Australian Geothermal Power Conversion Research Priorities (TIG6)

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The purpose of this document is to identify the research priorities for the Australian geothermal industry in the area of power conversion (TIG 6).

Thermodynamic Power Cycles

A comparative study of various thermodynamic cycles is required to evaluate the performance of various cycles in EGS particularly under typical Australian climatic conditions. This should be carried out for EGS in which either:

- water is used as the geothermal fluid, or;
- supercritical CO_2 (in the form of a CO_2 siphon) is employed as the geothermal fluid.

Working Fluids (Power Cycles)

There is ongoing research on optimum power fluid selection. This will have to continue. The loop at the University of Newcastle is a suitable facility to test such different fluids.

Plant Performance & Availability

A particular attention should be given to study the plant performance under non-design conditions and in particular part load, start-up and shut down operations. The maintenance characteristics of the plant and therefore its availability should be also studied under conditions pertinent to Australian geothermal resources and climatic conditions.

Hybrid Systems & Cascade End Use

Reasonably accurate information is required for utilisation of geothermal energy in various applications including

- electricity generation
- direct heat usage, including air conditioning and desalination
- hybrid systems where low-grade geothermal resources are boosted by solar thermal or other inputs

The requirement is for a database that draws on the global and the national experience. While there are no conceptual difficulties, access to some data may be difficult due to commercial concerns.

Expander/Turbine

Data are needed on off-design and part-load efficiencies of expanders and turbines on different power cycle fluids. This will help planning optimum extraction schedules for geothermal reservoirs.

The turbine laboratory being established at the Queensland Geothermal Energy Centre is designed to do this for small turbines (<5kW). Simulation tools will be developed to predict the same for larger industrial turbines.

There is also a need to continue exploring different expander options. Accumulation of local knowledge in turbine design and operation will help such efforts. In addition to generation of in-house alternatives, third-party inventions can be tested and evaluated in the QGEC turbine laboratory.

Heat Exchanger

Compared to direct water coolers or wet cooling towers, air-cooled heat exchangers are significantly more expensive. They also consume power and thus reduce the net power produced by the geothermal power plant.

At this stage, scoping studies are needed in this area to explore

- possible improvements in present air-cooled heat exchanger design
- natural-draft dry cooling towers
- hybrid systems where some evaporative cooling is added to boost the cooling performance
- other options such as nocturnal cooling by radiation (and storage of cold media for day usage)
- the heat exchanger design issues for supercritical (non-condensing) cycles

Economics

A comprehensive study of the economics of various geothermal power generation options is required. This should include the development of suitable criteria for assessment of the economic merits of various technology options.

Environmental Impacts & Mitigation

The investigation of the environmental impacts of technology options for geothermal power generation (e.g. leakage of non condensing gases, water soluble contaminants, etc) and methods of mitigating their impacts under is needed.