Summitraining SAS

White Paper

PCP Pump

Data Acquisition & Monitoring

ACCORDING to ISO 15136-1

Testing data is a vital step to use a Progressive-Cavity-Pump (PCP) in Oil Industry. A PCP pump with an excessively worn stator or excess vibration will injure the oil production business from its beginning with low flow rates, a high slip, high energy consumption, and the most harmful: the sudden stop of operations due to the complete failure of the pump stator.

Endeavour Consult C.A. / Summitraining SAS

Jesus Hidalgo / Frank Kenyery

NI Hardware and software:

cDAQ9185.
Software: NI LabVIEW 2018, NI LabVIEW DSD module 2018, NI Real Time module 2018.

The challenge:

The challenge is to monitor an artificial lift progress cavity pump (PCP) test stand and generate a Microsoft Excel report according to the ISO 15136-1 STANDARD test procedures. The PCP flow rate (Q), inlet absolute pressure (IP), discharge gauge pressure (DP), motor torque (M), and revolutions per minute (RPM) must be available to the operator at any time. The software needs to perform real-time calculations in order to fill up the MS Excel report in the form of tables and graphics. The real-time test stand variables Q, IP, DP, M, RPM, calculations, and report generation must be done from a Windows-based laptop connected to the pump test stand via Wi-Fi.

The solution:

A cDAQ9185 NI chassis, a NI9208 analog acquisition module, and a MOXA AWK-3121 access point were combined as a fast, reliable, and economically competitive solution to monitor the PCP test stand main variables. A Windows PC software was developed with LabVIEW 2018, created to guide the user to perform a PCP test according to the ISO 15136-1 STANDARD procedures. In the end, with just a click, the user can export the information collected during tests to a MS Microsoft Excel template created as client requirements and the ISO 15136-1 STANDARD.

Introduction:

The actual oil industry must meet high procedures and standards to accomplish environmentally, and highly energy-efficient processes. If these are not considered, then, not only could result in local and international penalties but in an inefficient use of resources with economic losses that, most of the time, become evident too late to be corrected in an oil contractor company. When talking about the oil upstream activities, this fact becomes critical with extraction devices such as progress cavity pumps. Using a PCP with an excessively worn stator or excess of vibration will injure the oil production business from its beginning with low flow rates, a high slip, high energy consumption, and the most harmful: the sudden stop of operations due to the complete failure of pump stator.

The International Standard Association develops recommended practices and a common language for users, purchasers, suppliers, and manufacturers with information on the selection, manufacturing, testing, and use of progress cavity pumps under standard 15136. A hydraulic validation testing shall be performed to determine PCP´s capacity per RPM, pressure capabilities, torque and power characteristics, and performance. To achieve those goals, the National

Instruments ecosystem allows a NI Partner: Endeavour Consult C.A., joins an expert company Summitraining S.A.S. in test stands and PCP evaluation, upon the robust NI platform for reliable acquisition data (cDAQ), a high-level development environment (LabVIEW), and offers to the industry market a professional solution tailor-made to successfully monitor PCP tests.

Application description:

The NI 9208 input module installed on the cDAQ9185 NI chassis receives 4-20 mA analog signals from a PCP inlet absolute pressure sensor, PCP discharge gauge pressure, an electromagnetic flow rate sensor, motor torque, and rpm reported by the VFD, as shown in Figure 1.

