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BELL BEND NUCLEAR POWER PLANT
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
BNP-2010-238 Docket No. 52-039

References: 1) BNP-2010-175, T. L. Harpster (PPL Bell Bend, LLC) to U.S. NRC, "July 2010 BBNPP Schedule Update", dated July 16, 2010

2) BNP-2010-155, R. R. Sgarro (PPL Bell Bend, LLC) to U.S. NRC, "Submittal of BBNPP RAI Schedule Information," dated August 4, 2010

3) BNP-2009-217, R. R. Sgarro (PPL Bell Bend LLC) to U.S. NRC, "Response to Requests for Additional Information, Second Submittal," dated August 10, 2009

4) BNP-2009-313, R. R. Sgarro (PPL Bell Bend LLC) to U.S. NRC, "Response to Requests for Additional Information, Sixth Submittal," dated October 19, 2009

5) S. Imboden (NRC) to R. Sgarro (PPL Bell Bend LLC), Bell Bend Env. – Final RAI EIS 5.11-7 (RAI No. 5021) – Accidents, e-mail dated September 7, 2010

In References 1 and 2, PPL Bell Bend, LLC (PPL) provided the NRC with schedule information related to the intended revision of the Bell Bend Nuclear Power Plant (BBNPP) footprint within the existing project boundary which has been characterized as the Plot Plan Change (PPC). As the NRC staff is aware, the plant footprint relocation will result in changes to the Combined License Application (COLA) and potentially to new and previously responded to Requests for Additional Information (RAIs).

Accordingly, PPL has committed to provide the NRC with COLA supplements, consisting of revised COLA Sections and associated RAI responses/revisions, as they are developed. These COLA supplements will only include the changes related to that particular section of the COLA and will not include all conforming COLA changes. Conforming changes for each supplement necessary for other COLA sections will be integrated into the respective COLA supplements and provided in accordance with the schedule, unless the supplement has already been submitted. In the latter case, the COLA will be updated through the normal internal change process. The revised COLA supplements will also include all other approved changes since the submittal of Revision 2. All COLA supplements and other approved changes will ultimately be incorporated into the next full COLA revision.

Enclosure 1 provides the revised BBNPP COLA Supplement, Part 3 (Environmental Report), Section 7.2, Revision 2a. The revised BBNPP COLA section supersedes previously submitted

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information in its entirety. No departures and/or exemptions to this BBNPP COLA section have been revised as a result of the PPC.

Enclosure 2 provides the revised responses to NRC RAI ACC 7.2-2, ACC 7.2-3, and ACC 7.2-5 which refer directly to the enclosed COLA section. These responses supersede the previous responses (References 3 and 4) in their entirety. The following revised RAI responses are included with this submittal:

RAI No.
ACC 7.2-2
ACC 7.2-3
ACC 7.2-5

Previously submitted NRC RAI responses which refer directly to the enclosed COLA section were also reviewed for impact from the PPC. The following previously submitted RAI responses were reviewed for impacts:

RAI No.	Response Impacted? (Yes/No)
ACC 7.2-1	No
ACC 7.2-4	No
ACC 7.2-6	No

Enclosure 3 provides the response to NRC RAI No. 5021 (Reference 5). This RAI requests additional information regarding a previous response (Reference 3) to RAI ACC 7.2-2.

The following RAI response is included with this submittal:

RAI No.
No. 5021

The only new regulatory commitment is to include the revised COLA section (Enclosure 1) in the next COLA revision.

If you have any questions, please contact the undersigned at 570.802.8102.

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

Executed on October 14, 2010

Respectfully,

Rocco R. Sgarro

RRS/kw

Enclosure 1: Revised BBNPP COLA Part 3 (ER); Section 7.2, Revision 2a

Enclosure 2: Response to RAI ACC 7.2-2 for COLA Part 3 (ER), Section 7.2
Response to RAI ACC 7.2-3 for COLA Part 3 (ER), Section 7.2
Response to RAI ACC 7.2-5 for COLA Part 3 (ER), Section 7.2

Enclosure 3: Response to RAI 5021

cc: (w/o Enclosures)

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Enclosure 1

Revised BBNPP COLA Part 3 (ER), Section 7.2, Revision 2a

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:

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)

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 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.

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.

The MACCS2 code primarily addresses dose from the air pathway, but also calculates dose from surface runoff and deposition on surface water. The code also evaluates the extent of contamination. The meteorology data used in the analysis was hourly data for one year that includes wind velocity (speed and direction), stability class, and rainfall.

To assess human health impacts, the analysis determined the expected number of early fatalities, expected number of latent cancer fatalities, and collective whole body dose from a severe accident to the year 2050 population within a 50-mile radius of the plant. Economic costs were also determined, including the costs associated with short-term relocation of people, decontamination of property and equipment, and interdiction of food supplies.

MACCS2 requires five input files: MET, SITE, ATMOS, EARLY, and CHRONC. ATMOS provides data to calculate the amount of material released to the atmosphere that is dispersed and deposited. The calculation uses a Gaussian plume model. Important site-specific inputs in this file include the core inventory, release fractions, and geometry of the reactor and associated buildings. EARLY provides inputs to calculations regarding exposure in the time period immediately following the release. Important site-specific information includes emergency response information such as evacuation time. CHRONC provides data for calculating long-term impacts and economic costs and includes region-specific data on agriculture and economic factors. These files access a meteorological file, which uses actual SSES Units 1 and 2 meteorological monitoring data from the years 2001 through 2007 and a site characteristics file, which uses site-specific population data, land usage, watershed index, and regions.

