They're very responsive, provide great technical support and working in coordination with them, we were able to come up with some very good control schemes. Together, we've done outstanding work on the profile control of our variable density films.

– JON MEANOR
ELECTRICAL ENGINEER AT DUPONT TEIJIN

PDO EXTENDS LIFE OF CRITICAL PLANT AUTOMATION ASSETS THROUGH TIMELY TECHNOLOGY UPGRDES

Case Study
As a major oil and gas industry operator, PDO required a proven solution allowing it to upgrade existing Process Automation System (PAS) and other automation assets to the latest technology without the risk of costly downtime or the loss of valuable intellectual property.

BACKGROUND

Petroleum Development Oman (PDO) is the leading exploration and production company in the Sultanate of Oman. PDO delivers the majority of the country’s crude oil production and natural gas supply. It is jointly owned by the Government of Oman, Royal Dutch Shell, Total and Partex. PDO’s first economic oil find was made in 1962, and the first oil consignment was exported in 1967.

PDO’s Government Gas Plant (GGP) was established in 1978 in northern Oman. The facility has been the main gas operation for the Sultanate of Oman, finding gas fields and developing them into producing assets on behalf of the government.

GGP was originally constructed by PDO at its Yibal field to process as much as 2 mm cmpd of gas, most of it to be delivered to the Al Ghubrah Power and Desalination Plant in Muscat via a 20-inch pipeline. Since then, the demand for gas in Oman has increased at a steady pace, calling for PDO to progressively expand the GGP and the pipelines and associated pressure-limiting and valve stations of its Gas Transportation System (GTS). Moreover, there was a need to upgrade the Process Automation System to the latest technology to meet the life cycle demands.

CHALLENGES

Gas processing facilities strive to optimize production throughput and minimize downtime and operational cost, while maintaining safe operation. To meet these objectives, their automation systems and related technology assets must meet stringent process control requirements, while being reliable and scalable.

Like other major petroleum industry organizations, PDO has a critical need to address which are as follows:

- Reduce the risk of unplanned downtime
- Increase the efficiency and reliability of processes
- Ensure consistent gas quality
- Achieve greater throughput with existing equipment

At PDO’s GGP facility, engineers sought to optimize the footprint of various control system components, including controllers and cabinets. They also wanted to upgrade all legacy Honeywell High-Performance Process Managers (HPMs) to Experion® PKS C300 controllers and enhance the capacity of the plant’s Fault Tolerant Ethernet (FTE) network infrastructure.

Over the years, the GGP facility had progressed from a TDC 3000 control system with Advanced Process Managers (APMs) to the TotalPlant™ Solution (TPS) platform with C200s and FailSafe Controllers (FSCs), then to Experion PKS with C300 controllers, and finally to the Enhanced High-Performance Process Manager (EHPM) and Enhanced Universal Control Network (EUCN) solutions. In 2019, the GGP upgraded all its FSCs to the new Safety Manager (SM) system.

Due to the increasing gas demand in Oman, PDO sought more sustainable operations and a better process control environment at the GGP facility. The specific goals for technology upgrades were to improve operational efficiency while retaining valuable intellectual property and enhancing lifecycle planning.

However, PDO’s project team faced several engineering, planning, and execution challenges in undertaking technology upgrades. The duration for an operational shutdown for the modernization tasks was critical. Engineering work for outdated auxiliary control room assets would prove to be complicated. Moving operator workstations and transitioning networks to a new standard would also be difficult. Wiring and loop checks for thousands of control loops would present significant risks.

Adding to above, an overarching challenge for the entire GGP upgrade project was the resource limitations imposed by the COVID-19 pandemic.

SOLUTION

PDO developed a technology rejuvenation strategy to improve the GGP’s ability to operate at higher availability and efficiency levels. This far-reaching project addressed numerous production assets across the company’s large gas processing operation.

Figure 1. PDO’s Government Gas Plant (GGP) is the main gas operation in Oman.
Based on the findings from a Baseline Assessment; Fire, Gas Dispersion, and Explosion Assessment (FGDEA); and Quantitative Risk Assessment (QRA), PDO decided to relocate the GGP’s Central Control Building (CCB) and Auxiliary Buildings (ABs) to a safer location away from the facility’s existing export line. The plan was to build a new Integrated Control Room (ICR) with the latest recommended ergonomic features in accordance with the Human Factor Engineering (HFE) standards as shown in Fig 2.

PDO’s modernization efforts would also be aimed at addressing 30-year-old legacy panels and the lack of update data, as well as the legacy network between safety systems. The company wanted to enhance operator effectiveness and improve their ability to make faster and smarter decisions by integrating crucial operations. Finally, plant management required a capacity increase to support various FCPs/projects.