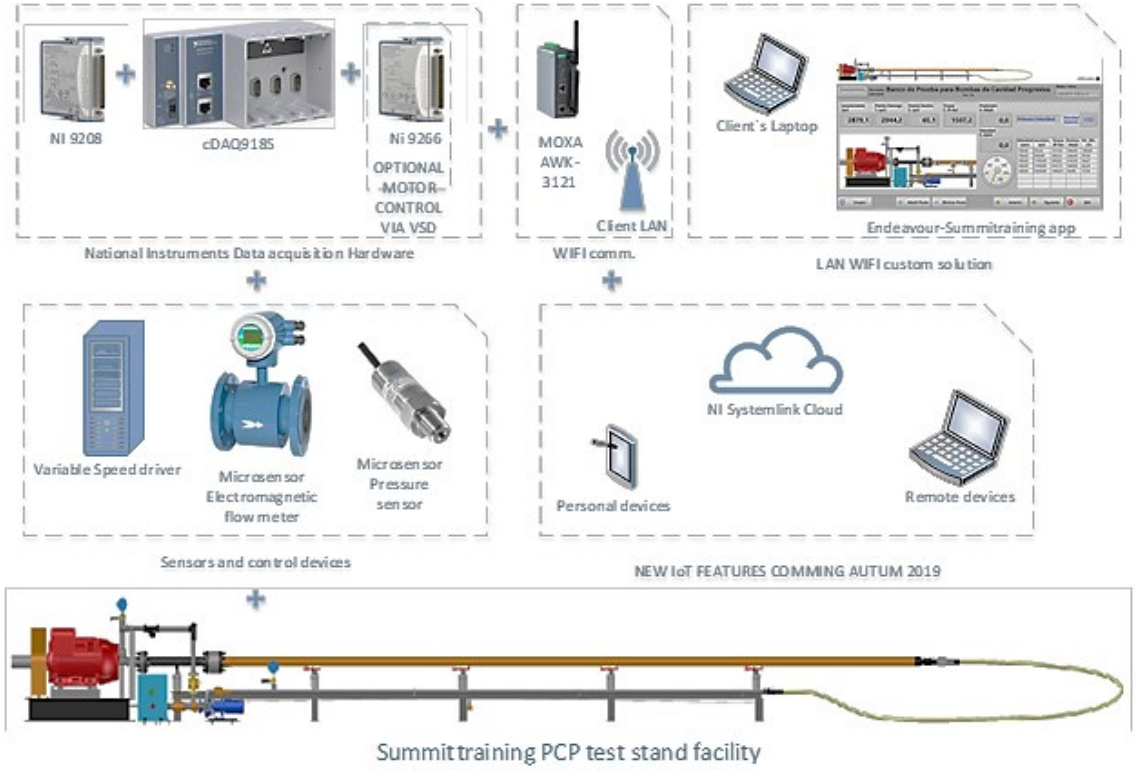

Figure 1. PCP test stand monitor Solution architecture

The hardware

The communication between the cDAQ9185 NI chassis, the user interface application installed on the client's Windows-based laptop, and the LAN/Internet is performed by an industrial environment wireless MOXA AWK-3121 access point with more than 500m coverage. This device is easily configured in one of the WIFI communication modes: AP/bridge, AP Client (STA AP-WDS) to meet the client's LAN requirements.

The software

LabVIEW 2018 allows us to quickly develop the user interface application as an executable (.exe) program including its corresponding Windows installer. This application connects directly to the NI9208 module and acquires the incoming signals from sensors (IP, DP, M, RPM, and Q), and scales it, from current to engineering units within a user editable .txt configuration file. This file

can be modified and adjusted depending on the units, scale, and limits of sensor vendor settings. Then, the signals are digitally filtered with a simple mathematical root median square function (RMS) and presented as numbers to the user. See Figure 2.

