Oversight is a state agency which independently monitors activities at the INL on behalf of the citizens of Idaho

State of Idaho Oversight Monitor

November 2006

Progress on Cleanup of Buried Waste

Archaeologists learn a great deal about past civilizations by studying their trash. In the case of the Idaho National Laboratory, the site's major landfill holds keys to understanding the dynamics that shape the site.

The landfill, known as the Subsurface Disposal Area (SDA), occupies less than 100 acres of the 570,000-acre INL. But its contents, about 35 acres of chemical and radioactive wastes, and its location about 600 feet above Idaho's largest aquifer, have made it the center of a long-standing controversy.

The history of the landfill is a case study in how public policy balances risks and benefits and how this balance can shift with time. Most Idahoans recognize the 1960s photos of trucks dumping barrels of radioactive and chemical waste in the eastern Idaho desert. This was comparable to many industries' practices at the time, but we now find hard to believe.

In 1952, when waste disposal at the INL landfill began, unbridled enthusiasm in the benefits of chemicals and nuclear materials overlooked the potential long-term environmental consequences we recognize today. The INL's first waste disposals were in cardboard boxes in shallow trenches. The intervening decades have seen more limits placed on the types of waste disposed, changes in treatment requirements, and increased recordkeeping.

Today we face the challenge of deciding how to make the area safe for site workers, the public and the environment, both now and for the long term. How should we deal with contamination, primarily caused by disposal practices of the 1950s and 1960s?

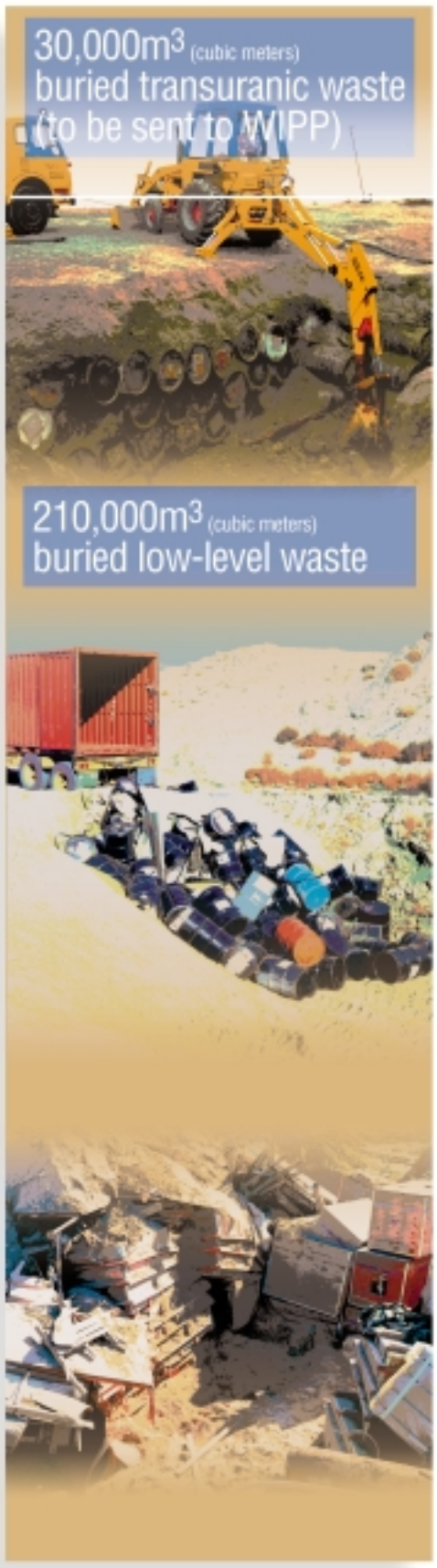
Two legal documents come together to provide the framework to help answer that question and meet the State's goals for cleanup of the SDA. One is a 1995 court settlement between the State, DOE and the Navy requiring removal of certain wastes from Idaho. The other is a 1991 agreement between DOE, EPA and the State, laying out a process for how to evaluate and clean up contaminated areas on the INL.

The meaning of "all"

Many recent news stories and editorials have focused on a lawsuit between Idaho and DOE over the meaning of the word "all" in the 1995 court settlement.

The settlement focuses on the removal of three types of nuclear waste: spent nuclear fuel, high-level waste, and transuranic waste. National policy dictates disposal of those waste types in deep geologic sites (as opposed to near-surface disposal).

Disagreement over the meaning of the settlement's requirement to remove "all transuranic waste" from Idaho brought DOE and the State back to court. In May, a federal



Transuranic waste

There is uncertainty about how much transuranic waste—contaminated with transuranic elements at or above a concentration of 100 nanocuries per gram—is in the Subsurface Disposal Area. Based on current estimates, about 13% of the waste in the Subsurface Disposal Area is transuranic, roughly 30,000 cubic meters or one million cubic feet.

Under the a **1995 Settlement Agreement** DOE must remove "all" the transuranic waste from the INL. DOE, however, opines that "all" refers to only some of the waste at the Radioactive Waste Management Complex. The legal battle between DOE and Idaho over this requirement continues to this day.

Low-level waste

About 87% of the waste in the Subsurface Disposal Area is not transuranic, so it falls into the catch-all category of "low-level waste."

This waste can be contaminated with long-lived, mobile radionuclides, hazardous chemicals, or transuranic elements below the threshold of 100 nanocuries per gram.

The 1995 Settlement Agreement does not require the removal of low-level waste from Idaho.

Contamination

A **1991 Cleanup Agreement** among the State, DOE and EPA addresses potential contamination from waste in the SDA.

The *Remedial Investigation & Baseline Risk Assessment* recently issued by the DOE confirms the SDA poses an unacceptable risk to human health and the environment.

The State, DOE and EPA have already agreed upon some cleanup actions to address SDA contamination, but still have decisions to make as to overall cleanup of the area.

Idaho's goals

1. Protect human health and the environment, now and in the future.
2. Maintain an appropriate balance of risks and benefits.
3. Ensure that the Department of Energy and its contractors treat its host state and its citizens with respect, establishing a partnership that will position the Idaho National Laboratory to help solve problems facing our nation and our world.

judge agreed with the State, finding "unless something is encountered that would prohibit its removal, the 1995 agreement obligates the United State to remove all transuranic wastes…," including waste in the SDA.

The federal government notified the court it would appeal the decision, continuing the legal battle on this issue.

