OLKARIA III – OPERATIONS & MAINTENANCE
SIX YEARS OF EXPERIENCE

• The development of geothermal power in the Olkaria area is divided into blocks
  – Olkaria I – 3, 15 MW by KenGen 1985
  – Olkaria II – 2, 35 MW by KenGen 2002

• The government opted to develop the Olkaria III field through a World Bank supervised international tender

• ORMAT International was awarded the tender for Olkaria III in 1998
The study involved a 3-dimensional model of the Olkaria III field through the collaboration of experts from KenGen, GeothermEx, PB Power, Orkustofnun and Ormat engineers.

The study was done in parallel with drilling of new wells.

The data collected was analyzed and integrated into the model enabling continuous calibration of the field.

The result was a decision on the power plant capacity and basis for the obligation to the PPA.
ORMAT BINARY PLANT

- Modular construction – match plant to the field
- Based on the Rankine Cycle
- Heat is transferred from the geothermal fluid to the organic fluid via heat exchangers (vaporizers and pre-heater), where the organic fluid is heated and vaporized.
- The organic fluid is then expanded in the turbine to a lower pressure and temperature at which it condenses in the air cooled condenser
- The organic fluid now in the liquid phase is pumped back to the heat exchangers – either vaporizer or pre-heater.
- The geothermal fluid after the heat has been extracted from it is re-injected to replenish the aquifer and ensure sustainability.
- The turbine drives the generator directly without a gearbox
• Phase I was commissioned in August 2000
  - initially generating 8 MW,
  - additional unit was added - output of 12 MW
  - plant optimized to achieve 13.6 MW
• Team selection
• Training
• Completion of construction and commissioning
• Team preparation of a maintenance manual and program
• During operation the field behavior was studied to identify the cyclic wells, weak wells and base wells
• Opportunistic maintenance was encouraged to minimize frequent stoppage
• Operation staff had been trained to play a dual role
TEAM’S FOCUS

• Established and procured critical spares, equipment and tools
• Established performance parameters
  – Operating temp. relative to saturation
  – Pentane level and consumption per annum
  – Monitored the output in MWh per shift and focused on setting and meeting targets specific for each shift
• Team work, hands on approach and a desire to excel drove performance
MAINTENANCE

- Basic maintenance tools were applied
  - Vibration analysis
  - Temperature monitoring
  - Oil and pentane usage
  - Monitoring of each unit’s efficiency
  - Annual inspection and cleaning of pre-heater tubes
  - Annual inspection and cleaning of cyclone separators
MAINTENANCE

• Failures experienced
  – Motor winding failure – feed pump and oil coolers
  – Mechanical seal – resulting in loss of pentane
  – Carbon bearing failure – due to excess vibration
  – Blocked tube in the pre-heater – had to improve cleaning regime
  – Other minor aspects
PLANT PERFORMANCE

• Three basic performance indicators of a geothermal facility
  – Capacity Factor
  – Load Factor
  – Availability Factor

  – OLKARIA III PERFORMANCE – 2001 - 2005
    • Availability Factor >98%
    • Load Factor >95%
ENVIRONMENTAL CONSIDERATION

- Olkaria III geothermal project lies partly within Hells Gate National park established in 1984 and Maella-Ng’ati-Kongoni farms
- The park is managed by the Kenya Wildlife Service (KWS) and hence operations of the geothermal plant requires strict compliance with the environmental policies of KWS
- A further project pipes the CO₂ to the neighboring Oserian Development Company, to accelerate the growth of flowers
- Orpower 4 project also works with the local community predominantly the Maasai pastoralists in providing assistance to the community
CONCLUSION

• Successful technology transfer is possible
• Necessary steps applicable to each case need to be developed to achieve the target availability.
  – Training
  – Spares, Tools & Equipment
  – Establish and monitor performance indicators
  – Prepare and manage strict maintenance procedure
  – Good level of automation and monitoring is not prohibitive but useful in managing the facility
  – Create a strong sense of ownership

THANK YOU