TEMPORARY INSTRUCTION 2800/043

INSPECTION OF FACILITIES POTENTIALLY CONTAMINATED WITH DISCRETE RADIUM-226 SOURCES

2800/043-01 PURPOSE

This Temporary Instruction (TI) applies to sites identified by the Office of Nuclear Material Safety and Safeguards (NMSS) in non-Agreement States, where byproduct material (specifically, discrete sources of radium-226) was historically used, or suspected to be used for commercial, medical, or research activities, and the site was not cleaned up (or records of clean-up are not available).

2800/043-02 OBJECTIVE

The Energy Policy Act of 2005 (EPAct) amended section 11e.(3) of the Atomic Energy Act of 1954, as amended (AEA), to place discrete sources of radium-226 (Ra-226) under U.S. Nuclear Regulatory Commission (NRC) regulatory authority as byproduct material. The objective of this TI is to evaluate former manufacturing and other facilities, operational from as far back as the late 1800s, to determine, via an initial site visit and typically a scoping survey, if Ra-226 sources are present at concentrations that could reasonably result in a radiological dose greater than the dose criterion in 10 Code of Federal Regulations (CFR) Part 20, Standards for Protection Against Radiation, Section 20.1402.

2800/043-03 BACKGROUND

The EPAct expanded the definition of byproduct material to include certain discrete sources of radium-226, other discrete sources of naturally-occurring radioactive material, and certain accelerator-produced radioactive material under NRC jurisdiction (collectively, these materials are referred to as Naturally-occurring or Accelerator-produced Radioactive Material (NARM)). The NRC's Agreement States and certain non-Agreement States may have had regulatory programs for NARM prior to the implementation of the Energy Policy Act of 2005.

Specifically, Section 651(e)(3)(A) of the EPAct (§11e.(3) of the AEA; 42 U.S.C. 2014(e)) amended the definition of byproduct material to include "any discrete source of radium-226 that is produced, extracted, or converted after extraction, before, on, or after [August 8, 2005] for use for a commercial, medical, or research activity." On November 30, 2007, the NRC implemented this provision of the EPAct by amending the definition of byproduct material in 10 CFR Parts 20, 30, 50, 72, 150, 170, and 171 to be consistent with the EPAct in the final rule "Requirements for Expanded Definition of Byproduct Material" (72 FR 55864; October 1, 2007) (NARM rule). Additionally, the NRC established a definition for the term "discrete source" to be used for the

purposes of the new definition of byproduct material as this term was not specifically defined by the EPAct. Accordingly, the NRC regulations in 10 CFR Parts 20, 30, 110, and 150 define a discrete source as "a radionuclide that has been processed so that its concentration within a material has been purposely increased for use for commercial, medical, or research activities." Id., at 55870. The Statements of Consideration (SOC) for the NARM rule noted that "once a discrete source meets the definition of byproduct material, any contamination resulting from the use of such discrete sources of this byproduct material will also be considered byproduct material and is not low-level waste." Id., at 55871.

The NRC staff initiated an effort through its contractor, Oak Ridge National Laboratory (ORNL), to identify non-military sites with potential radium contamination, concentrating on sites in non-Agreement States. The ORNL staff began this effort by identifying manufacturers of radium containing consumer products. The purpose of focusing on manufacturers of radium containing consumer products was to identify sites that likely handled large amounts of radium as unsealed materials. The result of the ORNL effort (Agencywide Document Access and Management System Accession No. ML16287A522) is a list of sites that may have potentially possessed discrete sources of Ra-226 along with summaries of available information regarding these sites. The ORNL effort did not verify whether radium contamination exists at these sites. The scope of this TI is limited to these non-military sites located in non-Agreement States and Federally-owned sites in Agreement States. The scope of the TI is also limited to providing guidance for planning, conducting, and reporting on surveys of selected commercial, medical, or research sites, potentially contaminated with radium. Some supporting activities such as outreach to states, resolving policy issues related to site cleanup, requesting site information from the states, letters to and initial phone calls with the property owners requesting site access, conducting initial dose assessments, and determining future actions are separate activities not within the scope of this TI.

The survey described in this TI is typically performed in two steps: an initial site visit and the scoping survey. For the initial site visit, one goal is to determine whether there are any current health and safety concerns. Therefore, NRC staff will use an action level related to a dose of 100 mrem/yr (the NRC public dose limit of 10 CFR 20.1301) to verify there are no meter readings above the screening threshold for occupancy. This will allow NRC staff to assess whether there is a current public health and safety concern at a site. See also Section 04.02.d and Figure 1 for additional information on this action level and the associated actions. The goal of the follow-up scoping survey is to determine whether or not remediation will be necessary to meet NRC's dose limit for license termination for unrestricted use in 10 CFR 20.1402 (i.e., 25 mrem/yr), so action levels for the scoping survey are based on a dose of 25 mrem/yr.

2800/043-04 INSPECTION REQUIREMENTS AND GUIDANCE

04.01 Survey Planning and Agreements.

a. The site summaries from the ORNL site identification effort are the starting point for understanding the publicly available information about each site. The inspector will review the site summary documents, information received from the State related to the site, and other pertinent information prior to the development of the initial site visit/scoping survey plan to identify the likely locations where discrete sources of

Ra-226 were manufactured, stored, etc.; and, therefore, to indicate the highest potential for locating residual contamination. Survey planning requires an understanding of potentially impacted media (e.g., building surfaces, soils, etc.), boundary conditions (physical, temporal, and practical boundaries of the area being evaluated), site scale, potential interferences (e.g., sources may be covered or buried), and other factors that should be considered during the planning phase of the survey.

b. Prior to performing the initial site visit, the inspector should determine the institutional memory of site operations by interviewing key personnel with knowledge of former operations, e.g., current site owners or other knowledgeable individuals. These inquiries can be made by telephone or written correspondence. A historical records review at local libraries, historical societies, and museums, as well as Chamber of Commerce reports and business guides from the time period should be considered. Coordinate data sharing opportunities so that both the NRC and the state have as complete a file as practicable for each property.

c. Data sharing opportunities will be initiated by the region and shall be coordinated with NMSS, as appropriate, so that all (need-to-know) parties have as complete a file as practicable for each property.

d. In an effort to have complete files, the regional staff shall obtain copies of documentation for the docket file, whenever possible. Documentation on any previous clean-up effort shall be obtained, if available, from the site, or through state record archives. If official (i.e., State or other government agency) documents are not available, then verbal confirmation may be considered to augment other documents to close out specific concerns about radium-226 sources. A record of such conversations shall be placed in the docket file.

