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Bevatron Decommission and Demolition

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Welcome to the San Francisco Bay Area
Thanks goes to:
Joseph Harkins, Lawrence Berkeley Laboratory
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for much of the technical information used in the presentation.
• The Bevatron was built in the 50’s at the Berkeley’s Rad Lab for a cost of $9 million (~$76 million 2012 $). 
• It began operation in 1954. 
• Bevatron was a initially a proton accelerator. 
• It was built to discover the anti-proton (discovered in 1955). 
• They also discovered the anti-neutron.
The Bevatron

- 180 feet diameter accelerator.
- Beam space was 4 square feet in cross section.
- The vacuum system was tremendous.
- The magnet was 12,000 tons.
- Concrete shielding 13,500 tons.
- It was built with no shielding on top, but shielding was added when the sky shine was discovered.

- Motor generators ramped up the magnet in 1.85 seconds for each 5 second cycle.
- It used a lot of power, this cost a lot and led to its demise.
The Life of the Bevatron 1953-1993

- The Bevatron experienced several reincarnations over the years.
- Converted from protons to heavy ion accelerator for High Energy Physics experiments.
- It was linked to the HILAC as its ion source.
- Converted to a nuclear medicine treatment center.
- Finally Bevatron was shutdown in 1993.

Ed Lofgren, chief of operations when the Bevatron started up, hitting the "Accelerator Off" button to finally turn off the Bevatron.

(HILAC-Heavy Ion Linear Accelerator)
Decommissioning the Bevatron

- The power/utilities were turned off for the accelerator and the building was to be used for its office space.
- Documentation/documents were “archived” off site.

The Bevatron had a lot of cool stuff…
- There was still useful equipment in the facility.
- The equipment was inventoried and distributed to other parts of Berkeley Lab.
- Additionally other Department of Energy (DOE) facilities benefited from this.
Decommissioning the Bevatron

De-staffing of the Bevatron
- When the Bevatron was shutdown the scientists, technicians and engineers were reassigned elsewhere.
- They walked away and left things as they were.
- Essentially everyone went on the next great project.

- The useful office rooms were used for training.
- The building sat idle for 15 years (1993-2008) while DOE considered what to do with the facility.
Decommissioning the Bevatron

- The fate of the Bevatron would be decided by the DOE managers at a later date, 15 years later.

Then things changed in 2008

- The DOE decided to resolve the Bevatron problem.
- After a change in administration and with a new DOE secretary, Dr. Chu, the demolition of the Bevatron project was supported and financed.

Surprise? Dr. Chu was an ex-LBNL Director- he knew the problem had to be resolved.
Demolition of the Bevatron 2008-2012

- The project was scheduled to take 4 years and cost $50 million. It was going to be a big deal.

- Project Milestones
  - Isolate utilities and remove stored hazards
  - Remove concrete shielding and the accelerator
  - Abate Hazardous Materials
  - Demolish 125,000 square feet metal frame structure
  - Remove shallow foundations and slabs
  - Remediate soils and then backfill
Milestone 1: Isolate Old Utilities and Establish Reliable Utilities

They established a boundary where all utilities had to be severed and then worked outward from there to where isolation breaks could be implemented.

Re-establish Reliable Utilities

In order to work in the building they needed power and other utilities that were reliable and manageable.
Milestone 2: Remove Shielding Blocks

- Removed shield blocks
- Used existing lift points
- Rad characterized
- Packaged
- Disposed per WMP
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When the Accelerator was removed then the interior of the building was cleared.
Before the building super-structure was demolished, there was abatement of the structure’s interior & exterior. Then they removed stored hazardous materials.
Milestone 4: Demolish the Building Structure

- Retaining walls were reinforced.
Milestone 4: Demolish the Building Structure

- The building super-structure was pre-weakened.
Milestone 4: Demolish the Building Structure

The super-structure was brought down in a controlled drop.
Milestone 5: Remove Foundations and Slabs

- Removed foundation system including pile/caisson caps, grade beams, shallow caissons, and facility floor
- Demolished deep tunnel
- Removed cooling tower basins
Milestone 5: Remove Foundations and Slabs

This process took over a year to complete because they had to methodically manage the hazards in the foundations and the soil.
Milestone 6: Remediate soils and then backfill

In order to remediate the soil they needed a Hazard Map.

- Hazard mapping began early,
- Hazardous materials mapping required “due diligence”,
- Developed at Lawrence Livermore National Laboratory (LLNL),
- Utilized a LLNL consultant to reconstruct hazard history,
- Start with records search
  - Operating conditions
  - Machine changes
  - Emergency events (spills, fires, etc.)
  - Inventory management
Milestone 6: Remediate soils and then backfill

Hazards Mapping (cont.)

- Interview personnel involved during operations
  - Operators
  - Scientists
  - Technicians
  - EH&S
  - Fire Department
  - Construction crafts
- Combine the information into a map of the facility
  - Areas of known contamination
  - Areas of prior clean up
  - Areas of suspected contamination
Milestone 6: RemEDIATE soils and then backfill
Developed a Hazard Map
Milestone 6: Remediate soils and then backfill

Hazards Mapping (cont.)

- Map was provided to the contractor to conduct samples of each area to characterize found hazards.

- Map was provided as a bid document to demolition contractor to inform their remediation efforts.

- The contractor was able to segregate the hazard, reuse material (soil) and backfill the excavation site.
Milestone 6: Remediating soils and then backfill

Radiological Evaluation Waste Materials

- They expected very few surface contaminated objects
- Activation products were predicted to be in:
  - Accelerator components, concrete shield blocks, floor slabs and foundations, and steel structures
- For the Blocks
  - Initially DOE OK’d characterization protocol
  - They used handheld Na-I, set a MDC of 2 pCi/g
  - They used a “clean” reference block for a baseline
  - An external lab analyzed the reference block (No MDC)
  - Found activation products < 2 pCi/g in reference block
  - DOE revised the protocol—said had radioactive material
Milestone 6: Remediate soils and then backfill

Rad Evaluation Criteria (cont.)
Milestone 6: RemEDIATE soils and then backfill

Rad Evaluation Criteria (cont.)

- Under revised DOE protocol
  - Had expected to release 60% of shielding blocks;
  - Actual blocks release reduced to 20%

- Had expected to release ~75% of slabs and foundations;
  - Actual slabs and foundations release reduced to ~20%

- This impacted remediation of blocks, slabs and foundations and cost several millions (~10) more

- Lesson - Specify MDC early, clearly & oversee analysis
Milestone 6: Remediate soils and then backfill

Tritium Levels

- Tritium History and the Expected Levels
  - Activation produced mainly prior to 1974, (36 years)
  - Significant quantities were not expected
  - It was expected to be found near other activation products
  - It was expected to be found in soil and groundwater under thin floors

- Found Tritium in unexpected places and concentrations
  - Under 54-inch foundations
  - Was not under slabs with highest activation products
  - Levels were at more than 4000 pCi/L
  - Was inconsistent with expected equilibrium condition
Milestone 6: Remediate soils and then backfill

Levels Tritium (cont.)

- How did it get there?
- First they discounted possible sources:
  - Adjacent facility, Accelerator experiments
  - Historically there were no known tritium releases
- Possible sources
  - Accelerator cooling water spill/leak
  - Movement from high activation areas to low activation areas from groundwater flow

However it got there it had to be remediated.
Milestone 6: Remediate soils and then backfill

Debris segregated for disposal or for backfill.
Final Site Configuration

- Retaining walls remain
- New drain lines
- To existing storm drain
Project Completed

The Bevatron