

Guide for procurement of power station equipment —

Part 2-9: Electrical equipment — Cabling systems

ICS 27.100; 29.060.01

National foreword

This British Standard is the UK implementation of EN 45510-2-9:2008.

The UK participation in its preparation was entrusted to Technical Committee E/-/20, Power engineering steering committee.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot confer immunity from legal obligations.

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Date	Comments

**Guide for procurement of power station equipment -
Part 2-9: Electrical equipment -
Cabling systems**

Guide pour l'acquisition d'équipements
destinés aux centrales de production
d'électricité -
Partie 2-9: Équipements électriques -
Systèmes de câblage

Leitfaden für die Beschaffung
von Ausrüstungen für Kraftwerke -
Teil 2-9: Elektrische Ausrüstung -
Kabelsysteme

This European Standard was approved by CENELEC on 2008-04-01.

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Foreword

This European Standard takes the form of a recommendation and is therefore entitled a 'Guide'.

This Guide for procurement has been prepared by the CEN/CENELEC TC 2 "CEN/CENELEC Joint Technical Group Power Engineering".

The text of the draft was submitted to the formal vote and was approved by CENELEC as EN 45510-2-9 on 2008-04-01.

The following dates were fixed:

- *latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement* (dop) 2009-04-01
- *latest date by which the national standards conflicting with the EN have to be withdrawn* (dow) 2011-04-01

This Guide for procurement has been prepared under mandates given to CEN and CENELEC by the European Commission and the European Free Trade Association.

This Guide for procurement is a part of a series of Guides mandated to cover the procurement of power station plant and equipment in conformity with European Procurement Directives. The Guides are:

EN 45510: Guide for procurement of power station equipment

Part 1: Common clauses

- Part 2-1 ¹⁾: Electrical equipment - Power transformers
- Part 2-2: Electrical equipment - Uninterruptible power supplies
- Part 2-3: Electrical equipment - Stationary batteries and chargers
- Part 2-4: Electrical equipment - High power static converters
- Part 2-5: Electrical equipment - Motors
- Part 2-6: Electrical equipment - Generators
- Part 2-7: Electrical equipment - Switchgear and controlgear
- Part 2-8: Electrical equipment - Power cables
- Part 2-9: Electrical equipment - Cabling systems

- Part 3-1: Boilers - Water tube boilers
- Part 3-2: Boilers - Shell boilers
- Part 3-3: Boilers - Boilers with fluidized bed firing

- Part 4-1: Boiler auxiliaries - Equipment for reduction of dust emissions
- Part 4-2: Boiler auxiliaries - Gas-air, steam-air and gas-gas heaters
- Part 4-3: Boiler auxiliaries - Draught plant
- Part 4-4: Boiler auxiliaries - Fuel preparation equipment
- Part 4-5: Boiler auxiliaries - Coal handling and bulk storage plant
- Part 4-6: Boiler auxiliaries - Flue gas desulphurization (De-SO_x) plant
- Part 4-7: Boiler auxiliaries - Ash handling plant
- Part 4-8: Boiler auxiliaries - Dust handling plant
- Part 4-9: Boiler auxiliaries - Sootblowers
- Part 4-10: Boiler auxiliaries - Flue gas denitrification (De-SO_x) plant

- Part 5-1: Steam turbines
- Part 5-2: Gas turbines
- Part 5-3: Wind turbines
- Part 5-4: Hydraulic turbines, storage pumps and pump-turbines

¹⁾ Under consideration.

- Part 6-1: Turbine auxiliaries - Deaerators
- Part 6-2: Turbine auxiliaries - Feedwater heaters
- Part 6-3: Turbine auxiliaries - Condenser plant
- Part 6-4: Turbine auxiliaries - Pumps
- Part 6-5: Turbine auxiliaries - Dry cooling systems
- Part 6-6: Turbine auxiliaries - Wet and wet/dry cooling towers
- Part 6-7: Turbine auxiliaries - Moisture separator reheaters
- Part 6-8: Turbine auxiliaries - Cranes
- Part 6-9: Turbine auxiliaries - Cooling water systems

- Part 7-1: Pipework and valves - High pressure piping systems
- Part 7-2: Pipework and valves - Boiler and high pressure piping valves

Part 8-1: Control and instrumentation

*EN 45510-1:1997 contains those clauses common to all the above Guides giving the provisions of a non **equipment** specific nature for use in the procurement of power station plant. EN 45510 is the responsibility of JTFPE. The so called 'common clauses', as appropriate, also appear in italics in the documents specific to particular **equipment**.*

Where paragraphs, or part of a paragraph/sentence, of 'common clauses' are omitted this is indicated by the symbol ***** at the end of the clause.

In this Guide, words in bold type indicate that they have the meaning given in the definitions, Clause 3.

In this Guide, sentences not in italics indicate the additional recommendations to be found in Guides specific to particular **equipment**.

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1 Scope

*This standard gives guidance on writing the technical **specification** for the procurement of **equipment** for use in electricity generating stations (power stations). This Guide for procurement is not applicable to **equipment** for use in the nuclear reactor plant area of nuclear power stations. Other possible applications of such **equipment** have not been considered in the preparation of this Guide.*

This Guide on **cabling systems** deals with a wide range of activities and may be used for any or all of these activities by selection of the relevant parts e.g.:

- provision of support for cable;
- laying of cable;
- completion of cable ends;

The Guide covers the installation of power cable up to and including 20,8/36 (42) kV and the supply and installation of control and instrumentation cable. The supply of power cable is covered by EN 45510-2-8.

The Guide includes the installation of protective conductor cable for earthing and equipotential bonding up to the **main earthing busbar(s)**, but not the below ground earth-electrode network.

*The **equipment** covered by this Guide is defined by its function rather than design type. Therefore, the guidance to the **specification** is stated in **performance** terms rather than being specified by a detailed description of the equipment to be supplied.*

*This Guide indicates to potential **purchasers** how their **specification** should be prepared so that*

- *the **equipment** type and capacity interfaces correctly with other elements of the systems,*
- *predicted **performance** is achieved,*
- *ancillary **equipment** is properly sized,*
- ***reliability, availability** and safety requirements are achieved,*
- *proper consideration is given to the evaluation process and the quality measures to be applied.*

*This Guide does not determine the type of **specification** (e.g. detailed, performance, functional) or the extent of supply for any given contract which is normally decided on the basis of the **purchaser's** project strategy. It does not cover*

- *any commercial, contractual or legal issues which are normally in separate parts of an **enquiry**,*
- *any allocation of responsibilities which are determined by the contract.*

*This Guide does not prescribe the arrangement of the documents in the **enquiry**.*

*NOTE As a comprehensive European environmental policy is still under preparation, this Guide does not address the environmental implications of the **equipment**.*

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 54	Fire detection and fire alarm systems
EN 45510-2-8	Guide for procurement of power station equipment - Part 2-8: Electrical equipment - Power cables
EN 50085 Series	Cable trunking systems and cable ducting systems for electrical installations
EN 50086-2-4	Conduit systems for cable management - Part 2-4: Particular requirements for conduit systems buried underground
EN 50146	Cable ties for electrical Installations
EN 50262	Cable glands for electrical installations
EN 50266 Series	Common test methods for cables under fire conditions - Test for vertical flame spread of vertically-mounted bunched wires or cables
EN 50386	Bushings up to 1 kV and from 250 A to 5 kA, for liquid filled transformers

EN 60079-14	Electrical apparatus for explosive gas atmospheres - Part 14: Electrical installations in hazardous areas (other than mines) (IEC 60079-14)
EN 60228	Conductors of insulated cables (IEC 60228)
EN 60529	Degrees of protection provided by enclosures (IP Code) (IEC 60529)
EN 60584-3	Thermocouples - Part 3: Extension and compensating cables - Tolerances and identification system (IEC 60584-3)
EN 60702-1	Mineral insulated cables and their terminations with a rated voltage not exceeding 750 V - Part 1: Cables (IEC 60702-1)
EN 60794 Series	Optical fibre cables (IEC 60794 Series)
EN 61196-3	Radio frequency cables - Part 3: Sectional specification for coaxial cables for local area networks (IEC 61196-3)
EN 61238-1	Compression and mechanical connectors for power cables for rated voltages up to 36 kV ($U_m = 42$ kV) - Part 1: Test methods and requirements (IEC 61238-1, mod.)
EN 61386 Series	Cable systems for cable management (IEC 61386 Series)
EN 61537	Cable management - Cable tray systems and cable ladder systems (IEC 61537)
EN ISO 9001	Quality management systems - Requirements (ISO 9001)
EN ISO 9002	Quality systems - Model for quality assurance in production, installation and servicing (ISO 9002)
HD 21.3	Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V - Part 3: Non-sheathed cables for fixed wiring
HD 22.3	Cables of rated voltages up to and including 450/750 V and having cross-linked insulation - Part 3: Heat resistant silicone rubber insulated cables
HD 22.9	Cables of rated voltages up to and including 450/750 V and having cross-linked insulation - Part 9: Single core halogen-free non-sheathed cables for fixed wiring having low emission of smoke
HD 22.15	Cables of rated voltages up to and including 450/750 V and having cross-linked insulation - Part 15: Multicore cables insulated and sheathed with heat resistant silicone rubber
HD 60364-4-41	Low-voltage electrical installations - Part 4-41: Protection for safety - Protection against electric shock (IEC 60364-4-41, mod.)
HD 60364-5-54	Low-voltage electrical installations - Part 5-54: Selection and erection of electrical equipment - Earthing arrangements, protective conductors and protective bonding conductors (IEC 60364-5-54, mod.)
HD 604	0,6/1 kV and 1,9/3,3 kV power cables with special fire performance for use in power stations
HD 622	Power cables having rated voltages from 3,6/6(7,2) kV up to and including 20,8/36(42) kV with special fire performance for use in power stations
HD 627	Multicore and multipair cable for installation above and below ground
HD 629	Test requirements on accessories for use on power cables of rated voltage from 3,6/6(7,2) kV up to 20,8/36(42) kV
IEC 60050-191	International electrotechnical vocabulary - Chapter 191: Dependability and quality of services
IEC 60050-195	International electrotechnical vocabulary - Chapter 195: Earthing and protection against electric shock
IEC 60050-461	International electrotechnical vocabulary - Chapter 461: Electric cables
IEC 60331 Series	Tests for electric cables under fire conditions - Circuit integrity
IEC 60332-3 Series	Tests on electric cables under fire conditions - Part 3: Test for vertical flame spread of vertically-mounted bunched wires or cables
IEC 61156 Series	Multicore and symmetrical pair/quad cables for digital communications
ISO 834 Series	Fire-resistance tests - Elements of building construction

3 Definitions

For the purposes of this Guide, the following definitions apply:

3.1 Organisational terms

3.1.1

purchaser

*recipient of a product and/or a service provided by a **supplier***

3.1.2

supplier

*person or **organisation** that provides a product and/or a service to the **purchaser***

3.1.3

specification

*document stating technical requirements of the **purchaser**. It may form part of an **enquiry** issued by a **purchaser***

3.1.4

enquiry

*invitation to **tender** issued by a **purchaser**. It will normally include a **specification** together with the necessary contractual and commercial conditions*

3.1.5

tender

*offer made by a **tenderer** in response to an **enquiry***

3.1.6

tenderer

*person or organisation submitting a **tender** for the **equipment** in response to the **enquiry***

3.1.7

site

*place to which the **equipment** is to be delivered or where work is to be done by the **supplier**, together with so much of the area surrounding as the **supplier** may, with the consent of the **purchaser**, use for the purposes of the contract*

NOTE Further definitions of useful organisational terms may be found in EN ISO 9000 (see Bibliography).

3.2 Technical terms

3.2.1

cabling system (**equipment** where typed in bold)

assembly of cables, cable accessories, fittings and associated items installed as a single entity

NOTE 1 This is a fixed installation.

NOTE 2 This includes wiring systems provided with additional mechanical protection.

3.2.2

schedule

list, drawing, diagram, plan, sheet or other means of presentation

3.2.3

identification of cable

cable manufacturers' description of cable

NOTE 1 This defines the cable type - rated voltage, materials (using recognised abbreviations), construction, relevant standard, fire test performance (if applicable) and cable size - number of cores and nominal cross-sectional area of conductor.

NOTE 2 This may be the same as the external marking on the cable sheath.

