**Missile Warning System**

**System Requirement Specification**

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**History**

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| **Date** | **Description** | **Name** | **Version** |
| 17-09-2010 | Initial document | kpi | 1 |
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| 23-9-2010 | Strukture from SSS-DID put in. Paragraph 3.8, 3.9 and 3.12 is updated. | LMU | 3 |

**References**

|  |  |  |
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| **ID** | **Document Name** | **Version** |
| Ref-1 | Therma case.pdf | 1 |
|  |  |  |

**Abbriviations**

|  |  |
| --- | --- |
| UR | User Requirement |
| FR | Functional Requirement |

# Scope

## Identification

This document describes a self protection suite for the F-16 combat aircraft used by the Royal Danish Air Force. The protection suite incorporates a pod for mounting under the left wing and an intelligent cockpit control unit for controlling the system. In the pod is mounted a Missile Warning System (MWS) which gives input to the cockpit control unit. From the cockpit control unit is the dispensing of flares and chaffs from the pod controlled. The solution shall provide warning upon detection of missile threats and be able to automatically dispense payloads in response.

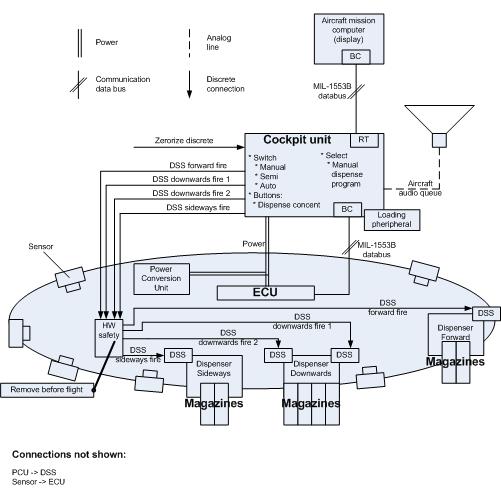
The MWS will be provided as Government Furnished Equipment (GFE) and be physically installed by your company.

If there where more information about the system it should also be placed here, that could be information about which version and type of MWS system that shall be mounted.

## System overview

The system is a self protection suite for a F-16 combat aircraft , it shall protect the aircraft against missile attacks. The system consists of 2 main systems:

* Cockpit Unit, which communicate with the systems in the POD and Aircraft Mission Computer. Has also an interface to the aircraft intercom system and an interface for the user to control the system.
* POD, which holds magazines for flares and chaffs and what is needed for firing them of, plus the MWS system.



Missiles shall be detected by the MWS that are provided as a GFE equipment and mounted by Company F. When missile attacks are detected information is sent to the cockpit control unit, which depending on the mode it is in will react on the information and is able to react according to a number of programs by dispensing flares and chaffs according to the program chosen. By the interface to the aircraft intercom system audio cues and warnings can be provided.

The system has a number of different users depending on what is done and where:

* On ground the system can be maintained by technicians that update SW and control the system
* Ground personnel shall be able to mount it and when ready to takeoff arm it.
* The pilot shall use the system, by choosing an appropriate program and depending on program chosen do further to let it dispense when missile attacks are detected.
* After dispensing has happened maintenance has to be done again to fill up the magazines again with flares and chaffs.

Other relevant documents for this system are:

* Technical description of MWS system. Document number xxx
* Mechanical description of MWS system. Document number xxx
* User handbook of MWS system. Document number xxx

System overview. This paragraph shall briefly state the purpose of the system to which

this document applies. It shall describe the general nature of the system; summarize the history

of system development, operation, and maintenance; identify the project sponsor, acquirer, user,

developer, and support agencies; identify current and planned operating sites; and list other

relevant documents.

## Document overview

This document shall describe all the Systems Requirements for the Self Protection System for the F-16 combat aircraft and the development of the system shall be based on this document, when the system fulfil the requirements in this document the requirement of the Royal Danish Air Force is fulfilled.

This document must only be used in the project group by Company F and project group and other personal at The Royal Danish Air force that are cleared to have access to this project.

Document overview. This paragraph shall summarize the purpose and contents of this

document and shall describe any security or privacy considerations associated with its use.

# Referenced documents

* Terma case.pdf Document received from TERMA at IHA 3/9 2010.
* Terma case comments v1.pdf
* Terma case meeting 17 9 2010 at IHA v1.pdf
* Terma case questions and answers v1.pdf Answers received at consultation meeting at IHA 17/9 2010 room 517.
* MIL standard 1600-2-9 v12.45 – POD design rules.

This section shall list the number, title, revision, and date of all

documents referenced in this specification. This section shall also identify the source for all

documents not available through normal Government stocking activities.

# 3. Requirements.

This section shall be divided into the following paragraphs to specify the

system requirements, that is, those characteristics of the system that are conditions for its

acceptance. Each requirement shall be assigned a project-unique identifier to support testing

and traceability and shall be stated in such a way that an objective test can be defined for it.

Each requirement shall be annotated with associated qualification method(s) (see section 4) and,

for subsystems, traceability to system requirements (see section 5.a), if not provided in those

sections. The degree of detail to be provided shall be guided by the following rule: Include those

characteristics of the system that are conditions for system acceptance; defer to design

descriptions those characteristics that the acquirer is willing to leave up to the developer. If there

are no requirements in a given paragraph, the paragraph shall so state. If a given requirement

fits into more than one paragraph, it may be stated once and referenced from the other

paragraphs.

## 3.1 Required states and modes.

R-X : The system shall be able to work in 2 different System states: Armed and Disarmed.

INFO:

* Armed: In this state the system is able to react on information from the MWS system and depending on which mode it is set to by the pilot (Manuel, Semi automatic or automatic from UR 12 in TBD) it will react according to the mode. But for security reasons there shall also be a “plane on ground” mode, where firing of chaffs and flares are disabled.

