

The Military Aviation Authority Certification of Military Air Systems

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1

What is Certification (Plain English)

- Certification is the process to **independently** demonstrate that an aircraft design complies with **reference** standards and can achieve an **acceptable** level of safety
- Culminates in the issue of a Type Certificate by an independent regulator



- Applies to initial entry of platform into service and all design changes during in-service phase.

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2

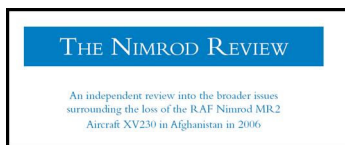
What is Certification (Regulatory English)

- **RA 5810 Military Type Certificate**
 - *Demonstrate that Air System's Type Design meets appropriate safety requirements*
 - *A systematic, independent certification process is required for **new types** of UK military registered Air Systems*
 - *Details the Military Air System Certification Process (MACP)*
- **RA5820 Changes in Type Design**
 - *During the life of an Air System (including related products, parts and appliances) there will be **changes in the Type Design***
 - *It is important that any such changes meet the appropriate safety requirements to ensure the airworthiness implications of the change are fully recognized*
 - *Any such changes are subject to classification and approval prior to the implementation of the change*
- **Manual of Military Air System Certification** (May 2024 Issue 4).

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3

Military Certification – Why?



- **Inadequately designed and certified design changes were at the root of the Nimrod XV230 accident**
- **Haddon-Cave Recommendation 21.E.6**
 - *The Regulator shall undertake a **review of the certification process for military aircraft** in order to align the Airworthiness assurance processes used by the three Services and to establish clear lines of accountability for the design, manufacture of aircraft types, and continued Airworthiness of specific platforms*
 - *For the avoidance of doubt, for Recommendation 21.E.6: the review shall consider the benefits of the civil certification system...*

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The Military Air Systems Certification Process (The MACP)

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5

MACP



- Broadly based on EASA Part 21 certification process
 - Detailed in RA5810
 - Nominally it has 6 Phases:
 - Phase 1 – identify the requirement for, and obtain, organizational approvals
 - Phase 2 – establish and agree the Type Certification Basis (TCB)
 - Phase 3 – agree the Certification Programme (CP)
 - Phase 4 – demonstrate compliance with the TCB
 - Phase 5 – MAA review of Certification evidence
 - Phase 6 – post Certification activities
- However, in the MMAC there is a further phase - Phase 0 - Planning.
[RA5810 & MMAC]

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MACP - Applicability

- Application of process (from 1 Sep 11):
 - New Air Systems:
 - MACP applied in full leading to Military Type Certificate (MTC)
 - Not yet in-service, but past Main Gate:
 - Tailored transitional arrangements leading to Statement of Type Design Assurance (STDA)
 - All Air Systems
 - All changes subject to relevant elements of the MACP
 - MAA oversight for Major Changes leading to Authorised Design Changes Certificate (ADCC) [RA5820]

| | Into-Service | Major change |
|--|--|--|
|  <p>Legacy Air System ie those that are in-Service but have not been awarded an MTC</p> | <p>No MAA Certification (although may have an MAA Statement of Type Design Assurance)</p> | <p>ADCC issued for first Major change and then up-issued following each Major change</p> |
|  <p>Air System ie those that have been subject to the MACP prior to In-Service</p> | <p>MTC Issued</p> | <p>MTC up-issued for each Major change</p> |

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7

MACP – Design Change Classification

- **Major Change Sub-Classification**
 - **Substantial**: so extensive that a substantially complete investigation of compliance is required.
 - **Significant**: relates to one or more of the following: general configuration, principles of construction, or the assumptions used for Certification (including usage).
 - **Not Significant**: all other Major Type Design changes.

