



IGA NEWS

Newsletter of the International Geothermal Association

IGA ACTIVITIES

Message from the President

John W. Lund, President



The Board of Directors held their 40th meeting in Brussels, Belgium on April 3-4, 2006. Burkhard Sanner, our host and organizer for the meeting, was able to arrange for us to meet in the Renewable Energy House. This impressive building has its energy supplied by solar and geothermal – the latter in the form of geothermal heat pumps. Dr. Sanner also arranged for a three-country field trip to the Klina Hospital in Antwerp to view the geothermal heat pump system, to Aachen to view a deep (2500 m) borehole heat exchanger project at the University of Aachen, and to Heerlen, Netherlands, to view a mine-water drilling project and to attend lectures on the subject. Much is going on in this corner of Europe.

At the recent BoD meeting, the members approved the formation of the Western Pacific Regional Branch (WPRB) as proposed by Jim Lawless of New Zealand. Mr. Lawless has since been active in recruiting country geothermal organizations to join the Branch. He made a presentation at the Australia Earth Science Convention in Melbourne in early July to invite the geothermal community to form an affiliate organization with IGA. Your President also gave a key-note address during the geothermal session on direct-use of geothermal energy. Mr. Lawless is planning to hold the first meeting of the WPRB during the New Zealand Geothermal Workshop on November 15, 2006. The second meeting is planned for the PNOC Geothermal Meeting in Manila, Philippines in March, 2007. To date, China, Japan,

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Korea and Indonesia have all shown interest in associating with WPRB. Additional information can be obtained from Mr. Lawless at: JLawless@skm.co.nz.

Also at the recent BoD meeting in Brussels, the members considered a proposal made by Mr. Peter E. Rae of Hydro Tasmania (Australia) for the IGA to affiliate with a newly formed International Renewable Energy Alliance (IREA). The Alliance presently consists of the World Wind Energy Association (WWEA), the International Solar Energy Society (ISES), and the International Hydropower Association (IHA). They are trying to have IGA join and are also looking for an international biomass organization to join as well. The purpose would be to present a united front to various political, governmental, and other organizations to enhance the recognition and value of renewable energy including efficiency, storage, transmission and distribution. Their main activities will be to:

- Cooperate jointly to the mutual advantage of each member organization
- Promote an on-going process of policy development and consensus building that encourages renewable energy development
- Research and publish authoritative, analytically sound information in support of renewable energy policy
- Participate in international frameworks and events enhancing the knowledge and acceptance of renewable energy including UN initiatives and programmes.
- Publicize renewable energy solutions through advertising, promotion and other means of information dissemination such as conference and meetings when and where appropriate.

The BoD decided to consider membership at the October board meeting in Japan. Your President met with the officers of the International Hydropower Association and Mr. Rae in Portland, Oregon in late July to discuss the affiliation and to present information on IGA. Mr. Rae has been invited to make a presentation at the board meeting in Japan in October.

Your President will be attending the dedication of the world's lowest temperature geothermal power plant at Chena Hot Springs, Alaska on August 20th. Chena Hot Springs, an isolated resort about 100 km northeast of Fairbanks, has no electrical power link to an outside power grid, so it has used diesel generators for power for many years. They have now installed a 200 kWe power unit built by United Technologies Corporation of Hartford, Connecticut, USA. This Organic Rankin Cycle binary power unit is running off 72.5°C water from a 213 m-deep well. The cooling water is from another well at 4°C. Also at Chena Hot Springs is the Aurora Ice Museum that uses an absorption chiller using the geothermal water to keep an ice building frozen all year around. In addition the resort has a greenhouse to provide vegetables and flowers, and hot pools for the guests at the lodge. We hope to have a more detailed article for the IGA News by the next issue. In the mean time, you can view their website at : www.yourownpower.com.

The next Annual General Meeting (AGM) of the IGA will be at the Renewable Energy 2006 conference in Chiba, Japan at the end of the BoD meeting on October 8th, 2006.

IGA Geothermal Conference Papers Database

Eduardo Iglesias, Chairman, IGA Information Committee

We recently completed the entry of the conference papers for the Stanford and New Zealand Workshops on the online IGA Geothermal Conference Papers Database. We now have the complete collections of both Workshops. The collection now stands at almost 5,000 papers.

Members of the Information Committee who have devoted a great deal of effort in building the collection include Roland Horne of Stanford University, USA, Adele Manzella of Italy, Rosa Maria Prol Ledesma of Mexico and Sylvia Ramos of Philippines. In adding the two most recent collections, a big debt of gratitude is due to Laura Garner at Stanford, who took care of 20 years of Stanford Workshops. The NZ Workshop scans were generously provided by Mighty River Power, and entered by Prof. Horne over the last year.

Currently, the IGA collection experiences an average of about 25 downloads per day, from countries across the world. The online collection has proven to be a very useful research tool for the international geothermal community. Please take a look in the IGA website, at "IGA Services/Geothermal conference papers search engine".

In memoriam, Dr. Valgardur Stefansson

Ingvar B. Fridleifsson

Dr. Valgardur Stefansson, Executive Director of IGA, died of cancer on 10th July 2006 at the age of 67. He leaves behind his wife Ingibjörg, four children and seven grandchildren.

Valgardur was born in Reykjavik on 2nd June 1939. He graduated from the Secondary Grammar School in Reykjavik in 1959. He studied physics at the University of Stockholm, and received his PhD in nuclear physics in 1973. He taught experimental physics at the university along with his studies during 1965-1973. Valgardur joined Orkustofnun (the National Energy Authority of Iceland) in 1973. In the beginning, he served as geophysicist in geothermal prospecting, but in 1975 he started to build up the geothermal logging and reservoir engineering unit within Orkustofnun. He was the Head of the Geothermal Logging Unit 1975-1985, and served simultaneously as Deputy Director of the Geothermal Division of Orkustofnun 1979-1985. He was a member of the Studies Board of the UNU Geothermal Training Programme in charge of Borehole Geophysics 1979-1985. During 1985-1990, Valgardur served as Interregional Advisor on Geothermal Energy at the Department of Technical Co-operation for Development at the United Nations in New York. He returned to Orkustofnun in 1990 where he served as Head of the Geothermal Reservoir Group 1990-1996, Chief Project Manager of Orkustofnun 1997-2003, and the Head of the Energy Resources Division of Orkustofnun 2003-2004. He became the Executive Director of IGA in 2004, when the IGA Secretariat moved to Iceland.



