

SAFETY EVALUATION REPORT  
APPROVAL OF PENNSYLVANIA DEPARTMENT OF ENVIRONMENTAL PROTECTION,  
BUREAU OF RADIATION PROTECTION DECOMMISSIONING PLAN, REVISION FOUR, FOR  
THE QUEHANNA SITE  
DOCKET NO. 030-29288

1.0 BACKGROUND

In a letter dated March 9, 2006, Region I received an application for an amendment to License No. 37-17860-02 to incorporate Revision Four of the Decommissioning Plan (DP) into the license. Approval of this application amendment would lead to completion of decommissioning and subsequent license termination and unrestricted release of the Quehanna site in Karthaus, Pennsylvania. In a subsequent letter dated July 28, 2006 the Pennsylvania Department of Environmental Protection, Bureau of Radiation Protection (PADEP, BRP) provided a response to an NRC request for additional information (RAI) regarding Revision Four of the DP. This SER refers to the license renewal request as amended through the July 28, 2006 response to the NRC RAI.

The staff reviewed the licensee's DP following the guidance in NUREG-1757, *Consolidated Decommissioning Guidance*, Volumes 1 and 2. NUREG-1757 recognizes that the information submitted in the DP, as well as the review of the DP, should be tailored to the complexity and safety significance of the proposed action since all of the information described in the NUREG need not be included in a DP. The object of this SER is to confirm that site decommissioning will be accomplished in accordance with applicable regulatory requirements.

The outline in Appendix G of Volume 1 of NUREG-1757 was used as the template for this SER, which follows the checklist of Appendix D of this same guidance document. Sections of the checklist that apply to the license amendment request are reviewed, and findings documented by NRC before a DP is approved.

The reviews of the specific sections of the DP were conducted using Appendix G and Sections 16.2, 16.4, 17.1, 17.2, 17.4, 17.5, and 17.6 of Volume 1 of NUREG-1757 and Sections 4.2 and 4.4 of Volume 2 of NUREG-1757.

2.0 TECHNICAL EVALUATION

**Section 2, Facility Operating History (Reviewed against Section 16.2, Vol. 1, NUREG-1757)**

The information supplied by the licensee was reviewed to determine if the description of the operating history of the site was adequate to allow an understanding of the types of radioactive material used at the site, the nature of the authorized use of these radioactive materials at the site, and activities at the site that may have contributed to residual contamination requiring remediation. Based on this review, the staff has determined that the licensee has provided sufficient information to aid the NRC staff in evaluating the licensee's determination of the radiological status of the facility, and the planned decommissioning activities, to ensure that decommissioning can be conducted in accordance with NRC requirements.

**Section 4, Radiological Status of the Facility (Reviewed against Section 16.4, Vol. 1, NUREG-1757)**

The information supplied by the licensee was reviewed to determine if the description of the current radiological status of the facility is adequate to allow the staff to fully understand the types and levels of radioactive material contamination and the extent of radioactive material contamination at the facility. Based on this review, the staff has determined that the licensee has described the types and activity of radioactive material contamination at its facility sufficiently to allow the NRC staff to evaluate the potential safety issues associated with remediation of the site, whether the remediation activities and radiation control measures proposed by the licensee are appropriate for the type of radioactive material present at the site, and whether the licensee's waste management practices are appropriate.

**Section 5, Dose Modeling Evaluations (Reviewed against Section 5.2, Vol. 2, NUREG-1757)**

PADEP, in Revision 4 of the DP, requested to depart from the grandfathered release criteria of their previously approved DP to an approach using Subpart E of 10 CFR 20. PADEP's plan is to remove the above grade structures, and place the demolition debris material in an industrial landfill. The at-grade concrete from the local pads will be used to fill the subgrade voids in the basement and remaining surfaces of the hot cells. This approach results in three basic source terms for the site: 1, above grade structures; 2, the below-grade concrete which will remain in place; and 3, the remaining soils around the site.

