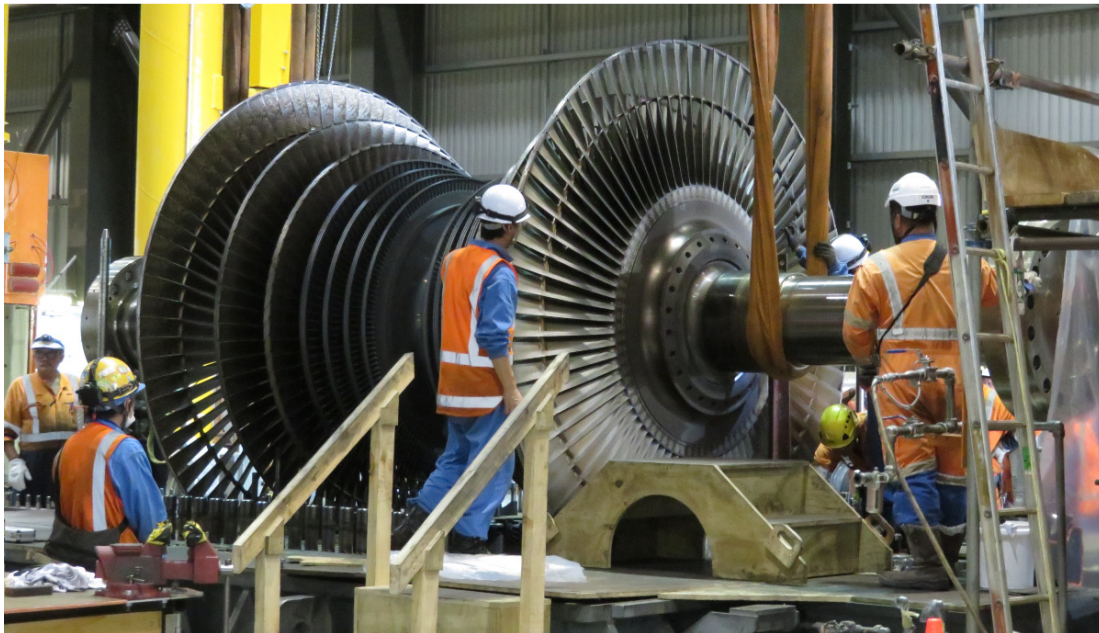




# **400MW Combined Cycle Plant Steam Turbine and Generator Overhaul Case Study**

**Oct-Dec - 2018**



<i>Case Study</i>	:	Project 1463
<i>Prepared by</i>	:	Alan Robinson / Brett Houston
<i>Date Issued</i>	:	May 2019

## EXECUTIVE SUMMARY

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The 400MW Combined Cycle Gas-Fired Thermal Power Plant was shut down in late October 2018 for the scheduled overhaul work on the combined cycle, steam turbine generator (STG) and balance of plant (BOP) equipment. ProGen was contracted to undertake the work relating to the STG and its auxiliary plant.

Pre-overhaul ProGen undertook the following preparation work:

- Review the scope of work and equipment manuals
- Visit site to attend and contribute to planning meetings and coordinate preparation activities
- Coordinate with client planner to review the overall plant outage plan.
- Review the inspection test plan (ITP) and assemble the relevant inspection test records (ITR's)
- Develop and issue Site Specific Safety Plan (SSSP)
- Provide all the key trade resources and logistics to undertake the scheduled work on the turbine, generator and nominated ancillary equipment
- Mobilise to site and coordinate the prestart activities with scaffolding and lagging and worksite layout

The ProGen staff key responsibilities for the turbine and generator overhaul project were:

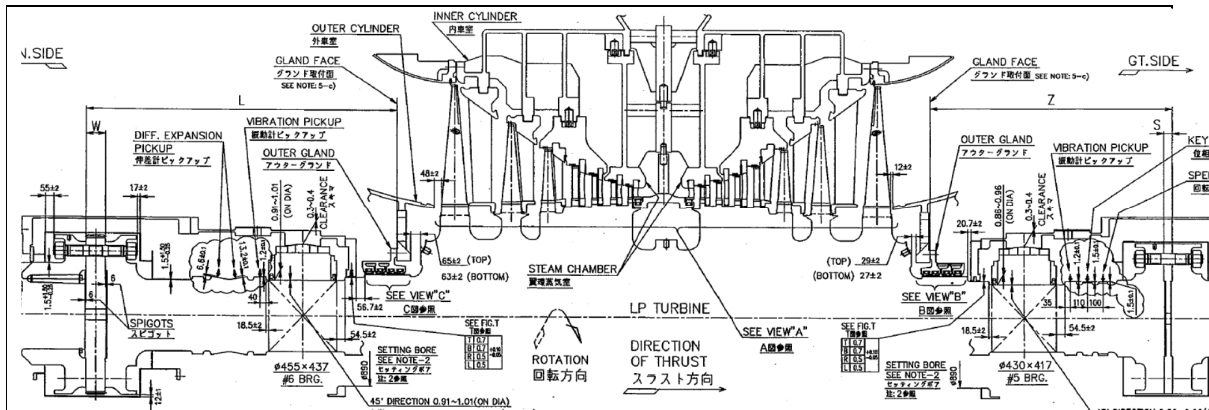
- Supply up to 45 staff (including supervision) to undertake all scheduled work.
- Assist with progress monitoring and work flow during the execution of the project
- Assist with pre-shut preparation work including site and workshop visits
- Provide mechanical, technical and supervisory support, in conjunction with client and OEM technical staff for the overhaul of the steam turbine and generator
- Removal and replacement of the HP-IP and LP turbine rotors
- Refurbishment of the HP-IP and LP turbine upper and lower casings
- Removal, inspection and reinstatement of the generator rotor
- Refurbishment of the generator ancillary equipment.
- Provide coordination of labour, material, tooling, transport logistics, mobile equipment and additional resources as required
- Liaise with contract support staff and informing them of work schedules, etc.
- Develop detailed requirements for critical work tasks
- Develop, support and implement critical lift plans for the major component lifts
- Combine with contract staff to ensure safety, environmental and quality assurance procedures, work instructions and standards are adhered to
- Attend project safety and coordination meetings as required
- Be an integral part of project pre-start and on-job toolbox meetings
- Submission of overhauling documentation complete with:
  - o As-found and as-left measurement records
  - o Detailed inspection records, pictures, findings and corrections
  - o Recommendations and supporting information for client and OEM decision-making.

