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Environmental Sustainability Group

1 March 2023

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Dear Sir/ Madam

CIRCULAR TO PROFESSIONAL INSTITUTES/ ASSOCIATIONS

ADOPTION OF THE CODE ON PERIODIC ENERGY AUDIT OF BUILDING COOLING SYSTEM (EDITION 4.0)

Aim

1 This circular is to inform the industry on the adoption of the Code on Periodic Energy Audit of Building Cooling System (Edition 4.0) (the “**Energy Audit Code**”) under the Building Control (Environmental Sustainability Measures for Existing Buildings) Regulation 2013.

Background

2 Under 22FF of the Building Control Act, building owners will be served a Notice to conduct an energy audit on their building cooling systems. The energy audit shall be carried out by a Professional Engineer (Mechanical) or an energy auditor registered with BCA and to be conducted in the prescribed manner specified in the Energy Audit Code.

3 The objective of the energy audit requirement is to ensure that the building cooling systems installed continue to operate as efficiently as designed. The level of operating system efficiency (OSE) of these systems must minimally meet the prescribed energy performance standard stipulated in the Codes and Green Mark Certification Standard referred to in the Building Control (Environmental Sustainability) Regulations 2008 (the “**ES Regulations 2008**”) and the Building Control (Environmental Sustainability Measures for Existing Buildings) Regulations 2013 (the “**ESM Regulations 2013**”).

Adoption of the Energy Audit Code

4 The Energy Audit Code is revised to align with the recent changes to the prescribed minimum energy performance standards spelled out in the following Codes and Standards namely :

- (a) Code for Environmental Sustainability of Buildings (Edition 4.0);
- (b) Code for Environmental Sustainability Measures for Existing Buildings (Edition 3.0); and
- (c) Green Mark Certification Standard 2021

5 The energy audit report submission template provided in the Energy Audit Code is also updated to include data required in relation to the total cooling system efficiency as well as the verification check requirement as part of the energy audit process.

6 The [Energy Audit Code](#) will apply to all energy audit reports submitted on or after 1 June 2023. The summary of key changes is detailed in Annex A for reference.

For Clarification

7. We would appreciate if you could convey the contents of this circular to members of your organisation. For clarification, please submit your enquiry through [BCA's Online Feedback Form](#) or call us at 1800 342 5222.

Thank you.

Yours faithfully



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Annex A – Amendments to the Energy Audit Code

