Fluor Hanford Makes Cleanup A Reality In Nearly 11 Years At Hanford Site

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Project Hanford Management Contractor for the
U.S. Department of Energy under Contract DE-AC06-96RL13200

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For Nuclear Futures magazine, 2007

TWO-PART SERIES

Part I: Fluor Hanford Changes Cleanup at Hanford Site

For nearly 11 years, Fluor Hanford has been busy cleaning up the legacy of nuclear weapons production at one of the Department of Energy’s (DOE’s) major sites in the United States. As prime nuclear waste cleanup contractor at the vast Hanford Site in southeastern Washington state, Fluor Hanford has changed the face of cleanup.

When DOE awarded a large waste remediation and site maintenance contract to Fluor beginning on October 1, 1996, Hanford Site cleanup was primarily a “paper exercise.” The Tri-Party Agreement, officially called the Hanford Federal Facility Agreement and Consent Order - the edict governing cleanup among the DOE, U.S. Environmental Protection Agency (EPA) and Washington state - was just seven years old. Milestones mandated in the agreement up until then had required mainly waste characterization, reporting, and planning, with actual waste remediation activities off in the future.

Real work, accessing waste “in the field” – or more literally in huge underground tanks, decaying spent fuel pools, groundwater, hundreds of contaminated facilities, solid waste burial grounds, and liquid waste disposal sites – began in earnest under Fluor Hanford. The fruits of labors initiated, completed and/or underway by Fluor Hanford can today be seen across the site.

Spent nuclear fuel is buttoned up in secure, dry containers stored away from regional water resources, reactive plutonium scraps are packaged in approved containers, transuranic (TRU) solid waste is being retrieved from burial trenches and shipped offsite for permanent disposal, contaminated facilities are being demolished, contaminated groundwater is being pumped out of aquifers at record rates, and many other inventive solutions are being applied to Hanford’s most intransigent nuclear wastes. (TRU waste contains more than 100 nanocuries per gram, and contains isotopes higher than uranium on the Periodic Table of the Elements. A nanocurie is one-billionth of a curie.)

At the same time, Fluor Hanford has dramatically improved safety records, and cost effectively maintained and streamlined infrastructure and equipment that is impossibly old and in many cases “extinct” in terms of spare parts and vendor support. The story of Fluor’s achievements at the Hanford Site – the oldest and most productive plutonium site in the world – is both inspiring and instructive.

Removing Spent Nuclear Fuel from the K Basins

In October 2004, the largest collection of spent fuel in the DOE complex was removed from wet storage. Fluor Hanford completed removing more than 2,300 tons (2,100 metric tons [MT]) of irradiated uranium fuel – just over 4.65-million pounds – that had been stored for as long as 30 years in two indoor pools known as the K Basins. The fuel, which represented 80 percent of DOE’s total spent fuel inventory, sat just one-
quarter mile from the Columbia River -- the eighth largest river in the world -- described by Washington's governor as "the lifeblood of the Pacific Northwest."

Fluor's Spent Nuclear Fuel (SNF) Project modified the 1950s K Basins with new equipment and structural upgrades, and built two new facilities to dry and store the fuel. Working on grating suspended above the 20-foot deep basins, Fluor employees retrieved the more than 105,000 fuel assemblies, washed and pieced them together, loaded them into underwater baskets and then into massive overpack containers, and hoisted them out of the basins. They also dried the fuel and transported it to safe, dry, interim storage in central Hanford, effectively neutralizing the risks formerly posed by the decaying fuel.

The more than 400 spent fuel containers were also welded and "N-stamped" by Fluor, meeting the highest technical standards of the American Society of Mechanical Engineers. They are the first such containers prepared for the national high-level waste repository planned for Yucca Mountain, Nevada.

Removing and drying the spent fuel marked a cornerstone event in Hanford's long farewell to arms, and was hailed as a huge success and step forward for the whole region by Washington's Governor, Senators and several Congressional Representatives, and all concerned with the Site. "The Columbia River and surrounding communities are safer today because of the success of this project," said then-Secretary of Energy Spencer Abraham. "This high risk material is now safely contained."

The accomplishment removed 95 percent of the radioactivity in Hanford's 100 Areas (river shore areas where the reactors used to operate), and paved the way for cleanup of 210 square miles of the river's shoreline bordering Hanford. In the two and one-half years after removing the K Basins fuel, FH also consolidated nearly all (more than 99 percent) of the other, smaller collections of spent fuel at the Site into dry storage in central Hanford.

Tackling the K Basins Sludge

In the same month that the SNF Project completed its mission, Fluor began the next ambitious phase of cleaning out the K Basins -- capturing and removing the highly radioactive sludge generated in basin water from metallic fuel corrosion. The sludge was a combination of dirt, sand, rust, chemicals, fuel corrosion products, and decay or fission products. It ranged from flaky particles to cake-like and hard-packed piles, and when disturbed, swirled through the 1.3-million gallons of water in each basin.

