

Ensuring Reliability

RED PALEY |
SULZER PUMPS |

Pumping and compression systems lie at the heart of all oil and gas production processes, be it extraction, loading, or transport via pipelines. The entire production infrastructure, including platforms and transcontinental pipelines, depends on the reliable operation of pumps and compressors. Working on a pump or compressor package in an offshore or other remote environment to undertake corrective work is much more expensive than the cost of testing in a carefully controlled environment such as the manufacturer's workshop. Sulzer Pumps tests complete pump and compressor packages at full-load operating conditions in order to detect any potential problem before it might appear in the field.

▶ These days, more and more oil and gas developments are being installed in remote and often difficult locations, where little or no immediate machinery repair infrastructure is yet established (Fig. 1). Frontier locations such as Angola, the Caspian Sea, or Siberia come to mind in this context. The ability to string-test rotating equipment as completely as possible before shipment to the job site is therefore becoming ever more important. The closer the testing at the manufacturer's works can be to actual on-site operating conditions, the better the chance of eliminating on-site problems, especially during the crucial start-up period. The risk to the project is minimized. The reduced risk in turn provides project management with the maximum degree of certainty as to the technical integrity of critical equipment and the minimum potential impact on the all-important project schedule.

Minimum Life-Cycle Costs

All end users want minimum life-cycle costs—which include initial start-up costs—for their rotating equipment. A key part of achieving this goal is testing not just the pump or compressor, but the machine with associated driver on the contract base frame, including gearbox, oil system, instrumentation, control panel, etc. Such tests are often referred to as string tests. To deliver these key services requires test facilities beyond the norm as well as skills and abilities not normally associated with manufacturers of pumping equipment.

Prototype Drivers

For a full string test, the contract driver has to be used whenever



Photo: BP p.l.c.

1 Equipment for the oil and gas industry has to operate in remote and hostile locations. The photo shows part of the 1300 km Trans Alaska Pipeline. Sulzer Pumps string tests pump and compressor packages at full load duty conditions to ensure their reliable operation.

possible. The most obvious driver option is an electric motor, which may be large (>10 MW) or inverter driven for variable speed operation (Fig. 2). Such drivers require sufficient power supply in the test facility, not only to run the machine, but to deliver the peak starting current necessitating sufficient operating margin above rated condition.

Another common option is a gas-turbine drive (Fig. 3). Gas turbines bring a set of particular requirements with them as far as running them in a test bed is concerned.

These include:

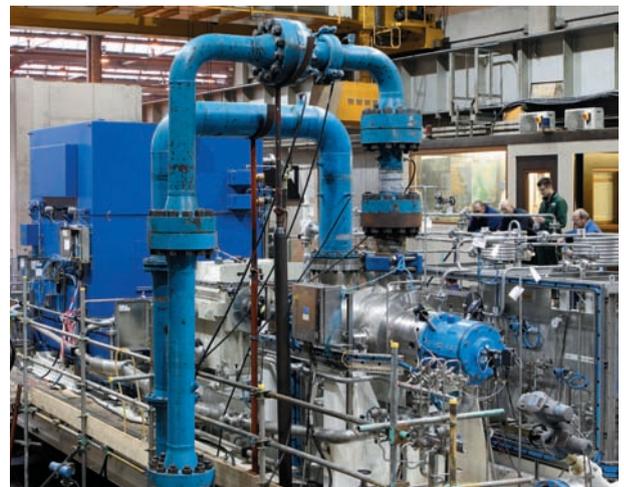
- ▶ Isolated testing environment (noise)
- ▶ Fuel supply
- ▶ Exhaust and external silencing equipment
- ▶ Control and monitoring systems
- ▶ Lubrication systems
- ▶ Knowledgeable staff to operate the test

The third option is an engine burning diesel or crude oil (Fig. 4). This type of engine has some of the requirements of gas turbines, e.g., fuel supply or exhaust and external silencing systems, but also higher mass and vibration levels than the other drive options.

