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ENERGY CONSERVATION ACT
(CHAPTER 92C)

ENERGY CONSERVATION
(ENERGY MANAGEMENT PRACTICES)
(AMENDMENT) REGULATIONS 2020

In exercise of the powers conferred by section 78(1) of the Energy Conservation Act, the Minister for Sustainability and the Environment makes the following Regulations:

Citation and commencement

1. These Regulations are the Energy Conservation (Energy Management Practices) (Amendment) Regulations 2020 and come into operation on 1 December 2020.

Amendment of regulation 2

2. Regulation 2 of the Energy Conservation (Energy Management Practices) Regulations 2013 (G.N. No. S 246/2013) (called in these Regulations the principal Regulations) is amended —

(*a*) by inserting, immediately after the definition of "greenhouse gas", the following definition:

> "'manufacturing and manufacturing-related services" has the meaning given by paragraph 2 of the Energy Conservation (Registrable Corporations) Order 2013 (G.N. No. S 248/2013);"; and

(*b*) by deleting the full-stop at the end of the definition of "specified energy consumption" and substituting a semi-colon, and by inserting immediately thereafter the following definitions:

" "supply of electricity, gas, steam, compressed air and chilled water for air-conditioning" has the meaning given by paragraph 2 of the Energy Conservation (Registrable Corporations) Order 2013;

"water supply and sewage and waste management" has the meaning given by paragraph 2 of the Energy Conservation (Registrable Corporations) Order 2013.".

Amendment of regulation 7A

3. Regulation 7A of the principal Regulations is amended —

(*a*) by deleting the definitions of "manufacturing and manufacturing-related services", "supply of electricity, gas, steam, compressed air and chilled water for air-conditioning" and "water supply and sewage and waste management"; and

(*b*) by deleting the semi-colon at the end of the definition of "post-assessment design" and substituting a full-stop.

New Part IIB

4. The principal Regulations are amended by inserting, immediately after regulation 7E, the following Part:

"PART IIB

MINIMUM ENERGY EFFICIENCY STANDARDS FOR ENERGY-CONSUMING SYSTEMS

Definitions of this Part

7F. In this Part, unless the context otherwise requires —

"antifreeze" means any additive that prevents water from freezing by depressing the freezing point of water;

"assessment report" means a report mentioned in section 26B(2)(*b*) or (3)(*b*) of the Act;

"booster pump" means a pump that is installed on a chilled water pipeline to overcome a drop in pressure in the

chilled water pipeline, to prevent over-pressurising chilled water in any parallel pipeline;

"certificate of statutory completion" has the meaning given by section 2(1) of the Building Control Act (Cap. 29);

"cooling tower" means any device in which atmospheric air is passed through sprayed water to lower the temperature of the sprayed water by evaporative cooling;

"end-to-end uncertainty", in relation to a parameter of a prescribed system, means the combined uncertainty of —

(*a*) every prescribed permanent measuring instrument installed for the prescribed system for measuring that parameter; and

(*b*) any accessory needed for the operation of those prescribed permanent measuring instruments, including a current or voltage transformer;

"energy management system", in relation to a prescribed system, means a system that processes, analyses, displays and stores data collected from prescribed permanent measuring instruments installed for the prescribed system;

"energy performance", in relation to a prescribed system, means —

(*a*) the ratio of electrical power consumption (measured in kilowatts) to the refrigeration output (measured in kilowatts) of the prescribed system; or

(*b*) the ratio of electrical energy consumption (measured in kilowatt-hours) to the refrigeration energy output (measured in kilowatt-hours) of the prescribed system;

"gross floor area" has the same meaning as "floor area" in rule 2(1) of the Planning (Development Charges) Rules (Cap. 232, R 5);

"kW_c", in relation to a prescribed system, means the refrigeration output of the prescribed system, expressed in kilowatts;

"prescribed permanent measuring instrument" means a measuring instrument mentioned in regulation 7J(1);

"prescribed system" means an energy-consuming system mentioned in regulation 7H;

"qualified person" means —

(*a*) an individual who is certified by the Institution of Engineers, Singapore as an energy efficiency opportunities assessor with systems-specific experience in chilled water systems; or

