Overview of Analyzer Integration Capabilities

- Feed Studies
- Detail Engineering & Design
- Built to Spec
- Integrated Testing & FAT
- Data Management
- Power Distribution
- Safety Systems
- Shelters
- Sample Systems
- Site Services

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40,100 ft² Facility in Coldspring, Texas

- 17500 ft² Environmentally controlled work shop space
- 8000 ft² Environmentally controlled material management warehouse
- 9600 ft² Additional secured shop/fabrication/storage space
- 5000 ft² Office Space

Wide array of utilities available

- 480/277/208/120 VAC voltage available
- Instrument Air
- Low volume/pressure steam
- Chilled water

Longest Operating Analytical System Integrator in the World
Expert execution of both large program projects as well as small end-user upgrades

**Largest Project to Date:** SADARA $112M
- 68 Shelters
- 100 Field Cabinets
- 150 Field Racks
- >300 Process Analyzers
- Single program project though 12 EPCs

**Other Key Projects:**
- Freeport LNG - Texas
- Shintech – Louisiana
- Formosa Plastics – Texas
- North West Redwater Refinery, Canada
Role of a Analyzer Systems Integrator

Provide a safe, reliable, and maintainable analytical solution on time and on budget.
Role of a Analyzer Systems Integration Package

Protect analytical investment
- Analyzer reliability and measurement precision often depends on stable climate conditions
- Sample conditioning often needed for proper analyzer operation

Provide safe operating environment
- Not all analyzers designed for hazardous locations
- Process samples could pose risk to technician and equipment.
- Utility and Support gases pose risk to technician and equipment

Collect and distribute analytical and maintenance data
- Modern analyzers generate large amounts of data
- Discrete signal and networking wiring needs to be routed to common data junction boxes
- Fiber optic patch panels for transmission of large amounts of data
The Complete System

Analyzer Shelter

- Sample Conditioning
- Stream Switching
- Analyzer Calibration
- Analyzer
- Sample Effluent Disposal
- Calibration Sample
- Utilities
- Process Return
- Process Supply
- Sample Extraction
- Sample Transport
- Bypass Return
- Fast Loop Bypass

Process Monitoring & Control

Data Handling System

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Sample Handling System: The SHS includes portions of the process itself, the sample nozzle and probe, the sample transport system, the sample conditioning system, the fluid pathway through the analyzer and the sample disposal facilities.

Sample Conditioning: The part of the sample handling system that conditions the sample to be compatible with the analyzer requirements.
Sample Conditioning System Engineering must ensure:

- * Sample to analyzer is representative of process

- * Sample to analyzer allows for timely response – **Response**: Time for change in process is recognized by analyzer

- * Control the sample pressure, temperature, and flow rate, reduce particulate, to comply with analyzer specified constraints

- * Preserve the gas phase or liquid phase – prevent mixed phase sample

- * Sample system is safe to operate and maintain
Sample Conditioning System Engineering must ensure:

- Adheres to relevant codes and regulations, NFPA, NEC, Seismic, Wind Loads, etc..

- Sample system components are compatible with potential sample compounds

- Use of suitable materials that do not allow reaction, permeation, or absorption to change the sample composition
Considerations for Shelter Construction Selection

- Ambient Condition Considerations
- Site Corrosive Atmosphere Considerations
- Weight and Size for civil considerations
- State and Government design requirements

Shelter Layout

◆ Maximize accessibility while minimizing costs
◆ Consideration for future growth and maintainability

Sample Systems

◆ Custom engineered for each application with consideration to client specification and process stream data

Wiring / cable management

◆ Conduit (NEC)
◆ Armored Cable (NEC 505 / IEC)
◆ Data and signal wiring including Ethernet and Fiber Optic

Rain shields

◆ Covering sample systems and bottles for UV and weather protection
Examples of Shelter Construction
Considerations for Extreme Climate Conditions

Extreme heat (Saudi Arabia)
- A/C sizing
- Dual A/C systems
- Equipment must be rated for 60-65°C if no A/C

Extreme cold (Canada / Russia)
- Added insulation including floor
- Gas bottles mounted inside or in heated external cabinets
- Split shelter (one side for analyzers – one for SCS)

Offshore platforms
- Severe Corrosive Exposure (materials of construction)
- Size of shelter limitations (cabinets)
Safety in Design Considerations

- Electrical components and installation methods are accepted by regulatory codes. NEC, NFPA, IEC, ATX, CEC.

- Hazardous Location installations

- Design and construction allows for safe maintenance of the packaged equipment.

- Sample and utility gases can pose risk to personnel and equipment. Design risk elimination and or mitigation and alarm systems.

- Consider interior of sample system enclosures as Div 1 areas where flammable samples are present without adequate ventilation.

  * NEC 500.5 (B) 1.2.3.
Hazardous Area Classifications

- Determined by the end-user *
  - Based on their corporate safety guidelines

- Major Standards
  - NFPA (U.S.)
  - CSA (Canada)
  - ATEX (Europe)
  - IECEx (Emerging Global Standard)

- Local Certification
  - Paid certification by local agency representative
  - Used for non-certified equipment
Overview of Hazardous Area Classifications

- Severity and nature of the hazardous conditions are defined by NFPA
  - Class 1: Flammable gases and vapors
  - Class 2: Flammable dust (e.g., coal bin dust)
  - Class 3: Flammable fibers (e.g., textile industry)

- Likelihood of hazardous condition is also defined
  - General Purpose: little to no possibility of hazard
  - Division II: possibility of hazard only under abnormal conditions
  - Division I: hazardous conditions are always or very likely present

- Chemical Group ratings
  - Group rating defines the chemicals that can be present
  - Groups C and D are typical hydrocarbons
  - Groups A (acetylene) and B (hydrogen) are expensive to meet

- Similar (but not exact) structure exists for ATEX
  - Zones instead of Divisions, etc.

