

**TECHNICAL EVALUATION REPORT
REVIEW OF U.S. ARMY REQUEST TO REMOVE THE
DIAMOND ORDNANCE RADIATION FACILITY FROM THE
WALTER REED ARMY MEDICAL CENTER SITE (WRAMC) NRC LICENSE AND
REQUEST TERMINATION OF THE WRAMC, WASHINGTON, DC LICENSE
DOCKET NO: 03001317, LICENSE NO: 08-01738-02**

1.0 Executive Summary

This Technical Evaluation Report has been prepared as part of the U.S. Nuclear Regulatory Commission (NRC) staff's review of the U.S. Department of the Army's (Army) May 6, 2013, request (ADAMS Accession No. ML13137A415) to remove the Diamond Ordnance Radiation Facility (DORF), Buildings 513 and 516, Forest Glen Section and Annex, Silver Spring, MD, as authorized locations for use or storage of licensed material under NRC License No. 08-01738-02 for the Walter Reed Army Medical Center (WRAMC). In addition, because these locations of use are the only remaining authorized locations of use under the license, the Army is requesting termination of the license.

The DORF has been most recently used by WRAMC for storage of radioactive waste for decay and for activities related to shipment of radioactive waste to facilities licensed for treatment or disposal of radioactive waste. This evaluation focuses on the radiological status of the DORF as a result of operations related to radioactive waste storage and shipment conducted by WRAMC and also considers the radiological condition of the facility as a result of residual radioactive material remaining at the facility from the Army's historical operation of a research and test reactor in Building 516. The Army possessed radioactive material and operated the test reactor under the authority of Chapter 9, "Military Application of Atomic Energy", Section 91.b. of the Atomic Energy Act of 1954 (AEA), as amended. Although the Army's reactor was decommissioned in 1980, residual volumetric contamination embedded in the concrete remains within the facility. The Army's authorization for the residual radioactive material from the test reactor operations is via a permit issued by the Army Reactor Office (ARO) to the U.S. Army Research Laboratory (ARL). The main Walter Reed hospital complex and other sites previously listed as authorized locations of use on the NRC license have been removed from the license after having met the NRC criteria for release for unrestricted use or have been removed as authorized locations of use from the license through transfer to other NRC licenses within the U.S. Department of Defense.

The NRC's technical evaluation included the staff's review of the Army's Final Status Survey Reports (FSSRs), review of NRC licensing documents, and consultation with staff from the ARL. Based on a review of radiological survey results accompanying the Army's request to remove the two buildings from the license and terminate the license, the staff determined that the Army has adequately demonstrated that NRC-licensed materials possessed under the WRAMC NRC license no longer remain at the facility. In regard to the residual radioactivity embedded in the concrete as a result of the historical test reactor operations, the Army utilized the measured exposure rates in Building 516 and concluded that based on a reasonable, conservative occupancy scenario, the potential dose to a hypothetical office worker, would be approximately 16 mrem/year, which is less than the criterion of 25 mrem/year in 10 CFR 20.1402. The NRC staff reviewed the Army's radiological survey data and calculations and concurred with the Army's assessment that the measured radiation exposure rates in Building 516, distinguishable

from background radiation levels, would not result in an annual exposure rate exceeding the criteria in 10 CFR 20.1402, and therefore the facility may be considered acceptable for unrestricted use. Because there is no longer any NRC-regulated material at the DORF, and the residual radiation exposure rates as a result of the residual contaminated concrete from the Army test reactor operations meets the criteria for release for unrestricted use, the facility may be removed as an authorized location of use under NRC License Number 08-01738-02. Because this facility is the only remaining authorized location of use under the WRAMC NRC license, NRC License Number 08-01738-02, issued to WRAMC, may also be terminated.

The NRC staff coordinated this review with staff from the Army, Walter Reed National Military Medical Center, and the ARL. On July 2, 2013, the NRC staff conducted an inspection of the facility that confirmed that the condition of the facility was as described in the documents accompanying the request.