Valgardur Stefansson

With his strong theoretical and experimental background in physics, Valgardur made a significant contribution to the logging of drillholes in geothermal fields. In 1975, he visited leading well logging companies in the USA to study logging techniques commonly used in the oil industry for measurements of porosity and permeability, with the purpose of adapting these to geothermal exploration. With assistance from the International Atomic Energy Agency (IAEA), Orkustofnun bought a logging truck with equipment which made it possible to measure routinely several new parameters (including neutron-neutron, gamma-gamma, and natural gamma) during geothermal drilling in Iceland. Valgardur was among the pioneers in borehole logging and reservoir engineering in high enthalpy geothermal fields. He was a key person in developing the reservoir models for the Krafla and later Nesjavellir fields in Iceland. He became one of the main proponents of geothermal research and utilization in Iceland, and later worldwide. He served as a geothermal advisor to international agencies and government institutions in over twenty countries, and served on many international evaluation committees. He was an excellent lecturer and gave lectures at international conferences and workshops in all continents. He published over one hundred papers in journals and conference proceedings. Amongst these were review papers on the world assessment of geothermal resources, the success rate of geothermal drilling worldwide, and world surveys on geothermal development and utilization. In the last decade, he wrote several papers on the renewability of geothermal energy resources and the sustainability of geothermal utilization.

Valgardur was very active in international co-operation on geothermal energy. He was a member of the Board of Directors (BoD) of IGA 1995-2001, and was for the whole time the Chairman of the Membership Committee. He made an excellent job of negotiating affiliation agreements with national geothermal associations which joined the IGA. He made big contributions to the BoD. It was enjoyable to watch him at board meetings. He always came well prepared to the meetings, and presented the matter in hand and his views in a clear and balanced way. He was a man of few words, and did not participate much in lengthy discussions at meetings. But when he spoke, everybody listened. Valgardur was a prime mover in the establishment of the Geothermal Association of Iceland in 2000. He was a member of its BoD from the beginning, acted as Treasurer 2000-2002, and as Vice President 2002-2006.

Valgardur was highly respected in the international geothermal community for his knowledge, long and wide ranging experience, logical mind, quiet manners, and his warm smile. He was a person who never forced his presence or opinions on anybody, but was always willing to assist and share his experience. He was a true friend.

EUROPE

Hungary

Introduction of Hungarian Thermal-Energy Society

Mihály Kurunczi president, Franciska H. Kármán IGA BoD Member, Roland Varga secretary

The Hungarian Thermal-Energy Society (HTES) was established in 2003. Hungary – as is known worldwide – is rich in low- and medium-enthalpy thermal water. There are some places where high enthalpy thermal water can be obtained and they might be able to produce electricity in the near future. The aim of establishing a new association was to ensure a new corporate and professional forum for experts working in the geothermal field.

The purpose of HTES:

- Pursuing public utility activities meeting and approximating society's, companies', municipalities' and the individual's common interests in the fields of exploration, utilization and research and development of thermal water and thermal energy, with specific attention paid to the effects of these activities upon the management of water resources and environmental protection (eg. disposal of used thermal water).
- The organization of education, training and support of experts working on the utilization of thermal energy, and assistance to new professionals in the field.
- The organization and the management of scientific exhibitions, conferences, lectures.

The Hungarian Thermal-Energy Society is advancing dynamically; its members are private individuals, companies, municipalities.

HTES has been very active since its inception. A presidium meeting is held yearly, where the previous period's events and results are summarized and future tasks are assigned. In Spring and in Autumn an open professional forum is held for everybody, where lectures about current geothermal events such as competition opportunities, regulatory background, finished projects, international status, etc., are presented by experts. Beside all these, the association is a regular exhibitor at Hungarian renewable energy exhibitions. The Hungarian Thermal-Energy Society hosted the EU TAIEX conference (Regulatory and Economic Tools Governing the Enhanced Exploitation of Geothermal Energy in the European Union) organized by the Hungarian Geological Survey in April 2005, where several experts participated from 15 countries. Guests had the chance to look at the geothermal system of the town of Kistelek. The conference was a great success. Its concluding report, known as "The Kistelek declaration", is downloadable from the Survey's homepage (<http://www.mgsz.hu/english/index.html>). In the same month two members represented HTES at the World Geothermal Conference in Antalya. In September, at the 39th IGA BoD meeting in Beijing, the president Mihály Kurunczi signed the Agreement of Affiliation of the Hungarian Thermal-Energy Society with the IGA.

HTES also takes part in an interdepartmental commission of the Ministry of Environment and Water, where it plays an active role in revising and preparing regulations affecting geothermal energy in Hungary. Its aim is to help and increase the complex and economical utilization of geothermal energy by using modern technologies such as reinjection of cooled water (even into sandstone) and inclusion of heat pumps in systems.

At the end of January 2006 HTES organized a very successful conference and workshop in Kistelek titled *Geothermal and Environmental Industry in the XXIst Century*.

Besides the very high-standard presentations, Norway and State Union Serbia and Montenegro introduced themselves as special guests. On the second day participants visited the new thermal project in Fülöpjakab, where a 1.5 hectare greenhouse is heated by geothermal energy with reinjection of cooled water into Pannonian sandstone. On 27 April HTES held its Spring forum, where new steps of regulation and new competition opportunities connected to the 2007-2013 EU budget were the main topics.

