



FROM WEAPONS TO WETLANDS



THE SUCCESSFUL CLEANUP OF THE FERNALD NUCLEAR SITE

FLUOR DANIEL®



“ The only way you can get it done is for all to work together. We exceeded all the expectations. The result even amazed me. ”

— Gene Branham,
president of Fernald Atomic Trades
and Labor president, hired in 1952

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tell me your vision

INTRODUCTION

1



Above: A cricket frog enjoys the view.

Inside cover: Red winged blackbirds discover a new sanctuary. (Both photos Chris Stewart/Dayton Daily News)

The sounds were almost too soft to hear, but the message they carried was resounding. A few clicks on the computer keyboard, followed by 49 footsteps from one end of the small office complex to the other. And then it was done: a copy of a declaration letter was transmitted from Fluor Fernald to the Department of Energy, officially completing the cleanup and closure of the Fernald nuclear production site at 4 p.m., Sunday, October 29, 2006.

Gone were 1.5 millions tons of the most contaminated waste to storage sites in Texas, Nevada and Arizona. The rest, 4.7 million tons, went into a specially designed storage facility on the site. And each day more and more of the 225 acres of the Great Miami Aquifer becomes cleaner and safer.

Meanwhile, out in the fields the bobolinks begin to “bwick” and the dickcissels counter with their “chuks” and “brzts.” At the same time, cricket frogs quietly stake their territorial conquests of new fresh water ponds. These small amphibians materialize where new wetlands are formed — wetlands that contain clear, clean water. Other amphibians have also discovered the area and a competition for new homes is underway.

It was a task that almost no one thought could be accomplished, a job that had no blueprints for success. Such a thing had never been attempted before. A 1992 government report forecast the cleanup of Fernald would not be completed before 2019 and at a cost of \$12.2 billion.

That was before Fluor Fernald got on the job. Fourteen years and \$4.4 billion later the cleanup is complete — nearly 50 percent quicker and 66 percent cheaper than estimated

The success was a total effort, the mission embraced by the workers and the community, state and federal regulators, environmentalists and the Fluor Fernald team. Working together with the Department of Energy made the success first possible and then unstoppable. Tomorrow’s Fernald is a lasting legacy to those who made it healthy again as well as to those who toiled there to defend our nation.

Today angry Canadian geese honk at anyone who dares to intrude on their new space. Kingfishers have moved beyond the fertile banks of Paddy’s Run to settle where nuclear workers once parked their vehicles.

In the tranquil North Pines section the remains of five Adena Native Americans rest, their 1,100 year journey at last complete. “Tell me your vision,” the Adena Ancient One would say to all who came to him and “be still enough to see them.” Only then can one succeed.

That was what we did. Soon the oak, the maple and the beech will appear, almost in the same spots in which they were located in 1812 when the area was first charted.

We can only imagine what spring will bring.



Above: Paddy's Run flows crisp and clean along the western perimeter of Fernald. (DOE)



Above: Members of the public try their hand at the Cleanupopoly game as they learn the challenge of cleaning up Fernald. (DOE)

During almost 38 years of operation, Fernald produced 462 million pounds of pure uranium metal products for use in production reactors elsewhere. It was the first link in America's nuclear arsenal. But in 1991, the mission of the Fernald site changed from uranium metal production to environmental remediation. To meet the new challenges of remediating a former uranium production site, the Department of Energy awarded an environmental cleanup contract in August 1992 to the Fernald Environmental Restoration Management Corp., later renamed Fluor Fernald.

It would start almost a decade after DOE reported that nearly 300 pounds of enriched uranium oxide had been

released to the environment from a Fernald dust collector system and that three off-property wells south of the site were contaminated with uranium.

Thus, Fluor Fernald had to both bind up the wounds of the community and the land.

"The climate at the time was unbelievable polarization between DOE and EPA and the community," said Bob Kispert, who went to work at Fernald as an 18-year-old high school graduate in 1954 and rose to become one of the plant elders. "Yet out of all of this — the

early turmoil, the exchanges and a whole litany of things that went on — came sanity."

Fluor Fernald identified 13 areas as keys to the program's success: project controls and estimating, funding, austerity program, risk management, war room, work authorization, claims management, exit and transition planning, footprint reduction, space management, property disposition and records disposition. As a result of the 2004 austerity program, for example, \$36.6 million of work that had been scheduled for performance in 2005 was accelerated into 2004.

It also joined with DOE to invent Cleanupopoly. Introduced in a March 1994 community meeting, the Monopoly-like game had the objective of getting through a fiscal year without running out of money. "It taught every one of us the harsh reality: there was only so much money," said Lisa Crawford of the Fernald Residents for Environmental Safety and Health (FRESH).

