

# TYPE APPROVAL CERTIFICATE

## This is to certify:

**That the Electric Power Cable**

with type designation(s)

**0,6/1 kV BFOI & BFOI(c) & BFOI(i) & FX-BFOI, 0.6/1kV(1.8/3kV) BFOI(VFD) & FX-BFOI(VFD)**

Issued to

**TMC Co., Ltd**

**Cheonan-si Chungcheongnam-do, Republic of Korea**

is found to comply with

**DNV GL rules for classification – Ships, offshore units, and high speed and light craft**

**IEC 60092-353 (2011-08)**

**IEC 60331-1/2 (2009-05)**

**IEC 60331-21 (1999-04)**

**IEC 60332-3-22 (2009-02)**

## Application :

**General power, lighting and control. Flame retardant Cat.A. Fire resistant. Halogen free. Low smoke. Low temperature.**

**Product(s) approved by this certificate is/are accepted for installation on all vessels classed by DNV GL.**

| Type                                                           | Voltage class (kV)      | Temp. class (°C) |
|----------------------------------------------------------------|-------------------------|------------------|
| <b>0,6/1 kV BFOI &amp; BFOI(c) &amp; BFOI(i) &amp; FX-BFOI</b> | <b>0,6/1</b>            | <b>90</b>        |
| <b>0.6/1kV(1.8/3kV) BFOI(VFD) &amp; FX-BFOI(VFD)</b>           | <b>0.6/1kV(1.8/3kV)</b> | <b>90</b>        |

This Certificate is valid until **2021-10-31**.

Issued at **Busan** on **2016-11-01**

DNV GL local station: **Seoul**

Approval Engineer: **Eun Jin Lee**

for **DNV GL**

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**Baeg Soon Choi**  
**Head of Section**

This Certificate is subject to terms and conditions overleaf. Any significant change in design or construction may render this Certificate invalid. The validity date relates to the Type Approval Certificate and not to the approval of equipment/systems installed.

## Product description

Type : 0,6/1 kV BFOI & BFOI(c) & BFOI(i) & FX-BFOI  
0.6/1kV(1.8/3kV) BFOI(VFD) & FX-BFOI(VFD)

Conductors: Plain or Tinned stranded copper class 2(class 5 for FX-type)  
Core insulation: Mica tape + XLPE  
Screen: AL/PS tape +Tinned copper drain wire  
CU/PS tape – VFD type  
Inner covering: Non-hygroscopic material  
Metal covering: Plain or Tinned copper wire braid  
Outer sheath: SHF1