HTES members can be any Hungarian and non-Hungarian natural person or legal entity who acknowledges the provisions of the articles of association as legally binding to itself, expresses his intention to join the association by signing the application for membership, and acknowledges his obligations regarding cooperation for realizing the association's purposes and the payment of the membership fee.

Availability of HTES:

E-mail: termalenergia@termalenergia.hu

Web: www.termalenergia.hu (shortly in English as well)

Poland

Geothermometric study of low-enthalpy thermal waters in Poland

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In 2004 the Institute of Geological Sciences, Polish Academy of Sciences, started a three-year research program concerning the application of selected chemical and isotopic geothermometers to low-enthalpy thermal waters of Poland. The research is supported mainly by the Ministry of Science and Informatics (scientific grant No 21 P04D 021 27 "Chemical and isotopic indicators of groundwater temperature in the Sudetic region and the western part of Polish Lowlands as premises for exploration of thermal waters"). The research covers practically all working occurrences of thermal waters in Poland: 16 wells and springs in the Sudetic Geothermal Region, 5 wells in the Polish Lowlands and 3 wells in the Carpathians, where temperatures at the outflow are not less than 20°C. Distinct hydrogeothermal systems occur in all these regions. In the Sudetic region waters of meteoric origin circulate in crystalline massifs within fissures and deep-rooted faults. The waters here are usually of low mineralization and their temperature depends first of all on the circulation depth and flow velocity through the ascending zones of the hydrogeological system. Within the tectonic units of the Polish Lowlands practically stagnant hot brines occur in sedimentary formations of the Mesozoic, mainly in sandy Dogger and Liassic sediments. In the Inner Carpathians the Podhale geothermal system is linked to Paleogene (carbonates and flysch) and Mesozoic sediments forming a typical artesian structure. The Outer Carpathians are less promising. Thermal waters occur here in generally slightly permeable Upper Cretaceous-Paleogene flysch sediments or in Palaeozoic rocks forming the basis of Carpathian nappes at considerable depths. All these hydrogeothermal systems are promising for further development of industrial utilization of thermal waters. Nevertheless, prospecting for new geothermal resources, always aiming for both high temperature of water and possibly high discharges, is very expensive mainly because of the frequent necessity to carry out deep drillings. Therefore, precise evaluation of extractable water resources and credible values of its temperature are of essential importance – especially in the areas where these parameters have not been directly explored by deep drillings.

Taking this into account, the main objective of the research project is the application and thermodynamic evaluation of selected chemical and isotopic geothermometers in low-enthalpy hydrogeothermal systems (mainly the oxygen isotope geothermometer in the $\text{SO}_4 - \text{H}_2\text{O}$ system) in order to forecast water temperature at depth. It is well known that chemical and isotopic temperature indicators are developed and applied mainly to high-temperature systems, where thermodynamic equilibria between water (or steam) and the rock environment or between particular dissolved water components are attained faster and more often than in low-temperature ones. Their applicability to low-temperature waters is often troublesome as the temperature forecasts provide dubious results. That is why - by studying and comparing distinct hydrogeothermal systems, where the origin of waters, their chemical composition and residence time in the aquifer vary considerably - we expect not only to evaluate the applicability of particular geothermometers but also to present quantitative and qualitative reasons for inconsistent temperature indications.

It is expected that the results of this study will allow us to work out clear and more precise procedures of particular geothermometer application to evaluate the geothermal potential of low-temperature groundwater systems.

Preliminary results of this study concerning the Sudetic Geothermal Region have been already presented during the World Geothermal Congress in Antalya, Turkey.

The whole project is going to be finished this year and further results will be published soon.

Iceland

UNU-GTP in Iceland starts 28th annual session

Inguar B. Fridleifsson, Director UNU-GTP

The 28th annual session of the United Nations University Geothermal Training Programme (UNU-GTP) opened in Reykjavik on 2nd May. Twenty one UNU Fellows from twelve countries participate in the six month specialized courses this year. They come from Azerbaijan 1, China 2, Costa Rica 2, Indonesia 3, Iran 2, Kenya 2, Mongolia 2, Nicaragua 1, Philippines 2, Tanzania 1, Turkey 1, and Uganda 2. They will be trained in: Geological Exploration 1, Borehole Geology 1, Geophysical Exploration 1, Reservoir Engineering 3, Chemistry of Thermal Fluids 6, Environmental Studies 3, and Geothermal Utilization 6.

During 1979-2005, 338 scientists and engineers from 39 countries have completed the six month courses (www.os.is/unugtp/). A lady scientist from Azerbaijan in this year's class brings the number of countries to 40. In many countries in Africa, Asia, Central America and Central and Eastern Europe, UNU-GTP graduates are among the leading specialists in geothermal research and development. They have been very successful, and have contributed significantly to energy development in their parts of the world.

Three former UNU Fellows have been working this year on their MSc projects under the cooperation agreement between the UNU-GTP and the University of Iceland. Mr. Kizito Opondo (geochemist from Kenya) started his MSc studies in February 2005 and defended his thesis in August 2006. Mr. Joshua O'Were (environmentalist from Kenya) and Mr. Iderbat Lkhagvadorj (mechanical engineer from Mongolia) started their MSc studies in September 2005. Six former UNU Fellows (from China, Djibouti, Iran, Kenya, and the Philippines) have been accepted for MSc studies at the University of Iceland commencing in September 2006. They will all receive Fellowships from the UNU-GTP. Eight former UNU Fellows have graduated since the MSc programme was started in cooperation with the University of Iceland in 2000.

The MSc thesis and the research reports of UNU Fellows attending the six month courses can be obtained on the UNU-GTP website www.os.is/unugtp/ under Yearbook.



