Experience with GRP Pipe in Desalination Plants and Cooling Systems

Past Experience and Current trends

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Future Pipe Industries

IDA_DM2010

Brief History of the FPI Group

- As of 2008, Group was the largest GRP (Fiberglass) pipe manufacturer in the world

- 10 Manufacturing Units around the world: USA, Holland, Egypt, Saudi Arabia, Qatar, Dubai, Abu Dhabi, Oman. Group 2008 Sales : > $ 800 million

- Over 32 years of successful experience in manufacture of Fiberglass pipe

Brief history of Fiberglass pipe

- The first ASTM specification for Fiberglass sewer pipe was published in 1973 (37 years ago !).
- The first ASTM water pipe specification was published in 1976 (34 years ago).
- The first AWWA (American Water Works Association) specification for Fiberglass water pipe was published in 1981.
- The Oil industry started using pipe in 1960's.
- First used in power plants in the USA in the early 1970's.

WHY FIBERGLASS?

Corrosive Soils + Ductile Iron Pipe

External Corrosion of Cement Lined Steel Pipe

Corrosion of Metal Piping

External and Internal Corrosion of Pre-stressed Concrete Pipe carrying Sea Water after 9 Years

The Solution to Corrosion Problems is Fiberglass Pipe !

- Long life 50 yr design life
- Low maintenance costs (none)
- Lowest lifecycle costs
- No coatings or linings to maintain
- No need for cathodic protection
- No need for chemical soil analysis

Advantages of Fiberglass Pipe

- Unaffected by long term UV exposure
- Unaffected by salt water
- Unaffected by chlorides & sulphates
- Unaffected by stray currents
- Unaffected by soft water
- Corrosion Proof throughout

Advantages of Fiberglass Pipe

Smooth bore 'C' = 150

→ Low friction losses

= Big Savings on initial pump costs and energy costs EVERY YEAR

Advantages of Fiberglass Pipe

Light weight + Long lengths = Lower installation costs onshore and offshore

Weight

¼ of steel

1/10 of Concrete

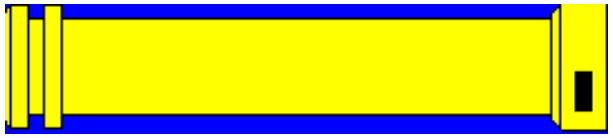
12M Lengths

→ **Low Transport Cost**
→ **Easy to install**

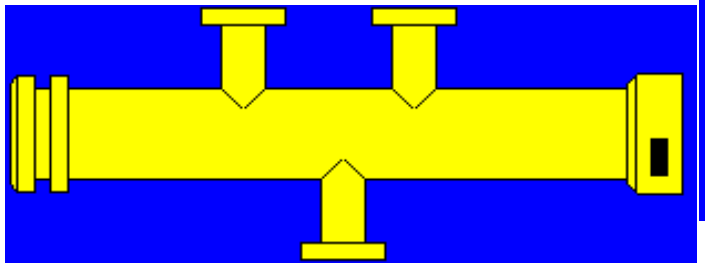
Requires Small Equipment

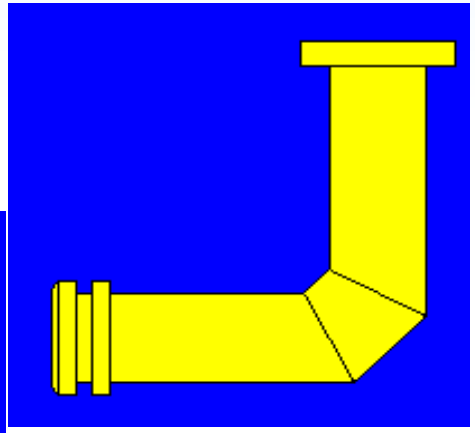
Advantages of Fiberstrong FRP Pre-Fabrication of Spools

Standard Pipe



Spool





Overview of Product Range

GRP [Filament wound]

