Canadian Radium and Uranium Site

Site Description and Background Information:

The former Canadian Radium and Uranium (CRU) facility is located to the east of Kisco Avenue and to the west of railroad tracks in the Village of Mount Kisco, Westchester County, New York, in a primarily suburban residential and commercial area. The historic CRU property (103 and 105 Kisco Avenue) is 2.72 acres and is currently occupied by a landscaping business (103 Kisco Avenue) and a stone, masonry, and landscaping business (105 Kisco Avenue). The property is bounded by Kisco Avenue to the west, southwest, and northwest; railroad tracks to the south, east, and northeast; and a large, privately-owned warehouse to the north and northeast.

From 1943 until approximately 1966, the CRU facility operations at the Canadian Radium and Uranium Corporation Site (the Site) included the recovery of uranium and other radioactive elements from uranium-bearing sludge, old instrumentation, and watch dials. This work began as part of the federal government's Manhattan Engineering District (Manhattan Project). From 1943 to the 1950s, the primary product was uranium; subsequently, radium became the principal product until the facility's closure. According to a Village of Mount Kisco memorandum, in 1957, CRU pleaded guilty to charges of allowing three employees to be overexposed to radiation. From March 5, 1958, until sometime after May 19, 1961, decontamination procedures and expectations were established for the CRU facility.

In November and December 1966, the facility buildings (a two-story concrete block building and two smaller one-story concrete block buildings) were decontaminated and demolished. Removal of radioactive dirt to a depth of 12 inches was required on the CRU premises. The most contaminated demolition materials were disposed of by Nuclear Diagnostic Laboratories located in Peekskill, New York, while the less contaminated materials were disposed of at Croton Point Sanitary Landfill located in Croton-on-Hudson, New York. After decontamination and demolition, a post-operation survey was conducted by Isotopes, Inc. Two locations on the Haggerty Millwork wall, which originally shared a wall with the CRU facility that was demolished during the 1966 decontamination and demolition process, were found above specifications. One contaminated location was removed by chiseling out the masonry of a wall. The second was a result of tailings from a leaking waste drum, which CRU had stored on the second floor fire escape. Since contamination was low here, the area was sealed with 1 to 2 inches of mortar. Railroad Avenue was constructed where the main CRU building once stood and was put in place by the urban renewal efforts in the area. Between 1964 (pre-decontamination/demolition) and 1971 (post-decontamination/demolition), the building layout of the Site completely changed and it is believed that none of the original CRU facility buildings remained after the year 1971.

On April 5, 1979, a local newspaper reported the 1957 death of the CRU plant manager due to leukemia from high radioactivity levels found in his body. On April 20, 1979, a survey was performed by the Assistant Commissioner of Health for Environmental Quality, Westchester Department of Health. Based on the surveys, the highest dose rates were found in a small portion of a locked, chain-link fenced area south of the old wood freight station on Railroad Avenue and east of the L. B. Richard's Lumber yard (*i.e.*, an area located adjacent to the railroad). All other elevated dose rates were found in areas covered by soil and vegetative growth. The 1979 investigation reported that the high readings were obtained from an area covering approximately

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one square yard of the property in an area not used by the public; after the review of data, the report indicated that the dose rates found did not pose a public health hazard to persons passing the fenced area, to persons working in buildings adjacent to the area, or to persons living across the railroad tracks to the east.

In a memorandum dated February 7, 1980, the Westchester County Health Department described investigation findings in more detail. The area in question was approximately 78 feet by 60 feet, enclosed by a chain-link fence located between the railroad tracks and a concrete paved area. The most significant contaminated area was a strip 15 feet by 5 feet, containing two separate "hot spots". A surface reading using an alpha probe survey meter measured 50 disintegrations per minute (dpm). Elevated readings several times above background were reported for an area extending about 50 feet south from the chain-link fence. The memorandum stated that the origin of this contamination was unknown and that it was not discovered in previous surveys.

In September 1993, the Bureau of Environmental Radiation Protection of the New York State Department of Health (NYSDOH) completed a survey of the Site; indoor radon measurements were collected (*i.e.*, office, show room, storage/sale floor) which documented a maximum concentration of 9.8 picocuries per liter (pCi/L), and the average of the different detectors was about 8.1 pCi/L. NYSDOH also identified two outdoor areas where presence of radioactive materials were indicated at the back of Richard's Lumber, and the road that runs next to the railroad tracks and adjacent to a fence post inside the fenced portion of what appeared to be Richard's Lumber property on the south side of Railroad Avenue.

