

Executive Summary

The U.S. Nuclear Regulatory Commission (NRC) requested that the Oak Ridge Institute for Science and Education (ORISE) perform a radiation survey of the property at 133 Hamilton Street in New Haven, Connecticut. This property contains structures that were once part of the former New Haven Clock Company, which used radium paint in the manufacturing of clocks and watches into the late 1950s.

The objective of this survey was to locate possible discrete sources of radium, if any, that would be associated with former New Haven Clock Company operations. ORISE performed the radiation survey on November 15, 2016, and identified elevated levels of radiation in buildings occupying the property. Because elevated levels of radiation identified were determined to be associated with radium-226, ORISE concluded that discrete sources of radium are present, but that current site uses (i.e., vacant) where radium was identified are unlikely to result in an unacceptable dose to occupants. Based on these results, it is recommended that the NRC maintain oversight by working with the site owner to control and mitigate risks from exposure to discrete sources of radium-226 at the former New Haven Clock Company until remediation can be completed. Due to the current occupancy (i.e., vacant areas), the site owner already had certain controls in place that limited access to areas confirmed to be contaminated during the initial site visit. The NRC inspector stressed the importance of maintaining these controls in place.

SITE STATUS REPORT

Property: New Haven Clock Company
133 Hamilton Street
New Haven, Connecticut 06511

Docket Number: 03038975

Current Property Name(s): Rosanne Yagovane, TSJ Inc.

Current Property Owner(s): Rosanne Yagovane, TSJ Inc.

Inspection Date: November 15, 2016

Inspector(s): Orysia Masnyk Bailey – Nuclear Regulatory Commission, Region I
David King – Oak Ridge Associated Universities

1.0 INTRODUCTION

The Energy Policy Act of 2005 amended section 11e.(3) of the Atomic Energy Act of 1954 to place discrete sources of radium-226 (Ra-226) under U.S. Nuclear Regulatory Commission (NRC) regulatory authority as byproduct material. The NRC is evaluating properties where our review of historical information has identified Ra-226 use. The property at 133 Hamilton Street in New Haven, Connecticut, was identified as the former New Haven Clock Company, a clock manufacturing facility that used Ra-226 in its manufacturing processes. The facility operated during the period from 1880 to 1959 (ORNL 2015). The objectives of the initial site visit were to determine if discrete sources of Ra-226 and/or distributed Ra-226 contamination are present, to identify the areas of highest contamination, and to determine if a more in-depth scoping survey is needed to better reach a conclusion on whether site cleanup is needed.

Data from the November 15, 2016 initial site visit are 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 requirements. Surveys were performed as described within NRC's procedures, Temporary Instruction 2800/043 "Inspection of Facilities Potentially Contaminated with Discrete Radium-226 Sources" (NRC 2016). It is important to note that destructive testing is not generally performed as described within NRC's procedures.

2.0 PROPERTY DESCRIPTION AND INITIAL SITE VISIT CONSIDERATIONS

2.1 Property Description and History

The site summary report (ORNL 2015) provides known site details about the type, form, history, potential locations, and other information related to discrete sources of Ra-226. The site summary report is supplemented by compiled works by the Agency for Toxic Substances and Disease Registry (ATSDR) (1999) and the Connecticut Department of Energy and Environmental Protection (CT-DEEP) (1998) that provide information about the work performed by radium dial clock companies located in the State of Connecticut.

The New Haven Clock Company was founded in 1853 and occupied a single four-story building on St. John Street. Between 1880 and 1959, the facility produced over 40 million watches, including many that had dials painted with luminous radium compounds (ATSDR 1999). In

1866, a fire destroyed the original clock factory, and the site was rebuilt and sectioned into interlacing building structures. Another fire in 1883 destroyed approximately one-third of the factory buildings resulting in a prolonged rebuilding effort until 1922, when the site established its current configuration (Fuss & O'Neill/DDES 2016). The company finally closed its doors in March of 1960 due to financial troubles after 107 years in business (ATSDR 1999).

In the late 1990s, most of the space within the interlacing building structures, now designated as 133 Hamilton Street, was either unoccupied or abandoned except for three occupants: Club International (now Scores Presents), located within the first and second floors; Goodies Repairs, located in a smaller section of the first floor; and St. John's Restaurant, located in a larger section of the first floor. No information could be found concerning the recent history of the currently unoccupied third and fourth floors. In 1998, the ATSDR conducted radiological survey activities of the first two floors and reported no radiological contamination in the areas housing Club International and St. John's Restaurant, although one small area within Goodies Repairs was identified with a positive reading of 35 microRoentgens/hour ($\mu\text{R}/\text{h}$). Based on these results, ATSDR concluded that there were no immediate health concerns for the current occupants (ATSDR 1999).

