

D&D COMPLIANCE WITH FACILITY END-POINT SPECIFICATIONS THROUGH INDEPENDENT VERIFICATION

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ABSTRACT

This paper provides an outline of an Independent Verification Organization (IVO) approach to ensure that decontamination and decommissioning (D&D) direct contractors to the Department of Energy (DOE) comply with specific facility end-point specifications for items, materials, and buildings. The verification process is an independent quality control (QC) check that provides assurance to DOE that materials and/or buildings are dispositioned accordingly, and that all specified regulatory requirements and regulatory guidelines regarding the D&D activities are met.

INTRODUCTION

The Department of Energy, Oak Ridge Operations (ORO), has established an Independent Verification Organization for ORO sites to ensure that D&D direct DOE contractors comply with facility end-point specifications, that materials removed from buildings are appropriately dispositioned, and that all specified regulatory and contractual guidelines regarding these D&D activities are met. Independent verification activities include but are not limited to: technical review of contractor plans and procedures, direct and indirect measurements for radioactive and hazardous materials (RCRA, TSCA, and asbestos) contamination, interpreting self-derived and D&D contractor data, and generating verification and analysis reports for both interim and final D&D activities.

This verification process is an independent evaluation of real and non-real property release that ensures the DOE, state agencies, and the general public that the unconditional releases of material, material title transfers, waste disposals, and final building end-point criteria comply with the appropriate regulations. The purpose of the independent verification process is to: provide an independent third-party review of D&D projects, evaluate the adequacy of the contractors documentation, validate the D&D contractors survey methodology, and to validate the accuracy and representativeness of measurements and techniques performed to achieve D&D activity goals.

It is anticipated that the degree of verification activities will vary based on the potential level of risk and hazard to the public and liability to DOE. The IVO establishes a level of confidence with the contractor based on the correlation of their results and the verification results. Two levels of verification exist, one being a Type A (limited) verification, which involves a complete document and data review. The other a Type B (full) verification which includes visual inspections and independent measurements and sampling, in addition to those activities included in a Type A verification. These verification activities include radiological verification, as well as a verification program for asbestos, polychlorinated biphenyls (PCB's), and other chemical contaminants. The scope of the IVO does not include oversight of occupational safety, radiological protection, environmental effluent, or emission oversight activities. This oversight is provided by other DOE organizations within ORO.

SCOPE

Independent verification of reindustrialization projects include, but are not limited to, the following D&D program areas:

- **Unconditional Release of Items, Materials, and Equipment**—All items, materials, and equipment that are unconditionally released will be in accordance with applicable DOE Orders

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and may be supplemented by NRC regulatory guidelines and/or any State requirements. All unconditionally released items, materials, and equipment will also be free of any RCRA/TSCA-regulated contamination. The IVO includes validation of D&D contractors release processes through independent and/or co-measurement activities, review of associated data and documentation, and concurrence regarding unrestricted releases.

- **Waste Stream Verification**—Waste stream verification includes reviewing process and historical knowledge, collecting field measurements, and performing data quality objective (DQO)-based laboratory analyses. Wastes include all materials identified for disposal including radioactive, RCRA, TSCA, mixed, and general industrial wastes. The IVO evaluates wastes against an identified waste acceptance criteria (WAC) for the facilities receiving the materials. The IVO includes validation of the waste disposal processes, which may include: independent sampling, obtaining co-measurements or samples, reviewing documents, and concurrence on characterization, processing, storage, shipments, and final disposition.
- **Material Title Transfer**—DOE material title transfers will meet the criteria of the Atomic Energy Act of 1954 and associated regulations. This includes title transfers between DOE sites, contractors, or NRC/Agreement State licensees. The IVO includes validation of all title transfers by document reviews and, as deemed necessary, visual inspections.
- **Building End-Point Specification**—On completion of D&D activities, the D&D contractor shall notify DOE, in writing, of the building status. Verification includes the validation of contractor process knowledge; survey and analytical data; collecting independent data; reviewing the D&D contractor final report; and preparing the verification report. Existing site conditions will also be verified.

APPROACH

Independent verification may use any of the following approaches:

- the IVO can co-develop plans and co-sample with the D&D contractor,
- the IVO can conduct evaluations independently of the D&D contractor, and
- the IVO can verify D&D after work is complete.

Co-developed Programs

The D&D contractors and IVO may jointly develop project specific plans (PSPs) that facilitate an independent, yet parallel, verification process sufficiently integrated with project activities so as not to negatively impact the project schedules. For in-process verification, the D&D contractor is required to define and provide processes, targeted schedules, and time lines to DOE for initial and continuing IVO baseline resource allotment. The IVO on a continuous basis: responds, resource loads, and coordinates with the D&D contractors schedule.

