

Engineering Procedure

SAEP-1624

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Preparation of System Design Documents

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Saudi Aramco DeskTop Standards

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1 Scope

1.1 Application

This Saudi Aramco Engineering Procedure (SAEP) provides instructions for the development and approval of a System Design Document (SDD) for both new and major expansion of process control and automation systems.

Any Process Automation System (PAS), Process Control Systems (PCS), Distributed Control Systems (DCS), Supervisory Control & Data Acquisition Systems (SCADA), combined DCS/SCADA, "Process Computers" and any combination of these items shall fall under the scope of this SAEP, provided that [SAEP-16](#) governs the execution of the project. These systems shall be referred to henceforth as a PAS in this document.

[SAEP-16](#) is applicable for projects in which a) a process automation system is included, and b) overall cost of the system is \$2,000,000 or greater.

1.2 Purpose

The System Design Document (SDD) documents the design basis of the Process Automation System (PAS) and Plant Information Management Systems (PIMS). It is a project-specific engineering document which addresses the system design aspects and supplements design considerations that are project specific normally not covered by Vendor's standard engineering and maintenance manuals.

This document defines the design basis of the architecture, configuration, data bases, hardware, software and communication (both internal and external) aspects of the PAS. It shall provide the basis for the detailed design and integration of the PAS.

The SDD is typically prepared by the Vendor and/or Integrator. It may also be authored by the design engineering contractor if he acts as the integrator.

1.3 Approval and Timing

The SDD is part of the 601 and 602 series of NMRs (Non-Material Requirements) as described in [SAEP-16](#).

This document must be approved by Saudi Aramco prior to any configuration, software development and assembly of equipment.

It shall be issued prior to mechanical completion as an "as-built" document as a key reference for system and control engineers. It shall provide accurate and sufficient detail as the key document for future modifications and expansions.

2 Conflicts and Deviations

- 2.1 Any conflicts between this Procedure and other applicable Saudi Aramco Engineering Procedures (SAEPs), Saudi Aramco Engineering Standards (SAESs), Saudi Aramco Materials System Specifications (SAMSSs), Saudi
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Aramco Standard Drawings (SASDs), or industry standards, codes, and forms shall be resolved in writing by the Company or Buyer Representative through the Manager, Process & Control Systems Department of Saudi Aramco, Dhahran.

- 2.2 Direct all requests to deviate from this Procedure in writing to the Company or Buyer Representative, who shall follow internal company procedure [SAEP-302](#) and forward such requests to the Manager, Process & Control Systems Department of Saudi Aramco, Dhahran.

3 Applicable Documents, Acronyms and Definitions

3.1 Applicable Documents

All referenced Procedures, Standards, Specifications, Codes, Forms, Drawings, and similar material or equipment supplied shall be considered part of this Procedure to the extent specified herein and shall be of the latest issue (including all revisions, addenda, and supplements) unless stated otherwise.

Saudi Aramco Engineering Procedures

[SAEP-16](#)

Project Execution Guide for Process Automation Systems

[SAEP-302](#)

Instructions for Obtaining a Waiver of a Mandatory Saudi Aramco Engineering Requirement

Saudi Aramco Engineering Standards

[SAES-J-003](#)

Instrumentation - Basic Design Criteria

[SAES-Z-001](#)

Process Control Systems

Saudi Aramco Materials System Specification

[23-SAMSS-010](#)

Distributed Control Systems (Material System Specification)

3.2 Acronyms

DCS	Distributed Control System
ESD	Emergency Shutdown System
FSD	Functional Specification Document
LAN	Local Area Network
MIS	Management Information System
NMR	Non-Material Requirements
P&CSD	Process & Control Systems Department

PAS	Process Automation System
PIMS	Plant Information Management System
SAEP	Saudi Aramco Engineering Procedure
SAMSS	Saudi Aramco Material System Specification
SAPMT	Saudi Aramco Project Management Team
SCADA	Supervisory Control and Data Acquisition
WAN	Wide Area Network

3.3 Definitions

In general, the definition sections of [23-SAMSS-010](#) and [SAES-Z-001](#) apply.

Auxiliary System: A control and/or monitoring system that is stand-alone, performs a specialized task, and communicates to the main control system for monitoring and operator control. Examples are ESD, Compressor Control, Rotating Machinery protection, process analyzers network.

Operating Organization: The department responsible for operating the facility, usually referred to as the "Proponent".

4 Responsibilities

This section defines the responsibilities of the parties involved in the execution of a PAS that is governed by [SAEP-16](#).

4.1 Saudi Aramco Project Management Team

- a. Maintain overall responsibility for the SDD.
- b. Initiate and coordinate the formal review of the SDD.
- c. Review and approve the SDD document.

4.2 Operating Organization

- a. Assign one responsible engineer to supply the detailed information required for the SDD.
- b. Review and approve the SDD document.

4.3 Process Control Systems Division

Provide technical consulting as requested to the Operating Organization and SAPMT.

