Engineering Standard

SAES-T-903 21 May 2012

Outside Plant Electrical Protection and Grounding

Document Responsibility: Communications Standards Committee

Saudi Aramco DeskTop Standards

Table of Contents

Primary contact: Ghamdi, Khalid Sulaiman on +966-3-8801354

Nufaii, Abdullah Sufran on +966-3-8801359

1 Scope

This standard prescribes mandatory requirements governing systems planning, designing and engineering of electrical protection for telecommunications outside plant, switching centers, central offices (CO) and other telecommunication equipments. This includes upgrading existing facility when a new cable is being placed.

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

All referenced Specifications, Standards and Codes, Forms, Drawings and similar material shall be of the latest issue (including all revisions, addenda and supplements) unless stated otherwise. Listed below are applicable standards.

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-P-111	*Grounding*
SAES-T-018	*Telecommunications - Symbols, Abbreviations and Definitions*
SAES-T-604	*Communications Plant - Clearances/Separations - Aerial*
SAES-T-624	*Telecommunications Outside Plant - Fiber Optics*
SAES-T-629	*Telecommunications Buried Cable and Wire*
SAES-T-634	*Telecommunications - Cable Testing and Acceptance*
SAES-T-795	*Communication Facility Grounding Systems*
SAES-T-887	*Telecommunications: Electrical Coordination-Protection at Power Plants and Radio Stations*
SAES-T-916	*Communications Building Cable System*
SAES-T-928	*Telecommunications - OSP Buried Plant*

SAES-T-938	*Telecommunications Outside Plant System Design*

Saudi Aramco Standard Drawings

AA-036391	*Grounding System for Telecommunication Building Facilities*
AA-036765	*Grounding for Remote Communication Sites*

3.2 Industry Codes and Standards

Building Industry Consulting Service International (BICSI)

TDMM	*Telecommunications Distribution Methods Manual*
OSPDRM	*Outside Plant Design Reference Manual*

American National Standards Institute

ANSI/NFPA 70	*National Electrical Code (NEC)*
ANSI C2	*National Electrical Safety Code (NESC)*
NFC	*National Fire Codes*

Underwriter's Laboratories

UL 497	*Protectors for Paired Conductor Communication Circuits*
UL 497A	*Secondary Protectors for Communication Circuits*
UL 497B	*Protectors for Data Communication and Fire Alarm Circuits*

4 Definitions and Terms

Approved Ground: A ground is suitable for connection to the building entrance facility protector, the entrance cable shield, or the PBX equipment single point ground. The NEC stresses the importance of bonding together all available electrodes into a system. The first choice for grounding of protectors is to the nearest available location on the system, whichever results in the shortest run (maximum allowable distance shall be 6.1 m of grounding conductor. Refer to SAES-T-916.

Common Grounding: Common grounding is the use of the same ground electrode by all services. Underwriter's Laboratories listed (UL-listed) or equivalent ground or bond connectors shall be used.

Common Bonding: Common bonding is the interconnecting of separate ground electrodes and is necessary at locations where common grounding cannot or has not been used. UL-listed or equivalent ground or bond connectors shall be used.

Distribution Facility: is the exchange plant from the central office to the user end (including the distribution point).

Entrance Facility: is the exchange plant from the outside plant distribution point at the street to the station protector.

Exposed Facilities: Any outside plant facilities that are subject to the effects of lightning, power crosses, power induction, or differences in ground potential. All Saudi Aramco cable and facilities are considered to be exposed.

Fuse: is an electrical safety device consisting of, or including, a wire or strip of fusible metal that melts and opens the circuit when the current becomes excessive.

Fuse Cable: A length of protective cable of # 24 AWG or # 26 AWG copper conductors that is inserted in the plant and intended to fuse open on foreign power currents before damage occurs to the cable, customer terminal wiring, or apparatus that it protects. It does not protect against lightning currents and associated voltages.

MGN (Multi-Grounded Neutral): is a neutral conductor of a wye-connected electrical supply system having at least four grounds in each mile of wire, with the primary and secondary neutrals solidly interconnected, and power ground connections at individual services.

Outside Plant (OSP): That portion of the telephone network that is normally located outside of the buildings. It may consist of aerial, buried or underground facilities and associated terminals, closures, pedestals and supporting structures.

Protector (Cable): A protector that limits the voltage between the conductors and shields of the cable. Standard cable protectors are equipped with 6-mil (blue) carbon blocks.

Protector (User Terminal or Switching Center): A device that limits voltage between conductors and ground. It is equipped with fail safe solid state arresters.

Single Point Terminal: It is the only acceptable point ground for connection from the equipment to the external protection grounding system. It shall consist of copper bus bar to which the main ground conductor, permanently attached to the power ground or building steel (which has been bonded to power ground), has been securely attached.

Sneak Current: A foreign current flowing to the ground through terminal wiring and equipment that is driven by a voltage that is too low to cause a protector to arc over or ground.

5 Design

5.1 Outside Plant Protection

The sections of BCSI OSPDRM, and BCSI TDMM on "Grounding, Bonding, and Protection", and the NEC Articles 800, 500, and 250 are integral part of Saudi Aramco Engineering Standard SAES-T-903. Mandatory items and modifications are listed herein.

