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**Standardization of technical and safety requirements in inland navigation:
Recommendations on Harmonized Europe-Wide Technical Requirements
for Inland Navigation Vessels (resolution No. 61, revision 2)**

Proposals to amend the new draft chapter, “Special provisions applicable to electric vessel propulsion”, of the annex to resolution No. 61, revision 2

Transmitted by the Danube Commission

Mandate

1. This document is submitted in line with the proposed programme budget for 2020, part V, Regional cooperation for development, section 20, Economic development in Europe, programme 17, “Economic development in Europe” (A/74/6 (Sect. 20) and Supplementary).
2. At its informal meeting held on 29 and 30 June 2020, the Working Party on the Standardization of Technical and Safety Requirements in Inland Navigation noted the proposal to amend the new draft chapter XX, “Special provisions applicable to electric vessel propulsion”, of the annex to resolution No. 61, submitted by the Danube Commission in informal document SC.3/WP.3 No. 24 (2020) based on the annex to ECE/TRANS/SC.3/WP.3/2020/3, and requested the secretariat, in cooperation with the Danube Commission, to prepare a working document based on the proposal for the sixty-fourth session of the Working Party on Inland Water Transport (SC.3).
3. The annex to this document contains an updated proposal for consideration at the sixty-fourth session of SC.3. Moreover, the references to the European Standard laying down Technical Requirements for Inland Navigation vessels (ES-TRIN) included in ECE/TRANS/SC.3/WP.3/2020/3 have been replaced with the corresponding paragraphs of the annex to resolution No. 61, based on document ECE/TRANS/SC.3/WP.3/2020/25, and editorial changes have been made to the Russian text.



Annex

Proposals to amend the new draft chapter, “Special provisions applicable to electric vessel propulsion”, of the Recommendations on Harmonized Europe-Wide Technical Requirements for Inland Navigation Vessels

XX-0 Definitions

For the purposes of this chapter, the following definitions shall apply:

1. “Propulsion installation”: a unit comprising an electrical power source including power electronics, electric propulsion motor, gearbox, shaft, propeller, etc. employed to generate movement of a craft;
2. “Electric vessel propulsion **system**”: either a purely electric or a diesel-electric or gas-electric propulsion installation of a craft, which is operated either by its own power supply or by the on-board **electrical** network and comprising at least one electric propulsion motor. In the case of a diesel-electric or gas-electric propulsion installation, this term refers solely to the electrical components of the propulsion installation in question;
3. “Electric main propulsion **system**”: an electric vessel propulsion **system** which is applied to achieve the manoeuvrability laid down in chapter 5;
4. “Electric auxiliary propulsion **system**”: an additional electric vessel propulsion **system** of a craft that is not an electric main propulsion **system**;
5. “Electric propulsion motor”: an electric motor to propel the propeller shaft or the shaft of comparable propulsion installations such as water-jet propulsion devices.

XX-1 General provisions for electric vessel propulsion

XX-1.1 A craft’s electric main propulsion **system** must consist of at least:

- (a) two electrical power sources, irrespective of the number of main propulsion **units**,
- (b) a switchgear,
- (c) an electric propulsion motor,
- (d) steering positions and
- (e) depending on the design of the electric main propulsion **system**, the corresponding power electronics.

XX-1.2 If an electric main propulsion **system** is equipped with only one propulsion motor and if the craft has no additional vessel propulsion **system** that ensures sufficient propulsion power, the electric main propulsion **system** must be designed in such a way that the craft is still capable of making steerageway under its own power while retaining the required manoeuvrability in the following cases:

- (a) failure in the power electronics or
- (b) failure in the **system** of regulation and control of the propulsion installation.

XX-1.3 The general plans concerning the entire electrical installation pursuant to {paragraph 9-1.3, subparagraph (i)}, shall also include the locations of the main components and the electrical service rooms of the electric vessel propulsion **system**.

XX-1.4 If the electric propulsion motors are fed by batteries or accumulators, their **current** capacity must be monitored and displayed.

It must be ensured that the capacity of batteries or accumulators shall enable the safe reaching of a berth **or authorized anchorage area** under the craft’s own power at all times and under all conditions.

In the event of a drop of the capacity of batteries or accumulators to the minimum residual capacity required pursuant **to the** second sentence, an optical and acoustic alarm is to be triggered and displayed in the wheelhouse.

XX-1.5 If the electric vessel propulsion **system** is gas-electric or diesel-electric, the electrical components must not negatively affect the gas or diesel engines **control systems**.

