Engineering Standard

SAES-J-801 21 December 2005

Control Buildings

Saudi Aramco DeskTop Standards

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1 Scope

This standard together with the referenced standards and specifications provides minimum requirements for the design and construction of control buildings. The standard covers Central Control Buildings, Local Control Buildings, and Process Interface Buildings. This standard does not cover maintenance buildings or analyzer buildings.

2 Conflicts and Deviations

2.1 Any conflicts between this Standard and other applicable Saudi Aramco Engineering Standards (SAESs), Materials System Specifications (SAMSSs) 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 standard 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 References

The selection of material and equipment, and the design, construction, maintenance, and repair of equipment and facilities covered by this standard shall comply with the latest edition of the references listed below, unless otherwise noted.

3.1 Saudi Aramco References

Saudi Aramco Engineering Procedure

SAEP-302	*Instructions for Obtaining a Waiver of a Mandatory Saudi Aramco Engineering Requirement*

Saudi Aramco Engineering Standards

SAES-A-105	*Noise Control*
SAES-B-008	*Restrictions to use of Cellars, Pits and Trenches*
SAES-B-014	*Safety Requirements for Plant and Operations Support Buildings*
SAES-B-055	*Plant Layout*
SAES-B-069	*Emergency Eyewash and Showers*
SAES-H-Series	*Paints and Coatings Saudi Aramco Engineering Standards*

SAES-J-505	*Combustible Gas and Hydrogen Sulfide in Air Detection Systems*
SAES-J-902	*Electrical Systems for Instrumentation*
SAES-K-001	*Heating, Ventilation and Air Conditioning (HVAC)*
SAES-K-002	*Air Conditioning Systems for Essential Operating Facilities*
SAES-M-009	*Design Criteria for Blast Resistant Buildings*
SAES-M-100	*Saudi Aramco Building Code*
SAES-O-126	*Blast Resistant Control Buildings*
SAES-P-100	*Basic Power System Design Criteria*
SAES-P-103	*Batteries and UPS Systems*
SAES-P-104	*Wiring Methods and Materials*
SAES-P-111	*Grounding*
SAES-P-123	*Lighting*
SAES-S-020	*Industrial Drainage and Sewers*
SAES-S-060	*Saudi Aramco Plumbing Code*
SAES-T-481	*Powered In-Plant Communications*

3.2 Vendor Manuals (reference only)

Site Planning and Installation Manuals

3.3 Industry Codes and Standards

American Petroleum Institute

API RP 554	*Process Instrumentation and Control*

The Instrumentation, Systems and Automation Society

ISA S71.04	*Environmental Conditions for Process Measurement and Control Systems: Airborne Contaminants*

National Fire Protection Association

NFPA 70	*National Electrical Code*

Underwriters Laboratories

UL 779 *Electrically Conducted Flooring*

4 Definitions

4.1 Local Control Buildings

In close proximity to the process facility for which it is designed, a Local Control Building is characterized by its relatively small size. Local Control Buildings are specifically designed to control a single process unit or plant. Field instrumentation will be connected directly to the control building process interface room. The building will be used to provide only the console areas, offices and facilities necessary to support the operation of the plant or process unit.

4.2 Central Control Buildings

Central Control Buildings are used to control several interconnected process modules or plants. They provide a single focus for plant or multi-plant wide operation and shall be used in conjunction with Process Interface Buildings and Local Control Buildings located at each process module or plant. The building shall be located to minimize the risk of external damage from fires, explosions, or toxic releases per SAES-B-014 and shall provide essential administrative facilities necessary to support the continuous operation of the plant(s).

4.3 Process Interface Room (Rack Room)

The Process Interface Room is typically a section of the Local Control Building, or Central Control Building (such as in small facilities), used as the termination and internal distribution point for instrumentation wiring. For Local Control Buildings, this will include field instrument wiring terminated in marshaling cabinets for inbound distribution to distributed control system interface modules. For Central Control Buildings incoming wiring will mainly feature electronic or fiber optic highways associated with the Process Control System (PCS) and ancillary control systems.

4.4 Process Interface Building (PIB)

The Process Interface Building is an unmanned building located near plant process areas and is used as the termination and internal distribution point for instrumentation wiring coming from the field. This building typically houses all marshalling cabinets, process automation system cabinets, emergency shutdown system cabinets, auxiliary systems cabinets, and relevant auxiliary systems diagnostic workstations.

5 Location of Control Buildings

General Requirements

5.1 Control buildings shall be located per SAES-B-014.

5.2 Minimum spacing between control buildings and pipeways or facilities shall be in accordance with SAES-B-055.

6 Control Building Floor Plan

6.1 General Requirements

Local and Central Control Buildings shall be designed to provide administrative and process control facilities to support safe operations and to provide a suitable environment for the operation and maintenance of the process unit or plant PCS.