For the Level 3 PRA, meteorological data for the BBNPP site for the years 2001 through 2007 were reviewed to determine the years with the least unusable data points. The year 2002 satisfied this criterion and was used for the base case.

7.2.1.2 Population Data

The population used in this analysis was generated using SECPOP2000 for the year 2000. Since the BBNPP site does not have an existing reactor, the coordinates of the site were used as input into SECPOP2000. Consistent with the BBNPP Level 3 PRA, population data from the 2000 U.S. Census and SECPOP2000 were compared with Susquehanna Steam Electric Station, proximate to the BBNPP site. This comparison was used to represent the population in the 50 mi (80 km) region surrounding the BBNPP site.

The 2000 population data were escalated to 2050 by a growth rate factor of 1.0549 per decade, which was estimated based on the population growth in the region from 2000 to 2005 by county and further compared to the growth rate estimated from the SECPOP2000 1990 data. The growth rate factors were comparable and the census-based escalation factor was used as it was slightly greater and therefore would be more conservative.

BBNPP has an expected start-up date of 2018, an operating life of 40 years and a 20-year license extension, bringing anticipated end-of-life to the year 2078. Recognizing that consequences increase with increasing time (i.e., increasing population), a time-averaged consequence can be estimated by looking at the midpoint of the BBNPP operational life, thus 2050 approximates to the base year used while calculating the consequences of a severe accident. Considering just the 40-year initial license period, selecting 2050 as the base year is conservative. As a sensitivity case, the approximate endpoint of the BBNPP operational life, 2080 is also evaluated.

7.2.1.3 Risk Calculation

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

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

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 ~~1.03E-03~~9.98E-04 person-rem per year for the U.S. EPR. This value is the sum of all 23 release categories.

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

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 ~~0.23~~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 ~~1.83E-05~~ 1.92E-05 and ~~2.75E-04,~~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.

The U.S. EPR dose-risk at the BBNPP site is less than the population risk for ~~all~~ 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.

The analysis indicates that risk from the water ingestion dose is small at ~~1.03E-03~~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 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.

