40 Years of Decommissioning Experiences and Some Key Take-Aways

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September, 2019

Presentation outline

- Overview of ANL D&D Program Activities

- Key Lessons Learned from our D&D Experiences

Argonne National Laboratory

- **Founded 1943 by University of Chicago**
- **Designated national laboratory in 1946**
- **Operated for US Department of Energy**
  - $780M/year budget, 3300 staff, 7200 facility users
  - Collaborate >600 organizations worldwide
- **Conduct multi-disciplinary research in basic and applied science**
- **Build/operate major national user facilities**
- **Mission areas: Energy, Environment, Security**

Decommissioning Program Components

- Decommissioning Projects
  - ANL
  - 1977 – current (42 years)

- Decommissioning Training and Fellowships / Technical Support
  - ANL
  - 1991 – current (28 years)

- Decommissioning Certificate Program
  - ANL and Oak Ridge Associated Universities
  - 2009 - current (10 years)

  - All of the components are a part of Argonne's 'nuclear heritage' in both domestic and international nuclear programs / activities

Completed D&D Projects*

- East Area Surplus Facilities (7 facilities)
- Zero Gradient Synchrotron Facility
- Plutonium Fuel Fabrication Facility (Building 350)
- Experimental Boiling Water Reactor (Building 331)
- Bldg 212 Plutonium Gloveboxes (61 gloveboxes in 9 laboratories)
- Bldg 200 M-Wing POB Hot Cells – Deactivated
- JANUS Reactor (Building 202)
- CP-5 Reactor (Building 330)
- 60-Inch Cyclotron (Building 211)
- Argonne Thermal Source Reactor (Building 316)
- Fast Neutron Generator (Building 314)
- Hot Samples Pneumatic Transfer System (Buildings 200-205)
- Waste Ion Exchange Facility (Building 594)
- Juggernaut Reactor (Building 335)
- Zero Power Reactors 6 & 9 (Building 315)
- Building 301 Hot Cell Facility
- Surplus Waste Retention Tanks (Building 310)
- Facility 317 Waste Vaults and Map Tube Facility

***Plus numerous other 'Smaller Scale D&D' projects**

Decommissioning of Facilities at ANL

CP-5 Research Reactor D&D Large Scale Demonstration Project (LSDP)

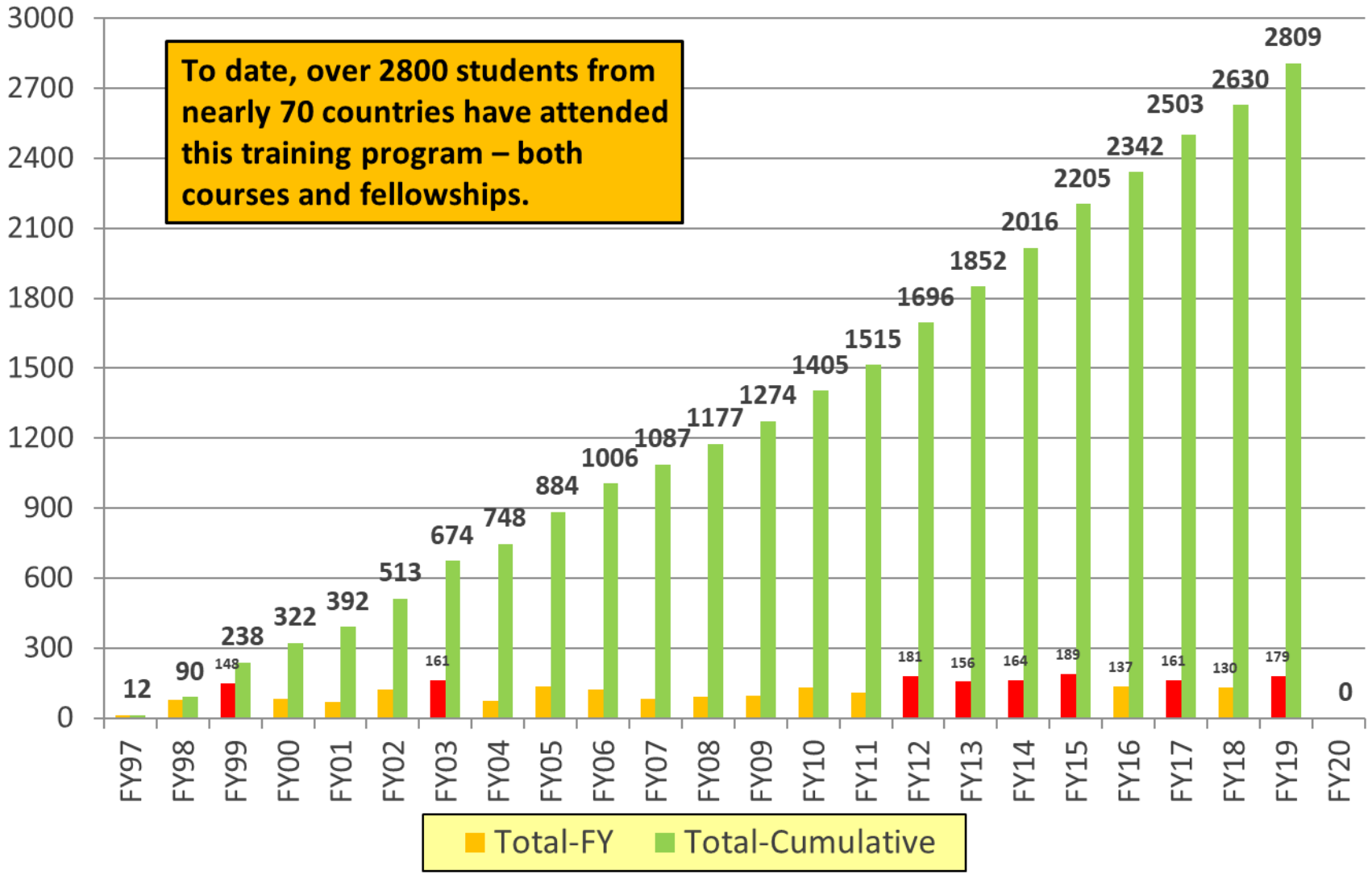
- Compared baseline technologies to improved technologies in course of decommissioning
- Consisted of a team of ANL, commercial utilities, decommissioning service providers, universities, technology developers, technology utilizers
  - ANL, FIU, 3M Corp, ICF Kaiser, ComEd
  - USACE used for independent evaluation
- Research reactors were one of about 12 problem area facility types within DOE
- Evaluated and demonstrated 23 technologies to compare to baseline methods – characterization, decontamination, dismantling, worker health and safety areas

