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March 25, 2014

ATTN: Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

BELL BEND NUCLEAR POWER PLANT
RESPONSE TO ER RAI ENV-26 AND
REVISED SCHEDULE INFORMATION
BNP-2014-002 Docket No. 52-039

References: 1) BNP-2010-333, R. R. Sgarro (PPL Bell Bend, LLC) to U.S. NRC, "BBNPP Plot Plan Change COLA Supplement, Part 3 (ER); Section 7.2 and Response to ER RAI's ACC 7.2-2, 7.2-3, 7.2-5, & 5021 EIS 5.11-7" dated December 20, 2010.

2) BNP-2013-132, R. R. Sgarro (PPL Bell Bend, LLC) to U.S. NRC, "Changes to COLA Part 3 from Revised Wind Direction Information" dated October 11, 2013.

3) BNP-2013-143, R. R. Sgarro (PPL Bell Bend, LLC) to U.S. NRC, "Correction to the Response to ER RAI Nos ACC 7.2-2 & 7.2-3" dated October 28, 2013.

4) T. Terry (NRC) to R. R. Sgarro (PPL Bell Bend, LLC), Final RAI ENV-26, email dated January 17, 2014

5) BNP-2014-017, R. R. Sgarro (PPL Bell Bend, LLC) to U.S. NRC, "Initial Response to and Schedule for RAI ENV-26," dated February 18, 2014.

In Reference 1, PPL Bell Bend, LLC (PPL) provided the NRC with a response to the Bell Bend Nuclear Power Plant (BBNPP) Combined License Application (COLA) Part 3 Environmental Report (ER), Requests for Additional Information (RAI) 5021 EIS 5.11-7. In Reference 3, PPL provided a revision to the responses to RAI ACC 7.2-2. The revision to the response to RAI ACC 7.2-2 also applies to the response to RAI 5021 EIS 5.11-7.

In Reference 4, the NRC provided additional RAIs related to the information provided in References 2 and 3. In Reference 5, PPL informed the NRC that PPL would provide responses to RAI ENV-26 Questions ACC 7327, ACC 7328, and ACC 7352 on or before March 27, 2014.

The Enclosure provides the response to NRC RAI ENV-26 Questions ACC 7327 and ACC 7328, including revised COLA content. The response to Question ACC 7327 is also the revised response to RAI 5021 EIS 5.11-7 and replaces the response in Reference 1 in its entirety.

PPL requires additional time to respond to NRC RAI ENV-26 Question ACC 7352. The response to Question ACC 7352 will be provided on, or before April 30, 2014. There are two

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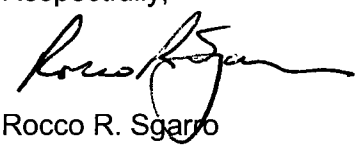
new regulatory commitments in this correspondence: Provide revised COLA content in a future COLA Revision; and, respond to RAI ENV-26 Question ACC 7352 on or before April 30, 2014.

Should you have questions, please contact the undersigned at 610.774.7552.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on March 25, 2014.

Respectfully,



Rocco R. Sgarro

RRS/kw

Enclosure: Response to RAI ENV-26 Questions ACC 7327 and ACC 7328

cc: w/ Enclosure

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Enclosure

Response to RAI ENV-26 Questions ACC 7327 and ACC 7328

ENV-26
Question ACC 7327

ESRP Section 7.2 directs the staff' to evaluate and provide input to the environmental impact statement (EIS) concerning the environmental risks of accidents involving radioactive material that can be postulated for the plant under review. Revisions have been made to the U.S. EPR PRA, as provided in DCD FSAR Chapter 19, Rev. 5, "PRA & Severe Accident Evaluation"). However, the revised material has not yet been incorporated in to BBNPP ER Section 7.2, "Severe Accidents." For example, referring to DCD, Rev. 5, PRA Section 19.1, Table 19.1-20, the radionuclide source term for each release category has been revised and the corresponding BBNPP ER Rev. 4 Table 7.2-2 ("Source Term Input to MACCS2") is no longer consistent with this DCD table. Additionally, BBNPP ER Section 7.2 does not reference the US EPR DCD as the source of the information in this section (e.g., Table 7.2-2). Provide an updated. BBNPP ER, Rev. 4, Chapter 7, "Environmental Impacts of Postulated Accidents Involving Radioactive Material," that is consistent with the revisions provided in the DCD FSAR Rev. 5. In addition, revise the references for BBNPP ER Section 7.2 to provide clarity as to the source of technical information in this section.

Response:

The revisions to the U.S. EPR Probabilistic Risk Analysis (PRA), as provided in the DCD Final Safety Analysis Report (FSAR) Chapter 19, Rev, 5 have been incorporated into the Bell Bend Nuclear Power Plant (BBNPP) Combined License Application (COLA), Part 3 Environmental Report (ER) Section 7.2 "Severe Accidents."

COLA Impact:

The BBNPP COLA will be revised as shown in the attachment to this enclosure.