"Unacceptable risk"

Dealing with "all transuranic waste" only addresses part of the problem. Transuranic waste, containing certain concentrations of transuranic elements like plutonium and americium, makes up an estimated 13% of waste volume in the SDA, but there are other sources of contamination.

DOE recently completed its investigation under the 1991 cleanup agreement of the landfill and the risks it may pose. DOE concluded certain organic (carbon containing) chemicals and radionuclides pose an "unacceptable risk" requiring some type of cleanup action. Other chemicals and radionuclides met health and environmental criteria. The risk posed by these contaminants was not judged to be "unacceptable."

The State, EPA, and DOE must work with the public to decide what cleanup actions are appropriate. The current plan is to make an overall cleanup decision by 2008.

The agencies have already agreed on some actions to move cleanup forward in the meantime.

Taken in January 1969, this photo of Pit 9 shows material that "surfaced" when the area was flooded. (69-881) Some of the waste in Pit 9 was retrieved in 2004.

Waste retrieved from Pit 9 included an assortment of protective clothing, equipment and other material contaminated with plutonium and chemicals at the Rocky Flats weapons plant.

Most of the waste wasn't very radioactive, but one barrel's worth of graphite from the plutonium machining process was highly contaminated.

454 barrels of waste were removed from Pit 9. Of those, 59, or 13%, contained transuranic waste.

The 59 barrels of transuranic waste removed from Pit 9 can be shipped to the Waste Isolation Pilot Plant in New Mexico for permanent disposal. WIPP accepts only transuranic waste.

Where will the rest of the waste go? That's one of the questions cleanup managers face as they decide what to do with waste removed from other areas of the landfill.

Progress in Pits 4 and 9

After a high-profile contract for a waste retrieval project at Pit 9 failed in 1998, Idaho, EPA and DOE went back to the drawing board. They selected a small, pie-shaped retrieval area (roughly 500 square feet) at Pit 9 based on probe data that found a relatively high concentration of plutonium.

The retrieval used a backhoe whose scoop operated in an area isolated from workers, and gloveboxes to protect workers as they sorted through retrieved waste. This project, called "GEM" for Glovebox Excavator Method," provided information to the agencies to improve the efficiency of larger-scale retrieval operations.

In conjunction with the GEM project, the cleanup agencies reviewed historic disposal records, probe data and geophysical studies to prioritize areas for larger-scale retrieval.

The Agencies selected Pit 9 back in the early 1990s because of its location on the corner of the SDA and a general knowledge of its contents. After better mapping of historic records and using a ½-acre scale for retrieval, the Agencies found Pit 4 was likely to contain more plutonium and mobile chemicals from Rocky Flats waste, placing it at the top of the retrieval priority list.

Excavation of a ½-acre of Pit 4 under the Accelerated Retrieval Project (ARP) began in 2005, and excavation of a second ½-acre of Pits 4 and 6 (ARP II) is slated to begin within a few months. Based on the Pit 9 GEM project and other data, and a balance of risks to workers and to the public, ARP focuses on the retrieval of certain waste types likely to contain higher concentrations of transuranics, uranium and volatile organic chemicals, including certain sludges, graphite waste and filters.

This approach allows faster retrieval of higher-concentration wastes, but leaves less hazardous, less radioactive wastes in the Pit. Agencies are reviewing waste and soil sampling data to determine if waste locations and types match historic disposal records and to identify if any changes in cleanup actions are needed.

Barrels of waste from Rocky Flats, 1965. This is probably Pit 4 or 5. From 1963 until 1969, waste was dumped into pits instead of stacked to save time and minimize worker exposure. Note the absence of personal protective wear. Workers participating in cleanup today wear protective clothing and take other steps to minimize exposure to hazards. (65-3458)

Waste in Pit 4 is now being removed through a pilot project called "Accelerated Retrieval Project," or "ARP."

The ARP retrieval in Pit 4 involves a tent-like enclosure placed over the area from which waste is removed. This picture, taken during construction, shows part of the frame upon which the tent will rest.

ARP's enclosure keeps contamination from the environment. Heavy equipment used to retrieve waste does not leave the enclosure.

Inside the ARP enclosure, colored balls suspended from the ceiling mark specific locations for sampling waste and surrounding soil.

Workers in protective clothing review safety procedures. Note the difference in protective clothing from the disposal photo (above) taken in 1965.

Waste in a disposal trench, 1962. Many of the waste containers have disintegrated, leaving loose waste scattered around the trench. (Photo 62-2134)

Naval Reactors Facility waste placed in a trench in 1973. A structure called a "crib" was placed in the trench to hold this waste. (Photo 73-2345)

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What's buried in the Subsurface Disposal Area?

Over the past 50 years there have been all kinds of rumors about what's buried in the Subsurface Disposal Area. Given the secrecy surrounding early nuclear experiments and other military activities, that's not surprising. The great majority of the waste is industrial waste, like any waste that would come from a large-scale production facility.

Early disposal records varied widely in quality, both as to what was being disposed and where it went. There are a few cases where INL workers had to retrieve items but couldn't locate them based on disposal records. Some areas of the SDA were also designated for disposal (pre-1970) of "classified" waste, information or material that requires special handling from a national security standpoint. Sketchy records, human remains and classified materials mean cleanup plans have to address sensitive items and the unexpected.

Here's what we know today about some of the more common perceptions:

Human Remains: Portions of the remains of the three people killed in the SL-1 reactor accident that were too radioactive for burial in their respective cemeteries were placed in the SDA. Dealing with contamination in this area will call for additional sensitivity.

Ambulance: The ambulance used to transport one of the victims from the 1961 SL-1 accident was rumored to have gone to the SDA, but this is not the case. It was parked for a month or two, decontaminated and put back in service. It was later donated to the Blackfoot Idaho Fire Department, which had been using a hearse as an ambulance. The Fire Department kept it as a backup when it acquired more modern vehicles.

Nuclear Fuel and Reactor Parts: There is nuclear fuel material in the SDA. Around 200 kilograms of irradiated natural uranium associated with the first commercial nuclear power reactor, located in Shippingport, Pennsylvania, were buried in the SDA in the 1960s. The Naval Reactors Program cooperated in the design of the reactor, and some of the reactor's fuel came to INL for examination. Small amounts of other fuel materials from INL research activities were buried in the SDA from the late 1950s to the early 1970s, ranging in size from small fragments to entire fuel rods.

Animal parts: Animal carcasses, parts, and feces from radioactive experiments at government sites and universities are in the SDA.

