**3GPP TSG-RAN WG4 Meeting # 107 R4-2307373**

**Incheon, KR, May 22 – May 26, 2023**

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| *CR-Form-v12.2* |
| **CHANGE REQUEST** |
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|  | **38.115-1** | **CR** | **0008** | **rev** | **-** | **Current version:** |  |  |
|  |
| *For* [***HE******LP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* |
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| ***Proposed change affects:*** | UICC apps |  | ME |  | Radio Access Network | **X** | Core Network |  |

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|  |
| ***Title:***  | CR for TS 38.115-1, Add manufacturer declarations for test configurations and RF channels |
|  |  |
| ***Source to WG:*** | CATT,NEC |
| ***Source to TSG:*** | R4 |
|  |  |
| ***Work item code:*** | NR\_repeaters-Perf |  | ***Date:*** | 2023-05-10 |
|  |  |  |  |  |
| ***Category:*** | F |  | ***Release:*** | Rel-17 |
|  | *Use one of the following categories:****F*** *(correction)****A*** *(mirror corresponding to a change in an earlier release)****B*** *(addition of feature),* ***C*** *(functional modification of feature)****D*** *(editorial modification)*Detailed explanations of the above categories canbe found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | *Use one of the following releases:Rel-8 (Release 8)Rel-9 (Release 9)Rel-10 (Release 10)Rel-11 (Release 11)…Rel-16 (Release 16)Rel-17 (Release 17)Rel-18 (Release 18)Rel-19 (Release 19)* |
|  |  |
| ***Reason for change:*** | 1. The definition of repeater RF Bandwidth used for test configurations and RF channels is missing.
2. Declared maximum passband Bandwidth used for test configurations is not defined in manufacturer declaration table. And it is confused with maximum repeater RF Bandwidth in RF Channels.
3. Declared maximum repeater RF Bandwidth in multi-band operation is not defined in manufacturer declaration table.
4. Occupied bandwidth and CA was not supported, so the RF channel for occupied bandwidth and CA is not needed.
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| ***Summary of change:*** | 1. Add Repeater RF Bandwidth terms in sub-clause 3.1.
2. Add Maximum repeater RF Bandwidth identifier (D.18) and Maximum repeater RF Bandwidth for multi-band operation declaration identifier (D.19) in Table 4.6-1.
3. Change Maximum repeater RF Bandwidth identifier from D.11 to D.18 in sub-clause 4.7.
4. Change Maximum repeater RF Bandwidth for multi-band operation declaration identifier from D.12 to D.19 in sub-clause 4.7.
5. Change “BS” to “Repeater” in Table 4.8.4-1.
6. Remove Occupied bandwidth and CA related content in sub-clause 4.9.1.

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| ***Consequences if not approved:*** | Test configurations and RF channels for repeater would be unclear. |
|  |  |
| ***Clauses affected:*** | 3.1, 4.6, 4.7.3.1, 4.7.5.1, 4.7.6.1, 4.7.7.1, 4.8.4, 4.9.1 |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** |  | **X** |  Other core specifications  | TS/TR ... CR ...  |
| ***affected:*** |  | **X** |  Test specifications | TS/TR ... CR ... |
| ***(show related CRs)*** |  | **X** |  O&M Specifications | TS/TR ... CR ...  |
|  |  |
| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** |  |

## **<Start of Change 1>**

# 3 Definitions of terms, symbols and abbreviations

## 3.1 Terms

For the purposes of the present document, the terms given in 3GPP TR 21.905 [1] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in 3GPP TR 21.905 [1].

**Antenna connector:** connector at the conducted interface of the *repeater type 1-C*

**Fractional bandwidth:** *fractional bandwidth* FBW is defined as

**gap between passbands:** frequency gap between two consecutive passbands that belong to the same *operating band*, where the RF requirements in the gap are based on co-existence for un-coordinated operation

**Inter-passband gap**: The frequency gap between two supported consecutive *passbands* that belong to different operating bands.