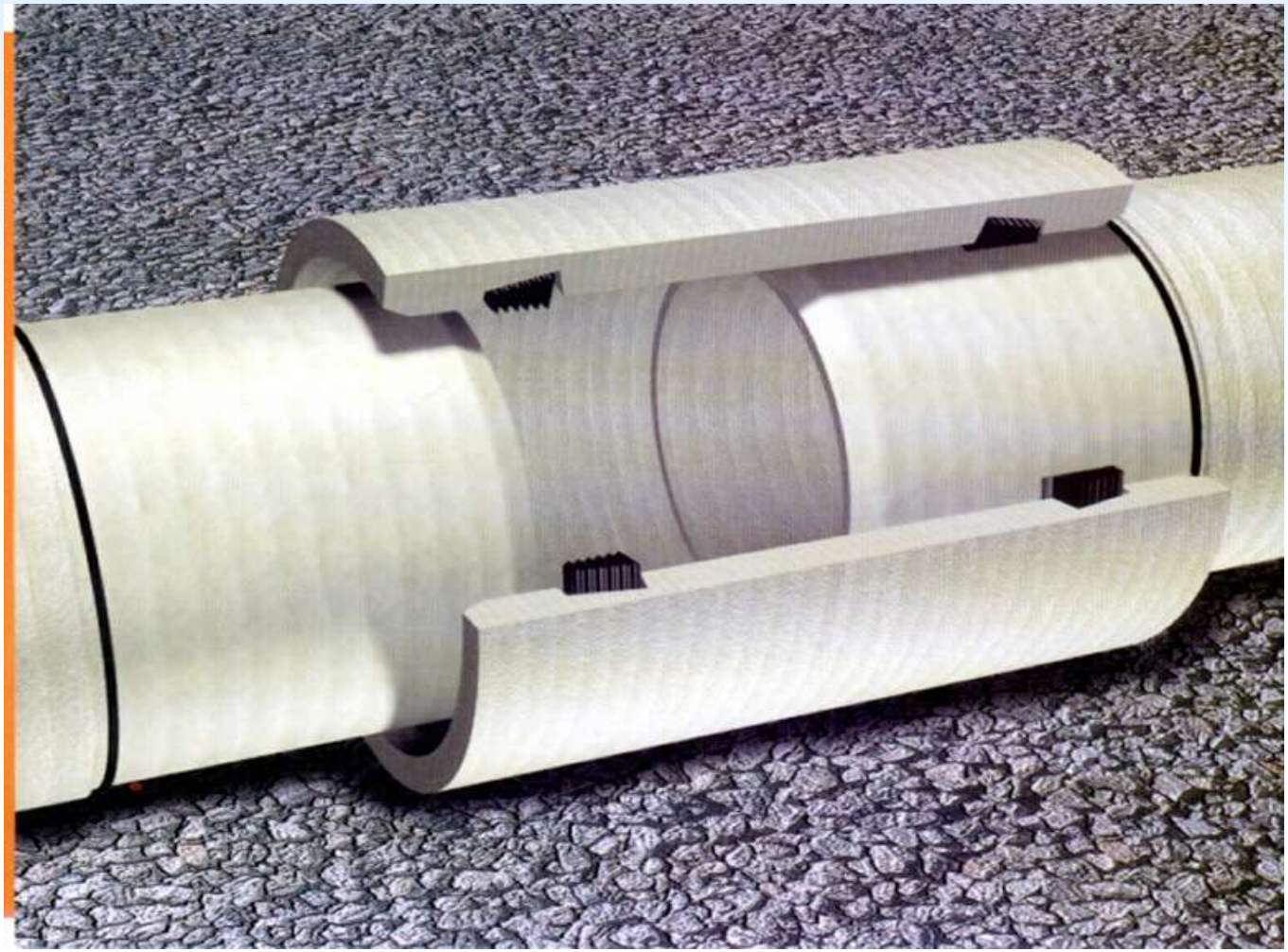
Diameter Range: 80 – 4000 mm (3”-158”)
Standard pressure classes: up to 20 bars
Standard lengths: 6M up 300mm, 12M for larger sizes

Standard Joints: Gasketed coupling, Lamination or flanges
Standard temperature range: - 40 → + 60 C (GRP)
(GRV up to 83 C, and GRE up to 100 C)

