

**C.A. LA ELECTRICIDAD DE CARACAS SACA  
DEPARTAMENTO DE INGENIERIA GENERAL**

# **DIG**

## **00110-A2**

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**General Technical Specification to**

**CURRENT TRANSFORMERS**

**Substation type: 245 kV and 72,5 kV**

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## **0. FOREWORD**

This specification has been approved by the competent Authorities from C.A. La Electricidad de Caracas on August 02, 1999 for the procurement of Current Transformers ( CT ) assigned to work at 69 kV and 230 kV EDC networks.

This specification may be revised as required. However, any revision must be approved by the above mentioned EDC Authorities.

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## **1. BASIC PRINCIPLES**

- 1.1. The continued advancement of Current Transformers technology, combined with the expansion of EDC's operations over the last few years, justifies a complete revision of the previous technical specifications.
- 1.2 The principal objective of this specification is to :
- a ) Assure thorough International Competitive Bidding (ICB) equal opportunities for all participants. This includes those companies and organizations who follow International Electrotechnical Commission ( IEC ), or American National Standards Institute ( ANSI ) recommendations, and all others who apply National Standards such VDE, NCF, etc. for the major part of their manufacturing programs.
  - b ) Define the most reliable equipment that can meet expected realistic behaviours of the current and future EDC power system.
- 1.3 Tenderers are requested to strictly follow all of the requirements stipulated in this specification. All offers not complying with this request will be rejected.
- 1.4 Alternate proposals accompanied with proper justifications are welcome, but will be considered only after the Basic Proposal has been evaluated as the most favourable proposal
- 1.5 Proposal will use only the metric measurement system ( SI ).
- 1.6 Only Suppliers that have been prequalified by EDC are eligible to participate.
- 1.7 The guarantee period required by EDC is 5 years. This period begins from the date of Current Transformers commissioning. The

Commissioning Date shall occur within a maximum of 6 ( six ) months after unloading the Current Transformer at a Venezuelan port.

During the Guarantee Period the Supplier will insure the Supply at one of the first-class Venezuelan banks by unconditional Performance Security to cover 10% ( ten percent ) of FOB Current Transformer Price. The banker's fees for such a Performance Security will be entirely paid by the Supplier.

- 1.8 For each Tender, the Particular Specifications are issued by EDC. All of EDC's specific requirements in the Particular Technical Specifications are related with numbering to certain clauses and subclauses of this document.

## **2. SCOPE : STANDARDIZED EDC CURRENT TRANSFORMERS (72,5 kV and 245 kV )**

- 2.1 This specification applies to bar primary or tank type, oil immersed current transformers, suitable for outdoor installation for use with electric secondary protective devices and measuring instruments.
- 2.2 It covers current transformers of the following standard values of highest voltage for equipment, rated values of primary and secondary currents and short circuit level specified herein :
- 72,5 kV (1250/2000) / 1-1-1 A ; (31,5 / 80 kA) or (40 / 100 kA), 3s
- 245 kV (1250/2000) / 1-1-1 A ; (40 / 100 kA) or (50 / 125 kA) , 3s
- 2.3 This specification is intended for use as a basis for the proper evaluation and selection of such equipment with the respect to performance, interchangeability and safety.

### 3. SERVICE CONDITIONS

The current transformers and all accessories shall be suitable for satisfactory operation under the following climatic conditions :

#### 3.1 NORMAL SERVICE CONDITIONS

##### 3.1.1 Altitude

Up to 1000 m above sea level.

##### 3.1.2 Humidity

The relative humidity design value is 90 % at 40 °C ambient temperature.

#### 3.2 ABNORMAL SERVICE CONDITIONS

##### 3.2.1 Ambient temperature

Maximum	40 °C
Daily mean over only 24 hours	35 °C
Mean in any year	30 °C
Minimum	0°C

##### 3.2.2 Contamination Grade

Specific leakage distance for insulators 25 mm/kV

##### 3.2.3 Wind conditions

The Current Transformers according to this specification shall be capable of withstand continuously mechanical stresses equivalent to winds of 150 km/h, equivalent to a wind pressure of 1100 N/m<sup>2</sup> .

