

## PT Pupuk Sriwidjaja Woodward MicroNet TMR increases productivity and reduces downtime in fertilizer turbine-compressor application



### Background

The fertilizer company PT Pupuk Sriwidjaja (Pusri) was founded in 1959 in the city of Palembang on the Indonesian island of Sumatra. Since the initial operation of the Pusri I plant in 1961, the company has built an additional four fertilizer plants in Palembang.

The facilities are named in sequence of their building dates. Each of the 5 plants now has a production capacity of 570,000 tons of fertilizer a year serving both domestic and international demand for artificial fertilizer.

In 2006 Pusri decided to upgrade the GB-102 steam turbine driven compressor of their Pusri 3 plant, manufactured by Borsig GmbH. The company implemented a Woodward MicroNet TMR (Triple Modular Redundant) controller, a customizable digital control platform that reliably controls and protects steam, gas turbines, and compressor trains.

### Challenge

The GB-102 compressor is a crucial part of the Pusri 3 fertilizer plant: The application controls the CO<sub>2</sub> feed to the fertilizer reactor. Without this CO<sub>2</sub> feed the plant is unable to operate and the facility loses its entire production. To ensure the quality of the fertilizer, the CO<sub>2</sub> feed has to stay aligned with the feed of other components (ammonia, oxygen, natural gas etc.) to the fertilizer reactor. Changes in this area require a fast and accurate response of the CO<sub>2</sub> feed to optimize and ensure the quality of the end product. Process operators must be able to intervene through process control set points in an accurate, fast and easy way.

Pusri had previously worked with Compressor Control Company (CCC) on the installation of CCC's Series 3 Plus control system for their Borsig GmbH CO<sub>2</sub> compressor. However, in the first year after the commissioning, the following issues appeared:

- Constant failure of the system's redundant power supply;
- The redundancy of the system was not able to perform hot backup;
- The CCC control system did not give operators accurate information to

### Solutions

- Woodward MicroNet TMR control system with dual inputs and outputs (IO);
- Local operating panel including multiple panel switches, lights and analog indicators;
- Desktop computer with HMI (Proficy iFIX);
- Custom-made cubicle to suit the limited space at the site for housing of the control system and local operator panel;
- Actuator system

### Results

- Increased production by 7 - 8 %
- Production Growth of 10 - 11 %
- Closing time of the recycle valve decreased by 90%



- determine the operation point of the compressor;
- The system's HMI (Human Machine Interface) was unable to provide remote command and control of the unit;
- CCC failed to provide prompt and successful service in the occurrence of system malfunctioning.

In 2006 Pusri decided to retrofit their GB-102 compressor control system. To ensure human safety, protect both the process and the compressor and increase productivity, the new control system required the following functions/features:

- Start/stop and speed control of the compressor;
- Capacity and anti-surge control;
- A local operating panel for easy operation of the system;
- HMI for remote control;
- A new integrating actuator for the steam valve;
- Modifications to enhance the response of the slow acting pneumatic recycle valve.

### Solution

Two parties were bidding on the retrofit of the GB-102: PM Control, Woodward's central distributor for Southeast Asia, and Compressor Control Company (CCC). PM Control, together with its local agent CV Samudra, proposed the following:

- Woodward MicroNet TMR control system with dual inputs and outputs (IO);
- Local operating panel including multiple panel switches, lights and analog indicators;
- Desktop computer with HMI (Proficy iFIX);
- Custom-made cubicle to suit the limited space at the site for housing of the control system and local operator panel;
- Actuator system including:
  - Integrating dual coil servo valve (Moog 72 series);
  - MCP 5-wire dual coil rotary variable differential transformer (RVDT);
  - Stainless steel manifold for the hydraulic actuator;
  - Aluminum RVDT housing with connector;
  - Volume booster to increase the response of pneumatic recycle valve (Emerson - Fisher 2625);
  - Field transmitters for suction flow, suction- and discharge pressure and suction temperature (Emerson - Rosemount).

### Woodward MicroNet TMR system

The Woodward MicroNet TMR system has three CPUs and is based on 2 out of 3 voting to ensure the highest reliability and availability. All control system inputs and outputs (IO) to and from the system are redundant, allowing the system to have a single point failure. PM Control developed the GAP software for the turbine, while Woodward ITCC software was used as the core software for the anti-surge algorithms. The software products were linked together and coded simultaneously to create one HEX-file. This HEX-file was downloaded into the three CPUs.

### Local Operating Panel

The local operating panel enabled the operators to control the system with the help of multiple switches, lamps and an analog indicator. The operator can choose to operate the turbine from either the local operating panel or from the Human Machine Interface (HMI). The local operating panel includes an annunciator displaying several alarms and shutdowns.



MicroNet TMR System



Actuator System

### Human Machine Interface (HMI)

The HMI allows operators easy access to relevant system parameters and enables them to start and stop the system and change operating set points. It has a multiple level login for operators, engineers and system administrators. Other features include alarm and shutdown monitoring and reset. The HMI has real time and historical trending and event logs, which are downloaded onto the computer's hard-drive for system analyzing and troubleshooting.

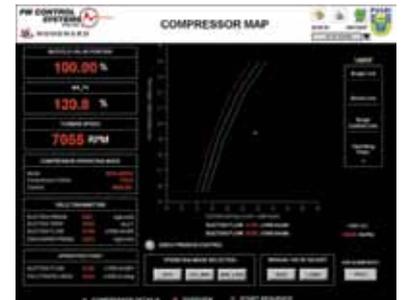


### Actuator system

The steam control valve of the turbine is controlled by the actuation system. The integrating actuator cards of the MicroNet drive the two coils of the servo valve. Control valve position feedback to the actuator cards is provided by the RVDT sensor. This closed loop allows the system to position the steam valve fast and accurately. Thanks to all double equipped components the actuation system is fully redundant.