Independent Measurements

The IVO program includes collecting independent samples and measurements for verification. Samples and measurements should verify that the D&D contractors data is representative of the radiological or chemical conditions. Independent measurements may include judgmental samples and measurements of elevated areas to determine adequacy and accuracy of the D&D contractors data and may include resampling.

Post-D&D Verification

The IVO may also verify completed D&D activities. In these cases, the IVO reviews existing data, conducts surveys, and collects samples to verify that the facility meets building end-point release criteria required by the contract.

VERIFICATION TASKS

Verification activities include reviewing D&D contractor documents, evaluating the D&D contractor's initial characterization of areas and materials and performing independent survey activities. The specific nature of verification tasks are described in the following paragraphs.

Document Review

One of the most important IVO tasks is reviewing the D&D contractor documentation for material transfers; waste disposal; unconditional release of items, material, and equipment; and building end-point release criteria. General D&D information is reviewed, including site/facility description, operating history, major contaminants, decommissioning activities performed, and waste disposal practices. This process is typically performed prior to the D&D contractor implementing any written procedures.

D&D Planning Activities

The site/facility description is reviewed to determine general locations of residual activity and identification of hazardous materials to be decontaminated, including locations of any spills or accidents involving hazardous or radioactive materials. The historical site assessment is reviewed to identify the processes performed and to ensure that all potential contamination pathways have been addressed. Review of the decommissioning activities is necessary to provide the IVO with an understanding of the current site condition (following remediation). Waste disposal practices are reviewed to determine their impact on the facility contamination status. Identification of the major contaminants is reviewed to ensure consistency with the stated operational history.

Survey Procedures Review

The following are included in the material disposition and building end-point survey procedures review:

- background level determinations;
- area/material classifications;
- reference grid size and placement; and
- survey measurements (e.g., surface scans, surface activity measurements, media sampling and analysis, and exposure rate measurements).

Identification of how the background levels were established for the site and area classifications are reviewed relative to the contamination potential in each surveyed area. Survey measurements are reviewed to ensure they are appropriate for the expected contaminants. Specifically, the review ensures, in part, that all potential radioactive contaminants or chemicals of concern have been measured, and that scanning and sampling techniques are capable of detecting locations of elevated activity, and that inaccessible areas have been addressed.

The rationale behind instrumentation selection is reviewed. Specifically, the review ensures that the instrumentation selected is appropriate for the desired survey measurement. Instrument calibration procedures are reviewed to ensure that the calibration source is representative of the contaminant(s) (e.g., similar source geometry and radiation energy) and that instrument response checks are performed at the specified frequency and agree with the established acceptance criteria. The calculated expression for instrument sensitivity typically stated as the minimum detectable concentration (MDC) is reviewed and the instrument sensitivity relative to the release criteria is assessed.

Survey and Analytical Results Review

The survey findings review ensures that the survey data are consistent with the objectives of the survey, and includes data interpretation, statistical evaluation, and comparison of results with guideline values. Data interpretation is reviewed to ensure that calculations used to convert survey data to units consistent with guideline units are appropriate and accurate, and that area averaging, when necessary, was performed correctly. The statistical evaluation is reviewed to determine that the appropriate statistical method was applied to the survey results. The comparison of survey results with guideline values is reviewed to ensure that results of survey measurements and sampling are in compliance with the guidelines, and that all guidelines and end-point specifications are satisfied with the specified statistical accuracy. Miscellaneous items that may also be reviewed include the following:

- indication of measurement and sampling locations,
- indication of remediated areas,
- data provided for all areas addressed during the final-status survey, and
- a statement that building end-point criteria have been met.

The IVO also reviews the analytical data following defined and approved procedures to ensure the results of sample collection activities support survey objectives. Standard data validation activities may be increased based on project-specific needs.

Initial Characterization

Site Characterization

Before verification, existing conditions reported by the D&D contractor are evaluated to ensure that all DQOs are met. These activities may include verifying:

- processes that occurred in the components,
- available radiological data correlates with process knowledge,
- major media types in the process areas,
- chemicals used in the facilities,
- locations of radiological/chemical spills or other contamination data, and
- contamination maps.

The information provided by the D&D contractor is used to develop the PSP for each site. The PSP developed by the IVO includes, at a minimum, the following subsections:

- Introduction
- Site Description
- Document Review
- Radiological Contamination
- Chemical Contamination
- Field Sampling and Measurements Plan
- Data Interpretation and Assessment
- Guidelines
- Procedures
- References

It is anticipated that each D&D contractor will characterize the site—including any areas exterior to buildings where operations will be conducted. At the direction of the DOE this survey will be verified by the IVO and existing site conditions will be established. Area classification usually follows an accepted methodology, such as guidance from NUREG-1575, “Multi-Agency Radiological Survey and Site Investigation Manual” (1). The IVO then reviews the D&D contractor classification before building decontamination commences.

