Training in isopentane handling

LaGeo, S.A. de C.V has a strong training program trough local workshops and courses in Iceland about Cycle Binary Systems. The training program has several modules, which has been carried since the first stage of the project and it will be extended until the operation of the plant.

Some of the courses carried out are described as follows:

Proposal (2) of training agenda

Binary Plant Berlin, El Salvador

The intension is to have two courses in two weeks time in March both with the same material for different groups of operators. It may be necessary to alter this schedule since it can be difficult for operators to attend. The time will be tailored as needed. The English draft of curriculum will be used.
Later this spring after the start of the plant another course will be held where start-up, operation, adjustments, maintenance, etc. will be on the agenda and the curriculum will be available in Spanish.

Tuesday first day

08:00 Björn H. Herbertsson, ENEX. Start-up and introduction to the training program. Javier Palma will translate in Spanish all through the course.
08:30 P&I Diagram (pipe and instrumentation diagram). Focus on main flow in P&I Diagram and connect the KKS-code to the systems and equipment.
12:00 LUNCH
13:00 PI-D Diagram Continued. Equipments location at site.
16:00 End of first day.

Wednesday second day

08:00 PI-D Diagram refreshed and continued. Focus on instruments, control loops and main adjustments.
10:30 Genset Rotoflow turbine and Flowserve seal
12:00 LUNCH
13:00 Electricity, high voltage 13,8 KV and 115 KV,
480 V, 240 V and 120V AC power supply,
110 V DC and 24 V DC.
16:00 End of second day.

Thursday third day

08:00 Refresh from the days before after demand.
09:00 Pre-Heaters, Reboilers, Recuperator, Condenser, Mist Eliminators, Cooling tower and other subsystems.
11:00 Isopentane properties and main operational pressures and temperatures.
12:00 LUNCH
13:00 Genset ABB generator, BHS Getriebe Integral Gear and supporting systems.
14:30 Debate and feedback.
16:00 End of training course.

Training in isopentane handling for Binary Cycle Berlin Plant

By:
Unidad Ambiental
Gerencia de Ingeniería
LaGeo S.A. de C.V.

1. Introduction

Isopentane is used in the operation of Binary Cycle Berlin Plant as a working fluid. This is a highly flammable fluid and requires special conditions for handling.

The present reports presents information about the training given to the staff will work in Binary Cycle Berlin Plant. The workshops includes operational as safety aspects in isopentane handling.

The training courses have been given by ENEX, the company that designed the plant. The workshops are described in the follows sections.

2.1 Workshop in hazards identification, HAZOP

HAZOP workshop was carried out at Binary Cycle Berlin Plant in June 2 and 3, 2005 (16 hours).

The contents and general scope of the workshop is:

General

All HSE reports must be based upon an analysis of potential hazards of the site in question. We suggest using the HAZOP hazard identification method for the power plant. The HAZOP method was originally developed by Imperial Chemical Industries in England. It is a system based on a question list derived from "guide words". The VGK application is based on the Guidelines for Hazard Evaluation Procedures from Center for Chemical Process Safety which is a part of the American Institute of Chemical Engineers.

This analysis technique requires study performed by an interdisciplinary team headed by a leader and with an assistant scriber. Usually this team consists of representative from the

process design group, from the operation, from the mechanical maintenance, from the instrument and control, from the laboratory if any and from the safety team.

Information to be used during HAZOP analysis

- Process Flow Diagrams
- Process and Instrumentation Diagrams
- Plot Plan and Equipment Layout Drawings, if available
- Previous Safety Analysis Reports if any, MSDS, Safety Literature if available
- Operating Procedures for Start-up, Operation and Shut-down
- Major Component Design Specifications

All of this information will be useful for the study, but of these items, however, an accurate P&ID will be most important for the review effort.

Objectives of HAZOP analysis

The objectives are to find the hazards, the possible consequences if those hazards would be materialized (decide who might be harmed and how) and evaluate the risk and decide whether existing precautions are adequate or whether more could be done. These findings are recorded in an action list and assign a responsible person for each item on the list.
Within reasonable time (to be decided upon by La Geo and Enex) the action list will be revised and status of each item checked. At that time all responsible persons must report their findings, whether they want to use the proposed solution, if they found an alternative solution or if they have found the occurrence of the hazard so unlikely that special actions are not necessary. Such a conclusion then needs reasoning to convince the other members of the HAZOP team that no action is needed.

Agenda for HAZOP analysis

Design Team Hazop
Thursday May 26th the design team will do a preliminary Hazop analysis on the existing P&I drawings. The main emphasis will be on design related issues. Enex is responsible for supplying the group participants.

LaGeo Team Hazop
Thursday June 2nd and Friday June 3rd the operating, maintenance and safety teams of El Geo will do a Hazop analysis of the power plant P&I drawings. Saturday June 4th is scheduled as a reserve time until 12 am. El Geo is responsible for supplying the group participants.
This will be a general Hazop analysis but local conditions must be addressed specifically.