### Installation and commissioning

PM Control, CV Samudra and Pusri engineers installed the various components. CV Samudra was responsible for all cabling and termination of the wiring. IO checking and calibration of the system was carried out by PM Control.



HMI Pages

The implementation of the control retrofit was challenging: The unit had to stay online around the clock and could not be taken out of operation until the next plant shutdown, which occurs once every three years. Any unscheduled shutdown would result in production and turnover loss for Pusri.

During commissioning, several test runs were made completed in which and faults were triggered or simulated to verify confirm proper operation of the system. During these test runs, special attention was given to the anti-surge logic and to verify the compressor map in the control system and its relation with the actual compressor map. This was done by forcing the compressor into a light surge at three different speeds. The compressor surge test confirmed that the performance map, which consisted of a single map for all three compressor stages, was indeed accurate.



Local Operating Panel

After an intensive testing period a duration test was done. During this test, the entire system was operational and the GB-102 compressor was integrated into the production process of the Pusri 3 fertilizer plant. Throughout this period PM Control provided maintenance-, operational- and troubleshooting training to different operator shifts. After duration testing Pusri confirmed that all its system requirements were met and the new system was officially handed over on 14 April 2007.

### Results

- Increased production by 7 - 8 %
- Production Growth of 10 - 11 %
- Closing time of the recycle valve decreased by 90%

Pusri has reported that since installation the new system has run smoothly without any disturbances. The Woodward MicroNet TMR has helped to reduce the downtime of the unit by 7-8 %, enabling Pusri to increase its production rates.

Due to the clear interface of the local operating panel and the HMI, operators are now able to run the system more effectively. This has led to a growth of 10-11% in Pusri 3's fertilizer production.

In the previous system, the opening and closing time of the recycle valve was very long (10-12 seconds). The reaction time was so slow that safety against surge events of the compressor could not be guaranteed. Yet through the installation of a pneumatic booster, the opening and closing time has been shortened by over 90% to approximately 1 second. The recycle valve is also reverse acting ensuring that in case of an actuator failure, the recycle valve will fully open, preventing surge from occurring.

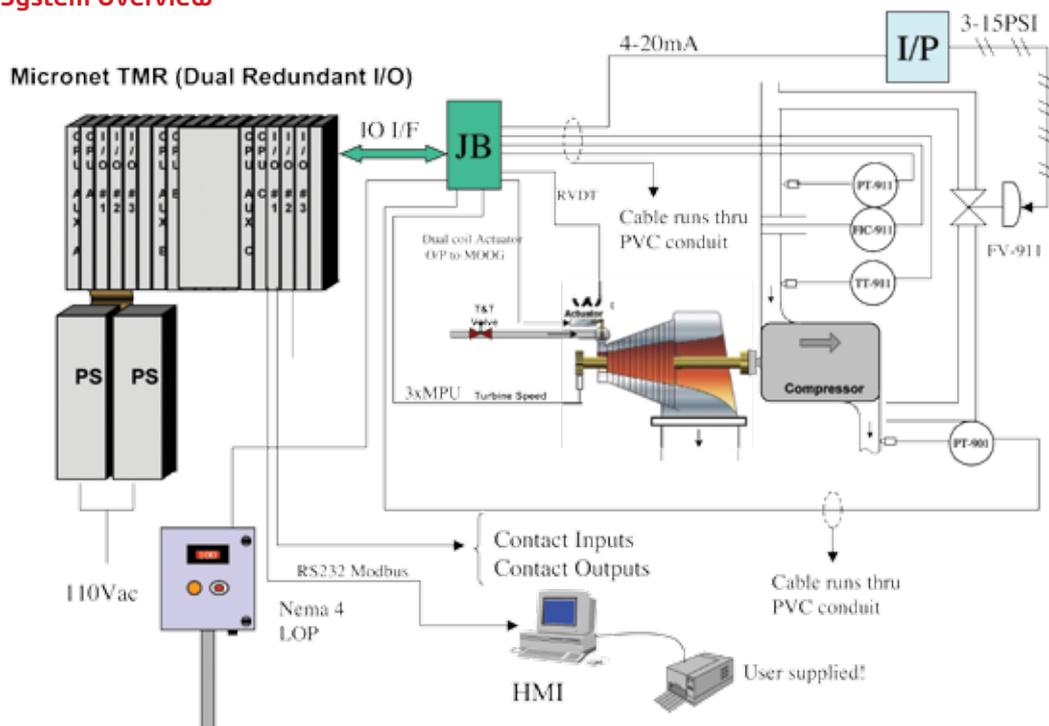
Thanks to the success of the GB-102 compressor retrofit, Pusri also assigned PM Control to implement the ITCC routines on a MicroNet TMR system of the air compressor in the Pusri 1B plant. The system was successfully installed and commissioned in 2010 during the Pusri 1B turnaround period.

Since then, PM Control has successfully upgraded multiple turbine and compressor control systems at the various Pusri plants. For the new Pusri 2B plant, expected to be completed in December 2015, Pusri has chosen redundant Woodward Integrated Turbine and Compressor Controls (ITCC) for all new compressors. For its new general-purpose steam turbines Pusri also continues to trust on Woodward.

### About PM Control

PM Control delivers energy optimisation solutions that increase efficiency while lowering emissions. Serving the energy, process and transportation markets, PM Control is the appointed distributor and recognized retrofit partner for Woodward Inc., Regional Technical Center for ABB Switzerland and Value Added Reseller for L&S Electric. Through our activities PM Control is having a positive impact on the lives of people across SE Asia, Australasia, India and beyond.

### System Overview



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