ENVIRONMENTAL MONITORING PROGRAM INFORMATION

Introduction

The high-level radioactive waste (HLW) presently stored at the West Valley Demonstration Project (the WVDP or Project) is the by-product of the reprocessing of spent nuclear fuel conducted during the late 1960s and early 1970s by Nuclear Fuel Services, Inc. (NFS).

Since the Western New York Nuclear Service Center (WNYNSC) is no longer an active nuclear fuel reprocessing facility, the environmental monitoring program focuses on measuring radioactivity and chemicals associated with the residual effects of NFS operations and the Project's high-level waste treatment operations. The following information about the operations at the WVDP and about radiation and radioactivity will be useful in understanding the activities of the Project and the terms used in reporting the results of environmental testing measurements.

Radiation and Radioactivity

Radioactivity is a process in which unstable atomic nuclei spontaneously disintegrate or "decay" into atomic nuclei of another isotope or element. (See p. 4 of the *Glossary*.) The nuclei continue to decay until only a stable, nonradioactive isotope remains. Depending on the isotope, this process can take anywhere from less than a second to hundreds of thousands of years.

Radiation is the energy released as atomic nuclei decay. By emitting energy the nucleus moves towards a less energetic, more stable state. The energy that is released takes three main forms: alpha particles, beta particles, and gamma rays.

α *Alpha Particles*

An alpha particle is a fragment of a much larger nucleus. It consists of two protons and two neutrons (similar to a helium atom nucleus) and is positively charged. Alpha particles are relatively large and heavy and do not travel very far when ejected by a decaying nucleus. Alpha radiation, therefore, is easily stopped by a thin layer of material such as paper or skin. However, if radioactive material is ingested or inhaled, the alpha particles released inside the body can damage soft internal tissues because all of their energy is absorbed by tissue cells in the immediate vicinity of the decay. An example of an alpha-emitting radionuclide is uranium-232. At the WVDP, uranium-232 can be detected in liquid waste streams as a result of a thorium-based nuclear fuels reprocessing campaign conducted by NFS.

β *Beta Particles*

A beta particle is an electron that results from the breakdown of a neutron in a radioactive nucleus. Beta particles are small compared to alpha particles, travel at a higher speed (close to the speed of light), and can be stopped by a material such as wood or aluminum less than an inch thick. If beta particles are released inside the body they do much less damage than an equal number of alpha particles. Because they are smaller and faster and have less of a charge, beta particles deposit energy in fewer tissue cells and over a larger volume than alpha particles. Strontium-90, a fission product, is an example of a beta-emitting radionuclide. Strontium-90 is found in the decontaminated supernatant.

γ *Gamma Rays*

Gamma rays are high-energy "packets" of electromagnetic radiation called photons emitted from the nucleus. They are similar to x-rays but generally have a shorter wavelength and therefore are more energetic than x-rays. If the alpha or beta particle released by the decaying nucleus does not carry off all the energy generated by the nuclear disintegration, the excess energy may be emitted as gamma rays. If the released energy is high, a very penetrating gamma ray is produced that can only be effectively reduced by shielding consisting of several inches of a heavy element, such as lead, or of water or concrete several feet thick. Although large amounts of gamma radiation are dangerous, gamma rays are also used in many lifesaving medical procedures. An example of a gamma-emitting radionuclide is barium-137m, a short-lived daughter product of cesium-137. Both barium-137m and cesium-137 are major constituents of the WVDP high-level radioactive waste.

Measurement of Radioactivity

The rate at which radiation is emitted from a disintegrating nucleus can be described by the number of decay events or nuclear transformations that occur in a radioactive material over a fixed period of time. This process of emitting energy, or radioactivity, is measured in curies (Ci) or becquerels (Bq).

The curie is based on the decay rate of the radionuclide radium-226 (Ra-226). One gram of Ra-226 decays at the rate of 37 billion nuclear disintegrations per second (3.7×10^{10} d/s), so one curie equals 37 billion nuclear disintegrations per second. One becquerel equals one decay, or disintegration, per second.

Very small amounts of radioactivity are sometimes measured in picocuries. A picocurie is one-trillionth (10^{-12}) of a curie, equal to 3.7E-02 disintegrations per second, or 2.22 disintegrations per minute.

Measurement of Dose

The amount of energy absorbed by the receiving material is measured in rads (radiation absorbed dose). A rad is 100 ergs of radiation energy absorbed per gram of material. (An erg is the amount of energy necessary to lift a mosquito about one-sixteenth of an inch.) "Dose" is a means of expressing the amount of energy absorbed, taking into account the effects of different kinds of radiation. Alpha, beta, and gamma radiation affect the body to different degrees. Each

Potential Effects of Radiation

The biological effects of radiation can be either somatic or genetic. Somatic effects are restricted to the person exposed to radiation. For example, sufficiently high exposure to radiation can cause clouding of the lens of the eye or loss of white blood cells.

