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## **EXECUTIVE SUMMARY**

This Specification covers the general requirements for the design, manufacture and testing of Oil filled power transformers for

The supplier shall adhere to the requirements as described in this document; all exceptions shall be approved by COMPANY.

## **DEFINITIONS / ABBREVIATIONS**

**Within this specification the following definitions shall apply:**

**COMPANY**

**CONTRACTOR**

The CONTRACTOR is the party which carries out all or part of the design, engineering, procurement, construction, commissioning or management of a project or operation/maintenance of a facility.

**SUPPLIER**

Company/organization supplying equipment, materials or services.

## **1. SCOPE**

- 1.1. This Specification covers the general requirements for the design, manufacture and testing of oil filled power transformers.
- 1.2. The specific requirements for individual transformers are provided on the Transformer Data Sheet. Transformers shall be brand new and unused.

## **2. CODES AND STANDARDS**

- 2.1. Transformer shall be designed, manufactured and tested in accordance with the latest applicable sections of the IEC codes and standards detailed in Appendix A and shall be approved for use in the Republic of Kazakhstan. Other standards may only be used with the consent of the COMPANY.
- 2.2. The codes and standards listed below are supplemented by this specification, which states only requirements in addition to, and deviations from the requirements stated in the codes and standards.
- 2.3. This specification shall also be read in conjunction with all other specifications and data sheets attached to the material requisition. Any conflicts between the referenced documents shall be identified to the COMPANY in writing for resolution.
- 2.4. Although not supplied for installation in a member country of the European Union, the equipment shall be supplied in accordance with all applicable European Community Directives. Particular attention shall be paid to:
  - Electromagnetic compatibility
  - Low voltage equipment
  - Machinery
  - Safety
  - CE marking
  - Directive 2014/34/EU "Equipment and Protective Systems Intended for use in Potentially Explosive Atmospheres" shall apply.
  - Compliance to custom union requirements
- 2.5. Where the Transformer Data Sheet indicates that the transformer is for use in a hazardous area, the transformer and all its associated parts shall comply with the requirements of an approved certifying authority and shall bear the labels and markings in accordance with the relevant sections of IEC 60079.
- 2.6. For the installation of Power Transformers National standard PUE- Rules for Electrical Installation and SNiP RoK– Electrotechnical devices shall be applied.

## **3. SERVICE CONDITIONS**

- 3.1. The site climatic conditions are stated in the Project Specification for Climatic, Environmental and Utility Data 23858-00L-3PS-0000-00003. The transformers and

associated equipment shall be designed generally for use in temperatures ranging minus 45 to plus 40 degrees Celsius and shall have a design life of at least 40 years and periodic maintenance interval of greater than four years.

- 3.2. The transformers will be installed in open sided enclosures. Control panels for automatic tap changers will be installed in a ventilated/heated substation building.

## **4. ELECTRICAL SYSTEM**

- 4.1. All components of the transformer shall be rated for the electrical system characteristics shown on the transformer data sheet. Where specified on the data sheet, the transformers shall also be suitable for the specified overload duties.
- 4.2. The winding connections of the transformer shall be to the phase group specified on the transformer data sheet.
- 4.3. The frequency variation shall be within  $\pm 2\%$  and voltage variation shall be within  $\pm 5\%$  of specifications provided on the transformer data sheet.
- 4.4. Motor unit transformers shall be capable of withstanding three successive starts and a further two successive starts after a half-hour cooling-off period.

