HUMBOLDT BAY POWER PLANT
HISTORY

► Site originally contained two oil-fired units and two gas turbines
► Unit 3 constructed early 1960s
  > Went on-line in August 1963
  > One of few reactors constructed underground
  > 63 MW boiling water reactor (BWR)
► Operated Unit 3 until 1976
► Discovered previously unidentified seismic faults during shutdown
► TMI incident increased safety requirements
► PG&E opted to decommission in 1983
  > Plant placed in SAFSTOR in 1988
► Nuclear fuel removed and placed into ISFSI in early 2010s
HUMBOLDT BAY POWER PLANT
DEMOLITION AND & DECOMMISSIONING SCOPE

► Decontaminate, decommission, and demolish all remaining nuclear and non-nuclear site structures
  > Radioactive decontamination
  > Asbestos
  > Lead
  > PCBs
  > Mercury
  > VOCs
  > PG&E was self-performing RPV removal

Areas - 7
  > Nuclear Facilities Demolition
  > Intake and Discharge Canal Remediation
  > Slurry Wall Installation
  > Dewatering Systems Installation
  > Caisson Removal
  > Office Facility Demobilization
  > Final Site Restoration

Also was tasked with
  > “EPC” Operations
  > Other Services
HUMBOLDT BAY POWER PLANT
BOILING WATER REACTOR
PROJECT CHALLENGES

► Remote location
  > No rail access
  > No water access
  > Trucks only method of transport

► Limited transport routes
  > Nearest interstate is 3 hours over the mountains
  > Highway 101 is impassable for some larger trucks
  > Frequent road closures in winter

► No in-state waste disposal
PROJECT CHALLENGES

► Weather
  > Eureka is in a temperate rain forest
  > Over 55” of rain annually
  > Rainy season is mid-October thru mid-April

► Humboldt Bay
  > Site is directly next to the bay
  > Tsunami zone
  > Heavy tidal influence
  > Winter storms are not fun
PROJECT STARTUP

► Work Packages
  ➔ Developed 80+ work packages
  ➔ Covered all aspects of work

► Health and Safety Plan
► Quality Assurance Plan
► Waste Management Plan
► Noise Plan
► Erosion and Sediment Control Plan
► Baseline Schedule
► Established EVMS
► Training programs
► Relocated 20+ personnel to the Eureka area
  ➔ Project kicked off July 2013
  ➔ Field work commenced April 2014
PROJECT STAFFING

HUMBOLDT BAY FTES

1.77M+
MAN-HOURS
WITH NO LOST
TIME INCIDENTS
WASTE MANAGEMENT

► Waste was largest effort
  > Multiple waste streams
  > Rad
  > Asbestos
  > VOC
  > Lead

► Used Intermodals
  > Had 100+ on-site at project height

► Used IP-1 bags
  > 20,000 pound capacity
WASTE MANAGEMENT

Installed two “tents”
► 100’ X 200’
► One for clean material
► One for contaminated material
► Needed to dry material out
WASTE MANAGEMENT

► Three primary waste disposal sites
  > Utah (EnergySolutions)
  > Texas (WCS)
  > Idaho (US Ecology)

► Recycling and reuse were critical to project success
  > Excavated 215,000+ CY of soil
  > Reused 168,000 CY on-site
  > Cost savings >$30M

► GARDIAN Systems
WASTE MANAGEMENT

► Conducted 7,775 waste shipments
  > 3,200+ rad waste, 2,600+ of these via IM

► Concrete
  > Handled ~43,000 CY
  > Recycled / reused ~8,000 CY

► Contaminated piping
  > ~1,200 CY

► Structural steel
  > Handled ~2,600 CY
  > Recycled ~1,000 CY

► Rebar
  > Handled ~300 CY
  > Recycled ~160 CY

► No violations
NUCLEAR FACILITIES

Consisted of multiple above and below ground buildings and structures

► Plant ventilation stack
► Solid rad waste building
► Low level rad waste building
► Liquid rad waste building
► Hot machine shop
► Spent fuel pool
► Refueling building
► Circulating cooling water pipes
  > Once thru cooling
► Others
NUCLEAR FACILITIES DEMOLITION

- Many buildings compressed into one “small” area
  - Radiological Control Area (RCA)
- Access controlled and all entry required permission
- Exits required full body scan
- Dosimetry required for all personnel working inside
LIQUID RAD WASTE BUILDING

► One of the most contaminated structures on-site
► Heavily reinforced concrete
  > Up to 3’ thick in many places
  > Surrounded by a pre-engineered steel building
► Building was maintained under negative pressure to prevent spread of contaminants
LIQUID RAD WASTE BUILDING
SPENT FUEL POOL

- Stored fuel rods after use
  > Numerous other items as well
- Developed cracks and leaks
- Original plan
  > Drain pool
  > Erect full enclosure / HEPA
  > Have personnel “scabble” interior
  > Use of remote equipment
- Areas of concern
  > Safety
  > Time
  > Waste
SPENT FUEL POOL

- Solution to handle decontamination underwater
- Took longer, was safer, and produced less waste
- Able to remove contamination from walls
- Applied fixative underwater to lock in remaining contamination
SPENT FUEL POOL
REFUELING BUILDING

► Complicated decontamination and demolition project
  > Asbestos
  > Lead paint
  > Rad contamination

