AmerGen℠

AmerGen Energy Company, LLC
200 Exelon Way
Suite 345
Kennett Square, PA 19348

www.exeloncorp.com

An Exelon/British Energy Company

January 12, 2001
2130-00-20309

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555-0001

SUBJECT: OYSTER CREEK GENERATING STATION (OYSTER CREEK)
OPERATING LICENSE NO. DPR-16
DOCKET NO. 50-219
RADIOLOGICAL CONSEQUENCE ANALYSIS FOR CONTROL ROOM OPERATORS AT OYSTER CREEK GENERATING STATION (TAC No. MA3465)

REFERENCE: LETTER TO THE NRC DATED MARCH 31, 1997 (6730-97-2099), "RADIOLOGICAL CONSEQUENCE ANALYSIS FOR CONTROL ROOM OPERATORS AT OYSTER CREEK NUCLEAR GENERATING STATION"

The above referenced letter provided the Oyster Creek control room operator dose calculation incorporating application of the NUREG-1465 source terms as a pilot plant application of alternate source-term methodology for a BWR 2, Mark 1 containment plant. This application is currently under NRC review.

As a result of a meeting with NRC on this topic held July 28, 2000, AmerGen committed to revise Attachment 1 of the referenced letter to incorporate several changes. These changes include: (1) use of NRC Standard Review Plan 6.4 control room occupancy factors, (2) revised containment spray shut-off pressure of 1.0 psig containment pressure to reflect current plant Emergency Operating Procedures (EOPs), and (3) use of ARCON96 methodology and updated meteorological data (1995-1999) for determining atmospheric dispersion parameters for ground level release applied to the control room air intake closest to the radiological source.

A detailed description of implementation of the ARCON96 methodology and the updated meteorological data set (1995 - 1999) utilized is provided in AmerGen's letter to the NRC, dated December 19, 2000 (2130-00-20264), entitled, "License Amendment Request No. 283 - Control Room Habitability."

A001

A revised Attachment 1 - "Application of the NUREG-1465 Revised Design Basis Accident Source Term to the AmerGen Oyster Creek Nuclear Generating Station for the Assessment of Post-DBA Control Room Habitability," dated October 6, 2000, is provided as an enclosure to this letter. This revised document incorporates the above noted changes. It is noted that control room operator dose remains well within the 5 rem TEDE limit.

Also enclosed is a copy of the Polestar Calculation No. PSAT 05201H.08, Revision 1, "Dose Assessment for Oyster Creek Control Room Habitability", and Polestar Document No. PSAT 05201U.03, Revision 3, "Dose Calculation Data Base For Application of the Revised DBA Source Term To The AmerGen Oyster Creek Generating Station." These documents provide the dose calculation and major parameters and assumptions used in the calculation, as requested in NRC Request for Additional Information, Item No. 3, dated October 10, 2000.

If any additional information is needed, please contact David J. Distel at (610) 765-5517.

Very truly yours,

George B. [signature] for
James A. Hutton
Director – Licensing
Mid-Atlantic Regional Operating Group

JAH/djd/vvg

Enclosures:
1. Application of the NUREG-1465 Revised Design Basis Accident Source Term to the AmerGen Oyster Creek Nuclear Generating Station for the Assessment of Post-DBA Control Room Habitability, October 6, 2000
2. Polestar Calculation No. PSAT 05201H.08, Revision 1, "Dose Assessment for Oyster Creek Control Room Habitability"
3. Polestar Document No. PSAT 05201U.03, Revision 3, "Dose Calculation Data Base For Application of the Revised DBA Source Term To The AmerGen Oyster Creek Generating Station"

cc: H. J. Miller, Administrator, USNRC, Region I
H. N. Pastis, USNRC Senior Project Manager, Oyster Creek
L. A. Dudes, USNRC Senior Resident Inspector, Oyster Creek
File No. 96059

Application of the NUREG-1465 Revised Design Basis Accident Source Term to the AmerGen Oyster Creek Nuclear Generating Station for the Assessment of Post-DBA Control Room Habitability

Prepared by:

Polestar Applied Technology, Inc.
Los Altos, CA

Under Contract No. WO4280-03 to:

Electric Power Research Institute
Palo Alto, CA

And revised

Under Purchase Order No. 01031110 to:

PECo Energy – Limerick Generating Station
Pottstown, PA
(Agent for AmerGen)

Approved by James Metcalf __________ **Date** 10/6/00 __________

Table of Contents

Introduction	Page 3
Important Plant Features	Page 3
Characterization of the Design Basis Event for Control Room Habitability	Page 4
OCNGS Dose Model for Control Room Habitability	Page 5
MSIV Leak Rate	Page 7
Reactor Building Bypass and Other Containment Leakage	Page 10
Spray and Natural Removal	Page 12
Containment Thermal-Hydraulics	Page 14
Meteorological Dispersion and Dose Calculation Methodology	Page 17
Results and Summary of Conservatisms	Page 18
Conclusions	Page 19
References	Page 20

Summary of Dose Analysis for OCNGS Control Room Habitability

Introduction

The purpose of this document is to provide a detailed description of the way in which satisfactory Control Room (CR) habitability is being demonstrated for the AmerGen Oyster Creek Nuclear Generating Station (OCNGS). The principal issue is one of demonstrating compliance with Item III.D.3.4 of NUREG-0737 (Reference 1). This item requires that each licensee evaluate CR habitability to determine if they are able to meet the CR habitability requirements of Standard Review Plan (SRP) 6.4, or alternatively, to "provide assurance that the habitability systems will operate under all postulated conditions to permit the control-room operators to remain in the control room to take appropriate actions required by General Design Criterion [GDC] 19." Licensees are also required to submit sufficient information to permit "an independent evaluation of the adequacy of the habitability systems".

Important Plant Features

The OCNGS employs a General Electric BWR2 reactor with a five-recirculation pump reactor coolant system (RCS), two main steamlines, and a Mark I vapor suppression primary containment. The primary containment consists of a drywell (housing the RCS), a torus or wetwell which contains a vapor suppression pool, and a vent system which connects the drywell to the torus with the vents terminating beneath the level of the pool. In the event of a Loss of Coolant Accident (LOCA), the drywell-to-wetwell vents conduct the resulting steam into the vapor suppression pool thereby limiting the pressure response in the primary containment. When the steam in the drywell subsequently condenses, wetwell-to-drywell vacuum breakers permit the return of non-condensable gases to the drywell from the wetwell airspace, thereby avoiding negative pressure in the drywell.

The purpose of the containment is to isolate the remainder of the plant from the thermal-hydraulic effects of the LOCA and also to contain any radioactivity that may be released with the reactor coolant. The primary containment is surrounded by a reactor building (RB) which serves as a secondary containment. Under accident conditions the secondary containment is maintained at a slightly negative pressure by the standby gas treatment system (SGTS) which collects any residual primary containment leakage by filtering the building exhaust. The filtered exhaust is directed to the plant stack to obtain an elevated release of any radioactivity which may escape filtration, in particular radioactive noble gases.

Leaktightness is verified by designing the primary containment and its penetrations in a way that facilitates leak rate testing. The primary containment, including its penetrations and isolation valves, is designed, tested, and maintained so that even with peak accident pressure inside the containment, not more than 1% per day of the primary containment contents will leak out. Most of that leakage would then be processed by the SGTS.

Because of the effectiveness of the secondary containment as an accident mitigation feature of the plant, there is a particular concern with respect to primary containment penetrations which connect to conduits (i.e., piping or ductwork) which also penetrate the secondary containment. Such conduits may provide a continuous path for bypass of the secondary containment. For OCNGS these pathways include not only the main steamlines specifically cited in SRP 6.4, but also the isolation condenser vents mentioned in Reference 2 and four other pathways: the 2" gaseous nitrogen line which penetrates the RB on the east side, the 8" gaseous nitrogen line which penetrates the RB on the east side, the instrument air backup to the containment nitrogen supply which terminates in the turbine building (TB), and potentially, one of two drywell spray service air test lines (in the event that spray has not operated in one of the two loops as discussed below) which also terminates in the TB. All of these RB bypass pathways are specifically included in the LOCA dose model which is discussed below.

There are two fluid systems which have the potential to greatly influence the course of a postulated LOCA at OCNGS. One is the core spray system (with two independent and redundant loops) which draws water from the suppression pool and sprays it into the core region as an emergency core cooling system (ECCS), and the second is a containment spray system (with two independent and redundant loops) which draws water from the suppression pool, cools it by passing it through heat exchangers, and then returns it to the containment either as a simple cooling water flow directly to the vapor suppression pool or as a fine spray injected into the drywell (with a small parallel spray flow delivered to the airspace of the torus).

Characterization of the Design Basis Event for Control Room Habitability

The Design Basis Accident (DBA) event for CR habitability is a postulated accident intended to present challenges to the accident mitigation features of OCNGS at least as great as those presented by any other credible accident. By assessing the onsite and offsite dose consequences of such an event and comparing those consequences to the radiation dose limits established by Title 10 of the Code of Federal Regulations (10CFR), one can be reasonably assured of the protection of public health and safety. The definition of such an event must also include the potential for the loss of all offsite electrical power (if such a loss would make the consequences of the accident more severe) and also must include the worst single-failure of the Safety-Related equipment incorporated into the plant design for the purpose of accident mitigation. Such a single-failure could be system-wide (e.g., the failure of a diesel generator to start which would fail one electrical power division) or it could be limited to a single component such as a main steam isolation valve (MSIV) failing to close.

The consequences of the accident must also be assessed conservatively; i.e., in any aspect of the accident analysis involving uncertainty or stochastic behavior the assessment must make use of worst-case conditions or conditions which would have a more adverse impact only rarely (e.g., less than 5% of the time). An example of one such aspect is the atmospheric dispersion (or "X/Q") of airborne releases of radioactivity which is a stochastic process. Several additional conservatisms are discussed in the next section, and a list of conservatisms is included at the end of this report.

The OCNGS DBA event for CR habitability is defined to be a complete, "double-ended" rupture (DER) of the piping in one of the five reactor coolant recirculation loops. Furthermore, regardless of the "single-failure" assumption referred to above, a complete failure of the ECCS for an extended period of time is also postulated. This extended failure of the ECCS permits substantial melting of the reactor core as required by 10CFR Part 100 for the definition of the DBA event for CR habitability. The duration of this complete ECCS failure is assumed to conform to the first two release periods of Reference 3.

Two single-failures were considered for the definition of the OCNGS DBA event for CR habitability. One was the loss of one of the two loops of containment spray/pool cooling. Current procedures instruct the operators to run only one system loop in spray mode even if both loops are available. Having the remaining loop operate in pool cooling actually increases the likelihood of having containment sprays shut off due to low drywell pressure; therefore, it is conservative to assume that both loops operate. The other, more limiting single-failure considered is the failure of an outboard MSIV to close in one of the two main steamlines. This failure eliminates a second point of leakage control in one of the two main steamlines and increases the assumed leak rate for that steamline. This failure also eliminates any delay and removal of airborne activity that could have occurred in the "dead" space between two closed MSIVs in the affected steamline.

A chronology of the assumed DBA event for CR habitability is given on Table I. The timing is taken principally from the assumptions of Reference 3, but details are taken from a MAAP4 (Reference 4) analysis of a recirculation loop LOCA with no ECCS for two hours after the onset of core damage. The onset of core damage is assumed to occur 30 seconds after the start of the LOCA. As stated in Reference 3, thirty seconds is a time-frame for onset of core damage that is more appropriate for a PWR, but it is being conservatively applied to OCNGS.

OCNGS Dose Model for Control Room Habitability

The overall dose calculation model consists of seven control volumes to represent the damaged core and RCS (CORE), the drywell portion of the primary containment (DW), the torus airspace or wetwell portion of the primary containment (WW), the suppression pool (SP), the reactor building or secondary containment (RB), the space between the two MSIVs in the one steamline wherein both MSIVs are assumed to successfully close (SL), and the control room, itself (CR). These control volumes are arranged as shown on Figure 1 with the various junctions that connect them. These junctions are associated with volumetric flows which determine the rate at which radioactivity is exchanged between the control volumes. In addition removal processes such as spray impaction, sedimentation, adsorption, pool scrubbing, filtration and others are modeled within and between the control volumes, as appropriate.

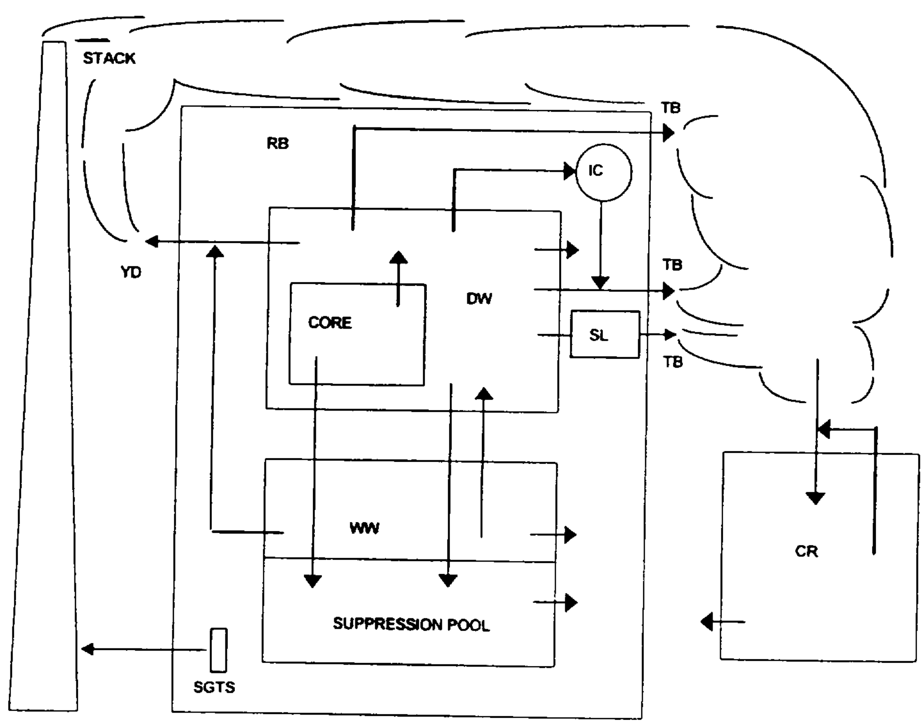
The junctions related to containment transport and environmental release include:

- Drywell-to-wetwell vent flow,
- Wetwell-to-drywell vacuum breaker flow,
- SGTS exhaust flow (via plant stack),
- Leakage flow to the RB from the drywell, the wetwell, and the suppression pool, and
- Bypass pathways (MSIV leakage, isolation condenser vent valve leakage, and service air leakage to the TB, and gaseous nitrogen leakage to the yard).

Table I

Time (sec)	Comment
0	DER of recirc loop - coolant activity released - containment leak rate 1 %/day
30	Release from damaged fuel begins (gap release phase)
600	First spray actuation
1345	Sprays stop
1495	Second spray actuation
1680	Sprays stop
1830	Release from damaged fuel accelerates (gap release phase ends, early in-vessel release phase begins)
2530	Third spray actuation
3370	Sprays stop
3930	Core collapse
4065	Vessel water saturated - steam flow to pool begins - fourth spray actuation
4665	Steam flow to pool ends (vessel dryout)
5265	Return flow of non-condensibles from wetwell airspace ends
7230	Release from damaged fuel ends (end of early in-vessel release phase) - well-mixed containment assumption begins - two-hour EAB doses calculated
13600	Sprays stop
18800	Fifth spray actuation
28240	Sprays stop
28800	X/Qs reduced for LPZ and CR
86400	X/Qs reduced for LPZ and CR - containment leak rate becomes 0.5%/day
345600	X/Qs reduced for LPZ and CR
2592000	30-day LPZ and CR doses calculated

Figure 1



The core junctions effect the release of radioactivity to both the drywell and the suppression pool in parallel. The drywell and suppression pool releases are an example of conservative "double-counting" in that the same amount of activity is assumed to be in both places at the same time.

Control room junctions exist in the model to take activity out of the environment (after it has been diluted by the appropriate X/Q) and bring it into the control room. The concentration of radioactivity within the control room is about the same as the concentration at the air intake, even on maximum recirculation flow.

There are several important aspects of the dose analysis model that require specific elaboration. These include MSIV Leak Rate, Reactor Building Bypass and Other Containment Leakage, Spray and Natural Removal, Containment Thermal-Hydraulics, and Meteorological Dispersion and Dose Calculation Methodology.

