Engineering Standard

SAES-T-493 18 July 2012

Digital Trunked Radio System

Document Responsibility: Communications Standards Committee

Saudi Aramco DeskTop Standards

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1 Scope

This standard presents minimum mandatory requirements for engineering and installation of Digital Trunked Radio System. This document doesn't address process automation systems design requirements.

2 Conflicts and Deviations

Any deviations, providing less than the mandatory requirements of this standard require written waiver approval as per Saudi Aramco Engineering 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-302	*Instructions for Obtaining a Waiver of a Mandatory Saudi Aramco Engineering Requirement*
SAEP-744	*Preventive Maintenance and Condition Assessment for Communication Towers*

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-T-492	*VHF/UHF Land-Mobile and Fixed Radio Communication*
SAES-T-500	*Central Office (CO) Digital Telephone Switching Systems*
SAES-T-744	*Design Criteria/Installation of Communication Towers*
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*

Material Instructions (MIs)

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*

General Instructions (GIs)

GI-0006.008	*Restriction of Portable Electrical/Electronic Devices*
GI-1603.000	*Importation of Communications Equipment*

3.2 Industrial Codes and Standards

Saudi Arabia Communication & Information Technology Commission (SC&ITC)

NFP	*National Frequency Plan for Saudi Arabia*

ETSI ETS 100-392 Series

ETSI EN 300 392	*Terrestrial Trunked Radio (TETRA)- Voice plus Data (V+D)*
ETSI EN 300 394	*Terrestrial trunked radio (TETRA) - Conformance Testing Specification*
ETSI EN 300 395	*Terrestrial Trunked Radio (TETRA) - Speech Codec for Full-Rate Traffic Channel*
ETSI EN 300 396	*Terrestrial Trunked Radio (TETRA) - Technical Requirements for Direct Operation (DMO)*
ETSI EN 302 109	*Terrestrial Trunked Radio (TETRA) - Security - Synchronization Mechanism for End-to-End Encryption*
ETSI EN 301 489-18	*Electromagnetic Compatibility and Radio Spectrum Matters (ERM) - Electromagnetic Compatibility (EMC) Standard for Radio Equipment and Services - Part 18: Specific Conditions for Terrestrial Trunked Radio (TETRA) Equipment*
ETSI EN 301 040	*Terrestrial Trunked Radio (TETRA) - Security - Lawful Interception (LI) Interface*

ETSI EN 300 827	*Electromagnetic Compatibility and Radio Spectrum Matters (ERM). Electromagnetic Compatibility (EMC) Standard for Terrestrial Trunked Radio (TETRA) and Ancillary Equipment*
ETSI EN 303 035	*Harmonized EN for TETRA Equipment Covering Essential Requirements under Article 3.2 of the R&TTE Directive*
ETSI EN 300 812	*Terrestrial Trunked Radio (TETRA); Security aspects; Subscriber Identity Module to Mobile Equipment (SIM-ME) interface*
ETSI ES 201 962	*Terrestrial Trunked Radio (TETRA); TETRA Advanced Packet Service (TAPS)*

UL Standards

UL 452	*Antenna Discharge Units for Radio and Television Receiving Appliances*
UL 497C	*Equipment Covered by the Standard for Protectors for Coaxial Communications Circuits*

National Fire Protection Association

NFPA 70 - 2008	*National Electric Code (NEC)*

International Electrotechnical Commission (IEC)

IEC 60079 - XX	*IEC60079 series*

4 Definitions

BER: Bit Error Rate

DCO: Digital Communications Office

IP: Internet Protocol

SCN: Switching and Control Node, a node that contains data switches and equipment for controlling, formatting, transmitting, routing, and receiving voice and data packets.

TEA1 and TEA3: TEA1 and TEA3 are air interface encryption algorithms for TETRA for Class 1 (Clear) and Class 3 (DCK, CCK & GCK) security.