5.1.1 General Protection Considerations

5.1.1.1 Protection for telecommunication facilities at crossings and parallels of power lines of over 20 kV phase-to-ground, serving or passing within a GPR zone of influence of power substations, shall be coordinated as specified by SAES-T-887.

5.1.1.2 All metallic loops in Saudi Aramco are considered exposed to lightning, except any on premises extensions that are:

a) Not exposed to 300 volts or more and

b) Not extended to a separate building located more than 43 m (140 ft.) away.

Commentary Note:

The 43 m (140 ft.) is the zone of protection and it is the physical wall-to-wall distance between buildings.

5.1.1.3 All exposed telecommunication cable conductors that enter buildings shall be protected with UL-listed protectors.

5.1.1.4 Never share a vault, pull box, or manhole with a power system of any voltage.

5.1.1.5 Telecommunication facilities shall not be grounded to a non-grounded power system.

5.1.1.6 Never share a trench with a power cable having a phase-to-ground voltage of more than 20 kV.

5.1.2 Electrical Code Requirements

5.1.2.1 Common grounding shall be provided as required by the National Electrical Code (NEC) Article 800, Section D - Grounding Method.

5.1.2.2 All telecommunications engineering design and construction shall comply with the National Electrical Code (NEC) Article 800, as well as applicable sections in the NESC.

5.1.3 Grounding Electrodes

5.1.3.1 Power ground shall be the preferred ground electrode. If the power service (first choice ground source) is not located within 6 m (20 ft.) of the telephone station protector, relocate the telecommunication protector, or use one of the following electrodes:

a) Ground ring of # 2 AWG (35 mm^2) minimum copper conductor, encircling the building at a minimum depth of 0.76 m (2.5 ft.)

b) Grounded metal frame of the building

c) A 25-ohm or less ground electrode bonded to power service ground

***Note**: All the above grounds present on the premises shall be bonded together, regardless of the distance between electrodes or ground systems.*

5.1.3.2 Ground rods are only allowed to be used when no other ground medium is available.

5.1.3.3 If more than one ground rod is required to achieve 25 ohms, they must be greater than 1.8 m (6 ft.) apart, and shall be bonded together with a minimum of # 6 AWG (16 mm^2) bare tinned-copper ground wire. Refer to NEC Article 800-40.

5.1.3.4 Chemical treatments of the earth around ground electrodes shall not be used. Marl or concrete could be used to assist in maintaining moisture content around ground electrodes.

5.1.3.5 To provide an electrode that will not readily dry-out, main electrodes shall consist of a minimum of 2.44 m (8 ft.) ground rod(s). If more than one is used, they shall be bonded together with a minimum of # 6 AWG (16 mm^2) bare tinned-copper ground wire. A ground resistance of 25 ohms or less shall be established.

5.1.3.6 Telecommunication ground rods shall be bonded to foreign ground rods when they are located within 2 m (6 ft.) of each other.

5.1.3.7 Locate distribution cable terminals or pedestals so that the drop or service wire can be run to the same side of the premises as the power service or to an adjacent side. The protector shall be located so that the total length of the ground and bond wire from the protector to the power service or building ground does not exceed 6.1 m (20 ft.). In all circumstances, the telecommunications ground shall be bonded to the power ground.

5.1.3.8 All ground conductors placed inside or on buildings shall be insulated according to NEC, Article 800.40 (a)(1).

5.1.4 Cables Entering Communication Buildings

5.1.4.1 Termination of Outside plant cables on distribution frames shall be fail safe solid state protectors, refer to Section 5.2.

5.1.4.2 Cables entering communication buildings, either directly or in vaults shall have fuse cables installed according to Table 1.

Table 1

Gauge of Entrance Cable	Gauge of Fuse Cable	Gauge of Tip Cable
19 or 22	24	22
19 or 22	26	24 or 22
24	None	22
24	26	24
26	None	24 or 22

5.1.4.3 Bonding and Grounding at Cable Entrances

All cables entering communication buildings and containing a metallic shield, armor and/or strength members shall be grounded and bonded:

a) To each other

b) Not more than 15 m (50 ft.) from the point of entrance, refer to Figure 1.

5.1.5 Cables Entering User Buildings

5.1.5.1 Station Terminal Equipment

5.1.5.1.1 Station terminal equipment is represented by such items as telephones, answering sets, PBX's, data and alarm circuits, modems, computers, computer terminals, or other electronic type installations. All of these items shall be served from a protected building entrance terminal.

5.1.5.1.2 Telephone service, power service, and CATV shall be provided with a common ground system to protect against differences in ground potential between the systems.

5.1.5.2 Bonding and Grounding at Cable Entrance

5.1.5.2.1 Refer to 5.1.4.3.

5.1.5.2.2 A metallic splice case must be used at the first splice point inside the building for cables of 400 pairs or less.

5.1.5.3 Metallic Conduits

All metallic conduits (entrance, riser, tie and station), shall be electrically bonded together and grounded to the main or floor ground bus bar.

5.1.5.4 Entrance Terminal Grounding

5.1.5.4.1 The ground lug of protected building terminals shall be connected to an approved and permanent ground (master ground bar) with a minimum of 6 AWG (16 mm^2) insulated solid copper ground wire with no cut, splices or sharp bends. The minimum acceptable bending radius shall be 15 cm (6 in.) for sizes up to # 6 AWG (16 mm^2). The maximum length of ground wire shall not exceed 6.1 m (20 ft.).

5.1.5.4.2 The design engineer shall illustrate the exact grounding arrangements on the construction drawings, from the ground lug of the protector to the power or building ground.

5.1.5.4.3 The actual grounding path shall be recorded on the "as-built" drawings.

5.1.6 Outside Plant Cable Bonding and Grounding

5.1.6.1 General

5.1.6.1.1 The design engineer shall review the existing distribution plant where construction activity is to take place (in pedestals and manholes where splicing, transfers, removal or placement of cable occurs) to ensure that the cable electrical protection devices and the bonding and grounding of cable sheaths meet current Saudi Aramco Standards. This review shall include the physical inspection and testing of made ground electrodes. All non-complying situations must be corrected. This shall include electrical protection devices, grounding, and bonding systems inside existing buildings.
The requirements of this paragraph apply to all projects and work orders.

Commentary Note:

The intent of this standard is to insure that the electrical protection system is maintained and safety hazards are highlighted and corrected. When an existing electrical protection device (bond and grounding connection and conductor, station protector) is found to be missing, defective or damaged, a report identifying (manhole, pedestal, terminal no. and location) each item is to be issued promptly. The report is to be forwarded to the responsible maintenance and operations agency so that immediate action can be taken to make repairs of the electrical protection system.

Exception:

The exception to this is when a project job order specifically calls for the repair of the electrical protection system in the scope of work and construction drawing.

5.1.6.1.2 The metallic shields (including any armors) of all cables through splices (in pedestals, direct buried or in manholes/handholes) splice cases, terminals, apparatus cabinets, etc., shall be continuous

throughout the length of the cable, except where it is purposely broken by an insulating joint (within zone of influence of electric power stations). All metallic shields and armors, if present, of all cables shall be made continuous with #6 AWG (16 mm²) or larger bonding wire. All bonds are to be connected to a common ground to ensure that all cables are at the same potential.

5.1.6.1.3 At junctions of cable and distribution and service wire, bond the support wire or armor of the service wire to the cable strand or shield.

5.1.6.1.4 When aerial telecommunication cables and CATV cables are jointly exposed, bond their separate strands:

a) At the beginning and the end of the exposure

b) Four times per 1.6 km (1 mile).

5.1.6.1.5 Cabinets and repeater housings shall be grounded using a grounding electrode with a resistance of 25 ohms or less according to the National Electrical Safety Code (NESC).

5.1.6.1.6 In sections that are not jointly used, the cable must be grounded using a grounding electrode with a resistance of 25 ohms or less at 610 m (2000 ft.) intervals.

5.1.6.2 Aerial Strand

5.1.6.2.1 Aerial strands shall be continuous and bonded together.

5.1.6.2.2 When power lines with voltages in excess of 300 volts (but not over 20 kV phase to phase) cross over telecommunication cables on a common pole and a power ground is present, bond the cable strand to the power ground. If separate poles are used, bond the cable strand to the power ground or a 25 ohm maximum man made ground electrode at the first pole on each side of the crossing.

5.1.6.2.3 If a power ground is not present, bond the cable strand to a ground electrode with a resistance of 25 ohms or less on each side of the crossing.

5.1.6.2.4 Cable shields and armors, if present, shall be bonded to the vertical power ground conductor within the communication space on joint-use poles.

5.1.6.2.5 Where two cables from different communication buildings terminate on the same pole at the exchange boundary from different directions, and are not electrically connected anywhere in their routes, their support strands shall be continuous or bonded together.

5.1.6.2.6 Separate telecommunication cables on the same supporting structures shall be bonded together at least every 610 m (2000 ft.). Where two cables are supported on the same cable suspension bolt, the bolt does not function as the necessary bond.

5.1.6.3 Aerial Polyethylene Sheath Cable

5.1.6.3.1 Where splice cases and splice case-type terminals are used, the metal of the sheath shall be bonded to the strand through the sheath clamps that are fastened to the splice case.

5.1.6.3.2 Telecommunication cables shall not be placed on power lines carrying voltages of 20 kV phase-to-phase or higher. Joint use shall not be permitted with delta-wired power distribution systems. Refer to SAES-T-604, "Plant - Clearances/ Separations - Aerial," for establishing the minimum acceptable clearances when constructing telecommunications plant on joint pole lines.

5.1.6.3.3 Bond down guys to support strands and vertical ground conductors. Any existing strain insulators shall be omitted or bonded across with a minimum of # 6 AWG (16 mm^2) copper ground wire unless they have been specifically placed for isolation in places such as at power substations.

5.1.6.3.4 Aerial cable shields and strands shall be continuous, bonded together and grounded to the power ground at intervals not exceeding 305 m (1000 ft.).

5.1.6.4 Fuse Cable Protection

Fuse cable shall be placed at the junction of aerial cable with buried or underground cable according to the matrix as shown in Table 2.

