



UNITED NATIONS  
UNIVERSITY

GEOTHERMAL TRAINING PROGRAMME



LaGeo S.A. de C.V.

## FIRST GEOTHERMAL DIPLOMA COURSE IN THE ACADEMIC SYSTEM IN EL SALVADOR AND CENTRAL AMERICA

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### ABSTRACT

The technological, social and economic development in the world requires that the energy services are guaranteed in a context of sustainable development, efforts toward the search for alternative energy supply solutions make the training of highly skilled professionals- in conversion, transmission, conservation and efficient use of the geothermal energy- a priority. For this matter, the Italian Cooperation has sponsored LaGeo in a cultural-scientific partnership with the University of El Salvador (UES) and the University of Palermo of Italy, to begin a Geothermal Diploma Course, which includes Central American students. This Diploma Course could be the previous step to establish a Regional Geothermal Training Center, and extend this project to Latin American and Caribbean countries.

### 1. INTRODUCTION

The energy supply in El Salvador is provided by three main sources: geothermal, hydraulic and fossil fuels. Geothermal energy provides 25%, which is considered the core of the system. Hydroelectric energy, despite its seasonal behavior, supplies 35%. The other 40% of energy is produced by burning fossil fuels. This last type of energy was originally used to supply demand peaks. Now it has become the base load, which entails a high dependency and whose costs vary depending on external factors and the international market's behavior.

The exploitation of geothermal resources to generate energy is highly important in countries where this resource is available. El Salvador is a successful example of how this exploitation has contributed to reduce the greenhouse effects due to lower emissions of carbon dioxide in the atmosphere emitted by fossil fuels.

In Central America, energy demand experiences a 6% annual growth. Efforts toward the search for alternative energy supply solutions make the training of highly skilled professionals- in conversion, transmission, conservation and efficient use of the geothermal energy- a priority. For this matter, the Italian Cooperation has sponsored La Geo in a cultural-scientific partnership with the University of El Salvador (UES), the National Commission of Science and Technology (CONACYT) and the University of Palermo of Italy, to begin a Geothermal Diploma Course. Its objective is to develop the first Diploma Course in Geothermal Energy in El Salvador, which includes Central American students. The goal is to make the geothermal energy more competitive, reducing costs and increasing production performance, through a training program aimed to students with high level of

understanding in science, to promote and/or strengthen key areas such as geothermal development in the region.

The project offers the opportunity to train young professionals, scientist and engineers in the geothermal research field through theoretical, laboratory practices and direct knowledge of the phenomena in the study of the exploitation fields in Ahuachapán and Berlin- operated by La Geo. This could be the basis of knowledge, to propose a plan of continuous development, with positive effects in terms of skills and employment.

The Diploma Course has been structured and developed according to the specialty and requirements obtained from the different areas and the participants needs. The Diploma syllabus contains the topics for each month, as shown below:

1. Geothermal energy general concepts;
2. Geothermal exploration;
3. Geochemistry of fluids;
4. Geothermal conceptual models and resource evaluation;
5. Reservoir engineering;
6. Environmental aspects in geothermal projects;
7. Geothermal power plants;
8. Field and laboratory practical work.

The announcement calling students to take the Geothermal Diploma Course was made through the main media news as shown in Figure 1.

Besides attending classes, students had additional support through a website where students could complement any other information needed to help with their classes through the virtual library (Figure 2).



**UNIVERSIDAD DE EL SALVADOR  
FACULTAD DE INGENIERIA Y ARQUITECTURA**

CON LA ASISTENCIA DE LA COOPERACION ITALIANA, EL CONSEJO NACIONAL DE INVESTIGACION – INSTITUTO DE GEOCIENCIAS Y GEORECURSOS (CNR-IGG) DE PISA ITALIA, LAGEO, EL CONACYT Y LA UNIVERSIDAD DE PALERMO, ITALIA, EN EL MARCO DEL PROYECTO “CREACION DE UNA ACTIVIDAD DE FORMACION EN GEOTERMIA EN EL SISTEMA ACADEMICO SALVADOREÑO”.