The UNU Fellows of the Class of 2006 of the UNU Geothermal Training Programme. From left: Yang Quanhe (China), Nyambayar Tsend-Ayush (Mongolia), Joseph Patrick Odong Okedi (Uganda), Evanson Munene Nyagah (Kenya), Jorge Isaac Cisne Altamirano (Nicaragua), Alejandro Rodriguez Badilla (Costa Rica), Manuel Antonio Barrantes Viquez (Costa Rica), Irada Ibragimova Shamar (Azerbaijan), Ali Ahmadi Nassirabad (Iran), Wang Wei (China), Ali Rakhshani Moghaddam (Iran), Özge Can Atas (Turkey), Dan Mainza (Uganda), Sukhgerel Javzan (Mongolia), Johnson W. Ndege (Kenya), Ronaldo R. Pendon (Philippines), Ahmad Yani (Indonesia), Jacob Manoni Mayalla (Tanzania), Tesha (Indonesia), Roy Bando Swandaru (Indonesia), and Erlindo Angcoy (Philippines).

Short courses as contribution to UN Millennium Development Goals

Ingvar B. Fridleifsson, Director UNU-GTP

The Government of Iceland has secured core funding for the UNU-GTP to expand its capacity building activities by annual workshops/short courses in geothermal development in selected countries in Africa (started in 2005), Central America (will start in 2006), and later in Asia (probably starting in 2007). The announcement on this was made at the International Conference for Renewable Energies held in Bonn (Germany) 1-4th June 2004. This is a contribution of the Government of Iceland towards the Millennium Development Goals of the UN.



Six countries with good geothermal potential in East Africa have decided to join forces and increase their cooperation in geothermal research and development within the African Rift Geothermal Facility (ARGeo). The UNU-GTP has accepted to play a leading role in guiding and implementing the capacity building component of ARGeo. The Workshop in November 2005 at Lake Naivasha in Kenya was the first step in the capacity building process. Participation was by invitation only. There were high-level decision makers from five of the ARGeo countries (Eritrea, Ethiopia, Kenya, Tanzania, and Uganda) at the Workshop, plus lecturers from Ethiopia (1), Iceland (4), Kenya (8) and Philippines (1). Representatives of each ARGeo country also presented priority projects from the respective countries.

The courses/workshops are 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/regions. A part of the objective of the workshops/short courses is to increase the cooperation between specialists in the respective countries in the field of sustainable use of geothermal resources. The courses may in the future develop into sustainable regional geothermal training centres.

The first workshop in Africa (entitled “Workshop for Decision Makers on Geothermal Projects and their Management”) was held in Kenya in November 2005 with participants from Eritrea, Ethiopia, Kenya, Tanzania and Uganda. It was co-hosted by the UNU-GTP and the Kenyan Electricity Generating Authority (KenGen), and organized in cooperation with UNEP (United Nations Environment Programme) and ICEIDA (Icelandic International Development Agency). The second workshop will be held in Kenya in November 2006. It will be entitled “Surface exploration for geothermal resources”. The workshop will deal with geological, geophysical, and geochemical exploration methods. The lecturers will (as in 2005) mainly be former UNU Fellows from Kenya plus four lecturers from the UNU-GTP. The UNU-GTP has 88 graduates in 10 African countries.

The first workshop in Central America is planned to be held in El Salvador in November 2006. It will be entitled “Workshop for Decision Makers on Geothermal Projects in Central America”, and will be co-hosted by the UNU-GTP

in Iceland and LaGeo S.A de C.V. in El Salvador. The participants will be decision makers and prime movers/specialists of geothermal project activities in the countries of Central America. Participation is by invitation only (30-40 participants). The aim of the workshop is to give high level decision makers from the respective energy and environmental ministries, leading geothermal agencies, and electric utilities in the region an overview of some of the key issues of geothermal development, with a special focus on environmental issues. Lecturers will include former UNU Fellows and other geothermal specialists from Costa Rica, El Salvador, Guatemala and Nicaragua plus three regular lecturers of the UNU-GTP. Lecturers will also be invited from Kenya, Philippines, USA, and Mexico. The UNU-GTP has 46 graduates in six Latin American countries.

THE AMERICAS

Mexico

Official ceremony of opening of the Los Azufres II project

Luis Gutiérrez Negrín, CFE, Mexico

On July 26th, 2006, the Mexican President, Vicente Fox, officially commissioned the power units of the Los Azufres II project at the geothermal field of the same name in the State of Michoacán, located in central Mexico. President Fox



President Fox and the Mexican Secretary of Energy unveil a commemorative plate.

was accompanied by the Mexican Secretary of Energy, the General Director of the Comisión Federal de Electricidad (CFE, the governmental utility in charge of production and commercialization of electricity), the Michoacán Governor and municipal authorities. It was the first time that President Fox has visited a geothermal field in his final six years of office, and reflects the increasing relevance that renewables, and particularly geothermics, are getting in the diversification of energy sources in Mexico.

Los Azufres II is composed of four 25 MWe condensing units (100 MWe in total) with the numbers U-13, U-14, U-15 and U-16. They consume around 7.5 tons of steam per hour (t/h) per MW, and each has a single flow condensing turbine with three impulse stages and four reaction stages. The turbines work at an inlet pressure of 8 bars absolute [bar(a)] and spin at 3600 revolutions per minute (rpm). Each unit also has a stainless steel direct-contact condenser working at a pressure of 0.12 bar(a), and a counter-flow cooling tower. The electric generator is of a synchronous type, air-cooled, and electric output of 13.8 kV that is elevated to 115 kV by an electric transformer located in an adjacent substation. The units are controlled by means of a distributed control system, control of all the units being possible from U-13 should it be necessary.

The units were constructed by Alstom, who was the winner of an international bid. They are operated by personnel of the CFE, who also operate and run the geothermal field and provide the steam. With these units in operation, Los Azufres has reached 188 MWe of geothermal electric capacity, becoming the biggest geothermal field of volcanic type in Latin America.

