Real Time Online Energy Management System (RTEMS) Implemented at Saudi Kayan Petrochemical Company

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• How does a Real Time Online Energy Management System based on Visual MESA work
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  – Optimization Actionable Items
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• Whatever utilities the process needs, the process gets.
• But the fulfillment of the process utilities needs should be done at the lower cost,
  – within emissions constraints (solving energy and carbon balance together is key for consistency),
  – within current operating constraints, and
  – within contractual constraints
• **A Utilities Real Time Optimizer** such as Visual MESA ensures that Operations is doing the best it can with the utilities assets available at that moment and within the current operating conditions.
• It provides Operations a **Real Time Target** for operating the utilities at the minimum Site-Wide overall Utilities cost.
How the RTEMS Works

Real Time Energy Management System (RTEMS)

[Diagram showing the flow of energy management with labels such as Measurements, Optimum Set Points, and various utilities systems like Hydrogen, Fuel, Steam, Water, and Electricity.]
Calculation Foundation for the Energy Related Key Performance Indicators

• The RTEMS model is the foundation
• A site-wide integrated real time utilities model ensures:
  – Data health
    • Data validation for all individual meters, including what happens to the model when a certain individual meter goes bad,
  – Data Consistency
    • By solving the integrated heat and material balances of the complete utilities systems
    • Imbalances (both steam and fuel) are key indicators of consistency
  – An online, real time Calculation Framework

Real time Site-wide Integrated Utilities Model
RTDB Historian
Visualization

Plant Data
KPI
Saudi Kayan Petrochemical Company is one of the largest petrochemical complexes in the world, located in Jubail Industrial City, Kingdom of Saudi Arabia.

A real time online utilities model was implemented to help with the energy cost minimization and energy management for the Petrochemical Complex.

The real time, online, energy management system allows identifying the different economic trade-offs that challenges the production and internal distribution of the energy at minimum cost.
• A detailed non-linear rigorous model of the steam, fuels, power, boiler feed water and condensates systems has been built, including all the interactions between these systems, constraints and degrees of freedom for their operation.

• The same model used for the online, real time optimization, is also used in stand-alone mode, populated either with current or historical data, to perform case studies for planning or evaluating alternatives for a better operation of the energy system.

• As a result of the project, the information of the Saudi Kayan Petrochemical Complex energy system has been organized into one real time model and a single environment to which everyone has access through a web browser.
Real Time Online Energy Management System
Implementation: Visual MESA model views
Optimization Actionable Items:

- Packaged Boilers steam production (Fuel Gas Consumer)
- Crude Oil Boilers steam production (Crude Oil Consumer)
- VHP Boiler steam production (Fuel Gas Consumer)
- Turbine/Motor Swaps (Cooling water pumps, BFW pumps, ...)
- Extraction/condensing turbines (Olefins Unit main compressors)

Steam let-downs, vents and condensing will change automatically, manipulated by the control system, as a consequence of the actions performed over the optimization handles.
The total Real Time Online Energy Management System benefits have been around \(3.42 \text{ MM$}/\text{year}\).

Additional savings were obtained from:

- Online Energy Monitoring, Auditing and Accounting
- Online Energy KPIs
- What-if studies:
  - Capital Project Opportunities
  - Planning / Scheduling of Utilities

An example will be presented in which Visual MESA recommendations were partially applied and, as consequence, \(1.05 \text{ MM$}/\text{year}\) of savings were achieved.
The next figure illustrates the savings that were obtained from real time optimization between February 28th and March 7th, 2013:

Before implementing recommendations:
Average potential savings: $390/h
Captured Savings: $120/h (1.05 MM$/year)

After implementing recommendations:
Average potential savings: $270/h

Around 3:00 AM on March 2nd, Operators applied one of the optimization actions calculated by the RTEMS and 1.05 MM$/year of savings were immediately captured (i.e., the predicted savings trend drops).

At that time, before SK operators took any action, Visual MESA was suggesting two turbine and motors swaps and increasing the extraction in all three extraction-condensing turbines at Olefins plant.

Captured Savings: $120/h (1.05 MM$/year)
• Around 3:00 AM on March 2nd, operators started increasing the MP steam extraction on KT-15010 turbine located at the Olefins plant. This was only one of the calculated optimization actions.

• Olefins steam let-downs were reduced

• High Pressure steam import from U&O to Olefins plant was reduced
High Pressure steam production at Package Boilers was reduced and consequently their total fuel gas consumption. This is the main source of savings together with the cost reduction on demineralized water consumption.

Package Boilers emissions were also reduced as a consequence of the reduction in steam demand.
Relevance of Visual MESA RTEMS for SK’s Sustainability Initiative

• RTEMS continuously calculates Key Performance Indicators (KPIs) such as boiler and heater efficiencies, plant energy consumptions, steam imbalances, etc. on a validated and consistent basis.

• RTEMS acts as the “Steam Vent and Letdown Police”. Everybody will know that Visual MESA is looking at the Site-wide situation 24x7x365. It is continuously helping reduce cost.

• And taking into account the site-wide emission constraints.
Conclusions

• Visual MESA based Real Time Energy Management System was successfully implemented at Saudi Kayan Petrochemical Complex, helping to achieve energy cost savings.

• The same model used for the online, real time optimization, can also used in stand-alone mode, populated either with current or historical data, to perform case studies for planning or to evaluate alternatives for a better operation of the energy system.

• As a result of the project, the information of the Saudi Kayan Petrochemical Complex energy system has been organized into one real time model and a single environment to which everyone has access through a web browser.