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Auto Pig Launcher

• April - November 2011

Figure 1: SmartTrap® Automated Combo Pigging System

Objectives

• Develop an automated tool launching device for pipeline cleaning to reduce required labor
• Comply with Class 1, Division 1 hazardous location requirements
• Meet NACE MR0175 requirement for corrosion resistance

Approach

• Implement Systems Engineering (SE) Lite methodology
• Specify product requirements
• Define system architecture
• Mitigate product risk (hazard analysis, FMEA, etc.)
• Build initial system prototype at the customer's facility

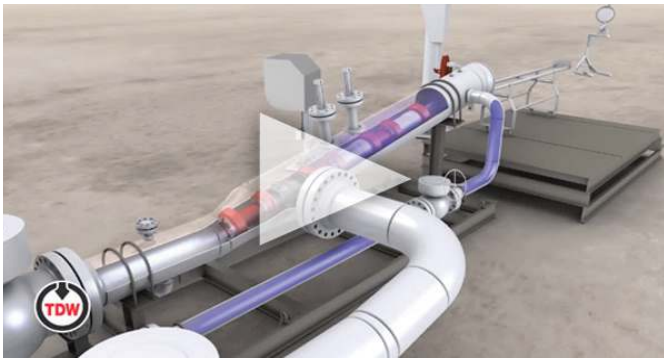
Results

• Introduced an automated pigging system resulting in a huge success for the customer, T.D. Williamson

A Complete Product Development Partner

- Brainstorming and Concept Generation
- Feasibility Studies and System Architecture
- Detailed Product Design
- Prototyping
- Design for Manufacturing (DFM)
- Verification Testing
- Manufacturing Assembly and Test Equipment
- Sustaining Engineering

Watch the SmartTrap® in action



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Complex Problem

T.D. Williamson partnered with Syncroness to develop an automated pig launcher in order to reduce labor required for pigging operations. "Pigs" are devices sent through oil or gas pipelines to perform a variety of functions, including cleaning, inspection, and lubrication. The proposed automated system needed to allow simple cleaning tools to be released on a specific frequency without the need for personnel to be onsite, while still permitting more complex inspection tooling to be launched when needed. Current sphere launchers were "not compatible with launching either cleaning pigs or inline inspection tools." The control system had to provide local or remote access to check on the status of the launcher and to adjust the system configuration, such as launch frequency. The entire system, which includes the control panel, hydraulic power unit, cylinder limit switches, electrical conduit, and connections, needed to be Class 1, Division 1 compliant.

Syncroness was in charge of designing the following parts of the system:

- Pins, customized hydraulic cylinders, and interface to the launcher tube
- Controls enclosures, physical user interface, mounting tower, and shroud
- Controls electronic component architecture, selection, and integration
- Controls software:
  - PLC programming
  - Graphical user interface
  - Remote interface
  - Software user's manual

Mechanical Pin Design

Following a broad-scope brainstorming, the system architecture was narrowed to a straightforward dual, alternating pin design to retain and systematically release single spherical cleaning tools into the pipeline.

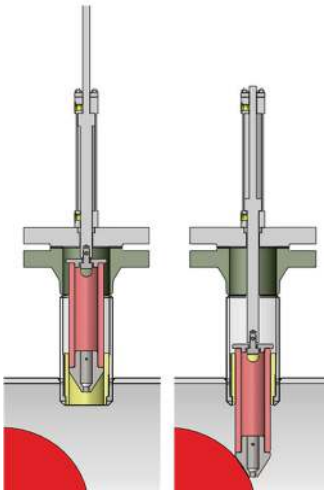

Figure 2: Pin assembly retracted (left) and extended (right) to retain pig

A primary purpose of the system was the ability to load and restrain loaded tools until they were ready for launch. This required determining the applicable forces on the system. To completely capture the design requirements, Syncroness tested and measured the sphere absorption of impact forces. These forces quantified the strength required in the pin assemblies that would be used to capture the loaded spheres. Similarly, Syncroness engineers calculated the forces

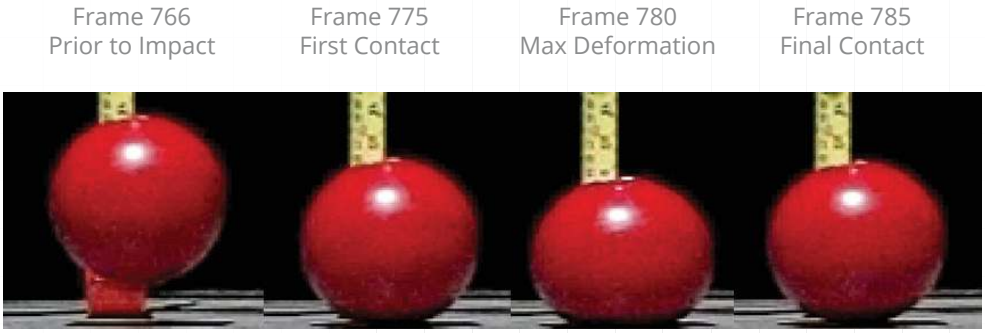

Figure 3: Measurement of sphere deformation during impact

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of the spheres on the pins when statically retaining the weight of a "stack" of staged the tools under all conditions.

