U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Ask the NRC

Steve Garry, NRR Hq

Bruce Dionne, Region I

John Cassidy, Region III

Steve Bell, Region III

June 29, 2016

Topics

- Inspection Findings and Violations
  - 3 related to ODCM
  - 5 related to effluent monitoring
  - 4 related to 10 CFR 20.1406, minimizing contamination, or 20.1501, surveys
- Regional Inspector Perspectives
- Industry Q&As

1st ODCM Finding or Violation (ML14127A496)

- Failure to evaluate changes made to the ODCM
  - Operators were receiving flow alarms on RHR service water monitors (used for monitoring discharges to spray pond)
  - The ODCM was revised to re-define its operability, and allow the RHR service water monitors to be non-functional for a period of up to 4 hours before being declared inoperable

2nd ODCM Finding or Violation (ML14225A852)

- Failure to evaluate ODCM changes for REMP air sampling
  - In 1999, a REMP air sample collection frequency was changed from weekly to biweekly without an analysis or evaluation to support the change
  - An air sample location was not established at the community with the highest D/Q

3rd ODCM Finding or Violation (ML15127A549)

- Failure to evaluate ODCM changes for REMP air sampling
  - An air sample location was changed without adequate justification
  - In 1997, there was a failure to establish an air sampling location at a community with the highest D/Q factor

1st Effluent Monitoring Finding or Violation (ML14304A459)

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

- Loss of plant effluent monitoring capability
  - One of the two plant vent effluent monitors was taken out of service for routine maintenance
  - The second effluent monitor failed (due to sample line separation)
    - System vacuum gauge indicated loss of vacuum
    - Operators attributed the cause was failure of gauge
  - Failed to take required compensatory actions (i.e., take back-up grab samples)

2nd Effluent Monitoring Finding or Violation (ML15216A565)

- Failure to assess potential gaseous effluents from equipment hatch during a loss of negative pressure
  - Containment purge fans had been turned off for 7 days
  - CAM was placed at equipment hatch for worker protection, but its filters were not evaluated
  - A low-volume effluent air sampler was not used at the equipment hatch
  - Unprepared to identify and evaluate radioactive effluent releases

3rd Effluent Monitoring Finding or Violation (ML15316A156)

- Failure to ensure adequate effluent monitor calibration
  - Condensation was occurring in plant vent sample line, the noble gas sample chamber, and in the particulate filter and iodine charcoal cartridges
  - Draining water was a common practice and was written into plant procedures
  - An evaluation had not been performed of the effect of water on monitor calibration and efficiency of particulate filters and iodine cartridges

4th Effluent Monitoring Finding or Violation (ML16042A073)

- Failure to adequately calibrate liquid effluent monitors
  - In 1993, NIST-traceable sources were not used in the primary monitor calibrations, or in subsequent calibrations (for steam generator blowdown and radwaste liquid effluent monitors)
  - Re-calibration with NIST-traceable sources resulted in monitor performance outside acceptance criteria

5th Effluent Monitoring Finding or Violation (ML16132A431)

- Failure to implement procedures for control of potentially cross-contaminated systems
  - An air sample from the service air system (also used for breathing air) was found with potential contamination (Co-58, Co-60, Mn-54, Zn-65)
  - The air sample was presumed to be invalid and system was not re-sampled
  - System contamination was caused by leakage through isolation valves from the higher pressure reactor water cleanup system

1st Minimizing Contamination Finding or Violation (ML15316A083)

- Failure to conduct operations to minimize residual radioactivity
  - 3 ground-water monitoring wells had a significant increase in tritium concentrations
  - Increased sampling to weekly and investigated the cause
  - Failed to identify a new leak (i.e., concluded that the leak was from previous event)
  - Did not take action to minimize the introduction of residual radioactivity into the subsurface

2nd Minimizing Contamination Finding or Violation (ML16041A493)

- Several spill or leak events resulted in contaminated areas and radioactivity reaching the environment and groundwater

- Failed to identify and evaluate control work practices to prevent spills and leaks with a credible mechanism to reach groundwater