One vivid, symbolic moment of progress was the razing of Plant No. 7, the only building visible from the highway. The first implosion attempt on September 10, 1994, failed on the structure built to withstand aerial bomb attacks. A second blast on September 14 brought it down.

And then there were the trains — more than 200 of them, hauling tons of waste out in specially designed gondola cars on new track, augmented by fleets of trucks. In case anyone doubted the direction of the cleanup, all that they saw pointed to progress.

a witches' brew

ELIMINATING RISK

3



Above: One of thousands of drums containing radioactive as well as unknown waste about to be dewatered and tested. (DOE)



Above: One part of the leachate transmission system carrying wastewater to the on-site advanced treatment facility, where uranium is removed and the water is discharged to the Great Miami River or re-injected back into the aquifer to flush uranium to pumping wells. (DOE)

The panorama of what had to be safely cleaned up was a frightening testimony to the way Fernald had been scavenged for almost two decades. Those Fluor Fernald officials and regulators who first saw the daunting task before them knew that haste did make waste and Fluor Fernald had stepped right in it.

"When I looked at it, I didn't think anybody could do it," Johnny Reising, DOE Fernald Closure Project Director, recalled.

When production operations ceased in 1989, there were 31 million pounds of uranium products scattered throughout the site, 2.5 billion pounds of waste and 2.75 million cubic yards of contaminated soil. In addition, a 223-acre portion of the underlying Greater

Miami Aquifer was found to be affected by uranium at levels above drinking water standards. By the time Fluor Fernald arrived, the safety culture had deteriorated. Workers were using the open floors as a control vessel. "Guys started losing respect for the nature of the material they were dealing with," said Dennis Carr, Fluor Fernald Project Director.

In theory, safety has always been part of the Fernald operation. Old photos show workers wearing white overalls that splayed slogans like "Safety is #1" and "Production with safety" across their backs. But radioactive and hazardous waste was collected using regular vacuum cleaners and employees were often told you could "eat a couple of teaspoons a day" of the product and "it would not hurt you."

Fluor Fernald immediately launched a safety first campaign. The cornerstone of the new safe cleanup culture was that every employee meeting started with a safety topic. The results were clear:

- First aid incidents dropped from 300 in 1992 to 50 in 2005 and 19 in 2006.
- Not a single OSHA incident on excavation of the waste pits, one of the most hazardous parts of the cleanup.
- 5 million hours recorded without a single lost time accident.
- Fernald's OSHA-measured lost day work rate was .18 lost work days per 100 full-time workers in 2003 and .47 days in 2004. By comparison, the average OSHA lost day work rate during that period was 4.1 days.
- Created a 24-hour Safety Culture.
- In 2006, set a safety record of 107 days without a first aid injury.
- Cincinnati Building Trades worked 10 years without a lost-time injury.

"I was positive we would never get it done. It was a pig sty. It was a dump. First thing I did was clean it up," said Don Paine, one of the first to arrive in 1992 and one of only two original Fluor Fernald managers still at the site. By the time closure was achieved, Fernald had become one of the safest workplaces in the DOE complex and safer than any other remediation site in the country.

our innovations

WORKING EFFICIENTLY AND CREATIVELY

4



Above: Specially-developed low-cost, multi-point soil radiation monitoring units in the South Field are inspected. (DOE)



Above: A Canada goose arrives in a newly-created wetland while another train of gondola cars exits with more waste.
(Chris Stewart/Dayton Daily News)

Cleaning up Fernald gave new credence to the well-respected axiom “necessity is the mother of invention.” Fluor Fernald displayed inventiveness in crafting tools, developing ways to clean up and mitigate dangerous waste, creating worker transition and easing labor disputes, salvaging a damaged relationship with regulators, making the right technology decisions and winning the trust and help of the community. On building construction for the cleanup alone Fluor Fernald and DOE spent \$350 million – one of many firsts.

“It was just like going to the moon, the costs and great people and the creativity,” said Rex Norton, site procurement manager. Innovations include:

- Mobile radiation laboratories were developed to find underground hot spots.

- Hydrosluicing mining techniques were developed to remove radiations waste from Silos 1 and 2, with remote video/ computer controlled devices to direct water blasting. Water was then recycled for use in sluicing operations.
- On-site developed computer modeling studies with reinjection wells enabled the work schedule to be compressed to 12 years.
- Developed the first electronic data validation system for radiological analysis to enable real time evaluation of quality of data.
- Increased PK expertise for characterizing legacy waste, cutting the need for massive sampling and analysis of the sizeable waste inventory prior to disposition.

