Energy and Engineered Risk

175 Water Street, 29th Floor, New York, NY 10038

Gainesville Renewable Energy Center (GREC)
11201 NW 13th Street
Gainesville, FL 32653

Boiler Machinery
Loss Control Survey Report
February 11, 2014

SUMMARY INFORMATION

RFS No.	65909
Survey date	February 11, 2014
Previous Survey	This is a first Survey.
Engineer	L. Martos Luis.Martos@aig.com (305)586-3998
GME Writing Office	Hartford
Owner	Gainesville Renewable Energy Center (GREC), LLP.
Operator	North American Energy Services
Location Address	11201 NW 13th Street (AKA US 441) Gainesville, FL 32653 Adjacent to the Gainesville Regional Utilities' Water Treatment Plant
Plant Type	Wood burning boiler and steam turbine generator. Privately owned Independent Power Generator.
Site Contacts **Name, Title, Phone and Email**	Russell Abel, Plant Manager, (386) 315-8014 **Russell.Abel@grecbiomass.com** Karin Hyler, Plant Administrator, (386) 315-8017 **KHyler@amrenewables.com** Tommy Gardner, Maintenance Supervisor, (386) 315-8012 **Tommy.Gardner@grecbiomass.com** Steven Marsh, Operations Supervisor, (386) 315-8015 **Steven.Marsh@grecbiomass.com**

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1. SUMMARY OF INSPECTION ACTIVITY

This report documents the boiler and machinery loss and risk control survey conducted January 23, 2014 of the Gainesville Renewable Energy Center (GREC) in the city of Gainesville, Alachua County, Florida. During the survey, the Plant's generating and balance of plant equipment was operating.

As part of the inspection, interviews were held with the Plant personnel listed above. Other persons also assisted during the inspection; all the writer's questions were answered in a transparent and efficient manner. All personnel in the meetings or interviews were professional, experienced and knowledgeable, and the writer is grateful for their assistance and cooperation. A review of selected Maintenance and Operation Documents and a walk down of the Plant were also part of the Inspection.

2. LOCATION OVERVIEW

The Plant occupies approximately 130 acres in Alachua County, FL. Note the Plant site is new and does not show in Google Earth nor in Google Maps, the approximate coordinates are:
Latitude 29.767231, Longitude = -82.406031

The site consists of 130 acres of which approximately 60 acres contain the power plant and fuel pile. The Plant perimeter is enclosed with a 6 foot chain link fence.

The GREC Plant consists of:

- One wood-biomass burning boiler, with natural gas start up.
- One Steam Turbine – Generator set (STG).
- Fuel processing equipment.
- Ash Handling equipment.
- Turbine – Generator Balance of Plant (BOP) equipment.

Date of Commercial Operation: December 17, 2013. It is owned by GREC Partners, operated and maintained by North American Energy Services (NAES) Inc, based in Washington state. The General Contractor was Fagen Inc., and the engineering firm was Zachry Engineering.

The Plant's condensers are cooled by a closed cooling system using a five cell, forced draft cooling tower, four cells are expected to be needed for maximum summer load. Make cooling water is reclaimed water from the municipal sewage treatment facility, well water and waters discharged from the Plant's Reverse Osmosis facility. This is a zero discharge Power Plant.

Plant structures are designed to withstand hurricane force winds. Buildings and structures are concrete block, poured concrete and steel.

3. LOSS PREVENTION DISCUSSION

The Plant is new. It was surveyed while at operating at full power and no off normal conditions were observed. The wood pile smells like freshly processed wood. The housekeeping was good. Some of the items observed in maintenance is still part of the Plant's learning curve.

The Plant is expected to be dispatched as a base load station. It can generate from cold startup in 16 hours. It does not have black start capabilities and requires off site power to start. The maximum gross capacity is 102 MW and requires 12 to 14 MW to operate.

The Plant is operated and monitored from a central Control Room. There are two Distributed Control Systems (DCS), one for the STG the other for the boiler; the rest of Plant equipment is PLC controlled with inputs into one of the two DCSs.

Maintenance Overview.
The Plant maintenance is tracked by the MP2 Computerized Maintenance System program. There is close cooperation and adherence to OEM maintenance guidelines. Industry's Best Practices are known to Plant personnel and are applied to the maintenance programs.

There is a major outage scheduled for October 2014, the outage is part of the Warranty Program and will include all major Plant components.