##### 3.2.4 Seismic conditions



The Current Transformers according to this specification shall be capable to withstand horizontal earthquake acceleration of at least 0,5 g. for design purpose, 70% of the above value should be considered for vertical ground acceleration.

#### **4. RATING**

Table 4.1.: The standard ratings of Current Transformers shall be as follows :

1)	Highest voltage for equipment ( $U_m$ )	kVrms	72,5	245
2)	Type design		Bar primary	Bar primary
3)	Extended current rating	%	120	120
4)	Rated primary current	A	1250/2000	1250/2000
5)	Rated secondary current	A	1-1-1	1-1-1
6)	Frecuencia nominal (+ 2 % / - 4 % )	Hz	60	60
7)	Rated secondary output :			
	- Measuring core (1)			
	- Protection core (2 )			
	- Protection core (3)			
8)	Accuracy class :			
	- Measuring Core		0,2	0,2
	- Protection Core		5P	5P
9)	Instrument security factor		5	5
10)	Accuracy limit factor for Protective Core		20	20
11)	Short time current rating :			
	- Thermal, $I_{th}$	kArms	31,5/40	40/50
	- Dynamic, $I_{dyn}$	kApico	80/100	100/125
	- Duration of short circuit	s	3	3
12)	Rated power frequency short duration withstand voltage ( AC )	kVrms	140	460
13)	Rated lightning impulse withstand voltage (LI)	kVpico	350	1050

14)	Rated Power frequency short duration withstand voltage (AC) kVrms secondary windings		3,0	3,0
15)	Interturn insulation of secondary winding :			
	One minute across the complete winding	kVpico	4,5	4,5
	One minute between the sections	kVrms	3,0	3,0
16)	Max. Partial discharge level	pC	10	10
17)	Minimum specific creepage distance. Pollution Level III	mm/kV	25	25
18)	Explosion proof certificate		required	required
19)	Temperature rise :			
	- winding ( resistance )	K	60	60
	- oil ( maximum )	K	55	55
20)	Secondary winding resistance (75°C)	$\Omega$	0,7 ( $\pm 10\%$ )	0,7 ( $\pm 10\%$ )
21)	Mechanical strength :			
	- Overpressure	kPa	70	70
	- Vacuum	kPa	27	27
22)	Transportation behaviours :			
	- Average vertical acceleration	g	1	1
	- Peak value	g	4	4
	- Frequency	Hz	25	25
	- Shocks ( unpaved road ) vertical and horizontal acceleration	g	7	7
	- Two hours type test (3g, 25 Hz)		required	required
23)	Stainless Steel Bellows endurance life test		required	required

## 24) Electrical strength :

Behaviour against high frequency stress (test with 600 chopped waves)

required

required

Partial discharge test ( according to IEC 44-4 ), but immediately after AC test

required

required

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## **5. DESIGN AND CONSTRUCTION REQUIREMENTS**

### **5.1 GENERAL**

5.1.1 The current transformer shall be single pole, oil immersed, vertical, self contained, outdoor type and shall be hermetically sealed.

5.1.2 The oil shall be class II, conforming to IEC 296.

5.1.3 Stainless steel bellows shall be used to accommodate oil expansion with suitable indicating device its position for 25 °C oil temperature as well as minimum and maximum level of oil.

5.1.4 Thermal ageing

Thermal ageing shall be determined on the basis of IEC Publication 216 " Guide for determination of thermal endurance properties of electrical insulating materials ":

### **5.2 CORES**

5.2.1 The core shall be made of high quality non-ageing nickel-iron with about 75 % nickel and cold-rolled grain oriented silicon steel to give the best magnetic characteristics. The core and winding structure shall be rigidly braced and clamped to sustain the mechanical forces under rated dynamic current and to prevent shifting of parts under transportation handling and installation.

5.2.2 The design of core and windings shall be such as to ensure high accuracy, uniform impulse distribution and low leakage reactance.

5.2.3 Suitable air gap shall be provided in the core to reduce remanence phenomenon.

### **5.3 WINDINGS**

5.3.1 Only pure, high quality insulating paper shall be used for the main insulation. The paper shall have excellent absorbing qualities for mineral or silicon oil.