ABOVE-GRADE STRUCTURE DISPOSAL REVIEW

Source Term

The contamination on the above-grade structure consists of surficial residual Sr-90. In their prior decontamination activities all of the surfaces were reduced to less than 1,000 dpm/100 cm<sup>2</sup>. After the recontamination event, some horizontal surfaces exceeded this value. PADEP is requesting a derived concentration guideline level (DCGL) of 250,000 dpm/100 cm<sup>2</sup>. Based on staff review of the revised decommissioning plan, the staff agrees that the above-grade structures are limited to surface contamination of Sr-90.

Scenario and Dose Analysis

PADEP is proposing to dispose of the debris in an industrial landfill. As this is a 10 CFR 20.2002-type analysis, a number of scenarios do need to be considered. PADEP provided a conservative analysis of a potential intruder dose to the disposed debris. However, the revised decommissioning plan does not include detailed analyses or discussion of other scenarios, such as trucking the material or the workers at the landfill. The staff used the generic analyses from NUREG-1640, Volume 3, "Radiological Assessments for Clearance of Materials from Nuclear Facilities, Appendices F and G," to inform their review on the magnitude of these scenarios.

Scenario	Source/Dose Rate	Total Dose
PADEP Landfill	1x10 <sup>-4</sup> mrem/dpm/100 cm <sup>2</sup>	24.7 mrem/yr

Scrap Truck Driver (pg F-76)	$2.8 \times 10^{-8}$ mrem/dpm/100 cm <sup>2</sup>	0.007 mrem/yr
Scrap Disposal - Industrial (pg F-118)	$2 \times 10^{-7}$ mrem/dpm/100 cm <sup>2</sup>	0.05 mrem/yr
Leachate- Industrial (pg F-128)	$3.3 \times 10^{-7}$ mrem/dpm/100 cm <sup>2</sup>	0.08 mrem/yr

From these results, the PADEP analysis easily bounds the dose from the other scenarios. However, the PADEP analysis is a very conservative analysis. PADEP used RESRAD version 6.31 to calculate the dose to an intruder who become a residential farmer on top of the landfill the year after the disposal of the waste. In addition, PADEP assumes no cover or other waste above the debris containing residual Sr-90. As Sr-90 has a half-life of 30 years, delay in the time of the scenario can result in significant risk reduction; therefore, assuming that a residential farmer lives on top of the facility the year after the waste is placed is very conservative, especially considering other reasonable assumptions about continued operations at a facility. Similarly, the assumption of no cover results in a very conservative analysis. The primary pathway is crop uptake. The presence of a cover or other waste over the debris would result in limited contamination of the crop roots. Even in the case of some waste being dug up and spread around (disregarding that it is generally steel debris), the debris would have been unintentionally mixed with "clean" (from the point of being free of licensable Sr-90 from Quehanna) soil-like material, which would lower the effective concentration and lower the dose. However, even this scenario is improbable as the residual material is mainly on steel, which should be recognizable as scrap and not allowed to exist around a residence, especially in the garden. For all of these reasons, the staff did not review in extensive detail the PADEP parameters or modeling and, instead, base their decision on the generic analyses from NUREG-1640.

#### Conclusions for Above-Grade Structures

The staff has reviewed the proposed DCGL for building surfaces of 250,000 dpm/100 cm<sup>2</sup> for Sr-90, which is based on the licensee's proposed approach to dispose of all surfaces less than this DCGL in a non-Atomic Energy Act-licensed landfill. Based on the generic analyses in NUREG-1640, and additional consideration that most of the surfaces are below 1,000 dpm/100 cm<sup>2</sup>, the staff finds that the resulting doses would be less than 1 mrem/yr for the various scenarios. As a few mrem per year is consistent with previous 10 CFR 20.2002 approvals, the staff recommends providing a 10 CFR 20.2002 approval and an exemption to allow PADEP to pursue this approach.

#### CONCRETE REVIEW

##### Source Term

During the previous decommissioning activities, it was assumed based on characterization surveys that the concrete was only contaminated at the surface. The recontamination event, however, proved that at least in sections of the concrete either surrounding, or part of, the hot cells have volumetric contamination. PADEP chose to evaluate the dose from the remaining activity rather than continue decommissioning activities.

PADEP assumed homogenous contamination across the concrete except for the reactor bay concrete, which has been shown previously to be unaffected by the Sr-90 contamination. Final status survey sampling will determine the degree of heterogeneity and the MARSSIM method

will control the allowable heterogeneity. The entire mass of concrete (except for the reactor bay) is assumed by the licensee to be at the DCGL, which is a conservative assumption. The staff finds the approach taken by PADEP to be adequate to calculate a DCGL.