The K Basins water became extremely murky, and workers needed special underwater cameras and lights to guide their efforts. They had to stand on grating above the basins' water, drawing the sludge into underwater containers with vacuuming hoses and wands known as "end effectors." Although Fluor employees designed multiple, unique end-effectors to capture sludge effectively, the work was still exhausting and frustrating. Workers compared it to "chasing smoke." Levels of airborne contamination in the K Basins work areas rose as the sludge was disturbed, forcing workers to don full personal protective clothing and air-purifying respirators.

Because tons of waste debris clogged the K Basins, Fluor decided to remove it before vacuuming the sludge. Several campaigns to remove debris were conducted during and between sludge vacuuming efforts. In all, more than 300 tons were removed. Of the two basins, K East had the majority of the sludge, about 40 cubic yards (30 cubic meters). The K West Basin contained about 14 cubic yards (11 cubic meters). It was
decided to clean out the KE Basin first, as water had leaked from it in the past and its deactivation and decommissioning (D&D) would contribute to greater reduction of environmental risk.

FH workers toiled for two years to collect all of the sludge in the KE Basin. When they completed vacuuming the bulk of it in October 2006, U.S. Representative Jay Inslee (Democrat-Washington, 1st District) called Fluor Hanford to say: “Congratulations on this important milestone. We recognize that doing a job like this required people to dig deeper than the standard operating procedure. When you tackle a project like this, you’re going the extra mile.”

As soon as K Basins workers finished collecting sludge in the East Basin, they started up a unique transfer system to move the sludge to waiting containers in the West Basin, one-quarter mile away. “Hose-in-hose” transfers of sludge out of the KE Basin completed in early summer 2007, at nearly the same time that the bulk of the KW sludge was captured by a vacuuming system there.

“Seeing the sludge now transferred into the K West Basin, while maintaining one of the best safety records at Hanford, is a real testament to the talent and dedication of Fluor workers,” said Pete Knollmeyer, vice president of the K Basins Closure Project for Fluor Hanford, when the complicated sludge transfer work was complete. “We have come a very long way in cleaning out the K East Basin and removing the environmental threat it once posed.” At the present time, D&D of the KE Basin is proceeding, while a treatment system is being designed to immobilize the sludge for disposal.

**Stabilizing and Repackaging Plutonium**

When Fluor became prime cleanup contractor at Hanford in 1996, it inherited a risky situation at the Site’s Plutonium Finishing Plant (PFP). The special PFP compound at Hanford stored nearly 20 tons (18 metric tons) of plutonium scraps, and the U.S. Defense Nuclear Facilities Safety Board (DNFSB) – a independent federal oversight agency – had issued an urgent mandate two years earlier to stabilize it, repackage it into sturdy and approved containers, and place it on various paths to disposition. (Stabilization of plutonium-bearing materials essentially involves heating the materials to drive off organic and water vapors that could support gas or other reactions within the plutonium.)

The age and plurality of materials at PFP when Fluor arrived, as well as the variety and condition of containers holding these materials, were crucial factors that made stabilizing and packaging one of the most daunting jobs in the cleanup universe. Fluor Hanford inventoried the materials and reorganized the work into a project. The company designed and built a new system of gloveboxes and state-of-the-art equipment in the plutonium storage vaults area, to process plutonium materials of high concentration and purity. It also refurbished and worked efficiently to safely use some of the old equipment at the PFP.

By 2000, Fluor had started up four new processes for stabilizing plutonium. The company ramped up the work quickly after that time, operating additional ovens and a magnesium-hydroxide precipitation process (later changed to an oxalate precipitation process) for stabilizing the inventory of 4,300 liters of plutonium-bearing solution. Altogether, Fluor Hanford quadrupled the plutonium stabilization rate in 2000 and quadrupled it again in 2001.
In 2001, Fluor Hanford workers at PFP became the first in the weapons complex to comply with DOE's new standard STD-3013, a set of strict safety and storage requirements for packages containing plutonium. In addition that year, Fluor Hanford started up a system at PFP to contain plutonium-bearing residues safely in large, heavily reinforced pipe overpack containers (POCs). Residues were those forms of solid, plutonium-bearing scrap that required no thermal stabilization, but sometimes required grinding and sifting into smaller pieces before repackaging. Later that year, a PFP team finished stabilizing and canning all of the plutonium metal at the compound.

