International Atomic Energy Agency

Overview of US NRC Decommissioning Surveys, Surface and Subsurface, Release Criteria and Records

R2D2P Workshop on Release of Buildings and Sites/Final Survey Research Reactors
Eureka, CA
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Objectives of this presentation

✓ Describe the NRC decommissioning survey requirements program
✓ Describe the various surveys that are used to support decommissioning
✓ Describe the MARSSIM process, a procedure typically used for final status surveys
✓ Records
10 CFR 20.1501 - a) Each licensee shall make or cause to be made, surveys of areas, \textit{including the subsurface}, [2012] that —

(2) Are reasonable under the circumstances to evaluate--

(i) The magnitude and extent of radiation levels; and

(ii) Concentrations or quantities of residual radioactivity; and

(iii) The potential radiological hazards of the radiation levels and residual radioactivity detected.

(b) Notwithstanding § 20.2103(a) of this part, records from surveys describing the location and amount of subsurface residual radioactivity identified at the site must be kept with records important for decommissioning, and such records must be retained in accordance with §§ 30.35(g), 40.36(f), 50.75(g), 70.25(g), or 72.30(d), as applicable.
US NRC Release Criteria

✓ Unrestricted Release
  • Total Effective Dose Equivalent (TEDE) ≤ 25 mrem (0.25 mSv/a) and As Low As is Reasonably Achievable (ALARA)
  • Average member of the critical group
  • All pathways
  • Period of performance - 1000 years

✓ Does not include Natural Background
How to demonstrate the Unrestricted Release have been meet?

*Derived Concentration Guideline Levels (DCGLs).* Radionuclide-specific concentration limits used by the licensee during decommissioning to achieve the regulatory dose standard that permits the release of the property and termination of the license. The DCGL applicable to the average concentration over a survey unit is called the DCGLW. The DCGL applicable to limited areas of elevated measurement concentrations within a survey unit is called the DCGLEMC.
Derived Concentration Guideline Concentrations (DCGLs)

✓ NRC DCGL Screening Values – Generic, conservative concentrations levels for surfaces and soils in NUREG 1757 Vol 1 Appendix B

✓ Develop Site Specific DCGLs – using the RESRAD Codes
Building Surfaces

- Cobalt - 60 - 7100 dpm/100 cm² (≈12k Bq/m²)
- Cesium-137 – 28000 dpm/100 cm² (≈ 47k Bq/m²)

Building Surface Screening Value assumptions: 10% (0.1) is removable, if 100% is removable, reduce by 10.

Soil

- Cobalt – 60 – 3.8 pCi/g (≈ 140 Bq/Kg)
- Cesium – 137 – 11 pCi/g (≈ 400 Bq/Kg)

NUREG 1757 Vol. 1 Rev. 1 Appendix B, www.nrc.gov
NRC Inspection Program

✓ Inspection Manual Chapter 2561
✓ Inspection Procedures (40)
✓ On-site Inspections
  ✓ Major dismantling activities
  ✓ Spent fuel handling and transfers
  ✓ Radioactive Waste/Transportation
✓ Radiological Surveys, Final Status Surveys and Reports in accordance with License Termination Plan (LTP) or Decommissioning Plan (DP)
Typical decommissioning surveys

- Background survey
- Scoping survey
- Characterization survey
- Remediation survey
- Final status survey (using MARSSIM)
- Confirmatory survey
NRC inspector conducting survey
Background survey

✓ Measurement of soil, water, natural surface radioactivity and ambient gamma radiation levels in vicinity of contaminated site

✓ Background survey is necessary because release guidelines are typically above background levels

✓ Surveys conducted in locations not impacted by site operations
Since background measurements will be subtracted from total contamination levels, the instrumentation used to collect background samples has to be equivalent to the instrumentation used for the final status surveys; that is, similar sensitivity and accuracy levels.