"Roswell waste" from UFOs: There are no records or indications of waste from the Roswell area or involving UFOs in the SDA.

Spontaneously igniting waste: Small amounts of waste in the SDA may be pyrophoric, meaning they can spontaneously catch fire when exposed to air. Pyrophoric uranium metal in Rocky Flats waste has been recently uncovered in Pit 4. Plans call for the material to burn itself out under controlled conditions.

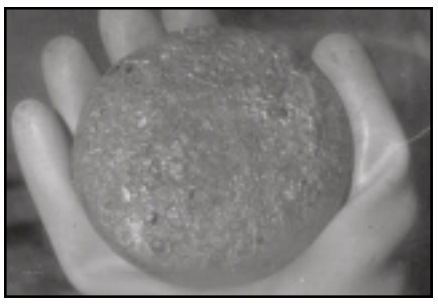
Barrels are rolled out of a truck and stacked in Pit 1. In some areas, workers stacked barrels and boxes vertically or horizontally. In the mid to late 1960s, waste was dumped straight from trucks to reduce worker exposure. DOE returned to stacking of waste in the 1970s. (Photo 58-1451)

Workers using a forklift to place the barrels of waste in Pit 11. (Photo 70-4429)

Disposal of Air Force waste from Sundance, Wyoming in 1969. Air Force personnel brought the waste to the site and helped with disposal. (Photo 69-3212)

Pit 10: a 12,000-gallon contaminated tank from Sundance Air Force Base, barrels used to prop the tank into place, and drums randomly scattered around the pit. (Photo 69-3209)

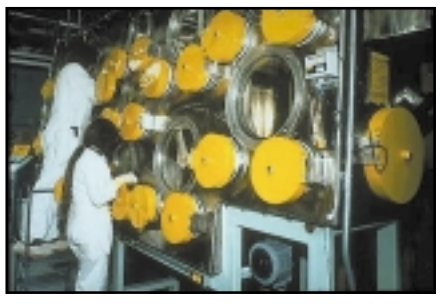
Rocky Flats: Building 707, a plutonium production building.



Plutonium: A finished "button" of plutonium at Rocky Flats.

Nuclear weapon: Rocky Flats made triggers for nuclear weapons like this MX Peacekeeper missile.

Workers: Rocky Flats recycled plutonium for warhead production in this room, the "XY Retriever Room."



Operations: Rocky Flats workers worked with plutonium using "glove boxes." Hundreds of gloveboxes were welded together to form lines, which were like assembly lines.

Conditions: Sometimes shortcuts were taken, particularly after a series of fires damaged facilities and equipment. Above, a glovebox repaired with tape.

Waste: Drums of waste stored at Rocky Flats. Some waste was stored before it was shipped to Idaho. Other waste was buried, then retrieved and sent to Idaho.

Fires: Damage from a 1969 fire at Rocky Flats. This was a glovebox in the main plutonium production facility. There were several fires at Rocky Flats, after which a great deal of "fire waste" was shipped to Idaho.

Buried waste: an Idaho import

waste created at Rocky Flats weapons production plant sent to Idaho

About 60,000 cubic meters of the 240,000 cubic meters (or around 25%) of the waste buried in the Radioactive Waste Management Complex came from the Rocky Flats weapons plant near Denver, Colorado. Rocky Flats waste, however, makes up most of the plutonium-contaminated waste in Idaho and lies at the heart of the controversy between the State and DOE over INL's burial grounds.

Established in 1951, Rocky Flats processed plutonium and other materials into detonators, or triggers, for nuclear weapons. In the 1980s, debate broadened about whether the plant's operations compromised the safety of the public, environment, and plant workers to meet production goals.

An FBI investigation into allegations of environmental malfeasance resulted in a "temporary" shutdown on November 13, 1989. The "temporary" shutdown became permanent when President Clinton officially ended the site's nuclear weapons production mission in 1993. As the weapons production ended, the site shifted its focus to cleanup, waste disposal and decommissioning of equipment and buildings (including what was once called "the most dangerous building in America" because of plutonium contamination).

After years of wrangling, the State of Colorado, local communities and the federal government agreed that the Rocky Flats site would become a national wildlife refuge after cleanup to certain standards. DOE certified Rocky Flats cleanup to be complete in 2005. Although cleanup of Rocky Flats contamination in Colorado may be complete, DOE must still address the cleanup challenges Rocky Flats waste poses in Idaho.

In 1954, Rocky Flats' first full year of production, 200 barrels of plutonium-contaminated waste were sent to Idaho each month. By 1956, 300 barrels were sent to Idaho each month; and by 1957, 400 barrels were sent to Idaho each month. Shipments to Idaho increased when a major fire occurred at a plutonium processing facility on Mother's Day, 1969.

Fire waste shipments included pieces of large equipment, while the more typical waste shipments included solidified sludges from equipment cleaning, used filters and worker clothing, and retired molds used to shape the plutonium metal. After 1970, Rocky Flats waste sent to Idaho was placed in above-ground storage. DOE insisted Rocky Flats waste would only be in Idaho temporarily, until a geologic repository opened in New Mexico (the Waste Isolation Pilot Plant).

When WIPP failed to open as scheduled in 1988 and no opening was in sight, Idaho Governor Andrus embargoed further Rocky Flats shipments. Although a similar, later Andrus embargo on spent fuel shipments to Idaho was ruled illegal, the closure of Rocky Flats in 1989 and DOE policy kept any more Rocky Flats waste from coming to Idaho.

It's uncertain how much plutonium came to Idaho in Rocky Flats waste, but rough estimates indicate one metric ton of plutonium is distributed among 60,000 cubic meters of waste in the burial grounds. This estimate is vague at best for several reasons, including sketchy disposal records, especially in the early years. In fact, Rocky Flats didn't make serious attempts to measure the amount of plutonium in its waste until 1964, when the Atomic Energy Commission—the precursor to DOE—determined it needed a better system to track what happened to the plutonium it produced.

Fire cleanup: Rocky Flats had a major fire in one of its production facilities on Mother's Day 1969.

Fire debris: Plutonium-contaminated litter, including fire hoses, after a fire.

In Idaho: Rocky Flats fire waste in Pit 10 in 1969. (Photo 69-6516)

In Idaho: Workers unloading Rocky Flats waste. (Photo 69-6135)

The long and winding road...

cleanup decision-making follows consistent process

The process used to make cleanup decisions was established by an Agreement between the Department of Energy, the Environmental Protection Agency and the State of Idaho. The Agreement, called the "Federal Facilities Agreement and Consent Order," is referred to as the FFA/CO or "the Cleanup Agreement." The Department of Environmental Quality manages the state's portion of cleanup decision-making.