► Situated directly over reactor caisson
  > Had to be removed prior to caisson removal

► Goal - demolition “open air” versus “tented enclosure”
REFUELING BUILDING

► 1+ year of decontamination, abatement, and planning
► Demonstrated we could safely proceed with open air demolition
INTAKE AND DISCHARGE CANALS

► Site set up for once through cooling
► Contamination existed in both intake canal and discharge canal
  > Primarily radiological
► Both canals presented unique challenges
  > Intake canal next to operating power plant
  > Discharge canal directly into Humboldt Bay
INTAKE CANAL

► Restrictions of canal entry - during “fish window”
  > Early summer through early fall
► Required seine to remove fish
  > Conducted multiple seining to satisfy regulators
INTAKE CANAL

- Installed bladder dam and sheet piles
  - Once installed and gaps in sheet pile filled, commenced dewatering
INTAKE CANAL

► Removed contaminated soil and eventually the headwall
► Headwall removal tricky due to switchyard
DISCHARGE CANAL

- Plugged outlet drain pipes
- Used same diving crew as Spent Fuel Pool
- Once drained, removed rad and asbestos coated pipes
DISCHARGE CANAL

► Once plugged, installed sheet piles in Humboldt Bay
  > Idea - block the bay and then drain the canal
  > Initial design worked … not really
DISCHARGE CANAL

► Storm hit in December 2014
► Had already drained canal and began remediation
► Wall failed
  > 1M+ gallons flooded the canal
DISCHARGE CANAL

► Revised sheet pile design
► Added whaler system
► Added additional dewatering pumps on bay side
DISCHARGE CANAL

► Canal was remediated
  > Very long process

► Dewatering ran through groundwater treatment system

► Limited processing
  > ~600 gpm

► Project was running well until December 2015, mother nature provided a curve ball
DISCHARGE CANAL
DISCHARGE CANAL
DISCHARGE CANAL

► Pump out of canal was performed, no equipment was lost
► Discharge canal
  > Repository for all on-site material destined for reuse
OFFICE FACILITIES

► Site contained 32 structures to be decontaminated, demolished, and/or removed
  > Asbestos
  > Lead
  > Rad contamination

► 40,000+ ft² of office, lab, and building space

► Included trailers as well as permanent buildings
SLURRY WALL

► Caisson was constructed underground
► Extends ~90’ below ground surface
► Because of proximity to Humboldt Bay, water infiltration needed to be addressed
► Original PG&E plan was to construct a bentonite slurry wall with soil nails to facilitate caisson removal
► Referred to as “the coffin”
SLURRY WALL

► After award, slurry wall determined to not be feasible or safe
► Sheet piles were complicated and ruled out
► APTIM proposed an alternative in-situ wall
CUTTER SOIL MIX (CSM) WALL

► Local contractor (Drill Tech) in Concord, CA had installed types of walls before
  > However, not as large and not as deep
► Spent 1+ year (partially in parallel with slurry wall work) on design
► Five concentric rings
  > 15’ total thickness
  > Outer ring went down ~200’ bgs to lock into clay layer for water cutoff
CUTTER SOIL MIX WALL
CUTTER SOIL MIX WALL
CUTTER SOIL MIX WALL
CUTTER SOIL MIX WALL

► In-situ design
► Sub had one drill rig (BG-40)
  > It was not large enough to reach 190’+ depth
► Pre-ordered BG-50 drill unit
  > Six month lead time due to being built in Germany and shipped to U.S.
CUTER SOIL MIX WALL

- Cutter head “chews” up soil / rock / clay
- Concrete mix pumped down
- Creates wall as it sets up
REACTOR PRESSURE VESSEL

- Reactor Pressure Vessel (RPV) is situated within the caisson and drywell structure
- PG&E scope to remove
- We would demo the caisson structure and drywell
REACTOR PRESSURE VESSEL
REACTOR PRESSURE VESSEL

- RPV was highly radioactive and contaminated
- Considered removing in one piece
  - Multiple logistical, regulatory, and political issues
- PG&E opted to cut the RPV into “windows” and remove that way
- Each window shipped separately in shielded IM
- After windows removed, remaining demo would occur indoors using existing equipment
REACTOR PRESSURE VESSEL

- Could not do “hot cuts”
- Used specially designed saw that could cut horizontally and vertically
- Allowed for cut windows and lift out
REACTOR PRESSURE VESSEL

► Issues with initial design
  > Vibration and shaking

► This part of the project fell far behind
  > Threatened to push entire project

► APTIM brought in to take over segmentation and get project back on track
  > Performed all segmentation and packaging
  > Pulled schedule in
CAISSON REMOVAL

► Dug our way down
► Three cranes used
  > One 275-ton crane to lift out waste
  > Two 65-ton cranes for emergency personnel evacuation
► Installed stair tower for normal entrance / egress
► Installed ventilation system
CAISSON REMOVAL

► Worked in 6’ lifts as the dig went down
► Challenge to keep clean and contaminated materials segregated
► All clean materials removed and stockpiled for reuse as backfill
CAISSON REMOVAL
FINAL SITE RESTORATION

► Restored a majority of the site to wetlands
► Removed parking lots and roads
► Contoured areas for stormwater management
► 10,000+ plants installed
FINAL SITE RESTORATION
Expect the Extraordinary.