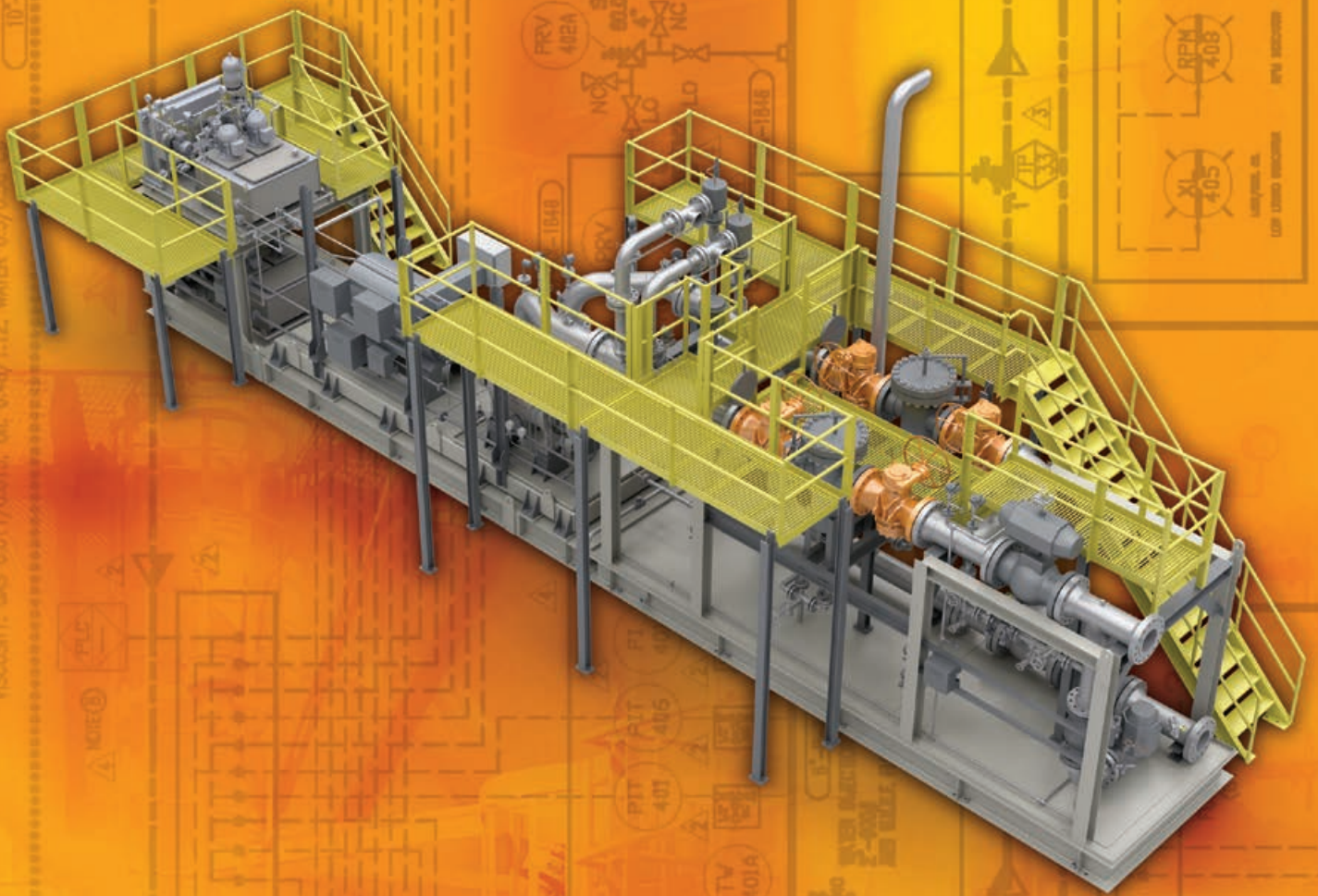
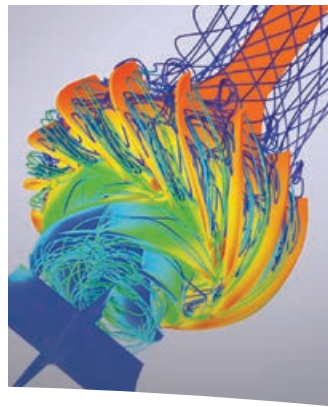




# *Multiphase Pumps and Wet Gas Compression Systems*



*Experience In Motion*



## **Pump Supplier to the World**

*Flowserve is the driving force in the global industrial pump marketplace. No other pump company in the world has the depth or breadth of expertise in the successful application of pre-engineered, engineered, and special purpose pumps and systems.*

### **Life Cycle Cost Solutions**

Flowserve provides pumping solutions that permit customers to reduce total life cycle costs and improve productivity, profitability and pumping system reliability.

