



CALCULATION SUMMARY SHEET (CSS)

Document No. 32 - 9080953 - 004

Safety Related: ☐ Yes ☒ No

Title Technical Input for COLA ER Section 5.4.4 for BBNPP (Dose to Biota)

PURPOSE AND SUMMARY OF RESULTS:

Purpose:

The purpose of this calculation is to determine the dose to biota other than members of the public, as a result of normal operations on the site of Bell Bend Nuclear Power Plant (BBNPP). This is in support of the preparation of Section 5.4.4 of the Environmental Report and the Combined Operating License (COL) application.

Revision 003 was created to address the revised liquid source term release rates, calculated using GALE in Reference [5] and gaseous source term release rates, calculated using GASPARD in Reference [2].

Revision 004 was created solely for the purpose of removing the "proprietary" wording from the document.

Summary of Results:

The doses to biota are contained in the following table. None of the doses exceeds the human total body limit found in 40 CFR 190.

Dilution Factor	Biota	Liquid Effluents (mrad/yr)			Gaseous Effluents (mrad/yr)			Fixed Sources (mrad/yr)	Total (mrad/yr)
		Internal	External	Total	Plume	Ground	Inhalation		
Low	Fish	1.09E-01	7.85E-02	1.88E-01	n/a	n/a	n/a	n/a	1.88E-01
	Invertebrate	5.00E-01	1.55E-01	6.55E-01	n/a	n/a	n/a	n/a	6.55E-01
	Algae	2.13E+00	1.77E-03	2.13E+00	n/a	n/a	n/a	n/a	2.13E+00
	Muskrat	5.59E-01	5.18E-02	6.11E-01	1.26E+00	3.52E-03	7.29E-03	1.87E+00	3.75E+00
	Duck	5.15E-01	7.72E-02	5.92E-01	1.26E+00	3.52E-03	7.29E-03	1.87E+00	3.73E+00
High	Raccoon	1.25E-01	3.07E-02	1.56E-01	1.26E+00	3.52E-03	7.29E-03	1.87E+00	3.30E+00
	Heron	1.61E+00	4.11E-02	1.65E+00	1.26E+00	3.52E-03	7.29E-03	1.87E+00	4.79E+00

THE FOLLOWING COMPUTER CODES HAVE BEEN USED IN THIS DOCUMENT:

CODE/VERSION/REV

CODE/VERSION/REV

LADTAP 2, Ver 01, Mod 00

THE DOCUMENT CONTAINS
ASSUMPTIONS THAT SHALL BE
VERIFIED PRIOR TO USE

☐ YES

☒ NO



Technical Input for COLA ER Section 5.4.4 for BBNPP (Dose to Biota)

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				

Technical Input for COLA ER Section 5.4.4 for BBNPP (Dose to Biota)

Record of Revision

Revision No.	Pages/Sections/Paragraphs Changed	Brief Description / Change Authorization
000	All	Initial Release
001	Section 3.4	Updated dilution values to annual average.
001	Section 5.0, Section 6.0	Removed unnecessary units conversion rem to R.
001	Section 7.0	Updated Reference [5], no impact on calculation.
001	Appendix A, Section 6.0	Corrected input variable. Flow changed 13.8 to 19.1 cfs.
002	Throughout	Minor edits
002	Throughout	Migrated the document to the current 0402-01-F01 template.
002	Throughout	Changed the page numbering format in the appendix by removing the "A" and having consecutive numbering throughout the report.
002	Calculation Summary Sheet	<ul style="list-style-type: none"> Added a sentence describing the purpose of Rev. 002. Added a statement regarding how this calculation addresses part of WebCAP CR 2010-7519. Updated the "Summary of Results" table. Deleted the "NOTE" following the Summary of Results table (which stated that the doses in this revision are bounded by those in Rev. 000), as it is not needed. Changed the "Code/Version" entry to reflect the EASI wording. For the checkbox under "The document contains assumptions that shall be verified prior to use," unchecked the "Yes" box and checked the "No" box.
002	Sect. 2.2	Inserted the words "far-field" to more accurately describe the conservatism of the assumption.
002	Sect. 2.2, 3.2	Added words to more completely describe the assumptions built into the gaseous effluent doses. Also changed the term "site boundary" to "Owner-Controlled Area boundary."
002	Table 3-2	Updated the dose results, based on Reference [4].
002	Sect. 3.3	<ul style="list-style-type: none"> Updated the direct dose value, based on Reference [6]. Added a parenthetical statement explaining how the "mrem/year" value was derived from the Reference [6] "mrem/hour" value. Changed the term "site boundary" to "Owner-Controlled Area boundary."

Technical Input for COLA ER Section 5.4.4 for BBNPP (Dose to Biota)

Record of Revision (continued)

Revision No.	Pages/Sections/Paragraphs Changed	Brief Description / Change Authorization
002	Table 3-3	<ul style="list-style-type: none"> Updated the “Case Title” in Record Type 1. Updated the Liquid Effluent Discharge Rate in Record Type 2 [8], and deleted the “assuming 3 cycles of con.” statement on the same line. Changed the “Print Control...” value in Record Type 2 to reflect the value actually used in this and the previous calculation revision. Deleted Record Type 3a, as it was not used. Changed the “Source Title” in Record Type 4. For Record Type 19, “Biota Exposure Location Data – Dilution (Low),” moved the parenthetical words from the Reference column to the Value column. Deleted the “Max Shoreline.” For Record Type 19, “Biota Exposure Location Data – Dilution (High),” moved the parenthetical words from the Reference column to the Value column.
002	Table 3-4	Added “Black Dash” to the table, based on Reference [10].
002	Sect. 4.0	<p>Additional detail was added regarding the migration of LADTAP II to EASI, the lack of reported software errors for LADTAP II, and the identification of the computer platform used for running LADTAP II.</p> <p>The statement on running verification test cases was deleted, as the statement is not needed here.</p> <p>A description of the files loaded to ColdStor, and their ColdStor path, were added.</p>
002	Sect. 5.0	In the fourth paragraph, edited the words to reflect the dilution values and assumptions actually used (correctly) in the calculation.
002	Table 5-1	Updated the dose values.
002	Table 6-1	Updated the dose values.
002	Sect. 7.0	Changed Reference [8] to the up-to-date reference for the liquid effluent discharge rate.
002	Sect. 7.0	Added References [1] (BBNPP Power Block Relocation DCR). Updated revision numbers for AREVA documents in References [4], [6], and [7] (new reference numbers).
002	Appendix A.1	Replaced the LADTAP II input file with the file used for this revision.

Technical Input for COLA ER Section 5.4.4 for BBNPP (Dose to Biota)

Record of Revision (continued)

Revision No.	Pages/Sections/Paragraphs Changed	Brief Description / Change Authorization
002	Appendix A.2	Replaced the LADTAP II output file with the file created for this revision.
003	Cover pages	All calculation cover pages up-dated.
003	Section 2.2	Specified near field and far field biotas.
003	Section 3.2	Replaced "OCA boundary" with "maximum dose location".
003	Table 3-1	Revised source term from Reference [5].
003	Table 3-2	Revised source term from Reference [2].
003	Table 3-3	Added footnote to clarify "not used" values in input deck as informational and made editorial changes.
003	Section 4.1	Added LADTAP documentation.
003	Tables 4-1	Updated the COLD listing.
003	Section 5.0	Specified near field and far field biotas.
003	Table 5-1	Updated results.
003	Table 6-1	Updated dose values.
003	Section 7.0	Update associated References 1, 2, and 5. Added reference 9 (32-9062452-000).
003	Appendix A.1	Replaced the LADTAP II input file with the file used for this revision.
003	Appendix A.2	Replaced the LADTAP II output file with the file used for this revision.
004	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.

 Technical Input for COLA ER Section 5.4.4 for BBNPP (Dose to Biota)

Table of Contents

	Page
SIGNATURE BLOCK.....	2
RECORD OF REVISION	3
LIST OF TABLES	7
LIST OF FIGURES	8
1.0 ANALYTICAL METHODOLOGY.....	9
1.1 Dose Determination.....	9
2.0 ASSUMPTIONS	10
2.1 Unverified Assumptions.....	10
2.2 Justified Assumptions.....	10
2.3 Modeling Simplifications.....	10
3.0 CALCULATION INPUTS	11
3.1 Liquid Source Term.....	11
3.2 Gaseous Doses.....	12
3.3 Fixed Sources of Direct Radiation.....	12
3.4 LADTAP II Input Variables	12
3.5 Important Species	14
4.0 COMPUTER USAGE	15
4.1 Software	15
4.2 Computer Files	15
5.0 CALCULATIONS.....	16
6.0 RESULTS.....	17
7.0 REFERENCES.....	18
APPENDIX A : LADTAP II FILES.....	19

Technical Input for COLA ER Section 5.4.4 for BBNPP (Dose to Biota)

List of Tables

	Page
Table 1-1: Biota Exposure Pathways	9
Table 3-1: GALE Liquid Release Rate	11
Table 3-2: Dose Due to Gaseous Releases to Man	12
Table 3-3: Input Data for LADTAP II Dose Assessment for Biota	12
Table 3-4: Important Species in the Area of BBNPP	14
Table 4-1: ColdStor Files	15
Table 5-1: Dose to Biota from Gaseous Effluents	16
Table 6-1: Dose Assessment for Biota	17

Technical Input for COLA ER Section 5.4.4 for BBNPP (Dose to Biota)

List of Figures

Page

None

Technical Input for COLA ER Section 5.4.4 for BBNPP (Dose to Biota)

1.0 ANALYTICAL METHODOLOGY

1.1 Dose Determination

The dose to biota is calculated with the LADTAP II computer program (Reference [1]). LADTAP II performs environmental dose analysis for releases of radioactive effluents from nuclear power plants into surface waters. The analysis estimates radiation dose to individuals, population groups, and biota from ingestion (aquatic foods, water, and terrestrial irrigated foods) and external exposure (shoreline, swimming, and boating) pathways.

For biota, the dose is calculated by the “CRITTR” routine in LADTAP II for a few representative species as shown in Table 1-1. LADTAP II only calculates the dose from the aquatic pathways. The dose from atmospheric pathways was calculated with GASPAR II in Reference [2].