### Scenario, Pathway and Analysis

PADEP is planning to consolidate the remaining concrete pads by filling the existing ground voids with the pads. The base of the ground voids will be first fractured to allow subsurface water to flow. All the concrete around the voids and in the pads to be used as fill will be sampled according to the sampling plan to show that they meet the DCGL of 30,000 pCi/g Sr-90 proposed by PADEP. PADEP plans to place concrete with the highest residual radioactivity at the greatest depth. Soil will then be placed to fill the void space and bring the areas to grade. The site will then be restored by planting native flora after appropriate regrading of the site.

The site currently exists as a grandfathered exemption in the Commonwealth of Pennsylvania law that established the Quehanna Wild Area, in the Moshannon State Forest. Commonwealth of Pennsylvania code (17 Pa. Code § 27.4) restricts the activities present at the site to recreational purposes only, primarily hunting and hiking. The site will revert to the Wild Area including limitation on access by vehicle and limitation on lengths of stay, including no permanent structures. As the Wild Area is a limited managed area, scenarios such as a maintenance worker or construction of recreational facilities are not reasonable to assume. Based on these, the exposure group most likely to be characterized as the critical group would be a temporary user of the site, such as a hunter or hiker.

This hunter would base their hunting camp on top of the debris pile (which will only be approximately 150 m<sup>2</sup> in size), spending a total of two weeks in the area (approximately 50% of that time on top of the debris pile). The hunter would supply half of his yearly meat intake from game in the surrounding area. The game are assumed to consume most all of their fodder from areas affected by the debris pile. In addition, the analysis ignores the presence of any cover material through regrading or fill. The staff notes that these last three assumptions are very conservative parameter choices for the scenario. Based on these assumptions, PADEP calculated the dose using RESRAD version 6.31. The staff reviewed their parameter choices. The two most sensitive parameters for this scenario are time on site and meat consumption rate. As PADEP has selected conservative values, in the staff's opinion, the staff finds the approach adequate. Based on this dose assessment, PADEP derived a concentration of 30,000 pCi/g for the concrete using a dose limit of 24 mrem/yr (1 mrem/yr is reserved for the remaining soils source term).

The assumption of the lack of the cover in the analysis results in most of the dose. If a cover of 1 meter or greater is assumed, based on staff analyses, the resulting dose for the same scenario will be near zero.

### Conclusions for Concrete

The staff finds the approach taken by PADEP adequate. It evaluates the likely modes of exposure at the site in the future without being unduly conservative or unrealistic in likely land uses. The staff finds the proposed DCGL for concrete of 30,000 pCi/g acceptable.

## REMAINING SOILS REVIEW

For the remaining soils on the site, PADEP performed a similar analysis, using again a hunter camp as the scenario.

### Source Term

PADEP assumed that the entire seven acres of the site was contaminated uniformly to the deepest depth of potential contamination (i.e., six meters) at the previously approved DCGL of 5 pCi/g of Sr-90. The previous final status survey did not locate any points higher than 4.5 pCi/g. Based on this information, the staff finds this a conservative approach to estimate the dose from the residual radioactivity and adequate for the purpose.

### Scenario, Pathways, and Analysis

PADEP used a hunter camp scenario again with the same basic assumptions as before (i.e., 2 weeks in the area with 50% of the time on site, no cover material, receives half his or her annual meat consumption from animals grazing on the contaminated material, etc.). Since the site is a lot bigger than the concrete debris area, PADEP also considered limited foraging of natural fruits and berries by the hunter during his or her visit (i.e., 1 kilogram). PADEP's analysis has 30% of the dose coming from the 1 kilogram and 70% from the affected game. The total dose is very small at 0.38 mrem/yr, with the highest dose occurring in the first year after termination.

### Conclusions for Remaining Soils

The staff finds the approach taken by PADEP adequate. It evaluates the likely modes of exposure at the site in the future without being unduly conservative or unrealistic in likely land uses. The use of the DCGL, while site data shows lower average concentrations results in an overestimation of dose. In addition, a number of scenario-specific parameters were selected conservatively.

