**3. 132/33kV POWER TRANSFORMER (AIS-AIS)**

| 132/33KV POWER TRANSFORMERS (AIS-AIS) | | UNIT | Data | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| REQUIRED | | | | OFFERED | | | | |
| 1 | Substation name |  | RUMURUTI/KABARNET  SUBSTATION | | | |  | | | | |
| 2 | Manufacture name & country |  | Should be Proposed By Tenderer | | | |  | | | | |
| 3 | Type designation |  | Should be Proposed By Tenderer | | | |  | | | | |
| 4 | Type of transformers |  | Two Windings | | | |  | | | | |
| 4.1 | Auto or separate windings |  | Separate | | | |  | | | | |
| 4.2 | Shell or core |  | Core | | | |  | | | | |
| 4.3 | Indoor or outdoor |  | Outdoor | | | |  | | | | |
| 4.4 | Three phases or single phases units |  | Three phase | | | |  | | | | |
| 5 | Type of cooling acc. to IEC |  |  | | | |  | | | | |
| 5.1 | First stage |  | ONAN | | | |  | | | | |
| 5.2 | Second stage |  | ONAF | | | |  | | | | |
| 5.3 | Third stage |  | - | | | |  | | | | |
| 6 | Rated frequency | Hz | 50 | | | |  | | | | |
| 7 | Rated voltage |  |  | | | |  | | | | |
| 7.1 | HV | kVrms | 132 | | | |  | | | | |
| 7.2 | LV | kVrms | 33 | | | |  | | | | |
| 8 | Continuous power rating at principle tap |  |  | | | |  | | | | |
| 8.1 | Type |  | ONAN/ONAF | | | |  | | | | |
| 8.2 | Nominal power rating at site conditions | MVA | 23 | | | |  | | | | |
| 8.3 | At first stage of cooling: |  |  | | | |  | | | | |
| 8.3.1 | HV winding | MVA | 18 | | | |  | | | | |
| 8.3.2 | LV winding | MVA | 18 | | | |  | | | | |
| 8.4 | At second stage of cooling: |  |  | | | |  | | | | |
| 8.4.1 | HV winding | MVA | 23 | | | |  | | | | |
| 8.4.2 | LV winding | MVA | 23 | | | |  | | | | |
| 9 | Maximum temperature rise at rated power outputs corrected for altitude & ambient temperature of site |  |  | | | |  | | | | |
| 9.1 | Top oil | °C | 56 | | | |  | | | | |
| 9.2 | Winding | °C | 61 | | | |  | | | | |
| 9.3 | Hottest spot | °C | 74 | | | |  | | | | |
| 10 | Off load tap changer |  | N.A | | | |  | | | | |
| 10.1 | Type |  | ----- | | | |  | | | | |
| 10.2 | Manufacture |  | ----- | | | |  | | | | |
| 10.3 | Rated current | Arms | ----- | | | |  | | | | |
| 10.4 | Total range | % | ----- | | | |  | | | | |
| 10.5 | Total number of steps |  | ----- | | | |  | | | | |
| 10.6 | Variation per step | % | ----- | | | |  | | | | |
| 10.7 | Position to tapings (winding) |  | ----- | | | |  | | | | |
| 11 | On load tap changer |  |  | | | |  | | | | |
| 11.1 | Type |  | On-load | | | |  | | | | |
| 11.1.1 | Resistor/reactor |  | Resistor | | | |  | | | | |
| 11.1.2 | In tank/ out of tank |  | In Tank | | | |  | | | | |
| 11.1.3 | Vacuum or oil |  | Vacuum | | | |  | | | | |
| 11.2 | Manufacturer |  | MR | | | |  | | | | |
| 11.3 | Country of manufacturer |  | Should be Proposed By Tenderer | | | |  | | | | |
| 11.4 | Standards |  | IEC 60214 | | | |  | | | | |
| 11.5 | Number of phases |  | 3 | | | |  | | | | |
| 11.6 | Arrangement of tapping (linear, coarse/fine, reversing) |  | Should be Proposed By Manufacturer | | | |  | | | | |
| 11.7 | Rated current | Arms | Min (140) | | | |  | | | | |
| 11.8 | Rated step voltage | Vrms | Should be Proposed By Manufacturer | | | |  | | | | |
| 11.9 | Rated switching capacity | kVA | Should be Proposed By Manufacturer | | | |  | | | | |
| 11.10. | Rated short circuit withstand current | kArms | Should be Proposed By Manufacturer | | | |  | | | | |
| 11.11 | Rated short circuit duration | sec | Should be Proposed By Manufacturer | | | |  | | | | |
| 11.12 | Total range | % | ±13.36 | | | |  | | | | |
| 11.13 | Total number of steps |  | ±8(1.67%)  steps | | | |  | | | | |
| 11.14 | Variation per step | V | 2200 | | | |  | | | | |
| 11.15 | Principle Tap Position |  | 9 | | | |  | | | | |
| 11.16 | Insulation level |  | Should be Proposed By Manufacturer | | | |  | | | | |
| 11.16.1 | Voltage class | kVrms | Should be Proposed By Manufacturer | | | |  | | | | |
| 11.16.2 | Highest voltage for equipment | kVrms | Should be Proposed By Manufacturer | | | |  | | | | |
| 11.16.3 | BIL to ground | kVpeak | Should be Proposed By Manufacturer | | | |  | | | | |
| 11.16.4 | BIL between diverter switch contacts | kVpeak | Should be Proposed By Manufacturer | | | |  | | | | |
| 11.16.5 | BIL across regulating winding | kVpeak | Should be Proposed By Manufacturer | | | |  | | | | |
| 11.17 | OLTC protection system |  | Should be Proposed By Manufacturer | | | |  | | | | |
| 11.17.1 | Is oil flow relay required? If so, type and manufacturer |  | Required | | | |  | | | | |
| 11.17.2 | Is pressure relief device required? If so, type and manufacturer |  | Required | | | |  | | | | |
| 11.17.3 | Over pressure relay type and manufacturer |  | Should be Proposed By Manufacturer | | | |  | | | | |
| 11.17.4 | Other protection device type & manufacturer |  | Should be Proposed By Manufacturer | | | |  | | | | |
| 11.18 | Rated voltage of drive system | V | 415/240 | | | |  | | | | |
| 11.19 | Rated voltage of control circuit | V | 110 | | | |  | | | | |
| 11.20. | All features, controls, alarms and interlocks as called for provide | Yes/No | Yes | | | |  | | | | |
| 11.21 | Whether remote control cubicle included in scope of work | Yes/No | Yes | | | |  | | | | |
