Circular No. 1-319

Policy for Evaluation of Certification Maintenance Requirements

April 11, 2013 First Issue

Airworthiness Division, Aviation Safety and Security Department
Japan Civil Aviation Bureau
Ministry of Land, Infrastructure, Transport and Tourism

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Subject: Policy for Evaluation of Certification Maintenance Requirements

1. Purpose.

This circular provides guidance on procedures for evaluation and approval of Certification Maintenance Requirement (hereinafter referred to as "CMR"), which includes tasks and intervals for continuing airworthiness, as a part of evaluation of Instruction for Continued Airworthiness required in article 17 of Ordinance for Enforcement of the Civil Aeronautics Act (Law) for a type of aircraft which intends to receive type certification or a type of aircraft which belongs to the same series as the said aircraft according to article 12 of the Civil Aeronautics Act (Law).

2. Applicability.

This circular applies when seeking JCAB approval for CMR or its revision for an airplane type designed in Japan, and intended to receive type certification as Transport Airplane Category or belonging to the same series as the said airplane.

3. Related Documents.

FAA AC 25-19A Certification Maintenance Requirements
FAA AC 25.1309-1A System Design and Analysis
ICAO Doc 9760 Airworthiness Manual vol.2 Design Certification and Continued Air worthiness

4. Definitions.

(1) Minor Failure Conditions.

Failure conditions that would not significantly reduce airplane safety, and which involve crew actions that are well within their capabilities. Minor failure conditions may include, for example:

1) A slight reduction in the safety margin or functional capabilities, or
2) A slight increase in crew workload, such as routine flight plan changes, or some physical discomfort to passengers or cabin crew.

(2) Major Failure Conditions.

Failure conditions that would reduce the capability of the airplane or the ability of the crew to cope with adverse operating conditions to the extent that there would be, for example:

1) A significant reduction in safety margins or functional capabilities,
2) A significant increase in crew workload or in conditions impairing crew efficiency, or
3) Discomfort to occupants, possibly including injures.

(3) Hazardous Failure Conditions.

Failure conditions that would reduce the capability of the airplane or the ability of the crew to cope with adverse operating conditions to the extent that there would be:

1) A large reduction in safety margins or functional capabilities,
2) Physical distress or higher workload such that the flight crew cannot be relied upon to perform their tasks accurately or completely, or
3) Serious or fatal injury to a relatively small number of the occupants. (Note: "Relatively small number" means the number of seriously or fatally injured persons are small in comparison with the number of persons on board.)

(4) Catastrophic Failure Conditions.

Failure conditions that would result in multiple fatalities, usually with the loss of the airplane. (Note: Catastrophic failure conditions are also defined as a failure condition that would prevent the continued safe flight and landing of the airplane.)

(5) Significant Latent Failures.

A failure is latent until it is made known to the flightcrew or maintenance personnel. Significant latent failures are latent failures that would, in combination with one or more other specific failures or events, result in a hazardous or catastrophic failure condition.

(6) Wear out.

A condition where a component is worn beyond a pre-determined limit.

5. Certification Maintenance Requirements (CMR) Definition.

(1) A CMR is a required scheduled maintenance task established during the design certification of the airplane systems as an operating limitation of the Type Certificate (TC). The CMRs are a subset of the instructions for continued airworthiness identified during the certification process.

A CMR usually results from a numerical analysis conducted to show compliance with the requirements regarding acceptable probability for catastrophic and hazardous failure conditions. Compliance may also result from a qualitative, engineering judgment-based analysis.

(2) The CMRs are required maintenance tasks, and associated intervals, developed to achieve compliance with Airworthiness Inspection Manual Part Ⅲ6-1-5 and other regulations requiring safety analyses (such as Airworthiness Inspection Manual Part Ⅲ4-3-1, 4-6-7, 5-1-1 and 5-1-7).

