



Queensland Curtis LNG project

Integrated automation, electrical and
telecommunications



- Reduction in total cost of ownership
- Schedule reduction
- Cost reduction
- Improved interface management

First Coal Seam Gas to LNG project in the world

Australia's energy industry has embarked on a multi-billion dollar project to convert natural gas, which has the lowest carbon emissions of all fossil fuels, from coal seams into liquefied natural gas that is now shipped economically around the world.

Queensland is one of the most abundant regions for coal seam gas in the Pacific basin. Located here is QGC, a leading Australian coal seam gas explorer and producer - wholly owned by Shell Australia. QGC's reserves and resources in Queensland have reached more than 21 trillion cubic feet.

The company is operating the Queensland Curtis LNG (QCLNG) Project, one of Australia's largest capital infrastructure projects. The project involved expanding QGC's coal seam gas production in the Surat and Bowen basins in Queensland.

The first phase of the QCLNG Project was based on gas wells being developed around Dalby, Chinchilla, Miles and Wandoan, west of Brisbane. A major 540 km underground steel pipeline takes the gas from the gas fields near Miles to Curtis Island off Gladstone on the central Queensland coast. This is the longest one-metre diameter pipeline laid in Australia.

On Curtis Island, QGC has built a liquefied natural gas (LNG) plant with first phase capacity of 8.5 million tonnes per year. The plant has gas pre-treatment facilities, a nitrogen rejection unit and three containment LNG storage tanks, each of 180,000 m³ capacity.

Project highlights

- 1,600 to 6,000 wellheads
- 24 compression stations
- 540 km pipeline
- 3500 km of gas and water gathering systems
- 8.5 million tonnes per annum (mtpa) LNG plant
- 3.6 mtpa of LNG purchased by CNOOC

ABB's scope of supply

ABB's order from QGC Pty Limited covered the provision of integrated automation, safety, electrical distribution, telecommunications systems and related equipment for the upstream and midstream coal seam gas project.

Aerial view of Ruby Jo CPP.



The scope of supply included ABB's Extended Automation System 800xA for process control and integration with other plant and remote pipeline systems, as well as integrated safety, compressor protection, emergency shutdown, fire and gas applications and other related automation equipment and services. It included telecommunication systems infrastructure and equipment, as well as installation, commissioning support and related project services. The electrical scope included the supply of low voltage and medium voltage switchgear and 132/ 33 kV transformers.

ABB's delivery optimised the efficiency of the upstream gas gathering and compression facilities, and provided communications and remote operation throughout the 540 km pipeline network.

This integration provides total visibility of the entire system for operations, maintenance and asset and alarm management.

Front-end engineering and design

ABB completed the initial front-end engineering and design (FEED) study for the project in early 2011, covering:

- Process control system
- Emergency shutdown systems
- Fire & Gas system (SIL 2)
- Integrated Operations
- Condition based maintenance systems
- Electrical systems
- Telecoms

ABB's global competence and international resources enabled utilising employees from a number of different countries during the various stages of the project.

Common training for local staff was established by ABB to ensure that everyone was working to the same standards. All of ABB's personnel worked to the same specifications, drawings and software to ensure consistency and effective performance for the clients.

Main Automation Contractor

ABB was appointed as the Main Automation Contractor (MAC) to supply automation, electrical and telecommunications systems including project management and expertise to provide a fully integrated solution, which was a key driver for QGC.

As the MAC, ABB also provided interface management of the engineering suppliers ensuring common supply and taking responsibility for the data transfer between parties.

The project was split between ABB in the UK and Australia and the company provided a strong, long term interactive relationship with over 130 engineers active between the two countries.

ABB's in-depth understanding of the scope of work with the knowledge of the agreed working strategies and philosophies has been utilised during design, construction, installation and commissioning phases.

The results:

- Reduced engineering and design cycle time
- Shorter procurement cycle
- Improved engineering data management
- Lower cost of ownership
- Efficient process and system availability

Other areas of responsibility included:

- Procurement
- Manufacture
- Factory Acceptance Tests
- Installation
- Construction
- Site Acceptance Tests
- Pre-commissioning
- Commissioning
- Post start-up support

The project has been commissioned in several phases, with first deliveries from 2011 through to project completion in 2014.

Collaborative Operations

Upstream operations are integrated and controlled by a single distributed control system, which automates and optimizes the main processes, minimizing operating costs and ensuring plant and personnel safety.

