1 Original 'A' Train GRS. **2** Upgraded GRS (LRVP obscured at floor level). **3** New LRVP and Seal Water Separator (located at powerhouse floor level).

WAIRAKEI B STATION REMOVAL SYSTEM (GRS) UPGRADE

jacobs for Contact Energy Limited

Project Location: Taupo

Jacobs were engaged to prepare the concept design and Front End Engineering Design for upgrading the Gas Removal Systems (GRS) of the Wairakei "B" power station. Jacobs also undertook detailed design and supported the project through implementation and commissioning over two years.

Jacobs' design focused on understanding the operating conditions and accounting for geothermal gas, water vapour and air components in the GRS feed, in particular, air leaking into vacuum systems. An improved gas solubility and heat balance model was developed and tested, undertaken in autumn with helium gas as a tracer. This method allowed Jacobs to quantify the extent of air leakage, and gave confidence that the gas solubility and heat balance model would provide robust predictions of summer and winter operating parameters. The maximum value of air leakage was used to calculate four design conditions for the new GRS, under summer (average temperature 22°C) and winter (average temperature 11°C) river temperature extremes, and for normal and peak levels of geothermal Non-Condensable Gas (NCG) in the steam supply.

A number of innovations were included in the design and provided advantages, including enhanced cost-effectiveness. The innovative decision was made to eliminate the gear unit between the Liquid Ring Vacuum Pumps (LRVP) and their driving motors, and twelve-pole electric motors were used to drive the vacuum pumps directly. The upgraded GRS was expected to operate at a normal level (0.36 wt%) of NCG in steam, Variable Speed Drives (VSD) allowing the vacuum pumps to run at reduced speed (RPM) and power draw compared to the peak gas level they were sized for. The expense and complexity of standby second stage ejectors was avoided by retaining the original 2-stage ejector GRS 'C' trains to back-up the vacuum pumps.

Coordination and planning by Contact Energy, Jacobs and the contractor, included early design of key interface points, allowing dismantling of the old and installation of the new GRS with minimal impact on generation. Due to space limitations, Jacobs designed a withdrawable LRVP and motor skid beneath the new ejectors and inter-condenser vessel to permit maintenance access. Capital costs were higher than expected due to the need to upgrade the unit 400V power supplies. After two years of operation, Contact Energy has gained a net generation increase of approximately 5½ MW from the B Station units, compared to an anticipated gain of 4½ MW. The upgraded GRS also provides increased operating flexibility for unit start-ups which have been simplified because the LRVP maintains stable vacuum during the hour-long turbine heat soaking employed by Contact Energy; regulating vacuum with the old ejectors required constant attention, and often the vacuum would go off target, requiring the heat soak period to be extended. And, as intended, the upgraded GRS also has the flexibility to economically accommodate a range of gas levels (up to 50% above the nominal value).

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Judging & Copyright Statement

This project is an entrant in the 2018 INNOVATE NZ Awards of Excellence competition. The winners will be celebrated at our Awards Gala Dinner on Friday, 3rd August 2018 in Hamilton.

For more media information and high resolution images, please contact Holly Morchat Stanko
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