**Maximum passband output power:** mean power level measured per *passband* at the *antenna connector*, during the transmitter ON state in a specified reference condition

**multi-band connector**: *Antenna Connector* for a *Multi-band repeater*.

**Multi-band repeater:** *Repeater Type 1-C* whose *antenna connector* is associated with a transmitter and/or receiver that is characterized by the ability to process two or more *passband(s)* in common active RF components simultaneously, where at least one *passband* is configured at a different operating band than the other *passband(s)* and where this different operating band is not a sub-band or superseding-band of another supported operating band

**Nominal channel bandwidth:** Bandwidth calculated as min(100MHz, BWpassband) in FR1 or min(400MHz, BWpassband) in FR2. If this bandwidth is not defined for BS channel bandwidth for the operating band, *nominal channel bandwidth* shall be defined as the widest BS channel bandwidth for the operating band which is narrower than BWpassband.

**Non-contiguous spectrum**: spectrum consisting of two or more *passbands* separated by *inter-passband gap*(s).

**Operating band:** frequency range in which NR operates (paired or unpaired), that is defined with a specific set of technical requirements

**passband edge***:* Frequency at the edge of the passband

**Repeater RF Bandwidth**: RF bandwidth in which a repeater transmits and/or receives single or multiple passband(s) within a supported operating band

NOTE: In single passband operation, the Repeater RF Bandwidth is equal to the passband bandwidth.

**Repeater type 1-C**: Repeater operating at FR1 with a requirement set consisting only of conducted requirements defined at individual *antenna connectors*.

**Requirement set**: one of the NR requirements set as defined for *NR repeater*

**single-band connector:** *Repeater type 1-C* *antenna connector* supporting operation either in a single *operating band* only, or in multiple *operating bands* but does not meet the conditions for a *multi-band connector*.

**Sub-band**: A *sub-band* of an operating band contains a part of the uplink and downlink frequency range of the operating band.

**sub-block:** one contiguous allocated block of spectrum for transmission and reception by the repeater.

**Superseding-band**: A *superseding-band* of an operating band includes the whole of the uplink and downlink frequency range of the operating band.

**Transmitter OFF state:** Time period during which the repeater downlink or uplink is not allowed to transmit in the corresponding direction.

## **<End of Change 1>**

## **<Start of Change 2>**

## 4.6 Manufacturer declarations

The following repeater declarations listed in table 4.6-1, when applicable to the repeater under test, are required to be provided by the manufacturer for the conducted requirements testing of the *repeater type 1-C*. Declarations can be made independently for UL and DL.

Table 4.6-1: Manufacturer declarations for *repeater type 1-C* conducted test requirements

