

Attachment B

Southern California Edison Company

SAN ONOFRE NUCLEAR GENERATING STATION

P.O. BOX 128

SAN CLEMENTE, CALIFORNIA 92672

April 12, 1984

U. S. Nuclear Regulatory Commission
Office of Inspection and Enforcement
Region V
1450 Maria Lane, Suite 210
Walnut Creek, California 94596-5358

Attention: Ray Fish, Team Leader
Emergency Preparedness Facility Appraisal

Subject: Docket No. 50-206/361/362
Dose Assessments for Scenarios Nos. 2, 5, 19 and 20
from NUREG/CR 3012, Volume 3
San Onofre Nuclear Generating Station, 1, 2 and 3

Per your request at the exit interview for the Emergency Preparedness Facility Appraisal, I have completed dose assessments using the EARS program for scenarios numbers 2, 5, 19 and 20 from NUREG/CR 3012, Volume 3. Copies of computer printouts of these assessments are attached for your review. The results of these dose assessments were compared to the results obtained from the IRADAM model utilized in the NUREG, and the following points were noted:

- 1) EARS currently uses a recirculation factor in the calculation of \bar{X}/Q . The value of this factor varies from about 4 at the site boundary to 1.1 at 10 miles. As a result of the recirculation effect, the \bar{X}/Q value calculated by EARS is slightly higher than the \bar{X}/Q calculated by IRDAM.
- 2) EARMAN utilizes a mixing depth (inversion layer) value which acts as an upper boundary for reflection of a plume. This value is a variable and is entered by the user during meteorological input. The current default for the mixing depth is 101 meters, as suggested by the Corporate Meteorologist. I performed two runs of each scenario utilizing mixing depths of 101 meters and 1000 meters to demonstrate the effect of different mixing depths on the calculated \bar{X}/Q values. When the mixing depth is low, the σ_z value quickly approaches the mixing height but cannot expand beyond this layer. As a result, the vertical dispersion is reduced and the concentration downwind is increased.

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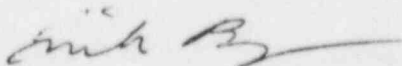
April 12, 1984

- 3) The dose rates at a distance downwind calculated by IRDAM are performed at slightly different locations than those calculated by EARS. For instance, EARS calculates the EAB dose rate at a distance of 580 meters, while IRDAM's first comparable calculation distance is for 500 meters.
- 4) Scenarios 19 and 20 were calculated by IRDAM as elevated releases; however, EARS calculates all releases at ground level. As a result of this difference in release height, the X/Q values calculated by EARS are higher than those calculated by IRDAM for these two scenarios.

When all the differences noted in points 1 through 4 have been addressed, the values calculated by EARS agree to within a factor of 2 or better with the values calculated by IRDAM. This comparison has been tabulated in Attachment 1 for scenarios 2 and 5. Comparisons between EARS (with L equal to 1000) and IRDAM can be made directly at distances of 2 and 5 miles, and indirectly from the hand calculation at any other distance.

Similar extensive comparisons with EARS printouts and hand calculations have been done to verify that the computer calculations are performed correctly, however, these are contained in various memos and log books. We are currently assimilating these documents and the validations on meteorological and RMS inputs performed by the Computer Group into one record. If you have any further questions regarding these or any other dose assessments provided, please contact me at (714) 492-7700, ext. 59-108.

Sincerely,



LINDA BRAY
Health Physics Engineer

Enclosures

cc: E. Branigan (USNRC Headquarters)

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Table of Dose Rate (mr/hr) Calculations

Scenario	2	EARS (L=101m)	EARS (L=1000m)	Hand Calculation*				IRDAM
				With Recirc Factor		Without Recirc Factor		
Distance				L = 101	L = 1000	L = 101	L = 1000	
0.3 mi.				19	19	4.8	4.8	4.97
0.36 mi.		7	9	16	16	4	4	
1		2.6	.8	2	1.65	0.7	0.5	
1.2				1.52	1.25	0.5	0.38	0.189
2		0.9	.09	0.7	0.13	0.35	0.07	0.06
5		0.3	.03	0.13	0.01	0.13	0.01	0.01
10		0.1	.01	0.07	0.01	0.07	0.01	
12.4				0.05	0.007	0.05	0.007	0.005
0.3	5			5.6E4	5.6E4	1.4E4	1.4E4	1.6E4
0.36		5E4	8E4	4.7E4	4.7E4	1.2E4	1.2E4	
1		1.1E4	3.6E3	5E3	4.7E3	1.7E3	1.6E3	
1.2						1.3E3	1.2E3	6.18E2
2		3.5E3	3.6E2	2E3	4E2	1E3	2E2	1.97E2
5		9.8E2	1.E2	4E2	4E1	4E2	4E1	3.6E1
10		4.6E2	4.7E1	2E2	2E1	2E2	2E1	
12.4				1.4E2	1.4E1	1.4E2	1.4E1	1.6E1

*Example Hand Calculations are included in Attachment 2.