Radiation also can cause chromosomes to break or rearrange themselves or to join incorrectly with others. These changes may produce genetic effects and may show up in future generations. Radiation-produced genetic defects and mutations in offspring of an exposed parent, while not positively identified in humans, have been observed in some animal studies.

The effect of radiation depends on the amount absorbed within a given exposure time. The only observable effect of an instantaneous whole-body dose of 50 rem (0.5 Sv) might be a temporary reduction in white blood cell count. An instantaneous dose of 100-200 rem (1-2 Sv) might cause additional temporary effects such as vomiting but usually would have no long-lasting side effects.

Assessing biological damage from low-level radiation is difficult because other factors can cause the same symptoms as radiation exposure. Moreover, the body apparently is able to repair damage caused by low-level radiation.

The effect most often associated with exposure to relatively high levels of radiation appears to be an increased risk of cancer. However, scientists have not been able to demonstrate with certainty that exposure to low-level radiation causes an increase in injurious biological effects, nor have they been able to determine if there is a level of radiation exposure below which there are no biological effects.

Background Radiation

Background radiation is always present and everyone is constantly exposed to low levels of such radiation from both naturally occurring and manmade sources. In the United States the average total annual exposure to this low-level background radiation is estimated to be about 360 millirem (mrem) or 3.6 millisieverts (mSv). Most of this radiation, approximately 300 mrem (3 mSv), comes from natural sources. The rest comes from medical procedures, consumer products, and other manmade sources. *(See Chapter 4, Radiological Dose Assessment, p. 4-3.)*

Background radiation includes cosmic rays, the decay of natural elements such as potassium, uranium, thorium, and radon, and radiation from sources such as chemical fertilizers, smoke detectors, and televisions. Actual doses vary depending on such factors as geographic location, building ventilation, and personal health and habits.

type of radiation is given a quality factor that indicates the extent of human cell damage it can cause compared with equal amounts of other ionizing radiation energy. Alpha particles cause twenty times as much damage to internal tissues as x-rays, so alpha radiation has a quality factor of 20 compared to gamma rays, x-rays, or beta particles, which have a quality factor of 1.

The unit of dose measurement to humans is the rem (roentgen-equivalent-man). Rems are equal to the number of rads multiplied by the quality factor for each type of radiation. Dose can also be expressed in sieverts. One sievert equals 100 rem.

evaluating potential exposure through the major pathways.

The on-site and off-site monitoring program at the WVDP includes measuring the concentration of solids containing alpha and beta radioactivity, conventionally referred to as "gross alpha" and "gross beta," in air and water effluents. Measuring the total alpha and beta radioactivity from key locations, which can be done within a matter of hours, produces a comprehensive picture of on-site and off-site levels of radioactivity from all sources. In a facility such as the WVDP, frequent updating and tracking of the overall levels of radioactivity in effluents is an important tool in maintaining acceptable operations.

Ionizing Radiation

Radiation can be damaging if, in colliding with other matter, the alpha or beta particles or gamma rays knock electrons loose from the absorber atoms. This process is called ionization, and the radiation that produces it is referred to as ionizing radiation because it changes a previously electrically neutral atom, in which the positively charged protons and the negatively charged electrons balance each other, into a charged atom called an ion. An ion can be either positively or negatively charged. Various kinds of ionizing radiation produce different degrees of damage.

Environmental Monitoring Program Overview

Human beings may be exposed to radioactivity primarily through air, water, and food. At the WVDP all three pathways are monitored, but air and surface water pathways are the two major means by which radioactive material can move off-site.

The geology of the site (kinds and structures of rock and soil), the hydrology (location and flow of surface and underground water), and meteorological characteristics of the site (wind speed, patterns, and direction) are all considered in

More detailed measurements are also made for specific radionuclides. Strontium-90 and cesium-137 are measured because they are normally present in WVDP waste streams. Radiation from other important radionuclides such as tritium or iodine-129 are not sufficiently energetic to be detected by gross measurement techniques, so these must be analyzed separately using methods with greater sensitivity. Heavy elements such as uranium, plutonium, and americium require special analysis to be measured because they exist in such small concentrations in the WVDP environs. The radionuclides monitored at the Project are those that might produce relatively higher doses or that are most abundant in air and water effluents. Because manmade sources of radiation at the Project have been decaying for more than twenty years, the monitoring program does not routinely include short-lived radionuclides, i.e., isotopes with a half-life of less than two years, which would have only 1/1,000 of the original radioactivity remaining. (See *Appendix A* [p. A-1 through A-46] for a schedule of samples and radionuclides measured and *Appendix B*, Table B-1 [p. B-3] for related Department of Energy protection standards, i.e., derived concentration guides [DCGs] and half-lives of radionuclides measured in WVDP samples.)

