

The objectives of NeSSI are to:

- Facilitate the acceptance and implementation of miniature, modular sample systems based on semiconductor (SEMI standard) work and the ISA² SP76 'draft' standard.
- Promote the concept of small rugged, field mounted, at the pipe analytical systems
- Lay the groundwork for "open connectivity" architecture (e.g. Ethernet, Bluetooth™), investigate the use of industry standard protocols such as OPC, Hart, Foundation Fieldbus, Profibus, etc. as well as promote the adoption of web enabled technology.
- Provide a technology bridge or platform to the process for the emerging class of "lab on a chip" analytical sensors
- Promote the concept of "smart" analytical systems by closely integrating flow, pressure and temperature with the analytical (chemical) sensors.

Request for Proposals

In order to ensure that process analytical substrate and component manufacturers were in tune to petrochemical End User needs a request for "typical" sample systems was made at an *ad hoc* meeting during a forum at Pittcon 2000. Out of this originated six typical sample designs, which cover a gamut of process sampling systems including liquid and vapor systems, multi-stream measurement systems, low-pressure measurements, sample vaporization, as well as toxic handling sampling systems. From the meeting at Pittcon 2000 also came the Analysis Function Block Matrix outlining the components required for a substrate as well as a method for the classification and organization of an analytical system. Additionally a model describing the criteria for a Smart Sample System was formulated.

These six candidate drawings, as well as the models for the Analysis Function Block Matrix and the Smart Sample System, were sent out to the NeSSI mail out list. Substrate manufacturers were invited to design prototype models of these candidate drawings using their modular components. In the same mail out interested parties were also invited to:

- Submit electrical and interface drawings
- Provide a functional description of the design
- Propose an electrical bus structure for sample/analytical sensors
- Propose ideas to standardize the software protocol interface
- Describe compliance and non-compliance to ISA SP76 standard as well as comments with respect to barriers for implementing this technology.

Response to Request for Proposals

Three manufacturers of substrates responded in various degrees of completeness to our proposals. Swagelok provided a very comprehensive multi-page proposal fully interpreting the NeSSI candidate drawings. Swagelok's proposal is built on their Lego® block style IGC II patented technology. IGC II allows the building of miniature systems from small component parts held together by an endoskeleton of aluminum. Currently they employ 'C' style metallic seals, but plan to introduce elastomeric seals at some point in the future. Their design is built on 3-channel with standard 1.5" blocks. Swagelok also demonstrated an interesting engineering design package. Using this package a design engineer can design a complete system and generate a bill of materials in a matter of minutes. Their design is compliant with SP76. Swagelok has several components suitable for mounting on the manifold. These by and large, however, are manual or pneumatic operated and they currently have no explosion-proof electrical components.

Parker-Hannifin's response was essentially a hybrid – combining certain elements of modular construction coupled with more traditional block and tube practices. Although compliant with SP76, Parker-Hannifin introduced some "twists" including the introduction of 5 channels as well as the introduction of the 2.25" block in addition to the SP76 standard 1.5" block. Each block is held together by a novel connection method which allows a high degree of fabrication flexibility. The 5 channels allow the introduction of heating fluids and signal air to the substrate. In addition channels between subsequent blocks can be isolated and by this means increase the flexibility of the modular system. The Parker-Hannifin system uses elastomer seals. Parker's Veriflo division has several

² ISA = The Instrumentation, Systems and Automation Society

components suitable for mounting on the manifold. Like Swagelok most of Parker-Hannifin's components are manual or pneumatic operated again with few explosion proof components.

Autoflow submitted a fully compliant SP76 model. They are the pioneers in this field and are using elastomeric as well as spring-loaded elastomeric seals. Again they use 1.5" blocks and 3-channel construction. Autoflow has given some thought to using explosion proof electrical devices and have devised a Division 1 cartridge heating system. They have some flow measuring and other components rated for classified areas.

All three vendors have actual, working products and some are available commercially.

Rosemount's response to the proposal demonstrated the synergy and collaboration that is an example of how the NeSSI can be advanced. They quickly integrated a Swagelok IGC II manifold to their GCX gas chromatography system. They should go on record as having created the first analytical system designed for field installation using modular, miniature components.

ABB Analytical in their response to proposals demonstrated an intuitive Human Machine Interface (HMI) graphical user interface. We suggest that this should be the model for man-machine interaction for analytical sample systems. They have also demonstrated a digital communication system, which allows direct connectivity to the sampling system modules. ABB Analytical partnered with Autoflow to create an At-Line system. They demonstrated that they could reduce the volume of component space by greater than five times by employing the miniature, modular concept! ABB Analytical has also done a cost study between standard "block and tube" systems compared to "miniature/modular" systems. Their studies indicate that even in the infancy of this technology the miniature, modular systems are cheaper to design and fabricate.

Certain manufacturers, as well as the substrate manufacturers, have submitted a list of components, which can be mounted on an ISA SP76 compliant manifold. They manufacturers include Tescom and Circor Group of Companies who represent the Circle Seal, Go and Hoke line of products. These components include filters, regulators, actuators, manual valves, and many other components.

Several companies submitted valuable comments and critiques. These collective comments have helped us define our next steps. The needs identified include a desire to:

- Adopt Division (Zone) 1 Groups A-D rating to the complete substrate and components
- Provide a sample system engineering software tool for ease of design
- Have flexible plug and play capability to allow maintenance friendly hot-swapping and account for nuances associated with handling various chemical processes
- Provide abilities to provide parallel systems not just long, linear manifolds
- Provide "elegant", miniature low flow devices for gas and liquid
- Provide electrical actuated valves – either solenoid or motorized – in addition to pneumatics
- Address sample system bus electrical signal connectivity, power distribution and heating mechanism
- Standardize on connectivity methodologies.
- Provide digital sensors for the substrate in order to do complete diagnostics and move to a Smart sample System design
- Provide a list of available components and form factors for the component manufacturers to design from.
- Think global.

Next Steps

Based on comments originating from the NeSSI the thrust for 2001 will be to "electrify" the manifold. To that end we will begin during Pittcon 2001 to develop plans to bring power, heat and signal to/from the manifold. We also intend to provide some means of communicating and cataloguing available components for this effort by means of a web page to made available at the CPAC site. We also will develop a "roadmap" for this initiative. Finally we will encourage physical and analytical sensor manufacturers to develop products for the substrate by means of technical workshops.

Summary

The request for proposals demonstrates that 3 vendors – Autoflow, Parker-Hannifin and Swagelok - can provide commercially available substrates – and generally to the SP76 guidelines. These manufacturers as well as others such as Tescom, Circor, and Fujikin among others can provide a wide range of substrate mounted components. Analyzer manufacturers such as Rosemount and ABB Analytical are currently very active in the integration of miniature, modular systems into their product lines. This being said the true value of the miniature, modular manifolds will emerge only when electrical systems and “smarts” are integrated into the sample system. The work to date is very encouraging. The mechanical aspect of miniature, modular systems should now be considered well along, if not complete in certain cases, on the development path.