

## ALTHEIM GEOTHERMAL PLANT FOR ELECTRICITY PRODUCTION BY ORGANIC RANKINE CYCLE TURBOGENERATOR

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### ABSTRACT

The paper describes the plan of the town Altheim in Upper Austria to produce electricity by an Organic Rankine Cycle-turbogenerator in the field of utilization of low temperature thermal water. The aim of the project is to improve the technical and economic situation of the geothermal plant.

### INTRODUCTION

Geographically Altheim is situated in the Austrian federalstate Upper Austria; about 15 km to the German border and about 60 km to Salzburg. The area of Altheim covers about 22 squarekilometers, about 4800 people live there. The yearly budget of the municipality amounts about 70 million ATS; converted into USD about 7 million.

Geologically Altheim is situated in the Molasse Basin. As Molasse are generally the sediments called in the saggings lie off the young rocks. The Upper Austrian Part is the area between the Flysch Zone of the Alps in the south and the old Bohemian Massif in the north.

#### Geologic structure of the Molasse Basin

The deepest units in the underground of the basin are the crystalline primary rocks - mainly granite - and the above lying rocks of the Mesozoic - mainly of the Jurassic system and the Cretaceous system.

The carbonates of the malmstone period belong to the the uppermost layers of the Jurassic system which show a good permeability along crevasses and commissures (in part through solution). Similarly obstructions and fractures are given waterways themselves.

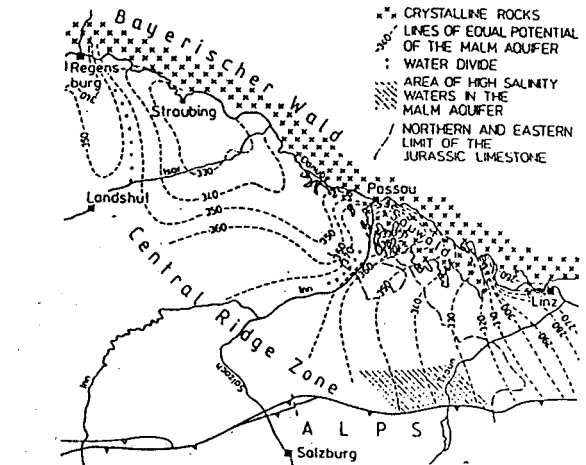
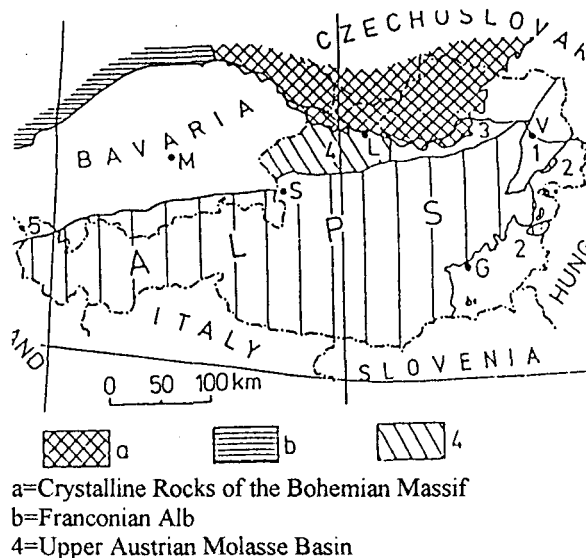


Fig.1 Situation of Alheim; geographically/geologically

The Alheim borehole "Thermal 1" was drilled in 1989 to a depth of about 2.400 m. The artesian flowrate



Pressure loss / vaporizer	1 bar
Pressure KWel	13 KW
Condenser difference	5 K
Condenser inlet temperature	10 ° C
Condenser outlet temperature	15 ° C
Cooling water capacity	8.552 KW
Cooling water flow	407 l/s
Pressure loss / condenser	1 bar
Pressure loss / KW el	61 KW
Effectiveness el	7,4 %
Capacity el	764 KW
Use to capacity	7.500 h/year
Produced work el	5.733 MWh/year
Losses	10 %
Losses	1.035 KW

It is obtained that the head temperature will increase up to 106 ° C by increasing the flow rate up to 100 l/s.

Furthermore it is assumed that a geothermal outlet temperature of about 77 ° C allows the further use of water for space heating and sanitary.

It is planned to install the turbogenerator within a heavy built up area (the production well is also situated in this area). Therefore it is not possible to make an air-cooled system.

The cooling water will be taken from the same river in which the used hotwater is discharged at present. The river is in a distance of about 200 m from the planned installation of the turbogenerator.

#### Working fluid:

The working fluid belongs to the HydroFluoro Carbon class and is now spreadly used in Europe and abroad in refrigeration plants (commercial name: R 134a).