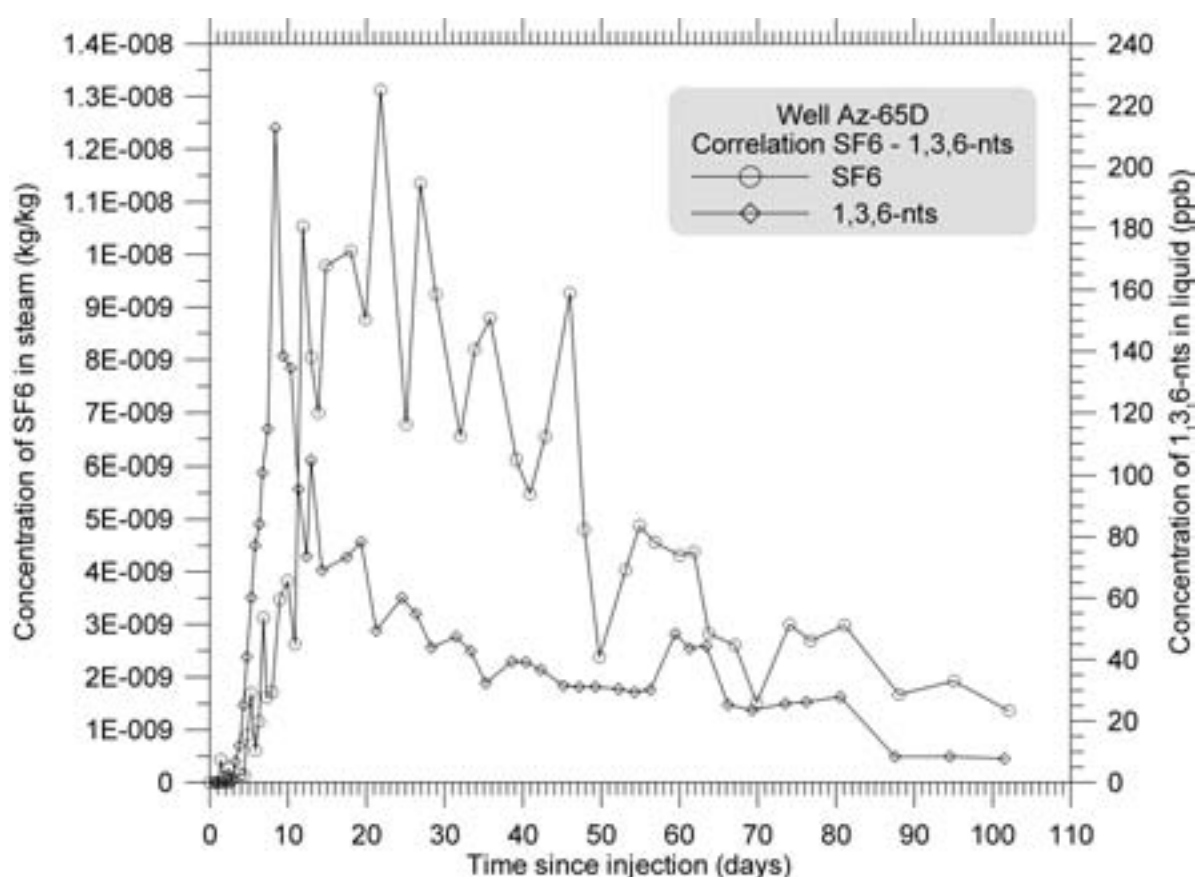
Two-phase tracer testing at the Los Azufres geothermal field

Eduardo R. Iglesias(1) , Magaly Flores Armenta(2) , José Luis Quijano León(2) , Marco A. Torres Rodríguez(2) and Rodolfo J. Torres(1)

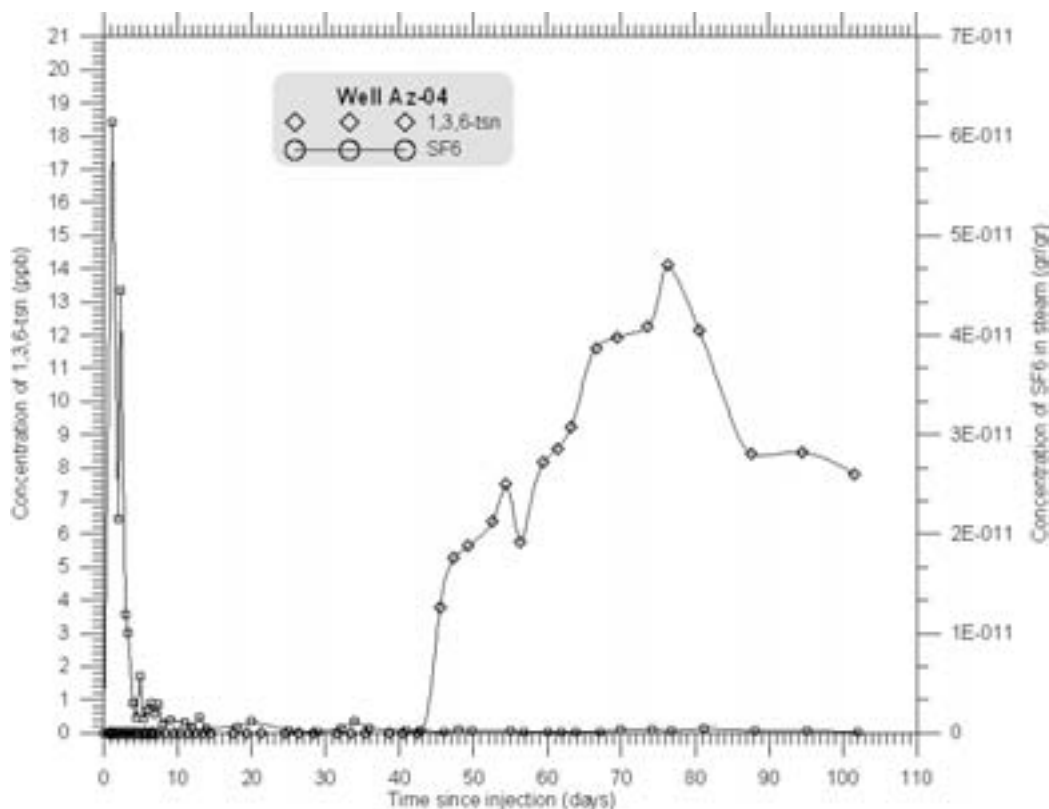
(1)Instituto de Investigaciones Eléctricas; (2)Comisión Federal de Electricidad, México.