Standard GRP Joints

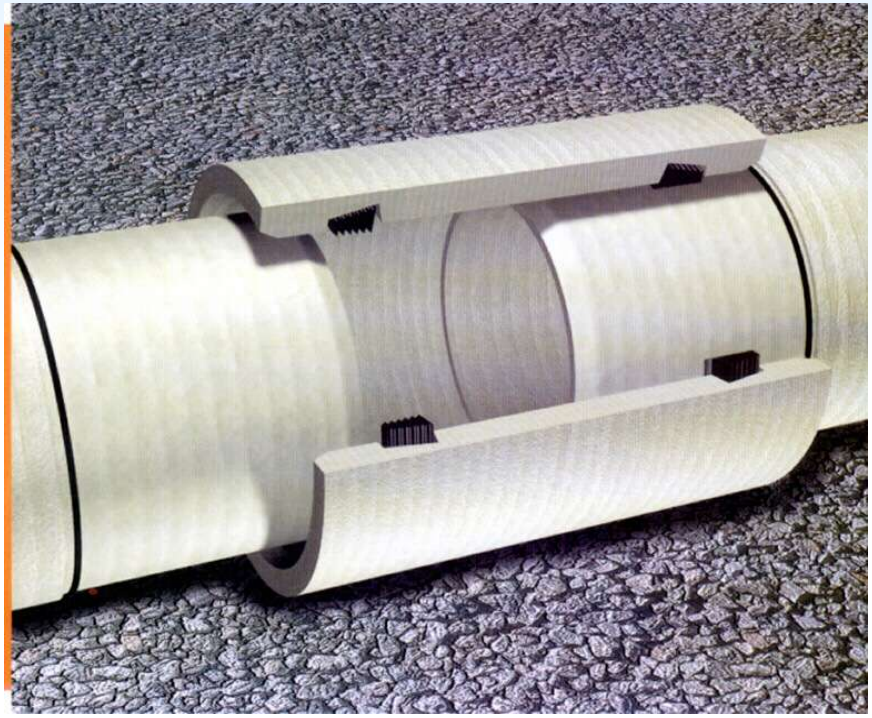
- Gasketed Coupling
- Lamination
- Flanges

Gasketed Coupling joints - Standard for underground use Onshore and Offshore



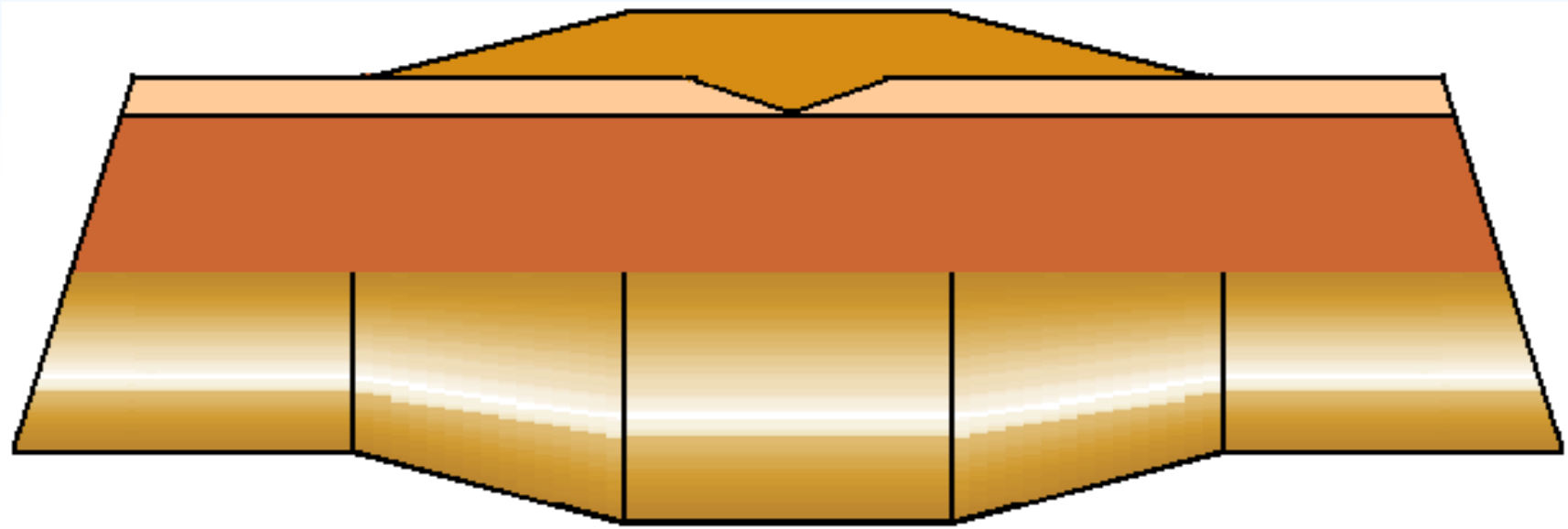
Advantages of Fiberglass Coupling Joints

