LIMERICK GENERATING STATION COMPLIANCE WITH REGULATORY REQUIREMENTS GOVERNING THE CLASSIFICATION OF LOW-LEVEL RADIOACTIVE WASTE

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ABSTRACT

The purpose of this paper is to summarize the program which Limerick Generating Station (LGS) uses to comply with regulatory requirements for the proper classification of low-level radioactive waste. LGS chose the AIF/NESP study on classification of low-level radioactive wastes (1) as the baseline from which the waste classification program was developed prior to plant specific off-site analysis. Following 100 full power days of operation, a plant, specific data base was established. A computer assisted surveillance program has been implemented to ensure that radionuclide distributions are within the guidelines of the May 11, 1983, NRC Division of Waste Management technical positon (TP) paper on waste classification (2).

INTRODUCTION

Limerick Generating Station (LGS) Unit 1 is an 1100 megawatt boiling water reactor (BWR) operated by the Philadelphia Electric Company. Fuel was first loaded on October 26, 1984 and criticality was achieved on December 22, 1984. LGS went on line for commercial operation on February 1, 1986. The first low-level radioactive wastes were shipped to a commercial site in December of 1985. This shipment consisted of condensate resins.

REGULATORY REQUIREMENTS

10 CRF Section 20.311 (Standards for Protection Against Radiation) requires that any licensee who transfers radioactive waste to a land disposal facility or to a waste collector or processor must classify the waste according to the requirements of 10 CFR Section 61.55. Included among these requirements are those pertaining to the classification of low-level radioactive wastes by radwaste generators. The NRC has recognized that there are various approaches to meeting the classification requirements of 10 CFR Part 61. In addition to the waste classification requirements of 10 CFR Part 61, 10 CFR Section 20.311 also stipulates manifests which must accompany the shipment. The total quantity of H-3, C-14, Tc-99 and I-129 and the quantity and identify of other significant radionuclides must be identified on the manifest, as well as identification of the waste as Class A, B, or C.

In May 1983, in order to support licensees in their endeavor to comply with waste classification requirements, the NRC issued it's Low-Level Waste Licensing Branch Technical Position on Radioactive Waste Classification (2). The staff notes that the "principal consideration for the acceptability of a compliance program will be whether a reasonable effort has been made to ensure a realistic representation of the distribution of radionuclides within waste and to classify waste in a consistent manner". The staff considers a reasonable target for determining measured or inferred radionuclide concentration is that the concentrations are accurate to within a factor of 10.

LGS WASTE CLASSIFICATION PROGRAM

The basic objective of the LGS waste classification program is to ensure a realistic representation of radionuclides within the waste and to classify waste in a consistent manner. In order to attain this objective, the LGS waste classification program has been designed to meet the intent of the NRC.

LGS chose the AIF/NESP study entitled "Methodologies for Classification of Low-Level Radioactive Wastes From Nuclear Power Plants" (1), as the basis for waste stream identification and reference isotope designation. The cornerstone of the AIF methodology is the application of scaling factors between more readily measured key radionuclides (e.g., Co-60 and Cs-137) and those not readily measured (e.g., Sr-90, Fe-55 and those listed in the classification tables of 10 CFR Section 61.55).

Another key element in the LGS waste classification program is provisions for the use of dose rate measurements to determine container curie content. LGS has adopted the DOSCON (Ref. 3) for such use. DOSCON is a small computer program developed by NWT Corporation for the Electric Power Research Institute (EPRI) to calculate radwaste package millicurie content from observed dose rate and relative radionuclide distribution. The DOSCON program has been adapted to address radionuclide distributions at LGS.

In order to facilitate the implementation of the AIF and EPRI methodology described above, LGS has procured a radwaste management and tracking computer program, PAKRAD, from Bechtel National, Inc., Advanced Technology Division.

The following discussion outlines, by waste category, the programs LGS uses to classify waste for burial

Initial Determination of Scaling Factors

Prior to 100 effective full power days of operation, samples of reactor coolant, reactor water cleanup resins, and condensate resins were obtained. The samples were analyzed by Chemistry using an intrinsic germanium gamma spectroscopy system. Identified isotopes were inputted into the PAKRAD computer program for the preparation of the shipping manifest and the unidentified isotopes in the PAKRAD library were automatically scaled (based on AIF/NESP scaling factors) to the concentrations or specific activity of Co-60 or Cs-137 identified by the gamma spectroscopy system.

After 100 effective full power days of operation, the sampling frequency defined in LGS's "Periodic Sampling and Analysis Program for the Determination of Abundance Factors" was employed. Under the current program, the following samples are collected and analyzed off-site to establish scaling factors for difficult to measure isotopes:

- o A reactor coolant sample composited from 60 daily reactor coolant samples;
- o A condensate resin sample composited from at least five batchs; and
- o A reactor water cleanup resin sample.

Offsite analysis confirmed that Cs-137 levels were below the lower-level of detectability (LLD) in LGS's present radioactive waste. To address the isotopes which are normally scaled to Cs-137 another heirarchy level was established. If Cs-137 is not present, the isotopes which have been identified in off-site analysis are scaled to Co-60.

The present heirarchy is as follows:

- o Transuranics

Scaled Isotope		Reference Isotope
Pu-241	scaled to	Pu-239
Am-243	scaled to	Am-241
Cm-243	scaled to	Cm-242

- o If a transuranic reference isotope is below LLD, the transuranics are scaled to Ce-144. If Ce-144 is below LLD, the transuranics are scaled to Cs-137;
- o Isotopes other than corrosion products are scaled to Cs-137. The exception is H-3 and C-14 which are addressed separately; and
- o If Cs-137 is below LLD, the isotopes are scaled to Co-60.