3.2.4

end item (termination point)

electrical equipment, equipment circuit or compartment, cubicle, cabinet, device, enclosure and frames etc, where the ends of scheduled cable are completed

NOTE 1 In this Guide the word equipment, where not printed in bold, refers to electrical equipment being provided under separate contracts or to existing electrical equipment.

NOTE 2 Examples of **end items** are switchboards, rotating electrical machines, electrically operated devices, control equipment, instruments, junction boxes etc.

3.2.5

identification of end item

title or the identifier with an **end item** identification system, of the **end item**

NOTE The identification may be shown on drawings or affixed to the **end item**.

3.2.6

cable identifier

numeric or alphanumeric identification allocated to each scheduled cable

NOTE The identification may be shown on drawings or affixed to the cable.

3.2.7

cable schedule

schedule containing the data that collectively defines each individual cable

NOTE Typically, this may contain the **cable identifier**, cable length, **identification of cable**, **identification of end item** (for both cable ends) and cable manufacturer.

3.2.8

cable scheduling

process of defining the data for each individual cable on the **cable schedule** in accordance with specified design criteria, if any

NOTE Once defined this becomes scheduled cable.

3.2.9

cable route

pathway for cable between **end items**

NOTE This is the space for cable along a **cable management system**.

3.2.10

cable route network

assembly of **cable routes** located in accordance with specified design criteria, if any

3.2.11

cable route identifier

identification allocated to each section, junction or node point in a **cable route network**

NOTE 1 The identification may be shown on drawings or affixed to the **cable management system** or its immediate surroundings.

NOTE 2 The **cable route identifier** may be the **cable identifier** on drawings.

3.2.12

cable route schedule

schedule containing a series of **cable route identifiers** that collectively define the **cable route** for scheduled cable

3.2.13

cable routing

process of defining the data on the **cable route schedule** for scheduled cable in accordance with specified design criteria, if any

NOTE 1 Once defined this becomes routed cable.

NOTE 2 This can provide an estimate of cable length.

3.2.14

cable system

different types and sizes of scheduled cable

3.2.15

cable support

provision of adequate load bearing surface for cable that is free from sharp edges

3.2.16

cable management system

assembly of cable accessories and fittings, building materials, structural steelwork, cable ducts and pipes, ground materials such as sand etc, for **cable support** in accordance with specified design criteria, if any

NOTE 1 **Cable management system** may either support or surround and support cable.

NOTE 2 **Cable support** may be provided in conjunction with a cable retaining devices.

NOTE 3 **Cable management systems** that surround and support also provide mechanical protection.

3.3.17

cable management system schedule

schedule defining the basic types of **cable management system** in the **cable route network**

3.2.18

cable fixing

securing or retaining of cable permanently in position, possibly in a set formation

3.2.19

cable fixing system

assembly of cable, cable accessories and fittings for **cable fixing** to the **cable management system** in accordance with specified design criteria, if any

NOTE This may not apply to **cable management systems** that surround the cable.

3.2.20

cable fixing system schedule

schedule defining the basic types of **cable fixing system** for the **cabling system**

3.2.21

cable entry

entry of cable into **end items** for **cable connection**

3.2.22

cable entry system

assembly of cable, cable accessories, fittings and where applicable protective conductor, for **cable entry** in accordance with specified design criteria, if any

NOTE 1 This may be combined with 3.2.25 as a cable ends system.

NOTE 2 This may not apply to frames, outdoor cable sealing ends, etc.

3.2.23**cable entry system schedule**

schedule defining the basic types of **cable entry system** for the **cabling system**

NOTE This may be combined with 3.2.26 as a cable ends system schedule.

3.2.24**cable connection**

terminating or jointing of cable core for the purposes of circuit continuity

3.2.25**cable connection system**

assembly of cable, cable accessories and fittings for **cable connection** at **end items** in accordance with specified design criteria, if any

NOTE This may be combined with 3.2.22 as a cable ends system.

3.2.26**cable connection system schedule**

schedule defining the basic types of **cable connection system** for the **cabling system**

NOTE This may be combined with 3.2.23 as a cable ends system **schedule**.

3.2.27**identification of core**

cable manufacturers' identification of cable core

NOTE This is as defined in the standard for the cable.

3.2.28**core identifier**

numeric or alphanumeric identification allocated to individual cable cores during circuit design

NOTE The identification may be shown on drawings or affixed to the core.

3.2.29**terminal identifier**

identification given to each individual terminal provided for the terminating or jointing of cable core

NOTE The identification may be shown on drawings or affixed to the terminal or its immediate surroundings.

3.2.30**core allocation schedule**

schedule defining the positions at **end items** where each individual cable core is terminated or jointed

NOTE 1 Typically, for each **cable identifier** at an **end item**, this relates the **identification of core** to the **terminal identifier** and **core identifier**, if required.

NOTE 2 This may not apply (a) where this information is contained within the **end item** (b) to power cable.

3.2.31**core allocating**

process of defining the data on **core allocation schedules** to establish functional circuits through scheduled cable in accordance with specified design criteria, if any

3.2.32**cable junctioning**

connection of non-power cable core to the core of other non-power cable or cables

3.2.33**cable junctioning system**

enclosures and frames for **cable junctioning** in accordance with specified design criteria, if any

3.2.34

cable junctioning system schedule

schedule defining the basic types and sizes of enclosures and frames for **cable junction** for the **cabling system**

3.2.35

cable jointing

connection of power cable to other power cable or cables

3.2.36

cable jointing system

cable joints and fittings or enclosures for **cable jointing** in accordance with specified design criteria, if any

3.2.37

cable jointing system schedule

schedule defining the basic types and sizes of **cable jointing system** for the **cabling system**

3.2.38

supply factors

factors such as manufacturers' standard lengths, packaging quantities, minimum order quantities, etc.

3.2.39

installation factors

factors such as wastage, measurement uncertainty, accidental damage/breakage, lost items, etc.

3.2.40

supply quantity

quantity delivered to the **supplier** that may include allowance for **supply factors** and **installation factors**

3.2.41

installed quantity

quantity installed by the **supplier**

NOTE This may be a measured or an estimated quantity.

3.2.42

estimate of installed quantity

quantity estimated to be the **installed quantity** made before installation

NOTE This may be determined by either the **purchaser** or the **supplier**.

3.2.43

cable quantities schedule

schedule quantifying the total length of the **cable system** for every routed cable

NOTE 1 This may be a **supply quantity**, **estimate of installed quantity** or an **installed quantity**.

NOTE 2 This should include the cable within **end items**.

3.2.44

cable management system quantities schedule

schedule quantifying the total content of the **cable management system schedule** for the **cable route network**

NOTE This may be a **supply quantity**, **estimate of installed quantity** or an **installed quantity**.

3.2.45

cable laying quantities schedule

schedule quantifying cable length as a sum of lengths sectionalised according to the **cable management system schedule** for each routed cable

NOTE 1 This may be an **estimate of installed quantity** or an **installed quantity**.

NOTE 2 This may be combined with 3.2.45 as a cable installation quantities schedule.

3.2.46**cable fixing system quantities schedule**

schedule quantifying the total content of the **cable fixing schedule** for every routed cable

NOTE 1 This may be a **supply quantity, estimate of installed quantity** or an **installed quantity**.

NOTE 2 This may be combined with 3.2.44 as a cable installation quantities schedule.

3.2.47**cable entry system quantities schedule**

schedule quantifying the total content of the **cable entry system schedule** for every scheduled cable

NOTE 1 This may be a **supply quantity, estimate of installed quantity** or an **installed quantity**.

NOTE 2 This may be combined with 3.2.47 as a cable ends quantities schedule.

3.2.48**cable connection system quantities schedule**

schedule quantifying the total content of the **cable connection system schedule** for every scheduled cable

NOTE 1 This may be a **supply quantity, estimate of installed quantity** or an **installed quantity**.

NOTE 2 This may be combined with 3.2.46 as a cable ends quantities schedule.

3.2.49**cable junctioning system quantities schedule**

schedule quantifying total numbers for the **cable junction schedule** for the **cabbling system**

NOTE This may be a **supply quantity, estimate of installed quantity** or an **installed quantity**.

3.2.50**cable jointing system quantities schedule**

schedule quantifying the total content of the **cable jointing system schedule** for the **cabbling system**

NOTE This may be a **supply quantity, estimate of installed quantity** or an **installed quantity**.

3.2.51**location drawing**

drawing, diagram, plan or other means of presentation defining installed position

NOTE 1 Information on type and size may be included, as applicable.

NOTE 2 Location may be shown on general arrangement and layout drawings.

3.2.52**design data**

information defining matters relevant to the design of the **cabbling system** such as the **cable schedule**

3.2.53**supply data**

technical and other information defining matters relevant to supply such as relevant standard, type, size and features, etc.

3.2.54**installation data**

information defining matters relevant to installation such as the method of mounting, installation techniques, minor cable accessories, minimum distances, etc.

3.2.55**main earthing busbar**

terminal or busbar which is part of the earthing arrangement of an installation and enabling the electric connection of a number of conductors for earthing purposes

[IEC 60050-195-02-33]

Other technical terms used in this Guide are in accordance with the IEC 60050-461.

3.3 General terms

3.3.1

equipment

plant, component, system and/or associated service to be provided in response to the **enquiry**

NOTE For the purposes of this standard this definition includes **cabling systems**.

3.3.2

conformity

fulfilment of specified requirements by a product, process or service

3.3.3

performance

obligations verified by specified tests

3.3.4

operating period

*time between planned outages or maintenance periods during which the **equipment** is in operation and/or does not restrict operational requirements of the power station*

3.3.5

life expectancy

*time period over which the **equipment** might be expected to operate with planned maintenance but without replacement of a significant component*

3.3.6

design life

operating hours of the **equipment** on which design calculations are based

3.3.7

acceptability

*compliance with criteria defined by the **purchaser** for assessing the suitability of **equipment***

3.3.8

equipment margins

*allowance for design, fabrication or operating contingency defined in the **specification**. These are separate to those normally included by the **supplier** for his own purposes*

3.3.9

proven equipment

equipment** which may be demonstrated to be similar to that offered and has operated for a sufficient time to have demonstrated **performance** and **availability

3.3.10

availability

as defined in IEC 60050-191

3.3.11

reliability

as defined in IEC 60050-191

3.3.12

maintainability

as defined in IEC 60050-191

4 Brief overall project description

4.1 Role and organisation of purchaser

The **enquiry** should define the **purchaser's** role in the project, including whether the **purchaser** will assume responsibility for the planning and technical co-ordination of the project, or whether other organisations will be appointed to carry out all or part of this function. The **enquiry** should define all organisational interfaces and the procedures to be employed for managing the contract and the **site**.

4.2 Site location

The **specification** should describe the geographical location of the **site** which may include surveying points, the previous use of the **site** and any local features such as impact of industrial or military activities and planning restrictions.

4.3 Equipment task

The **specification** should describe in general terms the function, task or role of the **equipment** to be purchased, e.g. whether it is part of a new power generating plant, a modification to an existing power generating plant or replacement **equipment**.

4.4 Equipment to be purchased

The **specification** should outline in broad terms the **cabling system** to be purchased stating whether this is for supply and installation, or for either supply or installation only. This may need to include any secondary activities such as the provision of fire barriers or the removal and disposal of existing cable.

The **specification** should identify the general extent of **end items** to be cabled. This may include the **site** areas where these are located. General information such as electrical system diagrams e.g. main electrical single line diagram, should also be included where relevant.

Information on the scale of the task such as the total number of scheduled cables may be stated if known or can reasonably be estimated.

The overall rates of progress with the completion of the **cabling system** over particular time periods, corresponding to the project programme dates, may need to be stated. This data is sometimes shown graphically on a histogram, typically defining the number of cables each week or month to be designed, laid, tested and completed.

The **specification** should contain adequate information on the general layout and features of the **site** that are relevant to the **cabling system**. For example, this might include information on

- overall layout of **site** and buildings,
- layout of main plant and equipment,
- design of main cable ways (or raceways), e.g. floor levels, risers, tunnels, ducts, trenches in floors designated as major **cable routes**.

General arrangement and layout information is normally supplied on drawings.

Measured works (bill of quantities) contracts are usually employed where a substantial portion of the design of the **cabling system** cannot be completed until after contract placement. With this type of contract, the **enquiry** may be based on the **estimate of installed quantity** with contract payment based on the **installed quantity**.