| 11.22 | Whether AVR required? | Yes/No | Yes | | | |  | | | | |
| 11.23 | Type of AVR |  | Should be Proposed By Manufacturer | | | |  | | | | |
| 11.24 | Full description of remote OLTC control included | Yes/No | Yes | | | |  | | | | |
| 11.25 | Parallel operation control required for number of transformers |  | 4 | | | |  | | | | |
| 11.26 | Method of parallel control |  | Acc. to Specifications | | | |  | | | | |
| 11.26.1 | Master /follower |  |  | | | |  | | | | |
| 11.26.2 | Min circulating current |  |  | | | |  | | | | |
| 11.26.3 | Reverse reactance method |  |  | | | |  | | | | |
| 11.27 | Is line drop compensation required? | Yes/No | Yes | | | |  | | | | |
| 11.28 | Tap position output type |  | BCD/mA/Ohm/Contact | | | |  | | | | |
| 12 | Vector group |  | Dyn1 (Rumuruti)/ Dyn11(Kabarnet) | | | |  | | | | |
| 13 | Impedance |  |  | | | |  | | | | |
|  | On the base of rated power of main windings | MVA | 23 | | | |  | | | | |
| 13.1 | Positive sequence impedance at 75 ̊C, on principal tapping and on: |  | This parameter should be identical with the existing 23MVA Power transformer at respective substations for parallel operation | | | |  | | | | |
| 13.1.1 | Between HV & LV winding | % | 9.58 (Rumuruti) / 9.59 (Kabarnet)  This parameter should be identical with the existing 23MVA Power transformer at respective substations for parallel operation | | | |  | | | | |
| 13.1.2 | Between HV & TV winding (if applicable) | % | Should be Filled By Manufacturer | | | |  | | | | |
| 13.1.3 | Between LV & TV winding (if applicable) | % | Should be Filled By Manufacturer | | | |  | | | | |
| 13.2 | Positive sequence impedance at 75 ̊C, on max. raise voltage and on: |  |  | | | |  | | | | |
| 13.2.1 | Between HV & LV windings | % | Should be Filled By Manufacturer | | | |  | | | | |
| 13.2.2 | Between HV & TV winding (if applicable) | % | Should be Filled By Manufacturer | | | |  | | | | |
| 13.2.3 | Between LV & TV winding (if applicable) | % | Should be Filled By Manufacturer | | | |  | | | | |
| 13.3 | Positive sequence impedance at 75 ̊C, on max. lower voltage and on: |  |  | | | |  | | | | |
| 13.3.1 | Between HV & LV windings | % | Should be Filled By Manufacturer | | | |  | | | | |
| 13.3.2 | Between HV & TV winding (if applicable) | % | Should be Filled By Manufacturer | | | |  | | | | |
| 13.3.3 | Between LV & TV winding (if applicable) | % | Should be Filled By Manufacturer | | | |  | | | | |
| 13.4 | Zero sequence impedance at 75 ̊C: |  |  | | | |  | | | | |
| 13.4.1 | Between HV & LV windings (LV open) | Ohm/ph. | Should be Filled By Manufacturer | | | |  | | | | |
| 13.4.2 | Between HV & LV windings (LV short) | Ohm/ph. | Should be Filled By Manufacturer | | | |  | | | | |
| 13.4.3 | Between LV & HV windings (HV open) | Ohm/ph. | Should be Filled By Manufacturer | | | |  | | | | |
| 13.4.4 | Between LV & HV windings (HV short) | Ohm/ph. | Should be Filled By Manufacturer | | | |  | | | | |
| 13.5 | Resistance of windings at 75 ̊C on principal tapping: |  |  | | | |  | | | | |
| 13.5.1 | HV | Ohm/ph. | Should be Filled By Manufacturer | | | |  | | | | |
| 13.5.2 | LV | Ohm/ph. | Should be Filled By Manufacturer | | | |  | | | | |
| 13.6 | Estimated winding capacitance's with: |  | Should be Filled By Manufacturer | | | |  | | | | |
| 13.6.1 | Series capacitance of HV phase winding | PF |  | | | |  | | | | |
| 13.6.2 | Series capacitance of LV phase winding | PF |  | | | |  | | | | |
| 13.6.3 | Shunt capacitance to earth of each HV phase winding with LV unearthed | PF |  | | | |  | | | | |
| 13.6.4 | Shunt capacitance to earth of each LV phase winding with HV unearthed | PF |  | | | |  | | | | |
| 13.6.5 | Capacitance of HV-LV phase winding with LV unearthed | PF |  | | | |  | | | | |
| 14 | Rated short circuit strength of windings (symmetrical values) |  | Should be Filled By Manufacturer | | | |  | | | | |
| 14.1 | HV system Indicate 1 and 3 phase | kA/kA | 31.5 | | | |  | | | | |
| 14.2 | LV system Indicate 1 and 3 phase | kA/kA | 25 | | | |  | | | | |
| 14.3 | Short circuit duration | sec | 2 | | | |  | | | | |
| 14.4 | Short circuit calculation will be submitted after award of contract | Yes/No | Yes | | | |  | | | | |
| 15 | Insulation levels |  |  | | | |  | | | | |
| 15.1 | Lightning impulse withstand voltages: |  |  | | | |  | | | | |
| 15.1.1 | HV winding/bushing | kVpeak / kVpeak | 650 | | | |  | | | | |
| 15.1.2 | LV winding/bushing | kVpeak / kVpeak | 250 | | | |  | | | | |
| 15.1.3 | Neutral end winding/bushing | kVpeak / kVpeak | 145 | | | |  | | | | |
| 15.2 | Switching impulse withstand voltages: |  |  | | | |  | | | | |
| 15.2.1 | HV winding/bushing | kVpeak / kVpeak | N.A | | | |  | | | | |
| 15.2.2 | LV winding/bushing | kVpeak / kVpeak | N.A | | | |  | | | | |
| 15.2.3 | Neutral end winding/bushing | kVpeak / kVpeak | N.A | | | |  | | | | |
| 15.3 | One minute power frequency withstand voltages: |  |  | | | |  | | | | |
| 15.3.1 | HV winding/bushing | kVrms / kVrms | 325 | | | |  | | | | |
| 15.3.2 | LV winding/bushing | kVrms / kVrms | 95 | | | |  | | | | |
| 15.3.3 | Neutral end winding/bushing | kVrms / kVrms | 50 | | | |  | | | | |
| 15.4 | Partial discharge measurement: |  |  | | | |  | | | | |