e. It is the regional management's role, in consultation with NMSS, to plan outreach discussions with the appropriate radiological control program staff within the state. Site information provided by the State will be used to decide if a site visit and scoping survey is necessary.

f. For sites in non-Agreement States, it is the responsibility of the regional assigned staff to coordinate all site visits with the appropriate radiological control program staff within the state. NMSS should be informed periodically of the status of site visits.

g. An informal access agreement between the NRC and the property owners detailing restrictions (e.g., time windows, access limitations, etc.) and primary points of contact, will be initiated by the regional management. If a site owner refuses access, the inspector and/or project manager shall discuss next steps to gain access with NRC management and Office of the General Counsel staff to determine a path forward. The inspector and/or project manager shall document the site owner's refusal in the docket file.

h. After an access agreement has been obtained, the inspector, in consultation with the NMSS and regional management, shall arrange mutually agreeable initial site visit and scoping survey times with property owners to ensure that knowledgeable individuals at

the site will be available for interview and inspection of the site. Non-Agreement States personnel should be invited to accompany the inspector on any initial site visits and scoping surveys. It shall be clearly communicated that accompanying State personnel are responsible for their own health and safety (see also Appendix A, Section 4.0).

i. Before, during, and after the initial site visit and scoping survey, the inspector will be in contact with the site owner about the project. The inspectors should use these interactions as opportunities to answer questions or address concerns the site owner has. Before leaving the site from the initial site visit and the scoping survey, the inspector will communicate to the site owner the general results of the visit, as available, and approximately when NRC anticipates being able to provide additional information.

04.02 Initial Site Visit.

a. The inspector and/or project manager will conduct an initial site visit before performing the scoping survey. The top half of Figure 1 presents high-level decision logic for the site visit. The purpose of the site visit is two-fold:

1. The initial site visit will be used to identify the locations with the highest potential for contamination; and therefore, should be surveyed and sampled during the scoping survey. This information will then be used to refine the scoping survey plan.

2. The initial site visit will be used to determine if there are any current health and safety concerns to current property occupants or the scoping survey team. The focus will be on areas where occupants spend time.

b. Inspectors shall document during the initial site visit, based on observation or from the property owner when available: 1) where occupants spend time; and 2) what type of activities take place in the area. This information will be used to better assess potential doses from Ra-226, if identified. Appendix B presents a checklist template for the initial site visit (and scoping survey) to help ensure that the gathered information is sufficient to plan future activities.

c. For the initial site visit, measurements shall consist primarily of gamma dose rate (or exposure rate) measurements at approximately one meter from the floor as an indication of dose rates to which occupants may be exposed. Representative background radiation levels should be determined in a nearby reference area that closely approximates the area to be surveyed. Per the site-specific plan, inspectors should also take limited smear samples in locations based on their professional judgment (e.g., in areas of elevated gamma dose rate) to provide an indicator of dispersible activity.

d. Inspectors shall complete NRC Form 303, “Request for Analysis and Chain of Custody” or an equivalent chain of custody document. Inspectors should make advance arrangements for shipping of samples and shall use a shipping method that maintains chain of custody.

