



**UNITED STATES  
NUCLEAR REGULATORY COMMISSION**  
REGION I  
2100 RENAISSANCE BLVD.  
KING OF PRUSSIA, PA 19406-2713

March 18, 2019

Harold Foley III  
Cherry Avenue Partners, LP  
325 Splading Gates Court  
Atlanta, GA 30328

SUBJECT: BENRUS CLOCK FACTORY, REQUEST FOR UNRESTRICTED RELEASE,  
DOCKET NO. 03038943

Dear Mr. Foley,

This is in response to the Cherry Avenue Partners, LP request in your letter dated February 14, 2018 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML18053A134) that the U.S. Nuclear Regulatory Commission (NRC) approve the Former Benrus Clock Factory site at 145 Cherry Avenue in Waterbury, Connecticut as acceptable for unrestricted release. Please find enclosed with this letter the Technical Evaluation Report associated with our review supporting approval of your request. The NRC staff has concluded that the residual radioactivity remaining on the building surfaces at the Former Benrus Clock Factory site meets the criteria of 10 CFR 20.1402 for unrestricted release (25 mrem/year) and the State of Connecticut annual dose limit (19 mrem/year). The property at 145 Cherry Avenue, Waterbury, Connecticut may be released for unrestricted use.

In accordance with 10 CFR 2.390, a copy of this letter and its enclosure will be available electronically for public inspection in the NRC Public Document Room or from the NRC's ADAMS, accessible from the NRC Web Site at <http://www.nrc.gov/reading-rm/adams.html>.

If you have any questions concerning this letter, you may contact Briana DeBoer, of my staff, at 610-337-5370, or [Briana.DeBoer@nrc.gov](mailto:Briana.DeBoer@nrc.gov).

Thank you for your cooperation.

Sincerely,

*/RA/*

James M. Trapp, Director  
Division of Nuclear Materials Safety  
Region I

Docket No. 03038943

Enclosure: Technical Evaluation Report

cc: State of Connecticut

BENRUS CLOCK COMPANY, REQUEST FOR UNRESTRICTED RELEASE, DOCKET NO. 03038943 DATED MARCH 18, 2019

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DATE	2/13/19	2/13/19	2/13/19	2/14/19	
OFFICE	RI/ORA	RI/DNMS	RI/DNMS		
NAME	BKlukan/BK	RPowell/RP	JTrapp/JT		
DATE	2/28/19	3/5/19	3/18/19		

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**TECHNICAL EVALUATION REPORT  
COMPLETION OF REMEDIATION ACTIVITIES  
FORMER BENRUS CLOCK FACTORY SITE, WATERBURY, CONNECTICUT  
DOCKET 030-38943**

**February 2019**

**1.0 INTRODUCTION**

**1.1 Cherry Avenue Partners, LP, Submittal and Request**

In a letter dated February 14, 2018 (Agency Documents Access and Management System (ADAMS) Accession No. ML18053A134), Cherry Avenue Partners, LP, current owner of the Former Benrus Clock Factory site (Former Benrus site) at 145 Cherry Avenue, Waterbury, Connecticut, submitted a notification that the radium contamination cleanup project conducted by their contractor, Decontamination Decommissioning and Environmental Services, LLC (DDES) at the Former Benrus site had been successfully completed. The letter from Cherry Avenue Partners referenced the January 19, 2018, Final Status Decontamination & Cleanup Survey Report (Cleanup Survey Report) (ADAMS Accession Nos. ML18248A338, ML18248A337, and ML18248A336) prepared and submitted by DDES to the NRC in a series of emails (ADAMS Accession Nos. ML18248A333, ML18248A334, and ML18248A335). The Cleanup Survey Report describes the results of remediation and final status survey activities conducted by DDES at the Former Benrus site in accordance with the May 17, 2017, Cleanup Plan – Former Benrus Clock Factory Site (Cleanup Plan) (ADAMS Accession No. ML17165A067) and the May 18, 2017, Former Benrus Clock Factory Site – Radiological Final Status Survey Plan (Final Status Survey) (ADAMS Accession No. ML17165A066). Implementation of the Cleanup Plan was intended to reduce radium contamination at the Former Benrus site to levels that would allow unrestricted release of the site in accordance with NRC requirements. In their February 14, 2018, letter, Cherry Avenue Partners, LP included confirmation that all radium-impacted wastes had been shipped from the site for disposal at an authorized facility and also requested NRC approval of the site as acceptable for unrestricted use.

This Technical Evaluation Report summarizes the actions taken by the NRC staff and contractors to identify and evaluate the presence of radium-226 (Ra-226) contamination at the facility, documents the NRC staff evaluation of the DDES Cleanup Survey Report and the associated September 2018 Confirmation Survey Report for the Former Benrus Clock Company (ORAU Confirmatory Survey Report) (ADAMS Accession No. ML18257A249) conducted by the NRC's contractor, Oak Ridge Associated Universities (ORAU), and documents the NRC staff's assessment regarding the acceptability of the facility for release for unrestricted use.

