INSERTION INSTRUCTIONS FOR AMENDMENT 5

Remove old pages and insert Amendment 5 pages as instructed below.

Transmittal letters along with these insertion instructions should either be filed or entered in Volume 1 in front of any existing letters, instructions, distribution lists, etc.

LEGEND

Remove/Insert Columns

Entries beginning with "T" or "F" designate table or figure numbers, respectively. All other entries are page numbers:

T2.3-14 = Table 2.3-14 F5.4-3 = Figure 5.4-3
2.1-9 = Page 2.1-94 EP2-1 = Page EP2-1 vii = Page vii

Pages printed back to back are indicated by a "/":

1.2-5/1.2-6 = Page 1.2-5 backed by Page 1.2-6

T2.3-14(5 of 5)/T2.3-15(1 of 3) = Table 2.3-14, sheet 5 of 5, backed by Table 2.3-15, sheet 1 of 3

Location Column

Ch = Chapter, S = Section, Ap = Appendix

Remove	Insert	Location
	VOLUME 1	
EP-i/blank	EP-i/blank	After frontispiece
EP2-1/EP2-2 EP2-3/blank	EP2-1/EP2-2 EP2-3/blank	After Chapter 2 tab
2.4-17/blank	2.4-17/blank	S 2.4
T2.4-5 (1 of 1)/ T2.4-6 (1 of 1)	T2.4-5/T2.4-6	S 2.4
2.6-1/2.6-2 2.6-3/2.6-4	2.6-1/2.6-2 2.6-3/2.6-4	S 2.6
T2.6-1 (1 of 1)/ T2.6-2 (1 of 1)	T2.6-1/T2.6-2	S 2.6
3.6-6/3.6-7 3.6-8/blank	3.6-7/3.6-8	S 3.6

INSERTION INSTRUCTIONS FOR AMENDMENT 5 (Cont)

Remove	Insert	Location
	VOLUME 2	
EP-i/blank	-	After frontispiece
EP5-1/EP5-2 EP5-3/EP5-4	EP5-1/EP5-2 EP5-3/EP5-4	After Chapter 5 tab
5.6-3/5.6-4 5.6-5/5.6-6	5.6-3/5.6-4 5.6-5/blank	S 5.6
T5.6-1 (1 of 1)/ T5.6-2 (1 of 1)	T5.6-1/T5.6-2	S 5.6
EP5D-1/blank	EP5D-1/blank	After Appendix 5D tab
5D-i/blank thru T5D-1 (1 of 1)/ blank	5D-i/blank	After Appendix 5D Title page
EP7-1/blank	EP7-1/blank	After Chapter 7 tab
7-v/blank	7-v/blank	After 7-iii/blank
7.1-3/7.1-4	7.1-3/7.1-4	S 7.1
7.1-19/7.1-20 7.1-21/7.1-22	7.1-19/7.1-20 thru 7.1-22a/blank	S 7.1
7.1-29/7.1-30 7.1-31/7.1-32	7.1-29/7.1-30 7.1-31/7.1-32	S 7.1
T7.1-3 (1 of 1)/ T7.1-4 (1 of 1)	T7.1-3/T7.1-4	S 7.1
F7.1-2/blank thru F7.1-6/blank	F7.1-2/blank thru F7.1-8/blank	After F7.1-1
EP8-1/blank	EP8-1/blank	After Chapter 8 tab
8-i/blank 8-iii/blank	8-i/blank 8-iii/blank	After EP8-1
8.1-1/8.1-2 8.1-3/blank	8.1-1/8.1-2 8.1-3/blank	S 8.1

INSERTION INSTRUCTIONS FOR AMENDMENT 5 (Cont)

Remove	Insert	Location
T8.1-1 (1 of 2)/ T8.1-1 (2 of 2) thru T8.1-4/blank	T8.1-1 (1 of 2)/ T8.1-1 (2 of 2) thru T8.1-4/blank	S 8.1
8.2-1/8.2-2	8.2-1/8.2-2	S 8.2
T8.2-1 (1 of 1)/blank	T8.2-1 (1 of 1)/blank	S 8.2
EPQ1-1/EPQ1-2	EPQ1-1/EPQ1-2	After May 4, 1983 tab
QE291.7-1/ QE291.8-1	QE291.7-1/ QE291.8-1	After QE291.5-1/QE291.6-1
EPQ2-1/blank	EPQ2-1/blank	After October 20, 1983 tab
QE451.5-1/QE451.6-1	QE451.5-1/QE451.5-2 TE451.5-1/TE451.5-2	After Figure E451.4-1
QE451.7-1/blank	QE451.6-1/QE451.7-1	After TE451.5-1/E451.5-2
	December 2, 1983 tab thru QE450.2-1/blank	After QE460.1-1/ QE450.2-1

SUMMARY LIST OF EFFECTIVE PAGES

Page, Table (T), or Figure (F)	Amendment Number
EP1-1	E
EP2-1	2
EP2-2 thru EP2-3	5
EP3-1 thru EP3-3	4
EP3A-1	2
EP3B-1	1
EP4-1	0
EP5-1 thru EP5-2	4
EP5-3 thru EP5-4	5
EP5A-1	2
EP5B-1	0
EP5C-1	3
EP5D-1	5
EP6-1	2
EP7-1	5
EP7A-1	2
EP8-1	5
EP9-1	E
EP10-1	0
EP11-1	E
EP12-1	4
EP13-1	0
EPQ1-1	5
EPQ1-2	4
EPQ2-1	5
EPQ3-1	5

LIST OF EFFECTIVE PAGES

Page, Table (T), or Figure (F)	Amendment Number
2-i thru 2-vii	0
2-viii	4
2-ix thru 2-x	0
2.1-1 thru 2.1-15	1
T2.1-1 (1 of 1)	0
T2.1-2 (1 of 1)	0
T2.1-3 (1 of 1)	0
T2.1-4 (1 of 1)	0
T2.1-5 (1 of 1)	0
T2.1-6 (1 of 1)	0
T2.1-7 (1 of 1)	1
T2.1-8 (1 of 1)	1
T2.1-9 (1 of 1)	0
T2.1-10 (1 of 1)	0
T2.1-11 (1 of 1)	1
T2.1-12 (1 of 1)	1
T2.1-13 (1 of 1)	1
T2.1-14 (1 of 1)	1
F2.1-1	0
F2.1-2	1
F2.1-3	0
F2.1-4	1
F2.1-5	4
F2.1-6	0
2.2-1 thru 2.2-2	2
2.2-3 thru 2.2-9	0
T2.2-1 (1 of 1)	2
T2.2-2 (1 thru 3 of 3)	2
T2.2-3 (1 thru 3 of 3)	2
T2.2-4 (1 of 1)	2
T2.2-5 (1 thru 3 of 3)	0
T2.2-6 (1 thru 2 of 2)	0
T2.2-7 (1 of 1)	0
T2.2-8 (1 of 1)	0
T2.2-9 (1 of 1)	0
T2.2-10 (1 thru 6 of 6)	0
T2.2-11 (1 thru 2 of 2)	0
T2.2-12 (1 thru 3 of 3)	0
T2.2-13 (1 thru 2 of 2)	0

LIST OF EFFECTIVE PAGES

LIST OF EFFECTIVE PAGES (Cont)

Ohio River Valley Water Sanitation Commission 1976. Assessment of Validity of Water Sampling Locations on the Ohio River and Lower Reach of Major Tributaries. River Quality Cross Section Study, November 1976.

Pennsylvania Department of Environmental Resources (DER) 1974. Rules and Regulations, Title 25.

Shirazi, M.A. and Davis, L.R. 1974. Workbook of Thermal Plume Prediction. Vol. 2, Surface Discharge. U.S. Environmental Protection Agency, EPA-RZ-72-005b.

U.S. Army Corps of Engineers 1970. Analysis of Flood Heights, Ohio River at Shippingport, Pennsylvania. Hydrologic Engineering Investigation, Pittsburgh District, Pennsylvania.

U.S. Army Corps of Engineers 1976. Letter from E.W. Thomas, Assistant Chief, Engineering Division, Pittsburgh District, to R.L. Naymark, Duquesne Light Company, dated September 17, 1976.

U.S. Army Corps of Engineers 1978. Letter from E.W. Thomas, Assistant Chief, Engineering Division, Pittsburgh District, to W.H. Bohlke, Stone & Webster Engineering Corporation, dated June 15, 1978.

U.S. Army Corps of Engineers, Ohio River Division, January 1981. Profiles - Ohio River.

U.S. Army Corps of Engineers, Pittsburgh District, 1967. Map of Regional Hydrology.

U.S. Army Corps of Engineers, Pittsburgh District, June 1977. Frequency Profile - Ohio River Mile 0 to Mile 54.

U.S. Geological Survey (USGS) 1976. Water Resources Data for Ohio, Water Year 1975. Vol. 1, Ohio River Basin.

U.S. Geological Survey 1978. Water Resources Data for Pennsylvania, Water Year 1977. Vol. 3, Ohio River and St. Lawrence River Basins. Water Data Report PA-77-3.

U.S. Geological Survey 1981. Water Resources Data for Pennsylvania, 1975 to 1980.

Yotsukura, N. and Sayre, W.W. 1976. Transverse Mixing in Natural Channels. Water Resources, Vol. 12, No. 4, August 1976.

TABLE 2.4-5

RESERVOIRS UPSTREAM OF THE SITE*

Name	Usable Storage (acre-feet)	Owner	Use**
Allegheny River Basin			
Allegheny Reservoir	1,180,000	Corps of Engineers	F,L,R,P
Conemaugh River Lake	273,600	Corps of Engineers	F,R
Crooked Creek Lake	93,900	Corps of Engineers	F,R
East Branch, Clarion River Lake	83,300	Corps of Engineers	F,L,R
Loyalhanna Lake	95,300	Corps of Engineers	F,R
Mahoning Creek Lake	74,100	Corps of Engineers	F,R
Tionesta Lake	133,400	Corps of Engineers	F,R
Union City Reservoir	47,650	Corps of Engineers	F
Woodcock Creek Lake	20,000	Corps of Engineers	F,R
Monongahela River Basin			
Deep Creek Reservoir	92,975	Pennsylvania Electric Power	P
Tygart Lake	285,000	Corps of Engineers	F,L,R
Youghiogheny River Lake	210,250	Corps of Engineers	F,L,R
Beaver River Basin			
Berlin Lake	91,150	Corps of Engineers	F,L,W
Milton Reservoir	29,150	City of Youngstown, Ohio	L,W
Michael J. Kirwan Reservoir	78,660	Corps of Engineers	F,L
Mosquito Creek Lake	102,290	Corps of Engineers	F,L,W
Meander Creek Reservoir	32,410	Corps of Engineers	W
Pymatuning Reservoir	188,040	State of Pennsylvania	F,R
Shenango River Lake	191,360	Corps of Engineers	F,L,R
Lake Arthur	37,000	State of Pennsylvania	R

NOTES:

*USGS 1978.
**P - Power
R - Recreation
F - Flood control
L - Low flow augmentation
W - Water supply

TABLE 2.4-6

RIVER STAGE INFORMATION
FOR THE NEW CUMBERLAND POOL*

River Stage	River Level at the Site (feet)
Downstream dam failure (minimum water level)	El 648.6
Normal pool	El 664.5
Ordinary high water	El 675.0
Maximum high water	El 693.0
100 year flood**	El 695.0
500 year flood***	El 700.0
Standard project flood (SPF)****	El 705.0
SPF with upstream dam failure	El 725.2
Probable maximum flood	El 730.0

NOTES:

*U.S. Army Corps of Engineers 1970.
**U.S. Army Corps of Engineers 1981.
***U.S. Army Corps of Engineers 1977.
****Reduced from 707.2 feet in January 1970.

2.6 REGIONAL HISTORIC, ARCHAEOLOGICAL, ARCHITECTURAL, SCENIC, CULTURAL, AND NATURAL FEATURES

Historic sites in the Beaver Valley Power Station (BVPS) region including National Register Historic Places within 10 miles of BVPS-2 and State of Pennsylvania historic sites within 5 miles of BVPS-2 are indicated in Tables 2.6-1 and 2.6-2. However, the historic character of the region, summarized in the following sections, remains as described in Sections 2.2 and 2.3 of the Environmental Report - Construction Permit Stage (ER-CPS).

2.6.1 Historic Background of the Region

The Beaver Valley Power Station - Units 1 and 2 (BVPS-1 and BVPS-2) is located on a series of terraces on the south bank of the Ohio River about 25 miles northwest of Pittsburgh, Pennsylvania. The region has played an important role in the nation's history, primarily as a result of its location along the Ohio River in the area known in the early nineteenth century as the "Gateway to the West."

Some traces of the history of the area, when it was an important stepping-off point for the west, can still be found within a few miles of BVPS-2. Many of the physical structures, however, have disappeared.

There are 12 National Register Historic Places within 10 miles of the BVPS-2 site as presented in Table 2.6-1. These sites, except for the U.S. Public Lands Survey Marker, were registered after the publication of the ER-CPS. Only the Beginning Point of the United States Public Lands Survey (U.S. Department of Interior 1981a) located on the Pennsylvania-Ohio border 4.8 miles west-northwest of the station is within 5 miles of the station. The properties listed in the National Register of Historic Places are generally located in nearby towns and cities and are examples of the area's early industrial history, its famous persons, and strategic location. |

The State of Pennsylvania also maintains a data base of historic sites. At present, there are 12 recorded sites in the area within 5 miles of the station. The locations and distances of the sites from the station are listed in Table 2.6-2. |

During the construction permit stage, BVPS-2 was evaluated in accordance with the requirements of the National Historic Preservation Act to determine whether any historic landmarks would be affected by station construction or operation. The Advisory Council on Historic Preservation (1969) concluded that the probable effect of the station could not be judged to be sufficiently adverse to warrant council comment. This conclusion was reaffirmed in 1978 by the Pennsylvania State Historic Preservation Office (Pennsylvania Historical and Museum Commission 1978).

Historic preservation officers for Pennsylvania, Ohio, and West Virginia were contacted in 1983 to verify listings of historic places and reevaluate the potential impacts on these places due to the operation and maintenance of BVPS-2. Based on the results of this assessment, no impact on National Register or other historic places during the operation or maintenance of BVPS-2 is expected (Pennsylvania Historical and Museum Commission 1983a, Ohio Historic Society 1983, West Virginia Department of Culture and History 1983).

2.6.2 Natural Landmarks

There are no registered natural landmarks in any of the three counties located within a 5-mile radius of the station (U.S. Department of Interior 1981b).

2.6.3 Regional Archaeological Sites

A number of archaeologically significant sites are located in the upper Ohio River region. Almost every major floodplain in the area was the site of a prehistoric Indian village which was occupied intermittently for many thousands of years. The first Indians inhabited the region as early as 12,000 B.C. when the glaciers began to recede. Numerous Indian artifacts, such as stone arrowheads, tools, and utensils, have been excavated from some of these sites, but many of the sites have been destroyed by urban and industrial expansion.

The Anthropology Center of the Carnegie Museum of Pittsburgh lists several archaeological sites in the BVPS vicinity. One Indian village site is near the abandoned Shippingport ferry docks on the south bank of the Ohio River about 0.5 mile upriver from the station. Other archaeological sites are found along the Ohio River at Industry and Vanport and throughout the Raccoon Creek valley beginning at the mouth of the creek 5 miles upriver from the station site (Carnegie Museum Archaeology Center 1978, 1981).