The **specification** should state specific exclusions, for example, cabling activities forming part of another supplier's contract.

The **specification** may also request supply options to be included in the tender or invite the **tenderer** to propose his preferred system.

The **specification** may also define preferences for **equipment** types (or give information) regarding compatibility with existing **equipment**, if required.

4.5 Control and instrumentation

4.6 Electrical supplies and other services

The **specification** should define the electrical supplies available for the operation of the **equipment**, their voltages and frequencies, with their range of variation, phases available and, where appropriate, the acceptable values of maximum load (kVA) and short circuit level at each voltage level and the harmonic content.

The **specification** may also need to include information such as the design values for earth fault currents and associated clearance times for the determination of protective conductor sizes or the maximum design values for transient overvoltages.

The **specification** may need to define civil works being provided under a separate contract for the **cabling system** e.g. digging and back filling of cable trenches in ground.

4.7 Other interfaces

The **specification** should contain adequate design information on the provisions at **end items** supplied under separate contracts for the completion of cable ends e.g.:

- general description of **end items**:
 - general arrangement;
 - type of earthing terminal (stud or busbar) and location (internal or external);
 - IP code to EN 60529 of **end item** or compartment for **cable connection**;
- provisions for **cable entry**:
 - location, incoming direction and size of **cable entry**;
 - type of **cable entry system** e.g. if gland plates detachable or fixed type, undrilled, pre-drilled or threaded, non-ferrous gland plates for heavy current single-core cables;
- provisions for **cable connection**:
 - general arrangement/position of terminals/connecting devices or terminal compartments/boxes;
 - **terminal identifier** system;
 - details of **cable connection system** e.g. bushing type for MV cables, types and sizes of terminals/connecting devices and any associated fittings.

End items should be able to accommodate the numbers, types and sizes of scheduled cable to be installed. While generally this is the case, it is sometimes found necessary to enlarge or re-design the cable accommodation for this purpose. However, many **end items** are 'standard' products' whose design cannot readily be modified and therefore the cabling arrangement selected has to be suitable for the accommodation provided. In this situation, the cable types and size may have to be changed to a suitable arrangement at a separate, locally mounted, enclosure.

Accommodation difficulties can typically arise if, for example, armoured cable is specified where the gland plate provided is sized for, smaller diameter, unarmoured cable. Another example where difficulties can arise is when larger conductor size, solid, aluminium conductors are being installed if the **end item** is sized for the equivalent current carrying capacity, smaller size, more pliable, stranded copper conductors. **End item** terminals can sometimes be too small for the cable conductor size or connection method proposed, or with more than one core per phase, unable to accommodate the number of terminations. With certain specific types of termination e.g. wire wrap, the cable core/conductor has to be of the correct type.

With extension or modification schemes, the **specification** may need to define the unused accommodation that is available for cable installation in **end items**.

Any known limitations when working in the **end items** e.g. restricted space, or special precautions that need to be taken e.g. against danger when working in live equipment, should be described.

4.8 Project programme

The **specification** should describe the overall programme and timescale in which the project is to be carried out. This may include the principal dates associated with tendering, placement of orders, access to **site**, start and completion of installation, commissioning, take-over and final acceptance.

4.9 Equipment identification systems

The **specification** may specify the **equipment** identification system for use during the operating life of the plant. If applicable to the **project**, a recognised European or international system should be used.

If the scheduled cables are grouped into functional systems and sub-systems for project planning and other purposes then the identification of the system of groupings may need to be defined.

The design basis for the **cable identifier** may need to be specified. For example, if design information is to be incorporated into the identification system such as the number of the operational unit at the generating station.

The **specification** may need to define the design basis for the **cable route identifier** system.

The **specification** may need to define the **terminal identifier** system to be adopted for **cable junctioning**.

The **specification** may need to define the design basis for the **core identifier** system.

The **core identifier** normally either fully or partly corresponds with the circuit identification shown on circuit or schematic diagrams, or on **end item** wiring diagrams.

The **specification** may need to define the identification system for **end items**.

The identification systems may need to be compatibility with existing schemes with an extension or refurbishment scheme.

The **specification** may need to define design requirements for the identification systems such as the types and method of fixing e.g. cable and core markers, identification labels, marker posts for buried **cable routes**, etc.

5 Extent of supply

The **specification** should define the extent of supply of all the **equipment**.

The **specification** should define each main activity to be performed by the **supplier** for the completion of the **cabling system** e.g.

- design, planning, scheduling, drawings, calculations,
- purchase of materials,
- inspection and testing at manufacturer's works,
- delivery, off-loading at site, site storage,
- assembly, erection, installation,
- site inspection and testing,
- record documentation.

The **specification** should define the design activities, if any, to be performed during the course of the contract and the responsibilities for the same. For example, the **purchaser** may be responsible for completion of certain **schedules** and **location drawings** with the **supplier** being responsible for the preparation of the remaining **schedules** e.g. **cable route schedule**, as well as other items of design detail such as calculations.

The **specification** should quantify the extent of the supply and/or installation of the **cabling system**. This may be a **supply quantity** or an **estimate of installed quantity**, as applicable. **Design data** such on **schedules** and **location drawings** may be used for this purpose.

If the **supplier** is being left to decide the design detail for the **cabling system**, then the **cable schedule**, **core allocation schedules** and **location drawings** may be sufficient to define the extent of supply.

However, particularly with larger **cabling systems**, the **purchaser** may prefer to define the extent of supply in more detail e.g. include the **cable connection system**. While this can be achieved with the addition of further design information such as assembly drawings, it may be preferable to breakdown the **cabling system** into its component parts by adopting a system of 'defined units'. A 'defined unit' can range from a type and size of component to a large assembly provided it enables the total quantity required to be defined.

This quantitative approach is adopted for measured works contracts where an **estimate of installed quantity**, based on numbers of 'defined units' derived from design studies or previous experience, is specified in the **enquiry**. The actual number of units installed i.e. the **installed quantity**, being periodically measured during the contract for valuation and contract payment purposes. An agreed monetary rate (covering labour and materials) is paid to the **supplier** for each unit installed.

Where appropriate, the full extent of the **cabling system** may be defined by preparation of a set of quantities schedules as defined in 3.2.42 to 3.2.49 inclusive.

With certain cabling accessories and components, besides type and size, factors such as material, construction, finish, features, technical parameters etc, can easily introduce excessive numbers of slightly different 'defined units'. Therefore, wherever possible, the assembled components e.g. modular **cable management system**, or a succession of activities e.g. cable laying and fixing, completion of cable ends, should be combined as a single 'defined unit'.

Other factors may need to be taken into account for the valuation of cable laying in addition to the type of **cable management system** concerned. Particularly with larger diameter/heavier cables 'defined units' may need to be included for the cable weight per metre range or for the setting up of cable drum and pulling in equipment, according to cable weight per metre range, prior to laying.

Any design information prepared under separate contracts for the to be handed over directly to the **supplier** e.g. **core allocation schedules**, should be defined.

Any cable or cabling accessories purchased under separate contracts to be handed over to the **supplier** for installation should be defined. The **specification** may need to define the **end items** where **core allocation schedules** do not apply as this information is contained within the **end item**.

It is often practice for potential **tenderers** to be invited to attend a **site** inspection to view the cabling task. This may appropriate where the working conditions cannot easily be defined or where all the necessary design information cannot readily be provided with the **specification**. The latter tends to occur with extension or refurbishment schemes where for some reason the design records are incomplete, out of date or no longer available.

Consumables and other items such as hand tools and tool kits may need to be included in the extent of supply.

A 'check list' on **design data**, **supply data** and **installation data** that may need to be specified is provided in Annexes A, B and C (informative) respectively.

The extent of supply may include training, technical and layout studies, requirements for cooperation with the purchaser and/or other suppliers and information on necessary interfaces, if any.

The **specification** may require that all parts of the **equipment** should be protected at all stages of delivery, storage and installation. Subsequent to final manufacture all **equipment** items should be protected against deterioration due to corrosion.

The **specification** may indicate the acceptability of alternative offers being included in the **tender**.

6 Terminal points

The **specification** should define the terminal points for the contract. Some examples of the terminal points for **cabling systems** are

- circuit terminals or connecting devices for the termination of conductors at **end items**,
- earth terminals or bars at **end items**,
- **main earthing terminal**.

The **specification** should also define terminal points for existing or proposed services, support structures or civil works.

7 Operational requirements

7.1 Operating environment

The **specification** should describe the operating environment in which the **equipment** will be required to function. Factors such as temperature, humidity, extent of weather protection, dust, vibration and electromagnetic environment (this may include both emission and immunity requirements) should be included for both normal and abnormal conditions. The type of installation, whether indoor or outdoor, should be stated.

7.2 Manning levels

7.3 Normal operation

The **specification** should define in broad terms the expected normal operation of the power station and of the **equipment**.

7.4 Operating hours

7.5 Start-up and shut-down

7.6 Abnormal conditions

The **specification** should provide information on the known abnormal conditions to which the **equipment** might be subjected. The **supplier** should take these into account in the design or selection of components/materials.

For example for **cabling systems** these might be

- immersion in water due to flooding e.g. with cable tunnels and basements,
- earthquake (seismic),
- ground subsidence for direct buried cables,
- fire or explosion hazard,
- high indoor ambient temperatures,
- mechanical damage due to falling objects.

7.7 Further operational requirements

This clause is used in other guides, but not in this Guide.

8 Life expectancy

8.1 Design life

8.1.1 General

The design life of the **cabling system** in years should be defined where appropriate. This should be based on guidance obtained from manufacturers.

*The **supplier** should define limitations on **equipment life**, if any, and these should be included in the **tender evaluation process**.*

8.1.2 Number of start-up and shut-down cycles

8.1.3 Equipment for monitoring remaining life

8.2 Components requiring periodic maintenance

*The **specification** should request the **supplier** to provide a schedule of components which require periodic maintenance or replacement. This should include the frequency of these operations.*

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9 Performance requirements

9.1 Duty

9.2 Performance

The **specification** may define the **performance** requirements for the **cabling system** and when these are to be demonstrated e.g. during testing and commissioning and/or at other points in the life of the **equipment**.

Examples of where **performance** may need to be verified are

- circuit insulation resistance (including any intermediate connections) exceeds a minimum value,
- circuit continuity and integrity of connections e.g. no loose or high resistance connections,
- maximum permitted temperatures not exceeded e.g. with power cable due to incorrect installation,
- circuit immunity to interference or disturbance under defined conditions,
- deterioration rate due to external influences within tolerable limits,
- no insecure supports and fixings or mechanical overloading,
- vibration in service not causing undue movement or strain e.g. due to lack of support,
- ingress of water does not occur e.g. through cable duct seals.

NOTE Failure to meet **performance** criteria is frequently the result of installation error. This type of error is generally found by inspection and testing and rectified as a site defect.

The **specification** may need to define acceptance criteria for **performance** where recommended limits are not contained in standards. These may be subject to agreement between the **purchaser** and the **supplier**.

9.3 Equipment margins

The **specification** may need to define **equipment margins** for the **cabling system**. For example, margin may need to be specified to make allowance for

- future installation of additional cables,
- design uncertainty,
- possible design changes or modifications e.g. spare cores.

Alternatively, the **specification** may describe a process for agreeing the design margin with the **supplier**.

9.4 Availability

The **specification** may define requirements on **availability**, **reliability** and **maintainability** for the **cabling system**.

9.5 Levels of component redundancy

9.6 Further performance requirements

10 Design and fabrication

10.1 Specific equipment features

10.1.1 Detailed features

10.1.1.1 Cable system

10.1.1.1.1 Cable supply quantities

In general, cable is purchased in economic quantities (lengths) that are delivered to **site** on drums or in coils. The length of cable required for each scheduled cable is cut off the drum or coil length during cable laying. Straight-through joints are generally restricted to long cable routes where more than one drum length of cable is required.

It may be desirable to standardise on certain cable types and sizes for the **cable system**. This may involve specifying a particular cable type or size for a broad range of applications to reduce the number of types and sizes required. The reasons for this may be

- economies of scale when purchasing,
- availability or delivery period,
- minimum order quantities,
- simplify stock control and drum handling,
- avoid excessive cable quantities being left over on completion.

10.1.1.1.2 Selection of basic cable types

The **specification** may need to define requirements on the selection and use of basic cable type(s) for the **cable system**. For example:

- halogenated and halogen free cable;
- armoured and unarmoured cable;
- rigid and flexible cable.

