From: <kulczyckyt@nimo.com>
To: WND2.WNP3(DSH)
Date: 5/19/98 2:52pm
Subject: NMP Unit 1 Control Room doses resulting from a Unit 2 MSLB

Attached calculation determines the radiological consequences of a Unit 2 Main Steam Line Break to the Unit 1 Control Room.

(See attached file: U2MSL-U1.doc)

The document is in WORD for Windows version 7.0 format - if unable to read please call. My number is 315-349-1949 or try my pager 1-800-732-4365, pager # 1072.

Ted Kulczycky

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OBJECTIVE OF CALCULATION

The objectives of this calculation are to determine the radiological consequences of a Unit 2 Main Steam Line Break (MSLB) accident to the Unit 1 Control Room (CR). Doses calculated will be compared to the 10CFR50 App A GDC19 (REF 1) dose limits to confirm that the Unit 1 Control Room is habitable following a design basis MSLB at Unit 2. Note that the Unit 2 MSLB is not a Unit 1 Design Basis Accident. However, it is analyzed to ensure Unit 1 Control Room Habitability can be maintained during a Unit 2 MSLB.
REASON FOR REVISION 1: The purpose of revision 1 is to incorporate design inputs relating to control room normal ventilation intake flow rate and control room air volume.

METHOD

The activity released in a Unit 2 MSLB, using power uprate activities, are input to Stone & Webster (SWEC) computer code DRAGON (REF 9) using a puff release model. A χ/Q value for the Unit 2 Turbine Building (actually main steam tunnel) blow out panel to the Unit 1 CR intake is modeled with Unit 1 emergency filtration conservatively assumed not to actuate. The activity release from the Unit 2 TB is completed within two hours, 720 hr CR doses are calculated. The results are then compared to the dose limits given in GDC 19 (REF 1).

DATA / ASSUMPTIONS

MSLB activities released, in units of Curies, are taken from the Unit 2 calculation PR-C-25-B-01A and are presented in Table 1 (REF 2).

The free volume of the Unit 1 control room is 1.31E+5 ft^3. (REF 3).

The control room normal ventilation intake flow rate is 2250 cfm ± 10%. 2250 cfm + 10% = 2475 cfm, use 2500 cfm. (REF 10).

The doors of the control room are weather-stripped and the penetrations sealed to maintain a positive pressure of approximately one-sixteenth of an inch of water (REF 4, page III-11), however, an unfiltered inleakage of 10 cfm to the control room is assumed per REF 5, Section III.3.d.(2).(ii). An additional 20 cfm is assumed to account for an unfiltered inleakage (REF 6) through an unsealed drain. The total inleakage of 30 cfm combined with the normal ventilation flow rate given in DATA/ASSUMPTIONS #3, makes the total Unit 1 CR air intake rate 2530 cfm.

Breathing rate of 3.47E-04 m3/sec (REF 7) is assumed for the duration (0-720 hr) of the accident.

Unit 2 TB Blowout Panel to Unit 1 Control Room 0 - 2 hr χ/Q is 3.41E-4 sec/m3 (Table

2 of REF 8).

GDC 19 (REF 1) dose limit 5 Rem whole body or its' equivalent. This equates to 30 Rem Thyroid and 30 Rem Beta (skin) per SRP 6.4 (REF 5)

TABLE 1 UNIT 2 MSLB ACTIVITY RELEASED (CI)	
ISOTOPE	ACTIVITY (CI)
I-131	1.13E+1
I-132	1.92E+1
I-133	1.40E+2
I-134	3.50E+2
I-135	1.48E+2
BR-83	1.12E+0
BR-84	1.50E+0
BR-85	8.25E-1
KR-83M	1.50E-1
KR-85M	2.52E-1
KR-85	8.02E-4
KR-87	8.90E-1
KR-88	8.90E-1
KR-89	5.50E+0
XE-131M	6.40E-4
XE-133M	1.20E-2
XE-133	3.44E-1
XE-135M	1.12E+0
XE-135	9.62E-1
XE-137	6.40E+0
XE-138	3.70E+0

Reference 2

CALCULATION

The following input is made to DRAGON run # 9736 dated 5/17/98. Note that a card input of the input to this run is included in Appendix A

DRAGON inputs:

Unit 2 Main Steam Tunnel volume - not required due to release is in fractions per day

Main Steam tunnel release rate 2.0E+5 fractions per day for the period 0 to 2 hrs. This is the DRAGON recommended value for puff releases.

Unit 1 Control Room

volume - 1.31E+5 cubic ft: DATA/ASSUMPTIONS #2
intake rate 0 to 720 hrs 2530 cfm : DATA/ASSUMPTIONS #3&4
filter efficiencies 0 - 720 hrs 0: DATA/ASSUMPTIONS #3

Breathing rate 0-720 hrs 3.47E-04 m3/sec: DATA/ASSUMPTIONS #5

0 - 2 hr χ/Q is 3.41E-4 sec/m3 DATA/ASSUMPTIONS #6. No χ/Q is required after 2 hours as all the activity has been released.

Activities in units of Ci from Table 1 are instantaneously released to Volume 1 (Main Steam Tunnel at T=0): DATA/ASSUMPTIONS #1.

RESULTS

The 0 to 720 hr Unit 1 Control Room Doses are as follows:

TABLE 2	Unit 1 Control Room Dose	
UNIT 2 MSLB TO UNIT 1 CONTROL ROOM		
	DOSE(REM)	
	Unit 1 CR	GDC 19 Limit
Thyroid	1.11E+01	30
Gamma	2.94E-03	5
Beta	1.98E-02	30

CONCLUSIONS

A design basis Unit 2 MSLB accident results in 30 day doses in the Unit 1 Control Room which are less than 10CFR50 Appendix A GDC 19 dose criteria without taking credit for Unit 1 CR emergency filters.

