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September 26, 1984

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Subject: Byron Generating Station Units 1 and 2
Braidwood Generating Station Units 1 and 2
Iodine Sampling of Stack Effluent
NRC Docket Nos. 50-454/455 and 50-456/457

Dear Mr. Denton:

This is to provide additional information regarding the design basis for the shielding associated with iodine sampling of the Byron/Braidwood vent stack effluent under post-accident conditions. NRR review and acceptance of this aspect of design is necessary to close open items identified during I&E inspections at Byron Station.

Table II.F.1-2 of NUREG-0737 indicates that an iodine source term of 100 μCi/cc and a sample time of 30 minutes are to be used as the design basis shield envelope for post-accident grab sampling of vent stack effluent. These criteria are unnecessarily conservative. We have verified that the existing equipment and procedures can be used to keep personnel exposures during sampling well within the limits imposed by General Design Criteria 19 (5 rem whole body and 75 rem extremity) assuming release of 1.5% of the core iodine inventory.

Details of our calculations are provided in Attachments 1 through 4 to this letter. Appendix E of the FSAR will be revised to document the iodine source term and sample time used in this evaluation of the shielding. These changes will be incorporated into the FSAR at the earliest opportunity.

Please address further questions regarding this matter to this office.

One signed original and fifteen copies of this letter and the attachments are provided for NRC review.

Very truly yours,

T. R. Tramm

T. R. Tramm
Nuclear Licensing Administrator

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cc: Byron Resident Inspector

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ATTACHMENT 1: Calculation of Iodine Source Term

The following iodine source term calculation is based on a loss of all AC power scenario (details of this scenario are available from G. T. Klopp, Project Engineering Department). 100% of the noble gas core inventory and 1.5% of the iodine core inventory is released 33 hours after the event occurs. The duration of the release is 4 hours. At the time of the release, it is assumed that one Auxiliary Building Vent Fan is operable and that the charcoal filters are 10% efficient in filtering iodines.

1. Iodine Core Inventory (Byron FSAR, Table 15.0-8)

I-131	8.8E7	curies	Decayed 33 hours*	5.14E6	curies
I-132	1.34E8	curies		5.30E3	curies
I-133	1.97E8	curies		6.38E7	curies
I-134	2.31E8	curies		8.01E-4	curies
I-135	1.79E8	curies		5.84E6	curies
			Total	7.49E7	curies

* Release occurs 33 hours after event.

2. Total Fraction of Iodines Released = .015

   7.49E7 Ci x .015 = 1.12E6 Ci released

3. Fraction of Iodines Released Per Minute

$$\frac{.015}{4\ \text{hrs}} \times \frac{1\ \text{hr}}{60\ \text{min}} = 6.25\text{E-}5/\text{minute} \times 7.49\text{E7Ci} = 4680\ \text{Ci/min}$$

4. Assume One Auxiliary Building Fan On.

$$\frac{4680\ \text{Ci}}{\text{min}} \div \frac{159000\ \text{ft}^3}{\text{min}} = 2.94\text{E-}2\ \text{Ci}/_{\text{ft}^3} = 1.04\text{E }0\ \text{uCi}/_{\text{cc}}$$

5. Assume Charcoal is 10% Efficient for Iodines.

   1.04E 0 uCi/cc ÷ 10 = 1.04E-1 uCi/cc Iodine Source Term

ATTACHMENT 2: Dose Rate from Iodine Filter Assembly

The following is a calculation of the dose rate from the General Atomic Wide Range Gas Monitor grab sample assembly. A one-minute grab sample is obtained. The monitor flowrate is 0.06 cfm.

1. Contact Dose Rate

$1.04E\text{-}1\ uCi/cc \times .06\ ft^3/min \times 28320\ cc/ft^3 \times 1\ min = 177\ uCi$ on assembly

$5.6E3 \times 1.77E\text{-}4\ Ci \times .5Mev = 4.95\text{-}1\ R/hr$
$= 495\ mR/hr$ at 1 cm

2. Dose Rate at One Foot

$$\frac{(495)\ (1)^2}{(30.48)^2} = .533\ mR/hr \text{ at } 1\ ft.$$

ATTACHMENT 3: TIME MOTION STUDY

The following summarizes the dose accumulated in the process of going to the General Atomic Wide Range Gas Monitor, obtaining the grab sample, and transporting the samples back to the laboratory for analysis. The purpose of this summary is to verify Byron can meet criteria of GDC 19 (5-rem whole body and 75-rem extremity). The dose rate specified at the monitor includes dose rates from the sample lines and from the two high range continuously sampling filter assemblies. Dose rates along the path to and from the monitor are based on values specified in the Postaccident Radiation Zone Maps found in Appendix E of the Byron FSAR (for a major line break accident in containment).