Beyond Traditional Testing

A traditional test facility cannot be readily used for a full range of string test options without severely compromising some aspect of the test. Manufacturers wishing to properly service customer requirements need purpose-built facilities designed specifically for string tests. Such facilities must include infrastructure for the various driver needs mentioned earlier. Additional requirements include sufficient craneage to lift complete skids and cooling capacity to dis-

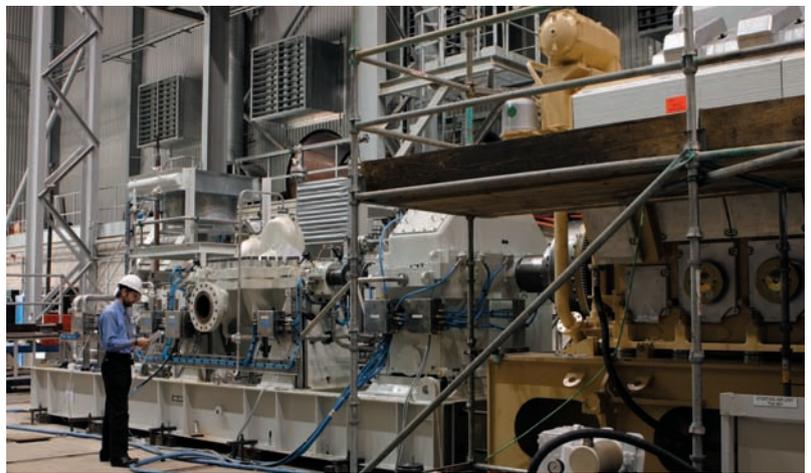
2 Electric drive: An injection pump complete with gear box, lube system, and all instrumentation being full-load tested on a 3-point mounted skid. The test was controlled by the contract pump systems panel.



sipate energy produced during test runs.

In Leeds (UK), Sulzer Pumps operates a facility designed specifically for string testing using any of the 3 main driver options. In addition, the ability to package and test gas compressors has been incorporated allowing customers the option of a one-stop shop for the packaging and testing of their project's key rotating machinery. This option has benefits for the inspection teams and ensures a common layout and logic to both the gas compression and pumping skids, a significant advantage for operational staff in the field.

3 Gas-turbine drive: A 27-MW injection pump driven by a Rolls-Royce RB211 gas turbine being set up for test. The photo shows the pump and drive module on a single 3-point mounted skid complete with all instrumentation and lube systems. The test was controlled using the contract self-contained control room.



4 Diesel/crude-oil engine drive: Setting up of the first of 18 main pipeline pumps for a major pipeline project. The 4.5-MW crude-burning engine drives the pump via a speed-increasing gearbox. The tests were run using project instrumentation, panels, and lube systems.

Advantages for End User

Sulzer Pumps has carried out several hundred string tests over the past 10 years, evidence of demand for the security string testing deliverers. These tests vary in complexity from a relatively straightforward pump and motor set through to the world's highest pressure centrifugal injection pump rated at 605 bar. Drivers for these tests included more than 30 gas-turbine-driven units with just about every common small to medium capacity gas-turbine drive from manufacturers like Solar, Alstom, Dresser, GE, and Rolls-Royce, including the world's largest injection pump at 27 MW absorbed power. All of these tests have been conducted by the company under the direct supervision of Sulzer staff. Having the pump manufacturer as the lead has advantages for the end user as the focus of attention remains on the pumping, rather than the drive system. Thus over time, Sulzer Pumps developed the internal capacity to test such equipment including a thorough understanding

of the unique requirements of the different drive types.

Preventing On-Site Repairs

Tests typically include a full mechanical run, a full hook-up and functional test on all aspects of the package including start-up, simulated emergency shutdown, variable speed operation, etc. Tests with new and artificially enlarged clearances (double new) on the driven equipment make it possible to assess behavior simulating end-of-life conditions. From this experience, many potential problems have been identified and resolved during string-testing, eliminating the need to carry out expensive and time consuming remedial work on site. ◀

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