- Very successful - this project was selected as one of DOE's 'Top 100 Achievements in its First 25 Years'

Off-Site D&D Training/Technical Support Activities

- Domestically
  - DOT-MARAD Nuclear Ship Savannah, Baltimore, MD
  - NASA Plum Brook Research Reactor, Sandusky, OH
  - DOE Sites – PPPL Tokamak Fusion Test Reactor, Hanford N-Reactor, LANL CMR Facility, Battelle Columbus Laboratories, West Valley Demonstration Project, Brookhaven National Laboratory, Savannah River Site, Mound Site
  - US Army Aberdeen Fast Pulsed Reactor; MIT Bates Laboratory Accelerator
- Internationally
  - BN-350 Fast Reactor, Kazakhstan; Salaspils IRT Reactor, Latvia; Magurele VVR Reactor, Romania; Paldiski Soviet Prototype Reactors facility, Estonia
- Training Courses/Workshops
  - USDOE/NNSA Surplus Facilities WG; USDOE/WVNS West Valley Site staff; EMCBC staff –Cincinnati; USEPA-HQ
  - South Korea; Argentina – CNEA; Australia; Canada; Russia – GAN
  - Fukui University and Hokkaido University seminar series, Japan
  - JAERI/USDOE cooperative exchange agreement – Japan/USA – 1990s

Training Course Program Graduates



Decommissioning Certificate Program (DCP)

