Desalination and Water Treatment
www.deswater.com

doi: 10.1080/19443994.2016.1157991

57 (2016) 22713–22717
October

Taylor & Francis
Taylor & Francis Group

The Red Sea–Dead Sea desalination project at Aqaba

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Received 15 August 2015; Accepted 14 February 2016

ABSTRACT

The Red Sea–Dead Sea desalination project is a joint initiative to promote regional cooperation among Israel, Jordan, and the Palestinian Authority. As a result of such cooperation, a memorandum of understanding (MoU) was signed on 9 December 2013 at the World Bank in Washington DC in which all parties agreed to start the implementation of phase 1 of the project. The MoU has been followed by signing of a project bi-lateral agreement between Jordan and Israel on 26 February 2015 in which both parties have agreed on the modalities of their cooperation in all stages of the project and on management and procedures. The project aims to extract 190–300 million cubic meters per year (mcm/y) of seawater from the Red Sea and convey them via pipelines to a desalination plant north of Aqaba airport in Jordan to produce about 65–85 mcm/y of desalinated fresh water of which 35–50 mcm/y are to be supplied to Israel in the south. In exchange, Israel will supply about 30 mcm/y to the northern governorates in Jordan at a previously agreed price. Also, 30 mcm/y will be supplied to the Aqaba region, and the brine and seawater of about 110–220 mcm/y are to be discharged to the Dead Sea. Phase II comprises increase in the amount of desalinated water by construction of a second treatment plant south of the Dead Sea with a water transmission system to deliver additional fresh water to Amman. The additional quantities are yet to be defined. Ultimately, the project aims to augment Jordan's water resources and replenish, or at least maintain, the level of the Dead Sea water, hence preserving its environment and economic benefits. To implement the RSDS regional project based on a BOT scheme, the Government of Jordan is seeking private sector participation and partnership with a capacity to build, operate and transfer of a desalination plant, water and brine pipelines, booster pump stations and provide technology and knowledge transfer to Jordanian counterparts. The capital cost of the project is expected to be approximately USD 950 million to provide 65–85 mcm of desalinated water annually.

Keywords: Red Sea; Dead Sea; Jordan; Israel; Palestine; Desalination

1. Objective and description of the project

The overall objective of the project is to establish a secure and affordable water supply for Jordan while saving the Dead Sea from extinction, support widespread economic growth in Jordan, and provide for a potential regional water supply for Jordan, Palestinian Authority, and Israel.

Presented at EuroMed 2015: Desalination for Clean Water and Energy Palermo, Italy, 10–14 May 2015. Organized by the European Desalination Society.

The project includes construction of a conveyance system for the transfer of Red Sea water and desalination plant brine to the Dead Sea; a hydropower station along the conveyance system with power line connections to the electric grid, if so decided; a desalination plant with a capacity of 85 million m^3 water per year to be constructed north of Aqaba Airport in Jordan with a seawater intake pipeline from the conveyance system; a desalinated water pipeline from the desalinated water storage reservoir to Aqaba, and a desalinated water pipeline from the desalinated water storage reservoir to an Israeli designated discharge point along the Jordan–Israel border.

The Government of Jordan has established four primary objectives for the project:

(1) Establish a secure and affordable water supply for Jordan while saving the Dead Sea from extinction.
(2) Support widespread economic growth in Jordan.
(3) Provide for a regional water supply which includes the supply of about 35–50 mcm/y to Israel to be swapped with the same quantity for Jordan from Lake Tiberias in the northern Jordan Valley at a previously agreed price, and the supply of about 35 mcm/y to the Aqaba region.
(4) Facilitate private and public financing and partnership.