ATTACHMENT 2

Hand Calculations of Dose Assessments for Scenarios 2, 5, 19 and 20 of NUREG/CR 3012

I. Scenario #2

Input: Windspeed $u = 4.5$ mps
 Stability Class = B
 Gross release rate = 1 Ci/sec total Noble gas
 Initial effective age = 2 hours
 Duration of release = 8 hours

Based on Stability Class B

Distance Downwind	EAB	1 mile	2 miles	5 miles	10 miles
σ_z	60	220	800	8,600	44,000
σ_y	90	200	400	900	1,700

With Mixing Height L

$$\text{for } \sigma_z < 2L \quad X/Q = \frac{K}{\pi \sigma_y^2 u} \left[1 + 2 \sum_{n=1}^7 \exp \left(-2 \frac{(nL)^2}{\sigma_z^2} \right) \right]$$

$$\text{for } \sigma_z \geq 2L \quad X/Q \approx \frac{K}{2\pi \sigma_y^2 L u}$$

where K = recirculation factor : $K = 4$ if $d \leq 1200$
 $K = 1$ if $d \geq 1500$, otherwise
 $K = -2.59814 (\log_{10} d)^3 + 31.70108 \log_{10} d^2$
 $129.38097 \log_{10} d + 177.6703$

$$D \text{ (whole body dose rate)} = X/Q \times Q \times DCF \times 1.14 \text{ E2} \times CR$$

where DCF = dose conversion factor $\frac{\text{mrem} \cdot \text{m}^3}{\text{yr} \cdot \mu\text{Ci}} \approx 2.94 \text{ E2}$ for Xe-133

1.14 E2 = conversion to $\frac{\text{mrem} \cdot \text{m}^3}{\text{hr} \cdot \text{Ci}}$

CR = correction factor for gas age ≈ 10

A) Case 1 : L = 101m

$$\text{at EAB : } X/Q_{\text{EAB}} = \frac{4}{\pi (60)(90)(4.5)} [1 + .01] = 5 \text{ E-5}$$

at 1 mile $\delta_z > 2L$, $K = 3$

$$\bar{x}/Q \approx \frac{3}{2\pi(200)(101)4.5} = 5.3 \text{ E-6}$$

at 2 miles $K = 2$

$$\bar{x}/Q = \frac{2}{2\pi(400)(101)4.5} = 2 \text{ E-6}$$

at 5 miles $K = 1$

$$\bar{x}/Q = \frac{1}{2\pi(900)(101)4.5} = 4 \text{ E-7}$$

at 10 miles $K = 1$

$$\bar{x}/Q = \frac{1}{2\pi(1,700)(101)4.5} = 2 \text{ E-7}$$

$$\therefore D_{EAB} = (\bar{x}/Q)_{EAB} \times \frac{1 \text{ Ci}}{\text{sec}} \times 2.94 \text{ E2} \times 1.14 \text{ E2} \times 10 = 4 \text{ E-5} \times (3.3 \text{ E5})$$

$$\approx 16 \text{ mrem/hr}$$

$$D_{1 \text{ mile}} = (\bar{x}/Q)_{1 \text{ mile}} \times 3.35 \text{ E5} \approx 2 \text{ mrem/hr}$$

$$D_{2 \text{ miles}} = (\bar{x}/Q)_{2 \text{ miles}} \times 3.35 \text{ E5} \approx 0.7 \text{ mrem/hr}$$

$$D_{5 \text{ miles}} = (\bar{x}/Q)_{5 \text{ miles}} \times 3.35 \text{ E5} \approx 0.13 \text{ mrem/hr}$$

$$D_{10 \text{ miles}} = (\bar{x}/Q)_{10 \text{ miles}} \times 3.35 \text{ E5} \approx 0.07 \text{ mrem/hr}$$

