Purpose of this template

This is a structure template for a **UAS Design Verification report** to be part of an application to MAA-NOR for a technical approval of a Norwegian military UAS category **Specific S2**.

Instructions to the applicant

1. As a minimum, all the elements of this template structure shall be found in the report delivered as part of the application, but the applicant can prepare the UAS Design Verification report using their own (or other) document template.
In the case that the structure of this template is not used in the report, the delivered document **SHALL** have a cross-reference table between the structure of the template and the structure of the organisation-specific document(s) delivered (included in the document, or as an attachment).
It is MAA-NOR advice that this attachment is sent to potential UAS suppliers as part of the acquisition preparations for them to provide the answers
2. **All topics in the template shall be covered and all specific questions shall be answered**, either with relevant information or with ***Not applicable***, explaining why it is not applicable.
3. All verification documents referred to in the report shall be listed in chapter 5, and the applicant must be prepared to provide these documents to MAA-NOR on request.
4. The paragraphs of text on blue background are AMC/GM for this template.
**These paragraphs shall be deleted from the finalized UAS Design Verification report before application submission** if this template is used for the delivered document.
5. The UAS Design Verification report shall have a unique document reference ID according to the applicant’s (the OEM or the UAS operator) document management system.
6. The UAS Design Verification report shall be attached to the MAA-NOR Form MUASTA as part of the application for technical approval of a military UAS.
The document reference ID shall be inserted in block 5.21 of MAA-NOR Form MUASTA for the application.
7. Any *block number* references made in the AMC/GM, relates to MAA-NOR Form MUASTA.

# Product manufacturing organisation and processes

## Quality system approvals

List which quality system approval(s) the product manufacturing organisation named in block 2.1 have, with date of approval and period of validity.
Examples are
- ISO 9001
- AS/EN ISO 9100
- EMAR 21 Subpart J and/or EMAR 21 Subpart G or F

In the case that the product manufacturing organisation does not have an internationally recognised quality system approval, a detailed description of the quality system of the product manufacturing organisation for design and production shall be submitted.

## Design criteria and standards

Provide a description of which design criteria and/or recognised standards that have been used when designing the UAS systems and equipment of the UAS entered in block 2.1 and 2.2.

## Software development

Provide a description of the UAS software development process and procedures used to develop, integrate, and verify its functionality and integrity.

## Continued and continuing airworthiness

Provide a description of how the continued and continuing airworthiness of the UAS is ensured.

Examples of topics to be covered are:

* Change Management (modifications to the UAS and its documentation)
* Maintenance schedules and inspections
* Repair and servicing
* Service Bulletins (or similar)

For all of the above, include how the organization communicate the information to the UAS operators.

## Handling of occurrences / Distribution of preventive and corrective action descriptions

Provide a description of the reporting system for technical occurrences affecting flight safety of its product(s), that have been reported to the organisation.

Provide a description of how the organization implements preventive and corrective actions as needed in response to such occurrence reports.

# UAS design description

For each sub-item of this chapter, the information in the answers shall be supported by relevant verification documentation.
References to this documentation shall be listed in chapter 5.

## UAV stability

Provide a description of the testing or analysis activities performed, including the conclusions, to ensure that the UAV, including all possible payloads, is stable and controllable in all sequences of flight and on-ground (as applicable), in all operational modes, throughout the full operational envelope.

## UAV Structural Elements

Provide a high-level description of the UAV structural elements, including the conclusions of the testing or analysis activities performed to ensure the structural integrity.

## UAV Propulsion system

Provide a high-level description of the propulsion system, including the conclusions of the performance testing or analysis.

## UAV Electrical power system

Provide a description of the electrical power system, including the conclusions from the performance testing or analysis activities.

## UAV Navigation system

Provide a description of the navigation system, including the sources of UAV position information. Include a description of the different navigation modes, the position accuracy, latency and redundancy of each mode, including the conclusions from the performance testing or analysis activities.

## UAS Communication link

Provide a description of the communication link between the UAV and ground control station, including the link standard(s) used, accuracy, latency and redundancy, how its integrity is monitored, including the conclusions from the performance testing or analysis activities.

## UAV Flight Control System

Provide a description of how the UAV is controlled, include any automatic stabilisation.
Include the conclusions from the performance testing or analysis activities.

## UAV Flight reference data

Provide a description of the onboard sources of attitude (yaw, roll, pitch), altitude, and airspeed, including the accuracy, latency and redundancy of the data provided. Include the conclusions from the performance testing or analysis activities.

## UAV Autopilot System

Provide a high-level description of the autopilot system of the UAV, including the accuracy, latency and redundancy of the function. Include the conclusions from the performance testing or analysis activities.

## Ground Control Station (GCS)

Provide a high-level description of the GCS, its main functions and its power sources.

