LIMERICK GENERATING STATION UNITS 1 & 2

ENVIRONMENTAL REPORT - OPERATING LICENSE STAGE

REVISION 1 PAGE CHANGES

The attached Revision 1 pages, tables, and figures are considered part of a controlled copy of the Limerick Generating Station EROL. This material should be incorporated into the EROL by following the collating instructions below:

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(1) These tables have been omitted from this report because of the large number of pages.
They are presented in Reference 2.3.2-9.

CHAPTER 2

THE SITE AND ENVIRONMENTAL INTERFACES

2.1 GEOGRAPHY AND DEMOGRAPHY

2.1.1 SITE LOCATION AND DESCRIPTION

2.1.1.1 Specification of Location

Limerick Generating Station is located in southeastern Pennsylvania on the Schuylkill River, about 1.7 miles southeast of the limits of the Borough of Pottstown, and about 20.7 miles northwest of the Philadelphia city limits. The Schuylkill River passes through the site, separating the western portion, located in East Coventry Township, Chester County, from the eastern portion, located in Limerick Township and Pottsgrove Township, Montgomery County, Pennsylvania. Figure 2.1-1 identifies the general location of the Limerick site, and Figure 2.1-2 shows the immediate environs, within 5 miles of the site.

The Universal Transverse Mercator coordinates of the Limerick Unit 1 reactor are 4,452,582.462 meters north and 449,984.170 meters east, Zone 18T. The corresponding Greenwich coordinates for Unit 1 are 40°13'26.67" north latitude and 75°35'16.27" west longitude. The Unit 2 reactor is located at 4,452,582.462 meters north and 450,033.548 meters east, Zone 18T of the Transverse Mercator Coordinate System, with corresponding 40°13'26.64" north latitude and 75°35'14.15" west longitude coordinates.

2.1.1.2 Site Area

The land portion of the site consists of 595 acres, as shown in Figure 2.1-3. The property within the site boundary is owned by Philadelphia Electric Company except as noted below. The site boundary is shown in Figure 2.1-3. As shown in Figure 2.1-3, the site is traversed by several public roads, a Conrail right-of-way, and the Schuylkill River. These areas, including the island in the river, are considered public passageways and not part of the site property.

The site is located in gently rolling countryside, transversed by numerous valleys containing small streams that empty into the Schuylkill River. On the eastern bank of the Schuylkill River, the terrain rises from just under el 110 MSL, at the river, to approximately el 300 MSL toward the east, which is the highest ground on the site boundary. Two parallel streams, Possum Hollow Run and Brocke Evans Creek, cut through the site in wooded valleys, running southwest into the Schuylkill River. Grade in the area of the reactor and turbine enclosures is about el 217

MSL. On the western bank of the river the terrain is relatively flat, rising only about 50 feet from the shore to the western edge of the site. One small stream flows southeastward through the site to the Schuylkill River.

The exclusion area for Limerick Generating Station, shown in Figure 2.1-3, is defined as the area encompassed by a radius of 2500 feet from the center of each reactor unit. The property within the exclusion area is owned by Philadelphia Electric Company, except as noted below. As shown in Figure 2.1-3, the exclusion area is traversed by several public roads, a Conrail right-of-way and the Schuylkill River. These areas, including the island in the river, are considered public passageways and not part of the site property. Arrangements for control of public access to these areas in the event of an emergency have been made with the Pennsylvania State Police and with Conrail, as described in the Emergency Plan.

There are no outstanding mineral rights within the exclusion area.

The locations of principal station structures are shown in Figure 2.1-4. In addition, the Limerick Atomic Information Center is located on the site property. The information center, owned and operated by Philadelphia Electric Company, is open to the public during specified hours. Admission to the information center is controlled by Philadelphia Electric Company.

A power plant simulator, to be used for training operating personnel, will be constructed adjacent to the site. This facility will be operated by General Physics Philadelphia Corporation. Use of the facility will be controlled by Philadelphia Electric Company.

2.1.1.3 Boundaries for Establishing Effluent Release Limits

The boundary line of the restricted area, as defined in 10 CFR Part 20, is identical to the site boundary line shown in Figure 2.1-3. The land area within the boundary lines is owned by Philadelphia Electric Company. Control of public passageways is discussed in Section 2.1.1.2.

There are no permanent residences within the restricted area.

Station effluent release points are shown in Figure 3.1-2.

2.1.2 POPULATION DISTRIBUTION

2.1.2.1 Population Within 10 Miles

The population distribution within 10 miles, as a function of distance and direction, for the decades 1970 through 2020, is listed in Tables 2.1-1 through 2.1-7. The 1983 projections are considered to be representative of population in the year of initial station operation, and the 2020 projections represent population at the anticipated end of station operation. A map, keyed to Tables 2.1-1 through 2.1-7, is provided in Figure 2.1-5.

The population distribution within 10 miles is based upon the number of households, obtained from a 1976 meter count of Philadelphia Electric Company's residential customer billing file, and a 1976 meter count of Metropolitan Edison Company's billing file. A factor of 3.58 persons per residential meter in Philadelphia Electric Company territory, and a factor of 2.85 persons per residential meter for the Metropolitan Edison Company territory were used to convert the meter count into population.

Projected populations were determined by using county projection factors obtained from state agencies. Where information was not available to the year 2020, Philadelphia Electric Company extended the available information through that year. Table 2.1-15 lists the sources of population information.

Population distribution is based upon the assumption that the population of each civil division is spread evenly over its area. Population per sector may then be determined by multiplying the fraction of each civil division's area within a given sector by its respective total population.

Population for the year 1983 was estimated by Philadelphia Electric Company by extrapolation of data between 1980 and 1990. Projections for the years 2010 and 2020 were made by increasing projections for the year 2000 at a rate of 20% per 10-year period.

2.1.2.2 Population Between 10 and 50 Miles

Population distribution between 10 and 50 miles for 1970 through 2020 is listed in Tables 2.1-8 through 2.1-14. This information was determined by the same techniques as in Section 2.1.2.1. A map, keyed to Tables 2.1-8 through 2.1-14, is provided in Figure 2.1-6

Population changes for 1950 through 1970 in the counties within 50 miles of the station are indicated in Table 2.1-16.

2.1.2.3 Transient Population

The transient population in the site area is classified as daily or seasonal. The daily transients result from an influx of employees to local business and industrial facilities. Local industries, and their location and employment, are listed in Table 2.1-17. The only industries with a significant daily transient population are the Firestone Tire and Rubber Company, and the Continental Distilling Corp.

Seasonal transients result from use of recreational areas, of which there is only the Countryside Swim Club, Inc., within 1.3 miles of the station. The maximum daily attendance at the swim club is estimated to be 800, with a daily average of 400 during the summer season.

2.1.2.4 Age Distribution

The age distribution in Montgomery County compared with the U.S. population in 1970 is shown below:

Age	Percent in Age Group	
	Montgomery County	United States
0-11	21.4	22.4
12-17	12.2	11.9
18 and over	66.4	65.7
Total	100.0	100.0

There is no reason to believe that there will be a significant difference in age distribution in the year 2000 between the United States and Montgomery County. The United States age distribution in 2000 is shown below:

Age	Percent in Age Group
0-11	17.3
12-17	9.2
18 and over	73.5

The Philadelphia Suburban Water Company utilizes additional surface and ground water sources. The ground water sources are located in hydrologic provinces completely separated from the site and are not affected by station effluents. Additional surface water sources used are the 4400-million-gallon Green Lane Reservoir on Perkiomen Creek and the 350-million-gallon Pickering Reservoir on Pickering Creek. Neither of these reservoirs is affected by station liquid effluents. The Citizens Utilities Home Water Company draws an additional 1.4 million gallons per day from a 600-foot well near the Schuylkill River, approximately 2 miles downstream from the Limerick site.

A door to door agricultural survey within 5 miles of the station as well as information for distances to 50 miles have provided no positive indication of the existence of agricultural irrigation downstream of Limerick Generating Station. Information was provided by the following agencies: Philadelphia County Extension Service, Montgomery County Extension Service, Delaware County Extension Service, Chester County Extension Service, New Jersey Dept. of Environmental Protection-Division of Water Resources, and the Delaware River Basin Commission.

Industrial water users are listed in Table 2.1-39 and located in Figure 2.1-9.

There is no commercial fishing or shellfishing industry throughout the entire length of the Schuylkill River. Furthermore, as a result of the river's physical restraints, future commercial fishing development is not anticipated.

The river downstream of the Limerick site is utilized for recreational boating and fishing. Table 2.1-40 lists the areas that are presently accessible for these purposes, and Table 2.1-41 lists potential downstream recreational areas. Boating and fishing hours spent on the river are listed in Tables 2.1-42 and 2.1-43, respectively. Table 2.1-44 lists the species of fish most frequently caught in the vicinity of Limerick Generating Station.

2.1.3.7 <u>Ground Water Use</u>

Present and projected ground water usage is discussed in Section 2.4.

TABLE 2.1-22

AIRPORTS WITHIN 10 MILES OF THE SITE[1]

Airport	Approximate Distance From Site (mi)	Type	Runway Surface/Service	Longest Runway (ft)
Pottstown Landing Field	2	Public use	Hard surface/lights	3500
Pottstown Municipal	5	Public use	Hard surface/lights	2700
New Hanover	5	Public use	Soft surface	3450
Perkiomen Valley	8.5	Public use	Hard surface/lights	290[illegible]
Sunset Strip	5	Private use	Soft surface	1550
Godshall	8	Private use	Soft surface	2000
Kings	8	Private use	Soft surface	1700
Yarrow	9	Private use	Soft surface	1800
Kunda	8.5	Private use	Soft surface	1300
Malickson	7	Private use	Soft surface	1800
Kolb	5	Private use	Soft surface	1500
Ginrich	4.5	Private use	Soft surface	1600
Emery	2	Private use	Soft surface	1300
Dimascio	5.5	Private use	Soft surface	1300
Hansen	7.5	Private use	Soft Surface	1800

(1) VFR Terminal Area Chart for Philadelphia, PA, March 20, 1980

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(1) These tables have been omitted from this report because of the large number of pages.
They are presented in Reference 2.3.2-9.

2.3.2.1.5 Humidity

Relative and absolute humidity, dewpoint temperature, and wet-bulb temperature from Weather Station No. 1 are summarized in the following tables of Ref 2.3.2-9.

Table 2.3.2-68	Annual Frequency Distribution of Relative Humidity
Table 2.3.2-69	Monthly Frequency Distribution of Relative Humidity
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Table 2.3.2-79	Monthly Summary of Diurnal Dew Point Variation
Table 2.3.2-80	Annual Cumulative Frequency Distribution of Wet-Bulb Temperature
Table 2.3.2-81	Monthly Cumulative Frequency Distribution of Wet-Bulb Temperature
Table 2.3.2-88	Joint Frequency Distribution of Relative Humidity, Wind Direction, Wind Speed and Atmospheric Stability Class.

The annual frequency distribution of relative humidity is shown in Table 2.3.2-68 of Ref 2.3.2-9. This distribution is skewed toward the higher humidities, with the 90 through 100% grouping containing approximately 30% of the total hours. A seasonal trend is evident in the monthly frequency distributions of relative humidity shown in Table 2.3.2-69 of Ref 2.3.2-9, as conditions of high relative humidity (90 through 100%) are more common in the summer and fall months.

A joint frequency distribution of relative humidity, wind direction, wind speed, and atmospheric stability class is given in Table 2.3.2-88 of Reference 2.3.2-9. Wind speed and direction from the 270-ft. level of Weather Station No. 1 are combined with temperature lapse rate stability classes determined from the 266-26 ft. delta temperature. The distribution within each stability class is then broken down into relative humidity classes using the same categories as Table 2.3.2-68.

In addition, the 70-79% relative humidity class has been divided into 70 to 75% and 76 to 79% categories to accommodate the droplet evaporation schemes found in some of the more common cooling tower drift depositon models. The joint frequency distribution shows the expected trend of low relative humidity occurring during unstable hours, and high relative humidity occurring during stable conditions.

The annual frequency distribution of absolute humidity from Weather Station No. 1 is shown in Table 2.3.2-72 of Ref 2.3.2-9. Absolute humidity is expressed in grams of water vapor per cubic meter of air. The maximum frequency is in the 3.01 to 4.00 g/m³ category, but the values are quite evenly distributed. There is also a large seasonal variation in absolute humidity as Table 2.3.2-73 of Ref 2.3.2-9 shows. This is what one would expect as the ability of dry air to hold water vapor is temperature-dependent.

