COOPERATIVE DECOMMISSIONING BETWEEN REGULATOR AND LICENSEE: A SUCCESS STORY

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ABSTRACT

Lacking cooperation, the relationship between the regulators and the licensee or owner can become adversarial. Licensees want to limit cost and schedule where regulators want to ensure that they can defend release limits as they relate to the protection of the public.

This is the story of a site that had been contamination for 90 years. This project was complicated for a number of reasons including the location of a 6-story commercial structure in an active urban area, a licensee with no prior experience or knowledge of radioactive materials management, and a new regulatory department conducting its first large scale decommissioning project. The affected building was constructed in the early 1900's and was a radium processing facility that produced materials such as those used for medicinal purposes and as a paint additive.

Previous decontamination activities in the 1960's and 1970's focused on specific areas within the building and/or only performed simple surface remediation. It was known that fixed alpha remained on the original building surfaces hidden behind modern construction materials in a few locations. In 1984, the building was determined to be sufficient by regulators to allow continued unrestricted use of the building. Throughout this period the building was used as an office building in a busy urban area. In 1999, owner concerns lead to the conclusion that a final complete cleaning under a materials license and subsequent license release was prudent.

Initial release criteria were selected to be consistent with Regulatory Guide 1.86 for radium. Alternative analysis using dose-based standards indicated that higher release standards could be justified, but these higher criteria were judged to be a possible public concern for building re-occupation by the regulating agency. Meeting the lower release criteria established by Regulatory Guide 1.86 alleviated these concerns, but added significant time and cost. Turn-of-the-century construction materials and methods strongly influenced both remediation techniques and exposure pathway scenarios. A balance was achieved by using the lower release criteria for all accessible surfaces, and developing a site-specific hazards assessment procedure (dose-based release) for inaccessible areas and structurally critical areas which could not be disturbed. In addition to developing release guidelines, background values were difficult to determine due to the wide variety of building materials used and limited access to some of those materials.

The owner and its consultant proposed to begin remediation while compiling characterization data for later submittal. This parallel path approach allowed work to begin, areas to be completed, and material backgrounds to be developed. Restrictive surface release criteria were applied to the accessible areas throughout the building. Characterization data was collected, then dose modeling was done in parallel with remediation to establish dose-based release limits.

Representative dose scenarios were developed and agreed to by all parties to evaluate future use of the building. Areas of the structure were identified as inaccessible, unsafe for further remediation or structural in nature to which risk based criteria could then be applied. The modeling and evaluation process itself took a parallel path to satisfy regulatory concerns for an agency that had not yet applied dose modeling to the release of a site.

As the project progressed, it was discovered that a significantly higher number of original building surfaces required cleaning. Cost and effort increases were necessary to complete the project. The coordinated effort included 28 different companies and multiple city, county and state offices. The building was remediated to both prescriptive and dose-based standards using site-specific urban occupational and use scenarios. It is a story of success through cooperation and learning in a productive iterative process.

INTRODUCTION

Effective communication and unique decommissioning strategies proved beneficial to the licensee of a radium contaminated building in Pennsylvania. The strategy entailed extensive communication efforts between the licensee, the consultant and state agency and performing common decommissioning tasks in an uncommon fashion.

SITE HISTORY

Joseph M. Flannery, President of the Standard Chemical Company, brought radium processing to Pittsburgh in the early 1910's. Mr. Flannery's process involved separation of uranium and actinium from carnotite ore at a facility in Canonsburg, PA followed by final radium separation at the Flannery Building in the Oakland section of Pittsburgh, PA.

The Flannery Building was originally constructed in 1911 as a flat-roofed, five-story, steel-framed structure with a basement situated on a 76 ft x 130 ft lot. The original floor systems were constructed of terra cotta shapes that spanned between the floor joists and surrounded the floor beams and joists. The terra cotta shapes provided structural support and they served as fireproofing material. Wood sleepers anchored a tongue and groove finished floor, and Beton (a lime-sand-aggregate mixture) filled the intersticial space between the wood sleepers providing additional fireproofing. Horsehair plaster was used on the underside of each original floor system as a ceiling surface. The exterior walls of the building varied in construction. These variations occurred in building geometry, building materials, number and types of windows, and number of entrances. Exterior wall building materials included solid brick masonry, terra-cotta architectural pieces, sandstone masonry, and concrete. Other original features included a sewer system, a freight elevator, pipe chases, and stairways.

