Optimizing Device Selection
Using New Procurement Specification for
“2SLP Safety Transmitter”

Technical buying narrative prepared for Technical Leaders and Procurement Directors
September 10, 2015
Introduction

This document will provide an overview of our standardized advanced technology, the **2SLP Safety Transmitter** for pressure and temperature, certified for use in SIL 2 (SC3) Safety Instrumented Systems. The 2SLP is representative of a new class of certified instrumentation designed with **unique risk reducing attributes and offered at a significantly lower price point** than certified process transmitters. Our purpose in this document is to illustrate how the 2SLP can help to address the objectives of project teams, especially those of safety, operability, maintainability, compliance and lower cost.

As a tool for rapidly delivering additional risk reduction, compensating measures, simplicity and new flexibility, the 2SLP aids the work of PHA leaders, safety practitioners and site engineers by offering a product which is strongly differentiated from certified process transmitters. This new technology can clear the way for optimizing device selection, driving improvements in safety and cost by EPs, Main Automation Contractors and supplier OEMs.

This paper provides both technical arguments and an analysis of potential cost savings beginning with the first projects. The cost models are shown on tables on pages 11-15. After review of this material by technical authorities and procurement directors, UE respectfully requests an opportunity to engage your technical authorities around the globe to further understand their needs and take steps that may lead, ultimately, to a procurement specification for this device and the attendant benefits.

*United Electric Controls Company*

*Watertown, Massachusetts*
Technology Overview

The 2SLP Safety Transmitter is a SIL capable device, SIL 2 (SC3) for pressure and temperature, unlike any instrument commercially available. It replaces more expensive and complex process transmitters in safety instrumented functions and other process safeguards, making Independent Protection Layers (IPLs) more robust, addressing process safety time constraints to better protect equipment, offering the highest diagnostic coverage of any transmitter on the market, and lessening the risks of misconfiguration and cyber-attack. Leading transmitter brands were designed, firstly, for process automation. As such, they cannot fully address the unique and sustainable requirements of safety instrumented functions, because of gaps in their capacity to provide risk reduction. For example, the use of process transmitters to build fault tolerant architectures create a sensitivity and vulnerability to random hardware failure and single points of failure in the DCS/PLC owing to common cause/common modes including misconfiguration, software patches, etc. The 2SLP Safety Transmitter addresses these weaknesses in the following ways:

- The 2SLP is a loop powered transmitter with an embedded certified safety relay, programmable at a set point
- The safety relay is rated 12-250 VAC @ 5.0 A and has high diagnostic coverage, SFF=97.8%
- It offers the added protection of a fast-acting, hard-wired trip of a final element, adding independency and redundancy
- The device also has a second certified digital output, rated 30 VDC @ 20 mA max, offering additional flexibility for designers
- In design and operability of the 2SLP is diverse
- High diagnostic coverage watchdogs internal health and critical process conditions, remotely and locally annunciating
- The 2SLP is password protected and can be programmed locally in 2 minutes
- It is cyber, hack proof. All outputs are unidirectional, reducing risk of unintended or unauthorized changes
- No communication vectors which can impact operability and safety
- Exceedingly simple to commission
- Device is standardized technology with uncomplex handover documentation
- The flexibility of outputs and internal logic facilitates rapid improvement and fast turnaround
- Device has the highest diagnostic coverage of any sensor currently available on the market
- Device is 1/2 the unit cost of certified process transmitters (see cost modeling, pages 11-15)
# Comparing Safety Attributes