There are few published results on simultaneous two-phase tracer testing in geothermal fields. Here we summarize some interesting recent results obtained at the Los Azufres, Mexico geothermal field.

There were six production wells included in the test. Three of them produce water and steam. The rest produce only steam.



We injected simultaneously two different tracers, one for the liquid phase (1,3,6 naphthalene trisulfonate [1,3,6-nts]), and one for the gas phase (sulfur hexafluoride [SF₆]). The former is highly soluble in water and essentially remains in the liquid phase under prevailing reservoir conditions. The latter is a gas with low solubility, similar to that of nitrogen; therefore, when in solution, it migrates rapidly to the gas phase as soon as two-phase conditions occur.



Steam and water samples were collected from the wells. We recorded SF₆ returns in all six wells. The liquid-phase tracer showed up in the three water-producing wells. The figures present the return curves of both tracers, for wells Az-65D and Az-04. We interpret the peaks in these curves as reflecting the fractured nature of this reservoir, which is hosted in a volcanic setting. Note that both tracers arrived in Az-65D essentially together, revealing that the injected fluid arrives as a liquid to Az-65D, and that boiling occurs at or near this well. However, in Az-04 SF₆ arrived much earlier than 1,3,6-nts. This shows that at least part of the liquid injectate boils and evolves gaseous SF₆ relatively soon after its injection. The gaseous SF₆ then traveled rapidly to Az-04, due to the superior mobility of the gas phase. In well Az-28, where both tracers were also recorded, we found results similar to those of Az-04 (not shown due to space restrictions).

The arrival velocities of both tracers differed by one to two orders of magnitude (see table). The difference seems to arise from thermodynamic conditions existing in the pathways conducting the flow: whenever two-phase conditions develop in them, essentially all the SF₆ in solution goes into the gas phase, and the higher mobility of the gas phase results in higher velocities for the gas tracer. Of course, relative permeability effects should influence the velocities of both phases in two-phase pathways.

The present results demonstrate some useful possibilities offered by simultaneous two-phase tracer testing, for detailed interpretation of phenomena occurring during injection in geothermal reservoirs.

(*)The quoted arrival velocities of SF₆ underestimate the true velocities, because this tracer arrived in the wells before the first steam samples were taken.

Well	Distance to injector	SF ₆	1,3,6-nts
	(m)	V _{arriv} (*) (m/hr)	V _{arriv} (m/hr)
Az-65D	793.45	29.78	10.14
Az-04	1,430.59	51.61	1.31
Az-41	1,577.58	55.24	-
Az-30	1,696.94	60.95	-
Az-28	1,965.20	74.44	0.44
Az-66D	1,966.48	75.17	-

ASIA/PACIFIC RIM

“Full Steam Ahead” at PNOC- EDC’s 27th Geothermal Conference

Jem Austria, PNOC-EDC

PNOC Energy Development Corporation (PNOC-EDC) held its 27th Annual Geothermal Conference on March 8-9, 2006 at the Hotel InterContinental Manila, Makati City. The theme of the conference, “Full Steam Ahead! Towards Geothermal Excellence and Energy Partnerships” marks PNOC-EDC’s 30 years of successful partnership with the government, industry, financial institutions, academia, and the international geothermal community. PNOC-EDC President and CEO Paul A. Aquino cited in his opening remarks the relevance of the conference theme to the company’s globalization thrust.

The conference was honored by the presence of PNOC-EDC Chairman Eduardo V. Mañalac, Department of Energy (DOE) Undersecretary Guillermo R. Balce, and California Energy (CalEn) President Joseph Sullivan. Chairman Mañalac, in his welcome address, stressed the relevance of strengthening the existing Build-Operate-Transfer (BOT) partnerships and the need to establish new ones to sustain PNOC-EDC’s gains for the past 30 years. The message of the Guest of Honor, DOE Secretary Raphael M. Lotilla, was read by Undersecretary Balce. The Secretary’s message emphasized the important role of geothermal in the Philippine power supply mix with the proposed installation of an additional 1,200 MWe of generating capacity on top of the existing 1,931 MWe capacity in order to reach 3,131 MWe by 2013 as provided under the Renewable Energy Policy Framework (REPF). Moreover, the impact of geothermal was highlighted through its contribution of 10,282 gigawatt-hour (GWh) or 18.4% to the power supply mix, displacing about 8.8 million tons-of-oil equivalent (MTOE). CalEn’s President Sullivan, in his keynote address, conveyed his company’s appreciation of being PNOC-EDC’s energy partner in the Leyte Geothermal Production Field’s Upper Mahiao Power Plant BOT partnership. Sullivan expressed CalEn’s interest to join PNOC-EDC in other future energy ventures.

The theme, Energy Partnerships, was highlighted by an audio visual presentation celebrating the first foray of PNOC-EDC into the BOT scheme and impending power plant operations and management with CalEn’s turn-over of the Upper Mahiao power plant in June 2006. Entitled “Upper Mahiao Power Plant: Ten years of successful BOT operations”, it also marked PNOC-EDC’s entry as a turnkey contractor of power plants and involvement in engineering, procurement, and construction (EPC) projects.

