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DOE HANDBOOK

ACTIVITY-LEVEL WORK PLANNING AND CONTROL IMPLEMENTATION

U.S. Department of Energy
Washington, DC 20585

AREA HDBK

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TABLE OF CONTENTS

FOREWORD ..... **v**
1.0. PURPOSE **1**
2.0. SCOPE **1**
3.0. APPLICABILITY **1**
4.0. REFERENCES **2**
5.0. DEFINITIONS **2**
6.0. IMPLEMENTATION OF WORK PLANNING AND CONTROL **7**
6.1. Work Planning and Control and Integrated Safety Management System (ISMS) 9
6.1.1 Roles and Responsibilities 9
6.1.2 Training Needs and Qualifications 14
6.1.3 Supporting ISMS Functional Elements 17
6.1.4 WP&C and Crosscutting Programs 20
6.1.5 Conduct of Operations Relationship to WP&C 23
6.1.6 Research and Development Activities' Relationship to WP&C 24
6.1.7 Supporting Facility-Level Documents 24
6.1.8 The Graded Approach and Tailoring in WP&C 26
6.1.9 Measuring System Effectiveness for Activity-Level WP&C 27
6.2. Defining the Scope of Work 28
6.2.1 Work Identification and Request 28
6.2.2 Work Screening, Validation, Prioritization, and Backlog Control 29
6.2.2.1 Emergency Work 31
6.2.2.2 Systematic Testing and Repairs of Failed Components 32
6.2.3 Work Scope Development 32
6.2.4 Planning Team 33
6.2.5 Acceptance Criteria 35
6.3. Planning the Work – Identify and Analyze Hazards 35
6.3.1 Hazard Identification 35
6.3.2 Identify Safety Requirements, Standards, and Guidance 36
6.3.3 Hazard Analysis 36
6.3.3.1 General Hazard Analysis 39
6.3.3.2 Job Hazard Analysis 39
6.3.3.3 JHA Walkdowns or Roundtable Reviews 41
6.4. Planning the Work – Develop and Implement Hazard Controls 42

6.4.1 Safety SSCs and Technical Safety Requirements 42
6.4.2 Establish a Hierarchy of Controls 43
6.4.3 ALWCD Development 44
6.4.3.1 Work Scope 45
6.4.3.2 ALWCD Types 45
6.4.3.3 ALWCD Use Categories 47
6.4.3.4 ALWCD Preparation 48
6.4.4 ALWCD Verification and Validation 49
6.4.5 ALWCD Approval 50
6.4.6 ALWCD Change Process 51
6.5. Planning the Work – Scheduling 52
6.5.1 Schedule Attributes and Detail 52
6.5.2 Schedule Integration 54
6.5.3 Schedule Approval and Changes 55
6.6. Performing Work within Controls 55
6.6.1 Preparation and Release of Work 56
6.6.2 Pre-Job Brief 57
6.6.3 Performing Work 60
6.6.3.1 Stop/Pause Work Expectations and Responsibilities 61
6.6.3.2 Monitoring Work, Status Updates, and Turnovers 63
6.6.4 Post-Work Testing 64
6.6.4.1 Post-Work Acceptance 65
6.6.4.2 ALWCD Closeout 66
6.7. Providing Feedback on Adequacy of Controls and Continuing to Improve Safety Management 66
6.7.1 Post-Work Review 66
6.7.2 Document Lessons Learned 67
6.7.3 Implement Lessons Learned 68
6.7.4 Assessing Performance 68
7.0. ACRONYMS 70
APPENDIX A. SKILL OF THE WORKER A-1
APPENDIX B. WORK PLANNING AND CONTROL METRICS, ANALYSIS, AND TRENDING B-1
APPENDIX C. COLLABORATIVE TEAM APPROACHES C-1
APPENDIX D. ACTIVITY-LEVEL WORK CONTROL DOCUMENT WRITERS GUIDE D-1

APPENDIX E. ACTIVITY-LEVEL WORK CONTROL DOCUMENT VERIFICATION AND VALIDATION GUIDELINES E-1

APPENDIX F. MULTI-WEEK SCHEDULING MANAGEMENT.....F-1

APPENDIX G. FOSTERING AN ENVIRONMENT TO PROMOTE A POSITIVE SAFETY CULTURE AND A SAFETY-CONSCIOUS WORK ENVIRONMENT G-1

APPENDIX H: DOE REQUIREMENT CITATIONS FOR PERFORMANCE EXPECTATIONS H-1

LIST OF FIGURES

Figure 1. WP&C Flow Diagram 8

Figure 2. Core Functions and Guiding Principles of ISM 18

Figure 3. An Illustration of Major Interactions between Organizational Levels for the Five ISM Core Functions 20

Figure 4. A Prioritization System 30

Figure C-1. Core Team Storefront Model C-2

LIST OF TABLES

Table B-1. Survey Results B-1

Table E-1. ALWCD Verification Checklist E-1

Table E-2. ALWCD Validation Checklist E-5

FOREWORD

This Handbook describes non-mandatory approaches for implementing Department of Energy (DOE) requirements for activity-level work planning and control (WP&C) at Hazard Category 1, 2 and 3 nuclear facilities and is intended to be a resource for improvement in the performance of work at the activity-level by the DOE contractor community. DOE's intentions for publishing this Handbook are that lessons will be shared and learned across all phases of work performance and that activity-level work is reinforced with a greater awareness and commitment by the DOE and its contractors. As important, this Handbook provides a common approach in developing or improving contractor WP&C processes.

Continuous improvement and long-term performance excellence are tenants of a strong safety culture. This Handbook strives to improve contractor work processes and their implementation, consistent with the DOE safety culture focus areas of leadership, employee/worker engagement and organizational learning.

DOE requirements have been referenced in the form of Performance Expectations to provide context for the described implementation approaches of activity-level WP&C. The Handbook further describes attributes and good practices for effective WP&C implementation, and is responsive to recommendations provided by the *DOE Analysis of Integrated Safety Management at the Activity-Level: Work Planning and Control*, August 1, 2013. Good practices of WP&C implementation are provided in Section 6 and Appendices. The Handbook presents a performance-based approach to activity-level WP&C.

DOE is also developing guidance on Federal oversight of WP&C in DOE G 226.1-2, *Federal Line Management Oversight of DOE Nuclear Facilities*. This Handbook complements the oversight approach described in the DOE Guide. However, information in this Handbook is not to be construed as requirements in any audit or appraisal for compliance with DOE rules and directives.

The Handbook's descriptions of performance expectations clarify the Integrated Safety Management (ISM) requirements in DOE regulations and directives that govern activity-level work. Appendix H also provides a full listing of requirement citations referenced in performance expectations.

The guidance documents listed below in addition to the reference documents in Section 4.0 were valuable resources in the development of this Handbook.

- Department of Energy, URS Global Management & Operations Services, *Work Planning and Control Program Standard*, Revision 1, January 31, 2013.
- Energy Facilities Contractor Group (EFCOG), *Work Planning and Control Guideline Document*, May 18, 2012.
- Department of Energy, *Environmental Management Work Planning and Control Guidelines*, April 7, 2010.
- National Nuclear Security Administration, *Activity Level Work Planning and Control Processes: Attributes, Best Practices, and Guidance for Effective Incorporation of Integrated Safety Management and Quality Assurance*, January 23, 2006.

1.0. PURPOSE

This Handbook was prepared as a resource document to improve activity-level work planning and control (WP&C) implementation for the Department of Energy (DOE) (including the National Nuclear Security Administration (NNSA)) and contractor line management since there is a lack of voluntary consensus standards for this topic. The Handbook contains performance expectations that are consistent with DOE requirements. It also contains attributes and good practices that are based on DOE guidance and nuclear industry experience. The Handbook presents a performance-based approach to executing activity-level WP&C while complementing existing Departmental guidance for:

- Federal Line Management Oversight of DOE Nuclear Facilities (DOE G 226.1-2A);
- Nuclear Facility Maintenance (DOE G 433.1-1A);
- Integrated Safety Management System (DOE G 450.4-1C);
- Human Performance Improvement (DOE-HDBK-1028-2009);
- Writer's Guide for Technical Procedures (DOE-STD-1029-1992); and
- Configuration Management (DOE-STD-1073-2003).

2.0. SCOPE

This Handbook is intended to provide information to DOE and contractors for the implementation of a fully effective activity-level WP&C system for Hazard Category 1, 2, and 3 nuclear facilities (see the definitions and interpretations in DOE-STD-1027-92). The Handbook presents performance expectations, attributes, and good practices that can be used to develop or improve contractor WP&C processes and provide performance-based approaches for improvement of WP&C execution.

Use of the Handbook is not mandatory.

3.0. APPLICABILITY

This Handbook is intended to support improvement and implementation of contractor WP&C processes, including WP&C processes of subcontractors, to all activities conducted within the lifecycle of a Hazard Category 1, 2, or 3 nuclear facility. This includes construction, research and development (R&D), operations, maintenance, and decontamination and decommissioning (D&D). Organizations at facilities other than Hazard Category 1, 2, and 3 nuclear facilities (e.g., chemical processing/storage, explosives processing/storage) also may find the information in this Handbook useful.

The terms "graded approach" and "tailoring" in this Handbook apply to different elements of activity-level WP&C. Graded approach applies to determining the level of effort, degree of detail, and rigor of application, to meet requirements and remain consistent with the seven attributes listed in the definition for graded approach when planning work. Tailoring applies to determining the types of controls that are appropriate to the analyzed hazards for the planned work.

4.0. REFERENCES

- 10 CFR Part 830, *Nuclear Safety Management*;
- 10 CFR Part 851, *Worker Safety and Health Program*;
- 48 CFR 970.5223-1, *Integration of Environment, Safety and Health into Work Planning and Execution*;
- DOE G 226.1-2A, *Federal Line Management Oversight of DOE Nuclear Facilities*;
- DOE O 226.1B, *Implementation of Department of Energy Oversight Policy*;
- DOE G 414.1-2B, *Quality Assurance Program Guide*;
- DOE O 414.1D, *Quality Assurance*;
- DOE O 420.1C, *Facility Safety*;
- DOE O 422.1, *Conduct of Operations*;
- DOE G 423.1-1A, *Implementation Guide for Use in Developing Technical Safety Requirements*;
- DOE O 426.2, *Personnel Selection, Training, Qualification, and Certification Requirements for DOE Nuclear Facilities*;
- DOE G 433.1-1A, *Nuclear Facility Maintenance Management Program Guide for Use with DOE O 433.1B*;
- DOE O 433.1B, *Maintenance Management Program for DOE Nuclear Facilities*;
- DOE G 440.1-1B, *Worker Safety and Health Program for DOE (Including the National Nuclear Security Administration) Federal and Contractor Employees*;
- DOE O 440.1B, *Worker Protection Program for DOE (Including the National Nuclear Security Administration) Federal Employees*;
- DOE O 450.2, *Integrated Safety Management*;
- DOE G 450.4-1C, *Integrated Safety Management Guide*
- DOE P 450.4A, *Integrated Safety Management System Policy*;
- DOE-HDBK-1028-2009, *Human Performance Improvement*;
- DOE-STD-1027-92, *Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23,* Nuclear Safety Analysis Reports;
- DOE-STD-1029-1992, *Writer's Guide for Technical Procedures*;
- DOE-STD-1073-2003, *Configuration Management*; and
- The American Society of Mechanical Engineers (ASME) standard for nuclear quality assurance (NQA)-1-2008, *Quality Assurance Requirements for Nuclear Facility Applications* (with the NQA-1a-2009 addenda).

5.0. DEFINITIONS

Active Controls: Hazard controls that require a change of state or personnel action to accomplish the safety function.

Activity-level work (ALW): Any job, task, or sub-task performed where hazards are present; are introduced by the work, such as R&D, D&D, construction, operations, and maintenance; or are introduced by the work environment (regardless of who is performing the work or the

organization with which they are affiliated). The hazards involved could be potentially adverse to worker health and safety, the public, the environment, or safeguards or security.

Activity-Level Work Control Document (ALWCD): A document that records, at a minimum, the scope of an activity, the Responsible Manager (RM), location, a list of activities or tasks, and the hazards and controls associated with the activity. This is the work document that is used in the field to execute activity-level work. This may include technical procedures, work packages, test plans, and work instructions for use by contractor personnel to perform activities.

ALWCD Validation: Part of the ALWCD approval process, utilizing worker input and involvement, which demonstrates that the ALWCD can be performed as written to accomplish the scope of work.

ALWCD Verification: Part of the ALWCD approval process that verifies the technical adequacy of the ALWCD. Verification ensures that the ALWCD is technically accurate, incorporating appropriate input, programmatic and regulatory requirements, and controls from SMEs.

Critical Step: An ALWCD work instruction step or series of steps that, if performed improperly, could cause irreversible harm to plant equipment or personnel, or could significantly affect facility operations. An action, if performed improperly, that has an immediate negative consequence that cannot be reversed or undone.

Documented safety analysis (DSA): A documented analysis of the extent to which a nuclear facility can be operated safely with respect to workers, the public, and the environment; including a description of the conditions, safe boundaries, and hazard controls that provide the basis for ensuring safety.

Emergency work: The highest priority work in the WP&C program. An activity or activities required to support emergency response or prevent or mitigate a situation that could cause serious personnel injury, environmental harm, a security breach, the loss of mission-critical systems or data, or significant property loss. Emergency work is completed without delay or interruption until the condition is stabilized with controls established by senior management or qualified designee instead of the normal work screening and planning processes.

General hazard analysis: The documented identification, analysis, and specification of mitigation for those industrial safety and industrial hygiene hazards routinely encountered at a facility, site, or area. Workers are trained to general safety and health requirements and expected to be cognizant of the conditions and apply controls for general hazards when the situation and tasks present themselves.

Graded Approach: The process of ensuring that the level of analysis, documentation, and actions used to comply with a requirement are commensurate with: (1) the relative importance to safety, safeguards, and security; (2) the magnitude of any hazard involved; (3) the lifecycle stage of a facility; (4) the programmatic mission of a facility; (5) the particular characteristics of a facility; (6) the relative importance of radiological and nonradiological hazards; and (7) any other relevant factor.

Hazard: A source of danger (i.e., material, energy source, or operation) with the potential to cause illness, injury, or death to a person (workers or the public), or damage to a facility, or to

the environment (without regard to the likelihood or credibility of accident scenarios or consequence mitigation).

Human Performance Improvement (HPI): A set of concepts and principles associated with a performance model that illustrates the organizational context of human performance. The model contends that human performance is a system that comprises a network of elements that work together to produce repeatable outcomes. The system encompasses organizational factors, job-site conditions, individual behavior, and results (DOE-HDBK-1028-2009).

Independent Verification: The act of checking, by a separate qualified person, that a given operation or component position conforms to established criteria.

Job hazards analysis (JHA): A documented analysis for specific activity-level work; identifies activity-wide, task- or step-specific, and work environment/location safety and health hazards and defines controls to eliminate or mitigate hazards to protect personnel and the environment. Another common term in industry is job safety analysis.

Limiting Condition for Operation (LCO): The limits that represent the lowest functional capability or performance level of safety structures, systems, and components (SSCs) required for safe operations.

Passive Controls: Hazard controls that may already exist as part of facility/equipment design and do not require change of state or personnel action to complete the safety function.

Pause Work: A request by any employee for a pause in the work activity, including clarification or resolution on a potential problem, concern, or issue. Organizational processes define when work release is required to resume work.

Performance Expectation: As used in this document, performance expectations reflect existing requirements and are cited accordingly. In some cases, performance expectations are direct quotes from requirements. Where performance expectations are paraphrased from requirements, the citations are followed with the word “see” and referenced requirements.

Post-Work Review: A review of the post-work testing, acceptance, and work documentation conducted at the completion of work activities, aimed at improving the effectiveness of the activity. A post-work review often includes an interactive discussion with the group that performed the work. Lessons learned and operating experience for continuous improvement are derived from this review.

Pre-Job Briefing: A briefing with formalization and details consistent with the complexity and hazards of the activity to be performed. Examples include: (1) a self-readiness check for individual workers working alone performing routine tasks, (2) a discussion between the Work Supervisor (WS) or Person in Charge (PIC) and the workers or support personnel, or (3) a formal, documented briefing between the WS or PIC and the workers or support personnel that is part of the ALWCD for initial, complex, or hazardous work.

Risk: The quantitative or qualitative expression of the possibility of an event occurring that considers both the probability that a hazard will cause harm and the consequences of that event. For the purpose of this Handbook, risk is determined by the frequency and complexity of the work activity as well as the hazards of the work and the environment.

Roundtable: Sometimes referred as a “tabletop.” A roundtable is often done in conjunction with a walkdown (often the second walkdown) to facilitate communication between the WS/PIC, work planner, operations or facility personnel, system engineer (if one is assigned), subject matter experts (SMEs), and the workers. Roundtable reviews ensure that all hazards are identified with adequate and compatible controls.

Safety Basis: The documented safety analysis and hazard controls that provide reasonable assurance that a DOE nuclear facility can be operated safely in a manner that adequately protects workers, the public, and the environment.

Safety-class structures, systems, and components (SSCs): The SSCs include portions of process systems whose preventive or mitigative function is necessary to limit radioactive hazardous material exposure to the public, as determined from the safety analysis.

Safety-significant SSCs: The SSCs that are not designated as safety-class SSCs, but whose preventive or mitigative function is a major contributor to defense in depth or worker safety, as determined from safety analyses.

Significant to Safety: Scope contained in an approved ALWCD that includes work impacting DSA-credited safety systems, equipment, or applicable Technical Safety Requirement (TSR) controls. Steps in the ALWCD that execute necessary actions resulting in planned impact on DSA-credited safety systems, equipment, or applicable TSR controls are referred to as steps significant to safety.

Skill of the Worker (SOW): Encompasses Skill of the Craft (SOC). The basic discipline-specific competencies, defined by the contractor organization, for each Worker includes the required proficiency, experience, knowledge, skill, and ability. Competencies are obtained through approved methods such as accepted training, qualification, certification, education, and experience.

Step: An action that must be performed in order to complete a work instruction task (e.g., **OPEN** cooling water discharge valve, **START** cooling water pump).

Stop Work: The authority given any employee to immediately cease an activity that, in the view of that person, could result in imminent danger (i.e., harm to persons or the environment if work continues). Resumption requires mitigation of the hazard and formal authorization from management.

SSCs: Physical items designed, built, or installed to support the operation of the facility. A structure is an element or a collection of elements to provide support or enclosure such as a building, freestanding tank, basin, dike, or stack. A system is a collection of components assembled to perform a function such as piping; cable trays; conduits; or heating, ventilation, and air conditioning. A component is an item of equipment such as a pump, valve, or relay or an element of a larger array such as a length of pipe, elbow, or reducer.

Tailoring: The method to determine the types of controls that are appropriate for the hazards associated with the planned work.

Task: A step (i.e., action) or series of steps designed to contribute to a specified end result for an activity. It has an identifiable beginning and end that is a measurable component of the duties and responsibilities of a specific activity (e.g., **INITIATE** cooling water system operation).

Technical Safety Requirements: The limits, controls, and related actions that establish the specific parameters and requisite actions for the safe operation of a nuclear facility and include, as appropriate for the work and the hazards in the DSA for the facility: Safety limits, operating limits, surveillance requirements, administrative and management controls, use and application provisions, and design features, as well as a basis appendix.

Troubleshooting: The process of locating and identifying SSC malfunctions through deductive and inductive reasoning or testing. The process includes activities such as evaluating components or systems by bounding (including applicable hazard identification and mitigation), what will be evaluated, providing an expectation of outcome, and identifying repairs to be made based on evaluation results.

Unreviewed Safety Question (USQ): A situation where (1) the probability of the occurrence or the consequences of an accident or the malfunction of equipment important to safety previously evaluated in the documented safety analysis could be increased; (2) the possibility of an accident or malfunction of a different type than any evaluated previously in the documented safety analysis could be created; (3) a margin of safety could be reduced; or (4) the documented safety analysis may not be bounding or may be otherwise inadequate.

USQ Process: The mechanism for keeping a safety basis current by reviewing potential USQs, reporting them to DOE, and obtaining approval from DOE prior to taking any action that involves an unreviewed safety question.

Validation: See ALWCD Validation.

Verification: See ALWCD Verification.

Walkdown: A method to identify the tasks needed to accomplish the activity and the hazards associated with the tasks. A walkdown also confirms that the controls selected align appropriately with the field conditions. This should be led by the work planner or RM and may include the Facility Manager (FM), SMEs, system engineers, workers, and the work requestor.

Work Approval: A formal process performed by line management to ensure that the ALWCD has been reviewed and is approved as a workable document.

Work Authorization: A formal process performed by an individual in authority who is responsible for overall facility/project activities signifying that all preparations or prerequisites (e.g., notification, permits, approvals) and required controls have been identified and can be implemented. Work authorization may be performed as part of the site's scheduling process.

Worker: A worker is anyone who performs assigned activity-level work tasks. Examples of workers include crafts, researchers, scientists, engineers, technicians, operators, and maintenance and test personnel. Workers can be contractor or subcontractor personnel who either normally work at the facility where the work is being performed or who normally work elsewhere at the site or offsite and are present at the facility to perform or support ongoing work activities.

Work Instruction: An instruction that provides the specific information, details, and actions on performing the tasks and associated steps necessary to carry out the activities described in an ALWCD.

Work Planner: A work planner is a trained and qualified individual responsible for facilitating the activity-level work planning process in development of ALWCDs.

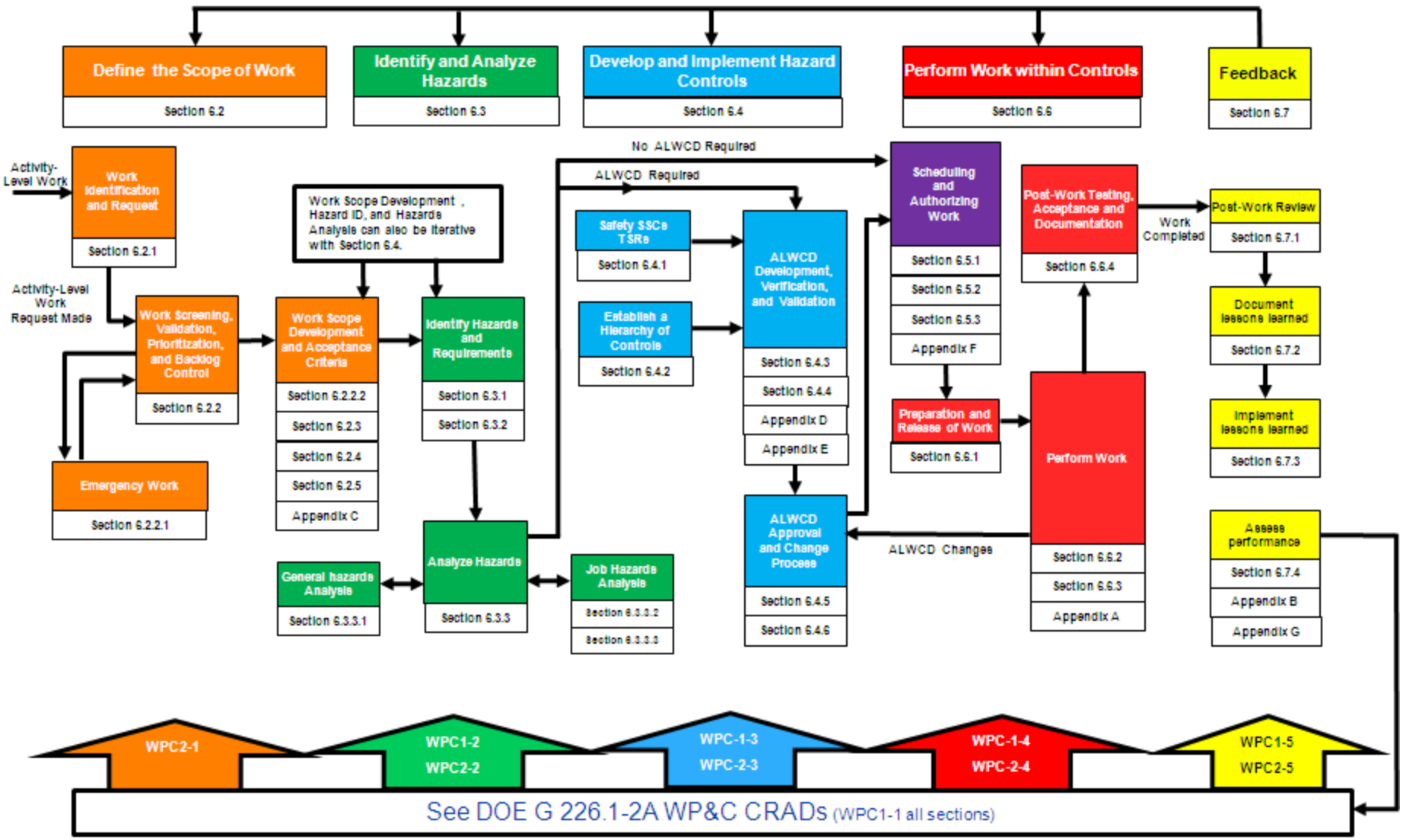
Work Release: A formal process performed by an individual in authority who is the designated point of release responsible for all work and site conditions in a facility or area. The process needs to evaluate workability for the specific activity, just prior to executing the activity, by ensuring that:

- Work is authorized and the ALWCD is reviewed so that workers understand the scope of work, including critical steps and associated hazards and controls;
- Concurrent work activities are compatible; and
- Work environment conditions and configuration support the specific activity.

6.0. IMPLEMENTATION OF WORK PLANNING AND CONTROL

This Handbook is intended to support improvement of contractor, including subcontractors, WP&C process and corresponding implementation to all activities conducted within the lifecycle of a Hazard Category 1, 2, or 3 nuclear facility. Activities include those associated with construction, research and development (R&D), operations, maintenance, and decontamination and decommissioning (D&D). Section 6.1 discusses the WP&C program and Integrated Safety Management (ISM) system. Sections 6.2-6.7 discuss an iterative WP&C implementation approach (see Figure 1). This Handbook includes Performance Expectations derived from DOE requirements, including the ISM Guiding Principles and Core Functions.

Figure 1 illustrates an example of a WP&C process with the prime input defined as “activity-level work.” A contractor or sub-contractor’s WP&C process and supporting resources will screen and prioritize such activities flowing from work breakdown structures, project plans or other drivers that document jobs, tasks, or sub-tasks that need to be performed where hazards are present or are introduced by the work or the work environment, for example:


Define the Scope of Work
Section 6.2
Identify and Analyze Hazards
Section 6.3
Develop and Implement Hazard Controls
Section 6.4
Perform Work within Controls
Section 6.6
Feedback
Section 6.7
Activity-Level Work
Work Identification and Request
Section 6.2.1
Activity-Level Work Request Made
Work Screening, Validation, Prioritization, and Backlog Control
Section 6.2.2
Emergency Work
Section 6.2.2.1
Work Scope Development , Hazard ID, and Hazards Analysis can also be iterative with Section 6.4.
Work Scope Development and Acceptance Criteria
Section 6.2.2.2
Section 6.2.3
Section 6.2.4
Section 6.2.5
Appendix C
Identify Hazards and Requirements
Section 6.3.1
Section 6.3.2
General hazards Analysis
Section 6.3.3.1
Analyze Hazards
Section 6.3.3
Job Hazards Analysis
Section 6.3.3.2
Section 6.3.3.3
No ALWCD Required
ALWCD Required
Safety SSCs TSRs
Section 6.4.1
Establish a Hierarchy of Controls
Section 6.4.2
ALWCD Development, Verification, and Validation
Section 6.4.3
Section 6.4.4
Appendix D
Appendix E
ALWCD Approval and Change Process
Section 6.4.5
Section 6.4.6
Scheduling and Authorizing Work
Section 6.5.1
Section 6.5.2
Section 6.5.3
Appendix F
Preparation and Release of Work
Section 6.6.1
Perform Work
Section 6.6.2
Section 6.6.3
Appendix A
ALWCD Changes
Post-Work Testing, Acceptance and Documentation
Section 6.6.4
Work Completed
Post-Work Review
Section 6.7.1
Document lessons learned
Section 6.7.2
Implement lessons learned
Section 6.7.3
Assess performance
Section 6.7.4
Appendix B
Appendix G
WPC2-1
WPC1-2
WPC2-2
WPC-1-3
WPC-2-3
WPC-1-4
WPC-2-4
WPC1-5
WPC2-5
See DOE G 226.1-2A WP&C CRADs (WPC1-1 all sections)

- Construction: e.g., activities to erect a new facility or modify an existing facility, field design change requests, and general condition items such as debris removal, temporary facilities,
- Operations: e.g., program operation campaigns, waste processing, component fabrication, operator rounds (see Section 6.1.5),
- Research and Development: e.g., programmatic research, laboratory directed R&D, R&D work for others (see Section 6.1.6),
- Maintenance: e.g., preventive maintenance, corrective maintenance, equipment replacement, and
- Decontamination and Decommissioning: e.g., facility decontamination, equipment removal, facility characterization, field design change requests, and general condition items such as debris removal, temporary facilities.

This Handbook can serve as a resource for contractors seeking to benchmark their WP&C process for improved implementation. This Handbook identifies performance expectations and good practices (see Sections 6.1-6.7). The goals for an effective WP&C process are:

1. Ensure protection of the worker, the public and the environment by scoping, planning, scheduling, and preparing in a manner that result in the safe execution of work.

2. Eliminate or mitigate the hazards associated with work.

3. Identify the impact of work to the facility and work groups and plan, control, and execute the work without incurring unanticipated issues resulting from the work.

4. Maximize the efficiency and effectiveness of site personnel and material resources.

5. Maximize the availability and reliability of facility equipment and systems.

6. Maximize continual improvement and learning with robust feedback and improvement processes.

Applying these principles can further improve an organization's WP&C process and culture.

6.1. Work Planning and Control and Integrated Safety Management System (ISMS)

6.1.1 Roles and Responsibilities

Performance Expectation: Organizational structure, functional roles, responsibilities, levels of authority, accountability, and interfaces for those managing, planning, performing, and assessing work are clearly defined and documented (see 10 CFR 830.122.a, 48 CFR 970.5223-1(b)(1) and (b)(2), DOE O 433.1B, Attachment 2, para. 1.a and 2.b, and DOE O 422.1, Attachment 2, Appendix A, para. 2.a).

Good Practices:

Roles and responsibilities for activity-level WP&C are defined and understood for work planners, work supervisors, responsible line managers, workers, subcontractors, subject matter experts, and all other personnel involved in such activity. The goal should be to

establish a work environment that strives for excellence in work planning and performance and that promotes productivity and safety. Open and effective communications, constructive feedback, and due consideration of diverse opinions should be encouraged at all organizational levels. Individual ownership, accountability, teamwork, continuous improvement, and proactiveness to prevent or address and correct issues before they become major are visible traits of a safety-conscious culture.

The responsibilities listed below are one possible combination of functional category positions. These roles and responsibilities may be performed by multiple and various positions depending on the organizational structure. Specific titles with associated roles and responsibilities (e.g., Facility XYZ Operations Manager as one of the RMs) would be addressed in contractor WP&C procedures. More detailed roles and responsibilities for specific subject matter experts (e.g., Radiation Protection, Maintenance, Security) can be found in other resources, for instance the *Work Management Process Description* (AP-928) published by the Institute of Nuclear Power Operations (INPO).

Senior Management:

- Assigns WP&C program roles and responsibilities.
- Approves and releases Emergency Work prior to execution.
- Delegates Emergency Work approval and release authority to qualified designees.
- Establish criteria to define when Independent Hazard Review Teams (IHRTs) are necessary.
- Leads IHRTs (i.e., senior management review board) of high-impact work during the ALWCD approval process.
- Establish expectations for key performance objectives and measures related to safe work accomplishment.

Responsible Manager (Line Management):

- Line Managers clearly understand how to safely conduct their work activities and accomplish their performance objectives.
- Ensures a complete understanding of the work scope and work environment where the work will be performed in order to effectively execute assigned responsibilities.
- Ensures that the timing of work activities supports safe work performance.
- Ensures that the work activity is adequately funded.
- Ensures that critical resources (equipment and trained personnel) for safe performance of work are available before authorizing work.
- Ensures that all of the appropriate controls are in place to protect the safety and health of workers during the execution of work activities.
- Ensures overall safety of the workers.
- Demonstrates visible leadership at the work site and in employee work areas, including coaching, mentoring, and reinforcing standards and positive behaviors.
- Ensures compliance with ALWCDs, including working within scope, documentation of work, and feedback during execution.
- Supports worker decisions in taking conservative actions (e.g., pause work, stop work) when faced with unexpected or uncertain conditions.
- Acknowledges personnel for self-identification and reporting of errors.

- Ensures compliance with the site and facility DSAs and TSRs.
- Ensures that activities affecting systems or components that require independent verification have been identified.
- Ensures that task-specific mitigations determined to be needed by JHAs are properly incorporated into the ALWCDs.
- Ensures that the feedback process is effectively implemented.
- Ensures the proper release of equipment and work areas.
- Ensures that subcontractors perform work in accordance with Integrated Safety Management System (ISMS) principles and contract requirements. At a minimum, meets with the organization's Subcontractor Technical Representative and the subcontractor's supervisor to review in detail the processes workers will follow, identify potential hazards, and describe methods for controlling those hazards.
- Ensures that work activities are coordinated with facility management.
- Implements the contractor's procedures that address line management's responsibility for safety, clearly defined roles and responsibilities, competence commensurate with responsibility, and a clearly documented graded approach program.
- Reviews and approves all requests for work.
- Reviews and approves ALWCDs for compliance and completeness and performs post-work acceptance and completion activities.
- Reviews and approves changes to ALWCDs.
- Controls the activity-related schedule, including setting priorities and integrating or interfacing with operations, project, site, and facility activities.
- Manages the schedule change control process to ensure the maximum utilization of resources.
- Approves the activity-related schedule and any changes.
- Authorizes shutdown of machinery, equipment, and systems.
- Reviews approved ALWCDs to ensure that conditions for performing the work are established, verifies the work is authorized, and grants work release.
- Reviews incoming requests for work for project, site, and facility impact.
- Establishes and maintains awareness of key performance measures related to safe work accomplishment and take action on adverse trends or anomalies.