COMPUTER RUN LOG

JOB #	DATE	DESCRIPTION OF RUN
9736	5/17/98	DRAGON (REF 9) Unit 2 MSLB to Unit 1 CR - no CR filters

Note: Card image of computer run listed above is given in APPENDIX A

REFERENCES

CFR Part 50, Appendix A, General Design Criteria 19.

NMPC Calculation PR-C-25-B-01 and Disposition 01A - "EAB, LPZ, and Control Room Doses Due to Main Steam Line Break Accident Outside Containment"

S10-210-HV12, Control Room & Auxiliary Control Room, revision 00, pages 45 and attachment I-3 and NMPC Drawings: C18810C, sheet 1; C18812C, sheet 1; C18804C, sheet 1.

Nine Mile Point Unit 1 Final Safety Analysis Report Revision 14 Section III.B.2.2, "Control Room Heating Ventilation and Air Conditioning System."

NUREG-0800, Standard Review Plan 6.4, "Control Room Habitability System."

NMPC calculation S10-CR277.A-U1.210, revision 00

Reg Guide 1.3, "Assumptions Used for Evaluating the Potential Radiological Consequences of a Loss of Coolant Accident for Boiling Water Reactors", Revison 2, June 1974.

MES Report " X/Q Values at NMP Unit 1 CR Air Intake and Emergency Operations Facility for All Nine Mile Point Unit 2 Release-Building Scenarios", 5/30/90.

DRAGON Computer Code, SWEC Number NU-115, Version 5, Level 0

Internal Correspondence, file code M98-014, from T. Mogren to T. Kulczycky dated 5/18/98, "Outside Air Flow Rate for Control Room Ventilation."

APPENDIX A (1 pages total)

CARD IMAGE OF COMPUTER RUNS

TITLE PAGE

CONTROL ROOM VENTILATION MONITOR SETPOINT - MSLB

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OBJECTIVE OF CALCULATION

The objective of this calculation is to determine a realistic setpoint limit for control room (CR) ventilation air intake monitors RE-210-42 (channel 11) and RE-210-43 (channel 12) based on the radioactive concentration at the CR air intake due to the post-main steam line (MSLB) accident release. The current setpoint of ≤ 1,000 cpm is based on a maximum radioactivity concentration (puff release) resulting from a MSLB accident with the total reactor coolant iodine activity of 25 μCi/gm (REFs 6 & 2.c). While re-establishing the MSLB design basis accident, based on the as-built design information (an action required for the closure of DER 1-97-0329), it was noticed that the radioactive isotopic concentration at the CR air intake was less than the value required to reach the setpoint of the monitor and initiate the CR emergency ventilation (CREV) system. If the CREV is not credited for the removal of iodine during and after the MSLB accident, the CR thyroid dose will exceed the GDC 19 limit (REF 11) for the current Licensing basis (REFs 1, 2, & 15). Therefore, the CR vent monitor setpoints are re-established for the following two cases:

1. The total iodine concentration of 25 μCi/gm in the reactor coolant released during the MSLB accident.

2. The total iodine concentration of 10 μCi/gm in the reactor coolant released during the MSLB accident.

An additional case is analyzed with the CREV actuation and total iodine concentration of 25 μCi/gm in the reactor coolant released during the MSLB accident.

METHOD

This section provides a brief discussion of the general methodology used in calculating the CR ventilation air intake monitor setpoints for the above two cases due to the MSLB accident releases. Additional details are provided in the specific calculation sections.

The DRAGON computer code (REF 14) is used to calculate isotopic activities in the turbine building (TB), the environment outside and inside the CR, and doses in the CR due to airborne activity. The initial noble gas and iodine isotopic activities released from the MSLB are taken from Tables 1, 2, & 3.

The break of a main steam line downstream of reactor building outboard isolation valve represents a potential escape route for reactor coolant from the vessel to the atmosphere until main steam line isolation valve closes within 11 seconds after the accident. The steam line break will be sensed by either increased pressure drop across the venturis or increased temperature in the main steam tunnel. The MSLB results in clad temperature no higher than the normal operating temperature, thus no clad perforations occur (REF 17, page 1-1). Therefore, the total iodine activity concentration in the reactor coolant mass release and noble gas activity concentrations in the steam mass release are normalized to the maximum limits specified in the UFSAR (REF 1.a, 1.b & 4) and Technical Specifications (REFs 2.a & 4) to obtain the initial activities releases during the MSLB accident (see Tables 1, 2, & 3).

DATA / ASSUMPTIONS

SOURCE TERM PARAMETERS-

1. The reactor is assumed to be operating at full power and reactor scrams at the time of MSLB accident (REF 3).

Total mass of coolant released is that amount in the steam line and the connecting lines at the time of the break plus the amount that passes through the valves prior to closure (REF 3, Item C.3):

Total mass of coolant = 80,900 lbs (REF 1.a, page XV-32 and REF 4, page 5)

3. Reactor coolant mass flashed into steam = 39,350 lbs (REF 1.a, page XV-34, and REF 4, page 6)

   Note: Iodine isotopic activities released during the MSLB accident are calculated in Reference 4, page 5, using the total coolant mass of 80,900 lbs. Only 39,350 lbs of coolant flashes into steam, thereby, releasing the corresponding amount of liquid-borne iodine in the environment. The information provided in the UFSAR page XV-32 (REF 1.a) is not transformed properly from the design basis document (REF 4). Therefore, the iodine isotopic activities in the flashed coolant are calculated in Tables 2 & 3 are used in this analysis.

4. Total mass of steam released during MSLB accident = 26,250 lbs (REF 1.a, page XV-33 and REF 4, page 4).

5. The isotopic noble gas activities in the steam released during MSLB accident are given in Reference 4, page 5. The total noble gas activity exceeds the limit of 70 Ci (REF 4 & 1.a), therefore, the noble gas activity in Table 1 is normalized to 70 Ci. The normalized noble gas isotopic activities are used in this analysis.