4.4 Vendor/Contractor

It is the Vendor/Contractor's sole responsibility to prepare this SDD and ensure compliance with all applicable Functional Specification Documents (FSD),

SAES's and SAMSS's including [SAES-J-003](#), [SAES-Z-001](#) and [23-SAMSS-010](#).

5 Instructions

- 5.1 The System Design Document (SDD) contains the design narratives and all essential design considerations. It is intended as a high level design document to establish the overall design philosophy of the PAS and PIMS for process facilities.
 - 5.2 The SDD shall consist of the following sections as shown in Appendix 1. State "Not Applicable" if a section does not apply to the system in question. All drawings, calculations and supporting detailed discussions and documents shall be included as appendices.
 - 5.3 Interfaces to auxiliary systems (such as emergency shutdown, boiler control, machine control and machinery protection) and external systems such as PIMS, MIS, Intranet and Internet are considered areas of prime importance and must be thoroughly documented.
 - 5.4 Network design is also considered an area of prime importance, especially when the PAS is integrated to other LANs and WANs. Provide definition with a conceptual drawing delineating the boundaries of the control network, the LAN and the WAN. Unless otherwise defined, the LAN shall be defined as an office environment inside the process facility which is multi-purpose including e-mail (both internal and via Internet); the WAN shall be defined as other Saudi Aramco cluster(s) of LANs outside the process facility.
 - 5.5 The following provides a general format and table of content for the SDD.
 - 5.5.1 Format and Content

Appendix 1 provides the guidelines for the format and contents of the SDD.
 - 5.5.2 Table of Contents

Show at least two levels of paragraph headings and page numbers. Decimal paragraph numbering shall be used similar to the Company's SAES.
 - 5.5.3 Drawings and Calculations

Flow charts, control loop diagrams and other visual aids shall be used to supplement and/or clarify the text. As a minimum, a system configuration drawing depicting the main elements, including each module on the main communication network, shall be supplied. All calculations shall be included as appendices.
 - 5.5.4 References
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A list of references shall be provided including author, publisher and date of publication.

Revision Summary

28 February 2005

Revised the "Next Planned Update". Reaffirmed the contents of the document, and reissued with no other changes.

Appendix 1 – System Design Document Contents

1. General
 - 1.1 Scope

This section shall define the overall scope. Also, indicate areas NOT in the scope so as to avoid ambiguity.
 - 1.2 Definitions

This section shall contain definitions of all specialized terms, symbols and acronyms.
 - 1.3 Basic Design Premises

This section shall describe the basic premises, philosophy and purpose of the PAS. It shall highlight how the intent of the FSD is to be met. It shall, equally importantly, highlight design constraints and the technically difficult and uncertain areas. A table of compliance to the FSD shall be included as an appendix.
 - 1.4 Applicable Documents

This section shall identify all documents referenced.
 2. System Overview

This section shall describe the over-all architecture. A block diagram or an overview drawing shall be included, sufficiently detailing the major components of the PAS.
 3. Standard Hardware

This section shall describe the standard hardware used to satisfy the FSD requirements. The following items are to be treated:

 - 3.1 Reliability and availability requirements.
 - 3.2 Maintainability requirements.
 - 3.3 Physical characteristics (e.g., dimensions, space requirements).
 - 3.4 Environmental requirements.
 - 3.5 Performance requirements (e.g., timing constraints, data rates).
 - 3.6 Power consumption (provide summary only. Include details as an appendix).
 - 3.7 Diagnostics tools.
 - 3.8 Configuration tools.
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4. Custom Hardware

This section shall describe the custom hardware used to satisfy the FSD requirements. The following items are to be treated:

- 4.1 Reliability/availability requirements.
- 4.2 Maintainability requirements.
- 4.3 Physical characteristics (e.g., dimensions).
- 4.4 Environmental requirements.
- 4.5 Performance requirements (e.g., timing constraints, data rates).
- 4.6 Power consumption (Provide summary only. Include details as an appendix).
- 4.7 Diagnostics tools.
- 4.8 Configuration tools.

5. Standard Software

This section describes the standard operating and application software requirements. Compliance to industry standards is to be indicated here. Any third party packages either interfaced to or embedded shall be identified, including the supplier and version number.

A listing of all software supplied shall be listed including:

- a) Name
- b) Version
- c) Source of supplier
- d) Brief description of its functions

6. Custom Software

This section describes any custom software. Custom software is hereby defined as "any software that is not offered and supported by the Vendors as standard package." A software package that requires configuration is considered "standard" as long as it is a general offering by the Vendor.

6.1 The following shall be described:

- a) Performance requirements (e.g., timing constraints)
- b) Resource allocation constraints (e.g., memory, disk space)
- c) Operational constraints and special hardware requirements
- d) Programming language used.

6.2 The main modules and their relationship.

- 6.3 Detailed step-by-step revision procedures.
- 6.4 Testing methodology and documentation of testing.
- 6.5 Revision procedures by users and testing requirements.
- 6.6 A detailed listing of error codes and their significance.

7. Custom Interface

This section describes any custom interfaces included in the PAS. For standard interfaces, the Vendor's standard interface documentation shall suffice.