By mid-2002, Fluor Hanford had stabilized all of PFP's plutonium-bearing solutions. In early 2003, it completed stabilizing polycubes -- a unique form of plutonium-bearing solids in a polystyrene matrix. All of the original residues materials in the DNFSB milestone were repackaged by August 2003, but in the interim, DOE had shifted about two tons of other materials into the residues category. Fluor continued repackaging residues until it finished the added scope in February 2004. Fluor Hanford workers completed stabilizing all solids, alloys, and oxides materials at the PFP in February 2004. In total, they packed 1,951 POCs of plutonium-bearing residues and about 2,250 of the 3013 cans.

When the work was completed, Washington's Governor Gary Locke called the achievement "a very important step forward in Hanford cleanup...[and] a major accomplishment for Hanford and for the Northwest."

Cleaning Out the PFP Compound

Even before the stabilization and packaging project ended at PFP, Fluor began the difficult work of cleaning out the old compound to prepare it for demolition. The 15-acre complex contained 63 buildings, many of them highly contaminated with alpha radionuclides. The main processing building is almost as long as two football fields, and nearly 50 feet tall. It held 189 gloveboxes contaminated with plutonium; thousands of feet of ventilation ducting and process areas; miles of piping; and thousands of valves, pumps, tanks and other equipment.

In 2004, Fluor Hanford began D&D activities at PFP by removing plutonium powders that had collected in equipment, piping and air ducts in contaminated facilities. In total, Fluor Hanford shipped over 500 drums containing legacy material from PFP to approved disposal by mid-2005, more than a year ahead of schedule. Another important cleanout task was removing contaminated equipment from gloveboxes and hoods. A hood is an open-faced metal box where radioactive materials can be handled.

Cleaning out these gloveboxes and hoods was, and is, very challenging work, because many areas are highly contaminated and cramped. Equipment in the boxes has sharp edges that can puncture gloves, the inside surfaces are embedded with contamination, and heat from plutonium processing has clouded the plastic windows. To begin D&D of the gloveboxes, workers removed and replaced covers that had sealed glove ports for many years. They used razor blades and small, round sanders to clean the glovebox windows, but still could not get them completely clear.

So far, Fluor Hanford has cleaned out more than 70 gloveboxes and hoods, removing enough equipment and contaminants that most of them qualified as low-level waste (LLW) at the end of the job. LLW contains less than 100 nanocuries per gram, and does not contain isotopes higher than uranium on the Periodic Table.
Another key achievement in PFP D&D has been cleaning out five highly contaminated vaults and tanks beneath the 241-Z Liquid Waste Treatment Facility. The 241-Z Facility was highly contaminated because, for 56 years, all of the contaminated liquid effluents from the PFP processing buildings were routed through it on the way to disposal. Workers cleaning out the 241-Z Facility vaults and tanks had to labor below-grade in confined spaces, in two pairs of full personal protective clothing with supplied-air respirators. They had to climb down ladders to scrape and remove waste, and even had to cut holes in the sides of the tanks with plasma-arc torches and remove the waste inside.

At the beginning of the job, surface contamination levels in the pits were often too high for instruments to read -- reaching millions of disintegrations per minute per square centimeter (dpm/cm²). Dpm measures how much energy is being emitted. Estimates from historical information showed that working in the vaults and disturbing contaminated surfaces for 15 minutes could generate derived air concentration (DAC) levels of 130,000 - 300,000. DAC is a measure of radioactivity in air established to determine the potential dose to an individual.

Fluor Hanford crews applied fogging aerosols before entry and used hand-held foggers during the work. They also developed and modified various “point-source ventilation” devices to direct air flow. Their techniques kept airborne contamination levels below the 800 DAC control point, and workers experienced only one minor skin contamination event in more than 400 entries into the vaults.

When Fluor Hanford workers began to clean out the 232-Z Plutonium Incinerator in the PFP compound, they encountered DAC values for plutonium more than four times higher than those found in the most radioactively contaminated buildings previously demolished in the United States. Yet, using effective and innovative contamination control techniques, many developed by the workers themselves, they emptied the building to LLW status.

Other significant FH D&D achievements at PFP in the last few years have included loading and shipping out 644 large, highly contaminated solution containers from the tunnels beneath the main processing facility, packing and disposing hundreds of fuel pins, and completing a three-year project disposing a large group of miscellaneous nuclear sources and standards. Additionally, the PFP Closure Project has demolished 15 ancillary facilities, and completed engineering evaluations and cost analyses for all waste sites and structures in and below the PFP complex. In 2005, the Project won the 2004 Fluor Hanford Environmental Stewardship Award, and in 1996 it won the Team Excellence Award from the Eastern Washington Chapter of the Academy of Certified Hazardous Materials Managers.

