Waste Isolation Pilot Plant

Coordinates: 32°22′18″N 103°47′37″W [1]

Waste Isolation Pilot Plant

WIPP

WIPP, a geological repository for radioactive waste

Country	United States
State	New Mexico
County	Eddy County
Nearest city	Carlsbad
Location	42 km east of Pecos River
- elevation	1,038 m (3,406 ft)
- coordinates	32°22′18″N 103°47′37″W [1]
Geology	Permian, Salado Formation
Date	March 26, 1999
Management	United States Department of Energy
Easiest access	New Mexico State Road 128

Schematic of WIPP facility

Website: DOE: Waste Isolation Pilot Plant [2]

The **Waste Isolation Pilot Plant**, or **WIPP**, is the world's third deep geological repository (after closure of Germany's Repository for radioactive waste Morsleben and the Schacht Asse II Salt Mine) licensed to permanently dispose of transuranic radioactive waste for 10,000 years[3] that is left from the research and production of nuclear weapons. The plant is estimated to incur a total cost of $19B.

It is located approximately 26 miles (42 km) east of Carlsbad, New Mexico, in eastern Eddy County, in an area known as the southeastern New Mexico nuclear corridor which also includes the National Enrichment Facility near Eunice, New Mexico, the Waste Control Specialists low-level waste disposal facility just over the border near Andrews, Texas, and the International Isotopes, Inc. facility to be built near Eunice, New Mexico.[4]

Various mishaps at the plant in 2014 brought focus to the problem of what to do with a mounting stockpile of spent fuel, from commercial nuclear reactors, currently stored at individual reactor sites. In 2010, the USDOE mothballed plans to develop Yucca Mountain nuclear waste repository in Nevada.

History

Geological history

The Waste Isolation Pilot Plant is located in the Delaware Basin of New Mexico. This 600-meter deep salt basin was formed during the Permian Period approximately 250 million years ago.[5] An ancient sea once covering the area evaporated and left behind a nearly impermeable layer of salt that over time was covered by 300 meters of soil and rock.[6] The Delaware Basin is geologically similar to other basins created by evaporated seas. As drilling in the salt beds began in 1975, geologists discovered that at the edge of the basin, there had been disturbances that had moved interbed layers into a nearly vertical position. In response, the site was moved toward the more stable center of the basin. Some suggested, early in the investigations, that the geological complexity of the basin was problematic, causing the hollowed-out caverns to be unstable.[7]

However, what is considered by some to be instability is considered by others to be a positive aspect of salt as a host rock. As far back as 1957, the National Academy of Sciences recommended salt for radioactive waste disposal because at depth it would plastically deform, a motion called "salt creep" in the salt-mining industry, to close and seal any openings created by the mining, and in and around the waste.[8]

Installing supports in waste disposal rooms to keep them stable until filled

Early conceptualization and facility placement

The United States Department of Energy (DOE) began studying sites for construction of the Waste Isolation Pilot Plant (WIPP) near Carlsbad, New Mexico in 1973, after the abandonment of a similar site in Lyons, Kansas. The Kansas site, tentatively selected by the Atomic Energy Commission (AEC) in 1970, was deemed unusable due to unmapped oil and gas wells located in the area and local and regional opposition. These uncharted wells were believed to potentially compromise the ability of the planned facility to contain nuclear waste. As a result of these concerns, and because of positive indications of interest from a southern New Mexico community, the DOE relocated the site of the proposed nuclear waste repository to the Delaware Basin salt beds located in New Mexico.

Exact placement of the construction site in the Delaware Basin changed multiple times due to safety concerns. Brine deposits located below the salt deposits in the Delaware Basin posed a potential safety problem. The brine was first discovered when a 1975 drilling released a pressurized deposit of the liquid from below the repository level. Constructing the plant near one of these deposits could, under specific circumstances, compromise the facility's safety. The brine could leak into the repository and either dissolve radioactivity or entrain particulate matter with radioactive waste to the surface. The contaminated brine would then need to be cleaned and properly disposed of. There is no drinking water near the site, so possible water pollution is not a concern. After multiple deep drilling, a final site was selected. The site is located approximately 40 km east of Carlsbad.

Addressing public concerns via the EEG

In order to address growing public unrest concerning construction of the WIPP, the New Mexico Environmental Evaluation Group (EEG) was created in 1978. This group, charged with overseeing the WIPP, verified statements, facts, and studies conducted and released by the DOE regarding the facility. The stewardship this group provided effectively lowered public fear and let the facility progress with little public opposition in comparison to similar facilities around the nation such as Yucca Mountain in Nevada.

