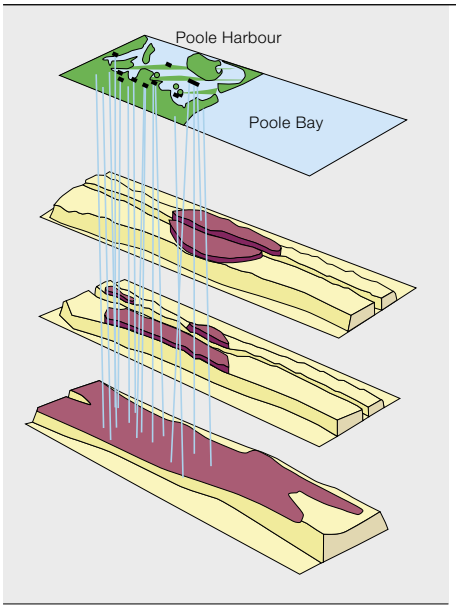
Fuel from integration

Integrated solutions for coal bed methane projects

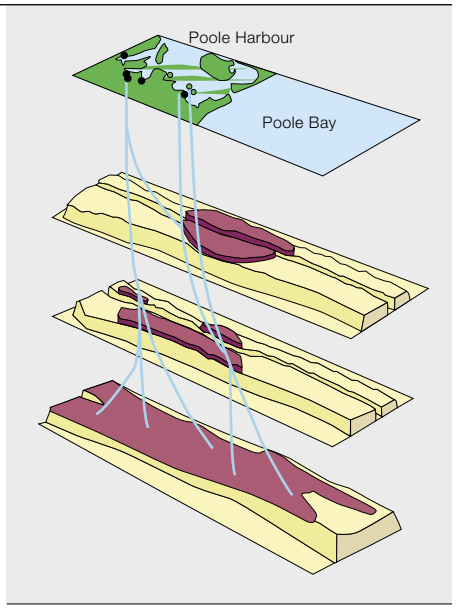
COLIN PEARSON – In an ever intensifying search for new energy sources, interest is growing in the methane gas contained in relatively shallow coal seams. Methane gas was and is a major source of hazard for mines and miners. In the past, such practices as placing canaries in the mine warned of its presence. Today technology exists to extract this gas in its liquefied form. Extracting this methane from coal seams not only provides commercial benefits but helps in preventing this gas naturally venting to the atmosphere.

ABB's contribution to coal bed methane (CBM) projects lies in its ability to provide total integrated solutions – combining automation, safety, electrical distribution, water management and telecommunications systems. This integration provides total visibility of the whole system (often distributed over a large and inaccessible geographical area) for operations, maintenance and asset and alarm management – stretching from the field to the business systems, regardless of where these may reside.

1 Single well solution versus directional well solution



1a Single Well Solution



1b Directional Well Solution

CBM is a naturally occurring component of solid hydrocarbons. Methane is "absorbed" into the coal seam over the geological timescale of its production and can be formed by either biological or thermal processes. During the earliest stage of coalification (the process that turns vegetable matter into coal), methane is generated as a by-product of microbial action. This methane remains locked in the coal until extraction (or venting) processes allow the gas to "desorb" from the seam at low pressures (1–4 bars). The technology required to enable this desorbsion and extraction is relatively low-tech and often portable.

Methane gas is the single largest cause of mining deaths around the world (accounting for 5000, or 80 percent of all annual mining deaths in China alone). Methane is also the biggest contributor to greenhouse gases, having a 21 percent greater affect on the environment than CO_2. By extracting this gas prior to excavating the coal, methane wastage is reduced by up to 70 or 80 percent – not to mention the improved safety for miners.

The typical coal seams where extraction is viable are relatively shallow and flooded. The initial phase of a well's life thus involves a period of "dewatering". This can take in the range of months to years depending on the seam conditions. Once the coal seam is sufficiently exposed, the gas desorbs and can be extracted for transport to LNG plants and onward sale.

The rate of gas desorbsion from the coal seam (desorbsion rate) depends on the quantity of exposed (ie, not submerged) coal. Water extraction can therefore be used to regulate the pressure and flow of methane. Managing this flow is extremely important as the low-pressure side often uses standard PVC piping. It is often not cost effective to add steel piping or expensive pressure relieving devices due to the high number of wells required to make these solutions viable (well numbers are typically in the order of thousands). Higher flow rates can furthermore lead to the premature depletion of a well.

The large volumes of water removed are an important factor in the extraction process and often require water-treatment plants and large reservoir facilities to manage the cleaning and safe disposal of this brackish bi-product.

