



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

TERMS OF REFERENCE (TOR)

FOR

**DETAILED DESIGN OF SULTAN
IBRAHIM IRRIGATION PROJECT**

ANNEX B2

**ELECTRICAL TECHNICAL REQUIREMENTS
FOR DETAILED DESIGN STAGE**

JUNE 2024



CONTENTS

C.1.	General.....	1
C.1.1.	Scope of Work.....	1
C.1.2.	Applicable Standards and Regulations	1
C.1.3.	Designs, Drawings, Calculations and Descriptive Matters	17
C.2.	Generator and Excitation System.....	17
C.2.1.	Scope of Work.....	17
C.2.2.	Technical Requirements	17
C.2.3.	Guarantees	17
C.3.	Main Transformer(s) and Auxiliary Transformer(s).....	17
C.3.1.	Scope of Work.....	17
C.3.2.	Standards	17
C.3.3.	Technical Requirements	18
C.3.4.	Guarantees	19
C.4.	Protection System	19
C.4.1.	Scope of Work.....	19
C.4.2.	Standards	19
C.4.3.	Technical Requirements	19
C.4.4.	Designs and Drawings.....	20
C.5.	Control and Monitoring System	20
C.5.1.	Scope of Work.....	20
C.5.2.	Technical Requirements	20
C.5.3.	Drawings, Calculations and Descriptive Matter.....	20
C.6.	Station Service System	20
C.6.1.	General	20
C.6.2.	Standards	20
C.6.3.	Technical Requirements	21
C.6.4.	Drawings, Calculations and Descriptive Matter.....	21
C.7.	Cables.....	21
C.7.1.	Scope of Work.....	21
C.7.2.	Standards	21
C.7.3.	Technical Requirements	21
C.7.4.	Drawings, Calculations and Descriptive Matter.....	21
C.8.	Lighting & wiring system design.....	21
C.8.1.	Scope of Work.....	21
C.8.2.	Standards	22
C.8.3.	Technical Requirements	22
C.8.4.	Drawings, Calculations and Descriptive Matter.....	22



C.8.4.	Drawings, Calculations and Descriptive Matter	21
C.9.	Fire Protection, Detection and Alarm System	22
C.9.1.	Scope of Work	22
C.9.2.	Technical Requirements	22
C.9.3.	Drawings, Calculations and Descriptive Matter	22
C.10.	Grounding system and Lightning Protection	22
C.10.1.	Scope of Work	22
C.10.2.	Standards	22
C.10.3.	Technical Requirements	22
C.10.4.	Drawings, Calculations and Descriptive Matter	23
C.11.	Switchgear / Switchyard	23
C.11.1.	Scope of Work	23
C.11.2.	Standards	23
C.11.3.	Technical Requirements	23
C.11.4.	Designs and Drawings	24



C.1. General

C.1.1. Scope of Work

This section relates to the general specifications of the electrical section of works envisaged for detailed design.

C.1.2. Applicable Standards and Regulations

C.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.

C.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



Norm Designation	Title
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)
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 1000 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>



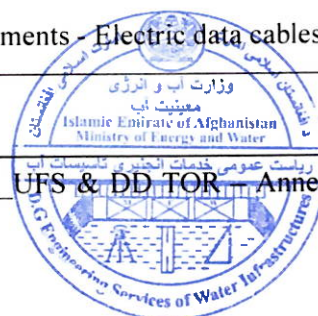
Norm Designation	Title
	<p>Measuring relays and protection equipment - Part 22-2: Electrical disturbance tests - Electrostatic discharge tests</p> <p>Measuring relays and protection equipment - Part 22-3: Electrical disturbance tests - Radiated electromagnetic field immunity</p> <p>Measuring relays and 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>
IEC 60034	Rotating electrical machines



Norm Designation	Title
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
IEC 60076-7	Power transformers - Part 7: Loading guide for oil-immersed power transformers



