



**ISLAMIC EMIRATE OF AFGHANISTAN
MINISTRY OF ENERGY AND WATER**

Terms of Reference (ToR)
for
UPGRADING THE FEASIBILITY STUDY of
SULTAN-IBRAHIM IRRIGATION PROJECT

ANNEX B1

**ELECTRICAL TECHNICAL REQUIREMENTS
FOR UPGRADING THE FEASIBILITY
STUDY STAGE**



JUNE 2024

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B.1. General

B.1.1. Scope of Work

This section relates to the general specifications of the electrical section of works envisaged for feasibility studies.

B.1.2. Applicable Standards and Regulations

B.1.2.1. General

All the designs, drawings, Materials, Goods, Plant, manufacture, testing, installations and performances of the Works shall comply with the latest ISO/IEC/NEC/IEEE/BS standards where applicable, and/or other approved Standards or Codes even if no reference to any standard is made in the Specifications.

When the Contract contains more restrictive requirements than those of the Standards or Codes, the Contract shall prevail.

For any reference in the Contract to Standards and Codes or to materials and equipment of a particular manufacturer, the Expression "equivalent or higher quality" can be considered. The potential contractor may propose for approval of the Employer alternative recognized Standards or Codes, materials or equipment, provided they are substantially equivalent or better, in every significant respect, to those specified.

If the potential contractor proposes deviations from the specified or approved Standards and Codes or desires to use Materials or equipment items not covered by these Standards and Codes, the potential contractor shall state the exact nature of the change, the reason for making the change and the proof that these equipment items or Materials are substantially equivalent or better, in every significant respect, to those specified.

For applications where no relevant standard exists, current recognized practice will apply.

B.1.2.2. Standards

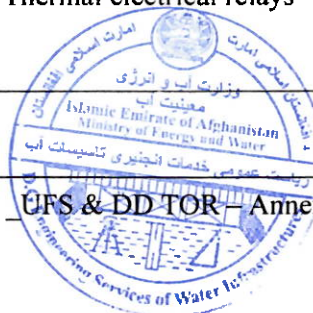
The following standards and regulations are applicable within the scope of works.

Norm Designation	Title
IEC 61511	Functional safety - Safety instrumented systems for the process industry sector
CCIR standards	Comité Consultatif International des Radiocommunication
CEE	Commission on the Rules for the Approval of the Electrical Equipment
DIN EN 60034-7; VDE 0530-7	Rotating electrical machines - Part 7: Classification of types of construction, mounting arrangements and terminal box position (IM code)

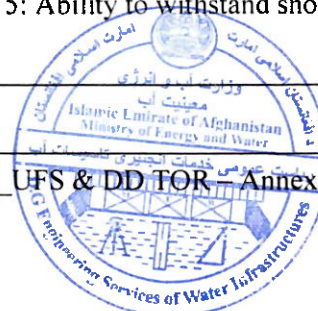
Norm Designation	Title
EN 779	Particulate air filters for general ventilation - Determination of the filtration performance
IEC 61672-1	Electroacoustic - Sound level meters - Part 1: Specifications
IEC 61672-2	Electroacoustic - Sound level meters - Part 2: Pattern evaluation tests
IEC 61672-3	Electroacoustic - Sound level meters - Part 3: Periodic tests
IEC 60137	Insulated bushings for alternating voltages above 1 000 V
IEC 60255	<p>Part 11: Electrical relays - Interruptions to and alternating component (ripple) in d.c. auxiliary energizing quantity of measuring relays</p> <p>Part 12: Electrical relays - Directional relays and power relays with two input energizing quantities</p> <p>Part 13: Electrical relays - Biased (percentage) differential relays</p> <p>Part 16: Electrical relays - Impedance measuring relays</p> <p>Part 21: Electrical relays -vibration, shock, bump and seismic tests on measuring relays and protection equipment - Section One: Vibration tests (sinusoidal)</p> <p>Part 21: Electrical relays - Vibration, shock, bump and seismic tests on measuring relays and protection equipment - Section Two: Shock and bump tests</p> <p>Part 21: Electrical relays - Vibration, shock, bump and seismic tests on measuring relays and protection equipment - Section 3: Seismic tests</p> <p>Measuring relays and protection equipment - Part 22-1: Electrical disturbance tests - 1 MHz burst immunity tests</p> <p>Measuring relays and protection equipment - Part 22-2: Electrical disturbance tests - Electrostatic discharge tests</p>