6. All of the iodine (no credit for plateout is allowed) from the released coolant are released to the atmosphere within 2 hours (REF 3 , Item C.5).

7. For the Licensing basis accident, the radioactivity in the coolant is assumed to be the maximum amount incorporated in the technical specifications provided that no further fuel failures are assumed to occur as a result of delay in valve closure (REF 3, Item C.4). The technical specification total iodine activity concentration limit is 25 μCi/gm (REF 2.a). For the radiation monitor setpoint, a value that results in acceptable CR doses without emergency filtration is used. Therefore, an additional case of total coolant iodine activity concentration of 10 μCi/gm is analyzed (predetermined to result in a thyroid dose of less than 30 Rem).

8. The main steam line isolation valves (MSIV) close within the maximum time incorporated in the Technical Specifications. This closure times verified by suitable periodic testing. The MSIV closure time is assumed to be 11 sec (REF 1, page XV-32) and verified to be less than10 sec every cold shutdown by surveillance procedure N1-ST-V8 (REFs 1.d, 16). The MSLB accident results in clad temperatures no higher than the normal operating temperature and thus no clad perforations or damage occurs (REF 17, page 1-1).

9. The breathing rate is assumed to be 3.47E-04 m3/s (REF 3, Item C.6.b).

10. It is assumed that the radioactive releases from the MSLB accident are released to the turbine building and finally released to the environment via the turbine building blowout panel (REFs 4 & 15).

11. Turbine building HVAC flow rate is 170,000 cfm (REF 1.c). This flow rate changes one volume of TB in one hour. Therefore, turbine building volume is calculated as follows:

    170,000 ft3/min x 60 min/hr x 1.0 hr = 1.02E+07 ft3

12. Atmospheric dispersion factors is 1.93E-03 s/m3 (REF 8).

CONTROL ROOM PARAMETERS

13. The free volume of the NMP 1 control room is 1.36E+5 ft^3. (REFs 13 & 18).

    CR Gross volume = 169,700 ft^3 (REF 18)
    Net CR Volume = 0.80 x 169,700 ft^3 = 1.36E+05 ft^3 (REF 13)

14. The control room normal intake rate is 3550 cfm unfiltered. This is calculated by taking the maximum flow rate of 16,300 minus the minimum recirc flow rate of 12,750 cfm (REF 1.e, Section III-B 2.2)

15. The iodine removal efficiency of the CREVS filter is assumed to be 99% for particulate iodine (REF 2.b, Sections 3.4.5.b and 3.4.5.c), and 90% for elemental and organic iodines. The weighted filter efficiencies are determined below to account for the 30 cfm unfiltered inleakage to the control room:

$$\text{Elemental \& Particulate Weighted Average} = \frac{(0.90*0.91) + (0.99*0.05)}{(0.91 + 0.05)} = 0.905$$

$$\text{Particulate \& Elemental Efficiency} = \frac{(3163\ \text{cfm})(.905) + (30\ \text{cfm})(0)}{3163\ \text{cfm} + 30\ \text{cfm}} = 0.896$$

$$\text{Methyl Efficiency} = \frac{(3163\ \text{cfm})(.90) + (30\ \text{cfm})(0)}{3163\ \text{cfm} + 30\ \text{cfm}} = 0.892$$

16. The doors of the control room are weather-stripped and the penetrations sealed to maintain a positive pressure of approximately one-sixteenth of an inch of water (REF 1, page III-11), however, an unfiltered inleakage of 10 cfm to the control room is assumed per Reference 10, Section III.3.d.(2).(ii). An additional 20 cfm is assumed to account for an unfiltered inleakage through an unsealed drain (REF 19). This makes the total air intake rate 3,580 cfm (3550 cfm + 30 cfm = 3,580 cfm).

    NOTE: The Standard Review Plan, Section 6.4 (REF 10), specifies control room pressurization of 1/8 inch water gauge with respect to all surrounding air spaces, and requires periodic verification of the ability to maintain this pressurization. This 1/8 inch water gauge requirement was not part of the design basis for the Unit 1 control room.

17. The control room recirculation air system has no iodine filter (REF 1, Fig III-14).

18. The maximum beta energies and percentage yield for isotopes decay by beta emission are obtained from Reference 9.

19. The KDB-1000 isotopic response to beta emission are obtained from Reference 7.

20. Activity release rate from TB:

    All of the iodine and noble gases from the released coolant are assumed to be released to the atmosphere within 2 hours (REF 3, Item C.5). Also, the initiation time of CREV is assumed to be 32 sec. If a puff release is assumed, all of the activity released will instantaneously be at the CR air intake during the initiation time which will result in a conservative dose, but a non-conservative setpoint. Therefore, a more realistic activity release rate is calculated in the following section, which distributes the release of 99.999% of activity from the TB in 2.0 hours:

    $A = A0\ e^{-\lambda t}$

Where A = activity at given time (t)

A0 = initial activity

λ = activity removal rate (fraction/hr)

t = activity removal time (2 hrs)

$A/A0 = (1 - 0.99999) = 0.00001$

Substituting the values in the above equation results:

$A/A0 = e^{-\lambda t}$

$0.00001 = e^{-\lambda t}$

$-\lambda t = -\lambda 2 = \ln 0.00001 = -11.51$

$\lambda = 11.51/2 = 5.755$ per hour = 138.0 volume/day

Therefore, a release rate of 138 volume/day is used which will release 99.999% of the activity from the TB in 2 hours.

21. This 30 day dose does not include any adjustment for control room occupancy. The X/Q value used for this accident is 1.93E-03 s/m3 which is for 0-8 hrs and does not include the occupancy factor.

