Chapter C2: Technical & Economic Facility Descriptions

This chapter presents additional information related to the facilities along the Ohio River. Section C2-1 presents detailed EIA data on the facilities and generating units addressed by this case study and within the scope of the Phase II rulemaking (i.e., in-scope facilities). Section C2-2 describes the configuration of the intake structure(s) at the in-scope facilities and out-of-scope electric generating and industrial facilities.

CHAPTER CONTENTS

C2-1 PLANT CONFIGURATION

This section discusses technical and economic plant and unit data for the nine Ohio River power plants subject to the Phase 2 regulation. Each subsection presents information on the location, size, operation, cooling water intake structure characteristics, economic characteristics, and ownership of the nine power plants and their generating units. The final subsection presents a summary table with key economic statistics.

a. W.H. Sammis

The **W.H. Sammis Generating Station** is located in Jefferson County, Ohio, one-half mile upstream of the New Cumberland Lock and Dam. The Ohio River in this area averages 22 feet in depth and 1,439 feet in width, and the channel bed slopes 0.2 feet per mile. In addition to the Sammis plants, there are 9 small boat facilities, 2 industrial intakes, 1 municipal intake, 11 industrial discharges, and 3 municipal discharges in the New Cumberland Pool (Environmental Science and Engineering, 1991). The W.H. Sammis plant is on the Ohio shore near Stratton, at river mile 53.9 (Environmental Science and Engineering, 1991). Land use in this section of the river is 39% forest, 27% cropland, 14% each for pasture and urban, and 6% other. Nearby tributaries include Tomlinson Run, located one mile upstream on the east side of the Ohio River, and Yellow Creek, which is about 3.5 miles upstream on the west side of the river.

The W.H. Sammis plant is a coal-fired facility with seven steam electric generating units capable of producing 2,454 MW.[1] In addition to the seven steam electric generating units, W.H. Sammis operates five internal combustion units of 2.5 MW each, which do not require cooling water. (See Table C2-1 below.)

❖ **W.H. Sammis Ownership Information**

W. H. Sammis is operated as regulated utility plant by Ohio Edison, a subsidiary of FirstEnergy. FirstEnergy is a domestic energy company with 13,830 employees. FirstEnergy owns or controls more than 12,500 MW of electric generating capacity. In 2000, FirstEnergy posted sales of $7.0 billion (Hoover's Online, 2001f).

[1] The data on electric generating units in this chapter come from U.S. Department of Energy (2001b).

Table C2-1: W.H. Sammis Generator Characteristics (1999)

Unit ID	Capacity (MW)	Prime Mover[a]	Energy Source[b]	In-Service Date	Operating Status	Net Generation (MWh)	Capacity Utilization[c]	ID of Associated CWIS
1	190	ST	BIT	Aug. 1959	Operating	1,245,173	74.7%	1
2	190	ST	BIT	Jul. 1960	Operating	1,166,481	69.9%	2
3	190	ST	BIT	Jul. 1961	Operating	1,355,552	81.3%	3
4	190	ST	BIT	Nov. 1962	Operating	1,402,218	84.1%	4
5	334	ST	BIT	Dec. 1967	Operating	1,680,064	57.4%	5
6	680	ST	BIT	Apr. 1969	Operating	4,417,164	74.2%	6
7	680	ST	BIT	Sep. 1971	Operating	3,652,144	61.3%	7
A1	2.5	IC	FO2	Mar. 1972	Operating	1,653	1.5%	Not applicable
B1	2.5	IC	FO2	Mar. 1972	Operating			
B2	2.5	IC	FO2	Mar. 1972	Operating			
B3	2.5	IC	FO2	Mar. 1972	Operating			
B4	2.5	IC	FO2	Mar. 1972	Operating			
Total	**2,468**					**14,920,449**	**69.0%**	

[a] Prime mover categories: ST = steam turbine; IC = internal combustion.
[b] Energy source categories: BIT = bituminous coal; FO2 = No. 2 Fuel Oil.
[c] Capacity utilization was calculated by dividing the unit's actual net generation by the potential net generation if the unit ran at full capacity all the time (i.e., capacity * 24 hours * 365 days).
Source: U.S. Department of Energy 2001a, 2001b, 2001d.

In 1999, W.H. Sammis had 431 employees and generated 14.9 million megawatt hours (MWh) of electricity.[2] Estimated 1999 revenues for the W.H. Sammis plant were approximately $1.2 billion, based on the plant's 1999 estimated electricity sales[3] of 14.2 million MWh and the 1999 company-level electricity revenues of $82.04 per MWh. W.H. Sammis's 1999 production expenses totaled $248 million, or 1.667 cents per KWh, for an operating income of $913 million.

b. Cardinal

The **Cardinal Plant** is located on the Ohio shore of the Ohio River approximately 3 miles southwest of Brilliant, Ohio and 20 miles upriver from Wheeling, West Virginia. The facility is located in the Pike Island Pool of the Ohio River, 76.7 miles downstream from Pittsburgh, PA. Near the intakes the river is about 1,376 feet wide and 40 feet deep (QST Environmental, 1998). The Cardinal facility has three coal-fired units. Units 1 and 2 began operation in February and July of 1967, respectively. Both units are rated at 615 MW and employ a once-through cooling system. Unit 3 went on-line in September 1977, is rated at 650 MW, and operates a closed cycle system with a cooling tower. (See Table C2-2 below.)