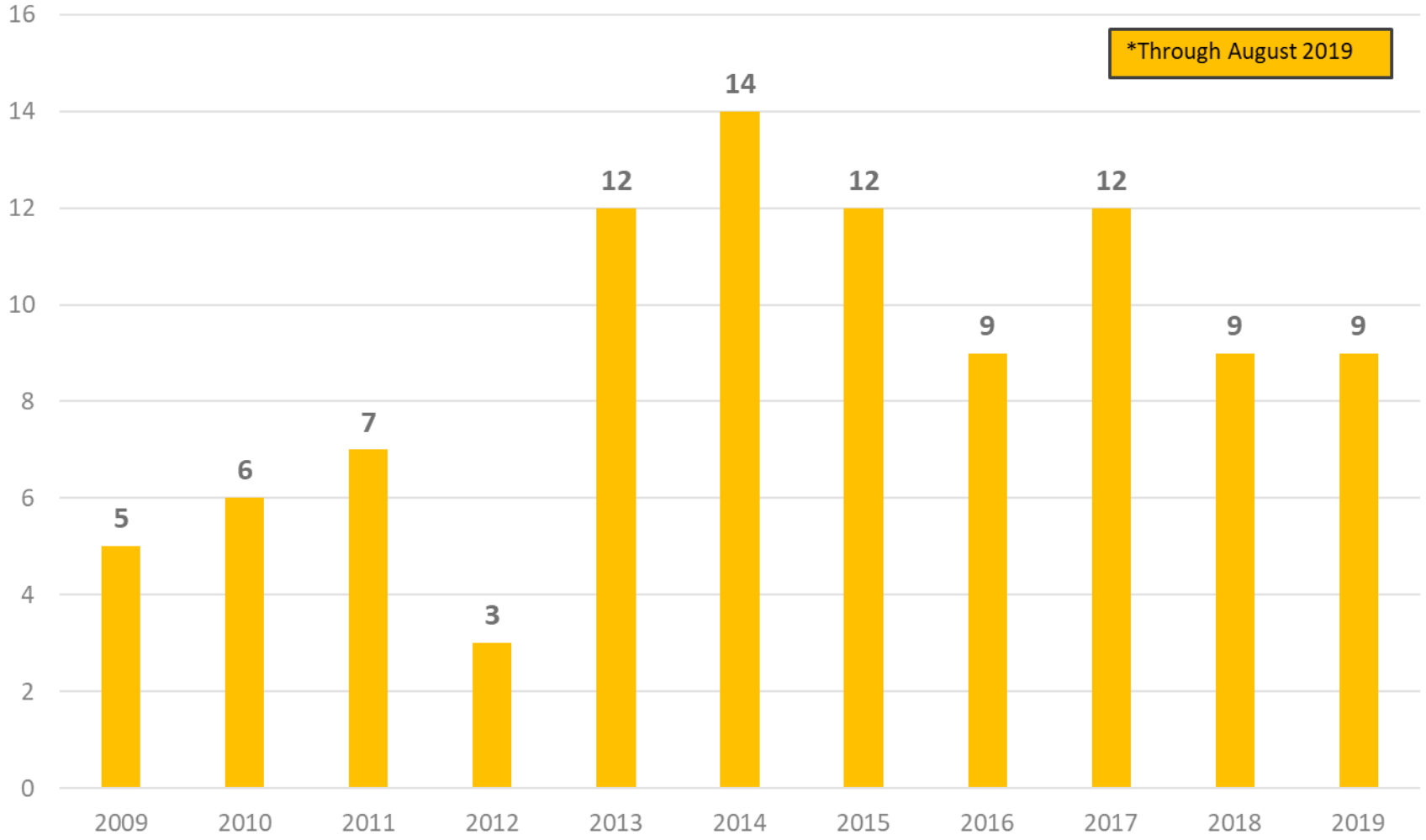
- Certificate issuing program developed by combined efforts of Argonne National Laboratory and Oak Ridge Associated Universities (ORAU)
  - Facility Decommissioning Class – ANL
  - MARSSIM Training – ORAU
  - Plus one of three other eligible decommissioning related training courses: RESRAD (ANL), Site Characterization (ORAU), or Gamma Spectroscopy (ORAU)

- Intended to leverage skills and expertise of staff members with DCP credentials

- About 100 Decommissioning Certificates issued as of mid-2019

- www.dd.anl.gov/ddtraining/DecommissioningCertificateProgram.pdf

ANL/ORAU DCP Awards by CY - Almost 100 Total



Action #1 - Information Exchange

- Knowledge - know what other resources and decommissioning projects are underway or completed and their experiences – learn from them
- Attend a good technical conference on the topic – you will be amazed at what you learn - gather ‘easy picking, low hanging fruit’
- Early planning as a licensee is important to start up the otherwise ‘slippery’ learning curve
- Regulations and guidance are complex – no consensus on standards or approaches
- Build your ‘Knowledge Management Library’ and ‘network of contacts’

Action #2 - Communications

- Communicate with the employees, team members, and community stakeholders – describe the path forward
  - **Typically less staff is needed to decommission than to operate and using a more streamlined structure – which can mean losses of quality employment opportunities and fluctuations in staff – in nearly all cases – its not a jobs program**
- Know and engage with your regulators and other stakeholders; communicate with them on a regular basis – no surprises
  - **"Township commissioner, said (the licensee) did a good job because it had been up-front with the community and early on held public meetings. "**
- Have well defined project scope and mutually agreed to clean-up / end-points criteria – understand the dose-based and risk-based standards concept
- 2020 NRC Report due to the US Congress on 'BP for Stakeholder Engagement' – NPP D&D