Total expected control room occupancy:
(occupancy factors per REF 10)

100% occupancy for first 24 hours	= 24 hours
60% occupancy from 24 - 96 hours	= 43.2 hours
40% occupancy from 96-720 hours	= 249.6 hours

Total occupancy time = 24 + 43.2 + 249.6 = 316.8 hours
Total time in 30 days = 720 hours

Occupancy adjustment factor = 316.8 / 720 = 0.44 used to calculate the average gamma dose rate for 0-30 days.

22. The CR doses reach equilibrium before 24 hours (no additional dose contribution after 24 hours), the reduction of CR doses by applying the occupancy factors is not appropriate for the current analysis, therefore, the occupancy factors are utilized to calculate the average gamma dose rate only.

23. The activity released during the first 30 seconds is arbitrarily used to calculate initial activity release rate (Ci/sec). The activity release rate at time t = 0 sec will produce a very higher monitor response. The longer release time will produce lower monitor response. Since the TB blowout panel release rate is extremely high (138 volume/day), the radioactive cloud will travel to the CR air intake within a short time, therefore, the longer release time can not be justified. The use of activity release over 30 second provides reasonably good average distribution of activity and release rate.

Table 1

Post-MSLB Noble Gas Activity Released

Isotopes	Gross * Isotopic Activity in Main Steam Ci	Activity Normalized to 70 Ci gm
Kr-83m	6.00E-01	4.34E-01
Kr-85m	1.10E+00	7.96E-01
Kr-85	5.10E-03	3.69E-03
Kr-87	3.30E+00	2.39E+00
Kr-88	3.30E+00	2.39E+00
Kr-89	1.40E+01	1.01E+01
Xe-131m	3.30E-03	2.39E-03
Xe-133m	5.10E-02	3.69E-02
Xe-133	1.40E+00	1.01E+00
Xe-135m	4.20E+00	3.04E+00
Xe-135	5.70E+00	4.13E+00
Xe-138	6.30E+01	4.56E+01
Total	9.67E+01	7.00E+01

* Gross activity released in total mass of steam

		Table 2		

Post-MSLB Iodine Inventory Based on Total Iodine Activity of 25 uCi/gm

Iodine Isotopes	Isotopic Activity uci/gm	Normalized Isotopic Activity uci/gm	Coolant Mass Released gm	Total Activity Released Ci
I-131	2.00E+00	1.67E+00	1.79E+07	2.98E+01
I-132	5.20E+00	4.33E+00	1.79E+07	7.74E+01
I-133	8.00E+00	6.67E+00	1.79E+07	1.19E+02
I-134	7.40E+00	6.17E+00	1.79E+07	1.10E+02
I-135	7.40E+00	6.17E+00	1.79E+07	1.10E+02
Total	3.00E+01	2.50E+01		4.46E+02

0.612
10.4
7.54
18.8
8.00

≈ 39,400 lb

Table 3

Post-MSLB Iodine Inventory Based on Total Iodine Activity of 10 uCi/gm				
Iodine Isotopes	Isotopic Activity uci/gm	Normalized Isotopic Activity uci/gm	Coolant Mass Released gm	Total Activity Released Ci
I-131	2.00E+00	6.67E-01	1.79E+07	1.19E+01
I-132	5.20E+00	1.73E+00	1.79E+07	3.09E+01
I-133	8.00E+00	2.67E+00	1.79E+07	4.76E+01
I-134	7.40E+00	2.47E+00	1.79E+07	4.40E+01
I-135	7.40E+00	2.47E+00	1.79E+07	4.40E+01
Total	3.00E+01	1.00E+01		1.79E+02

CALCULATION

Post-MSLB Accident Concentration at CR Vent Monitor (Cases 1 & 2)

During a MSLB accident the noble gas activity from the steam release and iodine activity from the coolant that flashed into steam are assumed to be released in the turbine building (TB). The isotopic noble gas activities in Table 1 (DATA/ASUMPTION 5) and iodine isotopic activities in Table 2 & 3 (DATA/ASSUMPTIONS 3 & 7) are released during the MSLB accident. The post-MSLB activity is released to the environment via TB blowout panel and carried over to the CR air intake.

The DRAGON computer code (REF 14) is used to calculate the post-MSLB activity concentrations at the CR vent monitor with the following design inputs:

Isotopic activities from Tables 1, 2, & 3 : DATA/ASSUMPTIONS 2, 5, & 7.

Atmospheric dispersion factor of 1.93E-03 @ TB blowout panel : DATA/ASSUMPTIONS 12.

Turbine Building:
volume - 1.02E+7 ft3 : DATA/ASSUMPTIONS 13
release rate 138.0 volume/day : DATA/ASSUMPTIONS 20

Control Room:
volume - 1.36E+5 cubic ft: DATA/ASSUMPTIONS 14
intake rate 0 to 720 days 3580 cfm : DATA/ASSUMPTIONS 15 & 17

Breathing rates DATA/ASSUMPTIONS 9

0-720 hrs   3.47E-04 m3/sec

The activities released to the environment for are given in the following Tables:

Case 1: Total iodine activity of 25 μCi/gm

DRAGON run # 862 dated 4/21/98 - Table 4

Case 2: Total iodine activity of 10 μCi/gm

DRAGON run # 873 dated 4/21/98 - Table 4

Case 3: Total iodine activity of 25 μCi/gm with CREV Actuation

DRAGON run # 7876 dated 4/30/98 - Table 4

The card image of input to the DRAGON run is given APPENDIX A.

