Driving Sustainability with Energy Digital Twin

Technical Presentation

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PETRONAS, Kuala Lumpur, Malaysia

Schlumberger Digital Forum 2022
21st September 2022

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Our story

- **PETRONAS** is a **Progressive Energy and Solutions Partner** with presence in over 50 countries.
- PETRONAS operations covers Upstream, Downstream, Gas Business and Clean Energy Solutions.
- Our team is part of the Process Department of Group Technical Solutions, Project Delivery & Technology (PD&T)
- As PETRONAS' **Centre of Excellence**, PD&T unites expertise in project, technical, digital and technology, to deliver sustainable energy and progressive value for the entire Group.
Steam is the number ONE choice for heating medium in the process industry

Steam generation:
• Standalone
• Centralised

Challenges:
• High fuel gas costs
• CO2 emissions

Digital driven system to improve efficiency & sustainability
Lifecycle application of first-principle model in energy audit and performance monitoring increases overall value

Regular automated reporting plus:
- Engineering analysis
- Optimization
- Troubleshooting
- OTS

It is an accepted best practice to perform a structured energy audit to identify value leakages and improvement opportunities.

Manual spreadsheeting for steam balance reporting
PETRONAS uses the Symmetry iCON® iUO, a custom energy modelling feature within Symmetry iCON® platform to construct a first principle model that runs an energy digital twin for a utility system.
Symmetry iCON® iUO Development

2004

Symmetry iCON® Version 1.0
Launched PETRONAS Operating Unit (OPU) Groupwide

2010

Symmetry iCON® iUO Version 1.0
To model steam system of most PETRONAS plants

2019

Symmetry iCON® iUO Version 2.0
iCON iUO Enhancement Project between PETRONAS and SLB

iUO 2.0 Go Live
The Energy Digital Twin architecture can be configured into a descriptive and predictive functionality to enhance the operation experience.

- **REAL TIME ENERGY ADVISORY DASHBOARD**
  - Real-time steam balance
  - Plant Energy KPI (Energy Index)
  - Equipment & overall energy consumption
  - Equipment and overall plant efficiencies
  - GHG Emissions, steam venting and loss management

- **1st PRINCIPLE MODEL**
  - Calculated new tags
  - Input to simulation engine

- **DATABASE & ANALYTICS**
  - Open Loop Optimizer
  - Data Reconciliation
  - Data Archive
  - DCS Sensors

- **MONITORING AND ADVISORY**
  - Planning & Operations
  - Performance Monitoring
  - Open Loop Optimizer
  - Data Reconciliation
  - Data Archive
  - iCON® iUO
An O&G terminal uses gas turbines to generate power and heat to bring up hot oil to the specified temperature.

- Power and heat combined cycle using gas turbine generators.
- Gas turbine exhaust sent to a waste heat recovery unit to re-heat returning heat transfer oil.
- Decision to analyse the optimum number of turbines to run with WHRU to reduce fuel gas consumption and greenhouse gas emissions.
Optimising the number of gas turbines in operations resulted in cost savings and reduced equipment carbon footprint

Fuel gas optimisation study conducted in the facility recommended to operate with two GTs running instead of three.

<table>
<thead>
<tr>
<th>Case Study</th>
<th>Fuel Gas Consumption (%)</th>
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<tbody>
<tr>
<td>Running two (2) instead of three (3) gas turbines</td>
<td>- 20%</td>
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Potential of cost savings of:
More than USD 1 Million per year

From Carbon Footprint Assessment, this may contribute to the reduction in CO2 emissions:
~ 400 tonnes of CO2e per year
An online energy digital twin developed using Symmetry iCON® iUO

Model Description:
- 3 Steam Header Level (HHP, HP, and LP)

Input to Model:
- Steam Header Pressure
- Steam user's flowrate
- Steam turbine discharge conditions (P&T)

Output from Model:
- Steam Header temperature
- Overall steam balance
- Steam turbine duty and efficiency
- LP steam flowrate to deaerator
A sample dashboard showing the comparison between plant data simulation model results and trending
Equipment performance such as efficiency and duty can be monitored near real-time.

- Deviation between modelled and plant data could be detected via near real-time monitoring.
- The discrepancies could trigger discussion among the technologist and operations to investigate the potential issues identified.
An online model acts as the foundation for an online open loop optimisation

- Reduce excess air to optimize Stack O2
- Install new STG to reduce steam letdown
- Optimize BFW pump outlet & deaerator pressure
- Optimize header pressure
- Reduce MP header venting
- Return condensate to reduce water import
Conclusions

• An **Energy Digital Twin** is a main enabler in moving towards digital transformation of the energy and utilities sector.

• Continuous monitoring of Key Performance Indicators (KPIs), efficiencies and losses enables **timely corrective and maintenance actions** by plant engineers and operators.
Recommendations on potential new features or digital solutions

Potential new features to Symmetry or other SLB digital solutions include:
  o Automated data retrieval and reconciliation
  o Solutions for faster convergence and robust optimization e.g. Equation Oriented (EO) Solver, data driven models

Implementation of these recommendations will improve agility, responsiveness, and efficiency to fully leverage on the complete digital twin experience.
Thank You

Special thanks to

Francisco Da Silva, Caleb Andrew Bell & SLB team