(*b*) a professional engineer registered under the Professional Engineers Act (Cap. 253) in the branch of mechanical engineering, electrical engineering or chemical engineering, who has in force a practising certificate issued under that Act;

"specified AHRI Standard" means the AHRI Standard 551/591-SI-2018 published by the Air-Conditioning, Heating and Refrigeration Institute;

"SS 591/2013" means the Singapore Standard 591:2013 — Code of Practice for long term measurement of central chilled water system energy efficiency, published by the Enterprise Singapore Board;

"temporary occupation permit" has the meaning given by section 2(1) of the Building Control Act;

"water-cooled chilled water system" means a system comprising one or more of each of the following components:

(*a*) a water-cooled chiller;

(*b*) a chilled water pump for a water-cooled chiller;

(*c*) a condenser water pump;

(*d*) a cooling tower,

with interconnections and accessories (including thermal storage tanks, if any), operating together to produce chilled water, whether or not each component is situated in the same premises, and excludes any booster pump and other energy-consuming systems that use the chilled water produced, either directly or indirectly;

"water-cooled chiller" means a factory-made and prefabricated assembly (whether or not it is shipped as one package) comprising one or more of each of the following:

(*a*) a compressor;

(*b*) a water-cooled condenser;

(*c*) an evaporator,

with interconnections and accessories, designed to produce chilled water by using a vapour compression refrigeration cycle to remove heat from chilled water in the evaporator and reject the heat to water in the condenser;

"water-cooled condenser" means a refrigeration system component where refrigerant vapour is condensed and the heat rejected to water, resulting in a rise in water temperature.

Relevant person

7G. Section 26B(1) of the Act applies to a corporation that has operational control of —

(*a*) any premises that are located within any land that is zoned as a Business 1 or Business 2 zone in the Master Plan under the Planning Act (Cap. 232); or

(*b*) a business activity that is attributable to any of the following industry sectors:

(i) manufacturing and manufacturing-related services;

(ii) supply of electricity, gas, steam, compressed air and chilled water for air-conditioning;

(iii) water supply and sewage and waste management.

Prescribed energy-consuming system

7H. For the purposes of section 26B(2) of the Act, the prescribed energy-consuming system is a water-cooled chilled water system that —

(*a*) is electrically driven;

(*b*) comprises at least one chiller that produces, or the relevant person intends to be used to produce, chilled water without requiring the use of antifreeze;

(*c*) has a total refrigeration capacity of 1055 kW_c or more when rated at standard rating conditions in accordance with the specified AHRI Standard; and

(*d*) generates, or the relevant person intends to be used to generate, chilled water at a temperature of 3°C or higher,

but excludes any chiller or part of a chiller comprised in the water-cooled chilled water system that produces, or that the relevant person intends to be used for the production of, chilled water requiring the use of antifreeze, and any chilled water pump for that chiller or part and interconnections to the pump.

Prescribed change to energy requirements

7I. For the purposes of paragraph (*b*) of the definition of "installation and retrofitting works" in section 26B(5) of the Act, any of the following changes to the energy requirements of a prescribed system are installation and retrofitting works:

(*a*) the addition of a water-cooled chiller (other than a water-cooled chiller that produces, or that the relevant person intends to be used to produce, chilled water requiring the use of antifreeze) to the prescribed system that changes the energy performance of the system;

(*b*) the substantial alteration or removal of a water-cooled chiller in the prescribed system that changes the energy performance of the system.

Prescribed permanent measuring instruments

7J.—(1) For the purposes of section 26B(2) of the Act, the following are the prescribed permanent measuring instruments for the purpose of assessing the as-built energy efficiency of a prescribed system:

(*a*) subject to paragraph (2) —

(i) a temperature sensor to measure the chilled water supply temperature of each water-cooled chiller in the prescribed system; and

(ii) a temperature sensor to measure the chilled water return temperature of each water-cooled chiller in the prescribed system;

(*b*) subject to paragraphs (2) and (4), a temperature sensor to measure the condenser water supply temperature of each water-cooled chiller in the prescribed system;

(*c*) subject to paragraphs (2) and (4), a temperature sensor to measure the condenser water return temperature of each water-cooled chiller in the prescribed system;

(*d*) subject to paragraph (2), one or more flowmeters by or from which the flowrate of the chilled water in each water-cooled chiller in the prescribed system may be measured or derived;

(*e*) subject to paragraphs (2) and (4), one or more flowmeters by or from which the flowrate of the

condenser water in each water-cooled chiller in the prescribed system may be measured or derived;

(*f*) one or more power meters by which the total electrical energy and electrical power consumption of each of the following groups of equipment may be measured or derived:

(i) the water-cooled chillers;

(ii) the chilled water pumps;

(iii) the condenser water pumps;

(iv) the cooling towers.

