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### **Notice of Improper Practices regarding High-Voltage Transformers**

It was identified on December 14, 2023 that AC withstand voltage tests and lightning impulse withstand voltage tests were conducted in a manner different from the testing standard (\*1) specified by customers in the type test (\*2) and acceptance test (\*3) of high-voltage transformers (\*4) manufactured at our Oyama Plant (Oyama City, Tochigi Prefecture) and that the test results were inappropriately reported (hereinafter collectively referred to as “this case”). We inform you of the facts that we have investigated to date and the measures to be taken as follows. If new facts come to light in the course of investigating this case, we will promptly disclose them.

As stated in the IR news “Incidents of Impropriety Regarding Certain Instrument Transformer Products” published on May 16, 2023, we are currently conducting a comprehensive quality inspection of all our products, and this case was identified in the process.

As we continue to conduct ongoing comprehensive inspections, we will promptly disclose any new incident that is identified.

(\*1) Major standards include JEC (Japanese Electrotechnical Committee of the Institute of Electrical Engineers of Japan) standards, JIS (Japanese Industrial Standards) standards, IEC (International Electrotechnical Commission) standards, and IEEE (Institute of Electrical and Electronics Engineers) standards

(\*2) Conformity test made on one or more products representative of the production

(\*3) Test to confirm that the product has performance equivalent to that in the type test

(\*4) Transformers for substations, shunt reactors, series reactors, neutral point reactors, earthing transformers, neutral point grounding resistors, mobile transformers, and power capacitors

#### **1. Outline of the subject products**

Products: Transformers for substations, shunt reactors, series reactors, neutral point reactors, earthing transformers, neutral point grounding resistors, mobile transformers, power capacitors

Note: Only transformers were delivered to customers overseas.

Period: From around 1980 to 2023 (\*5)

Number of units: 5,835 units out of 6,819 units delivered during this period (\*5) were the subject of improper practices in this case.

Note: Improper practices were confirmed in 458 of the units delivered to customers overseas.

(\*5) The timing of the start of these improper practices is estimated to be around 1980 based on the data available at the moment. For this reason, we counted the number of units of the products starting from products manufactured in 1980.

## 2. Outline of this case

In the type test and acceptance test of the subject products, the following improper practices were revealed in the AC withstand voltage tests and lightning impulse withstand voltage tests based on the testing standards specified by customers (hereinafter referred to as the “relevant standards”).

### (1) AC withstand voltage tests

The purpose of this test is to verify the insulation strength (\*6) against overvoltage that may occur during power system accidents and the insulation strength against grid voltage during the product lifespan of the transformer.

In the acceptance test, we should have applied the test voltage specified by the relevant standard (hereinafter referred to as the “AC normal test voltage value”). However, we applied a test voltage which was reduced by 10% or 15% (\*7) from the AC normal test voltage value (hereinafter referred to as the “AC reduced test voltage value”). Meanwhile, we recorded in the test reports that the AC normal test voltage value was applied to the transformers.

(\*6) Actual voltage that can be withstood by the electrical insulation of equipment

(\*7) We confirmed through interviews with parties involved that most of the tests were conducted at voltages reduced by 10%, and a few tests were conducted at voltages reduced by up to 15%.

### (2) Lightning impulse withstand voltage tests

The purpose of this test is to verify the insulation strength against instantaneous overvoltage that may occur when a lightning surge enters the power system.

In the type test and acceptance test, we should have applied the test voltage specified by the relevant standards (hereinafter referred to as the “LI normal test voltage value”). However, we applied a test voltage which was reduced by 25% (\*8) from the LI normal test voltage value (hereinafter referred to as the “LI reduced test voltage value”). Meanwhile, we recorded in the test reports that LI normal test voltage value was applied to the transformers.

(\*8) Based on the records of the setting conditions (capacitor numbers, gap lengths) of the test equipment for generating lightning impulse test voltage, we confirmed that some tests were conducted at LI normal test voltage value. However, most of the tests were conducted at LI reduced test voltage value.

## 3. Soundness of the subject products

In our insulation designs for transformers, we include margins exceeding the insulation strength required by the relevant standards. In the manufacturing and assembly processes of transformers, we manage manufacturing quality by paying attention to the dimensional control of the insulation structure (\*9), the withstand voltage control of insulation oil, and the prevention of moisture/foreign substances contamination. In addition, the type tests and acceptance tests are conducted to confirm that the designed and manufactured products have the insulation strength specified by the relevant standards. However, in this case, the subject products were not tested by AC normal test voltage value and LI normal test voltage value, which means that it was not confirmed that the subject products had the insulation strength specified by the relevant standards. Therefore, we reconfirmed the above-mentioned design policy and the actual conditions of the manufacturing and assembly processes and calculated the insulation strength of the subject products considering the insulation structure (insulation dimensions of the winding section) and assembly tolerance. As a result, we confirmed that the design, manufacturing, and assembly processes of the subject products were properly implemented.

(\*9) Shape of the insulation to be placed between the windings or between the windings and the iron core (between the windings and the earthing)

Since the subject products have only been confirmed to have the insulation strength to withstand the AC reduced test voltage value and the LI reduced test voltage value, we have evaluated the risk of insulation breakdown (\*10) of the subject products during use. As shown below, the risk is extremely low, and we have determined that problems will not occur under normal use unless there are special circumstances.

- AC withstand voltage performance

We calculated the probability of no insulation breakdown during periods of normal use and confirmed that these probabilities are sufficiently high.

- Lightning impulse withstand voltage performance

A survey of past test records has confirmed that some of the subject products were tested by LI normal test voltage value, and it is considered that products designed and manufactured with an insulation structure equivalent to or better than those products have the insulation strength specified by the relevant standards. In addition, lightning arresters (\*11) are usually installed in the vicinity of transformer(s) and, when lightning overvoltage invasion occurs, those lightning arresters can provide protection (suppress the intrusion voltage).

- Failure case review

As a result of reviewing the cases of failure (after 1997) of our transformers, we have confirmed that to date there have been no cases of insulation breakdown failures or partial discharge failures directly caused by improper practices in this case.

(\*10) Incident in which insulating materials that isolate conductors in electrical and power circuits or their parts cease to insulate and become conductive

(\*11) Equipment that protects electric power facilities from abnormal voltages caused by lightning strikes, etc.

#### **4. Future measures**

After this case was identified, we immediately suspended deliveries of the subject products and are proceeding with confirmation of each individual order accepted for the products identified in footnote 4 to ensure that only products for which all tests specified in the relevant standard have been properly conducted are delivered.

In view of the seriousness of this case, we have established an independent investigation and verification committee, which has no conflict of interest with us. The scope of this committee's responsibilities is as follows:

1. Investigation of this case
2. Analysis of the causes based on the investigation results and proposal of measures to prevent recurrence
3. Evaluation and validation of the comprehensive inspection and investigation we have implemented so far

At this time, there are no revisions to the consolidated performance forecast for the current fiscal year due to this case. In the event that this case is anticipated to have an impact on the consolidated performance for this fiscal year, we will promptly disclose such information.