Action #3 - Planning/Cost Estimates

- Safety does not happen by accident….plan the work – work the plan
- Fail to plan and plan to fail !!
  - Start the planning process early with all involved parties on board early in the planning process
  - Organize a dedicated project team with the proper resources and relevant experiences and/or training to do the job
- Develop realistic future land-use scenarios in order to understand the risk posed by the site after completion; also long term stewardship issues/responsibilities need to be understood
- Use a well qualified, proven cost estimating organization to perform a proper detailed cost estimate for your project – get it right the first time
- Proper and prompt operations deactivation assigns liabilities to the correct cost WBS elements and eliminates surprises later for the decommissioning team to handle; integrate decommissioning with environmental restoration

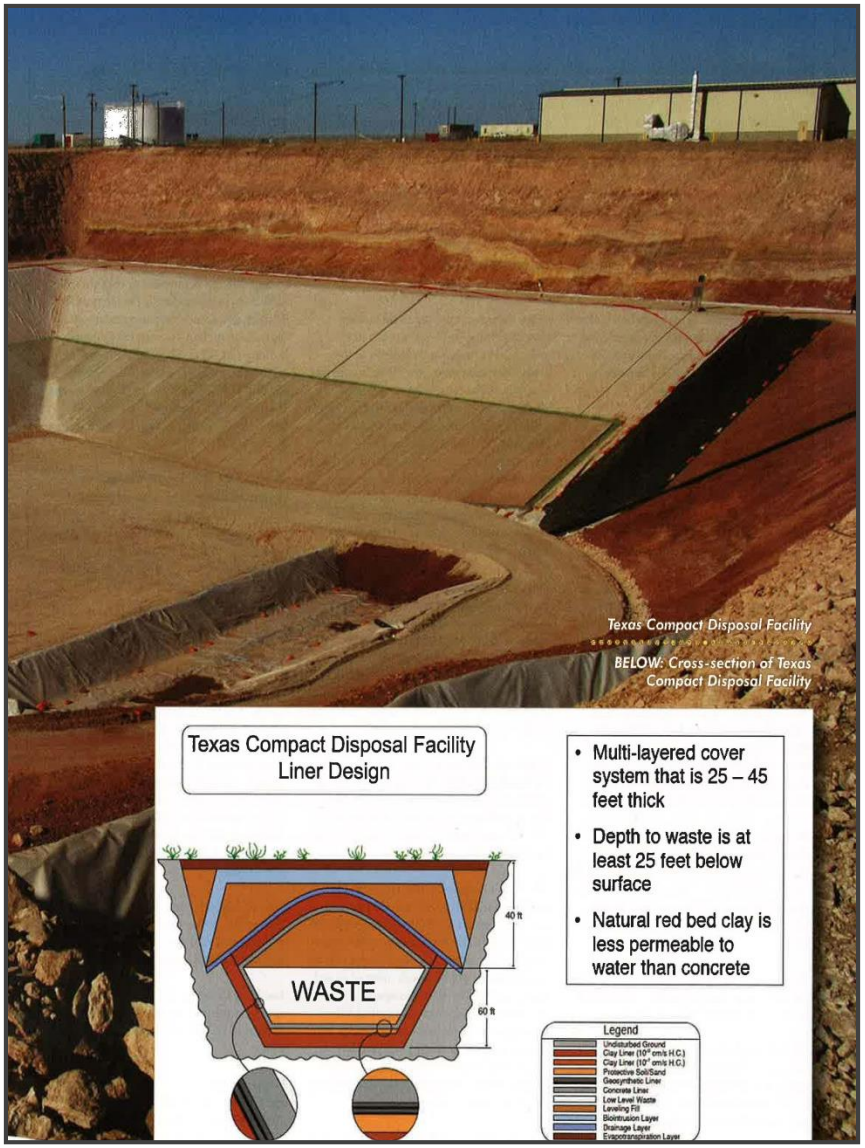
Action #4 - Site/Facility History

- Spend an adequate amount of time on developing a Historic Site Assessment in a sufficient level of detail to really understand the history of the site and facility
- Perform an adequate amount of project characterization to fully support becoming very familiar with the site and facility-never underestimate a site, facility or project – delving into some new areas
- Records 'gathering' and organization should (must) be started early in the planning cycle for decommissioning – otherwise - watch out for opportunities to lose possibly valuable, useful content and institutional knowledge

Action #5 – Waste Management

- Know your waste streams including their characteristics, composition, disposition paths, packaging requirements, clearance options, do your homework including cost-benefit analyses – waste is a large project cost driver
  - From CH2M-WG Idaho LLC - "The expanded use of the onsite Idaho CERCLA Disposal facility …… has been a major contributor to schedule and cost savings on major reactor and nuclear facility D&D projects at the INL site."
  - From USDOE-Mound Site – doubling of the anticipated amount of contaminated soils increased cost & delayed completion of the work
- If you don't know your waste streams well, someone else will
- Visit your waste disposal sites; don't be just a 'shipper or generator name on the paper' or a 'voice over the phone' or 'an email address'
- Remember - you are hostage to the waste disposal site – typically this aspect of decommissioning is one of the more costly parts

