Handout 8A

Aging Transport Systems Rulemaking Advisory Committee

Task 3

Final Report (1st draft)

Draft to ATSRAC Oct 11th 2000

October 9th, 2000

Tony Harbottle
Airbus Industrie
Task 3 sub-committee Chairman

List of Effective Pages

(to be included in the final report)

Table of Contents

****

Record of Revisions

Date	Revision
29 Sep 00	'1st draft to T3SC'. Prepared for Task 3 WG review prior to ATSRAC meeting Oct 11th/12th.
9 Oct 00	'2nd draft to T3SC'. Task 3SC comments added. Additional text proposed in Chapter 9. All changes in red and highlighted by change bar. ('Draft to ATSRAC Oct 11th 2000' is identical to '2nd draft to T3SC' but without red text and change bars)

Chapter 1

Background

(to be written)

Chapter 2

2.0 Terms of Reference

2.1 As defined by FAA in January 1999

The Terms of Reference for the Aging Transport Systems Advisory Committee (ATSRAC) were defined in January 1999. These identified five specific tasks that were subsequently given to four sub-committees (working groups) for detailed review and analysis.

The following text records the original Terms of Reference for the Specific Task 3 activity:

SPECIFIC TASK 3, IMPROVEMENT OF MAINTENANCE CRITERIA

Maintenance procedures currently in use in the air transport industry may not adequately or proactively address aging non-structural systems. While it is not expected that this advisory committee will define airplane model specific detailed maintenance activities, there is a need to define general criteria for maintenance and inspection activities which maintenance programs should exhibit to address aging systems issues. This task is therefore to improve general maintenance criteria for airplane systems to assure aging systems related problems are identified and corrected. This should be done by developing enhancements to the maintenance planning procedures, maintenance procedures, inspection procedures, inspection criteria, procedures for protection of systems during maintenance, and maintenance training programs to ensure that aging systems issues are adequately addressed. These enhancements, when applied to a specific airplane type, should lead to development of an airplane model specific maintenance program which adequately addresses aging systems issues. There are five subtasks to this effort.

<u>3.1) Review and Revise Maintenance Steering Group (MSG) –3 Processes :</u>

Revise Maintenance Steering Group (MSG)-3 processes to address catastrophic events associated with wire failures as MSG-3 review items. The revised processes should result in identification of wire and system failures which are catastrophic or reduce the ability of the crew to cope with adverse operating conditions; or which can induce these effects on other systems with which they are associated, either physically or functionally; and identification of maintenance tasks, inspection thresholds, and inspection intervals for failures with catastrophic consequences. Failures of components which could negatively affect HIRF, lightning protection, and electromagnetic compatibility features should be addressed. The MSG-3 process is to be updated by July 2000, with maintenance programs updated as necessary by October 2000.

<u>3.2) Define Improved Inspection Criteria :</u>

Define improved inspection criteria for wiring, connectors, and associated components using ATA best practices; i.e. ATA Specification 117, Wiring Maintenance Practice Guidelines, pertinent manufacturer's service data, and DOD/NASA "lessons learned" pertaining to airplane maintenance practice. Wire in conduits or the interior of large wire bundles is not inspectable under the current "general visual inspection" definition. Further there are many areas in the airplane where it is difficult to see and fully inspect even the surface of wire bundles. Evaluate the current definition of "general visual inspection" and determine if it is still appropriate to wire and wire systems. An expected result of this review would be the incorporation of inspections, improved maintenance practices, revised definitions, or other actions to detect potentially catastrophic electric faults. Include inspection criteria for components whose failure might negatively affect HIRF, lightning protection, and electromagnetic compatibility features. The inspections, improved maintenance practices, revised definitions, guidance or other actions to detect potentially catastrophic electrical faults are to be developed by January 2000 and should be incorporated in the work of Task 5.

