Optimisation of O&M Efficiency at Qatar Power using the PI System

Presented by Parasram Borkar
Sr Engineer- Commercial & Performance
Enlighten the life in Middle East

- Imagine Life without Power and Water
Enrich the life in Qatar

Energy, Power & Water plays the vital role in Qatar’s Development and Transformation
Changing Life Expectancies in Qatar

Power and Water plays a vital role
Changing Scenarios in Qatar

- Exponential growth and demand in power and water sector
- Rising demand for energy resource conservation due to climate change and green gas reduction
- Government initiated various energy and efficiency measures

- Optimisation of O&M Efficiency at Qatar Power
- PI System plays important role in improving O&M performance
Agenda

• About Qatar Power Company
• Business Environment and Challenge
• Case Study to improve O&M efficiency
• PI System Capabilities to solve Qatar Power’s Business Challenges
• Results Obtained and Business Impact
• Future Plan and next step
• Summary and Conclusion
Qatar Power Company

Ras Laffan-B Independent Water and Power Plant (IWPP)
Plant Capacity: Power 1025 MW and Water 60 MIGD
Company: Q Power Q.S.C, P O Box 22664, Doha, State of Qatar
Qatar Power Company

• Long term PWPA with Kahramaa (regulator of Qatar)
• IWPP project company, responsible for facility O&M for 25 years under BOOT agreement
• It is consortium of Engie (GDF Suez), Chubu Electric and Qatar Electricity and Water Company
• Commissioned full facility of 1025MW Power and 60MIGD Desalination Water in year 2008.
• State of art technology in power and water production
• Implemented PI System in year 2012
Plant Configuration

Commercial Operation Start: Jun 2008

Capacity
- 1025 MW Net
- 60 MIGD (272700 m³/day)

Plant Design
- 3 GT 237.35 MW
- 2 ST 221 MW
- 4 MSF 15.13 MIGD

Plant Technology
- GT: 94.3A-Siemens
- ST: M30-40-M2A-Siemens
- MSF: Doosan

Plant Net Efficiency
At Ref Conditions
- Facility: 40.29%
- GT: 37.45%
- MSF PR: 8.26
KPI - Plant Dependable Capacity Tests

**Power Plant Net Capacities in MW**

- Actual
- Plant Capacity

<table>
<thead>
<tr>
<th>Year</th>
<th>Actual</th>
<th>Plant Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>1045</td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td>1039</td>
<td></td>
</tr>
<tr>
<td>2010</td>
<td>1045</td>
<td></td>
</tr>
<tr>
<td>2011</td>
<td>1039</td>
<td></td>
</tr>
<tr>
<td>2012</td>
<td>1041</td>
<td></td>
</tr>
<tr>
<td>2013</td>
<td>1037</td>
<td></td>
</tr>
<tr>
<td>2014</td>
<td>1038</td>
<td></td>
</tr>
<tr>
<td>2015</td>
<td>1036</td>
<td></td>
</tr>
</tbody>
</table>

**Water Plant Net Capacities in MIGD**

- Actual
- Plant Capacity

<table>
<thead>
<tr>
<th>Year</th>
<th>Actual</th>
<th>Plant Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>61.0</td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td>60.6</td>
<td></td>
</tr>
<tr>
<td>2010</td>
<td>60.9</td>
<td></td>
</tr>
<tr>
<td>2011</td>
<td>61.0</td>
<td></td>
</tr>
<tr>
<td>2012</td>
<td>61.0</td>
<td></td>
</tr>
<tr>
<td>2013</td>
<td>61.0</td>
<td></td>
</tr>
<tr>
<td>2014</td>
<td>61.8</td>
<td></td>
</tr>
<tr>
<td>2015</td>
<td>61.7</td>
<td></td>
</tr>
</tbody>
</table>
KPI - Power Plant Availability and Reliability

Power Plant Annual Availability-%

- Plant Availability

2015 figs are till YTD - July 15

* Year 2010, Two Gas Turbine Power Plant Planned Outage for HGPI/Major overhaul

Power Plant Annual Reliability-%

- Plant Reliability

* Year 2007, plant commissioning period
KPI - Water Plant Availability and Reliability

Water Plant Annual Availability-%

- Plant Availability

Year 2010 & 2013, Two Desalination Water Plants Planned Outage for tube replacement hence not comparable for benchmarking.

Water Plant Reliability in %

2015 figs are till YTD- July-15
Awards and Recognition
Business Environment

• Company income through PWPA
• Fuel gas and seawater used for power and water generation is not directly pass-through under PWPA
• Efficient O&M is vital for higher profit and to avoid penalties.