Specific outage requirements for the STG are presently set for 6 years major outages 2 to three year minor outages, but this will change as operating experience is gained. The boiler will be inspected and NDE-NDT yearly.

The boiler tubes thicknesses were "mapped" or base lined prior to commercial operation.

Plant Maintenance staff consists of a manager, three I&C-Electrical techs, four Mechanical techs, one planner and one warehouse tech.

General Comments
The Plant is licensed to use:

- Locally available wood products from sources certified to meet forest sustainability standards. These include green sawdust and tree bark from tree logs processing mills,
- Urban Biomass: Primarily from private urban based gardens
- Other clean wood waste such as old pallets that have been turn to wood chips.

Plant personnel stated they will not use wood refuse from construction site nor other woods that may be contaminated. Most of the wood received is in chips ready to be used. The boiler tube materials are designed for the type of fuel expected to be burned.

Most of the fuel originates within a 75 mile radius from the Plant. There is a contract with Bio Resource Management, Inc. (BRM) to manage fuel procurement and ensure forest sustainability standards are met. BRM is a locally based consulting firm that specializes in biomass supply services BMR Inc.

The Power Purchase Agreement (PPA) is between GREC and Gainesville Regional Utilities (GRU). The PPA is for a nominal 100 MW net biomass fueled power plant and has a term of 30 years. The facility is connected to GRU's 138 kV transmission system. Metering equipment is installed in the GREC substation and is owned by GRU.

The facility is dispatched by GRU's operations using an Automatic Generation Control (AGC), the dispatcher controls load remotely by opening or closing the STG steam admissions valves. The maximum load change rate allowed by the governor is 3 MW per minute regardless of the urgency. The minimum dispatch load is 70 MW and the maximum is the design load of 102.5 MW. The PPA allows a maximum of 16 GRU dispatched shutdowns per year, and requires an unavailability factor of less than 5% for the summer period and 12.5% for the rest of the year.

The completed requirements of the PPA, including financial arrangements, were not discussed.

It has been estimated the available renewable fuel within 75 miles of the Plant can support 500 MW of electric power generation helping minimize the impact other similar power plant .

All the equipment observed appeared properly sized and well constructed. The level of details on the structures and the equipment is among the best for a Plant this type, per example, the Plant transformers have overvoltage counters.

There is redundancy in most Plant Auxiliary and Fuel Processing equipment. Per example there are three truck un-loaders (tippers), two hoggers; in boiler auxiliaries there are two boiler feed pumps. Critical process or equipment considered a choke point or bottleneck, has been identified and the method of restoring it to service has been addressed and spare parts are at hand. An example is the belt of the fuel conveyor from the fuel pile to the power plant, where there is a spare belt.

No significant issues from the Plant construction and start up were reported carried over into the Plant operation.

The GSU DGA was reviewed and no Risk aggravating conditions were observed. Start up tests and other documents were not reviewed.

The Plant's Insulation is Asbestos free.

Battery capacity and safety relief valves tests will be addressed in future surveys. There is a gas powered, 750 kw, emergency diesel generator for emergency power and light.

Manpower is somewhat larger than this surveyor expected from a power plant this size, and may decrease in future years. Plant personnel is experienced.

There are maintenance agreements ranging from one to five years with all major OEMs.

3.1 CONCLUSIONS

The GREC is a new power plant designed and built to good engineering and industry practices. There were no risk aggravating factors. It was new when surveyed and under warranty. The operators, supervisors and managers are experienced and knowledgeable.

4. RECOMMENDATIONS

4.1 NEW RECOMMENDATIONS

B20140201	**Consider installation of boiler monitoring cameras** Permanently installed boiler monitoring cameras that allow operators to observe the boiler furnace while in operation are very common in this type of plants through out the industry. It is recommended the Plant reassess the benefits such cameras will provide and if found acceptable install them.
Update	

B20140202	**Lock closed the attemperators bypass valves** It is recommended the Plant chain and lock closed the attemperators bypass valves, this will help minimize the possible water carry over into the STG. It is also a good industry practice.
Update	

B20140203	**Transformer Tests Verification** During the survey it could not be determined if the transformers had been tested for Corrosive Sulfur. It is recommended the Plant obtain the results of those tests from the start up documents and verify the transformers are free of corrosive sulfur. If the tests cannot be located it is highly recommended the transformers be tested for corrosive sulfur at the earliest possible time.
Update	