3.3.) Define Practices to Eliminate Wire Bundle Contamination During Maintenance :

Establish improved maintenance practices to prevent contamination of wiring and connectors with metal shavings or other harmful solids or fluids during maintenance of other components or modifications and repairs of airplane structure. Include those practices in appropriate maintenance instructions and training. The practices are to be prepared in the form of guidance material by January 2000 and should be considered in the work of Task 5.

3.4) Define Acceptance Criteria for Corrosion of Systems Components :

Define acceptance criteria for corrosion on flight control actuators, associated linkages, and hydraulic fittings, if they do not already exist in maintenance documents. Define limits for corrosion on these components based on manufacturer's service data, service history, and DOD/NASA "lessons learned". Provide recommendations to the FAA as to the acceptance criteria and on the means of incorporating these criteria into maintenance programs. Recommendations are to be provided by January 2000 and should be incorporated in the work of Task 5.

3.5) Present maintenance practices often do not relate the results of maintenance activities on components removed and replaced during line maintenance to the original service problem. Propose a process to assure that components removed during maintenance are examined for safety implications of the observed failures and the results are tracked back to the original service problem. This task is to be completed by July.2000.

2.2 As agreed by ATSRAC in April 2000

Following the formation of the Task 3 SC in Sep 1999, the team members analyzed the Terms of Reference and agreed on the best approach to satisfying the various issues raised.

This review led to some debate on the exact interpretation of certain aspects and, in a few cases, the validity of some issues under the 'aging systems' activity. Proposals were subsequently presented to the main ATSRAC committee by the Task 3 SC Chairman in the Jan 2000 meeting that identified modified objectives which were thought to address the areas of concern in a practicable way.

These proposals were fully discussed during both the Jan 00 and Apr 00 meetings and, after some modifications, were agreed. The following records the modified text:

(to be written)

(the following text will be included)

For the purposes of this report, and unless specified otherwise, the term wiring is used to indicate the installation of wires, connectors, clamps, contacts, tie wraps, etc. The term wiring does not refer to individual electrical system components, conduits, or circuit protective devices.

Chapter 3

3.0 Work Plan

(to be written - text will include the following)

Task 3 Sub-Committee (Task 3 SC) members:

Tony Harbottle	Airbus Industrie (chairman)
Norm Hennigs	Boeing
Gil Palafox	Boeing (from Sep 2000)
Frank Jaehn	Airbus Industrie
Martin Knegt	Fokker Services (representing AECMA)
Ric Anderson	ATA
Randy Boren	Northwest
Tim Herndon	Delta
Martin Cheshire	Virgin Atlantic (from Mar 2000)
Fred Sobeck	FAA
George Sedlack	FAA
Tony Heather	CAA (representing JAA)
Henry Dyck	Transport Canada
Armin Bruning	Electromec
Dave Allen	SAE

Product 1:
Based on tasks 3.1 & 3.2. Develop a logic process that can be applied to both new aircraft and in-service aircraft to ensure that appropriate attention is paid to age related deterioration of wiring/ wiring installations. This product will reflect the revised GVI definition.

Product 2:
Based on task 3.3. Develop recommendations to be followed in order to minimize the potential deterioration of wiring installations from the effects of contamination and accidental damage.

Product 3:
Based on task 3.4 (modified as agreed by ATSRAC on Jan 19th). Develop guidelines to permit appropriate attention to be given to flight control dual load path design during development of 'instructions for continued airworthiness'. Propose methodology that may be applied retrospectively to such features on in-service models.

Product 4:
Develop generalized recommendations to increase awareness of maintenance quality issues. This is aimed at highlighting the need for a corporate culture that places adequate attention on house keeping activities. This product will also provide guidance on the type of discrepancies that are expected to be addressed during general visual inspections.
The recommendations will address all systems.