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

Table 7.2-2— Source Term Input to MACCS2

~~-~~ -	~~XE/KR~~ XE/KR	~~I~~ I	~~Cs~~ Cs	~~Te~~ Te	~~Sr~~ Sr	~~Ru~~ Ru	~~La~~ La	~~Ce~~ Ce	~~Ba~~ Ba
~~RC101~~ **RC101**	~~8.8E-3~~ 8.8E-3	~~2.4E-5~~ 2.4E-5	~~2.0E-5~~ 2.0E-5	~~5.3E-5~~ 5.3E-5	~~8.5E-6~~ 8.5E-6	~~4.4E-5~~ 4.4E-5	~~2.8E-7~~ 2.8E-7	~~7.3E-7~~ 7.3E-7	~~2.4E-5~~ 2.4E-5
~~RC201~~ **RC201**	~~3.6E-1~~ 3.6E-1	~~1.0E-1~~ 1.0E-1	~~9.5E-2~~ 9.5E-2	~~7.6E-3~~ 9.6E-3	~~7.8E-5~~ 7.8E-5	~~1.1E-3~~ 1.1E-3	~~3.4E-6~~ 3.4E-6	~~1.7E-5~~ 1.7E-5	~~4.1E-4~~ 4.1E-4
~~RC202~~ **RC202**	~~7.9E-1~~ 7.9E-1	~~2.3E-2~~ 2.3E-2	~~1.5E-2~~ 1.5E-2	~~2.0E-2~~ 2.0E-2	~~2.4E-4~~ 2.4E-4	~~3.4E-3~~ 3.4E-3	~~1.9E-5~~ 1.9E-5	~~6.8E-5~~ 6.8E-5	~~2.4E-3~~ 2.4E-3
~~RC203~~ **RC203**	~~8.9E-1~~ 8.9E-1	~~5.3E-2~~ 5.3E-2	~~2.8E-2~~ 2.8E-2	~~1.6E-1~~ 1.6E-1	~~1.4E-4~~ 1.4E-4	~~6.8E-3~~ 6.8E-3	~~1.5E-5~~ 1.5E-5	~~2.4E-4~~ 2.4E-4	~~2.2E-3~~ 2.2E-3
~~RC204~~ **RC204**	~~9.5E-1~~ 9.5E-1	~~2.8E-2~~ 2.8E-2	~~1.6E-2~~ 1.6E-2	~~3.6E-2~~ 3.6E-2	~~1.7E-4~~ 1.7E-4	~~5.3E-3~~ 5.3E-3	~~1.4E-5~~ 1.4E-5	~~6.2E-5~~ 6.2E-5	~~3.2E-3~~ 3.2E-3
~~RC205~~ **RC205**	~~9.8E-1~~ 9.8E-1	~~5.7E-2~~ 5.7E-2	~~3.6E-2~~ 3.6E-2	~~9.3E-2~~ 9.3E-2	~~4.0E-3~~ 4.0E-3	~~9.8E-3~~ 9.8E-3	~~3.0E-4~~ 3.0E-4	~~5.3E-4~~ 5.3E-4	~~6.1E-3~~ 6.1E-3
~~RC206~~ **RC206**	~~1.9E-1~~ 1.9E-1	~~5.6E-3~~ 5.6E-3	~~5.0E-3~~ 5.0E-3	~~9.0E-3~~ 9.0E-3	~~1.2E-3~~ 1.2E-3	~~7.3E-3~~ 7.3E-3	~~5.5E-5~~ 5.5E-5	~~1.8E-4~~ 1.8E-4	~~4.2E-3~~ 4.2E-3
~~RC301~~ **RC301**	~~7.9E-1~~ 7.9E-1	~~2.3E-2~~ 2.3E-2	~~1.5E-2~~ 1.5E-2	~~2.0E-2~~ 2.0E-2	~~2.4E-4~~ 2.4E-4	~~3.4E-3~~ 3.4E-3	~~1.9E-5~~ 1.9E-5	~~6.8E-4~~ 6.8E-5	~~2.4E-3~~ 2.4E-3
~~RC302~~ **RC302**	~~8.9E-1~~ 8.9E-1	~~5.3E-2~~ 5.3E-2	~~2.8E-2~~ 2.8E-2	~~1.6E-1~~ 1.6E-1	~~1.4E-4~~ 1.4E-4	~~6.8E-3~~ 6.8E-3	~~1.5E-5~~ 1.5E-5	~~2.4E-4~~ 2.4E-4	~~2.2E-3~~ 2.2E-3
~~RC303~~ **RC303**	~~9.5E-1~~ 9.5E-1	~~2.8E-2~~ 2.8E-2	~~1.6E-2~~ 1.6E-2	~~3.6E-2~~ 3.6E-2	~~1.7E-4~~ 1.7E-4	~~5.3E-3~~ 5.3E-3	~~1.4E-5~~ 1.4E-5	~~6.2E-5~~ 6.2E-5	~~3.2E-3~~ 3.2E-3
~~RC304~~ **RC304**	~~9.8E-1~~ 9.8E-1	~~5.7E-2~~ 5.7E-2	~~3.6E-2~~ 3.6E-2	~~9.3E-2~~ 9.3E-2	~~4.0E-3~~ 4.0E-3	~~9.8E-3~~ 9.8E-3	~~3.0E-4~~ 3.0E-4	~~5.3E-4~~ 5.3E-4	~~6.1E-3~~ 6.1E-3