The separation process used at the Flannery Building involved boiling chemical compounds, chemical separation, and encapsulation of the radium. At peak production in 1922, the Standard Chemical Company produced about 18g of radium per year that was used for medicinal purposes and as an additive to paint used on clock dials, watch faces, and aircraft instrument dials. Radium processing at the Flannery Building ceased in the mid-1920's. However, contamination from of the radium processing operation remained.

In subsequent years, the Flannery Building was used for various office, laboratory, and banking activities with little consideration of remnant radium contamination until the 1960's when simple surface decontamination activities were first documented. Additional decontamination was performed in the early 1970's on the fourth floor, the fifth floor and the basement. As part of the fourth and fifth floor remediation conducted in the 1970s, all flooring materials except the structural terra cotta subfloor were removed and replaced with a three to four inch layer of concrete. The Pennsylvania Department of Environmental Protection (DEP) Bureau of Radiation Protection evaluated the radiological status of the building in 1984 and determined that the building was suitable for continued unrestricted use. Additional characterization activities occurred in the early 1990's, however, no further decontamination activities occurred until 1999 when the owner determined that a complete renovation of the Flannery Building was required.

By 1999, the Flannery Building had been modified several times. Significant changes included:

- the addition of pedestrian elevators,
- the abandonment and replacement of the original sewer system,
- the replacement of the fourth and fifth floors in the 1970s,
- the addition of a mezzanine level between the first and second floors in the 1972, and
- the installation of modern floor, wall and ceiling materials throughout the building.

In 1999, in anticipation of remodeling, the owner began the task of addressing remnant Ra-226 contamination. Radiological survey data from prior studies was compiled and reviewed by others and additional characterization data was collected. It was determined that limited residual contamination remained on several levels of the building, and it was recommended that additional decontamination be performed prior to renovation.

Since the facility had produced radium long before the Atomic Energy Act and because radium is excluded from the act when it is the solely utilized material at a site, it became necessary to find an appropriate mechanism for documenting the successful clean-up and release for the building. The DEP Bureau of Radiation Protection recommended the issuance of a State materials license as the mechanism to identify standards and record the successful release of this building for unrestricted use. By accepting this strategy the owner became a licensee in an unfamiliar realm.

In September 1999, the DEP issued Materials License No. PA-0821 for decontamination and decommissioning activities at the Flannery Building. This license set forth requirements for final release and subsequent license termination. License Release criteria were based on Regulatory Guide 1.86. Release limits were as follows:

Ra-226 Limits	Average*	Maximum	Removable
Alpha	100 dpm/100 cm^2	300 dpm/100 cm^2	20 dpm/100 cm^2
Beta-Gamma	100 dpm/100 cm^2	300 dpm/100 cm^2	20 dpm/100 cm^2

* Measurements of average contamination should not be averaged over more than 1 square meter. For objects of less surface area, the average should be derived for each object
dpm = disintegrations per minute

In addition, exposure rates in occupiable building areas were to be reduced to 5 microrems per hour above background as measured a distance of 1 meter from the floor/lower wall.

UNIQUE CHALLENGES

In 2000, the owner awarded contracts to ENERCON Services, Inc. (ENERCON) and a remediation contractor to initiate the work. ENERCON provided a radiation safety officer, project management, health physics support, and other expertise. ENERCON's responsibilities included data collection, compilation, analysis, and reporting; consultations with regulatory officials; documentation of activities; and guidance of remediation efforts. Soon after project award, ENERCON recognized that decontamination of the Flannery Building would present unique challenges.

If there were such a thing as an ideal building decommissioning project, it would probably involve an owner/licensee familiar with radioactive materials, an industrial building constructed of typical building materials, former employees with a working knowledge of site activities, established release criteria, and good characterization data. The Flannery Building Decommissioning Project had none of these elements. The owner was a banker, the structure was an office building constructed using antiquated techniques, former employees were all deceased, the release criteria was changing from prescriptive to dose-based, and the characterization data was incomplete. All of these factors complicated the Flannery Building decommissioning process.