**2.0 BACKGROUND**

**2.1 Regulatory Basis**

The Energy Policy Act of 2005 (EPAct) amended section 11e.(3) of the Atomic Energy Act of 1954 to place discrete sources of Ra-226 under NRC regulatory authority as byproduct material. The EPAct, in part, expanded the definition of byproduct material to include certain discrete

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sources of Ra-226. The NRC subsequently amended Parts of Title 10 of the Code of Federal Regulations to implement provisions of the EPA Act.

Because of the recognized hazard of Ra-226, the NRC staff, through its contractor, Oak Ridge National Laboratory (ORNL), initiated an effort to identify non-military sites with potential Ra-226 contamination in order to identify and evaluate potential residual Ra-226 contamination remaining at these sites that handled Ra-226. The ORNL effort resulted in a list of sites that potentially possessed discrete sources of Ra-226 along with additional information regarding the sites. The additional information collected on these sites typically included the type of work performed with Ra-226, locations of use within site buildings, the results of any historical radiological surveys, and if any Ra-226 remediation efforts were conducted. The ORNL effort was not intended to verify whether Ra-226 actually existed at these sites.

The use of Ra-226 at these identified sites pre-dates licensing by the NRC or its predecessor, the Atomic Energy Commission. Although the sites identified are not licensed, NRC initiated a special effort to evaluate potential Ra-226 contamination at these sites to determine if levels presented any public health hazard and required subsequent remedial action to reduce or eliminate the hazard. In order to assess residual contamination at these sites, NRC staff, along with its contractor ORAU, prepared a Temporary Instruction to the NRC Inspection Manual (Temporary Instruction 2800/043, Inspection of Facilities Potentially Contaminated with Discrete Radium-226 Sources, (ADAMS Accession No. ML16035A053) that provided a series of steps to be conducted by NRC staff and their contractors for conducting outreach to site owners, arranging for site visits, and evaluating the potential Ra-226 contamination at these sites. This Temporary Instruction was subsequently revised (ADAMS Accession Nos. ML16330A678 and ML17297B921) to incorporate refinements to the evaluation process.

The scope of the Temporary Instruction was limited to providing guidance for planning, conducting, and reporting on special radiological surveys of commercial, medical, or research sites potentially contaminated with Ra-226 that were identified in the earlier ORAU effort. These radiological surveys were typically performed in two steps: 1) an initial site visit and survey and 2) a subsequent more detailed scoping survey. The objectives of the initial site visit were to determine if discrete sources of Ra-226 and/or distributed Ra-226 contamination were present, to identify the areas of highest contamination, to determine if there were any current health and safety concerns, and to determine if a more in-depth scoping survey to better reach a conclusion on whether site cleanup was needed or to identify any follow-up access control actions.

The Temporary Instruction identified the NRC's dose limit in 10 CFR Part 20, Subpart E – "Radiological Criteria for License Termination," and specifically 10 CFR 20.1402, "Radiological Criteria for Unrestricted Use," (annual dose limit of 25 millirem<sup>1</sup>) as the applicable criterion for determining if remediation was necessary at a site. Data collected during the initial site visit was used to plan future actions that may be needed to reduce the exposure of Ra-226 to current or future site occupants to levels that do not exceed the applicable regulatory requirement. Because potential sites were limited to geographical areas where NRC had jurisdiction, (non-Agreement States), the Temporary Instruction assigned NRC regional staff the responsibility to coordinate activities with the appropriate radiological control program staff within the state. It should also be noted that because the Former Benrus site is located in the State of Connecticut,

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<sup>1</sup> 1 mrem is equivalent to  $1 \times 10^{-5}$  Sievert (Sv)

the post-remediation dose limit for the State (19 mrem/year, (Remediation Standards for Radionuclide Contamination in Connecticut, Connecticut Department of Environmental Protection and Connecticut Department of Public Health) is also applicable in determining if the site can be released in accordance with the State regulations.

## 2.2 Site History and Description

The NRC staff evaluated the information generated by ORNL on properties where historical information had indicated Ra-226 was previously used. The property at 145 Cherry Avenue in Waterbury, Connecticut, was identified as the former Benrus Clock Factory site, a manufacturing facility that used Ra-226 in the manufacture of radioluminescent dials on timepieces. The facility operated from the 1920s to the mid-1940s. At some later date, the property was transferred to the Bender Plumbing Company, who used the facility for the operation of the company's plumbing supply business, which included storage of material.

The main building (Figure 1) is a seven-story structure with a combination of brick and poured concrete walls, wood floors (possibly original), and concrete columns at regular intervals within the interior (Figure 2 shows the floor plan for floors 1 – 7). The main (first story) level was used for operation of the Bender Plumbing Company with the remaining floors used to store equipment and supplies. Additional and adjoining warehouse and office space was constructed outside the main building footprint after Ra-226 operations had been terminated.