5.3.2 In addition to the choice of the material, the shape given to the electrodes and the insulating parts is of a great importance. A quasi-homogeneous electrical field is aimed at and which is completely concentrated inside the paper insulation by means of metallic screen. The edges of the metallic screens are also well-rounded and will thus limit the electrical field to favourable values.

5.3.3 This applies also to the intermediate layers, which should be specially provided for field control.

Tenderers shall submit with their tenders a diagram of electrical lines of forces for proposed design.

The selected form for the electrodes, the screen and the paper shall not only give a good insulation in the interior but also acts to control and uniformly distribute the external field in the air.

The Tenderers shall submit with their tenders a detailed explanation of how they have obtained above mentioned behaviour.

#### 5.3.4 Primary Windings

According to clause 4, hair needle or through bar type.

#### 5.3.5 Secondary Windings

Each secondary winding shall be wound on a separate core and shall be uniformly distributed.

The resistance of protective winding for differential protection (mentioned in Table 4.1., sub-clause 20) shall be  $0.7 \text{ ohm} \pm 10\%$  at  $75^{\circ}\text{C}$ .

#### 5.3.6 Insulation

High-vacuum drying of the insulation at a maximum 27 Pa ( 0.2 Torr ) shall be applied. The tenders from manufactures who do not have such facilities will be rejected.

Filling with de-aerated oil shall also be done under high vacuum.

The oil to be used shall be SHELL DIALA DX, IEC 296, class II. (See 5.1.2)

#### 5.3.7 Aluminium shell between secondary parts and high voltage insulation in current transformers.

An acceptable design concept to EDC for head type current transformers is the provision of a complete shell around all wound cores by a torus-shaped aluminium housing and a connected tube inside which are the secondary leads. Outside of this welded structure which is rigidly grounded (40 kA, 3s ) at the lower tube side is the high voltage insulation and further outside the aluminium head housing on high potential. Should there be a breakdown of the high voltage insulation, the short circuit current from the line and consequently from the head of the current transformer will flow directly to ground through the aluminium shell without the possibility of an outside flashover with melting metal parts and burning oil as a possible consequence. Furthermore the secondary leads and all connected low voltage apparatus are protected during this dangerous period against direct or induced high voltage. An additional advantage of this metallic shell is the shielding provided between primary and secondary winding, so that the transmitted overvoltage caused by switching and lightning surges are at the minimum and abnormal stresses on connected apparatus like electronic relays are avoided. One more feature of the alu shell design is the equality of all cores and secondary windings in their positioning which means that cores for the line protection and the bus bar protection can be placed in any position.

## 5.4 PORCELAIN INSULATOR

- 5.4.1 The insulator shall be high grade, wet process porcelain homogenous, free from laminations, cracks, cavities or other physical irregularities. It shall be of one part, well vitrified, tough, impervious to moisture and shall be of brown colour.
- 5.4.2 The porcelain shall be fixed by cementing to a metal flange or metal housing. The manufacturer shall avoid any presence of air-bubbles in the joint, which may cause difficulties during PD measurement.
- 5.4.3 Creepage distance is defined in Table For the case of particular ambient condition the particular technical specification ( part of tender document ) shall be consulted.
- 5.4.4 Even carefully designed and manufactured high voltage instrument transformers can suffer an insulation breakdown caused by abnormal overstresses originated from a network resonance situation. Since the surroundings of an exploding oil-filled porcelain body is exposed to flying razor-sharp porcelain fragments two requirements have to be met as thoroughly as possible by Suppliers :
- a ) In order to prevent direct flash over in the interior of the porcelain insulator only the absolute minimum of electrically stressed insulating material should be within the range of the porcelain housing. Furthermore this insulating material should be stressed at a lower degree than that within the metallic housing.
  - b ) The dimension of the porcelain bodies should be as small as possible so that if need be only few porcelain fragments can be accelerated by a pressure wave.

EDC modern instrument transformers shall meet these requirements. Their magnetic part is no longer positioned within the area of the porcelain housing. The magnetic part where the ground to line insulation is concentrated is placed in a metallic housing. The porcelain separates only the hot and the grounded parts and therefore can be of a smaller diameter. Furthermore the bushing inside the porcelain can easily be insulated to higher withstand ability than the



insulation around the active part. This design concept contrasts with the older design where the porcelain reached from top to bottom and housed the main insulation around the magnetic part.

