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SPECIFICATION FOR INSTRUMENT CABLE

03	19/MAR/18	FI	S.Y.Kim.	Y.M.Park.	J.H.Noh.	
02	09/MAR/18	FI	S.Y.Kim.	Y.M.Park.	J.H.Noh.	
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00	28/DEC/17	IFA	M.K.Kim.	Y.M.Park.	J.H.Noh.	
REV.	DATE	Purpose of Issue	PRE'D	CHK'D	APP'D	AUT'D

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1.0 DOCUMENT PURPOSE

The present document defines the minimum requirements for design, manufacture and test of instrument cables for Southern Adish Gas Condensate Refinery Project.

Any deviation from this specification shall be subject to CLIENT approval.

2.0 REFERENCE

This document is complemented by the following documents;

SACR-DE-GEN-PR-SPC-0004	Basic Engineering Design Data (site data, utility condition)
SACR-DE-GEN-IN-SPC-0022	Specification for Instrument Installation
SRIC-BE-GEN-TI-SPC-0002	Specification for General Inspection and Test Activities
SACR-DE-GEN-IN-SPC-0005	Specification for Telecommunication Cables
SACR-DE-GEN-PC-PRC-0024	Packing and Marking Instruction
SACR-DE-GEN-PC-PRC-0025	Shipping Instruction
SRIC-BE-GEN-PP-PRC-0002	Spare Part Procedure

3.0 CODE & STANDARD

Instrument cables shall comply with the latest revision of relevant codes and standards referred to this document at the time of contract award.

In the event of conflict between codes and standards and/or this specification, the matter shall be highlighted for CLIENT attention/approval.

3.1 INTERNATIONAL STANDARD

British Standards Institute (BSI)

PAS 5308	Specification for Instrumentation Cables
BS 6746	Specification for PVC insulation and sheath of electric cables
BS 5099	Specification for spark testing electric cables
BS EN 50288-7	Multi-element metallic cable used in analogue and digital communication and control

International Electro technical Commission (IEC)

IEC 60028	“International Standard of Resistance Copper”
IEC 60079-14	“Explosive atmospheres, Electrical installations design, selection and erection”
IEC 60189	“Low-Frequency Cables and Wires with PVC Insulation and PVC Sheath”
IEC 60245-1 to 3	“Rubber Insulated Cables-Rated voltages up to & including 450/750 V”
IEC 60228	“Conductors of Insulated Cables”

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IEC 60331	“Tests for Electric Cables under Fire Conditions: Circuit Integrity”
IEC 60332-3	“Tests on Electric Cables under Fire Conditions –Part 1, 3C”
IEC 60445	“Basic and Safety Principles for Man-Machine Interface, Marking and Identification-Identification of Conductors by Colors or Numerals”
IEC 60811	“Electrical and Optical Fibber Cables-Test Methods for Non-Metallic Materials”
IEC 61034	“Measurement of Smoke Density of Electric Cables Burning Under Defined Conditions”
IEC 60227	“Polyvinyl Chloride Insulated Cables of Rated Voltages up to and including 450/750 V”
IEC 60502	“Power Cables with Extruded Insulation and Their Accessories for Rated Voltages from 1 kV”
IEC 60584	“Thermocouples”
IEC 60754	“Test on gases evolved during combustion of materials from cables”
IEC 60092-376	“Cables for Control and instrumentation circuits 150/250 V (300V)”

American Society of Testing and Materials (ASTM)

ASTM D1047	“PVC Jacket for Cables”
ASTM D2863	“Test Method for measuring the minimum oxygen concentration”

Other Standards

ISO 4589	“Determination of Burning Behaviour by Oxygen Index”
ITU Rec. G652	“Characteristics of a Single Mode Optical Fibber Cable”
ISO 9001	“Quality Management System-Requirements”
ISO 11801	“Generic Cabling”

3.2 IRANIAN STANDARDS

IPS (IRANIAN PETROLEUM STANDARDS)

IPS-E-IN-190	Engineering Standard for Transmission Systems
IPS-M-IN-190	Material and Equipment Standard for Transmission Systems
IPS-M-EL-271	Material and Equipment Standard for Low Voltage Cables and Wires

4.0 USE OF LANGUAGE

Throughout this specification, the words "will", "may", "should", "shall" when used have the following meaning:

“will” is used normally in conjunction with an action by CLIENT,

“may” is used where alternatives are equally acceptable,

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“should” is used where a solution is preferred