TETRA: TErrestrial **T**runked **Ra**dio (formerly known as Trans European Trunked RAdio) is an ETSI digital Trunked Mobile Radio and two-way transceiver standard.

Trunked Radio System: "Trunked" Radio system is complex type of computer-controlled radio system that uses a "pool of channels" which is available for a great many different groups of users.

VSWR: "Voltage Standing Wave Ratio" is the ratio of the amplitude of a partial standing voltage wave at an antinode (maximum) to the amplitude at an adjacent node (minimum), in a transmission line.

5 Adoption

The "ETSI ETS 100-392 series" is hereby adopted as Saudi Aramco standards for Digital Radio Trunked System. Subsequent Sections of this standard shall be adopted in addition to the above standards.

6 Design

6.1 Spectrum Regulation and Approval

6.1.1 Digital Trunked radio equipment shall conform and comply with the SC&ITC frequency regulations and the National Frequency Plan (NFP). Spectrum allocation request and approval shall be obtained from SC&ITC.

Note: *Spectrum Approval from SCI&ITC shall be obtained through IT Government Coordination Group, CE&TSD.*

6.1.2 All Digital Trunked radio equipments shall adhere to all importation procedures of radio telecommunication equipment into the Kingdom. For procedures 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*

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

6.1.4 All detailed design packages for TETRA project shall be reviewed by CE&TSD.

6.2 Portable Devices Use

All Portable Electrical/Electronic devices shall adhere to the minimum requirement of GI-0006.008 in terms of restriction, labeling and use.

6.3 Environmental Conditions

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

6.3.1 Temperature for Fixed Devices

Digital Trunked radio 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.

6.3.2 Temperature for Portable Devices

Portable digital trunked radio devices shall operate continuously under the following ambient air temperatures (indoor or outdoor) without any degradation of the manufacturer's guaranteed performance:

6.3.2.1 Minimum temperature is 0°C

6.3.2.2 Maximum temperature is 50°C

6.3.3 Humidity

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

6.4 Coverage Map

An RF colored signal coverage Map shall be developed showing base station coverage and received radio signal strength within the coverage area.

6.5 Hazardous Classified Area Requirements

6.5.1 All portable Digital Trunked radio devices shall comply with the requirements of SAES-P-100 and be in accordance with SAES-B-068. Electronic Communications and electronics equipment in hazardous areas shall meet listing/certification requirements, in accordance with NEC (Certificate of Compliance) or through an IECEx certificate (IECEx Certificate of Conformity), as specified in SAES-P-100. Label or certification shall be from an approved Saudi Aramco certifying agency or lab in accordance with SAES-P-100.

6.5.2 Per IEC60079-14, "Equipment of a lower EPL (Equipment Protection Level) shall not be taken into an area requiring a higher EPL (Equipment Protection Level), unless it is otherwise protected. Therefore, all portable equipment shall meet the requirements of the location to which the equipment will be exposed which requires the highest EPL. Similarly, the portable equipment group and temperature classification should be appropriate for all the gases, vapors and dusts in which the equipment may be used. Unless suitable precautions are taken, spare batteries shall not be taken into the hazardous area". Therefore, the minimum Equipment Protection Level (EPL) for the handheld radios, portable devices and portables' accessories shall be:

- Class 1, Zone 1, Gas Groups IIC (Acetylene, Hydrogen, Ethylene & Propane).
- All handheld and portable Digital Trunked radio devices shall be intrinsically safe "ib" or "ia".

6.5.3 All manufacturers' recommended practices/requirements for hazardous areas applications shall be followed or considered during the installation and operations.

6.5.4 All Portable Electrical/Electronic devices shall adhere to the requirement of GI-0006.008 in terms of restriction, labeling and use.

6.6 Network Management

The Digital Trunked Radio must include a Network management system based on SNMP version 2 and above to allow remote configure, access, modify, as well as monitor communication links status, traffic loading, and network performance. The network management system shall support: Fault management (detection, isolation and correction), Configuration management, Performance management, Security management, and Accounting management.