- Failed to do a 50.72(b)(2)(ii) report for notification to State and local authorities

3rd Minimizing Contamination Finding or Violation (ML15224A489)

- Failure to minimize residual radioactivity to in-plant areas
  - 14 year period of overfilling tanks & overflowing drains, and the abandonment of the concentrator
  - Resulted in highly contaminated areas needing control as LHRAs
  - Failure to address long standing issues of residual radioactivity

4th Minimizing Contamination Finding or Violation ML14044A033

- Failure to Perform Survey
  - Water seeping from ground
  - Assumed to be waste waster from sewage treatment plant
  - No radiological survey for 5 months
  - Later found to be a circulating water blowdown line leak
  - Leak contained tritium and Co-60

Q&A # 1 LLDs
during emergencies

- "There are required LLDs for the REMP. Are there any required environmental LLDs for environmental samples (air, water, vegetation, soil, snow, etc.) collected during an accidental release? For example, what LLDs were applicable during TMI?"

Q&A # 2 Plants & Animals

- Is the NRC developing a dose standard for the environment based on ICRP 103 & 108?

  Note: The 2016 NEA report No. 7265 states that no detrimental effect has been demonstrated below 10 μGy/hr or 1 mR/hr (8760 mR/yr) above background.

Q&A # 3 Kr-85

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

- The Bases for Standard Technical Specifications for BWRs, as presented in NUREGs-1433 and 1434, specify the noble gases of Xe-133, Xe-135, Xe-138, Kr-85, Kr-87, and Kr-88 to be included in the summed activity for compliance with the Main Condenser Offgas Specification.

- The inclusion of Kr-85 is contrary to Fuel Integrity Monitoring protocols recommended by EPRI in EPRI Technical Report 1019107, "Fuel Reliability Monitoring and Failure Evaluation Handbook, Revision 2, (2010)".

- Historically EPRI and INPO fuel integrity monitoring has included Kr-85m, rather than Kr-85. Considering the long half-life (~10.3 y), very low specific activity, and low gamma yield of Kr-85, it would not contribute any appreciable activity to the summed total of the other noble gases.

- Is the inclusion of Kr-85 in the Standard Technical Specifications a typographical error, and if so, how can this error be captured by the NRC to be addressed in future revisions of the NUREGs?

Q&A # 4

- RG 1.21 states that licensees should report volumes of water discharged during steam generator blowdowns. It states that this means “very low activity waste.” If there is no detectable activity in steam generator blowdown should the volumes be reported?”

Q&A # 5 LLDs

- There is a standard formula for calculating the *a priori* LLD as found in NUREGs-0472 and -1301. LLD = $4.66\sqrt{B} \times K$ where B is the background and K are the constants to convert into a concentration. Other NRC documents such as MARSSIM (NUREG-1575) page 6-34 refer to the Detection Limit $L_D = 3+4.65\sqrt{B}$ which can be converted to the MDC. For the REMP we are using $4.66\sqrt{B} \times K$. Which is the preferred method? MARSSIM appears to say that its formula is the "more" correct one.

Q&A # 6 Detecting RAM in REMP samples

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

- What formula does the NRC recommend us to use to determine whether a measured result, the *a posteriori* value, is above background.?

- For example, MARSSIM advocates the use of Currie's critical level $L_c = 2.33\sqrt{B}$ for the measurement to test whether we need to look more closely at a result before we conclude that the result is just a statistical fluctuation above zero? MARLAP (page 3-36) recommends that a detection decision should be made by comparison to the critical level $L_c = 2.33\sqrt{B}$. Currently we are determining that we have a positive result when $X-2\sigma > 0$. Could the NRC generate a document of preferred formulae and methodology for calculating the "*a posteriori* " value to use for determining whether we have a real positive result in a REMP sample?