<u>Work Requestor/Responsible Individual (RI) for Work Initiation:</u>

- Describes the proposed scope of work to include possible deliverables, milestones, and mission-critical needs.
- Provides accurate, detailed data and notifies the Project Manager, FM, or Shift Operations Manager (SOM) of field-observed conditions requiring interface support, awareness, or any followup work.
- Contacts the Project Manager, FM, or SOM for urgent or facility-impacting items immediately.
- Initiates a request for work.

<u>WP&C Management:</u>

- Ensures that SMEs identified as part of the planning team concur with, and participate in the development of the hazard analysis and the ALWCD.

- Ensures that the proper level of review and approval is identified and obtained for different types of ALWCDs.
- Ensures that ALWCDs are ready to work prior to the execution week.
- Ensures that resources are available to support all work planning and control activities.
- Ensures that ALWCDs have been properly completed and closed out.
- Screens requests against Davis-Bacon Act requirements, as applicable.
- Makes an initial determination of the type of ALWCD to be used for each work task based upon the hazards associated with and rigor level (complexity or failure mode consequence) of the work activity.
- Makes an initial determination if a work planner or planning team is necessary based on the graded approach. Selects work planner or planning team members that should comprise the appropriate personnel (e.g., work preparer/work planner, workers, operations, principal investigator, SME).
- Screens requests for work, ensuring that work scope and associated boundaries are clearly defined.
- Participates in scheduling and resolves obstacles to schedule execution.
- Conducts periodic assessments of the WP&C process in accordance with Contractor Assurance System guidance.
- Serves as qualification authority for work planners.

Work Planner (Preparer):

- Leads the planning process in work site scoping walkdowns; roundtables; work scope definition; job hazard identification, analysis, and control selection; and ALWCD development.
- Reviews lessons learned and feedback information for entries with applicability to the work to be performed.
- Takes Human Performance Improvement (HPI) factors into consideration.
- Develops the ALWCD, incorporating input from the planning team, the RM, and appropriate task-related requirements.
- Coordinates the integration of controls and preparation of the required permits (e.g., radiological work permits (RWPs), hot-work permits, confined-space permits).
- Coordinates ALWCD comment resolution and submits the package for concurrence by the WS and relevant SMEs and approval by the RM.
- Ensures that all documents necessary for completion of the work are included in the ALWCD (e.g., work instructions, drawings, permits).
- Makes sure controls based on the hierarchy of control principles (e.g., hazard elimination or reduction, engineered, administrative, or personal protective equipment (PPE)) are clearly delineated in the ALWCDs or supporting documents.
- Incorporates SME identified inspections, acceptance criteria, and hold and witness points into ALWCDs.
- Ensures that special task-specific training and medical screening and surveillance requirements are specified.
- Coordinates input for feedback and lessons learned in a timely manner to capture information for process improvement.

Subject Matter Expert (e.g., safety system engineers; functional experts in Radiological Controls, Safety, Industrial Hygiene, Engineering):

- Participates in the work site job or task walkdowns, roundtables, hazard identification, JHA and control selection, and ALWCD development as part of the planning team, consistent with the contractor's WP&C process.
- Supports the RM and preparer/work planner in reviewing ALWCDs to ensure that the hazard controls have been incorporated consistent with requirements.
- Contributes to the development of ALWCD instructions, ensuring that steps with DSA or regulatory permit requirements are properly incorporated.
- Ensures that planning decisions are consistent with programmatic requirements.
- Specifies inspections, acceptance criteria, and hold and witness points.
- Reviews SME discipline-related, subcontractor-prepared ALWCD documents for suitability.
- Supports the RM and preparer/work planner in reviewing the applicable completed ALWCDs to ensure that required data are properly recorded in accordance with programmatic requirements.
- Concurs with the ALWCD as part of the approval process.
- Performs or supports the specified inspections and supports the specified acceptance criteria, hold and witness points.

Work Supervisor:

- Ensures work group participation in the planning process.
- Supports scheduling activities.
- Ensures that the ALWCD is approved and that work is released.
- Ensures that the prerequisite activities for work have been completed.
- Ensures that hazard controls are implemented.
- Ensures that personnel executing the work have attended the pre-job briefing (or are briefed separately) and are fit to perform work.
- Ensures that the ALWCD workability review is conducted.
- Ensures that the referenced documents are current prior to start of work.
- Ensures that workers are aware of their responsibility to stop or pause work and notify supervision whenever changing conditions, unexpected conditions, or unidentified hazards are encountered or if work practices have the potential to compromise quality or safety.
- Ensures that controls based on the hierarchy of control principles (e.g., hazard elimination or reduction, engineered or administrative controls, or PPE) are clearly delineated in the ALWCDs or supporting documents.
- Ensures the proper turnover of work status when transferring WS responsibilities.
- Ensures that good housekeeping practices are followed during the performance of work and that work areas are cleaned and restored after the completion of work or the work activity cycle.
- Ensures compliance with ALWCDs, including working within scope, documentation of work, and feedback during execution.
- Acknowledges personnel for self-identification and reporting of errors.
- Ensures the proper completion of documentation, including work history.
- Ensures that post-work reviews are conducted.
- Concurs with the ALWCD, confirming workability, as part of the approval process.
- Conducts pre-job briefings to review the scope of work, hazards, and controls with assigned workers.

- Ensures that workers are trained and qualified and that they meet special program requirements (e.g., medical screening and surveillance requirements) to independently perform work.
- Supervises work activities to meet ALWCD requirements.
- Complies with the ALWCD change control process.
- Prepares and submits feedback and lessons learned in a timely manner to capture information for process improvement.

Worker:

- Participates in the work site job or task walkdowns, roundtables, hazard identification, JHA and control selection, and ALWCD development consistent with the contractor's WP&C process.
- Participates in the ALWCD validation walkdown and workability review prior to the start of work to ensure the adequacy of the ALWCD.
- Participates in the pre-job briefing and does not perform work until properly briefed and the scope of work and hazard control strategies are clearly understood.
- Complies with ALWCDs, including working within scope, documenting work, and providing feedback during execution.
- Completes documentation properly, including work history.
- Identifies and proposes the best tools and work practices for the activity.
- Identifies any special material requirements for the work to the WS and work planner.
- Performs only work that he or she is qualified to perform.
- Performs only work that he or she is authorized to perform after work is released by appropriate authority.
- Implements required controls specified in the ALWCD or for general hazards (as prescribed in general safety training, management policy, or as posted for hazard mitigation).
- Completes work activities safely in accordance with the ALWCD.
- Adheres to the requirements of supporting documents, including the RWP and other permits and site-specific waste management instructions.
- Promptly reports unintended failures to follow ALWCD or supporting document requirements.
- Adheres to Stop Work or Pause Work direction and notifies the WS if the work instructions cannot be followed as written, a change of scope is identified, changing conditions or unidentified hazards are encountered, or work practices could compromise safety or the environment.
- Participates in the post-work review and identifies feedback and process improvement opportunities to the WS.

6.1.2 Training Needs and Qualifications

Performance Expectations:

1. The knowledge, skills, and abilities required for performing assigned work are established, documented, and maintained (see 10 CFR 830.122(b) and (d), 48 CFR 970.5223-1(b)(3) and (b)(5), and DOE O 433.1B, Attachment 2, para. 2.g).
2. Personnel possess the knowledge, skills, and abilities required for performing assigned work (see 10 CFR 830.122(b), 48 CFR 970.5223-1(b)(3), DOE O 433.1B,

Attachment 2, para. 2.g, and DOE O 422.1, Attachment 2, Appendix A, para. 2.a(5), 2.a (6)(b), and 2.b(5)(a)).

3. Continuing training is provided, including lessons learned, to maintain and improve proficiency (see 10 CFR 830.122(b) and (d), 48 CFR 970.5223-1(b)(3), DOE O 433.1B, Attachment 2, para. 2.g).
4. Personnel are trained on the activity-level work planning and control process and understand how their function contributes to, and integrates with; the process (see 10 CFR 830.122(b) and (d), 48 CFR 970.5223-1(b)(2) and (b)(3), DOE O 422.1, Attachment 2, Appendix A, para. 2.a.(6)(b), DOE O 433.1B, Attachment 2, para. 2.g).

Good Practices:

Line management is responsible for defining WP&C training requirements for all personnel involved in WP&C program activities, including managers, planners, supervisors, SMEs, and workers. Line management is responsible for ensuring that only qualified personnel who meet the requirements are permitted to perform work independently. The training program and processes need to establish the required competencies and related knowledge, skills, and abilities to support assigned work.

Workers (e.g., crafts, operators, engineers, researchers, specialists) need to possess the skills required to perform the work and to be adequately trained prior to their performing work. Personnel who are not fully trained and qualified for the specific activity should be continuously supervised by qualified personnel.

All personnel with responsibilities for WP&C program activities, including managers, work planners, supervisors, SMEs, and workers, should receive training on the organization's WP&C procedures. ISMS Core Functions (CFs) and Guiding Principles (GPs) and the WP&C program overview should be included in the training programs of personnel with WP&C program responsibilities. Continuing training, focusing on WP&C process changes and lessons learned, should be conducted periodically, taking the form of briefings, issuance of lessons learned, and other forms of communication. Contractor training systems should produce records of the training and qualification of the aforementioned personnel.

The following topics should be included in the training and qualification programs of personnel with WP&C program responsibilities:

All personnel:

- ISMS CFs and GPs;
- WP&C program overview;
- Hazard identification;
- Hazard analysis and control selection processes;
- Work and activity request initiation processes;
- Conduct and oversight of work activities;Hazardous energy control awareness;
- Stop Work/Pause Work policies and procedures to include recognizing and responding to unexpected conditions; and
- Feedback and improvement processes.

Responsible Managers (Project, Site, or Facility Managers; Shift Operations Managers; or WP&C Managers):

- Work request approval, screening, prioritization, and categorization processes;
- ALWCD approval and change control processes;
- Work authorization and scheduling processes;
- Work release process;
- Work acceptance process;
- ALWCD closeout process; and
- WP&C program assessments and oversight.

Work Supervisor:

- Conduct and appropriate use of walkdowns;
- ALWCD compliance;
- Pre-job briefings (including minimum expectations and techniques);
- ALWCD verification and validation;
- ALWCD approval and change control processes;
- Work authorization and scheduling processes;
- Workability review;
- Work release process;
- Work turnover process;
- Work acceptance process;
- ALWCD closeout process; and
- Post-work reviews.

Worker:

- Conduct and appropriate use of walkdowns;
- ALWCD compliance;
- ALWCD validation;
- Workability review;
- Pre-job briefings;
- Work release process;
- Expectations for the conduct of work activities;
- Work acceptance process;
- ALWCD closeout process; and
- Post-work reviews.

Skill of the Worker:

SOW skills are evaluated, defined, and documented by line management based upon accepted industry practices, training and qualification, familiarity with tools and equipment, processes, and methods. See Appendix A for additional discussion on SOW.

Subject Matter Expert (e.g., Radiological Controls, Safety, Industrial Hygiene, Engineering):

- Conduct and appropriate use of walkdowns;
- Incorporation of hazard controls into the ALWCD;
- ALWCD verification;
- Work acceptance process;
- ALWCD closeout process; and
- Post-work reviews.

Planners:
There should be a training and qualification program for planners who are qualified by WP&C management. This program specifies the:

- Education, knowledge, and experience criteria to be included in the position description;
- Organization-, site-, and facility-specific training and qualification requirements;
- Mentoring, disqualification, and the remedial training process; and
- Continuing training requirements.

Planner training and qualification should include the following elements:

- Roles, responsibilities, authorities, and accountabilities of interfacing organizations;
- WP&C program procedures;
- Hazard analysis process procedures;
- Applicable WP&C systems (e.g., types of work performed, processes used, tools, software, ALWCD content, applying lessons learned);
- Incorporation of hazard controls into the ALWCD;
- Work instruction development;
- SOW protocols;
- Conduct and appropriate use of walkdowns;
- Applying applicable requirements, standards, permits, and regulations to work planning;
- The appropriate selection and use of SMEs;
- Facilitation of planning team meetings, walkdowns, and round tables;
- ALWCD verification and validation;
- Technical writing skills; and
- Use of feedback and improvement process outputs.

6.1.3 Supporting ISMS Functional Elements

WP&C, as described here, is an iterative process that incorporates the ISM CFs and GPs to accomplish work safely (see Figure 2).

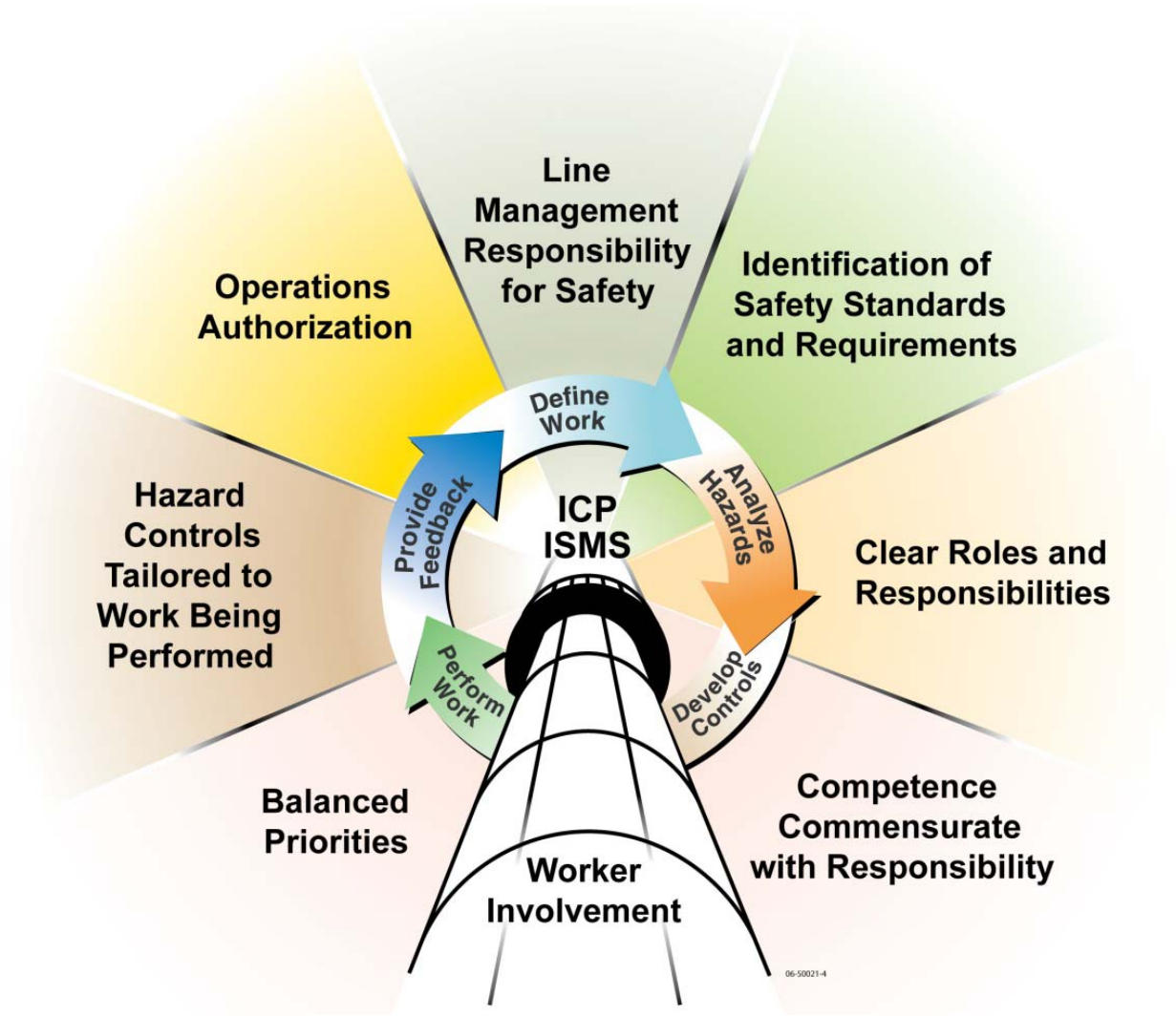


Figure 2: Core Functions and Guiding Principles of ISM (courtesy CH2M•WG, Idaho, LLC)

Performance Expectations:

1. A contractor's ISMS shall be integrated with business processes for work planning, budgeting, authorization, execution, and change control (48 CFR 970.5223-1(e)).
2. Contractors shall ensure that programmatic resources are effectively allocated to address environment, safety, and health (ES&H), programmatic, and operational considerations of an ISMS (48 CFR 970.5223-1(b)(4)).
3. WP&C processes are coordinated (see 48 CFR 970.5223-1(b)(2), 10 CFR 830.122(a) and (d), DOE O 422.1, Attachment 2, para. 2.a(6)(a), DOE O 433.1B, Attachment 2, para. 1.a and 2.b).

Good Practices:

ISM is DOE's management framework for integrating safety programs. Activity-level WP&C is embedded in ISM, as evidenced by the following regulations and directives that address WP&C:

- 48 CFR 970.5223.1, *Integration of Environment, Safety and Health into Work Planning and Execution*
- 10 CFR 851, *Worker Safety and Health Program*
- DOE O 226.1B, *Implementation of DOE Oversight Policy*
- DOE O 422.1, *Conduct of Operations*
- DOE O 433.1B, *Maintenance Management Program for DOE Nuclear Facilities*
- DOE P 450.4A, *Integrated Safety Management Policy*
- DOE O 450.2, *Integrated Safety Management*

DOE G 450.4-1C, Attachment 4, *Work Planning and Execution,* describes how activity-level WP&C fits into DOE's ISMS. In general, operating organizations perform work using both site-wide safety programs (e.g., fire protection and emergency planning) as well as facility- and activity-specific safety processes. Some of these programs are established at the site level to address, for example, radiation protection, environmental protection, industrial hygiene, industrial safety, and emergency planning. Other programs, such as those for configuration management and conduct of operations, are more appropriately specified at the facility or project level. Some processes, such as quality inspection or those used for task-level WP&C, can be specified at the activity level.

All safety control measures, programs, and processes—regardless of the level at which they are specified, and regardless of whether they are mandatory or voluntary—flow down and should be implemented at the appropriate work level to achieve adequate safety (Figure 3). Both DOE and the operating organization should review existing processes and programs to ensure they are properly integrated, flow down to the task or activity level, and adequately address ISMS requirements. For these reasons, an ISMS should include processes for selecting and applying site and facility processes or procedures to use in developing work-specific control measures.

The WP&C process should define work activities and boundaries in sufficient detail to enable work planners and planning teams to incorporate all ISMS functional elements for a defined scope of work and to produce an appropriate ALWCD. The extent of documentation and level of authority for authorizing work to begin can then be graded to the complexity and hazards associated with the work.

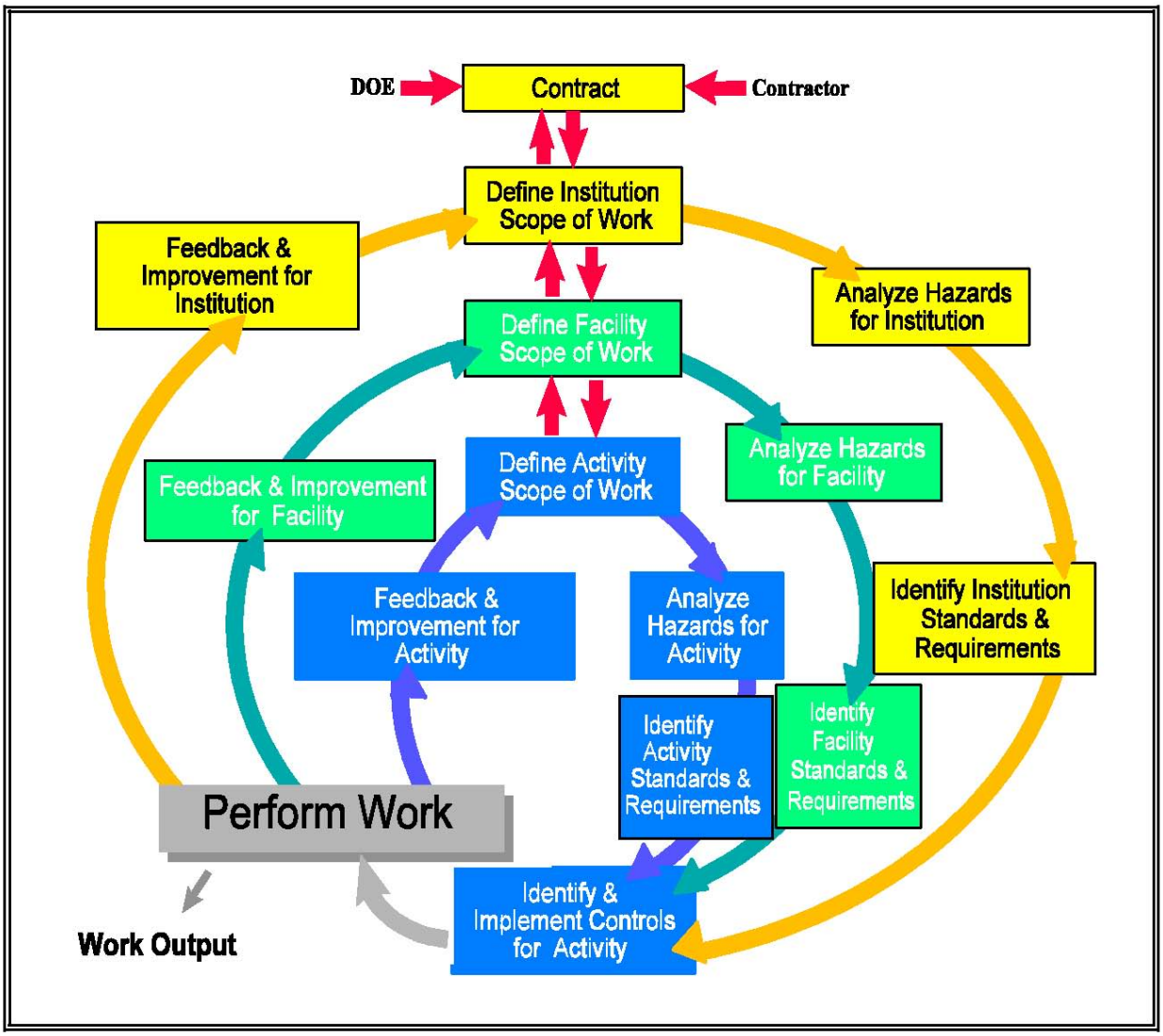


Figure 3: An Illustration of Major Interactions between Organizational Levels for the Five ISM Core Functions

6.1.4 WP&C and Crosscutting Programs

Performance Expectations:

1. The process(es) and requirements for incorporating ISMS CFs and GPs and quality assurance (QA) criteria into activity-level work planning, control, and execution are clearly documented (see 48 CFR 5223-1(b)(2) and (b)(5), 10 CFR 830.122(d) and (e), DOE O 422.1, Attachment 2, para. 2.a(6)(a), DOE O 433.1B, Attachment 2, para. 1.a, 2.a.(1)(b), and 2.a.(2)(a)).
2. The organizational structure, functional roles, responsibilities, levels of authority, accountability, and interfaces for those managing, planning, performing, and assessing work are clearly defined and documented (see 48 CFR 5223-1(b)(1) and (b)(2), 10 CFR 830.122(a), DOE O 433.1B, Attachment 2, para. 1.a, 2.b, and 2.d, DOE O 422.1, Attachment 2, para. 2.a.(1), 2.a(3) and 2.a.(4)).

Good Practices:

Worker Safety and Health Program

ALWPC activities should integrate with the requirements and guidance for hazard identification, assessment, and prevention in DOE's Worker Safety and Health Program, which is defined by:

- 10 CFR 851, *Worker Safety and Health Program*, and
- DOE G 440.1-1B, Admin Chg 1, *Worker Safety and Health Program for DOE (Including the National Nuclear Security Administration) Federal and Contractor Employees*.

Configuration Management Process

An effective configuration management process can provide confidence that information used to plan work is accurate and up to date. DOE-STD-1073-2003 provides detailed expectations and examples for developing configuration management processes for DOE facilities and activities. DOE O 420.1C requires contractors to establish configuration management processes for all Hazard Category 1, 2, and 3 nuclear facilities. Per DOE-STD-1073-2003, WP&C processes should ensure that when work activities are performed, consistency is maintained between design requirements, the physical configuration of the facility or activity, and relevant documentation (including analyses, drawings, and procedures).

Personnel authorized to approve work should ensure that the change control process is executed to identify changes that could impact the safety basis. If, during the performance of work, additional changes affecting the safety basis are identified, these changes should also undergo the change control process, including the USQ process, and work should not resume until the changes have been analyzed and approved. A post-work review is particularly important for work that was performed on an emergency basis where limited time was available for work planning. Document control and change control processes can ensure that developed and revised documents are maintained current and available to the users.

WP&C procedures should ensure that the site or facility configuration management process is effectively implemented so that design and physical configuration of the facility or activity, as well as the relevant documentation (including analysis, drawings, and procedures), are maintained up-to-date when work activities are completed.

Maintenance Management Program

DOE O 433.1B, Admin Chg 1, *Maintenance Management Program for DOE Nuclear Facilities,* requires DOE facility operators to develop and implement a Nuclear Maintenance Management Program (NMMP) for Hazard Category 1, 2, and 3 nuclear facilities.

DOE G 433.1-1A, *Nuclear Facility Maintenance Management Program Guide for Use with DOE O 433.1B,* includes detailed guidance in Section D, "Planning, Scheduling, and Coordination of Maintenance," that relates directly to activity-level WP&C for maintenance of safety SSCs. The maintenance management program includes the process for planning, scheduling, coordination, and control of maintenance activities,

and emphasizes equipment availability. The process includes the application of a cognizant system engineer (CSE) program in accordance with DOE O 420.1C, *Facility Safety,* in the planning and execution of maintenance activities.

Key considerations for the control of maintenance activities are:

- A maintenance program should be integrated with the WP&C program and with ISMS.
- Coordination is needed where various groups (e.g., mechanical, electrical, instrumentation and control) are involved in a work activity or are concurrently working in the same area.
- The WP&C program should ensure that work activities are consistent with the facility safety basis and effectively identified, initiated, planned, approved, scheduled, coordinated, performed, and reviewed for adequacy and completeness.
- The program should ensure the availability and operability of the safety SSCs that are a part of the facility's safety basis.
- The WP&C system should provide the data necessary to properly plan and schedule maintenance activities.
- The maintenance organization should establish high qualification standards for all personnel supervising and performing maintenance activities.
- Maintenance management should oversee work to ensure that it is conducted in accordance with DOE, contractor, and facility policies and procedures.
- Configuration control is maintained by ensuring that systems and equipment are restored to their original condition following maintenance.

Quality Assurance Program

DOE and its contractors are required to achieve quality for all work based upon the principles and requirements of the quality assurance program (QAP), as specified in:

- 10 CFR Part 830, Subpart A, *Quality Assurance Requirements*; and
- DOE O 414.1D, *Quality Assurance*.

In addition, the contracts for construction, operations, maintenance, and D&D for many of DOE's Hazard Category 1, 2, and 3 nuclear facilities include the following consensus standard:

- NQA-1-2008, *Quality Assurance Requirements for Nuclear Facility Applications,* with the NQA-1a-2009 addenda.

DOE has also issued DOE G 414.1-2B, Quality Assurance Program Guide, which provides information on principles, requirements, and practices used to establish and implement an effective QAP for nuclear facilities consistent with the requirements of DOE O 414.1D and 10 CFR Part 830, Subpart A. All 10 QA criteria listed in DOE O 414.1D and 10 CFR 830.122 are directly relevant to activity-level WP&C at Hazard Category 1, 2, and 3 nuclear facilities.

6.1.5 Conduct of Operations Relationship to WP&C

Performance Expectations:

1. Organizational structure, functional roles, responsibilities, levels of authority, accountability, and interfaces for those managing, planning, performing, and assessing work are clearly defined and documented (see 48 CFR 970.5223-1(b)(1) and (b)(2), 10 CFR 830.122(a), DOE O 433.1B attachment 2, para. 1.a and 2.b, DOE O 422.1, Attachment 2, Appendix A, para. 2.a.(1) and 2.a.(4)).
2. Personnel are trained on the activity-level work planning and control process and understand how their function contributes to and integrates with the process (see 10 CFR 830.122(b) and (d), 48 CFR 970.5223-1(b)(2) and (b)(3), DOE O 422.1, Attachment 2, para. 2.a(6)(b) and 2.b(5)(a), DOE O 433.1B, Attachment 2, para. 2.g).
3. WP&C processes are coordinated (see 48 CFR 970.5223-1(b)(2), 10 CFR 830.122(a) and (d), DOE O 422.1, Attachment 2, para. 2.a(6)(a), and DOE O 433.1B, Attachment 2, para. 2.b).
4. A graded approach methodology is incorporated into the WP&C process that determines the rigor for implementing these work planning and control attributes based on the significance and associated consequences of the activity (see 48 CFR 970.5223-1(b)(4) and (b)(6), DOE O 433.1B, Attachment 2, para. 2.h).

Good Practices:

DOE O 422.1, *Conduct of Operations,* states: “A Conduct of Operations Program consists of formal documentation, practices, and actions implementing disciplined and structured operations that support mission success and promote worker, public, and environmental protection.” Conduct of Operations is a time-tested process that seeks to ensure that management systems are in place to reduce human error, system failures, and latent hazardous conditions.

The term “operations” in DOE encompasses the work activities of any facility or organization, from building infrastructure to scientific research and nuclear facilities. Examples include, but are not limited to, operating science and technology machines, operating equipment, construction, decontamination and decommissioning, dismantlement, environmental characterization and monitoring activities, waste handling, research and development, maintenance, and laboratory analysis activities.

Given the above, the term “operations” is synonymous with “activity-level work,” as defined in this Handbook. However, for facilities with routine, day-to-day operations, management of Conduct of Operations may not necessarily reside in a WP&C organization or be applicable to the entire WP&C program.

For example, an operations organization may control operations procedures, such as alarm response and valve checklist procedures. Operator rounds may not need to be listed on a daily schedule. Normal operating procedures could be performed as standalone documents. This will vary, as no two facilities or organizations are alike.

Nonetheless, ISMS is involved in all aspects of operations. Conduct of Operations supports ISMS by providing techniques and practices to identify and analyze the

hazards, develop and implement hazard controls, and perform work within controls. Conduct of Operations is one of the safety management programs recognized in 10 CFR Part 830, *Nuclear Safety Management*.

6.1.6 Research and Development Activities' Relationship to WP&C

Good Practices:

This Handbook is applicable to R&D activities to the extent that they are consistent with ALW as defined in Section 5.0. Likewise, DOE O 422.1, *Conduct of Operations,* states that the term "operations" is defined as a "general term to encompass the work activities accomplished by [a] facility or project," including, but not limited to, "…operating science and technology machines,…research and development,…and laboratory analysis activities." Managing R&D ALW sometimes calls for a delicate balance between the R&D objective, the operational bounds of the facility, and the hazards associated with the R&D project. The R&D objective may be achieved through various processes to satisfy ISM and WP&C requirements.

A researcher might have multiple active R&D projects, ranging from continuous operations (e.g., material aging), to campaign operations (e.g., R&D with variable changes), to one-time activities (e.g., R&D testing). Each of these projects can range from simple to complex, those with standard industrial hazards to those with unique hazards, and those well suited to institutional WP&C processes to those requiring additional processes to safely address unique hazards. As with other types of ALW, a laboratory's process for safely planning, controlling, and executing R&D activities should be commensurate with the hazards and complexity of the work.

Laboratory WP&C programs, processes, and procedures should address the hazards, complexity, and work environment during the planning, control, and execution of R&D project work. Workers and ES&H SMEs should be routinely engaged by project managers to contribute expert-based identification and analysis of hazards and develop controls consistent with applicable programmatic requirements and standards. Management, worker, and SME reviews of R&D ALWCDs should focus on the hazards associated with the activity. Safety committees are a useful resource for reviewing projects and identifying applicable standards for certain hazards (e.g., ALARA, biological, laser, electrical) as needed. Changes to work scope should be evaluated to determine any new or changing hazards and the need to adjust controls or modify the method of project execution.

6.1.7 Supporting Facility-Level Documents

Performance Expectation: Organizational structure, functional roles, responsibilities, levels of authority, accountability, and interfaces for those managing, planning, performing, and assessing work are clearly defined and documented (see 48 CFR 970.5223-1(b)(1) and (b)(2), 10 CFR 830.122(a), DOE O 433.1B, Attachment 2, para. 1.a and 2.b, and DOE O 422.1, Attachment 2, Appendix A, para. 2.a).

Good Practices:

Integrated Safety Management can be viewed as having three levels: institutional, facility, and activity. Integration of all three levels needs to be effective for activity-level work to be planned and safely executed. Some of the key institutional-level interfaces

necessary for successful activity-level WP&C were described earlier in this section of this Handbook. The following is a discussion of facility-level interfaces.

DOE rules and directives addressing nuclear safety require the development of facility-level documents that, collectively, form the basis for safety and operation of a nuclear facility. Activity-level WP&C programs and procedures at DOE nuclear facilities should be integrated with the facility-level nuclear safety documents and other institutional-level documents (e.g., ISM System Description, Worker Safety and Health Program), to ensure that the planned work is consistent with safe operations.