XX-1.6 A malfunction of the electric vessel propulsion **system** shall not obstruct the operation of the craft such that the emergency systems provided for in accordance with this annex, in particular, the steerageway under its own power or the emergency electrical power supply, are affected.

XX-1.7 Two electric vessel propulsions **systems** can only be deemed independent if the power supply circuits of the electric propulsion motor are completely separate from one another or if an FMEA-S¹ safety study demonstrates that no failure of one electric propulsion **system** impairs the operation of the other.

XX-1.8 It must be possible to shut down or deactivate an electric vessel propulsion **system** manually in an emergency.

XX-2 Generators, transformers and switchgear for electric vessel propulsion

XX-2.1 The generators, transformers and switchgear must be designed for:

- (a) temporary overloads and
- (b) the effects of manoeuvres according to their application and operating conditions.

XX-2.2 The diesel or gas regulators of diesel or gas engines for electric propulsion systems must ensure safe operation over the entire speed range and for all sailing and manoeuvring conditions in single and parallel operation.

If an electrical power source set fails according to paragraph XX-1.1, subparagraph (a), there must be an automatic reduction in power so that the electric main propulsion **system** continues with reduced power such that the craft is still capable of making steerageway under its own power.

XX-2.3 The electrical power sources according to paragraph XX-1.1, subparagraph (a), of the generators must be designed so that they can record the reverse power occurring during reversing manoeuvres when considering the propulsion concept.

XX-2.4 Generators must be capable of being switched on and off without interrupting electric main propulsion.

XX-3 Electric propulsion motors for electric vessel propulsion

XX-3.1 According to their application and operating conditions, electric propulsion motors for electric vessel propulsion must be designed for:

- (a) temporary overloads and
- (b) the effects of manoeuvres.

XX-3.2 Electric propulsion motors must be designed in such a way that harmonics of currents and voltages do not impair their safe operation.

XX-3.3 ~~The insulation of the windings must be designed for overvoltages, which can occur due to manoeuvres and switching operations.~~ **Insulating materials of classes B, F or H according to international standard IEC 60085-2007, "Electrical insulation", are to be used for the insulation of the windings.**

XX-3.4 The main propulsion systems' propulsion engines, both electric and with external cooling, must be dimensioned such that, should the external cooling fail, they are still capable of operating on reduced power so that the craft is at least capable of making steerageway under its own power.

¹ Failure modes and effects analysis.

XX-3.5 Electric propulsion motors must withstand a short-circuit at their terminals and in the propulsion installation without damage under rated operating conditions until the protective device is triggered. **Fuses may not be used as protection for the main circuits and excitation circuits of electric propulsion motors.**

XX-4 Power electronics for electric vessel propulsion

XX-4.1 The power electronics requirements according to ~~[Article 10.18]~~ and paragraphs **9-2.18 and 9-2-19** shall apply with the following provisions.

XX-4.2 Power electronics must be designed for the anticipated loads, including overload and short circuit, during all operating and manoeuvring conditions. **The overload protection is to be preceded by an optical and acoustic alarm.**

XX-4.3 If power electronics are force-cooled, they must, if their cooling system fails, be able to continue operating with reduced power while ensuring, at a minimum, in the case of electric main propulsion, that the craft is capable of making steerageway under its own power. In the event of a failure of the cooling system, an alarm is to be triggered and displayed in the wheelhouse.

XX-4.4 Excitation circuits, the failure of which can endanger safe operation, ~~may~~ **are** only **to** be protected against short circuits.

XX-5 Monitoring equipment

XX-5.1 The operating state of the electric vessel propulsion and its principal components is to be displayed in the wheelhouse and in the propulsion installation.

XX-5.2 If the control system in the wheelhouse fails, the monitoring and operation of the electric main propulsion must be possible ~~on-site~~ **from a local control station**. The crew must be able to switch within a reasonably short time without having to make changes to the propulsion installation and propeller speed and direction. A ~~voice communication~~ **system for voice communication with the local control station** must be provided to the wheelhouse.

XX-5.3 The operating conditions and operation of the electric vessel propulsion, including the response of the protective device, are to be documented in a non-volatile computer memory such that the fault can be readily analysed in a verifiable manner.

XX-5.4 The electric vessel propulsion system must be equipped with a device for monitoring insulation resistance and with acoustic and optical alarms that are triggered if the insulation resistance lowers.

XX-5.5 When the electric vessel propulsion system is remote-controlled, it must be possible to monitor the execution of the given commands.