In 1994, the U.S. environmental Protection Agency (EPA) conducted an on-site inspection to measure radon levels, collect air and soil samples, and measure exposure rates. The purpose of the investigation was to determine if conditions required immediate action and if the Site was eligible for long-term remediation under the federal Superfund Program. Elevated exposure rate measurements were documented on both the northern (10–700 microroentgens per hour [μR/hr]) and southern (10–240 μR/hr) portions of the Site. Radium-226 (Ra-226) concentrations in soil samples taken from the top 1.5 feet ranged from 3 to 150 picocuries per gram (pCi/g). All of the radon measurements were below EPA's guideline (*i.e.*, 4 pCi/L) and the air samples collected at the Site did not detect any radioactive contamination.

In July 1998, a complete radiological survey of the Village of Mt. Kisco and Richard's Lumber (former CRU) was conducted by the New York State Department of Environmental Conservation (NYSDEC). The property owned by the Village of Mount Kisco (103 Kisco Avenue) was found to have contamination over one large unpaved area [approximately 4,000 to 5,000 square feet (ft^2)] and a few smaller areas. The 1998 report stated that, on the Mt. Kisco property, the highest concentrations of radium observed were a few hundred pCi/g and that most of the contamination was in the top 1 foot of soil. The report stated that the distribution suggests that uranium-containing material was placed on the surface and then the area was leveled. A new road (Railroad Avenue) had been built where the CRU facility once stood; soil sampling completed near the road showed elevated concentration of radium a few feet below the surface. NYSDEC reported that the distribution of radioactive material near the road appeared to be consistent with movement of soil as part of the building demolition and subsequent construction of the road. Sampling beneath the road surface was not performed. There is no documentation of shielding or other control measures

implemented on the 103 Kisco Avenue property, though current conditions suggest that the property had been recently paved with asphalt (of an unknown thickness) or other cover materials.

The 1998 report further stated that the survey of the Richard's Lumber (105 Kisco Avenue) property indicated that radioactive materials were present under the parking lot, but no samples were taken beneath the asphalt. The highest concentration of radium at the Site was found just north of Railroad Avenue (approximately 6,000 pCi/g). A large part of the main outside storage area was reported to be contaminated with radium near the surface as well as within some soil profiles to depths of approximately 4 feet. Survey data suggested that the contamination stopped abruptly at the edges of the paved areas. Railroad Avenue showed count rates that were lower than background soils; NYSDEC attributed these results to absorption by the road surface material (*i.e.*, shielding). The July 1998 report indicated that radiation doses to workers or visitors to the Site as it was used at the time were not significant. The Site location where the dose rate was highest was a small area near Richard's Lumber, just north of Railroad Avenue. Time spent at this location was small; therefore, the accumulated dose was also estimated to be small. The July 1998 report suggested that significant radium contamination was present on both Mt. Kisco and Richard's Lumber properties. NYSDEC did not consider the Site to be fully characterized at the completion of the survey.

In September 2013, Weston Solutions, Inc., Site Assessment Team (SAT), performed an on-site reconnaissance and gamma radiation screening of the historic CRU property and other suspected areas of contamination. Background readings taken north and northeast of the Site in the right-of-way (ROW) area alongside Kisco Avenue show background gamma radiation levels of approximately 7,500 counts per minute (cpm). The highest reading of 73,637 cpm was located on the 105 Kisco Avenue property. Most readings were below 2 times (2x) background. There were three areas with readings that exceeded 2x background, ranging from 30,000 cpm to 73,637 cpm. All three areas above 2x background were located in the back portion of the 105 Kisco Avenue property, east of the historic CRU facility. No signs of ground discoloration were observed.

Site conditions during SAT's radiological reconnaissance for the 105 Kisco Avenue property, New York Stone and Masonry Supply, were typical for a stone, masonry, and landscaping business and had not changed significantly since the 1998 report. In the back portion of the property, surplus materials were stored in corrals, separating different materials such as gravel, sand, wood chips, etc. The most southeastern portion of the property consisted of a newly paved asphalt parking area for customers. Although historical redevelopment activities at the Site were unclear, it is believed that none of the current buildings are part of the original CRU facility. Materials and heavy machinery were present throughout the property, including the concrete corrals for materials. Many areas were not accessible for screening due to obstructions (*e.g.*, wood piles, heavy machinery, roll-offs). The property owner did not allow SAT to perform gamma radiation screenings inside the main building; however, the owner allowed SAT to perform screenings in outdoor sheds and other storage warehouse-type buildings.