“shall” is used where a provision is mandatory

5.0 DEFINITIONS & ABBREVIATIONS

PROJECT	:	Southern Adish Gas Condensate Refinery Project
CLIENT	:	Southern Adish Gas Condensate Refinery Company
CONTRACT	:	Shall mean the agreement between the CLIENT and the CONTRACTOR.
CONTRACTOR	:	Shall mean the party which has entered under a CONTRACT or agreement with CLIENT for the execution of detail engineering of PROJECT facilities.
BASIC DESIGN COMPANY	:	Shall mean the parties which have implemented the basic engineering of this PROJECT, i.e. Energy Industries Engineering & Design (EIED) and Toyo Engineering.
LICENSOR	:	Shall mean the parties which have implemented the basic engineering of licensor units, i.e. AXENS for LPG treating Unit and Middle Distillate Hydrotreating Unit (MDH) and HALDOR TOPSOE for Naphtha Hydrotreating Unit (NHT).
BASIC DESIGN PACKAGE	:	Shall mean any engineering documents which were designed by BASIC DESIGN COMPANY and LICENSOR at basic engineering phase as the basis of detail engineering.
VENDOR	:	Shall mean any person, firm or business which manufacture or supply materials, equipment or services for the performance of any item of WORK.
SUBCONTRACTOR	:	Any company or person whom with prior approval of CLIENT has subcontracted directly or indirectly at any level and any part of PROJECT.
CONSTRUCTION CONTRACTOR	:	Shall mean the party which is assigned by CLIENT for the overall construction work of this PROJECT on site.

The following terms shall have the meanings indicated below, unless clearly indicated otherwise by the context of their use:

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PCS	Process Control System
ESD	Emergency shutdown
F&G	Fire and gas
IS	Intrinsically safe
ITR	Instrument Technical Room
XLPE	Cross-linked polyethylene
CR	Control Room
HCL	Hydrochloric Acid (Hydrogen Chloride)
PVC	Polyvinyl Chloride
LSZH	Low smoke Zero Halogen

6.0 ORDER OF PRECEDENCE

In case of conflict between documents relating in the inquiry or order, the following priority of documents shall apply:

1. First Priority: Contract/Purchase Order.
2. Second Priority: Material Requisition.
3. Third Priority: Data sheets / Engineering drawings.
4. Fourth Priority: Project specifications (attached to MR).
5. Fifth Priority: Local regulation (mostly for safety and environmental)
6. Sixth Priority: Codes and standards (referenced in MR and/or its attachments)

In case of conflict between data sheets and specifications/standards, VENDOR shall inform the CLIENT for resolution. No action can be taken prior to CLIENT approval.

7.0 ENVIRONMENTAL CONDITION

Instruments and equipments shall be designed to operate indoor/outdoor and at environmental conditions describe in document: SRIC-BE-GEN-PR-SPC-0001, “Basic Engineering Design Data (site data, utility condition.)”

All cables shall be able to withstand prolonged exposure to direct sunlight and to service

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conditions described below.

Cables shall be suitable for contacts with mineral oils, diesel oils, water, and glycol.

Single cables shall be run preferably on cable trays and multi pairs/cores will be run under and/or above ground.

Air shall be considered corrosive due to the presence of saline atmosphere, dust and traces of H₂S. The equipment will be installed in a seismically active area. The equipment also shall be designed to operate during an earthquake.

8.0 TECHNICAL REQUIREMENTS

8.1 GENERAL

All cables shall be water, oil, UV resistant, gas/vapour tight, and have an oxygen index better than 32 according to ISO 4589.

End of cables shall be thoroughly sealed to prevent entrance of moisture.

All cables shall be designed for Low Smoke and low halogen and Non Toxic fumes emission as per IEC-61034-2 and IEC 60754-1. Whenever F&G cables are utilized for indoor purpose, where the human settles permanently, the outer sheet of cables shall be selected as free halogen.

Allowances on delivered lengths shall be 0 to +5%. Cable drum length shall have a positive tolerance only. CONTRACTOR reserves the right to reject drums with a negative tolerance.

VENDOR shall provide fully completed Electrical Power, and Control and Instrumentation Cable Data Sheets for each cable type given in this section and for all standard cable sizes.

Cable make-up shall comply with the types detailed hereinafter and shall be from the VENDOR's standard production line for the type of cable required.

VENDOR shall specify the minimum installation handling temperature for each cable type.

All cables shall comply with the relevant applicable IEC recommendations and with the regulation of the country of installation.

Cables routed outdoor (buried or above ground) shall be armoured. Cables routed between technical room and field shall be armoured.

Cables installed and fully routed within CR or ITRs shall be Non-Armoured. Armour of cables shall be round Steel Wire Armoured (SWA) type.