The EEG, in addition to acting as a check for the government agencies overseeing the project, acted as a valuable advisor. In a 1981 drilling, pressurized brine was again discovered. The site was set to be abandoned when the EEG stepped in and suggested a series of tests on the brine and the surrounding area. These tests were conducted and the results showed that the brine deposit was relatively small and was isolated from other deposits. Drilling in the area was deemed safe due to these results. This saved the project valuable money and time by preventing a drastic relocation.

Early construction and testing complications

In 1979 Congress authorized construction of the facility.[9] In addition to formal authorization, Congress redefined the level of waste to be stored in the WIPP from high temperature to transuranic, or low level, waste. Transuranic waste often consists of materials which have come in contact with radioactive substances such as plutonium and uranium. This often includes gloves, tools, rags, and assorted machinery often used in the production of nuclear fuel and weapons. Although much less potent than nuclear reactor byproducts, this waste still remains radioactive for approximately 24,000 years. This change in classification led to a decrease in safety parameters for the proposed facility, allowing construction to continue at a faster pace.

The first extensive testing of the facility was due to begin in 1988. The proposed testing procedures involved interring samples of low level waste in the newly constructed caverns. Various structural and environmental tests would then be performed on the facility to verify its integrity and to prove its ability to safely contain nuclear waste.[10] Opposition from various external organizations delayed actual testing into the early 1990s. Attempts at testing were resumed in October 1991 with US Secretary of Energy James Watkins announcing that he would begin transportation of waste to the WIPP.

Despite apparent progress on the facility, construction still remained costly and complicated. Originally conceptualized in the 1970s as a warehouse for waste, the repository now had regulations similar to those of nuclear reactors. As of December 1991, the plant had been under construction for 20 years and was estimated to have cost over one billion dollars. At the time, WIPP officials reported over 28 different organizations claimed authority over operations of the facility.

Congressional approval

In November 1991, a federal judge ruled that Congress must approve WIPP before any waste, even for testing purposes, was sent to the facility. This indefinitely delayed testing until Congress gave its approval. The 102nd United States Congress passed legislation allowing use of the WIPP. The House of Representatives approved the facility on October 6, 1992 and the Senate passed a bill allowing the opening of the facility on October 8 of the same year.[11] The bill was met with much opposition in the Senate. Senator Richard H. Bryan fought the bill based on safety issues that concerned a similar facility located in Nevada, the state for which he was serving as senator. His efforts almost prevented the bill from passing. New Mexico senators Pete V. Domenici and Jeff Bingaman effectively reassured Senator Bryan that these issues would be addressed in the 103rd Congress. The final legislation provided safety standards requested by the House and an expedited timeline requested by the Senate.

The final legislation mandated that the Environmental Protection Agency (EPA) issue revised safety standards for the facility. It also required the EPA to approve testing plans for the facility within ten months. The legislation stated that the security standards mandated in the bill were only applicable to the WIPP in New Mexico and not to other facilities in the United States. This clause caused Senator Bryan to oppose the bill, as he wanted safety standards mandated by the bill to apply to the facility in Nevada as well.

Testing and final certification

In 1994, Congress ordered Sandia National Laboratories to begin an extensive evaluation of the facility against the standards set forth by the EPA. Evaluation of the facility continued for four years, resulting in a cumulative total of 25 years of evaluation. In May 1998, the EPA concluded that there was "reasonable expectation" that the facility would contain the vast majority of the waste interred there.

The first nuclear waste arrived to the plant on March 26, 1999. This waste shipment was from Los Alamos National Laboratory, a major nuclear weapons research and development facility located north of Albuquerque, New Mexico. Another shipment followed on April 6 of the same year. These shipments marked the beginning of plant operations.[] As of December 2010, the plant had received and stored 9,207 shipments (72,422 cubic meters) of waste. The majority of this waste was transported to the facility via railroad or truck. The final facility contains a total of 56 storage rooms located approximately 650 meters underground. Each room is 100 yards in length. The plant is estimated to continue accepting waste for 25 to 35 years and is estimated to cost a grand total of 19 billion dollars.

