

Geothermal Training course

Pisa

8th - 11th October 2013

Location: Pisa, Italy

DRAFT Program

Oct. 8-9, 2013

Technical Courses

Oct.10, 2013

Market aspects, Legal, Environmental, Financial aspects

Oct.11, 2013

Site visit: Larderello Geothermal Field, ENEL power plants

Day 1, Oct.8, 2013

8:30 – 8.45 **Welcome and Introduction**

Philippe Dumas, European Geothermal Energy Council (EGEC)
Adele Manzella, National Research Council (CNR)

8.45 – 9.00 **Participants Introductory ice breaker**

5 facts to introduce yourself

Session I: Geothermal Exploration

Pierre Durst, Bureau de Recherches Géologiques et Minières (BRGM), France

Jan-Diederik van Wees, Organization for Applied Scientific Research (TNO), Netherlands

Adele Manzella, CNR IGG, Italy

Isabella Nardini, CNR-IGG, Italy

The session will provide an overview of geothermal exploration methodologies, describing a step-by-step procedure on how to locate a reservoir using different techniques. It will introduce different tools and approaches to investigate resources from regional, local and reservoir scales. Examples will be provided to various geo-environments depending on the geological context of the site: from sedimentary to volcanic to crystalline reservoirs, both for natural system and EGS perspectives.

9.00 –9.30 **What is geothermal energy: origin and relation with earth dynamics**

- Thermal phenomena and earth internal structures
- Plate tectonics and geothermal energy
- The different types of geothermal energy

9.30 – 10.30 **Resource assessment: targets and tools**

- An overview of targets
- Geophysical methods
- Geochemical methods

10.30 – 11.00 **Coffee Break**

11.00 – 13.00 **Resource assessment: targets and tools**

- Geological and hydrogeological assessment
- Remote sensing
- Stress field analysis for EGS
- Site screening: Best practice to localize a geothermal site
- Case Studies: Various examples from known geothermal systems will be described and discussed

13.00 – 14.30 **Lunch**

Session II: EGS Technology

Jan-Diederik van Wees, Organization for Applied Scientific Research (TNO), Netherlands

Pierre Durst, Bureau de Recherches Géologiques et Minières (BRGM), France

This session provides an insight into the process of hydraulic fracturing and induced seismicity in EGS projects. Basic concepts of geomechanics and hydraulic fracking, results of hydraulic stimulation and induced seismicity in EGS projects will be covered by lessons learned from the GEISER FP7 project.

14.30 – 16.00 Basic concepts

- Rock mechanics and tectonics
- Hydraulic stimulation : objectives, physical principles, and best practices from oil and gas

16.00 – 16.30 Coffee Break

16.30 – 17.30 Case studies

- Enhancing flow rates
- Induced seismicity
- Outlook
- The Soultz projects: toward the deep geothermal exploitation

17.30 – 18.00 Conclusion / Feedback

Day 2, Oct.9, 2013

Session III: Plant operation, energy supply and grid integration

Franz Heilemann, EnBW Energie Baden-Württemberg, Germany

Sören Reith, University of Stuttgart, Germany

The session provides a broad understanding of the grid integration of geothermal energy. Although electric power cables are the most obvious precondition for a grid connection, many other topics become important in this context. The session will therefore answer beside technical also regulatory and economical questions.

9.00– 10.30 Fundamentals of energy economics

- regulation and energy trade
- electricity grid
- demand for geothermal power

10.30–11.00 Coffee Break

11.00 – 12.30 Grid integration of geothermal power

- approach for the grid integration of an increasing share of renewable power generation
- process of grid integration
- costs of grid integration

12.00 – 12.30 Plant operation

- Demand for geothermal power
- Lessons learned

12.30 – 14.00 Lunch

Session IV: Flash steam & binary technology

Fabio Sabatelli, ENEL GreenPower, Italy

Paola Bombarda, Politecnico Milano, Italy

The session provides an overview of geothermal power plants with focus on flash and binary thermodynamic cycles, geothermal steam gathering system and mechanical equipment used in the power plant. The course will provide examples and highlight the special features of utilizing geothermal fluid for power generation and different design considerations compared to conventional steam plants.

