

# V. Design, Application, Maintenance & Operation

## Technical Requirements

### V.H PJM Design & Application of Instrument Transformers

#### 1.0 Specification

- 1.1. As a minimum requirement, all instrument transformers should be specified to meet or exceed the requirements of all applicable industry standards, including but not limited to ANSI, IEEE, NEMA, and ASTM.
- 1.2. Instrument transformers are classified as either current transformers or voltage transformers.
- 1.3. Instrument transformers must be designed with adequate electrical, dimensional, mechanical, and safety characteristics for the specific electrical system on which they are installed and for the application for which they are intended.
- 1.4. Instrument transformers should be suitable for the usual service conditions as identified by applicable standards. Any unusual service conditions should be identified and considered for specific applications. These may include ambient temperature, high altitude, contamination, space or ventilation restrictions, or unusual duty requirements.

#### 2.0 Application

- 2.1. Instrument transformers should be utilized in applications for which they were designed.
- 2.2. Instrument transformers used in switchgear assemblies, power circuit breakers, power transformers, or outdoor bushings should be suitable for those applications.

#### 3.0 Ratings

- 3.1. Instrument transformer ratings should be suitable for the metering or relaying application for which they are intended.
- 3.2. These ratings include, but are not limited to: basic impulse insulation level (BIL), nominal system voltage, maximum system voltage, frequency, rated primary and secondary currents, rated primary voltage and ratio, accuracy classes at standard burdens, continuous thermal rating factor at 30° C ambient, and short time mechanical and thermal current ratings.
- 3.3. Normal and emergency ratings of current transformers should be determined by using the PJM TSS guide "VI.F - Determination of Current Transformer Ratings" latest revision.
- 3.4. The following ratings apply for use in the 60 Hz PJM system:

3.4.1.

Nominal voltage	69 kV	115 kV	138 kV	230 kV	345 kV	500 kV	765 kV
Maximum voltage	72.5 kV	121 kV	145 kV	242 kV	362 kV	550 kV	800 kV
BIL (minimum)	350 kV	550 kV	650 kV	900 kV	1300 kV	1800 kV	2050 kV

Table 1 – Dielectric Properties of Instrument Transformers

3.4.2. Current Transformers - To ensure the proper performance of the protective relay schemes, current transformers with appropriate accuracy capabilities and thermal ratings should be used.

Older electro-mechanical relay schemes and long wire runs from CT's to relays required accuracies of C800 in many applications. Newer microprocessor based relay schemes with low burden inputs can often times function properly with lower accuracy CT's. CT's accuracies appropriate to the proper operation of the relay schemes employed must be chosen.

In applying current transformers, secondary current limits need to be observed. To ensure this is the case for applications at various tap settings, and possible primary overload conditions, thermal rating factors of greater than 1.0 should be considered. The thermal rating factor selected must be appropriate to the proper operation of the facility.

3.4.3. Voltage Transformers (line to ground application):

To ensure the proper performance of the protective relay schemes, voltage transformers with appropriate accuracy capabilities should be used.

The following metering ratios and accuracies are recommended:

Nominal voltage	69 kV	115 kV	138 kV	230 kV	345 kV	500 kV	765 kV
Ratio	350/600:1	600/1000:1	700/1200:1	1200/2000:1	1800/3000:1	2500/4500:1	3750/6250:1
Accuracy (%) *	0.1	0.1	0.1	0.1	0.1	0.1	0.1

Table 2 – Metering Ratio and Accuracy for Voltage Transformers

\*W thru ZZ

The following relaying ratios and accuracies are recommended:

Nominal voltage	69 kV	115 kV	138 kV	230 kV	345 kV	500 kV	765 kV
Ratio	350/600:1	600/1000:1	700/1200:1	1200/2000:1	1800/3000:1	2500/4500:1	3750/6250:1
Accuracy (%) *	0.3	0.3	0.3	0.3	0.3	0.3	0.3

Table 3 – Relaying Ratio and Accuracy for Voltage Transformers

\*W thru ZZ

For CCVT, relay accuracy is commonly 1.2%

#### **4.0 Maintenance**

- 4.1. See “V.L. Line and Substation Operation and Maintenance,” section 2.H for maintenance requirements.