~~RC401~~ **RC401**	~~8.0E-1~~ 8.0E-1	~~4.6E-3~~ 4.6E-3	~~2.3E-3~~ 2.3E-3	~~3.4E-3~~ 3.4E-3	~~2.7E-3~~ 2.7E-3	~~1.5E-3~~ 1.5E-3	~~8.0E-5~~ 8.0E-5	~~3.4E-4~~ 3.4E-4	~~5.2E-3~~ 5.2E-3
~~RC402~~ **RC402**	~~9.7E-1~~ 9.7E-1	~~2.0E-2~~ 2.0E-2	~~1.0E-2~~ 1.0E-2	~~1.2E-2~~ 1.2E-2	~~3.8E-3~~ 3.8E-3	~~2.1E-3~~ 2.1E-3	~~1.1E-4~~ 1.1E-4	~~4.9E-4~~ 4.9E-4	~~7.3E-3~~ 7.3E-3
~~RC403~~ **RC403**	~~8.0E-1~~ 8.0E-1	~~4.6E-3~~ 4.6E-3	~~2.3E-3~~ 2.3E-3	~~3.4E-3~~ 3.4E-3	~~2.7E-3~~ 2.7E-3	~~1.5E-3~~ 1.5E-3	~~8.0E-5~~ 8.0E-5	~~3.4E-4~~ 3.4E-4	~~5.2E-3~~ 5.2E-3
~~RC404~~ **RC404**	~~9.7E-1~~ 9.7E-1	~~2.0E-2~~ 2.0E-2	~~1.0E-2~~ 1.0E-2	~~1.2E-2~~ 1.2E-2	~~3.8E-3~~ 3.8E-3	~~2.1E-3~~ 2.1E-3	~~1.1E-4~~ 1.1E-4	~~4.9E-4~~ 4.9E-4	~~7.3E-3~~ 7.3E-3
~~RC501~~ **RC501**	~~9.9E-1~~ 9.9E-1	~~7.7E-4~~ 7.7E-4	~~4.0E-4~~ 4.0E-4	~~1.7E-2~~ 1.7E-2	~~7.4E-6~~ 7.4E-6	~~4.4E-5~~ 4.4E-5	~~2.2E-7~~ 2.2E-7	~~7.0E-7~~ 7.0E-7	~~2.4E-5~~ 2.4E-5
~~RC502~~ **RC502**	~~9.9E-1~~ 9.9E-1	~~7.7E-4~~ 7.7E-4	~~4.0E-4~~ 4.0E-4	~~1.7E-2~~ 1.7E-2	~~7.4E-6~~ 7.4E-6	~~4.4E-5~~ 4.4E-5	~~2.2E-7~~ 2.2E-7	~~7.0E-7~~ 7.0E-7	~~2.4E-5~~ 2.4E-5
~~RC503~~ **RC503**	~~1.0E+0~~ 1.0E+0	~~4.1E-4~~ 4.1E-4	~~6.9E-5~~ 6.9E-5	~~5.1E-5~~ 6.1E-4	~~8.5E-6~~ 8.5E-6	~~4.4E-5~~ 4.4E-5	~~2.8E-7~~ 2.8E-7	~~7.3E-7~~ 7.3E-7	~~2.4E-5~~ 2.4E-5
~~RC504~~ **RC504**	~~1.0E+0~~ 1.0E+0	~~4.1E-4~~ 4.1E-4	~~6.9E-5~~ 6.9E-5	~~5.1E-5~~ 6.1E-4	~~8.5E-6~~ 8.5E-6	~~4.4E-5~~ 4.4E-5	~~2.8E-7~~ 2.8E-7	~~7.3E-7~~ 7.3E-7	~~2.4E-5~~ 2.4E-5
~~RC602~~ **RC602**	~~9.9E-1~~ 9.9E-1	~~7.7E-4~~ 7.7E-4	~~4.0E-4~~ 4.0E-4	~~1.7E-2~~ 1.7E-2	~~7.4E-6~~ 7.4E-6	~~4.4E-5~~ 4.4E-5	~~2.2E-7~~ 2.2E-7	~~7.0E-7~~ 7.0E-7	~~2.4E-5~~ 2.4E-5
~~RC701~~ **RC701**	~~1.1E-1~~ 1.1E-1	~~4.2E-3~~ 4.2E-3	~~4.4E-3~~ 4.4E-3	~~6.9E-3~~ 6.9E-3	~~6.0E-4~~ 6.0E-4	~~4.8E-3~~ 4.8E-3	~~2.2E-5~~ 2.2E-5	~~1.1E-4~~ 1.1E-4	~~2.7E-3~~ 2.7E-3
~~RC702~~ **RC702**	~~1.1E-1~~ 1.1E-1	~~8.4E-2~~ 8.4E-2	~~8.7E-2~~ 8.7E-2	~~1.4E-1~~ 1.4E-1	~~1.2E-2~~ 1.2E-2	~~9.6E-2~~ 9.6E-2	~~4.5E-4~~ 4.5E-4	~~2.2E-3~~ 2.2E-3	~~5.4E-2~~ 5.4E-2
~~RC802~~ **RC802**	~~9.8E-1~~ 9.8E-1	~~7.1E-1~~ 7.1E-1	~~6.9E-1~~ 6.9E-1	~~6.4E-1~~ 6.4E-1	~~1.3E-1~~ 1.3E-1	~~5.7E-1~~ 5.7E-1	~~3.9E-3~~ 3.9E-3	~~2.2E-2~~ 2.2E-2	~~3.8E-1~~ 3.8E-1

