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Kingdom of Saudi Arabia
Saline Water Conversion Corporation

- 9 OCT 1989

CENTRE FOR ARAB GULF STUDIES

UNIVERSITY OF EXETER

**DRINKING WATER PROJECT
FOR THE CITY OF RIYADH**

RIYADH 9/5/1403 A. H.
22/2/1983 A. D.

In the name of Allah, most merciful and compassionate

It is Allah who has subjected the sea to you,
that ship may sail through it by his command,
that you may seek of his bounty and that you
may be grateful.

Holy Koran



His Majesty King Fahd Bin Abdul Aziz



His Royal Highness The Crown Prince
and Deputy Premier



His Royal Highness
Second Deputy Premier
Minister of Defence and Aviation



Forward

Thanks for Allah and peace be upon his great Prophet.

One of the greatest blessings Allah has bestowed on this country is the continuous and great achievements accomplished in all aspects of life and the progressive development and construction projects serving the citizens to bring them happiness and improve their living standards.

You will find, dear reader, in this booklet the story of one of the many projects, which aims at bringing desalinated water to the city of Riyadh, as it did to many cities and villages in the Kingdom, bringing to it potable water of abundant quantity and of the best quality.

We are fortunate that this project is coming to light at the outset of this radiant era of His Majesty King Fahd Bin Abdul Aziz Al-Saud who has always been and is giving his faithful endeavours, fixed resolution and strong will aiming at the prosperity and the promotion of this beloved nation and its loyal people.

The Saline Water Conversion Corporation

has played an active role to achieve this excellent objective. Being a specialized establishment with great responsibilities it spared no effort for finding additional sources for drinking water from seawater, and generating great quantities of electric power. The Corporation is considered a great pillar in the construction movement and development in this country. With help from Almighty Allah, this Corporation will succeed in achieving the execution of all its well studied and prepared plans aimed at fulfilling the requirements for potable water in all our cities & villages.

Details about desalination Projects and Plants scattered everywhere in the Kingdom will be presented in another booklet.

As we are pleased now by inauguration of the desalinated water project for our dear Capital city, we have also been lucky in the near past in inauguration of desalination projects of the great Al-Khobar 2 Plant, and the great desalination plants in the holy city (Makkah) and Taif, in addition to other vital desalination plants elsewhere in the country in the near future.

I am optimistic for the future of this Corporation which is of great benefit for the prosperity of this nation and people. I am also pleased with the loyal national staff administering its works and shouldering various responsibilities, technical and administrative, as I am pleased with our Ministry of Agriculture and Water staff who all have the objective of fulfilling the needs of our citizens for drinking water in addition to other responsibilities which the Ministry is aiming to achieve.

Finally, I ask Almighty Allah to bless our Royal leadership and our people's endeavour for prosperity under the immortal Islamic faith.

Abdul Rahman Abdul Aziz Al-Sheikh

Minister of Agriculture and Water
Chairman of Board of Directors of Saline
Water Conversion Corporation.

Acknowledgement

I am very much pleased on this memorable occasion of His Majesty King Fahd Bin Abdul Aziz inauguration of the Riyadh water transmission system, to extend my sincere thanks to His Majesty on his continuous guidance and support that has made the successful completion of this project and other Saline Water Conversion Corporation's projects possible. We in SWCC are also indebted to H.E. Dr. Abdulrahman Al Sheikh, Minister of Agriculture and Water and Chairman of the board for his support and personal involvement in overcoming numerous hurdles. Our thanks are also due to their excellencies the SWCC's board members for their continuous cooperation and valuable comments.

Abdullah Mohammad Al Gholaikah
Governor
Saline Water Conversion Corporation

مشروع خط أنابيب مياه الرياض

RIYADH WATER TRANSMISSION SYSTEM



ROYAL COMMISSION OF SAUDI WATER & ELECTRICITY

Water in Riyadh, a historical background

Riyadh has been depending on wells for its drinking water supplies. These wells have been done by the Government at different locations of the city, most of them being scattered at Hanifa Valley. Some barriers were constructed on the Valley and on its branches to charge these wells with water. These wells and barriers have played a vital role in satisfying the needs of the Capital City when it was quite small with a small population and low consumption of water.

