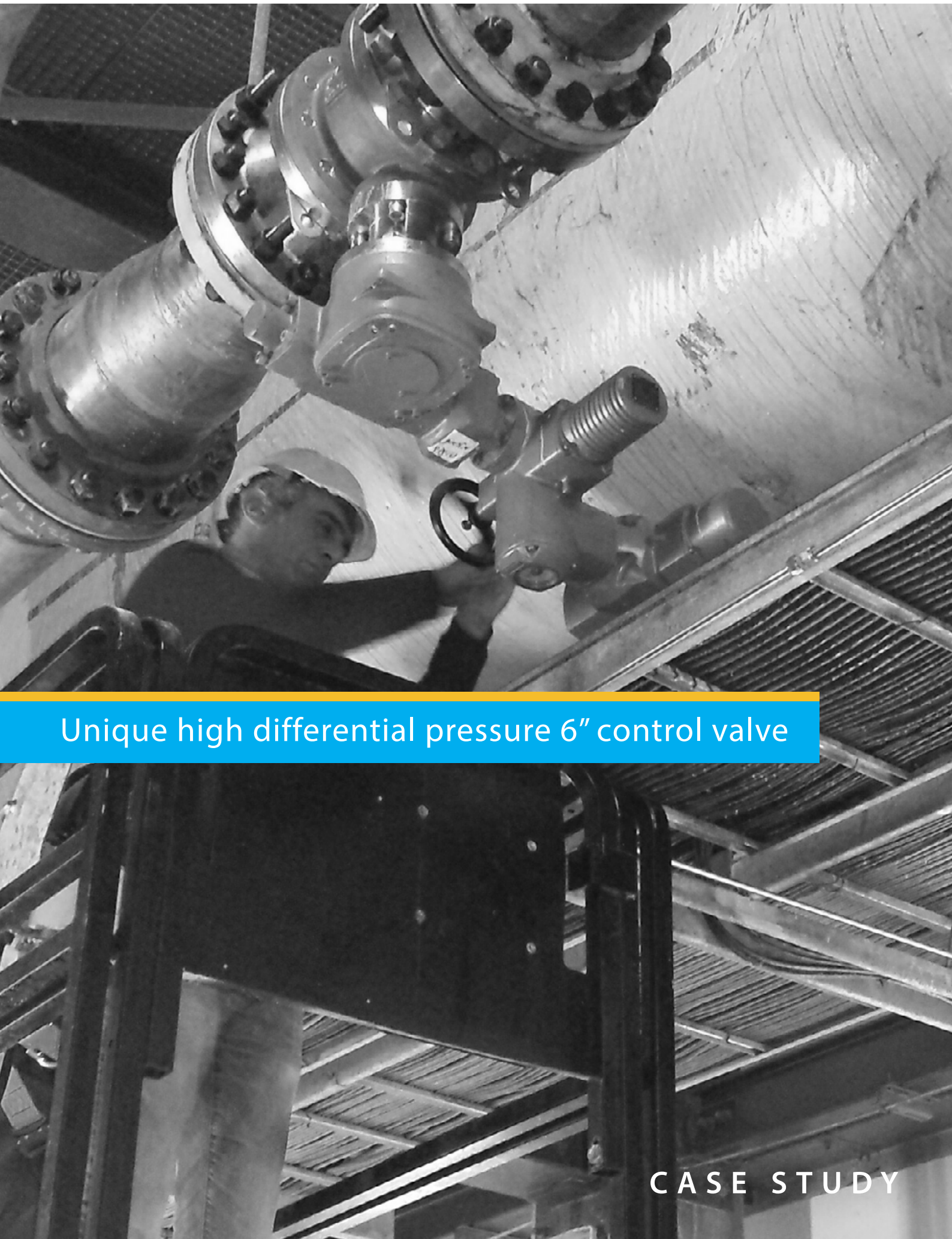
HABONIM
Industrial Valves & Actuators

Inspired By Challenge



Unique high differential pressure 6" control valve

CASE STUDY

Unique high differential pressure 6" control valve

for the world's largest reverse osmosis desalination plant guaranteed reliable flow of potable water.

Reverse Osmosis (RO) desalination uses the principle of osmosis to remove salt and other impurities, by transferring water through a series of semi-permeable membranes. The process requires pressures higher than the osmotic pressure of the saline water, around 70 bar at the first stage of sea water treatment, down to 13 bar at the last stage of a brackish water treatment. This results in advanced desalination facilities which excel in high level of efficiency, and recovery ratios of over 45%.