- Advanced development of use of geoprobes for determining the depth of soil and groundwater contamination.
- Developed the first large scale radon treatment facility to treat radon laden air exhibiting concentrations almost 10 million times the EPA standard.
- Created the Project Controls System, a fully integrated quantity, cost, schedule and estimating system that allowed Fluor Fernald team to perform needs assessments, manager resources and evaluate the impact of proposed changes on a real-time basis. It alone enabled the project to accelerate the schedule by at least nine months and \$300 million.
- Pioneered the use of a smaller replacement water treatment facility (instead of the standard larger, costly ones) to better clean the Greater Miami Aquifer.
- Developed unique rail container transit system.
- Largest ion exchange water treatment facility.
- Resolved disputes between labor unions by developing a way to better link the project labor agreement and the collective bargaining agreement, which set out the requirement as to which workers would do what types of work. Fluor Fernald workers were also invited and encouraged to participate in the planning of the various cleanup projects also helped.

Even before Fernald achieved closure its innovations and successes were being copied elsewhere. For example, when the cleanup of Rocky Flats started in 1995, they benefited from Fluor Fernald pioneering efforts with worker transitions issues, labor disputes, communication with environmentalists and community relations.

our workers

HUMAN CAPITAL MANAGEMENT

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Above: A laborer uses a cutting torch to reduce in size Building 6 machinery that is too large to be cut by a shear. (DOE)



Above: A worker visits the In Vivo Examination Center, which performed baseline, routine, termination and incident lung in vivo counts for those with potential exposure to airborne radioactive material. (DOE)

It's not easy convincing a work force to work themselves out of a job – and then to do it sooner rather than later. Since the Fernald foundry opened generations have known it as a place where there would always be jobs. "We be here when you arrived and we be when you leave," employees would instruct the latest management firm upon its arrival.

So among Fluor Fernald's many tasks was to convince workers that production was over and their last mission was to clean it up. At the same time Fluor Fernald had to ensure workers they would be treated fairly and safely while motivating them to be diligent and creative.

"You have to break all the old ways of doing something and we certainly brought a different culture with us," said Rex Norton.

As a first step Fluor Fernald developed a manpower planning system as a forecasting tool to determine the necessary number of employees, the proper mix of skills and the support requirements on a time-phased basis. This helped balance retaining key employees necessary to complete work while encouraging others to make the decision to move to their next career.

Fluor Fernald also created a unique "outsourcing" program where skill sets of some Fluor employees were shifted to other companies involved in the closure project. Those individuals were thus provided longer-term employment opportunities well beyond the

Fernald closure; this also ensured that Fluor Fernald continued to have the skilled, incumbent workers for the closure needs.

Additionally, significant resources were allocated to provide employees with the tools and help they needed to transition to "Life After Fernald." More than \$20 million was targeted to retrain workers and equip them with new skills to sustain closure and prepare them for future jobs. Degree and vocational training were encouraged and supported by reimbursing employees tuitions costs for successfully completing online and local college degree work, vocational skill improvement classes and professional certification.

In addition, Fluor Fernald worked with local universities to establish deferred tuition payment plans so that workers would not need to invest their own money up front to begin retraining. Collaboration with the University of Findlay helped establish and certify undergraduate and graduate degree coursework in Environmental Waste Management.

Fluor Fernald also provided on-site, after hours certified truck driver and fork lift operation training, providing craft skill update training in the use of new technology employed by craft workers in the commercial area.

To assist the work force in managing their own careers, employees were offered access to an on-site Career Development Center that helped refine a wide variety of crucial job-change skills and career goal issues. The Center also networked with the local community on behalf of Fernald workers.

Said Bob Kispert, "We preached the message that the times are changing and you have to adapt to new things."

our community

PARTNERING FOR A HIGHER PERFORMANCE

6



Above: Community members plant seeds to help recreate the past plant pageantry of the Fernald site. (DOE)

Building relationships and earning trust and respect after decades of secrecy and controversy took time and consistent performance.

At first, DOE and Fluor Fernald followed a regulatory mandated public review process that allowed opportunities for public input but did little to break down long-standing communications barriers or build trust. Local residents were concerned that key decisions, which would ultimately affect their lives, were being made behind closed doors or with limited public input. They insisted on more frequent, face-to-face interaction with Fernald decision-makers. As a result, DOE and Fluor Fernald adopted a new strategy for

public participation based on the premise that people have a desire to participate in decisions that affect their lives.

"It was putting people at the table and giving them a voice," said Lisa Crawford. "We would not be here today if they did not do this. They earned our trust by actually listening to us. I will give Fluor a tremendous amount of credit here, because they stuck with us. If they made promises, they kept them."

Fluor Fernald and DOE launched outreach programs with direct, two-way communication between management and the public early in the decision process. Decision-makers began meeting with stakeholder groups more frequently in various forums to provide

information about cleanup plans, invite feedback and answer questions. Stakeholders were encouraged to tour the site to become familiar with cleanup challenges.