| 15.4.1 | Standard |  | IEC 60270 | | | |  | | | | |
| 15.4.2 | Test method |  | IVPD | | | |  | | | | |
| 15.4.3 | Long duration induced voltage | kVrms | Acc. to IEC 60076-3 | | | |  | | | | |
| 15.4.4 | Enhancement voltage level | kVrms | Acc. to IEC 60076-3 | | | |  | | | | |
| 15.4.5 | Maximum allowable partial discharge | pC | Acc. to IEC 60076-3 | | | |  | | | | |
| 16 | Bushing data |  | HV | LV | TV | N | HV | | LV | TV | N |
| 16.1 | Manufacturer & country |  |  |  |  |  |  | |  |  |  |
| 16.2 | Type (OIP/RIP/RBP/...) |  | OIP | OIP | - | OIP |  | |  |  |  |
| 16.3 | Rated service voltage | kV | 132 | 33 | - | 24 |  | |  |  |  |
| 16.4 | Nominal current rating | A | 140 | 560 | - | 2000 |  | |  |  |  |
| 16.5 | Rated short circuit current | kA | 31.5 | 25 | - | 25 |  | |  |  |  |
| 16.6 | Rated thermal short time current duration | sec | 2 | 2 | - | 2 |  | |  |  |  |
| 16.7 | Power frequency withstand voltage (complete with all fittings) | kV | 315 | 95 | - | 50 |  | |  |  |  |
| 16.8 | Radio influence voltage level measured at 1.1 rated system voltage at 1MHz | microV | 2500 | | | |  | |  |  |  |
| 16.9 | Is test tap required? | Yes/No | Yes | No | - | No |  | |  |  |  |
| 16.10. | Quantity of oil per bushing | liters | Acc. to Manufacturer Data | Acc. to Manufacturer Data | - | Acc. to Manufacturer Data |  | |  |  |  |
| 16.11 | Type of internal insulation (oil impregnated/resin type) |  | Oil Impregnated | Oil Impregnated | - | Acc. to Manufacturer Data |  | |  |  |  |
| 16.12 | Equipped with magnetic oil indicator (in case of oil type) | Yes/No | Yes | No | - | No |  | |  |  |  |
| 16.13 | Creepage distance | mm | 4495 | 1116 | - | >900 |  | |  |  |  |
| 16.14 | Protected creepage distance | mm | Acc. to Manufacturer Data | Acc. to Manufacturer Data | - | Acc. to Manufacturer Data |  | |  |  |  |
| 16.15 | Loss angle (insulation power factor) at working Voltage |  | Acc. to Manufacturer Data | Acc. to Manufacturer Data | - | Acc. to Manufacturer Data |  | |  |  |  |
| 16.16 | Electrostatic capacity of complete bushing | PF | Acc. to Manufacturer Data | Acc. to Manufacturer Data | - | Acc. to Manufacturer Data |  | |  |  |  |
| 16.17 | Cantilever load class (Acc to IEC 60137) |  | Level II | Level II | - | Level II |  | |  |  |  |
| 16.18 | Max. mechanical forces |  | Acc. to Buswork Calc. | Acc. to Buswork Calc. | - | Acc. to Buswork Calc. |  | |  |  |  |
|  | Static, horizontal | N |  |  |  |  |  | |  |  |  |
| Static, vertical | N |  |  |  |  |  | |  |  |  |
| Dynamic, horizontal | N |  |  |  |  |  | |  |  |  |
| Dynamic, vertical | N |  |  |  |  |  | |  |  |  |
| 16.19 | Min. corona inception voltage | kV |  |  |  |  |  | |  |  |  |
| 16.20. | Washable in service | Yes/No | Yes | Yes | - | Yes |  | |  |  |  |
| 16.21 | Terminal leads full insulated at factory | Yes/No | Yes | Yes | - | Yes |  | |  |  |  |
| 16.22 | Bushing can be removed/ installed | Yes/No | Yes | Yes | - | Yes |  | |  |  |  |
| 16.23 | Bushing can be interchanged with spares | Yes/No | Yes | Yes | - | Yes |  | |  |  |  |
| 16.24 | Maximum external diameter of ring type current transformer which can be accommodated | mm | Acc. to Manufacturer Data | Acc. to Manufacturer Data | - | Acc. to Manufacturer Data |  | |  |  |  |
| 16.25 | Minimum external diameter of ring type current transformer which can be accommodated | mm | Acc. to Manufacturer Data | Acc. to Manufacturer Data | - | Acc. to Manufacturer Data |  | |  |  |  |
| 17 | Bushing type current transformer |  |  | | | | |  | | | |
| 17.1 | Fully complies with requirement | Yes/No | Yes | | | | |  | | | |
| 17.2 | Number of cores (HV,LV,HV-N,LV-N,TV) |  | Acc to SLD | | | | |  | | | |
| 17.3 | Specification |  | Acc to SLD | | | | |  | | | |
| 17.4 | Ratio accuracy class and burdens will be selected acc to owner request during design review | Yes/No | Yes | | | | |  | | | |
| 17.5 | Test conductor (winding) will be provided | Yes/No | Yes | | | | |  | | | |
| 18 | Losses |  |  | | | | |  | | | |
| 18.1 | No load losses at 75 ºC, rated frequency and rated voltage on principal tapping | kW | Max. 12  (Tolerance 0%) | | | | |  | | | |
| 18.2 | Load losses at rated frequency, 75 ºC And rated current on principal tapping: | kW | (Tolerance 0%) | | | | |  | | | |
| 18.2.1 | At first stage of cooling |  | Should be Filled By Tenderer | | | | |  | | | |
| a | HV/LV | kW |  | | | | |  | | | |
| b | HV/TV (if applicable) | kW |  | | | | |  | | | |
| c | LV/TV (if applicable) | kW |  | | | | |  | | | |
| 18.2.2 | At second stage of cooling |  |  | | | | |  | | | |
| a | HV/LV | kW | Max. 100 kW | | | | |  | | | |
| b | HV/TV (if applicable) | kW |  | | | | |  | | | |
| c | LV/TV (if applicable) | kW |  | | | | |  | | | |
| 18.2.3 | At third stage of cooling |  | NA | | | | |  | | | |
| a | HV/LV | kW | NA | | | | |  | | | |
| b | HV/TV (if applicable) | kW | NA | | | | |  | | | |
| c | LV/TV (if applicable) | kW | NA | | | | |  | | | |
| 18.3 | Load losses at 75ْ C and max. raise Voltage tapping: |  | Should be Filled By Tenderer | | | | |  | | | |
| 18.3.1 | At first stage of cooling |  |  | | | | |  | | | |
| a | HV/LV | kW |  | | | | |  | | | |
| b | HV/TV (if applicable) | kW |  | | | | |  | | | |
