Wastewater Characterization

Tenaska Westmoreland Generating Station

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1. EXECUTIVE SUMMARY

GE Water and Process Technologies (GEWPT) is pleased to have the opportunity to present an estimate of the characterization for the water systems for the proposed Tenaska Westmoreland Generating Station. The chemical treatment recommendations and wastewater characterizations are based on historical information regarding the quality of the Municipal Authority of Westmoreland County and a supplemental water analysis by GEWPT of the Indian Creek plant.

Section 2 provides a summary of the design basis for makeup water chemistry. In addition, it provides system design basis for boiler, evaporative cooling, open recirculating cooling, and reverse osmosis systems.

The water balance is based on a configuration of 3x1, gas turbines and HRSGs with single steam turbine. Additionally, information is provided which characterizes the plant wastewater based upon cooling tower operation at 6 cycles of concentration and 9 cycles of concentration. The 9 cycles of concentration was chosen as an upper limit to keep the estimated plant wastewater total dissolved solids below a limit of 2000 mg/l.

Section 3 provides specific information about the maximum expected product concentrations for the GEWPT specialty chemicals provided.

The water balance is based upon using reverse osmosis and electro de-ionization as boiler cycle makeup treatment. The water balance is also based upon 3 x 1 configuration at maximum summer operating conditions of duct firing and the use of evaporative coolers to increase power output.

Section 4 provides the water chemistries at various points in the plant. The sub-sections 4.1 and 4.2 provide details of the water chemistries at cooling tower cycles of concentration of 6 and 9, respectively. In addition, acid, hypochlorite, and cleaning chemical consumption was estimated for each case.

The estimated wastewater characterization is not a guarantee of plant wastewater quality or quantity. It is an estimate of expected wastewater quality under the normal operating conditions described, which is provided by GEWPT to Tenaska as a guide. Sound environmental engineering judgment must be applied to these estimates for any kind of further use.

Section 5 lists the GE products. Please disregard the Material Safety Data Sheets (MSDSs) sent previously. Under separate cover, I will send an updated set of MSDSs, which are specifically developed for PA and NJ.

The appendices provide additional information on MAWC water quality and the Preliminary Water Balance (from Tenaska) for the project.

2. DESIGN BASIS

2.1 Influent Water

Historical information regarding the quality of the Indian Creek System potable water was provided to Tenaska by Municipal Authority of Westmoreland County. That data included 13 parameters (Daily Typical Analysis), 2 microbiological and 16 inorganic contaminants, and 16 synthetic organic chemical analyses. (Details are included in Appendix A-1).

A supplemental water analysis was performed by GEWPT of the Indian Creek water on a sample taken October 8, 2011. The complete water analysis is provided in Appendix A-2.

For the purposes of plant wastewater characterization, the "design" water into the plant was chosen as a combination of maximum MAWC water quality and supplemental information from the GEWPT analysis. Please refer to Section 4 for a detailed listing of the design water.

2.2 Boiler System

The design and operating basis of each HRSG is assumed as follows:

Parameter	Value	Units		Parameter	Value	Units
Boiler Pressure	2200	psig		Steaming Rate	924,531	Lb/hr
Cycles of Concentration	50			Feedwater	943,022	Lb/hr
Operating days/ year	360			Total Blowdown	18,491	Lb/hr
Makeup Water	Demineralized			BD Flashed to Steam	14	%
Condensater Return	94.0	%		Net Blowdown to drain	32	gpm

Table 1 HRSG System Design Basis

The boiler system will be treated with chemicals designed to protect a high pressure boiler system;

- Phosphate based boiler internal treatment – Optisperse HP2100 and HP3100
- Oxygen scavenger – CorTrol OS5607
- Condensate treatment – Steamate NA1321

2.3 Gas Turbine Evaporative Coolers

The design and operating basis of each Gas Turbine Evaporative cooler is assumed as follows:

Parameter	Value	Units		Parameter	Value	Units	
Recirculation Rate	2,300	gpm		Cycles of Concentration	2.5		
Range	10	deg F		Evaporation	23	gpm	
Evaporation Factor	1.0			Blowdown	15	gpm	
				Makeup	38	gpm	

Table 2 Gas Turbine Evaporative Cooler System Design

MAWC Indian Creek System water will be used as makeup to each evaporative cooler. As they will operate at only 2.5 cycles of concentration, no chemical treatment is anticipated. Since the cycles of concentration are low, the blowdown from each evaporative cooler will be combined with boiler blowdown and directed to the open recirculating cooling system as makeup.