[2] One MWh equals 1,000 KWh.

[3] Electricity sales are net generation adjusted for utility-specific energy losses, energy furnished without charge, and energy used by the utility's own electricity department. See *Chapter C2: Cost Impact Analysis* for details on the estimation of plant-level electricity sales.

Table C2-2: Cardinal Generator Characteristics (1999)

Unit ID	Capacity (MW)	Prime Mover[a]	Energy Source[b]	In-Service Date	Operating Status	Net Generation (MWh)	Capacity Utilization[c]	ID of Associated CWIS
1	615	ST	BIT	Feb. 1967	Operating	2,947,309	54.7%	1
2	615	ST	BIT	Jul. 1967	Operating	3,036,031	56.3%	2
3	650	ST	BIT	Sep. 1977	Operating	3,372,119	59.2%	3
Total	**1,880**					**9,355,459**	**56.8%**	

[a] Prime mover categories: ST = steam turbine.
[b] Energy source categories: BIT = bituminous coal.
[c] Capacity utilization was calculated by dividing the unit's actual net generation by the potential net generation if the unit ran at full capacity all the time (i.e., capacity * 24 hours * 365 days).
Source: U.S. Department of Energy, 2001a, 2001b.

In 1999, Cardinal had 201 employees and generated 9.4 million megawatt hours (MWh) of electricity. Estimated 1999 revenues for the Cardinal plant were approximately $534 million, based on the plant's 1999 estimated electricity sales of 8.9 million MWh and the 1999 ECAR (East Central Area Reliability Coordination Agreement) average electricity revenues of $60.07 per MWh. Cardinal's 1999 production expenses totaled $253 million, or 2.698 cents per KWh, for an operating income of $280 million.

c. Kammer

The **Kammer Plant** is located in northwestern West Virginia, on the Hannibal Pool, at river mile 111.1 of the Ohio River. It is situated on the inside of a bend in the river approximately one mile downstream from the confluence of Captina Creek. The Ohio River is approximately 30 to 35 feet deep in the proximity of the Kammer plant (Balleto and Brown, 1980a).

The Kammer facility consists of three coal-fired generating units with a combined generating capacity of 713 MW (237.5 MW each). (See Table C2-3 below.)

Table C2-3: Kammer Generator Characteristics (1999)

Unit ID	Capacity (MW)	Prime Mover[a]	Energy Source[b]	In-Service Date	Operating Status	Net Generation (MWh)	Capacity Utilization[c]	ID of Associated CWIS
1	238	ST	BIT	Jul. 1958	Operating	1,234,747	59.3%	1
2	238	ST	BIT	Nov. 1958	Operating	1,580,411	76.0%	2
3	238	ST	BIT	Mar. 1959	Operating	1,328,945	63.9%	3
Total	**713**					**4,144,103**	**66.4%**	

[a] Prime mover categories: ST = steam turbine.
[b] Energy source categories: BIT = Bituminous Coal.
[c] Capacity utilization was calculated by dividing the unit's actual net generation by the potential net generation if the unit ran at full capacity all the time (i.e., capacity * 24 hours * 365 days).
Source: U.S. Department of Energy, 2001a, 2001b.

In 1999, Kammer had 150 employees and generated approximately 4.1 million megawatt hours (MWh) of electricity. Estimated 1999 revenues for the Kammer plant were approximately $186 million, based on the plant's 1999 estimated electricity sales of 4.0 million MWh and the 1999 company-level electricity revenues of $46.94 per MWh. Kammer's 1999 production expenses totaled $63 million, or 1.530 cents per KWh, for an operating income of $123 million.

d. Philip Sporn

The **Philip Sporn Plant** is located within the Robert Byrd Pool on the West Virginia side of the Ohio River near New Haven. It is approximately 4.5 miles downstream of the Racine Locks and Dam (Balletto and Brown, 1980b). The river reaches 25-30 feet deep near the plant.

The plant consists of five coal-fired generating units rated at 1,106 MW which began operating between 1950 and 1960 (Balletto and Brown, 1980b). Three cooling systems provide cooling water for the facility. (See Table C2-4 below.)

Table C2-4: Philip Sporn Generator Characteristics (1999)

Unit ID	Capacity (MW)	Prime Mover[a]	Energy Source[b]	In-Service Date	Operating Status	Net Generation (MWh)	Capacity Utilization[c]	ID of Associated CWIS
1	153	ST	BIT	Jan. 1950	Operating	949,105	71.0%	11
2	153	ST	BIT	Jul. 1950	Operating	939,616	70.3%	21
3	153	ST	BIT	Aug. 1951	Operating	858,815	64.3%	31
4	153	ST	BIT	Feb. 1952	Operating	1,014,363	75.9%	41
5	496	ST	BIT	Dec. 1960	Operating	2,308,243	53.2%	51
Total	**1,106**					**6,070,142**	**62.7%**	

[a] Prime mover categories: ST = steam turbine.
[b] Energy source categories: BIT = Bituminous Coal.
[c] Capacity utilization was calculated by dividing the unit's actual net generation by the potential net generation if the unit ran at full capacity all the time (i.e., capacity * 24 hours * 365 days).
Source: U.S. Department of Energy, 2001a, 2001b.

In 1999, Phillip Sporn had 177 employees and generated approximately 6.1 million megawatt hours (MWh) of electricity. Estimated 1999 revenues for the Phillip Sporn plant were approximately $345 million, based on the plant's 1999 estimated electricity sales of 5.7 million MWh and the 1999 ECAR (East Central Area Reliability Coordination Agreement) average electricity revenues of $60.07 per MWh. Phillip Sporn's 1999 production expenses totaled $104 million, or 1.716 cents per KWh, for an operating income of $241 million.

e. Kyger Creek

The **Kyger Creek Station** facility is located near Chesire, Ohio at river mile 260. This is about 21 miles upstream of the Gallipolis lock and dam, in the water body bounded by the Kanawha River and the Racine lock and dam (Brown and Van Hassel, 1981). Kyger Creek has five coal-fired units with a combined capacity of 1,086 MW (217.3 MW each). The five units began operation between February and December of 1955 and use a once-through cooling system. (See Table C2-5 below.)

❖ Kyger Creek and Clifty Creek Ownership Information

Kyger Creek is owned by Ohio Valley Electric Corporation (OVEC) while Clifty Creek is owned by Indiana-Kentucky Electric Corporation (IKEC), a subsidiary of OVEC. Both facilities are regulated power plants.

OVEC and IKEC were formed by investor-owned utilities furnishing electric service in the Ohio River Valley area in 1952. AEP and its subsidiaries own the largest equity share in OVEC, with 44.2 percent. In 2000, OVEC had 755 employees, posted operating revenues of $441 million, and sold 17.2 million MWh of electricity (OVEC 2000).

Table C2-5: Kyger Creek Generator Characteristics (1999)

Unit ID	Capacity (MW)	Prime Mover[a]	Energy Source[b]	In-Service Date	Operating Status	Net Generation (MWh)	Capacity Utilization[c]	ID of Associated CWIS
1	217	ST	BIT	Feb. 1955	Operating	1,505,772	79.1%	1
2	217	ST	BIT	Jun. 1955	Operating	1,547,178	81.3%	2
3	217	ST	BIT	Sep. 1955	Operating	1,710,320	89.9%	3
4	217	ST	BIT	Nov. 1955	Operating	1,582,369	83.1%	4
5	217	ST	BIT	Dec. 1955	Operating	1,472,895	77.4%	5
Total	**1,086**					**7,818,534**	**82.2%**	

[a] Prime mover categories: ST = steam turbine.
[b] Energy source categories: BIT = bituminous coal.
[c] Capacity utilization was calculated by dividing the unit's actual net generation by the potential net generation if the unit ran at full capacity all the time (i.e., capacity * 24 hours * 365 days).
Source: U.S. Department of Energy, 2001a, 2001b.

In 1999, Kyger Creek had 312 employees and generated 7.8 million megawatt hours (MWh) of electricity. Estimated 1999 revenues for the Kyger Creek plant were approximately $168 million, based on the plant's 1999 estimated electricity sales of 7.7 million MWh and the 1999 company-level electricity revenues of $21.74 per MWh. Kyger Creek's 1999 production expenses totaled $130 million, or 1.669 cents per KWh, for an operating income of $37 million.

f. W.C. Beckjord

The **W.C. Beckjord Generating Station** is located 18 miles upstream of Cincinnati, Ohio, and three miles downstream of New Richmond, Ohio, at river mile 452.9 (Cincinnati Gas & Electric Company, 1979). The facility is located within the Markland Pool. The Ohio River is approximately 1,600 feet wide and 25 feet deep near the facility. This section of the Ohio River is sparsely populated and agriculture is the dominant form of business.

❖ W.C. Beckjord and Miami Fort Ownership Information

W.C. Beckjord and Miami Fort are regulated utility plants operated by Cincinnati Gas & Electric, a subsidiary of Cinergy. Cinergy is a domestic energy company with more than 8,300 employees. Cinergy owns or controls more than 13,500 MW of electric generating capacity and posted sales of $8.4 billion in 2000 (Hoover's Online, 2001b).

The W.C. Beckjord facility has six coal-fired units with a combined capacity of 1,164 MW. Units 1, 2, and 3 began operation in 1952, 1953, and 1954, respectively, while Units 4,5, and 6 went on-line between 1958 and 1969. All six units use once-through cooling (Cincinnati Gas & Electric Company, 1979). In addition, the plant operates four gas turbines of 53 MW each, which do not require cooling water. (See Table C2-6 below.)