Typically, the owner of a contaminated building is in the business of either producing or managing radioactive materials and has some appreciation for the time and effort required to decontaminate such a building. On this project, the owner's business was banking. He had little interest in radiation, and less interest in the intricacies decommissioning. What he understood very well was that he owned a valuable piece of property if it could be decontaminated to allow release for unrestricted use. If it could not be released, he owned a significant liability. One of ENERCON's challenges was to educate the owner as the decommissioning process evolved, and another was to complete the decommissioning process in the most cost-effective manner possible.

By June 2000, ENERCON and the remediation contractor initiated decontamination activities based on the release criteria established in the license and a "Comprehensive Work Plan" prepared by others. The Comprehensive Work Plan prescribed that survey and sampling were to be conducted in accordance with NUREG/CR-5849. Decontamination work began on the first and third floors based on existing and new data. Soon after work began, it was discovered that the early 1990's data and the more recent data compiled by others did not reflect the actual extent of residual contamination.

ENERCON performed additional characterization to better define the remediation requirements. Characterization and decontamination activities continued simultaneously to minimize the impact on schedule. As ENERCON initiated characterization additional activities, another significant complicating factor came to bear. That was the dearth of information caused by the time lapse between radium processing and site decommissioning. Radium processing occurred between 1912 and 1926 and final decommissioning didn't start until 1998. The passing of three-quarters of a century coupled with extensive building remodeling left the decommissioning team with very little specific knowledge of the process configuration, process operations, or original floor layouts that might guide the decontamination process. As a result, decommissioning team members were forced to assume the roles of quasi-"CSI" investigators using science and intuition to piece together a picture of a long dead process.

By the end of 2000, it was determined that many of the original surfaces of the building were impacted by historical activities. At that point, it was determined that the scope of decontamination and license termination activities would need to encompass most of the building. Additional investigations indicated that low levels of residual contamination were present on the interior side of most of the exterior load-bearing walls, many of the brick encased exterior columns, a large portion of the original sub-floor, and some of the hollow terra-cotta block that constitute the load-bearing portion of the sub-floor construction. Low levels of residual contamination were also found in the structural exterior wall in and around the window frames as well as on the surfaces of the exterior windowsills. It was concluded that only a few of the original surfaces could be considered unaffected and decontamination activities were increased to address the affected areas.

Piping and mechanical systems in the building were also poorly understood when the project began. Process and drain piping was hidden in structural columns, and previous repair and decontamination attempts that were used to cover, fix or hide contamination would not meet the release standards. Piping throughout the building had to be traced and evaluated for removal and sampled to determine if it could be left in place. None of these issues were identified in previous characterization activities to the knowledge of the owner.

Even the development of basic background levels became daunting. Virtually every area in the building was affected. No similar buildings existed in the area that could be used for background comparison values. Additionally, there was a wide variance of natural materials used throughout the building. Clean or unaffected areas within the building were not available to adequately represent this array of materials. This would, in the end, represent a difficult challenge to the decommissioning team as we tried to determine how much decontamination was enough to satisfy the decommissioning standards selected for the building.

In short, the site now had a licensee who knew virtually nothing about the size and scope of its task ahead, and the decommissioning team had a monstrous task ahead in building adequate knowledge, allaying owner concerns, and building a successful working bridge with the DEP regulatory personnel.

OWNER CONCERNS

The Owner's concerns considering the expanded scope of work were consistent with those of most licensees:

- Can the building be free-released or should it be demolished?
- What is the most cost-effective method to complete the project?
- Have we selected and are we using standards that are reasonable for the work we must complete?
- Are these standards being fairly applied to my site, and is their application consistent with other sites?
- How do the standards impact on the project schedule and cost?
- How does the cost impact on the profitability of our company?

However, the site had some additional owner concerns that were unique to this facility. First and foremost, the property was located in a highly populated urban setting near a college campus. The issues related to the demolition of a building in a controlled manner in this setting were extremely daunting. Complicating the demolition scenario was the consideration that the building, a 3-story annex, and an adjacent 7-story parking garage were all structurally integrated.

In the early 1970s, an annex had been constructed using the west wall of building as a common structural wall. Therefore, demolition of the building would have meant demolition of the annex building as well. Adjacent to both of these structures was a seven-story parking garage. The annex and the parking garage were constructed concurrently to allow for garage exit ramps to be structurally supported as part of the annex. Essentially, the building demolition would have potentially required demolition of most of the structures in the same block. Considering the difficulty of controlling and separating contaminated waste from non-contaminated waste, the demolition scenario had the potential to generate extremely large quantities of contaminated waste.