Collaborative operations ensure plant data is made available to operational, maintenance, business and even package-vendor users remotely from the site facilities.

ABB's System 800xA's common dashboard lets operators monitor and regulate pipeline, processing facilities, 20 compressor stations and over 6,000 wells across 3,500 km². Just four operators manage all industrial, electrical, telecoms and instrumentation from a single, 24-hour control room in Chinchilla.

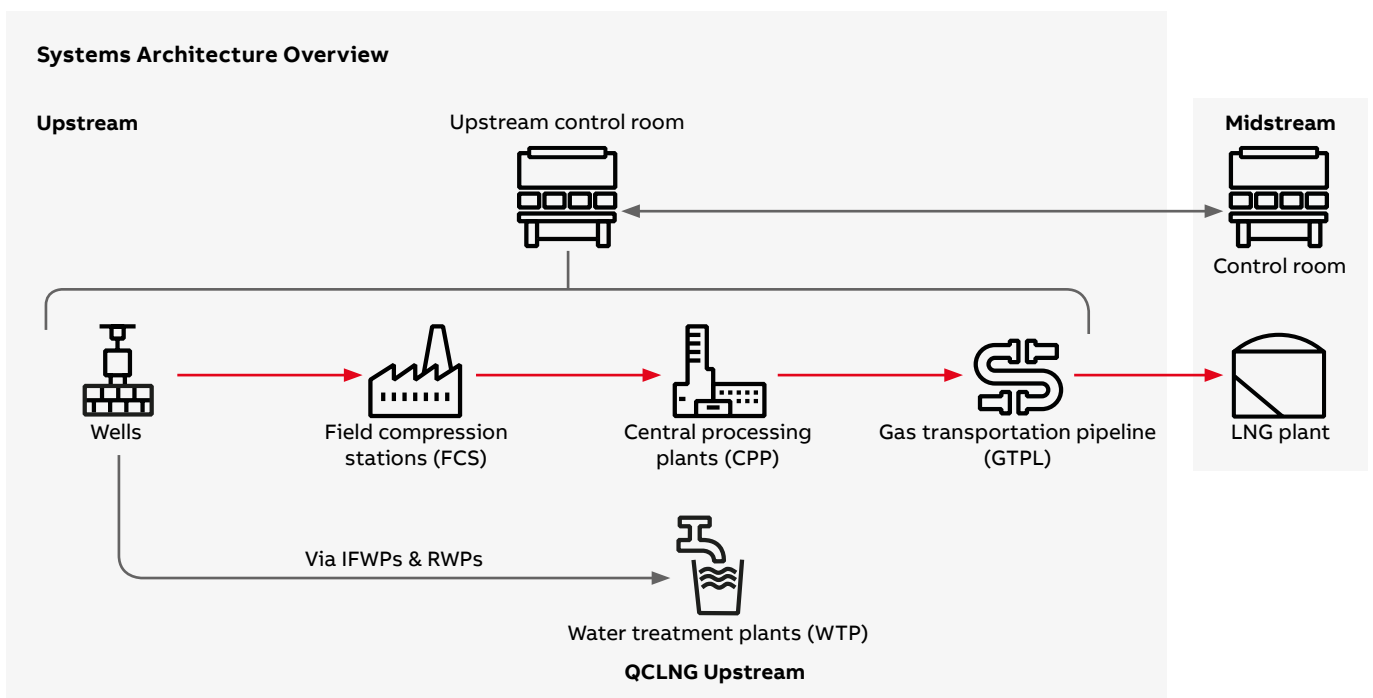
Remote monitoring and control reduces risk and cost by providing diagnostic data to the alarm and asset management systems and also minimizes the need for engineers to travel vast distances across the site to view information or

gather data. Being able to improve and optimize the systems remotely will also help to drive down capital and operational expenditure.

Collaboration is important for operations like QCLNG, where engineering resource is in short supply. Through remote operations and access to global technical support, system users get access to expertise from automation and third party suppliers without the expense and issues associated with global travel.

Collaborative operations also help business and production decisions to be made with real-time information and in a timely fashion based on data from several sources and at various levels of the infrastructure.

Collaboration enabled the efficient phased commissioning of the QCLNG Project, where the control system was expanded without having to shut down parts of the plant. ABB was also able to replicate and re-use tried and tested solutions from other projects.



Upstream automation, electrical and telecoms

Process areas

Low pressure production wells

ABB's engineered SCADA, interfaces with the wells and provides daily automatic gas meter upload, a history of gas meters with audit trail, seamless real-time/ historical access for data and history backfill for trends.