In a nutshell, the three agencies evaluate how much and what kind of contamination is present, as well as the types of threats posed. Then they study methods for reducing potential risks, develop a range of options on which to receive feedback from the public, and decide what actions are appropriate.

Knowing how the process works can help you understand what's going on and how you can participate in decision-making. It's particularly helpful to know what type of report accompanies each step. Here's more detail about the process used by the DOE, the EPA and DEQ (the agencies) to make cleanup decisions:

Is there a problem?

- **Is there contamination?**
- **What is it?**
- **Where is it?**
- **Does it pose a risk?**

"Remedial Investigation & Risk Assessment"

How can it be solved?

- **What are the options?**
- **What are the pros and cons of each option?**

"Feasibility Study"

What does the public think?

The agencies ask the public for input when a proposed plan is issued. Make sure you know when the public comment occurs by adding your name to mailing lists maintained by State Oversight (1-800-232-4635 or AskOversight @deq.idaho.gov) and the cleanup contractor (1-800-708-2680 or via idahocleanupproject.com.)

There are other things, not part of the formal process, that you can do to learn more about cleanup at the INL. They include:

(1) Visit the cleanup contractor's website, the state Oversight program's web site, and other sites with information about cleanup,

(2) Have someone from the State or INL talk with your group or classroom,

(3) Learn about the INL Environmental Management Citizen's Advisory Board (www.inlemcab.org,) attend some of the Board's meetings, and/or offer input to the Board, or

(4) Contact the INL to arrange for a site tour.

"Proposed Plan"

What will we do?

Finally, a decision is made. The Superfund Cleanup system requires decision-makers to consider nine criteria. At a minimum, the remedy must:

(1) Protect human health and environment, and

(2) Comply with applicable, relevant and appropriate laws, regulations and other requirements.

Other criteria must be taken into account:

(3) Long-term effectiveness and permanence,

(4) Reduction of toxicity; mobility or volume through treatment,

(5) Short-term effectiveness,

(6) Implementability,

(7) Cost,

(8) State acceptance, and

(9) Community acceptance.

"Record of Decision"

Was the decision a good one?

When contamination is left in place, agencies must review performance every five years to make sure cleanup goals are met.

"5-year Review"

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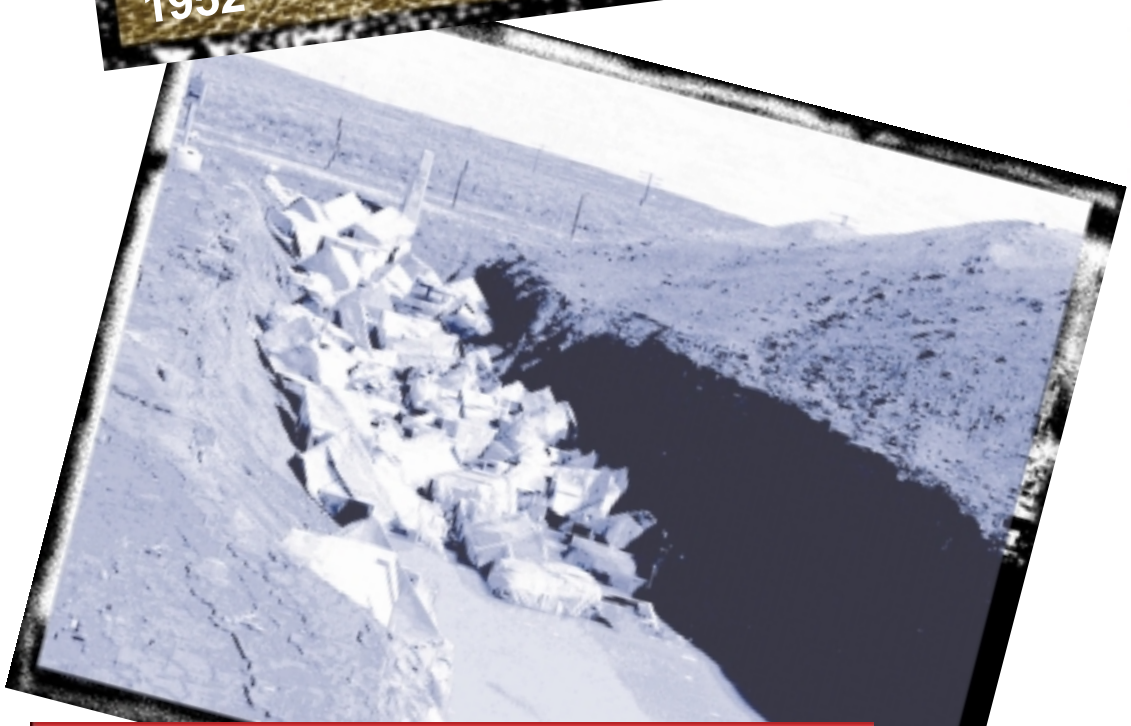