In 1993, the Fernald Citizens Task Force, later called the Fernald Citizens Advisory Board (FCAB), was established to consider issues threatening cleanup progress. The task force provided recommendations that became the foundation of the cleanup program, saved taxpayers billions of dollars and cut years off the schedule.

In 1994, the Fernald Envoy Program was established to further close any gaps between citizens and decision-makers. Coming from all fields and disciplines, Fernald Envoys were the eyes and ears for local business leaders, labor unions, school officials, environmental groups, regulatory agencies and elected officials.

"We had to make choices in three areas: What should cleaning lead to, will there be any on-site disposal and what to do with the land? Working with the task force one or two times a week, we could discuss more rational decisions, the range of land use possibilities, and have them share their options with us. Technology was explained and we all went out and got support," said Dennis Carr.

All the hard work paid off. When a series of negative articles appeared in 1996, the community and the stakeholders retained their faith in Fluor Fernald. The articles were later discredited — but never Fluor Fernald in the eyes of the community.

our tomorrow

A LASTING LEGACY

7



Above: Deer were the first animals to stake their claim to tomorrow's Fernald. (DOE)

It rises to the eyes almost majestically. The burial ground for the 4.7 million tons of waste is a modern day addition to the nearby Native American burial ground. Two earthen mounds, bookending the proud history of these 1,050 acres.

The distinctive waste mound, twice the size of the Empire State Building, will be one of the few icons at what was once Fernald, now on its way to being an undeveloped nature park. The mound will be off limits to the general public, fenced off behind small warning signs, a last reminder of the "keep out" approach that dominated the first part of Fernald's legacy.

Otherwise, the site now invites all. After more than 55 years of security, of keeping things out, Fernald has lost that battle — gleefully. An estimated 120 bird species and 78 plant species are expected to return, led by the already-present deer, great blue herons, Indian brown bat and Sloan's crayfish. Shiners and darters have taken over Paddy's Run, while sycamores and cottonwoods are growing strong.

Some humans, like John Ritzenthaler, Director of habitat conservation for Audubon Ohio in Columbus, got to stand on the mound and loved what the visage inspired.

"In terms of the birding potential, it could be a destination site for southwest Ohio. As far as the surface habitats, that is where I was surprised at the variety of the site," he said. "They will find it quickly."

It promises to be a good place for humans as well.

An old warehouse will become a learning center, where almost 200 prehistoric, historic and cultural artifacts uncovered during cleanup will be available for study. Small blue houses, much like ice fishing huts that festoon a frozen lake, are scattered throughout the park and in neighboring fields; they will continue to monitor ground water to ensure that it gets cleaner and safer every year.

Fernald has been many symbols — protecting the nation, reinvigorating the local and national economy. It made many feel safer during an uncertain and amorphous arms race with the Soviet Union. At Fernald, they believed they were still fighting the good fight.

Soon the roller coaster will come alive again at neighboring Stricker's Grove, the community picnics will carry voices across the fields to where the animals have returned, where the Native Americans and the Cold War waste rest. Hair will be snipped at Milt's, BBQ enjoyed at Boston Butz, the fragrant pastries savored at Ross's Bakery and the produce debated at Brown's Country Market. The quiet community, whose first fame was being the sweet sugar corn capital of the world, now has an elegant and respectful solution to what was once seen as a morass.

Fernald is a legacy and a roadmap for others seeking similar results for similar challenges. The lifecycle is now complete.

epilogue

Fluor Fernald worked to change the culture and mindset of all involved in the cleanup project to support safe, least costly, accelerate closure of the site. Some of the valuable lessons learned include:

- Develop innovative technological approaches to cleanup challenges.
Begin really exploring alternative technologies well in the beginning of the process and always do more work on R&D.
- Allow the contractor more flexibility to find innovations, work-arounds, efficiencies and effectiveness. Managing the contract, not the contractor, should be paramount.
- Utilize incentive based contracts — they work.
- Demonstrate commitment to excellence in safety performance.
- Work to clearly define the end state. Align with workers and organized labor on the vision.
- Align with regulators and stakeholders on their expectations and level of involvement.
- Focus resources on continuous improvement of work methods and procedures.
- Offer incentives to retain key workers and critical skills.
- Establish waste disposition pathways. Early on, have a team focus on those waste streams without an obvious disposition path.
- Establish the most aggressive schedule for completion to challenge the project teams.
- Select the right tools and systems to measure and manage the job.
- Apply disciplined project management practices throughout execution.
- Identify project risks early and develop mitigation plans.
- Continually analyze the execution strategy to identify risk/mitigation and acceleration opportunities.
- Apply aggressive austerity measures and manpower planning.
- Reward teams for safe, on-time compliance of project activities.
- Scrutinize of cost, schedule and safety performance on a regular basis.
- Develop "Going Out of Business Plans" for institutionalized functions.