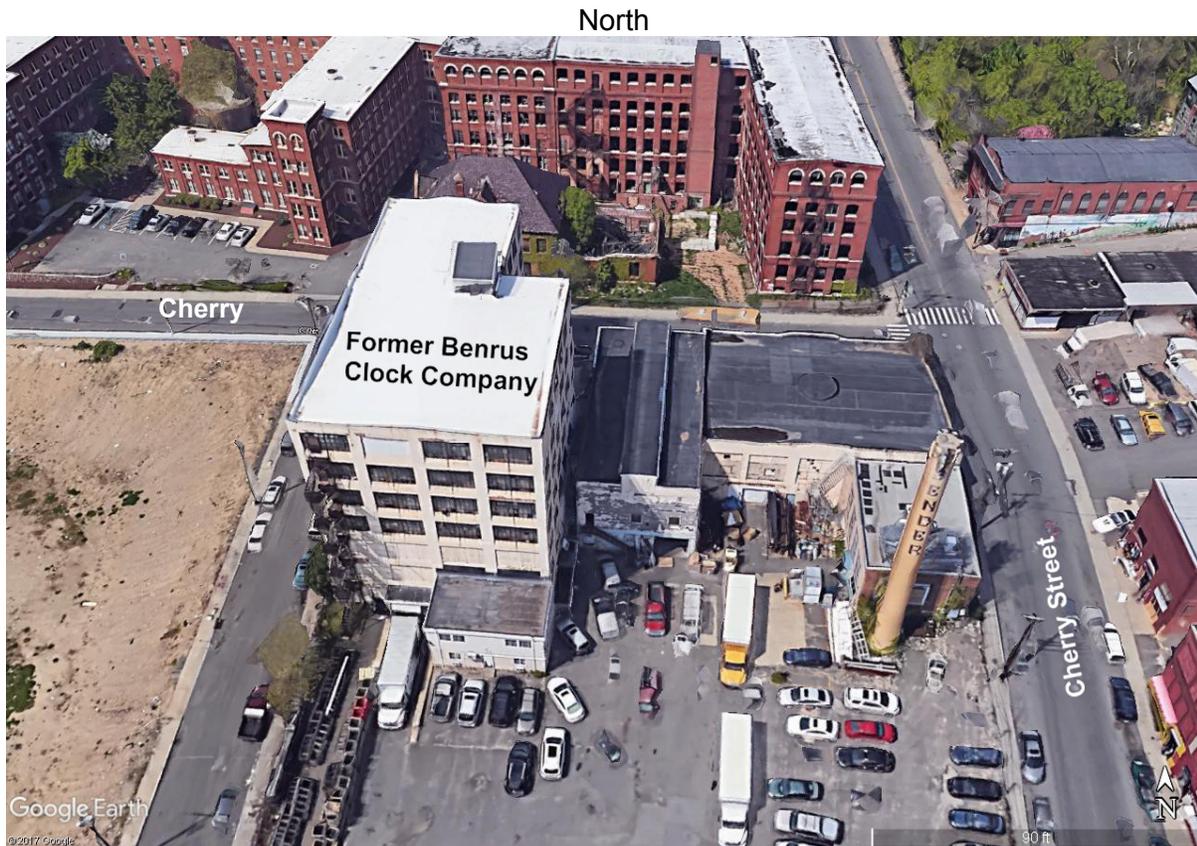


Figure 1. Former Benrus Clock Company, Waterbury, CT, (Google Earth)

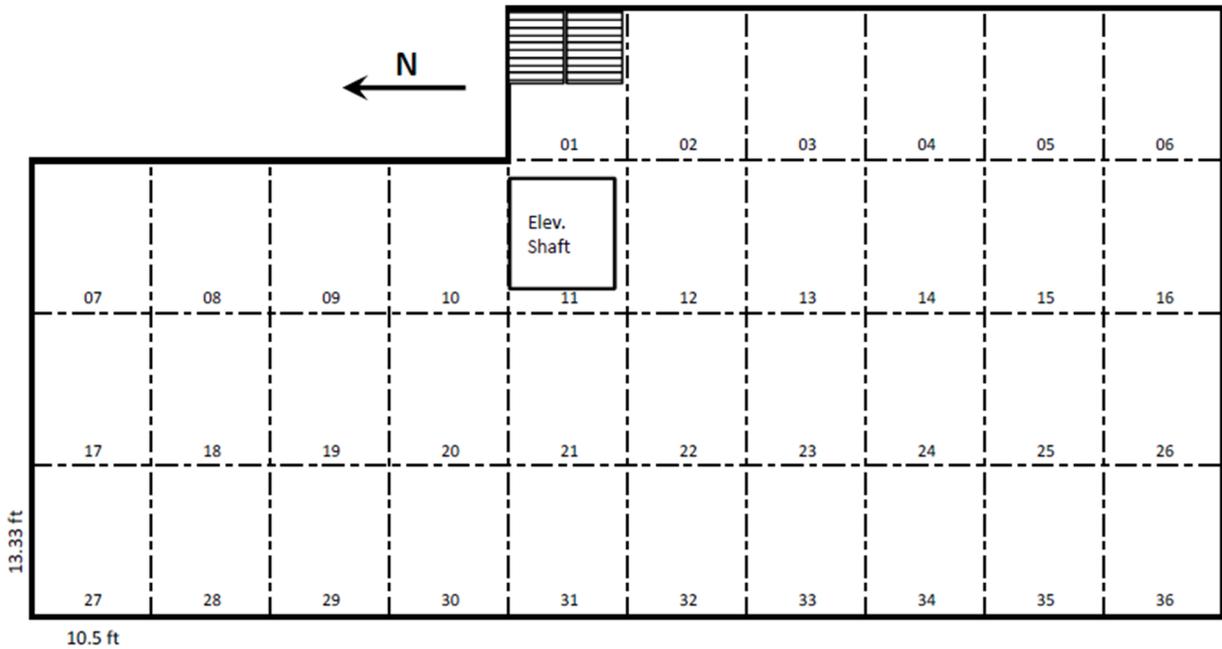


Figure 2. Benrus Floor Plan (Floors 1-7)