- Reduces installation time
- Internal joint testers available
- Can take up angular deflection up to 3degrees
- No welding or X-rays required
- No skilled labour required



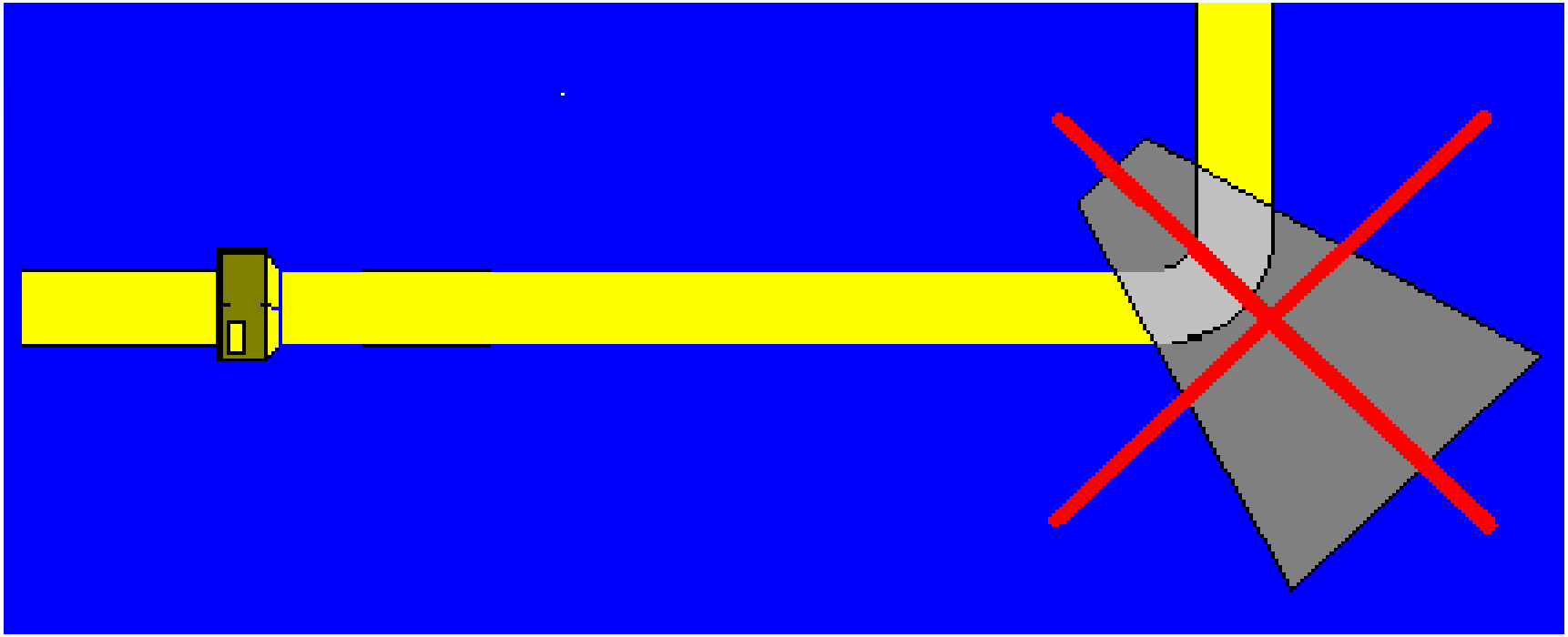
Coupling Joints

Lamination Joint
For above ground use or underground without thrust blocks



Lamination Joints Underground

→ **Allows pipelines to be designed without anchor blocks underground.**



Underground Seawater Supply Pipe System
2.5 m x 10 bars Fully Restrained (no thrust blocks)