MSIV Leak Rate

The MSIV leak rate as a function of containment pressure is based on a model identical to that from Reference 5 except that the MSIVs are assumed to be leaking at the current Technical Specification (TS) limit of 15.975 scfh under a test pressure of at least 35 psig (P_a - see Reference 6). The leak rate model of Reference 5 assumed a frictionless leak path for MSIV leakage and an isentropic expansion through that path. The flow can be modeled with the following expression:

$$\text{Mass flow} = \rho AV = \rho A\{2c_pT_0[1-(P/P_0)^{(k-1)/k}]\}^{1/2}$$

where: V = velocity at the orifice

ρ = expanded density of the gas

A = orifice area

c_p = specific heat capacity of the gas at constant pressure

T_0 = source temperature of the gas

P = expanded pressure of the gas

P_0 = source pressure of the gas

k = ratio of specific heats for the gas

Since $T_0 = P_0/(R\rho_0)$ and since $M^2 = 2/(1-k)[1-(P_0/P)^{(k-1)/k}]$ (where M is the maximum local Mach Number), then:

$$1-(P/P_0)^{(k-1)/k} = 1 - 2/[2-(1-k)M^2]$$

$$\text{Mass flow} = \rho A\{2c_pT_0[1-(P/P_0)^{(k-1)/k}]\}^{1/2} = \rho A\{2c_pP_0/R\rho_0\}^{1/2}\{1 - 2/[2+(k-1)M^2]\}^{1/2}$$

Then, since $\rho = \rho_0/\{[2+(k-1)M^2]/2\}^{1/(k-1)}$, and defining $f(M,k) = [2+(k-1)M^2]/2$:

$$\text{Mass flow} = A\{2c_pP_0\rho_0/R\}^{1/2}\{1-1/f(M,k)\}^{1/2}/\{f(M,k)\}^{1/(k-1)}$$

$$\text{Mass flow} = A\{2c_pP_0\rho_0/R\}^{1/2}\{f(M,k)^{2/(1-k)}- f(M,k)^{(k+1)/(1-k)}\}^{1/2}$$

Thus, the mass flow rate can be determined from the area, A, the upstream state, $P_0\rho_0$, the gas composition, c_p/R and k, and the local Mach Number. The local Mach Number, in turn, is a function of k and P/P_0 except it cannot exceed unity. The Mach Number is:

$$M = [2/(k-1)]^{1/2}[(P/P_0)^{(1-k)/k}-1]^{1/2} \leq 1$$

The value of P/P_0 corresponding to M = 1 is the critical pressure ratio. Since P is always assumed to be 14.7 psia (the environment), there is a containment pressure which maximizes M to 1. Increasing the containment pressure beyond this point has no effect on P/P_0 as used in this expression.

The ratio c_p/R and the value of k are both determined by the nature of the gas. For steam k is approximately 1.3 and for nitrogen (or air) k is approximately 1.4. A linear interpolation is made between these two values for k in the drywell, based on the mole fractions of steam and air/nitrogen. The ratio c_p/R is simply $k/(k-1)$.

As noted previously, this model is the same as that used for Reference 5. Based on this model, Reference 5 assumed that the orifice diameter corresponding to a single MSIV leaking at its maximum rate was 0.51 mm. At that time, the maximum allowable leak rate was approximately 12 scfh at 20 psig (34.7 psia).

For the present TS leak rate limit of approximately 16 scfh at 35 psig (49.7 psia), the orifice size is slightly smaller (i.e., the limit is more restrictive). The orifice size corresponding to the current test is 0.49 mm, i.e.:

Mass flow

$$= [\pi(0.49\text{ mm}/ 305\text{ mm/ft})^2/4][\sqrt{g_c}(2)(3.5)(49.7\text{ psia})(144\text{ in}^2/\text{ft}^2)(3.38)(0.075\text{ lbm/ft}^3)]$$

$$[(1.2)^{2/-0.4)} - (1.2)^{2.4/-0.4}]^{1/2}$$

$$= (2.03E\text{-}6\text{ ft}^2)(639.5\text{ lbm/ft}^2\text{-sec})(0.402 - 0.335)^{1/2} = 3.36E\text{-}4\text{ lbm/sec} = 16\text{ scfh}$$

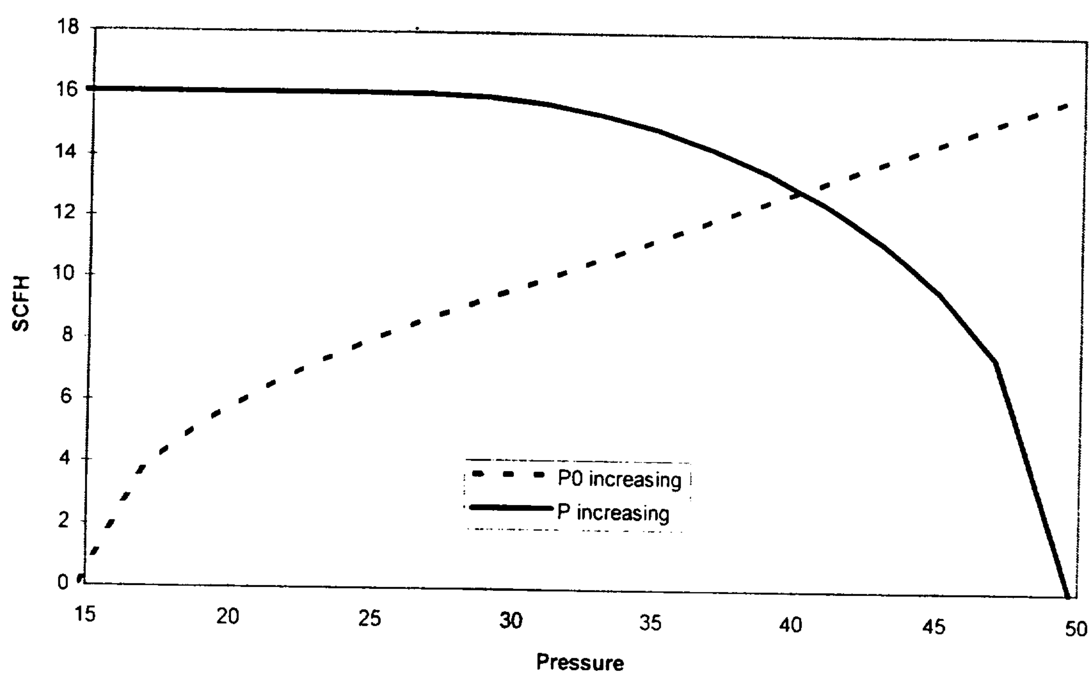
This orifice size is used with the above expression to determine the mass flow as a function of drywell absolute pressure and maximum local Mach Number (a function of the pressure ratio). The drywell density used to determine the mass flow is the sum of the steam and non-condensable gas masses divided by the volume of the drywell. The drywell volume leaked per unit time is the mass flow divided by the drywell density.

The only remaining question is the manner in which the leakages are affected by two closed isolation valves in series. If the Mach Number is very low (i.e., less than about 0.3, corresponding to a pressure difference of about 1 psi), the flow may be considered incompressible, and the pressure drop across two MSIVs in series leaking at the same rate would be the same for each valve. Such an assumption would be acceptable up to a total pressure difference of about 2 psi, 1 psi per valve. Under these conditions, the flow rate across each valve would be $\sqrt{2}/2$ times the flow rate for one valve. As the Mach Number increases and more and more of the pressure drop occurs across the second valve in series, the pressure between the valves becomes almost as great as P_0. This can be illustrated with the equation used above for the test case. For the fixed orifice area and gas properties, the expression reduces to:

$$\text{Mass flow (SCFH)} = 1.25P_0\{f(M,k)^{-6} - f(M,k)^{-5}\}^{1/2}$$

A plot of this equation is shown on Figure 2 assuming P_0 remains constant and P is increased (solid line). At P = 49.7 psia the flow rate goes to zero while for P = 14.7 psia the flow rate is the test value of approximately 16 SCFH. This is the leak rate through the inboard MSIV that would occur as the outboard MSIV becomes increasingly leak tight. One can also observe the result for the outboard valve as P_0 increases, where P_0 for the outboard valve is the pressure between the valves (the same pressure as P for the inboard valve). The outboard valve leak rate is the dashed line. Where the two lines cross the mass leak rate is the same. One can see that the leak rate is that corresponding to a P_0 (for the outboard valve) of about 40 psia, and the leak rate is about 13 SCFH or 81% of the maximum 16 SCFH.

Figure 2 - One Valve Leak Rate



Therefore, the following assumption is made for two valves in series: below a containment pressure of 16.7 psia (2 psig) it is assumed that the flowrate for two valves in series is 71% ($\sqrt{2}/2$) of that for a single valve. Between 2 psig and 35 psig (49.7 psia) the multiplier is assumed to increase linearly to 81%; i.e., an increase of 0.3% per psig.

The same isentropic expansion flow model is used for the other RB bypass pathways discussed in the next section. However, for these other bypass pathways only a single closed valve is credited.

Reactor Building Bypass and Other Containment Leakage

There are several important containment leakage paths which have the potential to bypass the leakage collection, filtration, and elevated release features of the OCNGS SGTS. In order to exhibit "bypass" characteristics, a pathway must not include a water seal, and the pathway must be continuous through the RB and terminate at a point beyond the RB secondary containment boundary. Besides the MSIVs, there are RB bypass pathways for OCNGS terminating in the TB as well as on the East wall of the RB.

One potential RB bypass pathway which was evaluated but judged not to exhibit bypass characteristics is the drywell ventilation supply. This pathway terminates on the TB roof very near the air intake for the CR, but it employs standard, fabricated sheet-metal ductwork in sections common to the RB ventilation supply outboard of the containment isolation valves (CIVs) V-27-3 and -4. With the SGTS in operation, the RB ventilation supply is isolated (by V-28-42 and -43, as well as by other dampers) and the RB is maintained at a negative pressure. Under these conditions, the standard ductwork sections (which are not leak-tight) would be expected to transfer any leakage to the RB atmosphere for collection by the SGTS.

The other bypass pathways (which must be evaluated in parallel with the MSIV leakage into the main steamlines) are as follows:

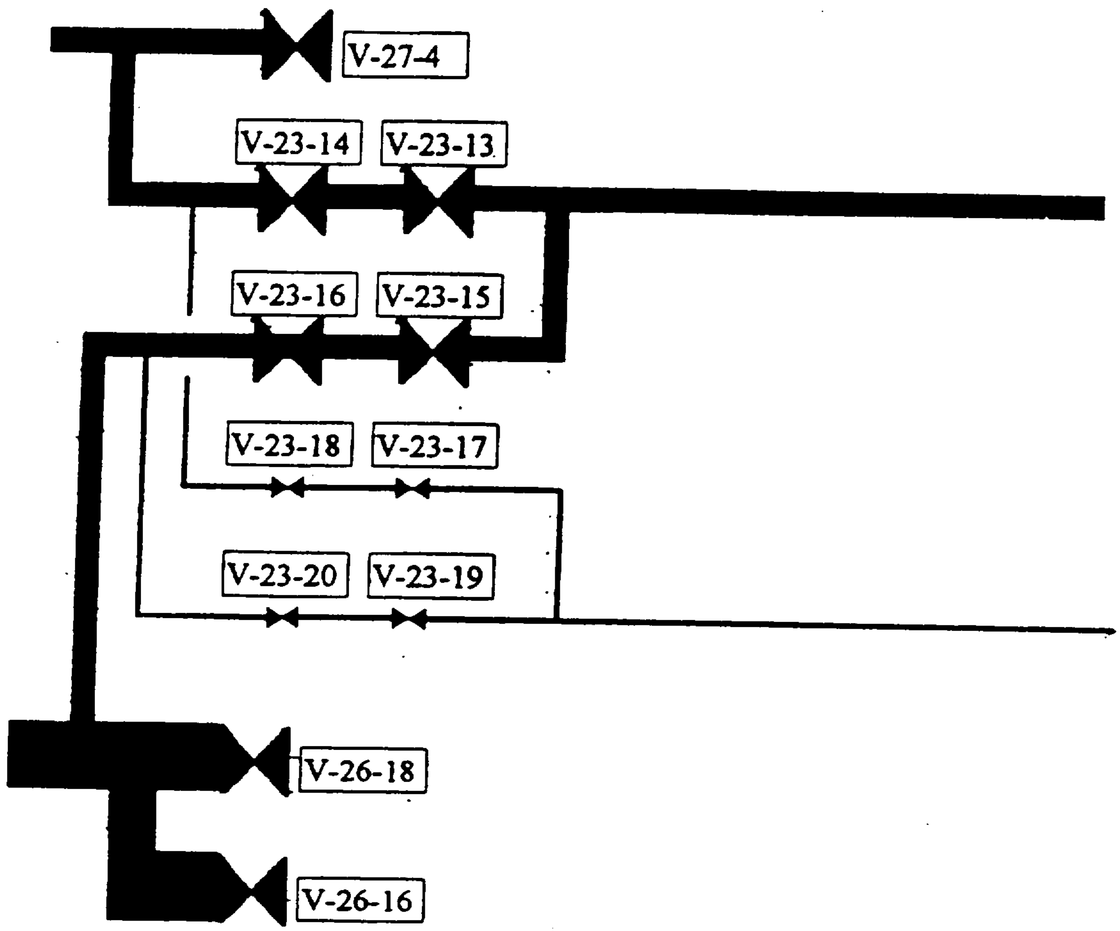
8-inch N_2 pathway

This pathway is connected to the drywell ventilation supply inboard of the CIV V-27-4. It is isolated by CIVs V-23-14 (inboard) and V-23-13 (outboard). It is also connected to the torus via CIVs V-23-16 and -15.

2-inch N_2 pathway

This pathway is connected to the drywell ventilation supply inboard of CIV V-27-4, tapping off of the 8" N_2 pathway upstream of V-23-14. It is isolated by CIVs V-23-18 (inboard) and V-23-17 (outboard). There is also a run of this line which ties into the 8" N_2 pathway inboard of the torus CIV V-23-16. This extension of the 2" N_2 pathway is isolated from the containment by CIVs V-23-20 and -19. The composite 8" and 2" N_2 pathways are shown on Figure 3. The total leakage evaluated for these pathways is 13 scfh in the 2" line and 8.5 scfh in the 8" line. Maximum leakage is assumed in the 2" line to minimize removal.

Figure 3



TIP Purge

This is a 1/2" flowpath that ultimately connects to the 2" N_2 line discussed above. With an administrative limit of only 0.05 SCFH (for V-23-70) its impact is negligible (compared to the 13 SCFH assumed in the 2" N_2 line).

Instrument Air

This is a straightforward bypass flowpath in that CIVs V-6-0393 (an inboard check valve) and V-6-0395 (an outboard pneumatic valve) serve to isolate the nitrogen supply to the drywell for pneumatically operated valves located inside the drywell. There is a back-up connection to the instrument air system that provides the bypass flowpath to the TB. The administrative leak rate limit for this flowpath is 2 SCFH.

Isolation Condenser Vents

These are two parallel flowpaths from the isolation condensers to the main steamlines beyond the outboard MSIVs. Each flowpath includes two CIVs, V-14-1 (inboard, B), V-14-5 (inboard, A), V-14-19 (outboard, B), and V-14-20 (outboard, A). Most of the run to the steamlines is a common 3/4" line. Each flowpath accounts for one SCFH; therefore, in the common piping the total flow would be 2 SCFH.

Drywell Spray Test Line

With sprays in operation it is unlikely that this line would provide a RB bypass pathway. However, for conservatism, it is assumed to leak at the same rate as the other bypass pathways to the TB.

Other Containment Leakage

The TS allowable leak rate for the OCNGS containment is 1.0 %/day. In order to consistently account for the explicit treatment of MSIV leakage and other RB bypass leak paths discussed above, the summation of the leak rates for these bypass pathways is subtracted from the global 1.0 %/day primary containment leak rate used in the dose analysis model. Together, these RB bypass pathways account for approximately 10 % of the assumed containment leakage. Also, given that the OCNGS containment spray system is credited for primary containment pressure control as well as airborne radioactivity removal (see the next section), it is reasonable to apply the overall leak rate reduction of 50 % at 24 hours normally reserved for PWRs (see Reference 7) to OCNGS. This 50 % reduction is not applied to the RB bypass pathways since pressure-dependent leakage for these pathways is calculated explicitly using the isentropic expansion flow model discussed above.

Spray and Natural Removal

A key feature differentiating the dose analysis for OCNGS from that for most BWRs is the crediting of the containment sprays in removing airborne radioactivity from the containment atmosphere as well as in controlling the containment pressure. The two parallel capabilities of the spray system (airborne radioactivity and containment pressure control) must be taken into account in the dose analysis.

The design flowrate of 3000 gpm (one pump operation in spray mode) is used in calculating the radioactivity removal capability of the containment spray system. Moreover, it is conservatively assumed that only one containment spray loop ever operates in spray mode. The other containment spray loop is assumed to be immediately placed into operation in containment heat removal mode. This is a conservative assumption because it maximizes the removal of heat from the containment while minimizing credit for radioactivity removal by the drywell sprays. Since sprays are tripped by the operator based on containment pressure and temperature limits, maximum cooling results in intermittent spray operation for more than the first hour of the two-hour radioactivity release phase. To a point, cold service water exacerbates this problem; and therefore, a moderately low service water temperature of 45 F is assumed. Colder service water temperatures have been investigated, but because they also result in a lowering of the initial containment temperature (and an increasing of the initial mass of non-condensable gases in the containment), it was found that intermittent spray operation did not occur under extreme "winter" conditions.

Spray system flowrates considerably greater (i.e., > 50 %) than the design value of 3000 gpm appear in the MAAP4 analysis of the plant's thermal-hydraulic behavior, and these flowrates contribute to the heat removal and intermittent spray operation. However, a substantial fraction of the spray flow may be "lost" (in terms of droplet formation and the development of a full spray pattern) because of interference with the containment shell and/or the reactor shield wall. Therefore, no increase beyond the 3000 gpm design flow is credited.

The nozzles are Spraying System Company 1-7G25 multi-cap designs wherein seven "caps" are clustered on a single nozzle. One cap sprays along the axis of the nozzle connection, while the six remaining caps are located around the body of the nozzle spraying at an angle approximately 60° to the axis. The nozzles are located on independent, redundant headers at two elevations in the drywell (two headers per loop) and on a common header in the torus airspace.

The upper drywell header (located at approximately the elevation of the drywell knuckle) uses 32 nozzles and the lower header (about 30 feet below) uses 56. At 40 psid these high-capacity nozzles pass about 34 gpm; therefore, with a total of 88 nozzles per loop, the total flow would be 2992 gpm. At 3000 gpm the pressure across the nozzles would be somewhat greater than 40 psid. At this differential pressure the mass median spray droplet size is 2600 μm (2.6 mm), with a 5th and 95th percentile of 1000 and 5000 μm.