6.2 Internal Layout

It is not intended that this document mandate control building layouts. Floor plans shall be developed on a case by case basis to support local operating practice and facilitate the installation and maintenance of the plant control system.

6.3 Access

6.3.1 The main entrance to the control building, which shall face away from the process plant or face the plant considered to have the least risk of fire or explosion, shall be provided with an air lock to sustain building pressurization. Locks are not required for emergency exits and service entrances. Certain emergency exist doors may be restricted from being opened from outside, but personnel shall be able to open them from inside.

6.3.2 The floor plan shall be designed to minimize casual personnel traffic through the control room. Offices and equipment rooms should be connected by internal corridors. For Central Control Buildings, the main entrance shall open onto a lobby or corridor from which the control room, offices and other facilities are accessed. For a Local Control Building, the main entrance may open directly through an air lock to the control room area.

6.3.3 The computer room (when specified), engineering room and process interface room (rack room) shall have their main access through the control room.

6.3.4 Emergency exits shall provide easy exit routes from each room and from the control building in accordance with SAES-M-100.

6.3.5 Double doors shall be installed to provide outside access to the control room, equipment rooms and rack rooms as required. If the control room is elevated above grade then loading platforms with stairways shall be provided to facilitate equipment handling during installation and maintenance. Equipment access doors shall be kept locked during normal operation and shall meet the blast resistance requirements of the structural walls of the building.

7 Control Building Room Requirements

7.1 Control Room

7.1.1 The control room shall be designed so that only activities associated with plant control are performed there.

7.1.2 The control room shall be engineered to accommodate future planned expansion.

7.1.3 Spacing between operator workstations and walls and between workstations must be at least 1.22 m wide to provide adequate access for routine maintenance.

7.1.4 The control room and equipment installed therein shall be designed for lowest practical background noise level. Maximum allowable noise levels shall be per SAES-A-105. Equipment that can not meet this criterion shall be installed in auxiliary equipment rooms or shall be located in an acoustic cabinet.

7.2 Computer Room (if specified)

7.2.1 A computer room shall be provided if there are special computers or servers which require either a specially controlled environment or a locked secure area.

7.2.2 If specified, computer rooms shall incorporate the following features:

a) A computer ID card reader or combination lock shall be fitted to the computer room door to prevent unauthorized access.

b) Environmental conditioning shall be provided in accordance with the equipment manufacturer's recommendations.

c) The temperature, relative humidity and environmental corrosion rate shall be monitored and alarmed in the control room.

7.3 Process Interface Building and Rack Room

7.3.1 All field wiring with the exception of control system communication links shall be terminated inside marshaling cabinets in accordance with SAES-J-902.

7.3.2 All incoming cables must be sealed in accordance with Section 15.4 of SAES-P-104.

Commentary Note:

The intent of the sealing requirements is to eliminate any incoming hazardous hydrocarbon gases, or products of combustion inside the incoming conduits or cables, from entering the building. Multi conductor instrument cables shall be sealed around the outer jacket at the building entry point.

7.3.3 Power, instrument analog and digital signal cables shall be segregated and run in accordance with SAES-J-902.

7.3.4 Spacing between cabinets and fire resistant walls shall be per SAES-M-009.

7.3.5 Workstations for machinery condition diagnostic systems and auxiliary instrumentation systems that do not need to be routinely monitored shall be installed in the Process Interface Building or rack room unless stated otherwise.

7.4 Mechanical Equipment Room

The mechanical equipment room containing air handling equipment, particle filters and chemical filters, if required, shall be fire separated from all other rooms.

7.5 Electrical Equipment Room

7.5.1 Electrical distribution panels and motor control centers associated with control building services and the control system UPS shall be located in the electrical equipment room.

7.5.2 The electrical equipment room shall be sized to permit top, front, side and back access for operation and maintenance of installed equipment.

7.6 Battery Rooms and Battery Installation

7.6.1 Batteries shall be located in separate battery rooms and installed in accordance with SAES-P-103.

7.6.2 Battery rooms shall be ventilated in accordance with SAES-K-002 and SAES-P-103.

7.6.3 Safety equipment shall be installed in accordance with SAES-B-069 and SAES-P-103.

7.7 Engineering Room

7.7.1 Engineering workstations shall be installed in the engineering room.

7.7.2 Secure fire resistant storage cabinets shall be provided for storage of computer software and documentation. This is not for storing back up system software, manuals and documentation which shall be stored in a secure off-site location.

7.7.3 The room shall provide space for desks and filing cabinets.

8 Building Construction

8.1 General Requirements

New Central Control, Local Control and Process Interface Buildings located in hydrocarbon producing or manufacturing facilities shall be constructed in accordance with SAES-B-014, and SAES-M-100. For small unmanned Process Interface Buildings, pre-fabricated buildings may be considered provided that the building construction is suitable for the area classification and is approved by Consulting Services Department and Loss Prevention Department.