Selection of basic cable type should be made with reference to the cable types defined in the relevant standard (see 10.1.1.1.3) and, where applicable, the recommendations contained in their 'Guide to Use'.

Halogen free cable emits significantly less smoke and acid forming gases under fire conditions. This may enhance visibility for emergency escape/fire fighting and reduce the extent of corrosion damage caused by fire effluent.

The need for cable armouring depends on factors such as the nature and severity of possible cable damage, type of sheathing material, national regulations and established practice. An advantage of armoured cable is that the armour wires or tapes can be used as the protective conductor.

Fire resistant cable may be required for critical circuits that must continue to function for a certain period of time in the event of a fire. For example, fire detection and fire protection circuits, emergency evacuation systems, main unit trip circuits for safe shutdown.

10.1.1.1.3 Selection of cable type

The **specification** may need to define the cable type(s) for the **cable system**.

The cable types selected should be in accordance with the standards given below and the options contain therein.

- Power cable

Refer to EN 45510-2-8 for guidance on LV and MV power cable type.

- Control and instrumentation cable

Multicore and multipair cable should be in accordance with HD 627.

- Fire resisting cable (non power)

Fire resisting cable should comply with the performance requirements of IEC 60331.

Mineral insulated cable should be in accordance with EN 60702-1.

- Data cable

Data (digital communication) cable with copper conductors should be in accordance with IEC 61156 or other applicable standards.

Coaxial cable for local area networks should be in accordance with EN 61196-3 or other applicable standards.

Optical fibre cable should be in accordance with EN 60794 or other applicable standards.

- Protective conductor

- High temperature resistant cable (non-power)

High temperature resistant cable should be in accordance with HD 22.3, HD 22.15 or other applicable standards.

- Thermocouple extension and compensating cable

Thermocouple extension and compensating cable should be in accordance with EN 60584-3.

- Non-sheathed cable for wiring (non-power)

Non-sheathed wiring cables should be in accordance with HD 21.3, HD 22.9 or other applicable standards.

Any additional cable requirements e.g. colour of the cable sheath and additional or optional external cable markings e.g. metre marking, year of manufacture, fire propagation test performance etc, may need to be specified, where permitted in the relevant standard.

10.1.1.1.4 Selection of cable size

The **specification** may need to define the maximum, minimum or preferred conductor size(s) and number of cores or pairs for the **cable system** selected from the range of conductor sizes and the number of cores or pairs available in the relevant standard.

The **specification** may need to include circuit etc, data for the selection of conductor size for power cables. EN 45510-2-8, Annex B, gives guidance on the design information that may be needed.

The selection of conductor size for control and instrumentation cable is normally based on general consideration of current carrying capacity and voltage drop within the cable conductors. It is common practice to standardise on a particular conductor size for a broad range of applications. Data on current ratings should be obtained from the cable manufacturer or the 'Guide to Use' in the relevant standard, where this data has been included.

It is common practice to select a smaller range of numbers of pairs or cores than defined in the relevant standard, based on consideration of the different applications.

The **cable system** should exclude cables sizes with minimum bending radii e.g. large power cables, which are too large to be correctly installed or satisfactorily accommodated on the **cable management system**.

10.1.1.2 Cable junctioning

The **specification** may need to define requirements for the selection and use of enclosures and frames for **cable junctioning**. For example, this may need to cover the types and sizes of enclosures and frames and the numbers, types and sizes of terminals or connecting devices. This may be to standardise on preferred on types and sizes.

The **specification** may need to define design criteria or general guidance for the placement of enclosures and frames. The **supplier** is often left to decide where minor enclosures can best be placed.

The **specification** may need to define design guidelines for **cable junctioning**. As a general rule, this is based on consideration of the numbers, types, sizes and lengths of the cables involved, plus associated costs for the completion of cable ends, provision of enclosures/frames, cable management system, size of cable accommodation etc. For example, it may be economic for circuits from a number of small devices to be grouped into a single larger cable containing sufficient cores to carry all the circuits to a cubicle if this is located some distance away. This is as opposed to installing separate cables from each device to the cubicle.

Indiscriminate use of 'in line' connections should be avoided.

The **specification** may need to define the applications or circuit functions where **cable junctioning** is not permitted between **end items** i.e. the cable must be installed as one single piece. This is usually specified where preservation of circuit integrity is the critical consideration e.g. with protection circuits, or for mutual redundancy.

10.1.1.3 Cable jointing

The **specification** may need to define requirements, or preferences, for the selection and use of straight-through, branch and transition cable joints e.g. resin filled, for **cable jointing**. This may need to include enclosures containing connecting devices/splices for above types of joint connection e.g. for changing from a rigid to a flexible power (generally LV) cable type.

MV power cable joints should comply with the performance requirements in HD 629.

The **specification** may need to define design criteria or general guidance on power cable joint placement.

10.1.1.4 Cable scheduling

The **specification** may need to define the data to be contained on the **cable schedule** and the design process to be followed for **cable scheduling**.

The **specification** may need to define the design basis for selection of the number of core and pairs for the scheduling of multicore and multipair cable e.g. scheduling of the nearest larger core and pair size cable than the number of cores or pairs that are needed. This consideration may need to define where spare cores are to be provided.

The type and size of cable required is sometimes advised by the **supplier** of the **end item**.

10.1.1.5 Cable routes

10.1.1.5.1 Cable route network

The **specification** may need to define design criteria for the determination of the **cable route network**. This may be on the general layout, placement, carrying capacity and interconnection of **cable routes** to form the **cable route network**.

Cable route networks are designed based on consideration of the location of **end items** and the numbers, types and sizes of scheduled cables involved. Estimates of the cable numbers involved, based on design studies or previous experience, are used where this design information is not available.

Cable route networks may be viewed as consisting of main and secondary **cable routes**. These can be located indoors and outdoors, above and below ground/floor level.

Main **cable routes** (raceways/highways) are established to accommodate medium to large numbers of cables. Typically these interconnect the various **end item** 'centres' e.g. central control room and distribution 'areas' e.g. turbine hall. Secondary **cable routes** are for relatively small numbers of cable. These typically run from main **cable routes** to **end items** and between **end items** that happen to be located near to each other. The placement of secondary **cable routes** is often left to the **supplier**.

In general, the main consideration when selecting the pathway for **cable routes** is economic to minimise the overall cost of the **cabling system**. This is within the fixed limitations on space imposed by building design and **site** layout, maintenance of reasonable separation distances from other suppliers' plant/equipment and not causing an obstruction. Specified design criteria on cable fire and other potential hazards may impose further restrictions.

With new projects, the location and space provisions for main **cable routes** may need to be integrated into the design of new buildings. This may be for major cable ways such as dedicated floor levels, rooms, risers, basements, tunnels, galleries, cable voids underneath floors, trenches in floors; incorporated into ceiling heights with suspended **cable routes**; or into the **site** layout with outdoor **cable routes**. Adequate space should be allowed during building design to accommodate the **cable routes**. Cable minimum bending radii, type of **cable management system** and access considerations can result in the usable space for cable being much smaller than the total space provided. The **purchaser** should arrange these space provisions.

The direction of **cable entry**, generally this is either top or bottom **cable entry**, should be considered with the placing of **cable routes** near **end items**. A vertical separation distance, at least equal to the minimum bending radius of the cable with the largest bending radii involved, needs to be allowed where horizontally installed cable has to turn through 90° for either top or bottom **cable entry**. A horizontal separation distance, at least equal to twice the minimum bending radius of the cable with the largest bending radii involved, needs to be allowed where vertically installed cable has to bend through 180° for either top or bottom **cable entry**.

The placement of **cable routes** may need to take account of aesthetic considerations. This particular applies to areas where the **cable routes** are on show, and may include the types of **cable management system** that can be used in these situations.

The **specification** may need to define where **cable routes** may not be placed. For example, building surfaces and structural components may not be suitable for use as the **cable management system**.

With extension and modification schemes, main **cable routes** may need to be integrated into an existing **cable route network**.

10.1.1.5.2 Cable segregation

NOTE Cables must also be routed in accordance with this design criteria.

The **specification** may need to define requirements for **cable routes** containing cables from different 'groups' to be segregated from each other in order to limit economic loss due to an incident such as a fire. For example, this may be between cable in any or all of the following groups:

- each unit in the generating station;
- each common services or station system;
- main and standby plant;
- main and emergency plant;
- alternative tripping supplies.

Segregation may be specified for all the cabling, for main **cable routes** only or as an optional improvement where this can be achieved at no additional cost.

The **specification** may need to define how segregation is to be achieved. For example, by being separated by

- main **cable routes** in air minimum separation distance (both vertically and horizontally) or separated by a fire barrier having a minimum fire rating,
- secondary **cables routes** in air minimum separation distance,
- direct buried **cable routes** minimum separation distance.

10.1.1.5.3 Cable separation

NOTE Cables must also be routed in accordance with this design criteria.

In order to minimise the effects of electrical interference between single/multicore power cables and control and instrumentation, data (excluding optical fibre) etc, cables, the **specification** may need to define minimum separation distances between cable types on the same, or adjacent, **cable routes**.

Design guidance on cable separation for multicore and multipair cable to HD 627 is contained in the Guide to Use within the relevant part or section of that standard.

The **specification** may need to define where this requirement strictly applies and the situations where it may be relaxed e.g. short secondary **cable routes**.

10.1.1.5.4 Preservation of access

The **specification** may need to define restrictions on the placing of **cable routes** for the preservation of access.

This is usually for the preservation of ground/floor level access for personnel or vehicles, in particular for general access areas. Minimum clearance heights may need to be defined. The adoption of high level e.g. suspended from supporting steelwork and ceilings, and below ground/floor **cable routes** cause minimal obstruction. Outdoor **cable routes** may limit site vehicular access unless suitably placed or designed. Duct routes are normally preferred for road crossings. **Cable routes** placed at ground/floor level should not create a tripping hazard.

For enclosed cable ways such as cable floors, risers, tunnels etc, the maximum length of emergency escape routes, from any point to the nearest exit point, plus minimum dimensions for width and ground/floor clearance height, for both personnel access and emergency escape routes, may need to be defined.

Access requirements for maintenance on nearby plant/equipment may need to be defined. This may be for removal, repair or replacement activities e.g. to allow overhead crane access.

10.1.1.5.5 Avoidance of adverse external influences

The **specification** may need to define requirements on the placement of **cable routes** to avoid cables being exposed to adverse external influences or, alternatively, that suitable precautions are taken. These can arise during the construction, operation or maintenance of the generating station.

Guidance on external influences that may need to be avoided is given in HD 60364-5-51.

10.1.1.6 Cable management system

10.1.1.6.1 Selection of basic type of cable management system

The **specification** may need to define requirements for the selection and application of the basic type(s) of **cable management system** for the **cable routes** e.g. indoor, outdoor, above and below ground/floor level.

The main types of **cable management system** used in generating stations are

- open, modular, types e.g. galvanised steel trays and ladders according to EN 61537,
- enclosed, modular types e.g. conduits (rigid and pliable) according to EN 61386 series or trunkings and ductings according to EN 50085 series,
- conduits buried underground according to EN 50086-2-4,
- covered troughs (pre-cast concrete type),
- covered trenches.

Selection of the appropriate type of **cable management system** is situation specific. In general, this is based on consideration of location, cable weight, carrying capacity, overall route length and access considerations. Adopting types that allow access to be easily gained in the future can be a major factor if it is envisaged that additional cables might need to be installed.

Modular type **cable management systems** offer flexibility allowing the placement of **cable routes** to be optimised to make the best use of available space. They can also accommodate large numbers of cable.

Direct buried conduits or ductings are generally used for long underground **cable routes**.

10.1.1.6.2 Selection of type of cable management system

The **specification** may need to define requirements for the design of the **cable management system** for both main and secondary **cable routes**. This may be to standardise on preferred numbers, types and sizes for particular applications, preferred assembly designs or configurations, the use certain components, fittings and accessories, or for compatibility with an existing **cable management system**.

The **purchaser** may need to define the number, type, size and location of **cable management systems** e.g. covered trenches, ducts, being provided under separate contracts.

The **specification** may need to define requirements for the application of modular **cable management systems**.

The main types of open, modular, type **cable management systems** are

- ladder racking systems,
- perforated tray systems,
- bracket or hanger systems e.g. U and J type.

