

**CALCULATION SUMMARY SHEET (CSS)**

Document No. 126 - 9070954 - 006

Safety Related: ☐ Yes ☒ No

Title Agricultural Production and Radiological Exposure Pathway Data for Bell Bend Nuclear Power Plant 1

**PURPOSE AND SUMMARY OF RESULTS:**

This calculation provides agricultural production and radiological exposure pathway data to support the preparation of ER Section 3.5, Cost Benefit Analysis, ER Section 5.4, Radiological Impacts of Normal Operation. The calculation describes the approach and process used to acquire the needed technical input as well as summarizes the results.

**Rev. 3**

No changes were made to the agricultural data as a result of the Power Block Relocation. The justification for this is found in Section 2.0.

**Rev. 4**

Rev. 4 was created, as stated above, to address changes due to the Power Block Relocation. Following the completion and release of Rev. 3, and during the revising of the individual gaseous dose calculation, 32-9077003-001 [Reference 107] for both the Power Block Relocation and Cut-and-Fill projects, changes were made in the land use census receptor locations found in Tables 1 and 2 of this calculation (consolidated into the new Table 1). This Rev. 4 addresses those changes.

**Rev. 5**

Rev. 5 was created, to correct the error in the total number persons per boat (i.e., change "2.3" to "3.3") per CR 2012- 2738.

**Rev. 6**

Rev. 6 was created solely for the purpose of removing the "proprietary" wording from the document.

Note: The technical objective of Figures A-1 and A-2 is to show the county lines and how they cross the 16 compass sector lines and the concentric distance circles. The technical objective of Figure A-4 is to show the dose receptor locations in relation to the Reactor Building (at the origin point of the sector lines). Any illegible text on these figures is not pertinent to the technical objective of the figures.

THE FOLLOWING COMPUTER CODES HAVE BEEN USED IN THIS DOCUMENT:

CODE/VERSION/REV

CODE/VERSION/REV

THE DOCUMENT CONTAINS  
ASSUMPTIONS THAT SHALL BE  
VERIFIED PRIOR TO USE☐ **YES**☒ **NO**




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Agricultural Production and Radiological Exposure Pathway Data for Bell Bend Nuclear Power Plant 1

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Review Method: ☒ Design Review (Detailed Check)  
☐ Alternate Calculation

**Signature Block**

Name and Title (printed or typed)	Signature	P/R/A and LP/LR	Date	Pages/Sections Prepared/Reviewed/Approved
Ted Messier Principal Scientist	TA MESSIER 6/4/2013	LP		All changes in current revision
Edward Cumming Advisory Scientist	ER CUMMING 6/4/2013	LR		All changes in current revision
Mark Rinckel Technical Manager	MA RINCKEL 6/5/2013	A		Reviewer is independent

**Note:** P/R/A designates Preparer (P), Reviewer (R), Approver (A);  
LP/LR designates Lead Preparer (LP), Lead Reviewer (LR)

**Project Manager Approval of Customer References (N/A if not applicable)**

Name (printed or typed)	Title (printed or typed)	Signature	Date
N/A			

**Mentoring Information (not required per 0402-01)**

Name (printed or typed)	Title (printed or typed)	Mentor to: (P/R)	Signature	Date
N/A				
N/A				



