

WELL LOGGING AND TRACER STUDY PROGRAMS

Effective Date: 05/16/2022

PROGRAM APPLICABILITY:IMC 2800

87123-01 INSPECTION OBJECTIVES

- 01.01 To determine if licensed activities are being conducted in a manner that will protect the health and safety of workers and the general public.
- 01.02 To determine if licensed programs are being conducted in accordance with U.S. Nuclear Regulatory Commission (NRC) requirements using a risk-informed, performance-based regulatory approach.

87123-02 INSPECTION REQUIREMENTS

The review of the licensed activities will be commensurate with the scope of the licensee's program. The inspector's evaluation of a licensee's program will be based on direct observation of work activities, interviews with workers, demonstrations by workers performing tasks regulated by NRC, and independent measurements of radiation conditions at the facility, rather than exclusive reliance on a review of records. Additionally, the inspector should use a risk-informed approach to perform the inspection, such as choosing the activities that carry the highest risk to inspect first. This can help ensure that in cases of limited time with the licensee due to varying circumstances, the most risk-significant licensee activities are reviewed for each inspection. If issues are identified, the inspector may refer to the Appendix for additional areas that may merit inspection.

This procedure is intended to provide the inspector with a performance-based and risk-informed method of developing a basis of confidence that licensed activities involving well logging operations involving sealed and unsealed material are being conducted in a manner that provides reasonable assurance of the protection of health and safety of workers and the general public.

This procedure is structured around a set of risk modules (RMs) that were developed to highlight the most risk significant aspect of well logging operations – the handling of sealed and unsealed sources at temporary job sites – as well as the programmatic elements of well logging operations that, when adequately implemented, most effectively mitigate the risks of handling these sources.

The structure and the emphasis of the inspection should be on the following RMs, which describe the outcomes of an effective radiation protection program for well logging operations. RMs are defined as program areas that present higher risk, or expected to effectively reduce

risk, to health, safety, and security that are identified in each inspection procedure in order to focus inspection effort on these particular program areas. To consider an inspection complete, the inspector should review applicable RMs based on ongoing activities at the time of the inspection. The RMs that carry the highest risk components should always be completed to the best of the inspector's ability. Additional inspection elements that carry less risk can be found as an appendix to this inspection procedure. These additional elements are not required to be reviewed as part of a risk-informed inspection approach but may be reviewed if the inspector has additional time, if the additional elements are related to safety issues identified in the RMs, or if multiple violations were identified through review of the following RMs.

02.01 RM-1: Observation of Licensed Activities

The licensee demonstrates that knowledgeable staff use effective engineering and procedural controls to ensure the safe and secure use of licensed material at authorized locations of use, including temporary job sites.

02.02 RM-2: Radiation Exposure Control

The licensee develops and implements as low as reasonably achievable (ALARA) practices consistent with operating procedures and design and performance criteria to effectively minimize and mitigate radiation exposures and contamination.

02.03 RM-3: Instrumentation and Dosimetry

The licensee has an appropriate kind and quantity of operable radiation instrumentation and dosimetry to promptly and accurately monitor radiation exposure and uptake levels received by workers and members of the public in normal and abnormal conditions.

02.04 RM-4: Security and Accountability of Material

The licensee maintains control of licensed material in its possession, utilizing appropriate storage methods and accounting measures to limit loss, theft or misplacement of material in use and in storage.

02.05 RM-5: Knowledge and Awareness of Hazards

Personnel are aware of radiation hazards and individuals authorized to use licensed material are sufficiently knowledgeable and empowered to handle it safely and securely under normal and abnormal conditions.

02.06 RM-6: Management Oversight

The licensee's management takes responsibility for and dedicates adequate resources to the radiation safety program, and through periodic assessments of past performance, present conditions, and future needs, demonstrates awareness of and concern for radiation safety best practices.

General Guidance

Well logging programs involve the use of radioactive material to study geologic formations and evaluate subsurface operations. Well logging licensees typically provide specialized services for extractive industries such as mining and oil and gas exploration but may also provide environmental services such as groundwater monitoring and subsurface pollution remediation.

Well logging licensees most commonly use sealed sources of gamma- and/or neutron-emitting material (and occasionally neutron generators containing tritium) to measure the physical properties of formations through which boreholes are drilled. They may also use unsealed material as a liquid tracer to study subsurface fluid movement in operations such as hydraulic fracturing and waste disposal via injection wells.

Note: Well logging licensees frequently operate in remote and hazardous environments, including offshore platforms, where rugged terrain, extreme temperatures, high noise levels, heavy equipment, suspended loads, fall hazards, and flammable and explosive substances may be present. As such, inspectors should consider the need for off-road vehicles and other specialized transportation to reach temporary job sites and should bring a full complement of personal protective equipment (PPE), including hard hat, safety glasses, steel-toed shoes, ear protection, gloves, and fire-resistant clothing. Sites may also require the use of intrinsically safe electronic equipment, including survey instruments, to minimize the potential for sparks or sources of ignition, and specialized safety training may be required as well.

The following inspection guidance is designed to assist the inspector in evaluating the performance of the licensee's radiation safety program. The guidance is organized by the individual risk modules described above; however, this does not mean that the risk modules should be reviewed in this specific order. Instead, the inspector should use a risk-informed approach to decide which of the risk modules to inspect first. This is going to be predicated upon what licensed activities are ongoing when the inspector arrives at the licensed facility or temporary job site. Furthermore, inspectors should not feel constrained by the guidance in this procedure. If an inspector obtains information that indicates that a problem may exist in an area of the licensee's radiation safety program not specifically addressed in this procedure, the inspector should address it.

An examination of the licensee's records should not be considered the primary part of the inspection program. Rather, observations of activities in progress, equipment, facilities and use areas, etc., will be a better indicator of the licensee's overall radiation safety program than a review of records alone.

