150209E

AEGIS

POWER GENERATION MACHINERY RISK ASSESSMENT

Prepared for:

City of Gainesville, Gainesville Regional Utilities
J. R. Kelly Generating Station
515 S. E. 5th Avenue
Gainesville, FL 32614

July 28, 2014

Attention:

Mr. Scott Whitlow
Production Manager

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Scope

The purpose of this Machinery Risk Assessment is to evaluate the critical plant equipment located at this facility with regard to operations and maintenance. Evaluations are risk-based with emphasis on the human element aspects of the loss control programs.

It is understood that each facility has its own specific conditions that characterize its design and operating procedures. Generally, national and industry recognized standards are the basis for the evaluation and suggestions. This is not to preclude a consultant's qualified judgment when evaluating the adequacy of existing programs.

Conferred With

Mrs. Melissa Jones	*GRU Director of Production*
Mr. Joe Shaw	*Utility Project Leader*
Mr. Lonnie Little	*Manager of Outage Planning & Major Maintenance Group*
Mr. Dino De Leo	*GRU Director of Production Assurance Support*
Mr. Dave Hollandsworth	*Principle Engineer (Gas and Steam Turbines)*
Mr. Eiton Lefkowitz	*Marsh USA Inc., VP Property Risk Consultant*
Mr. Scott Whitlow	*Production Manager Kelly Plant*
Mr. John Whalen	*Risk Engineer/Liberty Insurance Underwriters*

Executive Summary

A Machinery Risk Assessment was performed at the J.R. Kelly Generating Station for the City of Gainesville, FL on July 28, 2014.

A tour of the premises was conducted along with a review of hazards present, protective systems, building construction details, management programs and other related aspects of the facility. Plant management was interviewed to determine operational and maintenance practices at the location.

Site personnel were observed to be knowledgeable and in command of equipment in their charge. Equipment and systems were found in good condition; housekeeping at this generating plant was observed to be good from a machinery standpoint.

A management of change review process is in place. The process ensures operating procedures; maintenance program and P&IDs are kept current following changes in plant equipment or systems.

Overall, equipment conditions were found to meet industry standards and are acceptable for machinery breakdown insurance purposes.

The primary focus of this survey was to assess various aspects of the facility's risk reduction and loss recovery programs for mechanical and electrical systems and components that are vital to continued operation of the facility. Emphasis was placed on equipment and system reliability, current maintenance practices, equipment control and protection schemes, and contingency action plans to recover from vital equipment/system failure.

A tour of the premises was conducted, including a review of observed risks, protective systems, maintenance practices and procedures, management programs. Plant personnel were interviewed to determine operating and maintenance practices at the location. The cooperation by plant personnel was greatly appreciated and helpful in developing this report.

Major Equipment – Overall rated *Good*. The overall operational and maintenance conditions for the major equipment at the Kelly Generating Station were found to meet or exceed industry standards for a station of this size. The CT 1, 2, and 3 and Unit 7 were retired in October 2013.

Major Systems – Overall rated *Good*. Balance of Plant systems and equipment are well maintained and testing exceeds industry standards in many areas. Several programs that were reviewed exceeded industry standards and "best practices".

Operations – Overall rated *Good*. Factors that have a direct impact on incident likelihood at a generation station relate to operating environment, operating conditions, age and history, maintenance and the employment of experienced well-trained operators. Plant operating environment was found to be good from a boiler machinery standpoint. Station management is aware of problems associated with aging equipment.

Maintenance – Overall rated *Good*. Housekeeping observed throughout the facility, from a boiler and machinery standpoint, was very good for this type of risk.

The factors that drive consequences or incident severity relate to contingency planning and safety devices. This station maintains a fair spare parts inventory. A mixture of formal and informal contingency plans exists to mitigate the effects of damaged key equipment. Station management also has a plan to address capital and maintenance projects and expenditures. Outage and major equipment inspection frequencies meet or exceed industry standards. Station equipment is also protected by appropriately set and adequately-sized safety devices to ensure reliable operation from a machinery standpoint.

Risk Reduction Suggestions

No new risk reduction suggestions were made as a result of this risk assessment.

The following risk reduction suggestion remains outstanding:

KGS-B2012-01 **Steam Turbine Rotor Boresonic Inspection** - Perform boresonic inspection of bored rotors.

Assessment Summary

Overall, equipment conditions were found to be *Good* for machinery insurance purposes. Please refer to the **Risk Characteristics Rating** section of this report for details.

An exit interview was conducted with Mrs. Melissa Jones, Mr. Joe Shaw, Mr. Dino De Leo, and Mr. Scott Whitlow, where this report and any Risk Reduction Suggestions were reviewed.

Risk Reduction Suggestions

Risk Reduction Suggestions represent opportunities for continued improvement. The suggestions are risk-based and customized to this facility. The suggestions are made using national and industry recognized standards and recommended practices.

Probability Based on historic information provided by recognized industry organizations and AEGIS loss experience

High	The probability of a loss is greater than average.
Medium	The probability of a loss is average.
Low	The probability of a loss is less than average.