RAI ENV-26
Question ACC 7328

ESRP Section 7.2 directs the staff to evaluate and provide input to the environmental impact statement (EIS) concerning the environmental risks of accidents involving radioactive material that can be postulated for the plant under review. The scope of this review should include dose consequence analysis for severe accidents, including socioeconomic impacts. Enclosure 1 of PPL Letter, BNP-2013-143, "BBNPP Correction to Response to ER RAI Nos. ACC 7.2-2 & 7.2-3," dated October 28, 2013, provides revisions and comparisons to the previous cumulative risk of early and latent fatalities for individuals within one mile and 10 miles of the reactor with the revised average individual risk of early and latent fatalities for the same distances. However, Enclosure 2 of BNP-2010-333, dated December 20, 2010, provides revisions and comparison, using Enclosure 3 (i.e., response to RAI No. 5021 EIS 5.11-7) of BNP-2010-333, which presents the previous average individual risk of early and latent fatalities. This inconsistency should be resolved and the BBNPP ER revised appropriately. In addition, provide in a future revision of Bell Bend COL ER a discussion of the capability of BBNPP design to meet the NRC Safety Goals, as set forth in the Commission's Safety Goal Policy Statement (51 FR 30028) and with the doses estimated for normal operations (see page 7.2-5 of NUREG-1555, Section 7.2, Rev. 1 of July 2007). Provide an updated analysis for BBNPP ER, Rev. 4, Section 7.2, "Severe Accidents," that applies the updated meteorology data (see BNP-2013-143) and discusses the result in terms of impacts for the severe accident risk, such as the capability of the BBNPP design to meet the NRC Safety Goals (51 FR 30028) and with the doses estimated for normal operations.

Response:
Sections 7.2 and 7.3 of the BBNPP ER refer to the base case using an estimated 2050 population with a 50-mile radius and sensitivity case S1 using an estimated 2080 population (as the end-of-plant-life population) for BBNPP performed using the MACCS2 computer code. The MACCS2 computer code output, in combination with the release categories frequencies (from the Level 2 PRA), can be used to determine the average individual risk of early fatalities for individuals within one mile of the reactor and the average individual risk of latent cancer fatalities for individuals within 10 miles of the reactor, using the following formulas:

$$AIR\ (Early\ Fatalities\ at\ one\ mile) = \sum_{i=1}^{N} RCF_i \times Estimated\ AIREF_i\ (one\ mile)$$

where:

AIR (Early Fatalities at one mile) is the average individual risk of early fatalities within one mile from the reactor

RCF_i is the Release Category frequency for *RCi* (Level 2 PRA), and

Estimated $AIREF_i$ *(one mile)* is the average individual risk of early fatalities for *RCi* within one mile (from MACCS2)

$$AIR\ (Latent\ Cancer\ Fatalities\ at\ ten\ miles) = \sum_{i=1}^{N} RCF_i \times Estimated\ AIRLC_i\ (ten\ miles)$$

where:

AIR (Latent Cancer Fatalities within ten miles) is the average individual risk of latent cancer fatalities within ten miles from the reactor

RCF_i is the Release Category frequency for RC_i (Level 2 PRA), and

Estimated AIRLCi (ten miles) is the average individual risk of latent cancer fatalities for RC_i within ten miles (from MACCS2)

Average Individual Risk	Base Case		Sensitivity Case S1		NRC Safety Goal	
Early Fatalities within 1 mile / person-year	~~1.12E-11~~	3.40E-11	~~1.12E-11~~	3.40E-11	~~4E-07~~	5.0E-07
Latent Cancer Fatalities within 10 miles / person-year	~~9.23E-11~~	4.19E-10	~~9.23E-11~~	4.19E-10	2.0E-06	

Values previously reported in the response to RAI ACC 7.2-2[1] were the cumulative risk of early fatalities for individuals within one mile of the reactor and cumulative risk of latent cancer fatalities for individuals within 10 miles of the reactor.

Both the average individual risk of early fatalities for individuals within one mile of the reactor and the average individual risk of latent cancer fatalities for individuals within 10 miles of the reactor are far below their respective safety goals.

COLA Impact:
The BBNPP COLA will be changed as shown in the attachment to this enclosure.

[1] BNP-2013-143, R. R. Sgarro (PPL Bell Bend, LLC) to U.S. NRC, "Correction to the Response to ER RAI Nos ACC 7.2-2 & 7.2-3" dated October 28, 2013.

Attachment

BBNPP COLA Part 3 (ER) Markup

7.2 SEVERE ACCIDENTS

This section evaluates the potential environmental impacts of severe accidents on the Bell Bend Nuclear Power Plant (BBNPP) site from the proposed U.S. EPR plant. The environmental impacts from a postulated severe accident have been estimated using BBNPP site-specific data to demonstrate acceptability for a Combined License (COL) Application.

Severe accidents are defined as accidents with substantial damage to the reactor core and degradation of containment systems. Because the probability of a severe accident is very low for the U.S. EPR, such accidents are not part of the design basis for the plant. However, the Nuclear Regulatory Commission (NRC) requires, in its Policy Statement on Severe Reactor Accidents Regarding Future Designs and Existing Plants (FR, 1985), the completion of a probabilistic risk assessment (PRA) for severe accidents for new reactor designs. This requirement is codified in regulation 10 CFR 52.47, Contents of Applications.

A PRA was completed for the U.S. EPR as part of the application for design certification. This section presents the applicable results of the probabilistic risk assessment and includes site-specific characteristics of the BBNPP site and impacts of a severe accident over the entire life cycle. The purpose of this report is to identify the severe accident offsite radiological impacts, demonstrate that the impacts are acceptable, and support the severe accident mitigation alternatives analyses in Section 7.3.