Waste Control Specialists Disposal Site – West Texas



Zion ISFSI – Exelon – 2019

Action #6 - Project Management

- Effective implementation of Safety (ESH) and Project Management will lead to either your project's success or downfall – both key 'Project Dashboard' indicators
- Keep your 'decommissioning life' simple to the extent possible - within reasonable limits – approach, organization, technologies, PM techniques (EVM), etc
- Use **proven, well qualified, independent specialists** in decommissioning with prior project experience – look at recent or current players in the D&D industry
- Manage and assist your best asset – your people – for a careful transition to their next assignment/job
- Remember the 5 Essential Project Management items

Action #6 - Project Management (ctd)

- The 5 Essential Project Management items:
  - 1) Why, 2) What, 3) How, 4) Who, & 5) Tracking

1. Figure out what **business** you are in and mind your own business
2. Document the **requirements** and put them under revision control
3. Prepare a reasonable **plan**
4. Build a good **team** with clear ownership of tasks
5. **Track** and report project status once you are underway; track status and give it wide visibility

- https://www.youtube.com/watch?v=GcR-wpSzr4Y

Action #7 – Hazards Assessment

- **Integrate safety and environmental protection into all aspects of project; compliance will be crucial, closely trended and publicly visible**
- Updated safety assessment (safety analysis) **MUST** reflect the new state of the facility versus the previous operational state safety assessment (safety analysis)
- Assess the hazards your project poses to the workers, the environment and the public; industrial hazards often greatest; risk register – do you have one ?
- Understand how you can eliminate them, trend them, control them effectively – key problem areas - analysis of hazards, developing and implementing hazard controls & performing work within controls
  - "Real reason for safety – to go home in same condition we arrived to work in."