## **5. CONSTRUCTION**

### **5.1. General**

- 5.1.1. All transformers shall be capable of operating continuously and without adverse effects of overheating, under all specified conditions of operation including variations in system voltage and frequency as specified on the Power Transformer Data Sheet.
- 5.1.2. Performance figures shall be stated at the nominal system voltage and frequency.
- 5.1.3. Each transformer shall be designed for continuous operation at the specified kVA rating, at the ambient temperature, and site environmental conditions specified in the Power Transformer Data Sheet.
- 5.1.4. Unless otherwise specified on the Power Transformer Data Sheet, the temperature rise for natural air-cooled and forced air-cooled transformers based on a 40°C ambient shall not exceed:
- 65°C (measured by resistance) in the windings, and
  - 60°C (measured by thermometer) for the top oil when the transformer is sealed or equipped with a conservator, or
  - 55°C when the transformer is not sealed or equipped with a conservator
- 5.1.5. Transformers shall be factory filled with insulating oil prior to shipment unless the size and consequential weight of the unit precludes transportation whilst fully assembled. In this case, an inert gas filling shall ensure the integrity of the insulation during transportation and the insulating liquid shipped separately. Insulating liquids shall be certified not to contain Polychlorinated Biphenyls (PCBs). Unless otherwise

specified on the Power Transformer Data Sheet, the insulating liquid shall be mineral oil according to IEC 60296.

- 5.1.6. Transformers shall be provided with facilities for lifting the complete transformer as well as for lifting the core and coil assembly from the tank of conservator type transformers.
- 5.1.7. Transformer construction shall be such that the value of the internal pressure in service will not exceed approximately 0.35 kg/cm<sup>2</sup> for a range of top oil temperature from -50° to +90° C.
- 5.1.8. Materials of construction shall be selected having concern for the minimum temperature in which the equipment is required to operate.
- 5.1.9 Typically hermetically sealed transformer shall be for relatively low power with the deletion of the conservator and Buchholz relay.
- 5.1.10 For sealed transformers, the space between in the tank shall be filled with dry air or inert gas, as this enables expansion of oil caused by temperatures.
- 5.1.11 All valves and openings shall be provided with pad-lockable facility option.

## **5.2. Core**

- 5.2.1. The core assembly shall be constructed from high-quality, non-ageing, grain oriented, electrical grade silicon steel sheets, with both sides coated. The assembly shall be accurately cut and stacked. Joints shall have the least possible air gaps and shall be rigidly clamped to produce an assembly with minimum core loss and noise generation.
- 5.2.2. The core shall be braced to withstand a bolted fault on the secondary without mechanical damage. Core bracing and support shall also prevent any transformer damage that might take place during transportation and positioning.
- 5.2.3 The core shall be grounded through one connection which allows for detection of a loose connection. Core grounding shall be via an easily accessible, removable link.

## **5.3. Windings**

- 5.3.1 The transformer vector group shall be as specified on the Data Sheet. The windings shall be copper.
- 5.3.2. Minimum insulation levels for windings and connected parts shall be as specified in IEC 60076.
- 5.3.3. The windings insulation class shall be the SUPPLIER's standard unless otherwise specified on the Power Transformer Data Sheet.

- 5.3.4. Internal winding connections shall be welded, braced or crimped-on. Soldering or bolted connections are not acceptable.
- 5.3.5. The insulation class of the phase bushings shall not be less than the rated line-to-line voltage of the transformer windings.
- 5.3.6. The insulation class of the neutral bushing shall not be less than the rated line-to-neutral voltage of the winding.

## **5.4. Tank**

- 5.4.1. Tanks shall be constructed of steel.
- 5.4.2. Tanks shall be of strength to prevent distortion occurring when the transformers are lifted, jacked or transported. All joint seams and fittings shall be strong and protected to prevent leakage of oil. Tanks and conservators (where fitted) shall be of a strength to withstand, without deformation, the maximum internal pressures caused by the expansion of the oil and air/gas under service and maximum through-fault conditions. A pressure relief arrangement shall be provided where necessary.
- 5.4.3. Tank covers shall be of a construction that will prevent accumulation of moisture.
- 5.4.4. Hermetically sealed transformers shall have the cover fully seam welded with a continuous bead without undercutting. Bolting on of the covers with tack welded bolts is not acceptable. After filling, the tank filling orifices shall be permanently sealed and tamper-proof. Any gasket joints shall be below the cold oil level and the bolts made tamper-proof. The expansion space above the oil shall be filled with either dry air or dry inert gas. An oil level indicator and pressure / vacuum gauge shall be fitted.
- 5.4.5. Manhole and / or hand-hole covers shall be gasket and bolted. All gasket joints shall be below the cold oil level.
- 5.4.6. The design of cooling tubes, radiators or ribs shall permit cleaning and painting. Bends in tubes shall be smooth and any clearance gaps where they join the tank shall be effectively filled.