2.4 Recirculating Cooling System

The open recirculating cooling system design basis is shown below:

Parameter	Value	Units		Parameter	Value	Units	
Recirculation Rate	228,252	gpm		Cycles of Concentration	6		
Range	27.6	deg F		Evaporation	5,040	gpm	
Evaporation Factor	0.8			Drift	2	gpm	
System Volume	1000000	Gal		Blowdown	1,008	gpm	
Drift (% of Recirc)	0.001	%		Makeup	6,048	gpm	
Max Bulk Water Temp	360	deg F					
Max Skin Temp	Demineralized	deg F		Water Cost		$/Kgal	
Operating Days/year	360.0			Sewer Cost		$/Kgal	
Table 2 Cooling System Design Basis							

Table 3 Open Recirculating Cooling System design basis

The cooling tower will be treated with the following chemicals:

- Corrosion inhibitor – GenGard GN8004
- Deposit Control Agent - Depositrol BL5400
- Sulfuric acid – as needed for pH control
- Biocide – Sodium hypochlorite
- Dechlorination - Spectrus DT1404

Based on the cycle analysis, the cooling tower could be operated at much higher cycles of concentration, especially with acid feed. However, for the purposes of wastewater characterization, 6 cycles and 9 cycles of concentration were chosen. The data shown on this page is based on 6 cycles of concentration. The 9 cycles of concentration is discussed in a later section of the report.

Print Cycle-Up | Print MakeUps | Help

GE Water & Process Technologies

TOWER WATER CYCLING ANALYSIS

VERSION 7.9

110 °F (Hottest Skin) **90** °F (Hottest Bulk Water)

0.9 M-ALK FACTOR

Tenaska Westmoreland
Westmoreland, PA

Cooling Tower
11/21/2012

VOL	**1,000,000**	(gal)
RR	**200,000**	(gpm)
D T	**17**	(deg F)
EVAP	3,340	(gpm)
F	**1.00**	

CYCLES	pH	M-ALK (ppm as CaCO3)	Ca (ppm as CaCO3)	Mg (ppm as CaCO3)	SiO2 (ppm as SiO2)	COND (mmhos)	Cl (ppm as Cl)	SO4 (ppm as SO4)	LSI CaCO3 Index	MgSi ***** = Exceeds	CMSi ok = Under Sat	RT75 (Retention Time in days)	B.D. (gpm)	M.U. (gpm)
MAKEUP	7.80	45	60	25	5	300	75	42	-0.32					
3.5	8.04	142	210	88	18	1050	263	147	0.88	ok	ok	0.72	1,336.0	4,676
4.0	8.15	162	240	100	20	1200	300	168	1.09	ok	ok	0.86	1,113.3	4,453
4.5	8.24	182	270	113	23	1350	338	189	1.28	ok	ok	1.01	954.3	4,294
5.0	8.32	203	300	125	25	1500	375	210	1.45	ok	ok	1.15	835.0	4,175
5.5	8.40	223	330	138	28	1650	413	231	1.60	ok	ok	1.30	742.2	4,082
6.0	8.47	243	360	150	30	1800	450	252	1.74	ok	ok	1.44	668.0	4,008
6.5	8.53	263	390	163	33	1950	488	273	1.87	ok	ok	1.58	607.3	3,947
7.0	8.59	284	420	175	35	2100	525	294	1.99	ok	ok	1.73	556.7	3,897
7.5	8.65	304	450	188	38	2250	563	315	2.10	ok	ok	1.87	513.8	3,854
8.0	8.70	324	480	200	40	2400	600	336	2.20	ok	ok	2.02	477.1	3,817
8.5	8.75	344	510	213	43	2550	638	357	2.30	ok	ok	2.16	445.3	3,785
9.0	8.79	365	540	225	45	2700	675	378	2.39	ok	ok	2.31	417.5	3,758
9.5	8.84	385	570	238	48	2850	713	399	2.48	ok	*****	2.45	392.9	3,733
10.0	8.88	405	600	250	50	3000	750	420	2.56	ok	*****	2.59	371.1	3,711
10.5	8.92	425	630	263	53	3150	788	441	2.64	ok	*****	2.74	351.6	3,692
12.0	9.02	486	720	300	60	3600	900	504	*****	ok	*****	3.17	303.6	3,644
12.5	9.06	506	750	313	63	3750	938	525	*****	ok	*****	3.31	290.4	3,630
13.0	9.09	527	780	325	65	3900	975	546	*****	ok	*****	3.46	278.3	3,618

Table 4 Cycle-Up Analysis

2.5 Reverse Osmosis System

The reverse osmosis system design basis for the 3 x 1 configuration is shown below:

Parameter	Value	Units	Parameter	Value	Units
Product Water	111	gpm	Feedwater	139	gpm
Flow Recovery	80	%	Concentrate	28	gpm
Operating Days/year	360.0				

Table 5 Reverse Osmosis System Design

The reverse osmosis system will be continuously treated with the following chemicals:

- Antiscalant – Hypersperse MDC150
- Sulfuric acid – if needed
- Dechlorinating agent – BetzDearborn DCL30
- Miscellaneous caustic and acid for periodic cleaning

Under the configuration assuming 6 cycles of concentration in the cooling tower, the RO reject is sent to the waste sump and eventually combined with the plant waste. Under the 9 cycles of concentration, it is sent to the cooling tower as makeup.