2.6.4 Visual Effects of the Station

The immediate area surrounding the station is one of physical and cultural contrasts. Along the Ohio River, major industrial plants commingle with small- to medium-sized towns on the river terraces. Steep bluffs rise 400 to 600 feet above the river with many small, short streams cutting deep canyons down to the river's edge.

Above and back from the river, rolling hills surround expansive, plateau-like level areas. The area has many small farms, scattered rural settlements, and small crossroads villages. To the west of the site, the topography becomes more gentle, while to the east, even a mile back from the river, there are many steep-walled stream valleys and precipitous changes in elevation.

Seen in this setting, BVPS-2 poses no severe visual change. Almost all views of the plant are confined to the Ohio River Valley or the top of the adjacent bluffs, where the panorama has shown evidence of industry for decades. In addition, due to its proximity to BVPS-1 and Shippingport Atomic Power Station (SAPS), almost all views which include BVPS-2 also include BVPS-1 and SAPS. The Bruce Mansfield Plant, located approximately 1 mile northeast of BVPS-2, further reinforces the industrial character of the region. Therefore, no new or unique viewscape is created by BVPS-2, and visual impacts from BVPS-2 can be considered negligible.

Depending on meteorological conditions, the cooling tower plume may be visible over a greater area. However, experience with BVPS-1 indicates that when the plume is most extensive, the background sky is usually light white, and the clouds and fog merge with the plume, making it much less noticeable. In addition, plumes from BVPS-1 and the Bruce Mansfield Plant already exist and will occur simultaneously with those from BVPS-2. Thus, a minimal change will be added to the view by BVPS-2 plumes. Plume description and occurrence is discussed further in Section 5.1.4.

Since BVPS-2 does not change the established visual character of the area, no ground-level photographs are included in this section.

2.6.5 Transmission Corridor

Historic, archaeological, architectural, scenic, cultural, and natural features of the region will not be impacted by BVPS-2 transmission since existing corridors and transmission towers will be utilized in all offsite areas.

2.6.6 References for Section 2.6

Advisory Council on Historic Preservation 1969. Letter dated April 14, 1969.

Carnegie Museum Archaeology Center 1978. Letter from Dr. Stanley Lance, Field Archaeologist, dated August 17, 1978.

Carnegie Museum Archaeology Center 1981. Personal communication from Dr. Stanley Lance, Field Archaeologist, December 29, 1981.

Ohio Historic Society 1983. Signed concurrence by W. Ray Luce, State Historic Preservation Officer, September 12, 1983 on letter from E.G. Nelson, Stone & Webster Engineering Corp. (SWEC), dated August 30, 1983.

Pennsylvania Historical and Museum Commission 1978. Stamped approval by Vance Packard, State Historic Preservation Officer, August 17, 1978 on letter from Stuart L. Miner, Environmental Planner, NUS Corporation, dated August 14, 1978.

Pennsylvania Historical and Museum Commission 1983a. Signed concurrence by Ms. Brenda Barrett, Director, November 14, 1983 on letter from E.G. Nelson, SWEC, dated October 25, 1983.

Pennsylvania Historical and Museum Commission 1983b. Letter from Ms. Donna Williams, Chief, Division of Planning and Protection, September 29, 1983.

Pennsylvania Historical and Museum Commission 1984. Listing of historic properties in Beaver County from state data base in letter from Ms. Sharon Kukla, dated January 25, 1984.

U.S. Department of Interior 1981a. National Register of Historic Places. Heritage Conservation and Recreation Service, Annual Listing of Historic Properties.

U.S. Department of Interior 1981b. National Registry of Natural Landmarks. Heritage Conservation and Recreation Service.

West Virginia Department of Culture and History 1983. Letter from Rodney S. Collins, Director, Historic Preservation Unit, dated August 23, 1983.

TABLE 2.6-1

NATIONAL REGISTER OF HISTORIC PLACES
SITES WITHIN 10 MILES
OF BEAVER VALLEY POWER STATION

Site	Location	Distance from Station (Miles)	Direction from Station
Pennsylvania			
Fort McIntosh Site*	Beaver	9.0	NE
Matthew S. Quay House*	Beaver	9.0	NE
William B. Dunlap Mansion*	Bridgewater	9.0	NE
B.F. Jones Memorial Library*	Aliquippa	10.0	E
Merrill Lock No. 6*	Industry	5.2	NE
Ohio			
Beginning Point of U.S. Public Land Survey	East Liverpool (on Ohio-Pennsylvania boundary)	4.8	WNW
East Liverpool Post Office*	East Liverpool	7.5	W
East Liverpool Pottery*	East Liverpool	7.2	W
Cassius Clark Thompson House*	East Liverpool	7.0	W
Carnegie Public Library*	East Liverpool	7.5	W
Ikirt House*	East Liverpool	7.5	W
West Virginia			
Old Courthouse*	New Manchester	10.0	SW

NOTE:

*Sites added to National Register since publication of the ER-CPS.

TABLE 2.6-2

ADDITIONAL HISTORIC SITES WITHIN 5 MILES OF BVPS

Name	Location	Approximate Distance (miles)	Direction
Indian Petroglyphs*	Smiths Ferry	3.75	WNW
Service Creek Monuments*	Raccoon Township	4.25	SE
Service United Presbyterian Church*	Raccoon Township	4.50	SE
John Anderson Cemetery*	Raccoon Township	4.50	SE
Christler's Landing*	Shippingport	0.50	NNE
Christy Home*	Shippingport	0.50	NNE
Bethlehem Church*	Shippingport	1.25	NE
Nelson Place*	Greene Township	4.00	SW
Littell Homestead*	Greene Township	4.00	S
Bakers Landing*	Potter Township	5.00	ENE
Shippingport Atomic Power Station**	Shippingport	0.25	SW
Mill Creek Church***	Greene Township	4.50	SW

NOTES:

*Pennsylvania Historical and Museum Commission 1978.
**Pennsylvania Historical and Museum Commission 1983b. This site has been determined to be eligible for the National Register.
***Pennsylvania Historical and Museum Commission 1984.

3.6.8 Screenwash System

3.6.8.1 Main Intake Structure

The main intake structure is common to both units.

When only BVPS-1 is operating, the intake traveling screens are backwashed at 770 gpm for approximately 10 minutes, three times a day. When both BVPS-1 and BVPS-2 are operating, the frequency and daily average flows are doubled.

3.6.8.2 Auxiliary Intake Structure

The auxiliary intake structure is common to both units.

Although the auxiliary intake structure is not normally used, the intake travelling screens are backwashed at 195 gpm for approximately 3 hours once a week to prevent the buildup of debris.

3.6.9 Salt and Water Drift

A mathematical model was developed to determine the downwind distribution of salt and water deposition rate and airborne salt concentration resulting from cooling tower operation. A detailed description of the model and results are contained in Appendix 3B. The model takes into account the following: configuration and performance of the towers, drift rate, exit velocity, total dissolved solids level, droplet size distribution, evaporation rate, plume buoyancy, wind speed, wind direction, wet-bulb temperature, and relative humidity. One year of onsite meteorological data (January 1, 1976 to December 31, 1976) was used in the drift model.

A maximum salt deposition rate of 9.9 pounds per acre per year (0.11 $mg/cm^2/year$) occurs approximately 4,750 feet east of the cooling towers. The maximum water deposition rate of 20,300 pounds per acre per year (227.3 $mg/cm^2/year$) occurs at a distance of approximately 4,000 feet east of the towers. The maximum annual average airborne salt concentration is predicted to be 0.07 g/m^3 (7×10^{-8} mg/l) approximately 7,000 feet east of the towers, while the maximum hourly airborne concentration of 21.9 g/m^3 (2.19×10^{-5} mg/l) occurs 3,250 feet west-southwest of the towers. These maxima are the largest values occurring over the entire spatial grid of the model. Spatial averages of these concentrations are not given due to their insignificance in light of the small impacts caused by the maximum values (Section 5.3.3).

3.6.10 References for Section 3.6

Duquesne Light Company (DLC) 1978. Letter from R.J. McAllister, DLC, to B. Smith, U.S. Environmental Protection Agency, Region III, dated July 20, 1978.

LaQue, F. L. and Copson, H. R. 1963. Corrosion Resistance of Metals and Alloys, Second Edition. Reinhold Publishing Corporation, New York, N.Y.

NUS Corporation 1975. 1974 Baseline Report and Addenda November 1973 through December 1974. Aquatic Ecology Study.

U.S. Environmental Protection Agency 1974. Effluent Guidelines and Standards for the Steam Electric Power Generating Point Source Category. 40 CFR 423. Federal Register, Vol. 39, No. 196.

LIST OF EFFECTIVE PAGES

Page, Table (T), or Figure (F)	Amendment Number
T5.2-27 (1 of 1)	0
T5.2-28 (1 of 1)	3
T5.2-29 (1 of 1)	3
F5.2-1	0
F5.2-2	0
5.3-1 thru 5.3-2	1
5.3-3, 5.3-4, 5.3-4a	2
5.3-5 thru 5.3-8	1
5.3-9, 5.3-10, 5.3-10a	2
5.3-11 thru 5.3-12	1
T5.3-1 (1 of 1)	0
T5.3-2 (1 of 1)	0
T5.3-3 (1 thru 2 of 2)	0
T5.3-4 (1 thru 2 of 2)	1
T5.3-4a (1 of 1)	1
T5.3-5 (1 of 1)	0
5.4-1	2
T5.4-1 (1 of 1)	2
5.5-1 thru 5.5-2	0
5.5-3 thru 5.5-6	E
T5.5-1 (1 of 1)	0
5.6-1 thru 5.6-3	0
5.6-4 thru 5.6-5	5
5.6-6	0
T5.6-1 (1 of 1)	0
T5.6-2	5
F5.6-1	0
5.7-1 thru 5.7-2	2
5.7-3	0
T5.7-1 (1 of 1)	2
5.8-1 thru 5.8-3	0
5.8-4 thru 5.8-7	E

LIST OF EFFECTIVE PAGES

Page, Table (T), or Figure (F)	Amendment Number
T5.8-1 (1 of 1)	E
5.9-1	E
T5.9-1 (1 thru 5 of 5)	0

from the operation of BVPS-1, although generally inaudible, are in essence included in the 1977 ambient survey data. Therefore, it is not necessary to include the BVPS-1 sound levels in the BVPS-2 predictions to arrive at station impact. The total BVPS-2 operational sound levels, determined by logarithmically combining the contribution of each major source, are presented in Table 5.6-1. The prediction includes the effects of hemispherical divergence, atmospheric absorption (except for the low frequency noise from the transformer where it has little or no effect), and man-made barriers, but does not include the attenuating effects of intervening topography, vegetation, and meteorology. The levels predicted are assumed to be constant and are represented statistically by an L_{eq} as indicated in Table 5.6-1.

5.6.1.6 Impact Assessment

The noise from the operation of a nuclear power station is that of a continuous nonvarying noise source. The loudness does not vary from day to day or between night and day except for an occasional infrequent, short-term event, such as the release of excess steam. Since there are no state or local noise regulations currently in effect, the potential acoustical impact of the plant is assessed by comparing the predicted plant sound levels with requisite levels identified by the USEPA. The USEPA (1974) identifies an average day/night sound level (L_{dn}) of 55 dB as the maximum level for residential areas below which speech, sleep, relaxation, privacy, and other activity interference will not occur. Examination of Table 5.6-1 shows that, in the noise-sensitive areas adjacent to the BVPS site, the existing community L_{dn} sound levels are above 55 dB, indicating that there may already exist some speech and activity interference. The predicted BVPS-2 operational noise levels also shown in Table 5.6-1 are for the summertime, when all the previously described noise sources could be operating, which represents a worst case condition. During the winter months, the turbine hall power roof ventilation system operates intermittently and the summer wall vents are closed, resulting in lower operational noise levels. The predicted L_{dn} sound levels for BVPS-2 are lower at all locations than the USEPA-suggested 55 dB level except at location 2, where it is exceeded by only 3 dB.

Combining the existing community L_{dn} sound levels with the predicted BVPS-2 operational L_{dn} sound levels, it can be seen that there is no change in the community L_{dn} sound levels, except at location 2 where there is a 2 dB increase. Location 2 is at the BVPS property line in the vicinity of the nearest residential area. The BVPS-2 operational noise prediction, as previously described, is for a worst case condition that does not take into account the effects of topography, vegetation, and meteorology which would tend to reduce the predicted sound levels. The BVPS-2 operational yearly average L_{dn} sound levels will be somewhat less than the predicted L_{dn} sound levels due to the seasonal variations in BVPS-2 operational noise from reduced ventilation noise levels during the cooler months. Additionally, as

the noise activity at the Bruce Mansfield Plant increases, the impact of BVPS-2 will be less obvious. Therefore, there is no anticipated community reaction to the BVPS-2 operational noise.

5.6.2 Effects of Gaseous Emissions on Ambient Air Quality

5.6.2.1 Ground-Level Impact Under Normal Diffusion Conditions

The fossil-fueled equipment used at BVPS is discussed in Section 3.7.2. The four auxiliary boilers, four emergency diesel generators, the diesel fire protection pump, and the standby diesel generator at the plant will emit sulfur dioxide (SO_2), nitrogen oxides, carbon monoxide (CO), hydrocarbons, and particulate matter (Table 3.7-1). The auxiliary boilers have an estimated operating time of 1,424 hours per year. The diesel generators, the diesel fire protection pump, and the standby diesel generator operate only during emergency situations, but will be tested regularly for an estimated annual operating time of 24 hours (1 hour, twice a month), 26 hours (1/2-hour per week), and 12 hours (1 hour, once per month), respectively.

The auxiliary boilers and diesels will burn No. 2 fuel oil. The uncontrolled emission rates of the pollutants given in Table 3.7-1 indicate that the units will not be major sources of these pollutants and thus not subject to the Clean Air Act Amendments of 1977. A major source is one which emits or has the potential to emit 100 (or 250, depending on the source category) tons per year or more of any of the applicable pollutants. The applicable EPA requirement (40 CFR 52.2) for a Prevention of Significant Deterioration (PSD) analysis is 250 tons per year or more, which the station sources do not meet. Therefore, no impact analysis need be performed. In addition, since the auxiliary boilers have a heat input of less than 250 x 10^6 Btu/hour, and since the emergency diesels are not steam generators, the Federal New Source Performance Standards for SO_2, nitrogen oxides, and particulates are not applicable to these units. However, the state SO_2 and particulate emission regulations are applicable due to a heat input of greater than 2.5 x 10^6 Btu/hour to each unit. The emission rates of these pollutants from each unit (Table 3.7-1) are below the state standard.

5.6.3 References for Section 5.6

Capano, G.A. and Bradley, W.E. 1976. Noise Prediction Techniques for Siting Large Natural Draft and Mechanical Draft Cooling Towers. Stone & Webster Engineering Corporation, presented at the 38th Annual Meeting of the American Power Conference, Chicago, Ill., April 1976.

Schultz, M.W. and Ringlee, R.J. 1960. Some Characteristics of Audible Noise of Power Transformers and their Relationship to Audibility Criteria and Noise Ordinances. Power Apparatus and Systems, American Institute of Electrical Engineers, June 1960.

U.S. Environmental Protection Agency (USEPA) 1974. Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety. Report No. 550/9-74-004.

