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Country Update, Sweden

Leif Bjelm

Dept. of Engineering Geology, Lund Institute of Technology – Lund University. 20040722, Sweden

leif.bjelm@tg.lth.se

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ABSTRACT

In Sweden there is only one geothermal plant in operation. It is the geothermal heat pump plant established in Lund and in operation since 1984. The plant is owned and operated by the public utility company, Lunds Energi AB. The geothermal heat pump plant deliver a base heat load to the district heating network in the city corresponding to about 40% of the energy heat demand.

There are two new geothermal projects under exploration and completion in Sweden.

Both are in Scania in southernmost Sweden. In Malmö a private energy company, Sydkraft AB, drilled two wells during 2002 and 2003. Tests are scheduled to be finished spring 2004. Geothermal energy extraction will be accomplished through a system with an absorption heat pump. Start of operation estimated to 2004 or 2005. The second project is in Lund, operated by Lunds Energy AB in cooperation with Lund University of Technology. The drilling commenced during late 2002 and reached 3700 m in early 2003. Tests carried out late 2003 revealed feasible amounts of fluids and a second well will be drilled spring 2004.

In the Lund project an existing heat pump will convert the geothermal energy to the existing district heating net. Start of operation is 2004/2005. LTH has also carried out initial geothermal exploration work for Landskrona and Ystad communities also situated in Scania. Elsewhere in Sweden scientific geothermal exploration is carried out in the vicinities of Stockholm where a meteorite crater is investigated by The Royal Institute of Technology.

Details regarding production history and system facts will be given in the paper.

BACKGROUND

Geothermal energy in Sweden has a history since about 1976 when the government decided to release funds for basic research around the topic. With the first big oil crisis in mind and a political ambition to look for alternatives to reduce the dependency of nuclear energy resources were released. In principle and in a broader sense two scientific institutions were given the task. The Institute of Technology in Lund and Chalmers Institute of Technology in Gothenburg. Lund got the responsibility for geothermal energy related to sedimentary deposits and Gothenburg devoted their actions to basement potentials. As Lund sits in a typical sedimentary basin and Gothenburg in a basement province this was quite natural. In the province of Scania, where Lund is situated, a rather large amount of oil exploration wells were drilled before why a substantial data base was at hand. Gothenburg went rather early towards research around Hot dry rock applications. In Sweden there are only low or moderate geothermal temperatures at hand. Electric generation is therefore no choice and most of the geothermal energy ambitions are related to some kind of heat pump combination.

Till around 1990 the funding kept coming and the research was quite active in Sweden. However the next coming ten years till around 2000 became dormant as the funding more or less disappeared. But around 2000 new economical governmental resources became available when a new era on the reduction of nuclear energy dependency was introduced. This is where we stand today with a number of activities around the country but only two of them are right now related to commercial realities.

COMMERCIAL OUTCOME OF THE NATIONAL EFFORTS SO FAR

In Sweden there is only one commercial geothermal operation, the Lund Geothermal Heat Pump Plant. As a result of the exploration work carried by Lund Institute of Technology and as a result of a long term co-operation with the local and community owned energy company in Lund a geothermal heat pump plant stood ready for operation late 1984. The plant has been a complete success and still runs after soon 20 years of operation. It's a low temperature plant where about 500-600 l/sec of about 20°C of water is brought up from about 500-700 m of depth. There are 4 production wells and 5 injection wells with a spacing of about 1500 m.

The plant stands for about 40% of the heat demand in the local district heating net and two heat pump units cuts down the water temperature to about 3- 4°C. The total effect of the two heat pumps is about 45 MW. The wells are gravel packed stainless steel wire wrapped screen constructions and the capacity of each well is around 100 to 150 l/sec.

There was an attempt during the early eighties to establish a small heat pump application on the island of Gotland situated in the middle of the Baltic Sea. Unfortunately the productivity was to low and the project was abandoned. Another ambition took place 1981 when a shallow exploration drilling in the town of Landskrona, also in Scania, was carried out. Huge deposits of very porous sand was discovered by Lund Institute of Technology at about 1000 m of depth. However a heat pump energy solution did not fit the energy system structure in the city and the project was laid down.