When the Capital City continued its vast expansion surpassing all estimates, the Ministry of Agriculture and water constructed many water projects the last of them was a large project called Wasia Project, which is located at 110 Km. east of Riyadh. Thus, another 52.8 Million gallons of water was added to the amount of drinking water to be consumed. This vital project was inaugurated in Shaban 1401 A.H.

During the life history of drinking water for the Capital City, many sources have consecutively been put into service to dismiss the fear of thirst from its people.

In accomplishing this achievement the virtue after Almighty Allah, belongs to the wise guidance of this great country's leaders.



Project for bringing desalinated Seawater to Riyadh

Expanding the pioneer work achieved two years ago by Saline Water Conversion Corporation supplying desalinated water and power to the holy city of Medina and neighbourhood villages once resided by the Prophet, peace be on him, with a pipeline from the Medina Yanbu power and desalination plant located near Yanbu. The great achievements witnessed in the Kingdom of Saudi Arabia, under its faithful leadership, in the Arab and Islamic World and in International aspects through which it played a great and effective role in the events because of the great blessings it was bestowed by Almighty Allah. One of the greatest blessings is Islam and Islamic guidance role it practices with great confidence, and vast natural resources granted by Allah, specially petroleum resource, which has been used for the benefit of developing the country in different aspects and helping its brother countries in both Arab and Islamic world and contribution in International development activities for developing countries for the sake of flourishing the world economy.

Therefore, under these circumstances of ac-

tive and effective role of the Kingdom in the world, it was very natural to reach at this high degree of rise in progress and expansion in the Capital City and other cities of the Kingdom. As a consequence there have been a greater need for dependable water sources to fulfill the city's foreseen requirements of water which is considered the keystone of development everywhere in the world.

Feeling the necessity to guarantee a fixed and continuous source of drinking water for the city of Riyadh, the authorities in the Ministry of Agriculture and Water and in Saline Water Conversion Corporation had in mind the idea of bringing fresh water from the Arabian Gulf since 1396 A.H. Here, we must mention that His Royal Highness Prince Salman Bin Abdul Aziz, Governor of Riyadh, has supported and helped the responsible staff to commence studies on this great project. Furthermore there existed confidence, strong will and unlimited financial and spiritual support for the staff of the Ministry and Saline Water Conversion Corporation from our beloved government.

With guidance of Allah, in 1396 A.H. Saline Water Conversion Corporation started preparing designs, drawings and contracts for this giant project to enable the Capital in the furthest depth of Arab Semi-Island to drink fresh potable water coming from the Arabian Gulf. Construction work started in 1399 A.H.

to set up water desalination and an electric power generation plant at Jubail (Phase 2) to supply Riyadh with abundant quantity of water with a maximum capacity of 210 million gallons of water per day plus 1395 MegaWatts of electric Power.



Highlights Of «Jubail 2» Desalination plant

This Project has been designed according to the latest technical specifications and implemented by the help of many specialized national and international companies.

The project comprises of the following main elements:

Sea Water intake

Comprises of 20 pumps for drawing sea water each with capacity of 180.5 million gallons/day, 16 of them working to produce the maximum capacity of water and electricity. The remaining 4 pumps are for emergency use. Thus, the total quantity of sea water required for desalination and for cooling in the power plant will be 2900 million gallons/day. There are 20 movable and 16 fixed filters, 4 automatic pumps for mixing chemicals and 8 mixers for Sodium Hypochlorite, 40 chlorine units with 8 pumps. There also exists 40 cut-outs with 7.2 K.Volt pressure. 80 secondary electricity distribution points with 80 automatic motor centers and 20 panels for measurement gauges and control and observation instruments.

