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EUROPEAN
AVIATION

EUROCAE WG-107 Progress ED-57 update

ICAO EUR PBNC TF13-ECTL-NSG40

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WG-107 ToR

- Update ED-57 (MOPS for DME Ground Equipment) to bring the standard in line with current equipment capabilities to enable their existing performance in a Declaration of Conformity for a DME/DME based safety case to justify improved navigation performance supporting RNAV and RNP navigation specifications.
- Updates limited to DME/N; no changes on DME/P

Integrity for DME/N supporting RNP operations

2.3.4.2.2 Integrity for DME/N supporting RNP operations

Where DME/N provides a supporting role in RNP navigation, the probability of radiating erroneous information shall be less than 0.5×10^{-6} /h.

Appendix B Guidelines for Integrity Risk Derivation

This appendix provides some guidelines for harmonised quantitative estimation of integrity risk for typical design architectures

System design assurance - hardware and software

2.6 System design assurance

- Safety assessment methodology aligned with available GM:
 - SAE ARP4761 Guidelines for Conducting the Safety Assessment Process on Civil Aircraft, Systems, and Equipment
 - SAE ARP4754 Guidelines for Development of Civil Aircraft and Systems
 - EUROCONTROL Safety Assessment Methodology (SAM)
 - ED-109A /DO-278A Software Integrity Assurance Considerations CNS/ATM Systems
 - ED-153 Guidelines for ANS Software Safety Assurance
 - ED-80/DO-254 / Design Assurance Guidance for Airborne Electronic Hardware
- Item design assurance level guidance
 - For DME ground subsystems, **an integrity violation is in general considered a Hazardous event**; should be confirmed by a local safety assessment
 - **If Hazardous condition confirmed:**
 - **Software Assurance Level 2 and Hardware Assurance Level B**
 - **Architectural mitigations may result in more relaxed levels**

More stringent range error limits

3.1.1.5.1 Error Limits for DME/N

Received signal level range [dBm]		Mean μ (Bias)	Standard Deviation 2σ (Noise)
Min	Max		
-91	-81	$\pm 0.1 \mu\text{s}$ ($\pm 15 \text{ m}$)	$0.7 \mu\text{s}$ (105 m)
-81	-10	$\pm 0.1 \mu\text{s}$ ($\pm 15 \text{ m}$)	$0.2 \mu\text{s}$ (30 m)

TABLE 3-1-2a: ERROR LIMITS FOR DME/N GROUND EQUIPMENT

Appendix C

Derivation of 95 percentile as function of mean and standard deviation in a Gaussian error distribution function

$$X_{95}(\mu, \sigma) = |\mu| + 1.64\sigma + 0.32\sigma(e^{-3.7(|\mu|/\sigma)})$$

ICAO Annex 10

- 3.5.4.5.1 DME/N. The transponder shall not contribute more than plus or minus 1 microsecond (150 m (500 ft)) to the overall system error.
- ~~3.5.4.5.2 DME/N. A transponder associated with a landing aid shall not contribute more than plus or minus 0.5 microsecond (75 m (250 ft)) to the overall system error.~~

Reply capability

- 3.1.2 Reply Capability

The specified accuracy shall be maintained for reply rates up to 2430 pp/s for DME/P and up to ~~4000~~ 4800 pp/s for DME/N.