The annual frequency distribution of dewpoint temperatures from the site is shown in Table 2.3.2-76 of Ref 2.3.2-9. The largest frequency of hours occurs in the 60.0 to 64.9°F category, but the distribution is quite even between 20 and 65°F. The seasonal trend in dewpoint temperatures is self-evident.

Cumulative frequency distributions of wet-bulb temperature from the site are given for the annual and monthly cases in Tables 2.3.2-80 and 2.3.2-81 of Ref 2.3.2-9. Due to the unusually long period of record at the site (five years), the cumulative frequency distributions of wet-bulb temperature have been computed using onsite data rather than the Philadelphia or Allentown NWS data.

2.3.2.1.5.1 Climatological Representativeness of Humidity Data

Because of its sensitivity to changes in temperatures and elevation, comparisions of relative humidity data from site to site are difficult. Some idea of the climatological representativeness of the Limerick data can be seen in Table 2.3.2-82 where mean morning (7:00 a.m.) and afternoon (1:00 p.m.) values of relative humidity from Philadelphia, Allentown, and Limerick are compared. As the table shows, in most months the mean values from the three sites are within a few percent. Limerick and Allentown are the most similar, with Philadelphia usually a few percent lower, especially in the morning.

Another indication of the climatological representativeness of the Limerick relative humidity data can be seen from the summaries of daily average relative humidity given in Ref 2.3.2-8.

In this analysis, two and one half years (1/72 through 6/74) of Limerick daily average relative humidity data were compared with the concurrent and long-term (34 years) records from Philadelphia. These daily average relative humidity data are summarized in the frequency distribution in Table 2.3.2-83. This

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table shows that Limerick has a higher frequency of days in the 90 through 100% range, and that the concurrent data are representative of long-term conditions at the site. A comparison of frequency distributions of hourly relative humidity values between Limerick and Philadelphia is shown in Table 2.3.2-84. This comparison also indicates that Limerick has a larger frequency of high relative humidity values.

2.3.2.1.6 Fog

No measurements of natural fog or visibility have been made at the Limerick site. However, an approximation of the fog and visibility characteristics of the site can be obtained from the Philadelphia and Allentown NWS data. Table 2.3.2-85 compares the mean number of days with heavy fog at these two stations. Heavy fog is defined as fog causing visibility to decrease to one-quarter mile or less.

This comparison shows surprisingly little difference between the two sites, with Philadelphia averaging 25 days of heavy fog per year, compared to 29 for Allentown. It is reasonable to assume that a similar frequency of heavy fog would be found at Limerick.

2.3.2.2 Topography

The topography of the region surrounding the site out to a distance of 50 miles is summarized in Table 2.3.2-86 which lists the offsite terrain elevation in feet above mean sea level versus distance from a point midway between the Limerick vents. The value listed is the maximum elevation on or outside the site boundary which occurs within each of the sixteen 22-1/2° sectors at the distance listed. These terrain elevations were obtained from U.S. Geological Survey maps.

Onsite terrain elevations are provided in Table 2.3.2-87 which lists the onsite terrain elevation in feet above mean sea level versus distance from a point midway between the Limerick vents. The value listed is the maximum elevation on the site which occurs within each of the sixteen 22-1/2° sectors at the distance listed. The elevations listed represent the most recent data available with respect to final plant grade.

Figures 2.1-2 and 2.1-4 depict onsite and neighboring topographical features. The most recent data available with respect to final plant grade are provided in these figures.

2.3.2.3 References

2.3.2-1 Singer I.A. and Smith M.E., "Relation of Gustiness to Other Meteorological Parameters," Journal of Meteorology, Vol 10 (1953) pp. 121-126.

2.3.2-2 USNRC, Regulatory Guide 1.23, Onsite Meteorological Programs (1972).

2.3.2-3 Star Program, Philadelphia, Pennsylvania, 1971-1975, Job No. 13739, NOAA Environmental Data Service, National Climatic Center, Ashville, N.C.

2.3.2-4 Star Program, Allentown, Pennsylvania, 1973, Job. No. 15347, NOAA Environmental Data Service, National Climatic Center, Ashville, N.C.

2.3.2-5 Decennial Census of United States Climate, Summary of Hourly Observations, Philadelphia, Pennsylvania, 1951-1960, NOAA Environmental Data Service, National Climatic Center, Ashville, N.C.

2.3.2-6 Star Program, Allentown, Pennsylvania, 1964-1973, Job No. 14737, NOAA Environmental Data Service, National Climatic Center, Ashville, N.C.

2.3.2-7 Holzworth G.C., Mixing Heights, Wind Speeds, and Potential for Urban Air Pollution Throughout the Contiguous United States, USEPA, Office of Air Programs (1972).

2.3.2-8 Philadelphia Electric Company, Final Safety Analysis Report, Limerick Generating Station, Section 2.3.1.2.3.1 Docket Nos. 50-352 and 50-353.

2.3.2-9 Philadelpha Electric Company, "Micrometeorological Data and Analyses for the Limerick Generating Station," Environmental Report - Operating License Stage, and Final Safety Analysis Report Submittals, Section 2.3.2 (Data period: Jan 1972 - Dec 1976)

DISTANCE FROM SOURCE IN FEET	N	NNE	NE	ENE	E
0	217	217	217	217	217
200	217	217	217	217	217
400	217	217	217	217	217
600	266	266	217	217	217
800	266	266	266	224	215
1000	266	266	266	230	200
1200	258	266	266	247	166
1400	262	274	264	257	192
1600	274	278	268	258	220
1800	270	280	275	250	240
2000	280	280	280	250	250
2200	260	280	280	270	240
2400	260	260	280	280	260
2500	260	270	285	280	285
2600	250	270	280	280	285
2700	250	265	250	280	280
2800	240	240	250	250	280
2900	240	240		250	290
3000	225			290	290
3100	230			295	290
3200	220			295	290
3300	200			295	290
3400				295	290
3500				300	290
3600				300	290
3700				290	295
3800				300	295
3900					
4000					
4100					
4200					
4300					

NOTE: Onsite elevation (in
(Pa. coord. N 331,844,
Maximum elevation acro
highest elevation for

TABLE 2.3.2-87

ONSITE ELEVATIONS VERSUS DISTANCE FROM VENT

ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	ALL	DISTANCE FROM SOURCE IN MILES	DISTANCE FROM SOURCE IN METERS
217	217	217	217	217	217	217	217	217	217	217	217	0.0	0.0
217	217	217	217	217	217	217	217	217	217	217	217	0.038	60.960
217	217	217	217	217	217	217	217	217	217	217	217	0.076	121.920
210	192	186	202	202	210	215	216	216	229	266	266	0.114	182.880
152	150	130	160	166	160	160	216	228	240	266	266	0.152	243.840
150	178	178	150	140	140	140	228	228	242	266	266	0.189	304.800
192	206	200	160	137	137	140	160	228	243	266	266	0.227	365.760
216	220	208	166	116	110	110	110	215	238	260	274	0.265	426.720
226	224	200	162	112	110	110	110	170	245	262	278	0.303	487.680
270	220	180	140	110	115	120	115	110	225	260	280	0.341	548.640
270	210	170	120	110	120	130	130	110	230	250	280	0.379	609.600
250	190	170	110	110	140	140	140	110	230	250	280	0.417	670.560
230	180	160	110	120	140	150	150	120	230	260	280	0.455	731.520
210	160	140	110	130	120	150	140	120	220	245	285	0.473	762.000
200	150	140	110	130	130	150	150	125	210	245	285	0.492	792.480
210	135	140	110		130	160	150	125	210	245	280	0.511	822.960
	120	140	110		150	160	150	130	200	250	280	0.530	853.440
	135	150	110		160	150	150	140	200	250	290	0.549	883.920
	150	170	110		160		150		190	250	290	0.568	914.400
	160	170	110		160				190	250	295	0.587	944.880
	170	170	110		150					250	295	0.606	975.360
	180	160	110							250	295	0.625	1005.840
	200	180	110							250	295	0.644	1036.320
	210	200	110							250	300	0.663	1066.800
	215	140	110							240	300	0.682	1097.280
	220	130	110								295	0.701	1127.760
	225	120	110								300	0.720	1158.240
	200	120	110								200	0.739	1188.720
	210	120	110								210	0.758	1219.200
		120	110								120	0.777	1249.680
			110								110	0.795	1280.160
			110								110	0.814	1310.640

feet above MSL) vs distance (ft.) from Limerick vents
E 2,603,786.5) for each of sixteen 22.5 degree sectors.
ss each sector is listed. The last column lists the
all directions.

Table 2.3.2-88

This table is provided in a separate report, Micrometeorological Data and Analysis for the Limerick Generating Station Environmental Report - Operating License Stage, and Final Safety Analysis Report Submittals, (Section 2.3.2) (Data Period: Jan. 1972 - Dec. 1976)

2.4 HYDROLOGY

2.4.1 SURFACE WATER HYDROLOGY

The Limerick Generating Station is located on the east bank of the Schuylkill River, near river mile 48 (measured from the confluence of the Schuylkill with the Delaware River), at latitude 40° 13' 3" N and longitude 75° 35' 15" W, approximately 5.5 miles downstream from Pottstown, Pennsylvania. The drainage area of the Schuylkill River at this point is 1168 square miles, with riverbed elevations ranging from about 1750 feet above mean sea level (MSL) near the source, to about 105 feet (MSL) near the plant site.

The drainage basin of the Schuylkill River, from head to mouth, is about 80 miles long and 25 miles wide, and encompasses an area of 1909 square miles up to its confluence with the Delaware River at Philadelphia, Pennsylvania. As shown in Figure 2.4-1, the entire drainage area lies in southeastern Pennsylvania.

The principal towns and cities along the course of the Schuylkill River are Pottsville (river mile 123), Reading (river mile 71), Pottstown (river mile 54), Phoenixville (river mile 36), Norristown (river mile 24), Conshohocken (river mile 20), and Philadelphia (river mile 0).

The principal tributaries of the Schuylkill River are listed in Table 2.4-1.

Flow data for various gauging stations on the Schuylkill River are available in USGS publications (Ref 2.4-1 to 2.4-5). Active stream gaging stations upstream of the plant site are listed in Table 2.4-2. The locations of these gaging stations are shown in Figure 2.4-2.

Near the plant site, the Schuylkill is a meandering stream having a bed slope of 2 to 2.5 feet/mile. It is flanked by flood plains comprised of about 10% builtup areas, 30% forest growth, and 60% cultivated or fallow fields. There are nine bridges on the river in the reach between Pottstown (river mile 54) and Cromby (river mile 39.4).

A list of minor dams upstream of the plant site is given in Table 2.4-3. A list of dams on the main stream of the Schuylkill River, downstream of the Limerick Generating Station, is given in Table 2.4-4.

The dam nearest to the Limerick Site is the Vincent Dam, which is 3.3 miles downstream. It is an old, free overflow, rock-filled timber crib structure about 12 feet high with the crest at elevation 103.5 feet (MSL). It is used for recreation and

1.5 million gallons per day (Mgd) of water supply. This dam also serves as a sediment trap.

Three major dams, Blue Marsh, Ontelaunee, and Maiden Creek, exist or are currently planned in the Schuylkill River basin upstream of Limerick Generating Station (see Figure 2.4-2). Blue Marsh is a newly constructed (1979) U. S. Army Corps of Engineers dam, located about 35 miles upstream of Limerick on the Tulpehockan Creek. It has a total storage capacity of 50,000 acre-feet, of which 22,900 acre-feet are reserved for flood control. The maximum height of this dam is 96 feet.

Ontelaunee dam is owned by the city of Reading. It is located on Maiden Creek, about 37 miles upstream of Limerick. This dam is 52 feet high, with a storage capacity of 11,900 acre-feet.

The Maiden Creek Dam, authorized for future construction by the U.S. Army Corps of Engineers, will be located on the Maiden Creek, about 5 miles upstream of Ontelaunee dam. The height of this dam will be 110 feet. It was planned to have a storage capacity of 114,000 acre-feet, of which 38,000 acre-feet are reserved for flood control. Plans for construction of Maiden Creek Dam have been indefinitely deferred and the project is considered inactive at this time.

2.4.2 GROUNDWATER HYDROLOGY

2.4.2.1 Historic Floods

Major floods in the area are usually associated with tropical disturbances from the Gulf Coast, while snowmelt floods occur annually.

