PURPOSE AND USE OF PROCESS INDUSTRY PRACTICES

In an effort to minimize the cost of process industry facilities, this Practice has been prepared from the technical requirements in the existing standards of major industrial users, contractors, or standards organizations. By harmonizing these technical requirements into a single set of Practices, administrative, application, and engineering costs to both the purchaser and the manufacturer should be reduced. While this Practice is expected to incorporate the majority of requirements of most users, individual applications may involve requirements that will be appended to and take precedence over this Practice. Determinations concerning fitness for purpose and particular matters or application of the Practice to particular project or engineering situations should not be made solely on information contained in these materials. The use of trade names from time to time should not be viewed as an expression of preference but rather recognized as normal usage in the trade. Other brands having the same specifications are equally correct and may be substituted for those named. All Practices or guidelines are intended to be consistent with applicable laws and regulations including OSHA requirements. To the extent these Practices or guidelines should conflict with OSHA or other applicable laws or regulations, such laws or regulations must be followed. Consult an appropriate professional before applying or acting on any material contained in or suggested by the Practice.

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1. Introduction

1.1 Purpose

This Practice provides guidelines for the design, specification, purchasing, and installation of process analyzer systems.

1.2 Scope

This Practice describes the guidelines for implementation of process analyzer systems. This requires knowledge, integration, and management of multi-disciplinary engineering skills and resources that may bridge several different organizations. This Practice can be used to assist in assessment and definition of roles and responsibilities for those tasks required for a given project.

2. General References

Applicable parts of the following Practices, industry codes and standards, and references shall be considered an integral part of this Practice. The edition in effect on the date of contract award shall be used, except as otherwise noted. Short titles are used herein where appropriate.

2.1 Process Industry Practices (PIP)

- PIP PCSPA001 - Process Analyzer Project Documentation Data Sheet Instructions
- PIP PCSPA001-D - Process Analyzer Project Documentation Data Sheet
- PIP PCSPA002 - Process Analyzer System Data Sheet Instructions
- PIP PCSPA002-D - Process Analyzer System Data Sheet
- PIP PCSPA003 - Process Analyzer Shelter Data Sheet Instructions
- PIP PCSPA003-D - Process Analyzer Shelter Data Sheet
- PIP PCSPA004 - Process Analyzer Bid Proposal Data Sheet Instructions
- PIP PCSPA004-D - Process Analyzer Bid Proposal Data Sheet

2.2 Industry Codes and Standards

- National Fire Protection Association (NFPA)
  - NFPA 30 - Flammable and Combustibles Liquids Code
  - NFPA 496 - Standards for Purged and Pressurized Enclosures for Electrical Equipment
  - NFPA 497 - Recommended Practice for the Flammable Liquids, Gases, or Vapors and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas
3. **General**

3.1 The implementation of process analyzers can require the participation of only one or several of the following resource groups:

   a. Owner Company personnel
   b. Engineering and Construction contractor(s) (E&C)
   c. Analyzer Systems Vendor (ASV)
   d. Analyzer Original Equipment Manufacturer (OEM)

3.2 Different organizations interact to complete an analyzer project. A typical project includes, but may not be limited to, the following stages:

   a. Conceptual design
   b. Preliminary design
   c. Detailed design
   d. Installation
   e. Commissioning/startup/turnover
   f. Project completion

4. **Tasks and Deliverables**

A brief explanation of the analyzer project activity associated with each of the project stages is defined in this section. Specific analyzer-related tasks and deliverables for each design stage are further detailed for each of the participating organizations.

4.1 **Conceptual Design**

   4.1.1 Develop PFDs and heat and material balance data.
   4.1.2 Develop preliminary of P&IDs.
   4.1.3 Define preliminary analysis performance requirements (e.g., process, regulatory, quality, safety, and control).
   4.1.4 Define and specify acceptable analytical technologies and analysis methods.
   4.1.5 Develop preliminary analysis systems design (e.g., sample systems, sample probes, transport tubing).
   4.1.6 Initiate preparation of process analyzer system data sheets (e.g., *PIP PCSPA002-D*).
   4.1.7 Develop acceptable vendor lists for ASV, analyzer OEM, and system component manufacturers.
4.2 Preliminary Design

4.2.1 During the preliminary phase of a project, PFDs are further refined, the plant layout or general arrangement is defined, and P&IDs are further developed.

