# Columbus Closure Project
# Released without Radiological Restrictions

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## ABSTRACT

The Columbus Closure Project (CCP), a historic radiological research complex, was cleaned up for future use without radiological restriction in 2006. The CCP research and development site contributed to national defense, nuclear fuel fabrication, and the development of safe nuclear reactors in the United States until 1988 when research activities were concluded for site decommissioning. In November of 2003, the Ohio Field Office of the U.S. Department of Energy contracted ECC/E2 Closure Services, LLC (Closure Services) to complete the removal of radioactive contamination from of a 1955 era nuclear sciences area consisting of a large hot cell facility, research reactor building and underground piping. The project known as the Columbus Closure Project (CCP) was completed in 27 months and brought to a close 16 years of D&D in Columbus, Ohio.

This paper examines the project innovations and challenges presented during the Columbus Closure Project. The examination of the CCP includes the project regulatory environment, the CS safety program, accelerated clean up innovation, project execution strategies and management of project waste issues and the regulatory approach to site release "without radiological restrictions."

## COLUMBUS CLOSURE PROJECT –THE EXTREME GREEN MAKEOVER

***Figure – 1. The Columbus Closure Project site buildings previously contained a retired 2 mega-watt research reactor, a plutonium test facility and radioactive material analysis laboratory, three large hot cells, and contaminated 50 ft fuel pool basin.***

The Columbus Closure Project was awarded to ECC/E2 Closure Services, LLC (Closure Services) in November of 2003, as a small business set-aside prime contract for $24.2 million. The "Greenfield end-state" decommissioning project was expected to last for two years. The Columbus Closure Project, located 17 miles west of Columbus, Ohio, was an 11.7-acre site with five radiologically contaminated buildings ranging in size from 7,900 sq ft to 31,000 sq ft with connecting areas of 4,000 linear ft of contaminated underground piping and sanitary sewer filter beds.

The Nuclear Sciences Facilities of the CCP supported the Atomic Energy Commission to perform atomic energy research and development (R&D) activities. The nuclear materials research and development started in 1955 and discontinued operations in 1988. The contaminants of concern included americium-241 (Am-241), curium-244 (Cm-244), cesium-134 and 137 (Cs-134 and -137), cobalt-60 (Co-60), europium-154 (Eu-154), plutonium 239 and 240 (Pu-239 and -240), strontium-90 (Sr-90), and other mixed fission product radionuclides. (Cs-137, Co-60, and Sr-90 are the prominent isotopes present.) [1]

To achieve "Greenfield" status, Closure Services removed more than 51,000 tons of radioactively contaminated debris and soil. The project ending waste volume (3.7 times the approved baseline waste volume) was characterized, packaged and shipped for disposal without a significant schedule impact. Closure Services responded to the additional waste volume by implementing multiple cost savings strategies, which minimized the cost impact to the project and provided the best value to the client.

Closure Services declared the project physically complete and verified the site grounds released for use without radiological restrictions in February of 2006. Closure Services' site release certification is documented through independently verified final status survey reports and verification by the USNRC covering one hundred percent of the site property. The CCP final certification package has been submitted by the licensee for NRC site de-licensing procedures.

## ON COMMON GROUND-THE CCP REGULATORY SETTING

Uniquely, Closure Services worked under contract with the DOE and under the regulatory requirements of an NRC License held by the property owner. The site possessed an approved NRC decommissioning plan, which defined the radiological unrestricted use criteria. Due to the nature of the work, and the importance of completing the project in a timely manner, Closure Services established good relationships with key regulatory officials and agencies, which was essential to successful project execution.

The project regulatory framework included the following agencies:

- US Department of Energy, (DOE)
- US Nuclear Regulatory Commission, (USNRC)
- Ohio Department of Health, (ODH)
- Ohio Division of Natural Resources (ODNR)
- US Department of Transportation, (US DOT)
- Ohio Environmental Protection Agency (OEPA)
- US Environmental Protection Agency, (USEPA)
- Occupational Safety and Health Administration, (OSHA)

Closure Services' management team was assembled specifically for the CCP, with recent site closure and relevant regulatory compliance experience. This team of experienced leaders understood the regulatory environment and requirements to be key components for achievement of project performance goals. As a result of this management approach, CS received 38 external program reviews, conducted 42 internal quality assurance audits, and completed 3,175 regulated waste shipments without a single transportation, disposal site, or regulatory "notice of violation."

## SAFE AND SOUND- THE CCP SAFETY RECORD

Of the many CCP regulatory accomplishments, none were more notable than the project safety performance. The CCP management insisted on a safety culture beginning with "Zero Incident" performance as an expectation and promoted continuous improvement in safety performance. This leadership philosophy recognizes safety and welfare of employees as of primary importance to the project. The daily safety atmosphere encouraged safety awareness not only for oneself but also for ones co-workers. Supervisors implemented a mentoring program, which paired experienced members of the work force with less experienced workers. CCP management gave ownership of the safety program to all employees by combining mentoring along with employee safety recognition and reward programs. This "ownership" made co-workers personally responsible to one another for positive safety behavior. Visitors to the CCP site often admired the positive attitude and high morale visible on the job site. Closure Services achieved 355,977 safe work hours and finished the CCP without a single OSHA recordable injury or lost time incident. The safety record of the Columbus Closure Project was recognized by both DOE Head Quarters [2] and the National Safety Council, but was most appreciated by the men and women that contributed to the project's success.

## CCP-INNOVATION AT WORK

As with most sites designed for scientific research and development, the CCP site was not well suited for demolition and excavation activities. A variety of unusual circumstances presented CS management with opportunities to implement creative and cost effective solutions on the CCP. CS applied sound industry practices and project management innovations to all areas of the project.

After assuming responsibility for the site, CS planned new truck traffic routes separate from site foot traffic patterns. Truck site access improved bulk waste shipment preparation and facilitated transportation of containers off site. CS introduced construction logistics to the site by developing trucking lanes and maintained waste survey and storage areas in a manner that ensured the continuity of operations was maximized through out the work schedule.

CS, with support from DOE, received approval to segregate waste meeting the waste acceptance criteria (WAC) for disposal at licensed Subtitle D landfills. [3] The introduction of this cost effective waste option saved the CCP an estimated 5.8 million dollars and will continue to provide financial benefit to the DOE on future projects.

The hot cell building design included a stainless steel lined 50 foot deep fuel handling pool. The exposure of personnel to an excavation this deep would clearly be undesirable, from an industrial safety and site logistics standpoint. CS successfully removed the contaminated stainless steel liner and surface released the pool cavity such that a very deep excavation was not required to remove the pool. This free release effort/process was critical to the success of the project.

Several High Radiation areas and considerable amounts of loose surface contamination were present inside hot cell structures that would present undesirable working conditions and additional radiological controls in an outdoor environment. In response to this, CS executed an aggressive interior dismantlement and source term reduction campaign that removed as much radioactive material and debris as possible prior to dismantlement of the exterior building structures. This dismantlement and waste removal phase of the project was performed primarily using heavy equipment and saved an estimated collective dose of 150 person- mSv (15 person-Rem) by eliminating the need to place workers in close proximity to contaminated surfaces.

Accurate and timely radio-analytical data was instrumental to maintaining the accelerated site closure schedule. CS planned, constructed and successfully operated a fully functional temporary onsite radio-analytical laboratory (RAL). The RAL capabilities included wet chemistry, gamma spectroscopy, alpha spectroscopy, and gross alpha-beta analysis of environmental samples. The CCP temporary laboratory maintained National Environmental Laboratory Assessment Program certification and ensured proper waste stream verification, timely volumetric free release surveys, and expedited soil analysis, supporting the final certification of the site for unrestricted use.

The project site was small relative to the amount of demolition and excavation that was required. CS carefully scheduled activities to optimize work place safety. By sequencing the work in locations separated by physical distance from one another, an exclusion zone around the heavy equipment activities could be maintained and greatly reduced risk of personnel injury.

Similarly, by sectioning the site into smaller more manageable areas, the schedule dictated a balanced progressive approach also promoting a systematic progression of demolition, sub-grade excavation, backfilling and site restoration activities. Completion of individual site areas was achieved while other areas of the site were prepared for final status survey, independent verification, and NRC confirmation that site release criteria had been met. By staggering the start/finish all demolition, excavation and restoration phases of the individual sub projects, CS methodically reduced the site remediation footprint and allowed for resource leveling of activities.

## PROJECT EXECUTION HIGHLIGHTS

### Approach to Building Demolition

Two of the five site buildings scheduled for demolition, were strategically free released, by means of surface release criteria, prior to demolition. The CS Final Status Survey Reports documented that any surface decontamination was completed and the unconditional free release criteria had been met. Both the Oak Ridge Institute for Science and Education (ORISE) and the US NRC independently verified that CS survey data was accurate and the buildings were suitable for commercial demolition. The commercial demolition of these formerly radioactive facilities was performed more efficiently without radiological restrictions and the demolition debris was eligible for commercial waste disposal.

CS self performed the demolition planning, structural dismantlement and demolition debris sizing/loading. The self-performance of the demolition work enhanced safety compliance and increased awareness as well as experience associated with structural, heavy equipment and waste loading limitations. By applying these experiences gained from performing the clean demolition of the above grade structures, greater efficiency and proven methods were used in the later contaminated building demolition with the addition of radiological controls.

In parallel to achieving an approved free release status for the buildings, CS coordinated a systematic process aimed to identify and reduce radioactive contamination and radiation levels to the lowest level of radiological risk prior to removing the containment of exterior building structures. Using heavy equipment, CS removed and loaded potential sources of radiation fields, gross surface contamination, and potential sources of airborne radioactivity. The goal of interior dismantlement was achieved with exceptional ALARA benefits to the work force. The majority of the project's 118 person-mSv (11.8 person-Rem) collective dose was received during this phase of the project.

Concurrently to interior demolition and stabilization, CS removed all of the contaminated stainless steel fuel pool lining from the hot cell support pool and transfer canal. Plasma arc torch cutting was utilized in

conjunction with a network of HEPA ventilation to control fumes generated during cutting. The implementation of a cut plan that minimized the total cutting length and avoided areas of elevated surface contamination on the stainless steel panels was effective in quickly removing pool liner sections and packaging them for shipment. This extensive effort of liner removal by section, concrete surface decontamination, and final status survey concluded with an unconditional surface free release of the pool cavity. This permitted the 20 x 20 x 50 foot deep pool to be managed by CS without the potential of the deep excavation hazards that would have been associated with the complete excavation of the concrete pool structure.

