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July – September 2005

# IGA NEWS

*Newsletter of the International Geothermal Association*

## IGA ACTIVITIES

### *Message from the President*

***John W. Lund, President***

IGA activity has settled down since the World Geothermal Congress 2005 in Antalya, Turkey; however, reports and funding are still being finalized. Work has already started on WGC2010 in Bali, Indonesia, and the various committees will soon be formed. We are still waiting on funding support for various projects within IGA from the World Bank/GeoFund, along with paying for fellowships from WGC2005. Kiril Popovski has started planning for the International Summer School Workshop/Conference "International Geothermal Days – Ukraine 2006" in Odesa, Ukraine for 17-22 September 2006. Dr. Popovski can be contacted at: isskiril@sonet.com.mk for details. Gordon Bloomquist is finalizing the "Mineral Extraction from Geothermal Brines" workshop in Petropavlovsk-Kamchatka, Russia for September 12-16, 2005 in cooperation with the Russian Geothermal Society. Dr. Bloomquist can be contacted at: bloomquistr@energy.wsu.edu for details. The IGA Board of Directors will have their next meeting in Beijing, China during 13-14 September 2005 in conjunction with a symposium honoring the 20th anniversary of the Geothermal Council of China Energy Society (GCES). A number of the IGA board members will be presenting papers at this symposium.

Two world geothermal overview papers, one on electric power and the other on direct-use, were presented at WGC2005 based mainly on country update papers submitted to the congress. These have subsequently been updated by Ruggero Bertani (electric power) and John Lund, Derek Freeston and Tonya Boyd (direct-use) for publication in an upcoming issue of Geothermics. A summary of these revised numbers follows:

| Use | Installed Power MW | Annual Energy Use GWh/yr | Capacity Factor | Countries Reporting |
|---|---|---|---|---|
| Electric Power | 8,932 | 56,951 | 0.73 | 24 |
| Direct-Use | 28,268 | 75,943 | 0.31 | 72 |

Fuel oil, carbon and $CO_2$ savings from geothermal energy production

| Fuel Oil ($10^6$) | | Carbon ($10^6$ tonnes) | | | CO2 ($10^6$ tonnes) | | |
|---|---|---|---|---|---|---|---|
| Barrels | Tonnes | NG | Oil | Coal | NG | Oil | Coal |
| 267 | 40 | 8 | 37 | 43 | 27 | 113 | 131 |

Note: the fuel oil savings is equivalent to about 3.5 days of world-wide consumption.

Rankings for electrical power production (top 10 countries)

| Country | Installed Capacity (MW) | Annual Energy Produced (GWh/yr) | Capacity Factor |
|---|---|---|---|
| USA | 2 564 | 17 917 | 0.80 |
| Philippines | 1 931 | 9 419 | 0.56 |
| Mexico | 953 | 6 282 | 0.75 |
| Indonesia | 797 | 6 085 | 0.87 |
| Italy | 790 | 5 340 | 0.77 |
| Japan | 535 | 3 467 | 0.74 |
| New Zealand | 435 | 2 774 | 0.73 |
| Iceland | 202 | 1 483 | 0.84 |
| Costa Rica | 163 | 1 145 | 0.80 |
| Kenya | 129 | 1 088 | 0.96 |

Ranking for direct-use (top 10 countries) (including geothermal heat pumps)

| | | | |
|---|---|---|---|
| USA | 7 817 | 8 678 | 0.13 |
| Sweden | 3 840 | 10 001 | 0.30 |
| China | 3 687 | 12 605 | 0.39 |
| Iceland | 1 844 | 6 806 | 0.42 |
| Turkey | 1 495 | 6 900 | 0.53 |
| Japan | 822 | 2 862 | 0.40 |
| Italy | 607 | 2 098 | 0.39 |
| Norway | 600 | 857 | 0.16 |
| Switzerland | 582 | 1 175 | 0.23 |
| Germany | 505 | 808 | 0.18 |

However, the values for countries such as USA, Sweden, Norway, Switzerland and Germany are based mainly on geothermal heat pumps, as reflected in the low capacity factors. If the traditional direct-uses (excluding geothermal heat pumps) were only considered, then the rankings would be China, Iceland, Turkey, Japan, Hungary, USA, Italy, Brazil, Russia and New Zealand (for installed capacity), and China, Turkey, Iceland, Japan, USA, Hungary, New Zealand, Italy, Brazil and Russia (for annual energy use). If we just considered geothermal heat pumps, then the order would be USA, Sweden, Denmark, China, Switzerland, Norway, Canada, Germany, Austria and Finland (installed capacity), and Sweden, USA, China, Denmark, Switzerland, Norway, Germany, Canada, Finland and Austria (annual energy use). If energy use per land area and/or population were considered, then many of the smaller countries would rank high.

In summary, over the past five years (since WGC2000), almost 1000 MWe electric were brought on line along with about 13,000 MWt of direct-use, the latter mainly in the form of heat pumps. The growth in the electric power industry has increased 2.9% annually in both installed capacity and energy produced, and direct-use has increased 13.2% annually in installed capacity and 7.5% in energy produced. The low growth rate for electric power is due mainly to the low cost of competing natural gas plants; however, with the recent increase in fossil fuel prices, along with some favorable tax incentives being considered in the United States, I expect to see the growth of electric power increase substantially by WGC2010.

### Photographs of WGC2005

***Trevor Hunt, Chairman Publications and Information Subcommittee, WGC2005***

Some photographs taken at the Congress Dinner have now been placed on the official website, and can be downloaded as .jpg files. Photographs taken at the Opening and Closing ceremonies, Turkish Night and Exhibition will also be placed on the website soon. Keep checking the website: www.wgc2005.org

# EUROPE

## Germany

### The Geothermal Project "SuperC" of RWTH Aachen University
### Phase I: The well "RWTH-1"

***By Christoph Herzog, Stefan Lundershausen, Christian Niemann-Delius and Axel Preuße***

RWTH Aachen University plans to build a new students' service centre next to the main building. For this purpose an architectural competition was carried out in the year 2000. This competition was won by two architects from Aachen: Eva-Maria Pape and Susi Fritzer. As their layout looks like a giant "C" the building is called "SuperC" (fig. 1).

This building, which is going to be built in 2006, will be equipped with a cooling and heating system based on geothermal energy. Geothermal heat will be recovered on site by a deep geothermal heat exchanger (DHE). The DHE is a closed system which consists of an outer steel casing and an inner production pipe. Water as heat fluid is supposed to be circulated through this coaxial pipe system taking up the heat from the outside rocks and transporting it to the surface for further use in the building. Any exchange of matter between the DHE and the surrounding rocks is avoided which allows the system to be installed even in sensitive groundwater areas like the Aachen thermal spring system. This conception makes the system independent of any favourable hydrogeologic conditions. With a calculated capacity of 450 kW the deep heat exchanger is supposed to cover 80 % of the building's heat demand.

The necessary geothermal well "RWTH-1" was real-


*Fig. 1: Visualisation of the “SuperC”-building [FRITZER & PAPE 2000]*

ized within the project “SuperC”. This project was funded by the European Union in the “LifeIII-Environment”-Program under the main topic “Reduction of CO2-Emissions”. The project follows two main goals: drilling operation including the completion of the DHE and the installation of a multi-level heating system inside the building. As geoscientific research could not be financed by the geothermal project, an individual research project comprising the geoscientific branches of the RWTH Aachen was developed in cooperation with the Geological Survey of Northrhine-Westfalia and finally funded by the German Research Foundation (DFG). In accordance with German mining law, RWTH Aachen University applied for a scientific and economic licence for the exploration of geothermal heat. The scientific concession covers an area of approximately 214 $km^2$ and includes the smaller economic field, which covers all the University’s properties in Aachen. Since March 2001 the given licences make RWTH Aachen University the first German university with its own mining permission.

Aiming at exploring geothermal heat directly on the site of the SuperC building, the 2,500 m deep geothermal well “RWTH-1” was drilled between June and December 2004 at the prominent but small location on the inner city campus next to the university’s main building (fig. 1 and fig. 3). Special attention was paid to protect the neighbourhood (university employees nearly on-site and first inhabitants some 150 m away) from emissions, mainly noise emissions during the drilling operation (fig. 2).