The ORNL information generated for this site identified that historical radiological surveys were performed in the building in 1998, 1999 and 2003. Data from these surveys confirmed that Ra-226 contamination was identified on the 4th, 5th, and 7th floors.

### 3.0 SITE ASSESSMENTS

#### 3.1 Initial Site Visit Results

Utilizing the guidance in Temporary Instruction 2800/043, Inspection of Facilities Potentially Contaminated with Discrete Radium-226 Sources, in a letter dated October 6, 2016 (ADAMS Accession No. ML16277A291), the NRC contacted the current site owner to arrange an initial visit to the former Benrus site to assess potential Ra-226 contamination. On November 7 and 8, 2016, an NRC inspector and technical staff from ORAU, the NRC's radiological measurements contractor, performed a series of radiological measurements, including smear measurements to evaluate removable contamination, throughout accessible portions of the seven-story building, adjacent structures, and the immediate exterior areas of the buildings. The inspection team was accompanied by representatives from Bender and a representative from the Radiation Division of the Connecticut Department of Energy & Environmental Protection (CT DEEP). Although the inspection team had access to all areas of the site buildings, only about 50 percent of the building surfaces were able to be surveyed due to the presence of stored plumbing supplies, boxed records, and furniture.

The inspection team's measurements included gamma and alpha plus beta measurements to evaluate radiological conditions in the buildings. The measurements obtained essentially confirmed the elevated results from the previous surveys and confirmed the presence of

Ra-226. Gamma exposure rates on the seventh floor were in excess of NRC requirements for unrestricted use. Elevated radiation levels that may have required remediation were also identified on the fourth and fifth floors. Less significant elevated levels were also identified on the remaining floors. Limited measurements in the adjoining buildings (expected to be non-impacted because they were not part of the original structure) and in exterior areas were not distinguishable from background radiation exposure rates. As previously noted, however, obstacles covering a large fraction of the floor prevented a full assessment of areas. Smear measurements for removable contamination confirmed that only about 1 percent of the total contamination was readily removable with the remainder imbedded on floor and wall surfaces.

Discussions with the building owner indicated that based on the previous radiological surveys, he had put access controls in place to limit potential exposure to personnel on the floors with elevated readings. The building owner also indicated that they would be vacating the building to move to a new facility and the building's new ownership intended to renovate the building for residential and commercial use. At this time, NRC deferred a follow-up scoping survey because access controls were in place and although renovation plans were not complete, a characterization survey was expected to be completed prior to initiation of remediation activities.

### **3.2 Characterization Survey Results**

In early 2017, Bender Plumbing completely vacated the site. The entity that was to be the new ownership group, Cherry Avenue Partners, LP, retained DDES to perform a radiological characterization of the site to identify and quantify Ra-226 contamination levels and to develop cost estimates for remediation of contaminated areas to levels that would permit release for unrestricted use, with consideration that the foreseen use of the facility would be residential.

DDES developed a characterization plan for the facility and implemented the plan from April 19 through May 5, 2017. The survey was performed using guidance from the NUREG-1757, Consolidated Decommissioning Guidance series of documents and NUREG-1575, Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM). DDES performed the survey activities using procedures from its Commonwealth of Massachusetts Radiation Control Program License No. 56-0623, with the work performed under a reciprocity agreement with the NRC. A copy of the characterization survey results (ADAMS Accession No. ML17165A068) were provided to the NRC. In developing the target remediation criteria, DDES used the Connecticut 19 mrem/year annual dose limit to determine the extent of remediation required. All seven floors of the building were completely surveyed in order to determine if remediation would be required. Using guidance from MARSSIM, DDES divided the building into 49 survey units and determined 23 required remediation in order to meet the release criteria. These survey units were primarily located on floors 4, 5, and 7, in agreement with the NRC/ORAU survey and previous historical survey data. The characterization survey included both direct measurements for total contamination and smear measurements for removable contamination. Only three smear sample results were above the detection level, confirming that the Ra-226 contamination was generally not removable.

## **4.0 SITE REMEDIATION AND SURVEYS**

### **4.1 Cleanup Plan**

In addition to performing the site characterization, DDES was also retained by Cherry Avenue Partners, LP, to develop a site cleanup plan, based on the results of the characterization survey. The plan was developed using the guidance in the NUREG-1757, Consolidated Decommissioning Guidance series of documents and NUREG-1575, (MARSSIM). The cleanup levels (Derived Concentration Guideline Levels (DCGLs)) were developed in consideration of the 19 mrem/year State of Connecticut annual dose limit for radionuclide remediation.<sup>2</sup> Copies of the Cleanup Plan, Former Benrus Clock Factory Site, Waterbury, Connecticut dated May 17, 2017 (ADAMS Accession No. ML17165A067) and the Former Benrus Clock Factory Site, Radiological Final Status Survey Plan dated May 18, 2017 (ADAMS Accession No. ML17165A066) were submitted to the NRC for review.