TABLE 5.6-1

BVPS OPERATIONAL NOISE AND COMMUNITY SOUND LEVELS
(dBA re: 0.0002 microbar)

Location*	BVPS-2 Predicted Equipment Sound Level Contribution (dBA)									
					Turbine Hall				Existing Community	Combined Community/Station
	Cooling Tower	Main Transformer	Intake Fan Ventilation	Power Roof Ventilation	Summer Ventilation	Air Intake	Total	L_{dn}	L_{dn}	L_{dn}
1	33	30	23	25	26	20	36	42	70	70
2	51	41	38	40	37	31	52	58	61	63
3	29	28	19	22	24	18	33	39	67	67
4	35	32	25	28	29	23	38	44	61	61
5	30	30	21	24	26	20	35	41	66	66
6	34	32	25	28	28	22	38	44	63	63

NOTE:

*Predicted sound level locations are shown on Figure 5.6-1.

TABLE 5.6-2

MAXIMUM GROUND-LEVEL CONCENTRATIONS ($\mu g/m^3$) AND THEIR LOCATIONS FOR VARIOUS BVPS FOSSIL-FUELED SOURCES UNDER NORMAL AND SPECIAL DIFFUSION CONDITIONS

This table has been intentionally deleted from the BVPS-2 ER-OLS.

LIST OF EFFECTIVE PAGES

Page, Table (T), or Figure (F)	Amendment Number
Appendix 5D Title Page	0
Appendix 5D Deletion Page	5

Appendix 5D has been intentionally deleted from the BVPS-2 ER-OLS.

LIST OF EFFECTIVE PAGES

Page, Table (T), or Figure (F)	Amendment Number
7-i thru 7-iii	2
7-v	5
7.1-1 thru 7.1-2	2
7.1-3	5
7.1-4 thru 7.1-18	2
7.1-19 thru 7.1-22a	5
7.1-23 thru 7.1-29	2
7.1-30	5
7.1-31	2
7.1-32	5
7.1-1 thru 7.1-32	2
T7.1-1	2
T7.1-2	2
T7.1-3	5
T7.1-4	5
F7.1-1	2
F7.1-2	5
F7.1-3	5
F7.1-4	5
F7.1-5	5
F7.1-6	5
F7.1-7	5
F7.1-8	5
7.2-1	E
7.3-1 thru 7.3-2	2
7.3-3	0
7.3-4 thru 7.3-6	E
T7.3-1 (1 of 1)	0

LIST OF FIGURES

Reactors, U.S. Department of Energy (USDOE), formerly ERDA. The SAPS terminated operation in 1982 and is scheduled for decommissioning by the USDOE. The SAPS area is leased by DLC to the USDOE.

The low population zone (LPZ) surrounding BVPS-2 encompasses an area within an approximate 3.6-mile radius of the BVPS-2 reactor containment centerline. The distance for the LPZ is based on the requirements of 10 CFR 100. The 3.6-mile radius meets the requirement that the LPZ be an area in which sufficient protective measures can be taken to assure that the resident population does not receive a dose in excess of a specified level resulting from a postulated accident condition. No population centers with populations equal to or greater than 25,000 exist within the LPZ, or within an area of radius 1 1/3 times the LPZ radius, approximately 4.8 miles.

The population center nearest to BVPS-2, as defined by 10 CFR 100, is the township of McCandless, Pennsylvania, which supported approximately 26,250 people in 1980 at a density of 1,608 people per square mile. The township's closest corporate boundary to the station is approximately 17 miles east of BVPS-2. Existing population centers with over 25,000 people are presented in FSAR Table 2.1-24. Cities and towns projected to become population centers with over 25,000 people during the period 1980 to 2030 are listed in FSAR Table 2.1-25. The projected population distribution for 2010, based on 1980 census data, is found in FSAR Tables 2.1-7, 2.1-14, and 2.1-21.

The safety analysis of the BVPS-2 site has also included a review of potential external hazards generated by man (offsite activities that might cause an accident). This review encompassed nearby industrial, transportation, and military facilities that might create explosive, missile, toxic gas, or similar hazards. The risk to BVPS-2 from such hazards has been found to be negligible. A more detailed discussion of the compliance with siting criteria and the consideration of external hazards is given in FSAR Section 2.2. Also discussed in the FSAR are design provisions required for severe natural phenomena such as earthquakes, floods, and tornadoes.

7.1.2.3 Emergency Preparedness

An Emergency Preparedness Plan for BVPS is in place and is exercised on an annual basis. The plan applies to the operation of BVPS-1 during the construction of BVPS-2 and will be modified to address both units upon completion and operation of BVPS-2.

The BVPS Emergency Preparedness Plan provides guidance for coping with both onsite and offsite emergency situations. It ranges in scope from relatively minor unusual events and occurrences involving small releases of radioactive material to a major nuclear accident having significant offsite radiological consequences. This plan, together with the interrelated state and county emergency plans,

provides detailed arrangements for extending emergency measures to a radius of approximately 10 miles from BVPS. The elements of response to offsite emergency conditions are continued in the emergency plans and emergency operating procedures of the responsible offsite emergency organization. The 10-mile emergency planning zone surrounding BVPS encompasses three states: Pennsylvania, Ohio, and West Virginia; and three counties: Beaver County, Pa; Columbiana County, Ohio; and Hancock County, West Virginia. Continuing liaison with the emergency organizations of these jurisdictions ensures compatability with the BVPS plan. The coordination and liaison with offsite emergency organizations include formal agreements that individual organizations will perform their respective emergency functions in response to requests from BVPS.

7.1.3 Accident Risk and Impact Assessment

7.1.3.1 Design Basis Accidents

This section evaluates the environmental impact of postulated accidents and occurrences involving radioactivity. Assumptions used in these evaluations are based on normal operating conditions. This is in contrast to the highly conservative assumptions employed in the FSAR, where worst-case conditions are postulated.

Radiation doses are calculated using the core radioactivity given in FSAR Table 12.2-3, a χ/Q value of 9.6×10^{-4} sec/m^3, and the calculational methods described in Regulatory Guides 1.4, Revision 2, and 1.145, Revision 1, except that the average breathing rate is used. The χ/Q value of 9.6×10^{-4} sec/m^3 is the 0- to 2-hour value for the northwest sector of the exclusion area boundary. This is the 50-percent direction dependent (worst sector) value and is based on onsite meteorological data from January 1, 1976 through December 31, 1980. Section 2.3.4 describes the methodology used to develop meteorological values. Table 7.1-1 gives the integrated gamma, beta, and thyroid doses at the exclusion area boundary (EAB) from these accident analyses.

As is evidenced in Table 7.1-1, the resulting doses from the accidents described in the following sections are well below the values specified in 10 CFR 100. The environmental impact from such accidents would be minimal.

The design conditions are categorized as follows:

1. Incidents of moderate frequency

   These are events that can reasonably be expected to occur during any year of operation.

release category parameters used for the analysis are presented in Table 7.1-3.

Potential radiological consequences have been calculated for the nine release categories using the CRAC2 computer code. This code incorporates the models developed in the RSS. The analyses are site specific and employ environmental parameters associated with the BVPS-2 location. Meteorological data used in the analyses represent one full year of hourly averages of wind speed and direction, atmospheric lapse rate, and precipitation. Population data for the year 2010 is based on 1980 census data for the area within a 350-mile radius of the plant. Habitable land fraction out to 350 miles is also a site-specific input. In addition, the analyses require land use statistics as a function of state, including land value, farm product values, and growing season information for the area out to 350 miles. A diagram of the consequence analysis model is given on Figure 7.1-1.

In order to calculate consequences and their associated probabilities, weather data for 1 year are sampled. It would be prohibitively expensive to model the radioactivity release starting at each of the 8,760 possible hourly start times. Instead, a provision known as "bin sampling" is used. In this method, all of the hourly meteorological data are first classified into groups or bins (there are 29 bins defined in CRAC2) on the basis of similarity of weather sequences. Samples are selected from each bin. This ensures against exclusion or inappropriate weighting of some weather sequences.

Protective actions modeled which would reduce radiation doses include evacuation of nearby population, sheltering of non-evacuees, long-term relocation of people, and interdiction and decontamination of contaminated land. The evacuation plan used (refer to Appendix 7A) is site specific and includes two possible evacuation schemes. The evacuation parameters used in the model were extracted from a recent evacuation and mass notification study performed for BVPS (Alan M. Voorhees and Associates 1980).

7.1.3.2.1.6 Calculation of Risk Curves

This section describes the analytical techniques used to compile and assemble the results into risk diagrams. The assembly process is based on a matrix multiplication process. Matrices were constructed for the following separate analyses: initiating events, plant states, release categories, and consequences. Multiplication of the first three of these matrices provides the probability of occurrence associated with each release category, as shown in Table 7.1-2. These probabilities were then multiplied by the consequence matrix provided by the CRAC2 runs done on a conditional basis (release category probability equal to 1). This operation provides the additional probability associated with the weather conditions and

evacuation scenarios to yield the total probability and consequences that make up the risk curves.

7.1.3.2.2 Dose and Health Impacts of Atmospheric Releases

The results of the calculations for dose and health impacts are presented in the form of probability distributions functions, sometimes referred to as CCDFs (complementary cumulative distribution functions), or final risk curves. All of the release categories shown in Table 7.1-2 are included in each risk curve.

Figures 7.1-2 through 7.1-6 represent the probability distribution functions for the damage indices of early fatalities, total latent effects, population whole body man-Rem, thyroid cancer fatalities, and population with bone marrow dose over 200 Rem, respectively. Early fatalities refer to those deaths which might result within 1 year of a postulated accident. The total latent effects include fatalities from leukemia, cancers of the lung, gastrointestinal tract, breast, and bone, but do not include thyroid cancers. The population whole body man-Rem is the sum of the number of people exposed times the whole body dose received for each dose level.

The final risk curves represent the product of the analysis of initiating events, plant response, containment response, and site consequences for severe accident sequences at BVPS-2. Incorporated into each of these distributions is the probability of a plant state resulting in a release to the environment described by any of the nine release categories, for each year of reactor operation.

The left side of Figure 7.1-2 shows that there is approximately one chance in 10 million per reactor year that one or more fatalities might occur as a result of a severe accident at BVPS-2. This frequency of exceeding a given number of fatalities decreases as the damage index (number of fatalities) increases. Additionally, the risk curve shows that the probability of exceeding one early fatality and the probability of exceeding approximately 200 early fatalities are about the same.

Figure 7.1-3 shows the probability distribution for fatal cancers (excluding data groups "thyroid" and "whole body"). Calculation of these effects is based upon the dose response model presented in the BEIR report (National Academy of Sciences 1972) and is consistent with models developed in BEIR III (National Academy of Sciences 1980). There is typically a latent period after exposure of from 2 to 30 years before a cancer might be manifested. In addition, individuals are considered to be at risk of leukemia induction for 30 years after the latent period following exposure, while for all other cancers they are assumed to be at risk for the remainder of their lives. As a result, the predicted number of fatal cancers may be distributed over many years. The dose used in predicting the number of latent effects is a result of both acute and chronic exposure.

Figure 7.1-4 provides the probability distribution for total population whole body dose in man-Rem. Acute and chronic whole body doses to the population within 350 miles of the plant were used to generate this risk curve.

The thyroid cancer fatality risk distribution is presented in Figure 7.1-5. These results are based upon the assumption that 4% of the radiation induced thyroid nodules result in thyroid cancer fatality.

Figure 7.1-6 shows the probability distribution for the population exceeding a bone marrow dose of 200 Rem and provides an estimate of the number of people which might require supportive medical treatment.

As an indication of the spatial distribution of individual latent cancer fatality risk per year of reactor operation, contours of constant risk (isorisk curves) are plotted on a map of the site out to 10 miles (Figure 7.1-8).

7.1.3.2.3 Economic Impacts

Placing monetary values on the cost of human radiation exposure is at best a difficult and controversial task. However, it is possible to assess the economic impacts of avoidance of adverse health effects. Such a calculation has been performed for BVPS-2. The results are shown on Figure 7.1-7, which is the probability distribution function for total cost of offsite mitigating actions including decontamination efforts. Factors which contribute to these estimated costs include the following:

- Evacuation costs,
- Value of milk contaminated and condemned,
- Costs of decontamination of property where practical, and
- Indirect costs due to loss of property use and incomes derived therefrom.

The loss of land use and associated incomes derives from the possible need to interdict the land and property until it is free of contamination or can be economically decontaminated.

Several comments can be made concerning economic risks based upon Figure 7.1-7. The initial plateau portion of the curve indicates that the probability of total costs exceeding 1 million dollars and the probability of total costs exceeding 20 million dollars are the same. This is a direct result of calculating evacuation costs based upon evacuation of the entire 10-radial-mile area of the plant. The right side of the risk curve indicates that, although very unlikely (less than one chance in one hundred million), costs could exceed

several billion dollars (1980 dollars). These costs do not include the cost of decontamination and repair or replacement of the facility, nor the cost of replacement power.

7.1.3.2.4 Releases to Ground Water

7.1.3.2.4.1 Introduction

Releases of radioactivity to the ground-water system could occur following a postulated core meltdown with eventual penetration of the containment basemat. Core debris which exits the melt hole would then enter the water table, which is normally at an elevation of approximately 20 feet below the containment basemat, and radionuclides in the debris would be leached in the ground-water system. It is also possible for containment sump water, which could be rich in dissolved fission products, to be released through a breach in the containment.

An analysis of the potential consequences of such an event is presented by the USNRC staff in NUREG-0440, "Liquid Pathway Generic Study" or LPGS (USNRC 1978a). This generic report provides the basis for the comparative evaluation of BVPS-2.

The LPGS presents analyses for a four-loop Westinghouse pressurized water reactor (PWR) located at a number of land sites, one of which is on a river system which is very similar to the one at BVPS-2. The LPGS river site is on the Clinch River approximately 21 miles upstream of its juncture with the Tennessee River. The balance of this river system consists of the Tennessee River (567 miles), the Ohio River (46 miles) and the Mississippi River (954 miles). This system contains a number of dams and reservoirs, principally along the Tennessee River segment.

The BVPS-2 river system is similar, consisting of 946 miles of the Ohio River and the same 954 miles of the lower Mississippi River. Like the Tennessee, there are numerous dams along the Ohio. However, unlike the Tennessee, which is an important recreational resource, the Ohio is heavily industrialized.

In the LPGS, parameters for each generic site (including the Clinch River site) were chosen to be representative of the full spectrum of similar sites, in this case river sites. Parameters used for analysis in the LPGS, although typical, do not represent any actual plant site. In the LPGS it was concluded that individual and population doses for the liquid pathways would be small fractions of the airborne pathways dose which could result from a core meltdown accident.

Individual and population doses are reported in the LPGS for the principal liquid pathways: drinking water, aquatic food, and direct exposure from swimming and shoreline usage. Exposure resulting from

crop irrigation was also considered but was found to contribute insignificantly to dose (USNRC 1978a).

Doses to individuals and populations were calculated in the LPGS without taking credit for possible interdiction methods such as isolation of contaminated ground water, the temporary restriction of fishing, or the provision of alternate sources of drinking water (or additional purification equipment). Such interdiction methods would be highly successful in preventing exposure to radioactivity, and the liquid pathways consequences would therefore be economic and societal rather than radiological.

(perhaps orders of magnitude) smaller than that calculated in the LPGS.

The fish harvest downstream of the BVPS site is estimated to be more than a factor of 3.8 larger than that estimated in the LPGS. Since this pathway is also dominated by Sr-90 and Cs-137 (Sandia National Laboratories 1981), population exposure via this pathway will also be substantially less than that calculated in the LPGS.

