FINAL ENVIRONMENTAL REPORT

GRAND GULF

GRAND GULF NUCLEAR STATION

UNITS 1 AND 2

MISSISSIPPI POWER & LIGHT COMPANY

MIDDLE SOUTH ENERGY, INC.

MIDDLE SOUTH UTILITIES SYSTEM

AMENDMENT 7

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MISSISSIPPI POWER & LIGHT COMPANY
Helping Build Mississippi
P. O. BOX 1640, JACKSON, MISSISSIPPI 39205

JAMES P. McGAUGHY, JR.
ASSISTANT VICE PRESIDENT

U.S. Nuclear Regulatory Commission
Office of Nuclear Reactor Regulation
Washington, D.C. 20555

August 12, 1981

Attention: Mr. Harold R. Denton, Director

Dear Sir:

SUBJECT: Grand Gulf Nuclear Station
Units 1 and 2
Docket Nos. 50-416 and 50-417
File 0260/0277/M-900.0
Amendment 7 to the Final
Environmental Report
AECM-81/271

Attached are forty-one copies and three notorized originals of Amendment 7 to the Application for Licenses for Grand Gulf Nuclear Station, Units 1 and 2, in the matter of the Final Environmental Report (FER). Amendment 7 consists of additions to Sections 3.6 (Chemical and Biocide Waste), 6.1.3.1 (Meteorology) and the addition of Table 5.3.1.

Yours truly,

JPM:lm
Attachments

cc: Mr. N. L. Stampley
Mr. G. B. Taylor
Mr. R. B. McGehee
Mr. T. B. Conner

Mr. Victor Stello, Jr., Director
Office of Inspection & Enforcement
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

BEFORE THE

UNITED STATES NUCLEAR REGULATORY COMMISSION

DOCKET NOS. 50-416 AND 50-417

IN THE MATTER OF

MISSISSIPPI POWER & LIGHT COMPANY
and
MIDDLE SOUTH ENERGY, INC.
and
SOUTH MISSISSIPPI ELECTRIC POWER ASSOCIATION

AMENDMENT NO. 7 TO

APPLICATION FOR LICENSES
(FINAL ENVIRONMENTAL REPORT)

Mississippi Power & Light Company for itself and on behalf of Middle South Energy, Inc. and South Mississippi Electric Power Association herewith files this Amendment No. 7 to their Application for Licenses in the form of additions to Sections 3.6, 6.1.3.1 and the addition of Table 5.3.1.

Respectfully submitted,

Mississippi Power & Light Company

BY ______________________
J. P. McGaughy, Jr.
Assistant Vice President
Nuclear Production

STATE OF MISSISSIPPI
COUNTY OF HINDS

J. P. McGaughy, Jr., being duly sworn, states that he is Assistant Vice President - Nuclear Production of Mississippi Power & Light Company; that he is authorized on the part of said Company to sign and file with the Nuclear Regulatory Commission this Amendment No. 7 to the Application for Licenses (Final Environmental Report) on behalf of Company, Middle South Energy, Inc. and South Mississippi Electric Power Association; that he signed the forgoing amendment as Assistant Vice President - Nuclear Production of Mississippi Power & Light Company; and that the statements made and the matters set forth therein are true and correct to the best of his knowledge, information, and belief.

J. P. McGaughy, Jr.

SUBSCRIBED AND SWORN TO before me, a Notary Public, in and for the County and State above named, this 29 day of July, 1981.

(SEAL)

Notary Public

My commission expires:

My Commission Expires July 23, 1983.

MISSISSIPPI POWER & LIGHT COMPANY
GRAND GULF NUCLEAR STATION
UNITS 1 AND 2
DOCKET NOS. 50-416 and 417
AMENDMENT NO. 7

INSTRUCTIONS FOR FILING AMENDMENT NO. 7, 8/81

Remove and insert the ER pages and figures listed below. Dashes (---) in the remove column indicate no action required.