Chapter 4

4.0 Sources of Data

to be written – this section will also include details of

FAA AC
ATA
NTSB

<u>ASTF/ATSRAC Task 1</u>

Non-Intrusive Inspections
Intrusive Inspections

Chapter 5

Enhancement of Inspection criteria

Note*: The use of the word 'inspector' in this document is not an indication of the grading level/seniority of the person required to perform the inspection. It shall be understood to mean 'the person performing the inspection' and it is incumbent on the company to ensure that this person has the appropriate training.*

The ATA MSG-3 (Maintenance Steering Group -3) document provides guidance on a logical means to identify a minimum list of applicable and effective maintenance tasks that maintain the inherent safety and reliability levels of the systems and structure of the airplane. These tasks and their corresponding intervals are published in the Maintenance Review Board (MRB) Report and are used as the basis for the first issue of each operator's approved Maintenance Program (Schedule). Though the use of MSG-3 is technically only a means of compliance, in practice the MRB Reports of all FAR/JAR Part 25 aircraft type certificated since 1980 have used this logic process. Accordingly, the resultant maintenance programs identify levels of inspections that should be consistent in their definition, interpretation and application.

In practice, inspection definitions have been refined at various revisions of MSG-3 in order to improve consistency of application and to minimize differing standards between application on aircraft types. For example, the concept of Internal/External Surveillance Inspections and the Walk Around Check was deleted in MSG-3 Rev 1, thus simplifying the definitions of the inspections that could be selected.

The recent focus on the importance of visual inspections to identify conditions that might lead to undesirable failure conditions has identified that further clarification is necessary if a significant improvement is to be realized in this area.

Over the years, the application of these inspection levels has not been consistent. This concerns those developing maintenance programs as well as those performing inspections in the field. When this variation is added to the interpretations of other levels of inspection used in pre MSG-3 programs it becomes evident that the starting point in establishing uniform training of analysts and inspectors must first be to agree to a common interpretation of the inspection levels.

Since the determination of the necessary inspections starts with the development of the initial maintenance program, the Task 3 SC concluded that the ATA, through its MSG-3 WG, should address this issue.

MSG-3 Revision 2 gives the possibility to select three levels of inspection – General Visual Inspection, Detailed Inspection and Special Detailed Inspection. Further to a request from ATSRAC Task 3 SC, the definitions of these have been reviewed by ATA and agreement has been reached on changes that will be incorporated in MSG-3 Revision 2001 targeted for April 2001.

The following text (in bold) is that which is expected to be included in the revised MSG-3 document.

GENERAL VISUAL INSPECTION:

A visual examination of an interior or exterior area, installation or assembly to detect obvious damage, failure or irregularity. This level of inspection is made from within touching distance unless otherwise specified. A mirror may be necessary to ensure visual access to all surfaces in the inspection area. This level of inspection is made under normally available lighting conditions such as daylight, hangar lighting, flashlight or droplight and may require removal or opening of access panels or doors. Stands, ladders or platforms may be required to gain proximity to the area being checked.

Of the three levels of inspection, the term General Visual Inspection (GVI) received the most attention from the MSG-3 WG. Experience in the field had highlighted that there are considerable differences in how a GVI is considered in airlines and this has led to inconsistencies in their effectiveness. Though OEMs have tended towards a common standard in defining the scope and expectations of a GVI it has been recognized that this effort has not always been adequately addressed in the operators working environment.

One of the more significant concerns with the previous definition was the lack of guideline concerning from what distance a GVI should be performed. It is obvious that this has a significant influence on whether or not a particular degradation will be noted but, with no guidance, some GVIs are being performed from greater distances than foreseen by those concluding the task to be applicable and effective. In line with assumptions already taken by most OEM's, it was agreed that GVIs should be performed from within at least touching distance unless otherwise specified. Thus a GVI of a fin will generally require access stands but, in order to identify fin damage due to birdstrike/FOD etc, it remains valid to refer to the routine walk around check as a GVI, this being specified as being performed from the ground.