7.2.1 Methodology

7.2.1.1 Offsite Consequences

The probabilistic risk assessment for the U.S. EPR established containment event trees that define the possible end states of the containment following an accident sequence. The end states are grouped into five broad categories as follows:

801

1. Containment intact, isolated and not bypassed (RC 101)
2. Containment bypassed (RC701, 702, 802)
3. Containment not isolated (isolation failure) (RC 201-206)
4. Early failures (excluding not isolated and bypassed) (RC 301-304, 401-404)
5. Late containment failures (RC 501-504, 602)

one of them has

24

Using the Electric Power Research Institute code Modular Accident Analysis Program (MAAP), ~~23~~ release categories (RC) are assigned to represent all potential severe accident scenarios. It

is

should be noted that there are a total of 25 RCs, however ~~two of them have~~ zero frequency and ~~are~~ not included in the Level 3 PRA or in the results of this analysis. The release categories are described in Table 7.2-1. An accident frequency (release category frequency) is assigned to each of the ~~23~~ categories, and these are shown in Table 7.2-3.

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The NRC code MACCS2 (Sandia, 1997) was used to model the environmental consequences of the severe accidents. MACCS2 was developed specifically for NRC to evaluate severe accidents at nuclear power plants. The exposure pathways modeled include external exposure to the passing plume, external exposure to material deposited on the ground, inhalation of material in the passing plume or resuspended from the ground, and ingestion of contaminated food and surface water.

7.2.1.3 Risk Calculation

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Release heights vary, depending on the event sequence, ranging from ground level to the top of the containment annulus. The BBNNP Level 2 PRA provides the inputs for the MACCS2 analysis, and the spectrum of accident sequences analyzed includes containment releases with durations of up to ~~140~~ hours after the start of the accident in the cases of late containment failure. The MACCS2 analysis extends out to 5 years for the assessment of post accident interdiction measures and out to 30 years for the assessment of the long term dose to individuals..

The results of the MACCS2 calculations and accident frequency information were used to determine risk. The sum of all release category frequencies is the core damage frequency and includes internal and external initiating events. External events include internal fire events and internal flood events. Risk is the set of accident sequences, their respective frequencies and their respective consequences. Risk is often more simply quantified as the sum of the products of accident sequence frequencies and consequences. The consequence can be radiation dose or economic cost. Therefore, risk can be reported as a combination of person-rem per year and dollars per year.

7.2.2 Consequences to Population Groups

This section evaluates impacts of severe accidents from air, surface water and groundwater pathways. The MACCS2 code was used to evaluate the doses from the air pathway and from water ingestion with BBNPP site-specific data. MACCS2 does not model other surface water and groundwater dose pathways. These were analyzed qualitatively based on a comparison of the U.S. EPR atmospheric doses to those of the existing U.S. nuclear fleet.

The current U.S. nuclear fleet has an exceptional safety record. Through evolutionary and innovative design, the U.S. EPR has enhanced the ability to both prevent potential core damage events and to mitigate them should they occur. A list of example U.S. EPR design features which reduce plant risk is provided below.

- Increased redundancy and separation
- Four safety trains including four EFW divisions
- Separate power divisions for each safety train, each with dedicated battery division and EDG
- Two divisions each have a backup alternate AC diesel generator for SBO-type scenario
- State-of-the-art digital I&C
- Stand-still Seal System for backup to RCP seals
- Main Feedwater System with Startup and Shutdown System
- In-containment refueling water storage tank to eliminate transfer to long term recirculation
- Two, dedicated severe accident battery divisions

- Dedicated severe accident depressurization valves to prevent high pressure melt scenarios which can challenge containment due to postulated direct containment heating
- Containment combustible gas control system, including passive autocatalytic recombiners and gas mixing system
- Core stabilization system
- Passive cooling of molten core debris
- Active spray for environmental control of the containment atmosphere
- Active recirculation cooling of the molten core debris and containment atmosphere

The core damage frequency (CDF) is a measure of the impacts of potential accidents. CDF is estimated using PRA modeling which evaluates how changes to the reactor or auxiliary systems can change the severity of the accident. The CDF for the U.S. EPR is less than the CDFs for the current U.S. nuclear fleet.

7.2.2.1 Air Pathways

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The potential severe accidents for the U.S. EPR were grouped into ~~23~~ release categories based on their similarity of characteristics. Each release category was assigned a set of characteristics representative of the elements of that class. Each release category was analyzed with MACCS2 to estimate population dose, number of early and latent fatalities, cost, and farm land requiring decontamination. The analysis assumed that 95 percent of the population was evacuated following declaration of a general emergency.

For each release category, risk was calculated by multiplying each consequence (population dose, fatalities, cost, and contaminated land) with its corresponding frequency. A summary of the results are provided in Table 7.2-3. The calculation considers other consequences, such as evacuation costs, value of crops contaminated and condemned, value of milk contaminated and condemned, cost of decontamination of property, and indirect costs resulting from loss of use of the property and incomes derived as a result of the accident.

7.2.2.2 Surface Water Pathways

8.94E-03

BB-10-0253

Population can be exposed to radiation when airborne radioactivity is deposited onto surface water. The exposure pathway can be from drinking the water, external radiation from submersion in the water, external radiation from activities near the shoreline, or ingestion of fish or shellfish. MACCS2 only calculates the dose from drinking water. The MACCS2 severe accident dose-risk to the 50-mile population from drinking water is ~~9.98E-04~~ person-rem per year for the U.S. EPR. This value is the sum of all ~~23~~ release categories.

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Surface water pathways involving swimming, fishing, and boating are not modeled by MACCS2. Surface water bodies within the 50 mi (80 km) region of BBNPP include the Susquehanna River, Lehigh River, Beltzville Lake, and other smaller bodies of water. The NRC evaluated doses from the aquatic food pathway (fishing) for the current nuclear fleet discharging to various bodies of water in NUREG 1437, the Generic Environmental Impact Statement for License Renewal of Nuclear Plants (NRC, 1996). The NRC evaluation concluded that with interdiction, the risk associated with the aquatic food pathway is found to be small relative to the atmospheric pathway for most sites and essentially the same as the atmospheric

pathway for the few sites with large annual aquatic food harvests (which does not include BBNPP). Because the U.S. EPR atmospheric pathway doses are significantly lower that those of the current U.S. nuclear fleet, the doses from surface water sources would be consistently lower for the U.S. EPR as well.