INFO:

* Disarmed: in this state it shall be impossible to fire flares or chaffs even though the MWS system of any reason gives a warning against missile attack. In this state shall it also be possible to update SW in the MWS and run different tests to make sure every part of the system report normal conditions or some information about things that are not correct. In the test state it is possible to choose a simulated version of (Manuel, Semi automatic or automatic)

R-X : The system stateshall power up as Disarmed

R-X : The System state Shall change from Disarmed to Armed when all of the following conditions are met(ANDED):

1. The Flag to be removed before flight is removed
2. The plane is off ground

R-X : The System state Shall change from Armed to Disarmed when one of the following conditions are met(ORED):

1. The Flag to be removed before flight is removed
2. The plane is off ground



INFO : The Threat Response Subystem : When the AMC receives information about threats that are detected by the MWS, This subsystem will determine the response with respect to automatic semiautomatic or manual dispensing of chaffs and flares according to a Countermeasure program.

R-X : In Systemstate Armed the behaviour of the Thread respose subsystem shall be influenced by the mode (Manuel, Semi automatic, Automatic or Plane on Ground)

R-X: Changing between the modes : Manuel, Semi automatic or Automatic shall be chosen by the position of a selector switch in the cockpit.

R-X: Changing mode to “Plane on Ground” from any state of Manual , Semi automatic or Automatic shall happen when the plane is on ground.

R-X: Changing mode from “Plane on Ground” to any state of Manual , Semi automatic or Automatic shall happen when the plane is off ground and the Flag to be removed before flight is removed. The mode shall be chosen by the position of a selector switch in the cockpit.

LMU: Her skal vi have noget ind omkring hvor vi ellers behandler states og modes.

Required states and modes. If the system is required to operate in more than one state

or mode having requirements distinct from other states or modes, this paragraph shall identify and

define each state and mode. Examples of states and modes include: idle, ready, active, postuse

analysis, training, degraded, emergency, backup, wartime, peacetime. The distinction

between states and modes is arbitrary. A system may be described in terms of states only,

modes only, states within modes, modes within states, or any other scheme that is useful. If no

states or modes are required, this paragraph shall so state, without the need to create artificial

distinctions. If states and/or modes are required, each requirement or group of requirements in

this specification shall be correlated to the states and modes. The correlation may be indicated

by a table or other method in this paragraph, in an appendix referenced from this paragraph, or

by annotation of the requirements in the paragraphs where they appear.

## 3.2 System capability requirements.

This paragraph shall be divided into subparagraphs to

itemize the requirements associated with each capability of the system. A "capability" is defined

as a group of related requirements. The word "capability" may be replaced with "function,"

"subject," "object," or other term useful for presenting the requirements.

### 3.2.x (System capability).

Beskriver blot lige nogle tanker om struktur

POD

* Dispensing
  + Dispense forward, sideways and downwars
  + Hardware safety interlock
  + osv
* Optimal coverage

Cockpit Control Unit

* Control Power for dispensing system and MWS
* Interface Aircraft intercom to provide audio cues and warnings.

This paragraph shall identify a required system capability and shall

itemize the requirements associated with the capability. If the capability can be more clearly

specified by dividing it into constituent capabilities, the constituent capabilities shall be specified

in subparagraphs. The requirements shall specify required behavior of the system and shall

include applicable parameters, such as response times, throughput times, other timing constraints,

sequencing, accuracy, capacities (how much/how many), priorities, continuous operation requirements,

and allowable deviations based on operating conditions. The requirements shall include,

as applicable, required behavior under unexpected, unallowed, or "out of bounds" conditions,

requirements for error handling, and any provisions to be incorporated into the system to provide

continuity of operations in the event of emergencies. Paragraph 3.3.x of this DID provides a list

of topics to be considered when specifying requirements regarding inputs the system must accept

and outputs it must produce.

## 3.3 System external interface requirements.

This paragraph defines the requirements on the interfaces between the system and externals parts.

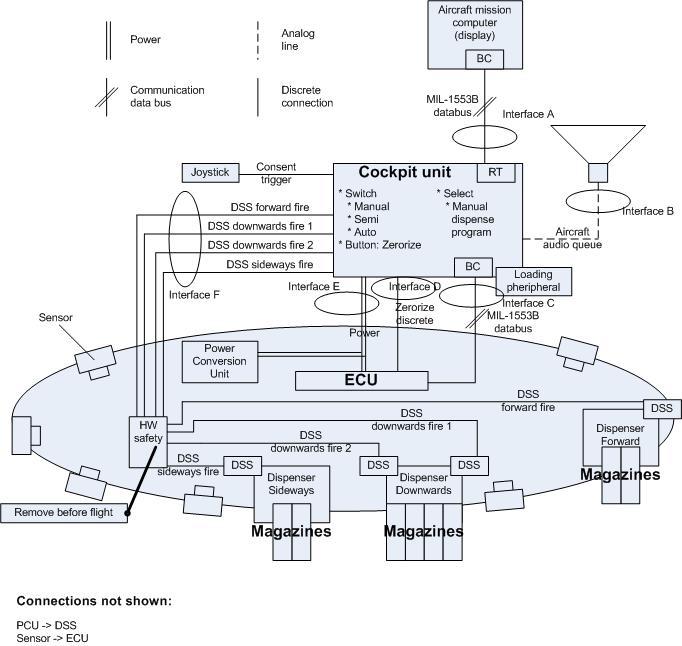
This paragraph shall be divided into subparagraphs

to specify the requirements, if any, for the system’s external interfaces. This paragraph

may reference one or more Interface Requirements Specifications (IRSs) or other documents

containing these requirements.

### 3.3.1 Interface identification and diagrams.



Oversigtstegning der viser de forskellige interfaces mellem Cockpit Control Unit og AMC samt Intercom.

### Interface A (Interface to Aircraft Mission Computer.

This interface shall make it possible to communicate with the AMC. Information will both be from AMC to the system and from the system to the AMC.

R-x:

Skal interface i vingen mellem pod og kabler fra CCU’en beskrives her eller under interne interfaces??.