The information has been compiled from published documents including Safety Certificates, FMEDAs, safety manuals and product data sheets. It compares safety attributes of the UE 2SLP Safety Transmitter with certified process pressure transmitters.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>United Electric Controls (UE)</td>
<td>2SLP One Series Safety Transmitter</td>
<td>98.6%</td>
<td>±3%</td>
<td>250 ms</td>
<td>&lt;100 ms</td>
<td>Every 6 sec</td>
<td>6 sec</td>
<td>5%</td>
<td>May-17</td>
<td>OneST-SM-02 April 2014</td>
</tr>
<tr>
<td>Rosemount Inc.</td>
<td>3051 S Advanced HART Diagnostics, option code DA2, Sensor Software Revision 7 or 8</td>
<td>95.0%</td>
<td>±2%</td>
<td>145-190 ms</td>
<td>N/A</td>
<td>Every 30 min</td>
<td>30 sec</td>
<td>5%</td>
<td>Sep-17</td>
<td>00809-0100-4801 Oct 2014</td>
</tr>
<tr>
<td>Rosemount Inc.</td>
<td>3051 S Advanced HART Diagnostics, option code DA2, Sensor Software Revision 5 or 6</td>
<td>95.0%</td>
<td>±2%</td>
<td>145-190 ms</td>
<td>N/A</td>
<td>Every 30 min</td>
<td>30 sec</td>
<td>5%</td>
<td>Sep-17</td>
<td>00809-0100-4801 Oct 2010</td>
</tr>
<tr>
<td>Yokogawa Electric Corporation</td>
<td>EJX A Series and J Series</td>
<td>90.8%</td>
<td>±2%</td>
<td>90 ms</td>
<td>N/A</td>
<td>Every 5 sec</td>
<td>5 sec</td>
<td>2%-10%</td>
<td>Jul-18</td>
<td>IM 01C25T01-06EN, 5th ed, June 2014</td>
</tr>
<tr>
<td>Rosemount Inc.</td>
<td>3051 S Software Revision 7.0 and Above</td>
<td>90.0%</td>
<td>±2%</td>
<td>220 ms</td>
<td>N/A</td>
<td>Every 60 min</td>
<td>60 min</td>
<td>5%</td>
<td>Sep-17</td>
<td>00809-0100-4801 Oct 2014</td>
</tr>
<tr>
<td>Rosemount Inc.</td>
<td>3051 w 4-20mA with HART Device Label SW 1.0.0-1.4x</td>
<td>90.0%</td>
<td>±2%</td>
<td>1.5 sec</td>
<td>N/A</td>
<td>Every 60 min</td>
<td>60 min</td>
<td>5%</td>
<td>Apr-18</td>
<td>00809-0100-4007 Sept 2013</td>
</tr>
<tr>
<td>Rosemount Inc.</td>
<td>2051 with 4-20mA with HART Device Label SW 1.0.0-1.4X</td>
<td>90.0%</td>
<td>±2%</td>
<td>1.5 sec</td>
<td>N/A</td>
<td>Every 60 min</td>
<td>60 min</td>
<td>5%</td>
<td>Apr-18</td>
<td>00809-0100-4109 June 2013</td>
</tr>
<tr>
<td>Honeywell Intl Inc.</td>
<td>SmartLine ST 800 HART</td>
<td>90.0%</td>
<td>±2%</td>
<td>90 ms</td>
<td>N/A</td>
<td>Every 9 min</td>
<td>9 minutes</td>
<td>5%</td>
<td>Dec-16</td>
<td>34-ST-25-37, Revision 4.0 June 2014</td>
</tr>
</tbody>
</table>
Optimizing Device Selection – Application Development

Here are several examples of where the 2SLP Safety Transmitter leverages SIL capability, simplicity, the flexible integration of analog and digital I/O, high diagnostic coverage and lower cost to meet ’s project objectives.

I. First, a Safety Transmitter
Simply stated, the 2SLP is a 0.5% accurate, 4 to 20mA pressure or temperature transmitter designed for safety control, alarm and interlock functions including Safety Instrumented Systems (SIS). Because of its high SIL capability, it can be rapidly deployed to upgrade legacy transmitters that suffer from weak validation, lack of internal or process diagnostics, obsolete software revisions, end of useful life, etc. Robust automatic, self-diagnostics allow for strategic proof testing and stretched out proof test intervals. A single, fault saturation level of 3.6 mA (NAMUR 43 standard) is provided. No security and alarm configuration is necessary. Field scalable, 2:1 turn down.

II. Powering
The 2SLP is powered on two wires via 24 VDC analog loop power (20-40 VDC @ 4-20 mA) or external 24 VDC power supply. Physical separation from the powering functions of the DCS/PCS may be desirable or necessary in some cases. The 2SLP provides both options.

III. Certified Digital Binary Outputs
In addition to its 4-20 mA current output, the 2SLP has three, safety certified digital outputs. Two of those outputs are controlled by the device’s programmable logic; the third is a universal diagnostic output signal. After entering the password, it takes only one minute to program a set point to directly de-energize-to-trip (DTT) a final element such as a solenoid operated valve (SOV) or the start/stop circuit of an MCC. That same programmable logic can provide a discrete output to a PLC or DCS. All outputs fault to a safe state.

The digital outputs on the 2SLP Safety Transmitter are further described as follows:

- High capacity safety relay output (SRO) rated 250 VAC @ 5 amp
- Low capacity discrete output rated 30 VDC @ 20 mA; mimics programmed set point value
- Low capacity discrete output for remote annunciation of internal health, sensor availability & loop compliance
- All outputs are certified per IEC 61508 as Safety Variable Outputs (reference FMEDA)

IV. “Uncoupling” from a single point of failure in the PLC/DCS
Shared equipment such as a process transmitter, a DCS/PLC, a controller, trip amplifier or valve requires a determination if any failure mode constitutes a single point of failure. Because of its multiple certified outputs and logic, the 2SLP safety transmitter can effectively uncouple an entire control loop from a single point of failure by providing an independent, hard-wired trip of a solenoid operated valve (SOV) with 0.1% set point repeatability. Successful risk reduction strategies consider this hardwired trip in the availability/unavailability calculations of an SIF or other process safeguards.1 The
2SLP also reduces the complexity, maintainability and cost of traditional recipe approaches where a second process transmitter is paired with an independent controller. The 2SLP can supply a 4 to 20mA, so the central logic solver can monitor and command the SOV and SDV redundantly.

