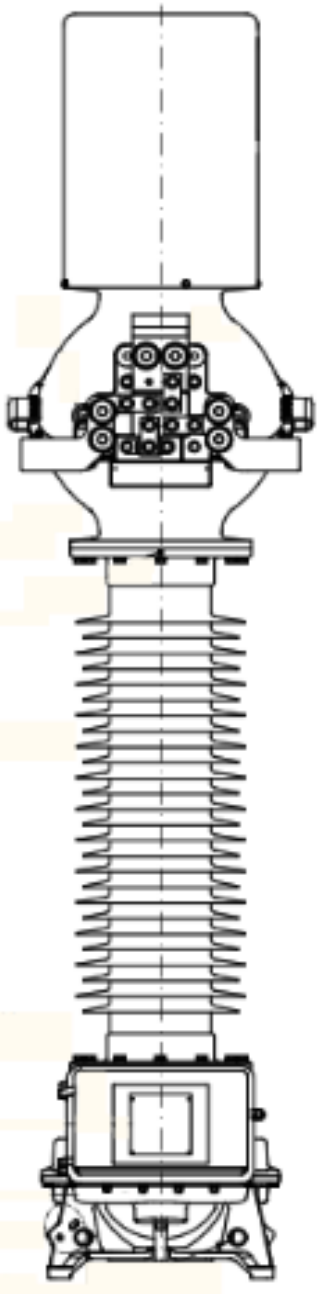
INSTRUCTION MANUAL - MIITR102

COMBINED INSTRUMENT TRANSFORMER

KOTEF 72.5...245



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Warning!

Any person involved with transport, installation, energizing, operation and maintenance of Combined Instrument Transformer (CIT) type KOTEF must read these instructions prior to any action related to these instrument transformers.

These CITs are built under strict conditions which guarantee the Highest Quality achievement. In order to keep this high-quality during CIT's lifespan, it is utmost important that the instructions in this Manual be thoroughly read and complied with.

THESE COMBINED INSTRUMENT TRANSFORMERS CAN NOT BE STORED IN A HORIZONTAL POSITION FOR MORE THAN FOUR MONTHS. IF THE TIME OF TRANSPORTION AND STORAGE EXCEEDS THIS PERIOD, IT IS MANDATORY TO UNPACK AND PUT THE TRANSFORMER INTO A VERTICAL POSITION, FIXING ITS BASE TO THE GROUND AND REMOVING THE BELLOWS BLOCKING SYSTEM (PLEASE REFER TO ITEM 4).

******WARNING******

DE-ENERGIZED HIGH VOLTAGE EQUIPMENT MAY CONTAIN TRAPPED CHARGES

Read this instruction book before installation and operation of the unit.

Never work on High voltage equipment without first having short-circuited and grounded all terminals and metallic housings as the inherent capacitance may have electric charges with voltage at the lethal level. In addition, a ground rod should stay on the line terminal as long as people work on the unit.

In the event an electrical test is to be performed, the person supervises the test will be held responsible for performing the test in a safe manner under the local / federal regulation. After the test, the ground rod should be put back to the line terminal until the unit is ready to be energized.

Note: To effectively discharge High voltage equipment do the following:

a) Put the ground rod onto the line terminal (Such action will short-circuit the entire unit and put the line terminal to the ground potential), and

b) Use another ground rod to attach to any intermediate metallic housing for duration of 10 –15 seconds to be certain that there is no residual electrical charge within the unit.

Preliminary Remarks

During reception of the CITs, it is important to check unpacking attentively in order to control the condition of the transportation crate and the transformer itself. Any irregularities shall be recorded on the transport delivery note and a formal communication shall be sent to the responsible person immediately.

The supplied insulator can be made of porcelain, therefore, sudden movements that can cause damage due to cracks shall be avoided.