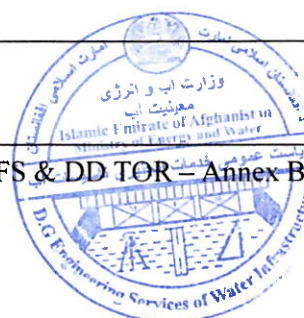
Norm Designation	Title
	<p>Measuring relays and protection equipment - Part 22-3: Electrical disturbance tests - Radiated electromagnetic field immunity</p> <p>Measuring relays and protection equipment - Part 22-4: Electrical disturbance tests - Electrical fast transient/burst immunity test</p> <p>Electrical relays - Part 22-5: Electrical disturbance tests for measuring relays and protection equipment - Surge immunity test</p> <p>Electrical relays - Part 22-6: Electrical disturbance tests for measuring relays and protection equipment - Immunity to conducted disturbances induced by radio frequency fields</p> <p>Electrical relays - Part 22-7: Electrical disturbance tests for measuring relays and protection equipment - Power frequency immunity tests</p> <p>Electrical relays - Part 24: Common format for transient data exchange (COMTRADE) for power systems</p> <p>Electrical relays - Part 25: Electromagnetic emission tests for measuring relays and protection equipment</p> <p>Measuring relays and protection equipment - Part 26: Electromagnetic compatibility requirements</p> <p>Measuring relays and protection equipment - Part 27: Product safety requirements</p> <p>Electrical relays - Part 3: Single input energizing quantity measuring relays with dependent or independent time</p> <p>Electrical Relays - Part 5: Insulation coordination for measuring relays and protection equipment - Requirements and tests</p> <p>Electrical relays - Part 6: Measuring relays and protection equipment</p> <p>Electrical relays - Part 8: Thermal electrical relays</p>



Norm Designation	Title
IEC 60034	Rotating electrical machines
IEC 60034-1	Rating and performance
IEC 60034-2-1)	Standard methods for determining losses and efficiency from tests (excluding machines for traction vehicles)
IEC 60034-3	Specific requirements for synchronous generators driven by steam turbines or combustion gas turbines
IEC 60034-7	Classification of types of construction, mounting arrangements and terminal box position (IM Code)
IEC 60044	Instrument transformers
IEC 60044-1	Current transformers
IEC 60044-2	Inductive voltage transformers
62271-100	High-voltage switchgear and control gear - Part 100: Alternating current circuit-breakers
IEC 60071-1	Insulation co-ordination - Part 1: Definitions, principles and rules
IEC 60071-2	Insulation co-ordination - Part 2: Application guide
IEC 60076	Power transformers
IEC 60076-1	Power transformers - Part 1: General
IEC 60076-2	Power transformers - Part 2: Temperature rise
IEC 60076-3	Power transformers - Part 3: Insulation levels, dielectric tests and external clearances in air
IEC 60076-4	Power Transformers-Part 4: Guide to the Lightning Impulse and Switching Impulse Testing - Power Transformers and Reactors
IEC 60076-5	Power transformers - Part 5: Ability to withstand short circuit



Norm Designation	Title
IEC 60076-7	Power transformers - Part 7: Loading guide for oil-immersed power transformers
IEC 60076-10	Power transformers – Part 10: Determination of sound levels - Application guide
IEC 60099-4	Surge arresters - Part 4: Metal-oxide surge arresters without gaps for a.c. systems
IEC 60120	Dimensions of ball and socket couplings of string insulator units
IEC 60137	Insulated bushings for alternating voltages above 1 000 V
IEC 60044-2	Instrument transformers - Part 2 : Inductive voltage transformers
IEC 60044-5	Instrument transformers - Part 5: Capacitor voltage transformers
IEC 60214	IEC 60214-1 Tap-changers - Part 1: Performance requirements and test methods
IEC 60214	IEC 60214-2 Tap-changers - Part 2: Application guide
IEC 60273	Characteristic of indoor and outdoor post insulators for systems with nominal voltages greater than 1000 V
IEC 60296	Fluids for electrotechnical applications - Unused mineral insulating oils for transformers and switchgear
IEC 60305	Insulators for overhead lines with a nominal voltage above 1000 V - Ceramic or glass insulator units for a.c. systems - Characteristics of insulator units of the cap and pin type
IEC 60331	Tests for electric cables under fire conditions - Circuit integrity