|  |  |  |
| --- | --- | --- |
| Declaration identifier | Declaration | Description |
| D.1 | Repeater class | Repeater class of the repeater, declared as Wide Area repeater, Medium Range repeater, or Local Area repeater. |
| D.2 | *Operating bands* and passband frequency ranges | List of NR *operating band(s)* supported by *single-band connector(s)* and/or *multi-band connector(s)* of the repeater and passband frequency range(s) within the *operating band(s)* that the repeater can operate in. Declarations shall be made per *antenna connector*. |
| D.3 | Spurious emission category | Declare the repeater spurious emission category as either category A or B with respect to the limits for spurious emissions, as defined in Recommendation ITU-R SM.329 [4].  |
| D.4 | Additional operating band unwanted emissions | The manufacturer shall declare whether the repeater under test is intended to operate in geographic areas where the additional operating band unwanted emission limits defined in clause 6.6.4.5.6 apply. (Note 2, Note 3). |
| D.5 | Co-existence with other systems | The manufacturer shall declare whether the repeater under test is intended to operate in geographic areas where one or more of the systems GSM850, GSM900, DCS1800, PCS1900, UTRA FDD, UTRA TDD, E-UTRA, PHS and/or NR operating in another band are deployed.  |
| D.6 | Co-location with other base stations, repeaters and IABs | The manufacturer shall declare whether the repeater under test is intended to operate co-located with Base Stations, repeaters and IABs of one or more of the systems GSM850, GSM900, DCS1800, PCS1900, UTRA FDD, UTRA TDD, E-UTRA and/or NR operating in another band.  |
| D.7 | *Single band connector* or *multi-band connector* | Declaration of the single band or multi-band capability of *single band connector(s)* or *multi-band connector(s),* declared for every connector. |
| D.8 | Other band combination multi-band restrictions | Declare any other limitations under simultaneous operation in the declared band combinations (D.12) for each *multi-band connector* which have any impact on the test configuration generation.Declared for every *multi-band connector*. |
| D.9 | Rated output powerper passband (Prated,p,AC) | Conducted rated output power per passband, per *single band connector* or *multi-band connector.*Declared per supported *passband*, per *antenna connector.* (Note 1) |
| D.10 | R*ated total output power* (Prated,t,AC) | Conducted total rated output power*.*Declared per supported *operating band*, per *antenna connector.*For *multi-band connectors* declared for each supported *operating band* in each supported band combination. (Note 1) |
| D.11 | Rated multi-band total output power, Prated,MB,AC | Conducted multi-band rated total output power*.*Declared per supported operating band combinations, per *multi-band connector*. (Note 1) |
| D.12 | Operating band combination support | List of operating bands combinations supported by *single-band connector(s)* and/or *multi-band connector(s)* of the repeater. Declared per *antenna connector.* |
| D.13 | Equivalent connectors | List of *antenna connectors* which have been declared equivalent.Equivalent connectors imply that the *antenna connector* are expected to behave in the same way when presented with identical signals under the same operating conditions. All declarations made for the *antenna connector* are identical and the transmitter unit and/or receiver unit driving the *antenna connector* are of identical design. |
| D.14 | Connecting network loss range for repeater testing with ancillary RF amplifiers | Declaration of the range of connecting network losses (in dB) for *repeater type 1-C* testing with ancillary Tx RF amplifier only, or with Rx RF amplifier only, or with combined Tx/Rx RF amplifiers. (Note 4) |
| D.15 | Long delay repeater | Declared only if the repeater internal delay between the input and output for this repeater does not fit within the TDD transient time. The repeater is intended for situations in which it will not cause interference to other nodes. This is achieved by RF isolation or by reservation of longer guard periods, which degrades frame utilization. The length of repeaters internal delay is declared using this declaration. |
| D.16 | Input signal power level for maximum output power | Declaration of input signal power level required to reach maximum output power. Declared per passband. |
| D.17 | Repeater radiating direction | Declaration on whether the repeater is intended to radiate in DL, UL or both. Testing shall be performed only for the direction(s) in which the repeater radiates. |
| D.18 | Maximum repeater RF Bandwidth | Maximum *repeater RF Bandwidth* in the *operating band* for single-band operation. Declared per supported *operating band,* per *antenna connector* for *repeater type 1-C.* (Note 5) |
| D.19  | Maximum repeater RF Bandwidth for multi-band operation | Maximum *repeater RF Bandwidth* for multi-band operation. Declared per supported *operating band,* per *antenna connector* for *repeater type 1-C*,*.* |
| NOTE 1: If a repeater is capable of 256QAM operation then up to two rated output power declarations may be made. One declaration is applicable when configured for 256QAM operation, and the other declaration is applicable when not configured for 256QAM operation. If a repeater is not capable of 256QAM operation, only one declaration can be made.NOTE 2: If repeater is declared to support Band n20 (D.2), the manufacturer shall declare if the repeater may operate in geographical areas allocated to broadcasting (DTT). Additionally, related declarations of the emission levels and maximum output power shall be declared.NOTE 3: If repeater BS is declared to support Band n24 (D.2), the manufacturer shall declare if the repeater may operate in geographical areas where FCC regulations apply. Additionally, related declarations of the emission levels and maximum output power shall be declared.NOTE 4: This manufacturer declaration is optional. NOTE 5: Parameters for contiguous or non-contiguous spectrum operation in the operating band are assumed to be the same unless they are separately declared. When separately declared, they shall still use the same declaration identifier. |

## 4.7 Test configurations

### 4.7.1 General

Test configurations in this specification refer to the configuration of test signals from test equipment that are provided to the repeater input.

The test configurations shall be constructed using the methods defined below, subject to the parameters declared by the manufacturer for the supported RF configurations as listed in clause 4.6. The test configurations to use for conformance testing are defined for each supported RF configuration in clauses 4.8.3 and 4.8.4.