Table 1-1: Biota Exposure Pathways

Biota Type	Aquatic Pathways	Atmospheric Pathways	Fixed Source Direct Radiation
Fish	Internal exposure from bioaccumulation of radionuclides External exposure from swimming and the shoreline	NA	NA
Invertebrates	Internal exposure from bioaccumulation of radionuclides External exposure from swimming and the shoreline	NA	NA
Algae	Internal exposure from bioaccumulation of radionuclides External exposure from swimming and the shoreline	NA	NA
Muskrat	Internal exposure from ingestion of aquatic plants External exposure from swimming and the shoreline	External gaseous plume immersion External exposure to ground plane deposition Gaseous effluent inhalation	External exposure to fixed sources of radiation
Raccoon	Internal exposure from ingestion of invertebrates External exposure from swimming and the shoreline	External gaseous plume immersion External exposure to ground plane deposition Gaseous effluent inhalation	External exposure to fixed sources of radiation
Heron	Internal exposure from ingestion of fish External exposure from swimming and the shoreline	External gaseous plume immersion External exposure to ground plane deposition Gaseous effluent inhalation	External exposure to fixed sources of radiation
Duck	Internal exposure from ingestion of aquatic plants External exposure from swimming and the shoreline	External gaseous plume immersion External exposure to ground plane deposition Gaseous effluent inhalation	External exposure to fixed sources of radiation

Technical Input for COLA ER Section 5.4.4 for BBNPP (Dose to Biota)

2.0 ASSUMPTIONS

2.1 Unverified Assumptions

No assumptions requiring verification were used.

2.2 Justified Assumptions

The transit times for effluents to the receptor were assumed to be zero. This is conservative as it does not account for radioactive decay between the source and the receptor.

The low dilution factor, given as the dilution 50 feet from the effluent release point (Reference [3]), was assigned to biota with a habitat that could have been at or near the release point. These near field aquatic biota are fish, invertebrate, and algae; and biota that may swim into the near field are muskrat, duck.

The high dilution factor, given as the fully mixed value (Reference [3]), was assigned to biota with a normal habitat not near the effluent release point. These far field biota that inhabit the shoreline are raccoon and heron.

Man is defined as a human of any age; infant, child, teen, or adult. For Table 3-2, the dose to man is the maximum of any age category.

The dose to biota from gaseous effluents by the ground plane is assumed to be two times that for man. This accounts for the closer proximity of the biota to the ground.

The location used to calculate the gaseous doses was the Owner-Controlled Area (OCA) boundary. This is conservative as the construction on the site of BBNPP will encourage the relocation of many of the indigenous biota to well outside the OCA boundary.

The location used to calculate the far-field shoreline dose was the maximally impacted shoreline (Reference [3]). This is a conservative assumption as most of the shoreline will in fact have a much higher dilution.

The dose rate due to fixed sources of radiation was assumed to be the value given as a bounding value in the direct dose calculation for BBNPP (Reference [4]). This is conservative as in reality the dose rate at any other position is much lower than the bounding value.

2.3 Modeling Simplifications

No modeling simplifications were used.

 Technical Input for COLA ER Section 5.4.4 for BBNPP (Dose to Biota)

3.0 CALCULATION INPUTS

3.1 Liquid Source Term

The following liquid release source term was calculated using the GALE computer code (Reference [5]).

Table 3-1: GALE Liquid Release Rate

Nuclide	Total Release Rate (Ci/yr)	Nuclide	Total Release Rate (Ci/yr)
H-3	1.66E+03	Y-93	3.30E-04
Na-24	5.72E-03	Zr-95	1.20E-04
Cr-51	9.60E-04	Nb-95	9.00E-05
Mn-54	5.10E-04	Mo-99	1.63E-03
Fe-55	3.80E-04	Tc-99m	1.59E-03
Fe-59	9.00E-05	Ru-103	2.34E-03
Co-58	1.44E-03	Rh-103m*	2.34E-03
Co-60	1.70E-04	Ru-106	2.84E-02
Zn-65	1.60E-04	Rh-106*	2.84E-02
Sr-89	4.00E-05	Ag-110m	4.10E-04
Sr-91	7.00E-05	Ag-110*	5.00E-05
Y-91m	5.00E-05	Te-129m	6.00E-05
Te-129	4.00E-05	Ba-137m*	3.04E-03
Te-131m	2.90E-04	Ba-140	3.93E-03
Te-131	5.00E-05	La-140	7.12E-03
Te-132	4.50E-04	Ce-141	5.00E-05
I-131	3.54E-02	Ce-143	5.70E-04
I-132	1.14E-03	Pr-143	5.00E-05
I-133	4.21E-02	Ce-144	1.23E-03
I-135	1.69E-02	Pr-144	1.23E-03
Cs-134	2.45E-03	W-187	4.30E-04
Cs-136	2.90E-04	Np-239	5.40E-04
Cs-137	3.25E-03		

*These nuclides are not contained in the LADTAP II library. They are taken to be in secular equilibrium with the parent nuclide and the dose factors in LADTAP II are adjusted accordingly.

Technical Input for COLA ER Section 5.4.4 for BBNPP (Dose to Biota)

3.2 Gaseous Doses

The total body dose due to normal gaseous effluents has been calculated for a hypothetical human living at a location(s) resulting in the maximum dose in Reference [2] (Plume: Table 5-8, Ground & Inhalation: Table 5-9). The results are contained in Table 3-2.

Table 3-2: Dose Due to Gaseous Releases to Man

Plume* (mrem/yr)	Ground* (mrem/yr)	Inhalation* (mrem/yr)	Total* (mrem/yr)
1.26E+00	1.76E-03	7.29E-03	1.27E+00

* Maximum dose to man at the maximum dose locations for the respective pathway.

3.3 Fixed Sources of Direct Radiation

The dose due to fixed sources of radiation during normal operations is 1.87 mrem/year (i.e., $2.13\text{E-}04$ mrem/hr x 24 hrs/day x 365 days/yr = 1.87 mrem/yr) (Reference [4], Table 6-1). This value is given for the western OCA boundary. It is conservative to assume this is the dose rate at all points along the OCA boundary.

3.4 LADTAP II Input Variables

Table 3-3: Input Data for LADTAP II Dose Assessment for Biota

Record Type	Record Description	Value	Reference
1	Case Title	bb-bio-3.inp	NA
2	Site Water Type, 0 = Fresh	0	NA
	Liquid Effluent Discharge Rate	19.3 cfs (8665 gpm)	[6]
	Source Term Multiplier	1	NA
	Print Control of % contribution, 0 no calc.	0	NA
	Block Data Change	0	NA
3	Site Population Information	Not used	NA
	Control to read 3a, 0 = do not read	0	NA
4	Source Title	GALE Liquid Source Term US EPR from AREVA Doc #32-9079121-003	NA
5	Radionuclide Release Information	See Table 3-1	[5]
6	Impoundment Reconcentration Model	0, no model	NA
7	ALARA - Default usage and consumption	1	NA
	ALARA - Shore width factor	Not used	NA
	ALARA - Dilution for aquatic food pathway	Not used	NA
	ALARA - Dilution for shoreline & swimming	Not used	NA
	ALARA - Dilution for drinking water	Not used	NA
	ALARA - Transit time to receptor (not water)	Not used	NA
	ALARA - Transit time to water supply	Not used	NA
7a-7d	Usage and consumption data	Not used	
8	Additional Usage Location Data	Not used	NA
9	Sport Fishing Usage Location Data – Harvest	Not used	NA

Technical Input for COLA ER Section 5.4.4 for BBNPP (Dose to Biota)

Record Type	Record Description	Value	Reference
	Sport Fishing Usage Location Data – Dilution	Not used	NA
	Sport Fishing Usage Location Data – Transit time	Not used	NA
	Sport Fishing Usage Location Data – Name	Not used	NA
10	Commercial Fishing Usage Location Data	Not used	NA
11	Sport Invertebrate Usage Location Data	Not used	NA
12	Commercial Invertebrate Usage Location Data	Not used	NA
13	Pop. Drinking Water Usage Location – Pop. Supplied	Not used	NA
	Pop. Drinking Water Usage Location – Dilution	Not used	NA
	Pop. Drinking Water Usage Location – Transit Time	Not used	NA
	Pop. Drinking Water Usage Location – Supply Rate	Not used	NA
	Pop. Drinking Water Usage Location – Usage Rate	Not used	NA
	Pop. Drinking Water Usage Location - Title	Not used	NA
	Pop. Drinking Water Usage Location – Pop.	Not used	NA
	Pop. Drinking Water Usage Location – Dilution	Not used	NA
	Pop. Drinking Water Usage Location – Transit Time	Not used	NA
	Pop. Drinking Water Usage Location – Supply Rate	Not used	NA
	Pop. Drinking Water Usage Location – Usage Rate	Not used	NA
14	Pop. Drinking Water Usage Location- Title	Not used	NA
15	Population Shoreline Usage Data	Not used	NA
16	Population Swimming Usage Data	Not used	NA
	Population Boating Usage Data- Usage Time	Not used	NA
	Population Boating Usage Data - Dilution	Not used	NA
	Population Boating Usage Data - Transit Time	Not used	NA
	Population Boating Usage Data - Title	Not used	NA
17	Food Pathway Data- Food Type	0, not food specific	NA
	Food Pathway Data- New Consumption Data	0, no new data	NA
	Food Pathway Data- Irrigation Rate	Not used	NA
	Food Pathway Data- Fraction of feed not irrigated	Not used	NA
	Food Pathway Data- Fraction of animal water not irrigation	Not used	NA
	Food Pathway Data- Total Production	Not used	NA
	Food Pathway Data- Growing Period	Not used	NA
	Food Pathway Data- Crop Yield	Not used	NA
17a	Food Consumption Parameters	Not used	NA

Technical Input for COLA ER Section 5.4.4 for BBNPP (Dose to Biota)

Record Type	Record Description	Value	Reference
18	Food Water Usage Location Data	Not Used	NA
19	Biota Exposure Location Data – Dilution (Low)	68.7 (Annual Ave./Scenario 5)	Table 10, Ref. [3]
	Biota Exposure Location Data – Transit time	0 hrs	Assumption (see Sect. 2.2)
	Biota Exposure Location Data - Title	Low dilution	NA
	Biota Exposure Location Data – Dilution (High)	86 (Annual Ave., Max Shoreline/Scenario 5)	Table 15, Ref. [3]
	Biota Exposure Location Data – Transit time	0 hrs	Assumption (see Sect. 2.2)
	Biota Exposure Location Data – Title	High Dilution	NA

Note: “Not Used” values in the input deck are informational, do not represent up-to-date values, and do not affect the biota output results for this calculation.

3.5 Important Species

Table 3-4 lists the important species, as identified in Reference [7], Table A2.4.1-A-1.