MSLB Accident Release Model

Table 4		
Activity Released to Environment @ Time t=30 sec		
ISOTOPE	ACTIVITY RELEASED TO ATMOSPHERE 25 uCi/gm Ci*	ACTIVITY RELEASED TO ATMOSPHERE 10 uCi/gm Ci**
I-131	1.39E+00	5.57E-01
I-132	3.62E+00	1.44E+00
I-133	5.56E+00	2.23E+00
I-134	5.13E+00	2.05E+00
I-135	5.14E+00	2.06E+00
KR-83M	2.03E-02	2.03E-02
KR-85M	3.72E-02	3.72E-02
KR-85	1.73E-04	1.73E-04
KR-87	1.12E-01	1.12E-01
KR-88	1.12E-01	1.12E-01
KR-89	4.48E-01	4.48E-01
XE-131M	1.12E-04	1.12E-04
XE-133M	1.73E-03	1.73E-03
XE-133	4.74E-02	4.73E-02
XE-135M	1.49E-01	1.44E-01
XE-135	1.95E-01	1.94E-01
XE-138	2.11E+00	2.11E+00
Total	2.41E+01	1.16E+01

* From Computer Run No. 862, Dated 04/21/98

** From Computer Run No. 873, Dated 04/21/98

Determination Of CR Vent Monitor Isotopic Conversion Factor

The isotopic conversion factor for detector response is calculated in Table 5 for the isotopes present in the post-MSLB release. The detector is a beta scintillation detector (REF 7, PAGE 2), therefore, isotopes that do not decay by beta emission will not be considered as contributors to the detector response.

The percentage yield of beta emission is multiplied by the KDB-1000 response to obtain the isotopic conversion factor at the given energy level. The conversion factors at the different energy levels are summed to obtain the total isotopic conversion factor as shown in Tables 5 & 6.

			Table 5		
Control Room Vent Monitor Isotopic Conversion Factor					
Isotope	Beta Energy B_{max} (Mev)	% Yield	KDB-1000 Response cpm/uCi/cc	Conversion Factor (CF) cpm/uCi/cc	Total CF cpm/uCi/cc
Kr-83m	0	0	0.00E+00	0.00E+00	0.00E+00
Kr-85m	0.84	78.6	2.40E+05	1.89E+05	1.89E+05
Kr-85	0.687	99.6	2.00E+05	1.99E+05	1.99E+05
Kr-87	0.928	4.4	2.60E+05	1.14E+04	3.70E+05
	1.334	9.5	3.30E+05	3.14E+04	
	1.475	5.51	3.40E+05	1.87E+04	
	>2.27	78	3.90E+05	3.04E+05	
Kr-88	0.365	2.65	7.60E+04	2.01E+03	1.86E+05
	0.521	67	1.40E+05	9.38E+04	
	0.681	9.1	2.00E+05	1.82E+04	
	1.198	1.92	3.00E+05	5.76E+03	
	2.051	1.3	3.80E+05	4.94E+03	
	>2.27	15.8	3.90E+05	6.16E+04	
Kr-89	1.25	2.36	3.10E+05	7.32E+03	3.45E+05
	1.44	1.49	3.40E+05	5.07E+03	
	1.61	1.55	3.60E+05	5.58E+03	
	1.6	2.09	3.50E+05	7.32E+03	
	1.64	2	3.60E+05	7.20E+03	
	2.1	4	3.90E+05	1.56E+04	
	2.19	1.51	3.90E+05	5.89E+03	
	>2.27	74.62	3.90E+05	2.91E+05	
Xe-131m	0	0	0.00E+00	0.00E+00	0.00E+00
Xe-133m	0	0	0.00E+00	0.00E+00	0.00E+00
Xe-133	0.346	99.3	6.90E+04	6.85E+04	6.85E+04
Xe-135m	0	0	0.00E+00	0.00E+00	0.00E+00
Xe-135	0.909	96.1	2.60E+05	2.50E+05	2.55E+05
	0.551	3.13	1.60E+05	5.01E+03	
Xe-138	0.4	3.06	9.40E+04	2.88E+03	2.90E+05
	0.48	9.5	1.30E+05	1.24E+04	
	0.71	32.6	2.10E+05	6.85E+04	
	>2.27	53	3.90E+05	2.07E+05	
I-131	0.2479	2.12	2.90E+04	6.15E+02	1.66E+05
	0.3338	7.36	6.60E+04	4.86E+03	
	0.6063	89.3	1.80E+05	1.61E+05	

Isotope	Beta Energy (Mev)	% Yield	KDB-1000 Response cpm/uCi/cc	Conversion Factor (CF) cpm/uCi/cc	Total CF cpm/uCi/cc
Table 5 (Cont'd)					
Control Room Vent Monitor Isotopic Conversion Factor					
I-132	0.741	12.4	2.20E+05	2.73E+04	2.97E+05
	0.74	1.9	2.20E+05	4.18E+03	
	0.91	3.55	2.60E+05	9.23E+03	
	0.966	8.1	2.70E+05	2.19E+04	
	0.991	2.75	2.70E+05	7.43E+03	
	0.996	3.36	2.70E+05	9.07E+03	
	1.155	2.49	2.90E+05	7.22E+03	
	1.185	18.9	2.90E+05	5.48E+04	
	1.413	1.7	3.40E+05	5.78E+03	
	1.47	10.1	3.40E+05	3.43E+04	
	1.468	2	3.40E+05	6.80E+03	
	1.617	12.4	3.60E+05	4.46E+04	
	2.14	16.9	3.80E+05	6.42E+04	
I-133	0.37	1.24	7.90E+04	9.80E+02	2.88E+05
	0.46	3.75	1.20E+05	4.50E+03	
	0.52	3.13	1.40E+05	4.38E+03	
	0.88	4.16	2.50E+05	1.04E+04	
	1.02	1.81	2.70E+05	4.89E+03	
	1.23	83.5	3.10E+05	2.59E+05	
	1.53	1.07	3.40E+05	3.64E+03	
I-134	0.77	1.48	2.30E+05	3.40E+03	3.37E+05
	1.07	1.22	2.90E+05	3.54E+03	
	1.28	32.5	3.10E+05	1.01E+05	
	1.5	8.1	3.40E+05	2.75E+04	
	1.56	16.3	3.50E+05	5.71E+04	
	1.6	3.67	3.50E+05	1.28E+04	
	1.74	7.6	3.60E+05	2.74E+04	
	1.8	11.2	3.60E+05	4.03E+04	
	1.85	1.12	3.70E+05	4.14E+03	
	2.23	3.7	3.90E+05	1.44E+04	
	2.42	11.5	3.90E+05	4.49E+04	
I-135	0.3	1.08	4.80E+04	5.18E+02	2.60E+05
	0.35	1.39	6.90E+04	9.59E+02	
	0.46	4.73	1.20E+05	5.68E+03	
	0.48	7.33	1.20E+05	8.80E+03	
	0.62	1.57	1.80E+05	2.83E+03	
	0.67	1.1	2.00E+05	2.20E+03	
	0.74	7.9	2.20E+05	1.74E+04	
	0.92	8.7	2.70E+05	2.35E+04	
	1.03	21.8	2.80E+05	6.10E+04	
	1.15	7.9	2.90E+05	2.29E+04	
	1.25	7.4	3.10E+05	2.29E+04	
	1.45	23.5	3.40E+05	8.02E+04	
	1.58	1.2	3.50E+05	4.20E+03	
	2.18	1.9	3.80E+05	7.22E+03	