(2) Where water-cooled chillers share a common chilled water header or a common condenser water header —

(*a*) a temperature sensor may be installed at the common header for the chilled water or the condenser water, as the case may be —

(i) instead of for each water-cooled chiller; or

(ii) in addition to the temperature sensors for each water-cooled chiller; and

(*b*) if temperature sensors are installed at the common headers to measure both the water supply and return temperatures for the chilled water or condenser water, a flowmeter may be installed at any common header for the chilled water or condenser water, as the case may be —

(i) instead of for each water-cooled chiller; or

(ii) in addition to the flowmeters for each water-cooled chiller.

(3) In relation to each temperature sensor mentioned in paragraph (1)(*a*), (*b*) or (*c*) —

(*a*) a test plug or thermowell must also be installed on the chilled water and condenser water pipelines before and after each temperature sensor; and

(*b*) any thermowell installed must enable the temperature sensor inserted in the thermowell to come into direct contact with the fluid in the pipeline.

(4) Paragraph (1)(*b*), (*c*) and (*e*) does not apply if the amount or rate of heat rejection of the prescribed system may be derived from other temperature and flowrate measurements taken in the prescribed system.

(5) The end-to-end uncertainty for each measurement from a prescribed permanent measuring instrument must not exceed —

(*a*) for a temperature sensor — ±0.05°C;

(*b*) for a flowmeter — ±1%; and

(*c*) for a power meter — ±2%.

(6) Where a relevant person satisfies the Director-General that it is not reasonably practicable to install a flowmeter that complies with paragraph (5)(*b*), the relevant person may install a flowmeter with an uncertainty for each measurement that does not exceed ±2%.

(7) The overall end-to-end uncertainty of all the prescribed permanent measuring instruments used in the prescribed system must not exceed ±5%.

(8) For the purposes of paragraph (7), the overall end-to-end uncertainty of the prescribed permanent measuring instruments is the number ascertained by calculating the square root of the formula $A^2 + B^2 + C^2$, where —

(*a*) A is the percentage end-to-end uncertainty of the difference between the chilled water supply and return temperatures, calculated in accordance with the formula $[\sqrt{D^2 + E^2} \div F] \times 100$, where —

(i) D is the end-to-end uncertainty of the chilled water supply temperature measurement;

(ii) E is the end-to-end uncertainty of the chilled water return temperature measurement; and

(iii) F is the smallest value of all values calculated for the prescribed system of the measured chilled water return temperatures less the measured chilled water supply temperatures for the water-cooled chillers in the prescribed system;

(*b*) B is the percentage end-to-end uncertainty of the chilled water flowrate measurement; and

(*c*) C is the percentage end-to-end uncertainty of power consumption measurement.

(9) The percentage system heat balance for the prescribed system (calculated in accordance with paragraph B.2.2 of SS 591/2013) must be within ±5% for at least 80% of data points.

Prescribed manner of assessment

7K.—(1) The assessment of the as-built energy efficiency of a prescribed system must be carried out in the following manner:

(*a*) the assessment must be based on measurements made by the prescribed permanent measuring instruments —

(i) collected at intervals of one minute and recorded in 3 decimal places or more;

(ii) collected from the operation of the prescribed system over a continuous period of not less than 2 weeks (called in these Regulations the assessment period); and

(iii) stored in an energy management system that stores and calculates the information specified in paragraph (3);

(*b*) a qualified person must certify that regulation 7J is complied with in relation to every prescribed permanent measuring instrument installed for the prescribed system and that the energy management

system mentioned in sub-paragraph (*a*)(iii) accurately calculates the information specified in paragraph (3);

(*c*) the qualified person mentioned in sub-paragraph (*b*) must separately verify the as-built energy efficiency of the prescribed system calculated by the energy management system, using the measurements mentioned in sub-paragraph (*a*).