Table 3-4: Important Species in the Area of BBNPP

Scientific Name	Common Name	Federal Status	State Status	Other Importance
<i>Myotis sodalist</i>	Indiana Bat	Endangered	Endangered	
<i>Myotis leibii</i>	Eastern Small footed Myotis		Threatened	
<i>Neotoma magister</i>	Allegheny Woodrat		Threatened	
<i>Myotis septentrionalis</i>	Northern Myotis		Rare (candidate)	
<i>Odocoileus virginianus</i>	White-tailed Deer			Recreation
<i>Ursus americanus</i>	Black Bear			Recreation
<i>Mircotus pennsylvanicus</i>	Meadow Vole			Ecological
<i>Peromyscus maniculatus</i>	Deer Mouse			Ecological
<i>Peromyscus leucopus</i>	White-footed Mouse			Ecological
<i>Falco peregrinus</i>	Peregrine Falcon		Endangered	
<i>Haliaeetus leucocephalus</i>	Bald Eagle		Threatened	
<i>Pandion haliaetus</i>	Osprey		Threatened	
<i>Meleagris gallopavo</i>	Wild Turkey			Recreation
<i>Piranaga olivacea</i>	Scarlet Tanager			Ecological
<i>Pseudemys rubriventris</i>	Redbelly Turtle		Threatened	
<i>Crotalus horridus</i>	Timber Rattlesnake		Candidate	
<i>Heterodon platyrhinos</i>	Eastern Hognose Snake		Concern	
<i>Scaphiopus holbrookii</i>	Eastern Spadefoot		Endangered	
<i>Enodia anthendon</i>	Northern Peary-eye		Vulnerable	
<i>Polites mystic</i>	Long Dash		Vulnerable	
<i>Poanes massasoit</i>	Mulberry Wing		Vulnerable	
<i>Euphydryas phoeton</i>	Baltimore Checkerspot		Vulnerable	
<i>Euphyes conspicua</i>	Black Dash		Vulnerable	

Technical Input for COLA ER Section 5.4.4 for BBNPP (Dose to Biota)

4.0 COMPUTER USAGE

4.1 Software

LADTAP II (Reference [1]) was used to perform the dose assessments using the inputs given in Section 3.0. The LADTAP II code is maintained in the UNIX environment at the Richland, Washington office of AREVA NP. This code was migrated to the Engineering Application Software Index (EASI) in March 2010, and is currently active there. All computer runs were carried out on the HP 9000/785 CPU running HP UX B.10.20. There are no software errors that affect their application in the present calculation. LAPTAP documentation can be found in Reference [9].

4.2 Computer Files

The files shown in Table 4-1 were loaded to ColdSTOR and can be found at:

\cold\A011PE2062\32-9080953-003\official\.

Table 4-1: ColdStor Files

File Name	ColdStor Date & Time	ColdStor File Size (bytes)	Description
bb-bio-3.inp	04-25-2012 09:23	5169	LADTAP II input file
bb-bio-3.out	04-25-2012 10:36	46415	LADTAP II output file

 Technical Input for COLA ER Section 5.4.4 for BBNPP (Dose to Biota)

5.0 CALCULATIONS

LADTAP II performs environmental dose analysis for releases of radioactive effluents from nuclear power plants into surface waters. The dose analysis estimates radiation dose to individuals, populations and biota from ingestion and external exposure pathways.

LADTAP II uses the calculation methodology described in Regulatory Guide 1.109 (Reference [7]).

Output from GASPAR II as well as the dose from direct radiation sources was quantified in units of mrem/year. When discussing doses to biota, the appropriate unit for dose assessment is mrad/year. The outputs of GASPAR II and the dose due to sources of direct radiation were converted from mrem/year to mrad/year with a conversion factor of 1.

The “low” dilution value of 68.7 to 1 represents the near field dilution at a distance of 50 feet from the discharge. This value is taken from Reference [3] Table 10. The “high” dilution value of 86 to 1 conservatively uses the maximum impacted shoreline value from Reference [3] Table 15. Both low (near field: fish, invertebrate, algae, muskrat, duck)) and high (far field: raccoon, heron) dilution values are based on Scenario 5 (annual mean flow), which is appropriate for biota that occupy the affected environment year-round.

The dose from ground plane exposure was also adjusted for application to biota by multiplying by two. The inhalation pathway is included for the biota dose assessment as a measure of conservatism, as no other accepted biota models are available. The results are contained in Table 5-1.

Table 5-1: Dose to Biota from Gaseous Effluents

	Plume	Ground	Inhalation	Total
Man	1.26E+00 (mrem/yr)	1.76E-03 (mrem/yr)	7.29E-03 (mrem/yr)	1.27E+00 (mrem/yr)
Biota	1.26E+00 (mrad/yr)	3.52E-03 (mrad/yr)	7.29E-03 (mrad/yr)	1.27E+00 (mrad/yr)



 Technical Input for COLA ER Section 5.4.4 for BBNPP (Dose to Biota)

6.0 RESULTS

The sum of doses due to liquid releases, gaseous releases, and direct radiation exposure due to normal operations from a U.S. EPR™ plant at BBNPP is contained in Table 6-1. This shows that no dose to biota exceeds the human total body dose limit of 25 mrad/year from 40 CFR 190.

Table 6-1: Dose Assessment for Biota

Dilution Factor	Biota	Liquid Effluents (mrad/yr)			Gaseous Effluents (mrad/yr)			Fixed Sources (mrad/yr)	Total (mrad/yr)
		Internal	External	Total	Plume	Ground	Inhalation		
Low	Fish	1.09E-01	7.85E-02	1.88E-01	N/A	N/A	N/A	N/A	1.88E-01
	Invertebrate	5.00E-01	1.55E-01	6.55E-01	N/A	N/A	N/A	N/A	6.55E-01
	Algae	2.13E+00	1.77E-03	2.13E+00	N/A	N/A	N/A	N/A	2.13E+00
	Muskrat	5.59E-01	5.18E-02	6.11E-01	1.26E+00	3.52E-03	7.29E-03	1.87E+00	3.75E+00
	Duck	5.15E-01	7.72E-02	5.92E-01	1.26E+00	3.52E-03	7.29E-03	1.87E+00	3.73E+00
High	Raccoon	1.25E-01	3.07E-02	1.56E-01	1.26E+00	3.52E-03	7.29E-03	1.87E+00	3.30E+00
	Heron	1.61E+00	4.11E-02	1.65E+00	1.26E+00	3.52E-03	7.29E-03	1.87E+00	4.79E+00

Technical Input for COLA ER Section 5.4.4 for BBNPP (Dose to Biota)

7.0 REFERENCES

1. AREVA Document Number 38-9043159-001, US NRC NUREG/CR-4013, "LADTAP II – Technical Reference and User Guide," April 1986.
2. AREVA Document Number 32-9077003-003, "Calculation of the Annual Offsite Dose to Individuals from Gaseous Effluent Releases from the U.S. EPR at the BBNPP."
3. AREVA Document Number 38-9083598-000, "BBNPP Discharge Thermal Plume and Dilution Modeling Report."
4. AREVA Document Number 32-9076634-002, "Direct Dose at the Owner Controlled Area Boundary for ER Section 5.4 for BBNPP."
5. AREVA Document Number 32-9079121-003, "Calculation of the US EPR Normal Operation Source Term (GALE) for Bell Bend."
6. AREVA Document Number 38-9087950-000, "UniStar Response to BBNPP RFI #08-278 (RFI SL-BER-053 related to ER 3.3)."
7. US NRC Regulatory Guide 1.109, "Calculation of Annual Dose to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I," Revision 1, October 1977.
8. AREVA Document Number 51-9079832-004, "Technical Input to COLA ER Section 2.4.1 for Bell Bend Unit 1."
9. AREVA Document Number 32-9062452-000, LADTAP II Computer Code Documentation Package.



 Technical Input for COLA ER Section 5.4.4 for BBNPP (Dose to Biota)

APPENDIX A: LADTAP II FILES

A.1 LADTAP II Input File (file name = bb-bio-3.inp)

[Note: This input file was used only to generate biota doses. Only the inputs specified in this calculation document have been verified in the input file shown below. No other input values have been verified.]

```

Bell Bend NPP Unit 3 Liquid Dose bb-bio-3.inp*****
0          19.3        1.0          0          0
2508636.      0
  GALE Liquid Source Term US EPR from AREVA Doc #32-9079121-003
  H   3      1.660E+03      0.
  NA  24      5.720E-03      0.
  CR  51      9.600E-04      0.
  MN  54      5.100E-04      0.
  FE  55      3.800E-04      0.
  FE  59      9.000E-05      0.
  CO  58      1.440E-03      0.
  CO  60      1.700E-04      0.
  ZN  65      1.600E-04      0.
  W   187     4.300E-04      0.
  NP  239     5.400E-04      0.
  SR  89      4.000E-05      0.
  SR  91      7.000E-05      0.
  Y   91M     5.000E-05      0.
  Y   93      3.300E-04      0.
  ZR  95      1.200E-04      0.
  NB  95      9.000E-05      0.
  MO  99      1.630E-03      0.
  TC  99M     1.590E-03      0.
  RU  103     2.340E-03      0.
  RU  106     2.840E-02      0.
  AG  110M    4.100E-04      0.
  TE  129M    6.000E-05      0.
  TE  129      4.000E-05      0.
  TE  131M    2.900E-04      0.
  TE  131      5.000E-05      0.
  TE  132      4.500E-04      0.
  I   131      3.540E-02      0.
  I   132      1.140E-03      0.
  I   133      4.210E-02      0.
  I   135      1.690E-02      0.
  CS  134      2.450E-03      0.
  CS  136      2.900E-04      0.
  CS  137      3.250E-03      0.
  BA  140      3.930E-03      0.
  LA  140      7.120E-03      0.
  CE  141      5.000E-05      0.
  CE  143      5.700E-04      0.
  CE  144      1.230E-03      0.
  PR  143      5.000E-05      0.
  PR  144      1.230E-03      0.

      0          0.          0.
      1          0.2        11.          44.          11.          0.          0.
     21.          5.0        0.0        730.          12.          12.          52.
  