- Temperature Rating (T-Rating) may also be an issue
  - Rates maximum skin temperatures to avoid combustion source
  - T1: 842°F to T6: 185°F
Safety System Design

- Safety systems monitor the conditions inside the shelter
  - Combustible analyzers
  - Toxic gas sensors (H₂S, etc)
  - Oxygen deficiency analyzers
    - Common when plant nitrogen used by analyzers
- Consider mounting locations and quantity for complete safety
- Warning lights, horns, actions
  - Contact signal to DCS
  - Annunciator panel to advise condition before entry to enclosure
  - Emergency ventilation for toxic or O₂ deficiency event
  - Sample shut off action for toxic or LEL event
One of the most expensive elements of a shelter system

Proper sizing requires calculation of the heat loading

- Summation of the wattage of equipment inside
- Avoid maximum wattage vs normal operation wattage

A/C system may also provide the shelter ventilation and purging
Shelter Utilities

- **Power**
  - Wattage and phase of power
  - Breaker Boxes and Junction Boxes
    - Sizing and location
  - Separate conduit for power and data signals
  - UPS systems
  - Shut off switches for each major device
    - Maintenance convenience

- **Instrument Air**
  - For analyzer operation like GCs
  - For purging of analyzer electronics
  - Confirm pressure requirements; especially if vortex coolers are involved

- **Plant Nitrogen**
  - May require oxygen deficiency monitors

- **Steam / Water**

- **Future expansion requirements**

- **Calibration and support gases**
Header and Manifold Systems

- Simplifies plumbing throughout the shelter
- Shared gas / utilities
  - Air / Steam
  - GC carrier gas
- Waste recovery headers
  - GC vent gases (need to be atmospheric pressure)
  - Check valves if tying into process (such as flare)
- Liquid recovery systems
  - Storage tank
  - Return pumps
Wall vs Rack vs Floor mounting
- Choice may dictate need for a floor
- Check manufacturer for requirements for side or back access

Allow space between analyzers for wiring and plumbing and maintenance access
- 12 – 18 inches typical

Consider height and its impact on maintenance personnel
Data Transmission

- Data signal junction boxes
- Separated from power conduits (analog signals especially)
  - Concern about power noise being picked up by the analog lines
- Ethernet connection considerations
  - Most analyzers now utilizing Ethernet
  - RJ-45 copper wiring vs fiber inside shelter
  - Fiber optics allow for tremendous data transmission.
Project Management

- **Documentation**
  - Can be difficult to control due to wide diversity of hardware suppliers
    - Made even worse if analyzer and shelter supplier are not the same
  - Approval drawing cycles
  - When will “as built” documentation be available

- **Factory Acceptance Tests**
  - Analyzers at analyzer manufacturer vs inside shelter

- **Shipping**
  - Shelter crating (the forgotten cost)
  - Shelters wider than 12’
  - Overseas shipping
Examples of Analyzer Integration
Examples of Analyzer Integration
Examples of Analyzer Integration
Examples Of Integration Types
Unparalleled Experience

Longest Operating Analytical System Integrator in the World

- 300+ combined man-years of analytical system engineering and project management experience currently on staff

- 450+ combined man-years of analytical system integration craftsmen
  - PMP Certified Project Managers
  - Certified PROFESSIONAL ENGINEER (Electrical) having experience in large and small power distribution design
  - Analyzer / Instrument / Tubing NCCER Craftsmen
  - Electrical Integration NCCER Craftsmen
    - Experienced in NEC, IEC, and CEC installation requirements.
  - 4 State Licensed Electricians
  - 1 Master Electrician
ISO 9001 : 2015 Certified Project Execution Procedures

- Project Management
- Engineering and Design Execution
- Interface Management
- Document Control
- Quality Assurance
- Safety
- Progress / Schedule Tracking and Reporting
Project Schedule Control

- Standard Project Schedule (Customize as needed)
- MS Project Typical (Primavera if required)
- Typical Project Milestones
  - Kickoff Meeting with Customer
  - Drawing Package / Specifications Submitted for Approval
  - Drawing Package / Specifications Submitted for Construction
  - Purchase of Major Equipment
  - Complex Analyzers FAT (Factory Acceptance Testing)
  - Receipt of Major Equipment
  - Production Start and Finish
  - Internal Testing
  - Customer FAT
  - Shipment
  - Final Documentation Submittal
Project Quality Gates

- Project Execution Quality Gates with Check Lists
  - Project Kickoff
  - Basic Design
  - Detail Design
  - Fabrication and Assembly
  - Internal Testing
  - FAT / Customer Witness Testing
  - Project Shipment
  - Project Transfer to Service
Analytical Support & Service, Freeport, TX

- Complete Service and Support for any analyzer systems
- Spare parts, service procurement, packaging, and shipment
- Field supervision of analyzer systems installation
- Pre-startup and calibration of process analyzers
- Commissioning of analyzer systems
- On-site trouble shooting of sample systems
- On-site or classroom training
- Maintenance programs available for Yokogawa and 3rd analyzers
- Contracts can be scaled to best fit customer needs