(2) For the purpose of the assessment under paragraph (1), any measurements collected under sub-paragraph (*a*)(ii) of that paragraph for any period for which any part of a water-cooled chiller in the prescribed system is producing chilled water requiring the use of antifreeze, must be disregarded in the assessment of the as-built energy efficiency of a prescribed system under that paragraph.

(3) The information mentioned in paragraph (1)(*a*)(iii) and (*b*) comprises all of the following:

(*a*) where any cooling tower of the prescribed system cools water from a source external to the prescribed system and any prescribed permanent measuring instrument measures a parameter partially attributable to that external source — the heat gained by and heat lost from cooling water from that external source;

(*b*) the electrical energy and electrical power consumed by all chilled water pumps in the prescribed system in pumping chilled water through all the evaporators in the prescribed system, based on the ratio of its flowrate to the total flowrate through the pumps, if applicable;

(*c*) the electrical energy and electrical power consumed by all condenser water pumps in the prescribed system in pumping water through all the water-cooled condensers in the prescribed system, based on the ratio of its flowrate to the total flowrate through the pumps, if applicable;

(*d*) the electrical energy and electrical power consumed by all cooling towers in the prescribed system in rejecting heat from water that passes through all the water-cooled condensers in the prescribed system, based on the ratio of its heat rejected to the total heat rejected by the cooling towers, if applicable;

(*e*) the operating hours of the prescribed system;

(*f*) the refrigeration output and refrigeration energy output of the chilled water, the rate or amount of heat removal from the condenser water, and the electrical energy and electrical power consumption of the prescribed system;

(*g*) the energy performance of the following groups of equipment in the prescribed system:

(i) the water-cooled chillers;

(ii) the chilled water pumps;

(iii) the condenser water pumps;

(iv) the cooling towers;

(*h*) the energy performance of the prescribed system;

(*i*) the heat balance of the prescribed system, calculated in accordance with paragraph B.2.2 of SS 591/2013.

(4) For the purposes of converting refrigeration output in refrigerant ton to kW_c, the refrigeration output in unit of refrigerant ton must be multiplied by 3.517 kW_c/RT.

Minimum energy efficiency standard

7L.—(1) For the purposes of section 26B(3) of the Act, the prescribed minimum energy efficiency standard applicable to a prescribed system is the energy performance corresponding to —

(*a*) for a prescribed system that is used to produce chilled water only at one setpoint temperature at all times —

the number ascertained in accordance with the formula specified in paragraph (2); and

(*b*) for a prescribed system that is used to produce chilled water at 2 or more setpoint temperatures — the refrigeration output or refrigeration energy output weighted-average of the number ascertained in accordance with the formula specified in paragraph (2) for each temperature at which chilled water is produced by the prescribed system.

(2) The formula mentioned in paragraph (1) is $0.212 - G \times 0.003$, where G is either of the following, measured in degrees Celsius:

(*a*) where the average temperature of the chilled water supply produced by the prescribed system during the assessment period is within 0.5°C of the setpoint temperature of the chilled water — the setpoint temperature rounded to the nearest 1°C;

(*b*) in any other case — the average temperature of chilled water supply rounded to the nearest 1°C.

Requirements for assessment reports

7M.—(1) The assessment of the prescribed system must be completed and the assessment report mentioned in section 26B(2)(*b*) of the Act must be submitted —

(*a*) where the prescribed system is situated in any premises that are wholly and lawfully used or occupied by only one person — within 15 months after the date the temporary occupation permit or certificate of statutory completion is issued (whichever is earlier) for building works that include the installation and retrofitting works on the prescribed system at the premises on which a water-cooled chiller is to be or is situated; or

(*b*) in any other case — within 3 months after the earlier of the following:

(i) the date on which the following requirements are satisfied:

(A) the temporary occupation permit or certificate of statutory completion is issued for the building works at the premises that include the installation and retrofitting works on the prescribed system;

(B) more than 80% of the gross floor area of the premises is occupied;

(ii) the expiry of 36 months after the temporary occupation permit or certificate of statutory completion is issued (whichever is earlier) for the building works at the premises that include the installation and retrofitting works on the prescribed system.

