WM2014 Conference Panel Report

PANEL SESSION 83: Risk & Dose Analysis for Decommissioning of NPPs and Complex Material Facilities

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Panelists:

1. **Christepher McKenney,** *Branch Chief, Performance Assessment Branch, US NRC*
2. **Richard Reid,** *Senior Project Manager, Electric Power Research Institute, EPRI*
3. **Roger Seitz,** *Senior Advisory Scientist, Savannah River National Lab.; US DOE*
4. **Manuel Rodriguez,** *Director of Decommissioning – NPP Site, ENRESA (Spain).*

This panel session focused on risk-dose criteria used in national and international decommissioning of Nuclear Power Plants (NPPs) and complex decommissioning facilities. The panel discussed updated standards, methods, data, and software used in demonstration of compliance with the dose/risk criteria for site release. Several examples were presented for actual facilities to explain methods, approaches, models, and software used to convert risk/dose into measured residual radioactivity.

Summary of Presentations

Christepher McKenney discussed "Determining Remediation Goals for NPPs;" addressing: regulations, graded modeling approach, parameterization, surveys, and impacts of survey techniques. In this regard, he discussed NRC regulations under 10 CFR Part 20 Subpart E, (20.1401 – 20.1406), and the time of compliance period *vis*. 1000 years. Subsequently he summarized decommissioning graded approach as provided in NRC Guidance: NUREG-1757, Vol. 2, Rev. 1 "Consolidated Decommissioning Guidance: Characterization, Survey and Determination of Radiological Criteria." He referred to NRC Screening Tables (NUREG-1757 Appendix H) including look up tables for "Building Surface Contamination" and look up tables for "Soil Contamination."

He continued with presenting an overview of "Site-Specific Modeling (NUREG-1757 Appendix I-M). Regarding model selection for dose analysis, he emphasized that models need to be fit for purpose. He iterated common models used for screening analysis of simple sites namely, DandD V. 2.0 code and RESRAD/RESRAD-Build codes that were used by licensee and staff review of the majority of decommissioning site-specific analysis. He also indicated that other codes were used for special cases by selecting specific groundwater models (for groundwater transport) as well as MicroShield®, and GoldSim codes. He added that licensee must justify parameters used as inputs to the codes/models using referring to NRC recommended approach: (a) start with a probabilistic approach (e.g., RESRAD using the NONNUC.TEM template); (b) identify parameters most affecting results, focusing on justification on these parameters; and (c) licensees may develop a deterministic data set from probabilistic sensitivity analyses to simplify derived concentration guideline level (DCGLs) development.

Finally, for survey results, he referred to Appendix A of NUREG-1757 and use of MARSSIM (NUREG-1575). In this context, he emphasized the approach of using full surface scan coupled with random sampling. He cautioned that if the estimated residual radioactivity levels are close to the DCGLs, there will be more samples required to establish adequate confidence in compliance with the dose criteria. In his closing remarks, he indicated that the current survey methodology is intended to reduce upper bound in dose estimates. Therefore, due to uncertainty in survey measurement, actual residual activity levels average for site release has to be lower than DCGL value.

Richard Reid addressed EPRI's perspective regarding **"**Evaluation of Dose and Risk in the Site Release Process for Commercial Power Reactors." He started his presentation by stating: *"If the Site Release Criteria are dose based, Site Release Limits (i.e., concentrations) need to be determined by dose modeling."* In this regard he described IAEA guidance on site release criteria focusing on IAEA concept of using the optimization approach to reduce potential dose impact as practicable. He compared that to NRC license termination dose criteria and the concept of using ALARA which is similar to the IAEA optimization concept.

He then addressed exposure scenarios and related input parameters indicating the commonly used term "Green Field" corresponds to the most conservative exposure scenario which is "residential farmer scenario." Regarding the codes/models used by EPRI, he indicated that the common computer codes typically used were RESRAD for land areas which allows modeling of soil and material used as backfill and groundwater transport analysis.

For release of buildings - RESRAD-Build code was commonly used with input parameters that can be adjusted to match site use scenarios. Mr. Reid provided vivid example of exposure scenario use and input parameter modifications for Ranch Seco NPP decommissioning and related experience regarding dose/risk analysis. He showed that residual radioactivity for "Industrial Worker Scenario" dropped to "Resident Farmer" levels after 30 Years due to decay and "weathering." He compared Rancho Seco DCGLs for soil release for Co-60, Ni-63, Sr-90, and Cs-137 with IAEA clearance levels.

He gave another example of groundwater release levels for Connecticut Yankee (CY) and compared those with EPA maximum contaminant levels emphasizing that such release limits may have a major effect on the amount of remediation required.

Subsequently Mr. Reid discussed surface contamination on concrete buildings using RESRSAD-Build code and gave an example of Rancho Seco where he compared building release levels using two exposure scenarios, namely, building occupancy scenario and building renovation scenario. In summary, he concluded that the choice of future use of the site greatly affects dose/risk assessment mainly due to: (a) differences in applicable exposure pathways; (b) rate of occupancy of the site in the future. Therefore, scenario selection n could impact site release limits and the resulting remediation required. He emphasized that use of "Realistic Scenarios" more closely represents the future use of the site and would better manage future risks and reduce remediation costs.