Table 2
Fuse Cable Requirement at Aerial-Buried or Underground Cable Junctions

Aerial Cable Gauge	Buried or Underground Cable Gauge	Fusing Required		Fuse Cable Gauge
		Yes	No	
26	Any		x	
24	26		x	
24	24, 22, 19		x (1)	
22	26, 24		x	
22	22, 19	x		24
19	26, 24		x	
19	22, 19	x		24

Note: (1) If 24 or heavier gauge cable extends to the central office, not fusing at this junction will require fusing at the central office unless 22 gauge tip cable is used.

5.1.6.5 Underground Polyethylene Sheath Cable

5.1.6.5.1 The manhole/handhole/pullbox ground electrode shall be:

a) Minimum of one 16 mm (5/8 in.) diameter by 2.44 m (8 ft.) long ground rod. If required to obtain required resistance, additional rods must be placed.

b) Tested and measured for resistance to meet requirements as stated in 5.1.3.

5.1.6.5.2 Bonding and grounding of polyethylene sheath cable at intermediate manholes or pull-throughs where no opening is made in the polyethylene jacket

is not required. However, ensure that the distance to a bonded and grounded point is not more than 305 m (1000 ft.).

5.1.6.5.3 When cables run through metallic conduits, bond the cable metallic shield (and armor if present) to each end of the conduit. Refer to SAES-T-629 for additional details.

5.1.6.5.4 The steel armor in wire /or tape-armored cables shall be bonded to its underlying metallic shield(s) on each side of all splices (in pedestals, direct buried or in manholes/handholes, etc.), junctions and terminations. If wire or tape-armored cable is spliced to a standard underground polyethylene-insulated cable (PIC) or to a submarine cable, both ends of the tapes or wires shall be bonded to the cable shields on both sides of the splice. Armor wires shall be bonded to the cable shield(s) at the end of the submarine cable. All bonds shall then be grounded to a common approved ground (refer to paragraph 4.1.4.1) with a minimum of #6 AWG (16 mm²) copper ground wire. This shall apply to all types of cable including standard feeder and distribution outside plant copper conductor cables, fiber optic cables (with or without interstitial copper pairs) and pulse code modulation (PCM) cables.

5.1.6.6 Buried Polyethylene Sheath Cable

5.1.6.6.1 Buried cable shields and armors shall be grounded at points not more than 610 m (2000 ft.) from a ground of 25 ohms or less.

5.1.6.6.2 When a telephone cable is buried beside or beneath aerial grounded power lines, bond the telephone cable shield to the power ground at the beginning of the exposure, at the end of the exposure, and at points not more than 305 m (1000 ft.) from a ground point.

5.1.6.6.3 When a telephone cable is buried besides or beneath aerial ungrounded (delta) power lines, establish 25 ohm or less man made grounds. Bond the telephone cable shield to the man made grounds at

the beginning of the exposure, at the end of the exposure and at points not more than 305 m (1000 ft.) from a ground point.

5.1.6.6.4 Where a terminal housing/pedestal is located within 3 m (10 ft.) of an electrical supply terminal or transformer housing (grounded system), a # 6 AWG (16 mm²) copper wire shall be used to bond the telecommunication terminal housing to the electrical supply terminal or secondary section of the transformer.

5.1.6.6.5 When telecommunication cables are buried parallel to buried power facilities (in a joint or separate trench) with fixed separation (one meter or less) and, where there is no requirement for a telecommunications pedestal/terminal, a telecommunication cable may be buried past distribution power transformers/terminals etc., without placing a telecommunications pedestal/terminal solely for the purpose of bonding the cable shield to the power ground. Ensure that no point on the cable is more than 150 m (500 ft.) from a bond to the power ground and bond the bare grounding conductor and the cable shield at:

- Each transformer
- Additional locations as required.

5.1.6.6.6 In areas where a terminal housing/pedestal is subject to disturbance/damage from vehicles, etc., it shall be protected with a pedestal guard. These have typically been constructed of steel pipe. Where pedestal guards are constructed of steel pipe or other metallic materials, they shall be bonded to the pedestal with a # 6 AWG (16 mm²) copper wire. The copper ground wire shall be attached to a metallic post of the pedestal guard (using cadweld method or an approved mechanical connector) at a point 50-75 mm above the concrete encasement of the metallic post base.

5.1.6.7 Joint Burial of Power and Telecommunications Cables

Separations between buried power facilities (power cable, power pedestals, etc.) and telecommunication cables (when crossing) shall not be less than 300 mm (12 in.) of well-tamped earth.

In areas where this is not possible, 75 mm (3 in.) of concrete or 100 mm (4 in.) of masonry is permitted.

Where the power exposure is greater than 15 kV phase to phase, buried telecommunication cables shall be placed inside PVC or similar characteristic conduit at the crossing. Refer to SAES-T-928.

5.1.6.8 Fiber Optic Cable

5.1.6.8.1 All metallic members of a fiber optic cable shall be bonded together and grounded at all splice locations. The ground shall meet these requirements:

1) Be of 25 ohms or less resistance.

2) Be bonded to the power ground, when available within 3 m (10 ft.). Where there is no requirement for a pedestal/terminal, a fiber optic cable may be buried past distribution power transformers/terminals, etc., without placing a pedestal/terminal solely for the purpose of bonding the cable metallic members to the power ground. Ensure that, no point on the cable is more than 150 m (500 ft.) from a bond to the power ground and bond the bare grounding conductor and the cable shield at:

- Each transformer
- Additional locations as required.