Data Reporting

Because no two samples are exactly the same, statistical methods are used to decide how a particular concentration compares with concentrations from similar samples. The term *confidence level* is used to describe the range of concentrations above and below the test result within which the "true" value can be expected to lie, at a specified degree of statistical certainty. The WVDP environmental monitoring program uses the 95% confidence level.

The uncertainty range is the expected range of values that account for random nuclear decay and small measurement process variations. The uncertainty range around a concentration is indicated by the plus-or-minus (±) value following the result (e.g., 5.30±3.6E-09 μCi/mL, with the exponent of 10^{-9} expressed as "E-09." Expressed in decimal form, the number would be 0.0000000053±0.0000000036 μCi/mL). Within this range a result will be "true" 95% of the time. For example, a value recorded as 5.30±3.6E-09 μCi/mL means that 95% of the time the "true" value for this sample will be found between 1.7E-09 μCi/mL and 8.9E-09 μCi/mL.

If the uncertainty range is greater than the value itself (e.g., 5.30±6.5E-09 μCi/mL), the result is below the detection limit. The values listed in tables of radioactivity measurements in the appendices include both the value and uncertainty regardless of the detection limit value. If the uncertainty range is greater than the value itself, measurements of radiological parameters may be represented by a "less than" ("<"). Chemical data are expressed by the detection limit prefaced by a "<" if that analyte was not measurable. (See also **Data Reporting** [p. 5-7] in *Chapter 5, Quality Assurance*.)

In general, the detection limit is the minimum amount of constituent or material of interest detected by an instrument or method that can be distinguished from background and instrument noise. Thus, the detection limit is the lowest value at which a sample result shows a statistically positive difference from a sample in which no constituent is present.

1995 Changes in the Environmental Monitoring Program

Changes in the 1995 environmental monitoring program enhanced the environmental sampling and surveillance network in order to support current activities and to prepare for future activities.

Changes included placing a weir at sampling point WNSP006 to allow direct measurement of flow; replacing the background air sampler, originally located at Dunkirk, with a new sampler located at Nashville in the town of Hanover; and installing an additional air monitoring sampler and back-up sampler for the vitrification heating, ventilation, and air conditioning exhaust system. These air samplers are providing baseline data during nonradioactive, pre-operational assessment of the vitrification facility.

A major update in 1995 was the entry into the Laboratory Information Management System (LIMS) of pre-set screening levels for the various parameters measured. The screening levels are based upon a statistical evaluation of historical results, regulatory limits or guides, or analytical method detection limits. Newly entered environmental data are electronically compared with the pre-set levels, thus allowing sampling results to be immediately evaluated for changes from previous levels.

Another major change occurred in the groundwater sampling program. With the program for the expanded characterization of groundwater completed in 1994, the number of monitoring points could be reduced and the parameters measured could be tailored more specifically to each active monitoring point.

Appendix A (pp. A-i through A-55) summarizes the program changes and lists the sample points and parameters measured in 1995.

Derived Concentration Guides

A derived concentration guide (DCG) is defined by the DOE as the concentration of a radionuclide in air or water that, under conditions of continuous exposure by one exposure mode (i.e., ingestion of water, submersion in air, or inhalation), for one year, would result in an effective dose equivalent of 100 mrem (1 mSv) to a "reference man." These concentrations (DCGs) are considered screening levels that enable site personnel to review effluent and environmental data and to decide if further investigation is needed. (See Table B-1, Appendix B, p. B-3.)

DOE Orders require that the hypothetical dose to the public from facility effluents be estimated using specific computer codes. (See Chapter 4, Radiological Dose Assessment [p. 4-4].) Doses estimated for WVDP activities are calculated using actual site data and are not related directly to DCG values.

Dose estimates are based on a sum of isotope quantities released and the dose equivalent effects for that isotope. For liquid effluent screening purposes, percentages of the DCGs for all radionuclides present are added: if the total percentage of the DCGs is less than 100, then the effluent released is in compliance with the DOE guideline.

Although the DOE provides DCGs for airborne radionuclides, the more stringent U.S. EPA NESHAP standards apply to Project airborne effluents.

As a convenient reference point, comparisons with DCGs are made throughout this report for both air and water samples.

Vitrification Overview

High-level radioactive waste from NFS operations was originally stored in two of four underground tanks (tanks 8D-2 and 8D-4). The waste in 8D-2, the larger of the active tanks, had settled into two layers: a liquid – the supernatant – and a precipitate layer on the tank bottom – the sludge.

To solidify the high-level waste, WVDP engineers designed and developed a process of pretreatment and vitrification.