```



 Technical Input for COLA ER Section 5.4.4 for BBNPP (Dose to Biota)

16.	3.8	0.0	510.	67.	67.	52.
6.9	1.7	0.0	510.	14.	14.	29.
0.0	0.0	0.0	330.	12.	12.	52.
236562.0	46.0	0.0	Sport Fishing Total			
1.0E-09	999.0	0.0	Commercial Fishing-NONE			
1.0E-09	999.0	0.0	Sport Invert-NONE			
1.0E-09	999.0	0.0	Commercial Invert-NONE			
4897.0	46.0	63.8	Danville MWA			
11043.0	46.0	63.8	Sunbury MWA			
1.0E-09	999.	999.	0.2	Shoreline-none		
1.0E-09	999.	999.	Swimming-none			
393584.0	46.0	119.	Boating			
68.7	0.	low dillution				
86.0	0.	high dillution				

Page 21



Technical Input for COLA ER Section 5.4.4 for BBNPP (Dose to Biota)

```

*
*****
1
11 Bend NPP Unit 3 Liquid Dose bb-bio-3.inp*****
0 DISCHARGE=1.93E+01 CFS SOURCE TERM MULTIPLIER=1.00E+00
0 50-MILE POPULATION=2.51E+06 FRACTION --- ADULT= .71
TEENAGER= .11
CHILD= .18
0 FRESHWATER SITE
1
GALE Liquid Source Term US EPR from AREVA Doc #32-9079121-003
NO INTERNAL RECONCENTRATION MODEL EMPLOYED
0 * * * ADULT DOSE FACTORS * * *
0
INGESTION DOSE FACTORS SHORELINE
(MREM/PCI INTAKE) (MREM/HR) / (PCI/M**2)
NUCLIDE CURIE/YEAR BONE LIVER TOTAL BODY THYROID KIDNEY LUNG GI-LLI SKIN TOTAL BODY RECON
1H 3 1.66E+03 .00E+00 5.99E-08 5.99E-08 5.99E-08 5.99E-08 5.99E-08 5.99E-08 .00E+00 .00E+00 1.00E+00
11NA 24 5.72E-03 1.70E-06 1.70E-06 1.70E-06 1.70E-06 1.70E-06 1.70E-06 1.70E-06 2.90E-08 2.50E-08 1.00E+00
24CR 51 9.60E-04 .00E+00 .00E+00 2.66E-09 1.59E-09 5.86E-10 3.53E-09 6.69E-07 2.60E-10 2.20E-10 1.00E+00
25MN 54 5.10E-04 .00E+00 4.57E-06 8.72E-07 .00E+00 1.36E-06 .00E+00 1.40E-05 6.80E-09 5.80E-09 1.00E+00
26FE 55 3.80E-04 2.75E-06 1.90E-06 4.43E-07 .00E+00 .00E+00 1.06E-06 1.09E-06 .00E+00 .00E+00 1.00E+00
26FE 59 9.00E-05 4.34E-06 1.02E-05 3.91E-06 .00E+00 .00E+00 2.85E-06 3.40E-05 9.40E-09 8.00E-09 1.00E+00
27CO 58 1.44E-03 .00E+00 7.45E-07 1.67E-06 .00E+00 .00E+00 .00E+00 1.51E-05 8.20E-09 7.00E-09 1.00E+00
27CO 60 1.70E-04 .00E+00 2.14E-06 4.72E-06 .00E+00 .00E+00 .00E+00 4.02E-05 2.00E-08 1.70E-08 1.00E+00
30ZN 65 1.60E-04 4.84E-06 1.54E-05 6.96E-06 .00E+00 1.03E-05 .00E+00 9.70E-06 4.60E-09 4.00E-09 1.00E+00
74W 187 4.30E-04 1.03E-07 8.61E-08 3.01E-08 .00E+00 .00E+00 .00E+00 2.82E-05 3.60E-09 3.10E-09 1.00E+00
93NP 239 5.40E-04 1.19E-09 1.17E-10 6.45E-11 .00E+00 3.65E-10 .00E+00 2.40E-05 1.10E-09 9.50E-10 1.00E+00
38SR 89 4.00E-05 3.08E-04 .00E+00 8.84E-06 .00E+00 .00E+00 .00E+00 4.94E-05 6.50E-13 5.60E-13 1.00E+00
38SR 91 7.00E-05 5.67E-06 .00E+00 2.29E-07 .00E+00 .00E+00 .00E+00 2.70E-05 8.30E-09 7.10E-09 1.00E+00
39Y 91M 5.00E-05 9.09E-11 .00E+00 3.52E-12 .00E+00 .00E+00 .00E+00 2.67E-10 4.40E-09 3.80E-09 1.00E+00
39Y 93 3.30E-04 2.68E-09 .00E+00 7.40E-11 .00E+00 .00E+00 .00E+00 8.50E-05 7.80E-10 5.70E-10 1.00E+00
40ZR 95 1.20E-04 3.04E-08 9.75E-09 6.60E-09 .00E+00 1.53E-08 .00E+00 3.09E-05 5.80E-09 5.00E-09 1.00E+00
41NB 95 9.00E-05 6.22E-09 3.46E-09 1.86E-09 .00E+00 3.42E-09 .00E+00 2.10E-05 6.00E-09 5.10E-09 1.00E+00
42MO 99 1.63E-03 .00E+00 4.31E-06 8.20E-07 .00E+00 9.76E-06 .00E+00 9.99E-06 2.20E-09 1.90E-09 1.00E+00
43TC 99M 1.59E-03 2.47E-10 6.98E-10 8.89E-09 .00E+00 1.06E-08 3.42E-10 4.13E-07 1.10E-09 9.60E-10 1.00E+00
44RU 103 2.34E-03 1.85E-07 .00E+00 7.97E-08 .00E+00 7.06E-07 .00E+00 2.16E-05 4.20E-09 3.60E-09 1.00E+00
44RU 106 2.84E-02 2.75E-06 .00E+00 3.48E-07 .00E+00 5.31E-06 .00E+00 1.78E-04 1.80E-09 1.50E-09 1.00E+00
47AG 110M 4.10E-04 1.60E-07 1.48E-07 8.79E-08 .00E+00 2.91E-07 .00E+00 6.04E-05 2.10E-08 1.80E-08 1.00E+00
52TE 129M 6.00E-05 1.15E-05 4.29E-06 1.82E-06 3.95E-06 4.80E-05 .00E+00 5.79E-05 9.00E-10 7.70E-10 1.00E+00
52TE 129 4.00E-05 3.14E-08 1.18E-08 7.65E-09 2.41E-08 1.32E-07 .00E+00 2.37E-08 8.40E-10 7.10E-10 1.00E+00
52TE 131M 2.90E-04 1.73E-06 8.46E-07 7.05E-07 1.34E-06 8.57E-06 .00E+00 8.40E-05 9.90E-09 8.40E-09 1.00E+00
52TE 131 5.00E-05 1.97E-08 8.23E-09 6.22E-09 1.62E-08 8.63E-08 .00E+00 2.79E-09 2.60E-06 2.20E-09 1.00E+00
52TE 132 4.50E-04 2.52E-06 1.63E-06 1.53E-06 1.80E-06 1.57E-05 .00E+00 7.71E-05 2.00E-09 1.70E-09 1.00E+00
53I 131 3.54E-02 4.16E-06 5.95E-06 3.41E-06 1.95E-03 1.02E-05 .00E+00 1.57E-06 3.40E-09 2.80E-09 1.00E+00
53I 132 1.14E-03 2.03E-07 5.43E-07 1.90E-07 1.90E-05 8.65E-07 .00E+00 1.02E-07 2.00E-08 1.70E-08 1.00E+00
53I 133 4.21E-02 1.42E-06 2.47E-06 7.53E-07 3.63E-04 4.31E-06 .00E+00 2.22E-06 4.50E-09 3.70E-09 1.00E+00
53I 135 1.69E-02 4.43E-07 1.16E-06 4.28E-07 7.65E-05 1.86E-06 .00E+00 1.31E-06 1.40E-08 1.20E-08 1.00E+00
55CS 134 2.45E-03 6.22E-05 1.48E-04 1.21E-04 .00E+00 4.79E-05 1.59E-05 2.59E-06 1.40E-08 1.20E-08 1.00E+00
55CS 136 2.90E-04 6.51E-06 2.57E-05 1.85E-05 .00E+00 1.43E-05 1.96E-06 2.92E-06 1.70E-08 1.50E-08 1.00E+00
55CS 137 3.25E-03 7.97E-05 1.09E-04 7.14E-05 .00E+00 3.70E-05 1.23E-05 2.11E-06 4.90E-09 4.20E-09 1.00E+00
56BA 140 3.93E-03 2.03E-05 2.55E-08 1.33E-06 .00E+00 8.67E-09 1.46E-08 4.18E-05 2.40E-09 2.10E-09 1.00E+00
57LA 140 7.12E-03 2.50E-09 1.26E-09 3.33E-10 .00E+00 .00E+00 .00E+00 9.25E-05 1.70E-08 1.50E-08 1.00E+00
58CE 141 5.00E-05 9.36E-09 6.33E-09 7.18E-10 .00E+00 2.94E-09 .00E+00 2.42E-05 6.20E-10 5.50E-10 1.00E+00
58CE 143 5.70E-04 1.65E-09 1.22E-06 1.35E-10 .00E+00 5.37E-10 .00E+00 4.56E-05 2.50E-09 2.20E-09 1.00E+00
58CE 144 1.23E-03 4.88E-07 2.04E-07 2.62E-08 .00E+00 1.21E-07 .00E+00 1.65E-04 3.70E-10 3.20E-10 1.00E+00
59PR 143 5.00E-05 9.20E-09 3.69E-09 4.56E-10 .00E+00 2.13E-09 .00E+00 4.03E-05 .00E+00 .00E+00 1.00E+00
59PR 144 1.23E-03 3.01E-11 1.25E-11 1.53E-12 .00E+00 7.05E-12 .00E+00 4.33E-18 2.30E-10 2.00E-10 1.00E+00
0 * * * TEENAGER DOSE FACTORS * * *
0
INGESTION DOSE FACTORS SHORELINE
(MREM/PCI INTAKE) (MREM/HR) / (PCI/M**2)
NUCLIDE CURIE/YEAR BONE LIVER TOTAL BODY THYROID KIDNEY LUNG GI-LLI SKIN TOTAL BODY RECON
1H 3 1.66E+03 .00E+00 6.04E-08 6.04E-08 6.04E-08 6.04E-08 6.04E-08 6.04E-08 .00E+00 .00E+00 1.00E+00
11NA 24 5.72E-03 2.30E-06 2.30E-06 2.30E-06 2.30E-06 2.30E-06 2.30E-06 2.30E-06 2.90E-08 2.50E-08 1.00E+00
24CR 51 9.60E-04 .00E+00 .00E+00 3.60E-09 2.00E-09 7.89E-10 5.14E-09 6.05E-07
25MN 54 5.10E-04 .00E+00 5.90E-06 1.17E-06 .00E+00 1.76E-06 .00E+00 1.21E-05
26FE 55 3.80E-04 3.78E-06 2.68E-06 6.25E-07 .00E+00 .00E+00 1.70E-06 1.16E-06
26FE 59 9.00E-05 5.87E-06 1.37E-05 5.29E-06 .00E+00 .00E+00 4.32E-06 3.24E-05
27CO 58 1.44E-03 .00E+00 9.72E-07 2.24E-06 .00E+00 .00E+00 .00E+00 1.34E-05
27CO 60 1.70E-04 .00E+00 2.81E-06 6.33E-06 .00E+00 .00E+00 .00E+00 3.66E-05
30ZN 65 1.60E-04 5.76E-06 2.00E-05 9.33E-06 .00E+00 1.28E-05 .00E+00 8.47E-06
74W 187 4.30E-04 1.46E-07 1.19E-07 4.17E-08 .00E+00 .00E+00 .00E+00 3.22E-05
93NP 239 5.40E-04 1.76E-09 1.66E-10 9.22E-11 .00E+00 5.21E-10 .00E+00 2.67E-05
38SR 89 4.00E-05 4.40E-04 .00E+00 1.26E-05 .00E+00 .00E+00 .00E+00 5.24E-05
38SR 91 7.00E-05 8.07E-06 .00E+00 3.21E-07 .00E+00 .00E+00 .00E+00 3.66E-05
39Y 91M 5.00E-05 1.29E-10 .00E+00 4.93E-12 .00E+00 .00E+00 .00E+00 6.09E-09
39Y 93 3.30E-04 3.83E-09 .00E+00 1.05E-10 .00E+00 .00E+00 .00E+00 1.17E-04
40ZR 95 1.20E-04 4.12E-08 1.30E-08 8.94E-09 .00E+00 1.91E-08 .00E+00 3.00E-05
41NB 95 9.00E-05 8.22E-09 4.56E-09 2.51E-09 .00E+00 4.42E-09 .00E+00 1.95E-05
42MO 99 1.63E-03 .00E+00 6.03E-06 1.15E-06 .00E+00 1.38E-05 .00E+00 1.08E-05