This paragraph shall identify the required external

interfaces of the system. The identification of each interface shall include a project-unique

identifier and shall designate the interfacing entities (systems, configuration items, users, etc.) by

name, number, version, and documentation references, as applicable. The identification shall

state which entities have fixed interface characteristics (and therefore impose interface

requirements on interfacing entities) and which are being developed or modified (thus having

interface requirements imposed on them). One or more interface diagrams shall be provided to

depict the interfaces.

### 3.3.x (Project-unique identifier of interface).

3.3.2 Beskrivelse af og krav til interface mellem CCU og AMC.

3.3.3 Beskrivelse af og krav til interface mellem CCU og Intercom.

This paragraph (beginning with 3.3.2) shall identify

a system external interface by project-unique identifier, shall briefly identify the interfacing entities,

and shall be divided into subparagraphs as needed to state the requirements imposed on the

system to achieve the interface. Interface characteristics of the other entities involved in the

interface shall be stated as assumptions or as "When [the entity not covered] does this, the

system shall...," not as requirements on the other entities. This paragraph may reference other

documents (such as data dictionaries, standards for communication protocols, and standards for

user interfaces) in place of stating the information here. The requirements shall include the

following, as applicable, presented in any order suited to the requirements, and shall note any

differences in these characteristics from the point of view of the interfacing entities (such as

different expectations about the size, frequency, or other characteristics of data elements):

a. Priority that the system must assign the interface

b. Requirements on the type of interface (such as real-time data transfer, storage-andretrieval

of data, etc.) to be implemented

c. Required characteristics of individual data elements that the system must provide, store,

send, access, receive, etc., such as:

1) Names/identifiers

a) Project-unique identifier

b) Non-technical (natural-language) name

c) DoD standard data element name

d) Technical name (e.g., variable or field name in code or database)

e) Abbreviation or synonymous names

2) Data type (alphanumeric, integer, etc.)

3) Size and format (such as length and punctuation of a character string)

4) Units of measurement (such as meters, dollars, nanoseconds)

5) Range or enumeration of possible values (such as 0-99)

6) Accuracy (how correct) and precision (number of significant digits)

7) Priority, timing, frequency, volume, sequencing, and other constraints, such as whether

the data element may be updated and whether business rules apply

8) Security and privacy constraints

9) Sources (setting/sending entities) and recipients (using/receiving entities)

d. Required characteristics of data element assemblies (records, messages, files, arrays,

displays, reports, etc.) that the system must provide, store, send, access, receive, etc.,

such as:

1) Names/identifiers

a) Project-unique identifier

b) Non-technical (natural language) name

c) Technical name (e.g., record or data structure name in code or database)

d) Abbreviations or synonymous names

2) Data elements in the assembly and their structure (number, order, grouping)

3) Medium (such as disk) and structure of data elements/assemblies on the medium

4) Visual and auditory characteristics of displays and other outputs (such as colors,

layouts, fonts, icons and other display elements, beeps, lights)

5) Relationships among assemblies, such as sorting/access characteristics

6) Priority, timing, frequency, volume, sequencing, and other constraints, such as whether

the assembly may be updated and whether business rules apply

7) Security and privacy constraints

8) Sources (setting/sending entities) and recipients (using/receiving entities)

e. Required characteristics of communication methods that the system must use for the

interface, such as:

1) Project-unique identifier(s)

2) Communication links/bands/frequencies/media and their characteristics

3) Message formatting

4) Flow control (such as sequence numbering and buffer allocation)

5) Data transfer rate, whether periodic/aperiodic, and interval between transfers

6) Routing, addressing, and naming conventions

7) Transmission services, including priority and grade

8) Safety/security/privacy considerations, such as encryption, user authentication,

compartmentalization, and auditing

f. Required characteristics of protocols the system must use for the interface, such as:

1) Project-unique identifier(s)

2) Priority/layer of the protocol

3) Packeting, including fragmentation and reassembly, routing, and addressing

4) Legality checks, error control, and recovery procedures

5) Synchronization, including connection establishment, maintenance, termination

6) Status, identification, and any other reporting features

g. Other required characteristics, such as physical compatibility of the interfacing entities

(dimensions, tolerances, loads, plug compatibility, etc.), voltages, etc.

## 3.4 System internal interface requirements.

Oversigttegning der viser interfaces mellem CCU og MWS/ECU, samt CCU og DSS’er.

This paragraph shall specify the requirements,

if any, imposed on interfaces internal to the system. If all internal interfaces are left to the design

or to requirement specifications for system components, this fact shall be so stated. If such

requirements are to be imposed, paragraph 3.3 of this DID provides a list of topics to be

considered.

## 3.5 System internal data requirements.

Interface CCU og MWS/ECU.

Interface CCU og DSS’er.

This paragraph shall specify the requirements, if any,

imposed on data internal to the system. Included shall be requirements, if any, on databases and

data files to be included in the system. If all decisions about internal data are left to the design

or to requirements specifications for system components, this fact shall be so stated. If such

requirements are to be imposed, paragraphs 3.3.x.c and 3.3.x.d of this DID provide a list of topics

to be considered.

## 3.6 Adaptation requirements.

Ikke relevant for os

This paragraph shall specify the requirements, if any,

concerning installation-dependent data that the system is required to provide (such as sitedependent

latitude and longitude or site-dependent state tax codes) and operational parameters

that the system is required to use that may vary according to operational needs (such as

parameters indicating operation-dependent targeting constants or data recording).

## 3.7 Safety requirements.

This paragraph shall specify the system requirements, if any,

concerned with preventing or minimizing unintended hazards to personnel, property, and the

physical environment. Examples include restricting the use of dangerous materials; classifying

explosives for purposes of shipping, handling, and storing; abort/escape provisions from

enclosures; gas detection and warning devices; grounding of electrical systems; decontamination;

and explosion proofing. This paragraph shall include the system requirements, if any, for nuclear

components, including, as applicable, requirements for component design, prevention of

inadvertent detonation, and compliance with nuclear safety rules.