Design factors for this type of **cable management system** include

- use of light, medium or heavy duty systems,
- use of systems with sides (shallow, medium, deep),
- range of accessories and components.

The **specification** may need to define where open, modular, type **cable management system** is not used e.g. if less than say two cables share the same **cable route**.

Ladder racking systems with deep sides have high cable carrying capacity and offer superior mechanical protection. However, the flatter profile types such as perforated tray can be more adaptable in tight situations and are manufactured in low cable carrying capacity sizes. Bracket systems form narrow routes that can be vertically stacked. Mechanical strength or duty is selected according to cable loading i.e. weight per metre, and support span. Open, modular, type **cable management systems** include facilities for **cable fixing**.

Conduit and trunking is mainly used indoors to enclose unprotected cable types e.g. non-sheathed single core cable that would otherwise be susceptible to mechanical damage.

The **specification** may need to define the situations where cables may be fixed direct to building surfaces and structural components e.g. with a single cable over short runs for practical reasons.

The **specification** may need to define the minimum depth of burial, quality of bedding sand if direct buried, duct types and sizes etc, for below ground **cable routes**.

The **specification** may need to state whether cables can be laid directly on the base of covered trenches or have to be supported on an open, modular type, **cable management systems**.

The **specification** may need to define requirements for the mechanical properties of the **cable management system**. For example, with open, modular, type **cable management systems**, column and beam loads or maximum deflection for a given uniform load and support span.

The **specification** may need to define any installation facilities for the **cable management system** being provided by the **purchaser** under separate contracts e.g. concrete inserts in floors, walls and ceilings for attachment of the **cable management system**, draw ropes in cleared and capped cable ducts, etc.

10.1.1.7 Cable management system capacity

The **specification** may need to define requirements for the determination of cable carrying capacity of each section of the **cable management system** for **cable routing** purposes. This may be based on previous experience.

Carrying capacity may be broadly expressed in terms of the number, times the width or diameter, as applicable, of the support surface e.g. 4 x 600 mm width of perforated tray.

The actual cable carrying capacity may be assessed from consideration of

- numbers and overall diameters (or cross-sectional areas) of the scheduled cables to be accommodated,
- cable types that can be grouped together as described in 10.1.1.5.3 (e.g. on the same tray level or in the same duct),
- formation of cables i.e. in a set formation or left loose, as described in 10.1.1.10,
- usable cross-sectional area for the size and configuration of the **cable management system**.

This data can be compiled for each section of a **cable management system**. A filling factor may need to be introduced to allow for the practicalities of cable installation.

A maximum number of layers or maximum depth of fill, may need to be specified for cable laid in multiple layers. Different formations may apply according to the orientation, as described in 10.1.1.9, and shape of the **cable management system** e.g. between flat and curved (ducts and pipes) support surfaces.

Design criteria may need to be specified for determining when the **cable management system** is full. This can be for part of the **cable route** e.g. level carrying power cables with a multi-layer, open modular type, **cable management system**. The limiting factor may be

- **cable management systems** in air maximum volume of combustible material per metre, corresponding to the selected fire test category for the cable types and sizes in accordance with EN 50266 or IEC 60332-3 series,
- **cable management systems** in air maximum weight per metre in order not to overload the support system e.g. if provided by others,
- all types of **cable management system** maximum number of cables, or percentage filled, in order not to overfill, allow individual cables to be accessed, or leave spare capacity.

10.1.1.8 Cable routing

The **specification** may need to define the data to be contained on the **cable route schedules** and the design process to be followed for **cable routing**. For example, the **cable route schedule** may need to contain an estimate of the distance between, or length of, each adjacent **cable route identifier** to enable an estimate of total **cable route** length to be determined.

With extension and modification schemes, the **specification** may need to define the unused or spare capacity on existing **cables routes**.

Design criteria may need to be specified for **cable routing**. This may include the maintenance of cable segregation (see 10.1.1.5.2), cable separation (see 10.1.1.5.3) and minimisation of **cable route** length.

It is sometimes practice for the **purchaser** to define **cable routes** in broad terms leaving the design detail to be completed by the **supplier**. For example, the **supplier** may be left to optimise the allocation of the cables to each level in a multi-layer, open modular type, **cable management system**, or to a particular duct with duct banks.

Space allowance may need to be made for any non-scheduled cable e.g. protective conductor, which is to be installed on the **cable management system**.

10.1.1.9 Cable laying

The **specification** may need to define requirements on cable drum handling, pulling in and laying, minimum bending radii, etc, for the scheduled cables. For further guidance reference should be made to the recommendations contained in the 'Guide to Use' in HD 604, HD 622 and HD 627, as applicable.

Particular consideration may need to be given to relatively heavy cable being installed on long, complex or difficult **cable routes**. This more usually applies to outdoor **cable routes** and may involve advanced planning calling for the preparation of suitable procedures on the way the cable is pulled in. It may be necessary to specify the use of certain types of pulling equipment and installation techniques and the method of calculating the cable pulling parameters may need to be defined. Maximum limits for the pulling tension and side-wall pressure should be obtained from the relevant standard or the cable manufacturer.

The **supplier** is often left to determine when a **cable route** is ready and available for the laying of cable.

For installation only contracts, the **purchaser** may be responsible for the allocation of the scheduled cable to the cable drums.

Cable routes make use of different orientations of the **cable support** surface. This factor can affect the time and/or manpower required for cable laying. This consideration mainly applies to open, modular type, **cable management systems** and supporting surfaces such as building material. The possible orientations are

- on a horizontal support surface running in the horizontal direction,
- against a vertical support surface running in the vertical direction (vertical riser),
- against a vertical support surface running in the horizontal direction,
- underneath a horizontal support surface running in the horizontal direction,
- angle variations of above e.g. inclination of 45°.

Cable support surface orientation may need to be taken into consideration in the **cable laying quantities schedule**.

Presentation can soon be lost if cables are installed in a haphazard manner, in particular if they are laid with too much slack or are inter-woven to form a tangle such as can happen where cables change route or direction, or bridge gaps in the **cable management system**.

A record may need to be kept of laid cable. This should contain the identifier of the cable drum each scheduled cable is pulled off and the **cable identifier** of the scheduled cable. Additional record information such as date laid and temperature of cable may be specified.

The **specification** may need to define special installation measures with more than one single core power cable per phase such as laid configuration and transposition for ensuring approximately equal current sharing between cores.

The **specification** may need to define the method of sheath repair in the event of the cable being damaged during installation.

10.1.1.10 Cable fixing system

The **specification** may need to define requirements for **cable fixing** e.g. cable retention device, application and fixing centres. This may be on a **cable fixing system schedule**.

Cable fixing mainly applies to open, modular, type **cable management systems**. Other applications are direct fixing to support surfaces (usually for a single cable) such as building materials, supporting and structural surfaces; and bunching of cables in groups for mutual support such as across gaps in the support surface e.g. approaching ducts.

The **specification** may require the cables to be tidied and dressed e.g. into a set formation, to present an orderly and neat appearance as part of **cable fixing**.

Cable may be left loose where there is no need for **cable fixing** e.g. multipair cable laid on a horizontal support surface running in the horizontal direction, although side restraint may still need to be provided by the **cable management system**. Where cables are arranged, and where necessary fixed, in a set formation this may be

- grouped into sensibly sized bundles,
- flat touching in single or multiple layers,
- individually spaced with multicore power cables (for increased current rating),
- flat or trefoil formation with single core power cables.

For further guidance on **cable fixing**, including special cases i.e. vertical risers and single core power cables, reference should be made to the recommendations contained in the 'Guide to Use' in HD 604, HD 622 and HD 627, as applicable. Shorter fixing centres between cable retention devices can result in a neater appearance where aesthetics is a consideration.

The cable retention device nearest to the **end item** should support the weight of the cable i.e., not allow the weight of the cable to be placed on the **cable entry** device or cable termination.

10.1.1.11 Cable ends

The **specification** should define design requirements for completion of the ends of the cables. This may be to standardise on preferred types and sizes of cable accessories and fittings, according to the facilities provided for this purpose at the **end item**, or for material compatibility reasons.

It may not be possible to determine all the cable accessories and fittings required for the completion of cable ends until design details of the **end item** are known. For practical reasons this is sometimes once the **end item** has been installed on **site**.

10.1.1.11.1 Cable entry system

The **specification** may need to define requirements for the selection of the **cable entry system** at **end items**, e.g.:

- mechanical cable glands;
- by passing straight through openings, either provided or site made, for this purpose;
- plug-in terminations.

This may be on a **cable ends system schedule**. This consideration may not apply to open or open entry types of **end items** such as frames or racks.

The **specification** may select a preference for the direction of **cable entry** where a choice of, for example, top and bottom entry, is available. Bottom **cable entry** may be preferred outdoors.

Cable entry devices such as mechanical glands offer a number of advantages in that they protect the cable from sharp edges at the point of entry, provide an environmental seal and can offer the facility for earthing the cable armours/braids and screens.

Mechanical cable glands should be in accordance with EN 50262. Further requirements may need to be specified on the selection of type of mechanical cable glands for the **cable system** and on application at **end items**, e.g.:

- types (unarmoured/type of armour/seals) and materials (brass, aluminium, plastic);
- insulating mechanical glands e.g. for single-point bonding;
- earthing terminal type (integral e.g. lug or separate accessory);
- accessories e.g. shrouds.

The **specification** may need to define requirements for the earthing of cable armours and screens e.g.:

- single-core and multicore power cables e.g. solidly bonded, cross-bonding;
- cable types other than power cables;
- insulating of bare drain wire using insulating sleeving;
- where protective conductors have to be connected to e.g. main earth terminal on **end item**;
- which cable end to be earthed with single-point bonding.

In the case of single-core power cables with armours and screens single point bonding to earth, the **specification** may need to define:

- maximum value of screen/armour standing voltage at full load and under earth fault conditions;
- sheath voltage limiters and associated accessories.

The **specification** may need to define requirements for the removal of the outer layers of cable where **cable entry** is through an opening. For example, the internal securing of cable using a cable retention device or the application of tape or heatshrinkable sleeving to seal the cable end against moisture entry.

Plug and socket connectors or couplings should be selected in accordance with the relevant standard. Requirements such as type and application may need to be defined.

10.1.1.11.2 Cable connection system

The **specification** may need to define requirements for the selection of the **cable connection systems** and its application at **end items**. This may need to include the types and sizes of terminations and connecting devices for each applicable type and size of cable and type of metallic connection at the termination interface. For example:

- power cable:
 - types and sizes of compression terminal lug or mechanical connector;
 - types and sizes of accessories for stress control for MV power cable e.g. slip-on, heat shrinkable etc, for indoor and outdoor applications;
 - cable sealing ends;
 - insulating sleeving/tape/markers for phase identification of cores.

Compression and mechanical connectors for power cables should comply with EN 61238-1.

MV power cable accessories should comply with the performance requirements in HD 629.

- control and instrumentation, data etc, cable:
 - types and size of terminal lug e.g. crimped, whether uninsulated or pre-insulated;
 - no terminal lug fitted i.e. insertion of bare conductor into connecting device;
 - insulation displacement and wrapped connection type connecting devices, etc;
 - splices.

With the smaller sizes of multi-strand conductor, pre-insulated crimped terminals grip the core insulation providing additional support for the conductor making the connection more resilient to vibration. Crimped terminals fitted on fine stranded multi-strand conductors protect against the risk of strand separation causing short-circuits.

The **specification** may need to define additional requirements e.g.:

- looming/dressing or harnessing of cores;
- core spare length allowance for possible re-termination;
- torque setting values for bolted connections;
- EMI shielding tapes and foils.

The **specification** may need to define the method of core repair in the event of the insulation being damaged during **cable connection**.

Fibre optic and coaxial connectors should be in accordance with the applicable standards.

10.1.1.12 Core allocating

The **specification** may need to define the data to be contained on the **core allocation schedules** and the design process to be followed for **core allocating**.

The **purchaser** should provide the necessary electrical schematic drawings, electrical diagrams, external wiring schedules etc showing the circuits to be established. This information should contain the **terminal identifiers** in **end items**. The type and application of **core identifiers**, if required, should be defined plus any other specific requirements e.g. order in which cores/pairs are selected for use or on the treatment of unused or spare cores.

Requirements on multi-way and patched connections may need to be defined e.g.

- maximum number of cores per terminal block;
- links for the paralleling of adjacent terminal blocks;
- jumper cable for terminal patching.