Site conditions during SAT's radiological reconnaissance for the 103 Kisco Avenue property, Hickory Homes and Properties, Inc., were typical for a landscaping supply and material storage facility. The property was semi-paved (during the 1998 report, the property was not paved), and completely fenced with an access gate. The access gate was closed and locked when employees were not on site. There was one small work trailer located at the northernmost portion of the

property which included an employee break room, office, and reception area. Trucks, forklifts, and other heavy machinery were parked on the property. Various on-site roll-offs were filled with debris and materials. Cement corrals for materials were also located on the property. A manhole was located at the northeast corner of the Site, although no elevated gamma levels were detected. Many areas were not accessible for screening due to obstructions (e.g., wood piles, heavy machinery, roll-offs). No elevated gamma radiation was documented on the 103 Kisco Avenue property. Gamma screenings of Railroad Avenue and the ROW area bordering Railroad Avenue showed gamma screening readings ranging from background (~7,500 cpm) to 15,000 cpm, with one elevated area located at the corner of the 105 Kisco Avenue property, which had readings ranging from 15,000 cpm to 30,000 cpm.

In November 2013, SAT advanced eight boreholes to depths of 10 feet at the Site for gamma screening and soil sample collection. Using a gamma scintillation meter (Ludlum 2221 Scaler Ratemeter), field gamma screening data collected during the sampling event documented the gamma exposure rates at 6-inch depth intervals vertically down each sample location borehole. The soil samples collected represented the highest levels of gamma radiation recorded for each borehole. The soil samples were analyzed for isotopic thorium (thorium-228, thorium-230 and thorium-232), isotopic uranium (uranium-233/234, uranium-235/236 and uranium-238), radium-226, radium-228.

Analytical data from the sampling effort suggest that there is measureable residual contamination remaining at the Site. All analytical results reported for the thorium-232 (Th-232) decay series (Th-232, Th-228, and Ra-228) ranged from 0.6 to 1.2 pCi/g, and were therefore considered to be at background levels. In addition, all of the individual radioisotopes in this decay series were observed to be in equilibrium in each sample. Analytical results reported for the uranium-238 (U-238) decay series (U-238, U-234, Th-230, and Ra-226) did not appear to be in equilibrium. Concentrations of the parent isotopes U-238 and U-234 were at background levels ranging from 0.4 pCi/g to 0.8 pCi/g. Th-230 concentrations in three of the samples (2222-S01, -S07, and -S08) were at background concentrations. Th-230 concentrations in samples 2222-S02, -S03, -S04, -S06, and -S09 exhibited significantly elevated levels ranging from 4.6 to 83.3 pCi/g. It was unclear if Th-230 was elevated in sample 2222-S05, as the measured result was 1.8 +/- 0.3 pCi/g. It was concluded that the contaminants represent residual contamination from processed material and not uranium ore.

Ra-226 analytical results in samples 2222-S01, -S02, -S03, -S04, -S05, -S06, and -S09 were all significantly elevated, ranging from 15.4 pCi/g to 135 pCi/g. Sample location 2222-S07 was, as expected, at a background level of 0.9 pCi/g. Sample 2222-S08, which was collected at an assumed background location near the northeast corner of the subject property, showed a Ra-226 concentration of 3.4 pCi/g, which is slightly elevated above the background level. In all instances, when an elevated concentration of Th-230 was detected in a sample, the Ra-226 was also elevated. Lead and thallium isotopes are a result of the decay chain of U-238 and Th-232. Sample 2222-S04 and field duplicate 2222-S09, exhibited greater than three times (3x) the highest background level of lead at concentrations of 1,000 milligrams per kilograms (mg/kg) and 440 mg/kg, respectively. It is unknown if this exceedance is linked to the residual radioactive contamination on the Site. There were no detections of thallium at the Site. Mercury concentrations greater than

3x the highest background level were documented at 2222-S01, -S03, and - S04, but it is unknown if this can be linked to the former on-site operations.

On August 3 through 7, 2015, EPA with the support of Weston Solutions, Inc., Removal Support Team 3 (RST 3) conducted radiological surveys, radon and soil sampling at Metropolitan Transit Authority (MTA), Milepost 136, 103 Kisco Avenue (Property C001), Hickory Homes and Properties, Inc., 103 Kisco Avenue (Property C002), New York Stone and Building Supply, 105 Kisco Avenue (Property C003), and at a background location (comprising a strip mall), 145-159 Kisco Avenue (Property C004). Gamma radiological surveys were conducted using Fluke Pressurized Ionization Chamber (FPIC) Model 451P, Ludlum Model 2241 (Ludlum-2241), and Reuter-Stokes RSS-131ER High Pressure Ion Chamber (HPIC) gamma survey meters. Specific isotopes were identified using a Berkeley Nucleonics Corporation (BNC) SAM 940™ (SAM 940) portable, radioisotope identification system. The gamma survey instruments were used to identify on-site locations with above-background gamma readings and to determine off-site locations least likely impacted by historic on-site activities in order to select a location to obtain background readings. The background reading of each instrument was compared with survey data collected with each instrument to determine areas with elevated gamma readings. A Durridge RAD7 electronic radon/thoron detector was utilized to measure the concentration of radon and thoron in air.

