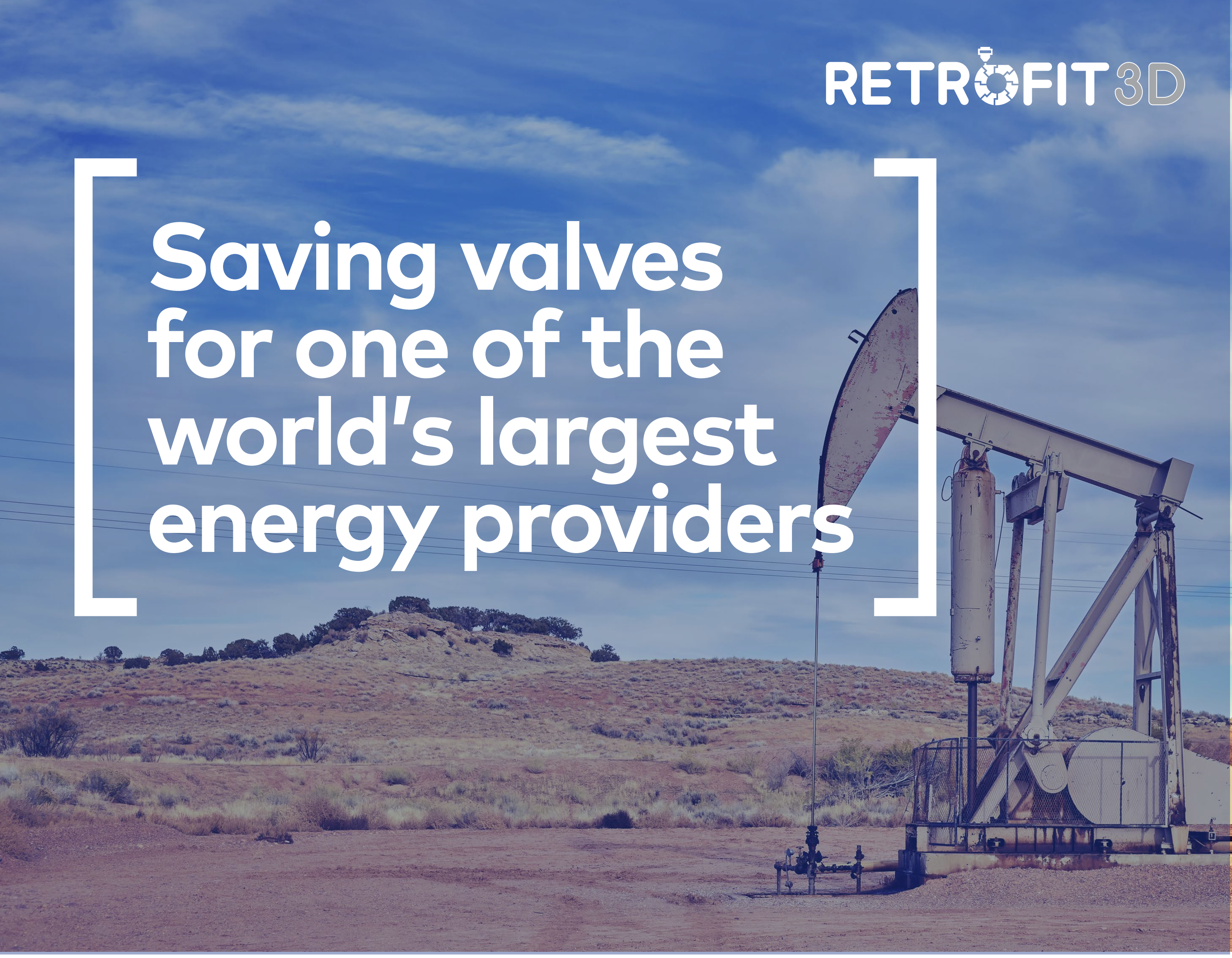
RETROFIT 3D



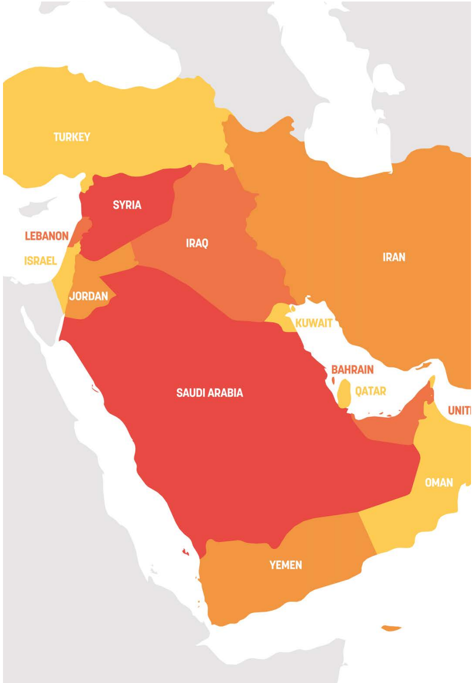
Saving valves for one of the world's largest energy providers