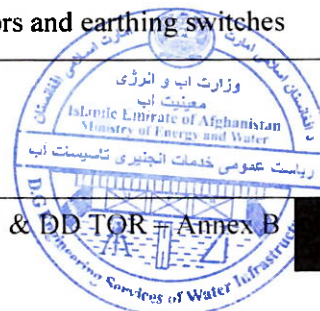
Norm Designation	Title
	<p>Part 11: Apparatus - Fire alone at a flame temperature of at least 750 °C</p> <p>Part 12: Apparatus - Fire with shock at a temperature of at least 830 °C</p> <p>Part 21: Procedures and requirements - Cables of rated voltage up to and including 0,6/1,0 kV</p> <p>Part 23: Procedures and requirements - Electric data cables</p> <p>Part 25: Procedures and requirements - Optical fibre cables</p> <p>Part 31: Procedures and requirements for fire with shock - Cables of rated voltage up to and including 0,6/1 kV</p>
IEC 60332	<p>Tests on electric and optical fibre cables under fire conditions</p> <p>Part 1-1: Test for vertical flame propagation for a single insulated wire or cable - Apparatus</p> <p>Part 1-2: Test for vertical flame propagation for a single insulated wire or cable - Procedure for 1 kW pre-mixed flame</p> <p>Part 1-3: Test for vertical flame propagation for a single insulated wire or cable - Procedure for determination of flaming droplets/particles</p> <p>Part 2-1: Test for vertical flame propagation for a single small insulated wire or cable - Apparatus</p> <p>Part 2-2: Test for vertical flame propagation for a single small insulated wire or cable - Procedure for diffusion flame</p> <p>Part 3-10: Test for vertical flame spread of vertically-mounted bunched wires or cables - Apparatus</p> <p>Part 3-21: Test for vertical flame spread of vertically-mounted bunched wires or cables - Category A F/R</p> <p>Part 3-22: Test for vertical flame spread of vertically-mounted bunched wires or cables - Category A</p> <p>Part 3-23: Test for vertical flame spread of vertically-mounted bunched wires or cables - Category B</p>



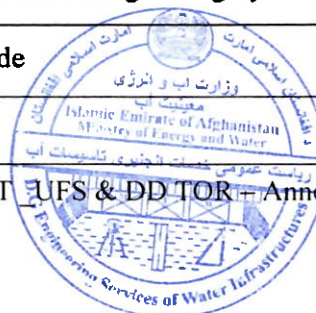
Norm Designation	Title
	Part 3-24: Test for vertical flame spread of vertically-mounted bunched wires or cables - Category C Part 3-25: Test for vertical flame spread of vertically-mounted bunched wires or cables - Category D
IEC 60383-1	Insulators for Overhead Lines with a Nominal Voltage Above 1 000 V Part 1: Ceramic or Glass Insulator Units for AC Systems - Definitions, Test Methods and Acceptance Criteria
IEC 60383-2	Insulators for Overhead Lines with a Nominal Voltage Above 1 000 V Part 2: Insulator Strings and Insulator Sets for A.C. Systems - Definitions, Test Methods and Acceptance Criteria
IEC 60439-1	Low-voltage switchgear and controlgear assemblies - Part 1: Type-tested and partially type-tested assemblies
IEC 60529	Degrees of protection provided by enclosures (IP Code)
IEC 60554	Specification for cellulosic papers for electrical purposes Part 1: Definitions and general requirements Part 2: Methods of test Part 3: Specifications for individual materials. Sheet 1: General purpose electrical paper Part 3: Specifications for individual materials. Sheet 2: Capacitor paper Part 3: Specifications for individual materials. Sheet 3: Crêpe paper Part 3: Specifications for individual materials. Sheet 4: Electrolytic capacitor paper Part 3: Specifications for individual materials. Sheet 5: Special papers
IEC 60672	Ceramic and glass insulating materials Part 1: Definitions and classification Part 2: Methods of test