7.2.2.3 Groundwater Pathways

Population can also receive a dose from groundwater pathways. Radioactivity released during an accident can enter groundwater that serves as a source of drinking water or irrigation, or can move through an aquifer that eventually discharges to surface water. The consequences of a radioactive spill not associated with an accident in COL application FSAR Section 2.4.13 have been evaluated and it has been determined that if radioactive liquids were released directly to groundwater, all isotopes would be below maximum permissible concentrations before they reached the local groundwater sources.

NUREG-1437 also evaluated the groundwater pathway dose, based on the analysis in NUREG 0440 (NRC, 1978), the Liquid Pathway Generic Study (LPGS). NUREG-0440 analyzed a core meltdown that contaminated groundwater that subsequently contaminated surface water. However, NUREG-0440 did not analyze direct drinking of groundwater because of the limited number of potable groundwater wells.

The LPGS results provide conservative, uninterdicted population dose estimates for six generic categories of plants. These dose estimates were one or more orders of magnitude less than those attributed to the atmospheric pathway. NUREG-1437 compared potential contamination at representative sites, including the existing Susquehanna Steam Electric Station (SSES). The conclusion for those sites is that the uninterdicted population doses are significantly less than the NUREG 0440 generic site. The proposed location for BBNPP has the same groundwater characteristics as the location of the existing SSES units and the CDF for the U.S. EPR is lower than that of the existing SSES units. Therefore, the doses from the BBNPP groundwater pathway would be smaller than from the existing SSES units.

7.2.3 Conclusions

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3.09E-04 and 2.10E-03,

BB-10-0253 The total calculated dose-risk to the 50 mi (80 km), year 2050 estimated population from airborne releases from a U.S. EPR reactor at BBNPP is expected to be approximately ~~0.22~~ person-rem per year (Table 7.2-3). The fraction of core inventory assumed to be released in each of the release categories is also included in Table 7.2-2. The number of persons exposed to doses greater than 200 rem (2 Sv) and 25 rem (0.25 Sv) are ~~1.92E-05 and 2.55E-04,~~ respectively. It must be noted that these populations exceeding a dose are only calculated by MACCS2 for the early phase of an accident, the long-term dose that could be accumulated is not included in this result. Long-term doses are mitigated by emergency response and remedial measures.

BB-09-0353 The U.S. EPR dose-risk at the BBNPP site is less than the population risk for current reactors that have undergone license renewal, and less than that for the five reactors analyzed in NUREG-1150 (NRC, 1990). As reported in NUREG-1811 (NRC, 2006), the lowest dose-risk reported for reactors currently undergoing license renewal is 0.55 person-rem per year.

8.94E-03

BB-10-0253 The analysis indicates that risk from the water ingestion dose is small at ~~9.98E-04~~ person-rem per year. As discussed in Section 7.2.2, risks from aquatic food pathway is small compared with the atmospheric pathway of the current U.S. nuclear fleet. As discussed in Section 7.2.3, the risk of groundwater contamination from a BBNPP severe accident is one or more orders of magnitude less than the risk from the atmospheric pathway for currently licensed reactors. Additionally, interdiction could substantially reduce the groundwater pathway risks.

The probability-weighted number of cancer fatalities from a severe accident for the U.S. EPR at BBNPP is reported in Table 7.2-3 as ~~1.30 E-04~~ 4.60E-04 per year, at 50 miles from the plant. The lifetime probability of an individual dying from any cancer is 2.3 E-01 (NCHS, 2007).

7.2.4 References

FR, 1985. NRC Policy Statement on Severe Reactor Accidents Regarding Future Designs and Existing Plants, 50 FR 32138, Nuclear Regulatory Commission, August 8, 1985.

NCHS, 2007. Table C, Percentage of total deaths, death rates, age-adjusted death rates for 2004, percentage change in age-adjusted death rates from 2003 to 2004 and ratio of age-adjusted death rates by race and sex for the 15 leading causes of death for the total population in 2004: United States, National Vital Statistics Report, Volume 55, Number 19, dated August 21, 2007, National Center for Health Statistics, Website: http://www.cdc.gov/nchs/data/nvsr/nvsr55/nvsr55_19.pdf, Date accessed: December 8, 2007.

Sandia, 1997. Code manual for MACCS2: Volume 1, User's Guide, SAND97-0594, D.I. Chanin and M.L. Young, Sandia National Laboratories, March 1997.

NRC, 1978. Liquid Pathway Generic Study, NUREG 0440, Nuclear Regulatory Commission, February 1978.

NRC, 1990. Severe Accident Risks: An Assessment for Five U.S. Nuclear Power Plants, NUREG-1150, Nuclear Regulatory Commission, December 1990.

NRC, 1996. Generic Environmental Impact Statement for License Renewal of Nuclear Plants, NUREG-1437, Volume 1, Nuclear Regulatory Commission, May 1996.

NRC, 2006. Environmental Impact Statement for an Early Site Permit (ESP) at the North Anna ESP Site, NUREG-1811, Nuclear Regulatory Commission, December 2006.