(2) Any assessment report (whether under section 26B(2)(*b*) or (3)(*b*) of the Act) on the prescribed system must include the following, where applicable:

(*a*) details of the components of the prescribed system, including —

(i) the unique identification of each component;

(ii) the type of each component, including whether variable frequency drives are present;

(iii) the installation year of each component;

(iv) the refrigeration capacity of each chiller at standard rating conditions in accordance with the specified AHRI Standard;

(v) the input power to each chiller where the refrigeration output corresponds to refrigeration capacity of the chiller mentioned in sub-paragraph (iv);

(vi) the chilled water supply temperature setpoint of each chiller;

(vii) the designed difference in chilled water supply temperature and return temperature of each chiller;

(viii) the rated performance of each chiller at standard rating conditions in accordance with the specified AHRI Standard;

(ix) the rated motor output power for each chilled water pump, condenser water pump and cooling tower fan;

(x) the pump head of each chilled water pump and condenser water pump;

(xi) the flowrate of each chilled water pump, condenser water pump and cooling tower;

(xii) the rated pump efficiency for each chilled water pump and condenser water pump;

(xiii) the rated fan efficiency for each cooling tower fan;

(xiv) the rated motor efficiency for each chilled water pump, condenser water pump and cooling tower fan;

(xv) an indication if the power consumption of each chilled water pump, condenser water pump and cooling tower fan is attributable only to the prescribed system; and

(xvi) the schematic of the prescribed system, including all components of the system;

(*b*) details of the prescribed permanent measuring instruments installed, including —

(i) the unique identification of each instrument;

(ii) the type of each instrument;

(iii) the parameter measured by each instrument;

(iv) the location of each instrument;

(v) the instrument range of each instrument;

(vi) the frequency of measurement taken by each instrument;

(vii) the end-to-end uncertainty of each measurement;

(viii) the last calibration date of each instrument; and

(ix) the location of each instrument superimposed on the schematic of the prescribed system;

(*c*) the assessment period;

(*d*) the information, documents or analyses relied upon by the qualified person in certifying the matters mentioned in regulation 7K(1)(*b*) and in conducting the verification in regulation 7K(1)(*c*);

(*e*) the reasons given to the Director-General under section 31B of the Act or regulation 7J(6) for any waiver or modification of a requirement under section 26B of the Act or in this Part, if any;

(*f*) the reasons for failing to comply with any requirement under section 26B of the Act or in this Part, if any;

(*g*) such other information or document as the Director-General may require.

(3) The report specified in paragraph (2) must be —

(*a*) endorsed by the qualified person mentioned in regulation 7K(1)(*b*);

(*b*) endorsed by the chief executive of the relevant person;

(*c*) submitted in the manner specified by the Director-General; and

(*d*) submitted by an employee of the relevant person who is authorised by the relevant person for this purpose.

Requirements relating to keeping of records

7N.—(1) Records containing the following information must be kept for the purposes of section 29(1) of the Act:

(*a*) all measurements mentioned in regulation 7K(1)(*a*) and information mentioned in regulation 7K(3);

(*b*) all calculations mentioned in regulation 7K made by the qualified person in preparing the assessment report;

(*c*) the as-built drawings of the prescribed system plant room layout indicating details of the location of every prescribed permanent measuring instrument and any test plug or thermowell;

(*d*) all as-built schematic drawings of the prescribed system;

(*e*) all calibration certificates from accredited laboratories or factory calibration certificates from manufacturers for every prescribed permanent measuring instrument;

(*f*) all input parameters for every prescribed permanent measuring instrument;

(*g*) the technical specifications of each component of the prescribed system;

(*h*) any other information relied on in preparing the assessment report.

(2) For the purposes of section 29(2)(*a*) of the Act, the prescribed period to keep and maintain the records mentioned in paragraph (1) in relation to an assessment report is 5 years after the date the assessment report is submitted.

(3) Without affecting paragraph (2), the measurements mentioned in regulation 7K(1)(*a*) and information mentioned in regulation 7K(3) must be kept in the energy management system for a period of at least 3 years after the date the assessment report is submitted.".

[G.N. Nos. S 752/2017; S 605/2018; S 898/2019]

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