Desalination Units

- 40 desalination units (evaporators) each producing 6,240,000 gallons of water per day at 90° C. The production could be increased when operating at higher temperature.
- 40 heat exchangers which receive the steam and heat the sea water.
- 40 air deaerators to purify the water entering to the evaporator from dissolved gases.
- 80 ejector units for shaking and air ejection.
- 40 cleaning units with chlorine.
- 80 pumps for pumping water from storage tanks to the plants of chemical treatment, then to the large storage tanks.
- 40 pumps for pumping salty residue to the drainage channel.
- 80 pumps for circulating water inside the distillation chambers.
- 80 pumps for shaking and evacuation units and 120 pumps for the product water.
- 135 electric cut-outs 7.2 K.Volts. Also

more than 200 auxiliary electric points and more than 350 automatic electric motors and 40 switchboard of panels for observation, measurement and control instruments complete with connecting pipes with different facilities of the plant.

Electric Power Plant

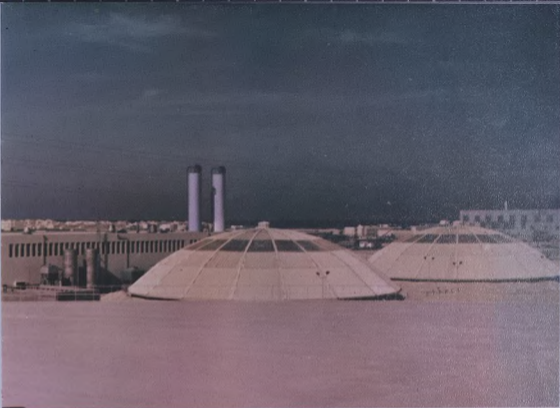
Consists of two parts-the plant is comprised of 10 boilers each with capacity of 783 ton/hour of compressed steam at 102 atm. 515° C. temp. plus 10 gas turbines, each of these turbines operates and electric generator producing about 129.5 Megawatt of electricity. Thus, the total product of electricity is 1295 MW Out of this amount, the plant, its auxiliaries, housing compound and energy required for pump station No. 1 for water transmission pipeline to Riyadh will be about 395 MW. The remaining 900 MW will be added to the Eastern province network.

There are two stand by boilers to replace any boiler which may stop or be defected during

operation. There are 10 cement chimneys, each of them belongs to a boiler. Each chimney is connected with a purification system to avoid any pollution around the plant. There is a complete system for fire protection, a lubrication system and preparing batteries to supply instruments and equipments with electric power in case of any breakdown or interruption in power generation.

There are 18 pumps to pump chemicals, and 20 large pumps for feeding the boilers with water, each having a capacity of 6 million gallons/day. 10 of these pumps are operated by means of a large electric motor of 6100 HP and a voltage of 6.9 K.Volts. The other 10 boilers are operated by smaller steam turbines to economize energy consumption and to guarantee continuous operation. There are another 24 pumps to feed the boilers and fuel tanks with fuel each of 16500 gallons/day capacity. Two condensers accumulate power which may not be consumed by facilities.

There are a great number of large electric transformers for raising the voltage from 13.8 K Volts to 230 K Volts; The voltage of electricity in the region. Also a number of medium and small size transformers which decrease



◆ Lime slurry tanks.

◆ Lime storage tanks.

Lime is added to product water to make it palatable and increase the total soluble salts.

voltage from 13.8 K Volts to the required voltages for operating pumps of different sizes 7.2 K Volts, 6.1 K Volts and 3.2 K Volts and the lower voltages of 220 Volts and 110 Volts. There are another 8 pumps (4 of them reserve) to draw cooling water to the closed circuit

power station each with capacity of 22.5 million gallons/day with electric cut-outs, switches and pipes for wires and cables for high, medium and low tension voltages and water connection pipes from the intake of the sea to cooling circuits.



Chemical laboratory. Chemical analysis of water and fuel are carried out.



Desalination units. A general view of desalination and power plants.

Two halls, each containing necessary equipments and instruments for measurement, control and observation. Another room for main observation equipped with computer for remote control and observation of all elements of the project and a unique communication system among the whole project sites, housing compound and administration buildings.

Auxiliary Electric Facilities

Including a plant for treatment of produced

water to make it palatable for drinking and to make it passive during its transfer. By adding and mixing some lime, the amount of dissolved solids rises from 25 ppm to 100 ppm before being transferred to the large storage tanks.

There also exist large fuel tanks containing enough fuel at least for one month, also fire

extinguishing pumps for the whole project and a plant for generating hydrogen to be used for cooling electric generators.