Field compression stations (FCS)

Each FCS includes one automation instrument local equipment room (ILER) and a panel mount HMI at each station for display of electrical signals. Each ILER contains fully fitted process and safety controller cabinets, two fully fitted process and safety I/O marshalling cabinets and combined desk mounted operator/engineering workstations along with two fully fitted telecoms cabinets.

Central processing plants (CPP)

There are four CPPs located at Woleebee, Bellevue, Jordan and Ruby. All CPPs are based on the use of 220 MMscfd 2-stage, variable speed, electric motor driven, centrifugal compressors.

- Ruby and Jordan 2 x 220 MMscfd each;
- Bellevue 1 x 220 MMscfd; and
- Woleebee Creek 3 x 220 MMscfd.

The CPP raises the gas pressure from 1,300 kPag to pipeline export pressure (up to 10,000 kPag), dehydrates the gas to export quality using TEG and routes the gas into the gas collection header for onward transport to the LNG plant.

Each CPP includes one 800xA system and one automation ILER including HVAC, lighting, 10 kW UPS and fire detection and suppression system.

There is also an electrical E-house at each CPP to house ABB's power management system (PMS) equipment.

Gas transportation pipeline

There are eight sites along the pipeline for which ABB is providing six pipeline main live valve stations, receipt/ launcher station and end of line station.

Each pipeline site includes one ILER including HVAC, lighting and UPS.

Upstream control room (UCR)

The control room houses System 800xA including control system hardware, operator and engineering workstations and servers, which are connected by industrialized redundant network switches and network cables on a 1Gbps backbone using fiber optic cabling.

From the control room, a system user can have visibility of the whole distributed system as well as faults occurring in any automation, electrical or telecoms assets. The user has visibility of any security system such as CCTV and access to facilities, control over any general alarm or public address systems as well as the generation of electronic work-orders for any asset that has failed, without having to leave the user workstation.

Having this data at hand guarantees that users have the information available to make the right decisions at the right time and ensures a speedy response to any upset condition.

33kV substation.



Extended Automation

System 800xA

ABB has provided System 800xA as the optimum solution for the QCLNG Upstream Project. It is recognized by the ARC Advisory Group as the world's leading distributed control system (DCS) with some 25 percent market share.

System 800xA is a fully industrialized and redundant client/ server based control system. The ability to integrate all process automation, electrical, power management, telecoms and instrumentation within one system means:

- Operators are able to have a consistent look and feel across the whole platform and therefore all plant assets. This includes common alarm lists, audit trails and asset management reporting for automation, electrical and telecoms.
- Common engineering tools are used for configuration and maintenance.
- The use of IEC 61850 as a standard for the integration of intelligent electrical devices (IEDs) reduces risks and cost as well as providing a large amount of diagnostic data to the integrated alarm/ event and asset management systems.

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Modern control room.

- Computerized maintenance management systems (CMMS) can manage any asset, whether it is a SMART field instrument, IED or telecoms system.
- Asset and production reporting can be generated from live data from all connected assets at the enterprise level. Business managers are able to make more accurate decisions if they have access to real-time information from across the whole plant. This leads to improvements in fiscal and production decisions.

By taking this approach, QGC obtains an unprecedented visibility of their assets and so permitting more efficient pipeline operations, along with environmental and personal safety.

System 800xA is a modern OPC and Object Oriented platform capable of providing end-users with a fully integrated solution. For the QCLNG Upstream Project this offering includes:

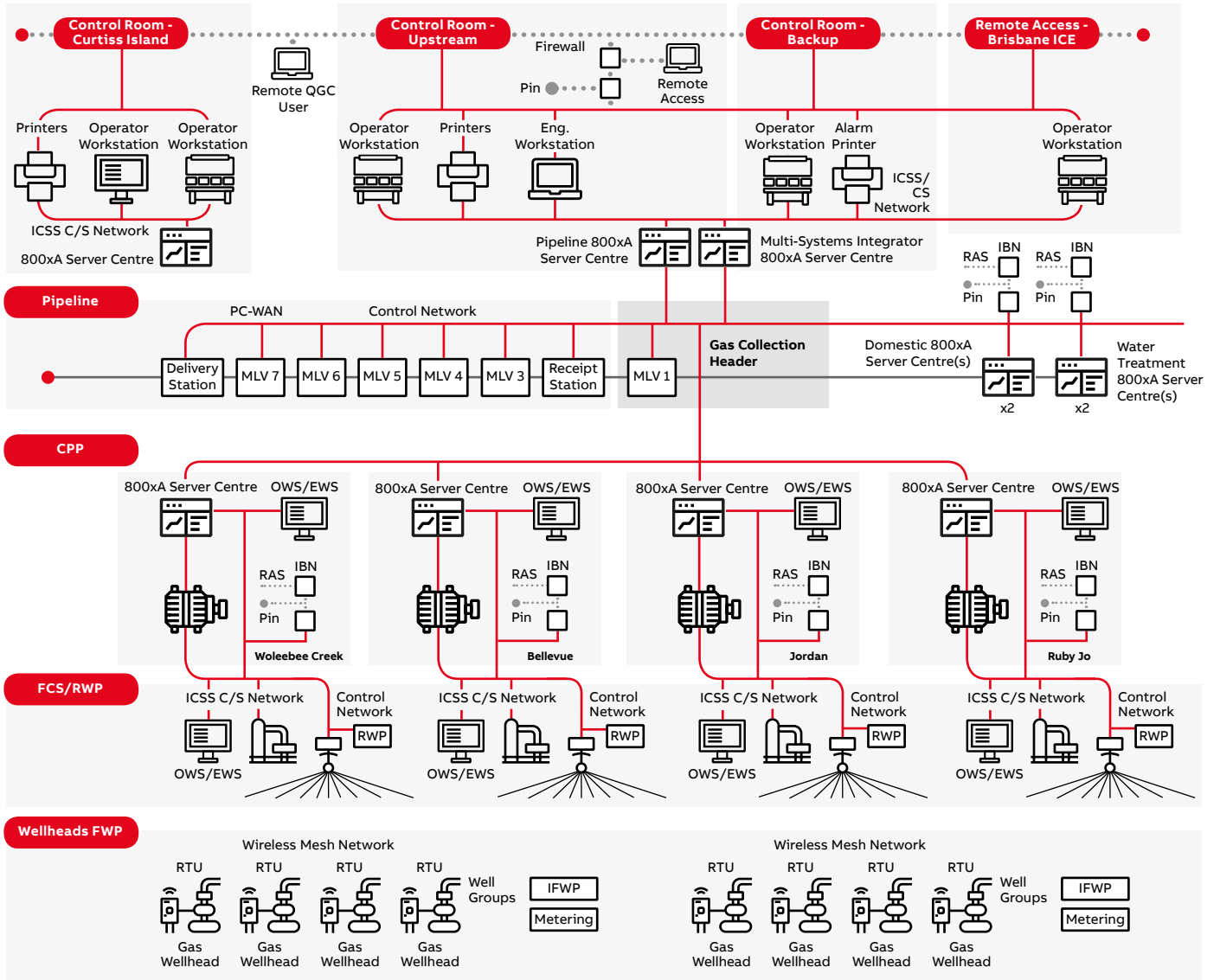
- Integrated Control and Safety System (ICSS)
- SPI bi-directional interface
- Power Management System
- IEC61850 for electrical substation integration
- LV, MV and HV integration
- Work Management System
- Alarm Analysis Package
- Telecoms infrastructure
- 800xA history

The advantages of 800xA in relation to the QGC project include:

- Simple to configure
- Robust and proven software
- Seamless migration through system lifetime
- Open system allowing integration to third party systems



QCLNG Integrated Control and Safety System



Telecommunications

ABB supplied various telecommunications systems including design engineering, factory acceptance testing (FAT), installation supervision, commissioning and support.

Fiber optic communications network

The communications network comprises a backbone fiber optic infrastructure and associated network equipment. It provides connectivity for segregated enterprise and process control networks.

The enterprise network is made up of hardware used for providing corporate network services. This includes all routers, switches, firewalls and necessary equipment to integrate telecommunications equipment.

The process control network consists of hardware used to support 800xA system requirements including routers, switches, firewalls and local cabling.

Structured cabling system

A primary requirement for the communications infrastructure is a highly resilient and fault tolerant backbone. To facilitate this, the export pipeline incorporated a site 'hopping' philosophy. Due to large physical distances between MLV stations, 'hopping' from one site to an alternate site can result in spans between stations of more than 160 km. A carrier grade transport system was supplied, providing an interface to both enterprise and ICSS networks and optical amplification. With amplification, optical range is up to 200 km making it suitable for the long spans between MLV stations.

VoIP system

ABB has provided additional VoIP handsets at various sites including CPP, FCS and MLV.