Area	Time Spent in Area	Dose Rate in Area	Dose Accumulated in Area
OSC to 451' Aux. Bldg.	3 minutes	1R/hr	50 mR
451' to 426' Aux. Bldg.	1 minute	15 mR/hr	.25 mR
426 to 451' Aux. Bldg.	.5 minute	10 R/hr	83.5 mR
451' to 477' Aux. Bldg.	1.5 minutes	10 R/hr	250 mR
At monitor *	4 minutes	60 mR/hr	4 mR
477' to 451' Aux. Bldg.	1.5 minutes	10 R/hr	250 mR
451' to Lab	1 minute	15 mR/hr	.25 mR
		Total	638 mR

*Includes contact dose rate from grab sample filter assembly.

Two individuals will be needed to perform this task, thus the total dose is multiplied by 2 to get a TOTAL dose for this task of 1.276 R whole body. The extremity dose to the sample collectors is not expected to exceed 2 R.

ATTACHMENT 4: Dose Rates from Sample Lines, Sample Casks

The following calculations document additional dose rates due to sample lines on the Wide Range Gas Monitor and the two continuous sampling filter assembly cask units. Sample line dose rates are based on noble gas activity in the lines. Specific values reported are obtained from "Analysis of Radiation Detectable from Stack Vent Sample Line Under Design Basis Accident Conditions - CECO contract 37844", prepared by Catalytic, Inc. (November, 1980).

1. Noble Gas Core Inventory (Byron FSAR, Table 15.0-8)

Kr 83 m	1.64E7 Ci	Decayed 33 hours*	7.50E 1 Ci
Kr 85	9.99E5 Ci		9.99E 5 Ci
Kr 85 m	3.95E7 Ci		2.18E 5 Ci
Kr 87	7.59E7 Ci		1.09E 0 Ci
Kr 88	1.08E8 Ci		3.06E 4 Ci
Kr 89	1.40E8 Ci		0 Ci
Xe 131 m	6.68E5 Ci		6.16E 5 Ci
Xe 133	2.03E8 Ci		1.69E 8 Ci
Xe 133 m	5.16E6 Ci		3.38E 6 Ci
Xe 135	5.55E7 Ci		4.55E 6 Ci
Xe 135 m	5.46E7 Ci		0 Ci
Xe 138	1.79E8 Ci		0 Ci
			1.79E 8 Ci

* Release occurs 33 hours after event.

2. 100% of noble gases released. Fraction released per minute:

$$\frac{1}{4\ hr} \times \frac{1\ hr}{60\ min} = 4.17E\text{-}3/min \times 1.79E8\ Ci = 7.46E5\ Ci/min$$

3. Assume One Auxiliary Building Fan On

$$7.46E5\ Ci/min \div 159000\ ft^3/min = 4.69\ Ci/ft^3 = 166\ uCi/cc$$

4. Sample Line Dose Rates

Dose rates are reported for (a) 2 foot section of 1-inch diameter sample line at 6 inches from the line and (b) 2 foot section of 3/8 inch diameter sample line at 6 inches from the line. This results in a conservative dose rate as the sample collector will actually be approximately 2 to 3 feet from the sample lines and actual sample lines are 3/4-inch and 1/8-inch in diameter.

a. Dose rate from 1-inch diameter line at 6 inches

$$.17\ \frac{mrem/hr}{uCi/cc} \times 166\ uCi/cc \times 1.4^* = 39.5\ mrem/hr$$

* Dose rate for 2 foot line section is 40% greater than for the .17 mrem/hr/uCi/cc value for a 1 foot line section.

b. Dose rate from 3/8-inch diameter line at 6 inches

$$.015 \frac{\text{mrem/hr}}{\text{uCi/cc}} \times 166 \text{ uCi/cc} \times 1.4 = 3.5 \text{ mrem/hr}$$

5. Sampling Cask Dose Rates

Dose rates from the two continuous sampling filter assemblies are based on the iodine source term of 1.04E-01 uCi/cc and a sample time of 30 minutes. The lead casks are 2 inches thick.

$1.04E\text{-}1 \text{uCi/cc} \times 28320 \text{ cc/ft}^3 \times .06 \text{ ft}^3\text{/min} \times 30 \text{ min} = 5300 \text{ uCi on filter assembly}$

$5.6E3 \times .5 \text{ Mev} \times 5.3E\text{-}3 \text{ Ci} = 14840 \text{ mR/hr at 1 cm}$

$= 575 \text{ mR/hr at 5.08 cm unshielded}$

$I = I_0 e^{-ux}$

$= 575e^{-(1.82)(5.08cm)}$

$= .05 \text{ mR/hr at surface of cask}$