Remove	Insert
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---	Page Revision Index tab and Page Revision Index Pages 1 to 24 immediately after Summary Table of Contents (Page iv)
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Table 3.6.1 (Sheet 2)	Table 3.6.1 (Sheet 2
Table 3.6.1 (Sheet 2a)	Table 3.6.1 (Sheet 2a)
Table 3.6.1 (Sheet 4)	Table 3.6.1 (Sheet 4)
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Table 6.1.9	Table 6.1.9 (Sheets 1, 2)

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3.6 CHEMICAL AND BIOCIDE WASTES

Chemicals are used to control water quality, scale, corrosion, and biological fouling as well as for equipment and building comfort cooling, extinguishing fires, waste solidification, equipment lubrication, fuel, regeneration of demineralizers, and for laboratory operations. Quantities and types of chemicals added to station systems and resultant discharges due to station operation are given in Tables 3.6.1 through 3.6.5 and various subsections in Sections 3.6 and 3.7 for two unit operation. Sources of chemicals discharged by the station are identified by the waste categories specified in 40 CFR Part 423 in Tables 3.6.3a, 3.6.3b, and 3.6.4. A station operational waste diagram is shown on Figure 3.6-1. 5

The principal chemicals and their uses are as follows:

a. Sulfuric acid and caustic soda are used for regeneration of the makeup and condensate demineralizers.

b. Salt is used to generate sodium hypochlorite on site.

c. Sodium hypochlorite and sulfuric acid are added to the circulating water and standby service water systems to prevent biological fouling, and for pH/scale control.

d. Sodium hypochlorite is added to disinfect the domestic water supply.

e. Sodium hypochlorite is added to the plant service water system to prevent biological fouling.

f. A non-toxic, liquid, polycarboxylic acid co-polymer is added to the plant service water and circulating water systems to disperse iron and silt.

g. A polyphosphonate is used in the circulating water as a calcium and hardness dispersion agent. 7

h. A biocide enhancer (surfactant) is added to the circulating water system. Addition is on an intermittent basis. 5

i Sodium nitrite and caustic soda may be added to the component cooling water and turbine building cooling water systems to minimize corrosion and for pH control. 7

j. Sodium nitrite and caustic soda may be added to the chilled water system to minimize corrosion and for pH control. 7

k. An EPA registered nonoxidizing biocide is used to prevent biological fouling in the standby service water system.

l. An organic/phosphonate polymer is added to the standby service water to disperse iron and silt. 7

m. Gaseous carbon dioxide is used for purging the main station generators of air or hydrogen and as a fire extinguishing agent. 7

n. Gaseous hydrogen is used for cooling the main station generators. 7

o. Portland cement, Type I or II, and sodium silicate are used during the solidification process in the solid radwaste system. 7

p. Various halogenated hydrocarbons are used as refrigerants in air conditioning systems and as fire extinguishing agents. 7 5

q. Various chemicals and solutions are used in the plant laboratories. 7

r. SAE 40 and No. 2 fuel oil are used for lubrication and fuel, respectively, for the standby and high pressure core spray (HPCS) system diesel engines. 7

s. No. 1 or No. 2 diesel fuel oil is used to fuel the diesel driven fire pumps. 7

t. Lube oil is used for lubricating the main station turbines and the reactor feed pump turbines. 7

u. Sodium nitrate and caustic soda are added to the diesel generator cooling water jackets to minimize corrosion and for pH control. 7

v. Borax and boric acid are mixed to produce sodium pentaborate which may be used to control reactor power level.

3.6.1 Cooling Tower Blowdown

As described in Section 3.4, the evaporation of water in the cooling tower results in an increase in the concentration of chemicals and solids in the circulating water. The circulating water system is operated to maintain the cycles of concentration between two and five (i.e., the concentration of solids 340.22

in the circulating water is two to five times that in the makeup water). This concentration ratio is maintained by a continuous blowdown of the circulating water from the system to the discharge basin and from there to the Mississippi River (see Figure 3.6-1). Cooling tower makeup replenishes this loss. Increasing the solids concentration increases the scaling tendencies of the water. Sulfuric acid and other chemicals are added to the circulating water to control scaling, prevent iron deposition, and maintain pH between 7.0 and 8.5.

Table 3.6.3a presents the design makeup water analysis and the predicted circulating water analyses for two, three, and five cycles of concentration. Based on pumpout tests conducted in late 1979, the makeup water is nominally expected to be composed of approximately 70 percent Mississippi River water and 30 percent ground water (alluvial aquifer) at the site; the radial collector well laterals extended under the river promote such a partitioning. The conservative, mean makeup water quality presented in Table 3.6.3a assumes a 50 percent mixture of ground water and river water. Plant discharge quality, Mississippi River water quality, and Federal discharge limitations are presented in Table 3.6.3b. The plant discharge is basically a combination of the cooling tower blowdown and makeup bypass.