## Agricultural Production and Radiological Exposure Pathway Data for Bell Bend Nuclear Power Plant 1

**Record of Revision**

<b>Revision No.</b>	<b>Pages/Sections/Paragraphs Changed</b>	<b>Brief Description / Change Authorization</b>
000	N/A	Initial Release
001	Complete re-issue	<p>Some agricultural data was corrected, resulting in changes to Table 3, Table 4, Table 9, Table 10, Table 11, Table 12, Table 13, Table 14, Table 21, Table 22, Table 23, Table 24, Table 25, Table 26, Table 27, Table 28, Table 29, Table 30, Table A 1, Table A 3, Table A 4, Table A 7, Table A 10, Table A 11, Table A 17, Table A 19, Table A 21, Table A 22, Table A 24, Table A 25, Table A 26, Table A 27, Table A 29, Table A 30.</p> <p>New data was added for PRA input, resulting in new sections 5.6, as well as new Table 38 through Table 46, and additions to sections A.3, A.7, A.8, A.9, A.10, A.11, and A.12.</p>
002	Complete re-issue	<p>Adjusted meat data to reflect dressed weight rather than live weight. Changes to Table 8, Table 9, Table 10, Table 11, Table 12, Table 13, Table 14, Table 15, Table A-1, Table A-11.</p> <p>Table A-1 and A-2 Updated with information from Reference [102]</p> <p>Removed Site Boundary distances</p> <p>Closed the open items, 1 and 2. Information was added to Table 1 and verified input parameter centerline of containment.</p>
003	Cover page	Description and illegibility statement added for Rev. 3.
	Sect. 2.0	Rationale provided for not re-calculating agricultural production rates.
	Sect. 5.1	Added a discussion on the new Tables 1 and 2.
	Sect. 6.0	Reference 102 was changed to the RFI that contains the new BBNPP Site Utilization Plot Plan.
	Sect. 8.0	This section (Open Items) was deleted, as all open items had been closed in the previous revision of this calculation, and no new open items were identified.
	Tables 1 to 46	Inserted a new Table 1, which shows the original Land Use Census REMP locations from Reference 101, along with their new distance and sector values following the Power Block relocation. The original Tables 1 to 45 were re-numbered to Tables 2 to 46.
	Sect. A.2	The new containment centerline coordinates were added, along with the distance between the old and new containment locations, and a statement regarding the assumption of the previous coordinates was deleted.



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### Record of Revision (continued)

Revision No.	Pages/Sections/Paragraphs Changed	Brief Description / Change Authorization
	Figure A-1 & A-2	The DeLorme maps were replaced with equivalent GIS maps, using the new containment coordinates.
	Figure A-4	Added this figure, produced by GIS, to show new sector locations of Land Use Survey REMP locations.
	Misc.	Corrected a few minor typographical errors.
004	Throughout	Minor editorial changes
	CSS	In the original statement of purpose for Rev. 2, corrected "Rev. 2" to "Rev. 3".
	CSS	Added a sentence describing the purpose of this revision.
	Section 5.1	Modified the description of the receptor/census locations and their source.
	Table 1 and Table 2	Both tables were replaced with a new Table 1, showing new census locations from Reference [107] (i.e., Table 2 has been effectively deleted). All succeeding tables have been renumbered.
	Section 6	Added reference 107.  Added "access dates" to all web page documents. These references had been added in a previous revision of this document, but did not have "access dates." To make compliant with AREVA procedure 0402-01 (Rev. 040), "access dates" were added to each web page reference, based where possible on the visible access date on the captured image in the 38 document, and otherwise based on the release date of the respective 38 document.
	Figure A-4	The figure has been replaced with one showing the new receptor locations from Table 1.
005	CSS, TOC	A statement was added and summary of Revision 005 was added.
	Section 1.1	Number of persons per boat was corrected per CR 2012-2738. This was done to support resolution of RAI 101. The total number of recreational boating hours calculated in Table A-40 is input to LADTAP-II used to calculate the population and Maximum Exposed Individual (MEI) due to recreational boating.
	Section 5.3	Section 5.3 updated per Section A.15 for the person-hours per year spent boating.
	Appendix A.15	Appendix A.15 corrected to change average number persons per boat from "2.3" to "3.3 (1 driver + 2.3 passengers)".



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**Record of Revision**  
(continued)

<b>Revision No.</b>	<b>Pages/Sections/Paragraphs Changed</b>	<b>Brief Description / Change Authorization</b>
	Table A-40	Table A-40, updated to correct persons per boat from "2.3" to "3.3", person-hours per day, and the person-hours per year spent boating entries were updated accordingly. A footnote was added to the table to clarify how the person-hours per year column were calculated.
	Section 6.0	Reference 107 revision number increased from "001" to "002". Revision 002 of Reference [107] does not affect the results of this analysis.
006	All	This revision consisted only of the removal of the "Proprietary" statement from page 1, the removal of the word "Proprietary" from all other pages, and the change to the latest revision of the 0402-01 template.




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## 1.0 INTRODUCTION

### 1.1 Purpose

Provide the technical input necessary to support detailed analyses associated with the Combined License (COL) application Environmental Report (ER) for the proposed EPR Bell Bend Nuclear Power Plant 1, located near Berwick, Pennsylvania.

#### Revision 005

The number of persons per boat was corrected per CR 2012-2738. This was done to support resolution of RAI 101. The affected sections in this calculation (Section 5.3 and Appendix A.15) were updated accordingly.