The shoreline and immersion pathway includes such activities as swimming, wading, and sunbathing. These are external exposure pathways, and dosage is dominated by Ru-106, Cs-137, and Co-60. For the BVPS site having a ground-water travel time of 25 years and assuming that Kd for Co-60 is 75, the transmitted fraction is vanishingly small, as has already been shown to be the case for Cs-137 and Ru-106. It is therefore concluded that the direct exposure dose would be negligible in comparison with those calculated in the LPGS.

7.1.3.2.4.5 Liquid Pathway Comparison Results

On the basis of BVPS site features and the specific comparisons of both radionuclide source and pathway populations, it is apparent that the spectrum of liquid pathways doses following a severe accident would be much lower for BVPS-2 than the doses calculated in the LPGS for a river-sited plant.

This is mainly due to the much smaller source released to the Ohio River which in turn results mainly from a much longer ground-water transport time. If shorter times are postulated, the adverse effect would be small and would probably be offset through the assumption of more realistic distribution coefficient (Kd) values.

In the extreme, if the same radionuclide source as in the LPGS were postulated, the pathways doses would still be within the same order of magnitude, since the pathways population ratios are not large.

7.1.3.3 Risk Consideration

The previous material has dealt with the likelihood of occurrence (frequency) of accidents as well as their impacts (consequences). Because it is difficult to compare such results with other types of risk in our environment, it is useful to combine these results into average risk values.

A common way in which this combination of factors is used to estimate risk is to multiply the probabilities by the consequences. The resultant risk is then expressed as a number of consequences expected per unit of time. Such a quantification of risk does not at all mean that there is universal agreement that peoples' attitudes about risks, or what constitutes an acceptable risk, can or should be

covered solely by such a measure. At best, it can be a contributing factor to a risk judgment, but not necessarily a decisive factor.

To accomplish these comparisons, the mean values for a damage index (for example, early fatalities) as calculated by CRAC2 for each release category were weighted by the corresponding release category frequency, and then summed. The resulting value is representative of the risk for the particular damage index per year of reactor operation. The results of these calculations are presented in Table 7.1-4 for early fatalities, latent cancer fatalities, population whole body man-Rem, thyroid cancer fatalities, population with bone marrow dose over 200 Rem, and the total cost with decontamination.

The mean risk of early fatality per year of BVPS-2 operation for all release categories is approximately 0.0002, for evacuation to 10 miles. The population at risk for early fatalities is within a 20-mile radius of the plant. The 2010 population within 20 miles of the plant, shown in FSAR Table 2.1-4, is 489,932. Accidental fatalities per year for a population of this size, based upon overall averages for the United States, are approximately 108 from motor vehicle accidents, 38 from falls, 15 from drowning, 14 from burns, and 6 from firearms (National Research Council 1980). The risk of early fatalities due to the operation of BVPS-2 is therefore very small in relation to other fatal risks to which the population is exposed.

For comparison with the population whole body dose mean value of 309 man-Rem, also shown in Table 7.1-4, the whole body dose to the population within 350 miles of BVPS-2 due to natural radiation from the environment can be calculated. In the northeastern United States, at the altitude of BVPS-2, the average annual dose to an individual due to natural radiation is approximately 103 mRem (National Academy of Sciences 1980). If the population at risk around BVPS-2 is considered to be those people within 350 miles, or a population of 94,971,369 as shown in FSAR Table 2.1-21, the population dose from natural radiation is 9,782,000 man-Rem. Based upon population whole body dose, the risk due to severe accidents resulting from operation of BVPS-2 is very small compared to the risk due to natural radiation.

The average number of latent cancer fatalities for the lifetime of the population within 350 miles of the reactor, due to one year of reactor operation, is approximately 2.1×10^{-2}. In comparison, assuming a representative United States population, the expected number of deaths per year due to cancer would be approximately 195,300 (U.S. Bureau of Census 1982). Although this is comparing a lifetime risk to a yearly risk, it is evident that the risk of cancer fatality due to severe accidents is very small in relation to existing cancer fatality risks.

7.1.3.4 Uncertainties

The methodology employed to provide this present risk assessment for BVPS-2 is essentially that of the Reactor Safety Study. There are substantial uncertainties associated with the numerical estimates of the likelihood, as well as the consequences, of reactor accidents that are evaluated using this methodology.

One of the chief areas of uncertainty is the magnitude of the source term, or fission product release to the atmosphere. This uncertainty arises from neglect of attenuation of fission products during transit through the primary coolant system following a postulated accident. Present analyses assume that fission products released from the core exit directly to the containment. Another uncertainty is the chemical form of the fission products released. WASH-1400 considered elemental iodine as the species released while recent investigations (USNRC 1981b) indicate iodine may be released as a less volatile cesium iodine. A thorough discussion of the uncertainties in the source term is provided in a British study, SRD 256 (United Kingdom Atomic Energy Authority 1982). Reduction of the source term as postulated by these documents would result in substantially lower estimates of detrimental health effects.

Additional uncertainties arise in the dose response model, evacuation model, and meteorological model employed by the CRAC2 code. In this present analysis, conservative reductions in evacuation speed based upon estimates of the relative probability of bad weather have been made. Although the attempt has been made in probabilistic risk assessment studies to provide realistic state-of-the-art analysis of consequences, there remain many areas of conservatism.

7.1.4 References for Section 7.1

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USNRC 1980. Clarification of TMI Action Plan Requirements. NUREG-0737.

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Westinghouse Electric Corporation 1982. Sizewell B Probabilistic Safety Study. WCAP-9991, Revision 1.

TABLE 7.1-3

RELEASE CATEGORY PARAMETERS

Release Category	Time to Release* (hr)	Release Duration (hr)	Warning Time** (hr)	Sensible Heat Rate*** (cal/sec)
BV-1	2.5	1.0	1.0	1.0×10^6
BV-2	0.72	2.0	0.2	7.9×10^6
BV-3	6.0	2.0	0.5	9.8×10^6
BV-4	8.3	0.5	4.1	2.4×10^7
BV-5	4.3	0.5	4.1	2.3×10^7
BV-6	20.1	0.5	16.0	2.9×10^7
BV-7	4.5	0.5	4.0	1.0×10^6
BV-8	21.0	0.5	2.0	1.0×10^6
BV-9	95.0	10.0	80.0	0

NOTES:

*Time between reactor shutdown and release to atmosphere.
**Time from beginning of official warning to beginning of atmospheric release.
***Due to thermal heat content of the released gases.

TABLE 7.1-4

MEAN VALUES FOR DAMAGE INDICES

Release Category	Early Fatalities	Latent Cancer Fatalities	Population Whole Body Man-Rem	Total Cost with Decontamination (1980 Dollars)	Population with Bone Marrow Dose Over 200 Rem	Thyroid Cancer Fatalities
BV-1	2.89×10^{-7}	1.82×10^{-4}	2.87	92.9	5.8×10^{-6}	2.8×10^{-5}
BV-2	7.23×10^{-7}	5.88×10^{-5}	0.90	53.0	4.5×10^{-6}	1.1×10^{-5}
BV-3	9.55×10^{-6}	8.16×10^{-4}	12.7	734.0	3.6×10^{-5}	1.3×10^{-4}
BV-4	5.21×10^{-5}	2.83×10^{-3}	41.9	2,350.0	7.1×10^{-4}	2.6×10^{-4}
BV-5	7.48×10^{-6}	3.68×10^{-4}	5.5	307.0	9.2×10^{-5}	3.5×10^{-5}
BV-6	1.66×10^{-4}	1.62×10^{-2}	243.0	11,230.0	7.0×10^{-4}	1.2×10^{-3}
BV-7	0	8.69×10^{-5}	1.4	404.0	0	9.1×10^{-5}
BV-8	0	4.43×10^{-5}	0.7	432.0	0	2.8×10^{-5}
BV-9	0	4.6×10^{-6}	0.1	552.0	0	3.7×10^{-6}
TOTAL	2.36×10^{-4}	2.06×10^{-2}	309.4	16,410.0	1.5×10^{-3}	1.8×10^{-3}

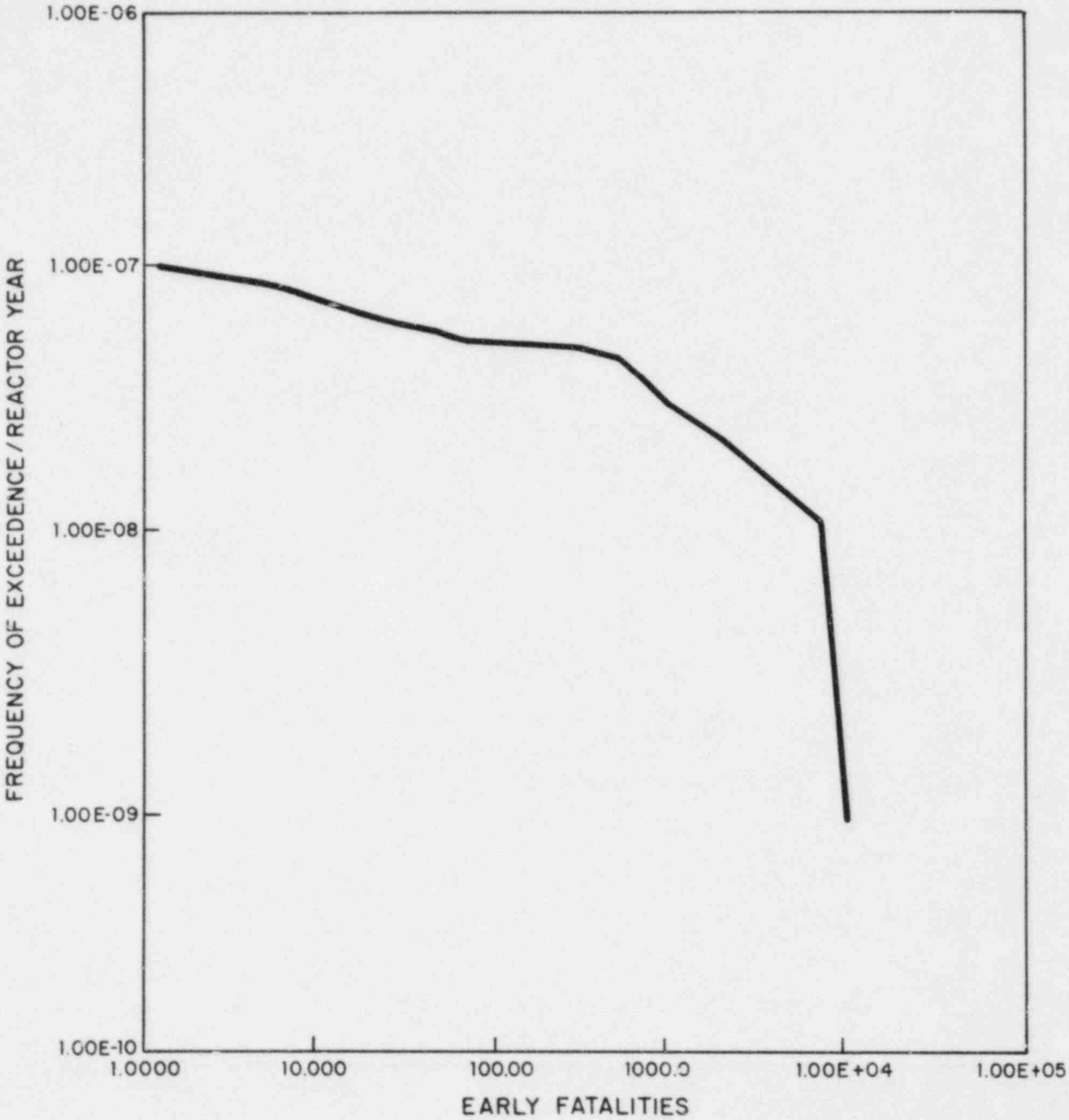


FIGURE 7.1-2
RISK CURVE FOR EARLY FATALITIES
BEAVER VALLEY POWER STATION-UNIT 2
ENVIRONMENTAL REPORT
OPERATING LICENSE STAGE

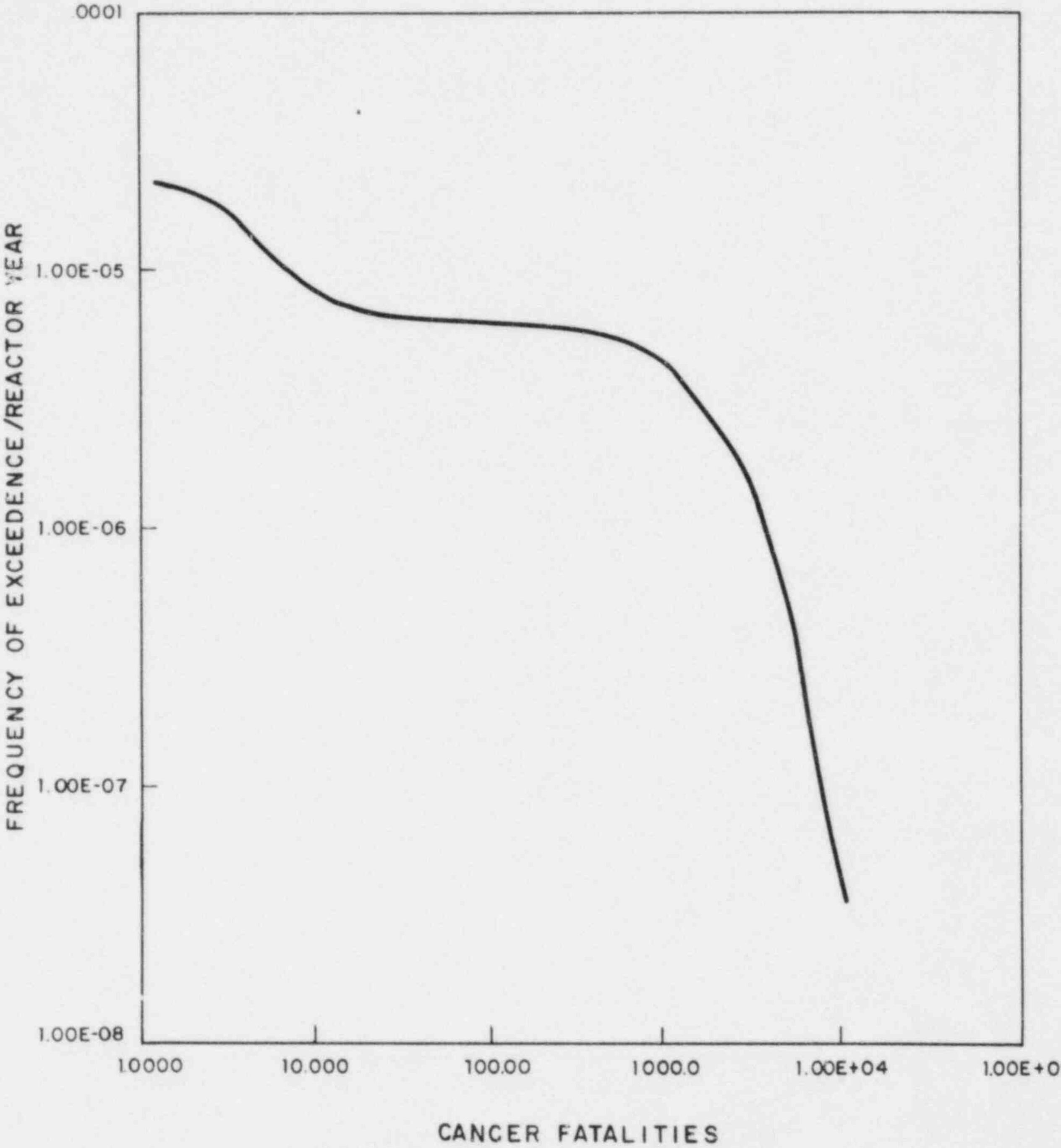


FIGURE 7.1-3
RISK CURVE FOR TOTAL LATENT CANCER FATALITIES
BEAVER VALLEY POWER STATION-UNIT 2
ENVIRONMENTAL REPORT
OPERATING LICENSE STAGE