Q Power-IWPP

Kahramaa

Power

Water

Profit

Margin

Fuel Gas
Seawater

Capacity
Available
Revenue

Output
Revenue
Business Environment

- Adverse & Harsh Climate Conditions: RH – 90% Temp-45 °C
- Annual system demand variation (summer-winter) - 230%
- Daily system peak and low power demand- 45%
- QPower Water Demand-100%
- QPower Power demand in Winter-30%
- QPower Power demand in Summer-98%
Business Challenges

• Meet Health and Safety Target
• Meet Power and Water Demand
• Maintain higher Plant Capacity available all the time
• Efficient O&M at all operating scenarios
• Deterioration in Plant Efficiency factor over the period
• Deterioration in fuel and seawater margins
• Availability of real time plant information
• Availability of historical plant data and archival
• Real time analysis and Management information system
Business Challenge & PI System

• Implemented PI System and tools to find solutions to Business Challenges

• Application implemented in real-time
## HSE: Monitoring Heat Stress Index

<table>
<thead>
<tr>
<th>Past</th>
<th>Present</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Difficult to monitor Heat Index.</td>
<td>• Online Monitoring of Heat Index through PI System</td>
</tr>
<tr>
<td>• Conventional manual monitoring.</td>
<td>• Real time messaging and notifications</td>
</tr>
<tr>
<td>• Difficult decision making</td>
<td>• Easy decision making</td>
</tr>
<tr>
<td>• Missing Controls</td>
<td>• System controlled measures</td>
</tr>
<tr>
<td>• No people awareness</td>
<td>• People awareness</td>
</tr>
<tr>
<td></td>
<td>• Dash Board and displays</td>
</tr>
</tbody>
</table>
HSE: Monitoring Heat Index - PI ProcessBook
HSE: Monitoring Heat Index - Notifications

Heat Stress Index Value = 42
Ambient Temp: 39 Deg C Relative Humidity: 30 %
Severity Category: Danger (Normal Category-Level-III)
Heat Syndrome: Sunstroke, Heat Cramps or Heat Exhaustion likely, Heat
Work Rest Period Minutes: 20:10
Water Requirements (1 cup = 1/4 liter): 1 Cup every 15 minutes
Controls: Work Under Shade
Notification Name = Heat Stress_1a
Triggering Condition = Heat Index => 19
System Name = QATARPOWER
Notification Start Time: 7/1/2014 13:00:00
Target Path = Heat Index

Heat Stress Index Value = 52
Ambient Temp: 35 Deg C Relative Humidity: 70 %
Severity Category: Danger (High Priority Category-Level-III)
Heat Syndrome: Sunstroke, Heat Cramps or Heat Exhaustion likely, Heat Stroke possible with prolonged exposure at
Work Rest Period Minutes: 20:10
Water Requirements (1 cup = 1/4 liter): 1 Cup every 10 minutes
Controls: Elevated Work and Confined Space Works under direct sunlight to be stopped.
Notification Name = Heat Stress_Level_1b
Triggering Condition = Heat Index => 50 AND Heat Index < 53
Notification Start Time: 8/27/2015 10:00:00
Target Path = Heat Index

Heat Stress Index Value = 54
Ambient Temp: 37 Deg C Relative Humidity: 50 %
Severity Category: Extreme Danger (Level-IV)
Heat Syndrome: Heat Stroke or Sunstroke imminent
Controls: All Work under direct sunlight to be stopped
Notification Name = Heat_Stress_Level_4
Triggering Condition = Heat Index => 54
Notification Start Time: 8/20/2015 15:00:00
Target Path = Heat Index

Regards,
Panaram Borkar
PI System Admin
+974 35840366
## HSE: Monitoring Heat Index – Asset Framework

### Heat Index

<table>
<thead>
<tr>
<th>Name</th>
<th>Value</th>
<th>Time Stamp</th>
<th>Description</th>
<th>Data Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMI_RH</td>
<td>80 %</td>
<td>8/23/2013 9:03:26 PM</td>
<td>Ambient Relative Humidity</td>
<td>Formula</td>
</tr>
<tr>
<td>AMI_TEMP</td>
<td>38 °C</td>
<td>8/23/2013 9:03:26 PM</td>
<td>Ambient Temp rounded</td>
<td>Formula</td>
</tr>
<tr>
<td>GT11_RH</td>
<td>53 %</td>
<td>8/23/2013 9:03:26 PM</td>
<td>Relative Humidity PI Point</td>
<td>PI Point</td>
</tr>
<tr>
<td>GT11_TEMP</td>
<td>32 °C</td>
<td>8/23/2013 9:03:26 PM</td>
<td>Relative Humidity PI Point</td>
<td>PI Point</td>
</tr>
<tr>
<td>GT12_RH</td>
<td>55 %</td>
<td>8/23/2013 9:03:26 PM</td>
<td>Relative Humidity PI Point</td>
<td>PI Point</td>
</tr>
<tr>
<td>HT Index</td>
<td>49 %</td>
<td>8/23/2013 9:03:26 PM</td>
<td>Heat Index Calculated</td>
<td>Formula</td>
</tr>
<tr>
<td>HT Index 10</td>
<td>35 %</td>
<td>8/23/2013 9:03:26 PM</td>
<td>Heat Index Table Lookup</td>
<td></td>
</tr>
<tr>
<td>HT Index 20</td>
<td>37 %</td>
<td>8/23/2013 9:03:26 PM</td>
<td>Heat Index Table Lookup</td>
<td></td>
</tr>
<tr>
<td>HT Index 30</td>
<td>41 %</td>
<td>8/23/2013 9:03:26 PM</td>
<td>Heat Index Table Lookup</td>
<td></td>
</tr>
<tr>
<td>HT Index 40</td>
<td>43 %</td>
<td>8/23/2013 9:03:26 PM</td>
<td>Heat Index Table Lookup</td>
<td></td>
</tr>
<tr>
<td>HT Index 50</td>
<td>49 %</td>
<td>8/23/2013 9:03:26 PM</td>
<td>Heat Index Table Lookup</td>
<td></td>
</tr>
<tr>
<td>HT Index 60</td>
<td>54 %</td>
<td>8/23/2013 9:03:26 PM</td>
<td>Heat Index Table Lookup</td>
<td></td>
</tr>
<tr>
<td>HT Index 70</td>
<td>54 %</td>
<td>8/23/2013 9:03:26 PM</td>
<td>Heat Index Table Lookup</td>
<td></td>
</tr>
<tr>
<td>HT Index 80</td>
<td>54 %</td>
<td>8/23/2013 9:03:26 PM</td>
<td>Heat Index Table Lookup</td>
<td></td>
</tr>
<tr>
<td>HT Index 90</td>
<td>54 %</td>
<td>8/23/2013 9:03:26 PM</td>
<td>Heat Index Table Lookup</td>
<td></td>
</tr>
<tr>
<td>RH</td>
<td>59 %</td>
<td>8/23/2013 9:03:26 PM</td>
<td>Relative Humidity PI Point</td>
<td>PI Point</td>
</tr>
<tr>
<td>Temp</td>
<td>37 °C</td>
<td>8/23/2013 9:03:26 PM</td>
<td>Ambient Temp</td>
<td>PI Point</td>
</tr>
</tbody>
</table>