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

(Page 1 of 2)

		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)~~ (person-rem)	Water Ingestion Dose-Risk ~~(person-rem)~~ (person-rem)	Cost (dollars)	Land Requiring Decontamination (acres)
~~RC101~~	~~3.39E-07~~	~~0.00E+00~~	~~4.27E-06~~	~~8.81E-03~~	~~9.39E-06~~	~~1.01E+00~~	~~1.56E-04~~
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~~	~~8.42E-12~~	~~6.32E-07~~	~~1.39E-03~~	~~1.74E-05~~	~~1.79E+00~~	~~7.17E-05~~
RC201	4.98E-10	8.67E-12	6.37E-07	1.40E-03	1.74E-05	1.78E+00	7.17E-05
~~RC202~~	~~4.00E-14~~	~~5.04E-17~~	~~4.84E-11~~	~~1.04E-07~~	~~2.55E-10~~	~~1.04E-04~~	~~6.84E-09~~
RC202	3.97E-14	3.86E-17	4.84E-11	1.03E-07	2.53E-10	1.04E-04	6.75E-09
~~RC203~~	~~8.45E-13~~	~~1.71E-14~~	~~1.59E-09~~	~~3.24E-06~~	~~9.80E-09~~	~~3.47E-03~~	~~1.86E-07~~
RC203	1.92E-12	3.19E-14	3.61E-09	7.35E-06	2.23E-08	7.89E-03	4.22E-07
~~RC204~~	~~2.41E-11~~	~~8.77E-14~~	~~3.18E-08~~	~~6.63E-05~~	~~1.61E-07~~	~~6.89E-02~~	~~4.31E-06~~
RC204	2.78E-11	7.87E-14	3.67E-08	7.65E-05	1.85E-07	7.95E-02	4.98E-06
~~RC205~~	~~4.10E-10~~	~~2.81E-12~~	~~8.32E-07~~	~~1.64E-03~~	~~7.18E-06~~	~~1.95E+00~~	~~9.14E-05~~
RC205	4.08E-10	3.61E-12	8.45E-07	1.67E-03	7.14E-06	1.94E+00	9.26E-05
~~RC206~~	~~1.64E-08~~	~~1.97E-09~~	~~1.30E-05~~	~~2.48E-02~~	~~9.18E-05~~	~~2.08E+01~~	~~1.50E-03~~
RC206	1.65E-08	1.32E-09	1.31E-05	2.51E-02	9.24E-05	2.11E+01	1.50E-03
~~RC301~~	~~1.63E-12~~	~~2.05E-15~~	~~1.97E-09~~	~~4.24E-06~~	~~1.04E-08~~	~~4.25E-03~~	~~2.79E-07~~
RC301	1.67E-12	1.62E-15	2.04E-09	4.34E-06	1.07E-08	4.36E-03	2.84E-07
~~RC302~~	~~1.51E-11~~	~~3.05E-13~~	~~2.84E-08~~	~~5.78E-05~~	~~1.75E-07~~	~~6.21E-02~~	~~3.32E-06~~
RC302	2.18E-11	3.62E-13	4.10E-08	8.35E-05	2.53E-07	8.96E-02	4.80E-06
~~RC303~~	~~2.29E-09~~	~~8.34E-12~~	~~3.02E-06~~	~~6.30E-03~~	~~1.53E-05~~	~~6.55E+00~~	~~4.10E-04~~
RC303	2.30E-09	6.51E-12	3.04E-06	6.33E-03	1.53E-05	6.58E+00	4.12E-04
~~RC304~~	~~1.76E-08~~	~~1.88E-10~~	~~3.63E-05~~	~~7.20E-02~~	~~3.08E-04~~	~~8.38E+01~~	~~4.01E-03~~
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~~	~~8.64E-09~~	~~1.88E-05~~	~~3.89E-08~~	~~1.22E-02~~	~~1.01E-06~~
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~~	~~6.66E-04~~	~~1.87E-06~~	~~6.66E-01~~	~~4.48E-05~~
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~~	~~3.96E-07~~	~~8.59E-04~~	~~1.93E-06~~	~~6.16E-01~~	~~4.82E-05~~
RC403	6.82E-10	0.00E+00	3.97E-07	8.59E-04	1.93E-06	6.20E-01	4.80E-05
~~RC404~~	~~1.35E-08~~	~~0.00E+00~~	~~1.50E-05~~	~~3.27E-02~~	~~9.18E-05~~	~~3.27E+01~~	~~2.20E-03~~
RC404	1.34E-08	0.00E+00	1.49E-05	3.23E-02	9.11E-05	3.24E+01	2.17E-03
~~RC501~~	~~2.65E-13~~	~~0.00E+00~~	~~1.16E-09~~	~~2.27E-06~~	~~4.53E-11~~	~~1.97E-03~~	~~6.63E-08~~
RC501	5.92E-13	0.00E+00	1.02E-10	2.24E-07	1.01E-10	3.10E-05	1.73E-08
~~RC502~~	~~1.11E-10~~	~~0.00E+00~~	~~4.62E-07~~	~~9.15E-04~~	~~1.90E-08~~	~~8.15E-01~~	~~2.74E-05~~
RC502	2.87E-10	0.00E+00	4.94E-08	1.08E-04	4.91E-08	1.50E-02	8.38E-06
~~RC503~~	~~3.65E-10~~	~~0.00E+00~~	~~1.07E-08~~	~~2.39E-05~~	~~1.24E-08~~	~~7.63E-04~~	~~5.44E-07~~
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~~	~~3.49E-06~~	~~7.79E-03~~	~~4.06E-06~~	~~2.49E-01~~	~~1.77E-04~~
RC504	1.19E-07	0.00E+00	3.67E-06	8.15E-03	4.06E-06	2.65E-01	2.07E-04
~~RC602~~	~~3.61E-10~~	~~0.00E+00~~	~~1.50E-06~~	~~2.97E-03~~	~~6.17E-08~~	~~2.65E+00~~	~~8.92E-05~~
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~~	~~1.35E-13~~	~~8.00E-06~~	~~1.55E-02~~	~~3.07E-05~~	~~1.21E+01~~	~~8.62E-04~~
RC701	1.02E-08	1.18E-13	8.06E-06	1.55E-02	3.07E-05	1.22E+01	8.57E-04
~~RC702~~	~~5.37E-09~~	~~2.25E-09~~	~~3.47E-05~~	~~4.10E-02~~	~~3.21E-04~~	~~3.50E+01~~	~~1.32E-03~~
RC702	5.38E-09	1.85E-09	3.54E-05	4.14E-02	3.21E-04	3.49E+01	1.32E-03

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

(Page 2 of 2)

		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)~~ (person-rem)**	**Water Ingestion Dose-Risk ~~(person-rem)~~ (person-rem)**	**Cost (dollars)**	**Land Requiring Decontamination (acres)**
~~RC802~~	~~2.64E-10~~	~~1.29E-09~~	~~8.53E-06~~	~~7.66E-3~~	~~1.34E-04~~	~~2.72E+00~~	~~4.49E-05~~
RC802	2.64E-10	1.22E-09	8.58E-06	7.66E-03	9.87E-05	2.67E+00	5.97E-05
-	-	-	-	-		-	
~~**Total**~~	~~**5.26E-07**~~	~~**5.72E-09**~~	~~**1.30E-04**~~	~~**2.25E-01**~~	~~**1.03E-03**~~	~~**2.04E+02**~~	~~**1.11E-02**~~
Total	5.31E-07	4.56E-09	1.30E-04	2.22E-01	9.98E-04	2.00E+02	1.10E-02