2. Why Jordan needs the Red Sea–Dead Sea (RSDS) project

(1) The project promises a comprehensive solution to two problems affecting Jordan. First, Jordan is the third most water-poor country in the world. Jordan's per capita water availability is 130 m^3/y, which is approximately just 13% of the internationally recognized water poverty level of 1,000 m^3/y. Second, the Dead Sea, a major ecological wonder and tourist attraction, has experienced a continual drop in surface water level due to evaporation and diversion (change or digression), and is expected to continue its decline at a rate of one meter per year.
(2) It is planned to proceed with an economic growth and development program that will involve planning, financing, designing and constructing multiple residential developments, commercial areas, industrial centers, resort areas, and other related business support functions.
(3) The Red Sea Desalination project is a joint initiative to promote regional cooperation among Israel, Jordan and Palestinian Authority.
(4) The government of Jordan is seeking the participation of interested parties to provide services, finance, and assistance to reach final implementation of the project parties such as:

(a) Experienced international engineering firms
(b) Experienced legal and financial firms
(c) International donor agencies
(d) Experienced international BOT bidders
(e) Development banks
(f) Private sector investors
(g) Governmental investment agencies

3. Demand assumptions for Jordan

The population in Jordan has increased by 36% in the last 15 years with an additional estimated 1.4 million Syrian refugees. Also, the municipal water deficit has increased by 410% in the last 15 years. The estimated water deficit in Jordan for domestic use is estimated to exceed 300 mcm in 2015, and 600 mcm in 2035.

By 2035, the total water demand for all purposes including irrigation needs in Jordan is expected to be more than 3,000 mcm/y. Jordan also aims to secure mega investments in the agricultural sector, and development projects in Wadi Araba in all sectors which will also increase demand for water.

4. Environmental impacts

Sinkholes are common where the rock below the land surface is lime stone, carbonate rock, salt beds, or rocks that can naturally be dissolved by groundwater circulating through them. Typically, sinkholes form so slowly that little change is noticeable, but they can form suddenly when a collapse occurs.

The water level in this historic sea is passing incredible falling rates, leaving behind thousands of holes. There are approximately 3,000 holes on the west side and hundreds of holes on the east side, and a strong increase in the form of these holes currently, while the sea contained only 40 holes in 1990.

Experts in this field point out that such holes are currently appearing at the rate of one per day. What is most frightening is that there is no way to know the

place or the time of their appearance which is directly related to the Dead Sea drying at a rate of one meter per year so that the ground suddenly collapses and forms a threat to the surrounding areas of the sea farms and roads.

5. World Bank study

The Red Sea–Dead Sea conveyance project is a proposed joint initiative to promote regional cooperation among Israel, Jordan and the Palestinian Authority and has the following objectives:

(1) Save the Dead Sea from environmental degradation.
(2) Desalinate water/generate energy at affordable prices for Jordan, Israel, and the Palestinian Authority.
(3) Build a symbol of peace and cooperation in the Middle East.

The project is undertaken in the context of the urgent need for potable water in the region, the arrest of the decline of the Dead Sea water level and to regional cooperation. It entails a seawater intake structure, a treatment and desalination plant, desalination brine conveyance pipeline and associated infrastructure works from which all beneficiary parties will benefit. It was jointly announced by Jordan, Israel and the Palestinian Authority in the memorandum of understanding signed 9 December 2013 in Washington.

The Government of Jordan and the Ministry of Water and Irrigation (MWI) of Jordan have indicated the urgency and value in the rapid initiation of the Project, a process is underway to select an engineering consulting firm to provide technical, legal, financial, and cost advice to MWI that takes into account the desire of MWI to balance the following considerations:

(1) The needs of each beneficiary party.
(2) The recent agreements between each beneficiary party to provide a secure and affordable water supply to all parties and to ensure timely completion of the project.
(3) The Government of Jordan public policy objectives.
(4) The bidder's (including lending entities and investors) financial, economic, and risk requirements.