Both the average individual risk of early fatalities for individuals within one mile of the reactor (3.40E-11 per person-year) and the average individual risk of latent cancer fatalities for individuals within 10 miles of the reactor (4.19E-10 per person-year) are far below their respective NRC safety goals of 5.0E-07 per person-year and 2.0E-06 per person-year, respectively.

RC801 | Interfacing System LOCA with Fission Product Scrubbing

Table 7.2-1 — Release Category Descriptions

Release Category	Description
RC101	No containment failure
RC201	Containment fails before vessel breach due to isolation failure, melt retained in vessel
RC202	Containment fails before vessel breach due to isolation failure, melt released from vessel, with molten core-concrete interaction (MCCI), melt not flooded ex-vessel, with containment spray
RC203	Containment fails before vessel breach due to isolation failure, melt released from vessel, with MCCI, melt not flooded ex-vessel, without containment spray
RC204	Containment fails before vessel breach due to isolation failure, melt released from vessel, without MCCI, melt flooded ex-vessel with containment spray
RC205	Containment failures before vessel breach due to isolation failure, melt released from vessel, without MCCI, melt flooded ex-vessel without containment spray
RC206	Small containment failure due to failure to isolate 2 inch or smaller lines
RC301	Containment fails before vessel breach due to containment rupture, with MCCI, melt not flooded ex-vessel, with containment spray
RC302	Containment fails before vessel breach due to containment rupture, with MCCI, melt not flooded ex-vessel, without containment spray
RC303	Containment fails before vessel breach due to containment rupture, without MCCI, melt flooded ex-vessel, with containment spray
RC304	Containment fails before vessel breach due to containment rupture, without MCCI, melt flooded ex-vessel, without containment spray
RC401	Containment failures after breach and up to melt transfer to the spreading area, with MCCI, without debris flooding, with containment spray
RC402	Containment failures after breach and up to melt transfer to the spreading area, with MCCI, without debris flooding, without containment spray
RC403	Containment failures after breach and up to melt transfer to the spreading area, without MCCI, with debris flooding, with containment spray
RC404	Containment failures after breach and up to melt transfer to the spreading area, without MCCI, with debris flooding, without containment spray
RC501	Long term containment failure during and after debris quench due to rupture, with MCCI, without debris flooding, with containment spray
RC502	Long term containment failure during and after debris quench due to rupture, with MCCI, without debris flooding, without containment spray
RC503	Long term containment failure during and after debris quench due to rupture, without MCCI, with debris flooding, with containment spray
RC504	Long term containment failure during and after debris quench due to rupture, without MCCI, with debris flooding, without containment spray
RC602	Long term containment failure due to basemat failure, without debris flooding, without containment spray
~~RC701~~	Steam Generator Tube Rupture with Fission Product Scrubbing
~~RC702~~	Steam Generator Tube Rupture without Fission Product Scrubbing
RC802	Interfacing System LOCA without Fission Product Scrubbing

RC701* → ~~RC701~~

RC702* → ~~RC702~~

*Note that RC701 and RC702 were further sub-divided into sub RCs by the cause of rupture and the number of tubes that ruptured to account for the different initiating event frequencies. Separate MAAPs runs were executed to characterize each of the sub-RCs, which were then used as input in the ATMOS input file to MACCS2. Some inputs and outputs are shown in Tables 7.2-2 and 7.2-3

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Table 7.2-2 — Source Term Input to MACCS2

	XE/KR	I	Cs	Te	Sr	Ru	La	Ce	Ba
RC101	8.8E-3	2.4E-5	2.0E-5	5.3E-5	8.5E-6	4.4E-5	2.8E-7	7.3E-7	2.4E-5
RC201	3.6E-1	1.0E-1	9.5E-2	9.6E-3	7.8E-5	1.1E-3	3.4E-6	1.7E-5	4.1E-4
RC202	7.9E-1	2.3E-2	1.5E-2	2.0E-2	2.4E-4	3.4E-3	1.9E-5	6.8E-5	2.4E-3
RC203	8.9E-1	5.3E-2	2.8E-2	1.6E-1	1.4E-4	6.8E-3	1.5E-5	2.4E-4	2.2E-3
RC204	9.5E-1	2.8E-2	1.6E-2	3.6E-2	1.7E-4	5.3E-3	1.4E-5	6.2E-5	3.2E-3
RC205	9.8E-1	5.7E-2	3.6E-2	9.3E-2	4.0E-3	9.8E-3	3.0E-4	5.3E-4	6.1E-3
RC206	1.9E-1	5.6E-3	5.0E-3	9.0E-3	1.2E-3	7.3E-3	5.5E-5	1.8E-4	4.2E-3
RC301	7.9E-1	2.3E-2	1.5E-2	2.0E-2	2.4E-4	3.4E-3	1.9E-5	6.8E-5	2.4E-3
RC302	8.9E-1	5.3E-2	2.8E-2	1.6E-1	1.4E-4	6.8E-3	1.5E-5	2.4E-4	2.2E-3
RC303	9.5E-1	2.8E-2	1.6E-2	3.6E-2	1.7E-4	5.3E-3	1.4E-5	6.2E-5	3.2E-3
RC304	9.8E-1	5.7E-2	3.6E-2	9.3E-2	4.0E-3	9.8E-3	3.0E-4	5.3E-4	6.1E-3
RC401	8.0E-1	4.6E-3	2.3E-3	3.4E-3	2.7E-3	1.5E-3	8.0E-5	3.4E-4	5.2E-3
RC402	9.7E-1	2.0E-2	1.0E-2	1.2E-2	3.8E-3	2.1E-3	1.1E-4	4.9E-4	7.3E-3
RC403	8.0E-1	4.6E-3	2.3E-3	3.4E-3	2.7E-3	1.5E-3	8.0E-5	3.4E-4	5.2E-3
RC404	9.7E-1	2.0E-2	1.0E-2	1.2E-2	3.8E-3	2.1E-3	1.1E-4	4.9E-4	7.3E-3
RC501	9.9E-1	7.7E-4	4.0E-4	1.7E-2	7.4E-6	4.4E-5	2.2E-7	7.0E-7	2.4E-5
RC502	9.9E-1	7.7E-4	4.0E-4	1.7E-2	7.4E-6	4.4E-5	2.2E-7	7.0E-7	2.4E-5
RC503	1.0E+0	4.1E-4	6.9E-5	6.1E-4	8.5E-6	4.4E-5	2.8E-7	7.3E-7	2.4E-5
RC504	1.0E+0	4.1E-4	6.9E-5	6.1E-4	8.5E-6	4.4E-5	2.8E-7	7.3E-7	2.4E-5
RC602	9.9E-1	7.7E-4	4.0E-4	1.7E-2	7.4E-6	4.4E-5	2.2E-7	7.0E-7	2.4E-5
RC701	1.1E-1	4.2E-3	4.4E-3	6.9E-3	6.0E-4	4.8E-3	2.2E-5	1.1E-4	2.7E-3
RC702	1.1E-1	8.4E-2	8.7E-2	1.4E-1	1.2E-2	9.6E-2	4.5E-4	2.2E-3	5.4E-2
RC802	9.8E-1	7.1E-1	6.9E-1	6.4E-1	1.3E-1	5.7E-1	3.9E-3	2.2E-2	3.8E-1

