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Nuclear Facility Construction Noncompliances: Part 1—Overview

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Over the past 5 years, the HSS Office of Enforcement has been actively involved in investigating nuclear safety regulatory noncompliances associated with several DOE contractors and subcontractors involved in the construction (both new construction and major modifications) of DOE nuclear facilities. Some of these noncompliances have led to the fabrication and installation of safety significant or safety class Structures, Systems, and Components (SSC) that did not meet specifications or requirements. In addition to the safety implications, the efforts to determine the extent of these conditions, and to correct them, were often extensive, causing significant additional costs and delays on some construction projects.

This three-part series of articles focuses on the processes and barriers under the direct control of the prime construction contractor, its subcontractors, and their lower-tier subcontractors to provide safety oversight and thereby prevent the types of recurrent issues described above. This article provides an overview and specific examples of issues identified by the Office of Enforcement.

Because nuclear facilities must be constructed to the highest standards to ensure safe operations, stringent Quality Assurance (QA) programs and an unusually high level of attention to detail are needed during the construction phase of the facility life cycle. In addition, the SSCs in nuclear facilities must be free of fabrication defects. Processes to preclude such defects include designated hold-points during fabrication, Quality Control (QC) inspection (in process and final) by the manufacturing subcontractor, and QC source inspection and receipt inspection by the prime contractor.

The Office of Enforcement found that two types of recurrent issues were evident during the construction of some DOE nuclear facilities. One issue is associated with weaknesses in the initial design and/or subsequent flow down of requirements into specifications. The other is associated with the introduction of manufacturing defects during the fabrication of the SSCs and the subsequent failure of several barriers in place to identify the defects before the facility received or installed the defective SSCs.

Although focusing on processes under control of the prime construction contractor and its subcontractors, the Office of Enforcement also recognizes that the nuclear safety oversight processes of various other organizations have been instrumental in identifying many construction-related issues. These include contractor and subcontractor corporate self-assessment programs and external oversight provided by DOE Headquarters line management, local DOE site offices, the HSS Office of Independent Oversight, the DOE Chief of Nuclear Safety, and the Defense Nuclear Facilities Safety Board (DNFSB).

Overview of Specific Cases

Some construction-related issues experienced by DOE contractors are briefly described below. The Office of Enforcement has pursued, or is in the process of investigating or reviewing, these issues. The intent here is to illustrate, in a broad sense, the commonalities in the types of breakdowns that have occurred. Information regarding the specific noncompliances and associated civil penalties (in cases where enforcement action has been taken) is available on the Office of Enforcement web site at http://www.hss.energy.gov/enforce.

- In January 2004, a prime construction contractor discovered one “black cell” (closed cells where access is not planned during plant operation or scheduled shutdown periods) vessel that had been received and installed, as well as

approximately 70 additional vessels that were being fabricated or in the procurement process, that did not comply with an authorization basis document requirement for Nondestructive Examination (NDE). The problem resulted from differing interpretations of the terms *confinement* and *containment* within the contractor organizations. This confusion led to the failure to adequately flow down to the fabrication subcontractor the definition of these terms and the applicable NDE requirements, as specified in the authorization basis document.

- In January 2005, a prime construction contractor discovered that some installed wall joggle penetrations lacked shield plates and were thus inconsistent with shielding design requirements. The contractor determined that a Design Change Notice (DCN) had been flowed down to the joggle fabrication subcontractor that incorrectly directed the removal of ***all*** associated shield plates, with the exception of those joggles already installed. This DCN introduced a design change that was not consistent with existing design calculations and criteria.
- In March 2005, a prime construction contractor discovered that 93 orders for pipe spools (a specified section of pipe) that should have gone to quality-level suppliers were inadvertently sent to commercial material suppliers. Contractor management relied on downstream barriers, such as receipt inspections, to detect such issues, but did not ensure that those barriers were established. The contractor's processes for checking transmittals to suppliers were not formalized.
- In September 2005, a prime construction contractor determined that it had received structural steel that could not be verified as meeting design criteria. The specifications that had flowed down to the fabrication subcontractor contained calculation errors and steel details that were not consistent with the design requirements.
- In October 2007, a prime construction contractor recognized that some of the piping to be installed in "black cells" did not receive the enhanced 100 percent radiographic testing required by the fabrication specification. The fabrication specification, which was flowed down to the fabricating subcontractors, did not clearly delineate which piping was to be installed in the facility "black cells."
- In January 2008, the DOE Office of Inspector General forwarded a report from a former subcontractor employee to a DOE project office alleging a number of "serious quality and public safety concerns" with respect to substandard construction workmanship and associated deficient quality inspection activities at a facility under construction. The prime construction contractor identified a significant number of instances where previously inspected and accepted, subcontractor-installed anchor bolts and pipe supports were later found to be deficient.
- In February 2008, a DOE project office identified several quality deficiencies in a subcontractor's installation of penetration fire seals at a facility under construction. The DOE inspection team found deficiencies in 18 of the 26 installed fire seals that were examined. These deficiencies included (1) seals that were not installed in accordance with the approved assembly drawing, (2) seals that were installed without an approved assembly drawing, and (3) completed documentation (fire seal traveler) indicating inspection and acceptance of the installed fire seals by the prime construction contractor and subcontractor QC inspectors when the installations were never performed.