In the Benrus Cleanup Plan, DDES calculated a DCGL of 819 disintegrations per minute/100 square centimeters (dpm/100 cm<sup>2</sup>) for total radium contamination using the DandD version 2.4 computer code. (The technical basis for the NRC dose model assumes no more than ten percent of the contamination (82 dpm/100 cm<sup>2</sup>) is removable). The 819 dpm/100 cm<sup>2</sup> value was intended to meet the State of Connecticut 19 mrem/year dose limit as well as satisfying the NRC criterion of 25 mrem/year. In the development of the guidance for assessing radium contamination at sites, NRC staff, along with their contractor ORAU, prepared a guidance document that provides an acceptable methodology for demonstrating levels of contamination from discrete sources of radium that would provide confidence that exposures would remain below the unrestricted release criterion in 10 CFR 20.1402. This document, "Dose Assessment Technical Basis Document for Potential Exposure to Discrete Sources of Radium-226 and Associated Contamination" (ADAMS Accession No. ML17152A204) (Dose Assessment Technical Basis Document) considered both industrial and residential building occupancy scenarios for structures to account for any likely typical future use scenarios. In the Benrus Cleanup Plan, the facility was reported as being redeveloped for residential use.

Using Dose Assessment Technical Basis Document input parameters, site-specific data on removable contamination levels, and the DandD Version 2.4 computer code, NRC staff performed an independent analysis of the DCGL values computed by DDES. This independent NRC analysis for the site yielded a Ra-226 total contamination value of 1200 dpm/100 cm<sup>2</sup> that would result in a 25 mrem/year annual dose. For the Connecticut 19 mrem/year annual dose limit, the value would be 940 dpm/100 cm<sup>2</sup>. The calculated DCGL of value of 819 dpm/100 cm<sup>2</sup> thus satisfies both the NRC and State of Connecticut annual dose limits. It should be noted that this analysis is very conservative since the assumption is that the entire facility has been cleaned to the DCGL level. The DDES characterization data had indicated that approximately half of the facility (primarily the lower floors) had no indication of historical Ra-226 contamination.

In their analysis, the NRC noted that certain inherent site assumptions must be true to satisfy the applicability of the calculated values for meeting the annual dose limits. The assumptions to be verified include: 1) residual radioactivity is limited to building surfaces; 2) if residual radioactivity exceeds 10 percent of the DCGL, the removable fraction must not exceed

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<sup>2</sup> Derived Concentration Guideline Levels (DCGLs) are radionuclide-specific concentration limits used to guide clean-up of a decommissioning site to meet radiological criteria for site release.

10 percent of the total contamination; and 3) for multiple radionuclide contaminants, the sum of the fractions must remain below unity. Applicable data from the DDES characterization survey confirmed that assumptions 2 and 3 are satisfied because virtually all contamination measurements indicated that contamination was not removable and the radionuclide of concern was limited to Ra-226. NRC staff experience has generally indicated that Ra-226 contamination in similar facilities has been limited to surface contamination due to the nature of the materials used and methodology for application of Ra-226 to the faces of timepieces. Discussions with DDES confirmed that based on their experience with similar Ra-226 decommissioning projects, contamination was typically limited to surfaces (versus volumetric). Additionally DDES staff indicated that if volumetric contamination was encountered, it was more economical to dispose of the material rather than to attempt cleaning. [Note: After completion of remediation and final status survey activities, NRC requested DDES to provide confirmation that any residual contamination was superficial and thus the dose model assumptions were valid. DDES provided an affirmative response in a September 25, 2018 email (ADAMS Accession No. ML18275A298)].

In a September 25, 2017 letter to DDES (ADAMS Accession No. ML17269A149), the NRC indicated that they had no further questions regarding the Benrus Cleanup and Final Status Survey Plans, and DDES could proceed with their remediation and survey activities at the site.

#### **4.2 Remediation Activities**

In October 2017, DDES initiated remediation and site radiological survey activities at the Former Benrus site. Remediation and survey activities were completed on January 9, 2018. In their review of the Cleanup Plan, NRC staff noted the majority of the impacted areas were wood floors, with the remainder being brick walls or concrete floors. The contaminated surfaces of the wood floors were planed, sanded, and vacuumed to remove contamination to levels that would permit unrestricted use. Floor sections with significant contamination levels were completely removed and disposed as radioactive waste. Concrete and brick surfaces were scabbled to remove the superficial layer of the contaminated surface. Contaminated radiators were removed and disposed as radioactive waste. Decontamination activities were typically conducted using containment structures with a high efficiency particulate air (HEPA) filtered exhaust. Scabbling and vacuum equipment were also equipped with HEPA filtration to capture particulate effluents.