Norm Designation	Title
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 Part 11: Apparatus - Fire alone at a flame temperature of at least 750 °C Part 12: Apparatus - Fire with shock at a temperature of at least 830 °C Part 21: Procedures and requirements - Cables of rated voltage up to and including 0,6/1,0 kV Part 23: Procedures and requirements - Electric data cables



Norm Designation	Title
	<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> <p>Part 3-24: Test for vertical flame spread of vertically-mounted bunched wires or cables - Category C</p> <p>Part 3-25: Test for vertical flame spread of vertically-mounted bunched wires or cables - Category D</p>
IEC 60383-1	<p>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</p>



Norm Designation	Title
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 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



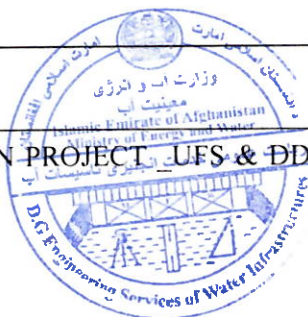
Norm Designation	Title
IEC 60870-5-103 and -104	Telecontrol equipment and systems - Part 5-103: Transmission protocols - Companion standard for the informative interface of protection equipment Telecontrol equipment and systems - Part 5-104: Transmission protocols - Network access for IEC 60870-5-101 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
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
IEC 60298	AC metal enclosed switchgear
IEC 60056	Circuit breakers



Norm Designation	Title
IEC 60265	High voltage switches
IEC 60129	Isolating switch and earthing switches
IEC 60282	High voltage fuses
IEC 60439	Part 1 and 2 : Low Voltage Switchgear and Control Gear
IEC60947	Parts 1, 2,3,5,6 & 7 : Low Voltage Switchgear and Circuit breakers
IEC 60519-1	Safety in Electrical Installations
IEC 60157-1&2	Low voltage circuit breakers
IEC 60158-1&1C	Low voltage contactors
IEC 60044-1	Current transformers
IEC 60038	Standard voltages
IEC 60034-6	Method of cooling rotating electrical machines
IEC 60051	Recommendation for indicating electrical measuring , instruments and their accessories
IEC 60086	Primary batteries
IEC 60146	Semi-conductor converters
IEC 60529	Classification of degree of protection provided by enclosures
IEC 60439	Low voltage distribution devices
IEC 60540	Cables & wires
IEC 60563	Classification of electrical & electronic equipment with regard to protection against electrical shock
IEC 60947	Specification for radio interface suppression of electrical appliance
IEEE 142	Recommended practice for grounding of industrial and commercial power systems



Norm Designation	Title
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
NFPA 70	National Electric Code
VDE 0101	Power installations exceeding AC 1 kV
VDE 0111	<p>Insulation co-ordination</p> <p>Part 1: Definitions, principles and rules</p> <p>Part 2: Application guide</p>
VDE 0141	Earthing systems for special power installations with nominal voltages above 1 kV
VDE 0530/72	<p>Rotating electrical machines</p> <p>Beiblatt 1 VDE 0530</p> <p>Guide for reference installation and reference service-conditions for low voltage general purpose cage induction motors with duty type S1</p>



Norm Designation	Title
	<p>Part 1: Rating and performance</p> <p>Part 11: Thermal protection</p> <p>Part 12: Starting performance of single-speed three-phase cage induction motors</p> <p>Part 14: Mechanical vibration of certain machines with shaft heights 56 mm and higher – Measurement, evaluation and limits of vibration severity</p> <p>Part 15: Impulse voltage withstand levels of rotation a.c. machines with form-wound stator coils</p> <p>Part 16: Excitation systems for synchronous machines - Definitions</p> <p>Beiblatt 1 VDE 0530-16</p> <p>Excitation systems for synchronous machines - Models for power system studies</p> <p>Part 17: Cage induction motors when fed from converters - Application guide</p> <p>Beiblatt 1 VDE 0530-18</p> <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</p>



Norm Designation	Title
	<p>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> <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>



Norm Designation	Title
	<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> <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>



Norm Designation	Title
	<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	<p>VDE 0302-1</p> <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>