V. Addressing process safety time constraints
The original edition 1 of IEC 61511 (2003) referenced “system response time” and it simply stated that it had to be specified and complied with. The new issue of IEC 61511 (Clause 3.2.56.1) is more specific in its definition of the concept of process safety time. It defines process safety time as “time period between a failure occurring in the process or the basic control system (with the potential to give rise to a hazardous event) and the occurrence of the hazardous event if the SIF is not performed.”

The issue of response can be critical to protecting rotating equipment and mitigating the potential loss of containment or the ejection of machine parts. A typical process transmitter is subject to constraints of response time, lag time, scan rates, etc. The 2SLP safety relay can address these constraints with a direct interface with the start/stop circuit of an MCC, providing hard-wired trips in ~60ms. Condition monitoring or the ultimate command of a safety function can be via the device’s 4-20mA output, but often process safety time constraints call for the use of discrete, fast acting trips for ESD.

VI. Improving Traditional Voting Mechanisms
Typical 2003 voting mechanisms that use process transmitters may NOT provide enough risk reduction because of issues of common cause/common mode failure. For example, three process transmitters of similar or identical characteristics deployed through a common logic solver to command redundant SOVs will not provide enough risk reduction in many SIFs to achieve the required SIL. This sensitivity to CCF/CMF (including β factor) had few cost effective solutions until the 2SLP made it possible to simplify and diversify output architectures to reduce stress. This mitigation can occur in a few different ways:

- The 2SLP can be employed as the third device supplying a voting analog output. This diversification is one method for strengthening the loop because it lowers the systematic risk owing to common cause, common mode failure. In the case of the 2SLP, the product’s high diagnostic coverage (which greatly exceeds that of all other process transmitters) may allow a strategic level of proof testing. For O&M personnel, any fault in the device, impulse line or electrical loop is annunciated locally and remotely within 6 seconds of detection.

- A second approach involves diversifying outputs. Instead of three analog outputs commanding a valve (or valves) through a common solver, the safety designer has the option of deploying the 2SLP’s programmable safety relay to command the final element. This uncouples the loop from a single point of failure, whether random in the sensor or logic solver (e.g. input module, output module, CPU) or systematic failure owing to misconfiguration of trip or alarm values. Certified Functional Safety Experts assert that the use of this diverse, independent high capacity output strengthens the IPL and provides significant achieved risk reduction. The 2SLP’s redundant 4 to 20 mA signal can be used to continuously monitor the process variable allowing the PLC/DCS to compare, vote and execute the safety function if this variable output is preferred.
A third approach uses the 2SLP’s safety relay status output (30 VDC @ 20 mA) which mimics the programmed set point value of the safety relay whether or not the relay is used. Like the relay, this digital output translates PV changes in ~60mS and further diversifies coverage. These simple, cost effective, efficient and secure digital outputs, integrated with analog I/O, make it easy to add strength to voting mechanisms for both risk reduction and availability.

V. Post PHA - Improvement and Compliance of SIFs
Safety designers have observed that the 2SLP is unique in that it provides evergreen options for improving and validating a safety critical loop after a PHA and LOPA determine more risk reduction is required. Front-end choices for optimizing device selection that include consideration of new certified devices like the 2SLP can lead to significant reduction in total cost and minimizing the chance of regret costs from traditional approaches and recipes.

A TÜV certified safety expert provided this example: Let us assume a process pressure transmitter was installed several years ago in a Greenfield project to provide an interlock for a pump or compressor. The 4 to 20 mA output was deployed to execute a shutdown of the pump through a remote logic solver. An updated PHA and LOPA now determine that more risk reduction is required to maintain the SIF as compliant, primarily because of process safety time constraints with the current control architecture and the risk of loss of containment. The current output from the process transmitter and associated processing time of >1 second is not satisfactory for protecting the pump. The EP designer looks for options and determines a new safety system using certified components in closer proximity to the pump, may be the only way to achieve the SIL. The decision involves a significant cost of installing a certified PLC, certified process transmitter, stainless steel cabinet, sub-panel, wiring and programing costs.