- Appendix E - calculation of transponder maximum reply capacity

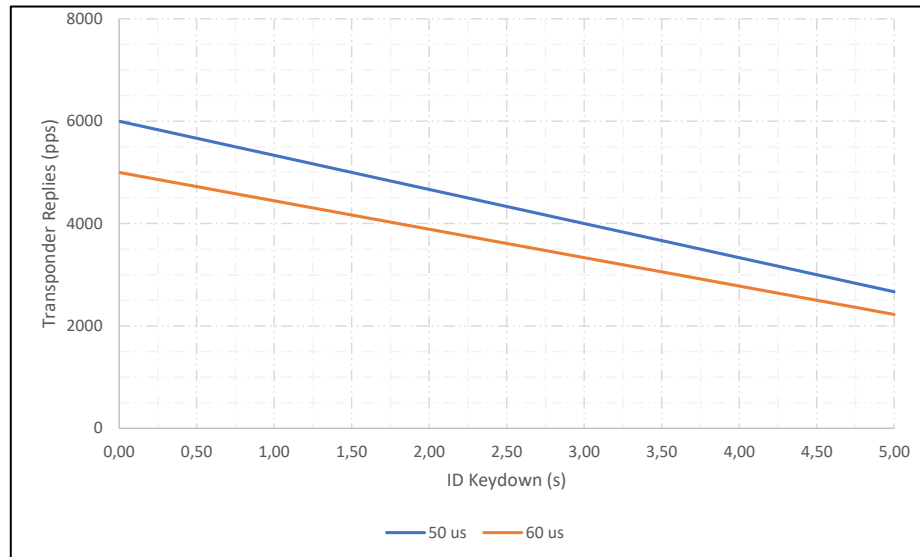


Figure E.4.2-2: Reply capacity vs. Identification Keydown time for $\eta = 70\%$ - $N_M = 20$ pp/s

Adjustable power output and sensitivity

3.2.4 Power output

In order to ensure the coverage stated in paragraph 1.2, and assuming a 6dB difference between EIRP and power at the transponder cabinet output connector, the transponder output power at the peak of each pulse shall be:

- (a) 1kW for enroute transponders adjustable/configurable by -1 dB steps down to -10 dB
- (b) 100W for terminal transponders adjustable/configurable by -1 dB steps down to - 3 dB

3.3.1.1.1 Sensitivity adjustment

To avoid replies to interrogations from outside the DOC the sensitivity should be reduceable by 1 dB steps down to -10 dB. This can occur if the actual DOC of the DME transponder is significantly less than the expected coverage stated in paragraph 1.2.

Recommended pulse rise time and transmitter spectrum mask

3.2.5.1.1 Recommendation

A rise time of $2.0 \pm 0.25 \mu\text{s}$ should be provided.

(requirement: 1.5 to 3 μs)

	DME/P	DME/N	
	80 W	100 W terminal	1 kW en-route
$f_0 \pm 0.8 \text{ MHz}$ (A1)	-35 dBc	-37 dBc	-47 dBc
$f_0 \pm 2.0 \text{ MHz}$ (A2)	-52 dBc	-55 dBc	-65 dBc

Table 3-2-1 DME spectrum mask

	DME/N	
	100 W terminal	1 kW en-route TX
$f_0 \pm 0.8 \text{ MHz}$ (B1)	-40 dBc	-50 dBc
$f_0 \pm 2.0 \text{ MHz}$ (B2)	-55 dBc	-65 dBc

