

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 400 North Main Street in Bristol, Connecticut. This property covers part of the footprint once occupied by the former Ingraham Clock Company, which used radium paint in the manufacturing of clocks and watches into the late 1950s. The original factory was torn down, and the land has been redeveloped. The objective of this survey was to locate possible discrete sources of radium, if any, that would be associated with former Ingraham Clock Company operations.

ORISE performed the radiation survey on November 16, 2016, and did not identify elevated levels of radiation associated with discrete sources of radium. Therefore, ORISE concludes that discrete sources of radium are not present in surface soils. Based on these results, it was recommended that the NRC not pursue additional action at 400 North Main Street property.

SITE STATUS REPORT

Property: Ingraham Clock Company
400 N. Main Street
Bristol, CT 06010

Docket Number: 03038987

Current Property Name(s): Ingraham Manor Nursing Home

Current Property Owner(s): Ingraham Manor Nursing Home

Inspection Dates: November 16, 2016

Inspector(s): Orysia Masnyk Bailey/NRC, assisted by David King/Oak Ridge Associated Universities (ORAU)

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.¹ The NRC is evaluating properties where our review of historical information has identified Ra-226 use. The property at 400 North Main Street in Bristol, CT, was identified as the former Ingraham Clock Company, a clock manufacturing facility, once operated during the period from 1884 to 1958 (ORNL 2015 and ATSDR 1999). 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, to determine if there are any current health and safety concerns, and to determine if a scoping survey is needed.

Data from the November 16, 2016 initial site visit can be used to plan future actions that may be needed to reduce the exposure to Ra-226 of current or future site occupants to levels that do not exceed the applicable regulatory requirement. It is important to note that destructive testing is not generally performed as described within NRC's procedures in Temporary Instruction 2800/043 "Inspection of Facilities Potentially Contaminated with Discrete Radium-226 Sources" (NRC 2016).

2.0 PROPERTY DESCRIPTION AND INITIAL SITE VISIT CONSIDERATIONS

2.1 Property Description and History

The site summary included in the "Historical Non-Military Radium Sites Research Effort Addendum" report (ORNL 2015) provides known site details about the type, form, history, potential locations, and other information related to discrete sources of Ra-226 used at the site. The information provided in ORNL 2015 is supplemented by the Agency for Toxic Substances and Disease Registry (ATSDR) report (ATSDR 1999) that addresses radium dial clock

¹ A discrete source of radium-226 is defined as "a radionuclide that has been processed so that its concentration within a material has been purposely increased for use for commercial, medical, or research activities." See Requirements for Expanded Definition of Byproduct Material Rule, 72 Fed. Reg. 55,888 (Oct. 1, 2007). This definition includes "radium contamination resulting from the use of purposely concentrated radium-226." *Id.*

companies located in the State of Connecticut. The Ingraham Clock Company was founded in 1884 and occupied several buildings on North Main Street in Bristol, CT. In 1904, as a result of increased sales due to improvements in manufacturing and machinery, Ingraham replaced the original wooden buildings with brick ones. Clocks and watches with luminous radium paint were manufactured in these buildings until production ceased in 1942 due to World War II. Production resumed again in 1946. In 1958, the company moved from North Main Street to Bristol's Redstone Hill Industrial Park (210 Redstone Hill Road) (ORNL 2015).

During the 1960s, the abandoned buildings at the North Main Street location were torn down as part of a redevelopment project. Extensive testing took place at the site prior to 1980, however neither the exact dates of testing nor the types of tests performed are known. Therefore, it is unknown if soil at the North Main Street location of the former Ingraham Company was tested for radium (ORNL 2015). At the time of site redevelopment, soil from the site was cleared for use as cover material at a Bristol landfill, a river running through the site was piped underground, and backfill was brought onto the site. As part of the redevelopment, residential and commercial properties were constructed at the North Main Street locations, including: (1) 430 N. Main Street in the early 1980s; (2) 284 N. Main Street in 1987; (3) 400 N. Main Street in 1989-90; and (4) 420 N. Main Street in 1990-91 (ORNL 2015). This report documents the initial site visit to the portion of the Ingraham property that is currently associated with 400 N. Main Street, pictured in Figure 1.