| Number of<br>cores x<br>conductor<br>cross-section<br>mm <sup>2</sup> | Number of<br>cores x<br>conductor<br>cross-section<br>mm <sup>2</sup> | Number of<br>cores x<br>conductor<br>cross-section<br>mm <sup>2</sup> | Number of<br>cores x<br>conductor<br>cross-section<br>mm <sup>2</sup> | Number of<br>cores x<br>conductor<br>cross-section<br>mm <sup>2</sup> |
|-----------------------------------------------------------------------|-----------------------------------------------------------------------|-----------------------------------------------------------------------|-----------------------------------------------------------------------|-----------------------------------------------------------------------|
| <b>BFOI</b>                                                           | 2 x 16 + E                                                            | 3 x 150 + E                                                           | 7 x 1,0                                                               | 37 x 2,5                                                              |
| 1 x 1,5                                                               | 2 x 25 + E                                                            | 3 x 185 + E                                                           | 9 x 1,0                                                               | 44 x 2,5                                                              |
| 1 x 2,5                                                               | 2 x 35 + E                                                            | 3 x 240 + E                                                           | 12 x 1,0                                                              |                                                                       |
| 1 x 4                                                                 | 2 x 50 + E                                                            |                                                                       | 16 x 1,0                                                              | 2 x 4                                                                 |
| 1 x 6                                                                 | 2 x 70 + E                                                            | 4 x 1,5                                                               | 19 x 1,0                                                              | 3 x 4                                                                 |
| 1 x 10                                                                | 2 x 95 + E                                                            | 4 x 2,5                                                               | 24 x 1,0                                                              | 4 x 4                                                                 |
| 1 x 16                                                                | 2 x 120 + E                                                           | 4 x 4                                                                 | 27 x 1,0                                                              | 5 x 4                                                                 |
| 1 x 25                                                                | 2 x 150 + E                                                           | 4 x 6                                                                 | 33 x 1,0                                                              | 7 x 4                                                                 |
| 1 x 35                                                                | 2 x 185 + E                                                           | 4 x 10                                                                | 37 x 1,0                                                              | 9 x 4                                                                 |
| 1 x 50                                                                |                                                                       | 4 x 16                                                                | 44 x 1,0                                                              | 12 x 4                                                                |
| 1 x 70                                                                | 3 x 1,5                                                               | 4 x 25                                                                |                                                                       | 16 x 4                                                                |
| 1 x 95                                                                | 3 x 2,5                                                               | 4 x 35                                                                | 2 x 1,5                                                               | 19 x 4                                                                |
| 1 x 120                                                               | 3 x 4                                                                 | 4 x 50                                                                | 3 x 1,5                                                               | 24 x 4                                                                |
| 1 x 150                                                               | 3 x 6                                                                 | 4 x 70                                                                | 4 x 1,5                                                               | 27 x 4                                                                |
| 1 x 185                                                               | 3 x 10                                                                | 4 x 95                                                                | 5 x 1,5                                                               | 33 x 4                                                                |
| 1 x 240                                                               | 3 x 16                                                                | 4 x 120                                                               | 7 x 1,5                                                               | 37 x 4                                                                |
| 1 x 300                                                               | 3 x 25                                                                | 4 x 150                                                               | 9 x 1,5                                                               | 44 x 4                                                                |
|                                                                       | 3 x 35                                                                | 4 x 185                                                               | 12 x 1,5                                                              | <b>BFOI(c)</b>                                                        |
| 2 x 1,5                                                               | 3 x 50                                                                |                                                                       | 16 x 1,5                                                              | 2 x 1,5                                                               |
| 2 x 2,5                                                               | 3 x 70                                                                | 4 x 1,5 + E                                                           | 19 x 1,5                                                              | 2 x 2,5                                                               |
| 2 x 4                                                                 | 3 x 95                                                                | 4 x 2,5 + E                                                           | 24 x 1,5                                                              | 2 x 4                                                                 |
| 2 x 6                                                                 | 3 x 120                                                               | 4 x 4 + E                                                             | 27 x 1,5                                                              | 2 x 6                                                                 |
| 2 x 10                                                                | 3 x 150                                                               | 4 x 6 + E                                                             | 33 x 1,5                                                              | 2 x 10                                                                |
| 2 x 16                                                                | 3 x 185                                                               | 4 x 10 + E                                                            | 37 x 1,5                                                              | 2 x 16                                                                |
| 2 x 25                                                                | 3 x 240                                                               | 4 x 16 + E                                                            | 44 x 1,5                                                              | 2 x 25                                                                |
| 2 x 35                                                                |                                                                       | 4 x 25 + E                                                            |                                                                       | 2 x 35                                                                |
| 2 x 50                                                                | 3 x 1,5 + E                                                           | 4 x 35 + E                                                            | 2 x 2,5                                                               |                                                                       |
| 2 x 70                                                                | 3 x 2,5 + E                                                           | 4 x 50 + E                                                            | 3 x 2,5                                                               | 3 x 1,5                                                               |
| 2 x 95                                                                | 3 x 4 + E                                                             | 4 x 70 + E                                                            | 4 x 2,5                                                               | 3 x 2,5                                                               |
| 2 x 120                                                               | 3 x 6 + E                                                             | 4 x 95 + E                                                            | 5 x 2,5                                                               | 3 x 4                                                                 |
| 2 x 150                                                               | 3 x 10 + E                                                            | 4 x 120 + E                                                           | 7 x 2,5                                                               | 3 x 6                                                                 |
| 2 x 185                                                               | 3 x 16 + E                                                            | 4 x 150 + E                                                           | 9 x 2,5                                                               | 3 x 10                                                                |
|                                                                       | 3 x 25 + E                                                            | 4 x 185 + E                                                           | 12 x 2,5                                                              | 3 x 16                                                                |
| 2 x 1,5 + E                                                           | 3 x 35 + E                                                            |                                                                       | 16 x 2,5                                                              | 3 x 25                                                                |
| 2 x 2,5 + E                                                           | 3 x 50 + E                                                            | 2 x 1,0                                                               | 19 x 2,5                                                              | 3 x 35                                                                |
| 2 x 4 + E                                                             | 3 x 70 + E                                                            | 3 x 1,0                                                               | 24 x 2,5                                                              |                                                                       |
| 2 x 6 + E                                                             | 3 x 95 + E                                                            | 4 x 1,0                                                               | 27 x 2,5                                                              | 2 x 1,0                                                               |
| 2 x 10 + E                                                            | 3 x 120 + E                                                           | 5 x 1,0                                                               | 33 x 2,5                                                              | 3 x 1,0                                                               |

