Control Loop Performance Monitoring
AT
Ras Gas, Qatar

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The RasGas Environment

- **High growth of operational complexity and capacity**
- **Increasing product portfolio volumes and diversity**
  - LNG, Condensate, Flowing Gas, Helium, LPG's

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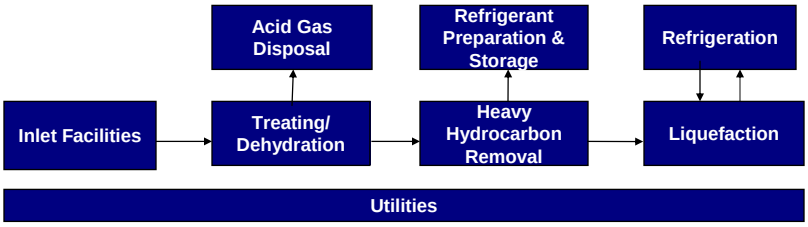
Components of Onshore Facility



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Common Plant Performance Issues –Control View

- Loops operating in manual or local
- Valve fully open or closed
- Different performance under different conditions -loop robustness
- Instability at any operating point
- Excessive valve maintenance / poor valve response
- Poor set point response
- Frequent operator interventions
- Poor load rejection
- Unexplained oscillations

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Overview

Objectives

A. Pre-requisite for APC Implementation

To keep regulatory loops responsive and optimised so that advanced controllers can do their job of optimisation against constraints.

B. Establish Benchmark AND KPIs TO:

- Define Baseline
- Identify Poor Performers
- Maintain Improvements

C. Help Optimize Regulatory Controls TO:

- Reduce Interactions / Disturbances
- Improve Robustness Over Controllable Range
- Maximize Benefits PRE-MPC Implementation at DCS LEVEL

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KPI's for Control System Performance

- Control Loop Availability
  - % Time in Manual
  - % Time output at limit
  - % Time PV unavailable
  - % Time PV at limit
  - % noise in PV
  - Mode changes/shift
- Control Loop Performance
  - Integrated error –IAE, ISE. IE
  - Valve wear (travel and reversals)
  - Oscillation
    - % hysteresis& % stiction
    - % time in oscillation
    - % error vs operating point
  - Cross-correlation

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Control Loops are Economic Assets ..

Train-3 Study shows that…

- 15% of control loops were oscillating.
- 33% had controller output at limit.
- 27% had excessive valve travel.
- 20% involved high variability.

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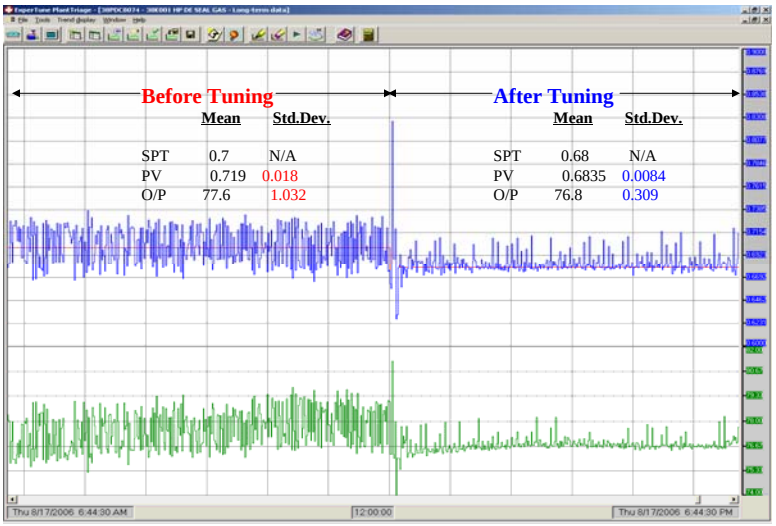

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KPI Comparison before and after tuning

Key Performance	Before Tuning	After Tuning
Avg.% to Threshold	72.06	47.32
Variability – KPI	4.423	2.593
Variability - %T	147.4%	86.42%
Variability - %E	73.71%	43.21%
Avg.absolute Error – KPI	1.338	0.5325
Avg.absolute Error - %T	26.76%	10.65%
Avg.absolute Error - %E	13.38%	5.325%
Output Std.Deviation - KPIOutput Std.Deviation - %T	0.8383 16.77%	0.3103 6.206
Output Std.Deviation - %E	8.383%	3.103%
Valve Travel – KPI	34550	3448
Valve Travel - %T	138.2%	%13.79%
Valve Travel -%E	69.1%	6.895%
Valve Reversal - KPI	25220	6726
Valve Reversal - %T	50.43%	13.45%
Valve Reversal - %E	25.22%	6.726%

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Improvements

IDENTIFIED

- Normal Modes requirements
- Valve Travels and Reversals
- Variability

LESSONS LEARNT

- **Project Execution**
  - **Training**
  - **Project execution Team**
  - **Follow-up post-installation**
- **Technical**
  - **LNG experience**
  - **System Configuration issues**

Way forward

- Continuous Improvement of Control Loops prior to APC implementation
- Run and analyze reports regularly (Monthly)

Started developing Process Surveillance Monthly report to indicate

  - Top 10 Biggest Payback loops
  - KPIs

- Roll-Out, Training and System Access
- Continuous Improvement Procedure

Questions ??

Thank you for your participation