Severity Based on insurable values, deductibles and AEGIS loss experience

Severe	The incident may result in significant financial impact to the facility.
Moderate	The incident may result in moderate financial impact to the facility.
Low	The incident may result in low to moderate financial impact to the facility.

Priority Matrix

Probability \ *Severity*	L	M	S
H	P2	P1	P1
M	P3	P2	P1
L	P3	P3	P2

Open Risk Reduction Suggestion

KGS-B2012-01 **Steam Turbine** **O&M Expenditure**

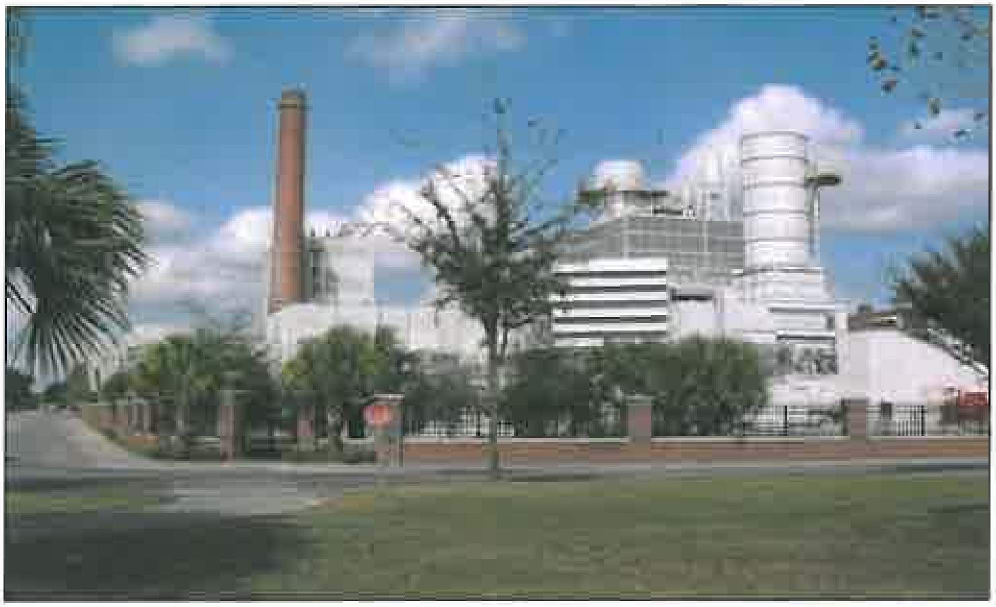
Priority 2 **Borescopic Inspection of Turbine Rotors (bored)** - Conduct boresonic inspection of bored turbine rotors.

References: Industry Best Practices

AEGIS Comments: It is important to assess the condition of rotors of this vintage. Periodic examination and trending of results should be conducted.

Status: Open **Member Response:** The plant will consider testing of the bored rotors in the future.

General Plant Information



J. R. Kelly Generating Station

Plant Description

The J. R. Kelly Generating Station is located within the city limits of Gainesville, FL. It consists of a 115 MW combined cycle unit that began operation during the spring of 2001 which includes the original 40 MW Unit 8 steam turbine generator that began operation during 1965 and a new 75 MW General Electric MS7001EA gas turbine generating unit (CT 4) that exhausts to a heat recovery steam generator (HRSG). Unit CT-4 has a damper between the gas turbine and the HRSG which allows it to operate simple cycle.

Depending on the unit, the generators produce power at 12,500 volts and 13,800 volts. Unit 8 steam turbine generator feeds directly to the adjacent J.R. Kelly sub-station at 12,500 volts where it is distributed to the in-city grid. There are two 56 MVA step-up transformers (T-31, T-32) that step-up power to 138,000 volts before it is provided to the Florida transmission grid. The 13,800 volt output of the gas turbine generator (CT 4) is stepped-up to 138,000 volts by a 120 MVA transformer (T-33) before being supplied directly to the transmission grid.

Kelly Units 1, 2 and 3 have been demolished and Units 4, 5 6, and 7 have been retired.

Unit	Year	Boiler Manufacturer	Turbine Manufacturer	Generator Manufacturer	MW	Service
8/CT	2001	ATS	Westinghouse	Westinghouse	115	Cycle

Operating Status

A walkdown inspection was performed on the HRSG unit. The control rooms were inspected as well as the main turbine floor. Housekeeping was good at this station. No major lights or alarms were showing on annunciator panels or computer screens.