Table 3-2-2 DME/N recommended spectrum mask

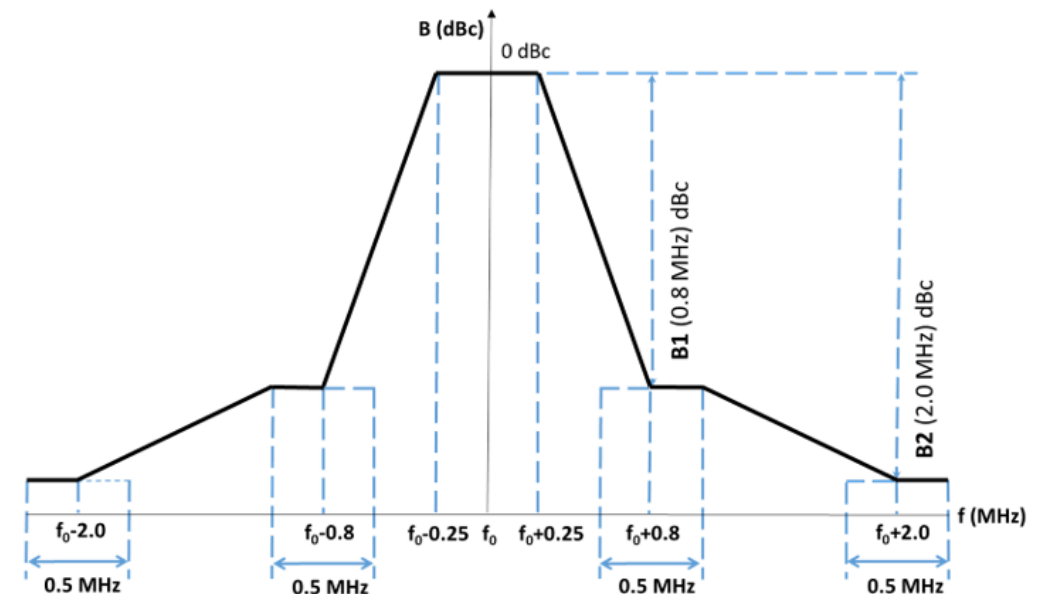


Figure 3.2-2. DME/N recommended spectrum mask

Selectivity mask

3.3.3.3 Selectivity Mask

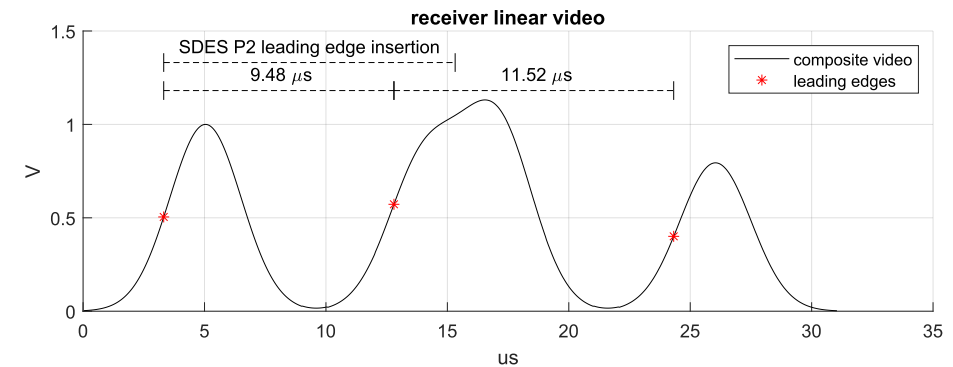