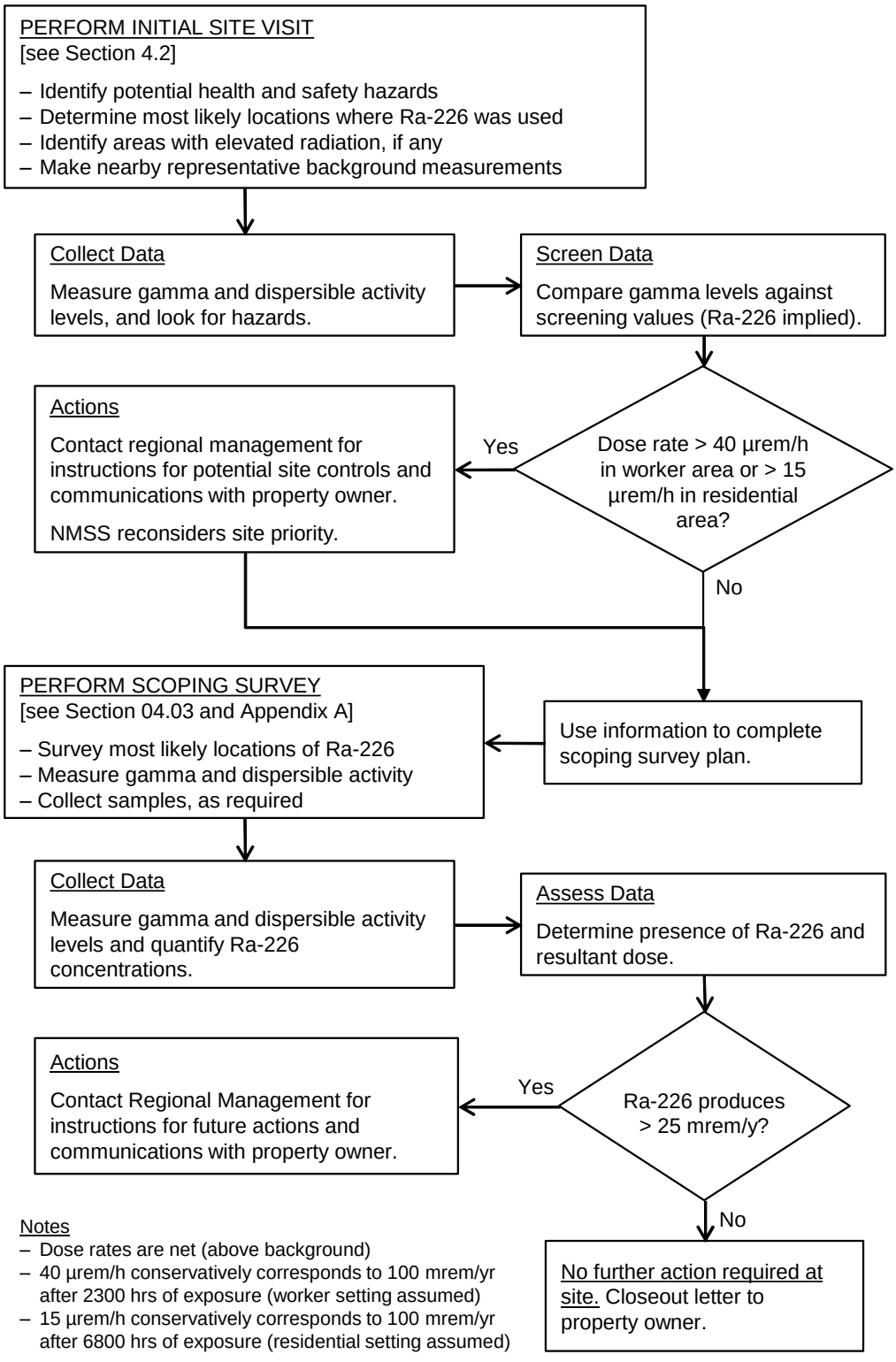

Figure 1. Typical Process for Site Visit and Scoping Survey

e. For the initial site visit only, two Action Levels (ALs) based on current site use will be used to identify radiation levels that could conservatively produce a dose of 100 mrem/yr per the public dose limit in 10 CFR Section 20.1301. The first AL of 15 µrem/hr (above background) correlates to 100 mrem/yr conservatively assuming a residential receptor spends up to 6800 hr/yr in close proximity to the source. This screen will be applied to areas that are clearly residential. The second AL of 40 µrem/hr (above background) correlates to 100 mrem/yr conservatively assuming a worker (or non-residential receptor) spends up to 2300 hr/yr in close proximity to the source. This screen will be applied to areas that are not clearly residential. Dose rate measurements above these ALs, applied to the appropriate setting, will prompt the inspector/project manager to contact NMSS and regional management for further instruction. If dose rates above the ALs are found, access controls should be discussed with the site owner. The inspector/project manager and management shall also refer to Inspection Manual Chapters (IMCs) 1301 and 1302 for information on potential site controls and other actions that may be taken. The implementation of these controls will be the responsibility of the site owner. NMSS will also use this information to reconsider the site's priority. Note that for the initial site visit, it is presumed that elevated gamma radiation levels are due to Ra-226 – confirmation will be made during the scoping survey.

f. It is expected that for most sites both an initial site visit and a scoping survey will be performed. However, under limited circumstances, which will be assessed on a site-by-site basis, a scoping survey may not be needed. After the initial site visit is complete, the inspector will prepare a summary of the initial site visit. Based on this report, the inspector and project manager will evaluate the need for performing a scoping survey and make a recommendation to NMSS and regional management. A preliminary dose assessment may be performed (see also Section 04.04), as appropriate, to further inform management's decision on the need to perform the scoping survey. Other considerations for this decision could include, but are not limited to: the suspected or known historic uses of radium on the site; additional information obtained during the visit regarding locations where radium was historically used; and the feasibility of obtaining additional data to demonstrate the presence or absence of radium on the site.

04.03 Scoping Survey.

a. After the initial site visit is complete, the inspector will finalize a scoping survey plan considering the template presented in Appendix A. The bottom half of Figure 1 presents high-level decision logic that inspectors will use during the scoping survey. In general, no surveys or sampling requiring destruction of property should be planned. If destruction of property is necessary to obtain critical measurements, the inspector shall consult with regional management for guidance. The completed site visit checklist, annotated maps, and other relevant information will be used as inputs to the plan. A goal of the scoping survey is that sufficient data will be obtained so that the NRC management can make a no-further-action determination (i.e., there is no Ra-226 resulting in dose greater than 25 mrem/yr), or to plan future actions (e.g., establish controls, perform additional site characterization, or clean-up).

b. The inspector will conduct the scoping survey to locate, delineate and quantify radiation levels and Ra-226 concentrations. For the scoping survey, measurements shall consist

of gamma dose rate (or exposure rate), surface contamination concentrations, removable surface contamination concentrations (swipes), and samples of soil or other media, as appropriate. Inaccessible areas will not be surveyed unless there is a clear indication that the inaccessible area may have levels of contamination critical to the NRC's decision. In such cases, the path forward will be discussed with regional management. Data collected during the scoping survey will be used to estimate the site-specific dose for comparison to the 25 mrem/yr limit in 10 CFR 20.1402. If Ra-226 is identified and confirmed via either field screening or laboratory spectroscopic analysis, then the inspector will promptly notify regional management for instructions on plans to proceed.

NOTE: If Ra-226 is identified, the inspector will contact their management, before leaving the site, to discuss the need for barriers, postings, and/ or administrative controls necessary to address any health and safety concerns.

c. Guidance on personal protective equipment (PPE) requirements for the survey is provided in Appendix A, Section 4.0, of this TI.

d. Appendix B presents a template for a scoping survey (and site visit) checklist to help ensure that the gathered information is sufficient to determine if further action is needed by the site owner.

e. The inspector will complete the inspection report, considering the Appendix C template, and make recommendations to the NMSS or regional management for either no-further-action or remedial action.

04.04 Dose Assessment.

a. If Ra-226 is identified, doses will typically be calculated after completing the scoping survey and the receipt of all laboratory analytical data (see Section 04.02.e for further details). The dose assessment is intended to determine whether Ra-226 is present at concentrations that could reasonably result in a radiological dose greater than the 25 mrem/yr dose criterion in 10 CFR Part 20, Standards for Protection Against Radiation, Section 20.1402.

b. The inspector shall obtain enough data (e.g., surveys and samples) as well as physical descriptions of contaminated areas, consistent with the site-specific scoping survey plan, in order for the NRC to perform a dose assessment. The site-specific dose analysis will be performed to assess whether or not current and plausible future exposures to Ra-226 exceed the criterion.

2800/043-05 REPORTING REQUIREMENTS

05.01 Reports to Site Owner. A letter summarizing the site visit and scoping surveys results, as applicable, will be submitted to the site owner and state.

05.02 Reports to NMSS. Regions should document results of the initial site visit and provide the report to the NMSS project manager. Regions should document results of the scoping

survey, including the type of information described in the example site status report provided in Appendix C, and provide the report to the NMSS project manager. Site status reports shall be forwarded to the contact listed in the site-specific scoping survey plan (see Appendix A, Section 3). Documentation demonstrating whether or not the site satisfies 10 CFR Part 20 Section 20.1402 shall be placed in the docket file for that site and sent to the NMSS contact.

05.03 NMSS Tracking of Site Status. NMSS/MDB will track each site referred to the region.

2800/043-06 COMPLETION SCHEDULE

The expected completion schedule for this TI is December 2019.

2800/043-07 EXPIRATION

This TI remains in effect until December 2019.

2800/043-08 CONTACT

Questions regarding this TI should be addressed to Robert Nelson, NMSS/MDB, at (301) 415-0707.

2800/043-09 RESOURCE ESTIMATE

The estimated on-site inspection time necessary to perform the initial site visit is 0.5–1 day (excluding travel). The time for a scoping survey is estimated to be 1–4 days per site (excluding travel), depending on the size and complexity of the property. Currently there are 29 known sites but the number of sites is an approximation and may change.