Thirty two (32) technical papers from PNOC-EDC and its energy partners were presented in the seven technical sessions of the conference. Of the 32 papers, twenty six (26) were written by the Geoservices, Geosciences, Reservoir Engineering, Environmental Management, Well Engineering, and Corporate Planning Departments of PNOC-EDC while two (2) were co-authored by PNOC-EDC with The World Bank and Veltrup Technik Philippines, Inc. Energy partners DOE, Mines and Geosciences Bureau, University of Iceland, Bicol University, Unocal Philippines, Inc., and Ormat contributed separate technical papers for a total of four (4) guest papers. A Special Session on Energy Partnerships emphasized the importance of BOT partnership with the private sector.

The gathering of many distinguished scientists, experts and policy makers during the 27th Annual PNOC-EDC Geothermal Conference manifests PNOC-EDC’s strong desire to continuously explore this indigenous energy resource and share its benefits with humanity.

NGAP holds 4th General Assembly Meeting, elects new Board

The National Geothermal Association of the Philippines (NGAP) held its 4th General Assembly Meeting on March 7, 2006 at PNOC-EDC’s Executive Lounge, Fort Bonifacio, Taguig City. The annual event served as an opportunity for the

outgoing Board of Directors to present the organization's accomplishments to the general membership for the period 2003-2006.

Former Energy Minister Geronimo Z. Velasco keynoted the event and shared his experiences as a key player in the Philippine government's pioneering efforts to develop indigenous energy including geothermal. He emphasized the importance of continuing these initiatives to further the use of geothermal and other renewable energy resources to contribute to the country's economic development.

The General Assembly also coincided with the election of NGAP's new Board of Directors (BoD) for the term 2006-2009. NGAP's officers and chairs of the various working committees were also selected among the BoD. The new officers and directors include: Glenn U. Golla, President; Lauro Bayrante, Vice President; Sylvia Ramos, Secretary; Sabino Santos, Treasurer; Roman Sta. Maria, Auditor; Edgar Sevilla, External Relations Officer; Guillermo Balce, Director; Restituto Taganas, Director; and Alfred Protacio, Director.

NGAP has evolved from its modest beginnings in 2003 to a robust organization with an active membership base of over 200 from among the key players of the Philippine geothermal industry and academia.

The NGAP champions and actively advocates the development of geothermal energy as a clean, viable, renewable and indigenous energy source. It has hosted technical lectures and scientific forums on fluid inclusion and reservoir engineering in Manila to contribute to the technical enhancement of its members. It has also conducted road shows at the Bicol University and Negros Oriental State University, state universities adjacent to the Tiwi and Bac-man geothermal operations respectively, as part of its information and education program to increase public awareness of renewable energy and support its membership campaign. The NGAP likewise advocates the promotion of government policies and reforms affecting geothermal operations, and intends to continue with the road shows in other geothermal areas in 2006.

First BOT Power Plant turned over to PNOC-EDC

R.R. Villa, Jr. and E.H. Alcober

The 130-MWe Upper Mahiao Power Plant, the biggest binary power plant in the world using the Ormat-designed Geothermal Combined Cycle Unit (GCCU) technology, was officially turned over to PNOC Energy Development Corporation (PNOC-EDC) by California Energy International, Ltd. in historic ceremonies on June 25 and 26, 2006. Upper Mahiao is the first geothermal power plant in the country built under the Build-Operate-Transfer (BOT) law that made possible its financing and construction. The plant's 10-year BOT arrangement with PNOC-EDC was officially concluded last June 25, 2006, and its ownership is now transferred to PNOC-EDC under the BOT Law. This event marks a milestone for PNOC-EDC because it is the first time that the company will venture into power plant operation and maintenance.

The construction of the Upper Mahiao power plant was undertaken by Ormat Energy, Inc. in August 1994, made possible by Republic Act No. 7718, also known as the expanded Build-Operate-Transfer Law of 1993. The law was used by then-President Fidel V. Ramos to spur infrastructure development. It proved effective in solving the country's power crisis of 1992-1994 as more independent power producers invested in power generation. This fast-tracked the development of geothermal power plants in the Leyte resource. Upper Mahiao is one of the several BOT power plants currently operating in PNOC-EDC's Tongonan steam field, for a total installed capacity of 703 megawatts of electricity.

Prior to the plant turn-over, PNOC-EDC was mainly involved in field exploration and steamfield development and operation, with its core business being geothermal steam production and steam sales to the National Power Corporation (NPC) plants. Having its own power plant, PNOC-EDC will not only sell steam to NPC, but also market its own energy generation to TransCo. Although PNOC-EDC has been selling energy to NPC/TransCo since 1996, all these were produced by BOT partners California Energy, Ormat and Oxbow-Marubeni. The turnover of Upper Mahiao highlights the country's experience with the BOT formula. More plants in Leyte and Mindanao are due to be transferred to PNOC-EDC ownership in the coming years.

OCEANIA

New Zealand

Govt to help fund Taupo Energy Technology Centre

Government funding has been approved, subject to conditions, to help the establishment of the New Zealand Clean Energy Centre in Taupo, Economic Development Minister Trevor Mallard and Taupo MP Mark Burton announced today.

“The New Zealand Clean Energy Centre will be a national centre for the commercialisation and application of clean energy research and technology, with the aim of increasing the direct use of clean geothermal and bio-energy resources in new and existing businesses,” Trevor Mallard said.

“I’m pleased the government has been able to support this Major Regional Initiative which is a joint project between Lake Taupo Development Company, the region’s economic development agency, the local council and industry groups.

“The Clean Energy Centre aims to focus on innovation, business development and incubation of energy-related businesses and provide technical assistance to increase the uptake of renewable energy opportunities in the region and nationally. The government will provide \$2 million to the initiative on condition that the centre secures \$2 million in funding from the energy industry by the end of this year,” Trevor Mallard said.

Mark Burton said the proposal made use of the region’s natural resources and existing expertise in clean energy technology.

“This will help the Taupo economy to further diversify beyond forestry, farming, and tourism, and the centre also aims to add value to existing industries.

“There are significant geothermal resources in the Taupo region. There is also good geothermal and biomass capability that includes energy companies, energy users, science and research capability, and technological consultancies.