Table C2-6: Beckjord Generator Characteristics (1999)

Unit ID	Capacity (MW)	Prime Mover[a]	Energy Source[b]	In-Service Date	Operating Status	Net Generation (MWh)	Capacity Utilization[c]	ID of Associated CWIS
1	100	ST	BIT	Jun. 1952	Operating	667,984	76.3%	1
2	100	ST	BIT	Oct. 1953	Operating	681,574	77.8%	2
3	125	ST	BIT	Nov. 1954	Operating	866,074	79.1%	3
4	165	ST	BIT	Jul. 1958	Operating	1,162,699	80.4%	4
5	240	ST	BIT	Dec. 1962	Operating	1,434,729	68.2%	5
6	434	ST	BIT	Jul. 1969	Operating	2,366,807	62.3%	6
GT1	53	GT	FO2	Apr. 1972	Operating	62,200	3.4%	Not Applicable
GT2	53	GT	FO2	Apr. 1972	Operating			
GT3	53	GT	FO2	Jun. 1972	Operating			
GT4	53	GT	FO2	Jun. 1972	Operating			
Total	**1,376**					**7,242,067**	**60.1%**	

[a] Prime mover categories: ST = steam turbine; GT = gas turbine.
[b] Energy source categories: BIT = Bituminous Coal; FO2 = No. 2 Fuel Oil.
[c] Capacity utilization was calculated by dividing the unit's actual net generation by the potential net generation if the unit ran at full capacity all the time (i.e., capacity * 24 hours * 365 days).
Source: U.S. Department of Energy, 2001a, 2001b, 2001d.

In 1999, Beckjord had 238 employees and generated 7.2 million megawatt hours (MWh) of electricity. Estimated 1999 revenues for the Beckjord plant were approximately $473 million, based on the plant's 1999 estimated electricity sales of 7.0 million MWh and the 1999 company-level electricity revenues of $67.62 per MWh. Beckjord's 1999 production expenses totaled $139 million, or 1.925 cents per KWh, for an operating income of $334 million.

g. Miami Fort

The **Miami Fort Generating Station** is located 20 miles downstream of Cincinnati, Ohio, and Newport and Covington, Kentucky, at river mile 490 (Cincinnati Gas & Electric Company, 1979). It sits on the lower third of the Markland Pool, less than a mile upstream of where the Great Miami River enters the Ohio River. This section of the Ohio River is heavily industrialized and receives discharge of chemical, industrial, and sewage waste. Near the facility, the Ohio River is approximately 1,800 feet wide and 25 feet deep (Cincinnati Gas & Electric Company, 1979).

The Miami Fort Station operates four active coal-fired units with a combined capacity of 1,292 MW. Units 5 and 6 use once-through cooling systems while Units 7 and 8 use recirculating cooling systems. Two additional coal-fired units, units 3 and 4, were retired from service in 1982. Unit 5 is used only in times of high energy demand or when other units are not in function. In addition to the coal units, Miami Fort has four gas turbines of 16.5 MW each, which do not require cooling water. Two additional gas turbines were retired in 1996. (See Table C2-7 below.)

Table C2-7: Miami Fort Generator Characteristics (1999)

Unit ID	Capacity (MW)	Prime Mover[a]	Energy Source[b]	In-Service Date	Operating Status	Net Generation (MWh)	Capacity Utilization[c]	ID of Associated CWIS
3	65	ST	BIT	Dec. 1938	Retired - Apr. 1982			
4	65	ST	BIT	Oct. 1942	Retired - Apr. 1982			
GT1	57	GT	FO2	Mar. 1971	Retired - Oct. 1996			
GT2	57	GT	FO2	Jun. 1971	Retired - Dec. 1996			
5	100	ST	BIT	Dec. 1949	Operating	261,413	29.8%	5
6	168	ST	BIT	Nov. 1960	Operating	1,224,603	83.2%	6
7	512	ST	BIT	May 1975	Operating	3,493,557	77.9%	7-8
8	512	ST	BIT	Feb. 1978	Operating	3,263,451	72.7%	7-8
GT3	17	GT	FO2	Jul. 1971	Operating	8,287	1.4%	Not Applicable
GT4	17	GT	FO2	Aug. 1971	Operating			
GT5	17	GT	FO2	Sep. 1971	Operating			
GT6	17	GT	FO2	Oct. 1971	Operating			
Total[d]	**1,358**					**8,251,311**	**69.3%**	

[a] Prime mover categories: ST = steam turbine; GT = gas turbine.
[b] Energy source categories: BIT = Bituminous Coal; FO2 = No. 2 Fuel Oil.
[c] Capacity utilization was calculated by dividing the unit's actual net generation by the potential net generation if the unit ran at full capacity all the time (i.e., capacity * 24 hours * 365 days).
[d] Total only includes units that are operating.
Source: U.S. Department of Energy, 2001a, 2001b, 2001d.

