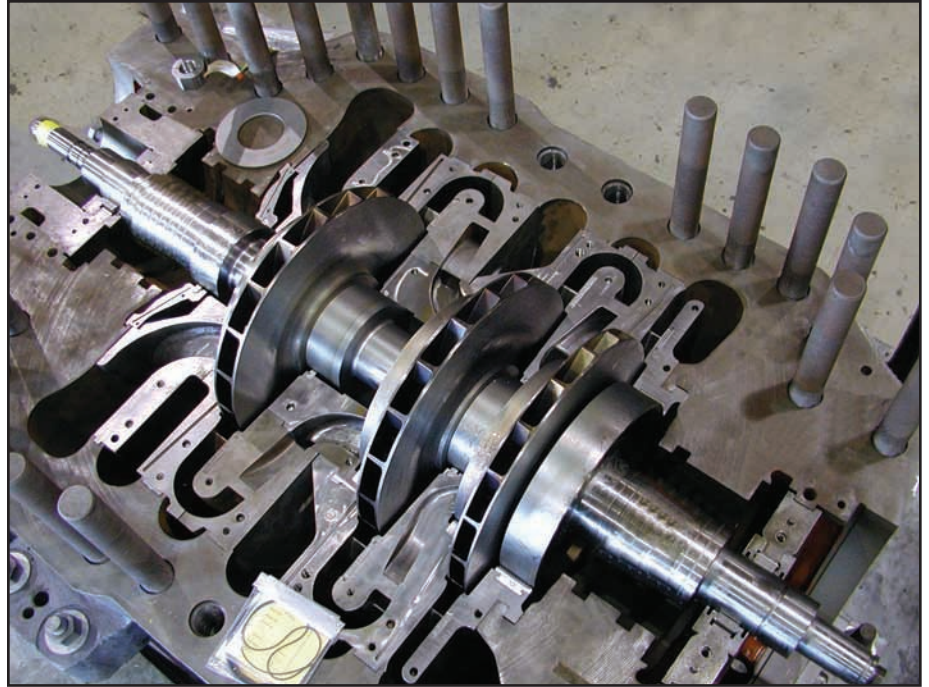


# PROACTIVE Revamp Program

Addresses the Impact of Process Creep



*Turbocompressor revamp.*

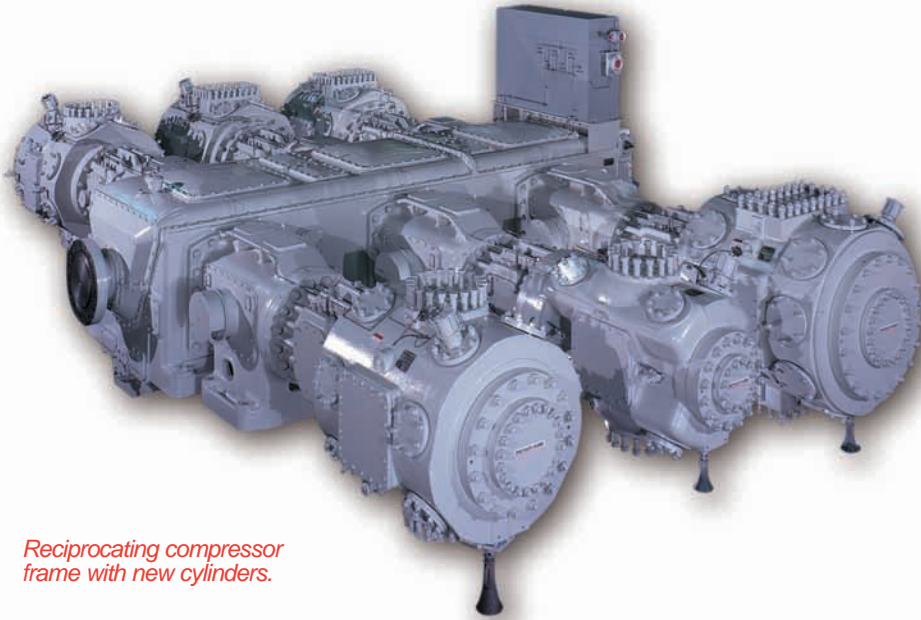
**TO GEOLOGISTS, THE TERM “CREEP”** defines the slow displacement of earth materials along a down slope. Because the activity is so gradual, it typically can be detected only over a period of several years. For energy industry operators of highly engineered-to-order equipment, “process creep” defines the gradual transition of machinery out of its original design conditions. Over time, this trend erodes performance and reliability that can affect maintenance, productivity, and safe operation.