The overhaul works started with the issue of required access permits to ProGen. The work on the turbine was scheduled to be undertaken on day and night 12 hr shifts running a six day on and one off - offset roster. The overhaul was completed as scheduled in a duration of seven weeks with an additional 2 days allowed for commissioning.

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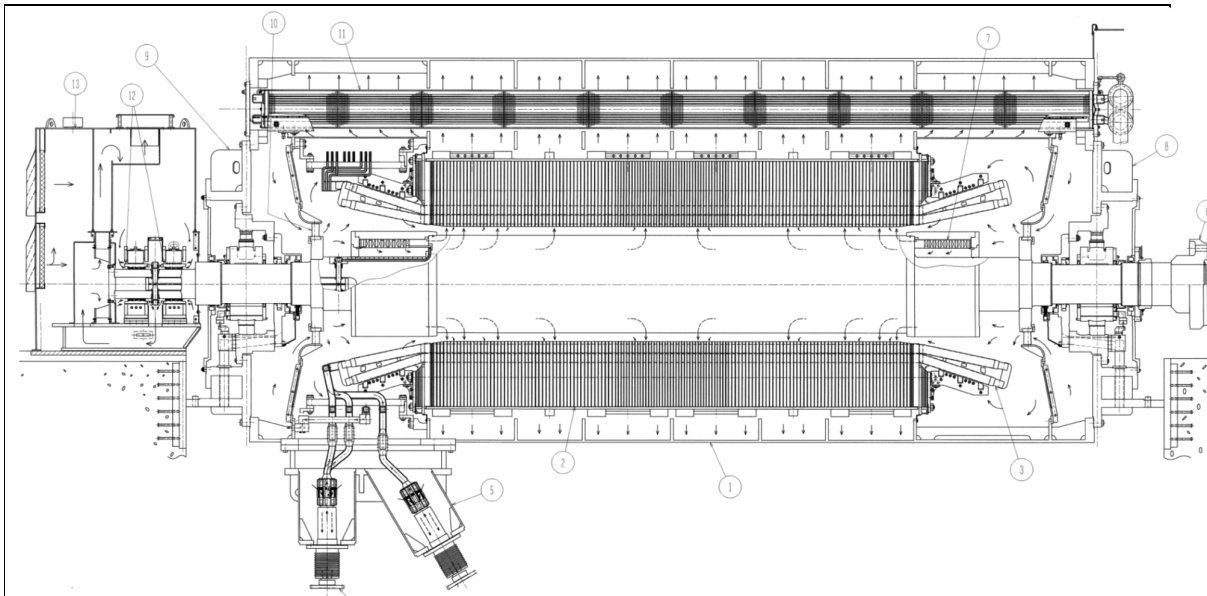
- The HP-IP Turbine was disassembled according to schedule and set aside for grit-blast cleaning and detailed inspection.
  - o As found clearances and datum settings were recorded during the dismantling process
- The inner casings, HP nozzle assembly, internal blade rings and dummy rings were removed for blast cleaning and detailed inspection
  - o Comprehensive NDT carried out on internal components along with the lifting of replicas from components specified by the OEM.
  - o Removal of the nozzle section from the inner casing followed by cleaning and NDT.
  - o All fasteners removed cleaned and NDT tested.
  - o Blade ring interstage seal condition inspected and burrs cleared to restore knife edges.
  - o Turbine glands and dummy seals inspected, cleared of contact burrs and re-knife-edged
  - o Half-joint surfaces checked for distortion, scaling and erosion damage.
- The HP-IP rotor was removed and dispatched for blast cleaning and NDT.
  - o Detailed inspection of the turbine blading, measuring for component wear and assessment of steam path efficiency.
  - o Replication carried out on rotor body sections.
  - o Rotor journals NDT'd, measured and restored to operating condition by removing the glaze.
  - o Coupling surfaces and bolt holes cleaned and checked. Burrs and imperfections removed and bolt/hole dimensions recorded.
- Reassembly of the HP-IP turbine was carried out after all of the internal inspections and dimension checks had been completed.