14.00 – 15:30 Flash power plants, gathering systems, equipment, operation and maintenance

- Thermodynamic aspects and optimization of flash cycles
- Main features and issues of gathering systems, power plants and equipment used
- Operation and maintenance aspects

15.30 – 16.00 *Coffee Break*

16.00 – 17.30 Binary power plants: thermodynamic cycles and equipment

- Thermodynamic aspects and optimization of binary cycles
- Equipment used in binary power plants

17.30 – 18.00 Conclusion / Feedback

DRAFT

Day 3, Oct.10, 2013

Session V: Market aspects

Constantine Karytsas, Centre for Renewable Energy Sources and Saving (CRES), Greece

Dimitrios Mendrinou, Centre for Renewable Energy Sources and Saving (CRES), Greece

Geothermal resources of Europe can contribute to the EU targets of 20% less greenhouse gas emissions, 20% RES share and 20% more energy efficiency by 2020. The session provides an overview of the present status and future prospects of global geothermal electricity market niche.

9.00 – 9.45 International Geothermal Market overview

Market aspects, including:

- market size (turnover, capacities, energy yields)
- near term growth, quality of resources, technologies employed,
- competition, energy costs, market barriers and incentives.

Case studies of plants in operation will be presented.

- First EGS plant: HDR project Soultz
- Low temperature plant: Simbach-Braunau.

Session VI: Legal, environmental & financial aspects

Fausto Batini, Magma Energy

Florence Jaudin, Bureau de Recherches Géologiques et Minières (BRGM), France

Robert Kutschick, Gaßner, Groth, Siederer & Coll., Germany

Roberto Barontini, Scuola Superiore Sant'Anna, Italy

Francesco Rizzi, Scuola Superiore Sant'Anna, Italy

Isabella Nardini, CNR-IGG, Italy

Stringent demands of investors and banks require an accurate planning of geothermal power projects; more precisely of the technology and phases of the project and the expected financial inflow and outflow. Risk management specially focuses on drilling risks and evaluates the risks in terms of their probability and economic consequences and prospects of suitable insurance products in Europe. The development of geothermal electricity in Europe depends on national legislations, for investors it is important to know in advance about current legal barriers and law-related conflicts.

9.50– 10.50 Sustainable development of a geothermal project:

- from green field exploration to operation

10.50 – 11.20 Coffee Break

11.20 – 12.00 Risk insurance:

- risk management: drilling

- existing insurance concepts to cover the geological risk in Europe
- risk insurance scheme at European level

12.00 – 12.40 Regulatory barriers

- regulation of geothermal electricity through national legislation
- legal barriers and law-related conflicts

12.40 – 14.00 Lunch Break

14.00 – 15.30 Investment analysis: real option approach

15:30 – 16.00 Coffee Break

16.00 – 17.00 Investment analysis: real option approach

17:00 – 17.30 Environment issues

- overview of possible environmental impact
- environmental management procedures

Day 4, Oct.11, 2013

Site visit: Larderello Geothermal field, ENEL power plants.

8:00 Departure (by bus)

10:00 - 10:40 Visit to the Museum in Larderello

10:40 – 11:10 Coffee Break

Session VII: Drilling

Alessandro Lazzarotto, ENEL GreenPower, Italy

The session provides a survey of technical solutions and related costs for drilling and completion of geothermal production and reinjection wells.

11:15 – 12:00 Types of geothermal wells and appropriate casing schemes:

Basic requirements: flow rate and temperature and its implications on wellbore schemes
A selection of Case Studies

12:00 – 13:00 Drilling and completion of geothermal wells:

- Drilling technology
- Test and stimulation techniques, pumps
- Costs
- Well and completion design

13:00 – 13:45 Lunch

13:45 – 15:30 Visit to Power Plant

Roberto Parri, ENEL GreenPower, Italy

15:40 Departure to Pisa

17:40 Arrival in Pisa