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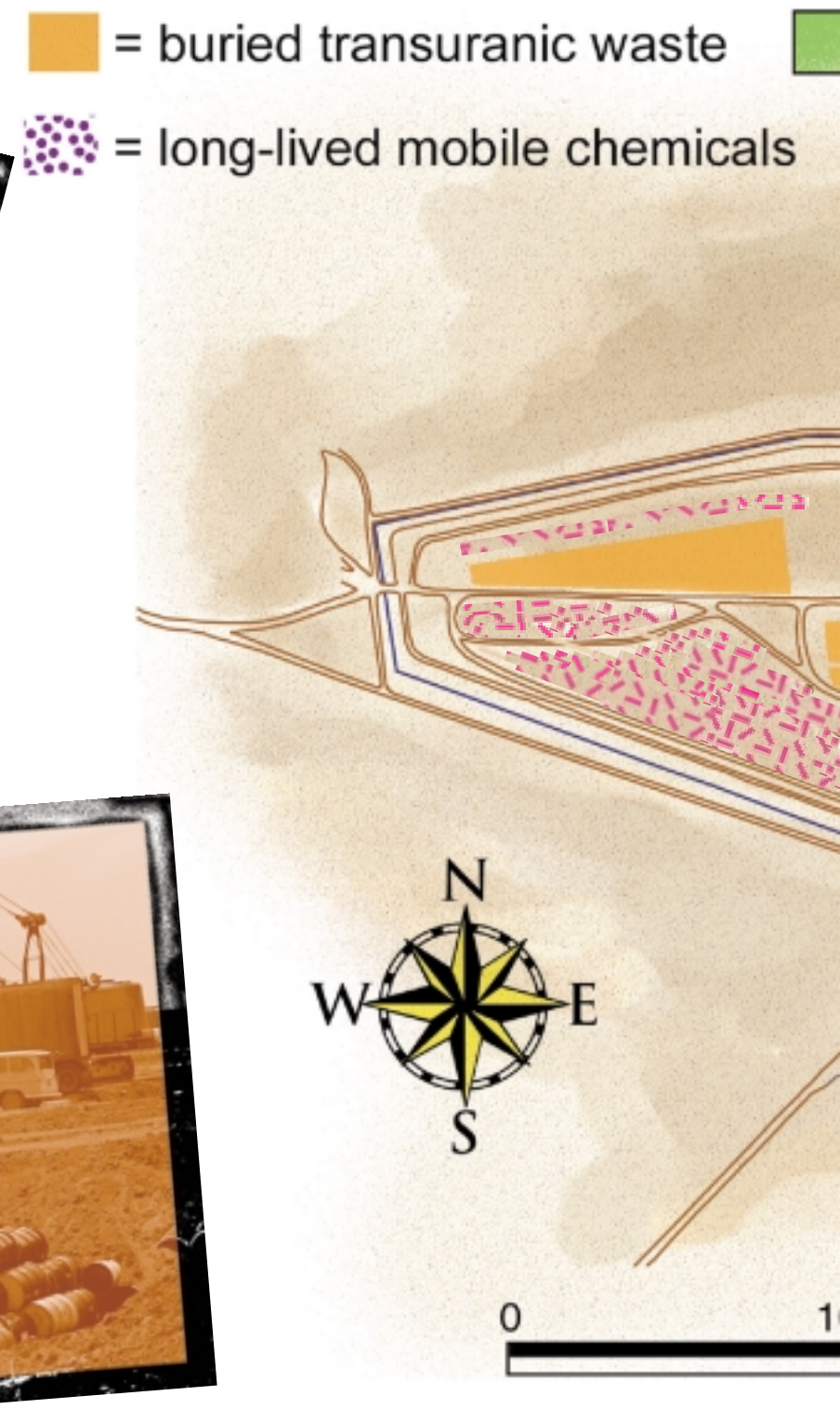

pits

Transuranic

What are they? Transuranics are radioactive elements heavier tha
beyond uranium). They are made artificially by bombarding uranium
with neutrons or other particles. The best known transuranic is pluto

Some isotopes of plutonium are used in nuclear weapons, while
and space probes. Plutonium and other transuranics at the RWMC
nuclear weapons production waste at the Rocky Flats plant in Color

What are the risks? Transuranics tend to move very slowly in grou
small amounts can move more quickly under special conditions.

Transuranic isotopes that remain radioactive for hundreds or tho
long-term concern. These include some isotopes of plutonium and
radiation in the form of alpha particles.

These particles cannot pass through the skin but can be inhaled
contaminated food or water, increasing a person's chances of deve
way to reduce risk to people and the environment from transuranics

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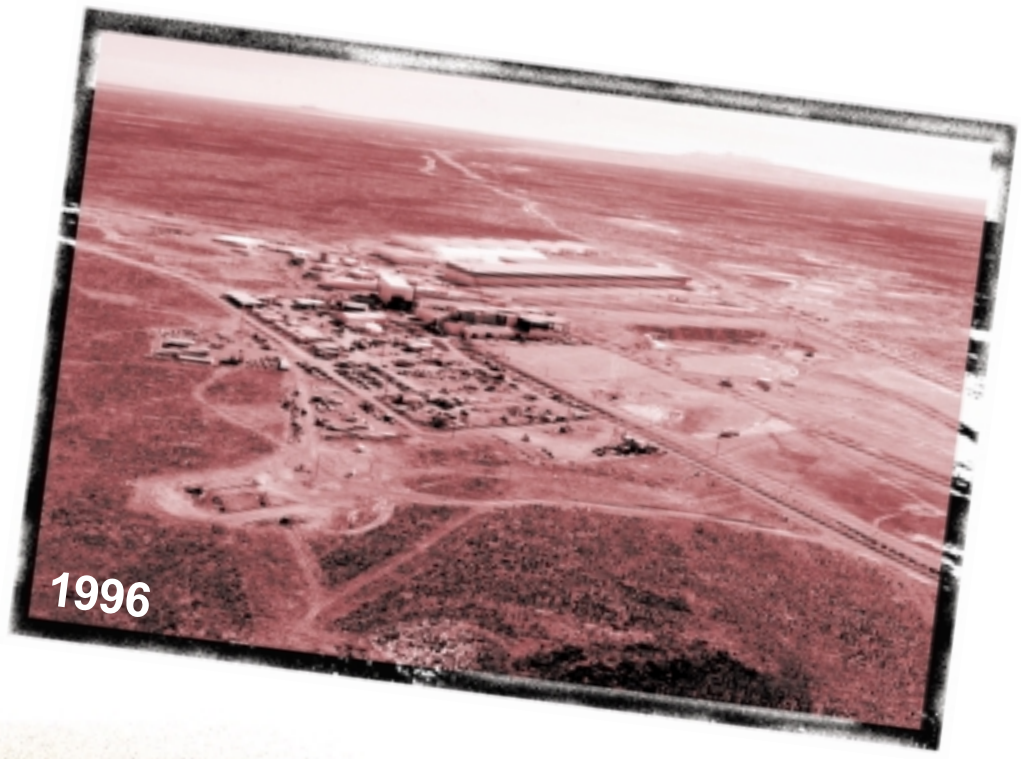

= stored transuranic waste = long-lived mobile radionuclides

= modern disposal pits (low-level waste) = acids, salts & other

roads and parking
DIRTRD
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Long-lived Mobile Chemicals

What are they? Organic compounds contain carbon. Many are refined or made artificially for a variety of industrial uses. “Volatile” organic compounds (VOC) produce vapors easily and make good solvents. Gasoline is a well-known VOC.

VOCs at the RWMC are primarily from waste from nuclear weapons production at Rocky Flats. Like other industries, Rocky Flats used VOCs to clean and lubricate equipment, and VOCs like carbon tetrachloride and trichloroethene, are found in some of its waste.