- In June 2008, a prime construction contractor performed a QA audit of one of its subcontractors to ensure compliance with its QA plan. The subcontractor was a member company of the prime contractor and was responsible for engineering, procurement and construction activities, including design activities associated with a project. The audit team concluded that the subcontractor's QA program was not properly implemented and lacked documentation to support the design work that had been completed. This, and other related problems, had previously been identified but not adequately corrected to prevent recurrence. Lack of prime contractor oversight of its subcontractor was identified as a major contributing factor.
- In February 2009, a prime construction contractor QC Manager noted that a safety-significant embed plate stud had broken loose and that some of the installed (not yet encased in concrete) embed plate studs had visible ceramic material covering portions of the stud welds. An extent-of-condition review performed by the contractor revealed many deficiencies associated with subcontractor fabricated embed plate weld quality.
- In February 2009, while observing a cut of safety-significant drain pipe during piping installation, a DOE Facility Representative observed deficiencies on the exposed internal surface of the pipe weld. A further review of the subcontractor-fabricated drain pipe revealed many weld deficiencies.
- In April 2009, during preparation of system turnover packages from construction to startup, a prime construction contractor discovered that the QC inspection checklists associated with the installation of approximately 450 safety class fire seals in a facility nearing completion were not in the work packages and that the inspections had not been performed by the QC inspector as required. Subsequent investigation by the contractor revealed that there is a similar problem in the operational side of an adjacent facility.
- In July 2009, a DOE site office identified significant technical- and quality-related issues in the Commercial Grade Dedication (CGD) process used by three sub-contractors providing material and components to a prime construction contractor. These issues indicated that the lessons learned and corrective actions from the contractor's CGD problems, identified 3 years ago, were not adequately flowed down to the subcontractors. The contractor conducted an extent-of-condition review that indicated that these problems were prevalent in many other of its quality-level suppliers. The contractor's lack of oversight of its suppliers' CGD processes was identified as a major contributor to the problem.

Based on an analysis of these construction issues, the Office of Enforcement determined that the primary causes were related to the failure of DOE prime contractors to adequately flow down requirements to their subcontractors and/or the failure of the prime contractors to provide sufficient nuclear safety oversight of their subcontractor. Part 2 of this series discusses the factors identified by the Office of Enforcement that contribute to such issues.

KEYWORDS: Nuclear facility, construction, noncompliance, fabrication, installation, extent of condition, subcontractors, QA/QC, inspections, oversight, procurement, configuration management, nondestructive examination, hold points, training, procedures, enforcement

ISM CORE FUNCTIONS: Define the Scope of Work, Analyze the Hazards, Develop and Implement Hazard Controls, Perform Work within Controls, Provide Feedback and Continuous Improvement

Nuclear Facility Construction Noncompliances: Part 2—Contributing Factors

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The HSS Office of Enforcement has been investigating nuclear safety regulatory noncompliances associated with several DOE contractors and subcontractors involved in the construction of DOE nuclear facilities. Some of these noncompliances have led to the fabrication and installation of safety significant or safety class Structures, Systems, and Components (SSC) that did not meet specifications or requirements.

Part 1 of this three-article series provided specific examples of some of the issues identified during the Office of Enforcement investigation. This article discusses two factors that can lead to noncompliances: inadequate flow down of requirements and insufficient oversight of subcontractors. Information regarding specific noncompliances and associated civil penalties (in cases where enforcement action has been taken) is available on the Office of Enforcement web site at http://www.hss.energy.gov/enforce.