The following is a brief summary of key facility-level documents:

Documented Safety Analysis (DSA)

The DOE nuclear safety rule, 10 CFR Part 830, *Nuclear Safety Management,* establishes requirements for contractors to ensure that the facility-level safety basis is applied and maintained for all work in the facility. Section 830.202, *Safety basis,* states:

> (a) The contractor responsible for a hazard category 1, 2, or 3 DOE nuclear facility must establish and maintain the safety basis for the facility... (4) Prepare a documented safety analysis for the facility; and (5) Establish the hazard controls upon which the contractor will rely to ensure adequate protection of workers, the public, and the environment.

Technical Safety Requirements (TSRs)

Specific limits, controls, and related actions are established in TSRs to describe the specific parameters and requisite actions for the safe operation of a nuclear facility. These limits, controls, and related actions are established consistent with the identified hazards and work permitted in the facility. Section 830.205 of the Nuclear Safety Rule states that: "(a) A contractor responsible for a hazard category 1, 2, or 3 DOE nuclear facility must: (1) Develop technical safety requirements that are derived from the documented safety analysis."

Unreviewed Safety Question (USQ) process

The USQ process is an important tool to evaluate whether changes affect the safety basis. The contractor's use of the process ensures that the safety basis for the facility is not undermined by changes in the facility, the work performed, the associated hazards, or other factors that support the adequacy of the safety basis. The USQ process provides the contractor with the flexibility to conduct day-to-day operations by requiring that only those changes and tests with a potential to impact the safety basis be approved by DOE. 10 CFR 830.203(d) provides the specific requirements.

As part of ALWCD approval (see Section 6.4.5), the USQ determination process is applied after the ALWCD completes verification and validation. This determination serves as a benchmark for whether the safety basis is being preserved.

Additional Facility-Level Documents

Other facility safety plans or specific operations safety plans developed for and maintained by the facility operations, engineering, or safety organizations may also be used by the work planning team to help ensure that the planned work is consistent with these safety documents.

6.1.8 The Graded Approach and Tailoring in WP&C

Performance Expectations:

1. A graded approach methodology is incorporated into the work planning and control process that determines the rigor for the level of analysis, documentation, and actions, commensurate with the activity-specific and facility-specific factors listed in the definition in 10 CFR 830.3 (see 48 CFR 970.5223-1(b)(4), 10 CFR 830.3, and DOE O 433.1B, Attachment 2, para. 1.a, and 2.h).
2. Administrative and engineering controls to prevent and mitigate hazards are tailored to the work being performed and associated hazards. Emphasis should be on designing the work and/or controls to reduce or eliminate the hazards and to prevent accidents and unplanned releases and exposures (48 CFR 970.5223-1(b)(6)).

Good Practices:

Contractor line management may apply a graded approach and tailoring based on the complexity and hazards of individual work activities or the collective scope of work activities at a given facility. The logic, method of implementation, and basis for grading should be documented and communicated, and the necessary degree of rigor should be documented by work processes.

Emphasis should be on designing the work and controls to reduce or eliminate the hazards and to prevent accidents and unplanned releases and exposures. The purpose of grading is to determine the level of effort, degree of detail, and rigor of application of the WP&C guideline elements, remaining consistent with their importance to safety when planning work. The purpose of tailoring is to determine the types of controls that are appropriate to the hazards associated with the planned work. Neither grading nor tailoring may be used to implement the USQ process or hazard controls that are documented in approved TSRs.

A thorough analysis of the hazards associated with the work is used to ensure that the degree of detail and formality in planning the work, identifying and implementing hazard controls, developing work instructions, specifying worker qualifications and skills requirements, and determining the amount of field supervision required are appropriate for ensuring that work is accomplished safely and reliably.

The graded approach considers the safety classification of the equipment impacted by the work (i.e., safety-class, safety-significant, defense-in-depth, worker safety-related) and the assumptions concerning equipment availability, operation, and performance that are documented in the applicable facility safety basis documents. Safety system CSEs, facility DSA safety analysts, and SMEs should be used to ensure that defense in depth is not unacceptably compromised.

The graded approach is applied to an organization's WP&C program and processes to ensure that the level of analysis, associated documentation, and related actions are commensurate with the complexity of the work, performance risk, and the following activity-specific or facility-specific factors:

- The impact or consequences on safety, safeguards, and security;
- The types of hazards (radiological, biological, chemical, physical) and associated consequences involved if not properly controlled;
- The relative importance of radiological and non-radiological hazards;
- The lifecycle stage of a facility or activity;
- The impact or consequences on the programmatic mission of a facility;
- The particular characteristics of a facility or activity; and
- Any other relevant factors.

Work activities should be described at a level of detail that allows work planners to ensure acceptable results given the complexity of the work, frequency of performance, the significance of the work, the hazards associated with the work, and worker knowledge and experience. The quality of work planning activities should be sufficient to ensure safe and reliable performance of work. WP&C procedures should provide the work planner and work planning team with clear guidance on applying the graded approach in a manner that ensures thorough planning, facility and worker safety, public safety, and protection of the environment while allowing the appropriate flexibility to accomplish work without imposing overly conservative or unnecessary restrictions, costs, or burdens.

Contractors may apply the graded approach to classes or categories of facilities or activities (e.g., roof replacement on office buildings as a class), but care should be exercised to ensure that the characteristics of a particular work instance are consistent with the assumptions and analysis used to grade the class. Legacy hazards in re-purposed buildings may need to be addressed. Also, the grading for a roof replacement on a chemical laboratory building is likely inconsistent with the grading that may be documented for working on office buildings. In both instances, a separate grading should be performed considering applicable factors and criteria to determine the necessary controls.

The logic, method of implementation, and basis for grading should be documented and communicated, and the necessary degree of rigor should be documented by work processes (procedures, instructions, specifications, and controls).

6.1.9 Measuring System Effectiveness for Activity-Level WP&C

Performance Expectations:

1. Organizations use their assessments and issues management processes to drive WP&C improvements (see 48 CFR 970.5223-1(b)(1) and (c)(5), 10 CFR 830.122(c), (i) and (j), DOE O 422.1, Attachment 2, para. 2.a(3), DOE O 433.1B, Attachment 2, para. 1.a, 2.o, and 2.p).
2. On an annual basis, the contractor shall review and update, for DOE approval, its safety performance objectives, performance measures, and commitments consistent

with and in response to DOE's program and budget execution guidance and direction (48 CFR 970.5223-1(e)).

Good Practices:

Measurement is the key to improving towards, or sustaining, excellent performance. Some metric attributes include:

1. A change in performance should result in visible change in the chosen metric(s).
2. A change in the metric(s) means performance has changed.
3. The metric should incentivize the organization to undertake positive actions.
4. Performance measurement data needs to be easy to gather; otherwise, it will be inaccurate or poorly acted upon.

Performance expectation #2 can be applied to activity-level WP&C and the ISMS. Safety performance objectives, measures, and commitments should consider:

- The context and operational definitions of objectives, measures, and commitments.
  - Identifying the processes that accomplish the objectives, measures, and commitments.
  - Deciding on the measures in the processes that are relevant to performance.
  - Setting up data sources and gathering the data that can be analyzed to provide the results of the measures. Performance measures data should be replicable.
- Robust performance measurement approaches (e.g., leading/lagging indicators and trending).

DOE G 450.4-1C, *Integrated Safety Management Guide*, Attachment 13, "Safety Performance Objectives, Measures, and Commitments," provides an overview and detailed information concerning the implementation of ISMSs.

Additional information about measuring activity-level WP&C performance is provided in Appendix B of this Handbook. It provides a list of candidate WP&C performance measures (referred to as "metrics" in the Appendix) that were derived from a survey of 15 of DOE's major sites and 6 external organizations with extensive WP&C experience.

6.2. Defining the Scope of Work

6.2.1 Work Identification and Request

Performance Expectation: A defined process is used to identify and request work (see 48 CFR 970.5223-1(b)(5) and (c)(1), 10 CFR 830.122(d) and (e), DOE P 450.4A, DOE O 433.1B, Attachment 2, para. 1.a).

Good Practices:

The work activity should be identified in sufficient detail and clarity so that the hazards associated with the work can be identified; appropriate controls can be selected; and appropriate schedules and priorities can be established. A work identification process

should allow anyone in the organization to submit requests for work and allow others to supplement the request with relevant information for effective screening, validation, and prioritization.

The following is a list of possible elements to include in the work identification process:

- Name of requester and contact information,
- Detailed description of the activity or issue, including previously identified or known hazards,
- Detailed location of the activity (facility name/building number/room number),
- Information from a preliminary scoping walkdown,
- Unique identifier for the applicable SSCs,
- Identification of DSA information (e.g., hazard categorization, SSC safety designation, TSRs), and the
- Requested date for completing the activity.

6.2.2 Work Screening, Validation, Prioritization, and Backlog Control

Performance Expectations:

1. A defined process is used to prioritize requested work; work priority is managed to achieve integration among all necessary interfaces (see 48 CFR 970.5223-1(b)(2) and (b)(4), 10 CFR 830.122(a), (d), and (e), and DOE O 433.1B, Attachment 2, para. 1.a).

2. Procedure scope and applicability are readily apparent (DOE O 422.1, Attachment 2, Appendix A, para. 2.p(3) (a)).

Good Practices:

Work screening is the first step to determine whether the work needs to be performed and whether the description of work is adequate. This screening evaluation is preliminary and does not preclude changes later (e.g., USQ screening determinations) in the work planning process. Screening considerations may include:

- Corrective action program applicability;
- Evaluation of the activity against any facility or safety basis impact; and
- Evaluation of the need for additional support from functional areas such as safety and security disciplines.

Validation is the outcome of the work screening process and should be completed in order for the work planning process to proceed with prioritization activities. Work prioritization should consider:

- Operational need,
- Resource constraints (e.g., personnel availability, status of procurement actions),

- Special controls required (e.g., facility conditions required for the work),
- Level of planning required, and
- Possible efficiencies gained by coordinating work planning to coincide with other activities requiring, for example, the same shutdown at the same location.

Collaboration among cognizant groups is important to enable the work planning team to set and establish priorities. Figure 4 illustrates a priority system from the DOE maintenance guide (DOE G 433.1-1A).

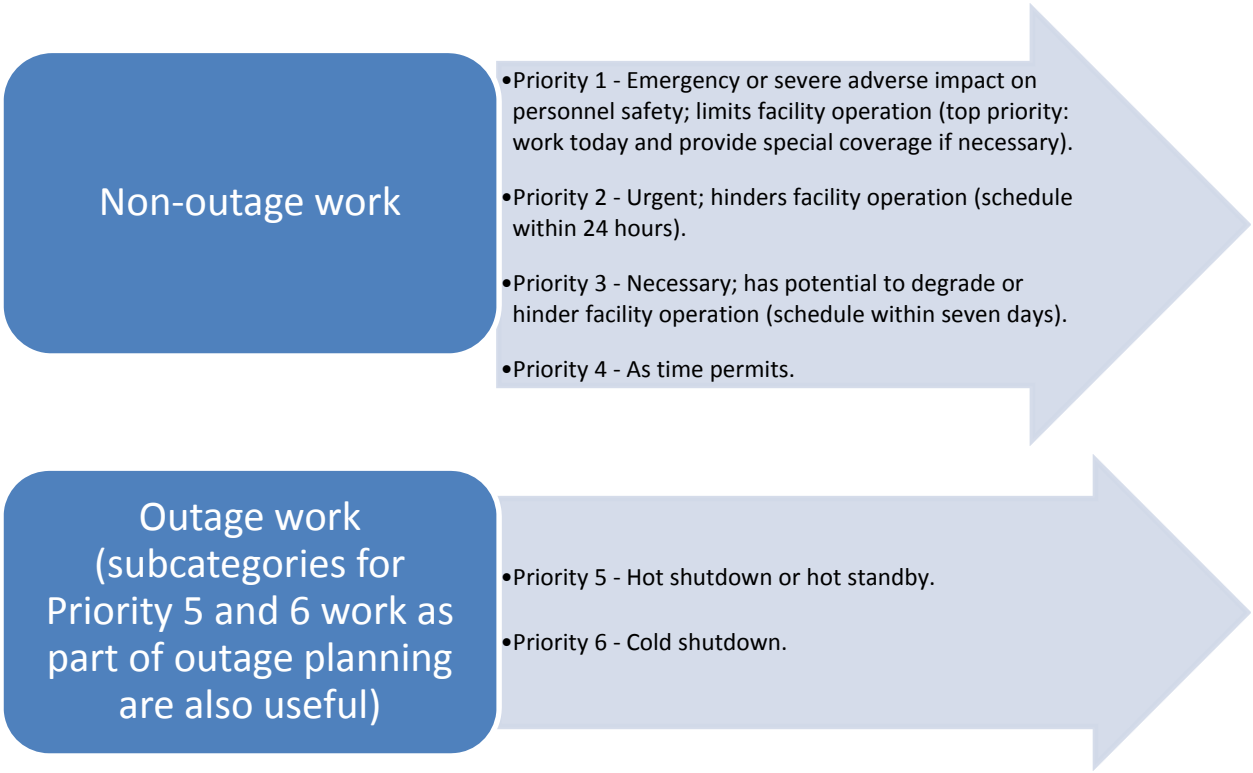


Figure 4: A Prioritization System (from DOE G 433.1-1A)

Backlog is work that is requested, but not complete. It is commonly used as a performance indicator of organizational effectiveness. Backlog work should be reviewed periodically, as determined by the organization, to validate the continued accuracy and prioritization of documented deficiencies and needed work. The system should provide a list of work requests with a brief description of work required, priority assigned, date initiated, and plant conditions required for performing the work. Reviews are most effectively conducted on a predetermined frequency to identify issues and trends for work that has not been completed. Backlog reviews determine how to re-prioritize the work request or whether it is still applicable. Factors that may need resolution and could prompt re-prioritization decisions can include:

- Does the work affect nuclear safety?
- Does the work affect safety or safeguards and security systems?

- If the work is not performed, could public safety, worker safety, safeguards and security, or the environment be degraded?
- Will the Department's program missions be degraded if the work is not performed?
- Will there be any regulatory consequences if the work is not performed?
- Are there resource issues or other conflicts inhibiting the work?

6.2.2.1 Emergency Work

Performance Expectation: A defined process is used to prioritize requested work; work priority is managed to achieve integration among all necessary interfaces (see 48 CFR 970.5223-1(b)(2) and (b)(4), 10 CFR 830.122(a), (d), and (e), and DOE O 433.1B attachment 2, para. 1.a).

Good Practices:

Emergency work should not be used to fast-track other work. To uphold the rare application of emergency work, it should be approved and released by senior management or qualified designee (e.g., facility managers, shift managers or other qualified designees). The WP&C program separately identifies high priority work through normal approval processes.

Emergency work processes should contain provisions for:

- Senior manager or qualified designee approval and release of emergency work;
- Entry criteria for emergency work, e.g.:
  - Prevent an accident or mitigate consequences following an accident.
  - Prevent or mitigate imminent danger to personnel, property, or the environment (e.g., release of or exposure to radioactive material or hazardous chemicals).
  - Prevent or mitigate a significant breach in security.
  - Restore ability to obtain critical information or provide critical functions following a serious impairment.
- A structured process to document all emergency work performed;
- Use of workers, SMEs, and supervisory resources in real-time to analyze hazards, identify controls, and safely execute work within controls;
- SMEs to provide real-time guidance for addressing safety and technical issues and providing necessary hold, inspection, witness, or verification points to indicate work was performed per current standards;
- Conducting a pre-job brief;
- Work to be accomplished without delay or interruption until the condition is stabilized;
- Testing required and acceptance criteria;
- Conducting a post-work review; and

- The final disposition of WP&C documents used and their retention requirements.

6.2.2.2 Systematic Testing and Repairs of Failed Components

Performance Expectations:

1. Define the work scope by identifying all activities required to complete the work (48 CFR 970.5223-1(c)(1), 10 CFR 830.122(d) and (e), and DOE P 450.4A).
2. Procedure scope and applicability are readily apparent (DOE O 422.1, Attachment 2, Appendix A, para. 2.p(3) (a)).

Good Practices:

Troubleshooting is the process of locating and identifying malfunctions through deductive and inductive reasoning or testing. The process includes activities such as identifying components or systems to be evaluated, providing an expectation of outcome, and identifying repair actions to be made based on evaluation results. Troubleshooting and the resulting repair actions should be performed on separate ALWCDs unless the failures can be narrowed to a limited number of components based on systems design. In that case, it is permissible to systematically test and repair or replace those components on an ALWCD provided that an approved revision to the ALWCD is completed. Areas of consideration for such work include:

- Individually sequence each testing activity and repair or replacement activity in the work document and identify the hazards and controls for each activity.
- Identify components or systems to be evaluated (including applicable hazard identification and mitigation), providing an expectation of evaluation outcome, identifying repairs to be made based on evaluation results, and specifying the testing for the specific repairs.

6.2.3 Work Scope Development

Performance Expectations:

1. Define the work scope by identifying all activities required to complete the work (48 CFR 970.5223-1(c)(1), 10 CFR 830.122(d) and (e), 10 CFR 830.202(b)(1), and DOE P 450.4A).
2. Procedure scope and applicability are readily apparent (DOE O 422.1, Attachment 2, Appendix A, para. 2.p(3) (a)).

Good Practices:

Development of a complete, detailed, and accurate scope of work establishes the foundation for the remaining portions of the work planning process. Considerations to address include:

- Identifying the necessary tasks for accomplishing the assigned work scope in order to identify hazards (i.e., what to do);
- The mechanisms/approaches for completing the assigned work scope (i.e., how to do it);

- The established boundaries for completing the assigned work scope (i.e., information to help prevent "scope creep" and work location); and
- The work type (e.g., maintenance, projects, operations, R&D).

Sufficient time and resources should be allocated for this activity to be successful. The requestor should describe the requested work activity scope and boundaries in sufficient detail to allow the work planning team to determine the necessary tasks and associated steps so that all hazards can be identified and analyzed, appropriate controls established, and adequate work instructions developed. The work should be accurately described, bounded, and clearly communicated through the ALWCDs. To some extent, work scope development is iterative (see Section 6.4.3.1).

An initial scoping walkdown may be performed, as determined by the RM or work supervisor. These walkdowns (which may be performed by an individual or a team) may be necessary to refine the scope of a particular activity and facilitate hazard identification. The number of walkdowns and the personnel needed to participate in the walkdowns varies depending on the complexity and hazards of the activity. Scoping walkdowns often facilitate later work planning efforts in hazard identification and in developing JHAs and ALWCD. For activities requiring an ALWCD, the scoping walkdowns may facilitate the planning team's efforts in developing draft work instructions and hazard identification for use in the JHA process.

The work scope should be developed considering the following types of information:

- The purpose and type of activity or work being performed, the location, and the desired outcome;
- A list of specific tasks necessary to accomplish the scope of work;
- Principal types of hazards directly involved or expected to be encountered, especially unique hazards involved with both the activity and the work environment;
- Closely associated or collocated work activities, systems, or components that are not part of the scope;
- Uncertainties that could affect the performance of facility systems;
- Historical facility documentation and process knowledge;
- Lessons learned applicable to the work to be performed;
- Nuclear safety and environmental impacts that could result from performance of the work or special techniques or tools that might challenge the facility or site safety basis; and
- Any special tools or techniques to be used that could introduce hazards.

6.2.4 Planning Team

Performance Expectation: Organizational structure, functional responsibilities, levels of authority, and interfaces are established for those managing, performing, and assessing the work (see 48 CFR 970.5223-1(b)(1) and (b)(2), 10 CFR 830.122(a), DOE O 433.1B, Attachment 2, para. 1.a and 2.b, and DOE O 422.1, Attachment 2, Appendix A, para. 2.a(1)).

Good Practices:

Planning teams should be established for the planning of work activities that are complex or potentially hazardous. The team can assist in the development of all phases of ALWCD preparation. Planning team members should have detailed knowledge of organizational WP&C processes and procedures. The planning team should include, at a minimum, a worker, a work planner, and a safety professional. In some cases, planning support from in-place permit processes and other approval processes are sufficient to supplement the work planner. See Appendix C for good practices in collaborative team approaches.

Performance Expectation: Personnel with the appropriate functional area expertise are used to plan the work (see 48 CFR 970.5223-1(b)(2) and (b)(3), 10 CFR 830.122b and d, and DOE O 422.1, Attachment 2, Appendix A, para. 2.a(6)).

Good Practices:

Personnel to consider for planning team participation include the following:

- Person-in-charge/RM,
- Work supervisor,
- Worker,
- System engineer
- Facility management representatives, and
- SME representatives (technical and ES&H professionals):
  - Radiological Control,
  - Engineering,
  - Industrial Hygiene,
  - Industrial Safety,
  - Environmental,
  - Nuclear Safety,
  - Fire Protection,
  - Security,
  - Operations,
  - QA, and
  - Other SMEs.

When feasible, the planning team should conduct planning activities as a single group. This is essential for complex, hazardous work where many SMEs with relatively narrow scope can better address the full work scope.

Workers should be involved in the work planning process to lend the benefit of their knowledge and experience, to communicate their concerns, and to provide their input concerning workability, preferred methods and approaches.

The planning team should communicate the scope of the planned work to the operations organization to determine:

- The facility conditions under which the work can be performed;
- Operating modes to be established before the work can be accomplished for work affecting operating facilities;
- The proposed scope and method for accomplishing post-work testing intended to verify operability;
- Criteria for returning equipment to service, and
- Criteria for restoring facility conditions and operating modes.

6.2.5 Acceptance Criteria

Performance Expectation: Establish acceptance/performance criteria to verify completion of the work (see 10 CFR 830.122(d), (e), and (h), DOE O 433.1B, Attachment 2, para. 2.q, and DOE O 422.1 Attachment 2, Appendix A, para. 2.h(5)(d)).

Good Practices:

An important element of defining the scope of work is establishing clear acceptance criteria that determine whether the work was performed successfully. The level of formality of the acceptance criteria and associated documentation should be commensurate with the complexity, hazards, or mission significance of the work. This level of formality could range from none for low-hazard, simple tasks (e.g., relocating simple laboratory equipment, staging non-hazardous materials or equipment, or general cleanup) to specific acceptance criteria for higher-hazard, complex, or mission-critical tasks (e.g., performance criteria and functional requirements for safety SSC maintenance). Acceptance criteria development is addressed in Section 6.4.3.2.

6.3. Planning the Work – Identify and Analyze Hazards

DOE regulations state that work planning is required to ensure that all hazards have been identified and analyzed. This section describes common methods for conducting hazard identification, hazard analysis elements and documentation, and the objective of the hazard analysis walkdown and rountable review. Identifying and analyzing hazards includes addressing:

- Potential hazards (e.g., hazards unique to the activity, legacy hazards, collocated work area hazards);
- Likely consequences of the hazards;
- Likelihood of occurrence; and
- Other contributing factors (e.g., environmental, weather, aging, human factors, etc) that have an impact on hazards.

6.3.1 Hazard Identification

Performance Expectation: Identify hazards with the work and the work environment; including potential undesirable events for the protection of workers, the public and the environment (see 48 CFR 970.5223-1(c)(2), 10 CFR 830.122(e) and .202(b), 10 CFR 851.21(a), DOE P 450.4A, DOE O 433.1B, Attachment 2, para. 2.d, and DOE O 422.1 Attachment 2, Appendix A, para. 2.i(a)(1), (b), and (c)).

Good Practices:

Hazard identification is most effectively performed using the planning team approach. The safety basis requirements of 10 CFR Part 830 requires the contractor responsible for a DOE nuclear facility to analyze the facility, the work to be performed, and the associated hazards. The worker safety and health requirements of Part 851 require contractors to establish procedures to identify existing and potential workplace hazards and assess the risk of injury and illness associated with them. Hazard identification may also include hazards that may impact facility resources. Hazard identification methods should satisfy the required elements for nuclear safety management and worker safety and health programs.

Activity-level hazard identification should address the hazards associated with individual tasks and associated steps. There is no single ideal system of hazard identification. The most appropriate systems vary to some extent with the work involved, and there is usually the need for a combination of methods to be used. Hazard identification should consider:

- Specific areas and activities of the work environment;
- Processes performed; and
- Occupations and their related tasks.

Hazards associated with specific work areas or processes may be found within facility-level documents (see Section 6.1.6). Information collected from the appropriate hazard identification techniques may then be used to perform a hazard analysis.

6.3.2 Identify Safety Requirements, Standards, and Guidance

Performance Expectation: Identify standards and requirements to address the hazards associated with the work and the work environment; including potential undesirable events, for the protection of workers, the public and the environment (see 48 CFR 970.5223-1(b)(5) and (c)(2), 10 CFR 830.122(e) and 202(b)(2), 10 CFR 851.20(a)(4) and .23, DOE P 450.4A, DOE O 433.1B, Attachment 2, para. 2.d, and DOE O 422.1, Attachment 2, Appendix A, para. 2.a(6) and 2.i(a)(1), (b), and (c)).

Good Practices:

Work planning includes identifying DOE's safety requirements, standards, and guidance that apply to the identified work activity hazards. Contractors should ensure that work is planned in accordance with applicable regulations and those requirements and standards in their contract while considering available guidance, manufacturer's information, and other resources to ensure that all relevant hazards are identified.

Other sources of requirements, standards, and guidance include facility design basis and safety basis information, operating experience and lessons learned, injury and illness data, and other resources.

6.3.3 Hazard Analysis

Performance Expectation: Analyze the hazards with the work and the work environment; including potential undesirable events (e.g., “what-if” scenarios), and select controls necessary for the protection of workers, the public and the environment (see 48 CFR 970.5223-1(b)(6), (c)(2) and (c)(3), 10 CFR 830.122(e), 10 CFR 851.121(a)(1)-(8), DOE P 450.4A, DOE O 422.1, Attachment 2, Appendix A, para. 2.a(6)), and DOE O 433.1B, Attachment 2, para. 1.a and 2.d).

Good Practices:

The objective of hazard analysis is to develop a comprehensive understanding of the hazards associated with an activity.

Activity-level hazard analysis has a different emphasis than facility-level hazard analysis, since it is primarily focused on worker protection. However, there is an important linkage between facility-level and activity-level hazard analysis in terms of the flow of hazards information and data. Facility-level information and assumptions related to hazardous material inventory (e.g., quantity, form, and location) feed into a activity-level hazards analysis in order to help identify the range, types, likelihood and consequences of potential hazards that workers may encounter while carrying out their duties (e.g., valve maintenance on a high-pressure liquid hazardous waste line). Conversely, activity-level hazards analysis may yield insights into hazards that have not been adequately covered within the facility-level analysis and, as such, may warrant further evaluation.

An effective approach used at many DOE sites is to begin with a work screening process that considers the complexity of work to be performed and potential hazards associated with the activity. These factors determine the necessary safety disciplines that should be involved in the hazards analysis, the level of analysis required, and the documentation (e.g., work permits, work instructions) required to authorize work.

The hazard analysis should be based on the following principles. It should:

- be comprehensive and systematic;
- be qualitative and/or quantitative;
- distinguish between activity-wide or task-specific hazards and controls;
- be complementary to other safety studies;
- use established methods and data; and
- review the adequacy of existing controls.

A hazards analysis considers events and actions, planned and unplanned, as well as potential failures of equipment, processes, people, and procedures.

Several DOE sites have employed computer-based tools to help automate activity-level hazard screening and analysis. Most of these systems provide electronic linkages to safety-related requirements and guidance, as well as specific facility and hazards information. Some systems go even further by providing checklists or questions that help guide planning teams through hazard analysis.

Hanford, for example, links the automated job hazard analysis with WP&C, medical, training, and human resource systems. With decommissioning in progress, reduced operational facilities, increased use of sub-contractors, and use of matrix workers in resource pools at the site, supervisor and planner knowledge of qualifications became more challenging. The integrated system architecture has helped consolidate and reduce data entry, track employees across the complex and across multiple ALWCDs, identify resource pools, and ensure qualifications are up to date.

Savannah River National Laboratory moved to an electronic database system for hazard analysis, as well, to allow hazards screening to be completed more efficiently and ensure that workers, researchers in this case, utilize the most up to date procedures and controls. The electronic system provides a Hazards and Controls Summary documents with succinct descriptions of hazards and controls associated with each task so that they will be more easily conveyed to all workers.

While these systems can be valuable tools, they need to be used with care so as not to replace sound human judgment and analytical thinking. Job hazard analysis tools should be evaluated for their effectiveness in addressing the specific hazards associated with activity-level work and to ensure these tools are maintained current. Automated job hazards analysis tools should not be relied upon as the sole means of job hazards analysis. Automated job hazards analysis tools should be applied as a starting point and supplemented by evaluation of specific hazards associated with the individual work activity.

IHRTs (also known as senior management review boards) are often used to evaluate high-impact activities that involve unique processes or hazards. The Independent Hazard Review (IHR) is a thorough and objective review, supported by designated experts, and is not intended to capture low- or medium-hazard activities, but rather high-hazard activities (such as explosive synthesis or high-risk radiological activities), activities that are complicated by multiple administrative controls to mitigate hazards, or activities where severe consequences could result from the failure of a control.

To ensure the quality and the objectivity of the IHR, the following typically apply to the review:

- Reviewers are not be directly involved in the subject work.
- Reviewers have current expertise in the subject area.
- The concurrence signatures for all applicable review group members are obtained prior to executing the work.
- Reviewers are chosen from an approved list of individuals maintained by facility.

Key factors of success in the IHR process are:

- Providing the IHR Team with a complete review package; no missing or incomplete pieces;
- Well written work scopes, with clear task breakdowns;
- IHR team members complete a thorough review of the review package prior to the IHR meeting;

- Using multidisciplinary teams; technical and scientific experts, who understand the operation or activity; safety professionals (health physics, industrial safety, industrial hygiene, explosives safety); environmental professionals, and; facility personnel, who are familiar with area hazards.
- Including walkdowns of work locations.

6.3.3.1 General Hazard Analysis

A general hazard analysis is the documented identification, analysis, and specification of controls for those hazards routinely encountered in a wide variety of work activities and work environments. General hazards and controls are limited to those mitigated by:

- Worker's site or facility safety orientation and training. Workers are trained in general safety and health requirements and are expected to apply controls as the hazards for the situation and activities present themselves. A critical aspect in all cases is the individual's responsibility to remain cognizant of job conditions and to stop or pause work if a hazard emerges or is encountered that was not appropriately addressed.
- General PPE (e.g., gloves, hearing protection, sturdy footwear for foot protection, and eye protection, such as safety glasses, goggles, or a face shield).

Often, postings such as signs or warning barricades identify hazards and controls to alert workers to the need for applying general or nonspecialized PPE. Some examples are hearing protection for a high-noise hazard in an emergency diesel generator room (when the diesel is running), eye protection when using shop equipment, or use of hard hats in areas with overhead bumping hazards.

ALWCDs, including JHAs, should not specify general hazards (e.g., standard industrial hazards) and controls because workers are trained to identify these types of hazards and the controls needed to mitigate the hazards. Specifying general hazards and controls in ALWCDs could result in diluting the importance of addressing the controls for hazards associated with accomplishment of specific activities and the work environment detailed in the ALWCD.

6.3.3.2 Job Hazard Analysis

A JHA, also known as a job safety analysis (JSA), is the most basic and widely used tool to identify hazards associated with activity–level work. A JHA is the systematic examination of an activity intended to identify potential hazards, assess the degree of hazard, and evaluate practical measures to control the hazard. The JHA involves breaking the activity into basic tasks and associated steps as necessary to support hazard evaluation. It involves analyzing each basic task or step of an activity to identify potential hazards and to determine the controls to safely perform the work.

The planning team, including experienced workers and supervisors may perform a JHA by analyzing the activity through walkdowns, discussion and observation (See Section 6.3.3.3). This approach has two distinct advantages. First, it involves more people, which allows for a wider base of experience. Second, the participation of stakeholders promotes faster acceptance of the ALWCD. See Appendix C for summary descriptions of other hazard analysis methods with team approaches.

The JHA technique is based on a step-by-step hazard analysis. To be effective, JHA should be applied to an activity that is neither too broad nor too simple. For example, manufacturing and pushing a button are too broad and too simple for such analysis. Lathe work, press tool work, spray painting, electric arc welding, and sheetmetal work are examples of appropriate activities that are suitable for hazard analysis using JHA (in terms of activity scope and potential hazard severity).

The JHA aims for accident prevention. To achieve this aim, it is important that the hazard controls developed from JHAs be integrated into the work, for example, as part of the ALWCD.

During the JHA process, an evaluation of hazards is performed during or following a JHA walkdown or roundtable review (see Section 6.3.3.3). Standard industrial hazards and controls that are expected of all workers (e.g., slip, trips, and falls; bee stings; bending; pinch points; et al) do not need to be included in the JHA. This allows the JHA process to focus on the unique hazards of the activity. The work planner or work planning team should:

- Review maintenance/equipment history, relevant lessons learned and other forms of feedback to assist in identifying hazards and controls;
- Evaluate activity-specific controls required by other hazard assessment or analysis documents (e.g., as low as reasonably achievable (ALARA) job review, industrial hygiene exposure assessment, shock and arc flash hazard analysis), and incorporate them into the JHA;
- Evaluate known radiological, chemical, biological, and physical processes and their associated hazards with the work environment;
- Review manufacturer- or vendor-provided operating instructions and safety documentation (e.g., equipment manuals, Material Safety Data Sheets, Safety Data Sheets, etc.) for hazards, warnings, operating limitations or controls and evaluate for incorporation in the JHA;
- Review drawings, notes, video, and photographs and conduct discussions with planning team members familiar with work sites;
- Review and validate the activity tasks, work scope, and draft work instructions;
- Identify and discuss the hazards associated with the activity, each task and associated steps, and the work environment, including potential undesirable events (e.g., the potential consequences of improperly performing or not performing the step);
- Identify and discuss potential transients or accidents (e.g., “what if”, Failure Modes and Effect Analysis (FMEA), fault tree analysis for scenarios such as spills, fires, exposures, failures, changing conditions, interference, alarms, unexpected equipment actuations, errors and their consequences);
- Prescribe specific controls necessary to eliminate or mitigate each identified hazard for the protection of workers, the public, and the environment; and
- Review work tasks from a human performance perspective to identify and either eliminate or develop contingencies for error-likely situations.