What are the risks? VOCs move readily in air and water. If inhaled or consumed with contaminated water or food, they can damage the nervous system, liver, kidneys and immune system. Some VOCs may also increase a person’s chances of developing cancer. VOCs at the RWMC don’t break down readily in nature, but VOCs can be thermally treated to reduce risks. There are several vacuum units at the INL that extract and treat VOC vapors.

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is to isolate them.

Long-lived Mobile Radionuclides

What are they? Uranium and other atoms split into smaller radioactive atoms in nuclear reactors and other processes. Some of these radionuclides remain radioactive for a long time and move readily in groundwater or are easily taken up by plants.

Long-lived, mobile radionuclides we are concerned about at RWMC include isotopes of technetium, iodine, carbon and uranium. They are primarily in waste from INL reactor operations, nuclear fuel examination, waste treatment, and other activities. Uranium also came from nuclear weapons production at Rocky Flats.

What are the risks? Long-lived, mobile radionuclides we are concerned about at the RWMC primarily emit beta particles. The main risk to people is from consuming contaminated water or food, which can increase a person’s chances of developing cancer. For example, radioactive iodine can concentrate in the thyroid gland and can cause cancer. Stabilizing and isolating long-lived radionuclides are the best ways to reduce their risks.

Waste is only a portion of Rocky Flats' legacy. From the 1950s-1980s, it produced nuclear weapon components. Nuclear production stopped in 1989; non-nuclear production stopped in 1992.

Rocky Flats had over 800 facilities on 385 acres. Cleanup began in 1995. Unlike the INL, the site was closed. It will not operate as a national laboratory.

One of the Rocky Flats buildings was considered the most dangerous building in the United States. There were many kinds of waste, both solid and liquid.

DOE considered the physical cleanup of Rocky Flats complete in 2005, 60 years early and for about $100 billion less than early estimates. A lot of the waste from Rocky Flats is still buried or stored in Idaho.

Options for cleanup

cleanup managers turn to identification & analysis of alternatives for cleanup

Most people won't be surprised by DOE's conclusion that some organic chemicals and radionuclides buried above the Eastern Snake River Plain Aquifer pose an "unacceptable risk." The Remedial Investigation and Baseline Risk Assessment, or RIBRA, was but the first step in a long decision-making process.

The final remedy, like the entire issue, won't be simple. It won't consist only of waste left as it is, a cap over some areas, targeted removal of waste, or removal of all waste in selected areas. Instead, the final remedy will be a combination of these things. At Rocky Flats, for example, buildings and waste above the ground were removed, and some structures and waste that were underground were left in place. Part of the property is capped, and part is not.

All of the remedies that will be considered, however, can be broken down into two categories: those that involve removal of waste, and those that involve waste being left in place. The decision, then is this: to dig or not to dig?

Would you like to learn more?

The RIBRA is available on-line at http://ar.inel.gov/, the INL's "administrative record" web site. From the main page, go to "select all for Waste Area Group," then to WAG 7.

There's an on-line course on "Remedial Design and Remedial Action" at epa.ppc.com/sdl/sdl_training.asp. A glossary of cleanup-related terms and acronyms can be found at www.epa.gov/superfund/resources/hrstrain/htmain/glossal.htm. Both of these courses take some time, but the more you know about the process used to make decisions, the more effective you can be when you make comments and ask questions.

The fact sheets on environmental contaminants available at www.atsdr.cdc.gov/toxfaq.html are the best we've found. You can search by contaminant, like "strontium" or "plutonium." There's also good information on ionizing radiation (www.atsdr.cdc.gov/tfacts149.html).

All of these links, and more, are available on Oversight's web page at www.deq.idaho.gov/inl_oversight/index.cfm. From the main page, go to Special Reports: Buried Waste.

Balancing risks and benefits

In answering "to dig or not to dig," state and federal agencies evaluate potential risks, both long and short term, to the public, workers, and environment from digging up contamination versus leaving it in place. That can involve comparing whether the risks posed by stirring up contamination and sending it somewhere else are less than those posed by leaving it in place.

"Dig" option—move hazards somewhere else

This option involves digging up material, packaging it and sending it somewhere better suited to keep it safe for the long term. Digging is the option of choice for two sources of contamination in the Subsurface Disposal Area—transuranic waste and organic chemical vapors. The State of Idaho, the Environmental Protection Agency and the Department of Energy are in the process of deciding whether the "dig" option is best for other hazards.

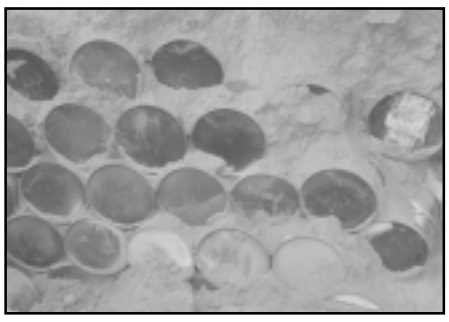
The three agencies have decided it is best to extract vapors from organic chemicals (cleaning solvents with properties similar to gasoline) that have leaked below the Subsurface Disposal Area. These vapors come largely from Rocky Flats waste, where the chemicals were used to clean equipment used in nuclear weapons manufacturing.

In this case, the "digging" is a vacuum process rather than using a backhoe, and the hazards posed by the

These photos show the diversity in containers and conditions that cleanup planners have to take into account.

An "Initial Drum Retrieval" building was inflated over Pits 11 and 12 in 1974. (Photo 74-2807)

The Initial Drum Retrieval building was inflated before waste was retrieved. (Photo 74-28-13)



Retrieved waste was stacked above ground, then covered with soil. A building was placed over the soil-covered waste. It is "stored waste." (Photo 74-3858)

A Health physicist examines a drum in the IDR. (Photo 74-4135)

organic chemicals are destroyed by thermal treatment. Over 200,000 pounds of organic vapors have been removed and destroyed since vacuuming began in 1996.

Under Idaho's court settlement with DOE, the State expects DOE to dig up transuranic waste from the Subsurface Disposal Area. Transuranic waste contains more than 100 nanocuries per gram of plutonium and other transuranic elements.

The Waste Isolation Pilot Plant, a deep salt formation in New Mexico, was designed to accept this type of waste. DOE completed a small-scale dig in Pit 9 in 2004, and is currently digging up transuranic waste in Pit 4. Transuranic waste in Pits 11 & 12 was also dug up in the 1970s.