## 3.8 Security and privacy requirements.

R-X: The system shall be able to erase sensitive data upon input from a discrete signal from aircraft.

R-X: The cockpit unit shall keep all sensitive data in an encrypted format as specified by the DOD sensitive data standard SDS23v.

R-X: The cockpit unit shall erase the decryption key using the DOD data wipe specification DWS12g.

R-X: The POD shall keep all sensitive data in an encrypted format as specified by the DOD sensitive data standard SDS23v.

R-X: The POD shall erase the decryption key using the DOD data wipe specification DWS12g.

R-X: When the erasing of sensitive data procedure is initiated, the POD erase sensitive data discrete shall be set within 10ms.

R-X: When the erasing of sensitive data procedure is initiated, the cockpit unit shall erase its sensitive data decryption key within 100ms.

R-X: The POD sensitive data decryption key shall be erased within 100ms of receiving the erase signal.

Krav og beskrivelse af zeroize signal/mulighed.

This paragraph shall specify the system requirements,

if any, concerned with maintaining security and privacy. The requirements shall include, as

applicable, the security/privacy environment in which the system must operate, the type and

degree of security or privacy to be provided, the security/privacy risks the system must withstand,

required safeguards to reduce those risks, the security/privacy policy that must be met, the

security/privacy accountability the system must provide, and the criteria that must be met for

security/privacy certification/accreditation.

## 3.9 System environment requirements.

This paragraph shall specify the environment regarding the environment in which the system must operate.

### Temperature.

R-x: The pod structure shall be operational at temperatures of 95 ̊C on the outer skin and of 102 ̊C on the leading edge for 25 minutes.

R-x: The pod structure shall be operational at temperatures of 134 ̊C on the outer skin and of 151 ̊C on the leading edge for 3 minutes.

R-x: The maximum temperature inside the pod shall not be more than 70 ̊C during and test and under normal operation.

### Acceleration.

R-x: The pod structure shall be without any failures after being exposed to a steady state acceleration of 5g fore.

R-x: The pod structure shall be without any failures after being exposed to a steady state acceleration of 2.5g aft.

R-x: The pod structure shall be without any failures after being exposed to a steady state acceleration of 25g up.

R-x: The pod structure shall be without any failures after being exposed to a steady state acceleration of 11g down.

Temperatur

G-påvirkninger

This paragraph shall specify the requirements, if any,

regarding the environment in which the system must operate. Examples for a software system

are the computer hardware and operating system on which the software must run. (Additional

requirements concerning computer resources are given in the next paragraph). Examples for a

hardware-software system include the environmental conditions that the system must withstand

during transportation, storage, and operation, such as conditions in the natural environment (wind,

rain, temperature, geographic location), the induced environment (motion, shock, noise,

electromagnetic radiation), and environments due to enemy action (explosions, radiation).

## 3.10 Computer resource requirements.

This paragraph shall be divided into the following

subparagraphs. Depending upon the nature of the system, the computer resources covered in

these subparagraphs may constitute the environment of the system (as for a software system)

or components of the system (as for a hardware-software system).

### 3.10.1 Computer hardware requirements.

This paragraph shall specify the requirements, if any,

regarding computer hardware that must be used by, or incorporated into, the system. The

requirements shall include, as applicable, number of each type of equipment, type, size, capacity,

and other required characteristics of processors, memory, input/output devices, auxiliary storage,

communications/network equipment, and other required equipment.

### 3.10.2 Computer hardware resource utilization requirements.

This paragraph shall specify the

requirements, if any, on the system’s computer hardware resource utilization, such as maximum

allowable use of processor capacity, memory capacity, input/output device capacity, auxiliary

storage device capacity, and communications/network equipment capacity. The requirements

(stated, for example, as percentages of the capacity of each computer hardware resource) shall

include the conditions, if any, under which the resource utilization is to be measured.

### 3.10.3 Computer software requirements.

This paragraph shall specify the requirements, if any,

regarding computer software that must be used by, or incorporated into, the system. Examples

include operating systems, database management systems, communications/network software,

utility software, input and equipment simulators, test software, and manufacturing software. The

correct nomenclature, version, and documentation references of each such software item shall

be provided.

### 3.10.4 Computer communications requirements.

This paragraph shall specify the additional

requirements, if any, concerning the computer communications that must be used by, or

incorporated into, the system. Examples include geographic locations to be linked; configuration

and network topology; transmission techniques; data transfer rates; gateways; required system

use times; type and volume of data to be transmitted/received; time boundaries for transmission/

reception/response; peak volumes of data; and diagnostic features.

## 3.11 System quality factors.

This paragraph shall specify the requirements, if any, pertaining

to system quality factors. Examples include quantitative requirements concerning system

functionality (the ability to perform all required functions), reliability (the ability to perform with

correct, consistent results -- such as mean time between failure for equipment), maintainability

(the ability to be easily serviced, repaired, or corrected), availability (the ability to be accessed and

operated when needed), flexibility (the ability to be easily adapted to changing requirements),

portability of software (the ability to be easily modified for a new environment), reusability (the

ability to be used in multiple applications), testability (the ability to be easily and thoroughly

tested), usability (the ability to be easily learned and used), and other attributes.

## 3.12 Design and construction constraints.

### Weight.

R-x: The total weight of pod shall not exceed 270 kg.

R-x: Weight of complete MWS is 18,2kg.

### Mounting.

R-x: The pod shall be mounted on the aircraft wing with standard T-hooks spaced by 13 inches.

R-x: The pod shall be mounted on the left-hand wing.

### MWS.

R-x: MWS will be provided as a Government Furnished Equipment.

R-x: MWS will physically be mounted by Company F.

### Power.

R-x: Power consumption of the pod shall not exceed 700W.

R-x: Power to the pod is 115VAC 400Hz.

R-x: The MWS requires maximum 85W from a 28VDC power source and a maximum of 100W from a 115VAC 400Hz power source.