B20140104	**Replace ABC Fire Extinguishers with CO2 Fire Extinguishers in the Control Room.** It is recommended the Plant replace all ABC extinguishers servicing Motor Control Centers or electrical rooms with CO2 extinguishers. An ABC extinguisher causes significant collateral damage often exceeding the damage caused by the fire.
Update	

B20140105	**Verify there is a contingency plan to replace the Plant Transformers in short notice.** It is recommended the Plant have in place a contingency plan to facilitate replacement of any of the Plant's transformers in short notice.
Update	

B20140106	**Analyze need for a warehouse to store spare parts.** A number of spare parts were observed on a concrete slab, open to the sky and to weather condition. It is recommended the Plant analyze the suitability of this type of arrangements and the effects it will have on the spare parts' availability and reliability when they are installed in the Plant.
Update	

4.2 PRIOR RECOMMENDATIONS

This is the first insurance survey of this Plant.

5. HISTORY & OWNERSHIP

The GREC Partnership developed and operate this Plant.

6. MAJOR EQUIPMENT

6.1 BOILER

The boiler was manufactured by METSO. The rated steam send out is 930,000 lbs/hr, at 1,650 psig, and 1,000 F, using approximately 1.2 to 1.4 tons of wood fuel per electric MW. Fuel heat output could vary significantly. The boiler is a model Hybex bubbling fluidized bed (BFB).
The MAWP is 1945 psig, the manufacturer's serial number: 103; National Board Certificate: R-8338.

The combustion chamber bottom contains approximately a 5 feet deep (approx 300 tons) bed of sand through which the combustion air is bubbled up. Natural gas is the startup fuel. The boiler is installed outdoors. The boiler exhaust is equipped with a selective catalyst reduction (SCR) system using 20% aqueous ammonia. There is a bag house sized for twice the actual flue flow. Sodium bicarbonate and pulverized activated coal may be injected as needed to control acidity and mercury levels of the flue gas. The boiler air permit is very strict, flue gas quality is monitored 24/7 by a Continuous Emissions Monitoring System, with monthly reports to the regulating authority.

A portion of the boiler's sand is lost with bottom ash removal and is continuously replenished, most of the lost sand is recycled.

The fuel handling equipment has magnets in several locations to remove any iron, magnetic objects, still a number of iron objects such as nails , wires, etc, make it through the boiler and are removed with the bottom ash. All ash is land filled.

Boiler tube metallurgy is compatible with the service, most critical boiler tubes are high chrome steels chemistry

BOILER							
Unit	Outage		Safety Valve Testing		Seamed High Energy Piping		
	Last	Freq	Last	Freq	Location	Last NDE	Freq
	*	Yearly	*	TBD	**		

*New Boiler TBD = To be determined. **No seamed piping was reported.

FEEDWATER					
Unit	Dearators		FAC Inspections		
	Last NDE	Freq	Location	Last	Freq
					TBD

Comments: New Plant. No aggravating risk were observed. The dearator tank is oversized and was reported to hold approximately 12 hours of boiler water.

Feedwater
Hotwell condensate is monitored real time. There are on line sensors monitoring hotwell conductivity. Conductivity readings are checked manually every shift. There is a dedicated water chemist on shift.

A boiler water production facility provides boiler feedwater make up, the facility uses RO and electric ionic-cationic polishers to treat the boiler water. Make up water is stored in above ground steel tanks.

There are two, 100% capacity each, electric driven feedwater pumps.

Fuel Supply to Boilers
The fuel storage is divided in two piles, one is semi automated using fuel that is boiler ready, this pile uses the truck tippers and the truck's contents is directed to the automatic stacker pile that also contains an automatic reclaimer that is used to send fuel to the boiler whenever the amount of boiler ready . There is the manual fuel pile where other Fuel can be processed from the pile two The Fuel supply

6.2 TURBINE - GENERATOR

Steam Turbines-Generator
Operations and Maintenance Data will be reviewed in future visits.

The steam turbine is a Siemens condensing turbine coupled to a with a Brush™ generator rated at 116.1 MW, 13.8 kV. The turbine does not have reheat steam.

6.2.2 Maintenance Overview
The STG will undergo a thorough warranty inspection in October 2014. To date there are no known OEM technical bulletins or advisories on the STG.