- Among records, priority should be given to examination of those closely related to health and safety, such as personnel dose-monitoring records, incident reports, and surveys. Look for trends such as increasing doses or releases; look for unusual doses (both high and low) or survey results; and look for licensee-identified issues and any corrective actions taken as a result.
- Other records which support the radiation protection program, such as receipt and transfer of licensed materials, inventory, leak tests, calibration of analytical or portable instruments used to make quantitative measurements, training and radiation protection

program reviews, may be reviewed by sampling and cross-checking to verify ongoing compliance and to evaluate the effectiveness of tracking mechanisms. The inspector may also examine these records more thoroughly, if necessary, to determine the extent of any performance concerns identified during the inspection.

Common elements to all inspections include entrance and exit meetings with appropriate licensee management, including the radiation safety officer (RSO), observations of facilities and work in progress, independent confirmatory surveys, and the evaluation of program scope and any special license conditions. Specific guidance regarding these common elements can be found in Inspection Manual Chapter (IMC) 2800.

Specific Guidance

03.01 RM-1: Observation of Licensed Activities

The primary inspection activity for well logging operations should be the observations of licensed activities in progress at field stations and at temporary job sites. Observations begin as soon as the inspector arrives at a location of use. Inspectors should ensure that they are wearing site-appropriate PPE and dosimetry, have a calibrated gamma (and, optionally, neutron) survey instrument turned on, and should remain vigilant for radiological and other industrial hazards.

Licensed activities at field stations include the handling of material for transfer from storage to a wireline rig and back again, as well as activation of neutron generators containing tritium inside shielded test barrels. Inspectors should be attentive to crews preparing to leave for job sites and confirm that they are ready to transport and use licensed material safely and securely before they depart.

Licensed activities at temporary job sites typically involve the handling of material for transfer from storage on a wireline rig to its designated location in a well logging tool (long cylindrical devices containing one or more sources and/or detectors attached to the drilling string or the logging rig via a spooled wireline), the insertion of these tools into a borehole or well, the subsequent retrieval of these tools upon completion of logging activities, and disassembly of the tool and return of material to storage. The time spent handling material before and after insertion is often quite short compared to the time it takes to complete a log or tracer study. Nevertheless, these actions present significantly elevated radiological risks compared to the logging operation or tracer study itself and should therefore be prioritized for observation.

If the well logging activity involves hydraulic fracturing or “fracking” operations, the company performing these operations will also be using one or more fixed nuclear gauges to monitor the density of hydraulic fracturing fluids. These gauges, known as densitometers or “densos,” will be mounted on short lengths of removable process piping or on vehicles involved in the operations. See IP 87124 for additional guidance on inspecting these fixed nuclear gauges.

In rare instances, direct observations of well logging activities may be too dangerous or impractical for inspectors given the nature of the associated hazards. In such cases, inspectors should instead interview staff and examine equipment before work begins and review an expanded selection of records related to these activities. Inspectors can consider requesting pictures or video of these activities in lieu of direct observations but

should be mindful that obtaining this media could be an undue distraction or burden to those working in a hazardous environment.

a. While at field stations:

- Tour the facility and keep an eye out for unlocked storage areas, unsecured storage containers on wireline rigs and other inadvertently unsecured material as staff prepare to depart for or have just returned from a job site.
- Verify that staff preparing sources for transport properly label their storage containers and secure them to vehicles with suitably sturdy mechanisms. Transportation packages have been known to fall from well logging rigs during transport if not adequately restrained. See Appendix M of NUREG-1556 [Volume 14, Revision 1](#) for additional information on USDOT hazardous materials transportation requirements.
- Interview staff preparing to perform work at job sites to assess their level of understanding of radiation safety principles and regulatory requirements and their preparedness to perform licensed activities safely. Confirm that staff have all required instrumentation, dosimetry, source handling tools, contamination control measures, etc., as well as shipping papers and a copy of the latest revision to the licensee's operating and emergency procedures, before leaving for the job site.
- Interview other staff working in the vicinity of source storage areas or in the presence of licensed activities to assess their familiarity with radiation hazards and associated postings. These individuals can provide valuable independent perspectives, for example to provide confirmation that source storage areas and containers are not left unsecured or unattended.
- Keep an eye out for other hazards such as explosive materials, flammable gases, and heavy equipment. Confirm that the licensee has considered and addressed the proximity and potential vulnerability of licensed material to these hazards.

b. While at temporary job sites:

- Verify that staff maintain control and constant surveillance of sources in use, or otherwise secure them against unauthorized access. Licensees should need only to remove sealed sources and tracer material from storage immediately before loading them into well logging tools and should thereafter maintain control and constant surveillance of these tools from loading to insertion and again from retrieval to disassembly.
- Observe or ask for demonstrations of well logging operations with an emphasis on visual checks and operability of safety-related equipment, use of ALARA practices while handling sources, and availability and effectiveness of contamination control measures for tracer materials and in the event of a breached sealed source. Personnel should also be mindful of areas where elevated radiation levels are present and should minimize occupancy factors therein to the extent practical.
 - If the licensee is using a neutron generator containing tritium, confirm that licensee personnel carefully follow established procedures for when to energize the generator. It should never be energized above a certain depth below the

surface (typically committed to via procedures) and should remain downhole for a certain amount of time to allow for the decay of short-lived activation products.

- Interview well logging supervisors and their assistants to assess their level of understanding of radiation safety principles, regulatory requirements, and the licensee's operating and emergency procedures including the agreement with well owner or operator, if applicable. Some examples of emergency scenarios to discuss with licensee personnel include but are not limited to:
 - A logging tool/source(s) becomes lodged in a well
 - A sealed source is ruptured on the job site
 - An uncontrolled release of tracer material on the job site, such as a sandout (i.e., fluid reversal) during hydraulic fracturing operations
 - A neutron generator fails to deactivate as it is brought to the surface
- If possible, interview other personnel working in the area as well to confirm they are aware that radiation hazards are present. These individuals can also provide valuable independent perspectives, for example to share concerns about licensed activities or to provide confirmation that licensee personnel are conducting them as required.
- Verify that staff have at least one calibrated and operable beta/gamma survey instrument, know how and when to use it, and can read and interpret results correctly. As in industrial radiography, many incidents involving excessive exposure or contamination during well logging operations could have been mitigated or even avoided had a calibrated and operable meter been used (or used correctly).
- Where and when safe to do so, perform independent surveys in the vicinity of source storage containers, in occupied areas of the job site, and in any publicly accessible locations to evaluate the adequacy of shielding, distancing, and postings, and to confirm the absence of contamination on the job site.
- Keep an eye out for other hazards such as explosive and flammable materials, suspended loads, and heavy equipment. Confirm that the licensee considers and addresses the proximity and potential vulnerability of licensed material to these hazards. See Manual Chapter 1007 for more information on referring industrial safety hazards to the U.S. Department of Labor's Occupational Safety and Health Administration.