Shipment of casks arriving at the WIPP

2014 incidents


The drum damaged in the Feb. 14, 2014 incident

On February 5, 2014 at around 11am a salt haul truck caught fire, prompting an evacuation of the underground facility. Six workers were taken to a local hospital with smoke inhalation, and were released by the next day. Lab tests after the fire confirmed there was zero release of radiological material during, or as a result of, the fire Underground air monitoring equipment was out of commission after the truck fire.

On February 15, 2014, authorities ordered workers to shelter in place at the facility after air monitors had detected unusually high radiation levels at 11:30pm the previous day. None of the facility's 139 workers were underground at the time of the incident Later, trace amounts of airborne radiation consisting of americium and plutonium particles were discovered above ground, a half mile from the facility. All in all 21 workers were exposed per WSJ. The *Carlsbad Current-Argus* wrote "the radiation leak occurred on the evening of February 14, according to new information made public at a news conference [on February 20]. Joe Franco, manager of the DOE Carlsbad Field Office, said an underground air monitor detected high levels of alpha and beta radiation activity consistent [*sic*] the waste buried at WIPP." Ceiling collapse is one theory of the cause of the leak. Regarding the elevated levels of plutonium and americium detected outside the nuclear waste repository, Ryan Flynn, New Mexico Environment Secretary stated during a news conference, "Events like this simply should never occur. From the state's perspective, one event is far too many."

On February 26, 2014, the DOE announced 13 WIPP above ground workers had tested positive for radiation exposure. Other employees were in process of being tested. On Thursday, February 27, DOE announced it sent out "a letter to tell people in two counties what they do know so far. Officials said it is too early to know what that means for the workers' health..".[12] Additional testing will be done on employees who were working at the site the day after the leak. Aboveground 182 employees continue to work.On February 27, 2014 update included comments on plans to discover what occurred below ground first by using unmanned probes and then people.[13]

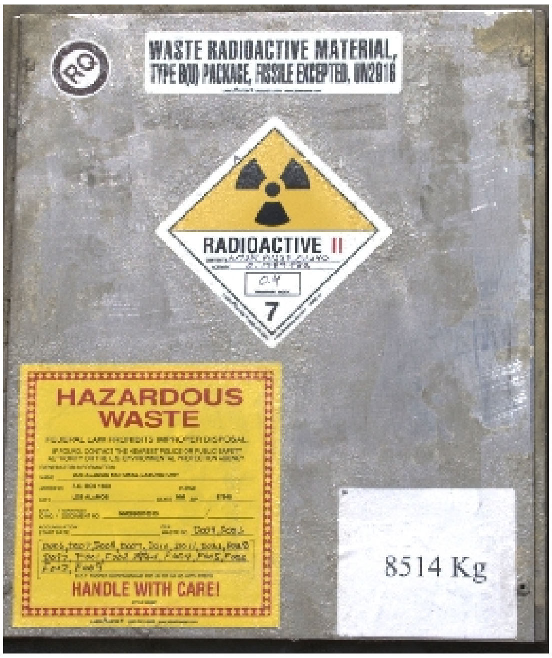
The Southwest Research and Information Center released a report on April 15, 2014 that one or more of 258 contact handled radioactive waste containers located in Room 7, Panel 7 of the underground repository released radioactive and toxic chemicals. The location of the leak was estimated to be approximately 1,500 feet (460 m) from the air monitor that triggered the contaminants in the filtration system. The contaminants were spread through more than 3,000 feet (910 m) of underground tunnels, leading to the 2,150-foot (660 m) exhaust shaft into the surrounding above-ground environment. Air monitoring station #107, located 0.5 miles (0.8 km) mile away detected the radiotoxins. The filter from Station #107 was analyzed by the Carlsbad Environmental Monitoring and Research Center (SMERC) and found to contain 0.64 becquerels (Bq) per cubic meter of air of americium-241 and 0.014 Bq of plutonium-239 and plutonium-240 per cubic meter of air. The DOE agrees that there was a release of radioactivity from the repository, and confirms that "The event took place starting at 14 February 2014 at 23:14 and continued to 15 February 2014 14:45. The DOE also confirmed that "A large shift in wind direction can be seen to occur around 8:30 AM on 2/15/14." The EPA reported on the radiological release on their WIPP News page.