In an industry where many critical rotating machines have been in service for 20 to 30 years or longer, much of this equipment is performing outside of its design parameters for various reasons. Processes may have changed as a result of catalyst improvements, changes in feedstock, government mandates, or simply as responses to increased market demand. Regardless of the reason, these changes directly affect the performance and reliability of the equipment.

The warning signs of “process creep” are gradual. The product, service, operating philosophy, and maintenance history all have an impact on the severity of problems encountered. However, there are similarities among equipment problems that experienced engineers can identify quickly. In steam turbine equipment, corrosion and fouling will lead to decreased power. Turbocompressors may demand increased power while demonstrating decreased mass flow, loss of ratio pressure, increased vibration, or speed fluctuations. Reciprocating compressors may experience excessive wear of rings, packings, riders, or valves. Most noticeably, there simply may be shorter cycle times between shutdowns to replace parts.

While operators may be aware of the root causes, they may not be aware of the impact on the unit’s operation or the long-term impact on unit reliability. “Most equipment operators are aware when a unit is not operating

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*Reciprocating compressor frame with new cylinders.*

within the unit design,” says Doug Craig, director of Worldwide Revamps at Dresser-Rand. “However, few are aware when they are operating beyond specification.” When referring to this condition, original equipment manufacturers are suggesting that a unit may be beyond design load and safe operating limits. “Typically there are warning and shutdown instruments to prevent this from occurring. Operating off original design point is not unique and it costs the client money in terms of lost efficiency and increased operating costs.”

#### **PROACTIVE REVAMP SOLUTIONS**

During the past 10 years there have been significant technological developments for turbo, steam, and reciprocating products. Advanced computer design techniques, improved manufacturing processes, and superior materials have all played roles in providing greater efficiencies and performance improvements for rotating equipment.

One solution to addressing the negative effects of process creep is a proactive revamp program

*“Often, revamps pay for the initial investment in less than a year as a result of increased production.”*

*— Doug Craig,  
Director of Worldwide  
Revamps*

designed to identify equipment issues before they become a problem. By revamping older units, a client can meet new or changing process requirements within the parameters of the existing equipment, providing a cost-effective and timesaving alternative to purchasing new equipment. Steps can be implemented to improve the safety, efficiency, and reliability of the equipment, achieve lower cost of ownership, and extend equipment life.

“A proactive revamp program is intended to make the client aware of the benefits of

upgrading the equipment in terms of increased production and improved reliability,” Craig notes. “Dresser-Rand has developed proven value propositions where we demonstrate a significant improvement in unit performance. This translates into increased production, and increased production directly impacts the bottom line of the operation. Often, revamps pay for the initial investment in less than a year as a result of increased production. This is especially true in critical processes where installed equipment has been in service for many years.”

While equipment operators may have considered revamping, or even replacing older units with new equipment, the step change in performance offered by improved technology is a fairly recent development – in the past 10 years, according to Craig. “Previously, the primary incentive to revamp a machine was to address significant changes in process conditions. More recently, technological developments in our product designs offer the opportunity to significantly improve efficiency in older installations. In the past, economics did not favor major changes to the equipment for process creep alone. It was easier and often cheaper to run off-design in inefficient ways.”