6.3.3.3 JHA Walkdowns or Roundtable Reviews

The objective of the walkdown or roundtable review, performed as part of the JHA, is to interactively ensure all hazards are identified; determine whether all hazards have adequate controls; determine whether identified controls are compatible; and determine whether the work can be done safely and in compliance with applicable requirements. To be most effective, draft work instructions and a draft JHA should be developed and made available to support the walkdown or roundtable. The walkdowns include an examination of work environments where activities are to be performed to familiarize the work planning team (or work planner for lower hazard or less complex work) with the physical conditions, potential stressors, and expected tasks.

A walkdown may be augmented by conducting a roundtable using technology and information obtained during the walkdown or by examination of pictures, drawings, specifications, or other technical data. However, roundtables and the use of technology and data reviews should not be used to circumvent the need for a walkdown. A walkdown is always preferred and should be performed unless it is not feasible (e.g., ALARA considerations, equipment not set up when activity was planned or room is sealed) or the risk is unacceptable and outweighs the benefits. In situations such as this, a roundtable should be conducted at a minimum. The work planner, in consultation with the planning team, decides when to conduct roundtable reviews of ALWCDs to more effectively communicate with personnel involved in the planning of the activity. The work planner may determine that a roundtable review is not necessary. However, for new or complex operations or significant changes in the scope of work or tasks, a roundtable review should be considered.

If a portion of the work environment is not accessible or the walkdown cannot be performed, steps should be included in the ALWCD (e.g., hold point) to verify that conditions are as planned. If conditions are not as planned, the work should be stopped or paused so that the change control process can be implemented.

The work planning team (or work planner for less complex or less hazardous activities) walks down the requested work using the draft JHA and draft work instructions to:

- Document the work needed, objectives to be accomplished, condition to be achieved or corrected, problem being addressed, and expected outcome;
- Identify or confirm the specific tasks and associated steps necessary to accomplish the work and support hazard identification and subsequent analysis;
- Identify the hazards associated with the work environment and each task or activity necessary to accomplish work;
- Identify any hazards that can be eliminated or reduced from the work tasks through process re-engineering or other changes;
- Identify the need to assess and quantify the hazards (e.g., noise decibel levels; radiation dose rates; chemical volumes or airborne levels; temperature limits or extremes; fluid or gas pressures; electrical voltage and amperage; weight of lifted or suspended components) so that analysis will result in the identification of appropriate controls;
- Identify planned transitions and the associated hazards and controls;

- Determine if the work activity is clearly and adequately bounded (e.g., physical boundaries such as equipment or components to which work activity is limited, specific work environment to which work is confined; conditions under which work can be performed; and organizations responsible for the various tasks); and
- Document worksite conditions, using photographs if necessary, to ensure appropriate consideration of special or unique planning requirements or circumstances.

6.4. Planning the Work – Develop and Implement Hazard Controls

Performance Expectations:

1. Hazards associated with the work are evaluated before work is performed and an agreed upon set of ES&H standards and requirements are identified that provide adequate assurance that employees, the public, and the environment are protected from adverse consequences (48 CFR 970.5223-1(b)(5)).
2. Hazard controls are developed and implemented to ensure adequate protection of workers, the public and the environment (see 48 CFR 970.5223-1(c)(4), and 10 CFR 830.202(b)(5) and .204(b)(4)).
3. Contractors must establish and implement a hazard prevention and abatement process to ensure that all identified and potential hazards are prevented or abated in a timely manner (10 CFR 851.22).
4. Develop and Implement Hazard Controls. Applicable standards and requirements are identified and agreed-upon, controls to prevent/mitigate hazards are identified, the safety envelope is established, and controls are implemented (DOE P 450.4A and 48 CFR 970.5223-1(c)(3)).

Good Practices:

DOE rules and directives require that hazard controls be identified and implemented to prevent or mitigate potential consequences from DOE activities to workers, public, and the environment. For hazard category 1, 2, and 3 nuclear facilities, hazard control identification and implementation starts with the DSA and TSRs and extends through activity-level JHAs. For work activities with ALWCDs, controls should be integrated into the work documents rather than simply referencing the JHA, TSR or DSA.

6.4.1 Safety SSCs and Technical Safety Requirements

The operations organization has the principal function to manage the operability of safety SSCs and comply with TSRs.

Operations procedures (i.e., ALWCDs) should provide sufficient direction to ensure that the facility is operated within its design basis and supports safe operation of the facility. This should include emergency operating procedures; operating procedures for all phases of operation, maintenance, and procedures for all surveillances required by TSR; Security Plan implementation; Emergency Plan implementation; fire protection; procedures governing the administrative aspects of operation of the facility; etc..

A system should be developed to control all procedures that provide assurance of safe operation. Procedures that are important to safety need to be identified for special attention to ensure they are performed reliably and given proper attention in proportion to the hazards that they control. The system should include the mechanism for review, approval, revision, control, and temporary changes to the procedures. Please refer to DOE G 423.1-1A for additional guidance on these matters.

The DSA identifies safety SSCs and controls required to mitigate the consequences of, and lower the probability of, accidents to workers, the public, and the environment. Controls credited to maintain safety SSCs operable for all modes of operation are identified in the TSRs. TSR Surveillance Requirements (SRs) are used to ensure that safety SSCs are operable and available and Specific Administrative Controls (SACs) implementing procedures ensure SAC safety functions identified in the DSA is met. As such, the ALWCDs developed to implement TSR SR and SAC implementing procedures should be technically accurate, workable, and clearly identify the acceptance criteria in order for Operations personnel to determine if a system is operable or a SAC's safety function is met.

6.4.2 Establish a Hierarchy of Controls

Performance Expectation: Contractors must select hazard controls based on the following hierarchy:

(1) Elimination or substitution of the hazards where feasible and appropriate;

(2) Engineering controls where feasible and appropriate;

(3) Work practices and administrative controls that limit worker exposures; and

(4) Personal protective equipment (10 CFR 851.22(b)).

Performance Expectation: Administrative and engineering controls to prevent and mitigate hazards are tailored to the work being performed and associated hazards. Emphasis should be on designing the work and/or controls to reduce or eliminate the hazards and to prevent accidents and unplanned releases and exposures (48 CFR 970.5223-1(b)(6)).

Good Practices:

DOE's hierarchy of controls for addressing hazards is to first eliminate or substitute hazards where feasible and appropriate. This is the desired method for preventing exposure of workers to a hazard. Then, if elimination or substitution is not an option, control of worker exposure to the hazards need to occur in the following order of preference:

- Engineered controls - Controls that mitigate a hazard through the use of engineered machinery or equipment (e.g., work remotely via manipulators, gloveboxes).
- Administrative controls - Contractor safety policies and processes, ALWCDs, hazardous energy control, supervision, schedules, and training.
- PPE - Includes all clothing and other work accessories designed to create a barrier against workplace hazards (e.g., safety goggles, blast shields, hard hats, hearing protectors, gloves, respirators, aprons, and work boots).

Key considerations during hazard control development for the JHA include:

- Ensure controls are identified for each task-specific hazard.
- Preference should be given to passive controls over active controls (see Section 5.0, Definitions).
- Analyze the identified hazards collectively to arrive at the optimum set of controls for the work being performed.
- Ensure that the selected controls do not conflict with each other or introduce additional hazards (e.g., anti-c requirement exacerbates heat stress environment).
- Explore the possible need for an implementation strategy in cases where steps to implement a control might be necessary. This might include special training, special postings, or implementing a disposition strategy per the hazard analysis process (e.g., ALWCD with continuous use work instruction, pre-job brief).
- How to maintain the control throughout the activity or until the hazard has been eliminated or reduced to a point where the control is no longer necessary.

6.4.3 ALWCD Development

Performance Expectations:

1. Develop instructions necessary to complete work activities safely and efficiently, including integration of specific hazard controls. Identify and integrate into the instructions applicable technical and administrative requirements (e.g., ES&H, QA, Security, Emergency Management, etc.) (see 48 CFR 970.5223-1(b)(5) and (c)(3), 10 CFR 830.122(d) and (e), DOE O 433.1B, Attachment 2, para. 2.f, and DOE O 422.1, Attachment 2, Appendix A, para. 2.a(6) and 2.b(5)).
2. Establish acceptance/performance criteria to verify completion of the work (see 10 CFR 830.122(d), (e), and (h), DOE O 433.1B, Attachment 2, para. 2.q, and DOE O 422.1, Attachment 2, Appendix A, para. 2.h(5)(d))
3. For hazards identified either in the facility design or during the development of procedures, controls must be incorporated in the appropriate facility design or procedure (10 CFR 851.22(a)(1)).
4. The operator (e.g., responsible manager) must establish and implement operations practices for developing and maintaining accurate, understandable written technical procedures that ensure safe and effective facility and equipment operation (DOE O 422.1, Attachment 2, Appendix A, Para 2.p).
5. Methods for approving, posting, maintaining, and controlling access to electronic operations documents (procedures, drawings, schedules, maintenance actions, etc.) if electronic documents are used. (DOE O 422.1, Attachment 2, Appendix A, Para 2.a(7).

Good Practices:

The ALWCD should contain only the information needed to perform the work. Examples include permits, drawings, sketches, manufacturer instructions, required attachments to perform the work (e.g., pre-job and post-job briefing sheets, inspection forms), in addition to the ALWCD. All other documentation compiled during planning activities

should be separated and maintained, if needed upon request. Examples include the job hazard analysis, arc flash evaluations, and floor loading evaluations.

6.4.3.1 Work Scope

Good Practices:

Work scope development (Section 6.2.5) is the entry point for an iterative process to determine the need for development and level of detail for an ALWCD. A thoughtful analysis of the work is required, breaking down the work into discrete tasks and breaking tasks down into work steps that can be analyzed for associated hazards. This is done using a graded approach (i.e., more in-depth analysis for complex, high-hazard activities).

Improvements from the initially developed scope of work can be derived from the following:

- Review and update the work needed, objectives to be accomplished, condition to be achieved or corrected, problem being addressed, and expected outcome;
- Review and update the hazards directly involved or expected to be encountered, with both the activity and the work environment;
- Review and update lessons learned applicable to the work to be performed;
- Review of safety basis, environmental or regulatory impacts that could result from performance of the work;
- Review and update any special tools or techniques that will be used that could introduce their own hazards; and
- Review and update equipment, components, and locations described in the work request.

Completion of scope development will factor heavily in determining the level of planning and ALWCD type (see Section 6.4.3.2) needed to perform the activity. High-hazard, high-complexity, and infrequently performed activities, along with activities performed by multiple disciplines, warrant the highest level of planning. Due to the potential consequences from ineffective performance, ALWCDs for these activities undergo the highest level of discipline in their preparation and implementation and should include step-by-step work instructions listed in a specified sequence that require verbatim compliance (see Section 6.4.3.3).

Frequently performed lower-hazard or lower-complexity activities may only require ALWCDs with a work scope statement. The statement should communicate the scope, work boundaries, and limits of the work to be performed such that the associated hazards are identified, analyzed and mitigated.

6.4.3.2 ALWCD Types

Good Practices:

Work planning is an iterative function that includes work scope development, job hazard identification and analysis, hazard control incorporation, and work instruction development, which should be performed simultaneously in preparing an ALWCD. The complexity and hazards of the activity, the location where the work is being performed, and the frequency of the work affect the probability of consistent, safe and reliable performance.

Organizational processes and procedures manage these factors by defining the types of ALWCD, manner of incorporating JHA controls into the ALWCD, and the subsequent level of detail communicated to the worker.

An example of ALWCD types (Detailed, Moderate, Minor, and Model) is described below (see Appendix D for additional considerations and examples while developing Detailed or Moderate ALWCDs).

Level 1: Detailed ALWCD

Detailed ALWCDs are most appropriate for activities that are highly complex, highly hazardous, performed infrequently, or involve multiple disciplines or organizations. Detailed ALWCDs typically include:

- Scope,
- Precautions and limitations,
- Prerequisites and initial conditions,
- Special training and medical requirements,
- Special tools and equipment,
- Work instructions,
- Post-work activities,
- Closeout,
- Status logs and data sheets, and
- Additional supporting documentation.

Appendix D contains a recommended Detailed ALWCD format, including information to consider while developing Detailed ALWCDs and associated work instructions.

Level 2: Moderate ALWCD

Moderate ALWCDs are appropriate for activities that are moderately complex, moderately hazardous, and performed frequently. Moderate ALWCDs contain either general directions or step-by-step instructions, as appropriate to the SOW and the complexity and hazards of the activity. A moderate ALWCD may be appropriate in cases where no special hazard controls are needed. Moderate ALWCDs may also be appropriate for activities that are fairly complex, fairly hazardous, and performed infrequently when detailed instructions are available in existing documents such as vendor manuals and operating procedures. In general, Moderate ALWCDs rely less on detailed work instructions and more on the SOW. Reliance on the SOW should be deemed appropriate only after careful consideration of the factors defined in

organizational procedures (see also Appendix A). See Appendix D for consideration during the development of Moderate ALWCDs.

Level 3: Minor ALWCD (No Work Instructions Required)

Minor ALWCDs are appropriate for routine activities that are fairly simple, do not affect nuclear safety, do not increase the probability of upset conditions, are performed frequently, and rely solely on SOW to mitigate hazards that are minor in nature. As such, work instructions do not need to be developed and formally communicated to the worker in either an ALWCD or through cross-reference to an existing work instruction or another ALWCD. Minor ALWCDs contain a statement of work with a bounding scope statement and limitations that rely on SOW. Reliance on the SOW should be deemed appropriate only after careful consideration of the factors discussed in organizational procedures (see also Appendix A).

Model ALWCD

ALWCDs ranging from Detailed to Minor are often used to perform repetitive or reoccurring work activities. Model ALWCDs should be used for activities that are repeated or very similar work when the activity is next performed. The most recently closed ALWCD, with any associated feedback, should be used by the work planner or planning team as a model ALWCD the next time similar work is performed. Prior to each use, model ALWCDs are to be reviewed to ensure the accuracy of the task description and to verify that the hazards and environmental aspects have been identified, and that controls are appropriate to the intended work. The review incorporates safety feedback for improvement, previous comments, operating experience, activity-specific information and appropriate authorization, approval, and release prior to execution.

6.4.3.3 ALWCD Use Categories

Good Practices:

Organizational WP&C processes and procedures should establish expected ALWCD use categories, which detail the expected manner in which ALWCD work instructions should be performed.

Example use categories include Continuous Use and Reference Use.

Continuous Use

ALWCDs categorized as Continuous Use (sometimes referred to as Use Every Time) should be utilized for activities where improper performance could result in unacceptable consequences.

ALWCDs categorized as Continuous Use should be at the work location, open to the work instruction being performed, completed as written in a step-by-step sequence, and should be signed or documented unless otherwise specified. Detailed ALCWDs should be considered for the Continuous Use categorization.

Reference Use

ALWCDs categorized as Reference Use should be utilized for routine, less complex activities where improper performance does not result in unacceptable consequences. These ALWCDs do not require documented verification upon satisfactory completion of the individual steps or the entire task. ALWCDs categorized as Reference Use should be located near the work location and readily available upon request. Although step-by-step compliance with work instructions is expected, it can be accomplished by workers periodically referencing the ALWCD, conducting effective pre-job briefings, or utilizing SOW. Moderate ALWCDs containing step-by-step work instructions should be considered for the Reference Use categorization.

6.4.3.4 ALWCD Preparation

Good Practices:

The Planning Team should develop ALWCDs necessary to complete work activities safely and efficiently in accordance with DOE O 422.1, DOE-STD-1029, and the organization's writer's guide or procedure for WCD development. The WCD should:

- Clearly identify the boundaries which are not to be exceeded during ALWCD execution
- Identify prerequisite actions and initial conditions to be completed prior to continuing the ALWCD execution
- Identify all resources needed to ensure that the activity can be accomplished without unnecessary interruption or pauses such as:
  - Documents necessary for accomplishing the work (e.g., procedures, drawings, vendor manuals, specifications, requirements, performance criteria, permits).
  - Special equipment, tools, materials, and parts needed for the work along with their instrument ranges, accuracy, and calibration requirements.
  - Special mockup, training, qualifications, or medical requirements.
  - Required support services, permits, and hold points such as QA/quality control (QC), radiological controls, industrial hygiene, fire watches, confined space entry, and hot work.
  - Independent verification personnel.
- Ensure SME identified technical and administrative requirements and controls (e.g., ES&H, QA, Security, Safety Basis) are implemented;
- Integrate activity wide and task-specific hazard controls identified in the JHA are appropriately documented and readily identified;
  - Activity wide hazards and associated controls should be identified in the ALWCD Precautions and Limitations,
  - Task specific hazards and controls should be identified in the ALWCD Work Instructions.
    - Personnel hazards should be identified with a Warning.
    - Equipment/facility hazards should be identified with a Caution.

  - Clearly identify when hazard controls are able to be relaxed due to the mitigation or reduction of specific hazards;
- Provide work instructions which:
  - Identify the tasks and hazard controls required to safely and efficiently complete the ALWCD
  - Follow the logical flow of the work activity
  - Consider SOW competencies in determining the level of detail required to safely and efficiently execute the ALWCD
  - Are user friendly and capable of being performed as written,
  - Preclude the potential for misinterpretation or error
  - Consider the hazards associated with the activity, complexity of the activity, frequency of activity performance, and potential consequences of improper execution of the activity while determining the level of detail required to safely and efficiently execute the ALWCD.
- Establish acceptance or performance criteria to verify completion of the work;

A good practice being used by many contractors is clearly denoting steps or work instructions implementing acceptance criteria in TSR SRs and on the associated data sheets. Examples include work instructions with the step's text in bold letters, inserting an identifier in the ALWCD margin, and inserting a Note preceding the step or work instruction stating that the step or work instruction implements a TSR control.

6.4.4 ALWCD Verification and Validation

Performance Expectations:

1. Readiness is confirmed prior to scheduled work performance, with regard to system, prerequisite controls, work environment, people, documents, tools and materials (see 48 CFR 970.5223-1(b)(1) and (4), DOE O 433.1B, Attachment 2, para. 1.a, 2.d and 2.i).

2. Directives include provisions to use walkthroughs (procedure execution with actual or simulated operation of components by subject matter expert(s)) to validate procedure changes and revisions. (DOE O 422.1, Attachment 2, 2.p(4)(h)).

3. Directives include provisions for review of new and revised procedures prior to use and periodically for technical accuracy and human factors considerations. (DOE O 422.1, Attachment 1, 2.p(7)(a)).

4. Procedure reviews include validation walkthroughs (DOE O 422.1, Attachment 1, 2.p(7)(e)).

Good Practices:

Guidance should be provided for the development, writing, verification, validation, approval, and use of procedures (see DOE G 433.1B).

ALWCD Verification

Verification involves reviewing a new or revised ALWCD to determine whether it is technically accurate and in the proper format. The review should ensure that the work activity is adequately described, all hazards are analyzed and controls are established, acceptance or performance criteria is specified, and that human factors principles and appropriate administrative policies are incorporated. A review of the ALWCD technical accuracy against the design requirement should be performed for the system or component it concerns (e.g., comparing the vendor manual and design specifications with the procedure).

Verification should be conducted by one or more reviewers who were not involved in writing the procedure but are representative of the intended users. Reviewers from other disciplines, such as health physics, engineering, and operations, should be considered for involvement in the process.

ALWCD Validation

Validation comprises the review of a ALWCD by representatives of the disciplines or organizations intended to perform the activity to determine its usability and correctness, whether it can be performed exactly as written, and whether it is within the intended SOW. This review evaluates whether the ALWCD provides sufficient and understandable direction to the worker and whether it is compatible with the equipment or system being operated or maintained. Validations should be performed at the location where the work will be performed to identify any issues with equipment, the ALWCD, access and egress, unanticipated hazards, and controls. In certain hazardous circumstances, such as a high-radiation area, it may be necessary to identify issues without performing the validation at the work location.

Contractors should apply the graded approach to determine the rigor of Verification and Validation for the different levels of ALWCDs. For example, a Level 3 ALWCD, with no work instructions or specific hazard controls may not warrant Verification and Validation, whereas a Level 3 ALWCD with specific hazard controls may warrant Verification, at a minimum. Verification and Validation reviews (see Appendix E) should be the final step in ALWCD development prior to being submitted to the ALWCD approval process.

6.4.5 ALWCD Approval

Performance Expectation: ALWCDs are formally reviewed and approved (see 48 CFR 970.5223-1(b)(1) and (b)(2), 10 CFR 830.122(a), (d), and (e), DOE O 433.1B, Attachment 2, para. 2.d and 2.f, and DOE O 422.1, Attachment 2, Appendix A, para. 2.h(5)(b), and 2.p(6)).

Good Practices:

Once the ALWCD is verified and validated, it should be routed for review and approval. Different levels of work may require different levels of approval based upon work complexity and hazards. The review and approval process may be iterative, requiring incorporation and disposition of review comments. The following should be performed as part of the review and approval process:

- Obtain review and concurrence from the responsible WP&C manager that the ALWCD has been properly developed and reviewed;

- Route to appropriate affected organizations and SMEs (i.e., operations, maintenance, safety, engineering, quality assurance, and environmental) for review and to:
  - Confirm the technical adequacy of the ALWCD through ALWCD Verification;
  - Concur that hazard controls are appropriate for the work and that applicable programmatic and regulatory requirements are adequately incorporated in the ALWCD; and
  - Ensure that all comments received are satisfactorily resolved prior to ALWCD approval.
- Perform Independent Hazard Review for high-impact work (e.g., high-hazard, high-complexity, first-time-use, multiple work groups)per established criteria (see Section 6.3.3);
- Complete the USQ process; and
- Route to the appropriate responsible manager for final approval.

6.4.6 ALWCD Change Process

Performance Expectations:

1. The operator must establish and implement operations practices for developing and maintaining accurate, understandable written technical procedures that ensure safe and effective facility and equipment operation, addressing the following elements:
   a. A process for procedure changes (pen and ink or page changes) and revisions (complete reissues) (DOE O 422.1, Attachment 2, Appendix A, para. 2.p(4));
   b. A process for training personnel on new, revised, or changed procedures (DOE O 422.1, Attachment 2, Appendix A, para. 2.p(5)); and
   c. A process for approval of new, revised, or changed procedures (DOE O 422.1, Attachment 2, Appendix A, para. 2.p(6)).
2. The contractor responsible for a hazard category 1, 2, or 3 DOE nuclear facility must implement the DOE approved USQ procedure in situations where there is a:
   (1) Temporary or permanent change in the facility as described in the existing DSA;
   (2) Temporary or permanent change in the procedures as described in the existing documented safety analysis;
   (3) Test or experiment not described in the existing DSA; or
   (4) Potential inadequacy of the DSA because the analysis potentially may not be bounding or may be otherwise inadequate (10 CFR 830.203(d)).

Good Practices:

Contractors should establish processes to change approved ALWCDs. These processes should ensure that changes in work scope, field conditions, or work execution are thoroughly reviewed, analyzed (including adequacy of existing hazards analysis and

specified controls), documented, and approved before being implemented. These processes should include:

- Requirements for the clear identification of the ALWCD change's scope in order to adequately identify and analyze associated hazards, implement hazard controls, and develop supplemental work instructions;
- Identification of personnel authorized and required to concur or approve ALWCD changes;
- Definitions of administrative, editorial and technical changes; change significance levels (e.g. pen and ink, field change, revision); and the criteria for implementing the change significance levels, including change control criteria for the USQ and configuration management processes;
- Methods of incorporating changes into ALWCDs;
- Criteria for reconvening the ALWCD planning team for ALWCD changes;
- Requirements to review the existing hazard analysis after any changes to the ALWCD to determine if new hazards were created, any existing hazards were modified, addition of conflicting controls, or if any existing hazards were eliminated by the change;
- Requirements to brief or train workers on the changes.

6.5. Planning the Work – Scheduling

Performance Expectation: An integrated schedule(s) is developed that balances priorities and resources in a disciplined manner to ensure that work is accomplished safely and efficiently. The scheduling process has provisions for work not requiring a formal schedule. The schedule is managed through a formal change control process (see 48 CFR 970.5223-1(b)(2), (b)(4) and (b)(6); 10 CFR 830.122(a), (d) and (e); and DOE O 433.1B, Attachment 2, para. 1.a, 2.b, and 2.d).

Good Practices:

6.5.1 Schedule Attributes and Detail

The majority of attributes and detail described below are derived from DOE G 433.1-1A and adapted for all activity-level work.

A schedule is a management tool to control and direct activity-level work (ALW) activities. The schedule should be a concise method for tracking completion of ALW tasks. Management can use it to integrate facility activities, determine the critical path, and explore alternatives when needed. Routine activities previously defined and approved by line management (e.g., operator rounds, instrument source checks, pre-operational equipment checks, basic shop work) may not need to be listed on facility schedules. The following attributes should be included in the schedule or scheduling process:

- Approved work is incorporated in schedules (e.g., daily, weekly);
- Responsible manager approves schedules prior to use;
- Work identified on approved schedules is considered authorized;
- Conflicting work is precluded;
- Coordination of related work activities, when required, is clearly identified;
- The schedule report format is appropriate for the user. The level of detail in the schedule needed by the facility manager may be different from the level of detail needed by a craft supervisor;
- The schedule is reviewed and accepted by those responsible for getting the work done (e.g., Work Supervisor, RM, PIC);
- The schedule is an accurate, living document and flexible to deal with unanticipated events;
- A hierarchy of schedules of varying detail, used by different levels of personnel, is obtained from a common database;
- Intermediate milestones are available as an overall measure of the progress of ALW activities and identify tasks significantly behind schedule; and
- All supervisory personnel report progress of work and have an understanding of the schedule process appropriate to their needs and uses.

In a site or facility where the WP&C process is functioning well, work is identified in a timely way and sent to the work planner or planning team. On weekly and daily schedules, work groups are given the quantity of work that they can accomplish. The most important work is scheduled first.

The detail included in the overall schedule should be that required to ensure coordination of work and to allow assessment of progress. It is particularly important to include details of activities that have interfaces among the various craft and support personnel. The following are some examples of detail that may be required:

- Facility management are able to identify and establish required facility configuration (e.g, equipment status, operating modes, lockout needs);
- Radiological protection personnel are able to anticipate the need for RWPs, technician support, and major radiological protection actions, such as installation of temporary shielding for a particular task;
- QC personnel and other inspection groups are able to anticipate the need for their presence at the job site;
- Critical resource needs, such as overhead cranes and scaffolding, are described in sufficient detail to avoid interference, conflicts, and work delays;
- The schedule is craft-loaded and the sequence and timing of activities adjusted to ensure that resource requirements are consistent with resource availability;
- Tests, inspections, or other tasks that may identify additional work are scheduled as early as possible to permit time for completion of the additional work within the established time frame; and

- Significant post-ALW testing is factored into the schedule. Time is allotted for testing, lineup, and other activities required for returning systems to service. System interactions and operator resources are considered when scheduling system and facility startup.

Schedules should be periodically reviewed. Opportunities for schedule improvements should be explored during the review process. This should include the review of TSRs and other regulatory requirements to determine whether changes that may result in work efficiency or schedule improvements are safe.

The schedule review process and worker input to the planning process requires a sense of ownership of the schedule for those who are expected to implement it. The individuals responsible for the work should likewise be the individuals responsible for reporting progress of the work.

6.5.2 Schedule Integration

Integration of major activities is key to successful schedule development. There should be an integrated ALW schedule that includes work to be done by both site personnel and non-facility contractors. The planning organization should involve non-facility contractors as early as possible in the planning process to ensure their work is integrated and scheduled properly.

By providing sufficient detail in the integrated ALW schedule to coordinate activities and track progress, a more efficient use of technical support and resources can be achieved. The integrated ALW schedule should form the basis for progress reporting. For example, work can be scheduled and combined with other ALW activities on the same equipment, or with other ALW on similar equipment in proximity. Program outages to coincide with equipment changeout or modification could be scheduled simultaneously with an instrument calibration, equipment lubrication, or other preventive or predictive maintenance that requires a similar lockout/tagout.

A computerized scheduling system may enable personnel to be responsive to the needs of management. Depending upon the type of computerized scheduling system employed, the following advantages are possible:

- Rapid update capability;
- Ease in exploring alternatives;
- Resource determination and capability;
- Work-site congestion identification; and
- Tailored reports to specific groups or users.

Multi-week scheduling can be used to ensure that the highest priority work is being completed on a weekly basis. Appendix F provides more information on effective multi-week scheduling.

Effective daily schedules are generated through the multi-week process. Daily schedules ensure that the highest priority work is being completed on a daily basis; that clarity, consensus, and commitment regarding work to be done is achieved through joint

prioritization; and that clear expectations are communicated to work groups for daily assignments. Daily schedules are important to ensure that work is properly coordinated even when there are last-minute schedule changes. A daily schedule is generally used as the basis for discussions at daily meetings (e.g., Plan-of-the-Day). Daily meetings with affected individuals should be conducted to focus on the progress of key activities and to provide short-range coordination of scheduled activities. Meetings should be managed to use the time of the managers and supervisors efficiently, minimizing redirection of work in progress, and preventing delays to oncoming work shifts.

A detailed review of the daily schedule should be an integral part of shift turnover activities to ensure that the oncoming shift is familiar with any recent adjustments made to the schedule and ongoing activities. This is particularly important for operator turnovers to ensure that operators know the status of the facility and are familiar with upcoming ALW activities.

A three-day outlook schedule, updated and issued daily, has proven useful at many facilities. This schedule provides the detail necessary to control the present day‘s work and provides an opportunity for a look ahead without an unreasonable amount of data. Extending the outlook period further than about five days or not issuing the schedule on a daily basis increases the risk that data may not be current when needed.

Supervisors may elect to identify fill-in work assigned to maintain crew productivity. If fill-in work has facility condition requirements associated with it, then it should be identified on the rolling schedule so that all cognizant groups are aware of the activities.

6.5.3 Schedule Approval and Changes

Schedule approval includes an evaluation of the current facility/project conditions and configuration to coordinate and integrate other scheduled work activities; minimize impacts such as priority, schedules, and resources; determine availability of required facilities, systems, or equipment; address conflicting controls (including integration of workers from different companies or organizations); and address access restrictions. Once the ALWCD is approved and identified on a responsible manager approved schedule (e.g., Plan of the Day, Plan of the Week), the work is authorized and ready to be released (see Section 6.6.1). It is recognized that many activities may not require an ALWCD. Contractors should include mechanisms within their work control process to account for approval and authorization of such activities.

Emergent work identified after the schedule has been approved follows the normal work planning process based on prioritization. The new work is reviewed against the already authorized activities and changes are approved at the same approval authority level to ensure that no conflicts exist prior to authorization. This also holds true for the ALWCD change process (see Section 6.4.6).

6.6. Performing Work within Controls

Performance Expectation: Work is performed within controls (DOE P 450.4A and 48 CFR 970.5223-1(c)(4)).

Good Practices:

This section discusses attributes and good practices associated with ISMS Core Function 4. Once the planning effort is completed, the work group is responsible for executing the activity in accordance with the ALWCD. A bias is set on proving that work activities are safe before proceeding, rather than proving them unsafe before halting. The work group does not proceed and does not allow others to proceed when safety is uncertain. Line management is supportive of these decisions. If the activity cannot be performed as prescribed, then employ the ALWCD change process (see Section 6.4.6) for disposition prior to proceeding with the activity.

6.6.1 Preparation and Release of Work

Performance Expectation: Work is formally authorized to proceed (see 48 CFR 970.5223-1(b)(1), (b)(2) and (b)(7), 10 CFR 830.122.e, DOE O 433.1B, Attachment 2, para. 2.b and 2.d, and DOE O 422.1, Attachment 2, Appendix A, Para. 2.a (2) and 2.h(5)(b)).

Good Practices:

There is a process to confirm adequate preparation and readiness to begin work prior to authorizing the performance of work at the facility, project, or activity level. The formality and rigor of the process and the extent of documentation and level of approval is based on the hazards and complexity of work. Readiness is assured by verifying that controls are adequate to mitigate the identified hazards and that the controls are implemented prior to commencement of work (DOE G 450.4-1C, Attachment 2, Section 4).

For example, facility personnel should be apprised of scheduled activities to ensure coordination. This may be accomplished by publishing and updating a short-duration rolling schedule covering the current week. Routine activities previously defined and approved by line management (e.g., operator rounds, instrument source checks, pre-operational equipment checks, basic shop work, etc.) may not need a formal release and may be performed on an ongoing basis, unless otherwise directed by the release authority.

The work supervisor should be provided with ALWCDs in time to allow for adequate preparation and pre-job brief before starting the activity. ALWCDs are reviewed by workers prior to work performance to ensure workability and familiarity with the activity.

Personnel are not given work until the activity is ready to be done, the equipment has been cleared and prepared, the materials are available to do the activity, and work groups have coordinated through joint prioritization in the scheduling meetings, as appropriate.

A workability review, based on site requirements, should be conducted prior to obtaining work release. The work group will use this opportunity to look at the ALWCD work instructions in context with current conditions at the job site, including a walkdown when conditions permit. Many organizations have found a checklist useful in completing such reviews. During the review, check or verify the following:

- determine if circumstances have changed since the activity was planned that could affect the safe performance of work,

- ensure that the hazards analysis results translate to the actual work environment (i.e., reflect actual conditions),
- all hazards that could potentially affect the safety of workers have been identified and that selected controls are appropriate and adequate,.
- all necessary parts, tools, and special equipment are on-hand,
- support organizations (e.g., system engineers, QC inspectors) have allocated trained and qualified personnel to support the activity;
- all necessary permits and documents are prepared and ready; and
- the impact of tools and temporary equipment (e.g., scaffolding, rigging, power supplies, welding equipment, enclosures, insulation, shielding) on facility systems and equipment are understood and accepted.