| Items | Requirements | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|--|--|--|-----------|---|------|---|--|--|--|--|--------------------------------|---|---|---|---|----|---|--|------|------|------|------|------|--|--|-----------|-----------------------------------|---------------|--|----------------------------|----------------------|--|------------|-----------|
| <p>Minimum Operating System Efficiency (OSE) Standard</p> <ul style="list-style-type: none"> - ESM Reg 2013 - ES Reg 2008 | <ul style="list-style-type: none"> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p style="text-align: center; background-color: #e0e0e0; margin: 0;">Total System Efficiency (TSE) for Water-Cooled Building Cooling System (kW/RT)</p> <table border="1" style="width: 100%; border-collapse: collapse; margin: 5px 0;"> <tr> <td style="width: 40%;">Existing Building with Major Energy-Use Change</td> <td style="text-align: center;">0.9 kW/RT</td> </tr> </table> <p style="font-size: small; margin: 5px 0;">where TSE refers to combined system efficiency of the chiller plant and air distribution systems and the minimum requirement on water-side component efficiency will be based on the chilled water supply temperature and as follows:</p> <table border="1" style="width: 100%; border-collapse: collapse; margin: 5px 0;"> <thead> <tr> <th colspan="7" style="text-align: center; background-color: #e0e0e0;">Minimum Water-Cooled Chilled Water Plant Efficiency</th> </tr> <tr> <th style="font-size: small;">Chilled Water Supply Temp (°C)</th> <th style="font-size: small;">6</th> <th style="font-size: small;">7</th> <th style="font-size: small;">8</th> <th style="font-size: small;">9</th> <th style="font-size: small;">10</th> <th rowspan="2" style="font-size: x-small; vertical-align: middle;">For chilled water supply temp above 10°C, the threshold will be adjusted from 0.64kW/RT for every 1°C increase in chilled water temperature</th> </tr> </thead> <tbody> <tr> <td style="font-size: small;">Water-Cooled Chiller System Efficiency (kW/RT)</td> <td style="text-align: center;">0.68</td> <td style="text-align: center;">0.67</td> <td style="text-align: center;">0.66</td> <td style="text-align: center;">0.65</td> <td style="text-align: center;">0.64</td> <td></td> </tr> </tbody> </table> </div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p style="text-align: center; background-color: #e0e0e0; margin: 0;">Total System Efficiency (TSE) for Air-Cooled Building Cooling System (kW/RT)</p> <table border="1" style="width: 100%; border-collapse: collapse; margin: 5px 0;"> <tr> <td style="width: 40%;">Existing building with Major Energy-Use Change</td> <td style="text-align: center;">1.0 kW/RT</td> </tr> </table> <p style="font-size: small; margin: 5px 0;">where the minimum water-side component efficiency for air-cooled chilled water plant is 0.85 kW/RT</p> </div> <p style="margin: 0;">Minimum OSE standards applicable for buildings on land sold on or after 1 June 2022 under the Government Land Sales Programme and subject to ES Regulations 2008.</p> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p style="text-align: center; background-color: #e0e0e0; margin: 0;">Total System Efficiency (TSE) for Water-Cooled Building Cooling System (kW/RT)</p> <table border="1" style="width: 100%; border-collapse: collapse; margin: 5px 0;"> <thead> <tr> <th rowspan="2" style="font-size: small;">Green Mark Certification Standard</th> <th colspan="2" style="font-size: small;">Building Type</th> </tr> <tr> <th style="font-size: x-small;">Office/ Retail/ Hotel/ IHL</th> <th style="font-size: x-small;">Other Building Types</th> </tr> </thead> <tbody> <tr> <td style="font-size: small;">Green Mark Platinum Super Low Energy (SLE)</td> <td style="text-align: center;">0.68 kW/RT</td> <td style="text-align: center;">0.7 kW/RT</td> </tr> </tbody> </table> </div> | Existing Building with Major Energy-Use Change | 0.9 kW/RT | Minimum Water-Cooled Chilled Water Plant Efficiency | | | | | | | Chilled Water Supply Temp (°C) | 6 | 7 | 8 | 9 | 10 | For chilled water supply temp above 10°C, the threshold will be adjusted from 0.64kW/RT for every 1°C increase in chilled water temperature | Water-Cooled Chiller System Efficiency (kW/RT) | 0.68 | 0.67 | 0.66 | 0.65 | 0.64 | | Existing building with Major Energy-Use Change | 1.0 kW/RT | Green Mark Certification Standard | Building Type | | Office/ Retail/ Hotel/ IHL | Other Building Types | Green Mark Platinum Super Low Energy (SLE) | 0.68 kW/RT | 0.7 kW/RT |
| Existing Building with Major Energy-Use Change | 0.9 kW/RT | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Minimum Water-Cooled Chilled Water Plant Efficiency | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Chilled Water Supply Temp (°C) | 6 | 7 | 8 | 9 | 10 | For chilled water supply temp above 10°C, the threshold will be adjusted from 0.64kW/RT for every 1°C increase in chilled water temperature | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Water-Cooled Chiller System Efficiency (kW/RT) | 0.68 | 0.67 | 0.66 | 0.65 | 0.64 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Existing building with Major Energy-Use Change | 1.0 kW/RT | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Green Mark Certification Standard | Building Type | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Office/ Retail/ Hotel/ IHL | Other Building Types | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Green Mark Platinum Super Low Energy (SLE) | 0.68 kW/RT | 0.7 kW/RT | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

- Minimum OSE standards applicable to buildings where the applications for planning permission were submitted to the competent authority under the Planning Act 1998 on or after 1 Dec 2021 under the ES Regulations 2008.

| Total System Efficiency (TSE) for Water-Cooled Building Cooling System (kW/RT) | | | | | | | |
|--|--|-----------------------------|------|---|------|------|---|
| New Buildings <i>(based on classification under the Code for Environmental Sustainability of Building (Edition 4.0))</i> | | | | Existing Buildings undergoing Major Retrofitting/ Additions & Alterations | | | |
| 0.85 kW/RT | | | | 0.9 kW/RT | | | |
| where the minimum water-side component efficiency for commercial building development shall not be more than 0.63 kW/RT. As for other building developments, the minimum water-side component efficiency will be based on the chilled water supply temperature and as follows: | | | | | | | |
| Minimum Water-Cooled Chilled Water Plant Efficiency (KW/RT) | | | | | | | |
| Commercial Building | Chilled Water Supply Temp (°C) | Other Building Developments | | | | | For chilled water supply temp above 10°C, the threshold will be adjusted from 0.64kW/RT for every 1°C increase in chilled water temperature |
| | | 6 | 7 | 8 | 9 | 10 | |
| 0.63 kW/RT | Water-Cooled Chiller System Efficiency (kW/RT) | 0.68 | 0.67 | 0.66 | 0.65 | 0.64 | |

| Total System Efficiency (TSE) for Air-Cooled Building Cooling System (kW/RT) | |
|--|-----------|
| All buildings including existing buildings undergoing Major Retrofitting / Major Additions and Alterations | 1.0 kW/RT |
| where the minimum water-side component efficiency for air-cooled chilled water plant is 0.85 kW/RT | |