After analysis by CMERC, the Station A filter was found on February 15, 2014 to be contaminated with 4,335.71 Bq of Am-241 per cubic meter, and 671.61 Bq of plutonium-239 and plutonium-240 per cubic meter. Bob Alvarez, former DOE official, stated that the long-term ramifications of the WIPP issue as being grounded in the fact that the DOE has 66,000 cubic meters of transuranic waste that has not been disposed of due to the fact that there are no long-term disposition plans in order for transuranic waste, including 5 tons of plutonium that are in-situ at the Savannah River Site, as well as water from the Hanford Nuclear Reservation in Washington State. In an article in the Bulletin of the Atomic Scientists, Alvarez wrote that "Wastes containing plutonium blew through the WIPP ventilation system, traveling 2,150 feet to the surface, contaminating at least 17 workers, and spreading small amounts of radioactive material into the environment." The URS Corporation, who oversees WIPP removed and demoted the contracted manager of the repository. Alvarez ponders the notion of "contract handling" of radioactive waste because it deploys conventional processing practices that do not take into consideration the tens of thousands of containers buried before 1970 at several Department of Energy sites. Alvarez states that the quantity of this pre-1970 plutonium waste is 1,300 times more than the amount permitted to "leak" into the environment at WIPP, however much of this waste is simply buried a few feet underground at DOE sites.

The 2014 incidents bring focus to the problem of what to do with a mounting stockpile of spent fuel, from commercial nuclear reactors, currently stored at individual reactor sites. In 2010, the USDOE mothballed plans to develop Yucca Mountain nuclear waste repository in Nevada.

Future

Following the interment of waste in the facility, the storage caverns will be collapsed and sealed with 13 layers of concrete and soil. Salt will then seep into and fill the various fissures and cracks surrounding the casks of waste. After approximately 75 years, the waste will be completely isolated from the environment.[14]



Warnings on a Waste container

Criteria

Waste that is to be disposed of at WIPP must meet certain "waste acceptance criteria". It accepts transuranic waste generated from DOE activities. The waste must have radioactivity exceeding 100 nanocuries (3.7 kBq) per gram from TRUs that produce alpha radiation with a half life greater than 20 years. This criterion includes plutonium, uranium, americium,and neptunium among others. Mixed waste contains both radioactive and hazardous constituents, and WIPP first received mixed waste on September 9, 2000. Mixed waste is joint-regulated by the EPA and the New Mexico Environment Department.

The containers may also contain a limited amount of liquids. The energy released from radioactive materials will dissociate water into hydrogen and oxygen (radiolysis). This could then create a potentially explosive environment inside the container. The containers must be vented, as well, to prevent this from happening.

Principle

Waste is placed in rooms 2,150 feet (660 m) underground that have been excavated within a 3,000 feet (910 m) thick salt formation (Salado and Castile Formations) where salt tectonics have been stable for more than 250 million yearsWikipedia:Citation needed. Because of plasticity effects, salt and water will flow to any cracks that develop, a major reason why the area was chosen as a host medium for the WIPP project. Because drilling or excavation in the area will be hazardous long after the area is actively used, there are plans to construct markers to deter inadvertent human intrusion for the next ten thousand years.[15][16][17]

The Salado Formation is a massive bedded salt deposit (>99% NaCl) that has a simple hydrogeology. Because massive NaCl is somewhat plastic and holes close under pressure, the rock becomes non-porous by effectively closing pores and fractures. This has a significant effect on the overall hydraulic conductivities (water permeabilities) and molecular diffusion coefficients. These are on the order of $\leq 10^{-14}$ m/s and $\leq 10^{-15}$ m^2/s respectively.[18]


Storage of radioactive waste at WIPP


Labeled 100-gallon drums staged for downloading and emplacement in the repository


The DOSCO rotary head mining machine at WIPP

Warning messages for future humans

Since 1983, the DOE has been working with linguists, archeologists/anthropologists, materials scientists, science fiction writers, and futurists to come up with a warning system. For the case of the WIPP, the markers, called "passive institutional controls", will include an outer perimeter of 32, 25-foot (7.6 m)-tall granite pillars built in a four-mile (6 km) square. These pillars will surround an earthen wall, 33 feet (10 m) tall and 100 feet (30 m) wide. Enclosed within this wall will be another 16 granite pillars. At the center, directly above the waste site, will sit a roofless, 15-foot (4.6 m) granite room providing more information. The team intends to etch warnings and informational messages into the granite slabs and pillars.


2007 ISO radioactivity danger logo

This information will be recorded in the six official languages of the United Nations (English, Spanish, Russian, French, Chinese, Arabic) as well as the Native American Navajo language native to the region, with additional space for translation into future languages. Pictograms are also being considered, such as stick figure images and the iconic "The Scream" from Edvard Munch's painting. Complete details about the plant will not be stored on site; instead, they would be distributed to archives and libraries around the world. The team plans to submit their final plan to the U.S. Government by around 2028.