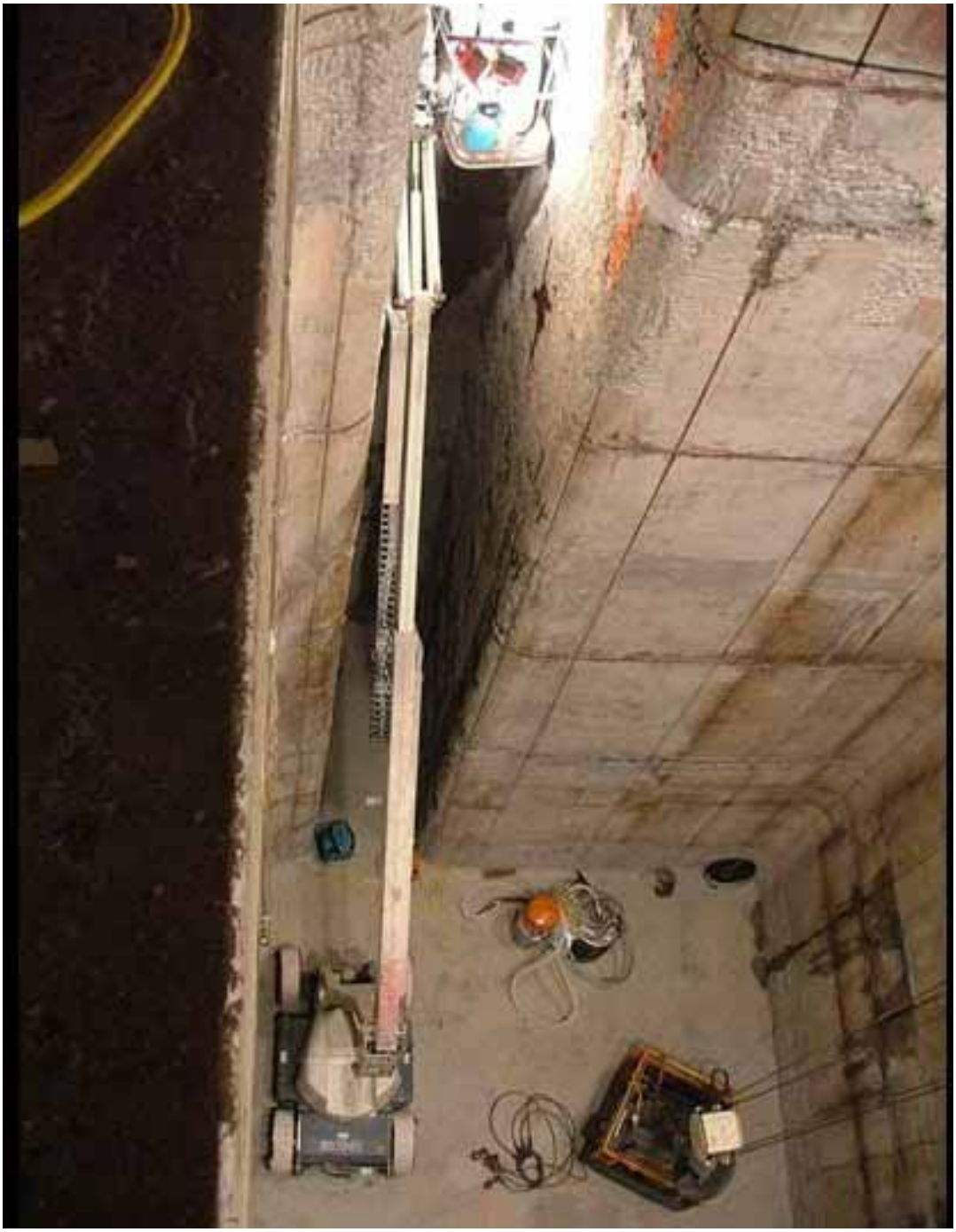

***Figure 2. Closure Services successfully removed the stainless steel liner and surface released the fuel basin extending 50 feet below surface grade and avoiding costly excavation of the structure.***

The radiologically contaminated building demolition focused on the Hot Cell facility structure. This facility was comprised of three adjacent interconnecting buildings. The building, designed to shield occupants from over one million curies of radioactive material, was constructed from massive quantities of high and regular density concrete. Each of the buildings under went a thorough process of hazardous material abatement, low-level radioactive and mixed waste segregation, interior dismantlement/source term reduction, and surface contamination hazard stabilization.

Prior to demolition of the contaminated facilities, a detailed evaluation of all demolition activities was documented and potential air release levels evaluated against environmental monitoring targets. The open-air dismantlement target values were determined by using environmental dispersion modeling and by gaining concurrence from the US NRC. Once interior surface contamination levels dictated by the dispersion model were achieved, the hot cell building structure could be progressively dismantled and carefully loaded into 20 cubic yard inter-modal waste containers

**Approach to Excavation of Contaminated Soil and Piping**

The CCP site contained over four thousand linear feet of underground piping with contamination levels above the site release criteria. CS developed a procedure/work instruction document that directed a phased removal and sampling of the overburden soil and applying volumetric release protocols to segregate unaffected overburden from soil in contact with the contaminated piping. [4] The US NRC approved CS excavation methodology and determined that it was compliant with the site license and decommissioning plan. The CS excavation process standardized the trenching and sampling process that documented overburden soil as meeting release criteria and as suitable for re-use as backfill.

***Figure 3, Closure Services minimized the waste volume of soil surrounding the underground-contaminated lines that were removed by using a CS procedure approved by the U.S. NRC.***

CS adopted an excavation management practice of minimizing the time for each excavation to remain open. The below grade piping removal excavations were scheduled to coincide with below grade building drain removal wherever practical. By employing this strategy, the total number of open excavations could be reduced to a minimum and work place safety was improved. This excavation management process permitted any open excavation to be scheduled for final status survey and independently verification by ORISE and the US NRC as early as possible. When CS soil release analytical data for each excavation was confirmed, crews began backfilling and open excavation site restoration activities.

CS managed ground water and storm water infiltration into open excavations regularly. Due the potential contact with active remediation (inside excavations), CS developed and implemented a site procedure that directed surface water containment in holding tanks, which was sampled and volumetrically released, for discharge at an approved waste water discharge facility.

## HERE TODAY, GONE TOMORROW

The CCP managed a total disposal waste volume growth of over three times the Project Baseline waste volume. The baseline waste estimate of 477,462 cubic feet was far below the actual waste volume at project completion of 1,765,141 cubic feet. Closure Services quickly responded to the waste volume growth by implementing several waste volume mitigation measures to control project cost and schedule impact from the volume increase.

***Figure 4. Closure Services prepared and shipped large numbers of intermodal containers to offset increased LLW volumes using multiple methods, reducing the cost and schedule impact from project waste growth.***

CS shipped Low Level waste to Energy Solutions (ES) through several different avenues.