Norm Designation	Title
	Part 3: Specifications for individual materials
IEC 60189-3	Low-frequency cables and wires with PVC insulation and PVC sheath - Part 3: Equipment wires with solid or stranded conductor wires, PVC insulated, in singles, pairs and triples
IEC 60840	Power cables with extruded insulation and their accessories for rated voltages above 30 kV ($U_m = 36$ kV) up to 150 kV ($U_m = 170$ kV) - Test methods and requirements
IEC 60870-5-103 and -104	Telecontrol equipment and systems - Part 5-103: Transmission protocols - Companion standard for the informative interface of protection equipment Telecontrol equipment and systems - Part 5-104: Transmission protocols - Network access for IEC 60870-5-101 using standard transport profiles
IEC 60947-1	Low-voltage switchgear and controlgear - Part 1: General rules
IEC 60947-2	Low-voltage switchgear and controlgear - Part 2: Circuit-breakers
IEC 60034-4	Rotating electrical machines - Part 4: Methods for determining synchronous machine quantities from tests
IEC 60034-5	Rotating electrical machines - Part 5: Degrees of protection provided by the integral design of rotating electrical machines (IP code) - Classification
IEC 60168	Tests on indoor and outdoor post insulators of ceramic material or glass for systems with nominal voltages greater than 1000 V
IEC 62271-100	High-voltage alternating current circuit breakers
IEC 62271-102	High-Voltage Switchgear and Control gear - Part 102: Alternating current disconnectors and earthing switches



Norm Designation	Title
IEC 62041	Power transformers, power supply units, reactors and similar products EMC requirements.
IEC 60189-3	Low-frequency cables and wires with PVC insulation and PVC sheath – Part 3: Equipment wires with solid or stranded conductor wires, PVC insulated, in singles, pairs and triples
IEC 60364-6	Low-voltage electrical installations - Part 6: Verification
IEC 61000-2	Electromagnetic compatibility (EMC) Part 2-4: Environment - Compatibility levels for low-frequency conducted disturbances
IEEE 142	Recommended practice for grounding of industrial and commercial power systems
IEEE 367	Recommended practice for determining the electric power station ground potential rise and induced voltage from a power fault
IEEE 80	Guide for safety in AC substation grounding
ISO 3046/II and III	<p>ISO 3046-1</p> <p>Reciprocating internal combustion engines - Performance - Part 1: Declarations of power, fuel and lubricating oil consumptions, and test methods; Additional requirements for engines for general use</p> <p>ISO 3046-2</p> <p>>> replaced by part 1</p> <p>ISO 3046-3</p> <p>Reciprocating internal combustion engines - Performance - Part 3: Test measurements</p>
NFPA 10	Standard for Portable Fire Extinguishers
NFPA 12	Standard on Carbon Dioxide Extinguishing Systems
NFPA 72	National Fire Alarm Code



Norm Designation	Title
NFPA 70	National Electric Code
VDE 0101	Power installations exceeding AC 1 kV
VDE 0111	Insulation co-ordination Part 1: Definitions, principles and rules Part 2: Application guide
VDE 0141	Earthing systems for special power installations with nominal voltages above 1 kV
VDE 0530/72	Rotating electrical machines Beiblatt 1 VDE 0530 Guide for reference installation and reference service-conditions for low voltage general purpose cage induction motors with duty type S1 Part 1: Rating and performance Part 11: Thermal protection Part 12: Starting performance of single-speed three-phase cage induction motors Part 14: Mechanical vibration of certain machines with shaft heights 56 mm and higher – Measurement, evaluation and limits of vibration severity Part 15: Impulse voltage withstand levels of rotation a.c. machines with form-wound stator coils Part 16: Excitation systems for synchronous machines - Definitions Beiblatt 1 VDE 0530-16 Excitation systems for synchronous machines - Models for power system studies Part 17: Cage induction motors when fed from converters - Application guide Beiblatt 1 VDE 0530-18