Another concern related to the use of mirrors in performing a GVI. It is evident that if mirrors are not used some significant deterioration may not be evident and thus a more intensive level of inspection would need to be called up in order to detect such degradation. It was concluded that those defining the level of inspection necessary shall assume that the person performing the inspection has a mirror available and will use it (as far as is practicable without item dislocation) in order to determine the absence of obvious deterioration on the rear surfaces of components. The mirror is not to increase the intensity of the inspection but purely to ensure that all surfaces are examined for obvious signs of deterioration. It was highlighted that without such a revision to the definition a higher level of inspection would be required for the majority of zones thus rendering the GVI of questionable effectiveness.

DETAILED INSPECTION:

An intensive examination of a specific item, installation or assembly to detect damage, failure or irregularity. Available lighting is normally supplemented with a direct source of good lighting at an intensity deemed appropriate. Inspection aids

such as mirrors, magnifying lenses etc may be necessary. Surface cleaning and elaborate access procedures may be required.

This level of inspection is often abbreviated to 'DVI' although the title intentionally does not include the word 'Visual'. The ATA MSG-3 agreed that the word 'visual' (previously written after 'intensive') might suggest that a Detailed Inspection is restricted to an examination using only eyesight. It was argued that this is an unnecessary limitation since the scope of such an inspection will always need to be explained in jobcard / workcard and therefore could also include the use of other sensory faculties. In particular, it was highlighted that a Detailed Inspection could include tactile assessment in which a component or assembly is checked for tightness/security. This is of significance when identifying applicable and effective tasks to ensure the continued integrity of such installations as bonding jumpers, terminal connectors, etc.

Though the term Detailed Visual Inspection remains valid for Detailed Inspections using only eyesight it should be recognized that this may represent only part of the inspection called for in the source documents used to establish an operator's Maintenance Program. Task 3 SC thus recommends that the abbreviation 'DI' or 'DET' is used in place of 'DVI'.

SPECIAL DETAILED INSPECTION:

An intensive examination of a specific item, installation, or assembly to detect damage, failure or irregularity. The examination is likely to make extensive use of specialized Inspection Techniques and/or equipment. Intricate cleaning and substantial access or disassembly procedure may be required.

The ATA MSG-3 WG concluded that there was no need to amend this definition.

ATSRAC Task 3 SC worked with the ATA MSG-3 WG throughout the development period and fully endorse their conclusion. These definitions have been used in the determination of enhancements to the maintenance criteria that, once incorporated, will lead to a more consistent approach to the performance of General Visual Inspections.

It is Industry practice to develop a separate inspection program that is complementary to the Structures Program and the Systems & Power Plant Program. According to MSG-3 guidelines, this program is referred to as the Zonal Inspection Program (ZIP) and it consists of General Visual Inspections of the majority of the airplane. Note: The practice on 'pre MSG-3 airplanes' was not always the same and this leads Task 3 SC to recommend that the starting point for the 'Enhanced ZIP' must be a well defined Zonal Inspection Program. This is likely to lead to more work being required on the programs of some older aircraft types.

The inspections called for in the Zonal Inspection Program are identified by reference to the zone (usually a number or alphanumeric designation). The extent of the task is determined by the access requirements. ie what doors, access panels and/or equipment must be removed or displaced. The repeat interval is determined from consideration of several factors that might influence the probability of deterioration. However, in the ZIP task description, no mention is made of any particular item or feature. It is assumed that all systems and structural features evident with the quoted access will be subjected to the same level of inspection. Experience with pre MSG-3 programs suggests that mentioning that particular attention should be given to specified items leads to 'tunnel vision' on the part of the person performing the inspection with a consequent risk that inadequate attention may be paid to features not specified.

It is possible for a General Visual Inspection to exist as a stand-alone task in either the Systems & Power Plant or Structures Program. In such cases, the task description can clearly identify any need to focus on a specific feature. In practice, most GVIs identified as applicable and effective from application of MSG-3 logic are considered adequately covered by the ZIP and thus do not appear as dedicated tasks. Analysts have an option to upgrade those that are not considered covered by the ZIP to Detailed Inspection.