The applicable test models for generation of the carrier transmit test signal are defined in clause 4.9.

NOTE: If required, carriers are shifted to align with the channel raster.

### 4.7.2 Test signal used to build Test Configurations

The signal's channel bandwidth and subcarrier spacing used to build NR Test Configurations shall be selected according to table 4.7.2-1.

Table 4.7.2-1: Signal to be used to build NR repeater TCs

|  |  |  |
| --- | --- | --- |
| Operating Band characteristics | FDL\_high – FDL\_low or FUL\_high – FUL\_low <100 MHz (Note 2) | FDL\_high – FDL\_low or FUL\_high – FUL\_low ≥ 100 MHz (Note 2) |
| TC signal  | BWchannel | 5 MHz (Note 1) | 20 MHz (Note 1) |
| characteristics | Subcarrier spacing | Smallest supported subcarrier spacing of the operating band |
| NOTE 1: If this channel bandwidth is not supported for the operating band, the narrowest supported channel bandwidth shall be used.NOTE 2: Either the DL operating band characteristics or the UL operating band characteristics should be considered (if different) depending on the tested transmission direction. |

### 4.7.3 RTC1: Contiguous spectrum operation

The purpose of test configuration RTC1 is to test all repeater requirements that need an input signal in the *passband* when there is only one *passband* per *operating band*.

#### 4.7.3.1 RTC1 generation

RTC1 shall be constructed on a per band basis using the following method:

- Declared maximum repeater RF Bandwidth supported shall be used (D.18);

- Select the carrier to be tested according to 4.7.2 and place it adjacent to the lower *passband* edge. If the width of the *passband* is at least twice the bandwidth of the signal to be tested then place a second signal adjacent to the upper *passband* edge. Otherwise reposition the carrier to be tested according to the single carrier test frequencies described in section 4.9.1.

The test configuration should be constructed sequentially on a per band basis using the same *antenna connector*. All configured component carriers are transmitted simultaneously in the tests where the repeater should be ON.

#### 4.7.3.2 RTC1 power allocation

Set the power spectral density of each carrier to the same level so that the sum of the carrier powers equals the expected input power to the repeater for the test (i.e., either Prated,in or Prated,in + 10dB) according to the manufacturer's declaration in clause 4.6.

### 4.7.5 RTC2: Non-contiguous spectrum operation

The purpose of RTC2 is to test all repeater requirements that need an input signal in the *passband* when there is more than one *passband* per *operating band*.

#### 4.7.5.1 RTC2 generation

RTC2 is constructed on a per band basis using the following method:

- The repeater *passband* bandwidths shall be the delcared maximum repeater RF Bandwidth supported for multiple passbands (D.18). The repeater RF Bandwidth consists of one sub-block gap and the two highest and lowest declared *passbands* .

- For each *passband*, select the carrier to be tested according to 4.7.2. If the width of the *passband* is at least twice that of the carrier to be tested then place a carrier adjacent to the upper *passband* edge and another carrier (as described in 4.7.2) adjacent to the lower *passband* edge. Otherwise, tests shall be applied with one carrier adjacent to the lower sub-block edge and one carrier adjacent to the upper sub-block edge for each sub-block gap.

- The sub-block edges adjacent to the sub-block gap shall be determined using the specified Foffset\_high and Foffset\_low for the carriers adjacent to the sub-block gap.

#### 4.7.5.2 RTC2 power allocation

Set the power of each carrier to the same level so that the sum of the carrier powers equals the expected input power to the repeater for the test (i.e., either Prated,in or Prated,in + 10dB) according to the manufacturer's declaration in clause 4.6.

### 4.7.6 RTC3: Multi-band test configuration for full carrier allocation

The purpose of RTC3 is to test multi-band operation aspects.

#### 4.7.6.1 RTC3 generation

RTC3 is based on re-using the previously specified test configurations applicable per band involved in multi-band operation. It is constructed using the following method:

- The repeater RF Bandwidth of each supported operating band shall be the declared maximum repeater RF Bandwidth in multi-band operation (D.19).