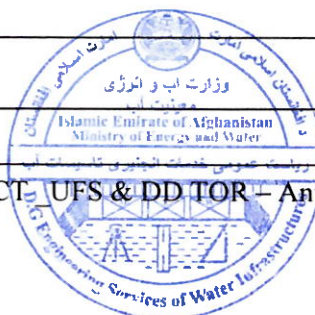
Norm Designation	Title
	<p>Functional evaluation of insulation systems - Test procedures for form-wound windings - Evaluation of thermomechanical endurance of insulation systems</p> <p>Part 18-1:</p> <p>Functional evaluation of insulation systems - General guidelines</p> <p>Part 18-21:</p> <p>Functional evaluation of insulating systems - Test procedures for wire-wound windings - Thermal evaluation and classification</p> <p>Part 18-22:</p> <p>Functional evaluation of insulating systems - Test procedures for wire-wound windings - Classification of changes and insulation component substitutions</p> <p>Part 18-31:</p> <p>Functional evaluation of insulating systems - Test procedure for form-wound windings - Thermal evaluation and classification of insulating systems used in machines up to and including 50 MVA and 15 kV</p> <p>Part 18-32: Functional evaluation of insulation systems – Test procedures for form-wound windings - Electrical evaluation of insulation systems used in rotating electrical machines</p> <p>Part 18-33: Functional evaluation of insulation systems - Test procedures for multifunctional evaluation of form-wound windings by endurance under combined thermal and electrical stresses of insulation systems used in machines</p> <p>Part 18-42: Qualification and acceptance tests for Type II electrical insulation systems used in rotating electrical machines fed from voltage converters</p> <p>Part 2:</p>



Norm Designation	Title
	<p>Methods for determining losses and efficiency of rotating electrical machinery from tests (excluding machines for traction vehicles)</p> <p>Part 2-1: Standard methods for determining losses and efficiency from tests (excluding machines for traction vehicles)</p> <p>Part 2-20:</p> <p>Equivalent loading and superposition techniques - Indirect testing to determine temperature rise</p> <p>Part 22:</p> <p>C. generators for reciprocating internal combustion (RIC) engine driven generating sets</p> <p>VDE 0530-240</p> <p>Rotating electrical machines</p> <p>Part 24: Detection and diagnosis of potential failures at the active parts of rotating electrical machines and of bearing currents – Application guide</p> <p>Part 25: Guide for the design and performance of a.c. motors specifically designed for converter supply</p> <p>Part 26: Effects of unbalanced voltages on the performance of three-phase cage induction motors</p> <p>Part 27: Partial discharge off-line measurements on the stator winding insulation of rotating machinery</p> <p>Part 28: Test methods for determining quantities of equivalent circuit diagrams for three-phase low-voltage cage induction motors</p> <p>Part 29: Equivalent loading and super-position techniques - Indirect testing to determine temperature rise</p> <p>Part 3: Specific requirements for cylindrical rotor synchronous machines</p> <p>Part 30: Efficiency classes of single-speed three-phase cage induction motors</p>



Norm Designation	Title
	<p>Part 31: Guide for the selection and application of energy-efficient motors including variable-speed applications</p> <p>Part 33: Test of insulation of bars and coils of high-voltage machines</p> <p>Part 4: Methods determining synchronous machine quantities from tests</p> <p>Part 5: Degrees of protection provided by integral design of rotating electrical machines (IP code) - Classification</p> <p>Part 6: Methods of cooling (IC-Code)</p> <p>Part 7: Classification of types of construction, mounting arrangements and terminal box position (IM Code)</p> <p>Part 8: Terminal markings and direction of rotation</p> <p>Part 9: Noise limits</p> <p>VDE V 0530-18-32: Functional evaluation of insulation systems - Test procedures for form-wound windings; Electrical evaluation of insulation systems used in machines up to and including 50 MVA and 15 kV</p> <p>VDE V 0530-18-33: Functional evaluation of insulation systems - Test procedures for form-wound windings; Multifactor functional evaluation; Endurance under combined thermal and electrical stresses of insulation systems used in machines up to and including 50 MVA and 15 kV</p> <p>VDE V 0530-18-41: Part 18-41: Qualification and type tests for Type I electrical insulation systems used in rotating electrical machines fed from voltage converters</p> <p>VDE V 0530-23: Part 23: Specification for the refurbishing of rotating electrical machines</p> <p>VDE V 0530-25</p> <p>Part 25: Guide for the design and performance of cage induction motors specifically designed for converter supply</p>
VDE 0302	VDE 0302-1