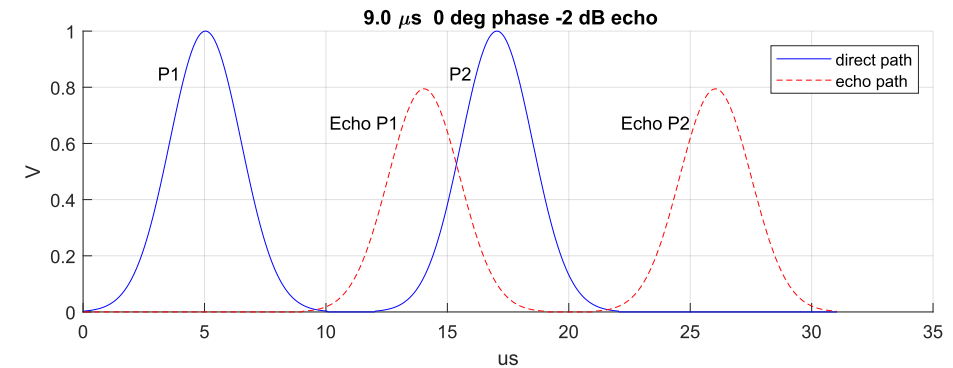
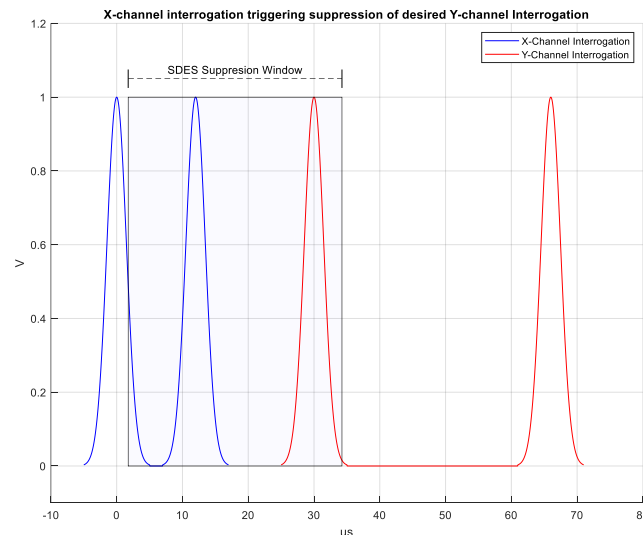
The sensitivity requirements defined in Table 3-3-1 shall be met in the presence of an interfering CW signal per the following table:

CW Interference Level	Frequency
MTL + 20 dB	± 2 MHz
MTL + 50 dB	± 5 MHz
MTL + 75 dB	$>\pm 15$ MHz and $<\pm 200$ MHz

TABLE 3-3-2: SELECTIVITY FIGURES

Extended echo suppression section

- Subsections defining requirements for
 - Short Distance Echo Suppression
 - Long Distance Echo Suppression
 - Echo Suppression Enable/Disable
- Explicative figures

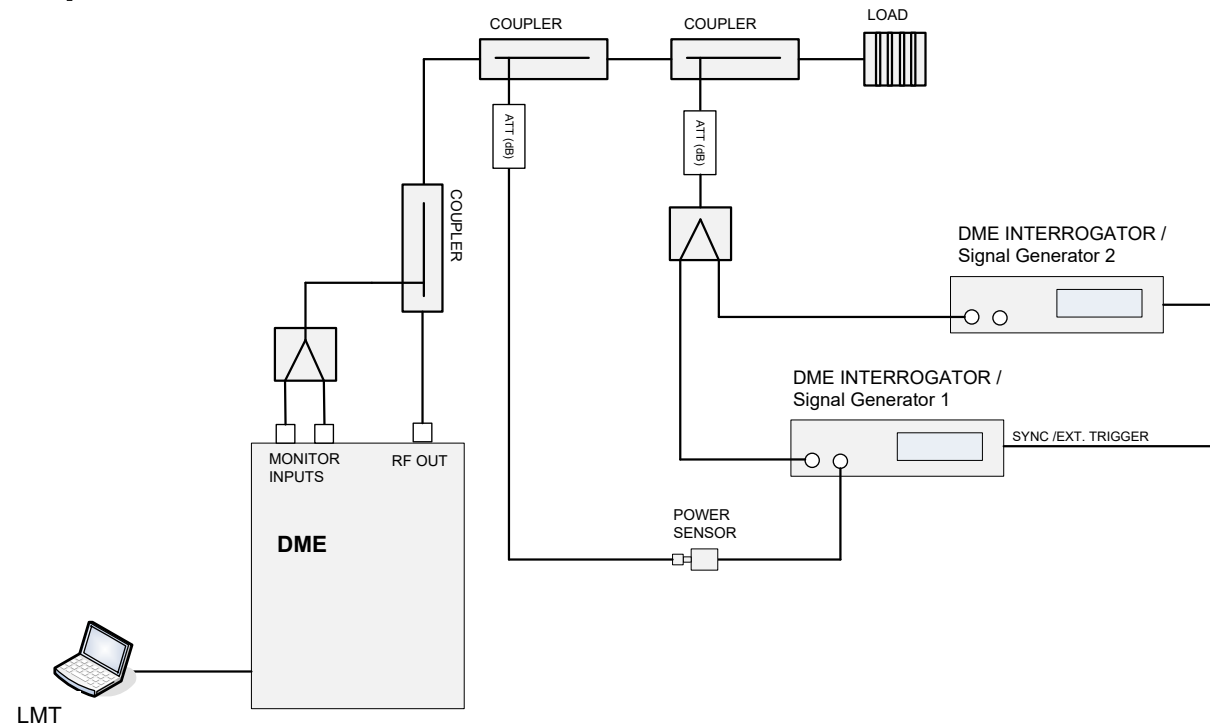


Data logs

- New requirements to log:
 - Interrogation load
 - CW interference events
 - SDES/LDES activation
 - History of alarms
 - Executive actions
 - Primary & Secondary alarm conditions
 - Monitor Bypass
 - Monitors integrity test history

New tests chapter

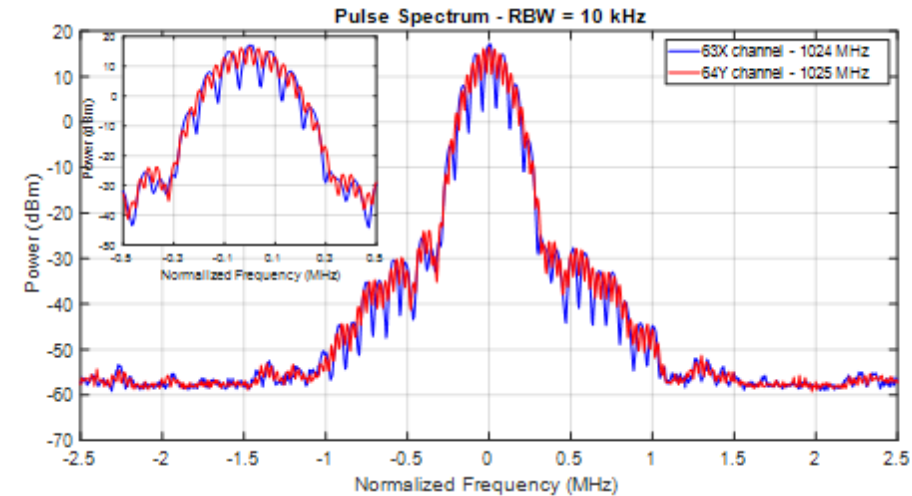
- Major revision of chapter 4
- General guidelines to test to compliance with requirements of Chapter 3.
- Updated generic test set-ups