A lot more ambitious effort was established 1978 when a plugged and abandoned oil well in southernmost Scania was drilled out. The community of Vellinge, VIAK AB and to some part the Lund Institute of Technology built a gravel packed well in the reopened and former oil exploration well and tested it. The well gave a fair amount of water of around 60°C but the community declined to use the resource.

STATUS 2004 IN BRIEF

Since the latest funding stimulated research and investigations a number of activities has started. The governmental funding activated former actors and a couple of new actors have come in with different project ideas.

In Malmö, in Scania, the power company Sydkraft AB has started exploration activities and so did the former actor in Lund, Lunds Energy AB. Both have direct commercial intentions close to be realized. The new Lund project the so called Deep Geothermal Project was initiated and explored by Lund Institute of Technology and the Malmö project by DONG a Danish oil and gas operator. The projects will be further described later on in the article.

In both cases substantial governmental funding was provided but the main part has been financed by the owners.

The new geothermal approaches in Sweden are related to a couple of early exploration projects around the geothermal potential within old meteorite impact structures. The projects have no nearby commercial potential but represent interesting geothermal research projects. One project, the Birka project, situated west of Stockholm is run by the Royal Institute of Technology in Stockholm. Mainly geophysical pre investigation work and a couple of shallow core drillings have been carried out. The main emphasis is on the hydraulic properties of the basement rock related to the mechanical deformation caused by the impact. A similar study is carried out by the same group in mid Sweden around the Dellen Lakes where another meteorite impact took place.

THE DEEP GEOTHERMAL PROJECT IN LUND.

Lund Institute of Technology (LTH) initiated the project by formulating an exploration concept related to a major deformation structure in northern Europe called the Tornqvist zone.

The concept lines out deep seated potentials in the heavily tectonized basement rocks within the deformation zone. Substantial seismic surveying was carried out to delineate the complex tectonic features.

The concept was approved by Lunds Energy AB and drilling started late 2002. The intention was to find and utilize hot water, > 100°C, for direct heat application in the existing district heat net in Lund. Another task within the project, specially aimed at LTH's research, was to investigate the applicability of alternative drilling methods of crystalline basement formations. In all 4 different drilling methods were used in the project. Conventional heavy mud drilling, air-drilling, percussion or air hammer drilling and the innovative mud hammer drilling. Valuable experiences were derived from these attempts.

Total depth became 3700 m whereof the last 1700 m were drilled in different kinds of basement rocks. The productivity was however to poor and the project was redesigned to a medium temperature project with water extraction from the sedimentary deposits resting on top of the basement. The productivity from those deposits meets the demands for a second geothermal heat pump plant in Lund. About 40°C and around 100 l/sec. The second well, the production well, has recently been drilled and the well completion was carried out mid July 2004. Within a section of an upside down stratigraphy due to the intense faulting >160 m of virtually unconsolidated cretaceous sand was confirmed and 140 m of these sands have been successfully screened and gravel packed. The production will take place from an interval between 1500 and 1670 m. The production test pumping will take place in August and September 2004 and estimated start of energy production is set to early 2005. According to Lunds Energy AB another 25 % of the energy demand for the local district heating net could then be covered by geothermal energy.

THE MALMÖ GEOTHERMAL PROJECT

The Malmö project run by Malmö Energi AB, owned by Sydkraft AB, is also a conventional sedimentary basin geothermal prospect. It also started in 2002 and the second well was drilled during 2003. Based on knowledge from the old oil exploration days and new seismic investigations a prospect was identified more or less in the city of Malmö close to the sea. Two wells were drilled to about 2000 m. The first gave a good flow matching the demands of the project concept. The second well, deviated, was not that productive but according to the owner the project is still economically feasible. The final decisions to go ahead and build the energy production system is still pending but is seems likely that Malmö will be the second commercial geothermal project in Sweden.