Entergy

Entergy Operations, Inc.

Rick J. King

RBG-45989

July 18, 2002

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

SUBJECT: River Bend Station, Unit 1
Docket No. 50-458
Supplement to License Amendment Request
Full Scope Application of NUREG-1465 Alternative Source Term Insights, TAC No. MB5021

REFERENCE: Entergy letter to NRC dated April 24, 2002, RBG-45930

Dear Sir or Madam:

By the above referenced letter, Entergy Operations, Inc. (Entergy) proposed a change to the River Bend Station (RBS) Operating License and Technical Specifications associated with a full scope application of NUREG-1465, Alternative Source Term. Attachment 1 to this letter provides supplemental information to support the NRC review of the request.

There are no technical changes to the original submittal proposed. The original no significant hazards considerations included in the referenced submittal is not affected by any information contained in this supplemental letter. There are no new commitments made in this submittal.

Should you have any questions or comments concerning this request, please contact Greg Norris at (225) 336-6391.

A001

I declare under penalty of perjury that the foregoing is true and correct. Executed on July 18, 2002.

Sincerely,

Rick J. King
Director, Nuclear Safety Assurance

RJK/DNL

Attachment

cc: U. S. Nuclear Regulatory Commission
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NRC Senior Resident Inspector
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U.S. Nuclear Regulatory Commission
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Attachment 1

To

RBG-45989

Additional Information for Alternative Source Term License Amendment Request

Additional Information Related to

Alternative Source Term License Amendment Request

Summary:

The purpose of this Attachment is to provide additional information related to the RBS Suppression Pool pH analysis prepared in support of the licensing submittal requesting a "Full Scope" application of the Alternative Source Term (AST) dose methodology for River Bend Station. Note that this information is supplemental to the information initially provided in Attachment 5 (Post-LOCA Suppression Pool pH Evaluation Summary) of the submittal. This information is consistent with that initially provided to the NRC.

This supplement provides additional details of the analysis used for calculating buffering effect of the Standby Liquid Control System (SLC) sodium pentaborate solution on the suppression pool pH. This includes the following information: (1) generation of hydrochloric acid from radiolysis of the containment cables, (2) formation of nitric acid in the containment, and (3) methods used for determining the suppression pool pH before and after injection of the sodium pentaborate solution.

Detailed Information:

Hydriodic Acid Production

NUREG-1465 states that no more than 5% of the iodine existing in the reactor coolant system will be composed as Hydriodic Acid (HI) and elemental iodine (I). The RBS analysis conservatively assumed that 5% of the release was in the form of HI to maximize the generation of Hydriodic Acid. The release process is assumed to occur over a constant rate with 5% being released over the gap release period (30 minutes), and 25% being released over the "Early In-Vessel" (EIV) release period (90 minutes). The Hydriodic Acid is generated from the halogen core inventory of 51.7 gm-moles.

Nitric Acid Production

The RBS pH analysis utilized the methodology described in NUREG/CR-5950 in determining the amount of nitric acid in the suppression pool. This methodology generally assumes that the generation of nitric acid is proportional to the integrated value of a time dependent radiation dose rate in the suppression pool. The dose rate includes both beta and gamma radiation present in the pool. Nitric acid, in the amount of 497 gm-moles, was generated over the 30 day transient.

Hydrochloric Acid Production

Hydrochloric acid is generated in the post-LOCA environment by radiolytic decomposition of Hypalon cable jacketing by beta and gamma radiation. The amount generated is proportional to the radiation energy absorbed by the jacketing. The methodology utilized in the RBS pH analysis was based on NUREG/CR-5950 and NUREG-1081, "Post-Accident Gas Generation from Radiolysis of Organic Materials." The total chlorine-bearing cable mass exposed was estimated to be 38,000 lbm with roughly 51% being free drop cable and 49% being contained in cable trays. The rate of hydrochloric acid is given by the following equations:

$$R = R_{\gamma H} + R_{\beta H}$$

where,

R = total HCl generation rate from gamma and beta radiolysis,
$R_{\gamma H}$ = HCl generation rate from gamma radiolysis, and
$R_{\beta H}$ = HCl generation rate from beta radiolysis

Gamma Radiolysis

$R_{\gamma H} = G_H * \phi_{\gamma C} * S * A_{\gamma H}$, NUREG-5950 Appendix B Eqn. B.2

where,

G_H = radiation G value for radiolysis of Hypalon,
$\phi_{\gamma C}$ = gamma radiation energy flux on the cable surface,
S = total surface area (cm^2) of the cables, and
$A_{\gamma H}$ = absorption of gamma radiation energy by Hypalon.

Beta Radiolysis

$R_{\beta H} = G_H * \phi_{\beta C} * S * A_{\beta H}$, NUREG-5950 Appendix B Eqn. B.10

where,

G_H = radiation G value for radiolysis of Hypalon,
$\phi_{\beta C}$ = beta radiation energy flux on the cable surface,
S = total surface area of the cables, and
$A_{\beta H}$ = absorption of beta radiation energy by Hypalon.

Cesium Hydroxide Production

Cesium hydroxide is assumed to be produced as a result of the fission products released during the accident. NUREG-1465 specifies that during the gap and EIV release phases, 25 percent of the cesium core inventory is released into the suppression pool. Cesium hydroxide is generated over a 2 hour period (gap plus EIV) based on a core inventory of 510.7 gm-moles. NUREG-1465 states that the iodines exiting the reactor coolant system (RCS) will be compromised of 95% Cesium Iodide (CsI). The cesium that is not in the chemical form of CsI is assumed to exit the RCS in the form of Cesium Hydroxide (CsOH) and be deposited into the suppression pool.

Sodium Pentaborate

Following a LOCA where core geometry is compromised (i.e., a "fuel melt" scenario) at least 977 lbs of sodium pentaborate would be injected into the vessel for reactivity control via the SLC. Emergency Operations Procedures (EOPs) also direct SLC to be used to add inventory if RPV level can not be maintained above 10 inches (Top of Active Fuel is -162 inches). It is assumed that all of this sodium pentaborate eventually will get into the suppression pool water forming 1.815E-03 gm-mol boron/liter solution.

General Assumptions and Methodology

RBS calculated the suppression pool pH values covering 30 days after a LOCA. Two cases were considered:

- Release to the suppression pool of all acidic chemicals and cesium hydroxide, and
- Release to the suppression pool of all acidic chemicals and sodium pentaborate.

The methodology used in the analyses was based on guidance from NUREG/CR-5950, "Iodine Evolution and pH Control." Case 1 determined that suppression pool pH will decrease with time as the acidic chemicals will accumulate in the suppression pool water and will eventually reach a value well below 7.0.

In the second case, the values of the suppression pool pH will also decrease, but at a much slower rate. This is due to the fact that the SLC system is assumed to be initiated early into the event. The entire 977 lbs of sodium pentaborate is injected within the first 2 hours of the event. The impact of cesium hydroxide is conservatively neglected in the second case. The suppression pool pH was calculated to be 8.17 after 30 days. Thus, utilizing sodium pentaborate is effective in maintaining a basic solution. Also, a parametric study was performed which determined that only 475 of the 1657 gallons (28.7%) of sodium pentaborate is required to ensure that the pool pH remains >7.0.