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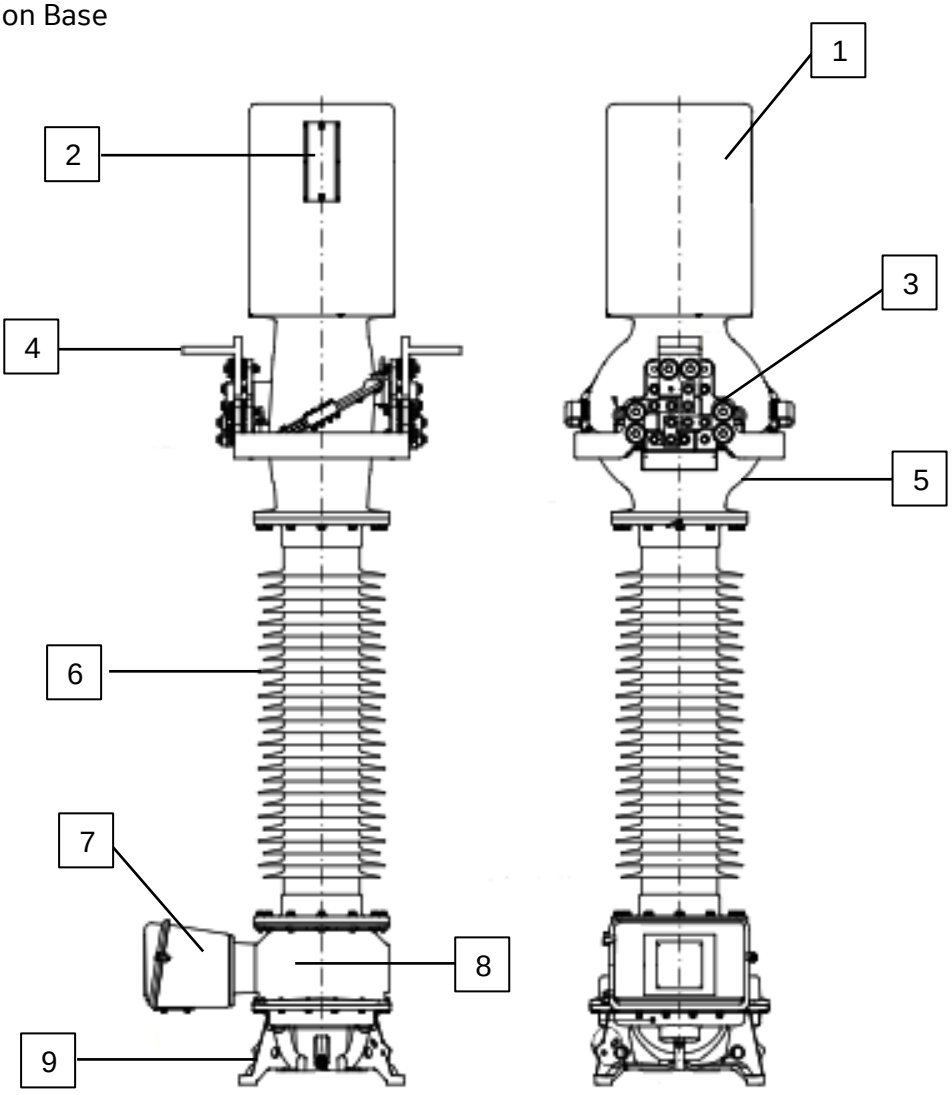
1. GENERAL DRAWING

Description and characteristics of the KOTEF Combined Instrument Transformers. For more details, please refer to the picture below.

1. Top Cover
2. Oil Level Indicator (metallic bellows)
3. Primary Reconnection Terminals
4. Primary terminals: aluminum or copper
5. CT Headhousing (current transformer part)
6. Porcelain or composite insulator
7. Terminal box of secondary windings and cover
8. VT Tank (voltage transformer part)
9. Fixation Base



General Drawing of KOTEF

2. DESIGN AND CONSTRUCTION

2.1. Construction and primary circuit

The active part of the voltage transformer is located below the porcelain insulator and the current transformer part above. The primary circuit is short, rigid and straight, minimizing heating. In addition, it withstands electrodynamics forces more easily, allowing high level performance, related to electrodynamics and thermal effects, in a presence of short-circuit currents.

Primary series and parallel connections with external links (for reconnection 1:2 or 1:2:4) or, if necessary, n-turn (more than 4 turns) designs can be provided. This arrangement allows also better accuracy in transient conditions.

The primary terminals are directly connected to the conductor.
Attention! Do not lift the unit at the primary terminals or remove the primary terminals!

2.2. Secondary circuit

Related to the CT's active part, the toroidal ferromagnetic cores are manufactured either from very high permeability grain-oriented steel or from specialized alloys. In order to achieve a satisfactory transient behavior, protection cores can also be provided with gaps.

All secondary windings are enclosed in an aluminum box which protects them against high frequency disturbances while acting as a low voltage shielding electrode. This aluminum box is extended up to the base by an aluminum tube which contains all secondary leads. The cross section of the earth connections is designed to support fault currents.

