



The reception terminal in Almería.

Medgaz: pipeline construction in the ultra deep

Challenging seabed topography, pipelay depths reaching 2,155 m below water level and deep water cable crossings were just some of the obstacles successfully navigated by the team of engineers and pipeline construction workers on the Medgaz Pipeline.

The 24 inch diameter, 210 km Medgaz Pipeline commenced transporting gas from the Algerian port of Beni Saf to a landing point near Almeria on Spain's coast in March 2011.

The pipeline, which has the capacity to transport 8 Bcm/a of gas, is supplied with gas from the Hassi R'mel field in Algeria, through a 547 km, 48 inch diameter pipeline which was constructed as part of the project. In Spain, a 48 inch diameter pipeline connects Medgaz to the Spanish gas network.

The idea of building a direct gas pipeline between Algeria and Europe arose in the 1970s. Feasibility studies were conducted at that time, however technical limitations prevented the construction and operation of a gas pipeline in ultra-deep waters.

More than two decades later, Spain's growing demand for natural gas combined with its own limited indigenous petroleum resources prompted CEPSA and Sonatrach to reassess the project in association with a

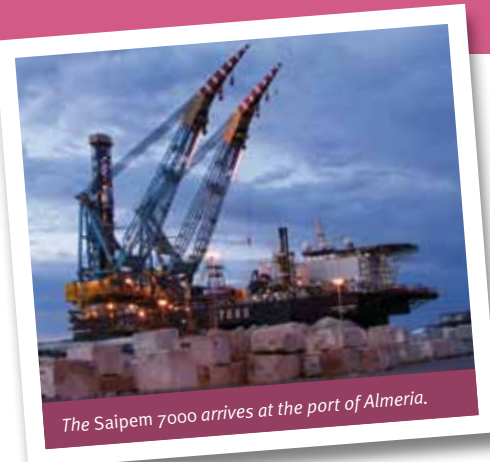
group of major multinational companies that comprise of Iberdrola, Endesa, and GDF Suez.

In the years between the initial feasibility and the renewed interest in the project, more advanced engineering technologies had been developed, making it possible to execute the sophisticated work required to successfully complete the project.

In 2001, CEPSA and Sonatrach formed MEDGAZ S.A to design, construct and operate the Medgaz Pipeline.

Survey and mapping

In 2002 the first marine survey was completed by C&C Inc. This survey was conducted to seek a suitable pipeline corridor between Algeria and Spain. The two survey vessels, *Odin Finder* and *Rig Supporter*, used the most current seabed mapping technologies at the time including the most modern multi-beam equipment mounted on an unmanned submarine



The Saipem 7000 arrives at the port of Almería.

named *C-Surveyor I*, which operated totally autonomously, without any physical connection to the parent ship, carrying out its 50-hour missions 40 m above the seabed.

After successfully completing this phase, which required overcoming a number of geological obstacles in record-breaking water depths exceeding 2,100 m, a suitable pipeline corridor was found crossing the Alborán Sea area in the Western Mediterranean.



Offshore gas pipeline pre-commissioning tests in Beni Saf.

- Ensured pipelay feasibility by both S- and J-lay vessels;
- Minimised spanning; and,
- Minimised locations of high stress and potential upheaval initiators.

Intec contracted US-based company D'Appolonia to carry out the geohazard evaluation for the Medgaz Pipeline.

D'Appolonia says that the primary technical issues associated with the project were:

- Seismic hazards;
- Fault rupture hazards; and,
- Landslide risks.

The work undertaken by D'Appolonia provided the basis for selection of a route that minimised geohazard risk, particularly in continental shelf break slope areas. Residual geohazard risks were determined to be at acceptable levels for pipeline construction and operation.

Following the completion of FEED in 2004, the offshore route length was 197.65 km. Approximately 49 per cent of the pipeline was to be constructed at depths greater than 1,000 m, with the maximum water depth reaching 2,155 km. The design included 17 pipeline curves and five in-service cable crossings, which were all greater than 1,000 m in length.

Intec's pipeline design included a crossing of the Yusuf Fault at kilometre point (KP) 74 and also required construction across a number of steep slopes (up to 14°) between KP 71 and KP 77.

Design

In June 2003, Intec Engineering (now Intecsea) was awarded the contract to perform front-end engineering and design (FEED) for the pipeline. Intec's scope of work for the contract included the design and engineering of the offshore pipeline, the shore approaches and the short onshore pipeline sections to the onshore terminals at either end of the trunkline.

Intec built on lessons learned from its work on the Bluestream and Mardi Gras deep water pipelines, capturing relevant experience of pipeline design, fabrication and installation in ultra-deepwater to

ensure an optimised and safe design for Medgaz.

Intec said that issues specific to the Medgaz Pipeline included geohazards associated with steep continental shelf margins and the bio-diverse coastal areas of Spain and Algeria, both of which cater for fishing and tourism industries.

Intec was required to provide a design that:

- Minimised environmental impact;
- Minimised pipeline route length;
- Avoided seabed obstructions;
- Avoided geohazards;
- Minimised the number of crossings;

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