Norm Designation	Title
	<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> <p>VDE 0302-6</p> <p>Insulation systems of electrical equipment</p> <p>Multi-factor functional testing - Test procedures</p> <p>VDE 0302-7</p> <p>Insulation systems of electrical equipment</p> <p>Mechanical endurance functional tests for electrical insulation systems</p> <p>VDE 0302-91</p> <p>Electrical insulation systems - Electrical stresses produced by repetitive impulses</p> <p>Part 1: General method of evaluation of electrical endurance</p>
VGB R 171	Richtlinie zur Lieferung der technischen Dokumentation für fossile und regenerative Kraftwerke
NEMA 6, IEC 529, EN 60529	Flow meter protecting against water seepage and moisture
EN 45001	Flow meters method of measuring, regulation and calibration
DIN 2501, BS 4504, AWWA	Flow meters unit and flange connections size
DIN S1006, IEC 68	Flow meters environmental condition
DIN 2690, ANSIB16.21	Components of several parts of instrument



C.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 Employers
- 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



C.1.3. Designs, Drawings, Calculations and Descriptive Matters

All the documents concerning the 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).

C.2. Generator and Excitation System

C.2.1. Scope of Work

The consultant is required to prepare the detailed design, drawing, circuit diagrams and technical specifications of the generator(s) and its excitation system. Provide the operation and maintenance manuals of the generator and the concerned auxiliary equipment.

C.2.2. Technical Requirements

The consultant should, in consideration of the feasibility study documents and latest edition of the approved standard, prepare the detailed design with calculation, drawings, circuit diagrams and technical specifications of the generator(s) with the excitation system and all of its auxiliary equipment; Prepare the operation and maintenance manual. The Generator(s) and all the related equipment/devices, material and conductors should be specified to be high quality and the brands should also be specified. All the parameters and rating should be of the optimum values.

C.2.3. Guarantees

The consultant is required to state and guarantee all the specifications concerning rated output for continuous operation, rated voltage, frequency, synchronous speed, rated power factor and the ratings of the excitation and automatic voltage regulation system and any other ratings related to the auxiliary systems of the generator(s).

C.3. Main Transformer(s) and Auxiliary Transformer(s)

C.3.1. Scope of Work

The consultant is required to prepare the detailed design, drawing and technical specifications for transformer(s) and its concerned components. Provide the operation and maintenance manuals for the transformer(s) and the concerned auxiliary equipment.

C.3.2. Standards

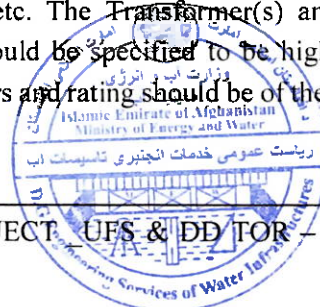
Unless otherwise specified, hereinafter, the transformer shall be designed, manufactured and tested in accordance with the latest versions of the following standards and/or documents (or any other accepted entity's standards/regulations).



S/No	Standards	Description
1	IEC Publication 60076-1	Power Transformer Part- 1: General
2	IEC Publication 60076-2	Power Transformer Part- 2: Temperature Rise
3	IEC Publication 60076-3 and Amendment 60076.No:1	Power Transformer Part- 3: Insulation Levels and Dielectric Tests
4	IEC Publication 60076-4	Power Transformer Part- 4: Tapping and Connections
5	IEC Publication 60076-5	Power Transformer Part- 5: Ability to Withstand Short Circuit
6	IEC Publication 60076-8	Power Transformers-Part-8: Application guide
7	IEC Publication 60296	Specification of New Insulating Oil for Transformers and Switchgear
8	IEC Publication 60354	Loading Guide for Oil-Immersed Transformers
9	IEC Publication 60551	Measurement of Transformer and Reactor Sound Levels
10	IEC Publication 60567	Guide for Sampling Oil-Filled Electrical Equipment of Gases and of Oil and for the Analysis of Free and Dissolved Gases"
11	IEC Publication 60722	Guide to the Lightning Impulse and Switching Impulse Testing of Power Transformers and Reactors
12	IEC Publication 60137	Insulating Bushing for Alternating Voltages above 1000 Volts