10.1.1.13 Protective conductor system

Protective earthing and equipotential bonding should be in accordance with national conditions and regulations and the relevant standards.

The **specification** may need to define requirements for the selection of protective conductor types:

- protective conductor cable;
- multicore cable containing a protective or PEN conductor;
- additional core in a multicore cable;
- armour wire and other cable metal covering of certain cable types;
- metal enclosures for conductors e.g. conduit.

NOTE Certain extraneous conductive parts may also be used as a protective conductor but are outside the scope of this Guide. For further guidance, refer to HD 60364-5-54.

Protective conductor may be uninsulated (bare) or insulated type, either stranded, solid round or tape. Insulated cable should be in accordance with HD 21.3, HD 22.9 or other applicable standards. Bare conductor should comply with EN 60228, as applicable.

The **specification** may need to define the basis for the selection of conductor size i.e. cross-sectional area, for the protective conductors. Minimum conductor sizes for protective conductors are defined in HD 60364-5-54. Conductor sizes larger than the stated minimum conductor size may need to be selected for mechanical strength reasons.

The **specification** may need to define requirements on the application of protective conductor types and sizes for the earthing of exposed conductive parts and equipotential bonding of extraneous conductive parts in accordance with HD 60364-4-41.

- protective earthing of exposed conductive parts e.g.:
 - metal enclosures of **end items**;
 - cable armours and screens.
- equipotential bonding (including any supplementary bonding) of extraneous conductive parts e.g.:
 - metal structural and supporting steelwork;
 - metal pipework and tanks;
 - metal fences and gates.

The installation of protective conductor for the connection of electrical system neutral points/neutral earthing devices to earth may need to be included.

The **specification** may need to define requirements for the provision of a main earthing network e.g.:

- network configuration e.g. in ring or radial circuits for interconnection of **main earthing busbars**;
- application of protective conduct sizes;
- **cable routes** for protective conductor (if not laid on **cable management system**);
- provision of **main earthing busbars**;
- connections to other earthing arrangements.

The **specification** may need to define requirements for secondary earthing arrangements such as required for multipair cable screens that are collectively earthed to a **main earthing busbar** at a single point.

The **specification** may need to include requirements for functional earthing e.g. telecomms.

The **specification** may need to define requirements for the type and application of conductor joints and terminations e.g.:

- bolted type terminal lugs;
- two/three/four way branch connectors;
- exothermic welding and brazing.

Joints and terminations should be accessible for periodic inspection and testing.

The **specification** may need to define requirements for **main earthing busbars**, if required e.g.:

- selection of **main earthing busbar** sizes and application;
- guidance on placement of **main earthing busbars**.

10.1.2 Maintenance features

The **specification** may need to define requirements for maintenance and testing. For example, means of circuit isolation by the provision of terminal blocks with isolating links or the use of connector types that permit disconnection of the cable cores.

10.1.3 Measuring and sampling points

10.1.4 Legislation measurement points

10.2 Design justification

*The **supplier** should provide **equipment** descriptions as part of the justification of selection, description of the basic, principles employed, extent of extrapolation, degree of innovation, references to the options considered, economic implications and **conformity** with the **purchaser's** requirements. In addition, the **specification** may define requirements for justification of specific design features.*

For example, economic justification for the design of the **cable route network** the **supplier** has selected.

10.3 Material selection

*The materials of construction should normally be selected by the **supplier**. The **specification** may, however, define the preferred materials selection and request an alternative offer using these materials.*

*Where the **supplier** has made the selection of materials, the **supplier** should provide justification for the selection of materials and proposed fabrication methods.*

10.4 Safety

10.4.1 General

*The **equipment** should comply with international, national and local safety requirements during installation and operation. The **supplier's** personnel on site should also comply with such requirements.*

In addition, the **specification** may define requirements on general safety such as:

- measures to notify personnel of danger and prevention of unauthorised access e.g.:
 - safety notices and labels;
 - method of securing to prevent unauthorised access e.g. by undoing of screws, special keys or by the fitting of a padlock.
- measures to prevent inadvertent contact with exposed live parts e.g.:
 - earthed metal or dielectric barriers;
 - insulating shrouds and screens.

Special measures are required with **cabling systems** in hazardous areas containing explosive gas atmospheres. Reference should be made to EN 60079-14 and other relevant standards.

10.4.2 Equipment protection

The **specification** may request information regarding the measures taken to confine the **equipment** within safe operating limits, prevention of fire, protection against lightning, protection against rain water ingress, etc.

10.4.2.1 Protection against fire

The **specification** may need to define measures to minimise the damage or economic consequences of a fire. This may apply to areas where a **cable route**, or **cable routes** which are in close proximity to each other, exceed a prescribed limit e.g. in the total cable non metallic volume (NMV), in litres per metre or to areas where the risk of fire involving cables starting is high. These measures may involve the provision of fire barriers to create fire zones, fire detection systems, fire coatings and the fire sealing of cable openings.

The **specification** may need to define requirements for fire barriers, fire coatings and fire sealing of openings e.g.:

- fire resistance and other performance requirements;
- fire barrier purpose i.e. to resist spread of fire or contain smoke and fumes;
- application and placement of fire barriers e.g. to provide cable segregation;
- application of fire coatings and fire seals at openings e.g. around cables where cables pass through holes in walls, floors, ceilings and fire barriers;
- provision of access doors in fire barriers.

For further guidance on the determination of the fire resistance of elements of construction refer to ISO 834.

The **specification** may need to define requirements for fire detection e.g.:

- type of detection system;
- extent of application e.g. in all high cable density areas such as main cable ways;
- maximum area of coverage for each fire detecting zone;
- positioning of detectors;
- performance requirements of detectors;
- test facilities and alarms.

For further guidance on fire detection and fire alarm systems refer to EN 54.

10.4.2.2 Protection against deterioration and ingress

The **specification** may need to define requirements for protection against deterioration and prevention of ingress e.g.

- protection against corrosion e.g. galvanising;
- seals against water and vermin ingress into buildings through cable ducts etc;
- indoor/outdoor IP code (EN 60529) and anti-condensation measures for enclosures;
- measures for the preservation of electrical continuity of protective conductor terminations against mechanical and chemical deterioration.

10.4.2.3 Protection against mechanical damage

The **specification** may need to define requirements for additional protection against mechanical damage at vulnerable positions. This is usually achieved by the fitting of barriers, covers or shields e.g.:

- cover plates fitted over low level cable tray where vulnerable to being stepped on;
- barriers fitted around vertical cable tray at floor level where vulnerable to being knocked.

Additional protection may need to be provided against impact damage caused by sharp edges or falling objects, abrasion damage through repeated rubbing or from being knocked or crushed by a heavy object.

10.5 Interchangeability

The **purchaser** may wish to secure interchangeability or commonality (use of identical components) within the **site** or between **sites** operated by the **purchaser**. This may be achieved either by specifying the type of components or supplying the components for incorporation into the plant.

For example, the **purchaser** may specify that certain cable types and sizes, or cabling accessories, should be the same as those already installed.

NOTE If the **purchaser** wishes to specify a particular **supplier** the requirements of relevant European and national legislation should be noted.

10.6 Fabrication methods

The **specification** may need to define **installation data**. These may include minimum standards or good practice. Guidance in the form of a 'check list' is given in Annex C (informative).

11 Maintenance requirements

11.1 Planned maintenance

11.2 Personnel safety

11.3 Requirements for access

The **specification** should define whether permanent access is required for all operation and maintenance of the **equipment** or whether temporary staging or scaffolding is acceptable for specific operational and maintenance activities.

11.4 Lifting requirements

11.5 Special tools

The **specification** should request the **supplier** to identify where special tools are required for operation and maintenance and to recommend the number to be supplied.

The **specification** should define whether special tools intended for long term use may be employed during installation.

11.6 Test equipment

The **specification** should request the **supplier** to identify test equipment required for routine testing of the **equipment**. If specific, this may be offered by the **supplier** as a separate item in the supply.

11.7 Spare parts strategy

The **specification** should request the **supplier** to make recommendations for holdings of spare parts based on estimated replacement rates and delivery times.

11.8 Special precautions

The **supplier** should be asked to identify special precautions required during maintenance operations.

12 Technical documentation

12.1 Tender documentation

The **specification** should request **tenderers** to provide sufficient information in the **tender** to

- facilitate system studies,
- demonstrate that the **tender** matches the **purchaser's** requirements set out in the **enquiry**,
- allow evaluation by the **purchaser**.

For **cabling systems** this information may include technical particulars, design proposals, general arrangement drawings, descriptions of design principles, examples of cable planning information, type test certification, installation techniques, supplemental test data e.g. fire performance test reports, and reference installations.

The **specification** may need to request supporting information such as proposals on specific design aspects, inspection and test procedures, quality control documentation, etc.

Examples of **design data**, **supply data** and **installation data** that may need to be provided are given in Annexes A, B and C (informative) respectively.

12.2 Contract documentation

The **specification** should define a list of documents to be provided by the **supplier**. This should include a definition of when or at what stage the documents should be made available.

The **specification** may request general layout drawings, detailed arrangement drawings and assembly drawings.

The **specification** may request supporting information regarding the construction programme, design submissions, design studies, test procedures, operating and maintenance instructions and quality control information.

The **specification** may specify the general layout of all documents (to be transmitted or made available) and provide specific schedules for completion by the **supplier**.

The **specification** should define the method of data transfer (software compatibility), its form (paper, microfiche, electronic), the addresses to which they should be sent, the number of copies and status notation (i.e. provisional, definitive, final).

For **cabling systems** this may include providing descriptions of the **cabling system** selected, copies of design calculations, references to any options considered, economic implications and compliance with the **purchaser's** requirements. Examples of design studies are the assessment of cable fire risk or that **cable routes** are adequately sized for the estimated numbers of cables to be installed.

The **specification** may need to define the design information to be provided by the **purchaser** during the course of the contract and the timescale for its provision. This may include **schedules**, **location drawings**, detailed arrangement and layout drawings and installation procedures, etc.

The **specification** may need to define the cabling information system to be employed for management of the contract including by whom it will be operated, its main features, and if this is a computer based system, the software program. The information system may be to enable progress with the **cabling system** to be monitored through the design phase (e.g. **cable scheduling**, **cable routing**, preparation of **cable connection** details) and site installation (e.g. **cable route** available, cable laid, cable ends completed, cable tested). Features may include stock control and periodic valuations.

The **specification** should define the information to be handed over to the **purchaser** at the end of the contract e.g. as installed record drawings, final **schedules**, quality assurance records, test records, etc.

13 Applicable legislation, regulations, standards and further requirements

13.1 Legislation and regulations

The *international, national and local legislation and regulations having significant influence on design of the **equipment** should be identified in the **enquiry**. These may include health and safety requirements, environmental protection and waste disposal and planning constraints. The **enquiry** should also identify specific construction features and site activities covered by local legislation.*

*The **enquiry** should state that such information is not necessarily exhaustive and does not modify the legal obligations of the **supplier**.*

13.2 Standards

*The **specification** should identify those standards whose use is obligatory and other standards or codes with which the **equipment** should comply, if any.*

*The **purchaser** may ask the **tenderer** to define other standards or codes, in addition to those identified in the **specification**, applicable to the **tender**.*

13.3 Further requirements

*The **purchaser's** own guidelines for design, manufacture and construction may be specified.*

NOTE Attention is drawn to European, national and/or local legislation which may place restrictions in this area.

*The **specification** should define the units of measurement to be employed in the **tender** and the contract.*

14 Evaluation criteria

14.1 General

NOTE European legislation designed to promote the Single Market identifies some criteria on which the contracting parties may base the award of contracts. Provision is also made for auditing evaluations.

*The **enquiry** should advise the **tenderer** of the method of **tender** evaluation.*

*With the complexity of **equipment** covered by this Guide, the most economically advantageous **tender** evaluation will normally be applied.*

Criteria, such as the following, should be considered, depending on the contract in question:

- *delivery or completion date;*
- *running costs;*
- *cost-effectiveness;*
- *quality;*
- *aesthetic and functional characteristics;*
- *technical merit;*
- *after-sales service and technical assistance;*
- *commitments with regard to spare parts;*
- *security of supplies;*
- *price.*

14.2 Technical criteria

*The **enquiry** should define the method of incorporation of the following factors, where appropriate, in the evaluation.*

14.2.1 Quality

Availability is a measure of total quality and the **purchaser** may evaluate the **tender** in terms of data on **availability**, **reliability** and **maintainability**.