Item, Material, and Equipment Characterization

The IVO compares written process knowledge with existing documentation to verify the characterization of process equipment, non-process equipment, and general debris. If process knowledge indicates that the equipment is not contaminated (i.e., determined to be non-impacted), the IVO will typically concur with the certification statement and recommend the release of the property. If process knowledge does not support a non-impacted decision, the equipment is treated as contaminated. Contamination status is verified by reviewing the D&D contractor data. This data may also be supported by co-measurements, split samples, independent measurements, and other samples as detailed in the PSP.

Independent Survey Activities

The independent survey and sampling activities ensure data collected by the D&D contractor are accurate and fully characterize the material or area surveyed. The IVO typically develops a flexible approach to verification where survey frequency is contingent on findings as the survey progresses. The IVO survey may include in-process verifications to expedite the D&D process. The IVO survey frequencies are normally based on equipment accuracy and area classification. The following general classification system is typically used by the IVO:

- **Class 1**-Items, materials, equipment, and/or areas that have, or had a potential for contamination (based on process knowledge) or known contamination (based on previous surveys) above the unrestricted release criteria for surface contamination.
- **Class 2**-Items, materials, equipment, and/or areas that have, or had a potential for or known contamination, that are not expected to be above the unrestricted release criteria for surface contamination but are expected to contain residual contamination greater than 25 percent of the unrestricted release criteria based on process knowledge or previous surveys.
- **Class 3**-Any impacted items, materials, equipment, and/or areas that are not expected to contain any residual contamination, or expected to contain residual contamination less than 25 percent of the unrestricted release criteria for surface contamination based on process knowledge or previous surveys.

Survey Procedures

Independent verification survey activities for radioactive contaminants are performed following approved IVO procedures. Additional guidance for survey activities may be obtained from draft NUREG/CR-5849, "Manual for Conducting Radiological Surveys in Support of License Termination," (2), NUREG-1507, "Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants in Field Conditions," (3) and the MARSSIM (1).

The IVO ensures that material-specific background measurements were performed as appropriate for the specific material being surveyed. The frequency of measurements chosen by the D&D contractor are also evaluated and should be based on the appropriate classification as specified in the D&D contractor work plan. Judgmental measurements and samples, random or systematic, are collected at the frequencies specified in the PSPs developed by the IVO. Whenever possible, the IVO uses the grid coordinate system established by the D&D contractor to reference survey locations.

Sampling for asbestos and chemical contaminants is usually performed according to standard operating procedures (SOPs) developed by the IVO. Sampling for transferable radioactive contamination are conducted using conventional smears/swipes. Asbestos verification may consist of confirmatory analysis, visual inspections, and/or air-clearance testing. PCB levels are assessed using standard hexane wipes, while chemical verification is conducted using the appropriate EPA sampling method for the particular chemical. All sampling is conducted according to field SOPs and approved methodologies. The following is typically included in the sample records:

- Sampling methods
- Sample purpose
- Date and time of collection
- Sample identification number
- Sample location
- Analytical methodology
- Process description
- Number and volume of samples
- Field measurements (pH, percent lower exposure limit (LEL), photoionizable gases, etc.)
- Field observations
- Sample designation
- Signature of the sample collector

Survey Instrumentation

Radiological survey instrumentation used by the IVO is based on up-to-date and available technology, type of contamination, and defined release limits. For example, large-area automated detectors with data logging capabilities may be used to survey most of the open floor and wall surfaces. Conventional survey instrumentation includes sodium iodide scintillation detectors, gas flow proportional detectors, Geiger-Mueller (GM) detectors, pressurized ionization chambers, and zinc sulfide detectors.

Waste Stream Verification

The IVO reviews and verifies waste disposal to ensure the wastes meet the identified WAC at the treatment, storage, and disposal facility (TSDF). The IVO validates the D&D release processes for both primary and secondary waste stream generation and the characterization of wastes. This may be performed through independent measurements and samples, documentation review, and concurrence on characterization, processing, storage, shipments, and final disposition. This procedure typically is a four step process to include: license/permit evaluation, quantity/concentration determination, waste stream determinations, and shipment evaluation. The license or permit and calculation methodologies are evaluated for each facility before shipment of the material occurs.

The IVO also verifies that sampling methods and analytical tests comply with American Society for Testing and Materials-approved or EPA-approved procedures, reviews the analytical laboratories QA program plans before sample shipment, and reviews the sample collector permanent log of sampling activities, the RCRA hazardous waste and TSCA determination, and the level of radioactive contamination.