Background Media may include Soil, Concrete, Metal, Glass and others.
Must determine whether the radionuclides of concern are naturally present in the background.

This will impact your data analysis during the final status survey.

For example, uranium, thorium, radium, cesium-137 may be in background; while europium-154 will not be in background.
Scoping survey

Survey conducted early in decommissioning process to identify radionuclides at the site

✔ Used to determine general extent of contamination - activity levels and areas

✔ Supports preliminary assessment of site

✔ Used in conjunction with historical site assessment to develop decommissioning plan
Scoping survey, cont.

- Scoping survey is like a miniature final status survey
- Judgmental (biased) sampling
- Consists of surface, water, soil, gamma radiation samples and measurements
- Doesn’t have to be comprehensive, but the results should allow you to classify site into affected and unaffected areas
The instrumentation does not have to meet the accuracy and sensitivity of instruments used for final status survey, unless the scoping survey results will be used in the final status survey.
Characterization survey

✓ Survey used to precisely define the extent and magnitude of site contamination
✓ Should be comprehensive enough to plan the decommissioning effort:
  ▪ identify decontamination techniques
  ▪ establish schedule and estimate costs
  ▪ estimate waste volumes
  ▪ provide inputs for dose modeling
Characterization survey, cont.

✓ Conducted in areas identified as contaminated during scoping survey
✓ No need to survey unaffected areas
✓ If the survey identifies areas that will pass release criteria, then the survey instruments should have sensitivity and accuracy of instruments used for final status survey so the data can be used as part of the final status survey
Remedial Action Survey

✓ Surveys conducted during decommissioning, in part, to help guide decommissioning activities
✓ Surveys may concentrate on one parameter
✓ For example, soil remediation will continue in an area until soil sample results indicate that the radioactivity is below release criteria
Soil sampling to guide remediation
Soil sampling in sea of mud
Some projects will use mobile labs to support remediation activities.

Survey results are primarily used for screening purposes (pass-fail):
- Results may not be accurate
- Rarely used for final status survey
- Results may not always be recorded
Kaiser Mobile Laboratory
Final status survey

✓ Survey used to determine final condition of the site after decontamination efforts have been completed
✓ Provides data to demonstrate that all radiological parameters satisfy release criteria; results formally documented
✓ Final status survey report used to help justify site release or license termination
Final status survey, cont.

- Recall that some of the data collected during background, scoping, and characterization surveys may be included in the final status survey report.
- The design and implementation of final status survey will be described in detail as part of the MARSSIM presentation.
Final Status Survey – planning

Class 1 - impacted areas with concentrations of residual radioactivity that exceed the release criteria – 100 % survey

Class 2 - impacted areas with concentrations of residual activity that are not expected to exceed release criteria - 10 - 50 % survey

Class 3 - impacted areas with low probability of having residual radioactivity - 10 % Survey
# Final Status Survey design

## Table 1: Suggested Survey Unit Areas

<table>
<thead>
<tr>
<th>Classification</th>
<th>Suggested Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class 1</td>
<td></td>
</tr>
<tr>
<td>Structures</td>
<td>up to 100 m²</td>
</tr>
<tr>
<td>Land Areas</td>
<td>up to 2,000 m²</td>
</tr>
<tr>
<td>Class 2</td>
<td></td>
</tr>
<tr>
<td>Structures</td>
<td>100 to 1,000 m²</td>
</tr>
<tr>
<td>Land Areas</td>
<td>2,000 to 10,000 m²</td>
</tr>
<tr>
<td>Class 3</td>
<td></td>
</tr>
<tr>
<td>Structures</td>
<td>no limit</td>
</tr>
<tr>
<td>Land Areas</td>
<td>no limit</td>
</tr>
</tbody>
</table>
The Connecticut Yankee Big Dig
CY Surveys in the Bottom of Big Dig
CY Debris Removal
Kaiser Soil Remediation
Contamination and Erosion Control
Residual levels of radioactive material that could be present and still assure that an individual would not exceed the acceptable radiation dose limits.