- The number of carriers of each supported *operating band* shall be sufficient to fill all of the *passbands* with one or two carriers (depending on the passband bandwidth). Carriers shall be selected according to 4.7.2 and shall first be placed at the outermost edges of the declared repeater Radio Bandwidth. Additional carriers shall next be placed at the repeater RF Bandwidths edges, if possible.

- Each concerned band shall be considered as an independent band and the carrier placement in each band shall be according to RTC1, where the declared parameters for multi-band operation shall apply. The mirror image of the single-band test configuration shall be used in each alternate band(s) and in the highest band.

- If the bandwidth of any *passband* is insufficient to accommodate two carriers then tests shall be repeated with the test carriers positioned such that there is a carrier adjacent to the lower edge of a sub-block gap or inter-band gap and a carrier adjacent to the upper edge of the sub-block gap or inter-band gap, for each sub-block gap or inter-block gap.

#### 4.7.6.2 RTC3 power allocation

Unless otherwise stated, set the power of each carrier in all supported *operating bands* to the same level so that the sum of the carrier powers equals the expected input power to the repeater for the test (i.e., either Prated,in or Prated,in + 10dB) according to the manufacturer's declaration in clause 4.6.

### 4.7.7 RTC4: Multi-band test configuration with high PSD per carrier

The purpose of RTC4 is to test multi-band operation aspects considering higher PSD cases with reduced number of carriers and non-contiguous operation (if supported) in multi-band mode.

#### 4.7.7.1 RTC4 generation

RTC4 is based on re-using the existing test configuration applicable per band involved in multi-band operation. It is constructed using the following method:

- The repeater RF Bandwidth of each supported *operating band* shall be the declared maximum repeater RF Bandwidth in multi-band operation (D.19).

- The allocated repeater RF Bandwidth of the outermost bands shall be located at the outermost edges of the declared Maximum Radio Bandwidth.

- The maximum number of carriers is limited to two per band. Carriers shall be selected according to 4.7.2 and shall first be placed at the outermost edges of the declared Maximum Radio Bandwidth for outermost bands and at the Repeater RF Bandwidths edges for middle band(s) if any. Additional carriers shall next be placed at the Repeater RF Bandwidths edges, if possible.

- Each concerned band shall be considered as an independent band and the carrier placement in each band shall be according to RTC3, where the declared parameters for multi-band operation shall apply. Narrowest supported NR channel bandwidth and smallest subcarrier spacing shall be used in the test configuration.

- If only one carrier can be placed for the concerned band(s), the carrier(s) shall be placed at the outermost edges of the declared maximum radio bandwidth for outermost band(s) and at one of the outermost edges of the supported frequency range within the Base Station RF Bandwidths for middle band(s) if any.

#### 4.7.7.2 RTC4 power allocation

Unless otherwise stated, set the power of each carrier in all supported operating bands to the same level so that the sum of the carrier powers equals the expected input power to the repeater for the test (i.e., either Prated,in or Prated,in + 10dB) according to the manufacturer's declaration in clause 4.6.

## **<End of Change 2>**

## **<Start of Change 3>**

### 4.8.4 Applicability of test configurations for multi-bandoperation

For a repeater declared to be capable of multi-band operation, the test configuration in table 4.8.4-1 and/or table 4.8.3-1 shall be used for testing. In the case where multiple bands are mapped on common *multi-band connector*, the test configuration in the second column of table 4.8.4-1 shall be used. In the case where multiple bands are mapped on common *single-band connector*, the test configuration in table 4.8.3-1 shall be used. In the case where multiple bands are mapped on separate *single-band connector* or *multi-band connector*, the test configuration in the third column of table 4.8.4-1 shall be used.