**Diagram:**

- [Image: EMEA USERS CONFERENCE 2015](image-url)
HSE Performance Achievements

• No heat stress related incidents.

• Achieved 4.2 million man-hours in 3,452 days without LTA
Plant O&M Optimisation

- Difficult to optimise Plant Configuration
- Inherent Energy Losses
- Plant efficiency deterioration
- Plant life and maintenance issues
- Lower fuel and seawater margins
- Real time data archival and analysis
Plant O&M Optimisation

![Graph showing daily load variance and efficiency factor variance from 1-Jan-15 to 27-Jul-15 with max and min MW values.](image)
Plant O&M Optimisation - Dash Boards

QATAR POWER COMPANY, RAS LAFFAN-B, IWPP
8/28/2015 10:18:09

POWER DISPATCH 920 MW
POWER GENERATION 979 MW
FREQUENCY 50.03 Hz
AMBIENT TEMP 38.04 °C
AMBIENT RH 62.05 %

LTA MAN HOURS 4,216,382 Hrs
LTA MAN DAYS 3,452 Days
HEAT INDEX 54
WIND SPEED 4.06 m/s

POWER ISLAND
KPI DASH BOARD
GT 11 OVERVIEW
GT 12 OVERVIEW
GT 13 OVERVIEW
HRSG 11 OVERVIEW
HRSG 12 OVERVIEW
HRSG 13 OVERVIEW
ST 14 OVERVIEW
ST 15 OVERVIEW
FUEL GAS SYSTEM
FEED WATER SYSTEM
WATER STEAM SYS
STM WTR CHEMISTRY

WATER ISLAND
WATER ISLAND KPI
MSF 21 OVERVIEW
MSF 22 OVERVIEW
MSF 23 OVERVIEW
MSF 24 OVERVIEW
DESAL OVERVIEW
DWPS OVERVIEW
PWPS OVERVIEW
SEA WATER SUPPLY
REMIN SYSTEM
PWPS ELECTRICAL
ELECTRICAL SYSTEM
AIR COMPRESSOR

PRODUCTION GOR PR
MSF 21 2796 T/h 7.64 7.94
MSF 22 2827 T/h 7.33 7.64
MSF 23 2812 T/h 8.08 8.38
MSF 24 2908 T/h 7.92 8.22
PLANT WTR 11343 T/h
POTABLE WTR 10500 m3/h
DISTILLATE 840 m3/h
Plant O&M Optimisation - PI ProcessBook

**Power Island Overview**

- **GT11**
  - 216.98 MW
  - 9994 kJ/kWh
  - 36.02%
- **GT12**
  - 222.13 MW
  - 9963 kJ/kWh
  - 36.13%
- **GT13**
  - 224.25 MW
  - 9928 kJ/kWh
  - 36.26%
- **HRSG11**
  - 144.21 kg/s
  - 552.90 °C
  - 74.03 bar
- **HRSG12**
  - 150.26 kg/s
  - 553.44 °C
  - 78.16 bar
- **HRSG13**
  - 164.73 kg/s
  - 554.46 °C
  - 78.70 bar
- **ST14**
  - 160.59 MW
  - 0.35%
- **ST15**
  - 153.48 MW
  - 0.46%