Where direct buried cables are to be used in Process Areas, where areas are susceptible to oil or contamination, they shall be considered as Oil resistant, round Steel Wire Armoured (SWA) type, with lead sheath in accordance with EN 50307.*

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*Note: For special cables if commercially not available with lead sheath, vendor may propose other solutions for CLIENT's approval.

It should be noted that the specification of Modbus and Ethernet cables should be confirmed and/or finalized by plant DCS system VENDOR. In case the supply of these cables is included in the scope of supply of one of plant control systems VENDOR (i.e. DCS or PLC's), the VENDOR recommended specifications should be considered as project reference specifications. CONTRACTOR will inform other VENDORS for replaced and reference specifications.

All instrument cables, mentioned below, as a minimum shall be flame retardant as per IEC 60332. All F&G systems shall be fire resistant cables.

ESD/EDP Energized to trip signals shall be fire resistant cable.

Fire resistant cable shall be able to withstand the IEC 60331 fire resistant test. Instrument cables may be included but not limited to the following categories;

1. 4-20 mA analogue signals between conventional transmitters and junction boxes.
2. 4-20 mA analogue signals between junction boxes and control room
3. Switches, solenoids and discrete signals between systems.
4. Signals between thermocouple elements and remote transmitters.
5. Signals between RTD elements and remote transmitters.
6. Ethernet Network Communication Links, OPC Links, Modbus, indoor use

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8.2 CONDUCTORS

The conductors shall be stranded tinned copper wire according to BS EN 50288-7 class 2. The conductor for thermocouple shall be as following table acc. to IEC-60584-1:

Thermocouple Type	Positive Leg	Negative Leg
R	Platinum-%13 Rhodium	Platinum
S	Platinum-%10 Rhodium	Platinum
B	Platinum-%30 Rhodium	Platinum-%6 Rhodium
J	Iron	Copper-Nickel
T	Copper	Copper-Nickel
E	Nickel-Chromium	Copper-Nickel
K	Nickel-Chromium	Nickel-Aluminium
N	Nickel-Chromium-Silicon	Nickel- Silicon

Three conductor sizes shall be used:

- 0.75 mm² Multi-Pair/Triple for analogue/digital signals.
- 1.5 mm² Single-pair/Triple for analogue/digital signals, Single-pair and multi-pair for Fire alarm system cables and thermocouple cables.
- 1.5 mm² minimum for ON/OFF command (SOV) from DCS/ESD/F&G
- 2.5 mm² minimum for sounder and flasher of F&G

8.3 VOLTAGE GRADE

- Analog and discrete signals cables: insulation grade to be 300/500 V
- Instrument power cables: insulation grade to be 600/1000V.
- Instrument earthing cable: Insulation grade to be 450/750 V.

8.4 PARTICULAR CHARACTERISTICS

Cables shall have the following maximum characteristics:

- capacitance between conductors: less than 250 pF/m in accordance with BS EN 50288-7
- Inductance to resistance ratio (Acc. to BS EN-50288-7): < 25 micro H/ohm for up to 1mm² < 40 micro H/ohm for 1.5 mm²

For intrinsically safe services:

- Mutual capacitance: less than 200pF/m and
- Inductance: less than 1micro H/m or L/R less than 30 micro H/ohm as per IEC-60079-14

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8.5 FLAME RETARDANT ARMoured CABLES

Type: Flame retardant according to IEC 60332-3

Conductor: Stranded tinned copper wire according to BS EN 50288-7 class 2. Section: In accordance with § 8.2.

Insulation: XLPE – low smoke, low halogen, Thickness in accordance with BS EN 50288-7.

Twining: The insulated conductors shall be twisted together to form a pair/triple/quad. Cores are twisted 20 times per meter to form a pair/triple/quad. Also multiple pairs shall be twisted at least 6 times per meter.

Wrapping for individual screen (as specified): Each pair / triad / quad shall be wrapped with polyester tape 0.023 mm thick applied with 25 % overlap.

Individual screen (as specified): each pair shall have a laminated screening tape applied with a minimum overlap of 25% with the metallic side down in electrical contact with a drain wire. The laminated screening tape shall comprise aluminium bonded to polyester with a minimum thickness of aluminium of 0.008 mm and a minimum thickness of polyester of 0.010mm.

The drain wire shall comprise of one or more tinned annealed copper wires with a total cross section of not less than 0.5 mm². Over the screening tape, either two polyester tapes shall be applied with a minimum overlap of 25%, or one polyester tape shall be applied with a minimum overlap of 50% in accordance with PAS 5308-1

Overall screen (as specified): laminated screening tape shall comprise aluminium bonded to polyester with a minimum thickness of aluminium of 0.008 mm and a minimum thickness of polyester of 0.010mm and a drain wire comprised of one or more tinned annealed copper wires with a total cross section not less than 0.5 mm² in accordance with PAS 5308-1.