3.0 MAXIMUM DISCHARGE TREATMENT CHEMICAL CONCENTRATIONS

Table 6 provides a summary of the expected maximum concentrations of the GE Water and Process Technologies specialty water treatment chemicals in the plant discharge of the 3 x 1 configuration at 6 cycles of concentration in the cooling tower. Chemical dosages were estimated to calculate maximum daily quantity of chemical. Then, the product quantity was divided by the total plant effluent flow to calculate a maximum product concentration, assuming no degradation of product.

Estimated Plant Discharge Flow	1042.0	gpm						
GEWPT Treatment Chemicals	Max Daily Qty.	Max product concentration in discharge	Product Concentration, mg/g			Outfall Concentration, mg/l		
	#/day	mg/l	COD	TOC	BOD5	COD	TOC	BOD5
Optisperse HP2100	67.9	5.4	83	25	0	0.5	0.1	0.0
Optisperse HP3100	67.9	5.4	79	24	0	0.4	0.1	0.0
CorTrol OS5607	67.9	5.4	442	187	57	2.4	1.0	0.3
Steamate NA1321	101.9	8.1	0	0	0	0.0	0.0	0.0
GenGard GN8004	120.9	9.7	385	109	0	3.7	1.1	0.0
Depositrol BL5400	48.4	3.9	300	70	1	1.2	0.3	0.0
Spectrus DT1404	30.2	2.4	20	0	0	0.0	0.0	0.0
Hypersperse MDC150	6.7	0.5	180	40	2	0.1	0.0	0.0
BetzDearborn DCL30	1.7	0.1	49	0	0	0.0	0.0	0.0
Total						8.3	2.6	0.3
Note 1 Concentration of COD, TOC, and BOD5 are based on the contribution of these constituents from treatment chemicals and does not include any background levels that might be present in the makeup or from operation.								

Table 6 Maximum Discharge Treatment Chemical Concentrations 3 x 1, 6 cycles

Table 7 provides a summary of the expected maximum concentrations of the GE Water and Process Technologies specialty water treatment chemicals in the plant discharge of the 3 x 1 configuration at 9 cycles of concentration in the cooling tower. Chemical dosages were estimated to calculate maximum daily quantity of chemical. Then, the product quantity was divided by the total plant effluent flow to calculate a maximum product concentration, assuming no degradation of product.

Estimated Plant Discharge Flow	664.0	gpm							
GEWPT Treatment Chemicals	Max Daily Qty.	Max product concentration in discharge	Product Concentration, mg/g			Outfall Concentration, mg/l			
	#/day	mg/l	COD	TOC	BOD5	COD	TOC	BOD5	
Optisperse HP2100	67.9	5.4	83	25	0	0.5	0.1	0.0	
Optisperse HP3100	67.9	5.4	79	24	0	0.4	0.1	0.0	
CorTrol OS5607	67.9	5.4	442	187	57	2.4	1.0	0.3	
Steamate NA1321	101.9	8.1	0	0	0	0.0	0.0	0.0	
GenGard GN8004	113.4	9.1	385	109	0	3.5	1.0	0.0	
Depositrol BL5400	45.4	3.6	300	70	1	1.1	0.3	0.0	
Spectrus DT1404	18.9	1.5	20	0	0	0.0	0.0	0.0	
Hyperspherse MDC150	6.7	0.5	180	40	2	0.1	0.0	0.0	
BetzDearborn DCL30	1.7	0.1	49	0	0	0.0	0.0	0.0	
Total						8.0	2.5	0.3	
Note 1 Concentration of COD, TOC, and BOD5 are based on the contribution of these constituents from treatment chemicals									
	and does not include any background levels that might be present in the makeup or from operation.								

Table 7 Maximum Discharge Treatment Chemical Concentrations 3 x 1, 9 cycles

Note: The chemical concentrations listed are provided as a guide of the expected concentration in a plant operating under normal conditions..

4.0 ESTIMATED WATER CHEMISTRIES - 3 x 1 Configuration

4.1 3x1 Configuration, 6 Cycles, RO Reject to waste

Table 8 below, can be used to provide a summary of the expected water chemistries in various parts of the plant for 6 cycles in the cooling tower. The cooling tower blowdown represents the majority of the plant discharge since the plant discharge flow will be1042 gpm:

- 3 x 1 configuration
- 6 cooling tower cycles of concentration
- RO reject (concentrate) to waste

As indicated previously, these are estimates, not guarantees, of the expected chemistries and flows in various parts of the plant under normal operating conditions. Sound environmental engineering must be applied to these estimates if used for any other purpose.