Pretreatment Accomplishments

The supernatant (in tank 8D-2) was composed mostly of sodium and potassium salts dissolved in water. Radioactive cesium in solution accounted for more than 99% of the total radioactivity in the supernatant. During pretreatment, sodium salts and sulfates were separated from the radioactive constituents in both the liquid portion of the high-level waste and the sludge layer in the bottom of the tank.

Pretreatment of the supernatant began in 1988. A four-part process, the integrated radwaste treatment system (IRTS), reduced the volume of the high-level waste needing vitrification by producing low-level waste stabilized in cement.

- The supernatant was passed through zeolite-filled ion exchange columns in the supernatant treatment system (STS) to remove more than 99.9% of the radioactive cesium.

- The resulting liquid was then concentrated by evaporation in the liquid waste treatment system (LWTS).

- This low-level radioactive concentrate was blended with cement in the cement solidification system (CSS) and placed in 269-liter (71-gal) steel drums. This cement-stabilized waste form has been accepted by the U.S. Nuclear Regulatory Commission (NRC).

- Finally, the steel drums were stored in an on-site aboveground vault, the drum cell.

Processing of the supernatant was completed in 1990 with more than 10,000 drums of cemented waste produced.

The sludge that remained was composed mostly of iron hydroxide. Strontium-90 accounted for most of the radioactivity in the sludge.

Pretreatment of the sludge layer in high-level waste tank 8D-2 began in 1991. Five specially designed 50-foot-long pumps were installed in the tank to mix the sludge layer with water in order to produce a uniform sludge blend and to dissolve the sodium salts and sulfates that would interfere with vitrification. After mixing and allowing the sludge to settle, processing of the wash water through the integrated radwaste treatment system began. Processing removed radioactive constituents for later solidification into glass, and the wash water containing salts was then stabilized in cement.

Sludge washing was completed in 1994 after approximately 765,000 gallons of wash water had been processed. About 8,000 drums of cement-stabilized wash water were produced. In January 1995, high-level waste liquid stored in tank 8D-4 was transferred to tank 8D-2. The resulting mixture was washed and the wash water was processed. The IRTS processing of the combined wash waters was completed in May 1995. Tank 8D-4 contained THOREX high-level radioactive waste. This waste was produced by a single reprocessing campaign of a special fuel containing thorium that had been conducted by the previous facility operators from November 1968 to January 1969. In all, through the supernatant treatment process and the sludge wash process, more than 1.7 million gallons of liquid had been processed by the end of 1995, producing a total of 19,877 drums of cemented low-level waste.

As one of the final steps, the ion-exchange material (zeolite) used in the integrated radwaste treatment system to remove radioactivity will be blended with the washed sludge before being transferred to the vitrification facility for blending with the glass-formers. In 1995 approximately 91% of the spent zeolite was transferred to high-level waste tank 8D-2 in preparation for vitrification.

Vitrification Accomplishments

Several major milestones have been reached in completing the Project's vitrification facility. Non-radioactive testing of a full-scale vitrification system was conducted from 1984 to 1989. In 1990 all vitrification equipment was removed to allow installation of shield walls for fully remote radioactive operations. The walls and shielded tunnel connecting the vitrification facility to the former reprocessing plant were completed in 1991.

The slurry-fed ceramic melter was fully assembled, bricked, and installed in 1993. In addition, the cold chemical building was completed, as was the sludge mobilization system that will transfer high-level waste to the melter. This system was fully tested in 1994. A number of additional major systems components also were installed in 1994: the canister turntable, which positions the vessels as they are filled with molten glass; the submerged bed scrubber, which cleans gases produced by the vitrification process; and the transfer cart, which moves filled canisters to the storage area.

1995 Activities at the WVDP

Vitrification

Nonradiological testing ("cold" operations) of the vitrification facility began in 1995, and the first canister of nonradiological glass was produced. The WVDP declared its readiness to proceed with the necessary equipment tie-ins of the ventilation and utility systems to the vitrification facility building and tie-ins of the transfer lines to and from the high-level waste tank farm and the vitrification facility. In this closed-loop system, the transfer lines connect to multiple common lines so that material can be moved among all the points in the system.

Solidification into glass is scheduled to begin in 1996. The high-level waste mixture of washed sludge and spent zeolite from the ion-exchange process will be combined with glass-forming chemicals, fed to a ceramic melter, heated to approximately 2,000°F, and poured into stainless steel canisters. Approximately 300 stainless steel canisters, 10 feet long by 2 feet in diameter, will be filled with a uniform, high-level waste glass that will be suitable for eventual shipment to a federal repository.

Environmental Management

Aqueous Radioactive Waste

Water containing radioactive material from site process operations is collected and treated in the low-level liquid waste treatment facility (LLWTF). (Water from the sanitary system, which does not contain added radioactive material, is managed in a separate system.)