Additional new Appendices

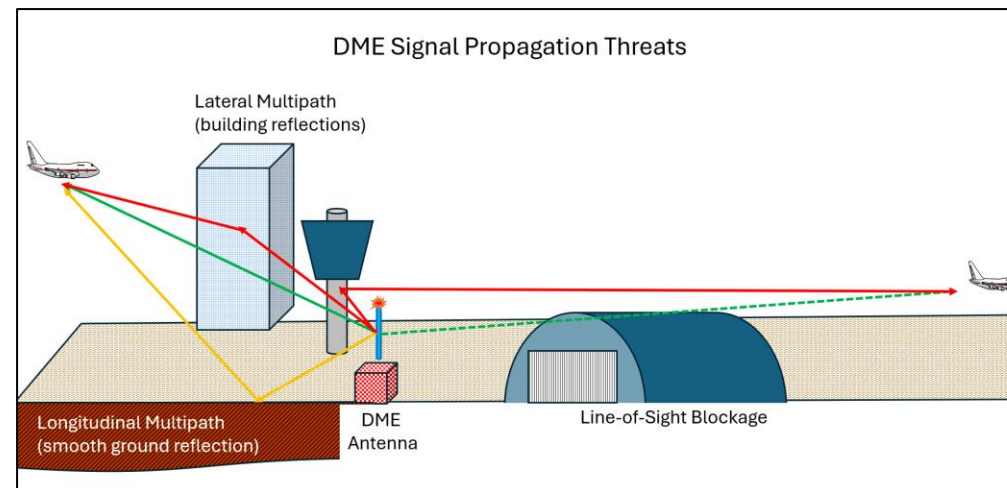
- Appendix D

Spectrum Measurement - RBW Selection Criteria

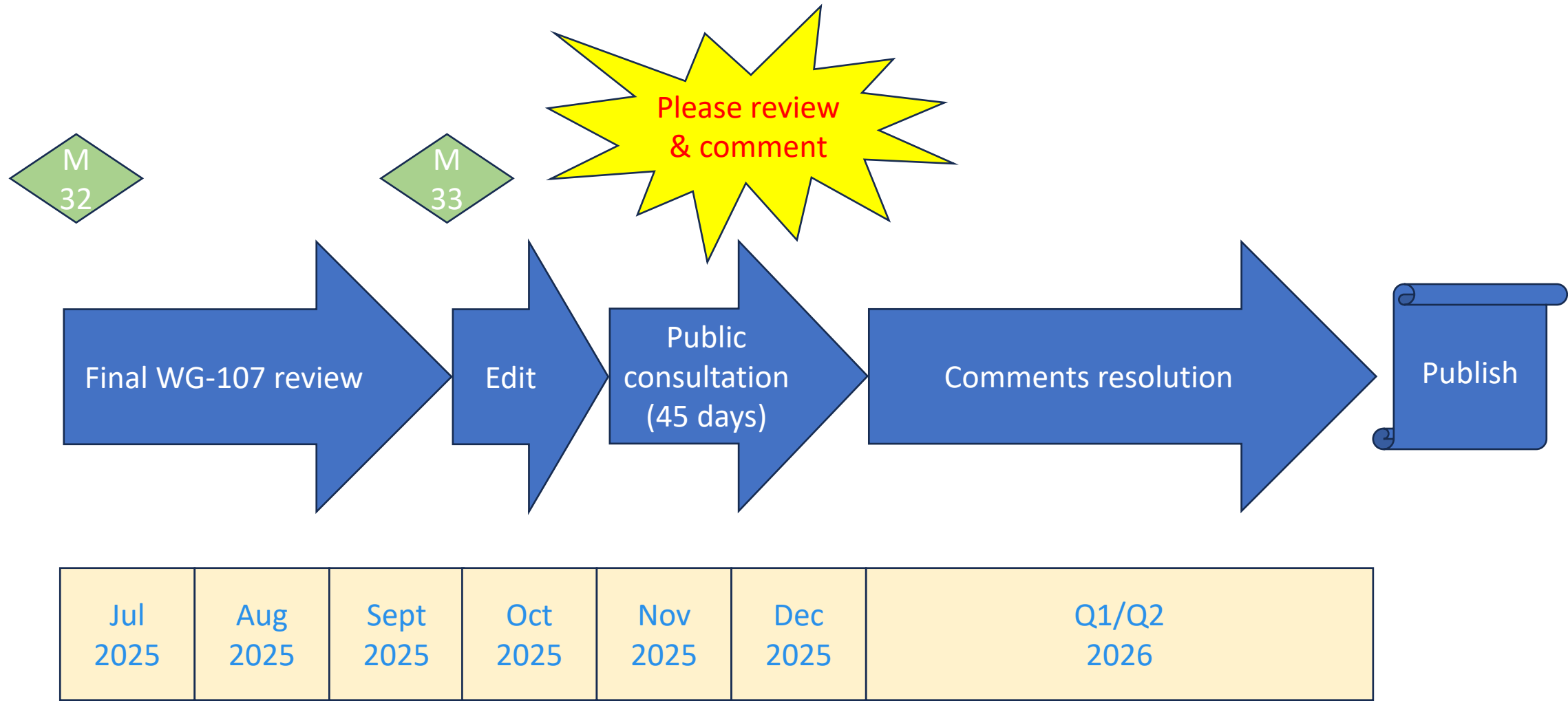


- Appendix F

DME Ground Equipment Siting Criteria



Status and next steps





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Thank you!