| c | LV/TV (if applicable) | kW |  | | | | |  | | | |
| 18.3.2 | At second stage of cooling |  | Should be Filled By Tenderer | | | | |  | | | |
| a | HV/LV | kW |  | | | | |  | | | |
| b | HV/TV (if applicable) | kW |  | | | | |  | | | |
| c | LV/TV (if applicable) | kW |  | | | | |  | | | |
| 18.3.3 | At third stage of cooling |  | NA | | | | |  | | | |
| a | HV/LV | kW | NA | | | | |  | | | |
| b | HV/TV (if applicable) | kW | NA | | | | |  | | | |
| c | LV/TV (if applicable) | kW | NA | | | | |  | | | |
| 18.4 | Load losses at 75ْ C and max. lower voltage tapping: |  | Should be Filled By Tenderer | | | | |  | | | |
| 18.4.1 | At first stage of cooling |  |  | | | | |  | | | |
| a | HV/LV | kW |  | | | | |  | | | |
| b | HV/TV (if applicable) | kW |  | | | | |  | | | |
| c | LV/TV (if applicable) | kW |  | | | | |  | | | |
| 18.4.2 | At second stage of cooling |  |  | | | | |  | | | |
| a | HV/LV | kW |  | | | | |  | | | |
| b | HV/TV (if applicable) | kW |  | | | | |  | | | |
| c | LV/TV (if applicable) | kW |  | | | | |  | | | |
| 18.4.3 | At third stage of cooling |  | NA | | | | |  | | | |
| a | HV/LV | kW | NA | | | | |  | | | |
| b | HV/TV (if applicable) | kW | NA | | | | |  | | | |
| c | LV/TV (if applicable) | kW | NA | | | | |  | | | |
| 18.5 | Cooling plant losses at ONAF/OFAF rating | kW | Max. 2 | | | | |  | | | |
| 19 | Efficiency at winding temperature of 75ْ C & PF=1 |  |  | | | | |  | | | |
| 19.1 | At ONAN rating, full load, ¾ full load, ½ full load | % |  | | | | |  | | | |
| 19.2 | At ONAF rating, full load, ¾ full load, ½ full load (ONAF1) | % |  | | | | |  | | | |
| 19.3 | At OFAF rating, full load, ¾ full load, ½ full load (ONAF2) | % | NA | | | | |  | | | |
| 19.4 | No load losses capitalized value | US$/KW | 9000 | | | | |  | | | |
| 19.5 | load losses capitalized value | US$/KW | 4000 | | | | |  | | | |
| 20 | Cooling system data |  |  | | | | |  | | | |
| 20.1 | ONAF system |  | Should be Filled By Tenderer | | | | |  | | | |
| 20.1.1 | Number of coolers or cooler banks |  | Should be Filled By Tenderer | | | | |  | | | |
| 20.1.2 | Number of radiator units in each bank |  | Should be Filled By Tenderer | | | | |  | | | |
| 20.1.3 | Manufacturer and type of radiators |  | painted | | | | |  | | | |
| 20.1.4 | Number of fans |  | Should be Filled By Tenderer | | | | |  | | | |
| 20.1.5 | Make and type of fans |  | Should be Filled By Tenderer | | | | |  | | | |
| 20.1.6 | Capacity of each fan | kW | Should be Filled By Tenderer | | | | |  | | | |
| 20.1.7 | Rated operating voltage | Vrms | Should be Filled By Tenderer | | | | |  | | | |
| 20.1.8 | Three phase or single phase |  | Should be Filled By Tenderer | | | | |  | | | |
| 20.1.9 | Starting current of each | Arms | Should be Filled By Tenderer | | | | |  | | | |
| 20.1.10 | Efficiency of each fan | % | Should be Filled By Tenderer | | | | |  | | | |
| 20.2 | OFAF system |  | NA | | | | |  | | | |
| 20.2.1 | Number of pumps |  | NA | | | | |  | | | |
| 20.2.2 | Manufacturer and type of pumps |  | NA | | | | |  | | | |
| 20.2.3 | Capacity of each pumps | HP | NA | | | | |  | | | |
| 20.2.4 | Rated operating voltage of pumps | Vrms | NA | | | | |  | | | |
| 20.2.5 | Three phase or single phase |  | NA | | | | |  | | | |
| 20.2.6 | Starting current of each | Arms | NA | | | | |  | | | |
| 20.2.7 | Efficiency of each pump | % | NA | | | | |  | | | |
| 21 | Capability of transformer to remain in operation from hot condition without Injurious heating at rated full load in case of failure of: |  | Should be Filled By Tenderer | | | | |  | | | |
| 21.1 | 50% of air forced cooling | Minute |  | | | | |  | | | |
| 21.2 | 100% of air forced cooling | Minute |  | | | | |  | | | |
| 21.3 | All of air and oil forced cooling | Minute |  | | | | |  | | | |
| 21.4 | Condition of injurious heating (hot spot temp.) | °C |  | | | | |  | | | |
| 22 | Exciting current |  | Should be Filled By Tenderer | | | | |  | | | |
| 22.1 | At rated voltage when excited from HV side | Arms |  | | | | |  | | | |
| 22.2 | At 110% rated voltage when excited from HV side | Arms |  | | | | |  | | | |
| 23 | Core and winding data |  | Should be Filled By Tenderer | | | | |  | | | |
| 23.1 | Three limb/ five limb |  |  | | | | |  | | | |
| 23.2 | Type of core stacking |  | Step Lap | | | | |  | | | |
| 23.3 | Type of steel core lamination |  | Should be Filled By Tenderer | | | | |  | | | |
| 23.4 | Manufactures of steel core material |  |  | | | | |  | | | |
| 23.5 | Thickness of steel core lamination | mm | <0.3 | | | | |  | | | |
| 23.6 | Flux density of core on principal tap |  |  | | | | |  | | | |
| 23.6.1 | At rated HV voltage | Wb/m2 |  | | | | |  | | | |
| 23.6.2 | At 110% rated HV voltage | Wb/m2 |  | | | | |  | | | |
| 23.7 | Main limb/yoke cross section | cm2/cm2 |  | | | | |  | | | |
| 23.8. | Types and arrangement of winding |  |  | | | | |  | | | |
| 23.8.1 | HV winding |  |  | | | | |  | | | |
| 23.8.2 | LV winding |  |  | | | | |  | | | |
| 23.8.3 | TV winding |  |  | | | | |  | | | |
| 23.9 | Winding arrangement |  |  | | | | |  | | | |
| 23.10 | Current density at rated power and voltage |  |  | | | | |  | | | |