The IVO performs verification measurements consisting of direct readings and/or sampling as appropriate on selected shipments. The number and types of surveys performed and samples collected are specified in the PSP. The IVO samples each waste stream at the point of generation as well as co-sample or split sample whenever possible. Typically, from 1 to 10 percent of the measurements or samples collected by the D&D contractor are verified by the IVO.

At a minimum, the following is included in the IVO records:

- copies of disposal facility licenses or permits filed in the project files,
- copies of the NRC Form 741 (required if more than 1 g (0.035 oz) of special nuclear material is shipped) and the supporting documentation filed by receiving facility and shipment number, and
- results of verification measurements.
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Material Title Transfer

The IVO reviews and verifies material transfers to ensure the material meets the identified material acceptance criteria at the receiving facility. The IVO validates this by both documentation review, and as deemed necessary, visual inspection, surveying, and sampling. The IVO procedures are based on the material

WM99 CONFERENCE, FEBRUARY 28 - MARCH 4, 1999

acceptance criteria (i.e., license and/or operating permit of the receiving facility) and the level of radiological and hazardous material contamination.

Material transported for recycling or reuse follow these four steps: license/permit evaluation, quantity/concentration determination, material contamination determination, and shipment evaluation. The license/permit and methodology for calculations are evaluated for each facility before shipment occurs.

The IVO also performs verification measurements consisting of direct readings and/or samples as appropriate on some specified fraction of shipments. The number and types of surveys performed and samples collected are detailed in the PSP. Typically from 1 to 10 percent of the measurements or samples collected by the D&D contractor are verified. The IVO also reviews each DOE/NRC Form 741 as applicable.

At a minimum, the following are included in the IVO records:

- copies of receiving facility licenses or permits filed in the project files,
- copies of the NRC Form 741 and the supporting documentation filed by the receiving facility and shipment number, and
- results of verification measurements.

Unconditional Release Of Items, Materials, And Equipment

The IVO reviews and verifies unconditionally released items, materials, and equipment to ensure they meet the defined release criteria. This is typically performed through document reviews and independent surveys. The unconditional release of items and materials are based on historical site assessment, including process knowledge and contamination classification, according to surveys and analytical results. When available, equipment drawings and specifications facilitate the material unconditional release program. Unconditional releases are based on accepted guidelines specified in the contract, such as NRC Regulatory Guidelines 1.86 and DOE Order 5400.5 guidelines for radiological contaminants and 40 CFR for RCRA and TSCA contaminants.

Unconditional releases must not contain friable asbestos, non-friable asbestos in need of repair, chemicals, regulated PCBs, petroleum products (other than in working machinery), or radioactive contamination that exceed release criteria. The IVO requires from the contractor, at a minimum, the following documentation before items, material, and equipment are presented to the IVO for unconditionally released:

- certification that the material is releasable,
- radiation surveys,
- RCRA/TSCA paperwork (including analytical results if samples were collected),
- analytical results (if samples for radioactivity were collected), and
- shipping papers identifying weight or volume and destination.

Building End-Point Release Criteria

IVO activities for building end-point specification include reviews of the D&D contractor final-status survey documentation and independent verification surveys of each building. The IVO PSP for building verification surveys depend on the specific building end-point release criteria. This process follows the majority of the topics outlined above.

Advantages and Conclusion

The regulatory agencies have found the independent verification process to be a solid tool for ensuring that the work performed during D&D projects meets the requirements for protection of human health and the environment. The process provides for a complete review of documentation, thereby ensuring consistency and uniformity. Any discrepancies identified during the process may be addressed early in the project. By

WM99 CONFERENCE, FEBRUARY 28 - MARCH 4, 1999

identifying these issues early in the project, increased costs, impacted schedules, and additional surveys can be avoided by correcting these deficiencies prior to demobilization of the D&D contractor. Experience has demonstrated that when there is an early IVO involvement in D&D activities between the regulatory agency, site representatives and their contractors, the entire process is streamlined and the effectiveness enhanced.

In summary, the verification process provides for timely identification of problems associated with determining a site's final radiological and/or chemical hazard status, increased uniformity and consistency of final-status surveys and resulting documentation, increased probability of complete remediation, and finally for the stakeholders, enhanced credibility of the conclusions reached for the site's final radiological and/or chemical hazard status.

REFERENCES

1. Nuclear Regulatory Guide. December 1997. Multi-Agency Radiation Survey and Site Investigations Manual (MARSSIM), NUREG-1575.
2. Nuclear Regulatory Guide. 1992. Manual for Conducting Radiological Surveys in Support of License Termination.
3. Nuclear Regulatory Guide. June 1998. Minimum Detectable Concentrations With Typical Radiation Survey Instruments for Various Contaminants in Field Conditions.