```




Technical Input for COLA ER Section 5.4.4 for BBNPP (Dose to Biota)

43TC	99M	1.59E-03	3.32E-10	9.26E-10	1.20E-08	.00E+00	1.38E-08	5.14E-10	6.08E-07				
44RU	103	2.34E-03	2.55E-07	.00E+00	1.09E-07	.00E+00	8.99E-07	.00E+00	2.13E-05				
44RU	106	2.84E-02	3.92E-06	.00E+00	4.94E-07	.00E+00	7.56E-06	.00E+00	1.88E-04				
47AG	110M	4.10E-04	2.05E-07	1.94E-07	1.18E-07	.00E+00	3.70E-07	.00E+00	5.45E-05				
52TE	129M	6.00E-05	1.63E-05	6.05E-06	2.58E-06	5.26E-06	6.82E-05	.00E+00	6.12E-05				
52TE	129	4.00E-05	4.48E-08	1.67E-08	1.09E-08	3.20E-08	1.88E-07	.00E+00	2.45E-07				
52TE	131M	2.90E-04	2.44E-06	1.17E-06	9.76E-07	1.76E-06	1.22E-05	.00E+00	9.39E-05				
52TE	131	5.00E-05	2.79E-08	1.15E-08	8.72E-09	2.15E-08	1.22E-07	.00E+00	2.29E-09				
52TE	132	4.50E-04	3.49E-06	2.21E-06	2.08E-06	2.33E-06	2.12E-05	.00E+00	7.00E-05				
53I	131	3.54E-02	5.85E-06	8.19E-06	4.40E-06	2.39E-03	1.41E-05	.00E+00	1.62E-06				
53I	132	1.14E-03	2.79E-07	7.30E-07	2.62E-07	2.46E-05	1.15E-06	.00E+00	3.18E-07				
53I	133	4.21E-02	2.01E-06	3.41E-06	1.04E-06	4.76E-04	5.98E-06	.00E+00	2.58E-06				
53I	135	1.69E-02	6.10E-07	1.57E-06	5.82E-07	1.01E-04	2.48E-06	.00E+00	1.74E-06				
55CS	134	2.45E-03	8.37E-05	1.97E-04	9.14E-05	.00E+00	6.26E-05	2.39E-05	2.45E-06				
55CS	136	2.90E-04	8.59E-06	3.38E-05	2.27E-05	.00E+00	1.84E-05	2.90E-06	2.72E-06				
55CS	137	3.25E-03	1.12E-04	1.49E-04	5.19E-05	.00E+00	5.07E-05	1.97E-05	2.12E-06				
56BA	140	3.93E-03	2.84E-05	3.48E-08	1.83E-06	.00E+00	1.18E-08	2.34E-08	4.38E-05				
57LA	140	7.12E-03	3.48E-09	1.71E-09	4.55E-10	.00E+00	.00E+00	.00E+00	9.82E-05				
58CE	141	5.00E-05	1.33E-08	8.88E-09	1.02E-09	.00E+00	4.18E-09	.00E+00	2.54E-05				
58CE	143	5.70E-04	2.35E-09	1.71E-06	1.91E-10	.00E+00	7.67E-10	.00E+00	5.14E-05				
58CE	144	1.23E-03	6.96E-07	2.88E-07	3.74E-08	.00E+00	1.72E-07	.00E+00	1.75E-04				
59PR	143	5.00E-05	1.31E-08	5.23E-09	6.52E-10	.00E+00	3.04E-09	.00E+00	4.31E-05				
59PR	144	1.23E-03	4.30E-11	1.76E-11	2.18E-12	.00E+00	1.01E-11	.00E+00	4.74E-14				
CHILD DOSE FACTORS													
INGESTION DOSE FACTORS													
(MREM/PCI INTAKE)													
NUCLIDE	CURIE/YEAR	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI	(MREM/HR) / (PCI/M**2)		SKIN	TOTAL BODY	RECON
1H	3	1.66E+03	.00E+00	1.16E-07	1.16E-07	1.16E-07	1.16E-07	1.16E-07	1.16E-07				
11NA	24	5.72E-03	5.80E-06	5.80E-06	5.80E-06	5.80E-06	5.80E-06	5.80E-06	5.80E-06				
24CR	51	9.60E-04	.00E+00	.00E+00	8.90E-09	4.94E-09	1.35E-09	9.02E-09	4.72E-07				
25MN	54	5.10E-04	.00E+00	1.07E-05	2.85E-06	.00E+00	3.00E-06	.00E+00	8.98E-06				
26FE	55	3.80E-04	1.15E-05	6.10E-06	1.89E-06	.00E+00	.00E+00	3.45E-06	1.13E-06				
26FE	59	9.00E-05	1.65E-05	2.67E-05	1.33E-05	.00E+00	.00E+00	7.74E-06	2.78E-05				
27CO	58	1.44E-03	.00E+00	1.80E-06	5.51E-06	.00E+00	.00E+00	.00E+00	1.05E-05				
27CO	60	1.70E-04	.00E+00	5.29E-06	1.56E-05	.00E+00	.00E+00	.00E+00	2.93E-05				
30ZN	65	1.60E-04	1.37E-05	3.65E-05	2.27E-05	.00E+00	2.30E-05	.00E+00	6.41E-06				
74W	187	4.30E-04	4.29E-07	2.54E-07	1.14E-07	.00E+00	.00E+00	.00E+00	3.57E-05				
93NP	239	5.40E-04	5.25E-09	3.77E-10	2.65E-10	.00E+00	1.09E-09	.00E+00	2.79E-05				
38SR	89	4.00E-05	1.32E-03	.00E+00	3.77E-05	.00E+00	.00E+00	.00E+00	5.11E-05				
38SR	91	7.00E-05	2.40E-05	.00E+00	9.06E-07	.00E+00	.00E+00	.00E+00	5.30E-05				
39Y	91M	5.00E-05	3.82E-10	.00E+00	1.39E-11	.00E+00	.00E+00	.00E+00	7.48E-07				
39Y	93	3.30E-04	1.14E-08	.00E+00	3.13E-10	.00E+00	.00E+00	.00E+00	1.70E-04				
40ZR	95	1.20E-04	1.16E-07	2.55E-08	2.27E-08	.00E+00	3.65E-08	.00E+00	2.66E-05				
41NB	95	9.00E-05	2.25E-08	8.76E-09	6.26E-09	.00E+00	8.23E-09	.00E+00	1.62E-05				
42MO	99	1.63E-03	.00E+00	1.33E-05	3.29E-06	.00E+00	2.84E-05	.00E+00	1.10E-05				
43TC	99M	1.59E-03	9.23E-10	1.81E-09	3.00E-08	.00E+00	2.63E-08	9.19E-10	1.03E-06				
44RU	103	2.34E-03	7.31E-07	.00E+00	2.81E-07	.00E+00	1.84E-06	.00E+00	1.89E-05				
44RU	106	2.84E-02	1.17E-05	.00E+00	1.46E-06	.00E+00	1.58E-05	.00E+00	1.82E-04				
47AG	110M	4.10E-04	5.39E-07	3.64E-07	2.91E-07	.00E+00	6.78E-07	.00E+00	4.33E-05				
52TE	129M	6.00E-05	4.87E-05	1.36E-05	7.56E-06	1.57E-05	1.43E-04	.00E+00	5.94E-05				
52TE	129	4.00E-05	1.34E-07	3.74E-08	3.18E-08	9.56E-08	3.92E-07	.00E+00	8.34E-06				
52TE	131M	2.90E-04	7.20E-06	2.49E-06	2.65E-06	5.12E-06	2.41E-05	.00E+00	1.01E-04				
52TE	131	5.00E-05	8.30E-08	2.53E-08	2.47E-08	6.35E-08	2.51E-07	.00E+00	4.36E-07				
52TE	132	4.50E-04	1.01E-05	4.47E-06	5.40E-06	6.51E-06	4.15E-05	.00E+00	4.50E-05				
53I	131	3.54E-02	1.72E-05	1.73E-05	9.83E-06	5.72E-03	2.84E-05	.00E+00	1.54E-06				
53I	132	1.14E-03	8.00E-07	1.47E-06	6.76E-07	6.82E-05	2.25E-06	.00E+00	1.73E-06				
53I	133	4.21E-02	5.92E-06	7.32E-06	2.77E-06	1.36E-03	1.22E-05	.00E+00	2.95E-06				
53I	135	1.69E-02	1.75E-06	3.15E-06	1.49E-06	2.79E-04	4.83E-06	.00E+00	2.40E-06				
55CS	134	2.45E-03	2.34E-04	3.84E-04	8.10E-05	.00E+00	1.19E-04	4.27E-05	2.07E-06				
55CS	136	2.90E-04	2.35E-05	6.46E-05	4.18E-05	.00E+00	3.44E-05	5.13E-06	2.27E-06				
55CS	137	3.25E-03	3.27E-04	3.13E-04	4.62E-05	.00E+00	1.02E-04	3.67E-05	1.96E-06				
56BA	140	3.93E-03	8.31E-05	7.28E-08	4.85E-06	.00E+00	2.37E-08	4.34E-08	4.21E-05				
57LA	140	7.12E-03	1.01E-08	3.53E-09	1.19E-09	.00E+00	.00E+00	.00E+00	9.84E-05				
58CE	141	5.00E-05	3.97E-08	1.98E-08	2.94E-09	.00E+00	8.68E-09	.00E+00	2.47E-05				
58CE	143	5.70E-04	6.99E-09	3.79E-06	5.49E-10	.00E+00	1.59E-09	.00E+00	5.55E-05				
58CE	144	1.23E-03	2.08E-06	6.52E-07	1.11E-07	.00E+00	3.61E-07	.00E+00	1.70E-04				
59PR	143	5.00E-05	3.93E-08	1.18E-08	1.95E-09	.00E+00	6.39E-09	.00E+00	4.24E-05				
59PR	144	1.23E-03	1.29E-10	3.99E-11	6.49E-12	.00E+00	2.11E-11	.00E+00	8.59E-08				
INFANT DOSE FACTORS													
INGESTION DOSE FACTORS													
(MREM/PCI INTAKE)													
NUCLIDE	CURIE/YEAR	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI	(MREM/HR) / (PCI/M**2)		SKIN	TOTAL BODY	RECON
1H	3	1.66E+03	.00E+00	1.76E-07	1.76E-07	1.76E-07	1.76E-07	1.76E-07	1.76E-07				
11NA	24	5.72E-03	1.01E-05	1.01E-05	1.01E-05	1.01E-05	1.01E-05	1.01E-05	1.01E-05				
24CR	51	9.60E-04	.00E+00	.00E+00	1.41E-08	9.20E-09	2.01E-09	1.79E-08	4.11E-07				
25MN	54	5.10E-04	.00E+00	1.99E-05	4.51E-06	.00E+00	4.41E-06	.00E+00	7.31E-06				
26FE	55	3.80E-04	1.39E-05	8.98E-06	2.40E-06	.00E+00	.00E+00	4.39E-06	1.14E-06				
26FE	59	9.00E-05	3.08E-05	5.38E-05	2.12E-05	.00E+00	.00E+00	1.59E-05	2.57E-05				
27CO	58	1.44E-03	.00E+00	3.60E-06	8.98E-06	.00E+00	.00E+00	.00E+00	8.97E-06				