The treated process water is held, sampled, and analyzed before it is released through a State Pollutant Discharge Elimination System (SPDES)-permitted outfall. In 1995, 39 million liters (10.3 million gal) of water were treated in the LLWTF and released through the lagoon 3 weir.

The discharge waters contained an estimated 22 millicuries of gross alpha plus gross beta radioactivity. Comparable releases during the previous ten years averaged about 44 millicuries per year. The 1995 release was about 50% of this average. (See **Radiological Monitoring,** *Low-level Waste Treatment Facility Sampling Location* in *Chapter 2, Environmental Monitoring* [p. 2-7].)

Approximately 1.4 curies of tritium were released in WVDP liquid effluents in 1995. This is 79% of the ten-year average of 1.77 curies.

Non-Aqueous Radioactive Waste

In 1995, 2,939 liters (776 gal) of low-level radioactive waste oil was sent to Diversified Scientific Services, Inc. in Oak Ridge, Tennessee for processing.

Solid Radioactive Waste

Low-level radioactive waste at the WVDP, stored in aboveground facilities, consists of various materials generated through site maintenance and cleanup activities. Metal piping and tanks are cut up and packaged in a special size-reduction facility, and dry compressible materials such as paper and plastic are compacted to reduce waste volume. For more details see the *Environmental Compliance Summary: Calendar Year 1995* (p. xliv).

Airborne Radioactive Emissions

Air used to ventilate the facilities where radioactive material cleanup processes are operated is passed through filtration devices before being emitted to the atmosphere.

Ventilated air from the various points in the IRTS process (high-level waste sludge treatment, main plant and liquid waste treatment system, cement solidification system, and the LLWTF) and from other waste management activities centered in the main plant building is sampled continuously during operation. In addition to monitors that alarm if radioactivity increases above preset levels, the sample media are analyzed in the laboratory for the specific radionuclides that are present in the radioactive materials being handled.

Air emissions in 1995, primarily from the main plant ventilation, contained an estimated 0.3 millicuries of gross alpha plus gross beta radioactivity. This compares to less than 0.04 millicuries of combined gross alpha and beta activity in 1994 and 0.03 millicuries in 1993 and reflects an increase in current processing operations. (See *Chapter 2, Environmental Monitoring* [p. 2-15], for more detail.)

Approximately 0.036 curies of tritium (as hydrogen tritium oxide [HTO]) were released in facility air emissions in 1995. This compares with 0.032 curies in 1994 and 0.031 curies in 1993.

Waste Minimization Program

The WVDP formalized a waste minimization program in 1991 to reduce the generation of low-level waste, mixed waste, and hazardous waste. Industrial waste and sanitary waste reduction goals were added in 1994. By using source reduction, recycling, and other techniques, waste in all of these categories has been greatly reduced. In 1995, the fifth year of the program, reductions in all categories exceeded the 1995 reduction goals by as much as 80%. (For more details see the *Environmental Compliance Summary: Calendar Year 1995* [p. xlvii].)

Pollution Prevention Awareness Program

The WVDP's pollution prevention awareness program is a significant part of the Project's overall waste minimization program. The program includes hazard communication training and new-employee orientation that provides information about the WVDP's Industrial Hygiene and Safety Manual, environmental pollution control procedures, and the Hazardous Waste Management Plan.

The WVDP's goal is to make all employees aware of the importance of pollution prevention both at work and at home.

National Environmental Policy Act Activities

Under the National Environmental Policy Act (NEPA), the Department of Energy is required to consider the overall environmental effects of its proposed actions or federal projects. The President's Council on Environmental Quality established a screening system of analyses and documentation that requires each proposed action to be categorized according to the extent of its potential environmental effect. The levels of documentation include categorical exclusions (CXs), environmental assessments (EAs), and environmental impact statements (EISs).

Categorical exclusions evaluate and document actions that will not have a significant effect on the environment. Environmental assessments evaluate the extent to which the proposed action will affect the environment. If a proposed action has the potential for significant effects, an environmental impact statement is prepared that describes proposed alternatives to an action and explains the effects.

NEPA activities at the WVDP involve facility maintenance and minor projects that support high-level waste vitrification. These projects are documented and submitted for approval as categorical exclusions, although environmental assessments are occasionally necessary. (See the *Environmental Compliance Summary: Calendar Year 1995* [p. lv] for a discussion of specific NEPA activities in 1995.)

In December 1988 the DOE published a Notice of Intent to prepare an environmental impact statement for the completion of the WVDP and closure of the facilities at the WNYNSC. The environmental impact statement will describe the potential environmental effects associated with Project completion and various site closure alternatives. Preparation of the draft environmental impact statement was nearly completed by the end of 1995.