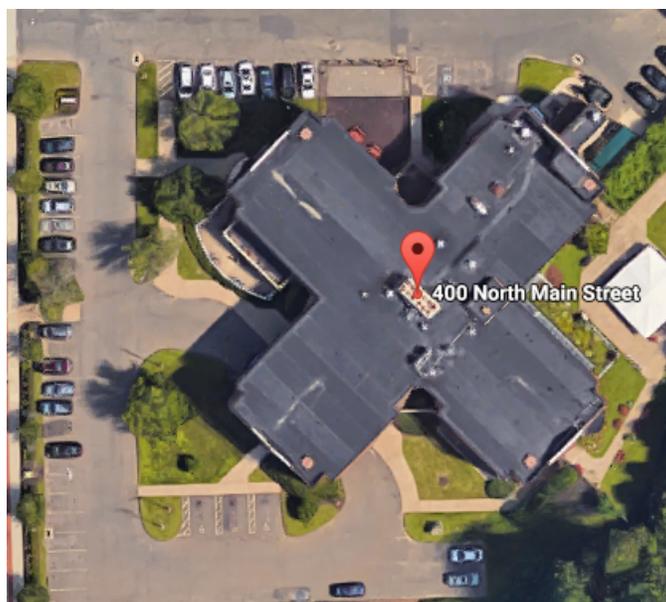


Figure 1. Aerial Photo of 400 North Main Street.

2.2 Initial Site Visit Considerations

Based on the above history of the property and its redevelopment, NRC staff considered the likelihood of discrete sources of Ra-226 existing in current property structures to be negligible. Rather, were discrete sources of Ra-226 present, they would likely be in subsurface soils. As stated above, however, during redevelopment activities surface soils were transported offsite and backfill materials were brought in. Potential mixing between the backfill and remaining subsurface soils would likely further dilute any remaining discrete subsurface sources of Ra-226. The structures and other obstructions on the property limited the area in which initial surveys were performed. Instead, this initial site visit focused on the accessible land areas to

try and identify any discrete Ra-226 sources in surface soil that may be indicative of Ra-226 in subsurface soil. The team focused its activities near the footprint of the former factory buildings, but performed general area surveys over the entire site.

3.0 SITE OBSERVATIONS AND FINDINGS

3.1 Summary of Activities

The inspection team conducted a radiological site visit at the 400 N. Main Street property on November 16, 2016. A pre-inspection meeting was held with Bristol Hospital staff members Albert Lamptey, Rebecca Colasanto, and Jonathan Neagle, as well as Denny Galloway (Connecticut Department of Energy and Environmental Protection (CT-DEEP)), David King (ORAU), and Orysia Masnyk Bailey (NRC).

Radiological surveys consisted of gamma radiation scans using a Ludlum model 44-10 2-inch by 2-inch sodium iodide detector (2×2) connected to a Ludlum model 2221 ratemeter/scaler and exposure rate measurements using a Ludlum model 192. The sodium iodide detector data was collected near the ground surface, and the exposure rate readings were collected at approximately 1 meter (3 feet) above the ground surface. A SAM-940 spectrum analyzer was also available in case elevated gamma radiation levels were identified. Table 1 presents the specific instruments used during the site visit.