8.2 Floors

In Central Control, Local Control and Process Interface Buildings, two types of floor will generally be provided. Areas containing computers and process control equipment shall be provided with raised computer floors. Other areas shall have conventional tiled or surfaced concrete floors. The finished surface of the conventional concrete floor shall be leveled with the surface of the raised computer floor.

In Local Control Buildings, with proponent approval, conventional concrete floors may be used throughout the entire facility. This will have an impact on the design of the air conditioning system which shall have ducting installed in accordance with Section 9 of this standard. Overhead wire systems shall be installed in accordance with Section 10.5.

8.2.1 Conventional Floor

8.2.1.1 The surface of conventional concrete floors shall be a minimum of 0.15 m above grade.

8.2.1.2 Non combustible high pressure laminated fiber resin floor tiles shall be permanently bonded to the surface of the conventional floor unless approved otherwise by the proponent.

8.2.2 Raised Computer Floor

Raised Computer Floors shall comply with the following requirements when installed in control buildings:

8.2.2.1 Raised computer floors (pedestal floors) shall be installed in the Central Control, Local Control, and Process Interface Buildings where specified in Paragraph 8.2.

8.2.2.2 Pedestal floors shall provide a minimum 610 mm or 0.61 m clearance between the finished floor surface and subfloor.

8.2.2.3 The floor shall be designed for the static and dynamic loads encountered during normal operation and during the installation of the distributed control system. Static loads and load factors associated with the installation of a particular PCS shall be based on vendor design data.

8.2.2.4 Pedestals and stringers shall be designed to accommodate the required clearance and shall provide a rigid stable platform. The pedestal system shall be selected to minimize leveling problems. The floor surface shall be leveled to within + 0.25 mm per panel and + 1.65 mm in 3.0 m.

8.2.2.5 Floor panels shall be gravity held, electrically conductive per UL 779 and shall be made of noncombustible materials per SAES-B-014.

8.2.2.6 Floor panels shall be surfaced with high pressure laminated fiber resin. If carpet tiles are used in certain areas as allowed by SAES-B-014, they shall be lint-free and shall be specified to inhibit the build up of static electricity.

8.2.2.7 The floor pedestal system shall be grounded at diagonally opposite corners of the support structure. Grounding conductors shall be run in conduit.

8.2.3 Subfloors

The following requirements apply to sub floors for pedestal floor systems.

8.2.3.1 The subfloor of control buildings located within 60 m of a hydrocarbon facility shall be at least 0.15 m above grade. Taking the sub floor as the reference line, the surface of the raised floor shall be minimum 0.75 m above grade. Cable entry shall be in accordance with SAES-B-008.

8.2.3.2 The surface of the concrete subfloor shall be coated with a sealant to prevent dusting.

8.2.3.3 Drains shall be provided in the subfloor to prevent flooding. Floor drain traps shall be 0.1 m deep in accordance with SAES-S-060.

Exception:

With proponent approval, drains are not required for Process Interface Buildings or Central Control Buildings that use dry chemical fire extinguishers and that have no potential source of moisture ingress or water.

8.2.4 Battery Room Floors

The floors of battery rooms in which open wet cell batteries are installed shall be tiled with acid resistant tiles, sloped to a gravity drain constructed with acid resistant material in accordance with SAES-S-020, SAES-S-060 and SAES-P-103.

8.3 Interior Finish

8.3.1 For large Central Control Buildings, it is recommended that specialist control building architectural consultants and/or interior designers be used to coordinate interior decoration of the control room.

8.3.2 Process Interface Buildings and Local Control Buildings' walls shall be prepared and sealed in accordance with H-series Saudi Aramco Engineering Standards.

8.3.3 Decorating materials and all internal finishes shall comply with SAES-B-014.

8.3.4 The minimum recommended floor-to-ceiling height is 3 meters per API RP 554.

8.3.5 Suspended ceilings shall be made of noncombustible and nondusting type of acoustic tiles or boards. Sufficient space between the ceiling and the roof shall be provided to allow for ducts, lighting fixtures and trays.

8.4 Doors

8.4.1 External frames for blast resistant doors shall be set in grooves on all sides to prevent doors and frames from being blown into the building in the event of an explosion. Blast doors shall comply with SAES-M-009.

8.4.2 Blast resistant doors shall have door closers and dust proof/air stop weather strips. Door closers shall be selected to provide adequate closing capacity in consideration of the building's pressurization.

8.4.3 Manufacturers shall certify that blast resistant doors are designed to withstand intended blast loading per SAES-O-126.

8.5 Plumbing

Pluming installations and fittings shall be in accordance with SAES-S-060.

