5.0 STANDARDS AND QUALITY ASSURANCE

5.1 Environmental Standards and Regulations

The following Department of Energy Orders, environmental standards and laws are applicable to the WVDP:

- DOE Order 5480.1, "Requirements for Radiation Protection," August 1981.
- DOE Order 5484.1, "Environmental Protection, Safety, and Health Protection Information Reporting Requirements," February 1981.
- Clean Air Act, 42 USC 1857 et seq., as amended.
- Federal Water Pollution Control Act (Clean Water Act), 33 USC 1251, as amended.
- Resource Conservation and Recovery Act, 42 USC 6905, as amended. (Including Hazardous and Solid Waste Amendments of 1984).
- Comprehensive Environmental Response, Compensation and Liability Act, 42 USC 960. (Including Superfund Amendments and Reauthorization Act of 1986).
- Toxic Substances Control Act, 15 USC 2601, as amended.
- Environmental Conservation Law of New York State.

The standards and guides applicable to releases of radionuclides from the WVDP are those of DOE Order 5480.1 Chapter XI, dated August 13, 1981, entitled, "Requirements for Radiation Protection." Radiation protection standards and selected radioactivity limitations from Chapter XI, as amended by the Derived Concentration Guides, are listed in Appendix B.

These listed concentrations are guidelines provided by DOE to assure compliance with the performance standard of 100 mrem effective dose equivalent to the maximally exposed individual. Ambient water quality standards contained in the SPDES permit issued for the facility are listed in Table C-5.2. Airborne discharges are also regulated by the U.S. Environmental Protection Agency, National Emission Standards for Hazardous Air Pollutants, 40 CFR 61, 1984.

5.2 Quality Assurance

Off-site laboratories performed the majority of the analyses requiring radiochemical separation or chemical pollutant analyses for the environmental samples collected during 1987. The documented quality assurance plan used by these laboratories includes periodic interlaboratory cross-checks, prepared standard and blank analyses, routine instrument calibration, and use of standardized procedures. Off-site laboratories analyze blind duplicates of approximately 10 percent of the samples analyzed on-site for the same parameters in addition to unknown cross-check samples.

Physical surveys were made of the contract laboratory facilities in conjunction with quality assurance reviews by Project personnel.

Sample collection, preparation, and most direct radiometric analyses were performed at the WVDP Environmental Laboratory for all media collected. The determination of Sr-90 in water is a routine radiochemical measurement performed in the Environmental Laboratory. For all continuous sampling equipment, measurement devices, and counting instruments, periodic calibration was maintained using standards traceable to the National Bureau of Standards.

Sampling protocols based on the EPA requirements for nonradiological analyses are established specifically for groundwater collection. Other collections, such as surface water, sediments, and biological samples are performed using appropriate techniques to meet established procedures and schedules. Sampling methods are periodically reviewed in the field by senior laboratory personnel as well as outside agencies such as the U.S. NRC and the New York State DEC.

Formal cross-check programs between the WVDP Environmental Laboratory, the DOE Radiological and Environmental Science Laboratory (RESL) at the Idaho National Engineering Laboratory (INEL), and the Environmental Measurements Laboratory (EML), New York City, included the entire range of environmental samples monitored in 1987. Comparative data from a variety of environmental materials analyzed at WVDP, off-site contract labs, and EML are summarized in Tables D-1.1 and D-1.2. Cross-check results of water and charcoal analyses for gamma-emitting isotopes are given in Table D-1.3. New York State Department of Health Environmental Laboratory Accreditation Program (NYSDOH ELAP) certification samples are reported in Tables D-1.4 and D-1.5. The U.S. Environmental Protection Agency (EPA) cross-check programs for nonradiological water quality parameters also provided audit samples in 1987 (Table D-1.6). Data in Table D-1.7 gives TLD monitoring point results from dosimeters co-located with the U.S. NRC.

The 168 blind quality assurance parameters measured and reported in 1987 showed an acceptable program, but with several areas requiring improvement or special attention. The 100 percent overall acceptability of 81 environmental media analyses in the EML cross-check program (Tables D-1.1 and D-1.2) provided a high degree of assurance that the types of environmental samples represented by the EML cross-check analyses are accurately and precisely measured.

A water sample for gamma isotopic analysis provided by INEL revealed a 10 to 13 percent inaccuracy in measurement of fresh fission product isotopes, which are normally not encountered at WVDP. The source of the discrepancy was traced to inadequate count rates due to the age of standard geometry sources, for those isotopes which did not meet the 5 percent uncertainty acceptability level. Fresh standards are being acquired and statistical smoothing was employed to improve the accuracy in regions for which adequate calibration count rates were not available. No isotopes counted and reported at WVDP were affected by the discrepancy.