There also exists large workshop and laboratories for analyzing water and chemicals and mixing proportions.



Outfall channel.

Civil Work

ing civil works are gas building, a building for fire fighting trucks, maintenance work shop and building, 6 gates for the project, guard rooms, rain water and sanitary drainage pipes, and roads inside the project site. These works have no connection with the work of housing compound at Jubail.

Apart from power plant buildings, the remain-



Housing compound.

Common Drainage Channel

The project is comprised of a drainage canal 5

meters deep and 3000 m long. The width at the bottom starts with 7.3 m near the first desalination unit and electric power generation unit of (Jubail 1) project. Then it widens gradually while passing along other units until it becomes 39 m. wide at bottom near the last unit of Jubail phase II project to enable it to hold all the excess salt residue coming out of evaporators and cooling water returning back

from power plants. The canal then expands towards outside to pour out to the Gulf, faraway from the sea water intake.

14 bridges have been constructed on the channel, 6 of them for pedestrians, cars and heavy transportation to the workshops. The other 8 bridges are used for pipes, cables and other necessary connections.

Housing Compound

To provide comfortable housing for all the

employees in this large project a large and complete housing compound has been set up with all necessary facilities and services. It consists of 2500 housing units provided with all necessary facilities and services as lighting the streets, water distribution network, asphalted roads, traffic lights, irrigation, drainage, sewage and rain water drainage networks, a sewage water purification plant, a plant for burning refuses, electric power distribution and automatic telephone networks and plantings. There is a small hospital with specialists in most of the important medical branches, also schools for boys and for girls, sports club, administration building, shopping center, post office, police station and other facilities. There

is a large mosque at the center with 4 other mosques at different locations of the compound.

Riyadh Water Pipeline

This pipeline is considered the most important part of this vital project. The line extends starting from the project site at Jubail passing from Dhahran, Hufuf, Khurais to Riyadh. It consists of two parallel pipelines, each with

capacity of 109.6 million gallons of water per day as maximum. The normal capacity for both lines is 145.7 million gallons per day. The length of both lines is 932 Km. of mild steel 1.5 m in diameter (about 60 inches), each line is 466 Km. long, buried in two separate and parallel trenches. There are 6 pump stations with 6 concrete storage tanks each holding 13.2 million gallons of water 35 Km. east of Riyadh. There are also houses for employees in each pump station except the first station which is located in the boundaries of Jubail having its own housing compound.

This pipeline is lined internally with cement mortar and externally covered with polyethylene.

Description of 3 pipeline project feeding Riyadh from location 35 Km east of the city

The drinking water brought from Gulf to the storage tanks built on the outskirts of Riyadh where the Gulf water is mixed with water coming from Wasia project and then transferred to Riyadh through 3 main pipelines operating by gravity as the location of storage tanks is higher than Riyadh, so the water flows easily without need for using pumps. Pipes are made of

prestressed concrete, 2 meters in diameter with a total length of 130 Km connecting desalination storage tanks to the tanks of the Ministry of Agriculture and Water at Rawdha, Kharij road and north of Riyadh.

This large vital project with many other water projects all over different cities and

villages of the Kingdom clearly reflects the government deep concern and endeavour for supplying all the citizens with potable water which is not restricted for big cities, but open to every village and every populated location without considering the distance. The saline water conversion corporation has set up desalination plants in Jeddah. It has done the same at

Farasan, Haql and Duba, as sane as Al-Khobar, Makkah and Assir. Many suitable desalination plants are being built at Al-Khafji, Al-Birk, Rabigh and Al-Wajh which goes parallel with other development projects everywhere. The projects for drinking water implemented by the Ministry of Agriculture and Water include the remotest location as well

the large cities.

There are complete united projects for provinces like great Al-Washm water project, Tihama Valley water project and bringing water to cities of Taif and Hada, also the great united comprehensive project for Sideir,

Shuaib and Mahmal region which are currently being set up to supply 63 cities and villages with water, apart from Ahsa water project and many others. All are being implemented by the Ministry of Agriculture and Water and Saline Water Conversion Corporation with full support and continuous follow up from His Majesty the King and His Faithful Crown Prince.

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