New Risk Characteristics Ratings

Area Rated	Rating	Risk Reduction Suggestions/Comments
Major Equipment		
Boilers	G	
Steam Turbines	F	KGS-B2012-01
Generators	G	
Transformers	G	
Major Systems		
High Energy Piping	G	
Feedwater and Condensate	G	
Operations		
Control Room Review	G	
Operating Procedures and Training	G	
Operational Testing	G	
Maintenance		
Maintenance Management and Training	G	
Predictive Maintenance (PdM)	G	
Pressure Vessels	G	
Auxiliary Safety Valve Maintenance	G	
Electrical Maintenance	G	
Emergency Battery	G	

(blue)	**Excellent**	The facility has taken measures that exceed industry standards and best practices. Loss potential is considered significantly reduced.
(green)	**Good**	The facility has taken measures that are consistent with industry standards and best practices. Loss potential is considered to be average.
(yellow)	**Fair**	The facility has taken some measures that approach industry standards and best practices; however, deficiencies exist. Loss potential is considered somewhat increased.
(red)	**Poor**	The facility has major deficiencies and does not approach industry standards and best practices. Loss potential is considered to be significantly increased.

Major Equipment

Boilers

Boiler #	MFG	Boiler Type	Design Rating		
			LB/HR	Main Steam PSIG/°F	Primary/Secondary Fuel
HRSG	ATS	Pressurized	308,000	1,120/950	Waste Heat

Boiler Draft

The HRSG has pressure of the exhaust gases from the CT. The CEMS was upgraded for the HRSG and bypass exhaust stacks by replacement of the existing analyzers and equipment.

Boiler Protection

CT-4 HRSG trips consist of Bypass Damper Trips, DCS Manual, HP drum HI/HI level 50 inches, LP drum LO/LO level 20 inches, HP superheater steam HI/HI temp, 985F, HPHT Economizer 2 outlet temp HI/HI, 575F, LP superheater outlet temp HI/HI, 325F, HP drum pressure HI/HI, 1075 psig, LP drum pressure HI/HI, 90 psig., LP steam drum pressure trips LP crossover valves (steam admission LP stop valves), HP steam drum level HI/HI, +6 inches, LP steam drum level HI/HI, +6 inches.

Drum Level Indication

The steam drum level high and low trips are enabled. See protection for boiler information.

The HRSG has Hydra-Step digital level indicators for the HP and LP drums as well as gauge glasses for local level indication for each drum.

Boiler Safety Valves

Plant steam boiler safety relief valves are tested annually by National Board "VR" certified repair concerns. The HRSG boiler valves were inspected in 2014 during the outage.

Summary of Major Boiler Modifications and Design Changes

There have been no modifications or design changes.

Summary of Major Boiler Maintenance

The last major HRSG inspection was performed by HRST, Inc. in March 2014. CC-1 had 37,612 fired hours and 2,329 starts. All accessible areas were inspected. Some weld repairs were made to boiler casing. Potential hot spots were uncovered and packed with insulation. The HP superheater lower header baffle in the inlet duct had many failed welds across the width of the unit. New angle pieces were installed in the lower crawl space that secure the baffle plate to the liner.

Some lower header baffles were unrestrained. Repaired the failed floor mounts and install restraint for the upper portion of the baffles accounting for thermal growth. There are several welds along the length of the lower header baffle that have failed and allow the baffle to flutter or shift during operation. The baffles were repositioned and weld repaired.

Mechanical wear was found on several tubes near the lower headers from the interference with the lower header gas baffle. This wear is minor at this time. They should be monitored when access to the area is available.

Steam Turbine

Unit	Year	Manufacturer	MW	RPM	Pressure/Temperature
8	1978	Westinghouse	44	3600	1250/950°F

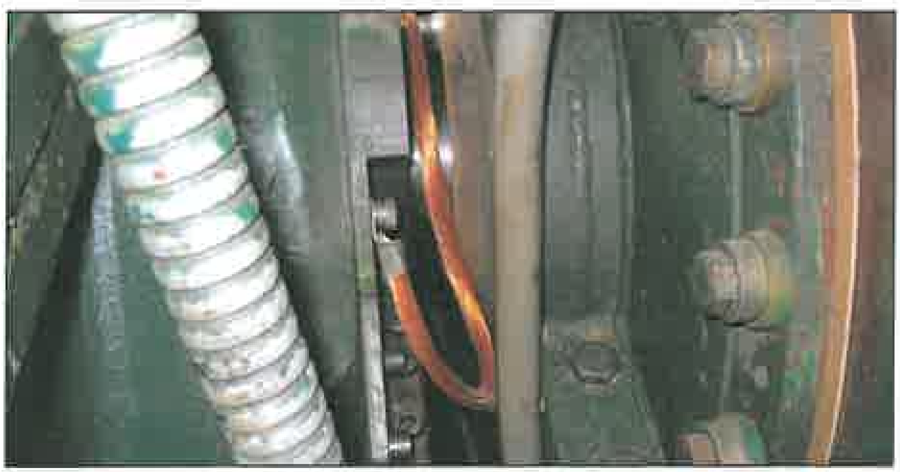
Unit 8 nameplate information: Frame: HT-486Model #A5, HP Serial #13-A-2832-1, LP Serial #13-A-2833-1, MOC (Mechanical Oil Control System) 6 Governor Valves, 2 Throttle Valves

Steam Turbine Protection

#8 Steam: Turbine inputs to Trip coil include Trip pushbuttons, ETSI trip (8ST-TURB143ZYS), turbine overspeed (electrical) at 3888 rpm, throttle valve (east) servo trip, throttle valve (west) servo trip, active trip input to coil, speed fail, from speed sensor, automatic turbine sequencing trip, trip coil solenoid monitor, DCS Manual Trip, HP Drum HI/HI level +6 inches, and any steam turbine bearing temp high 235°F.