4.2.2 Analyzer system requirements are defined during this stage (e.g., sample tap locations, process operating conditions, and specific analysis requirements).

4.2.3 Owner Company and/or E&C Tasks and Deliverables

4.2.3.1 Locate and identify sample point requirements and sample return requirements on P&IDs.

4.2.3.2 Locate and identify laboratory sample stations on P&IDs and provide laboratory sample station requirements.

4.2.3.3 Locate and identify primary and secondary sample conditioning systems by type and size on P&IDs.

4.2.3.4 Supply ASV with a block of instrument loop numbers for identifying instruments on analyzer system P&IDs and other drawings as required.

4.2.3.5 Update P&ID representation of alarm and signal requirements between analyzers, sample systems, and host computer.

4.2.3.6 Prepare flow diagrams for sample systems.

4.2.3.7 Produce drawing representation or written functional description of host computer interface and control functions for any automated sampling, calibration, flushing, inerting operations, and valve sequencing.

4.2.3.8 Specify sample line materials of construction, insulation, and heating requirements.

4.2.3.9 Specify acceptable materials of construction for process-wetted sample-handling components.

4.2.3.10 Specify analyzer calibration/validation method.

4.2.3.11 List available support utilities (e.g., nitrogen, instrument air, electric power, etc).

4.2.3.12 Specify shelter type(s):
   a. Type I - field mounted
   b. Type II - freely ventilated
   c. Type III - climate controlled
   d. Type IV - controlled for area classification reduction

4.2.3.13 Locate process analyzer shelter(s) on plot plan or model.

4.2.3.14 Identify all relevant local and industry standards and certification requirements.

4.2.3.15 Determine materials of construction for analyzer shelters.

4.2.3.16 Identify maintenance support peripherals (e.g., cylinder racks, apron around shelter, walkways, maintenance data highways, etc.).
4.2.3.17 Define electrical area classification for each analyzer location.

4.2.3.18 Update process analyzer system data sheets (e.g., PIP PCSPA002-D).

4.2.3.19 Initiate preparation of process analyzer shelter data sheets (e.g., PIP PCSPA003-D).

4.2.3.20 Request budgetary quotations from ASV and/or OEM.

4.2.3.21 Prepare preliminary process analyzer budgetary cost estimate based on budgetary quotations from ASV and/or OEM.

4.2.4 ASV Tasks and Deliverables
Provide budgetary quotations.

4.2.5 Analyzer OEM Tasks and Deliverables
Provide budgetary quotations.

4.3 Detailed Design

4.3.1 During the detailed design phase of a project, PFDs, plant layout, and P&IDs are finalized.

4.3.2 Analyzer system requirements and specifications are finalized.

4.3.3 Owner Company and/or E&C Tasks and Deliverables

4.3.3.1 Prepare overview document to describe the project scope.

4.3.3.2 Compile all applicable standards, codes, or approved supplier lists that will impact the design, fabrication, and installation of the analyzer systems, including those listed in the references.

4.3.3.3 Provide physical location information for all analyzer sample taps and sample return points. Include physical orientation (vertical vs. horizontal pipe run, nozzle orientation: top vs. side of pipe, etc.), sample probe type (i.e., retractable vs. non-retractable), and accommodate maintenance accessibility.

4.3.3.4 Locate and orient all field-mounted analyzers, pre-conditioning assemblies, analyzer enclosures, analyzer shelter, and cylinder racks to assure maintenance accessibility and tie-in to field piping and utility support.

4.3.3.5 Define interconnection requirements for power, analog/digital, and fiber optic signals for host computer and process field wiring.

4.3.3.6 Based on project requirements, some instruments may be purchased by Owner and/or E&C and drop-shipped to ASV or others (e.g., modifications to meet installation electrical area classification and local electrical codes, sample system integration, etc).