Prior to releasing the work, the release authority should consider the following:

- Is the activity authorized (on the approved schedule)?
- Is the ALWCD approved?
- Are current conditions consistent with the ALWCD?
- Are there other ongoing activities that this work may adversely affect?
- Do building occupants need to be notified of any aspect of the work (e.g., noise, duration, limited access, etc)?
- Is the facility in the proper configuration and is there any impact on the safety basis (e.g., have TSRs been implemented)?

6.6.2 Pre-Job Brief

Performance Expectation: Pre-job briefings should be conducted (see 48 CFR 970.5223-1(c)(4), 10 CFR 830.122.e, 10 CFR 851.25(a), DOE O 433.1B, Attachment 2, para. 2.d, DOE O 422.1, Attachment 2, Appendix A, Para. 2.l).

Good Practices:

A pre-job briefing (based on site requirements) should be conducted each work period (day or shift if there is more than one shift per day) prior to performing work or periodically as noted below. The supervisor or designee may conduct additional pre-job briefings at the start of a new activity or suite of tasks, when new personnel are assigned, or when there is a major change.

Pre-job brief frequency, detail, and extent vary according to hazards associated with and the complexity of the activity, consequence of recognized failure mode, mission significance, and the experience of the work group. At the less frequent (e.g., performed for the first time), more detailed range is work that is hazardous, complex, or performed by teams or multiple individuals with different skill sets. This work may require the integration and coordination of several activities or related tasks. At the more frequent, less detailed range of activities are workers performing routine, low-hazard activities.

The pre-job brief should be conducted in a work environment that fosters attention and participation. The supervisor or designee should familiarize themselves with various aspects of the activity prior to conducting the pre-job brief. The following is a list of things to consider:

- Topics identified by the planner in the ALWCD;
- Scope of work;
- Relationship of the work to applicable regulatory requirements (e.g.,TSRs, DSA), radiation work/confined space permits, material safety data sheets, safety data sheets, etc.;
- Hazards and associated controls (e.g., precautions, limitations, warnings, cautions);
- Prerequisites, such as facility configuration, operating mode, lockout and tagout, isolation requirements, alarm deactivation, and outages;
- Key points from diagrams, drawings, vendor documentation, and other supporting documents;
- Workability walkdown results;
- Emergency escape routes;
- Worker training and certification requirements;
- Needed support resources;
- Staging of parts, tools, and equipment;
- Human performance improvement techniques;
- Lessons learned;
- Hold points;
- Interfaces between crafts or with other organizations; and
- The resolution of a stop work action prior to restarting the work.

The workgroup (e.g., supervisor or designee, workers and support personnel) then conduct an interactive pre-job brief using all of the necessary documentation, (e.g., ALWCD, RWP, permits) to review and confirm the workgroup's readiness to perform the activity. The content of the pre-job brief should address the following:

- Situational awareness of factors (e.g., weather conditions, noise, lighting) that may impact the activity, other ongoing activities, or collocated workers;
- Each member of the workgroup has reviewed the current ALWCD and understands the tasks and associated hazards and controls for activities to be performed;
- Applicable lessons learned are identified and discussed from previous performance of identical or similar activities;
- Workgroup personnel have the training and qualifications to perform their assigned tasks, including familiarity with applicable general hazards;
- Workgroup personnel have required medical approval to perform their assigned tasks;
- Workgroup personnel understand the work scope and boundaries for the activity;

- Workgroup personnel are cognizant of any critical steps associated with the activity, the mistakes that can be made at those points, the worst thing that could happen, and the barriers or defenses that are needed;
- Workgroup personnel are aware of holdpoints;
- Responsibility for specific tasks is assigned to specific workers and support personnel;
- Workgroup personnel understand the ALWCD prior to performing work;
- Workgroup personnel readiness and fitness-for-duty is evaluated that day;
- Expectations for workgroup personnel to apply and follow procedures, observe limits, and work within the released scope of work;
- Expectations for workgroup personnel for prompt communications to their supervisor for changes in the work scope, situations where the ALWCD cannot be followed or performed as written, unexpected conditions are encountered, or other conditions that may require re-evaluation of the activity;
- Expectations for workgroup personnel to use pause work or stop work actions;
- Identify actions in the event of an upset condition;
- Activity coordination between different work groups;
- Expected results (e.g., acceptance criteria, housekeeping); and
- Workgroup questions.

Most sites have a fairly standard format for conducting pre-job briefings prior to the execution of work. A reverse pre-job briefing assists in engaging the work force by fostering an environment where employees can raise concerns without fear of retaliation and promoting a questioning attitude. Reverse-briefing techniques include asking:

- Open-ended questions to promote a more thorough discussion;
- Each worker to describe their respective role/responsibility in performing the task;
- Each worker to describe hazards, controls and critical steps associated with their assignment;
- Workers about previous operating experiences or lessons learned;
- Workers to describe communication methods (voice, phone, radio, etc.);
- Workers to identify any known error precursors;
- Workers to discuss Human Performance Improvement tools (e.g., self-check, peer-check, questioning attitude, effective communication, time out) that can be used during the job; and
- Workers to describe potential problems including “worst case scenarios” and associated responses.

For more information regarding the reverse pre-job briefing process, refer to URS – Nuclear Waste Partnership LLC, outlined in WP 04-AD30303, Pre-Job & Post-Job Reviews.

6.6.3 Performing Work

Performance Expectation: Work is performed and documented in accordance with the ALWCD. Documentation includes acceptance results, problems encountered during execution of the work, and feedback information considered useful for improving the work process (see 48 CFR 970.5223-1, para. (b)(5) and (c)(3)-(5), 10 CFR 830.122.d-e, DOE P 450.4A, DOE O 433.1B, Attachment 2, para. 2.d and 2.f, and DOE O 422.1, Attachment 2, Appendix A, para. 2.a (3)(b); 2.b.(1), (2) and (5); 2.h(5)(c); and 2.p(1), (8), and (9)).

Good Practices:

Following the pre-job briefing, workers should conduct the activity and record results in accordance with the ALWCD.

Workers should:

- Perform work in accordance with the ALWCD;
- Understand their responsibility and authority to stop or pause work if conditions are deemed unsafe or if there is doubt concerning how to proceed safely;
- Promptly report unintended failures to follow ALWCD or supporting document requirements.
- Ensure that safety issues or errors discovered during the course of performing work are reported promptly, and the effect on current work activities is thoroughly assessed, before proceeding.
- Keep the work supervisor informed;
- Know where to go, what to do, and who to call for help if new or different hazards or circumstances other than addressed in the ALWCD are encountered;
- Look for collocated hazards that the ALWCD did not address. If such hazards exist, stop or pause work and inform supervision;
- Continue to assess current field conditions at the work site to ensure that conditions are as expected to perform the work safely. If conditions are not as expected, stop or pause work and inform supervision;
- Verify work is done on specified equipment in the ALWCD;
- Follow ALWCD use categories consistent with locally developed procedures; and
- Follow alarm, upset condition, and abnormal operating procedures as applicable.

Line Management and first line supervisors should:

- Oversee the work to ensure compliance with the ALWCD;
- Provide accurate and timely status reports;
- Demonstrate visible leadership at the work site and in employee work areas, including coaching, mentoring, and reinforcing standards and positive behaviors;
- Coordinate supporting and interfacing work activities; and

- Ensure the timely availability of tools, supplies, and parts.

6.6.3.1 Stop/Pause Work Expectations and Responsibilities

Performance Expectations:

1. Stop work authority is defined and available to all contract and subcontract personnel (48 CFR 970.5223-1, para. (i)).
2. Contractor Management: Establish procedures to permit workers to stop work or decline to perform an assigned task because of a reasonable belief that the task poses an imminent risk of death, serious physical harm, or other serious hazard to workers, in circumstances where the workers believe there is insufficient time to utilize normal hazard reporting and abatement procedures (10 CFR 851.20, para (a)(9)).
3. Workers: Stop work when the worker discovers employee exposures to immediately dangerous conditions or other serious hazards; provided that any stop-work authority must be exercised in a justifiable and responsible manner in accordance with procedures established in the approved worker safety and health program (10 CFR 851.20, para. (b)(9)).
4. Policies clearly define operations personnel authority, accountability, and relationships with other groups, including Stop-Work authority (DOE O 422.1 Attachment 2, Appendix A, Para. 2.a(1)(f)).
5. Contractor and subcontractor employees have the responsibility and the right to report concerns relating to the environment, safety, health or management of DOE-related activities, including those that have not been resolved through normal work processes (see DOE O 442.1a, Attachment 1, and DOE O 442.2, Attachment 1, para. 1).

Good Practices:

This section discusses one methodology for identifying and resolving situations involving the use of stop-work authority. A pause work concept is also introduced. In order for either concept to be successful, managers and supervisors should be responsive and supportive of each request without recrimination, stigma, or punishment. Below are recommended responsibilities and actions for concerned employees, employees performing the activity, and responsible managers.

A concerned employee should initiate a Pause Work when a condition of concern or an unexpected condition is perceived to exist. For example, a step in the procedure cannot be worked as written or another task being performed in the adjacent area presents a conflict. In many such instances, the performing employee or the responsible manager may be able to correct the condition of concern with minimal effort and time. In simple cases, the situation could be resolved via face to face communications such that the concerned employee is satisfied with the solution or explanation. However, if the condition represents an imminent risk of death, serious physical harm, or other serious hazard to workers, a concerned employee should promptlyinitiate a formal Stop Work action.

Stop Work Action:

Once aware of a potentially unsafe condition that represents an imminent risk of death, serious physical harm, or other serious hazard to workers, the concerned employee should perform the following:

- Stop the unsafe work activities and those of any other individuals in the area who may be affected by the situation.
- Clear all at-risk personnel from the area and warn others trying to enter the area.
- Inform all affected personnel of the reason for the work stoppage.
- Notify the the line foreman, supervisor, or manager of the situation.

When necessary, the responsible manager takes immediate and interim corrective actions to protect personnel. All employees should honor Stop Work declarations by stopping work. When a Stop Work is in effect, the responsible manager should only allow work to continue that will not interfere with, impact, or circumvent the Stop Work declaration.

Stop Work Resolution:

Upon declaration of the Stop Work action, the concerned employee should contact the cognizant supervisor, responsible manager, and the appropriate ES&H and Quality (ESH&Q) representative, and describe the situation that resulted in the Stop Work.

The concerned employee documents the details of the Stop Work action and the responsible manager evaluates the Stop Work action, including a determination whether the Stop Work action affects other locations/activities across the site.

The responsible manager, in consultation with the process owner, concerned employee, and applicable ESH&Q representative(s), determines the appropriate corrective action(s) to resolve the potentially unsafe condition, keeping the following in mind:

- Follow related organizational processes, such as:
  - Control of nonconforming items;
  - Corrective action system;
  - Identification, reporting, and resolution of Price-Anderson noncompliances;
  - Event investigation and occurrence reporting; and
  - Lessons learned.
- Proposed corrective actions should reduce or eliminate the hazards and not introduce new or additional hazards.
- Keep employee(s) apprised of the Stop Work action resolution.

The responsible manager implements the agreed upon corrective action(s) in accordance with locally approved processes. These corrective actions are reviewed by line management and appropriate subject matter experts in order to support a formal

and documented resumption of activities or restart of operations. Line management's formal approval should consider the following:

- Contact the concerned employee who reported the situation for an evaluation of the action(s) taken. If unavailable, select a peer of that employee to evaluate the action taken.

- If the actions taken implement applicable requirements and the concerned employee agrees with the action taken, document that an acceptable resolution has been achieved.

- If the actions taken do not implement applicable requirements or satisfy the concerned employee, consult with the concerned employee, Facility Manager, and appropriate ESH&Q representative in order to resolve concerns.

- The employee may seek to further address the concern, if it becomes necessary, through local processes for employee concerns. If the concern is a technical ES&H matter, a differing professional opinion (DPO) may be initiated through the DOE process in DOE O 442.2 (see http://www.hss.doe.gov/nuclearsafety/qa/dpo.html).

The responsible manager directs employees affected by the Stop Work declaration to resume activities.

A good practice for the affected organization is to maintain a completed Stop Work action form as a facility record in accordance with locally approved procedures.

Pause Work Action:

For conditions of concern or when encountering unexpected conditions,, the concerned employee should initiate a Pause Work if performing the work, or ask the employee performing the work to Pause Work, and raise the concern with the employee or supervisor. When confident that the condition of concern has been corrected, the concerned employee should verbally concur with the supervisor or performing employee.

If another employee requests a Pause Work from a task due to a safety concern, the performing employee(s) should honor the Pause Work and correct the condition that caused the Pause Work. Inform the concerned employee when the situation is corrected, and request his or her verbal concurrence with the correction.

Actions taken under a Pause Work should not normally warrant a formal corrective action plan or be further tracked and trended. However, resolutions may result in changes to the ALWCD through the change control process and the supervisor should consider reporting the Pause Work action to the appropriate authority, depending on the nature of the concern.

6.6.3.2 Monitoring Work, Status Updates, and Turnovers

Performance Expectation: The operator must establish and implement operations practices to ensure that operators are informed of conditions, manage equipment deficiencies, ongoing activities, while promptly notifying operating personnel and supervisors of changes in the facility status, abnormalities, or difficulties encountered in

performing assigned tasks (see DOE O 422.1, Attachment 2, Appendix A, para. 2.b.(1), 2.h(5)(c), and 2.l).

Good Practices:

The role of the work supervisor is a key element to the successful execution of work. DOE-HDBK-1117-99, *Guide to Good Practices for Maintenance Supervisor Selection and Development*, contains a wealth of information regarding attributes needed to be an effective supervisor. Care should be exercised in the selection of these individuals.

Responsible managers and first line supervisors communicate management expectations to the workforce and exhibit integrity in directing the work efforts of personnel. Their roles include asking questions, coaching, mentoring, evaluating personnel for fitness for duty, monitoring progress of work, reinforcing standards and positive behaviors, and coordinating with other organizations to support the effort. It is critically important that a supervisor maintain the big picture on the progress of an activity and consistently look ahead to anticipate the needs of his or her personnel in support of the activity.

During the course of the work, the supervisor and responsible manager routinely ensure work is being safely and compliantly executed in accordance with the ALWCD and solicit feedback from the workers by spending time on the floor and in employee work areas. Any issues should be properly documented, disclosed to the appropriate levels of supervision, and addressed. When the activity is being performed, consider the following information for entry into the ALWCD status log or other equivalent mechanism:

- Work interruptions (Pause Work/Stop Work);
- Work delays (such as unavailability of material, support personnel, work area access);
- Work clarification;
- Progress/status and turnover of work completed – daily or per shift; and
- Documentation of unexpected events or conditions encountered during the performance of the activity.

In some work situations, it may be necessary to turn an activity over to another shift. Effective processes need to be in place to ensure that a smooth turnover of responsibility and work status occurs. An accurate and up-to-date status log is a key part of that process. Ideally, the offgoing supervisor and oncoming supervisor should meet on the jobsite and go over the conditions of the work and any problems encountered over the previous shift. Staging of materials and other needed resources should also be discussed. Additionally, any other activity that is ongoing or scheduled that could be impacted by this work or could otherwise affect this work should be discussed. See also DOE-STD-1038-93 (CH-1), *Guide to Good Practices for Operations Turnover*.

6.6.4 Post-Work Testing

Performance Expectations:

1. Management of equipment deficiencies, maintenance activities, post-maintenance testing, and return to service include ALWCDs that specify retest requirements to ensure, prior to restoration to service, proper functioning, effectiveness of the maintenance, and that no new problems were introduced (DOE O 422.1, Att. 2 para. 2.h(5)(d) and (e)).
2. The Nuclear Maintenance Management Plan must clearly address the process for conducting post-maintenance testing to verify that safety SSCs can perform their intended function when returned to service (DOE O 433.1B, Attachment 2, para. 2.q).

Good Practices:

ALWCDs specify testing requirements to ensure functionality and that no new problems were introduced as a result of the work. For example, the safety functions of safety SSCs are protected by the established controls within TSRs.

Post-work testing should verify the completion of work activities and ensure the following:

- The work was performed correctly;
- The outcome is acceptable;
- The work does not introduce or cause other deficiencies or problems;
- Applicable design, safety, and interface criteria are met;
- Safety SSC performance criteria and functional requirements are met;
- Systems and equipment affected by the work operate correctly; and
- Affected equipment is restored to normal or desired operational status.

Additional considerations to prepare for, or conduct, post-work testing include:

- Providing specific instructions or reference a separate test instruction and provide traceability to testing data;
- Providing a place to record the data directly on the ALWCD or reference it on data sheets or instructions;
- Establishing the conditions necessary to conduct tests (e.g., flow, differential pressure, temperature, input signal values, and fluid type);
- Ensuring testing measures performance versus criteria on key parameters and allows for documentation and review of test data for the equipment;
- Using TSR surveillances to verify operability of safety SSCs;
- Ensuring that the testing has been tailored to the specific activity that was performed; and
- Performing the testing identified in the ALWCD.

6.6.4.1 Post-Work Acceptance

Post-work acceptance activities may include verification that the activity was performed correctly; the outcome is acceptable; the systems and equipment affected by the work operate correctly and are restored to normal or desired operational status; or the work environment has been restored, including packaging and removal of any wastes generated during the course of work, and is left in a clean and orderly condition.

The RM accepts completed work. The acceptance process includes confirmation that post-work testing and acceptance activities verified that acceptance criteria and requirements have been met (e.g., values are within ranges specified by engineering). The acceptance process may include interface with system engineers prior to equipment or systems being returned to service. The acceptance process should be commensurate with the type of work that was performed. Appendix D contains additional information on post-work testing and acceptance.

6.6.4.2 ALWCD Closeout

Performance Expectation: Timely updates and improvements are incorporated into affected documents (such as engineering drawings, training documents, operating procedures, hazard analysis) (see 10 CFR 830.122(c), (d) and (e)).

Good Practices:

Once work is completed, the completed ALWCDs should be reviewed for:

- Forms properly filled out;
- Results, observations, and comments recorded;
- Information describing issues, problems, deviations, abnormal conditions, and resultant actions taken;
- As-found and as-left conditions;
- Change control and documentation completion issues;
- Design or functional issues from acceptance or post-maintenance testing;
- The need for possible changes to safety management programs, safety analyses, process safety information, drawings, or other analysis or documentation as a result of the completed work;
- The need to update equipment history; and
- Lessons learned and other feedback and improvement information.

Following review and completion of documentation, the ALWCD should be routed for record retention.

6.7. Providing Feedback on Adequacy of Controls and Continuing to Improve Safety Management

6.7.1 Post-Work Review

Performance Expectation: Reviews are conducted to collect feedback, including lessons learned (see 48 CFR 970.5223-1(b)(2) and (c)(5), 10 CFR 830.122(c), (d) and (e), DOE P 450.4A, and DOE O 433.1B, Attachment 2, para. 2.l and 2.o).

Good Practices:

Post-work reviews are the chief information source for lessons learned (both positive and negative) from every work activity. The goal of these reviews is to improve WP&C processes and their implementation. The post-work review process should include participation by appropriate workgroup members. Items to discuss include what went right, what went wrong, and what can we do to improve. The results should be documented and catalogued so they may be used by the organization to implement lessons learned in future work activities.

6.7.2 Document Lessons Learned

Performance Expectation: Feedback and lessons learned information is analyzed to identify improvement opportunities. Improvement opportunities are effectively implemented (see 48 CFR 970.5223-1(b)(1), (c)(2) and (c)(5), 10 CFR 830.122(c) and (d), DOE P 450.4A, and DOE O 433.1B, Attachment 2, para. 2.o and 2.p).

Good Practices:

Documentation associated with the planning and execution of completed work, including feedback and lessons learned information, should be archived and easily retrievable to allow it to be used in the planning of similar work activities in the future.

Sources of lessons learned should be reviewed to identify specific lessons learned for incorporation or use in planning work activities. Corporate databases supported by the Office of Health, Safety and Security are listed on http://energy.gov/hss/services/reporting. Sources of lessons learned that may be applicable to work being planned include:

- DOE Corporate Lessons Learned database including the Corporate Operating Experience Review Program;Accident Investigation reports;
- Injury and illness data (Computerized Accident/Incident Reporting System (CAIRS));
- assessments, audits, and appraisals;
- causal analyses and root cause determinations;
- stakeholder feedback;
- deficiency reports;
- ALWCD planning and post-work critiques;
- emergency readiness assurance activities;
- Occurrence Reporting and Processing System (including near-miss reports);
- Noncompliance Tracking System;
- Operational Readiness Reviews;

- personal experiences and observations captured in post-job briefs;
- process improvement initiatives;
- Price-Anderson Amendments Act findings; and
- safety meetings.

6.7.3 Implement Lessons Learned

The WP&C process should involve supervisors, workers, and facility personnel to consider how the quality and safety outcomes could be improved. Personnel involved in work planning and execution should be trained on the importance of, and mechanisms for, providing feedback and lessons-learned information and incorporating the information into ongoing and future work activities. Lessons learned may be integrated into the planning of work in a variety of ways, including:

- addressing them as a topic for a pre-job briefing,
- attaching them for review by those approving the ALWCD,
- incorporating them into hazard controls, or
- incorporating them directly into work instructions.

Effectiveness reviews are one way to establish that lessons learned are driving continuous improvement. These reviews should involve observations of work in the field to verify that lessons learned are being implemented. Additionally, lessons learned developed from activity-level WP&C deficiencies may be rolled up in management review activities for broader application.

6.7.4 Assessing Performance

Performance Expectation: Contractors monitor and evaluate all work performed under their contracts, including the work of subcontractors, to ensure work performance meets the applicable requirements for environment, safety, and health, including quality assurance and integrated safety management. A contractor assurance system assures both the DOE and contractor managements that work is being performed safely, securely, and in compliance with all requirements; issues are being identified and managed; and that the systems of control are effective and efficient (DOE O 226.1B, Attachment 1, para. 1, 2.a, 2.b(2) and 2.b(3)(a)-(b), and DOE O 422.1, Attachment 2, Appendix A, Para. 2.a(3)).

Good Practices:

A contractor assurance system:

- Monitors and evaluates safety performance;
- Performs self-assessment and feedback and improvement activities;
- Performs trending and analysis to support proactive decisions; and
- Provides evidence to assure DOE and contractor management that work is being performed safely, hazards are identified and managed, and controls are effective.

Contractors should be aware that DOE oversight includes WP&C as a core performance area for nuclear safety to warrant special attention for its role in protecting workers, the public, and the environment from potential hazards (see DOE G 226.1-2).

Performance assessment should contain three principal elements:

- A comprehensive set of routine operational awareness activities that, through direct on-the-floor observation, evaluate the effectiveness of WP&C activities (e.g., work planning walkdowns, hazard analyses, pre-job briefs, execution of work). Assessment of effectiveness can be based upon the following examples:
  - Performance compared to industry benchmark or locally established WP&C performance metrics (see Section 6.1.8 and Appendix B),
  - Issues and corrective action status,
  - Related occurrence reports,
  - Prior activity-level WP&C assessment results,
  - WP&C program implementing procedure changes;
- A comprehensive method for selecting the type, sample size, and frequency of routine operational awareness activities to assure WP&C is effectively implemented; and
- Periodic formal assessments including self-assessments, internal and external independent assessments, and operational awareness activities are identified and conducted.

Formal assessment of activity-level WP&C program effectiveness should be incorporated into integrated assessment schedules. Identified deficiencies and strengths should be documented using organizational issues management programs, and corrective actions should be tracked to completion. Assessments should be done using Criteria and Review Approach Documents (CRADs) that provide assessment objectives, criteria, and approach guidelines for performing assessments targeted at the particular area of activity level WP&C. CRADs are available to perform these assessments in DOE G 226.1-2.

Assessment and metrics data should be analyzed both vertically (within a program, project, or organization) and horizontally (across different programs, projects, and organizations at a site) to identify trends and potential problems.

A safe working environment is impossible without an effective safety culture. A method to allow objective and systematic measurement of the organizational behaviors that impact safety performance is a useful tool to better understand organizational trends. See Appendix G for further information.

7.0. ACRONYMS

ALARA .....As low as reasonably achievable
ALW .....Activity-level work
ALWCD .....Activity-Level Work Control Document
AQM.....Automated Qualification Matrix
ASME.....American Society of Mechanical Engineers
CF .....Core Function
CFR.....Code of Federal Regulations
CSE.....Cognizant System Engineer
D&D .....Decontamination and Decommissioning
DEAR .....Department of Energy Acquisition Regulation
DOE .....U.S. Department of Energy
DSA.....Documented Safety Analysis
EFCOG .....Energy Facility Contractors Group
ES&H .....Environment, safety, and health
ESH&Q .....Environment, safety, health, and quality
FM.....Facility Manager
FMEA .....Failure Modes and Effect Analysis
GP.....Guiding Principle
HPI .....Human Performance Improvement
IHR.....Independent Hazard Review
IHRT.....Independent Hazard Review Team
ISM.....Integrated Safety Management
ISMS .....Integrated Safety Management System
JHA .....Job Hazards Analysis
JSA .....Job Safety Analysis
LCO.....Limiting Condition for Operation
NNSA .....National Nuclear Security Administration
NQA .....Nuclear Quality Assurance
PIC .....Person in Charge
PPE.....Personal Protective Equipment
QA.....Quality Assurance
QC…….Quality Control

QAP .....Quality Assurance Program
R&D .....Research and Development
RI .....Responsible Individual
RM .....Responsible Manager
RWP.....Radiological Work Permit
SAC.....Specific Administrative Control
SME .....Subject Matter Expert
SOC .....Skill of the Craft
SOM.....Shift Operations Manager
SOW .....Skill of the Worker
SR .....Surveillance Requirement
SRNS .....Savannah River Nuclear Solutions
SSC.....System, Structure, or Component
TPD.....Training Program Description
TRAIN .....Training Records and Information Network
TSR.....Technical Safety Requirement
USQ .....Unreviewed Safety Question
WP&C .....Work Planning and Control
WS .....Work Supervisor

APPENDIX A. SKILL OF THE WORKER

Skill of the worker (SOW) describes the basic discipline-specific competencies, defined by the contractor organization, for each Worker includes the required proficiency, experience, knowledge, skill, and ability. Competencies are obtained through approved methods such as accepted training, qualification, certification, education, and experience. SOW-type work can be defined as work that can be safely performed by a worker possessing the needed proficiency, skill, job position training, and experience to perform a given activity with limited work planning and hazard analysis (see Level 2: Moderate ALWCD and Level 3: Minor ALWCD in Section 6.4.3.2). The hazards of performing these tasks are assessed and documented as part of the individual's job description, and the training necessary to control these hazards is outlined in the individual or position training requirements document. There is little potential for identified hazards to change during the work activity.

SOW-type work tasks are those that should not negatively impact:

- Facility operations,
- Safety systems, structures, and components (SSCs) (e.g., diminished capability, loss of redundancy, entry into Limited Conditions for Operation (LCOs)),
- Scheduled activities; or the
- Facility design and safety basis.

SOW-type work tasks are those that should not require:

- Outside resources or expertise,
- Controls beyond worker capabilities,
- Permits,
- Safety evaluations,
- Changes in facility configuration, or
- Detailed work instructions that include, for example:
  - Critical steps that involve special controls or holdpoints
  - Independent verifications

Although the graded approach includes the flexibility to use SOW-type work, the work process needs to be formal and accompanied by high levels of accountability to ensure adequate performance. Task hazards may be mitigated by SOW and documented in a hazard analysis to state the basis for that determination, define the bounding conditions associated with that determination, and identify the set of controls and procedures that workers are expected to implement during the performance of the task. That set of controls is used to determine subsequent qualification, training, requalification, and experience. Newly designated SOW-type work activities should be validated prior to first time use to ensure the activities or tasks and associated controls and work instructions are within the worker knowledge, skill, and ability set.

The hazard analysis should be available to workers and supervisors to review as necessary to ensure proposed work falls within the scope of that analysis.

SOW qualifications should be delineated for each worker and include:

- Tool or instrument qualifications;
- Trade qualifications;
- Site or institutional training required to perform work; and
- Required training to perform specific tasks.

Considerations for qualifications include minimum year experience, such as on-the-job experience or journey-level certification through an approved apprenticeship program or formal classroom training to qualify as a journey level craft/worker. Formal related training from a college or trade school should be evaluated for equivalence. Each craft or worker should be evaluated against the delineated qualifications (commensurate with responsibility) by their line supervisor to determine whether they qualify at the journey level. The scope of work and the qualification considerations for each discipline of the craft or worker should be documented with a clear description of their respective work tasks.

An individual's qualifications should be reviewed annually by their supervisors to verify the determination remains accurate and the employees clearly understand their work tasks, the hazards associated with the work tasks, and the appropriate controls. This should be documented, and the supervisor should ensure that the individual worker reviews and signs the documentation.

Individuals who are not current in their qualifications for a task should work under the direct supervision of a person certified as journey-level qualified.

SOW Good Practice:

In August 2013, Savannah River Nuclear Solutions (SRNS) issued its Site Maintenance Training Program Description (TPD) (PROGSMTMPDES000100, Revision 00) which thoroughly documents SOW training and qualification criteria for maintenance personnel, including subcontractors and other non-permanent workers (like construction) who replace, or are employed in lieu of permanent personnel at Savannah River Site nuclear and non-nuclear facilities. This TPD lists specific responsibilities for program implementation for SRNS and subcontractor personnel, from the Director of Maintenance Services to the Trainees. The TPD contains the following notable practices:

- Selection of Personnel - The screening, selection, and assignment process is used to identify personnel who have a high probability of successfully completing training and qualification requirements with reasonable amounts of training. This process considers such factors as problem solving ability, background, work time or job experience, physical attributes, medical examination, educational level, mechanical aptitude, and other specified requirements (e.g., professional license) as appropriate.
- Alternatives to Education & Experience Requirements - The primary purpose of establishing education and experience requirements is to ensure that personnel have the requisite knowledge and experience necessary for safe and reliable job performance. Education requirements are used as an indicator of acquired knowledge, either general or job specific. Experience requirements are used to examine an individual's work history, diversity, and job

changes.

Substitution (alternatives) may be used for variations in education and experience to allow multiple routes into the maintenance organization. Specific work experience may be substituted for education and education may be substituted for specific work experience.

- Medical Examination Requirements - An initial medical examination needs to be given to candidates to verify health and physical fitness to safely perform their assigned tasks.
- Physical Attributes – Attributes that are recommended for safe performance of essential job duties. The list of attributes include: Natural or corrected near-distance visual acuity; Color vision sufficient to discern wiring, system, and component color coding; and Hearing sufficient to respond properly to audible alarms and use of communications systems.
- Training – Training that is conducted efficiently and effectively and is directly related to the needs of the job is fundamental to safe maintenance. The goal of maintenance training programs is to ensure that maintenance personnel possess the knowledge and skills necessary to perform their assigned responsibilities in an efficient, cost effective manner that promotes safe and reliable maintenance.

  Personnel who are training for initial qualification should work under the direct supervision of a qualified individual, and should not independently make decisions or take actions that could affect plant or personnel safety, and personnel without requisite qualitifications should not be placed in such positions. However, they may independently perform specific tasks or job assignments for which they are qualified.
- Evaluations - The quality of training programs, course content and instructional methods are best evaluated by monitoring trainee performance.
- Training Remediation - Remedial training programs are provided as necessary to prepare the trainee to meet the identified training program requirements for areas where he/ she may be deficient. In cases where a trainee fails an evaluation, remedial training is based upon the weaknesses identified in the evaluation.
- Maintenance Personnel Training - Maintenance personnel who perform work on Engineered Safety Features as identified in the facility Documented Safety Analysis should be trained on those system/ components. Included in this category are systems having a direct impact on the safe operation of the facility.
- Continuing Training - The continuing training program ensures that maintenance personnel maintain and improve their skills and are cognizant of changes that could affect their job performance. Continuing training is not a repeat of the initial training program, rather the subject material and depth to be covered in the continuing training program Intends to build on job experiences subsequent to the initial training program.
- Qualification Process - A comprehensive final written examination need not be administered to ascertain formal qualification of maintenance personnel. However, qualification of maintenance personnel should include demonstrated performance capabilities (performance demonstrations). Satisfactory participation in the continuing training program and satisfactory performance of their assigned duties is sufficient to determine their suitability to continue to perform in their assigned positions and serves as adequate evidence of maintenance of their qualification.

  Subcontractors who work independently should be qualified to perform assigned tasks. Assurance should be obtained that these personnel have the required knowledge, skills and

abilities prior to active (independent) involvement in plant maintenance or other support activities.

- Training Records - Records relating to training are maintained to permit review of content, schedule, attendance, results of evaluations, and personnel qualification to perform independent work activities.

In addition to the TPD, SRNS has also developed the Automated Qualification Matrix[1] (AQM) which tracks an individual's readiness to perform a job or task based on the successful completion of a set of requirements consisting of a mixture of Course and Qualification codes. AQM is a part of the SRNS Training Records and Information Network (TRAIN) system that is used to document planning, completion, funding, and effectiveness of employee training and development. The AQM User's Guide, referenced below, contains detailed instructions and screen shots on how to navigate, submit data, and generate personnel training reports within the AQM application module.

[1] *Training Records and Information Network (TRAIN) Automated Qualification Matrix (AQM) User Guide.* B_UG_G_00018, Rev. 00. Savannah River Nuclear Solutions. Savannah River Site. May 3, 2010.

APPENDIX B. WORK PLANNING AND CONTROL METRICS, ANALYSIS, AND TRENDING

Those responsible for activity-level work planning and control (ALWPC) may find the below information about possible performance metrics useful for selecting metrics that are appropriate for their work activities. Such metrics may then be monitored and analyzed to assess program performance.