A CMR is intended to be set for:

① Detecting safety-significant latent failures that would, in combination with one or more other specific failures or events, result in a hazardous or catastrophic failure condition.

② Detecting an impending wear-out of an item whose failure is associated with a hazardous or catastrophic failure condition

(3) The CMRs verify that a certain failure has or has not occurred, indicate that repairs are necessary if the item has failed, or identify the need to inspect for impending failures (e.g., heavy wear or leakage). Because the exposure time to a latent failure is a key element in the calculations used in a safety analysis, limiting the exposure time will have a significant effect on the resultant overall failure probability of the system. The intervals for CMR tasks should be designated in terms of flight hours, cycles, or calendar time, as appropriate.

(4) It is important to note that CMRs are derived from a fundamentally different analysis process than the maintenance tasks and intervals that result from the MSG-3 (Maintenance Steering Group 3) analysis associated with MRB activities. Although both types of analysis may produce equivalent maintenance tasks and intervals, it is not always appropriate to substitute a CMR with an MSG-3 task.

(5) The type certification process assumes the airplane will be maintained in a condition

of airworthiness equal to its certified or properly altered condition. The process described in this circular is not intended to establish normal maintenance tasks that should be defined through the MSG-3 analysis process. Also, this process is not intended to establish CMRs for the purpose of providing supplemental margins of safety for concerns arising late in the type design approval process. Such concerns should be resolved by appropriate means, which are unlikely to include CMRs not established via normal safety analyses.

(6) CMRs should not be confused with required structural inspection programs that are developed by the TC applicant to meet the inspection requirements for damage tolerance, as required by Airworthiness Inspection Manual Part Ⅲ 3-9-1, 7-2-11A and Appendix H.4 (Airworthiness Limitations section). The CMRs are to be developed and managed separately from any structural inspections programs.

6. General process for determination of CMRs.

6-1 Identification of candidate of CMRs.

An applicant for type certification (hereinafter referred to as "applicant") should perform safety analyses and identify candidate requirements for selecting CMRs (candidate CMR, hereinafter referred to as "CCMR").

6-2 Establishment of the Certification Maintenance Coordination Committee.

6-2-1 Purpose.

In order to grant airplane operators an opportunity to participate in the selection of CMRs, and to assess the candidate CMRs and the proposed MRB tasks and intervals in an integrated process, the TC applicant should convene a Certification Maintenance Coordination Committee (herein after referred to as "CMCC").

6-2-2 Meeting scheduling.

As early as possible in the design phase of the airplane program, and at intervals as necessary, the applicant should hold the CMCC to review candidate CMRs and their purpose, the failure conditions and their criticality, the intended tasks, and other relevant factors.

6-2-3 Structure.

The CMCC should be made up of manufacturer representatives (typically maintenance, design, and safety engineering personnel), operator representatives

designated by the Industry Steering Committee (ISC) Chairperson, JCAB specialists such as aeronautical engineer and the MRB Chairperson.

6-3 Selection of CMRs.

The CMCC, functioning as an advisory committee for the applicant, reviews all CCMRs and make proposed CMRs, and proposed MRB tasks and/or intervals determined to be set as substitute for CMR according to the provision of 8-3. The applicant should provide sufficient information to the CMCC to enable an understanding of the failure conditions and the failure or event combinations that result in the CCMRs.

6-4 Coordination with the ISC.

The results of the CMCC (proposed CMRs and proposed MRB tasks and/or intervals that meet the intent of the CCMRs) are forwarded by the applicant to the ISC for consideration. ISC evaluates the proposed MRB tasks and/or intervals and determine acceptance or rejection. CMCC proposed MRB tasks and/or intervals accepted by the ISC are reflected in the MRB report proposal. Proposed MRB tasks and/or intervals rejected by the ISC will result in CMR tasks.

6-5 Approval of CMRs.

Following the ISC's consideration, the applicant submits the CMR document to JCAB for final review and approval.