The bottom of the hermetic and watertight secondary terminal box is closed by a fitted plate, with or without cable gland depending on customer requirements.

2.3. Paper-oil insulation

The active part of the transformer is insulated by a vacuum impregnated oil/paper system. Degassed and filtered mineral oil is used and is heated before filling to provide maximum impregnation. It is an insulating oil with excellent aging stability and gas absorbing properties. **It does not contain any Polychlorinated Biphenyl (PCB).**

2.4. Oil volume compensation system

To protect the oil from the environment, the CT head is sealed by a metallic bellows. The bellows assembly provides pressure compensation for temperature variation and allows the transformer to work virtually free of over-pressure.
The bellows resists aging and corrosion.

IF THE HERMETIC SEAL OTHER THAN DURING OIL SAMPLING IS BROKEN, CONTACT THE MANUFACTURER IMMEDIATELY.

An oil level indicator is provided and is scaled to show the oil level over the

operating range. It is visible from ground level behind a Plexiglas window in the top cover. The limit positions are marked by red stripes at the top and bottom. Please refer to item 7 for more information.

2.5.

2.6. Cast aluminum tank

The base tank is made of corrosion-proof aluminum. The core housing (CT-part) has up to 7 independent toroidal cores enclosed in a thick-walled aluminum alloy core housing and is connected to the base through a stem and a ground fault current carrying connection. Attached to it are a large terminal box, ground pad and oil sampling valve. For the location of the secondary terminals and the neutral end of the HV winding of the VT part (for example H2, N...).

2.7. External metallic parts

The external metallic parts do not require maintenance and they are protected against corrosion effects.

3. TRANSPORT, RECEPTION, UNPACKING AND STORAGE

3.1. Transportation

Transformers are shipped in horizontal position with the feet mounted to the crate/skid and the head resting on damping foam. For overseas shipment, the CIT is packed in wooden crates designed according to SEI (cat. 4) specification. The crates can be stacked, but no more than one crate stacked over.

3.2. Reception

Whether the shipment is of manufacturer's or customer's responsibility, the customer inspector or the service agent must check the following on receipt of delivery:

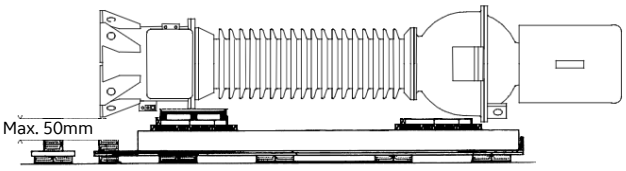
If the crates show any signs of impact, blows or fractures, or if the transformers have any sign of damage or oil leakage, the customer inspector or the service agent in charge of receipt shall make a written remark on shipment documents. The receipt control, mainly for the insulators and the secondary terminal box, shall be done in the presence of the forwarding agent, if possible. The remarks regarding the condition of the goods shall clearly state details of the damages found at the time of reception.

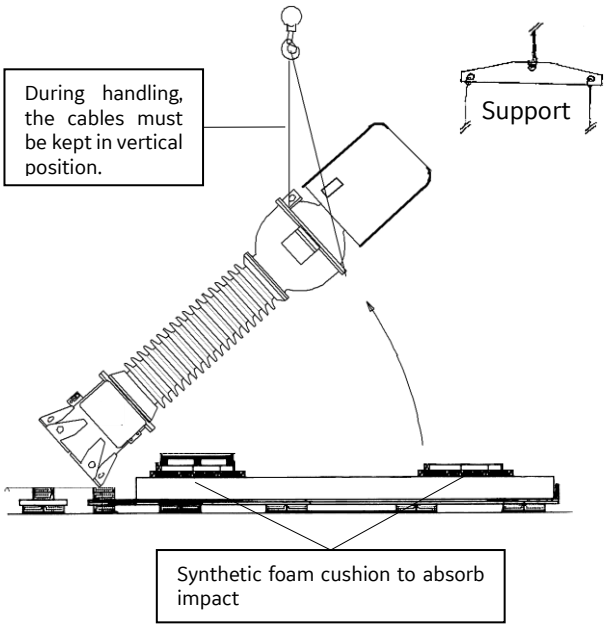
In case of damages, the customer inspector in charge of receipt shall notify GE and the insurance representative. All contact information is indicated on shipment insurance documents. This declaration shall be made within eight days after receipt of the material.

