Best Practice Form

Best Practice Title:	**The Use of Explosives to Demolish the 185-3K Cooling Tower**		
DOE Site:	Savannah River Site	**Facility Name:**	185-3K Cooling Tower
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Brief Description of Best Practice: (Provide a short, "abstract-like" description of the best practice)

Savannah River Site's (SRS) massive K Cooling Tower was safely demolished on May 25, 2010 as part of the site-wide Footprint Reduction Initiative funded by the American Recovery and Reinvestment Act (ARRA). Before the demolition of the cooling tower concrete structure, all pumps, motors, switch gears, and control rooms were removed. The cooling tower was constructed out of steel reinforced concrete and had a height of 452 feet, a base inner diameter of 345 feet, and a top inner diameter of 210 feet. The wall thickness ranged from 36 inches to 8 inches.

Detailed planning, design, and execution, as well as a cooperative team effort from the Department of Energy (DOE), Savannah River Nuclear Solutions (SRNS), Wackenhut Security/Safeguards Personnel, American Demolition and Nuclear Decommissioning (DND), Inc. and Controlled Demolition, Inc. (CDI) and LVI Services of North Carolina Inc. (LVI) helped ensure a safe, on time and uneventful delivery of the explosive demolition.

The practices that were followed on the project that contributed to the overall best practice include the following:

- Choosing implosion over other demolition methods.
- Calculating a precise amount of explosive to use.
- Recycling as much steel and other metals from the project as possible.
- Designing a customized crane man-basket to safely enable drilling at all of the explosives locations.
- Briefly closing public roads during the implosion.
- Management of the airborne silica dust.
- Management of noise exposure while preparing the tower for implosion.

Summary:

The 185-3K or "K" Area Cooling Tower, built in 1992 to cool the water from the K Reactor, was no longer needed when the Cold War ended. The cooling tower became obsolete and no other economical use was available due to its unique and dedicated design and location. The DOE decided to demolish the cooling tower to eliminate ongoing carrying costs and reduce the footprint of unnecessary facilities at SRS. DOE evaluated methods to demolish the structure and ultimately selected implosion as the most effective and safest approach to ensure the fewest amount of man hours at risk.

SRNS subcontracted to American DND, Inc. who further subcontracted to CDI and LVI. American DND performed the overall coordination and oversight of on-site activities. CDI, with more than six decades of experience using explosives to take down manmade structures, was able to implement their experience from previous projects in the planning of the implosion. LVI brought resources and heavy equipment to perform the cleanup effort, size reduction, and transportation of the debris to the SRS landfill.

Prior to demolition, a seismic study was performed and concluded that ground vibration levels would be well below project specified limits. In addition, a Demolition and Stabilization Plan was developed and approved, and the shell was covered with a layer of chain link fence and geo-textile fabric where explosives were placed in order to minimize flying debris.

Non-electric methods were used to initiate the explosives as they provide a high level of safety against accidental initiation by static electricity, stray electrical currents, and radio frequency energy. CDI used two non-electric blasting detonators, with non-electric signal tube, at each initiation point. Approximately 3,900 holes were drilled in the cooling tower to place explosive charges. Over 50% of the holes were located 120 feet above grade or higher. Over 1,300 pounds of nitroglycerin-based explosive, 13,000 feet of detonating cord, 900 non-electric detonators, and 2,000 feet of non-electric signal tubing were used. The charges were detonated in precise sequencing and timing to ensure the tower fell in the selected impact-zone. The firing position for demolition was situated 1000 feet from the base of the cooling tower and all other site personnel were removed to a safe area a minimum of 2640 feet from the tower.

One concern during the planning was for the carcinogenic affects of silica exposure to the workers during demolition and subsequent load-out activities. In response to this concern, an extensive Silica & Dust Monitoring Program was implemented. The Industrial Hygiene & Safety Team implemented a comprehensive and well documented Respiratory Protection Plan and Personal Air Sampling Monitoring Program to protect the workers to well below the permissible Occupational Safety and Health Administration (OSHA) and American Conference of Governmental Industrial Hygienist (ACGIH) standards. Based on a review of air monitoring analytical data, the Industrial Hygiene/Safety Team generated negative exposure assessments which provided documentation that the engineering controls, administrative control measures and personal protective equipment utilized for the project were effective. Airborne concentrations of silica and nuisance dust were below the documented ACGIH threshold limit values and the OSHA permissible exposure limits.

Another concern was the use of pneumatic drills and other demolition equipment that present high potential noise exposure. In response, the Hearing Conservation Management Program included the design of safe work zones to ensure that workers had the right hearing protection and maintained noise exposure readings at the lowest levels possible.

Immediately prior to detonation of the explosives, the adjacent public roadways were shut down to ensure public safety. The roads were re-opened within 15 minutes following the implosion, minimizing any inconvenience the road closure may have caused members of the public. In addition, wind speed and direction limits were established to preclude the resultant dust cloud from entering occupied areas. The resultant dust cloud meandered over unoccupied site areas and was fully dissipated within approximately 12 minutes following detonation. The seismic impact was less than 1/5th the allowable limit for peak particle velocity.