| Number of<br>cores x<br>conductor<br>cross-section<br>mm <sup>2</sup> |
|-----------------------------------------------------------------------|
| 4 x 1,0                                                               |
| 5 x 1,0                                                               |
| 7 x 1,0                                                               |
| 9 x 1,0                                                               |
| 12 x 1,0                                                              |
| 16 x 1,0                                                              |
| 19 x 1,0                                                              |
| 24 x 1,0                                                              |
| 27 x 1,0                                                              |
| 33 x 1,0                                                              |
| 37 x 1,0                                                              |
| 44 x 1,0                                                              |
|                                                                       |
| 2 x 1,5                                                               |
| 3 x 1,5                                                               |
| 4 x 1,5                                                               |
| 5 x 1,5                                                               |
| 7 x 1,5                                                               |
| 9 x 1,5                                                               |
| 12 x 1,5                                                              |
| 16 x 1,5                                                              |
| 19 x 1,5                                                              |
| 23 x 1,5                                                              |
| 24 x 1,5                                                              |
| 27 x 1,5                                                              |
| 33 x 1,5                                                              |
| 37 x 1,5                                                              |
| 44 x 1,5                                                              |
|                                                                       |
| 2 x 2,5                                                               |
| 3 x 2,5                                                               |
| 4 x 2,5                                                               |
| 5 x 2,5                                                               |
| 7 x 2,5                                                               |
| 9 x 2,5                                                               |
| 12 x 2,5                                                              |
| 16 x 2,5                                                              |
| 19 x 2,5                                                              |
| 24 x 2,5                                                              |
| 27 x 2,5                                                              |
| 33 x 2,5                                                              |
| 37 x 2,5                                                              |
| 44 x 2,5                                                              |
| <b>BFOI(i)</b>                                                        |
| 2 x 1,0                                                               |
| 3 x 1,0                                                               |
| 4 x 1,0                                                               |
| 5 x 1,0                                                               |
| 7 x 1,0                                                               |