Due to the age of the building and its unique architectural appearance, the building was considered a possible candidate to be designated a historical structure and thus be required to maintain its current appearance. All of these factors were identified by the owner as significant technical, logistical, and cost problems. Eventually, the owner focused on achieving unrestricted release of the building as the primary goal of the project.

STATE AGENCY CONCERNS

From the DEP's perspective, there was a complicated set of issues to deal with regard to this licensee and this site. The licensee had no understanding of the process that was used nor did it have any knowledge of radioactive material management. The regulatory agency had little initial confidence that the owner had the appropriate focus on protective results instead of the corporate bottom line. The decommissioning team hired to resolve the issues had to work to develop the confidence of both regulator and licensee. In this difficult scenario, the DEP initially adopted a position of "Trust but Verify" with regard to licensee submittals and data.

Another concern was raised when ENERCON proposed use of dose-based release criteria. When the project began, the release criteria were selected by the DEP to be consistent with Regulatory Guide 1.86 for radium. Subsequently, U.S. Nuclear Regulatory Commission, (NRC) 10CFR20 Subpart E, which requires a dose-based release approach was published. With limited experience with the new dose-based release requirements, the DEP Decommissioning Branch was concerned about its application to this project.
At the start of the project, it was believed that the impacted surfaces were restricted to a relatively small number of locations in the building. So compliance with the more restrictive requirements of Regulatory Guide 1.86 (Reg Guide 1.86) did not seem to pose a problem for decommissioning. However, as layers of modern building materials were removed to access the original surfaces, it became apparent that some of the building surfaces were impacted above the Reg Guide 1.86 release standards, and decontamination to these levels was not practicable.

Preliminary analysis performed by ENERCON using a dose-based approach indicated that higher release standards could be justified throughout the building. Adoption of dose-based release standards throughout the building concerned DEP because the dose-based release criteria were dramatically higher than current license criteria and the owner had already demonstrated an ability to meet current license criteria on most building surfaces with reasonable effort.

Another DEP concern was the adequacy of the original Decontamination Plan prepared by others. Their concerns arose when initial decontamination efforts revealed the increased extent of contamination. At that point it became apparent that the original Decontamination Plan was based on inadequate characterization data. This concern lead DEP to question whether decontamination work should continue with the existing Decontamination Plan or stop to allow additional characterization and Decontamination Plan revision.

Lastly, the development of adequate background information was a continuous concern throughout the process. To begin with, material backgrounds were difficult to develop due to the extent of contamination throughout the building. In addition, the wide variety of turn-of-the-century construction materials caused a wide variance in NORM levels. For these reasons, development of adequate background values was a significant concern to regulatory personnel and represented the single largest challenge to the successful documentation of project completion.

THE DECOMMISSIONING PROCESS

The approach to decommissioning was not a simple. Once the contamination was found on and inside original building construction materials throughout the building, ENERCON had to redefine the approach. At this stage, the decontamination process was in full operation and positive efforts were being made to remediate the building. Due to the owner's concerns of budgetary expenditures, it was decided that a parallel path approach between decontamination, characterization and final status surveys would be more cost effective than stopping decontamination and remobilizing after a complete characterization effort was performed. A process developed in which decontamination efforts complimented both characterization surveys and final status surveys. At any one time, some areas of the building were undergoing final status survey while others were being decontaminated. The final status survey process and decontamination process became a merged effort as hot spots were found and decontaminated as the final status survey was completed.

Survey equipment was selected that provided an adequate response to radiation and demonstrated compliance with accepted release criteria. Due to the general level of contamination, Minimum detectable activity (MDA) development required vigilance. MDA was calculated in accordance with NUREG/CR-5849. Instruments were calibrated daily and or annually as required.

Extensive decontamination and demolition was performed on all levels of the Flannery Building. The decontamination efforts used to remove contamination from building surfaces were substantial and aggressive. The decontamination techniques employed are widely used in the decommissioning industry and did not pose unusual, or significant, health and safety concerns. These techniques included, chemical cleaning, needle gunning, grinding/scarifying, grit blasting, demolition and the use of HEPA vacuums.