03.02 RM-2: Radiation Exposure Control

a. Development and Implementation of ALARA Practices.

To minimize the radiological risk of operations in the field, well logging licensees must develop and implement reasonable measures to keep radiation exposures to personnel and to members of the public as low as reasonably achievable. This includes measures to reduce radiation exposure levels from sealed sources and tracer materials, as well as measures to reduce and remediate radioactive contamination from tracer materials and potentially ruptured sealed sources. There are several specific measures which the licensee's operating and emergency procedures are required to cover at a minimum; however, additional measures may be prudent and necessary to ensure compliance with applicable limits. Refer to section 8.10.11 of NUREG-1556 Volume 14 for additional

guidance on contamination control. [Title 10 of the *Code of Federal Regulations* (10 CFR) 20.1101(a); 10 CFR 39.63]

- Perform independent surveys in the vicinity of source storage locations, in occupied areas of a facility, and in any publicly accessible locations to evaluate the adequacy of shielding, distancing, and postings, and to confirm the absence of contamination. The licensee should be aware of any areas where elevated radiation levels are present; occupancy factors therein should be minimized.
- Observe or ask for demonstrations of contamination control activities, such as area surveys and spill or sandout response procedures, and interview personnel involved in them. Surveys should be deliberate and thorough, and individuals performing them should understand what to look for, how to find it, as well as what to do if contamination is found.
 - If contamination has been found since the last inspection, review the incident with those involved to verify that the licensee responded in a timely manner and in accordance with its procedures.
 - Special attention should be paid to contamination found at temporary job sites. Licensees must be able to demonstrate that they maintained control of and adequately remediated this material before departure from the job site.
 - Refer to IP 87103 for additional guidance on reviewing incidents.
- Review the licensee's selection and availability of personal protective equipment and decontamination materials to evaluate the adequacy of contamination control measures. At a minimum, the selection must include protective gloves for those who handle tracers. [10 CFR 39.45(a)]
- If the licensee has had a well logging tool containing a sealed source become lodged in a well at a job site since the last inspection, review the incident with those involved to verify that the licensee made a reasonable effort to recover the equipment in accordance with emergency procedures and its agreement with the well owner/operator. Recovery efforts must include monitoring circulating fluids from the well for contamination whenever retrieval operations are ongoing, since such efforts (known also as "fishing") can potentially damage logging tools and the sources contained therein. If these recovery efforts were not successful, confirm that the licensee notified and obtained NRC approval to implement the licensee's abandonment procedures. [10 CFR 39.15, 39.69(c), and 39.77(c)]

b. Inspection & Maintenance of Well Logging Equipment

To support the safe conduct of operations in the field, well logging licensees are required to implement a program of visual inspection and routine maintenance on certain pieces of safety-related equipment as part of their operating and emergency procedures. This program must include visual checks before each use, as well as semiannual visual inspections and routine maintenance. If the licensee identifies any defects through these evaluations, the equipment must be removed from service until repaired and a record must be made. [10 CFR 39.43(a) and (b) and 39.63(k)]

Equipment Subject to Inspection & Maintenance

Checked before use and semiannually:

- Source holders
- Logging tools
- Source handling tools

Checked semiannually:

- Injection tools
- Source storage containers
- Source transport containers
- Uranium sinker bars

Unless specifically authorized, well logging licensees cannot remove sealed sources from source holders or perform maintenance on sealed sources or source holders. This includes operations to remove sealed sources stuck in a holder. [10 CFR 39.43(c) and (d)]

- Inspect a selection of well logging equipment in storage to verify that the equipment appears to be free of defects, in good condition and properly labeled. If not, the licensee can either address the deficiency immediately or remove the equipment from service. The licensee's methods for removing defective equipment from service (tag out, relocation, etc.) should provide reasonable assurance that the equipment will not be used again until the deficiency is addressed.
- Observe or ask for demonstrations of inspection and maintenance activities and interview personnel involved in them. The program should be implemented consistently, and individuals performing these activities should understand what to look for and what to do if a defect is found, as well as the licensee's limitations regarding non-routine maintenance.
 - If defects have been found since the last inspection, review records of them to confirm that they were corrected before the equipment was returned to service, and that the licensee evaluated the defects for reportability under 10 CFR Part 21. Consider sampling additional inspection and maintenance records to evaluate for trends and potentially generic issues.

03.03 RM-3: Instrumentation and Dosimetry

a. Survey Instrumentation.

To confirm the adequacy of shielding and exposure control measures, well logging licensees must maintain calibrated and operable survey instruments to perform the surveys required by 10 CFR 39.67 and, as necessary, 10 CFR Part 20. At a minimum, this includes at least one instrument at each field station and job site that can detect beta and gamma radiation. Licensees also must have or have access to a survey instrument sensitive enough to detect low levels of radiation and contamination in the event of a ruptured sealed source (10 CFR 39.33(b)). Licensees typically commit to use instruments that meet the specifications in Appendix H to NUREG-1556 Volume 14.

They may also request approval to implement the model calibration program also found in Appendix H. [10 CFR 39.33(a)]

In addition to ambient radiation and contamination survey instrumentation, well logging licensees may be required to maintain additional detection equipment for bioassay measurements (if required) and for leak test analysis (if authorized).