Demolishing Buildings Contaminated with Plutonium

Another innovation by Fluor Hanford that is safely saving time, money and worker exposure is demolishing buildings contaminated with plutonium in “open air” conditions. Fluor pioneered this technique in 2003 by demolishing the 233-S Plutonium Concentration Facility, a 50-year old structure in which a plutonium fire in 1963 had spread contamination throughout the building. Limited cleanout had been conducted in subsequent years, but the structure remained highly contaminated when FH crews tackled
it. Inside surfaces of outer walls demonstrated alpha contamination levels of 34 million dpm/cm² and the inner processing area read 500 million dpm/cm² in some places.

Planning for demolition began with extensive studies of air circulation in and around the structure. Data that was collected allowed FH teams of radiological control specialists to establish contamination and buffer zone perimeters in concentric circles around the building. Crews then selected tools and work practices that would generate the least amount of contaminated dust and debris, and applied latex-based fixatives to the surfaces of the building’s interior to “glue” contamination in place. When work began, employees directed a fine mist from a “fog cannon” at the saw slicing the outer walls of the building. They also mounted a mister on the saw itself. As soon as a cut was made and a new surface exposed, workers applied fixatives to those portions also.

Throughout the demolition work, ingress and egress to the contamination and buffer zones were closely controlled, and workers entering the contamination area wore respiratory protection and special protective clothing. Continuous air monitors and fixed head air samplers installed at the site monitored air conditions in real time.

Workers used large concrete saws on tracks to cut the walls and roof into large blocks. A crane then lowered the blocks onto a segregated area of ground where they were wrapped for disposal. Within seven months, the building had been demolished and all the rubble removed, despite record-breaking cold weather and winds that often stopped work. More than 4,000 employee entrances were made into the contamination zone during the demolition, yet there were no skin contaminations and no recordable injuries.

In 2006, Flour Hanford D&D teams took the open air demolition technique several steps further, when they razed the 232-Z Plutonium Incinerator Facility. The 233-S Building stood clear of other structures on three sides, but the 232-Z Facility was wedged on three sides among operating buildings that were the workday home to nearly 600 people. Some of these buildings stored special nuclear material, so that security guards had to closely supervise the work.

To protect nearby buildings from potential radioactive dust, crews put up false metal walls between the 232-Z Facility and nearby structures, and draped other structures in plastic sheeting weighted down by industrial magnets. They also practiced defense-in-depth methods by installing a fixed-head misting system on nearby buildings. They also installed sump pumps, sand berms and absorbent pillows known as "pigs" to control water runoff and to hold it in marked contaminated portions of the demolition site.

All of the procedures and precautions developed in the open-air 233-S job were incorporated into demolishing the 232-Z Building. In addition, because the 232-Z Building was “munched” by an excavator and reduced to rubble, loading out and removing the demolition debris into waste containers had to be an innovative and carefully controlled process. Workers developed a special process they called “following the Yellow Brick Road” that used bright yellow plastic sheeting to carefully delineate a route to fill and release waste containers from the demolition zone. Trucks loaded with waste containers came and went from the zone on this special plastic path, which was then “trimmed” and disposed along with the waste just as the trucks left the boundary.

Demolishing and removing rubble at the 232-Z Facility took less than three months, during some of Hanford’s hottest summer weather, with no recordable injuries. After the rubble was removed, the 232-Z concrete slab was sprayed with a long-term
fixative and covered with more than 18-inches of clean gravel, then carefully surveyed and marked.

In 2007, FH D&D crews again used their techniques for open air demolition to level the plutonium-contaminated 241-Z Liquid Waste Treatment Facility and two contaminated ancillary facilities, including removing the rubble, in less than three months.

Part II: Fluor Hanford Delves Into Site Cleanup at New Levels, Locations

Remediating Groundwater Contamination Along the Columbia River

During the height of plutonium production, nine massive nuclear reactors stretched across approximately 13 miles of shoreline in the northern “horn” of the Hanford Site, each one positioned within one-quarter mile of the magnificent Columbia River. When the oldest defense reactors were operating from 1944-1971, sodium dichromate was added to filtered river water before it was pumped through the reactors to cool them. The chemical was used to prevent corrosion in the reactor process tubes.

Over the years, underground piping between the early reactors and their pump houses sometimes broke, and pipes and holding basins for effluent water cracked and leaked. As a result, a great deal of sodium dichromate reached groundwater. Today, Fluor Hanford is managing a massive, multi-pronged project to clean plumes of hexavalent chromium (also called chromium+6 or Cr+6, a water-soluble carcinogen) from the groundwater and soil of Hanford’s 100 Areas before they can reach the Columbia in substantive amounts.

Hanford’s 100 H Area borders some of the most important and prolific salmon spawning areas in the United States. The Hanford Reach of the Columbia River – the 51-mile stretch of river flowing through the Hanford Site – was named a National Monument in 2000 and has been documented as an important habitat for salmon, steelhead and other fish species.