5.1.6.8.2 When a fiber optic cable containing metallic members is placed on a pole line (and the inductive effects of nearby power lines are not calculated), bond the metallic members to the support strand at all splice points and at intervals not to exceed 2 km (1.25 miles). Where it is not practical to place bonds every 2 km, or where there are complicated power

exposures, the bonding and grounding design must be reviewed and approved in writing by the Saudi Aramco Communications Standards Committee Chairman. In any case, the separation between bonds will not be permitted to exceed 4.8 km (3 miles). Each bond point shall be grounded to the power ground, where available. In other areas, a ground electrode of 25 ohms resistance or less shall be provided. Joint use with delta power systems is not permitted. Refer to SAES-T-624.

5.1.6.8.3 Bond the support strand to the power ground at intervals of 610 m (2000 ft.) or less.

5.2 Protection Equipment in Communication Buildings

5.2.1 Protection Types

5.2.1.1 Cables Entering CO Buildings

5.2.1.1.1 The shields and armors of all cables (including the metallic members of fiber optic cables) entering switching centers, central offices and other telecommunication equipment buildings (includes radio and microwave buildings) must be bonded to each other and connected to the CO ground (CEGB or Cable Entrance Ground Bar).

5.2.1.1.2 Ground wires must be as short as possible, contain no sharp bends and the number of bends kept at a minimum number. Common bonding between the telephone protector ground the power service ground system is required. Refer to NEC Article 800-100.

All cables entering the CO must have all metalic members (shields, strand, etc.) grounded as close as practical to, but not to exceed 50 ft (15 m) from the entrance point. Refer to NEC Articles 800-47 and 48.

5.2.1.2 All outside plant metallic twisted cable pairs entering switching centers, central offices and other telecommunication equipment buildings (includes radio and microwave buildings) shall be protected with fail safe solid state protectors.

5.2.1.3 Telecommunication digital facilities shall not be located where the maximum Ground Potential Rise (GPR) exceeds 300 V peak, or where the Electromagnetic field originated by a fault in the power system would impose more than 3.33 Joules within the digital communication facility. Refer to SAES-T-887.

5.2.1.4 UL Listings

Central office protectors shall be UL (Underwriters' Laboratories) listed as a complete assembly. Refer to paragraph 3.2 above for the appropriate industry standard. CO protectors include the following:

1. Fused and fuseless station protectors.
2. Protected cable terminals.
3. Protected terminal blocks.
4. CP protectors.

5.2.1.5 Fail Safe

Arresters used on Saudi Aramco Telecommunication circuits must be a type that always fail in the shorted/grounded condition.

5.2.1.6 Ground Resistance Minimum Requirements:

- 3 ohms for communications facilities with Electronic Switching and Transmission Systems
- 2 ohms for communications facilities with communications Towers
- 25 ohms for Microwave Remote Repeater Site (no switching or multiplex equipment)

For communication facility grounding systems refer to SAES-T-795, SAES-P-111, AA-036765 and AA-036391.

5.2.1.7 Fuse Cable Protection

a) Fuse cable of a minimum length of 2 m of fine gauge (24 or 26 AWG) cable shall be installed if the outside plant entrance cable contains 22 AWG or larger gauge conductors, refer to 5.1.4.2.

b) No additional fuse cable is required if the entrance cable contains 24 or 26 AWG copper conductors and the central office connector stub (tip cable) contains conductors which are at least two gauges larger than the conductors in the entrance cable (i.e., 22 AWG for 24 AWG entrance/fuse cable), refer to 5.1.4.2.

5.2.1.8 Terminating cable conductors shall be two gauges larger than the fuse cable conductors. Indoor PVC sheath cables must not be exposed to sunlight. When the tip splice is located in the CO equipment room, the outside polyethylene sheath cable must be wrapped with arc and fire-retardant tape from the tip splice to the building entrance point.

5.2.1.9 Heat coils protect equipment against prolonged currents of small magnitude which might eventually cause a fire or damage equipment. Central office protectors shall be equipped with heat coils unless the equipment manufacturer directs otherwise. The manufacturers' instructions must be followed to avoid the possibility of violating the warranty conditions of the manufacturer.

5.2.2 Protection Devices, Solid State Protectors

Solid state protectors shall be used for CO protection.

5.2.3 Protector Application Guidelines

5.2.3.1 All new telecommunication equipment projects shall specify five-pin/four pin protector modules equipped with 300 V solid state protection devices.

5.2.3.2 Refer to sections 6 and 7 for the protector modules installation and testing.

5.2.3.3 Digital Switches and Remote Line Concentrators: Existing protectors need to be replaced for maintenance and repair purpose etc. shall be replaced with solid state protectors.

5.3 Station Protection for telecommunication plant of less than 25 pair cables.

5.3.1 General

5.3.1.1 The 60 Hz Flashover Voltage Requirements

a) A minimum of 5,000 VDC breakdown voltage between

the line cord conductors and parts of the set in constant contact with the user (telephone hand set).

b) A minimum of 1,000 VDC to parts in short term contact with the user.

