Engineering Standard

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Very Small Aperture Terminal (VSAT) Network Design

Document Responsibility: Communications Standards Committee

Contents

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1 Scope

This standard presents the minimum mandatory requirements for engineering of Very Small Aperture Terminal (VSAT) system and equipment.

2 Conflicts and Deviations

Any conflicts between this document and other applicable Mandatory Saudi Aramco Engineering Requirements (MSAERs) shall be addressed to the EK&RD Coordinator.

Any deviation from the requirements herein shall follow internal company procedure SAEP-302.

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 Procedures

SAEP-99	*Process Automation Networks and Systems Security*
SAEP-302	*Waiver of a Mandatory Saudi Aramco Engineering Requirement*

Saudi Aramco Engineering Standards

SAES-B-068	*Electrical Area Classification*
SAES-J-003	*Instrumentation - Basic Design Criteria*
SAES-P-100	*Basic Power System Design Criteria*
SAES-P-103	*UPS and DC Systems*
SAES-Q-001	*Criteria for Design and Construction of Concrete Structures*
SAES-Q-005	*Concrete Foundations*
SAES-T-018	*Telecommunications - Symbols, Abbreviations, and Definitions*
SAES-T-624	*Telecommunications Outside Plant - Fiber Optics*
SAES-T-795	*Communications Facility Grounding Systems*

SAES-T-911	*Telecommunication Conduit System Design*
SAES-T-916	*Telecommunications Building Cable Systems*
SAES-Z-004	*Supervisory Control and Data Acquisition (SCADA) System*

Saudi Aramco Materials System Specification

09-SAMSS-097	*Ready-Mixed Portland Cement Concrete*

Saudi Aramco Standards Drawing

AA-036373	*Telecommunications PVC Direct Buried/Encased Conduit*

General Instructions (GIs)

GI-0002.100	*Work Permit System*
GI-1603.000	*Importation of Communications Equipment*

3.2 Industry Codes and Standards

Saudi Arabia Communication & Information Technology Commission

NFP	*National Frequency Plan for Saudi Arabia*

European Telecommunications Standard Institute

EN300 421	*Digital Video Broadcasting (DVB); Framing Structure, Channel Coding and Modulation for 11/12 GHz Satellite Services*
EN 301 790	*Digital Video Broadcasting (DVB); Interaction Channel for Satellite Distribution Systems*
EN302 307	*Digital Video Broadcasting; Second Generation Framing Structure, Channel Coding, and Modulation Systems for Broadband Satellite Applications*

IEC Standards

IEC 1319-1	*Interconnections of Satellite Receiving Equipment*

3.3 Terms and Definitions

VSAT: Abbreviation for a Very Small Aperture Terminal which is a two-way satellite ground station with a dish antenna that is smaller than 3 meters.

NFP: National Frequency Plan

NMS: Network Management System

SNMP: Simple Network Management Protocol

DVB: Digital Video Broadcasting

OSP: Outside Plant

RF: Radio Frequency

BER: Bit Error Rate

4 Design

4.1 Spectrum Regulation and Approval

4.1.1 All VSAT equipment must conform to all government requirements for importation of radio telecommunication equipment into the Kingdom.

GI-1603.000 Importation of Communications Equipment

4.1.2 VSAT equipment shall comply with the Saudi Arabia National Frequency Plan (NFP) and all Saudi Arabia Communication & Information Technology Commission requirements.

4.1.3 New frequency assignments to Saudi Aramco shall be monitored/scanned by the project to ensure interference-free channels prior to utilization.

4.1.4 All detailed design packages for VSAT project shall be reviewed by IT/CE&TSD.

4.2 The VSAT network design shall meet the following minimum requirements:

4.2.1 The VSAT system shall support voice/fax/data/video services kingdom-wide and shall have the flexibility to be installed and operated at various locations throughout Saudi Arabia (as the projects/users require).

4.2.2 The VSAT network shall have one (1) Network Management System (NMS) based on SNMP. The NMS shall interface and be integrated into existing VSAT NMS.

4.2.3 The VSAT network shall support Satellite Carrier Monitoring System (SCMS).

4.2.4 All VSAT gateways and remote terminals must be compatible and connected to Saudi Aramco Network.

4.2.5 The VSAT network shall support STAR network topology. VSAT mesh topology can be considered as needed with proper justification.

4.2.6 The VSAT networks shall have a modular design.

4.2.7 The VSAT network shall be designed to operation on other candidate satellites with similar performance parameters.

4.2.8 The VSAT network shall be designed in accordance with the requirements of DVB-S2 Standards based on ETSI EN300 421, EN 301 790, and EN302 307 or better.

4.2.9 The VSAT network's design shall provide optimized overall network data throughput efficiency, with minimum of 2 bits/second of data per Hertz of bandwidth.

4.2.10 The VSAT network design shall have either an overhead formats of 2 bit/s/Hz or 5 bit/s/Hz; the recommended overhead format use is 2 bit/s/Hz.

4.2.11 The VSAT design shall perform optimized information data transmission rate for remote users using TCP/IP protocol acceleration techniques and efficient Quality of Service (QoS) based user access protocols.

4.2.12 The VSAT network shall support IPSec Security Protocol for data encryption, authentication, and key exchange.

4.2.13 VSAT Gateways shall be a fully redundant configuration.

4.3 The civil work for the gateway site and remote site shall be in accordance with relevant Saudi Aramco Engineering Standard. It shall include:

4.3.1 All concrete foundations shall comply with SAES-Q-001, SAES-Q-005, and 09-SAMSS-097; this includes the concrete foundations for the earth station antenna, underground concrete encased duct bank for the inter-facility link to bring the cables to the communications room.

Commentary Note:

Concrete foundations are not required for platforms and offshore locations.