Structured cabling at the CPPs.



CCTV system

A digital networked CCTV system has been supplied that allows each CPP to be fitted with a Digital Video Manager Server (DVM) recording images from cameras at associated FCSs and also a neighbouring CPP. Images from a CPP site are therefore not lost should a catastrophic failure at that site destroy the digital video recorder at that location. Operators are able to view, control and playback images from cameras at all sites.

The CCTV system has been integrated with the following systems:

- 800xA ICSS
- Perimeter Intrusion Detection System
- Security Access Control System

Detection of an intruder or a fire and gas event will automatically pan and tilt the relevant camera(s) to defined viewing area(s) of interest and activate Infra-red lighting if required.

Perimeter intruder detection system

ABB has installed a Perimeter Intrusion Detection Systems (PIDS) at the CPPs. The system was intended to detect human intruders passing through the detection field. However, as it was likely wildlife may disturb the perimeter, a fence mounted vibration detection system would have resulted in frequent false alarms. As such sensor cables have been buried inside the fence perimeter.

Security access control system

A security access control system comprises a number of proximity card readers and door locking hardware at various sites.

Public address/general alarm (PAGA)

The PAGA relays vital safety instructions, warnings and general announcements through public address and alarm facilities at FCS and CPP sites.

The system is controlled from a master control station located at the upstream control room. Remote systems have been installed at CPP and FCS sites and operators can broadcast voice announcements or general alarms to all or any of these locations.

The system interfaces with the ICSS and fire and gas systems, triggering alarm tones and beacons in the event of an emergency.



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Access point radio mast
at Ruby Jo.

Local equipment rooms (LERs)

The 33 fabricated LERs for the upstream project provide a fully serviced enclosure for the process control and telecomm-unications facilities. A primary objective of the design was to minimize work on site. The LER and the equipment contained has been commissioned prior to shipment.

The CPP and FCS LERs include:

- HVAC system that will maintain the LER temperature to 28°C and will auto-restart on reconnection of power after loss.
- Lighting and small power.
- Fire detection in FCSs will be provided by two smoke detectors and a manual call point wired back to the ICSS panel.
- Fire detection and protection in CPPs will be provided by a system complying with AS1670 and have a fire indicating panel (FIP).

The pipeline LERs contain:

- HVAC system to maintain the LER temperature at 28°C and will auto-restart on reconnection of power after loss.
- Lighting and small power.
- Two smoke detectors and a manual call point wired back to the ICSS Panel.

The building contains the following equipment:

- Telecoms panel
- Tetra/microwave panel
- Process Control Cabinet
- UPS cabinet and batteries
- Cathodic protection panel

LERs at Argyle FCS.



Electrical

ABB have supplied various high and low voltage equipment rooms, compressor stations, transformers and power management systems for the QCLNG Project.

The electrical scope of supply includes:

- 19 HV fabricated local equipment rooms
- 19 LV fabricated local equipment rooms
- 2 domestic compressor stations
- 2 LV fabricated local equipment rooms
- 8 HV train electrical rooms
- 8 LV train electrical rooms
- 8 HV electrical rooms
- 8 LV electrical rooms
- 8 LV rooms
- Various transformers

Power management system

The load shedding system ensures the availability of electrical power to all essential and most critical loads in the processing plants. This is achieved by switching off non essential loads. A lack of electrical power can be caused by disconnecting (whole or partly) from the public power supply grid and/ or loss of own generation capacity. The load shedding system has to ensure:

- load shedding should disturb the production process as little as possible.
- only the amount of power that is necessary should be shed.
- the load shedding system should not operate inadvertently.
- the system should be reliable and the number of spurious operations should be limited during the lifetime of the system.

The PMS supports three types of load shedding functions:

- Primary load shedding (fast load shedding)
- Under frequency load shedding
- Component overload load shedding

PMS systems have been installed at Ruby, Jordan Bellevue and Woleebee. Each PMS comprises load shedding, load sharing, generator control and monitoring, synchronization, circuit breaker control and monitoring, alarms, transformer monitoring and control, large load inhibit, sequential restarting and SOE functions.

At all four CPP sites, the PMS has been fully integrated with ICSS thus eliminating the need for a dedicated 800xA system for PMS. The PMS shares 800xA system servers and HMI with ICSS. A dedicated redundant controller and redundant IEC61850 server has been provided for PMS.

This hardware, along with the IEC 61850 connectivity server is located in the ILER.

MV switchgear at LER.





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