STEAM TURBINE										
Unit	Overhaul		Valve Inspection		Borescope		Testing Frequency			
	Last	Freq	Last	Freq	Last	Freq	Overspeed	Valves	NRV	Aux oil
		*					Annual			Weekly

*New Plant, the inspection frequencies are being evaluated, presently expected to be 6 years between major inspections, overhauls. Steam Valves and NRV's are exercised weekly. The STG complies with the ASME water induction prevention guidelines.

GENERATORS										
Unit	Disassembled		Ring NDE		Rewind		Testing Frequency			
	Last	Freq	Last	Freq	Stator	Field	Electrical	PD	Flux	Liquid Detectors
		*								

*New Plant, the inspection frequencies are being evaluated, presently expected to be 6 years between major inspections, overhauls.

6.3 TRANSFORMERS & ELECTRICAL SYSTEMS

GENERATOR STEP UP TRANSFORMERS (GSU)

All Transformers are three phase, shell type, oil insulated, ONAF cooled, manually operated taps.

	Voltage Ratio, kV	Mfg	Year	Serial	Rating, MVA
GSU	13.8/138	*	2012	N4669101	104/139/173

*Pennsylvania Transformers. The GSU has a Calisto™ continuous H_2, CO and moisture detector.

6.4 CONTROL ROOMS & CONTROL SYSTEMS

The Plant employs 41 persons. There are 30 persons assigned to four shift groups following a modified DuPont schedule.

Operators in the Control Room monitor the whole Plant. Although the operator can control, the operator cannot override set equipment safeguards; the safeguards can only be changed by the DCS programmer, with the approval of Senior Plant management. The number of monitors and screens available to the operators is adequate allowing monitoring of equipment simultaneously. A number of less critical parameters are manually logged by the field operators. Operators use paper check for their logs.

Shift staffing is adequate. Communications among personnel on shift is via two way radio or cell phones. All principal and most BOP equipment is monitored by the DCS.
There is a management of change procedure consisting of retraining of all personnel on all major changes in Control Systems as well as in equipment are covered in the procedure. DCS logic changes need Management approval.

6.5 FUEL STORAGE & HANDLING

There is one outdoors storage pile that is divided in two areas. Fuel is received by trucks, and unloaded via truck tippers or dumpers. The fuel is carried by conveyor belt to the top of the stacker from there, depending on the fuel, it is directed directly to the pile or, is processed through the hoggers which are hammer mills that cut oversized fuel into smaller pieces or chips. There are screens that allow only properly sized fuel to be placed on the pile. From the pile it is recovered by an automatic re-claimer and sent to two day silos or bins prior to being used in the boiler. The fuel boiler feed equipment from the day bins to the boiler is metered and controlled. The day bins hold approximately 12 hours of fuel.

In addition to the automatic re-claimer, fuel can be fed from the pile to the conveyor and into the Plant by front loaders. It should be noted the front loaders are cleaned (pressure washed) every four hours in a dedicated wash station.

The Plant receives on average 120 trucks per day during daylight hours only, usually Monday to Saturday. Each truck carries approximately 22 -24 tons. Fuel is used within 30 days of being received in order to minimize potential for spontaneous fires. The PPA requires 15 days of fuel be kept on the pile. Fuel moisture content is on average 39%.

Natural gas is used for boiler start up and for stabilizing combustion. Natural gas is received into the Plant by a GRU owned pipeline. The boiler could produce approximately 20 MW using only natural gas. No risk aggravating factors were observed in the natural gas fuel trains or burners.

6.6 ANCILLARY EQUIPMENT & SYSTEMS – BALANCE OF PLANT

The inspection of the facility included walk down all of the major Plant equipment. All equipment observed was operating as expected.

Condensing - Cooling Water

Cooling water is recycled water, received via a pipeline from the municipal sewage treatment plant. The cooling tower is of carbon reinforced fiberglass construction, forced draft, with five cells. No risk aggravating factors were observed.

Hydrogen

Hydrogen is not used in the Plant.

Ammonia
There is one approximately 10,000 gallons tank that stores aqueous ammonia used for NOx reduction. No risk aggravating factors were observed.

Service Water
Service water to this facility is supplied by wells.

Process Water
The Plant produces its own boiler feed water using an house facility that uses RO and electric ionic removal equipment. Demineralized water is stored in a steel tank.

Waste & Effluent Handling
No risk aggravating factors were observed in the waste and effluent handling facility. Ashes are land filled. This is a zero discharge Plant.