Due to a lack of deep geological information a prediction of the strata to be drilled was difficult. The technical planning was based on two geological profiles based on two different tectonic models for the Aachen area. The drilled rocks were mainly paleozoic shales, siltstones and sandstones and at a lower level limestones and coals of the Carboniferous and Upper Devonian.

The borehole was designed as a vertical well with respect to the demanded minimum (casing) diameter of approximately 20 cm at total depth (TD). Technical preparations were made to deal with possible mud losses in a lower carboniferous limestone known as “Kohlenkalk”. Due to expected Upper Carboniferous quartzitic conglomerates the well was drilled basically with standard tricone bits at a diameter of 23’’, 17 1⁄2’’ and 8 1⁄2’’ (fig. 3). The average rate of penetration was between 1.5 and 2.2 m/h (net).

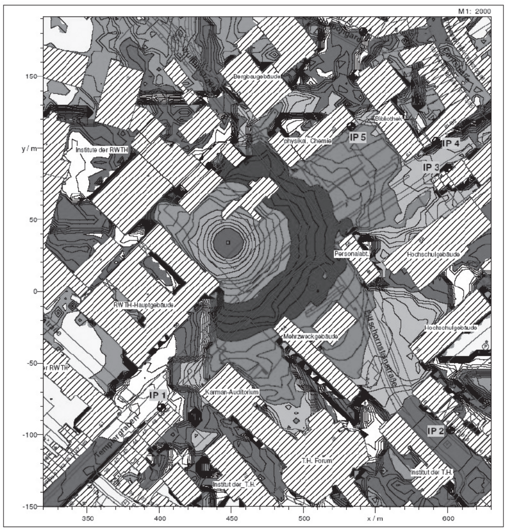


*Fig. 2: Noise emission prognosis [HEITKÄMPER 2003]*

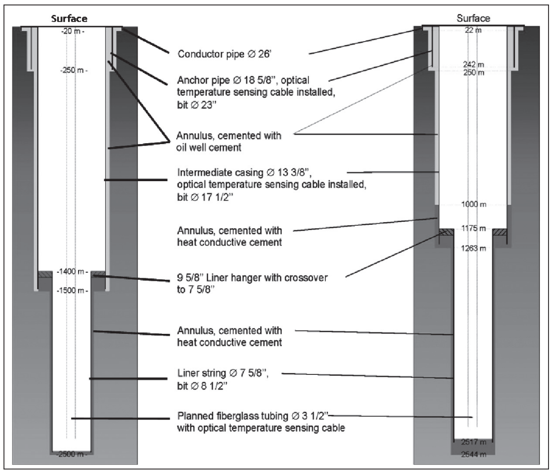


*Fig. 3: Planned and realized well scheme [LUNDERSHAUSEN 2004]*

In the 8 1⁄2’’ section below 1,263 m three intervals were cored to gain rock material for scientific purposes. Apart from severe bit damage due to high wear the expected technical problems concerning well instability or mud losses did not occur. Total depth was reached at 2,544.5 m after a drilling time of 140 days, corresponding to a true vertical depth of 2,498 m. The open hole sections were examined intensively by geophysical means to gain both necessary technical and scientific data. A temperature measurement carried out in January 2005 showed a roughly constant increase in temperature up to 72.5 °C at the bottom of the well. An influence of the drilling process on rock temperature is likely, as a second run in April 2005 delivered nearly 81 °C at TD.

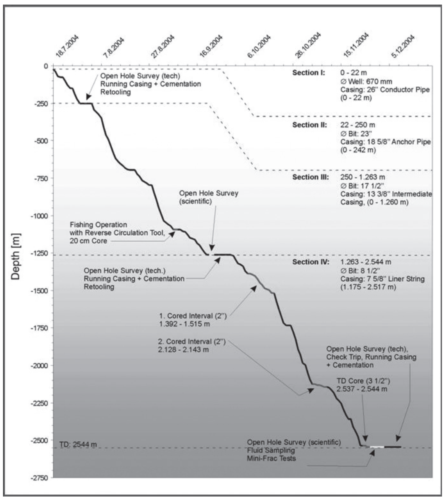


*Fig. 4: Depth vs. time [LUNDERSHAUSEN 2004]*

Within the annulus of the anchor pipe and the intermediate casing a fibre glass cable was installed for optical temperature measurements. In the future these data will be used for operating the DHE. So far the cable has been used successfully to survey the setting of the cement slurry in the annulus. During 2005 further temperature measurements are planned and the inner production pipe will be installed for well completion.

## Iceland

### ICEIDA and Geothermal Development

***Gestur Gíslason, Reykjavik Energy, Iceland***

International development assistance is an important aspect of Iceland's foreign policy, and a political decision has recently been made to increase Iceland's contribution from 0.19% of GDP in 2004 to 0.35% in 2009. The Icelandic Government thus affirmed its commitment towards efforts made to achieve the Millennium Development Goals adopted at the United Nations' 55th General Assembly in September 2000. Until the late nineties Iceland's development aid was mainly focused on the field of fisheries, the best known exception being the United Nations Geothermal Training Programme (UNU-GTP), but 85% of the programme is funded by Icelandic development assistance (multi-lateral). This year UNU-GTP celebrates a 25 year success story, and recently the Government has decided to increase further its financial support to UNU-GTP, which will enable more students to attend the programme in Iceland and facilitate UNU-GTP to conduct seminars in developing countries.

The Icelandic International Development Agency (ICEIDA) is an autonomous agency of the Ministry of Foreign Affairs and is the main executing agency for bi-lateral development assistance for the Government of Iceland. ICEIDA works with only a small number of partner countries and has focused on the poorest countries in Africa. A decision has recently been made to expand the operations of ICEIDA, both to include more partner countries and to include more fields of co-operation, including the energy sector, with emphasis on environmental sustainability of resource utility, including geothermal energy.

Uganda has been a partner country of ICEIDA since 2001, and the ongoing geothermal exploration project in Western Uganda (see IGA News # 59) has been supported by ICEIDA. This geothermal project was initiated in 1993 by the Ministry of Energy in Uganda, with the Geological Survey and Mines Department in Entebbe as the executing agency. The first phase was carried out in co-operation with UNDP, but co-funded by the Icelandic Government and OPEC. Three geothermal areas within the western branch of the East African Rift System in Western Uganda were selected (Katwe, Buranga and Kibiro), and during the first phase all geothermal manifestations were mapped within these three areas and an intensive geochemical sampling programme carried out. Results were promising, indicating reservoir temperature in the range of 200°C or higher for two of the areas, but funds to complete the pre-feasibility study were not available. During the late 1990s and early 2000s the International Atomic Energy Agency supported further chemical and isotopic studies in Uganda that increased the understanding of groundwater flow and sub-surface temperatures. In 2003 the geothermal programme got support from an alternative energy study programme funded by the African Development Bank. The aim was to carry out geophysical surveys in two of the study areas (Katwe and Buranga) using geological and geophysical methods (i.e. resistivity (TEM), gravity and magnetics). At the same time ICEIDA signed an agreement with the Government of Uganda to carry out a geological and geophysical survey in the third area, Kibiro. Neither of the two programmes were completed during the field season of 2004 but the results are promising, showing large low resistivity anomalies in both study areas. Following these positive results, the government of Uganda secured continued support from ICEIDA and the World Bank to complete the pre-feasibility study in Katwe and Kibiro. ICEIDA provides geothermal experts but the World Bank provides funds for locally incurred costs as well as the drilling contracts for 10 shallow temperature gradient boreholes. The project is currently being carried out and is scheduled for completion in November 2005, pending the progress of the drilling programme. Furthermore, the German Geological Agency (BGR) is currently carrying out geophysical studies in Buranga in February, involving resistivity and seismic studies.

The vast geothermal resources of eastern Africa are largely untapped, although proven. In order to overcome the financial, investment and technical risks and barriers which are delaying the development of geothermal resources in the region, an African Rift Geothermal Facility (ARGeo) is being established. ARGeo was initiated by several countries in Eastern Africa, will be funded by the Global Environment Facility (GEF) and implemented by the United Nations Environment Programme (UNEP) and the German Development Bank (KfW). The project will be executed in partnership with UNU-GTP, ICEIDA, the Italian Ministry of Environment, the USA Government, the German Geological Agency (BGR) and others. One of the objectives of ARGeo is to encourage co-operation between the participating countries by pooling the existing resources and regional expertise. ICEIDA has agreed to undertake a regional inventory of the existing equipment as well as the human resources in the eastern Africa region. The findings will be presented at a seminar in Nairobi in November this year.