| Number of<br>cores x<br>conductor<br>cross-section<br>mm <sup>2</sup> |
|-----------------------------------------------------------------------|
| 9 x 1,0                                                               |
| 12 x 1,0                                                              |
| 16 x 1,0                                                              |
| 19 x 1,0                                                              |
| 24 x 1,0                                                              |
| 27 x 1,0                                                              |
| 33 x 1,0                                                              |
| 37 x 1,0                                                              |
| 44 x 1,0                                                              |
|                                                                       |
| 2 x 1,5                                                               |
| 3 x 1,5                                                               |
| 4 x 1,5                                                               |
| 5 x 1,5                                                               |
| 7 x 1,5                                                               |
| 9 x 1,5                                                               |
| 12 x 1,5                                                              |
| 16 x 1,5                                                              |
| 19 x 1,5                                                              |
| 24 x 1,5                                                              |
| 27 x 1,5                                                              |
| 33 x 1,5                                                              |
| 37 x 1,5                                                              |
| 44 x 1,5                                                              |
|                                                                       |
| 2 x 2,5                                                               |
| 3 x 2,5                                                               |
| 4 x 2,5                                                               |
| 5 x 2,5                                                               |
| 7 x 2,5                                                               |
| 9 x 2,5                                                               |
| 12 x 2,5                                                              |
| 16 x 2,5                                                              |
| 19 x 2,5                                                              |
| 24 x 2,5                                                              |
| 27 x 2,5                                                              |
| 33 x 2,5                                                              |
| 37 x 2,5                                                              |
| 44 x 2,5                                                              |
| <b>FX-BFOI</b>                                                        |
| 1 x 1,5                                                               |
| 1 x 2,5                                                               |
| 1 x 4                                                                 |
| 1 x 6                                                                 |
| 1 x 10                                                                |
| 1 x 16                                                                |
| 1 x 25                                                                |
| 1 x 35                                                                |
| 1 x 50                                                                |

| Number of<br>cores x<br>conductor<br>cross-section<br>mm <sup>2</sup> |
|-----------------------------------------------------------------------|
| 1 x 70                                                                |
| 1 x 95                                                                |
| 1 x 120                                                               |
| 1 x 150                                                               |
| 1 x 185                                                               |
| 1 x 240                                                               |
| 1 x 300                                                               |
|                                                                       |
| 2 x 1,5                                                               |
| 2 x 2,5                                                               |
| 2 x 4                                                                 |
| 2 x 6                                                                 |
| 2 x 10                                                                |
| 2 x 16                                                                |
| 2 x 25                                                                |
| 2 x 35                                                                |
| 2 x 50                                                                |
| 2 x 70                                                                |
| 2 x 95                                                                |
| 2 x 120                                                               |
| 2 x 150                                                               |
| 2 x 185                                                               |
| 2 x 240                                                               |
| 2 x 300                                                               |
|                                                                       |
| 2 x 1,5 + E                                                           |
| 2 x 2,5 + E                                                           |
| 2 x 4 + E                                                             |
| 2 x 6 + E                                                             |
| 2 x 10 + E                                                            |
| 2 x 16 + E                                                            |
| 2 x 25 + E                                                            |
| 2 x 35 + E                                                            |
| 2 x 50 + E                                                            |
| 2 x 70 + E                                                            |
| 2 x 95 + E                                                            |
| 2 x 120 + E                                                           |
| 2 x 150 + E                                                           |
| 2 x 185 + E                                                           |
| 2 x 240 + E                                                           |
|                                                                       |
| 3 x 1,5                                                               |
| 3 x 2,5                                                               |
| 3 x 4                                                                 |
| 3 x 6                                                                 |
| 3 x 10                                                                |
| 3 x 16                                                                |
| 3 x 25                                                                |
| 3 x 35                                                                |