**Power Dispatch**
- 917 MW

**Power Generated**
- 976 MW

**Plant Net Efficiency**
- 40.54%

**Plant Aux Power**
- 59 MW

**To Desal Plant**
- 11751.9 M³/HR
Plant O&M Optimisation - Equipment monitoring

Gas Turbine 11 Overview

<table>
<thead>
<tr>
<th>Environment</th>
<th>Fuel</th>
<th>Power</th>
<th>N.O. of Starts</th>
<th>Shaft Position</th>
<th>Compressor Outlet</th>
<th>EOH</th>
<th>Report</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature</td>
<td>37.94 °C</td>
<td>217.07 MW</td>
<td>109</td>
<td>2.05 mm</td>
<td>15.74 bara</td>
<td>70104.2</td>
<td>REPORT</td>
</tr>
<tr>
<td>Rel. Humidity</td>
<td>60.92 %</td>
<td></td>
<td></td>
<td>2.17 mm</td>
<td>15.76 bara</td>
<td>68320.5</td>
<td></td>
</tr>
<tr>
<td>Pressure</td>
<td>1002.12 mbar</td>
<td></td>
<td></td>
<td>2.21 mm</td>
<td>15.74 bara</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dew Point Temp</td>
<td>28.80 °C</td>
<td></td>
<td></td>
<td>2.22 mm</td>
<td>15.74 bara</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Inlet Air</th>
<th>IGV Act Position</th>
<th>Air Flow</th>
<th>Compressor Inlet</th>
<th>Compressor Outlet</th>
<th>SWGR Voltage</th>
<th>Exciter Current</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rel. Humidity</td>
<td>55.38 %</td>
<td>100.0 %</td>
<td>978.8 mbar</td>
<td>32.0 °C</td>
<td>431.42 °C</td>
<td>1114.2 A</td>
</tr>
<tr>
<td>Pressure</td>
<td>1000.4 mbar</td>
<td></td>
<td></td>
<td>32.0 °C</td>
<td>435.16 °C</td>
<td></td>
</tr>
<tr>
<td>Temperature</td>
<td>39.37 °C</td>
<td></td>
<td></td>
<td>32.0 °C</td>
<td>433.29 °C</td>
<td></td>
</tr>
<tr>
<td>Dew Point Temp</td>
<td>28.80 °C</td>
<td></td>
<td></td>
<td>32.0 °C</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>EOH</th>
<th>OP Hours</th>
<th>No. of Starts</th>
</tr>
</thead>
<tbody>
<tr>
<td>70104.2</td>
<td>68320.5</td>
<td>109</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Power Island</th>
<th>GT Exhaust</th>
<th>GT Exhaust Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>POWER</td>
<td>FREQ</td>
<td>HEAT RATE</td>
</tr>
<tr>
<td>217.07 MW</td>
<td>50.00 s⁻¹</td>
<td>10003 kJ/kWh</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fuel</th>
<th>Power Factor</th>
<th>Cycle Efficiency</th>
<th>Comp. Efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>56.12 °C</td>
<td>0.97</td>
<td>35.99 %</td>
<td>95.46 %</td>
</tr>
<tr>
<td>NG FLOW</td>
<td>13.76 kg/s</td>
<td>585.71 °C</td>
<td>593.9 °C</td>
</tr>
<tr>
<td>V8 FLOW</td>
<td>12.81 kg/s</td>
<td>586.3 °C</td>
<td>593.9 °C</td>
</tr>
<tr>
<td>PILOT GAS FLOW</td>
<td>0.97 kg/s</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Gas Turbine 11 Overview</th>
<th>To HRSG 11</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Island</td>
<td>Flue Gas Stack</td>
</tr>
<tr>
<td>POWER</td>
<td>NOx</td>
</tr>
<tr>
<td>217.07 MW</td>
<td>22.77 mg/Nm³</td>
</tr>
<tr>
<td>FREQ</td>
<td>CO</td>
</tr>
<tr>
<td>50.00 s⁻¹</td>
<td>4.92 mg/Nm³</td>
</tr>
<tr>
<td>HEAT RATE</td>
<td>SO2</td>
</tr>
<tr>
<td>10003 kJ/kWh</td>
<td>1.48 mg/Nm³</td>
</tr>
</tbody>
</table>

EMEA USERS CONFERENCE 2015 © Copyright 2015 OSIsoft, LLC
# Plant O&M Optimisation - PI ProcessBook Report

## Gas Turbine Report

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Units</th>
<th>GT11</th>
<th>GT12</th>
<th>GT13</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambient Temperature</td>
<td>ºC</td>
<td>39.37</td>
<td>37.56</td>
<td>37.30</td>
</tr>
<tr>
<td>Ambient Pressure</td>
<td>mbar</td>
<td>1000.44</td>
<td>1000.30</td>
<td>1000.16</td>
</tr>
<tr>
<td>Ambient Humidity</td>
<td>%</td>
<td>56.54</td>
<td>63.94</td>
<td>59.72</td>
</tr>
<tr>
<td>Fuel LHV</td>
<td>MJ/Nm³</td>
<td>38.81</td>
<td>38.81</td>
<td>38.81</td>
</tr>
<tr>
<td>Power Output</td>
<td>MW</td>
<td>217.57</td>
<td>221.69</td>
<td>226.56</td>
</tr>
<tr>
<td>Heatrate LHV</td>
<td>kJ/kWh</td>
<td>9981</td>
<td>9896</td>
<td>9866</td>
</tr>
<tr>
<td>Thermal Efficiency</td>
<td>%</td>
<td>36.07</td>
<td>36.38</td>
<td>36.49</td>
</tr>
<tr>
<td>Evap Cooler Effectiveness</td>
<td>%</td>
<td>88.3</td>
<td>85.6</td>
<td>77.0</td>
</tr>
<tr>
<td>Evap Cooler ON / OFF</td>
<td></td>
<td>ON</td>
<td>ON</td>
<td>ON</td>
</tr>
<tr>
<td>Fuel Flow</td>
<td>kg/s</td>
<td>13.78</td>
<td>14.00</td>
<td>14.23</td>
</tr>
<tr>
<td>Air Flow</td>
<td>kg/s</td>
<td>614.0</td>
<td>617.5</td>
<td>610.7</td>
</tr>
<tr>
<td>Exhaust Flow</td>
<td>kg/s</td>
<td>645.2</td>
<td>645.2</td>
<td>640.2</td>
</tr>
<tr>
<td>Exhaust Temperature</td>
<td>ºC</td>
<td>591.6</td>
<td>594.2</td>
<td>597.9</td>
</tr>
<tr>
<td>Flue Gas Stack NOx</td>
<td>mg/Nm³</td>
<td>22.40</td>
<td>25.77</td>
<td>31.12</td>
</tr>
<tr>
<td>Flue Gas Stack CO</td>
<td>mg/Nm³</td>
<td>4.59</td>
<td>4.74</td>
<td>2.44</td>
</tr>
<tr>
<td>Flue Gas Stack SO2</td>
<td>mg/Nm³</td>
<td>1.72</td>
<td>3.00</td>
<td>1.00</td>
</tr>
</tbody>
</table>