Minor Change:

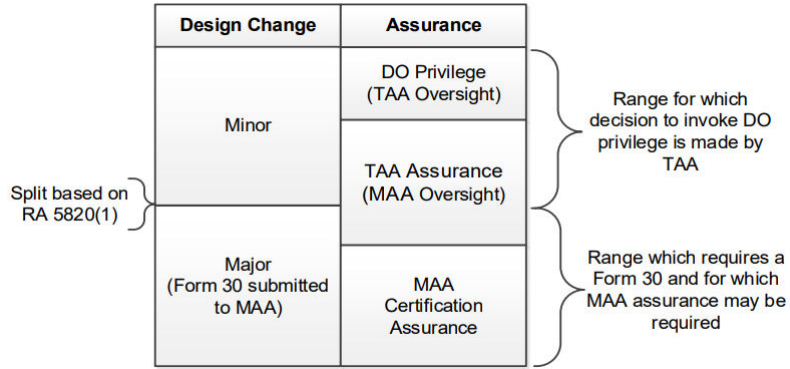
Has no appreciable effect on the mass, balance, structural strength, operational characteristics or other characteristics affecting airworthiness. All other changes should be classified Major.

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8

MACP – Design Change Assurance

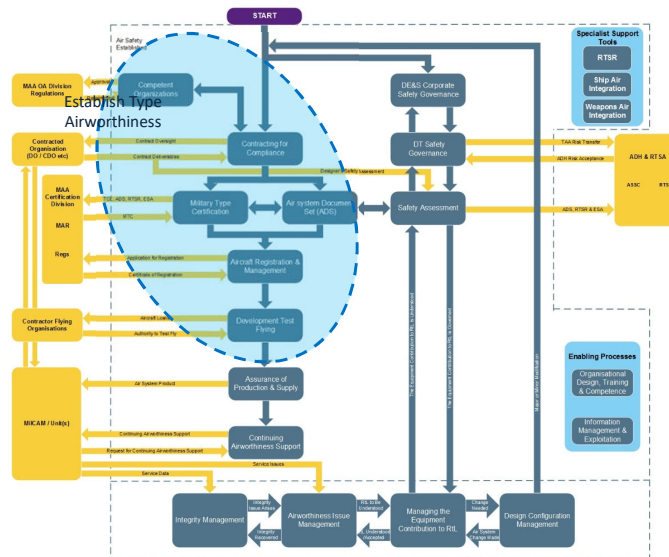
- Design Changes are assured dependent on their classification:



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9

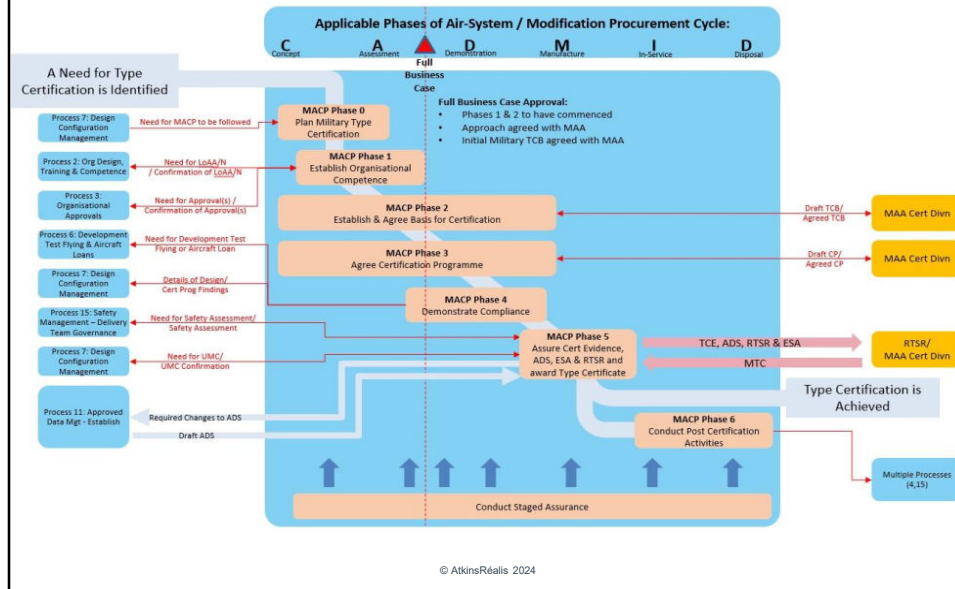
MACP – ASPIRE AET



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10

MACP – ASPIRE AET



11

Planning (Phase 0)

- Planning is fundamental to a successful certification programme, assessed by the MAA as consistently weak amongst DTs
- There is a need to move to continuous assessment vs final exam crisis - **early and regular engagement**
- Keep in close dialogue with the MAA and build in time for MAA reviews
- Key message:
The MAA Need Adequate Warning of Key Events and Their Flexibility is Limited
- ASPIRE Tools have been developed that can assist in the planning activities.