## CONCLUSION FOR DOSE MODELING EVALUATIONS

The staff concludes that the dose modeling completed for the three source terms at the site (i.e., (1) building surfaces, (2) remaining concrete, and (3) surrounding soil) is reasonable and appropriate for the exposure scenarios under consideration. The dose estimates provide reasonable assurance that the dose to the average member of the critical group is not likely to exceed the annual dose limit of 10 CFR 20.1402. This conclusion is based on the modeling effort performed by the licensee and the independent analyses and the review performed by the staff.

In determining the dose, the licensee has used a combination of the conceptual model(s), exposure scenarios, mathematical models(s), and input parameters to calculate a reasonable estimate of dose. The licensee has adequately bounded the potential dose by conservative assumptions so that detailed analysis of uncertainties is unnecessary.

As part of the proposed decommissioning plan, PADEP is planning on disposing of the above-grade structures in a non-Atomic Energy Act licensed industrial landfill. This will require an approval under 10 CFR 20.2002 and appropriate exemption. In accordance with the provisions

of 10 CFR 30.11, "the Commission may, upon application by an interested person or upon its own initiative, grant such exemptions from the requirements of the regulations. . .as it determines are authorized by law and will not endanger life or property or the common defense and security and are otherwise in the public interest." Based on the above analyses, this material authorized for disposal poses no danger to public health and safety, does not involve information or activities that could potentially impact the common defense and security of the United States, and it is in the public interest to dispose of wastes in a controlled environment such as that provided by the Commonwealth of Pennsylvania-licensed landfills. Therefore, to the extent that this material authorized for disposal in this 20.2002 authorization is otherwise licensable, the staff concludes that the site receiving the material is exempt from further Atomic Energy Act (AEA) and NRC licensing requirements.

**Section 8, Planned Decommissioning Activities (Reviewed against Section 17.1, Vol. 1, NUREG-1757)**

The information supplied by the licensee was reviewed to determine if the description of the planned decommissioning activities was adequate to allow the staff to fully understand the methods and procedures the licensee intended to use to remediate residual radioactive material at the site to levels that allow for release of the site in accordance with NRC requirements. Based on this review the staff has determined that sufficient information has been provided to allow the staff to evaluate the licensee's planned decommissioning activities to ensure that the decommissioning can be conducted in accordance with NRC requirements.

**Section 9, Project Management and Organization (Reviewed against Section 17.2, Vol. 1, NUREG-1757)**

The staff has reviewed the information supplied by the licensee to determine if the description of the licensee's decommissioning project organization and management structure is sufficient to allow the staff to fully understand how the licensee will ensure that it will exercise adequate control over site decommissioning. Based on this review, the staff has determined that the licensee has provided sufficient information to allow the staff to evaluate the licensee's decommissioning project management organization and structure to determine if the decommissioning can be conducted safely and in accordance with NRC requirements.

**Section 10, Health and Safety Programs (Reviewed against Section 17.3, Vol. 1, NUREG-1757)**

The staff has reviewed the information supplied by the licensee to determine if the health and safety measures to be used to control and monitor the impacts of ionizing radiation on workers comply with the NRC's regulations in 10 CFR Parts 19 and 20. Based on this review, the staff has determined that the licensee has provided sufficient information to allow the staff to evaluate the health and safety programs for decommissioning and determine if the decommissioning can be conducted safely and in accordance with NRC

**Section 11, Environmental Monitoring and Control (Reviewed against Section 17.4, Vol. 1, NUREG-1757)**

The NRC staff has reviewed the information submitted by the licensee to determine if the environmental monitoring and control program complies with the regulatory requirements in 10 CFR Part 20, if it is adequate to protect workers, the public, and the environment from ionizing radiation during site decommissioning activities, and if it is adequate to ensure that radiological

effluent levels are maintained within applicable standards and are as low as reasonably achievable (ALARA). Based on this review, the staff has determined that the licensee has provided sufficient information to conclude that the licensee's program will comply with 10 CFR Part 20.