Nicaragua is a new partner country of ICEIDA, and co-operation programmes are being negotiated. The Nicaraguan Government has expressed interest in geothermal co-operation, and currently the form and nature of a possible geothermal project is being discussed.

## Iceland

### Strong participation of UNU-GTP at WGC 2005

***Ingvar B. Fridleifsson, UNU-GTP, Iceland***

The United Nations University Geothermal Training Programme (UNU-GTP) in Iceland was very well represented at the WGC 2005 last April. Amongst the 705 refereed papers accepted by the Technical Committee for presentation (oral and poster), 141 papers (20%) were authored or co-authored by 104 former UNU Fellows from 26 countries (out of 318 graduates of the UNU-GTP). The papers were divided between 23 of the 24 technical sessions of the conference.

Seventy seven former UNU Fellows from 25 countries attended the congress. Most of them received travel fellowships funded by the UNU-GTP in Iceland and the UNU Centre in Japan. Sixty one attended the WGC 2000 in Japan and 35 the WGC 1995 in Italy. The UNU-GTP policy to support the participation of former UNU Fellows in the WGC every five years has made it possible for a large number of professionals from all continents to share their research results and experience with the international geothermal community. Their enthusiasm and hard work gives them the opportunity to keep up with new technical developments as well as the pleasure of meeting friends and colleagues from various parts of the world, reminisce about the past, and plan for the future.

## Italy

### EU Training Programme on Geothermal

***Adele Manzella, CNR-IGG, Pisa, Italy***

Under the auspices of the Leonardo da Vinci Programme, an Education and Culture Programme of the European Commission, a training project named “Development of young researchers’ competences to EU standards in the geothermal field” was carried out from May 13th to July 3rd, 2005. Eight young researchers from University of Oradea, Romania, participated in the project and were hosted by the Institute of Geosciences and Earth Resources of the Italian National Research Council (CNR-IGG) in Pisa, Italy.

The training period consisted of lectures, field trips, language courses, cultural events. Participants had also been offered the facilities of the library and the Italian geothermal database.

Lectures were given by E. Barbier (Geothermal energy and the other renewable energy sources), G. Gianelli (Deep seated geothermal systems), A. Manzella (Geophysical methods for geothermal exploration), G. Ruggieri (Application of fluid inclusions to investigate geothermal systems), S. Grassi (Thermal springs of Tuscany), C. Calore (Modelling of geothermal systems), G. Moratti (Geology and geothermics, an overview), A. Minissale (Geochemical methods for geothermal exploration), M. Frey (Economic aspects of the utilization of geothermal resources) and A. Franco (Heat pump technology).

The eight researchers from University of Oradea had the opportunity to visit the Larderello geothermal field, with its museum and its plants for power generation. They also enjoyed a visit to the southern Tuscany hydrothermal areas (Sarturnia, Bagno Vignoni), the geothermal area of Mt. Amiata and a fish farming facility. Dr Carella and IGG personnel guided them also to Ferrara, where they had the opportunity to visit the geothermal/combined heating system, and to Abano Terme, where they could visit other spas and learn about local use of thermal waters.

Participants had the opportunity to visit many historical towns and places, both in Tuscany and other Italian surrounding regions.

The project was promoted by A. Setel of the University of Oradea, Romania. The eight young researchers from University of Oradea were: Indrie Liliana, Timar Adrian, Mihnea Diana, Pantea Stelian, Chirila Florina, Paul Marius, Clitan Cristian and Puscas Dana.

The Italian organization was coordinated by P. Manetti with the support of A. Manzella. Beside the lecturers, CNR-IGG personnel involved in the training were S. Bellani, E. Calvi, A. Caprai, M. Dickson, C. Giussani, L. Gori, A. Innocenti, A. Rossi and F. Tateo.

## Portugal

## PICO VERMELHO GEOTHERMAL PROJECT

*Uri Kaplan – ORMAT Technologies Ltd.*

### 1. INTRODUCTION

The local Electric Company in the Azores Islands has given the green light for the construction of a new geothermal power plant at the Pico Vermelho site on the São Miguel Island. The new power plant is expected to contribute to the efforts of the local authorities to have the base load needs of the Island provided by dependable, indigenous and clean geothermal power. The new plant will optimize energy utilization by converting geothermal steam and brine from geothermal wells into electric power energy. The new plant will use air-cooled condensers which enable 100% geothermal fluid reinjection. The 100% reinjection serves both to sustain the reservoir and to produce electrical power with virtually no environmental impact. It will utilize the high performance, high efficiency organic turbines developed by ORMAT for geothermal and industrial recovered-energy applications.

### 2. DEVELOPMENT OF THE GEOTHERMAL RESOURCE

The Sociedade Geotermica dos Açores, S.A. (SOGEO) operates the Ribeira Grande and Pico Vermelho geothermal power plants, both located at the Lagoa do Fogo (Agua de Pau) volcano in the central part of the island of São Miguel, Azores, Portugal. The two plants are supplied by separate well fields that exploit different areas within a single extensive geothermal system on the northern slope of the volcano.

Exploration and development of the lower (northern) part of the field where the Pico Vermelho plant is located took place during the late 1970s and early 1980s. Five deep wells (RG 1 , RG 22, PV 1 , PV 2 and SB 1 ) were drilled during 1978-1981, and the 3 MW Pico Vermelho plant began operation in 1981. Well damage and scaling problems left PV 1 as the only well available for use by the plant, and as a result the plant output has typically not exceeded 0.7 MW.

During the late 1980s exploration of the southern part of the field (higher elevations on the volcano) was undertaken in an effort to identify a geothermal resource of higher temperature and lower scaling potential. Well CL 1 was drilled in 1988-89 and wells CL 2 , CL 3 and CL 4 during 1992-94. The production from these wells was more than sufficient to supply Phase A of the Ribeira Grande power plant (5.08 MW) located in the upper part of the field. Constructed in 1993-94, this plant consists of two binary-cycle ORMAT® Energy Converters (OECs). Wells CL 1 and CL 2 served as production wells for the plant.

Phase B (9.4 MW) was installed at Ribeira Grande in 1997, bringing the total capacity of the plant to 14 MW (approximately 12 MW net to the grid). Well CL 3 and the excess capacities of wells CL 1 and CL 2 are used to supply this facility. CL 4 has also been used intermittently; however, following the assessment described below, this well has been converted to injection and a new production well is being drilled to replace it. CL 5, which was drilled a few years ago, and CL 6, which is currently being drilled, will contribute to sustain the operation of the Ribeira Grande power plant.

### 3. DESCRIPTION OF THE POWER PLANT

#### 3.1 Two-Phase Flow with High Liquid Fraction

The geothermal resource of the Lagoa do Fogo Volcano is characterized by low enthalpy fluid (900 1100 kJ/kg) and as a result the separated fluid consists of a high portion of water (brine) and a low portion of steam. Typical figures are 78% water and 22% steam at a separation pressure of 5 bar a, and fluid enthalpy of 1100 kJ/kg.

ORMAT has developed the bi-phase type ORMAT® Energy Converter (OEC) to utilize this type of geothermal resource efficiently. The bi-phase OEC uses the separated steam to vaporize the organic fluid (pentane) in the vaporizer and the mixture of condensed steam and brine is used as the heating source for the preheater. Figure 1 is a schematic flow diagram of the bi-phase process. The ratio of heat quantities of steam and condensate/brine mixtures are similar to the heat quantities of the boiling and preheating of the pentane in the OEC. Figure 2 presents a TQ (temperature, heat quantity) diagram showing the heat quantities and temperatures of the heating fluid and working fluid in the OEC cycle. The figure shows the perfect match between the shape and quantities of the working fluid and heating fluid, indicating a very high efficiency in utilization of the heating source.

The bi-phase OEC concept is used in other low enthalpy geothermal resources in locations such as the Zunil project in Guatemala (24 MW), Ngawha project in New Zealand (12 MW), and the Olkaria III early generation project in Kenya (12 MW).