Lamination Joints Aboveground

Flanged Joints

Part I - Mega Cooling Water Systems

Al Jubail II Sea Water Cooling System
Kingdom of Saudi Arabia

The sea water cooling system for the Jubail Industrial City, KSA

Original system installed by the Royal Commission (Project manager: Bechtel) from 1981 to 1984 consisted of 12 km of open canals and 100 km of pipe of Diameter 1.6 m , 2.0 m and 3.0 m used as inverted siphons and pipe laterals feeding the industrial parks. Pipe material selected was Pre-stressed Concrete pipe.

4

1981-1984
Installation of 1.6 m coal tar Epoxy Coated Pre-stressed Concrete Pipes

This section of the Jubail Industrial City seawater cooling system in Saudi Arabia utilizes six barrels of 1600-mm-diameter prestressed concrete cylinder

The Sea Water Cooling System for the Jubail Industrial City, KSA

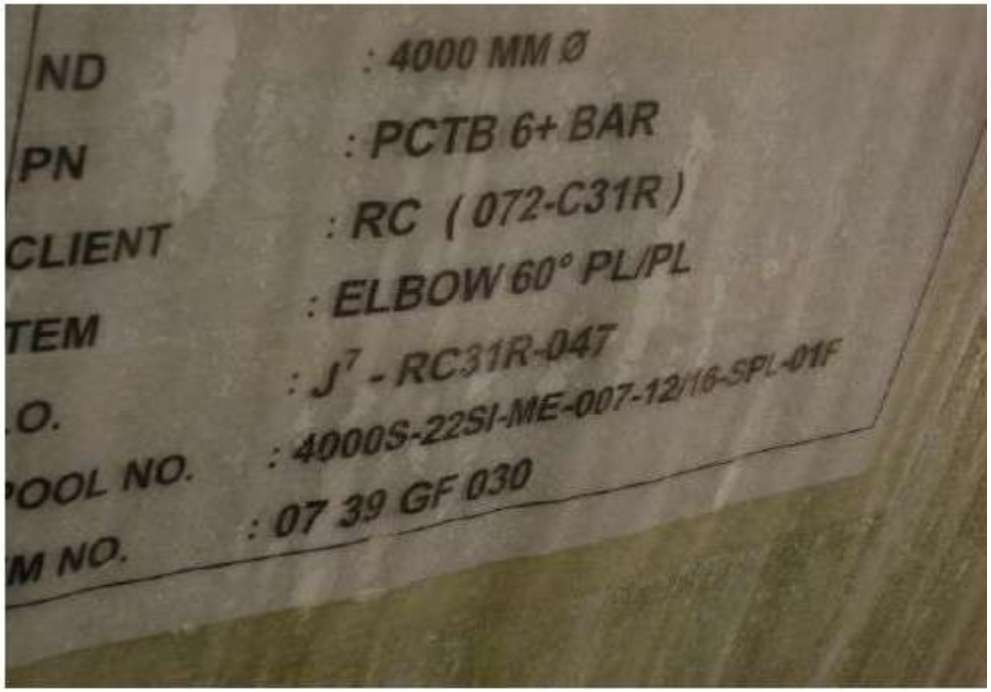
- In less than 7 years, severe internal and external corrosion started appearing in some of the pipe and on some of the open canals.
- The Royal Commission started looking into repair methods to keep the cooling system in operation. For the Canals, 4800 Aluminum-zinc sacrificial anodes connected to the R-bars were installed during 1987. Many concrete pipe sections were relined with GRP pipe !