Other Unit 8 Turbine trips are, Overspeed (mechanical and electrical) 3960 rpm, Manual pushbuttons at the pedestal and switchboard, Low vacuum at 16.5 inches, Low bearing oil pressure at 7 psig, and Thrust bearing 80 psi.

Shaft Grounding Device



Unit 8 Generator Shaft Ground Device

The LP turbine has water seals but as a precaution from stray voltages and currents the plant has installed shaft grounding devices.

Water Induction Protection

Unit 8 had three heaters that receive extraction steam from the turbines. During the retrofit to combined cycle operation, these heaters were physically disconnected from the extraction steam and feedwater system and are no longer in service and do not require periodic testing. CC 1 also has #5 neck heater that is used only when firing with fuel oil. Firing with fuel would occur in the result of an emergency (hurricane).

Summary of Major Turbine Modifications and Design Changes

There have been no major turbine design changes.

Summary of Major Steam Turbine Maintenance

There is no record of the last turbine boresonic inspection of Unit 8. See Risk Reduction Suggestion KGS-B2012-01.

A major outage on #8 steam turbine was completed in 2013. The work included an overhaul of the HP and LP turbine. The #8 S boiler feedwater pump motor was reconditioned.

Unit 8 spring 2010 outage work on the turbine consisted of the following:

- Replaced both thrust nozzles after inspections found them worn out and plugged. The thrust trip for Unit 8 was tested during the start up.
- New differential expansion probes and cables were replaced with Bently Nevada 3500 system.
- The turbine valves for Unit 8 are stroke-tested prior to starting the unit for operation. The steam chest was inspected and the governor valves were disassembled and inspected in 2/2011.

Unit 8 spring 2013 outage work on the turbine consisted of the following:

The #8 turbine overhaul:

1. Cracks in the HP steam chest were found during the inspection. These were weld repaired. The repairs were Post Weld Heat Treated and x-rayed with satisfactory results,
2. The nozzle blocks were inspected and repairs were completed.
3. Bearings 1 and 2 were sent out to be re-poured and bored to proper clearances with the journals.
4. All 4 lead LP hood pressure relief diaphragms were replaced.
5. Radial seal strips in the HP #1 blade ring and HP rotor body for rows #1 through #8 were damaged. All were replaced.
6. Problems were corrected with the HP and LP turbine rotor axial travel (float). These were both corrected.
7. Throttle valve components, in the past, were changed out with Inconel stems and the pilot valve bodies' stem bushings were made of stellite. Some stem to bushing clearances were reestablished to lessen the likelihood of valves sticking.
8. The #1 governor valve was lapped to provide good seating. All other valves had good seating contact.
9. The old Kingsburg thrust bearing was sent to Kingsburg and modified to a new design, which allows for less difficult assembly.

Combustion Turbine

Unit	Year	Manu.	MW	Model/ Serial #	Total Fired Hours	Manual Starts	Total Starts
JRKCT-4	2001	GE	74	MS7001EA/ 297392		NAV	

Combustion Turbine Protection

CT4 Combustion Turbine Trips include a standard Mark V trip list, a bypass damper over-ride close command, 80 seconds and damper not fully closed, and DCS Manual. CT 4 has an M-3425A Generator Protection System. The DCS for CT 4 has been upgraded.

The emergency lube oil pumps are tested for the CT's as part of the start-up logic. In addition to this, the plant tests the motors and pumps during the annual outage via the pressure drop method.

Summary of Major Combustion Turbine Modifications and Design Changes

None

Summary of OEM Bulletin Compliance

The gas turbines are inspected per OEM test and inspection guidelines. The plant will have on site a Technical Engineer for guidance during Major and Hot Gas Inspections. The Gas Turbine CT-4 inspections are based on the OEM's formula that factors in operating hours, fired starts, and fired trips.

Summary of Major Combustion Turbine Maintenance

The generator for CT-4 has had the stator and field rewound. A full set of liners, fuel nozzles, transition pieces, 1st and 2nd stage turbine hardware (shrouds, buckets and nozzles) are kept at the site for spares. An off line water wash is performed every 6 months. The GE operating procedures are followed for water wash.

This report describes and documents the February 27th, 2013 borescope examination of the General Electric Frame MS7001EA combustion turbine. This inspection included the compressor section, the combustion section, the turbine section and the exhaust section. The compressor stages S-1 through S-4 stator vane shims were inspected IAW TIL 1562. The spacers and platforms on the stage R-17 rotor blades were inspected for any signs of movement IAW TIL 1090-2R1. The stage S-17, EGV1 and EGV2 stator ring rail and CDC hook fits were inspected IAW TIL 1744. The inspection on liners 5 and 7 were limited to an inspection through the crossfire tubes. The borescope plug on combustion liner 7 was not removed for this inspection. The unit was not rotated for this inspection.