Iron in the intake water is expected to be primarily in the dissolved (soluble ferrous) form. Due to oxygenation within the cooling towers, dissolved iron will be oxidized to suspended (ferric), and essentially no dissolved iron will, therefore, be present in the cooling tower blowdown. However, under certain operating conditions (e.g., high cycles of concentration in the circulating water system), a portion of the intake water containing dissolved iron will be bypassed directly to discharge. Then, when this bypass and the blowdown stream are combined, the dissolved ferrous iron is oxidized by the dissolved oxygen in the cooling tower blowdown; ferrous iron is, therefore, reduced by both oxidation and dilution. The net effect of combining the two streams is that the dissolved iron concentrations in the discharge to the Mississippi River are below the makeup water's dissolved iron concentration. 340.22

Although the intake water is oxygen deficient, recirculation and reaeration in the cooling towers increase the dissolved oxygen concentration to saturation levels. However, oxidation of dissolved iron in any bypass reduces the dissolved oxygen concentrations in the plant discharge. Section 5.3 provides a discussion of the possible impact of discharge of cooling water with slightly reduced oxygen levels.

Neutralization of bicarbonate for scale control produces a large excess of carbon dioxide in the circulating water; therefore, local, instantaneous concentrations of several

hundred parts per million can be expected. However, elevated temperatures and recirculation combined with gas stripping in the cooling towers can be expected to reduce the CO_2 level in the blowdown to the order of 1 mg/l.

The concentrations of conservative substances in the plant effluent are determined entirely by the relative magnitude of the plant makeup and discharge. At two cycles of concentration, no makeup bypass is required; therefore, the plant discharge is just the cooling tower blowdown. At higher cycles of concentrations (e.g., three and five cycles), both the total plant makeup and discharge are constant (bypass flow rates do differ); therefore, the discharge concentrations of conservative substances remain the same. 340.22

3.6.2 Cooling Tower Drift

Chemical and solids concentrations in the cooling tower drift are essentially the same as those in the circulating water. The design cooling tower drift rate is 0.008 percent of the design circulating water system flow rate resulting in a drift flow rate of 46 gpm per unit. Ground deposition of chemicals entrained in the drift is given in subsection 5.1.4.

3.6.3 Treatment of Circulating Water and Service Water Systems Against Biological Fouling 340.4

To minimize undesirable slime and algal growths in the circulating water systems, a biocide is added intermittently. An onsite generated, 0.8 percent equivalent chlorine, sodium hypochlorite solution is used as the biocide. 7 The actual dosage of hypochlorite depends on the chlorine demand of the water, presence of organic substances, ammonia, etc. A biocide enhancement agent may also be added if determined to be necessary on the basis of plant operating experience. 5 However, two basic criteria govern the biocide dosage applied: 1) to keep the chlorine residuals in the blowdown within the permissible regulatory limits, and 2) to apply sufficient dosage so that flow and heat transfer efficiencies are maintained at their design values.

Hypochlorination is normally performed two times a day per unit during which period the blowdown discharge is interrupted for approximately 1 hour. The injection times of each unit are staggered. During the first half-hour period of the treatment process, hypochlorite solution is added until a free chlorine residual of 0.5 mg/l is attained and maintained at the condenser outlet. During the remaining half-hour period the residual chlorine is allowed to decay. Upon resumption of blowdown the maximum free available chlorine concentration is less than 0.5 mg/l and is expected to average less than 0.2 mg/l. With both units operating and only one unit chlorinated at a given time, the discharge from the second unit provides additional dilution and total

residual chlorine reduction, when the blowdown from the unit which has undergone treatment is resumed. Neither detectable free available chlorine nor total residual chlorine is discharged from any unit for more than 2 hours in any one

wastes is adjusted to between 6 and 9 prior to discharge to the station discharge basin. The design maximum and average discharge flow rates are 200 gpm and 50 gpm, respectively.

3.6.5 <u>Corrosion Inhibitors</u>

Corrosion inhibitors may be used in the turbine building 7
cooling water systems, component cooling water systems,
chilled water systems, standby diesel generator cooling jackets, 7
and the auxiliary steam system. With the exception of the
auxiliary steam system, all are closed loop systems with no
discharge to the environment.

