



# Hydro turbine pressure monitoring system

**Are cavitation and rough load zone damaging your hydro turbine and reducing efficiency? Will you be operating in new head and flow conditions and want to know how your turbine will behave?**

Hydro-generation plants deal with a large amount of variability. Hydro units today are being dispatched differently to accommodate wind turbines and other dynamic energy sources on the grid. At the same time, Hydro plants must deal with extremes in reservoir and river levels. These conditions can result in cavitation and/or rough load zone (RLZ) problems at many sites.

Even if you can't control when these problems occur, you can manage their effects more intelligently. Varying loads, heads, and flow rates make hydraulic disturbances a multi-dimensional problem—one you cannot solve without sensors and historical data. This is especially apparent

when installing air injection systems. Mapping the relevant variables through the seasons can give you a clear understanding of when these phenomena occur, and help you optimize when and where to inject air.

In response to customer requests, Baker Hughes announces the release of our hydro turbine dynamic pressure sensing system from the Bently Nevada<sup>1</sup> product line. The system leverages our industry-standard 3500 rack already installed at many sites, adds a new hydro dynamic pressure channel type<sup>1</sup> to the 3500/46M Hydro Monitor, and includes a new Bently Nevada dynamic pressure sensor that has been tested and proven in hydro applications.

Three pressure sensor range options are available to match the particular head characteristics of your units. The sensors measure pulsations down to 0.2 Hz, and are typically installed on the head cover and/or draft tube. Each 3500/46M monitor added to your 3500 rack will accept up to four dynamic pressure signals. A unique feature of this system is that it provides both static and dynamic pressure measurements from a single sensor and channel.

The hydro turbine dynamic pressure sensing system consists of all the hardware<sup>2</sup> you need to retrofit your existing hydro generator 3500 system, or include in a new 3500 monitoring system for your unit:

- 3500/46M      Hydro monitor with multimode positive input I/O<sup>3</sup>
- 350300      Dynamic pressure sensor
- 146824      Pressure sensor cables (lengths from 10 to 1,000 ft.)

## Variables and settings for the hydro dynamic pressure channel in 3500:

Direct amplitude	Direct peak (or RMS) amplitude of dynamic pressure in psi or kPa
Static pressure	Measured in psi or kPa
1X Amplitude	1X filtered peak (or RMS) amplitude of dynamic pressure in psi or kPa
1X Phase lag	1X phase lag measured in degrees
2X Amplitude	2X filtered peak (or RMS) amplitude of dynamic pressure in psi or kPa
2X Phase lag	2X phase lag measured in degrees
Mode	Unique alarm setpoints for each defined mode of unit operation (when multimode feature is enabled)
Alarm latching/delays	Additional control of alarm latching and time delays, allowing for additional control of your alarming scheme
Timed OK channel defeat	Intelligent detection of faulty sensor/circuit, protecting you against false trips. Now with time delay
Recorder outputs	4-20 mA outputs (one for each channel) for integration into an external recorder or display
Trip multiply	Input contact for increased Alert and Danger levels for startup and/or rough load zone operation

## System 1 diagnostic plots available with the hydro dynamic pressure channel:

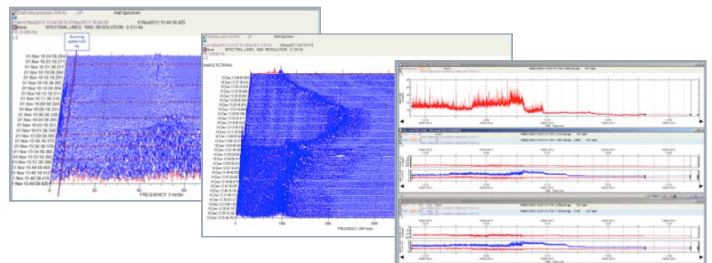
Trended variables	Highly customizable software pre-alarms
Direct waveforms	Visual interpretation and diagnostics
Spectrum plots	Frequencies of interest over time, speed, and load changes
X-Y plots, performance maps	Pressure pulsations vs. machine loading (MW) or other measurements

The 3500 System provides all the benefits you have come to expect from Baker Hughes Bently Nevada product line in terms of reliability, connectivity, and ease of use. The 3500/93 LCD or 3500/94 VGA touch-screen panels provide local, configurable display of all measurements. The 3500 system provides total alarm control, with Alert and Danger setpoints for direct (dynamic pressure) amplitude, static pressure, and 1X and 2X amplitude and phase.<sup>4</sup> The 3500/32 or 3500/33 relay output modules provide four or 16 channels of relays that can drive alarms and annunciation when conditions worsen.

Data values can be easily mapped into Modbus registers for communication to your DCS or SCADA. The data can also be streamed into System 1<sup>†</sup> diagnostic software, which can be installed on any desktop computer in your organization. This diagnostic software provides current values and historical trends, full dynamic analysis with waveforms and spectrum plots, and static or dynamic pressure amplitudes vs. MW load or reservoir level. System 1 software<sup>5</sup> can also provide email notifications of alarms so that appropriate individuals can remain informed and up to date on the status of your hydro turbine generator units.

## Notes

1. Available with 3500/01 rack configuration software version 5.2 or later.
2. Installation-specific hardware such as isolation valves, piping and brackets not included.
3. An existing 3500/46M with multimode positive I/O module can be reconfigured for use with the 350300 dynamic pressure sensors. Note that both channel pairs (all four channels) will become hydro dynamic pressure channel type.
4. 1X and 2X amplitude and phase measurements require a Keyphasor signal.
5. Available with System 1 version 6.9 or later.



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