## **5.5. Transformer Taps**

The HV windings of transformers shall be provided with tapping for constant kVA rating to compensate for variations in the supply voltage. Unless otherwise specified in the data sheet, the taps for 35/6kV, 6/0.69kV and 6/0.4kV transformers with fixed off-circuit taps shall be  $\pm 2.5\%$  and  $\pm 5\%$  of nominal rated voltage. Taps for 110/35kV transformers with on-load tap changers shall be  $\pm 10\%$  using 1% tap intervals.

- 5.5.1 Off / Circuit Tap Changer
  - Tapping range shall be  $\pm 5\%$  in 2.5% steps except for 110/35kV transformers
  - Each tap position shall be lockable in these positions
  - Operating handle shall be provided with padlock to lock the tap changer
  - Operating handle shall be metal and sized to allow operations without tools being needed
  - One handle shall operate all phases simultaneously

### 5.5.2 On-load Tap Changer

On-load tap changers shall be of the motor driven type enclosed in a separate oil filled compartment. No movement of insulating oil shall be permitted between the tap changer enclosure and the main transformer tank. The tap changer compartment shall be provided with oil level gauge and oil topping and drainage facilities with plugs. Where a conservator is required for the tap changer, it shall be a separate conservator or a separate compartment within the main conservator and shall be provided with fittings as specified in the transformer data sheet. The control equipment for the tap-changer drive shall be accommodated in a separate transformer mounted enclosure.

- Tapping range shall be  $\pm 10\%$  in 1% steps
- Tap changer and motor drive mechanism shall comply with IEC 60214-2
- Insulation levels and short circuit rating shall not be less than that of the winding

## 5.6. Cooling

5.6.1 Oil-immersed transformers shall be of the natural oil circulation, naturally air-cooled (ONAN) type unless otherwise specified.

5.6.2. When forced air cooling (ONAF) is specified on the data sheets, the auxiliary cooling equipment (fans and control) shall be completely installed and wired to auxiliary terminal boxes. In general, forced air cooling equipment control shall be automatically controlled by a top oil temperature switch with provision for manual override.

5.6.3. Control equipment shall include the following:

- Top oil temperature actuated switch containing electrical contacts for control of the auxiliary cooling equipment, and one additional contact that opens to alarm on high temperature. This device may be incorporated in a dial-type thermometer.
- Weatherproof cabinet, IP 55 minimum, for control equipment located on the transformer at a height suitable for operation and maintenance by a person standing at base level.
- Manually operated switch for choosing automatic or manual control.
- All motor controllers, relays, terminal blocks necessary for control of the cooling fans
- All conduit, multicore cable and wiring necessary to connect the control equipment into a complete, functional system.

5.6.4 The power for the transformer auxiliary cooling equipment will be supplied by the COMPANY.

5.6.5 When "Future" forced air cooling is specified, all items that cannot be safely installed while the transformer is energized shall be supplied and installed on the initial order. This includes increased conductor size, bushings, additional cooling surface, as necessary to meet the maximum rating specified.

## 5.7. Earthing

5.7.1. All metal parts of the core, frame tank or enclosure shall be maintained at earth potential.



- 5.7.2. Transformers shall be provided with two earth terminals on the outside of the transformer frame or tank wall.
- 5.7.3. Each earth connection shall consist of an earthing pad or M12 boss, brass bolt and phosphor bronze washer. They shall be located on opposite sides of the transformer, preferably near the main cable boxes.
- 5.7.4. Provisions shall be made adjacent to each gland plate for earthing connection of cable armour or bus duct earthing connection.
- 5.7.5. Control panels, marshalling boxes and enclosures shall be provided with earthing connections suitable for an M10 bolt.