![Graph showing gas turbine data](image-url)
Plant O&M Optimisation - PI ProcessBook

Water Island Overview

Water Production:
- MSF 21: TBT 110.24°C, BBT 44.68°C, PROD 2809.45 t/h, STEAM 361.00 t/h, GOR 7.50, DIST/SW 0.12, SEA WATER 22200.00 m³/h, BLOW DOWN 5198 m³/h
- MSF 22: TBT 109.96°C, BBT 45.04°C, PROD 2812.95 t/h, STEAM 381.95 t/h, GOR 7.46, DIST/SW 0.12, SEA WATER 22399.00 m³/h, BLOW DOWN 5280 m³/h
- MSF 23: TBT 110.14°C, BBT 44.71°C, PROD 2781.80 t/h, STEAM 350.45 t/h, GOR 8.16, DIST/SW 0.14, SEA WATER 20616.00 m³/h, BLOW DOWN 5357 m³/h
- MSF 24: TBT 110.28°C, BBT 44.17°C, PROD 2921.10 t/h, STEAM 352.95 t/h, GOR 8.20, DIST/SW 0.12, SEA WATER 23580.00 m³/h, BLOW DOWN 5358 m³/h

Average SW DT: 9.31 Deg C

WATER PRODUCTION:
- 11133 m³/h
- 10960 m³/h

WATER DISPATCH:
- 11133 m³/h
- 10960 m³/h

POWER PLANT:
- TBT 109.96°C
- BBT 45.04°C
- PROD 2812.95 t/h
- STEAM 381.95 t/h
- GOR 7.46
- DIST/SW 0.12
- SEA WATER 22399.00 m³/h
- BLOW DOWN 5280 m³/h

DUMP CONDENSER 1:
- 361.00 t/h
- 381.95 t/h
- 0.00 kg/s

DUMP CONDENSER 2:
- 350.45 t/h
- 352.95 t/h
- 0.00 kg/s

WATER PERFORMANCE RATIO:
- MSF 21
- MSF 22
- MSF 23
- MSF 24

DIST CONDUCTIVITY:
- 5.67
- 5.18

Plant O&M Optimisation - Water Plant Monitoring
Plant O&M Optimisation – Real-time Reports

MSF 21 OVERVIEW
8/28/2015 10:33:15

MSF 21 BRINE RECIRCULATION PUMP 1
8/28/2015 10:33:30

MSF 21 OVERVIEW
8/28/2015 10:33:15

MSF 21 BRINE RECIRCULATION PUMP 1
8/28/2015 10:33:30

COMMON SYSTEMS

HYD CANS SW DISCHARGE COMMON HEADER 9.56 ppm
HYD CANS SW SUPPLY COMMON HEADER 0.09 ppm
CL SEA WATER HEADER 0.00 ppm
PRODUCT WATER ALKALINITY 60.93 ppm
CL PRODUCT WATER 6.93 ppm
CLOG LOW PRESSURE LINE 0.01 ppm
POTABLE WATER CLOG 0.44 ppm
RESIDUAL CLORINE LOW PRESSURE LINE 0.39 ppm
RESIDUAL CLORINE HIGH PRESSURE LINE 0.12 ppm

DISTILLATE WATER PH 7.16 ppm
PRODUCT WATER PH 7.88 ppm
POTABLE WATER PH 7.94 ppm
NEUTRAL WATER PH 7.49 ppm

SW COMMON HEADER DISCHARGE CONDUCTIVITY 53.13 uS/cm
SW HEADER ANALYZE CONDUCTIVITY 55.44 uS/cm
DISTILLATE WATER CONDUCTIVITY 3.76 uS/cm
PRODUCT WATER CONDUCTIVITY 173.96 uS/cm
POTABLE WATER CONDUCTIVITY 180.20 uS/cm

