Case Study

RTR Asia Meeting, November 2008

PM CONTROL SYSTEMS PTE LTD

Woodward system increases productivity and reduces downtime in fertilizer turbine-compressor application

BACKGROUND

PT Pupuk Sriwidjaja (Pusri) fertilizer plant implemented a Woodward MicroNet TMR system for the GB-102 steam turbine driven Compressor at Pusri 3 to increase the productivity and reduce downtime of the system

Pusri, founded in 1957, is based at the city of Palembang on the Indonesian island Sumatra. Since the beginning of the company, Pusri was involved in the production if fertilizer. Over the years an additional 4 fertilizer plants were build at the Palembang location. Each plant is called in sequence of the building date, calling the different plants Pusri 1 through Pusri 5.

In 1979, the Indonesian government assigned Pusri as the subsidiary for fertilizer production for the country. Nowadays a significant part of Pusri's production is meant for export.

In 1990 Pusri 1 was replaced by a new plant called Pusri 1B to upgrade the technology, increase the efficiency and production.
Each of the 5 plants has a capacity production of 570,000 tons of fertilizer a year.

Manufacture of the GB-102 turbine and compressor is Borsig GmbH.

The GB-102 turbine/compressor train is one of the most crucial systems in the Pusri 3 fertilizer plant.

The GB-102 compressor controls the CO_2 feed to the fertilizer reactor. Without this CO_2 feed the entire Pusri 3 has to shutdown and losses its entire fertilizer production.

CHALLENGE

There were multiple challenges for the control retrofit of the GB-102 turbine/compressor train.

First of all, the unit has to be on-line around the clock and should not be taken out of operation until the next plant shutdown which occurs each every three years. Any unscheduled shutdown would cause the loss in production and turnover for Pusri.

To ensure the quality of the fertilizer the feed of the CO_2 has to stay in tune with the feed of the other components (ammonia, oxygen, natural gas etc) to the fertilizer reactor. Any change in process feed of components requires a fast and accurate response for the CO_2 feed to ensure the quality of the produced fertilizer.

Therefore, process operator should be able to interfere in process parameters in an accurate, fast and easy way.

Although the compressor is a 3-stage compressor with two intercoolers there is only one compressor performance map which combines the 3 stages. Hence for anti-surge control the compressor was considered it as a single stage compressor with one recycle valve.

Solutions

- Solution provider
  - PM Control Systems
  - CV Samudra
- Turbine/compressor control system
  - Woodward MicroNet TMR system
  - Integrated turbine and compressor anti-surge software.
  - Moog Integrating Servo Valve
  - Various Emerson field transmitters

Results

- Operational impact
  - 7-8 % increased productivity.
- Reliability impact
  - 10-11 % decreased downtime.
- Commercial impact
  - Follow up order for other units.

The old control system did not give Operators accurate information to determine the operation point of the compressor. The recycle valve was fully manual controlled. Due to the lack of overview, Operators can demand too much of the system, causing unsafe compressor operation.

Clear overview of compressor and turbine parameters were required from the new system to prevent such unsafe operation.

Effective compressor anti-surge routines were required to protect the process, the compressor and human safety in case of process disturbance and/or human error.

In 2006 Pusri decided to modernize the control system for the GB-102 turbine-compressor train in order to increase the productivity and decrease the downtime.

Requirements for the new control system included following functions/features:

- Start/stop and speed control of the entire train.
- Capacity and anti-surge control of the compressor.
- A local operating panel to have full operation of the turbine and compressor.
- HMI (Human Machine Interface) for remote control.
- A new actuator system for the integrating steam control valve of the turbine.
- Modifications to enhance the response of the slow acting pneumatic recycle valve, used for the compressor anti-surge routines.
- Multiple field sensors required for effective anti-surge control.

SOLUTION

Two parties were bidding on the retrofit of GB-102 namely: PM Control and a competitor.

The Competitor previously installed their system on the Borsig GmbH CO_2 compressor.

However the competitor failed to meet Pusri's expectations. In the first year after the commissioning the following problems appeared to their system:

- Constant failure of system's redundant power supply.
- The redundancy of the system was not able to perform hot backup.
- The system's HMI was also not able to provide remote command and control of the unit.
- The competitor failed to provide prompt and successful service in case of malfunction of the system.

PM Control systems, Woodward Central Distributor South-East Asia and CV Samudra, local agent of PM Control in the Palembang area made a proposal.

The following was proposed for GB-102 turbine/compressor train:

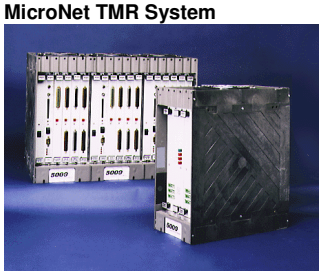
- Woodward MicroNet TMR control system with dual IO.
- Local Operator Panel including multiple panel switches, lights and analog indicators.
- A desktop computer with a Proficy Ifix HMI.
- A custom made Cubicle to suit the limited space at site for housing of the MicroNet TMR system and the local operator panel.
- Actuator system including:
  - Moog 72 series integrating Servo valve, Dual Coil.
  - MCP 5-wire RVDT, Dual Coil.
  - Stainless steel Actuator Hydraulic Manifold.
  - Aluminum RVDT housing with connector.
- Emerson-fisher Type 2625 Volume Booster to increase the response of pneumatic recycle valve.
- Emerson-Rosemount Field transmitters for Suction Flow, Suction- and Discharge Pressure and Suction Temperature.