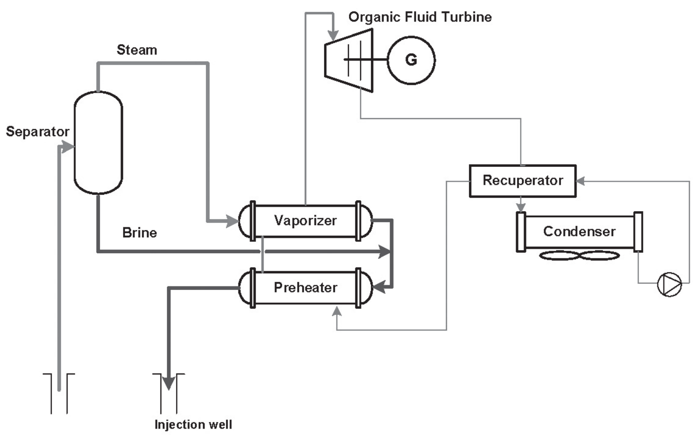


*Figure 1 – Schematic Flow Diagram of the Bi-Phase Process*

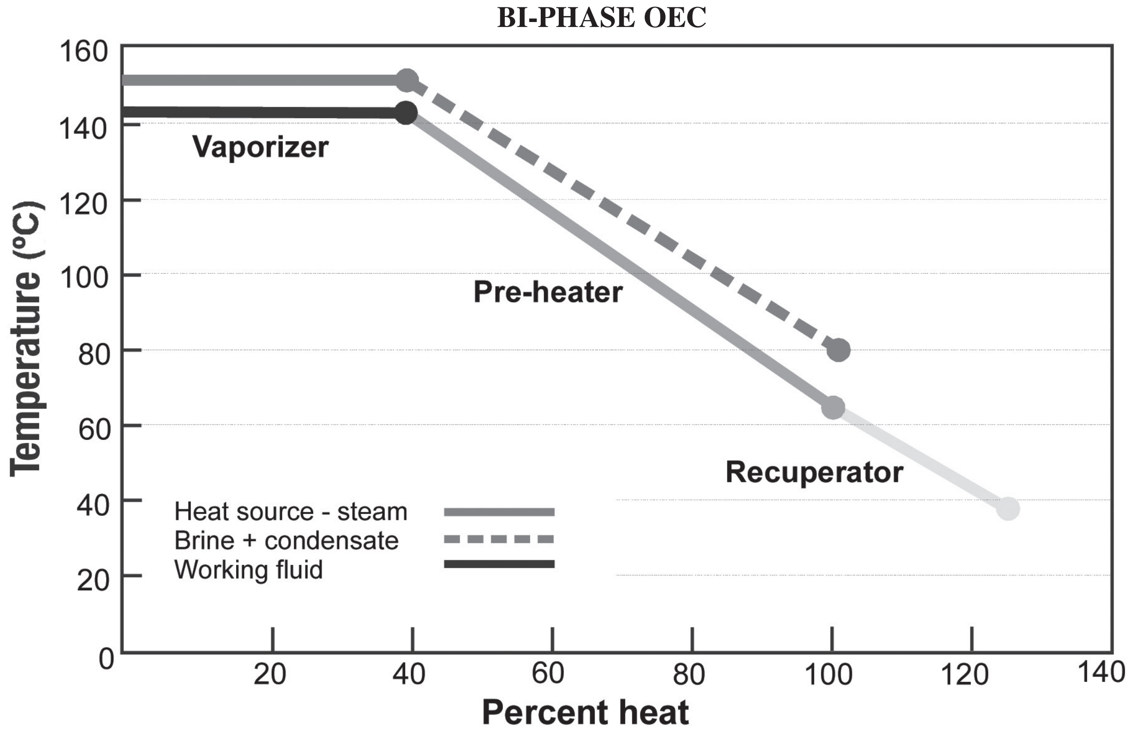


*Figure 2 – TQ Diagram*

### 3.2 Stages in the Construction of the São Miguel Geothermal Project

The construction of the Pico Vermelho project is the fourth stage in the development and construction of the geothermal plant on the São Miguel island.

Pico Vermelho Phase A

- The first stage was a 3 MW back pressure steam turbine utilizing the steam of PV 1 but generating only about 600 kW.

Ribeira Grande Phase A

- The first ORMAT project in the Azores was the Ribeira Grande Phase A of 5.08 MW gross, using the steam and brine of wells CL 1 and CL 2 . The working parameters of the project were as follows (design point):

| | | |
|---|---|---|
| Steam flow | : | 43.7 t/h |
| Brine flow | : | 74.6 t/h |
| Steam pressure at inlet to plant | : | 5.16 bar a |
| Brine temperature at inlet to plant | : | 152°C |
| NCG in steam | : | 7.4% |
| Design ambient temperature | : | 13°C |
| Power generation (gross at generator terminals) | : | 5,080 kW |
| Power generation (net at sub station inlet) | : | 4,400 kW |

The generation unit consists of two bi-phase OEC units, each with two turbines connected to a common generator.

Ribeira Grande Phase B

- The second phase of the Ribeira Grande project was the construction of two additional OEC units on the same site, using the same plant facilities and the geothermal fluid from wells CL 3 , CL 4 and CL 5. As mentioned above, well CL 4 was later converted to an injection well.

Phase B parameters are as follows:

| | | |
|---|---|---|
| Steam flow | : | 71.1 t/h |
| Brine flow | : | 263 t/h |
| Steam pressure | : | 5.11 bar a |
| Brine temperature | : | 153°C |
| NCG in steam | : | 7.6% |
| Design ambient temperature | : | 13°C |
| Power generation (gross) | : | 9,400 kW |
| Power generation (net) | : | 8,000 kW |

The figures given above are at "design point" as presented in the project agreement and are based on the best information on the well production at the time of the project conceptual phase. During the acceptance tests of the two phases the well production performance was slightly different from the design point figures. However, the performance of the generating equipment – the OEC units - was better than the expected performance at the new conditions, when applying the correction curves.

Pico Vermehlo Phase B

In mid 2004 SOGEO issued a bid for the design, manufacture and construction of a 10 MW (net) geothermal project using the steam and brine from four production wells - PV 1 , PV 2 , PV 3 and PV 4 . The spent fluid would be injected to two injection wells – PV 5 and PV 6. Wells PV 4 , PV 5 and PV 6 have not yet been drilled and will be drilled in parallel to the construction of the power plant.

Based on the experience of the previous phases, a resource analysis was conducted by GeothermEx to determine the design separation pressure which would take into consideration future reservoir depletion and would result in best overall reservoir sustainability and maximum plant energy production. The result was a relatively low design working pressure, as shown the following working parameters:

| | | |
|---|---|---|
| Steam flow | : | 76.8 t/h |
| Brine flow | : | 346.7 t/h |
| Steam pressure at inlet to plant | : | 5 bar a |
| Brine temperature at inlet to plant | : | 161.3°C |
| NCG in steam | : | 1.8% |
| Design ambient temperature | : | 22°C |
| Gross power at design point | : | 12,000 kW |
| Gross power at 13°C ambient temperature | : | 13,000 kW |
| Net power at design point | : | 10,500 kW |

**4. CONTINUOUS IMPROVEMENT**

The three phases of ORMAT equipment in the Azores are a good example of the continuing improvement of the energy conversion equipment (OEC unit and the auxiliary component) resulting in higher efficiency and better reliability and lifetime.

The first phase of the Ribeira Grande project included two dual OEC units, each consisting of two 3,000 rpm turbines and two speed reduction units connected to a 1,500 rpm generator.

The second phase included two improved OEC units with 1,500 rpm turbines direct-coupled to the generator without the need for reduction gears and with much higher expansion efficiency.

The third phase – the Pico Vermehlo plant - will have one of the new generation OECs with a capacity of up to 18 MW.

Table 1 presents the improvement in turbine expansion efficiency since ORMAT's first geothermal projects in 1984, resulting from an improvement in the nozzle and blade design, better wheel geometry which came with the reduction of the turbine speed from 3000/3600 rpm to 1500/1800 rpm (for 50 and 60 Hz grids respectively).

The reduction in the turbine speed was also one of the main reasons for the significant improvement in the reliability of the mechanical components such as bearings and seals, and of the extremely high availability and lifetime of the plants.