Self-Assessments

Self-assessments continued to be conducted in 1995 to review the management and effectiveness of the WVDP environmental protection and monitoring programs. Results of these self-assessments are evaluated and corrective actions tracked through completion. Overall results of these self-assessments found that the WVDP continued to implement and in some cases improve the quality of the environmental protection and monitoring program. (For more details see the *Environmental Compliance Summary: Calendar Year 1995* [p. lviii].)

Occupational Safety and Environmental Training

The occupational safety of personnel who are involved in industrial operations is protected by standards promulgated under the Occupational Safety and Health Act (OSHA). This act governs diverse occupational hazards ranging from electrical safety and protection from fire to the handling of hazardous materials. The purpose of OSHA is to maintain a safe and healthy v
environment for employees.

29 CFR 1910.120, Hazardous Waste Op(
and Emergency Response, requires that em
at treatment, storage, and disposal faciliti
may be exposed to health and safety hazard
hazardous waste operations, receive training
priate to their job function and responsibiliti
WVDP Environmental, Health, and Safety t
matrix identifies the specific training requir
for affected employees.

The WVDP provides the standard twent
hour hazardous waste operations and eme
response training. (Emergency response t
includes controlling contamination to gro
ter and spill response measures.) Tr
programs also contain information on wast
mization and pollution prevention. Besid
standard training, employees working in
logical areas receive additional traini
subjects such as understanding radiation
diation warning signs, dosimetry, and resp
protection. In addition, specific qualif
standards for specific job functions at the
required and maintained. These program
evolved into a comprehensive curricul
knowledge and skills necessary to maint
health and safety of employees and ens
continued environmental compliance
WVDP.

The WVDP maintains a hazardous materi
sponse team that is trained to respond to s
hazardous materials. This team maintains i
ficiency through classroom instructio
scheduled training drills.

Any person working at the WVDP that
picture badge receives general employee tr
covering health and safety, emergency res
and environmental compliance issues.

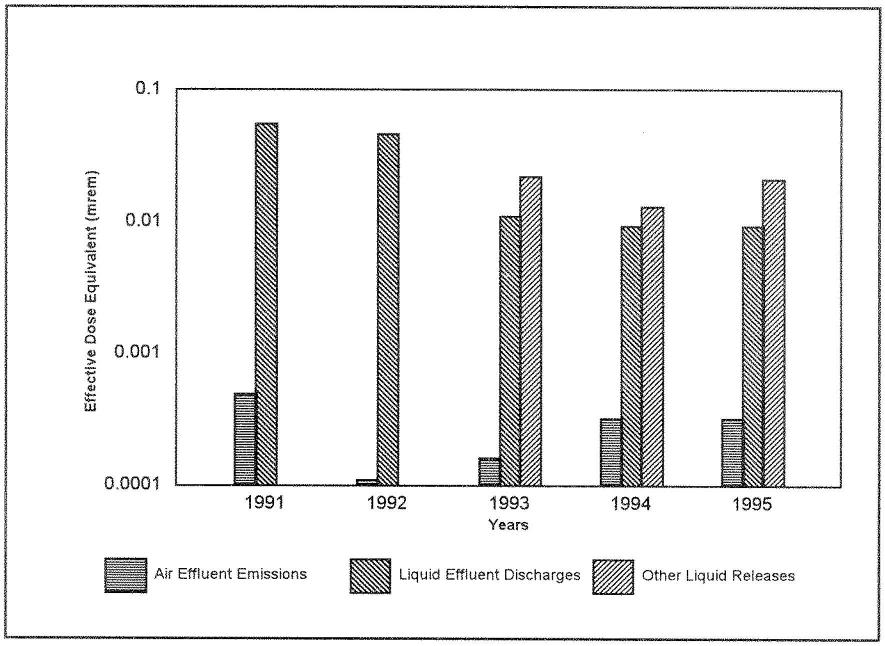

Figure 1-1. Annual Effective Dose Equivalent to the Maximally Exposed Individual

All visitors to the WVDP also receive a site-specific briefing on safety and emergency procedures before being admitted to the site.

Performance Measures

Performance measures can be used to evaluate effectiveness, efficiency, quality, timeliness, productivity, safety, or other areas that reflect achievements related to an organization's or process' goals. Performance measures can be used as a tool to identify the need to institute changes.

Several performance measures applicable to operations conducted at the WVDP are discussed below. These measures reflect process performance related to wastewater treatment in the LLWTF, the identification of spills and releases, the reduction in the generation of wastes, and the potential radiological dose received by the maximally exposed off-site individual.