## **5.8. Mounting and handling facilities**

- 5.8.1. Transformers shall be skid mounted.
- 5.8.2. Transformers and associated cooling equipment when transported separately shall each be provided with adequate lifting lugs to facilitate transport to, and assembly at site.

## **6. ACCESSORIES AND FITTINGS**

### **6.1 General**

- 6.1.1. In addition to standard fittings and accessories as listed in the reference codes and standards and/or mentioned above, each transformer shall be furnished with the accessories listed on the Transformer Data Sheet.
- 6.1.2. Each transformer shall be provided with a thermometer pocket which shall be welded into the tank in an accessible position in such a way that a thermometer or thermocouple can be inserted to measure the top oil temperature even when the oil is at its lowest level. The pocket size shall not be less than 12.4mm internal diameter and 152mm deep and shall be provided with a screwed sealing cap.
- 6.1.3. Temperature indicators shall be provided, as specified on the data sheet, complete with adjustable changeover contacts for alarm and trip signals and to provide control for forced air cooling. The temperature indicators shall be operated by temperature sensors placed adjacent to hotspots in the windings and in the core assembly, as specified on the data sheet.
- 6.1.4. A sudden pressure device shall be provided for tripping the transformer on internal faults. The pressure device shall be fitted with a changeover contact. In the case of conservator tank type transformers Buchholz relays shall be provided giving alarm for build-up of pressure and trip for sudden pressure.
- 6.1.5. Instruments provided with the transformers shall be arranged so that they can be easily read by a person standing at ground level.
- 6.1.6. When 'Off Circuit' tap changers are specified, they shall be manually operated with the transformer de-energised. The operating handle shall be external and accessible at ground level, with spindle enclosed in an oil or grease filled chamber (situated

below cold oil level) to prevent gas or oil leakage. Tap changers shall have provision for padlocking in all positions with the tap setting readily visible.

6.1.7. 'On Load' tap changers, when specified, shall be of the motor driven type enclosed in a separate compartment such that interchange of insulating oil between it and the main transformer tank is prevented. The tap changer compartment shall be provided with oil level gauge and oil topping and drainage facilities with plugs. A separate Buchholz relay shall be fitted between the conservator tank and tap changer compartment. The control equipment for the tap changer drive shall be accommodated in a transformer mounted enclosure. The control equipment shall include an alarm annunciator and there shall be facilities for the connection of the following remote control/indication functions:

- Tap position indication (analogue signal)
- Tap change in progress indication
- Voltage set point adjustment
- Local/remote status indication
- Master/slave selector and status indication
- Manual/auto selector and status indication
- Raise/lower manual control switch
- Remote common alarm

6.1.8. When removable radiators or remote oil coolers are employed, isolating valves shall be provided to enable the cooler to be removed without lowering the oil level in the main tank of the transformer.

6.1.9. When cooling fans or pumps are specified on the Data Sheet the protective and control equipment shall be installed in a transformer mounted enclosure. Each motor shall be protected individually against short circuit and overload. The control equipment shall be fully automatic, based upon winding temperature and shall include an alarm annunciator with provision for connection of a remote common alarm. When a transformer has no self-cooled rating, e.g. forced oil cooled, there shall be provision for accepting redundant auxiliary power supplies. Fans shall be mounted on separate mounting brackets, and not directly to the cooling fins.

6.1.10. When provision for future cooling fans is specified on the Data Sheet, the provision shall include the temperature control device with two contacts (one for alarm and one for fan control), mounting space and brackets for the fans, and mounting space for the control enclosure.

6.1.11. When a conservator tank is specified it shall be provided with level indication, vent, silica gel or refrigeration type (Drycol) breathers, drain and filling connections. When an 'on load' tap changer requiring a conservator is fitted to the transformer, a separate conservator for the tap changer, or a conservator having separate compartments and fittings shall be provided.

6.1.12. When oil filled disconnecting chambers are specified, the interchange of oil between the link chamber and the main tank shall be prevented. Link chambers shall be fitted with oil level gauge, oil topping and draining facilities with plugs.

