(12)

Date: March 3, 1994

To: Nick Shah
USNRC

From: Ed Kokosky
Detroit Edison Fermi 2

Subject: **Lower Limit of Detection on Fermi 2 Radiation Protection Gamma Spectroscopy System**

Per recent discussion, attached is a lower limit of detection (LLD) verification to Fermi 2's ODCM required criteria for radioactive liquid waste sampling and analysis program.

The verification has been completed in the past as A Priori count and was used to establish the present count time of 1000 seconds.

This was discussed with Al Junuska, in past inspections, and also with Dr. Currie who authored NUREG 4007.

The first attachment is the verification. The remaining pages are the actual documentation of the two (2) counts and LLD reports.

If you have any further questions, please contact me at 313-586-4933.

Attachments

EFK/ssr

cc: S. Bartman
R. DeLong
J. Tibai

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Attachment 1

VERIFICATION

ISOTOPE	ODCM LLD'S	1000 SECOND COUNT	2000 SECOND COUNT
MN-54	5E -7	4.88E -8	3.12E -8
FE-59	5E -7	8.67E -8	7.08E -8
CO-60	5E -7	8.53E -8	4.26E -8
CO-58	5E -7	3.78E -8	2.76E -8
ZN-65	5E -7	1.23E -7	7.14E -8
MO-99	5E -7	9.82E -8	2.18E -7
CS-134	5E -7	2.88E -8	1.44E -8
CS-137	5E -7	1.31E -8	1.79E -8
CE-141	5E -7	3.90E -8	1.78E -8
CE-144	5E -7	1.65E -7	8.76E -8
I-131	1E -6	2.22E -8	2.24E -8
XE-133	1E -5	4.10E -8	4.16E -8
XE-135	1E -5	1.88E -8	1.42E -8

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TABLE 3.11.1.1.1-1

RADIOACTIVE LIQUID WASTE SAMPLING AND ANALYSIS PROGRAM

Liquid Release Type	Sampling Frequency	Minimum Analysis Frequency	Type of Activity Analysis	Lower Limit of Detection (LLD)[a] (uCi/ml)
A. Batch Waste Release[b] Sample Tanks (3)	P Each Batch	P Each Batch	Principal Gamma Emitters[c]	5×10^{-7}
			I-131	1×10^{-6}
	P One Batch/M	M	Dissolved and Entrained Gases (Gamma Emitters)	1×10^{-5}
	P	M	H-3	1×10^{-5}
	Each Batch	Composite[d]	Gross Alpha	1×10^{-7}
	P	Q	Sr-89, Sr-90	5×10^{-8}
	Each Batch	Composite[d]	Fe-55	1×10^{-6}
B Continuous Releases[e] Circulating Water System (if contaminated)	M	M	Principal Gamma Emitters[c]	5×10^{-7}
	NA	Composite[d]	I-131	1×10^{-6}
	W Grab Sample	M	Dissolved and Entrained Gases (Gamma Emitters)	1×10^{-5}
		M	H-3	1×10^{-5}
	NA	Composite[d]	Gross Alpha	1×10^{-7}
		Q	Sr-89, Sr-90	5×10^{-8}
	NA	Composite[d]	Fe-55	1×10^{-6}

TABLE 4.11.1.1.1-1 (Continued)

TABLE NOTATION

[a]The LLD is defined, for purposes of these controls, as the smallest concentration of radioactive material in a sample that will yield a net count, above system background, that will be detected with 95% probability with only 5% probability of falsely concluding that a blank observation represents a "real" signal.

For a particular measurement system, which may include radiochemical separation:

$$LLD = \frac{4.66\ s_b}{E \cdot V \cdot 2.22 \times 10^6 \cdot Y \cdot \exp(-\lambda t)}$$

Where:

LLD is the "a priori" lower limit of detection as defined above, as microcuries per unit mass or volume,

s_b is the standard deviation of the background counting rate or of the counting rate of a blank sample as appropriate, as counts per minute,

E is the counting efficiency, as counts per disintegration,

V is the sample size in units of mass or volume,

2.22×10^6 is the number of disintegrations per minute per microcurie,

Y is the fractional radiochemical yield, when applicable,

λ is the radioactive decay constant for the particular radionuclide, and

t for plant effluents is the elapsed time between the midpoint of sample collection and time of counting.

Typical values of E, V, Y, and t should be used in the calculation.

It should be recognized that the LLD is defined as an a priori (before the fact) limit representing the capability of a measurement system and not as an a posteriori (after the fact) limit for a particular measurement.

[b]A batch release is the discharge of liquid wastes of a discrete volume. Prior to sampling for analyses, each batch shall be isolated, and then thoroughly mixed by a method described in the ODCM to assure representative sampling.

TABLE 4.11.1.1.1-1 (Continued)

TABLE NOTATION

[c]The principal gamma emitters for which the LLD specification applies exclusively are: Mn-54, Fe-59, Co-58, Co-60, Zn-65, Mo-99, Cs-134, Cs-137, Ce-141, and Ce-144. This does not mean that only these nuclides are to be considered. Other peaks that are identifiable, together with those of the above nuclides, shall also be analyzed and reported in the Annual Radioactive Effluent Release Report pursuant to Control 5.9.1.8.

[d]A composite sample is one in which the quantity of liquid samples is proportional to the quantity of liquid waste discharged and in which the method of sampling employed results in a specimen that is representative of the liquids released. This may be accomplished through composites of grab samples obtained prior to discharge after the tanks have been recirculated.

[e]A continuous release is the discharge of liquid wastes of a nondiscrete volume; e.g., from a volume of a system that has an input flow during the continuous release.