In June 1972, Hurricane Agnes produced record floods on many streams in Pennsylvania. On the Schuylkill River at Pottstown, the USGS estimated the record flood of 1972 as 95,900 cubic feet per second (cfs) (Ref 2.4-1). The peak stages and discharges for major historic floods at various stations on the Schuylkill River are given in Table 2.4-5. Until June 1972, the 1902 flood with a peak discharge of 53,900 cfs was the largest known flood at Pottstown. However, stage-discharge data for Reading and Philadelphia (Table 2.4-5) indicate that the 1902 flood could have been exceeded by the 1869, 1850, and 1839 floods.

The drainage area of the Schuylkill River at Limerick is about 2% greater than that at the Pottstown gaging station. Therefore, it is assumed that the streamflows at Limerick (river mile 48) are the same as those at Pottstown (river mile 54).

The flood frequency curve of the Schuylkill River at Pottstown is shown in Figure 2.4-3. This curve is based upon the regional flood discharge relationships contained in Ref 2.4-6. Recorded annual peak flows for the Schuylkill River at Pottstown for 1928 through 1961 were used in preparing the curve along with the estimated peak flow for 1902. Subsequently, recorded annual peak flows for 1962 through 1980 were added to the originally-used flows, and new flood-frequency valves were computed. The curve of Figure 2.4-3 was found to be a conservative estimate of peak flood flows for any given recurrence interval when compared to recorded values.

2.4.2.2 Low Streamflows

June, July, August, and September are generally the months of low streamflows on the Schuylkill River. The average discharge over a period of 50 years (1927 - 1976) at Pottstown is 1877 cfs (Ref 2.4-1). The instantaneous and average daily minimum flows of the Schuylkill River at Pottstown from 1927 to 1976 are listed in Table 2.4-6. The instantaneous minimum flow for the period of record was 87 cfs on August 13, 1930 (Ref 2.4-1). The frequency curves of low flows at Pottstown for 1, 3, 7, 14, 30, 60, and 120 consecutive days are shown in Figure 2.4-4. A curve for the annual minimum instantaneous flows is also shown in Figure 2.4-4. The data used to develop the curves of Figure 2.4-4 included the effects of existing controls on the Schuylkill River. The effect of regulation provided by Blue Marsh Dam (completed in 1979) is not included. It is estimated that the completion of Blue Marsh Dam will augment the low flows of the Schuylkill River by about 65 cfs (Ref 2.4-7). A flow duration table for the Schuylkill River at Pottstown is given in Table 2.4-7, and the corresponding flow duration curve is shown in Figure 2.4-5 (Ref 2.4-8). The data used to develop this curve were the observed mean daily flows at Pottstown, and so included the effects of existing upstream controls. However, the effect of regulation provided by Blue Marsh Dam is not included.

The 7-day, 10-year low flow at Limerick is estimated to be 230 cfs (see Figure 2.4-4). Philadelphia Electric does not plan to construct any upstream storage reservoirs to augment Schuylkill River flows, because flow augmentation is not required. Low flows may be augmented in future years by controlled releases from storage dams constructed in the Schuylkill River Basin upstream from the Pottstown gaging station. As discussed in Section 2.4.1, the Blue Marsh Dam has recently been completed. The long-term average monthly flows are given in Table 2.4-8.

2.4.2.3 Perkiomen Creek and Delaware River Flows

As explained later in Section 2.4.6, the Perkiomen Creek and Delaware River are supplementary sources of water for the Limerick Generating Station. Duration tables for the Perkiomen Creek flows at Graterford (D.A = 279 mi^2) and the Delaware River at Trenton (D.A. = 6780 mi^2) are given in Table 2.4-7 (Ref 2.4-8). Perkiomen Creek flows are regulated by the Green Lane Reservoir (D.A. = 70.9 mi^2) constructed in 1956. The Delaware River flows are regulated by Lakes Wallenpaupack, Hopatcong, Pepacton, Cannonsville, Swinging Bridge, Toronto, Cliff, Neversink, Wild Creek, and several other smaller reservoirs (Ref 2.4-1). Long-term monthly average flows of the Perkiomen Creek at Graterford, and the Delaware River at Trenton are listed in Table 2.4-8.

2.4.3 WATER LEVELS

To determine the elevation of the June 1972 flood at Limerick, Philadelphia Electric Company commissioned a special survey in July 1972. About seven hours before the peaking of the June 1972 flood, an oil lagoon at Pottstown was overtopped by the flood waters. This produced an oil slick along the river that left oil marks for a considerable distance downstream. In the above-mentioned survey, readings were taken on the top of the oil marks along the east bank of the Schuylkill River from Sanatoga (1.4 miles upstream from Limerick) to Cromby (8.6 miles downstream of Limerick). Assuming that the upper envelope of these readings represents the actual high-water profile, it was concluded that the 1972 flood elevation at Limerick was about 131 feet (MSL).

Figure 2.4-6 shows the expected water surface elevations at the plant site for flows ranging from 80 cfs to 356,000 cfs. This rating curve is based upon values given in Table 2.4-9. Low-flow portions of this curve were developed using the slope-area method. The cross-section of the river near the site was taken from a survey conducted in 1969. The roughness coefficient was estimated from the average water surface slope shown in Ref 2.4-9. The low-stage computations were verified with field observations in December 1969. For flows over 20,000 cfs, the water levels were computed using the U. S. Army Corps of Engineers Standard Step Backwater Program (Ref 2.4-10). The computations covered a 14.1-mile reach of the river from Pottstown (5.5 miles upstream of the plant site) to Cromby (8.6 miles downstream of the plant site). It is not expected that this discharge rating curve, consequently, the estimated water levels, would change significantly during the course of plant operations.

Computed water surface profiles between Sanatoga Highway Bridge (4800 feet upstream from the plant site) and Linfield Railroad Bridge (7500 feet downstream from the plant site) for flood flows of 21,000 cfs, 28,000 cfs, and 99,000 cfs are shown in Figure 2.4-7. The average annual flood on the Schuylkill River at Pottstown is 21,000 cfs based on 42-years (1928-1969) and 24,300 cfs based on 53 years of record (1928-1980). The regional data, presented in Ref. 2.4-6, indicates for Pottstown an average annual flood flow of 28,000 cfs and 100-year peak flow of 99,000 cfs. The estimated probable maximum peak flood flow is 500,000 cfs which would result in a maximum water surface elevation of 174 ft at the Limerick plant site. Plant grade elevation is 217 ft.

2.4.4 HYDROLOGIC DESCRIPTION OF THE SITE ENVIRONMENT

The plant site is located between Sanatoga Creek and Possum Hollow Run, both of which are tributaries to the Schuylkill River. Sanatoga Creek drains an area of less than 10 square miles, just north of the plant site. At a point 1400 feet upstream of its confluence with the Schuylkill River, the creek is nearest to the plant site. At this location, the thalweg of the creek is at approximately el 127 feet. The spray pond (see Section 2.4.8) is located mostly within the Sanatoga Creek Basin. The cooling towers are located on a ridge that rises in an ENE direction, and separates the cooling towers from the spray pond area. The same ridge forms the drainage boundary between Sanatoga Creek and Possum Hollow Run, and isolates the

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turbine-reactor area from Sanatoga Creek. Possum Hollow Run drains an area of 1.3 square miles. It rises approximately 2.5 miles northeast of the Limerick site, flows in a southwesterly direction, and finally enters the Schuylkill River through a gorge on the south side of the station. The bed slope of the Possum Hollow Run is very steep, approximately 2%.

2.4.5 SURFACE WATER USERS

Domestic and industrial users of surface water on the Schuylkill River downstream of Limerick Generating Station are listed in Tables 2.4-10 and 2.4-11, respectively. The entitlement and approximate location of each user are indicated in the respective tables. The total entitlement for domestic use is 470 cfs, out of which 28 cfs is for consumptive use. The total entitlement for industrial use is 1020 cfs, out of which 20 cfs is for consumption. The nearest user, the Citizens Utility Home Water Company, is 2.3 miles downstream of the plant site.

According to the Delaware River Basin Commission, the data presented in Tables 2.4-10 and 2.4-11 represent volumes of water for which entitlement was identified as of 1978. No new entitlements had been recognized as of August 1980.

2.4.6 PLANT WATER REQUIREMENT

The plant circulating water and service water systems will be closed loop with natural draft cooling towers. The water requirements of the plant are discussed in Section 3.3.

The Schuylkill River flows cannot support the requirements of the plant and downstream users at all times. To supplement the supply available from the Schuylkill River, water will be withdrawn from the Delaware River via Perkiomen Creek. This system is shown in Figure 2.4-8. To authorize this withdrawal, the Delaware River Basin Commission has issued a water use approval (D-69-210 CP) for the Limerick Generating Station. The terms and conditions of this permit are given in Appendix 2.4A.

The Delaware River Basin Commission (DRBC) has exclusive jurisdiction over the necessity for and approval of compensating water storage capacity for Limerick Generating Station. An application for such capacity has been submitted at the request of the DRBC and is now under consideration by the DRBC. With regard to the water supply aspects of the facility, the station will be operated under the terms and conditions imposed by the DRBC whether or not compensating water storage capacity is required.

2.4.7 WATER QUALITY

2.4.7.1 Chemical Characteristics of Surface Water Bodie

2.4.7.1.1 Chemical Characteristics of the Schuylkill River

The Schuylkill has been beset with water quality problems since early recorded history. These along with the stresses they exert on indigenous biological communities are summarized in Section 2.2. Water quality studies in relation to LGS were initiated in May 1974, and a summary of the program is given in Section 6.1.

Table 2.4-12 is a summary of Schuylkill River water quality data which covers the period 1975 through 1978. The data in this table, collected at S77660, are grouped in four time blocks as follows: December, January, February; March, April, May; June, July, August; and September, October, November. This grouping was selected so that the Schuylkill River source water quality might be examined in seasonal periods with and without diversion.

These data depict a typical hard warmwater stream which is moderately polluted. The Schuylkill River ionic base is sulfate, and the water generally contains high concentrations of major cations.

The major cations (sodium, potassium, calcium, and magnesium) and major anions (sulfate, carbonate, and chloride) are conservative with respect to flow; that is, as the flow decreases the concentrations of these elements increases. Therefore, these elements are at their highest concentrations July through November (Table 2.4-12). The Schuylkill also has a number of the ions that are considered essential plant nutrients (i.e. ammonia, nitrite, nitrate, and phosphate). While these parameters generally behave conservatively with respect to flow, they are influenced by man's activities, and are subject to increases during periods of high flow as a result of increased runoff and increased discharge of domestic and industrial wastes during increased flow periods. The transition series elements present in highest concentration in the Schuylkill at LGS are iron, manganese, zinc, copper, and chromium (Table 2.4-6) all of which can be toxic in high concentrations.

2.4.7.1.2 Chemical Characteristics of the Perkiomen Creek

Water quality studies in relation to LGS were initiated in May 1974. Table 2.4-13 is a summary of Perkiomen Creek water quality data covering 1975 through 1978. These data were collected at P14390 as part of the program described in Section 6.1. The data are reflective of a moderately hard warmwater stream that receives moderate amounts of pollution. The mainstem Perkiomen Creek has an ionic base which fluctuates between sulfate and

2.6 REGIONAL HISTORIC, ARCHEOLOGICAL, AND NATURAL FEATURES

The regional historic, archeological and natural features were discussed in Sections 2.1.2, 2.1.3, 2.3, and Supplement 1, Question 3 of the Environmental Report - Construction Permit Stage and Section 2.3 of the Final Environmental Statement.

In accordance with 10CFR51 and Regulatory Guide 4.2, no further discussion is necessary.

CHAPTER 3

THE STATION

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3.3 STATION WATER USE

The Limerick Generating Station uses recirculated cooling water systems with natural draft hyperbolic cooling towers for the rejection of heat contained in the turbine exhaust steam and auxiliary cooling systems. These cooling systems are used for normal operation and consist of the circulating water system and the service water system. The two systems consist of separate loops using separate pumping facilities, but the two flows are mixed together in the cooling tower. The circulating water system delivers the heated water from the main condenser to the cooling tower where heat removed from the turbine exhaust steam is rejected to the atmosphere. The service water system supplies the water for station auxiliary cooling needs required during normal operation, such as the various enclosure coolers, chilling equipment, lubricating oil coolers, fuel pool coolers, and other equipment.