R-x: The power required to ignite a payload is up to 126W for a period of up to 20ms.

### Coverage against missile threats.

R-x: The six sensors shall be located to cover all angles which are not shaded by the aircraft.

Weight.

Mounting (Under left wing, T-hooks 13” osv.)

Use of MWS provided as GFE

Optimal coverage against Missi…

This paragraph shall specify the requirements, if any,

that constrain the design and construction of the system. For hardware-software systems, this

paragraph shall include the physical requirements imposed on the system. These requirements

may be specified by reference to appropriate commercial or military standards and specifications.

Examples include requirements concerning:

a. Use of a particular system architecture or requirements on the architecture, such as

required subsystems; use of standard, military, or existing components; or use of

Government/acquirer-furnished property (equipment, information, or software)

b. Use of particular design or construction standards; use of particular data standards; use

of a particular programming language; workmanship requirements and production

techniques

c. Physical characteristics of the system (such as weight limits, dimensional limits, color,

protective coatings); interchangeability of parts; ability to be transported from one location

to another; ability to be carried or set up by one, or a given number of, persons

d. Materials that can and cannot be used; requirements on the handling of toxic materials;

limits on the electromagnetic radiation that the system is permitted to generate

e. Use of nameplates, part marking, serial and lot number marking, and other identifying

markings

f. Flexibility and expandability that must be provided to support anticipated areas of growth

or changes in technology, threat, or mission

## 3.13 Personnel-related requirements.

This paragraph shall specify the system requirements,

if any, included to accommodate the number, skill levels, duty cycles, training needs, or other

information about the personnel who will use or support the system. Examples include

requirements for the number of work stations to be provided and for built-in help and training

features. Also included shall be the human factors engineering requirements, if any, imposed on

the system. These requirements shall include, as applicable, considerations for the capabilities

and limitations of humans, foreseeable human errors under both normal and extreme conditions,

and specific areas where the effects of human error would be particularly serious. Examples

include requirements for adjustable-height work stations, color and duration of error messages,

physical placement of critical indicators or buttons, and use of auditory signals.

## 3.14 Training-related requirements.

This paragraph shall specify the system requirements, if

any, pertaining to training. Examples include training devices and training materials to be

included in the system.

## 3.15 Logistics-related requirements.

This paragraph shall specify the system requirements, if

any, concerned with logistics considerations. These considerations may include: system

maintenance, software support, system transportation modes, supply-system requirements, impact

on existing facilities, and impact on existing equipment.

## 3.16 Other requirements.

This paragraph shall specify additional system requirements, if any,

not covered in the previous paragraphs. Examples include requirements for system documentation,

such as specifications, drawings, technical manuals, test plans and procedures, and

installation instruction data, if not covered in other contractual documents.

## 3.17 Packaging requirements.

This section shall specify the requirements, if any, for

packaging, labeling, and handling the system and its components for delivery. Applicable military

specifications and standards may be referenced if appropriate.

## 3.18 Precedence and criticality of requirements.

This paragraph shall specify, if applicable, the

order of precedence, criticality, or assigned weights indicating the relative importance of the

requirements in this specification. Examples include identifying those requirements deemed

critical to safety, to security, or to privacy for purposes of singling them out for special treatment.

If all requirements have equal weight, this paragraph shall so state.

# 4. Qualification provisions.

Her skal vi lægge vores informationer om hvordan vi vil teste/vise at de forskellige requirements er opfyldt.

|  |  |  |
| --- | --- | --- |
| Requirement # | Qualification method |  |
| FR-1 | Test by….. |  |
| FR-? | Analysis that shows that….. |  |

This section shall define a set of qualification methods and shall

specify for each requirement in Section 3 the method(s) to be used to ensure that the requirement

has been met. A table may be used to present this information, or each requirement in Section

3 may be annotated with the method(s) to be used. Qualification methods may include:

a. Demonstration: The operation of the system, or a part of the system, that relies on

observable functional operation not requiring the use of instrumentation, special test

equipment, or subsequent analysis.

b. Test: The operation of the system, or a part of the system, using instrumentation or other

special test equipment to collect data for later analysis.

c. Analysis: The processing of accumulated data obtained from other qualification methods.

Examples are reduction, interpolation, or extrapolation of test results.

d. Inspection: The visual examination of system components, documentation, etc.

e. Special qualification methods. Any special qualification methods for the system, such as

special tools, techniques, procedures, facilities, acceptance limits, use of standard

samples, preproduction or periodic production samples, pilot models, or pilot lots.

# 5. Requirements traceability.

Her skal vi lægge vores matrix ind for den ene vej og den anden vej eller henvise til hvor det findes.

|  |  |  |  |
| --- | --- | --- | --- |
| **REQ ID** | **Requirement (short)** | **Trace ID** | **Reference** |
| FR-1 |  | UR-1 |  |

For system-level specifications, this paragraph does not apply.

For subsystem-level specifications, this paragraph shall contain:

a. Traceability from each subsystem requirement in this specification to the system

requirements it addresses. (Alternatively, this traceability may be provided by annotating

each requirement in Section 3.)

Note: Each level of system refinement may result in requirements not directly traceable

to higher-level requirements. For example, a system architectural design that creates two

subsystems may result in requirements about how the subsystems will interface, even

though these interfaces are not covered in system requirements. Such requirements may

be traced to a general requirement such as "system implementation" or to the system

design decisions that resulted in their generation.

b. Traceability from each system requirement that has been allocated to the subsystem

covered by this specification to the subsystem requirements that address it. All system

requirements allocated to the subsystem shall be accounted for. Those that trace to

subsystem requirements contained in Interface Requirements Specifications (IRSs) shall

reference those IRSs.

# 6. Notes.

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This section shall contain any general information that aids in understanding this

document (e.g., background information, glossary, rationale). This section shall contain an

alphabetical listing of all acronyms, abbreviations, and their meanings as used in this document

and a list of any terms and definitions needed to understand this document.

