PUBLIC DISSEMINATION REPORT

Grantee Name: Granite Power Ltd
Project Title: Solar Supercritical Organic Rankine Cycle for Power and Industrial Heat
Project Number: 3-A017
Date: 02 Mar 2012 to 07 Jun 2014
Total Project Cost: $2,195,011

Contributions:
- ARENA – $812,000
- NEP SOLAR – application of the NEP Solar Polytrough to supercritical fluids
- TURBO POWER SYSTEMS (UK) – application of high speed generator in the turbine
- YOKOGAWA (Australia) – control hardware and software, and control design assistance
- THE CITY OF NEWCASTLE – facilitating use of land and connection to Wallsend Swimming Pool
- THE UNIVERSITY OF NEWCASTLE – research and development assistance
- NEWCASTLE INNOVATION – commercialisation assistance

Project Summary

The Wallsend Demonstration Site is a demonstration of the GRANEX® heat to electricity technology. Heat is collected in a solar thermal mirror array and either immediately converted to electricity or stored in thermal storage for conversion and dispatch at a later time. Low grade waste heat that cannot be converted to electricity by the GRANEX® plant is used to heat Wallsend Swimming Pool and the electricity produced is supplied to the grid.
Technical Specifications

- Mirror collection area 332 m²
- Total plant footprint 732 m²
- NEP Solar parabolic troughs 1.8m Diameter, single axis tracking, self shut down when no sun and in event of a storm
- Evacuated glass tube receivers
- Pressurised working fluid in receivers
- Fully automatic and unattended
- Thermal output: 196 kW peak, 150 kW av
- Capacity of thermal storage tank: 150 kWh (charged at 50 kW)
  1 hr full power output
- Turbo-generator power range: 3 to 30 kW
- Plant parasitic load: 3 to 8 kW (dependant on ambient temperature)
- Hot water output to swimming pool: 100 kW average
- 150 kW LPG burner used for backup during extended periods of cloud cover

Major Project Achievements

1. Direct Heating

World first demonstration of direct heating a supercritical organic working fluid in a parabolic solar trough. This avoids the need for an auxiliary thermal fluid transfer system, which has additional complexity, cost and efficiency losses.

2. Development of a semi-hermetic high speed Turbine Generator

This turbine generator uses state-of-the-art magnetic bearings to support the turbine and generator rotor without the need of any oil lubrication. This very low friction bearing allows the shaft to spin at speeds over 40,000 rpm to deliver up to 30 kW of electricity. The generator is directly coupled to the turbine which eliminates a reduction gearbox. The unit is sealed in a semi-hermetic pressure tight casing to eliminate any mechanical seals. This design is ultra-low maintenance and high efficiency.
3. Low cost energy storage

Using low cost materials such as clay paving bricks, the thermal energy from the sun is stored and released as required. This storage tank can provide another hour of continuous full power, or several hours of low power output. A back-up heat source can be added and in Wallsend a LPG burner is used to run the plant after sustained cloudy periods.

4. Maximum system efficiency by delivering power in both electricity and heat

Of the solar thermal energy collected, thermodynamic limitations mean less than 20% goes to electricity and about 70% is rejected as heat. As an example of how this heat can still be useful, the Wallsend public swimming pool is heated.
About Granite Power

Granite Power Limited (GPL) is an electricity utility focused on thermal energy systems with low-to-medium temperature, low cost & zero carbon emissions. Heat sources utilised include:

- Exhaust from large reciprocating and gas turbine engines
- Industrial processes (refineries, brick kilns, cement works etc)
- Solar Thermal
- Hybrid Waste Heat/Solar Thermal

**Engineering capability:** Granite Power builds, owns and operates (full bespoke design, supply, install, operate and jointly managed interface).

**Power Purchase Agreement:** Complete commercial framework for term supply contract.

**Commercial philosophy:** Replication of normal grid supply, at isolated sites. Utility service: additional, low cost, zero carbon power, with zero capital outlay.

**Technical philosophy:** Highly reliable and efficient plant, with minimal maintenance, and zero impact on customer’s activities.

**Core technology:** GRANEX® is a patented high efficiency version of the Organic Rankine Cycle.

Contact

For further information about this project, please contact:

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