#### ECONOMIC ASPECTS:

##### Investment costs:

Reinjection well with connection pipe to the production well	3,000.000,00 USD
Turbogenerator, cooling, pumps, wellhead, pipes etc.	1,500.000,00 USD
Electric equipment	245.000,00 USD
<b>TOTAL</b>	<b>4,745.000,00 USD</b>

##### Annual costs:

Repayment	530.000,00 USD
Electricity, working material	150.000,00 USD
Personell	56.000,00 USD
Maintenance	85.000,00 USD
Insurances, taxes	54.000,00 USD

**TOTAL 875.000,00 USD**

**Production costs/MW<sub>e</sub> 152,00 USD**

Such costs are not competitive. And so the municipality will try to get support from the European Union (THERMIE-framework).

THERMIE is a vital part of the European Union's strategy for meeting the energy challenges which we face today:

- to reduce lasting and reliable energy services at affordable costs and conditions;
- to reduce energy consumption;
- to reduce the environmental impact of the production and use of energy, in particular CO<sub>2</sub> emissions;
- to strengthen the technological basis of industry.

THERMIE operates around two principal axes:

- sharing costs for **projects** implementing innovative energy technologies;
- **other measures** to define energy RTD (research/technological development) strategies and to promote and disseminate energy technologies.

To the THERMIE's objectives belong among other things:

- to improve energy efficiency, in both demand and supply sectors;
- to promote a wider utilization of renewable energy sources.

In the field of renewable energy sources the THERMIE program covers also the sector of geothermal energy.

European Community financial support may be granted for shared cost projects. Projects eligible are those designed to advance or implement innovative techniques, processes or products, for which the

research and development stage has, for the most part, been completed. This type of project is designed to prove the technical viability and the economic advantages of new technologies by applying them on a sufficiently large scale for the first time.

According to the technical annex 3.7 "GEOHERMAL ENERGY" of the THERMIE-programme support will be allocated to demonstration projects aiming at improving the energy efficiency and cost-effectiveness of geothermal plants in the following configurations (selection):

- exploitation of geothermal fields where resources are proven or well documented, in order to reduce mining risks;
- production of electricity

To be accepted, a project must meet several conditions (for instance):

- it must use, with a view to their implementation and propagation, innovative techniques, processes or products;
- it must offer technically and economically viable prospects of subsequent commercial exploitation of the relevant technology;
- it must be difficult to finance because of major technical and economic risks. Commercial investment projects cannot be supported;
- normally, it must be proposed and carried out by at least two not affiliated legal entities which must be established in different member states or in at least one member state and one associated state. Applications from small and medium-sized enterprises are encouraged;
- the proposers must be capable of implementing and applying the techniques, processes or products referred to in point one above and of contributing to or assisting in the dissemination of the product or results thereof;

What financial support can be received ?

- The maximum financial support for shared cost projects is **40 % of the eligible costs**.
- The total amount of **public support** for a THERMIE project, including the Community's

support, **must not exceed 49 %** of the total cost of the project.

- Contractor shall not make any profit or other surplus on account of the financial contribution of the Commission.

**Our project is in full adequation with the technical annex of THERMIE program.**

Hence we expect that the European Commission will give full financial support.

With such a support the production costs for one MW<sub>e</sub> can be reduced to USD 106,00. Such costs are competitive.

For the realization of the project a group of consultants and investors from **Austria, France, Germany and Italy** will be established.

The utilization of low temperature resources for generation electricity is **also applicable in Bavaria, in South West Germany, in Italy (Po plain), in the Pannonian Basin and in France.**

In these regions there are temperatures of about 100 ° C proven or well documented.

Above all abandoned oil exploration drillings could be used.

#### BENEFITS:

- The benefits of such an electricity generation are obvious:

It is unimportant if it is summer or winter, if the sun is shining or not, if it is windy or calm. The air keeps clean, no negative effects on the landscape.

As the used thermal water is given back to the underground geothermal energy production works like a rechargeable battery. And users can say: "We are literally sitting on our own energy source".

Beside the additional save of CO<sub>2</sub> emissions the yearly savings of oil amounts about 1.500 tons.

#### PROBLEMS CONCERNING THE REALIZATION:

At the time being we have only one potential partner for selling the electricity. We hope it will succeed to

enact a european law which obliges electricity companies to provide their grid for transporting electricity.

Another problem is that geothermal energy at present in the Austrian public opinion does not play the same role like windenergy or biomass. And most politicians act very reserved.

But we may not be discouraged; we must bring geothermal energy more before the public and opinion leaders and for this it is necessary not only making organizations, workshops etc. for insiders but publishing in newspapers, magazines, too, which are accessible for the public at large.

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