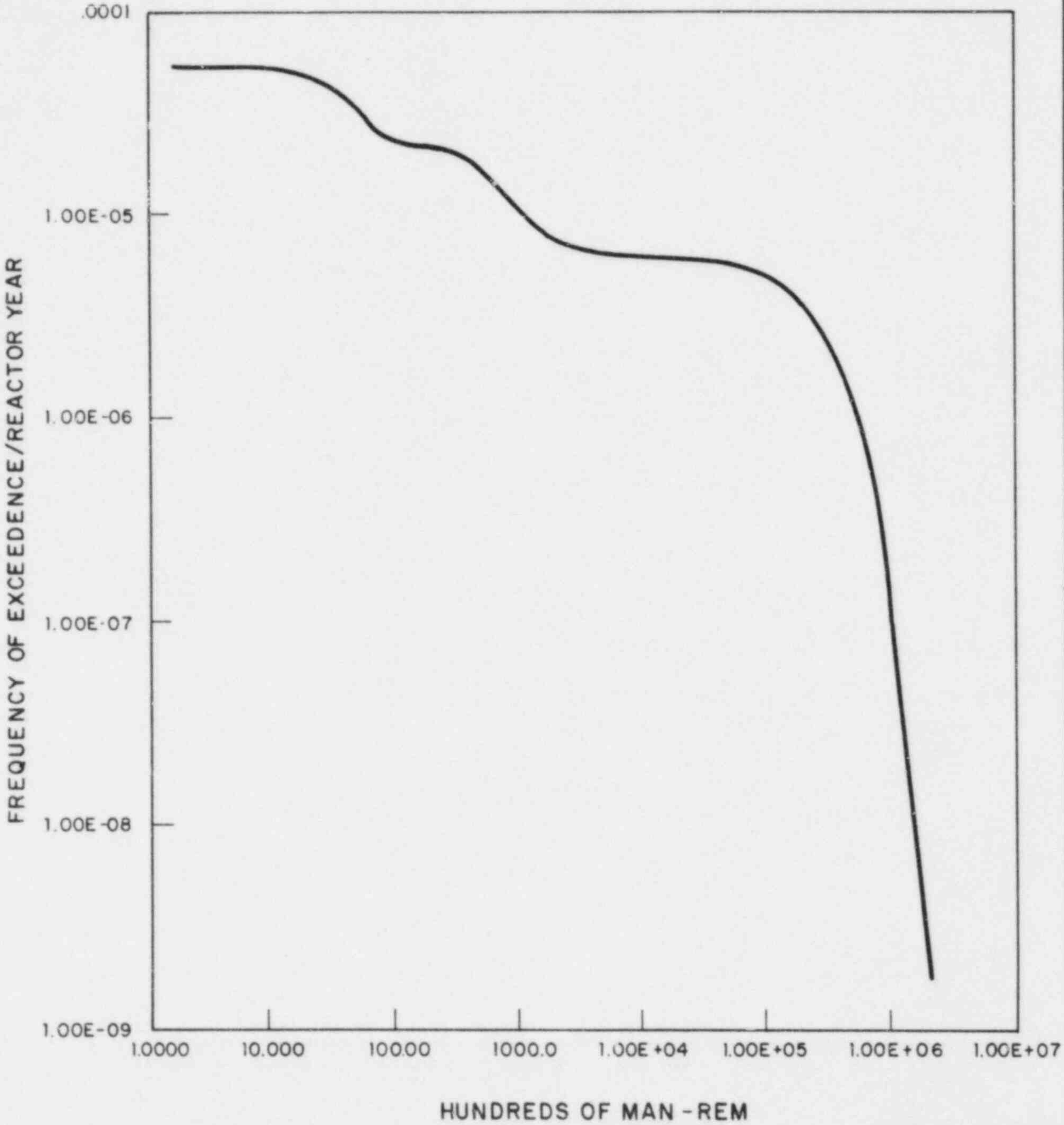


FIGURE 7.1-4
RISK CURVE FOR TOTAL POPULATION WHOLE BODY MAN-REM
BEAVER VALLEY POWER STATION-UNIT 2
ENVIRONMENTAL REPORT
OPERATING LICENSE STAGE

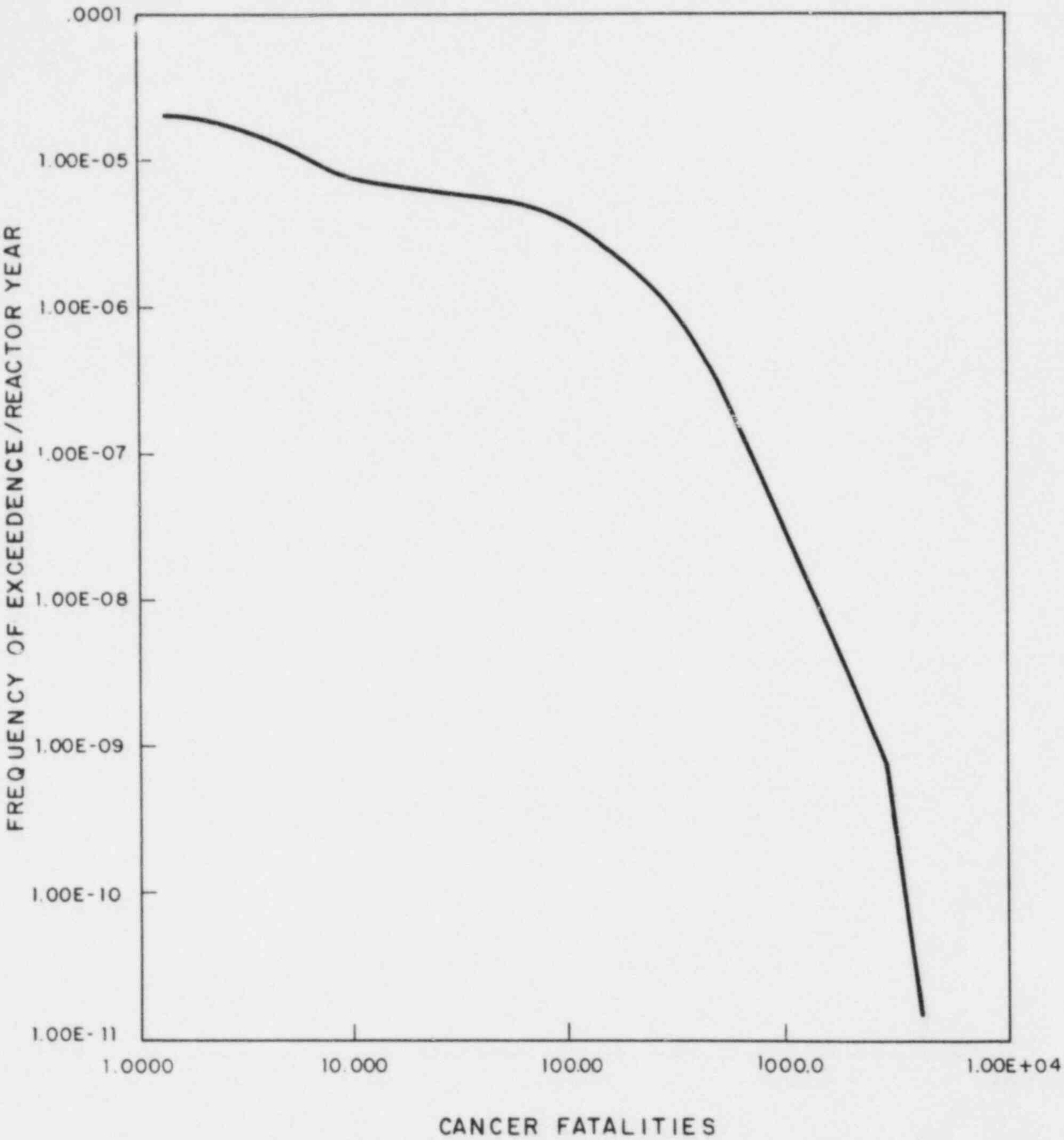


FIGURE 7.1-5
POINT ESTIMATE RISK CURVE FOR THYROID CANCER FATALITIES
BEAVER VALLEY POWER STATION-UNIT 2
ENVIRONMENTAL REPORT
OPERATING LICENSE STAGE

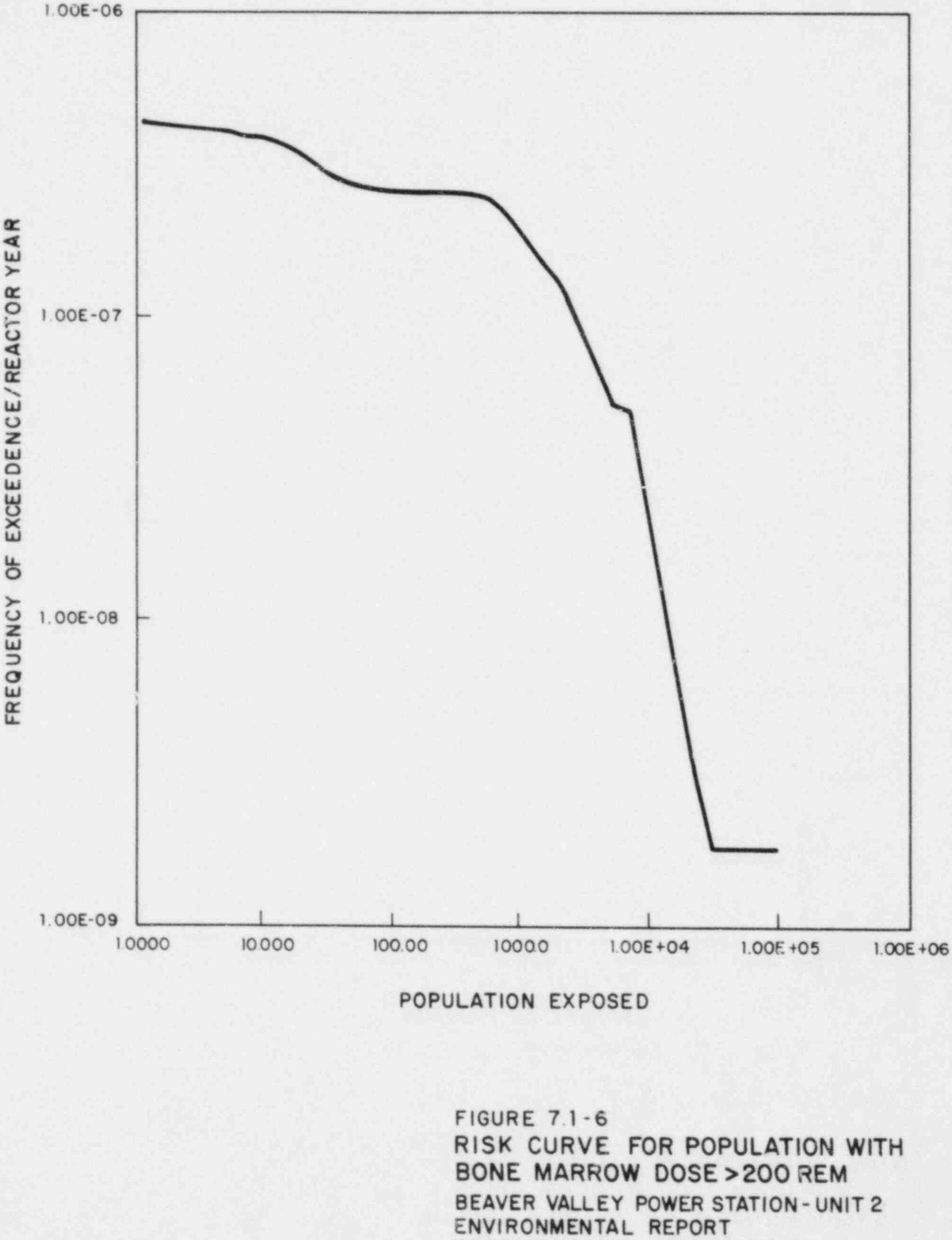


FIGURE 7.1-6
RISK CURVE FOR POPULATION WITH BONE MARROW DOSE >200 REM
BEAVER VALLEY POWER STATION - UNIT 2
ENVIRONMENTAL REPORT
OPERATING LICENSE STAGE