Ludlum-2241 gamma surveys results indicated above-background readings at six of the 11 soil sampling locations, with values ranging from 20,000 to 180,000 cpm. Above-background gamma readings were also observed in the southeast corner of one indoor location at Warehouse-2 in Property C003 (12,000 to 15,000 cpm). FPIC gamma survey results indicated above-background values ranging from 9 to 15 μR/hr at waist level and 14 to 51 μR/hr at contact in the Electrical Room of the main building and from 14 to 16 μR/hr at waist level and 9 to 15 μR/hr at contact in the southeast corner of Warehouse-2. HPIC gamma survey results indicated above-background value of 14.0 μR/hr in the Electrical Room and at six of the 11 soil sampling locations, with values ranging from 14.6 to 36 μR/hr. SAM-940 screening of all the jarred soil samples collected on-site did not indicate any radionuclides except for the soil sample collected from location C003-SS002 which indicated the presence of Ra-226. RAD7 radon/thoron surveys results of exterior on-site locations did not indicate any elevated readings; however, above background values were observed in nine of the 13 locations surveyed in the main building at Property C003.

On August 3, 2015, an RST 3-procured National Radon Proficiency Program (NRPP)-certified company utilized passive activated charcoal canisters (radon canisters) to conduct short-term radon sampling tests that lasted a minimum of approximately 72 hours. A total of 32 radon canisters, including two field duplicates and two field blanks, were deployed in on-site buildings at Property C003. On August 4, 2015, five radon canisters were deployed in Property C001 and six radon canisters were deployed in Property C002. Canister placement was conducted in accordance with the guidelines set forth in the American National Standards Institute (ANSI)/American Association of Radon Scientists and Technologists (AARST) *Protocol for Conducting Radon and Radon Decay Product Measurements in Multifamily Buildings* (MAMF 2012) and as directed by the EPA On-Scene Coordinator (OSC). Radon testing locations were focused on frequently occupied spaces in each on-site building. Analytical results were compared with the EPA Site-Specific Action Level (SSAL) of 4.0 pCi/L. Analytical results did not indicate radon concentration above

the EPA SSAL in living spaces sampled at Properties C001 and C002. Analytical results were above the EPA SSAL in 11 of the 13 samples, including one field duplicate, collected from the main building at Property C003. Analytical results were above the EPA SSAL in two of the four samples collected in Warehouse-2.

In August 2015, RST 3 conducted a soil sampling event to verify the presence of residual contamination, identify additional source areas, and potential releases of radiation-containing material in soil associated with the former CRU facility. Based upon the radiological survey data from SAT's site investigation and survey data from the radiological investigation conducted by RST 3, soil sampling locations suspected to contain radionuclides and metals/metalloids were identified and flagged on-site by the EPA OSC. On August 5, 2015, RST 3 collected three soil samples from Property C002, four soil samples, including one field duplicate, from Property C003, and one aqueous rinsate blank sample. On August 7, 2015, RST 3 collected one soil sample from a background location at Property C004. On August 18, 2015, RST 3 collected four soil samples, including one field duplicate, and one aqueous rinsate blank sample from Property C001. The soil samples were analyzed for target analyte list (TAL) metals (including mercury) via SW846, 6010C/7471B methods; isotopic thorium and isotopic uranium via alpha spectroscopy Health and Safety Laboratory (HASL)-300-A-01-R; radium-226 (21 days ingrowth), radium-228 and other gamma emitting radioisotopes via gamma spectroscopy HASL-300-GA-01-R. Analytical results indicated elevated above-background concentrations of Ra-226 in eight of the 13 soil samples collected during this event. Lead concentration was above the EPA Removal Management Level (RML) of 400 mg/kg in one soil sample with a concentration of 510 mg/kg.

During the August 2015 Removal Assessment, EPA and RST 3 observed a radon mitigation system being installed by the property owner in the main building at Property C003. Analytical results from the radon sampling conducted during this event indicated elevated levels of radon in the main building at Property C003. When the radon mitigation system became operational in October 2015, EPA suggested that a post-mitigation radon sampling event be conducted to determine if the radon mitigation system was effectively addressing radon contamination in air within the main building of Property C003. On October 23 through 26, 2015, an RST 3-procured NRPP-certified company deployed a total of 27 radon canisters, including two field duplicates and two field blanks, in the main building at Property C003. Analytical results indicated radon levels within the building were below the EPA SSAL of 4.0 pCi/L.