As a result of the above practices, Task 3 SC believed that it would be beneficial to provide guidance on the type of deterioration that a person performing a GVI would be expected to notice and address. Though it may be realistically assumed that all operators provide such guidance to their inspectors it is evident that significant variations exist and, in certain areas of the world, a significant enhancement of the GVI could be obtained if internationally agreed guidance material could be produced. Though this is recognized as an ambitious target, text has been generated which is proposed to be incorporated in operators training material and in the introductory section of maintenance planning documentation. This text is proposed in Chapter 7 of this report.

Chapter 6

6.0 Maintenance Program enhancement

6.1 Scope

Task 3 SC committed to working with facts generated by specialists familiar with the design, operation and maintenance of commercial airplanes. Consideration was also given to issues that had been identified in military/government areas of aviation where the possibility of read across to the civil sector could not be ruled out.

During the period that Task 3 SC developed enhanced maintenance criteria, the driving force was the results of the non intrusive inspections performed by the ASTF under ATSRAC Task 1. Though during the latter part of development some initial results from the intrusive inspections were available, Task 3 SC agreed that it would not be appropriate to try to address any specific concerns from this exercise until the conclusions had been presented and agreed.

As a result of the above, the development of an enhanced maintenance program procedure was based on a need to consider additional tasks to address discrepancies that are visible without the need for specialized inspection techniques. No facts were tabled to justify development of a logic process that could lead to the identification of Special Detailed Inspections.

Task 3 SC considers that the results of their study shall be applicable to all CFR Part 25 certificated airplanes. The 8 airplane types surveyed by the ASTF have been selected in consideration of their age and thus their ability to provide inputs on enhancements that are necessary. Unlike the Task 1 activity, Task 3 is not specific to aircraft type.

Though the ATSRAC activity is driven by the need to assess age related deterioration of systems installations, the findings from Task 1 activity confirm that there is little evidence that pure aging phenomena is causing deterioration that might lead to an airworthiness concern. However, aging due to time in service and the consequent increased probability that mechanical damage, improper repairs and inadequate maintenance may have occurred is evident. Taking these contributors as the cause of deterioration, Task 3 SC agreed that since they could occur at any age there is no justification for identifying high initial intervals followed by more frequent repeat inspections. Thus, in practice, the aging influence is not directly addressed within the scope of Task 3 SC activity.

The initial focus of the ATSRAC activity was on wiring with the determination of any need to enhance the maintenance of other systems to be defined later. Following extensive discussion, the ATSRAC committee concluded that there is, today, no evidence to suggest that deterioration of other systems might lead to a direct airworthiness condition in the same way as had been concluded for electrical wiring. As a result, the Task 3 SC enhanced logic methodology addresses only the wiring issues.

6.2 Current MSG-3 Zonal Analysis Procedures

The existing MSG-3 guidelines Section 2.5 identify the need for a Zonal Inspection Program (ZIP) and provide an outline procedure. This procedure leads to the identification of general visual inspections of the majority of the zones of the airplane. The extent of the inspection is determined by the access requirement and the interval is defined according to susceptibility to damage, the amount of activity in the zone and previous experience with similar systems, powerplants and structures.

The Zonal WG that defines the GVIs that constitute the ZIP make a full assessment of the structure and systems installations within each zone and use this knowledge to determine access and interval. To avoid possible 'tunnel vision', the task description intentionally does not refer to any specific components or types of degradation.

6.3 Concerns relating to the adequacy of existing Zonal Inspection Programs

As a result of accident/incident investigations and surveys of in-service aircraft, it has been highlighted that the condition of aircraft system installations may not be receiving sufficient attention during the routine scheduled maintenance activity required by approved maintenance programs.