2.0 Facility Operating History

The DORF was operated by the Army's Harry Diamond Laboratories (now part of ARL) at the WRAMC Forest Glen Annex pursuant to an Army Reactor Permit. Building 516 at the DORF housed a TRIGA Mark F research reactor that was used for radiation effects research by the Army. The reactor was operated from September 1961 through September 1977, at which time reactor operations were terminated and plans were developed for decommissioning the reactor.

NRC records indicate that the Forest Glen Annex was listed as an authorized location of use on the WRAMC license as early as 1969, although the specific buildings were not specified. Discussions with Army and former Army staff indicated that the WRAMC Health Physics Office staff used buildings on the Forest Glen Annex for offices and storage. In addition to the duties at the nearby hospital and research facilities, staff from the WRAMC Health Physics Office provided technical support for the reactor during routine operations and during the decommissioning of the reactor through an intra-agency agreement. From these discussions, it was also determined that Building 513 was used for storage of instruments and equipment and was not impacted by reactor operations or the WRAMC waste handling operations.

Following termination of the research reactor operations, the Army contracted with Rockwell International (Rockwell) to prepare and implement a decommissioning plan for the research reactor. The plan included provisions for the removal of all special nuclear material (fuel elements) and sufficient residual radioactivity such that the site could be released for unrestricted use. Decommissioning activities were conducted from 1979 through 1980. These activities included removal of all fuel elements from the reactor and shipment offsite to authorized recipients, draining and releasing the reactor pool water, dismantlement of major components and structures associated with the reactor, filling the reactor pool with non-impacted rubble and concrete, and disposing of the radioactive waste generated from the decommissioning project. Post-decommissioning surveys by Rockwell and subsequent verification surveys by Army representatives certified that the contracted cleanup criteria had been met and the project completed. The cleanup guidance regarding acceptable residual radioactivity in effect at this time was the criteria in NRC Regulatory Guide 1.86, "Termination of Operating Licenses for Nuclear Reactors." The Army reactor permit was then terminated.

In conjunction with the decision to terminate the reactor operations and decommission the reactor, the Army considered the beneficial re-use of Building 516. Because of the suitable available space and its proximity to the WRAMC hospital and research facilities, the Army

developed plans for the use of the facility to support the low-level radioactive waste collection, storage, packaging, and shipping activities for the WRAMC license. In July 1979, the Army submitted a plan to use Building 516 for low level waste support activities in a request to amend the WRAMC license. After the reactor decommissioning and radiological survey activities were complete, the NRC approved an amendment to the WRAMC license on July 16, 1982, that authorized the building to be used to support the low-level waste handling, packaging, and transportation activities. WRAMC staff collected low-level radioactive waste from the hospital and research areas and stored the waste on shelves, refrigerators, and a walk-in freezer installed in the DORF. The low-level radioactive waste was loaded into drums that were prepared for shipment to authorized facilities. A drum compactor and vial crusher were used for waste volume reduction.

In 1996, in anticipation of the NRC issuance of new decommissioning regulations, ARO staff commenced a review of documents regarding all operating and non-operating Army reactors to determine their current radiological status. At that time, ARO authorized conducting a radiological survey at the DORF to determine the current radiological conditions at the DORF. The radiological survey revealed low, but detectable, ambient radiation exposure rates in the former exposure room. The elevated exposure rates were due to neutron activation in concrete associated with the historical reactor operations. In response to that finding, the ARO issued Army Radiation Permit No. DORF-1-97, which established controls and monitoring procedures to prevent removal or disturbance of the activated concrete. The permit was issued for a ten-year period and was later renewed through 2017. The Health Physics Office at WRAMC continued collecting radioactive waste from the research laboratories and hospital and transported these materials to the DORF for storage, surveying, and packaging.

In 1999, three 5,000-gallon underground hold-up tanks for liquid effluents were removed after characterization measurements determined that the tanks and surrounding soil were free of any residual radioactivity. The underground storage tanks had been used during the reactor operations, but were not used to support the WRAMC waste handling operations.