2800/043-10 TRAINING

Inspections conducted under this TI will be performed by staff qualified to perform decommissioning inspections under Inspection Procedure (IP) 87104. No additional training is required.

END

Appendices:
A. Sample Scoping Survey Plan
B. Site Visit and Scoping Survey Checklist
C. Example Site Status Report

APPENDIX A[1]

SAMPLE SCOPING SURVEY PLAN

Property: Historical Name
Address
City, State, Zip Code

Docket Number:

Current Property Name(s): (as applicable)

Current Property Owner(s): (as applicable)

Inspection Dates: Month, Day, Year

Inspector(s): Name(s) and affiliation(s)

1.0 INTRODUCTION

The Energy Policy Act of 2005 amended section 11e.(3) of the Atomic Energy Act of 1954, as amended (AEA), to place discrete sources of radium-226 (Ra-226) under U.S. Nuclear Regulatory Commission (NRC) regulatory authority as byproduct material. The NRC is evaluating [SITE NAME], a potentially contaminated facility, operational from [DATES], to determine via a scoping survey if discrete sources of Ra-226 or distributed contamination from the manufacturing or use of such sources are present at concentrations that could reasonably result in a radiological dose above 25 mrem/yr to a current or plausible future receptor, per 10 Code of Federal Regulations (CFR) Part 20, Standards for Protection Against Radiation, Section 20.1402.

Data from this scoping survey will be used either to eliminate the property from future NRC consideration (i.e., when no sources are identified that cause a radiation exposure to any member of the public that exceeds the 25 mrem/yr limit) or to plan future actions and minimize exposure of current or plausible future receptors to source materials.

2.0 PROPERTY DESCRIPTION AND CONCEPTUAL MODEL

The attached site summary report (ORNL [YEAR]) provides known site details about the type, form, history, potential locations and other information related to manufacture or use of discrete sources of Ra-226. The property is [BRIEF PHYSICAL DESCRIPTION OF CURRENT CONDITIONS]. Based on the site history and the property's current configuration, discrete sources of Ra-226 were most likely to be located or used during prior operations [WHERE] in [MEDIUM]. [ADDITIONAL DETAIL ADDED TO DESCRIBE THE CONCEPTUAL MODEL]

[1] Appendix A, Sample Scoping Survey Plan, will be completed by inspectors with input from NMSS staff prior to inspectors performing the Scoping Survey.

3.0 DATA QUALITY OBJECTIVES

The Data Quality Objectives (DQOs) described herein are consistent with the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) (NUREG-1575, 2000) and provide a formalized method for planning radiation surveys, improving survey efficiency and effectiveness, and ensuring that the type, quality, and quantity of data collected are adequate for the intended decision applications. The seven steps in the DQO process are outlined below.

1. State the problem
2. Identify the decision
3. Identify inputs to the decision
4. Define the study boundaries
5. Develop a decision rule
6. Specify limits on decision errors
7. Optimize the design for obtaining data

3.1 Step 1 – State the Problem.

The first step in the DQO process defines the problem that necessitates the study; identifies the planning team; and examines the budget and schedule. The Energy Policy Act of 2005 amended section 11e.(3) of the Atomic Energy Act of 1954, as amended, to place discrete sources of Ra-226 under U.S. Nuclear Regulatory Commission (NRC) regulatory authority as byproduct material. The NRC is evaluating former manufacturing facilities and other identified locations where Ra-226 was historically used or stored to determine if residual Ra-226 sources are present and at concentrations above 10 CFR 20.1402 requirements. Based on this background, the problem statement is as follows:

> Scoping surveys are required to locate the extent of Ra-226 contamination and its boundary, and assess the quantity of Ra-226, if present, to determine the radiological dose from exposure to Ra-226.

a. Project Organization and Responsibilities. Table A-1 presents the project organization across programs and departments, including key personnel, roles, and contact information.

   The inspector will coordinate with NMSS and the property owner to gain site access. Regional management will coordinate with the property owner for access agreements and scheduling. The inspector will coordinate with the NMSS project manager for site coordination, state coordination, outreach, and internal NRC coordination.

Table A-1. Key Personnel Contact Information				
Name	Organization	Role	Phone	E-mail
Branch Chief	NRC	Branch Chief	TBD	TBD
Inspector	TBD	Inspector	TBD	TBD
Project Manager	TBD	Project Manager	TBD	TBD
Property Owner	TBD	Property Owner	TBD	TBD
Other	TBD	Other (describe)	TBD	TBD

b. Project Budget and Schedule. The project is funded by the NRC and the scoping survey is tentatively scheduled for the month of [MONTH AND YEAR]. Fieldwork is anticipated to last [NUMBER] days and reporting should be completed [NUMBER] weeks after sample results, should sampling be required, are reported by the analytical laboratory.

3.2 Step 2 – Identify the Decision.

The second step in the DQO process identifies the Principal Study Question (PSQ) and Alternate Actions (AAs); develops a decision statement; and organizes multiple decisions, as appropriate. This is done by specifying AAs that could result from a "yes" response to the PSQ and combining the PSQ and AAs into a decision statement. Table A-2 presents the PSQs and AAs combined into a decision statement.

Table A-2. Ra-226 TI PSQs, AAs and Decision Statement	
Principal Study Question	Alternative Actions
PSQ1: Has the scoping survey identified Ra-226?	No: The data will be used to support the conclusion that the NRC does not have jurisdiction over the property. Yes: Proceed to PSQ2
PSQ2: If identified, could exposure to the Ra-226 clearly and reasonably produce a radiological dose above 25 mrem/yr to current or reasonably foreseeable receptors, based on a screening-level (non-site-specific) dose assessment?	No: If clearly no, the data will be used to support the conclusion that the NRC does not require remedial action. Unclear: Proceed to PSQ3 Yes: If clearly yes, the data will be used to plan future actions to control and mitigate risks from exposure to the source.
PSQ3: If identified, could exposure to the Ra-226 result in a radiological dose above 25 mrem/yr to current or reasonably foreseeable receptors, based on a site-specific dose assessment?	No: The data will be used to support the conclusion that the NRC does not require remedial action. Yes: The data will be used to plan future actions to control and mitigate risks from exposure to the source.
Decision Statement	
Ra-226 is (or is not) present and could (or could not) reasonably produce radiation doses above 25 mrem/yr, and the NRC does (or does not) require remedial action at the property.	

