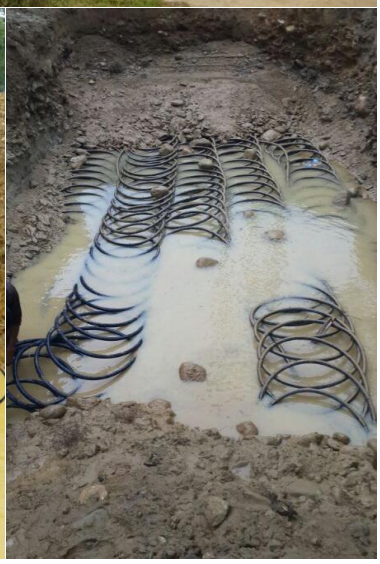
Geothermal based heat pump integrated with remote monitoring system

TERI has designed and commissioned a geothermal based heat pump system for space cooling and heating in Arunachal Pradesh. The project will be a technology demonstration for the entire north east region where there is tremendous potential for geothermal energy utilisation as there is requirement of both cooling and heating in many parts of the region, which is ideal for such a system. Geothermal means exchange of heat available inside the earth through convection and conduction. It has been experimentally proven that temperature of earth at a depth of 12ft is equal to average air temperature of that region and it doesn't vary much with further increase in depth.

A geothermal (water to air based) heat pump which provides both heating and cooling, where the refrigerant exchanges heat with room air thus providing heating or cooling and in turn gains or rejects heat to or from the ground through the water being circulated through the geo-exchange loops has been implemented at the Science Centre in Itanagar.



Apart from conservation of energy through high efficiency variable refrigerant volume heat pump, this system also addresses conservation of water which is another crucial resource that needs to be conserved. In conventional water based systems, after the refrigeration effect (either cooling / heating) is produced, the refrigerant further rejects or gains heat to or from the water, which further rejects heat to air in a cooling tower or gains heat in a boiler, which requires constant supply of water due to associated evaporative water losses. In order to conserve water, the water circuit is converted into a closed loop geo-exchange system thereby eliminating any loss of water.

Initially a feasibility study of implementing a geothermal based heat pump integrated with renewable energy system was carried out for a selected space at Science Centre, Itanagar. The detailed heat loads were calculated through computerised energy simulation tools which showed

the peak cooling and heating demand of the space to be 4.6 TR and 7.5 TR, respectively. In order to cater to this requirement, a VRV heat pump having a cooling capacity of 6.4 TR was selected. Analysis showed that in cooling mode, geothermal based heat pump are 29% more efficient than conventional water based heat pump and in heating mode geothermal based heat pump are 31% more efficient that conventional electrical heater. Compressor in the heat pump requires electrical energy for its operation. This electrical energy was proposed to be offset through renewable source of energy. A feasibility study was also carried out to establish the potential of solar photovoltaic energy to offset the electrical energy requirements of the system. A 15 kWp solar PV system was proposed to cater to the electrical energy demand of the selected machine.

In addition to high efficiency VRV heat pump coupled with geo-exchange system, a remote monitoring system has also been designed and commissioned to monitor the performance of the system from any remote location for real time performance evaluation and diagnostics of the system operation. The remote monitoring will also provide necessary data for generating research outputs that will be another outcome of the project.

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