New Extensions of the Jubail Cooling System

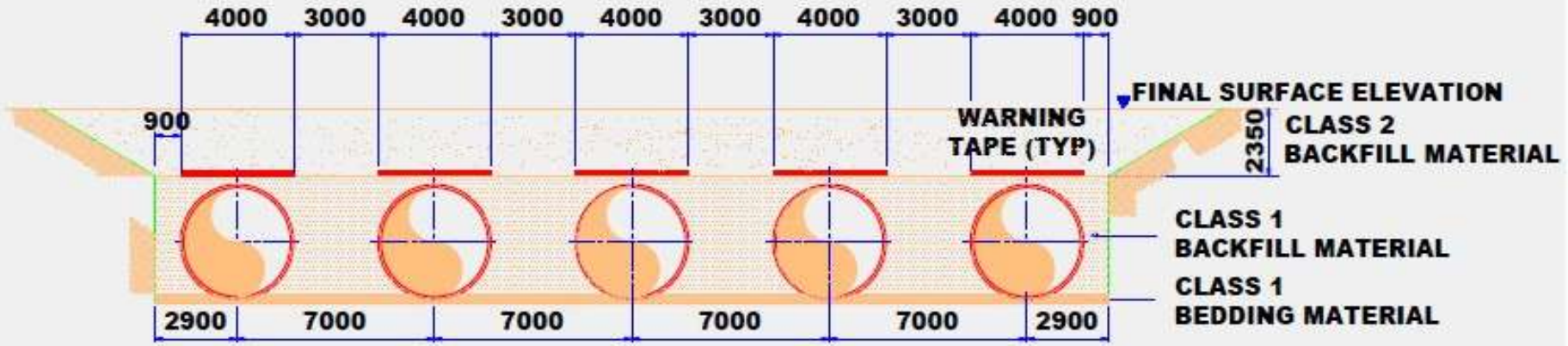
- The largest extension of the Jubail system was started in the design phase in 2004 with the announcement of Al Jubail II city (a 16 Billion Riyal government investment; Project Manager: Bechtel) covering around 45 million m^2. This extension of the system was done with GRP pipe only having a diameter of 3.0 m & 4.0 m (!). After the extension It is now the world's largest single sea water cooling system with a design capacity of 30 million m3 per day.

Piping

- 4 m for East West Piping 55 km GRP
- 3 m for North South Laterals 21 km GRP
- 2 m for industry connection
- Valves 4 m (31) / 3m (21) / 2m (66)



Trenching Detail



TYPICAL TRENCH FOR 5 - DN 4000 SWC PIPES
UNPAVED AREAS

5 Barrels of 4.0M pipe installed in 34M wide common trench

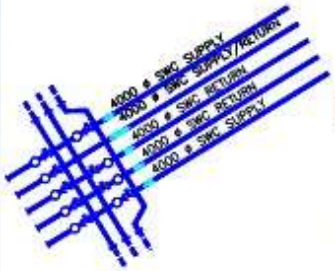
KRT Area

4.0M Lines – 4 Parallel Lines

Long curves achieved with deflection of coupling joints

500 mm (20”) air valve connection on 4M pipe

Manifold 3 D



4M Equal Tee with Flanged 4M Branch on site

T

4M Equal Tee with Flanged 4M Branch on site T

4M Butterfly Valve Installation

Bobcats being used to place backfill on sides on pipe

Power & Desalination Plants using GRP pipe for Cooling and Plant Process Piping

A Visual Reference List

Desalination Plans using GRP Pipe – Fujairah F1

2004 - Cost $ 802 Million. EPC : Doosan Heavy Industries

Fujairah Combined Cycle Power Plant (660MW) + Desalination Plant (450,000 m3/day)

5 Flash Distillation Units each producing 49000 m3/d + One RO unit producing 140000 m3/d of water

Fujairah F1 Combined Cycle Power Plant (660MW) + Desalination Plant (450,000 m3/day)

Marafiq Al Jubail III 2750 MW Power & 800,000 M3/Day Water IWPP

This is currently world largest combined power and desalination plant

27 MED desalination unites x 30,000 M3/day

EPC : GE Power/Hyundai/Sidem - Cost 3.4 Billion $

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Ras Abu Fontas B - Qatar

Ras Abu Fontas 'B' (ABB-Ewbank Preece) Qatar

609 MW Power & Desalination Plant-1997-Cost $1.1 Billion

Ras Abu Fontas B - Qatar

2.5 m pipe (100”) x 3 sea water supply lines

pipe system is restrained – no thrust blocks

Ras Abu Fontas B - Qatar

Main Sea Water Pump House Header 2.5 mm dia. Length = 66M

Desalination Plants Using GRP Pipe

Ras Abu Fontas B (ABB) Offshore Installation– 36M Pipe sections pre-assembled onshore