If a custom interface is required, the following shall be provided:

7.1 Custom Hardware Interface:

- a) Parts list with specifications
- b) Printed circuit board layouts
- c) Fabrication drawings
- d) Assembly drawings
- e) Electrical characteristics (e.g., voltage, current levels)
- f) Pin definitions
- g) Type of connector(s)
- h) Physical characteristics (e.g., dimensions, geometry)
- i) Data transfer rate
- j) Communications protocol
- k) Narrative as required to support and clarify the above items
- l) Grounding details

7.2 Custom Software Interface

- a) Detailed design representations (e.g., flow charts, decision tables, structure charts)
 - b) Input and output data organization
 - c) Programming languages and versions used
 - d) Source listings (per contractual requirement)
 - e) Resource utilization (e.g., memory, computational time)
 - f) Software QA procedure and testing results
 - g) Detailed definition of message format
 - h) Definition of parameters
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- i) Message transfer protocol
- j) Transfer rate
- k) Narrative as required to support and clarify the above items

8. Operator (or Human Machine) Interface

This section shall address any specific design considerations for the operator interface, for example: a) how is the PAS engineered to satisfy FSD requirements and b) how does the PAS handle different control areas/groups.

9. Operator Graphical Displays

A graphics convention is required. The requirements of [SAES-Z-001](#) shall be used as a minimum.

If a separate operator display document is provided by the Company, it shall be referred to indicating its version, date of publication.

10. System Security and Integration

System security shall be thoroughly discussed and the philosophy for user privileges, resource allocations, on-site back-up and offsite backup requirements shall be established.

Detailed definition shall be provided for the integration requirements of the PAS. Interfaces to other systems such as emergency shutdown, machinery protection, Plant Information System, Laboratory Information Management System and corporate Management Information System shall be described.

The "Interface Control Document", if used, shall be referenced as appropriate.

11. Process Control Configuration Recommendation

Since each PAS supplier has its own specific methodology in configuration and is hardware specific, the PAS Vendor shall provide its recommended practice based on its own experience. This is intended as a guideline for further development of a detailed configuration plan normally supplied by an engineering contractor for new projects and supplied by Saudi Aramco for expansions.

11.1 Analog Proportional, Integral and Derivative Control (PID) Configuration

An example configuration consisting of an analog input, a PID control block and an analog output shall be provided based on Vendor's experience. Any recommended filtering requirements shall be provided. If Vendor uses user-connectable functional blocks to build a PID loop, these shall be shown in a diagram.

11.2 Discrete Device Loop Configuration

An example of a discrete device such as a MOV configuration shall be provided. If Vendor uses functional blocks to build such loops, these shall be shown in a diagram.

11.3 Logic Configuration

An example of standard configuration for a logic loop connecting to a PID and/or discrete device shall be provided. If Vendor uses functional blocks to build such loops, these shall be shown in a diagram.

11.4 Advanced Regulatory Control

Guidelines for advanced regulatory control (any strategy more complicated than cascade) shall be provided, based on Vendor's recommended practice. Any limitations involving control strategies that might be resident in different modules or different data highways shall be highlighted. If Vendor has standard documentation, an attachment to the SDD shall suffice.

12. Network Design

Network design - Detail description of the design concept of the network shall be included. Pinpoint areas of weakness and precautions to ensure reliability. Redundancy provisions shall be stressed. The following are to be addressed:

12.1 Detailed description, with network diagrams.

12.2 Redundancy provisions described in detail.

12.3 Security provisions described in detail

12.3.1 Segregation of control and information networks.

12.3.2 Protection from Company's Wide Area Network.

12.4 Network standards employed or description in detail of any proprietary network protocols employed.

12.5 Network monitoring tools provided within the system.

12.6 Network analysis tools for troubleshooting network problems.

12.6.1 Standard products from third party vendors.

12.6.2 Special products from the system vendor.

12.6.3 System administration software.

12.7 A loading analysis based on projected network loads

12.7.1 Normal average load.

12.7.2 Burst conditions during plant upsets or other potential causes.

12.8 Network node addressing scheme(s)

12.8.1 Internal to the PAS.

12.8.2 If using TCP/IP, addressing scheme and integration with Company's TCP/IP.

13. Data Base Description

A description of the real-time and historical data bases including the following:

13.1 Resource requirements.

13.2 Operating system software interfaces.

13.3 Security and protection.

13.4 Recovery method.

13.5 Method of locating or modifying data.

13.6 Relationship between real-time and historical data bases.

13.7 Step-by-step description of archiving historical data.

13.8 Step-by-step description of retrieval and display of archived data.

14. System Design Document Appendices

Appendix A: System Layout.

A diagram depicting the overall architecture of the system shall be provided.

Appendix B: Process Control Configuration Examples.

Examples of recommended configuration to be included in this appendix.

Appendix C: Reliability Data and Calculations.

Appendix D: Estimated Power Consumption and Heat Dissipation.

Appendix E: Others as Required.

Appendix (Last): References.