The challenge

A leading energy provider had significantly increased oil production from a field in the Arabian Gulf. Higher production increased the pressure of the flow passing through its water injection system so much so that multiple control valves began to fail after a short period of operation, with severe cavitation damage to the valve trim. This resulted in high costs due to the need for frequent maintenance and trim replacement.

The smooth operation of the valves is essential not only to the efficiency and safety of the plant but helps to protect the environmentally sensitive bay in which the field is located. The bay provides livelihoods for coastal fishing communities and its ecosystem teems with marine life and habitats, from turtles to coral reefs. A miracle of engineering in the form of artificial islands allows the operator to tap into a vast oil and gas field while protecting the bay's biodiversity.

The client asked IMI Critical Engineering to investigate and recommend a solution.



IMI Critical Engineering

Breakthrough Engineering

The solution

Engineers from IMI Critical Engineering analysed the current process conditions in the plant, including production volumes, the properties of the injected water, pressure, and temperature ranges. Valve problems are often wrongly attributed to the age of a plant and its components. More often than not, however, the components start to suffer because the operating conditions have changed. Valves are designed around a precise set of operating conditions, which govern the type and design of components and materials. When process conditions change, problems can arise, including excess vibration and noise, cavitation and leakages, as well as reduced control over the flow through the valve.

IMI Critical Engineering's engineers identified a change in the inlet pressure as the root of the problem. During earlier periods of operation, inlet pressure had been below 1000psig, but when production from the field increased significantly, inlet pressures rose to 2500psig, putting stress on the internal parts of the valve. Furthermore, water saline content is double that of seawater (70,000 ppm), as the plant is pulling the injection water from the reservoir and the fluid velocity exceeds 100 ft/sec through the valve.

In the past, operators would have had to replace the whole valve with a new one customised to the current process conditions, attracting significant costs and disruption. Now, with the advent of additive manufacturing – 3D printing – it is possible to retrofit a new valve trim to the existing valve, saving time and money.

IMI Critical Engineering's innovative Retrofit3D product has been designed to do just this. The team recommended replacing the valve trim with a custom-designed Retrofit3D solution. The key component would be an additively manufactured disk stack, using IMI Critical Engineering's renowned pressure-reducing DRAG technology that would meet the process conditions in the field.

The disk stack was manufactured using a specialist additive manufacturing process called Binder Jetting. Binder Jetting is made up of two components, a metal powder and a binder that binds the metal powder layers. It is called a "green component" which is subsequently sintered to provide the strength and material properties required. The disk stack, plug and seat ring were all manufactured in Stellite 6, an alloy with outstanding resistance to corrosion and wear.

The new valve trim was designed, assembled, and tested before being installed.

Five months after the new trim was installed, the valve was disassembled and inspected to see how it had performed in real process conditions. The valve trim met all the field trial success criteria, including precise controllability of less than 5% deviation to the designed valve characteristics, seat leakage according to class IV of ANSI FCI 70-2 at full shut off, and no evidence of excessive erosion or wear.

After it was installed, the process condition was monitored closely. During the trial period of five months the operator was happy with the performance of the retrofitted valve.

> “ **The valve trim exceeded all our expectations**, the client said,
> **and we are planning to retrofit more valves as a result**.