Inner sheath: PVC, low smoke, low halogen, thickness in accordance with BS 5308.

Wrapping below inner sheath: The screened cable shall be wrapped with Polyester tape helically wound.

Armour: Galvanized round steel wire armour (SWA), density and thickness in accordance with BS EN-50288-7. (See Section 8.1)

Overall outer sheath: PVC low smoke emission flame retardant type in accordance with IEC 60332-3. The outer sheath shall be resistant to water, UV, and aliphatic hydrocarbons or aromatic hydrocarbons (when required).

Outer sheath colour: In accordance with § 8.15

Notes: All cables specified, as individual screen shall also have an overall screen.

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8.6 FIRE RESISTANT ARMOURED CABLES

Type: Fire resistant according to IEC 60331.

Conductor: Stranded tinned copper wire according to BS EN-50288-7 class 2.

Section: In accordance with § 8.2.

Insulation: Silicone rubber, low smoke, low halogen, Thickness in accordance with IEC 60245.

Twining: The insulated conductors shall be twisted together to form a pair/triple/quad. Cores are twisted 20 times per meter to form a pair/triple/quad. Also multiple pairs shall be twisted at least 6 times per meter.

Wrapping for individual screen (as specified): Each pair / triad / quad shall be wrapped with polyester tape 0.023 mm thick applied with 25 % overlap.

Individual screen (as specified): each pair shall have a laminated screening tape applied with a minimum overlap of 25% with the metallic side down in electrical contact with a drain wire. The laminated screening tape shall comprise aluminium bonded to polyester with a minimum thickness of aluminium of 0.008 mm and a minimum thickness of polyester of 0.010mm.

The drain wire shall comprise of one or more tinned annealed copper wires with a total cross section of not less than 0.5 mm². Over the screening tape, either two polyester tapes shall be applied with a minimum overlap of 25%, or one polyester tape shall be applied with a minimum overlap of 50% in accordance with PAS 5308-1

Overall screen(as specified): laminated screening tape shall comprise aluminium bonded to polyester with a minimum thickness of aluminium of 0.008 mm and a minimum thickness of polyester of 0.010mm and a drain wire comprised of one or more tinned annealed copper wires with a total cross section not less than 0.5 mm² in accordance with PAS 5308-1.

Wrapping below inner sheath: The screened cable shall be wrapped with polyester tape helically wound.

Inner sheath: Thermoplastic, low smoke, low halogen, thickness in accordance with BS EN 50288-7.

Armour: Galvanized round steel wire armour (SWA), density and thickness in accordance with BS EN 50288-7. (See Section 8.1)

Overall outer sheath: PVC low smoke emission fire resistant type, in accordance with IEC 60331. The outer/sheath shall be resistant to water, UV, and aliphatic hydrocarbons or aromatic hydrocarbons (when required).

Outer sheath colour: In accordance with § 8.15.

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Notes: All cables specified, as individual screen shall also have an overall screen.

8.7 FLAME RETARDANT UNARMoured CABLES

8.8

Type: Flame retardant according to IEC 60332-3.

Conductor: Stranded tinned copper wire according to BS EN 50288-7 class 2.

Section: In accordance with §8.2.

Insulation: XLPE low smoke, low halogen, Thickness in accordance with BS-EN 50288-7.

Twining: The insulated conductors shall be twisted together to form a pair/triple/quad. Cores are twisted 20 times per meter to form a pair/triple/quad. Also multiple pairs shall be twisted at least 6 times per meter.

Wrapping for individual screen (as specified): Each pair / triad / quad shall be wrapped with polyester tape 0.023 mm thick applied with 25 % overlap.

Individual screen (as specified): each pair shall have a laminated screening tape applied with a minimum overlap of 25% with the metallic side down in electrical contact with a drain wire. The laminated screening tape shall comprise aluminium bonded to polyester with a minimum thickness of aluminium of 0.008 mm and a minimum thickness of polyester of 0.010mm.

The drain wire shall comprise of one or more tinned annealed copper wires with a total cross section of not less than 0.5 mm². Over the screening tape, either two polyester tapes shall be applied with a minimum overlap of 25%, or one polyester tape shall be applied with a minimum overlap of 50% in accordance with PAS 5308-1

Overall screen(as specified): laminated screening tape shall comprise aluminium bonded to polyester with a minimum thickness of aluminium of 0.008 mm and a minimum thickness of polyester of 0.010mm and a drain wire comprised of one or more tinned annealed copper wires with a total cross section not less than 0.5 mm² in accordance with PAS 5308-1.