HRSG Report
8/28/2015 11:02:58

Parameter | Units | HRSG 11 | HRSG 12 | HRSG 13
--- | --- | --- | --- | ---
Feedwater flow | kg/s | 143.35 | 140.21 | 144.74
HP Steam flow | kg/s | 143.81 | 149.67 | 153.01
HP Steam temperature | °C | 562.00 | 565.96 | 563.62
HP Steam pressure | bar | 74.60 | 74.60 | 74.60
Duct Burner Fuel flow | Nm³/h | 6735.60 | 7673.47 | 7585.61
Duct Burner 2 Fuel flow | Nm³/h | 6671.68 | 6662.95 | 6590.66
Duct Burner Inlet temp | °C | NO DATA | NO DATA | NO DATA
Duct Burner Outlet temp | °C | NO DATA | NO DATA | NO DATA
Duct Burner Inlet temp | °C | NO DATA | NO DATA | NO DATA
Duct Burner Outlet temp | °C | NO DATA | NO DATA | NO DATA
Drum Pressure | bar | 81.86 | 81.20 | 80.80
GT Exhaust flow | kg/s | 645.25 | 644.87 | 627.68
HRSG Efficiency | % |
Online Monitoring of equipment performance used for performance & condition based maintenance of distillers, lime stone filters and major pumps, GT suction filters etc.
Seawater Margin Improvement
Plant O&M Optimisation - Monthly KPI Reporting

QATAR POWER COMPANY, RAS LAFFAN-B, IWPP

8/28/2015 10:38:40

MONTHLY PERFORMANCE REPORTS

MONTHLY PERFORMANCE REPORTS

META - R Power Analytical Performance Review - JUN-2015

Input KPis sheet -

- All data is related to the month
- For % of Target is not calculated

- Commercial Power Availability (%) - Planned outage
- Commercial Power Availability (%) - Unplanned outage

© Copyright 2015 OSIsoft, LLC
### Power Plant KPI

<table>
<thead>
<tr>
<th>Key Performance Indicator</th>
<th>Unit</th>
<th>Design</th>
<th>Current Value</th>
<th>Average</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Std Dev</th>
</tr>
</thead>
<tbody>
<tr>
<td>GROSS POWER GENERATION</td>
<td>MW</td>
<td>1050</td>
<td>974.13</td>
<td>892.13</td>
<td>722.42</td>
<td>987.70</td>
<td>80.26</td>
</tr>
<tr>
<td>POWER EXPORT</td>
<td>MW</td>
<td>1025</td>
<td>914.62</td>
<td>832.53</td>
<td>663.07</td>
<td>927.93</td>
<td>80.08</td>
</tr>
<tr>
<td>PLANT EFFICIENCY</td>
<td>%</td>
<td>40.29</td>
<td>40.57</td>
<td>38.56</td>
<td>34.22</td>
<td>41.43</td>
<td>1.87</td>
</tr>
<tr>
<td>PLANT EFFICIENCY FACTOR</td>
<td></td>
<td>1</td>
<td>1.09</td>
<td>1.09</td>
<td>1.09</td>
<td>1.18</td>
<td>0.05</td>
</tr>
<tr>
<td>PLANT LOAD FACTOR</td>
<td>%</td>
<td>100</td>
<td>89.23</td>
<td>89.23</td>
<td>89.18</td>
<td>90.26</td>
<td>0.29</td>
</tr>
<tr>
<td>GT 11 LOAD</td>
<td>MW</td>
<td>233</td>
<td>218.89</td>
<td>192.37</td>
<td>133.02</td>
<td>221.70</td>
<td>26.29</td>
</tr>
<tr>
<td>GT 11 EFFICIENCY</td>
<td>%</td>
<td>36.76</td>
<td>35.79</td>
<td>34.96</td>
<td>31.35</td>
<td>36.68</td>
<td>1.29</td>
</tr>
<tr>
<td>GT 12 LOAD</td>
<td>MW</td>
<td>233</td>
<td>220.29</td>
<td>193.34</td>
<td>134.60</td>
<td>226.61</td>
<td>27.19</td>
</tr>
<tr>
<td>GT 12 EFFICIENCY</td>
<td>%</td>
<td>36.76</td>
<td>36.24</td>
<td>35.06</td>
<td>31.24</td>
<td>36.93</td>
<td>1.38</td>
</tr>
<tr>
<td>GT 13 LOAD</td>
<td>MW</td>
<td>233</td>
<td>223.00</td>
<td>193.79</td>
<td>134.99</td>
<td>229.50</td>
<td>27.66</td>
</tr>
<tr>
<td>GT 13 EFFICIENCY</td>
<td>%</td>
<td>36.76</td>
<td>36.36</td>
<td>35.08</td>
<td>31.25</td>
<td>37.02</td>
<td>1.40</td>
</tr>
<tr>
<td>ST 14 LOAD</td>
<td>MW</td>
<td>220</td>
<td>159.69</td>
<td>160.21</td>
<td>158.23</td>
<td>162.22</td>
<td>0.41</td>
</tr>
<tr>
<td>ST 15 LOAD</td>
<td>MW</td>
<td>220</td>
<td>152.27</td>
<td>152.43</td>
<td>137.56</td>
<td>157.40</td>
<td>1.82</td>
</tr>
<tr>
<td>HRSG 11 STEAM TEMP</td>
<td>Deg C</td>
<td>566.6</td>
<td>549.66</td>
<td>555.29</td>
<td>547.20</td>
<td>563.58</td>
<td>4.05</td>
</tr>
<tr>
<td>HRSG 11 STEAM FLOW</td>
<td>Kg/Sec</td>
<td>175.9</td>
<td>143.40</td>
<td>143.32</td>
<td>139.26</td>
<td>146.59</td>
<td>1.02</td>
</tr>
<tr>
<td>HRSG 11 STEAM PRESSURE</td>
<td>Bar</td>
<td>86.7</td>
<td>73.81</td>
<td>74.49</td>
<td>72.92</td>
<td>75.71</td>
<td>0.49</td>
</tr>
<tr>
<td>HRSG 11 E/HEAT EXIT TEMP</td>
<td>Deg C</td>
<td>144.7</td>
<td>140.56</td>
<td>142.06</td>
<td>140.78</td>
<td>140.92</td>
<td>0.00</td>
</tr>
</tbody>
</table>