7. Identification of CCMRs.

(1) Establishing CMRs for periodic maintenance to detect significant latent failures when they occur is undesirable. Practical and reliable failure monitoring and indication systems to detect significant latent failures should be implemented.

A practical failure monitoring and indication system is one that is considered to be within the state of the art. Reliable failure monitoring and indication should utilize current state of the art technology to minimize the probability of falsely detecting and indicating non-existent failures. Experienced judgment should be applied when determining whether or not a failure monitoring and warning system would be practical and reliable. Comparison with similar, previously approved systems is sometimes helpful.

Appendix 1 of this AC outlines design considerations that should be followed in any decision to establish CMR instead of implementing these systems.

(2) Maintenance tasks that are candidates for selection as CMRs usually come from safety analyses (e.g., System Safety Assessments (hereinafter referred to as "SSA"), which establishes whether there is a need for maintenance tasks to be carried out periodically to comply with Airworthiness Inspection Manual Part Ⅲ 6-1-5, and other requirements requiring this type of analysis (such as Airworthiness Inspection Manual Part Ⅲ 4-3-1, 4-6-7, 5-1-1 and 5-1-7)). The SSA should identify following items as CCMRs, but not limited to them;

① Maintenance tasks intended to detect latent failures that would, in combination with one or more specified failures or events, lead to a hazardous or catastrophic failure condition

② Maintenance tasks intended to inspect for impending failures due to wear out.

CCMR should identify the failure mode to be detected, the failure condition of concern, the check interval, and the maintenance task.

(3) All Significant latent failures should be addressed in the SAA. In some situations, a failure condition might meet the quantitative probability objective, yet contain a component that, per the analysis, does not require inspections to meet that objective (i.e., could be left latently failed for the life of the airplane). In that situation, we believe that some inspections in the life of the airplane are necessary to avoid undue exposure to catastrophic or hazardous "single failure" situations, therefore a qualitative assessment to determine the required maintenance before end of airplane life is still necessary.

(4) As the safety analysis may be qualitative or quantitative, some task intervals may be derived in a qualitative manner (e.g., engineering judgment and service experience). Numerical analysis supplements, but does not replace, qualitative engineering and operational judgments. Therefore, other tasks that are not derived from numerical analysis of significant latent failures, but are based on properly justified engineering judgment, can also be candidates for CMRs. The justification should include the logic leading to identification as a candidate CMR, and the data and experience base supporting the logic. CMRs may also be identified for latent failures that would, in combination with one or more specified failures or events, lead to a major failure condition that is not identified and assigned a maintenance task via the MSG-3 process.

8. Selection of CMRs.

8-1 Establishment of maintenance tasks.

(1) CCMRs are evaluated in the context of the failure conditions in which they are involved, e.g., whether the latent failure is part of a dual failure, or a more complex failure condition.

(2) The CMR designation should be applied in the case listed below in principle.

(a) Catastrophic failure condition that results from two failures where one failure is latent.

(b) Catastrophic failure condition that results from two failures where one failure is from wear out of a component.

8-2 Establishment of the task intervals.

(1) The interval for the CMR task should be chosen such that the system safety analysis assumptions are protected in service, while allowing flexibility for the airplane operators to manage their maintenance programs.

(2) In the case where the system safety analysis does not specify an interval, it may be established so that it is less than the life of the airplane considering factors that influence the outcome of the failure condition, such as the nature of the fault, field experience, or the task characteristics.

(3) Where multiple tasks result from a quantitative analysis, it may be possible to extend a given interval at the expense of one or more other interval, in order to optimize the required maintenance activity. However, once a decision is made to create a CMR, then the CMR task interval should be solely based on the results of the safety analysis.

8-3 Relevance with maintenance tasks of MRB.