# A. Appendixes.

Appendix A:

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Appendixes may be used to provide information published separately for

convenience in document maintenance (e.g., charts, classified data). As applicable, each

appendix shall be referenced in the main body of the document where the data would normally

have been provided. Appendixes may be bound as separate documents for ease in handling.

Appendixes shall be lettered alphabetically (A, B, etc.).

# Requirements

## Functional requirements

|  |  |
| --- | --- |
| **REQ ID** | **Requirement** |
| FR-12 | The systems shall comply with all F-16 EW standards for EMC and data bus load as specified by the F-16 EW standard *FE16d*. |

## CCU

|  |  |
| --- | --- |
| **REQ ID** | **Requirement** |
| FR-12 | The systems shall comply with all F-16 EW standards for EMC and data bus load as specified by the F-16 EW standard *FE16d*. |
| FR-20 | The ECU shall perform the built in test that is supported by this Government Furnished Equipment (*GFE*). |
| FR-21 | The cockpit unit shall perform an internal built-in test of its internal subsystems and HW, as specified by the F-16 subsystem BIT standard *FBIT12c*. |
| FR-23 | The cockpit unit shall request status information from the ECU every 20ms. |
| FR-24 | The ECU shall report the status information available for this Government Furnished Equipment (*GFE*). |
| FR-26 | The cockpit unit shall play an audio cue on the aircrafts audio system when a threat is detected. |
| FR-27 | The audio cue played in case of a threat shall be an indication of threat type (e.g. “Missile”), location (e.g. “4 o’clock”) and elevation (e.g. “low”), as specified by the audio queue table *ACTv2*. |
| FR-31 | The cockpit unit shall keep all sensitive data in an encrypted format as specified by the DOD sensitive data standard *SDS23v*. |
| FR-32 | The cockpit unit shall erase the decryption key using the DOD data wipe specification *DWS12g*. |

## POD

|  |  |
| --- | --- |
| **REQ ID** | **Requirement** |
| FR-1 | The POD shall contain three dispenser magazine mounts.  INFO: These shall henceforth be named first, second and third. |
| FR-2 | The POD’s first dispenser magazine mount shall physically be located before the second and third dispenser magazine mount relative to the nose of the plane. |
| FR-3 | The POD’s first dispenser magazine mount shall support forward dispensing. |
| FR-4 | The POD’s first dispenser magazine mount shall support two magazines. |
| FR-5 | The POD’s second dispenser magazine mount shall physically be located before the third dispenser magazine mount relative to the nose of the plane. |
| FR-6 | The POD’s second dispenser magazine mount shall support leftwards dispensing. |
| FR-7 | The POD’s second dispenser magazine mount shall support four magazines. |
| FR-8 | The POD’s third dispenser magazine mount shall support downwards dispensing. |
| FR-9 | The POD’s third dispenser magazine mount shall support two magazines. |
| FR-11 | The POD shall comply with all F-16 requirements for aerodynamics and radar reflections as specified by the F-16 POD standard *FP42f*. |
| FR-13 | The POD shall be mounted under the left wing. |
| FR-20 | The ECU shall perform the built in test that is supported by this Government Furnished Equipment (*GFE*). |
| FR-24 | The ECU shall report the status information available for this Government Furnished Equipment (*GFE*). |
| FR-28 | The POD shall include a safety pin that prevents the dispenser from firing. |
| FR-29 | The POD safety pin shall be clearly labelled and accessible by aircraft maintenance crew as specified by the aircraft maintenance manual *AMM32f*. |
| FR-39 | The POD shall supply the status of the following LRUs:   * The Sensors * The ECU   INFO: The Magazines and DSS are not seen as LRUs and also do not have status reporting capabilities.  INFO: It is assumed that the ECU has the ability to deliver this information. |
| FR-44 | The status reported by the POD as a whole shall be:   1. POD internal temperature 2. ECU operational status (OK, ERROR)   INFO: It is assumed that the ECU has the ability to deliver this information.  INFO: It is assumed that the ECU has a temperature sensor inside the POD and is able to deliver its reading on the data bus. |

## Performance requirements

## CCU

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| --- | --- |
| **REQ ID** | **Requirement** |
| FR-16 | The cockpit unit shall forward the threat data received from the MWS within 20ms. |
| FR-19 | The cockpit unit shall request the performance of a built in test by the ECU every 15 minutes. |
| FR-22 | The cockpit unit shall forward the built in test results to the aircraft mission computer with a maximum latency of 1 second from receiving the results. |
| FR-25 | The cockpit unit shall forward the status of the individual subsystems and LRUs; ECU, POD and aircraft unit to the aircraft mission computer with a maximum latency of 100ms from receiving the information.  INFO: The Magazines and DSS are not seen as LRUs and also do not have status reporting capabilities. |
| FR-34 | When the erasing of sensitive data procedure is initiated, the cockpit unit shall erase its sensitive data decryption key within 100ms. |

## Environment requirements

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| **REQ ID** | **Requirement** |
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|  |  |

## External interface requirements

## CCU

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| --- | --- |
| **REQ ID** | **Requirement** |
| FR-15a | The cockpit unit shall communicate with the aircraft mission computer via the planes main MIL-1553B data bus. |
| FR-15b | The cockpit unit shall forward all threat data received from the MWS to the aircraft mission computer in body frame format. |
| FR-17 | The cockpit unit shall use the NATO dispenser threat format *DF14b* to forward threat data to the aircraft mission computer. |
| FR-30 | The cockpit unit shall receive an input discrete which when set to logic 0 shall trigger the erasing of sensitive data procedure. |
| FR-47 | The cockpit unit shall include a consent button to use with semi-automatic dispensing. |

## POD

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| --- | --- |
| **REQ ID** | **Requirement** |
| FR-10 | The POD shall support standard NATO dispenser magazines type *DM30p*. |
| FR-14 | The POD shall be mounted by two T-hooks as specified by the F-16 POD mounting standard *PM11b*. |