The initial assessment of Ra-226 contamination on the wood floors of the building identified a layer of felt between the top two layers of flooring. The felt layer was identified as an asbestos-containing material (ACM). DDES determined that the ACM required specific remediation techniques and waste handling considerations on the portions of the floor that were being removed. The ACM remediation included, in part, plastic containment tents, filtered exhaust systems, and monitoring for control of asbestos fibers. Flooring that was removed was sized and packaged to meet State ACM disposal and transportation requirements. The packages were also sufficient to control release of the Ra-226 contamination.

Another challenge for the site remediation resulted from historical water infiltration (likely from broken windows) into areas that had been contaminated with Ra-226. The water infiltration spread Ra-226 contamination down some of the interior brick walls and onto floor joists supporting the wood floors. In areas of water infiltration, brick surfaces were scabbled to remove contamination and contaminated floor joists and floors were removed and disposed as

radioactive waste. An engineering contractor was subsequently retained to construct structural floor supports and access control barriers as safety measures where floor joists had been removed.

Remediation wastes consisted primarily of sections of contaminated wood flooring, but also included contaminated radiators, bricks, vacuum bags, plastic sheeting, and personnel protective equipment. Although the flooring was contaminated with Ra-226, the waste also contained ACM and had to be packaged in the more prescriptive requirements for ACM waste. Waste was staged in a secure, locked area and shipped offsite for disposal upon completion of the project. Approximately 90 cubic yards (approximately 100,000 pounds) of waste were shipped to the US Ecology facility in Grandview, Idaho for disposal. DDES provided signed copies of the non-hazardous waste manifests certifying that the waste was received for disposal at the Idaho facility (ADAMS Accession Nos. ML18330A061 and ML18330A062). Due to the relatively low average concentration of Ra-226 in the remediation wastes (approximately 11 picoCuries/gram), the material was not classified as radioactive waste in accordance with U.S. Department of Transportation regulations, but was shipped as an Environmentally Hazardous Substance due to the asbestos content. NRC staff confirmed that the US Ecology-Idaho facility is authorized to accept bulk quantities of Naturally Occurring Radioactive Material Other Than Uranium and Thorium Uniformly Dispersed in Soil or Other Media at concentrations less than 500 picoCuries/gram (averaged over the container or conveyance).

#### **4.3 Final Status Survey Results**

Following completion of remediation activities within the Former Benrus site, DDES performed radiological surveys to demonstrate compliance with the established cleanup criteria. The radiological surveys were designed to implement the guidance provided in MARSSIM and to demonstrate compliance with the cleanup and final status survey plans. As indicated above, DDES determined a total DCGL of 819 dpm/100 cm<sup>2</sup> (82 dpm/100 cm<sup>2</sup> removable) in order to be able to meet both the NRC and Connecticut annual dose limits for unrestricted use for remediated facilities. DDES also applied an administrative goal of 100 dpm/100 cm<sup>2</sup> total and 20 dpm/100 cm<sup>2</sup> removable as target remediation values and for consideration that the remediation activities were being conducted so that the residual radioactivity would be reduced to levels as low as reasonably achievable (ALARA). DDES reported that all of their final survey readings met the DCGL values and 88 percent of the final survey readings met the administrative/ALARA goal.

Final status survey measurements consisted of surface scans for alpha activity using a large area gas proportional detector and ratemeter (larger areas), surface scans for alpha activity using a Zinc Sulfide (ZnS) scintillation detector and ratemeter (small areas), smear measurements for gross alpha and gross beta activities using a ZnS and plastic scintillation detector and scaler (removable contamination), and a sodium iodide (NaI) scintillation detector (gamma dose rate). Instruments were calibrated with National Institute of Standards and Technology (NIST) traceable sources. Instrument functional checks for activity and background were performed each day instruments were used. Due to the inherent variability in background activity for the various types of surfaces being monitored, material specific background measurements were made for wood, concrete, brick, and metal. More than 10 percent of the measurements were duplicated as quality assurance checks. The duplicate measurements did not vary significantly from the original measurements.

Using the DandD computer code and the residential occupancy scenario parameters, DDES performed a dose calculation for the Former Berrus site using the highest measured value for residual contamination (210 dpm/100 cm<sup>2</sup>). The annual dose calculated by DDES from residual activity was 4.7 mrem/year using the very conservative assumption that the entire facility was uniformly contaminated at the maximum value. This calculated value meets the NRC (and Connecticut) annual dose limits for release for unrestricted use.

#### **4.4 ORAU/NRC Confirmatory Measurements**

Following completion of the remediation and survey activities, ORAU and NRC staff conducted a confirmatory radiological survey of the remediated areas of the Former Berrus site on January 9, 2018. The objective of the survey was to confirm that Ra-226 contamination had been remediated to levels that would produce an annual dose less than the 25 mrem/year NRC criterion for release for unrestricted use.