**Turbine Efficiency**

| Year of First Use | Representative Projects | Turbine Efficiency % |
|---|---|---|
| 1984 | Steamboat | 72 |
| 1985 | Ormesa | 75 |
| 1989 | Puna | 78 |
| 1993 | Heber | 83 |
| 1996 | Upper Mahaio/Rotokawa | 84 |
| 2000 | Olkaria | 88 |

**CONCLUSIONS**

The development of geothermal power generation projects in the Azores started in the late 70s and today includes four power plants with an accumulated capacity of close to 25 MW.

The 10 MW Pico Vermehlo power plant is the third ORMAT plant in the Azores and represents the successful cooperation between the Azores electric company – SOGEO - and ORMAT to develop high reliability, efficient power plants utilizing the available geothermal energy.

# THE AMERICAS

## Chile

### ENEL AND ENAP SIGN AN AGREEMENT FOR THE GEOTHERMAL DEVELOPMENT OF CHILE

***Translation from Italian by Iris Perticone, ENEL, Italy***

Chilean Empresa Nacional Del Petróleo (ENAP), which is among the largest energy companies of Latin America and the first one in its country, and ENEL signed an agreement in Santiago de Chile for the development of geothermal exploration projects in central-southern Chile and aiming at electricity generation. With the agreement, signed in a ceremony presided over by Chile's Secretary of the National Energy Commission Luis Sanchez, the two companies became shareholders, through an exchange of bonds (51 % ENEL and 49 % ENAP), of the Empresa Nacional de Geotermia, the joint venture that will carry on the exploration of the geothermal resources in the promising areas of Calabozo and Chillán, located at about 1,200 m elevation in the Precordilleran Andes. If the outcomes of the studies are positive, new wells could be drilled in 2006 and production could start within four years.

The aim is to add up to 300 MW of new generation capacity over the next seven years by exploiting the earth's natural heat to produce electric energy. The energy capacity thus generated will come from a renewable source, will be without emissions, and capable of meeting the annual needs of some 1,800,000 Chilean families. The avoided emissions into the atmosphere would be equivalent to 1,500,000 tonnes per year of carbon dioxide. This represents a significant contribution to the diversification of energy sources for a country (Chile) that is strongly dependent on imported fossil fuels, while its outstanding hydroelectric capacity has to reckon with recurrent droughts.

ENEL Chief Operating Officer Sandro Fontecedro stated that the company, which is already a world leader in renewable energies, is committed to go further in this direction. ENEL is investing both in Italy and abroad, focusing mainly in those fields where it has the soundest expertise, geothermal and wind energy. In particular, ENEL experience in geothermal dates back more than one century, and the company is willing to make the most out of the remarkable extent of acquired expertise. ENEL is keen to grab the chance to grow and, at the same time, to grant a support to the energy development of the countries that hold this valuable natural resource, as well as contributing to the reduction of global greenhouse gas emissions.

The agreement with ENAP is an important step in the implementation of this strategy that ENEL intends to follow with determination; in fact various development initiatives in Europe and other countries in Central and South America such as El Salvador and Guatemala are currently under consideration.

Chile is part of the so called "Ring of Fire", characterized by frequent volcanic activity. For this reason it holds a large potential for electricity generation from geothermal resource.

A stimulating negotiation is also under way with Codelco, the Chilean national company that mines copper and which is interested in the exploitation of geothermal energy occurring in the El Tatio area, north of Santiago.

Geothermal resources are currently exploited in 23 countries worldwide, with an installed capacity of 8,300 MW.

With the available technology, and developing proven resources, it could be possible to increase this figure up to some 72,000 MW. Foreseeable technological progress could lead to an additional doubling of geothermal capacity in a few years.

In Italy, in southern Tuscany, ENEL has realized over 700MW derived from geothermal sources with 5 billion kilowatt hours of annual production, which met the yearly need of almost two million Italian families, equal to 1.6 % of national consumption and avoiding carbon dioxide emissions of 3 billion tonnes per year. These records give ENEL an undeniable authority worldwide in this field.

## Nicaragua

### Bids received for two projects in Nicaragua

***John Garnish, IGA News editorial team***

The project advisor to Nicaragua's energy regulator INE, Ariel Zúñiga, reported on 7 June that offers have been received from three bidders interested in developing two geothermal projects with total installed capacity of 400MW.

The contracts are for the 250MW El Hoyo Monte Galán project 6km from Momotombo, an active volcano in León department, and the 150MW Managua-Chiltepe project, which is about 12km from the capital city, Managua. Bidders could submit bids for either project or for both projects. INE sold eight packages of bidding rules and received bids on May 31.

US company Ormat submitted one bid for the El Hoyo Monte Galán project, while GeoNica, a consortium of Italian company ENEL and El Salvadorian company La Geo, submitted offers for both projects, as did Canadian company Cerro Colorado Power.

Ormat has 3MW of installed geothermal capacity in Mexico, 24MW in Guatemala, 15.5MW in Costa Rica and 30MW in Nicaragua.

INE has already begun the evaluation process, which is usually for a two-month period but can legally be extended up to three months.

## Nicaragua

### Another Geothermal Power Project In Nicaragua Successful

***James Lawless, Sinclair Knight Merz of New Zealand***

On 20 July 2005 the San Jacinto geothermal power plant was officially opened by President Bolaños of Nicaragua who, as a chemical engineer, has taken a keen interest in the project since its inception. This is the second geothermal power project in Nicaragua after Momotombo.

The San Jacinto-Tizate resource is located in a volcanic area near the Nicaraguan colonial city of Leon, 90 kilometres north west of the country's capital, Managua.

The geothermal field concession is controlled by a Nicaraguan subsidiary of publicly-listed Polaris Geothermal Inc., whose major shareholders include companies based in Nicaragua, Germany, the USA and Canada.

This has been a project with a very strong international flavour, quite apart from its diverse ownership. Technical support and design for the project has been provided by Sinclair Knight Merz of New Zealand. LaGeo of El Salvador supplied and installed the turbines. TIC of the USA was the steamfield contractor. Standard Bank of London was the lead financier and also a shareholder in the project.

The San Jacinto concession was acquired from a joint company owned by Russian geothermal developers and the Nicaraguan Government. Thus, when Polaris took over the project there were already successful wells drilled. That led to a development strategy aimed at making early and best use of the existing assets, which inevitably involved a staged programme.

The first stage, now installed, consists of a 10 MWe plant making use of two second-hand back-pressure turbines from El Salvador to generate immediate energy and revenue returns using the steam available from two existing wells. Additional generating capacity will then be installed as new wells are brought on line, to enable the plant to reach the full 66 MW (net) output allowed for under the existing Power Purchase Agreement. Planning for the next stage is already under way.

Polaris and its partners also hold a second geothermal concession area in Nicaragua, nearby at Casita, and have recently put in a bid for a third. 75 to 80% of Nicaragua's power is currently supplied by thermal (oil or gas fired) plants using imported fuels with rapidly rising prices. The private sector development of renewable hydro and geothermal resources is not only expected to solve the country's energy crisis, but make it a potential exporter of energy to the rest of Central America, so the geothermal future in Nicaragua looks bright.

## USA

### US production tax credits extended to cover geothermal energy

***John Garnish, IGA News editorial team***

In a recent press release, Karl Gawell, Executive Director of the Geothermal Energy Association, and Alyssa Kagel described the implications of the new US Energy Bill. The Bill was passed by the Senate on 29 July 2005 and is expected to be signed into law by President Bush. For geothermal energy, the bill includes significant new tax incentives, improvements in federal leasing laws, and support for continued technology development.

Section 45 of the bill extends and modifies the renewable electricity production credit to allow geothermal the full 1.9 cents per kilowatt hour federal tax incentive that has helped spur wind energy projects across the nation. The production tax credit, or PTC, is awarded for ten years to new facilities placed in service by December 31, 2007. Last year, Congress expanded the PTC to include geothermal and other renewables, but they would receive the credit for only half of the period, or five years. The decision to give geothermal the full ten year credit period, placing it on equal terms with wind, is a huge victory for the geothermal community, and will help spur new development across the West.

The Energy Bill includes provisions directing the Department of Energy to conduct a near-term assessment of the resource potential for all renewable technologies, including geothermal, with the publication of yearly reports on the results. It also directs DOE's future geothermal energy research efforts to work towards several important goals.

In addition, Congress has created a new Clean Renewable Energy Bond ("CREB") to provide cooperatives and other not-for-profit electric companies, as well as Indian Tribal governments, incentives for building new geothermal and other qualified energy projects. Taken together, these provisions represent the first major overhaul of the Geothermal Steam Act since 1970.