3.3 Step 3 – Identify Inputs to the Decision.

The third step in the DQO process identifies both the information needed and the sources for this information; determines the basis for action levels; and identifies sampling and analytical methods that will meet data requirements. For this effort, information inputs include the following:

- Energy Policy Act of 2005 amended section 11e.(3) of the Atomic Energy Act of 1954, as amended;
- 10 CFR Part 20, Standards for Protection Against Radiation, Sections 20.1402 and 1301;
- Site summary documentation (ORNL [YEAR]) and information gathered during the initial site visit;
- Site access agreements and associated limitations, if any;
- NUREG-1507 for estimating detector-specific Minimum Detectable Concentrations (MDCs);
- Applicable field instrumentation and survey procedures, method procedures, data/sample management procedures, and survey results;
- Applicable analytical laboratory procedures, method procedures, data/sample management procedures, and analytical results; and
- Dose modeling software (e.g., the RESRAD family of codes), data inputs, and dose consequence outputs.

3.4 Step 4 – Define the Study Boundaries.

The fourth step in the DQO process defines target populations and spatial boundaries; determines the timeframe for collecting data and making decisions; addresses practical constraints; and determines the smallest subpopulations, area, volume, and time for which separate decisions must be made.

Boundary conditions include physical, temporal, and practical factors that may limit an inspector's access to the property. More specifically:

- Physical boundary: Subject properties vary in physical size from very small (e.g., an abandoned shed) to very large (e.g., multiple large-scale manufacturing buildings). Tools such as photos and GPS coordinates should be considered to help define the boundaries.
  - ORNL [YEAR] may be used to better define physical boundary conditions and high-priority target areas.

- Temporal boundary: Inspectors may have limited time to survey all accessible portions of the property and access may only be available during small windows of time.

- Practical boundary: Inspectors may have limited property access, based on either the access agreement or the inspector's general health and safety.

To address these boundary conditions, the scoping plan must be based on judgmental sampling (rather than statistical sampling) to target accessible locations with the highest potential for containing Ra-226 contamination. In general, the inspector will collect as much data as possible from accessible areas with the highest potential of containing Ra-226 sources, in the time allotted to perform the scoping survey. Inaccessible areas will not be surveyed unless there is a clear indication that the inaccessible areas may have levels of contamination critical to the NRC's decision. In such cases, the path forward will be discussed with regional management.

Decisions may be made based on any single confirmed discrete source (the smallest subpopulation) that could produce a radiological dose of 25 mrem/yr, assuming a plausible current-use scenario. If suspected Ra-226 is encountered, the inspector should spend enough time to gather data from the area to delineate and quantify contamination levels [ADDITIONAL DETAILS ADDED TO PROVIDE FIELD GUIDANCE ON APPROPRIATE TIME/EFFORT]. These data will support the dose analysis and programmatic decisions.

3.5 Step 5 – Develop a Decision Rule.

The fifth step in the DQO process specifies appropriate population parameters (e.g., mean, median); confirms ALs are above detection limits; and develops an "if…then…" decision rule statement. The objective of the scoping survey is to locate discrete sources of Ra-226 and, if located, determine if the sources (either individually or in combination) could result in an unacceptable dose based on current or reasonably expected future use. Inspectors are required, via implementation of this plan, to collect the data that will be used to locate and delineate Ra-226 contamination. This data will then be used to calculate the site-specific dose for comparison to the 25 mrem/yr limit. Specific ALs, therefore, are thresholds that will be used to prompt more extensive data collection in a particular area:

1. Positive identification, by visual inspection or other means, of discrete sources of Ra-226.

2. For dose rate measurements near any identified source or any medium (e.g., soil, piping, an unsealed instrument dial), a result that is clearly above ambient background, determined using the inspector's professional judgment.

3. For direct measurements on any medium at any location within the facility, based on detectable concentrations as described in NUREG-1507:
   - [VALUE] gross counts per minute (cpm) corresponding to a concentration of [VALUE] pCi/g above background in soil or bulk materials, or
   - [VALUE] dpm/100 cm^2 on facility structures/surfaces.

4. Surface contamination (e.g., building media), confirmed removable Ra-226 activity [VALUE] dpm/100 cm^2 as an indication of dispersible, potential airborne, contamination.

In all these cases it is presumed that the resulting dose, to a current or potential future receptor, could reasonably exceed 25 mrem/yr. A site-specific dose analysis may result from the confirmation of any of these four items.

For Item 2, dose rate measurements will be made using a sodium-iodide, tissue-equivalent scintillator that is calibrated for the measurement of Ra-226, or a comparable detector which produces stable dose rate measurements at typical ambient environmental levels. The inspector will use professional judgment to identify localized dose rates that are clearly above ambient levels and suggest the presence of Ra-226. Elevated dose rate measurements will generally not be sufficient to conclude no further action will be needed. Thus, elevated results will prompt the inspector to collect additional data/information in the area.

For Item 3, inspectors will use the methods described in NUREG-1507 to estimate the MDC for hand-held instruments. MDCs may be calculated using the NUREG-1507 methods considering a variety of alpha, beta, and gamma radiation detectors and potentially contaminated media. A detector response above the corresponding MDC will prompt the inspector to collect additional data/information in the immediate area.

For Item 4, smears will be collected and measured for gross alpha or beta activity to quantify the removable fraction, or more specifically, to determine if removable Ra-226 is present. Smears may be counted in the analytical laboratory to confirm the presence of Ra-226. Direct measurements will also be performed using a combination gas proportional detector (or functional equivalent). Both alpha and alpha-plus-beta measurements should be collected to optimize detection potential. Ra-226 and some associated decay products are alpha emitters. The alpha radiation may be easily attenuated by thin layers of duct, clean paint, moisture, etc. The beta emissions from other progeny will often provide a more accurate quantification of the total surface activity levels. Smear and direct measurement (totals) data may be used to support dose calculations, as required.

All quantitative ALs are measurements in excess of background for confirmed Ra-226 contamination. Inspectors may use in situ or volumetric sampling, as required, to confirm that radiation emanating from the source is due to Ra-226.

3.6 Step 6 – Specify Limits on Decision Errors.

The sixth step in the DQO process specifies the decision maker's limits on decision errors, which are then used to establish performance goals for the survey. The nature of this project, and boundary conditions typical for scoping surveys, do not support robust decision error as may be developed for a statistical (rather than judgmental) survey design. Statistical-based methods are routinely applied to characterization or final-status efforts and not scoping, which are typically smaller scaled and rely on judgmental (rather that statistical) data. Additionally, the identification of only one discrete source of Ra-226 would result in future NRC action. Therefore, decision errors here are associated with a measurement goal of no more than 10–50 percent of quantifiable ALs.