## LP TURBINE



- The LP turbine was disassembled. The upper and lower steam chamber, internal blade rings and glands were removed for inspection.
  - o All internal operating clearances and datums were recorded during the dismantling process.
  - o LP rotor cleaned and inspected for wear, corrosion to blading, other damage to erosion shields and seal surfaces
  - o Rotor journals measured for wear and then restored to operating condition to remove any glazing.
  - o The turbine bearings were inspected, NDT'd and cleared for reinstatement.
  - o Coupling surfaces checked for unusual conditions, bolt holes cleaned, burrs removed and dimensions checked.
  - o The LP turbine casing was cleaned and prepared for reassembly. Some of the crossover studs were required to be replaced
- The LP cylinder was reassembled following acceptance of the condition and operating clearances.
- Shaft alignments were completed upon reassembly of the steam cylinders.

## GENERATOR



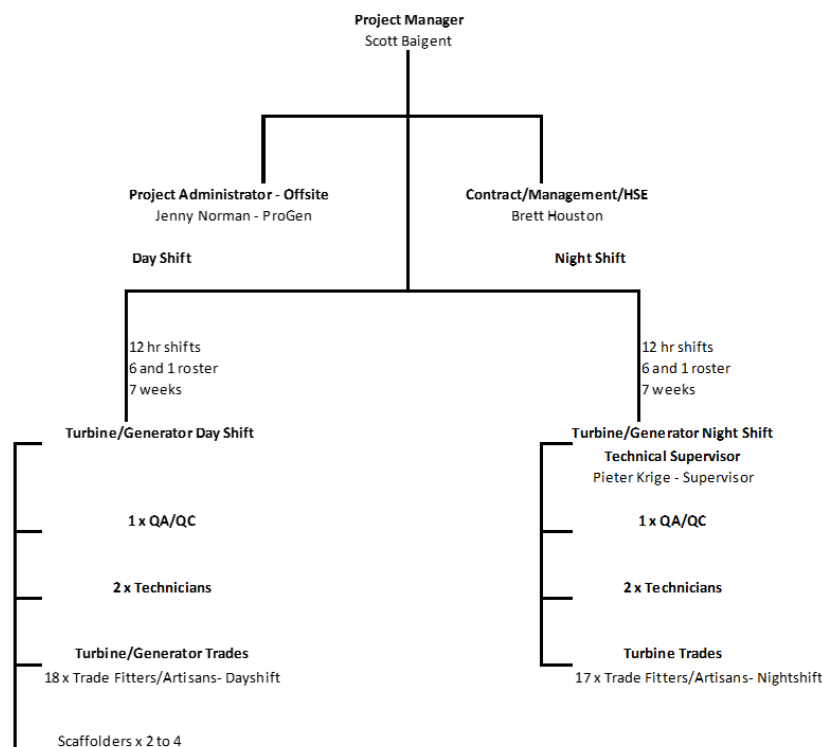
- The generator rotor was removed for a scheduled inspection. The excitation slip ring housing and brush-gear was removed for electrical assessment and refurbishment.

- The bearings were removed for inspection and NDT then prepared for reinstatement during the reassembly process. The rotor journals were measured/inspected for wear and condition. The journal was cleaned to remove the glaze.
- The hydrogen seal components were removed, inspected and NDT'd. The H<sub>2</sub> seal components were found to be in good condition and required limited cleaning.
- The end door brackets and bearing carrier components were cleaned and prepared for reassembly.
- The H<sub>2</sub> cooler waterboxes were removed for inspection. The tubes were cleaned and inspected for corrosion. The waterboxes required some minor coating repairs.
- The OEM and client electrical engineering staff completed a comprehensive set of physical inspections and testing on the stator and rotor as well as the supplementary components whilst the rotor was outside the stator.
- The generator was reassembled on completion of all of the required testing and inspection items planned. The exciter slip ring assembly and housing were installed and secured.
- Alignment of the generator rotor was completed within specification.
- The generator frame was successfully tested to ensure hydrogen containment and compliance with statutory requirements

A strong focus on HSE was maintained throughout the overhaul. There were no first aid injuries or near misses reported. Safety observations were undertaken by staff using the ProGen 'Stop & Think' forms, weekly "Supervisor inspections" and five "Safety Audits" were conducted by the ProGen supervisory staff. Twice daily shift toolboxes were held in each area and recorded. There were no environmental issues.

The quality of the work completed met all required standards. HSE standards were maintained throughout the project with a strong focus on auditing and monitoring safe work practices.

The combined ProGen and separate Gas Turbine/BOP Contractor teams worked extremely well together and completed all work to the quality required in a safe and efficient manner. In addition, the support and assistance of the OEM and Client staff allowed quick and efficient decisions to be made. This allowed work progress to be maintained at an effective, productive rate.





## DIAGRAMS AND PHOTOS

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