12

Planning (Phase 0)

- During Phase 0, the DT establishes or reviews the fundamental building blocks for certification. Elements covered are:
 - Airworthiness Strategy
 - Type Certification Strategy
 - Certification Specification and Design Change classification (DAT Form 30 (AET Tool 8I))
 - User and System Requirements Document (URD & SRD)
 - Statement of Operating Intent (and Usage) (SOI/SOIU)
 - Design Safety Target
 - Form 30 –submission to MAA initiates the formal certification process.

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13

Planning (Phase 0) – ASPIRE AET

- ASPIRE AET Process 8 provides guidance and tools/templates to achieve Phase 0 activities:
 - Airworthiness Strategy (0F)
 - Military Type Certificate (MTC) Strategy (8G)
 - Minor/Major Change Record template (8I)
 - Understanding the Airworthiness Certification Boundary (8L)
 - Delivering Military Type Certification with the Integrated Test Evaluation and Acceptance Process (ITEAP) (8M)
 - Commodity Equipment – Certification and Design Change (8Q)
 - Programmable Elements Assurance Plan (PEAP) (8Y)
- AET Process 7 Design Configuration Management provides guidance on the Design Change Process.

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14

MACP Phase 1 – Organizational Approvals

- Identify requirement for, and obtain, organizational approvals to ensure that airworthiness-critical certification roles are only undertaken by competent organizations
 - Design Approved Organisation Scheme (DAOS)
 - Other organizational approvals from a recognised regulator may also be acceptable
 - Contractor Flying or Maintenance Organisations
 - ITE and ISA
 - SQEP TAA & DT Desk Officers
 - LoE & LoAA
 - RTSA Desk Officers.



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15

MACP Phase 1 – Organizational Approvals

- ASPIRE Tool 2 – Organisational Design, Training, Competence provides the process for obtaining approvals for:
 - SQEP TAA & DT Desk Officers
- ASPIRE Tool 3 – Organisational Approval is in development and will provide the process for obtaining approvals for:
 - Design Approved Organisation Scheme (DAOS)
 - Other organizational approvals from a recognised regulator may also be acceptable
 - Contractor Flying Approved Organisation Scheme (CFAOS) or Maintenance Approved Organisation Scheme (MAOS).

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16

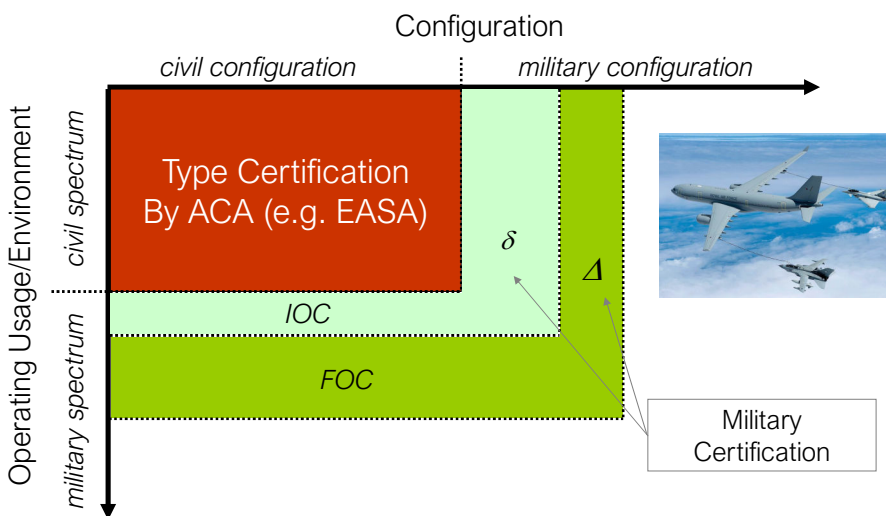
MACP Phase 2 – Agree Type Certification Basis

- Establish and agree TCB through early involvement with MAA:
 - TCB = design requirements against which it will be certified
 - Airworthiness Code(s) plus
 - ...MCRIs
 - Special Conditions
 - Deviation
 - Equivalent Safety Finding
 - Benchmark standard is Def Stan 00-970. Formal MAA approval required for use of Alternative Airworthiness Codes (AACs) (i.e. EASA Certification Specifications)
 - Where AACs proposed, TCB equivalence to Def Stan 00-970 must be demonstrated.