Factors Associated with Failure to Adequately Flow Down Requirements

Proper flow down of requirements is an essential element of ensuring that SSCs meet all necessary requirements and specifications. The Office of Enforcement analysis identified the following factors that can result in failure to adequately flow down this essential information.

- **Ineffective Communication.** Communication of nuclear safety specifications and requirements to the prime construction contractor's subcontractors is a routine, but necessary and important, aspect of the procurement process. Several of DOE's current construction projects are extremely large and complex. Only a few companies in the United States have the proven expertise to construct these facilities, and they maintain large, multidisciplinary organizations to accomplish the tasks needed to complete such construction projects. Failures in communication within organizational elements of the company can lead, and have led, to failure to accurately convey specifications and requirements to subcontractors.
- **Ineffective Internal Review.** The approach to facility construction used for some DOE projects calls for starting construction activities while the design phase is ongoing. While this concurrent design and construct approach can expedite construction of needed facilities, it presents many challenges to DOE's prime construction contractors, particularly in the functional areas of procurement and configuration management. Procurement personnel must be able to accurately interpret design specifications and ensure that the subcontractors selected are capable and qualified to meet these specifications. The very large number of design changes typical in a complex construction project can present unique challenges to contractor engineering from the standpoint of review and approval of the changes and maintaining configuration management. Breakdowns in the review of subcontractor submittals by prime contractor procurement and in the engineering review of the prime contractor's design changes also can lead, and have led, to a failure to accurately convey specifications and requirements to subcontractors.
- **Lack of Experienced Personnel.** With the cessation of the construction of new commercial nuclear power plants after the Three Mile Island accident, few new nuclear facilities have been constructed since the late 1970s. As a result, the number of experienced nuclear professionals has dropped off dramatically due to retirement and lack

of new personnel entering the industry. Thus, DOE prime construction contractors face challenges in hiring engineers who are experienced in the design and construction of nuclear facilities. DOE contractors have sometimes had to hire personnel who lack the desired experience level and have placed them in positions important to the construction of the facility. In some cases, their lack of experience has contributed to the introduction of design inconsistencies and the failure to detect these inconsistencies when introduced.

- **Inadequate Positive Material Identification (PMI).** In two similar instances, procurement required both PMI and special testing to be performed to verify the carbon content of low carbon stainless steel (e.g., 304L, 316L). The responsible subcontractors contracted with a sub-tier contractor to perform the PMI; however, they did not flow down the special testing requirement for low carbon content stainless steel. The sub-tier contractor used x-ray fluorescence tests to verify the material content, but this technique could not accurately measure the low carbon content in the steel. The DOE prime construction contractors initially did not recognize that the special testing was not conducted as required. Given that the Office of Enforcement found two similar instances in the relatively small number of cases investigated, similar problems are likely to be found elsewhere across the DOE Complex.

Factors Associated with Insufficient Oversight of Subcontractors

In addition to causing challenges in hiring personnel with experience in the construction of nuclear facilities, lack of experienced personnel makes it difficult for DOE contractors to find subcontractors and suppliers who are certified to provide nuclear quality level SSCs. This situation has led to an increased use of the Commercial Grade Dedication (CGD) process to procure SSCs for DOE nuclear facilities and a greater reliance on subcontractors and suppliers that lack significant experience in the nuclear industry. These subcontractors and suppliers often do not fully appreciate that nuclear-related construction activities require greater attention to detail—and significantly more administrative detail—to ensure the quality of the SSCs and proper documentation of their suitability. Thus, DOE prime construction contractors must provide increased and effective oversight of their subcontractors and suppliers to ensure that the provided products meet specifications and requirements. Recent enforcement activities show that, in some cases, subcontractors and suppliers have not sufficiently met nuclear safety specifications and requirements and DOE construction contractors' oversight of their subcontractors and suppliers has been inadequate to detect problems. This situation has led to the procurement and, in some cases, installation of deficient SSCs. The following are some factors contributing to the failure to provide sufficient oversight.