In 1999, Miami Fort had 261 employees and generated 8.3 million megawatt hours (MWh) of electricity. Estimated 1999 revenues for the Miami Fort plant were approximately $541 million, based on the plant's 1999 estimated electricity sales of 8.0 million MWh and the 1999 company-level electricity revenues of $67.62 per MWh. Miami Fort's 1999 production expenses totaled $138 million, or 1.670 cents per KWh, for an operating income of $403 million.

h. Tanners Creek

The **Tanners Creek Plant** is located near the town of Lawrenceburg, Indiana, approximately 494 miles downstream from Pittsburgh, Pennsylvania (Energy Impact Associates Inc., 1978a; Balletto & Zaabel, 1978b). Tanners Creek is located in the Markland Pool of the Ohio River, formed by the structures of the Meldahl Lock and Dam upstream and the Markland Lock and Dam downstream.

Tanners Creek has four coal-fire units with a total capacity of 1,100 MW. Units 1,2, and 3 began operation in 1951, 1952, and 1954 respectively. Unit 4 started operation in 1964. The facility uses once-through cooling, drawing approximately 1,066 MGD from the Ohio River. (See Table C2-8 below.)

Table C2-8: Tanners Creek Generator Characteristics (1999)

Unit ID	Capacity (MW)	Prime Mover[a]	Energy Source[b]	In-Service Date	Operating Status	Net Generation (MWh)	Capacity Utilization[c]	ID of Associated CWIS
1	153	ST	BIT	Mar. 1951	Operating	841,025	63.0%	U1
2	153	ST	BIT	Oct. 1952	Operating	874,831	65.5%	U2
3	215	ST	BIT	Dec. 1954	Operating	1,009,431	53.5%	U3
4	580	ST	BIT	Jul. 1964	Operating	3,179,553	62.6%	U4
Total	**1,100**					**5,904,840**	**61.3%**	

[a] Prime mover categories: ST = steam turbine.
[b] Energy source categories: BIT = bituminous coal.
[c] Capacity utilization was calculated by dividing the unit's actual net generation by the potential net generation if the unit ran at full capacity all the time (i.e., capacity * 24 hours * 365 days).
Source: U.S. Department of Energy, 2001a, 2001b.

In 1996, Tanners Creek had 204 employees.[4] It generated 5.9 million megawatt hours (MWh) of electricity in 1999. Estimated 1999 revenues for the Tanners Creek plant were $340 million, based on the plant's 1999 estimated electricity sales of 5.6 million MWh and the 1999 company-level electricity revenues of $61.09 per MWh. Tanners Creek's 1999 production expenses totaled $109 million, or 1.841 cents per KWh, for an operating income of $232 million.

i. Clifty Creek

The **Clifty Creek Station** is located near the town of Madison, Indiana at RM 560 (Balletto and Zabel, 1978a; Energy Impact Associates, 1978a; EA Science and Technology, 1987). Clifty Creek resides within the McAlpine Pool on the Ohio River, formed by the boundaries of the Markland Lock and Dam upstream, and the McAlpine Lock and Dam approximately 47 miles downstream. This coal-fired facility has six generating units with a combined generating capacity of 1,304 MW (217.3 MW each). Units 1 through 5 were completed in 1955, and unit 6 was completed in 1956.

All six units use once-though cooling. (See Table C2-9 below.)

Table C2-9: Clifty Creek Generator Characteristics (1999)

Unit ID	Capacity (MW)	Prime Mover[a]	Energy Source[b]	In-Service Date	Operating Status	Net Generation (MWh)	Capacity Utilization[c]	ID of Associated CWIS
1	217	ST	BIT	Feb. 1955	Operating	1,364,612	71.7%	1
2	217	ST	BIT	May 1955	Operating	1,318,629	69.3%	2
3	217	ST	BIT	Jul. 1955	Operating	1,358,305	71.4%	3
4	217	ST	BIT	Oct. 1955	Operating	1,473,476	77.4%	4
5	217	ST	BIT	Nov. 1955	Operating	1,497,589	78.7%	5
6	217	ST	BIT	Mar. 1956	Operating	1,519,257	79.8%	6
Total	**1,304**					**8,531,868**	**74.7%**	

[a] Prime mover categories: ST = steam turbine.
[b] Energy source categories: BIT = Bituminous Coal.
[c] Capacity utilization was calculated by dividing the unit's actual net generation by the potential net generation if the unit ran at full capacity all the time (i.e., capacity * 24 hours * 365 days).
Source: U.S. Department of Energy, 2001a, 2001b.

In 1999, Clifty Creek had 390 employees and generated 8.5 million megawatt hours (MWh) of electricity. Estimated 1999 revenues for the Clifty Creek plant were approximately $167 million, based on the plant's 1999 estimated electricity sales of

[4] Employment data for this facility are not available after 1996.

8.5 million MWh and the 1999 company-level electricity revenues of $19.73 per MWh. Clifty Creek's 1999 production expenses totaled $146 million, or 1.708 cents per KWh, for an operating income of $22 million.

j. Summary of Facility Economic Characteristics

Table C2-10 below summarizes the important economic characteristics of the nine Ohio River power plants.