The Energy Facility Contractors Group (EFCOG) Integrated Safety Management (ISM)/Quality Assurance (QA) Working Group, in the 2011-2012 timeframe, conducted a survey of WP&C performance metrics in use or recommended. The survey participants and sources included 12 Department of Energy (DOE) contractors, and six external organizations. Survey results (Table B-1) identified nearly 90 possible WP&C performance metrics.

*Desired Range: Some of these indicators do not have desired ranges but may prove valuable to evaluating the effectiveness of WP&C programs. Contractors are encouraged to develop their own ranges to include in their annual safety performance objectives, metrics, and commitments.

Table B-1. Survey Results

Indicator	Definition	*Desired Range (If Available)	Number of Sources Using this Indicator
PLANNING/SCHEDULING			
Preventive Maintenance (PM) completion %	Percentage of scheduled PMs that were completed for the period	95-98%	13
PM deferrals	# of PMs deferred per approved process.	5-2%	10
Ratio of PM tasks in the grace period or overdue (past the grace period) to total PM tasks	The ratio is a measure of the preventive maintenance tasks that are in grace period compared to total preventive maintenance tasks. The 1.25 grace period (i.e., 125% of the grace period) is the allowable interval of time after the date a PM is due.		2
PMs in last 50% of grace period	Self explanatory.		3
Deferred PMs	The total number of PMs that are incomplete and beyond the grace period, i.e., exceeding 125% of the		1

Indicator	Definition	*Desired Range (If Available)	Number of Sources Using this Indicator
	PMs' grace period.		
% CM vs Total Maintenance	Self explanatory.	<40%	9
Schedule performance	% of scheduled ALWCDs completed	> 80%	13
Schedule personnel resource loading	% of personnel resources loaded onto the schedule	> 80%	7
Scope stability/schedule consistency	For T-week schedules, the percentage of scheduled work that was completed. For example, take a T-4 schedule (4 weeks from execution week), and see how much of the work scheduled at T-4 that was actually performed during the execution week.		5
ALWCD production/completion	Total maintenance output, measured in completed ALWCDs		11
% of emergent work	Number of emergent ALWCDs divided by the total number of ALWCDs for the period	< 5%	5
CM backlog total	Total number of CM ALWCDs created but not completed		12
CM backlog in crew weeks	Amount of time it would take the entire maintenance workforce to complete all ALWCDs in the backlog. Assumes that the workforce works nothing else but the backlog. Calculated by dividing the estimated hours in the backlog by total maintenance resources.	4 - 8 wks	8
Backlog of dispatch/minor maintenance work	Total number of dispatch or minor (i.e., low hazard, unplanned, unscheduled, low priority) maintenance work orders created but not completed		2
CM backlog age	Average age of work orders in the backlog		7
Ready-to-work backlog	Percentage of the backlogged work orders that have been planned and are ready to work compared to total number of backlog items.		3
Backlog trending	Percentage change in the number of backlog orders		1
Completed Fix-It-Now	Number of Fix-It-Now (FIN)/expedited/minor		7

Indicator	Definition	*Desired Range (If Available)	Number of Sources Using this Indicator
(FIN)/Expedited/Minor Maintenance	maintenance orders completed for the period		
Number of add-on activities (emergent work)	Number of activities added to the schedule after scope freeze		6
Cost estimating accuracy	Ratio of estimated to actual work order costs	90 - 110%	6
Craft % overtime	% craft overtime when compared to straight-time hours	< 10%	7
Manpower utilization	% of maintenance resources used during the period		6
Work Control Performance Index(WCPI)-	*1,000,000 x SUM [Eventl x Weighting Factor (WF) +Event2 x WF +....+ EventN x WF] / Hours worked*		2
Equipment and test inspection	Equipment and Test Inspection performance, i.e., number of test equipment inspections and calibrations performed in a calibration laboratory		1
Total field calibration performance	Test and Inspection group's productivity; i.e., number of test equipment inspections and calibrations performed at the point of use in the field		4
% rework	Percentage of work orders compared to total work orders that failed post-maintenance testing		8
False starts	Number of jobs released that were never started		1
Job package quality	Quality review of work packages. Specific values require development by the contractor.		2
Planning errors	Number of errors by type (e.g., ISM core function)		3
Maintenance quality	T*he number of work orders reworked divided by the number of work orders in the month.* The rating system encompasses effectiveness, cost, time, and breadth on a scale between 1 (low) and 5 (high).		3
Work package change	The total number of work package changes compared to total work packages over a period of time		1
Work order feedback	Measure of amount and utility of craft feedback on work orders. Specific values require development by the contractor.		1

Indicator	Definition	*Desired Range (If Available)	Number of Sources Using this Indicator
Percent of issues coded affiliated with work management (WM)	Use the Occurrence Reporting and Processing System (ORPS) database (DOE O 232.2, *Occurrence Reporting and Processing of Operations Information*), Attachment 5 *Causal Analysis Tree*) coding for Work Management (WM) issues in comparison to total occurrences for a site/facility in a given period		1
Work Management/Operations/Electrical Safety/Rigging Reports trends	Corrective action trending, over a certain time period, using site-specific ORPS subcodes; i.e., local codes that are based on the ORPS codes and provide greater detail such as work group, facility, and area		1
HUMAN PERFORMANCE IMPROVEMENT (HPI)			
Total number of HPI events (per 10,000 labor hours)	Total # of HPI events (per 10,000 labor hours)		4
HPI Event Clock resets	How many significant human errors reset event clocks (hours of error-free operation)		4
Human Performance training (hours per employee)	Measure of how much HPI training an employee receives	$\geq$8 hours	1
Human Performance Supervisory Observations (per month)	Number of Human Performance Improvement Management Observations (HPI MOVs) or observations performed by supervisors	$\geq$4	1
Open procedure revision requests	Self-explanatory		2
Open corrective actions	Self-explanatory		2
Self-identified human performance problems	Number of HPI problems discovered internally rather than by external entities		2
Work control field execution effectiveness	Measures the number of attributes observed during an observation and how well specific attributes are being implemented		1
FACILITY CONDITION			

Indicator	Definition	*Desired Range (If Available)	Number of Sources Using this Indicator
Building inspection results	Condition Inspection		3
Modification backlog	Number of facility modifications that are in backlog (not executed)		5
EQUIPMENT RELIABILITY			
Unscheduled vs. Scheduled downtime	Hours of unscheduled outage downtime relative to total outage downtime		4
Utilities availability	Percentage of system availability		4
Mechanical utility availability	Percentage of system availability		3
Mean Time Between Failures (MTBF)	Self-explanatory		1
Safety system availability	Percentage of safety system availability		1
CORRECTIVE ACTION INTERFACE			
Integrated Safety Management System (ISMS) Breakdown Measure	Number of deficiencies sorted per the ISMS core functions (Define Work, Analyze hazards, Develop Controls, Perform Work, Feedback and Improvement)		2
On-time completion of corrective actions	Self-explanatory		2
Average age of uncompleted Corrective Action Plan (CAP) issues	The average age of uncompleted issues that are being tracked in the Corrective Action Plan		1
Condition reports open >12 months	Self-explanatory		1
Condition report self-identification	Self-explanatory		1
Number of repeat events	Self-explanatory		1
Corrective action quality	This indicator is the scorecard/criteria used by a Management Review Board for corrective actions to evaluate the effectiveness of the corrective action at sites that have a Management Review Board		1
OTHER LEADING INDICATORS			
On-time training completion	Percentage of completed training vs. scheduled training		7

Indicator	Definition	*Desired Range (If Available)	Number of Sources Using this Indicator
Staffing resource levels	% filled positions		1
Staffing turnover rate	% turnover per time period		1
Rate and nature of procedure violations	Self-explanatory		3
Frequency of procedure reworks	# procedure reworks per time period		3
Frequency of unexpected equip. failures	# of equipment failures per period		3
Frequency of challenges to controls	Equipment challenges (i.e. boiler high drum level) that almost, but didn't, trip the equipment		3
Continuing training participation	% of personnel that attend yearly continuing training per DOE O 426.2		3
OTHERS			
ORPS reports involving conduct of operations	ORPS report with work management cause codes		1
Worker effectiveness	Number of work activities performed on a per-person, per-week basis.		2
Expediting cost	Costs associated with expediting materials to support work activities.		2
Work on hold for engineering	Self-explanatory		4
Contamination events	Self-explanatory		1
Personal Protective Equipment (PPE) infractions	Self-explanatory		1
Engineering backlog	How many engineering requests have yet to be completed		2
EMPLOYEE ATTITUDES			
Employee satisfaction indicator	Number of allegations, employee concerns, and grievances received during each time period. Indicator trends may provide an early warning of issues affecting employee attitudes and concerns.		1

Indicator	Definition	*Desired Range (If Available)	Number of Sources Using this Indicator
Lost time due to illness	Sick hours divided by total work hours. An increasing rate of employee absences could indicate increased stress on station personnel or a change in personnel satisfaction.		2
Industry involvement	Rolling average number of benchmarking visits, participants in self-assessments or similar activities at other DOE sites, and participants in industry activities such as EFCOG working meetings, workshops, and owner's group activities.		1
Supervisory time available for worker interactions	Percentage of work time available for first-line supervisors to interact with staff members who report directly to them.		3
ACCIDENT/ILLNESS RATES			
Total Recordable Case (TRC) rate	The Occupational Safety and Health Act of 1970 require covered employers to prepare and maintain records of occupational injuries and illnesses. The incidence rates are calculated by multiplying the number of injuries, illnesses, or lost workdays by 200,000 and dividing by the total number of work hours.		14
Days Away, Restricted, or Transferred (DART) rate	The Occupational Safety and Health Act of 1970 require covered employers to prepare and maintain records of occupational injuries and illnesses. The DART rates are calculated by multiplying the total number of days away, restricted, or transferred from work by 200,000 and dividing by the total number of work hours.		14
Near misses	Incidents where no property was damaged and no personal injury sustained, but where, given a slight shift in time or position, damage or injury could have occurred.		6

APPENDIX C. COLLABORATIVE TEAM APPROACHES

Work Planning and Control teams are formed to efficiently and effectively develop ALWCDs. Consistently deploying right-sized teams can be a challenge in terms of identifying or acquiring needed technical and craft expertise for the wide variety of work that takes place within a Hazard Category 1, 2 and 3 nuclear facility.

Most DOE contractors employ work control processes that define local requirements for using work planning teams. Roles and responsibilities are defined and methods are established to optimally deploy the needed expertise for each work activity. A network of individuals are typically identified by discipline and may be further specified by facility, system or other discriminator to aid the work planner or responsible individual in forming an effective team. Good practices for improving processes or deploying teams:

- Establish subject matter experts, workers, and planners based upon established criteria in the work control process;
- Publish and maintain lists of SMEs by expertise to improve communication during team formation;
- Train work planners as facilitators;
- Require minimum representation (e.g., facility management, health and safety, craft) and additional representation (e.g., radiological controls, cognizant safety engineer) depending upon the type, complexity or hazard of the work;
- Worker involvement to ensure consistent and reliable ALWCD development;
- Institute team walkdowns or tabletop reviews to review and finalize the team's ALWCD;
- Define ALWCD change management for planning teams and ALWCD performers in WP&C processes; and
- Implement training and periodically perform effectiveness reviews on work planning teams.

Key success factors or tools improve the likelihood of effective work planning teams. Several site contractors responded to a survey on what made their planning teams successful. Consider these as possible good practices to employ at your site:

- Qualified SMEs are identified and made available through the WP&C process;
- Schedule limited resources (e.g., craft, SMEs) for work planning teams to maximize productivity and maintain priorities;
- Work Control Centers serve as hubs for work review coordination and the electronic Integrated Work System to provide consistent, reliable work packages (LLNL);
- Employ Hazards Profile Screening Checklists to better address hazard elimination or mitigations within established hierarchy of controls (INL-CWI);
- Employ Integration and Approval Checklists and identify SMEs who will ensure technical accuracy during ALWCD verification and validation (INL-CWI);

- Formal processes for feedback and improvement (e.g., interim status reviews, lessons learned) by planning teams; and
- A storefront approach (See Figure C-1) to performing work through the use of Facility Core Teams allows a core staff element to manage all aspects of planning and performing work with clear roles, responsibilities, authorities and accountabilities (PNNL).

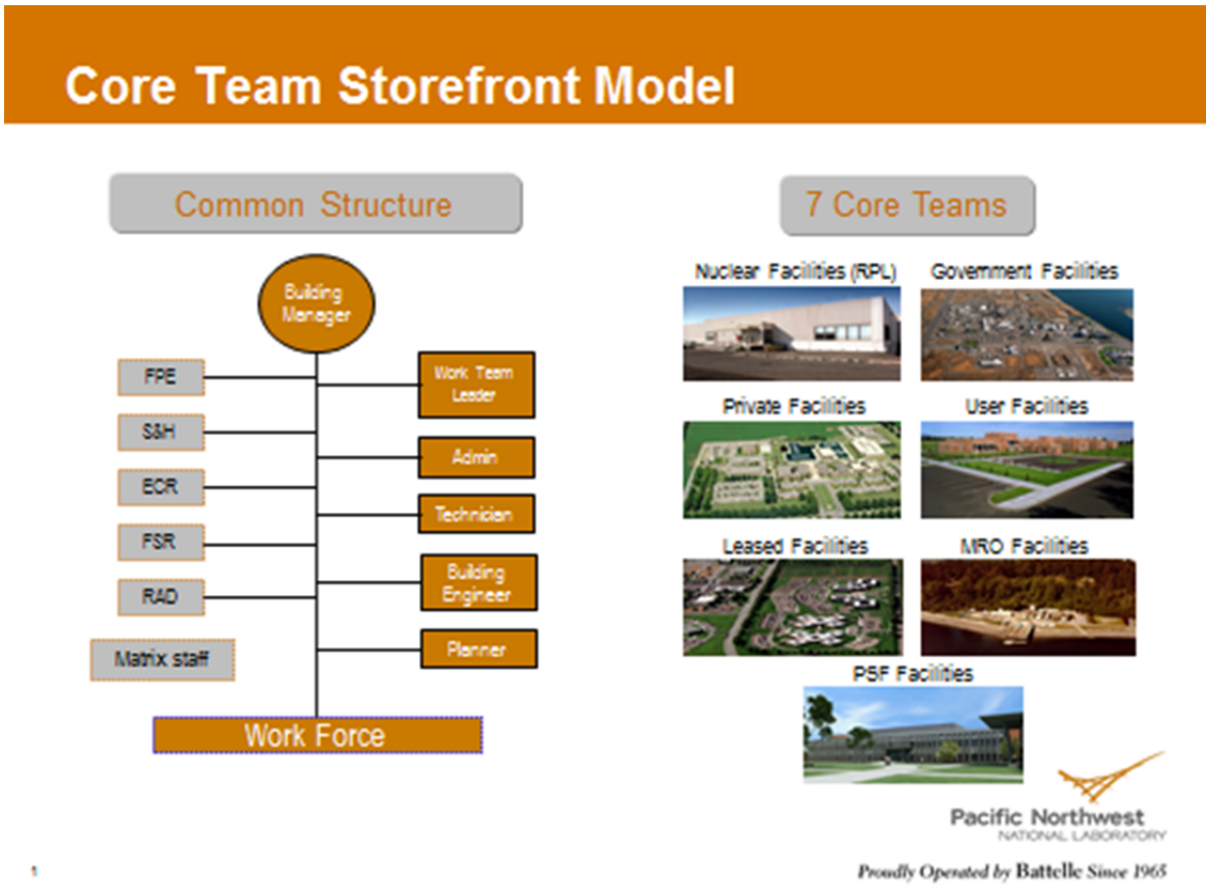


Figure C-1. Core Team Storefront Model

Team collaboration can be aided by employing various hazard analysis methods, depending on the need. The following methods help a multidisciplinary team identify hazards and controls with defined evaluation techniques:

Hazard and Operability Study (HAZOP): HAZOP is a formally structured method to systematically investigate each element of a system for all of the ways in which important parameters can deviate from the intended design conditions to create hazards and operability problems. The hazard and operability problems are typically determined by a study of the piping and instrument diagrams (or plant model) by a team of personnel who critically analyze the effects of potential problems arising in each pipeline and each vessel of the operation.

What-If. The What-If method uses a set of prepared questions to stimulate discussion and thinking, often in the form of a What-If discussion. The questions are developed by experts who have conducted many hazards analyses and who have extensive experience with the design, operation and maintenance of process facilities.

Functional Hazard Analysis (FHA). A FHA is a technique to identify all the hazards which can affect the outcome of the principal functional activities that need to be carried out to accomplish a given mission. Those hazards may consist of a loss of critical function, inadvertent activation of the function, outside influences on the performance of the function, or some combination of the three.

Human Error Analysis. A human error analysis is a technique to evaluate the potential for hazard causes related to human interaction. A human error analysis ensures that human factors engineering principles are applied to the design to eliminate or mitigate potential hazards associated with the human-system interfaces.

Sometimes, as a result of lessons learned or other feedback mechanisms on work already completed, the following methods may also be considered by planning teams to further improve hazard identification, hazard analysis or establishment of controls on future work:

Fault Tree Analysis (FTA). FTA is a deductive System Safety analysis that provides qualitative and quantitative measures of the likelihood of failure of a system, subsystem, or event. This analysis estimates the likelihood that a top-level or causal event will occur, identifies possible causes leading to that event, and documents the results of the analytic process to provide a baseline for future studies of alternate designs.

Event Tree Analysis (ETA). ETA is a system analysis technique that explores responses to an initiating event and enables assessment of the probabilities of unfavorable or favorable outcomes.

Failure Modes and Effects Analysis (FMEA). FMEA is a system analysis by which each potential failure in a system is analyzed to determine the effects on the system and to classify each potential failure according to its severity and likelihood. FMEA are typically considered to be reliability analysis tools, but they can be used as part of a System Safety analysis.

Cause/Effect Analysis. Cause/Effect Analysis graphically represents the relationships between a problem and its possible causes. This technique is also known as a fishbone or Ishikawa diagram.

APPENDIX D. ACTIVITY-LEVEL WORK CONTROL DOCUMENT WRITERS GUIDE

Portions of this Appendix were derived from DOE-STD-1029-92, *WRITER'S GUIDE FOR TECHNICAL PROCEDURES.*

Scope

The Scope section identifies the approved range of activities for ALWCDs. It states the ALWCD startpoint or the triggering events that make use of the ALWCD necessary, and the ALWCD endpoint or final condition. If necessary, the scope may also address the ALWCD limits (i.e., what the ALWCD does not cover).

Precautions and Limitations

The Precautions and Limitations section delineates provisions that affect the entire ALWCD or that occur at more than one point in the ALWCD. Precautions alert workers to actions and conditions that represent potential personnel hazards, pose the potential for equipment damage, or could result in abnormal facility conditions. Precautions also identify the job hazards analysis (JHA)-identified hazard controls associated with those actions and conditions. Limitations define boundaries that are not to be exceeded, including system or equipment capacities or conditions during ALWCD completion. Since Precautions and Limitations cannot be effectively executed by individual steps, they should be identified early in the ALWCD or at the beginning of the ALWCD section to which they apply.

Precautions and Limitations may be presented by order of occurrence, severity of consequences, or any other appropriate criteria. However, steps specified in the Precautions and Limitations section may be performed in any sequence since they generally apply to the entire ALWCD, or multiple ALWCD steps, and do not direct the performance or completion of specific actions, tasks, or conditions.

While drafting Precautions and Limitations, planning personnel should:

- Not include any Precautions and Limitations the worker cannot control by using the ALWCD;
- Not include worker actions in the Precautions and Limitations section;
- Limit the number of Precautions and Limitations so that the worker can remember them while performing the activities in the ALWCD;
- Avoid generic Precautions and Limitations that are part of a job description or inherent in the activity;
- Inform workers of hazardous conditions, their potential effects, and associated hazard controls; and
- If the hazard is present during the entire activity or in multiple places within the ALWCD, place the warning or caution in the Precautions and Limitations section.

Prerequisites/Initial Conditions

The Prerequisites/Initial Conditions section identifies actions to be completed by the worker and requirements to be met before the worker continues with the ALWCD. The ALWCD identifies

which prerequisites or initial conditions should be completed in a specified sequence and which may be completed in any order.

While drafting the Prerequisites/Initial Conditions section, personnel should consider the following:

- Required facility or system mode or configuration to be established and confirmed;
- Safety structures, systems, and components (SSCs) statusthat need to be in a condition to preclude violation of requirements in the Technical Safety Requirements (TSRs) or Documented Safety Analysis (DSA);
- Implementation of hazard controls (e.g. lockout/tagout, fire watches, cold and dark);
- Special tools, equipment, parts, or supplies that will be needed;
- Specifiying the required security measures that need to be in place;
- Required permits;
- Required approvals;
- Affected personnel/organizations that need to be notified and available to support the activity;
- Coordination with other organizations/work groups that needs to be established;
- Support equipment that needs to be available; and
- Minimum personnel staffing needed to complete the ALWCD.

Special Training/Medical Requirements

The Special Training/Medical Requirements section identifies training or medical requirements unique to the activity being performed or the work environment associated with the activity. Generic requirements should not be listed in this section.

While drafting this section, personnel consider the following:

- Mockups;
- Training on vendor-provided equipment, including instructions or requirements;
- Normal worker training, qualifications, and proficiencies;
- Safety training (e.g., fall protection, competent person);
- Radiological worker medical screening and surveillance;
- Beryllium worker medical screening and surveillance; and
- Respiratory protection user medical screening and surveillance.

Special Tools/Equipment

The Special Tools/Equipment section identified special tools, measuring and test equipment, parts, and supplies required to perform the activities in the ALWCD. Strict attention to the completeness and correctness of this section is important. For example, the failure to specify a

necessary item could result in costly equipment downtime or using a substitute for a specialized tool could harm personnel or damage equipment.

While developing this section, personnel:

- Identify certified or qualified parts and equipment needed for the activities;
- Provide guidelines for selecting and assembling special tools, measuring and test equipment, parts, and supplies;
- Provide separate action steps for the different categories such as parts, supplies, or measuring and test equipment; and
- Specify alternative tools and equipment, if applicable.

Work Instructions

Work Instructions provide the specific information, details, and actions on how to perform the tasks and associated steps necessary to carry out an ALWCD.

When developing work instructions, personnel:

- Clearly define the work scope and boundaries;
- Write work instructions and action steps in a clear, concise manner;
- Preclude the potential for misinterpretation or error;
- Avoid terminology such as if applicable, if needed, as necessary, and as directed;
- Sequence the work steps in a logical flow to ensure that work is performed safely, efficiently, and effectively;
- Ensure there is only one action per work step;
- Start the basic action step with a single present-tense action verb such as ”Open;”
- Format the text of action steps so that it stays together;
- Identify each action step and action sub-step with a special identifier to distinguish the action steps from each other and from topical headings and explanations;
- Identify equipment precisely as it is in the facility;
- Use main action steps to allow workers to quickly comprehend the purpose of the action step;
- Use action sub-steps to provide specific details for performance. Both main action steps and action sub-steps use the same basic action step form;
- Ensure that work steps and sub-steps include descriptive language on their sequence (e.g., conditional use, nonsequential use, concurrent, continuous, repeated);
- Use only acronyms and abbreviations that are included in an approved site-specific list;
- Identify the person to perform the task directly above the affected action step if someone other than the primary worker is responsible for performing an action step;

- Identify critical work steps and controls (i.e., steps with significance to safety, the DSA, or those that are regulatory in nature);
- Integrate hold points into the work instructions;
- Incorporate all activity-specific and task-specific hazard controls from the JHA into the ALWCD work instruction section;
- Clearly identify task-specific hazard controls in Warning and Caution statements;
- Ensure that Warnings (potential personnel hazards,) Cautions (potential equipment or environmental damage,) and Notes (supplemental information) are used appropriately;
- Do not direct actions in Warnings, Cautions, or Notes;
- Clearly identify the action steps that require independent verification;
- Avoid requiring workers to make conversions from one unit of measure to another whenever possible. Provide an aid for the worker if conversions are essential. Do not require mental calculations;
- Specify numbers and units in the ALWCD with the same precision as the instruments;
- Where a word is used that requires a definition, include the definition as a Note immediately preceding the action step;
- Ensure that there are adequate instructions regarding the use of ”Not Applicable;”
- Clearly identify those action steps or groups of action steps where first-line supervisor presence is required; and
- Clearly identify when workers need to communicate with other organizations or locations (e.g., control room, workers in another location).

Hold Points

Hold points are work instruction steps in the ALWCD at which the worker should wait for another person to do something or for some other event to occur to ensure protection of workers, facilities, or the environment. Examples include radiological protection surveys, quality assurance (QA) inspections, and industrial hygiene samples.

Action Steps with Warnings and Cautions

Warning and Caution statements are an effective way to incorporate JHA-identified task or step-specific hazard controls into ALWCDs. Warning statements alert workers to potential hazards to personnel. Caution statements alert workers to situations that have the potential for damage to products or equipment, including inadvertent activation or entry into a Limiting Condition of Operation condition.

Warnings and cautions attract attention to information that is essential to safe performance and consist of the conditions, design limitations, practices, and actions to be complied with to avoid loss of life, personal injury, health hazards, or damage to equipment.

When developing Warning and Caution statements, personnel:

- Review potential hazards with workers and subject matter experts (SMEs) to determine warnings or cautions that need to be included;
- Determine those parts of the ALWCD where the addition of information is necessary;
- Review each action step and list the potential hazards in Warning or Caution format;
- Position Warnings and Cautions on the page so they are complete and appear immediately before and on the same page as the action step(s) to which they apply;
- Place Warnings ahead of Cautions whenever more than one type is used at the same point in an ALWCD;
- Do not include action steps in Warnings and Cautions;
- Write Warnings and Cautions as clear, concise and specific statements. Write Warnings and Cautions as statements rather than as commands to distinguish them from action steps;
- Ensure that Cautions and Warnings provide a description of the hazardous condition, the consequences of failing to heed the warning or caution, and critical time considerations;
- Present the text of Warnings and Cautions using appropriate techniques to ensure visual identification.
- Include only one topic in each Warning or Caution.
- Number each Warning or Caution when more than one exists;
- Place the Warning or Caution in the Precautions and Limitations section if the hazard is present throughout, or in multiple places within, the ALWCD;
- Repeat the information in the Precautions and Limitations as separate Cautions or Warnings within the body of the ALWCD as it applies to individual action steps; and
- Use Warnings and Cautions judiciously.

Action Steps with Notes

Notes call attention to important supplemental information. The information can be a reminder of preparatory information needed to perform the activities of an ALWCD or action step. When developing Notes, personnel:

- Use notes to present information that assists the worker in making decisions or improving task performance;
- Position notes so they are complete on one page and appear immediately before and on the same page as the action steps to which they apply;
- Place Warnings and Cautions ahead of Notes whenever more than one type is used at the same point in an ALWCD;
- Ensure that action steps are not included in Notes. Embedded actions should be removed from the Note and written as action steps;
- Number the Notes if more than one is entered at the same location in a section or subsection;
- Write Notes as short, concise statements rather than as commands to distinguish them from action steps;

- Use appropriate emphasis techniques to distinguish Notes from Cautions or Warnings;
- Include only one topic in each Note; and
- Avoid overusing Notes.

Time-Dependent Action Steps

Some action steps contain actions that impose time requirements on the worker by specifying the duration of actions or actions to be completed within a specific period of time. When developing time-dependent action steps, personnel:

- Place a Note before the action steps to alert the worker.
- Begin the action steps with instructions for the worker to record critical time information and provide the worker with a place to record this information. Typically, this information will be the time that starts the clock, and the time by which some action step or action should be completed.
- Include guidance to identify the actions to take in the event that the time-dependent action step cannot be performed within the specified time.

Conditional Action Steps

Conditional action steps are used when a decision is based upon the occurrence of a condition or a combination of conditions. The use of conditional action steps is important, as they structure the decisions required by the worker. Conditional action steps use the following logic terms:

- IF or WHEN to present the condition to the worker,
- THEN to present the action,
- OR or AND to present more complex conditions, and
- NOT to negate the condition.

When developing conditional action steps, personnel:

- Describe the condition first and then the action to be taken if that condition applies. State the action to be taken on a new line.
- Avoid using AND and OR in the same conditional statement as the resulting logic can be ambiguous and difficult to understand.
- Emphasize conditional terms in ALWCDs. The emphasis techniques used for conditional terms should be applied uniquely to conditional terms.
- Place the conditional term AND between the conditions, if two conditions are required and both of these conditions must be met.
- Place the conditional term <u>OR</u> in underlined capital letters between the conditions, if two conditions are involved and one or both of these conditions must be met before the action is taken.

- Use the conditional term NOT for a negative condition. Avoid using NOT if a single word can be used and the condition can be stated in a positive manner.
- Provide a space for the worker to mark conditional action steps where a sign-off or check-off is desired.

Nonsequential Action Steps

Workers should perform the action steps in the order they are written unless they are specifically directed to perform action steps in another order. When the objectives of the action steps will be met regardless of the sequence in which they are performed, use nonsequential actions steps.

When developing nonsequential action steps, personnel:

- Sequence the action steps according to usability criteria, such as according to equipment or control board layout, to reduce opportunities for error;
- Identify in a consistent fashion the series of action steps that can be performed nonsequentially;
- Place a note before the sequence of action steps that can be performed nonsequentially; for example "**NOTE:** The activities in Action Steps [1] through [7] may be performed in any order;" and
- Provide a check box or signoff line for every action in a series of nonsequential action steps to ensure that action steps are not omitted.

Concurrent Action Steps

Concurrent action steps contain actions that are performed at the same time. For example, parameters may have to be monitored or checked while the worker accomplishes another action, or two workers in different locations may have to execute actions simultaneously.

When developing concurrent action steps, personnel consider the following:

- Clearly identify which action steps are to be performed concurrently;
- If concurrent action steps are to be performed by one person, place those actions in one action step that describes precisely the relationship between the action steps;and
- If concurrent action steps are to be performed by more than one person, place a note before the first concurrent action step, as appropriate, identifying:
  - Concurrent action steps,
  - Personnel needed to perform each concurrent action step,
  - Locations where the action steps are performed, and
  - Means of communication between locations.

Continuous Action Steps

Continuous action steps are conditional action steps where the conditions they describe are monitored throughout an ALWCD or a portion of an ALWCD. For example, a worker may need to monitor a gauge and take a specific action if the gauge, at any point during the ALWCD, indicates a reading above or below a specific level.

When developing continuous action steps, personnel:

- Clearly identify which action steps are to be performed continuously;
- Place continuous action steps in the ALWCD at the point at which they first apply. Repeat the action steps periodically, as appropriate, on the facing pages of the ALWCD or in the body of the ALWCD; and
- Format continuous action steps as conditional action steps and state the portion of the ALWCD during which they are applicable.

Repeated Action Steps

Repeated action steps are simple action steps that are performed more than once during the execution of an ALWCD.

When developing repeated action steps, personnel consider the following:

- Clearly identifying the action steps that are to be performed repeatedly;
- If an action step must be repeated an indefinite number of times to achieve an objective, specify that the action step is to be repeated until the expected results are achieved. Only a single signoff line is provided for this action step regardless of the number of times the action step is performed;
- If it is important to know the number of times the sequence is repeated, clearly state so and provide space for recording the number;
- If an action must be performed repeatedly at timed intervals, place instructions in the ALWCD and provide suitable space to record the times that the action step is performed;
- If an action step is to be performed periodically throughout an ALWCD or a portion of an ALWCD (but not at specific timed intervals), place reminders as action steps in the body of the ALWCD;
- If a large group of repetitive actions is required and becomes cumbersome, address the actions in action steps that reference a table, a list, or an appendix (an example of a large group of repetitive actions is a series of valve alignments); and
- Notify the worker when repeated action steps are to be initiated and discontinued.

Action Steps Containing Verifications, Checks, Notifications, and Data Recording

Verification action steps ensure that a specific activity has occurred or that a stated condition exists. Manipulation by the worker may be required. Check action steps call for a comparison with stated requirements; no manipulation by the worker occurs. Notification action steps require reporting when given criteria are met. Data recording action steps ensure that desired data is recorded.

When developing action steps with Verifications, Checks, Notifications, and Data Recording, personnel:

- Provide appropriate space or tables for entering data (either in the ALWCD or in data sheets);
- Provide the appropriate actions to take if the condition to be verified or checked is not found; and
- Include labeled lines in action steps as necessary for workers to record required information.

Action Steps Directing Workers Elsewhere—Branching and Referencing

To perform a task, sometimes workers need to reference another section of the ALWCD they are using (base ALWCD) or another ALWCD. Branching directs the worker to other action steps or sections within the base ALWCD or another ALWCD, but does not return the worker to the original position in the base ALWCD. Referencing directs the worker to other action steps or sections within the base ALWCD or another ALWCD, but returns the workers to the original position in the base ALWCD.

Referencing and branching may make ALWCDs more concise, enhance consistency, and simplify ALWCD maintenance. But these techniques are complex and can be confusing to workers. Confusion could increase the potential for error, with resulting safety or performance consequences. Use referencing and branching only when it is necessary to direct the worker to information that is vital to the performance of the activity and it is not appropriate to incorporate that information into the base ALWCD. When using branching and referencing, be careful to direct the workers to the correct point elsewhere in the same or other ALWCD.

Referencing or branching may be appropriate when:

- The information is crucial to activity performance;
- It is not practical to incorporate the information into the base ALWCD because:
  - The material consists of a large group of information (e.g., multiple steps or a long table);
  - Incorporating the material into the base ALWCD would result in a needlessly long or confusing ALWCD; or
  - The material is repeated frequently.

When considering the use of referencing or branching, consider the following:

- Can action steps readily be incorporated rather than referenced or branched to?
- Will referencing or branching decrease worker comprehension and ease of use?
- Will worker be directed to small, isolated sections, rather than to whole ALWCDs or appendices?
- Will branching and referencing cause workers to bypass prerequisites that affect the section to which they are being directed?
- Will branching and referencing cause workers to bypass precautions and limitations that affect the section to which they are being directed?