6.1.13. When a disconnect switch is specified on the Data Sheet it shall be mounted on the supply side disconnect chamber and shall comply with the requirements of the referenced specification.

6.1.14. When Current Transformers (CTs) are specified, all secondary leads shall be run in

armoured cable or conduit to the auxiliary terminal box. The leads for each CT shall be crimped using self-insulated compression ring-type lugs and terminated to adjacent terminals of a shorting screw-type terminal block. The terminal blocks shall be clearly marked designating the CT phase, and tap number in accordance with referenced standards.

- 6.1.15. If neutral point CTs are specified they shall be situated between the neutral tap off point and the earth connection point unless stated otherwise. All CTs and their connections shall be accessible.

## 6.2. Auxiliary Supplies

- 6.2.1. Auxiliary supplies shall comply with the following table:

Transformer Accessory	Auxiliary Supply
Tap Changer Motor	* 690V 3phase 3-wire 50Hz
Cooling Fans	* 690V 3phase 3-wire 50Hz
Controls	110V dc
Anti-condensation heater	230V 1 phase 50Hz
Auxiliary motors (less than 1kW)	230V 1 phase 50Hz

- Voltage shall be confirmed in Datasheet.

## 7. TERMINATIONS

- 7.1. When terminations for bus duct are specified on the Data Sheet, provision shall be made for the support and fastening of the ducting at the throat of the transformer. The transformer terminals shall provide a sufficient pre-drilled contact area for accepting flexible connectors, and provision shall be made for access for convenient making off, or disconnection of, the connections while the duct remains in place. The SUPPLIER of the bus duct shall liaise with the transformer MANUFACTURER to ensure proper connection integrity is maintained. The SUPPLIER of the bus duct shall provide the transformer flexible connections. To avoid contamination from H<sub>2</sub>S the silver plating of conductors shall be avoided.
- 7.2. When air filled cable terminal chambers are specified on the Data Sheet, access covers shall be full height, bolted and gasket. An internal earthing point and removable bottom undrilled gland-plate shall be provided. Clearance between the termination and the gland-plate shall allow for the bending of cables as necessary.
- 7.3. Provision shall be made for connecting the number of conductors per phase as specified on the Data Sheet.<sup>1</sup>
- 7.4. In case of a three phase and neutral arrangement, all four terminals shall be provided in a single terminal compartment. The star point earth terminal shall be accommodated in a separate terminal box.

The use of non-magnetic gland plate is justified to prevent eddy currents and associated hotspot effects caused by magnetic field of a single core cable.

- 7.5. Cable termination accessories including stress relieving devices, where necessary, and cable glands, will be provided by the COMPANY unless specified otherwise on the Data Sheet.
- 7.6. Where specified, Elastimold (or equivalent) connections shall be used whereby the MANUFACTURER shall provide the termination kits with facilities for connection onto the transformer.
- 7.7. Where single core cables are specified on the Data Sheet, the gland plate shall be of brass (4mm minimum).
- 7.8. A separate terminal box shall be provided for termination of auxiliary items such as alarms, CTs, fans etc.
- 7.9. Terminal compartments, auxiliaries enclosures, and boxes shall be mounted at a height of at least 1.0 metre above the foundation level. They shall be IP 55 as a minimum unless stated otherwise in the Data Sheets.
- 7.10. Cable entry shall be from below unless otherwise specified on the Data Sheet. SUPPLIER shall make provision for mounting clamps below the terminal boxes to support cables rising from ground level.
- 7.11. Alarm/trip wiring, current transformer wiring, cooling fan power and control wiring, tap changer power and control wiring and all alarm wiring shall have copper conductors of the manufacturers standard sizing, (subject to COMPANY's approval) and shall be run in armoured cable or conduit to the terminal box. Wiring shall be crimped using self-insulated compression spade-type terminal blocks which shall be suitably identified. Conductors shall be fitted with sleeve ferrules bearing the same identification as the terminal to which they are connected.
- 7.12. Conductors shall be marked to indicate the phase colouring. The following colours shall be adopted:

**3 Phase/Neutral Systems -**

Line 1:	Yellow
Line 2:	Green
Line 3:	Red
Neutral:	Blue
Earth:	Green/Yellow

**Single Phase/Neutral (2 wire) Systems -**

Line:	Red (When the single phase conductors are branches of a three phase system the single phase conductor shall be marked as the respective phases of the three phase system.
Neutral:	Blue
Earth:	Green/Yellow

**Direct Current Systems -**

Positive:	Red
Negative:	Dark Blue
Earth:	Green/Yellow

## **8. ELECTROMAGNETIC COMPATIBILITY**

- 8.1. For immunity, all equipment covered by this specification shall, as a minimum, be suitable for operation on electrical power distribution systems having overall disturbance characteristics defined in IEC 61000 and having limits specified for Class 2
- 8.2. EMC emissions shall also be limited as far as practical to meet the limits for Class 2 as defined in IEC 61000 but may be subject to more stringent requirements dependent on the outcome of the power system studies subject to agreement between COMPANY and SUPPLIER.
- 8.3. The design of the equipment shall be of an adequate standard to maintain its performance during its operational life in its installed environment.

## **9. NAMEPLATES**

- 9.1. The MANUFACTURER's rating plate shall be of stainless steel and show all information in accordance with IEC 60076-11 and shall also include COMPANY's purchase order number.
- 9.2. The word 'SEALED' shall be added to the cooling classification where applicable.
- 9.3. The impedance value stamped on the nameplate shall be the actual measured value obtained during testing.
- 9.4. In addition to the standard nameplate referred to above, each transformer shall be identified with a transformer identification plate. Plates shall be machine engraved phenolic, with black figures on a white background and shall be securely attached with stainless steel rivets and screws. Identification plate information shall be defined by the COMPANY.
- 9.5. All text on nameplates and labels shall be in both Russian and English.
- 9.6. Danger/warning labels shall be black on a yellow background pictogram. Any lettering shall be black on yellow.

## **10. NOISE**

- 10.1. Noise levels shall conform to the requirements specified in the applicable standards of section 2.8 and the attachments to the material requisition. As a general rule, transformers up to 2.5MVA; noise level shall not exceed 81dbA at 1 metre. The MANUFACTURER shall state in his tender the maximum noise level.

## **11. PAINTING AND FINISH**

- 11.1. Transformers shall be prepared, painted and finished as specified on the attachments to the material requisition and in accordance with the Project Specification for External Coating P3PFC-00C-3PS-WX00-30002.

- 11.2. MANUFACTURER's standard paint finish for specified service conditions is acceptable provided that it is no less effective than that specified above and suitable for the environmental data specified in 4.0 above. The SUPPLIER shall provide copies of the standard paint specification with his quotation.
- 11.3. The SUPPLIER shall supply a quantity of paint, identical with equipment finish, for field touch up.

## **12. TEMPERATURE MEASUREMENT**

The temperature of each winding shall be determined by one set of measurement per phase by means of thermistors or Pt 100 resistance type temperature detectors.

The thermistors or resistance elements shall be supplied with auxiliary equipment necessary to initiate remote alarms/trips via voltage free contacts

## **13. TRANSFORMER LOSSES**

- 13.1. The transformer losses stated in his quotation shall be guaranteed by the SUPPLIER.

## **14. INSPECTION AND TESTING**

Type tests, including a short circuit test, shall have been carried out on identical transformers by an independent testing authority and type test certificates shall be supplied with the quotation.

### **14.1. Routine Tests**

- The following routine tests shall be carried out on all transformers:
- Measurement of winding resistance (IEC 60076-1 10.2)
- Voltage ratio, voltage vector relationship and polarity (IEC 60076-1 10.3)
- Short Circuit Impedance and Load loss (IEC 60076-1 10.4)
- No-load losses and no-load current (IEC 60076-1 10.5)
- Dielectric routine tests (IEC 60076-3)
- Tap changer operation and measurement of tap voltage(IEC 60076-1 10.8)

In addition to the above and other standard routine tests, the following shall be performed:

- All tap-changers, alarm/trip contacts, sudden pressure sensors, current transformers, fans and all other accessories shall be electrically and functionally tested.
- In the case of a sealed transformer; before final sealing the completed transformer shall be filled with oil and subjected to a hydraulic pressure test of 0.56 kg/cm<sup>2</sup> without leakage or loss of pressure for 24 hours; after which the oil level shall be adjusted to its correct value and the filler cap sealed.
- A tan delta test shall be performed on all transformer windings above 3 MVA.