**Section 12, Radioactive Waste Management (Reviewed against Section 17.5, Vol. 1, NUREG-1757)**

The staff has reviewed the information supplied by the licensee to determine if the description of the program for the management of radioactive waste generated as part of the decommissioning of the facility is adequate to allow the staff to fully understand the types of radioactive waste that will be generated by decommissioning operations and the manner in which the licensee will manage these wastes. Based on this review, the staff has determined that the licensee's programs for the management of radioactive waste generated during decommissioning operations ensure that the waste will be managed in accordance with NRC requirements and in a manner that is protective of the public health and safety. In addition, all debris is expected to be below the site-specific DCGLs.

**Section 13, Quality Assurance Program (Reviewed against Section 17.6, Vol. 1, NUREG-1757)**

The staff reviewed the information supplied by the licensee to determine if the description of the quality assurance (QA) program was adequate to allow the staff to conclude that the licensee has adequate controls in place to support the decommissioning. Further, if the licensee effectively implements the QA program described, the data collected should be accurate and of sufficient quality to justify the conclusions drawn from the information. Based on this review, the staff has determined that the licensee's QA program is sufficient to ensure that information submitted to support the decommissioning of its facility should be of sufficient quality to allow the staff to determine if the licensee's planned decommissioning activities can be conducted in accordance with NRC requirements.

**Section 14, Facility Radiation Surveys (Reviewed against Sections 4.2 and 4.4, Vol. 2, NUREG-1757)**

The NUREG-1757 requires that the staff review the characterization survey results to determine whether the characterization survey provides sufficient information to permit planning for site remediation that will be effective and will not endanger the remediation workers, to demonstrate that it is unlikely that significant quantities of residual radioactivity have gone undetected, and to provide information that will be used to design the Final Status Survey (FSS). NUREG-1757 also requires that the staff review the FSS design to determine whether the survey design is adequate for demonstrating compliance with the radiological criteria for license termination. Upon completion, the staff will review the results of the FSS to determine whether the survey demonstrates that the site, area, or building meets the radiological criteria for license termination.

Based on a review of licensee's data and an independent NRC confirmatory survey conducted in May 2005, the staff has determined that the description of radioactive contamination at the site was adequate to permit planning for remediation that will be effective and will not endanger workers, is unlikely that significant quantities of residual radioactivity have not gone undetected, and will provide information that will be used to design the FSS.

The FSS plan to demonstrate that the site meets the radiological criteria for license termination will be submitted at a later date and will be reviewed at that time.

### 3.0 ENVIRONMENTAL CONSIDERATIONS

Pursuant to 10 CFR Part 51, an EA and Finding of No Significant Impact were published in the *Federal Register* on October 11, 2006. Based on the EA, the Commission has determined that the issuance of this amendment will not have a significant effect on the quality of the human environment. Accordingly, it has been determined that a Finding of No Significant Impact is appropriate.

### 4.0 CONCLUSIONS

This review finds the licensee's amendment request to incorporate revision four of the DP in to the license is reasonable and will allow the licensee to remediate the site to dose levels such that the site will meet the criteria for unrestricted release under 10 CFR 20, Subpart E. Additionally, the disposal of low level-contaminated demolition debris in an industrial landfill was demonstrated to be below the NRC dose policy limit of "a few millirem." The licensee used appropriate exposure scenarios and analyses methodology to demonstrate compliance with the required dose limits. Completion of site remediation under revision four of the DP will result in decommissioning of the site safely and with out significant environmental impact as documented in the Environmental Assessment and Finding of No Significant Impact (ML062720161).

Further, in accordance with the provisions of 10 CFR 30.11, "the Commission may, upon application by an interested person or upon its own initiative, grant such exemptions from the requirements of the regulations. . .as it determines are authorized by law and will not endanger life or property or the common defense and security and are otherwise in the public interest." Based on the above analyses, this material authorized for disposal poses no danger to public health and safety, does not involve information or activities that could potentially impact the common defense and security of the United States, and it is in the public interest to dispose of wastes in a controlled environment such as that provided by the Commonwealth of Pennsylvania-licensed landfills. Therefore, to the extent that this material authorized for disposal in this 20.2002 authorization is otherwise licensable, the staff concludes that the site receiving the material is exempt from further Atomic Energy Act (AEA) and NRC licensing requirements.