Enclosure 2

Response to RAI ACC 7.2-2 for COLA Part 3 (ER), Section 7.2

Response to RAI ACC 7.2-3 for COLA Part 3 (ER), Section 7.2

Response to RAI ACC 7.2-5 for COLA Part 3 (ER), Section 7.2

ACC 7.2-2

ESRP 7.2

Summary: *Provide the average early and latent cancer fatalities.*

Full Text: ESRP 7.2 directs the staff to evaluate the average individual risk of an early fatality for individuals within 1 mi of the reactor and the average individual risk of latent cancer fatalities for individuals within 10 mi of the reactor (See Commission's 1986 Policy Statement, 51 FR 28044) for inclusion in the EIS.

Response: Sections 7.2 and 7.3 of the 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 estimate the risk of early fatalities and the risk of latent cancer fatalities, using the following formulas:

$$Risk\ (Early\ Fatalities\ at\ one\ mile) = \sum_{i=1}^{N} RCF_i\ x\ Estimated\ EF_i\ (one\ mile)$$

where: RCF_i is the Release Category frequency for RC i (Level 2 PRA), and

$Estimated\ EF_i\ (one\ mile)$ is the estimated number of early fatalities for RC i at one mile (MACCS2)

$$Risk\ (Latent\ Cancer\ Fatalities\ at\ ten\ miles) = \sum_{i=1}^{N} RCF_i\ x\ Estimated\ LC_i\ (ten\ miles)$$

where: RCF_i is the Release Category frequency for RC i (Level 2 PRA), and

$Estimated\ LC_i\ (ten\ miles)$ is the estimated number of latent cancers for RC i at ten miles (MACCS2)

	Base Case	Sensitivity Case S1
Risk (Early Fatalities/year)	3.17E-09	3.74E-09
Risk (Latent Cancers/year)	7.49E-06	8.71E-09

COLA Impact:
The COLA will not be revised as a result of this response.

ACC 7.2-3

ESRP 7.2

Summary: *Provide a qualitative discussion on the Bell Bend Nuclear Power Plant (BBNPP) un-interdicted aquatic food pathway and explain whether and how the Susquehanna Steam Electric Station (SSES) dose bounds the BBNPP dose for this pathway.*

Full Text: The ER refers to NUREG 1437 for a qualitative analysis for the un-interdicted aquatic food pathway. No quantitative, site-specific study was performed for this pathway. The NUREG 1437 analyzes water pathways, including un-interdicted aquatic food pathway, for many nuclear power plants, including SSES, which is classified as a plant located on a small river. Please explain how this study is pertinent to an US EPR at the BBNPP site. Please provide a qualitative link between SSES, covered by NUREG 1437, and a US EPR at the BBNPP site.

Response: The aquatic food pathway dose-risk evaluation in the BBNPP ER Section 7.2.2.2 assumed that the SSES dose-risk bounds the BBNPP dose-risk for this pathway. This is valid because:

- The core damage frequency (CDF) of BBNPP (i.e., 5.3E-07 per year for internal events, fire, and flood from U.S. EPR FSAR, Tier 2 Section 19.1.8.1) is smaller than the CDF of the SSES (i.e., 2.0E-06 per year for internal events and flood from NUREG-1437 Supplement 35, Table 5-3).
- The total atmospheric pathway dose-risk of BBNPP (0.22 person-rem per year from Table 7.2-3) is smaller than that of the SSES (i.e., 1.90 person-rem per year from NUREG-1437 Supplement 35 Table 5-4).
- Due to proximity, the site characteristics for BBNPP are similar to the SSES. The potentially higher risk due to the larger source term of the BBNPP, compared with the SSES (BBNPP is approximately 1600 MWe, compared with approximately 1150 MWe for SSES), is more than compensated for by the decrease in risk due to the lower CDF, particularly considering that the reported BBNPP CDF includes fire risk while the reported SSES CDF does not. This is reflected in the comparison of atmospheric pathway dose-risk above. The BBNPP containment design is similar to existing containments and does not result in a disproportionately large contribution to the aquatic food pathway dose-risk. Therefore, the SSES dose-risk bounds the BBNPP dose-risk for the aquatic food pathway.

COLA Impact:
The COLA will not be revised as a result of this response.

ACC 7.2-5

ESRP 7.2

Summary: *Provide reference and justification for the 5.7 person-rem/yr value for normal operation used in ER.*

Full Text: The ER states that "as reported in ER Section 5.4, the total collective dose from normal operations is ... 5.7 person-rem per year." Where in ER Section 5.4 is this information? Please justify this conclusion.

Response: The reference to 5.7 person-rem was incorrectly taken from Section 7.2.3 of the CCNPP3 ER. The correct value is tabulated from BBNPP ER Table 5.4-15 and Table 5.4-19 as shown below.

- Table 5.4-15 states that the 50-mile total body year 2070 population dose from gaseous effluents is 5.31 person-rem.
- Table 5.4-19 states that the 50-mile total body population dose from liquid effluents is 0.165 person-rem. This table also refers to the 2070 population.