6. Main findings of the Water Bank study

The project aims to extract 190–300 million cubic meters per year of seawater from the Red Sea and convey them via pipelines to a desalination plant to produce about 65–80 mcm/y of desalinated fresh water, of which 35–50 mcm/y will be swapped with Israel at BOT price in return for 50 mcm/y to be supplied by Israel to the northern governorates in Jordan at previously agreed price, to alleviate the water shortage problem in these areas.

Also 30 mcm/y will be supplied to the Aqaba region, and the brine and seawater of about 110–220 mcm/y to be discharged to the Dead Sea. This is considered to be Phase I of the project, with the next phase comprising increasing the amount of desalinated water by construction of a second treatment plant south of Dead Sea with the required water transmission system to deliver additional freshwater to Amman. The additional quantities for next phase to be defined based on the National Water Strategy to fulfill the demand requirements.

Ultimately, the project aims to augment (increase) the Kingdom's water resources and replenish (renew), or at least maintain, the level of the Dead Sea water; hence (therefor), preserving its environment and economic benefits to the Kingdom.

In addition, the project is part of the regional Red Sea–Dead Sea Project proposed by the World Bank at a total cost of about USD 11.0 billion, and when completed by phases, will enable investors to participate and realize substantial revenue from increase of freshwater quantities to supply Amman and from the development-related projects that will accompany the start of Phase II of the project.

7. Agreed project to be implemented-project facilities

The project will initially provide 65–85 mcm/y of desalinated freshwater to the Aqaba region and for Israel, transfer brines to the Dead Sea, while at the same time initiating the fundamental infrastructure elements for providing additional freshwater to the Amman region in subsequent phases of the project.

The cost of water produced by the project must be demonstrably affordable and relatively consistent with an acceptable cost of water. There are two primary strategies used in defining the minimal Project configuration:

(1) Minimize the short-term CAPEX and OPEX costs (including securing grant funding for the project).
(2) Maximize the long-term best value to Jordan.

The following is an initial assessment of the project components; however, more details of the project

facilities will be provided in the Request for Proposals (RFP), once completed, by the consultant who will be assigned to prepare the tender documents for the BOT candidates and to provide technical, legal, financial, and transactional services to MWI.

The following project components will serve as an acceptable base for the purpose to prepare and submit the prequalification document in response to this call.

8. Proposed components

(1) Construction of the intake facility with a capacity to abstract about 700 mcm/y, with depth of about 150 m as proposed by the World Bank managed study and sufficient horizontal distance from the Red Sea shore at the Northern site of the Gulf of Aqaba, to be able to construct the intake structure at the proposed depth.
(2) Construction of an intake pumping station, one 3.7 m diameter 2.5 km in length through Ayla development, and 2.8 m diameter with about 22 km in length pipeline to transfer the Red Sea water to the desalination plant location.
(3) Construction of a treatment and a desalination plant with a capacity of 65–85 mcm/y north of Aqaba airport.
(4) Construction of about 19 km of 900 mm freshwater pipeline from desalination plant to Aqaba terminal reservoir, and 4 km of 1.2 m diameter pipeline to deliver the freshwater to Israel.
(5) Construction of two pumping stations to pump the resulting brine to a reservoir at the highest point in Wadi Araba near Risheh area.
(6) Construction of a 2.2 m diameter, 56 km length pipeline to convey the brine from the desalination plant to the storage reservoir in Al-Risheh, and a 2.2 m diameter, 140 km length pipeline to convey the brine from the reservoir to the Dead Sea, and the construction of the facility to discharge the brine in the Dead Sea at sufficient depth to avoid the formation of stratifications in the Dead Sea water.
(7) Hydropower generation plants on the course of the brines conveyance.
(8) Electrical instruments, chlorination, connection from the national electrical grid to the project facilities, and a SCADA system.

Note: upon the condition of a justification by in-depth studies by the consultant during the preparation of the tender documents, some of the above figures may evolve and change along the study process.

9. Benefits of Phase I to beneficial parties

As a result of such cooperation between the beneficial parties, some of the major benefits will be achieved from Phase 1 and the upcoming phases as well.