- Inspect a selection of the licensee's survey instruments to verify that those available for use are in good condition and have been calibrated within the last six months. [10 CFR 39.33(c)(1)]
- Review the licensee's methods for tagging out inoperable instruments. These devices should be clearly marked out of service and/or kept in a location that indicates as such. Interview staff involved in well logging operations to confirm that they understand which instruments are available for use and which are not, and what would indicate a malfunctioning or inoperable instrument.
- Have the licensee demonstrate operability and response checks for a selection of survey instruments, using check sources or areas of elevated ambient exposure (i.e., near source storage locations), and perform confirmatory surveys with NRC instrumentation. Readings between instruments should be comparable (within about 20 percent).
- If the licensee is authorized to calibrate survey meters, observe or ask for demonstrations of this activity. The licensee should be mindful of any radiation field created during the calibration process, and use shielding or other ALARA practices to minimize exposures to personnel in the vicinity. Refer to IP 87143 for additional guidance on inspecting instrument calibrators.

b. Dosimetry Program.

To demonstrate the ongoing effectiveness of its radiation safety program, well logging licensees must develop and implement a radiation dosimetry program to evaluate radiation doses that result from licensed activities. During normal conditions, this program must include, at a minimum, the use of personnel dosimeters for logging supervisors and assistants while handling licensed materials. It may also need to include bioassay for personnel using unsealed tracer materials, though this is uncommon since most such materials are non-volatile. [10 CFR 39.65 (a) and (b)]

If well logging licensees are required to perform bioassay, they may implement their own bioassay program, in which case they typically commit to implementing a program consistent with Regulatory Guide 8.20. Alternatively, they may contract with a provider of bioassay services or commit that individuals working under the license will not use more than a certain quantity of unsealed licensed material at a time.

The licensee must also be able to demonstrate that monitoring of additional personnel, the public and the environment is not required, or else must utilize additional monitoring to demonstrate compliance with regulatory limits. Refer to IP 83822 for additional guidance on personnel monitoring. [10 CFR 20.1501 and 20.1502]

- Review selected reports of monitoring results for logging supervisors, assistants, and others whom the licensee has deemed necessary to monitor. Doses should reflect the nature and scope of their involvement in licensee activities.
 - If monitoring results do not reflect the nature and scope of the licensee's activities, or if there is wide variability in the doses for specific job categories, interview the workers in question to determine the basis for the disparity in their doses. Discuss this variability with radiation safety staff to confirm that they are aware of the disparity. If the disparity justifies additional review, and if the licensee provides a basis, consider verifying that basis with additional independent calculations.
 - Ask if any monitored staff have lost a dosimeter, and if so, under what circumstances. If the lost dosimeter was expected to have recorded more than minimal occupational dose, confirm that the licensee estimated and added this dose to the individual's dose of record. Ask how and where the control badge is stored. If the control badge is stored in a high-background area, such as a source storage area, the occupational results will be depressed.
- If any incident or unusual occurrence was noted or reported since the last routine inspection, review reports of monitoring results for the period(s) in which those incidents occurred and evaluate the extent of exposure for involved individuals. If additional unmonitored individuals were known to be involved, confirm that the licensee evaluated or estimated their exposure as well.
- If the licensee possesses volatile radionuclides in quantities sufficient to require a bioassay program or contract bioassay services, verify that the licensee has established an appropriate monitoring frequency for identifying intakes of radioactive materials, as well as appropriate calculations and methodologies for converting intake measurements to dose.
- If unmonitored workers other than logging supervisors and assistants are suspected to receive dose in excess of limits to members of the public, interview radiation safety staff to discuss whether a prospective analysis for these workers was performed. If the licensee uses unsealed material (especially volatile materials such as radioiodine) the analysis should also consider internal dose contributions.

03.04 RM-4: Security and Accountability of Licensed Material

The control of material is critical to minimizing radiological risk in well logging operations because well logging sources are often small and unremarkable in appearance and present a significant exposure hazard to unsuspecting members of the public who may encounter them.

In most cases, the amount of licensed material used during well logging operations represents less than a category 2 quantity and is therefore subject only to 10 CFR 39.31 and 39.71 and the general security requirements in 10 CFR 20 Subpart I. It is possible, however, for well logging licensees to aggregate a category 2 quantity of material, in storage at field stations or in transport (refer to RIS 2007-07). If so, the additional security requirements in 10 CFR Part 37 may apply. Refer to IP 87137 for additional guidance on reviewing compliance with Part 37 requirements.

a. Source Storage.

Designated storage areas at authorized locations of use for well logging may take many forms: locked rooms inside field stations, locked sheds outdoors on the premises, or even locked holes or pits inside or outside that use the earth itself to provide additional shielding as well as a robust security barrier. Regardless of the exact configuration, all well logging sources in storage (or in transport) must be kept in a container or package that is locked and physically secured to prevent tampering or removal of sources by unauthorized personnel. [10 CFR 39.31(b)]

- Tour authorized locations of use to confirm that the licensee has secured all licensed material on the premises from unauthorized access and removal. If transport containers are not kept in locked vaults or rooms, confirm that both the source and the container are secured from unauthorized removal.
- Inspect a selection of source storage containers to confirm that they are properly labeled and can prevent tampering or removal of sources.

b. Accountability of Licensed Material.

Since material used in well logging operations is routinely dispatched to and, in the case of tracer materials, consumed at temporary job sites, well logging licensees must carefully account for the material in their possession to provide high confidence that material has not been lost, stolen, or misplaced. This includes a system of records to document material use as well as periodic physical inventories of all licensed material. These inventories must be completed and documented semi-annually, and must include neutron generators containing tritium, unused tracer material, and other smaller licensed sources such as depth and collar markers, uranium sinker bars, and energy compensation sources. [10 CFR 39.37 and 39.39]

- Observe the licensee perform a physical inventory of all or a selection of material in its possession. Confirm that the licensee positively identifies the presence of each source.
 - Sealed logging sources and tracer materials are most appropriately verified through surveys of storage containers and/or confirmation of intact tamper indicators, if any, so as to minimize the potential for exposure and contamination while performing an inventory.
 - Surveys at the surface of locked downhole storage locations may not yield useful confirmation since more than one source may be stored downhole. Before requesting that a licensee open a downhole storage location, however, confirm with the licensee that any sources stored there are in shielded containers before opening. Some licensees have been known to keep downhole sources unshielded on trays or racks rather than in shielded containers or transport packages.
 - Neutron generators containing tritium, energy compensation sources, uranium sinker bars, and other small sources should be verified by visual confirmation.
- Select one or more sealed and/or unsealed sources currently or formerly in the licensee's possession and review its possession history, from receipt, storage, use,

and disposal (if applicable) to confirm that the licensee has fully accounted for this material.

