From: "Gucwa, Len" <LGUCW90@entergy.com>
To: <rxe@nrc.gov>
Date: 6/7/04 12:57PM
Subject: FW: BVY 04-050 Attach 1

<<BVY 04-050 Attach. 1.doc>>

-----Original Message-----
From: Daflucas, Ronda
Sent: Monday, June 07, 2004 11:35 AM
To: Gucwa, Len
Subject: BVY 04-050 Attach 1

Len,
Would you please provide a WORD version of BVY 04-050 Attachment 1 to Rick Ennis? The EEIB reviewer requested it. He doesn't need the S&W document, just our Word doc.

Thank you,

Ronda Daflucas
Vermont Yankee Project Manager, NRR
Entergy Nuclear Operations, Inc.
802-258-4232

CC: "Daflucas, Ronda" <rdafluc@prod.entergy.com>

B-41

Response to NRC EEIB-B RAI No. 1

NRC EEIB-B RAI No. 1 requested the following: Provide the results of the additional analysis referenced in Section 10.3.1 of Attachment 6 [Power Uprate Safety Analysis Report (PUSAR)] of your submittal dated September 10, 2003, for the effect of the EPU on the environmental qualification (EQ) of electrical equipment in harsh environments located inside and outside the containment.

Section 10.3.1 of Attachment 6 evaluated the change in plant environments as they relate to the Vermont Yankee Nuclear Power Station (VYNPS). The submittal states in Part:

"Inside Containment"

"...the total integrated doses (normal plus accident) for [constant pressure power uprate] CPPU conditions were determined to challenge the qualification of some equipment located inside containment. Equipment that required further evaluation included certain cable types, splices, and electrical penetrations. A qualitative evaluation, using equipment-specific radiation dose assessment, indicates that with additional analysis, the equipment should be acceptable for the CPPU conditions."

"Outside Containment"

"...the total integrated doses (normal plus accident) for CPPU conditions were evaluated. There were several types of equipment located outside of containment that were adversely affected by the radiation dose increase. A qualitative evaluation, using equipment specific radiation dose assessment indicates that with additional analysis, the equipment should be acceptable for the CPPU conditions"

The VYNPS TID-14844 source term based radiation analysis is contained in a plant calculation. The calculation divided the plant into volumes or zones and determined a generic integrated dose for the volume. Additional equipment specific analyses have been added to the calculation over the years as needed. For CPPU the total integrated dose for each volume, or specific analysis, was adjusted using a scaling methodology. This evaluation was captured in a Technical Evaluation (TE). The statements in the PUSAR were developed based on the TE results. The TE identified a number of volumes or specific analyses where the CPPU integrated dose exceeded the qualified dose of the equipment located in that volume. Subsequently, a new calculation was prepared that performed localized specific analyses for those components identified for CPPU conditions.

While preparing the new calculation it was discovered that the original radiation dose calculation failed to consider the internal post-LOCA drywell air radiation dose to some equipment. The re-evaluation to correct this error was included in the new calculation.

The following is a summary of the major adjustments to the current licensing basis (CLB) EQ dose specifications that were incorporated in the present calculation:

A. LOCA Source Term

(1) The source term for airborne releases was updated (using ORIGEN-2.1 and data libraries for extended burnup) to reflect 1950 MWt, 4.65 wt % U-235, 3-cycle and 3-region core configuration, 52.4 GWD/MTU, and three potential accident times during the 3rd cycle (for sensitivity evaluations).

The CLB model had a single cycle, end-of-cycle inventories, and a power level of 1665 MWt (based on ORIGEN-1).

(2) For the waterborne source term, the ORIGEN-2.1 computer runs were also used to produce the time-dependent photon spectra emanating from contaminated liquids. The radionuclide core-inventory fractions which were assumed to be released to the liquids were 0% noble gases, 50% halogens, and 1% of the others (also identified as a 0/50/1 mixture of "noble-gases/halogens/others")[1]. The noble gases produced by the decay of waterborne halogens were assumed to remain within the coolant and contribute to the dose.