4.3.3.7 Define analyzer system installation, start-up, and commissioning requirements and determine responsible party.

4.3.3.8 Design and provide all sample and sample return line routings and lengths.
4.3.3.9 For Type III and Type IV shelters, design and provide the routing, distance, and support needs for the fresh air intake stack, if required.

4.3.3.10 Design and provide utility support requirements.

4.3.3.11 Complete process analyzer system data sheets (e.g., \textit{PIP PCSPA002-D}).

4.3.3.12 Complete process analyzer shelter data sheets (e.g., \textit{PIP PCSPA003-D}).

4.3.3.13 Prepare and complete process analyzer project documentation requirements (e.g., \textit{PIP PCSPA001-D}).

4.3.3.14 Prepare bid specification(s) for analyzer system project (e.g., \textit{PIP PCSPA004-D}).

4.3.3.15 Request final quotes from ASV and/or OEM.

4.3.3.16 Review ASV bid package, drawings, and specifications.

4.3.3.17 Approve ASV and/or OEM bid packages.

4.3.3.18 Award contract(s) and issue purchase order(s) to ASV and/or OEM for process analyzer systems.

4.3.3.19 Conduct analyzer systems safety review before final approval for fabrication.

4.3.3.20 Approve all documentation including:
   a. Specifications
   b. Drawings
   c. Acceptance test procedures / reports
   d. Inspections
   e. Interfaces/interconnections to other instrumentation or process equipment

4.3.3.21 Participate in Factory Acceptance Tests (FAT) of fabricated analyzer systems.

4.3.3.22 Use Document Control for tracking all manuals, drawings, etc., for the analyzer project.

\textbf{4.3.4 ASV Tasks and Deliverables}

4.3.4.1 Complete and submit bid proposal for process analyzer package in accordance with bid specification(s) for analyzer system.

\textbf{4.3.4.2 Analyzer Shelter}

1. Design, purchase, and fabricate analyzer shelter(s) including:
   a. HVAC
   b. Orientation
   c. Utility connections
d. Location

e. Layout

f. Sizing

g. Mounting and orientation of analyzers

h. Sample probes

i. Sample systems

j. Pre-conditioning assemblies

k. Other supplied accessories in accordance with bid specification, installation criteria, electrical area classification, and any other related project requirements

2. Prepare written specifications for all major equipment and system components that are not being purchased by owner and/or E&C contractor (e.g., HVAC system).

3. Provide shelter pressurization and airflow calculations required to purge for toxic gas, combustible gas, or asphyxiant gas leaks into the interior of the shelter.

4. Design sample return interface including sample recovery systems, vents, drains, process headers, etc.

5. Design for all utility requirements including load and consumption calculations.

6. Design for all cabling requirements.

7. Provide required certifications.

8. Prepare and provide detailed documentation for the installation by the E&C contractor for all analyzer systems shelters and ancillary equipment.

9. If required, provide preliminary drawings for outline and mounting dimensions and interconnections.

4.3.4.3 Analyzer Systems

1. Design and provide calculations for sample line size in accordance with sample loop residence and analyzer response time requirements.

2. Ensure that sample system design includes the following:

   a. Calibration and validation systems with standards as defined on the data sheets

   b. Temperature, pressure, flow indication, and control

   c. Suitable materials of construction to meet process tap and return conditions
3. Design functional details for sample-handling system:
   a. Single vs. multi-point
   b. Differential pressure vs. pumped vs. aspirated sample transport
   c. Fast loop and analyzer flow requirements
   d. Auto vs. manual stream switching
   e. Auto vs. manual calibration and validation

4. Design fabrication details for sample-handling system:
   a. Layout
   b. Mounting and installation considerations

5. Prepare and issue all drawings in accordance with process analyzer project documentation requirements (e.g., PIP PCSPA001-D).

6. Purchase all analyzers not included in owner alliance agreements and associated hardware required to fabricate and mount all analyzer sample system enclosures, shelters, and racks.