1. The positive identification of Ra-226 through visual inspection or other means is not associated with a quantifiable AL. Thus there is no measurement goal.

2. The survey meter produces a stable response at ambient levels, on the order of 10 µrem/hr. Therefore the measurement goal is satisfied even for a relatively restrictive AL (e.g., a few µrem/hr above background).

3. For direct measurements:

    a. The analytical MDC for Ra-226 is typically ~0.5 pCi/g, therefore laboratory analysis can easily satisfy the measurement goal for the [VALUE] pCi/g net (above background) AL.

    b. Direct measurement MDCs using a gas proportional detector are dependent on background/medium-specific and instrument-specific inputs. Thus associated ALs are not included here. NUREG-1507 provides guidance on determining MDCs for direct measurements. However, some dpm/100 cm^2 for alpha and beta activity may be used to support site-specific dose analysis, when required.

4. The Minimum Detectable Activity (MDA) for smears is ~5 dpm/100 cm^2 for gross alpha and ~15 dpm/100 cm^2 for gross beta. There is no specific quantitative AL (it is detected or not detected); thus there is no measurement goal. However, the confirmed detections of Ra-226 above the MDAs may lead to additional actions.

Though not directly associated with scoping ALs, hand-held instruments may be used to locate and delineate contamination associated with Ra-226. Table A-3 presents example MDCs for a Ludlum Model 43-68 gas proportional detector, assuming an alpha background response of 2 cpm and an alpha-plus-beta background response of 350 cpm. A 2-inch × 2-inch sodium iodide detector (2×2) may also be used to locate and delineate Ra-226 contamination. Using the default methods of NUREG-1507 (Minimum Detectable Concentrations with Typical Radiation Survey Contaminants and Field Conditions), the scan MDC for Ra-226 is estimated at 2.8 pCi/g, as presented in Table A-3. Property-specific MDCs will be established in the associated plan and site-specific background conditions and instrumentation.

Table A-3. Example Minimum Detectable Concentrations

Gross Activity	Instrument [a]	Typical Bkg (cpm)	Typical Total Eff. [b]	Detector Area (cm^2)	Static MDC
Alpha only	GP	2	0.11	126	70 dpm/100 cm^2
Alpha-plus-beta	GP	350	0.80	126	90 dpm/100 cm^2
Gamma (soil)	2×2	10,000	N/A	N/A	2.8 pCi/g [c]

[a] GP = gas proportional, 2x2 = 2-inch by 2-inch sodium iodide

[b] Assumes 50 percent equilibrium with progeny

[c] Scan MDC from NUREG-1507

3.7 Step 7 – Optimize the Design for Obtaining Data.

The seventh step in the DQO process is used to review DQO outputs; develop data collection design alternatives; formulate mathematical expressions for each design; select the sample size to satisfy DQOs; decide on the most resource-effective design of agreed alternatives; and document requisite details. The overall approach is to collect as much data as possible given the boundary conditions identified in Section 3.4, Step 4. The scoping survey approach is divided into several general steps, starting with property reconnaissance and the division of accessible areas into logical Survey Units (SUs). The inspector should clearly specify which areas are accessible and which are not (and for what reasons). Within each SU, and considering Figure A-1, the inspector shall:

- Perform a cursory survey using a NaI detector to locate areas of elevated gamma radiation. These locations will represent the highest potential for containing Ra-226.

- Based on professional judgment, collect measurements at the locations with the highest gamma radiation levels:
  - For all media, collect a dose rate measurement and a gross NaI measurement at contact with the surface and at one meter from the surface; and
  - For building/structural media only, also collect alpha and alpha-plus-beta measurements, plus a smear sample.

- If a potential Ra-226 source is identified:
  - Collect isotopic data to confirm the presence of Ra-226 using an isotope identifier (e.g., SAM-940 or Gr-135) or by collecting a sample for off-site laboratory analysis;
  - Delineate the contaminated area and specifies location, boundaries, and magnitude of contamination including “hot spots” and illustrates this information in a logbook or annotates a map for future reference;
  - Collect sufficient smear samples (from appropriate media) to estimate the removable fraction in the area; and
  - Note the proximity of the contaminant relative to habitable spaces.

  This information will be used, if required, to conduct a property-specific dose assessment.

- Collect any random or systematic samples as required by the site-specific plan.

To document and plan for possible access restrictions, the site-specific plan will address, as appropriate, the potential for subsurface contamination in foundations and filled-in basements of previously demolished buildings; subsurface contamination under paved parking lots; subsurface soil sampling; and contamination in pipes and drains of buildings. The site-specific plan will also address surveys of occupied buildings with many occupants. These unusual site conditions may require specialty equipment, communication and coordination with the property owner, longer scoping survey durations, or other considerations that should be identified and incorporated in the site-specific scoping plan, as necessary. In general, no surveys or sampling requiring destruction of property should be performed. If destruction of property is necessary to obtain critical measurements, then the inspector shall consult with regional management for guidance.

Given a typical scoping survey will be performed during a relatively short time window and property access may be restricted, the inspectors should focus their efforts on the areas most likely to contain Ra-226. The selection of these areas will be based on the site summary and the property layout. Example target areas should include but are not limited to: storage areas, loading docks, ventilation systems, drains, outfalls, ditches, downspouts, and run-off areas.

It is presumed that Ra-226 will generate a detectable gamma radiation signal and is most easily located in the field using gamma radiation instrumentation. Therefore, inspectors will initially screen the property using hand-held or cart-mounted NaI detectors, depending on the survey environment. Locations with a maximum gamma radiation signature, potentially containing Ra-226, may then be prioritized for further evaluation using dose-rate and alpha/beta instruments, and/or may be sampled, as deemed necessary.

A detailed logbook will be maintained, which will provide a comprehensive description of field activities. Inspectors, at a minimum, will clearly document the following:

- Dates, times, and individual performing the survey;
- Instrumentation type and identification numbers;
- Site and environmental conditions and instrument background measurement data;
- NaI screening results by room, area, or other logical property division;
- Direct measurement results;
- Sample (smear and volumetric) identification numbers and proposed analyses;
- Detailed maps or drawings documenting measurement and sample location information;
- Detailed description of the location, and physical characteristics and radiation levels associated with confirmed discreet sources, if identified;
- Relevant discussions or interactions with non-project personnel/stakeholders; and
- Details regarding any deviation from the plan.

Survey forms, interview forms, and annotated maps should also be used to record radiation measurement and location information.