The CLB model was overly conservative and assumed a mix of 100/50/1, implying that all core-inventory noble gases will remain in the liquid phase.

B. Submersion Doses in Drywell

(1) Consideration was given to the noble gas decay products (Rb and Cs) in the dose calculations. The software employed in the CLB analysis did not have that capability.

(2) The airborne fraction of halogens was conservatively assumed to be 25%, and to be unaffected by plateout and spray effects. The other half of the released iodines (25% of the core inventory) is expected to be retained by the primary coolant. This assumption differs from the original VYNPS EQ analysis which was based on 50% of the halogens remaining airborne for the duration of the accident.

(3) The gamma doses were computed with an improved point-kernel shielding computer code for obtaining the time-dependent dose rates and cumulative doses.

C. Submersion Doses in Reactor Building

(1) Consideration was given to the noble gas decay products (Rb and Cs) in the dose calculations. The software employed in the CLB analysis did not have that capability.

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[1] Photon spectra were also calculated for a 0/25/1 mix, for the dose to equipment components that are exposed to both airborne and waterborne sources. Use of these spectra could have reduced the doses by about 17%; however, it was determined that this dose reduction credit was not necessary, and was not implemented.

(2) Credit for mixing in the Reactor Building (RB) was increased from 50% to 100% of the building volume, and the RB exhaust rate was increased from 1 air change per day to 1.140 (the latter corresponding to the SGTS design flow rate of 1500 cfm with single-fan operation, less 100 cfm). Use of full mixing in the RB is justifiable since the SGTS flow distribution, drawing air from all elevations of the reactor building via the same ductwork as the normal ventilation exhaust, along with diffusion through the open equipment hatch, will lead to practically uniform concentration within the entire RB in a short time (in comparison to the exposure interval of one year).

(3) The immersion gamma doses in the RB were reduced by taking credit for the actual volume contributing to dose in each floor, in lieu of the entire RB volume.

D. Adjustments to Drywell and RB Beta Doses for Shielding and Small Submersion Volumes.

(1) The beta shielding provided by component sheathing and coatings was based on a tabulation of adjustment factors prepared through the use of Monte Carlo calculations. In the CLB, the shielding adjustment factors were based on different approaches, depending on radionuclide.

(2) Changes in beta-shielding thicknesses between the CLB and those used in the present calculation. It is noted that the CLB thicknesses were conservatively selected, and do not reflect the actual conditions.

The results of this new calculation are summarized in the following table. The major differences discussed above apply to all the components in the table. In addition, the table has comments for specific dose adjustments.