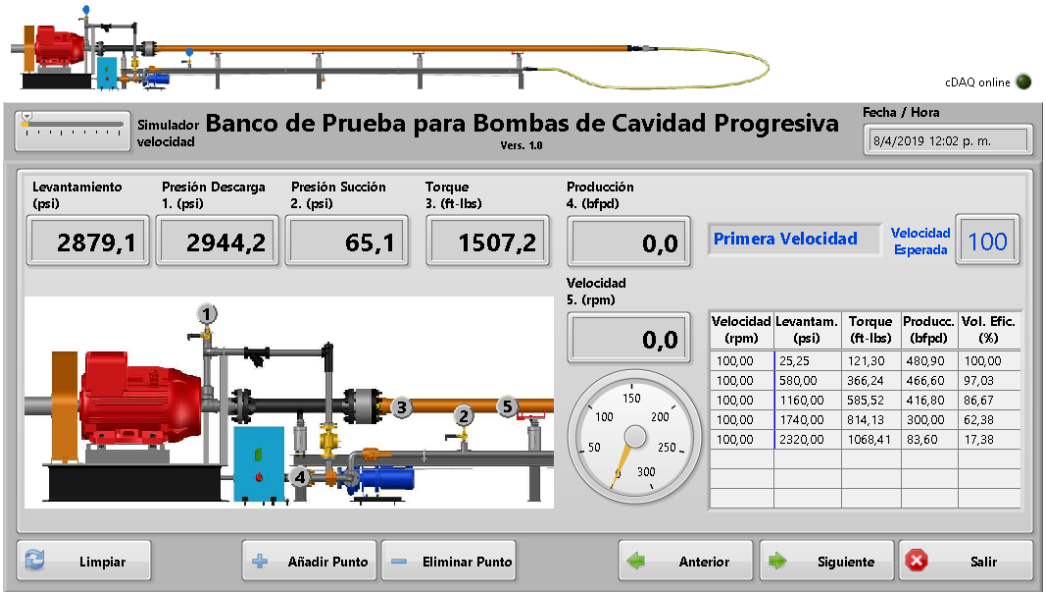

Figure 2. PCP monitor Windows application created with LabVIEW 2018

The user interface application was created using consecutives cognitive windows, determined by our partner expert recommendations (Summitraining, Colombia), to require information step by step and efficiently guide the user to create the PCP performance curves. See Figure 2 and Figure 3.

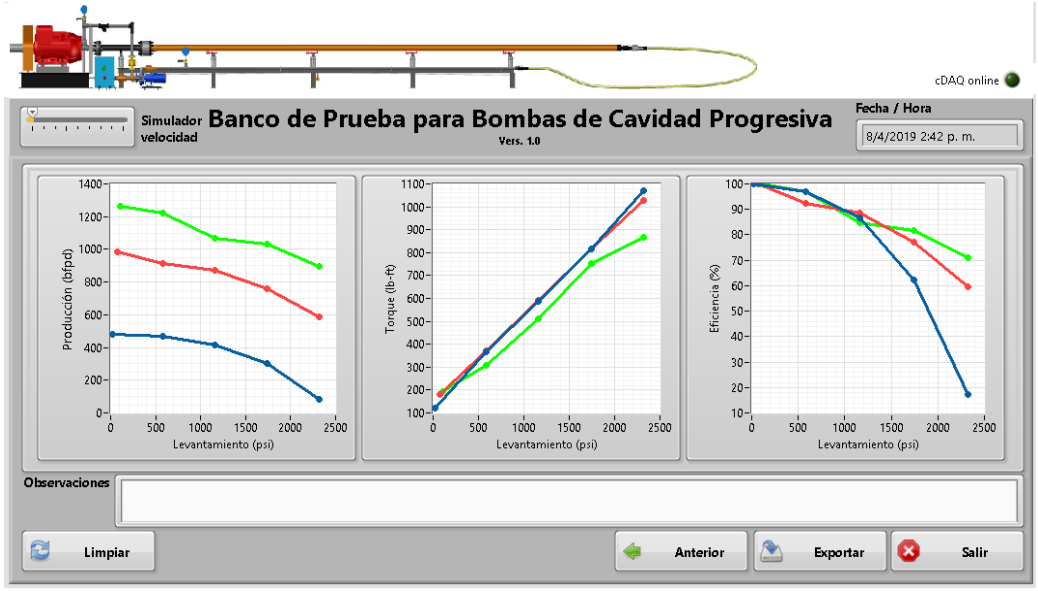

Figure 3. PCP monitor application curves window.

If curves are satisfactory to the user requirements, then they will be saved as a Microsoft Excel Report under a unique identifier number. Also, a custom backup txt database is filled up with the

report information so, the user can verify and validate an excel report with its identifier number in the future, as seen on Figure 4.

Once the user realizes that the pump under evaluation shows a behavior deviated from the factory settings, as unexpected flow rate decrement under a certain pressure discharge (phenomena known as slip) or an increment in the torque, it can be determined the wear of the stator at an early stage, or a necessity of bearing replacement that can be corroborated with further evaluations as vibration tests.

