout should have been reviewed and approved by all disciplines.
		The location of the major site facilities is completed. Civil-structural drawings of buildings and large structures are in development and ready for design analysis and qualification. Grading and foundation design work may be substantially completed as long as the loads are known.
	60%	The 3D layout of distribution systems (piping, ducts, cable trays, etc.) and components (fans, compressors, etc.) should be completed, in accordance with the 60% design, most interferences resolved. Most of the space allocations should be firm with smaller items, such as wire-ways for instrumentation cables still in being laid out. Underground utilities and overhead power and communication line layouts should be final.
	90%	Layout reflects final specifications and design of systems and components.
Civil/Structural	30%	The design and qualification codes, standards, criteria should be completed.
		The design basis loads (normal, natural phenomena hazards, etc.) and safety and seismic classifications should have been defined.
		Building models should have been started. Utility layout for water, firewater, sewer, cover roads, access, parking areas, storm water management, etc. should be in progress.
	60%	The structural design analyses should be near completion. Utility layout for water, firewater, sewer, cover roads, access, parking areas, storm water management, etc. should be complete.
		The in-structure seismic response spectra should be final for the design of SSCs.
	90%	The design calculations, analyses, reports, specifications, drawings should be completed, reviewed, and approved, with no open items so that they are ready for turn-over to procurement, and field construction.
Materials and Corrosion	30%	The design and qualification codes, standards, criteria should be completed. The corrosion mechanisms should have been defined for each system and subsystem.
		Materials options for the base processes should have been selected.

Attachment B
DESIGN REVIEWS
Page 6 of 9

Discipline	Percent Design Review	Expectation What should be completed at each stage
Materials and Corrosion	30%	Material tests should have been planned for alloys and non-metallic materials for corrosive environments.
	60%	Materials (base metal and weldments) tests should have been completed and materials selected and incorporated into project specifications.
		Design lives and risk-informed inspections and replacement strategies should have been developed.
	90%	Material selections should be final.
Mechanical - Equipment	30%	The codes, standards, and design criteria for mechanical distribution systems (piping, tubing) and equipment (static: vessels, tanks; and active: pumps, valves, compressors) should be documented.
		The design loads and environments should be in development.
		The location of major mechanical equipment (reactors, process rooms, etc.) should be completed and provided to layout.
	60%	The design of 60% of the mechanical equipment should be completed, including 90% of the Basic chemical and nuclear equipment, in accordance with their safety classification.
		The pressure safety strategy and other safety strategies should be completed. Data sheets shall be completed and ready for review on equipment and components such as tanks, pumps, compressors, etc.
	90%	The design calculations, analyses, reports, specifications, drawings should be completed, reviewed, and approved, with no open items so that they are ready to be issued for use.
Mechanical – Fire Protection	30%	The design and qualification codes, standards, criteria should be completed.
		Site selection should have accounted for fire and emergency response capabilities on and offsite.
		Internal and external fire sources should be completed, including a fire hazard analysis if one is required.
		The fire protection strategy (fire water source, fire loop, wet or dry system, standpipe, building distribution system, active and passive protection, fire walls and fire doors, etc.) should be completed.
		The multi-layer strategy for safety-related fire protection should be completed, including defense in depth, and single failure.
		The controls for the interface with the ventilation system should be completed.
		The location of major fire protection equipment (water tanks, water main loop, etc.) should be completed and provided to layout.

Attachment B
DESIGN REVIEWS
Page 7 of 9

Discipline	Percent Design Review	Expectation What should be completed at each stage
Mechanical – Fire Protection	60%	The layout and hydraulic sizing should be completed.
		The mechanical design should show evidence that fire safety and emergency response were considered in the design.
		The design of 60% of the mechanical equipment should be completed, including 90% of the fire protection for the Basic chemical and nuclear equipment, in accordance with the safety classification.
	90%	The design calculations, analyses, reports, specifications, drawings should be completed, reviewed, and approved with no open items so that they are ready to be issued for use.
		Procedures for alarms, evacuation, fire watches, and emergency response should be completed.
Mechanical – Ventilation Confinement	30%	The design and qualification codes, standards, criteria should be completed.
		The multi-layer strategy for containment (radiation and fluids) and confinement (particulate) should be completed, including active vs. passive, safety classification, defense in depth, and single failure.
		The controls for the interface with the ventilation system should be completed.
		The safety classification of the ventilation subsystems should be completed.
		The location of major ventilation equipment (air handling units, intake and discharge plenums, stacks, etc.) should be completed and provided to layout.
	60%	The layout and hydraulic sizing should be completed.
		The design of 60% of the mechanical equipment should be completed, including 90% of the ventilation system for the basic chemical and nuclear equipment, and the containment-confinement system in accordance with the safety classification. Data sheets should be complete and ready for review on the major items of ventilation and/or HVAC.
	90%	The design calculations, analyses, reports, specifications, drawings should be completed, reviewed, and approved with no open items so that they are ready to be issued for use.
Electrical	30%	The design and qualification codes, standards, criteria should be completed.
		The normal power supplies and emergency power supplies should be defined to prevent black-out.
		The multi-layer strategy for safety-related electrical systems should be completed, including defense in depth, and single failure.
		The location of major electrical equipment (substations, switchgear, power lines, motor control center room, etc.) should be completed and provided to layout.