The 2SLP Safety Transmitter with embedded safety relay solves this challenge at fraction of the cost. The 12-250 VAC @ 5.0 A relay is interfaced with the start/stop circuit of the MCC to protect the pump in 60 ms. The device’s 4-20mA output monitors the safety function remotely, just as before. Had the 2SLP been deployed originally, this current fix would have involved simply pulling an additional pair of wires to the certified safety relay for bringing the loop back into compliance. Optimizing device selection for Greenfield projects should consider this new technology with multiple certified analog and discrete output capability.

VII. Approved Dual Seal
The 2SLP has an option for a secondary process seal for preventing media from entering the enclosure and conduit system in the event that the primary (sensor) seal is breached. This meets the optional process connection requirements of ANSI/ISA 12.27.01 & NEC 501.17, now strictly enforced in Canada and parts of the US and Europe. This seal is all stainless for process compatibility, and has an articulating, threaded collection port. The burst pressure rating far exceeds the operating and over range pressures for maximum safety and dual seal certification. This optional sensor is NOT a traditional filled (Type A) diaphragm seal, but a hermetically sealed pass-through integral to the standard 2SLP process connection. (See drawings on page 7.)
VIII. SIL Verification Summary Involving Digital Outputs

Newer technology that embeds a certified digital output or outputs into a pressure or temperature transmitter has revolutionized the potential value for rapidly improving thousands of process safeguards from a compliance and cost standpoint. Evidence for this is shown in the results of a SIL verification summary conducted by exida\(^3\) which challenges the traditional recipe of near total reliance on generic or even certified process transmitters in safety control, alarm and interlock functions including SIS. This verification summary modeled four unique pressure measurement devices in a high pressure protection SIF, measuring steam pressure in the boiler output header and opening a vent valve if the pressure exceeded set point. The instrumentation
modeled included  

- a) Generic Process Transmitter  
- b) Certified Process Transmitter, SIL 2, SC3  
- c) Safety Switch, SIL 1, with programmable digital MOSFET output  
- d) Generic Process Switch, Type A.

The results of the SIL verification summary were as follows: The programmable Safety Switch (c) provided **more than twice the achieved risk reduction (RRF)** when compared with the generic process transmitter (a). It also achieved more RRF than the certified SIL 2 (SC3) process transmitter (b).

The exida study also evaluated the devices for spurious trip behavior and found the digital sensor had a longer Mean Time to Failure Spurious (MTTFS) than all of the other devices. New, advanced technology SIL capable devices providing digital outputs, or combination analog and digital outputs, have a critical role to play in cost-effective improvement of safety instrumented systems and other process safeguards.

**IX. ASME VC, Section 1**

UE can provide declaration of conformity to ASME VC, Section 1 and related EN norms. These declarations pertain to Maximum Allowable Working Pressure (MAWP) including paragraph PG-22. A complete list of ZSLP product certifications & approvals can be viewed and downloaded at the following link:  


Other declarations of conformance may be available specific to ‘s requirements.
X. Reducing complexity by eliminating trip amplifiers and interposing relays

This drawing was supplied by an EP who recommended the 2SLP for replacing a trip amplifier and interposing relay in a safety critical loop at a major North American refinery. Because of common cause, two inputs from the same device would NOT be used to increase hardware fault tolerance to achieve higher SIL. But the Safety Transmitter gives designers the flexibility of selecting a primary analog or digital output, and deploying the second one for redundancy of control or monitoring, is a unique attribute of the Safety Transmitter.

1. Legacy process transmitters are more reliable than process switches, so they are often specified along with trip amplifiers for upgrading critical loops. But this architecture invites complexity in added equipment, wiring, programming and validation.

2. Trip amplifiers take the analog output from the process transmitter and provide a discrete output to a final element. A compliant loop requires the process output and the diagnostic outputs to be wired in series be monitored.

3. A redundant 24 VDC power supply is located at a panel. This is required if 24 VDC is used for relays, trip amplifier, lamp, etc. Otherwise 110 VAC can be trip amplifier supply.

5. The 2SLP Safety Transmitter eliminates the trip amplifier, interposing relay and associated wiring. It can simplify programming. Analog loop power excites all outputs on the 2 SPL. Alternatively, the device can be powered externally on 24 VDC for use of digital/discrete outputs only.

4. An interposing safety relay interfaces the digital output from the trip amplifier with the final element, usually a solenoid actuated valve (SOV).
UE Comment on Security Misconfiguration
Security misconfiguration is one of the Top 5 most common security vulnerabilities and the most dangerous according to InfoSec, a leading institute of cyber security experts. HART enabled process transmitters pose a possible vector for a cyber-attack, but the more serious threat arises from unintentional or intentional configuration changes from friendly personnel or anonymous inside actors where the device is found to be unsecure. The 2SLP is designed to address this systematic stress in four ways:

- Device is password protected.
- Outputs are unidirectional.
- Device is always in secure, failsafe mode.
- All outputs fault to a single, pre-determined failsafe state; ≤3.6mA for current output; open state for digital outputs.