Karl Gawell is quoted as saying "This new energy bill will revolutionize geothermal energy use in the US. It will encourage new geothermal power plants helping to ease the West's power crisis, and stimulate new geothermal direct use projects that will help communities and business grow while reducing dependence on imported fossil fuels. The bill streamlines some of the most bureaucratic aspects of the law, provides clear direction for the agencies to make geothermal a priority, gives local governments more funding to mitigate impacts, and ensures that the federal agencies will have the resources needed to implement the new law and quickly work-off a 30 year backlog of unfinished studies and ignored lease applications."

Congress' decision last year to include geothermal power in the Production Tax Credit has generated significant interest in new production. Between January and May 2005, there were 483 megawatts of new geothermal power purchase agreements signed. These new projects are located throughout California, Nevada, Arizona, and Idaho, and represent the power generation equivalent of the total 2,000 megawatts of wind projects operating throughout California today. Also, there are other power projects in Utah, Idaho, and California, and small-scale projects in New Mexico, Alaska, Nevada and California hoping to move forward that are not included in this total.

Direct uses applications -- where geothermal fluids are used for home heating, spas, greenhouses, or aquaculture -- are found today in 26 states. But federal law has dramatically stifled direct uses on public lands, and the new energy bill changes that. It simplifies procedures to obtain leases for direct use purposes, replaces complex royalty payments with a straight-forward fee schedule, and allows state and local governments to use geothermal resources for public purposes at only a nominal charge. Hundreds of communities and business in the West will now be able to use geothermal resources to meet their energy needs.

For information on the federal research and technology development programs visit: http://www.eere.energy.gov/geothermal/.

## AFRICA

### Kenya

### Workshop for Decision Makers on Geothermal Projects in Africa

***Ingvar B. Fridleifsson, Director,***
***United Nations University***
***Geothermal Training Programme,***
***Orkustofnun, Reykjavik, Iceland (ibf@os.is)***

A *Workshop for Decision Makers on Geothermal Projects and their Management* will be held in Kenya 14-18 November 2005. It is organized by the UNU-GTP (United Nations University Geothermal Training Programme in Iceland), KenGen (Kenya Electricity Generating Co.), and UNEP (United Nations Environment Programme), in collaboration with the African Rift Geothermal Facility (ARGeo), which is in the process of being established by UNEP, the Global Environment Facility (GEF), the six ARGeo countries (Djibouti, Eritrea, Ethiopia, Kenya, Tanzania and Uganda), and bilateral aid agencies from several countries. The UNU-GTP has been asked to play the leading role in guiding and implementing the capacity building component of ARGeo.

The workshop is planned as an important first step in the ARGeo capacity building process. The aim of the workshop is to make high level decision makers from the respective energy ministries, leading geothermal agencies, and electric utilities in the ARGeo countries better informed about the main phases of geothermal development and what kind of manpower, equipment, and financing is needed for each phase. They will learn of the present availability of equipment and experience within the ARGeo countries and be asked for their advice and opinion on geothermal capacity building activities which are being prepared and the feasibility of pooling of specialised equipment in the region.

A survey on geothermal training needs in the ARGeo countries will be conducted in advance of the workshop, as well as a survey on the availability of equipment for geothermal exploration in the ARGeo countries (conducted by the Icelandic International Development Agency ICEIDA as a contribution to ARGeo). The workshop will probably also discuss a preliminary proposal for an ARGeo Geothermal Training Centre in Kenya, and a preliminary draft on the establishment of an ARGeo equipment pool.

The Workshop will hopefully give top energy decision makers in the ARGeo countries an overview of the planning and execution of geothermal projects and the preparations needed for proposals for financing of geothermal projects at different stages of development. The Workshop is expected to be an excellent venue to strengthen the cooperation at the level of top decision makers in the sustainable use of geothermal resources in East Africa. Participation is by invitation only. There are expected about twenty participants from the ARGeo countries plus lecturers.

Later courses/workshops planned in Africa by the same agencies (2006 and onwards) will be more specific on subjects such as a) geothermal exploration, b) geothermal field development, and c) operations and maintenance of geothermal plants and production fields. The teaching will mainly be in the hands of former UNU Fellows in Kenya and the regular lecturers of the UNU-GTP. A part of the objective of the short courses/workshops is to increase the cooperation between specialists in the respective African countries in the field of sustainable use of geothermal resources. The UNU-GTP has over 80 graduates in 10 African countries (whereof 57 are still working in geothermal). Most of them have come from Kenya (35) and Ethiopia (22).

The Government of Iceland has secured core funding for the UNU-GTP to expand its capacity building activities by short courses in geothermal development in selected countries in Africa, and later in Central America and Asia. The announcement on this was made at the International Conference for Renewable Energies held in Bonn (Germany) 1-4th June 2004.

The courses/workshops will be set up in cooperation with the energy agencies/utilities and earth science institutions responsible for the exploration, development and operation of geothermal energy power stations and utilities in the respective countries. The courses may in the future develop into sustainable regional geothermal training centres. The first workshop in Africa will, as mentioned above, be held in Kenya in November 2005. The time plans for the first courses or workshops in Central America and Asia have tentatively been set for 2006-2008.

## ASIA/PACIFIC RIM

### China

### The First Geothermal Village in China

***Keyan Zheng, Geothermal Council of China Energy Society (GCES)***

In this village peasants no longer cultivate the fields. They all live in two storey villas. There are geothermal baths and geothermal space heating in their houses. It is not the "Arabian Nights". This is the Village of Nangong, located in a suburb of Beijing. There are 2,700 people in the village. Their output value per capita has exceeded $10,000 annually, while their per-capita income has exceeded $1,000 annually. The economic support of the village is geothermal development and related service trades.

Nangong village is an advanced community of spiritual civilization national-wide. Under the leadership of National Model Worker Mr. Wu, the village council drew up their policy of 'Changing traditional agriculture, going on towards urbanization'. Based on local rural conditions, they decided to use the local superiority of geothermal and land resources, to do well in geothermal enterprise-like operation, and to develop a geothermal economy.

In 2000 a geothermal well was completed in the village with 2,380 $m^3$/d of water at 72°C. Under the advice of the Beijing Geothermal Engineering Institute, these geothermal resources have been used in cascade to support a comprehensive development. The geothermal water is used first for space heating, supplying heating and hot water to an area of 30,000 $m^2$, including residential houses, guesthouse, hotel, offices and a geothermal exhibition center. The return water, with a decreased temperature of 48°C, then enters the second stage where it is used for floor heating and hot spring recreation in the Hot Spring Water World and Hot Spring Fishing Center. After that, the thermal water, cooler still, enters the third stage of use in the Hot Spring Special Aquafarm. Various famous, excellent, special and new species of edible and fancy fishes are fed there. Finally, the temperature having dropped below 30°C, the water is reheated by passage through a heat pump or adding a proportion of original geothermal water and then enters the fourth stage of use. It is used in greenhouses for soil heating and irrigation. In their "Greenhouse Park", there is a large-scale (20,000 $m^2$) geothermal greenhouse with glass roof and wall. There are tropical banana trees and a wonderful "Hundred Melon Garden" in the

*Peasants of Nangong Village live in these villas now*

glass-greenhouse. In addition as an overall geothermal utilization in the 'World Geothermal Natural Science Park', there is another Geothermal Popular Science Exhibition Center. The center has a multi-function show hall showing a geothermal film and an exhibition hall exhibiting geothermal popular science. Basically, this project has embraced every direct use of low temperature geothermal. This achievement has been showed on Beijing TV.

At present, a second geothermal well has been completed in the village. A Geothermal Physiotherapy Center and a five star hotel are being constructed, and a third geothermal well is being drilled. This is a planned reinjection well, in order to ensure the sustainable development and use of the geothermal resources.