Waste water (primarily from ash handling) is evaporated using a fallen film evaporator that uses a 700 HP compressor to pressurize waste steam. The resultant solids are compressed and land filled.

Compressed Air
In house air compressors with adequate supply for both service water and instrument air. Service air was reported to be dried and filtered.

Power Piping
No issues with power piping was reported.

Other Equipment
There is one diesel engine driven electric generator (standby service) to provide emergency power and light. Rated 750 kw, stand by duty. Switching and synchronizing is automatic.

7. MANAGEMENT PROGRAMS

7.1 GENERAL ORGANIZATION
Plant staffing and organization is in line with the IPP industry.

7.2 ORGANIZATION, QUALIFICATIONS & EXPERIENCE
The Plant is new. When surveyed it was well organized with qualified operating and maintenance personnel. Plant personnel were trained by the OEM of the various plant equipment. Most personnel were reported to have come from similar power plants, all key Plant personnel have extensive power plant experience.

Operator Training
After initial classroom and on-the-job training, additional training on as needed basis.

Operational Procedures & Routines
Operation procedures were reported to cover most Plant operations and maintenance work. There is a library with the equipment information.

Work Permit
Work permits are generated for maintenance tasks. Hot work permits are used where required. There is a Lock Out/Tag Out procedure, Confined Space procedure.

7.3 MAINTENANCE, INSPECTION & TESTING

Organization, Qualifications & Experience
The Plant Maintenance personnel is experienced. Maintenance personnel is qualified by education, training and experience.

Planning
The MP2 CMMS is used at the Plant and widely used throughout the industry. It meets the requirements for issuing Work Orders, archiving, record keeping and spare parts management, facilitating the planning tasks of Plant personnel.

Records & Analysis
The Plant is new, record keeping will be analyzed in future surveys.

Boilers and Steam Generators
The boiler is expected to undergo yearly inspections and NDE NDT.

Prime Movers and Generators
All rotating equipment maintenance protocols follow industry standards and OEM recommendations.

Transformers & Electrical Systems
Transformer DGA results were reviewed no aggravating factors were observed.

Auxiliary Equipment & Systems - Balance of Plant
All other equipment in the plant was observed in good operating condition, well maintained.

Spare Parts & Contingencies
The Plant' in house spare parts include many critical spares, including one full length conveyor belt. The total value of the spares in the Plant was reported at 2.4 million USD.

There are no spare transformers, however the GSU and the Plant Service transformers can be readily replaced from available stock available from several vendors.

Workshop & Repair Facilities

Major repairs will be performed by outside concerns. Plant staff is adequate to handle Preventative maintenance.

Contractors & Contractor Screening

NEAS has a procurement and screening process, which evaluates a contractor's capacity to complete a task on time, safely and efficiently. Contractors are chosen by the Plant using NAES guidelines.

7.4 RISK & SAFETY MANAGEMENT

Organization & Safety Programs

NEAS has safety programs that comply with all regulating agencies requirements and industry best practices.

Safety Awareness & Auditing

The Plant is new and audit frequencies are being established. All personnel are responsible for safety.

Management of Change

There is a formal procedure for both engineering and operational changes. All changes are reviewed by appropriate personnel and signed off by the plant manager.

Environmental Issues and Operational Permits

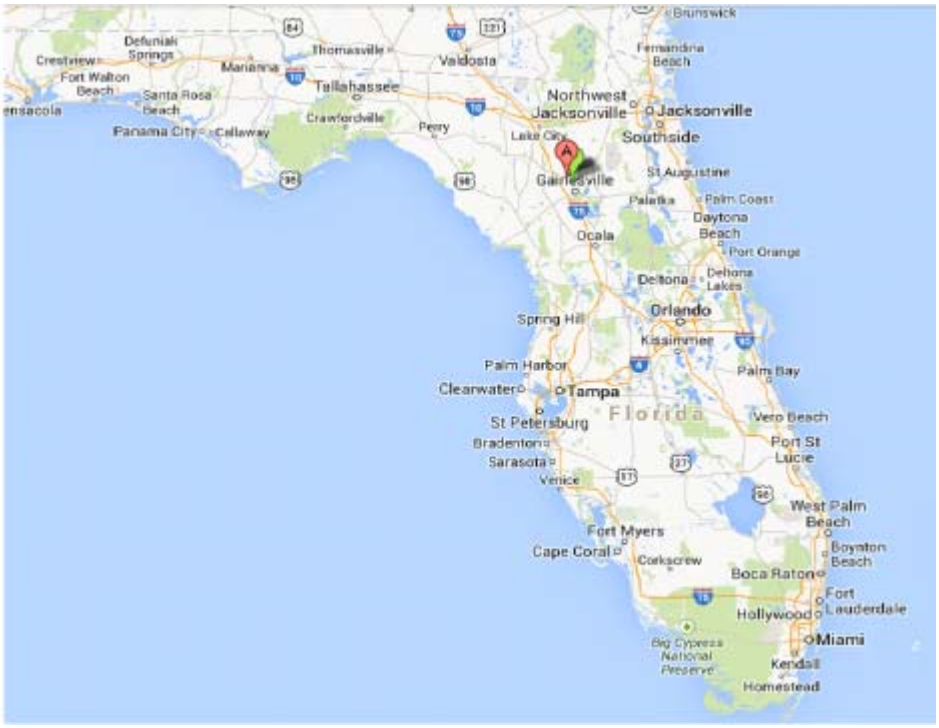
There were no environmental or operational issues reported by the facility during this inspection