In 2005, the WRAMC was identified as one of the military installations for realignment by the Base Realignment and Closure (BRAC) Commission. The hospital and research activities were relocated to other nearby NRC-licensed facilities and the facilities identified as authorized locations of use or storage of licensed material under the WRAMC NRC license were phased out. The waste storage and handling operations continued at DORF until the first quarter of 2009 when the last shipment of radioactive waste was made. Following removal of all stored waste, the U. S. Army Corps of Engineers (USACE) contracted for a radiological evaluation of the DORF that was conducted from mid-2009 through 2010. USACE also contracted for a supplemental evaluation of the former exposure room and the filled reactor pool. The reports from these two evaluations were transmitted to the NRC in 2013 with the request to remove the DORF from the WRAMC NRC license and terminate the license.

3.0 Facility Description

The DORF is located within the metropolitan area of Washington, DC, at the Forest Glen Annex of WRAMC, approximately eight miles north of the center of Washington, DC in Silver Spring, MD. The DORF site, which is part of the larger Forest Glen Annex, covers 4.2 acres and is surrounded by a perimeter exclusion fence with a single gated entrance. The research reactor was housed in a two-story building (Building 516) constructed of brick and reinforced concrete and secured with locked metal doors. The reactor pool extended from the first floor into the

basement of the building. Building 516 measures 65 feet by 50 feet by 25 feet high, with approximately 6,900 square feet of floor space.

Building 513, also within the fenced area, is a one-floor brick building (approximately 600 square feet) that was used for instrument and equipment storage during the research reactor operations, but was not utilized or impacted by the WRAMC waste handling activities.

4. 0 Radiological Status of Facility

Following termination of the operation of the Army research reactor at the DORF, Rockwell was contracted to decommission the facility. As indicated, these decommissioning activities included removal and offsite transportation of fuel elements and radiologically contaminated reactor components and structures. In the exposure room associated with the reactor, neutrons generated during the reactor operations resulted in neutron activation of stable cobalt and europium elements in the reinforced concrete that resulted in concentrations of Co-60 (half-life 5.26 years), Eu-152 (half-life 12.7 years), Eu-154 (half-life 16 years) at depth within the concrete. Although contamination levels were non-uniform, the levels were generally higher on the concrete surfaces closer to the reactor. In the contract issued to Rockwell for dismantlement of the research reactor, the Army specified the values in Table I of NRC Regulatory Guide 1.86, "Termination of Operating Licenses for Nuclear Reactors", as the governing document for the cleanup. In addition, Rockwell established lower target values so that the cleanup effort would result in residual contamination levels that would be considered to be "as low as reasonably achievable." The post-remediation surveys conducted by Rockwell and subsequent confirmatory measurements by the U.S. Army Environmental Hygiene Agency indicated that the Table I values from Regulatory Guide 1.86 had been met in all areas, and the lower Rockwell target values were met in all areas except for in the exposure room. In all of the areas, the acceptable surface contamination levels (levels in disintegrations per minute per 100 square centimeters) were met; however the criteria for beta-gamma dose rate (levels in millirad per hour) were not met for the Rockwell criteria. Although approximately 40,000 pounds of activated concrete adjacent to the reactor were removed and disposed as radioactive waste, some neutron activated reinforced concrete was left in place. Elevated exposure rates (contact readings as high as 0.4 millirad per hour, but less than the 1.0 millirad per hour cleanup criterion) above natural background were measured in the exposure room; however, the Army reactor permit was terminated in early 1980 because the decontamination effort was sufficient to meet the criteria in NRC Regulatory Guide 1.86, "Termination of Operating Licenses for Nuclear Reactors."

As previously indicated, the NRC authorized the low-level waste support activities in an amendment to the WRAMC license approved on July 16, 1982. The WRAMC Health Physics Office staff collected low-level radioactive waste from the WRAMC research laboratories and hospital, transported these materials to the DORF for storage, surveying, and packaging. Radioactive waste was stored on shelves, refrigerators, and a walk-in freezer installed in the DORF until sufficient volumes were accumulated to make economical waste shipments to authorized facilities. Waste volume reduction was accomplished using a drum compactor and vial crusher for liquid scintillation vials. The radionuclides utilized in the hospital and research activities were primarily H-3, C-14, P-32, Cr-51, S-35, I-125, and I-131. The radionuclides identified in the activated concrete (Co-60, Eu-152, and Eu-154) were not utilized in hospital and research activities and thus not present in the WRAMC waste stored at the DORF.