## 14.2. Type Tests

The following type tests shall be carried out on one transformer of each type /rating on transformers above 1.6 MVA:

- Temperature rise test (IEC 60076-3)
- Dielectric type tests (IEC 60076-3)

## 14.3 Special Tests

Other special tests if required, will be as stated on the transformer Data Sheet or other attachment to the material requisition.

- Dielectric special tests (IEC 60076-3)
- Determination of capacitances windings-to-earth, and between windings
- Determination of transient voltage transfer characteristics.
- Zero-sequence impedances on three phase transformers. (IEC 60076-1 10.7)
- Short Circuit withstand test (IEC 60076-5)
- Determination of sound levels (IEC 60076-10)
- Measurement of the harmonics of the no-load current (IEC 60076-1 10.6)
- Measurement of the power taken by fan and oil pump motors.
- Measurement of insulation resistance to earth of the windings, and or measurement of dissipation factor (tan delta) of the insulation system capacitances.

14.4 The MANUFACTURER shall submit to the COMPANY for approval a full set of standard test sheets suitable for recording all test results. Where tests are required to be carried out for which there is no standard test sheet, the MANUFACTURER shall prepare suitable test sheets for approval by the COMPANY.

14.5 The MANUFACTURER shall supply all necessary personnel, tools, tackle, test equipment and other items required to satisfactorily carry out all the tests. All instruments shall be calibrated in accordance with the manufacturer's recommendation. Copies of the calibration certificates shall be provided with the test results.

14.7 On satisfactory completion of the tests and before despatch, the MANUFACTURER shall submit copies of the test certificates for approval. The equipments shall not be dispatched until the COMPANY has approved the test certificates.

Inspection and testing documentation shall be prepared by the MANUFACTURER and submitted to the COMPANY prior to works acceptance.

Acceptance or acknowledgement of any test results or data by the COMPANY does not relieve the MANUFACTURER of responsibility for the equipment supplied, as required in the Specification, relevant Standards, Regulations or Codes of Practice.

## **15. SHIPPING, HANDLING AND STORAGE**

- 15.1. Preparation for shipment shall be as stated in the Project Specification for Protection, Packing, Marking and Shipping Documentation Instructions, Doc. No |                    \_GT-SPC-00001 and |                    \_GT-SPC-00002. The SUPPLIER shall be solely responsible for the adequacy of the preparation for shipment provisions stated.
- 15.2. The equipment shall be shipped in the largest practical sections whilst permitting ease of handling for transportation and installation.
- 15.3. Each shipping section shall be provided with supports in the form of steel sections, lifting eyes etc. to maintain alignment of parts during shipping, handling, hoisting and installation. Location of lifting points shall be clearly marked on all shipping containers and on drawings. Each shipping section shall have its weight and centre of gravity clearly marked on the container.
- 15.4. Preparation for shipment shall protect the component parts against corrosion, dampness, breakage or vibration injury during transportation and installation. The MANUFACTURER shall include for the provision of impact recorders for transformers rated above 10MVA.
- 15.5. Each shipping container shall be identified with the contents, purchase order number and item number.
- 15.6. Where equipment has to be split for shipping, instructions shall be provided for reassembly. Materials and special tools shall be provided if necessary for reassembly at site.
- 15.7. The SUPPLIER is required to provide the COMPANY with a Certificate of Compliance prior to shipping of equipment.
- 15.8. The SUPPLIER is to provide a shock recorder for large transformers for the purpose of recording loading, transportation and unloading from SUPPLIER to site.
- 15.9. SUPPLIER shall provide shipping, installation, operation and maintenance weights including centre or gravity.