In the mid-1990s, Hanford engineers and operators drilled and began pumping-and-treating contaminated groundwater from extraction wells in the 100 H Area. The treatment effectively changed the Cr+6 to trivalent chromium (Cr+3) – a form that is not water-soluble and not as harmful to living organisms.

By mid-2005, for the first time in nearly 50 years, pumping efforts had reduced the Cr+6 contamination levels in groundwater in the 100 H Area to better than (below) the drinking-water standard of 100 micrograms per liter (µg/L) established by the U.S. EPA. (A microgram is a measure of parts per billion - ppb.) In most parts of the 100 H Area, the Cr+6 contamination levels were actually reduced to less than half that level.

Today, the pump-and-treat system at the 100 H Area has removed more than 75 pounds of Cr+6, but Fluor is still pumping, striving toward the even purer aquatic water safety standard (10 ppb or 22 µg/L) designed to protect fish habitat.

At the 100 D Area, just upstream of the 100 H Area, Fluor’s Soil and Groundwater Remediation Project (SGRP) has expanded pump-and-treat systems to remediate plumes of contaminated water that have some of the highest concentrations of Cr+6 anywhere at Hanford. Thus far, 100 D Area pump-and-treat systems have
processed nearly 400 million gallons of groundwater and removed more than 600 pounds of Cr+6.

This year, using a special funding allocation from DOE, SGRP scientists are installing and testing three new technologies to further attack Cr+6 contamination in the 100 D Area. The new work is testing electrocoagulation as a treatment process, strengthening an existing underground chemical barrier in the area, and drilling wells to search for an elusive, long-term source of the Cr+6.

At the 100 K Reactor Area, about three miles west of 100 D Area, Fluor Hanford pump-and-treat efforts have cut in half and substantially reduced a large Cr+6 plume in the groundwater. Like the 100 D Area, the 100 K Area borders particularly important fish habitat. In 2005, FH successfully tested an innovative treatment system using calcium polysulfide in the 100 K Area, and in 2007 finished building and began operating an expanded treatment system there.

Snuggled between the 100 D and 100 K Areas in north Hanford lays the 100 N Area, home to the largest production reactor ever built at the site. The New Production Reactor (or N Reactor), built in response to the launch of Sputnik by the former Soviet Union in 1957, operated longer than any of Hanford’s other production reactors (23 years).

Different operating parameters and fuels at N Reactor produced a large plume of strontium 90 (Sr-90) in the soil and groundwater in 100 N Area. Sr-90 is harmful to living organisms because it is a bone-seeker, replacing calcium in bones and weakening or sickening the organisms it enters. In 100 N Area, strontium is present in groundwater at levels more than one thousand times those allowed in drinking water, and is found in river plants and clams.

Recently, SGRP scientists and engineers installed a new system of wells along a 300-foot stretch of river shore at 100 N Area, and injected the wells with a calcium phosphate compound. This compound reacts chemically to form an apatite barrier — similar to tooth enamel — to bind the strontium in place, keeping it from the river while its radioactivity decays. Regulatory agencies have expressed enormous hope about the protective potential of the barrier, and have praised FH and the DOE for its inventive deployment.

Digging Into Hanford’s Central Plateau

The large land area of central Hanford (approximately 70 square miles) is known as “the plateau” or sometimes simply “the hill,” because it is raised 250-300 feet above the groundwater table. The Central Plateau contains Hanford’s radiochemical reprocessing areas – the 200 Areas – including the most highly radioactive wastes and contaminated facilities at the Hanford Site. Facilities include five huge plutonium separations facilities — known by Hanford workers as “canyons” — extremely contaminated with radioactive and chemical hazards.

In addition to other nuclear-grade facilities – that is, facilities containing enough nuclear material and hazards to require high levels of surveillance and maintenance – the Central Plateau encompasses 884 identified soil waste sites (including more than 50 miles of waste burial grounds), over 900 structures, and all of Hanford’s high-level waste tanks.

Fluor Hanford has moved aggressively to ‘invade’ 200 Area waste sites in the last few years, digging nearly 450 boreholes, test pits, direct soil “pushes” or drive points,
logging geophysical data sets, and performing electrical resistivity scans (a new
technique that maps patterns of sub-surface soil conductivity). In March 2007, Fluor
developed a work plan that will add 238 characterization activities in the Central Plateau
during fiscal years (FYs) 2007-2010. All of these actions are aimed at pinpointing
contamination areas in soil and solid waste sites, so that cost-effective and appropriate
remediation decisions can be made.

In 2005, Fluor’s Central Plateau Deactivation and Decommissioning (CP D&D)
Project completed a comprehensive Central Plateau Closure Plan that organized cleanup
work over the next several decades into 22 “closure zones.” There is a zone for each
reprocessing canyon, for the Plutonium Finishing Plant, for waste ponds, tank farms,
solid waste burial sites and for other contaminated portions of the 200 Areas.

That same year, the CP D&D Project completed and achieved acceptance of the
first Record of Decision (ROD) for disposing a Hanford canyon. Since that time, it has
produced a Remedial Action Work Plan, and started Phase I work, including engineering
studies to reactivate those portions of U Plant’s equipment that will be needed to
demolish the plant in place. In addition, this year it is sampling a large collection of
radioactive liquid in a tank near the plant in preparation for removing and treating the
material.

The CP D&D project is currently cleaning out one of its nuclear facilities to
reduce it to a “radiological” facility, requiring less surveillance and saving costs. In
similar manner, it will clean out two more nuclear facilities in 2008. Fluor has
demolished over 115 facilities in the Central Plateau in the past three years.
In the meantime, the old Hanford canyons require extensive maintenance, including
replacement of huge fans, filters and exhaust stack probes that are, in some cases, original
1940s equipment. The work is unique, inventive and highly hazardous, as more aging
systems fail and work continually emerges to keep the facilities safe until final
demolition can occur.

Retrieving and Shipping Transuranic Waste Offsite; Treating Other Solid and
Liquid Wastes

A Fluor Hanford cleanup project called the Waste Stabilization & Disposition
(WSD) Project operates ten major solid and liquid processing and analytical facilities for
radioactive and/or hazardous wastes. One facility alone is a waste storage complex of
more than 50 buildings. Fluor’s WSD also provides crosscutting waste management
services to other contractors at the Hanford Site. WSD manages the majority of
Hanford’s post-1970 mixed TRU waste, low-level waste (MLLW) and LLW facilities,
including more than 750,000 cubic meters of waste in the Low-Level Burial Grounds
(LLBGs).

Every year, Fluor’s WSD treats millions of gallons of liquids from across the
Hanford Site in liquid processing facilities. Since Fluor arrived in 1996, more than three
billion gallons of contaminated liquids have been processed through the 200 Area
Effluent Treatment Facility, and the 300 and 200 Area Treated Effluent Disposal
Facilities.

In addition, WSD safely stores the two most highly radioactive, consolidated
waste collections on the Hanford Site - nearly 2,000 capsules of extremely radioactive
cesium and strontium at its Waste Encapsulation and Storage Facility, and nearly 4.5-
million pounds of spent nuclear fuel at the Canister Storage Building. In total, WSD maintains safe storage of approximately 40 percent of the radioactivity at the Hanford Site in these two facilities.

In 1996, Fluor initiated operations of the Waste Receiving and Processing Facility (WRAP) at Hanford—a facility unique in the waste handling world because it combines so many functions under one roof in an integrated program. WRAP's main function is to prepare TRU waste for shipment and permanent disposal at the Waste isolation Pilot Plant (WIPP) in New Mexico, about 1,800 miles south of the Hanford Site. In WRAP's glove boxes, waste containers can be opened remotely to remove items not compliant with WIPP criteria. Damaged or corroded drums can be repackaged.

Soon after WIPP opened, Hanford's TRU program was certified through WIPP's rigorous process. WSD sent the first shipment of TRU waste from Hanford in July 2000, and has since sent over 350 shipments. The WSD shipments to WIPP are the only radioactive waste loads that have left the Hanford Site since cleanup began.

In 2003, as part of a negotiated settlement with Washington state, DOE agreed to begin digging up approximately 38,000 drums and boxes (enough waste to fill 76,000 standard 55-gallon drums) of "suspect-TRU" waste stored in LLBGs at Hanford between 1970 and 1987. The wastes also had to be characterized, and their final disposition determined and accomplished. In addition, DOE agreed to assay and disposition 40,000 drum-equivalents of suspect-TRU waste stored aboveground in facilities. DOE assigned these formidable tasks to Fluor's WSD.

Although Fluor found daunting challenges, including badly degraded waste containers, the company began retrieving suspect-TRU waste in October 2003. In January 2005, the first retrieved waste was shipped to WIPP, and by mid-2007, more than one third of the buried waste had been retrieved.

Other important WSD successes include finishing disposing 12,000 drums of mixed waste from past uranium fuel fabrication processes in 2005, and completing treatment of the first portion of sludge from the K Basins in 2006. The 332 drums of hardened sludge represent the first fuel-basin sludge ever treated in Hanford's history.

Operating an Aging Site Infrastructure and Making It Look Easy

The vast Hanford Site was built by the Manhattan Project in World War II. As such, its infrastructure, utilities, pipelines and many of its facilities are now nearly 65 years old. The rush of construction during 1943-45, while done superbly by master craftsmen, sometimes used shorthand methods and materials in building infrastructure components, while saving the tightly rationed, grade-AAA materials for the reactors and other key facilities. The WWII "Hanford Engineer Works" was not designed to function into the 21st century.

Yet, when Fluor Hanford began managing the Site, including its extensive infrastructure, in 1996, the cleanup mission had a long future reliant on dependable roads, utilities, pipelines, heating, ventilation and cooling (HVAC) systems, electrical, communications and other systems. The challenge for Fluor's Closure Services and Infrastructure (CS&I) organization was to provide the utilities, infrastructure and support services necessary to sustain the cleanup, while aggressively reducing those same functions and saving any non-essential expenses that could be directed at waste remediation.
“Essentially,” says Fluor’s Executive Vice President and Chief Operating Officer George Jackson, “CS&I had to remain invisible and at the same time provide seamless service using components older than most of the workers. Cleanup projects plan their work while taking support services like water and utility services for granted — and that’s how we want it. If we can make infrastructure services look easy, we’ve succeeded. However, working with Hanford’s aging systems is far from easy. CS&I has successfully met the challenge of reducing services and expenses while constantly supporting the primary cleanup mission.”

During Fluor’s tenure at Hanford, CS&I has carefully balanced infrastructure reduction against risk by establishing “one deep” services with prudent maintenance for essential services while allowing monitored degradation of those areas with limited remaining demand. It shifted maintenance from preventative schedules to condition-based work. As a result of these and other streamlining and consolidation measures, staffing levels (with attendant costs) have been reduced.

In 1998, Fluor implemented DOE’s direction to close out Site railroad operations after 50 years of operations without a lost workday injury. A short railroad connection in the southern part of the Site near Richland, along with five square miles of adjacent land, was transferred to a local economic development entity. Bus and taxi services were also eliminated to save costs. CS&I also shut down three large, 1940s coal-fired steam plants and replaced them with small “package boilers” geared to specific needs of facilities across the Site. It also closed two water filter plants and consolidated fleet maintenance activities.

Electrical utility services were streamlined, renovating one substation and eliminating two others. Importantly, leaks in the water distribution system that aggravated migration of underground contamination toward the groundwater, were addressed. CS&I redesigned the pumping configuration, and used a “mortar lining” process to cost-effectively reline portions of the water system. This innovative and environmentally-friendly repair won a DOE 2004 Pollution Prevention Best-in-Class award and was nominated for the EPA’s regional 10 Champions for Environmental Leadership and Green Government Innovation awards.

Other awards won by Fluor’s CS&I include a 1997 World Safety Organization Concerned Corporation/Company award and two 1999 “Hammer” awards from Vice President Albert Gore for streamlining government operations. In 2004, the project won a Fluor Hanford Environmental Stewardship award for recovering used oil. In 2005, it won a DOE Executive Award for leadership and innovation in moving the 62-year old Site Fabrication Shops Program offsite and into private operation.

A special part of CS&I’s operations includes managing the Hanford Fire Department (HFD) and site emergency response services. The desert expanse of Hanford’s 586 square miles represents a significant challenge to the HFD — a challenge that is routinely met with deceptive ease. In 1999, the HFD received DOE’s top award for fire protection, the Walter W. Maybee Award, in recognition of its cost-effective and exemplary approach in delivering fire and emergency services.

In June 2000, HFD, along with help from other regional fire departments, successfully battled a huge wildland fire that swept over 192,000 acres, encompassing nearly half the Hanford Site and some surrounding areas. HFD kept the fire from reaching...
any nuclear facilities. In 2004, a major Site contractor company recognized HFD’s performance with a Life Saving Award.

**Dramatically Improving Safety**

During Fluor’s nearly 11 years managing and remediating the Hanford Site, perhaps no change has been as comprehensive as the sweeping improvements in all aspects of safety. One fact stands out above all: the year before FH managed the Site (FY 1996), the recordable injury rate as measured by the U.S. Occupational Safety and Health Administration (OSHA) was 5.37 per 200,000 hours worked. In the most recent year for which complete statistics are available (FY 2006), the recordable injury rate was 0.93 – nearly a six-fold decrease! Likewise, rates have dropped in the categories of days away from work and days restricted from work.

In every way, Fluor communicates to and with its workers that safety is Job One. Every single FH meeting begins with a safety topic, covering tips for reducing accidents and increasing safety awareness at work and off the job. Zero Accident Councils led by workers, with management participation, operate in every major FH facility and project, and a Presidents’ Zero Accident Council meets monthly in a large open forum and reviews every accident. With workers, labor leaders, and senior management present, any and all topics that could improve safety are placed on the table.

Fluor wrote the first Integrated Safety Management System (ISMS) plan on the Hanford Site in 1997. ISMS is a five-part program implemented for every job, mandating steps to ensure that work is performed safely. As part of ISMS, every Fluor worker has “stop work authority” for any job, if he or she believes the work is being or will be performed in an unsafe manner.