In 1996, ARO staff commenced a review of documents regarding all operating and non-operating Army reactors to determine their current radiological status. At this time, the NRC had issued case-by-case cleanup criteria for decommissioned facilities, but was in the process of developing decommissioning regulations for inclusion in 10 CFR Part 20. To the extent practicable, the Army also utilizes the NRC requirements in 10 CFR Part 20 for its activities conducted with Section 91.b. material. Based on the Army's review of the DORF historical radiological surveys, the ARL was requested by the ARO to perform a radiological survey at the DORF to measure the radiological conditions at the DORF and determine if the results were consistent with NRC decommissioning standards under development. As indicated earlier, the radiological survey revealed low, but detectable ambient radiation exposure rates in the former exposure room in excess of normal background exposure rates. These radiation levels were attributed to the residual radioactivity in the concrete from the historical reactor operations. In response to that finding and in order to establish controls and monitoring procedures to prevent removal or disturbance of the activated concrete, the ARO issued Army Radiation Permit No. DORF-1-97 to the ARL. The permit was subsequently renewed in 2007 and expires in 2017. The WRAMC Health Physics Office continued utilizing Building 516 for radioactive waste operations up until these operations were moved to other locations and all WRAMC waste and associated equipment were removed as a result of the BRAC Commission determination to realign activities at the WRAMC.

The USACE was assigned to coordinate decommissioning activities at the DORF and contracted for a Final Status Survey (FSS) that was conducted from 2009 through 2010. All NRC-regulated low-level radioactive waste possessed under the WRAMC license and all equipment used for storage and handling the NRC-licensed waste were removed from the facility in advance of the radiological survey. The contractor for the survey used historical information and prior survey results to characterize the radiological conditions of the facility. The facility was divided into logical Operating Units (survey units) for the FSS and radiological surveys commensurate with the area classifications were then conducted. Action levels for the survey were set to the screening values in Appendix B to NUREG-1757, Vol. 1, "Consolidated Decommissioning Guidance." The NUREG-1757, Vol. 1, Table B-2 screening values for surface soil contamination were used as action levels for comparison to the volumetric contamination data for the concrete. A 10 microroentgen per hour ($10 \mu\text{R/hr}$) action level for gamma exposure rate was also established. The screening values in NUREG-1757, Vol. 1 have been developed by the NRC so that a facility remediated to these levels would meet the dose limits in 10 CFR Part 20, Subpart E. However, in this case, the Army used the screening values and their exposure rate as Action Levels for determining if additional measurements were needed to meet the NRC dose criteria in 10 CFR 20.1402 for release for unrestricted use.

With the exception of the exposure room, the radiological surveys in all of the areas throughout Building 516, the Building 516 roof, Building 513, outdoor areas surrounding the buildings, and areas in the vicinity of the underground storage tanks that had been removed demonstrated no radioactivity levels in excess of the NUREG-1757 screening criteria. In the exposure room, some surface scans for beta activity on the walls exceeded the screening criteria; however, these surface scan results were attributable to the volumetric concrete contamination. Areas adjacent to the walls, floor, and ceiling all exceeded the 10 microroentgens per hour ($10 \mu\text{R/hr}$) action level for gamma exposure rate. All surface measurements for low-energy beta-emitting radionuclides (i.e. H-3 and C-14), alpha activity, and all removable activity were well less than the corresponding screening criteria. Gamma spectrometry measurements on concrete cores removed from the walls, floor, and ceiling confirmed the presence of Eu-152 in some of the concrete samples at levels above the

screening levels. Due to radioactive decay, only very low levels of Eu-154 were detected in some samples and Co-60 was not detected in any samples.

In addition to the concrete cores obtained from the exposure room, the contractor also cored holes into the reactor pool to obtain samples of the concrete and fill. Gamma spectrometry on these samples identified only naturally-occurring radionuclides in these samples.

