



SHORT COURSE IV ON GEOTHERMAL DEVELOPMENT AND GEOTHERMAL WELLS

Organized by UNU-GTP and LaGeo
in El Salvador, 11th – 17th March, 2012

SUNDAY, 11 MARCH

Participants and trainers arrive in El Salvador and register into the Hilton Hotel.

18:30-22:00 *Opening dinner*

MONDAY, 12 MARCH

08:30-09:00 **Registration**

09:00-09:20 **Opening ceremony – Lic. Julio Valdivieso, President LaGeo**

09:20-09:30 **Aim of the short course – organization and practical matters**

Lúdvík S. Georgsson, UNU-GTP and Evelyn de Velis, LaGeo

Geothermal energy in the world – Chairman: Manuel M. Monterrosa, LaGeo

09:30-10:15 **Geothermal energy in the world with some emphasis on the status in Latin America and capacity building**

Ingvar Birgir Fridleifsson and Lúdvík S. Georgsson, UNU-GTP

10:15-11:00 **Sustainable geothermal utilization**

Gudni Axelsson, ÍSOR

11:00-11:30 *Coffee break*

11:30-12:15 **Kenya's plans for geothermal development – a giant step forward for geothermal**

Paul K. Ngugi, GDC, Kenya

12:15-13:00 **Current status of geothermal resources development in Central America**

Francisco E. Montalvo, LaGeo

13:00-14:00 *Lunch*

**Status of geothermal development in Latin America and the Caribbean Islands –
Chairman: Lúdvík S. Georgsson, UNU-GTP**

14:00-14:30 **Geothermal activity and development in Mexico – keeping the production going**

Magaly Flores-Armenta, CFE

14:30-15:00 **Production and injection at Miravalles and Las Pailas geothermal fields,
Costa Rica**

Paul Moya, Federico Nietzen and Sergio Castro, ICE

15:00-15:30 **Geothermal activity and development in El Salvador – producing and developing**

Julio Guidos, LaGeo

15:30-16:00 *Coffee break*

16:00-16:20 **Geothermal activity and development in Nicaragua – producing and developing**

Francisco Ruiz, MEM

16:20-16:40 **Status update of geothermal development in Guatemala**

Alberto Francisco Asturias, ENEL

16:40-17:00 **Geothermal development progress in the Eastern Caribbean Islands**

Anelda Maynard-Date, NEVLEC

17:00-17:30 **Geothermal activity and development in S-America: A short overview**

Ingimar G. Haraldsson, UNU-GTP

17:30-18:00 **General discussion on status and future development of geothermal in Lat. America**

TUESDAY, 13 MARCH

What does geothermal cost, and how can it be financed? – Chairman: Gudni Axelsson, ÍSOR

- 09:00-09:45 **The Hellisheidi geothermal project -Financial aspects of geothermal development**
Einar Gunnlaugsson, Reykjavik Energy
- 09:45-10:15 **What does geothermal cost? – the Kenya experience**
Paul K. Ngugi, GDC, Kenya
- 10:15-10:45 **Financing the Kenyan geothermal vision**
Paul K. Ngugi, GDC, Kenya
- 10:45-11:15 *Coffee break*
- 11:15-12:00 **IDB – support for geothermal development and projects in Latin America**
Toshitaka Takeuchi, IDB
- 12:00-12:45 **World Bank – support for geothermal development in Latin America & the Caribbean Islands**
Xiaoping Wang and Alfredo Idiarte, World Bank
- 12:45-14:00 *Lunch*

Session continued – Chairman: Sverrir Thórhallsson, ÍSOR

- 14:00-14:30 **Geothermal project funding through the Clean Development Mechanism**
Ingimar G. Haraldsson, UNU-GTP
- 14:30-15:00 **Geothermal development, climate change and CDM benefits in El Salvador**
Luis A. Franco, LaGeo
- 15:00-15:30 **Legal and regulatory framework – barrier or motivation for geothermal development?**
Ingimar G. Haraldsson, UNU-GTP
- 15:30-16:00 *Coffee break*
- 16:00-16:30 **Master plan for geothermal and hydropower development in Iceland**
Sveinbjörn Björnsson, Orkustofnun, Benedikt Steingrímsson and Árni Ragnarsson, ÍSOR, Hákon Adalsteinsson, Nat. Power Corp. and Gudni Axelsson, ÍSOR
- 16:30-18:00 **Importance of governmental support, plans and incentives – discussion session**
Paul K. Ngugi, GDC, Gudni Axelsson, ÍSOR and Carlos Guzman, LaGeo

WEDNESDAY, 14 MARCH

Field trip to Ahuachapan geothermal field and power plant under the guidance of *Ana Silvia de Arevalo* and *Luz Barrios*, LaGeo.