Post HAZOP activities
After the latter HAZOP analysis study the leader will make a hazop report to Enex and La Geo about the Hazop findings and the action list. This hazop report can be used as the basis for emergency, health and environmental planning for the power plant.

Participants in the workshop:

Leader:	**Employed by:**	**Participants:**	**Employed by:**
Teitur Gunnarsson (TG)	VGK	Alexander Bollman	Technica International
Secretary:		Ernesto Borja	Technica International
Gunnar Tryggvason (GT)	Enex	Havier	Technica International

		Saul Padilla	LaGeo
		Jose Luis Henriquez	LaGeo
		Roberto Cortez	LaGeo
		Victor Zuleta	LaGeo
		Ana Silvia de Arevalo	LaGeo
		De Hsuan Wang	LaGeo
		Roberto Betancourth	LaGeo
		Kevin Padilla	LaGeo
		Guido Molina	LaGeo
		Arnoldo Perez	LaGeo
		Juan Carlos Lopez	LaGeo
		Fernando Mayorga	LaGeo

2.2 Workshop in plant operation

Enex gave a workshop in Binary Cycle plants in March 6-8 and March 13-15 (48 hours) to operation personnel. The activities were carried out in Binary Cycle Berlin Plan.

The workshop was based in the "*Binary Plant Berlin Operation and Instruction Manual"* realized by ENEX. The manual contents the safety requirements to Isopentane handling and the contents studied are:

1 Introduction and Scope
2 Safety Precautions
3 Plant Description
4 Installation
5 Plant Operating Instructions
6 Control System
7 Equipment and Systems Description
8 Maintenance
9 Utilities
10 Safety Requirements
11 Emergencies
12 Warranty
13 Appendices
14 Drawings

Topics 2 and 4 are focused specifically in isopentane handling.

The participants were:

1. Dinora Esther Reyes
2. Alvaro Maravilla
3. José Javier Perdomo
4. William Alberto Castro
5. Mario Alexander Franco
6. Wilfredo Rafael González
7. Leonel Leonardo López
8. Jorge Armando Ávila
9. José Alfredo Hernández

LaGeo

HOJA DE ASISTENCIA A CAPACITACION

NOMBRE CAPACITACIÓN: Binary Plant Berlin, Operation and Instruction Manual

FECHA: DEL 06 AL 08 DE MARZO DE 2007.

NOMBRE	MARTES 06	MIERCOLES 07	JUEVES 08
Álvaro Marroquín			
José Javier [illegible]			
William Alberto Castro			
Mario Alexander Franco			
Wilfredo Rafael González			
[illegible]			
Jorge Armando Avila Ortez			
[illegible]			
Miguel Angel Nájera M.			
Carlos Melgar			

10. Miguel Ángel Nájera
11. Carlos Melgar
12. Jesús Antonio Duánez
13. Luis Ruiz
14. Miguel Martínez
15. Jeremías Antonio Martínez
16. William Avimael Campos
17. José Antonio Martínez
18. Pedro Alfonso Castro
19. José Edgardo Gutiérrez
20. Milton Ricardo González
21. Víctor Zuleta

LaGeo

HOJA DE ASISTENCIA A CAPACITACION

NOMBRE CAPACITACIÒN: Binary Plant Berlin, Operation and Instruction Manual

FECHA: DEL 13 AL 15 DE MARZO DE 2007.

NOMBRE	MARTES 13/	MIERCOLES 14	JUEVES 15
Jesus Antonio Duarte G.			
Luis G. Reiz			
Miguel M...			
Jeremias Antonio Martinez			
Wilman Armael Campos.			
José Antonio Martínez Dubón			
Pedro Alfonso Cestin			
José Edgardo Gutierrez			
Milton Ricardo Bonilla			
Victor M. Zuleta M			

Leader:	Employed by:	Participants:	Employed by:	Drawings:

HAZOP REPORT

Company: **LaGeo** Date: June 2nd and 3rd

Division: **Unidad Generadora de Ciclo Binaro - Berlin** 2005

Teitur Gunnarsson (TG)	VGK	Alexander Bollman	Technica International	KM-000-005.dwg
Secretary:		Ernesto Borja	Technica International	
Gunnar Tryggvason (GT)	Enex	Havier	Technica International	
		Saul Padilla	LaGeo	
		Jose Luis Henriquez	LaGeo	
		Roberto Cortez	LaGeo	
		Victor Zuleta	LaGeo	
		Ana Silvia de Arevalo	LaGeo	
		De Hsuan Wang	LaGeo	
		Roberto Betancourth	LaGeo	
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		Juan Carlos Lopez	LaGeo	
		Fernando Mayorga	LaGeo	