Because the volumetric contamination in the concrete in the exposure room caused some of the measurements to exceed the Army's Action Levels, in early 2012, the contractor performed a series of supplemental integrated dose rate measurements in the exposure room to assess the potential dose to a hypothetical office worker. The dose rates were measured at points near each wall and in the center of the room. The average net dose rate was determined to be 8 μ R/hr. The Army concluded that the potential dose to a hypothetical office worker, based on a reasonable, conservative occupancy scenario, would be approximately 16 mrem/year, which is less than the criterion of 25 mrem/year in 10 CFR 20.1402.

5.0 Technical Evaluation

Building 516 at the DORF housed an Army research reactor (authorized under Section 91.b. of the AEA). Operation of the reactor resulted in neutron activation of stable cobalt and europium elements in the reinforced concrete in the walls, ceiling, and floor of the exposure room. Beginning in 1979, decommissioning activities conducted after the reactor operations were terminated removed the reactor fuel, reactor systems, and a large portion of the activated concrete. Radiological surveys conducted following completion of decommissioning demonstrated that the release criteria had been met; however, because some of the activated concrete remained, residual concentrations of Co-60, Eu-152, and Eu-154 were present in these structures that resulted in low, but detectable ambient radiation exposure rates in excess of normal background exposure rates remaining in the exposure room. At this time the Army permit for the test reactor was terminated. As indicated previously, following completion of decommissioning, in an amendment to the WRAMC license issued in 1982, the NRC authorized the WRAMC to use the DORF for storage and packaging of radioactive waste from research and hospital operations. Subsequent radiation measurements performed by the Army in 1996 in Building 516 that confirmed elevated radiation levels were still present in the building led the ARO to re-issue a permit to the ARL for the facility. The DORF was thus an authorized location of use under NRC License No. 08-01738-02 for the WRAMC as well as being permitted by the Army for the 91.b. material.

Following the determination from the BRAC Commission to realign operations at the WRAMC complex, except for DORF, licensed activities at the main hospital and other sites listed as authorized locations of use on the license were removed from the license after having met the NRC criteria for release for unrestricted use or were removed as authorized locations of use from the license through transfer to other NRC licenses within the U.S. Department of Defense. Radiological surveys conducted following removal of the WRAMC licensed material from the DORF confirmed that all the NRC-licensed material had been removed from the facility. Observations during an NRC inspection in 2013 of the DORF also confirmed that no licensed material was present. Residual activity, in excess of natural background levels, remaining at DORF existed solely due to the historical Army research reactor operations. Radiation dose rates measured at the DORF in 2012 and used in a conservative occupancy scenario indicated that the levels of residual contamination would result in an annual radiation dose of approximately 16 millirem and thus would meet the annual dose limits in 10 CFR Part

20, Subpart E (25 millirem). NRC reviewed the radiation surveys of the facility and also reviewed the occupational dose scenario and confirmed the Army's conclusions. Using the generic basis described in NUREG 1757, Volume 2, staff also evaluated the requirement in 10 CFR Part 20, Subpart E that residual radioactivity be reduced to levels that are As Low As Reasonably Achievable (ALARA). Staff determined that any additional remediation would involve shipping a large volume of radioactive waste to a low-level waste disposal facility and would not be cost effective for unrestricted release due to the high costs of transportation and disposal. Staff concluded that a specific analysis to meet the requirement in 10 CFR Part 20, Subpart E that residual radioactivity be reduced to levels that are ALARA was not required and that the ALARA criterion was met via the generic basis from NUREG 1757, Volume 2. Because NRC-regulated materials are no longer present at the facility and the potential dose to individuals is less than the limits in 10 CFR Part 20, Subpart E, and the previous remediation met the criterion that residual radioactivity was reduced to levels that are ALARA, no further decommissioning activities by WRAMC are needed. The facility meets the requirements for release for unrestricted use.

6.0 Environmental Considerations

Decommissioning of the NRC-licensed material in Building 516 at the Forest Glen Annex was performed by the licensee utilizing routine radioactive waste handling and radiological survey procedures that were not different from the routine operating procedures. Building 513 thus did not contain any NRC-licensed materials and had not been used for reactor operations and did not require any decommissioning work. A routine radiological survey was performed that confirmed that no radioactive materials were present in the building. The procedures employed in the decommissioning of Building 516 only involved the relocation and shipment for disposal of packaged low-level radioactive waste and the routine removal of support equipment (i.e shelves, refrigerator) and the conduct of a radiological survey to confirm residual activity levels in the building. These activities did not generate any airborne concentrations of radioactive material or release of radioactivity to the environment that were significantly higher than routinely encountered during operations. A review of the WRAMC license (NRC License No. 08-01738-02) did not identify any license condition that required submitting a decommissioning plan. Therefore, a decommissioning plan was not required to meet the regulations in 10 CFR 30.36 (g)(1).