Therefore, the total collective dose from normal operations is approximately 5.5 person-rem. Additionally, the projected 50-mile population for year 2080 has been changed to year 2070 consistent with BBNPP ER Table 5.4-15 and 5.4-19.

The severe accident dose-risk in the same ER paragraph was also incorrectly taken from Section 7.2.3 of the CCNPP3 ER. This is corrected in the ER Impact portion of this response.

COLA Impact
ER Section 7.2.3 has been revised as follows and is included in Enclosure 1.

7.2.2.2 Surface Water Pathways

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 ~~1.03E-03~~ 9.98E-04 person-rem per year for the U.S. EPR. This value is the sum of all 23 release categories.

7.2.3 CONCLUSIONS

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 ~~0.23~~ 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 ~~1.83E-05 and 2.75E-04~~ 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.

The U.S. EPR dose-risk at the BBNPP site is less than the population risk for all 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.

The analysis indicates that risk from the water ingestion dose is small at ~~1.03E-03~~ 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.

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	~~7.6E-3~~ 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-4	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	~~5.1E-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	~~5.1E-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

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	Latent Cancers	Population Dose-Risk (person-rem)	Water Ingestion Dose-Risk (person-rem)	Cost (dollars)	Land Requiring Decontamination (acres)
RC101	~~3.39E-07~~ 3.43E-07	0.00E+00	~~4.27E-06~~ 4.36E-08	~~8.81E-03~~ 8.99E-03	~~9.39E-06~~ 9.50E-06	~~1.01E+00~~ 1.03E+00	~~1.56E-04~~ 1.58E-04
RC201	4.98E-10	~~8.42E-12~~ 8.67E-12	~~6.32E-07~~ 6.37E-07	~~1.39E-03~~ 1.40E-03	1.74E-05	~~1.79E+00~~ 1.78E+00	7.17E-05
RC202	~~4.00E-14~~ 3.97E-14	~~5.04E-17~~ 3.86E-17	4.84E-11	~~1.04E-07~~ 1.03E-07	~~2.55E-10~~ 2.53E-10	1.04E-04	~~6.84E-09~~ 6.75E-09
RC203	~~8.45E-13~~ 1.92E-12	~~1.71E-14~~ 3.19E-14	~~1.59E-09~~ 3.61E-09	~~3.24E-06~~ 7.35E-06	~~9.80E-09~~ 2.23E-08	~~3.47E-03~~ 7.89E-03	~~1.86E-07~~ 4.22E-07
RC204	~~2.41E-11~~ 2.78E-11	~~8.77E-14~~ 7.87E-14	~~3.18E-08~~ 3.67E-08	~~6.63E-05~~ 7.65E-05	~~1.61E-07~~ 1.85E-07	~~6.89E-02~~ 7.95E-02	~~4.31E-06~~ 4.98E-06
RC205	~~4.10E-10~~ 4.08E-10	~~2.81E-12~~ 3.61E-12	~~8.32E-07~~ 8.45E-07	~~1.64E-03~~ 1.67E-03	~~7.18E-06~~ 7.14E-06	~~1.95E+00~~ 1.94E+00	~~9.14E-05~~ 9.26E-05
RC206	~~1.64E-08~~ 1.65E-08	~~1.97E-09~~ 1.32E-09	~~1.30E-05~~ 1.31E-05	~~2.48E-02~~ 2.51E-02	~~9.18E-05~~ 9.24E-05	~~2.08E+01~~ 2.11E+01	1.50E-03
RC301	~~1.63E-12~~ 1.67E-12	~~2.05E-15~~ 1.62E-15	~~1.97E-09~~ 2.04E-09	~~4.24E-06~~ 4.34E-06	~~1.04E-08~~ 1.07E-08	~~4.25E-03~~ 4.36E-03	~~2.79E-07~~ 2.84E-07
RC302	~~1.51E-11~~ 2.18E-11	~~3.05E-13~~ 3.62E-13	~~2.84E-08~~ 4.10E-08	~~5.78E-05~~ 8.35E-05	~~1.75E-07~~ 2.53E-07	~~6.21E-02~~ 8.96E-02	~~3.32E-06~~ 4.80E-06
RC303	~~2.29E-09~~ 2.30E-09	~~8.34E-12~~ 6.51E-12	~~3.02E-06~~ 3.04E-06	~~6.30E-03~~ 6.33E-03	1.53E-05	~~6.55E+00~~ 6.58E+00	~~4.10E-04~~ 4.12E-04
RC304	~~1.76E-08~~ 1.75E-08	~~1.88E-10~~ 1.55E-10	~~3.63E-05~~ 3.62E-05	~~7.20E-02~~ 7.16E-02	~~3.08E-04~~ 3.06E-04	~~8.38E+01~~ 8.31E+01	~~4.01E-03~~ 3.97E-03
RC401	1.38E-11	0.00E+00	~~8.64E-09~~ 8.03E-09	~~1.88E-05~~ 1.74E-05	~~3.89E-08~~ 3.91E-08	~~1.22E-02~~ 1.25E-02	~~1.01E-06~~ 9.72E-07
RC402	2.75E-10	0.00E+00	3.05E-07	~~6.66E-04~~ 6.63E-04	1.87E-06	6.66E-01	~~4.48E-05~~ 4.46E-05
RC403	6.82E-10	0.00E+00	~~3.96E-07~~ 3.97E-07	8.59E-04	1.93E-06	~~6.16E-01~~ 6.20E-01	~~4.82E-05~~ 4.80E-05
RC404	~~1.35E-08~~ 1.34E-08	0.00E+00	~~1.50E-05~~ 1.49E-05	~~3.27E-02~~ 3.23E-02	~~9.18E-05~~ 9.11E-05	~~3.27E+01~~ 3.24E+01	~~2.20E-03~~ 2.17E-03
RC501	~~2.65E-13~~ 5.92E-13	0.00E+00	~~1.16E-09~~ 1.02E-10	~~2.27E-06~~ 2.24E-07	~~4.53E-11~~ 1.01E-10	~~1.97E-03~~ 3.10E-05	~~6.63E-08~~ 1.73E-08
RC502	~~1.11E-10~~ 2.87E-10	0.00E+00	~~4.62E-07~~ 4.94E-08	~~9.15E-04~~ 1.08E-04	~~1.90E-08~~ 4.91E-08	~~8.15E-01~~ 1.50E-02	~~2.74E-05~~ 8.38E-06
RC503	~~3.65E-10~~ 6.01E-10	0.00E+00	~~1.07E-08~~ 1.85E-08	~~2.39E-05~~ 4.12E-05	~~1.24E-08~~ 2.05E-08	~~7.63E-04~~ 1.34E-03	~~5.44E-07~~ 1.05E-06
RC504	1.19E-07	0.00E+00	~~3.49E-06~~ 3.67E-06	~~7.79E-03~~ 8.15E-03	4.06E-06	~~2.49E-01~~ 2.65E-01	~~1.77E-04~~ 2.07E-04
RC602	~~3.61E-10~~ 6.50E-10	0.00E+00	~~1.50E-06~~ 1.12E-07	~~2.97E-03~~ 2.46E-04	~~6.17E-08~~ 1.11E-07	~~2.65E+00~~ 3.40E-02	~~8.92E-05~~ 1.90E-05
RC701	1.02E-08	~~1.35E-13~~ 1.18E-13	~~8.00E-06~~ 8.06E-06	1.55E-02	3.07E-05	~~1.21E+01~~ 1.22E+01	~~8.62E-04~~ 8.57E-04
RC702	~~5.37E-09~~ 5.38E-09	~~2.25E-09~~ 1.85E-09	~~3.47E-05~~ 3.54E-05	~~4.10E-02~~ 4.14E-02	3.21E-04	~~3.50E+01~~ 3.49E+01	1.32E-03
RC802	2.64E-10	~~1.29E-09~~ 1.22E-09	~~8.53E-06~~ 8.58E-06	7.66E-03	~~1.34E-04~~ 9.87E-05	~~2.72E+00~~ 2.67E+00	~~4.49E-05~~ 5.97E-05
Total	~~5.26E-07~~ 5.31E-07	~~5.72E-09~~ 4.56E-09	1.30E-04	~~2.25E-01~~ 2.22E-01	~~1.03E-03~~ 9.98E-04	~~2.04E+02~~ 2.00E+02	~~1.11E-02~~ 1.10E-02