The Subsurface Disposal Area poses some challenges to digging. Knowing what waste is where can be a problem, especially in locations used in the 1950s and 1960s when record-keeping requirements were less than they are today. Other challenges involve working around large, unwieldy equipment and vehicles buried in the pits. Some areas contain materials that can ignite when exposed to air and items that are radioactive enough to require remote handling.

"Not to dig" option—keep hazards from spreading

This option involves leaving contamination in place, but taking actions to prevent it from reaching areas where it poses a risk to humans or the environment. That can involve using caps, liners, or other barriers to prevent water from reaching contamination and spreading it.

These can also prevent people or burrowing animals from unwittingly spreading contamination. "Not to dig" options can also involve using sealants or grouts to encapsulate and stabilize contamination so it cannot move as easily. It is likely that low-level waste disposed in the Subsurface Disposal Area since 1985 under stricter standards in Pits 17-20 will remain in place with steps taken to ensure it is not a source of contamination.

Monitoring & Maintenance

If contamination remains in place, it's important to monitor the area to make sure the safety measures are working like they are supposed to. At the INL, the groundwater, air and soil are monitored, with specific monitoring plans developed for contamination areas.

When contamination is left in place, signs and other warnings are also typically posted in an area to prevent access.

The Superfund cleanup process also requires an evaluation of cleanup sites where contamination remains at least once every five years. This review process involves inspecting caps and other physical safeguards, checking sign postings, and making sure the assumptions supporting cleanup decisions are still valid.

If something doesn't work or hazards are greater than assumed, the agencies consider additional actions. The US EPA, Idaho DEQ and DOE completed the most recent "5-year review" of the INL in October 2005.

In 1969, while waste was being dumped, other waste was retrieved.

The retrieval occurred during an unsuccessful attempt to recover some experimental equipment. *(Photo 69-6998)*

Rocky Flats waste retrieved in 1969. Some is in good shape, some isn't. Waste containers have continued to deteriorate underground.

Cleanup planners expect to find containers in various stages of deterioration. Some may still be intact, particularly in areas where barrels were stacked. *(Photos 69-7001 and 69-6969)*

At the Rocky Mountain Arsenal site in Colorado, the site's contaminated material was disposed (or re-disposed) of on the site, not shipped off-site for disposal at another facility.

This triple-lined landfill was constructed to consolidate contaminated material on the site. It keeps contamination away from groundwater and other environmental pathways.

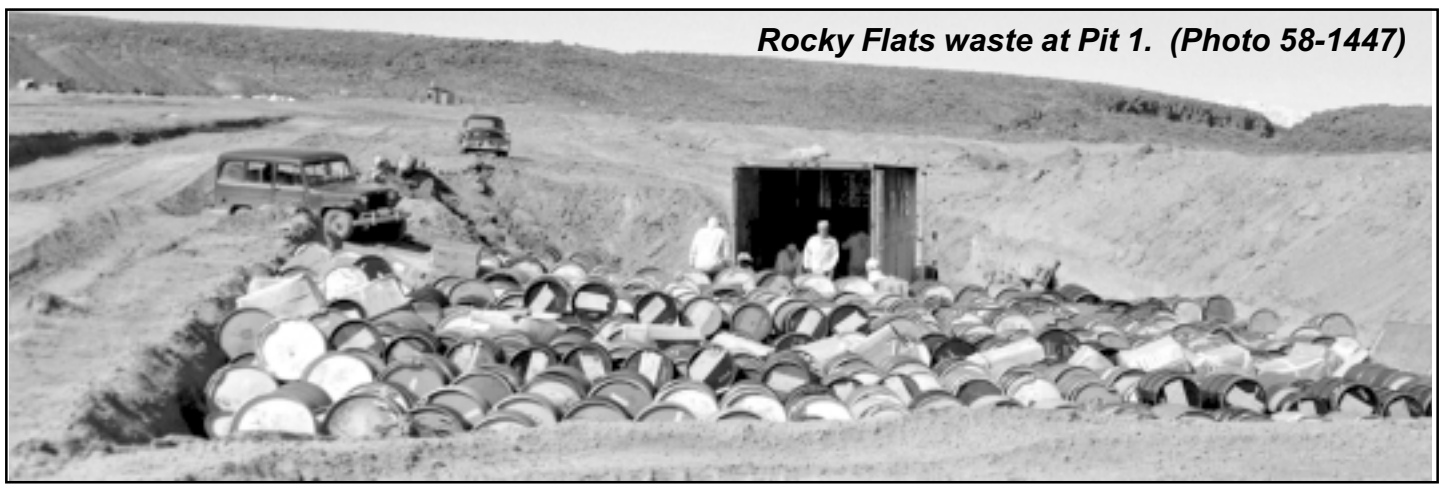
Where potential groundwater contamination is not a problem, caps may still be needed to keep animals and people out. This rock cap over the SL-1 reactor area lets water flow through but keeps intruders out. (PN99-034)

Four wastewater ponds (left) at DOE's facility in Oak Ridge, Tennessee were drained and capped. The capped area, shown below, is now used as a parking lot. Unlike the cap shown above, which lets water flow through, this cap keeps water from moving through the soil.

How did we get here?

History of waste disposal at the SDA 1950-present

1950s



Rocky Flats waste at Pit 1. (Photo 58-1447)

In July 1952, the Atomic Energy Commission opened a new landfill at what is now the INL. From 1952 until 1959, taped cardboard boxes of radioactively contaminated garbage were dumped into trenches 1 through 15. The trenches averaged 6 feet wide, 13 feet deep and about 900 feet long.

No attempt was made to line the trenches or to prevent contaminated waste from coming out of the boxes. In some cases, when radioactivity levels of the waste were excessively high, wooden boxes or metal cans were used in place of the cardboard boxes. At times the radiation levels of the waste were high enough to require special transport vehicles to protect workers. Much of the early waste came from the INL nuclear reactor facilities.

The Rocky Flats nuclear weapons plant in Colorado began sending waste to INL in 1954. Waste from the weapons manufacturing process contained both industrial chemicals and transuranic elements like plutonium.

In 1957, due to the need to bury items too large for trenches, the first large pit (called Pit 1) was excavated at the burial grounds. Because disposal records were not required until 1959, information on waste buried before that time is very limited. Records sometime weren't even clear as to the locations of trenches, but later geophysical studies have provided that information.