Table 6	
Control Room Vent Monitor Response	
ISOTOPE	**CONVERSION FACTOR cpm/uc/cc**
I-131	1.66E+05
I-132	2.97E+05
I-133	2.88E+05
I-134	3.37E+05
I-135	2.60E+05
KR-83M	0.00E+00
KR-85M	1.89E+05
KR-85	1.99E+05
KR-87	3.70E+05
KR-88	1.86E+05
KR-89	3.45E+05
Xe-131M	0.00E+00
XE-133M	0.00E+00
XE-133	6.85E+05
XE-135M	0.00E+00
XE-135	2.55E+05
XE-138	2.90E+05

Determination of CR Vent Monitor Setpoint

The activities released to the environment during the MSLB accident are listed in Table 4 for both cases for the first 30 sec releases. The isotopic activity (Ci) is divided by 30 sec to obtain the release rate of activity in Ci/sec which is further multiplied by the atmospheric dispersion factor or X/Q (sec/m3) to calculate the isotopic concentration (μCi/cc) at the CR vent monitor (see Tables 7 & 8). The isotopic concentration (μCi/cc) is multiplied by the applicable isotopic conversion factor (cpm/μCi/cc) to obtain the monitor response in count per minute (cpm). The isotopic responses in cpm are summed to get the total monitor response which becomes the basis for the CR ventilation air intake monitor setpoint. The CR vent monitor setpoints are 443 cpm and 213 cpm for total iodine concentrations of 25 μCi/cc and 10 μCi/cc respectively (Tables 7 & 8). Since the current CR monitor setpoint of ≤ 1,000 cpm is higher than 443 cpm and 213 cpm, the CREV system will not be actuated during or following the MSLB accident. Therefore, the CR doses in Case 1 & 2 are analyzed without taking credit of the CREV system.

Table 7

CR Air Intake Monitor Setpoint Based on Total Iodine Activity of 25 uCi/gm

ISOTOPE	ACTIVITY RELEASED TO ATMOSPHERE Ci*	ACTIVITY RELEASE RATE Ci/sec	X/Q (sec/m3)	ACTIVITY AT CR AIR INTAKE uci/cc	MONITOR CONVERSION FACTOR cpm/uCi/cc	MONITOR RESPONSE cpm
I-131	1.39E+00	4.63E-02	1.93E-03	8.94E-05	1.66E+05	1.48E+01
I-132	3.62E+00	1.21E-01	1.93E-03	2.33E-04	2.97E+05	6.92E+01
I-133	5.56E+00	1.85E-01	1.93E-03	3.58E-04	2.88E+05	1.03E+02
I-134	5.13E+00	1.71E-01	1.93E-03	3.30E-04	3.37E+05	1.11E+02
I-135	5.14E+00	1.71E-01	1.93E-03	3.31E-04	2.60E+05	8.60E+01
BR-83	0.00E+00	0.00E+00	1.93E-03	0.00E+00	0.00E+00	0.00E+00
BR-84	0.00E+00	0.00E+00	1.93E-03	0.00E+00	0.00E+00	0.00E+00
KR-83M	2.03E-02	6.77E-04	1.93E-03	1.31E-06	0.00E+00	0.00E+00
KR-85M	3.72E-02	1.24E-03	1.93E-03	2.39E-06	1.89E+05	4.52E-01
KR-85	1.73E-04	5.77E-06	1.93E-03	1.11E-08	1.99E+05	2.21E-03
KR-87	1.12E-01	3.73E-03	1.93E-03	7.21E-06	3.70E+05	2.67E+00
KR-88	1.12E-01	3.73E-03	1.93E-03	7.21E-06	1.86E+05	1.34E+00
KR-89	4.48E-01	1.49E-02	1.93E-03	2.88E-05	3.45E+05	9.94E+00
XE-131M	1.12E-04	3.73E-06	1.93E-03	7.21E-09	0.00E+00	0.00E+00
XE-133M	1.73E-03	5.77E-05	1.93E-03	1.11E-07	0.00E+00	0.00E+00
XE-133	4.74E-02	1.58E-03	1.93E-03	3.05E-06	6.85E+05	2.09E+00
XE-135M	1.49E-01	4.97E-03	1.93E-03	9.59E-06	0.00E+00	0.00E+00
XE-135	1.95E-01	6.50E-03	1.93E-03	1.25E-05	2.55E+05	3.20E+00
XE-137	0.00E+00	0.00E+00	1.93E-03	0.00E+00	0.00E+00	0.00E+00
XE-138	2.11E+00	7.03E-02	1.93E-03	1.36E-04	2.90E+05	3.94E+01
Total	2.41E+01				TOTAL	4.43E+02