Technical Input for COLA ER Section 5.4.4 for BBNPP (Dose to Biota)

27CO	60	1.70E-04	.00E+00	1.08E-05	2.55E-05	.00E+00	.00E+00	.00E+00	2.57E-05
30ZN	65	1.60E-04	1.84E-05	6.31E-05	2.91E-05	.00E+00	3.06E-05	.00E+00	5.33E-05
74W	187	4.30E-04	9.03E-07	6.28E-07	2.17E-07	.00E+00	.00E+00	.00E+00	3.69E-05
93NP	239	5.40E-04	1.11E-08	9.93E-10	5.61E-10	.00E+00	1.98E-09	.00E+00	2.87E-05
38SR	89	4.00E-05	2.51E-03	.00E+00	7.20E-05	.00E+00	.00E+00	.00E+00	5.16E-05
38SR	91	7.00E-05	5.00E-05	.00E+00	1.81E-06	.00E+00	.00E+00	.00E+00	5.92E-05
39Y	91M	5.00E-05	8.10E-10	.00E+00	2.76E-11	.00E+00	.00E+00	.00E+00	2.70E-06
39Y	93	3.30E-04	2.43E-08	.00E+00	6.62E-10	.00E+00	.00E+00	.00E+00	1.92E-04
40ZR	95	1.20E-04	2.06E-07	5.02E-08	3.56E-08	.00E+00	5.41E-08	.00E+00	2.50E-05
41NB	95	9.00E-05	4.20E-08	1.73E-08	1.00E-08	.00E+00	1.24E-08	.00E+00	1.46E-05
42MO	99	1.63E-03	.00E+00	3.40E-05	6.63E-06	.00E+00	5.08E-05	.00E+00	1.12E-05
43TC	99M	1.59E-03	1.92E-09	3.96E-09	5.10E-08	.00E+00	4.26E-08	2.07E-09	1.15E-06
44RU	103	2.34E-03	1.48E-06	.00E+00	4.95E-07	.00E+00	3.08E-06	.00E+00	1.80E-05
44RU	106	2.84E-02	2.41E-05	.00E+00	3.01E-06	.00E+00	2.85E-05	.00E+00	1.83E-04
47AG	110M	4.10E-04	9.96E-07	7.27E-07	4.81E-07	.00E+00	1.04E-06	.00E+00	3.77E-05
52TE	129M	6.00E-05	1.00E-04	3.43E-05	1.54E-05	3.84E-05	2.50E-04	.00E+00	5.97E-05
52TE	129	4.00E-05	2.84E-07	9.79E-08	6.63E-08	2.38E-07	7.07E-07	.00E+00	2.27E-05
52TE	131M	2.90E-04	1.52E-05	6.12E-06	5.05E-06	1.24E-05	4.21E-05	.00E+00	1.03E-04
52TE	131	5.00E-05	1.76E-07	6.50E-08	4.94E-08	1.57E-07	4.50E-07	.00E+00	7.11E-06
52TE	132	4.50E-04	2.08E-05	1.03E-05	9.61E-06	1.52E-05	6.44E-05	.00E+00	3.81E-05
53I	131	3.54E-02	3.59E-05	4.23E-05	1.86E-05	1.39E-02	4.94E-05	.00E+00	1.51E-06
53I	132	1.14E-03	1.66E-06	3.37E-06	1.20E-06	1.58E-04	3.76E-06	.00E+00	2.73E-06
53I	133	4.21E-02	1.25E-05	1.82E-05	5.33E-06	3.31E-03	2.14E-05	.00E+00	3.08E-06
53I	135	1.69E-02	3.64E-06	7.24E-06	2.64E-06	6.49E-04	8.07E-06	.00E+00	2.62E-06
55CS	134	2.45E-03	3.77E-04	7.03E-04	7.10E-05	.00E+00	1.81E-04	7.42E-05	1.91E-06
55CS	136	2.90E-04	4.59E-05	1.35E-04	5.04E-05	.00E+00	5.38E-05	1.10E-05	2.05E-06
55CS	137	3.25E-03	5.22E-04	6.11E-04	4.33E-05	.00E+00	1.64E-04	6.64E-05	1.91E-06
56BA	140	3.93E-03	1.71E-04	1.71E-07	8.81E-06	.00E+00	4.06E-08	1.05E-07	4.20E-05
57LA	140	7.12E-03	2.11E-08	8.32E-09	2.14E-09	.00E+00	.00E+00	.00E+00	9.77E-05
58CE	141	5.00E-05	7.87E-08	4.80E-08	5.65E-09	.00E+00	1.48E-08	.00E+00	2.48E-05
58CE	143	5.70E-04	1.48E-08	9.82E-06	1.12E-09	.00E+00	2.86E-09	.00E+00	5.73E-05
58CE	144	1.23E-03	2.98E-06	1.22E-06	1.67E-07	.00E+00	4.93E-07	.00E+00	1.71E-04
59PR	143	5.00E-05	8.13E-08	3.04E-08	4.03E-09	.00E+00	1.13E-08	.00E+00	4.29E-05
59PR	144	1.23E-03	2.74E-10	1.06E-10	1.38E-11	.00E+00	3.84E-11	.00E+00	4.93E-06
OTOTAL NUMBER		IN SOURCE TERM IS		41	TOTAL RELEASE IS 1.6602E+03				
1				*	*	*	AS LOW AS REASONABLY ACHIEVABLE		
0		A D U L T		D O S E S					
0									
OPATHWAY		SKIN	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
FISH			9.22E-02	1.71E-01	1.29E-01	1.27E-01	6.51E-02	2.75E-02	3.00E-02
INVERTEBRATE			1.26E-02	2.80E-02	1.81E-02	1.18E-02	1.37E-02	4.52E-03	8.70E-02
DRINKING			2.98E-03	3.86E-01	3.85E-01	6.78E-01	3.86E-01	3.83E-01	4.07E-01
SHORELINE	3.85E-05		3.28E-05	3.28E-05	3.28E-05	3.28E-05	3.28E-05	3.28E-05	3.28E-05
SWIMMING			3.78E-06	3.78E-06	3.78E-06	3.78E-06	3.78E-06	3.78E-06	3.78E-06
BOATING			3.28E-05	3.28E-05	3.28E-05	3.28E-05	3.28E-05	3.28E-05	3.28E-05
TOTAL		3.85E-05	1.08E-01	5.86E-01	5.32E-01	8.16E-01	4.65E-01	4.15E-01	5.24E-01
0		USAGE (KG/YR,HR/YR)	DILUTION	TIME (HR)	SHOREWIDTH FACTOR= .2				
FISH		21.0	11.0	24.00					
INVERTEBRATE		5.0	11.0	24.00					
DRINKING		730.0	11.0	12.00					
SHORELINE		12.0	44.0	.00					
SWIMMING		12.0	44.0	.00					
BOATING		52.0	11.0	.00					
0		T E E N A G E R		D O S E S					
0									
OPATHWAY		SKIN	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
FISH			9.71E-02	1.73E-01	7.54E-02	1.17E-01	6.39E-02	2.85E-02	2.29E-02
INVERTEBRATE			1.33E-02	2.78E-02	1.15E-02	1.07E-02	1.34E-02	4.36E-03	6.68E-02
DRINKING			2.91E-03	2.73E-01	2.71E-01	5.25E-01	2.73E-01	2.70E-01	2.87E-01
SHORELINE	2.15E-04		1.83E-04	1.83E-04	1.83E-04	1.83E-04	1.83E-04	1.83E-04	1.83E-04
SWIMMING			2.11E-05	2.11E-05	2.11E-05	2.11E-05	2.11E-05	2.11E-05	2.11E-05
BOATING			3.28E-05	3.28E-05	3.28E-05	3.28E-05	3.28E-05	3.28E-05	3.28E-05
TOTAL		2.15E-04	1.14E-01	4.75E-01	3.58E-01	6.53E-01	3.50E-01	3.03E-01	3.77E-01
0		USAGE (KG/YR,HR/YR)	DILUTION	TIME (HR)	SHOREWIDTH FACTOR= .2				
FISH		16.0	11.0	24.00					
INVERTEBRATE		3.8	11.0	24.00					
DRINKING		510.0	11.0	12.00					
SHORELINE		67.0	44.0	.00					
SWIMMING		67.0	44.0	.00					
BOATING		52.0	11.0	.00					
0		C H I L D		D O S E S					
0									
OPATHWAY		SKIN	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
FISH			1.20E-01	1.51E-01	3.31E-02	1.22E-01	5.38E-02	2.27E-02	1.23E-02
INVERTEBRATE			1.71E-02	2.45E-02	6.69E-03	1.13E-02	1.16E-02	3.65E-03	2.83E-02
DRINKING			8.45E-03	5.25E-01	5.20E-01	1.15E+00	5.24E-01	5.18E-01	5.35E-01
SHORELINE	4.49E-05		3.83E-05	3.83E-05	3.83E-05	3.83E-05	3.83E-05	3.83E-05	3.83E-05
SWIMMING			4.41E-06	4.41E-06	4.41E-06	4.41E-06	4.41E-06	4.41E-06	4.41E-06
BOATING			1.83E-05	1.83E-05	1.83E-05	1.83E-05	1.83E-05	1.83E-05	1.83E-05
TOTAL		4.49E-05	1.46E-01	7.01E-01	5.60E-01	1.28E+00	5.90E-01	5.45E-01	5.76E-01
0		USAGE (KG/YR,HR/YR)	DILUTION	TIME (HR)	SHOREWIDTH FACTOR= .2				
FISH		6.9	11.0	24.00					
INVERTEBRATE		1.7	11.0	24.00					
DRINKING		510.0	11.0	12.00					
SHORELINE		14.0	44.0	.00					
SWIMMING		14.0	44.0	.00					



