

# GMR (Great Man-made River)

## Water Supply Project, Libya

### Key Data

#### Phase II

Pumping from the south western aquifer (Fezzan) to Tripoli and Jeffara plain

Designed for future expansion in Phase III

#### Phase IV

Extension of distribution network; construction of a pipeline linking the Ajdabiya reservoir to Tobruk

#### Phase V

Connection of the eastern and western systems into a single network in Sirt

### Full specifications

Contracts were awarded in 2001-02 for the next phase of Libya's Great Man-Made River Project, an enormous, long-term undertaking to supply the country's needs by drawing water from aquifers beneath the Sahara and conveying it along a network of huge underground pipes.

In October 2001, the Great Man-Made River Authority (GMRA) awarded an \$82 million contract for the construction of major new pumping facilities to a consortium led by Frankenthal KSB Fluid Systems. In January the following year, the Nippon Koei / Halcrow consortium was selected to provide the preliminary engineering and design works for Phase III of the operation, worth \$15.5 million.

The pumping station is scheduled to be completed in the summer of 2004 and KSB will subsequently be responsible for servicing the plant and providing technical support for one year after completion. The preliminary stages of phase III run until June 2005, though it is anticipated that GMRA will invite tenders for the detailed design and construction works towards the end of 2004.

When completed, phase III, which requires an additional 1,200km of pipeline, will ultimately increase the total daily supply capacity of the existing system to 3.68 million m<sup>3</sup> and provide a further 138,000m<sup>3</sup>/day to Tobruk and the coast.

## **BACKGROUND**

In 1953, the search for new oilfields in the deserts of southern Libya led to the discovery not only of the significant oil reserves, but also vast quantities of fresh water trapped in the underlying strata. The majority of this water was collected between 38,000 and 14,000 years ago, though some pockets are only 7,000 years old.

There are four major underground basins. The Kufra basin, lying in the south

east, near the Egyptian border, covers an area of 350,000km<sup>2</sup>, forming an aquifer layer over 2,000m deep, with an estimated capacity of 20,000km<sup>3</sup> in the Libyan sector. The 600m-deep aquifer in the Sirt basin is estimated to hold over 10,000km<sup>3</sup> of water, while the 450,000km<sup>2</sup> Murzuk basin, south of Jabal Fezzan, is estimated to hold 4,800km<sup>3</sup>. Further water lies in the Hamadah and Jufrah basins, which extend from the Qargaf Arch and Jabal Sawda to the coast.

The GMR project - the world's largest engineering venture - is intended to transport water from these aquifers to the northern coastal belt, to provide for the country's 5.6 million inhabitants and for irrigation. Intended to be the showpiece of the Libyan revolution, Colonel Moammar Gaddafi called it the "eighth wonder of the world".

First conceived in the late 1960s, the initial feasibility studies were conducted in 1974 and work began ten years later. The project, which still has an estimated 25 years to run, was designed in five phases. Each one is largely separate in itself but will eventually combine to form an integrated system.

## PHASES I AND II

The first and largest phase, providing 2 million m<sup>3</sup>/day along a 1,200km pipeline from As-Sarir and Tazerbo to Benghazi and Sirt, via the Ajdabiya reservoir, was formally inaugurated in August 1991. This was a massive undertaking, using a quarter of a million sections of concrete pipe, 2.5 million t of cement, 13 million t of aggregate, 2 million km of pre-stressed wire and requiring 85 million m<sup>3</sup> of excavation, for a finished cost of \$14 billion.

The Tazerbo wellfield consists of both production and piezometric observation wells and yields around 1 million m<sup>3</sup>/day at a rate of 120L/s per well. Only 98 of the 108 production wells are used, with the others on stand-by. A collection network conveys the water to a 170,000m<sup>3</sup> off-line steel header tank. From here, the main conveyance system is routed 256km to the north, to two similar header tanks at Sarir, where the second Phase I wellfield is located. A further 1 million m<sup>3</sup> is produced here, using 114 of the 126 production wells, at an average flow rate of 102L/s per well. The wells at both Tazerbo and Sarir are about 450m deep and are equipped with submersible pumps at a depth of 145m.

From Sarir, two parallel, 4m-diameter pipelines convey the now chlorine-treated water to the 4 million m<sup>3</sup> Ajdabiya holding reservoir, 380km to the north. The water flows from this 900m-diameter reservoir through two pipelines, one heading west to Sirt and the other north to Benghazi. Each pipeline discharges into a circular earth embankment end reservoir, with a storage capacity of 6.8 million m<sup>3</sup> at Sirt and 4.7 million m<sup>3</sup> at Benghazi, which have been designed to balance fluctuations in supply and demand. In addition, large reservoirs - 37 million m<sup>3</sup> in the Sirt area and 76 million m<sup>3</sup> in Benghazi - have been built to act as storage facilities for summer or drought conditions.

Phase II delivers 1 million m<sup>3</sup>/day from the Fezzan region to the fertile Jeffara plain in the western coastal belt and also supplies Tripoli. The system starts at a wellfield at Sarir Qattusah, consisting of 127 wells distributed along three east-west collector pipelines and ultimately feeds a 28 million m<sup>3</sup> terminal reservoir at

Suq El Ahad.

## **PHASE III**

Phase III falls into two main parts. Firstly, it will provide the planned expansion of the existing Phase I system, adding an additional 1.68 million m<sup>3</sup>/day along with 700km of new pipeline and new pumping stations to produce a final total capacity to 3.68 million m<sup>3</sup>/day. Secondly, it will supply 138,000m<sup>3</sup>/day to Tobruk and the coast from a new wellfield at Al Jaghboub. This will require the construction of a reservoir south of Tobruk and the laying of a further 500km of pipeline.

The preliminary engineering and design contract runs for 41 months and includes geotechnical and topographic surveys. The conceptual designs phase features extensive consideration of pipeline routing and profiling, hydraulics, pumping stations, M&E, control / communications system, reservoirs and other structures, corrosion control, power, operational support and maintenance provision. The evaluation of tenders for the detailed design is expected in the first quarter of 2005.

The last two phases of the project involve the extension of the distribution network together with the construction of a pipeline linking the Ajdabiya reservoir to Tobruk and finally the connection at Sirt of the eastern and western systems into a single network.

When completed, irrigation water from the GMR will enable about 155,000ha of land to be cultivated - echoing the Libyan leader's original prediction that the project would make the desert as green as the country's flag.

## **KEY PLAYERS**

The project is owned by the Great Man-made River Authority and funded by the Libyan Government. Brown & Root and Price Brothers produced the original project design and the main contractor for the initial phases was Dong Ah, with Enka Construction and Al Nah acting as sub-contractors. The preliminary engineering and design contractor for Phase III is Nippon Koei / Halcrow consortium. The Frankenthal KSB consortium won the pumping station construction and technical support contract and SNC-Lavalin are responsible for the pipe production plant O&M. Libyan Cement supplied the concrete. Thane-Coat and Harkmel provided pipeline coating services and Corrintec supplied the cathodic protection system. Thyssen Krupp Fördertechnik provided technical services for the excavation planning and a number of local companies carried out elements of the construction and ancillary work.

<http://www.water-technology.net/projects/gmr/>