2.2 Initial Site Visit Considerations

At this time, the windows on all floors of the building are either covered or boarded up, and the building is unoccupied except for Scores Presents on the south side of the facility and a small auto detailer shop on the north side of the facility, both located on the first floor (ORNL 2015). Currently, Decontamination Decommissioning & Environmental Services, LLC (DDES), who is partnering with Fuss & O'Neill, has been contracted to characterize the site and support the long-term plan to remediate the facility. The Fuss & O'Neill (2016) report contains detailed radiological survey results for data collected to date.

3.0 SITE OBSERVATIONS AND FINDINGS

3.1 Summary of Activities

The inspection team conducted an initial site visit at the 133 Hamilton Street property on November 15, 2016. A pre-inspection meeting was held with Ryan Fahey (DDES, LLC), Rosanne Yagovane (TSJ Inc. and property owner), Gary McCahill (Connecticut Department of Energy and Environmental Protection), Stephanie Wierszchalek (Fuss & O'Neill, Inc.), and Orysia Masnyk Bailey (NRC). Participants discussed the inspection team's intention to view the north wing of the facility and collect representative data on each floor of the building, and to visit the body shop on the north side of the building where slightly elevated gamma radiation measurements had been previously reported. For the latter location, confirmation of elevated measurements may lead the NRC to recommend limited actions to reduce potential radiological exposures to individuals in the area.

Radiological surveys performed by the inspection team consisted of gamma radiation scans using a Ludlum model 44-10 2-inch by 2-inch sodium iodide detector (2x2) connected to a Ludlum model 2221 ratemeter/scaler and radiation exposure rate measurements using a Ludlum model 192 sodium iodide based microRoentgen (μR) ratemeter. The sodium iodide detector gamma radiation scans were collected near the floor or ground surfaces and the radiation exposure rate readings were collected at approximately 3 feet (1 m) above the floor or ground surfaces. A SAM-940 spectrum analyzer was available for identification of specific radionuclides in elevated gamma radiation level areas if needed. The specific instruments used

during the initial site visit are presented in Table 3.1. The team was also prepared to collect smear surveys to identify readily removable Ra-226 contamination.

Table 3.1. New Haven Clock Company Survey Instruments			
Radiation Type (units)	Detector Type	Detector Model (No.)	Ratemeter Model (No.)
Gross gamma (cpm)	Sodium Iodide	44-10 (908) Calibrated 11/1/2016	2221 (590)
Gross gamma (μ R/h)	Exposure Meter	192 (1127) Calibrated 6/3/2016	N/A
Gross alpha/beta (cpm)	Plastic Scintillator	44-142 (1031)	2221 (1143)
Gamma Spectrum Analyzer (SAM-940)	Lanthanum Bromide	940 (864) Daily check source response	N/A

N/A = not applicable; a separate ratemeter is not required for these instruments.

μ R/h = micro roentgen per hour

cpm = counts per minute

The inspection team was aware of the efforts by DDES in performing radiological characterization measurements at the site, and was also aware that previous measurements had identified the presence of radium contamination within the facility. Therefore, the inspection team concentrated their efforts on performing confirmatory checks of the readily accessible floors of Building 10 and 11 (see Figure 3.1), in particular where DDES had identified several small areas of elevated activity on the second, third, and fourth floors. The inspection team also entered the small detailer shop on the bottom floor of Building 10, from the northern entrance. The team performed scans to attempt to locate the spot where elevated gamma radiation levels had been previously identified. The DDES manager indicated that one of the original surveyors saw a spike in the exposure ratemeter, reaching as high as 30 μ R/h¹. The inspection team (and the DDES manager) spent an hour surveying the shop, but did not collect any anomalous elevated readings. Elevated background radiation levels due to naturally occurring radioactive materials in the brick walls and floors limited the efforts to confirm the previously identified elevated measurement. A 40 μ R/h, above background, threshold is established in the NRC's Temporary Instruction 2800/043 (NRC 2016) to implement controls. Elevated measurements relative to background collected across the facility indicate that, with conservative assumptions, a member of the public regularly working in these areas could receive an annual dose in excess of NRC's public dose limit of 100 mrem/yr (10 CFR 20.1301).

¹ NOTE: Roentgen is a unit of exposure (energy absorbed in air), whereas a Rem is a unit of dose delivered to a person (resulting from the radiation energy absorbed in that person). While Roentgen and Rem are related, these are different units. Because they are similar for gamma ray energies from Ra-226, NRC makes the simplifying assumption in this case that these units are equivalent (1 Roentgen = 1 Rem).



Figure 3.1. Subdivision of the Former New Haven Clock Company (Fuss & O'Neill 2016)

3.2 Summary of Results

Table 3.2 presents a summary of results from the November 15, 2016, initial site visit. Data from the Fuss & O'Neill report are included for completeness. The inspectors confirmed the locations of several of the elevated measurements already identified in the Fuss & O'Neill report. The radiological surveys covered only a small percentage of the total facility, noting that the DDES team is performing a complete characterization of the facility. Because the radiological conditions at the facility have been previously measured and DDES is completing a comprehensive characterization effort, the team determined that use of the SAM-940, to identify specific radionuclides in areas of elevated gamma radiation levels, and collection of smear samples, to assess the presence of removable contamination, was not necessary.