* 30 second release

Set Point is Calculated Based on Total Iodine Activity of 25 uCi/gm

Table 8

CR Air Intake Monitor Setpoint Based on Total Iodine Activity of 10 uCi/gm

ISOTOPE	ACTIVITY RELEASED TO ATMOSPHERE Ci*	ACTIVITY RELEASE RATE Ci/sec	X/Q (sec/m3)	ACTIVITY AT CR AIR INTAKE uci/cc	MONITOR CONVERSION FACTOR cpm/uCi/cc	MONITOR RESPONSE cpm
I-131	5.57E-01	1.86E-02	1.93E-03	3.58E-05	1.66E+05	5.95E+00
I-132	1.44E+00	4.80E-02	1.93E-03	9.26E-05	2.97E+05	2.75E+01
I-133	2.23E+00	7.43E-02	1.93E-03	1.43E-04	2.88E+05	4.13E+01
I-134	2.05E+00	6.83E-02	1.93E-03	1.32E-04	3.37E+05	4.44E+01
I-135	2.06E+00	6.87E-02	1.93E-03	1.33E-04	2.60E+05	3.45E+01
BR-83	0.00E+00	0.00E+00	1.93E-03	0.00E+00	0.00E+00	0.00E+00
BR-84	0.00E+00	0.00E+00	1.93E-03	0.00E+00	0.00E+00	0.00E+00
KR-83M	2.03E-02	6.77E-04	1.93E-03	1.31E-06	0.00E+00	0.00E+00
KR-85M	3.72E-02	1.24E-03	1.93E-03	2.39E-06	1.89E+05	4.52E-01
KR-85	1.73E-04	5.77E-06	1.93E-03	1.11E-08	1.99E+05	2.21E-03
KR-87	1.12E-01	3.73E-03	1.93E-03	7.21E-06	3.70E+05	2.67E+00
KR-88	1.12E-01	3.73E-03	1.93E-03	7.21E-06	1.86E+05	1.34E+00
KR-89	4.48E-01	1.49E-02	1.93E-03	2.88E-05	3.45E+05	9.94E+00
XE-131M	1.12E-04	3.73E-06	1.93E-03	7.21E-09	0.00E+00	0.00E+00
XE-133M	1.73E-03	5.77E-05	1.93E-03	1.11E-07	0.00E+00	0.00E+00
XE-133	4.73E-02	1.58E-03	1.93E-03	3.04E-06	6.85E+05	2.08E+00
XE-135M	1.44E-01	4.80E-03	1.93E-03	9.26E-06	0.00E+00	0.00E+00
XE-135	1.94E-01	6.47E-03	1.93E-03	1.25E-05	2.55E+05	3.18E+00
XE-137	0.00E+00	0.00E+00	1.93E-03	0.00E+00	0.00E+00	0.00E+00
XE-138	2.11E+00	7.03E-02	1.93E-03	1.36E-04	2.90E+05	3.94E+01
Total	1.16E+01				TOTAL	2.13E+02

* 30 second release

Set Point is Calculated Based on Total Iodine Activity of 10 uCi/gm

RESULTS

The calculated control room doses from post-MSLB accident releases for Case 1 (25 μCi/gm) and Case 2 (10 μCi/gm) are given in Table 9 and the corresponding monitor set points are given in Table 10. The total number of curies released to the environment is given in Table 11. The CR thyroid dose for Case 1 (25 μCi/gm) exceeds the GDC allowable limit of 30 Rem (Table 9).

The post-MSLB accident control room gamma dose calculated in Table 9 is divided by the number of hours of expected control room occupancy to determine the **average gamma dose rate** to control room workers for the assumed 30-day duration of the LOCA.

Case 1

Total 30-day gamma dose in control room = 1.22E-02 Rem

Total expected control room occupancy, calculated previously using occupancy factors from REF. 10 = 316.8 hrs DATA/ASSUMPTIONS 21.

average gamma dose rate = 1.22E-02/316.8 hrs = 3.85E-05 Rem/hr = 3.85E-02 mRem/hr.

Case 2

Total 30-day gamma dose in control room = 5.09E-03 Rem

Total expected control room occupancy, calculated previously using occupancy factors from REF. 10 = 316.8 hrs DATA/ASSUMPTIONS 21.

average gamma dose rate = 5.09E-03/316.8 hrs = 1.61E-05 Rem/hr = 1.61E-02 mRem/hr.

Case 3

Total 30-day gamma dose in control room = 3.86E-03 Rem

Total expected control room occupancy, calculated previously using occupancy factors from REF. 10 = 316.8 hrs DATA/ASSUMPTIONS 21.

average gamma dose rate = 3.86E-03/316.8 hrs = 1.22E-05 Rem/hr = 1.22E-02 mRem/hr.

Table 9			
Dose In Control Room			
Release Path	Dose (Rem)		
	Thyroid	Gamma	Beta Skin
Case 1 25 (uCi/cc)	7.22E+01	1.22E-02	7.81E-02
Allowable Limit	3.00E+01	5.00E+00	3.00E+01
Case 2 10 (uCi/cc)	2.89E+01	5.09E-03	3.39E-02
Allowable Limit	3.00E+01	5.00E+00	3.00E+01
Case 3 25 (uCi/cc)	1.12E+01	3.86E-03	2.99E-02
Allowable Limit	3.00E+01	5.00E+00	3.00E+01

Table 10	
Control Room Vent Monitor	
Setpoint (cpm)	
Case 1 25 uCi/gm	4.43E+02
Case 2 10 uCi/gm	2.13E+02