The desired product range covered pipelines and tools sized anywhere from 6-inch through 20-inch. To limit variance across the product line, Syncroness optimized two unique design configurations of the pin launch assembly that were able to cover the entire range of pipeline sizes. This design maximized the number of common components both between the two unique designs and within each configuration to limit warehouse stock. The standardization of parts included working with Parker Hannifin to design and approve two versions of a custom flange mounted hydraulic cylinders that would work across the entire range of products and lengths of required actuations.

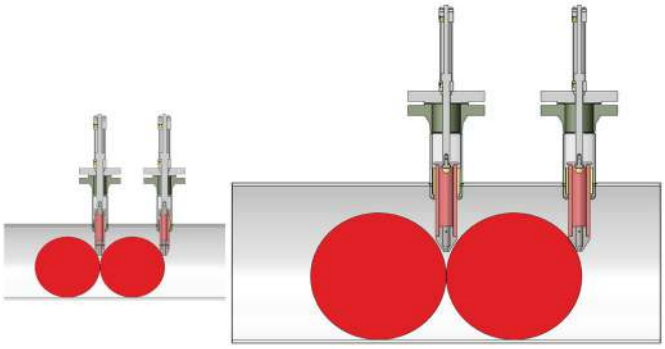

Figure 4: Small pin assembly (left) for 6" through 10" pipelines. Large pin assembly (right) for 12" through 20" pipelines

Control Electronics

The system required a dedicated control system within the hazardous environment at the launcher for local control of the pins. Syncroness designed a Class 1, Div. 1 rated, explosion proof controls system specific for this application, with the safety of the operator as the paramount criterion for the design. The control electronics includes a central Programmable Logic Controller (PLC) to manage the logic, inputs, and outputs of the entire system. The PLC is housed within a custom enclosure, which includes a dedicated display unit and a simple five button interface. The control system design required accommodations for the variety of harsh environmental the oil and gas pipelines may exist, from freezing artic environments to arid desert environments. To that end, the enclosure was subjected to thermal testing to verify that the heaters within the enclosure would maintain the operating temperatures of the display unit.

Figure 5: Controls enclosure, mounting tower, and shroud as designed (left) and in the field (right)

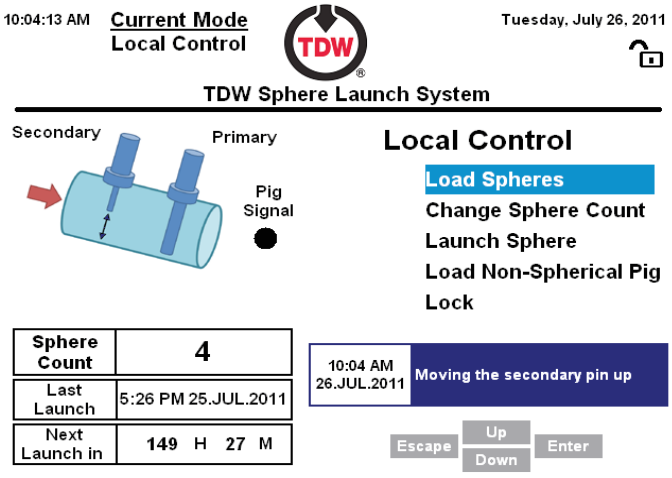

Figure 6: GUI for sphere launch system

Figure 7: Syncroness-designed portable interface system

Software

The functionality within the system far exceeds the direct control available with a simple button user interface; therefore, Syncroness developed a Graphical User Interface (GUI) on the dedicated display. Powered by logic within both the display unit and the PLC, the operator now has direct access to functions for loading spherical tools, launching tools, scheduling periodic launches of tools, as well as loading and launching of standard, inspection, and other specialized tools. "The control panel of the SmartTrap® Automated Combo Pigging System includes a history log that records the most recent 100 events, including warnings or alerts and user log-ins. This history log is accessible either on-site (as shown here) or from a remote location." [1]

Final delivery of the system included a manual with instructions for how to operate the software and access all software functions.

Parallel Development

Rather than a traditional waterfall approach among engineering disciplines, prototypes and models were used to facilitate parallel development. Software engineers created mockups during initial software development, which were used to flesh out the layout of the GUI screens and the flow of the operator interactions with the systems independent of the status the electrical hardware. System prototypes included a portable interface prototype for testing firmware modifications and updates, as well as a platform for ongoing system improvements.

Syncroness' Solution

With Syncroness' support, "TDW introduced an automated pigging system that combines the ability to perform all three pigging functions:

1. Routinely pig using automatically launched spheres
2. Clean the pipeline with cleaning pigs
3. Inspect the pipeline with inline inspection tools" [1]

Reference

[1] T.D. Williamson, "The new SmartTrap® Automated Combo Pigging System offers a unique answer to the needs of the wet gas market," *Innovations*™ magazine, Vol IV, No. 1, Jan-Mar 2012.