- **Overreliance on Certified Subcontractors.** The use of NQA-1 certified subcontractors and suppliers is desirable in the procurement of SSCs. Certification provides a certain level of confidence that the subcontractor or supplier has the necessary experience and can meet the rigorous specifications, requirements, and administrative controls required for DOE construction. However, recent experience has shown that when DOE prime construction contractors rely too much on certifications and neglect direct and physical evaluations and oversight of the subcontractor or supplier, the result can be receipt and installation of material and components that do not meet nuclear safety specifications or requirements.
- **Insufficient Number of QC Personnel.** DOE prime construction contractors often assign too few trained, dedicated QC personnel to perform source inspections of subcontractor

activities. Source inspections are the prime contractor's first opportunity to detect problems in the fabrication of the product, and early detection is a cost-effective means to ensure product quality. Even when the prime contractor allocates enough trained personnel to perform source inspections, these inspectors are often assigned to oversight of a subcontractor for extended periods of time, potentially leading to complacency and resulting in less-critical inspections.

- **Inadequate Documentation of Observed Deficiencies.** An important aspect of a prime contractor's source inspection process is the documentation of observed deficiencies. This documentation can take the form of log book entries, completion of QC checklists or travelers, nonconformance reports, and condition reports. This information is useful in tracking the completion of actions taken to correct the deficiencies and in identifying adverse trends in subcontractor activities. In several instances, DOE prime construction contractor QC inspectors did not sufficiently document the results of their source inspection activities, and this lack of formality led to uncertainty about the quality of delivered products.

  Another problem is that subcontractors or suppliers do not always generate appropriate nonconformance reports. Typically, subcontractors' internal procedures require in-process and final inspections, with nonconformance reports required only for deficiencies identified during final inspection. However, some subcontractors consider every inspection to be an in-process inspection until all deficiencies have been resolved, at which time they perform the final inspection. In this approach, no nonconformance reports are generated throughout the entire process with the associated adverse impact on the contractor's or subcontractor's ability to track and trend identified deficiencies. A contributing factor to this problem is that some implementing procedures do not adequately define or communicate an effective process that specifies when nonconformance reports are required.

- **Inadequate Source Inspection Procedures and Guidance.** Prime contractor management is responsible for providing its QC inspectors with adequate procedures and guidance to aid them in performing their assigned duties. Management is also responsible for clearly defining inspectors' roles and responsibilities. In some cases, DOE prime construction contractors have not provided sufficient direction and tools to ensure that their inspectors are effective in performing oversight of subcontractors and suppliers. Procedures and guidance were either lacking or not appropriate for their subcontractor oversight activities, and inspectors' roles and responsibilities were not clearly defined. In some cases, it was not clear whether the individual was intended to serve as a QC inspector or as a mentor/advisor to the subcontractor.

- **Inadequate Receipt Inspection.** Receipt inspections of SSCs from subcontractors or suppliers are the last formal opportunity for the prime contractors to ensure that the products meet specifications and requirements. Recent experience indicates that DOE prime construction contractors' receipt inspections have not been effective in identifying deficiencies in the supplied products and preventing installation of the deficient materials. Some DOE construction contractors rely on their source inspections to identify subcontractor and supplier deficiencies and correspondingly have reduced the rigor and effectiveness of their receipt inspections. Although it is desirable to identify subcontractor deficiencies at the source, receipt inspections provide a useful and important final barrier to ensure product integrity.

- **Lack of Management Work Activity Awareness.** Management (prime contractor and subcontractor) awareness of work activities under their cognizance is a fundamental responsibility of a manager and provides an additional barrier to ensure product quality. This is especially true for first-line supervision that has direct oversight responsibilities for the work being performed. Recent case history suggests that contractor or subcontractor first-line management has not been sufficiently engaged in work activities taking place on the shop floor and has been ineffective in identifying obvious deficiencies in the quality of the delivered product. Causal analyses have often failed to evaluate the extent to which the lack of management work activity awareness contributed to the product quality issue.

Several actions have been taken to address known problems in flow down of nuclear safety requirements and insufficient oversight of construction subcontractors and suppliers. These actions will be discussed in Part 3 of this series.

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Nuclear Facility Construction Noncompliances: Part 3—Ongoing Actions/Conclusions

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Some nuclear safety regulation noncompliances associated with several DOE contractors and subcontractors involved in the construction of DOE nuclear facilities have led to the fabrication and installation of safety significant or safety class Structures, Systems, and Components (SSC) that did not meet specifications or requirements. Over a 5-year period, the HSS Office of Enforcement investigated these noncompliances, identifying factors that led to them, and actions that can be taken to address them.