Insert 1

Insert 1 (Table 7.2-2 Source Term Inputs to MACCS2)

	XE/KR	I	Cs	Te	Sr	Ru	La	Ce	Ba
RC101	1.9E-03	4.9E-05	4.3E-05	7.2E-05	8.3E-06	5.4E-05	2.1E-07	1.4E-06	2.1E-05
RC201	3.3E-01	5.9E-02	4.2E-02	3.5E-02	2.5E-04	9.8E-03	2.7E-06	9.5E-06	1.9E-03
RC202	7.8E-01	1.1E-02	7.5E-03	6.9E-02	3.7E-02	1.5E-02	3.7E-02	3.7E-02	3.1E-02
RC203	8.0E-01	1.4E-02	1.1E-02	7.9E-02	4.0E-02	1.7E-02	4.0E-02	4.0E-02	3.4E-02
RC204	9.9E-01	1.7E-02	1.4E-02	1.1E-01	5.9E-03	5.9E-03	5.2E-03	5.3E-03	6.4E-03
RC205	1.0E+00	5.6E-02	3.1E-02	1.6E-01	7.3E-03	7.0E-03	5.8E-03	5.9E-03	8.1E-03
RC206	5.8E-01	6.8E-03	6.1E-03	9.6E-03	9.7E-04	7.0E-03	2.3E-05	9.4E-05	2.6E-03
RC301	9.9E-01	1.7E-02	1.9E-02	1.4E-01	3.7E-03	4.2E-03	3.0E-03	3.0E-03	5.1E-03
RC302	9.8E-01	5.3E-02	4.3E-02	2.8E-01	4.7E-03	5.1E-03	3.4E-03	3.4E-03	7.0E-03
RC303	9.9E-01	1.8E-02	1.5E-02	1.0E-01	4.2E-02	1.2E-02	4.1E-02	4.1E-02	3.2E-02
RC304	1.0E+00	5.7E-02	3.6E-02	1.6E-01	4.6E-02	1.3E-02	4.5E-02	4.5E-02	3.5E-02
RC401	9.9E-01	8.9E-03	1.8E-02	1.5E-02	4.4E-03	6.6E-03	7.9E-05	4.5E-04	7.2E-03
RC402	9.8E-01	1.9E-02	4.4E-02	3.4E-02	5.9E-03	9.2E-03	1.1E-04	6.5E-04	1.0E-02
RC403	9.9E-01	8.8E-03	2.2E-02	1.4E-02	4.3E-03	6.6E-03	7.9E-05	4.5E-04	7.2E-03
RC404	1.0E+00	2.2E-02	5.9E-02	3.5E-02	5.9E-03	9.3E-03	1.1E-04	6.4E-04	1.0E-02
RC501	1.0E+00	7.6E-05	8.4E-05	1.5E-03	8.4E-06	5.5E-05	2.1E-07	1.5E-06	2.2E-05
RC502	1.0E+00	6.5E-04	1.4E-03	1.7E-02	8.5E-06	5.5E-05	2.1E-07	1.5E-06	3.5E-05
RC503	1.0E+00	7.1E-05	5.8E-05	9.1E-05	8.3E-06	5.4E-05	2.1E-07	1.4E-06	2.1E-05
RC504	1.0E+00	4.0E-04	7.3E-04	6.2E-02	8.3E-06	5.4E-05	2.1E-07	1.4E-06	2.1E-05
RC602	1.0E+00	6.5E-04	1.4E-03	1.7E-02	8.5E-06	5.5E-05	2.1E-07	1.5E-06	3.5E-05
RC702k (20-tube, creep induced)	9.6E-01	9.3E-01	9.2E-01	9.5E-01	8.6E-02	3.3E-01	3.4E-03	2.7E-02	2.1E-01
RC701i (1-tube, initiating event)	6.8E-01	1.1E-02	2.3E-03	1.4E-02	6.7E-05	1.7E-03	6.5E-06	4.6E-05	1.1E-03
RC702i (1-tube, initiating event)	6.8E-01	5.0E-01	1.0E-01	6.5E-01	3.0E-03	7.5E-02	2.9E-04	2.1E-03	4.7E-02