Table 4.8.4-1: Test configuration for a Repeater capable of multi-band operation

|  |  |
| --- | --- |
| Repeater test case | Test configuration  |
|  | Common connector | Separate connectors |
| Repeater output power | RTC1/2 (Note 1), RTC3 | RTC1/2 (Note 1), RTC3 |
| Frequency stability | Tested with Error Vector Magnitude | Tested with Error Vector Magnitude |
| Out of band gain | N/A | N/A |
| Transmit ON/OFF power (only applied for NR TDD Repeater) | RTC3 | RTC3  |
| Frequency error | Tested with Error Vector Magnitude | Tested with Error Vector Magnitude |
| Error Vector Magnitude (Note 8) | RTC1/2 (Note 1), RTC3 | RTC1/2 (Note 1), RTC3 |
| Adjacent Channel Leakage power Ratio (ACLR) | RTC1/2 (Note 1), RTC4 (Note 2) | RTC1/2 (Note 1, 3), RTC4 (Note 2, 3) |
| Cumulative ACLR requirement in non-contiguous spectrum | RTC2 (Note 1), RTC4 (Note 2) | RTC2 (Note 1, 3) |
| Operating band unwanted emissions | RTC1/2 (Note 1), RTC4 | RTC1/2 (Note 1, 3), RTC4 (Note 3) |
| Transmitter spurious emissions | RTC1/2 (Note 1), RTC4 | RTC1/2 (Note 1, 3), RTC4 (Note 3) |
| Output intermodulation | RTC1/2 (Note 1) | RTC1/2 (Note 1, 3) |
| Input Intermodulation | N/A | N/A |
| Adjacent Channel Rejection Ratio | RTC1/2 (Note 1), RTC4 (Note 2) | RTC1/2 (Note 1, 3), RTC4 (Note 2, 3) |
| Receiver spurious emissions | RTC1/2 (Note 1), RTC4 | RTC1/2 (Note 1, 3), RTC4 (Note 3) |
| Note 1: RTC1 and/or RTC2 shall be applied in each supported operating band.Note 2: RTC4 may be applied for Inter RF Bandwidth gap only.Note 3: For single-band operation test, other antenna connector(s) is (are) terminated. |

## 4.9 RF channels and test models

### 4.9.1 RF channels

For the single passband testing many tests in this TS are performed with appropriate frequencies in the bottom, middle and top channels of the supported frequency range of the repeater. These are denoted as RF channels B (bottom), M (middle) and T (top).

Unless otherwise stated, the test shall be performed with a single passband at each of the RF channels B, M and T.

Many tests in this TS are performed with the maximum repeater RF Bandwidth located at the bottom, middle and top of the supported frequency range in the operating band. These are denoted as BRFBW (bottom), MRFBW (middle) and TRFBW (top).

Unless otherwise stated, the test shall be performed at BRFBW, MRFBW and TRFBW defined as following:

- BRFBW: maximum repeater RF Bandwidth located at the bottom of the supported frequency range in the operating band.

- MRFBW: maximum repeater RF Bandwidth located in the middle of the supported frequency range in the operating band.

- TRFBW: maximum repeater RF Bandwidth located at the top of the supported frequency range in the operating band.

For repeater capable of multi-band operation, unless otherwise stated, the test shall be performed at BRFBW\_T'RFBW and B'RFBW\_TRFBW defined as following:

- BRFBW\_T'RFBW: the *repeater RF Bandwidths* located at the bottom of the supported frequency range in the lowest operating band and at the highest possible simultaneous frequency position, within the Maximum Radio Bandwidth, in the highest operating band.

- B'RFBW\_TRFBW: the *repeater RF Bandwidths* located at the top of the supported frequency range in the highest operating band and at the lowest possible simultaneous frequency position, within the Maximum Radio Bandwidth, in the lowest operating band.

NOTE: BRFBW\_T'RFBW = B'RFBW\_TRFBW = BRFBW\_TRFBW when the declared Maximum Radio Bandwidth spans all operating bands. BRFBW\_TRFBW means the *repeater RF Bandwidths* are located at the bottom of the supported frequency range in the lower operating band and at the top of the supported frequency range in the upper operating band.

When a test is performed by a test laboratory, the position of B, M and T for single passband, BRFBW, MRFBW and TRFBW for single band operation, the position of BRFBW\_T'RFBW and B'RFBW\_TRFBW in the supported operating band combinations shall be specified by the laboratory. The laboratory may consult with operators, the manufacturer or other bodies.

## **<End of Change 3>**