## Japan

### *A New Ground-coupled Heat Pump survived the Magnitude 7.0 Earthquake in Fukuoka, Kyushu, Japan*

*Sachio Ehara and Koichiro Fukuoka, Kyushu University*

*Koji Morita, National Institute of Advanced Industrial Science and Technology (AIST)*

Public energy consumption has reached about 30 % of total energy consumption in Japan. Moreover, the heat island phenomenon in the urban areas is progressing rapidly in big cities in Japan, including Fukuoka city which has a population of over 1.4 million. Therefore it is very important to convert the energy source for housing from conventional to renewable natural energy. The number of ground-source heat pumps is increasing rapidly in some European countries and in the U.S.A., but we have only a small number of installed units in Japan. One major reason is the high cost of drilling because of difficult geologic conditions. Another reason is the high cost of electric power. In Japan, the price of electric power per unit heat amount is about 4 times higher than that of heating oil. Therefore we are trying to develop new high efficiency and cost effective space heating and cooling systems with ground- coupled heat pumps.

The Downhole Coaxial Heat Exchanger (DCHE) system was selected to extract heat from the underground for the experimental house in Fukuoka city. Our space heating and cooling system is quite simple and composed of the DCHE, which is 60 m long, two heat pumps, a circulation pump and five direct expansion/condensing fan-coil units as shown in Fig.1. The refrigerant is carried directly from the heat pumps to the fan-coil units as shown in Fig.2. The experimental house was constructed on newly reclaimed land. It is made of brick and is a standard 2-storey house for a family of 4 with an area of about 150 $m^2$ (Fig.3). The numerical simulation indicated that a high COP of 4.0 to 4.5 could be expected for the system. Experimental operation of the system started in the middle of February 2005.

A big earthquake of magnitude 7.0 (main shock) hit the western offshore of Fukuoka Prefecture on March 20, 2005. The epicentral distance to the experimental house is about 20 km. The seismic intensity was 6L JMA (Japan Meteorological Agency). The maximum ground acceleration was over 350 gal, and a woman was killed and more than 1000 people injured. More than 4000 houses and buildings were damaged. However, both our experimental house and ground-coupled heat pump system survived the strong earthquake even though they were constructed on reclaimed land. The strong earthquake unexpectedly verified that our ground-coupled heat pump system is earthquake-proof. The system may be the first ground-coupled heat pump system in the world to have survived such a big earthquake.

An observation well was also drilled to monitor the changes in physical properties due to the heat extraction and disposal. The distance between the observation and heat extraction wells is seven metres. We also set up a pressure sensor to monitor the groundwater level. We had been monitoring the groundwater level since the end of January, 2005, about 50 days before the occurrence of the main shock. Just after the main shock, we retrieved the water level data and found a peculiar change in groundwater level before the main shock, as shown in Fig.4. Until 2 March the groundwater level showed a simple sinusoidal curve with dominant period of about one month which is controlled by ocean tides. From 2 March, the groundwater level began to deviate from the sinusoidal curve and maintained a constant level. After that, from 12 March, the water level began to decrease and then to increase again from 16 or 17 March. The rapid increase on 16 March was probably affected by rainfall. We had a rainfall of 22.5 mm on 16 March. The main shock occurred on 20 March while the water level was rising.

In summary, we observed the following three stages in groundwater level change before the main shock: the first step is “the water level plateau”, the second stage is “gradual decrease in water level” and the third stage is “quick rise of water level”. The main shock occurred while water level was rising, that is, the third stage. After the main shock the water level dropped quickly by about 60 cm and began to increase again two days after the main shock. Subsequently several large aftershocks also showed a similar pattern of water level change. The mechanism of the aforementioned water level change is interpreted in terms of the dilatancy-diffusion model (Scholtz,1977). The peculiar precursory water level change observed in Fukuoka area implies the possibility of the prediction of timing and magnitude of earthquakes. Geothermal study may contribute to the study of earthquake prediction.

**Reference**

Scholtz, C. H., A physical interpretation of the earthquake prediction, *Nature*, Vol.267, 121-124, (1977).

**Figure captions**

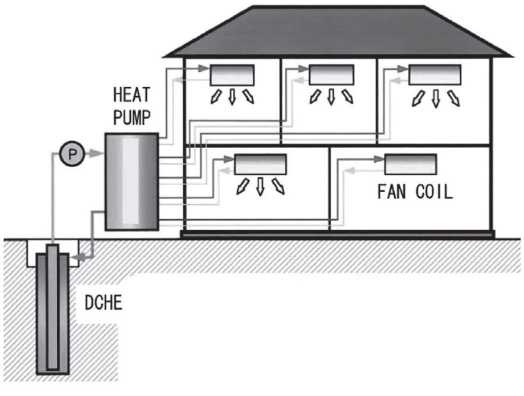


*Fig.1 Schematic diagram of the DCHE and the space heating and cooling system in the experimental house.*

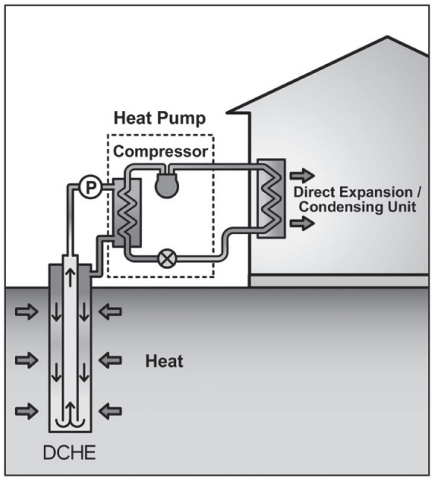


*Fig.2 The newly developed ground-coupled heat pump system.*

*Fig.3 An experimental house constructed on reclaimed land in Fukuoka city, Kyushu, Japan. It is made of brick and is a standard 2-storey house for a family of four.*

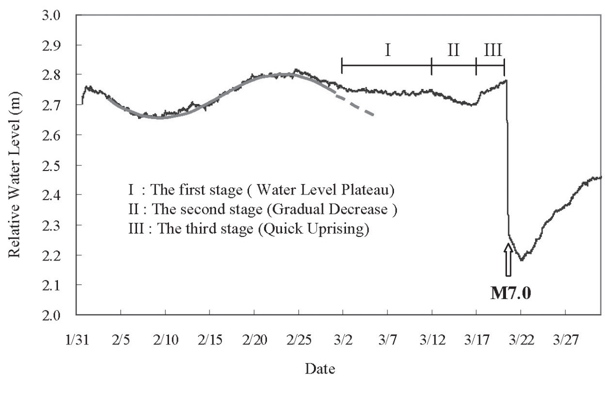


*Fig.4 Changes in the groundwater level before and after the main shock at the observation well in Fukuoka city, Kyushu, Japan. For reference, the smooth solid line shows the sinusoidal curve with a double amplitude of 15 cm and a period of one month.*

## Philippines

### *Update on the Philippine Renewable Energy (RE) Bill (as of 2 August 2005)*

***by Quintin Pastrana and Ed Sevilla***

The National Geothermal Association of the Philippines (NGAP), through its Public Affairs Committee, has been a principal member of the multi-sectoral coalition composed of the Philippine Department of Energy (DOE), World Wildlife Fund (WWF), United Nations Development Programme (UNDP), Klima and the Confederation of Renewable Energy Sources (CORE). These groups represent the hydropower, biomass, solar, wind, and geothermal sectors.

The Coalition advocates the proper formulation and immediate passage of the Renewable Energy (RE) Bill in the Philippine Congress. To this end, the Coalition has been engaged by the House Committee on Energy to serve as the primary resource for crafting this legislative measure. After a series of organizational meetings, workshops and presentations, House Bill 1068 was formulated in a form and content aligned with the interests of the Renewable Energy Sector. The Coalition is now in the process of arranging briefings with various sponsors at the Senate, where a similar bill has been filed by Senators Juan Flavier and Edgardo Angara.

In summary, the RE Bill endeavors to create a level playing field for RE sources by:

1. rationalizing incentives,
2. lowering royalties on energy sources like geothermal (which is currently levied 60% of net revenues, while other sources like coal are imported tax free), and
3. providing for increased applications for RE to ensure the country's energy self sufficiency and sustainable development.

As a result of the meetings conducted by the technical working group (TWG), it was agreed that the proposed fiscal incentives under the RE bill would be aligned with pertinent provisions of House Bill No. 3295, "The Consolidated Incentives and Investment Code of the Philippines."

Moreover, the Coalition is advocating the preferential treatment (i.e., zero-rating) of RE sources under the new Expanded Value-Added Tax Law (E-VAT), which serves to enhance the competitiveness of RE sources. Equally important is the focus of the Coalition on generating awareness for the increased use of Renewable Energy.