Roger Seitz presented "Dose/Risk Analyses to Support DOE Facility Closure." He provided perspectives on approaches used for risk and dose assessment for closure of DOE facilities. In this regard, he addressed regulatory frameworks of the States, US EPA, and US DOE. He also discussed assessment strategies and methods use in a graded approach for risk-informed decision making and software tools used in risk/dose analysis.

Mr. Seitz outlined briefly key objectives designed to achieve a risk-based end state consistent with future land use; he referred to CERCLA and DOE Order 458.1, Radiation Protection of the Public and Environment. In this context, he discussed approaches to establish a risk-based end state in consideration of future land uses particularly considering residential, industrial, and/or recreational exposure scenarios.

He also addressed institutional control issues indicating that such controls must be maintained when considering credit for in risk/dose analysis. He added that the ultimate objective is protection of worker and public health, and the environment. He discussed briefly the importance of stakeholder's involvement in the decision making process the need to achieve risk reduction in a timely manner. He reiterated that DOE Order 435.1, Radioactive Waste Management, must also be met for disposal of decommissioning waste at DOE facilities.

In making decisions regarding alternatives, he presented nine criteria under CERCLA: protection of human health and the environment; compliance with Federal and State regulations; long-term effectiveness and permanence; reduction of toxicity, mobility, or volume; short-term effectiveness; implement ability at the site; cost-effectiveness; regulatory acceptance (State and/or US EPA); and community acceptance.

He also presented ongoing efforts for continuous improvement of modeling tools. Nevertheless, he stated that decision-making is often based on output from software such as the RESRAD family of codes, GoldSim™, or site-specific screening tools. These tools were often supported with more detailed simulations using tools such as PORFLOW, MODFLOW, and STOMP codes. He added that DOE-EM is also supporting development of more detailed assessment tools, including the "Advanced Simulation Capability for Environmental Management and the Cementations Barriers Partnership."

Mr. Seitz closed his presentation by providing his perspective of key considerations related to risk/dose application of approach which included: (a) robust and structured approach for decision-making involving external regulators and input from the public; (b) strong commitments to maintain institutional controls as necessary to support selected option; (c) must meet external regulatory requirements and DOE requirements; (d) provide quantitative and qualitative assessments of potential impacts using multiple alternatives; and (e) use multiple different tools as available continuously update and enhance such tools.

Manuel Rodriguez presented decommission experience of "Spain Jose Cabrera NPP Buildings and Site Release." First, he described the decommissioning facility indicating that it was the first example in Spain to complete dismantling of a nuclear site, and manage of the resulting radioactive materials from decommissioning. He outlined ENRESA

decommissioning management strategy which included: (a) system modification; (b) equipment retrieval; (c) building demolition; and (d) site release. Subsequently, he described facility and material characterization processes using: (a) initial characterization; (b) in-situ characterization, (c) building clearance; and (d) site release. He described in detail each process and gave example of characterization difficulty in finding correlation between difficult and easy to measure isotopes.

He gave examples of different isotopes compositions for biological shielding, spend fuel pool, refuel cavity, evaporator, waste package storage, and other places within the NPP facility. Mr. Rodriguez described in detail automatic measurements and survey for surface clearance using two CCP cameras and methodology for grids and sampling in x, y, and z axis coordinates. For example for automatic identification of survey units he used data on: identification of the SU wall; date and time; coordinates X, Y, Z of the origin of wall coordinates; orientation vector of both the origin and measured point; coordinates X´, Y´, Z' of the measurement point; and images of the measurement point.

He then described site release criteria and regulatory framework (e.g.; Spain Safety Instruction IS-13 (Spanish Nuclear Safety Council); clearance levels for buildings based on Spain RP 113 (Demolition and reuse); soil specifically derived DCGLs based on specific land use and subsurface land use. The dose criteria used 0.1 mSv / year under institutional controls, and 1 mSv / year (in case controls fail). ENRESA used U.S. MARSSIM survey methodology for sampling and for derivation n of DCGLs. The scenarios used for soil release included: industrial, agricultural/residential, and maintenance worker. For subsurface land use the scenario selected was "industrial use" with no water is used for drinking.

Finally, Mr. Rodriguez closed his presentation by outlining issues and lessons learned: (a) too much paper work and sampling; there is a need to automatize and rationalize the use of MARSSIM; (b) there was a need for 3D assessment of subsurface contaminated soil using 3D geo-statistical tools; (c) there was a limitation for use of MARSSIM approach for subsurface; (d) need improved approach to assess efficiency of soil remediation techniques; (e) questions were raised regarding removal and disposal of large volume of low-level contaminated soil.

Questions and Answer & Conclusions

Several questions and comments were raised regarding decommissioning criteria for release of facilities when comparing NRC, EPA, CERCLA, DOE, IAEA and site clearance criteria in Spain and other European countries. In addition, question s were raised regarding costs for removal of large volumes of soils with very low level of residual radioactivity. Most participants expressed the need to develop guidance for subsurface survey for release of facilities with subsurface contamination. Participants also emphasized the need to use realistic scenarios in the risk/dose analysis for decommissioning. Some expressed concern regarding certain countries use of 0.01 mSv/y for release of facilities as such value could be within the uncertainty of measurements and dose conversion. Updating and benchmarking of codes/models was recommended by commentators.

In summary, the session elucidated insights of risk/dose analysis for decommissioning and discussed issues influencing release of facilities after decommissioning. Comparison of international approaches to decommissioning was of great interest. This Session was of interest to the public, and to Federal, State, and Industry officials; as well as to international participants.