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|--|--|------------------|--|----|---|--|--|----|--|----|---|----|--|-------------------|--|----|---|----|--|----|---|---|--|----|--|----|---|-----|---|-----|---|
| <p>Verification Check by appointed Qualified Professionals</p> <p>PE(Mech) or Energy Auditor (EA)</p> | <table border="1"> <tr> <td colspan="2">BMS Check</td> </tr> <tr> <td>1.</td> <td>Temperature sensors' ABC coefficient constants input as reflected in the calibration certificates</td> </tr> <tr> <td colspan="2">Power Meter (Consistency Check)</td> </tr> <tr> <td>2.</td> <td>Check power meter reading and BMS reading are same</td> </tr> <tr> <td>3.</td> <td>Check power meter reading and chiller panel or pump VSD display reading is $\leq 3\%$</td> </tr> <tr> <td>4.</td> <td>Check the Current Transformer ratio tallies with power meter setting</td> </tr> <tr> <td colspan="2">Flow Meter</td> </tr> <tr> <td>5.</td> <td>Check sum of flow meter branches tallies with flow meter header reading (if there are flowmeters at header and individual chillers)</td> </tr> <tr> <td>6.</td> <td>Check flowmeter reading and BMS reading are same</td> </tr> <tr> <td>7.</td> <td>Check flowmeter do not have any correction factor or off-set factor input</td> </tr> <tr> <td colspan="2">Verified Temperature Sensor Accuracy</td> </tr> <tr> <td>8.</td> <td>Use calibrated reference temperature sensor with end-to-end uncertainty of owners of buildings with poor energy performance ≤ 0.05 °C</td> </tr> <tr> <td>9.</td> <td>Synchronise the reference temperature sensor device timing with BMS</td> </tr> <tr> <td>10.</td> <td>Collect at least 20 sets of reading from reference temperature sensor device (after insertion into spare test plug) and BMS</td> </tr> <tr> <td>11.</td> <td>Compare the difference between both set of readings, with average of absolute difference to be ≤ 0.07 °C</td> </tr> </table> | BMS Check | | 1. | Temperature sensors' ABC coefficient constants input as reflected in the calibration certificates | Power Meter (Consistency Check) | | 2. | Check power meter reading and BMS reading are same | 3. | Check power meter reading and chiller panel or pump VSD display reading is $\leq 3\%$ | 4. | Check the Current Transformer ratio tallies with power meter setting | Flow Meter | | 5. | Check sum of flow meter branches tallies with flow meter header reading (if there are flowmeters at header and individual chillers) | 6. | Check flowmeter reading and BMS reading are same | 7. | Check flowmeter do not have any correction factor or off-set factor input | Verified Temperature Sensor Accuracy | | 8. | Use calibrated reference temperature sensor with end-to-end uncertainty of owners of buildings with poor energy performance ≤ 0.05 °C | 9. | Synchronise the reference temperature sensor device timing with BMS | 10. | Collect at least 20 sets of reading from reference temperature sensor device (after insertion into spare test plug) and BMS | 11. | Compare the difference between both set of readings, with average of absolute difference to be ≤ 0.07 °C |
| BMS Check | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1. | Temperature sensors' ABC coefficient constants input as reflected in the calibration certificates | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Power Meter (Consistency Check) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2. | Check power meter reading and BMS reading are same | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3. | Check power meter reading and chiller panel or pump VSD display reading is $\leq 3\%$ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| Flow Meter | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 5. | Check sum of flow meter branches tallies with flow meter header reading (if there are flowmeters at header and individual chillers) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| Verified Temperature Sensor Accuracy | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 8. | Use calibrated reference temperature sensor with end-to-end uncertainty of owners of buildings with poor energy performance ≤ 0.05 °C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 11. | Compare the difference between both set of readings, with average of absolute difference to be ≤ 0.07 °C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <p>Total building cooling system efficiency to include airside component</p> | <ul style="list-style-type: none"> • Changes to incorporate in Appendix C of the Energy Audit Report Template (provided in Annex A of the Energy Audit Code) • The super-imposed plot of daily total cooling system efficiency (kW/RT) to be provided as illustrated in Figure 21. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |