MARITIME ELECTRIC

CHARLOTTETOWN GENERATING STATION

STUDY

PERFORM AN ANALYSIS ON THE REQUIREMENTS TO OPERATE THE GENERATING UNITS IN A SAFE MANNER TO THE END OF 2018

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APPENDIX

1.0 EXECUTIVE SUMMARY

ROS Consulting Inc. was contracted by Maritime Electric to perform a condition assessment and operational analysis to determine the ability of the Charlottetown Generating Station units to operate in a safe manner to the end of year 2018. The study generally used the following assessment criteria as a basis to determine acceptable risk for equipment failure:

- Operational and performance history
- Maintenance history and results from last inspection
- OEM design and failure history
- OEM inspection recommendations
- Interim inspection and maintenance in between majors
- Age and operating time of the units
- Lay-up procedures during shutdown and time layed-up
- Industry maintenance standards

Comprehensive inspection and maintenance activities have been limited over the past several years and present condition of many critical plant components is unknown. This report attempts to identify critical equipment areas of concern and make recommendations which could mitigate or lessen equipment failure risks that could result in compromising plant personnel safety. Reliability of the units was considered a secondary issue but a considerable effort was made in the study to address it and recommendations are made which could limit the potential of equipment failure.

In summary, without a comprehensive inspection of generating unit system components, it is impossible to be absolutely confident that failures will not occur and pose some risk to safety of plant personnel. The report recommendations, if implemented, support Maritime Electric's continued operation of the station to the end of the year 2018 with a significant reduction to the safety risk of plant personnel while also enhancing the potential of increased reliability of the units.

The major recommendations of this report are as follows:

- Strong recommendation to inspect #6 generator rotor end caps and conduct a major overhaul of the turbine/auxiliaries. If Maritime Electric decides to retire the unit at the end of 2015 and not carry out a fall training run, there is no need to implement this recommendation.
- Strong recommendation to inspect #7 generator rotor end caps and conduct a modified major overhaul of the turbine/auxiliaries. The modified major is based on an assumption that an OEM service engineer conducts an operational review of the unit to ensure it is safe to operate and critical problems discovered are resolved.
- To eliminate the need for a major overhaul of #8 turbine/generator/auxiliaries, I strongly recommend that an OEM service engineer conduct an operational review of the unit to ensure it is safe to operate and any critical problems found are resolved. The generator rotor field winding insulation is in a critical state based on the latest testing results and failure could occur at any time. Since the only fix is to reinsulate the rotor at an

estimated cost of $750K to $1 million, it is my recommendation, based on limited operation of the unit, to continue operation and risk failure which would have no safety implications for station staff.

- To eliminate the need for a major overhaul of #9 turbine/generator/auxiliaries, I strongly recommend that an OEM service engineer conduct an operational review of the unit to ensure it is safe to operate and any critical problems found as a result of the assessment are repaired.
- To eliminate the need for a major overhaul of #10 turbine/auxiliaries, I strongly recommend that an OEM service engineer conduct an operational review of the unit to ensure it is safe to operate and any critical problems found as a result of the assessment are repaired. The generator rotor end caps must be inspected due to the fact that they are made of a material that is prone to stress corrosion cracking and failure would result in catastrophic damage to the unit and pose a significant safety risk to plant personnel.
- On the assumption that Maritime Electric contracts an OEM service engineer and controls engineer to conduct a boiler general inspection and an evaluation of the boiler control and safety systems to ensure that they will adequately protect both station staff and the units to end of the year 2018, no further work is recommended on boilers #4, #5, #6, #9 and #10 except for maintenance as required to operate in a safe and reliable state and conducting a minor thickness evaluation of #5 boiler near drum generating bank tubes.
- Reliability of all station unit control systems is and will be an issue and any significant improvement in reliability would require extensive and costly capital upgrades. External support is available to assist in the troubleshooting and maintenance of this equipment and for the short time it will be in service, there is a good probability that the systems can be kept working until the station end of life.
- It is strongly recommended that units #9 and #10 deaerators be non-destructive inspected due to the fact that failure could result in plant personnel injury or fatality.
- It is strongly recommended that a sample of all units high energy piping systems be non-destructive inspected due to the fact that failures could result in plant personnel injury or fatality. These piping systems are old, have a significant number of operating hours and no records could be found to confirm that any inspection has ever been done.
- Due to the condition of the steam path blading in units #8, #9 and #10, it is recommended that new vibration monitoring systems with unit trip capability be installed on the units. Although not guarantee, they could eliminate or limit the damage to the units caused by blade failures, bearing failures, etc.
- Due to the age and condition of all units, it is my strong recommendation that when units are put into service they be kept online at some load until no longer required. This action will limit the number of thermal cycles and reduce the risk of component failure.
- Staffing experience and levels are critical to the operation of this station. Pending retirement of key maintenance and operating personnel and a lack in numbers of experienced operating staff presents a significant risk to the safe operation of the station.

2.0 STUDY SCOPE AND OBJECTIVES

Consulting to perform an analysis on the requirement to operate the Charlottetown Thermal Generating facilities in a safe manner until the end of the year 2018 subject to:

- Two, 2 week training runs to take place annually;
- During the training run, only one unit is slated to operate at a time;
- Generation may be called upon due to system contingencies; and
- The Charlottetown generating units will not be in the economic dispatch queue.

3.0 STATION BACKGROUND

The Charlottetown Generating Station was established on this site in 1900 and since 1947 has increased its generating capacity to its present 65 MW output.

Rating of Major Units

Turbines

No.	Rating	Manufacturer	Operating Hrs To Aug 2014	Installed	Extension Age to Retirement (April 2018)
6	7,500 KW	C. A. Parsons	215,269	1952	66 yrs
7	7,500 KW	Brown-Boveri	187,247	1956	62 yrs
8	10,000 KW	C. A. Parsons	122,125	1960	58 yrs
9	20,000 KW	A. E. I.	165,061	1963	55 yrs
10	20,000 KW	A. E. I.	129,586	1968	50 yrs

Boilers

No.	Rating	Pressure	Temp	Operating Hrs To Aug 2014	Installed	Extension Age to Retirement
2	16,000 lb/hr	110 PSIG	350 F	67,690	1987/1997	
4	100,000 lb/hr	400 PSIG	750 F	204,110	1954	64 yrs
5	105,000 lb/hr	400 PSIG	750 F	154,000	1960	58 yrs
6	75,000 lb/hr	400 PSIG	750 F	126,771	1976	42 yrs
9	190,000 lb/hr	900 PSIG	875 F	165,833	1963	55 yrs
10	190,000 lb/hr	900 PSIG	875 F	130,360	1968	50 yrs

Significant maintenance and station upgrades including a rebuild of #9 boiler were completed during the period from 1990 to 2005 with emphasis on the turbines, generators and boilers and to a lesser extent the balance of station systems. Since 2005, except for some significant electrical upgrades, maintenance on all units was limited to maintain equipment as required to operate all units in a standby mode, training runs and system peaking requirements. Each unit is expected to operate under this criteria for a maximum 1,200 hours until the end of year 2018 at which time the station will be retired.

4.0 SUMMARY OF STATION EQUIPMENT ASSESSMENT

All station equipment assessments are based on available records and documentation which are difficult to locate, along with meetings and discussions with Station management, senior operations and maintenance staff. In most cases where equipment maintenance or records could not be found, no opinion is given as to the state of the equipment's condition. Maritime Electric insurer reports and discussion with Provincial boiler inspector were also used to refine the study recommendations. Considerable effort was also taken to highlight equipment conditions where failure could result in catastrophic damage to these components and put Plant personnel at risk.

4.1 Turbine, Generator and Auxiliaries

In 1987, the Canadian Electrical Association developed a set of specific guidelines for overhaul frequency of turbine, generator and auxiliaries which have been adopted by most North American utilities. (CEA Report Number 610 G 562). Significant input to the Report was made by utilities, original equipment manufacturers and insurance companies. Although these standard utility practices recommend a complete major overhaul on this equipment at intervals no greater than 10 years, regardless of their operating hours, projected limited operation of the Charlottetown Plant was taken into account with respect to future maintenance requirements that would allow the units continued operation to retirement at the end of 2018. These recommendations are the minimum actions that could be taken to allow safe operation of the units but not totally mitigate the risk of substantial operational damage to the units.

4.1.1 Unit #6 Turbine, Generator and Auxiliaries

- The last major overhauls completed on this unit were in 1987 and 1995. The unit has operated 1720 hours since the last major in 1995. No records were found to indicate that any major work has been completed on this unit since the last major.
- During the last major, the steam path blading was considered acceptable except for the last 2 rows of LP blading. Extensive steam erosion existed and recommendations were made at that time to replace erosion shields to protect the blades from further damage and risk of failure – no replacement has taken place.
- During the last major, the turbine control valves, front pedestal equipment (i.e. governor, etc.), and auxiliaries were overhauled and refurbished. Very few new parts were used to refurbish as new spares were limited at that time.
- The generator was overhauled during the 1995 major and repaired as required. The generator rotor end caps (rings) were inspected and rejected due to numerous pitting/cracking issues. The defects discovered were caused by moisture, most likely present due to old lay-up methods or air cooler leaks. A temporary 2 to 3 year fix was

made by machining out the defects and installing shrink rings to the I.D. shrink areas of both rings. The end cap material is 18Cr-4.5Mn and is very prone to stress corrosion cracking and resultant failure. Parsons, the OEM, at that time strongly recommended replacement of these caps with the new corrosion resistant 18Cr-18Mn material caps. End cap failures pose a significant safety risk to plant personnel and failure would also result in extensive damage to the turbine/generator set and could damage surrounding station equipment. **It is my strong recommendation that this unit not be operated until such time that the caps are inspected. In addition, a major overhaul of the turbine/auxiliaries should be done to comply with standard utility practice of major overhauls recommended to be done every 50,000 equivalent operating hours or every 10 years regardless of operating hours.** Maritime Electric is considering retirement of this unit at the end of 2015 which would therefore eliminate all need for recommended actions. It has been 20 years since the last major on the turbine/auxiliaries.

4.1.2 Unit #7 Turbine, Generator and Auxiliaries

- The last major overhaul completed on this unit was in 1994. The unit has operated 3,241 hours since the last major. No records were found to indicate that any major work has been completed on this unit since last major.
- All normal turbine/auxiliaries major overhaul items were inspected, repaired and/or replaced with new parts during this overhaul. The turbine bleed (extraction) non-return valves were inspected and found seized in the open position. They were repaired and placed back in service. These non-return valves act as protection from water induction into the turbine and not working would cause significant turbine damage should feedwater heater level control system not function properly. It is imperative for turbine protection that these valves and the feedwater heater system be properly maintained. This recommendation applies to all station turbine/generator sets. No significant turbine blading issues were identified. The recorded 2001 visual inspection of the last 2 rows of blading show no issues of concern.
- A major overhaul and electrical testing of the generator was also done in 1994. Repairs were made as required and no major issues were identified. The generator rotor end caps (rings) were inspected and rejected due to numerous pitting/cracking issues. The defects discovered were most likely caused by moisture, likely due to old lay-up methods or air cooler leaks. A temporary 2 to 3 year fix was made by machining out the defects and installing shrink rings to the I.D. shrink areas of both rings. The end cap material is 18Cr-4.5Mn and is very prone to stress corrosion cracking and resultant failure. All OEM suppliers strongly recommend replacement of these caps with the new corrosion resistant 18Cr-18Mn material caps. End cap failures pose a significant safety risk to plant personnel and failure would also result in extensive damage to the turbine/generator set and could damage surrounding station equipment. **It is my strong recommendation**

that this unit not be operated until such time that the caps are inspected. In addition, a major overhaul of the turbine/auxiliaries should be done to comply with standard utility practice of major overhauls recommended to be done every 50,000 equivalent operating hours or every 10 years regardless of operating hours. It has been 21 years since the last major on this turbine/auxiliaries. The scope of the major overhaul could be reduced if Maritime Electric elects to have commissioning engineer assess the turbine/generator/auxiliaries start-up, operating, and shutdown conditions of the unit. **I would feel comfortable recommending restricting the inspection of the turbine/auxiliaries to the rotor/stationary blading including nozzles and all bearings/oil seals. This includes NDT of blading and bearing babbit bonding condition. The remainder of the components would be inspected/repaired conditional on the commissioning engineer's assessment of the unit operation.** The restricted inspection of the unit along with doing this work at the same time as the generator end cap inspection could significantly reduce the estimated cost identified in the report.

4.1.3 Unit #8 Turbine, Generator and Auxiliaries

- The last major overhauls completed on this unit were in 1991, 1995 and 2006. The unit has operated 603 hours since the last major in 2006. No records were found to indicate that any major work has been completed on this unit since the last major.
- In 2006, all major turbine/auxiliaries items were inspected and repaired/replaced. Both the emergency stop and control valves had experienced significant erosion, pitting and wear damage when overhauled in both 1991 and 1995. Repairs made during those outages and most likely less boiler carry-over, resulted in less damage found during the 2006 inspection. The stop and control valves were overhauled in 2006 and considered acceptable to operate. The inlet steam nozzles, fixed and rotating impulse blading have experienced significant boiler carry-over denting and pitting damage. Blade rows 1-26 have experienced similar damage with worst damage at front-end of machine and not much at row 26. This damage is similar to that found in 1991 and 1995 overhauls. All nozzles and blading were non-destructive tested and no cracking issues were discovered. Damaged blades were dressed up so that damaged/thin sections would not breakoff and cause damage to steam path blading. Heavy to moderate erosion was found on blade tips and erosion shields on row 33 and 34 last stage blading. The blades were left as found and it was recommended that they be visually inspected each year to monitor blade condition. No records could be found that the non-return valves were inspected and they should be done soon. Although a risk remains of blade failures and significant turbine/generator damage, this unit could operate to end of life in 2018 based on the following:

    A. Maximum operation of unit would be limited to the projected 1200 hours until retirement at end of 2018.

B. Cold starts must be limited and when unit is online, it should be kept there until no longer required.

C. This recommendation is backed up by Siemens 2006 Overhaul Report that accepted the unit for continued operation.

D. An OEM start-up engineer review onsite the operating conditions of the unit at the earliest possible date and accept the unit for continued operation.

E. Install a Bentley Nevada vibration monitoring/trip system on the unit. This system could possibly save or limit damage to the unit should a blade failure occur.

- Major overhauls and electrical testing were completed on the generator in 1991, 1995 and 2006. In 1991, the generator end caps (rings) were inspected and significant stress corrosion defects were discovered. The defects were most likely caused by old lay-up methods or air cooler leaks. A temporary 2 to 3 year fix was made by machining out the defects and installing shrink rings to the I.D. shrink areas of both rings. The end cap material is 18Cr-4.5Mn and is very prone to stress corrosion cracking and resultant failure. The end caps were replaced in the 1995 outage with new stress corrosion resistant 18Cr-18Mn material caps and no issues were reported with the new caps during the 2006 major outage. Electrical testing during the 2006 outage discovered that the rotor field winding insulation resistance to rotor body was 0.75 mega-ohm and a retest in 2009 was 0.61 mega-ohm. This value should range in the order of 10 mega-ohm to 100 mega-ohm. It is suspected that air cooler leaks may have caused this issue and further action is required to restore the rotor insulation resistance to an acceptable level to reduce the possibility of an unexpected outage. Other than the rotor field winding insulation issue there is nothing in the outage report that indicates that the generator cannot operate to the end of 2018.

- The generator rotor field winding insulation is in a critical state based on the latest testing results and failure could occur at any time. Since the only fix is to reinsulate the rotor at an estimated cost of $750,000 to $1,000,000, **it is my recommendation, based on limited operation of the unit to continue operation and risk failure which would have no safety implications for station staff.**

4.1.4 Unit #9 Turbine, Generator and Auxiliaries

- The last major overhauls on this unit were completed in 1990, 1993, 2002 and generator only for a re-wedge in 2005. The unit has operated 3,811 hours since last major on turbine/generator set and 1,741 hours since last major on generator in 2005.

- The 1990 major overhaul discovered significant pitting, denting, and corrosion issues on blading rows 1 to 17. The inlet nozzles were found to be in bad shape with the same type of damage and the last 2 rows of blading were showing significant signs of erosion on the

blade tips and erosion shields. The stop and control valves were also found in bad shape and they, along with all other issues found were temporarily repaired and major work required was deferred to a major scheduled in 1993.

- The 1993 major on the turbine/auxiliaries addressed most issues discovered in 1990 and the steam inlet nozzle blades were replaced. The stop and control valves, governor, main oil pump, turbine/generator bearings, etc. were refurbished. The turbine blading, rows 1-17, was not replaced. These blades show significant pitting, denting and corrosion damage with the worst areas located in rows 1-6. All blading was cleaned up as good as possible by grinding out weak areas and considered acceptable based on Maritime Electric projected low hours of operation to the retirement of the unit. The last stage 2 rows of blading were again noted that significant blade tip and erosion shield damage exists but utility made decision to continue operation without repair or replacement.

- The last major on the turbine/auxiliaries was in 2002. The front pedestal control equipment was inspected and found in acceptable condition, and since only 6,000 hours of operation since last major work on main oil pump, over-speed rings and governor drive gear, no further work was recommended for these items. All stop and control valves were refurbished as required and considered acceptable for further operation based on future predicted operating hours to end of life of unit. The turbine steam path blading was in generally the same shape as left after the 1993 outage. The only exception was a major concern discovered with the lifting of the shroud on stage 1 velocity wheel and inspection of the shroud was recommended to be done sometime before another maximum 6,000 hours of operation. Concern was again expressed about the condition of the last stage blading as future accelerated erosion would be expected due to condition of erosion shields and exposed blade material. No records could be found to confirm inspection of bleed steam non-return valves and therefore, they should be looked at as soon as possible.

- The generator and auxiliaries were overhauled in 1990, 1993, 2002, and 2005. In the 1990 major on the generator, the rotor end caps (rings) were inspected and significant stress corrosion defects were discovered. The defects were machined out of the rings and were replaced with new 18Cr-18Mn caps in 1993. The caps were inspected during the 2002 major outage and no problems were discovered. In 2005, the generator stator was re-wedged, rotor inspected and tested with good results. On the assumption that the generator is kept dry (air cooler issue and dehumidifier always in service when unit offline), the generator should be ok to operate until the end of 2018 with no further majors required.

- Although a risk remains of blade failures and as a result significant turbine/generator damage, this unit could operate to end of life in 2018 based on the following:

    A. Maximum operation of unit would be limited to the projected 1200 hours until retirement at end of 2018.

B. Cold starts must be limited and when unit is online, it should be kept there until no longer required.

C. This recommendation is backed up by the OEM 2006 Overhaul Report that accepted the unit for continued operation.

D. An OEM start-up engineer review onsite the operating conditions of the unit at the earliest possible date and accept the unit for continued operation.

E. Install a Bentley Nevada vibration monitoring/trip system on the unit. This system could possibly save or limit damage to the unit should a blade failure occur.

4.1.5 Unit #10 Turbine, Generator and Auxiliaries

- Major overhauls were completed on this unit in 1990, 2004 and generator only for re-wedge in 2005. The unit has operated 2,374 hours since the last major maintenance overhaul and 2,020 hours since generator re-wedge in 2005.

- The major overhaul in 1990 was a life extension assessment outage to assess the condition of the unit. The life extension outage in 1992 addressed the deficiencies found in 1990. Noted concerns found in both 1990 and 1992 was the poor condition of the stop and control valves, steam path blading and related components. The concerns found included corrosion, erosion and pitting damage most likely caused by solid particle carry-over from the boiler and turbine lay-up conditions. The 2004 major overhaul again noted significant damage to the stop and control valves and steam path blading. The turbine steam path discs, blading, shrouds, tenons and glands were found to be significantly pitted, dented, and corroded. The damage was most evident at the steam inlet end and had disappeared by row 17. Localized sections of shrouding on stages 2 to 8 were more affected than the remaining stages. The stage 1 velocity wheel – first row of blades were significantly thinned due to erosion and impact damage. Stage 1 velocity wheel – second row of blades – also had similar damage, but to a lesser extent. All blades dressed to minimize the risk of material becoming detached and carried through the steam path. It goes without saying that if pieces break off, they could damage or fail remaining blades and cause catastrophic damage to the unit. The last 2 rows of blading have been heavily eroded at the leading edge. The severity of the erosion increased towards the tip of the blades and the last ¼" to ½" of shielding had completely disappeared. Undercutting at the blade to shield interface is taking place and therefore reducing the effect of blade erosion protection provided by the shields. The OEM expressed concern about the condition of this blading and recommended that they be replaced. Regular visual inspection was considered essential; if the blades not replaced, to ensure integrity of blading for future operation. All stationary blade assemblies were non-destructive tested. Stages 2-11 showed inner and outer spacer bands to be cracked from the trailing edge of every blade to edge of band. Cracks were also present from the back form of the blades

to the outer edge of the band. No records could be found to indicate that the extraction steam non-return valves have been inspected during any of the latest major overhauls.

- The generator and auxiliaries were overhauled in 2005. The stator was re-wedged, inspected and along with the rotor tested with good results. The major issue with the generator is the rotor retaining caps (rings) due to the fact they are made of the old 18Cr-4.5Mn material which is very prone to stress corrosion cracking driven by moisture pitting attack. Review of the 1991 outage report found that the caps were inspected and results revealed one significant defect on the end of each cap. These defects were removed by hand dressing and polishing. In addition, there was evidence of corrosion micro pitting on the exposed surfaces of both caps but was considered acceptable under the reject criteria established by OEM standard. It was recommended that the pitting be removed, but Maritime Electric elected not to complete this work. Recommendation was also made to re-inspect the rings during the next major outage and in addition, for any life extension, they should be replaced with new 18Cr-18Mn caps. The end caps were removed and inspected in 2004. Both rings had micro pitting on the exterior surface similar to that discovered in 1991. No cracking was found on either end cap and they were accepted for further operation. It has been 10 years since last inspection of caps and unknown if they were exposed to any moisture during that period. A risk remains that they could have been exposed to moisture during that period and, if so, could crack and fail with catastrophic consequences.

- Although a risk remains of blade failures and as a result significant turbine/generator damage, this unit could operate to end of life in 2018 based on the following:

    A. Maximum operation of the unit would be limited to the projected 1200 hours until retirement at end of 2018.

    B. Cold starts must be limited and when unit is online, it should be kept there until no longer required.

    C. That the generator end caps be inspected to eliminate the risk of failure. This is a personnel safety issue and failure would also result in significant turbine/generator set damage.

    D. An OEM start-up engineer review onsite the operating conditions of the unit at the earliest possible date and accept the unit for continued operation.

    E. Install a Bentley Nevada vibration monitoring/trip system on the unit. This system could possibly save or limit damage to the unit should a blade failure occur.

4.2 Boilers and Auxiliaries

Maritime Electric carried out a 15 year life assessment study on all station boilers and auxiliaries in 1989/1990 and using the study recommendations completed an extensive rebuild of this equipment during the years 1990-1995. Except for #9 boiler, no major maintenance or boiler tube, header or drum upgrades have taken place and other than yearly visual inspections very little non-destructive testing has taken place to confirm the integrity of these components. Boiler and auxiliaries' lay-up procedures have been improved significantly and provide much better protection during long periods of unit shutdown. Maintenance on the boiler and auxiliaries is completed on an as required basis when problems are discovered during operational runs. **For all boilers, it is my strong recommendation that Maritime Electric engage the services of a boiler service engineer and a boiler control engineer to evaluate all boilers to ensure that they are capable to operate safely to end of 2018.**

4.2.1 Unit #10 Boiler and Auxiliaries

- Based on the recommendations of the condition assessment report, a major rebuild of this boiler took place in 1992. The work scope was as follows:
  - replaced all 78 primary superheater elements;
  - replaced attemperator header/attemperator;
  - replaced 71 sidewall tubes (2 feet from furnace floor ranging from 10 to 20 feet in length) on both sides of the boiler; and
  - replaced 36 sidewall riser tubes and 6 sidewall feeder tubes.
- In 1995, an inspection of the near mud drum 2 inch and 3 inch tubes discovered some areas of thinning and corrosion pitting. Tubes were considered acceptable for continued operation.
- In 2001, sample thickness measurements were taken on the front of both sidewalls and rear furnace tubes along with a complete inspection of the generating bank tubes. Some thinning, corrosion and erosion was found but all tubes were considered acceptable for continued operation.
- Past lay-up procedures, condenser tube leaks and copper/zinc carry-over from the feedwater system were considered the main causes of the poor tube conditions found in 1991 boiler assessment program.
- No records could be found that confirmed any other areas of the boiler had had significant replacement work and no other major assessment of the boiler condition has been done since 1991/1992. The boiler components not replaced in 1992 are some wall tubes, generating bank, headers and secondary superheater.

- Lay-up procedures for all boilers at the Plant have improved significantly and provide much better protection during long periods of unit shutdown.
- In summary, based on past boiler history, good reliability of the unit over the past few years, projected limited cold starts and low projected operating hours to end of life; there are no outstanding known issues that would restrict operation of boiler to end of 2018. This analysis is made on the assumption that all required maintenance is done, current plant lay-up activities are continued, boiler safety valves are yearly tested, and boiler safety interlock, control and metering devices, etc. are maintained, calibrated and checked to ensure safe operation of the boiler. Recent insurance reports and Provincial boiler inspector verbal statements provide a backup to this recommendation.

NOTE: All boiler summaries contain the majority of content reported in the 2009 Life Assessment Report to ensure all up to date reviews are located in the same document.

4.2.2 Unit #9 Boiler and Auxiliaries

- Based on the 1990 condition assessment report recommendations, and extensive boiler damage as a result of a boiler explosion in 1994, a major rebuild of the boiler took place in 1995. The work scope included the following:
  - replaced primary superheater;
  - replaced all generating bank tubes;
  - replaced all wall tubes and associated backstays;
  - replaced the majority of floor tubing back to mud drum;
  - replaced bridgewall and screen tubes;
  - replaced drum internals and header hand hole caps with welded type; and
  - overhauled Ljungstrum air heater, forced draft fan, burners & linkages, safety valves and repaired or replaced most of the boiler refractory.
- In 2001, 25 superheater bends were inspected along IK 92 boiler cavity and no significant thinning issues were found. 189 generating bank (2 inch only) tubes were also inspected along with all of the near mud drum generating bank tubes with no reported issues.
- No records could be found that confirmed that the secondary superheater, the primary & secondary headers, and the attemperator have been replaced.
- Plant lay-up procedures condenser tube leaks and copper/zinc carry-over from the feedwater system were considered the main cause of the poor tube conditions found in the 1990 boiler assessment program.

- No records could be found that confirmed any other areas of the boiler had significant replacement work and no other major assessment of the boiler condition has been done.
- Lay-up procedures for all boilers at the Plant have significantly improved and provide much better protection during long periods of unit shutdown.
- In summary, based on past boiler history, good reliability of the unit over the past few years, projected limited cold starts and low projected operating hours to end of life; there are no outstanding known issues that would restrict operation of boiler to end of 2018. This analysis is made on the assumption that all required maintenance is done, current plant lay-up activities are continued, boiler safety valves are yearly tested and overhauled as needed, and boiler safety interlock, control and metering devices, etc. are maintained, calibrated and checked to ensure safe operation of the boiler. Recent insurance reports and Provincial boiler inspector verbal statements provide a backup to this recommendation.

4.2.3 Unit #6 Boiler and Auxiliaries

- Based on the 1994 condition assessment report recommendations, a major boiler refurbishment took place in 1995. The work scope included the following:
  - replaced complete superheater including inlet and outlet headers;
  - replaced 76 roof, sidewall and floor tubes;
  - replaced 24 rear wall tubes along with 43 convection side wall tubes and 11 convection rear wall tubes; and
  - replaced 104 division wall tubes along with 583 generating bank tubes and 32 screen tubes.
- In 2001, 109 generating bank tubes were full length inspected and tube thinning and some pitting damage was reported. A follow-up inspection was recommended.
- No records could be found that confirmed any other areas of the boiler had significant replacement work and no other major assessment of the boiler condition has been done.
- Lay-up procedures for all boilers at the Plant have improved significantly and provide much better protection during long periods of unit shutdown.
- In summary, based on past boiler history, good reliability of the unit over the past few years, projected limited cold starts and low projected operating hours to end of life; there are no outstanding known issues that would restrict operation of boiler to end of 2018. This analysis is made on the assumption that all required maintenance is done, current plant lay-up activities are continued, boiler safety valves are yearly tested and overhauled as needed, and boiler safety interlock, control and metering devices, etc. are maintained,

calibrated and checked to ensure safe operation of the boiler. Recent insurance reports and Provincial boiler inspector verbal statements provide a backup to this recommendation.

4.2.4 Unit #5 Boiler and Auxiliaries

- Records are limited on repairs to this boiler previous to and after the life extension assessment done in 1991. In 1993, both the primary and secondary superheater along with the superheater inlet and outlet headers and bridgewall tubes were replaced.
- In 2001, the boiler generating bank had a full length inspection and some thinning was noted near the mud drum with 60 tubes of some concern (wall thickness of 0.090 inches or less - minimum wall calculated at 0.081 inches). Erosion/corrosion considered to be cause of thinning. The same inspection was repeated in 2006 and it showed no significant change from the 2001 results.
- No records could be found that confirmed any other areas of the boiler had significant replacement work and no other major assessment of the boiler condition has been done.
- Since these tubes have thinning close to minimum wall, a repeat inspection should take place to ensure no further degradation has taken place and any tubes less than minimum wall replaced. This inspection should only include 100 generating bank tubes near drum (2" from tube sheet). Reference the Stasuk May 2006 report. Remaining length of individual tubes of no concern.
- Lay-up procedures for all boilers at the Plant have improved significantly and provide much better protection during long periods of unit shutdown.
- In summary, based on past boiler history, good reliability of the unit over the past few years, projected limited cold starts and low projected operating hours to end of life; there are no outstanding known issues that would restrict operation of boiler to end of 2018, except for repair or acceptance of near drum generating bank thinning issues based on inspection results. This analysis is made on the assumption that all required maintenance is done, current plant lay-up activities are continued, boiler safety valves are yearly tested and overhauled as needed, and boiler safety interlock, control and metering devices, etc. are maintained, calibrated and checked to ensure safe operation of the boiler. Recent insurance reports and Provincial boiler inspector verbal statements provide a backup to this recommendation.

4.2.5 Unit #4 Boiler and Auxiliaries

- Records are limited on repairs to this boiler previous to and after the life extension assessment done in 1992

- The 1992 assessment identified several boiler and auxiliary issues that needed attention including the need to replace the complete superheater and associated headers.
- Valves, fans, sootblower, burners, hand hole caps, tubular air heater, wall header cracking issue, refractory, steam coil, air heaters, etc. were all in need of significant maintenance.
- In 1993, the complete superheater along with associated headers and bridgewall tubes were replaced.
- In 2001, all generating bank tubes were full length inspected and no significant issues were reported.
- In 2003, a superheater tube failed due to overheating. The suspected cause was due to condensate clearing during start-up or deposit buildup in the bend. Concern was expressed about the significant magnetite build up in the failed tube and the potential magnetite cracking/pieces breaking off the tubes and getting carried over to the turbine. Any carryover would cause damage to the turbine control valves and turbine blading.
- Lay-up procedures for all boilers at the Plant have improved significantly and provide much better protection during long periods of unit shutdown.
- In summary, based on past boiler history, good reliability of the unit over the past few years, projected limited cold starts and low projected operating hours to end of life; there are no outstanding known issues that would restrict operation of boiler to end of 2018. This analysis is made on the assumption that all required maintenance is done, current plant lay-up activities are continued, boiler safety valves are yearly tested and overhauled as needed, and boiler safety interlock, control and metering devices, etc. are maintained, calibrated and checked to ensure safe operation of the boiler. Recent insurance reports and Provincial boiler inspector verbal statements provide a backup to this recommendation.

4.2.6 Instrumentation and Controls

- The Plant has a common central control room for all station generating units. The older units use mostly the original pneumatic control systems and panels in the control room with push buttons, chart recorders, lights and relay cabinets. A new DCS was installed for Units 9 and 10 and it provides operators with control and monitoring of the boiler, steam turbine and plant auxiliary equipment along with providing alarms, logs and trending.
- Age and lack of spares for all the old plant instrumentation and control systems is a reliability issue. Most pneumatic transmitters, valve and drive positioners, etc. are obsolete and relatively few spares exist for maintenance of this equipment. Experienced station staff have done a remarkable job keeping this equipment in service and assuming

this staff is available (or replacement with similar background) for the next 4 years, there is a good probability that they can keep this equipment operational.

- NFPA standard burner management systems have been installed on the older #4, #5 and #6 boilers, and with regular maintenance should be adequate for safe operation of the unit to end of life.
- Units 9 and 10 DCS systems were reported in an ABB report that the system components are now or will soon be obsolete. With limited operation of the units over the next 4 years and support from the OEM, or others if required, there is no reason why this system can't continue to function without major upgrades to end of 2018.
- Reliability of all station control systems is and will be an issue and any significant improvement in reliability would require extensive and costly capital upgrades. External support is available to assist in the troubleshooting and maintenance of this equipment and for the short period of time it will be in service, there is a good probability that the systems can be kept working until the station end of life.

4.2.7 Station Safety Valves

- Safety valves on all pressure vessels at the station require mandatory scheduled inspection and maintenance programs in accordance with the relative Provincial Boiler and Pressure Vessel Act. Generating stations are required to have approved station instructions/procedures and/or maintenance plans in place to ensure inspection, maintenance and testing of safety relief valves comply with the relative Provincial Act.
- The documented program established by your station staff and accepted by your Provincial boiler inspector is adequate to provide protection to all station pressure vessels. All valves are inspected and maintained on a 6 year schedule and repaired or replaced as required should any valve leak or fail to reseat.
- Station staff have assured me that the established program is being followed and that maintenance and inspection records are available for review as required.
- In between the 6 year scheduled maintenance program, standard operating practice for all boilers is to manually lift all boiler drum and superheater safety values. This practice takes place each year at the end of each fall training run to ensure valves are operational. **My recommendation would be to lift all valves at the start of each training run to ensure that atmospheric conditions in the plant during the 8 month layup has not affected their operational capability and they provide protection during the training run.**

4.2.8 Deaerators

- Catastrophic failure of deaerator pressure vessel welds has included incidents that resulted in plant personnel fatalities. Failures originated as cracks caused by residual, thermal, static and dynamic stresses, with growth of cracks accelerated by corrosion fatigue. In older designs, similar to those on Units #9 and #10, up to 50% of those that have been inspected have cracking issues in both the circumferential and longitudinal weld seams with the highest incidence occurring at the "T" junction of the two seams. Cracking has also appeared at different service nozzle welds affected by thermal expansion and thermal shock. Cracking was also prevalent in areas where corrosion pitting exists and as a result corrosion fatigue of the material,
- Inspection of the internal tank and weld seams should include circumferential, longitudinal, nozzles and other welds affected by residual and operating stresses.
- National Board and NACE have established criteria that defines frequency of deaerator inspection requirements. In summary, repaired cracks should be inspected within one year and no vessel should operate longer than 5 years without a comprehensive NDT inspection.
- A limited inspection was performed on both Unit #9 and #10 deaerators in 2007 and no records have been found to confirm any further inspection has taken place. **As failure could result in personnel injury or fatality, it is my strong recommendation that this inspection take place as soon as possible.**

4.2.9 High Energy Piping – All Units

- Assessment of critical components or systems that could fail and cause personnel injury or a fatality is an internal part of this report; and as such, high energy piping systems must be included.
- Limited records are available that confirm the generating units have had an audit and inspection of their high energy piping systems. **It is recommended that a sample of all units most highly stressed joints, piping hangers and feedwater piping susceptible to flow accelerated corrosion be NDT inspected.** High energy piping systems that should be included in this sample inspection program are as follows:
  - Main steam from superheater outlet header to and including steam turbine inlet pipe;
  - Condensate and feedwater system piping; and
  - High pressure boiler and turbine drain piping and 250 pound auxiliary steam.

  Note: The 400 pound common header had an inspection in 2007 and only minor wall thickness reduction was identified and all welds inspected showed no defects. One or

two areas that indicated some wall thinning should be reinspected to ensure safe operation to end of 2018.

- **I would recommend that Maritime Electric request the services of Rob Griffin, Senior Technical Specialist with NB Power to assist station staff develop a sample inspection program that would be cost effective yet provide the station with some confidence that the piping systems can survive without a catastrophic failure to the end of their operating life.** Rob is responsible for the development and implementation of this program for NB Power. For information only, inspection and analysis of 12 sites would cost around 30 thousand dollars.

4.2.10 Turbine Extraction Steam Non-return Valves

- Turbine extraction steam non-return valves provide water induction protection to the turbine in the event of a feedwater heater tube leak and level control malfunction, thus flooding the extraction line. Feedwater then could be inducted into the turbine steam path and cause catastrophic damage.
- **As no documentation could be found that maintenance and inspection of any unit extraction non-return valves has been done since early 1990, it is strongly recommended that these valves are inspected for valve internals condition and are in adequate condition to protect each turbine.**

4.2.11 High and Low Pressure Feedwater Heaters

- Unit #10 H.P. heater was 100% retubed in 2005.
- Unit #10 L.P. heater #1 tube bundle was 100% eddy current inspected in 1991. Wall thinning was detected in most tubes in the range of 20 to 45% wall loss.
- Unit #10 L.P. heater #2 tube bundle was 100% eddy current inspected in 1991. Wall thinning was detected in most tubes in the range of 20 to 60% wall loss. 18 of the tubes were rejected and assumed plugged.
- New safety valves were installed on both L.P. heaters in 2002.
- A spare tube bundle for one L.P. heater is available in Stores.
- Unit #9 H.P. and L.P. heaters were eddy current inspected in 1990 but the report could not be located. GEC Alstom noted during the major turbine overhaul that year significant erosion/corrosion of all heater shells. In 2008, H.P. heater experienced a leak and new safety valves were installed on both L.P. heaters.

- Unit #8 H.P. and L.P. heaters were 100% eddy current tested in 1991 with no major issues detected.
- Unit #7 H.P. heater tube bundle was 100% eddy current tested in 1994. Significant erosion was noted around tube sheet area. 5 tubes were found plugged prior to inspection and several tubes noted to have denting and fretting issues. 4 of these tubes were rejected and assumed plugged.
- Unit #7 L.P. heater #1 tube bundle was 100% eddy current inspected in 1994. 69 of tubes were rejected with greater than 60% wall loss and assumed plugged.
- Unit #7 L.P. heater #2 tube bundle was 100% eddy current inspected in 1994. Several tubes had wall loss due to pitting in 30% to 40% range and 2 were rejected with greater than 60% wall loss and assumed plugged.
- Unit #6 H.P. and L.P. heaters – no records available.
- As with most balance of plant systems, maintenance is done on this system for each unit on a repair as required basis. This maintenance should be adequate to get these systems through to the end of 2018. Based on available records found, very little repairs have been made to each unit's feedwater systems and there is a probable risk that some heaters will experience leaks. It is therefore critical that the feedwater heater level control systems on all units are maintained and checked on a regular basis to ensure proper operation. Malfunction of the system could result in feedwater being induced into the turbine steam extraction lines and if non-return check valves not working properly, would result in carryover to turbine and result in significant damage to the unit.

4.2.12 Generator Air Coolers

- Documents related to past history of maintenance and inspection of all generator air coolers is limited and as such, it is impossible to know the present condition of these coolers.
- Any cooler leaks present a significant risk to all generators, especially to the rotor field winding insulation resistance resulting in a forced outage and to generator end rings when exposed to moisture which could lead to stress corrosion cracking and resultant failure of the rings.
- Failure of any generator rotor end ring would pose a significant safety risk to plant personnel and it is imperative that these coolers are maintained in such a manor to eliminate any possibility of cooler leaks. According to experts, end ring shrink fit stresses are present even during shutdown and failure could occur in less than 500 hours in moist conditions.

- **All generator air coolers should be inspected, tubes tested for leaks and repaired as required to ensure no moisture ingress to the generator. This is considered a very high level priority for generator and end cap reliability.**

4.2.13 Generator Dehumidification Systems

- In summary, operations and maintenance staff do an adequate job monitoring and maintaining these systems and insure that they are in operation as required.

4.2.14 Turbine/Generator Vibration Monitoring Systems

- **Due to the condition of the steam path blading in units #8, #9 and #10, it is my recommendation that new Bentley Nevada (or similar quality) vibration monitoring system with trip capability be installed on the units.**
- New systems would monitor shaft vibration (much more sensitive to vibration issues than current bearing shell type) and would, although not guarantee, trip the units before catastrophic damage to the units caused by blade failures, bearing failures, etc.
- Installed cost per unit would be around $50,000.

4.2.15 Staff Plant System Training and Layup Documentation

- Staff plant system training documentation is very good and provides excellent training guidelines for all operation staff and is used each year during unit training and operational runs.
- Plant layup procedures and documentation are very good and provide excellent guidelines to operation and maintenance staff on how and what is required to properly layup each unit during the 8 month shutdown period.
- Operations and maintenance staff should be required to sign off on all documented layup and start-up/shutdown activities to ensure that all systems and equipment work was completed.

4.2.16 Unit Operation

- **Due to the age and condition of all units, it is my strong recommendation that when units are put into service during the fall training and system demand winter runs they be kept online at some load until no longer required.** This action will limit the

number of thermal cycles the equipment will undergo and reduce the risk of component failure.

4.2.17 Generating Unit Operational Review

- The Charlottetown Station generating units are old and most systems and components are reaching the end of their operating life. Station staff have done a remarkable job keeping the units in service as required when called upon to operate and provide critical Island load. The goal of continued safe and relative reliability of the units is of the highest priority for the Utility at the executive and station management levels. **To assist meeting this objective, I strongly recommend an evaluation of each unit's turbine and boiler control and safety systems to ensure that they will adequately protect both station staff and the units to the end of the year 2018.** The scope of the evaluation would be as follows:

  - Turbine and Auxiliaries

    - Contract an OEM experienced start-up/commissioning engineer to provide overview and direction, where required, to cover the following:

      A. Review of the existing start-up, operation and shutdown of each unit.

      B. Modification, if required, to pre-operation checklists, start-up, in service, and shutdown procedures. Modifications, if required, must take into account the age and condition of each unit.

      C. Review of the 8 month lay-up program for each unit.

      D. Review of the existing turbine/generator supervisory monitoring and trip protection devices to ensure that they are in an adequate condition to provide protection of the units to the end of their operational life.

      E. Provide a list of pre-operational maintenance/calibration requirements for unit supervisory, monitoring and trip protection devices.

  - Boiler and Auxiliaries

    - Utility requests the services of an experienced boiler service engineer and a boiler control engineer to review the following:

      A. Boiler service engineer will review the boiler maintenance programs, visually inspect the furnace framing system (i.e. buck-stays, stiffeners, supports, etc. and review the safe work practices employed for boiler start-up, shutdown, and lay-up.

B. Boiler control engineer will perform an audit of the burner management system which includes a review of documentation and system test to confirm safety systems are active and properly functioning. This review will ensure that the boiler is protected from explosion and can operate in a safe manner.

4.2.18 Low Voltage (48v) Switchgear

- The existing old low voltage switchgear does not have arc flash hazard protection. The switchgear bus bars are not insulated and both the line and load studs are fully exposed when the breakers racked in or racked out of the cell. A recent arc flash study was completed and provided recommendations for different levels of staff protective gear that must be provided and worn when working on or operating this switchgear. For plant personnel safety, it is imperative that these recommendations are enforced.

4.2.19 Operating #6 Boiler for Auxiliary Steam

- Station staff operate #6 boiler to provide auxiliary steam to different plant systems such as bunker "C" tank and plant supply line heating, atomizing steam for start-up of other boilers, etc. In this mode, the boiler operates at a low steam load and generally not optimized fuel combustion. More than normal unburned carbon is carried over in the gas stream and gets deposited in the air heater and, in addition, drops out of the stream where flue ducts make abrupt changes in direction. This situation creates a potential risk for a serious back end fire from spark carry over and station staff must take care to ensure that these areas are clean to prevent the potential for this to happen. Stations staff at the end of each operating year clean up the gas duct and air heater, but in addition should inspect these areas during operational periods on a regular basis when boiler is shut down to ensure the risk for back end fire is eliminated.

4.2.20 Staffing Issues

- Having qualified and experienced staff available to operate and maintain the Charlottetown Plant generating units until the end of 2018 is both critical and essential to operation of these units in a safe manner.
- It becomes even more critical if Island load continues to increase and more frequent generation is required from the Station. It is my understanding that as many as five key experienced maintenance and operations staff could potentially retire within the next two years and this could have a serious impact on the plants ability to operate in a safe and

reliable manner. A priority concerted effort is required by Maritime Electric executive and station management to develop a program that will ensure that existing station experienced staff are retained to the end of 2018. Should this not be possible, other options that could be considered are to hire part time experienced retired staff from utilities like NB Power or Nova Scotia Power to cover the 5 or 6 month period they would be required each year. This type of experienced staff must all have older unit operating and maintenance backgrounds similar to what is required at the Charlottetown Plant as this would reduce critical retraining requirements. Original Equipment Manufacturer's expertise is still available on the maintenance and controls areas and, although expensive, could supplement or provide full time services to meet station needs.

APPENDIX A

ALSTOM SERVICE BULLETIN – GENERATOR END RETAINING RINGS

What This *Bulletin* Is All About

Stress Corrosion Cracking (SCC) in retaining rings made of X55MnCr185 steel continues to be a problem throughout the industry. Even when every effort is made to ensure the correct operation and maintenance environments, failures cannot be excluded completely. A number of power plants have experienced retaining ring failures in the recent past resulting in considerable damage and loss of production.

ALSTOM therefore strongly recommends replacing retaining rings made of X55MnCr185 with ones made of X8CrMnN1818. This new material was first introduced in the early eighties and has proven to be more resistant to SCC than the older steels. These recommendations are independent of the original manufacturer and former history of the turbo generator.

Until a replacement of existing retaining rings made of X55MnCr185 can take place, ALSTOM recommends, for all kinds of generators, to perform inspections at every outage and to reduce risk by taking the precautionary measures as described within this service bulletin.

However, bearing in mind that the risk of SCC cannot be excluded completely, even by carefully implemented preventive measures, an increasing number of customers are deciding to install retaining rings made of the new resistant steels, thereby overcoming Stress Corrosion Cracking-related problems.

Contents

Background

The main function of the retaining ring is to retain the field windings. These windings extend beyond the main body of the rotor at each end of the generator and during operation exert a high centrifugal force on the retaining rings. This results in the retaining ring being a significantly stressed generator component.

Until the beginning of the 1980's and the introduction of the new material X8CrMnN1818, retaining rings throughout the industry were manufactured from steels which proved to be susceptible to a phenomenon known as Stress Corrosion Cracking (SCC). Stress corrosion cracking is understood to be a continuously growing crack in metals and steels under the influence of a corrosive environment at pure static tensile stress or superposed low frequency pulsating stress (DIN50900).

The industry changed to the new retaining ring material when it became available, but there still remain about 16,000 retaining rings in use world-wide with old steels. This has resulted in a number of test techniques being developed to assess the condition of these older rings. However even these have not been sufficient to avoid occasional very serious failures.

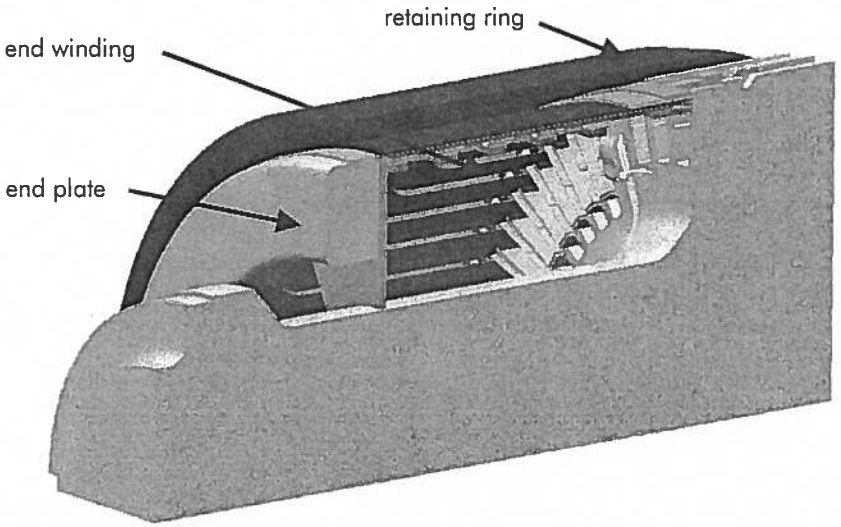

Figure 1: cutaway view of a retaining ring and end winding

Our Solution

Although the steel of the old retaining rings (X55MnCr185) has given reliable service for some decades now, it has always had one significant handicap – it is liable to Stress Corrosion Cracking. The formation of cracks are facilitated if stress and a corrosive agent (pure water is sufficient) are present.

Until a replacement of existing retaining rings made of X55MnCr185 can take place, ALSTOM recommends for all kinds of generators:

- Careful inspection at every outage. When returning retaining rings made of older steels to operation, they must be free of surface defects.
- Utmost care must be taken to keep the rings dry under all circumstances.
- We encourage customers to discuss appropriate measures for the various types of generators with ALSTOM's qualified personnel.

Furthermore, to reduce the risk of SCC, the following measures and precautions are necessary:

- Monitoring of the dew point with a stationary gauge
- Under no circumstances should the generator be operated with the dew point above the recommended level
- At every outage the cooler and pipes inside the stator should be checked for leakage
- The retaining rings should be protected at every outage against moisture and handled only by properly trained personnel

Available inspection methods

There are several methods available for crack inspection of retaining rings. ALSTOM's methods are dye penetrate, ultrasonic and eddy current inspection. Each of these methods has their advantages and disadvantages as outlined below, and all indicate only the state of integrity of the retaining rings at that particular point in time.

Dye penetrates and eddy current inspection methods only detect cracks on the surface of the retaining rings. Thus each ring has to be removed to allow inspection of the bore of the ring. Consequently these methods are time-consuming and laborious.

Ultrasonic inspection can be performed with the retaining rings, and often even the rotor, in situ. This naturally shortens investigation time but the method requires special equipment and highly skilled and specialized personnel.

The assessment of the inspection can also be difficult depending on the geometry of the retaining ring. Ambiguous results may lead to the removal of a ring without any SCC.

The new steel for retaining rings

After the problems experienced with the old steels, a new alloy steel, X8CrMnN1818 was developed which exhibits much better resistance to Stress Corrosion Cracking. It is the best material available today in terms of strength, toughness and pitting resistance. Service experience with this material is very positive. The industry quickly changed to the new retaining ring material when it became available.

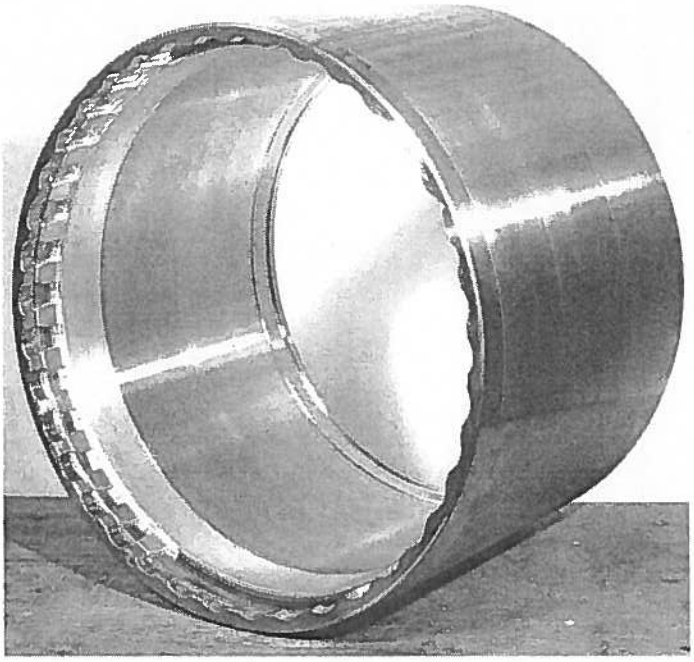

Figure 2: New steel retaining ring

Comparison of old and new material

With the old material, the crack propagation rate increases rapidly with stress level, as shown by our tests. In these tests, the lowest measurable crack propagation rate was 2×10^{-11} m/s (measurement accuracy). With the new material, no crack propagation could be detected over the whole stress range. We therefore know it is certainly below 2×10^{-11} m/s, as indicated in the diagram by the arrows pointing downward.

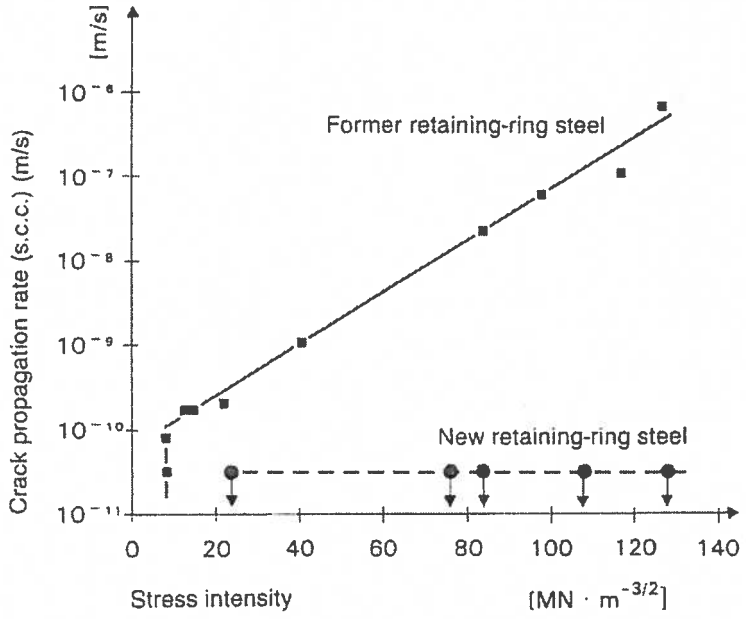

Figure 3: Crack propagation rates old steel / new steel

Your Benefits

ALSTOM has accumulated a wealth of technical, manufacturing and maintenance experience with retaining rings. We can provide competent advice and assistance in overcoming the potentially very serious effects of Stress Corrosion Cracking.

In 1997 approximately 20,000 retaining rings made of the new material (X8CrMnN1818) were in operation. This steel is now well accepted as *the* standard material for retaining rings throughout the industry. Its advantages can be simply summarized as follows:

- It is the best material available today in terms of strength, toughness and pitting resistance. Very positive service experiences with the material

- Therefore ALSTOM strongly recommends changing the retaining rings to X8CrMnN1818 material.

Should you have any questions regarding any of the above, please do not hesitate to contact us, referring to the number and subject of this Service Bulletin.

ALSTOM

ALSTOM (Switzerland) Ltd, Power Service, Brown Boveri Strasse 7, CH- 5401 Baden / Switzerland,
Phone +41 (0)56 205 77 33, Fax +41 (0)56 205 71 71, www.service.power.alstom.com

APPENDIX B

ALSTOM QUOTE TO PROVIDE EXPERIENCED START-UP ENGINEER TO ASSESS OVERALL OPERATION OF GENERATING UNITS

Appendix "B"

Re: Maritime Electric Unit 6,8 & 9 Operation support

From:	Gary Ross <garyross@nb.sympatico.ca>
To:	PATEL Ghanshyam <ghanshyam.patel@power.alstom.com>
Cc:	RUDDOCK Richard D <richard.d.ruddock@power.alstom.com>
Priority:	Normal
Date	12/21/2014 07:55 PM

As discussed, the following is what the requirement is.

Maritime Electric Charlottetown Generating Station consists of the following turbine/generator sets:
- Unit #6 - C.A. Parsons - 7.5 M.W. - installed in 1952 - operating hours: 216,000
- Unit #7 - Brown Boveri - 7.5 M.W. - installed in 1956 - operating hours: 188,000
- Unit #8 - C.A. Parsons - 10 M.W. - installed in 1960 - operating hours: 123,000
- Unit #9 - AEI - 20 M.W. - installed in 1963 - operating hours: 165,000
- Unit #10 - AEI - 20 M.W. - installed in 1968 -operating hours: 129,000

The utility requests the services of an experienced startup/commissioning engineer. The scope of service would include the overview and direction, where required, of station staff and cover the following:
- Review of the existing startup,unit operation, and shut down of each unit.
- Modification, if required, to pre-operational checklist, startup, in service and shut down procedures. Modifications, if required, must take into account the age and condition of each unit.
- Review of the 8 month layup procedures for each unit.
- Review of the existing turbine/generator supervisory monitoring and trip protection devices and recommend, if required, additional protection equipment that would be adequate to extend the safe operation of the units to the Spring of 2018.
- Provide a list of pre-operational maintenance/calibration requirements for unit supervisory/monitoring/trip protection devices.

Yearly operation of each unit until the Spring of 2018 will be as follows:
- Late Fall startup of each unit for training staff - approximately 48 hours each. Units would be put online for that period with no other cold start.

Some time between mid-January to the end of February, all units may be required for system load. Run-up and operation of each unit would be used as training runs and system load requirements. Units will not be shut down during this period and will be operating between minimum and maximum load. Projected operations to be approximately 240 hours/unit.

Operational summary - Approximately 300 hours per unit / year.

Please provide, as soon as possible, your daily rate for start up/commissioning engineer, along with your estimated time to complete this work. Also, provide a plus 25% cost estimate including expenses to complete the above scope of work. Start up/commissioning engineer is required for the mid-January to end of February run - units will be started up sometime in this period.

APPENDIX "B"

POWER
THERMAL SERVICES

ALSTOM

January 20, 2015

To,
Ross Consulting Inc.
Gulliver Drive, Fredericton
E3A 5B1

Attention: **Gary Ross**

Reference: **Maritime Electric – Unit #9 & 10 Operational Support**
ALSTOM Proposal # G01-CA-0001645-S04-40624

Alstom Canada Inc. is pleased to submit the attached proposal for the supply of a Commissioning Engineer **(Class D)** to provide Start-up and commissioning support for Maritime Electric Charlottetown Generating Station. We thank you for the opportunity to offer our services to assist Maritime Electric Generating Station.

In order to meet the requirements of the work scope identified, we are pleased to offer the following for your consideration and acceptance.

1. SCOPE OF WORK

Alstom to provide technical support and specialist services for Maritime Electric Generating Station consisting of:

One Commissioning Engineer **(Class-D) to assist MEGS First Line Managers and Assistants assigned to the Unit 9 & 10 to perform** Start-up and commissioning turbine /generator sets.

Alstom will also provide the following service under fixed price.

- Project preparation and Report writing
- Project management
- Submission of Report
- Immigration Support

845 Harrington Court
Burlington, Ont. L7N 3P3
Tel: (905) 333-2052
Fax: (905) 333-4921

Alstom Power Canada Inc.

The following **variable price services** will be provided. The variable pricing will be based on a "time and expense basis" in accordance with Alstom Power Canada Inc's 2015 Service Rates. Please note that once a component of variable pricing is selected, the corresponding fixed pricing must also be selected.

Alstom Commissioning Engineer will provide technical overview and direction for following scope:

- Review the existing startup, unit operation and coast down of unit 9 & 10
- Modifications, if required to pre-operational checklist, start up, in service and shut down procedures
- Review of 8 month layup procedures for unit 9 & 10
- Review of existing turbine/generator supervisory monitoring and trip protection devices and recommend, if required, additional protection equipment to extend the safe operation of the units till Spring of 2018
- Provide a list of pre-operational maintenance/calibration requirements for unit supervisory/monitoring/trip protection devices

Please note that this proposal is subject to the availability of personnel at the time of receipt of a purchase order from Maritimes Electric Generating Station. Alstom needs one week's advance notice for the arrangement of our Commissioning Engineer (Class-D).

Estimated Duration at Site: Three (3) working weeks; 6 days a week (minimum 60 hours each week)

2. ALSTOM'S RESPONSIBILITIES:

Alstom will provide technical services and advice to Maritimes Electric GS (MEGS) First Line Manager. The technical service and advice will include:

- Advising MEGS personnel as required.
- Coordinating responses to queries from MEGS that require a response from the responsible Alstom Service Execution Center;
- Providing recommendations, as requested by MEGS, based on operational review of the unit.

3. MARITIMES ELECTRIC GENERATING STATION (MEGS) RESPONSIBILITIES:

Maritimes Electric Generating Station (MEGS) maintenance and operating personnel will be involved in all aspects of the startup, unit operation and shut down of unit 9 & 10. MEGS responsibilities with regards to the commissioning shall consist of the following:

- All responsibilities associated with meeting station regulatory requirements, managing the outage (schedule, resources, etc.), providing reasonable office space and services for Alstom personnel and following up on and dispositioning of any reports submitted by Alstom;
- Provision of standard and special OEM tooling for the MEGS Unit

- Monitoring costs incurred by MEGS for the technical services being provided by Alstom and advising Alstom if and when the MEGS allocated budget for these services will be exceeded and when these services are no longer required;
- Identify in writing within 10 days from the date MEGS becomes aware of any concerns, it has regarding the quality and completeness of any technical advice and recommendations provided by Alstom, to the designated Alstom Project Manager;

3. PRICE

All pricing refers to the entire scope of services offered and shall only be valid in the stated quantities. If only individual parts of the scope of delivery are ordered, we reserve the right to adjust the price(s) concerned accordingly.

3.1 FIXED PRICE SCOPE:

Outage Management Fixed price: **$19,300.00 CDN (Fixed)**

The above fixed price covers Commissioning Engineer preparation time, report writing time, project management support and immigration support.

The above price does not include taxes/duties, which will be billed at actual cost separately. (i.e. Delivery Duty Unpaid (DDU – Incoterms 2000).

3.2 VARIABLE PRICE SCOPE (T & M):

The following **variable prices (T & M)** will be invoiced for **Commissioning Engineer (Class-D).** The variable pricing will be invoiced based on actual "time and expense basis" in accordance with Alstom Canada Inc., Power's 2015 Service Rates. Please note that once a component of variable pricing is selected, the corresponding fixed pricing must also be selected.

Daily time sheets will be documented and submitted to MEGS with the invoice. Unique or regular evening and nightshift arrangement for shift work will be subject to a premium (30%) as per the Alstom Canada Inc., Power's 2015 Service Rate sheet.

The following is an estimated price for Alstom **Commissioning Engineer (Class-D):**

Estimated Price: **$ 72,000.00 CDN (Variable)**

Not included in our price:

- Any engineering activities in respect to the outage other than those described above. These activities will need to be covered under the Alstom ERTS System and will be quoted and invoiced separately if required.

Stand Down Period:

In the event, a "Stand Down" period is invoked, in order for Alstom to protect these Commissioning Engineer from being assigned to other contracts and thus provide the services and continuity required by MEGS, we would be faced with expenses much more than the application of "overhead costs". It is corporate policy for these occasions to provide a fair and equitable price to our customers; whilst still maintaining revenue to the company therefore we would require their cost/hr for 8 hours/day be charged plus all expenses at cost.

5. MILESTONE PAYMENTS

Alstom's offer and pricing is based upon the following progress payment schedule.
100% of purchase order value due upon completion of work
Alstom's payment terms are Net 30 days from date of invoice.

If MEGS disputes the accuracy of any invoice or statement issued by Alstom, then MEGS must notify Alstom in writing before the due date of the amount in dispute, reasoning for dispute and proposed remedy. Any undisputed amount owing shall be paid in full by MEGS before the due date.

6.0 SCHEDULE

Planned travel date:	Tentative January 25, 2015
Start date on site:	January 26, 2015
Estimated travel back date:	February 15, 2015

Approx. duration on site: 3 weeks; 6 days a week
Approx. working time: 10 h / day

Please note that this planned date is based on Maritime Electric Generating Station Purchase Order receipt. Any change in start date will be based on mutual agreement.

7.0 PROPOSAL VALIDITY

Proposal is valid for 30 days from the date shown above. The availability of Alstom-Commissioning Engineering Service is subject to prior sale.

8.0 EXTRA WORK

Extra work is defined as "work, which is beyond the defined Scope of Work. Extra work will be performed under Alstom published rate schedules in effect at the time the work is performed. Extra work may affect the project schedule.

9.0 CANCELLATION PROVISION

If Customer cancels all or any part of the work after award, a 10% cancellation fee will apply and customer will be charged for work completed to date of cancellation. Charges for work completed to date of cancellation will be calculated at the T&M rates in effect at the time of such cancellation. The charges for work completed are in addition to the 10% cancellation fee. Alstom shall be promptly reimbursed for cancellation fees and such charges.

10.0 PROPRIETARY STATEMENT

The information contained in this proposal is proprietary to Alstom and shall be retained by the recipient in confidence and shall not be published or otherwise disclosed to third parties without the express written consent of Alstom. The foregoing shall not preclude the use of any data which (i) was in the Customer's possession without restriction as to use prior to receipt as proprietary of the same or similar data from Alstom, (ii) is or becomes available from a public source on or after such receipt from Alstom or (iii) is obtained by the recipient from a third party not under obligation of confidentiality or other restriction with respect to use.

11.0 TERMS AND CONDITIONS

The terms and conditions offered for this proposal are as per Alstom Terms and Conditions as attached.

We trust that the above proposal meets with your requirements.

Alstom would like to thank you for providing the opportunity to support this project. If you have any questions, please contact Niketa Patel at (905) 333-2037.

Yours truly,

Niketa Patel, P. Eng., P.M.P
Proposal/Project Manager, Rotating Equipment
Tel: (905) 333-2037
Cell: (416) 659-2473
Fax: (905) 333-4921

Proposal attachments:

Attachment 1: ALSTOM Technical Service Advisor's Rate Sheet 2015
Attachment 2: ALSTOM Terms and conditions.

RE: Maritime Electric Unit 6,8 & 9 Operation support

From: PATEL Ghanshyam <ghanshyam.patel@power.alstom.com>
To: garyross <garyross@nb.sympatico.ca>
Cc: PATEL Niketa <niketa.patel@power.alstom.com>

Priority: Normal
Date 01/20/2015 08:28 AM

Gary,

Our expert is available to start on Monday (Jan 26th)
Are you guys ready to have him on site to start for Jan26th ?

I am going to submit a proposal today morning and need a PO before end of today.

Best Regards,
Ghanshyam

From: garyross [mailto:garyross@nb.sympatico.ca]
Sent: Thursday, January 15, 2015 3:50 PM
To: PATEL Ghanshyam
Subject: RE: Maritime Electric Unit 6,8 & 9 Operation support

Your proposal is ok. These two units are the most important, so give us your proposal asap. Thanks .

Sent from my BlackBerry® PlayBook™
www.blackberry.com

From: "PATEL Ghanshyam" <ghanshyam.patel@power.alstom.com>
To: "Gary Ross" <garyross@nb.sympatico.ca>
CC: "RUDDOCK Richard D" <richard.d.ruddock@power.alstom.com>, "PATEL Niketa" <niketa.patel@power.alstom.com>
Sent: January 15, 2015 2:53 PM
Subject: RE: Maritime Electric Unit 6,8 & 9 Operation support

Hi Gary,

We can offer support for only Unit 9 and Unit10. Alstom is not willing to commit supporting the units, which are not Alstom.
If this is acceptable let me know and I will find out availability and then provide a proposal.

Currently Alstom have one LTFA scheduled to be in the office until the start of March. Taking account of other commitments, we could potentially spare 2 or 3 weeks in that window if helpful.

From our records, we have only worked on the AEI 20MW units in the past (Unit 9 Andy White 2002 and Unit 10 Chris McGrath 2004).

Sorry Alstom is not able to meet your request completely, however I would like to be upfront and clear with what we can offer.

Best Regards,
Ghanshyam
1-289-244-3408

From: Gary Ross [mailto:garyross@nb.sympatico.ca]
Sent: Sunday, December 21, 2014 4:55 PM
To: PATEL Ghanshyam
Cc: RUDDOCK Richard D
Subject: Re: Maritime Electric Unit 6,8 & 9 Operation support

As discussed, the following is what the requirement is.

Maritime Electric Charlottetown Generating Station consists of the following turbine/generator sets:
- Unit #6 - C.A. Parsons - 7.5 M.W. - installed in 1952 - operating hours: 216,000
- Unit #7 - Brown Boveri - 7.5 M.W. - installed in 1956 - operating hours: 188,000
- Unit #8 - C.A. Parsons - 10 M.W. - installed in 1960 - operating hours: 123,000
- Unit #9 - AEI - 20 M.W. - installed in 1963 - operating hours: 165,000
- Unit #10 - AEI - 20 M.W. - installed in 1968 -operating hours: 129,000

The utility requests the services of an experienced startup/commissioning engineer. The scope of service would include the overview and direction, where required, of station staff and cover the following:
- Review of the existing startup,unit operation, and shut down of each unit.
- Modification, if required, to pre-operational checklist, startup, in service and shut down procedures. Modifications, if required, must take into account the age and condition of each unit.
- Review of the 8 month layup procedures for each unit.
- Review of the existing turbine/generator supervisory monitoring and trip protection devices and recommend, if required, additional protection equipment that would be adequate to extend the safe operation of the units to the Spring of 2018.
- Provide a list of pre-operational maintenance/calibration requirements for unit supervisory/monitoring/trip protection devices.

Yearly operation of each unit until the Spring of 2018 will be as follows:
- Late Fall startup of each unit for training staff - approximately 48 hours each. Units would be put online for that period with no other cold start.

Some time between mid-January to the end of February, all units may be required for system load. Run-up and operation of each unit would be used as training runs and system load requirements. Units will not be shut down during this period and will be operating between minimum and maximum load. Projected operations to be approximately 240 hours/unit.

Operational summary - Approximately 300 hours per unit / year.

Please provide, as soon as possible, your daily rate for start up/commissioning engineer, along with your estimated time to complete this work. Also, provide a plus 25% cost estimate including expenses to complete the above scope of work. Start up/commissioning engineer is required for the mid-January to end of February run - units will be started up sometime in this period.

CONFIDENTIALITY : This e-mail and any attachments are confidential and may be privileged. If you are not a named recipient, please notify the sender immediately and do not disclose the contents to another person, use it for any purpose or store or copy the information in any medium.

ALSTOM

Alstom Power Canada Inc. 2015

Thermal and Nuclear Service Technical Field Advisor (TFA) Rates **(January 1, 2015)**

Field Services are offered in five categories for technical advice during installation, inspection, investigation, testing, overhaul and maintenance, of equipment installed within Canada.

Rate Schedule

Class	Description	Straight Time(3 *)	Overtime (4 **)	Overtime (5 ***)
A	**Specialized Hands-on support services: Turbine Bladers, Generator Winders, Machinists,, etc**	**$236.00/hr**	**$321.00/hr**	**$404.00/hr**
B	**Advisors, Site Managers and Technicians, with a high level of experience and training**	**$246.00/hr**	**$334.00/hr**	**$422.00/hr**
C	**Lead or Specialized Advisors and Technicians**	**$278.00/hr**	**$378.00/hr**	**$477.00/hr**
D	**Senior Technical Advisors, Site Engineers for administering of O & M contracts, mechanical and electrical/I & C.**	**$315.00/hr**	**$429.00/hr**	**$542.00/hr**
E	**Factory based Consultants and Engineers for Performance Evaluation, Condition Assessment**	**$340.00/hr**	**$462.00/hr**	**$582.00/hr**

Notes:

1. a) All rates are quoted in Canadian Dollars and apply for Canadian personnel. Applicable rate classifications for personnel based outside Canada will be confirmed prior to commencement of work. b) All rates are based on a ***Minimum 60 hour work week (10 hours per day).***c) All rates are subject to a ***Minimum Billing*** requirement of: "8 hours" per day, for any hours worked or traveled, if less than actual 8 hours. d) Unique or regular evening and night shift arrangement for shift work will be subject to a premium (30%), and will be negotiated in accordance with applicable labour laws prior to a contract commencing. e) TRAVEL: as specified below: and f) RENTAL: as specified below (if any).

2. "Assignment preparation or pre-shutdown scheduling and demobilization" will be charged per actual hours worked. Special report preparation requirements will be subject to negotiated additional hourly charges.

3. *"Straight Time" (i) for first 8 hours worked, Monday to Friday; (ii) all hours traveled, which are not subject to double time if worked as an Alstom Power recognized holiday; and (iii) customer's recognized holidays whether worked or not, and which are not subject to double time if worked as an Alstom Power recognized holiday.

4. **"Overtime" hours worked in excess of an 8 hour workday, Monday to Friday, and hours worked Saturday, up to 8 hours.

5. ***"Overtime" hours (i) worked on Saturday beyond 8 hours; (ii) worked on Sundays; and (iii) worked or traveled on Alstom recognized Holidays.

6. "Administrative time and expenses" for services provided by non-technical personnel, will be charged as an added cost at the rate of $125.00/hour or part thereof, plus actual expenses. These charges shall apply to those added requirements imposed/requested by Alstom Power's customer, which result in added administrative, accounting, purchasing, clerical etc., cost to Alstom Power.

7. Individual Engineering Hours -$320.00 per hour, Block of 100 Engineering Hours - $26,185.00

In addition to the above RATE SCHEDULE, travel, living and miscellaneous expenses will be charged as follows.

PER DIEM	Calculated from day of departure through, day of return. Per Diem covers meals, local travel and transportation (car rental extra mileage will be billed at cost where applicable), miscellaneous ordinary living expenses and lodging. Per Diem will be invoiced based upon the applicable range of local lodging expense, as follows: (1) $199.00/day (with no local lodging expense) (2) $275.00/day (with local lodging expense, up to $77.00) or; (3) $321.00/day (with local lodging expense $77.00 to $122.00); or (4) $367.00/day (with local lodging expense $122.00 to 168.00); or (5) For Lodging expenses in excess of $168.00, hotel costs will be invoiced, plus 10% admin. Charged in addition to (1) above ($199.00) Proof of lodging expense will be provided a (copy of lodging invoice) and anytime during the assignment that such expense changes. Lodging expense is the sum of the room cost plus applicable taxes.
TRAVEL (invoiced directly to the Customer)	From point of origin to jobsite and return travel. The travel expenses includes (I) travel time at the applicable class rate and (ii) travel expenses as follows: (1) Airfare, taxis, limos, tolls, parking at actual cost, plus personal auto transportation; or (2) Alstom Power or personal automobile mileage at 50 cents/km, for the most direct route.
RENTAL	Alstom Power, quoted rates for instruments, test equipment and special tools from day of shipment to point of return, plus shipping costs from point of origin and return
Immigration	Standard letter $1100.00 Emergency/3rd Party $1800.00 + LTSA $400.00

The above rates do not include HST/PST/GST or any with-holding amounts for Revenue Canada Income Tax Regulations.

Subject to ALSTOM Power Canada Inc., Terms and Conditions for Service, in effect on the date the order is received. Rates are subject to change without notice.

ALSTOM

TERMS & CONDITIONS OF SALE

These terms and conditions of sale shall apply to all, services, equipment, goods or products manufactured, distributed or sold by ALSTOM Power Canada Inc. ("Seller") unless otherwise agreed in writing by the Seller and the Purchaser.

1. **ACCEPTANCE OF CONDITIONS**

The Purchaser, upon receipt of the Seller's acknowledgement of an order, or upon receipt in whole or in part of the shipment sold under an order, or upon payment in whole or in part for the equipment, workmanship, goods, products, and the license of software, related materials supplied hereunder, ("Equipment") or rendition of services ("Services") or both shall be deemed to be an unconditional acceptance by Purchaser of these terms and conditions. Any deletions from, alterations or modifications or additions to the terms and conditions of this order, shall not be binding unless they are expressed in writing and signed by both the Seller's and the Purchaser's authorized representatives.

2. **DELIVERY**

2.1 Equipment sold hereunder unless agreed otherwise shall be delivered Ex Works (...named place) as per Incoterms 2010. Delivery dates specified in any quote are approximate, unless specified as binding. Delivery performance is dependent upon prompt receipt from the Purchaser of all specifications, final approved drawings and any other details essential to the proper execution of this order.

2.2 Upon notification of readiness of Equipment by Seller to Purchaser, Purchaser shall promptly take delivery of the Equipment. Purchaser's delay to take delivery of the Equipment shall result in Purchaser paying storage, maintenance and associated charges and Seller shall invoice Purchaser as if shipment or other performance had been made as originally scheduled. Such storage, handling and maintenance shall be performed at Purchaser's cost and risk. Failure of Purchaser to take prompt delivery shall result in payment terms tied to such delivery becoming due immediately and payable. The Warranty Period hereinafter defined will begin upon such notification of readiness.

2.3 Unless otherwise agreed upon between the parties, Purchaser shall have the sole responsibility of choosing the carrier and routing from Seller's manufacturing facilities to the final destination.

3. **FORCE MAJEURE**

The Seller shall not be liable for the inability to perform or for delays in the execution of its obligations due to causes beyond its reasonable control including but not limited to acts of God, earthquake, terrorism, fires, strikes, labour disturbances, floods, epidemics, quarantine restrictions, war, insurrection or riot, acts of a civil or military authority, compliance with priority orders or preference ratings issued by any Government, acts of Government authorities with respect to revocation of export or reexport permits/licenses, freight embargoes, car shortages, wrecks or delays in transportation, unusually severe weather, or inability to obtain necessary labour, materials or manufacturing facilities or supplies or delays of subcontractors. In the event of any such delay, the Contract schedule will be extended for a minimum of time equal to the period of the delay. The contract of sale will in no event be subject to termination by the Purchaser, due either to delay in delivery or to any other cause, without the prior written consent of the Seller. In the case of termination, termination charges shall apply, including the payment for work performed to the date of termination, overhead and costs arising out of the termination.

4. **WARRANTIES**

4.1 The Seller warrants that during the warranty period hereinafter defined the Equipment sold shall be free from defects in material and workmanship.

4.2 If within eighteen (18) months from the date of notification of readiness of shipment or shipment, as the case may be, or twelve (12) months from date of first use by Purchaser or the end user, whichever date occurs first, the Equipment does not meet the warranties specified above, the Seller agrees to correct any defect, at its option, either by repairing any defective parts, or by making available Ex Works, repaired or replacement parts, provided the Purchaser notifies the Seller promptly of any such defects.

4.3 The cost of removal of the defective Equipment from its related system, site and/or ancillary equipment, and the cost of its reinstallation in such system, site and/or ancillary equipment, including all transportation costs to and from Seller's plant or repair shop, shall be borne exclusively by the Purchaser. The Purchaser shall not return or dispose of any Equipment or part thereof with respect to which it intends to make a claim under the foregoing warranty, without the Seller's express prior written authorization.

4.4 Seller warrants that it shall repair or replace, at its option and Ex Works, software products which fail in a manner which significantly and adversely affects operating performance to conform to Seller's published software product description applicable to the specific software version as delivered to the Purchaser, provided Seller receives written notification of any such failure to conform within ninety (90) days from the readiness of shipment of software. Seller does not warrant that the functions contained in the software will operate in combinations which may be selected for use by the Purchaser, or that the software products are free from errors.

4.5 Where Seller supplies Services, Seller warrants that it shall re-perform Services which are found to have been performed other than in a professional manner and in accordance with sound, generally accepted and professional practices in effect at the time of performance, for a period of one (1) year following completion of the Service, provided Seller receives immediate written notification of the defect.

4.6 Any repaired or replacement part or reperformed Service only shall be warranted for 1 year from the date of repair or replacement. In any and all events, the Seller's warranty obligations shall terminate in their entirety thirty (30) months from notification of readiness to ship or actual shipment, as the case may be, or thirty (30) months following completion of services. The foregoing warranties shall be void in respect to any deficiency or defect resulting from, the Equipment or Services being improperly operated or maintained by the Purchaser, operated under abnormal conditions or contrary to specifications or instructions of Seller, normal wear and tear, modifications or alterations made by Purchaser or a third party without Seller's consent. The Seller shall not be responsible or liable for latent defects.

4.7 **THE EXPRESS WARRANTIES SET FORTH IN THIS ARTICLE 4 ARE EXCLUSIVE AND NO OTHER WARRANTIES OF ANY KIND, WHETHER STATUTORY, ORAL, WRITTEN, EXPRESS OR IMPLIED, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, SHALL APPLY. THE PURCHASER'S EXCLUSIVE REMEDIES AND THE SELLER'S ONLY OBLIGATIONS ARISING OUT OF OR IN CONNECTION WITH DEFECTIVE EQUIPMENT OR SERVICES OR BOTH, WHETHER BASED ON WARRANTY,**

CONTRACT, TORT (INCLUDING NEGLIGENCE) OR OTHERWISE, SHALL BE THOSE STATED HEREIN.

5. **INSURANCE, CHARGES & PROPER CARE**

So long as sums shall remain owing by Purchaser to Seller hereunder, Purchaser shall exercise proper care in the possession and use of the Equipment and shall keep same at all times in good repair and free of all liens, options, taxes, charges, pledges, privileges and encumbrances. Purchaser shall insure Equipment against loss, destruction or theft for the full value of the replacement purchase price of the Equipment.

5.1 The Purchaser waives, on its own behalf and on behalf of its insurers, any right to claim from the Seller, its suppliers, subcontractors or its insurers, any compensation or indemnification whatsoever for damages, loss or costs caused by the Seller, its suppliers or subcontractors.

6. **TITLE & RISK**

6.1 The title to and property rights in the Equipment sold hereunder and any substitutions or additions thereto and the right to possession thereof, whether attached to realty or otherwise, shall pass from the Seller to the Purchaser when the full purchase price of the Equipment has been paid. Upon failure to make any payment as herein provided, the whole purchase price and any note or security given on account therefor shall forthwith become due and payable and the Seller may immediately enter the premises where the Equipment is located and take possession of and remove the same as its personal property, and may retain any or all partial payments already received as a rental charge for the use of the Equipment without affecting any further or other claims which Seller may have against the Purchaser.

6.2 Equipment sold hereunder shall be at the Purchaser's risk on delivery to it as specified in Article 2 above, and the loss or destruction of all or part of said Equipment shall not release Purchaser from any obligations of payment hereunder.

7. **LIMITATION OF LIABILITY**

7.1 Modifications or adjustments to Purchaser's processes or equipment upon the good faith recommendations of Seller shall be made at Purchaser's risk. In no event shall Seller be liable for conditions of Purchaser's site.

7.2 The liability of the Seller, its agents, directors, officers, subcontractors, suppliers, employees and affiliated companies, for any and all claims of any nature, demands, actions, judgements, losses, costs, expenses arising out of performance or non-performance of the Contract or any other matter in connection therewith; shall in no event exceed the Contract Value. Where Seller sells Services, the liability of the Seller, its agents, directors, officers, employees, subcontractors or suppliers for all claims, demands, actions, judgment or expenses related to or resulting from any loss or damage arising out of performance or non-performance of Services, shall in no case exceed in the aggregate the amount paid by the Purchaser to Seller for the Services performed under the Contract.

7.3 No such claim shall be asserted against the Seller, its agents, directors, officers, employees, affiliated companies, subcontractors or suppliers, unless the injury, loss or damage giving rise to the claim is sustained prior to the expiration of the period of warranty herein and no suit or action thereon shall be instituted or maintained unless it is filed in a court of competent jurisdiction within one year after the expiration of the warranty.

7.4 In no event shall Seller, its agents, directors, officers, employees, subcontractors, affiliated companies or suppliers be liable to Purchaser for loss or damage due to delays; loss of profit or revenue; loss of use; economic loss; loss of data; loss of production; costs of capital or costs of replacement power; loss by reason of plant shutdown or inability to operate at rated capacity; downtime, increased expense of operation of plant or equipment; increased cost of purchasing or providing equipment, materials, supplies, or services outside of the Seller's scope of supply, inventory or use charges; claims of Purchaser's customers including owner/end user, even if Seller has been advised of the possibility of such damages; or any indirect, incidental, remote, special or consequential damages of any nature whatsoever, whether such claim is based in contract, warranty, indemnity, tort (including negligence), strict liability, property damage, product liability or any other legal theory.

7.5 The limitations set forth in this Article 7 shall apply and be effective with respect to any claim, cause of action, or legal theory whatsoever including, but not limited to, contract or warranty (including performance guarantees) or breach thereof, indemnity, tort (including negligence), property damage, strict liability, professional liability or product liability.

7.6 Clause 7 shall prevail over any conflicting or inconsistent provisions contained elsewhere in the Contract.

8. **PRICES & PAYMENT TERMS**

8.1 Prices are valid thirty (30) days from date of quotation by Seller. Price adjustment clauses, if applicable, will be stated at the time of quotation and a copy will be included as part of these Terms and Conditions, in an Appendix thereto.

8.2 All prices are Ex Works unless otherwise specified in writing by Seller. Prices quoted do not include federal, provincial, local or any other taxes, charges, levies and duties, and if same are applicable these shall be promptly paid by the Purchaser. Purchaser shall reimburse Seller any late payment penalty.

8.3 In cases where Seller's price includes taxes, charges, levies and duties, in the event of any changes in any taxes, charges, levies or duties, imposed under any federal, provincial municipal or local legislation or authority, after the date of submitting of Seller's tender or quotation and applicable to Equipment or Services sold hereunder, the Seller's sale price shall be adjusted to reflect such increases or decreases. Any penalty or interest charge levied against the Seller due to the Purchaser's late payment shall be to Purchaser's account.

8.4 Price information published in catalogues, bulletins or price lists is not a definite quotation or offer to sell.

8.5 Seller reserves the right to adjust prices on any order for any alterations or changes authorized or made by the Purchaser subsequent to acceptance of the order.

8.6 All prices are in Canadian Dollars unless otherwise specified.

8.7 Payment shall be made direct to Seller's office in accordance with the conditions stated in the order. Unless otherwise specified, payment shall be due net thirty (30) days from the date of sending of the relevant invoice by the Seller, and time is of the essence in Purchaser's execution of any payment hereunder. Any late payment shall bear interest at the rate set by the Seller from time to time which is one and a half percent (1.5%) per month, eighteen

ALSTOM

TERMS & CONDITIONS OF SALE

percent per annum (18%), at the date of issue, calculated and due on a monthly basis.

9. **PATENT INFRINGEMENT**

The Seller will, at Seller's expense, defend any suit which may be brought against the Purchaser based on a claim that any Equipment or part furnished under contract constitutes an infringement of any Canadian patent (provided the Seller is notified promptly of such suit and copies of all papers therein are promptly delivered to Seller) and Seller has exclusive control and decision making power in respect with the claim or suit. In case said Equipment or any part is held by final judgment to constitute infringement and the use of the Equipment or part is enjoined, the Seller shall, at its own expense and at its sole discretion, either procure for the Purchaser the right to continue using the Equipment or part; or replace with non-infringing Equipment; or modify it so that it becomes non-infringing; or remove the Equipment and refund the purchase price and the transportation and installation costs thereof. The foregoing states the entire liability of the Seller for patent infringement in respect to the Equipment or any part thereof. This provision shall not apply to any equipment or part which is manufactured by Seller or third parties, to Purchaser's design or specifications. The Seller assumes no liability for any such infringement and the Purchaser agrees to defend any suit against Seller for alleged infringement arising through the manufacture and sale of Equipment made to Purchaser's design or specifications and to indemnify and hold Seller harmless from any liability arising from any such infringement.

10. **DAMAGES & LOSS CLAIMS**

10.1 Seller shall carefully pack all Equipment sold hereunder and the Seller shall assume no responsibility for damage after having received "in good order" receipts from the carrier at Seller's works.

10.2 All claims for loss, damage and delay in transit are to be transacted by the consignee directly with the carrier. Claims for shortages or incorrect equipment must be made in writing to the Seller within fifteen (15) days after receipt of the shipment. Failure to give such notice shall constitute unqualified acceptance and a waiver by the Purchaser of all claims for shortages or incorrect equipment.

11. **CHANGES**

Seller reserves the right to make changes in design or to add any improvement on Equipment or other goods at any time, without incurring any obligations to install same on equipment or goods previously purchased or leased. Any changes caused or requested by Purchaser affecting the Equipment or otherwise affecting the scope of work must be accepted by Seller and resulting adjustment to price, schedule, or both, mutually agreed in writing.

12. **TESTING & ACCEPTANCE OF GOODS**

12.1 Testing of the Equipment before shipment is carried out in accordance with Seller's test procedures and at Seller's cost. Additional tests shall be agreed upon specifically between Seller and Purchaser and shall be charged to the Purchaser.

12.2 The Purchaser shall examine the Equipment upon taking possession of same and shall inform Seller immediately in writing of all defects and deficiencies for which Seller is responsible. If Purchaser omits to so notify Seller within thirty (30) days of Purchaser's possession of the Equipment, same shall be deemed to have been accepted.

12.3 Acceptance tests are carried out only if they have been agreed upon in writing by the Seller. As far as circumstances allow, such tests will be carried out in Seller's factory. If, for reasons beyond Seller's control, the acceptance tests cannot be carried out within the specified time, the qualities to be determined by these tests shall be deemed proved.

12.4 If it is found from one of the aforementioned tests that the Equipment does not fulfil the terms of the Contract, the Purchaser shall make available to Seller suitable opportunity to remedy any deficiency within a reasonable period of time.

12.5 The Purchaser shall have no other rights than the rights outlined above, in case of delivery of deficient equipment.

13. **TECHNICAL DOCUMENTS**

13.1 Technical documents, such as drawings, descriptions, illustrations and the like, and all weight data, shall serve as an approximate indication only, provided they have not been expressly specified as binding. Seller reserves the right to make any alterations considered necessary.

13.2 All plans, drawings, technical specifications, documents, software, microfilm, data, or proprietary information relating to the Equipment sold, distributed or manufactured hereunder shall be treated in confidence by the Purchaser, who shall ensure the confidentiality thereof. They remain Seller's exclusive property and may be neither copied nor reproduced nor communicated to a third party in any way whatever nor used for manufacture of the Equipment, or parts thereof. They may be used only for operation and maintenance of the Equipment, under terms and conditions specified by the Seller.

13.3 All documents submitted with tenders which do not result in an order shall be returned to Seller on request.

14. **SOFTWARE**

14.1 Where Seller supplies a system program, Seller hereby grants to Purchaser a revocable non-transferable and non-exclusive license to use the computer software packages, related materials, and the intellectual property contained therein, furnished hereunder (collectively, the "Program") for the limited use described herein and in the other documents transmitted to Purchaser by Seller. This license shall remain in effect unless terminated by Seller due to Purchaser's breach of the provisions of this Agreement.

14.2 The Program shall be used only in connection with Seller's Equipment. Purchaser shall have no right to use, print, display, modify or disclose the Program nor duplicate or copy the Program, with the exception that one copy may be made for security purposes.

14.3 The Program is proprietary to Seller and this license allows the Purchaser only the limited right to use the Program, and nothing contained herein shall be deemed to convey any title to or ownership in the Program to the Purchaser.

15. **GENERAL**

15.1 Purchaser shall not assign this contract or any part thereof without the written consent of the Seller, which consent shall not be unreasonably withheld.

15.2 Any order received by the Seller is subject to credit approval and may be cancelled if the Purchaser's credit standing is not satisfactory to Seller.

15.3 This Agreement shall be interpreted according to the laws of the Canadian Province in which the Contract is executed and any and all disputes arising from this Contract shall be submitted to arbitration pursuant to the Provincial Arbitration Act upon consent of

the parties or be referred to a court of competent jurisdiction in the province in which the Contract is executed.

15.4 No terms of Purchaser's purchase order shall apply to this contract, even if subsequent to the terms and conditions hereof, unless agreed in writing by an authorized representative of the Seller.

15.5 No penalties or liquidated damages shall apply pursuant to the inexecution of Seller's obligations hereunder, unless accepted in writing by a duly authorized representative of the Seller.

15.6 These terms and conditions shall supersede and abrogate all previous communications, obligations, commitments or agreements, oral or written, expressed or implied, between the Purchaser and the Seller, in relation to this Agreement and all provisions under the United Nations Convention on the International Sale of Goods (Vienna Convention) shall be excluded.

15.7 Purchaser and Seller acknowledge having specifically requested that this Agreement and all related documents and correspondence be drafted in English.

15.8 Any addenda or appendices to this Agreement, to be applicable to any Contract hereunder, must be signed by both Purchaser's and Seller's respective authorized representatives.

15.9 Notwithstanding anything to the contrary contained in the Contract Documents, in no event shall the Seller be liable for any loss of use of the Purchaser's property or for any tangible property damage to such property.

15.10 Purchaser and its Insurers waive all rights of subrogation against the Seller and its subcontractors for any loss, damage, claim or otherwise arising from or connected with this Contract.

16.0 **DELAYS BY PURCHASER**
The Seller shall be entitled to a contract adjustment in respect to the Contract price and time schedule if its ability to perform the Work is impaired or delayed by the Purchaser or those for whom the Purchaser is legally responsible. The Purchaser and the Seller shall mutually agree on an appropriate adjustment in contract price and time schedule.

17.0 **TIME**
Unless expressly provided in the Agreement in the form of liquidated damages for delay and mutually agreed to in writing, Seller shall have no liability in connection with delay in delivery of goods or services.

18.0 **HAZARDOUS SUBSTANCES**
The Purchaser recognizes that hazardous substances, including but not limited to asbestos may be present at the Worksite or may be generated by the Work, the Purchaser, its agents or subcontractors and the Purchaser agrees to provide for, assume at no cost and to defend, indemnify and hold the Seller harmless from all loss, liability, costs and expenses including legal fees arising out of or connected with injuries or death resulting from exposure to, or from storage and disposal of, such substances by the Seller, its agents, employees and subcontractors. All additional costs resulting from performing the Work in areas where the Seller's employees or subcontractors may be exposed to hazardous substances including costs incurred for their protection as required by Federal and Provincial regulations, shall be to the Purchaser's account.

19.0 **CHANGE IN LAW**
Any changes in laws, taxes, duties, codes or regulations occurring after the date of the Contract shall entitle the Seller to claim for a schedule and price adjustment.

20.0 **OTHER CONTRACTORS**
The Seller shall have no liability arising out of work, installation or assembly performed by the Purchaser or by others, including without limitation any liability arising out of any statutory or implied warranty.

21.0 **EXTRAS**
Seller reserves the right to make changes in design or to add any improvement on Equipment or other goods at any time, without incurring any obligations to install same on equipment or goods previously purchased or leased. Any changes caused or requested by Purchaser affecting the Equipment or otherwise affecting the scope of work must be accepted by Seller and resulting adjustment to price, schedule, or both, mutually agreed in writing.

22.0 **CANCELLATION**
In the event that the Purchaser should terminate this Contract for convenience of the Purchaser, the Purchaser shall pay to the Seller all costs committed to or incurred to date of cancellation, including but not limited to the cost of all labour, material, overhead charges and expenses, plus a share of profit pro-rata with the stage of completion of the Work at the time of such cancellation. In determining cancellation costs reference will be made to the Seller's price structure and hourly charge-out rates as stated in the Contract Documents.

23.0 **TERMINATION BY SELLER**
In the event that the Purchaser is petitioned into bankruptcy, or makes a general assignment for the benefit of its creditors or a receiver is appointed for the property of the Purchaser then the Seller may, without liability terminate this Contract in which case it shall be paid for all work performed to the date of such termination including profit and all overheads together with all other damages arising out of the Purchaser's breach.

In the event that the Purchaser is in breach of its contractual obligations including non-payment of the Seller's invoices then upon written notice given by the Seller the Purchaser shall be given fourteen (14) days to correct the default, failing which the Seller may, without liability, terminate the Contract. The Seller shall be paid for all work performed to the date of cancellation including profit and all overhead together with all other damages arising out of the Purchaser's breach.

24.0 **NOTICE**
The Purchaser agrees to give the Seller immediate notice of any and all claims for which the Purchaser may be liable and the Seller agrees to give the Purchaser immediate notice of any and all claims for which the Purchaser may be liable. All notices, requests, demands or other communications hereunder shall be made in writing and shall be deemed to have been duly given if delivered by hand or if mailed, first class, registered mail, postage prepaid.

25.0 **INDEMNITY**
The Seller shall indemnify the Purchaser against liability for damages arising out of bodily injury to persons including death or tangible damage to property of third parties only to the extent that same were directly caused by the Seller's negligent acts or omissions, but not for the concurrent or sole negligence of the Purchaser, their agents, employees or those for whom in law they are responsible. The Purchaser shall promptly advise the Seller of all such third party claims. The limitation of the Seller's liability for indemnity pursuant to this clause shall be in accordance with the

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TERMS & CONDITIONS OF SALE

Limitation of Liability clause herein. The Seller shall have exclusive control and conduct over the defence of any such indemnified claim.

26.0 The Seller shall retain ownership of all designs, drawings, plans, software, technical documents and know how relating to the Equipment, and the intellectual property rights therein whether made or acquired by the Seller prior to or during performance of the Agreement.

The Seller grants to the Purchaser the non exclusive right to use the technical information provided by the Seller, for the sole purpose of their operation and maintenance of its facility.

27.0 It is understood and agreed by the parties that nothing herein shall be interpreted as placing any responsibility or liability on Seller for pre-existing site conditions, including but not limited to pollution, contamination, hazardous waste or toxic material; or for the generation, emission, or disposal of such substances. Purchaser shall protect and indemnify Seller against any and all claims or liabilities based on such pre-existing conditions.

28.0 The Purchaser shall be responsible for prevention of accidents and unsafe working conditions. Before commencement of this Contract, the Purchaser shall inform the Seller's personnel of the particular conditions of execution of the work, and health and safety rules. The Seller reserves the right to suspend the performance of the Work if health and safety conditions are not met. In case of accident or injury to Seller's personnel, the Purchaser shall provide medical care and required assistance.

29.0 The Purchaser warrants the equipment involved with Seller's Work is free from asbestos.

In case asbestos is encountered during the course of the work, the Seller shall immediately; contact the Purchaser, stop the Work in progress and remove its personnel from the corresponding area. The Seller shall immediately liaise with the Purchaser in order to mutually agree on the actions necessary to minimise delay of the work (if any). The responsibility and costs for the removal and disposal of asbestos shall remain with the Purchaser. Performance of the Work shall be suspended until total disposal of asbestos. The time for performance of the work shall be extended accordingly. If suspension for asbestos continues for more than four (4) weeks, the Seller shall be entitled at any time thereafter to terminate this Contract, by written notice, and the provisions of the Cancellation Clause, shall apply. Any resulting costs whatsoever (including demobilisation and/or mobilisation) incurred by the Seller shall be reimbursed by the Purchaser.

Should any claim be made by the Seller's personnel or any third party against the Seller as a result of the presence of asbestos, the Purchaser shall indemnify the Seller against any and all losses, damages, costs and expenses awarded against or incurred by the Seller.

30.0 The Seller shall not be liable in any way for any costs, loss, damages or claims related to or arising from environmental sources, incidents, accidents, the work or otherwise.

31.0 Should conditions encountered in the performance of the Work which could not have been reasonably anticipated by the Seller be at variance with the conditions indicated by the Tender documents, or should unknown physical conditions be encountered different from those normally inherent in the work, then the schedule for completion and the compensation due the Seller shall be equitably adjusted by change order upon claim by the Seller, which equitable adjustment shall be made within a reasonable time after the first observance of such differing conditions.

32.0 The rights and remedies of the Purchaser are as expressly provided in the contract and no rights or remedies at law or in equity shall apply.

33.0 Any proposal made by the Seller and any order or contract resulting therefrom shall be governed only by these General Conditions of Sale, the Special Conditions if applicable and the technical specifications agreed in writing between the Seller and the Purchaser, to the exclusion of any other terms and conditions. Any additional, inconsistent, or different terms and conditions contained in Purchaser's Orders or other documents supplied by the Purchaser are hereby expressly waived.

34.0 If the Purchaser fails to make any payment on the due date or fails to perform on time any of its other obligations under the Contract:

a) the Seller shall be entitled to suspend performance of the Order until the failure is remedied;
b) the time for performance of the Contract by the Seller shall be extended accordingly;
c) any resulting costs incurred by the Seller shall be reimbursed by the Purchaser.

If performance of the Contract is suspended for any reason attributable to the Purchaser and such suspension continues for more than two (2) months, the Seller shall be entitled, at any time thereafter during the continued suspension, to forthwith terminate the Contract, by written notice. In this event, the provisions of the Cancellation Clause shall apply.

35.0 If the Purchaser is not the end user of the Equipment or Services, then the Purchaser shall indemnify the Seller, its affiliates and its agents, employees, subcontractors, and suppliers from any liability, cost, loss or expense for which the Seller would not have been liable pursuant to this contract.

36.0 The Seller shall not be responsible for any consequences resulting from the Purchaser's refusal to implement necessary modifications of the work.

37.0 Audit rights of the Purchaser shall extend only to work of a cost-plus nature.

38.0 If there is a delay of more than sixty (60) calendar days in the contract schedule due to any cause beyond the control of the Seller, then the Seller shall have the right to terminate the contract and shall be entitled to immediate payment of all sums owing to the Seller, including any retention, for work performed and costs incurred to the date of such termination.

39.0 This document, together with all attachments referenced herein, constitutes the complete contract between the parties. All prior communications, whether oral or written, are hereby abrogated and withdrawn.

No modification of the Contract shall be binding upon the parties hereto, or either of them, unless such modification shall be in writing and signed by a duly authorized representative of both parties.

The terms and conditions contained herein shall supersede all other terms and conditions contained in any other document, unless otherwise agreed in writing to by the parties.

40.0 In the event any data, information, reports or other materials are made available by the Seller to the Purchaser which are considered to be the proprietary information of the Seller then the Purchaser agrees to maintain the information in confidence and not to make or allow to be made any reproduction, publication or communication of such information to third parties without the prior written consent of the Seller. The Purchaser will not permit the fabrication of equipment or components thereof from the Seller's drawings or other confidential and proprietary information without the Seller's prior written consent. The Purchaser will defend and indemnify the Seller and hold the Seller harmless from all claims, demands, losses, damages, liabilities, suits and judgments based upon personal injury or death or property damage or other loss related to any such equipment or component which is fabricated without the Seller's prior written consent.

APPENDIX C

BABCOCK AND WILCOX CANADA LTD. QUOTE TO PERFORM A BOILER SAFETY EVALUATION ON BOILERS 4, 5, 6, 9, AND 10

APPENDIX "C"

babcock & wilcox canada ltd.

Field Engineering Services

Engineering Study Proposal

Customer: **Maritime Electric Limited.**

Subject: Boiler Safety Evaluation

Ref No:

Original Date: 13 February 2015

Introduction

Maritime Electric in PEI maintain a fossil fuel fired thermal generating station consisting of 5 Boiler/Turbine sets ranging from 7.5 MW(e) to 20 MW (e). The plant is maintained as a back up to provide generation during required conditions. The anticipated operating requirements are about 300 hours per year per unit until the year 2018, when it is expected that an undersea cable feed from the mainland will be installed to provide a stable power supply to the Island.

Maritime Electric has requested a review of the existing plant to ensure that the systems are safe to operate for the expected life of the plant. A review of the turbine and auxiliaries will be carried out by a turbine OEM. The scope of this study is to review the safety of the boiler plant.

The safe operation of the boiler is protected by three independent systems.

1) The boiler pressure parts are protected from catastrophic failure by the installed safety valves which are designed to relieve any pressure in the system in excess of the boiler design pressure.

2) The furnace is protected from explosion/implosion by the furnace framing system, which consists of stiffeners, buck-stays, braces and supports.

3) The boiler is protected from explosion and overheat damage with interlocks incorporated in the burner management system . These interlocks prevent operation of the equipment in an unsafe manner.

In order to assess the safety of all of these systems, a two person team will be required to review the components of all 5 units. The team will consist of a boiler service engineer and a controls engineer.

The Boiler Service Engineer will review the safety valve installation and maintenance program, visually inspect the furnace framing systems, and review the safe work practices employed for boiler start up, shutdown and boiler lay up.

The boiler controls engineer will perform an audit of the burner management system. This audit will include a review of all documentation, as well as system tests to confirm the safety systems are active and properly functioning.

Pricing

Pricing is based on the attached time and material estimate.
The estimated price to a carry out this work will be as follows:

Ninety Seven Thousand Canadian Dollars $97,000.00

If additional time is required due to equipment availability, it will be charged on a time and material basis as per the attached rate sheet B-142 FS.)

The Study Report will be released three (3) weeks from completion of the site visits. Site visits will commence based on unit availability after receipt of purchase order, and the official release by NSPI to proceed. Personnel availability and therefore the schedule are subject to workload commitments and subject to prior sale.

Payment Terms

- Payment (100%) is due upon submittal of report.
- All payments are net 30 days from date of invoice. Taxes and GST are extra.
- This proposal is valid for 30 days from original issue date.
- The Terms and Conditions for the Engineering study are contained within this proposal and follow this section.

Terms & Conditions – Engineering Study

Governing Law and Language

The contract shall be governed by the laws of the Province of Ontario, Canada and the Purchaser and B&W agree to attorn to the jurisdiction of the courts of the Province of Ontario. All communication, documents, drawings and correspondence will be in English.

Payment

Invoices will be submitted upon completion of the study, and payment is due net 30 days from date of invoice. All overdue payments will bear interest at the rate of 2% per month from 30 days after the date of invoice.

Price Adjustment

The contract price is subject to increase to reflect any present or future taxes levied on the services provided.

For services outside Canada, the price does not include any taxes or levies of any nature imposed by any tier of government of any country.

Inaccurate Data

B&W is not responsible for the accuracy or adequacy of information and data submitted by the Purchaser which B&W was not required or able to verify but on which it has based its report.

Proprietary Information

Any proprietary information concerning B&W's or its suppliers' products or manufacturing process which is so designated by B&W or its suppliers and disclosed to Purchaser incident to the performance of this Agreement shall remain the property of B&W or its suppliers and is disclosed in confidence, and Purchaser shall not publish or otherwise disclose it to others without the written approval of B&W, and no rights implied or otherwise are granted to produce or have produced any such products or to practise or cause to be practised any such manufacturing processes or other processes.

B&W shall have and retain the right to publish, use, have used, and permit others so to do any information or data used, developed, or acquired by B&W in the course of performance of the Work hereunder.

Warranty

(Please note that the following limitations apply only to this contract. Should Babcock & Wilcox be subsequently retained to perform any work recommended in the report, a separate contract governing such work will be concluded containing standard warranty and liability terms.)

It is understood by the parties that the services to be furnished hereunder shall be within the industry state-of-the-art at the time of performance.

B&W warrants that advice and consultation services and engineering studies will be performed in a manner consistent with generally accepted industry standards and practices. The sole remedy is that any portion of the services furnished to Purchaser which is shown not to have been so performed shall be corrected or re-performed to the standards in effect at the time of original performance at B&W expense; provided all necessary information and access requested by B&W is given to substantiate such claim, and further provided that such non-conformance is detected by Purchaser within ninety (90) days following completion of that portion of the services, and B&W is immediately notified in writing.

The foregoing shall not apply to services performed under the direct supervision of Purchaser. B&W shall not be responsible for suitability or performance of work done by others or for loss or expense arising from same, unless it is specifically ordered by B&W.

There is no warranty or representation, express or implied, with respect to the accuracy, completeness or usefulness of the information contained in any report, or that the use of any report contents may not infringe privately-owned rights. Moreover, B&W will assume no liability for any direct or indirect damages, however caused, including (without limitation) by professional negligence or fundamental breach of contract, resulting from reliance upon or application of the contents of the report by any person.

IN CONSIDERATION OF THE ABOVE EXPRESS WARRANTY EXTENDED BY B&W, ALL OTHER WARRANTIES OR CONDITIONS, EITHER EXPRESS OR IMPLIED WHETHER ARISING AT LAW, IN EQUITY, BY STATUTE, CUSTOM OF TRADE, OR OTHERWISE, INCLUDING MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE EXCLUDED.

Patents

The Purchaser shall hold B&W harmless for any expense or loss resulting from infringement of patents arising from compliance with the Purchaser's specifications.

System of Measurement

Where metric measurements are given, they are a "soft" conversion from the Imperial/English systems of measurement, unless otherwise stated.

Codes, Regulations

Any boiler work recommended as a result of the report is based on the ASME Boiler Pressure Vessel Code. Any other codes or standards compliance will be as specified in the report or on the face hereof. Any reference to codes or regulations shall be construed as those in effect as at the date of the Quotation.

Delay in Performance

B&W will not be liable for any expense, loss or damage resulting from delay or prevention of performance caused by fires, floods, acts of God, strikes, labour disruptions, delays by or default of B&W's subcontractors, riots, thefts, sabotage, accidents, acts or failure to act of Government or Purchaser, or any other cause whatsoever beyond the reasonable control of B&W which may delay or prevent B&W's performance.

In the event of any such delay, B&W shall promptly notify Purchaser, and the time for contract performance shall be extended by a period of time equal to the time lost by reason of such delay and the contract price and terms of payment will be adjusted to compensate B&W for any adverse effects of such delay.

Cancellation

Should Purchaser cancel the work, it shall pay to B&W termination costs including the value of work performed but not paid for, termination charges from any B&W subcontractors, lost contribution to fixed overhead costs, general and administrative expense and anticipated contract profit. Such charges will be invoiced upon cancellation and will be payable net 30 days from the date of issue.

Independence of Contract

The Purchaser acknowledges that this contract is separate and distinct from any other transaction, and agrees to promptly compensate B&W in accordance with the contract terms regardless of any amount owed or allegedly owed by B&W or any of its affiliates to the Purchaser arising from any other transaction or issue whatsoever. B&W will not be responsible for any charges unless accepted in writing by authorized B&W personnel.

Risk of Damage

Any risk of damage to equipment upon which the work is being performed rests with the Purchaser at all times.

Insurance

The Purchaser shall maintain adequate insurance on its property in the names of the Purchaser and B&W as their interests may appear, without subrogation against B&W.

The regulation under the Professional Engineers Act (Ontario) requires the Consultant to notify the customer that the Consultant is not insured for professional liability in accordance with the minimum requirements of that regulation. The customer hereby acknowledges written notice from the Consultant as follows:

> The Consultant hereby advises you that the Consultant is not insured for professional liability in accordance with the minimum requirements of Regulation 941 of the Revised Regulations of Ontario, 1990, made under the Professional Engineers Act, R.R.O. 1990 Reg.941, s. 74.

The customer understands that the Consultant is not so insured and hereby authorizes the Consultant to provide professional engineering services pursuant to this Contract without such professional liability insurance.

Responsibility

The Purchaser agrees to indemnify B&W for injuries to any person or persons or damage to, or related to, property due to any negligent act or omission of the Purchaser, or of his employees or of any employee paid directly by the Purchaser who may be utilized by B&W to do all or any part of the work.

Since B&W personnel are neither authorized nor licensed to operate the Purchaser's equipment, the responsibility for operation of such equipment rests with the Purchaser at all times.

Should B&W deem it necessary to remove any of its personnel from the contract, comparable replacement personnel will be furnished.

B&W personnel will comply with all of customer's reasonable site safety rules, which will be made available in advance to B&W.

Limitation of Liability

Notwithstanding any other provision of the contract, in no event shall B&W or its employees or subcontractors be liable for the following:

(a) Loss of anticipated profits, loss by reason of plant shutdown, non-operation or increased expense of operation, service interruptions, cost of purchased or replacement power or steam, claims of customers, loss of use of capital or revenue, cost of money or for any indirect, incidental, or consequential loss or damage of any nature arising at any time from any cause whatsoever, and

(b) An aggregate amount for any and all claims in excess of the price actually paid to B&W by the Purchaser under the terms of the contract

Regardless whether arising under contract (including breach, fundamental or otherwise; or implied or statutory conditions or warranties), tort (including negligence); or based upon strict liability or other theory or law or equity.

Waiver and Severability

No waiver of any breach of any provision of the contract by either party shall be considered as a waiver of any other or subsequent breach. The terms of the contract shall survive completion expiration, termination or cancellation of the contract. If any clause is ruled invalid, all other clauses, including the valid part of such invalid clause, shall remain in full force and effect and be construed to fulfill the object and intent of the contract.

babcock & wilcox canada ltd

Babcock and Wilcox
479 Rothesay Ave
Saint John, New Brunswick

Service Estimate

DATE 30-Jan-15

JOB NUMBER CUSTOMER Gary Ross

CUSTOMER PO# LOCATION Maritime Electric PEI

		HRS	RATE		TOTAL	
Boiler Service	TRAVEL TIME	24	$231.25		$5,550.00	
Engineer	Preparation	16	$231.25		$3,700.00	
	Regualr time	120	$231.25		$27,750.00	
	overtime at 1 1/2X	5	$346.88		$1,734.38	
	overtime at 2X	0	$462.50		$0.00	
	Report Time	24	$231.25		$5,550.00	
Controls	TRAVEL TIME	24	$231.25		$5,550.00	
Engineer	Preparation	16	$231.25		$3,700.00	
	Regualr time	120	$231.25		$27,750.00	
	overtime at 1 1/2X	5	$346.88		$1,734.38	
	overtime at 2X	0	$462.50		$0.00	
	Report Time	24	$231.25		$5,550.00	
	SUB-TOTAL					$88,568.75
		Quantity	Rate		Total	
EXPENSES	AIRFARE		0			
	HOTEL	30	$150.00		$4,500.00	
	MEALS	30	$50.00		$1,500.00	
	MILEAGE @.57/km	3000	$1,710.00		$1,710.00	
	MISC.		721.25			
	Expenses total					$8,431.25
	SUB -TOTAL					$97,000.00
	HST					$12,610.00
	TOTAL					$109,610.00

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BABCOCK AND WILCOX, CANADA

babcock & wilcox
power generation group canada

Babcock & Wilcox PGG Canada Field Service Terms and Conditions
Effective January 1, 2015 to December 31, 2015
F-142-FS-2015 Rev.00

BABCOCK & WILCOX PGG CANADA (hereinafter referred to as B&W) will provide Field Service personnel to advise the Purchaser's operating staff during the installation, start-up, initial operation, and testing of new equipment supplied by B&W and/or to assist the PURCHASER in the operation, maintenance and repair of existing equipment, all in accordance with the terms and conditions contained in this document "Babcock & Wilcox PGG Canada Field Service Terms and Conditions F-142-FS". The proposal or purchase order is based solely on the following terms and conditions and notice of objection to additional or different terms and conditions is hereby given. PURCHASER agrees that this Proposal shall constitute the complete and final agreement between BABCOCK & WILCOX PGG CANADA (B&W) and PURCHASER in respect to this transaction.

1. BABCOCK & WILCOX PGG CANADA (B&W) proposes to furnish a Field Representative to advise and consult with the PURCHASER. The base rate that will be charged for a representative per standard working day (Monday to Friday 8 hours per day) or part thereof is as follows:

    - Service Engineer/Technician ($1,500 Cnd)
    - Service Engineer/Technician Trainee ($1,250 Cnd)
    - Specialist Service Engineer ($1,850 Cnd)
    - Product Technical Representative (PTR) ($1,850 US)
    - The Babcock & Wilcox Company US based Service Engineer ($1,850 US)

    A surcharge of 25% applies to work in remote areas (i.e. Fort McMurray Alberta, Fort Nelson BC, NWT, Yukon and Nunavut)

2. PURCHASER shall pay for said services on a calendar day basis at the agreed rate above. Said rate applies to a normal workday of eight (8) hours/day Monday through Friday, including travel time from point of origin and return. If overtime work (hours in excess of the normal working day of eight (8) hours, Monday through Friday) is required, it shall be covered by a proportionate increase to the price for service work at the rate of one and one half (1-1/2) times the per diem rate. For work that is performed on Saturdays, the overtime rate will be and one half (1-1/2) times the above rates. For work that is performed on Sundays and Statutory Holidays the overtime rate will be two (2) times the above rates. Standby time will be charged at the standard rates listed above. Payment is due thirty (30) days after receipt of the B&W invoice for said services.

3. All travel and living expenses, as well as any duties, taxes, or levies assessed, imposed or paid on the Service Personnel's personal effects, tools and/or instruments incidental to the performance of this service, shall be to the account of the PURCHASER at cost plus a mark up of 10%. These expenses may be reimbursed directly or included on the PURCHASER'S invoice at the choice of the PURCHASER. In addition, Purchaser pays living expenses for intervening weekends, holidays or when work is not available. In lieu of such expenses, travel costs for a round trip to the point of origin may be substituted. If more than one Field Engineer is required, Purchaser shall pay for each individual Field Engineer on the above basis.

4. The above rates are exclusive of any commissioning spares, field material, rental equipment, subcontractor's work, or service personnel from vendors other than B&W. Sub-contract vendor service, material and equipment will be charged at actual invoiced cost plus a mark up of 20%. The sub-contractor(s) or vendor(s) standard conditions of service will apply to that portion of the work performed by his personnel.

5. B&W personnel are authorized only to advise and consult with the PURCHASER and are not licensed or authorized to erect or operate the equipment. All erection and operation of the equipment,

including testing, shall be performed by and under the control of the PURCHASER. Any risk of damage to equipment upon which the work is being performed rests with the PURCHASER at all times.

6. B&W shall provide and maintain until completion of the above described service the following forms of insurance in respect to its Field Representative(s):

   - Statutory Worker's Compensation
   - Comprehensive General Liability Insurance for Third party bodily injury and Property damage for a limit of $2,000,000 in the Aggregate
   - Automobile Liability Insurance for Owned and Non-Owned (including hired) – Limit - $2,000,000 inclusive and in the aggregate.

   The Purchaser shall maintain adequate insurance on its property in the names of the Purchaser and B&W as their interests may appear, without subrogation against B&W.

   The regulation under the Professional Engineers Act (Ontario) requires B&W to notify the Purchaser that B&W is not insured for professional liability in accordance with the minimum requirements of that regulation. The Purchaser hereby acknowledges written notice from B&W as follows:

   > B&W hereby advises you that B&W is not insured for professional liability in accordance with the minimum requirements of Regulation 941 of the Revised Regulations of Ontario, 1990, made under the Professional Engineers Act, R.R.O. 1990 Reg.941, s. 74.

   The Purchaser understands that B&W is not so insured and hereby authorizes B&W to provide professional engineering services to the Purchaser pursuant to this contract without such professional liability insurance.

7. B&W shall not be liable for any expense, loss, or damage for failure to furnish the Field Representative, or for delay in completion of the work because of fire, flood, acts of God, strikes, labour disputes, labour shortages, riots, thefts, accidents, transportation delays, acts or failure to act of Government or PURCHASER, or any other cause whatsoever, whether similar or dissimilar to those enumerated above, beyond the reasonable control of B&W. If required by B&W, the contract schedule will be extended by a period at least equal to the time lost by reason of such delay.

8. Notwithstanding any other provision of this contract, in no event shall B&W or its employees or suppliers be liable, whether arising under contract (including breach, fundamental or otherwise; or implied or statutory or decreed conditions or warranties), tort (including negligence), strict liability or otherwise, for the loss of anticipated profits, loss by reason of plant shutdown, non-operation or increased expense of operation, service interruption, cost of purchased or replacement power, claims of customers, cost of money, loss of use of capital or revenue, fines or penalties assessed or levied against the PURCHASER by any governmental agency, or for any indirect, special, incidental, or consequential loss or damage of any nature arising at any time or from any cause whatsoever. Notwithstanding any other provision of this contract, the maximum liability of B&W, its employees and suppliers for any and all claims, losses and/or damages arising from any cause whatsoever, whether arising under contract (including breach, fundamental or otherwise; or implied or statutory or decreed conditions or warranties), tort (including negligence), strict liability or otherwise, shall be the price actually paid to B&W by the PURCHASER for the services of B&W's Field Representative under the Terms of the Contract.

9. B&W warrants that the advice and consultation services will be performed in a manner consistent with generally accepted industry standards and practices. The sole remedy is that any portion of the services furnished to PURCHASER which is shown not to have been so performed shall be corrected or re-performed to the standards in effect at the time of original performance at B&W's expense; provided all necessary information and access requested by B&W is given to substantiate such claim, and further provided that such non-conformance is detected by PURCHASER, within ninety (90) days following completion of that portion of the services, and B&W is immediately notified in writing. The foregoing shall not apply to services performed under the direct supervision of PURCHASER. B&W shall not be responsible for suitability or performance of work done by others or for loss or expense arising from same, unless it is specifically ordered by B&W.

   IN CONSIDERATION OF THE ABOVE EXPRESS WARRANTY EXTENDED BY B&W, ALL OTHER WARRANTIES OR CONDITIONS, EITHER EXPRESS OR IMPLIED, WHETHER ARISING AT LAW, IN EQUITY, BY STATUTE, CUSTOM OF TRADE, OR OTHERWISE, INCLUDING MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE EXCLUDED.

10. The PURCHASER shall provide and pay for any and all permits required for the performance of the work hereunder.

11. The PURCHASER shall indemnify and hold harmless B&W against any loss, liabilities or expense in connection with any accidents, injury to person (including death) and property damage at any time arising out of, or in connection with, the services provided hereunder, except such as may be the direct and proximate result of the Field Representative(s)'s negligent acts.

12. The contract price excludes any present Federal, provincial, local or other taxes levied in Canada applicable to this contract or the material or equipment or services covered hereunder. The contract price includes the taxes levied on wages and/or salaries paid to B&W's employees. All other present and all future taxes, duties, tariffs, fees and other charges, shall be the obligation of the PURCHASER. Any such items paid by B&W shall be added to the contract price and the PURCHASER shall reimburse B&W for the amount of such taxes, duties, tariffs, fees and other charges and expenses incidental thereto upon presentation of an invoice therefore.

13. In no event shall the PURCHASER be entitled at any time to set-off against any amount payable by the PURCHASER in connection with this contract any amount owed, or allegedly owed, by B&W to the PURCHASER arising from this or any other transaction between B&W and the PURCHASER or his predecessors or successors in interest.

14. There is no warranty or condition, expressed or implied, whether statutory or otherwise, relating to field workmanship arising from the furnishing of the Field Representative. B&W shall not be responsible for the repair of defective workmanship and the PURCHASER agrees to indemnify and hold harmless B&W from all claims, actions, suits, or proceedings against B&W arising out of such defective workmanship.

15. This contract shall be construed in accordance with the laws of the Province of Ontario, Canada.

16. There are no understandings between the parties hereto, except as expressly provided herein, and any purchase order issued shall be for record and billing purposes only, and any and all conditions of said purchase order are hereby expressly objected to. All previous communications relative hereto, whether verbal or written, are hereby abrogated and withdrawn and this document shall constitute the entire agreement between the parties.

17. B&W's Field Representative agrees to abide by all site security and safety rules and regulations as specified by the Purchaser while on the site. Any specific safety training that is required for B&W's Field Representative prior to arriving on site must be defined by the Purchaser and are to Purchaser's account. It is the Purchaser's responsibility to provide information as to the potential hazards that B&W's Field Representative may be exposed to at the site, within the plant or in relation to the equipment where B&W's Field Representative is working. B&W's Field Representative shall not be required to begin, or proceed with, or work in any area if any hazards are present until the Purchaser can demonstrate and assure B&W's Field Representative, that the Site and environment is a safe and healthy workplace.

RE: Fwd: Re: Maritime Electric Unit 6,8 & 9 Operation support

From: "Regan, Daniel" <DRegan@babcock.com>
To: Gary Ross <garyross@nb.sympatico.ca>
Cc: "Dick, Jerome S" <JSDick@babcock.com>, "Westerveld, Gary R" <GRWesterveld@babcock.com>, "Ojanpera, Ron O" <ROOjanpera@babcock.com>

Priority: Normal
Date 02/13/2015 10:16 AM

Gary – As per our discussion, please find attached a draft of our budget proposal for the evaluation of the boiler safety systems on the 5 boilers at Maritime Electric. I have included for three weeks of site time for a Boiler Service Engineer and a controls specialist. This should be sufficient time to evaluate all 5 boilers if the proper documentation is available, and the plant has the flexibility to fire and trip the boilers as required to demonstrate the safe operation of the interlocks. If we are constrained by generating requirements, the schedule and cost will be extended.

Let me know if you have any comments of questions on this material. If this draft meets your requirements, let me know and I will issue it as final with a proposal number for tracking purposes.

All the best to you and your wife.

Regards

Dan

From: Gary Ross [mailto:garyross@nb.sympatico.ca]
Sent: Wednesday, February 11, 2015 3:05 PM
To: Regan, Daniel
Subject: EXTERNAL: Fwd: Re: Maritime Electric Unit 6,8 & 9 Operation support

As discussed. Look forward to your reply.

---------- Original Message ----------
From: Gary Ross <garyross@nb.sympatico.ca>
To: PATEL Ghanshyam <ghanshyam.patel@power.alstom.com>
Cc: RUDDOCK Richard D <richard.d.ruddock@power.alstom.com>
Date: December 21, 2014 at 7:55 PM
Subject: Re: Maritime Electric Unit 6,8 & 9 Operation support

As discussed, the following is what the requirement is.

Maritime Electric Charlottetown Generating Station consists of the following turbine/generator sets:
- Unit #6 - C.A. Parsons - 7.5 M.W. - installed in 1952 - operating hours: 216,000
- Unit #7 - Brown Boveri - 7.5 M.W. - installed in 1956 - operating hours: 188,000
- Unit #8 - C.A. Parsons - 10 M.W. - installed in 1960 - operating hours: 123,000
- Unit #9 - AEI - 20 M.W. - installed in 1963 - operating hours: 165,000
- Unit #10 - AEI - 20 M.W. - installed in 1968 -operating hours: 129,000

The utility requests the services of an experienced startup/commissioning engineer. The scope of service would include the overview and direction, where required, of station staff and cover the following:
- Review of the existing startup,unit operation, and shut down of each unit.
- Modification, if required, to pre-operational checklist, startup, in service and shut down procedures. Modifications, if required, must take into account the age and condition of each unit.
- Review of the 8 month layup procedures for each unit.
- Review of the existing turbine/generator supervisory monitoring and trip protection devices and recommend, if required, additional protection equipment that would be adequate to extend the safe operation of the units to the Spring of 2018.
- Provide a list of pre-operational maintenance/calibration requirements for unit supervisory/monitoring/trip protection devices.

Yearly operation of each unit until the Spring of 2018 will be as follows:

- Late Fall startup of each unit for training staff - approximately 48 hours each. Units would be put online for that period with no other cold start.

Some time between mid-January to the end of February, all units may be required for system load. Run-up and operation of each unit would be used as training runs and system load requirements. Units will not be shut down during this period and will be operating between minimum and maximum load. Projected operations to be approximately 240 hours/unit.

Operational summary - Approximately 300 hours per unit / year.

Please provide, as soon as possible, your daily rate for start up/commissioning engineer, along with your estimated time to complete this work. Also, provide a plus 25% cost estimate including expenses to complete the above scope of work. Start up/commissioning engineer is required for the mid-January to end of February run - units will be started up sometime in this period.

Boiler Study proposal_Draft.pdf	**Content-Type:** application/pdf; name="Boiler Study proposal_Draft.pdf" **Size:** 508.37 KB

APPENDIX D

SIEMEN'S QUOTE TO INSPECT UNITS #6, #7 AND #10 GENERATOR END RETAINING RINGS

Appendix "D"

Subject: PEI Charlottetown –Proposed Inspection of Generator Rotors

1. INTRODUCTION

We have been contacted by a representative of Maritime Electric regarding the inspection of generator rotors of Charlottetown Units 6, 7 and 10.

These units are only operated for 300 hours each per year.

The customer would like the rotors to be inspected from "safety" viewpoint and intend to keep the units operational (most of the time on standby) up to 2018.

Unit 6 is a Parsons unit, machine # 2814, 7.5 MW.

Unit 7 is a 7.5 MW BBC unit.

Unit 10 is a 20 MW AEI unit.

2. ROTOR INSPECTION

The recommended inspection programme of the rotor has been developed and is available for consideration. This can be discussed further.

The specifics of the end cap (retaining ring) inspection process is detailed in the write-up below.

3. END CAP (RETAINING RING) INSPECTION

3.1. Unit 6 rotor end caps

We have previously inspected the unit 6 rotor in 1995. One of the 18Mn-4Cr end caps was fitted with an insert ring to repair the cracked area of shrink face. Though the end caps were recommended to be replaced with new 18/18 caps, this was not performed.

Since the rotor will be operational only for a small period of 1-2 weeks per year for the next 3-4 years, our initial opinion is that the rotor can be inspected from electrical and NDE aspects and returned to service if acceptable. However the existing 18/4 end cap insert ring will need to be removed, the end caps skimmed all over to remove another 0.010" on each surface to facilitate NDE. A new spacer ring will then need to be manufactured and installed.

Siemens have reviewed the past inspection report 95-422E for this rotor (Mc# 2814).

Based on this report we know that material has already been removed on the end cap thickness. Stress corrosion cracking usually occurs beneath the surface of the material. So there are two requirements for dressing, i.e. to remove surface contamination and to remove the surface to a depth where stress

corrosion cracking is detectable by dye penetrant NDT. Our standard is to remove 0.010" of material by skimming in order to do this, however it may be possible to only remove 0.005" in the bore of the end cap if the surface condition of the material is good enough. We would also recommend UT inspection of the end caps in addition to dye penetrant check.

Considering the amount of material already removed and based on the assumption that a further 0.010" of material would be removed from each surface for NDT, hoop stress calculations would be required for the end caps. The calculations can be performed by Siemens Newcastle but some time would be required in order to do them (plus associated costs).

Rotor slot wedges underwent an alpha beta test in 1994. Eleven out of 220+ wedges failed the 15% alpha content and were replaced. The alpha beta test only needs to be done once to confirm the micro-structure of the material. The results will not change with time / operation so the test does not need to be repeated.

3.2 Unit 7 rotor (BBC make) & Unit 10 (AEI make)

With regard to the BBC and AEI units we are also able to support end cap machining and insert ring manufacture. We would however require:

1. Dimensional information, i.e. drawings, if available, and gauged dimensions from site when the end caps are removed.

2. Material properties for the rotor end caps. If the design shrink is not known for those units then we would also require the material properties for the rotor shafts and relevant shaft dimensions. Ideally material specifications and / or material test certificates should be provided.

The input data for the end cap stress program such as the dimensions of the end caps (retaining rings), rotor coils etc. would need to be collected and inputted into the program for stress analysis of retaining rings. The required input data template can be provided by Siemens and sizes measured on site after removal of the retaining rings.

Assumptions:

Maritime Electric:

- The inspection work on the generator rotors will be done on site - Time and Material
- Would provide or assist with end cap insulation for the U7 and U10 machines
- The work program is based on working single shift 5-8's per week (40 hrs)
- The end caps will be shipped off site for machining – inspection – hoop stress calculations are not included.
- The end caps of U7 and U10 are slip on fit – no special tools required for removal
- Only end cap removal and the inspection of the end caps are included, this proposal does not include other discovery issues.
- Would provide OEM special tooling to open/ close machine – remove rotor

- This proposal is for budget purposes only, specific issues and refinement of workscope/ price can be addressed later at the next steps.
- The support staff – QA & EHS hours have been kept to a minimum – this can be discussed
- End cap rings are priced as forgings and have a 10 week delivery

The work is based on opening/ closing 3 units one after the other for a duration of 7 to 8 weeks – budget value for this is between $450K and $550K.

The inspection on the rotors (qty 3) is based on one after the other for a duration of 12 weeks- budget value for this $590K and $740K.

- If the station would like to provide some labour – this can be discussed

Proprietary Information

APPENDIX E

NB POWER RECOMMENDATIONS FOR OVERHAULING STEAM TURBOSETS

Generation Standard

Énergie NB Power

Production Generation

Number: GS-065 Date Effective: 2011.10.01

Reference: GD-091

Title: Overhauling Steam Turbosets

Responsibility of: Director, Generation Engineering

Prepared by: D.R. Fewkes

File: A-0160-01

Introduction:

Periodic inspections of steam turbine components will ensure good reliability. Appropriate scheduling of these inspections is important so as to achieve this reliability in the most cost effective manner.

This Standard reflects the NB Power Generation (NBPG) philosophy concerning maintenance of large steam turbosets. It should be used by station personnel for planning and execution of overhauls.

Background:

Following evaluation of discussions held with several major utilities and manufacturers regarding experience gained during overhauls and of statistics of breakdown for individual components, NBPG has developed recommendations for maintenance of our turbosets. They are intended to assist station personnel when planning overhauls with respect to the kind of overhaul, timing, scope and duration.

Economic operation of a thermal power station is governed not only by the thermal efficiency but also, to a large extent, by the equivalent availability of the plant as a whole. The objective of these recommendations is to effectively assure the availability and safety of our turbosets on a long-term basis.

Standard:

1. DISCUSSION

Overhauls are regular inspections, planned to take place at set times, of components or of the whole plant, with the objective of avoiding interruptions in service due to failure of components and systems. When carried out at regular intervals, they enable wear and pending failure to be detected and enable review of faulty parts before they fail altogether.

The overall equivalent availability, however, is not only determined by operational interruptions, but also by planned shutdowns. Therefore, every operational interruption should be treated as a planned outage, which will enable obtaining optimal results from all types of overhauls. This is possible under the following conditions:

- Overhauls need to be performed at the right time to be cost effective.
- The work to be performed should be predicted exactly in advance.
- The duration of overhauls should be minimized by comprehensive planning and expert execution.

2. KINDS OF OVERHAUL

There are three kinds of overhaul:

2.1 Inspection, Lasting 1 to 2 Weeks

Such inspections can be scheduled, but are preferably performed when the unit is brought to a standstill for reasons not necessarily attributable to the turboset. The scope of inspection is then governed mainly by the observations made during operation.

- Deliberate measures depending on the operating observations.
- Examination of the safety devices on turbine and generator.
- Spot checks of control elements and systems.

2.2 Minor Overhauls, Lasting 2 to 4 Weeks

These are planned and prepared in accordance with our maintenance program and operational experience, having the following scope:

- Opening of turbine casings.
- Visual inspection of the LP last stage blades.
- Boroscopic examination of accessible parts of the turbine.
- *Inspection of the bearings when considered necessary.
- *Check of shaft alignment when considered necessary.
- Examination of the safety devices for turbine and generator.
- Overhaul of the turbine control system, oil pumps, etc.
- Inspection of the steam valves.
- Examination of the condensing and feed-heating systems.
- Comprehensive overhaul of the generator without pulling out the rotor.
- Checking the generator ancillaries.
- Checking the excitation and starting equipment.
- Boroscopic inspection of rotor and stator slot wedges of the generator.

*NOTE: These activities (*) are dictated by operational experience.

2.3 Major Overhaul, Lasting About 8 Weeks

Such overhauls are comprehensive examinations of the entire turbine and generator. They include the opening of all turbine casings and removing the rotor of the generator. The scope of work to be performed is given in individual overhaul plans.

3. FREQUENCY OF OVERHAULS

The time at which the first overhaul should be performed and at what interval subsequent overhauls should follow is largely determined by the number of operating hours, the mode of operation upsets and the number of starts performed by the turboset. These influence the wear on parts of the set and its auxiliaries and contribute to fatigue of the individual materials. Up to about 100,000 hours of operation, material fatigue is relatively insignificant.

After extensive discussion with several major utilities, insurance companies and turbine/generator manufacturers, NBPG has established its own standards for the frequency of overhauls as follows:

3.1 For major turbine/generator components; i.e. HP, IP, LP generator rotor/stator, the interval between inspections is scheduled at 50,000 to 80,000 equivalent operating hours.

<u>For the Turbine components:</u>

Turbine equivalent operating hours T ET = Ta + (Tsc x Ns) + (Tsh x Ns)

Where Ta = actual operating hours

Tsc = operating hours charged to one cold start (40 hours)

Tsh = operating hours charged to one hot start (20 hours)

Ns = number of starts

For the Generator components:

Generator equivalent operating hours T EG = Ta + (Ts x Ns)

Where Ta = actual operating hours
Ts = operating hours charged to any start (20 hours)
Ns = number of starts

3.2 Major overhaul inspections need not occur before this equivalent operating time except where:

(a) Operational conditions of the unit show that an earlier inspection is required; i.e. significant change in vibration levels, or serious efficiency performance degradation or evidence of a failed component or major operational incident.

(b) For the generator if the maximum time interval is ten years since the last inspection. (This is primarily for detection of SCC on generator rotor retaining rings which are under stress during shutdown conditions). [This is applicable to all Coleson Cove units and to Dalhousie unit 2 only.]

(c) The OEM issues a requirement to inspect due to potential evidence of a serious generic design defect.

3.3 For auxiliary components (i.e. steam valves, pumps, coolers, etc.) the interval is determined by past inspection results and operating history. This scheduling duration may be in operating hours or, where a component can deteriorate during shutdown, may be in calendar durations. Refer to the individual unit sectionalized maintenance sheets for details of each inspection interval.

3.4 The time on turning gear must be monitored and recorded. This is with respect to inspection intervals of the turning gear and associated components. Also, the generator rotor end windings and turbine rotor blading can have problems from excessive time on turning gear. (Refer to Generation Standard GS-007 "Steam Turbine Turning Gear")

3.5 The overhaul frequency may increase past 50,000 hours if there are indications that component integrity is still good by consideration of:

(a) operational condition monitoring
(b) efficiency monitoring
(c) past inspection history
(d) similar units' history
(e) non-intrusive inspections (video, borescope) where possible
(f) age of the unit

The outage optimization schedule needs to be updated periodically to ensure that the inspection of a major component will only take place when absolutely required. This ensures maximum cost effectiveness without risk of component failure.

4. PLANNING

About 12 months before an overhaul is due to start, NBPG shall contact the manufacturer and the insurance company, taking into account their recommendations, NBPG observations, and the applicable regulations of the insurance company. Agreement should be reached on the timing and kind of overhaul to be performed, and its duration.

The manufacturer, in conjunction with NBPG and our insurance company, are to draw up a list of jobs which are considered advisable, based on experience gained from similar plants, with the object of covering the following points exhaustively:

A. Scope of Overhaul: Specify the scope of the overhaul with the aid of NBPG's operational observations, the overhaul plans, experience of the manufacturer, and insurance company.

B. Spare Part Requirements: In accordance with the scope of overhaul, specify the spare parts likely to be needed.

C. Stock of Spare Parts: Check the required stock of spare parts for completeness and condition. Procure essential spare parts well in advance of the start of the overhaul.

D. Tools and Fixtures: Check whether the necessary tools and fixtures are in our possession or ensure they will be provided by the manufacturer or others on time and in sufficient quantities.

E. Organization Chart: Define personnel responsibilities and an organization chart jointly with the manufacturer.

F. Working Plan: Create a joint working plan stipulating which jobs are to be performed in NBPG and in the manufacturer's workshops.

G. Capacity Planning: NBPG and, if necessary, the manufacturer should ensure that the requisite workshop and machine capacities are available and reserved at the time required.

5. INSPECTION MEASUREMENTS

Well in advance of the start of the overhaul, the current or "actual state" of the turboset needs to be determined by carrying out operational check measurements (i.e., temperature and pressure distributions, vibration, displacement of foundations, temperature rise of the generator, etc.). These measurements are then compared with the original (desired) state. The results of these measurements are then jointly reviewed by NBPG and the manufacturer. At this juncture, the final number of personnel required, their respective qualifications, the composition of the overhaul team and shift schedules (manufacturer, operator and outside contractor) are specified.

For effective coordination of overhauls, each station needs to prepare a detailed schedule (bar chart or critical path diagram). Detailed planning and quick dismantling at maximum effort enables early inspection to be carried out, the findings of which may permit unforeseen work to be performed within the planned shutdown period.

6. OPERATING HOURS

For effective scheduling of major overhauls, records must be maintained on the number of starts (hot or cold). In order to effectively use the formulas to update the Sectionalized Maintenance Schedules, at the beginning of each fiscal year each station shall supply to Generation Engineering the total number of operating hours, the total number of hot starts and the total number of cold starts for the previous fiscal year. These figures are also used for calculations regarding the expected remaining lifetime of individual "hot" components.

Reference: GS-007 Steam Turbine Turning Gear

Contact Department: Generation Engineering

Director, Generation Engineering

Revision Number	Revised Section(s)	Revision Summary	Revised By:	Effective Date:	Review Cycle
0	All	O&M No. 65 updated and reformatted as a Standard.	D. Fewkes	2009.06.15	2 Years
1	-	Review cycle update, no changes except signing authority and changed review cycle timing.	D. Fewkes	2011.10.01	5 Years

APPENDIX F

NB POWER GENERATOR END RETAINING RING INSPECTION O&M PROCEDURE

Appendix "F"

NEW BRUNSWICK POWER
ENERGIE NOUVEAU - BRUNSWICK
1149 SMYTHE STREET; FREDERICTON, NB; E3B 3H4
OUR FAX NUMBER: (506) 458-3588

TELECOPIER TRANSMITTAL

ATTENTION: MR. K. RODWELL FROM: D. FENKES

COMPANY: MARITIME ELECTRIC DATE: 91.04.10

FAX NUMBER: 902 566 9196 OPERATOR: Natalie

OUR FACSIMILE EQUIPMENT IS: NEC/NEFAX 400
FOR ASSISTANCE CALL: (506) 458-4071 OR (506) 458-4072
NUMBER OF PAGES FOLLOWING THE COVER SHEET: 6

COMMENTS: SUBJECT : GENERATOR ROTOR END RING INSPECTION.

DEAR KEN,

AS REQUESTED, PLEASE FIND DETAILS OF OUR INSPECTION PROCEDURE FOR END RINGS. YOU WILL SEE FROM THE PROCEDURE THAT THE ACCEPTANCE CRITERIA NBEPC USE IS VERY STRINGENT.

IF YOU REQUIRE ANY FURTHER INFORMATION PLEASE LET ME KNOW.

Regards,

D. Fenkes

Sr. Specialist - Turbines

SUBJECT: VISUAL AND LIQUID PENETRANT EXAMINATION OF GENERATOR ENDRINGS (ENDRINGS REMOVED).

1.0 SCOPE

1.1 This procedure details the visual and liquid penetrant examination of high-strength nonmagnetic generator endrings. The intent of the examination is to detect corrosion damage, defined to include corrosion pitting and stress corrosion cracking (SCC).

1.2 The stress corrosion process occurs in three steps, first pitting, leading to small crack propagation, finally large crack propagation, resulting in complete rupture. Small discontinuities in the order of .005" are significant in the presence of moisture; therefore, we have elected not to use ultrasonic examination due to a known detection limit.

2.0 REFERENCES

2.1 ASME B & PV CODE SECTION V ARTICLE 6

2.2 NBEPC NDE PROCEDURES F23800-04160 & N0087-04160

2.3 EPRI REPORT EL/EM-5117-SR, GUIDELINES FOR EVALUATION OF GENERATOR RETAINING RINGS.

3.0 PERSONNEL CERTIFICATION

3.1 Examination personnel shall be certified to CGSB 48-GP9M and only personnel certified to Level II or Level III shall evaluate indications.

3.2 Arrangements should be made for utility QA or cognizant NDE personnel to witness the examination.

4.0 PREPARATION

4.1 Prior to the examination, clean all paint or protective coatings from the examination surfaces. Coatings can conceal cracks and render the visual and penetrant inspections ineffective. All cleaning should be done in accordance with the recommended procedure obtained from the OEM.

4.2 Surface preparation of the ID of the endrings will generally be carried out by mild abrasive polishing with emery cloth. This polishing must remove all operational associated debris such as oil, grease, varnish and insulation bonded to the bore.

4.3 Do not expose the endrings to water or other corrodents during the cleaning or examination phase of the the inspection. Chlorinated cleaning agents must be avoided, since they can cause pitting in extremely short times.

4.4 CAUTION the use of chemical paint removers and strippers should not be used on endrings except under closely controlled conditions which permit complete cleanup of all surfaces.

4.5 Preparation for the visual and liquid penetrant examinations may take place with the endrings in the following conditions.

4.5.1 OD of the endrings with the rotor removed from the stator. This would be a first step examination to establish the condition of the OD and to determine if further examination is necessary.

4.5.2 OD/ID of the endrings with the rotor removed from the stator but the coupling in place.

4.5.3 OD/ID of the endrings after complete removal of the endrings from the rotor.

5.0 EXAMINATION

5.1 Visual inspection

5.1.1 Visual inspection should be performed before and after the preparation steps.

5.1.2 During the visual inspection the following conditions should be noted and reported.

- pitting
- rusting
- water staining
- mechanical damage, such as scratches and gouges
- heat tinting (bluing of the surface)
- arcing, at the nose of the endring between the ring and the rotor at the shrink fit
- arcing, at the interface of the endring and the endplate.
- machining marks
- cracking

5.2 EQUIPMENT FOR VISUAL INSPECTION

5.2.1 The endrings shall be given a close visual inspection in an area illuminated to a level of not less than 500 lux.

5.2.2 To aid in interpretation a low power magnifier may be used.

5.3 PENETRANT INSPECTION

5.3.1 The preferred technique is high sensitive fluorescent liquid penetrant. The penetrant will be applied after mild abrasive cleaning followed by a flushing of all the inspection surfaces with mineral spirits and allowing the rings to completely dry.

5.3.2 Insuring that the rings are completely dry, all surfaces of the endrings must be covered with an even coating of fluorescent liquid penetrant - Ardrox 985-P14, sensitivity Level 4 (ultra-high). The penetrant may be applied by either brush or aerosol spray.

5.3.3 The fluorescent penetrant shall be allowed to soak into the surface for a minimum of 60 minutes. Ensure that the penetrant does not dry out during the dwell period and that no contamination on the endring limits the penetration.

5.3.4 After the required penetration time all traces of the surface penetrant must be removed, using lint-free cloths. After wiping the excess penetrant, lightly moisten the lint-free cloths with Ardrox 9PR-50 (low sulphur/halogen) cleaner and continue to wipe the surface until all remaining traces of the excess penetrant has been removed.

5.3.5 Stress corrosion cracking may be shallow, tight and contain oxides, to minimize the removal of penetrant from these discontinuities take care in the use of excess cleaner. Flushing of the surface with cleaner following the application of the penetrant and prior to developing is prohibited.

5.3.6 During removal of the excess penetrant the part must be monitored with a blacklight to ensure proper removal. After

satisfactory removal of the excess penetrant allow the rings to air dry for 5 minutes before applying the developer.

5.3.7 Following the removal of the excess penetrant and the short drying period, the rings shall be coated with a thin even coat of Ardrox 9D1B Developer (low sulphur/halogen).

5.4 Examination and Evaluation

5.4.1 Examinations of critical components under blacklight must be carried out in a darkened area that has a maximum of 32 lux of ambient light.

5.4.2 Due to the small penetration entrapment capability of stress corrosion cracking, the inspector must be in a darken inspection area for a minimum of 5 min. prior to the inspection so that his eyes will adapt to dark viewing.

5.4.3 Examination can begin while applying the developer and full viewing will take place at the following intervals 7 min. 15 min., 30 min. and a final examination at 60 min.

5.4.4 Stress corrosion cracks can be quite small, contaminated with oxides or corrosion products and under compression when the endring is removed. These factors have been considered in the selection of the penetrant, the dwell and development times and examination conditions. Changes in any of the examination steps could result in undetected cracks. Ref. Fig. 1

5.4.5 The blacklight used for inspection must have an intensity of 800 micro watts per centimeter squared and checked prior to the examination. Allow a minimum of 5 min. of warm-up prior to the intensity check.

5.4.6 Critical areas for cracking are shown in Fig. 2. Corrosion pitting may be detected at all locations on the OD & ID of the endrings.

5.4.7 A major stress corrosion cracking site is the vent holes on air cooled units. The ventilation holes act as stress concentrations and have severe and localized areas of work

hardening at the hole surface due to drilling, this results in a loss of ductility.

5.4.8 Pit-like indications due to inclusions or voids present in the endring at the time of manufacture may be detected during the examination. If these are suspected, local grinding or polishing may be desirable, bearing in mind that additional voids and inclusions may be below the surface.

6.0 REPORTING

6.1 All indications detected by the visual or penetrant examination shall be reported to the plant mechanical maintenance supervisor.

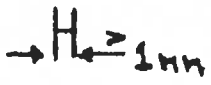
6.2 No remedial action shall be carried out by the inspection staff.

7.0 ACCEPTANCE/REJECTION CRITERIA

7.1 Permissible levels of pitting and linear indications are design specific and set by the OEM's.

7.2 Following is an acceptance criteria that has been applied to NBEPC generator endrings during previous inspections.

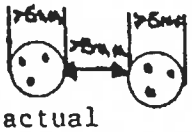
7.2.1 linear defects>1 mm length - not acceptable



7.2.2 linear array of 3 or more point defects with less than 3 mm between points - not acceptable

7.2.3 Random groups of 3 or more points within a circle of less than 5 mm in diameter - not acceptable

7.2.4 Random groups acceptable to criteria 3 but less than 5 mm from a similar group - not acceptable



NOTE: A point defect is a very small surface blemish the actual diameter of which is less than .5 mm.

8.0 POST CLEANING

8.1 All traces of the penetrant inspection materials must be removed from the endrings as soon as possible after final inspection and reporting.

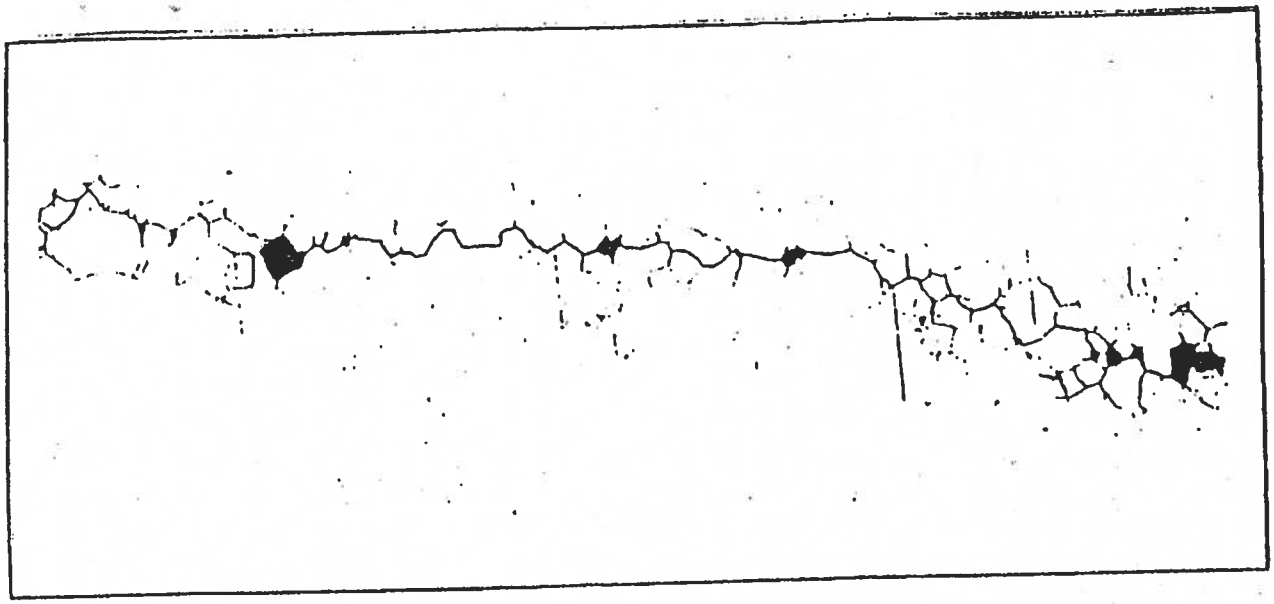


Fig. 1 Cross Section of a typical stress-corrosion crack

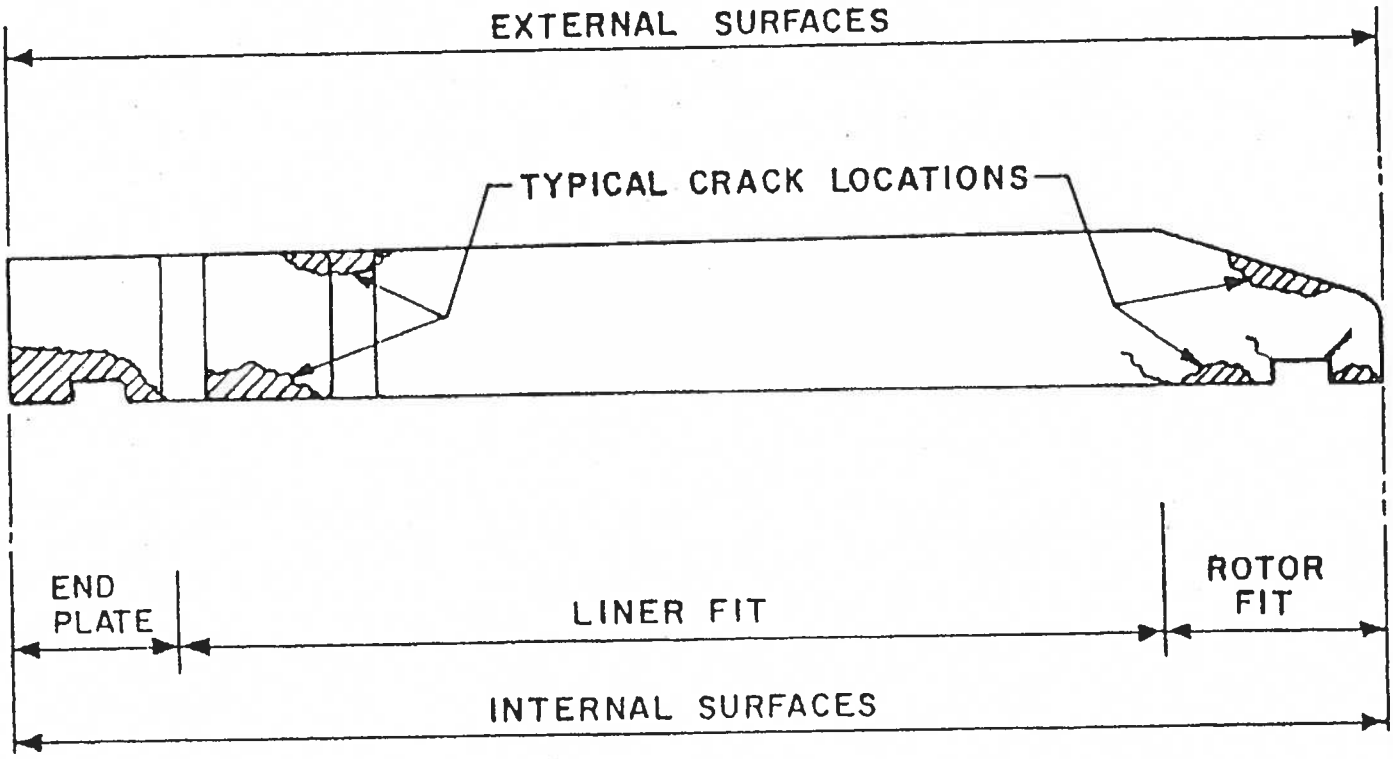


Fig. 2 Location of cracks found during In-Service Inspection of Endrings
(Corrosion pitting may be found on all endring surfaces)

THE NEW BRUNSWICK ELECTRIC POWER COMMISSION CENTRAL TECHNICAL SERVICES		
TITLE: VISUAL AND LPI OF GENERATOR ENDRINGS (REMOVED) DATE 90-03-07 PREPARED BY W. PERRIN APPROVED BY (NBEPC) R. GRIFFIN APPROVED BY (NBDOL) N/A PROCEDURE NO. E23800-04160-4-A PAGE 6 OF 6	00 REV	90-03 DATE

APPENDIX G

NB POWER O&M PROCEDURE FOR INSECTION, MAINTENANCE AND TESTING OF SAFETY VALVES

APPENDIX "G"

Generation Standard

Énergie NB Power

Number: GS-017 Date Effective: 2012.10.01
Reference: GD-060; GD-091

Title: **Inspection, Maintenance & Testing of Safety Valves**

Responsibility of: Director, Generation Engineering
Prepared by: K. MacLean
File: A-0160-01

Introduction:

The purpose of this Standard is to ensure the safe and reliable operation of safety, relief, and safety relief valves located in generating stations through periodic inspection, maintenance and testing.

Standard:

1. Inspection, maintenance and testing of safety, relief, and safety relief valves shall be performed in accordance with the New Brunswick Boiler and Pressure Vessel Act Chapter B-7.1.
2. Each generating station shall have approved station instructions/procedures and/or maintenance plans in place to ensure inspection, maintenance and testing of safety, relief, and safety relief valves complies with the above Act and with this Standard.
3. All inspection, maintenance and testing of safety, relief, and safety relief valves by an external repair organization on behalf of NB Power shall be performed by an organization holding a current National Board Certificate of Authorization for use of the "VR" (Repair of Pressure Relief Valves) symbol stamp.
4. All external adjustments on safety, relief, and safety relief valves shall be sealed to prevent unauthorized adjustments and identify the organization that performed the last repair and/or setting.
5. Scheduled inspection, maintenance and testing requirements for safety, relief, and safety relief valves (hereafter referred to as "safeties")are as follows:
   a. Superheater safeties shall be hydroset on a two (2) year schedule.
   b. Steam drum safeties shall be hydroset on a two (2) year schedule.
   c. Reheater safeties shall be hydroset on a four (4) year schedule.
   d. Other steam service safeties shall be hydroset or bench tested on a six (6) year schedule.
   e. Hot liquid service safeties shall be bench tested on a six (6) year schedule.
   f. Compressed gas/air safeties shall be bench or lever tested on a ten (10) year schedule.
   g. Safeties shall only be opened for visual internal inspection and overhauled when they are leaking or have failed to reseat.
   h. If any of the superheater, steam drum, reheater or deaerator safeties has not leaked or failed to reseat in the past ten (10) years it shall be opened for internal inspection and overhauled.
6. Performance testing on repaired boiler safeties shall be performed with a hydraulic or pneumatic device that applies an auxiliary lifting load on the spring of the valve to establish set pressure (hydroset).
7. Live (full steam) testing shall be performed on newly installed valves to verify initial blowdown and lift. Subsequent blowdown and lift shall be accomplished by setting the adjustment rings as per manufacturer's recommendations and documenting these settings.

8. A boiler inspector may require inspection and testing requirements in addition to those listed in this Instruction and associated Directive as allowed under Section 17 of the New Brunswick Boiler and Pressure Vessel Act Chapter B-7.1.

Reference/Appendix: New Brunswick Boiler and Pressure Vessel Act Chapter B-7.1

Contact Departments: Generation Engineering

Director, Generation Engineering

Revision Number	Revised Section(s)	Revision Summary	Revised By:	Effective Date:	Review Cycle
0	All	O&M No. 17 updated and reformatted as a Directive and associated Instruction.	K. MacLean	2008.12.01	2 Years
1	Title block, items	File number added, signing authority title changed; revised document type to Standard and deleted Directive; added items 1-4 and renumbered the rest.	K. Calhoun	2009.06.15	2 Years
2	-	Changed Title of person responsible.	K. MacLean	2012.10.01	5 Years

APPENDIX H

REPORT LIMITING CONDITIONS

ROS Consulting Inc. based the information provided in this report on the practices and conditions observed and documentation available at the time the report was prepared. The report should not be considered a complete listing of all existing safety risks nor an absolute solution to all identified risks. ROS Consulting Inc. assumes no responsibility for loss or damage of any kind or nature resulting from reliance upon the statements and information contained in this report. ROS Consulting Inc. assumes no responsibility for loss or damage of any kind or nature suffered by any third party as a result of decisions made or actions based on this report.

APPENDIX I

RECOMMENDATION'S COST ESTIMATE

A. TURBINE, GENERATOR AND AUXILIARIES

- Turbine/generator start-up/commissioning engineer
  - Plus 25 percent cost estimate - $150,000 (#8, #9, #10)
- Generator end ring inspection (#6, #7, #10)
  - Plus 25 percent cost estimate - $550,000
- Extraction steam non-return valve inspection
  - In-house maintenance staff cost
- Generator air cooler inspection
  - In-house maintenance staff cost
- Major overhauls of turbines (#6 and #7)
  - Plus 25 percent cost estimate - $700,000
- Vibration monitoring/trip systems (#8, #9 and #10)
  - Plus 25 percent cost estimate - $150,000

Total turbine, generator and auxiliaries: $1,550,000

B. BOILERS AND AUXILIARIES

- Boiler service engineer and boiler control engineer
  - Plus 25 percent cost estimate - $125,000
- #5 boiler sample inspection of near mud drum generating bank tubes (≈60 tubes)
  - Plus 25 percent cost estimate - $8,000

Total boilers and auxiliaries: $133,000

C. UNITS #9 AND #10 DEAERATOR

- Inspection
  - Plus 25 percent cost estimate - $20,000

D. HIGH ENERGY PIPING

- Sample inspection and analysis of all high energy piping systems (approximately 36 sites)
  - Plus 25 percent cost estimate - $150,000

E. FEEDWATER SYSTEM MAINTENANCE AND CONTROL SYSTEM

- In-house maintenance staff cost

F. UNIT OPERATION – EXTRA FUEL AND STAFF COSTS

- Maritime Electric to determine costs

G. STAFFING ISSUES

- Extra costs depends upon potential retirement of staff or extra costs to retain existing employees

TOTAL COST OF RECOMMENDATIONS - $1,853,000

PLUS

STATION COSTS

APPENDIX J

SCOPE OF BOILER INSPECTION

The safe operation of the boiler is protected by three independent systems.

1) The boiler pressure parts are protected from catastrophic failure by the installed safety valves which are designed to relieve any pressure in the system in excess of the boiler design pressure.
2) The furnace is protected from explosion/implosion by the furnace framing system, which consists of stiffeners, buck-stays, braces and supports.
3) The boiler is protected from explosion and overheat damage with interlocks incorporated in the burner management system. These interlocks prevent operation of the equipment in an unsafe manner.

In order to assess the safety of all these systems, a two person team will be required to review the components of the 5 units. The team will consist of a boiler service engineer and a controls engineer.

The boiler service engineer will review the safety valve installation and maintenance program, visually inspect the furnace framing systems, and review the safe work practices employed for boiler start-up, shutdown and boiler layup.

The boiler controls engineer will perform an audit of the burner management system. This audit will include a review of all documentation, as well as system tests to confirm the safety systems are active and properly functioning.

APPENDIX K

SUMMARY OF RECOMMENDATIONS AND COST WITH MARITIME ELECTRIC COMMENTS

Charlottetown Thermal Generating Station

System	Equipment	Last Major Overhaul	Hours Since Last Major	Assessment	Priority (L/M/H)	Recommendation	Cost	Comments	MECL Comments
Turbine/Generator	# 6	1995	1,720	End cap material is 18Cr-4.5Mn	High	Inspect end caps and replace if necessary	$ 183,333	Inspection only for $183,333	Will retire # 6 in 2016, no action required
Turbine/Generator	# 6	1995	1,720	End cap material is 18Cr-4.5Mn	High	Replace end caps	$ 300,000		Will retire # 6 in 2016, no action required
Turbine/Generator	# 6	1995	1,720	In need of a major overhaul	High	Carry out a major overhaul on the unit	$ 350,000		Will retire # 6 in 2016, no action required
Turbine/Generator	# 7	1994	3,241	End cap material is 18Cr-4.5Mn	High	Inspect end caps and replace if necessary	$ 183,333		Agree
Turbine/Generator	# 7	1994	3,241	End cap material is 18Cr-4.5Mn	High	Replace end caps	$ 300,000		Agree
Turbine/Generator	# 7	1994	3,241	In need of a major overhaul	High	Carry out a major overhaul on the unit	$ 350,000		Agree
Turbine/Generator	# 8	2006	603	Operable	Low	Limit operation of unit to 1200 hours	$ -		Agree
Turbine/Generator	# 8	2006	603	Operable	Low	Limit cold starts	$ -		Agree
Turbine/Generator	# 8	2006	603	Operable	Medium	Have OEM review operating conditions of the unit	$ 50,000		Agree
Turbine/Generator	# 8	2006	603	Operable	Medium	Install a Bentley Nevada vibration monitoring/trip system	$ 50,000		Agree
Turbine/Generator	# 8	2006	603	Operable	Medium	Retest rotor field winding insulation	$ -	Can be done internally	Agree
Turbine/Generator	# 9	2002/2005	3,811/1,741	Operable	Low	Limit operation of unit to 1200 hours	$ -	generator stator re-wedge only in 2005. 3,811 hours since 2002 and 1,741 hours since 2005	Agree
Turbine/Generator	# 9	2002/2005	3,811/1,741	Operable	Low	Limit cold starts	$ -	generator stator re-wedge only in 2005. 3,811 hours since 2002 and 1,741 hours since 2005	Agree
Turbine/Generator	# 9	2002/2005	3,811/1,741	Operable	Medium	Have OEM review operating conditions of the unit	$ 50,000	generator stator re-wedge only in 2005. 3,811 hours since 2002 and 1,741 hours since 2005	Agree
Turbine/Generator	# 9	2002/2005	3,811/1,741	Operable	Medium	Install a Bentley Nevada vibration monitoring/trip system	$ 50,000	generator stator re-wedge only in 2005. 3,811 hours since 2002 and 1,741 hours since 2005	Agree
Turbine/Generator	# 10	2004/2005	2,374/2,020	Operable	Low	Limit operation of unit to 1200 hours	$ -	generator stator re-wedge only in 2005. 2,374 hours since 2004 and 2,020 hours since 2005	Agree
Turbine/Generator	# 10	2004/2005	2,374/2,020	Operable	Low	Limit cold starts	$ -	generator stator re-wedge only in 2005. 2,374 hours since 2004 and 2,020 hours since 2005	Agree
Turbine/Generator	# 10	2004/2005	2,374/2,020	Operable	High	Inspect end caps and replace if necessary	$ 183,333	generator stator re-wedge only in 2005. 2,374 hours since 2004 and 2,020 hours since 2005	Agree
Turbine/Generator	# 10	2004/2005	2,374/2,020	Operable	High	Replace end caps	$ 300,000		Agree
Turbine/Generator	# 10	2004/2005	2,374/2,020	Operable	Medium	Have OEM review operating conditions of the unit	$ 50,000	generator stator re-wedge only in 2005. 2,374 hours since 2004 and 2,020 hours since 2005	Agree
Turbine/Generator	# 10	2004/2005	2,374/2,020	Operable	Medium	Install a Bentley Nevada vibration monitoring/trip system	$ 50,000	generator stator re-wedge only in 2005. 2,374 hours since 2004 and 2,020 hours since 2005	Agree
Boilers	# 10	1992		Operable		None	$ -	Rebuild in 1992	
Boilers	# 9	1995		Operable		None	$ -	Rebuild in 1995	
Boilers	# 6	1995		Operable		None	$ -	Refurbishment in 1995	
Boilers	# 5	2006		Inspection Required	Medium	Inspect 2" length from tube sheet generating bank tubes (WIP/NIP)	$ 8,000	Full length generating bank tube inspection in 2006, near mud drum had 60 tubes with thinning	Agree
Boilers	# 4	2001		Operable		None	$ -	In 2001, all generating bank tubes inspected full length, no issues found	
Instrumentation & Controls				Operable		None	$ -		
Station Safety Valves				Operable		None	$ -	Lift all valves at the start of each training run	
Deaerators				Operable	Medium	Inspect internal tank and weld seams; including circumferential, longitudinal, nozzles and other	$ 20,000	Units # 9 & # 10	Agree
High Energy Piping				Operable	High	Sample of most highly stressed joints, pipe hangers and feedwater piping for NDT	$ 150,000		Agree
Turbine Extraction Steam Non-return Valves				Operable	Low	Inspect valves	$ -	Can be done internally	Agree
High and Low Pressure Feedwwater Heaters				Operable	Low	Document all maintenance	$ -		Agree
Generator Air Coolers						Inspect, leak test and plug/repair as required			
Generator Dehumidification Systems				Operable		None	$ -		
Vibration Monitoring Systems						See recommendations under T/G #8, # 9 and # 10	$ -		
Training and Layup Documentation						None, MECL uses Maximo and Company training database	$ -		
Unit Operation						Limit cold starts	$ -		
Generating Unit Operational Review	Turbines					OEM review, included above	$ -		
Generating Unit Operational Review	Boilers					Boiler service engineer review	$ 125,000		Agree
Low Voltage Swtichgear					Low	Awareness	$ -		
Operating # 6 Boiler for Aux Steam						None	$ -		
Total							$ 2,753,000		

APPENDIX L

NORMAL MAJOR OVERHAUL REQUIREMENTS

CONTENTS

ITEM	ACTION REQUIRED		COMMENT
1. Checks to be carried out before shutdown			

To establish the general condition of the turbine and generator before carrying out the inspection, it is recommended that the measurements listed below are recorded with the unit in service immediately before the inspection and repeated when the turbine is re-assembled and returned to service.

1.1 Three plane vibration measurements at turbine and generator bearings with phase angles if possible at various loads, and at no load.

1.2 Steam pressure measurements :

Before turbine stop valve.
After turbine stop valve.
After turbine governor valve.
In wheelcase.
Turbine exhaust.
Condenser vacuum.

1.3 Temperatures :

Steam before turbine stop valves
Steam at bleed points.
Steam at turbine exhaust.
Condensate at condenser outlet.

1.4 Electrical :

Readings of the excitation voltage and current, rotor temperature and shaft voltage should be taken. A complete log of all generator instrumentation together with coolant temperatures at inlet and outlet of coolers.

2. HP STEAM ADMISSION VALVE ACTUATORS & RELAYS	1.	Rig check before dismantling. Record as-found settings, record leaks, if any.	Use recorded settings to assist adjustment during re-assembly.
	2.	NDE springs for cracks.	
	3.	Dimensional checks on all components.	Review clearances and tolerances.
	4.	Inspect oil pipe connections.	Evaluate the extent required based on condition found in preliminary examination.

ITEM	ACTION REQUIRED	COMMENT
	5. Flush control gear systems to achieve a high standard of cleanliness.	
	6. Recommission valves to achieve design settings.	
	7. Carry out rig check to confirm satisfactory operation.	
3. TURBINE STOP AND GOVERNOR VALVE & SEATS	1. Dimensional checks on all components.	Review clearances and tolerances.
	2. NDE key welds and fasteners. Record wear/damage/cracks etc. Check G.V. skirts for cracks	High temperature fasteners not subject to routine replacement must be checked for cracks.
	3. NDE valve seats.	Report whether seat cracks are radial or circumferential.
	4. Check steam strainer fit and inspect strainers for integrity and blockage. Clean as necessary to restore area.	
	5. Check valve spindles for straightness.	If any signs of wear on spindles or valves, institute a full concentricity check of all location diameters.
	6. NDE stop valve and governor valve power springs for cracks and check free length.	Compare free lengths with design specification.

ITEM	ACTION REQUIRED	COMMENT
4. TURBINE STOP AND GOVERNOR STEAM CHESTS	1. Distortion checks.	Dishing and ovality checks at cover joint face.
	2. Measure stud squareness to chest joint faces.	
	3. Remove seat cages and NDE (MPI) internal surfaces of chests. Full visual inspection of inside and outside surfaces.	Close attention to be given to changes of section, e.g. at the side wall and spigot adjacent to the valve cage seating.
	4. Crack detect surfaces of seats.	If cracked report if radial or circumferential cracks.
	5. NDE of chest covers and fasteners.	High temperature fasteners not subject to routine replacement must be checked for cracks.
	6. Check visually chest stud hole thread form for damage and measure core diameters 7. Check stud hole bellmouth and stud squareness check.	Checks are to be made if studs are removed. The extent of measurements required will be determined from the inspection and distortion checks.
	8. NDE (MPI) all pipe connections to the chest, including penetrations for temperature and pressure measurement.	
5. TURBINE INLET PIPES	1. Check cold draw.	Compare with original on drawing. Record the as-found pipe position after cutting pipe.
	2. NDE all welds and penetrations.	MPI and ultrasonic. Check hardness at and adjacent to welds. Concentrate ultrasonic check on pipe wall opposite drain and instrument tappings for cracks due to water flash back.

ITEM	ACTION REQUIRED	COMMENT
	3. NDE (MPI) inlet flange bolts.	
	4. Measure pipe thickness.	Particularly around the drain connection for erosion damage.
6. TURBINE CYLINDER, TOP HALF	1. Record datum position measurement at cylinder body keys, pedestals etc.	Must be done before slackening any fasteners on cylinders or bearing pedestals.
	2. Unbolt and remove T.H. casing.	Carry out checks 10.1 to 10.3 inclusive on the HP rotor before commencing this operation.
	3. Check vertical faces of top half diaphragm carriers for evidence of pick-up when top half outer casing was removed.	
	4. Invert top half cylinder and record diaphragm steps, lifts and diaphragm/cylinder radial clearances on last stage.	Replace all diaphragm T.H. retaining bolts.
	5. Remove lagging around steam connections, clean and NDE. Particularly adjacent to paddle gland areas.	Only high stress areas to be examined unless a problem is found.
	6. Inspect all cylinder penetrations.	Pay particular attention to internal surfaces at junction with wall of cylinder.
	7. Examine sealing surfaces for evidence of leakage.	
	8. Record 'rub' pattern, severity and distribution at glands and diaphragm before cleaning up.	
	9. Remove last stage diaphragm and diaphragm gland segments, ash blash and NDE including stationary blading.	Carry out checks 10.3 and 10.4 before commencing this operation.

ITEM	ACTION REQUIRED	COMMENT
10.	Ash blast inner and outer surfaces particularly diaphragm and carrier grooves.	
11.	Carry out checks on diaphragm bore closure and diametral and axial distortion.	
12.	With diaphragm out check condition of axial seal face surfaces and diaphragm side support 'ledges' in cylinder.	
13.	Remove nozzle box and carry out N.D.E.	
14.	Measure thoats and pitch of nozzle blading.	
15.	Check nozzle box for axial and radial distortion.	
16.	Crack detect nozzle blade outlet edges and welds.	
17.	Note whether gland faces at each end and other annular faces are in line, top to bottom halves.	Carry out during distortion checks when dowelled and fully bolted.
18.	Check gland segments, dimensions and springs. Inspect gland carriers including dimensional checks.	Replace on reassembly as required.
19.	Inspect/all cylinder location keys and keyways.	
20.	Check paddle glands for leakage/ erosion damage between race and casing.	
21.	NDE paddle wheel gland housing.	Check for distortion.
22.	NDE casing half joint fasteners and holes.	Where not due for routine replacement. Replace defective fasteners.

ITEM	ACTION REQUIRED	COMMENT
	23. NDE under half joint flange area.	To check effect of flange warming.
7. TURBINE DIAPHRAGM CARRIERS TOP HALF	1. Unbolt and remove.	
	2. Record top half diaphragm steps, lifts and diaphragm/cylinder radial clearances.	Replace all T.H. diaphragm retaining bolts.
	3. Record rub pattern severity and distribution at diaphragm glands before cleaning up.	
	4. Remove diaphragms and diaphragm gland segments, ash blast and NDE, including stationary blading.	The detailed history of blade problems is required to evaluate repair/replacement options.
	5. Ash blast and NDE the inner surface, the outer surface and diaphragm grooves.	Ash blast finish to N7 (63 CLA) is required on all steam passages.
	6. Carry out checks on diaphragm bore closure and diametral and axial distortion.	
	7. With diaphragms out check condition of annular seal face surfaces and diaphragm side support 'ledges' in the cylinder.	
	8. Crack detect diaphragm blade outlet edges and diaphragm welds.	
	9. Inspect locating dowels, keys and keyways. Check fits.	
	10. NDE half joint fasteners and holes.	
	11. Note whether faces at each end and other annular faces are in line, top and bottom halves.	Check during distortion checks when two halves are doweled and fully bolted.
	Check gland segments and	Replace on re-assembly as

ITEM	ACTION REQUIRED	COMMENT
8. TURBINE DIAPHRAGM CARRIERS BOTTOM HALF	1. Check bottom half radial and axial clearances, at the half joint, for each stage with rotor in cold set position.	
	2. Record bottom half diaphragm steps, key clearances and diaphragm/cylinder radial clearances.	
	3. Remove diaphragms and diaphragm gland segments, ash blast and NDE.	
	4. Remove bottom half carriers	
	5. Ash blast clean and NDE inner and outer surface, including diaphragm grooves.	Ash blast finish to N7 (63CLA) is required on all steam passages.
	6. Carry out checks on diaphragm bore closure and diametral and axial distortion.	
	7. With diaphragms out check condition of annular seal face surfaces and diaphragm side support 'ledges' in the cylinder.	
	8. Crack detect diaphragm blade outlet edges and diaphragm welds.	The detailed history of blade problems is required to evaluate repair/replacement options.
	9. Inspect locating dowels, keys and keyways. Check fits.	
	10. Check carrier distortion by measuring free gaps and bolting up using a mandrel.	Compare with previous measurements. This is carried out as an exercise with the outer casing.
	11. Record distribution of main joint gaps bolted and unbolted.	In conjunction with distortion checks in 8.10
	12. Check gland segments and dimensions. Inspect support springs.	

ITEM	ACTION REQUIRED	COMMENT
9. TURBINE CYLINDER BOTTOM HALF	1. Check bottom half radial and axial clearances, at the half joint, for each stage with rotor in cold set position.	
	2. Record bottom half diaphragm steps, key clearances and diaphragm/cylinder radial clearances.	
	3. Remove diaphragms and diaphragm gland segments, ash blast and NDE.	
	4. Remove bottom half carriers	
	5. Clean and NDE inner and outer surface, including diaphragm grooves.	Finish to N7 (63 CLA) is required on all steam passages.
	6. Carry out checks on diaphragm bore closure and diametral and axial distortion.	
	7. With diaphragms out check condition of annular seal face surfaces and diaphragm side support 'ledges' in the cylinder.	
	8. Crack detect diaphragm blade outlet edges and diaphragm welds.	The detailed history of blade problems is required to evaluate repair/replacement options.
	9. Inspect locating dowels, keys and keyways. Check fits.	
	10. Remove nozzle box, NDE and check for distortion.	
	11. Check cylinder distortion by measuring free gaps and bolting up using a mandrel.	Compare with all previous measurements to estimate rate of progression.
	12. Record distribution of main joint gaps bolted and unbolted.	In conjunction with distortion checks in 8.10
	13. Examine sealing surfaces for evidence of leakage due to erosion/corrosion.	Include joint bolt spot faces in line with joint warming spaces.

ITEM	ACTION REQUIRED	COMMENT
	14. Record 'rub' pattern severity and distribution at gland area before cleaning up.	
	15. Inspect/NDE all keys and keyways.	
	16. Check for symmetrical load distribution at the support points.	
	17. Remove all lagging. Remove B.H. casing, clean and NDE, particularly adjacent to paddle gland areas.	Only the high stress areas to be examined unless a problem is found.
	18. Clean and NDE the full interior, including gland areas and half joint holes.	
	19. Inspect all cylinder penetrations.	Pay particular attention to internal surfaces at junction with wall of cylinder.
	20. Check gland segments, dimensions and springs. Inspect gland carriers including dimensional checks.	Replace on reassembly as required.
	21. Check paddle glands for leakage/ erosion damage between race and casing.	
	22. NDE paddle wheel gland housing.	
	23. NDE under half joint flange area.	
10. TURBINE ROTOR	**(Turbine Rotor inspection checks to be carried out in accordance with GEC ALSTHOM Process Specification PS 181/0220.)**	
	1. Check coupled concentricity before unbolting.	To be compared with past records and design recommendations and used to determine corrective work and adjustment required before re-assembly.
	2. Break coupling and record shaft alignment.	
	3. Check and record bump clearances.	
	4. Record a full set of axial and side radial clearances.	

ITEM	ACTION REQUIRED	COMMENT
	5. Note condition and fit of coupling bolt holes.	
	6. Check condition/wear of stub shaft and driving key.	
	7. Remove rotor and ash blast.	Ash blast all surfaces for NDE to a surface finish or N7 (63 CLA). This standard is particularly required on all steam passages.
	8. Check that the bore hole plugs are secure. Measure rotor truth, preferably in a lathe.	Include coupling face and periphery, turbovisory sensing tracks, thrust faces, bearing journals, main and interstage gland journals. If necessary, machine a track on the coupling periphery which is concentric to the bearing journals.
	9. NDE 100% of rotor surface including disc panels, blading and shrouding.	Magnetic particle inspection. The detailed history of blade problems is required to evaluate repair/replacement options.
	10. Observe and record erosion/ other damage.	
	11. Blade distortion and alignment measurement.	Refer to previous operating background.
	12. Review operating records for quality of balance.	Consider need to rebalance based on previous running performance, residual deposits after cleaning and repair work carried out.
	13. Check paddle wheel gland screws are in correct material.	12% chrome - not 18/8 stainless.
11. TURBINE EXHAUST CHAMBER	1. Examine joint at condenser neck.	
	2. Inspect cylinder bottom half and exhaust frame supports.	Check for gaps under exhaust frame packers.
	3. Inspect ribs and braces in cylinder, hoods, and exhaust.	

ITEM	ACTION REQUIRED	COMMENT
12. TURNING GEAR	1. Check condition of gears for wear and backlash. Check oil sprays.	
	2. Inspect bearings.	
	3. Check all other components for wear/damage.	
13. SHAFT COUPLINGS	1. Routine NDE flex coupling	Inspect for debris in convolutions, squareness and concentricity of coupling faces and peripheries.
	2. Journal/journal concentricity measurement.	
	3. Measure bolting and bolt hole diameters.	
14. PEDESTALS	1. Remove front pedestal and check ped/soleplate keys for wear and axial, restriction.	
	2. Degrease and clean high stress areas (e.g. bearing supports).	
	3. NDE high stress areas.	
	4. Restore surface protection.	
	5. Inspect palms and palm supports.	Visual inspection around feet for obvious wear.
	6. Inspect sliding surfaces between pedestal and soleplate, check that there is no obstruction to axial expansion at the alignment keys, gland pipes, soleplates etc.	
	7. Inspect keys and keyways.	
	8. Inspect greasing connections, flush out grease ways and pipes.	

ITEM	ACTION REQUIRED	COMMENT
	9. Check that oil wiper bottom centre drains are clear.	
	10. Measure oil wiper clearances.	
	11. Inspect oil wipers for evidence of carbonisation.	
	12. Check bolding down fasteners for security.	
	13. Check pedestal inclination at horizontal joint when machine cold and compare with previous measurement.	
15. BEARINGS	1. Check bridge gauge reading with adjacent rotor coupling broken and compare with previous measurement.	
	2. Check and correct if necessary, the quality of 'bed' between the housing and support ring (spherical) and between locating pads and pedestal bore (cylindrical).	
	3. Record then remove all traces of fretting damage.	
	4. Check the fit/pinch of the shells within the housings.	
	5. Check the condition of retaining screws and anti-rotation keys.	
	6. Check white metal adhesion.	
	7. Check axial float of turbine thrust bearing.	To be done before removing main and surge pads to carry out rotor bump checks.
	8. Check squareness of thrust bearing housing.	
	9. Check condition of thrust pads for white metal adhesion, cracking and wear.	

ITEM	ACTION REQUIRED	COMMENT
16. GOVERNOR & OVERSPEED BOLTS	1. Note in-service performance of governors prior to the outage.	
	2. Check all components for signs of rubbing/wear and excessive play/ clearance through the full range of movement.	
	3. Check dimensions of critical components such as : Overspeed bolt dimensions. MPI of governor cross-shaft, shaft run out, drive gear backlash.	
	4. Check springs of speed and emergency governors	Include test of stiffness rate in spring check. Replace if operation is inconsistent.
	5. Carry out rig check of governor/valves after re-assembly.	
17. OIL SYSTEMS	1. Drain main oil tank. Inspect interior for deterioration of protective covering.	Clean out sludge. Check security of fasteners.
	2. Remove sample pipes on both supply and drains. Examine for internal deposits and corrosion (Lub oil, jacking oil, relay oil and seal oil systems).	Depending on findings Chemical cleaning may be appropriate.
	3. Overhaul main oil pump gearing.	
	4. Inspect thrust bearings. leakage.	
	5. Check oil cooler floating head leakage.	) For detail checks,) see 33. AUXILIARY CW COOLERS)
	6. Pull oil cooler tube bundles and inspect for corrosion.	))
	7. Inspect all oil filters and strainers for wear/damage and clean.	

ITEM		ACTION REQUIRED	COMMENT
	8.	Overhaul all pumps, fans and motors to manufactures instructions.	For detail checks, see 35, 36, 37, etc.
	9.	Overhaul and clean the oil purifying equipment.	
18. NON-RETURN VALVES	1	Check assembly for freedom of operation.	
	2.	Remove covers and carry out a full inspection for wear at bearings and other moving parts.	
	3.	Check bedding of valve on to seat.	
	4.	Check the integrity of valve seat. (N.D.E. seated area of valve and seat of bled steam N.R.V.'s).	In particular check the security of screwed or rolled-in seats.
	5.	Where valve flap is bolted check condition of fastening.	
	6.	Check balance weights, where fitted, for security and setting.	
	7.	Refurbish as necessary, reassemble and test.	
19. STEAM DRAINS SYSTEMS	1.	Carry out maintenance on valves and actuators in accordance with manufacturers instructions.	
	2.	Confirm that drain pipes, including trap by-passes, are not restricted.	
	3.	Check that drain pipework has not been disturbed and that a continuous fall is maintained to ensure efficient drainage.	

ITEM	ACTION REQUIRED	COMMENT
	4. Check integrity and setting of pipework supports.	
	5. Inspect trap internals and check for evidence of wear or damage which would adversely affect their correct function in service.	
	6. Check drain strainer elements (if fitted) for wear, damage and cleanliness. Analyse any debris, which may have collected.	
	7. Open and clean dirt traps.	
	8. Check that drain line instrumentation (where specified) is complete, in satisfactory working order, and correctly calibrated.	
	9. Check lagging on high temperature drain pipes for damage and restore as necessary.	
20. STEAM DRAINS RECEIVERS/ TANKS	1. Gain access and check for cleanliness, corrosion, erosion and cracks.	
	2. Clean and refurbish as necessary.	
	3. Inspect and service vent spray cooling (where fitted).	
	4. Service water level gauge glasses.	
	5. Check all drains to receivers are clear.	
	6. Inspect and service all drain valves and traps.	

ITEM	ACTION REQUIRED	COMMENT
21. GENERATOR ROTOR	1. Check rotor winding resistance, insulation resistance and carry out RSO check.	
	2. Check rotor winding impedance. Carry out pole balance and if necessary coil balance check.	
	3. Check operation and condition of brushgear.	
	4. Inspect journal and seal surfaces.	
	5. Check for ventilation port blockage.	
	6. Remove retaining rings (end bells).	
	7. NDE inspect retaining rings using dyeline and ultrasonic techniques for cracks on all outside and inside surfaces.	Remove paint with emery paper (protecting any apertures), vacuum clean and finish with white white spirit.
	8. Inspect endwinding packings for condition and security.	
	9. Inspect endwinding distortion, condition of field lead connections, and pole to pole connections.	
	10. Inspect endwinding for mechanical effects such as fretting etc.	
	11. Check condition of interturn and slot cell insulation.	

ITEM	ACTION REQUIRED	COMMENT
	12. Carry out a general visual inspection of the rotor body, wedges, sliprings, couplings and balance weights.	Sliprings should be replaced if outside diameter is less than 14.875 inches. Slipring grooves should be re-cut if less than 0.125 inches deep.
	13. Clean and check condition of rotor fan blades and N.D.T. Check stationary parts. Check fan hub by M.P.I.	On fan hub pay particular attention to the corners of the blade slots.
22. GENERATOR STATOR	1. Check stator winding insulation resistance.	
	2. Inspect and clean stator winding.	
	3. Check the slot wedges for tightness.	
	4. Inspect for any damaged laminations.	
	5. Examine the tightness of the stator core for slackness. Inspect core vent ducts.	
	6. Check the security of the clamps, packings, fasteners, etc. to the overhang supports.	
	7. Inspect stator coil endwinding insulation particulary at the coil clamping and support positions.	Examine for signs of dusting or marking which indicates fretting or coil movement during service.
	8. Examine stator coils for tape migration at the slot ends.	
	9. Check the terminal arrangement for security and any signs of overheating.	

ITEM	ACTION REQUIRED	COMMENT
	10. Carry out I.R., P.I., loss tangent and capacitance tests on the stator winding.	If loss tangent values have not been measured before they can be used as a reference for future tests.
	11. EL CID and ring flux test the stator core and examine with thermal imaging camera for hot spots.	Recommend EL CID test to be carried out first.
	12. Check all internal wiring for thermocouples and R.T.D.'s for security and measure their resistance.	Any instrumentation found to be defective during pre-commissioning checks should be attended to at this time.
	13. Check integrity of air coolers.	See 31. AUXILIARY COOLERS
	14. Check condition of stator air ducting. Reseal and repaint as necessary.	
23. GENERATOR FRAME	1. Visually inspect the frame condition and the condition of the frame welds.	
	2. Check integrity of any connections to frame.	
24. EXCITER	1. Inspect exciter rotor for damage and cleanliness.	
	2. Inspect exciter stator for damage and cleanliness.	
	3. Check commutator's diameter not worn beyond design tolerance.	
	4. Check integrity of commutator mounting spider.	

ITEM	ACTION REQUIRED	COMMENT
	5. Check brushgear for wear and cleanliness.	
	6. IR test rotor winding.)	Compare with records of previous tests.
	7. IR test stator winding.)	
	8. Check rotor winding impedence.)	
	9. Check ventilation passages.	
	10. Check pedestal and pipework insulation.	
	11. Check condition of bearings.	
25. CONDENSER	1. Check water box internals for corrosion.	
	2. Inspect internal welds. Check for cracks.	Include support strut welds.
	3. Visual inspection of erosion problems.	
	4. Eddy current test of tubing.	Particularly at tube to tube plate joint and tube support plates. History of all tube problems required.
	5. NDE air and condensate extraction line expansion joints.	
	6. NDE all drain manifolds /hotwell and suction line to condensate extraction pump.	Including ultrasonic thickness checks.
	7. Water test tube/tubeplate sealing and tube nest.	Fluorescence check.
	8. Inspect jacks and springs.	
	9. Inspect condenser foundation for signs of cracking or subsidence.	

ITEM	ACTION REQUIRED	COMMENT
	10. Examine condenser and associated pipework with respect to any adverse influence on turbine alignment.	
26. ATMOSPHERIC VALVE	1. Remove cover and check wear, general integrity and freedom of movement.	
	2. Check security of seat and valve flap.	
	3. Check bedding of valve on to seat.	
	4. Check balance weight for security and setting.	
	5. Check functioning and integrity of water seal system.	
27. CONDEN-SATE EXTRACTION PUMP	See 34. AUXILIARY PUMPS (Centrifugal)	
28. AIR EJECTORS	1. Remove steam pipes and remove ejectors.	
	2. Examine ejector nozzles for wear and damage.	
	3. Remove the surface condenser fabricated shell.	
	4. Check surface condenser tubes for leaks.	
	5. Replace, re-expand or plug any leaking tubes.	

ITEM	ACTION REQUIRED	COMMENT
	6. Refit surface condensers fabricated shell. Carry out pressure and leakage test.	
	7. Flush out interstage drains.	
	8. Refit ejectors and steam pipework.	
29. FEED HEATERS	1. Inspect water boxes for erosion wear, damage and debris. Clean up as necessary.	
	2. Check tubes for leaks.	
	3. Re-expand, re-seal or plug leaking tubes as necessary and recheck for leakage.	
	4. Replace water box access covers and test for leakage.	
	5. Inspect steam space for erosion, corrosion at accessible points.	
	6. Check and service level control equipment. (If fitted).	
	7. Clean magnets and check operation of all level switches.	
	8. Check integrity and service feed water bypass equipment. (H.P. feed heaters only).	
30. FLASHBOXES	1. Open and Clean	
	2. Inspect drain diffusers and nozzles for wear, trapped debris, etc.	

ITEM	ACTION REQUIRED	COMMENT
	3. Check internal surfaces for water erosion, wall thinning, etc.	
	4. Check internal drain at standpipe base is clear.	
31. ORIFICE PLATES	1. Remove and check all orifice plates for wear.	
	2. Remove any debris collected on upstream side.	
	3. Check for pipe wall erosion on downstream side.	
32. CW SYSTEM	1. Normal maintenance.	
	PLUS	
	2. Check integrity of inlet and outlet C.W. isolating valves.	
	3. Inspect inlet and discharge channels.	
33. AUXILIARY-CW COOLERS	1. Remove water box cover(s), body side inlet and outlet connections, sludge drain(s), vent(s) and any outer connections or blanks.	
	2. Examine internals of waterbox(es) for erosion/corrosion of waterbox(es) and tubeplate(s). Check inlet entries of tubes for erosion. Check tubes for general cleanliness and freedom from debris.	
	3. In waterboxes with a splitter plate, check joints at tubeplate and cover intact with no evidence of erosion/leakage.	

ITEM	ACTION REQUIRED	COMMENT
	4. Examine visible tube nest surfaces and internal baffles for cleanliness and damage through all available access points. If indicated necessary withdraw tube nest and clean/refurbish.	
	5. Carry out hydraulic pressure and leakage tests. Re-expand or plug tubes as necessary and re-test.	
	6. Where fitted check sacrifical anodes for condition/replacement, etc. or Check integrity of anti-corrosion coatings.	
	7. Check all miscellaneous fittings, instrumentation, valves, etc. and refurbish as necessary.	
	NB Refer to manufacturers instructions for more detailed checks and strip down, repair and assembly procedures.	
34. MANUAL & MOTOR OPERATED VALVES	1. Check limits of travel.	
	2. Check lubricaion.	
	3. Repack valve spindle glands as applicable.	
	4. Inspect diaphragms of Saunders type valves for wear and replace as necessary.	
	5. Strip down valves with suspect tightness. Examine and rebed valve to seat and test.	

ITEM	ACTION REQUIRED	COMMENT
35. AUXILIARY PUMPS (Centri-fugal)	1. Open pump casing and check impeller and casing internal surfaces for erosion, corrosion and fouling. Clean and refurbish as necessary. 2. Check security of fixing of impeller to shaft and other shrunk on components. 3. Check wear rings and replace as necessary to restore design clearances. 4. Inspect journal bearings and thrust for wear and refurbish/ replace components as necessary. 5. Inspect gland sealing arrangements and re-pack (re-furbish mechanical seals) as necessary.	
36. AUXILIARY PUMPS (Gear Type)	1. Open casing. Check gears for wear, bedding and backlash. Check bearings and seals for wear. 2. Refurbish/replace components as necessary to restore design clearances.	
37. AUXILIARY MOTORS	1. Dismantle the motor as per Manufacturers Instructions. 2. Examine motor components for mechanical damage or excessive wear, paying particular attention to the following: 2.1 Rotor 2.1.1 Inspect journals for wear and damage and check rotor in way of seals for wear, erosion, etc. Refurbish as necessary.	

ITEM	ACTION REQUIRED	COMMENT
	2.1.2 Clean rotor winding.	
	2.1.3 Check integrity of any textile lashing material and rotor blading.	
	2.1.4 Check winding visually for signs of hot spots, paying particular attention to rotor end plates of large indication motors.	
	2.1.5 Check wear of slip rings or commutators as applicable and dress or grind as necessary.	
	2.1.6 On completion of rotor work apply a thin coat of grey oil resistant varnish.	
	2.2 Stator	
	2.2.1 Clean stator windings.	
	2.2.2 Check stator winding supports, lashings and packing.	
	2.2.3 Check stator winding for hot spots.	
	2.2.4 Clean all passages and ducts in air cooling circuit.	
	2.2.5 Check integrity of air cooling circuit paying particular attention to any baffles where damage would result in air bypass and loss of cooling.	
	2.2.6 Check air circuit water coolers, where relevant, for leaks and clean tubes and waterboxes. Refurbish as necessary.	

ITEM	ACTION REQUIRED	COMMENT
	2.3 Bearings	
	2.3.1 Check bearings for wear and damage and refurbish/ replace components as necessary.	
	2.3.2 Check integrity of lubrication system, clean and recharge with fresh lubricant to Manufacturers Instructions	
	2.3.3 Check integrity of bearing lubricant seals, baffles, etc.	
	2.4 Couplings	
	2.4.1 Check couplings and coupling bolts for wear, paying particular attention to arrangements for drive flexibility.	
	2.4.2 Check integrity of coupling guards and fasteners.	
3	Carry out any other motor checks as per Manufacturers Instructions.	
4.	Reassemble the motor as per Manufacturers Instructions.	
5.	Conduct motor checks:	
	5.1 Make general inspection regarding completness of installation, in particular the holding down bolts and dowels, etc. are correctly fitted.	
	5.2 Check that motor earthing strip is correctly fitted to the motor and the appropriate station earth ring.	

ITEM	ACTION REQUIRED	COMMENT
	5.3 Check IR of motor winding.	
	5.4 Check with the aid of the correct schematic diagram, that remote and auto starting function have been correctly incorporated in the control circuits together with all tripping functions.	
	5.5 Check lubrication.	
	5.6 Check alarms, alarm facia indications and instrumentation.	
	5.7 Check that coupling bolts, belt or chain drive, etc. have been removed.	
	5.8 Check freedom of rotation by hand.	
	5.9 Run motor briefly to check direction of rotation.	
38. DC MACHINES	1. Check commutator for cleanliness.	
	2. Check brush gear generally.	
	3. Check brush pressure and record.	
	4. Check starter resistance.	
39. LARGE ELECTRICAL MACHINES (Above 100 HP)	1. Check air gaps.	
	2. Check bearing float.	
	3. Check pedestal insulation.	