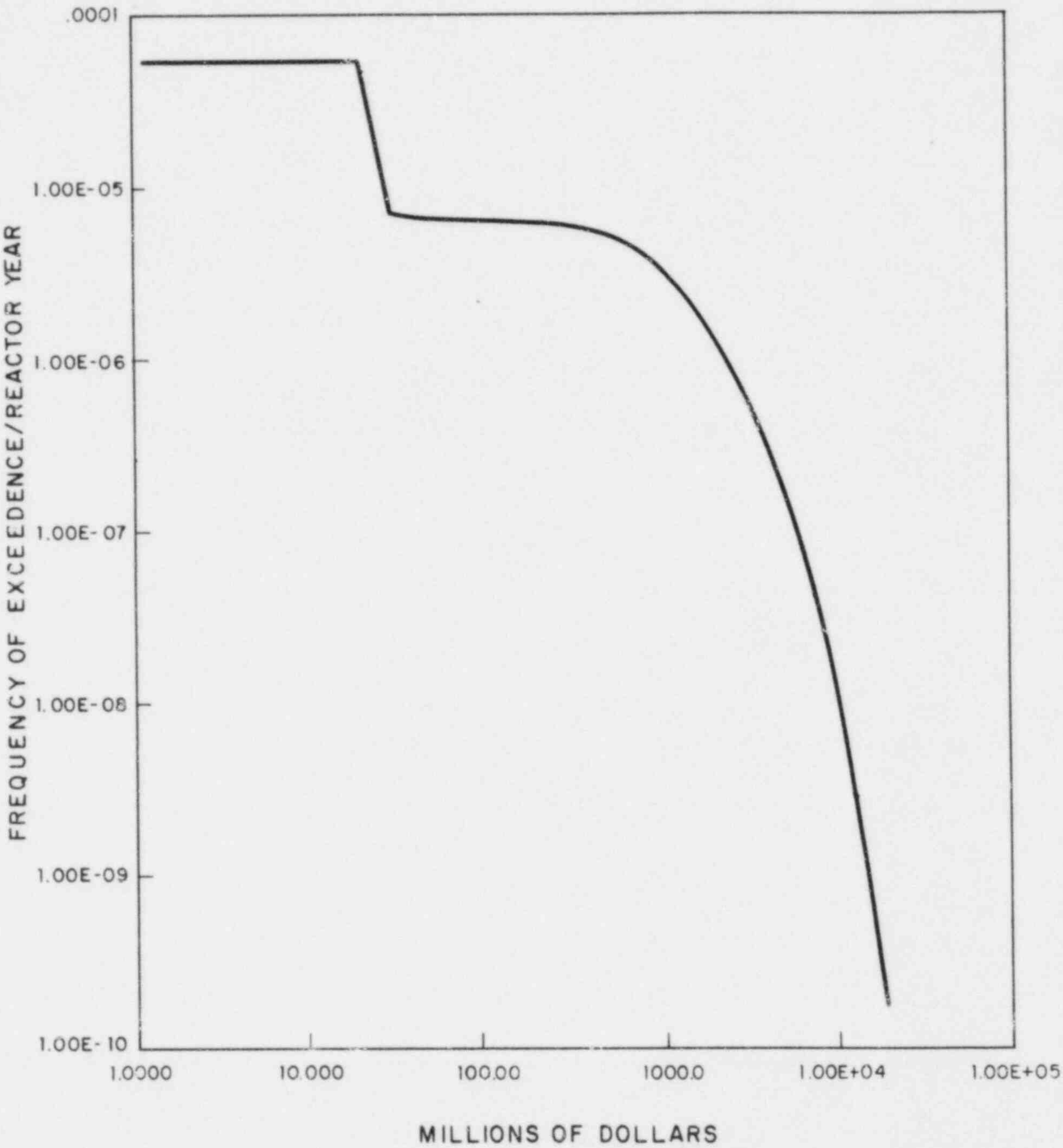
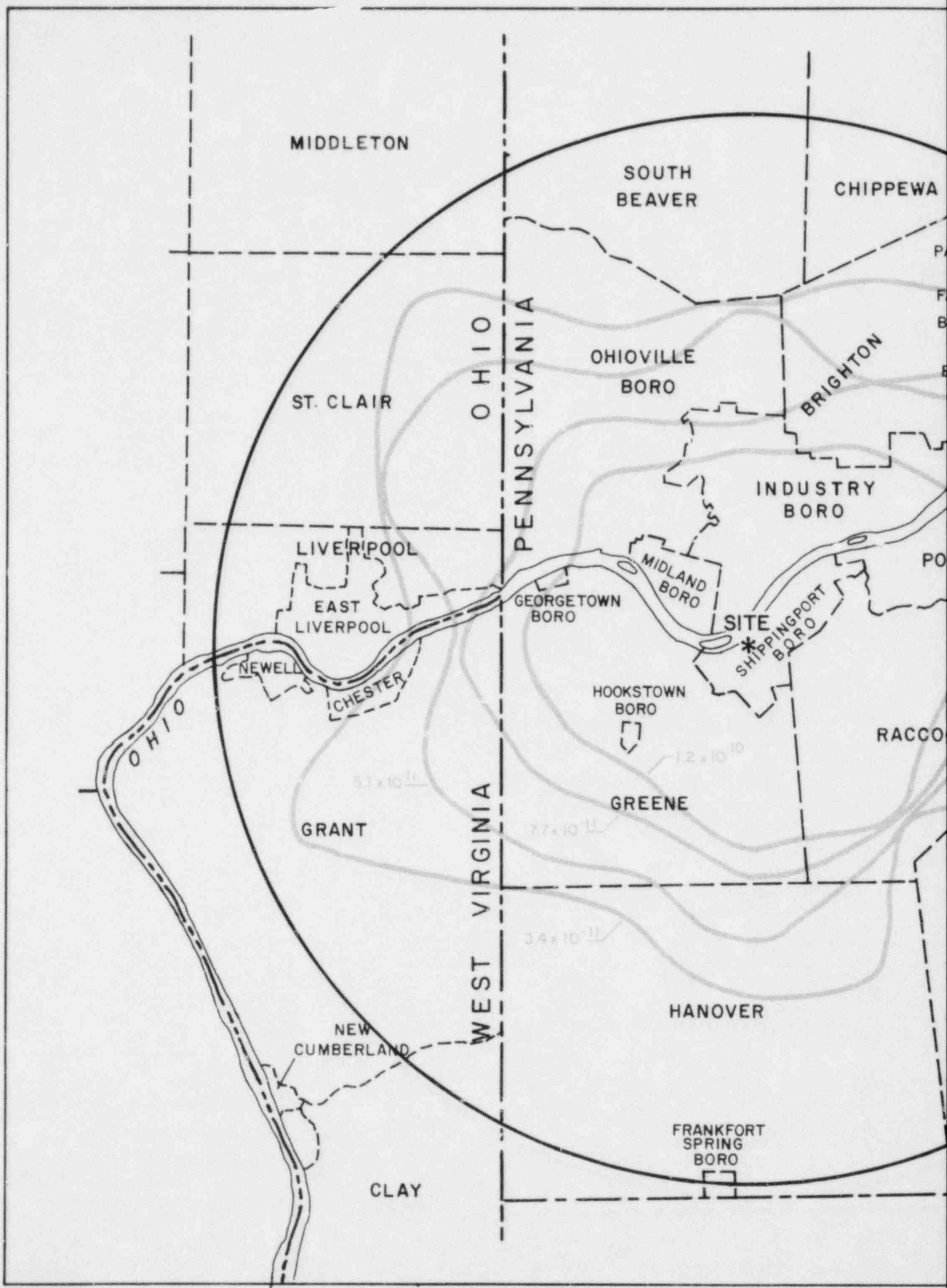
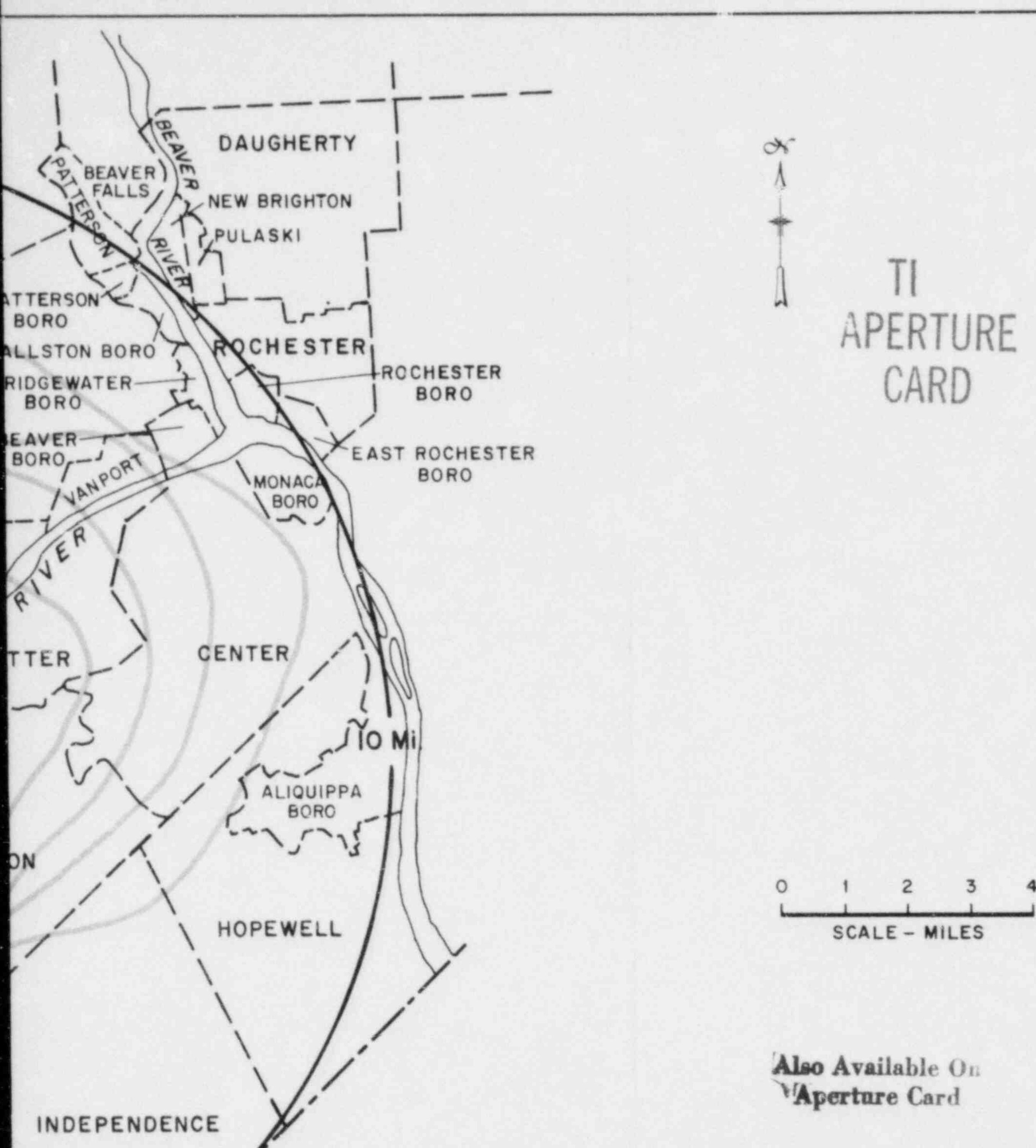


FIGURE 7.1-7
RISK CURVE FOR TOTAL COST
WITH DECONTAMINATION
BEAVER VALLEY POWER STATION-UNIT 2
ENVIRONMENTAL REPORT
OPERATING LICENSE STAGE



MIDDLETON
SOUTH BEAVER
CHIPPEWA
OHIOVILLE BORO
BRIGHTON
ST. CLAIR
OHIO
PENNSYLVANIA
INDUSTRY BORO
LIVERPOOL
EAST LIVERPOOL
MIDLAND BORO
GEORGETOWN BORO
SITE
SHIPPINGPORT BORO
NEWELL
CHESTER
OHIO
HOOKSTOWN BORO
RACCO
1.2×10^{-10}
5.1×10^{-11}
GREENE
GRANT
7.7×10^{-11}
WEST VIRGINIA
3.4×10^{-11}
HANOVER
NEW CUMBERLAND
FRANKFORT SPRING BORO
CLAY



TI APERTURE CARD

Also Available On Aperture Card

FIGURE 7.1-8

ISORISK CONTOURS OF LATENT CANCER FATALITY PER REACTOR-YEAR TO AN INDIVIDUAL

BEAVER VALLEY POWER STATION - UNIT 2
ENVIRONMENTAL REPORT
OPERATING LICENSE STAGE

8403290146-01

LIST OF EFFECTIVE PAGES

Page, Table (T), or Figure (F)	Amendment Number
8-i thru 8-iii	E
8.1-1 thru 8.1-3	5
T8.1-1 (1 thru 2 of 2)	5
T8.1-2 (1 of 1)	0
T8.1-3 (1 of 1)	5
T8.1-4 (1 of 1)	5
8.2-1 thru 8.2-2	5
T8.2-1 (1 of 1)	5

CHAPTER 8

TABLE OF CONTENTS

LIST OF TABLES

CHAPTER 8

ECONOMIC AND SOCIAL EFFECTS OF STATION OPERATION

8.1 BENEFITS

This section describes the benefits associated with the operation of Beaver Valley Power Station - Unit 2 (BVPS-2) and supplements those benefits presented in Chapter 8 of the Environmental Report - Construction Permit Stage. The costs presented in this Chapter are in 1986 dollars.

8.1.1 Primary Benefits

Beaver Valley Power Station - Unit 2 is scheduled to be operational in May 1986 and will generate 833 MWe (net) of reliable base load electric power to meet the projected needs of industrial, commercial, residential, and other customers for the area served by the Central Area Power Coordination (CAPCO) group.

The ownership of the participants in BVPS-2 is as follows:

Duquesne Light Company	13.74 percent
The Cleveland Electric Illuminating Company	24.47 percent
Ohio Edison Company	41.88 percent
The Toledo Edison Company	19.91 percent

The BVPS-2 is intended to help supply electric energy to five major cities and their surrounding areas. These cities are Pittsburgh, Cleveland, Akron, Youngstown, and Toledo, which have broad economic bases of business and industry.

Socioeconomic benefits are both direct and indirect. Direct benefits affect the owners and operators of the facility and their customers (Table 8.1-1). Indirect benefits, often referred to as external effects, impact persons and interests in the vicinity of the proposed activity or those indirectly related to the facility. These indirect benefits, which include the expansion of business and industry, are the backbone for economic growth in an area. An important factor in this growth is an adequate supply of electric energy. The BVPS-2 will help contribute electric energy needed to maintain economic growth in these areas.

The BVPS-2 is expected to generate approximately 4,962 million net kilowatt-hours (kWh) annually assuming an average capacity factor of approximately 68 percent (Table 8.1-2). Of the 1989 projected generation of 5,617 million kWh, approximately 1,417 million kWh will go to residential customers, 1,289 million kWh to commercial

customers, 2,637 million kWh to industrial customers, 36 million kWh to street lighting, and 237 million kWh to sales for resale and other uses, as shown in Table 8.1-3. The primary benefit of the proposed plant lies in the 4,962 million kWh per year of electricity to be delivered to customers over its 40-year operational life. This can also be represented by an annual revenue to CAPCO of $229,786,000 in 1986, which will rise to $357,137,499 in 1987 when BVPS-2 is fully operational. This value is based on the rate structure and fuel clauses of each CAPCO party in effect as of mid-1983. No sales of steam or other products or services from the plant are anticipated. There is also a savings in natural fuel resources; this is discussed further in Section 8.1.2.4.

8.1.2 Other Social and Economic Benefits

8.1.2.1 Tax Revenues

Although tax rates levied on BVPS-2 are under the discretion of state and local authorities, certain tax revenues generated during the operation of BVPS-2 can be approximated.

There is a minimal amount of local property tax assessed on non-utility property. The Commonwealth of Pennsylvania, under the Public Utility Realty Tax Act (PURTA), levies a tax of 30 mills on certain utility property. The taxable property includes land, buildings, towers, smokestacks, and other structures but excludes machinery, equipment, poles, and transmission towers whether or not attached to taxable property. This tax revenue is distributed to various local governments in the state based upon a formula established by the state. The state will realize an estimated levelized annual PURTA tax of $15,735,053 (in 1986 dollars). In addition to the PURTA tax, Ohio and Pennsylvania will also realize an average annual gross receipts tax of $13,000,000 (in 1986 dollars) through taxes on the sale of electricity. Pennsylvania and the federal government will jointly realize average annual state and federal corporate net income tax revenue of approximately $90 million (in 1986 dollars) paid by plant owners on the sale of electricity generated by BVPS-2.

In addition to these tax revenues, the federal, state, and local governments will realize tax revenues through the collection of personal income taxes on the payroll generated in operating the plant. A discussion of these revenues follows.

8.1.2.2 Payrolls and Employment

The present worth of the payroll in 1986 dollars for the 465 operating personnel of BVPS-2 is estimated to be approximately $126 million (40 years).

From the operating payroll, personal income taxes will be realized by various municipalities and the state and federal governments. The federal income tax to be paid by the operating personnel on an annual

basis is estimated to be $3,294,990 (in 1986 dollars) assuming 1983 rates. State income tax paid by operating personnel is estimated to be $431,985 on an annual basis (in 1986 dollars). Local wage taxes to be paid by operating personnel to various municipalities are estimated at $183,768 on an annual basis (in 1986 dollars). Total annual local, state, and federal taxes are $122,600,000 in 1986 dollars (Table 8.1-1).

8.1.2.3 Environmental Studies

The operation of BVPS-2 will contribute to knowledge of the surrounding environment. These contributions will result from ecological studies already completed and monitoring activities that will be conducted throughout the life of the plant. The data from these studies will provide the scientific community with information which will enable it to predict the effect of a similar activity on the environment. These studies are discussed in Chapters 2, 5, and 6.