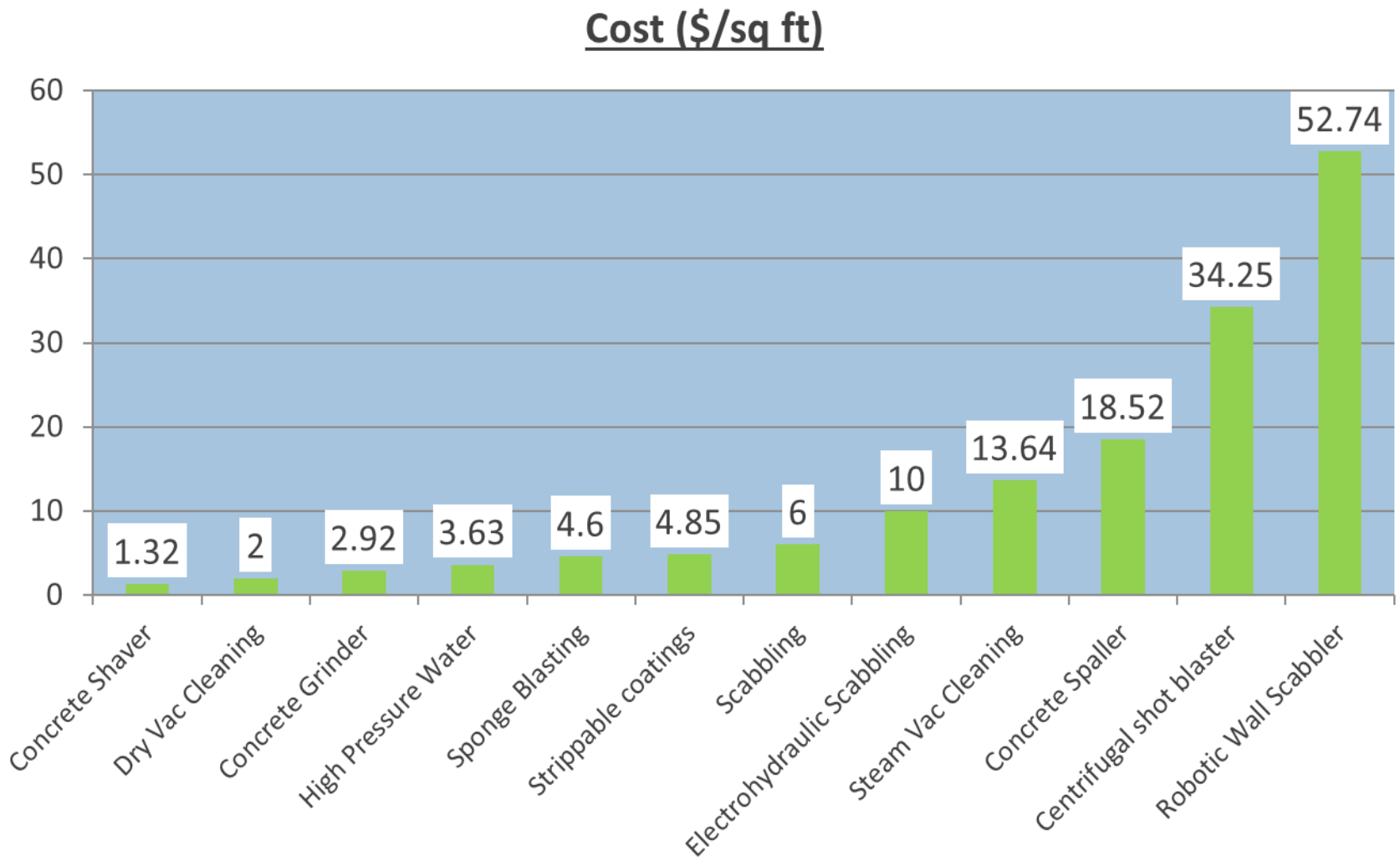
Action #8 - Technologies

- Technologies for decommissioning are typically readily available 'off-the-shelf' to fully support the work activities; carefully analyze the costs/benefits of different technologies
- Stay current on new and evolving technologies but you don't want to be the first site to use an unproven technology
- Constantly exploring new tools can lead to an improved business and increased efficiency

Typical Tools & Technologies Used

- Circular saws
- Electric chainsaws
- BROKK
- Plasma arc cutting system
- Electric chiselers
- Abrasive wheel cutters
- Reciprocating saws
- Long handled tools
- Pallet jacks
- BRISTAR expanding grout
- Containment tents
- Portable diesel powered A/C units
- “Peel Away” paint remover
- Load cells and dynamometers