During shutdowns loss of offsite power, or loss of coolant accident (LOCA), the residual heat removal (RHR) service water system provides cooling water for the RHR heat exchangers to remove residual decay heat generated in the reactors. The emergency service water (ESW) system provides cooling water for various station equipment and area coolers and the diesel-generators in the event of loss of offsite power, or LOCA. The ESW and RHR service water systems are recirculated cooling water systems using vertical wet pit pumps located in the spray pond pump structure. These pumps provide the motive force to circulate cooling water between the various heat exchangers and either the cooling towers or the spray pond. Normally the heat will be rejected to atmosphere by way of the cooling towers. However, should the cooling towers be unavailable the spray pond will be used. In this event, cooling water would be withdrawn from, and returned to, the spray pond.

The cooling process in a hyperbolic cooling tower results in evaporation of a portion of the water being circulated. A carryover of water droplets into the air stream (drift) also occurs, and a small portion of the circulating water must be continuously discharged (blowdown) to prevent buildup of dissolved and suspended solids in the cooling water. The sum of these factors (evaporation, drift, and blowdown) is the amount of makeup water which must be supplied to the cooling towers. The concentration factor of the cooling tower is the makeup rate divided by the blowdown rate. The makeup rate is controlled to provide a constant concentration factor of about 3.4. The cooling tower blowdown rate for two units is expected to average 14 million gallons per day (MGD) and reach a maximum of 17 MGD.

The spray pond has a surface area of 9.6 acres. The spray pond is lined with 12 inches of soil and bentonite. If the spray pond were not lined, makeup for solar evaporation (35 inches per year) and seepage would be no more than 100,000 gpd during normal station operation. Since the pond is lined, this value is conservative. When the pond is in use, losses due to natural evaporation, plant heat load evaporation, seepage, drift loss, and fuel pool makeup are expected to total 17.3 MG over a 30-day period. Spray pond makeup water is normally supplied through a 6-inch branch line from the Schuylkill river makeup system, but water from either cooling tower basin could be added to the spray pond through normally closed 36-inch lines if necessary.

Rainfall and runoff into the spray pond is normally excess water that overflows a weir at el 250 feet MSL. The spray pond overflow averages about 50,000 gpd based on a yearly rainfall cycle. Spray pond overflow from the once-a-year, 24-hour rainfall event is about 1 MGD. The spray pond overflow is routed through an 8-inch pipe to the cooling tower blowdown line and eventually discharges to the Schuylkill River through the same diffuser that is used for cooling tower blowdown. The spray pond also has an emergency spillway (formed at el 251 feet MSL by a dip in the paved perimeter road on the north edge of the spray pond) that would spill only during intense precipitation exceeding the once-in-100-years storm. The maximum expected outflow during the probable maximum precipitation is less than 200 cfs. This spillway drains across existing terrain northward to Sanatoga Creek.

The Delaware River Basin Commission (DRBC) has exclusive jurisdiction over the necessity for and approval of compensating water storage capacity for the Limerick Generating Station. An application for such capacity has been submitted at the request of the DRBC and is now under consideration by the DRBC. With regard to the water supply aspects of the facility, the station will be operated under the terms and conditions imposed by the DRBC whether or not compensating water storage capacity is required.

Monthly average water use during two-unit, full-power operation is given in Table 3.3-1. Annual consumptive water usage rates distribution by source are 50% Schuylkill, 4% Perkiomen, and 46% Delaware. In addition to cooling tower blowdown, nonconsumptive water use includes water treated for process water makeup and subsequent waste discharge which is expected to average 100,000 gpd and reach a maximum of 300,000 gpd. A water-use schematic is shown in Figure 3.3-1 which includes the various station water systems that are described further in Sections 3.4 through 3.7.

3.4.6 PERKIOMEN MAKEUP WATER SYSTEM

The Perkiomen makeup water system is utilized when consumptive water is not available from the Schuylkill River. Water is conveyed from the Perkiomen pump structure, which is unattended and remotely controlled, through a 36-inch pipeline that extends about 8 miles to the Limerick site. A 1.5 million gallon water storage surge tank is connected to the pipeline to provide smooth operation during changing flow rates. The pipeline is installed along an existing electric transmission right-of-way, as shown in Figure 3.4-11.

The Perkiomen pump structure is located on the west bank of Perkiomen Creek, about 0.6 miles south of Graterford. The pump structure, as shown in Figures 3.4-12 through 3.4-15, is equipped with three wet-pit vertical turbine pumps rated at 14,600 gpm per pump. The pump structure is about 90 feet inshore from the normal river bank, and connected to the intake screens by buried pipes, as shown in Figure 3.4-12.

The intake consists of a series of submerged stationary wedge-wire screens, placed at midstream in Perkiomen Creek. The screens are cylindrical, approximately 6 feet long and 2 feet in diameter, with a slot size of 2 mm. The average through-slot velocity is less than 0.4 fps; maximum through-slot velocity is less than 0.5 fps. The screens are placed end-to-end in a series, with the long axis parallel to the creek flow. The top of the screens is approximately 7 inches below the minimum water surface elevation (el 111 feet MSL). The intake screens are supported by a concrete header buried approximately 2 feet below the existing creek bottom. Three buried 36-inch diameter concrete pipes connect the header with the pump structure.

Upon being actuated by an automatic timer at regular intervals, or on high differential pressure, the screens are cleaned by an airburst cleaning system to complement the screening system's ability to minimize impingement and entrainment of aquatic organisms. The channel downstream from the intake is stabilized by construction of a concrete weir (minimum crest elevation of 111 feet MSL), as shown in Figure 3.4-14.

Deposition of sediment around the screens to a depth sufficient to cause plant shutdown is highly improbable since the screens are located in mid-stream at the point of greatest depth and their centerline will be over 1.5 feet above the existing creek bed. There will be no excavated area required to facilitate area required to facilitate water withdrawal.

3.9 TRANSMISSION FACILITIES

3.9.1 DESCRIPTION OF TRANSMISSION FACILITIES

As described in Section 3.2 of the Environmental Report-Construction Permit Stage and 3.7 of the Final Environmental Statement, five outlets for generation will be provided as shown schematically in Figure 3.9-1. The existing Peach Bottom to Whitpain 500-kV line will be routed through the Limerick 500-kV substation where the line will be cut and reconnected to provide two generation outlets. A 500-kV Limerick to Whitpain line will be constructed entirely on existing rights-of-way (ROW). This line is referred to in Sections 3.9.1.1 and 3.9.2.1. Two 230-kV Limerick to Cromby lines will be constructed along two existing railroad ROWs. These lines are referred to in Sections 3.9.1.2 and 3.9.2.2.

In addition to these previously described transmission facilities, two new 230-kV lines are required. A new 230-kV line from Cromby to North Wales will be constructed on existing ROW. This line is discussed in greater detail in Sections 3.9.1.3 and 3.9.2.3. A new 230-kV line from Cromby to Plymouth Meeting will be constructed using a combination of existing and railroad ROW. This is discussed in greater detail in Sections 3.9.1.4 and 3.9.2.4.

Figure 3.9-2 provides a detailed illustration of the transmission facilities associated with the Limerick Generating Station.

3.9.1.1 Limerick to Whitpain 500-kV Line

The Limerick to Whitpain 500-kV line was discussed in Section 3.2 of the Environmental Report-Construction Permit Stage and Section 3.7 of the Final Environmental Statement. In accordance with NRC Regulatory Guide 4.2 and 10 CFR 51, no further discussion is necessary.

3.9.1.2 Two Limerick to Cromby 230-kV Lines

The two Limerick to Cromby lines were discussed in Section 3.2 of the Environmental Report-Construction Permit Stage and Section 3.7 of the Final Environmental Statement. In accordance with NRC Regulatory Guide 4.2 and 10 CFR 51, no further discussion is necessary.

3.9.1.3 Cromby to North Wales 230-kV Line

The proposed Cromby to North Wales 230-kV transmission line will be approximately 16 miles in length. Philadelphia Electric Company owns, or has easement for, 100% of the proposed ROW for this line. The ROW varies between 150 and 300 feet in width. At the present time, this ROW contains a 138-kV lattice tower transmission line. Most properties adjacent to the ROW are farms and much of the ROW is farmed. For this reason, tree trimming for the Cromby-North Wales line will be minimal. Less than 5% of the ROW is wooded. No changes in land usage are anticipated. The new line will cross the Schuylkill River, Perkiomen Creek, and the northeast extension of the Pennsylvania Turnpike.

The route selection for this line was based upon using an existing ROW. The existence of this ROW makes further consideration of alternative routes for this line impractical, as discussed in Section 10.9.

The new line will be supported on gray, single-circuit, triangular-configuration, tubular steel structures (Figure 3.9-4) for a distance of approximately 15 miles from Cromby to West Point Pike in Upper Gwynedd Township. The conductor configuration will change from triangular to vertical where sharp turns in the ROW are encountered.

The last mile the line requires installation of double-circuit vertical tubular structures (Figure 3.9-5). These structures will carry the new line and the existing Whitpain-North Wales line, which must be relocated, to new bus takeoff positions at North Wales Substation. The double-circuit vertical structures are needed because of the narrowness of the ROW in this area. These structures will also be painted gray.

The Cromby-North Wales line will be a high-capacity, 230-kV line with two 1590-kcmil (1.545 inches in diameter) ACSR conductors per phase. This line will have a summer normal rating of 1200 mVA and an emergency rating of 1400 mVA. The ruling span for this line will vary between 600 and 1200 feet depending upon terrain. All clearances will meet or exceed the minimum requirements of National Electric Safety Code (NESC) Section 23. The line will be designed to maintain a minimum vertical clearance to the ground of 25 feet at a maximum conductor temperature of 140°C, (284°F). This temperature is the conductor temperature used to establish clearances for ACSR conductors. The maximum electric field strengths anticipated for typical spans are indicated on the ROW cross sections (Figure 3.9-2).

The visual impact of the new line will be minimized by locating the new structures next to the existing line towers. This procedure takes full advantage of existing foliage which now shields the line towers from view and ensures that no structures will be placed where the general public has become accustomed to seeing only the conductors.

3.9.1.4 Cromby to Plymouth Meeting 230-kV Line

The proposed Cromby to Plymouth Meeting 230-kV transmission line will be approximately 14.5 miles long and will be constructed on existing Conrail and Philadelphia Electric Company ROW. The existence of the ROW makes further consideration of alternative routes for this line impractical, as discussed in Section 10.9.

The new line will exit Cromby Substation to the east, cross the Schuylkill River, and join the existing Cromby-Barbadoes ROW crossing over the Schuylkill River and Perkiomen Creek near Oaks, Pennsylvania. Additional width for swingout clearances may be required in this section. From Oaks to Plymouth Meeting Substation, the line will follow Conrail (formerly Penn Central Transportation Company) ROW.

The section of line between Cromby and Haws Avenue in Norristown, a distance of approximately 8.5 miles, will be constructed with gray tubular steel structures (Figure 3.9-4). The conductors will vary from horizontal, to vertical, to triangular configurations. The exact configuration will depend upon ROW width restrictions. The ruling span will vary between 300 and 800 feet for these structures. River crossing spans will be 1000 feet or more.

From Haws Avenue to Plymouth Meeting Substation, the proposed line will utilize the wide flange (WF) type of steel structure (Figures 3.9-6 and 3.9-7). This type of structure is normally used by the railroad to support catenaries and railroad transmission lines. The existing WF structures between Haws Avenue and the Pennsylvania Turnpike will be reinforced to provide adequate structural strength to support the additional loading. Tubular steel poles will be used to negotiate sharp angles in the line. Unguyed tubular structures will be used to turn the corner at the intersection of the railroad and the turnpike and at the substation (Figure 3.9-2, Sheet 6). New WF structures will be installed from the turnpike location to Plymouth Meeting.

The conductors on the WF portion of the proposed line will vary from horizontal, to vertical, to triangular configurations. The structures will be made of steel with either steel or aluminum crossarms. These structures will be similar to other railroad structures existing in this area. Between the turnpike and Plymouth Meeting Substation, the railroad ROW parallels an existing 315-foot-wide Philadelphia Electric Company ROW containing five transmission lines. The cost to build this portion of the proposed line on Applicant's ROW would be prohibitive due to the need to relocate the existing lines.

The proposed line will use two 1590-kcmil (.545 inches in diameter) ACSR conductors per phase and will have a summer normal and emergency rating of 1200 mVA and 1400 mVA, respectively.