The spray removal rates for airborne particulate in the DW are calculated with the STARNAUA computer code (Reference 8). The thermal-hydraulic input for this analysis comes from the data discussed in the next section.

As mentioned previously, in addition to the drywell sprays, there is a small spray header at the top of the torus airspace with 10 nozzles (flow of about 340 gpm based on 40 psid across the nozzles). For these nozzles the removal rate is calculated based on the simple model described in SRP 6.5.2. It is substantially lower than the removal rates calculated for the drywell sprays.

It is assumed that elemental iodine is removed by the containment sprays at a rate equal to that of the particulate. It is believed that the elemental iodine, being reactive, will adhere to the aerosol. Even if this were not so, elemental iodine would be removed from the containment atmosphere at a rate greater than that of the particulate. Re-evolution of elemental iodine may occur to a limited degree as the pH of the suppression pool falls below 7 late in the event (beyond three weeks), but the small degree of re-evolution that may occur will not contribute noticeably to the radiation dose from airborne iodine.

In bypass flowpaths aerosol sedimentation is considered. For the one steamline in which two MSIVs are closed, the space between the two MSIVs is considered to be well-mixed, and STARNAUA is used to calculate the sedimentation. The elemental iodine is assumed to be deposited with the particulate. However, 50% of the deposited elemental iodine is assumed to be re-evolved.

For bypass pathways other than the MSIVs, plug-flow is calculated to exist (in the limiting cases), and an exponential particulate removal is calculated based on sedimentation velocity as the flow transits the line. Only horizontal lengths are considered. Here, too, 50% of the deposited elemental iodine is assumed to be re-evolved.

For the steamline with the outboard MSIV assumed to be failed open aerosol deposition due to impaction (as the flow enters the assumed 0.5 mm diameter leakpath of the closed inboard MSIV) is considered. Based on Reference 9, it is expected that this deposition will conservatively exceed a factor of two (and actually, that the aerosol will plug the leak path, but this effect is neglected); and therefore, a factor of two removal is applied to both the particulate iodine and to the elemental iodine assumed to be adhered to it. For the steamline with both MSIVs closed, this effect is included in the STARNAUA sedimentation calculation.

Containment Thermal-Hydraulics

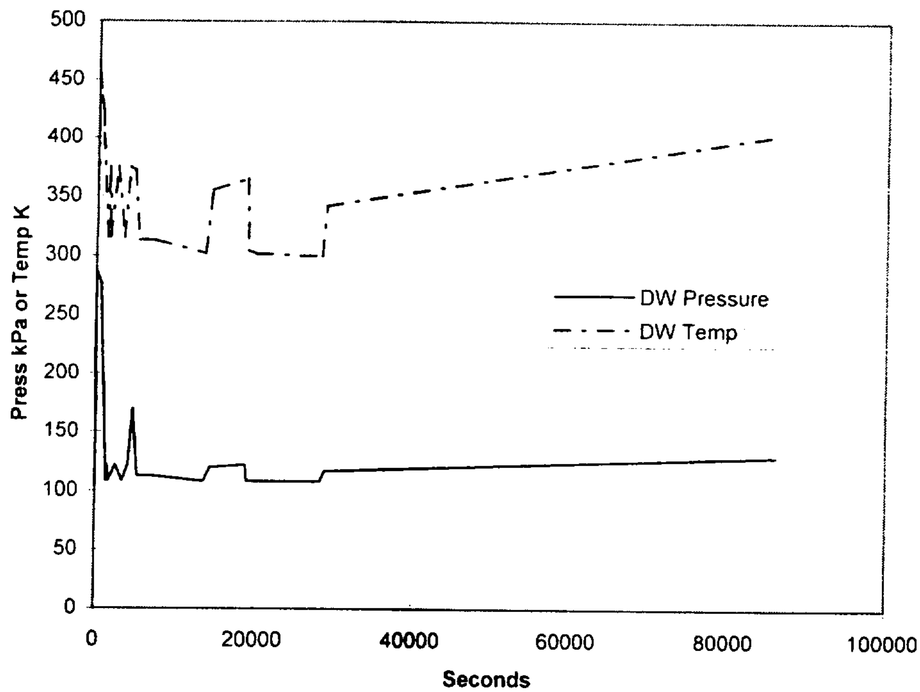
As has been previously discussed, a MAAP4 analysis for a double-ended rupture of one of the five recirculation loops is used as the basis for the analysis of radioactivity transport through the OCNGS facility and for its release to the environment.

At the beginning of the postulated event there is a rapid increase in the containment pressure, but by the time the assumed release of radioactivity begins 30 seconds later, the reactor blowdown is complete and the containment pressure is already decreasing. The structural heat sink of the containment shell would be about one-third thermally saturated by this time, and complete saturation would require only about four to five minutes more. Therefore, beyond five minutes, the containment pressure would be decreasing only slowly, and the containment would become essentially quiescent.

At ten minutes the containment sprays are assumed to be actuated and the containment pressure decreases rapidly. Figure 4 (which shows the drywell pressure and temperature response) shows this quite well. Following the rapid decrease in drywell pressure, the sprays are terminated at one psig by operator action as discussed above. For simplicity, only two actuations are included in the dose analysis model, one during the gap release phase and one during the early in-vessel release phase. In making this simplification, however, the correct fraction of time that the sprays are running in each phase is preserved. This fraction is approximately one-third for each of the two phases; e.g., between 1345 seconds (when the sprays are first tripped) and the time that debris quench steaming begins at 4065 seconds. It is during this period of intermittent spray operation that most particulate radioactivity is leaked from the containment.

The moderate pressure spike which occurs at about 4000 seconds on Figure 4 is the relocation of core debris to the lower plenum of the reactor vessel. At this time, about one half of the drywell non-condensables are purged into the torus airspace bringing about the modest increase in drywell pressure.

Figure 4 - Design Basis DW T/H



This would be an opportunity for substantial suppression pool scrubbing; but with an allowable leakage area of 10.5 in^2 for pool bypass, about 30 percent of the flow bypasses the pool. Using the SRP 6.5.5 value for pool scrubbing DF (DF = 5 for flow through a Mark I suppression pool), the overall DF is limited to 2.3 because of the bypass.

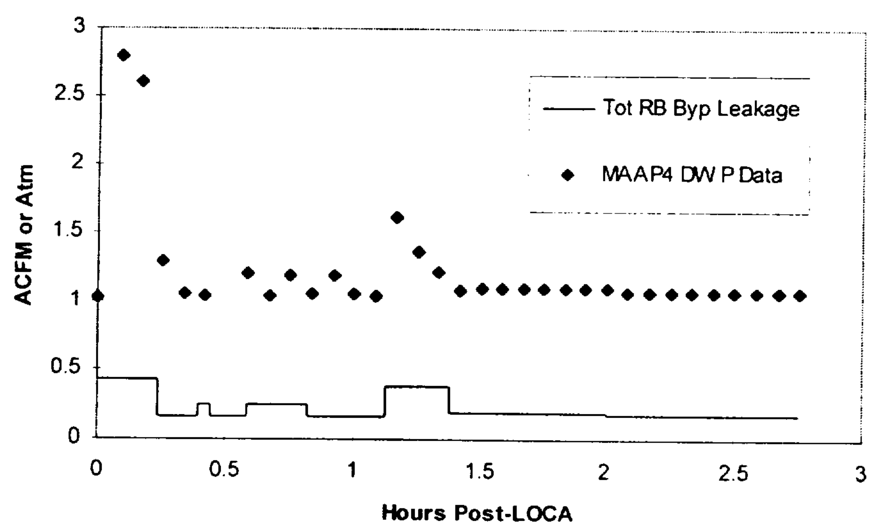
Of much greater importance is the spray actuation that begins at 4065 seconds when the drywell meets the pressure and temperature conditions for manual initiation. After this spray actuation the sprays remain on for a substantial period of time - until 13600 seconds. It is this spray actuation that provides the bulk of the containment atmosphere "clean-up". When ECCS is restored at 7230 seconds the sprays are already running. Thus, the containment pressure response is not greatly affected.

Following spray shut-off at 13600 seconds, the sprays are returned to operation at 18800 seconds and then are not finally tripped off until nearly eight hours into the event. By 14 hours (50400 seconds) into the event (when the MAAP4 analysis ends) the containment pressure has nearly reached 3 psig; but because the MAAP4 analysis has ended, it is assumed that the containment pressure continues to increase with no further spray actuations until 24 hours into the event. Beyond 24 hours, it is assumed that the containment pressure is one psig. This is in recognition of the fact that a combination of spray cooling, decreasing decay power, and assumed containment leakage of 0.5 %/day (15 % over 30 days) would be reducing the pressure continuously. Given the 30-day dose integration period for the CR habitability assessment, the tendency would be for the containment pressure to approach atmospheric or even sub-atmospheric over that period. However, maintenance of a minimum containment pressure of one psig is a goal of the emergency operating procedures to ensure that oxygen intrusion does not occur; and it is assumed in this analysis that that objective is met.

The timing of the spray actuations discussed above is representative of many kinds of events. The key feature is that up to the time of rapid steam production associated with core debris interaction with water in the vessel lower plenum and/or ECCS restart, the sprays have the potential (under unique conditions of containment and service water temperature) to be intermittent. Once any substantial coolant water interaction has occurred, however, the combination of steaming and hydrogen production will keep the sprays in operation for a long period of time.

In addition to establishing the conditions under which containment sprays may be assumed to operate, containment pressure and temperature also affect the containment volumetric leak rate. Figure 5 focuses on this relationship for the bypass pathways for which the leak rate (in ACFM) is calculated using the isentropic expansion flow model as described above.

Figure 5 - DW Press and RB Bypass



The plot concentrates on the first 10000 seconds of the event since that is the most radiologically significant period. The diamond-shaped data points are the drywell pressure plot file points from the MAAP4 analysis. The total RB bypass leakage, including MSIV leakage, (as modeled in this analysis) is shown as the solid line. For comparison, a one percent per day leak rate for the entire 308000 ft^3

primary containment free volume would be about 2.1 ACFM; therefore, the bypass leakage is about 10 % (on average) of the overall containment leak rate.

Meteorological Dispersion and Dose Calculation Methodology

The methods of Reference 10 (i.e., the ARCON-96 computer code) were used in evaluating the ground-level release onsite meteorological dispersion for this analysis. This represents a change from the analysis presented in Reference 5 which used the method endorsed by SRP 6.4. However, the elevated release dispersion characteristics (i.e., for releases from the stack) are the same as those of Reference 5.

The N_2 bypass pathways are assumed to release on the East wall of the RB (RB/E) and are, therefore, closer to the "A" CR air intake than to "B" CR air intake. The isolation condenser, instrument air, and containment spray test bypass pathways are assumed to release from the same point as the MSIV leakage releases. This point is closer to the "B" CR air intake. In spite of the fact that both intakes would not be expected to operate at the same time, the most conservative dispersion characteristics are assumed for each point of release (RB(E) to the "A" intake and TB to the "B" intake).

The assumed RB/E release point bears 75° from the "A" CR air intake (i.e., ENE). For the TB release point the normal to the East wall of the TB is used as the direction from which the TB releases would approach the CR air intakes. This normal bears 255° (i.e., WSW) from the CR air intakes. Since the entire surface of the TB East wall is considered as the source of the TB release, the shortest distance to the wall along this normal is taken to be the separation distance between the source and the intake.

In connection with the question of what wind directions can affect the CR air intake, it should be noted that even though the assumed TB and RB/E release points are opposite, the contributions from each release point to the CR air intakes are applied simultaneously.

The STARDOSE computer code (Reference 11) is used to perform operator dose calculations for that radioactivity having entered the CR. Doses from sources external to the CR (other than plume shine) were calculated in 1985 (Reference 12), and are used in this analysis in the same way as they were used in the submittal of Reference 5. For plume shine a factor is applied to the whole body (WB) dose internal to the CR to account for this external contribution. With one foot of concrete shielding assumed, this factor is small.

Dose conversion factors (DCFs) are based on Reference 13 for inhalation doses and on Reference 14 for external doses (WB and skin) except where Reference 13 provides updated information. Following current NRC and international practice regarding radiation protection (e.g., revisions to 10CFR Part 20 and Part 100), Total Effective Dose Equivalent (TEDE) doses are being reported in lieu of separate WB, skin, and thyroid doses. This is fully consistent with 10CFR Part 50, Appendix A, GDC-19 which establishes an operator dose limit of 5 rem WB "or its equivalent to any part of the body". The TEDE concept is based on equivalent doses to all important organs and parts of the body; and since by definition TEDE includes the WB contribution, it is quite conservative to establish a 5 rem TEDE limit as that which corresponds to the 5 rem WB equivalency of GDC-19.

Results and Summary of Conservatisms

The 30-day dose to operator due to the DBA event for CR habitability is as follows (Reference 15):

▪ CEDE due to inhalation of organic iodine -	1.13 rem
▪ CEDE due to inhalation of elemental iodine -	0.29 rem (including pool reevol.)
▪ CEDE due to inhalation of particulate iodine -	1.10 rem
▪ CEDE due to inhalation of cesium/rubidium -	0.19 rem
▪ CEDE due to inhalation of tellurium/antimony -	0.04 rem
▪ CEDE due to inhalation of barium -	0.01 rem
▪ CEDE due to inhalation of noble metals -	0.03 rem
▪ CEDE due to inhalation of lanthanum group -	0.02 rem
▪ CEDE due to inhalation of cerium group -	0.10 rem
▪ CEDE due to inhalation of strontium -	0.03 rem
▪ Whole body due to plume inside CR -	0.26 rem
▪ Whole body due to plume outside CR -	0.03 rem
▪ Whole body due to other external sources -	0.60 rem
▪ TEDE	3.83 rem

The following are important conservatisms in this analysis:

- An assumed TEDE limit equal to the current WB limit of 5 rem (even though TEDE includes WB)
- Use of high initial drywell temperature with "average" service water temperature (contributing to intermittent spray operation)
- Maximum suppression pool bypass to minimize pool scrubbing
- No credit for more rapid removal of hygroscopic aerosols
- No credit for aerosol/elemental iodine deposition in intact steamlines (other than between closed MSIVs)
- No delay in the release of re-evolved gaseous iodine in RB bypass pathways
- No credit for aerosol plugging of sub-millimeter leakpaths
- Only a single closed valve credited in non-MSIV RB bypass pathways
- Use of minimum-calculated bypass pathway particulate removal efficiencies (by release point)
- ARCON 96 X/Qs (dispersion parameters) applied to the most conservative CR air intake ("A" or "B", based on the distance from point of release) simultaneously

- Simultaneous contribution to CR dose from release points nearly 180° opposed
- No credit for non-Seismic structures (TB, steamlines, main condenser)
- No credit for the CR particulate filter
- SRP Occupancy Factors
- Maximum suppression pool temperature at 24 hours (based on cooling water temperature of 85 F) used to determine I_2 partitioning at 30 days
- No attenuation of I_2 re-evolved from suppression pool
- Use of the same inhalation DCFs for organic iodine forms as for more soluble forms

Conclusions

The CR dose analysis contained in this report demonstrates that the OCNGS meets the radiological requirements of 10CFR Part 50, GDC-19 with respect to limiting the dose to the most exposed CR operator. Under the conditions imposed by the DBA event for CR habitability the most exposed operator would not be subjected to radiation exposure resulting in doses in excess of 5 rem whole body or its equivalent to any part of the body for the duration of the accident. By demonstrating compliance with GDC-19 NUREG-0737, Item III.D.3.4, is also satisfied.

References

1. NUREG-0737, "Clarification of TMI Action Plan Requirements", November 1980

2. GPUN Letter, DeVine to USNRC Document Control Desk, dated June 20, 1991

3. NUREG-1465, "Accident Source Terms for Light-Water Nuclear Power Plants", February 1995

4. GPUN Calculation C-1302-243-E610-074, "OC Thermal-Hydraulic Conditions Following a LOCA Using MAAP4"

5. GPUN Letter, Wilson to Zwolinski (NRC), dated June 17, 1985

6. OCNGS DCC File No. 20.1801.0005, "Primary Containment Leakage Rate Testing Program", Revision 0, October 11, 1996

7. USNRC Regulatory Guide 1.4, "Assumptions Used for Evaluating the Potential Radiological Consequences of a Loss of Coolant Accident for Pressurized Water Reactors", Revision 2, June 1974

8. PSAT C101.02, Rev. 1.02, "STARNAUA - A Code for Evaluating Severe Accident Aerosol Behavior in Nuclear Power Plant Containments: A Validation and Verification Report", December 31, 1996

9. Morewitz, H.A., "Leakage of Aerosols from Containment Buildings", Health Physics, Volume 42, No.2, February 1982

10. Ramsdell, J.V., Jr., et al., "Atmospheric Relative Concentration in Building Wakes", NUREG/CR-6331, Revision 1

11. PSAT CI09.03, Rev 0, "STARDOSE Model Report", January 31, 1997

12. United Engineers & Constructors, Inc., "Analyses in Support of GPUN Responses to NRC RAIs Concerning Compliance with NUREG-0737, Item II.B.2", June 1985

13. Federal Guide 11, "Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion", 1988

14. NUREG/CR-5106 (Manual for TACT5 - Version SAIC 9/23/87)

15. Polestar Applied Technology Calculation PSAT 05201H.08, "Dose Assessment for OCNGS Control Room Habitability", Revision 1

CALCULATION TITLE PAGE

CALCULATION NUMBER: PSAT 05201H.08

CALCULATION TITLE: "Dose Assessment for Oyster Creek Control Room Habitability

	ORIGINATOR Print/Sign/Date	CHECKER Print/Sign/Date	IND REVIEWER Print/Sign/Date
REVISION: 0			
1	Fred Hennion / F Hennion 9/29/00	James Metcalf / J Metcalf 9/29/00	David Leaver / D Leaver 10/5/00
2			

REASON FOR REVISION: Nonconformance Rpt

Revision 0:

1. Initial Issue N/A

Revision 1:

1. Update revision number for ~~References~~ Reference 3 ~~and 11~~ due to corrected Control Room X/Qs (Yard and Turbine Building), corrected Control Room Occupancy Factors based on SRP values, and use of 1.0 psig drywell spray cutoff pressure instead of 0.6 psig DL 10/5/00
2. Correct STARDOSE "Input.dat" file according to the revised Reference 3

CONTROLLED COPY

Table of Contents

Section	Page
Purpose	3
Methodology	3
Assumptions	5
References	5
Calculation	6
Results	7
Conclusions	7

Attachment 1 - LIBFILE.TXT (2 pages)

Attachment 2 - INPUT.DAT (14 pages)

Attachment 3 - Excerpts of RESULTS.OUT (21-Day and 30-Day CR/Env Edits) (2 pages)

Purpose

The purpose of this calculation is to apply the revised DBA source term of Reference 1 and the STARDOSE Computer Code (Reference 2) to the calculation of Control Room (CR) Total Effective Dose Equivalent (TEDE) for the Oyster Creek Generating Station.