9 Air Conditioning

The space between the false ceiling and roof shall not be used as a return air plenum unless overhead cable systems conform to NFPA 70 NEC Article 300-22.

9.1 Pressurization and air conditioning

Control Building pressurization and air conditioning systems shall be designed and installed in accordance with SAES-K-002.

9.2 Air quality

9.2.1 The air quality inside the control room shall meet the requirements specified by ISA S71.04 Severity Level G1, unless otherwise stated by the process control system, auxiliary control, or computer vendor. The most stringent requirement shall apply. Chemical filters shall be supplied as required in accordance with SAES-K-002.

9.2.2 Particle/dust filters shall be provided in accordance with SAES-K-001.

9.2.3 Temperature and relative humidity shall be controlled to meet or exceed the specifications contained in SAES-K-001 or PCS vendors site planning manual.

9.3 Monitoring

9.3.1 An on-line corrosion monitor shall be installed in the computer room.

9.3.2 Temperature and relative humidity inside the Process Interface Buildings, rack rooms or computer rooms shall be monitored.

9.3.3 Building pressurization shall be monitored by a differential pressure switch or transmitter connected between the inside and outside of the building. Loss of building pressurization shall be alarmed at the DCS console.

9.3.4 In hazardous (Class I, Zone 2 or Class I, Division 2) areas or areas defined by the building risk assessment of SAES-B-014, appropriate gas detectors shall be installed in the pressurization air intake ducts to detect toxic or flammable gases. At the gas concentrations specified below, an alarm shall be activated and all outside air intake into the building shall be shut off automatically. Hydrogen sulfide and combustible gas monitors shall be selected and installed in accordance with SAES-J-505. When concentration of Combustible gas exceeds 10% LEL or hydrogen sulfide exceeds 10 PPM, pressurization fans shall be automatically shut down and fresh air intake dampers shall be closed.

9.3.5 Smoke detection in control buildings shall be in accordance with SAES-B-014.

9.4 Ducting

9.4.1 Air conditioning air intakes shall be installed in accordance with SAES-B-014.

9.4.2 Non combustible air distribution ducting shall be installed above suspended ceilings in preference to installation beneath computer floors.

9.4.3 Air diffusers shall not discharge directly onto any panel or equipment cabinet and shall be sized to eliminate noise induced by air flow.

10 Electrical Requirements

10.1 General Requirements

Electrical installations shall conform to SAES-B-014, SAES-J-902, SAES-P-Series and NFPA 70.

10.2 Grounding

10.2.1 Electrical equipment and field instrument systems shall be grounded in accordance with SAES-J-902 and SAES-P-111.

10.2.2 Distributed control system workstations, computers, I/O cabinets and auxiliary equipment shall be grounded in accordance with SAES-J-902 and the PCS vendor's recommendations.

10.2.3 PLC based Emergency Shutdown Systems (ESD) shall be grounded in accordance with SAES-J-902 and the ESD Programmable Logic Controller (PLC) manufacturer's recommendations.

10.3 Lighting

Deep parabolic reflector fluorescent tubes shall be used in combination with incandescent spots to provide variable illumination, without glare or shadow, at operator workstations and task lighting for work surfaces. Lighting details shall be in accordance with SAES-P-123.

10.4 Uninterruptible Power Supplies (UPS)

10.4.1 Critical instrument and control systems shall be connected to a UPS system. These systems include:

Gas Detection System

Fixed Fire Suppression System

Emergency Shutdown System

Process Control System

Burner Management System

Emergency Lighting

All local and field instrumentation devices

Other auxiliary protection, monitoring or control systems.

10.4.2 The UPS system shall be configured and installed in accordance with SAES-P-103.

10.5 Wiring

10.5.1 Under floor power distribution cable systems shall be installed in accordance with NFPA 70 NEC Article 645-5.

10.5.2 Wiring systems shall be maintained in accordance with SAES-J-902.

10.5.3 Data highways shall be terminated directly to PCS interface equipment.

10.5.4 Cables and conduits entering blast resistant control buildings shall be sealed in accordance with Section 15.4 of SAES-P-104 and SAES-O-126. Multi conductor instrument cables shall be sealed around the outer jacket at the building entry point. Cable end seals shall be applied as required by the NEC.

10.5.5 Signal and power cables installed in air conditioning plenums shall conform to NFPA 70 NEC Article 300-22.

11 Personnel and Equipment Protection

11.1 Fire alarm and fixed detection systems shall be designed in accordance with SAES-B-014.

11.2 Designs for separation and fixed fire suppression systems shall meet SAES-B-014 and shall be approved by the Chief Fire Prevention Engineer or his designated representative.

11.3 Flooring and furniture shall be selected from materials that minimize the effect of static electricity.

12 Communications

In-plant Communication systems shall be designed and installed in accordance with SAES-T-481.

Revision Summary

21 December 2005 Major revision to address major VE proposals.