- Will branching and referencing degrade the accuracy and completeness of recording information during ALWCD performance?

If the answer to all these questions is no, then referencing or branching may be a useful technique.

Branching

A branching step identifies three specific elements:

1. Departure point,
2. Destination, and
3. Action that is to be performed at the destination.

At the departure point, it should be clearly emphasized that the worker is being directed to another portion of the same ALWCD, or to another ALWCD, and that the worker is not expected to return to the sequence of steps that initiated the branch. In a branching step, the notice of departure, the destination, and the action to be performed once the destination is reached are all stated in one step.

Referencing

A referencing step identifies the following elements:

- Departure point,
- Destination,
- Action to be performed at the destination, and
- Return point.

A referencing step directs the worker to a destination or location in the base ALWCD or another ALWCD or document; specifies the action to be performed; and instructs the worker to return to the originating step in base ALWCD. When using referencing, it is important to provide unambiguous instructions to the worker. When developing action steps directing workers elsewhere, personnel consider the following:

If referencing or branching is appropriate, then use the following methods for referencing and branching:

- Make it clear to the workers that they are being directed to other material. Do not expect them to know implicitly that other material is being referenced.
- Fully specify the location the worker is to go when crossreferencing. If the worker is being sent to another ALWCD, identify the ALWCD number, title, and section of the ALWCD. If the worker is being sent to another location in the base ALWCD, identify the specific location in the ALWCD.
- Use a consistent format for presenting crossreferences. Emphasize key words consistently so that workers can identify a crossreferenced action step.

- Ensure that a reference or branch directs the worker to all material needed as a prerequisite to the identified material. For example, ensure that in executing a reference or branch, the worker does not bypass an applicable precaution, limitation, or prerequisite/initial condition.
- Data sheets are used exclusively for recording information, not prescribing how action steps are to be completed. Therefore, the referencing and branching techniques of this section are not applicable to data sheets.

Action Steps with Acceptance Criteria

Acceptance criteria provide a basis for determining the success or failure of an activity. Acceptance criteria may be qualitative or quantitative. When developing action steps with acceptance criteria, personnel:

- Determine where specific acceptance criteria are to be presented in the ALWCD;
- State the location of acceptance criteria, whether located at:
  - Individual action steps (used when criteria are satisfied at the time of performance), or
  - Status logs, data sheets, or other ALWCDs.
- When acceptance criteria are located in other ALWCDs, link ALWCDs using referencing techniques if the information cannot be included in the ALWCD;
- Provide a summary of the acceptance criteria in a table or a list as an appendix;
- Include instructions for notifications to be made or actions to be taken immediately by the worker, in the event that specified acceptance criteria are not met;
- Place these instructions or actions in the body of the ALWCD;
- Ensure that these actions are consistent with administrative instructions; and
- Include subsequent notifications and actions, such as those to be taken by reviewers, with the acceptance criteria.

Action Steps with SignOffs

Written responses for action steps that require independent verification, inspection, data or acceptance criteria recording, or documentation of completion can also be placekeeping devices. The use of signatures, initials, identification of technical discipline (e.g., Radcon Technician), check marks, and N/A should be defined in Organizational WP&C processes and procedures. Additionally, enough information should be provided in the action step to clearly state what a signoff means (e.g., Radiological contamination levels are below designated threshold). When developing signoffs for action steps, consider the following:

- A blank line for verification, notification, or inspection signatures or initials;
- A blank line for signoff by a person other than the worker;
- Blanks for recording data and the initials or signatures of persons recording the data;
- If the ALWCD requires that action steps be signed off, provide space for the signoff of the action step;

- Provide a space for the date and time of a signoff where such information is determined to be useful;
- Position a blank signature or initial line (for entering initials that identify the persons signing off on the action step) immediately following the affected action step, or on a separate data sheet or checklist, if necessary; and
- If the signoff is located in one ALWCD and the action to be signed off is located in a referenced ALWCD, indicate in the base ALWCD action step that documentation occurs in the referenced ALWCD signoff space.

Action Steps with Placekeeping

Placekeeping helps workers to keep track of their progress in an ALWCD and reduces the probability of omitting or duplicating action steps. When developing placekeeping for action steps, personnel consider the following:

- If initials or signatures are not required, placekeeping typically consists of check boxes.
- Provide a placekeeping check box near the right margin of the page or the right side of a table.

Acceptance Criteria

Acceptance criteria are used to determine whether the work was performed successfully without causing other problems or deficiencies. The level of formality of the acceptance criteria and associated documentation is commensurate with the complexity, hazards, or mission-significance of the work. This will range from none for low-hazard, simple tasks (e.g., relocating simple laboratory equipment, staging non-hazardous materials or equipment, or general cleanup) to specific acceptance criteria for higher-hazard, complex, or mission-critical tasks (e.g., SSC maintenance, relying on DSA-specified performance criteria and functional requirements or particular operational alignments).

Acceptance criteria should ensure that:

- Work specified in the ALWCD iscompleted and documented;
- Equipment and systems are available to be returned to service; and
- Design and safety functions are met.

Some activities, such as long-term R&D or construction projects, may have milestones or project phases with acceptance criteria. Where these criteria exist, they should be integrated into the ALWCD acceptance criteria. Acceptance criteria may not be applicable for some work (e.g., where the outcome is unknown (R&D), or cannot or need not be precisely determined in advance).

Acceptance criteria should contain specific instructions or reference separate instructions (e.g., equipment/systems commissioning, construction acceptance testing, post maintenance testing). Post maintenance tests (PMTs) are a good example of how acceptance criteria can be applied.

PMT verifies the completion of work activities by answering the following types of questions:

- Was the work performed correctly?

- Is the outcome acceptable or successful?
- Did the work introduce or cause other deficiencies or problems?
- Were applicable design, safety, and interface criteria met?
- Have safety SSC performance criteria and functional requirements been met?
- Do systems and equipment affected by the work operate correctly?
- Is the effected equipment restored to the desired operational status?

Representative examples of common PMTs, when combined with appropriate acceptance criteria, can provide a complete PMT:

- Visual or dimensional inspections and nondestructive tests specified by code;
- Voltage, current, integrity, or continuity checks;
- Calibration or alignment of a component or instrument loop;
- Leak rate testing;
- Closure and response times, strokes;
- Hydrostatic or other pressure tests with visual inspection for leaks;
- Visual inspections or nondestructive examinations for loose fasteners and mechanical misalignments;
- Operational testing of the component, including checks such as valve stroke time; measurement of vibration, flow, pressure, and temperature; operation of interlocks; and comparison against other applicable equipment;
- Response time test of an instrument or instrument loop; and
- System or component inspections for cleanliness.

Post-Work Activities

The Post-Work Activities section identifies actions that should be performed once the work is complete.

While drafting this section, personnel consider the following:

- Post-maintenance and functional testing;
- SME review and concurrence;
- System Engineer (as applicable) review and concurrence on all modifications, temporary modifications, and SSC functional testing, including performance criteria and functional requirement verification;
- Operations acceptance;
- System return to service and desired operational status;
- Post-work review;
- Work Supervisor review for completeness; and
- Return of the ALWCD to work control management for closeout and lessons learned.

Closeout

The Closeout section identifies actions that should be performed once post-work activities are complete. While drafting this section, personnel consider the following:

- ALWCD archiving,
- Record retention, and
- Revising associated documentation (e.g., system drawings, system descriptions, training materials).

Status Logs/Data Sheets

The Status Logs/Data Sheets section provides a means for recording information associated with completing the ALWCD such as WS turnover; work pause or stoppage and resumption; ALWCD changes, including the reason for the change, where the change was made, and change approval; and any other information that may be helpful to personnel using the ALWCD. This section also provides for the retention of any data sheets generated during performance of the work covered by the ALWCD.

Miscellaneous

The Miscellaneous section provides for including any drawings, sketches, illustrations, vendor or manufacturer information, Material Safety Data Sheets, Safety Data Sheets, waste stream disposition information, and field-generated paperwork that may be useful to personnel using the ALWCD or retaining records.

APPENDIX E. ACTIVITY-LEVEL WORK CONTROL DOCUMENT VERIFICATION AND VALIDATION GUIDELINES

Verification Guidance

Purpose: Verification addresses technical accuracy of the ALWCD.

Scope: Verification is not intended to replicate the ALWCD development or review process; verification substantiates the technical accuracy of the ALWCD. To the degree possible, verification is incorporated into the technical review process, but additional actions may be required to ensure that each ALWCD is of highest quality.

The verification process is intended to ensure the ALWCD:

- Is technically accurate;
- Incorporates appropriate input, programmatic and regulatory requirements / controls from the appropriate subject/technical discipline (e.g., Safety, Radiological controls, IH, QA, Environmental).
- Development and review processes have been conducted consistent with the applicable management controls,
- Is consistent with existing related procedures (e.g., DOE STD 1029, ALWCD Writer's Guide) and consistent with ongoing initiatives,
- Development and review processes have not inadvertently introduced requirements / controls that are inconsistent with current contracts and approved operating practices.

If verification comments are received, resolve comments with the Team that performed the verification; incorporate resolutions into the draft ALWCD, and obtain review concurrence with the resolution prior to submitting for approval. Comments should be routed to Work Control Management and Work Control Planners as part of the organization's feedback and improvement process.

Table E-1. ALWCD Verification Checklist

Review ALWCD for each of the following characteristics and check appropriate response. Any "No" answer requires explanation in the comment section.	**Yes**	**No**	**N/A**
Are all necessary prerequisites identified? For example: • Actions or other ALWCDs that must be completed prior to use of this ALCWD. • Plant, system, or equipment conditions that must be met prior to use of this ALWCD. • Organizations that must be notified prior to use of this ALWCD.			
Are accurate equipment checklists/lineups included?			
Are hazard analysis identified hazard controls incorporated?			

Review ALWCD for each of the following characteristics and check appropriate response. Any "No" answer requires explanation in the comment section.	**Yes**	**No**	**N/A**
Are hold points (e.g. lifting and landing leads, component torque, confined space monitoring) identified and placed?			
Are permitting requirements and regulatory notifications incorporated?			
Are controlled parts identified?			
Are calibration requirements identified?			
Are special Tools and M&TE identified?			
Do post work activities verify form, fit and function of structures, systems, and components?			
Are hazard controls identified in the hazard analysis appropriately incorporated into the ALWCD?			
• Do Precautions and Limitations relate to hazards/conditions which may be encountered throughout performance, or at more than one time, during theALWCD?			
• Do Cautions relate to specific equipment or environmental hazards and contain information essential to safe performance?			
• Do Warnings relate to specific personnel hazards and contain information essential to safe performance?			
• Do mitigation steps appear as a step just prior to the step in which the hazard(s) is encountered?			
Are Warnings, Cautions, and Notes:			
• Placed immediately prior to the step/section to which they apply, unless they appear only in Precautions?			
• Worded in a passive voice and do not direct action?			
• Placed entirely on the same page as their related steps?			
Are acceptance criteria and limits expressed in quantitative terms?			
Are acceptance criteria and limits expressed as a nominal value and acceptable range rather than as a single value?			
Is the specified instrument proper for the ALWCD's intended task (e.g. adequate range for all modes of equipment/system operation, scale and readability adequate for determination of specified parameters)?			
Are specified units consistent with the instrument's units and range?			
Are numerical values and tolerances consistent with system design and do they meet acceptance criteria?			
Are consistent units and conversation factors specified in the ALWCD and on data sheets/forms for recorded data?			
Are actions that place safety structures, systems, and components (SSCs) in an inoperable condition identified?			

Review ALWCD for each of the following characteristics and check appropriate response. Any "No" answer requires explanation in the comment section.	**Yes**	**No**	**N/A**
Does the ALWCD clearly identify which data is required to be recorded (e.g. component position, instrumentation values, initials) and where to record the data?			
Are engineering and mathematical symbols used correctly?			
Are graphs, charts, tables, and diagrams correct and easily readable?			
Are tasks/steps requiring independent verification or second check identified?			
Are additional documents required to perform the activity (e.g. design output documents, vendor documents,) identified?			
Are place keeping requirements identified?			
Are formulas correct and workable?			
Do work steps identify and verify expected facility response (e.g., alarm actuation)?			
Are reference documents clearly identified and listed under References?			
Does the ALWCD provide the following for each component that requires alignment: • Is the component individually identified?			
• Is the position where components are to be placed/have been placed identified?			
• Is ALWCD component nomenclature consistent with equipment/facility labeling?			
• Are check-offs or sign-offs required for verifying component position?			
Are equipment, components, and materials quality levels identified?			
Are restoration steps identified to return system/equipment to desired configuration?			
Do ALWCDs list follow-on actions or tests?			
Are interfaces identified for the installation and removal of required support equipment (e.g. scaffolding,temporary ventilation, jumpers)?			
Were applicable lessons learned incorporated into the ALWCD?			
Comments:			

Validation Guidance

Purpose: Validation is a demonstration that the ALWCD can be performed by the work group exactly as written, accomplishes the scope and objectives of the work document effectively and efficiently, and is endorsed by management.

Scope: A validation is conducted prior to approval to ensure the ALWCD can be used as written. Validation focuses on use, a factor that should have already been incorporated in the development phase by subject/technical experts, but which should be reassessed prior to approval. Specifically, the validation allows independent assessment after resolution of review comments to demonstrate that the ALWCD can be used as written and in the environment where the activity is to be performed.

Validation includes ensuring that the work instructions and action steps are properly sequenced and are within the intended work group qualifications and skill level. Validation confirms: written equipment labeling information matches actual component labeling; identification of special equipment and supporting calculations (e.g., arc flash hazard analysis, respiratory protection, etc.) are available to select appropriate PPE. Another focus of Validation is to flag and resolve Human Performance Error Precursors that have been embedded in the procedure.

Methods: There are two basic approaches to conducting validation of ALWCDs. A Simulated Evaluation Approach in which work group performs simulation of work instructions and action steps at the work site and a Table Top Approach in which a work group evaluates the technical content and usability of work instructions and action steps through a talk-through process. The Simulated Evaluation Approach is the preferred method because it is more likely to identify ALWCD discrepancies at the work site.

<u>Simulated Evaluation Approach:</u> This method should be used for new ALWCDs and significant technical revisions.

- Plan and schedule performance of the validation for when the facility and equipment are accessible and personnel are available.

- Assemble a Validation Team consisting of knowledgeable, experienced worker/craft representing each craft which will be performing the work, an ALWCD writer, first line supervisor, and any support organizations that are required to either complete the activity or are accountable for its content, (e.g., Environmental, Radiological Controls, Nuclear Safety, Engineering, Safety.)

- Conduct the validation via Reader/Worker method in which the ALWCD writer reads each step of the ALWCD to the Worker who simulates performance of each step and verbally acknowledges that the step can be completed as written, or declares that the step cannot be completed as written. The ALWCD writer documents results of each step along with recommended changes to address workability issues.

- After working through the entire ALWCD, the Validation Team discusses ALWCD discrepancies and reaches consensus on recommended changes.

- The ALWCD mark-up and the completed ALWCD Validation Checklist are provided to the Work Group Manager who will make a determination as to whether the changes will warrant a repeat of the validation.

Tabletop Approach: This method is used for minor revisions or when accessibility to equipment for a simulated evaluation is not feasible.

- Assemble a Validation Team consisting of knowledgeable, experienced worker/craft representing each craft which will be performing the work, a ALWCD planner, first line supervisor, and any support organizations that are required to either complete sections of the procedure or are accountable for its content (e.g., Environmental, Radcon, Nuclear Safety, Engineering, Safety,).

- The ALWCD Validation Team convenes and reviews each step of the ALWCD and determines whether the step can be completed as written. The planner documents results of each step along with recommended changes to address workability issues.

- After working through the entire ALWCD, the Validation Team discusses discrepancies and reaches consensus on recommended changes.

- The ALWCD mark-up and the completed ALWCD Validation Checklist are provided to the Work Group Manager who will make a determination as to whether the changes will warrant a repeat of the validation.

Validation is typically the final step in ALWCD development prior to being submitted to the Unreviewed Safety Question (USQ) process. In some cases, however, validation may be used as an element of periodic reviews, as the first step in a planned revision, or as subsequent use of a Model ALWCD. An ALWCD that requires significant revision after the initial validation will most likely require a repeat validation prior to approval.

If validation comments are received, the Planning Team should resolve comments with the Validation Team; incorporate resolutions into the draft ALWCD, and obtain review concurrence with the resolution prior to submitting for approval. Comments should be routed to Work Control Management and Work Planners as part of the organization's feedback and improvement process.

Table E-2. ALWCD Validation Checklist

Review ALWCD for each of the following characteristics and check appropriate response. Any "No" answer requires an explanation in the comment section.	**Yes**	**No**	**N/A**
Are all ALWCD pages present and appropriately numbered?			
Are the ALWCD's purpose, scope, and boundaries identified?			
Are responsibilities and interfaces with other organizations clearly identified?			
Are all necessary prerequisites clearly identified and executable?			
Are Warnings, Cautions, and Notes easily understood by the work group?			
Are special tools, equipment, and materials identified and adequate for performance of the activity?			
Is the work group able to complete the activity using only ALWCD identified parts, equipment, tools, and supplies?			
Does the ALWCD nomenclature match facility, equipment, and component labeling?			

Review ALWCD for each of the following characteristics and check appropriate response. Any "No" answer requires an explanation in the comment section.	**Yes**	**No**	**N/A**
Are ALWCD specified instrument ranges, units of measurement, set points, and indicators consistent with field installation?			
Does the ALWCD identify the appropriate parameter verification method (e.g. gauge to verify pressure, meter to verify voltage, etc)?			
Is the ALWCD level of detail appropriate for the complexity of the activity and qualifications of the work group performing the activity?			
Does the ALWCD contain sufficient information for the work group to perform the activity without obtaining additional information from other persons or documents?			
If not, were those other persons or documents specifically identified?			
Is the work group able to complete the activity by following the work instructions (i.e. no missing necessary steps)?			
Is the work group able to perform each step as written?			
Is step wording short, clear, and concise?			
Are steps limited to one action unless multiple actions are required to perform a single task?			
Does the step provide the best method to perform the task?			
Can all steps be performed safely?			
Is the work group able to follow branching and referencing instructions?			
Do steps follow the natural flow of the work and are they written in the order of performance, unless there is a basis otherwise (e.g. valve line up sequencing, breaker/switch manipulation,)?			
Are steps sequenced by worker/craft type (e.g. electrician, maintenance, radiological controls, QA,) unless there's a basis otherwise?			
Does the ALWCD allow enough time to perform time-dependent actions?			
Does work instruction step numbering match data sheets or forms?			
Where specific step sequence is not required, are the applicable steps bounded by a Note such as "Steps X through Z may be performed in any order"?			
Is the identification of non-sequence mandatory steps correct? (Frequently, ALWCDs incorrectly identify steps as non-sequence mandatory that must be performed in a specified sequence (e.g., steps 1-5 are identified as non-sequence mandatory but step 3 "Open breaker Z," step 4 "LOTO breaker Z," step 5 "replace fan belt" must be performed in sequence.)).			
Are support groups identified prior to performance of actions that may impact them (e.g., notification of expected alarms to control room)?			

Review ALWCD for each of the following characteristics and check appropriate response. Any "No" answer requires an explanation in the comment section.	**Yes**	**No**	**N/A**
Do work steps identify and verify expected facility response (e.g., alarm actuation)?			
Are graphs, charts, tables, and data sheets adequate for readability and extraction of values?			
Are the following requirements met: • Are acceptance criteria and limits in quantitative terms?			
• Are acceptance criteria and limits expressed as a nominal point and range vs. a single point?			
• Are specified units consistent with the instrument's units and range?			
Are referenced attachments provided in the ALWCD?			
Are formulas workable?			
Is the requirement for calculations by the work group minimized?			
Do the ALWCD and associated forms and data sheets provide adequate space to perform calculations and record data?			
Does the ALWCD provide the following for each component that requires alignment: • Is the component individually identified and labeled?			
• Is the position where components are to be placed/have been placed identified, consistent with equipment/facility labeling, and are check-offs or sign-offs required for verification?			
Can the activity be performed as the ALWCD is written by the least experienced qualified user?			
Comments:			

APPENDIX F. MULTI-WEEK SCHEDULING MANAGEMENT

This appendix provides an example of multi-week scheduling. The purpose of multi-week scheduling is to ensure that the highest priority work is being completed on a weekly basis and that clarity, consensus, and commitment regarding work to be done is achieved through joint prioritization. Work is selected based on what is important to the operation of the facility in order to maximize availability and minimize cost. Preventive and predictive maintenance are essential to accomplishing these goals. Effective long-range scheduling will aid in ensuring that these activities are accomplished consistently.

The multi-week scheduling process is a system used to plan and execute all on-line and off-line maintenance. It is a well-integrated, interdepartmental plan that will promote employees to work safely without challenging facility operations, and, ultimately, reduces the cost.

The process is designed to ensure that the work identified at the initial stage equals the work completed at the end of the cycle. The facility would be able to track every activity that enters the system from start to finish, whether it is a modification that is a project with a due date, or maintenance work that is scheduled in a multi-week cycle.

While a Supervisor reporting to aResponsible Manager is the primary owner of the Planning and Scheduling Processes, there is a need for support from all other groups on site to complete the activities as scheduled in the Planning and Scheduling Process.

Schedules are prepared for each crew for the multi-weeks following the current week, henceforth referred to as Week T4, T3, T2, T1, and T0. Various multi-week scenarios can exist depending on the unique situation at the plant. Which work will be scheduled first is a matter of plant policy and joint prioritization; however, it is recommended that preventive and predictive maintenance be the first items included in each of the multi-weeks, followed by higher priority corrective work and capital projects or modifications. Each week the available labor is scheduled up to the following approximate amounts:

- Week T4: 30%,
- Week T3: 50%,
- Week T2: 70%,
- Week T1: 70%, and
- Week T0: 100% (this is the week work is executed).

Work is scheduled against available labor resources, but only as man-hours available versus man-hours estimated for the entire week's activities. Individuals can be matched up with activities before the work week or during the daily scheduling process depending on a person's special skills and on coordination with other groups. Specific start dates within the week are not identified unless they are required for coordination of resources.

The intended outcome of multi-week scheduling is published schedules for all Maintenance, R&D, Operations and Engineering activities.

Then, each day during work week T0, weekly scheduled work is placed into daily schedules that reflect 100% of the available labor for each crew. It is at this time that matching activities up with individual craftspeople is finalized.

As work week T0 comes to a close, all work incomplete or not started will be rolled over into subsequent work weeks.

The following section describes the significant steps in the work week management processes.

The work week process should consist of a rolling multi-week schedule, such as a four-week schedule, developed by the schedulers with input from joint prioritization between System Owners, Work Planners, Maintenance, Operations, Engineering, and Subject Matter Experts. These work weeks will be updated weekly at a Weekly Scheduling meeting.

Activity by Week

Week T4—Work to be Performed 4 Weeks Away

Labor availability information is submitted each week for the upcoming multi-weeks. First LineSupervisors discuss availability with team members. During this week, the facility submits its priorities on work driven by condition.

Additionally, the system owner will review system equipment indicators for impending problems and review and prioritize the outstanding work on the system. The system owner identifies a recommended activity list for the window four weeks away.

During this week, the Schedulers make sure a joint prioritization takes place for work to be placed on the T4 work week. At the weekly scheduling meeting, joint prioritization can be agreed to in relation to all work assigned to the various work weeks.

Work Planners or planning team will begin planning activities identified for week T4.

Week T3—Work to be Performed 3 Weeks Away

Labor availability information is submitted each week for the above mentioned crews for the upcoming multi-weeks. Gather the information required to complete the labor availability. First-Line Supervisors discuss availability with crew members.

The facility reviews and provides input on the prioritization of work.

Work Planners or planning team will continue planning activities.

Week T2—Work to be Performed 2 Weeks Away

Labor availability information is submitted each week, for the abovementioned crews, for the upcoming multi-weeks.

Ensure that all man-hour estimates are correct and that all resources are available, or scheduled to be available, by the end of business on Friday.

Perform materials management to ensure all parts are available for the activities by the end of business on Friday. Staging of parts may be started at this point.

Supervisors review their available man-hours for the work week and compare to the scope of the window and then commit to the schedule.

Perform a final evaluation of the work week. The Work Planner or scheduler should remove work activities from the window if parts or resources will not be available.

After this week, any work added to the work week receives management approval in accordance with an approved schedule addition process.

Week T1—Work to be Performed Next Week

Labor availability information is submitted each week for the above mentioned crews for the upcoming multi-weeks. First Line Supervisors discuss availability with crew members.

On Monday of Week T1, all work is incorporated into a master work-week schedule.

On Friday, work that will roll over from T0 into T1 is identified and entered into the schedule.

Supervisors review their available man-hours for the work week and compare to the scope of the work week and commit to accomplishing all work. Notify Planning and Scheduling of any discrepancies by the end of business on Friday.

Supervisors can begin to assign the work to specific personnel and obtain buy-in to the schedule.

The Supervisor evaluates the activities in the week to identify possible conflicts.

The Rev 0 schedule, reflecting available resources, is issued on Friday.

Week T0—Work Execution Week

Daily meetings are held to discuss authorized work activities, work in progress, new priorities and emergent work. All emergent work should goes through the work authorization process.

Work Week Critique

Review schedule compliance, what went well, what did not go well during the week, and compare to schedule compliance goals.

Daily Scheduling

The purpose of daily scheduling is to ensure that the highest priority work is being completed on a daily basis and to achieve consensus regarding work to be done.

Daily Scheduling Meeting/POD

<u>Purpose</u>

- Ensure regular communication, cooperation, and coordination between Operations, Maintenance and other groups.
- Review recently completed work to ensure organizations are aware of critical activities that have been performed.
- Review issues or concerns that impacted work accomplishment.

- Review current activities to ensure understanding of status.
- Review tentative schedules for the next working day, including potential carry-over work.
- Discuss conditions necessary to conduct scheduled activities.

Responsibilities

Preparation Prior to the Meeting

First-Line Supervisors:

- Review yesterday's important activities to be sure they were completed.
- Review today's updated daily work schedules to assess current work progress and identify potential carry-over work.
- Review the work-order backlog to identify emergent work that may require scheduling.
- Develop tentative plan to meet schedule commitments for the next working day.
- Collect scheduled ALWCDs.

During the Meeting

- Open meeting with current facility conditions.
- Discuss recent significant events or lessons learned.
- Discuss issues that impacted yesterday's schedules.
- Follow the standard daily meeting agenda.
- All participants provide necessary information per agenda item.
- Identify changes to daily schedules.
- Deconflict on-going and planned activities.
- Allocate resources.
- Reprioritize scheduled activities based on available resources.

After the Meeting

- First-line Supervisors complete preparation for planned work.
- Make work assignments.
- Discuss issues and concerns that impacted schedule compliance and work accomplishment.
- Review priorities from the three-week schedules and the backlog.
- Identify potential carry-over work for tomorrow's schedule.

APPENDIX G. FOSTERING AN ENVIRONMENT TO PROMOTE A POSITIVE SAFETY CULTURE AND A SAFETY-CONSCIOUS WORK ENVIRONMENT

Expectations and Guidance for Department of Energy (DOE) Organizations

DOE P 450.4A, *Integrated Safety Management Policy,* states,

> To complement these systems and mechanisms, the Department expects all organizations to embrace a strong safety culture where safe performance of work and involvement of workers in all aspects of work performance are core values that are deeply, strongly, and consistently held by managers and workers. The Department encourages a questioning attitude by all employees and a work environment that fosters such attitude.

DOE O 450.2, *Integrated Safety Management,* includes requirements for DOE organizations to develop strategies to improve safety culture.

DOE G 450.4-1C, was issued in September 2011. Attachment 10 of the Guide, *Safety Culture Focus Areas and Associated Attributes*, was based on experience and the results of research gained during the preceding decade. It provides three safety culture focus areas (Leadership, Employee/Worker Engagement, and Organizational Learning)with a corresponding list of attributes, that collectively describe a strong safety culture that supports achieving excellence in both safety and mission performance.

Additionally, the Department of Energy is committed to a strong and sustained safety culture, including a Safety-Conscious Work Environment (SCWE). A SCWE is a work environment in which employees feel free to raise safety concerns to management or a regulator without fear of retaliation.

Safety Culture Attributes Related to Work Planning and Control (WP&C)

Safety culture attributes with direct relevance to WP&C are listed below. Sections of this Handbook where these attributes are applied are referenced in parentheses:

- Line managers enhance work activities, procedures, and processes with safety practices and policies (6.1.1 Responsible Manager (RM) roles and responsibilities (R&R)).
- Line managers clearly understand their work activities and performance objectives, and how to safely conduct their work activities to accomplish their performance objectives (6.1.1 RM R&R, 6.1.8 performance expectations (PEs) and good practices (GPs)).
- Employees are expected, authorized, and supported by managers to take conservative actions when faced with unexpected or uncertain conditions (6.1.1 Worker R&R, 6.1.2 all personnel training and qualifications (T&Q), 6.6.2 Pre-job briefing (PJB) for worker expectations, 6.6.3.1 Stop/Pause Work PEs and GPs).
- The bias is set on proving that work activities are safe before proceeding, rather than proving them unsafe before halting. Personnel do not proceed, and do not allow others to proceed, when safety is uncertain and management is supportive of these decisions (6.6 GP).

- Line managers spend time on the floor and in employee work areas (6.6.3.2 supervisor and RM).
- Line managers practice visible leadership by placing eyes on the work, asking questions, coaching, mentoring, and reinforcing standards and positive behaviors (6.1.1 and 6.6.3.2).
- Deviations from expectations are corrected promptly and, when appropriate, collectively analyzed to understand why the behaviors occurred (6.1.1 work supervisor (WS), 6.6.3.1 GP).
- Training should include the ability to appreciate the potential for unexpected conditions and to recognize and respond to a variety of problems and anomalies (6.1.2 all personnel T&Q).
- Individuals at all levels of the organization promptly report errors and incidents and offer suggestions for improvement (6.4.4, 6.4.6, 6.5.3, 6.6.1, 6.6.2, 6.6.3.1, 6.6.3.2, 6.7).
- A variety of methods are available for personnel to raise safety issues, and line managers promptly and effectively respond to personnel who raise safety issues (6.6.3.1, Appendix H).
- Line managers provide ongoing performance reviews of assigned roles and responsibilities, reinforcing expectations and ensuring that key safety responsibilities and expectations are being met (6.1.1 and 6.6.3.2).
- Unintended failures to follow requirements are promptly reported, and personnel and organizations are acknowledged for self-identification and reporting errors (6.1.1 RM, WS, and Worker, 6.6.3 GP).
- Responsibility and authority for safety are well-defined and clearly understood as an integral part of performing work (6.1.1).
- Individuals understand and demonstrate responsibility for safety. Safety and its ownership are apparent in everyone's actions and deeds (6.1.1, 6.1.2, 6.3.3.3, 6.4.4, 6.6).
- Individuals are actively involved in the identification, planning, and improvement of work and work practices (6.2 - 6.7).
- Individuals follow approved work practices and procedures (6.1.1 WS and Worker, 6.1.2, 6.1.5, 6.6.3).
- Individuals at all levels can stop unsafe work or work during unexpected conditions (6.1.1, 6.1.2, 6.6.3.1).
- Design, analysis, and continuous improvement of work practices and processes are valued as core organizational competencies; expertise in these competencies is evaluated and rewarded (6.1.1, 6.1.2 all personnel, 6.4.3, 6.4.6, 6.7).
- Organizational safety responsibilities are sufficiently comprehensive to address the work activities and hazards involved (6.1.1, 6.1.2 all personnel and SME).
- Work hazards are identified and controlled to prevent or mitigate accidents, with particular attention to high-consequence events with unacceptable consequences (6.1.6, 6.3.3.2, 6.4.1, 6.4.5, 6.4.6).
- Individuals understand and proactively identify hazards and controls before beginning work activities (6.2.4, 6.3.3, 6.4, 6.6.1, 6.6.2).
- Line managers maintain a strong focus on the safe conduct of work activities (6.1.1, 6.6, 6.7).

- Line managers maintain awareness of key performance indicators related to safe work accomplishment, watch carefully for adverse trends or indications, and take prompt action to understand adverse trends and anomalies (6.1.1 senior management and RM, 6.7.4, Appendices B and G).
- Individuals pay keen attention to current operations and focus on identifying situations where conditions or actions diverge from what was assumed, expected, or planned (6.1.1, 6.1.5, 6.6, 6.7).
- Individuals and leaders act to resolve deviations early before issues escalate and consequences become large (6.1.1, 6.4.2, 6.4.4, 6.5.2, 6.6.1, 6.6.2, 6.6.3).

Assessing Safety Culture

Assessing an organization's safety culture is necessary for understanding how to further improve WP&C implementation. Organizational safety culture is definable, assessable, and manageable. Overall safety performance can be improved through the implementation of cost-effective intervention strategies focused on improving the weak behaviors. Effective safety performance and organizational safety culture support the effective implementation of an organization's work planning and control program.

Measuring and Monitoring SCWE

Organizations can evaluate and monitor their SCWE effectiveness through collectively analyzing trends and other data, including, but not limited to:

- Conducting anonymous employee surveys and confidential employee interviews and focus groups to gauge perceptions of SCWE;
- Using the results of those surveys, interviews, and focus groups to perform an assessment of the SCWE; and
- Tracking and trending the performance of processes that contribute to a SCWE, which could include stop work/pause work, management walk-arounds, problem identification and resolution program information, employee concerns program information, differing professional opinion data, union grievances, retention rates, and exit interviews.