Radiation Doses to the Maximally Exposed Off-Site Individual

Some of the most important information derived from environmental monitoring program data is the potential radiological dose to an off-site individual from on-site activities. As an overall assessment of Project activities and the effectiveness of the as-low-as-reasonably achievable (ALARA) concept, the effective radiological dose to the maximally exposed off-site individual provides an indicator of well-managed radiological operations. The effective dose for air emissions, water effluent, and the total effective dose for 1991 through 1995 are graphed in Figure 1-1. Note that these values are well below the DOE standard of 100 mrem. These consistently low results indicate that radiological activities at the site are well-controlled.

SPDES Permit Exceedances

Effective operation of the LLWTF is indicated by compliance with the applicable discharge permit limitations. Approximately sixty parameters are monitored regularly as part of the SPDES permit requirements. The analytical results are reported to the state via Discharge Monitoring Reports required under the SPDES program. The goal of LLWTF operations is to operate the LLWTF such that effluent monitoring results are consistently within the permit requirements. A graph of the number of exceedances occurring in each calendar year from 1991 through 1995 is shown in Figure 1-2 (p. 1-12).

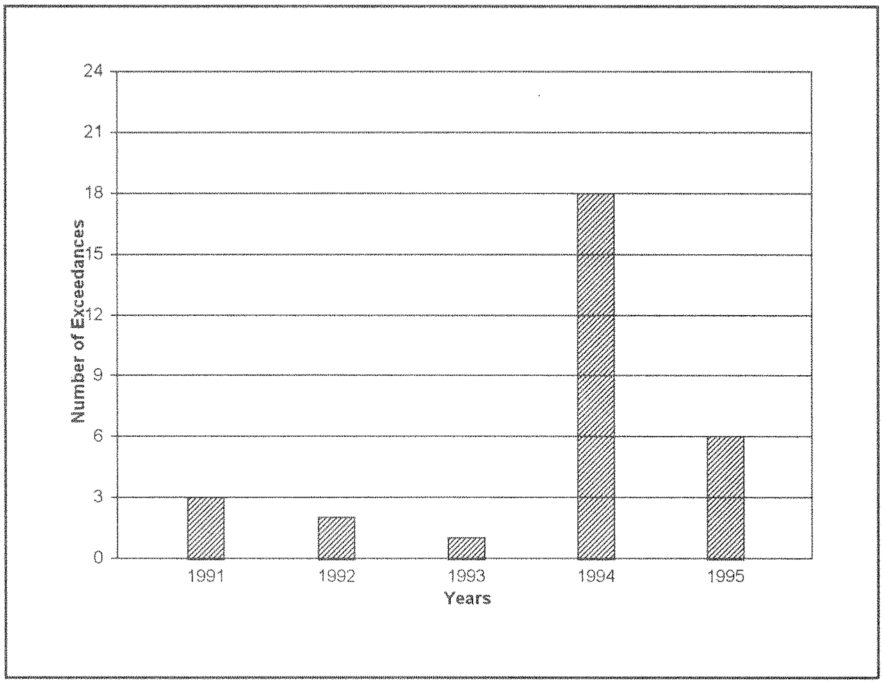

Figure 1-2. SPDES Permit Exceedances by Year

Exceedances do occur periodically. Although they are not always related to operating deficiencies, they still can indicate the need to institute changes. For example, of the eighteen exceedances that occurred in 1994, seven were related to the pH of the outfall 001 effluent and occurred over a five-day span. Similarly, five of the 1994 exceedances were related to five-day biochemical oxygen demand at the 007 outfall in the month of April. Both of these problems were successfully addressed through operational changes and the installation of additional or alternate process equipment. All exceedances are evaluated to determine their cause and to identify potential means of correcting operating problems or treatment techniques.

Waste Minimization and Pollution Prevention

The WVDP has initiated a program to reduce the quantities of waste generated from site activities. Reductions in the generation of low-level radioactive waste, radioactive mixed waste, hazardous waste, industrial wastes, and sanitary wastes (rubbish) were targeted. To demonstrate the effectiveness of the waste minimization program, a graph of the percentage of waste reduction achieved above the annual goal for each category is presented in Figure 1-3 for calendar years 1991 through 1995. Not all waste streams have been tracked over this period. Note that the low-level radioactive waste figures from 1993 through 1995 include the vol-