## **16. DEVIATIONS**

- 16.1. Deviations from this specification are only acceptable where the SUPPLIER has listed in his quotation the requirements he cannot or does not wish to comply with, and the COMPANY has accepted, in writing, the deviations before the order is placed. If the SUPPLIER is also to offer alternatives resulting in technical or price advantages he shall submit a supplement to the main tender.
- 16.2. In the absence of a list of deviations, it will be assumed by the COMPANY that the SUPPLIER complies with this specification.

## **17. DOCUMENTATION REQUIREMENTS**



Supplier shall produce all required documents as requested in the tender in the required language(s).

The following drawings/documents shall be submitted as a minimum:

- General arrangement showing masses, main dimensions, arrangement of auxiliary components and the minimum clearances required for ventilation and safety during operation and maintenance
- Drawings of nameplate and all termination arrangements
- Foundation plan including foundation loading
- Schematic and connection diagrams covering all equipment pertaining to the transformer
- Type and special test certificates
- Schedule of recommended spare parts
- Technical manual giving installation, operation and maintenance instructions

All test reports performed on the transformers and its auxiliaries shall be produced and made available to COMPANY

## **18. INTERNATIONAL STANDARDS, KAZAKH STANDARDS AND PROJECT SPECIFICATIONS**

IEC 60034	Rotating electrical machines (e.g. for cooler fan motors)
IEC 60038	IEC Standard Voltages
IEC 60044-1	Instrument transformers – Part 1 Current transformers
IEC 60071	Co-ordination of insulation.
IEC 60076 (series)	Power transformers
IEC 60079	Electrical apparatus for explosive gas atmospheres
IEC 60085	Electrical insulation - Thermal classification
IEC 60099	Surge Arrestors.
IEC 60137	Insulating bushings for alternating voltages above 1000V
IEC 60214-1	Tap-changers Part 1 – Performance requirements and test methods
IEC 60214-2	Tap-changers Part 2 – Application guide
IEC 60270	High-voltage test techniques - Partial discharge measurements

IEC 60296	Fluids for electrotechnical applications - Unused mineral insulating oils for transformers and switchgear
IEC 60354	Loading Guide for Oil Immersed Power Transformer
IEC 60404	Magnetic Materials
IEC 60417 DB	Graphical symbols for use on equipment - Part 1: Overview and Application
IEC 60445	Basic and safety principles for man-machine interface, marking and identification - Identification of equipment terminals and of terminations of certain designated conductors, including general rules for an alphanumeric system
IEC 60529	Degrees of protection provided by enclosures (IP Code)
IEC 60542	Application Guide for On-Load Tap Changers
IEC 60551	Determination of Transformers and Reactor sound levels
IEC 60606	Application Guide for Power Transformers
IEC 60616	Terminal and Tapping Markings for Power Transformers
IEC 60617	DB Graphical symbols for diagrams Part 1: General Information, General Index Cross-Reference Tables
IEC 60722	Guide For Lightning Impulse and Switching Impulse Testing of Power Transformers
IEC 61000	Electromagnetic Compatibility (EMC)

### **Kazakh Standards**

PUE RoK	Rules for the arrangement of electrical installations
SNiP RoK 4.04-06- 2002	Electro-technical devices
SN RoK 4.04-19-2003	Regulation for design of power and lighting equipment of industrial facilities
	Environmental Code of the Republic of Kazakhstan
GOST 14254-96	Degrees of protection provided by enclosures (IP Code)
GOST 11677-85	Power Transformers. General Specification
GOST 16110-82	Power Transformers. Terms and Definitions
GOST 30830-2002	Power Transformers. Part I. General
GOST 12.1.003-83	Noise. General safety requirements

## **Project Specifications**

LGT-SPC-00001  
-LGT-SPC-00002

Project Specification for Protection, Packing,  
Marking and Shipping Documentation  
Instructions.

23858-00L-3PS-0000-00003

Project Specification for Climatic and  
Environmental Data

23858-00L-3PS-W000-00013

Project Specification for External Coating