LA UNIDAD DEL SISTEMA DE POSGRADOS DE LA FACULTAD DE INGENIERÍA Y ARQUITECTURA CONVOCA A LOS INTERESADOS A PARTICIPAR EN EL:

**DIPLOMADO DE ESPECIALIZACION EN GEOTERMIA**

**OBJETIVO GENERAL**

Elevar la capacidad analítica, científica y tecnológica de los participantes, mediante la formación en geotermia, para fortalecer el manejo y uso eficiente y sostenible de la geotermia en armonía con el medio ambiente.

**TIEMPO DE DURACION**

El Diplomado tiene una duración de ocho meses. Está estructurado en 8 módulos de 60 horas clase. Se impartirá de lunes a viernes de 5:30 p.m. a 8:30 p.m. y sábados de 8:00 a.m. a 12:00 m.

**INTERESADOS PRESENTARSE EN**

Unidad del Sistema de Posgrados de la Facultad de Ingeniería y Arquitectura, 2ª planta del Edificio Administrativo. Para mayor información: Teléfono: 2235-0235, Correo electrónico: [uposgrados@fia.ues.edu.sv](mailto:uposgrados@fia.ues.edu.sv)  
Compra y retiro de solicitudes: del 22 al 25 de marzo de 2010.  
Recepción de solicitudes: del 22 al 26 de marzo de 2010.  
Entrevistas a los aspirantes del 6 al 7 de abril de 2010.  
Publicación de los aspirantes seleccionados el 8 de abril de 2010.  
Pago de matrícula y primera mensualidad el 8 al 12 de abril de 2010.

**INVERSION**

Solicitud de Ingreso 6.00 USD, Matrícula 60.00 USD y 8 mensualidades de 125.00 USD.  
Se otorgarán 20 becas a aspirantes nacionales y 4 becas a aspirantes regionales (2 Nicaragua y 2 Guatemala).

**INICIO DE CLASES**

Lunes 12 de abril de 2010.

“HACIA LA LIBERTAD POR LA CULTURA”

CIUDAD UNIVERSITARIA, SAN SALVADOR, 21 DE MARZO DE 2010



Università di Palermo  
Italia

FIGURE 1: Newspaper publication on March 21, 2010



FIGURE 2: Website of the Geothermal Diploma Course, at the virtual library of the UES

## 2. DESCRIPTION OF THE PROJECT

This project focused on the development of a Geothermal Diploma Course to train in different geothermal areas and performing activities for technical and academic research for the staff and students of the University of El Salvador (UES), and other public or private institutions. The project has been carried out with the support of the Italian Cooperation, involving the participation of lecturers from the Geosciences and Earth Resources of the National Research Council of Italy Institute (IGG-CNR), University of El Salvador (UES) - San Salvador, LaGeo - Santa Tecla, CONACYT (Scientific and Technical Research Centre)- San Salvador, and the University of Palermo (UNIPA) - Italy. The technical support through the exchange of educational experts in some specific academic subjects, as well as economic aid for the acquisition of laboratory equipment, and specialized books are required for this specialized training. All of these resources were provided to the project with the support of this sponsorship.

In order to continue with this specialized training, the University of El Salvador (UES), should run a course in "Geosciences, Earth Resources and Geothermal Engineering" in the future. The main objectives are to achieve and create technical knowledge based on a regional process of formation of future researchers and technicians of the Central American countries, where geothermal natural resources are available. They can actively participate in programs of integrated management of exploitation of renewable resources, to be able to oversee all the issues and being recognized as a reference for other companies and/or operators of the region's energy sector.

It is very important if the Geothermal Diploma Course could be the first step to establish a formal technical training activity in the geothermal area, managed locally with the appropriate partnerships- such as the Italian Cooperation has done so far. The current geothermal training program is the first step to create a Regional Geothermal Training Center in El Salvador, to prepare students from Latin America and the Caribbean, taking the existing contacts mainly with the University of El Salvador and LaGeo, leading the creation of training and specialization courses in El Salvador. It is very important that the government's role, supporting this project through the implementation of national energy policies and strategies to promote renewable sources of energy.