Attachment B
DESIGN REVIEWS
Page 8 of 9

Discipline	Percent Design Review	Expectation What should be completed at each stage
Electrical	60%	The electrical design diagrams (single-line electrical drawings, electrical site plans, lighting panels, panel schedules, etc.) should be completed or nearly completed. And long lead electrical items should be turned over to procurement.
		The design of 60% of the electrical equipment should be completed, in accordance with the safety classification.
	90%	The design calculations, analyses, reports, specifications, drawings should be completed, reviewed, and approved with no open items so that they are ready to be issued for use.
Instrumentation and Controls (I&C)	30%	The I&C design and qualification codes, standards, criteria should be completed.
		The safety classification of I&C systems should be completed, including compliance to safety instrumentation levels criteria.
		The multi-layer strategy for safety-related I&C systems should be completed, including defense in depth, and single failure.
	60%	The I&C design and P&ID diagrams should be at least 60% complete.
		The design of the I&C equipment should be 60% complete, including 60% of the I&C for the Basic chemical and nuclear equipment, in accordance with the safety classification; with a good interface with operations and human factor engineering.
	90%	The I&C design should be complete, including the calculations, analyses, reports, specifications, drawings, so that they are ready to be issued for use.
Safety Basis	30%	The safety analysis codes, standards, criteria should be completed.
		The portion of the safety analyses leading to the safety classification of the Basic chemical and nuclear systems and the containment confinement systems should be completed, accounting for nuclear, criticality, chemical, and environmental effects.
	60%	The detailed safety analyses for safety classification at the component level should be on-going for all structures, systems, and components.
	90%	The safety analyses should be completed, reviewed, and approved, with no open items.
Construction	30%	Construction should have reviewed the layout plans, excavation plans, foundation plans, and the location of major buildings and equipment.
		Construction should have reviewed the design codes and standards for building structures and major equipment for construction feasibility and qualifications of construction personnel and contractors.
	60%	Construction should have reviewed the 60% layout and drawings for constructability.
	90%	Construction should have reviewed the 90% layout and drawings for constructability.

Attachment B
DESIGN REVIEWS
Page 9 of 9

Discipline	Percent Design Review	Expectation What should be completed at each stage
Operations	30%	Operations should have reviewed the 30% design of the process/system design, the plant layout, the I&C design, and the emergency preparedness.
	60%	Operations should have reviewed the 60% design of the process/system design, the plant layout, the I&C design, and the emergency preparedness.
	90%	Operations should have reviewed the 90% design of the process/system design, the plant layout, the I&C design, and the emergency preparedness.
QA and Maintenance Note: May not be applicable to all projects	30%	QA and Maintenance should have reviewed the 30% design of the materials, mechanical, electrical, and I&C disciplines for the feasibility of access for inspections, tests, and repair-replacements.
	60%	QA and Maintenance should have reviewed the 60% design of the materials, mechanical, electrical, and I&C disciplines for the feasibility of access for inspections, tests, and repair-replacements.
	90%	QA and Maintenance should have reviewed the 90% design of the materials, mechanical, electrical, and I&C disciplines for the feasibility of access for inspections, tests, and repair-replacements.
Fire Alarm- Fire Protection	30%	The codes, standards, and design criteria should be documented. The Fire Alarm Control Panel Model and Manufacturer should be identified.
	60%	The fire alarm design drawings should be completed or nearly completed including Shop Drawings, Floor Plan Drawings, System Riser Diagram, and Control Unit Diagram.
	90%	The design drawings should be completed reviewed and approved with no open items so that they are ready to be issued for use. This includes Shop Drawings, Floor Plan Drawings, System Riser Diagram, and Control Unit Diagram The design calculations should be completed, reviewed, and approved including battery calculations, notification appliance voltage drop calculations and any other required calculations The narrative input/output matrix of operations should be completed and approved. The typical wiring diagrams should be provided for all devices, notification appliances, remote indicators, annunciators, remote test stations, and end of line and power supervisory devices.
Fire Barriers- Fire Protection	30%	The codes, standards, and design criteria should be documented.
	60%	The design layout drawings should be completed or nearly completed. Construction materials and fire barrier listed design specification should be documented and provided.
	90%	Final design layout drawings should be completed, reviewed, and approved with no open items so that they are ready for use. Final construction materials and fire barrier listed design specification should be documented and provided.