(1) The Gulf of Aqaba is protected, no environmental effects.
(2) Infrastructure is designed to be expanded.
(3) No infrastructure is abandoned in future phases.
(4) The Phase I desalination facility at Aqaba provides flexibility in delivering freshwater to current consumers.
(5) Project financing is feasible through a combination of acceptable water rates and financial grants.
(6) The project initiates the process to save the Dead Sea.

10. General operation philosophy

The project is to be undertaken by a private sector company or consortium which will be granted necessary rights in relation to the project.

The preferred investors will be responsible for the operation and maintenance of all project components including: the intake structure, intake pumping station, seawater pipeline, treatment and desalination plant, freshwater pumping satiation, freshwater conveyance pipelines to Aqaba and to the Israeli border, brine water conveyance pipeline, collection reservoir, hydropower plants, brine discharge facilities to the Dead Sea, all SCADA systems, electromechanical instruments, chlorination, and all other project components.

All the O and M costs shall be paid by the investors during the project concession period.

The project company, once established, shall enter into a take or pay agreement with MWI, who will purchase all the produced desalinated water quantities of 65–85 mcm/y. MWI will enter into take-or-pay agreements with Israel and Aqaba Water Company to provide them jointly with the water quantities purchased from the water company.

11. Financing plan of the RSDS project—Phase 1

To implement the Red Sea–Dead Sea regional project based on BOT scheme, the Government of Jordan

is seeking a private sector participation and partnership with a capacity to build, operate, and transfer of desalination plant, water and brine pipelines, booster pump stations, and provide technology and knowledge transfer to Jordanian counterparts. The project is expected to have a capital cost of approximately USD 950 million and will provide 65–80 mcm of desalinated water annually.

The project company will be responsible for arranging and securing all finances required for the project without any recourse to MWI. MWI will, however, solicit international financial institutions to provide grant and concessionary financing to the project company for the purpose of brine disposal and transfer to the Dead Sea.

The water-swap agreement with Israel will substantially reduce the cost per cubic meter of water which makes it attractive to Jordan to proceed with this investment project.

12. Phase II

In the future, the Government seeks to expand the project's infrastructure to increase the amount of fresh water produced. This will offer investors the opportunity to take part in the coming phase.

13. Progress update

By a RFP, published on 23 July 2015, MWI announced the start of a competitive process to select a company or consortium to provide consulting services for technical, legal, financial, and transactional services for tendering of the Red Sea–Dead Sea water project (Phase I) in the Hashemite Kingdom of Jordan on a Build, Operate and Transfer (BOT) basis.

Phase one: preliminary services.
Phase two: procurement services.
Phase three: negotiation support.
Phase four: transaction support.

The duration of services is expected to be 12 months from commencement, and Phase Four will be for duration of 12 months or until financial close whichever is the later.

The Call for Submission of a Prequalification Document ended 30 January 2016. The latest date for submission of a Prequalification Document is 30 March 2016. (Eng. Saad Abu Hammour, Secretary General, Jordan Valley Authority, Chairman of the Project Special Tendering Committee).

14. Planned time schedule

Planned time schedule		Task by
Call for engineering consultant	July 2015	MWI team
Select consultant	December 2015	
Start tender preparation services—consultant	January 2016	Consultant
Call for submission of prequalification documents (announce expression of interest)—contractors	November–January 2015	
Collect prequalification documents (contractors)	April 2016	Consultant and MWI team
Evaluation of prequalification documents	May 2016	
Short list (contractors)	May–June 2016	
Distribute RFP for the short list	June 2016	
Collect technical and financial offers	December 2016	
Evaluate proposal and announce preferred bidder	June 2017	
Initiation of the project agreement	July 2017	
Negotiation and financial close	December 2017	
Commencing implementation	January 2018	Contractor
Commercial operation	End of 2020	