| Number of<br>cores x<br>conductor<br>cross-section<br>mm <sup>2</sup> |
|-----------------------------------------------------------------------|
| 3 x 50                                                                |
| 3 x 70                                                                |
| 3 x 95                                                                |
| 3 x 120                                                               |
| 3 x 150                                                               |
| 3 x 185                                                               |
| 3 x 240                                                               |
| 3 x 300                                                               |
|                                                                       |
| 3 x 1,5 + E                                                           |
| 3 x 2,5 + E                                                           |
| 3 x 4 + E                                                             |
| 3 x 6 + E                                                             |
| 3 x 10 + E                                                            |
| 3 x 16 + E                                                            |
| 3 x 25 + E                                                            |
| 3 x 35 + E                                                            |
| 3 x 50 + E                                                            |
| 3 x 70 + E                                                            |
| 3 x 95 + E                                                            |
| 3 x 120 + E                                                           |
| 3 x 150 + E                                                           |
| 3 x 185 + E                                                           |
| 3 x 240 + E                                                           |
|                                                                       |
| 4 x 1,5                                                               |
| 4 x 2,5                                                               |
| 4 x 4                                                                 |
| 4 x 6                                                                 |
| 4 x 10                                                                |
| 4 x 16                                                                |
| 4 x 25                                                                |
| 4 x 35                                                                |
| 4 x 50                                                                |
| 4 x 70                                                                |
| 4 x 95                                                                |
| 4 x 120                                                               |
| 4 x 150                                                               |
| 4 x 185                                                               |
| 4 x 240                                                               |
| 4 x 300                                                               |
|                                                                       |
| 5 x 1,0                                                               |
| 6 x 1,0                                                               |
| 7 x 1,0                                                               |
| 8 x 1,0                                                               |
| 9 x 1,0                                                               |
| 10 x 1,0                                                              |
| 12 x 1,0                                                              |

| Number of<br>cores x<br>conductor<br>cross-section<br>mm <sup>2</sup> |
|-----------------------------------------------------------------------|
| 14 x 1,0                                                              |
| 16 x 1,0                                                              |
| 19 x 1,0                                                              |
| 20 x 1,0                                                              |
| 24 x 1,0                                                              |
| 27 x 1,0                                                              |
| 30 x 1,0                                                              |
| 33 x 1,0                                                              |
| 37 x 1,0                                                              |
| 44 x 1,0                                                              |
|                                                                       |
| 5 x 1,5                                                               |
| 6 x 1,5                                                               |
| 7 x 1,5                                                               |
| 8 x 1,5                                                               |
| 9 x 1,5                                                               |
| 10 x 1,5                                                              |
| 12 x 1,5                                                              |
| 14 x 1,5                                                              |
| 16 x 1,5                                                              |
| 19 x 1,5                                                              |
| 20 x 1,5                                                              |
| 24 x 1,5                                                              |
| 27 x 1,5                                                              |
| 30 x 1,5                                                              |
| 33 x 1,5                                                              |
| 37 x 1,5                                                              |
| 44 x 1,5                                                              |
|                                                                       |
| 5 x 2,5                                                               |
| 6 x 2,5                                                               |
| 7 x 2,5                                                               |
| 8 x 2,5                                                               |
| 9 x 2,5                                                               |
| 10 x 2,5                                                              |
| 12 x 2,5                                                              |
| 14 x 2,5                                                              |
| 16 x 2,5                                                              |
| 19 x 2,5                                                              |
| 20 x 2,5                                                              |
| 24 x 2,5                                                              |
| 27 x 2,5                                                              |
| 30 x 2,5                                                              |
| 33 x 2,5                                                              |
| 37 x 2,5                                                              |
| 44 x 2,5                                                              |
| <b>BFOI(VFD) &amp;<br/>FX-<br/>BFOI(VFD)</b>                          |

| Number of<br>cores x<br>conductor<br>cross-section<br>mm <sup>2</sup> | Number of<br>cores x<br>conductor<br>cross-section<br>mm <sup>2</sup> | Number of<br>cores x<br>conductor<br>cross-section<br>mm <sup>2</sup> | Number of<br>cores x<br>conductor<br>cross-section<br>mm <sup>2</sup> | Number of<br>cores x<br>conductor<br>cross-section<br>mm <sup>2</sup> |
|-----------------------------------------------------------------------|-----------------------------------------------------------------------|-----------------------------------------------------------------------|-----------------------------------------------------------------------|-----------------------------------------------------------------------|
| 1 x 10                                                                | 1 x 70                                                                | 1 x 240                                                               | 3 x 35 + E                                                            | 3 x 150 + E                                                           |
| 1 x 16                                                                | 1 x 95                                                                | 1 x 300                                                               | 3 x 50 + E                                                            | 3 x 185 + E                                                           |
| 1 x 25                                                                | 1 x 120                                                               |                                                                       | 3 x 70 + E                                                            | 3 x 240 + E                                                           |
| 1 x 35                                                                | 1 x 150                                                               | 3 x 16 + E                                                            | 3 x 95 + E                                                            |                                                                       |
| 1 x 50                                                                | 1 x 185                                                               | 3 x 25 + E                                                            | 3 x 120 + E                                                           |                                                                       |