A second INEL sample for gamma isotopic analysis in a charcoal cartridge showed acceptable analytical results for the mock I-131 (Ba-133) measurement for which a reference geometry was available, but the remaining isotope results were not acceptable. Although WVDP does not presently possess a standard for measuring gamma isotopes in charcoal, a correction factor was determined for reference to a standard geometry presently in use. The offset ratio reported in Table D-1.3 reflects that correction factor.

Quality assurance cross-check samples from the NYSDOH and EPA showed satisfactory results overall. Of the 78 sample results, the five unsatisfactory results have been reviewed and appropriate actions have been taken to improve these analyses.

TLDs co-located with NRC dosimeters around the WVDP perimeter and facility showed acceptable agreement for two quarters compared with the exception of one second quarter measurement at NRC TLD #11 (Table D-1.7). The apparent discrepancy is being resolved by the NRC dosimetry laboratory and is thought to have been an artifact in the measurement process.

Based on the various audit and cross-check results, the WVDP Environmental Monitoring Program is functioning well, and the areas needing improvement have been identified and are receiving appropriate attention.

5.3 Statistical Reporting Of Data

Except where noted, individual analytical results are reported with plus or minus (±) two standard deviations (2 σ) giving a value at the 95 percent confidence level. The arithmetic averages were calculated using actual results, including zero and negative values. In the final results, if the uncertainty (2 σ) was equal to or greater than the value, the measurement was considered to be below the Minimum Detectable Concentration (MDC) (see Section 5.4), and is reported as a less-than (<) value. These MDC values will vary among samples, especially in biological media where sample size cannot be easily standardized.

The total statistical uncertainty for radiological measurements, including systematic (processing and physical measurement) uncertainty plus the random radioactivity counting uncertainty, is reported as one value for the 1987 data. In most cases, systematic uncertainties (e.g., due to laboratory glassware or analytical balance variation) are a small percentage of the larger counting uncertainties at typical environmental levels of radioactivity. The notation normally used in reporting of raw laboratory data to convey the total uncertainty is in the form: (V.00 ± R.O or T.O) E-00 where "V.00" is the analytical value to three significant figures, "R.O" is the random uncertainty to two significant figures, "T.O" is the total of random plus systematic uncertainties, and "E-00" is the exponent of 10 used to signify the magnitude of the parenthetical expression.

5.4 Analytical Detection Limits

For unique or individual samples analyzed on an infrequent basis, generic minimum detection limits for the entire analytical measurement protocol have not been developed, although a Lower Limit of Detection (LLD) based solely on the counting uncertainty is calculated for each sample. For routine measurements using standardized sample sizes, equipment, and preparation techniques, an average Minimum Detectable Concentration (MDC) has been calculated for WVDP environmental samples. These are listed in Table 5-1.

Specific sample media were analyzed for radionuclides from multiple split samples using routine procedures, normal laboratory techniques, and standard counting parameters. The counting statistics determined the estimated LLD above which there was 95 percent probability that radioactivity was present. This LLD is derived from the detection efficiency of the measuring instrument for the type of activity being measured, the level of normal background signal with no sample present (determined by counting a "background" of the same material as the sample) and the length of time the background and sample were counted. For radioactive decay, these factors can be used to accurately predict what value is the lowest which can be measured at a given confidence level.

A separate calculation for systematic uncertainty, including the variation between duplicate samples, labware differences, and physical measurements, was made and added to the statistical counting LLD to obtain the minimum analytical detection limit or MDC for the entire process. Volumetric measurement of sample flow rates, calibration standard uncertainties, and pipetting device accuracy were some of the factors included in this calculation. The overall result is the average Minimum Detectable Concentration (at the 95 percent confidence level) for each type of sample treated in a uniform manner. For most sample analyses, there is little or no significant difference between the LLD and the MDC.

TABLE 5-1
MINIMUM DETECTABLE CONCENTRATIONS FOR ROUTINE SAMPLES

Measurement	Medium	Sample Size	MDC
gross alpha	water	1 L	8.1 E-10 µCi/mL
gross beta	water	1 L	7.7 E-10 µCi/mL
Cs-137	water	250 mL	2.1 E-08 µCi/mL
H-3	water	5 mL	1.0 E-07µCi/mL
Sr-90	water	1 L	1.6 E-09 µCi/mL
gross alpha	air	400 m3	1.1 E-15 µCi/mL
gross beta	air	400 m3	1.9 E-06 µCi/mL
Cs-137	air	400 m3	1.4 E-14 µCi/mL
gross alpha	soil	150 mg	5.5 E-06 µCi/g
gross beta	soil	150 mg	5.3 E-06 µCi/g
Cs-137	soil	350 g	6.3 E-08 µCi/g

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