Wrapping below outer sheath: The screened cable shall be wrapped with polyester tape helically wound.

Overall outer sheath: PVC low smoke emission, flame retardant type in accordance with IEC 60332-3. The outer shall be resistant to water, UV, and aliphatic hydrocarbons and aromatic hydrocarbons (when required).

Outer sheath colour: In accordance with § 8.15

Notes: All cables specified, as individual screen shall also have an overall screen.

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8.9 FIRE RESISTANT UNARMoured CABLES

Type: Fire resistant according to IEC 60331.

Conductor: Stranded tinned copper wire according to BS EN 50288-7 class 2.

Section: In accordance § 8.2.

Insulation: Silicone rubber, low smoke, low halogen, thickness in accordance with IEC 60245.

Twining: The insulated conductors shall be twisted together to form a pair/triple/quad. Cores are twisted 20 times per meter to form a pair/triple/quad. Also multiple pairs shall be twisted at least 6 times per meter.

Wrapping for individual screen (as specified): Each pair / triad / quad shall be wrapped with polyester 0.023 mm thick applied with 25 % overlap.

Individual screen (as specified): each pair shall have a laminated screening tape applied with a minimum overlap of 25% with the metallic side down in electrical contact with a drain wire. The laminated screening tape shall comprise aluminium bonded to polyester with a minimum thickness of aluminium of 0.008 mm and a minimum thickness of polyester of 0.010mm.

The drain wire shall comprise of one or more tinned annealed copper wires with a total cross section of not less than 0.5 mm². Over the screening tape, either two polyester tapes shall be applied with a minimum overlap of 25%, or one polyester tape shall be applied with a minimum overlap of 50% in accordance with PAS 5308-1 Overall screen (as specified): laminated screening tape shall comprise aluminium bonded to polyester with a minimum thickness of aluminium of 0.008 mm and a minimum thickness of polyester of 0.010mm and a drain wire comprised of one or more tinned annealed copper wires with a total cross section not less than 0.5 mm² in accordance with PAS 5308-1.

Wrapping below outer sheath: The screened cable shall be wrapped with polyester tape helically wound.

Overall outer sheath: LSZH compound for indoor use, Fire resistant according to IEC 60331. The outer sheath shall be resistant to water, UV, aliphatic hydrocarbons and aromatic hydrocarbons (when required).

Outer sheath colour: In accordance with § 8.15

Notes: All cables specified, as individual screen shall also have an overall screen.

8.10 FLAME RETARDANT EARTHING CABLES

Conductors: tinned copper, stranded.

No of Cores: one

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Outer sheath: PVC low smoke emission, flame retardant type in accordance with IEC 60332-3 and IEC 60227. The outer sheath shall be resistant to water, UV, aliphatic hydrocarbons and aromatic hydrocarbons (when required).

Outer sheath color: see § 8.15

8.11 POWER CABLES

Instrument Power cables shall be manufactured according to IEC 60502 and shall be flame retardant tested according to IEC 60332-3. All cables shall be suitable for usage in wet and dry industrial locations, for fixed installation indoor and outdoor, on trays, racks, in conduits, and direct burial.

Instrument Power Cable: Two Cores, Flame Retardant, Armored.

Application: for instrumentation power distribution

Reference Standard: Cables shall be manufactured strictly in accordance with IEC 60502 in all respects with considering other requirements mentioned in this specification. Number of Cores: 2 cores plus earth wire

Conductor: Stranded annealed copper,

Section: 2.5 mm² as minimum (Calculation is needed for 110 VAC and 230 VAC power cables)

Insulation: XLPE, low halogen

Aarmor: Galvanized round steel wire armour (SWA)

Bedding: PVC, Black colored

Overall outer sheath: PVC, Black colored

Voltage rating: 0.6 / 1 KV

Cores Identification: 230 VAC Power: Brown - Blue, DC Power: Red - Black,

The cores below bedding shall be wrapped with Polyester tape helically wound.

8.12 FIBER OPTIC CABLES

In addition to all applicable specifications requested for normal I&C cables in this document, further Fiber optic (FO) cables requirements have been introduced in Telecommunication Cable Specification. Best normal practices shall be followed by VENDOR for any items uncovered by this specification for FO cables. VENDOR shall inform the Purchaser for such items and provide back-up information.