The CMR designation may not be necessary if there is an equivalent MSG-3 task, or an approved AFM procedure, to accommodate the CCMR. This determination is made if one of conditions from (1) to (3) and (4), which are listed below, are met:

(1) The SSA allows the failure to be latent for the life of the airplane, or

(2) Latent failures leaving the airplane one failure away from hazardous failure conditions, or

(3) A wear out failure mode that directly or in combination with another failure, leads to a hazardous failure condition.

(4) In all the above cases, the CCMR is satisfied by (a) or (b) listed below:

(a) A MSG-3 task provided it meets all of the following criteria:

1) It is a Failure Effect Category 8 task (FEC8) for latent failure, or a Failure Effect Category 5 task (FEC5) task for evident failure due to wear out. Note that because the MSG-3 logic may not consider a failure condition containing three or more failures, it is possible that there is no MSG-3 task identified for a CCMR.

2) The FEC8 or FEC5 task interval is shorter than the interval that would be required for the CMR. For example, some applicants have applied, and the Authorities have accepted, a factor of one half of the CMR interval as a margin to guard against potential escalation of FEC8 task intervals beyond the intervals specified by the CMR.

3) The applicant has procedures in place (e.g. tagging of tasks to identify those derived from the safety analysis) so that the FEC8 or FEC5 task would not be susceptible to escalation beyond the interval that would otherwise be required by a CMR. For example, due to difficulty in accessing the item, a task may not be conducted at the required interval. Engineering judgment indicates a CMR is appropriate for compliance.

(b) Tasks covered by the approved Airplane Flight Manual (AFM) procedures.

8-4 Procedures for complex failure conditions.

In complex failure conditions (e.g., a combination of three or more failures), the SSA may identify more than one CCMR. Equivalent and compatible MSG-3 tasks (if they exist) may be used to satisfy some of those CCMRs. It should be noted that the rationale for the disposition of each CCMR should be presented to JCAB for approval.

9. Documentation and Handling of CMRs.

9-1 Documentation guideline.

CMRs approved by JCAB should be included in an independent document (CMR document), and it should be referenced in the Type Certificate Data Sheet (TCDS). The latest version of the CMR document should be controlled by a log of pages approved by JCAB. In this way, changes to CMRs following certification will not require an amendment to the TCDS. In addition, CMRs may be included in the applicable section of the Maintenance Planning Data (MPD) or the Airworthiness Limitations section of the airplane maintenance manual.

9-2 Handling in the case “exceptional short term extension” for CMR intervals.

(1) Since CMRs are based on statistical averages and reliability rates, an “exceptional short term extension” for CMR intervals may be made on one airplane for a specific

period of time without risking safety. An exceptional short term extension may be needed to cover an uncontrollable or unexpected situation.

(2) The exceptional short term extension process is applicable to CMR intervals.

Repeated use of exceptional short term extensions, either on the same airplane or on similar airplanes in an operator's fleet, should not be used as a substitute for good management practices. Exceptional short term extensions must not be used for fleet CMR interval escalation.

Operator should follow the procedure prescribed in relevant circulars when making allowable extensions according to the CMR document.

The CMR document should state that JCAB must approve, prior to its use, any desired exceptional short term extension not explicitly listed in the CMR document.

(3) Any allowable increase must be defined either as a percent of the normal interval, or a stated number of flight hours, flight cycles, or calendar days.

If no exceptional short term extension is to be allowed for a given CMR, this restriction should be stated in the CMR document.

10. Post-Certification Changes to CMRs.

Any new CMRs or any post-certification changes should be reviewed by the same entities that were involved in the CMCC at time of initial certification and must be approved by JCAB.

10-1 Relaxation of CMRs.

Since the purpose of a CMR is to limit the exposure time to a given Significant Latent Failure, or a given wear out, as part of an engineering analysis of overall system safety, instances of a CMR task repeatedly finding that no failure has occurred may not be sufficient justification for deleting the task or increasing the time between repetitive performances of the CMR task.