Design maximum loading conditions for this voltage level is 1-inch-radial ice and an 8-pound-per-square-foot wind at -17.80°C (0°F). The minimum clearances at conductor operating temperature of (140°C) 284°F will be equal to or greater than the NESC requirements.

3.9.2 ENVIRONMENTAL IMPACT

The overall impact of transmission line installations associated with Limerick Generating Station on the terrestrial ecology of the area will be minimal due to the routing of the new lines along existing ROW and through areas that are not sensitive to additional disturbance. Environmental impacts of new transmission lines are addressed in this section.

3.9.2.1 Limerick to Whitpain 500-kV Line

The Limerick to Whitpain 500-kV line is discussed in Section 3.2 of the Environmental Report-Construction Permit Stage and Section 3.7 of the Final Environmental Statement. In accordance with NRC Regulatory Guide 4.2 and 10 CFR 51, no further discussion is necessary.

3.9.2.2 Two Limerick to Cromby 230-kV Lines

The two Limerick to Cromby 230-kV lines are discussed in Section 3.2 of the Environmental Report-Construction Permit Stage and Section 3.7 of the Final Environmental Statement. In accordance with NRC Regulatory Guide 4.2 and 10 CFR 51, no further discussion is necessary.

3.9.2.3 Cromby to North Wales 230-kV Line

This new line will leave Cromby toward the east and follow the existing Cromby to North Wales 138-kV transmission ROW. This route has been cleared to the boundary lines of the ROW and no additional clearing will be necessary. Current land use inside this ROW is mostly agricultural (corn, wheat, soybeans, and pasture) with the remainder in various successional stages similar to an old-field community. The ground cover on ROW land that is not used for agricultural purposes is a mixture of composites (asters, goldenrods, and grasses) which in places is covered with a well-developed vine layer composed primarily of Japanese honeysuckle and blackberry. Some areas also exhibit a sparse tree layer (red cedar, black locust, white ash, sassafras, and other early successional tree species). This layer is not permitted to develop to maturity and must be cleared periodically.

The environmental impact of this transmission line would be primarily due to the small loss of agricultural land under the tower bases.

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$$DF^{sh} = 2.13 \times 10^{-3} \times 10^{-4} \times 0.5 \sum_{ij} \bar{E}_{\gamma ij} \times F_{\gamma ij} \times U'_{\gamma j} \times E(U''_{\gamma j} a_o) \times \exp(U_{\gamma j} D) \quad (5.2\text{-}13)$$

Where

10^{-4} = $\dfrac{1 m^2}{10000\ cm^2}$

0.5 = ground roughness correction.

$\bar{E}_{\gamma ij}$ = gamma energy for nuclide i, and energy range j, (MeV/dis).

$F_{\gamma ij}$ = fraction of disintegration resulting in a gamma photon of energy j from nuclide i.

$u'_{\gamma ij}$ = mass energy absorption coefficient in air (for shoreline and ground plane exposure) or water (for bottom sediment exposure for photon energy j (cm^2/g).

$u''_{\gamma j}$ = mass energy absorption coefficient in muscle tissue for photon energy j (cm^2/g).

D = product of tissue density and depth to determine total body exposure (g/cm^2).

$E(u''_{\gamma j} a_o)$ = result of the first order exponential integral.

Where

$u''_{\gamma j}$ = linear attenuation coefficient in air (for shoreline and ground plane exposure) or water (for bottom sediment exposure) for photon energy j(1/cm).

a_o = distance from plane to point of exposure.

The results of the dose calculations to various species of biota are presented in Table 5.2-10. It must be realized that the results of these calculations are extremely conservative due to the minimal environmental dilution considered.

Section 5.2.4.3 discusses direct radiation doses from the facility to man. Utilizing this same methodology, maximum direct radiation doses to biota are expected to occur near the Schuylkill River pump structure. Assuming a 50% residency factor for the biota in this area, a resulting direct radiation dose of 35 mrad/yr is derived.

5.2.4 DOSE RATE ESTIMATES FOR MAN

5.2.4.1 Liquid Pathways

Individual doses through the aquatic environment from liquid effluents of LGS were calculated using the equations and assumptions presented in USNRC Regulatory Guide 1.109 (Ref 5.2-1). The USNRC computer code "LADTAP" was used for this evaluation. A description of the dose calculational model is presented in Appendix 5.2A.

As discussed in Section 2.1.3, a door to door agricultural survey, and information obtained from local agencies have provided no positive indication of agricultural irrigation downstream of the site out to 50 miles. For this reason, the irrigation pathway was not evaluated.

Five users of Schuylkill River water for drinking purposes are located within 50 miles downstream of LGS. Usage information is presented in Section 2.1.3. Since one user, Philadelphia Suburban Water Company, is allocated only 22% of its water requirements from the Schuylkill, calculated doses at this station were adjusted to reflect this fact. Similarly, Citizens' Utility Home Water Company pumps about 48% of its water requirements from the Schuylkill River and the calculated doses have been reduced to reflect this fact.

The calculated annual dose that results from Limerick liquid radwaste releases, along with the critical organ for the location at which any of the following pathways (eating fish, swimming, boating, drinking, shoreline, and total) produces the highest maximum individual dose, are presented in Table 5.2-11. Table 5.2-12 lists the highest calculated dose to each organ through all real pathways, and the location at which it occurred.

Appendix 5.2A includes a map of the locations evaluated. The location with the highest total dose to any organ is the Limerick outfall area (Location 1) where eating fish, swimming, and shoreline recreation doses have been calculated. This location provides the highest doses from the swimming, eating fish, and total pathways, with the total body as the critical organ for the swimming pathway, and bone as the critical organ for the eating fish and total pathways. The location with the highest calculated dose to any organ for the shoreline recreation pathway is the Schuylkill River Crew Course (Location 9), with skin as the critical organ. The Phoenixville Water Authority (Location 5) represents the maximum dose from drinking water. Vincent Dam (Location 4) has the highest dose to the total body from the boating pathway.

TABLE 5.2-18

COMPARISON OF MAXIMUM INDIVIDUAL DOSES RESULTING FROM LGS UNITS 1 AND 2 WITH 10 CFR 50 APPENDIX I DESIGN OBJECTIVES

	LIMERICK LIQUID DOSE UNITS 1 AND 2	10 CFR 50, APPENDIX I DESIGN OBJ./2 UNITS
Total body	1.02 mrem/year	6 mrem/year
Max. organ	1.78 mrem/year (Bone)	20 mrem/year

	LIMERICK GASEOUS DOSE UNITS 1 AND 2	10 CFR 50, APPENDIX I DESIGN OBJ./2 UNITS	RM-50-2 SITE % OF DESIGN OBJECTIVE[3]
Gamma air dose (mrad/yr)[1]	.86	20	-
Beta air dose (mrad/yr)[1]	.59	40	-
Total body of individual (mrm/yr)[1]	.46	10	5
Skin of individual (mrem/yr)[1]	.90	30	15
Any organ all pathways (mrem/yr)[2]	1.92 (Thyroid)	30	15

[1]Doses from noble gases only

[2]Doses from radioiodines and air particulates with half lives greater than eight days

[3]Annex to Appendix I, 10CFR50; Concluding Statement of Position of the Regulatory Staff, Public Rulemaking Hearing on Numerical Guides for Design Objectives and Limiting Conditions for Operation to meet the criterion "as low as practicable" for Radioactive Material in Light Water Cooled Nuclear Reactors, USAEC Docket No. RM-50-2.

TABLE 6.1-45

LGS PROPOSED PREOPERATIONAL RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

PROGRAM STATUS AT:	SAMPLE TYPE	ANALYSIS	NUMBER OF STATIONS	FREQUENCY OF ANALYSIS
2 years prior to fuel load	Air (particulate and iodine)	Radioiodine (I-131) Gross Beta Gamma Isotopic	None 17 6	None Weekly Quarterly Composite
	Direct Radiation	Gamma Dose	35	Monthly
	Sediment	Gamma Isotopic	3	Semi-Annually
	Fish	Gamma Isotopic	3	Seasonal or Semi-Annually
	Crops	Gamma Isotopic	2	Semi-Annually
1 year prior to fuel load	Air (particulate and iodine)	Radioiodine (I-131) Gross Beta Gamma Isotopic	17 17 6	Weekly(1) Weekly Quarterly Composite
	Direct Radiation	Gamma Dose	35	Monthly
	Surface Water(3)	Gamma Isotopic Tritium Gross Beta (Sol. and Ins. separately)	2 2 2	Monthly Quarterly Monthly
	Drinking Water(3)	Gamma Isotopic Tritium Gross Beta	2 2 2	Monthly Quarterly Monthly
	Ground Water	Gamma Isotopic Tritium	2 2	Semi-Annually Semi-Annually
	Sediment	Gamma Isotopic	3	Semi-Annually
	Milk	Gamma Isotopic	10	Quarterly
		Iodine (I-131)	10	Quarterly(2)
	Fish	Gamma Isotopic	3	Seasonal or Semi-Annually
	Crops	Gamma Isotopic	2	Semi-Annually
	Game	Gamma Isotopic	1	Annually

TABLE 6.1-45 (Cont'd)

PROGRAM STATUS AT:	SAMPLE TYPE	ANALYSIS	NUMBER OF STATIONS	FREQUENCY OF ANALYSIS
6 months prior to fuel load	Air (Particulate and Iodine)	Radioiodine (I-131)	17	Weekly(1)
		Gross Beta	17	Weekly
		Gamma Isotopic	6	Quarterly Composite
	Direct Radiation	Gamma Dose	35	Monthly
	Surface Water(3)	Gamma Isotopic	2	Monthly
		Tritium	2	Quarterly
		Gross Beta (Sol. and Ins. separately)	2	Monthly
	Drinking Water(3)	Gamma Isotopic	2	Monthly
		Tritium	2	Quarterly
		Gross Beta	2	Monthly
	Ground Water	Gamma Isotopic	2	Semi-Annually
		Tritium	2	Semi-Annually
	Sediment	Gamma Isotopic	3	Semi-Annually
	Milk	Gamma Isotopic	10	Quarterly
		Iodine (I-131)	7	Semi-Monthly(2)
			3	Quarterly
	Fish	Gamma Isotopic	3	Seasonal or Semi-Annually
	Crops	Gamma Isotopic	2	Semi-Annually
	Game	Gamma Isotopic	1	Annually

(1) Iodine cartridge exchanged at 17 stations and I-131 analysis weekly on 6 of these cartridges.
(2) Quarterly samples until six months prior to fuel load at which time 7 stations will be sampled semi-monthly during the grazing season and monthly during the non-grazing season.
(3) 10 ml aliquot collected at approximately 50 minute intervals and composited monthly.

TABLE 6.1-47

ENVIRONMENTAL SAMPLING AND MEASURING EQUIPMENT

SAMPLE TYPE OR MEASUREMENT	EQUIPMENT
Airborne Particulate & Radioiodine	Continuous Air Pump which passes approximately 1CFM through filter paper and charcoal cartridge
Surface Water (composite)	Automatic Composite Sampler
Drinking Water (composite)	Automatic Composite Sampler
Direct Radiation	Thermoluminescent Dosimeter
Fish	Trap Net, Seine, Hook and Line, Electro Fishing Apparatus and/or Equivalent Equipment

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CHAPTER 7

ENVIRONMENTAL EFFECTS OF ACCIDENTS

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CHAPTER 7

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CHAPTER 7

FIGURES

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7.1-1	Limerick/WASH-1400 Risk Comparison
7.1-2	Comparison of the CCDF for Latent Fatalities for the Population Surrounding the LGS: WASH-1400 Composite Site BWR and the Limerick Site Specific Evaluation

7.1 STATION ACCIDENTS INVOLVING RADIOACTIVITY - PROBABILITY RISK ASSESSMENT

The Limerick Generating Station Probabilistic Risk Assessment (PRA), reference 7.1-1, was performed as requested by the NRC in its May 6, 1980 letter from D.G. Eisenhut to E.G. Bauer. Philadelphia Electric submitted the PRA to the NRC in its March 17, 1981 letter from E.J. Bradley to H.R. Denton.

The executive summary from the PRA is reproduced in Section 7.1.1. Descriptions of the risk assessment methodologies utilized are found in reference 7.1-1.