Typical process transmitters require configuration of security and alarm settings. Failure to manage these change can endanger the plant, equipment or personnel. **The UE device requires no security or alarm configuration.** All outputs fault to a pre-determined safe state. The 2SLP has the unique characteristic of being designed without bi-directional communication, so that parameter changes cannot be made remotely or with a handheld communicator, though the device is easily programmed in under two minutes by authorized O&M personnel. Fault annunciation, likewise, is not configurable, but automatic. This diminishes the risk of misconfiguration or mismatches with the central logic solver. For example, certified process transmitters may have as many as four sets of fault saturation alarm parameters which adds to the potential for human error. It complicates and may jeopardize the operability of the SIF.
Optimizing Device Selection – Cost Modeling

Optimizing device selection means making the most effective use of new or available technology to drive improvement in safety and cost. The process of optimization is easier and more sustainable with certified products, because presumably the devices meet minimum safety and reliability criteria wherever process safeguards are needed in the plant. Comparing device attributes and total cost can be viewed with clarity. For your worldwide projects, those considerations and priorities likely include:

- Compliance to IEC 61511 or ISA 84.00.01
- MOC
- Understanding and consideration of new technology to drive improvement and lower cost
- Ease of integration and commissioning
- Minimum turnaround time
- Cost reduction
- Maintainability
- Handover documentation

New procurement specifications can help to differentiate new technology from legacy technology so that project teams can leverage the desired and expected improvements from EPS, MACs and supplier OEMs. Without this new specification mindset that differentiates newer technology, significant improvement may not be possible, compliance more difficult, and regret costs more likely.

Table 1 illustrates a legacy, benchmark specification for a certified SIL 2 (SC 3) in-line process pressure transmitter using a pre-selected set of critical specifications including standard accuracies, stability and communication protocol. Hypothetical project quantities and alliance pricing are shown with cost scaling to Total Spend.

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Base Cost - “Benchmark” Legacy Specification for In-Line Process Pressure Transmitter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Procurement Specification</td>
<td>Certificate</td>
</tr>
<tr>
<td>Process Transmitter</td>
<td>SIL 2 (SC3)</td>
</tr>
<tr>
<td>Cost Δ - Percentage and ($US)</td>
<td>100%</td>
</tr>
<tr>
<td>1. Assumed alliance pricing</td>
<td></td>
</tr>
</tbody>
</table>
Table 2 offers a base unit cost comparison between the benchmark legacy specification and a new specification called “Safety Transmitter” shown in green. The critical differentiators in the new procurement spec are provided to assist a given project team thru FEED, and ultimately help site engineers optimize device selection. The ideal time for this may be following a PHA and LOPA where new demands for risk reduction may surface.

Optimizing device selection and improvement does not imply wholesale replacement of legacy process transmitters or other devices. But it should require consideration of new devices which can leverage significant improvement. PHA, LOPA, turnaround demands, budget, site specific considerations (e.g. O&M personnel) inform which of these two specifications shown below or mix thereof, are most appropriate for helping compliance of the SIF and meeting overall project objectives, technically and commercially. Strategies can involve adding devices with higher diagnostic coverage, addressing process safety time constraints, integrating or reusing discrete I/O to reduce cost and complexity, deploying hard-wired trips to improve availability calculations, immunizing devices from security risks, mitigating dangers from unintended or unauthorized configuration changes, eliminating complexity for the benefit of the available O&M resources, adding diversity for common cause avoidance and more.

