



GEOCAP
Geothermal Capacity Building Program Indonesia - Netherlands

Study Guidelines GEOCAP trainings 2017

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COOPERATING COMPANIES & UNIVERSITIES



GEOCAP

Geothermal Capacity Building Program Indonesia - Netherlands



INAGA



University of Twente,
Faculty ITC



IF technology



University of Indonesia



DNV GL



Gadjah Mada University



Technical University
Bandung



Utrecht University, Faculty of
Geosciences, Department of
Earth Sciences



Delft University of
Technology, Department
of Geotechnology



Netherlands
Organisation for Applied
Scientific Research

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1 WORKSHOP FOR INSPECTORS – METHOD AND TECHNIQUES IN GEOTHERMAL POWER PLANT INSPECTION

Development and use

This course was developed by ITB and DNV GL team that has the following members:

1. Jooned Hendrarsakti – ITB
2. Nursanty Elisabeth – ITB
3. Agastyo Nugroho – ITB
4. Frank Rasing – DNV GL
5. Kees van den Ende – DNV GL
6. Theo van der Meer – University of Twente
7. Bart in 't Groen – DNV GL

The purpose of this course is enable geothermal power plant personnel especially the inspector to perform their operation activities.

Abstract

Inspection of geothermal power plants requires insight in the engineering and construction of the power plant and its main components. Several inspection techniques are applied, depending on the component type, materials used, and operational parameters and operational environment of these components and structures. One of the problems during the operation stage of geothermal development is how to maintain the output of the resource. It is a natural situation when there is an output decline during the development due to the fluid extraction. However, a significant decline of the output can be observed for many fields around the world. The possible causes of the decline can be from subsurface condition and/or upper-surface facilities. Most of the problems found in the upper-surface facilities is caused by the lack of understanding on the behaviour of the field, operation and maintenance activities of the power plant. Therefore, the understanding on the above subjects is very important. Based on the above conditions, the main of the course consists of basic knowledge, geothermal equipment plant, and inspection techniques applied for geothermal power plants.

Target group

The target groups of course are practitioners, trainers/lecturers. To attend this course, the entry level of the participants should be graduated from under graduated level or have experiences in geothermal related works.

Content and Duration

The twoday course content is designed as follows:

- I. Introduction – 1 hour
 - a. Introduction to the program of the course
 - b. Introduction of trainers and participants
- II. Overview Power Plant Design – 3 hours
 - a. List of Geothermal Power Plant in Indonesia
 - b. Methodology of power plant development
 - c. Dry steam cycle
 - d. Flash steam cycle (double and single)
 - e. Binary cycle: Organic Rankine Cycle (ORC)
 - f. Exercise: choose the right plant – 30 minutes

- III. Introduction of Power Plant – 4 hours
 - a. Main component: Steam turbine
 - b. Main component: Condenser
 - c. Main component: Steam Ejector
 - d. Main component: Cooling Tower
 - e. Other components:
 - Wellhead (valves, blowout preventer and control, etc.)
 - Separation (separator, flasher, water collecting tank, etc.)
 - Transmission (steam, two-phase and brine pipelines, condensate trap, expansion loop, support, demister, moisture remover, rock muffler, etc.)
 - Utilisation (lubricating oil system, air compressor, condensate pump and motor, etc.)
 - Heat and geofluid disposals (gas removal, scrubber, water cooling tower, cooling water pump, injection pump, injection well, spray ponds, etc.)
 - Pipes (for transport of geothermal brine and secondary fluids), pumps, heat exchangers, Etc.
 - f. Exercise: Failure – 30 minutes

- IV. Standard of geothermal power plant design – 2 hours
 - a. Overview of relevant standards for geothermal power plant design
 - b. Overview of material use, prescribed by these standards
 Overview of other requirements for inspections and maintenance in geothermal power plants Tools in power plant operations – 1 hour