In many cases, the installation benefits alone of a thoroughly evaluated proactive revamp can be large, bordering on the benefits of new hardware itself. This is largely because the unit is already in position and the necessary piping and support structure is installed. Installation of a new unit would more than likely result in major re-work of the piping and possibly the foundation and locations of surrounding auxiliary equipment. These benefits can be manifested in actual work scope costs, as well as a reduction in unit downtime.

#### **REVAMPS BASED ON KNOWLEDGE**

Dresser-Rand prepares proactive revamp programs for rotating equipment across the

spectrum of upstream, midstream, and downstream applications for Dresser-Rand and other manufacturers' equipment. "We evaluate non-heritage equipment the same way we evaluate our own equipment," says Craig. "The same benefits we propose for Dresser-Rand legacy products are equally applied to all brands of similar products."

According to Craig, the first step in any planned revamp program is to gather information. "We meet with the client on site, ask questions to get a better understanding of what the client needs, and define any problems that may already exist. We then obtain data that specify performance requirements, and review the data and model performance."

To determine if equipment is being pushed beyond its normal operating conditions, Dresser-Rand conducts a comparison with the appropriate operating conditions (current or planned) as plotted on the existing hardware's performance curve. In addition to a review of historical documents, mechanical and rotor-dynamic reviews are performed to investigate issues that would indicate operation outside the design map.

In the case of turbo units, the company employs a SmartPerf model analysis. The SmartPerf Revamp Option, Dresser-Rand's performance selection program for centrifugal compressors, is a useful tool (because it eliminates the time and labor of a full-scale design review) to determine whether a revamp is appropriate in a particular situation. The revamp specialist can quickly investigate different options and determine which one best suits the client's needs. With the information on the laptop, the revamp specialist can give the client a visual perception of the proposed revamp in a colorful, cross-section diagram of a compressor, complete with curves and data.

"We then select operating conditions (or use client-provided data) that may maximize the

flow through the compressor," Craig says. "Or, we may use the available driver power and develop an alternate aero solution (for a complete flow path or a mix-and-match solution) to allow the unit to perform at those conditions. Budgetary pricing and a scope of recommendations is developed for the appropriate scenarios, and the information is provided to the client in a written proposal, teleconference, or face-to-face presentation."

The proactive revamp review process, which typically takes between one and three weeks, takes into consideration the entire process and all supporting equipment and systems such as gears, electric motors, and control systems, according to Craig. "Dresser-Rand takes into consideration the entire system when evaluating a critical piece of equipment."

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— Craig

#### PROVEN SUCCESS

This proactive approach to revamp solutions has already demonstrated success for clients. According to Craig, "On a recent syn gas train revamp, we developed the model and made some operating condition assumptions to optimize the unit's performance. We then made an educational presentation based on our technology and findings. The client provided us with actual operating conditions with which

to further refine our solution. As a result, the client ultimately revamped five casings at three facilities, thereby reducing power consumption, improving rotordynamics, and increasing the uptime of the critical units."

In another client application, Dresser-Rand used the SmartPerf revamp tool to determine the feasibility of increasing capacity at an ethylene production facility in Latin America. After intensely analyzing the design, reviewing hardware options, and formulating revamp solutions, the Dresser-Rand team reviewed and selected the best revamping options for their charge gas, ethylene, and propylene compressors. The team proposed the best options for maximizing production capacity by gaining a thorough understanding of the process and how the equipment could be revamped to best meet the client's requirements.

While new equipment is always an option, in some cases the negative effects of process creep can be eliminated by a thorough, strategic revamp program. Depending on the scope, a revamp may average anywhere from 50 to 75 percent of the cost of new equipment, based on hardware alone. In addition, a revamp can usually be delivered in a significantly shorter time than a new unit and installation costs are reduced when compared with new equipment.

The short-term benefits of a successful revamp are usually realized through the correction of minor, recurring reliability issues that may or may not have been directly related to off-design operation. The long-term benefits, however, typically translate into increased production, improved equipment availability, and increased profitability of the operation. ■