### **Market-Focused Customer Support**

Product and industry specialists develop effective proposals and solutions directed toward market and customer preferences. They offer technical advice and assistance throughout each stage of the product life cycle, beginning with the initial inquiry.

### **Broad Product Lines**

Flowserve offers a wide range of complementary pump types, from pre-engineered process pumps to highly engineered and special purpose pumps and systems. Pumps are built to recognized global standards and customer specifications.

Pump designs include:

- Single-stage process
- Between bearings single-stage
- Between bearings multistage
- Vertical
- Submersible motor
- Positive displacement
- Nuclear
- Specialty

### **Product Brands of Distinction**

*ACEC™*

*Aldrich™*

*Byron Jackson®*

*Calder™ Energy Recovery Devices*

*Cameron™*

*Durco®*

*Flowserve®*

*HALBERG™*

*IDP®*

*INNOMAG®*

*Lawrence Pumps®*

*Niigata Worthington™*

*Pacific®*

*Pleuger®*

*Scienco™*

*Sier-Bath®*

*SIHI®*

*TKL™*

*United Centrifugal®*

*Western Land Roller™*

*Wilson-Snyder®*

*Worthington®*

*Worthington Simpson™*

**Multiphase Pumps and Wet Gas Compression Systems**



Engine-driven MP1-430 installed off the coast of Turkmenistan in the Caspian Sea undergoing a string test



MP1-275 running as a WGC with GFV above 99% in Indonesia

**MP1 Double-Suction, Twin-Screw, Positive Displacement Pumps (API 676) for Multiphase and Wet Gas Compression Systems**

The robust design and powerful construction of the Flowserve MP1 multiphase pump allow it to be used in a broad range of operating conditions, ranging from highly viscous liquids to 100% gas. The MP1 is often applied with only minor or no modification to its standard design.

**Wet Gas Compression**

Without any modifications to the pump itself, MP1 units have been used successfully and routinely in WGC applications, often with GVF ratios in excess of 98% and up to 100% for indefinite lengths of time. Extensive Flowserve research and development has made this possible by better understanding the requirements of such applications. This in turn, has enabled Flowserve engineers to insightfully design system auxiliary components to address these tough conditions and prevent temperature rise across the pump internals and seals.

**Onshore and Offshore**

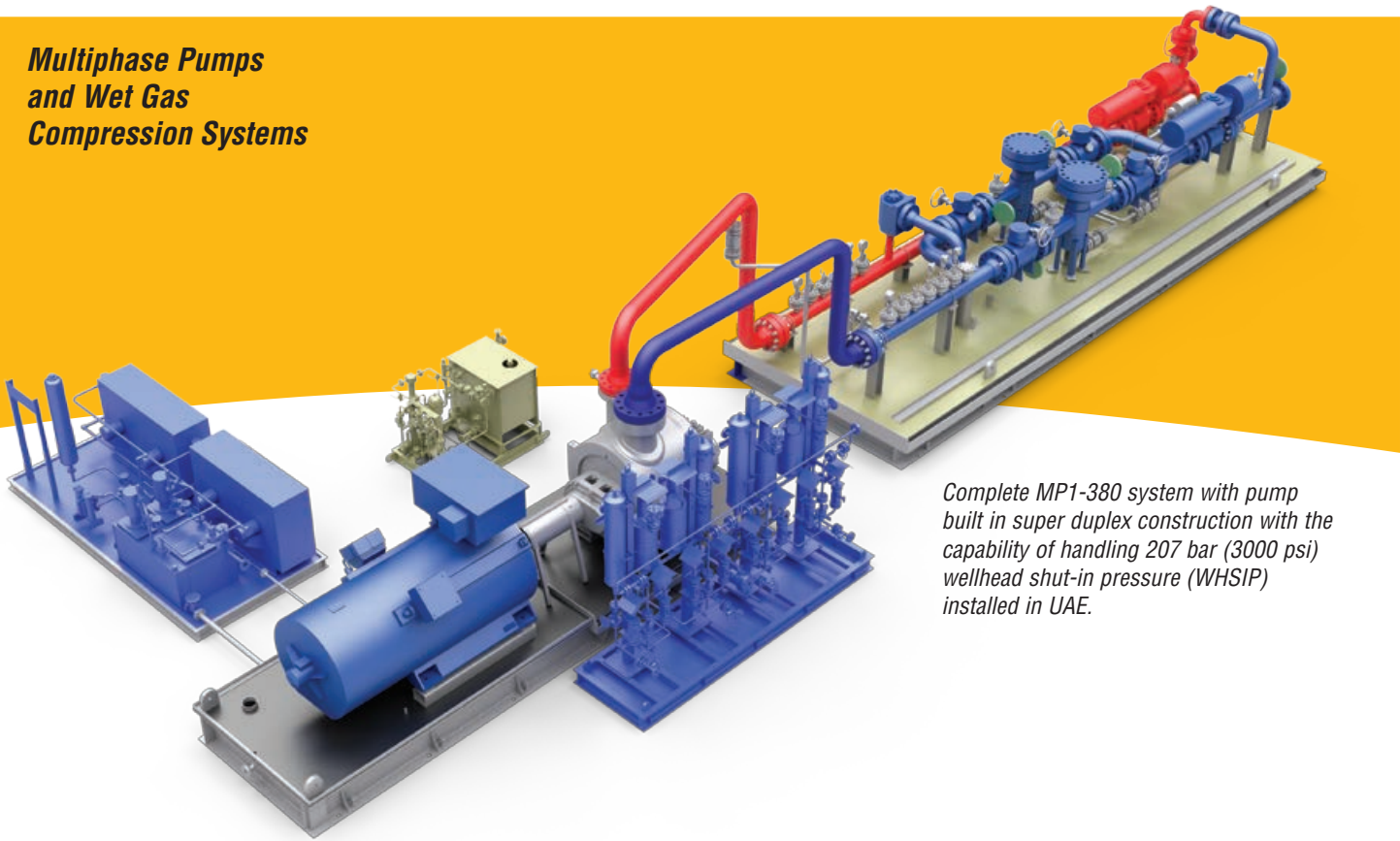
Off-the-shelf, multiphase pump packages are often not adequate for complex applications. Flowserve understands the varying requirements and design nuances in building equipment for onshore and offshore applications. Our expertise in engineering these systems to required industry standards, geographic and regional codes, or to customer specification is widely recognized by the global leaders in oil and gas exploration and production.