Confirmatory survey measurements consisted of gamma radiation scans using a 2-inch x 2-inch NaI scintillation detector and ratemeter, alpha plus beta direct measurements using a plastic scintillator detector and ratemeter, and a NaI scintillation detector for gamma dose rate. Smear samples were collected and submitted for gross alpha and gross beta analyses at a radio-analytical laboratory. The ORAU survey team concentrated their measurements in areas that had the highest contamination levels and required the most significant remediation. Gamma scans were performed on approximately 100 percent of the accessible areas of the 7<sup>th</sup> floor. Due to the removal of some sections of the floor, some 7<sup>th</sup> floor areas were not accessible; however, ORAU staff were able to use detectors affixed to extendable poles to enable surveys to be conducted beyond the personnel safety barriers and nearly all of the 7<sup>th</sup> floor was able to be surveyed. Approximately 50 to 75 percent of the 4<sup>th</sup>, 5<sup>th</sup>, and 6<sup>th</sup> floors were also surveyed by the ORAU team. As part of the confirmatory survey, ORAU staff also reviewed the DDES final status survey report. In addition to the ORAU/NRC measurements, staff from the CT DEEP were present to observe survey activities and also conducted gamma scan survey measurements and smear sampling on the 7<sup>th</sup> floor.

The ORAU survey identified a few small areas of elevated activity from their gamma scan measurements that DDES did not identify using the alpha-only measurements with the large area gas proportional detector. This suggests that the gamma measurements may often be more effective for locating discrete sources of Ra-226 if the alpha measurement efficiency is reduced due to the presence of dirt or other material. In some areas, ORAU noted that elevated measurements were attributed to naturally occurring radioactive material, especially in the exterior brick walls. For evaluation of elevated measurements, ORAU independently compared their measurement data to Table 6.1, Derived Screening Value Summary for Ra-226 and Associated Progeny for Building Surface Contamination Residential Scenario in the Dose Assessment Technical Basis Document. The values in Table 6.1 equate to an annual dose of 25 mrem for an area of a designated size contaminated with Ra-226. ORAU found two discrete areas on the 4<sup>th</sup> floor and two discrete areas on the 7<sup>th</sup> floor that exceeded the 630 dpm/100 cm<sup>2</sup> screening value for a large area source (> 10 m<sup>2</sup>) in Table 6.1. Total removal activity in each area was less than one percent of this value, which is in agreement with earlier characterization data that virtually all of the Ra-226 contamination was fixed on surfaces. ORAU determined that each of the four areas were highly localized (less than 0.1 m<sup>2</sup> in size). With consideration of the area factors in Table 6.1, a much higher contamination level (63,000 dpm/100 cm<sup>2</sup>) would

equate to the 25 mrem annual dose. Based on the ORAU data, the maximum contamination levels found were 1300 dpm/100 cm<sup>2</sup>, which does not approach the 63,000 dpm/100 cm<sup>2</sup> value.

ORAU used their data from the confirmatory survey along with the Dose Assessment Technical Basis Document to make dose estimates for the measured residual contamination. Using the confirmatory survey data, ORAU computed localized average contamination values in the vicinity of the locations of the identified elevated areas on the 4<sup>th</sup> and 7<sup>th</sup> floors. These localized average values were 440 dpm/100 cm<sup>2</sup> for the 4<sup>th</sup> floor and 280 dpm/100 cm<sup>2</sup> for the 7<sup>th</sup> floor. Using the Dose Assessment Technical Basis Document, the resulting dose to the average member of the critical exposure group (residential occupants) would be in conformance with the requirements of 10 CFR 20.1402 and State of Connecticut annual dose limits for unrestricted release. Dose pathways for residential occupancy include direct gamma exposure, inhalation, and secondary ingestion. These dose estimates are conservative given that the removable fractions are much less than the 10 percent assumption in the Dose Assessment Technical Basis Document (i.e., because the residual contamination is not removable, thus the inhalation and secondary ingestion pathways are not significant).

In addition to the small elevated areas identified by ORAU, CT DEEP staff found another four small areas on the 7<sup>th</sup> floor that they identified to the NRC inspectors. In lieu of any further analysis, DDES staff remediated and resurveyed the elevated areas identified by ORAU and the CT DEEP surveyors.

During the confirmatory survey process, the NRC inspectors noted that the primary measurement methodologies used by DDES for the Final Status Survey and those used by ORAU in the confirmatory survey were not similar, i.e., alpha-only scans by DDES with direct separate alpha and beta confirmatory measurements versus gamma scans with alpha plus beta direct confirmatory measurements by ORAU. In order to make an assessment of the DDES and ORAU measurements, the NRC inspectors requested that ORAU and DDES perform a series of direct side-by-side measurements at twenty locations using each of their direct measurement techniques. The two paired measurements were made as near as possible to the same location as each other. The objective of the paired measurements was to determine if the DDES results were consistent with ORAU results, or whether adjustments would be required to ensure final status survey data accurately represented site conditions. Using the data obtained from the paired measurements, the site-specific background measurements, and the reported instrument efficiencies, ORAU determined that both the alpha and beta efficiency determinations used by DDES were conservatively low, which would tend to overestimate the contamination levels reported by DDES.