Insert 1 – (continued) (Table 7.2-2 Source Term Inputs to MACCS2)

	XE/KR	I	Cs	Te	Sr	Ru	La	Ce	Ba
RC701a (1-tube, pressure induced)	9.3E-01	1.3E-02	4.8E-03	1.5E-02	8.7E-05	2.6E-03	6.0E-06	3.5E-05	1.1E-03
RC702a (1-tube, pressure induced)	9.3E-01	6.1E-01	2.1E-01	6.8E-01	3.9E-03	1.1E-01	2.7E-04	1.6E-03	5.1E-02
RC701b (2-tube, pressure induced)	9.9E-01	1.5E-02	7.7E-03	1.3E-02	3.5E-04	4.3E-03	2.0E-05	5.8E-05	2.0E-03
RC702b (2-tube, pressure induced	9.9E-01	6.7E-01	3.5E-01	5.6E-01	1.6E-02	1.9E-01	9.0E-04	2.6E-03	9.1E-02
RC701c (5-tube, pressure induced)	9.9E-01	1.9E-02	1.7E-02	1.7E-02	1.5E-03	8.5E-03	8.2E-05	2.4E-04	5.8E-03
RC702c (5-tube, pressure induced)	9.9E-01	8.4E-01	7.7E-01	7.8E-01	6.7E-02	3.8E-01	3.7E-03	1.1E-02	2.6E-01
RC701d (10-tube, pressure induced)	1.0E+00	2.0E-02	2.0E-02	2.0E-02	1.9E-03	1.2E-02	7.4E-05	2.8E-04	7.2E-03
RC702d (10-tube, pressure induced)	1.0E+00	9.2E-01	9.1E-01	9.0E-01	8.3E-02	5.5E-01	3.3E-03	1.3E-02	3.2E-01
RC801	8.4E-01	1.7E-02	1.7E-02	1.7E-02	1.1E-03	7.2E-03	3.5E-05	2.5E-04	3.6E-03
RC802	8.4E-01	7.7E-01	7.7E-01	7.6E-01	4.9E-02	3.2E-01	1.6E-03	1.1E-02	1.6E-01

BB-10-0253

Table 7.2-3 — U.S. EPR Severe Accidents Analysis Impacts - 50-Mile Radius and 2050 Population

		Number of Fatalities (per year) at 50 mi (80km)		Environmental Risk (per year) at 50 mi (80km)			
Release Category	Release Category Frequency (per year)	Early Fatalities	Latent Cancers	Population Dose-Risk (person-rem)	Water Ingestion Dose-Risk (person-rem)	Cost (dollars)	Land Requiring Decontamination (acres)
RC101	3.43E-07	0.00E+00	4.36E-06	8.99E-03	9.50E-06	1.03E+00	1.58E-04
RC201	4.98E-10	8.67E-12	6.37E-07	1.40E-03	1.74E-05	1.78E+00	7.17E-05
RC202	3.97E-14	3.86E-17	4.84E-11	1.03E-07	2.53E-10	1.04E-04	6.75E-09
RC203	1.92E-12	3.19E-14	3.61E-09	7.35E-06	2.23E-08	7.89E-03	4.22E-07
RC204	2.78E-11	7.87E-14	3.67E-08	7.65E-05	1.85E-07	7.95E-02	4.98E-06
RC205	4.08E-10	3.61E-12	8.45E-07	1.67E-03	7.14E-06	1.94E+00	9.26E-05
RC206	1.65E-08	1.32E-09	1.31E-05	2.51E-02	9.24E-05	2.11E+01	1.50E-03
RC301	1.67E-12	1.62E-15	2.04E-09	4.34E-06	1.07E-08	4.36E-03	2.84E-07
RC302	2.18E-11	3.62E-13	4.10E-08	8.35E-05	2.53E-07	8.96E-02	4.80E-06
RC303	2.30E-09	6.51E-12	3.04E-06	6.33E-03	1.53E-05	6.58E+00	4.12E-04
RC304	1.75E-08	1.55E-10	3.62E-05	7.16E-02	3.06E-04	8.31E+01	3.97E-03
RC401	1.38E-11	0.00E+00	8.03E-09	1.74E-05	3.91E-08	1.25E-02	9.72E-07
RC402	2.75E-10	0.00E+00	3.05E-07	6.63E-04	1.87E-06	6.66E-01	4.46E-05
RC403	6.82E-10	0.00E+00	3.97E-07	8.59E-04	1.93E-06	6.20E-01	4.80E-05
RC404	1.34E-08	0.00E+00	1.49E-05	3.23E-02	9.11E-05	3.24E+01	2.17E-03
RC501	5.92E-13	0.00E+00	1.02E-10	2.24E-07	1.01E-10	3.10E-05	1.73E-08
RC502	2.87E-10	0.00E+00	4.94E-08	1.08E-04	4.91E-08	1.50E-02	8.38E-06
RC503	6.01E-10	0.00E+00	1.85E-08	4.12E-05	2.05E-08	1.34E-03	1.05E-06
RC504	1.19E-07	0.00E+00	3.67E-06	8.15E-03	4.06E-06	2.65E-01	2.07E-04
RC602	6.50E-10	0.00E+00	1.12E-07	2.46E-04	1.11E-07	3.40E-02	1.90E-05
RC701	1.02E-08	1.18E-13	8.06E-06	1.55E-02	3.07E-05	1.22E+01	8.57E-04
RC702	5.38E-09	1.85E-09	3.54E-05	4.14E-02	3.21E-04	3.49E+01	1.32E-03
RC802	2.64E-10	1.22E-09	8.58E-06	7.66E-03	9.87E-05	2.67E+00	5.97E-05
Total	5.31E-07	4.56E-09	1.30E-04	2.22E-01	9.98E-04	2.00E+02	1.10E-02

