



Engineering Standard

SAES-T-494

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Very Small Aperture Terminal (VSAT) Network Design

Document Responsibility: Communications Standards Committee

Saudi Aramco DeskTop Standards

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1 Scope

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

2 Conflicts and Deviations

- 2.1 All 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 Manager, Process & Control Systems Department, 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, Saudi Aramco, Dhahran.
- 2.3 Direct all requests for interpretation of this standard in writing to the Company or Buyer Representative who shall forward them to the Chairman, Communications Standards Committee for resolution. The Chairman, Communications Standards Committee shall be solely responsible for determining whether a proposed installation meets the requirements of this standard.

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-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

<u>SAES-Q-001</u>	<i>Criteria for Design and Construction of Concrete Structures</i>
<u>SAES-Q-005</u>	<i>Concrete Foundations</i>
<u>SAES-T-018</u>	<i>Telecommunications - Symbols, Abbreviations and Definitions</i>
<u>SAES-T-624</u>	<i>Telecommunications Outside Plant - Fiber Optics</i>
<u>SAES-T-795</u>	<i>Communications Facility Grounding Systems</i>
<u>SAES-T-887</u>	<i>Telecommunications: Electrical Coordination - Protection at Power Plants & Radio Stations</i>
<u>SAES-T-911</u>	<i>Telecommunication Conduit System Design</i>
<u>SAES-T-916</u>	<i>Telecommunications Building Cable Systems</i>
<u>SAES-Z-004</u>	<i>Supervisory Control and Data Acquisition (SCADA) System</i>

Saudi Aramco Materials System Specification

<u>09-SAMSS-097</u>	<i>Ready-Mixed Portland Cement Concrete</i>
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Saudi Aramco Standards Drawing

<u>AA-036373</u>	<i>Telecommunications PVC Direct Buried/Encased Conduit</i>
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Material Instructions (MIs)

<i>MI-321.015</i>	<i>Materials Requiring Saudi Arab Government Import Permits, Letters of Authorization, and/or Clearance Permits</i>
<i>MI-321.021</i>	<i>Import Permits for Communications Equipment</i>

General Instructions (GIs)

<i>GI-0002.100</i>	<i>Work Permit System</i>
<i>GI-1603.000</i>	<i>Importation of Communications Equipment</i>

3.2 Industry Codes and Standards

Saudi Arabia Communication & Information Technology Commission

<i>NFP</i>	<i>National Frequency Plan for Saudi Arabia</i>
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European Telecommunications Standard Institute

<i>EN300 421</i>	<i>Digital Video Broadcasting (DVB); Framing</i>
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	<i>Structure, Channel Coding and Modulation for 11/12 GHz Satellite Services</i>
<i>EN 301 192</i>	<i>Digital Video Broadcasting (DVB); DVB Specification for Data Broadcasting</i>
<i>EN 301 790</i>	<i>Digital Video Broadcasting (DVB); Interaction Channel for Satellite Distribution Systems</i>
<i>EN302 307</i>	<i>Digital Video Broadcasting; Second Generation Framing Structure, Channel Coding, and Modulation Systems for Broadband Satellite Applications</i>
<i>ETSI EN 301 428</i>	<i>Satellite Earth stations and Systems (SES); Harmonized EN for Very Small Aperture Terminal (VSAT); Transmit-only, Transmit/Receive or Receive-Only Satellite Earth Stations Operating in the 11/12/14 GHz Frequency Bands Covering Essential Requirements under Article 3(2) of the R&TTE Directive</i>
IEC Standards	
<i>IEC 1319-1</i>	<i>Interconnections of Satellite Receiving Equipment</i>
SatLab	
<i>SatLabs</i>	<i>SatLabs System Recommendations</i>
<i>SatLabs</i>	<i>Compliance/Interoperability Outline Test Plan</i>

3.3 Terms and Definitions

VSAT: it is 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 equipments must conform to all government requirements for importation of radio telecommunication equipment into the Kingdom. For procedure on radio equipment importation, refer to the following requirement documents:

*MI-321.015 Materials Requiring Saudi Arab Government
Import Permits, Letters of Authorization,
and/or Clearance Permits*

MI-321.021 Import Permits for Communications Equipment

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 Saudi Aramco central 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.
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- 4.2.6 The VSAT networks shall have modular design to allow for operation on other candidate satellites with similar performance parameters.
- 4.2.7 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.
- 4.2.8 The VSAT system (gateway and terminals) design shall be operationally compatible with other manufacturers' remote VSAT terminals, as established by the SatLabs Group.
- 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.
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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 equipments 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 equipments 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 software implemented to provide reliable and high availability operation for VSAT gateways and terminals shall be provided in accordance with [SAES-P-103](#).

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 without obtaining written approval from P&CSD Manager.

- 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](#).

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. Terminals installed outside DCO shall obtain written approval from CE&TSD.
- 5.6 Where applicable, requirement for electrical protection of telecommunications system shall be followed as per [SAES-T-887](#).
- 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”.
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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.
- 6.5 Checking Signal-to-Noise Ratio and Bit error rate for receiver systems. The minimum BER must be 10^{-8} .
- 6.6 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).

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.