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Certification – The Military “Delta”



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MACP Phase 2 – Agree TCB

- Process 8 – Military Type Certification provides guidance and tools/templates to achieve Phase 2 activities:
 - Military TCB [AET - 8T]
 - Administrative Military Certification Review Item (MCRI) A-03 [AET 8R & 8S]
 - Regulatory Compliance MCRI [AET 8U & 8V]
- All information is captured in the Certification Log [AET 8N].

| Certification Log | | | | | | | | | | | | | | |
|-------------------|---------|-----------------------------|-------------------|--------------|---------|-------------|---------------------|----------------|-----------------------------|--------------|------------------------|-----|--------------------------------|-----------------------------------|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| Unique ID | Subpart | Certification Specification | Amendment / Issue | CS Paragraph | Heading | Requirement | Existing Agreements | Applicability | Applicability Justification | Affected | Affected Justification | AMC | Regulatory Compliance MCRI No. | Regulatory Compliance MCRI System |
| A - General | | | | | | | | Applicable | | Affected | | | | Open |
| B - Flight | | | | | | | | Not Applicable | | Not Affected | | | | Closed |
| C - Structures | | | | | | | | | | | | | | |

Taken from Airworthiness Code
TCB Specific

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19

MACP Phase 3 – Agree Certification Programme

- Agree type-specific Certification Programme (CP) to define:
 - The process to be used to manage certification task
 - Control of the compliance process
 - Proposed Means of Compliance and Regulator Level of Involvement (LoI) to deliver evidence against each aspect of Certification Basis
- Anticipate that this will normally be part of the ITEAP (Integrated Test Evaluation & Acceptance Plan)
- Key components of CP:
 - Detailed description of Type Design
 - Project schedule and milestones
 - Identification of key airworthiness personnel
 - Arrangements for delivery of certification evidence for review
 - Certification Log
 - Compliance Demonstration Items (more later).

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20

MACP Phase 3 – Agree CP

- Process 8 provides guidance and tools/templates to achieve Phase 3 activities
 - Military Type CP [AET 8K]
 - Managing Air System Configuration Changes During the Certification Process [AET 8J]
 - Certification Log [AET 8N].

| Phase 3 | | | | | | | | | | | | | | |
|---------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|---------|---------------|-----------------|-------------|-------------|
| 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 |
| Means of Compliance | | | | | | | | | | | Involvement | | | |
| MC0 | MC1 | MC2 | MC3 | MC4 | MC5 | MC6 | MC7 | MC8 | MC9 | Remarks | CDI Reference | ITE Involvement | LoI TAA | LoI MAA |
| | | | | | | | | | | | | Witness | Witness | Witness |
| | | | | | | | | | | | | None | Approve | Approve |
| | | | | | | | | | | | | Information | Information | Information |
| | | | | | | | | | | | | Report | Report | Report |
| | | | | | | | | | | | | Plan | Plan | Plan |

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21

MACP Phase 3 – Agree CP

- Process 8 provides guidance and tools/templates to achieve Phase 3 activities
 - Certification Log [AET 8N]:
 - Records means of compliance
 - Develops with time as evidence becomes available and is reviewed. Includes:
 - Applicable Military Certification Review Items (MCRIs)
 - Means of Compliance Codes.
 - TAA and MAA Level of Involvement (LoI).

| Phase 3 | | | | | | | | | | | | | | |
|---------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|---------|---------------|-----------------|-------------|-------------|
| 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 |
| Means of Compliance | | | | | | | | | | | Involvement | | | |
| MC0 | MC1 | MC2 | MC3 | MC4 | MC5 | MC6 | MC7 | MC8 | MC9 | Remarks | CDI Reference | ITE Involvement | LoI TAA | LoI MAA |
| | | | | | | | | | | | | Witness | Witness | Witness |
| | | | | | | | | | | | | None | Approve | Approve |
| | | | | | | | | | | | | Information | Information | Information |
| | | | | | | | | | | | | Report | Report | Report |
| | | | | | | | | | | | | Plan | Plan | Plan |