Table C2-10: Summary of Ohio River Power Plants (1999)

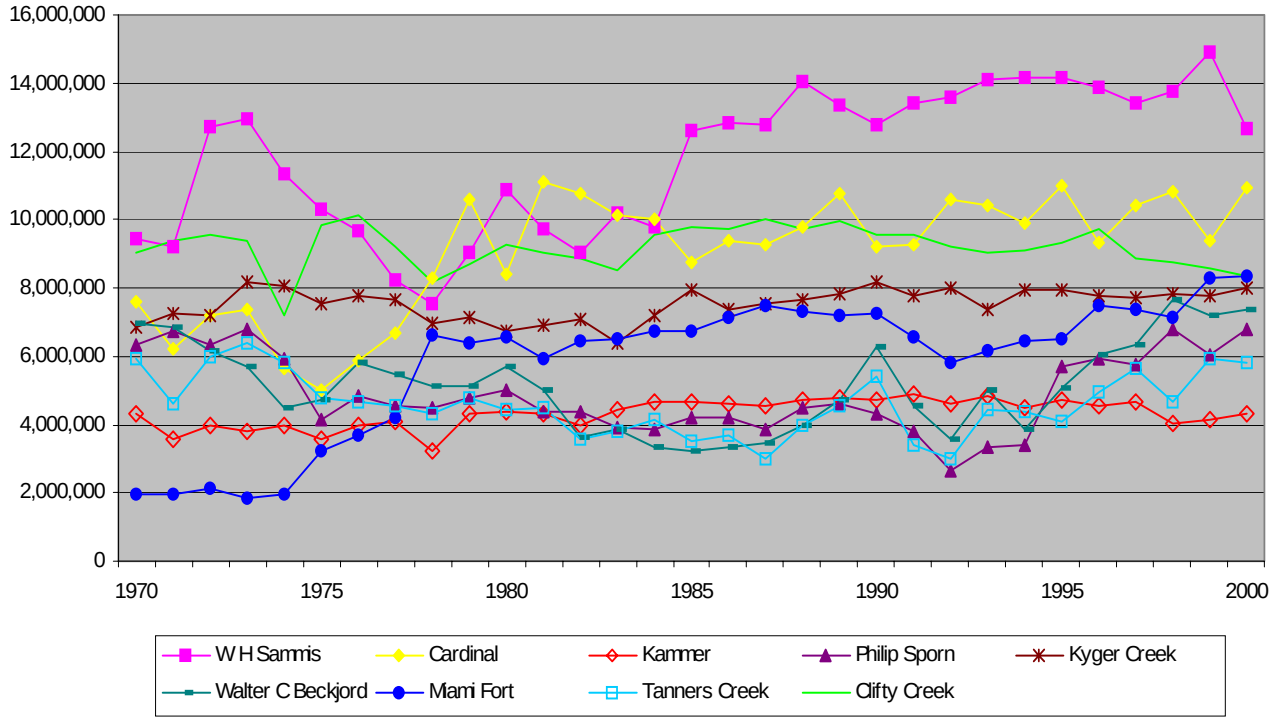
	W.H. Sammis	Cardinal	Kammer	Phillip Sporn	Kyger Creek
Plant EIA Code	2866	2828	3947	3938	2876
NERC Region	ECAR	ECAR	ECAR	ECAR	ECAR
Total Capacity (MW)	2,468	1,880	713	1,106	1,086
Primary Fuel	Coal	Coal	Coal	Coal	Coal
Number of Employees	431	201	150	177	312
Net Generation (million MWh)	14.9	9.4	4.1	6.1	7.8
Estimated Revenues (million)	$1,162	$534	$186	$345	$168
Total Production Expense (million)	$248	$253	$63	$104	$130
Production Expense (¢/KWh)	1.667¢	2.698¢	1.530¢	1.716¢	1.669¢
Estimated Operating Income (million)	$913	$280	$123	$241	$37
	W.C. Beckjord	**Miami Fort**	**Tanners Creek**	**Clifty Creek**	
Plant EIA Code	2830	2832	988	983	
NERC Region	ECAR	ECAR	ECAR	ECAR	
Total Capacity (MW)	1,376	1,358	1,100	1,304	
Primary Fuel	Coal	Coal	Coal	Coal	
Number of Employees	238	261	204[a]	390	
Net Generation (million MWh)	7.2	8.3	5.9	8.5	
Estimated Revenues (million)	$473	$541	$340	$167	
Total Production Expense (million)	$139	$138	$109	$146	
Production Expense (¢/KWh)	1.925¢	1.670¢	1.841¢	1.708¢	
Estimated Operating Income (million)	$334	$403	$232	$22	

Notes: NERC = North American Electric Reliability Council
ECAR = East Central Area Reliability Coordination Agreement
Dollars are in $2001.
[a] 1996 data.

Source: U.S. Department of Energy, 2001b, 2001e.

Figure C2-1 below presents the electricity generation history of the nine Ohio River power plants between 1970 and 2000.

Figure C2-1: Net Electricity Generation 1970 - 2000 (in MWh)



Source: U.S. Department of Energy, 2001d.

C2-2 CWIS Configuration and Water Withdrawal

This section describes clean water intake structure technologies at power generating facilities on the Ohio River. In all, there are 29 facilities. EPA has performed a detailed analysis of nine of these facilities, as described in the subsequent sections. At the end of each section below, additional facilities for which data was collected, but not studied in detail, is included in table format.

a. W.H. Sammis

Sammis has one intake structure serving the entire facility. The facility utilizes once-through cooling with a maximum intake flow of 60 m^3/sec (2,104 cfs) (Environmental Science and Engineering, 1991). Water is drawn through a submerged intake (with a trash rack) under a highway and into a forebay, from which each generating unit withdraws its cooling water. Vertical traveling screens provide the next level of screening, including a high pressure spray and a trash sluice which empties into the discharge channel. The screens for units 1-4 rotate and undergo the cleaning process each 30 minutes, and the screens for units 5-7 rotate continuously when the intake is in use. The maximum intake velocity for the plant is 5.11 ft/s (Geo-Marine Inc., 1978). The total design intake flow for W.H. Sammis is 1,803 MGD.

b. Cardinal

Cardinal has five intake structures: 4 supplying units 1 and 2 (2 each) and one for unit 3. For units 1 and 2, the intakes are situated along the shoreline of the forebay (307' x 200') and are perpendicular to the flow of the mainstem. Each section contains three intake gates, three trash racks, three traveling screens, and one circulating water pump. Cooling water first passes through a trash rack, which is cleaned by a mechanical rake. Vertical traveling screens provide the next level of

screening, including a high pressure spray and a trash sluice which empties into the discharge channel. The screens rotate and undergo the cleaning process each 8 hours, except in conditions of screen blockage when the screen will initiate the cleaning process automatically. Typical intake velocities are approximately 0.74 ft/s through the trash racks and 1.28 ft/s through the intake screens (American Electric Power Service Corporation, 1981). The total design intake flow for Cardinal is 1,161 MGD.

Based on the information provided, it can be deduced that unit 3 is a recirculating system with a cooling tower. It was also assumed that the passive intake in use at Cardinal is installed at the intake for unit 3. Unit 3 is located several thousand feet downriver from units 1 and 2 and operates independently of the other units (American Electric Power Service Corporation, 1981).

c. Kammer

Kammer Plant has one intake structure for each of its three generating units. The three intakes are located in a 150 foot deep forebay that reaches approximately 200 feet into the shoreline and openly joins the mainstem of the Ohio River. The intakes are situated along the shoreline of the forebay and are perpendicular to the flow of the mainstem (Balletto and Brown, 1980a). The total design intake flow for Kammer is 1,068 MGD.

The screen house containing the intakes is divided into 3 sections (one for each intake structure), with each section supplying cooling water for an individual generating unit. Each section contains three intake gates, three trash racks, three traveling screens, and two circulating water pumps. Cooling water first passes through a trash rack, which is cleaned by a mechanical rake. Vertical traveling screens provide the next level of screening, including a high pressure spray and a trash sluice which empties into the discharge channel. The screens rotate and undergo the cleaning process each 8 hours, except in conditions of screen blockage when the screen will initiate the cleaning process automatically (Balletto and Brown, 1980a).

d. Phillip Sporn

The Phillip Sporn Plant employs three once-through cooling systems with five separate intake structures (U.S. EPA, 2001c). Units 1-4 contain one turbine condenser each, and have an average intake velocity of 1.81 feet per second. Unit 5 contains two turbine condensers, and has an average intake velocity of 2.17 feet per second. Each intake structure employs trash racks and intake screens. The total design intake flow for Philip Sporn is 1,038 MGD.

e. Kyger Creek

Kyger Creek has one intake structure for each of its five generating units with each section supplying cooling water for an individual generating unit. The five intake structures are located in a forebay that reaches approximately 190 feet into the shoreline and openly joins the mainstem of the Ohio River. The intakes are situated along the shoreline of the forebay and is perpendicular to the flow of the mainstem. (Brown and VanHassel, 1981) The total design intake flow for Kyger Creek is 1,166 MGD.

The screen house containing the intakes is divided into 5 sections (one for each intake structure). Each intake structure is comprised of three intake gates, three trash racks, three traveling screens, and two circulating water pumps. Cooling water first passes through a trash rack, which is cleaned by a mechanical rake. Vertical traveling screens provide the next level of screening, including a high pressure spray and a trash sluice which empties into the discharge channel. The screens rotate and undergo the cleaning process each 8 hours, except in conditions of screen blockage when the screen will initiate the cleaning process automatically. The intake velocity at the Kyger Creek intake structure was measured in 1979. Intake velocities at the face of the intake ranged from 0.27 ft/s to 1.60 ft/s at depths of up to 5 meters (Brown and VanHassel, 1981).

f. W.C. Beckjord

The Beckjord Station employs three cooling water intake structures. For each structure, water first passes through a trash rack, which is periodically cleaned by hand. Vertical traveling screens provide the next level of screening, including a high pressure spray and a trash sluice which empties into the discharge channel. In addition, the facility periodically performs system cleaning by chlorination (Cincinnati Gas and Electric Company, 1979). Intake velocities vary from 1.48 to 3.13 fps. The total design intake flow for W.C. Beckjord is 739 MGD.