Stream number	MAWC			(1)	(14)	(19)	(32)
Stream name	MAWC Normal	MAWC MAX	GE Oct 8th	MAWC MAX	Cooling twr BD	RO reject	Estimated Plant Discharge
Parameter (mg/l except as noted)				Design -			
Flow, gpm				6,170	1,008	34	1042
pH, standard units	7.6	7.8	7.1	7.8	8.4	8.4	8.5
Specific Conductance, 25°C,	245	300	182	300	1,794	1,439	1,774
Total Dissolved Solids	166	203	115	203	1,215	975	1,201
Alkalinity, "P", as CaCO3				0	0	1	5
Total Alkalinity, "M", as CaC	16	45	23	45	258	216	256
Sulfur, Total as SO4	60	42	42	42	260	202	257
Chloride as Cl	41	75	20	75	455	360	450
Phosphate, Total as PO4	0.6	0.7	1.3	0.7	7	3.4	6.7
Nitrate, as NO3	0.9	0.9	0.9	0.9	5	4.3	5.3
Silica, Total as SiO2	3.5	5.2	5.2	5.2	31	25	31
Calcium, Total as CaCO3	50	60	55	60	358	288	355
Magnesium, Total as CaCO3	20	25	22	25	149	120	148
Total Hardness as CaCO3	70	85	77	85	508	408	502
Sodium as Na	35	45	18	45	274	216	271
Copper, Total as Cu	0.020	0.220	0.220	0.220	1.314	1.055	1.300
Iron, Total as Fe	0.010	0.100	0.060	0.100	0.597	0.480	0.591
Lead as Pb	0.004			0.000	0.000	0.000	0.000
Manganese, Total as Mn	0.010	0.100	0.010	0.100	0.597	0.480	0.591
Zinc, Total as Zn	0.140	0.140	0.140	0.140	0.8	0.671	0.827
Total Suspended Solids				0	0	0	TBD
NH-4	0.0	0.1		0.1	1	0	0.7

Table 8 - Estimated wastewater discharge characteristics – 3 x 1 configuration, 6 cycles

Additional Chemicals

Bleach – Liquid sodium hypochlorite will be used as the primary oxidizing biocide for the cooling tower treatment. This will be fed on a regular basis to maintain continuous chlorine residual in the cooling tower to minimize biological fouling with the cooling system. Approximately 53,000 gallons of industrial strength bleach will be used annually. The effect (primarily increases in sodium and chloride) of this product is shown in the above Estimated Wastewater Discharge Characteristics.

Acid – Sulfuric acid may not be needed if the cooling tower operates at 6 cycles of concentration. If it were to be needed, the consumption would be less than 5,000 gallons per year. The net impact on the cooling tower blowdown would be an increase in sulfate (SO_4) of less than 20 ppm.

Spectrus NX1100 – Spectrus NX1100 is a liquid non-oxidizing biocide specifically approved for use in recirculating cooling tower systems for periodic control of microbiological activity. It is fed only if it is determined that additional microbiological control is needed. It is estimated that approximately 36 gallons would be fed into the cooling tower basin for each application. Feed is not expected to exceed 6 times per year. The feed of Spectrus NX1100 is carefully planned to be added when the tower volume is low and the cooling tower blowdown turned off. Administrative controls will be in place to assure that the blowdown is not opened until the Spectrus NX1100 has degraded due to the actions of pH, temperature, and time.

Reverse Osmosis Cleaning Chemicals – The plant will need to clean the ultrafiltration (UF) membranes (if included in design) and the reverse osmosis (RO) membranes on a periodic basis. The following information is typical of cleaning for UF and RO systems.

The ultrafiltration (UF) membrane will require cleaning using sodium hypochlorite and citric acid on a monthly basis. This low volume cleaning waste has an expected consumption for each of 1 gallon of hypochlorite and 2 gallons of citric acid per cleaning. The cleaning removes inorganic and organic contaminants from the membranes in separate steps. The cleaning waste is combined, neutralized if needed, and slowly sent to the plant sump system for eventual discharge.

The reverse osmosis (RO) membrane will require cleaning using Kleen MCT103 and Kleen MCT511 (typical products) on a quarterly or 6 month basis. This low volume cleaning waste has an expected consumption for each of 12 gallon of MCT103 and 12 gallons of MCT511 per cleaning. The cleaning removes inorganic and organic contaminants from the membranes in separate steps. The cleaning waste is combined, neutralized if needed, and slowly sent to the plant sump system for eventual discharge.

4.2 3x1 Configuration, 9 Cycles, RO Reject to cooling tower

Table 8, provided above, can be used to provide a summary of the expected water chemistries in various parts of the plant for 9 cycles in the cooling tower. The cooling tower blowdown represents the majority of the plant discharge and the 3x1 configuration does not change that percentage significantly. However, for the 3x1 configuration, the plant discharge flow will be636 gpm, since the RO reject will be sent to the cooling tower:

- 3 x 1 configuration
- 9 cooling tower cycles of concentration

- RO reject (concentrate) to cooling tower as makeup

As indicated previously, these are estimates, not guarantees, of the expected chemistries and flows in various parts of the plant under normal operating conditions. Sound environmental engineering must be applied to these estimates if used for any other purpose.

Stream number	MAWC			(1)	(14)	(32)
Stream name	MAWC Normal	MAWC MAX	GE Oct 8th	MAWC MAX	Cooling tower BD	Estimated Plant Discharge
Parameter (mg/l except as noted)				Design -		
Flow, gpm				5,792	630	664
pH, standard units	7.6	7.8	7.1	7.8	8.4	8.5
Specific Conductance, 25°C, µm	245	300	182	300	2,854	2,823
Total Dissolved Solids	166	203	115	203	1,933	1,912
Alkalinity, "P", as CaCO3				0	0	6
Total Alkalinity, "M", as CaCO3	16	45	23	45	314	312
Sulfur, Total as SO4	60	42	42	42	475	469
Chloride as Cl	41	75	20	75	695	688
Phosphate, Total as PO4	0.6	0.7	1.3	0.7	8	8.4
Nitrate, as NO3	0.9	0.9	0.9	0.9	8	8.1
Silica, Total as SiO2	3.5	5.2	5.2	5.2	48	47
Calcium, Total as CaCO3	50	60	55	60	548	542
Magnesium, Total as CaCO3	20	25	22	25	229	226
Total Hardness as CaCO3	70	85	77	85	776	768
Sodium as Na	35	45	18	45	419	414
Copper, Total as Cu	0.020	0.220	0.220	0.220	2.010	1.988
Iron, Total as Fe	0.010	0.100	0.060	0.100	0.913	0.904
Lead as Pb	0.004			0.000	0.000	0.000
Manganese, Total as Mn	0.010	0.100	0.010	0.100	0.913	0.904
Zinc, Total as Zn	0.140	0.140	0.140	0.140	1.3	1.265
Total Suspended Solids				0	0	0
NH-4	0.0	0.1		0.1	1	1.1

Table 9 - Estimated wastewater discharge characteristics – 3 x 1 configuration, 9 cycles

Additional Chemicals

Bleach – Liquid sodium hypochlorite will be used as the primary oxidizing biocide for the cooling tower treatment. This will be fed on a regular basis to maintain continuous chlorine residual in the cooling tower to minimize biological fouling with the cooling system. Approximately 50,000 gallons of industrial strength bleach will be used annually. The effect (primarily increase in chlorides) of this product is shown in the above Estimated Wastewater Discharge Characteristics.

Acid – Sulfuric acid will be needed if the cooling tower operates at 9 cycles of concentration. The consumption would be approximately 20,000 gallons per year. The net impact on the cooling tower blowdown would be an increase in sulfate (SO_4), which has already been included in the Estimated Wastewater Discharge Characteristics.

Spectrus NX1100 – Spectrus NX1100 is a liquid non-oxidizing biocide specifically approved for use in recirculating cooling tower systems for periodic control of microbiological activity. It is fed only if it is determined that additional microbiological control is needed. It is estimated that approximately 36 gallons would be fed into the cooling tower basin for each application. Feed is not expected to exceed 6 times per year. The feed of Spectrus NX1100 is carefully planned to be added when the tower volume is low and the cooling tower blowdown turned off. Administrative controls will be in place to assure that the blowdown is not opened until the Spectrus NX1100 has degraded due to the actions of pH, temperature, and time.

Reverse Osmosis Cleaning Chemicals – The plant will need to clean the ultrafiltration membranes (if included in design) and the reverse osmosis membranes on a periodic basis.

The ultrafiltration (UF) membrane will require cleaning using sodium hypochlorite and citric acid on a monthly basis. This low volume cleaning waste has an expected consumption for each of 1 gallon of hypochlorite and 2 gallons of citric acid per cleaning. The cleaning removes inorganic and organic contaminants from the membranes in separate steps. The cleaning waste is combined, neutralized if needed, and slowly sent to the plant sump system for eventual discharge.

The reverse osmosis (RO) membrane will require cleaning using Kleen MCT103 and Kleen MCT511 (typical products) on a quarterly or 6 month basis. This low volume cleaning waste has an expected consumption for each of 12 gallon of MCT103 and 12 gallons of MCT511 per cleaning. The cleaning removes inorganic and organic contaminants from the membranes in separate steps. The cleaning waste is combined, neutralized if needed, and slowly sent to the plant sump system for eventual discharge.

5.0 MATERIAL SAFETY DATA SHEETS

Please disregard the Material Safety Data Sheets (MSDSs) sent previously. Under separate cover, GE will provide an updated set of MSDSs, which are specifically designed for PA and NJ for the following products:

Boiler	Cooling	Membrane
OptiSperse HP2100	GenGard GN	HyperSperse MDC150
OptiSperse HP3100	Depositrol BL5400	BetzDearborn DCL30
CorTrol OS5607	Spectrus DT1404	Kleen MCT103
Steamate NA1231	Spectrus NX1100	Kleen MCT511

Our Product Stewardship group provided the following information regarding the PA DEP Reportable Hazardous Substances List…The PA DEP 297 Reportable Hazardous Substance list appears to have materials that would also be considered OSHA Hazardous. Having said that, irregardless of U.S. Federal or PA/NJ MSDS any OSHA Hazardous substance present in our composition >1% would be present in MSDS Section 3. If it is a carcinogen it would be <0.1%. If I use ferric chloride as an example this is contained in Klaraid CDP1360 and identified in MSDS Section 3 for both U.S. Federal and PA MSDS. The PA/NJ MSDS discloses non-Hazardous ingredients not on Federal.

APPENDIX A-1 – MAWC Water Quality

DAILY TYPICAL ANALYSIS	UNIT	BEAVER RUN SYS Measured Level	BEAVER RUN SYS Range	INDIAN CREEK SYS Measured Level	INDIAN CREEK SYS Range	MCKEESPORT SYS Measured Level	MCKEESPORT SYS Range
pH	pH	7.5	7.6-7.8	7.6	7.6-7.8	7.6	7.4-7.5
Alkalinity	ppm	35	22-56	16	10-45	34	25-37
Hardness	ppm	100	80-130	70	20 -85	88	80-104
Conductivity	umhos	270	250-350	245	200-300	230	210-255
Turbidity	NTU	0.04	0.02-0.10	0.05	0.03-0.11	0.08	0.03-0.08
Chlorides	ppm	50	40 -60	41	35-75	46	40-57
Chlorine(total)	ppm	2.5	1.6 - 2.6	2.4	1.6 - 2.5	1.6	1.3-2.8
Ammonia(free)	ppm	0.08		0.04	0.02-0.10	0.0	
Iron	ppm	0.01	0.0-0.1	0.01	0.0-0.1	<0.01	0.0-0.03
Manganese	ppm	0.02	0.0-0.1	0.01	0.0-0.1	0.018	0.0-0.03
Phosphate	ppm	0.84	0.7-0.9	0.62	0.6-0.70	0.9	0.43-0.89
Sodium	ppm	30	(a)			8.5	(a)
Zinc	ppm					<0.17	(a)

CONTAMINANT	UNIT	MCL	BEAVER RUN SYS Detected Level	BEAVER RUN SYS Range	INDIAN CREEK SYS Detected Level	INDIAN CREEK SYS Range	MCKEESPORT SYS Detected Level	MCKEESPORT SYS Range
MICROBIOLOGICAL								
Turbidity	NTU	0.5	0.3	(c)	0.11	(c)	0.12	(c)
Bacteria		P/A	A	(c)	A	(c)	A	(c)
NORGANICS								
Copper	ppm	1.3	0.09	(b)	0.02	(b)	0.07	(b)
Fluoride	ppm	4.0	0.25	(a)	0.24	(a)	ND	0.0 - 0.2
Lead	ppb	15	5.8	(b)	3.8	(b)	2.82	(b)
Nitrate	ppm	10	0.48	(a)	0.89	(a)	ND	(a)
Nitrite	ppm	1.0	<0.01	(a)		(a)		
Antimony	ppm	0.006	ND	(a)	ND	(a)	ND	(a)
Arsenic	ppm	0.05	ND	(a)	ND	(a)	ND	(a)
Barium	ppm	2.0	ND	(a)	ND	(a)	0.037	(a)
Beryllium	ppm	0.001	ND	(a)	ND	(a)	ND	(a)
Chromium	ppm	0.1	ND	(a)	ND	(a)	ND	(a)
Cyanide	ppm	0.2	ND	(a)	ND	(a)	ND	(a)
Mercury	ppm	0.002	ND	(a)	ND	(a)	ND	(a)
Nickel	ppm	0.1	ND	(a)	ND	(a)	0.0034	(a)
Selenium	ppm	0.05	ND	(a)	ND	(a)	ND	(a)
Potassium							0.55	(a)
Silver							<0.005	(a)

	UNIT	MCL	BEAVER RUN SYS Detected Level	BEAVER RUN SYS Range	INDIAN CREEK SYS Detected Level	INDIAN CREEK SYS Range	MCKEESPORT SYS Detected Level	MCKEESPORT SYS Range
SYNTHETIC ORGANIC CHEMICALS								
Lindane	ppm	0.0002	ND	(a)	ND	(a)	ND	(a)
Methoxychlor	ppm	0.04	ND	(a)	ND	(a)	ND	(a)
Atrazine	ppm	0.003	ND	(a)	ND	(a)	0.00013	
Endothal	ppm	0.1	ND	(a)	ND	(a)	ND	(a)
Di(2-ethylhexyl)adipate	ppm	0.5	ND	(a)	ND	(a)	ND	(a)
Di(2-ethylhexyl)phthalates	ppm	0.006	ND	(a)	ND	(a)	ND	(a)
Oxamyl (Vydate)	ppm	0.2	ND	(a)	ND	(a)	ND	(a)
Simazine	ppm	0.004	ND	(a)	ND	(a)	ND	(a)
Picloram	ppm	0.5	ND	(a)	ND	(a)	ND	(a)
Hexachlorocycopentadiene	ppm	0.05	ND	(a)	ND	(a)	ND	(a)
Carbofuran	ppm	0.04	ND	(a)	ND	(a)	ND	(a)
Alachlor	ppm	0.002	ND	(a)	ND	(a)	ND	(a)
Benzo(a)pyrene (PAH)	ppm	0.0002	ND	(a)	ND	(a)	ND	(a)
Pentachlorophenol	ppm	0.001	ND	(a)	ND	(a)	ND	(a)
Dibromochloropropane (DBCP)	ppm	0.0002	ND	(a)	ND	(a)	ND	(a)
Chlordane	ppm	0.002	ND	(a)	ND	(a)	ND	(a)