3.6.6 <u>Auxiliary Boiler Blowdown</u>

Two auxiliary boilers, each with a rated capacity of approximately 35,000 pounds per hour, are used to provide steam during station startup, normal operation, and shutdown.
Boiler water quality is maintained by blowdown, makeup,
chemical feed and mechanical deaeration. Conductivity and
pH are controlled by the addition of sodium hydroxide and 7
sodium sulfite in order to maintain a maximum conductivity
of 4000 μmhos/cm and a minimum pH of 8.5. The addition of
sodium hydroxide is very infrequent due to the concentrating
characteristics of the boiler. Maximum limits on conductivity
and pH are controlled by blowdown and demineralized makeup
water. Maximum quantity of NaOH used will be determined by
the frequency of use but will not exceed 100 pounds per
year. Disodium phosphate will be added as required to
maintain a 2 ppm phosphate residual for scale control.

Oxygen is controlled by mechanical deaeration and minimum
sulfite addition to the condenser system. Other chemical
parameters are controlled by blowdown and addition of demine-
ralized makeup water. 7

Corrosion inhibition is maintained in the condenser and feedwater system by the addition of a proprietary ascorbic acid.

Blowdown does not generate large quantities of solid waste. Based on reported data, concentrations of total suspended solids, oil and grease, and copper and iron should be less than that allowed by 40 CFR Part 423.15 (Ref. 1). The pH of the blowdown is adjusted to between 6 and 9 prior to discharge to the station discharge basin.

3.6.7 Laundry Waste

Contaminated clothing originating from the site will be either shipped to a commercial radioactive laundry facility or processed on site. Laundry processed on site will be 7
either dry cleaned or wet laundered. The contaminated fluids (solvents or water) will be processed as radioactive waste, resulting in zero discharge to the plant or the environment from other than the liquid radwaste processing system (see Subsection 3.5.2.3).

3.6.8 Corrosion Products

The condenser tubes, as well as the component cooling water heat exchanger tubes and turbine building cooling water heat exchanger tubes, are stainless steel. The circulating water piping is primarily cement lined carbon steel. The plant service water piping from the radial wells through the yard is primarily carbon steel. 7
The stainless steel condenser tubes would not be expected to contribute appreciable amounts of corrosion/erosion products to the plant discharge. Iron resulting from corrosion of the carbon steel piping in the associated pathways and the carbon steel condenser water boxes is expected to be present to some degree in the cooling tower blowdown, but the amount is uncertain. No copper materials are used in the circulating water system.

3.6.9 References

1. EPA 440/1-77/084, Supplement for Pretreatment to the Development Document for the Steam Electric Power Generating, Point Source Category, April 1977, Table V-4, Page 54

TABLE 3.6.1

LIST OF CHEMICALS TO BE USED AT STATION (Note 1)

Chemical		Use	Frequency of Use	Maximum (Note 2)	Average/Annual Quantity
Sulfuric acid (66° Be')	a.	Makeup demineralizers - regeneration	Daily	426 gal (day)	38,125 gal
	b.	Condensate deep bed demineralizers - regeneration	30-90 days	632 gal (day)	7,200 gal
	c.	Circulating water system - makeup water pH/scale control	Essentially continuous	280 gal (hour)	1,630,000 gal
	d.	Standby service water system - pH/scale control	Refueling and scheduled maintenance outage (once per year per unit	34,560 gal (annual)	17,280 gal
Caustic soda	a.	Makeup demineralizers - regeneration	Daily	384 gal (day)	65,840 gal
	b.	Condensate deep bed demineralizers - regeneration	30-90 days	716 gal (day)	16,370 gal
	c.	Turbine building cooling water system - pH adjustment	As required	Sufficient to maintain pH between 9.0 and 9.7	
	d.	Component cooling water system - pH adjustment	As required	Sufficient to maintain pH between 9.0 and 9.7	
	e.	Diesel generator cooling water jackets	As required	Sufficient to maintain pH between 9.0 and 9.7	
	f.	Auxiliary boiler - Conductivity and pH adjustment	As required	<100 lbs (annual)	7
Sodium sulfite	a.	Auxiliary boiler conductivity adjustment	Continuous	70 lbs (day)	20,000 lbs
Salt (NaCl)	a.	Makeup water treatment system - to produce NaOCl	Daily	7,400 lbs (day)	2,117,000 lbs
Sodium hopochlorite (0.8% Cl_2 equivalent)	a.	Circulating water system-biocide	(See sub-section 3.6.3)	(Note 3)	8,450,000 gal
	b.	Plant service water system - biocide	Three 1-hour injections per day per unit	430,000 gal (annual)	390,000 gal
	c.	Standby service water water system - biocide	During system operation which is at refueling (once/year/unit) and system testing (once/month/unit)	72,000 gal (annual)	36,000 gal
	d.	Domestic water system - disenfectant	Essentially continuous	1.3 gal (day)	300 gal

TABLE 3.6.1 (Cont.)

