

**Requirements on Measurement & Verification (M&V) System**

**Data points to be measured**

Minimally, the following data points shall be measured and monitored:

- a) Chilled water supply and return temperatures, in °C, for chilled water header;
- b) Chilled water flow rate, in L/s, for chilled water header;
- c) Condenser water supply and return temperatures, in °C, for condenser water header;
- d) Condenser water flow rate, in L/s, for condenser water header;
- e) Electrical power inputs, in kW<sub>E</sub>, to the following groups of equipment of the chilled water system:
  - i. chiller(s),
  - ii. chilled water pump(s),
  - iii. condenser water pump(s), and
  - iv. cooling tower(s).

2 If the condenser water from the chilled water system is used to remove heat from any other source(s), for example, the compressed air system, within the boundary of the M&V system, the temperature and flow of the condenser water to these additional heat sources shall be measured so that their heat loads can be known and be nett off from the heat load transferred from the chilled water system. The heat load from these sources are also used to apportion the electrical consumption of the condenser water pumps and cooling towers to the chilled water system.

**Instrument Accuracy**

3 The end-to-end accuracy of each measurement system is as shown in Table 1.

**Table 1 – End-to-end accuracy for each measurement system**

<b>Measurement system</b>	<b>End-to-end Accuracy<sup>1</sup></b>
Temperature	±0.05 <sup>0</sup> C.
Flow	±1%
Power <sup>2</sup>	±1%

<sup>1</sup> The accuracy requirement covers the entire chain of measurement i.e. sensor/meter, wiring, transmitter (if applicable), data acquisition system and any signal conditioning.

<sup>2</sup> Include any associated voltage and current transformers

#### Additional requirement for temperature measurement

4 Additional thermowells before and after each temperature sensor shall be installed along the chilled water and condenser water pipe lines for verification purposes.

#### Centralised monitoring system

5 A centralised monitoring system should be utilised for the data collection and monitoring such as a Building Automation System (BAS) or a standalone Energy Management System (EMS). Data shall be collected at a minimum sampling interval of one minute, and be recorded and stored up to at least 3 decimal places. All raw data shall be kept for at least 3 years.

6 The centralised monitoring system should have the capability to aggregate per-minute data and transfer them via internet to NEA online portal automatically and at a frequency of at least once a month.