Provide answers to the following specific questions:

1. What alarms, warnings, cautions, and system status does the GCS provide to the remote pilot?
2. Is the information presented to the remote pilot readable in all applicable light conditions?
3. How accurately can the remote pilot determine the attitude (yaw, roll and pitch), course and speed, and 3D geographic position of the UAV?
Provide the conclusions of the performance testing or analysis activities.

## Computer software

Provide a description regarding the design, and the conclusions from testing and/or analysis performed to ensure the integrity of the Systems Software.

## Computer hardware

Provide a description regarding the design, and the conclusions from testing and/or analysis performed to ensure the integrity of the Systems Hardware.

## Detection and management of critical faults

Provide a description of the incorporated means for detection of critical faults that can affect the flight safety, and any fault isolation / fault management in the UAS, and the conclusions from testing and/or analysis performed.

## Resistance against electromagnetic jamming

Provide the conclusions of the test-activities (or analysis) performed regarding the UAS’s resistance against electromagnetic jamming related to airworthiness.

## Single Points Of Failure (SPOF)

Identify, for each subsystem of the UAS, where SPOF might exist, or alternatively where redundancy exists.

## Fail-safe modes

Provide a description of the incorporated fail-safe modes of UAS, and the conclusions from testing and/or analysis performed.

# Responses to loss of control

In this chapter, the applicant shall answer a set of questions regarding the behaviour/response of the UAV in the defined cases of loss of control.

All questions shall have an answer, as described in **Instructions to the applicant**, item 2.

## Loss of communication links

Provide answers to these questions:

1. What happens when command link is lost?
2. How does the UAV respond if link is never re-established?
3. How does the UAV recognize that loss of command link has occurred?
4. How does the remote pilot at the ground control station recognize loss of command link has occurred?
5. Is there a backup command transmitter and receiver?
6. What is the effect of Electromagnetic Interference on the command and control system?
7. What is the reaction of the UAS to degraded signal strengths or jamming?

## Loss of UAV position information

Provide answers to these questions:

1. Does the UAS have a function that will indicate to the remote pilot that the UAV position is wrong?
2. If the UAS loses primary position information, is UAV control also lost?
3. How does the UAV autopilot respond to loss of primary internal navigation source?

## Corrupted or loss of flight reference data

Provide answers to this question:

1. How does the UAV respond to loss or corrupted flight reference data, ref. section 2.9 above?

## Unresponsive flight control surfaces

Provide answers to this question:

1. How does the system respond if the flight control surfaces cannot be controlled?

## Loss of propulsion or loss of control of propulsion

Provide answers to these questions:

1. What happens to the UAV when propulsion stops?
2. Will sufficient velocity (and electrical power) remain for controlled emergency landing without propulsion power?
3. Can the engine be restarted in flight?
4. What happens in the case of loss of control of propulsion?

## Loss of electrical power

Provide answers to these questions:

1. What happens when primary electrical power is lost?
2. Does automatic system load shedding occur if power is reduced?
3. Are there "essential busses" for reduced power operations?
4. Are all flight essential systems on an essential bus?

## Loss of Ground Control Station

Provide answers to this question:

1. What happens to the UAV if the GCS is unable to control the UAV?

# UAS safety history and reliability

Include references to existing documentation for the items below in ch. 5.

## UAS flight history

Include total recorded flight hours for the UAS type, if available.
If available, include the distribution of these flight hours over

* applicable environmental conditions (temperature/humidity ranges, weather/precipitation conditions, maritime/desert environments, etc.)
* flight hours during development
* operational flight hours.

## Mean Time Between Failure (MTBF)

If available, include the MTBF number for the UAS, and the source of this number (calculated or measured).

# List of document containing verification results

List in this table the documents that has been referred to for results or other information in the text above.

|  |  |
| --- | --- |
| 2.1 UAV stability |  |
| 2.2 UAV Structural Elements |  |
| 2.3 UAV Propulsion system |  |
| 2.4 UAV Electrical power system |  |
| 2.5 UAV Navigation |  |
| 2.6 UAS Communication link |  |
| 2.7 UAV Flight Control System |  |
| 2.8 UAV Flight reference data |  |
| 2.9 UAV Autopilot System |  |
| 2.10 Ground Control Station (GCS) Q3 |  |
| 2.11 Computer software |  |
| 2.12 Computer hardware |  |
| 2.13 Detection and management of critical faults |  |
| 2.14 Resistance against electromagnetic jamming |  |
| 2.15 Single Points Of Failure (SPOF) |  |
| 2.16 Fail-safe modes |  |
| 4.1 UAS flight history |  |
| 4.2 Mean Time Between Failure (MTBF) |  |

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**Template version history**

|  |  |  |
| --- | --- | --- |
| **Date** | **Version** | **Description** |
| xx.xx.2024 |  |  |

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