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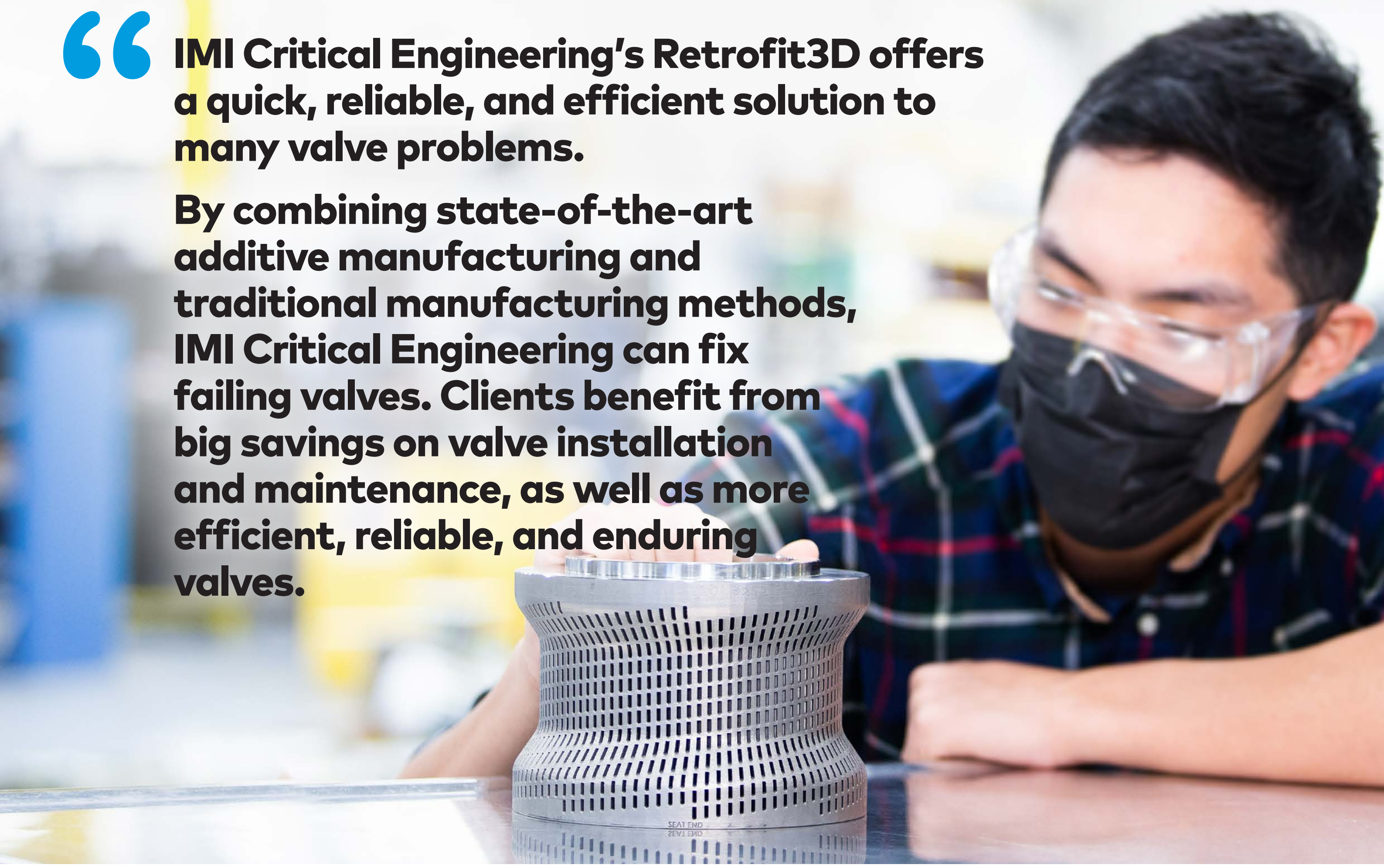


> **IMI Critical Engineering's Retrofit3D offers a quick, reliable, and efficient solution to many valve problems.**
>
> **By combining state-of-the-art additive manufacturing and traditional manufacturing methods, IMI Critical Engineering can fix failing valves. Clients benefit from big savings on valve installation and maintenance, as well as more efficient, reliable, and enduring valves.**

Introducing IMI Critical Engineering's Retrofit3D – a 'drop-in' solution for valve problems

IMI Critical Engineering's Retrofit3D provides a speedy and cost-effective solution to many valve problems, including those arising from a change in the process conditions.

Retrofit3D combines additive manufacturing – 3D printing – and traditional manufacturing techniques to engineer valve trims that are optimised for the process conditions.

Unlike traditional manufacturing techniques which are subtractive – ie, they remove material – additive manufacturing works by building components by 'printing' layer upon layer. This provides extra flexibility in valve design, as internal features and complex geometries can be incorporated that would be impossible to achieve with traditional manufacturing techniques. Additive manufacturing also allows for more efficient use of space, with disk stacks up to 40% smaller, which can be retrofitted into a wide range of valve bodies.

Additive manufacturing is a widely-used term, but covers many different, sophisticated techniques – and new techniques are constantly being developed. Laser Powder Bed Fusion (LBPF) or Direct Metal laser Sintering (DMLS) are among the most known technics for stainless steel and nickel based alloys printing, but IMI Critical Engineering also uses Binder Jetting techniques for specialist applications requiring specific materials such as Stellite6.

IMI Critical Engineering is at the forefront of additive manufacturing, having successfully used the technology for over ten years, and playing an active role in the industry, from the development and testing of materials, parts qualification, to standards development.

