In the depths of the desert

The challenges of building oil and gas infrastructure in a remote and inhospitable part of the Sahara Desert

SERGIO CASATI – Over the past 45 years ABB has successfully completed more than 300 engineering, procurement and construction (EPC) projects in the oil and gas, power generation and water industries. Many of these projects have been carried out in remote and demanding environments where the logistical constraints of deploying equipment, materials and labor across multiple work fronts were a major challenge. One such ongoing project is the El Merk oil and gas development in Algeria for which ABB is designing, procuring, constructing and commissioning a significant part of the field infrastructure. Located in the remote south-east corner of the country, El Merk is a vast and searing desert land of towering, intermeshing sand dunes that stretches across an area of some 5,000 square kilometers. The sheer expanse and complexity of the El Merk development demands a unique set of EPC skills and tools to ensure that the project is implemented and completed on time and on budget.

The El Merk oil and gas fields are situated in the Berkine Basin, the second largest hydrocarbons basin in Algeria and one of the most prolific in the country in terms of output and the frequency of new discoveries. Located in the depths of the Sahara Desert, El Merk is characterized by its harsh and inhospitable environment: Temperatures frequently reach 50 °C, rainfall is negligible and the terrain is largely composed of huge interlocking sand dunes, which tower to a height of 300 meters and whose contours are constantly shifting in the burning dry wind. It is also a remote area with no previous infrastructure – situated some 1,000 kilometers from the cities and ports of the northern coastal belt where 90 percent of Algeria's 35 million inhabitants live ➔ 1.

The El Merk development comprises four fields within two blocks (Blocks 405 and 208). The four oil and gas fields (known as EKT, EMN, EME and EMK) are being developed by a consortium of six partners (Sonatrach, Anadarko, Eni, Maersk, ConocoPhillips and Talisman) and the development is managed by the Sonatrach-Anadarko Association[1] joint venture, Groupement Berkine. At full capacity the El Merk facility will process 160,000 barrels of oil equivalent a day from nearly 140 wells. The wells will be linked by a system of field pipelines to ten field gathering stations (FGS), from where the product will be piped to a central processing facility for separation, stabilization, gas compression, natural gas liquid extraction and storage. The gas will then be re-injected via six gas distribution manifolds (GDM) distributed throughout the four fields. In 2012, it is planned to have approximately 80 wells in production.

ABB's EPC responsibility

Groupement Berkine has awarded several EPC contracts for El Merk for the construction of the central processing facility, offsite facilities, camp accommodation (base de vie) and industrial base, and for the export pipelines, power lines and substation. The ABB-led consortium, com-

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Title picture
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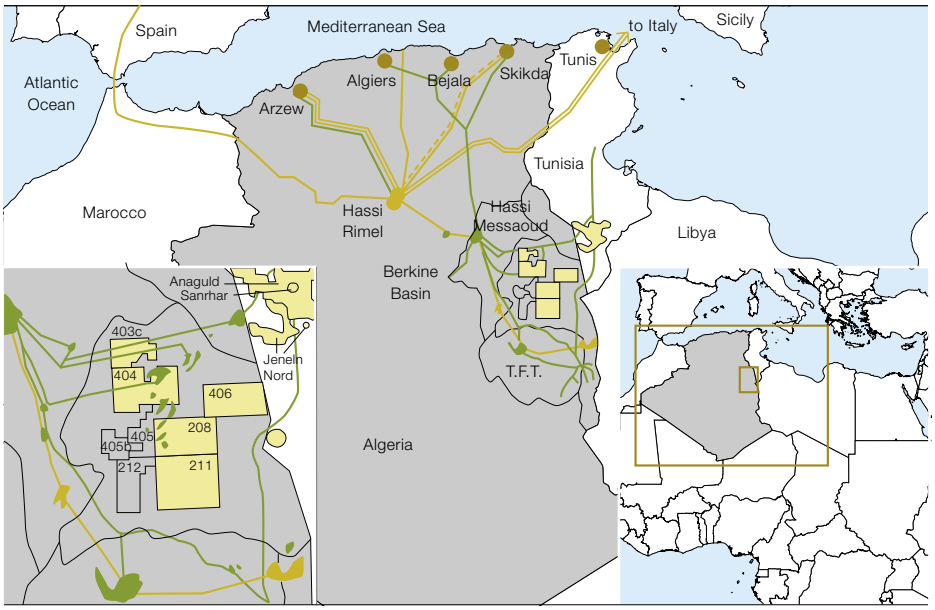
Footnote
1 The Sonatrach-Anadarko Association is jointly owned by Sonatrach (the Algerian state-owned oil and gas company), Anadarko (the US-based independent oil and gas company), Eni (the Italian national oil company) and Maersk (the Danish privately-owned oil and gas company).

prising ABB, Sarpi of Algeria and PetroJet of Egypt, is responsible for the offsite facilities. The contract, worth $650 million, is one of the largest EPC contracts in ABB's history. It states that the company is responsible for the design, procurement, transportation, construction, commissioning and startup of:

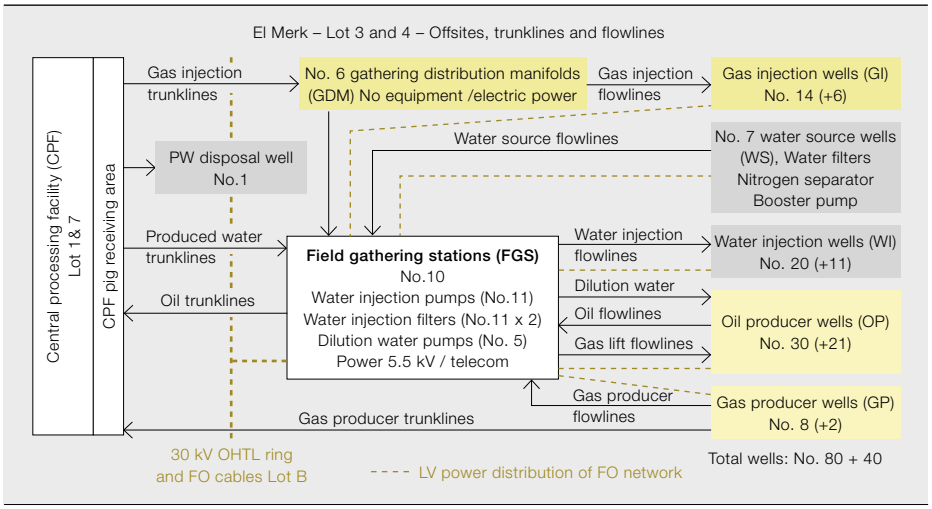
– The ten field gathering stations
– Six gas distribution manifolds
– The complete material supply for 120 wells as well as the hooking up of the first 80 for production
– The 719 km of pipelines and process piping across all four fields of block 208

ABB's scope of supply ➔ 2 includes the water systems for injection; the flowlines for production, gas lift, dilution water and water supply; the trunk lines for oil and gas condensate, gas injection and water injection; and the process piping. In terms of equipment and products, ABB will supply water injection pumps, source water booster pumps, dilution water pumps, water filters, recycle coolers and nitrogen separators. On the electrical side it includes medium- and low-voltage switchboards and power transformers; and in instrumentation it comprises the metering system, multi-phase flowmeters, wellhead valves and field instruments. The chemical injection skids, pipeline pig launcher and receiver stations, and cathodic protection systems will also be supplied by ABB.

1 The location of the Berkine Basin and El Merk in Algeria.



2 ABB project highlights as presented at the El Merk field kick-off meeting



GIS precision and efficiency

Another key ABB deliverable is the geographic information system (GIS) for the entire El Merk project. The GIS is a geospatial-based infrastructure management system that enables all the field infrastructure and production assets to be designed, constructed, maintained and managed at the highest level of efficiency and precision. It provides all participants in El Merk with an accurate and up-to-date view of the progress of the project in real time. It integrates data coming from many different sources and performs precise calculations of the amount of material needed for construction. It assesses all possible interferences along the pipeline corridors, such as differences in elevation, the angle of dune slopes, and so on. And it automatically generates alignment sheets and documents, including all information needed in the field. The solution supports the pipeline open data standard (PODS) model, the most widely used pipeline data model in the oil and gas industry.

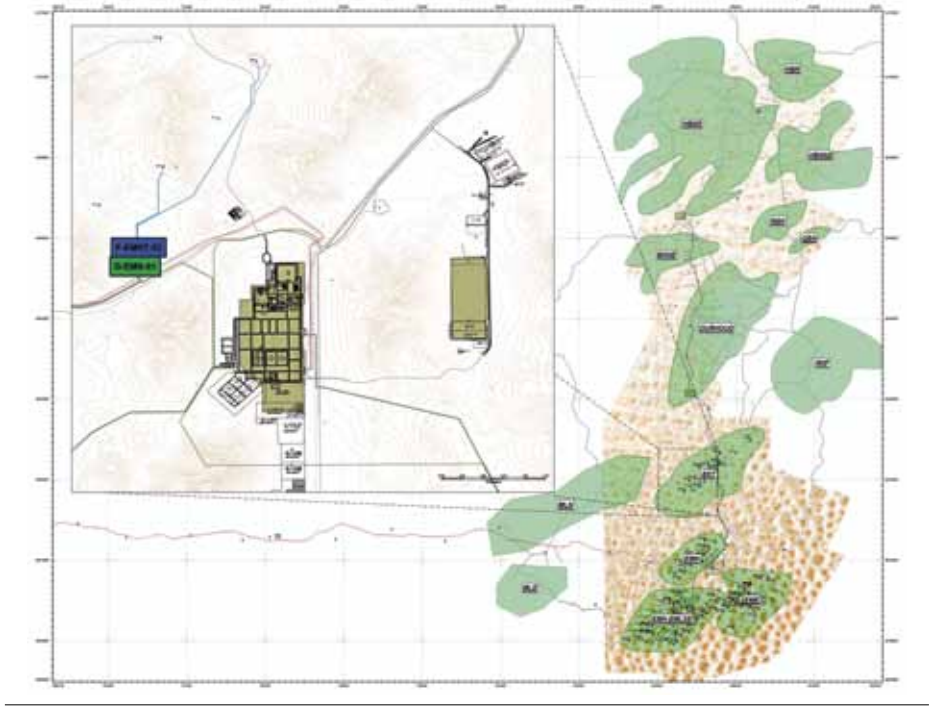
The GIS is a major contributor to the success of a major infrastructure project like El Merk, where there are numerous EPCs and subcontractors and thousands of workers involved at any one time ➔ 3. Without it, the ASP consortium has estimated that the development of El Merk would likely take an additional 12 months, with all the added costs and revenue loss that such a delay entails. For instance, in a project of this scale it is not unusual for the location of wells or the route of pipelines to change as reservoir development progresses. Because subcontractors tend to interpret geodetic data differently, disagreements as to the correct positioning of production assets are common. The ABB GIS solution not only prevents any possible misunderstanding (and thus potential sources of delays), but it also brings precision and efficiency to the field.