Norm Designation	Title
	<p>Evaluation and qualification of electrical insulation systems</p> <p>VDE 0302-11</p> <p>Electrical insulation systems - Procedures for thermal evaluation</p> <p>Part 1: General requirements - Low-voltage</p> <p>VDE 0302-21</p> <p>Electrical insulation systems - Procedures for thermal evaluation</p> <p>Part 21: Specific requirements for general purpose models - Wire-wound applications</p> <p>VDE 0302-22</p> <p>Electrical Insulation Systems - Procedures for thermal evaluation</p> <p>Specific requirements for encapsulated-coil model - Wire-wound electrical insulation system (EIS)</p> <p>VDE 0302-23</p> <p>Electrical Insulation Systems - Procedures for thermal evaluation</p> <p>Specific requirements for general-purpose, tall-channel model - Wire-wound electrical insulation system (EIS)</p> <p>VDE 0302-30</p> <p>Electrical insulation systems - Thermal evaluation of modifications to an established wire-wound EIS</p> <p>VDE 0302-4</p> <p>Insulation systems of electrical equipment</p> <p>Electrical endurance - General considerations, evaluation procedures</p> <p>VDE 0302-5</p> <p>Insulation systems of electrical equipment</p> <p>Performance evaluation</p>



Norm Designation	Title
	VDE 0302-6 Insulation systems of electrical equipment Multi-factor functional testing - Test procedures VDE 0302-7 Insulation systems of electrical equipment Mechanical endurance functional tests for electrical insulation systems VDE 0302-91 Electrical insulation systems - Electrical stresses produced by repetitive impulses Part 1: General method of evaluation of electrical endurance
VGB R 171	Richtlinie zur Lieferung der technischen Dokumentation für fossile und regenerative Kraftwerke

B.1.2.3. Acceptable Organizations of Standardization

Publications issued by the following organization are deemed as approved standards for works.

- AGMA American Gear Manufacturers Association
- AISI American Iron and Steel Institute
- ANSI American National Standards Institute
- ASME American Society of Mechanical Engineers
- ASTM American Society for Testing and Materials
- AWS American Welding Society
- BS British Standards
- CCITT International Telephone & Telegraph Consulting committee
- CECT European Committee for Manufacturing of Boilers & Kindred Steel Structures
- CMAA Crane Manufacturers Association of America



- ČSN Czech National Standards
- DIN Deutsches Institut für Normung
- EN European Standards
- IEC International Electrotechnical Commission
- IEEE Institute of Electrical and Electronic Engineers
- IIW International Institute of Welding
- ICEA Insulated Power Cable Employer's Association
- ISO International Standards Organization
- NEMA National Electrical Manufacturers Association
- NFPA National Fire Protection Association
- VDE Verein Deutscher Elektroingenieure
- VDI Verein Deutscher Ingenieure
- SIS Swedish Standards Institute

B.1.3. Primary Design, Drawings, Calculations and Descriptive Matters

All the documents concerning the primary designs, drawings, calculations, operation and maintenance manuals, specifications and standards/regulations should be in ENGLISH except the operation and maintenance manuals which should also be drafted in local languages (Dari/Pashto).

B.2. GENERATOR AND EXCITATION SYSTEM

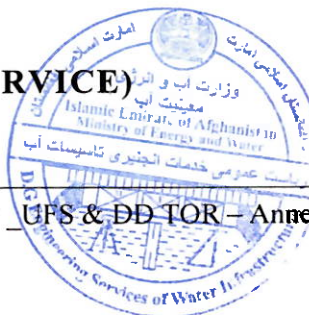
B.2.1. Scope of Work

The potential contractor is required to prepare the feasibility study level technical specification for the generator(s) and its excitation system.