14.2.2 Functional characteristics

This may be based not only on information declared by the **supplier** but also on independent information obtained by the **purchaser**. The evaluation may take into account the **performance** requirements given in Clause 9.

14.2.3 Technical merit

Where the **specification** calls for **proven equipment**, the demonstration should be in the form of either documentation, which may be audited, and/or site visits. The **purchaser** may evaluate the **tender** in terms of whether the **equipment** is novel or has been used extensively for similar applications.

14.2.4 Running costs

The main technical factors for running costs are absorbed power and consumables at defined operating conditions.

14.2.5 Technical assistance

The **purchaser** may assess the technical competence and resources at the disposal of the **supplier** and the **supplier's** record of technical fulfilment of similar contracts.

15 Quality measures

15.1 General

The **enquiry** may specify minimum requirements relating to the quality system of the **supplier**. The **enquiry** may refer to the EN ISO 9000 series and particularly EN ISO 9001, which covers design, development, production, installation and servicing and/or to EN ISO 9002, which does not cover design or development, as appropriate.

The **enquiry** should define the audit requirements between the parties, if applicable, if there are any, the audit programme should be agreed between the **purchaser** and the **supplier** and adequate access should be given by the **supplier** for audit.

15.2 Approvals procedure

The **enquiry** may define the requirements for submission of drawings, calculations and manufacturing procedures for approval. The **supplier** may submit a quality plan (or equivalent document) for the supply and the **enquiry** may indicate hold points, beyond which work may not be continued without informing or obtaining the agreement of the **purchaser**.

The **supplier** should give adequate notice to the **purchaser** when hold points are reached. Adequate time should be allowed for the **purchaser** to examine submissions and the notification by the **purchaser** of approval or rejection should be in sufficient time reasonably to avoid delays in the **project**.

15.3 Inspection requirements

The **enquiry** should state the inspection requirements, if any. In that case, the inspection programme should be agreed between the **purchaser** and **supplier** and adequate access to carry out inspection should be given by the **supplier**.

15.4 Non-conformity

The **enquiry** should define policy with respect to non-conformity and rectification of defects.

16 Site factors

16.1 Access

The **enquiry** may need to define the location of the access to the **site** and any on-site dimensional, time, weight and other restrictions.

16.2 Facilities

16.2.1 General

The **enquiry** should define the facilities to be made available to the **supplier** at the **site** during installation and commissioning of the **equipment**. Such facilities may include the following.

16.2.2 Accommodation

If the **purchaser** provides accommodation on **site** for the **supplier's** personnel, the extent of this accommodation, its location and the facilities provided should be stated in the **enquiry**, for example, **site** huts, heating, lighting, telephones, car parking, first aid, toilets and canteen.

16.2.3 Site services

The **enquiry** should state the location and conditions of use of site services, such as connections for electricity, water and other services provided for **site** construction. The supply voltages and maximum capacity of the supplies should be stated. Information on the capacity of lifting equipment, anchorage points, etc. should be given where appropriate, together with other site equipment which is available for use by the **supplier**.

16.2.4 Disposal of waste

The **enquiry** should identify **site** waste disposal requirements and disposal points and provisions for maintenance of cleanliness in working areas.

16.2.5 Storage and handling

The **enquiry** should identify the areas where the **supplier** may store materials, components, etc. and provide information on storage conditions.

16.2.6 Working hours

The **enquiry** should identify any **site** specific restrictions placed on the times of working, for example normal allowable hours of work, week-end working, etc.

16.3 Site specific requirements

The **enquiry** should state **site** specific requirements for installation and commissioning.

These may include

- sequence of works that may be necessary for the installation of other equipment or the continued operation of plant particularly in cases of retrofit operations,
- detailed **plans** for tests of integration of **equipment**,
- components and systems which have to be operable for commissioning of other plant,
- definition of the commissioning process and the necessary documentation required.

17 Verification of specified performance

17.1 General

Tests will, in general, be required on the **equipment** at various stages of the contract to verify its **performance**. The **specification** should define the tests required and their conditions and organisation. This may include definition of the provision of **site** services, personnel, etc.

17.2 Works tests

Tests during manufacture may include type tests, special tests and routine tests. Test requirements are identified in the reference standards, where these exist, with special tests being carried out only when required by the **specification**.

The **specification** should define the tests to be carried out during the manufacturing process for the verification of **performance** and the **supplier** should give adequate notice to allow witnessing of the tests.

Repetition of type tests is usually not required.

The **supplier** should recognise the need for testing in the programme of work and define when and how (i.e. what testing methods or standards) the tests are to be conducted.

17.3 Tests during installation and commissioning

The **specification** should define the requirements (methods and criteria) for tests during installation and commissioning together with a list of the testing standards.

Test parameters for cables should be in accordance with the relevant standard or as recommended by the cable manufacturer. Minimum acceptance values should be specified if not defined in the relevant standard. The conditions for the performance of electrical testing on cable cores may need to be specified, e.g. prior to core termination, to avoid the risk of over stressing or damage to other contractor's equipment.

NOTE The contractual consequences of the outcome of the tests during installation and commissioning should be stated in the **enquiry**, where appropriate.

17.4 Technical conditions for trial run

Upon initial start up of the **equipment**, the date of which should be agreed with the **purchaser**, the **supplier** should carry out the continuous trial run if specified. The purpose of the trial run is to prove the functional capability of the **equipment** and to show that it will, with, high probability meet its **performance** targets. During the run, therefore, all significant components should be in operation.

The **specification** may define in what circumstances breakdown of a significant component will constitute an interruption of the trial, with the start of operation after reinstatement of the component becoming the trial commencement. The **purchaser** may also give concessions criteria for breakdowns of a very short period, for example simply extending the period of the trial by the outage time. The **purchaser** may consider that multiple breakdowns occurring during the trial run are unacceptable and therefore define the circumstances in which concessions will be withdrawn, for example giving the number and duration of breakdowns that may not be exceeded.

The conditions that have to be met for the successful completion of the trial run should be defined in the **specification**.

These may include fulfilment of minimum **performance** requirements, fulfilment of legal and safety requirements applicable to the **site** and obligations to make minor corrections and changes and rectify minor defects, etc. within a specified time.

NOTE The contractual consequences of the outcome of the trial run should be stated in the **enquiry**, where appropriate.

17.5 Functional and performance tests

The **specification** should define the minimum requirements for both functional and **performance** tests, the applicable standards, if any, and the criteria against which the test results will be assessed. The **supplier** should provide a schedule of the tests to be conducted for approval by the **purchaser** who should be given adequate notice to allow witnessing of the tests.

Functional tests are carried out to demonstrate the ability of the **equipment** to satisfy the operational requirements, such as automatic start-up and shut-down, modulating capabilities and subsystem suitability.

Performance tests are conducted at agreed predefined operating points. Where appropriate, the **supplier** should provide correction curves to allow the interpretation of results.

In addition to the **performance** tests, the **specification** may also define a period of operation during which additional tests may be required.

The **specification** may also define a period during which the **equipment** should operate to specified levels of, for example, target efficiency and/or target **availability**. The nature and frequency of testing to verify the relevant requirements, if applicable, should be defined in the **specification**. The **specification** should define the level of maintenance that may be carried out before tests.

NOTE The contractual consequences of the outcome of **performance** tests should be stated in the **enquiry**, where appropriate.

Annex A (informative)

Design data (Check list)

The following provides guidance on the **design data** that may be specified.

- scheduled cable:
 - **cable schedule**;
 - cabling information to be provided on the **cable schedule**;
 - design basis for scheduling cables;
 - **cable system** or preferred cable types and conductor sizes and applications;
 - design basis for **cable identifier**;
 - cable drum identification for each **scheduled cable**;
 - cable manufacturers' dimensional information for determination of cable accessory and fitting sizes.
- enclosures and frames:
 - **cable junctioning system schedule**;
 - design basis for **cable junctioning**;
 - assembly drawings for enclosures and frames;
 - **location drawings** for enclosures and frames;
 - design guidance on placing for minor enclosures.
- **end items**:
 - **identification of end items**;
 - **location drawings** for **end items**;
 - position of **terminal identifiers**;
 - provisions for **cable entry** and **cable termination**.
- **cable routes** - location:
 - space allocated to **cable routes**;
 - **location drawings** for **cable routes** and **cable route network** cable ways, indoor/outdoor, above/below ground/floor level, between buildings, in equipment rooms and plant areas;
 - unusable space within **cable routes** e.g. for ventilation ductwork, fire protection pipework;
 - location or proximity of buried **cable routes** other services;
 - guidance on placing of minor **cable routes**;
 - details of openings in walls, floors and ceilings provided for **cable routes**;
 - profile details for long buried **cable routes**;
 - ground conditions for buried **cable routes** e.g. sand, clay, rocky soil, etc.;
 - design guidance on permissible locations for making openings in walls, floors and ceilings for **cable routes**.
- **cable management system**:
 - preferred types of **cable management system**;
 - **cable management system schedule** and application;
 - types of **cable management system** and cable carrying capacity for each **cable route**;
 - design of **cable management system** in floor levels, risers, tunnels, in equipment rooms and plant areas, trenches in floors, etc.;
 - **location drawings** for **cable management systems** provided under separate contracts e.g. trenches;
 - position/type of concrete inserts for attaching fixings in floors, walls and ceilings.

- assembly drawings for open, modular type, **cable management systems**:
 - single and multi-layer **cable management system** configurations;
 - bridges to cross-over other **cable route**;
 - different types of junction points e.g. tee junctions.
- assembly drawings for enclosed, modular type, **cable management systems**:
 - siting of conduit system pulling points.
- assembly drawings for cable ducts and cable troughs:
 - duct banks and manholes, pre-cast troughs.
- **cable routing**:
 - **cable route identifier** system;
 - location of each **cable route identifier**;
 - design basis for **cable routing**;
 - **cable route schedule**;
 - unused or spare capacity with existing **cable routes**.
- **cable fixing**:
 - preferred types of **cable fixing system**;
 - **cable fixing system schedule**;
 - assembly drawings for **cable fixing**.
- cable completion:
 - preferred types of **cable entry system**;
 - **cable entry system schedule**;
 - assembly drawings for **cable entry system**;
 - preferred types of **cable termination system**;
 - **cable termination system schedule**;
 - assembly drawings for **cable termination system**.
- **core allocating**:
 - design basis for **core allocating**;
 - **core allocation schedules**;
 - electrical design drawings etc, for preparation of **core allocation schedules**.
- earthing and equipotential bonding:
 - **location drawings** for main earthing network and **main earthing busbars**;
 - design and application of **main earthing busbars**;
 - guidance on placement of **main earthing busbars**;
 - preferred protective conductor sizes and applications;
 - types and application of joints and connections;
 - exposed conductive parts to be earthed;
 - extraneous conductive parts to be earthed;
 - location of earthing terminals and equipotential bonding terminals.
- fire protection:
 - assembly drawings for fire barriers;
 - **location drawings** for fire barriers or fire zones;
 - **location drawings** for fire detectors.

NOTE This list is not intended to be exhaustive.

Annex B
(informative)**Supply data (Check list)**

The following provides guidance on **supply data** that may be specified:

- cable:
 - applicable standard(s);
 - voltage rating and type;
 - conductor size(s), material, plating, number and diameter of wires or if solid, shape; insulation material;
 - number of cores or pairs, screen type and application;
 - construction of sheathing layers, material and colour, if armoured type, material and finish;
 - external marking;
 - environmental conditions e.g. direct buried in wet locations;
 - additional fire propagation test requirements;
 - additional information e.g. maximum longitudinal induced voltage, for underground use in wet locations etc.
- modular **cable management systems**:
 - applicable standard(s);
 - type and if pliable for conduit;
 - class of duty;
 - dimensional information e.g. length, width, depth, angle, thickness (gauge), diameter;
 - material, finish e.g. for resistance to corrosion and colour;
 - mechanical properties;
 - fittings and accessories.
- direct buried in ground:
 - quality of bedding sand;
 - types of protective covers or covering strip, marker tape;
 - types of marker posts.
- ducts or conduits:
 - duct/conduit diameters and material;
 - overall dimensions of access manholes and load bearing capability.
- covered troughs:
 - length, depth and width of troughs;
 - load bearing capability of covers.
- cable retention devices:
 - applicable standard(s);
 - types of cable retention device e.g. cable cleats according to EN 50146, cable ties according to EN 50386, tape;
 - cable diameter range for cleats;
 - length/size/releasable/non-releasable for ties/straps;
 - environmental conditions e.g. resistance to sunlight;
 - non-combustible cable retention devices e.g. stainless steel types;
 - material and colour;
 - mechanical properties e.g. minimum value of tensile strength for plastic ties;
 - short circuit current and duration for single core power cable retention devices.

