Attachment 9

PSAT Calculation 04011H.07

"Drywell Leakage Rate Direct to Environment Mimicking Case 2 Early Bypass of SGTS"

CALCULATION TITLE PAGE

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	ORIGINATOR Print/Sign	Date	CHECKER Print/Sign	Date	IND REVIEWER Print/Sign	Date
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Purpose

The purpose of this calculation is to address an issue raised in Reference 1 regarding a 90 second interval (from t=15 seconds to t=105 seconds) at the beginning of the DBA LOCA during which the RB may exhibit a positive pressure and during which some flow out of the RB, therefore, may bypass the SGTS. In Reference 1 this issue was handled with a supplementary model shown on Exhibit 1. In this model the RB is explicitly modeled as a "hold-up" control volume between the drywell as a source and the environment. For the revised source term analysis (covered by this calculation) a direct release model is being used in which there is no "hold-up" control volume between the drywell and the environment for this release. The purpose of this calculation, therefore, is to develop a surrogate leak rate directly from the drywell to the environment that would conservatively represent the model of Exhibit 1.

Methodology

The approach is to:

(1) Calculate the release from the drywell to the RB assuming the containment is leaking at the design leakrate with "A" as the time-averaged activity airborne in the drywell over the first 105 seconds,

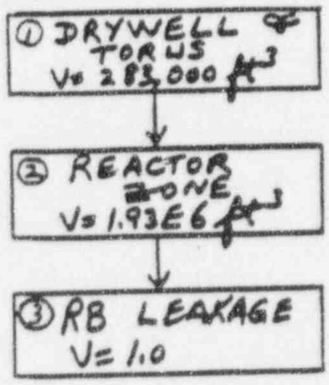
(2) Calculate the effective reduction in what would then be leaked to the environment

Exhibit 1

The STP model used to determine the RB leakage contribution to the CR doses is shown in Figure 3. The flows associated with the model are shown in Figure 4.

FIGURE 3.
STP MODEL
"S2LEAK"

SOURCE: 100% NG
25% I (INORG.)
25% I (ORG.)
0% PARTICULATES



(COMPONENT 3 IS AN ACCUMULATOR)

FIGURE 4
FLOWS IN STP MODEL S2LEAK

COMPONENT		FLOW
1	2	2%/d = 235.8 cfh
2	3	t=0-0.00417hr (15 sec) 0.0 cfh
		t=0.00417hr-0.02917hr (105 sec) 1542.4 cfh
		t>0.02917hr 0.0

To guarantee conservatism to the RB leakage dose, there is no SGTS flow assumed during the 15 to 105 second time period when the leakage occurs. This assures the maximum RB concentration during the period of RB leakage and hence a maximum dose from the leakage.

considering the presence of the RB, and

(3) Calculate a revised direct leakrate from the drywell that would then match that release to the environment from (2).

Assumptions

Assumption 1: It is conservative to place all drywell leakage that would occur over the first 105 seconds into the RB at the start of the accident.

Justification: The release from the containment does not begin until the start of the gap release at t=30 seconds (see Item 2.1 of Reference 2). Therefore, the RB has lost its residual negative pressure 15 seconds before the start of the gap release to the drywell and the corresponding release from the drywell to the RB. During the next 75 seconds (t=30 seconds to t=105 seconds), there will be a progressive release from the drywell to the RB as the drywell radionuclide concentration builds. During the first 105 seconds of the event, a time-averaged airborne radionuclide concentration, A, in the drywell can be defined. The leakage into the RB during the first 105 seconds can then be calculated as "A" times the fraction of the drywell volume leaked into the RB over the first 105 seconds. For simplification, then, it can be conservatively assumed that this product "AxB" (where "B" is the fraction of the drywell volume leaked to the RB over the first 105 seconds) appears in the RB at t=0 since this will maximize the radionuclide leakage from the RB to the environment over the subsequent 105 seconds.

References

Reference 1: TVA Calc ND-Q0065-900052, "CR Doses for 2 SGTS Fans Including RB Leakage", Revision 2, 5/4/93

Reference 2: PSAT 04000U.03, "Design Data Base for Application of the Revised DBA Source Term to the TVA Browns Ferry Nuclear Power Plant", Revision 1, September 22, 1995

Calculation

By Assumption 1, the radioactivity in the RB during the first 105 seconds of the DBA LOCA may be conservatively calculated to be:

$$\text{RB activity} = \frac{A \times \text{Volumetric Leakrate, Drywell to RB (Item 3.12 of Reference 2)}}{\text{Volume of Drywell (Item 3.1 of Reference 2)}} \times 105 \text{ sec}$$

where "A" is the time-averaged airborne activity in the drywell over the first 105 seconds.

$$= A \times (132.5 \text{ cfh}/159000 \text{ ft}^3) \times 105 \text{ sec}/3600 \text{ sec/hr} = 2.43\text{E-}5 \times A$$

This activity, if placed in the RB at t=0 and if leaked from the RB at the RB leakrate of 1540 cfh (the flow out of the RB that does not pass through the SGTS when the RB pressure is positive, Item 3.30 of Reference 2), would yield a corresponding release of activity to the environment over the first 105 seconds (even neglecting the first 15 seconds when the RB pressure is negative) of:

$$\text{Activity released} = \frac{2.43\text{E-}5 \times A \times 1540 \text{ cfh} \times 105 \text{ seconds}}{\text{Volume of the RB} \times 3600 \text{ sec/hr}}$$

$$= 0.0011A/\text{Volume of the RB in ft}^3$$

$$= 0.0011A/1.932\text{E}6 \text{ ft}^3 \text{ (Item 3.4 of Reference 2)} = 5.7\text{E-}10 \times A$$

To release the same amount of activity directly from the drywell over 105 seconds, the leakrate (in cfh) would have to be:

$$\text{Leakrate} = (5.7\text{E-}10 \times A \times 3600 \text{ sec/hr} \times \text{drywell volume in ft}^3)/(A \times 105 \text{ seconds})$$

$$= 1.95\text{E-}8 \times \text{drywell volume in ft}^3$$

$$= 1.95\text{E-}8 \times 159000 \text{ ft}^3 = 3.1\text{E-}3 \text{ cfh}$$

Results

A drywell leakrate directly to the environment which would conservatively mimic the "hold-up" model presented in Exhibit 1 is 3.1E-3 cfh.

Conclusions

Using this approach, about 1E-4 ft^3 of drywell atmosphere (3.1E-3 cfh x 105/3600 hours) is assumed to be released directly to the environment over the first 105 seconds as opposed to the four cubic feet that would actually be released (to the RB) if the leakrate were the design value of

132.5 cfh. Dilution of this four cubic feet in the secondary containment atmosphere (with a volume of about 2 million cubic feet) would amount to about a factor of 500000. Since the leakrate out of the RB, however, is a factor of 12 greater than that from the drywell (1540 cfh vs 132.5 cfh) the "effective" dilution in the RB is reduced to about a factor of 40000. Therefore, one would expect that four cubic feet of drywell atmosphere released through the RB would contain about the same amount of activity as 4/40000 cubic feet of drywell atmosphere released without benefit of mixing and dilution in the RB. This value "4/40000 cubic feet" is 1E-4 ft^3, the same "drywell volume released" value calculated above using the leakrate of 3.1E-3 cfh.