B) Case 2 L = 1000m (Comparable to IRDAM treatment of mixing depth, includes variable recirculation factor) 7

$$\text{at EAB : } (\bar{X}/Q) = \frac{4}{\pi(60)(90)(4.5)} \left[1 + 2 \sum_{n=1}^7 \exp \left(-2 \frac{(nL)^2}{\delta_z} \right) \right]$$

$$\approx \frac{4}{\pi(60)(90)(4.5)} [1 + \approx 0]$$

$$\approx 5 \text{ E-5}$$

$$\text{at 1 mile } (\bar{X}/Q) = \frac{3}{\pi(220)(200)4.5} [1 + \approx 0]$$

$$= 5 \text{ E-6}$$

$$\text{at 2 miles } (\bar{X}/Q) = \frac{2}{\pi(800)(400)4.5} [1 + \approx 0]$$

$$= 4 \text{ E-7}$$

$$\text{at 5 miles } (\bar{X}/Q) = \frac{1}{2\pi(900)(1000)4.5}$$

$$= 4 \text{ E-8}$$

$$\text{at 10 miles } (\bar{X}/Q) = \frac{1}{2\pi(1700)(1000)4.5}$$

$$= 2 \text{ E-8}$$

$$\therefore D_{\text{EAB}} = 5 \text{ E-5} \times 3.35\text{E5} \approx 16$$

$$D_{1 \text{ mile}} = 4 \text{ E-6} \times 3.35\text{E5} \approx 1.65$$

$$D_{2 \text{ miles}} = 0.13$$

$$D_{5 \text{ miles}} = 0.01$$

$$D_{10 \text{ miles}} = 0.01$$

II. Scenario #5

Same meteorological inputs as Scenario #2, therefore, same X/Q values.

Gross release rate = 1 Ci/sec Iodine

$$D_{Thy} = (X/Q) \times Q \times THYDCF \times 3.6 E6 \times CR$$

where THYDCF = dose conversion factor for I-131 $\approx 5.15 E2 \frac{\text{rem m}^3}{\text{sec Ci}}$

3.6 E6 = converts rem/sec to mrem/hr

CR = correction for gas mix age ≈ 0.5

A) Case 1 : L = 101m

$$\begin{aligned} \text{at EAB } D_{THY} &= (X/Q) \times 1 \times 5.15 E2 \times 3.6 E6 \times 0.5 = X/Q \times 9.3 E8 \\ &= 5 E-5 \frac{\text{sec}}{\text{m}^3} \times 9.3 E8 \\ &\approx 4.7 E4 \text{ mrem/hr} \end{aligned}$$

$$\text{at 1 mile } D_{THY} = 5.3 E-6 \times 9.3 E8 \approx 5 E3 \text{ mrem/hr}$$

$$\text{at 2 miles } D_{THY} = 2 E-6 \times 9.3 E8 \approx 2 E3 \text{ mrem/hr}$$

$$\text{at 5 miles } D_{THY} = 4 E-7 \times 9.3 E8 \approx 4 E2 \text{ mrem/hr}$$

$$\text{at 10 miles } D_{THY} = 2 E-7 \times 9.3 E8 \approx 2 E2 \text{ mrem/hr}$$

B) Case 2 : L = 1000m

$$\text{at EAB } D_{THY} = 5 E-5 \times 9.3 E8 \approx 4.7 E4 \text{ mrem/hr}$$

$$\text{at 1 mile } D_{THY} = 5 E-6 \times 9.3 E8 \approx 4.7 E3$$

$$\text{at 2 miles } D_{THY} = 4 E-7 \times 9.3 E8 \approx 4 E2$$

$$\text{at 5 miles } D_{THY} = 4 E-8 \times 9.3 E8 \approx 4 E1$$

$$\text{at 10 miles } D_{THY} = 2 E-8 \times 9.3 E8 \approx 2 E1$$

Attachment C

Message:

RADIOLOGICAL ACTION LEVEL @ 84/03/29 1900 : Alert

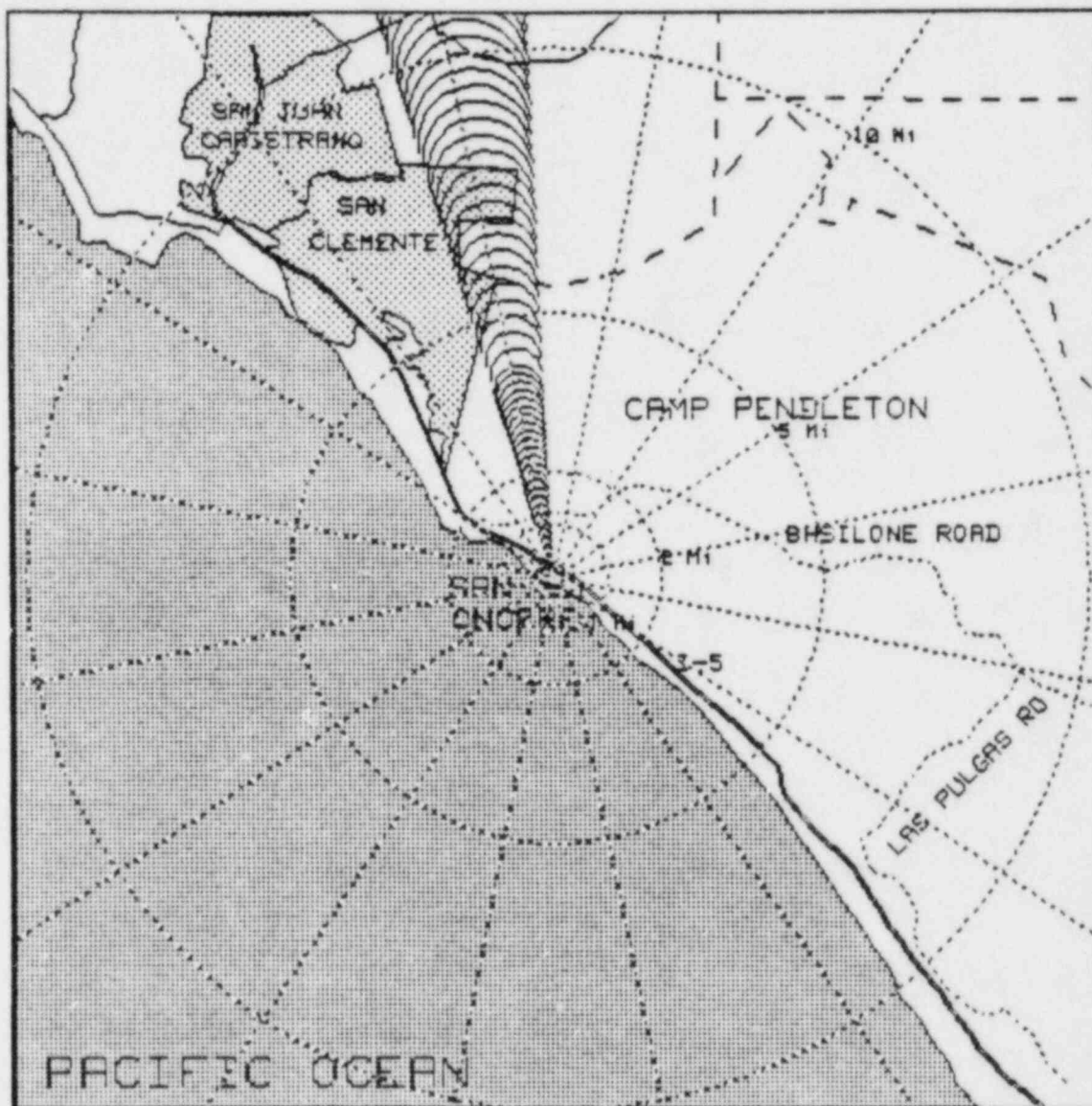
DOSE TYPE	CLASS A MODEL		SEC- TOR	UNUSUAL EVENT	EMERGENCY CLASS CRITERION		
	CURRENT ESTIMATE @ EAB				ALERT	SITE EMERGENCY	GENERAL EMERGENCY
TECH SPEC. WHOLE BODY (N.GASES ONLY)	1.7E+00 mrem/hr		A	.057* mrem/hr (A1-1)	.570* mrem/hr (A2-1)	---	----
TECH SPEC. SKIN	4.0E+00 mrem/hr		A	.340* mrem/hr (A1-1)	3.400* mrem/hr (A2-1)	----	----
TECH SPEC. THYROID	8.5E-03 mrem/hr		A	.170 mrem/hr (A1-1)	1.700 mrem/hr (A2-1)	----	----
EPA P.A.G. WHOLE BODY	3.0E+00 mrem		A	----	----	500 mrem (A3-8)	----
EPA P.A.G. THYROID	1.7E-02 mrem		A	----	----	5000 mrem (A3-8)	----
NUREG 0654 WHOLE BODY (ALL ISOTOPES)	1.5E+00 mrem/hr		A	----	----	50 mrem/hr (A3-3)	500 mrem/hr (A4-1)
NUREG 0654 THYROID	8.5E-03 mrem/hr		A	----	----	250 mrem/hr (A3-4)	5000 mrem/hr (A4-2)

* Identifies Any Value Which Exceeds the Radiological Action Level

NOTE: The Above Calculations are based on a CHI/Q of 5.0E-05 Calculated from the Most Recently Entered MET Data.

NOTE: State of California Regulations Require the Site and General Emergency Values to be 500 mrem (mrem/hr) rather than 1000 mrem (mrem/hr) as recommended for Whole Body Exposure by NUREG 0654 and EPA P.A.G.

Attachment D



10 Mile Radius

Release Start: 84/03/28 1005

Plume Update: 84/03/28 1205

Wind Speed: 4.0 M/sec

Wind Dir. : 170.0 Deg

Edge Dose Rate & Type: $6.1E-02$ mrem/hr (THYROID)