Desalination Plants using GRP Pipe

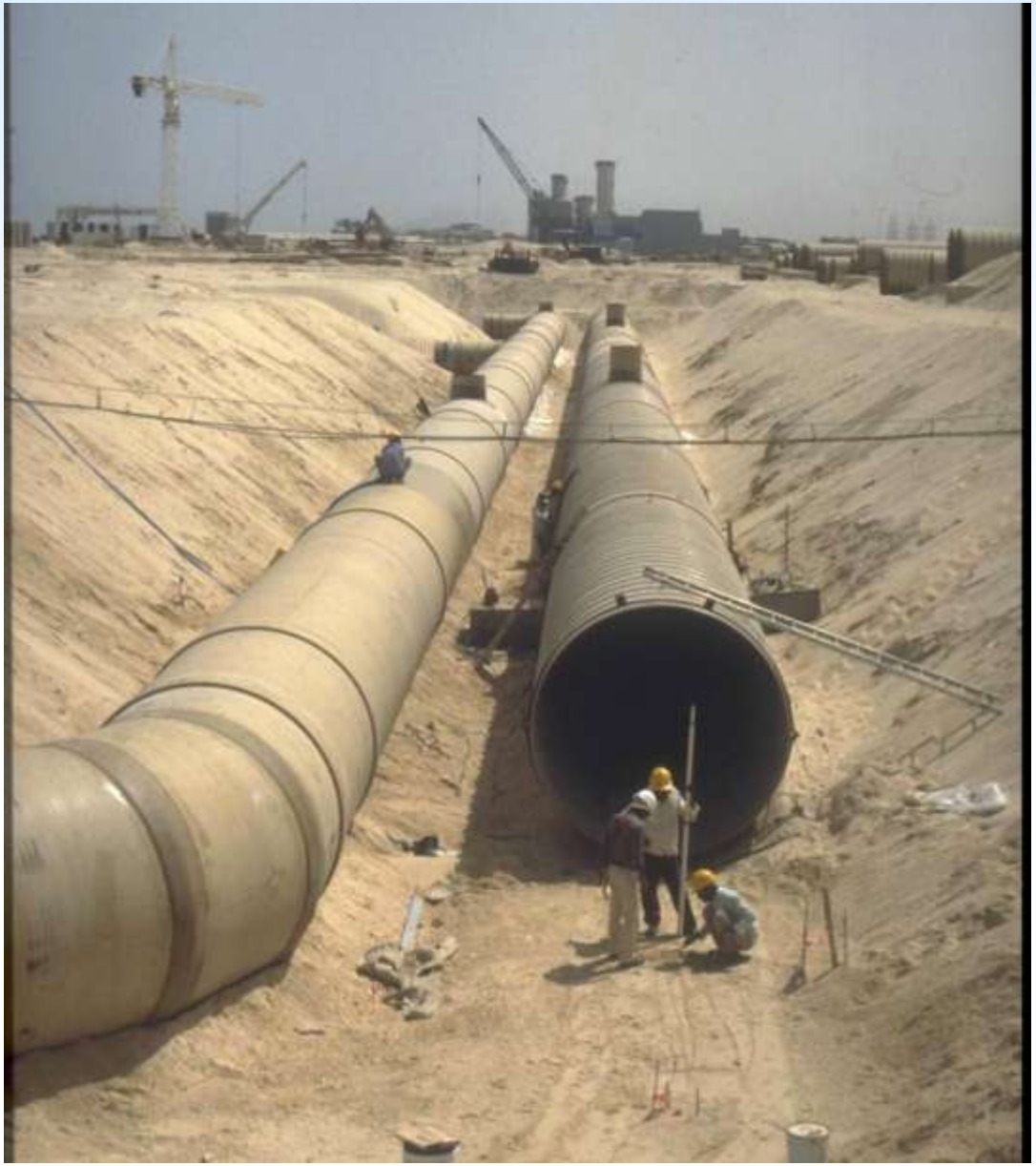
1.9M Intake Pipe L=36M – Ras Abu Fontas B (ABB) On barge – Notice DN 900 mm flanged access man-ways