The purpose of this borescope examination was to look for conditions considered to be abnormal to the unit and to gather trending data.

CT-4 requires a Combustion Inspection every 400 starts, the unit averages 200 starts a year.

During the 2014 outage the three rows of turbine buckets and hardware were replaced with new/refurbished customer supplied buckets and hardware.

A hot gas path inspection was performed by GE on CT-4 in February 2012. The aft compressor discharge casing was removed to facilitate closer inspection of the compressor. The next hot gas path inspection will be performed in the spring of 2014 to address the compressor blade/vane issue. The major outage will include replacement of compressor vanes stages 5 through 8. These vanes have been ordered and will be installed during the next major outage. The compressor stage R-2 rotor blade number 28 leading edge tear was removed and dye penetrant inspected after blending. There was no evidence of any indication after blending. NDE was performed on the compressor R-17 blades.

Final filters are changed every three years and the pre-filters are changed annually or sooner if warranted.

A Combustion Inspection was performed on the Frame 7 CT-4 in 2012. All components were inspected and generally were found to be in fair condition. Some transition pieces did have cracking of the aft mounting bracket. These were repaired. Repairs were made in the exhaust plenum to cracks. There were girders and supports added for strength.

All internal combustion components were replaced with new or remanufactured parts with the exception of the flow sleeves, which were inspected and found suitable for continued use. The first stage nozzle was inspected and suitable for reuse.

Combustion cans were visually inspected for bulges and cracks and other imperfections. No discrepancies were found.

The fuel nozzles were inspected and the cover assemblies were replaced by those from a remanufactured set.

Generators

Unit	Manufacturer	MVA	Cooling Method	Voltage (kV)
Unit 8	Westinghouse	58,822	Hydrogen	12.5
JRK CT-4	GE	74	Air	13.8

The #8 generator has not been rewound. Number 8 has a brushless (diode and fuses) type of exciter.

A flux probe test on CT-4 showed no shorted turns in 9/2010. A flux probe test is performed annually.

Generator Protection

CC 1 generator trips consist of loss of excitation, any time turbine trips, reverse current, generator breaker, emergency trip buttons in switchboard, under frequency (~58 Hz for 12 cycles & 20 seconds), over-current, and Beckwith 3420 trip list. A new generator breaker was installed for CT-4. As part of the tripping sequence change, the generator field breaker will not open until 3550 rpm, which shows a decaying rpm is detected.

Unit 8 Generator, loss of excitation, under frequency, (58 Hz for 12 cycles & 20 seconds), over-current, any time turbine trips, reverse current, generator breaker, and emergency trip buttons in switchboard.

In 2013 a PDA monitor and flux probe was installed on #8 generator. The installation of six EMC couplers has been completed in accordance with the current installation guide. Considering that the System couplers were mounted on the removable sections of the iso-phase bus duct, special care for the couplers should be taken in case of iso-phase bus maintenance.

On-line partial discharge testing for the stator winding of this turbine generator Unit 8 is now possible. Depending on the condition of the winding insulation, regular testing at half-yearly or shorter intervals is strongly recommended to establish and maintain an effective predictive maintenance program for this stator winding. The trending and analysis of the data so obtained will provide useful information on the rate and severity of deterioration of the insulation, and therefore assist the maintenance planning of this asset on a predictive basis.

Retaining Rings

All CT generators have 18Mn-18Cr material for the retaining rings. The steam turbines have magnetic retaining rings.

Hydrogen Conditioning

The plant does have hydrogen dryers for Unit 8 generator. Steam turbine generator #8 has the hydrogen low alarm set at 90%.

Hydrogen purity is controlled by the vent and purge method.

Summary of Major Generator Maintenance

The generator stator was rewound in 2006. The generator field was rewound at National Electric Coil and placed back in service in February 2009.

On February 14, 2012, AGT Services, during a generator outage at Kelly Generating Station, performed tests and inspections on the CT #4 GE generator. A complete battery of electrical tests and visual inspections of stator and field were completed. The rotor was not removed from the generator for this inspection.

Electrical tests include, winding copper and insulation resistance/polarization index, DC leakage of each phase, and a 1 minute hi-pot of each phase. Hi-pot voltage was at a lower voltage. A resistance check and a 1 minute resistance of all RTD's were completed. The three phases yielded excellent test results up to and including the 30kV hi-pot level. The RTD's testing results showed all to be functional and test results satisfactory.

A visual inspection with limited access of generator was performed. The generator field appeared quite clean. The end turns showed no signs of coil distortion or movement of blocking. The field has a fully assembled brushless exciter. The exciter appears to be in good condition.

Recommendations for Future Outages include the following:

- Remove field from stator to facilitate a complete visual inspection of stator and field.
- Perform a complete DC test series on both the stator and field.
- Perform an ELCID test at the next major to check for shorted stator laminations.
- Perform periodic flux probe testing to monitor for field shorted turns.
- Perform a complete stator wedge tightness survey.