Radiation Type (units)	Detector Type	Detector (Number)	Ratemeter (Number)
Gross gamma (cpm)	Sodium Iodide	44-10 (908) Calibrated 11/1/2016	2221 (590) Calibrated 8/19/2016
Gross gamma (μR/h)	Exposure Meter	192 (1127) Calibrated 6/3/2016	N/A
Gamma Spectrum Analyzer (SAM-940)	Lanthanum Bromide	940 (864) Daily check source response	N/A

N/A = not applicable; ratemeter is not required
 Number = equipment tracking number
 cpm = counts per minute
 μR/h= micro roentgen per hour

3.2 Summary of Scan Results

Figure 2 presents a summary of results from the initial site visit on November 16, 2016. Inspectors identified two anomalous gamma radiation measurements associated with large rocks. Surveys covered up to an estimated 25% of the total site area, noting that most of the outdoor area is covered by concrete, asphalt, and cars. Paved areas of the site parking lot were surveyed though the depth and density of the asphalt could shield gamma radiation from a discrete source of Ra-226. Asphalt provides more shielding than soil, making identification of a potential discrete source more unlikely than if soil were the only shielding material. While the

most likely location of Ra-226 material is in subsurface soil, there were no indications that subsurface contamination exists and sampling was not performed. Because there were no anomalous readings attributed to discrete sources of radium, the SAM-940 was not used.

SITE: Ingraham	AREA: 400 N. Main St.	DATE: 11/16/16	TIME: 10:00 – 12:30
SURVEYOR(S): D. King		PURPOSE: Site Visit	

TYPE	INSTRUMENT	DETECTOR	BACKGROUND
Gamma	2221 #590	44-10 #908	*
Gamma	192 #1127	N/A	*
N/A	N/A	N/A	N/A

*Background readings varied depending on proximity to red brick buildings and ground materials such as concrete, asphalt, and natural media (e.g., landscaping). Surveyors noted no radiological anomalies.