## Internal interface requirements (POD and CCU)

|  |  |
| --- | --- |
| **REQ ID** | **Requirement** |
| FR-18a | The ECU shall communicate with the cockpit unit via a dedicated *MIL-1553B* data bus. |
| FR-18b | The ECU shall forward threat data to the cockpit unit in NATO dispenser threat format *DF14b*. |
| FR-46 | The cockpit unit shall display the LRU status received from the POD as indicated by the LRU status display specification. |
| FR-45 | The POD LRU status shall be reported in the POD status format specified under interfaces.  INFO: This interface is specified by the ECU (GFE). |

**Explanation:**

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| --- | --- |
| Threat Response Subystem | When the AMC receives information about threats that are detected by the MWS, This subsystem will determine the response with respect to automatic semiautomatic or manual dispensing of chaffs and flares according to a Countermeasure program. |
| Countermeasure program | A preprogrammed sequence of dispensing chaffs and or flares in certain directions with a certain timing |
| Thread pattern | A thread pattern is a certain number of threads attacking the aircraft from certain angles |

|  |  |  |  |
| --- | --- | --- | --- |
| Requirement continued | TestMethod | Trace | Completion |
| 1. Controlling power on/off, for the dispensing system and the MWS shall be done by a secured switch Mil.Grade.xyz inside the cockpit | Observe that the power led in the MWS is turned on and off by controlling the switch in the cockpit | UR-11 | TBR |
| * 1. When turning on power a maximum of 5 seconds will last before the system is fully operational | Using an oscilloscope and checking the delay from turning on the switch to the “operational led” is on | UR-11 indirect | TBR |
| * 1. When turning off power a maximum of 2 seconds will last before the system is fully closed down | Using an oscilloscope and checking the delay from turning off the switch to the “operational led” is off | UR-11  Indirect | TBR |
| 1. When the AMC receives information about threats that are detected by the MWS, the kind of threat and the direction (body frame format) shall be displayed in the cockpit ,( within 20 milliseconds from AMC is receiving threat info) | Test ???? | UR7 | TBR |
| 1. When the AMC receives information about threats that are detected by the MWS the Threat Response Subsystem shall be triggered ( within 20 milliseconds from AMC is receiving threat info) |  |  |  |
| 1. The Threat Response Subsystem shall be in one of three modes : Manual, Semiautomatic, Automatic. The mode shall be chosen by the position of a selector switch | Test that the status LED’s reflect the setting of the appropriate selector switch | UR12 | TBR |
| * 1. When the Threat Response Subsystem is in the manual mode, the threads shall be heard and seen by the pilot but he himself must select and execute a Countermeasure program | Tested by using the Threat simulator mode of the MWS | UR13 | TBR |
| * 1. When the Threat Response Subsystem is in the Semiautomatic mode a countermeasure program shall be chosen by the system and executed but only upon consent from the pilot | Tested by using the Threat simulator mode of the MWS | UR14 | TBR |
| * 1. When the Threat Response Subsystem is in the Automatic mode a countermeasure program shall be chosen by the system and executed | Tested by using the Threat simulator mode of the MWS | UR15 | TBR |
| 1. The Threat Response Subsystem shall be able to store 100 countermeasure programs, each of these are configured as being best suited for a given Threat pattern    1. All data concerning the countermeasure programs shall be handled by the winXYZapplication. This includes programming configuration uploading or downloading to the Threat response system |  | UR21 |  |
| 1. The Threat Response Subsystem shall be able to store 100 Threat patterns    1. All data concerning the Threat patterns shall be handled by the winXYZapplication. This includes programming configuration uploading or downloading to the Threat response system |  | UR21 |  |
| 1. When the Threat Response Subsystem chooses a countermeasure program, it shall be done by matching the stored Thread patterns with the actual threat pattern and finding the best match using the mathematical zyx procedure.    1. All data concerning the mathematical zyx procedure shall be handled by the winXYZapplication. This includes programming configuration uploading or downloading to the Threat response system |  | UR15 |  |

## States and modes

The system shall be able to work in 2 different states:

* Armed: In this state the system is able to react on information from the MWS system and depending on which mode it is set to by the pilot (Manuel, Semi automatic or automatic from UR 12 in TBD) it will react according to the mode. But for security reasons there shall also be a “plane on ground” mode, where firing of chaffs and flares are disabled.
* Disarmed: in this state it shall be impossible to fire flares or chaffs even though the MWS system of any reason gives a warning against missile attack. In this state shall it also be possible to update SW in the MWS and run different tests to make sure every part of the system report normal conditions or some information about things that are not correct.