The outer radial lead seals were found to be leaking slightly. Plant personnel installed new radial lead seals and hardware.

During the outage on CT-4 in 2014, the #8 generator stator was re-wedged.

The stator was rewedged based on the tap test results. The electrical tests included an insulation resistance and Polarization Index (PI). DC winding resistance, DC controlled overvoltage, ELCID, through bolt and end winding insulation, wedge tightness mapping by tap test and core tightness check.

A total of three El-CID tests were conducted during this outage. The purpose of the initial test was to determine the "as-found" stator core condition prior to commencement of maintenance work. The second test was conducted following removal of the old wedging system and completion of the stator core tightening. The third and final test was conducted following replacement of the stator wedge system and to establish a baseline for future measurements.

Rotor work included a borescope and visual inspection of the assembled rotor followed by electrical testing. Electrical tests consisted of a winding resistance, AC impedance, pole balance, DC winding resistance and a pressure test of the radial stud assembly.

The main leads between the brushless exciter and generator rotors were inspected and repaired.

Transformers

Unit	Year	Manufacturer	Ø	Type	MVA	Voltage (kV)
T-33 GSU	2000	Crompton Greaves	3	OA/FA	120	138/13.8
T-31 Substation	Original	Westinghouse	3	OA/FA	56	138/12.5
T-32 Substation	Original	Westinghouse	3	OA/FA	56	138/12.5
T-21 Substation	2009	Global Power Supply	3	OA/FA	5/6.25	12.47/4.16

Each transformer has a type of Mineral Oil in them. The transformers are of the core type design.

Transformer Protection

The transformers are provided with electrical isolation that includes over-current protection, winding temperature indication, sudden pressure relay and lightning arrestors.

GSU transformer for CT-4 (T-33) has a conservator and has a Buchholz Relay which will alarm and trip the Transformer.

Transformer Oil Analysis

For transformer dielectric failures, the failure precursor or incipient state is the appearance of various dissolved gasses in the oil. While the industry has significant successful experience of detecting and mitigating slowly evolving dielectric failures using traditional DGA sampling techniques, it has less favorable experience with quickly developing failures. The plant has installed an online gas in oil monitor (Calisto). This will alert plant personnel of problems at an early stage. Dissolved gas analysis (DGA) is conducted every six months.

Summary of Major Transformer Maintenance

Reports for last DGA testing in July 2014 were reviewed and found satisfactory. The transformers are provided with electrical isolation that includes over-current protection, winding temperature indication, sudden pressure relay and lightening arrestors. The transformers are electrically tested every 5 years.

Major Systems

High Energy Piping

The high energy piping on HRSG is not very old. The main steam piping for steam turbine #8 was replaced with new piping when the conversion from the boiler to the HRSG was completed. There is no seamed piping in the main steam piping.

Piping Hanger Inspection & Testing

Hanger inspections are conducted at maintenance outages. A hot survey is performed prior to the start of scheduled outage and follows this up with a cold walkdown after the outage is started.

The plant has undertaken studies to evaluate high energy piping and support members.

Feedwater and Condensate

The Electric Power Research Institute (EPRI) defines Flow-assisted corrosion (FAC) as “a process whereby the normally protective oxide layer on carbon or low-alloy steel dissolves into a stream of flowing water or a water-steam mixture”. Prior to the term FAC, it was generally referred to as erosion/corrosion. Flow accelerated corrosion can occur in single and two-phase systems. The variables that influence FAC are: flow rate (velocity), oxygen content, water treatment, temperature, geometry and metallurgy.

Boiler feedwater systems fabricated from material having a chromium content below 0.4 percent are numerous and especially vulnerable to FAC when operating between the temperatures of 200°F - 450°F. Piping systems that may be damaged include, but are not limited to; feedwater, condensate, blowdown, feedwater heater (drains, drips and vents) and wet steam extractions.

FAC inspections have been performed at this station. On the HRSG LP drum some thinning was found as a result of FAC. Continue to maintain high pH in order to minimize FAC risk. Monitor this location in the LP drum in future inspections.

Deaerator/Feedwater Heater NDE Examination

The plant has an excellent deaerator inspection program which includes WFMT inspection at least every 5 years. The deaerator inspection with NDE was completed during the outage in 2013.

Boiler Feed Pumps

Unit 8 has two one hundred per cent 700 HP, Westinghouse motor driven boiler feed pumps.

Water Treatment

The HRSG uses trisodium phosphate for Ph control. They also utilize a continuous blowdown system to control conductivity, silica and to control Ph. Chemtreat BL-1285 is a volatile oxygen scavenger and reducing agent with exceptional metal passivating properties. It is superior to hydrazine as a metal passivator and oxygen scavenger.

Operations

Unit	Time Period	Total Hours Generated	Total Starts	Run Hours
JRK8	N/A	N/A	N/A	N/A
JRKCT-4				

Control Room Review

Operation and control of equipment in the plant is accomplished from the Control Room. Monitoring of equipment is performed with meters, gages, digital read-out devices and other devices located in each Control Room. Continuous vibration monitoring systems are installed on each turbine generator. Narrative logs of daily activities are kept in the Control Room. The Control Room is constantly attended.