Enclosure 3

Response to RAI 5021

RAI No. 5021 EIS 5.11-7

Summary: *The response to request for additional information (RAI) ACC 7.2-2 provides estimates of individual early fatality and latent cancer risk for severe accidents at the Bell Bend Nuclear Power Plant (BBNPP) site. Clarify the units used for both risk estimates. Discuss the estimates in context of providing specific comparisons with the U.S. Nuclear Regulatory Commission (NRC) safety goals for average individual early fatality and latent cancer fatality risks from reactor accidents as set forth in the Safety Goal Policy Statement 51 Federal Register (FR) 30028.*

Full Text (Supporting Information): ESRP 7.2 provides for the staff to evaluate the average individual risk of an early fatality 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 (see Commission's 1986 Policy Statement, 51 FR 30028) for inclusion in the Environmental Impact Statement (EIS). NRC reviewed the initial response to RAI ACC 7.2-2 and determined that PPL has not clearly presented comparisons of estimates of average individual early fatality and latent cancer fatality risks to the Commission's Safety Goal Policy Statement (51 FR 30028). Specifically, PPL does not present units for risk results. Additionally, the apparent average individual latent fatality risk result of 7.36E-6 (units not given) appears to be greater than the Commission's quantitative health objective for cancer fatality risk of 2.0 E-6 per year. Therefore, present clear comparisons of the BBNPP risk estimates (including providing proper units) to the Commission's safety goals.

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:

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

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 RC i (Level 2 PRA), and
Estimated $AIREF_i$ *(one mile)* is the average individual risk of early fatalities for *RC i* within one mile (from MACCS2)

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

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 $AIRLC_i$ *(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	1.12E-11	5.0E-07
Latent Cancer Fatalities within 10 miles / person-year	9.23E-11	9.23E-11	2.0E-06

Values previously reported in the response to RAI ACC 7.2-2 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 ER will not be changed as a result of this question.