Following removal of all NRC-licensed material from the facility along with the associated storage and handling equipment, the Army commissioned radiological surveys to be conducted to identify and quantify any residual contamination or radiation levels remaining in the facility. These radiological surveys did not identify any residual radioactivity that was attributable to the NRC-licensed activities that had been conducted at the facility. The radiological surveys did identify low, but detectable, ambient radiation exposure rates in the former exposure room. The elevated exposure rates were attributable to neutron activation in concrete associated with the historical operations of the test reactor by the Army. Based on these measurements, the Army calculated that the potential dose to a hypothetical office worker, distinguishable from background radiation, based on a reasonable, conservative occupancy scenario, would be approximately 16 mrem/year, which is less than the criterion of 25 mrem/year in 10 CFR 20.1402. NRC staff reviewed the Army's data and confirmed their conclusion.

Because the decommissioning of the facility was limited to the use of radioactive materials in such a manner that a decommissioning plan is not required by 10 CFR 30.36(g)(1) and the NRC determined that the facility meets the radiological criteria in 10 CFR 20.1402 without further

remediation or analysis, an environmental assessment for this action is not required since this action is categorically excluded under 10 CFR 51.22(c)(20)(iii).

7.0 Summary and Conclusion of Technical Evaluation

The NRC staff has completed its review of the Army's request to remove the DORF (Buildings 513 and 516) from the WRAMC's NRC License Number 08-01738-02, and subsequently terminate the license. The NRC's technical evaluation included the staff's review of the Army's Final Status Survey Reports (FSSRs), review of NRC licensing documents, and consultation with staff from the ARL. Based on a review of radiological survey results accompanying the Army's request to remove the two buildings from the license and terminate the license and observations from a July 2013 inspection, the staff determined that the Army has adequately demonstrated that NRC-licensed materials possessed under the WRAMC NRC license no longer remain at the facility. In regard to the residual radioactivity embedded in the concrete as a result of the historical test reactor operations used under the authority of Section 91.b. of the AEA, the Army utilized the measured exposure rates from their radiological surveys in Building 516 and concluded that based on a reasonable, conservative occupancy scenario, the potential dose to a hypothetical office worker, would be approximately 16 mrem/year, which is less than the criterion of 25 mrem/year in 10 CFR 20.1402.

The NRC staff reviewed the Army's radiological survey data and calculations and confirmed the Army's assessment that the measured radiation exposure rates in Building 516, distinguishable from background radiation levels, would not result in an annual exposure rate exceeding the criteria in 10 CFR 20.1402, and also concluded that the previous remediation activities were sufficient to meet the criterion that residual radioactivity was reduced to levels that are ALARA; therefore the facility may be considered acceptable for unrestricted use and no further remediation activities are needed. Based on the information provided, the NRC staff determined that, in accordance with 10 CFR 30.36(k), that: (1) licensed material has been properly disposed; (2) reasonable effort has been made to eliminate residual radioactive contamination; (3) the licensee has submitted site radiological survey and other information that demonstrates that the site is suitable for release for unrestricted use in accordance with the radiological criteria for license termination in 10 CFR Part 20, Subpart E; and (4) records required by §§30.51(d) and (f) have been received. Therefore, because there is no longer any NRC-regulated material at the DORF, and the residual radiation exposure rates as a result of the residual contaminated concrete from the Army test reactor operations meets the criteria for release for unrestricted use, the facility may be removed as an authorized location of use under NRC License Number 08-01738-02. Also, because this facility is the only remaining authorized location of use under the WRAMC NRC license, NRC License Number 08-01738-02, issued to WRAMC, may also be terminated.

8.0 Principal Contributor

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9.0 References

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