## 5.5 HOUSING AND TANKS

The housing shall be of welded steel plate or cast iron construction and of sufficient strength and rigidity to provide a tight-fitting gasket and sealed enclosure. The shape of housing shall follow the shape of current transformer active part.

The complete assemblies shall form a sealed enclosures capable of sustaining pressure developed within housing, either above or below atmospheric, under all conditions of operation and maintenance.

## 5.6 TERMINALS

### 5.6.1 Primary terminals

Primary connections to the current transformer shall not change their contact resistance during the whole life. They shall also be mechanically solid enough to withstand all mechanical forces applied by wind, weight of conductors or bars, short circuit and during installation or maintenance.

For 72,5 kV current transformers the primary terminals shall be single stem, horizontal, made of aluminium 30 mm diameter, 125 mm in length. Terminals shall be Corona free and adequately shielded.

For 245 kV current transformers the primary terminals shall be single stem, horizontal, made of aluminium 40 mm diameter, 125 mm in length. Terminals shall be Corona free and adequately shielded.

### 5.6.2 Secondary terminals

#### 5.6.2.1 Terminal box

All secondary winding leads shall be brought to a weatherproof terminal box near the transformer base and terminated at the terminals. Provision shall be made in the terminal box for entry of and connection with 8 conductors, 2,5 mm<sup>2</sup> copper cables.

The terminals of the measuring windings shall accept at least 10 mm<sup>2</sup> wires.

Heaters for condensation prevention with satisfactory circuit breaker protection and thermostatic control shall be installed.

The terminal box shall have protection IP 54.

#### 5.6.2.2 Control Box

A control box shall be mounted on centre phase structure with terminals to terminate cables from secondaries of all phases. At least 25 % spare terminals shall be provided. Cable entry shall be through suitable glands.

Suitable shorting strips shall be provided for each core, capable of carrying full short circuit current.

#### 5.6.3 Ground Terminals

Two ground terminals at diagonally opposite position on the tanks shall be provided. Each terminal shall be capable of carrying full short circuit current and be suitable for accommodating 95 to 120 mm<sup>2</sup>, copper conductors.

#### 5.6.4 Terminal Markings

The terminal markings for the current transformer shall be in accordance with clause 22 of IEC 185.

### 5.7 SURFACE TREATMENTS

### 5.7.1 Zinc coating

All steel and malleable iron parts shall be hot dipped zinc coated prior to eventual painting.

### 5.7.2 Painting

All exposed metallic parts shall be painted except where painting will interfere with the normal operation of the equipment. Where surfaces are left unpainted for mounting purposes they shall be suitable protected to prevent corrosion during storage and transport.

After surface preparation and cleaning of all surfaces to be painted, the surfaces not in contact with oil shall be painted with two coats of epoxy primer containing red lead, zinc or aluminium. The surfaces shall be finish coated with two coats of enamel applied to provide a uniform smooth surface free from blemishes.

## 5.8. RATING PLATE

The rating plate marking shall be in accordance with clause 23 of IEC Publication 185.

## 5.9 DESIGN REQUIREMENTS

### 5.9.1 Mechanical stresses

#### 5.9.1.1 Operational stresses

The equipment shall withstand all mechanical stresses due to, normal and abnormal operational conditions, short circuits and environmental influences.

#### 5.9.1.2 Transportation and installation stresses

The equipment will be subject to stochastic oscillations or single shocks during transportation and installation.

The manufacturer shall take into consideration the following basic design parameters for transportation :

- average vertical acceleration 1g / 25 Hz,
- peak value of v.a. 4 g
- horizontal acceleration 0.8/25 Hz;
- for shocks ( unpaved road ),  
vertical and horizontal acceleration 7 g.

To confirm good design, two hours test with acceleration 3g and 25 Hz for 36 kV to 72.5 kV, and four hours test under same conditions for 72,5 kV to 245 kV CT's are requested.

If the completely assembled equipment is higher than 3 meters, it shall be packed and transported horizontally without effecting its performance.