8.1.2.4 Coal and Fuel Oil Conservation

The operation of BVPS-2 will result in a significant savings of coal and fuel oil. As shown in Table 8.1-4, the operation of BVPS-2 will result in the savings of 1,730,500 tons of coal in 1986 and 2,603,502 tons of coal in 1987. The next four years of operation will save a total of 9,150,505 tons of coal. The operation of BVPS-2 will also save 4,153,200 gallons of fuel oil in 1986, 1,607,100 gallons in 1987, and 6,615,200 gallons during the years 1988 through 1991. The dollar savings of coal and fuel oil associated with the on-schedule operation of BVPS-2 is estimated to be $189 million (in 1986 dollars) for the years 1986 through 1989.

8.1.2.5 Air Quality

The on-schedule operation of BVPS-2 will result in less coal and fuel oil burned by CAPCO utilities, thus precluding the emission of air pollutants associated with burning coal and oil. The quantities of sulfur dioxide, nitrogen oxides, particulate matter, carbon monoxide, and non-methane hydrocarbon emissions due to a delay of BVPS-2 operation for 1986 are shown in Table 8.1-1.

TABLE 8.1-1

ANNUAL BENEFITS FROM BVPS-2

Direct Benefits	
Expected average annual generation* (kWh/yr)	$4,962 \times 10^6$
Capacity (kWe)	833×10^3
Proportional distribution of electrical energy expected (kWh/yr for 1989)	
Industrial	$2,637 \times 10^6$
Commercial	$1,289 \times 10^6$
Residential	$1,417 \times 10^6$
Other	273×10^6
Expected average annual steam sold from the facility	0
Expected average annual delivery of other beneficial products	0
Revenues** from delivered benefits	
Electrical energy generated (1987)	$357,000,000
Steam sold	0
Other products	0
Indirect Benefits	
Annual taxes**	
State PURTA, gross receipts tax	$ 28,735,000
State, federal income tax	90,000,000
State personal income tax	432,000
Federal personal income tax	3,295,000
Local wage tax	184,000
Research	Past and present environmental studies
Environmental enhancement	
Recreation	None
Navigation	None
Air quality (savings in emissions, May 1986-December 1986, tons)	
SO_2	5,300
NO	13,066
Particulates	525
Others:	
CO	402
HC	47

TABLE 8.1-1 (Cont)

Indirect Benefits (Cont)

Environmental monitoring	Meteorological, ecological, radiological
Savings of coal (tons/yr)	2.4×10^6
Savings of fuel oil*** (gal/yr)	2.5×10^6
Operating employment (number of employees)	465

NOTES:

*Based on 68.0 percent plant capacity factor.
**1986 dollars.
***Represents increased running of peaking units if BVPS-2 is not in service for the first 3 years. The annual savings equals the total savings for 1986 through 1989 divided by the 3 years of delay.

TABLE 8.1-2

TYPICAL EXPECTED BVPS-2 CAPACITY

	Annual Average
NSSS rating - MWt	2,652
Maximum net capacity (MNC) - MWe	833
Plant capacity factor (PCF) - percent	68*
Annual plant net production - million kWh (MNC x PCF x hrs/year)	4,962

NOTE:

*Typical average plant capacity factor for plant lifetime.

TABLE 8.1-3

BVPS-2 GENERATION (kWh) FORECAST BY CUSTOMER CLASS (1986-1990)

Customer Class	1986	1987	1988	1989	1990
Residential	884,601,880	1,368,298,400	1,030,041,400	1,416,874,600	1,153,552,400
Commercial	795,401,340	1,235,260,200	934,762,210	1,289,406,400	1,052,687,900
Industrial	1,614,127,300	2,511,154,100	1,912,774,700	2,637,112,000	2,138,932,500
Street lighting	23,777,725	36,311,395	26,913,752	36,270,070	29,332,719
Other	38,457,013	60,125,947	45,897,810	63,848,114	52,757,992
Sales for resale	104,634,780	163,849,880	124,610,170	173,254,150	142,736,400
Total generation	3,461,000,000	5,375,000,000	4,075,000,000	5,617,000,000	4,570,000,000

TABLE 8.1-4

PROJECTED COAL AND FUEL OIL SAVINGS BY CAPCO DUE TO OPERATION OF BVPS-2

Year	Coal (Tons)	Fuel Oil (Gallons)
1986	1,730,500	4,153,200
1987	2,603,502	1,607,100
1988	1,988,600	1,222,500
1989	2,628,756	1,685,100
1990	2,296,425	1,828,000
1991	2,236,724	1,879,600
Total	13,484,507	12,375,500

TABLE 8.2-1

BVPS-2 INTERNAL COSTS OVER 40-YEAR OPERATIONAL LIFE (1986 DOLLARS)

Description	Cost
Plant cost	$3,076,000,000
Fuel	772,763,000
Operation and maintenance	939,292,000
USNRC fees for Construction Permit	1,069,000
USNRC fees for Operating License	1,024,500
USNRC annual operating fees	2,800,000
Decommissioning	65,800,000
Total	$4,859,000,000

NRC LETTER DATED
MAY 4, 1983
LIST OF EFFECTIVE PAGES

Page, Table (T), or Figure (F)	Amendment Number
Index (1 thru 4 of 4)	1
QE100.1-1	1
TE100.1-1 (1 thru 2 of 4)	1
TE100.1-1 (3 thru 4 of 4)	4
QE240.01-1	1
QE240.02-1	1
QE240.03-1	1
QE240.04-1	1
QE240.05-1	1
QE290.1-1	1
QE290.2-1	1
QE290.3-1	1
QE290.4-1	1
QE291.1-1	3
QE291.1-2	3
QE291.2-1	1
QE291.3-1	1
QE291.4-1	1
QE291.5-1	2
QE291.6-1	2
QE291.7-1	1
QE291.8-1	5
QE291.9-1	1
QE291.10-1	1
QE291.11-1	1
QE291.12-1	1
QE291.13-1	1
QE291.14-1	1
QE291.15-1 thru QE291.15-2	2
QE291.15-3	1
TE291.15-1	1
QE291.16-1	1
QE291.17-1 thru QE291.17-2	1

LIST OF EFFECTIVE PAGES (Cont)

NRC Letter: May 4, 1983

Question E291.7 (ER Section 2.4.2)

Indicate the surface area (in hectares or acres) of the New Cumberland Pool. Also, indicate the surface area of the river from the BVPS site to an 80 km (50 mi) distance downstream. (Note: Assume normal pool elevations.)

Response:

The following estimates of river surface area were provided by the U.S. Army Corps of Engineers and are based on normal pool elevations:

River Section	River Miles	Surface Area (acres)
New Cumberland Pool	31.7 to 54.4	3,840
Pike Island Pool	54.4 to 84.3	5,140
Hannibal Pool	84.3 to 126.4	6,650
Shippingport (BVPS site) to Pike Island Dam (approximately 50 mi downstream of BVPS)	35.0 to 84.3 (total = 49.3 mi)	8,420

Reference:

U.S Army Corps of Engineers 1983. Personal communications between G. Armocida, U.S. Army Corps of Engineers, and D. Knowles, Stone & Webster Engineering Corporation, May 18 and May 19, 1983.

NRC Letter: May 4, 1983

Question E291.8 (ER Section 3.4.2.7)

Indicate the experience, during BVPS Unit 1 operation, with regard to required frequency of dredging at the intake.

Response:

An Operation Surveillance Test (OST) procedure "Silt Check" had been used at BVPS-1 since it began operation. This procedure required a quarterly check of silt buildup on the inside of the main intake structure. If the silt buildup exceeded the limits in the OST, the silt buildup was removed. Trending of this quarterly data was used to develop a test procedure, "Silt Check-Main Intake Structure" to replace the OST procedure. This test procedure, effective March 1983, requires a semi-annual check of silt buildup on the inside of the main intake structure. Recent BVPS-1 operating experience has shown that silt has been removed from inside the main intake structure once per year. When abnormal buildup is observed, soundings are taken in front of the intake structure to determine the need for dredging.

Silt buildup has been removed from in front of the main intake structure only once: in August 1981.

NRC LETTER DATED
OCTOBER 20, 1983
LIST OF EFFECTIVE PAGES

Page, Table (T), or Figure (F)	Amendment Number
INDEX (1 thru 2 of 2)	4
QE291.32-1	4
QE291.33-1 thru QE291.33-2	4
TE291.33-1 (1 of 1)	4
QE310.1-1	4
QE310.2-1	4
QE310.3-1 thru QE310.3-2	4
QE310.4-1	4
QE310.5-1	4
QE310.6-1	4
TE310.6-1 (1 thru 2 of 2)	4
QE310.7-1	4
QE310.8-1	4
QE310.9-1	4
QE310.10-1	4
QE451.4-1 thru QE451.4-4	4
TE451.4-1 (1 of 1)	4
TE451.4-2 (1 of 1)	4
TE451.4-3 (1 of 1)	4
TE451.4-4 (1 of 1)	4
FE451.4-1	4
QE451.5-1 thru QE451.5-2	5
TE451.5-1 (1 of 1)	5
TE451.5-2 (1 of 1)	5
QE451.6-1	4
QE451.7-1	4
QE460.1-1	4
QE460.2-1	4

NRC Letter: October 20, 1983

Question E451.5

(ER Section 2.3)

In the assessssment of long-term (routine) diffusion estimates (which is cross referenced to FSAR Section 2.3.5), a methodology is described. Releases from the process vent, attached to the Beaver Valley Power Station Unit 1 natural draft cooling tower, are considered to be totally elevated. According to staff review of effluents expected to be emitted from this process vent, radioiodines will be released. The diffusion models are based on the assumption that all radioactive material is in gaseous form. Provide a transport and deposition assessment of radioiodines captured by the cooling tower drift.

Response:

An assessment of the quantity of radioiodines that may be captured by the cooling tower drift and its subsequent transport and deposition has been performed. This assessment leads to the conclusion that less than 0.1 percent of radioiodines leaving the process vent will be captured by drift and that the FSAR analysis of relative deposition (Section 2.3.5) due to gaseous emissions from the process vent is more conservative than that of drift deposition of radioiodines. The details of this assessment are discussed below.

The amount of radioiodines that may be captured by cooling tower drift is proportional to the ratio of the drift volume to exit air volume leaving the tower. Based on a drift loss percentage of 0.05 of the circulating water flow and an exit air volume of approximately 35×10^{6} cfm at the design condition, this volume ratio is less than 1×10^{-6}. Due to the turbulent flow characteristic of the cooling tower/process vent system interface, the contact time between the radioiodines and the drift droplets is unfavorable for sustaining a radioiodine-drift water reaction. Therefore, the maximum amount of radioiodines leaving the process vent and becoming suspended in the drift droplets is estimated to be less than 0.1 percent of the total iodine released from this vent. It is assumed that once iodine becomes associated with a drift droplet, it will remain with the droplet throughout its flight path.

In order to assess the transport and deposition of the very small amount of radioiodines that may be captured by the drift, the results of the existing salt drift modeling analysis (ER Section 3.6.9) were adapated to produce values of normalized deposition rate (D/Q) similar to those in FSAR Tables 2.3-53 and 2.3-54. This was done by dividing the predicated salt depositon amounts by the quantity of solids leaving the cooling tower in the drift. The solids emission rate was determined from the drift rate (0.05 percent of the

circulating water flow), the circulating water flow rate (507,400 gpm), and the concentration of dissolved solids in the water (412 ppm). This yields an emission rate of 458,278 lbs of salt per year which can be used to transform salt deposition (lbs/acre/year) to values of D/Q (M^{-2}). These D/Q values are indicative of how drift is transported and dispersed without considering the actual amount of radioiodines being emitted from the vent and captured by drift.

The results of this dispersion analysis are presented in Tables E451.5-1 and 2 which give the highest D/Q values for both the annual-average and grazing season periods in each sector for the individual receptors (vegetable garden, milk cow, milk goat, meat animal, and residents), at the site boundary, and at the 10 radial population distances. These tables can be compared directly to FSAR Tables 2.3-53 and 54 which provide D/Q values for gaseous emissions from the process vent in the absence of cooling tower drift. Although two different meteorological data periods were used to generate these tables (1976 for drift D/Q values and 1976-1980 for gaseous D/Q values), year to year variation in meteorological parameters should not significantly affect the comparison of the magnitudes of the D/Q values.

The analysis indicates that the magnitude of drift dispersion is somewhat similar to gaseous dispersion as evidenced by the similarity of the two sets of D/Q values. The highest annual drift D/Q value is 3.75×10^{-9} M^{-2} compared with a gaseous D/Q value of 1.10×10^{-8} M^{-2}. The major differences between the two kinds of D/Q values lie in their spatial distribution. The drift D/Q values at the closest set of distances (site boundary) are generally much smaller than the gaseous D/Q values. Although the different meteorological data periods may be responsible in part for the smaller drift D/Q values, the larger plume rise of the warm, buoyant cooling tower effluent, which carries the drift well above the top of the cooling tower before it begins to fall to the ground, most likely accounts for most of these differences. Although drift D/Q values are higher than the gaseous D/Q values by small amounts, the maximum drift D/Q value for each set of distances is always less than the gaseous D/Q value (except for grazing season value at 2.412 m). This fact, combined with the low percentage (<0.1 percent) of entrained iodine in the drift, leads to the conclusion that the FSAR analysis of relative deposition (Section 2.3.5) due to gaseous emissions from the process vent is more conservative than an assessment of drift deposition of radioiodines.

NRC Letter: October 20, 1983

Question E451.6 (ER Section 2.3)

One complete year (8,760 hours) of consecutive hourly meteorological data (i.e., no missing data) is used by the staff in evaluating the environmental impact of postulated accidents through a probabilistic risk assessment (PRA) using a version of the computer code CRAC Calculation of Reactor Accident Consequence (CRAC). Data recovery for each annual period of record is less than 100 percent, requiring that data be substituted to enable the staff to perform the PRA. For the one-year data set considered to be most representative of meteorological conditions in the vicinity of the Beaver Valley site, provide substituted data for all missing periods for wind speed, wind direction, atmospheric stability, and precipitation. Provide the basis for selection of the one-year period, identify the source of substituted data, and provide a brief description of the bases for selecting substituted data. The data set selected for the PRA should be encoded on a magnetic tape as described in the enclosed guidance.

Response:

One complete year (8,760 hours) of consecutive hourly meteorological data for the BVPS site in NRC format for use in the computer code CRAC will be provided under separate cover. The 1-year period of January 1, 1979 through December 31, 1979 was chosen for this purpose since this calendar year displayed the highest data recovery percentage (93.1 percent) from among the five years of data (1976-1980).

The factors in determining the method of data substitution are threefold. First, an analysis of the missing periods of wind speed, wind direction, and atmospheric stability indicate that the majority of outages are 6 hours or less in duration. Second, missing data periods of upper level data often coincide with those of the lower level data, making this possible method of substitutions sporadic. Third, the influence of the valley/ridge terrain characteristic of the BVPS site area on low-level (35-ft) wind data along with the large difference in height increment between the 150-35 ft ΔT and the 500-35 ft ΔT cast significant doubt on the validity of substituting upper level (150- and 500-ft) data for low-level data. Therefore, to be consistent and preserve the representativeness of the low-level data, the substitution of data for missing hours was done by inserting the previous good hour of data, i.e., persistance. This method best maintains the validity of the data.

The onsite precipitation data for the January 1979 to December 1979 period has a data recovery percentage of 93 percent. The missing hours of data have been replaced with the corresponding hourly precipitation amounts from observations at the Greater Pittsburgh Airport.