- Utilization logs and physical inventories can also be reviewed to confirm the adequacy and accuracy of the licensee's accounting practices.

03.05 RM-5: Knowledge and Awareness of Hazards

Due to the often-remote nature of well logging operations, personnel in the field have a high degree of responsibility for implementation of the licensee's radiation safety program. They must therefore be knowledgeable of the hazards involved in working with radioactive material and confident in implementing the licensee's operating and emergency procedures

a. Authorized Users.

Authorized users for well logging operations fall into one of two categories: logging supervisors and logging assistants. Supervisors use or oversee the use of licensed material at temporary job sites and are responsible to the licensee for assuring compliance with radiation safety requirements. Assistants directly handle licensed material and/or perform required radiation surveys under the personal supervision of a logging supervisor.

Authorized users may be named on an NRC license, or may be approved by the licensee upon completion of required training. Licensees must thereafter conduct annual inspections of job performance of each logging supervisor, as well as annual radiation safety reviews for all authorized users. For additional guidance on training criteria for logging supervisors and assistants, refer to Appendix F of NUREG-1556 Volume 14. [10 CFR 39.13(d) and 39.61(a), (b), and (c)]

If the licensee is subject to the additional security requirements for radioactive material quantities of concern, authorized users may require additional training.

- Observe or ask for demonstrations of annual job performance inspections or initial field evaluations and interview personnel involved in administering them. These evaluations should be conducted during actual well logging operations if possible and should, at a minimum, cover the topics in the Inspection Checklist provided in Appendix G of NUREG-1556 Volume 14.
 - If deficiencies had been identified through job performance inspections or field evaluations, review these assessments with those involved and subsequent or follow-up assessments to verify that the licensee adequately addressed the deficiency. Consider sampling additional records of job performance inspections to evaluate for trends in performance.
- If the licensee provides initial or refresher safety training to logging supervisors and assistants, and if it occurs during the inspection, consider attending a portion of this training and interview instructors as well as attendees afterwards if time allows. Instructors should understand radiation protection principles beyond those provided in the instruction, should communicate clearly and effectively to attendees, and should provide them with ample opportunity to ask questions. Attendees should be

engaged and attentive and should feel free to raise questions to the instructor when the opportunity arises.

- Review the content of annual safety reviews completed since the last inspection to confirm that the licensee discusses recent and relevant operating experience with authorized users.

b. Other Personnel.

Well logging operations may involve other personnel such as yard or maintenance staff at field stations or rigging crews at job sites who could be subject to radiation exposure from licensed activities in the course of their assigned duties. Although these exposures are likely to be less than that received by well logging supervisors and assistants, they nevertheless may still be a concern because these individuals most likely qualify as members of the public and as such are subject to much more stringent limits on exposure.

- Interview other staff to see if they have any questions or concerns about the presence of radiation hazards and the use of licensed material. Confirm that they are familiar with, or at least aware of radiation safety postings and notices.
- If the licensee provides basic radiation instruction to staff, and if it occurs during the inspection, consider attending a portion of this training and interview instructors as well as attendees afterwards if time allows. Instructors should understand radiation protection principles beyond those provided in the instruction, should communicate clearly and effectively to attendees and should provide them with ample opportunity to ask questions. Attendees should be engaged and attentive and should feel free to raise questions when the opportunity arises.

03.06 RM-6: Management Oversight

a. Licensee Management and Radiation Safety Staff.

All licensees are responsible for developing their own radiation safety programs and are accountable for the actions of all personnel and contractors who implement them. It is therefore essential that licensees maintain strong management control and oversight of these programs to provide reasonable assurance to the NRC of the ongoing protection of the health and safety of workers and the general public, and of sustained compliance with regulatory requirements.

Well logging licensees, like all other specific licensees, must appoint a RSO who agrees to oversee the ongoing implementation the radiation safety program. Senior management should provide this individual with adequate time, resources, and support to fulfill this assignment, and should provide him or her with the authority, organizational freedom, and managerial prerogative to direct personnel as it pertains to the safe and secure use of licensed material, and to terminate any such use that he or she deems unsafe.

The RSO may delegate certain aspects of the radiation safety program to other individuals who may not be approved by the NRC or named on a license. For example, large well logging firms with numerous field stations may appoint Site RSOs to oversee the day-to-day implementation of licensed activities at a given location. Such delegation

may be on a temporary or ongoing basis; in either case, the RSO is still responsible for the oversight provided by these delegates.

- Interview senior managers whose responsibilities include the radiation safety program to discuss their awareness of and involvement in the program. Specific areas of management focus should include significant events, audit findings and other performance issues, the adequacy of resources committed to the program, and open and timely communications with the NRC. Indicators of strong management control and oversight include but are not limited to:
 - An awareness of and commitment to a positive safety culture within the organization
 - The consistent implementation of radiation safety best practices across the organization
 - Robust self-assessment and corrective action mechanisms
- Interview radiation safety staff to discuss their duties, with emphasis on confirming a high level of understanding of radiation protection principles, regulatory requirements, and the scope and status of the program. These staff should feel comfortable and confident with the time resources and support given to them by management to implement the program.

Common Required Communications with the NRC

- Changes requiring a license amendment
- Transferring control of the license
- Voluntary or involuntary bankruptcy
- Discontinuing all licensed activities
- Decommissioning certain facilities
- Reportable incidents
- Manufacturing defects in safety-related equipment
- Responding to select generic communications

b. Audit Activities.

Well logging licensees are responsible for the continuing effectiveness of their radiation safety program, as well as their access authorization and physical security programs if subject to the additional security requirements in 10 CFR Part 37. At a minimum, licensees must review the content and implementation of these programs at least annually. A comprehensive example audit checklist is available in Appendix E to NUREG-1556 Volume 14 to assist licensees in meeting this requirement for radiation safety programs.