Technical Input for COLA ER Section 5.4.4 for BBNPP (Dose to Biota)

BOATING	29.0	11.0	.00						
0	I N F A N T	D O S E S							
0									
OPATHWAY	SKIN	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI	
FISH		.00E+00	.00E+00	.00E+00	.00E+00	.00E+00	.00E+00	.00E+00	
DRINKING		9.97E-03	5.18E-01	5.10E-01	1.50E+00	5.16E-01	5.09E-01	5.20E-01	
SHORELINE	3.85E-05	3.28E-05	3.28E-05	3.28E-05	3.28E-05	3.28E-05	3.28E-05	3.28E-05	
SWIMMING		3.78E-06	3.78E-06	3.78E-06	3.78E-06	3.78E-06	3.78E-06	3.78E-06	
BOATING		3.28E-05	3.28E-05	3.28E-05	3.28E-05	3.28E-05	3.28E-05	3.28E-05	
TOTAL	3.85E-05	1.00E-02	5.18E-01	5.11E-01	1.50E+00	5.16E-01	5.09E-01	5.20E-01	
0	USAGE (KG/YR,HR/YR)	DILUTION	TIME(HR)						
FISH	.0	11.0	24.00						
DRINKING	330.0	11.0	12.00						
SHORELINE	12.0	44.0	.00						
SWIMMING	12.0	44.0	.00						
BOATING	52.0	11.0	.00						
1									
0	SPORT HARVEST								
0									
OPATHWAY	AGE GROUP	USAGE	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
FISH	ADULT	1.98E+05	2.06E-01	3.82E-01	2.87E-01	1.63E-01	1.44E-01	6.16E-02	5.75E-02
FISH	TEENAGER	2.31E+04	3.33E-02	5.93E-02	2.58E-02	2.28E-02	2.16E-02	9.76E-03	6.67E-03
FISH	CHILD	1.60E+04	6.62E-02	8.30E-02	1.80E-02	3.70E-02	2.93E-02	1.25E-02	5.98E-03
FISH	TOTAL	2.37E+05	3.06E-01	5.25E-01	3.31E-01	2.23E-01	1.95E-01	8.39E-02	7.02E-02
0	LOCATION	DILUTION	CATCH	TIME(HR)	INCLUDES	FOOD PROCESSING	TIME OF		
0	Commercial Fishing Total	4.60E+01	2.37E+05	1.68E+02			1.68E+02	HR	POPULATION=4.03E+04
0	AVERAGE INDIVIDUAL CONSUMPTION (KG/YR)								
1									
0	COMMERCIAL HARVEST								
0									
OPATHWAY	AGE GROUP	USAGE	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
FISH	ADULT	1.23E+07	1.34E-17	2.48E-17	1.86E-17	8.54E-18	9.33E-18	4.01E-18	3.65E-18
FISH	TEENAGER	1.43E+06	2.16E-18	3.85E-18	1.67E-18	1.19E-18	1.40E-18	6.34E-19	4.23E-19
FISH	CHILD	9.93E+05	4.30E-18	5.39E-18	1.17E-18	1.91E-18	1.90E-18	8.13E-19	3.83E-19
FISH	TOTAL	1.47E+07	1.99E-17	3.41E-17	2.15E-17	1.16E-17	1.26E-17	5.45E-18	4.45E-18
0	LOCATION	DILUTION	CATCH	TIME(HR)	INCLUDES	FOOD PROCESSING	TIME OF		
0	Commercial Fishing-N	9.99E+02	1.00E-09	2.40E+02			2.40E+02	HR	POPULATION=2.51E+06
0	AVERAGE INDIVIDUAL CONSUMPTION (KG/YR)								
1									
0	NEPA DOSES								
0	NOTE--TOTAL NEPA DOSE INCLUDES SPORT CATCH								
0									
OPATHWAY	AGE GROUP	USAGE	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
FISH	ADULT	1.98E+05	2.06E-01	3.82E-01	2.87E-01	1.63E-01	1.44E-01	6.16E-02	5.75E-02
FISH	TEENAGER	2.31E+04	3.33E-02	5.93E-02	2.58E-02	2.28E-02	2.16E-02	9.76E-03	6.67E-03
FISH	CHILD	1.60E+04	6.62E-02	8.30E-02	1.80E-02	3.70E-02	2.93E-02	1.25E-02	5.98E-03
FISH	TOTAL	2.37E+05	3.06E-01	5.25E-01	3.31E-01	2.23E-01	1.95E-01	8.39E-02	7.02E-02
1									
0	SPORT HARVEST								
0									
OPATHWAY	AGE GROUP	USAGE	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
INVER	ADULT	8.33E-10	2.25E-17	5.07E-17	3.28E-17	1.36E-17	2.31E-17	8.25E-18	1.27E-16
INVER	TEENAGER	9.68E-11	3.62E-18	7.70E-18	3.17E-18	1.83E-18	3.44E-18	1.21E-18	1.48E-17
INVER	CHILD	6.97E-11	7.49E-18	1.09E-17	2.93E-18	2.98E-18	4.78E-18	1.63E-18	1.01E-17
INVER	TOTAL	1.00E-09	3.36E-17	6.93E-17	3.89E-17	1.84E-17	3.14E-17	1.11E-17	1.52E-16
0	LOCATION	DILUTION	CATCH	TIME(HR)	INCLUDES	FOOD PROCESSING	TIME OF		
0	Commercial Invert-NONE	9.99E+02	1.00E-09	1.68E+02			1.68E+02	HR	POPULATION=1.17E-09
0	AVERAGE INDIVIDUAL CONSUMPTION (KG/YR)								
1									
0	COMMERCIAL HARVEST								
0									
OPATHWAY	AGE GROUP	USAGE	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
INVER	ADULT	1.78E+06	2.07E-17	4.69E-17	3.03E-17	1.06E-17	2.12E-17	7.65E-18	1.15E-16
INVER	TEENAGER	2.07E+05	3.33E-18	7.13E-18	2.93E-18	1.42E-18	3.14E-18	1.13E-18	1.34E-17
INVER	CHILD	1.49E+05	6.90E-18	1.01E-17	2.70E-18	2.28E-18	4.37E-18	1.51E-18	9.13E-18
INVER	TOTAL	2.14E+06	3.10E-17	6.42E-17	3.60E-17	1.43E-17	2.87E-17	1.03E-17	1.37E-16
0	LOCATION	DILUTION	CATCH	TIME(HR)	INCLUDES	FOOD PROCESSING	TIME OF		
0	Commercial Invert-No	9.99E+02	1.00E-09	2.40E+02			2.40E+02	HR	POPULATION=2.51E+06
0	AVERAGE INDIVIDUAL CONSUMPTION (KG/YR)								
1									
0	NEPA DOSES								
0	NOTE--TOTAL NEPA DOSE INCLUDES SPORT CATCH								
0									
OPATHWAY	AGE GROUP	USAGE	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
INVER	ADULT	1.67E-09	4.48E-17	1.01E-16	6.54E-17	2.50E-17	4.59E-17	1.65E-17	2.51E-16
INVER	TEENAGER	1.94E-10	7.20E-18	1.54E-17	6.33E-18	3.35E-18	6.82E-18	2.43E-18	2.92E-17
INVER	CHILD	1.39E-10	1.49E-17	2.18E-17	5.83E-18	5.44E-18	9.49E-18	3.26E-18	1.99E-17
INVER	TOTAL	2.00E-09	6.70E-17	1.38E-16	7.76E-17	3.38E-17	6.22E-17	2.22E-17	3.00E-16
1									
0	SUPPLIER-Danville MWA								
0									
OPATHWAY	AGE GROUP	USAGE	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
DRINKING	ADULT	1.29E+06	1.11E-03	1.63E-01	1.62E-01	2.44E-01	1.62E-01	1.61E-01	1.70E-01
DRINKING	TEENAGER	1.40E+05	1.68E-04	1.79E-02	1.78E-02	2.88E-02	1.79E-02	1.77E-02	1.88E-02
DRINKING	CHILD	2.29E+05	7.98E-04	5.63E-02	5.58E-02	9.91E-02	5.61E-02	5.57E-02	5.73E-02
DRINKING	TOTAL	1.66E+06	2.07E-03	2.37E-01	2.36E-01	3.72E-01	2.36E-01	2.35E-01	2.46E-01
0	POPULATION=4.90E+03	DILUTION=4.60E+01		TRANSIT TIME=8.78E+01	HR (INCLUDING 24 HR FOR TREATMENT FACILITY)				
0	AVERAGE INDIVIDUAL CONSUMPTION (L/YR)			ADULT=3.70E+02	TEEN=2.60E+02	CHILD=2.60E+02			
0									