Response to NRC EEIB-B RAI No. 1

Qualification Documentation Review Pckag(QDR) #and Component[1]	Qual.[2] (rad)	CLB[3] (rad)	CPPU[4] (rad)	Comments[5]
QDR 3.1 - Limitorque Valve Operators - RB above El. 223'-9" outboard of torus	2.00E+07	1.80E+07	1.96E+07	C1, C4, C7
QDR 35.2A - Target Rock Model 75E Solenoid Valves NG-13A and NG-13B - RB El. 213'-9" & 232'-6"	1.00E+08	7.47E+06	8.69E+06	C1, C7, C9
QDR 8.7 - Teledyne H2/O2 Analyzers - Parts not in contact with drywell nor RB air - RB El. 280'-0" Vol 29	1.60E+06	1.59E+06	4.29E+05	C1
QDR 36.3 - Filnor Knife Switch - RB El. 280'-0" Vol 21 - Fuel Pool Line Area	1.34E+06	1.31E+06	1.23E+06	C1
QDR 35.2A - Target Rock Model 75E Solenoid Valve VG-9A - RB El. 303'-0" [Dose during post-LOCA drywell purge]	1.00E+08	8.51E+04	7.18E+07	C1, C3, C8
QDR 5.1 - Rosemount Model 710 DU Trip/Cal Systems, ECCS Cabinet 25-5B Circuit Boards - RB El. 280'-0" Vol. 20	2.00E+05	1.95E+05	1.93E+05	C1, C3
QDR 5.2 - Rosemount Model 510 DU Trip/Cal Systems - ECCS Cabinet 25-6B Circuit Boards - RB El. 280'-0" Vol. 22	1.90E+05	1.75E+05	1.48E+05	C1, C3
QDR 6.4-2 - Rockbestos (CERRO) XLPE/Firewall III Cable - RB El. 280'-0" and Vol 41	1.84E+08	4.79E+07	1.11E+08	C1, C13
QDRs 10.1 and 10.1A - Chromalox 9 KW Duct Heater and High Temperature Cut-Out Switch - RB El. 280'-0" Vol. 29	4.80E+07	4.35E+07	1.28E+07	C1
QDR 35.2A - Target Rock Model 75E Solenoid Valve - RB El. 280'-0" Vol 29	1.00E+08	1.50E+06	9.64E+05	C1, C7
QDRs 6.14, 14.3, 16.2, 35.3 - RB El. 280'-0" Vol 29	2.00E+08	8.53E+07	3.13E+07	C1
QDR 9.3 - Microswitch Limit Switches - RB El. 280'-0" Vol 29	7.80E+07	7.75E+07	2.85E+07	C1
QDR 8.7 - Teledyne H2/O2 Analyzer A - O2 Membrane - RB El. 280'-0" Vol 29 [30-day LOCA Dose]	1.00E+08	9.42E+06	5.73E+07	C1, C3, C12
QDR 8.7 - Teledyne H2/O2 Analyzer A - Pump/Regulator Diaphragms - RB El. 280'-0" Vol 29 [30-day LOCA Dose]	2.00E+08	1.60E+07	1.11E+08	C1, C3, C12
QDRs 8.7, 35.3 - Teledyne H2/O2 Analyzers / Solenoid Valves - RB El. 280'-0" Vol 29 [30-day LOCA Dose]	6.00E+07	8.87E+06	5.53E+07	C1, C3, C12
QDR 8.7 - Teledyne H2/O2 Analyzers - Flow Alarms - RB El. 280'-0" Vol 29 [30-day LOCA Dose]	2.00E+08	6.78E+06	4.06E+07	C1, C3, C12
QDR 34.4 EGS/PATEL P1 Thread Sealant - Drywell outside sacrificial shield	1.70E+08	1.56E+08	7.97E+07	C1, C3
QDR 6.23 - Rockbestos RSS-6-104 Coaxial Cable - Drywell Below El. 290', > 5' from Recirc Pipe & at least 3' from sacrificial shield openings	1.71E+08	1.71E+08	8.59E+07	C1, C3
QDR 15.3 GE Penetration Assembly Cable - Drywell Below El. 290, within 5' of Recirc Pipe & at least 3' from sacrificial shield	1.80E+08	1.60E+08	1.62E+08	C1, C3
QDRs 6.4-2, 6.29, 6.31,16.2 Cable - Drywell Below 270, > 5' from Recirc Pipe & at least 3' from sacrificial shield openings	1.84E+08	1.83E+08	1.29E+08	C1, C3
QDR 2.1 Westinghouse MCC-8B - RB El. 280'-0" Vol 29	8.70E+05	8.63E+05	8.26E+05	C1, C3
QDR 2.1 Westinghouse MCC-DC-2A - RB El. 280'-0" Vol 21	8.70E+05	8.15E+05	8.08E+05	C1
QDR 2.1 Westinghouse MCC-9B - RB El. 280'-0" Vol 22	8.70E+05	7.29E+05	7.61E+05	C1
QDR 8.3 ITT-Barton Differential Pressure Switch - RB El. 213'-9" Vol 53	1.00E+06	9.79E+05	8.46E+05	C1
QDR 8.3 - Barton 288/289 Pressure Switch - RB El. 213'-9" Vol 32	1.00E+06	9.79E+05	8.46E+05	C1
QDR 8.3 - Barton 288/289 Pressure Switch - RB El. 213'-9" Vol 53	1.00E+06	9.79E+05	8.46E+05	C1

Footnotes

[1] These are the components that were identified in a conservative screening process to potentially exceed their qualification dose limits.
[2] Equipment qualification radiation level in rads. Equipment is qualified to the given value.
[3] The current dose specification is based on a power level of 1665 MWt. The current licensed power level is 1593 MWt.
[4] Constant Pressure Power Uprate (CPPU) is 120% of the current licensed power level, or 1912 MWt. The dose specification for CPPU is based on 1950 MWt.
[5] References are to comments appended to the end of the table.