Chemical		Use	Frequency of Use	Maximum (Note 2)	Average/Annual Quantity
Ascorbic acid	a.	Auxiliary boiler condenser and feed system corrosion inhibition	Continuous	10 gal (day)	3,650 gal
Disodium phosphate	a.	Auxiliary boiler scale control	Continuous	0.5 lb (day)	183 lbs
Polycarbolic acid copolymer	a.	Plant service system and circulating water system - iron and silt dispersant	Continuous	1,150 lbs (day)	253,000 lbs
Polyphosphonate	a.	Circulating water system - calcium dispersant	Continuous	775 lbs (day)	339,000 lb
Sur[illegible]ctant	a.	Circulating water system - biocide enhancer	Twice daily with chlorination if required	200 lbs (day)	50,000 lbs
Chlorine	a.	Sanitary waste system effluent - disinfectant	Essentially continuous	1 lb (day)	230 lbs
Sodium nitrite	a.	Turbine building cooling water system - corrosion inhibitor	Monthly	1 1/4 lbs (annual)	1 lb
	b.	Component cooling water system - corrosion inhibitors	Monthly	1 1/4 lbs (annual)	1 lb
	c.	Chilled water system - corrosion inhibitor	As required	10 lbs (annual)	7 lbs
	d.	Diesel generator cooling water jackets	As required	1 lb (annual)	-
EPA registered nonoxidizing biocide	a.	Standby service water system - biocide	Not determined	Not determined	Not determined
Gaseous carbon dioxide	a.	Carbon dioxide system - purging the main station generators	*9180 ft^3/unit required prior to gassing the gen[illegible] to [illegible]nd 9180 ft^3 [illegible]it when removing hydrogen from the generator during maintenance only	36,720 ft^3 (*)	-
	b.	Fire protection system - automatic fire suppression agent	1. *At initial plant startup	40 tons (*)	Nominal leakage
			2. *In case of fire	14 tons (*)	Nominal leakage
	c.	Fire protection system - hand held fire extinguishers	*In case of fire	80 lbs (*)	Nominal leakage

TABLE 3.6.1 (Cont.)

Chemical		Use	Frequency of Use	Maximum (Note 2)	Average/Annual Quantity	
Gaseous hydrogen	a.	Hydrogen system - cooling main station generators	1. *Estimated once per year. At initial fill or during shut-down	59,670 ft^3 (*)	-	
			2. Leakage	1950 ft^3 (day)	<711,750 ft^3	
Organic phosphonate polymer	a.	Standby service water system	As required	15 gal (day)	5,500 gal	7
Portland cement Type I or II	a.	Solid radwaste system - solidification process	14.6 batches per year	1.5 x 10^7 lbs (annual)	8.9 x 10^5 lbs	
Sodium silicate	a.	Solid radwaste system - solidification process	2.4 batches per year	2.3 x 10^6 lbs (annual)	1.6 x 10^5 lbs	

TABLE 3.6.1 (Cont.)

Chemical	Use	Frequency of Use	Maximum (Note 2)	Average/Annual Quantity
	b. No. 1 or No. 2 diesel fuel oil - fuel diesel driven fire pumps	1. Two hours per week	(Note 3)	1,000 gal
		2. Six hours per year	(Note 3)	60 gal
Borax and boric acid	a. Mixed to produce sodium pentaborate which in turn may be used to control reactor power output	Emergency use only/leakage	7,406 lbs (Note 6)	300 lbs
Hand held dry chemical extinguishers	a. Fire protection system - fire suppression agent	•Only in case of fire	2,924 lbs (•)	-
Hand held Halon 1211 fire extinguishers	a. Fire protection system - fire suppression agent	•Only in case of fire	1,360 lbs (•)	Nominal leakage
Palladium	a. Catalytic absorption of dissolved oxygen in primary water system (Note 4)	-	2,108 pounds is contained in 380 liters of alumina (Al_2O_3)	
Tritium	a. Activate primary water system (Note 4)	-	Sufficient to activate primary water up to a specific activity of 3×10^{-2} $\mu c/cm^3$	
Thallium	a. Conductivity control in primary water system (Note 4)	-	(Note 3)	0.44 lbs
Methane	a. Leakage detection in primary water system (Note 5)	-	340 ft^3 (day)	124,100 ft^3

NOTES: • Frequency of use initiated by an asterisk refers to corresponding maximum quantity indicated by an asterisk enclosed by parentheses.

