# Facility Decommissioning and Demolition in High Hazard Environments



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# **Synopsis of Presentation**

- Demolition is inherently dangerous work.
- Demolition in facilities such as Nuclear Plants, Chemical Weapons Plants, Smelters and Refineries add additional risks and challenges.
- A thorough understanding of hazards, and detailed plans and procedures are needed to perform work in these environments.
- Every job is different and the unexpected is routine.
- A poor decision can have devastating consequences.





# Accidents Are Always A Mistake Away

# Six Killed in Philadelphia Building Collapse June 5, 2013





# **Accidents Are Always A Mistake Away**

# Shrapnel From Imploding Plant Injures 5 Spectators August 3, 2013





### **Some Facts**

Injuries and deaths related to demolition accidents are often caused by:

Improper planning/execution.

- Premature collapse of buildings.
- Falls from workplaces and access routes such as scaffoldings.
- Failure of explosives to completely fell structure.



# **Challenges in Working in Facilities**

- Facilities are active and contractor must share work area with plant operations and other contractors.
- Demolition area is surrounded by facility components (i.e. tanks, structures) that must be preserved.
- Dealing with the physical hazards (gravity) and other hazards such as radiation, chemicals and wildlife.
- Your crew is human.





#### Hazards Combined with Human Behavior =





# **Demolition of Uranium Conversion Facility**

- Demolition of 15 structures including uranium contaminated systems and uranium hexafluoride conversion process equipment.
- Size reduction of stored piping, tanks, pumps, and valves staged in storage area.
- Solidification/neutralization of water and hydrofluoric acid in select equipment components.
- Decontamination of structures to remove bulk of residual uranium.
- Removing, loading and over packing approximately 22,000 drums of legacy wastes and transportation to onsite landfill.



# Hazards

# Radiation

- Hydrofluoric Acid
- Heavy Metals
- ACM
- Normal hazards of felling structures, working around structures and utilities to remain, constricted operating areas inside structures, CO generation inside structures.



- Understand the true hazards of the project i.e. heavy metals bigger risk than radiation due to alpha and beta emissions.
- Mitigate Hazards
  - Training-HAZWOPER, Rad Worker, ACM, Rigging, Site PPE, HF
  - Procedures-Adopted Site Radiation Protection Plan, Developed HASP, Radiation Work Permits (15-20 by task and hazard), AHA's, Constant third party monitoring by lapel, badge, perimeter.

#### Methods

- Source removal prior to demolition to minimize spread of contamination during demolition and allow mechanical demolition.
- Keep shell of structures intact to last, remove building side and seal door ways to contain water used for dust control.
- Enclosed contaminated process equipment in plastic/plywood to keep uranium dust inside during transport to onsite landfill.



## Results

- No injuries, releases, incidents in 20,000 man hours.
- Recovery of 100,000 lbs (\$3.5-\$6 million) of Uranium for future reuse.
- Recovery of \$1 million worth of equipment sold for reuse.
- Approx. 10% of project costs spent on decontamination of equipment, some pieces needed complete disassembly and sand blasting.
- Finished cost plus project 20% under projected costs due to methods utilized.



- Series of projects lasting 12 years.
- Decontamination, demolition, sizing and disposal of 254 structures at a Chemical Weapons Arsenal used to manufacture and store Sarin gas.
- The facility was also used to neutralize and dispose of other chemical munitions including Mustard and VX.
- Excavation and disposal of 20,700 lf of chemical sewers, filter viaducts and trenches and 407,800 bank cy of contaminated soils to onsite landfills.





- Exposure to chemical warfare agents.
- Histoplasmosis fungus (buildings had been abandoned for several years)
- Silica (concrete breaking and truck traffic)
- Numerous biological hazards due to building abandonment (rattle snakes, Brown Recluse spiders, wasps.
- Hantavirus from rodent feces (outbreak in area at the time of the project)
- Normal hazards of felling structures, working around structures and utilities to remain, constricted operating areas inside structures.



- Understanding by all onsite personnel that chemical agents were the greatest health risk and were present in many areas including areas not previously identified; such as bone yards and warehouses.
- Crews for this project underwent 24 hours of site specific training before being allowed in the field; including the use of Hold Points, proper use of level A, B and C PPE, use and care of supplied air escape packs and proper application of atropine injection.
- Used project management and craft personnel and subcontractors experienced with operating in Level A and B PPE and site procedures.
- Retained craft personnel through course of projects.



- Equipment dismantling and decontamination performed in Level A PPE. Chemical sewer excavation and transportation to landfill conducted in Level B PPE. Air bottles mounted on equipment.
- Continuous third party monitoring of all onsite activities by mobile chemical agent monitoring (CAM) units. Strategic location of CAM units to take full advantage of limits imposed by use of 150' sampling line.
- Use of Hold points to ensure safe completion of a task per detailed work plan before moving on to another.