Licensees may audit their own programs; however, even a modest measure of independence, such as having a senior manager perform the audit, can greatly enhance the efficacy of these reviews. Some licensees may even hire knowledgeable outside consultants to review their programs.

- Observe or ask for demonstrations of audit activities. Note that some activities may include observations of employee job performance, area surveys, etc. that are congruent with activities discussed in other sections of this procedure.
- Interview radiation safety staff and other personnel (including contractors) involved in audit activities to discuss the overall status of the radiation safety program, and any recent findings they may have identified or been made aware of. Individuals overseeing and auditing the program should be familiar with the scope, status, and

nature of licensed activities, and demonstrate a commitment to proactive and ongoing self-improvement of safe operations, rather than waiting for annual audits or periodic regulatory inspections to identify and/or address issues.

- Review documentation of audits and other program reviews completed since the last inspection. The review should identify and thoroughly describe any conditions that negatively impact the program, the cause of the conditions, and any corrective actions recommended or taken, including those necessary to preclude repetition of the condition. These reviews should also include a reassessment of adverse conditions identified in previous reviews.
- Sample a selection of records and/or tracking mechanisms (if any) relating to the completion of periodic requirements to independently confirm the adequacy of the licensee's audits and the effectiveness of its routine oversight of the program. Some periodic requirements applicable to well logging include, but are not limited to:
 - Well logging equipment inspection and maintenance
 - Sealed source leak tests
 - Survey meter calibrations
 - Annual occupational exposure notifications
 - Annual safety reviews for well logging supervisors and assistants
 - Job performance inspections for well logging supervisors
 - Hazardous materials transportation refresher training

If the inspector identifies a deficiency, such as the non-timely completion of a periodic requirement, the scope of their review for that aspect should always be expanded to determine whether the issue is isolated or has programmatic significance.

87123-04 RESOURCE ESTIMATE

The length of time necessary to complete an inspection using this procedure will vary depending on the kinds and quantities of materials used, the number and location of field stations, and the status of well logging activities at temporary job sites. Large programs may require a full day or more at a main office in order to evaluate program oversight, interview management, and review records. Field stations where material for well logging is stored typically require 2-4 hours of on-site inspection effort. Observing well logging activities often requires a half to full day of effort when travel to remote work locations, site-specific safety training, and standby during intermittent phases of logging operations are included. Additional time may also be necessary to evaluate the licensee's compliance with 10 CFR Part 37 if it aggregates a Category 2 quantity of material at any location.

87123-05 REFERENCES

A listing of IMCs and IPs, applicable to the inspection program for materials licensees, can be found in IMC 2800. These documents are to be used as guidelines for inspectors in determining the inspection requirements for operational and radiological safety aspects of various types of licensee activities.

END

Appendix:
Appendix A: Additional Inspection Elements

Attachment:
Attachment 1: Revision History for IP 87123

Appendix A: Additional Inspection Elements

87123A-01 PURPOSE

The guidance in this Appendix is intended to supplement inspection requirements and associated guidance provided in this procedure. The additional inspection guidance provided herein may be used as time allows or to assist in completing a rounded performance-based inspection.

87123A-02 BACKGROUND

Risk modules are defined as program areas that present higher risk, or expected to effectively reduce risk, to health, safety, and security that are identified in each inspection procedure in order to focus inspection effort on these particular program areas. The risk profile for each licensed program could be different and some programs may need more in-depth review. Therefore, the additional inspection elements included herein may be used to expand the scope inspection effort and/or supplement the risk modules in this procedure.

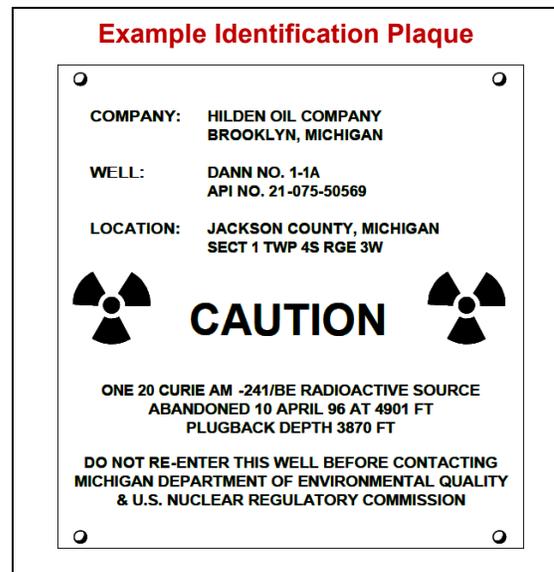
87123A-03 GUIDANCE

03.01 Agreements with Well Owners and Operators

Well logging operations involving one or more sealed sources, neutron generators containing over 30 curies of tritium, or neutron generators used in a well without surface casing can only commence once the licensee has a written agreement with the employing well owner or operator (assuming the well logging is not performed by someone in the same corporate structure as the well owner or operator). The agreement must identify who will meet the requirements in 10 CFR 39.15(a) for retrieving lodged sources, radiation surveys, contamination, and abandonment including placement of a permanent identification plaque at the surface of the well when possible.

This agreement is important to radiation safety because, if implemented as required, it grants the licensee authority to perform a retrieval or formally abandon the source.

- While at the licensee's main office or at field stations, confirm that relevant processes and procedures include execution of a written agreement with employing well owners and operators that contains all required information prior to the commencement of licensed activities involving relevant licensed material at temporary job sites.