### 5.9.2 Temperature rise

The maximum temperature rise of the current transformer windings under conditions specified in IEC 185 shall not be more than 60K ( e.g. the temperature rise of a current transformer when carrying a primary current equal to rated continuous thermal current with unity power factor and burden corresponding to rated burden ).

### 5.9.3 Short Circuit Characteristics

The short time current ratings are:

72.5 kV	31.5 / 80 kA or 40 / 100 kA
245 kV	40 / 100 kA or 50 / 125 kA

### 5.9.4 High frequency Stress ( only for 245 kV CTs )

Type test procedure that prescribes the application of 600 chopped wave impulses is required. Evaluation of the test is made on the basis of the current to ground value and wave-shapes and on the difference of gas content before and after the test.

Impulse crest voltages are the following :

- 650 kV for 245 kV current transformers
- For 72,5 kV current transformers chopped wave tests are not required.

#### 5.9.5 Radio Frequency Interference

The equipment shall not cause any interference with radio and television reception or telephone communication circuits. The maximum value of radio interference voltage shall be indicated.

#### 5.9.6 Partial Discharge

The maximum values of partial discharge ( PD ) levels shall be as follow (according to IEC Publication 44-4 " Instrument transformers- Measurement of partial discharge" ) :

<b>U<sub>m</sub></b>	<b>Type of grounding</b>	<b>Pre-stress Voltage ≥ 10s</b>	<b>Measuring Voltage ≥ 10s</b>	<b>Type of Insulation</b>	<b>Permissible PD level Apparent charge</b>
72,5kV	effectively grounded star point	75,40kV	46.10kV	Liquid immersed	10pC
245kV	effectively grounded star point	254.80kV	155.78kV	Liquid immersed	10pC

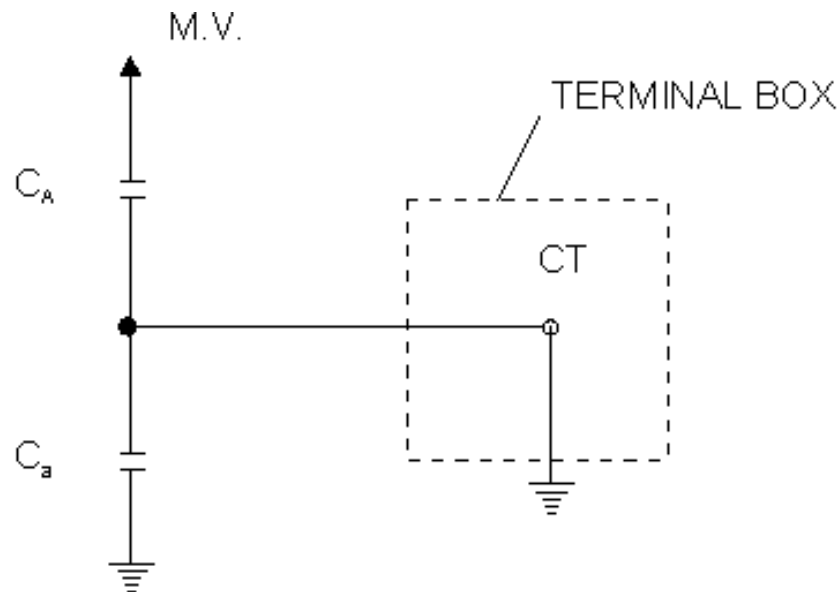
## 5.10 CAPACITIVE VOLTAGE DIVIDER ( TAP )

The bushing of every current transformer is provided with capacitive tap.

The insulation layers in the primary winding can be utilized as a capacitive voltage divider. For this purpose a tap will be brought out from the last but one condenser layer through a small bushing in the transformer tank. The terminal is intended for following purposes :

- ◆ Voltage indication, synchronising or similar purposes.
- ◆ For checking of the paper insulation by power factor test.