MP1-390 unit packaged with a two-tiered system installed offshore the coast of India



Liquid separator used to maintain stable temperatures in MP1 units running in high-GVF applications or as wet gas compressors

**Multiphase Pumps  
and Wet Gas  
Compression Systems**



*Complete MP1-380 system with pump built in super duplex construction with the capability of handling 207 bar (3000 psi) wellhead shut-in pressure (WHSIP) installed in UAE.*

**More Than Pumps**

Standard or custom engineered system packaging is available to include:

- Power houses
- Driver and speed control options
- Complete piping systems or skids
- Complete, integrated instrumentation and control systems, including control panels
- Single and multiple skid options and configurations
- Special enclosures for environmental considerations

**Drive Options**

Flowserve will provide the pump system drive and speed control that best fit your power source availability, requirements and preference. These include:

- Electric motors fitted with Variable Frequency Drives (VFD)
- Natural gas or diesel engines, gas or steam turbines fitted with mechanical or electrical speed control devices, hydraulic torque converters or couplings

**Lubrication Systems**

API or non-API compliant lube oil systems can be designed to support the pump bearings and timing gears, electric motor, turbine or engine. These systems can be mounted on the pump skid itself or supplied separately on a dedicated skid. Less costly alternatives, such as integral shaft-mounted recirculation pumps, are also available to maintain acceptable bearing temperatures for pumps up to certain power and speed.





*In and Out piping with bypass and relief valves and lines during a complete unit string test.*



*Fully compliant API Plan 53B systems to support robust multiphase mechanical seals mounted on a dedicated skid.*

### ***Piping Skids***

Compliant with ASME and API 676, latest edition requirements, piping skids can be independent or part of the same pump skid. They contain components intended to either protect or control the process and the pump. These components include:

- Suction, discharge, recirculation, bypass and pressure safety relief piping
- Block, control and check valves
- Manual, pneumatic or hydraulic valve actuators
- Filters and strainers
- Pressure, temperature and flow instrumentation

### ***Mechanical Seals and Seal Flush Systems***

As an integrated supplier of pumps, mechanical seals and seal flush systems, Flowserve is a unique single-source supplier offering total unit responsibility. API Plans 02, 11, 31, 32 and 62 are available to support single mechanical seals. API Plans 53 (A, B or C) and 54 are available for dual pressurized mechanical seals.



*MP1-380 and piping in a single baseplate with separate API Plan 54 seal flush system supplied to Petrobras Energía S.A.*

**Multiphase  
Pumps and  
Wet Gas  
Compression  
Systems**



**Power and Control Systems**

Flowserve can provide complete and fully integrated electrical power and control systems for its MP1 installations.