### Application/Limitation

This type of cable is fire resistant in accordance with IEC Publication 60331.

The requirement of SOLAS Chapter II-1 Part D Reg.45, 5.2 to limit Fire Propagation along Bunches of Cables or Wires are fulfilled without any additional measures.

### Type Approval documentation

#### Tests carried out

| Standard        | Release | General description                                                                                                                                                                                                       | Limitation                                         |
|-----------------|---------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------|
| IEC 60092-353   | 2011    | Power cables for rated voltages 1kV and 3kV                                                                                                                                                                               |                                                    |
| IEC 60331-21    | 1999-04 | Tests for electric cables under fire conditions<br>– Circuit integrity – Part 21: Procedures and requirements – Cables of rated voltage up to 0,6/1,0 kV                                                                  | @ 750°C/90 min. test                               |
| IEC 60331-1/-2  | 2009-05 | Fire resistance / Circuit integrity – Test method for fire <i>with shock</i> at temperature of at least 830°C for cables rated up to and including 0,6/1 kV                                                               | @ 830 °C w/shock (120 min)                         |
| IEC 60332-3-22  | 2009    | Tests on electric and optical fibre cables under fire conditions - Part 3-22: Test for vertical flame spread of vertically-mounted bunched wires or cables - Category A                                                   | Bunch test Cat.A                                   |
| IEC 60754-1     | 2011    | Test on gases evolved during combustion of materials from cables – Determination of the amount of halogen acid gas                                                                                                        | Low Halogen : < 0.5% halogen                       |
| IEC 60754-2     | 2011    | Test on gases evolved during combustion of materials from cables – Determination of the degree of acidity of gases evolved during the combustion of materials taken from electric cables by measuring pH and conductivity | Halogen free :<br>pH > 4.3,<br>Conductivity < 10µS |
| IEC 61034-2     | 2005    | Measurement of smoke density of cables burning under defined conditions – Test apparatus, procedure and requirements                                                                                                      | Low smoke : > 60%                                  |
| CSA C22.2 No.03 | 2009-09 | 5.11 Flexibility at any specified temperature                                                                                                                                                                             | Cold bend: -40°C                                   |

Job Id: **262.1-000306-4**  
Certificate No: **TAE00001F3**

|                 |         |                                        |                    |
|-----------------|---------|----------------------------------------|--------------------|
| CSA C22.2 No.03 | 2009-09 | 5.12 Abnormal low temperature – impact | Cold impact: -35°C |
|-----------------|---------|----------------------------------------|--------------------|

### Marking of product

0.6/1 kV – Type designation – Size – IEC 60331(120min) – IEC 60332-3 Cat.A – TMC – Year of manufacture – Length

### Periodical assessment

The scope of the retention/renewal survey is to verify that the conditions stipulated for the Type Approval Certificate are complied with and that no alterations are made to the design and/or the material of product.

The main elements of the survey are:

- Inspection on factory samples, selected at random from the production line (where practicable)
- Check of the results from Production Sample Tests(PST) and Routine Tests(RT)  
(if not available, PSTand RT are to be carried out)
- Review of type approval documentation
- Review of possible changes in design, material and performance
- Ensuring traceability between manufacturer's product type marking and Type Approval Certificate

Survey is to be performed at least every second year.

END OF CERTIFICATE