3.3. Unpacking

Material required for unpacking and lifting the transformer up to vertical position:

Qty	Description
1	Crane, munck or hoist
1	Swing-bar of 0.7 to 0.9m of length with 2 holes
4	Shackles of 18mm (3/4") diameter
1	Graphite grease MOLYKOTE type P37 or equivalent.
2	Slings with proper length to execute the lifting operation safely

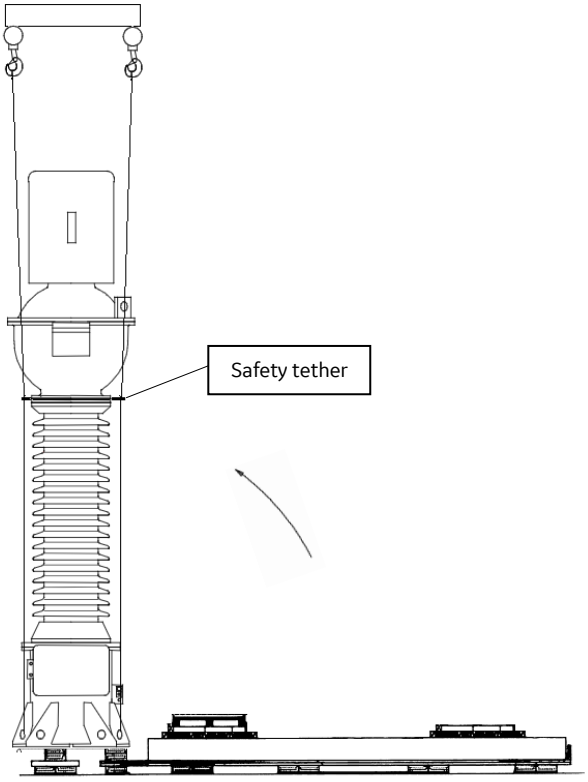




Unpacking the transformer shall be made with caution:

1) Remove the smaller extremities;
2) Remove the upper cover;
3) Remove the larger extremities.

<u>Attention!</u>
<u>NEVER</u> lift a transformer by its primary terminals. Lift it by the lifting eyes on the transformer top. All four lifting eyes must be used during lifting operation.



To lift the transformer with crane or munck, follow the marks on the wooden crate, once they indicate the right position for the slings (nylon belts reinforced) and avoids blows and vibrations.
Follow the instructions shown in the following drawings for lifting the unit. All cables or slings shall be kept in vertical position during the lifting. It is recommended to lift the transformer slowly.

Once the transformer is in the vertical position, it should be moved and mounted according to the latter figure. Be careful not to tilt the unit such that the center of gravity moves beyond any of the four (4) matched slings. Use a safety tether. Refer to the nameplate for weight

3.4. Storage

The units can be stored:

- no more than four months after the CITs left the factory,
  - in the horizontal position,
  - on a smooth surface and
  - within minimum and maximum ambient temperature as per CIT specification.

- more than four months after the CITs left the factory,
  - on a smooth surface,
  - unpacked,
  - put in vertical position and
  - after removal the bellows blocking device as described in item 4.

NOTE: The units stored outdoors in vertical position must be screwed on to the ground, even if the storage is foreseen for a short period of time.

4. BELLOWS BLOCKING SYSTEM AND ASSEMBLY IN THE STRUCTURE

4.1. Bellows blocking system

For transportation purposes, the metallic bellows device is blocked (secured from movement) using cushions of synthetic foam slightly compressed by the top cover. A protection of plastic film is also put in place around the bellows to protect it against contact with the top cover.

In order to remove the blocking system, place the transformer in vertical position on a flat surface.

Remove the bellows blocking device, following the procedure below:

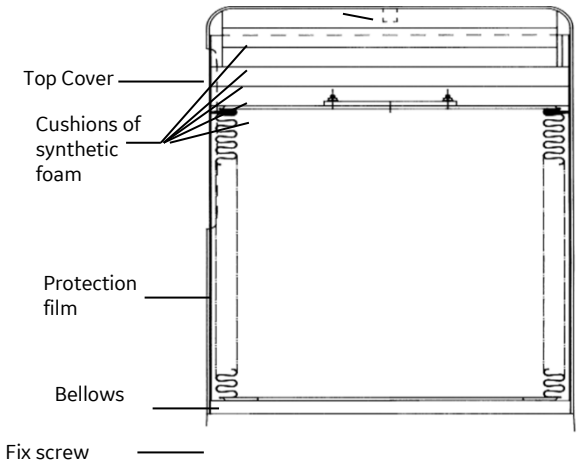
1) Mark the position of the top cover with respect to the head of the transformer with a vertical line (using a marker, chalk or pencil);
2) Remove the screws that fix the top cover;
3) Remove the bellows blocking device and the protection film;
4) Confirm by visual check that the bellows device is in good condition:
   a) Geometry: Top of the bellows is horizontal (i.e., not tilted due to possible deformation of the bellows convolutions). No distortion and/or asymmetry of the bellows (i.e., convolutions are evenly displaced around the circumference of the bellows)
   b) Surface: no damage or deformation such as dents and/or buckling in the bellows