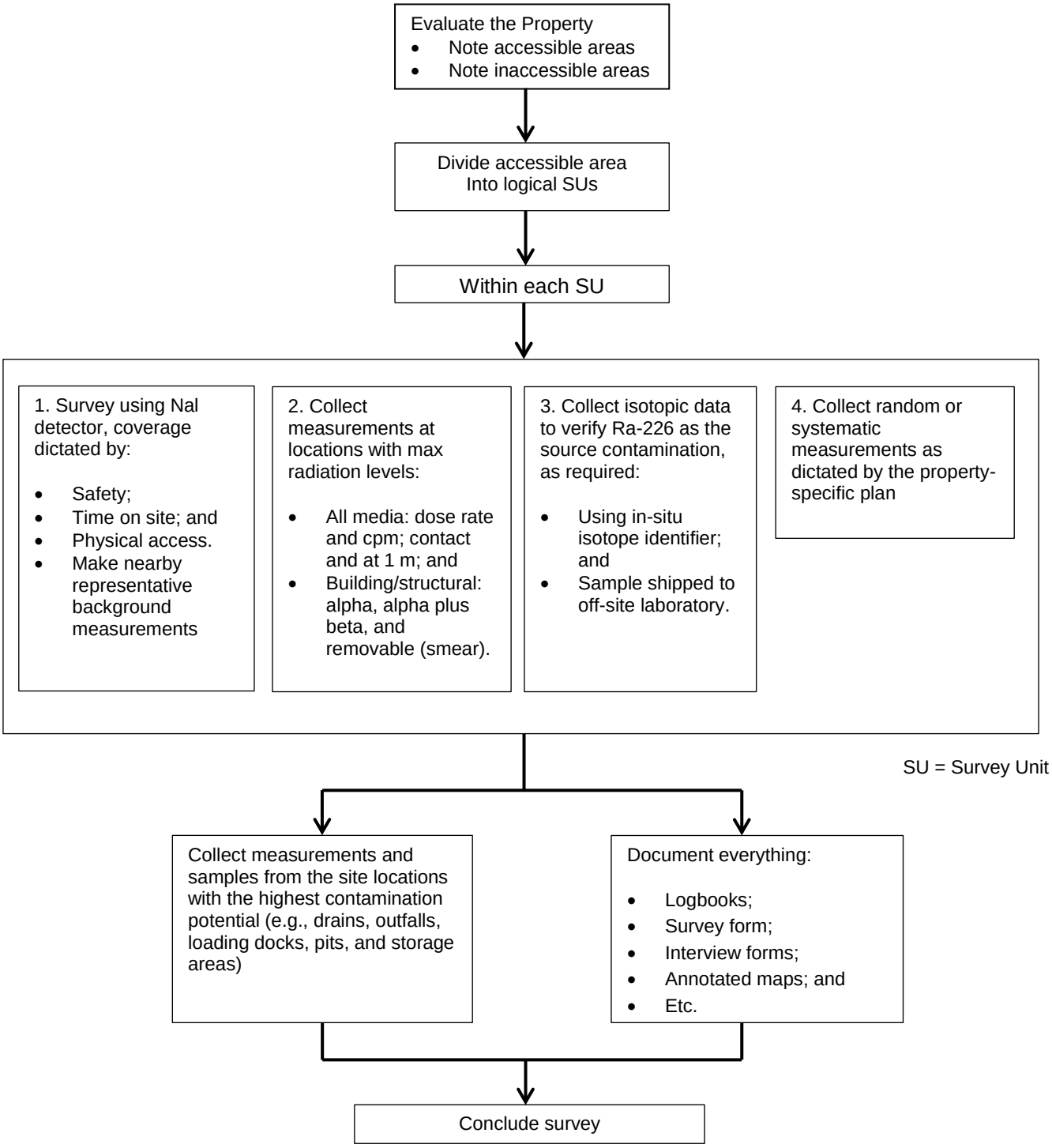

Figure A-1. Scoping Survey Overview

4.0 HEALTH AND SAFETY

Because the level of contamination, if any, is unknown, inspectors will need to be flexible and prepared to upgrade Personal Protective Equipment (PPE) if needed. Initial PPE will be minimal and will be adjusted as necessary because radium can be dispersible.

- Appropriate PPE for the scoping surveys consists of safety glasses and sturdy work shoes. Appropriate PPE will be determined by the Health and Safety Plan.

- If an exposure rate is encountered >2 mrem/hr, or if the area is suspected of containing airborne contamination, then:
  - Coordinate with regional management prior to the scoping survey or upon encountering significant contamination to determine how best to limit access and control the area; as well as coordination with the property owners.
  - Consider how best to delineate and control the area, and, if appropriate, clearly post the area to limit public access during and after sampling activities.
  - Inspectors may be required to upgrade the level of PPE while sampling.
  - Any waste (e.g., PPE and sampling equipment) will be managed according to the waste management plan (see Section 5.0).

Note that a state representative may request to accompany the inspector during the scoping survey. It should be clearly communicated that these individuals are responsible for their own health and safety.

5.0 WASTE MANAGEMENT

Scoping survey activities have the potential for generating waste containing non-trivial levels of Ra-226 activity. Types of waste include PPE, sampling equipment (e.g., trowels, scrapers), and the sampled media (e.g., soil, smears). Inspectors will implement a waste management plan prepared for these activities to assure that potentially contaminated materials, generated during the scoping survey, are safely removed and ultimately dispositioned at an appropriate facility.

6.0 ANALYTICAL REQUIREMENTS

Table A-4 presents example parameters used to plan the collection and analysis of medium-specific radium samples. Inspectors will consider medium-specific requirements during the planning phase of the project, including coordinating with the contract laboratory to assure that analytical data meet quality requirements.

All samples, including smears, will be assigned a unique sample identification number and will be maintained under chain-of-custody until they are transferred to an approved laboratory. The analytical laboratory will perform analyses in accordance with:

- U.S. NRC, “Quality Assurance Manual for the Office of Nuclear Material Safety and Safeguards”;

- ASME-NQA-1, “Quality Assurance Program Requirements for Nuclear Facilities”; and
- U.S. NRC, Multi-Agency Radiological Laboratory Analytical Protocols Manual (MARLAP), NUREG-1576.

Table A-4. Example Sample and Analytical Parameters

Analyte	Matrix	Container	Preserv.	Hold Time	Method	MDC
Ra-226	Soil/solids	1 L HDPE	None	180 d	Gamma spec	0.5 pCi/g
					Alpha spec	0.33 pCi/g
	Surface Residue	Smear	None	180 d	Gross α/β	15 dpm/100 cm^2
					Gamma spec	14 pCi/smear
					Alpha spec	0.05 pCi/smear

HDPE = high-density polyethylene

APPENDIX B

SITE VISIT AND SCOPING SURVEY CHECKLIST

SITE: _____

DATE: _____

INSPECTOR(S):_____

PURPOSE: ☐ Site Visit or ☐ Scoping Survey

SITE DESCRIPTION

Brief description of the site location and physical characteristics

INSTRUMENTATION

List model and serial numbers (e.g., Ludlum model 44-10, no. 54321)

POTENTIAL HAZARDS OR ACCESS RESTRICTION (GENERAL)

General description of the site to be supplemented by location-specific descriptions

Inspectors will use the following form to describe each location of interest, including the range and maximum detector responses per location, applicable detector-specific background levels, and smear and sample identification numbers, if collected. A description of the location will also be included to document Ra-226 sources, physical or radiological hazards, access issues, or other information that may be used to plan future actions at each location. Locations should also be noted on a site map or drawing for ease of future reference.

LOCATION NO.___

Dose rate or count rate and units: Range__________________Units________ Max____________________Units________ Background______________Units________ Smear/sample no.____________________ Picture no. __________________________	Description:

LOCATION NO.___

Dose rate or count rate and units: Range__________________Units________ Max____________________Units________ Background______________Units________ Smear/sample no.____________________ Picture no. __________________________	Description:

LOCATION NO.___

Dose rate or count rate and units: Range__________________Units________ Max____________________Units________ Background______________Units________ Smear/sample no.____________________ Picture no. __________________________	Description:

LOCATION NO.___

Dose rate or count rate and units: Range__________________Units________ Max____________________Units________ Background______________Units________ Smear/sample no.____________________ Picture no. __________________________	Description:

LOCATION NO.___

Dose rate or count rate and units: Range__________________Units________ Max____________________Units________ Background______________Units________ Smear/sample no.____________________ Picture no. __________________________	Description:

APPENDIX C

EXAMPLE SITE STATUS REPORT

Property: Historical Name
Address
City, State, Zip Code

Docket Number:

Current Property Name(s): (as applicable)

Current Property Owner(s): (as applicable)

Inspection Dates: Month, Day, Year

Inspector(s): Name(s) and affiliation(s)

1.0 INTRODUCTION

The Energy Policy Act of 2005 amended section 11e.(3) of the Atomic Energy Act of 1954 to place discrete sources of radium-226 (Ra-226) under U.S. Nuclear Regulatory Commission (NRC) regulatory authority as byproduct material. The NRC is evaluating [SITE NAME], a former manufacturing facility, operational from [DATES], to determine via a scoping survey if discrete sources of Ra-226 and distributed contamination are present at concentrations that could reasonably result in a radiological dose above 25 mrem/yr, per 10 Code of Federal Regulations (CFR) Part 20, Standards for Protection Against Radiation, Section 20.1402.

Data from [DATES] scoping survey are used herein [EITHER] to [eliminate the property from future NRC consideration (i.e., no sources were identified)] [OR] [plan future actions and minimize exposure of current or plausible future receptors to source materials.]

2.0 PROPERTY DESCRIPTION AND CONCEPTUAL MODEL

The site summary report (ORNL [YEAR]) provides known site details about the type, form, history, potential locations and other information related to discrete sources of Ra-226. The property is [BRIEF PHYSICAL DESCRIPTION OF CURRENT CONDITIONS]. Based on the site history and the property's current configuration, Ra-226 is most likely to be located [WHERE] in [MEDIUM]. The scoping survey determined that Ra-226 [IS OR IS NOT] present at the site, as described in the following discussion.

3.0 SITE OBSERVATIONS AND FINDING

3.1 Summary of Activities.

[The author should describe the nature of the survey, including, but not limited to the following]:

- A general description of the property covered by the inspector, noting inaccessible areas, the reasons for access limitations, and the potential impact to final decisions, relevant property features, etc.;

- A summary of conversations that relate to the survey; and

- Maps of the property noting the general location of scoping survey activities, relevant property features, and Ra-226, if identified.

3.2 Summary of Results.

- A description of on-site radiation measurements collected during the scoping survey:
  - Instruments used during the scoping survey;
  - A text description of data collected (direct alpha measurements, direct alpha-plus-beta measurements, 2×2 measurements, etc.);
  - A map, if practicable, of measurement locations;
  - Tabulated results for each type of measurement data collected;
  - An estimate of the percent of the property covered during the scoping survey (e.g., inspectors collected data in eight of the ten rooms in a building); and
  - The specific location, nature, and extent of contamination associated with identified discrete sources of Ra-226.

- A description of the samples collected for off-site analysis:
  - A text description of each type of sample, including the total number of samples collected;
  - A map, if practicable, of sample locations;
  - Tabulated results for each type of sample collected; and
  - The specific location, nature, and extent of contamination associated with identified discrete sources of Ra-226.

3.3 Summary of Dose Assessment Results.

- Residual radioactivity source information, including radionuclides of interest, configuration of the source, and areal variability of the source;

- Description of the conceptual model of the site including the source term and physical features important to modeling the transport pathways;

- Description of the exposure scenario and pathways including a description of the critical group;

- Discussion and justification for use of screening assessment versus site-specific dose assessment;

- Identification and description of the mathematical model used (e.g., hand calculations, DandD, or RESRAD);

- Description of and justification for the parameters used in the analysis;

- Discussion about the effect of uncertainty on the results;

- Input and output files or printouts, if a computer program was used; and

- Results (calculated doses)

4.0 CONCLUSIONS AND RECOMMENDATIONS

Based on this body of evidence, the property [NAME] [does, does not, or may] contain discrete sources. [The author should expand upon the following]:

- No Ra-226 was found. Therefore it is concluded that NRC does not require remedial action at the property.

- If Ra-226 was found, but the dose is less than 25 mrem/yr; it is concluded that the NRC does not require remedial action at the property.

- Ra-226 was found, and there is a reasonable probability that the 25 mrem/yr dose limit will be exceeded by current or reasonably foreseeable receptors [PROVIDE DETAILS]. Therefore, it is concluded that the NRC does require remedial action at the property.
    - Describe the sources and give the rationale for this conclusion.

Attachment 1 - Revision History for TI 2800/043

Commitment Tracking Number	Accession Number Issue Date Change Notice	Description of Change	Description of Training Required and Completion Date	Comment and Feedback Resolution Accession Number (Pre-Decisional, Non-Public)
	ML16035A053 10/28/16 CN 16-028	This is an initial issuance for surveys of sites identified by the NMSS in non-Agreement States, where byproduct material (specifically, discrete sources of radium-226) was used, or suspected to be used, historically for commercial, medical, or research activities.		ML16145A370