Methodology

The overall dose calculation model consists of seven control volumes to represent the damaged core and RCS (CORE), the drywell portion of the primary containment (DW), the torus airspace or wetwell portion of the primary containment (WW), the suppression pool (SP), the reactor building or secondary containment (RB), the space between the two MSIVs in the one steam line wherein both MSIVs are assumed to successfully close (SL), and the control room, itself (CR). These control volumes are arranged as shown on Figure 1 with the various junctions that connect them. These junctions are associated with volumetric flows which determine the rate at which radioactivity is exchanged between the control volumes. In addition removal processes such as spray impaction, sedimentation, adsorption, pool scrubbing, filtration and others are modeled within and between the control volumes, as appropriate.

The junctions related to containment transport and environmental release include:

- Drywell-to-wetwell vent flow,
- Wetwell-to-drywell vacuum breaker flow,
- SGTS exhaust flow (via plant stack),
- Leakage flow to the reactor building from the drywell, the wetwell, and the suppression pool, and
- Bypass pathways (MSIV leakage, isolation condenser vent valve leakage, service air leakage, and containment spray test line leakage to the turbine building, and gaseous nitrogen leakage to the yard).

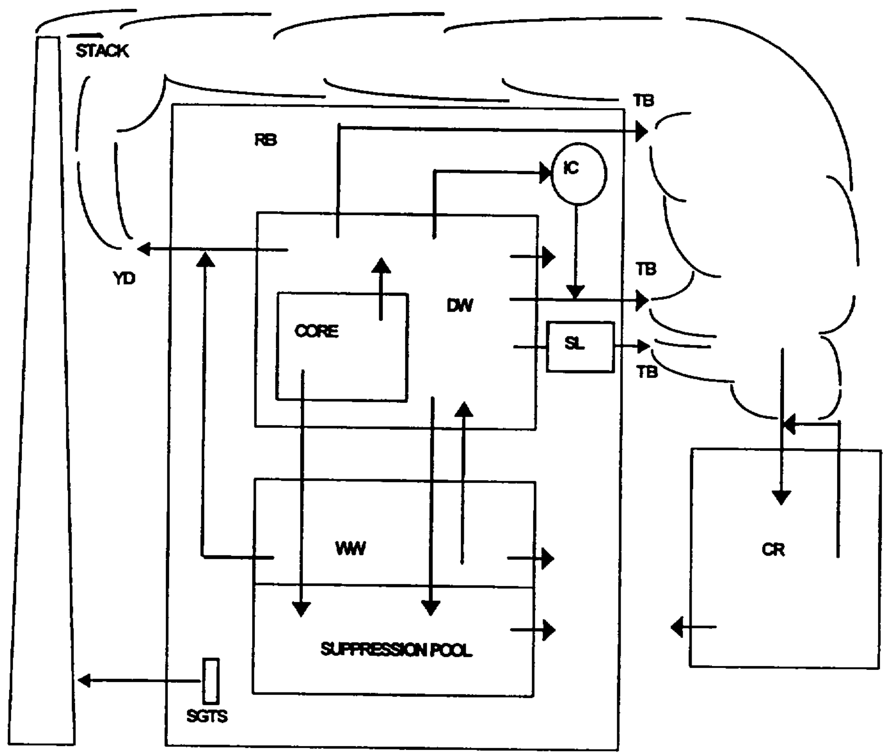


Figure 1

The core junctions effect the release of radioactivity to both the drywell and the suppression pool in parallel. The drywell and suppression pool releases are an example of conservative "double-counting" in that the same amount of activity is assumed to be in both places at the same time. In fact, the release of radioactivity to the suppression pool is assumed in the analysis to be complete within the first two hours of the accident, even though it actually takes many hours for the sprays and other mechanisms to remove the radioactivity from the containment atmosphere and get it into the water of the suppression pool.

Control room junctions exist in the model to take activity out of the environment (after it has been diluted by the appropriate X/Q) and bring it into the control room. For Oyster Creek there are no credited filters in the control room ventilation; there are only redundant intakes and air-handling units and provision for recirculating the air so that intake can be minimized under accident conditions. As a practical matter, the concentration of radioactivity within the control room tracks very closely the concentration at the at the air intake, even on maximum recirculation flow (see Assumption 1).

The STARDOSE Computer Code (Reference 2) is used for the dose calculation. All input to this model except for radionuclide data is documented in Reference 3. For plume shine a factor is applied to the WB dose internal to the CR to account for this external contribution. The factor is calculated below. With one foot of concrete shielding assumed, this factor is small.

A second factor from Reference 3 is used to account for re-evolved radioiodine from the suppression pool. This factor is applied to the organic radioiodine dose contribution over a specified time interval defined below.

Assumptions

Assumption 1: The radionuclide concentration inside the CR is the same as that of the plume at the air intake.

Justification: The CR volume from Reference 3, Item 3.5 is 27500 ft^3. The volumetric exchange rate (with the environment) is assumed to be 14000 cfm (Item 3.13). Even on maximum recirculation flow, the volumetric flow is greater than 1/10 of the assumed 14000 cfm; and therefore, the exchange rate will always be greater than 0.05 per minute or 3 per hour. Since the time to come to equilibrium is about three inverse exchanges, it requires only one hour for the CR to equilibrate with the evironment. The total duration of the dose calculation is 720 hours with concentration changing slowly with time. Therefore, equilibrium can be assumed.

References

1. NUREG-1465, "Accident Source Terms for Light-Water Nuclear Power Plants", February 1995

2. PSAT CI09.03, Rev 0, "STARDOSE Model Report", January 31, 1997

3. PSAT 05201U.03, "Dose Calculation Data Base for Application of the Revised DBA Source Term to the Oyster Creek Nuclear Power Plant", Revision 3

4. Federal Guide 11, "Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion", 1988

5. NUREG/CR-5106 (Manual for TACT5 - Version SAIC 9/23/87)

6. NUREG/CR-4691, "MELCOR Accident Consequence Code System (MACCS)", February 1990

7. TID-14844, "Calculation of Distance Factors for Power and Test Reactor Sites", March 1962

8. Price, W.J., Nuclear Radiation Detection, McGraw-Hill, New York, 1958

9. NUREG-0737, "Clarification of TMI Action Plan Requirements", November 1980

Calculation

To perform operator dose calculations for radioactivity having entered the CR, the STARDOSE computer code is used (Reference 2). Dose conversion factors are based on Reference 4 for inhalation doses and Reference 5 for external doses (WB and skin) except where Reference 4 provides updated information. Radioactive decay rates are also taken from Reference 5. All radionuclide input data (including core inventory per Mw from Reference 3) is presented in the LIBFILE1.TXT file (Attachment 1) used with STARDOSE. The radionuclides considered are those from Reference 6 (except the cobalt isotopes which are not significant) plus additional Kr and Xe isotopes, in particular those included in Reference 7.

The STARDOSE input file (INPUT.DAT) is included as Attachment 2. It has been manually annotated to show where the data appears in Reference 3.

Following current NRC and international practice regarding radiation protection (e.g., revisions to 10CFR Part 20 and Part 100), Total Effective Dose Equivalent (TEDE) doses are being reported in lieu of separate WB, skin, and thyroid doses. This is fully consistent with 10CFR Part 50, Appendix A, GDC-19 which establishes an operator dose limit of 5 rem WB or the equivalent to any other part of the body. The TEDE concept is based on equivalent doses to all important organs and parts of the body; and since by definition TEDE includes the WB contribution, it is quite conservative to establish a 5 rem TEDE limit as that which corresponds to the 5 rem WB equivalency of GDC-19.

To calculate the external plume contribution to the inside dose, the assumption of equal activity concentrations inside and outside the CR is used (Assumption 1). The STARDOSE code makes use of the following correction to the whole body dose inside the CR to account for the finite volume (note that the DCFs used from Reference 5 are for a semi-infinite volume):

$$\text{Correction Factor} = (V_{CR})^{0.338}/1173 = (27500)^{0.338}/1173 = 0.027.$$

Considering one foot of concrete shielding and an "average" gamma energy of 0.7 MeV (e.g., from Reference 7), the shielding effectiveness can be approximated as:

$$\text{Eff} = e^{-\mu d}$$

where the μ is the mass absorption coefficient and d is the thickness of the shield. From Figure 1-12 of Reference 8, the mass absorption coefficient for a 0.7 MeV gamma (normalized by density) is about 0.08 cm^2/g. Assuming a concrete density of 2.5 g/cc (2.5 that of water) and a d of 30 cm (one foot) thickness, the coefficient becomes 0.2 and the overall expression becomes 2.5E-3. Therefore, the one foot concrete thickness is about ten times more effective in reducing gamma dose to the operator than the finite volume of the CR. To account for the external plume contribution to the operator dose, the whole body dose calculated by STARDOSE for sources inside the CR will be multiplied by a factor of 0.1.

Results

The results for the STARDOSE edits at 21 days and at 30 days are presented as Attachment 3 (excerpted from RESULTS.OUT). This is for the run identified as 03:47:26 PM September 15, 2000. From the 21-day edit, one can see that the organic iodine dose contribution to the CR dose is 1.08 rem CEDE. At 30 days the contribution is 1.13 rem CEDE. Therefore, the organic iodine dose contribution from 21 to 30 days is 0.05 rem CEDE. Multiplying this organic iodine dose contribution by the factor of 4 to account for elemental iodine re-evolution from the suppression pool (Reference 3, Item 7.6), one can obtain the overall dose results below:

▪ CEDE due to inhalation of organic iodine -	1.13 rem
▪ CEDE due to inhalation of elemental iodine -	0.29 rem (including pool reevol.)
▪ CEDE due to inhalation of particulate iodine -	1.10 rem
▪ CEDE due to inhalation of cesium/rubidium -	0.19 rem
▪ CEDE due to inhalation of tellurium/antimony -	0.04 rem
▪ CEDE due to inhalation of barium -	0.01 rem
▪ CEDE due to inhalation of noble metals -	0.03 rem
▪ CEDE due to inhalation of lanthanum group -	0.02 rem
▪ CEDE due to inhalation of cerium group -	0.10 rem
▪ CEDE due to inhalation of strontium -	0.03 rem
▪ Whole body due to plume inside CR -	0.26 rem
▪ Whole body due to plume outside CR -	0.03 rem
▪ Whole body due to other external sources -	0.60 rem
▪ TEDE	3.83 rem

Conclusions

The CR dose analysis contained in this report demonstrates that the Oyster Creek meets the radiological requirements of 10CFR Part 50, GDC-19 with respect to limiting the dose to the most exposed CR operator. Under the conditions imposed by the DBA event for CR habitability the most exposed operator would not be subjected to radiation exposure resulting in doses in excess of 5 rem whole body or its equivalent to any part of the body for the duration of the accident. By demonstrating compliance with GDC-19 NUREG-0737 (Reference 9), Item III.D.3.4, is also satisfied.

n_isotopes 76 n_isotope_groups 11

Kr83m	N_Gas	NONE	NONE	4.15E+03	1.04E-04	0	4.20E-06	0	0	0	0	0	0	0	0	0	0
Kr85m	N_Gas	NONE	NONE	6.94E+03	4.39E-05	0	0.03069	0	0	0.05	0	0.22	0	0	0	0	0
Kr85	N_Gas	NONE	NONE	4.03E+02	2.04E-09	0	0.00048	0	0	0.05	0	0.22	0	0	0	0	0
Kr87	N_Gas	NONE	NONE	1.29E+04	1.52E-04	0	0.14626	0	0	0.34	0	1.48	0	0	0	0	0
Kr88	N_Gas	NONE	NONE	1.83E+04	6.88E-05	0	0.3708	0	0	0.08	0	0.35	0	0	0	0	0
Kr89	N_Gas	NONE	NONE	3.98E+04	3.63E-03	0	0.303	0	0	0.35	0	1.52	0	0	0	0	0
Xe131m	N_Gas	NONE	NONE	2.60E+02	6.68E-07	0	0.00152	0	0	0.02	0	0.04	0	0	0	0	0
Xe133m	N_Gas	NONE	NONE	1.38E+03	3.49E-06	0	0.00554	0	0	0.03	0	0.13	0	0	0	0	0
Xe133	N_Gas	I133Part	NONE	5.23E+04	1.52E-06	0	0.00625	0	0	0.01	0	0.04	0	0	0	0	0
Xe135m	N_Gas	NONE	NONE	1.56E+04	7.40E-04	0	0.07756	0	0	0.02	0	0.09	0	0	0	0	0
Xe135	N_Gas	I135Part	NONE	1.81E+04	2.09E-05	0	0.0482	0	0	0.06	0	0.26	0	0	0	0	0
Xe137	N_Gas	NONE	NONE	5.10E+04	2.96E-03	0	0.0283	0	0	0.46	0	2	0	0	0	0	0
Xe138	N_Gas	NONE	NONE	4.78E+04	6.80E-04	0	0.19776	0	0	0.15	0	0.65	0	0	0	0	0
I131Org	Org_I	NONE	NONE	2.51E+04	9.96E-07	1080400	0.0559	0	0	0.03	32893	0.13	0	0	0	0	0
I132Org	Org_I	NONE	NONE	3.66E+04	8.27E-05	6438	0.355	0	0	0.11	381.1	0.48	0	0	0	0	0
I133Org	Org_I	NONE	NONE	5.18E+04	9.22E-06	179820	0.0911	0	0	0.09	5846	0.39	0	0	0	0	0
I134Org	Org_I	NONE	NONE	5.60E+04	2.23E-04	1065.6	0.411	0	0	0.14	131.35	0.61	0	0	0	0	0
I135Org	Org_I	NONE	NONE	4.82E+04	2.86E-05	31302	0.249	0	0	0.08	1228.4	0.35	0	0	0	0	0
I131Elem	Elm_I	Te131m	NONE	2.51E+04	9.96E-07	1080400	0.0559	0	0	0.03	32893	0.13	0	0	0	0	0
I132Elem	Elm_I	Te132	NONE	3.66E+04	8.27E-05	6438	0.355	0	0	0.11	381.1	0.48	0	0	0	0	0
I133Elem	Elm_I	NONE	NONE	5.18E+04	9.22E-06	179820	0.0911	0	0	0.09	5846	0.39	0	0	0	0	0
I134Elem	Elm_I	NONE	NONE	5.60E+04	2.23E-04	1065.6	0.411	0	0	0.14	131.35	0.61	0	0	0	0	0
I135Elem	Elm_I	NONE	NONE	4.82E+04	2.86E-05	31302	0.249	0	0	0.08	1228.4	0.35	0	0	0	0	0
I131Part	Prt_I	NONE	NONE	2.51E+04	9.96E-07	1080400	0.0559	0	0	0.03	32893	0.13	0	0	0	0	0
I132Part	Prt_I	NONE	NONE	3.66E+04	8.27E-05	6438	0.355	0	0	0.11	381.1	0.48	0	0	0	0	0
I133Part	Prt_I	NONE	Xe133	5.18E+04	9.22E-06	179820	0.0911	0	0	0.09	5846	0.39	0	0	0	0	0
I134Part	Prt_I	NONE	NONE	5.60E+04	2.23E-04	1065.6	0.411	0	0	0.14	131.35	0.61	0	0	0	0	0
I135Part	Prt_I	NONE	Xe135	4.82E+04	2.86E-05	31302	0.249	0	0	0.08	1228.4	0.35	0	0	0	0	0
Rb86	CsGrp	NONE	NONE	4.03E+01	4.29E-07	4921	0	0	0	0	6623	0	0	0	0	0	0
Cs134	CsGrp	NONE	NONE	4.83E+03	9.55E-09	41070	0	0	0	0	46250	0	0	0	0	0	0
Cs136	CsGrp	NONE	NONE	1.39E+03	6.16E-07	6401	0	0	0	0	7326	0	0	0	0	0	0
Cs137	CsGrp	NONE	Ba137m	4.56E+03	7.30E-10	29341	0	0	0	0	31931	0	0	0	0	0	0
Sb127	TeGrp	NONE	Te127	2.33E+03	2.07E-06	227.55	0	0	0	0	6031	0	0	0	0	0	0
Sb129	TeGrp	NONE	Te129	8.03E+03	4.42E-05	35.964	0	0	0	0	643.8	0	0	0	0	0	0
Te127m	TeGrp	NONE	NONE	3.12E+02	7.64E-08	357.42	0	0	0	0	21497	0	0	0	0	0	0
Te127	TeGrp	Sb127	NONE	2.32E+03	2.06E-05	6.808	0	0	0	0	318.2	0	0	0	0	0	0
Te129m	TeGrp	NONE	NONE	1.21E+03	2.36E-07	577.2	0	0	0	0	23939	0	0	0	0	0	0
Te129	TeGrp	Sb129	NONE	7.93E+03	1.57E-04	1.8833	0	0	0	0	77.33	0	0	0	0	0	0
Te131m	TeGrp	NONE	I131Elem	3.77E+03	6.42E-06	133570	0	0	0	0	6401	0	0	0	0	0	0
Te132	TeGrp	NONE	I132Elem	3.60E+04	2.51E-06	232360	0	0	0	0	9435	0	0	0	0	0	0
Ba137m	BaGrp	Cs137	NONE	1.81E+03	4.53E-03	0	0	0	0	0	0	0	0	0	0	0	0
Ba139	BaGrp	NONE	NONE	4.61E+04	1.39E-04	8.88	0	0	0	0	171.68	0	0	0	0	0	0
Ba140	BaGrp	NONE	La140	4.51E+04	6.27E-07	947.2	0	0	0	0	3737	0	0	0	0	0	0
Mo99	NMtls	NONE	Tc99m	4.70E+04	2.87E-06	56.24	0	0	0	0	3959	0	0	0	0	0	0
Tc99m	NMtls	Mo99	NONE	4.11E+04	3.18E-05	185.37	0	0	0	0	32.56	0	0	0	0	0	0
Ru103	NMtls	NONE	NONE	3.98E+04	2.03E-07	950.9	0	0	0	0	8954	0	0	0	0	0	0