This article discusses both ongoing actions and opportunities for additional actions to address nuclear safety regulation noncompliances and also provides conclusions by the Office of Enforcement. Part 1 of the three-part series included an overview and specific examples of noncompliances, and Part 2 discussed the factors that contribute to such noncompliances. Information regarding specific noncompliances and associated civil penalties (in cases where enforcement action has been taken) is available on the Office of Enforcement web site at http://www.hss.energy.gov/enforce.

Ongoing Actions and Opportunities for Additional Actions

Several actions have been taken to address known problems in the flow down of nuclear safety requirements and insufficient oversight of construction subcontractors and suppliers. It is important that these actions be sustained and that an equitable balance be maintained between the costs of implementing the actions and the derived benefits of enhanced product quality and the resulting enhanced facility operability and safety system performance. Following are some of the more significant actions that have been taken or could be taken to enhance Quality Assurance (QA), compliance with safety requirements, and assurance that nuclear facilities will be constructed in a manner that ensures protection of the workers, the public, and the environment.

- **Embrace a Positive Nuclear Safety Culture** — To drive improvement in construction of DOE nuclear facilities, senior management support for a positive nuclear safety culture is essential. Management at all levels must instill an attitude that nuclear safety is an overriding priority within their organizations and convey this expectation to their subcontractors and suppliers. Repeated evidence of an organization's inability to detect errors in design changes, along with a lack of communication and questioning of specification ambiguity and failure to detect gross defects in product quality prior to installation, may be symptoms of contractor management's inability to instill a sound nuclear safety culture within the organization and among their subcontractors and suppliers. In 2006, Bechtel National Inc. recognized that organizational improvement was needed in its nuclear safety culture at the Waste Treatment and Immobilization Plant and initiated its Nuclear Safety and Quality Imperative, which is ongoing today. Changing the safety culture of an organization is not an isolated, one-time action, but rather an effort that must be sustained over the life cycle of the facility.
- **Improved Corrective Action Management** — Office of Enforcement experience has shown that, in many cases involving the construction of DOE nuclear facilities, problems were known months, and in some cases years, before formal recognition and response by the DOE prime construction contractors. The failure of the prime construction contractors to adequately analyze and correct problems

has led to increased cost of corrective actions, adverse impact on mission accomplishment, and Office of Enforcement intervention. Improvement in these contractors' corrective action management processes (including causal analysis, extent-of-condition review, common cause review, corrective action development, and corrective action effectiveness reviews) is vital to enhancing the quality of their products and those provided by their subcontractors and suppliers.

- **Prioritized, Risk-Based Approach to Subcontractor Oversight** — Not all procurements of SSCs involve the same level of complexity and risk. Items of low complexity and low risk to facility construction, operation, and safety system performance do not warrant rigorous oversight. On the other end of the spectrum, items of high complexity and high risk warrant a significant level of oversight on the part of the prime contractors. Means of providing enhanced oversight may include full-time resident Quality Control (QC) inspectors at the subcontractor's facility, 100 percent nondestructive examination of all welds, and additional hold points during the fabrication process. A graded approach is needed to properly balance construction cost, mission accomplishment, and quality objectives. NQA-1 audits and surveillances cannot replace direct physical oversight of the subcontractor.
- **Management Support for the QC Function** — In most cases involving the failure of DOE construction contractor oversight of its subcontractors, management did not provide its QC inspectors with the tools and resources to perform their oversight activities. Insufficient personnel, insufficient training, inadequate procedures and guidance, and undefined roles and responsibilities were factors contributing to the problem. In addition, it is important to regularly (e.g., annually) rotate QC inspectors assigned to subcontractor facilities to avoid complacency setting in. Some DOE construction contractors have recognized these contributing factors and have acted quickly and appropriately to address them.
- **Enhanced Receipt Inspections** — Receipt inspection is often the last formal barrier to ensure that received material and components meet specifications and requirements. Recent experience indicates that receipt inspections by DOE construction contractors do not always identify deficiencies in the delivered product, even those that can be readily observed by a visual inspection. For quality-level procurements, the critical attributes and characteristics of quality need to be defined and subsequently verified upon receipt of material or components. Relying solely on source inspections is not sufficient to ensure product quality.

Conclusions

The nuclear facilities currently undergoing construction or major modification within DOE are highly complex, employ state-of-the-art technology, are very expensive to construct, and are designed to perform missions of vital importance to the nation. Barriers must be in place to identify problems in construction at the earliest possible time to ensure safety and avoid costs associated with corrective actions and adverse impacts on the construction schedule. DOE and the public are justified in their demand that construction of these nuclear facilities be held to a very high standard and that the barriers be effectively designed and implemented to ensure safety.