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8.13 CATALOGUE OF CABLES

The CLIENT/CONTRACTOR shall define the catalogue of cable with related codification to be used for the Plant, in accordance with the general principle listed hereafter

- Type 1:
 - 2 (or 3) core cables for Instrument Power Cable – flame retardant – without screen – SWA – lead sheath.
- Type 2A:
 - Single pair(or triple) cables for analogue – flame retardant – individual screen - SWA – non lead sheath.
 - Multi pair(or triple) cables for analogue – flame retardant – individual & overall screen - SWA – lead sheath.
- Type 2B:
 - Single pair(or triple) cables for switches, discrete signals between systems – flame retardant – individual screen - SWA – non lead sheath.
 - Multi pair(or triple) cables for switches, discrete signals between systems – flame retardant – overall screen - SWA – lead sheath.
- Type 3:

03

 - 2 core cables for solenoids and ON/OFF commands – flame retardant – without screen – SWA – non lead sheath
 - Multi core cables for solenoids and ON/OFF commands – flame retardant – without screen – SWA – lead sheath
- Type 4A:
 - Single pair(or triple) cables for analogue – fire resistant – individual screen - SWA – non lead sheath.
 - Multi pair(or triple) cables for analogue – fire resistant – individual & overall screen - SWA – lead sheath.
- Type 4B:

03

 - 2 core cables for F&G discrete signals, Alarms and Commands – fire resistant – individual screen – SWA – non lead sheath.

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- Multi core cables for F&G Alarms and Commands – fire resistant –overall screen - SWA – lead sheath.
- Type 5
 - Communication cable – flame retardant – overall screen – SWA – non lead sheath (to be complied with VENDOR requirement and CLIENT approval)
- Type 6:
 - System cable – flame retardant – overall screen (to be confirmed with System VENDOR / Supplier).
- Type 11:
 - 2 (or 3) core cables for Instrument Power Cable – flame retardant – without screen - without armour – non lead sheath.
- Type 12A:
 - Single pair(or triple) cables for analogue – flame retardant – individual screen - without armour – non lead sheath.
 - Multi pair(or triple) cables for analogue – flame retardant – individual & overall screen - without armour – non lead sheath.
- Type 12B:
 - Single pair(or triple) cables for switches, discrete signals between systems – flame retardant – individual screen - without armour – non lead sheath.
 - Multi pair(or triple) cables for switches, discrete signals between systems – flame retardant –overall screen - without armour – non lead sheath.



- Type 13:
 - 2 core cables for solenoids and ON/OFF commands – flame retardant – without screen - without armour – non lead sheath.
 - Multi core cables for solenoids and ON/OFF commands – flame retardant – without screen - without armour – non lead sheath.
- Type 14A:
 - Single pair(or triple)cables for analogue – fire resistant – individual screen & without armour – non lead sheath.

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- Multi pair(or triple)cables for analogue – fire resistant – individual & overall screen - without armour – non lead sheath.



- Type 14B:
 - 2 core cables for F&G discrete signals, Alarms and Commands – fire resistant – individual screen - without armour – non lead sheath.
 - Multi core cables for F&G discrete signals, Alarms and Commands – fire resistant –overall screen - without armour – non lead sheath.
- Type 15:
 - Communication cable – flame retardant – overall screen – without armour – non lead sheath (to be complied with VENDOR requirement and CLIENT approval)

8.14 CONDUCTORS NUMBER

The number of pairs/cores in signal cables shall be as follows:

- number of pairs, triples or quads :
 - 1 pair/triple/quad,
 - 2 pair/triple/quad,
 - 3 pair/triple/quad,
 - 4 pair/triple/quad,
 - 7 pairs/triples/quads,
 - 12 pairs/triples/quads,
 - 19 pairs/triples/quads,
 - 27 pairs/triples/quads,
- number of cores:
 - 2 cores
 - 14 cores
 - 20 cores
 - 24 cores

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8.15 REQUIRED INFORMATIONS

The VENDOR shall provide the following information for each cable type:

- resistance at 35°C in Ohms/1000 m,
- inductance at 50 Hz in mH/1000 m,
- capacitance at 50 Hz in micro F/1000 m,
- weight in kg/1000 m,
- overall cable diameter and tolerances,
- diameter of cable under braiding and tolerance,
- thickness of braiding and tolerance,
- bending radius at minimum installation temperature,
- minimum installation temperature,
- maximum pulling tension of cable,
- cable drums capacity and weight of drums,
- Oxygen index.