XX-6 Control, regulation and automatic power limitation

XX-6.1 **Each station must be provided with signalling to indicate which station is being used for control, and commands must be given only from the active station. The station switch must have a locking mechanism that prevents switching between stations without deactivating the propulsion system.**

XX-6.2 To protect the on-board network from being overloaded, provision shall also be made for:

- (a) an automatic shutdown of the electrical equipment not relating to personal safety **of the persons on board** or safe navigation and
- (b) where required, additional automatic power limitation of the electric propulsion motors.

XX-6.3 The provisions of [Article 8.03(4)] **paragraph 8-2.3.6** apply mutatis mutandis.

XX-6.4 In the event of individual propulsion units being shut down as a result of an automatic power limitation, the propulsion asymmetry is to be kept to a minimum.

XX-6.5 Loss of the automatic functions of the electric vessel propulsion control system are to trigger an alarm.

XX-7 Protection of the electric vessel propulsion system

XX-7.1 The automatic switching off of the electric vessel propulsion **system**, which would affect the manoeuvrability of the craft, must be restricted to malfunctions that would result in significant damage within the propulsion installation.

XX-7.2 Protective devices must be set so that ~~it is~~**they are** not triggered in the event of situations referred to in paragraphs XX-2.1 and XX-3.1.

XX-7.3 If a measured or reference value is lost or in the event of a power supply failure of the control or regulation system in accordance with section XX-6:

- (a) the propeller speed must not increase to inadmissible levels;
- (b) the propulsion system must not reverse of its own accord;
- (c) no other dangerous operating condition must arise.

XX-7.4 If an electric vessel propulsion **system** can be mechanically locked uncontrollably, it must be equipped with a monitoring device which shall protect the electric vessel propulsion **system** against damage.

XX-7.5 Each electric propulsion motor is to be fitted with:

- (a) earth fault monitoring;
- (b) differential protection or equivalent protective device and;
- (c) winding temperature monitoring system with an alarm trigger at high winding temperatures.

XX-7.6 The following additional protective devices must be provided:

- (a) overspeed protection;
- (b) protection against overcurrent and short circuit;
- (c) protection against harmful bearing currents (**for semiconductor electric motors**) by means of steep voltage edges.

XX-7.7 It must be ensured when protective devices are triggered that:

- (a) the power is reduced or malfunctioning subsystems are selectively switched off;
- (b) electric vessel propulsion **units** are shut down in a controlled manner;
- (c) the power stored in components and in the load circuit ~~do~~ **cannot** have a detrimental impact when they are switched off.

XX-7.8 The triggering of protective, reducing and alarm devices must be displayed optically and acoustically in the wheelhouse and at a suitable position of the craft. The display must be reset only after acknowledgement. An alarm condition must remain visible even after the shutdown.

XX-7.9 The electric vessel propulsion system must have undervoltage protection against unintentional starting after any protective device has been triggered.

XX-8 Protection of the electric vessel propulsion system

XX-8.1 The test concept envisaged by the manufacturer of the electric vessel propulsion **system** must be submitted to the inspection body before being put into service for the first time. The latter may demand additional testing and proof confirming the safe operation of the electric vessel propulsion **system** and its functions. This applies in particular to those instances where the craft is required to be capable of making steerageway under its own power in the event of a malfunctioning propulsion **system**. The test concept accepted by the inspection body is deemed to be a manufacturer's instructions according to paragraph XX-8.2.

XX-8.2 The testing of the electric vessel propulsion **system** must be carried out by an expert according to the manufacturer's instructions:

- (a) before being put into service for the first time,
- (b) before being put back into service after any major modification or repair,
- (c) on every periodical inspection.

An inspection ~~attestation~~ **certificate** shall be issued, signed by the expert and showing the date of the inspection. The inspection ~~attestation~~ **certificate** must be permanently kept on board.

XX-9 Electric auxiliary propulsion with power electronics

XX-9.1 An electric auxiliary propulsion **system** with power electronics for speed control must consist of at least a switchgear, an electric propulsion motor and the corresponding power electronics.

XX-9.2 In addition to the provisions pursuant to ~~[Article 10.18]~~ **paragraph 9-2.19** the power electronics of electric auxiliary propulsion **system** shall comply with the following requirements:

- (a) The power electronics components must be protected against exceeding their current and voltage limits;
 - (b) Semiconductor fuses must be monitored. In the event of a failure of the power electronics, the electric auxiliary propulsion **system** is to be switched off if necessary in order to avoid consequential damage having regard to the safe operation of the craft;
 - (c) When the protective devices of power electronics are triggered, the provisions of paragraph XX-7.7 shall apply mutatis mutandis;
 - (d) The triggering of protective devices must be indicated by an alarm signal in the wheelhouse and on the protective devices.
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