While many aspects of the safety of nuclear facilities under construction have been effective, DOE has experienced a number of lapses in the fabrication and inspection of material and components. In some cases, materials have been received indicating a high percentage of visible deficiencies. Further, in some instances, there have been breakdowns in the barriers that are intended to detect deficient components and conditions,

resulting in installation of defective components in nuclear facilities. Correcting such conditions has been expensive, has resulted in delays in construction schedules, and has potentially increased the risk to workers, the environment, and the public.

Deficiencies in QA programs and insufficient attention to overseeing subcontractors' performance have been an underlying factor in these issues. The deficiencies in barriers and QA programs for facilities in the construction phase are a long-standing concern; for example, a Defense Nuclear Facilities Safety Board (DNFSB) Staff Issue Report dated September 8, 1999, states: "[r]ecently within the DOE defense nuclear complex, there have been several cases in which welded piping and components passed all the specified inspections and were ready for installation or use, but were found at the last minute to contain defective welds. These discoveries were typically made by workers or observers in the area who noticed the defective welds. Such last-minute discoveries of defective welds result in additional costs and schedule delays. However, of far greater concern is the breakdown in the weld quality assurance program, and the implication that there may be defective welds in operating systems with a potential impact on facility safety." The report identified that the causes for the defective piping and components going undetected until the "last minute" were attributed to (1) inadequate oversight by owners, (2) inadequate fabrication inspection, and (3) inadequate receipt inspection.

The Office of Enforcement's review of recent cases involving DOE prime construction contractors indicates that too many lapses are still occurring. Further, the Office of Enforcement echoes the DNFSB's concern about the breakdown in QA programs and barriers that are intended to preclude the use of defective material and components in operating systems with a potential impact on facility safety.

Management at DOE facilities undergoing construction or major modification should consider the information in these three articles in their ongoing self-assessments and reviews of construction activities, QA programs, and barriers. When deficiencies are identified, such as those discussed in Part 1, site management should identify causal factors, establish timely corrective actions, and devote sustained attention to improving QA programs and barriers.

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The Office of Health, Safety and Security (HSS), Office of Analysis publishes the *Operating Experience Summary* to promote safety throughout the Department of Energy (DOE) complex by encouraging the exchange of lessons-learned information among DOE facilities.

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Commonly Used Acronyms and Initialisms

Agencies/Organizations	
ACGIH	American Conference of Governmental Industrial Hygienists
ANSI	American National Standards Institute
CPSC	Consumer Product Safety Commission
DOE	Department of Energy
DOT	Department of Transportation
EPA	Environmental Protection Agency
INPO	Institute for Nuclear Power Operations
NIOSH	National Institute for Occupational Safety and Health
NNSA	National Nuclear Security Administration
NRC	Nuclear Regulatory Commission
OSHA	Occupational Safety and Health Administration

Units of Measure	
AC	alternating current
DC	direct current
mg	milligram (1/1000th of a gram)
kg	kilogram (1000 grams)
psi (a)(d)(g)	pounds per square inch (absolute) (differential) (gauge)
RAD	Radiation Absorbed Dose
REM	Roentgen Equivalent Man
TWA	Time Weighted Average
v/kv	volt/kilovolt

Job Titles/Positions	
RCT	Radiological Control Technician

Authorization Basis/Documents	
JHA	Job Hazards Analysis
JSA	Job Safety Analysis
NOV	Notice of Violation
SAR	Safety Analysis Report
TSR	Technical Safety Requirement
USQ	Unreviewed Safety Question

Regulations/Acts	
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
D&D	Decontamination and Decommissioning
DD&D	Decontamination, Decommissioning, and Dismantlement
RCRA	Resource Conservation and Recovery Act
TSCA	Toxic Substances Control Act

Miscellaneous	
ALARA	As low as reasonably achievable
HEPA	High Efficiency Particulate Air
HVAC	Heating, Ventilation, and Air Conditioning
ISM	Integrated Safety Management
MSDS	Material Safety Data Sheet
ORPS	Occurrence Reporting and Processing System
PPE	Personal Protective Equipment
QA/QC	Quality Assurance/Quality Control
SME	Subject Matter Expert