7.1.1 PRA EXECUTIVE SUMMARY

Background

At the request of the Nuclear Regulatory Commission, Philadelphia Electric Company, its contractor, the General Electric Company, and prime subcontractor, Science Applications, Inc., have performed a probabilistic risk assessment (PRA) of the Limerick Generating Station. The purpose of the analysis was to assess the risk of Limerick, specifically with regard to its location near a high population density area. These risks were evaluated to determine if they represent a disproportionately high segment of the total societal risk from postulated nuclear reactor accidents. The NRC requested that the Limerick analysis employ the methodology of the Reactor Safety Study (WASH-1400), with modifications to account for both the design differences and the site-specific differences between Limerick and the WASH-1400 reference plant and site. In addition, the NRC requested that recognition of the various criticisms of the WASH-1400 analysis approach and conduct (including those of the Lewis Committee) be considered in the Limerick Study.

The Limerick PRA

The Reactor Safety Study (WASH-1400) published in 1975 was the first thorough application of probabilistic methods to analyzing nuclear power plant risk. The Limerick analysis employs the basic approach and techniques utilized in the Reactor Safety Study, i.e., the use of fault trees and event tree logic models to quantify the probability of accident sequences. However, in reponse to NRC direction, the Limerick analysis accounted for a revised list of accident initiators based on the Limerick plant design and a more detailed analytical modeling of event sequences following each accident initiator. Plant-specific and site-specific data were also included in the analysis of the Limerick Mark II containment and in the meteorology and demography inputs to the evaluation of accident consequences. Criticisms of the WASH-1400 methodology (specifically those in the Risk Assessment Review Group Report to the NRC (NUREG/CR-0400)) were addressed in the Limerick PRA through a more detailed evaluation of accident sequences and sequence probabilities. Furthermore, there has been an attempt to apply the learning and experience gained over the six years since WASH-1400 to update and improve the risk assessment methodology. The most recent available data from operating experience was employed. Additionally, updated consequence evaluation analytical techniques were utilized. The Limerick analysis includes consideration and characterization of uncertainties in the results.

Results

The figure of merit employed in the Reactor Safety Study to quantify nuclear reactor risk is a graphical representation of the complementary cumulative distribution function (CCDF). The CCDF relates the expected frequency (number of accident events per year) to the consequence (e.g., number of early or latent fatalities).

Figure 7.1-1 presents the calculated CCDF for the Limerick site-specific analysis for early fatalities. Also shown in Figure 7.1-1 is the calculated CCDF for the composite site for the WASH-1400 BWR. For comparison, the CCDF curves estimated for total man-caused risk (excluding automobile crashes) and total natural risk to the population around the Limerick site are also plotted in Figure 7.1-1. In addition, the CCDF curve for airplane crashes causing early fatalities to humans on the ground is separated out from the total man-caused risk and presented. This component has been specifically included as an example of the risk to which the population is subjected without conscious decision.

Figure 7.1-2 presents the calculated CCDF for both the Limerick site-specific case and the WASH-1400 BWR composite site case for latent fatalities due to radionuclide releases following low probability accident sequences.

Conclusions

A comparison of the CCDF curves generated in this study for the Limerick site with those presented in the reactor safety study leads to the following conclusions:

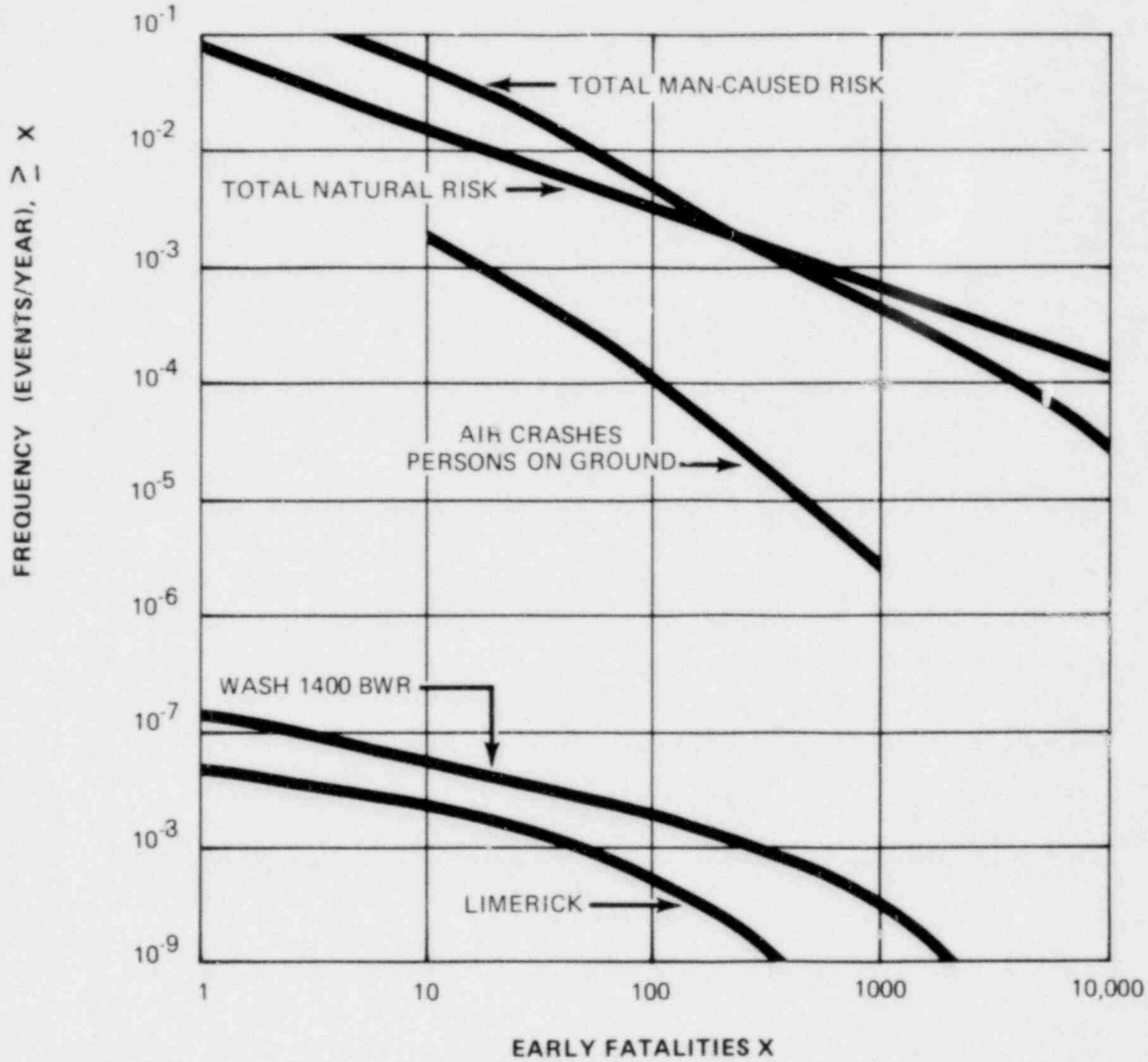
The Limerick site-specific best estimate CCDF curves are slightly below the WASH-1400 curves for both early fatalities and latent fatalities for all calculated consequences.

The Limerick CCDF for early fatalities is several orders of magnitude below the CCDF due to all natural and man-made risks as evaluated in WASH-1400.

Based upon this analysis, the Limerick Generating Station is not expected to represent a disproportionately high segment of the total societal risk from reactor accidents.

7.1.2 REFERENCES

7.1-1 Limerick Generating Station Probabilistic Risk Assessment, Philadelphia Electric Co. (March, 1981).



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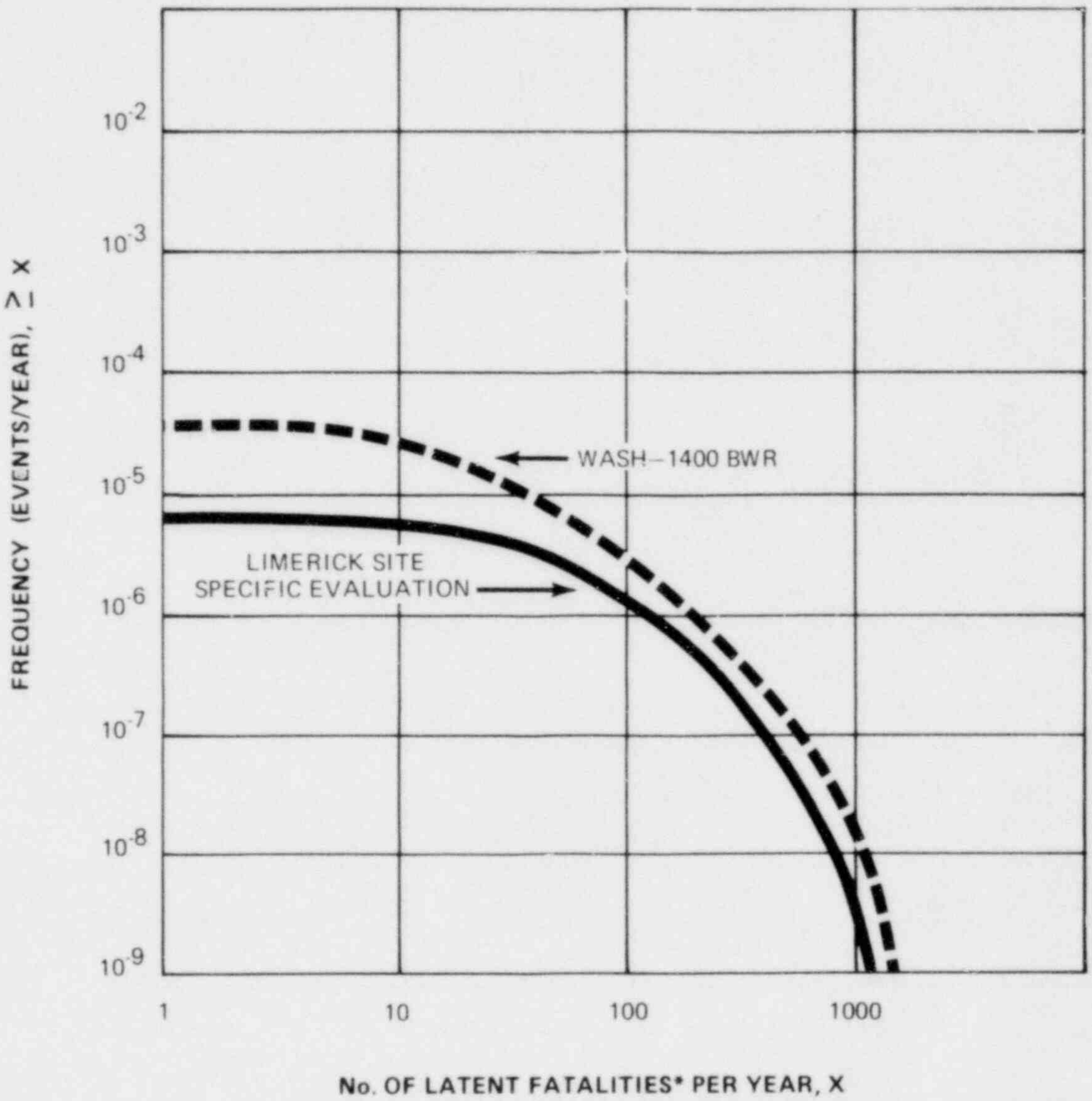
LIMERICK GENERATING STATION
UNITS 1 AND 2
ENVIRONMENTAL REPORT

LIMERICK RISK ASSESSMENT
LIMERICK/WASH-1400
RISK COMPARISON

FIGURE 7.1-1



* LATENT FATALITIES DUE TO CORE MELT ACCIDENT SEQUENCES

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COMPARISON OF THE CCDF FOR LATENT FATALITIES FOR THE POPULATION SURROUNDING THE LGS: WASH–1400 COMPOSITE SITE BWR AND THE LIMERICK SITE SPECIFIC EVALUATION

FIGURE 7.1-2

10.7 ALTERNATIVE LIQUID RADWASTE SYSTEMS

The liquid radwaste system is described in Section 3.5. Alternatives were discussed in Section 8.4.3.1 of the Environmental Report-Construction Permit Stage and Section 11.7 of the Final Environmental Statement. No further consideration has been done to formulating liquid radwaste system design since analysis indicates that liquid radioactive effluents from Limerick will be within the "as low as reasonably achievable" numerical guides for design objectives and limiting conditions of operation set forth in Appendix I of 10 CFR 50 and will satisfy the guides for design objectives proposed in the concluding statement of position of the Regulatory Staff in Docket RM-50-2.