Why the best practice was used: (Briefly describe the issue/improvement opportunity the best practice was developed to address)

The DOE and SRNS selected controlled implosion as the most effective and safest approach to ensure the fewest number of man hours at risk for demolishing this unique structure.

CDI had previously imploded the largest cooling tower ever demolished at the former Trojan Nuclear Station in Rainer, Oregon. CDI's explosive Demolition Plan was deemed a success for the Trojan Project and CDI utilized this successful experience for the design and implosion of the SRS Cooling Tower.

What problems/issues were associated with the best practice: (Briefly describe the problems/issues experienced with the initial deployment of the best practice that, if avoided, would make the deployment of this best practice easier the" next time.")

The use of explosives on any DOE site poses unique challenges for coordination, logistics, permitting, security and safeguards. SRNS's and American DND's onsite project managers, coupled with CDI's management team, all worked diligently for three months to complete all permitting, submittals, task specific packages, work plans, activity hazard assessments, explosives permitting, designs and layout to minimize any problems during project execution.

With the exception of a 13.8kv power line that had to be isolated and removed prior to implosion, there were no utilities within a six-mile radius of the work site. In order to mobilize, the project had to bring in drinking water, generators, and trailers as well as install repeater antennas to facilitate cell phone service.

Due to the height and configuration of the cooling tower, typical self-propelled man-lifts could not be utilized for drilling at all of the explosives locations. CDI designed and custom fabricated a crane lifted man-basket for the drilling of the holes and placement of explosives and cover materials from elevations 100 feet to 250 feet above grade. The man-basket was designed to meet all OSHA and ANSI standards and passed the testing and inspection requirements. It was positioned with a 150-ton Linkbelt crane with 300 feet of boom and jib. The man- basket could literally "roll" around the tower as the crane moved it and included specialty design factors to help shade the workers to prevent heat stress as well as special arms and other attachments to help with the drilling and installation of cover materials and chain link fabric.

Due to the height of the tower, the Federal Aviation Administration had to be notified as the strobe lights affixed atop the tower would soon no longer be visible and the tower, which was once a landmark, would no longer exist.

How the success of the Best Practice was measured: (What data/operating experience is available to document how successful the best practice has been?)

The planning process paid big dividends in the safe and successful performance of this project, the second largest cooling tower ever demolished. The upfront planning included permitting, submittals, task specific packages, work plans, activity hazard assessments, explosives permitting, designs and layout.

The controlled failure of the massive cooling tower into its own footprint was textbook and the resultant debris pile was well-fractured and neatly contained; a mere 1% of the tower debris came to rest outside the cooling tower basin footprint.

The tower took 8 seconds to fall from the time of "fire" to the top ring hitting the ground. The dust cloud was harmless as it passed over unoccupied site areas and was fully dissipated in approximately 12 minutes. The seismic impact was less than $1/5^{th}$ the allowable limit for 'peak particle velocity.'

The project was also deemed a success due to completing the project one month ahead of schedule as well as performing more than 18,500 man hours of safe work with zero OSHA recordables, zero accidents, and zero recordable case rates.

Over 1,100 tons of steel rebar, stainless steel and aluminum piping, steel plates, and copper wire were recycled, keeping 125 truckloads of material out of the site landfill.

What are the benefits of the best practice: (Briefly describe the benefits derived from implementing the best practice.)

SRNS, American DND, CDI and LVI all contributed their experience and expertise to the successful demolition of the SRS Cooling Tower. The benefits to this best practice are a safe, on schedule, controlled and efficient demolition of the 185-3K Cooling Tower. Use of explosives significantly reduced worker exposure to conventional demolition hazards. In addition, since the structure collapsed into its own footprint, this provided easier access onsite during size reduction and cleanup activities. Finally, the use of explosives did not require the use or the costs associated with special heavy machinery for demolition, increased equipment maintenance, equipment operation, and repair labor.

Alternative solutions considered: (Other solutions to the issue/improvement opportunity considered prior to implementing the best practice?)

DOE evaluated methods to demolish the structure and ultimately selected implosion as the most effective and safest approach to ensure the fewest amount of man hours at risk. The American DND along with 2 other bidders provided DOE with options that included three different implosion designs with three different blasters and multiple options for recycling the materials as part of an overall approach and comprehensive plan for the work. SRNS-DOE selected the CDI Implosion Design that was ultimately used.

Additional Information	
References:	"Implosion of the Savannah River Site 185-3K Cooling Tower," Demolition Magazine, July/August 2010. Schaab, Bill and Michael Furner, "Implosion and Debris Cleanup of Savannah River Site hyperbolic Concrete Cooling Tower," Waste Management 2010 Conference, Paper 11599. English, Robert, "Implosion of K-Area Cooling Tower," SRS Presentation, May 25, 2010.
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