There are computer screens located in the Control Room that are easily visible for the critical equipment. Direct remote visual water level indication is located in the control rooms for the boilers. Equipment monitoring and control utilizes a Distributive Control System (DCS). The Control Room operator and shift supervisor have the authority to trip the units if conditions warrant.

Operating Procedures

Written Standard Operating Procedures (SOP) draft have been generated and distributed by plant personnel. These will assure consistency over time and will be updated as required as a result of equipment changes and when operating parameter conditions change. All of Unit 8 SOPs are complete. The process of generating and implementing emergency SOP's has also been completed.

Operator Training

Training consists of a combination of on-the-job training utilizing a Job Task List, class room instruction developed by subject matter experts, and a General Physics computer based training program. The employee is evaluated by the shift supervisor. Final qualification is a comprehensive oral assessment given by a shift supervisor that is not the employee's immediate supervisor and Plant Manager.

Operational Testing

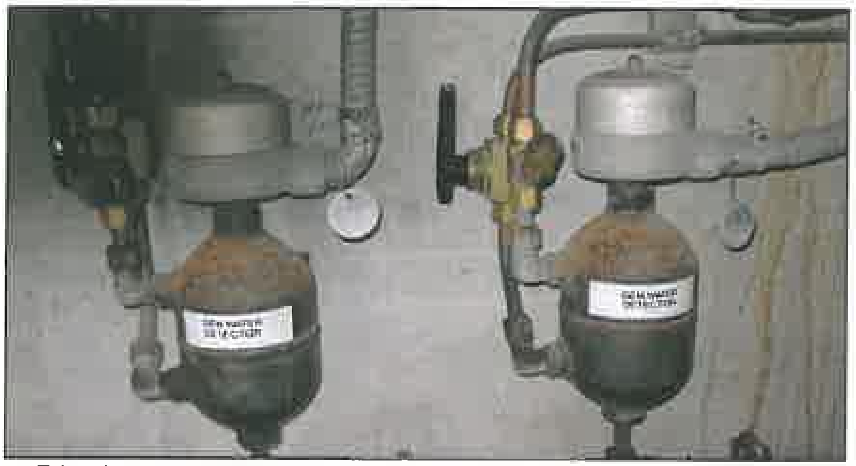
Overspeed Trip Testing

Unit 8 has a mechanical and electronic overspeed device. The electronic overspeed device is tested annually.

Turbine Valve Testing

Since the Unit 8 is operating as a base loaded unit, valve tests are performed periodically.

Generator Liquid Level Detector Testing



Liquid Level Detector showing valves for functional testing

Steam generator liquid detectors are tested monthly by pouring a liquid into the device until it activates the alarm.

Feedwater Heater Level Control Testing

There are no feedwater heaters that have extraction steam from the turbine.

Emergency Lube and Seal Oil Pump Testing

Unit 8 has a DC emergency lube oil pump and seal oil pump for the turbine/generator. These units do not have thermal overloads in their motors; they have energized DC circuitry, and are tested monthly by the pressure drop method.

Maintenance

Maintenance Management

Station management utilizes a Computerized Maintenance Management System (CMMS) MP2 Enterprise package. All maintenance activities utilize this program to schedule, coordinate, prioritize, complete and track all aspects of preventative, predictive and corrective maintenance activities. Work orders (WO) are a part of this package. The system tasks are prioritized. Outage schedules are consistent with industries best practices for the steam turbine generators. Overall scheduling includes annual review and planning meetings to discuss issues and capital expenditures. The plant has a Mechanical Integrity, Management of Change and System Process Hazard Analysis system in place. A separate CMMS system, SAP, is used for finance, inventory, and purchasing. The MP2 Enterprise is used for scheduling, work orders, and predictive maintenance activities.

The plant utilizes a combination of Preventive and Predictive maintenance practices. Most preventative tasks are performed at calendar-based intervals versus condition based maintenance intervals.

A major change in operation and maintenance procedures and practices has been made at the plant. The plant staffing was reduced from 30 to 23. The remaining personnel have gone from single skill craft employees to multi-skilled employees called Production Technicians. All remaining personnel have their journey level skill and each was cross-trained to an apprentice level in another skill set.

All employees must either have a journey or apprentice level operations skill set as well as a journey or apprentice level craft skill set.

Preventive maintenance and day-to-day maintenance is performed by the Production Technicians. Heavy maintenance is now performed by the Outage Planning and Major Maintenance Group at Deerhaven.

Maintenance Training

The program provides training and mentorship to the journeyman level. This includes formal classroom training, hands-on training, and actual OJT by being assigned to maintenance personnel.

Predictive Maintenance (PdM)

Thermographic Inspection

Infrared scanning is conducted annually by a contractor on station electrical transmission and distribution systems down to the 480 volt level. This includes all electrical equipment to and including the switchyard. Findings are immediately dispositioned and handled accordingly. Scanning is conducted prior to scheduled maintenance outages.