10.8 ALTERNATIVE GASEOUS RADWASTE SYSTEMS

The gaseous radwaste system is described in Section 3.5. No further consideration has been given to formulating alternative gaseous radwaste system designs since analysis indicates that gaseous radioactive effluents from LGS will be within the "as low as reasonably achievable" numerical guides for design objectives and limiting conditions of operation set forth in Appendix I of 10 CFR 50 and will satisfy the guides for design objectives proposed in the Concluding Statement of Position of the Regulatory Staff in Docket RM-50-2.

10.9 ALTERNATIVE TRANSMISSION FACILITIES

As discussed in sections 3.2 and 5.4 of the Environmental Report - Construction Permit Stage and section 3.7 of the Final Environmental Statement, transmission requirements were a significant factor in the selection of the Limerick Site, because the necessary rights-of-way were already established. In section 3.7 of the Final Environmental Statement, the NRC Staff concurred with the Applicant in finding "...that grouped systems within fewer transmission corridors, rather than a growth in the number of corridors, are a better approach to land planning".

Consistant with the finding, the routing of transmission facilities not previously described was selected so as to utilize existing rights-of-way exclusively. Specifically, the Cromby to North Wales and Cromby to Plymouth Meeting 230 kV lines described in section 3.9 of this report will be constructed entirely on previously existing transmission line and railroad rights-of-way. Alternative routings for these lines would require the acquisition of new private rights-of-way with attendant adverse environmental impacts, and are therefore not evaluated further.

12.3 WATER QUALITY CERTIFICATION

Water quality certification under Section 401 of the Federal Water Pollution Control Act, as amended, has been requested and received for each of the Federal permits received thus far, and are listed in Section 12.1, PERMITS. Water quality certification for the remaining Federal permits or licenses will be requested from the Pennsylvania Department of Environmental Resources (DER) at the time of submittal of the application.

The DER has received authority to administer the National Pollutant Discharge Elimination System (NPDES) program in Pennsylvania. The Applicant will submit a NPDES permit application for the plant operating discharges to the DER. Because of the DER now having this authority, the water quality certification will not be required for issuance of the NPDES permit.

QUESTION E240.1 (Section 2.4.1)

Identify the anticipated date of operation of Maiden Creek Dam.

RESPONSE

According to information received from the Philadelphia District of the U.S. Army Corps of Engineers, plans for construction of Maiden Creek Dam have been indefinitely deferred and the project is considered inactive at this time. The anticipated date of operation is therefore unknown. Section 2.4.1 has been changed to indicate this.

QUESTION E240.2 (Section 2.4.2)

Identify the period of record used to develop the flood frequency-curve (Figure 2.4-3). The period of record considered was apparently prior to the date indicated in Reference 2.4-5 (1968). Re-estimate the curve using the period of record through 1980 so that the effects of Tropical Storm Agnes (June 1972) and other events since may be included.

RESPONSE

The requested information has been added to Section 2.4.2.1.

QUESTION E240.3 (Section 2.4.2)

Table 2.4-7 and Figure 2.4-5 apparently have been based on records through 1967. We understand other incidents of low flow have occurred which may alter estimates of the low flow frequency characteristics of streams in the site region. Accordingly, discuss the low flow characteristics of the Schuylkill River, Perkiomen Creek, and the Delaware River at Trenton through 1980.

RESPONSE

The requested information will be provided in the fourth quarter of 1981.

QUESTION E240.4 (Section 2.4.2)

The last paragraph of Section 2.4.2.2 does not indicate whether flow augmentation will be achieved by any storage to be provided by Philadelphia Electric Company as a result of requirements imposed by the Delaware River Basin Commission. Indicate whether such augmentation will occur, when it is likely to occur, and the amount and reliability of such augmentation. If the Point Pleasant Diversion Plan is the source of that augmentation of the appropriate background information should be referenced and summarized such as: the DRBC FEIS of February 1973, the DRBC Final Environmental Assessment of August 1980, the DRBC Proceedings on Docket No. D-79-52CP OF February 18, 1981, the DRBC Proceedings on Docket No. D-65-7CP(8) of February 18, 1981, and the Army actions on NAPOP-R-0534-3 and NAPOP-R-0813-13.

RESPONSE

Section 2.4.2.2 discusses low streamflows on the Schuylkill River only. Philadelphia Electric Company will not be providing any augmentation flow in the Schuylkill River, is not providing any storage facilities on the Schuylkill River, and is not required by the Delaware River Basin Commission to provide such. The Point Pleasant Diversion Plan will supply water from the Delaware River directly to Limerick Generating Station and will not provide any augmentation to the Schuylkill River.
Section 2.4.2.2 has been changed to clarify the reference to augmentation.

QUESTION E240.5 (Section 2.4.3)

Indicate whether estimates of water levels are likely to change during the course of plant operation due to erosion and sedimentation, and discuss the basis for your evaluation.

RESPONSE

The water levels were estimated from a discharge rating curve of the Schuylkill River near the plant site. EROL Section 2.4.3 has been changed to indicate that this discharge rating curve, and consequently the estimated water levels, are not expected to change significantly during the course of plant operations.

No net deposition or erosion is expected to occur in the vicinity of the Schuylkill intake structure. Likewise, no deposition or erosion effects from the discharge into the Schuylkill River through the blowdown diffuser are expected as discussed in Section 3.4.5. In addition, a channel stabilization structure, which incorporates the project blowdown diffuser has been constructed across the river channel downstream of the intake location.

Consequently, the estimated water levels would not change.

QUESTION E240.6 (Section 2.4.3)

The last paragraph of Section 2.4.3 indicates that flow-frequency estimates have been based on pre-1968 data. Revise the estimates to reflect the flow history through 1980.

RESPONSE

Section 2.4.3 has been changed to reflect the flow history through 1980.

QUESTION E240.7 (Section 2.4.4)

The bed slope for Possum Hollow Run appears to be incorrect and should be checked.

RESPONSE

Slope is normally defined as the amount of vertical fall per horizontal distance. The slope of the Schuylkill River is given in Section 2.4.1 as 2 to 2.5 feet per mile. This is a gentle slope, characteristic of a meandering stream.

Possum Hollow has a much steeper slope than the Schuylkill River near the site. Possum Hollow has a bed slope of about 100 feet per mile as it passes the site and enters the Schuylkill River. Occasionally slope is expressed in percent and on this basis Possum Hollow has a slope of about 2%. EROL Section 2.4.4 has been changed accordingly.

QUESTION E240.8 (Section 2.4.5)

Tables 2.4-10 and 2.4-11 indicate downstream water users apparently identified at the time the ER for the CP was written. Provide any other anticipated users or changing user requirements that have been identified for the future.

RESPONSE

Section 2.4.5 has been changed to indicate that no new entitlements had been recognized as of August 1980. No changes in user requirements have been identified since Tables 2.4-10 and 2.4-11 were originally prepared.

QUESTION E240.9 (Section 2.4.6)

(a) The Delaware River Basin Commission permit for water use was the subject of considerable discussion during the course of the Construction Permit review. The initial decision of the Atomic Safety and Licensing Board indicated that a separate DRBC Decision was to be made by January 1, 1977 on whether or not compensation storage would be required. Indicate what the status of that process has been. (See Question E240.4 above).

(b) As part of the same issue, considerable discussion occurred about the consequences of plant operation if Tocks Island Dam was not constructed and compensating storage was not provided. The data used to project the periods of non-full power operation did not include information for the middle and late 1970s. Identify the likelihoood and duration of plant shutdown assuming that the present flow augmentation planning process is carried out.

RESPONSE

(a) In Resolution No. 76-13, adopted by the Delaware River Basin Commission on September 30, 1976, the Commission required Philadelphia Electric Company and Public Service Electric and Gas Company to provide water storage to assure the availability of water for consumptive use at the Limerick and Hope Creek Generating Stations during periods of low flows in the Delaware River. An Application under Section 3.8 of the Commission's Compact and an Environmental Report were filed December 30, 1977, for approval of the required storage.

The storage proposed is a reservoir to be constructed by a group of seven utilities, including the two previously named companies, on Merrill Creek, in Harmony Township, Warren County, New Jersey. An updated Application was submitted to the Commission in May, 1981, to respond to concerns raised by Federal and State agencies in their initial review of the project. Formal action by the Commission on the Application is expected in mid-1982. Dam and water pipeline land acquisition is proceeding and currently most property necessary for the project is available. Some limited land acquisition in certain areas remains. Construction of the project is expected to begin in 1983.

(b) Following completion of the Merrill Creek Reservoir Project and the water transport system there is little likelihood that the Limerick Generating Station will be shut down due to a lack of water. The Merrill Creek storage will be capable of yielding 200 cubic feet per second (cfs) of water for a period of 115 days. The applicant companies in their

June 1975 Master Siting Study projected for 1989 an average consumptive water use in the Delaware River Basin for power plant cooling of 180 cfs. The Delaware River Basin Commission, as a result of their extensive drought studies, concluded that the proposed storage will provide protection should the most severe drought of record recur.

QUESTION E240.10 (Section 4.5.1)

Identify any effects on runoff that have occurred due to plant construction. Include an evaluation of the erosion that has occurred on drainage courses upstream of construction areas, and the impact of erosion and/or deposition on downstream areas.

RESPONSE

Plant construction has resulted in some erosion during heavy storms. However, the construction erosion control program has been effective and as of August, 1981 operation of detention ponds and sedimentation basins has been effective. Storm water discharge has not created any impact on Possum Hollow. No noticeable deposition or erosion has occurred downstream as a result of storm-water runoff from the construction site.

No unusual erosion has occurred on areas upstream of the construction area. A check with the U.S. Geological Survey personnel confirmed this observation.

QUESTION E240.11 (Section 5.1)

In section 5.1 two additional effects should be identified. First, the effects of plant water use on other users should be identified (and possibly cross references to other sections of the ER). Secondly erosion and deposition effects of water intake and discharge should be considered.

RESPONSE

This information will be provided in the fourth quarter of 1981.

QUESTION E240.12 (Section 5.1.1)

Identify Department of Environmental Resources and Delaware River Basin Commission standards for receiving water that may differ. Indicate which standards you intend to comply with.

RESPONSE

The requested information will be provided in the fourth quarter of 1981.

QUESTION E240.13 (Section 5.1.2)

Identify the range of initial blowdown dilution areas anticipated for the corresponding range of Schuylkill River flows that are likely to occur during plant operation.

RESPONSE

The requested information will be provided in the fourth quarter of 1981.

QUESTION E240.14 (Section 5.1.2)

Describe the deposition and erosion in front of the intake structure anticipated during the life of the plant.

RESPONSE

No net deposition or erosion is expected to occur in the vicinity of either the Perkiomen or the Schuylkill intake structures. Concrete weirs have been constructed slightly downstream from each intake structure as described in Sections 3.4.5 and 3.4.6. These weirs, constructed of reinforced concrete, were set with their top elevation at the stable river bed elevation. They will prevent any erosion from progressing upstream to the intake, but will not cause a flow obstruction and, thus, provide positive stabilization of the river bed.

QUESTION E240.15 (Section 5.1.2)

Average monthly blowdown temperature alone do not indicate the range of temperature likely to occur during plant operation. Provide your estimates of the extreme temperatures likely to occur during operation and indicate whether such temperatures are likely to cause impacts such as being a constraint on plant operation.

RESPONSE

The requested information will be provided in the fourth quarter of 1981.

QUESTION E240.16 (Section 5.1.2)

Indicate the likelihood of the intake structure on Perkiomen Creek being inoperable due to flooding or erosion. Provide the basis for your analysis.

RESPONSE

The requested information will be provided in the fourth quarter of 1981.

QUESTION E240.17 (Section 5.1.2)

Indicate the period of record used to estimate the percentage of diverted flow in Perkiomen Creek described in Section 5.1.3.2.2, and, if necessary, update for data collected through 1980.

RESPONSE

The requested information will be provided in the fourth quarter of 1981.

QUESTION E240.18 (Section 5.1.2)

Indicate whether deposition in front of the intake structure on Perkiomen Creek is likely to cause plant shutdown.

RESPONSE

As described in Section 3.4.6, the Perkiomen intake structure is located about 90 feet inshore and utilizes stationary, cylindrical wedge-wire screens placed at mid stream. These screens will be located at the deepest point in the creek bed. The screen centerline will be over 1.5 feet above the existing creek bottom. There will be no excavated area to collect sediments, block the screens and cause a plant shutdown.