FIG. 5.10-1. CAPACITIVE VOLTAGE DIVIDER



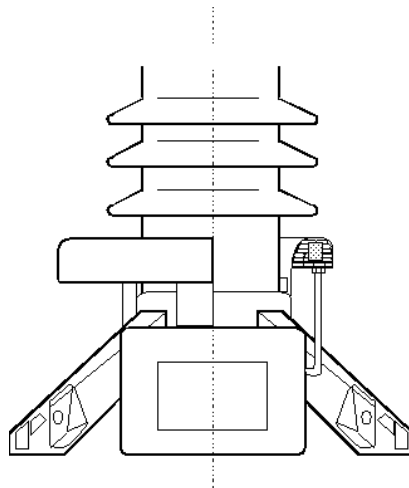
## 5.11 GROUND FAULT CT

Every transformer shall be equipped with a ground fault CT.

The purpose of this CT is measurement of the outer sparkover between head and base.

The ground fault CT consists of one ring type core with secondary winding and should be embedded by means of epoxy resin in the aluminium housing. The housing should be welded to the CT base. The terminals should be located in the terminal box ( see Fig. 5.11-1 )

FIG. 5.11-1. GROUND FAULT CT





## **6. ACCESSORIES**

The following accessories shall be provided :

- 1 ) Suitable lifting lug
- 2 ) 15 mm drain valve and 20 mm filling valves equipped with non corrosive plugs.
- 3 ) Bellows position indicator

## **7 TESTS**

### **7.1 TYPE TESTS**

The following type tests shall be performed in accordance with the Publication IEC 185 ( clauses mentioned hereafter refer to IEC 185 ).

- 1) Short-time current test ( clause 12 )
- 2) Temperature-rise test ( clause 13 )
- 3) Impulse voltage test ( clause 14 )
- 4) Wet test for outdoor type transformer ( clause 15 )
- 5) Test for accuracy for metering core of current transformer (clause 29 )
- 6) Test for instrument security current for measuring core of current transformers ( clause 31 )
- 7) Test for composite error for protective core of current transformer ( clause 39 )

The above type tests may be omitted if complete type test report of an identical transformer can be supplied.

### **7.2 ROUTINE TESTS**

The following routine tests shall be performed in accordance with the IEC Publication 185 for all ratios and all taps ( clauses mentioned hereafter refer to IEC 185 ).

- 1) Verification of terminal markings (clause 16 ).
- 2) Power frequency withstand test at primary windings and measurement of partial discharges ( clause 17 ).
- 3) Power frequency withstand test between sections of primary and secondary windings and on secondary windings ( clause 18 ).
- 4) Test of interturn insulation ( clause 19 ).

- 5 ) Test of accuracy in accordance with clause 30 and / or clause 38 as applicable in case of metering or protective core of current transformer.
- 6 ) Partial discharge measurement tests. The measuring equipment must comply with IEC-270 and IEC-44-4.
- 7 ) Measurement of dielectric dissipation-factor ( clause 21 ).
- 8 ) Sealing-proof test.

### 7.3 SPECIAL TESTS

- 1 )Chopped lightning impulse test in primary winding ( clause 20 )
- 2 )Measurement of open-circuit voltage (ANSI IEEE C 57,13-1978; sub-clause 8.9)
- 3 )Tangent Delta measurement test. The variation of to tangent Delta measured at  $1.1 U_m$  must be less than 0.2 % between 20 °C and 75 °C.
- 4 )Mechanical strength test for bar primary type current transformers ( test will include all specified requirements ).

### 7.4 COMMISSIONING TESTS

The following test will be carried out during commissioning procedure :

#### 7.4.1 Various Checks

- 1 ) Visual checks of equipment after transportation
- 2 ) Potential links
- 3 ) State of Bellows
- 4 ) Conditions of accessories

#### 7.4.2 Electrical Checks

- 1 ) Insulation resistance measurements
- 2 ) The polarity of winding by means of an electric battery when a step of current is established
- 3 ) The secondary windings resistance measurement
- 4 ) Primary current injection test
- 5 ) Open secondary circuit injection test

Just after energizing :

- 6 ) Acoustic noise
- 7 ) Checking of the current values

## 7.5 CRITERIA FOR ACCEPTANCE

Any negative result of a type test shall involve the rejection of all equipment of the sample type of supply. The Purchaser will accept the repetition of the test if the contractor proposes to modify the design of the transformer within a reasonable period of time and to repeat, at his own expenses, all type tests specified under clause 7.1, on two units selected by the Purchaser from the new lot.