- While at job sites where relevant licensed material is used, confirm that a written agreement containing all required information exists between the licensee and the well owner or operator. Note that agreement is not required to be kept at the job site. [10 CFR 39.15]

03.02 Small Sources Used in Well Logging

a. Radioactive Markers

Well logging licensees may use radioactive material as pipe collar, subsidence, or control markers for depth determination or direction orientation in wells. This material usually takes the form of wires, tape, or nails. Licensees are not limited in the number of markers they can use; however, each marker must not exceed the quantities listed in 10 CFR 30.71.

b. Uranium Sinker Bars

Well logging licensees may use depleted uranium for the purposes of providing a small volume mass to pull logging tools towards the bottom of a well. These uranium “sinker bars” may be generally licensed under the terms and conditions of 10 CFR 40.25. They may also be specifically licensed, in which case they must be included in physical inventories and inspection and maintenance programs for well logging equipment and must be appropriately labeled per 10 CFR 39.49.

c. Energy Compensation Sources

Well logging licensees may use small sealed sources containing less than or equal to 100 microcuries of byproduct material as internal reference standards for stabilizing and calibrating well logging tools. These sources are typically exempt from design, performance, and leak testing requirements for well logging sources, as well as requirements for monitoring and abandonment during or after source recovery operations. However, they are not exempt from requirements for physical inventory and records of use, nor are they exempt from other parts of NRC regulations such as 10 CFR 20 and 30.

03.03 Sealed Source Leak Testing

Well logging licensees must periodically test certain non-exempt sealed sources for removable contamination. If any test returns more than 185 becquerels (5 nanocuries) of removable radioactive material, the licensee must immediately remove the source from service, check associated equipment for contamination, and make appropriate notifications to the NRC. [10 CFR 39.35]

Anyone who possesses a sealed source can collect a leak test wipe sample, however licensees must be specifically authorized to analyze them. If the licensee analyzes its own leak tests, refer to Appendix L of NUREG-1556 Volume 14, which describes a Model Leak Test Program that licensees can incorporate into their radiation safety program by reference.

- Observe or ask for demonstrations of leak test collection (and analysis if the licensee is authorized to do so) and interview personnel involved in these activities. Individuals performing leak tests must collect them from the nearest accessible point to the sealed source where contamination might accumulate. Individuals overseeing the tests should understand which sources must be checked and when, as well as what to do if a source is found to be leaking. [10 CFR 39.35(b)]
 - If any leak tests since the last inspection returned readings in excess of 5 nanocuries, confirm that the licensee removed the source from service, decontaminated appropriately, and provided a timely and complete report of this finding to the appropriate NRC Regional Office. [10 CFR 39.35(d)]
 - (1) Perform additional independent surveys to confirm that the licensee decontaminated affected equipment if it was not disposed of.
 - (2) Independently determine the root and contributing causes of the leaking source. Compare this to the licensee's own determination and confirm that its corrective actions satisfactorily address the root and contributing causes.

**Sources Exempt from Part 39
Leak Test Requirements**

Hydrogen-3 (tritium) sources

Sources containing material with a half-life of 30 days or less

Sealed sources containing licensed material in gaseous form

Gamma- or beta-emitting sources with an activity of 100 μ Ci or less

Alpha- or neutron-emitting sources with an activity of 10 μ Ci or less

03.04 Additional Transportation Topics

Sealed sources used in well logging are often transported in packages labeled as Yellow-III; therefore, wireline rigs and other vehicles transporting these packages are required to be placarded, and therefore marked with a USDOT identification number issued by the Federal Motor Carrier Safety Administration. Drivers of placarded vehicles are required to obtain a CDL.

Licensees may opt to test and certify their own USDOT Type A packages for transportation of licensed material. If so, review and discuss the licensee's test procedures with knowledgeable staff and review the licensee's certification documentation for these packages to confirm that the packages used by the licensee are equivalent to those tested and certified. Design requirements for Type A packages can be found in 49 CFR 173.412.

Some well logging sources may require transport in USDOT Type B packages. If so, verify that these packages are used in accordance with a valid Certificate of Compliance (COC) issued by the NRC. Licensees must maintain copies of these COCs to ensure

that it follows any instructions and limitations for the packages when preparing them for shipment.

Licensees must also maintain shipping papers and emergency response information on vehicles transporting licensed material (unless the material represents an excepted quantity or article per 49 CFR 173.421 through 426). Requirements for the content of shipping papers are very specific and can be found in 49 CFR 172 Subpart C. Requirements for retention and accessibility of shipping papers can be found in 49 CFR 177.817. Shipping papers must be within immediate reach of the driver while restrained by his or her seatbelt while driving and must be **readily visible** to a person entering the driver's compartment OR in a holder mounted to the inside of the driver's door. Licensees of all kinds have been known to place shipping papers inside a binder containing other required documents and records (such as those required by 10 CFR 39.75). Even if the shipping papers are first among these documents, if they are inside the binder and the binder is not opened to that page during transport, they are not readily visible to a person entering the driver's compartment. If the binder has a cover sleeve, however, licensees can consider placing the shipping paper in the sleeve so that it can be made readily visible on the outside of the binder, so long as the cover of the binder is not otherwise obstructed by an armrest, seat cushion, or other documents.

03.05 Receipt and Transfer of Licensed Material

Well logging licensees often receive material via common carrier. Drivers for common carriers have been known to leave licensed material in unsecured areas, deliver licensed material to anyone willing to sign without regard to whether they are appropriately trained or authorized to handle the material, and even to deliver empty, damaged packages no longer containing their radioactive contents.

If the licensee does regularly receive material via common carrier, consider discussing with the licensee its methods and measures for receipt of this material to confirm that the licensee properly secures receiving areas or otherwise maintains control material upon receipt from the carrier. Individuals who receive these packages and/or maintain control of them until picked up by well logging and/or radiation safety personnel should be aware of the potential hazards associated with handling these packages (namely, radiation exposure levels as indicated by labels and potential for contamination), the basic methods of mitigating these hazards, and should understand that these packages cannot be left unsecured. Shipments of category 2 quantities of material, though unlikely in well logging, must be received by an individual deemed trustworthy and reliable and approved for unescorted access by the licensee.

Within three hours of receipt of any labeled (White-I, Yellow-II, Yellow-III) package containing a Type A quantity of radioactive material (most well logging sources contain at least a Type A quantity), licensed must monitor the external surfaces for radiation levels and, if it does not contain material in special form (i.e., a sealed source), for removable radioactive contamination. Acceptable radiation limits for a given label can be found in 49 CFR 172.403. Contamination limits can be found in 49 CFR 173.443 (note the use of wipe efficiency when relating the values in the table to the values used by the licensee).