<table>
<thead>
<tr>
<th>Table 2</th>
<th>Base Cost Comparison – “Benchmark” Legacy Specification vs New Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Procurement Specification</strong></td>
<td><strong>Certificate</strong></td>
</tr>
<tr>
<td>Process Transmitter</td>
<td>SIL 2 (SC3)</td>
</tr>
<tr>
<td><strong>Accuracy</strong></td>
<td>Equal or better than ±0.1%</td>
</tr>
<tr>
<td><strong>Stability/Year</strong></td>
<td>±0.20%</td>
</tr>
<tr>
<td><strong>Communication</strong></td>
<td>Bi-directional</td>
</tr>
<tr>
<td><strong>Supplier</strong></td>
<td>Emerson Rosemount</td>
</tr>
<tr>
<td><strong>Project Quantity Basis</strong></td>
<td>100</td>
</tr>
<tr>
<td><strong>Base Unit Cost</strong></td>
<td>1500²</td>
</tr>
<tr>
<td><strong>Total spend</strong></td>
<td>+150,000</td>
</tr>
<tr>
<td><strong>Is procurement spec drafted and in use?</strong></td>
<td>Yes</td>
</tr>
<tr>
<td>Safety Transmitter</td>
<td>SIL 2 (SC3)</td>
</tr>
<tr>
<td><strong>Accuracy</strong></td>
<td>Equal or better than ±0.5%</td>
</tr>
<tr>
<td><strong>Stability/Year</strong></td>
<td>±0.25%</td>
</tr>
<tr>
<td><strong>Communication</strong></td>
<td>Uni-directional</td>
</tr>
<tr>
<td><strong>Supplier</strong></td>
<td>United Electric</td>
</tr>
<tr>
<td><strong>Project Quantity Basis</strong></td>
<td>100</td>
</tr>
<tr>
<td><strong>Base Unit Cost</strong></td>
<td>795²</td>
</tr>
<tr>
<td><strong>Total spend</strong></td>
<td>+79,500</td>
</tr>
<tr>
<td><strong>Is procurement spec drafted and in use?</strong></td>
<td>No</td>
</tr>
</tbody>
</table>

Cost Δ – Percentage & $ US  
1. Assumed alliance pricing  
2. Published list price, 8/14
Assuming technical compliance, time-sensitive scheduling and cost are important priorities, Table 3 illustrates a hypothetical project involving (100) transmitters with a high level of participation (75%) using the new 2SLP Safety Transmitter specification and scaling back deployment of a more expensive process transmitter (25%). The intention is not simply to cut cost, but to **optimize the device selection** based upon a review of requirements and demands, and using available new technology specification to leverage significant improvement.

<table>
<thead>
<tr>
<th>Procurement Specification</th>
<th>Certificate</th>
<th>Accuracy</th>
<th>Stability/Year</th>
<th>Communication</th>
<th>Supplier</th>
<th>Percentage participation</th>
<th>Project Quantity</th>
<th>Base unit cost ($US)</th>
<th>Total spend</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process Transmitter</td>
<td>SIL 2 (SC3)</td>
<td>Equal or better than ±0.1%</td>
<td>±0.2%</td>
<td>Bi-directional</td>
<td>Emerson Rosemount</td>
<td>25%</td>
<td>25</td>
<td>1500</td>
<td>+37,500</td>
</tr>
<tr>
<td>2SLP Safety Transmitter</td>
<td>SIL 2 (SC3)</td>
<td>Equal or better than ±0.5%</td>
<td>±0.25%</td>
<td>Uni-directional</td>
<td>United Electric</td>
<td>75%</td>
<td>75</td>
<td>795</td>
<td>+59,625</td>
</tr>
</tbody>
</table>

New spend after optimizing device selection and applying new specification 97,125

Original total spend 150,000

Cost Out ∆ -705 -52,875

This scenario above suggests above that the analysis of SIFs or other project objectives (e.g. turnaround time) may demand a higher participation for the new procurement specification and device. The requirements of each SIF and SIS will present differently, and require different responses by the site engineering team. This reality argues favorably for the 2SLP Safety Transmitter because of its flexibility of certified outputs, high diagnostics, embedded logic, speed of response, overall simplicity, and significantly lower unit cost.
Table 4 is the same as Table 3 except with a 50/50 mix of the new to legacy device. This cost modeling nonetheless presents significant cost out of $705 per unit or $35K+ assuming (100) units deployed.

<table>
<thead>
<tr>
<th>Procurement Specification</th>
<th>Certificate</th>
<th>Accuracy</th>
<th>Stability/Year</th>
<th>Communication</th>
<th>Supplier</th>
<th>Percentage participation</th>
<th>Project Quantity</th>
<th>Base unit cost ($US)</th>
<th>Total spend</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process Transmitter</td>
<td>SIL 2 (SC3)</td>
<td>Equal or better than ±0.1%</td>
<td>±0.20%</td>
<td>Bi-directional</td>
<td>Emerson Rosemount</td>
<td>50%</td>
<td>50</td>
<td>1500</td>
<td>75,000</td>
</tr>
<tr>
<td>2SLP Safety Transmitter</td>
<td>SIL 2 (SC3)</td>
<td>Equal or better than ±0.5%</td>
<td>±0.25%</td>
<td>Uni-directional</td>
<td>United Electric</td>
<td>50%</td>
<td>50</td>
<td>795</td>
<td>39,750</td>
</tr>
</tbody>
</table>

New spend after optimizing device selection applying new specification: 114,750

Original total spend: 150,000

Cost Out Δ: -705 - 35,250
Scaling Improvement across Multiple Projects

Table 5 shows the effects of a new procurement specification on reducing costs when scaled across multiple projects. The model assumes a hypothetical 75/25 mix of usage (as in Table 3) which could be called the “realization of a new procurement specification and fully optimized device selection.” The table begins with a partial project involving (25) points and scales up to corporate-wide participation with multiple assets.