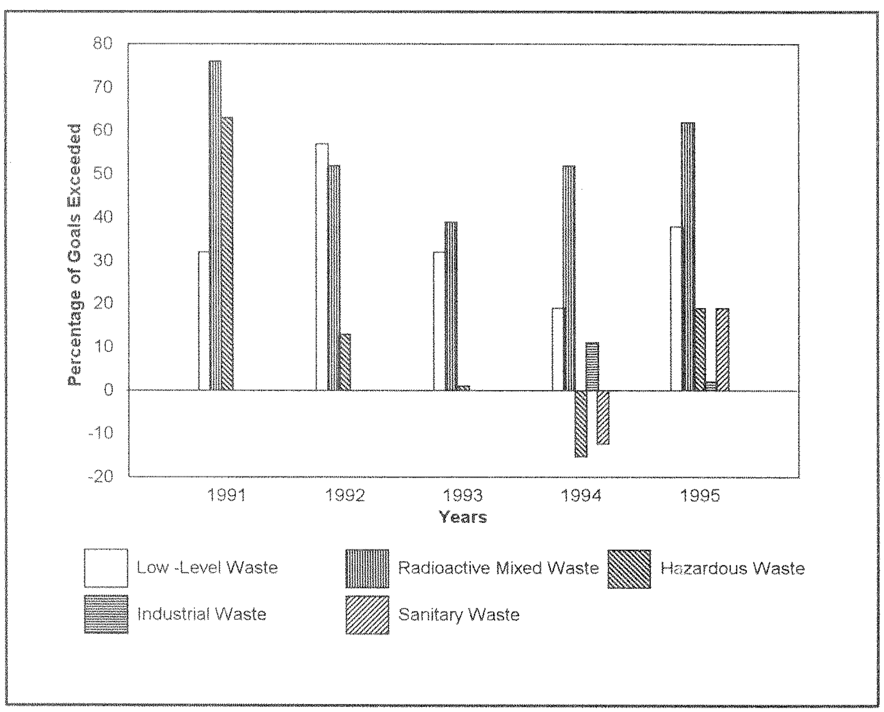

Figure 1-3. Waste Reduction Percentage Exceeding Goals

ume of drummed waste produced in the cement solidification system. The hazardous waste quantity for 1994 also includes 1,891 kilograms (about 4,170 lbs) of waste produced in relation to preparation for vitrification.

Spills and Releases

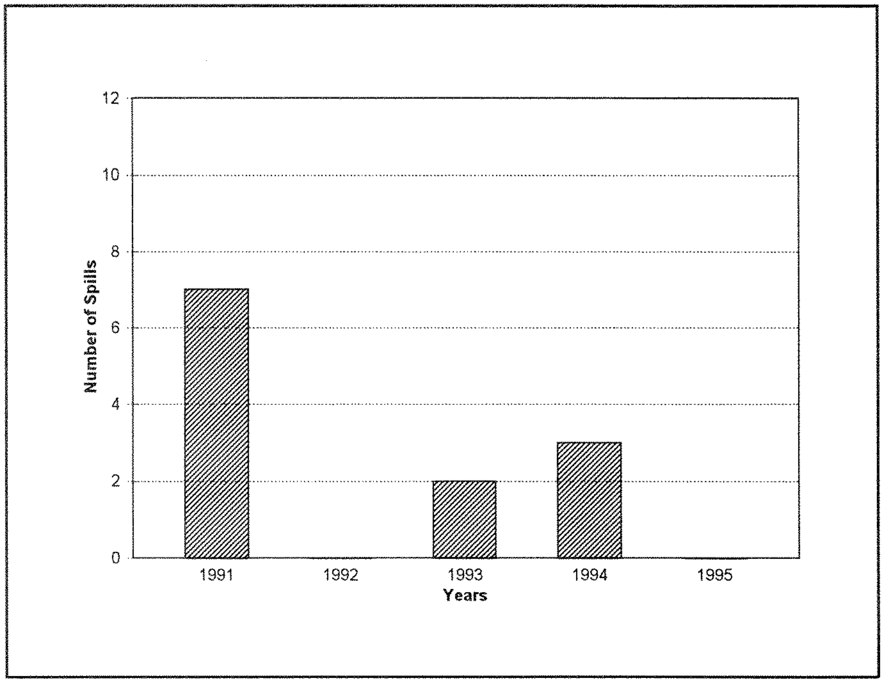

Figure 1-4. Number of Immediately Reportable Spills and Releases

Prevention is the best means of protection against oil and chemical spills or releases. WVDP employees are trained in applicable standard operating procedures for equipment that they use, and best management practices have been developed that identify potential spill sources and present measures to reduce the potential for releases to occur. Spill training, notification, and reporting policies have also been developed to emphasize the responsibility of each employee to report spills. This first-line reporting helps to ensure that spills will be properly documented and mitigated in accordance with applicable regulations.

Chemical spills greater than the applicable reportable quantity must be reported immediately to NYSDEC and the National Response Center and other agencies as required. Petroleum spills greater than 10 gallons must be reported within two hours to NYSDEC. Spills of any amount that travel to waters of the state (i.e., groundwater, surface water, drainage systems) must be reported immediately to the NYSDEC spill hotline and entered in the monthly log. There were no reportable spills in 1995. (See Fig. 1-4 for a bar graph of immediately reportable spills from 1991 to 1995.)