The upstream desalination and compression systems inevitably require large amounts of power which can exceed the requirements of the midstream (LNG plant) by a factor of 10.

The upstream systems can be classified as large scale power distribution and water management systems with methane gas as bi-product.

Extraction technology

CBM is extracted by drilling wells into various areas of the relatively shallow coal seam (100's rather than 1000's of meters). Hydraulic fracturing of the coal seam is performed by pumping large volumes of water and sand at high pressure into the coal seam. The sand deposits itself in the fractures that open up and prevents them closing when the pumping pressure ceases. The gas then moves through the sand-filled fractures to the wellhead → 1.

> In today's global and competitive market place, systems are required to be more high-tech than ever before.

Wells generally have two phases during their lifecycle, a "dewatering phase" and a "free flowing phase". In the initial dewatering phase, a well is comprised of a downhole pumping unit. This can be removed once the well becomes free-flowing. The remaining components are a water separation rig, instrumentation, solar panel with battery units and remote terminal devices (RTU's). The RTU passes the

wellhead information back to a central recording and controlling system via wireless networks. In ABB's case the host system can either be a SCADA or 800xA system installation for a fully integrated solution.

Viable CBM projects can require many thousands of wellheads where several drilling solutions can be used. Regional topology and environmental impact studies will often be the deciding factor when selecting the solution to be used. This can include direct vertical drilling – one well/ one RTU or directional drilling solutions where one RTU can manage the production from up to ten wells and has a much lower environmental impact.

ABB TotalFlow is the US market leader in CBM wellhead solutions. Of the 30,000 to 35,000 wellheads in the US, 20,000 to 25,000 contain ABB equipment ➔ 2.

Technical challenges

From the point of view of these large distributed systems, CBM projects can provide many technical, operational and maintenance challenges that either require personnel at each field facility (compression stations), or require an infrastructure that provides communications and field personnel to react to failures, fault or configuration issues.

Integration ensures information and facilities are made available for operational, maintenance and business purposes and even to package-vendors – remotely from a central control and engineering facility. This provides the opportunity to minimize staff requirements in the field, making these systems more efficient to operate as well as improving safety.

ABB is observing a clear drive towards these integrated solutions. The emphasis on integration is leading end-users and owner-operators to work much closer with EPC's (engineering, procurement and construction suppliers) early on in the project's design phase to ensure long term operational benefits are part of the initial design criteria. Without this, end-user input the goals of the EPC can often conflict with the processes required for long term operational benefits.

ABB's "operational excellence" focused thinking and "integrated operations" products and services combined with existing technologies are providing an extremely effective solution for such projects and end-user thinking. Several key factors that are attracting end-users to this approach are: ➔ 3.

ABB's customers

Forward thinking owner/ operators are already preparing for changes to their automation strategies to accommodate these future challenges and necessities for integration (as recently seen on Australian CBM projects). The concept of "integrated solutions" ideally suits the current System 800xA topology as well as its future direction which will ensure our clients can better utilize their long term assets as well as maximize their available personnel whilst providing them a safe environment to work in.

> As the markets for LNG are already committed, it is more important than ever that it is efficiently and reliably extracted and distributed.

With ABB's ability to integrate its automation, telecoms and electrical systems (IEC 61850 and Profinet) into the System 800xA environment, ABB is able to provide end-users with unprecedented visibility of their assets and so permit more efficient operations.

In a recent ARC study, it was estimated that by providing visibility of the system drive's health from a central control facility, it is possible to prevent over 44 percent of drive failures which will obviously increase production and minimize downtime.

The advantages of a fully integrated solution for process automation, safety, electrical control, power management and telecommunications using a common system and protocols can be numerous. Some of these are listed in ➔ 4.

Centralized control of CBM projects

With such large distributed systems it is imperative that the system users have access to the relevant information without regard for location or system type. By offering a single harmonized and con-

2 ABB and CBM projects

ABB has been supplying systems to coal bed methane projects in the US and Canada for many years through its ABB TotalFlow organization. The company has delivered more than 30,000 remote terminal units (RTUs) for CBM wellheads in these countries. ABB has also recently won a $58 million (and increasing) CBM order in Australia, with BG (UK), for a fully integrated solution using System 800xA and third party RTU devices.

Several major gas companies now consider CBM as a viable business and are investing billions of dollars in exploration, mining and infrastructure. China is one of the largest areas for CBM development.

Although historically this extracted gas has generally been supplied directly to "consumers", it is now becoming viable to sell it to the open market in its liquefied state.