### 1.2 Background

This calculation specifically addresses the technical input needed to support the preparation of ER Section 3.5, Cost Benefit Analysis, and ER Section 5.4, Radiological Impacts of Normal Operation. The calculation describes the approach and process used to acquire the needed technical input as well as summarizes the results.

This calculation is non-safety related and has been prepared using the applicable procedures to comply with the AREVA NP Quality Management Document 56-5015885-07, relating to non-safety work.

### 1.3 Open Items

There may be cases when necessary technical input data is unavailable at the time that this calculation is released. If this happens a Product Upgrade List (PUL) is prepared as directed by AREVA NP Procedure 0412-66 to indicate the changes or additions required at the time the calculation is released.

The “open items” are identified by the words “Open Item,” followed by the number symbol and a reference number, all enclosed in brackets and in bold type, e.g., **{Open Item #1}**. When the required information becomes available the calculation will be revised and the PUL will be closed.



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### 2.0 ANALYTICAL METHODOLOGY

The calculation used a three-step approach to acquire the technical input needed to support the preparation of the associated sections of the ER. First, data and information needs were identified by reviewing the relevant sections of the following regulatory guidance documents:

- NUREG-1555, “Standard Review Plans for Environmental Reviews for Nuclear Power Plants” (Reference 1).
- Regulatory Guide 4.2, “Preparation of Environmental Reports for Nuclear Power Plants” (Reference 2).
- Regulatory Guide 1.109, “Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I” (Reference 3)

Second, the identified technical data needed were gathered from both internal and public sources. Internal sources included documents such as site-related Nine Mile Point documents submitted to the U.S. Nuclear Regulatory Commission (NRC), NRC Regulatory guides, and the Internet. Any document down-loaded from the Internet is saved in and is available through AREVA Records Management (Documentum).

Third, the technical data gathered were summarized in tabular format in accordance with Regulatory Guide 4.2 (Reference 2).

The center of the containment building is the focal point of the compass sector/distance grid that is used in determining agricultural production rates (and animal densities) within a 50-mile distance of the plant. This grid is made up of 16 compass sector lines and 10 concentric circles (at 1, 2, 3, 4, 5, 10, 20, 30, 40, and 50 miles), which delineate 160 “segments” within a distance of 50 miles of the plant. This grid is overlaid on a map showing county border lines (see Figure A-1). Each map segment was examined to identify the counties that lie within the segment borders. For all of the county-specific agricultural production rates represented in a given map segment, the maximum rate was assigned to that segment.

Evaluation of the Need for Recalculation of Agricultural Data: As part of the Power Block relocation, the center of the containment building will be moved 972 feet to the north and 300 feet west of its previous location (Reference 102). Consideration was given to the need for the revision of segment-specific agricultural production rates due to the shift of the compass sector/distance grid relative to county boundary lines. It was determined that a recalculation of segment-specific agricultural production rates would not be warranted, for the following reasons:

- No change in counties within a segment: For a map segment that has the same county(ies) represented following the shift of the sector/distance grid, no change would be made in the agricultural production rates assigned to that segment. This is because the maximum rate for each agricultural product, for all the represented counties in that segment, is assigned, regardless of the relative areas represented in the segment by the counties. The assigned rate would therefore remain conservative.
- A county drops out of a segment: For a map segment that has a county drop outside of its boundaries following the shift of the sector/distance grid, the currently assigned agricultural production rate for the segment would stay the same. In the event that the dropped county did not have the maximum production rate for a given agricultural product, the level of conservatism for the segment would remain the same. On the other hand, if the sector that dropped out had the maximum production rate for a given agricultural product, for all the counties represented in that segment, the resulting analysis would be even more



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conservative, since that county's maximum rate would still be assigned to the segment even though that county was no longer represented in the segment.

- A new county falls within a segment: For a map segment that has a new county shift into its borders following the shift of the sector distance grid, the new county would only occupy a very small fraction of that segment. If the new county had an equivalent or lower production rate than the counties currently represented in that segment, there would be no change, and the production rate would remain conservative. In the event that the new county had a higher production rate than the counties currently represented in that segment, not using that production rate would have a negligible impact on the level of conservatism in the overall analysis because of the very small fraction of the county that would be represented in that segment, particularly in light of the conservatisms already introduced through the use of the maximum production rates for the other segments of the grid.
- A new county falls into the 50-mile grid: A close examination of the 50-mile concentric circle on Figure A-1 shows that the shift of the circle approximately 1000 feet north would not result in the introduction of any counties that have not already been included in the analysis. Hence, there is no risk that a new county with a higher agricultural production rate would be introduced into the analysis by this grid shift.