Ru105	NMtls	NONE	Rh105	2.57E+04	4.22E-05	15.355	0	0	0	0	455.1	0	0	0	0	0	0
Ru106	NMtls	NONE	NONE	1.41E+04	2.20E-08	6364	0	0	0	0	477300	0	0	0	0	0	0
Rh105	NMtls	Ru105	NONE	2.49E+04	5.40E-06	10.656	0	0	0	0	954.6	0	0	0	0	0	0
Y90	LaGrp	Sr90	NONE	3.42E+03	2.99E-06	1.9129	0	0	0	0	8436	0	0	0	0	0	0
Y91	LaGrp	Sr91	NONE	3.27E+04	1.38E-07	31.45	0	0	0	0	48840	0	0	0	0	0	0
Y92	LaGrp	Sr92	NONE	3.37E+04	5.35E-05	3.885	0	0	0	0	780.7	0	0	0	0	0	0
Y93	LaGrp	NONE	NONE	3.87E+04	1.91E-05	3.4262	0	0	0	0	2153.4	0	0	0	0	0	0
Zr95	LaGrp	NONE	Nb95	4.42E+04	1.27E-07	4292	0	0	0	0	23347	0	0	0	0	0	0
Zr97	LaGrp	NONE	NONE	4.37E+04	1.13E-05	85.47	0	0	0	0	4329	0	0	0	0	0	0
Nb95	LaGrp	Zr95	NONE	4.46E+04	2.29E-07	1324.6	0	0	0	0	5809	0	0	0	0	0	0
La140	LaGrp	Ba140	NONE	4.63E+04	4.77E-06	254.19	0	0	0	0	4847	0	0	0	0	0	0
La141	LaGrp	NONE	Ce141	4.26E+04	4.94E-05	9.065	0	0	0	0	562.4	0	0	0	0	0	0
La142	LaGrp	NONE	NONE	4.12E+04	1.26E-04	18.167	0	0	0	0	203.5	0	0	0	0	0	0
Pr143	LaGrp	Ce143	NONE	3.97E+04	5.85E-07	6.20E-06	0	0	0	0	8103	0	0	0	0	0	0
Nd147	LaGrp	NONE	NONE	1.68E+04	7.10E-07	67.34	0	0	0	0	6845	0	0	0	0	0	0
Am241	LaGrp	NONE	NONE	8.50E+00	4.80E-11	5920	0	0	0	0	4.40E+08	0	0	0	0	0	0
Cm242	LaGrp	NONE	NONE	1.78E+03	4.94E-08	3481.7	0	0	0	0	1.70E+07	0	0	0	0	0	0
Cm244	LaGrp	NONE	NONE	7.10E+01	1.25E-09	3737	0	0	0	0	2.50E+08	0	0	0	0	0	0
Ce141	CeGrp	La141	NONE	4.31E+04	2.51E-07	94.35	0	0	0	0	8954	0	0	0	0	0	0
Ce143	CeGrp	NONE	Pr143	3.98E+04	6.03E-06	23.051	0	0	0	0	3389.2	0	0	0	0	0	0
Ce144	CeGrp	NONE	NONE	3.48E+04	2.77E-08	1080.4	0	0	0	0	373700	0	0	0	0	0	0
Np239	CeGrp	NONE	NONE	5.07E+05	3.44E-06	28.194	0	0	0	0	2508.6	0	0	0	0	0	0
Pu238	CeGrp	NONE	NONE	1.04E+02	2.40E-10	3559.4	0	0	0	0	3.90E+08	0	0	0	0	0	0
Pu239	CeGrp	NONE	NONE	1.43E+01	9.00E-13	3341.1	0	0	0	0	4.30E+08	0	0	0	0	0	0
Pu240	CeGrp	NONE	NONE	2.10E+01	3.30E-12	3348.5	0	0	0	0	4.30E+08	0	0	0	0	0	0
Pu241	CeGrp	NONE	NONE	4.99E+03	1.67E-09	45.88	0	0	0	0	8251000	0	0	0	0	0	0
Sr89	SrGrp	NONE	NONE	2.54E+04	1.59E-07	1539.2	0	0	0	0	6512	0	0	0	0	0	0
Sr90	SrGrp	NONE	Y90	3.33E+03	8.00E-10	9768	0	0	0	0	239390	0	0	0	0	0	0
Sr91	SrGrp	NONE	Y91	3.15E+04	2.01E-05	150.96	0	0	0	0	932.4	0	0	0	0	0	0
Sr92	SrGrp	NONE	Y92	3.35E+04	7.29E-05	81.03	0	0	0	0	629	0	0	0	0	0	0

```
edit_time
0        0.167    1.129    2.008    4        8        24
72       96       504      720
end_edit_time

participating_isotopes
Kr83m    Kr85m    Kr85     Kr87     Kr88     Kr89
Xe131m   Xe133m   Xe133    Xe135m   Xe135    Xe137    Xe138
I131Org  I131Elem          I131Part
I132Org  I132Elem          I132Part
I133Org  I133Elem          I133Part
I134Org  I134Elem          I134Part
I135Org  I135Elem          I135Part
Rb86     Cs134    Cs136    Cs137
Sb127    Sb129    Te127m   Te127    Te129m   Te129    Te131m   Te132
Ba137m   Ba139    Ba140
Mo99     Tc99m    Ru103    Ru105    Ru106    Rh105
Y90      Y91      Y92      Y93      Zr95     Zr97     Nb95
La140    La141    La142    Pr143    Nd147    Am241    Cm242    Cm244
Ce141    Ce143    Ce144    Np239    Pu238    Pu239    Pu240    Pu241
Sr89     Sr90     Sr91     Sr92
end_participating_isotopes
```

Item 1.2

```
core
thermal_power                       1969
elemental_iodine_frac               0.0485
organic_iodine_frac                 0.0015
particulate_iodine_frac             0.95
release_frac
to_control_volume                   DW
Time     N_Gas    I_Grp    CsGrp    TeGrp    BaGrp    NMtls    CeGrp    LaGrp    SrGrp
0.008    0        0        0        0        0        0        0        0        0
0.508    0.1      0.1      0.1      0        0        0        0        0        0
2.008    0.633    0.167    0.133    0.033    0.0133   0.00167  0.00033  0.00013
0.0133
720      0        0        0        0        0        0        0        0        0
end_to_control_volume
to_control_volume                   SP
Time     N_Gas    I_Grp    CsGrp    TeGrp    BaGrp    NMtls    CeGrp    LaGrp    SrGrp
0.008    0        0        0        0        0        0        0        0        0
0.508    0        0.1      0        0        0        0        0        0        0
2.008    0        0.167    0        0        0        0        0        0        0
720      0        0        0        0        0        0        0        0        0
end_to_control_volume
end_release_frac
end_core
```

Item 1.1

Items 2.2 / 2.3

Items 2.2/2.3

Items 2.2/2.3

```
control_volume
obj_type                            OBJ_CV
name                                DW
air_volume                          1.80e+005
water_volume                        0
surface_area                        1
has_recirc_filter                   false
removal_rate_to_surface
```

Item 3.1

```
Time    NobleGas   ElemIodine   OrgIodine   PartIodine   Solubles   Insolubles
0.1663 0.          0.1884        0.         0.1884       0.1884      0.1884
0.3710 0.          29.112        0.         29.112       29.112      29.112
0.4142 0.          0.1391        0.         0.1391       0.1391      0.1391
0.4645 0.          31.715        0.         31.715       31.715      31.715
0.7019 0.          0.2725        0.         0.2725       0.2725      0.2725
0.9336 0.          43.141        0.         43.141       43.141      43.141
1.1291 0.          0.3249        0.         0.3249       0.3249      0.3249
1.2935 0.          47.768        0.         47.768       47.768      47.768      Item 4.2
1.4341 0.          38.321        0.         38.321       38.321      38.321
1.4998 0.          22.051        0.         22.051       22.051      22.051
1.5698 0.          18.779        0.         18.779       18.779      18.779
1.6567 0.          17.362        0.         17.362       17.362      17.362
1.7535 0.          16.711        0.         16.711       16.711      16.711
2.0073 0.          16.450        0.         16.450       16.450      16.450
2.3386 0.          5.6187        0.         5.6187       5.6187      5.6187
3.7749 0.          6.398         0.         6.398        6.398       6.398
4.6334 0.          0.0645        0.         0.0645       0.0645      0.0645
5.9327 0.          2.3642        0.         2.3642       2.3642      2.3642
6.3527 0.          3.4811        0.         3.4811       3.4811      3.4811
6.8036 0.          4.4852        0.         4.4852       4.4852      4.4852
7.2442 0.          5.4898        0.         5.4898       5.4898      5.4898
7.6754 0.          6.4876        0.         6.4876       6.4876      6.4876
7.7909 0.          7.4403        0.         7.4403       7.4403      7.4403
24.729 0.          0.1997        0.         0.1997       0.1997      0.1997
720.00 0.          0.0           0.         0.0          0.0         0.0
end_removal_rate_to_surface

frac_4_daughter_resusp_from_surface
Time   NobleGas   ElemIodine        OrgIodine   PartIodine   Solubles   Insolubles
720    1          0                 0           0            0          0
end_frac_4_daughter_resusp_from_surface

end_control_volume

control_volume
obj_type                                       OBJ_CV
name                                           WW
air_volume                                     1.28e+005  ] Items 3.2/3.3
water_volume                                   8.2e+004
surface_area                                   0
has_recirc_filter                              false
removal_rate_to_waterpool
Time    NobleGas   ElemIodine   OrgIodine   PartIodine   Solubles   Insolubles
1.129   0          0            0           0            0          0
3.778   0          1.5          0           1.5          1.5        1.5           Item 4.3
5.222   0          0            0           0            0          0
7.844   0          0.15         0           0.15         0.15       0.15
720     0          0            0           0            0          0
end_removal_rate_to_waterpool

frac_4_daughter_resusp_from_water
Time   NobleGas   ElemIodine   OrgIodine   PartIodine   Solubles   Insolubles
720    1          0            0           0            0          0
end_frac_4_daughter_resusp_from_water

decontamination_factor
```

```
Time    NobleGas  ElemIodine  OrgIodine  PartIodine  Solubles  Insolubles
1.129   1         1           1          1           1         1          ]Item 4.8
1.296   1         2.3         1          2.3         2.3       2.3
720     1         1           1          1           1         1
end_decontamination_factor

end_control_volume

control_volume
obj_type                                       OBJ_CV
name                                           RB
air_volume                                     1.8e+006   Item 3.4
water_volume                                   0
surface_area                                   0
has_recirc_filter                              false
end_control_volume

control_volume
obj_type                                       OBJ_CV
name                                           SL
air_volume                                     32.36   Item 3.6
water_volume                                   0
surface_area                                   1
has_recirc_filter                              false
removal_rate_to_surface
Time    NobleGas  ElemIodine  OrgIodine  PartIodine  Solubles  Insolubles
0.5117  0         0         0       1.3604    1.3604    1.3604       ]
1.0089  0         0         0       2.5427    2.5427    2.5427
2.2385  0         0         0       2.4120    2.4120    2.4120
2.8033  0         0         0       2.5895    2.5895    2.5895       Item 4.4
3.0875  0         0         0       2.1079    2.1079    2.1079
5.0413  0         0         0       1.3937    1.3937    1.3937
9.8705  0         0         0       0.6557    0.6557    0.6557
14.115  0         0         0       0.3987    0.3987    0.3987
24.008  0         0         0       0.3718    0.3718    0.3718
720.00  0         0         0       0.0       0.0       0.0
end_removal_rate_to_surface

frac_4_daughter_resusp_from_surface
Time    NobleGas  ElemIodine  OrgIodine  PartIodine  Solubles  Insolubles
720     1         1           0          0           0         0
end_frac_4_daughter_resusp_from_surface

end_control_volume

control_volume
obj_type                                       OBJ_CV
name                                           SP
air_volume                                     8.2e+004   Item 3.3
water_volume                                   0
surface_area                                   0
has_recirc_filter                              false
end_control_volume

control_volume
obj_type                                       OBJ_CR
name                                           Control_Room
```

```
air_volume                                    27500    Item 3.5
water_volume                                  0
surface_area                                  0
has_recirc_filter                             false
breathing_rate
Time (hr)        Value (cms)
720              0.000347      Item 5.2
end_breathing_rate

occupancy_factor
Time (hr)        Value (frac)
24               1             ]
96               0.6           ]  Item 5.3
720              0.4           ]
end_occupancy_factor

end_control_volume

junction
junction_type                                 AIR_JUNCTION
downstream_location                           AIR_SPACE
upstream                                      CORE
downstream                                    DW
flow_rate
Time (hr)        Rate (cfm)
0.508            1
720              1
end_flow_rate
has_filter                                    false
end_junction

junction
junction_type                                 AIR_JUNCTION
downstream_location                           AIR_SPACE
upstream                                      CORE
downstream                                    SP
flow_rate
Time (hr)        Rate (cfm)
0.508            1
720              1
end_flow_rate
has_filter                                    false
end_junction

junction
junction_type                                 AIR_JUNCTION
downstream_location                           WATER_POOL
upstream                                      DW
downstream                                    WW
has_filter                                    false
flow_rate
Time (hr)        Value (cfm)
1.129            0             ]
1.296            9180          ]  Item 3.7
2.008            0             ]
720              3e+004        ]
end_flow_rate
```

```
end_junction

junction
junction_type                              AIR_JUNCTION
downstream_location                        AIR_SPACE
upstream                                   DW
downstream                                 RB
has_filter                                 false
flow_rate
Time (hr)       Value (cfm)
0.236           0.96
0.394           1.14
0.442           1.08
0.585           1.14
0.819           1.08
1.129           1.14
1.379           0.99
2.008           1.12
3.778           1.13
4               1.11
5.222           1.08
5.556           1.14
7.844           1.14
8               1.12
14              1.08
24              1.06
720             0.52
end_flow_rate
end_junction
```

Item 3.15, DW to RB

```
junction
junction_type                              AIR_JUNCTION
downstream_location                        AIR_SPACE
upstream                                   DW
downstream                                 SL
has_filter                                 false
flow_rate
Time (hr)       Value (cfm)
0.236           0.095
0.394           0.032
0.442           0.053
0.585           0.032
0.819           0.053
1.129           0.032
1.379           0.080
2.008           0.041
3.778           0.037
4               0.042
5.222           0.053
5.556           0.033
7.844           0.033
8               0.040
14              0.051
24              0.058
720             0.033
end_flow_rate
end_junction
```

Item 3.14, MSIV 2

```
junction
junction_type                               AIR_JUNCTION
downstream_location -                       AIR_SPACE
upstream                                    SL
downstream                                  environment
has_filter                                  true
flow_rate
Time (hr)       Value (cfm)
0.236           0.170
0.394           0.059
0.442           0.095
0.585           0.059
0.819           0.095
1.129           0.059
1.379           0.144
2.008           0.073
3.778           0.066
4               0.076
5.222           0.096
5.556           0.059
7.844           0.059
8               0.072
14              0.092
24              0.105
720             0.059
end_flow_rate

filter_efficiency
Time  NobleGas  ElemIodine  OrgIodine  PartIodine  Solubles  Insolubles
720   0         0.50        0          0           0         0
end_filter_efficiency

frac_4_daughter_resusp
Time  NobleGas  ElemIodine  OrgIodine  PartIodine  Solubles  Insolubles
720   1         0           0          0           0         0
end_frac_4_daughter_resusp

X_over_Q_4_ctrl_room
Time (hr)       Value (s/m*3)
8               0.00271
24              0.000876
96              0.000863
720             0.000845
end_X_over_Q_4_ctrl_room

X_over_Q_4_site_boundary
Time  (hr)      Value (s/m*3)
2.008           1.1e-3
8               0
24              0
96              0
720             0
end_X_over_Q_4_site_boundary

X_over_Q_4_low_population_zone
Time (hr)       Value (s/m*3)
```