Technical Input for COLA ER Section 5.4.4 for BBNPP (Dose to Biota)

```

OSUPPLIER-Sunbury MWA
0
-----DOSE (PERSON-REM)-----
OPATHWAY  AGE GROUP  USAGE      BONE      LIVER      TOTAL BODY  THYROID      KIDNEY      LUNG      GI-LLI
DRINKING   ADULT      2.90E+06   2.50E-03   3.67E-01   3.66E-01   5.50E-01   3.66E-01   3.64E-01   3.84E-01
DRINKING   TEENAGER   3.16E+05   3.79E-04   4.04E-02   4.01E-02   6.49E-02   4.03E-02   3.99E-02   4.23E-02
DRINKING   CHILD      5.17E+05   1.80E-03   1.27E-01   1.26E-01   2.24E-01   1.27E-01   1.26E-01   1.29E-01
DRINKING   TOTAL      3.73E+06   4.67E-03   5.34E-01   5.32E-01   8.39E-01   5.33E-01   5.29E-01   5.56E-01
OPOPULATION=1.10E+04  DILUTION=4.60E+01  TRANSIT TIME=8.78E+01 HR (INCLUDING 24 HR FOR TREATMENT FACILITY)
OAVVERAGE INDIVIDUAL CONSUMPTION (L/YR)  ADULT=3.70E+02  TEEN=2.60E+02  CHILD=2.60E+02
0-----CUMULATIVE TOTAL-----
OPATHWAY  AGE GROUP  USAGE      BONE      LIVER      TOTAL BODY  THYROID      KIDNEY      LUNG      GI-LLI
DRINKING   CUMUL TOTAL  5.39E+06   6.75E-03   7.71E-01   7.67E-01   1.21E+00   7.69E-01   7.64E-01   8.02E-01
0
0  HYDROSPHERE TRITIUM DOSE
OAVVERAGE INDIVIDUAL WATER CONSUMPTION = 3.0 L/DAY
OPATHWAY  AGE GROUP  USAGE      BONE      LIVER      TOTAL BODY  THYROID      KIDNEY      LUNG      GI-LLI
WATER      TOTAL      2.86E+11   .00E+00   1.27E-02   1.27E-02   1.27E-02   1.27E-02   1.27E-02   1.27E-02
1
0  RECREATION POPULATION DOSES
0
0  LOCATION- Shoreline-none
ODILUTION= 9.99E+02  TRANSIT TIME= 9.99E+02 HR  SWF= .2
0  DOSE (PERSON-REM)
OPATHWAY  AGE GROUP  USAGE      SKIN      TOTAL BODY  THYROID
SHORELINE  TOTAL POPUL  1.00E-09   1.35E-19   1.15E-19   1.15E-19
0
0  LOCATION- Swimming-none
ODILUTION= 9.99E+02  TRANSIT TIME= 9.99E+02 HR
0  DOSE (PERSON-REM)
OPATHWAY  AGE GROUP  USAGE      SKIN      TOTAL BODY  THYROID
SWIMMING   TOTAL POPUL  1.00E-09   1.61E-21   1.61E-21
0
0  LOCATION- Boating
ODILUTION= 4.60E+01  TRANSIT TIME= 1.19E+02 HR
0  DOSE (PERSON-REM)
OPATHWAY  AGE GROUP  USAGE      SKIN      TOTAL BODY  THYROID
BOATING    TOTAL POPUL  3.94E+05   1.37E-05   1.37E-05
1* * * DOSE TO BIOTA * * *
0  MRADS PER YEAR
0
0  low dillution  DILUTION= 6.87E+01  TRANSIT TIME= .00E+00 HR
0  INTERNAL  EXTERNAL  TOTAL
FISH        1.09E-01   7.85E-02   1.88E-01
INVERTEBRATE  5.00E-01   1.55E-01   6.55E-01
ALGAE       2.13E+00   1.77E-03   2.13E+00
MUSKRAT     5.59E-01   5.18E-02   6.11E-01
RACCOON     1.56E-01   3.84E-02   1.95E-01
HERON       2.02E+00   5.15E-02   2.07E+00
DUCK        5.15E-01   7.72E-02   5.92E-01
1* * * DOSE TO BIOTA * * *
0  MRADS PER YEAR
0
0  high dillution  DILUTION= 8.60E+01  TRANSIT TIME= .00E+00 HR
0  INTERNAL  EXTERNAL  TOTAL
FISH        8.74E-02   6.27E-02   1.50E-01
INVERTEBRATE  3.99E-01   1.24E-01   5.23E-01
ALGAE       1.70E+00   1.41E-03   1.70E+00
MUSKRAT     4.47E-01   4.14E-02   4.88E-01
RACCOON     1.25E-01   3.07E-02   1.56E-01
HERON       1.61E+00   4.11E-02   1.65E+00
DUCK        4.12E-01   6.17E-02   4.73E-01
1* * * COST-BENEFIT ANALYSIS * * *
0  NUCLIDE  RELEASE  PERSON-REM DOSE  PERSON-REM PER CURIE
0  CI/YR  TOTAL BODY  THYROID  TOTAL BODY  THYROID
1H 3 1.66E+03 7.91E-01 7.91E-01 4.77E-04 4.77E-04
11NA 24 5.72E-03 1.77E-06 1.77E-06 3.10E-04 3.10E-04
24CR 51 9.60E-04 1.85E-07 1.13E-07 1.92E-04 1.17E-04
25MN 54 5.10E-04 6.62E-05 1.88E-07 1.30E-01 3.68E-04
26FE 55 3.80E-04 7.99E-06 6.01E-12 2.10E-02 1.58E-08
26FE 59 9.00E-05 1.44E-05 4.55E-08 1.60E-01 5.05E-04
27CO 58 1.44E-03 6.16E-05 6.13E-07 4.28E-02 4.25E-04
27CO 60 1.70E-04 2.17E-05 1.94E-07 1.28E-01 1.14E-03
30ZN 65 1.60E-04 7.82E-04 4.30E-08 4.89E+00 2.69E-04
74W 187 4.30E-04 5.62E-08 2.81E-09 1.31E-04 6.54E-06
93NP 239 5.40E-04 7.63E-09 7.49E-09 1.41E-05 1.39E-05
38SR 89 4.00E-05 7.02E-06 4.26E-11 1.76E-01 1.07E-06
38SR 91 7.00E-05 2.63E-10 5.51E-12 3.76E-06 7.88E-08
39Y 91M 5.00E-05 .00E+00 .00E+00 .00E+00 .00E+00
39Y 93 3.30E-04 4.94E-12 4.35E-12 1.50E-08 1.32E-08
40ZR 95 1.20E-04 5.03E-08 4.23E-08 4.19E-04 3.53E-04
41NB 95 9.00E-05 1.59E-06 2.83E-08 1.76E-02 3.15E-04
42MO 99 1.63E-03 6.14E-06 5.44E-08 3.76E-03 3.34E-05
43TC 99M 1.59E-03 5.39E-12 1.05E-13 3.39E-09 6.62E-11
44RU 103 2.34E-03 2.71E-06 4.73E-07 1.16E-03 2.02E-04
44RU 106 2.84E-02 1.38E-04 2.65E-06 4.85E-03 9.34E-05

```


Technical Input for COLA ER Section 5.4.4 for BBNPP (Dose to Biota)

47AG 110M	4.10E-04	8.47E-07	4.92E-07	2.07E-03	1.20E-03
52TE 129M	6.00E-05	1.51E-05	3.23E-05	2.52E-01	5.39E-01
52TE 129	4.00E-05	.00E+00	.00E+00	.00E+00	.00E+00
52TE 131M	2.90E-04	8.83E-07	1.67E-06	3.04E-03	5.75E-03
52TE 131	5.00E-05	.00E+00	.00E+00	.00E+00	.00E+00
52TE 132	4.50E-04	2.53E-05	2.98E-05	5.63E-02	6.63E-02
53I 131	3.54E-02	1.11E-03	6.35E-01	3.15E-02	1.79E+01
53I 132	1.14E-03	.00E+00	.00E+00	.00E+00	.00E+00
53I 133	4.21E-02	1.71E-05	8.15E-03	4.05E-04	1.94E-01
53I 135	1.69E-02	6.67E-09	1.20E-06	3.95E-07	7.10E-05
55CS 134	2.45E-03	1.69E-01	1.75E-06	6.91E+01	7.16E-04
55CS 136	2.90E-04	2.48E-03	2.27E-07	8.56E+00	7.82E-04
55CS 137	3.25E-03	1.33E-01	8.06E-07	4.09E+01	2.48E-04
56BA 140	3.93E-03	4.63E-05	3.65E-07	1.18E-02	9.29E-05
57LA 140	7.12E-03	9.40E-07	9.34E-07	1.32E-04	1.31E-04
58CE 141	5.00E-05	1.79E-09	1.45E-09	3.58E-05	2.90E-05
58CE 143	5.70E-04	6.81E-09	6.69E-09	1.19E-05	1.17E-05
58CE 144	1.23E-03	3.60E-07	2.59E-08	2.93E-04	2.11E-05
59PR 143	5.00E-05	3.57E-10	1.54E-11	7.14E-06	3.08E-07
59PR 144	1.23E-03	.00E+00	.00E+00	.00E+00	.00E+00
0 TOTAL		1.10E+00	1.43E+00		

```
1
1 LADTAP2 dayfile
```

```
+ AFL=0
+ IFL=0
+ JFL=0
+ OFL=0
+ EFL=1
+ getopts a:i:j:o: OPTION
+ IN4=18070
+ AFL=1
+ getopts a:i:j:o: OPTION
+ IN1=bb-bio-3.inp
+ IFL=1
+ getopts a:i:j:o: OPTION
+ IN2=ladtap2.lib
+ JFL=1
+ getopts a:i:j:o: OPTION
+ OUL=bb-bio-3.out
+ OFL=1
+ getopts a:i:j:o: OPTION
+ [ 1 -eq 1 -a 1 -eq 1 -a 1 -eq 1 -a 1 -eq 1 ]
+ ERR=0
+ [ 0 -ne 0 ]
+ + pwd
TDIR=/home/users09/amancini/bb
+ RUND=/tmp/ladtap2.18096
+ mkdir /tmp/ladtap2.18096
+ cd /tmp/ladtap2.18096
+ ln -s /home/users09/amancini/bb/bb-bio-3.inp ftn09
+ ln -s /home/users09/amancini/bb/ladtap2.lib ftn20
+ . /SCL/scladmin/sclproc
+ sclproc ladtap2
+ l> ladtap2.ban
+ whence ladtap2
+ timex /SCL/ladtap2/ladtap2.e
+ l> ftn16

real      0.06
user      0.04
sys       0.01

+ STATUS=0
+ echo 1
+ l> /home/users09/amancini/bb/bb-bio-3.out
+ cat ladtap2.ban
+ l>> /home/users09/amancini/bb/bb-bio-3.out
+ cat ftn16
+ l>> /home/users09/amancini/bb/bb-bio-3.out
+ copysbf /home/users09/amancini/bb/dayladtap2.18070 out2 LADTAP2 dayfile
```