References

[1] http://tools.wmflabs.org/geohack/geohack.php?pagename=Waste_Isolation_Pilot_Plant&params=32_22_18_N_103_47_37_W_type:landmark_region:US-NM
[2] http://www.wipp.energy.gov/
[3] 2010 WIPP Recertification Decision (http://www.epa.gov/radiation/wipp/2010recertification.html)
[4] International Isotopes Inc.: Project Overview (http://www.intisoid.com/index.php/fep/more-information/project-overview/)
[5] Weeks, Jennifer. "Nuclear Waste Buried for the Ages in New Mexico Desert". *CQ Researcher* 21.4 (2011): 84–85. Print.
[6] Kerr, Richard A. "For Radioactive Waste from Weapons, a Home at Last". *Science* 283.5408 (1999): 1626. Print.
[7] Charles, Dan. "Will America's Nuclear Waste Be Laid To Rest?" *New Scientist* 132.1799 (1991): 16. Print.
[8] National Academy of Sciences-National Research Council, 1957, "The Disposal of Radioactive Waste on Land", Report of the Committee on Waste Disposal of the Division of Earth Sciences, Harry H. Hess, Chairman, John N. Adkins, William E. Benson, John C. Frye, William B. Heroy, M. Kinh Hubbert, Richard J, Russell and Charles V. Theis, Publication 519, Washington, D.C. http://www.nap.edu/openbook.php?record_id=10294
[9] Lorenzi, Neal. "DOE May Open Nuclear Waste Isolation Plant". *Professional Safety* 41.4 (1996): 54. Print.
[10] Monastersky, Richard. "First nuclear waste dump finally ready". *Science News* 140.15 (1991): 228. Print.
[11] Palmer, Elizabeth A. "Senate Clears Bill To Start Tests At New Mexico Nuclear Dump". *Congressional Quarterly Weekly Report* 50.40 (1992): 3156. Print.
[12] http://krqe.com/2014/02/26/13-wipp-employees-test-positive-for-radiation/
[13] http://krqe.com/2014/02/27/update-expected-on-radiation-leak-at-wipp/
[14] Renaud, Chris. "Cool Wipp". *Environment* 41.1 (1999): 22. Print.
[15] WIPP Permanent Markers Implementation Plan, rev1 (2004) (http://www.wipp.energy.gov/picsprog/test1/Permanent_Markers_Implementation_Plan_rev1.pdf)
[16] Expert Judgment on Markers to Deter Inadvertent Human Intrusion into the Waste Isolation Pilot Plant, [[Sandia National Laboratories (http://infoserve.sandia.gov/sand_doc/1992/921382.pdf)] report SAND92-1382 / UC-721 (1993)]
[17] Excerpts of SAND92-1382 in HTML format (http://downlode.org/etext/wipp/)
[18] J. L. Conca, M. J. Apted, and R. C. Arthur, "Aqueous Diffusion in Repository and Backfill Environments", *Scientific Basis for Nuclear Waste Management XVI*, Materials Research Society Symposium Proceedings, vol. 294, p. 395 (1993).

Further reading

- Weitzberg, Abraham, 1982, "Building on Existing Institutions to Perpetuate Knowledge of Waste Repositories", ONWI-379, available through the National Technical Information Service.
- Kaplan, Maureen F., 1982, "Archeological Data as a Basis for Repository Marker Design", ONWI-354, available through the National Technical Information Service.
- Berry, Warren E., 1983, "Durability of Marker Materials for Nuclear Waste Isolation Sites", ONWI-474, available through the National Technical Information Service.
- Human Interference Task Force, 1984, "Reducing the Likelihood of Future Human Activities that could Affect Geologic High-level Waste Repositories", BMI/ONWI-537, available through the National Technical Information Service.
- Sebeok, Thomas A., 1984, "Communication Measures to Bridge Ten Millennia", BMI/ONWI-532, available through the National Technical Information Service.
- INTERA Technologies, 1985, "Preliminary Analyses of Scenarios for Potential Human Interference for Repositories in Three Salt Formations", BMI/ONWI-553, available through the National Technical Information Service.