| 23.10.1 | HV winding | A/mm2 |  | | | | |  | | | |
| 23.10.2 | LV winding | A/mm2 |  | | | | |  | | | |
| 23.10.3 | TV winding | A/mm2 |  | | | | |  | | | |
| 23.10.4 | Tap winding | A/mm2 |  | | | | |  | | | |
| 23.11 | Insulation of core |  |  | | | | |  | | | |
| 23.11.1 | Lamination |  |  | | | | |  | | | |
| 23.11.2 | Core bolts |  |  | | | | |  | | | |
| 23.11.3 | Strapping |  |  | | | | |  | | | |
| 23.12 | Type of Insulation of winding (uniform/graded) |  |  | | | | |  | | | |
| 23.12.1 | HV |  | Graded | | | | |  | | | |
| 23.12.2 | LV |  | Uniform | | | | |  | | | |
| 23.12.3 | TV |  | Uniform | | | | |  | | | |
| 23.13 | Insulation material |  |  | | | | |  | | | |
| 23.13.1 | Turn insulation HV/LV |  |  | | | | |  | | | |
| 23.13.2 | Between windings HV/LV |  |  | | | | |  | | | |
| 23.13.3 | Between core and LV side |  |  | | | | |  | | | |
| 23.13.4 | Between laminations |  |  | | | | |  | | | |
| 23.13.5 | Core bolts |  |  | | | | |  | | | |
| 23.13.6 | Core bolts washers |  |  | | | | |  | | | |
| 23.13.7 | Side plates |  |  | | | | |  | | | |
| 23.13.8 | Core lamination |  |  | | | | |  | | | |
| 23.13.9 | Tapping |  |  | | | | |  | | | |
| 23.13.10 | Tapping connections |  |  | | | | |  | | | |
| 24 | Calculated thermal time constant |  | Should be Filled By Tenderer | | | | |  | | | |
| 24.1 | Natural cooling | sec |  | | | | |  | | | |
| 24.2 | Forced cooling | sec |  | | | | |  | | | |
| 25 | Tank |  | Should be Filled By Tenderer | | | | |  | | | |
| 25.1 | Tank design conventional/bell shaped |  | Conventional | | | | |  | | | |
| 25.2 | Thickness of transformer plates: |  |  | | | | |  | | | |
| 25.2.1 | Cover of tank | mm |  | | | | |  | | | |
| 25.2.2 | Sides | mm |  | | | | |  | | | |
| 25.2.3 | Bottom | mm |  | | | | |  | | | |
| 25.2.4 | Conservator | mm |  | | | | |  | | | |
| 25.2.5 | Radiator plates | mm |  | | | | |  | | | |
| 26 | Vacuum withstand capability |  | Should be Filled By Tenderer | | | | |  | | | |
| 26.1 | Tank | mm Hg |  | | | | |  | | | |
| 26.2 | Radiators | mm Hg |  | | | | |  | | | |
| 26.3 | Conservator | mm Hg |  | | | | |  | | | |
| 26.4 | Positive pressure withstand capability for complete Transformer | mm Hg |  | | | | |  | | | |
| 27 | Oil |  |  | | | | |  | | | |
| 27.1 | Manufacture |  | Shell | | | | |  | | | |
| 27.2 | Type designation |  | Diala S4 ZX-I | | | | |  | | | |
| 27.3 | Oil preservation system |  | Air-bag | | | | |  | | | |
| 27.4 | Country of manufacture |  |  | | | | |  | | | |
| 27.5 | Naphthenic or Paraphenic based oil |  | Naphthenic | | | | |  | | | |
| 27.6 | Type – inhibited/ trace inhibited/ non-inhibited |  | non-inhibited | | | | |  | | | |
| 27.7 | Details of inhibitor |  | By manufacturer | | | | |  | | | |
| 27.8 | Details of passivators |  | By manufacturer | | | | |  | | | |
| 27.9 | Viscosity at 40 °C (Acc. to ISO 3104) | mm2/s | Max. 12 | | | | |  | | | |
| 27.10 | Viscosity at –30 °C (Acc. to ISO 3104) | mm2/s | Max. 1800 | | | | |  | | | |
| 27.11 | Pour point (Acc. To ISO 3016) | °C | Max. -40 | | | | |  | | | |
| 27.12 | Water content (Acc. To IEC 60814) | mg/kg | Max. 40 for delivery in drums (IBC) | | | | |  | | | |
| 27.13 | Breakdown voltage (Acc. To IEC 60156) |  |  | | | | |  | | | |
| 27.13.1 | As delivered | kV | Min. 30 | | | | |  | | | |
| 27.13.2 | After laboratory treatment | kV | Min. 70 | | | | |  | | | |
| 27.14 | Density at 20 °C (Acc. To ISO3675 or ISO12185) | g/ml | Max. 0.895 | | | | |  | | | |
| 27.15 | DDF at 90 °C (Acc. To IEC 60247 / IEC 61620) |  | Max. 0.005 | | | | |  | | | |
| 27.16 | Appearance |  | Clear, free from sediment and suspended matter | | | | |  | | | |
| 27.17 | Acidity (Acc. To IEC 62021-1 / IEC 62021-2) | mg KOH/g | Max. 0.01 | | | | |  | | | |
| 27.18 | Interfacial tension  (Acc. To EN 14210/ASTM D971) | mN/m | Min. 40 | | | | |  | | | |
| 27.19 | Total Sulphur content  (Acc. To IP 373 / ISO 14596) | % | Max. 0.05 | | | | |  | | | |
| 27.20 | Corrosive Sulphur (Acc. To DIN 51353) |  | Not corrosive | | | | |  | | | |
| 27.21 | Copper Corrosion (Acc. To IEC 62535) |  | Not corrosive | | | | |  | | | |
| 27.22 | Potentially corrosive Sulphur  (Acc. To IEC 62535) |  | Not corrosive | | | | |  | | | |
| 27.23 | DBDS (Acc. To IEC 62697-1) | mg/kg | Not detectable ( <5 ) | | | | |  | | | |
| 27.24 | Inhibitors of IEC 60666  (Acc. To IEC 60666) | % | (U) uninhibited oil  (Max. 0.01) | | | | |  | | | |
| 27.25 | Metal passivator additivesof IEC 60666 | mg/kg | Max. 5 | | | | |  | | | |
| 27.26 | 2-Furfural and related compounds content (Acc. To IEC 61198) | mg/kg | Max. 0.05 (for each individual compound) | | | | |  | | | |
| 27.27 | Oxidation stability (Acc. To IEC 61125:1992 (Method C)) |  |  | | | | |  | | | |
| 27.27.1 | Test duration (for uninhibited oil) | h | 164 | | | | |  | | | |
| 27.27.2 | Total acidity  (Acc. To 1.9.4 of IEC 61125:1992) | mg KOH/g | Max. 1.2 | | | | |  | | | |
| 27.27.3 | Sludge (Acc. To 1.9.1 of IEC 61125:1992) | % | Max. 0.80 | | | | |  | | | |
| 27.27.4 | DDF at 90 °C  (Acc. To 1.9.6 of IEC 61125, Amendment 1 (2004) +IEC 60247) |  | Max. 0.50 | | | | |  | | | |
| 27.28 | Flash point (Acc. To ISO 2719) | °C | Min. 135 | | | | |  | | | |
| 27.29 | PCA content (Acc. To IP 346) | % | Max. 3 | | | | |  | | | |
