PI System Based Air Emission Calculation & Reporting System at Dolphin Energy

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Agenda

• Project Overview
• Dolphin Energy Limited (DEL)
• Project Drivers and Objectives
• Project Scope and Schedule
• System Total Revamp Activities
• System Results and Examples
• Best Practices and Lessons Learned
Project Overview

• Dolphin Energy Limited (DEL) developed the Air Emissions Calculation System (AECS) in PI for real-time monitoring of instruments such as continuous emissions monitoring system (CEMS), fuel gas flow meters for *environmental regulatory and corporate sustainability reporting requirements*.

• AECS was commissioned in 2006. Overtime, many changes and errors were found and the calculation results became unreliable for reporting.

• Since 2010, Trinity T3 was engaged by DEL Environmental to identify root causes and update air pollutants calculation methods, add greenhouse gas emissions, and reconfigure PI Performance Equations (PI PE) to improve AECS quality.
AECS with The PI System

“We did the project to ensure the AECS can produce reliable data for all air emission reporting including corporate KPI. The new system will save us a lot of time for QA/QC and produce accurate reports.”

Dr. Rola Atiyeh
Dolphin Energy

Business Challenge

• Mistakes caused by AECS equations, instrument failures, process shutdown
• Difficult to QA/QC and time consuming for reporting process

Solution

• Verify & document equation methods
• Tag status check & reconcile values for accurate data
• Establish calculations based on reporting requirements

Results and Benefits

• Accurate, verifiable, and documented technical/scientific calculation methodologies
• Calculations with 100% validated data & meeting EHS compliance/reporting requirements
DEL’s Commitment to Environmental Sustainability

• AECS is essential for providing reliable emission data to measure environmental performance

• The AECS improvement project involved many groups:
  – Environmental Department
  – Automation Engineers
  – Operation Groups
  – Process and Application Engineers
  – Instrument Department
  – Laboratory
  – Consultants
Trinity Consultants, funded in 1974, has been providing innovative, cost-effective, and sustainable solutions to EH&S compliance, modeling, monitoring, and data management globally.
Project Drivers – AECS Data & Calculation Issues

- Process unit shutdown but CEMS analyzers still in operation
- PI Tag shows “Bad Data” due to instrument failure while unit still in operation caused missing emission data
- Incorrect or missing raw data PI Tags as inputs to calculation equations
- Incorrect equations coded previously in PI Performance Equations
- Incorrect/inconsistent engineering units labeled for PI Tags result in incorrect calculations
- Poor documentation for calculation methods, PI Performance Equations, and validation process
AECS – Mission Critical System for Reporting Requirements

- **Emission Inventory** – Pollutants corrected concentrations and emission rates
- **GHG Accounting** – Carbon footprints
- **Flare** – Gas flared, heat release, pollutants emission rates
- **Process** – Efficiency, Excess Oxygen, Exhaust Gas Temperature, Heat Release
- **Production** – SRU throughput, efficiency, fuel usage
Project Objectives

- To ensure the AECS related calculations are established in the PI System based on the following criteria:
  - Calculations can meet environmental compliance and reporting requirements
  - Calculation equations are coded accurately in the PI Tags with proper validation procedure to fill-in missing data gaps
  - Calculation input data are based on real time process data in RTDB for real-time data quality and emission limits monitoring
  - Well documented calculation methodologies to support the system be verified by 3rd party auditors
Project Scope

• AECS enhancement started in Q1 2012:
  – Reviewed and confirmed all existing AECS related emission calculation methodologies
  – Revised, removed, and added PI PE with logics and formulae
  – Configured tags in tiers to handle sequential calculations
  – Simulated all PI Tag calculations in a PI System simulation environment; validated calculation results from simulation system to ensure equations were coded properly
  – Transferred all new/revised PI Tags to the DEL PI System; tested calculation process in April 2013
  – Documented technical basis of AECS for future references
  – On-going validating/updating AECS since April 2013
Air Emissions Calculation System