In late 1959, the AEC designated the INL burial grounds as an interim disposal facility for both commercial and government generators of nuclear waste. Until 1963, waste generated at a variety of locations around the country was shipped to INL and buried in pits 2 through 5 and trenches 16 through 25.

1960s

During the early 1960s new standards were established to improve disposal operations, including keeping better disposal records. But, ironically, one of the "improvements" increased the spread of contamination. Starting in 1963, and continuing until 1969, drums of waste from the Rocky Flats plant were randomly dumped in pits 4 through 9 and in trenches 26 through 50, rather than being stacked in an orderly way. This was done to reduce labor costs and minimize worker radiation exposures, but caused drums to break open and likely resulted in more contamination movement into the soil and rock layers over the aquifer.

Further compounding the waste containment problem was the practice instituted from 1964 to 1970 of dropping a heavy steel plate to compress waste once it was in the trenches. This practice crushed the boxes and drums, commonly resulting in the release of their contents.

In 1962, and again in 1969, excessive water runoff due to rainfall and snow melting on frozen ground caused open waste pits to fill with water. Waste drums and boxes floated in the pits, and some moved a considerable distance. Large volumes of water flowing through crushed and broken waste containers likely resulted in movement of the contaminants towards the aquifer.

1970s

In 1970, a new policy required separate and retrievable storage of all transuranic waste. From this point on, transuranic waste was sent to the *Transuranic Storage Area* adjacent to the burial grounds. During the 1970s, DOE also retrieved barrels from Pits 11 and 12 and placed them in the Transuranic Storage Area. Radioactive waste that was not classified as transuranic continued to be buried in pits 10 to 16 and trenches 51 to 58.

In 1972, a special asphalt pad, Pad A, was constructed for segregated disposal of waste contaminated with transuranic radionuclides at concentrations less than that required to meet the definition of transuranic waste. It was used until 1978.

Unloading barrels of waste from a fire at Rocky Flats into Pit 10. The Department of Energy now considers Rocky Flats a triumph of the cleanup program. But much of the waste generated at the Rocky Flats site isn't cleaned up... it's here in Idaho. (69-6138)

Stacked barrels—probably Pit 10 (Photo 70-2522)

Starting in 1977, unlined, vertical soil vaults with diameters of 1 to 7 feet and an average depth of 12 feet were used for disposal of waste with higher radiation levels. Soil vaults 1 to 13 were used concurrently with the trenches for disposal of high-radiation, remotely handled waste until the use of burial trenches was stopped in 1981.

From 1970 to 1985, amid concerns about the continued availability of burial space, several changes were made to disposal practices. Waste was now compacted prior to disposal and standard packaging criteria were established. The pits were also made larger using heavy equipment and, at times, by blasting the bedrock with explosives to make the pits deeper.

1980s & 1990s

In 1982, DOE redefined transuranic waste, instituting a ten-fold increase in the level of radioactivity required to meet the new definition. This definition change did not, however, result in any additional "alpha-contaminated waste" being buried in the pits and trenches—DOE has prohibited placing such waste in the INL burial ground since 1970.

In 1984, INL stopped receiving low-level waste from other sites, and now only uses the burial grounds for low-level waste from INL activities.

The current era of waste disposal at the burial grounds began in 1985, when new environmental regulations prevented burying hazardous wastes in the pits. Prior to 1985, much radioactive waste also contained hazardous constituents, like organic solvents and metals.

Pits 17 to 20, used since 1985, are known as the "Active Pit." The large excavation that comprises these pits was blasted 33 feet into the bedrock. The exposed basalt was covered by 2 feet of soil and a thin layer of gravel to reduce leaching of contaminants to the aquifer. Containers of waste are stacked in the pits to a maximum height of about 24 feet, and as sections become full, the waste is covered with 4 feet of fine-grained soil. This soil cover is then sloped and compacted and seeded with native grasses for erosion control. To prevent water from entering, the excavated area containing pits 17-20 also has a contoured earthen berm surrounding it.

While waste with lower radiation levels is placed in the pits, higher radiation waste is kept shielded in soil vaults (discontinued in 1993) and concrete vaults. About 200 concrete vaults are located along the southwest corner of pit 20, and less then half of them have been filled with remote-handled, low-level radioactive waste. After waste is placed into the vaults, a 4-foot thick reinforced concrete plug is placed over the top of the vault, and the vault is sealed from moisture using a silicone adhesive.

The 1991 cleanup agreement led to measures to reduce the spread of contamination from the burial grounds, such as operation of a vacuum system to remove volatile organic vapors, installing a temporary soil cover on Pad A, and grouting blocks of beryllium.

In the future...

The State, EPA and DOE plan to make the final cleanup decision for the burial grounds in 2008, and DOE is moving ahead with retrieval of transuranic and other waste in some areas the Agencies agree need digging up. DOE plans to end low-level waste disposal at the Active Pit in 2009 and is considering what operational improvements can be made in the meantime. DOE has required the INL contractor to evaluate how to dispose of low-level waste from ongoing missions after 2009. Under federal law, the Nuclear Regulatory Commission (or states with delegated NRC authority) regulates commercial disposal facilities. DOE can regulate disposal of its own waste on DOE sites. It currently disposes of low-level waste at six of its sites, including INL.

After more than 50 years, disposal at the burial grounds is coming to an end. With the lessons learned over the decades, how should INL balance disposal, transportation and security risks and manage low-level radioactive waste from ongoing research activities?

Waste being stacked in 1971 (Photo 71-3515)

Waste sits in Transuranic Storage Area, 1971 (Photo 71-5066)

Modern waste disposal methods, 1999. This waste, in Pit 17, 18, or 19, is covered up now. The buildings in the background are from an unsuccessful attempt to clean up Pit 9. They will be removed.

State of Idaho Oversight Monitor

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This newsletter was created by the INL Oversight & Radiation Control Program, a Division of the Idaho Department of Environmental Quality. Oversight was created in 1989 to independently monitor activities at the INL on behalf of the citizens of Idaho. More information about this and other topics relating to the INL is available at our web site at www.deq.idaho.gov/inl_oversight/index.cfm.

Photos labeled with a number, such as 67-2345, were provided by the Department of Energy or one of DOE's contractors. The first number, i.e. 67, indicates when the picture was taken. In this case, it was taken in 1967. The second number is a catalog number.

State of Idaho Oversight
Idaho's eyes on the Idaho National Laboratory

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