The interior of the Flannery Building was disassembled as necessary to allow thorough decontamination to achieve material license termination. Partition (non-load bearing) walls were completely removed, floors and walls were disassembled and abraded, soil was excavated, and piping systems were removed or exposed for radiological characterization. Asbestos abatement was also completed to support decontamination efforts. Concrete floors in the basement, fourth and fifth floors were scabbled, needle-gunned, chipped, and where necessary, removed. Steel columns were exposed and ground down to remove fixed contamination. Wooden freight elevator rails were carefully sanded to maintain working tolerances. All original surfaces that were accessible during facility operations were exposed and surveyed to meet license requirements.

Some areas could not be released using original license release criteria due to structural concerns, accessibility issues, or safety concerns. These limited areas had to be evaluated using dose based release criteria. Midway through the project the DEP adopted release criteria consistent with US NRC 10CFR20 Subpart E. This provided the opportunity for the licensee to develop dose-based release criteria for difficult or inaccessible areas. This concept was utilized for those areas that previously established release criteria could not release. These areas included small voids and openings, spaces between floors and inside of terra-cotta block, inaccessible walls, elevator shafts and components, roofs and other areas that are not generally accessible to building occupants. These areas could not be decontaminated and directly monitored without irreversibly damaging the structural integrity of the building or critical building systems or potentially affect the safety of remediation workers. Because these areas are inaccessible and will remain inaccessible to building occupants after license termination, the potential radiation exposure to residual radioactive materials can be addressed using a dosed-based approach, which requires them to meet the following criteria:

- Maximum dose exposure to an average member of the critical population groups does not exceed 25 millirem per year (mrem/yr) from residual radioactivity from licensed material

- As Low As Reasonably Achievable (ALARA) cost benefit analysis meets the requirements of Appendix D of NUREG 1727 "NMSS Decommissioning Standard Review Plan".

Areas that were considered for dose-based release were considered Hazard Assessment (HA) areas and fell into one or more of the following categories:

- Structural HA Areas – Areas where complete remediation or demolition (building material removal) would affect the structural integrity of the building.
- Inaccessible HA Areas – Areas where portions of the building were not accessible due to the style or type of building construction, or where portions of the building were not accessible due to the proximity of critical building systems that were required to remain in-place.
- Safety Related HA Areas – Areas where portions of the structure could not be completely remediated due to an inability to design and implement adequate safety into procedures and methods. This inability to meet adequate safety standards was due to either the lack of as-built structural drawings and sufficient construction details on the building, or the need to maintain operational building support systems for the public.

HA areas underwent an evaluation to show that those areas were in compliance with 25 mrem/yr limit. In addition, ALARA cost benefit analysis as described in Appendix D of NUREG 1727 "NMSS Decommissioning Standard Review Plan" was used as necessary to support license termination. Dose exposure calculations for these areas were based on the hazard assessment as described in E. W. Abelquist's book "Decommissioning Health Physics A Handbook for MARSSIM Users" (Institute of Physics Publishing, 2001). This analysis was prescribed by the DEP to establish license release conditions consistent with existing regulations. For this reason, the dosed-based release criteria were incorporated into the existing license.

For each HA area, a description of the location was given including the data obtained from associated surveys and/or sampling activities. An adequate number of survey points and/or samples were taken to properly characterize and bound the source term and area. From this data, the highest recorded measurement was first evaluated against the NRC's default (most restrictive) screening value for Ra-226 of 1,010 dpm/100 cm^2, as found in Table 5.19 Concentration (dpm/100 cm^2) equivalent to 25 mrem/yr for the specified value of P_{crit} of NUREG/CR-5512, Volume 3. The Ra-226 screening value of 1,010 dpm/100 cm^2 was chosen rather than the more restrictive value for Ra-226 and progeny because it was determined that radium was not in equilibrium with its beta emitting progeny. Field measurements of radium and its key beta producing progeny taken during characterization and decontamination not only determined that radium was not in equilibrium but were used to develop more accurate dose conversion factors for HA calculations.

If the identified data was less than the screening value of 1,010 dpm/100 cm^2, the area met the unrestricted dose-based release criterion from 10 CFR 20 Subpart E and no HA calculations or ALARA analysis were required. For those HA areas that have data exceeding the 1,010 dpm/100 cm^2 screening value, all data applicable to that area was evaluated and averaged. An area size was determined from survey and/or sampling data and a logical explanation was presented to explain the most likely group of people (critical population group) that would be exposed to that HA area. In addition, the time the group would be exposed to that area and each applicable exposure pathway was presented. Critical population groups and exposure pathways such as Direct contact, Inhalation, and Ingestion, were used in conjunction with the applicable data to calculate the dose using equations as presented in E. W. Abelquist's book "Decommissioning Health Physics A Handbook for MARSSIM Users." All HA areas were shown to meet the dose-based release criteria of 25 millirem per year. In addition, all HA areas were shown to meet ALARA requirements.