### Water Plant KPI

<table>
<thead>
<tr>
<th>Key Performance Indicator</th>
<th>Unit</th>
<th>Design</th>
<th>Current Value</th>
<th>Average</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Std Dev</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTAL WATER PRODUCTION</td>
<td>M3/Hr</td>
<td>11426.3</td>
<td>11120.56</td>
<td>11116.73</td>
<td>11148.76</td>
<td>11207.55</td>
<td>21.76</td>
</tr>
<tr>
<td>TOTAL WATER EXPORT</td>
<td>M3/Hr</td>
<td>19362.5</td>
<td>10940.63</td>
<td>11117.83</td>
<td>10812.63</td>
<td>11206.88</td>
<td>105.42</td>
</tr>
<tr>
<td>PW DISPATCH</td>
<td>M3/Hr</td>
<td>97.10</td>
<td>97.07</td>
<td>97.62</td>
<td>97.24</td>
<td>97.48</td>
<td>0.09</td>
</tr>
<tr>
<td>DISTILLATE DISPATCH</td>
<td>M3/Hr</td>
<td>717.83</td>
<td>786.67</td>
<td>411.45</td>
<td>958.86</td>
<td>118.27</td>
<td></td>
</tr>
<tr>
<td>WATER PLANT LOAD FACTOR</td>
<td>%</td>
<td>100</td>
<td>10940.63</td>
<td>10956.70</td>
<td>10940.63</td>
<td>10967.21</td>
<td>8.74</td>
</tr>
<tr>
<td>MSP21 DIST PROD</td>
<td>M3/Hr</td>
<td>2640.9</td>
<td>2715.08</td>
<td>2778.87</td>
<td>2561.03</td>
<td>2911.30</td>
<td>24.74</td>
</tr>
<tr>
<td>MSP21 STEAM CONSUMPTION</td>
<td>TPH</td>
<td>336.9</td>
<td>382.35</td>
<td>363.10</td>
<td>340.70</td>
<td>373.80</td>
<td>3.68</td>
</tr>
<tr>
<td>MSP21 SW INTAKE</td>
<td>Ton/Hr</td>
<td>22500</td>
<td>22797.00</td>
<td>22645.37</td>
<td>21360.00</td>
<td>24102.00</td>
<td>326.13</td>
</tr>
<tr>
<td>MSP21 DISTILLATE COND</td>
<td>us</td>
<td>&lt;25</td>
<td>38.31</td>
<td>35.09</td>
<td>28.65</td>
<td>40.29</td>
<td>2.77</td>
</tr>
<tr>
<td>MSP21 BRINE HEATER PR</td>
<td>Bar</td>
<td>0.78</td>
<td>0.78</td>
<td>0.77</td>
<td>0.77</td>
<td>0.80</td>
<td>0.00</td>
</tr>
<tr>
<td>MSP21 GOR</td>
<td>Kg Dist/Kg Steam</td>
<td>8.43</td>
<td>7.61</td>
<td>7.63</td>
<td>7.53</td>
<td>7.69</td>
<td>0.06</td>
</tr>
<tr>
<td>MSP21 COVERSION FACTOR</td>
<td>%</td>
<td>0.13</td>
<td>0.12</td>
<td>0.12</td>
<td>0.12</td>
<td>0.13</td>
<td>0.00</td>
</tr>
<tr>
<td>MSP21 TBT</td>
<td>Deg C</td>
<td>110</td>
<td>110.26</td>
<td>110.26</td>
<td>109.95</td>
<td>110.44</td>
<td>0.99</td>
</tr>
<tr>
<td>MSP21 BBT</td>
<td>Deg C</td>
<td>43.8</td>
<td>44.88</td>
<td>45.01</td>
<td>44.43</td>
<td>45.83</td>
<td>0.29</td>
</tr>
<tr>
<td>MSP21 ANTIFOAM</td>
<td>L/Hr</td>
<td>0.027</td>
<td>82.98</td>
<td>81.77</td>
<td>77.44</td>
<td>121.54</td>
<td>1.36</td>
</tr>
<tr>
<td>MSP21 ANTISCALANT</td>
<td>L/Hr</td>
<td>146.91</td>
<td>141.38</td>
<td>133.95</td>
<td>127.54</td>
<td>120.06</td>
<td>2.03</td>
</tr>
<tr>
<td>MSP22 DIST PROD</td>
<td>M3/Hr</td>
<td>2640.9</td>
<td>2601.75</td>
<td>2601.86</td>
<td>2714.60</td>
<td>2911.65</td>
<td>21.77</td>
</tr>
<tr>
<td>MSP22 STEAM CONSUMPTION</td>
<td>TPH</td>
<td>336.9</td>
<td>374.75</td>
<td>377.46</td>
<td>369.00</td>
<td>386.16</td>
<td>2.83</td>
</tr>
</tbody>
</table>