5.3.1.2 Fuseless Station Protectors

5.3.1.2.1 UL Listings

Fuseless station protectors shall be Underwriter's Laboratories (UL) listed as a complete assembly. See UL 497, UL 497A, or UL 497B for detailed requirements.

5.3.1.2.2 Fail Safe

Arresters used on Saudi Aramco telecommunication circuits must be a type that always fail in the shorted/grounded condition.

5.3.1.3 Fuseless station protectors shall be used when:

a) A 24 AWG building entrance cable is used and its metal shield is grounded to the station ground and bonded to the distribution cable shield.

b) A distribution cable serves the entrance facility from:

- A cable terminal with a 24 AWG stub connecting it to the distribution facility.
- Pedestal terminal equipped with terminal blocks, provided the cable pair is connected to the terminal block binding post by a minimum of 450 mm of 24 AWG leads.

c) A distribution facility is entirely underground or buried; entrance facility may be aerial, underground, or buried.

5.3.1.4 Selecting protectors

Solid state type protectors shall be the basic method of protection at all stations.

5.3.2 Station Protectors Application

5.3.2.1 Electrical protection for telecommunication stations is mandatory in any of the following conditions:

a) Station equipment is operated by local AC or DC power in excess of 50 volts, or the station is in a bathroom, near a swimming pool, on a boat dock or in a boat (the station equipment location and length of the cords must be such that the handset cannot be submerged in water or taken into a shower).

b) Loop exposed to lightning (all loops in Saudi Aramco operating area are considered exposed to lightning), except any on-premises extensions which are not exposed to 300 volts or more and not extended to a separate building more than 23 m away.

5.3.2.2 Heat Coils

Station protectors shall not be equipped with heat coils due to the limited protection they provide and certain components of equipment may be damaged by currents which are too small to operate the heat coils.

5.3.2.3 Fusible Link

5.3.2.3.1 Fusible links must be provided in all entrance facilities.

5.3.2.3.2 The fusible link may be one of the following:

a) The conductors of the main distribution cable.

b) The terminal cable stub.

c) The entrance cable.

5.3.2.3.3 To keep the protector from overheating and to reduce the fire hazard, the fusible link must:

a) Be between the exposed plant and protectors.

b) Begin (or be) at the outside plant distribution cable end of the service entrance when aerial drops or buried service wires are used.

5.3.2.3.4 Conductor Size

The fusible link conductors must be 24 AWG or smaller.

5.3.2.3.5 Removing Sheath

Do not remove sheath from a 24 or 26 AWG entrance cable to make connections to a terminal unless the terminal is mounted in an enclosed metallic terminal box.

5.3.2.4 Methods of Furnishing the Fusible Link

5.3.2.4.1 Service Entrance Facilities

All new service entrance cables shall be shielded cable which has its shield and armor, if present, effectively grounded at both ends. Refer to Sections 5.1.4 and 5.1.5.

5.3.2.4.2 Buried Wire/Drop Wire as Service Entrance

a) Bond the shield or armor of the wire to the grounded strand, shield or armor of the distribution plant.

b) Connect the shield or armor to the station ground.

c) Connect the wire's conductors to the distribution plant.

d) A minimum of 600 mm of stub fuse cable or a minimum of 150 mm of terminal leads must be visible.

5.3.2.4.3 Fuse-Link Wire

Never install fuse-link wire at the house end of the service drop.

Commentary Note:

This is to avoid any fire hazard at the building from fusing of the fuse-link wire.

5.3.2.4.4 Distribution Plant

a) 24 or 26 AWG conductors in shielded cable may provide the fusible link in the distribution plant when the conductors are located where the drop or cable entrance connection is made.

b) Do not expose service entrance facilities to power facility contacts above 300 volts to ground.

c) Stubs containing 24 AWG conductors may provide the fusible link. Stubs from the main cable to a terminal must be at least 600 mm long.

d) A minimum of 600 mm of stub fuse cable or a minimum of 150 mm of terminal leads must be visible.

5.3.2.4.5 Fixed Count Terminals

a) Distribution plant may provide fusible link if the terminal is mounted on 24 or 26 AWG distribution cable.

b) If the distribution cable is 22 AWG or larger, 24 or 26 AWG conductors shall provide the fuse link inside the 600 mm terminal stub.

5.3.3 Station Protectors Description

Only fuseless type station protectors shall be used on Saudi Aramco telecommunication circuits.

5.3.4 Station Protectors Installation

5.3.4.1 Selecting Protector Locations

The selection for station protector's location depends on:

5.3.4.1.1 Maximum Length of Ground Wire

Ground wire runs from the station protector to the ground source (building ground etc.) must not exceed 6 m.

5.3.4.1.2 Protector Location

a) Protector and entrance facilities shall be located at least 300 mm from:

- Electric light or power line facilities
- Facilities of other utilities

b) Avoid flammable materials and areas where the atmosphere may be combustible.

c) Locate 150 mm or more away from window curtains.

d) Avoid excessively damp locations.

e) Avoid locations where the protector will be subjected to tampering and where the material might be piled against it.

5.3.4.1.3 Protectors at Waterside Locations

For telephones installed in boats, plug-in dockside service, or telephones on docks, the protector shall be installed at the nearest land or any nearer location where a proper ground is available.