| 27.30 | PCB content (Acc. To IEC 61619) | mg/kg | Not detectable (Max. 2) | | | | |  | | | |
| 27.31 | Quantity of oil |  |  | | | | |  | | | |
| 27.31.1 | Main tank | Liters | By manufacturer | | | | |  | | | |
| 27.31.2 | Conservator | Liters | By manufacturer | | | | |  | | | |
| 27.31.3 | Radiator | Liters | By manufacturer | | | | |  | | | |
| 27.32 | Total oil required for commissioning | Liters | By manufacturer | | | | |  | | | |
| 27.33 | Total oil provided (including 5% extra) | Liters | By manufacturer | | | | |  | | | |
| 27.34 | Way of shipping |  | By drums | | | | |  | | | |
| 27.35 | Total number of drums provided |  | By manufacturer | | | | |  | | | |
| 28 | Maximum sound pressure level (NEMA TR1 – 5dB(A)) | dB(A) | 74 | | | | |  | | | |
| 29 | Max. RIV at 1 MHz for complete transformer acc. to NEMA 107 | Micro V | 500 | | | | |  | | | |
| 30 | Applicable standard for overload capacity of transformer with cooling system in operation |  | IEC 60076-3 | | | | |  | | | |
| 31 | Vibration at rated frequency, voltage and 75ْ C | Micron | <=100 | | | | |  | | | |
| 32 | Physical data |  | Should be Filled By Tenderer | | | | |  | | | |
| 32.1 | Overall height, including bushings | mm |  | | | | |  | | | |
| 32.2 | Overall width, including mounted accessories | mm |  | | | | |  | | | |
| 32.3 | Overall length, including mounted accessories | mm |  | | | | |  | | | |
| 32.4 | Height over cover for lifting core and coils | mm |  | | | | |  | | | |
| 32.5 | Dimensions of transformer arranged for transport |  |  | | | | |  | | | |
| 32.6 | Length | m |  | | | | |  | | | |
| 32.7 | Height | m |  | | | | |  | | | |
| 32.8 | Width | m |  | | | | |  | | | |
| 32.9 | Weight of oil | kg |  | | | | |  | | | |
| 32.10. | Weight of on load tap changer | kg |  | | | | |  | | | |
| 32.11 | Total weight of core and coils | kg |  | | | | |  | | | |
| 32.12 | Total weight of tank/cooler and fittings | kg |  | | | | |  | | | |
| 32.13 | Total weight of windings | kg |  | | | | |  | | | |
| 32.14 | Total weight of core (steel lamination) | kg |  | | | | |  | | | |
| 32.15 | Total weight steel (tank, fittings, conservator, etc) | kg |  | | | | |  | | | |
| 32.16 | Total weight of complete transformer | kg |  | | | | |  | | | |
| 32.17 | Max. shipping weight (heaviest item) | kg |  | | | | |  | | | |
| 33 | Provisions for tank mounting lightning arresters |  |  | | | | |  | | | |
| 33.1 | HV | Yes/No | No | | | | |  | | | |
| 33.2 | LV | Yes/No | No | | | | |  | | | |
| 33.3 | TV | Yes/No | No | | | | |  | | | |
| 33.3.1 | Type |  |  | | | | |  | | | |
| 33.3.2 | Type designation |  |  | | | | |  | | | |
| 33.3.3 | Standard |  |  | | | | |  | | | |
| 33.3.4 | Rated/system voltage | kV |  | | | | |  | | | |
| 33.3.5 | Maximum overvoltage factor on the system due to any switching duty | pu |  | | | | |  | | | |
| 33.3.6 | Rated system frequency | Hz |  | | | | |  | | | |
| 33.3.7 | Condition of system neutral |  |  | | | | |  | | | |
| 33.3.8 | Nominal Discharge current | kAcrest |  | | | | |  | | | |
| 33.3.9 | Energy capability as per IEC 60099-4 | kJ/kV |  | | | | |  | | | |
| 33.3.10 | Rated Voltage – MOA | kV |  | | | | |  | | | |
| 33.3.11 | Long duration discharge class as per IEC 99-1 | Class |  | | | | |  | | | |
| 33.3.12 | Maximum Continuous Operating Voltage (COV) | kV |  | | | | |  | | | |
| 33.3.13 | TOV capability for |  |  | | | | |  | | | |
|  | 1sec | kV |  | | | | |  | | | |
|  | 10sec | kV |  | | | | |  | | | |
| 33.3.14 | Maximum residual voltage with current wave |  |  | | | | |  | | | |
|  | Switching Surges – 1kA/2kA | kV |  | | | | |  | | | |
|  | 8/20 μs – 5kA | kV |  | | | | |  | | | |
|  | 8/20 μs – 20kA | kV |  | | | | |  | | | |
| 33.3.15 | Discharge current withstand strength |  |  | | | | |  | | | |
|  | High current 4/10 μs | KAp |  | | | | |  | | | |
|  | Low current 2000 μs | KAp |  | | | | |  | | | |
| 34 | Anti-vibrations pads | Yes/No | Yes | | | | |  | | | |
| 35 | Radiators mounted separate | Yes/No | No | | | | |  | | | |
| 36 | Wheels | Yes/No | Acc. to Project Requirements | | | | |  | | | |
| 36.1 | Plain/ Flanged |  | Plain | | | | |  | | | |
| 36.2 | Unidirectional/ bi-directional |  | bi-directional (If Needed) | | | | |  | | | |
| 36.3 | Gauge | mm |  | | | | |  | | | |
| 37 | All accessories supplied as specified | Yes/No | Yes | | | | |  | | | |
| 38 | All drawings and documents enclosed | Yes/No | Yes | | | | |  | | | |
| 39 | Schedule of deviations filled | Yes/No |  | | | | |  | | | |
| 40 | Fire protection scheme | Yes/No | Acc. to Project Requirements | | | | |  | | | |
| 41 | All additional equipment specified provided | Yes/No | Yes | | | | |  | | | |
| 42 | Accessories make and type |  |  | | | | |  | | | |
| 42.1 | Buchholz relay with sampling device |  |  | | | | |  | | | |
| 42.1.1 | For conservator main compartment |  | Yes | | | | |  | | | |
| 42.1.2 | For conservator OLTC |  | Yes | | | | |  | | | |
| 42.2 | Pressure relief Relay |  | Yes | | | | |  | | | |
| 42.3 | Oil level indicator: |  |  | | | | |  | | | |
| 42.3.1 | For conservator main compartment |  | Yes | | | | |  | | | |
| 42.3.2 | For conservator OLTC |  | Yes | | | | |  | | | |