Housekeeping

Good Housekeeping throughout the Site.

8. APPENDIX

General Map, red marker indicates Plant location.



Aerial Pictures

The site is too new and photographs are not available in Google Maps nor Google Earth.

9. LOSS HISTORY

No losses were reported.

10. LOSS ESTIMATES

10.1 BOILER AND MACHINERY LOSS ESTIMATES

NO DEDUCTIBLES ARE APPLIED.

Boiler and Machinery Events (B&M)				
Values in Millions USD		**NLE**	**PML**	**EML**
CFB - Sub-critical Circulating Fluidised Bed Boiler 116MW	Event description	Few tube ruptures caused by erosion, soot impingement, or overheating	A significant over heat event requires major tube replacement	Massive tube failure results in steam explosion damage to peripheral plant
	PD	0.258	10.8	71.9
	BI period	6 days	180 days	30 months
	BI Value	1.63	48.794	244
	Total Loss	1.888	59.594	**315.9**
Steam Turbine + Generator 116MW	Event description	Minor damage to last stage of blades, or stator requires repair in-situ.	Major blade, rotor failure caused by overspeed or loss of lube oil.	Catastrophic overspeed major damage to STG and peripheral equip.
	PD	0.68 (ST=0.55; Gen=0.68)	8.6 (ST=8.6; Gen=3.8)	29.2 (ST=20; Gen=9.2)
	BI period	45 days	8 months	14 months
	BI Value	12.2	65.06	113.85
	Total Loss	**12.88**	73.66	142.4
Transformer (Core Form), 15-300kV (normal) AC/AC 3 phase) 136MVA	Event description	Damaged bushing, broken leads, damaged tap changer	Extensive electrical damage to the coils requiring a complete rewind	Catastrophic damage to transformer, includes core, tank.
	PD	0.085	2.7	4.4
	BI period	30 days	9 months	11 months
	BI Value	8.13	73.191	89.06
	Total Loss	8.195	**75.891**	93.46

Exchange Rate Used: 1 USD= 1 USD. **BI values based on projected figures as the Plant is new, 18 months projection**. BI days per ULE tool, Feb 20 2014. Power station cap = 116 MW = max installed equipment capacity. Costs not indexed forward.

Boiler and Machinery Events (B&M)				
Values in Millions USD		**NLE**	**PML**	**EML**
Fuel Handling Equipment	Event description	Loss of motor- gear box fuel conveyor.	Failure of conveyor fuel belt.	EML = PML
	PD	0.75	0.9	0.9
	BI period	12 hours	4 days	4 days
	BI Value	0.135	0.95	0.95
	Total Loss	.885	1.85	1.85

Fuel Handling Equipment estimated using data from the Business Interruption - Report of Values for GREC. NO DEDUCTIBLES ARE APPLIED.

10.2 INSURED VALUES

TOTAL INSURABLE VALUES			
PD		**TIME ELEMENT**	
Buildings	**$8,998,603**	**BI**	**$92,964,000**
Contents	**$280,397,633**	**EE**	**0**
Other*	**$4,839,000**	**Rents**	
Stock			
Tanks			
Other			
TOTAL	**$294,235,236**	**TOTAL**	**$92,964,000**
Total Insured Value	**$387,199,236**		

* Personal Property