“Aquaculture, floriculture, greenhouses, agricultural drying, bathing, space heating, and tourism businesses are already using geothermal and bio-energy sources. However, there is significant opportunity for more to do so,” Mark Burton said.

The government funding, from New Zealand Trade and Enterprise’s Regional Partnership Programme, will be provided in three stages over three years to help establish governance arrangements for the centre, construct a building, and implement commercialisation programmes.

Contact: Astrid Smeele (press secretary to Trevor Mallard) 04 4719080 or 0274 664438.

Email: astrid.smeele@parliament.govt.nz

Lake Taupo Development Company welcomes major government funding support for Energy Technology Centre

Press release -NZCEC

The government will provide \$2 million to establish a national centre for sustainable energy research and technology in Taupo, Lake Taupo Development Company CEO Barry Delany welcomed today.

“New Zealand’s future is highly dependent on energy security,” Delany said. “In particular we must find innovative and sustainable ways to use our natural energy resources to power industry and transport without further threat to our pristine environment. The New Zealand Clean Energy Centre will lead the way towards this goal.”

“The project is important for both the local and national economy and will provide substantial job opportunities for local people.”

The funding, together with that awarded last week to the Taupo Motor Sport Park, was obtained after extensive representations by the Lake Taupo Development Company. Whilst still conditional on finding significant additional funding from non-government sources, the Company is confident this condition will be met and the establishment of the centre will proceed without delay.

Chief Executive Barry Delany said “This exciting concept has come directly from the District’s economic development strategy. There are significant geothermal and biomass resources in the district together with the technical capability of energy companies, science and research organisations and energy consultants. Aquaculture, floriculture, greenhouses, timber treatment, space heating and tourism businesses are already using geothermal and bioenergy sources. There is considerable opportunity to enlarge the scope and efficiency of these kinds of processes.”

“The NZCEC will not only be a huge benefit to the district by creating new, locally-based business opportunities and jobs, but will help New Zealand as a whole to work towards a sustainable, environmentally-friendly energy future.”, Delany went on to say.

Lake Taupo Development Company is already working on a number of energy-related projects which will be transferred to the centre as soon as it is established. These projects include a feasibility study on a geothermal district heating system for Taupo Hospital, funded by Contact Energy and the Energy Efficiency Conservation Authority, and an energy farming and biorefinery project in partnership with Auckland-based Genesis Research and Development. Another clean energy project for the centre, funded by a major industry organisation, will be announced shortly.

The Geothermal Institute

Jane Brotheridge, Mike O’Sullivan and Stuart Simmons

After a four-year hiatus, the world-renowned Geothermal Institute at the University of Auckland, New Zealand, will be running geothermal technology courses once again.

The new course will run for one semester only, commencing in July 2007. As with the previous diploma course it will cater to both geothermal scientists and engineers with the two disciplines diverging into separate papers mid-way through the course. There will also be a project that all students will work on and present.

From 1979 to 2002, the Geothermal Institute ran a 9-month Diploma course at post-graduate level for scientists and engineers. Funding for the course was withdrawn in 2003, but the Geothermal Institute under the auspices of the University of Auckland have worked hard to find alternative funding sources and re-introduce this popular and well-regarded course.

Additionally, the long tradition of geothermal training of overseas students is being repackaged into a series of short courses (4-8 weeks) for industry that provide upskilling to engineers and scientists. Short-course topics include geothermal exploration, reservoir engineering and monitoring, power stations, steam-field layout and design, and environmental aspects. These can be tailored to the needs of individual organisations.

Geothermal power development continues to grow in New Zealand with the new 39 MWe extension of the Mokai Power Station being the most recent addition (officially opened in Feb 2006). This brings the total installed capacity to 450 MWe and there is possibly another 400 MWe in the planning. Currently geothermal energy produces 7% of NZ electricity supply. With this growth comes the need for more scientists and engineers specifically trained in geothermal technology, and this need is reflected around the globe. The Geothermal Institute regularly receives enquires as to when the courses will be running again.

Look in our web site for more information: <http://www.science.auckland.ac.nz/uoa/science/about/research/gei/gei.cfm>

UPCOMING EVENTS

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

Sustainable Energy & Energy Efficiency Expo 2006, London, UK, October 10-12, 2006. Contact: www.energy-expo.info

28th New Zealand Geothermal Workshop and NZ Geothermal Association Seminar, November 15-17 2006, Auckland University, Auckland, New Zealand. Contact: Jane Brotheridge: j.brotheridge@auckland.ac.nz

1st African Geothermal Conference (ARGeoC1). Addis Ababa, Ethiopia, 23 Nov. – 01 Dec. 2006. www.bgr.de/geotherm/ArGeoC1/index.html

AGU Fall Meeting – Geothermal Reservoir System session. San Francisco, California, USA, 11-15 Dec. 2006. www.agu.org/meetings/fm06

3rd BSME-ASME International Conference on Thermal Engineering. Dhaka, Bangladesh, December 20-22, 2006. Contact: www.iutoic-dhaka.edu/bsme_asme_ict2006/index.html

4th International Congress on Numerical Methods in Engineering and Applied Sciences, Morelia, Mexico, January 17-19, 2007. Contact: Dr. César Suárez : msuarez@zeus.umich.mx, <http://congress.cimne.upc.es/morelia07>

37th Stanford Workshop on Geothermal Reservoir Engineering, Stanford, California, USA, January 29-31 2007. <http://ekofisk.stanford.edu/geoth/workshop2007.htm>

28th PNOC-EDC Geothermal Conference, Makati City, Philippines, March 7-8 2007. Contact: Mr. Ernie Gagto: geothermalcon@energy.com.ph

Enertec 2007, Leipzig, Germany, March 13-16, 2007. Contact: www.eventseye.com/fairs/trade_fair_event_711.html

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 consists 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.

Send IGA News contributions to:

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APPLICATION FOR MEMBERSHIP



Please complete the following form and return it with payment to:

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