Handwritten annotations: flow_rate values — "Item 3.14, SL out"; filter_efficiency row — "Item 4.6"; X_over_Q_4_ctrl_room values — "Item 5.1, TB"; X_over_Q_4_site_boundary values — "Item 5.4, EAB - Ground"

```
8               5.6e-5
24              9.0e-6
96              5.4e-6
720             1.9e-6
end_X_over_Q_4_low_population_zone

end_junction

junction
junction_type                          AIR_JUNCTION
downstream_location                    AIR_SPACE
upstream                               DW
downstream                             environment
has_filter                             true
flow_rate
Time (hr)       Value (cfm)
0.236           0.12
0.394           0.046
0.442           0.074
0.585           0.046
0.819           0.074
1.129           0.046
1.379           0.109
2.008           0.057
3.778           0.052
4               0.059
5.222           0.075
5.556           0.046
7.844           0.046
8               0.057
14              0.072
24              0.082
720             0.046
end_flow_rate

filter_efficiency
Time NobleGas ElemIodine OrgIodine PartIodine Solubles Insolubles
720  0        0.5        0         0.5        0.5      0.5
end_filter_efficiency

frac_4_daughter_resusp
Time NobleGas ElemIodine OrgIodine PartIodine Solubles Insolubles
720  1        1          0         0          0        0
end_frac_4_daughter_resusp

X_over_Q_4_ctrl_room
Time (hr)       Value (s/m*3)
8               0.00271
24              0.000876
96              0.000863
720             0.000845
end_X_over_Q_4_ctrl_room

X_over_Q_4_site_boundary
Time (hr)       Value (s/m*3)
2.008           1.1e-3
8               0
```

Handwritten annotations (beside the bracketed lines):
- Item 5.4, LPZ - Ground (LPZ X/Q values)
- Item 3.14, MSIV 1 (flow_rate values)
- Item 4.5 (filter_efficiency)
- Item 5.1, TB (ctrl_room X/Q values)
- Item 5.4, EAB - Ground (site_boundary X/Q values)

```
24              0
96              0
720             0
end_X_over_Q_4_site_boundary
```

Item 5.4, EAB - Ground (continued)

```
X_over_Q_4_low_population_zone
Time (hr)       Value (s/m*3)
8               5.6e-5
24              9.0e-6
96              5.4e-6
720             1.9e-6
end_X_over_Q_4_low_population_zone
```

Item 5.4, LPZ - Ground

```
end_junction

junction
junction_type                          AIR_JUNCTION
downstream_location                    AIR_SPACE
upstream                               DW
downstream                             environment
has_filter                             true
flow_rate
Time (hr)       Value (cfm)
0.236           0.045
0.394           0.017
0.442           0.028
0.585           0.017
0.819           0.028
1.129           0.017
1.379           0.041
2.008           0.021
3.778           0.020
4               0.022
5.222           0.028
5.556           0.018
7.844           0.018
8               0.021
14              0.027
24              0.031
720             0.018
end_flow_rate
```

Item 3.14, TB

```
filter_efficiency
Time  NobleGas  ElemIodine  OrgIodine  PartIodine  Solubles  Insolubles
720   0         0.5         0          0.965       0.965     0.965
end_filter_efficiency
```

Item 4.7

```
frac_4_daughter_resusp
Time  NobleGas  ElemIodine  OrgIodine  PartIodine  Solubles  Insolubles
720   1         1           0          0           0         0
end_frac_4_daughter_resusp

X_over_Q_4_ctrl_room
Time (hr)       Value (s/m*3)
8               0.00271
24              0.000876
96              0.000863
```

Item 5.1, TB

```
720                 0.000845
end_X_over_Q_4_ctrl_room
```

Item 5.1, TB (continued)

```
X_over_Q_4_site_boundary
Time (hr)           Value (s/m*3)
2.008               1.1e-3
8                   0
24                  0
96                  0
720                 0
end_X_over_Q_4_site_boundary
```

Item 5.4, EAB - Ground

```
X_over_Q_4_low_population_zone
Time (hr)           Value (s/m*3)
8                   5.6e-5
24                  9.0e-6
96                  5.4e-6
720                 1.9e-6
end_X_over_Q_4_low_population_zone
```

Item 5.4, LPZ - Ground

```
end_junction

junction
junction_type                                 AIR_JUNCTION
downstream_location                           AIR_SPACE
upstream                                      DW
downstream                                    environment
has_filter                                    true
flow_rate
Time (hr)           Value (cfm)
0.236               0.0301
0.394               0.0114
0.442               0.0185
0.585               0.0114
0.819               0.0185
1.129               0.0114
1.379               0.0273
2.008               0.0143
3.778               0.0128
4                   0.0148
5.222               0.0187
5.556               0.0116
7.844               0.0115
8                   0.0141
14                  0.0180
24                  0.0204
720                 0.0115
end_flow_rate
```

Item 3.14, RB (DW)

```
filter_efficiency
Time  NobleGas  ElemIodine  OrgIodine  PartIodine  Solubles  Insolubles
720   0         0.5         0          0.916       0.916     0.916
end_filter_efficiency
```

Item 4.7

```
frac_4_daughter_resusp
Time  NobleGas  ElemIodine  OrgIodine  PartIodine  Solubles  Insolubles
720   1         1           0          0           0         0
```

```
end_frac_4_daughter_resusp

X_over_Q_4_ctrl_room
Time (hr)          Value (s/m*3)
8                  2.59e-003
24                 1.15e-003
96                 8.44e-004
720                7.18e-004
end_X_over_Q_4_ctrl_room
```

Item 5.1, Yard

```
X_over_Q_4_site_boundary
Time (hr)          Value (s/m*3)
2.008              1.1e-3
8                  0
24                 0
96                 0
720                0
end_X_over_Q_4_site_boundary
```

Item 5.4, EAB - Ground

```
X_over_Q_4_low_population_zone
Time (hr)          Value (s/m*3)
8                  5.6e-5
24                 9.0e-6
96                 5.4e-6
720                1.9e-6
end_X_over_Q_4_low_population_zone
```

Item 5.4, LPZ - Ground

```
end_junction

junction
junction_type                          AIR_JUNCTION
downstream_location                    AIR_SPACE
upstream                               WW
downstream                             DW
has_filter                             false
flow_rate
Time (hr)          Value (cfm)
1.296              0
1.463              9180
2.008              0
720                3e+004
end_flow_rate
end_junction
```

Item 3.8

```
junction
junction_type                          AIR_JUNCTION
downstream_location                    AIR_SPACE
upstream                               WW
downstream                             RB
has_filter                             false
flow_rate
Time (hr)          Value (cfm)
0.236              0.76
0.394              0.84
0.442              0.81
0.585              0.84
0.819              0.81
```

Item 3.15, WW to RB

```
1.129            0.84
1.379            0.77
2.008            0.83
3.778            0.83
4                0.82
5.222            0.81
5.556            0.84
7.844            0.84
8                0.83
14               0.81
24               0.80
720              0.39
end_flow_rate
end_junction
```

Item 3.15, WW to RB

```
junction
junction_type                          AIR_JUNCTION
downstream_location                    AIR_SPACE
upstream                               WW
downstream                             environment
has_filter                             true
flow_rate
Time (hr)        Value (cfm)
0.236            0.13
0.394            0.050
0.442            0.081
0.585            0.050
0.819            0.081
1.129            0.050
1.379            0.12
2.008            0.063
3.778            0.056
4                0.065
5.222            0.082
5.556            0.050
7.844            0.050
8                0.062
14               0.079
24               0.090
720              0.050
end_flow_rate
```

Item 3.14, RB (WW)

```
filter_efficiency
Time  NobleGas  ElemIodine  OrgIodine  PartIodine  Solubles  Insolubles
720   0         0.5         0          0.916       0.916     0.916
end_filter_efficiency
```

Item 4.7

```
frac_4_daughter_resusp
Time  NobleGas  ElemIodine  OrgIodine  PartIodine  Solubles  Insolubles
720   1         1           0          0           0         0
end_frac_4_daughter_resusp

X_over_Q_4_ctrl_room
Time (hr)        Value (s/m*3)
8                2.59e-003
24               1.15e-003
96               8.44e-004
```

Item 5.1, Yard

```
720                7.18e-004        Item 5.1, Yard
end_X_over_Q_4_ctrl_room

X_over_Q_4_site_boundary
Time (hr)          Value (s/m*3)
2.008              1.1e-3
8                  0
24                 0                Item 5.4, EAB - Ground
96                 0
720                0
end_X_over_Q_4_site_boundary

X_over_Q_4_low_population_zone
Time (hr)          Value (s/m*3)
8                  5.6e-5
24                 9.0e-6            Item 5.4, LPZ - Ground
96                 5.4e-6
720                1.9e-6
end_X_over_Q_4_low_population_zone

end_junction

junction
junction_type                                 AIR_JUNCTION
downstream_location                           AIR_SPACE
upstream                                      SP
downstream                                    RB
has_filter                                    true
flow_rate
Time (hr)          Rate (cfm)
720                0.13             Item 3.12
end_flow_rate

filter_efficiency
Time  NobleGas  ElemIodine  OrgIodine  PartIodine  Solubles  Insolubles
720   0         .9          .9         .9          0         0            Item 4.9
end_filter_efficiency

frac_4_daughter_resusp
Time  NobleGas  ElemIodine  OrgIodine  PartIodine  Solubles  Insolubles
720   1         0           0          0           0         0
end_frac_4_daughter_resusp

end_junction

junction
junction_type                                 AIR_JUNCTION
downstream_location                           AIR_SPACE
upstream                                      RB
downstream                                    environment
has_filter                                    true
flow_rate
Time (hr)          Value (cfm)
720                2600             Item 3.9
end_flow_rate

filter_efficiency
```

```
Time   NobleGas   ElemIodine   OrgIodine   PartIodine   Solubles   Insolubles
720    0          0.9          0.9         0.9          0.9        0.9
end_filter_efficiency

frac_4_daughter_resusp
Time   NobleGas   ElemIodine   OrgIodine   PartIodine   Solubles   Insolubles
720    1          1            0           0            0          0
end_frac_4_daughter_resusp

X_over_Q_4_ctrl_room
Time (hr)         Value (s/m*3)
1.508             1.8e-004
2.008             1.8e-004
8                 1.8e-004
24                9.67e-005
96                2.5e-005
720               3.6e-006
end_X_over_Q_4_ctrl_room

X_over_Q_4_site_boundary
Time (hr)         Value (s/m*3)
1.508             1.9e-6
2.008             1.9e-6
8                 0
24                0
96                0
720               0
end_X_over_Q_4_site_boundary

X_over_Q_4_low_population_zone
Time (hr)         Value (s/m*3)
1.508             5.3e-7
2.008             5.3e-7
8                 5.3e-7
24                1.8e-7
96                1.1e-7
720               4.8e-8
end_X_over_Q_4_low_population_zone

end_junction

junction
junction_type                                  AIR_JUNCTION
downstream_location                            AIR_SPACE
upstream                                       environment
downstream                                     Control_Room
has_filter                                     false
flow_rate
Time (hr)         Value (cfm)
720               14000
end_flow_rate
end_junction

junction
junction_type                                  AIR_JUNCTION
downstream_location                            AIR_SPACE
upstream                                       Control_Room
```

Handwritten annotations: "Item 4.1" (filter efficiency); "Item 5.1, Stack" (ctrl room X/Q); "Item 5.4, EAB - Elev" (site boundary X/Q); "Item 5.4, LPZ - Elev" (low population zone X/Q); "Item 3.13" (flow rate 14000).

```
downstream                                   environment
has_filter                                   false
flow_rate
Time (hr)         Value (cfm)
720               14000         Item 3.13
end_flow_rate

X_over_Q_4_ctrl_room
Time (hr)         Value (s/m*3)
720               0
end_X_over_Q_4_ctrl_room

X_over_Q_4_site_boundary
Time (hr)         Value (s/m*3)
720               0
end_X_over_Q_4_site_boundary

X_over_Q_4_low_population_zone
Time (hr)         Value (s/m*3)
720               0
end_X_over_Q_4_low_population_zone

end_junction

environment
breathing_rate_sb
Time (hr)         Value (cms)
8                 0.000347   ]
24                0.0        ]   Item 5.2
720               0.0        ]
end_breathing_rate_sb

breathing_rate_lpz
Time (hr)         Value (cms)
8                 0.000347   ]
24                0.000175   ]   Item 5.2
720               0.000232   ]
end_breathing_rate_lpz

end_environment
_
```

STARDOSE 1.0 (c) 1996 Polestar Applied Technology, Inc.
03:47:26 PM September 15, 2000

edit time 504.000000

Control_Room

	thyroid	wbody	skin	CEDE
Total dose:	7.41E+001	2.63E-001	1.01E+001	2.68E+000
Noble gas	0.00E+000	2.60E-001	1.00E+001	0.00E+000
Org iodine	3.50E+001	5.25E-004	1.07E-002	1.08E+000
Elem iodine	3.01E+000	1.93E-004	2.89E-003	9.40E-002
Part iodine	3.51E+001	1.75E-003	2.85E-002	1.09E+000
Cesium	1.74E-001	0.00E+000	0.00E+000	1.93E-001
Tellurium	7.51E-001	0.00E+000	0.00E+000	3.55E-002
Barium	1.49E-003	0.00E+000	0.00E+000	5.98E-003
Noble metal	5.99E-004	0.00E+000	0.00E+000	3.20E-002
Lanthanides	9.57E-005	0.00E+000	0.00E+000	2.16E-002
Cerium	4.95E-005	0.00E+000	0.00E+000	9.66E-002
Strontinum	2.70E-003	0.00E+000	0.00E+000	3.49E-002

environment

	thyroid	wbody	skin	CEDE
EAB dose:	8.45E+000	4.93E-001	3.46E-001	3.94E-001
LPZ dose:	7.96E-001	1.34E-001	1.20E-001	3.20E-002

	thyrd_eab	wbody_eab	skin_eab	CEDE_eab	thyrd_lpz	wbody_lpz	skin_lpz	CEDE_lpz
Noble gas	0.00E+000	4.69E-001	3.36E-001	0.00E+000	0.00E+000	1.32E-001	1.19E-001	0.00E+000
Org iodine	4.23E-001	1.08E-003	4.57E-004	1.33E-002	2.82E-001	2.94E-004	1.53E-004	8.71E-003
Elem iodine	5.65E-001	1.67E-003	6.84E-004	1.78E-002	4.31E-002	1.18E-004	4.80E-005	1.35E-003
Part iodine	7.16E+000	2.11E-002	8.68E-003	2.25E-001	4.55E-001	1.17E-003	4.87E-004	1.42E-002
Cesium	5.87E-002	0.00E+000	0.00E+000	6.53E-002	3.24E-003	0.00E+000	0.00E+000	3.60E-003
Tellurium	2.42E-001	0.00E+000	0.00E+000	1.15E-002	1.38E-002	0.00E+000	0.00E+000	6.54E-004
Barium	4.77E-004	0.00E+000	0.00E+000	1.92E-003	2.73E-005	0.00E+000	0.00E+000	1.10E-004
Noble metal	1.94E-004	0.00E+000	0.00E+000	1.03E-002	1.11E-005	0.00E+000	0.00E+000	5.89E-004
Lanthanides	3.01E-005	0.00E+000	0.00E+000	6.21E-003	1.73E-006	0.00E+000	0.00E+000	3.61E-004
Cerium	1.60E-005	0.00E+000	0.00E+000	3.12E-002	9.12E-007	0.00E+000	0.00E+000	1.78E-003
Strontinum	8.73E-004	0.00E+000	0.00E+000	1.12E-002	4.98E-005	0.00E+000	0.00E+000	6.41E-004

edit time 720.000000

Control_Room

	thyroid	wbody	skin	CEDE
Total dose:	7.60E+001	2.64E-001	1.02E+001	2.74E+000
Noble gas	0.00E+000	2.62E-001	1.02E+001	0.00E+000
Org iodine	3.68E+001	5.32E-004	1.08E-002	1.13E+000
Elem iodine	3.02E+000	1.93E-004	2.89E-003	9.43E-002
Part iodine	3.53E+001	1.75E-003	2.85E-002	1.10E+000
Cesium	1.74E-001	0.00E+000	0.00E+000	1.93E-001
Tellurium	7.51E-001	0.00E+000	0.00E+000	3.55E-002
Barium	1.49E-003	0.00E+000	0.00E+000	5.98E-003
Noble metal	5.99E-004	0.00E+000	0.00E+000	3.20E-002
Lanthanides	9.57E-005	0.00E+000	0.00E+000	2.16E-002
Cerium	4.95E-005	0.00E+000	0.00E+000	9.66E-002
Strontinum	2.70E-003	0.00E+000	0.00E+000	3.49E-002

environment

	thyroid	wbody	skin	CEDE
EAB dose:	8.45E+000	4.93E-001	3.46E-001	3.94E-001
LPZ dose:	8.08E-001	1.34E-001	1.21E-001	3.24E-002

	thyrd_eab	wbody_eab	skin_eab	CEDE_eab	thyrd_lpz	wbody_lpz	skin_lpz	CEDE_lpz
Noble gas	0.00E+000	4.69E-001	3.36E-001	0.00E+000	0.00E+000	1.33E-001	1.21E-001	0.00E+000
Org iodine	4.23E-001	1.08E-003	4.57E-004	1.33E-002	2.89E-001	2.96E-004	1.54E-004	8.93E-003
Elem iodine	5.65E-001	1.67E-003	6.84E-004	1.78E-002	4.32E-002	1.18E-004	4.80E-005	1.36E-003
Part iodine	7.16E+000	2.11E-002	8.68E-003	2.25E-001	4.58E-001	1.17E-003	4.87E-004	1.44E-002
Cesium	5.87E-002	0.00E+000	0.00E+000	6.53E-002	3.24E-003	0.00E+000	0.00E+000	3.60E-003
Tellurium	2.42E-001	0.00E+000	0.00E+000	1.15E-002	1.38E-002	0.00E+000	0.00E+000	6.54E-004
Barium	4.77E-004	0.00E+000	0.00E+000	1.92E-003	2.73E-005	0.00E+000	0.00E+000	1.10E-004
Noble metal	1.94E-004	0.00E+000	0.00E+000	1.03E-002	1.11E-005	0.00E+000	0.00E+000	5.89E-004
Lanthanides	3.01E-005	0.00E+000	0.00E+000	6.21E-003	1.73E-006	0.00E+000	0.00E+000	3.61E-004
Cerium	1.60E-005	0.00E+000	0.00E+000	3.12E-002	9.12E-007	0.00E+000	0.00E+000	1.78E-003
Strontinum	8.73E-004	0.00E+000	0.00E+000	1.12E-002	4.98E-005	0.00E+000	0.00E+000	6.41E-004