6.7 Communications Antennas

6.7.1 Antennas for base station, vehicles, and radio frequency dispatch units (Desktop Radio) must adhere to SAES-T-492 Section 5.2, or equivalent.

6.7.2 All antennas, including desktop antennas, shall be installed outside the building (away from personnel work area). Desktop Radio transceiver shall be installed separately in the equipment or communications room (away from the control head).

6.8 Roaming

Mobile users shall be able to roam freely within the coverage area for all types of voice and data calls. The system shall initiate an automatic site registration/de-registration process without user interference.

6.9 Security

The Digital Trunked Radio systems shall support:

6.9.1 User authentication for Dispatcher workstation

6.9.2 TETRA based system shall support at least two air interface encryption, namely TEA1 for Class 1 security and TEA3 for Class 3 Security.

6.10 Interoperability

Standard interoperability certificate shall be provided for Digital Trunked Radio systems and end-user equipment.

6.11 Recording System

All Digital Trunked Radio systems shall be provided with a recording system for voice channels.

6.12 Performance

Digital Trunked Radio systems shall be designed and provisioned to meet the

following performance parameters under the intended traffic demand level (design):

6.12.1 At minimum, 95% of calls attempted shall be processed without being queued, AND the remaining 5% of call attempts shall not have queuing delay in excess of 3 seconds.

6.12.2 The maximum call setup time for talk group and individual calls within single SCN is 300 and 770 millisecond, respectively.

6.13 Anti-Jamming Detection

Jamming and interception detection shall be supported by the system.

6.14 Voice Services

Digital Trunked Radio system shall support group calls, individual calls (Full Duplex voice Calls, Half Duplex voice calls), voice call Priority, Direct Mode (unit-to-unit without the use of a BS), Call Pre-emptive Priority, Emergency voice Call capabilities, and voice Calling Line and Talking Party Identity Presentation.

6.15 Data Services

Digital Trunked Radio system shall support IP packet data services (IP over Ethernet transmissions without the need to use of multiplexers or any other additional hardware) and short data messages.

6.16 Wireless connectivity using Digital Trunked Radio system may be used for remote monitoring applications. For SCADA applications, it shall adhere to SAES-Z-004.

6.17 Per SAES-T-500, all digital exchange equipment requiring direct current, shall be designed to operate at a nominal voltage of -48 Vdc. The operating voltage may vary from -44 to -52 Vdc with positive polarity to ground, and the digital equipment shall be designed to operate normally within this voltage range.

7 Installation

7.1 The recommended practices by manufacturer shall be followed.

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

7.3 All Antennas for DTRS base station shall install a surge arrestor as per UL 452 "Antenna Discharge Units for Radio and Television Receiving Appliances" and

UL497C "Equipment Covered by the Standard for Protectors for Coaxial Communications Circuits."

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

7.5 All Base Stations equipment shall be installed in DCO. Base Stations installed outside DCO shall obtain written approval from CE&TSD.

7.6 Tower installation shall comply with SAES-T-744 and SAEP-744.

8 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:

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

8.2 Verifying the operating frequencies of transmitters and receivers.

8.3 Verifying RF power of transmitter and confirming coverage area of base station.

8.4 Checking RF cable and antenna matching.

8.5 Measure VSWR Signal-to-Noise Ratio and Bit Error Rate (BER) for Base station receiver.

8.6 Visual inspection for Base station after installation to check for Physical connectivity and various indicators status.

8.7 The Contractor shall provide as-built drawings in accordance with Saudi requirements in SAES-T-911.

8.8 Inspecting all devices operated in hazardous areas to have a label or/and certification from an approved Saudi Aramco certifying agency in accordance with SAES-P-100.

Revision Summary

13 December 2011	Major revision.
18 July 2012	Editorial revision to change the primary contact.