External links

- Official website (http://www.wipp.energy.gov/)
- Annotated bibliography (http://alsos.wlu.edu/adv_rst.aspx?keyword=wipp&results=20) for WIPP from the Alsos Digital Library for Nuclear Issues

Article Sources and Contributors

Waste Isolation Pilot Plant *Source*: http://en.wikipedia.org/w/index.php?oldid=612355086 *Contributors*: AKF1986, Abevanluik, Amandag6, Amcarroll32, Andrewa, Anomalocaris, ArmadaSki3r, Athaenara, Backspace, Beefman, Beland, Bm gub, Bobblewik, Bryan Derksen, Brycehughes, Carabinieri, Chendy, Dbxdesign, Ddoomdoom, Dja1979, Dlindqui, Drew3D, Eastlaw, El Suizo, Epicgenius, Epolk, Eumolpo, Excirial, F, Fasettle, Fredrik, Geopersona, Giersp, Gijoend81, Gogokoba, Ground Zero, GroveGuy, H-stt, Hibernian, JamesAM, Jeffness, Jeffreymcmanus, John Vandenberg, Johnfos, Julesd, KG4LQ, Kirk Hilliard, Klemen Kocjancic, Kolbasz, Leaflet, Lightmouse, Lloydd, Lofor, Mark Arsten, Matzeachmann, Mhoulden, Milkunderwood, Mion, Nbarth, Netherzone, Ohconfucius, Old.timer, Olhaf, Oliverdl, Omegatron, Orange Suede Sofa, PaulinSaudi, Pstudier, Psychless, Rawveggie, Rbowtrout, Rmhermen, Saxifrage, Simesa, Skysmith, Spike Wilbury, Suchwings123, TDogg310, Thbaill, TheParanoidOne, Theanphibian, Tim!, Tweenk, Vanished user kjdioejh329io3rksdkj, Vortexrealm, Wda, Webmgr, Whosasking, WikiDon, Wingman4l7, Wippingboy, Woohookitty, Wuerzele, WurmWoode, Wwoods, Yolodoggs, Zanimum, زرشک, 51 anonymous edits

Image Sources, Licenses and Contributors

File:Waste Isolation Pilot Plant 2004.jpg *Source*: http://en.wikipedia.org/w/index.php?title=File:Waste_Isolation_Pilot_Plant_2004.jpg *License*: Public Domain *Contributors*: Leaflet

File:Flag of the United States.svg *Source*: http://en.wikipedia.org/w/index.php?title=File:Flag_of_the_United_States.svg *License*: Public Domain *Contributors*: Anomie

File:Flag of New Mexico.svg *Source*: http://en.wikipedia.org/w/index.php?title=File:Flag_of_New_Mexico.svg *License*: Public Domain *Contributors*: AnonMoos, Bdk, Diltsgd, Dzordzm, Fry1989, Homo lupus, Mattes, Myself488, Nightstallion, Origamiemensch, Permjak, Rocket000, Serinde, Zscout370, 6 anonymous edits

File:WIPP-09.jpeg *Source*: http://en.wikipedia.org/w/index.php?title=File:WIPP-09.jpeg *License*: Public Domain *Contributors*: DOE Photo

File:Transuranic waste casks.jpg *Source*: http://en.wikipedia.org/w/index.php?title=File:Transuranic_waste_casks.jpg *License*: Public Domain *Contributors*: Federal Government of the United States

File:WIPP DoE 2014-05-15 5 15 Image lrg.jpg *Source*: http://en.wikipedia.org/w/index.php?title=File:WIPP_DoE_2014-05-15_5_15_Image_lrg.jpg *License*: Public Domain *Contributors*: DoE photographer

File:WIPP-05.jpeg *Source*: http://en.wikipedia.org/w/index.php?title=File:WIPP-05.jpeg *License*: Public Domain *Contributors*: DOE Photo

File:WIPP-04.jpeg *Source*: http://en.wikipedia.org/w/index.php?title=File:WIPP-04.jpeg *License*: Public Domain *Contributors*: DOE Photo

File:WIPP-07.jpeg *Source*: http://en.wikipedia.org/w/index.php?title=File:WIPP-07.jpeg *License*: Public Domain *Contributors*: DOE Photo

File:WIPP-08.jpeg *Source*: http://en.wikipedia.org/w/index.php?title=File:WIPP-08.jpeg *License*: Public Domain *Contributors*: DOE Photo

File:Logo iso radiation.svg *Source*: http://en.wikipedia.org/w/index.php?title=File:Logo_iso_radiation.svg *License*: Public Domain *Contributors*: historicair 19:47, 25 February 2007 (UTC)

License