THURSDAY, 15 MARCH

Geothermal wells: Types, maintenance, restoration and lifetime – Chairman: Luz Barrios, LaGeo

- 09:00-09:45 **Life cycle of geothermal wells – general experience**
Sverrir Thórhallsson, ÍSOR
- 09:45-10:15 **Life cycle of geothermal wells – experience in Mexico**
Jesús Guillermo Jaimes-Maldonado, Luis C.A. Gutiérrez-Negrín and Heber D. Díez León, CFE
- 10:15-11:00 **Planning large scale geothermal drilling in Kenya**
Paul K. Ngugi, GDC, Kenya

- 11:00-11:30 *Coffee break*
 11:30-12:00 **Geothermal drilling cost and drilling effectiveness**
 Sverrir Thórhallsson, ÍSOR and Björn M. Sveinbjörnsson
 12:00-12:30 **Geothermal drilling targets and well siting**
 Gudni Axelsson and Hjalti Franzson, ÍSOR
 12:30-13:00 **Directional wells**
 Sverrir Thórhallsson, ÍSOR, and Einar Gunnlaugsson, Reykjavik Energy
 13:00-14:00 *Lunch break*

Session continued – Chairman: Andelda Maynard-Date, NEVLEC

- 14:00-14:20 **Geothermal reinjection systems in El Salvador**
 Herbert Mayorga, LaGeo
 14:20-14:40 **Aerated drilling**
 Saúl A. Ramos, PSB
 14:40-15:00 **Workover operations in El Salvador**
 Jaime Arévalo, PSB
 15:00-15:30 **Slim wells for geothermal exploration**
 Sverrir Thórhallsson and Stefán S. Gunnsteinsson, ÍSOR
 15:30-16:00 *Coffee break*
 16:00-16:20 **Downhole videos from geothermal wells – some examples from Iceland**
 Gudni Axelsson and Sverrir Thórhallsson, ÍSOR
 16:20-18:00 **Practical session on well type selection, targeting and testing**
 Gudni Axelsson, ÍSOR, Sverrir Thórhallsson, ÍSOR and Paul Moya, ICE

FRIDAY, 16 MARCH

Stimulation of geothermal wells: Enhancement of permeability – other possibilities

Chairman: Einar Gunnlaugsson, Reykjavik Energy

- 09:00-09:30 **Role and management of geothermal reinjection**
 Gudni Axelsson, ÍSOR
 09:30-10:00 **Logging, testing and monitoring geothermal wells**
 Gudni Axelsson and Benedikt Steingrímsson, ÍSOR
 10:00-10:45 **Cleaning and stimulation of geothermal wells**
 Sverrir Thórhallsson, ÍSOR
 10:45-11:15 *Coffee break*
 11:15-12:00 **How much stimulation can we afford?**
 Magaly Flores-Armenta and Lilibeth Morales Alcalá, CFE
 12:00-12:30 **Acid stimulation of geothermal reservoirs**
 Luz Barrios, Emilio Guerra, Patricia Jacobo, and Herbert Mayorga, LaGeo
 12:30-13:00 **Increasing permeability in geothermal wells through hydro-fracturing for the Las Pailas and Borinquen geothermal fields, Costa Rica**
 Sergio Castro, ICE
Stimulating wells – the experience in the Momotombo geothermal field, Nicaragua
 Enrique A. Porras, Ormat Nicaragua (*only given as a paper*)
 13:00-14:00 *Lunch break*

Scaling and corrosion in geothermal wells and installations –

Chairman: Ingimar G. Haraldsson, ISOR

- 14:00-14:40 **Common problems faced in geothermal generation and how to deal with them**
 Sverrir Thórhallsson, ÍSOR

- 14:45-15:30 **Geochemical monitoring: Understanding and solving problems associated with geothermal fluid chemistry**
Eddy Sánchez-Rivera and Leonardo Solís-Salguero, ICE
- 15:30-16:00 **Scaling prediction modelling**
Einar Gunnlaugsson, Reykjavik Energy
- 16:00-16:30 *Coffee break*
- 16:30-18:00 **Practical session and group work on scaling prediction**
Einar Gunnlaugsson, Reykjavik Energy, Luz Barrios, LaGeo, and Eddy Sánchez-Rivera, ICE

SATURDAY, 17 MARCH

Session continued – Chairman: Magaly Flores-Armenta, CFE

- 09:00-09:30 **pH modifications for silica control in geothermal fluids**
Emilio Guerra and Patricia Jacobo, LaGeo
- 09:30-10:15 **Performance of calcium carbonate inhibition and neutralization systems for production wells at the Miravalles geothermal field**
Paul Moya and Federico Nietzen, ICE
- 10:15-10:45 **Calcite scaling in El Salvador and possible mitigation**
Patricia Jacobo and Emilio Guerra, LaGeo
- 10:45-11:15 *Coffee break*
- 11:15-11:45 **Iron meters for production wells at the Miravalles geothermal field**
Paul Moya and Rodrigo Mora, ICE
- 11:45-12:15 **Scaling in geothermal installations in Iceland**
Einar Gunnlaugsson, Reykjavik Energy
- 12:15-12:45 **Corrosion in geothermal wells and installations**
Sverrir Thórhallsson, ÍSOR
- 12:45-14:00 *Lunch*

Course review – Chairman: Ingimar G. Haraldsson, UNU-GTP

- 14:00-14:30 **Review** (Instructors and Trainees)
- 14:30-15:00 **Discussion and recommendations**
- 15:00-15:30 *Coffee break*

Conclusions and closing remarks – Chairman: Lúdvík S. Georgsson, UNU-GTP

- 15:30-16:00 **Summary of the discussion, conclusions and recommendations**
- 16:00-17:00 **Final closing ceremony**
- 17:00-17:30 *Course assessment and next steps in training courses for Central America Meeting and review by instructors*
- 19:00-21:00 *Closing cocktail at LaGeo*

SUNDAY, 18 MARCH

All guests depart from San Salvador for their home countries.