• Process Units:
  – Boilers/Heaters/ Furnace
  – Turbines
  – Incinerators
  – Sulfur Recovery

• Flares
  – Offshore Flares
  – Onshore Flares

• Compounds/ Pollutants:
  – O₂
  – NOₓ
  – CO
  – SO₂/H₂S
  – Greenhouse Gases (GHG):
    ▪ CO₂
    ▪ CH₄
    ▪ N₂O
AECS
TOTAL REVAMP ACTIVITIES
AECS Review – Process & Environmental Knowledge

- Reviewed/confirmed/revised/added calculation methods
- Identify all PI Tags related to air emissions calculations
- Review/confirm existing tags and tag equations
- Revise and add new tags based on environmental regulatory compliance requirements
PI Tag Data Reconciliation Process

CEMS Analyzers, Process Instrument, or Flow Meters

Analyzer or Meter Processing

Data Passed to PI Tags

Is the Unit Shutdown?

No

Is the Unit In Maintenance?

Yes

Status Tag Indicates Maintenance

Use Last Good Value or Design Value? (Pre-defined)

No

Last Good Value

AECS Calculations

Results Based on Last Good Value

Yes

CEMS Analyzer < 0? Yes

Tag w/ Good Value?

No

AECS Results = 0

AECS Calculations

Results Based on Real-Time Data

Check Data validity and range comparison

No

Yes

AECS Results = 0

AECS Calculations

Results Based on Design Value
Revamped AECS PI Tags Summary

- Identified analyzer/instrument/LIMS tags as input data tags to AECS
- Identified instrument maintenance tags to set status
- Add constant tags for design values, emission factors, etc.
- Totally revamped and recreated calculation tags:
  - Tags for existing air emissions calculations
  - Tags for GHG calculations
  - Status tags for each input data tag
  - Reconciled value (RV) PI Tags for each raw tags based on Status PI Tags
  - Hourly average of RV PI Tags for final calculations
OSIsoft Products Applied

- PI Performance Equations (PI PE)
- PI System Management Tools (PI SMT)
- PI Tag Configurator
- PI DataLink
- PI ProcessBook
Tags Uploaded to The PI System

- Identified sources of calculation input tags; passed DCS tags to PI System; Verify input tags UOM Created new tags in PI System
- Determined calculation frequency; Created Hourly Average tags for reporting; Established scan frequency for calculation tiers;
- Developed & uploaded additional calculation PI Tags; Tested all calculations
- Validate hourly calculation results
AECS Results
Project Results – AECS Improvement

Pre-Study System

- Questionable calculation methods
- Bad data and failed calculations in various conditions
- Labor intensive and difficult to correct calculated results from the PI System
- Unreliable results for compliance and sustainability reports

Post-Study System

- Calculation methodology has been thoroughly reviewed and confirmed in PI Tag equations
- Reliable and accurate calculations generated in RTDB and accessible to all DEL users
- User can identify analyzer downtime easily
- Data can be relied on for reporting requirements
Example – Differences of Calculated Results

Pre-Project Calculation, Post-Project Calculation, Emission Limit
Effects of Reconciliation

Raw PI Tag Value, Post-Project Reconciled Value, Hourly Average of RV
PI ProcessBook Display Example
A Dashboard of All Key Parameters for A Process Unit

- O2
- NOx
- CO
- SO2
- Fuel
- NOx Emission Rate
- CO Emission Rate
- SO2 Emission Rate
Best Practices and Lessons learned

1. Use data reconciliation for mission critical reports
2. Documentation, Documentation, Documentation
3. Validation, Validation, Validation
4. Training for End-Users to gain confidence in real-time data
5. The PI System is powerful system to enhance EHS compliance:
   – Calculations within the PI System for real-time results to reduce uncertainty of process measurement and monitoring data
   – PI ProcessBook allows user review many data sets and quickly identify proper resolutions to improve data quality.
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