- cable mechanical glands:
 - applicable standard(s);
 - type e.g. metallic gland, insulated gland or polymeric gland;
 - short circuit or earth fault current and duration (power cables);
 - dimension over cable bedding or inner sheath;
 - dimension over the cable oversheath;
 - armour type, size and material;
 - outer/inner seals;
 - integral armour earthing facility;
 - integral screen terminator;
 - fittings and accessories may include backnuts, shrouds and earthing tags.

- LV cable terminations:
 - applicable standard(s);
 - for crimped connections e.g. splices, uninsulated or pre-insulated; terminal shape - pin, ring, fork, push-on;
 - for compressed connections e.g. bimetallic lug, terminal palm width, length and bolt size;
 - short circuit current and duration;
 - nominal cross-sectional area of conductor, material, shape, number and diameter of wires, degree of compaction;
 - nominal core overall diameter or insulation thickness;
 - accessories such as insulating sleeving.

- LV plug-in terminations:
 - applicable standard;
 - cable type and size;
 - voltage and current rating;
 - socket/pin arrangement (number of pins, poles, neutral, earth) and material;
 - degree of protection (IP Code).

- MV cable terminations:
 - applicable standard(s);
 - voltage rating;
 - type e.g. pre-moulded, heat shrink;
 - application e.g. indoor or outdoor, environmental conditions;
 - cable type (including insulation) and size;
 - dimensional information e.g. diameter over core insulation;
 - type of bushing;
 - accessories e.g. earthing kits.

- enclosures and frames - construction:
 - type and dimensional size of **end item** e.g. junction box;
 - general construction e.g. class of duty, indoor/outdoor, material (metal/plastic types) and surface finish;
 - degree of protection (IP code);
 - means of gaining internal access, e.g. hinged lid, screwed covers;
 - means of preventing unauthorised access;
 - means of gaining access to connectors e.g. hinged swing frames;
 - means of cable entry e.g. detachable gland plates and location;
 - minimum spacing distance between gland plate and terminals;
 - mounting provisions e.g. for surface or frame mounting, free-standing, etc;
 - provisions for routing and supporting of cores;
 - provisions for earthing and material e.g. brass earth stud;
 - fitted with breather to assist in minimising condensation;
 - explosion relief;
 - means for dissipation of heat;
 - anti-condensation measures;
 - sloping roof shed if exposed to severe weather conditions.

- enclosures and frames - terminal arrangements:
 - numbers and types of connecting devices e.g. terminal blocks, splices;
 - nominal voltage and current ratings of connecting devices;
 - method of mounting terminals e.g. rail mounted;
 - general arrangement and minimum spacing distances between terminals and connecting devices e.g. number of rows, in vertical or horizontal rows, length of rows, if rail mounted, level of accessibility e.g. adequate working space for use of hand held tools;
 - measures to assist with terminal identification e.g. terminals arranged in a logical order, terminals divided into a number of discrete modules;
 - material for contact surface e.g. plain copper;
 - connecting device features e.g. moulding material, colour, fully shrouded contacts etc, types of terminals and connecting devices e.g. stud, screw clamp, screwless, high integrity (spring loaded) screw camp;
 - accessories e.g. terminal markers, shrouds, connecting links, etc.;
 - fitting of identification labels.

- straight-through joints/cable sealing ends:
 - applicable standard(s);
 - voltage rating, power frequency and impulse voltage test levels;
 - short circuit and earth fault currents and durations;
 - type e.g. pre-moulded, heat shrink, compound filled;
 - cable type (including insulation) and size;
 - dimensional information e.g. overall cable diameter and diameter over core insulation;
 - material properties and compatibility;
 - accessories such as earthing kits;
 - degree of mechanical protection e.g. for outdoor application.

- **main earthing busbars:**
 - earth fault current and duration;
 - material and grade;
 - length, width, depth;
 - if pre-drilled, number, diameter and spacing of holes.

- fire resisting barriers and seals:
 - applicable standard(s);
 - type of barrier or seal;
 - fire rating e.g. duration, furnace temperature (or fire curve), 'cold face' maximum temperature and measurement position;
 - dimensional information for fire barriers and features e.g. access doors;
 - mechanical properties such as resistance to impact damage, differential pressure, water spray;
 - environmental conditions.

NOTE This list is not intended to be exhaustive.

Annex C (informative)

Installation data (Check list)

The following provides guidance on **installation data** that may be specified.

- permitted works:
 - cutting of minor holes through floors, walls and ceilings for **cable routes**;
 - types of fixings that can be made to building material (floors, walls and ceilings);
 - types of fixings to structural components e.g. drilling, welding, mechanical clamps;
 - removal and replacement of trench covers and floor/ceiling tiles.
- modular **cable management system**:
 - site fabricated assemblies;
 - rear spacing distance e.g. from wall to allow cable retaining devices to be fitted;
 - removal of sharp edges and burrs from cut ends;
 - corrosion protection of steel at cut edges;
 - recommended torque settings or tightness.
- enclosures and frames:
 - mounting arrangement e.g. free-standing, attached to frames or supports, surface mounted, spaced slightly off support surface;
 - site fabricated mounting frames;
 - maximum and minimum mounting heights from floor level.
- digging of trenches in ground:
 - precautions when digging;
 - method of excavation, levelling of base, timbering of sides;
 - keeping excavation free of unwanted materials (debris and percolating water);
 - disposal of surplus spoil.
- direct buried in ground:
 - minimum depth of MV and LV cables in dug trenches;
 - depths and compaction of bedding sand;
 - back filling and reinstatement;
 - application of protective covers or covering strip, marker tape;
 - application of marker posts including locations and maximum spacing distance.
- ducts or conduits:
 - duct/pipe depths and centre spacing distances with duct banks;
 - placing of access manholes or cable pulling points including maximum spacing distance with straight runs;
 - demonstration that ducts are free from obstruction by pulling through of a mandrel;
 - capping of ducts and provision of draw ropes;
 - keeping manholes free of debris and percolating water.
- covered troughs (pre-cast type) and trenches:
 - sunk in ground to leave top of covers flush with ground surface or laid on top of ground;
 - removal and replacement of covers.

- cable laying – techniques and precautions:
 - general drum handling;
 - pulling techniques and type of equipment used;
 - use of pulling lubricants;
 - monitoring of maximum pulling tension (when being winch pulled);
 - not exceeding minimum bending radii for installation of cable;
 - temporary securing of cable in position;
 - temporary sealing of cable ends against moisture ingress;
 - temporary protection of part laid cable;
 - temporary protection of cable at ends e.g. by coiling and tying;
 - conditions for installation when ambient temperature low.

- cable laying and fixing - orderly and neat appearance (this may apply more to areas where the cables are on show):
 - order in which cables are laid;
 - laid together in straight parallel lines;
 - keeping cables even in length around bends;
 - laid on same side of support system that cable peels off to avoid, as far as possible, crossing over other cables;
 - not exceeding minimum bending radii in final operating position.

- **cable entry:**
 - bottom entry only into outdoor **end items**;
 - where side **cable entry** permitted;
 - drilling of gland plates;
 - blanking off spare holes.

- **cable and core identifiers:**
 - colour/size and durability of markers;
 - location of cable identification markers e.g. at both cable ends, at duct entries, etc;
 - use of printed strip or ferrule marker system;
 - threaded or clip on type core identification markers;
 - ability to replace core identification markers without having to first disconnect termination;
 - core identification to be read from terminal outwards.

- preparation of cores:
 - removal of protective layers on entry;
 - looming/harnessing and dressing of cores;
 - general configuration or arrangement of terminations e.g. so stiff or rigid cores do not place undue strain on equipment terminals;
 - leaving spare core length for one re-termination;
 - leaving sufficient spare length to termination core at any other terminal position;
 - orderly and neat arrangement.

- **cable connection:**
 - insulation of each core maintained up to the metal of the terminal;
 - joint preparation;
 - procedure for making joints and terminations;
 - bolt, washer sizes;
 - use of approved tools, periodic checking of tools;
 - quality control with exothermic welds;
 - recommended torque settings or tightness;
 - removal of cut ends and other surplus material on completion.

- earthing and equipotential bonding:
 - procedure for making joints and terminations;
 - method of mounting **main earthing busbars**;
 - accessibility of **main earthing busbars** for inspection and testing;
 - protection of joints and terminations against mechanical and chemical deterioration.
- fire barriers and seals:
 - erection of fire barriers;
 - sealing of cables at holes in walls, fire barriers etc, after cables have been laid.

NOTE This list is not intended to be exhaustive.

Bibliography

EN 50086 Series	Conduit systems for cable management
EN 50109 Series	Hand crimping tools - Tools for the crimp termination of electric cables and wires for low frequency and radio frequency applications
EN 50267 Series	Common test methods for cables under fire conditions - Tests on gases evolved during combustion of materials from cables
EN 50288 Series	Multi-element metallic cables used in analogue and digital communication and control
EN 50289 Series	Communication cables - Specifications for test methods
EN 50290 Series	Communication cables
EN 60332-1 Series	Tests on electric and optical fibre cables under fire conditions - Part 1: Test for vertical flame propagation for a single insulated wire or cable (IEC 60332-1 Series)
EN 60332-2 Series	Tests on electric and optical fibre cables under fire conditions - Part 2: Test for vertical flame propagation for a single small insulated wire or cable (IEC 60332-2 Series)
EN 60352 Series	Solderless connections (IEC 60352 Series)
EN 60684 Series	Flexible insulating sleeving (IEC 60684 Series)
EN 60702-2	Mineral insulated cables and their terminations with a rated voltage not exceeding 750 V - Part 2: Terminations (IEC 60702-2)
EN 60708	Low-frequency cables with polyolefin insulated and moisture barrier polyolefin sheath (IEC 60708)
EN 60721 Series/ HD 478 Series	Classification of environmental conditions (IEC 60721 Series)
EN 60874 Series	Connectors for optical fibres and cables (IEC 60874 Series)
EN 60999 Series	Connecting devices - Electrical copper conductors - Safety requirements for screw-type and screwless-type clamping units (IEC 60999 Series)
EN 61034 Series	Measurement of smoke density of cables burning under defined conditions (IEC 61034 Series)
EN 61210	Connecting devices - Flat quick-connect terminations for electrical copper conductors - Safety requirements (IEC 61210, mod.)
EN 61442	Test methods for accessories for power cables with rated voltages from 6 kV ($U_m = 7,2$ kV) up to 30 kV ($U_m = 36$ kV) (IEC 61442, mod.)
EN ISO 9000	Quality management systems - Fundamentals and vocabulary (ISO 9000)
HD 21 Series	Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V
HD 22 Series	Cables of rated voltages up to and including 450/750 V and having cross-linked insulation
HD 586.3	Mineral insulated cables with a rated voltage not exceeding 750 V - Part 3: Guide to use
HD 60364-5-51	Electrical installations of buildings - Part 5-51: Selection and erection of electrical equipment - Common rules (IEC 60364-5-51, mod.)
HD 637	Power installations exceeding 1 kV a.c.
IEC 60050-442	International electrotechnical vocabulary - Part 442: Electrical accessories
IEC 60189 Series	Low-frequency cables and wires with PVC insulation and PVC sheath
IEC 60614 Series	Conduits for electrical installations
IEC 60754	Test on gases evolved during combustion of materials from cables
IEC 60981	Extra-heavy duty rigid steel conduits for electrical installations
IEC 61035 Series	Specification for conduit fittings for electrical installations

IEC/TR 61238-2 ²⁾	Compression and mechanical connectors for power cables with copper or aluminium conductors - Part 2: Terminal lugs for power cables to fit equipment up to and including 1 kV - Overall dimensions
IEC 61545	Connecting devices - Devices for the connection of aluminium conductors in clamping units of any material and copper conductors in aluminium bonded clamping units

NOTE This list is not intended to be exhaustive.

²⁾ Withdrawn publication.

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