When looking at the machinery assets in a typical industrial plant, the big critical rotating machines like steam turbines, gas turbines, and high speed compressors are often the focus of a lot of attention, and rightfully so. When problems occur, the entire plant can be taken offline, or production can come to an abrupt halt, causing maintenance headaches, lost production, unsafe conditions, and even in some cases insolvency for the operation.

However, ask most machinery folks what machines give them the most headache and they will often tell you that pumps and pumping systems are the source of most of their frustration.

We rely heavily on these machines to keep our operations running, whether it be a Main Line Oil
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(MOL) pump at a refinery, a wastewater pump at a municipal plant, a water supply pump at a mining operation, or a highly critical boiler feed pump at a power generation station. Regardless of the service, these machines are some of the most-abused at our plants and probably also receive the least attention in terms of condition monitoring. Consequently, when the machinery and maintenance teams sit down on Monday morning to prioritize their tasks for the week, pumps often find themselves at the top of the list.

In most plants, pumps are often fitted with gages on the discharge (occasionally a gage is also installed on the suction side) to ensure it is delivering enough head for the service it is in, and that NPSH requirements are met. If the plant personnel are lucky and the plant has been somewhat proactive, static pressure sensors may have been installed and connected to a recorder or DCS system to provide some basic trending. In some cases, perhaps where the pump has had a problem in the past, the plant may even have installed some vibration monitoring on the pump. Whatever the scenario, these are the typical tools used by plants to help diagnose and solve pumping issues.

Consider also the fact that while the pump OEM can anticipate and correct many potential problems before the pump leaves the factory, they have little or no control as to how the pump gets deployed. What sort of piping arrangement will the pump be connected to? Will there be restrictions in the suction side piping? Is the piping properly sized for the service and application? Is the piping properly braced? Will check valves be installed?

When we examine in more detail some of the pumping problems encountered in the field such as: cavitation, pressure pulsations, water hammer, piping vibration, and general flow instabilities, we find that many are dynamic in nature and sometimes difficult to diagnose with pressure gauges, static pressure sensors, and even with vibration measurements that are not always a direct measurement of the root phenomenon, leaving many plants to react only when the problem has become acute.

Don Bently would have said:
“If you want to know what is going on, then take a direct measurement at the source.”
If instead we had a way to look at the dynamic pressure signals, the waveforms and spectrums on the hydraulic side of the machine, we could see the components of interest that are a result of or are precursors to machine problems. If we could see this dynamic data, we could then take proactive measures to fix problems before they become chronic.

Bently Nevada has researched dynamic pressure and has identified diagnostics that can only be obtained from such a dynamic pressure system. As outlined in previous Orbit articles:

*How our pump lab is increasing our understanding of pump behavior*
*Orbit Magazine 2Q-3Q, 1999*

*Detecting Cavitation in Centrifugal Pumps*
*Orbit Magazine 2Q, 2000*

For example, cavitation in pumps can be detected early using a dynamic pressure sensor by tracking the vane-pass frequency in the suction side of the pump. *As indicated in the plot below, the disappearance of the vane pass frequency, which is present in normal operation (shown here at 5X), provides an early indication of the onset of cavitation, even before it can be
**Dynamic Pressure, what’s the Value?**

Plant operations vary greatly across industries, but pumps that are critical in nature are always an area of concern and the economics of a failing critical machine are always compelling. At a typical power plant for example, a boiler feed pump that shuts down unexpectedly means the plant may have to reduce generation amounting to $100,000 per day or much more depending on the size of the plant, not including the cost of repairs or replacement.

To help our customers detect, understand, and resolve these issues before they become acute, Bently Nevada announces the introduction of the new 350300 Dynamic Pressure sensor for use with the 3500/46M monitor and System 1 software.

The new 350300 sensor has an all 316L stainless steel case construction (316L wetted parts as
well) for use with a variety of fluids, a common ¼-18 NPT male port for use with standard process connections, and a robust MIL-SPEC connector and cable that is available in lengths up to 1,000ft (304 meters).

The new sensor is designed to be connected to the 3500/46M 4-channel monitor using the standard positive input I/O module. A new channel type has been provided in the 3500 software (v5.2 or later) that allows for pressure measurements in units of psi or kPa absolute and in peak or RMS.

For the first time, both the static and dynamic signals can be read from a single pressure sensor and process and diagnostic data provided to the plant DCS and System 1 respectively.

The 3500 system can provide this pressure data in many formats and signal types for maximum flexibility that our customers have become accustomed to. High and Low pass filter options are available. Multiple Alert and Danger alarms can be set in the 3500 system along with time delays, latching, and trip multiply. 4-20mA recorder outputs are available on the rear of the 3500/46M I/O module for integration into a PLC if needed. Modbus data is provided with the 3500/92 Communications Gateway module. Local display can also be provided by the 3500/94 module and touch-screen display.

Operators can see static pressure data in the DCS to know how to operate the pumps. Machinery and performance engineers using System 1 can see both the static and dynamic data to allow for performance diagnostics and prognostics.

System 1 provides the ultimate Optimization and Diagnostics platform in which to view the data (v6.9 or later is required). Static data can be trended and software alarms configured to tailor each particular machine. Valuable dynamic data in the form of hydraulic spectrums and waveforms can be obtained. Performance of the machine can be tracked using Bently Performance software. Most importantly this hydraulic data can now be easily trended and compared with vibration data and process data which opens up new doors for plants to increase reliability, safety, and the productivity of their operations.