Insert 2

Insert 2 (Table 7.2-3 – U.S. EPR Severe Accidents Analysis Impacts – 50-Mile Radius and 2050 Population)

		Number of Fatalities (per year) at 50 mi (80 km)		Environmental Risk (per year) at 50 mi (80km)			
Release Category	Release Category Frequency (per year)	Early Fatalities	Late Cancers	Population Dose-Risk (person-rem)	Water Ingestion Dose-Risk (person-rem)	Cost (dollars)	Land Requiring Decontamination (acres)
RC101	3.16E-07	0.00E+00	9.76E-06	2.07E-02	1.89E-05	7.80E+00	3.76E-04
RC201	5.51E-10	1.27E-11	6.88E-07	1.02E-03	1.01E-05	1.16E+00	4.71E-05
RC202	1.08E-11	9.72E-16	1.37E-07	1.88E-04	3.47E-07	6.60E-02	2.23E-06
RC203	1.56E-09	2.69E-13	2.16E-05	2.94E-02	5.64E-05	9.75E+00	3.23E-04
RC204	9.73E-10	0.00E+00	2.66E-06	4.45E-03	1.09E-05	3.71E+00	1.66E-04
RC205	2.54E-09	2.90E-13	7.93E-06	1.32E-02	5.16E-05	1.07E+01	4.83E-04
RC206	4.62E-08	1.97E-09	4.02E-05	7.15E-02	3.36E-04	6.97E+01	4.24E-03
RC301	6.63E-13	6.63E-18	1.37E-09	2.49E-06	8.16E-09	2.24E-03	1.10E-07
RC302	1.05E-11	9.35E-15	2.63E-08	4.73E-05	2.63E-07	4.20E-02	1.99E-06
RC303	7.65E-11	2.10E-14	1.15E-06	1.56E-03	2.88E-06	4.75E-01	1.57E-05
RC304	5.34E-10	5.10E-13	7.64E-06	1.04E-02	2.67E-05	3.44E+00	1.11E-04
RC401	1.09E-12	0.00E+00	1.12E-09	2.17E-06	1.34E-08	2.60E-03	1.62E-07
RC402	2.35E-11	0.00E+00	3.22E-08	6.21E-05	6.19E-07	7.83E-02	4.07E-06
RC403	9.87E-11	2.24E-15	1.06E-07	2.02E-04	1.34E-06	2.36E-01	1.42E-05
RC404	1.10E-09	0.00E+00	1.56E-06	3.04E-03	3.61E-05	4.08E+00	2.04E-04
RC501	1.58E-12	0.00E+00	6.46E-11	1.37E-07	6.27E-11	7.86E-06	3.64E-09
RC502	2.84E-10	0.00E+00	8.12E-08	1.79E-04	1.64E-07	6.70E-02	1.16E-05
RC503	1.24E-09	0.00E+00	2.93E-08	6.19E-05	2.89E-08	1.92E-03	3.25E-07
RC504	2.93E-08	0.00E+00	5.63E-06	1.23E-02	7.07E-06	3.08E+00	1.27E-03
RC602	2.65E-08	0.00E+00	7.58E-06	1.67E-02	1.53E-05	6.26E+00	1.08E-03
RC702k	8.11E-09	5.61E-08	1.64E-04	1.59E-01	4.50E-03	5.66E+01	1.56E-03
RC701i	2.63E-08	0.00E+00	1.28E-05	2.66E-02	4.74E-05	1.94E+01	2.20E-03
RC702i	6.06E-09	5.25E-09	2.67E-05	3.72E-02	4.74E-04	3.14E+01	1.32E-03
RC701a	9.77E-10	3.26E-14	5.00E-07	1.03E-03	1.97E-06	8.85E-01	9.08E-05
RC702a	2.25E-10	3.26E-10	1.47E-06	1.74E-03	1.98E-05	1.10E+00	4.25E-05
RC701b	4.89E-10	0.00E+00	3.25E-07	6.65E-04	1.70E-06	7.04E-01	5.82E-05
RC702b	1.12E-10	7.63E-12	6.33E-07	7.74E-04	1.78E-05	6.94E-01	2.44E-05
RC701c	4.89E-10	0.00E+00	4.83E-07	9.38E-04	3.96E-06	1.10E+00	7.18E-05
RC702c	1.12E-10	2.85E-11	1.12E-06	1.18E-03	4.11E-05	7.77E-01	2.25E-05
RC701d	1.95E-12	1.49E-16	2.29E-09	4.12E-06	1.82E-08	4.57E-03	2.89E-07
RC702d	4.49E-13	1.70E-12	1.01E-08	8.90E-06	1.90E-07	3.06E-03	8.58E-08
RC801	7.82E-09	8.37E-14	7.90E-06	1.49E-02	6.79E-05	1.70E+01	1.10E-03
RC802	8.09E-09	1.43E-08	1.37E-04	1.29E-01	3.18E-03	5.41E+01	1.59E-03
Total	4.86E-07	7.80E-08	4.60E-04	5.57E-01	8.94E-03	3.05E+02	1.64E-02