| 42.4 | Temperature indicators: |  |  | | | | |  | | | |
| 42.4.1 | Oil |  | Yes | | | | |  | | | |
| 42.4.2 | HV winding |  | Yes | | | | |  | | | |
| 42.4.3 | LV winding |  | Yes | | | | |  | | | |
| 42.4.4 | TV winding |  | Yes | | | | |  | | | |
| 42.5 | Conservator type: |  |  | | | | |  | | | |
| 42.5.1 | Normal/air bag (diaphragm) |  | Air bag | | | | |  | | | |
| 42.5.2 | Air detector relay (for air bag) | Yes/No | Yes | | | | |  | | | |
| 42.6 | breather |  | Maintenance free type | | | | |  | | | |
| 42.7 | Cables |  | By Contractor | | | | |  | | | |
| 42.8 | Control cabinets |  | By Contractor | | | | |  | | | |
| 42.9 | Fire extinguishing system: |  | Acc. to Project Requirements | | | | |  | | | |
| 42.9.1 | Drainage and mixing |  |  | | | | |  | | | |
| 42.9.2 | Water sprinkler system |  |  | | | | |  | | | |
| 42.9.3 | Whether full information are attached | Yes/No | Should be confirmed by Tenderer | | | | |  | | | |
| 42.10 | Whether all catalogues of accessories are enclosed | Yes/No | Should be confirmed by Tenderer | | | | |  | | | |
| 43 | Fault currents and mechanical forces and stresses. |  | Should be Filled by Tenderer | | | | |  | | | |
| 43.1 | Max. fault current in windings on which mechanical stresses are based. |  |  | | | | |  | | | |
| 43.1.1 | HV winding |  |  | | | | |  | | | |
| a | Symmetrical component current | Arms |  | | | | |  | | | |
| b | Asymmetrical crest current | AmpPeak |  | | | | |  | | | |
| 43.1.2 | LV winding |  |  | | | | |  | | | |
| a | Symmetrical component current | Arms |  | | | | |  | | | |
| b | Asymmetrical crest current | AmpPeak |  | | | | |  | | | |
| 43.1.3 | Tapped winding |  |  | | | | |  | | | |
| a | Symmetrical component current | Arms |  | | | | |  | | | |
| b | Asymmetrical crest current | AmpPeak |  | | | | |  | | | |
| 43.2 | Max. fault current on which mechanical stresses are based for OLTC (main+arcing contacts): |  |  | | | | |  | | | |
| 43.2.1 | Symmetrical short circuit current | kArms |  | | | | |  | | | |
| 43.2.2 | Dynamic short circuit current value |  |  | | | | |  | | | |
| 43.2.2 | Asymmetrical crest current | Ampcrest |  | | | | |  | | | |
| 43.3 | Max. fault current on which mechanical stresses are based for leads to OLTC are: |  |  | | | | |  | | | |
| 43.3.1 | Symmetrical short circuit current | Arms |  | | | | |  | | | |
| 43.3.2 | Asymmetrical crest current | Ampcrest |  | | | | |  | | | |
| 43.4 | Max. fault current on which mechanical Stresses are based for various bushings of: |  |  | | | | |  | | | |
| 43.4.1 | HV side | kArms |  | | | | |  | | | |
| 43.4.2 | LV side | kArms |  | | | | |  | | | |
| 43.4.3 | Neutral HV/LV | kArms |  | | | | |  | | | |
| 43.5 | Current density in windings on principal tapping under the most onerous fault condition |  |  | | | | |  | | | |
| 43.5.1 | HV winding | A/mm2 |  | | | | |  | | | |
| 43.5.2 | LV winding | A/mm2 |  | | | | |  | | | |
| 43.5.3 | Tapped windings | A/mm2 |  | | | | |  | | | |
| 43.5.4 | Tapping lead connections | A/mm2 |  | | | | |  | | | |
| 43.5.5 | Neutral | A/mm2 |  | | | | |  | | | |
| 43.5.6 | HV bushings | A/mm2 |  | | | | |  | | | |
| 43.5.7 | LV bushings | A/mm2 |  | | | | |  | | | |
| 43.5.8 | Neutral bushings | A/mm2 |  | | | | |  | | | |
| 43.6 | Hoop stress in winding conductors: |  |  | | | | |  | | | |
| 43.6.1 | HV winding | N/m2 |  | | | | |  | | | |
| 43.6.2 | LV winding | N/m2 |  | | | | |  | | | |
| 43.6.3 | Tapping | N/m2 |  | | | | |  | | | |
| 43.7 | Total axial compressive force in windings: |  |  | | | | |  | | | |
| 43.7.1 | HV winding | N |  | | | | |  | | | |
| 43.7.2 | LV winding | N |  | | | | |  | | | |
| 43.7.3 | Tapped winding | N |  | | | | |  | | | |
| 43.7.4 | Tertiary winding | N |  | | | | |  | | | |
| 43.8 | Max. stress to flexion of conductor between two adjacent spacers: |  |  | | | | |  | | | |
| 43.8.1 | HV winding | N/m2 |  | | | | |  | | | |
| 43.8.2 | LV winding | N/m2 |  | | | | |  | | | |
| 43.8.3 | Tapping | N/m2 |  | | | | |  | | | |
| 43.9 | Total axial and thurst in windings: |  |  | | | | |  | | | |
| 43.9.1 | HV winding | N |  | | | | |  | | | |
| 43.9.2 | LV winding | N |  | | | | |  | | | |
| 43.9.3 | Tapping | N |  | | | | |  | | | |
| 43.10. | Max. stresses in end insulation and supports: |  |  | | | | |  | | | |
| 43.10.1 | HV winding | N/m2 |  | | | | |  | | | |
| 43.10.2 | LV winding | N/m2 |  | | | | |  | | | |
| 43.10.3 | Tapped winding | N/m2 |  | | | | |  | | | |
| 43.11 | Relative axial displacement at the windings assumed in items 43.9, 43.10 Above |  |  | | | | |  | | | |
| 43.12 | Cross sectional area of conductor for each windings: | % |  | | | | |  | | | |
| 43.12.1 | HV winding | mm2 |  | | | | |  | | | |
| 43.12.2 | LV winding | mm2 |  | | | | |  | | | |
| 43.12.3 | Tapped winding | mm2 |  | | | | |  | | | |
| 43.13 | Cross section area of insulation for: |  |  | | | | |  | | | |
| 43.13.1 | HV winding | mm2 |  | | | | |  | | | |
| 43.13.2 | LV winding | mm2 |  | | | | |  | | | |
| 43.13.3 | Tapped winding | mm2 |  | | | | |  | | | |
| 43.14 | Specific heat in watt- seconds per degree Celsius per pound of conductor Material for: |  |  | | | | |  | | | |
| 43.14.1 | HV winding | mm2 |  | | | | |  | | | |