The evolution of the geothermal resources exploitation has entered its third generation of geothermic, which uses electricity to produce lower temperatures of traditional geothermal energy. Other aims of the course will be dedicated to the environmental aspects of geothermal energy and technical advice to international science.

The main objectives achieved in this project, can be summarized as follows:

- a) Transfer techniques and scientific know-how in order to contribute to the study of natural geothermal resources in El Salvador's geological areas;
- b) Developing a suitable plan for management of the geothermal resources in the future in Central America;
- c) Contribute to setup an specific sector within academic and research institutions responsible for management and exploitation of natural resources, having it as an output to increase manpower, and particularly technical skilled personnel;
- d) Create a closer link between institutions, academic community, and the local population where geothermal activities have been carried on (Ahuachapán, Berlin and others).

As an expected consequence of these objectives, the project will be helpful in promoting and improving Academic and Research Institutions as far as the energy field of investigation is concerned. Priority will be given to El Salvador's Institutions which are involved in the investigation of natural resources and their potentiality; consequently it will promote specialized training with theoretical and practical knowledge to trainees in the geothermal science.

### **3. HUMAN RESOURCES FOR THE GEOTHERMAL INDUSTRY IN CENTRAL AMERICA**

The current world energy crisis and the availability of resources in the region, promote the need to begin and strengthen the participation of new specialists in geothermal resources within the academic-scientific and technical program. It aims to develop skills in young professionals and technicians, making the diploma course sustainable in the next future.

Training skilled young professionals is the high importance to the existing industries or public management of resources, letting them identify those which are the basic steps needed to focus on research into geothermal energy, through specific geoscientist and engineering activities for the detection of potential exploitable resources.

The courses related to the study of the geothermal systems at high, medium and low enthalpy and techniques available for the management and exploitation of both traditional methods with EGS (Enhanced Geothermal Systems, where certain features of the system are artificially enhanced) are becoming essential to ensure steady development of the resources available. The previous Italian experience, both operational and basic research in the geothermal field, supports the extension of a program, helping the development and application of advanced technologies for extracting heat from rocks deep systems at high temperature. The establishment of a Faculty of Geosciences and Earth Resources, provided by the University of El Salvador, would ensure a future high-level training of researchers and practitioners in the field. Doing is will allow the UES to become an international point of reference.

This diploma course was planned to last 8 months, besides one month of field practices. The Diploma began in April and ended by December 2010 with the Geothermal Congress. All the students presented the practical work results related to different disciplines like Geochemistry, Geophysics, Geology, Power Plants and Environmental aspects in geothermal projects.

Up to date, 39 students and professionals from different academic college degrees (Chemical, Electrical, Mechanical and Civil Engineers, Chemists and Mathematicians) are trained in the

Geothermal Diploma Course at the Faculty of Engineering and Architecture of the University of El Salvador. All the students, including 3 from Nicaragua were granted with a fellowship under the Italian Cooperation sponsorship.

The reduced training opportunities restrict young professional candidates the access to a specialized training around the world, then developing countries the high course costs and living expenses cannot be afforded by companies or governments with their own financial resources.

Due to these limitations, it is very important to establish a Regional Geothermal Training Center and this Diploma Course, could be the beginning for this project extending the training in the next future to Latin America and Caribbean geoscientists and engineers, therefore, it is very important to find out the financial supporting institutions to make sustainable the Diploma Course.

## REFERENCES

UES, 2010: *Diplomado de especialización en geotermia 2010*. Facultad de Ingeniería y Arquitectura, Universidad de El Salvador.

Website: <http://mail.fia.ues.edu.sv/moodle/course/view.php?id=71>.

Website: [http://scienzaonline.com/index.php?option=com\\_content&view=article&id=294:progetto-per-la-creazione-di-una-attivita-di-formazione-in-geotermia-nel-sistema-accademico-salvadoregno&catid=41:geologia&Itemid=73](http://scienzaonline.com/index.php?option=com_content&view=article&id=294:progetto-per-la-creazione-di-una-attivita-di-formazione-in-geotermia-nel-sistema-accademico-salvadoregno&catid=41:geologia&Itemid=73).