03:54:32 PM September 15, 2000
Total elapsed hours: 00, mins: 07, secs: 06

DOSE CALCULATION DATA BASE FOR

APPLICATION OF THE REVISED DBA SOURCE TERM

TO THE AMERGEN OYSTER CREEK GENERATING STATION

REVISION 0 1 2 [3] 4

	PROJECT MGR		REVIEWER		TECH CONT	
	Print/Sign	Date	Print/Sign	Date	Print/Sign	Date
REV: 0	James Metcalf s/ James Metcalf	3/20/97	Dave Leaver s/ Dave Leaver	3/24/97	Nick Trikouros (GPUN) s/ Nick Trikouros	3/21/97
REV: 1	James Metcalf s/ James Metcalf	3/27/97	Dave Leaver s/ Dave Leaver	3/28/97	Nick Trikouros (GPUN) s/ Nick Trikouros	3/28/97
REV: 2	James Metcalf s/ James Metcalf	3/31/97	Dave Leaver s/ Dave Leaver	3/31/97	Nick Trikouros (GPUN) s/ Nick Trikouros	3/28/97
REV: 3	James Metcalf s/ James Metcalf	9/16/00	Dave Leaver s/ Dave Leaver	9/22/00	Gordon Wissinger (PECo) s/ Gordon Wissinger	9/29/00

Reasons for Revision 0

1. First Issue of the document

Reasons for Revision 1

1. Corrected Rev 0 signature data typo for Dave Leaver
2. Provided final references for Items 3.7 and 3.8 and clarified basis for long-term mixing rate
3. Provided final references for Item 3.14 and 3.15
4. Added preliminary Item 3.17, ICV/IA (i.e., RB bypass to TB) leak rate multiplier to account for spray test line
5. Corrected Item 4.2, removal lambda for t=1.129 to t=1.294 hours
6. Corrected and increased the resolution of Item 4.10, preliminary maximum ratio of re-evolved elemental iodine to organic in the containment atmosphere
7. Added "Mobil 78" to Item 6.4 and finalized references for Items 6.3 and 6.4
8. Added Item 6.5, minimum suppression pool pH values
9. Provided final reference for Item 7.5
10. Added Item 7.6, preliminary organic iodine dose multiplier to account for pool reevolution of I_2
11. Provided final reference for Item 8.1 and clarified table headings
12. Added Item 8.3, maximum spray HX cooling water temperature
13. Finalized reference for Item 9.1
14. Added Items 9.6 and 9.7, midplane elevation of the torus and nominal pool depth
15. Added References 21 – 24

Reasons for Revision 2

1. Provided final references for Items 3.17, 4.2, 4.3, 4.4, 4.7, 4.8, 4.10, and 7.6

Reasons for Revision 3

1. Update name of plant owner on title page
2. Change tables and update references for Items 3.14, and 3.15
3. Update references for Items 4.2, and 4.4
4. Change filter efficiency for all particulates in Item 4.7, and update related references
5. Change TB and Yard CR X/Qs in Item 5.1, and update related references
6. Change CR occupancy factor in Item 5.3, and update related reference
7. Change reference for Item 6.1

1. Radionuclide Data

1.1 Core Power - Radiological Calculations - 1969 MW(t) (Reference 1 for power of 1930 MW(t) and 102% multiplier)

1.2 Core Inventory @ t=0 (Reference 2 except for * which are from Reference 3)

Nuclide	Per Mw(t)	10^6Ci	10^6Ci+2%
Kr83m	4.15E+03*	8.01E+00	8.18E+00
Kr85m	6.94E+03	1.34E+01	1.37E+01
Kr85	4.03E+02	7.78E-01	7.94E-01
Kr87	1.29E+04	2.49E+01	2.54E+01
Kr88	1.83E+04	3.54E+01	3.61E+01
Kr89	3.98E+04*	7.68E+01	7.83E+01
Xe131m	2.60E+02*	5.01E-01	5.11E-01
Xe133m	1.38E+03*	2.67E+00	2.73E+00
Xe133	5.23E+04	1.01E+02	1.03E+02
Xe135m	1.56E+04*	3.01E+01	3.07E+01
Xe135	1.81E+04	3.50E+01	3.57E+01
Xe137	5.10E+04*	9.85E+01	1.00E+02
Xe138	4.78E+04*	9.22E+01	9.40E+01
I131	2.51E+04	4.84E+01	4.94E+01
I132	3.66E+04	7.06E+01	7.20E+01
I133	5.18E+04	1.00E+02	1.02E+02
I134	5.60E+04	1.08E+02	1.10E+02
I135	4.82E+04	9.31E+01	9.50E+01
Rb86	4.03E+01	7.78E-02	7.94E-02
Cs134	4.83E+03	9.32E+00	9.51E+00
Cs136	1.39E+03	2.69E+00	2.74E+00
Cs137	4.56E+03	8.80E+00	8.98E+00
Sb127	2.33E+03	4.50E+00	4.59E+00
Sb129	8.03E+03	1.55E+01	1.58E+01
Te127m	3.12E+02	6.02E-01	6.14E-01
Te127	2.32E+03	4.47E+00	4.56E+00
Te129m	1.21E+03	2.33E+00	2.38E+00
Te129	7.93E+03	1.53E+01	1.56E+01
Te131m	3.77E+03	7.28E+00	7.43E+00
Te132	3.60E+04	6.94E+01	7.08E+01
Ba137m	1.81E+03*	3.50E+00	3.57E+00
Ba139	4.61E+04	8.90E+01	9.08E+01
Ba140	4.51E+04	8.70E+01	8.87E+01
Mo99	4.70E+04	9.08E+01	9.26E+01
Tc99m	4.11E+04	7.93E+01	8.09E+01
Ru103	3.98E+04	7.68E+01	7.83E+01
Ru105	2.57E+04	4.96E+01	5.06E+01
Ru106	1.41E+04	2.73E+01	2.78E+01

Rh105	2.49E+04	4.81E+01	4.91E+01
Y90	3.42E+03	6.60E+00	6.73E+00
Y91	3.27E+04	6.32E+01	6.45E+01
Y92	3.37E+04	6.50E+01	6.63E+01
Y93	3.87E+04	7.46E+01	7.61E+01
Zr95	4.42E+04	8.53E+01	8.70E+01
Zr97	4.37E+04	8.43E+01	8.60E+01
Nb95	4.46E+04	8.61E+01	8.78E+01
La140	4.63E+04	8.94E+01	9.12E+01
La141	4.26E+04	8.23E+01	8.40E+01
La142	4.12E+04	7.95E+01	8.11E+01
Pr143	3.97E+04	7.67E+01	7.82E+01
Nd147	1.68E+04	3.24E+01	3.31E+01
Am241	8.50E+00	1.64E-02	1.67E-02
Cm242	1.78E+03	3.44E+00	3.51E+00
Cm244	7.10E+01	1.37E-01	1.40E-01
Ce141	4.31E+04	8.32E+01	8.49E+01
Ce143	3.98E+04	7.68E+01	7.83E+01
Ce144	3.48E+04	6.71E+01	6.84E+01
Np239	5.07E+05	9.78E+02	9.97E+02
Pu238	1.04E+02	2.01E-01	2.05E-01
Pu239	1.43E+01	2.75E-02	2.81E-02
Pu240	2.10E+01	4.06E-02	4.14E-02
Pu241	4.99E+03	9.64E+00	9.83E+00
Sr89	2.54E+04	4.90E+01	5.00E+01
Sr90	3.33E+03	6.43E+00	6.56E+00
Sr91	3.15E+04	6.08E+01	6.20E+01
Sr92	3.35E+04	6.47E+01	6.60E+01

1.3 Core Inventory by Mass (Reference 2)

Group	Grams	* 1.34E5 for Cs at BOC
Cs-Rb (Cs + Rb isotopes):	2.44E5* + 2.99E4	= 2.74E5
I-Br (I + Br isotopes): 2.04E4	1.85E4 + 1.88E3	=
TeGrp (Te, Sb, Se isotopes):	3.74E4 + 1.27E3 + 4.75E3	= 4.34E4
Ba-Sr (Ba + Sr isotopes):	1.22E5 + 7.94E4	= 2.01E5
NMet (Mo, Tc, Ru, Rh, Pd isotopes):	2.8E5 + 6.66E4 + 1.88E5 + 3.77E4 + 9.33E4	= 6.66E5
LaGrp (La, Y, Zr, Nb, Pr, Nd, Pm, Sm, Eu, Am, Cm isotopes):	1.04E5 + 4.15E4 + 3.08E5 + 2.21E3 + 9.42E4 + 3.23E5 + 1.42E4 + 5.85E4 + 1.19E4 + 1.16E4 + 2.78E3	= 9.60E5
CeGrp (Ce, Np, Pu isotopes):	2.25E5 + 4.09E4 + 7.61E5	= 1.03E6

2. Source Terms (Reference 4, except as noted)

2.1 Fraction of core inventory, 0 - 0.008 hours: no releases (conservative for BWR - expected to be >)

2.2 Fraction of core inventory, 0.008 - 0.508 hours: Gases - Xe, Kr - 0.1 /hr (0.05 total)
Elemental I - 4.9E-3 /hr (2.4E-3 total)
Organic I - 1.5E-4 /hr (7.5E-5 total)

Aerosols - I, Br - 0.095 /hr (0.0475 total)
Cs, Rb - 0.1 /hr (0.05 total)

2.3 Fraction of core inventory, 0.508 - 2.008 hours: Gases - Xe, Kr - 0.63 /hr (0.95 total)
Elemental I - 8.1E-3 /hr (1.2E-2 total)
Organic I - 2.5E-4 /hr (3.8E-4 total)

Aerosols - I, Br - 0.158 /hr (0.2375 total)
Cs, Rb - 0.133 /hr (0.2 total)
Te Group - 0.033 /hr (0.05 total)
Ba, Sr - 0.013 /hr (0.02 total)
Noble Met - 1.7E-3 /hr (2.5E-3 tot)
La Group - 1.3E-4 /hr (2E-4 tot)
Ce Group - 3.3E-4 /hr (5E-4 tot)

2.4 Aerosol mass release rates, 30 - 1830 seconds (based on Items 1.3 and 2.2):

I, Br - 0.095 /hr x 2.04E4 /3600 = 0.54 g/sec
Cs, Rb - 0.1 /hr x 2.74E5 /3600 = 7.6 g/sec
Inert material assumed equal to sum = 8.14 g/sec (conservatively* low based on Reference 4)
Total = 16.3 g/sec

2.5 Aerosol mass release rates, 1830 - 7230 seconds (based on Items 1.3 and 2.3):

I, Br - 0.158 /hr x 2.04E4 /3600 = 0.90 g/sec
Cs, Rb - 0.133 /hr x 2.74E5 /3600 = 10.1 g/sec
Te Group - 0.033 /hr x 4.34E4 /3600 = 0.40 g/sec
Ba, Sr - 0.013 /hr x 2.01E5 /3600 = 0.73 g/sec
Noble Metals - 1.7E-3 /hr x 6.66E5 /3600 = 0.31 g/sec
La Group - 1.3E-4 /hr x 9.6E5 /3600 = 0.035 g/sec
Ce Group - 3.3E-4 /hr x 1.03E6 /3600 = 0.094 g/sec
Inert material assumed equal to sum = 12.6 g/sec (conservatively* low based on Reference 4)
Total = 25.2 g/sec

* Total inert release prorated - conservative for maximizing airborne activity in second phase

3. Volumes and Volumetric Flowrates

3.1 Volume of Drywell - 180000 ft^3 (Reference 5, 5.2)

3.2 Total Volume of Wetwell/Torus (including Pool) - 210000 ft^3 (Reference 5, 5.2)

3.3 Min/Max Volume of Suppression Pool - 92000 ft^3 (max) (Reference 5, 3.5.A.1)
- 82000 ft^3 (min)

3.4 Volume of Reactor Building - 1.8E6 ft3 (Reference 6, Tbl 6.2-11, and Reference 7)

3.5 Volume of Control Room (CR) - 27500 ft3 (Reference 6, Section 6.4, and Ref 8)

3.6 Volume of Steamline between MSIVs - 32.4 ft^3 (Reference 9)
(based on 12.77' stem-to-stem, 24" steam line, assumed Sch 80 wall = $(12.77')\pi(21.56")^2/4/144$)

3.7 Volumetric Flowrate, Drywell to Wetwell: (Reference, Calc PSAT 05201H.01, Rev 0)
From t=0 to t=1.129 hours - 0
From t=1.129 to t=1.296 hours - 9180 cfm
From t=1.296 to t=2.008 hours - 0
From t=2.008 hours to end of problem - 3E4 cfm (assumed to be well-mixed @ 10 dw vol/hr)

3.8 Volumetric Flowrate, Wetwell to Drywell: (Reference, Calc PSAT 05201H.01, Rev 0)
From t=0 to t=1.296 hours - 0
From t=1.296 to t=1.463 hours - 9180 cfm
From t=1.463 to t=2.008 hours - 0
From t=2.008 hours to end of problem - 3E4 cfm (assumed to be well-mixed @ 10 dw vol/hr)

3.9 Volumetric Flowrate, RB to Environment- 2600 cfm (Reference 6, Tbl 6.2-11, and Reference 7)

3.10 Drywell Sprays - One Loop, One Pump/Loop - 3000 gpm (Reference 6, Tbl 6.2-3)

3.11 Flow through one 1-7G25 Spraying Systems Co. Nozzle @ 40 psid - 34 gpm
(Reference 6, Tbl 6.2-8)

3.12 Volumetric Flowrate, ESF Leakage: (Reference 1)
From t=0 to t=720 hours - 60 gph

3.13 Volumetric Flowrate, Environment to CR (Unfiltered): (Reference 6, Section 6.4 and Reference 10, Section 5.3)
From t=0 to t=720 hours - 14000 cfm

3.14 RB Bypass Volumetric Flowrates (cfm) (* hours): (Reference – Calc PSAT 05201H.02, Rev 1)

Up to t*	MSIV 1	MSIV 2	SL Out	2" N2	ICV	TB	RB(DW)	RB(WW)
0.236	0.1204	0.0946	0.1700	0.0980	0.0150	0.0450	0.0301	0.1317
0.394	0.0456	0.0324	0.0588	0.0370	0.0064	0.0166	0.0114	0.0498
0.442	0.0741	0.0528	0.0950	0.0600	0.0090	0.0280	0.0185	0.0811
0.585	0.0456	0.0324	0.0588	0.0370	0.0064	0.0166	0.0114	0.0498
0.819	0.0741	0.0528	0.0950	0.0600	0.0090	0.0280	0.0185	0.0811
1.129	0.0456	0.0324	0.0588	0.0370	0.0064	0.0166	0.0114	0.0498
1.379	0.1091	0.0801	0.1440	0.0890	0.0140	0.0410	0.0273	0.1194
2.008	0.0571	0.0405	0.0730	0.0460	0.0070	0.0210	0.0143	0.0625
3.778	0.0516	0.0366	0.0664	0.0421	0.0066	0.0199	0.0128	0.0564
4	0.0595	0.0423	0.0764	0.0480	0.0076	0.0218	0.0148	0.0651
5.222	0.0747	0.0532	0.0960	0.0610	0.0090	0.0280	0.0187	0.0817
5.556	0.0460	0.0327	0.0594	0.0374	0.0055	0.0176	0.0116	0.0504
7.844	0.0458	0.0325	0.0591	0.0378	0.0059	0.0177	0.0115	0.0501
8	0.0566	0.0402	0.0724	0.0461	0.0077	0.0208	0.0141	0.0619
14	0.0718	0.0511	0.0920	0.0580	0.0090	0.0270	0.0180	0.0786
24	0.0818	0.0585	0.1050	0.0660	0.0100	0.0310	0.0204	0.0895
720	0.0459	0.0326	0.0588	0.0370	0.0064	0.0179	0.0115	0.0503

"MSIV1" = one valve from DW, "MSIV2" = first valve into closed SL, "SL Out" = out of closed SL, "2"N2" = for deposition in 2"N2 line, "ICV" = for deposition in ICV line, "TB" = DW to TB, "RB(DW)" = DW to East wall of RB, "RB(WW)" = WW to East wall of RB.