The intake will be used about 50% of the year so ample opportunity is available to inspect for sediment buildup and to take corrective action if required before the intake is needed.

QUESTION E240.19 (Section 5.1.2)

Estimate the increased flow risk to property along the east branch of Perkiomen Creek due to diversion from the Delaware River, that is, provided an estimate of the increased likelihood of flooding due to high creek flows from diversions coincident with heavy precipitation.

RESPONSE

The requested information will be provided in the fourth quarter of 1981.

QUESTION E240.20 (Section 6.1.1)

Were any streamflow and water level measurements made by Philadelphia Electric Company on either the Schuylkill River or Perkiomen Creek? If so, described their nature and data collected.

RESPONSE

Philadelphia Electric Company has not made any continuous, regular streamflow or water level measurements on the Schuylkill River or the Perkiomen Creek. The Company has utilized data collected by the U.S. Geological Survey at the Pottstown gage station on the Schuylkill River and at the Graterford gage station on Perkiomen Creek whenever stream flow information is required. The periods of record for these two stations began in October 1926 and June 1914 respectively.

On one occasion during 1979 a series of Schuylkill River cross sections were obtained between Limerick and Cromby Generating Stations and water velocities measured in connection with a radwaste dilution study. This field work comprises the only known streamflow information collected for the two areas.

Water levels were observed on a few occasions (see Table 2.4-9) but generally water level information used in the design of structures and in the prediction of flood or drought levels has been calculated.

QUESTION E240.21 (Section 7.1)

Calculate the radiological consequences of a liquid pathway release from a postulated core melt accident. The analysis should assume, unless otherwise justified, that there was a penetration of the reactor basemat by the molten core mass, and that a substantial portion of radioactively contaminated suppression pool water was released to the ground. Doses should be compared to those calculated in the Liquid Pathway Generic Study (NUREG-0440, 1978). Provide a summary of your analysis procedures and the values of parameters used (such as permeabilities, gradients, populations affected, water use). It is suggested that meetings with the staff of the Hydrologic Engineering Section be arranged so that we may share with you the body of information necessary to perform this analysis.

RESPONSE

The response to this question will be provided in the fourth quarter of 1981.

QUESTION E240.22 (Section 2.4.2)

Descriptions of floodplains, as required by Executive Order 11988, Floodplain Management, have not been provided. The definition used in the Executive Order is:

Floodplain: The lowland and relatively flat areas adjoining inland and coastal waters including floodprone areas of offshore islands, including at a minimum that are subject to a one percent or greater change of flooding in any given year.

a. Provide descriptions of the floodplains adjoining the Schuylkill River. Perkiomen Creek, East Branch Perkiomen Creek, and the Delaware River adjacent to the site, plant facilities ane reaches used for carrying pumped diversion flow. On a suitable scale map(s) provide delineations of those areas that will be flooded during the one percent (100 year) flood both before and after plant construction or operation.

b. Provide details of the methods used to determine the floodplains in response to a. above. Include your assumptions of and basis for the pertinent parameters used in the computation of the flood flows and water elevations. If studies approved by the Federal Insurance Administration (FIA) are available for the site and other affected areas, the details of the analysis used in the reports need not be supplied. You can instead provide the reports from which you obtained the floodplain information.

c. Identify, locate on a map and describe all plant structures and topographic alterations in the floodplains. Indicate the start and completion dates of all such items.

RESPONSE

The requested information will be provided in the fourth quarter of 1981.

QUESTION E240.23 (Section 2.4.2)

a) Discuss the hydrologic effects of all items identified in response to questions 240.22c. Discuss the potential for altered flood flows and levels, offsite. Discuss the effects on offsite areas of debris generated from the site during flood events.

b) Provide the details of your analysis used in response to a. above. The level of detail is similar to that identified in item 240.22b.

RESPONSE

The requested information will be provided in the fourth quarter of 1981.

QUESTION E290.1 (Sections 3.9.2 & 5.5)

Endangered Species

Are there any proposed or listed Threatened or Endangered Plant Species potentially occurring along the proposed Limerick transmission line corridors?

RESPONSE

Investigations of the Limerick transmission line corridors revealed no proposed or listed threatened or endangered plant species along those corridors.

QUESTION E290.2 (Sections 3.9.3 & 5.5)

Provide a description of the grounding systems which will be used to reduce induced voltages and currents in conducting objects, such as metal fences, in the vicinity of the right-of-way.

RESPONSE

Conducting objects such as metal fences in the vicinity of the rights of way that could have annoying voltages and currents induced in them are bonded to ensure electrical continuity and grounded to reduce such voltages and currents. The most commonly used method is to connect the fence to driven ground rods approximately ten feet in length. If the fence is near an existing grounding system, such as at a substation or a transmission tower, the fence is connected to the system ground.

QUESTION E311.1 (Section 2.1.1.2)

It is indicated on page 2.1.-2 of the environmental report that there are sections of land within the exclusion area that are not presently owned by Philadelphia Electric Company but are controlled by the Commonwealth of Pennsylvania, and that they will be acquired or an agreement will be executed with the Commonwealth so that Philadelphia Electric Company can restrict access to these properties, if necessary.

Indicate the date by which either of the procedures listed above will provide Philadelphia Electric Company the authority to determine all activities within the exclusion area as required by 10 CFR Part 100.

RESPONSE

Philadelphia Electric Company has acquired ownership of all property within the exclusion area with the exception of the public roads, the Schuylkill River and the Conrail right of way which traverse the site. This information has been added to Section 2.1.1.2, as well as a description of arrangements made to control access to these public passageways in the event of an emergency, in compliance with 10 CFR Part 100.

QUESTION E450.1 (Section 7.1.1)

In accordance with NRC's Interim Policy (45FR40101) revise Section 7.1.1 to include a probabilistic evaluation of impacts of accidents including those formerly called Class 9 accidents.

RESPONSE

Section 7.1 has been changed to reference the Limerick Generating Station Probabilistic Risk Assessment (PRA). The PRA was performed as requested by the NRC in its May 6, 1980 letter from D. G. Eisenhut to E. G. Bauer, and was transmitted to the NRC by letter from E. J. Bradley to H. R. Denton, dated March 17, 1981. The PRA evaluates the impacts of those accidents formerly called Class 9 accidents.

The Executive Summary of the PRA has been reproduced in Section 7.1. Philadelphia Electric believes this constitutes satisfactory conformance to NRC's Interim Policy on Accident Considerations under NEPA (45FR40101).

QUESTION E451.1 (Section 2.3.2.2)

Table 2.3.2-86 presents offsite terrain elevation. In order to determine the effect of terrain on an effluent, onsite elevations, by direction, using the same distance intervals as in Table 2.3.2-86 are needed.

RESPONSE

The requested information has been added to Section 2.3.2.2.

QUESTION E451.2 (Section 2.3.2.2)

As specified in Regulatory Guide 4.2, Revision 2, the following maps are needed: (a) a map showing detailed topographic features (as modified by the station) on a large scale within a five-mile radius of the station and, (b) a smaller scale map showing topography within a 50 mile radius of the station.

RESPONSE

Figures 2.1-2 and 2.1-4 depict onsite and neighboring topographical features. In lieu of the 5 mile and 50 mile radius offsite topographical maps, a more useful and readily accessible offsite elevation vs. distance by sector table has been substituted (Table 2.3.2-86). Section 2.3.2.2 has been modified accordingly.

QUESTION E451.3 (Section 2.3.2)

A separate report, referred to in the ER as "Micrometeorological Data and Analysis for the Limerick Generating Station Environmental Report - Operating License Stage and Final Safety Analysis Report Submittals," has not been submitted to the NRC. Since this report appears to have essential information which will be used in DES preparation, we request the applicant to submit two copies of it.

RESPONSE

Two copies of "Micrometeorological Data and Analysis for the Limerick Generating Station Environmental Report - Operating License Stage and Final Safety Analysis Report Submittals, Section 2.3.2" were transmitted to the NRC by letter from E. J. Bradley to D. G. Eisenhut dated July 27, 1981.

QUESTION E451.4 (Section 5.1.4.2)

No data are presented in the ER to permit an independent assessment of the environmental impact of the cooling tower plume as specified in Regulatory Guide 4.2, Revision 2, Section 2.3

RESPONSE

A joint frequency distribution of relative humidity, wind direction, wind speed, and atmospheric stability class is described and referenced in Section 2.3.2.1.5.

QUESTION E471.1 (Sections 2.1.3.6 & 5.2.4.1)

The agricultural survey should be extended from 5 miles to 50 miles (not river miles). Same comment both page 2.1-11 and page 5.2-14.

RESPONSE

Sections 2.1.3.6 and 5.2.4.1 have been modified to clarify that no downstream users of water for irrigational purpose have been found to a distance of 50 miles.

QUESTION E471.2 (Section 5.2)

Although PECo claims to be using 1.109 equations and assumptions, it appears they have modified critical parameters such as dose conversion factors. While they are free to do so, NRC will perform an independent assessment of population dose to determine compliance with 10 CFR Part 50, Appendix I.

RESPONSE

The NRC computer programs LADTAP and GASPAR, which incorporate the computational models and conversion factors described in Reg. Guide 1.109 Rev. 1 (October 1977), were used to assess maximum individual and population doses. Decay during transport for all noble gases was included and site specific usage factors were utilized when sufficient data were available. When site specific data were not available, Reg. Guide 1.109 Rev. 1 usage factors were used.

QUESTION E471.3 (Section 5.2.2.1)

Table I.2-51(sic) "X/Q depleted" should include both radioactive decay and deposition occuring during atmospheric transport.

RESPONSE

Although Table 5.2-5 "X/Q depleted" includes deposition, decay is not included because, as stated in Appendix 5.2B.1, the atmospheric transport times to all receptor locations evaluated were too short to permit any appreciable decay of radioiodines and air particulates during transport to the receptor locations. Individual and population dose assessments utilizing these values are conservative.

QUESTION E471.4 (Section 6.1.5.2)

Table 6.1-45: 1 year and 6 months prior to fuel load: While six radioiodine air samples per week is more than adequate, the samples should include 3 offsite areas expected to exhibit the highest annual average D/Q during operation.

Direct Radiation Measurements: There should be 2 rings of 16 each (32) plus 8 areas of special interest such as schools, nearby residences, and population centers, for a total of 40. Thirty-five stations may be enough, but the smaller number will require a justification.

Surface Water Samples and Drinking Water Samples should be collected by continuous sampling, not composited from grab samples. It is not clear from this table (or Table 6.1-47) whether PEC proposes to do that.

Ground Water Samples: should be collected quarterly if the wells are likely to be affected.

RESPONSE

As indicated in Section 6.1.5.2.1 and Table 5.2-6 the E, ESE and SE sectors are the sectors with the highest offsite annual average D/Q. The radioiodine air samples located in these sectors are located as near as practicable to the location within the sector with the highest annual average D/Q. A total of 17 radioiodine air sampling stations have been established around the plant. Six of these will be analyzed weekly and the remaining 11 will be analyzed if conditions warrant.

A total of 48 direct radiation measurement stations have been established around the plant according to the two ring methodology. Schools and population centers are adequately covered.

All surface water and drinking water samples which fulfill the requirements of the Branch Technical Position, Rev. 1 on Reg. Guide 4.8 will be collected by automatic composite samplers which collect an aliquot at time intervals which are very short (e.g. hourly) relative to the compositing period (e.g. monthly). One water sampling station established to provide additional assurance will consist of grab samples collected at less frequent intervals and be composited monthly. Footnote 3 to Table 6.1-45 clarifies this protocol.

Hydrological evaluations have demonstrated that ground water will not likely be affected (Section 2.4). However, in the interest of providing additional public assurance, two nearby wells will be sampled semi-annually.

QUESTION E471.5 (Section 6.1.5.2)

Table 6.1-46: MDL I-131 in water is missing. Is there a reason for this?

RESPONSE

Table 1 of the Brancn Technical Position on Reg. Guide 4.8, Revision 1, states that I131 analysis in drinking water need routinely be performed if "the dose calculated for the consumption of water is greater than 1 mrem per year" using Reg. Guide 1.109 methodologies and site specific usage factors. Table 5.2-11 of the EROL shows the dose rate to the maximum organ (thyroid) and age group (infant) to be well below this value. Hence, we do not intend to routinely analyze composite water samples for I-131 and have not provided an MDL for I-131 in water.