In general, a CMR task change or interval escalation could only be made if world fleet service experience indicates that certain assumptions regarding component failure rates made early during the engineering analysis were too conservative, and a re-calculation of system reliability with revised failure rates of certain components reveals that the task or interval may be changed.

If later data provide a sufficient basis for the relaxation of a CMR (e.g. cancelation of task, extension of task interval, the change may be documented by a revision to the CMR document and approved by JCAB.

10-2 Increase of CMRs.

If JCAB determines that the requirements of an existing CMR must be increased (more restrictive actions to be performed), the new requirements will be mandated by an airworthiness directive (TCD) and the CMR document will be revised to include the change.

10-3 Other Changes.

New CMRs that are unrelated to in-service events may be created and they should be documented and approved by JCAB. New CMRs can arise in situations such as:

(1) Certification of design changes, or

(2) Updates to the applicant's certification compliance documentation. These may result from regulation changes, AD actions on similar systems or airplanes, awareness of additional hazardous or catastrophic failure conditions, revised failure rates, consideration of extended service goals, etc.

APPENDIX 1 Supplemental Guidance for CMR Use

(1) JCAB intends that the manufacturer chooses a system design that minimizes the number of significant latent failures, with the goal being no such failures if it is practical to do so. A practical and reliable monitoring and/or warning system should be considered as the first means to expose the significant latent failure. If the cost of adding practical and reliable monitoring and/or warning to a system is large, and the added maintenance cost of a CMR is small, addition of a CMR may be the solution of choice for both the type certificate applicant and the operator, provided all applicable regulations are met.

(2) A decision to create a CMR may include a trade-off of the cost, weight, or complexity of providing an alerting mechanism or device that will expose the latent failure, versus the requirement for the operator to conduct a maintenance or inspection task at fixed intervals. The following points should be considered in any decision to create a CMR:

a. What is the magnitude of the changes to the system and/or airplane needed to add a reliable monitoring and/or warning device that would expose the hidden failure? What is the cost in added system complexity?

b. Is it possible to introduce a self-test on power-up?

c. Is the monitoring and warning system reliable? False warnings must be considered, as well as a lack of warnings.

d. Does the monitoring or warning system itself need a CMR due to its latent failure potential?

e. Is the CMR task reasonable, considering all aspects of the failure condition that the task is intended to address?