8.16 IDENTIFICATION

8.16.1 OUTER SHEATH COLOURS

Flame retardant type (Non IS):	Grey
Fire resistant type (Non IS):	Grey with Red stripes
Flame retardant (IS):	Blue
Fire resistant (IS):	Blue with red stripes
Instrument Protective Earth (IPE):	Green/Yellow
Instrument Electronic Earth (IE):	Green
Instrument Safe Electronic Earth (ISE):	Green
Modbus Cable	Orange
High Speed Ethernet Network Cable	Orange

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8.16.1.1 THERMOCOUPLE TEMPERATURE MEASUREMENT. (TYPE K)

Flame Retardant Outer sheath colours: Yellow

Fire Resistant Outer sheath colours: Yellow/Red Stripe

8.16.2 CORE COLOURS

Following colours shall be used for core identification:

2 Core: Red, Black

Multi Core: Each core shall be numbered and sequentially with white coloured conductor

Single pair: Black, white

Multi pair: Black, white (the pairs shall be identified numerically and sequentially)

Single triple: Black, White, Red

Multi triple: Black, White, Red (each core printed with triple number)

Single quad: White, Red, Blue, Yellow

Multi quad: White, Red, Blue, Yellow. (The quads shall be identified numerically and sequentially).

8.16.2.1 THERMOCOUPLE COLOUR CODING SHALL BE AS FOLLOW

The insulation of the negative conductor shall be WHITE for all thermocouple types. The insulation of the positive conductor shall be as following table:

Thermocouple Type	T	E	J	K	N	B	R	S
Color of positive conductor and	Brown	Violet	Black	Green	Pink	Grey	Orange	Orange
sheath insulation								

9.0 NAMEPLATE, MARKING AND LABLING

9.1 CABLES MARKING

The outer sheath of the cable shall be embossed at regular intervals, (i.e. 1000 mm), with marks to distinguish each cable type.

The following minimum will be used.

- Manufacturer's name and year of manufacture
- Cable Type

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- Number of cores and size of conductors
- Voltage rating
- Quality of outer sheath
- Reference to fire test
- Metric marking with remaining length
- Base Standard

9.2 CABLES DRUMS MARKING

VENDOR shall specify his standard cable production lengths and respective drum types and sizes for the quantities of each type of cable required. All drum lengths stated shall be continuous. Cable or conductor jointing in any form is unacceptable.

Cable drums shall each be provided with two 220^{mm}x200^{mm} identification labels made from aluminium or similar durable material, securely affixed one per side and at the top and bottom of each drum. Each label shall be engraved with the following information as a minimum:

- Manufacturer's Name
- Purchaser's name
- Purchase Order Number/Purchase Order Item Number
- Base Standard
- Project Number
- Date of Manufacture
- Batch Number
- Drum number in accordance with the Purchaser's drum numbering system/Description
- Cable type code
- Insulation voltage grade
- Cable size (number of cores and cross sectional area)
- Drummed cable length (meters)

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- Net and gross weights(kg)/Overall Dimensions

Drum identification labels shall be robust and non-fading.

10.0 INSPECTION AND TESTS

10.1 GENERAL

Cables shall be fully inspected and tested at the VENDOR's works to ensure satisfactory operation before packing and shipping. A schedule for testing and inspection shall be detailed in the manufacturing quality plan. The tests will be witnessed by the CLIENT.

These tests shall be performed either on all finished cable lengths or on samples of completed cables.

10.2 TESTS

Copies of test certificate shall be supplied as per project and requisition requirements. These tests shall be performed by the VENDOR and in accordance with the IEC/BS standards.

VENDOR shall also provide type test certificates as specified on the enquiry requisition for the cable designs being offered and test results / reports of all applicable fire performance tests performed to meet the specified standards.

VENDOR shall advise test methods and results for the following performance characteristics of all cable types specified.

- Toxic fumes emission
- Limiting Oxygen Index (minimum value of 32 required)
- Temperature Index
- HCL emission

The VENDOR shall supply with his bid a complete description of his proposed test procedures. These tests shall include but shall not be limited to the following:

10.2.1 GENERAL TESTS

- Qualitative and quantitative control of technical documentation given with cables and its compliance with the particular specifications.
- Control of drums: quality of flanges, marking and labelling, cable designation, length, section, sizes and weight, observance of minimum curve radius, capping of terminations, packaging and protection against shocks.
- Control of conformity with the technical documentation.

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- Visual and Dimensional Inspection
- Voltage grade test
- Dielectric Test
- Uniformity of galvanized armour

10.2.2 NON ELECTRICAL TESTS

- Control of the nature and composition of conductors.
- Control of mechanical properties of insulating covering.
- Bending Test for All Cables
- Measurement of the thickness of the insulating covering.
- Inspection of bedding and assembly.
- Control of the mechanical properties of the external protective sheaths.
- Measurement of the thickness of the external sheaths.
- Verification of the nature, composition and thickness of the metallic armour.
- Measurement of the external dimensions of the complete cable.
- Test for flame retardant according to I.E.C. 60332 for bunched cables.
- Test for fire resistance according to I.E.C. 60331.
- Conformity of fibre optic cables with required specification and code.
- Reflectometry test of fibre optic cables during FAT.
- Reflectometry test of fibre optic cables at site, before pulling.