22

MACP Phase 3 – Agree CP

| Col No | Means of Compliance | Type of Compliance |
|--------|---------------------|--|
| 16 | MC0 | Compliance statement <ul style="list-style-type: none"> • Reference to Type Design documents • Election of methods, factors... • Definitions Associated Compliance Documents: • Type Design documents • Recorded statements |
| 17 | MC1 | Design review Associated Compliance Documents: <ul style="list-style-type: none"> • Descriptions • Drawings (or equivalent) |
| 18 | MC2 | Calculation/Analysis Associated Compliance Documents: <ul style="list-style-type: none"> • Substantiation reports |
| 19 | MC3 | Safety Assessment Associated Compliance Documents: <ul style="list-style-type: none"> • Safety analysis |
| 20 | MC4 | Laboratory tests Associated Compliance Documents: <ul style="list-style-type: none"> • Test programmes • Test reports • Test interpretations |

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23

MACP Phase 3 – Agree CP

| Col No | Means of Compliance | Type of Compliance |
|--------|---------------------|--|
| 21 | MC5 | Ground tests on related product Associated Compliance Documents: <ul style="list-style-type: none"> • Test programmes • Test reports • Test interpretations |
| 22 | MC6 | Flight Tests Associated Compliance Documents: <ul style="list-style-type: none"> • Test programmes • Test reports • Test interpretations |
| 23 | MC7 | Design inspection/audit Associated Compliance Documents: <ul style="list-style-type: none"> • Inspection or audit reports |
| 24 | MC8 | Simulation Associated Compliance Documents: <ul style="list-style-type: none"> • Test programmes • Test reports • Test interpretations |
| 25 | MC9 | Equipment qualification Note: Equipment qualification is a process which may include all previous means of compliance. |
| 26 | MC Remarks | Any further relevant comments/details against Means of Compliance |

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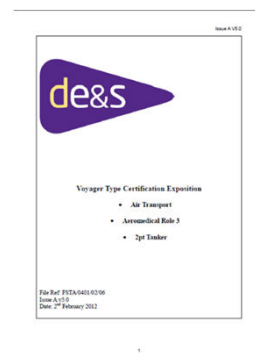
24

MACP Phase 3 – Agree CP

- Compliance Demonstration Items (CDI)
 - Meaningful groups of compliance demonstration activities and data
 - Scope of CDI, description and information on novelty, complexity and criticality included in CP
 - CDI can be considered in isolation by MAA to establish Lol
 - CDI grouping options (not exhaustive):
 - Simple projects may group all evidence by technical area (or system)
 - Level of technically related compliance demonstration activities and data May facilitate compliance by novelty, complexity and criticality.

MACP Phase 4 – Demonstrate Compliance

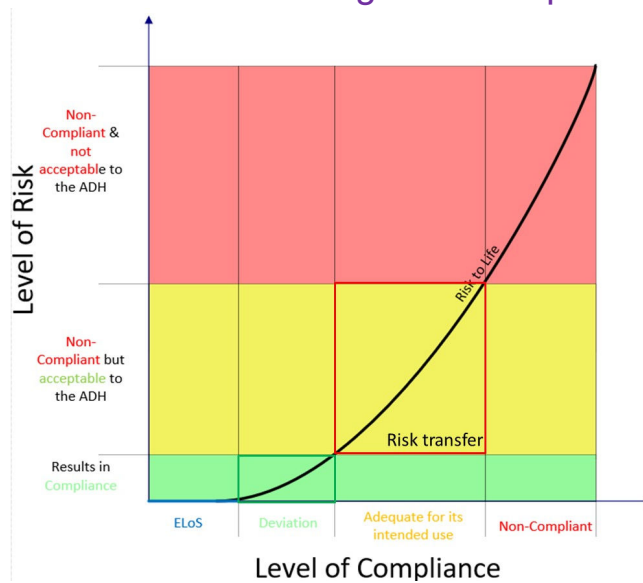
- Phase 4 - TAA assurance that all certification requirements have been satisfied
- Phase concluded by the TAA producing Type Certification Exposition (TCE)
 - Refer to ASPIRE Tool 80(Oscar) for TCE guidance
 - *“It is best practice to initiate the TCE as soon as practicable in the programme and to use the document to provide evidence to the MAA for agreement incrementally as the MACP artefacts become available”*
- The fundamental requirement for certification is that the approved TCB is met.
- Non-compliance with a Certification Requirement can have the potential to increase the risk to life and must be addressed.