	UNIT	MCL	BEAVER RUN SYS Detected Level	BEAVER RUN SYS Range	INDIAN CREEK SYS Detected Level	INDIAN CREEK SYS Range	MCKEESPORT SYS Detected Level	MCKEESPORT SYS Range
VOLATILE ORGANIC CHEMICALS								
Benzene	ppm	0.005	ND	(a)	ND	(a)	ND	(a)
Carbon tetrachloride	ppm	0.005	ND	(a)	ND	(a)	ND	(a)
Dichloroethane (1,2-)	ppm	0.005	ND	(a)	ND	(a)	ND	(a)
Dichlorobenzene o-, m-	ppm	0.6	ND	(a)	ND	(a)	ND	(a)
Dichlorobenzene p-	ppm	0.075	ND	(a)	ND	(a)	ND	(a)
Dichloroethylene (1,1-)	ppm	0.007	ND	(a)	ND	(a)	ND	(a)
cis-1,2-dichloroethylene	ppm	0.07	ND	(a)	ND	(a)	ND	(a)
dichloroethylene trans-1,2-	ppm	0.1	ND	(a)	ND	(a)	ND	(a)
Dichloromethane	ppm	0.005	ND	(a)	ND	(a)	ND	(a)
Dichloropropane (1,2-)	ppm	0.005	ND	(a)	ND	(a)	ND	(a)
Ethylbenzene	ppm	0.7	ND	(a)	ND	(a)	ND	(a)
Monochlorobenzene	ppm	0.1	ND	(a)	ND	(a)	ND	(a)
Styrene	ppm	0.1	ND	(a)	ND	(a)	ND	(a)
tetrachloroethylene	ppm	0.005	ND	(a)	ND	(a)	ND	(a)
toluene	ppm	1.0	ND	(a)	ND	(a)	ND	(a)
Trichlorobenzene (1,2,4-)	ppm	0.07	ND	(a)	ND	(a)	ND	(a)
Trichloethane (1,1,1-)	ppm	0.2	ND	(a)	ND	(a)	ND	(a)
Trichloethane (1,1,2-)	ppm	0.005	ND	(a)	ND	(a)	ND	(a)
trichloroethylene	ppm	0.005	ND	(a)	ND	(a)	ND	(a)
vinyl chloride	ppm	0.002	ND	(a)	ND	(a)	ND	(a)
xylene	ppm	10	ND	(a)	ND	(a)	ND	(a)
Total Trihalomethanes	ppb	100	51.5	24.9-37.9	43.6	22.4-46.3	49.2	10.3-71.3
HAA 5	ppb	60	24.5	14.6-15.3	24.8	14.4-36.8	33.1	7.4-36.5
RADIOACTIVE								
Alpha Radon & Uranium	ug/l	15					1.3	(a)
Radium-226	pCi/L	20					0.1	(a)
Radium-228	pCi/L	20					0.0	(a)
Gross Beta particles	pCi/L	20			1.34	(a)	4	(a)
Strontium 90	pCi/L				0.4	(a)		
Beta/photon emitters	pCi/L	50	1.93	(a)				

APPENDIX A-2 – GEWPT Water Sample October 8, 2011

WATER ANALYSIS REPORT

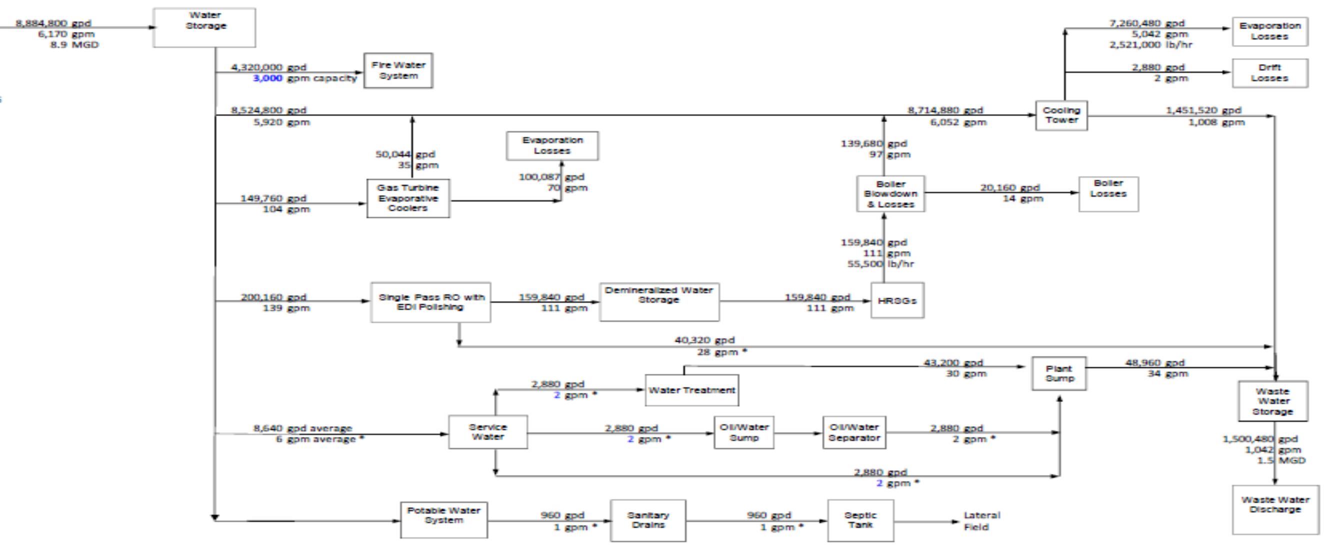
TENASKA WESTMORELAND
S.Huntington Twp, PA
US