10.2.3 ELECTRICAL TESTS

- Measurement of electrical resistance of conductors.
- Electric strength tests (voltage grade level)
- Continuity of conductors and shields/galvanized
- Shield isolation jackets shall withstand a dry test of 2000 VAC between shields for one minute.

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- The insulation resistance between shields shall be a minimum of 10 mega ohms per 300m Cable corrected to 15.6 °C.
- Capacitance between conductors.
- Capacitance between conductor and shield.
- Inductance to resistance ratio.

10.3 INSPECTION AND TESTING PROCEDURES

The VENDOR shall submit detailed procedures and test sheets for CLIENT approval which cover the Factory Acceptance Testing 8 weeks before FAT. These procedures shall adequately cover both the VENDOR's own equipment/design and that of any sub- VENDORS.

Where sub-supplied equipment/design is not explicitly covered by the VENDOR's procedures, then this must be covered by documentation provided with the sub-supply. The VENDOR is responsible for the inspection, co-ordination and retention of the documentation.

10.4 INSPECTION AND TESTING DOCUMENTATION

The VENDOR shall maintain up to date documentation at all times reflecting the inspection/testing status of the equipment. The VENDOR will be required to formally submit certain parts of the documentation as defined in the CLIENT's order. However, the submitted documentation shall not be regarded as the total requirements.

The CLIENT will wish to inspect retained documentation such as internal test results, equipment logs and fault correction records. The original signed test procedures and test sheets shall be supplied to the CLIENT at the completion of the tests.

10.5 FACTORY ACCEPTANCE TEST (FAT)

Prior to advising the CLIENT that the equipment is ready for the Factory Acceptance Test (FAT), the VENDOR shall have completed his own 100% in-house test of cables. On successful completion of this, the VENDOR shall then undertake the FAT.

The CLIENT will wish to witness the FAT prior to releasing the equipment for shipment. The VENDOR shall be responsible for conducting the test and providing all necessary facilities, test equipment and personnel.

10.6 PRESERVATION AND PACKING

Cable shall be delivered in maximum manufacturing drum length, except if a specific length is required.

Drum lengths shall be continuous. Cable or conductor jointing, in any form, is unacceptable.

Cable ends shall be fitted with a heat-shrink cap to prevent entry of moisture inside the cable and shall be fixed to the drum.

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Cable shall be shipped on non-returnable drums.

The drums shall be lagged or covered with suitable material, to provide physical protection during transit, ordinary storage and handling operations.

Packaging shall be suitable for shipment and prolonged storage under tropical conditions to a desert or offshore location. VENDOR shall clearly state any special measures required – e.g. power to anti-condensation heaters.

Pre shipment Inspection of the packing and marking shall be carried out before any shipment by an approved third party. In case any export licenses and/or other necessary permits, authorization, etc., are required by authorities in the exporting country then the VENDOR shall obtain such export licenses, permits, authorizations, etc. prior to shipment at own cost and risk.

During loading the VENDOR shall witness the loading and bracing to satisfy himself that all reasonable precautions have been taken to prevent damage occurs during transit. Preparation for shipment and packing will be subject to inspection and rejection by CLIENT's inspectors. All costs occasioned by such rejection shall be to the account of the VENDOR.

Packing shall be in accordance with project specification "Packing, Marking & shipping Procedure SRIC-BE-GEN-PP-PRC-0001

11.0 DOCUMENTATION

Documentation shall be provided in accordance with the CLIENT Documentation Instructions.

The documentation shall include as a minimum the following documents:

- Dimensional Drawing
- Cable Datasheets
- Certification (Type Tests, and etc.)

VENDOR shall provide a detailed schedule for engineering, production, assembly, testing and shipping of the cables. This shall identify all major milestones, including production of documentation, dates for receipt of critical data from CLIENT, order of long lead items, production of test procedures, integration requirements, FAT and integrated test dates. An indication of proposed manning levels shall also be provided in accordance with the proposed schedule.

12.0 SITE SUPERVISION

When specified in the Purchase Order, the VENDOR shall provide representatives to assist the CLIENT during installation, commissioning and initial start-up for all aspects of the equipment.

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13.0 QUALITY

VENDOR shall maintain a quality management system equivalent to ISO 9001 for the supply of equipment and materials as specified in this document.