<table>
<thead>
<tr>
<th>Total Number of Projects ---→</th>
<th>0.25</th>
<th>0.5</th>
<th>1</th>
<th>5</th>
<th>10</th>
<th>25</th>
<th>50</th>
<th>75</th>
<th>100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total # Points</td>
<td>25</td>
<td>50</td>
<td>100</td>
<td>500</td>
<td>1,000</td>
<td>2,500</td>
<td>5,000</td>
<td>7,500</td>
<td>10,000</td>
</tr>
<tr>
<td>Legacy &quot;cost out&quot;</td>
<td>-28,125</td>
<td>-56,250</td>
<td>-112,500</td>
<td>-187,500</td>
<td>-375,000</td>
<td>-937,500</td>
<td>-1,875,000</td>
<td>-2,812,500</td>
<td>-3,750,000</td>
</tr>
<tr>
<td>New specification &quot;cost in&quot;</td>
<td>+14,906</td>
<td>+29,813</td>
<td>+59,625</td>
<td>+298,125</td>
<td>+596,250</td>
<td>+1,490,625</td>
<td>+2,981,250</td>
<td>+4,471,875</td>
<td>+5,962,500</td>
</tr>
<tr>
<td>New cost w/ optimized device selection realized</td>
<td>24,281</td>
<td>48,563</td>
<td>97,125</td>
<td>485,625</td>
<td>971,250</td>
<td>2,428,125</td>
<td>4,856,250</td>
<td>7,284,375</td>
<td>9,712,500</td>
</tr>
<tr>
<td>Original unimproved cost</td>
<td>37,500</td>
<td>75,000</td>
<td>150,000</td>
<td>750,000</td>
<td>1,500,000</td>
<td>3,750,000</td>
<td>7,500,000</td>
<td>11,250,000</td>
<td>15,000,000</td>
</tr>
<tr>
<td>Net Cost Savings</td>
<td>13,219</td>
<td>26,437</td>
<td>52,875</td>
<td>264,375</td>
<td>528,750</td>
<td>1,321,875</td>
<td>2,643,750</td>
<td>3,965,625</td>
<td>5,287,500</td>
</tr>
</tbody>
</table>
UE summary of optimized device/project criteria

New technology mandates the creation of new commodity classes and procurement specifications. This is part of the critical path to improvement as it allows multiple stakeholders to leverage new technology, whether for one loop, one project or multiple projects. The UE 2SLP is a standardized solution intended to simplify compliance, improve operability, maintainability and safety and to provide of sound way of leveraging improvements in safety and cost. The scope of applications is Brownfield and Greenfield projects in the upstream, midstream and downstream space.

To summarize, the project criteria contemplated for 2SLP are safety controls, alarm and interlocks (SCAI) for pressure and temperature, including Safety Instrumented Systems (SIS) per ANSI/ISA 84.00.01 (IEC 61511, modified.) The 2SLP has also been applied in Safety Related Electrical Controls (SREC) per IEC 62061. In summary, the following project criteria are suggested:

- Where compliance with ANSI/ISA 84.00.01-2004 (IEC 61511 mod.) is required.
- Where standardized devices certified for use in SIL 2 (SC3) safety instrumented functions are desirable or necessary.
- Where device accuracy of ± 0.5% for the 4 to 20mA (NAMUR 43 STD) output signal is safe and acceptable.
- Where simplicity of commissioning, operability and maintainability are high priorities.
- Where deployment of hard-wired trips can improve safety, protect equipment and validate weak IPLs.
- Where bi-directional, HART-enabled communication is neither critical nor desirable for security reasons.
- Where high diagnostic coverage (e.g. SFF > 97%) is required or desired.
- Where more robust Independent Protection Layers (IPLs) are necessary for risk reduction and SIL achievement.
- Where fault tolerant architectures are sensitive to common cause or single point of failure in the PLC/DCS.
- Where diversity is advantageous for avoidance of CCM/CCF avoidance and for minimizing human errors.
- Where process safety time, scan rates or lag time are constraints and could benefit from faster response (< 100mS.)
- Where minimal fault detection time (< 30 seconds) is desirable or necessary (reference updated IEC 61511 draft.)
- Where optional deployment of an integral and compliant dual seal per ANSI/ISA 12.27.01 and NEC 501.17 is desirable or needed.
- Where declaration of conformity to ASME VC, Section 1 may be advantageous or mandatory.
- Where Safety Related Electrical Systems (SRES) are being implemented for heavy machinery protection per IEC 62061.
United Electrical proposal summarized:

1. The creation of a new commodity class of SIL capable instrumentation specifically earmarked for functions of safety control, alarm and interlock (SCAI) to include Safety Instrumented Systems (SIS), high integrity pressure protection systems (HIPPS) and related safeguards and equipment per IEC 61508 and ANSI/ISA 84.00.01.