Sampled: 08-OCT-2011
Reported: 21-OCT-2011
Field Rep: Soltysiak, David J.
91002166

	BLR MU	CT MU
	V1013063	V1013064
pH	7.1	7.1
Specific Conductance, at 25°C, µmhos	181	182
Alkalinity, "P" as $CaCO_3$, ppm	0	0
Alkalinity, "M" as $CaCO_3$, ppm	22	23
Sulfur, Total, as SO_4, ppm	29	42
Chloride, as Cl, ppm	20	19.9
Hardness, Total, as $CaCO_3$, ppm	54	78
Calcium Hardness, Total, as $CaCO_3$, ppm	39	55
Magnesium Hardness, Total, as $CaCO_3$, ppm	15.0	22
Copper, Total, as Cu, ppm	0.22	0.11
Iron, Total, as Fe, ppm	< 0.05	0.06
Sodium, as Na, ppm	12.8	17.7
Zinc, Total, as Zn, ppm		0.14
Manganese, Total, as Mn, ppm		< 0.01
Phosphate, Total, as PO_4, ppm	1	1.3
Phosphate, Ortho-, as PO_4, ppm	1.0	0.8
Silica, Total, as SiO_2, ppm	3.8	5.2

Appendix B – Water Balance 3 x 1 Configuration

Preliminary Water Balance - Westmoreland County, PA



Cycle Configuration	
Case	Case C-5
Option	Option_C
Lookup	Case-5
CT Configuration	3x100% CTG
Evaporative Cooler Status	Evap On
Duct Firing	Fired
Ambient Conditions	
Pressure, psia	14.180
Dry Bulb Temperature, °F	90.0
Relative Humidity, %	42.5%
Wet Bulb Temperature, °F	72.0
CIT, °F	73.5
Heat Load	
Condenser, MBtu/h	2702.2
Aux., MBtu/h	150.0
Total, MBtu/h	2,852
Cooling Tower	
Circulation Flow, gpm	228,252
Circulating Water Flow to Tower, lb/h	113,943,336
Recirculation Allowance, °F	2
Tower Makeup Water Temperature, °F	60
Tower Makeup Water Enthalpy, Btu/lb	28.1
Cycles of Concentration	6
Liquid to Gas Ratio	1.2
Drift Rate	0.0010%
Tower Makeup Flow	
Evaporation Rate, gpm	5,042
Blowdown, gpm	1,008
Drift, gpm	2
Total Makeup Flow, gpm	6,053
Miscellaneous	
Number of HRSG/CTG's Operating	3
Steam Production Per HRSG	
HP Steam, lb/h	862,541
IP Evaporator, lb/h	41,095
LP Evaporator, lb/h	20,895
Total Steam Production, lb/h	924,530
Total Steam Production, gpm	5,556
Boiler Blowdown, %	2%
Number of Plant Staff	24
Gallons/Day/Plant Staff Member	40
Evaporative Cooling Losses per CTG, gpm	23
Total Evaporative Cooling Losses, gpm	69.5
Evaporator Effectiveness,%	85%
CT Evaporative Coolers COC	3
RO Waste Flow, %	20%
Boiler Losses, %	13%

Preliminary Water Analysis - MAWC Indian Creek

	Typical	Range	
pH	7.6	7.6-7.8	
Conductivity	245	200-300	µmho
Alkalinity	16	10-45	ppm
Hardness	70	20-85	ppm
Turbidity	0.05	0.03-0.11	NTU
Ammonia (free)	0.04	0.02-0.10	ppm
Chloride as Cl	41	35-75	ppm
Chlorine (total) as Cl	2.4	1.6-2.5	ppm
Copper as Cu	0.02		ppm
Fluoride as F	0.24		ppm
Iron as Fe	0.01	0.0-0.1	ppm
Lead as Pb	3.8		ppm
Manganese as Mn	0.01	0.0-0.1	ppm
Nitrate as NO_3	0.89		ppm
Phosphate as PO_4	0.62	0.6-0.70	ppm
Strontium	0.4		pC/l
Gross Beta Radioactivity	1.34		pC/l

Water Storage:	Gallons	Hours
City Water	7,500,000	20.3
Fire Water	360,000	2.0
Demin Water	1,200,000	180.2
Waste Water	650,000	10.4

Ambient Conditions (DBT/RH/WBT): 90°F / 42.5% RH / 72.0°F
Compressor Inlet Temperature: 73.5°F
3x100% CTG
Evap On
Fired
*** Intermittant Flow - Average Flow Rates Shown**