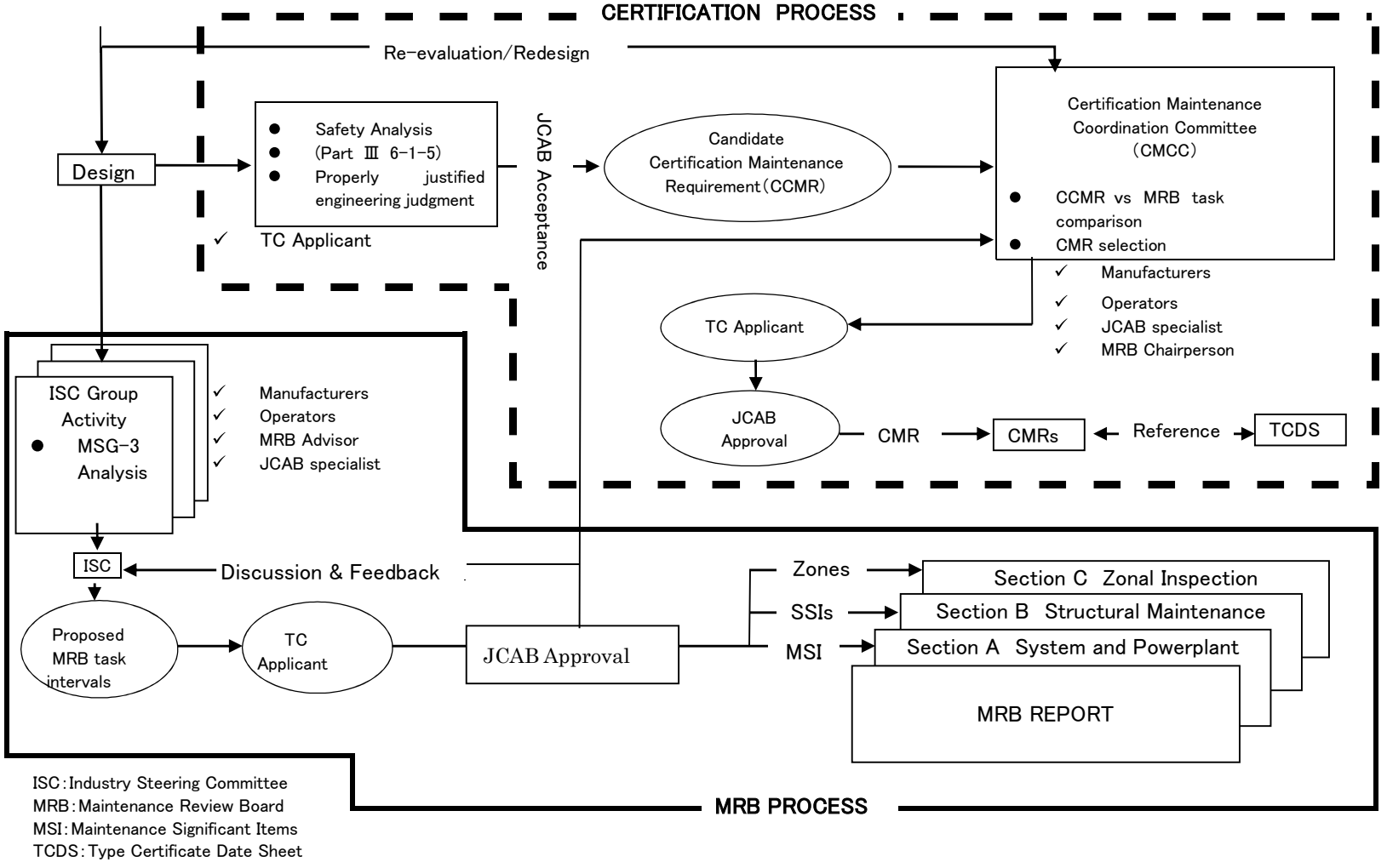
f. How long (or short) is the CMR task interval?

g. Is the proposed CMR task labor intensive or time consuming? Can it be done without having to "gain access" and/or without workstands? Without test equipment? Can the CMR task be done without removing equipment from the airplane? Without having to re-adjust equipment? Without leak checks and/or engine runs?

h. Can a simple visual inspection be used instead of a complex one? Can a simple operational check suffice in lieu of a formal functional check against measured requirements?

i. Is there "added value" to the proposed task (i.e., will the proposed task do more harm than good if the airplane must be continually inspected)?

j. Have all alternatives been evaluated?


CERTIFICATION PROCESS
Re-evaluation/Redesign
Design
Safety Analysis
(Part Ⅲ 6-1-5)
Properly justified engineering judgment
TC Applicant
JCAB Acceptance
Candidate Certification Maintenance Requirement (CCMR)
Certification Maintenance Coordination Committee (CMCC)
CCMR vs MRB task comparison
CMR selection
Manufacturers
Operators
JCAB specialist
MRB Chairperson
TC Applicant
JCAB Approval
CMR
CMRs
Reference
TCDS
ISC Group Activity
MSG-3 Analysis
Manufacturers
Operators
MRB Advisor
JCAB specialist
ISC
Discussion & Feedback
Proposed MRB task intervals
TC Applicant
JCAB Approval
Zones
SSIs
MSI
Section C Zonal Inspection
Section B Structural Maintenance
Section A System and Powerplant
MRB REPORT
MRB PROCESS
ISC : Industry Steering Committee
MRB : Maintenance Review Board
MSI : Maintenance Significant Items
TCDS : Type Certificate Date Sheet