TO AVOID DAMAGE TO THE BELLOWS DEVICE, NEVER SUPPORT ANY MATERIAL ON THE BELLOWS.

5) Reinstall the Top Cover with care lining up the vertical marker line with the head of the transformer to ensure that original fixing position is maintained. Confirm that the bellows is free for internal movement and in a vertical position.

The green oil level marker shall be clearly visible through the window.

6) Tighten the fixing screws. The threads shall be lubricated with grease << MOLYKOTE P37>> or equivalent. The screws shall be tightened to a maximum torque of 7N.m for screw M6 and 16N.m for screw M8.



4.2. Assembly in the structure

The transformer shall be set up in vertical position.

It is very important that the surface on which the CIT will be set up is flat (tolerance for no more than 1mm).
Verify if the four feet are supported on the structure. If not, it is necessary to insert a shim before putting the fixation screws.

Remove the lower lid of black plastic, if applicable, from secondary terminal box. It is only used for transport. It cannot be used as tube guide.

5. CONTACT SURFACES PREPARATION

It is recommended to clean all aluminum contact surfaces with sandpaper 150 grain in order to eliminate the oxidation layer. Scrub the contact surfaces with a metallic brush (diameter of the thread 0.3mm) and impregnate with grease of the type “PENETROX” or equivalent. All the surfaces must be completely covered with grease.

For plated contacts, only clean (do not use sandpaper) and polish the side of the aluminum. Cleaning plated surfaces with sandpaper could cause damage to the protection coat.

6. CONNECTIONS

6.1. Primary Terminals

Connect the high voltage cable, or tube, to the primary terminals with appropriate connectors so that they assure a good contact.

6.2. Primary bar type (if applicable)

Primary bar is always supplied completely assembled with the delivered transformer. Clean the primary terminal as explained in item 4).

6.3. Double / Triple Reconnection Primary type (if applicable)

The current ratio of the CIT can be single with only one single bar, double or triple primary ratio. Double or triple primary ratio can be easily changed by the user

following the instruction of the approved set of drawing. This changing ratio is made by means of reconnection bars located in the headhousing, closer to primary terminals. Please refer to the set of drawing to know how the reconnection bars need to be positioned in order to have the required ratio.

6.4. Secondary terminals/Neutral Terminal

The unit is shipped with the current transformer secondary short circuited and connected to the secondary box ground, the voltage transformer part is open circuited and not grounded.

Attention!
Do not leave any secondary windings of the current transformer part open - High Voltage!
Do not short-circuit the secondary winding of the voltage transformer part! The neutral terminal of the voltage transformer part must be connected to ground prior to and during operation!

6.5. Terminal marking

Primary and secondary terminal marking are done according to the specified standard. please refer to the set of drawing.

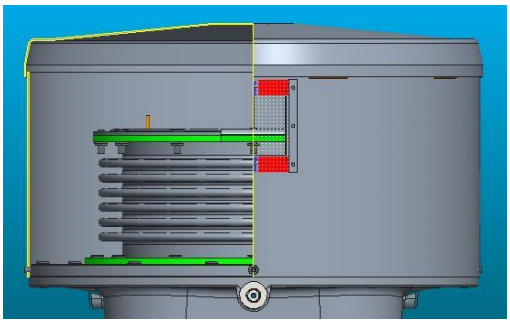
Primary and secondary connection scheme are shown on schematic plates.

7. OIL LEVEL INDICATOR

The position of the oil indicator can be verified through the rectangular window of the top cover.

The plate of the indicator is divided in three areas. Central area shows the green strip and higher and lower areas are shown with a red strip. In normal conditions, the indicator shows the green strip of the indicator.

In case of oil level indicator is in either of the red areas, the transformer must be removed from operation and GE informed immediately.