MACP Phase 4 – Addressing Non-Compliances

- Potential approaches to dealing with non-compliances:
 - Get more evidence in order to show compliance
 - Change the design to eliminate the non-compliance
 - Generate an Equivalent Level of Safety (ELOS) Argument at system level through controls, factors, or mitigations
 - Utilise AltMoC to demonstrate that the essential requirements for airworthiness have been met and a Deviation is issued
 - Transfer residual risk to the Aviation Duty Holder (ADH)
- } Results in a compliant position
- } Remains a non-compliant position

MACP Phase 4 – Addressing Non-Compliances



MACP Phase 4 – Demonstrate Compliance

- Demonstration and acceptance of compliance:
 - Onus on 'Applicant' to produce evidence that demonstrates compliance with the agreed TCB
- MAA prepared to give credit to cert activities performed by an Accepted Certification Authority (ACA)
 - EASA / FAA / CAA are accepted ACAs
 - 'Mutual Recognition' of other military airworthiness regulators
- Military applicability considerations:
 - Implications of different usage – SOI/SOIU is key
 - Areas where military requirements are more stringent
 - The deltas must be assessed for aircraft, engine and propeller
 - Define approach early (cert strategy)
 - TCB 'mix' of Def Stan 00-970 and Alternative Certification Specifications.



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29

MACP Phase 4 – Demonstrate Compliance

- Process 8 provides guidance and tools/templates to achieve Phase 4 activities
 - Certification Evidence Review Process Guidance [AET 8AB]
 - Military Type Certification Exposition [AET 8O]
 - Equivalent Safety Findings [AET 8P]
 - Release to Service Recommendations [AET 8W]
- Supported by:
 - Process 6 - Development Test Flying and Aircraft Loans.
 - Process 7 - Design Configuration Management (DCM).



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30

MACP Phase 5 – Report & Certification

- Assurance of Certification Evidence
- MAA reviews TCE and produces Type Certification Report (TCR) detailing MAA's investigation and findings
 - TCR based on TCE content and MAA LoI
 - MACP Actions
- MAA carries out independent audit of the RTSR (for new types and marks.)....



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31

MACP Phase 5 - RTSR Audit Activity

- MAA independently audits TAA RTSR submission to RTSA:
 - Normally applies to MTC issues/up-issues
 - Compliance of design with appropriate standards
 - ISA and ITE scrutiny
 - Approved Air System Document Set [AET Tool 11]
 - Air Safety Management System
 - Review of MAA audit observations
 - Type/Continuing Airworthiness arrangements
 - More Certification Actions
- Once content, MAA D Tech will authorize the issue of a MTC with Restrictions if necessary.

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MACP Phase 5 – Issue MTC

- Positive assessment of TCE, RTSR and supporting documentation will result in issue of an MTC
- For new Air System, covers entire system.

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MACP Phase 6 – Post-Certification

- After an Air System has been certified there will be ongoing involvement from MAA Cert Div:
 - MACP Actions
 - Approve Major changes
 - Monitoring Type Airworthiness through life – Attendance at TAW reviews. Safety meetings & Integrity WGs
 - Periodic reviews of type certification and associated MTC as part of MAA's through-life assurance activities
 - Audits (DE&S 1* clusters/DT, CAMOs, Operating Units).



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34

Certification and the ASMS

- Independently confirms compliance with applicable design and safety standards to demonstrate that the equipment is **Safe to Operate**
- Gaps in compliance must be dealt with by risk management. Residual risks must be transferred to ADH
- AET Tool 8 used to support the MTC with input from other ASPIRE processes
- Certification underpins the Type Airworthiness Safety Assessment (TASA) and TASA Report (TASAR)
- Which, in-turn, underpins the ADH's Air System Safety Case.

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35



36