#### **4.5 NRC Inspections**

An NRC Region I inspector performed an inspection at the former Benrus Clock Factory site when remediation activities were being initiated in October 2017. The inspector observed radiological survey activities, reviewed operating procedures, radiological training materials, and confirmed that radioactive waste was being securely stored. At the time of the inspection, asbestos containing material had just been identified beneath the top layer of flooring. The inspector observed the set-up of containment tents and associated ventilation equipment for removal of flooring contaminated with radium and asbestos containing material and observed training for the asbestos workers. No issues were identified. Results of the inspection are

documented in NRC Inspection Report 2017001 (Reciprocity docket number 15000020), dated October 20, 2017, (ADAMS Accession No. ML17305B395).

As discussed above, NRC inspectors also accompanied staff from the ORAU during their confirmatory radiological survey of the facility in January 2018 following completion of remediation activities. The inspectors observed the ORAU survey activities and, as indicated above, requested ORAU and DDES to make some side-by-side measurements in approximately 20 locations for direct data comparison. The inspectors also accompanied staff from the CT DEEP during their measurements.

#### **4.6 State of Connecticut Consultations**

Staff from the State of Connecticut DEEP performed measurements on sections of the locations of the slightly elevated areas they identified during radiological scans of the remediated areas. Because the DDES remediation contractor was still present at the site the day of the measurements, additional spot remediation was conducted in these areas to reduce the measured levels.

### **5.0 ENVIRONMENTAL CONSIDERATIONS**

#### **5.1 Evaluation of EPA/NRC Memorandum of Understanding Consultation Triggers**

The NRC staff considered whether concentrations of residual radioactivity in soil or ground water would trigger consultation with the U.S. Environmental Protection Agency (EPA) under the EPA/NRC Memorandum of Understanding (MOU) (see NUREG-1757, Vol. 1, Rev. 2, Appendix H). At the Former Benrus site, Ra-226 contamination was not identified in any exterior soil areas and there is no groundwater involvement. Contamination was limited to building interior surfaces. Therefore, NRC staff concluded that the conditions in the MOU have not been met to trigger consultation with the EPA.

#### **5.2 10 CFR Part 51 Evaluation**

A proposed action is eligible for a categorical exclusion or otherwise not required to have an environmental review under Title 10 of the *Code of Federal Regulations* (10 CFR) 51.22(c)(20) if it is related to the decommissioning of a site where a decommissioning plan is not required by 10 CFR 30.36(g)(1), 40.42(g)(1), or 70.38(g)(1) and the NRC has determined that the facility meets the radiological criteria for unrestricted use in 10 CFR 20.1402 without further remediation or analysis.

The action under consideration by NRC staff is the determination that the former Benrus Clock Factory site is acceptable for unrestricted use without further remediation or analysis. Because the site is not licensed by the NRC, there was no license condition for the site requiring submission of a decommissioning plan. Therefore, the NRC staff finds that a decommissioning plan was not required by 10 CFR 30.36(g)(1), 40.42(g)(1), or 70.38(g)(1). NRC staff notes, however, that an acceptable cleanup plan was submitted by DDES with the request to perform the remediation activities under the NRC reciprocity program. In addition, based on the NRC evaluation of the FSS results and the results of the ORAU confirmatory measurements, the facility meets the radiological criteria for unrestricted use in 10 CFR 20.1402 without further remediation or analysis. Thus, the decommissioning activities at this site and the subsequent

designation of the site as acceptable for release for unrestricted use by the NRC are within the scope of the categorical exclusion in 10 CFR 51.22(c)(20). Therefore, neither an Environmental Assessment nor an Environmental Impact Statement is warranted for this action.

## **6.0 CONCLUSIONS**

As discussed above, based on a review of documents and direct observation of site activities by NRC staff and contractors, the NRC staff makes the following conclusions:

1. The remediation of the Former Benrus site and offsite disposal of radium-contaminated building demolition debris was performed in accordance with the Cleanup Plan commitments.
2. Based on final status survey results and confirmatory survey results by NRC's contractor, ORAU, the NRC staff has reasonable assurance that the residual radioactivity remaining on the building surfaces at the former Benrus Clock Factory site is in conformance with the requirements in 10 CFR 20.1402 for unrestricted release (25 mrem/year). In their confirmatory survey report, based on the results of their measurements and their dose estimates from residual contamination, ORAU does not recommend that NRC pursue any further actions at the former Benrus Clock Factory site.
3. The NRC staff also notes that the projected dose from residual Ra-226 contamination levels meet the State of Connecticut annual dose limit (19 mrem/year) for a post-remediation radiologically contaminated facility.
4. NRC staff consulted with and considered comments from the CT DEEP during the confirmatory survey.
5. Radioactive wastes generated as a result of the remediation activities have been properly transported from the site and transferred to an authorized facility for disposal.
6. NRC staff consultation with the EPA is not required.

Therefore, the NRC staff concludes that remediation of the former Benrus Clock Company Site in Waterbury, Connecticut was completed in accordance with the Cleanup Plan and is consistent with applicable NRC criteria and guidance. The staff recommends that no further oversight be conducted by NRC and that the entire site be designated acceptable for unrestricted use. This evaluation makes conclusions only on the radiological condition of the facility and does not address the possible presence of EPA or State regulated hazardous materials at the site.

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