8. INSPECTION BEFORE FIRST ENERGIZING

After putting the CITs in vertical position, it is necessary to wait at least 48 hours before energizing it!

Verify terminals connections to assure the correct tightening torque.

Make sure that the neutral terminal of the voltage transformer part (H2, N ...) is connected to ground. Confirm all intended groundings.

Confirm that the secondary circuit of the voltage transformer part is <u>not</u> shorted.

Make sure that <u>no</u> secondary winding of the current transformer part is open circuited.

Verify the correct position of the primary terminal (transformer with reconnection primary bars). Refer to the set of drawing.

Verify that the oil level indicator is in the green strip area.

Whilst all care is taken in the factory during oil filling, the surface near of screws and bellows could have a small quantity of oil. This shall not be considered as an oil leakage provided the bellows are positioned within the green strip area.

It is not necessary to remove oil samples for analysis. The CIT is hermetically sealed

If required, small quantity of oil can be taken. Always verify oil level indicator before take oil samples.

Never complete oil volume without prior formal authorization of GE.

<u>Important remark</u>:
During commissioning, it is recommended to register the values acquired for each of the performed tests in order to compare with future measurements during the CIT's lifetime. The measurements taken in the factory are important as so the measurements during commissioning of each transformer. The comparison between test results measured at the field allows following the evolution of each parameter.

9. MAINTAINENCE AFTER ENERGIZING

Besides regular cleaning of the transformer surface and especially the insulator, no routine maintenance is required on the transformers. However, the oil level indicator position should be checked regularly, along with visual inspections during the normal scheduled maintenance periods. It is good practice to compare the oil level indicator position of neighboring units. Also, the inside of the terminal box and the ventilation screens should be checked for cleanliness.
After installation and energizing, the transformers shall not require any further intervention. However, it is suggested performing visual inspections during the first weeks of service in order to:

Verify if there is no oil leakage near the fixation base and secondary terminal box.

With an infrared imaging device, check if the primary terminal connections are not overheating. Compare with other CITs in the same circuit.

After one year of operation, it is advised a detailed inspection of tightening torques and oil leakage and thereafter twice per year according to the substation maintenance contract.

If possible, GE suggests disconnecting the equipment to perform the following examinations:

1) Insulator: Depending on the pollution level, it is necessary to clean the porcelain;
2) Metallic components: check for corrosion;
3) Tightening torque of primary and secondary connections. Any adjustments shall be conducted as described in the item "Primary Terminals" of this document;
4) Secondary terminal box: If necessary clean inside the terminal box.
5) Verify oil level indicator and if there is any signal of oil leakage;
6) Remove the top cover to have access to the bellows and verify if there is any signal of oil leakage near the fixation of the bellows and / or if the bellows is in good condition.

Tests

It is recommended after the first few hours of operation and whenever there is a change in the primary current (in the bar connection), performing the measurement of the primary terminal temperature with a proper temperature measuring instrument.

It is advised to perform the following tests before putting the equipment in operation and thereafter at four-year intervals depending on availability of the:

1) Ratio (TTR);
2) Polarity (Polarity meter);
3) Saturation Voltage (ac voltage source, Voltmeter and Ammeter);
4) Ohm Resistance (Wheatstone bridge);
5) Insulation Resistance with any megohmmeter;
6) Tan δ of the HV insulation (Double M4100, Omicron CPC100 or any equivalent).

Important remark:

During commissioning and tests, it is recommended recording the results acquired in the tests abovementioned.

In case of doubts, please contact the technical assistance support of GE: +55 35 3629 7042 or 7038 or 7000

10. PROPER DISPOSAL OF TRANSFORMERS COMPONENTS AFTER LIFESPAN

The instrument transformers are mainly composed of the following components, which after transformer's lifespans require a properly disposal in order to prevent environmental contamination.

Components	Recommended Disposal
Metallic materials	Metal recycling company
Resin and materials saturated with resin	Oil disposing company properly licensed to perform such activity
Oil (PCB-free) – classified as Class I hazardous residue	Oil disposing company properly licensed to perform such activity
Material contaminated with oil	Co-processing or incineration at a company properly licensed
Porcelain insulator	Industrial landfill properly licensed

Composite insulator	Industrial landfill properly licensed
Other materials	Industrial landfill properly licensed

The disposal of oil and components contaminated with oil directly into the soil or water is prohibited.

For further information or clarifications, contact GE environment department: +55 35 36297112.