- High and medium voltage transformers and switchgears
- Programmable Logic Controllers (PLC)
- Integration of the control of pumps, valves, instrumentation, motors and VFD
- Motor Control Centers (MCC)
- Integrating components can be supplied loose or in a powerhouse or enclosure to include HVAC, operator's terminal, fire and gas detection and suppression systems or any other specific requirements



*SIL-2 PLCs with interactive touch-screen color HMI and BN monitoring systems inside a control room*

**Training and Life Cycle Support**

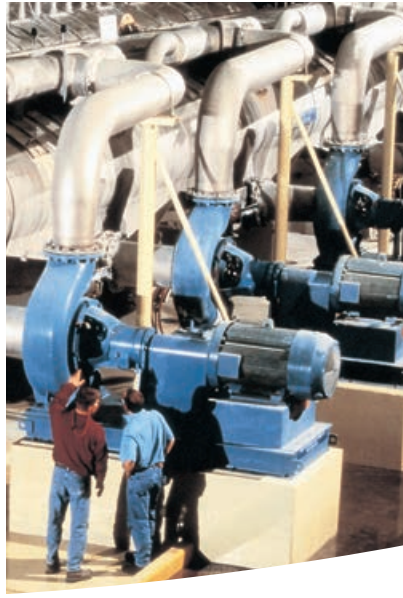
The main goal of utilizing MP1 WGC systems is to enhance production. Shipment of the hardware, delivery of the software and provision of the technical documentation are important, but is only the starting point. Flowserve offers much more — all focused on streamlined startup, safe operation, and predictable and reliable long-term production.

- Commissioning, installation and startup assistance provided by a team of expert field service supervisors and technicians
- Operator training delivered by experienced and knowledgeable instructors at state-of-the-art Flowserve training facilities located around the world or on-site
- Aftermarket technical support and service, including parts, re-rates and upgrades, available from a global network of Flowserve Quick Response Centers (QRC)
- Decommissioning services



*Fully equipped power house with switchgear, PLCs, HVAC, and fire and gas system to control and operate two MP1-380 units in Argentina*

Global Service  
and Technical  
Support



## Life Cycle Cost Solutions

Typically, 90% of the total life cycle cost (LCC) of a pumping system is accumulated after the equipment is purchased and installed. Flowserve has developed a comprehensive suite of solutions aimed at providing customers with unprecedented value and cost savings throughout the life span of the pumping system. These solutions account for every facet of life cycle cost, including:

### Capital Expenses

- Initial purchase
- Installation

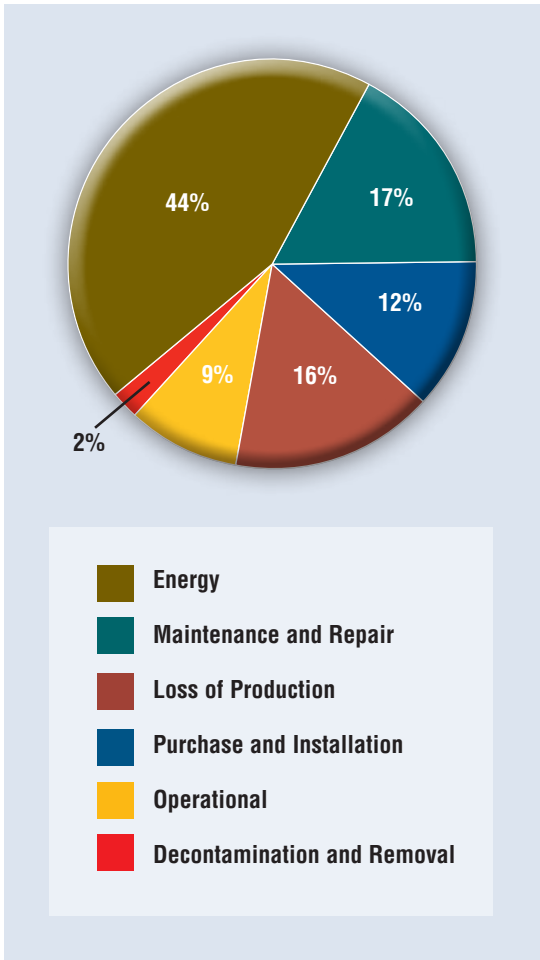
### Operating Expenses

- Energy consumption
- Maintenance
- Production losses
- Environmental
- Inventory
- Operating
- Removal

### Innovative Life Cycle Cost Solutions

- New Pump Selection
- Turnkey Engineering and Field Service
- Energy Management
- Pump Availability
- Proactive Maintenance
- Inventory Management

### Typical Pump Life Cycle Costs<sup>1</sup>



<sup>1</sup> While exact values may differ, these percentages are consistent with those published by leading pump manufacturers and end users, as well as industry associations and government agencies worldwide.



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