All routine tests shall have positive results within the tolerances allowed where applicable. In the case of negative result of a routine test, each unsound equipment shall be rejected or repaired at contractor expense.

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## **8 SPARE PARTS**

### **8.1 SPARE PARTS LIST**

The requirements of spare parts are listed in clause 8.2 and shall be delivered along with the first consignment of the current transformer.

All spare parts shall be new, unused and strictly interchangeable with the parts by which they are intended to be replaced and shall strictly conform to the relevant specifications.

The bidder shall attach to his bid:

- a ) A list with the prices of all spare parts or their alternatives, which he deems necessary to stock, including the ones included in actual contract. The prices shall be binding according to an agreed formula for cost increase submitted by the bidder.
- b ) A list with prices of the spare parts necessary when alternatives are offered. While preparing the list of the supplementary spare parts, the bidder shall keep the contents of clause 8.2. in view.

### **8.2. ESTIMATION OF REQUIREMENTS**

The list of the spare parts has been prepared keeping in view of the following concepts :

- a ) Replacement required in due course of time due to wear and tear of the equipment under normal working conditions.
- b ) Replacement required due to accidents, malfunctioning of the equipment or any other emergencies.
- c ) Replacement of the heat sensitive parts such as gaskets, due to severe service conditions.

The following spare parts as applicable shall be required for each group of 20 current transformers of some characteristics and ratings.

<b>Sr. No.</b>	<b>Description</b>	<b>Quantity</b>
1.	single pole current transformer complete	1 No.
2.	Set of gaskets used	2 Sets
3.	State of Bellows indicator	1 No.

### 8.3 PACKING OF SPARE PARTS

The spare parts shall be treated and packed for long storage under the service conditions specified in clause 3. Each spare part shall be clearly marked or labelled on the outside of its packing with its description and purpose, and when more than one spare part is packed in a single case or container, general description of its content shall be shown on the outside of such case or container and a detailed list enclosed. All cases, containers or packages shall be marked and numbered for identification.

All cases, containers or other packages are liable to be opened for examination and packing shall be designed to facilitate opening and thereafter repackaging.

## **9 DOCUMENTS**

### **9.1 . TENDER DOCUMENTS**

The following information is required with the tender :

- 1 ) The information listed in clause 9.3 " Schedule of Technical Data " shall be supplied with drawings.
- 2 ) Detailed dimensional drawings of the current transformer also showing the location of accessories, along with a list of components duly crossed referred with the drawings.
- 3 ) Sectional drawings of the current transformer indicating the inner details.
- 4 ) Primary connections arrangement drawing if applicable.
- 5 ) Secondary terminal box drawing & control box termination details.
- 6 ) Drawings showing fixing arrangement of the bellows.
- 7 ) Drawings showing the method of sealing and attachment in case of bellows also indicating material and a life cycle test report.
- 8 ) Typical current error and phase displacement curves for the standard burdens from 0 to 1.2 times rates secondary current for metering cores.
- 9 ) Typical composite error curves from 0 to 20 times rated secondary current for protective cores.
- 10 ) Typical excitation curves showing the knee point for metering and protection cores.
- 11 ) Transient response curves.
- 12) Resistance of the secondary winding for protective current transformer.
- 13 ) The maximum allowable mechanical loads for :
  - a) Any one primary terminal in any direction.
  - b) Total resulting load applicable to top assembly in any direction on primary terminals.

- c) Torque / resulting torque in horizontal direction on primary terminals.
- 14 ) Technical catalogue in respect of the porcelain insulators.
- 15 ) Installation, erection, maintenance and operation instruction manuals.
- 16 ) Information / certified technical data regarding oil.
- 17 ) Life cycle test report for stainless steel bellows to be used.

## 9.2. APPROVAL DOCUMENTS

The approval documents shall be submitted for approval after the order is placed and before the manufacture is started and shall include the following :

- 1 ) All data and drawings asked for in sub-clause 9.1 above.
- 2 ) Drawings and dimensions details of terminal box.
- 3 ) Name plate drawing.
- 4 ) Connection diagram plate drawing.
- 5 ) Large scale dimensioned outlines along with reproducible of the current transformer showing the details of base and its fixing arrangement on steel and / or reinforced concrete supporting structure.
- 6 ) Two printed / photostat copies along with one copy of reproducible of the installation, erection, maintenance and operation instruction books in Spanish language.
- 7 ) Diagram of electrical lines of forces and distribution of the electrical field in air.
- 8 ) Short circuit calculation.