| 43.14.2 | LV winding | mm2 |  | | | | |  | | | |
| 43.14.3 | Tapped winding | mm2 |  | | | | |  | | | |
| 43.15 | Position and magnitude of max. axial stress on inter turn insulation in: |  |  | | | | |  | | | |
| 43.15.1 | HV winding | N/m2 |  | | | | |  | | | |
| 43.15.2 | LV winding | N/m2 |  | | | | |  | | | |
| 43.15.3 | Tapped winding | N/m2 |  | | | | |  | | | |
| 44 | On-line gas monitoring |  | Should be Filled by Tenderer | | | | |  | | | |
| 44.1 | Manufacturer |  |  | | | | |  | | | |
| 44.2 | Country of manufacturer |  |  | | | | |  | | | |
| 44.3 | Model/Type |  |  | | | | |  | | | |
| 44.4 | Detectable key gases |  |  | | | | |  | | | |
| 44.5 | Moisture detection | Yes/No | Yes | | | | |  | | | |
| 44.6 | Lower detection limit (LDL) | ppm | Should be confirmed by Tenderer | | | | |  | | | |
| 44.7 | Accuracy of sensor | % | Should be confirmed by Tenderer | | | | |  | | | |
| 44.8 | Response time | Minute | Should be confirmed by Tenderer | | | | |  | | | |
| 44.9 | Operating range |  |  | | | | |  | | | |
| 44.9.1 | Operating temperature | ºC |  | | | | |  | | | |
| 44.9.2 | Operating oil temperature | ºC |  | | | | |  | | | |
| 44.9.3 | Operating oil pressure | PSI |  | | | | |  | | | |
| 44.9.4 | Operating humidity | % RH |  | | | | |  | | | |
| 44.9.5 | Storage temperature | ºC |  | | | | |  | | | |
| 44.9.6 | Storage humidity | % RH |  | | | | |  | | | |
| 44.9.7 | Altitude | m |  | | | | |  | | | |
| 44.10 | Input power requirement |  |  | | | | |  | | | |
| 44.10.1 | Voltage | V AC |  | | | | |  | | | |
| 44.10.2 | Frequency | Hz |  | | | | |  | | | |
| 44.10.3 | Current or power | A or kW |  | | | | |  | | | |
| 44.11 | Communication option |  |  | | | | |  | | | |
| 44.11.1 | Display |  |  | | | | |  | | | |
| 44.11.2 | Communication protocols |  |  | | | | |  | | | |
| 44.11.3 | Communication ports and analog I/O |  |  | | | | |  | | | |
| 44.11.4 | Measurement alarms |  |  | | | | |  | | | |
| 44.11.5 | Alarm contacts |  |  | | | | |  | | | |
| 44.11.6 | Data storage | Year |  | | | | |  | | | |
| 44.12 | Software |  |  | | | | |  | | | |
| 44.13 | Dimensions |  |  | | | | |  | | | |
| 44.14 | Weight | kg |  | | | | |  | | | |
| 44.15 | Whether all catalogues and description of the system attached | Yes/No |  | | | | |  | | | |
| 45 | Minimum Clearances (IEC 60076-3)- (Should be according to Altitude of Substation) |  | Should be confirmed by Tenderer | | | | |  | | | |
| 45.1 | Line to earth |  |  | | | | |  | | | |
| 45.1.1 | HV side | mm | 1300 | | | | |  | | | |
| 45.1.2 | LV side | mm | 320 | | | | |  | | | |
| 45.2 | Phase to phase |  |  | | | | |  | | | |
| 45.2.1 | HV side | mm | 1500 | | | | |  | | | |
| 45.2.2 | LV side | mm | 320 | | | | |  | | | |
| 45 | System Grounding |  |  | | | | |  | | | |
| 45.1 | HV system |  | Non-Effective | | | | |  | | | |
| 45.2 | LV system |  | Effective | | | | |  | | | |
| 45.3 | TV system |  | N.A. | | | | |  | | | |
| 45 | Winding and oil temp. (Dial type or temp. monitoring) |  | Dial type | | | | |  | | | |
| 46 | Size of copper ground conductor |  | 240 | | | | |  | | | |
| 47 | Type of terminals |  |  | | | | |  | | | |
|  | HV |  | Air bushing | | | | |  | | | |
|  | LV |  | Air bushing | | | | |  | | | |
|  | TV |  | N.A. | | | | |  | | | |
|  | Neutral |  | Air bushing | | | | |  | | | |
| 48 | Pre-stressed non-return valve (PNRV) | Yes/No | Yes | | | | |  | | | |
| 49 | Buchholz relay test pump | Yes/No | Yes | | | | |  | | | |
| 50 | Color of exterior/finishing paint |  | Will be Finalized During Detail Design | | | | |  | | | |
| 51 | Manufacturer quality assurance |  | Yes | | | | |  | | | |
| 52 | According to ISO 9000, 9001, 9002, 9003 and 9004 | Validity | Yes | | | | |  | | | |
| 52.1 | Certificate attached to the offer | Yes/No | Yes | | | | |  | | | |
| 52.2 | Type test certificate to be issued by: |  | Yes | | | | |  | | | |
| 53 | Independent laboratory or independently witnessed type test certificate | Yes/No |  | | | | |  | | | |
| 53.1 | Certificate attached to the offer | Yes/No | Yes | | | | |  | | | |
| 53.2 | Special Tests to be performed:  As Type test = T  As Routine test = R |  | Yes | | | | |  | | | |
| 54 | Chopped Wave Lightning Impulse Test  (\*)Type or routine test as appropriate to transformer HV Um |  | Yes (\*) | | | | |  | | | |
| 54.1 | Measurement of zero-sequence impedance |  | Yes (T) | | | | |  | | | |
| 54.2 | Determination of sound levels |  | Yes (T) | | | | |  | | | |
| 54.3 | Measurement of harmonics of no-load current |  | Yes (T) | | | | |  | | | |
| 54.4 | Frequency response analysis (FRA) |  | Yes (R) | | | | |  | | | |
| 54.5 | Measurement of the power by the fan motors and oil pumps |  | Yes (T) | | | | |  | | | |
| 54.6 | Check of external coating |  | Yes (R) | | | | |  | | | |
| 54.7 | Determination of capacitance, windings to earth and between windings |  | Yes (R) | | | | |  | | | |
| 54.8 | Measurement of insulation resistance to earth and loss angle of insulation system capacitances |  | Yes (R) | | | | |  | | | |
| 54.9 | Short circuit withstand test/calculations |  | Yes (Calculation) | | | | |  | | | |
| 54.10 | Wheel locking capability on Transformer rails | Yes/No | Yes | | | | |  | | | |