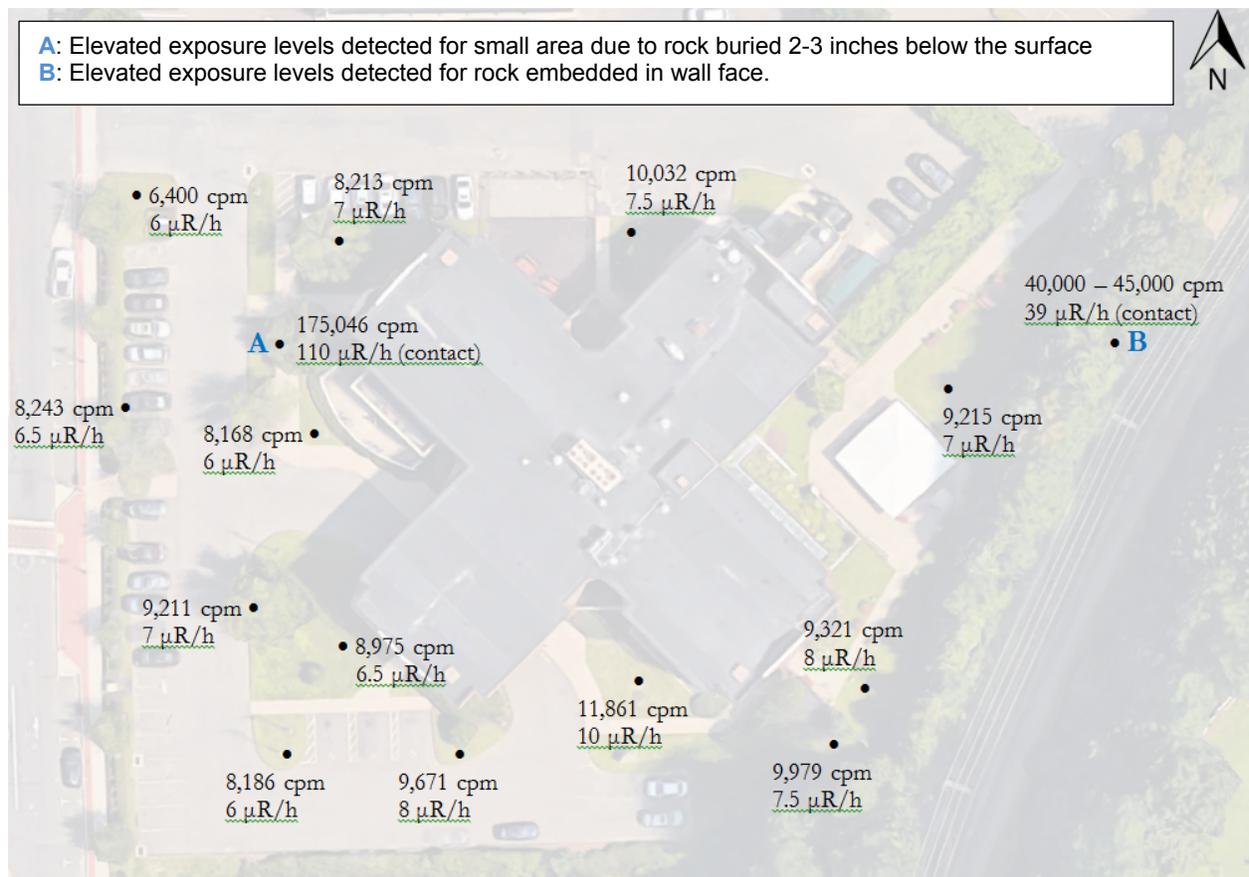


Figure 2. Survey Result for the 400 N. Main Property

In general, the sodium iodide detector background responses ranged from about 6,000 to 7,500 cpm over asphalt except next to buildings where the maximum detector response of approximately 12,000 cpm was noted. In grassy areas, sodium iodide detector background responses ranged from about 8,000 to 9,000 cpm. Exposure rates ranged from 4 to 7 µR/h over asphalt except next to buildings where responses ranged from 8 to 10 µR/h. In grassy areas, exposure rates ranged from about 6 to 7 µR/h.

Increased responses were observed in 2 areas within the 400 N. Main Street property. Details include (see A and B in Figure 2):

- The maximum sodium iodide detector gross count rate and exposure rate of approximately 175,000 cpm and 110 $\mu\text{R}/\text{h}$ (contact), respectively, were measured at Location A and are associated with a rock buried 2 to 3 inches underground—the rock could not be removed without a considerable effort, so the original site conditions, including surface soil and sod were retained after measurements were collected.
- The second identified location, Location B, exhibited sodium iodide detector count rates ranging from 40,000 to 45,000 cpm and an exposure rate of 39 $\mu\text{R}/\text{h}$ (contact). These elevated radiation levels were due to a rock embedded in the wall face on the eastern edge of property.

The inspection team and the CT-DEEP representative agreed that these elevated levels were from naturally occurring radionuclides in the rock (likely granite) and not from discrete sources of Ra-226. These results are expected from the naturally occurring radioactive materials identified. The CT-DEEP representative indicated that rocks like those found at this site are common in the area (King 2016).

3.3 Summary of Dose Assessment Results

Because no radiation levels were detected above background due to discrete sources of radium, a dose attributed to discrete radium sources could not be calculated.

4.0 OBSERVATIONS AND RECOMMENDATIONS

There was no indication from the areas surveyed that surface soil at 400 N. Main Street property, occupying a portion of the former Ingraham Clock Company, contains discrete sources of Ra-226 as determined by the following observations:

- Gamma radiation levels were consistent with background (aside from the naturally occurring radioactive material identified (likely granite)).
- The absence of observable gamma radiation anomalies (aside from the naturally occurring radioactive material identified (likely granite)) is indicative that there are no discrete sources of Ra-226 present in surface soil.
- There is no historical evidence that discrete sources of Ra-226 are present following the 1960s facility demolition and the property's subsequent redevelopment.
- Risk of potential contamination on the site is low and, if present, would most likely be found at a significant depth in the subsurface soil.

Therefore, the recommendation to the NRC staff is that a more detailed scoping survey is not justified at this time and NRC staff should not pursue additional action at the 400 N. Main Street property.

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).

King 2016. Conversation between David King, Denny Galloway, and Orysia Bailey at the former Ingraham Clock Factory site regarding rocks with elevated gamma signature. November 16.

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).