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### **3.0 ASSUMPTIONS**

Specific assumptions within a data category are presented and discussed in the relevant subsections of Section 5.0, related tables, and Appendix A.





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### **4.0 CALCULATIONS**

Data collected, in many cases, required unit conversions (e.g., English to SI), or other manipulations to obtain the desired results. The details are shown in Appendix A.



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## **5.0 RESULTS, SUMMARY/CONCLUSION**

### **5.1 Agricultural Data**

From Regulatory Guide 4.2, Section 2.1.3 (Reference 2), “Uses of Adjacent Lands and Waters”, adjacent land use data for the nearest milk, vegetable garden, and residence location are required in tabular form for each of 16 sectors to a distance of 5 miles from the proposed site. Table 1 lists the locations as determined in Reference 107. The locations are shown graphically in Figure A-4.

Also, from Regulatory Guide 4.2, Section 2.1.3 (Reference 2), the other data needs are as follows:

Provide data on annual meat, milk, (cow and goat), and truck farm production within a 50 mile radius from the proposed site. Provide the data by sector in the same manner as indicated in Sections 2.1.2.1 and 2.1.2.2 of Regulatory Guide 4.2. Furnish information type, quantity, and yield of crops grown with a 50 mile radius from the proposed site. Provide information on the grazing season (dates), feeding regimes for cattle (such as grazing practices, green chop feeding, corn and grass silage feeding, and hay feeding), pasture grass density and yield for harvested forage crops for beef and dairy cattle feeding within the 50 mile radius of the proposed site.

Table 2 through Table 29 summarizes the annual meat, milk (cow and goat), and truck farm production and the distribution by sector within 50 miles of the proposed site. The principal data source is statistics from the United States Department of Agriculture. See Appendix A for details on how the data was developed.

### **5.2 Fisheries Data**

From Regulatory Guide 4.2, Section 2.1.3 (Reference 2), “Uses of Adjacent Lands and Waters,” the past, present, and projected commercial fish and shellfish catch (according to the National Marine Fisheries Service (NMFS) standard reporting units) from contiguous waters within 50 miles of the station discharge are required. The amounts used as human food is also required. There was no commercial fishing or shell fishing within 50 miles downstream of the Bell Bend discharge based on a search of NOAA fishery landings data (Reference 71, 72). Therefore, there are no commercial fishing ports within 50 miles of the discharge.

Regulatory Guide 4.2, Section 2.1.3 requires the location of principal fishing areas and ports of landing associated with these contiguous waters. The Susquehanna River system includes the Susquehanna River North Branch and West Branch, the Juniata River and the main stem Susquehanna River. The Susquehanna River is recognized as one of the premier fresh water fishing destinations on the East coast (Reference 73). As a general observation, however, Pennsylvania Fish and Boat Commission (PFBC) monitoring has shown that since 2000, production of Young of the Year (YOY) smallmouth bass has been near or below the long term average within the drainage. The main stem, extending from Sunbury to the Maryland state line, has exhibited densities which have been below average. This section of the river has been a recent focus of Fish and Boat Commission attention as a result (Reference 74) and was the subject of a major creel census in 2007.

Regulatory Guide 4.2, Section 2.1.3 requires a determination and tabulation of the present and projected recreational fish and shellfish harvest from these waters. The present and projected recreational fish harvest is summarized in Table 30 by principal species and total weight. The total amount of fish that could be used as human food is also listed. Conservative assumptions were made regarding the fish harvest and the number of fishing trips made each year on the Susquehanna River within 50 miles downstream of the discharge. Catch and release fishing has become the norm in Pennsylvania (Reference 75) so the harvest estimate is probably high. Because the status of the Susquehanna River fishery is being studied, the best estimate of the projected recreational harvest is to use the present harvest. Details of the calculation and data sources are contained in



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Appendix A.14. There is no documented recreational shellfish harvest or harvest and use of seaweed, other aquatic life, or any vegetation used as human food from these waters within 50 miles of the station discharge.

Regulatory Guide 4.2, Section 2.1.3 requires a determination of the closest location to the point of discharge that is publicly accessible (from land and from water) and influenced by the discharge flow. A qualitative estimate of the fishing success that a fisherman could have at this location is also required. The river can be accessed from both banks downstream of the discharge. Fishing in the river is generally acknowledged as good (Reference 73).