Upon receipt of the detailed results from the offsite laboratory, the PAKRAD scaling factor library is modified as appropriate to reflect the new data.

Periodic Determination of Scaling Factors for Gamma Emitting Isotopes

A sixty day composited sample of reactor coolant is collected and analyzed on a quarterly basis. Based on the composited sample results, the radionuclide distributions are updated on a quarterly basis. In addition, to verify that radionuclide distributions in solid radwaste streams are reasonably consistent from batch to batch, average reactor coolant isotopic concentrations are reviewed. Significant changes may result in the initiation of offsite analyses. This periodic surveillance program is defined below.

SURVEILLANCE PROGRAM

A surveillance program is established to ensure that estimated radionuclide distributions are consistent with actual values, and identify the need for non-routine off-site analysis for the difficult to measure radionuclides. The program is based on monitoring the reactor coolant for changes in the relative abundance of gamma emitting radionuclides. These changes are identified by comparing present reactor coolant samples to the reactor coolant sample sent off-site for analysis.

The sample obtained for off-site analysis is a composite of daily reactor coolant samples collected over a 60 day period. Therefore, the effective age of the sample is 0 to 60 days. During the 60 day collection period, the daily samples are analyzed by on-site gamma spectroscopy and the data is entered into the PAKRAD data base. At the end of 60 days, the daily concentrations for the individual radionuclides are averaged. These averaged values are referred to as referenced values and are applicable as long as the corresponding off-site analysis is in use. The reference values are compared to the daily sample, a five-day rolling average and a sixty-day rolling average of reactor coolant.

The sixty and five day rolling average of reactor coolant is maintained to identify trends and events which may affect the relative abundance of difficult-to-measure isotopes. The abundance factors are determined by dividing the individual isotopic concentrations by the total concentration (both beta and gamma emitters). Scaling factors are derived on the basis of the average data. The sixty day rolling average identifies trends and correlates to the generation period of those wastes generated over an extended period of time such as dry active waste (DAW). The five day rolling average is more sensitive to transient events which may be masked by averaging over an extended period of time. It also serves as an alert for trend development within the system.

The calculated scaling factors of the daily reactor coolant sample are compared to the scaling factors of the reference, the sixty day rolling average and the five day rolling average. If any scaling factor varies by greater than a factor of 100, it is flagged for assessment.

The scaling factors calculated from the five day rolling average are compared to the abundance factors of the reference and the sixty day rolling average. The scaling factors of the sixty day rolling average are compared only to the reference. If any scaling factor, in either case, varies by more than a factor of ten, it is flagged.

DETERMINATION OF ISOTOPIC DISTRIBUTION IN RADIOACTIVE WASTE

The gamma-emitting isotopes identified by on-site gamma spectroscopy are inputted into the PAKRAD computer program for the preparation of the shipping manifest. PAKRAD tracks the set of 33 isotopes shown in Table I. These isotopes were

selected because of their importance in determining a container's dose rate and waste classification or because of regulatory requirements. The shorter lived isotopes (e.g. Cr-51 and I-131) do not generally have a significant impact on waste classification but may make significant contributions to the container's dose rate at the time of packaging. H-3, C-14, Tc-99, and I-129 are of relatively small importance in BWR wastes but are included to satisfy 10 CFR Section 20.311 requirements regarding waste disposal reports. The remaining isotopes were selected to include all those specifically mentioned in 10 CFR Section 61.55 and to account for the bulk of the activity in typical BWR wastes.

The difficult to measure radionuclides are automatically scaled to the appropriate reference isotope identified by gamma spectroscopy. In those instances where isotopic analysis is not performed, such as DAW, the dose rate to curie program of PAKRAD is used to determine the curie content.

The dose rate to curie program addresses the radionuclide distribution based on the following reference streams:

- o Dry active waste is based on quarterly sixty day composited sample of reactor coolant;
- o Condensate resins are averaged over the previous five condensate resin samples; and
- o Depending on change out frequency, reactor water cleanup resins maybe averaged over the last quarter.

The C-14 curie content is based on the Carbon-14 concentration reported from off-site analysis for the appropriate waste stream. Tritium curie content is based on off-site analysis of reactor coolant and projected water content of the waste.

TABLE I

Isotopes Tracked by PAKRAD

H-3	Sr-90	Cs-136
C-14	Nb-94	Cs-137
Cr-51	Nb-95	Ba-140
Mn-54	Zr-95	Ce-141
Fe-55	Tc-99	Ce-144
Co-58	Ru-103	Pu-239
Fe-59	Ru-106	Pu-241
Ni-59	I-129	Am-241
Co-60	I-131	Am-243
Ni-63	Cs-134	Cm-242
Zn-65	Cs-135	Cm-243

REFERENCES

1. Atomic Industrial Forum, Inc., "Methodologies for Classification of Low-Level Radioactive Wastes from Nuclear Power Plants,: AIF/NESP-027, Nov. 1983.
2. U. S. Nuclear Regulatory Commission, "Final Waste Classification and Waste Form Technical Position Papers," Division of Waste Management, May 11, 1983.
3. EPRI, "Determination of Waste Container Curie Content from Dose Rates Measurements, " EPRI NP-3223, NWT Corporation, July 1983.