2. The creation of a standardized procurement specification for the aforementioned technology which will invoke the necessary distinction between it and alternative classes of instrumentation including generic and certified process transmitters and process switches.

3. The pre-qualification leading to pre-selection of a supplier or suppliers for this commercialized safety sensor technology and the pre-negotiation of alliance pricing, terms and conditions, and global support functions for the new commodity.

4. Follow-up discussions with site technical and procurement leaders for AVL consideration and engagement on a project-by-project basis.

Conclusion
United Electric Controls Company, a recognized leader in the manufacturer of process switches, transmitters and temperature sensors has successfully commercialized two distinct SIL capable pressure and temperature devices that challenge the default choice of generic or certified process transmitters in safety critical applications. UE is known around the world as a manufacturer of cost effective pressure and temperature controls for alarm, interlock, permissive, trip and emergency shutdown. Designed per the requirements of IEC 61508, ed2, 2010, these instruments serve enhanced and refined protective functions with critical differentiating characteristics including lower cost. Our devices have been designed rather than adapted for safety instrumented systems to offer uncommon flexibility for designers. The results have been easier SIL achievement, significantly reduced total cost, high diagnostic coverage, continuous monitoring and discrete functionality, simple strategic proof testing and overall compliance. As the cost of projects escalates and the need for upgrading process automation and safety systems grow, we propose that you consider creating a new procurement specification recognizing this differentiating technology, so that it may leveraged for improvement in safety, process availability and cost.
Background on United Electric

United Electric Controls Company (UE) is an eighty-year-old privately held manufacturer of pressure and temperature instrumentation including transmitters, process switches and temperature sensors with global approvals. UE is well known as a manufacturer of products for safety critical annunciation, alarm, trip and emergency shutdown. We are one of the leading practitioners in the world of lean, demand-flow manufacturing modeled after the Toyota Production System. Most Acceptable Vendors List (AVL) for process switches include United Electric, but our newer SIL-capable technology requires a widening scope of acceptance for UE so full engagement with our latest technology is possible for your organization.

Product and support is provided directly by our corporation and a network of (78) stocking distributors around the globe. Our Duns # is 001018084 and our U.S. Tax Registration # is 041923170. Additional financial information for qualification purposes can be provided by contacting Brian Hallahan, Comptroller, at the number or email given below.

UE Contacts:
Channing Reis, co-Director, Functional Safety Technologies
617-899-1132
creis@ueonline.com

Scott Pierce, co-Director, Functional Safety Technologies
513-535-5486
spierce@ueonline.com

For Financial statements and related:
Brian Hallahan, Comptroller
bhallahan@ueonline.com
617-321-1140

United Electric Controls Company
P.O. Box 9143
180 Dexter Avenue
Watertown, MA (USA) 02471-9143

The 2SLP Safety Transmitter is manufactured in the USA.
Appendix 1 – Drawings

Figure 1  2SLP Safety Transmitter Pressure
Figure 2 2SLP Safety Transmitter Pressure Differential
Figure 3  2SLP Safety Transmitter Remote Temperature
Figure 4  2SLP Safety Transmitter Local Temperature
Figure 5  2SLP Safety Transmitter Spring loaded temperature)
Appendix 2 - Standardized Handover Documentation

Safety Documents
- exida certificate
- FMEDA
- Functional Safety Assessment

Product Documentation
- 2SLP Safety Transmitter Overview Bulletin
- Product Certifications & Approvals
  http://www.ueonline.com/one_series_st_certs.html
- Product Manual
  http://www.ueonline.com/techinfo/im_one_st.pdf
- Safety Manual
- Dual Seal Option
  http://www.ueonline.com/techinfo/im_one_ds.pdf

Drawings
- 2SLP Pressure
- 2SLP Pressure Differential
- 2SLP Temperature Local
- 2SLP Temperature Local Spring Loaded
- 2SLP Temperature Remote
End notes and references


3 SIL Verification Summary, One Series in High Pressure Protection SIF, exida Contract No. UEC 08/04-43 Report No.: UEC 08-04-43 R001 Version V1, Revision R1, December 15, 2008
   http://www.ueonline.com/whatnew/one_series_sil_verification.pdf