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2. Extension to Sea Water Cooling System (Kuwait)

Owner: State of Kuwait, Shuaiba Area Authority

*Engineer: Motor-Columbus, Consulting Engineers Inc.,
Baden, Switzerland*

Joint Engineer: Dr. M. H. Ali El-Saie, Consulting Engineers

Construction Dates: 1979-1983.

General

The Shuaiba Industrial Area is situated about 50 km south of Kuwait City and covers an area of approximately 2,400 ha.

Shuaiba Area Authority (SAA) is the planning and supervision agency and provides infrastructure and related services to the industries. In this context, it is of main importance that the Authority provides the sea water needed for cooling and distillation purposes.

Within the numerous industries, existing or planned, the following main water consumers must be mentioned: Kuwait National Petroleum Company; Shuaiba Refinery Petrochemical Industries Company (PIC): Fertilizer Unit, Aromatics Production Plant, Olefines Production Plant, Ammonia Production Lines, Kuwait Melamine Company; Mina Abdulla Refinery; Ministry of Electricity and Water: North and South Power and Water Production Station.

Due to the rapid development in the southern part of Shuaiba, the Owner has decided to extend the pumping plant B from 36,000 m³/h to 207,000 m³/h.

Data collection

For the purpose of review and acquaintance with the existing plant, an official mission has been delegated to the project site to collect and prepare all necessary preliminary data and instructions related with the project which are described and listed below:

Government Rules and Regulations, Climatic and Sea Water Conditions, Air Pollution, Cost of Energy and Water, Debris and Marine Fouling Condition, Topographical Surveys and Subsoil Investigations, Telecommunication, Grounding, Main Power Distribution and Chlorination Systems, Consumer Data and Requirements.

Intakes

The intakes are consisting of four reinforced concrete pipes, (diameter 3.3 m) reaching approx. 365 m into the sea. Intake structure caissons terminate the pipes at their ultimate end into the sea furnished with appropriate trash rack, stoplogs and handling facilities. The maximum intakes capacity were checked considering losses due to friction, turbulences, waves and marine fouling allowances.

Forebay and pump deck structures

The intake pipes are terminating on shore at the forebay with their openings equipped with four sluice gates.

The deck structure is designed to accommodate 16 vertical pumps. (Maximum weight of the pumps and motor 72 tonnes).

The pump chamber is 7 m below admiralty level at the bottom and 5.5 m up the ground level, which is the nominal level of all onshore station facilities.

Cooling water pipelines

The new required cooling water pipelines will have a total length of about 8,000 m.

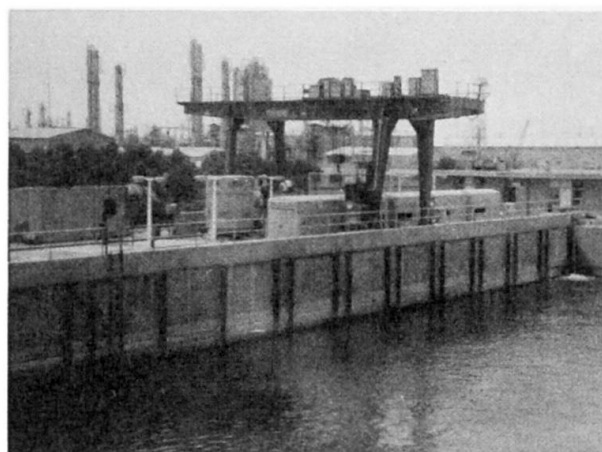
The preliminary design was studied considering: effects of velocity, water hammer and temperatures, friction losses, corrosion resistance, working reliability and maintenance possibilities, economic diameter and network alternatives.

The corrosion resistance to chlorinated sea water was given great importance and, therefore, such advanced technology as GRP-Pipes (glass-reinforced plastics) and 90/10 copper-nickel clad steel pipes were also considered.