B.2.2. Technical Requirements

The potential contractor should in consideration of the latest edition of the approved standard and site conditions prepare technical specifications and conceptual design, drawings/diagrams of the generator(s) and the excitation system. All the parameters and rating should be the optimum values.

B.3. TRANSFORMERS (MAIN & SERVICE)



B.3.1. Scope of Work

The contractor is required to prepare the feasibility level design, drawing and technical specifications for the transformers and its concerned components.

B.3.2. Standards

Unless otherwise specified, hereinafter, the transformer shall be considered in accordance with the latest versions of the following standards and/or documents (or any other accepted entity's standards/regulations).

IEC Publication 60076-1 : Power Transformer Part- 1: General

IEC Publication 60076-2 : Power Transformer Part- 2: Temperature Rise

IEC Publication 60076-3

and Amendment 60076.No:1 : Power Transformer Part- 3: Insulation Levels and Dielectric Tests

IEC Publication 60076-4 : Power Transformer Part- 4: Tapping and Connections

IEC Publication 60076-5 : Power Transformer Part- 5: Ability to Withstand Short Circuit

IEC Publication 60076-8 : Power Transformers-Part-8: Application guide

IEC Publication 60296 : Specification of New Insulating Oil for Transformers and Switchgear

IEC Publication 60354 : Loading Guide for Oil-Immersed Transformers

IEC Publication 60551 : Measurement of Transformer and Reactor Sound Levels

IEC Publication 60567 : Guide for Sampling Oil-Filled Electrical Equipment of Gases and of Oil and for the Analysis of Free and Dissolved Gases”

IEC Publication 60722 : Guide to the Lightning Impulse and Switching Impulse Testing
of Power Transformers and Reactors

IEC Publication 60137 : Insulating Bushing for Alternating Voltages above 1000 Volts

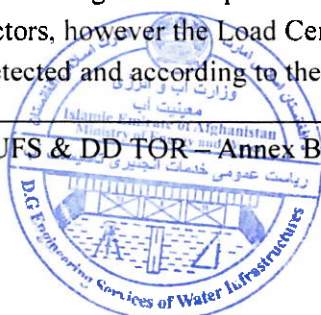
B.3.3. Technical Requirements

The contractor should, in consideration of the latest edition of the mentioned standards, prepare the feasibility study level design, drawing, circuit diagrams and technical specification for the transformers including all the related auxiliary equipment, protection equipment/schemes, measurement equipment and related parts along with their relevant specifications. All the parameters and rating should be the optimum values.

B.4. TRANSMISSION LINE

B.4.1. Scope of Work

The scope of work comprises the feasibility study level design of three phase transmission line with optimum cross sectional area of ACSR conductors, however the Load Center and/or Integration Point to existing National Grid should be detected and according to the Length of



Transmission line and the Power that to be Transmitted, the optimum voltage level should be specified, for voltage level equal or above 110 KV, the transmission line will be on lattice frame steel Towers, and for voltage level below 110 KV (20 KV), the transmission will be on Concrete Pole.

B.4.2. Standards

Unless otherwise specified, hereinafter, the Transmission line shall be designed in accordance with the latest versions of the following standards and/or documents (or any other accepted entity's standards/regulations).

Sl No	Standard	Description
1	IEC 60826	Design criteria of overhead transmission line
2	IEC : 889 and IEC 1089	ACSR Conductor.
3	IEC : 888	Galvanization of Steel wires.
4	IEC-61089	Round wire concentric layover head electrical stranded conductors.
5	IEC-61232	Aluminium-clad steel wires for electrical purposes.
6	IEC-61284	Overhead lines-Requirements and tests for fittings.
7	IEC-6139	Creep test procedures for stranded conductors
8	ASTM-B415	Standard Specification for Hard-Drawn Aluminum-Clad Steel Wire.
9	IEC 60793	Optical fibers
10	IEC 60874	Connectors for optical fibers.
11	IEEE-1138	IEEE Standard Construction of Composite Fibre Optic Ground Wire (OPGW) for Use on Electric Utility power Lines.
12	IEC-60793-1	Optical fibres – Generic & product specifications, measurement methods & test procedures specification.
13	IEC-60794-1-1	Optical fibre cables – Generic specification
14	IEC-60794-1-2	Optical fibre cables – Basic optical cable test procedure
15	IEC-60794-3	Optical fibre cables – Duct, buried and aerial cables – sectional specification