1. Two unit operation quantities are provided
2. Maximum usage time frame varies according to chemical use.
3. Average and maximum usage for a typical year are essentially equivalent.
4. Primary water system is a closed cooling water system serving the main station generators.
5. Quantity based on replacement of entire storage capacity of fuel oil.
6. Maximum usage based on initial loading per standby liquid control unit.

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TABLE 5.3.1

AMBIENT RIVER CHEMICAL CONCENTRATIONS AND STATE WATER QUALITY CRITERIA
(Note 1)

Parameters	Units	Ambient River Concentration (Note 2)	Water Quality Criteria Mississippi (Note 3)	Water Quality Criteria Louisiana (Note 4
Total dissolved solids	mg/l	230	400	400
Dissolved oxygen	mg/l	8.6	5 (Note 5)	5 (Note 5)
pH	No units	7.5	6-8.5 (Note 6)	6.5-9.0 (Note 6)
Bacteria (fecal coliform)	(log mean count)	Not available	2000/100 ml (Note 7)	1000/100 ml Note 8)
Specific Conductance	micromho/cm	370	1000 (Note 9)	(Note 10)
Phenolic compounds	mg/l	Not available	0.05	(Note 10)
Temperature	degrees (F)	(Note 11)	Max. temp. rise 5 F; Max. temp. 90 F. (Note 11)	Max. temp. rise 5 F Max. temp. 90 F (Note 11)
Sulfates	mg/l	50	120	120
Chlorides	mg/l	23	75	75

Notes:

1. All criteria apply at all stages of streamflow which exceed the 7-day, 10-year minimum flow.
2. Ambient river concentrations are provided in Table 3.6.3.b. Only those parameters for which a specific numerical criteria exists are given in this table.
3. Abstracted from "Mississippi Air and Water Pollution Control Commission Water Quality Criteria for Intrastate, Interstate, and Coastal Waters;" adopted April 24, 1973, amended November 12, 1974.
4. Abstracted from "Louisiana Water Quality Criteria;" adopted August 14, 1973 by Louisiana Stream Control Commission.
5. Dissolved oxygen concentration may range between 4.0 and 5.0 mg/l under extreme conditions.
6. Discharges shall not cause the pH to vary more than 1.0 unit above or below normal pH of the water.
7. Not more than 10 percent of the samples examined shall exceed a log mean fecal coliform count of 4000/100 ml.
8. Not more than 10 percent of the samples examined shall exceed a log mean fecal coliform count of 2000/100 ml.
9. Limit given in applicable to fresh water streams.
10. No numerical standard exists for this parameter.
11. See Sections 3.4 and 5.1 for details regarding thermal discharges.

Surface	-	MRI 302	Tipping bucket rain gauge
33 feet	-	MRI 1090-1	Air bearing anemometer
		MRI 1074-2	Wind System
		MRI 809	Delta temperature system (with reference temperature)
		MRI 830	Relative humidity sensor
		MRI 830	Temperature sensor
133 feet	-	MRI 1074-2	Wind system
		MRI 809	Delta temperature system
162 feet	-	MRI 1074-2	Wind System
		MRI 809	Delta temperature system
		MRI 830	Relative humidity sensor

All arms used to place gear are 12 feet from the tower face.