LLD

This equation determines an ***a priori*** limit of detection based on optimal characteristics of the detection system and the sample (this is the NRC definition for RETS).

$$LLD, \mu Ci/mL = \frac{4.66 \times \sigma_b}{(3.7 \times 10^4 \times E \times V \times Y \times e^{-\lambda \Delta t})}$$

Where:

σ_b = standard deviation of the background
E = detector efficiency
V = volume of sample in mL
Y = Chemical yield (=1 for gamma spec)
Δt = elapsed time between sampling and counting

Detection Equation Calculations

			Activity at beginning of Count interval, pCi/L			
	Bg, cps	Fractional Efficiency	Lc	MDA	LLD	MDC
14400 sec	0.01	0.01	6.2	10.5	12.3	12.9
(4 Hours)	0.05	0.01	13.8	23.5	27.6	28.1
	0.1	0.01	19.5	33.3	39.0	39.5
	1	0.11	5.6	9.6	11.2	11.2
	10	0.21	9.3	15.8	18.6	18.6
	100	0.31	19.9	33.9	39.8	39.7
3600 sec	0.01	0.01	12.3	21.0	24.7	27.0
(1 Hour)	0.05	0.01	27.6	47.0	55.2	57.5
	0.1	0.01	39.0	66.5	78.0	80.3
	1	0.11	11.2	19.1	22.4	22.6
	10	0.21	18.6	31.7	37.1	37.2
	100	0.31	39.8	67.9	79.6	79.5

Note that the value for the constants in the MDA equation used were A=0, B=0 and C=5.43. This was done to allow the numerator to align with the L_D value of twice the L_C. If the usual value of 21.7 was used, the MDA value would have been a factor of about 2 *higher*

Minimum Detectable Concentration

$$MDC = \frac{\frac{2.71}{t_s} + 3.29\sqrt{R_b\left(\frac{1}{t_s} + \frac{1}{t_b}\right)}}{E \cdot V \cdot 2.22 x 10^6 \cdot Y \cdot e^{-\lambda \Delta t}}$$

where:

MDC	=	the *a priori* MINIMUM DETECTABLE CONCENTRATION (µCi per unit mass or volume).
2.71	=	the square of the standard normal variate (1.645) for the 95 percent confidence level (Ref. 12, Section II.D).
3.29	=	two times the standard normal variate (1.645) for the 95 percent confidence level (Ref. 12, Section II.C).
R_b	=	the background counting rate, or the counting rate of a blank sample, as appropriate (counts per minute).
t_s	=	the length of the sample counting period (minutes).
t_b	=	the length of the background counting period (minutes).
E	=	the counting efficiency (counts per disintegration)
V	=	the sample size (units of mass or volume).
2.22×10^6	=	the number of disintegrations per minute per µCi.

RETS MINIMUM DETECTABLE CONCENTRATION (LLD) μCi/mL (pCi/L)		REMP Reporting Level (Minimum Detectable Concentration, MDC)	
A. Waste Tanks Producing BATCH RELEASES		Analysis	Water (pCi/L)
PRINCIPAL GAMMA EMITTERS	5 E-7 (5E+2)	Fe-59 Mn-54 Co-58	4E+2 1E+3 1E+3
I-131	1 E-6 (1E+3)		
Dissolved and Entrained Gases (Gamma Emitters)	1 E-5 (1E+4)		
H-3	1 E-5 (1E+4)	H-3	2 E+4[a]
Gross Alpha	1 E-7 (1E+2)		
Sr-89, Sr-90	5 E-8 (5E+1)		
Fe-55	1 E-6 (1E+3)		

B. CONTINUOUS RELEASES[c] SGBD			
PRINCIPAL GAMMA EMITTERS	5 E-7 (5E+2)	Zn-65 Co-60 Zr-95 Nb-95 Cs-134 Cs-137	3 E+2 3E+2 4E+2 7E+2 3E+1 5E+1
I-131	1 E-6 (1E+3)	I-131	2E+0
Dissolved and Entrained Gases (Gamma Emitters)	1 E-5		
H-3	1 E-5		
Gross Alpha	1 E-7		
Sr-89, Sr-90	5 E-8	I-131	2 E+0[b]
Fe-55	1 E-6		

Regional perspectives

- Region I Inspector
  - Bruce Dionne
- Region III Inspectors
  - John Cassidy
  - Steve Bell