- V. Basic of maintenance and reliability in geothermal power plant – 1 hour
 - a. Definition and objective of maintenance and reliability program
 - b. Type of maintenance
 - c. Planning and scheduling in maintenance program
 - d. Maintenance of main equipment in geothermal power plant
 - e. Performance measurement and management
 - f. PLN Standard of O&M Power Plant in Indonesia

- VI. Inspection techniques, Sampling and reporting – 4 hours
 - c. Failure mode (general introduction)
 - d. General visual guidelines for inspection:
 - Identify high risk components
 - Non-destructive and destructive techniques
 - Specific attention to composite materials and coatings
 - Exercise: failure cases: solve the problem!
 - e. Reporting
 - Failure reporting
 - Failure database
 - Exercise: reporting failure case – 30 minutes

- VII. Day closure

Instructors

Day 1, March 20th, 2017

- I. Introduction – Frank Rasing or Kees van den Ende – DNV GL
- II. Overview Power Plant Design – Theo van der Meer – University of Twente
- III. Introduction of Power Plant – Jooned Hendrarsakti – ITB

Day 2, March 21th, 2017

- IV. Standard of Geothermal Power Plant Design – Jooned Hendrarsakti – ITB
- V. Basic of Maintenance and Reliability in Geothermal Power Plant – Jooned Hendrarsakti – ITB
- VI. Inspection Techniques, Sampling and Reporting – Frank Rasing or Kees van den Ende – DNV GL
- VII. Day closure – Jooned Hendrarsakti - ITB

Learning outcomes

After completing the series of this course, the participants are expected:

- To understand the implementation of the overview of a geothermal power plant design.
- To understand the equipment used for inspections in geothermal power plants
- To understand the concept and principles of identifying high risk components
- To understand the concept of proactive maintenance

Study load

Study load is defined as the amount of time needed by the student or participant to study the course. This includes all activities: self-study, following lectures, conducting assignments, practical, field work, etc. Please fill in the following table:

Activity	Number of hours
Self-study of the materials and the assignments	-
Lectures	15
Supervised practical	1
Project based learning	-
Preparation for assessment	-
Field work/trip	-
Total	16

Course structure

The study load is spread in time as shown in the following timetable.

Main Topic	Sub Topic	Day-	
		1	2
Introduction	Program of The Course		
	Trainers and Participants		
Overview Power Plant Design	Dry Steam Cycle		
	Flash Steam Cycle (Double and Single)		
	Binary Cycle: Organic Rankine Cycle (ORC)		
	Exercise: Choose The Right Plant		
Introduction of Power Plant	Steam Turbine		
	Condensor		
	Steam Ejector		

Main Topic	Sub Topic	Day-	
		1	2
	Cooling Tower		
	Other components:		
	Exercise: Failures		
Standard of Geothermal Power Plant Design	Overview of Relevant Standards for Geothermal Power Plant Design		
	Overview of Material Use, Prescribed by These Standards		
	Overview of Other Requirements for Inspections and Maintenance in Geothermal Power Plants		
Tools in Power Plant Operations			
Basic of Maintenance and Reliability in Geothermal Power Plant	Definition and objective of maintenance and reliability		
	Type of maintenance		
	Planning and Scheduling in Maintenance Program		
	Maintenance of Main Equipment in Geothermal Power Plant		
	Performance Measurement And Management		
	PLN Standard of O&M Power Plant in Indonesia		
Inspection Techniques, Sampling and & Reporting	Failure Mode (General Introduction)		
	General Visual Guidelines for Inspection		
	Reporting		

Teaching and learning methods

Learning and teaching methods are:

- Lecture
- Individual assignment

All these activities are conducted in a face to face setting in the class room and/or the field.

Assessment

The assessment formats are taken as:

- Assignment
- Presentation

Study materials

The study materials used in the course are:

- Articles
- Hand-outs

Teaching materials

The teaching materials available for teaching this course.

- Power point