Desalination Plants using GRP Pipe

Ras Abu Fontas B (ABB) offshore- 36M installed in one dive = large $ savings, 4 Parallel Lines; each 2 km deep

Jebel Ali G station, Dubai, United Arab Emirates

Areal view of Jebel Ali G Station (400 MW) Power & 270,000 M3 / Day Water Production



2.4m & 2.7m GRP Pipe

Jebel Ali G station – Dubai

400 MW + 270,000 m3/day water- Cost $ 1000 million

Engineer: Ewbank Preece
EPC: Siemens (Power)
Weir Westgarth (Desal) – 1992

2.4m supply & 2.7m Return Pipe – Jebel Ali G station 270,000 M3/day-1992

Jebel Ali G station – 1200 mm GRP Product water at MSF evaporators

Power Plants using GRP Pipe for Cooling Water

Jebel Ali G station – 1800mm GRP Sea water supply piping to MSF evaporators

Ras Laffan 2 - Qatar

EPC : Siemens PG (CCGT) and Doosan Heavy Industries , Owner's Engineer : Mott MacDonald

Ras Laffan "2" power/Desal plant 2008, 1025 MW, 273,000 m3 water/day-IWPP-Cost 900M$
Desalination EPC : Doosan Heavy Industries , Process : MSF – 4 units

Fujairah F2 Power & Desalination plant

2000 MW Combined Cycle Power Plant + 600,000 M3 Water/day – EPC: Alstom – Sidem

Cost : 2.8 Billion $ - Work started on site Jan 2008 To be completed in end 2010

Contract type IWPP – 20 year agreement with Abu Dhabi water & Electricity

This will be the largest Power and largest Desalination plant built in the United Arab Emirates when completed and second largest IWPP project in the world

Fujairah F2 Power & Desalination plant (600 0000 M3 / day water)

- 455 000 M3 per day produced by MED (supplied by Sidem)
- 136 000 M3 per day produced by Reverse Osmosis (Supplied by OTV) Total Desal cost $ 750 M$

Fujairah F2 – 2000 MW Combined cycle power plant + 600,000 M3 Water/day – EPC: Alstom – Sidem - 2008

4M GRP Intake pipe

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12 MED Desalination units + RO unit

Largest RO plant in Africa – Hamma supplies the Capital of Algeria – Algiers – Build by GE Water at a cost of 250 M $

Plant produces 200,000 M3 of drinking water per day which is 25% of the water needs of the capital

Hamma Desalination Plant – Algeria

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Hamma Desalination Plant - Algeria

Abutaraba Desal plant in Libya – completed in 2007

Plant produces 40,000 M3 of drinking water per day from 3 desalinations units, EPC: Sidem
MED process with Thermal Vapor compression

Abutaraba RO plant in Libya – completed in 2007

Plant produces 40,000 M3 of drinking water per day – EPC: Sidem

6 Stage MED – TVC process

Al Hidd IWPP power and Desalination plant – Bahrain – Commissioned in 2007 – Added to existing 1000 MW plant

Plant produces 272 000 M3 of drinking water per day (60 MIGD) – EPC : Sidem
10 Desalination units using MED with Thermal Vapor Compression – Cost $ 336 M

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10 Desalination units using MED TVC Process

Zuara Libya Desalination plant - extension – 2 x 20 000 M3/day units

Plant produces 40,000 M3 of drinking water per day – EPC: Sidem
2 Desalination units using MED TVC Process

Zuara Libya Desalination plant - extension – 2 x 20 000 M3/day units

Plant produces 40,000 M3 of drinking water per day – EPC: Sidem

2 Desalination units using MED TVC Process

Zuara Libya Desalination plant III

Plant produces 40,000 M3 of drinking water per day – Completed in 2006

End of Session…Thank you