Fluor believes strongly in the DOE’s Voluntary Protection Plan (VPP), a program of high safety standards modeled after an OSHA program for private industry. Today, Fluor leads the entire DOE complex because eight of its major projects (plus the affiliated Fluor Government Group office in Richland) have attained “Star Status” in the VPP program -- more projects than any other DOE Site or contractor. VPP Star Status is reached after a rigorous application and examination process that verifies several indicators of a good safety program, including worker knowledge of systems, worker responses to emergency drills, management presence in the work place, and of course low accident and injury rates.

Under Fluor, a fledgling ALARA (as low as reasonably achievable) Center has blossomed into a multi-purpose resource center that finds and demonstrates products, and even invents first-of-a-kind solutions, to execute work safely and/or with less exposure to hazards. The FH ALARA Center now serves international clients, and consults across the world. After Fluor established a Radiological Control Center of Expertise at Hanford, skin contaminations dropped by 33 percent from 1997 to 2006. FH personnel make more than 100,000 entries per year in posted radiological Contamination Areas, yet experienced only one skin contamination in 2006 (the last full year for which statistics are available).

Similarly under Fluor, a nascent work hazards analysis system has grown into a sophisticated yet user-friendly Automated Job Hazards Analysis (AJHA), a computerized tool in which the potential risks of every job are evaluated and mitigations built in. The AJHA uses a graded approach, so that undue bureaucracy is not inserted into simple or
routine jobs, yet more complex jobs receive the step-wise scrutiny they need. After work is done, the AHA collects lessons learned for future reference.

The Fluor-initiated Employee Job Task Analysis (EJTA) identifies hazards employees may encounter in routine assignments, and generates a quantitative assessment of exposure risk. The EJTA information is then given to the Hanford Site medical contractor to better tailor medical surveillance and health care to each individual worker.

One of the most stunning achievements of Fluor Hanford's safety program has been creating and opening the Hazardous Materials Management and Emergency Response (HAMMER) Training and Education Center on the Hanford Site in 1997. At the 80-acre HAMMER campus, Hanford Site environmental cleanup workers, as well as emergency responders from around the world, train on unique "props" that include a burning building, an overturned rail car, confined space trenches and tunnels, a search and rescue building, a pond, the deactivated shell of a SCUD missile, vehicle portal monitors used at border crossings, and many others.

Approximately 40,000 "student days" of training are conducted each year at HAMMER, and over 330,000 student days of training have been conducted at the facility since 1997. HAMMER is legendary for providing training "as real as it gets." In 2003, 2004 and 2005, HAMMER posted injury and illness rates 75 percent better than industry standards. John Sweeney, president of the American Federation of Labor-Congress of Industrial Organizations Building and Construction Trades Department has said that "HAMMER is one of the most important partnerships of Labor and management in this country today."

Fluor's safety program at Hanford also encompasses its matchless nuclear guard force, which includes the officer who has been the "top gun" (best sharpshooter) in Washington state for 25 years in a row! In late 2006, Occupational Hazards magazine, a publication of Penton Media, selected Fluor, including all of its business lines, as one of America's 10 Safest Companies.

CONCLUSION

In addition to specific accomplishments by waste cleanup and support projects, Fluor Hanford has achieved other successes too numerous to mention in its nearly 11 years at Hanford. It has made major strides in safely decommissioning the large and complex Fast Flux Test Reactor, and has won multiple awards for community involvement and contributions. It has also streamlined electronic and business systems in substantive ways so as to direct more funds to cleanup. In 2006, FH's Procurement organization won DOE's Procurement Award/Innovation Award for the fourth year in a row. It is hard to reach any other conclusion than that Fluor Hanford has made major and positive impacts on the Hanford Site.
Fluor Hanford article for: Nuclear Futures Magazine
Michele Gerber
2007

PHOTOS and CAPTIONS:
Please use first 3 photos for Part I of story; and last 3 photos for Part II.

00120016-29: State-of-the-art cask containing spent nuclear fuel is hoisted out of the K West Basin at the Hanford Site, 2000.

DSC-0036: Fluor Hanford workers remove debris from the K East Basin at the Hanford Site, during the course of removing sludge, 2006.

232-Z Internal cleanout.jpg: Fluor Hanford workers clean out filtration area of the 232-Z Plutonium Incinerator at the Hanford Site - formerly one of the most contaminated structures per square foot in the United States -- in 2005.


06050006-105df: Fluor Hanford workers collect contaminated samples inside a specially designed enclosure while drilling a borehole under a historical soil disposal site at Hanford, 2006.

TRU Drums Retrieval.jpg: Fluor Hanford workers retrieve buried solid waste at the Hanford Site, 2004/
23.2 Internal Cleaning: great
1/11/04 - 218-W-4C, Trench 4, West End

TRU Drums Retrieval great