If licensees regularly ship or transfer licensed material to other entities, consider reviewing its measures and methods of preparing packages for shipment, with emphasis on appropriate packaging and labeling, surveys to confirm that radiation and

contamination levels of outgoing packages are within USDOT limits, and on verifying that each recipient is authorized to receive the types and quantities of materials shipped to them.

03.06 Radioactive Waste Handling

Well logging licensees who use tracer material typically generate small quantities of waste in the form of unused material and contaminated protective equipment such as chucks and gloves. Tracer material typically contains isotopes with half-lives of less than 120 days, and therefore licensees authorized to use this material should have a standard condition on their license allowing for its disposal via decay-in-storage. Regardless, licensees should have a dedicated area for the safe and secure storage of waste and other disused licensed material. Refer to Appendix N of NUREG-1446 Volume 14 which describes Model Waste Management Procedures that licensees can incorporate into their radiation safety program by reference.

- Tour the licensee's waste storage area to verify that the area is adequately posted and secured, and that waste is protected from other hazards. If any of the waste is volatile, it should be sealed, and the area well-ventilated. The licensee may need to perform additional air monitoring to demonstrate compliance with air effluent limits.
- Confirm that licensee personnel survey waste held for decay-in-storage and removes or obliterates labels prior to disposing of it in ordinary trash. These personnel should know that the waste can only be disposed in this manner if radiation levels at the surface of each waste container are indistinguishable from background
- Interview staff involved in well logging operations to determine if the licensee disposes of waste via any other methods, such as disposal of liquid waste via sanitary sewerage. If so, have the licensee's radiation safety staff demonstrate that these disposals complied with effluent limits and other regulatory requirements.

Since sealed well logging sources typically contain long-lived isotopes such as Cs-137 and Am-241, licensees do not dispose of them frequently. When they do, it should always be by transfer to an authorized recipient such as a source manufacturer, service provider, or licensed disposal facility.

Some well logging licensees have been known to send older or outdated sealed sources to be combined for higher yield and/or re-encapsulated to fit new logging tools, while others have been known to send larger sources to be split into multiple smaller ones. If the inspector encounters such a scenario, pay close attention to whether the new source or sources comply with the licensee's current possession limits, notably the authorized source models, number of sources and activity per source.

03.07 Postings and Notices

Well logging licensees must communicate radiological hazards to employees with appropriate caution signage in facilities and, if necessary, at temporary job sites. Such postings are required for any area that meets the definition of radiation area, high radiation area, etc., and includes areas where certain quantities of material are stored. Exceptions to these requirements applicable to well logging may include areas where sources are present for short periods of time as well as storage areas for sealed sources with low exposure rates. [10 CFR 20.1902 and 20.1903]

Well logging licensees must also post or make available current copies of 10 CFR 19 and 20, the NRC license, operating and emergency procedures, notices of violation and other enforcement actions involving radiological working conditions and must prominently post current versions of NRC Form 3, "Notice to Employees."

- Tour the licensee's facility and confirm that the appropriate caution signs are conspicuously posted at or near access points to radiation areas and other areas containing licensed materials. Required signage should be durable and legible, using the correct colors and symbols.
- Perform independent surveys in the vicinity of source storage locations, in occupied areas of a facility, and in any publicly accessible locations to confirm that the licensee has adequately posted any area where signage appears to be required.
- Tour the licensee's facility and confirm that the required documents and notices are posted conspicuously in enough places to permit individuals engaged in licensed activities to observe them on the way to or from any licensed activity location to which the posting would apply. Confirm that the licensee has posted the latest version of each document.

Quantities Requiring Posting for Common Well Logging Isotopes

H-3	10 mCi
Sc-46	100 µCi
Co-57	1 mCi
Co-60	10 µCi
Br-82	1 mCi
Sb-124	100 µCi
I-131	10 µCi
Cs-137	100 µCi
Ir-192	10 µCi
Ra-226	1 µCi
Th-232	1 mCi
U-238	1 mCi
Am-241	10 nCi
Cf-252	10 nCi

03.08 Fire Protection

Materials licensees are not required by NRC regulations to implement a fire protection program. However, in many cases, the risk posed to radiological safety by fires is comparable to or exceeds the risk from other events involving licensed activities. Determine if licensees have a plan in place for preventing fires and combating fires that might occur. Any perceived problems/deficiencies (i.e., improper storage of combustible or flammable material, fire extinguishers out of service, lack of fire alarm or detection system, lack of fire suppression system) noted by the inspector should be brought to the licensee's attention and discussed with regional management. Proper fire protection systems can be evidenced by the licensee's involvement with the local fire department.

END

Attachment 1: Revision History for IP 87123

Commitment Tracking Number	Accession Number Issue Date Change Notice	Description of Change	Description of Training Required and Completion Date	Comment Resolution and Closed Feedback Form Accession Number (Pre-Decisional, Non-Public Information)
N/A	ML030300666 12/31/02 CN 02-047	First Issuance - IP 87123 (Well Logging Programs) is issued to assess a licensee's radiation safety program for well logging activities authorized under 10 CFR Part 39 and to replace IP 87113.	No special training requirements were identified	
N/A	ML033370337 11/25/03 CN 03-037	Revision 1, change was made in Section 03.02 to advise inspectors to physically examine a representative sample of source handling tools to determine their condition and their ability to adequately secure a source during transfer to and from its source storage container and to examine source storage containers to ensure that they are in good condition and that design safety features function as intended.	No special training requirements were identified	N/A
N/A	ML19074A272 07/02/19 CN 19-021	Revision 2 - revisions to Inspection Procedure (IP) 87123, "Well Logging Programs," to ensure inspectors assess the potential for licensees to aggregate materials as part of routine inspections.	No special training requirements were identified	ML19074A277
N/A	ML22062B654 04/26/22 CN 22-008	Revised in its entirety. Specific changes include: (1) divided inspection guidance into risk-modules; (2) included inspectors' observations; (3) updated inspection guidance; (4) added an estimated level of effort to complete an inspection; and (5) developed new appendix titled "Additional inspection elements."	No special training requirements were identified	ML22062B653