Regulatory Guide 4.2, Section 2.1.3 requires the identification of any fish farms or similar aquatic activity within the 50-mile area utilizing water that reasonably may be affected by the power station discharge. The species and production from each of these facilities and the amounts consumed locally are also required. No aquaculture facilities have been identified on the Susquehanna River within 50 miles downstream of the discharge. There are no state fish hatcheries on the Susquehanna River within 50 miles downstream of the discharge (Reference 76).

### **5.3 Recreational Data**

A survey of Pennsylvania state parks did not reveal any swimming along the main stem of the Susquehanna River within 50-miles downstream of the discharge (Reference 85, 86).

The Shikellamy State Park in Union and Northumberland Counties provides seasonal recreational boating in Lake Augusta. The 3,060 acre Lake is formed seasonally by the world's largest inflatable dam (Reference 87). It is estimated that 564,660 person hours per year are spent on the water in boating related activities. Details of the estimate are contained in Appendix A.15.

### **5.4 Drinking Water and Irrigation Data**

Regulatory Guide 4.2 requires information on a monthly basis regarding the identity, location, nature, and amounts of present and projected surface water use (e.g., water supplies, irrigation) within 50 miles of the station where the water supplies may be contaminated by station effluents and the present and projected population associated with each use point, where appropriate.

The Susquehanna River is not a source for drinking water in Luzerne and Columbia Counties but becomes a source for residents downstream of Danville Borough, Montour County, PA (Reference 88). There are domestic water supplies approximately 30 miles downstream, at Danville, Montour County and approximately 40 miles downstream at Sunbury, Northumberland County (Reference 88). A summary of the community water supplies within 50-miles downstream of the discharge that use the Susquehanna River as a source appears in Table 31. Pumping capacity and source safe yield are included.

The USGS has gauging stations on the Susquehanna River upstream of the site at Wilkes-Barre; downstream of the site in Danville and Sunbury (near the locations of the water withdrawals); and on the West Branch of the Susquehanna at Lewisburg (References 97, 98, 99, and 100). Sunbury is downstream of the confluence of the Susquehanna and the West Branch and the discharge reflects the combined discharge of the two rivers. The monthly mean discharges at these four locations are shown in Table 32 through Table 35 for the ten year period from 1996 to 2005.

The 2002 USDA Census of Agriculture contains data by state and county on the number of farms irrigating crops and the number of acres under irrigation (Reference 6). The Susquehanna River flows 50-miles down stream of the discharge through Luzerne, Columbia, Montour, North Umberland and Snyder Counties. If all the irrigation water used in these Counties came from the River, the irrigation water use could amount to 12.60 million gallons



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per day (47.7 million liters per day). If irrigation use had the same average as other consumptive uses in the Susquehanna River Basin, irrigation use could peak at 23.05 million gallons per day (87.26 million liters per day). Monthly and seasonal use is dependant on climatic conditions and the amount of natural precipitation. Details of the calculation are contained in Appendix A.16.

### **5.5 Site Specific Data**

R.G. 1.109 requires site-specific data as input to radiological computer models related to vegetables and animal feed crops during the growing season. Table 36 lists the input requirements, the site specific values and the default values that have been used from R.G. 1.109 in the absence of site specific values.

### **5.6 Probabilistic Risk Assessment Input**

The level 3 PRA input requires several types of data. Only the farm and crop data are provided here. A summary is shown in Table 37, which shows the average area fraction over the 50 mile radius of the various crop types. The fraction crop land devoted to each crop type is shown in Table 38 through Table 45. The crop fractions are provided for the same crop categories as the rest of this calculation: grain, feed, leafy vegetables, other above ground vegetables, below ground vegetables, orchard fruit, and berries. There is one exception to this: the area fraction of soybeans was taken out of the grain area fraction and reported separately. The calculation of this data is shown in the various appropriate sections in Appendix A.



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## **7.0 COMPUTER OUTPUT**

The spreadsheet with the agricultural data is saved on the COLD server as:

126-9070954-000.mht, 2/27/2008 (Revision 000)

126-9070954-001.mht, 4/08/2008 (Revision 001)

126-9070954-002.mht, 7/1/2008 (Revision 002)

Note that these files must be opened from within Excel.