NRC Letter: October 20, 1983

Question E451.7 (ER Section 2.3)

Section 2.3.6 of the ER provides a qualitative description of air quality in the vicinity of the site and states that these conditions will not "adversely affect station operation." Describe station sources of criteria air pollutants, including estimated emissions, and compare these emissions to the DeMinimus criteria established by the Environmental Protection Agency. If station emissions are in excess of the impact of DeMinimus levels, provide a quantitative assessment of the station emissions on local air quality using current EPA guidelines on atmospheric depression modeling.

Response:

Station sources of criteria air pollutants along with their respective estimated emissions are described in Section 3.7.2. The applicable EPA requirement for a Prevention of Significant Deterioration (PSD) analysis (40 CFR 52.21) is a new source with potential to emit more than 250 tons per year of any criteria pollutant. As indicated in Table 3.7-1, Amendment 4, none of the station sources exceed this 250-tons-per-year criterion, therefore the DeMinimis levels are not applicable.

TABLE E451.5-1

MAXIMUM ANNUAL AVERAGE D/Q VALUES (x $10^{-\text{[illegible]}}$ $M^{-\text{[illegible]}}$) FOR THE BVPS-1 COOLING TOWER DRIFT

	Individual Receptors*						Population Distances (meters)									
Downwind Sector	Site Boundary	Veg. Garden	Milk Cow	Milk Goat	Meat Animal	Residence	805	2,412	4,023	5,633	7,242	12,070	24,140	40,230	56,330	72,420
N	0.03	1.41	-	0.55	0.75	1.48	1.08	1.37	0.70	0.33	0.22	<0.20	<0.20	<0.20	<0.20	<0.20
NNE	0.66	1.73	-	0.45	1.68	1.76	1.25	1.74	1.00	0.54	0.32	<0.30	<0.30	<0.30	<0.30	<0.30
NE	0.00	1.49	0.46	0.46	0.46	1.18	1.22	2.49	1.41	0.77	0.50	<0.50	<0.50	<0.50	<0.50	<0.50
ENE	0.00	3.43	-	0.43	-	3.43	1.66	2.63	1.36	0.62	0.41	<0.40	<0.40	<0.40	<0.40	<0.40
E	0.46	3.75	0.51	1.42	1.42	3.75	2.35	3.04	1.53	0.76	0.54	<0.50	<0.50	<0.50	<0.50	<0.50
ESE	0.71	1.98	-	1.22	1.98	2.00	1.02	1.47	0.79	0.40	0.27	<0.25	<0.25	<0.25	<0.25	<0.25
SE	0.66	1.19	0.22	0.22	0.72	1.19	0.62	0.96	0.54	0.25	0.21	<0.20	<0.20	<0.20	<0.20	<0.20
SSE	1.26	1.04	0.27	0.13	1.03	1.23	1.11	0.84	0.43	0.23	0.14	<0.13	<0.13	<0.13	<0.13	<0.13
S	1.58	0.93	0.86	-	1.41	1.44	1.05	1.43	0.63	0.32	0.23	<0.20	<0.20	<0.20	<0.20	<0.20
SSW	1.08	0.59	0.32	0.13	0.59	0.94	0.97	0.61	0.26	0.17	0.09	<0.09	<0.09	<0.09	<0.09	<0.09
SW	1.39	0.88	-	0.58	0.76	0.88	1.32	0.88	0.39	0.18	0.10	<0.10	<0.10	<0.10	<0.10	<0.10
WSW	1.57	1.12	0.30	-	1.03	1.12	1.90	1.13	0.52	0.26	0.14	<0.13	<0.13	<0.13	<0.13	<0.13
W	1.54	0.94	0.50	-	0.80	0.94	2.00	1.80	0.83	0.37	0.19	<0.18	<0.18	<0.18	<0.18	<0.18
WNW	1.46	0.48	0.34	0.10	0.48	0.48	1.83	0.93	0.41	0.24	0.11	<0.10	<0.10	<0.10	<0.10	<0.10
NW	0.04	1.62	-	0.12	0.45	1.62	0.74	1.14	0.51	0.24	0.13	<0.12	<0.12	<0.12	<0.12	<0.12
NNW	0.00	0.85	-	0.08	0.36	0.85	0.51	0.75	0.33	0.14	0.09	<0.08	<0.08	<0.08	<0.08	<0.08

NOTE:

*Distances from the BVPS-1 cooling tower to these receptors are the same as given in FSAR Table 2.3-41 with the following exceptions:

Vegetable Garden	Residents
N - 2,391 m	NNE - 2,396 m
NE - 3,852 m	NW - 1,335 m
ENE - 1,562 m	NNW - 1,285 m
NW - 1,367 m	
NNW - 1,366 m	

TABLE E451.5-2

GRAZING SEASON AVERAGE D/Q VALUES (x 10^{-9} M^{-2}) FOR COOLING TOWER DRIFT

Downwind Sector	Individual Receptors: Site Boundary	Veg. Garden	Milk Cow	Milk Goat	Meat Animal	Residence
N	-	1.06	-	.440	0.549	1.09
NNE	0.190	1.53	-	.490	1.50	1.55
NE	-	1.85	.495	.489	0.495	1.28
ENE	-	4.71	-	.529	-	4.71
E	0.443	4.94	.628	2.04	2.04	4.94
ESE	1.30	3.20	-	1.89	3.20	3.25
SE	1.24	1.95	.327	.327	1.09	1.95
SSE	1.48	1.40	.442	.171	1.38	1.51
S	2.16	1.21	1.10	-	1.74	1.78
SSW	1.44	0.835	.478	.206	0.835	1.22
SW	1.73	1.27	-	.922	1.19	1.27
WSW	1.58	1.53	.464	-	1.40	1.53
W	2.24	1.23	.653	-	1.04	1.23
WNW	1.34	0.628	.421	.110	0.628	0.628
NW	-	1.98	-	.148	0.570	1.98
NNW	-	0.328	-	.034	.167	0.373

Downwind Sector	Population Distances (meters): 805	2,412	4.023	5,633	7,242	12,070	24,140	40,230	56,330	72,420
N	1.45	1.03	.528	0.257	0.149	<.126	<.126	<.126	<.126	<.126
NNE	1.18	1.53	0.943	0.540	0.355	<.328	<.328	<.328	<.328	<.328
NE	1.51	2.97	1.75	0.992	0.537	<.489	<.489	<.489	<.489	<.489
ENE	2.56	3.29	1.76	1.54	0.476	<.386	<.386	<.386	<.386	<.386
E	3.63	4.07	2.17	1.08	0.612	<.494	<.494	<.494	<.494	<.494
ESE	1.94	2.28	1.23	0.626	0.348	<.292	<.292	<.292	<.292	<.292
SE	1.24	1.54	0.846	0.382	0.228	<.188	<.188	<.188	<.188	<.188
SSE	1.33	1.12	0.636	0.384	0.190	<.171	<.171	<.171	<.171	<.171
S	1.71	1.78	0.856	0.507	0.329	<.264	<.264	<.264	<.264	<.264
SSW	1.38	0.860	0.371	0.265	0.135	<.129	<.129	<.129	<.129	<.129
SW	.986	1.27	0.594	0.264	0.136	<.129	<.129	<.129	<.129	<.129
WSW	1.85	1.53	0.772	0.395	0.193	<.178	<.178	<.178	<.178	<.178
W	2.90	2.42	1.11	0.494	0.234	<.216	<.216	<.216	<.216	<.216
WNW	1.88	1.22	0.516	0.304	0.121	<.110	<.110	<.110	<.110	<.110
NW	1.21	1.29	0.654	0.283	0.161	<.149	<.149	<.149	<.149	<.149
NNW	.291	0.273	0.157	0.081	0.034	<.034	<.034	<.034	<.034	<.034

NRC LETTER DATED
DECEMBER 2, 1983

LIST OF EFFECTIVE PAGES

NRC QUESTIONS AND RESPONSE INDEX

BEAVER VALLEY POWER STATION - UNIT 2
ENVIRONMENTAL REPORT - OPERATING LICENSE STAGE
DOCKET NO. 50-412
DECEMBER 2, 1983

NRC QUESTION	ER-OLS SECTION	KEYWORDS
E450.1	7.1	Fatality and cancer from risk estimates and economic impact from damage to BVPS-2
E450.2	7A.2	Basis for assumption of supportive medical treatment in severe accident analysis

NRC Letter: December 2, 1983

Question E450.1

While you have tried to follow the staff's approach to and the structure of presentation of the results of such analyses in several DES/FESs persuant to the Statement of Interim Policy (Federal Register, June 13, 1983),

a. Your use of the population data for the year 1980, instead of the data for the plant mid-life year, is consistent with the staff's practice. Please provide basis for your selection of this population data; and

b. Information regarding the following items are absent in ER-OL:

   i. Risk estimates to an individual of early fatality as a function of distance or as isopleths,

   ii. Probability distribution and risk estimates of thryoid cancer fatalities,

   iii. Estimated person-rem and cancer fatalities (excluding thyroid, and thyroid only) CCDFs and risks within the 50-mi region,

   iv. Estimated distributions of number of persons exposed above 25 rems to whole-body, 300 rems to thyroid, and 200 rems to total bone marrow from early exposure, and

   v. Estimated economic cost of damage to the plant.

Either provide this information, or a justification why such information is unnecessary in support of your Environmental Report.

Response:

a. The results of the severe accident analysis for BVPS-2 provided in Section 7.1.3.2 has been revised. The analysis is now based upon the projected population distribution for the year 2010. Refer to Section 7.1, Amendment 5.

b. (i) CRAC2 calculations for the BVPS-2 plant and site indicate that the risk of fatality due to early exposure within the 10-mile emergency planning zone (EPZ) are quite limited. Only those people living within 1.5 miles of the plant are predicted to be at risk of early fatality with mean risk to the entire population of approximately 3.8×10^{-7} per reactor-year. The individual risk of early fatality ranges

from approximately 1.5 x 10^{-13} per reactor-year to 5.9 x 10^{-9} per reactor-year in the populated land elements. Approximately 40 percent of the 48 land elements within 1.5 miles are unpopulated. Because of the extremely low fatality risk and the limited area involved, the plotting of early fatality isopleths would not provide significant additional information.

b. (ii) The risk curve for thyroid cancer is provided on Figure 7.1-5, Amendment 5.

b. (iii) Generation of risk curves for the population within 50 miles of BVPS-2 requires an additional set of CRAC runs. The additional information gained by performing these analyses does not warrant the additional effort required.

However, without performing additional analyses, some estimates of risk within 50 miles are possible. Detailed output for latent cancer fatalities as a function of location due to early exposure was available in numerical form from the CRAC2 analyses. These results indicate that the ratio of latent cancer fatalities within 50 miles to that within 350 miles is approximately 0.65. The population within 50 miles of the plant, therefore, assumes about 65 percent of the total latent cancer fatality risk due to early exposure. Assuming that the latent cancer fatalities due to chronic exposure are spatially distributed approximately the same as the population, then the apportionment of this cancer fatality risk between the population within 50 miles and the total population can be estimated. The ratio of the populations is:

$$\frac{P\ (0\text{-}50\ mi)}{P\ (0\text{-}350\ mi)} = \frac{3{,}950{,}000}{94{,}971{,}000} = 0.04$$

The mean value for the latent cancer fatalities due to early exposure (for the total population) is 1.86 x 10^{-3} per reactor-year, while the mean value for latent cancer fatality due to chronic exposure is 1.85 x 10^{-2} per reactor-year. The estimated cancer risk (early and chronic) within 50 miles is $0.65(1.86x10^{-3}) + 0.04(1.85x10^{-2}) = 1.95x10^{-3}$ per reactor-year.

The total cancer fatality risk mean value for the population within 350 miles is 2.0 x 10^{-2} per reactor year. Therefore, the cancer risk assumed by the population within 50 miles of the plant is approximately 10 percent of the total cancer risk. A similar relationship would hold for the distribution of population total body man-Rem between the population

within 50 miles of BVPS-2 and the total population within 350 miles.

b. (iv) The CCDF for population with bone marrow dose greater than 200 Rem is shown on Figure 7.1-6, Amendment 5. Producing risk curves for population with whole body dose above 25 Rem and population with thyroid dose above 300 Rem requires separate CRAC2 calculations with the present version of the code. The value of the information gained by performing these analyses does not warrant the additional effort required. The results for the population with bone marrow dose greater than 200 Rem can be used as an indication of the order of magnitude of the least number of people to receive 300 Rem thyroid dose or 25 Rem whole body dose.

b. (v) The economic cost of damages to the plant would be associated with decontamination, repair or replacement of the plant, and replacement power. Although no detailed methodology has been developed to estimate the contribution of an accident to the economic risk to the licensee for decontamination and restoration of the plant, experience in these areas is being gained as cleanup of Three Mile Island Unit 2 continues.

The economic penalty associated with an accident occuring during the first year of operation of BVPS-2 can be estimated at $1,600 million, in time-of-expenditure dollars, for decontamination and restoration (Comptroller General of the United States 1981).

In addition, during each restoration year, the utility will need to purchase replacement power for the damaged unit. This cost is estimated to be approximately $575 million, in 1986 dollars, assuming the plant would be shut down for eight years and that the energy which would have been produced by BVPS-2 (assuming a 67-percent average capacity factor) would be replaced largely by coal-fired generation within the CAPCO grid. This cost is based, in part (1987-1991), on production cost savings data previously provided in response to NRC question E320.1 of the BVPS-2 Environmental Report, Amendment 3. These projected cost savings were subsequently estimated for the years 1992-1994 to provide 8 years of data for prediction of power replacement costs. The estimated CAPCO production cost savings for the years 1992, 1993, and 1994 were $80 million, $66 million, and $65 million, in 1986 dollars, respectively.

If the probability of sustaining a total loss of the plant is assumed equal to the sum of the probabilities of the occurence of core-melt accidents, there would be approximately 5.1 chances in 100,000 that a disabling accident would occur during each year of service life of BVPS-2. Multiplying the previously estimated cost of $2,175 million for an accident at BVPS-2 during the initial year of its operation by the 5.1×10^{-5} probability results in an economic risk of $111,000 applicable to BVPS-2 during that year. The economic risk in subsequent years is assumed to be the same with the effects of inflation on restoration and cleanup costs approximately offset by the effects of plant depreciation and reduced capacity.

Reference:

Comptroller General of the United States 1981. "Report to the Congress," EMD-81-106, Washington, DC, August 26, 1981.

NRC Letter: December 2, 1983

Question E450.2

As stated in Section 7A.2, the estimates of early fatalities in ER-OL were made with the assumption of supportive medical treatment. Please discuss this basis for this assumption, including the availability of such medical treatment to all persons requiring the treatment subsequent to acute radiological exposure resulting from severe accidents in the BVPS-2 reactor.

Response:

The CCDF for population having bone marrow doses in excess of 200 Rem indicates that the frequency of exceeding the capacity of supportive treatment facilities (2,500-5,000 beds, WASH-1400) is very small (about 7 out of one hundred million per year of reactor operation). This frequency is, in effect, an estimate of the probability of having underpredicted the number of early fatalities by using the supportive medical treatment dose response function. Inherent in the consequence analysis performed for BVPS-2 is the assumption of a 10-mile sheltering distance. Increasing the sheltering distance to 25 miles would further reduce the likelihood of exceeding the capacity of treatment facilities.