Process displays, AF Asset Model and reports are build in-house within short time.
Plant O&M Optimisation - Performance Reports
Plant O&M Optimisation - Performance Reports

- Daily, Weekly and Monthly Performance reports
- Daily O&M meeting discussion on performance issues with real time data reporting
  - Plant Efficiency
  - Plant Loading
  - GT/MSF/HRSG Efficiency
  - GT Evaporative cooler efficiency
  - HRSG Main Steam Temp
  - HRSG Flue Gas Exit Temp
  - GT Comb Chamber Monitoring
  - Seawater Consumption
  - Chemical Consumption
  - MSF Distillate Conductivity
  - GT Suction Filter perf. Monitoring
  - Step Change and abnormality reporting
Application of PI System Tools and Capabilities

**ProcessBook**
- Real-time data analysis
- Dashboards
- Process Displays
- Equipment performance
- Trending
- Real-time deviation

**PI DataLink**
- Real-time data analysis
- Online performance monitoring
- Reports
- Equipment performance
- Trending
- Excel add ins

**PI Coresight**
- Real-time data analysis
- Dash Boards
- Equipment performance
- Trending
- Real-time decision making

**PI Analytics AF Server**
- Analytical
- Performance Calculation
- Heat stress index
- Creating asset model analytics and notification

**Notifications**
- Real-time messaging
- Notification on heat stress
- Alerting high deviations
- Equipment tripping's
- Start/stop notification
Application of PI ProcessBooks and PI DataLink

- 24/7 access to plant data from Engineers desktop
- Applications can be build in house without in depth expertise in IT
Application of PI Coresight

Mainly designed for Senior Management
Application of PI Server and Analytics

- Asset Model developed based on function and equipment
- Created templates for equipment performance analysis
- Used for HSE heat stress index calculation and notifications
Application of Notifications

Heat Stress Index Value: 50
Ambient Temp: 34 Deg C Relative Humidity: 70%
Severity Category: Danger (High Priority Category - Level III)
Heat Syndrome: Sunstroke, Heat Cramps or Heat Exhaustion likely
Work Rest Period Minutes: 20:10
Water Requirements (1 cup = 1/4 liter): 1 cup every 10 minutes

ST15 Synchronized 9/16/2014 6:15:14 PM Arab Standard Time (GMT+03:00:00)
PI_AFServer@QATARPOWER.NET
Sent: Tue 9/16/2014 6:22 PM
To: Pararam Borkar

Dear User,
ST15 is synchronized at 9/16/2014 6:15:14 PM Arab Standard Time (GMT+03:00:00)
Generator Output is 2.133247

This is an automated notification from PI. Please contact PI Admin if you feel that you received this message in error.
- PI Notifications

Regards,
Pararam Borkar
840366
Continuous monitoring of O&M efficiency, the savings through fuel margin have improved.
Result Obtained - Seawater Margin Improvement

- Continuous monitoring of seawater usage leads to savings of more than 1 million USD in first year
Results Obtained and Business Impact

- HSE Performance Improved
- Availability and Reliability Improved
- Fuel efficiency Factor Improved- Fuel margin improved
- Seawater usage reduced- Seawater margin improved
- ROI of PI System implementation is achieved

At QPower, the PI System has been utilised in an effective way to improve the plant efficiency, troubleshooting, reducing seawater consumption and condition monitoring. This improved O&M capability and continue to maintain the plant in a healthy condition for higher reliability.

QPower utilised PI System for HSE performance improvement which is unique step towards protection of human resource occupational health hazards.
Future Plan

• Event Frames
• PI Coresight with future data
• Building displays with PI ProcessBook and PI Coresight
• Continue to improve availability, reliability and plant efficiency through utilization of PI System tools
• Create value to the stake holders
Summary

QPower: Emerged as a most trusted reliable and efficient source of power and water for the State of Qatar. Contributed to Qatar’s national growth to fulfill Vision 2030. The PI System creates value to QPower’s business through real-time KPI monitoring for financial benefits.

BUSINESS CHALLENGES

A. Availability of operational data across the company
B. Improve the fuel and seawater margin
C. Improve O&M efficiency
D. Improve reliability, availability
E. Improve HSE performance

SOLUTION

A. Implemented PI system infrastructure and historian with the powerful analytical tools
B. Devised real time performance management system
C. Integration of Offline FDM with PI DataLink

RESULTS AND BENEFITS

- Real-time data availability. Implementation of dashboards includes operational efficiency and KPIs for quick decision making
- Fuel Efficiency Factor improved by 0.98% resulting into fuel margin of 1.4 million USD/year (0.2%)
- Seawater margin improved by 1.3 million USD for year 2013 &14.
- Positive NPV with ROI – 8 months
Contact Information

Parasram Borkar
pdborkar@qatarpower.net
Sr Engineer - Commercial & Performance
Qatar Power Company
Questions

Please wait for the microphone before asking your questions

Please don’t forget to...

Complete the Online Survey for this session

http://eventmobi.com/emeauc15

State your name & company
Thank You