7. Fabricate all process analyzers systems, shelters, and racks.

8. Provide all material, test equipment, and personnel to conduct the Factory Acceptance Tests, including calibration gases and standard generators.

9. Host and conduct Factory Acceptance Tests for all process analyzers and associated hardware purchased by the ASV. Provide system test results to owner and E&C contractor.

10. Provide a list of start-up and commissioning spares and a list of spare parts for 2-year operation.

11. Identify any consumable or limited shelf-life items that may require special shipping requirements (e.g., pH electrodes).

4.3.5 **Analyzer OEM(s) Tasks and Deliverables**

4.3.5.1 Provide the process analyzers as defined in accordance with process analyzer system data sheets (e.g., PIP PCSPA002-D).

4.3.5.2 Provide all information, documentation, software, and ancillary equipment as required for a fully operational and functional analyzer.

4.3.5.3 Provide dimensional outline, electrical, and utility interconnection diagrams.

4.3.5.4 Provide all material and personnel to conduct the Analyzer OEM Factory Acceptance Test.

4.4 **Installation**

4.4.1 The E&C contractor or a contractor designated by the owner normally handles the field installation of the analyzer systems.
4.4.2 Owner and/or E&C Tasks and Deliverables

4.4.2.1 Site preparation

4.4.2.2 Install foundations

4.4.2.3 Set major equipment

4.4.2.4 Install analyzer systems, including sample lines

4.4.2.5 In accordance with ASV installation detail drawings, purchase required materials for mounting and installing analyzer shelters and all field-mounted hardware, including sample lines and sample line heat trace termination kits.

4.4.2.6 Connect all interface points (e.g., piping, utilities, electrical, and instrumentation).

4.4.3 ASV Tasks and Deliverables

4.4.3.1 May provide on-site supervision for off-loading and site installation of all analyzers, shelters, or systems, including HVAC ductwork, sample probes, sample lines, and calibration systems in their supply.

4.4.3.2 May provide supervision for termination of field power, signal cabling, connection of all utilities, and mounting of all systems and ancillary equipment.

4.4.3.3 Prepare data books and training program for the operation, calibration, start-up, shutdown, maintenance, troubleshooting, and analyzer system diagnostics of the process analyzer systems, shelters, alarms, and safety systems.

4.5 Commissioning/Start-up/Turnover

4.5.1 Commissioning is the demonstrated operation of the analyzer systems and all associated hardware and software.

4.5.2 Start-up is the demonstrated operation of the analyzer systems with actual process samples.

4.5.3 After successful commissioning, start-up, and a defined period of uninterrupted on-line operation, turnover (or transfer of ownership) of the systems to the owner is completed.

4.5.4 Commissioning, start-up, and turnover typically involves resources from the owner, the E&C contractor, the ASV, and/or the Analyzer OEM.

4.5.5 Owner and/or E&C Contractor Tasks and Deliverables

4.5.5.1 Participate in site start-up and commissioning of all analyzers and ancillary equipment.

4.5.5.2 If specified, issue requisition to ASV and Analyzer OEM to perform on-site start-up, commissioning, and training.
4.5.6 ASV Tasks and Deliverables

4.5.6.1 Provide on-site test procedures and test documentation requirements (e.g., software interfaces, I/O mapping, etc.).

4.5.6.2 Provide start-up and commissioning requirements that refer to all ASV provided equipment analyzers, analyzer shelter, ancillary equipment, etc.

4.5.6.3 Provide on-site training program for owner personnel on operation and maintenance of the equipment, if required.

4.5.7 Analyzer OEM Tasks and Deliverables

4.5.7.1 Provide on-site start-up assistance and training as required.

4.6 Project Completion

4.6.1 The installation, commissioning, and start-up of an analyzer system may require field modifications or changes that can require updates to the project design drawings and documentation.

4.6.2 Project drawings and documentation should be updated to reflect “as-built” condition of the installed systems.

4.6.3 The E&C contractor, ASV, and/or the Analyzer OEM are typically involved in ensuring the accuracy of the “as-builts.”