CBM projects are made up of several relatively low tech sections: wellheads, compression, distribution and accumulation, liquefaction plant and loading facilities. The wellheads discharge the water they produce into large holding facilities for later disposal. Low pressure compressors are used to transfer the "wet gas" to a drying facility and then on through high pressure compression units to a distribution and accumulation pipeline network which is also used for accumulation and storage during specific plant conditions. Downstream of these pipeline systems are standard LNG facilities and ship distribution systems.

Due to their often vast topographical nature, it is imperative that integration is maximized. This reduces the need to send maintenance crews and engineers into the field (often in very difficult terrain) for troubleshooting and configuration purposes.

Drawing on its extensive know-how and portfolio, ABB is able to meet the requirements of these vast projects by providing fully integrated solutions, combining automation, safety, electrical distribution, water management and telecommunications. Without the level of integration offered by ABB, the end user cannot maximize the level of diagnostic data available at the host system (800xA) and as such is forced to send people into the field which furthermore increases the potential for health and safety issues when problems do occur.

3 Key factors favoring integrated operations in CBM

- The shrinking engineering pool and, as a consequence, the difficulty of getting the right people in front of the systems to ensure that all important production uptime. This will be particularly important in places such as Australia with their expected engineering resource issues.
- Capabilities now available with remote operations and access to global technical support. This gives system users access to expertise from ABB and third party suppliers without the expense and issues associated with global travel.
- CBM projects are often in extremely remote or (environmentally) hostile locations. The number and complexity of onsite service agreements can therefore be minimized.
- Ever present demand to drive down capital and operational expenditure by being able to improve and optimize the systems remotely.
- In the near future EPC's and end-users will have to integrate their automation, IT and electrical engineering resources due to cost/ skill availability issues. This is being made easier due to the integrated nature of automation systems and engineering database tools such as Intergraph's SmartPlant and Comos PT.
- Ever tighter project execution schedules, disparate systems mean more risk to schedules.
- Operational excellence policies are themselves being developed by end-users within their own groups as this is being seen by them as the key to successful long term profitability.
- Business decisions need to be made with real-time information and in a timely fashion to take full advantage of process variants and market conditions.
- Often on CBM projects several stake-holders may "own" wells or groups of wells making the management of production complex and will require decisions based on data from several sources and at various levels of the infrastructure (field to enterprise layer).
- The shifting experience and expectations of the IT savvy "operator" generation. Future training will begin to encompass all aspects of automation systems including electrical, telecommunications and IT systems.
- Requirements for central production operational staff to have visibility of multiple process plants in order to harmonize company-wide operational and maintenance procedures.

These issues are very real and very relevant for the extremely large scale and long term CBM projects.

4 Benefits of full integration

- 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 possible for configuration and maintenance.
- The use of IEC 61850 as a standard for the integration of intelligent electrical devices (IED's) reduces risks and cost as well as providing a large amount of diagnostic data to the integrated alarm/ event and asset management systems.
- Computerized maintenance management systems (CMMS) can manage all assets, whether it is a SMART field instrument, an IED or a telecom asset.
- 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 both fiscal and production decision making.

ABB can offer this from one single harmonized system making our 800xA system an industry leader for such large distributed CBM projects.

5 The ABB 800xA Extended Operator Workstation

sistent environment, ABB is able to supply its clients with systems and solutions that allow them to comply with the latest EEMUA (191 and 201) and the more stringent ISO 11064 guidelines. These guidelines indicate the "how" these systems should be used.

By planning systems to take into account the "how" clients operate, ABB is driven to provide integrated offerings with common user interfaces regardless of the provider of the "field-level systems". This serves the long term interests of clients and gives ABB an advantage over other system suppliers as the 800xA system is designed around this very concept.

Having the necessary operational or maintenance information 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 urgent upset condition → 5.

This has obvious benefits when time to repair is critical.

System 800xA, through its HMI[1] and EOW[2] systems are allowing CBM system users (operators, maintainers and managers) to carry out their business much more efficiently than ever before.

Potential Barriers

To some extent, barriers to long term operational excellence can be created at the procurement stage. Often procurement strategies dictate that, for cost comparison purposes, various sections of a solution must be held up for cost comparison across multiple suppliers. Although there is a very good reason for this, it does often lead to procurement teams "cherry-picking" a cheaper component with little regard for integration or associated costs for long term operation.

With its recent Australian CBM projects, ABB was able to bring together all its products and services to enable clients to get the absolute maximum from their systems. Customers are thus receiving a globally leading solution, which will put them at the forefront of CBM production.

Colin Pearson
ABB Process Automation
St Neots, United Kingdom
colin.pearson@gb.abb.com

Footnotes
1 HMI: Human machine interface
2 EOW: Extended operator workplace