5.3.4.1.4 Minimum Ground Wire Capacity

Ground wire runs from the station protector to the ground source (building ground etc.) shall be an insulated No. 6 AWG solid copper conductor or coarser.

5.3.4.1.5 Solid State Protectors

Solid state station protectors shall be used for all new stations.

5.3.4.2 Installation

Where protection for multiple services is required, a protected building terminal shall be installed in a terminal box for station protection.

5.3.5 Station Protection - Mobile Home Installation

Work done at mobile home locations shall be of a permanent nature.

5.3.5.1 Testing Mobile Home Chassis for Foreign Voltages

Before making bodily contact with any metal portion of the mobile home, confirm that there are no hazardous voltages on the mobile home chassis (trailer body to ground) using a volt-ohm-meter (VOM).

5.3.5.2 Installing Station Protectors, Wire, and Cable

5.3.5.2.1 Locating the Protector

The protector shall be located on a post as near as possible (not more than 300 mm) to the mobile home. Direct protector attachment to the trailer is not permissible.

5.3.5.2.2 Bonding Mobile Homes

The mobile home chassis must be bonded directly to the telephone ground electrode using No. 6 AWG ground wire to limit the differences in electrical potential that may develop between telephone equipment, metal surfaces, and the wiring of the mobile home.

5.3.5.2.3 Wiring

When the post cannot be placed 300 mm or less from the mobile home, a conduit from the post to the mobile shall be used to protect station wiring from damage. If metal conduit is used, place a bond between it and the ground at each end of the conduit to prevent forming chokes.

5.3.5.2.4 Connection

a) Where a power ground rod is used, connect the protector ground and chassis ground to the grounding medium with separate UL listed clamps. Bonding of grounding connections to power ground facilities must be done in accordance with SAES-P-111.

b) Never coil or wrap ground wire around pipes or run it through metal rings.

c) Do not make bends less than 150 mm in the ground wire (wire between protector and ground source).

d) Attach No. 6 AWG ground wires to the post with station wire nails or galvanized clamps.

e) Attach No. 6 AWG ground wire to the post with 10 mm staples or clamps.

5.3.5.2.5 Burying Ground Wire

Ground wire shall be buried to a minimum depth of:

a) 450 mm under lawns

b) 450 mm under driveways

c) 600 mm where the earth may be disturbed in the future

5.3.6 Installation - Special Services Circuit Safeguarding on User Premises

5.3.6.1 Examples of special services lines, which require guarding against service interruption due to accidental contact are the following:

a) Carrier telegraph.

b) Program supply (radio).

c) Remote control, signal and alarm, including fire, industrial security and various instrument gauge lines.

d) Ringing supply lines for hospital, fire and industrial security departments.

e) Special facilities intended for use in case of major disaster.

f) Trunk circuits (digital & analog).

5.3.6.2 Extreme care must be exercised when working on or near special service circuits. Unauthorized work on these lines may result in a service interruption, or accidental start of special equipment.

5.3.7 Station Grounding Requirements – Description

5.3.7.1 Preferred Ground Electrodes

a) The power service ground electrode or ground system shall be used as the telephone protector ground electrode except as permitted in paragraph 5.3.7.2.

b) The telephone protector grounding conductor may be connected to:

- Power service equipment enclosure (external portions of enclosure only)
- Power service grounding electrode conductor
- Other ground electrodes as permitted by NEC, Article 800.

5.3.7.2 If the power service (first choice ground source) is not located within 6 m of the telephone station protector, relocate the telecommunication protector, or one of the following electrodes may be used if it is bonded to the power service ground and forms a part of the building ground system:

a) Grounded metal frame of the building.

b) Ground ring encircling the building at 0.76 m minimum depth, of No. 2 AWG minimum copper conductor, and having a minimum circumference of 6 m.

c) All the above grounds present on the premises must be bonded together regardless of the distance between electrodes or ground systems.

d) A 25 ohms or less ground electrode bonded to power service ground.

e) Ground resistance measurements shall be made in accordance with SAES-T-887.

5.3.8 Station Grounds Installation

5.3.8.1 The ground wire shall be located where:

a) It will be continuous (without splices) and free from sharp bends

b) It will not be subjected to tampering

c) The run will be as short as possible, and no longer than 6 m.

5.3.8.2 Notes

a) Do not fish ground wires through walls or under floors.

b) The ground wire may run through the same entrance as the station wire if:

- A station protector is mounted outside, and
- The ground is located under the building.

c) Do not run the station protector ground wire in attics.

d) Bury the ground wire running from a building to an exterior ground connection.

e) Avoid locating the ground wire where it is likely to be disturbed.

f) Never encircle the ground wire with a metal ring because the ring will act as an RF choke.

5.3.8.3 Ground Conductor Connections

In grounding (bonding) wire runs, sharp kinks and bends shall be avoided. Slack ground wire shall not be coiled or wrapped around the ground electrode. Ground wires may be stapled or clamped in position, but they must not be run through bridle rings, closed metallic clips, sleeves, metallic pipes, or wrapped around nails or any other objects.

5.3.8.4 Inside Station Wire Connections

To create a choke to prevent lightning from following the wire, each of the inside station wire conductors shall be coiled with three or four turns about 25 mm diameter before being connected to the station protector.