ABB selected Intergraph as its partner in the GIS project, with Intergraph supplying the geospatial platform and ABB managing the project information and interfacing the data from all EPCs and contractors ➔ 4. The system monitors the construction of every single site asset – from the wells and pipelines to the workshops, offices and housing on the base, and the power lines, utilities and communication cables that link the assets into a national network.

Meeting the challenges of complexity

El Merk is not just a highly complex and challenging project but it is all this in a remote and very harsh environment. From an engineering point of view, the

3 Panoramic views of part of the El Merk site.



fields are spread over a wide area and work such as well drilling, the laying of the pipelines and construction of the facilities will be carried out in parallel. On the logistical side, this means ordering huge volumes of equipment and materials [2] from suppliers and factories across the globe and transporting it the 1,000 km from Algeria's ports to the desert site. This all has to be executed in an efficient and cost-effective manner to ensure everything arrives according to schedule.

GIS is a geospatial-based infrastructure management system that enables the design, construction, and management of field infrastructure and production assets.

Up to 6,000 local and foreign personnel will be working on the project at its peak. Language barriers and cultural differences in a community of this size are common and have to be planned for and managed. Security is another aspect that has to be considered. From an ABB point of view, the facts and figures of its contribution to the project are outlined in → 5.

Health and safety

With a workforce of 1,500 people working several million man hours, the need to excel in health, safety and environment (HSE) is a crucial aspect of ABB's responsibility [3]. ABB's HSE targets for the El Merk project are:

– To instill a zero-incident culture throughout the workforce

Footnotes

2 All equipment and material should be capable of operating in temperatures of 55 °C.

3 ABB's overall HSE objective is: no harm to people; no damage to the environment; no damage to property; no loss or damage to data and documents.

4 GIS presentation on the El Merk scope of supply, which shows the extent of the infrastructure and facilities

5 El Merk project – ABB facts and figures

To implement the project, ABB estimates that it will spend:
- 150,000 man-hours on procurement and project management
- A further 200,000 man-hours on engineering.

ABB's electrical scope includes:
- 300 km of high-voltage cables
- 200 km of low-voltage cables
- More than 150 high-, medium- and low-voltage switchboards
- 140 transformers
- 3,000 field instruments (control valves, transmitters, pressure gauges, flowmeters, etc)
- 400 km of instrument cables
- 400 km of fiber-optic cables

With regard to hardware, the ABB consortium is responsible for designing, delivering, installing and commissioning some 700 km of pipeline, which will be fitted with almost 10,000 manual valves.

ABB is also responsible for five telecom towers, and the heat, ventilation and air conditioning (HVAC) and fire fighting systems at the ten field gathering stations.

An ABB team will supervise the field activities of the almost 2,000 people employed by Sarpi and PetroJet on site. This workforce is expected to spend five million man-hours building and installing the El Merk off-site facilities over the course of some 42 months.

- To design HSE into all consortium facilities and worksites
- To develop and implement an HSE management system and risk management process
- To implement site-specific HSE plans and programs for contractors
- To have in place operational readiness for a seamless handover of HSE procedures and systems upon project completion

The expanse and complexity of the El Merk development demands a unique set of skills and tools to ensure that the project is implemented and completed on time and on budget.

EPC center of excellence

ABB is directing its part of the project, which is currently on schedule, from its EPC center of excellence in Milan. The completion of more than 300 EPC projects in the oil and gas, power generation and water industries, many of which were carried out in remote and environmentally hostile regions, makes ABB one of the most experienced and successful EPC contractors in the business. This is not the only factor that determined ABB's suitability as a contractor for the El Merk project: The company has had a strong local presence in Algeria since the 1970s and its involvement in the growth of the country's oil and gas industry, which led to the formation in 1993 of Sarpi, a joint venture with Sonatrach, were also contributing factors.

Other EPC projects in Algeria that ABB is currently implementing include a gas flaring elimination project at Haoud Berkaoui on behalf of Sonatrach (the contract is valued at $225 million and covers gas compression trains and re-instrumentation at three sites); and the delivery of utilities, storage and export facilities for the central processing plant at MLE in the Berkine Basin (a contract worth $245 million).

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