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 5400.1, "General Environmental Protection Program", November, 1988.
- 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 EPA under the 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 1988. 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 provided through the WVDP Environmental Laboratory.

Physical surveys were made of the contract laboratory facilities and in the process of qualifying and adding off-site service contracts 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. For all continuous sampling equipment, measurement devices, and counting instruments, periodic calibration was maintained using standards traceable to the National Institute of Standards and Technology (formerly National Bureau of Standards). Specific calibration schedules and operational checks are required and were met in 1988 for critical instruments.

Sampling protocols based on the EPA requirements for nonradiological analyses were established specifically for groundwater collection. Other collections, such as surface water, sediments, and biological samples were performed using appropriate techniques to meet established laboratory procedures and surveillance program schedules. Sampling methods are periodically observed and evaluated in practice by senior laboratory personnel as well as outside agencies such as the NRC and the NYSDEC.

Formal cross-check programs between the WVDP Environmental Laboratory, the DOE Radiological and Environmental Science Laboratory at the Idaho National Engineering Laboratory (INEL), the EPA Environmental Monitoring Systems Laboratory in Las Vegas (EMSL), and the Environmental Measurements Laboratory (EML), New York City, included the entire range of environmental sample types monitored in 1988. Comparative data from a variety of environmental materials analyzed at WVDP, off-site contract labs, and EML are summarized in Table D-1.1 Table D-1.2 compares the results of the program initiated in 1988 with EPA's EMSL environmental radioactivity measurement. Table D-1.3 gives the cross-check results from the INEL's gamma-in-water sample. 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 EPA cross-check programs for nonradiological water quality parameters also provided audit samples in 1988 (Table D-1.6). Data in Table D-1.7 are TLD monitoring point results from dosimeters co-located with the NRC.

The 214 blind quality assurance parameters and cross-checks measured and reported in 1988 showed an acceptable program, with one specific facet requiring improvement. Gamma spectroscopy sensitivity had been identified for improvement. After obtaining additional certified standards and preparing a more sensitive geometry for normal use, the accuracy of the gamma spectroscopy analyses was improved to one percent of the DOE DCG for cesium-137. This process was completed by April of 1988.

No isotopes counted and reported at the WVDP had been affected by the lower sensitivity, but the overall improvement in detection levels increased the precision on routine samples by a significant amount.

Of the 36 analyses reported in Table D-1.1 for the EML air, soil, vegetation, and water samples, one plutonium-239 analysis in soil performed by a contract laboratory fell outside the "passing" range and three other analyses were within the marginally acceptable area. These numbers represent 97 percent passing and 89 percent completely acceptable on these media. The overall test results, including all analyses, averaged a ratio of 1.04.

Results for the new program with EMSL are recorded in Table D-1.2. The initial gamma-in-water test, although below the normal instrument detection limits of the WVDP Environmental Laboratory geometry in use at the time, showed the results to be correct within the limits of uncertainty of our analysis. The precision was not adequate, however, to meet the rigorous criteria applied by the EPA's program in this instance. Once identified improvements were implemented before the second EPA gamma-in-water tests, the required precision was obtained for acceptable values. One sample for iodine-131 in milk and two samples for strontium-89/90 in milk analyzed off-site were unacceptable; the two unacceptable radium results were reported on preliminary data which were adjusted to what would have been acceptable values in the final contract laboratory report, received after the internal reporting deadline. The overall ratio is 1.02 for 53 EMSL sample results, with 79 percent of these results within the acceptable range. If the initial gamma scan and the preliminary radium results are not included, the result is an 89 percent passing rate.

The INEL sample, tallied in Table D-1.3, shows good agreement on those isotopes which are normally reported in the WVDP environmental surveillance program. The lack of precision in the remaining isotopes was corrected, as shown in subsequent cross-checks, by use of a new calibration source set.

The chemical analyses represented in Tables D-1.4, D-1.5, and D-1.6 were all satisfactory, but two. These were not due to incorrect analytical techniques, but resulted from failure to add in a dilution factor per the test instructions. The results overall were 98 percent acceptable, with a ratio of 1.02 on the January NYSDOH samples, 0.99 for the June

NYSDOH samples (excluding the two miscalculated outliers), and 1.02 for the EPA July samples.

TLDs co-located with NRC dosimeters at eight points around the WVDP perimeter and facility showed acceptable agreement for all four quarters compared (Table D-1.7). The comparison ratio is 1.11 for the two systems of TLDs in 1988. Project dosimetry is consistently placed at a height of 1 meter (3 ft.), but the NRC dosimeters are usually placed at 1.5 to 3 meters (5-10 ft.), which may partially account for the variances.

As indicated by the various audit and cross-check results, the WVDP Environmental Monitoring Program is functioning well, and the improvements in 1988 have been reflected in a very satisfactory cross-check record.

5.3 STATISTICAL REPORTING OF DATA

Except where noted, individual analytical results are reported with plus or minus ($\pm$) two standard deviations (2σ) 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 (2σ) 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 1988 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 $\pm$ R.0 or T.0) E-00 where "V.00" is the analytical value to three significant figures, "R.0" is the random uncertainty to two significant figures, "T.0" 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 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" sample of the same material) and the length of time the background and sample were counted. For radioactive decay, these factors can be used to accurately predict the lowest value that 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 MDC (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
cesium-137	water	500 mL	1.0 E-08 μCi/mL
tritium	water	5 mL	1.0 E-07 μCi/mL
strontium-90	water	1 L	1.6 E-09 μCi/mL
gross alpha	air	400 m3	7.0 E-16 μCi/mL
gross beta	air	400 m3	7.0 E-15 μCi/mL
cesium-137	air	400 m3	1.4 E-14 μCi/mL
gross alpha	soil	100 mg	5.5 E-06 μCi/g
gross beta	soil	100 mg	5.3 E-06 μCi/g
cesium-137	soil	350 g	6.3 E-08 μCi/g

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