5.3.8.5 Conduit for Ground Wires

When conduit is required for ground wires, always use non metallic conduit. If metallic conduit must be used, the ground wire shall be bonded to the conduit at each end. Also, when OSP cables run through metallic conduits, bond the cable metallic shield and armor if present to each end of the conduit.

Exception:

For an exception to this requirement, refer to SAES-T-629.

6 Installation

Electrical protection of all types of communication facilities including, but not limited to, copper conductor cables used for feed and distribution, pulse code modulation (PCM) cables used for carrier and local distribution, CO and station protectors and metallic fiber optic cables (with or without interstitial copper pairs) is mandatory and shall be according to SAES-T-887, SAES-T-916 and other applicable standards as referenced in this standard.

7 Testing and Inspection

Electrical protection equipment shall be tested with the cable according to SAES-T-634. All CO and station protectors shall be Underwriters Laboratories (UL) listed or equivalent. Inspection of installations shall be carried out by the Saudi Aramco Inspection Department during all phases of construction.

Revision Summary

5 October 2008	Major revision.
12 June 2011	Editorial revision to remove the committee members' list and change the document's Primary Contact Person.
21 May 2012	Editorial revision to change the primary contact.

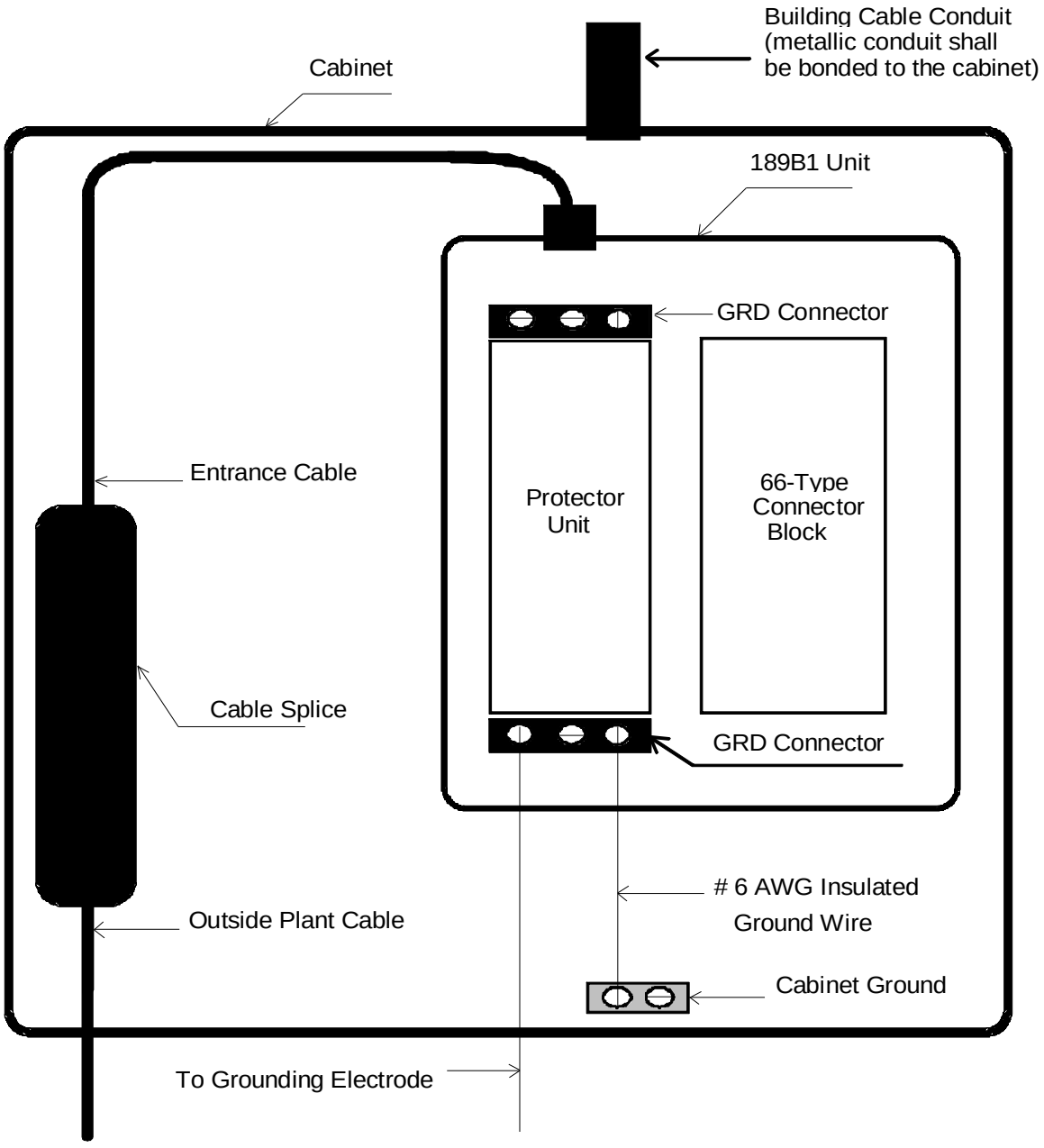

Figure 1 – Bonding and Grounding at Cable Entrance