In order to determine a point at which a decontamination effort could be considered complete, it was necessary to know the background activity in the materials being cleaned. This required a study of both radionuclide concentration in the building materials due to NORM and direct radiation levels throughout the building. The building was not of uniform construction but contained a variety of types of brick, terracotta, marble, concrete, granite, steel, wood, and plaster each of which required a NORM determination. Simple sample collection and analysis was difficult because a majority of the building was at least minimally impacted by the historical activities.

The building was of unique construction, therefore, the option of measuring backgrounds from materials in a similar building was not available. Consistent with the parallel approach, the background studies were completed after a significant portion of the remediation was complete. Samples of various building materials were taken and analyzed from areas which were cleaned to release criteria or from the few areas thought unimpacted by historical processes. The concentrations of radionuclides in the samples were converted to surface activity using a program developed by ENERCON, which estimates alpha surface activity based on concentration data. Finally, each field measurement in the database was corrected to account for the appropriate material specific background.

The background radiation levels could not be studied until after the remediation process was complete. Once the remediation was complete, a microrem survey of the entire building was completed at 1 meter. After studying the data, it was obvious that 1 background for the entire building was not appropriate. Even a floor-specific background was not always appropriate as it did not account for material and geometrical differences throughout each floor. To account for these differences, each survey unit in the building was analyzed for material and geometrical construction and the background adjusted. Each adjustment was applied to the raw data and given a detailed justification in the final report.

COMMITMENT AND COST

The completed effort has been significant both in cost and in shear mass of material removed. The total project cost was $8.1 Million and expended over 85 man-years of time in 3 years. The coordination effort included:

- 1 radiological decommissioning oversight contractor
- 2 remediation subcontractors
- 2 asbestos removal subcontractors

- 2 waste hauling companies
- 3 disposal facilities
- 3 Railroad companies
- 1 building external renovation and cleaning company
- 2 plumbing companies
- A structural engineering company
- An electrical contractor
- An elevator company
- A roofing company
- 5 radiological laboratories
- The client
- The client's real estate consultant
- The client's attorney
- 3 city and county departments
- The regional state environmental office staff
- The state environmental headquarters office staff
- The state's radiological consultant
- The state's structural engineering consultant

DEP regulatory personnel from both the regional office and the central office in Harrisburg worked closely with the decommissioning team to resolve issues and overcome problems. Meetings by telephone and at the site played critical roles in the rapid completion of this complex process.

THE SUCCESSFUL RESULT

The start condition of the building was an operating, financially viable structure that contributed to the local economy. A successful result for the owner would be achieving unrestricted release of the building, and returning the building to its status as a commercially viable business operation. From the perspective of the regulatory agency, this was also a successful result, provided that all technical issues were resolved.

Communication issues, a key part of every project, needed to undergo a fundamental shift for a successful project. Since the owner's primary business was strictly a customer service business in a highly regulated environment, they did not have any experience in dealing with a highly technical specialty. In this area, the initial lack of understanding of the owner was clearly recognized by the regulatory staff, and they made a special effort to continually educate and advise as clearly as possible about technical issues. Work proceeded continually for more than two years supported by periodic meetings and review. However, when it became clear that some very specialized approaches would be required, the frequency and duration of the meetings was significantly increased. Specialized tasks in the building required additional subcontractors, exterior surface cleaning specialists, new waste classifications and handling methods, and a critical review by the owner to decide if the chosen course of action should continue.

Eventually, all the tough technical and specialized problems were successfully solved. In excess of 550 tons of materials were removed and disposed at a waste disposal facility in Texas, and another 5 tons was disposed at a facility in Washington. The remaining structural areas that could not be removed without causing irreparable damage to the building structure were sampled to allow for dose hazard assessment based on four potential scenarios. These scenarios were a building occupant, a building resident, a maintenance worker, and a demolition scenario for complete building destruction at a future date. The dose hazard assessment in all cases were found to be far below 25 millirem per year and the site was released for unrestricted use.