Woodward MicroNet TMR system

The MicroNet TMR has three CPU and is based on 2 out of 3 voting. All IO to and from the system is redundant allowing the system to have a single point failure.

The following cards and its corresponding FTMs were used:

MicroNet TMR System



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- TMR Motorola CPU (p/n: 5501-470)
- High Density Discrete IO card (p/n: 5466-258)
- High Density TMR Analog Combo Card (p/n: 5466-253)
- Integrating Actuator Controller Card (p/n: 5501-429)
- LON Network Controller Card (pn: 5466-031)
- Linknet 8 CH Analog Output (p/n: 9905-972)

The GAP software for the turbine is developed by PM Control. The GAP software for the anti-surge is the Woodward ITCC software.
Both software are linked together and coded simultaneously to create one HEX-file. This HEX-file is downloaded into the 3 MicroNet CPUs.

Custom made Cubicle
The cubicle was designed by PM Control, fabricated by a local panel builder. Due to the fact that Pusri had special requirement regarding the dimensions a standard size panel could not being used.

The cubicle also had to house the Local Operating Panel and existing Bentley-Nevada vibration monitoring/safety system.

Cubicle components like redundant 24VDC power supplies and terminal strips were from Phoenix Contacts.

Local Operating Panel
The Local Operating Panel enables the Operators to use and operate the turbine and the compressor. Multiple switches, lamps, analog indicator make this possible.

System control from the Local Operating Panel can only be done if in local control mode is selected. If remote control mode is selected, system control can only be done by HMI.

The Local Operating Panel includes an annunciator displaying several alarms and shutdowns.

HMI Human Machine Interface.
The HMI is used to enable operators' easy access to relevant system parameters and allow them to start and stop the system and change operating setpoints.

The system has multiple level login for operators, engineers and system administrators.

Other features are alarm and shutdown monitoring and reset. The HMI has real time and historical trending and event log which are downloaded onto the computer's hard drive for system analizing and trouble shooting.

Actuator System
The steam control valve of the turbine is controlled by the actuator system.

The integrating actuator cards of the MicroNet driving the two coils of the Moog servo valve. Control valve position feedback to the actuator cards are provided by the dual coil RVDT.

This close loop allows the system to position the integrating steam valve. All double equipped components in the actuator system ensure it to be fully redundant.

Recycle valve Booster
In the existing system the opening of closing time of recycle valve was very long (10-12sec). Its reaction was so low that safety against surge events of the compressor could not be guaranteed.

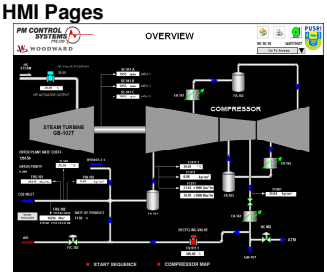
Installation of a pneumatic booster shortens the opening and closing time to approx. 1 second.

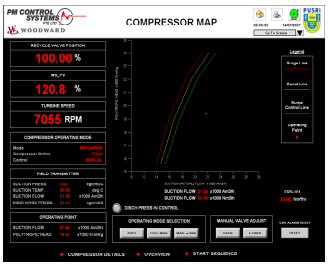
The recycle valve is also reverse acting ensuring in case of an actuator failure the recycle valve will fully open preventing surge to occur.

Installation and commissioning
Installation of the various components was done by engineers from PM Control,

CV Samudra and Pusri. CV Samudra was responsible for all cabling laying and termination of the wiring. IO

HMI Pages





Local Operating Panel

Actuator System

checking and calibration of the system was carried out by PM Control.

During commissioning, several test runs were made and fault were triggered or simulated to verify proper operation of the system.

Special attention was given to verify the anti-surge logic and verification of the compressor map in the control system and its relation with the actual compressor map. This was done to force the compressor in a light surge at three different speeds.

After an intensive testing period a duration test was done on the entire system. During the duration test the entire system was operational and the GB-102 compressor was integrated in the production of the fertilizer plant of Pusri 3.

Pusri operators are controlling the system and engineers of PM Control are only available as after sales support.

During this period maintenance, operational and trouble shooting training was provides to different operator shifts.

After duration testing Pusri approved all its system requirements were met and the new system was officially handed over on 14 April 2007

RESULTS

Pusri reports that over the period that the new system is installed no unforeseen events have happened with the GB-102 compressor which was related to the new system. This has helped to reduce the down time of the unit with 7-8%.

Due to the clear interface of the local panel and the HMI operators are able to run the system with greater efficiency. This has caused a general grow of 10-11% of fertilizer production of Pusri 3.

Due to the success of the retrofit of the GB-102 compressor Pusri has assigned PM Control Systems to implement the ITCC routines on a MicroNet TMR system (already provided by PM Control) of the air compressor of Pusri 1B. Final installation and commissioning is scheduled at the next turn around period of Pusri 1B in 2010.

SYSTEM OVERVIEW