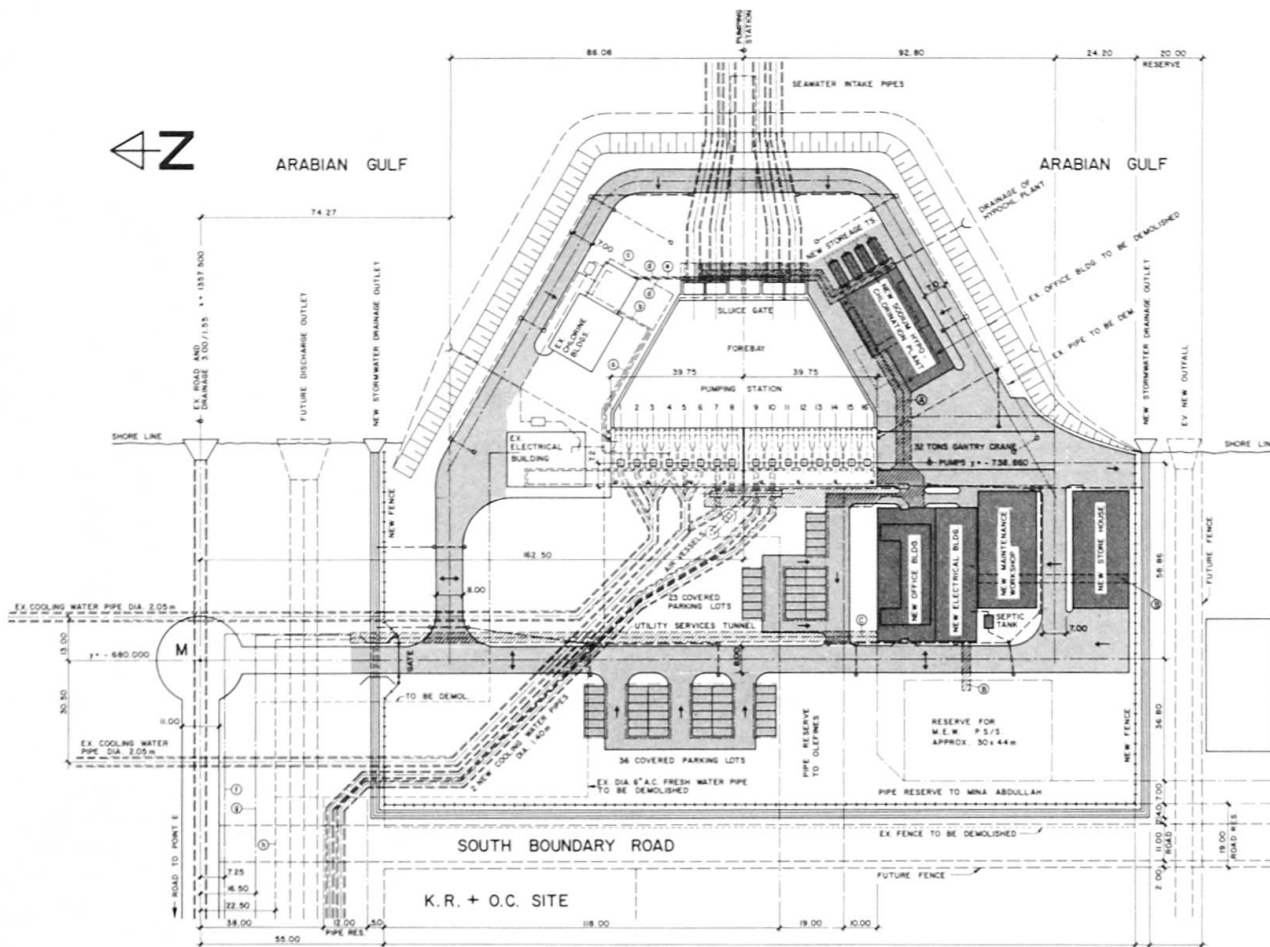
Following the above-mentioned design criteria, the Engineer and the Client selected cement mortar lined steel pipes and having the following characteristics:

2 dia. 1,400 mm, length 1,600 m each
2 dia. 2,000 mm, length 900 m each
2 dia. 1,800 mm, length 1,500 m each

At the beginning and end of the pipeline, headers and terminal points were foreseen, allowing for directing and measuring the cooling water flow.



Pumping plant



General layout

Infrastructure works

The following work was required to improve and extend this pumping plant:

Earth work, demolition work, new control, workshop, office, store and hypochlorination buildings, roads, drainage, water supply, sewage and cable trenches and forebay cleaning equipment.

Other services provided by the Engineer

The following special investigations had to be performed by the Engineer:

Shore protection study

The pumping plant had to be protected against tide, storm and waves action and the Engineer recommended a three-layer rubble-mound protection with tetrapodes.

Hot water recirculation study

The main aspect of this analysis was to study the Gulf water thermal distribution along the Shuaiba shore and the effects of industrial cooling water outfalls on the intakes.

Technical and economical investigations for off-shore sodium hypochlorination plant

This study compared the injection of chlorine solution produced industrially with the offshore sodium hypochlorination procedure against organic growth in sea-water system.

Prequalification analysis

The consultant prepared the appropriate document for prequalification of experienced international contractors.

The prequalification as well as the tendering was prepared to select 3 main contractors, e.g.:

- Lot A – Civil Works and Civil Works Pipelines
- Lot B – Mechanical Equipment
- Lot C – Electrical Equipment

Mechanical and electrical equipment

16 sea water cooling water pumps, each having a capacity of approx. 4 to 5 m³/s with a head of up to 60 m including asynchronous motors of rated output of 2,000 to 4,000 kW. Mechanical sea water cleaning equipment including trash racks, travelling had screens. Switchgear and motor control center, power transformers, power cables, emergency standby and process-control pumping plant mimic board.

(P. Y. Christen)