- No recordable incidents in over 1,000,000 man hours.
- No release of nerve agent to environment in 12 years of onsite demolition and remediation services.
- Recycled 9,082 tons of steel (\$1.8 million) and generated 176,000 cy of demolition debris.



- 6 Complete or partial smelter demolitions (BC, MT, OR, WA.)
- Demolition of in excess of 3 million square feet of structures.
- Demolition of dozens of vessels in excess of 100' tall.
- Demolition of 2250 Aluminum Reduction Cells(Pots).
- Demolish & crush hundreds of thousands of tons of concrete and used as fill onsite.
- Removal of miles of subsurface utilities.





## **Reduction Cell Removal**

- ACM in interesting places.
- Working inside with cranes and excavating equipment on cells that consisting of 30 tons anode and 50 tons cathode.
- SPL produces HCN and Ammonia gases when wet with small combustions.

#### Structure Removal

- Large footprints of 1 million square feet with numerous multiple story structures including conveyor galleries at 120 feet or more.
- Numerous vessels exceeding 100 feet in height.
- Carbon, alumina, bath process material/waste which becomes airborne easily.
- High voltage power to work around.



## Security

 Once start processing for shipment have millions of dollars of portable assets lying around.

# Material Sizing

 Example: Aluminum bus – one smelter alone had to size 30 miles (48 kilometers) of 8" Inch thick bus to 6 feet long.

Working in communities where closure has caused economic/social issues



- Used crews that have done this before.
- Asked former managers of facility of who their top exemployees were, especially overhead crane operators.
- Labor intensive when doing pot demolition but want to mechanize as many or the processes as possible.
- Re-evaluated processing throughout project paying careful attention to crew input concerning better methods.
- Stress security of assets and zero tolerance of souvenir collection to employees from day one.



- 100,000 tons of steel recovered, sized, and recycled.
- 7,060,000 lbs of copper recovered, sized, and recycled.
- 30,000,000 lbs of aluminum recovered, sized, and recycled.
- \$75 million dollars of assets removed.
- 75,000 tons of SPL removed and sent to landfill.



- Complete demolition of former manufactured gas plant
- 155 acre site project site with manufactured gas processing systems on 20 acre footprint.
- Plant constructed in 1948 for the recovery of petroleum hydrocarbon products from natural gas via fractionation, heat exchangers, chillers, compressors and distillation towers; manufacturing operations ceased in1998.
- Removal of ACM from boilers, heat exchangers towers, and above-ground piping (over 38k lf).
- Excavation and off-site disposal of ACM waste from two on-site landfills.
- Demolition of four boilers, 17 distilling towers, multiple tanks and vaults, 10 buildings, rail spurs, and other facility processing systems and structures.
- Removal of more than five miles of underground piping; recovery of petroleum distillate product from piping and tanks.



- Demolition hazards associated with felling tall towers (>135 feet); working around unstable structures and active gas pipelines
- Excavation, remediation and removal of underground piping including some pressurized hydrocarbon and sulfuric acid pipelines.
- ACM
- Hydrocarbons in vessels and lines.
- High winds, severe thunderstorms, and extreme temperatures.
- Rattlesnakes.



# Hazards

The rattlesnake infestation became a significant health hazard to project personnel.





- Consulting engineer's work plan stated "Rattlesnakes have been observed on the Gas Plant property. Caution must be exercised when accessing warm enclosed spaces where rattlesnakes could potentially reside."
- Control of Work procedures, including PPE requirements, were developed and implemented to address specific entry and clearance procedures in suspect areas of rattlesnake populations.
- After a few weeks onsite, a member of the Oversight Engineering staff entered a location outside our work area without essential PPE (snake gaiters/chaps) was struck by a rattlesnake in the calf.
- The snake bit Engineer convalesced four days in the hospital, recuperating from the bite having been administered anti-venom exceeding \$20k.



# Actions Taken:

- Site activities suspended for seven days pending re-evaluation of rattlesnake hazards.
- Provided rattlesnake awareness training for all project personnel.
- Full time "snake wrangler" (herpetologist) contracted by Oversight Engineer to patrol site and catch snakes.
- Implemented procedures to eliminate potential rattlesnake nesting, migration and feeding habitats (rubble piles, weeds, burrows) within the 155 acre site.
- Provided all site personnel (Envirocon crew; subcontractors and vendors) appropriate PPE (snake gaitors and chaps).
- Ongoing awareness training for rattlesnake dangers as seasons changed.



## Results

- By the end of the nine month project, the "snake wrangler" had caught 108 rattlesnakes.
- 50,000 man hours worked post rattlesnake incident without any further strikes or bites.
- Recovered \$1,000,000 in assets



- Understanding all potential site hazards is essential for ensuring a safe project.
- Significant hazards are not always obvious.
- Planning and training is key.
- Effective management of change is critical
- Mechanize whenever possible.
- Involvement and participation of entire project team is essential.