Fully loaded intermodal containers were shipped via truck transport directly to the disposal site and through the CCP Ohio Department of Health, licensed, intermodal trans-loading rail yard in Hilliard, Ohio. CS loaded up to seven intermodals per flat rail car and transport up to 21 intermodals per day. These two options had drawbacks because they limited the re-use of the intermodal containers. Due to the rail delivery schedule, and the 3 month container return cycle, intermodal containers typically were not available for re-use when needed. With the increased waste volumes, CCP needed to find other options to supplement these methods and provide higher volume transportation and disposal of LLW.

As a result, CS contracted intermodal waste bulking services at a licensed waste transfer facility regionally located near the CCP. The CCP shipped up ten intermodal shipments per day to this facility. This facility could transfer on average 5-6 loaded intermodals into a single gondola rail car and return the empty intermodal containers to the CCP within the same week. This quick turnaround process was instrumental in keeping the project waste moving as the waste loading and shipping became the critical path for the project.

CS instituted double work shifts to maximize waste loading, and on site waste shipment preparation, which enabled the CCP to remove over 120 intermodal containers per week at the peak of the CS waste volume recovery plan.

Heavy equipment operators worked closely with characterization staff daily to identify waste that could be separated from the Energy Solutions waste stream. Where practical waste meeting the WAC for disposal at Subtitle D landfill was maximized. Dual verification was possible to ensure the bulk waste was acceptable for this waste stream. The CS onsite laboratory analyzed soil samples and use of direct ISOCS scanning of each waste container confirmed the waste could be disposed of more cost effectively and in parallel to the CS LLW shipping schedule.

As an added benefit, radiological waste identification and sampling process yielded analytical data supporting volumetric release of waste materials adjacent to radiologically controlled areas.

## UNRESTRICTED RELEASE AND INDEPENDENT VERIFICATION

CS maintained regular communication with the Environmental Survey and Site Assessment Program (ESSAP) of the Oak Ridge Institute for Science and Education (ORISE). ORISE was designated by DOE to fulfill the Independent Verification Contractor (IVC) role for the CCP. The CS/ORISE interface was designed to relay updates regarding ongoing D&D activities, FSSR completion schedules, and in-process remediation data. These communications ensured that the IVC arrived on site fully informed of CS activities. The US Nuclear Regulatory Commission (NRC) also performed independent review of the in-process final status surveys.

The CS final status survey processes adhered to the requirements of the "Radiological Characterization and Final Status Plan for CCP. Final status surveys were performed using the methods described in draft NUREG 5849, "Manual for Conducting Radiological Surveys in Support of License Termination," as reflected in the Decommissioning Plan. The combination of 29 CS final status survey reports, NRC inspection reports, in conjunction with the IVC Letter Reports certify and document that the endpoint criteria objectives of the NRC-approved Decommissioning Plan have been met for CCP site.

CS worked closely with the property owner using the feedback from the US NRC to complete the Final Certification Package (FCP), CCP contract deliverable. The FCP incorporates the FSSRs documenting the final condition of the site areas, the ORISE Final IVC Reports, and the applicable NRC inspection reports. To demonstrate the end-state data supports de-licensing of the site, the NRC licensee will use the CS Final Certification Package.

## CONCLUSIONS

The Columbus Closure Project, with the adversity of significantly increased waste volumes generated during the demolition, dismantlement, and excavation work scope, completed the release of the 11.7 acre site for use with out radiological restrictions and returned the site to the property owner for future use. The impact of the almost 300% increased waste volumes caused the project to complete in February of 2006 (a 13% schedule increase) and costs were limited to twice the baseline estimate. The project

performance in the areas of regulatory compliance and safety are outstanding. The Columbus Closure Project site is currently scheduled for NRC de-licensing proceedings utilizing the remediation documentation generated, and should serve as model for performing effective remediation work in the future.

## REFERENCES

1. *Final Certificate of Completion, Columbus Closure Project, West Jefferson North Site, West Jefferson Ohio*. ECC &E2 Closure Services, LLC, Final June 29, 2006.
2. *U.S Department of Energy Letter, from Jim Rispoli*, Assistant Secretary for Environmental Management, September 12, 2006,
3. *Approval Request for the Department of Energy Order 435.1 Exemption Revision to October 1993 Exemption for the Commercial Treatment and Disposal of Mixed Low Level Waste and Disposal of Low Level Waste*, U.S Department of Energy Memorandum C05-006, Ohio Field Office R.F Warther to John Sattler, January 27, 2005.
4. *WI-2806, Excavation and Trench Sampling and surveys*, CCP CS Work Instruction Revision 1, September 15, 2004.