PACKED ROCKBED THERMAL STORAGE FACILITY

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Brief Description

A packed rock bed thermal storage facility for use in the storage of thermal energy derived from a suitable heat source. The design is especially appropriate for use in association with concentrating solar powerplants or combined cycle power plants, although it is not limited to these.

Target Market

Utilities, renewable energy plant developers, housing developers, city and town Councils.

Value proposition/ Benefits

Storage of thermal energy in molten salts or alternatively as latent heat in the case of phase change materials and ceramics, have been successful to a greater or lesser extent, but there is considerable scope for improvement, particularly in the reduction of cost.

The storage facility as electricity source can be scaled from several MW to tens of GW, the lower limits being determined by the efficiency limits of steam turbines, but smaller sizing is possible for heating and cooling applications.

Unique Characteristics

Packed rock beds at high temperature (>500 °C) have not been implemented or cost-effectively designed. Our design

- utilises the natural angles of repose of a rock-pile
- minimises the cost of construction, containment, insulation and energy extraction
- is suitable for areas with high solar radiation and easy access to suitable rock types (igneous rocks or metamorphic rocks formed at temperatures higher than the intended storage temperature), such as the Northern Cape in South Africa.

The rock bed material is constrained such that it is free to expand and contract with changing temperatures without creating significant stress and corresponding movement that may lead to deformation of the bed and containment, or erosion and breaking of the rock.

The invention is part of an integrated solar energy facility with storage developed at Stellenbosch University in South Africa, but can be deployed with any suitable heat source.

Technical Description
The thermal energy storage facility may be used in many different situations.

One such implementation may include a compressor for supplying air to a central solar receiver, the compressor being driven by a first turbine, driven by the output from a combustor, in turn fed with heated air from the central solar receiver. Gases entering the first turbine drive a first generator, generating electrical energy. The exhaust gas from the turbine at a temperature of about 500°C or more is passed through the packed bed of rock to elevate the temperature of the rock and store thermal energy.

In order to recover the stored heat from the packed bed of rock, ambient air is passed through the packed bed in the opposite direction, through the heated packed rock bed, and thence to a boiler (Rankine cycle) that includes a second turbine driving a second electrical generator. The spent steam can be passed through a condenser that could be of either a dry or hybrid type and the condensate can be recycled to the boiler. Both the first and second electrical generators may feed electrical energy into a grid.

**Innovation Status**

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**Principal Researchers**

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