Table 6.1.9 shows the specifications which pertain to the original meteorological equipment installed at Grand Gulf. All data collected since the starting date of about August 1, 1972, have met Regulatory Guide 1.23 requirements except the relative humidity data. Maintenance and operational difficulties were experienced with the relative humidity sensors. The sensors were replaced by two Tech-Ecology MetSet 5-T Dewpoint Systems in December 1976. 7

A full-time resident weather equipment technician was assigned to the site from March 1972 through July 1973. During the second annual cycle, August 1973 through July 1974, the tower and equipment were serviced and maintained by technicians from Vicksburg. The original MRI sensors were replaced in January 1980 with Climatronics and General Eastern equipment. A breakdown of the sensors at each of the indicated levels is given below:

Surface	Climatronics	100097	Tipping bucket rain gauge
	Climatronics	100088-2	Delta temperature translator (utilizes 33- and 162-foot temperature sensors) 7
33 feet	Climatronics	100075	Wind speed sensor
		100076	Wind direction sensor
		100093	Temperature sensor
	General Eastern	1200 MSCM	Dew point sensor

162 feet	Climatronics	100075	Wind speed sensor
		100076	Wind direction sensor
		100093	Temperature sensor

Table 6.1.9 also shows the specifications which pertain to the new meteorological equipment.

Meteorological data from the permanent tower will be supplemented with information from the backup meteorological tower. This tower will monitor wind speed, wind direction, and sigma theta. The information from the backup tower will be supplied to the control room via a telemetry system. This information will be utilized to ensure data availability should a temporary loss of the permanent tower occur. 7

All information recorded by the meteorological instruments on the permanent tower are stored both in digital and analog forms. The analog traces serve as backup to the digital system. Data from the temporary tower instrumentation were recorded by analog trace only.

The permanent (main) tower serves as a representative observation station (i.e., meteorological conditions at that location are considered to be representative of the site). The river station was installed primarily to measure and record winds in and along the river valley to evaluate the possible meteorological effects of the hills along the eastern shoreline.

The percentage of data recovery during the first annual cycle at the Grand Gulf main meteorological station is given in Table 6.1.10 for the combination of sensor systems used in preparation of joint frequency distributions presented in this report and used in diffusion analyses. For this combination of sensor systems (162-foot/33-foot ΔT, 33-foot wind direction and speed), 98.73 percent of all possible sets of hourly values from August 1, 1972 through July 31, 1973 were recovered.

Corresponding data recovery percentages for the second and third annualy cycle are shown in Table 6.1.11 and 6.1.12.

During the first two annual data cycles, the meteorological systems were calibrated by professional meteorologists and technicians employed by Woodward-Envicon/Woodward-Clyde Consultants. In the third annual cycle, Grand Gulf plant staff performed the required calibration program with assistance from the consultants. All calibrations were performed in compliance with Regulatory Guide 1.23.

6.1.3.1.1 Meteorological Data Processing

The data processing procedure for 3 years of Grand Gulf meteorological data involves three basic steps:

a. Data collection

b. Data processing

c. Data analysis

Seven computer programs have been developed to process the collected data according to steps b and c above. This section includes a summary of the data collection methods and a description of the applications of the system of programs.

a. Data Collection

The onsite meteorological data are recorded in both analog and digital form.

The Analog Data

The analog traces are recorded on strip charts which act mainly as a backup and verification for the digital data. The data are recorded continuously on five chart rolls, one for each of the following sets of parameters:

1. 162-foot wind speed and direction

2. 33-foot wind speed and direction

3. Surface precipitation 7

4. 33-foot temperature and 162-foot/33-foot ΔT

5. 33-foot dew point temperature

All wind speeds are recorded in miles per hour. Wind directions are recorded on a 0-540 degree scale. Temperatures are recorded in F (degrees Fahrenheit). The precipitation is a step trace, each step representing 0.01 inch. 7

The Digital Data

The digital data consist of a 15-minute average value derived from 180 samples obtained every 5 seconds (for every recorded parameter). This 15-minute average value is recorded on a 9-track, 1600 bit per inch magnetic tape. Each record on the tape is headed 7

by a date-time identifier (Julian date and minute of the day). This tape is the source of input for the computer programs. 7

Data Available to the Control Room

The meteorological data are telemetered to the main control room (Bristol telemetry system Model 877231A) and is available to personnel via the balance of plant computer. Those parameters which are telemetered to the control room are outlined below:

1. Wind speed - 33-foot and 162-foot elevations

2. Wind direction - 33-foot and 162-foot elevations 7

3. Temperature - 33-foot elevation

4. Differential temperature (ΔT) - 33-foot and 162-foot elevations

5. Dewpoint - 33-foot elevation

6. Precipitation - ground level

b. Data Processing

The recorded digital data go through three processing phases in preparation for computer analyses.

Editing Data

The first phase consists of editing the tape for computer compatibility and editing the data for meteorological reasonability.