4.3.2 All conduit and cable tray design and installation shall be in compliance with SAES-T-911, SAES-T-916, and AA-036373 including spanning conduit or cable tray inside the communications room from the building entry point to the VSAT equipment rack.

4.3.3 The underground duct bank design and installation for the inter-facility link to bring the cables to the communications room shall be in compliance with SAES-T-911. Minimum of two 4"-conduits concrete encased duct bank shall be installed; one conduit shall host subducts in accordance with SAES-T-624 Paragraph 4.3; and the other conduit will be reserved for maintenance use. No direct buried cable installation is allowed. The concrete encased duct bank between the outdoor equipment and the indoor equipment is shall not be part of the existing OSP infrastructure duct system.

4.4 Environmental Conditions

As per SAES-J-003, the following environmental requirement must be met:

4.4.1 Temperature for Fixed Devices

All VSAT terminals and equipment's shall operate continuously under the following ambient air temperatures without any degradation of the manufacturer's guaranteed performance:

	Indoor Air Conditioned (2)	Outdoor Sheltered (1)(2)(3)	Outdoor Unsheltered (2)(3)
Maximum	35°C (95°F)	55°C (131°F)	65°C (149°F)
Minimum	10°C (50°F)	0°C (32°F)	0°C (32°F)

Notes:

1) "Sheltered" refers to permanent, ventilated enclosures or buildings, or permanently fixed sunshades with a top and three sides.

2) For devices which dissipate internal heat and are installed in custom engineered enclosures (e.g., enclosures not included in the original manufacturer's temperature certification), an additional 15°C shall be added to the above maximum temperatures. An example, for "indoor air conditioned" installation, the equipment must perform at 35 + 15 = 50°C. Similarly, for the "outdoor unsheltered" case, the equipment shall be designed for a maximum operating temperature of 65 + 15 = 80°C.

3) For the outdoor installations only, the designer can take credit for forced or passive cooling to eliminate or reduce the 15°C heat rise. No more than 15°C reduction in temperature will be given as credit. The designer shall substantiate his claim by providing the support data and calculations.

4.4.2 Humidity

Indoor humidity design basis shall be 20% to 80% relative humidity. Outdoor design basis shall be 5% to 95% relative humidity (non-condensing).

4.5 Area Classification Requirements

All VSAT equipment's and devices installed in classified area shall adhere to the requirements of SAES-B-068 and device certification requirements as per SAES-P-100, Section 8.

Commentary Note:

It is highly recommended and common engineering practice to install VSAT system in non-classified area. All efforts shall be made to locate the VSAT system in a non-classified area.

4.6 UPS/Battery capability and UPS management software implemented to provide reliable and high availability operation for VSAT gateways and terminals shall be provided in accordance with SAES-P-103.

4.7 Design drawings shall use conventional symbols as specified in SAES-T-018 (Telecommunications-Symbols, Abbreviations, and Definitions) and BICSI.

4.8 SCADA communications requirements shall adhere to SAES-Z-004 and SAEP-99.

Commentary Note:

Wireless connectivity using VSAT network shall not be used for process control (e.g., open loop control and closed loop control) and emergency shutdown applications.

4.9 For all devices/systems that are not connected to the Corporate IT Network, project design and proponent must follow the identity and access control requirements as stated in SAEP-99.

5 Installation

5.1 The instructions and recommended practices issued by the manufacturer shall be followed.

5.2 Satellite receiving equipment shall be interconnected in according to IEC 1319-1.

5.3 Grounding of radio equipment and antenna shall be in accordance with SAES-T-795, "Communications Facility Grounding Systems."

5.4 All indoor cabling infrastructure and installation shall comply with SAES-T-916.

5.5 All ground stations equipment shall be installed in DCO. If there is no existing DCO in the location of installation then all indoor equipment shall be installed inside a data room or locked data closet.

5.6 Where applicable, requirement for electrical protection of telecommunications system shall be followed as per SAES-T-795.

5.7 Work Permits shall be handled in accordance with GI-0002.100, "Work Permits". In Refinery and Plant areas, work permit procedures shall also comply with the "Refinery Instructions Manual" and the Plant "Operations Instructions Manual".

6 Testing and Inspection

Field testing and inspection of the radio equipment shall be recorded in a log book and handed to Proponent Department. Field Tests shall include, as a minimum requirement, the following:

6.1 Inspecting solid connections of wires and grounds to insure safety and proper operation.

6.2 Verifying the operating frequencies of ground stations.

6.3 Verifying RF power of ground stations.

6.4 Checking RF cable and antenna matching.

6.5 Checking the data throughput from the gateway to the terminal and from the terminal to the gateway.

6.6 Checking Signal-to-Noise Ratio and Bit error rate for receiver systems. The minimum BER must be 10^{-7} on return channel and 10-8 on the forward channel.

6.7 Check for system availability over a period of 7 days. The minimum availability shall be 99.9%. This availability target covers the ground segment parameters and excludes uncontrollable factors such as satellite outage due to transponders failure, intentional/unauthorized interference, or natural phenomena (e.g., sun spots).

Commentary Note:

The availability for remote sites such as remote offices or wellsites can be lower than 99.9% based on the user requirement.

6.8 One-way latency must be equal or less than 400 ms (latency < 400 ms).

Revision Summary

14 February 2010	New Saudi Aramco Engineering Standard.
20 March 2010	Editorial revision to provide better write up and clarification.
18 July 2012	Editorial revision to change the primary contact.
12 June 2013	Editorial revision to reference SAES-Z-004 for SCADA requirements.
1 January 2018	Editorial revision to modify paragraph 4.6, Commentary Note.
6 February 2018	Added requirements address to cyber security following SAEP-99 and Paragraph 4.6, Commentary Note has been moved to Paragraph 4.8.