C.3.3. Technical Requirements

The consultant should, in consideration of the feasibility study documents and latest edition of the mentioned standards, prepare the detailed design, drawings, circuit diagrams and technical specifications of the transformer(s) with all of its auxiliary equipment, protection equipment/schemes, measurement equipment, etc. The Transformer(s) and all the related equipment/devices, material and conductors should be specified to be high quality and the brands should also be specified. All the parameters and rating should be of the optimum values.



C.3.4. Guarantees

The consultant is required to state and guarantee all the specifications concerning losses, impedances, temperature rises etc. related to the transformer(s).

C.4. Protection System

C.4.1. Scope of Work

The consultant is required to prepare the design, drawings, circuit diagrams and technical specifications of the protection system. Provide the operation and maintenance manuals for protection system and its related components.

C.4.2. Standards

The system and equipment shall be designed to the latest revisions of the following standards. In the event of other standards being applicable, these will be compared for specific requirements and specifically approved during detailed engineering for the intended purpose.

S/No	Standards	Description
1	IEC 60044-1	Instrument transformers - Part 1 : Current transformers
2	IEC 60044-2	Instrument transformers - Part 2 : Inductive voltage transformers
3	IEC 60044-6	Instrument transformers - Part 6 : Requirements for protective current transformers for transient performance
4	IEC 62271-100	High-voltage switchgear and controlgear - Part 100: High-voltage alternating-current circuit-breakers
5	IEC 62271-200	High-voltage switchgear and controlgear - Part 200: A.C. metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV
6	IEC-62271-102	HV AC disconnectors and grounding switches
7	IEC-60255/61180	Relays
8	IEC-60050/60055	Cables
9	IEC 60694	Common specifications for high-voltage switchgear and controlgear standards
10	IEC-60695	Fire hazard testing

C.4.3. Technical Requirements

The consultant should, in consideration of the feasibility study documents and the latest edition of the mentioned standards, prepare the detailed design, drawings, circuit diagrams and technical specifications of the protection system and all the protection equipment such as, but not limited to, cubicles, switchboards, circuit breakers, current transformers, voltage

transformers, generator neutral grounding, surge protection equipment, metering equipment, relays, HMI, grounding equipment, cable ways, etc. Prepare the operation and maintenance manual of the system and its related equipment. All the equipment/devices, material and conductors should be specified to be high quality and the brands should also be specified. All the parameters and rating should be of the optimum values.

C.4.4. Designs and Drawings

The consultant shall furnish complete drawings, wiring diagrams and design notes for the equipment and such detail drawings and diagrams as are needed for installations operation and maintenance.

C.5. Control and Monitoring System

C.5.1. Scope of Work

The consultant is required to prepare the design, drawings, circuit diagrams and technical specifications of the control and monitoring system. Provide the operation and maintenance manuals for the control and monitoring system and its related equipment.

C.5.2. Technical Requirements

The consultant should, in consideration of the feasibility study documents and the latest edition of the approved standards, prepare the detailed design, drawings, circuit diagrams and technical specifications of the control and monitoring system and its related equipment such as, but not limited to, Programmable Logic Controller(s) (PLC), instrumentation devices, control devices, control room, metering devices, relays, operation, SCADA system, Intrusion Warning System (IWS), Fire Detection System (FDS), Closed Circuit Television System (CCTV), Signaling System (SS), Control Networks (CN), Communication Interconnection (CI). All the equipment/devices, material and conductors should be specified to be high quality and the brands should also be specified. All the parameters and rating should be of the optimum values.

C.5.3. Drawings, Calculations and Descriptive Matter

The consultant shall supply all the calculations and descriptive matter including all the logic diagrams, drawings, power systems, etc. concerning each section comprising the Control and Monitoring System.