Typically site specific Derived Concentration Guidance Levels (DCGLs) calculated, but in U.S. generic screening criteria may be used NUREG 1757 V1 Appendix B.

For example DCGLs for soil/structures are calculated using the RESRAD program.
Automated Soil Surveyor and Sorter
Courtesy of J. Shonka, Phd
Saxton Soil Remediation
RESRAD Computer Codes

Argonne National Laboratory – RESRAD

Dose Modeling Computer Codes for determining the Derived Concentration Guideline Limits (DCGLs):

✓ RESRAD
✓ RESRAD Build
✓ RESRAD Recycle
✓ RESRAD Biota

www.evs.anl.gov/RESRAD
RESRAD – All pathways analysis

Scenarios:
- Resident with Deep Basement Scenario
- Building Occupancy Scenario
- Resident Farmer Scenario

Pathways:
- Direct Radiation and Inhalation
- Drinking Water
- Ingestion of Meats, Plants, or Fish

Remediated Soil Zone
Groundwater Flow and Transport
✓ All pathways analysis
✓ Evaluate a variety of exposure scenarios; resident farmer, resident gardener, commercial and industrial
✓ Uses conservative defaults or site specific radionuclide transfer fractions and coefficients (soil Kd, resuspension, inhalation)
✓ One dimensional Ground Water dispersion model

RESRAD
RESRAD Build

- Analyzes doses from building surfaces and building materials.
- Models up to 10 sources and receptors.
- Models a building with 3 compartments.
- Determines external exposures, inhalation and ingestion of soil and dust.
- Analyzes variety of exposure scenarios; resident, office worker and others.
Confirmatory survey

✓ Used to confirm the adequacy and accuracy of the licensees final status survey
✓ Similar to final status survey (instruments, protocols) but on smaller scale
✓ Typically includes 1% to 10% of the site
✓ The results of survey will help regulator to decide whether to release site or terminate license
Confirmatory survey of pipe tunnel
Confirmatory survey, cont.

✓ Confirmatory survey sometimes conducted during final status survey
  - Verify compliance with site procedures
  - Collect side-by-side measurements

✓ Other times, the confirmatory survey is conducted after the final status survey has been completed
  - Review final status survey results
  - Resurvey areas previously surveyed
Confirmatory survey, cont.

- NRC samples have to be controlled to prevent loss of integrity during the sampling event.
- Inspectors use sampling procedures which explain how to collect samples.
- Inspectors have to maintain custody of samples using chain of custody forms.
- Inspectors have to maintain physical control of samples or use tamper-resistant seals.
Ambient gamma radiation survey
Ambient gamma radiation survey
Indoor direct and scan measurements
Embedded Pipe Surveys

GM Pipe Detector

CsI Pipe Detector
Outdoor split soil sampling
Outdoor split soil sampling
Soil sampling for laboratory analysis
Soil Remediation Segregation and Packaging
Outdoor scanning of concrete rubble
Filtered water sampling
Indoor sump sampling
Trojan Spent Fuel Pool Survey
Big Rock Point Containment Excavation
Surveys and Sampling
NRC Independent Sample Analysis

- Contracts Oak Ridge Associated Universities (ORISE) to be a World-Class Independent Laboratory

- Inter-laboratory testing Program by Radiological Environmental Science Laboratory at Idaho National Engineering Laboratory

- Annual NRC Audit
Decommissioning Survey Issues

- Use of Surrogate Radionuclides
- Composite Sampling
- InSitu Gamma Spectroscopy
- Sampling for hard-to-detect radionuclides
Truck Monitors
10 CFR 20 Required records to retained important to decommissioning

- Spills
- Subsurface
- Groundwater

Radiological Lifetime Records

- Calibration Records
- Radiological Survey Records
- Final Status Survey Records
Thank You!

Questions???