Prior to the control technology modernization, the automation architecture at the GGP facility incorporated 16 UCP controllers, 13 redundant FSCs, four redundant HPMs, and 22 C300s with HART and FOUNDATION Fieldbus modules. On L2, there were different number of servers and engineering and operator workstations. This included one Experion Server-TPS (ESVT), one redundant Experion Server (ESV), and one redundant OPC/FDM server. All these nodes were connected by 22 backbone old switches and associated routers and firewalls.

The proposed scope of the overall technology upgrade was to move all HPMS to C300s and replace FSCs with SMs while keeping the same I/O modules. The work also focused on transitioning the plant’s supervisory control level to the latest software release along with a hardware refresh. The result would be a standardized system architecture supporting continuous improvement opportunities while providing a smaller footprint.

In addition, the technology upgrade project involved the deployment of new RS485-type interfaces with low-voltage (LV) switchgear and the installation of heating, ventilation and air conditioning (HVAC); uninterruptible power system (UPS); and closed-circuit television (CCTV) equipment.

A phased approach was employed for the automation technology and control room upgrades to minimize disruptions to normal plant operations and ensure efficient execution of the various project steps. Activities ranged from shifting the control supervisory level to the ICR, including servers and operator/engineering workstations, to introducing a new Fire & Gas (F&G) zone and IAC. Important aspects of the project were implementing the new ergonomic control environment and shifting more than 30 CCTV cameras from the CCB to the ICR. Project team members also upgraded Experion software from R450 to R500.

The key phases of project execution included:

**Phase 1A:**
- Changing transmitters to wireless and integrating them with the Experion PKS system

**Phase 1B:**
- Adding an F&G zone in the ACBs, including a new SM system

**Phase 2A:**
- Relocating all control operations to the new ICR

**Phase 2B:**
- Implementing ergonomic features for the ICR

**Phase 3A:**
- Upgrading all Distributed Control System (DCS) controllers and supervisory level assets. This phase included migrating the TPS system to Experion PKS in ACB1 and ACB2, and duplicating CCB systems in the new ICR ACB1 and ACB2 areas

**Phase 3B:**
- Shifting I/O and third-party systems from the CCB to the ICR

**RESULTS**

Thanks to its modernization efforts, PDO achieved a standardized control and safety system architecture with a reduced hardware footprint, fewer operator screens, and integrated C300 and SM controllers. The company also implemented the Honeywell Trace solution for better monitoring of critical control assets. The technology upgrades improved network and control capacity by moving the legacy system to a new, advanced automation platform.

Currently, PDO has realized numerous valuable benefits from its control technology rejuvenation efforts.

**Plant Operational Benefits:**
- System restoration after power failure is much faster with less manual intervention and ease of troubleshooting for start-up
- Controller and cabinet footprint has been optimized
  - Existing I/O in CCB was merged with C300 controller in the ICR
  - New C300s paired with Series C I/O in the ICR are an exact replica of the existing C300/PMIO in the old CCB
  - Existing FSC I/O was merged with new SM in the ICR
- P2P communication for MOS and ESD signals between SM and FSC was avoided
- HPM to C300 upgrade was fully implemented (eliminated LCN and UCN networks as well as coax cables and related cable noise and reliability issues)
- FTE capacity was enhanced with higher speed network and enhanced diagnostics for monitoring and troubleshooting (two networks of LCN/UCN unified with 100 mbps FTE)
- Seamless P2P across FCS controllers was implemented
Site-specific Benefits:

- Improved control scalability in terms of PU by doing HPM to C300 upgrade
- Expanded third-party interface support (Modbus TCP, Profibus, etc.)
- Reduced maintenance cost due to unified hardware
- Faster ESV to ESV data exchange over the Distributed System Architecture (DSA) compared to ESV to ESVT
- Increased resource availability for current technology systems
- Improved overall system performance and faster graphics call-up with the latest PC hardware
- Simplified online modification support for point mix changes (for C300 controllers, point mix does not require a shutdown)
- Faster cycle time for SM versus FSC (achieved by replacing HBD and VBD in FSC system with faster backplane communication in SM)
- Lower cost of spare parts for refreshed hardware

Overall Project Benefits:

- Greater sustainability
  - Keeps system running longer
  - Protects existing investments
  - Improves utilization of skills and resources
- Increased operational/control efficiency
  - Expanded production with identical controllers
  - Modernization and preservation of core intellectual property
  - Greater consistency in operations
- Enhanced lifecycle planning
  - Better diagnostics
  - Reduced maintenance
  - Increased skilled labor availability
  - Reduced footprint

CONCLUSION

By implementing a phased approach to control and safety system upgrades, PDO was able to extend the life of critical plant assets, protect valuable intellectual property, minimize project execution risks and avoid costly downtime. The company now has a modern, standardized control architecture for its gas processing operations.

For More Information
To learn more about how Honeywell’s system and process modernization can improve performance, visit www.process.honeywell.com or contact your Honeywell Account Manager.

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