3.15 Primary Containment to RB Volumetric Flowrates (cfm):
(Reference – Calc PSAT 05201H.02, Rev 1)

Up to t hours	DW to RB	WW to RB
0.236	0.96	0.76
0.394	1.14	0.84
0.442	1.08	0.81
0.585	1.14	0.84
0.819	1.08	0.81
1.129	1.14	0.84

Up to t hours	DW to RB	WW to RB
1.38	0.99	0.77
2.01	1.12	0.83
3.78	1.13	0.83
4.00	1.11	0.82
5.22	1.08	0.81
5.56	1.14	0.84

Up to t hours	DW to RB	WW to RB
8.	1.14	0.84
8	1.12	0.83
14	1.08	0.81
24	1.06	0.80
720	0.52	0.39

3.16 Design Basis Leakrates:

Primary containment:	1 %/day	(Reference 5, Pg 4.5-11)
MSIV (V-1-0007 to -0010):	15.975 scfh @ 35 psig	(Reference 11)
Instr Air (V-6-0393 and V-6-0395):	2 scfh @ 35 psig	(")
Iso Cond Vent (V-14-0001/-0005 and V-14-0019/-0020)	1 scfh (typ of 2) @ 35 psig	(")
2"N_2/8"N_2 (V-23-0014, V-23-0018, and V-27-0004)	3 scfh @ 35 psig	(")
2"N_2/8"N_2 (V-23-0016, V-23-0020, V-26-0016, and V-26-0018)	10 scfh @ 35 psig	(")
8"N_2 V-23-0013	1 scfh @ 35 psig	(")
8"N_2 V-23-0015	7.5 scfh @ 35 psig	(")
2"N_2 V-23-0017	1.5 scfh @ 35 psig	(")
2"N_2 V-23-0019	0.5 scfh @ 35 psig	(")
TIP Purge V-23-0070	0.05 scfh @ 35 psig	(")

3.17 Multiplier on RB bypass to TB to account for spray test line - 1.5 (Reference – 3/6/97 Mtg @ Oyster Creek)

4. Filter Efficiencies, Removal Lambdas, and Decontamination Factors

4.1 Filter Efficiency - SGTS: (Reference 6, Pg 6.5-9)

- For All Iodines Except Particulate - 90%
- For Particulates - 90% (conservative for particulates, especially for particulate iodine)
- For Noble Gas - 0%

4.2 Removal (Spray + Sedimentation) Lambdas in Drywell: (Ref – Calc PSAT 05201H.03, Rev 1)

For All Particulates and Elemental Iodine:

- From t=0 to t=0.166 hours - 0.19 /hour
- From t=0.166 to t=0.371 hours - 29.1 /hour
- From t=0.371 to t=0.414 hours - 0.14 /hour
- From t=0.414 to t=0.465 hours - 31.7 /hour
- From t=0 465 to t=0.702 hours - 0.27 /hour
- From t=0.702 to t=0.934 hours - 43.1 /hour
- From t=0.934 to t=1.129 hours - 0.32 /hour
- From t=1.129 to t=1.294 hours - 47.8 /hour
- From t=1.294 to t=1.434 hours - 38.3 /hour
- From t=1.434 to t=1.5 hours - 22.1 /hour
- From t=1.5 to t=1.57 hours - 18.8 /hour
- From t=1.57 to t=1.657 hours - 17.4 /hour
- From t=1.657 to t=1.754 hours - 16.7 /hour

- From t=1.754 to t=2.007 hours - 16.5 /hour
- From t=2.007 to t=2.339 hours - 5.62 /hour
- From t=2.339 to t=3.775 hours - 6.4 /hour
- From t=3.775 to t=4.633 hours - 0.06 /hour
- From t=4.633 to t=5.933 hours - 2.36 /hour
- From t=5.933 to t=6.353 hours - 3.48 /hour
- From t=6.353 to t=6.804 hours - 4.49 /hour
- From t=6.804 to t=7.244 hours - 5.49 /hour
- From t=7.244 to t=7.675 hours - 6.49 /hour
- From t=7.675 to t=7.791 hours - 7.44 /hour
- From t=7.791 to t=24 hours - 0.2 /hour
- From t=24 hours to end - 0 /hour

For Organic Iodine and Noble Gas:

- From t=0 to end - 0/hour

4.3 Removal (Spray) Lambdas in Torus: (Reference – Calc PSAT 05201H.06, Rev 0)

For All Particulates and Elemental Iodine:

- From t=0 to t=1.129 hours - 0 /hour
- From t=1.129 to t=3.778 hours - 1.5 /hour
- From t=3.778 to t=5.222 hours - 0 /hour
- From t=5.222 to t=7.844 hours - 0.15 /hour
- From t=7.844 hours to end - 0 /hour

For Organic Iodine and Noble Gas:

- From t=0 to end - 0/hour

4.4 Removal (Sedimentation) Lambdas in Closed Steamline: (Ref – Calc PSAT 05201H.03, Rev 1)

For All Particulates:

- From t=0 to t=0.512 hours - 1.36 /hour
- From t=0.512 to t=1.009 hours - 2.54 /hour
- From t=1.009 to t=2.239 hours - 2.41 /hour
- From t=2.239 to t=2.803 hours - 2.59 /hour
- From t=2.803 to t=3.088 hours - 2.11 /hour
- From t=3.088 to t=5.041 hours - 1.39 /hour
- From t=5.041 to t=9.871 hours - 0.66 /hour
- From t=9.871 to t=14.12 hours - 0.4 /hour
- From t=14.12 to t=24 hours - 0.37 /hour
- From t=24 hours to end - 0 /hour

For Elemental and Organic Iodine and Noble Gas:

- From t=0 to end - 0/hour

4.5 Filter Efficiency for MSIV1 (in Line with One MSIV Failed Open) (Reference 12)

- For All Particulates and Elemental Iodine (assumed adsorbed on particulate): 50%

  For Organic Iodine and Noble Gas: 0%

4.6 Filter Efficiency for MSIV2 (Closed Steamline)

- For All Particulates: 0% (see Item 4.4)
- For Elemental Iodine: 50%
  (assumed adsorbed on particulate but 50% re-evolved - see Reference 13 where elemental iodine surface fixation rate is observed to equal or bound corresponding resuspension rate between 300 and 560 K)
- For Organic Iodine and Noble Gas: 0%

4.7 Filter Efficiency for Other Bypass Leakpaths

For 2"N_2/8"N_2 (i.e., Releases from East Wall of RB):

- For All Particulates: 91.6% (References – Calc PSAT 05201H.04, Rev 0 and Calc PSAT 05201H.02, Rev 1)
- For Elemental Iodine: 50%
  (assumed adsorbed on particulate but 50% re-evolved - see Reference 13 where elemental iodine surface fixation rate is observed to equal or bound corresponding resuspension rate between 300 and 560 K)
- For Organic Iodine and Noble Gas: 0%

For Iso Cond Vent/ Instr Air/DW Spray Test (i.e., Releases for TB):

- For All Particulates: 96.5% (References – Calc PSAT 05201H.04, Rev 0 and Calc PSAT 05201H.02, Rev 1)
- For Elemental Iodine: 50%
  (assumed adsorbed on particulate but 50% re-evolved - see Reference 13 where elemental iodine surface fixation rate is observed to equal or bound corresponding resuspension rate between 300 and 560 K)
- For Organic Iodine and Noble Gas: 0%

4.8 Suppression Pool DF: (Reference – Calc PSAT 05201H.06, Rev 0)

For Particulates and Elemental Iodine:

- From t=0 to t=1.129 hours - 0
- From t=1.129 to t=1.296 hours - 2.3
- From t=1.296 hours to end - 0

For Organic Iodine and Noble Gas:

- From t=0 to end - 0

4.9 Release Fraction of Radioiodine in ESF Leakage - 0.1 (Reference 14)

4.10 Maximum Ratio of Re-Evolved Elem Iodine to Organic in Containment Atmosphere:
(Reference – Calc PSAT 05201H.06, Rev 0)

- First 21 days: 1:18
- 21 to 24 days: 1:2
- 24 to 27 days: 2:1
- 27 to 30 days: 11:1

5. X/Q Values, Breathing Rates, and Occupancy Factors

5.1 CR X/Q (sec/m^3):

	Stack	Yard	TB
From t=0 to t=8 hours	1.80E-4	2.59E-3	2.71E-3
From t=8 to t=24 hours	9.67E-5	1.15E-3	8.76E-4
From t=24 to t=96 hours	2.50E-5	8.44E-4	8.63E-4
From t=96 to t=720 hours	3.60E-6	7.18E-4	8.45E-4

(Reference 1 for Stack, Reference 25 for Yard and TB)

5.2 Breathing rates: (Reference 15 for CR, Reference 16 and Reference 6, Pg 5.6-9 for other)

0 - 8 hours	3.47E-4 m^3/sec (used in CR for 0 - 720 hours)
8 - 24 hours	1.75E-4 m^3/sec
24 - 720 hours	2.32E-4 m^3/sec

5.3 CR Occupancy Factors: (Reference 15)

From t = 0 to t = 1 day	1.0
From t = 1 day to t = 4 days	0.6
From t = 4 days to t = 30 days	0.4

5.4 Offsite X/Q (sec/m^3)

	EAB-Elev	EAB-Grnd	LPZ-Elev	LPZ-Grnd
From t=0 to 2 hours	1.9E-6	1.1E-3	5.3E-7	5.6E-5
From t=2 to t=8 hours			5.3E-7	5.6E-5
From t=8 to t=24 hours			1.8E-7	9.0E-6
From t=24 to t=96 hours			1.1E-7	5.4E-6
From t=96 to t=720 hours			4.8E-8	1.9E-6

(Reference 6, Tbls 2.3-29 and 2.3-30)

6. Chemistry Data

6.1 Initial Pool pH - 6.23 (Reference – Calc PSAT 05201H.10, Rev 0)

6.2 Water Volume in Containment (including RCS):
82000 ft^3 minimum in the suppression pool + 7600 ft^3 for the RCS = 89600 ft^3
(Note that this does not include all possible in-containment water which is conservative for iodine concentration effect; pH not greatly sensitive) (See Item 3.1 and Reference 6, Pg 6.2-7)

6.3 Mass of Chloride-Bearing Electrical Insulation inside Containment – Negligible (Reference 21)

6.4 Use of Organic Coatings in Containment
None (Drywell) (Reference 22)
Mobil 78 coating applied 1983/1984 (Torus) (References 22/23)

6.5 Minimum Suppression Pool pH Values: (Reference – Calc PSAT 05201H.05, Rev 0)

First 21 days (not including pre-release conditions) – 8.0
21 to 24 days: 6.8
24 to 27 days: 6.0
27 to 30 days: 4.9

7. Fission Product Transport Data

7.1 Suppression Pool Bypass Area - 10.5 in^2 (Reference 5, Pg 4.5-12)

7.2 DW Dimensions: (Reference 6, Pg 6.2-2, except as noted)
Diameter of Sphere = 70'
Diameter of Cylindrical Extension = 33'
Height of Extension = 23'
Average DW Shell Thickness = Approx 1" (Reference 18)

7.3 Torus Dimensions: (Reference 6, Pg 6.2-2)
Major Diameter = 101'
Minor Diameter = 30'

7.4 RB Bypass Pathway Horizontal Lengths and Diameters (Reference 19)

2"N_2 Length: 3' + 2' + 10' + 4' + 20' + 20' + 40' + 38' + 40' + 12' + 13' + 4' + 34' = 240'
2"N_2 Diameter: 2" nominal

8"N_2 Length: 10' + 20' + 1' + 40' + 38' + 40' + 25' + 2' +34' = 210'
8"N_2 Diameter: 8" nominal

TIP Purge Length: 25' + 80' + 10' + 25' + 1' = 141'
TIP Purge Diameter: 1/2" nominal

Iso Cond Vents (Common Part Only) Length: 12.5' + 24.25' + 0.5' + 1.25' + 18' + 20.5' + 1' + 15.33' + 9.5' + 21.67' + 63.5' + 2.5' + 1' + 2.33' + 6' + 0.33' + 4.75' = 205'
Iso Cond Vents (Common Part Only) Diameter: 3/4" nominal

Instr Air Length - 2" Dia Part: 15' + 2' + 1' + 10' + 10' + 1' + 10' + 30' = 79'
- 2.5" Dia Part: 4' + 2' = 6'

- 4" Dia Part: 47' + 22' = 69'   Total = 154'

Instr Air Diameter: $\{[(2")^2(79')+(2.5")^2(6')+(4")^2(69')]/154\}^{1/2}$ = 3" effective

7.5 RB Bypass Pathway Minimum Plug-Flow Residence Times (Ref – Calc PSAT 05201H.02, Rev 0)

2"N_2 - 92.8 minutes
8"N_2 - 2472 minutes
Iso Cond Vent - 74.8 minutes
Instrument Air - 946.8 minutes

7.6 Organic Iodine Dose Multiplier to Account for Pool Re-Evolution of I_2 – 4
(Reference – Calc PSAT 05201H.06, Rev 0)

8. Thermal-Hydraulic Data

8.1 STARNAUA input (Reference PSAT 05201H.01)

t (NAUA)	Cond Rate	Spray Rate/Temp		DW Temp/R/H/Press			Leak
seconds*	g/sec	g/sec	deg C	deg C	%	atmospheres	%/day
0	9090	0	n/a	182	20	2.834467	0
270	0	0	n/a	162	45	2.785172	0
570	0	1.90E+05	30	150	60	2.730947	0
610	0	1.90E+05	30	130	100	2.60278	0
1315	0	0	29	42	100	1.040126	0
1465	0	1.90E+05	29	102	10	1.2028	0
1650	0	0	29	42	100	1.040126	0
2500	0	1.90E+05	28	102	10	1.2028	0
3340	0	0	28	42	100	1.040126	0
4035	0	1.90E+05	28	102	10	1.2028	7344
4635	0	1.90E+05	29	99	100	1.676033	0
5235	0	1.90E+05	30	40	100	1.109139	0
7200	0	1.90E+05	29	40	100	1.109139	0
13570	0	0	27	29	100	1.040126	0
14370	0	0	n/a	82	8	1.183082	0
18770	0	1.90E+05	29	92	5	1.2028	0
18970	0	1.90E+05	29	32	100	1.054915	0
19970	0	1.90E+05	29	29	100	1.054915	0
28210	0	0	24	27	100	1.040126	0
28770	0	0	n/a	69	15	1.153505	0
50370	0	0	n/a	92	3	1.2028	0
86370	0	0	n/a	130	1	1.281672	0

* NAUA t=0 is actually t=30 seconds (since STARNAUA analysis begins with gap release)

8.2 Maximum Suppression Pool Temperature - 140 F @ 1 hour, 105 F @ 24 hours
(for $T_{initial}$ = 90 F)   (Reference 6, Fig 6.2-5)

8.3 Maximum Spray HX Cooling Water Temperature - 85 F (Reference 6. Tbl 6.2-7)

9. System-Related Data (Other than Volumetric Flows)

9.1 Spray Fall Height in Drywell - 826 cm (approx 27'1") (Reference 24)

9.2 Spray Nozzle Characteristics: (Reference 6, Tbl 6.2-8, except as noted)
Type: 1-7G25
Number on Upper DW Header: 32 per each of two
Number on Lower DW Header: 56 per each of two
Number on Torus Header: 10 total (shared header) (Reference 6, Pg 6.2-23)
Torus Header Elev = 10'2" (Reference 6, Pg 6.2-23)
Mass Median Droplet Size @ 40 psid = 2600 μm (Reference 20)
16th Percentile Droplet Size @ 40 psid = 1500 μm (Reference 20)
84th Percentile Droplet Size @ 40 psid = 4100 μm (Reference 20)

9.3 Spray Trip DW Pressure - 0.6 psig (Reference 6, Pg 6.2-23)

9.4 Minimum Vent Submergence - 3 ft (Reference 6, Pg 6.2-2)

9.5 Normal Operating Steam Dome Pressure - 1035 psia (Reference 6, Tbl 15.6-1)

9.6 Midplane Elevation of the Torus - (-)2'6" (Reference 18)

9.7 Nominal Suppression Pool Depth - 12' (Reference 6, Pg 6.2-2)

References

1. Enclosure to June 17, 1985 Letter, Wilson (GPUN) to Zwolinski (NRC)
2. GPUN Calc C-1302-226-E620-369, "Oyster Creek Source Terms for Two Year Cycles" by R.V. Furia, 12/6/96
3. TACT5 User's Manual, File MLWRICRP.30
4. NUREG-1465
5. Oyster Creek Technical Specifications
6. Oyster Creek UFSAR
7. Oyster Creek Post-Accident Shielding Study, June 1985 (CMT # 171570)
8. GPUN Calc C-1302-411-5310-057
9. Oyster Creek Dwg JCP-19442
10. TDR 893, "Control Room Habitability", April 1988
11. "Primary Containment Leakage Rate Testing Program", Revision 0, October 1996 (CMT # 171570)
12. Morewitz, "Leakage of Aerosols from Containment Buildings", Health Physics Vol. 42, No. 2, February 1982
13. Cline, "MSIV Leakage Iodine Transport Analysis", prepared for USNRC under Contract NRC-03-87-029, Task Order 75, March 26, 1991
14. SRP 15.6.5
15. Murphy-Campe (cited in SRP 6.4)
16. Regulatory Guide 1.3
17. Reference deleted.
18. Oyster Creek Dwg CB&I 9-0971
19. Letter with Attachments, Radvansky (GPUN) to Metcalf (Polestar), dated January 20, 1997 (CMT # 171570)
20. Spraying Systems Dwg 12135-5
21. GPUN Calc C-1302-900-E540-012, Rev 0
22. Email, Radvansky (GPUN) to Metcalf (Polestar), Subject: "Drywell Coating Information", 1/28/97
23. Fax, Radvansky (GPUN) to Metcalf (Polestar), 3/27/96
24. GPUN Calc C-1302-241-E540-077, Rev 0
25. GPUN Calc C-1302-826-E540-017, Rev 0 per emails from A Baig (Amergen) to J. Metcalf (Polestar) dated 8/10/00 and 9/8/00