C.6. Station Service System

C.6.1. General

The consultant is required to prepare the design, drawings, circuit diagrams and technical specifications of the service system. Provide the operation and maintenance manuals for the service system and the concerned auxiliary equipment.

C.6.2. Standards

The design, rating and selection of all the equipment, devices and cables should be in accordance with the relevant and updated IEC, BS, NFPA, ~~IEEE~~, UL standards.



C.6.3. Technical Requirements

The consultant should, in consideration of the feasibility study documents and the latest edition of the standards, prepare the design, drawings, circuit diagrams and technical specifications for the station service system (AC and DC) and all the necessary equipment and devices such as, but not limited to, service transformer(s), AC Panels, DC Panels, AC-DC converter(s) and charger(s), UPS system (Batteries) and diesel generator(s) and their relevant specifications. All the equipment/devices, material and conductors should be specified to be high quality and the brands should also be specified, the battery type should be specified to be VRLA type. All the parameters and rating should be of the optimum values.

C.6.4. Drawings, Calculations and Descriptive Matter

The consultant is required to furnish all drawings, calculations and descriptive matter to ensure the adequacy of the service station systems.

C.7. Cables

C.7.1. Scope of Work

The detailed design, drawings, diagrams and specifications all the Power cables, communication cables, control cables and wiring system are required.

C.7.2. Standards

The design of all the cables should be in accordance with the relevant and updated IEC, BS, IEEE, NFPA, UL standards.

C.7.3. Technical Requirements

The consultant should, in consideration of the feasibility study documents and the latest edition of the approved standards/codes, prepare the design, drawings, circuit diagrams and technical specifications of all the cable types such as, but not limited to, MV Cables, LV Cables (AC and DC), Control, Protection, Communication, Measurement, Signaling and Telecommunication Cables and their relevant component and specifications. All the material and conductors should be specified to be high quality and the brands should also be specified. All the parameters and rating should be of the optimum values.

C.7.4. Drawings, Calculations and Descriptive Matter

The consultant is required to furnish all the drawings, calculations and descriptive matter to ensure the adequacy of the wiring system.

C.8. Lighting & wiring system design

C.8.1. Scope of Work

The consultant is required to prepare the detailed design, drawings, circuit diagrams and technical specifications of the lighting system. Prepare the operation and maintenance manuals of the lighting system.



C.8.2. Standards

The design of the interior and exterior lighting and power system of all the buildings such as but not limited to power house, control building, admin building, colony, guard rooms, should be in accordance with the recommendation in the Requirement for Electrical Installations – IEE Wiring Regulations, BS 7671, NFPA 70, IEC 60364 or another equivalent international standard and requirements.

C.8.3. Technical Requirements

The consultant should, in consideration of the feasibility study documents and the latest edition of the approved standards/codes, prepare the detailed design, calculations, drawings, circuit diagrams and technical specifications for interior and exterior lighting, cabling and power system of all the buildings including all the concerned equipment, such as, but not limited to, the lighting fixtures, lamps, light switches, receptacles, HVAC system power supply, cables and conductors along with their relevant specifications. All the equipment/devices, lighting fixtures, material and conductors should be specified to be high quality and the brands should also be specified, all the lights should be specified that to be LED type. All the parameters and rating should be of the optimum values.

C.8.4. Drawings, Calculations and Descriptive Matter

The consultant should provide all drawings, calculations and method statements concerning illumination to ensure the adequacy of the lighting system.

C.9. Fire Protection, Detection and Alarm System

C.9.1. Scope of Work

The consultant is required to prepare the detailed design, drawings, circuit diagrams and technical specifications of the fire protection, detection and alarm system and all the related components. Provide the operation and maintenance manuals for the fire detection and alarm system and its related equipment.