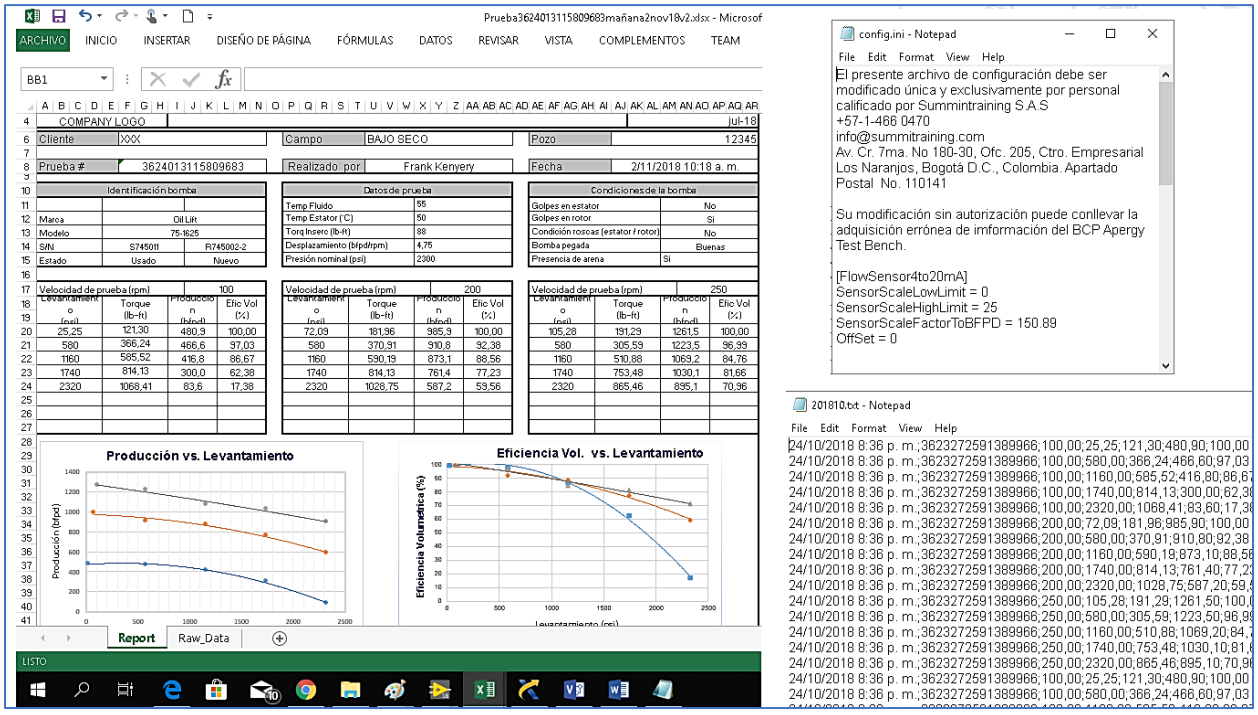

Figure 4. Ms Excel report (left), configuration file (up-right), reports history backup (down-right)

Solution strategy, development, and deployment times

The developed software uses short iterative phases of work known as a scrum in combination with a traditional Microsoft project management plan. It took 5 weeks from the kickoff reunion until the final deployment to the client, including architecture design, code development, unitary tests, stress tests, partner validation, deployment to the final client, and client validation tests. Because of the size and type of test stand, the software and hardware can't be fully tested until the final assembly during the client's validation tests, so a simulation code was added to tests, as best as possible, the application during most stages of development. Hardware assembly and software applications were developed in separate cities without any physical contact between the working engineers. Just only remote-control access to the client's computer and a couple of technical cellphone conversations was required to deploy the application.

Solution expansion capabilities

This solution can be easily expandable for a full test stand operation, the PCP's rpm from the client's computer with a 4-20 mA signal control attached to the variable frequency drive analog

input module. A motorized control valve can also be controlled with another 4-20 mA signal and minimal changes in software.

Endeavour Consult / Summitraining is updating its portfolio's plug-and-play solutions to exchange information with the NI System-Link Cloud Internet of Things platform and allow the final client secure and reliable access to monitor and control their test stand, and access to all history tests, without the hard effort of configuring and maintaining an internet web server.

Conclusion:

The National Instruments ecosystems combine a powerful system-design platform and development environment LabVIEW 2018, a reliable data acquisition hardware cDAQ with worldwide technical experts and NI partners to offer to the energy industry fast and practical solutions, according to their needs and budget. This improves the evaluation of cavity pump test's according to ISO 15136-1 standards.

FOR MORE INFORMATION ON DATA ACQUISITION, AND PUMP MONITORING AND TO REQUEST A DEMO OF OUR PRODUCT, PLEASE VISIT SUMMITRAINING.COM