Vibration Monitoring and Analysis

The station has a comprehensive predictive maintenance program in place monitoring vibrations of rotating equipment. This includes a monthly route-based vibration analysis program performed by an outside contractor. The turbine generators have Bently Nevada vibration continuous monitoring systems in place. Unit 8 has Bently Nevada dual axis proximity probes. The vibration trips are not enabled. The plant depends on operator experience and training to trip the units in case of high vibration levels.

Lube Oil Analysis

A lube oil analysis for the CT-4 and #8 steam turbine/generators is performed semi-annually. Samples are drawn by plant personnel and sent to contract laboratories for analysis. The PM was reviewed by this Inspector.

Pressure Vessels

There are no feedwater heaters in service at this station.

Auxiliary Safety Valve Maintenance

All safety valves for the HRSG were tested in 2012. Valve maintenance is contracted out to certified organizations. Boiler safety valves are inspected every one to two years. Boiler and off boiler safety and relief valves are all tracked on a master list.

Electrical Maintenance

Protective Relays and Circuit Breakers

The plant preventative and predictive maintenance program is quite comprehensive relating to electrical testing. All equipment is visually inspected annually. Circuit breakers receive energized and de-energized maintenance. The dielectric strength of fluid in oil circuit breakers is tested during outages. The tanks and reservoirs are cleaned, primed and painted as required. Air circuit breakers are inspected and include a clean and inspect, lubrication of compressor, oil change, pressure switch calibration and compressor operating efficiency. Relay testing and calibration was reviewed and inspections are current.

Protective relay testing is performed every three years for electro-mechanical relays and every six years for microprocessor-based relays. The relays are a mixture of electro-mechanical and microprocessor-based relays. Relay testing for CT-4 was performed in 2012.

The plant has completed an Arc Flash Hazard Analysis. The fault current and coordination study is to evaluate the protection equipment ratings, to determine settings and to see where problems may exist. The results of the Arc Flash Hazard Analysis are used to label equipment and recommend Personal Protective Equipment (PPE).

Emergency Battery

Battery Description	Install Date	String/Cells/volts	Model	Date Tested	Battery Capacity
CT-4	3/15/2011	1/56/127.0	Enersys 4DX-11	5/2011	100%
CC 1	6/2006	1/60/129.7	Enersys 3CC-9	5/2011	100%

The battery rooms and equipment is checked daily by operators.

Monthly inspections include: batteries cell voltage reading, specific gravity, positive and negative to ground, charger volts and amps, plus checks of rooms and ventilation equipment.

Quarterly battery checks for each cell include specific gravity, cell voltage, battery bank voltage reading, electrolyte temperature and level and a visual inspection for loose connections, corrosion and cleanliness.

Batteries are well maintained and are kept in cool ventilated rooms. All batteries are current with the load capacity tests. Since the last site visit, hydrogen detectors have been installed in the Unit 8 battery room.

Yearly checks include neutralizing corrosion, correcting electrolyte levels, getting cell impedance readings on all cells, taking cell to cell bus resistance checks and cell specific gravity and voltage checks.

Loss History

CT 4 generator stator failure problems and field heat imbalance issue in 2007. CT4 had a phase to phase fault caused by water intrusion according to GE. Two top bars were replaced, rewedged and tested, due to the incident and three others that failed testing. The stator failure problem was corrected by the addition of a cover over the exciter end of the generator thus preventing rain water from entering the internals of the generator. The exciter ground fault transmitter was damaged and replaced by Kato. The field heat imbalance was caused by rotor slot insulating material migration. Numerous improvements were made to rotor materials during the rewind process. A bump test and final hi-pot was performed. The air intake enclosure was modified to prevent further water intrusion.

Loss Estimates

Probable Maximum Loss (PML)

The PML is defined as the physical damage and time loss expected to occur assuming the failure of a primary operating control and the failure of at least one safety or protective device. In addition, the affected equipment experiences a delayed shutdown or isolation.

The PML is calculated using percentages of the equipment value and is expressed as a specific total dollar amount.

PML Scenario

Loss of lubricating/seal oil to 60 KVA steam turbine/generator resulting in damage to bearings, seals, turbine blading, diaphragms, rotor, etc. or major blade failure resulting in significant damage to rotating and stationary steam path components

PML *$3,000,000* *(Loss without consideration of a deductible or business interruption)*

Maximum Foreseeable Loss (MFL)

The MFL is defined as the maximum amount of physical damage and time loss expected to occur under the worst possible conditions. This is based on the failure of operating controls and safety or protective devices with no shutdown or isolation of affected equipment. The MFL assumes this equipment operates to destruction.

The MFL is calculated using a percentage of the equipment value and is expressed as a specific total dollar amount.

MFL Scenario

Catastrophic mechanical failure of the steam turbine/generator due to an overspeed or high vibration condition resulting in significant damage to the unit requiring major repairs/replacement

MFL *$13,200,000* *(Loss without consideration of a deductible or business interruption)*