Table 3.2. New Haven Clock Company Site Visit Discrete Measurements							
Building / Floor	Location ^a	Alpha plus Beta		Gamma			Notes
		Gross (cpm)	Total (dpm/100 cm ²)	Contact (kcpm ^b)	1 m (μR/h)	1 m (μR/h)	
11/4	10	9,804	5,940	42	30	20	About 2 ft ²
10/3	4	7,324	4,390	197	110	35	About 2 ft ²
10/2	13	2,211	1,194	54	42	27	About 1 ft ²
11/Shop	N/A	550-750	0	20-24	N/A	15-20	General Area
	Background				12	12	

N/A = not applicable, not collected, or unknown

^aSee Fuss & O'Neill (2016) pages 39/40 of 160 (Location 10), page 40/41 of 160 (Location 4), page 42/43 of 160 (Location 13).

^bkcpm = thousand counts per minute (cpm)

μR/h = micro roentgen per hour

dpm/100cm²= disintegrations per minute per 100 square centimeters

Note: Yellow highlight indicates that these values are above background.

3.3 Summary of Dose Assessment Results

The Fuss & O'Neill report (2016) presents a large dataset that may be used to estimate the radiation dose to potential future occupants. Data from the Fuss & O'Neill report indicate that background is approximately 12 μR/h. As reported in the Fuss & O'Neill report (2016), average and maximum measurements in excess of the Temporary Instruction threshold of 40 μR/h (NRC 2016), from the external exposure pathway only, are noted in Buildings 1C, 1D, 10 and 11. There is a maximum average of 49 μR/h in Building 11 (2nd floor), and an outright maximum of 110 μR/h in Building 1D (2nd floor). Because these measurements are in excess of the NRC's threshold of 40 μR/h (associated with 100 mrem/yr), the data also supports the conclusion that a plausible future occupant may receive a radiation dose in excess of the release criterion for unrestricted use in 10 CFR Part 20.1402 (i.e., 25 mrem/yr) limit. This is in alignment with the conclusion from the Fuss & O'Neill report (2016), which states that certain areas "will require remediation to achieve unrestricted release of these areas."

4.0 OBSERVATIONS AND RECOMMENDATIONS

Based on the information provided in this report, building surfaces at the 133 Hamilton Street property, the former New Haven Clock Company property, contain discrete sources of Ra-226 in excess of NRC regulatory requirements. This conclusion is based on the following observations:

- Elevated alpha, beta, and gamma radiation levels are present in several areas of the facility. In the Fuss & O'Neill Characterization Survey Report, gamma levels are well above the Temporary Instruction threshold of 40 $\mu\text{R/h}$ (associated with NRC's public dose limit in 10 CFR 20.1301), and contamination levels may result in a radiation dose to a plausible future occupant in excess of the 25 mrem/yr limit for unrestricted use in 10 CFR 20.1402.

Due to the extensive characterization effort by DDES, previous elevated radiation levels measured at the facility, NRC measurements during the initial site visit that confirm elevated radiation readings, and the ongoing characterization and planned cleanup by the site owner's contractor, ORISE does not recommend that the NRC conduct a more detailed scoping survey. However, the NRC should maintain oversight at the 133 Hamilton Street property regarding future actions for site remediation.

5.0 REFERENCES

ATSDR 1999. *Public Health Implications of Radiation Contamination at Former Clock Factories Located in Bristol (Hartford County), New Haven, (New Haven County), Thomaston (Litchfield County), and Waterbury (New Haven County), Connecticut*. U.S. Department of Health and Human Services. January 29. (Agencywide Documents Access and Management System [ADAMS] Accession No. ML17038A052).

Fuss & O'Neill/DDES 2016. *Former New Haven Clock Factory Site: Radiological Characterization Survey Report*, Fuss & O'Neill/Decontamination Decommissioning and Environmental Services (DDES), LLC, Manchester, CT, September 2016. (ADAMS Accession No. ML17037C920).

DEEP 1998, Data on Former Watch Manufacturers in Connecticut – Noted from the Connecticut Department of Energy and Environmental Protection (formerly Department of Environmental Protection [DEP]). (ADAMS Accession No. ML17038A170).

NRC 2016. *Inspection of Facilities Potentially Contaminated with Discrete Radium-226 Sources*, Temporary Instruction 2800/043, U.S. Nuclear Regulatory Commission, Office of Nuclear Material Safety and Safeguards, Washington, D.C., October. (ADAMS Accession No. ML16035A053).

ORNL 2015. *Historical Non-Military Radium Sites Research Effort Addendum*. Oak Ridge National Laboratory, Oak Ridge, Tennessee, November 24. (ADAMS Accession No. ML16291A488).