COMMENTS	DESCRIPTION	Value or Adjustment	
C1	The 40-year normal background doses were adjusted by the factor [32*1593 + 8*(1950/1.02)] / (40*1593) = 1.040, reflecting a 20% increase in the background radiation levels as a result of power uprate, and an estimated 8-year operation at the EPU level. (See Comment C6 for exception.)	Background	1.040
C2	Power level adjustment factor for LOCA beta and gamma doses (1950 MWt/1665 MWt)	LOCA, beta/gamma	1.171
C3	Dose adjustments applying finite cloud and/or shielding.		
C4	The dose listed for the Limitorque Valve Operators from post-LOCA torus sources in the current licensing basis (i.e., pre-EPU, namely, 1.46E+07 rad) was incorrect. The actual dose is 1.36E+07 rad. This dose is due to both airborne and waterborne sources within the torus. Adjusting for the power level (see C2), the corrected dose is 1.36E+07 * 1.171 = 1.59E+07 rad.	Typo plus power adjustment	1.59E+07
C5	The doses listed for the 24 vdc power supplies are for a HPCI Line Break, based on the technical specification limit of 1.1 µCi/gm DE-I131 [TS 3.6 (B)], and the activity release rate to the atmosphere of 0.16 Ci/sec (after 30 min decay) [TS Sec. 3.8(K)]. The current licensing basis (i.e., pre-EPU) analysis used 1.1 µCi/gm DE-I131 in the coolant, and 0.3 Ci/sec for the atmospheric release, and is therefore bounding.		
	There is no beta dose since the Technipower power supplies are sealed in metal containers; there is no access to any components within the supplies.	Shielding adjustment	0.0
	The gamma dose listed for the 24 vdc power supplies in the current licensing basis (i.e., pre-EPU, namely 14 rad) is not correct. The actual dose is 1.4 rad. Adjusting for the power level (see C2), the corrected dose is 1.4 * 1.171 = 1.64 rad.	Typo plus power adjustment	1.6
C6	The component life time in the current licensing basis (i.e., pre-EPU) is currently limited to 10 years. Following power uprate, the normal background radiation is expected to be 12 mrad/hr (a 20% increase on the pre-uprate value). In order to maintain the qualification limit under both pre- and post-uprate levels, these components must now be replaced every 8 years (corresponding to a background dose of 0.012 * 8760 * 8 = 841 rad).	gamma	841
C7	Internal dose is not a concern and was considered to be zero. [Note: Internal doses to QDR 35.2A valves has been considered (containment purge valves).]		

COMMENTS	DESCRIPTION	Value or Adjustment	
C8	Drywell purge under the CLB is based on purge initiation at 192 hours and continued through 1 year. The corresponding basis for the EPU calls for intermittent purging starting at 35 days post LOCA to maintain drywell pressure below 28 psig. The valve internal exposure in the present application was conservatively assumed to cover the interval from 192 hrs to one year, for both the CLB and the EPU; the external gamma exposure is for one year.		
C9	The dose listed is from post-LOCA torus sources. It was calculated using the power adjustment factor under C2.		
C10	The dose to internal components due to drywell air is included.		
C11	Limitorque MOVs dose contribution from the SGTS filters.		
C12	Dose is for the 30-day mission time and the doses from "Gamma LOCA Other" (i.e., from the SGTS filters in these cases) are for one-year exposure.		
C13	ELEC31 cable requirement that the cable be in excess of 2 ft away from the SGTS carbon beds.		