## 9.3. Schedule of general and technical data



The following information, as applicable shall be furnished with the bid for each type of Current Transformer :

		<b>72,5 kV</b>	<b>245 kV</b>
0)	Standard enforced ( with reservation as Mentioned in Technical specifications )	-----	-----
1)	Manufacturer	-----	-----
2)	Type	-----	-----
3)	Designation	-----	-----
4)	Type test certificate :		
	a) Issuing Institute	-----	-----
	b) Number and date	-----	-----
5)	Highest voltage for equipment ( $U_m$ )	kV	-----
6)	Rated frequency	Hz	-----
7)	Rated normal primary current	A	-----
8)	Rated secondary current	A	-----
9)	Rated secondary output :		
	a) measuring	VA	-----
	b) protection	VA	-----
10)	Accuracy class :		
	a) measuring	-----	-----
	b) protection	-----	-----
11)	Rated transformer ratios	-----	-----
12)	Accuracy limit factor	-----	-----
13)	Extended current rating	%	-----
14)	Rated currents :		
	a) Short time thermal ( lth) ,3s	kArms	-----

	b) Dynamic ( $I_{dyn}$ )	kApico	-----	-----
15	Rated Burden P.F. = 0.8	VA	-----	-----
16	The maximum guaranteed instrument security factor, for measuring core		-----	-----
17	Power frequency withstand voltage (AC ) on primary winding	kVrms	-----	-----
18	Impulse withstand voltage ( LI ) / kVpeak Impulse wave form 1,2/ 50		-----	-----
19	Chopped wave withstand voltage / kVpeak wave form 1,2/ 3		-----	-----
20	Power frequency withstand voltage (AC) on secondary windings:		-----	-----
	a) Winding to ground	kVrms	-----	-----
	b) Between windings	kVrms	-----	-----
21	Maximum RIV at 1 Hz and test voltage		-----	-----
22	Mechanical loads of primary terminals :			
	a) Dynamic load	N	-----	-----
	b) Static load	N	-----	-----
23	Material of bellows, bellows state indicator		-----	-----
24	Minimum height	mm	-----	-----
25	Minimum phase spacing	mm	-----	-----
26	Minimum clearance	mm	-----	-----
27	Minimum creepage distance	mm	-----	-----
28	Overall dimensions (l x w x h )	mm	-----	-----

29	Size and section of terminal bolt (Attach drawing)	mm	-----	-----
30	Weight per pole	kg	-----	-----
31	Weight of oil per pole	kg	-----	-----
32	Weight of supporting structure, if applicable	kg	-----	-----
33	Type of oil & reference specifications		-----	-----
34	Oil density at 25 °C	gr/ml	-----	-----
35	Oil viscosity at 25 °C	cs	-----	-----
36	Maximum allowable static and dynamic forces applied at outmost point of porcelain insulator		-----	-----
	a) Horizontal	N	-----	-----
	b) Vertical	N	-----	-----
37	Internal partial discharges with test voltage according to IEC 44-4 requirements ( extended tests )	pC	-----	-----

## 9.4. INSTRUCTION MANUALS

One copy of instruction manuals in English language for installation, commissioning, operation and maintenance, enclosed in thick polyethylene bags, shall be placed in the main casing of each equipment at shipping with a corresponding indication tag at the outside of the crate.

## 9.5. SPARE PARTS BOOKS

For each separate piece of equipment the manufacturer shall give a spare parts books. This spare parts book shall contain an assembly drawing of the equipment which shall show all parts of the equipment separately marked, designed and referenced. The book shall also contain sketches of each part with the part number and the designation of the part. The material of the part shall also be indicated. These sketches and list of parts shall be cross-indexed with the assembly drawings. The spare parts book shall present information in a simple manner so that non-technical personnel may be able to manner and to indent these spare parts. The list of spare parts required shall be made with reference to the spare parts book.