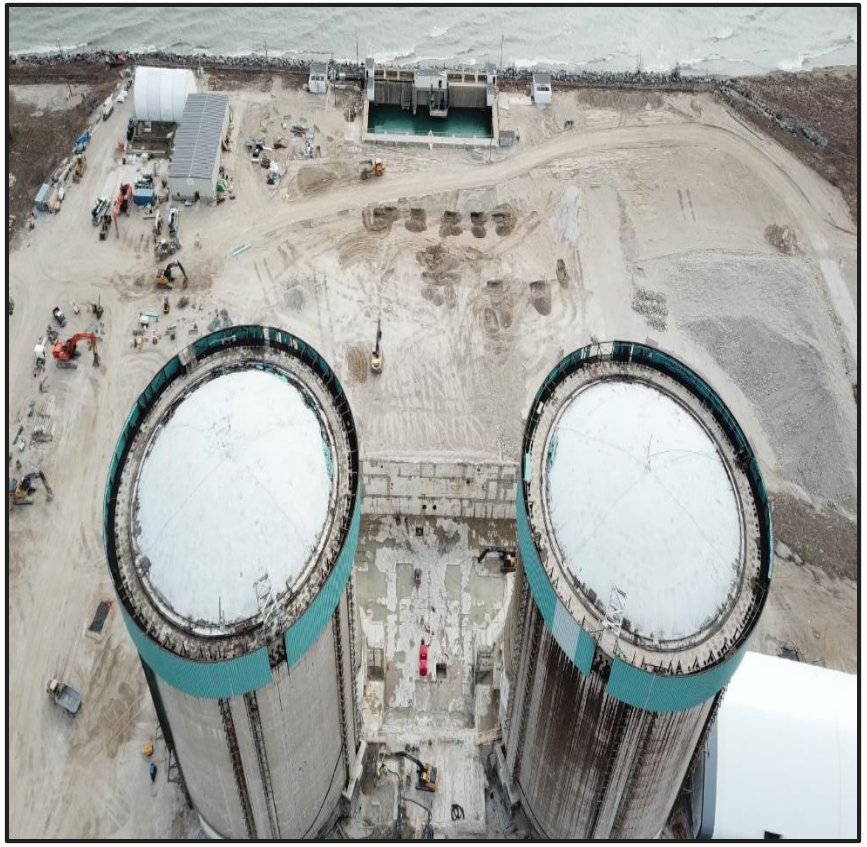
Physical Decon Production Costs - ITSRs



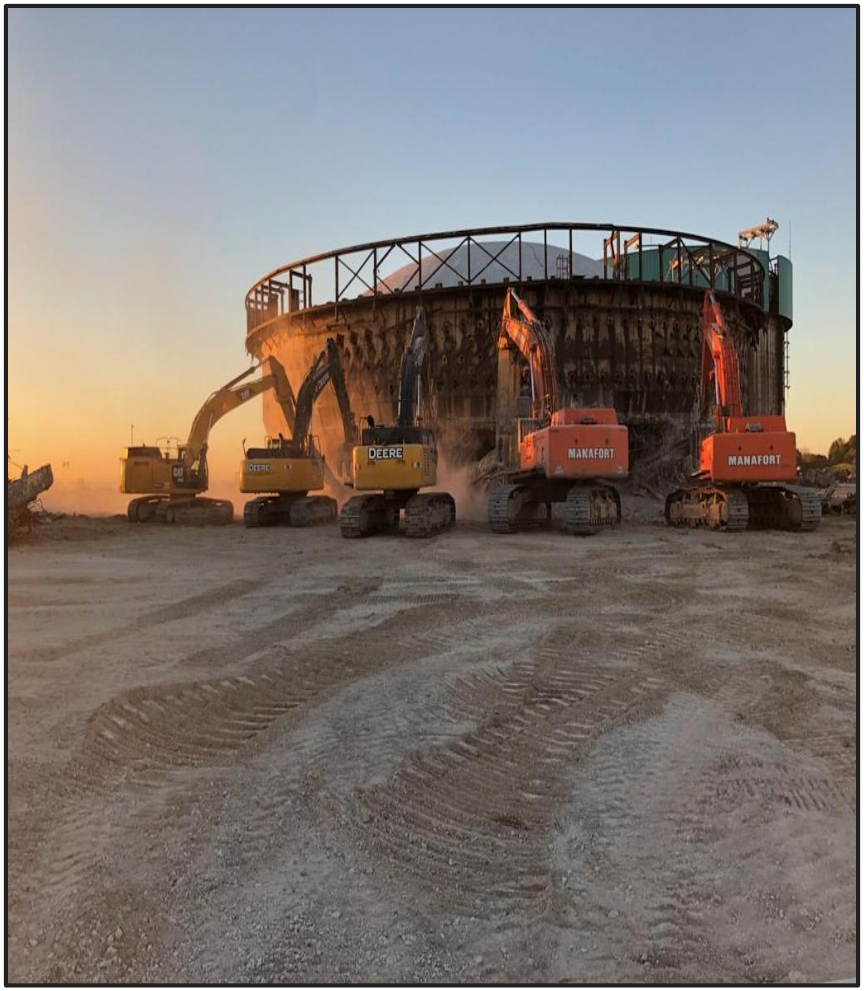
Floor Decon @ NASA-Plum Brook Research Reactor

Photo courtesy of Bluegrass Bit Company

Zion NPPs – May 2018 – Drone photos



Zion NPPs – October, 2018



Action #9 – Final Surveys

- The last 5% of any project is always the most difficult to complete
- Final survey planning **must** start before the project field activities are even close to starting – plan, collect, analyze, document and report
- This is the **regulators last chance to hold the licensee accountable** if unrestricted release and license termination is planned (just when you thought the hard part of the work was over)

Action #10 - Teamwork

- Learn how to work well together as a team - do your job well and others will notice how well the team is doing the job
- Invest in the project team and give them the tools to do their job well – build the project team's base of knowledge to enhance capable execution of the project - one shot at getting it right
- Share lessons learned to help future projects to build upon your work and be successful; 'reach out to others'

Summary

- Wide scope of involvement in and expertise for addressing the full spectrum of needs for both the national & international decommissioning community
- Recognized as independent subject matter experts in the decommissioning field
- Engaged in training future decommissioning specialists and in assisting others solve their decommissioning challenges for a safe and optimized D&D process
- Provided some key take-aways for the decommissioning process based on our experiences in our D&D work nationally and internationally

Contact information

- **Contact**

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Share the Knowledge

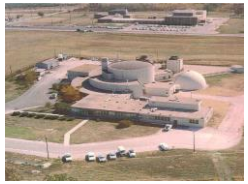
Experience Summary - Larry Boing

- **40+ years of Decommissioning Experience**
- College
  - Purdue University, 1979
- Health Physicist (HP) – ERC – 4 years
  - ORNL, U S Nuclear Regulatory Commission, U S Environmental Protection Agency, Commercial clients
- HP / Planning Analyst - UNC Nuclear Industries – 3 years
  - DOE Surplus Facilities Mgmt Program
  - U S NRC Evaluation of Nuclear Facility Decomm Projects (ENFDP) program
- Professional Societies
  - American Nuclear Society – Decomm & Env Sciences Div – Chair & Past Exec Board (DDR); Current Awards Comm & Conf Technical Prog Comm
  - Health Physics Society – Decomm Section
- Argonne National Laboratory – 33+ Years
  - Decomm Project Manager
    - Managed decomm projects
  - Decomm Program Manager
    - Managed Decomm Program
  - Special Projects Manager/SME
    - Subject Matter Expert on Facility Decomm / D&D Knowledge Mgmt
    - CP-5 Large Scale D&D Demonstration Project
    - D&D TC Program – ~2800 graduates, 70 countries & Fellows Program
    - International D&D Programs-IAEA, OECD/NEA TAG on D&D, Japanese, Korean, Argentina / total of ~25 countries
    - Various US regulated D&D projects and Other International projects