C.9.2. Technical Requirements

The consultant should, in consideration of the feasibility study documents and the latest edition of the approved standards, prepare the detailed design, drawings, circuit diagrams and technical specifications of the fire protection, detection and alarm system and all the fire detection and alarm equipment and devices such as, but not limited to detectors, announcers, control panel, manual call point, wiring, along with their relevant components, specifications and software. All the equipment/devices, material and conductors should be specified to be high quality and the brands should also be specified. All the parameters and rating should be of the optimum values.

C.9.3. Drawings, Calculations and Descriptive Matter

The consultant should furnish all the calculations and descriptive matter including all the logic diagrams, drawings, etc. concerning the fire detection and alarm system.



C.10. Grounding system and Lightning Protection

C.10.1. Scope of Work

The consultant is required to prepare the detailed design, calculations, drawings, circuit diagrams and technical specifications of the grounding system and Lightning Protection System with concerned components. Prepare the operation and maintenance manual of the systems.

C.10.2. Standards

The complete grounding system and lightning protection system designs with engineering of the project structures shall be in accordance with the recommendation in the Guide for Safety in Substation Grounding "IEEE Std. 80, IEEE Std. 82", BS 7430, ANSI-IEEE 665, NFPA 780 or another equivalent international standard and the requirements of this section.

C.10.3. Technical Requirements

The consultant, in consideration of the feasibility study documents and latest edition of the recommended standards, should prepare the detailed design, calculations, drawings, diagrams and technical specifications for the grounding system and lightning protection system with the related components. All the equipment/devices, material and conductors should be specified to be high quality and the brands should also be specified. All the parameters and rating should be of the optimum values.

C.10.4. Drawings, Calculations and Descriptive Matter

The consultant should submit all calculations and descriptive matter ensuring the adequacy of the Grounding System.

C.11. Switchgear / Switchyard

C.11.1. Scope of Work

The consultant is required to prepare the detailed design, drawings, circuit diagrams and technical specifications of the power plant's switchyard (outdoor) and switchgear (indoor). Provide the operation and maintenance manuals for switchyard and switchgear with its related components.

C.11.2. Standards

The switchyard system and equipment shall be designed to the latest revisions of the following and provided standards in this document. In the event of other standards being applicable, these will be compared for specific requirements and specifically approved during detailed engineering for the intended purpose.

S/No	Standards	Description
1	IEC 60044-1	Instrument transformers - Part 1 : Current transformers



2	IEC 60044-2	Instrument transformers - Part 2 : Inductive voltage transformers
3	IEC 60044-6	Instrument transformers - Part 6 : Requirements for protective current transformers for transient performance
4	IEC 62271-100	High-voltage switchgear and controlgear - Part 100: High-voltage alternating-current circuit-breakers
5	IEC 62271-200	High-voltage switchgear and controlgear - Part 200: A.C. metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV
6	IEC-62271-102	HV AC disconnectors and grounding switches
7	IEC-	Relays
8	IEC-	Cables
9	IEC 60694	Common specifications for high-voltage switchgear and controlgear standards
10	IEC-60695	Fire hazard testing

C.11.3. Technical Requirements

The consultant should, in consideration of the feasibility study documents and the latest edition of the mentioned standards, prepare the detailed design, calculations, drawings, circuit diagrams and technical specifications for the switchgear and switchyard with all the related equipment/components such as, but not limited to, bus bars, circuit breakers, disconnecting switches, earthing switches, current transformers, voltage transformers, lightning/surge arresters, cubicles, switchboards, surge protection equipment, metering equipment, relays, grounding equipment, insulators, portals, cable ways, etc. Prepare the operation and maintenance manual of the system and its related equipment. According to site requirement, for medium voltage (MV) i.e. 20 KV and below, there should be used indoor switchgear; and for high voltage (HV) i.e. 110 kV and above there should be used outdoor switchyard. All the equipment/devices, material and conductors should be specified to be high quality and the brands should also be specified. All the parameters and rating should be of the optimum values.

C.11.4. Designs and Drawings

The consultant shall furnish complete drawings, wiring diagrams and design notes for the equipment and such detail drawings and diagrams as are needed for installations operation and maintenance.

-----Concluded-----