The term recovery ratio represents the volumetric processing efficiency of a water purification process. In general, a primary design objective in water desalination projects is to have the highest practical water recovery. In other words extract maximum drinking water from the sea water. This does two things: it maximizes the use of scarce water resources and produces less concentrate requiring disposal.

The highly saline environment of the concentrates, sets a metallurgical challenge to the site designer. Low pressure segments can be dealt with using polymer based materials, however, with high osmotic pressures, premium materials such as Duplex, Super duplex, 254SMO and sometimes even Titanium are required.

The brine flow is 'chocked' at every stage by a pressure control valve. The pressure at the upstream side is set to levels higher than the osmotic pressure, generating a continuous potable water flush through the semi-permeable membranes.

The pressure control valve must be designed to break high differential pressure levels combined with high flow rates, and under conditions of severe cavitation. When water flow crosses the narrowest hydraulic passage (the Vena-Contracta), the flow is at its maximum velocity, and the stream pressure drops to its minimum level. Once the water pressure drops below its vapor pressure, the liquid boils and air bubbles segregate in the stream. Once past the Vena-Contracta the pressure recovers to above the vapor pressure, and the air bubbles implode creating strong shocks and tearing of the metal material from the surface of and the valve and piping, accompanied by loud noise and vibration.

Habonim high differential pressure

The challange we faced was to design a unique control valve to accurately control the upstream pressure by releasing corrosive brine, while minimizing mechanical damage and noise levels caused by severe cavitation. The valve must be able to work 12 months without interrupting water production.

Four 'flow conditioner' plates assambly

The customer used a costly 6" full port Cage valve integrated with 10" #300 flanges at its osmosis desalination facility. During operation, the customer confronted with issues of increased torque and valve jamming which required continuous maintenance.
Maintenance required shutting down one production train and removal of the heavy valve to the workshop for maintenance - replacement of valve parts, filling and grinding of damaged internal parts and reinstalling the valve back in-line.
Shut-downs became more frequent, until it was difficult to guarantee a reliable flow of drinking water to the populations of the surrounding cities.

Conditions	
Service	High differential pressure 6" control valve
Flow min.	230 m^3/Hour
Flow max.	800 m^3/Hour
Pressure upstream	23.5 bar
Pressure downstream	0.5 bar
Media	Brackish water

Habonim unique LTPN surface treatment

The given application parameters were beyond the limits of a standard quarter turn segmented V seat, and therefore a different approach was taken. Four 'flow conditioner' plates were designed at the downstream side of a V-Port quarter turn control valve. Each plate was designed to 'break' a constant pressure level at a given flow, while the ball-seat set dynamically controlled the upstream pressure.
The plates created a higher back pressure, so the segmented metal seat effectively 'sees' a much lower differential pressure, and thus less cavitation damage. Numerous iterations were produced by Habonim's engineers, in an effort to achieve the best controllability combined with minimum noise and vibration at both minimum and maximum flow limits. Each iteration included changing the number of plates, the thickness of the plates, the diameters of the holes in the plates and the number of holes in each plate, as well as changing the size and the shape of the segmented downstream metal seat.
Once approved, the valve was made at the customer's request from stainless steel 316L with Habonim's unique LTPN surface treatment, which hardened the ball / seat set and the four plates to a value greater than 60 HRC.

On February 21st 2016, the valve was installed at the customer's site, 100 feet from the point where a Cage valve works under identical conditions.
The Habonim valve demonstrates reduced noise, as well as lower vibration levels, operating torque and weight. After confirming that hydraulically, a quarter turn control ball valve based on a segmented V seat with downstream flow conditioner plates provides a reliable and stable solution, the customer requested an identical valve to be made from Super-Duplex.

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www.habonim.com

Habonim ISRAEL
Tel: +972-4-6914911
Fax: +972-4-6914935
sales_international@habonim.com

Habonim EUROPE
Tel: +34 640 384 759
sales_eu@habonim.com

Habonim UK
Tel: +44-1633-484554
Fax: +44-1633-482252
sales_uk@habonim.com

Habonim USA
Toll Free Phone: 1-866-261-8400
Toll Free Fax: 1-866-243-9959
sales_usa@habonim.com

Habonim CHINA
Tel: + 86 21 64453190 *146
sales_china@habonim.com

Habonim AUSTRALIA
Tel: +61 3 9556 5428
sales_au@habonimau.com