APPENDIX H: DOE REQUIREMENT CITATIONS FOR PERFORMANCE EXPECTATIONS

This Appendix details all DOE requirement references listed under Performance Expectations within the Handbook. The intent is to provide a ready reference of requirements associated with WP&C process components.

ISM DEAR Clause (48 CFR 970.5223-1), Integration of Environment, Safety and Health

(b) In performing work under this contract, the Contractor shall perform work safely, in a manner that ensures adequate protection for employees, the public, and the environment, and shall be accountable for the safe performance of work. The Contractor shall exercise a degree of care commensurate with the work and the associated hazards. The Contractor shall ensure that management of environment, safety and health (ES&H) functions and activities becomes an integral but visible part of the Contractor's work planning and execution processes. The Contractor shall, in the performance of work, ensure that:

(1) Line management is responsible for the protection of employees, the public, and the environment. Line management includes those Contractor and subcontractor employees managing or supervising employees performing work.
(2) Clear and unambiguous lines of authority and responsibility for ensuring ES&H are established and maintained at all organizational levels.
(3) Personnel possess the experience, knowledge, skills, and abilities that are necessary to discharge their responsibilities.
(4) Resources are effectively allocated to address ES&H, programmatic, and operational considerations. Protecting employees, the public, and the environment is a priority whenever activities are planned and performed.
(5) Before work is performed, the associated hazards are evaluated and an agreed-upon set of ES&H standards and requirements are established which, if properly implemented, provide adequate assurance that employees, the public, and the environment are protected from adverse consequences.
(6) Administrative and engineering controls to prevent and mitigate hazards are tailored to the work being performed and associated hazards. Emphasis should be on designing the work and/or controls to reduce or eliminate the hazards and to prevent accidents and unplanned releases and exposures.
(7) The conditions and requirements to be satisfied for operations to be initiated and conducted are established and agreed-upon by DOE and the Contractor. These agreed-upon conditions and requirements are requirements of the contract and binding upon the Contractor. The extent of documentation and level of authority for agreement shall be tailored to the complexity and hazards associated with the work and shall be established in a Safety Management System.

(c) The Contractor shall manage and perform work in accordance with a documented Safety Management System (System) that fulfills all conditions in paragraph (b) of this clause at a minimum. Documentation of the System shall describe how the Contractor will—

(1) Define the scope of work;
(2) Identify and analyze hazards associated with the work;
(3) Develop and implement hazard controls;

(4) Perform work within controls; and
(5) Provide feedback on adequacy of controls and continue to improve safety management.

(e) The Contractor shall submit to the Contracting Officer documentation of its System for review and approval. Dates for submittal, discussions, and revisions to the System will be established by the Contracting Officer. Guidance on the preparation, content, review, and approval of the System will be provided by the Contracting Officer. On an annual basis, the Contractor shall review and update, for DOE approval, its safety performance objectives, performance measures, and commitments consistent with and in response to DOE's program and budget execution guidance and direction. Resources shall be identified and allocated to meet the safety objectives and performance commitments as well as maintain the integrity of the entire System. Accordingly, the System shall be integrated with the Contractor's business processes for work planning, budgeting, authorization, execution, and change control.

(i) The Contractor shall include a clause substantially the same as this clause in subcontracts involving complex or hazardous work on site at a DOE-owned or-leased facility. Such subcontracts shall provide for the right to stop work under the conditions described in paragraph (g) of this clause. Depending on the complexity and hazards associated with the work, the Contractor may choose not to require the subcontractor to submit a Safety Management System for the Contractor's review and approval.

10 CFR 830, Nuclear Safety Management

10 CFR 830.3 Definitions: *Graded approach* means the process of ensuring that the level of analysis, documentation, and actions used to comply with a requirement in this part are commensurate with:

(1) The relative importance to safety, safeguards, and security;
(2) The magnitude of any hazard involved;
(3) The life cycle stage of a facility;
(4) The programmatic mission of a facility;
(5) The particular characteristics of a facility;
(6) The relative importance of radiological and non-radiological hazards; and
(7) Any other relevant factor.

10 CFR 830, Subpart A, Quality Assurance

122 Quality Assurance Criteria. The QAP must address the following management, performance, and assessment criteria:

(a) Criterion 1—Management/Program.

(1) Establish an organizational structure, functional responsibilities, levels of authority, and interfaces for those managing, performing, and assessing the work.
(2) Establish management processes, including planning, scheduling, and providing resources for the work.

(b) Criterion 2—Management/Personnel Training and Qualification.

(1) Train and qualify personnel to be capable of performing their assigned work.
(2) Provide continuing training to personnel to maintain their job proficiency.

(c) Criterion 3—Management/Quality Improvement.

(1) Establish and implement processes to detect and prevent quality problems.
(2) Identify, control, and correct items, services, and processes that do not meet established requirements.
(3) Identify the causes of problems and work to prevent recurrence as a part of correcting the problem.
(4) Review item characteristics, process implementation, and other quality related information to identify items, services, and processes needing improvement.

(d) Criterion 4—Management/Documents and Records.

(1) Prepare, review, approve, issue, use, and revise documents to prescribe processes, specify requirements, or establish design.
(2) Specify, prepare, review, approve, and maintain records.

(e) Criterion 5—Performance/Work Processes.

(1) Perform work consistent with technical standards, administrative controls, and other hazard controls adopted to meet regulatory or contract requirements, using approved instructions, procedures, or other appropriate means.

(2) Identify and control items to ensure their proper use.

(3) Maintain items to prevent their damage, loss, or deterioration.

(4) Calibrate and maintain equipment used for process monitoring or data collection.

(h) Criterion 8—Performance/Inspection and Acceptance Testing.

(1) Inspect and test specified items, services, and processes using established acceptance and performance criteria.

(2) Calibrate and maintain equipment used for inspections and tests.

(i) Criterion 9—Assessment/Management Assessment. Ensure managers assess their management processes and identify and correct problems that hinder the organization from achieving its objectives.

(j) Criterion 10—Assessment/Independent Assessment.

(1) Plan and conduct independent assessments to measure item and service quality, to measure the adequacy of work performance, and to promote improvement.
(2) Establish sufficient authority, and freedom from line management, for the group performing independent assessments.
(3) Ensure persons who perform independent assessments are technically qualified and knowledgeable in the areas to be assessed.

10 CFR 830, Subpart B, Safety Basis Requirements

202(b) In establishing the safety basis for a hazard category 1, 2, or 3 DOE nuclear facility, the contractor responsible for the facility must:

(1) Define the scope of the work to be performed;

(2) Identify and analyze the hazards associated with the work; and
(5) Establish the hazard controls upon which the contractor will rely to ensure adequate protection of workers, the public, and the environment.

203(d) **Unreviewed Safety Question Process.** The contractor responsible for a hazard category 1, 2, or 3 DOE nuclear facility must implement the DOE-approved USQ procedure in situations where there is a:

(1) Temporary or permanent change in the facility as described in the existing documented safety analysis;
(2) Temporary or permanent change in the procedures as described in the existing documented safety analysis;
(3) Test or experiment not described in the existing documented safety analysis; or
(4) Potential inadequacy of the documented safety analysis because the analysis potentially may not be bounding or may be otherwise inadequate.

204(b) The documented safety analysis for a hazard category 1, 2, or 3 DOE nuclear facility must, as appropriate for the complexities and hazards associated with the facility:

(4) Derive the hazard controls necessary to ensure adequate protection of workers, the public, and the environment, demonstrate the adequacy of these controls to eliminate, limit, or mitigate identified hazards, and define the process for maintaining the hazard controls current at all times and controlling their use.

10 CFR 851, Worker Safety and Health Program

20(a) ***Management responsibilities.*** Contractors are responsible for the safety and health of their workforce and must ensure that contractor management at a covered workplace:

(4) Provide mechanisms to involve workers and their elected representatives in the development of the worker safety and health program goals, objectives, and performance measures and in the identification and control of hazards in the workplace; and

(9) Establish procedures to permit workers to stop work or decline to perform an assigned task because of a reasonable belief that the task poses an imminent risk of death, serious physical harm, or other serious hazard to workers, in circumstances where the workers believe there is insufficient time to utilize normal hazard reporting and abatement procedures.

20(b) ***Worker rights and responsibilities.*** Workers must comply with the requirements of this part, including the worker safety and health program, which are applicable to their own actions and conduct. Workers at a covered workplace have the right, without reprisal, to:

(9) Stop work when the worker discovers employee exposures to imminently dangerous conditions or other serious hazards; provided that any stop work authority must be exercised in a justifiable and responsible manner in accordance with procedures established in the approved worker safety and health program.

21(a) Contractors must establish procedures to identify existing and potential workplace hazards and assess the risk of associated workers injury and illness. Procedures must include methods to:

(1) Assess worker exposure to chemical, physical, biological, or safety workplace hazards through appropriate workplace monitoring;

(2) Document assessment for chemical, physical, biological, and safety workplace hazards using recognized exposure assessment and testing methodologies and using of accredited and certified laboratories;

(3) Record observations, testing and monitoring results;

(4) Analyze designs of new facilities and modifications to existing facilities and equipment for potential workplace hazards;

(5) Evaluate operations, procedures, and facilities to identify workplace hazards;

(6) Perform routine job activity-level hazard analyses;

(7) Review site safety and health experience information; and

(8) Consider interaction between workplace hazards and other hazards such as radiological hazards.

22(a) Contractors must establish and implement a hazard prevention and abatement process to ensure that all identified and potential hazards are prevented or abated in a timely manner.

(1) For hazards identified either in the facility design or during the development of procedures, controls must be incorporated in the appropriate facility design or procedure.

22(b) Contractors must select hazard controls based on the following hierarchy:

(1) Elimination or substitution of the hazards where feasible and appropriate;

(2) Engineering controls where feasible and appropriate;

(3) Work practices and administrative controls that limit worker exposures; and

(4) Personal protective equipment.

23(a) Contractors must comply with the following safety and health standards that are applicable to the hazards at their covered workplace:

(1) Title 10 Code of Federal Regulations (CFR) 850, ‘‘Chronic Beryllium Disease Prevention Program.’’

(2) Title 29 CFR, Parts 1904.4 through 1904.11, 1904.29 through 1904.33; 1904.44, and 1904.46, ‘‘Recording and Reporting Occupational Injuries and Illnesses.’’

(3) Title 29 CFR, Part 1910, ‘‘Occupational Safety and Health Standards.’’

(7) Title 29 CFR, Part 1926, ‘‘Safety and Health Regulations for Construction.’’

(9) American Conference of Governmental Industrial Hygienists (ACGIH), ‘‘Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices,’’ (2005) (incorporated by reference, see § 851.27) when the ACGIH Threshold Limit Values (TLVs) are lower (more protective) than permissible exposure limits in 29 CFR 1910. When the ACGIH TLVs are used as exposure limits, contractors must nonetheless comply with the other provisions of any applicable expanded health standard found in 29 CFR 1910.

(10) American National Standards Institute (ANSI) Z88.2, ‘‘American National Standard for Respiratory Protection,’’ (1992) (incorporated by reference, see § 851.27).

(11) ANSI Z136.1, ‘‘Safe Use of Lasers,’’ (2000) (incorporated by reference, see § 851.27).

(12) ANSI Z49.1, ‘‘Safety in Welding, Cutting and Allied Processes,’’ sections 4.3 and E4.3 (1999) (incorporated by reference, see § 851.27).

(13) National Fire Protection Association (NFPA) 70, ‘‘National Electrical Code,’’ (2005) (incorporated by reference, see § 851.27).

(14) NFPA 70E, ‘‘Standard for Electrical Safety in the Workplace,’’ (2004) (incorporated by reference, see § 851.27).

23(b) Nothing in this part must be construed as relieving a contractor from complying with any additional specific safety and health requirement that it determines to be necessary to protect the safety and health of workers.

25(a) Contractors must develop and implement a worker safety and health training and information program to ensure that all workers exposed or potentially exposed to hazards are provided with the training and information on that hazard in order to perform their duties in a safe and healthful manner.

DOE P 450.4A, Integrated Safety Management Policy

These five core safety management functions provide the necessary structure for any work activity that could potentially affect the workers, the public, and the environment. The functions are applied as a continuous cycle with the degree of rigor appropriate to address the type of work activity and the hazards involved.

DEFINE THE SCOPE OF WORK. *Missions are translated into work, expectations are set, tasks are identified and prioritized, and resources are allocated.*

ANALYZE THE HAZARDS. *Hazards associated with the work are identified, analyzed, and categorized.*

DEVELOP AND IMPLEMENT HAZARD CONTROLS. *Applicable standards and requirements are identified and agreed-upon, controls to prevent/mitigate hazards are identified, the safety envelope is established, and controls are implemented.*

PERFORM WORK WITHIN CONTROLS. *Readiness is confirmed and work is performed safely.*

PROVIDE FEEDBACK AND CONTINUOUS IMPROVEMENT. *Feedback information on the adequacy of controls is gathered; opportunities for improving the definition and planning of work are identified and implemented.*

DOE O 226.1, Attachment 1, Contractor Requirements Document

1. Responsibilities. Regardless of the performer of the work, the contractor is responsible for complying with the requirements of this Contractor Requirements Document (CRD). The contractor is responsible for flowing down the requirements of this CRD to subcontractors at any tier to the extent necessary to ensure the contractor’s compliance with the requirements. Contractors must monitor and evaluate all work performed under their contracts, including the work of subcontractors, to ensure work performance meets the applicable requirements for environment, safety, and health, including quality assurance and integrated safety management; safeguards and security; cyber security; and emergency management.

2.a Requirements. The contractor must establish an assurance system that includes assignment of management responsibilities and accountabilities and provides evidence to assure both the Department of Energy’s (DOE) and the contractor’s managements

that work is being performed safely, securely, and in compliance with all requirements; risks are being identified and managed; and that the systems of control are effective and efficient.

2.b The contractor assurance system, at a minimum, must include the following:

(2) Rigorous, risk-informed, and credible self-assessment and feedback and improvement activities. Assessment programs must be risk-informed, formally described and documented, and appropriately cover potentially high consequence activities.

(3) A structured issues management system that is formally described and documented and that:

(a) Captures program and performance deficiencies (individually and collectively) in systems that provide for timely reporting, and taking compensatory corrective actions when needed.

(b) Contains an issues management process that is capable of categorizing the significance of findings based on risk and priority and other appropriate factors that enables contractor management to ensure that problems are evaluated and corrected on a timely basis.

DOE O 422.1, Attachment 2, Appendix A, Conduct of Operations, Detailed Conduct of Operations Matrix

2.a The operator must establish policies, programs, and procedures that define an effective operations organization, including the following elements:

(1) Organizational roles, responsibilities, authority, and accountability:

a. Written policies state goals for operations, safety, and security, the means to achieve them, and the controls instituted for the Conduct of Operations Program.
b. Policies and procedures implement DOE requirements for operations.
c. Policies and procedures implement DOE safety requirements.
d. Policies and procedures implement DOE security requirements.
e. Personnel and organizations are assigned responsibilities for implementing policies.
f. Policies clearly define operations personnel authority, accountability, and relationships with other groups, including Stop-Work authority.

(2) Adequate material and personnel resources to accomplish operations:

a. Sufficient qualified operators are available to complete assigned tasks without excessive overtime.
b. Adequate technical personnel are assigned to support operations.
d. Adequate material, tooling, equipment, safety gear, and facilities are available for safe operations.

(3) Monitoring and self-assessment of operations:

a. Operating problems are documented and evaluated, and corrective actions are taken.
b. Supervisors and managers directly observe operations frequently and provide feedback.

c. Appropriate outside organizations such as Quality Assurance or other oversight organizations observe operations and provide feedback.
d. Assessment and observation issues are tracked and corrected.
e. Auditable, measurable, realistic, and challenging safety, environmental, and operations goals are set. Examples are safety system operability; radiological or other exposure; facility operational availability; unscheduled shutdowns; overtime; staffing; qualification, and training; waste production; and plant instrumentation alarms and warnings.
f. Facilities develop an action plan to achieve safety, environment, and operations goals with input from operations personnel, and review and approval by management.
g. Facilities monitor and report to line and DOE management their progress on completing the action plan and achieving goals. Goals and plans are adjusted and modified as needed.

(4) Management and worker accountability for the safe performance of work:

a. Management systems are designed to minimize the effects of human performance failures.
b. Personnel involved in repeated or willful violations of operating practices are counseled, retrained, or disciplined as appropriate
c. Personnel are recognized for notable safety improvement actions or ideas.
d. Supervisory performance appraisals and promotions take operational and safety performance into consideration.

(5) Management training, qualification, succession, and, when appropriate, certification:

a. Formal supervisory and management training is provided for first-line and shift supervisors.
b. Development, qualification, retention, and succession for supervisors is managed under a long range staffing plan.
c. Supervisors achieve certification when required for their duties.

(6) Methods for the analysis of hazards and implementation of hazard controls in the work planning and execution process:

a. The DOE Integrated Safety Management System is used to plan work.
b. Operations personnel are trained in, and understand, integrating safety into work planning.

(7) Methods for approving, posting, maintaining, and controlling access to electronic operations documents (procedures, drawings, schedules, maintenance actions, etc.) if electronic documents are used:

a. Management approves electronic document accessibility on both internal and public computer systems, considering security and privacy concerns.
b. Procedures define the methods and positions responsible for approving, revising, and posting electronic documents.

2.b The operator must establish and implement operations practices to ensure shift operators are alert, informed of conditions, and properly operate equipment, addressing the following elements:

(1) Prompt notification to operating personnel and supervisors of changes in the facility status, abnormalities, or difficulties encountered in performing assigned tasks:

a. Supervisors and Operators keep each other informed of facility status changes, abnormalities, or difficulties.
b. Operators keep Supervisors informed of unexpected situations.

(2) Adherence by operating personnel and other workers to established safety requirements:

a. Operators comply with safety programs, e.g. industrial, chemical, explosive, pressure, temperature, confined space, or others applicable to the facility.
b. Operators use proper personal protective equipment (PPE).
c. Operators use ladders or other approved means for overhead access in the absence of permanent ladders or catwalks.
d. Operators do not routinely climb or walk on components.
e. Operators use appropriate electrical safety procedures.

(5) Procedures for protecting operators from personnel hazards, e.g. chemical, radiological, laser, noise, electromagnetic, toxic or nano-scale materials:

a. Operators are appropriately qualified for expected hazards and know protection practices to maintain personnel exposure as low as reasonably achievable and within facility controls for radiation, chemicals, electromagnetic fields, toxic materials, and other personnel hazards.
b. Operators comply with all posted personnel protection requirements and precautions.
c. Operators properly use appropriate monitoring instruments when required.
d. Operators remain aware of their radiological, toxic, or other exposures and take action to minimize them.
e. Operators properly use appropriate administrative controls such as work permits, radiological work permits, and confined space permits.
f. Operators promptly report and take corrective action for radiological or hazardous material protection deficiencies.
g. Operators and Supervisors notify protection personnel prior to activities that affect the protection status (Industrial Hygiene, Radiological, etc.).
h. Supervisors periodically review exposure trends of operators to detect and correct adverse factors that contribute to personnel exposures.

2.h The operator must establish and implement operations practices for initial equipment lineups and subsequent changes to ensure facilities operate with known, proper configuration as designed, addressing the following elements:

(5) Management of equipment deficiencies, maintenance activities, post maintenance testing, and return to service

b. Designated managers authorize in writing the work control documents for all activities, including maintenance on equipment important to safety, on equipment that affects operations, or that changes control indications or alarms.

c. The status of work in progress is documented and available for review by operators.

d. Work control documents specify retest requirements to ensure, prior to restoration to service, proper functioning, effectiveness of the maintenance, and that no new problems were introduced.

e. Supervisors assure themselves of proper equipment operation before authorizing its return to service after maintenance, testing, or emergency/abnormal event.

2.i(1) The operator must establish and implement operations practices that address the installation and removal of lockout/tagouts for the protection of personnel:

(a) Procedures, roles and responsibilities associated with the development, documentation, review, installation, and removal of a lockout/Tagout:

(1) Procedures and/or Lockout/Tagout Program implements OSHA Rules and is designed to control hazardous energy and materials during servicing, maintenance, or whenever unexpected operation or energization could cause injury.

(b) Compliance with Occupational Safety and Health Administration Rules, 29 CFR Part 1910 and/or 29 CFR Part 1926, requirements for the protection of workers using lockout/Tagout.

(c) Compliance with National Fire Protection Association Standard 70E electrical safety requirements using lockout/tagout.

2.l The operator must establish and implement operations practices for thorough, accurate transfer of information and responsibilities at shift or operator relief to ensure continued safe operation, addressing the following elements:

(1) Definitions for all key positions requiring a formal turnover process:

a. Procedures contain provisions for using a turnover process for at least the supervisory positions.

b. Procedures contain provisions for using a turnover process for key positions, including appropriate stations staffed part-time.

(2) Turnover of equipment/facility status, duties, and responsibilities that results in the safe and effective transfer of equipment status and in progress or planned activities from one shift or workgroup to the next:

a. Turnover procedures contain provisions for documenting a review of checklists or other documents that record key information appropriate for the position, either operational or supervisory, such as:

- Facility operating mode and status
- Key process parameters
- Key tank or vessel levels
- Status of safety equipment
- Operational limits in effect
- Limiting Conditions for Operations in effect, either normal or abnormal
- Any procedures, either standard or temporary, in progress
- Changes in radiological or hazardous material conditions
- Waste management status

- Required samples or analyses
- Upcoming or in-progress maintenance, testing, or evolutions

b. Turnover procedures contain provisions for operators and supervisors to complete document reviews before assuming responsibility for their position, reviewing in enough detail to understand status, important history, and plans. Such reviews normally extend back the shorter of 24 hours or their last shift.

c. Turnover procedures contain provisions for operators and supervisors to walk down appropriate control panels and computer displays to determine facility status, alarms, lineups, and equipment configuration. For control areas, the oncoming and off-going personnel jointly walk down the control panels and displays. Supervisors and operators walk down panels early in the shift and preferably before turnover.

d. Turnover procedures contain provisions for off-going and oncoming operators and supervisors to discuss, during stable facility conditions whenever possible, turnover documentation and clarify any questions.

e. Turnover procedures contain provisions that when all turnover items are complete and the oncoming person understands the status, they formally state that they assume responsibility and make a narrative log entry to that effect.

f. Turnover procedures contain provisions for operations supervisors to conduct briefings as needed for their oncoming shift operators and appropriate support personnel (vendors, maintenance, crafts) to review status, problems, upcoming work, or other appropriate topics.

(3) Process for reliefs during a shift:

a. Turnover procedures contain provisions for conducting operator and supervisor reliefs during shifts. These turnovers may include a less exhaustive process than the regular shift change as long as the oncoming person is at least as knowledgeable as they would be from a regular turnover.

2.p The operator must establish and implement operations practices for developing and maintaining accurate, understandable written technical procedures that ensure safe and effective facility and equipment operation, addressing the following elements.

(1) Expectations for the use of procedures to perform operations:

a. Management policies establish the expectation that operators will use written procedures for operations, will perform them as written, and will stop work and notify management when procedures cannot be executed as written.

(2) A process for procedure development:

a. Directives include a written process for procedure development, including format, clear language standards, and configuration control.

b. Management policies designate procedures to be developed for all anticipated operations, evolutions, tests, and abnormal or emergency situations.

c. Management policies direct alarm/annunciator response procedures to be developed for all alarm panels.

d. Directives designate a senior manager responsibility for procedure development, and include provisions for the capabilities and experience of procedure writers.

e. Directives include a process for completing and documenting procedure review and approval of both hard-copy and electronic procedures.

f. Directives specify that procedures will provide administrative and technical direction to effectively conduct the operation, using detail appropriate to the complexity of the task, the experience and training of the operators, the frequency of performance, and the significance of the consequences of error.

g. Procedure preparation records contain documentation of the reason for key steps so they are not inadvertently deleted or changed in revisions and changes.

(3) Procedure content, including consistent format and use of terms (e.g. prerequisites, warnings, cautions, notes, hold points, etc.), detail sufficient for accomplishing the operation, technically accurate procedures capable of performance as written, and procedure conformance with the facility design and manufacturer documentation:

a. Procedure scope and applicability are readily apparent.

b. Procedures for multiple equipment trains are clearly distinguishable from each other.

c. Emergency procedures are clearly distinguishable from normal operating procedures.

d. Procedures incorporate appropriate information from applicable source documents, including design, safety basis, and vendor technical documents.

e. Prerequisites and initial conditions are clearly specified.

f. Tools, equipment, and materials are specified and procedures provide measures to document their calibration or condition before use.

g. Hold points requiring independent verification or approval are clearly indicated.

h. Procedure language is clear, definitions are explained, and detail is appropriate for the operators' skill, experience, and training.

i. Procedure format standards: One action per step; Warnings, Notes, and Cautions are clear, do not contain actions, and precede the applicable step; Warnings, Notes, Cautions, and headings appear on the same page as the applicable step.

j. Procedures are technically and administratively accurate: instructions and information are correct; referenced documents are correctly identified; and instructions for transferring between procedures are clear.

k. Critical steps include signature/initial/checkoff blocks, with only one action per block.

l. Instrument readings and tolerances are specified and conform to instrument scales or readability.

m. Procedures contain explicit parameters and do not require mental arithmetic to determine acceptability. Any calculations are clearly explained and procedures provide space to record them.

n. Procedure step sequence conforms to normal operational sequence.

o. Procedures reflect human factors considerations such as procedure callouts exactly matching equipment labels, units in procedures match instrument markings, charts and graphs easily read, and important steps or information highlighted.

p. Emergency procedures provide guidance for both single and multiple casualties.

q. When procedures use or refer to other procedures or steps, they are clearly identified with the exact identification to prevent confusion in transferring to or from them.

r. Procedures specify the restoration or shutdown steps for equipment following tests or other operations.

(4) A process for procedure changes (pen and ink or page changes) and revisions (complete reissues):

a. Directives include a documented process for review and approval of revisions and changes. Directives may also use only a revision process or may use an electronic publishing process. In all cases, configuration control must be maintained.

b. Procedure changes intended for more than one-time use are documented in a location readily available for operator reference and noted in timely orders/instructions and/or turnover documents.

c. Directives contain provisions for initiation of changes or revisions if procedure problems are found, including provisions for emergent changes or revisions necessary to proceed with operations when a procedure is faulty.

d. Directives contain provisions for initiating a procedure revision when changes remain in effect for extended periods (e.g. more than 6 months) or when several changes have accumulated (e.g. more than 5).

e. Directives contain provisions for including all outstanding changes in any procedure’s revision.

f. Directives include provisions for implementing revisions for permanent equipment modifications or replacements, and implementing changes for temporary equipment modifications.

g. Directives include provisions to review procedure development records of the reason for key steps to prevent inadvertent deletion or change.

h. Directives include provisions to use walkthroughs (procedure execution with actual or simulated operation of components by subject matter expert(s)) to validate procedure changes and revisions.

(5) A process for training personnel on new, revised, or changed procedures:

a. Directives include provisions for communicating important procedure changes and revisions to operating personnel through required reading or other appropriate method.

b. Directives include provisions for communication of procedure changes and revisions to the training department to update training courses.

c. Directives include provisions for communication of procedure changes and revisions to the organizations responsible for personnel qualification to update qualification requirements.

(6) A process for approval of new, revised, or changed procedures:

a. Directives include provisions for operations supervisor or manager approval of new or revised procedures prior to use, with reviews of revisions to at least the depth as the initial version.

b. Directives include provisions for safety committee or safety manager or equivalent, and, if applicable, emergency manager, review of procedures that affect safety-related equipment or emergency response.

c. Directives include provisions defining appropriate circumstances for expeditious approval of minor procedure changes and the process, with a minimum of at least one designated senior qualified operator and one senior operations manager approval, followed up by standard review and approval within a short period, up to 2 weeks.

d. Directives include provisions for using the standard review and approval process for changes that do not meet the facility's criteria for minor changes.

(7) Initial-issue and periodic review and testing of procedures:

a. Directives include provisions for review of new and revised procedures prior to use and periodically for technical accuracy and human factors considerations.

b. Directives specify the frequency of periodic procedure reviews, considering the complexity of the operation, maturity of operations, and facility life cycle.

c. Directives include provisions for reviewing procedures after a significant occurrence, either human error or equipment upset.

d. Procedure reviews include comparison to source documents to verify accuracy.

e. Procedure reviews include validation walkthroughs.

(8) Availability and use of the latest revisions of procedures:

a. Directives include provisions for maintenance of a controlled copy of all operating procedures at the control area for operator reference, and selected procedure controlled copies at appropriate locations outside the control area.

b. Directives include provisions for verifying working copies of procedures against controlled copies for use during evolutions, and controlling working copies to prevent using outdated procedures.

c. Directives include provisions for maintenance of controlled copies of alarm and annunciator response procedures readily accessible to operators for alarm response.

d. Directives detail how operators obtain current copies of electronic or hard-copy procedures for performing evolutions, and how to determine procedure approval and revision status.

(9) Specified and defined procedure use requirements, i.e., reader-worker method, reference use only, use-each-time, and emergency response.

a. Operators are trained in procedure use requirements and management oversight reinforces the expectations.

b. Directives and management policy contain provisions for operators to report deficient procedures and initiate changes or revisions to correct them instead of continuing on. During emergency conditions, operators may take necessary action to place the facility in a safe condition, and to protect equipment, personnel, and public safety without first initiating a procedure change.

c. Directives define applicable procedure use methods and specify when to use them. Options include reader-worker, reference, fill out steps as a checklist, and others.

d. Directives include provisions for use of procedures for emergency response. Normally, immediate actions are committed to memory and may be executed without reference to the procedure. When conditions permit, operators use the procedure to check completion of the immediate actions and continue with follow-up actions.

DOE O 433.1, Attachment 2, Maintenance Management Program Requirements for Nuclear Facilities

1.a Federal and contractor organizations responsible for hazard category 1, 2, or 3 nuclear facilities, as defined by DOE Standard 1027-92 must develop and implement a nuclear maintenance management program (NMMP) through tailored application (e.g., graded approach) of the Specific Requirements in this attachment. The definition of graded approach is provided in Title 10 Code of Federal Regulations (CFR) 830.3. The NMMP must describe the safety management program for maintenance and the reliable performance of structures, systems and components (SSCs) that are part of the safety basis at hazard category 1, 2 and 3 DOE nuclear facilities. Guidance on applying the Specific Requirements, including a graded approach, is provided in DOE G 433.1-1A, *Nuclear Facility Maintenance Management Program Guide for Use with DOE O 433.1*.

The referenced Guide is available on the DOE Directives web site, www.directives.doe.gov.

2.a The NMMP must clearly address integration with Regulations and DOE Orders and Manuals (and their CRDs). The NMMP must be integrated with applicable programs (e.g., Safety Management Programs) and requirements identified by Federal regulations and other DOE Orders and Manuals (and their CRDs) to include:

(1)(a) DOE O 226.1B, *Implementation of Department of Energy Oversight Policy*, dated 4-25-11;
(1)(b) DOE O 414.1D, *Quality Assurance*, dated 4-25-11;
(1)(f) DOE O 422.1, *Conduct of Operations*, dated 6-29-10;
(2)(a) 10 CFR part 830, Nuclear Safety Management; Subpart A, Quality Assurance Requirements;
(2)(b) 10 CFR part 830, Nuclear Safety Management; Subpart B, Safety Basis Requirements;
(2)(c) Integrated Safety Management System (ISMS) provisions contained in 48 CFR 970.5223-1, *Integration of Environment,Safety, and Health into Work Planning and Execution; and*
(2)(f) 10 CFR part 851, *Worker Safety and Health Program*.

2.b Maintenance Organization and Administration. The management structure that applies sufficient resources (e.g., oversight and independent assessment, management involvement, funding, assignment of personnel roles and responsibilities, facilities, tools, and equipment) necessary to support the requirements described in this attachment and ensures integration with other programs.

2.d Planning, Scheduling, and Coordination of Maintenance. The process for planning, scheduling, coordination, and control of maintenance activities, and properly emphasizing equipment availability. The process must describe the application of a System Engineer Program in accordance with DOE O 420.1C in the planning and execution of maintenance activities.

2.f Maintenance Procedures. The process for developing and implementing documented and approved work instructions for work on safety SSCs (i.e., work packages, procedures, work instructions, and drawings).

2.g Training and Qualification. The training and qualification program for maintenance positions specified in DOE O 426.2.

2.h Configuration Management. The incorporation of the configuration management program to control approved modifications and to prevent unauthorized modifications to safety SSCs.

2.i Procurement. The appropriate integration of the procurement process with the NMMP to ensure the availability of parts, materials and services for maintenance activities.

2.l Maintenance History. The process for developing and maintaining documented and retrievable maintenance history (i.e., cost data, system availability data, and failure data) to support work planning, performance trending, analysis of problems to determine root causes of unplanned occurrences related to maintenance, and continuous program improvement.

2.o Performance Measures. The process for developing, maintaining, and communicating performance measures to identify maintenance issues requiring corrective action and lessons learned.

2.p Facility Condition Inspection. The process for conducting and implementing routine assessment of facilities to identify issues related to operability, reliability, housekeeping, and general condition.

2.q Post Maintenance Testing. The process for conducting post maintenance testing to verify that safety SSCs can perform their intended function when returned to service.

DOE O 442.1a, Attachment 1, Contractor Requirement's Document for DOE Employee Concerns Program

- In support of the effective implementation of the Department of Energy (DOE) Employee Concerns Program (ECP), contractors are required to ensure that contractor and subcontractor employees are advised that they have the right and responsibility to report concerns relating to the environment, safety, health, or management of DOE-related activities.

DOE O 442.2, Attachment 1, Contractor Requirement's Document for Differing Professional Opinions for Technical Issues Involving Environment, Safety and Health

1. The Contractor must ensure that all employees and subcontractor employees are notified quarterly that they have the right to report environment, safety, and health technical concerns that have not been resolved through routine work processes through the Department of Energy Differing Professional Opinion (DPO) process.