16	IEC-60794-4	Optical fibre cables – Overhead cables
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B.4.3. Technical Requirements

The contractor should, in consideration of the latest edition of the mentioned standards, prepare the feasibility study level design, drawing, circuit diagrams and technical specification including but not limited to the conductors, Line accessories and insulation components with all the associated works and related parts and accessories with their relevant specifications and standards.

B.5. TOWERS (STRUCTURES) FOR TRANSMISSION LINE

B.5.1. Scope of Work

For voltage level equal or above 110 KV, the transmission line will be on lattice frame steel Towers; The towers shall be self-supporting, hot dip galvanized lattice frame steel type, & designed to carry the single circuit or double circuit conductors according to requirement and/or optimization.

B.5.2. Standards

The contractor is required to state and guarantee all the specifications concerning ice and wind loadings, sag and tension calculations and all the tests related to transmission line. All the parameters and rating should meet the optimum values and tolerances as per standards and are to be reflected in Type test reports and site tests as applicable.

Sl No	Standard	Description
1	AS3995	Design of steel lattice towers and masts
2	AS4100	Steel Structures
3	ASCE	Design of Latticed Steel Transmission Structures
4	ECCS	Recommendations for Angles in Lattice Transmission Towers, European Convention for Constructional Steel Work
5	IEEE 691-2001	Guide for transmission tower foundation design

Following are the IEC standards pertaining to Transmission towers.

466-08-01 Tower

466-08-02 lattice tower

466-08-03 bracing system

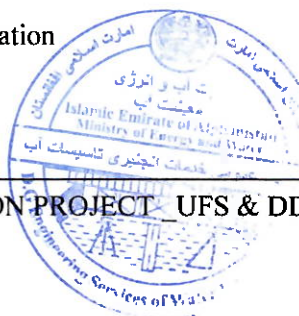
466-08-04 single warren



466-08-05 double warren
 466-08-06 triple warren
 466-08-07 K bracing
 466-08-08 double warren redundant support
 466-08-09 top hamper
 466-08-10 earth wire peak
 466-08-11 beam gantry
 466-08-12 Cross arm
 466-08-13 Fork
 466-08-14 plan bracing
 466-08-15 tower body
 466-08-16 Waist
 466-08-17 main bracing
 466-08-18 redundant bracings
 466-08-19 main leg
 466-08-20 leg slope
 466-08-21 Node
 466-08-22 anti-climbing guard
 466-08-23 Foot
 466-08-24 hill-side extension
 466-08-25 body extension

Section 466-09: Foundations

466-09-01 Foundation
 466-09-02 block foundation
 466-09-03 separate footing foundations
 466-09-04 pad and chimney foundation
 466-09-05 stub (of a support)



- 466-09-06 chimney (of a foundation)
- 466-09-07 Muff
- 466-09-08 pad (of a foundation) (US)
- 466-09-09 excavation
- 466-09-10 backfill
- 466-09-11 imported backfill
- 466-09-12 reinforcing rods (in a pad and chimney foundation)
- 466-09-13 cleat (in a pad and chimney foundation)
- 466-09-14 Bell
- 466-09-15 grillage foundation
- 466-09-16 pile foundation
- 466-09-17 driven pile
- 466-09-18 angled pile
- 466-09-19 pressure injected pile
- 466-09-20 expanded pile
- 466-09-21 anchor rod
- 466-09-22 anchor

B.5.3. Technical Requirements

A feasibility study level design, including but not limited to right-of-way (RoW) identification and specifying the required numbers of the Towers, as per the terrain conditions en route, should be provided.

-----Concluded-----