TABLE 11		
Activity Released To Environment		
	Curie	
Isotope	**Case 1***	**Case 2****
	25 uCi/gm	**10 uCi/gm**
I-129	0.00E+00	0.00E+00
I-131	2.98E+01	1.19E+01
I-132	7.35E+01	2.94E+01
I-133	1.18E+02	4.73E+01
I-134	9.67E+01	3.87E+01
I-135	1.08E+02	4.32E+01
Br-83	0.00E+00	0.00E+00
Br-84	0.00E+00	0.00E+00
Br-85	0.00E+00	0.00E+00
Br-87	0.00E+00	0.00E+00
Kr-83m	4.07E-01	4.07E-01
Ke-85m	7.75E-01	7.75E-01
Kr-85	3.69E-03	3.69E-03
Kr-87	2.18E+00	2.18E+00
Kr-88	2.29E+00	2.29E+00
Kr-89	3.08E+00	3.08E+00
Xe-131m	2.53E-03	2.44E-03
Xe-133m	4.47E-02	4.00E-02
Xe-133	1.12E+00	1.05E+00
X-135m	7.41E+00	4.20E+00
Xe-135	5.37E+00	4.61E+00
Xe-137	0.00E+00	0.00E+00
Xe-137	3.02E+01	3.02E+01
Total	4.79E+02	2.19E+02

* From Computer Run No. 862, Dated 04/21/98

** From Computer Run No. 873, Dated 04/21/98

Activity Release for 0 - 30 days

CONCLUSIONS

As shown Table 9, the post-MSLB control room thyroid dose exceeds the GDC allowable limit of 30 Rem for Case 1 with the total reactor coolant iodine activity of 25 μCi/gm and no emergency ventilation actuation. The thyroid dose for case 2, with 10 μCi/gm is within the GDC allowable limit. The setpoint should be within the low detectable range of the monitor to avoid spurious alarm, and at or below the point where emergency ventilation is required to maintain the doses in the CR below GDC 19 limits. The analytical limit for the setpoint should be established including the total loop uncertainty associated with the detection and measurement based on the monitor response, sampling, and functions of other components which generate a signal for final controlling function. The resulting CR ventilation air intake monitor setpoint limit due to the post-MSLB accident releases is 213 cpm above the background for the total reactor coolant iodine activity concentration of 10 μCi/gm (Table 10). Use the setpoint of 210 cpm which equals to a thyroid dose of 28.5 Rem (95% of limit). This setpoint is less than the current setpoint of ≤ 1,000 cpm. Since the activity concentration at CR air intake during the MSLB accident does not reach the monitor setpoint value, the credit for CR emergency filtration is not taken in the analyses.

The results of Case 3 analyzed with the Tech Spec total reactor coolant iodine activity of 25 μCi/gm and automatic actuation of emergency ventilation (damper closed at 32 seconds) show that the CR doses are within the GDC 19 limits.

COMPUTER RUN LOG

JOB #	DATE	DESCRIPTION OF RUN
DRAGON RUNS:		
862	04/21/98	MSLB accident release - reactor coolant iodine activity at 25 μCi/gm.
873	04/21/98	MSLB accident release - reactor coolant iodine activity at 10 μCi/gm.
7876	04/30/98	MSLB accident release - reactor coolant iodine activity at 25 μCi/gm with actuation of emergency filtration.

Run on SWEC Mainframe Computer

Note: Card images of computer runs listed above are given in APPENDIX A

REFERENCES

1. Nine Mile Point Unit 1 Final Safety Analysis Report Revision 14.

    a. Chapter XV, Section C.1.3.1 "Radioactivity Releases."

    b. Table XV-6, "Iodine Concentrations (µCi/gm)"

    c. Chapter III, Section 2.2, Page III-6.

    d. Table VI-3a, "Reactor Coolant System Isolation Valves."

    e. Section III.B.2.2, "Control Room Heating Ventilation and Air Conditioning System."

Nine Mile Point Unit 1 Technical Specifications.

    a. Section 3.2.4.a, "Limiting Condition for Operation of Reactor Coolant Activity Specification."

    b. Section 3.4.5.b, 3.4.5.c, and 3.4.5.d, "Limiting Condition for Operation of Control Room Air Treatment System."

    c. Section 3.6.2, Table 3.6.2l, "Control Room Air Treatment System Initiation."

3. Regulatory Guide 1.5, "Assumptions Used for Evaluating the Potential Radiological Consequences of a Steam Line Break Accident for Boiling Water Reactors.

4. G&H Calculation No. N83-2, Rev 0, "MSLB - CR, TSC & EOF Doses."

5. Not Used.

6. DER No. 1-98-0948, "Control Room Vent radiation monitor will not automatically initiate emergency ventilation during a main steam line break accident."

7. Nine Mile Point Unit 1 In-Duct Noble Gas Detector Primary Calibration Assessment Technical Report ASI 460052-003, February15, 1989.

8. Internal Correspondence From R. Caiazza to S. Karpen, Dated 03/07/84, "Control Room Habitability."

9. Radioactive Decay Data Tables, By Kocher, 1981.

10. NUREG-0800, Standard Review Plan 6.4, "Control Room Habitability System."

11. 10 Codes of Federal Regulation, Part 50, Appendix A, General Design Criteria 19.

12. NUREG-0737, Section III.D.3.4, "Control Room Habitability Requirements."

13. NMPC Internal Correspondence, R.J. Cazzolli to Distribution, Dated 08/30/91, Subject: DBD Input, File Code: SM-HP91-0115.

14. DRAGON Computer Code, SWEC Number NU-115, Version 5, Level 0.

15. NMPC Letter to NRC, Dated 03/19/84, "Response to TMI Action Item III.D.3.4 - Control Room Habitability."

16. NMP1 Surveillance Test Procedure N-ST-08, Rev 7.

17. NEDO - 10045, July 1969, Class I, "Consequences of a Steam Line Break in a General Electric Boiling Water Reactor."

18. NMPC Letter to G&H, From Sandra Karpen (NMPC) to Siva Kumar (G&H), Dated 09/02/83.

19. NMPC Calculation No. S10-CR277.A-U1.210

APPENDIX A

Card Image Of Input to DRAGON run # 862 04/21/98

APPENDIX A

Card Image Of Input to DRAGON run # 873 04/21/98

APPENDIX A

Card Image Of Input to DRAGON run # 7876 04/30/98