Competitor part
After 3 months in operation

RETROFIT3D
After 5 months in operation

Figure 1: Post operation OEM seat

Figure 2: Post operation Retrofit3D seat

Figure 3: Post operation OEM Plug assembly

Figure 4: Post operation Retrofit3D Plug assembly

Figure 5: Post operation OEM cage

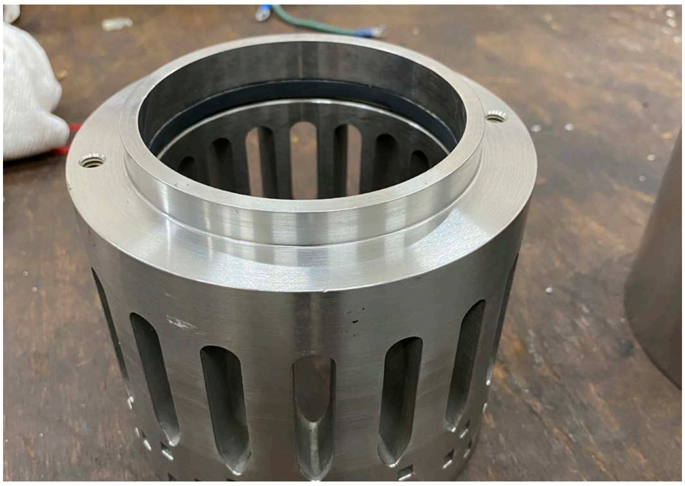


Figure 6: Post operation Retrofit3D cage

RETROFIT3D

Great value from great valves

By taking advantage of IMI Critical's Retrofit3D solution technology, our customers are able to:

Save money

Retrofit3D is a cost-effective solution, avoiding expensive installation costs such as engineering, pipe cutting, welding, pressure testing, and QA testing.

Move quickly

As a drop-in solution, Retrofit3D takes away the time-consuming activities of replacing an entire valve. Futhermore, using additive manufacturing technology, Retrofit3D allows quick turnaround, so you don't have to plan months ahead.

Improve TCO

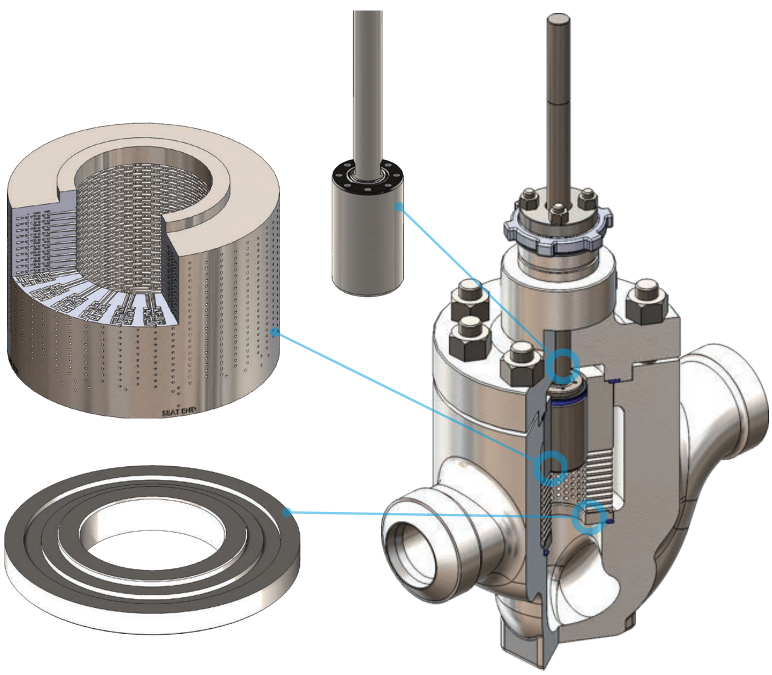
Lower maintenance, improved efficiency, and better trim performance along with a reduced need to plan and stock spares, provides a better cost of ownership.

Increase efficiencies and reliability

The retrofitted valves deliver greater process control, higher performance levels, and stronger reliability for the plant.

Example trim

IMI Critical's Retrofit3D solution and DRAG® Disk Stack technology allow plants to seamlessly upgrade their valves to cope with significant changes to process conditions.



RETROFIT 3D

“ IMI CCI valves require minimal maintenance and deliver exceptional performance.

“ It is expensive and time-consuming to replace a valve... being able to simply drop in a trim set – that is huge.

“ Retrofit3D helped us stay within our budget and keep the plant competitive in the marketplace.

Retrofit3D is available for over 50 different valve models, so contact us at retrofit3d@imi-critical.com now, and let us improve your control valve operations!

IMI Critical Engineering

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