To support its advocacy initiatives, an information campaign has been launched by the Coalition with the WWF as lead implementor. This has resulted in high impact projects, including:

- Monthly Ad Campaign in the Philippine Daily Inquirer (a top Philippine broadsheet) that started in January and continues to present;
- Erection of high profile billboards starting in March at North Avenue, North Expressway and EDSA;
- Familiarization Tour last April for the chairman and key members of the House Committee on Energy that featured briefings and site visits to existing RE plants in Southern Luzon, namely: the SunPower Solar Plant in Sta. Rosa, Laguna, Mak-Ban Geothermal Plant in Laguna and Batangas, and Villa Escudero Mini-hydro plant in Quezon. This familiarization trip resulted in the adoption of the RE cause by more legislators, including Rep. Etta Rosales (Akbayan);
- Eco-Adventure Race to launch Southeast Asia's first ever wind farm (25 MW) in Ilocos Norte, Northern Philippines, last June was covered by MTV, GMA 7, Inq7.net and other media outlets; and
- Round table and in-depth feature about the RE Bill in the July issue of local magazines.

The combination of policy advocacy efforts and awareness campaigns have proved to be an effective strategy in ensuring the prospects of the RE Bill's passage. The Coalition hopes that with the Senate's support the bill will have a good chance of passage and eventual enactment by 2006.

At the time of writing, the House Energy Committee is slated to conduct a committee meeting on the draft substitute renewable energy bill, tentatively on 9 August 2005, with the Philippine Department of Energy and CORE members as resource persons. Another meeting is scheduled later this August to hear the inputs of Philippine energy and finance officials. The House Committee on Energy expects to come up with its committee report after these meetings.

## *UPCOMING EVENTS*

**International Conference "Mineral Extraction from Geothermal Brines"**, Petropavlosk-Kamchatsky, Russia, September 12-16, 2005. Websites: English version http://geoheat.oit.edu/minerals/minerals.htm, Russian version http://www.gesa.ru. Contacts: R. Gordon Bloomquist (bloomquistr@energy.wsu.edu), John Lund (lundj@oit.edu), Oleg Povarov (povarov@geotherm.ru), or Yuri Trukhin (nigtc@kcs.iks.ru).

**Symposium of the Geothermal Council of China Energy Society.** Beijing, China, 14-18 September 2005. Contact: Keyan Zheng, e-mail kzheng@public3.bta.net.cn

**World Energy Engineering Congress (WEEC),** 14-16 September 2005, Austin TX, USA. Contact: www.energycongress.com/

**International Geothermal Conference "Renewable Energy: Problems and Prospects".** Makhachkala, Republic of Daghestan, 19 – 22 September 2005.

Contact: Alibek Alkhasov (danterm@xtreem.ru), website: http://www.geoterm.iwt.ru/info-e.htm

**3rd International Exhibition for all Renewable Energy Technologies**, 21-24 September 2005, Jakarta, Indonesia. Contact: www.pamerindo.com/2005/ele05exh.htm

**GRC Annual Meeting.** Reno, NV, USA, 25 – 28 September 2005. website: www.geothermal.org.

**3rd Exhibition Conference on Energy Resources and Technologies**, 4-7 October 2005, Milan, Italy. Contact: www.milanoenergia.it

**27th New Zealand Geothermal Workshop**, 26-28 October 2005, Rotorua, New Zealand. Contact: Stuart Simmons sf.simmons@auckland.ac.nz, www.auckland.ac.nz/gei

**Creating the Climate for Change- The 2nd Annual Sustainable Energy Finance Round-table on Clean Energy Investment**, 27 October 2005, New York, USA. Contact: www.greenpowerconferences.com/events/SustainableEnergyFinanceRoundtable.htm

**Green Power – Mediterranean,** 15-16 November 2005, Rome, Italy. Contact: www.greenpowerconferences.com/GreenPowerMed.htm

**Mexican Geothermal Association Annual Meeting.** Los Azufres, Mich., México, November 27-28, 2005. Contact: José Luis Quijano-León (luis.quijano@cfe.gob.mx) or Luis C.A. Gutiérrez-Negrín (luis.gutierrez03@cfe.gob.mx).

**Clean Energy Power 2006**, 18-19 January 2006, Berlin, Germany. Contact: alberti@energie-server.de, www.energiemessen.de/engl/index.htm

**31st Stanford Geothermal Workshop**. Stanford, California, USA, 30 January – 1 February 2006. Contact: Laura Garner (lgarner@pangea.stanford.edu), http://ekofisk.stanford.edu/geoth/workshop2006.htm

**27th Annual PNOC-EDC Geothermal Conference.** Manila, Philippines, 8-9 March 2005. Contact: Arnel Mejorada, email: geothermalcon@energy.com.ph, www.energy.com.ph/geoscientific/geocon2006.htm

**International Heat Transfer Conference,** 13-18 August 2006, Sidney, Australia. Contact: ihtc-13@unsw.edu.au, http://ihtc-13.mech.unsw.edu.au/

**World Renewable Energy Congress IX & Exhibition**, 19-25 August 2006, Florence, Italy. Contact: asayigh@netcomuk.co.uk, www.wrenuk.co.uk/menu/htm

**International Conference and Exhibition "Renewable Energy 2006".** Makuhari Mese, Chiba, Japan, 9-13 October 2006. Website: www.re2006.org.

## IGA News

IGA News is published quarterly by the International Geothermal Association. The function of IGA News is to disseminate timely information about geothermal activities throughout the world. To this end, a group of correspondents has agreed to supply news for each issue. The core of this group consist of the IGA Information Committee:

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The members of this group submit geothermal news from their parts of the world, or relevant to their areas of specialization. If you have some news, a report, or an article for IGA News, you can send it to any of the above individuals, or directly to the IGA Secretariat, whatever is most convenient. Please help us to become essential reading for anyone seeking the latest information on geothermal worldwide.

While the editorial team make every effort to ensure accuracy, the opinions expressed in contributed articles remain those of the authors and are not necessarily those of the IGA.

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**Contributions to the next issue of IGA News must be received by 10 November 2005.**

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# APPLICATION FOR MEMBERSHIP

**Please complete the following form and return it with payment to:**
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Fax (area code) ______________________________
e-mail ______________________________

**Note:** The information you provide will be held on the IGA database. It will be used to update you on the activities of the Association, and may be changed or cancelled at any time upon your request. It will be included in the IGA Directory , which may be circulated in printed or electronic form to IGA members only. If you do not wish your details to be used for this purpose, please tick the box (in which case your name will not be printed in the IGA Directory) ❒

## Membership category

❒ Individual – USD 30
❒ Student – USD 5
❒ Corporate – USD 300
❒ Institutional – USD 750
❒ Sustaining: individual – USD 100
❒ Sustaining: corporate – USD 1000

Representatives of Corporate and Institutional members:

Contact person ______________________________
Second person ______________________________
Third person ______________________________

## Payment

There are three ways to make payment to IGA:

1. **International Wire Transfer** in USD

Please notify the Secretariat by fax or e-mail when you wire funds.

Bank: ICEBANK LTD
Branch 1154
Address: Skeifan 11
108 Reykjavik
Iceland

Account # 1154-38-100550
SWIFT: LSIC IS RE
IBAN: IS94 1154 38 100550 460395 2679

2. **Bank draft, company or personal check in USD.**

3. **Credit card**

❒ Master Card
❒ American Express
❒ Visa

Card # ______________________________
Expiration date ______________________________
Signature ______________________________
Date of signature ______________________________
2005 dues USD ______________________________
2006 dues USD ______________________________
2007 dues USD ______________________________
2008 dues USD ______________________________
Contribution USD ______________________________
TOTAL USD ______________________________

These financial data will not be stored on a database, and will not be recorded in any electronic form.



## Rates for advertising in IGA News

| Space/Format | Size mm | Number of Issues | |
|---|---|---|---|
| | | 1 | 4 (per issue) |
| Full Page | 185 x 245 | USD 450 | USD 350 |
| Half Page (horizontal) | 185 x 120 | USD 310 | USD 215 |
| Half Page (vertical) | 90 x 245 | USD 310 | USD 215 |
| Quarter Page (horizontal) | 120 x 90 | USD 195 | USD 155 |
| Quarter Page (vertical) | 90 x 120 | USD 195 | USD 155 |