Decontamination and Decommissioning (D&D) Program

D&D Goal

The goal of the Argonne Decommissioning Program is to be recognized as a leader in the areas of planning, supporting and implementing the process of safe and efficient shutdown (deactivation) and decommissioning of surplus facilities at Argonne, DOE sites, non-DOE sites and foreign sites. The support provided is intended to be based upon a thorough technical understanding of the circumstances and issues involved in and relevant to the particular facility and the optimization of any and all of these processes, especially incorporation of lessons learned from earlier industry experience. Also included within this goal is an element of outreach to others in the areas of education and training, optimization, sharing of lessons learned, and enhancement of technology as well as technical information exchange.



CP-5 Reactor Site and Decommissioning Activities

D&D Experience

Argonne's D&D Projects Group has been leading and supporting the decommissioning of research reactors and other nuclear facilities at Argonne and other sites within the United States and abroad for over 40 years. The knowledge gained and the lessons learned from this work has been applied to subsequent projects and shared with others. The hands-on decommissioning work was performed using Argonne's in-house labor forces integrated with contractor work forces. Other efforts focused on analysis of strategies and general planning support.

The Argonne D&D Projects group is recognized as subject matter experts in various areas. These areas of expertise include:

- Project management and execution including cost, schedule, quality and technical baseline management
- "Path Forward" planning, development, preparation and review (Decommissioning Plan, Radiation Protection, Characterization Plan, Health & Safety, Quality Assurance Plan).
- Project Readiness Reviews and Facility Walk-downs
- Project Health Physics and Industrial Safety Oversight
- NRC Licensing Activities
- License Termination Process
- Quality Assurance Audits and Assessments
- Decommissioning Training

Argonne Decommissioning Projects

Argonne research facilities decommissioned include:

- Experimental Boiling Water Reactor
- Chicago Pile 5 Research Reactor
- JANUS Biological Reactor Facility
- Argonne Thermal Source Reactor
- Building 212 Plutonium Gloveboxes
- 60-Inch Cyclotron Facility
- Building 200 M-Wing Hot Cells (decontaminated for safe storage)
- Building 301 Hot Cells
- Experimental Breeder Reactor-II (placed in safe storage)
- Small-scale D&D projects

D&D Support to Outside Customers

The Argonne D&D Projects Group has been providing technical support to various DOE organizations, including:

- Tokomak Fusion Test Reactor at Princeton Plasma Physics Laboratory,
- Los Alamos National Laboratory,
- Brookhaven National Laboratory,
- Savannah River Site,
- Mound Site,
- Battelle Columbus Laboratories,
- Hanford N Reactor, and
- West Valley Demonstration Project.

The Argonne D&D Projects Group also provides technical support to various non-DOE organizations, including:

- the International Atomic Energy Agency,
- the OECD/NEA Technical Advisory Group on Decommissioning,
- the U.S. Army Aberdeen Fast Pulsed Reactor Facility, and
- other foreign reactor facilities.

Recently, a team of Argonne decommissioning subject matter experts assigned to the NASA Plum Brook Research Reactor Facility assisted the USNRC licensee in completing facility preparations and other activities setting the stage for final license termination activities at the facility. They provided direct technical support to NASA in this decommissioning activity at the NASA-Plum Brook Station in the areas of construction management, radiation safety, licensing and quality assurance oversight, and industrial safety.

Argonne staff members are currently engaged in providing technical support to a shipborne reactor plant decommissioning project. The U.S. Department of Transportation/Maritime Administration (USDOT/MARAD) is the USNRC license holder for the Nuclear Ship Savannah (NSS). ANL is currently supporting MARAD in preparing for the final decommissioning of the nuclear licensed areas of NSS.

International Technical Support

The D&D Projects Group has been conducting D&D training for over eight years. More than 100 in-depth training courses (ranging in length from 1-2 days to 3-weeks) have been conducted for national and international trainees on the decommissioning of nuclear facilities. The courses have focused on various types of contaminated facilities – power reactors, research reactors, hot cells, glovebox facilities, production reactors, waste management facilities, and other non-reactor facilities. To date, over 2,800 participants from over 65 countries have participated in these training courses. The training course has been given at various U.S and international locations and at customer's sites.

An Argonne Organized Decommissioning Training Course