1. The first action of the editing phase is to lengthen all records to a standard length of 4507 bytes. Most records are already this length (75 bytes for each of the 60 one-minute data sequences, and 7 for the date-time identifier). However, there are often several short records due to power failure or equipment malfunction. Thus a program (EDIT 1) has been developed to lengthen these short records by adding the appropriate number of zeros to the end of the record.

2. Next, the data are checked for meteorological reasonability and sequential errors. Each minute of data is checked against criteria that have been established for absolute level and relative variation of each parameter in time and space. Notification of each violation of these limits is printed out. The program developed for this function is the EDIT program.

3. The output of the EDIT program is submitted to a professional meteorologist. He checks all of the EDIT printout with the analog charts and determines which of the data, if any, need replacing. These data (from those hours requiring data replacement) are coded onto forms from the chart rolls where possible (or coded as missing data otherwise). A card deck is punched as input to the next phase.

Consolidation of the Data

The second phase consists of consolidating the minute-by-minute data on the tape with the card corrections from the editing phase into a data base of hourly values. The program that provides this capability is the DATBAS program. The data base that is created by this program is used as input, directly or indirectly, for all subsequent programs.

Quality Control

Before each data set (usually 1 month of data) is entered onto the permanent file, a printed summary of the consolidated hourly data undergoes a third phase consisting of a quality control check against the analog charts to ensure the validity of the data. Any necessary corrections are coded and added to the card input deck of DATBAS. This program is then rerun using the complete input deck and the output is entered onto the permanent file.

c. Data Analysis

Six major computer programs have been used to perform certain calculations on the data. Most of these programs have the capability to accept both onsite data and Jackson, Mississippi data from the National Climatic Center (N.C.C.) in Asheville, North Carolina. The other programs can easily be adapted to accept the N.C.C. data. This provides the capability to compare Jackson data with data from the Grand Gulf site.

TABLE 6.1.9

METEOROLOGICAL EQUIPMENT SPECIFICATION AND PERFORMANCE CHARACTERISTICS

Temporary Towers

MRI 1071 Mechanical Weather Station

Wind Direction	Start threshold: <0.75 mph Accuracy: ±4 degree azimuth Delay distance: 50% recovery - 8 ft
Wind Run (Speed)	Start threshold: <0.5 mph Accuracy: ±2% Response distance: 18 ft (63% recovery)
Temperature	Range: -30 F to 120 F Accuracy: ±3 F (Calibrated to ±1 F)

Permanent Tower

MRI 1074-2 Wind Systems

Wind Direction	Start threshold: 0.75 mph Accuracy: ±1% Delay distance: 4 ft (50% recovery)
Wind Speed	Start threshold: 0.75 mph Accuracy: ±0.4 mph or 1% (whichever is greater) Response distance: 18 ft (63% recovery)

MRI 809 Temperature

Temperature	Range: -30 C to +50 C Accuracy: ±0.5 C
Differential Temperature	Range: ±5 C Accuracy: ±0.1 C

Rain Gauge - MRI 302 Tipping Bucket Rain Gauge

Accuracy: ±1% at 3 in. of rain/hr
Picks up each 0.01 in. of rain for each tip of bucket.

TABLE 6.1.9 (Cont.)

Permanent Tower (Cont.)

MRI 1090-1 Air Bearing Anemometer (wind speed only)

	Start threshold: <0.25 mph Response distance: Approximately 10 ft at 2 mph Range: 0.25 to 20 mph Accuracy: 0.10 mph or 1% of reading

MetSet 5-T Dewpoint Sensor (installed in December 1976)

	Range: -50 C to +50 C Accuracy: ±0.5 C

New Equipment

Climatronics System

Wind Direction	Start threshold: 0.6 mph Accuracy: ±3 degrees Delay distance: 0.76 meters Dampening ratio: 0.4/3.7 feet Range: 0 to 540 degrees
Wind Speed	Start threshold: 0.6 mph Accuracy: ±1% or 0.1 mph Distance constant: 5 ft 7 Range: 0 to 100 mph
Temperature	Accuracy: ±0.2 F Range: -30 F to 122 F
ΔT	Accuracy: ±0.1 F or 1% of ΔT
Precipitation	Accuracy: ±1% up to 3 in./hr Resolution: 0.01 to 15 in.
Dew Point	Accuracy: ±0.72 F