## Functional requirements

## External interfaces

## Internal nterfaces

## Design constraints

# Requirement traceability

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| --- | --- | --- | --- | --- | --- |
| **REQ ID** | **Requirement (short)** | **Trace ID** | **Reference** | **Test description** | **Test type** |
| FR-1 |  | UR-2 |  | Inspect that the requested dispenser mounts are located on the POD | Inspection |
| FR-2 |  | UR-2 |  | Inspect that the first dispenser mount is mounted correctly on the POD. | Inspection |
| FR-3 |  | UR-2 |  | Inspect that the first dispenser mount is placed correctly on the POD. | Inspection |
| FR-4 |  | UR-1 |  | Inspect that the first dispenser mount can hold 2 magazines. | Inspection |
| FR-5 |  | UR-2 |  | Inspect that the second dispenser mount is placed correctly on the POD. | Inspection |
| FR-6 |  | UR-2 |  | Inspect that the second dispenser mount is placed correctly on the POD. | Inspection |
| FR-7 |  | UR-1 |  | Inspect that the second dispenser mount can hold 4 magazines. | Inspection |
| FR-8 |  | UR-2 |  | Inspect that the third dispenser mount is placed correctly on the POD. | Inspection |
| FR-9 |  | UR-1 |  | Inspect that the third dispenser mount can hold 2 magazines. | Inspection |
| FR-10 |  | UR-1 |  | Inspect that the dispenser mounts support the correct magazine type. | Inspection |
| FR-11 |  | UR-3 |  | The POD design and implementation must be verified by a certified third party F-16 POD certifying authority. | Inspection and verification |
| FR-12 |  | UR-3 |  | The POD design and implementation must be verified by a certified third party F-16 EW certifying authority. | Inspection and verification |
| FR-13 |  | UR-4 |  | Inspect that the POD is mounted correctly. | Inspection |
| FR-14 |  | UR-4 |  | Inspect that the POD is mounted correctly. | Inspection |
| FR-15 |  | UR-5 |  | Inspect the code and run simulation with a MWS simulator to verify the inertial format to body-frame format conversion. | Code inspection and test |
| FR-16 |  | UR-5 |  | Run simulation with a MWS simulator to verify the delay from cockpit unit reception to availability on aircraft mission bus. A simulator of the aircraft mission bus must be set up to poll the cockpit unit as fast as possible. | Test |
| FR-17 |  | UR-5 |  | Inspect the code and run simulation with a MWS simulator to verify the threat data format. | Code inspection and test |
| FR-18a |  | UR-5 |  | Inspect that the MWS uses a dedicated MIL-1553B data bus. | Inspection |
| FR-18b |  | UR-5 |  | Inspect the code and run simulation with a MWS simulator to verify the threat data format. | Code inspection and test |
| FR-19 |  | UR-6 |  | Run simulation with a MWS simulator to verify the BIT request interval. | Test |
| FR-20 |  | UR-6 |  | Inspect that the supported BIT is requested and run simulation with a MWS simulator to verify the BIT responses. | Code inspection and test |
| FR-21 |  | UR-6 |  | Inspect the internal BIT code and run test with test setup (faulty HW) to verify BIT responses. | Code inspection and test |
| FR-22 |  | UR-6 |  | Run simulation with a MWS simulator to verify the maximum delay. A simulator of the aircraft mission bus must be set up to poll the cockpit unit as fast as possible. | Test |
| FR-23 |  | UR-6 |  | Inspect the status request code time and run test with MWS simulator to verify status request interval. | Code inspection and test |
| FR-24 |  | UR-6 |  | Verify that all available status information is placed on the MWS to cockpit unit data bus. | Test |
| FR-25 |  | UR-6 |  | Run simulation with a MWS simulator to verify the maximum delay. A simulator of the aircraft mission bus must be set up to poll the cockpit unit as fast as possible. | Test |
| FR-26 |  | UR-7 |  | Run simulation with a MWS simulator to verify an audio cue is played. | Test |
| FR-27 |  | UR-7 |  | Run simulation with a MWS simulator to verify the correct audio cues are played. | Test |
| FR-28 |  | UR-8 |  | Verify that a removable pin exists and that firing is disabled when the pin is present in the POD. | Inspection and test |
| FR-29 |  | UR-8 |  | Verify pin design according to standard | Inspection |
| FR-30 |  | UR-9 |  | Verify that zerorize button is present on cockpit unit. | Inspection |
| FR-31 |  | UR-9 |  | Verify the DOD standard is met with respect to sensitive data storage. | Code inspection |
| FR-32 |  | UR-9 |  | Verify the DOD standard is met with respect to decryption key erase. | Code inspection |
| FR-33 |  | UR-9 |  | Verify that the POD erase discrete is set within 10ms of depressing the zerorize button. | Test |
| FR-34 |  | UR-9 |  | Show that it is probable that the key will be wiped within 100ms. | Code inspection |
| FR-35 |  | UR-9 |  | Verify the DOD standard is met with respect to sensitive data storage. | Code inspection |
| FR-36 |  | UR-9 |  | Verify that the POD erases its sensitive data decryption key when the POD erase discrete is set. | Test |
| FR-37 |  | UR-9 |  | Verify the DOD standard is met with respect to decryption key erase. | Code inspection |
| FR-38 |  | UR-9 |  | Show that it is probable that the key will be wiped within 100ms. | Code inspection |
| FR-39 |  | UR-10 |  | Verify with MWS simulator that the required status is available and correct. | Test |
| FR-44 |  | UR-10 |  | Verify with MWS simulator that the required status is available and correct. | Test |
| FR-45 |  | UR-10 |  | Verify with MWS simulator that the required status is available and correct. | Test |
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## Standards

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| **Standard** | **Description** |
| DM30p | NATO dispenser magazine type contains the complete details about the magazines physical constructions and interface, |
| FP42f | F-16 POD standard contains complete specification about requirements for POD manufacturing, including size, weight, material, shape, etc. |
| FE16d | F-16 EW standard contains the requirements and test procedures required to have a new system approved on an F-16. |
| PM11b | F-16 POD mounting standard includes specifications on how a POD shall safely be mounted to an F-16 aircraft. |
| DF14b | NATO dispenser threat format specify the protocol to use when exchanging threat data with the F-16 aircraft mission computer. |
| GFE | The complete specification of the Government Furnished Equipment that is the MWS. |
| FBIT12c | F-16 subsystem BIT standard indicate how a subsystem shall test its internal status to comply with the F-16 operational standard. |
| ACTv2 | Separate document excluded due to the fact that it is not important for the process. |
| AMM32f | Aircraft maintenance manual contains details about how removable parts on aircraft shall be located and labeled. |
| SDS23v | DOD sensitive data standard specify how sensitive data must be stored, and also how the decryption key must be stored. |
| DWS12g | DOD data wipe specification dictates how sensitive data must be wiped from different media. |
| MIL-1553B | Military standard for a redundant communication protocol. The MIL-1553B is pure master-slave(s), and can have 1 Bus Controller (BC) and a number of Remote Terminals (RT). Only the BC can initiate communication, so if two RTs are to communicate it must be programmed into the BC. The MIL-1553B specify polling frequencies of up to 50Hz, meaning that a given package (e.g. status information) can be requested (and thereby sent) with a minimum interval of 20ms. |
|  |  |