g. Miami Fort

Cooling water is taken into the Miami Fort plant via one intake structure (a submerged intake tunnel), which empties into a forebay prior to entering the intake structures. The average intake velocity through the tunnel is 2.73 ft/s. For units 3 through 6 (once through cooling), water enters the forebay and passes through a trash rack, which is periodically cleaned by hand. Vertical traveling screens provide the next level of screening, including a high pressure spray and a trash sluice which empties

into the discharge channel. Units 7 and 8 are recirculating systems, but take in cooling water via the same intake forebay and screen house. In addition, the facility periodically performs system cleaning by chlorination (Cincinnati Gas and Electric Company, 1979). The total design intake flow for Miami Fort is 252 MGD.

h. Tanners Creek

Tanners Creek is supplied by four cooling water intake structures contained in two separate screen houses. The intake screen house servicing units 3 and 4 is located upstream of the screen house servicing units 1 and 2. Water entering the facility must first pass through trash racks with vertical bars spaced 2.75 inches apart that trap coarse debris. Trash rack debris is removed by a mechanical rake. After this water passes through the traveling screens which have 3.8 inch mesh steel openings. Under normal operations the traveling screens are moved vertically every 8 hours, and the screens are sprayed continuously for one hour. Debris is washed into a trash trough that empties into the discharge channel (Energy Impact Associates, 1978a). The total design intake flow for Tanners Creek is 1,065 MGD.

The intake velocity at the trash racks of Tanners Creek reached 1.4 ft/s at depths of up to 33 meters for units 1, 2 and 3, and 3.4 ft/s at a depth of 4.5 meters for unit 4. Additionally, the facility periodically performs system cleaning by chlorination (Energy Impact Associates, 1978a).

i. Clifty Creek

Clifty Creek has a total of six intake structures, all located within a single screen house. The screen house is divided into 5 sections (one for each intake structure). Cooling water first passes through a trash rack, which is cleaned by a mechanical rake. Vertical traveling screens provide the next level of screening, including a high pressure spray and a trash sluice which empties into the discharge channel. The screens rotate and undergo the cleaning process each 8 hours, except in conditions of screen blockage when the screen will initiate the cleaning process automatically. The intake velocity at the trash racks of Clifty Creek reached 1.69 ft/s at depths of up to 3 meters (Balletto and Zabel, 1978a). The total design intake flow for Clifty Creek is 2,034 MGD.

The configuration of the forebay and the flow of the river has given rise to some deposition of sediments in the mouth of the forebay. A mud bar has developed and is visible under normal flow conditions. Efforts to dredge the bar were halted, due to the recurring expense and likely minimal effect on improving I&E rates (Balletto and Zabel, 1978a).

j. Facilities not studied in detail

The following facilities were not analyzed as thoroughly as the above case study facilities. These 20 facilities were used to determine damage assessments and to assess potential benefits from the proposed rule. As noted, some facilities received short technical surveys and therefore do not have “true” values for design intake flow. These flows were estimated based on other data. Facilities with combination cooling systems also list the intake flow if the facility were entirely once through (equivalent once through flow).

Table C2-11: CWIS Configuration and Water Withdrawal of Ohio River Facilities Not Studied in Detail

Facility Name	CWS Type	Design Intake Flow (GPD) (Equivalent Once Through Flow)	Current Technologies
Beaver Valley	Recirculating	1,361,376,000[a]	Intake Screen
Rockport	Recirculating	216,382,885[a]	Passive Intake Structure
Ghent	Recirculating	186,958,757	Vertical Single Entry/Exit Screen Fish Conveyance
Bruce Mansfield	*Data may be considered confidential*		
Pleasants	*Data may be considered confidential*		
JM Gavin	Recirculating	60,330,706[a]	Trash Racks Intake Screen
Shawnee	Once-through	1,506,995,051[a]	Intake Screen
Joppa Stream	Once-through	743,040,000	Fixed Screen Vertical Single Entry/Exit Screen Fish Conveyance
Warrick	Once-through	654,329,886[a]	Intake Screen Passive Intake
FB Culley	Once-through	576,358,838[a]	Intake Screen Passive Intake Structure
Cane Run	Once-through	524,719,332[a]	Intake Screen Fish Handling and/or Return
R Gallagher	*Data may be considered confidential*		
Coleman	Once-through	366,421,129[a]	Intake Screen
Richard H Gorsuch	Once-through	362,199,846[a]	Intake Screen Passive Intake
RE Burger	Once-through	335,944,829[a]	Intake Screen
Elmer Smith	Once-through	272,100,000	Trash Racks Vertical Single Entry/Exit Screen
Willow Island	*Data may be considered confidential*		
JM Stuart	Combination	990,000,000 (1,178,100,000)	Trash Racks Vertical Single Entry/Exit Screen
Mill Creek	Combination	286,000,000 (457,000,000)	Vertical Single Entry/Exit Screen Combined Fish/Debris Trough Fish Conveyance
WH Zimmer	Combination	73,548,949[a] (Indeterminate)	Passive Intake Structure

[a] Facility submitted a short technical questionnaire. Design intake flow estimated based on the number of operating days and the average daily intake.