Though specific system functions may be adequately addressed through dedicated operational and functional checks, it is perceived that the condition of the installations, particularly the wires, pipes and ducting that connect system components, receive inadequate attention.

There is concern that in certain cases a GVI may be inadequate to confirm the continuous airworthiness characteristics of an installation. In addition, the application of the GVIs may not be performed in a consistent manner and thus improvements need to be identified to ensure that these inspections are effective.

6.4 Enhancement of scheduled maintenance programs

The objective of Task 3 SC was to identify a logical means that could be applied to in-service aircraft and new designs to ensure that adequate consideration is given to potential deterioration of system installations. The target was to develop a common process for old and new designs though it was recognized that some variation may ultimately be necessary in view of the variance in availability of design data.

Today, reliance is placed on the Zonal Inspection Program to address deterioration of the components that constitute system installations. Task 3 SC have reviewed the current ZIP philosophy with the objective to:

(i) identify its limitations and
(ii) to propose improvements that could lead to a more consistent application of the GVI requirements.

The following text addresses (i). The improvements associated with (ii) are described in Chapters 5 and 7 of this report.

Task 3 SC recognized that the starting point for any enhancement must be the MSG-3 logic process that has been used to develop scheduled maintenance requirements since 1980. However, this logic could not have been used in the creation of the original maintenance programs for the older airplane types. As a result, since the focus of ATSRAC is on these older airplanes, before the proposed enhancements are developed, there is a need to have a collection of general visual inspections of each zone that can be regarded as equivalent to the Zonal Inspection Programs identified on later types.

MSG-3 provides procedures to develop three separate programs that together constitute the initial list of tasks to be included in an operators approved Maintenance Program. The procedures for these programs – Systems & Powerplant, Structures and Zonal Inspection – were reviewed in order to determine if they could be adapted to address the industry concerns and thus provide the necessary enhancements. In addition, the idea of a fourth program was considered.

After much discussion it was concluded that a change to the procedures used to develop the Zonal Inspection Program offered the best route to achieving the objectives.

6.5 Enhanced Zonal Analysis Procedure

The changes that are proposed to the Zonal Analysis procedure are introduced in order to identify the limitations of a GVI performed within a Zonal Inspection Program. The aim was to create a logical process whereby an analyst can determine whether a zonal GVI is adequate or whether either a standalone GVI task or a Detailed Inspection is justified. In addition, the logic includes a means to identify a dedicated task that would lead to the minimization of local accumulation of combustible material.

Task 3 SC developed a logic diagram for the existing MSG-3 Zonal Analysis (not previously available) and then through a series of iterations, modified this to address the need to be able to identify tasks other than zonal GVIs.

Throughout the exercise, Task 3 SC were aware that the final result must be practicable and must lead to the necessary reinforcement of maintenance programs. This would not be achieved by declaring a need to perform, for example, Detailed Inspections in all zones or to introduce dedicated tasks to inspect all wiring. The focus of the team's efforts was thus directed at identifying as simple a logic as possible that would lead to the addition of new tasks only where they are justified.

The logic diagram developed was concluded to be suitable for OEMs to use to determine the need for enhancements to the maintenance programs of the in-service airplane types. It was however considered unnecessarily complex for introduction into the MSG-3 guidelines document. That document is written in such a way as to permit alternative means to reach the objective. It is the OEM's Policy and Procedure Handbooks that details the precise means that will be used to achieve those objectives. As a result, this Chapter provides:

6.5.1 Application to in-service airplanes (to be written later)
6.5.2 Application to future designs (to be written later)

The purpose of the Enhanced Zonal Analysis Procedure is to identify tasks:

- To detect damage of structure and systems for those components and system installations for which no specific task has been created
- To detect damage to components and structure (including MSI and SSIs) caused by failure of other installations in the zone.
- To detect deterioration due to influence of environmental conditions and the surrounding systems
- To detect damage on wiring
- To combine transferred items coming from the System & Power Plant and Structure Program.

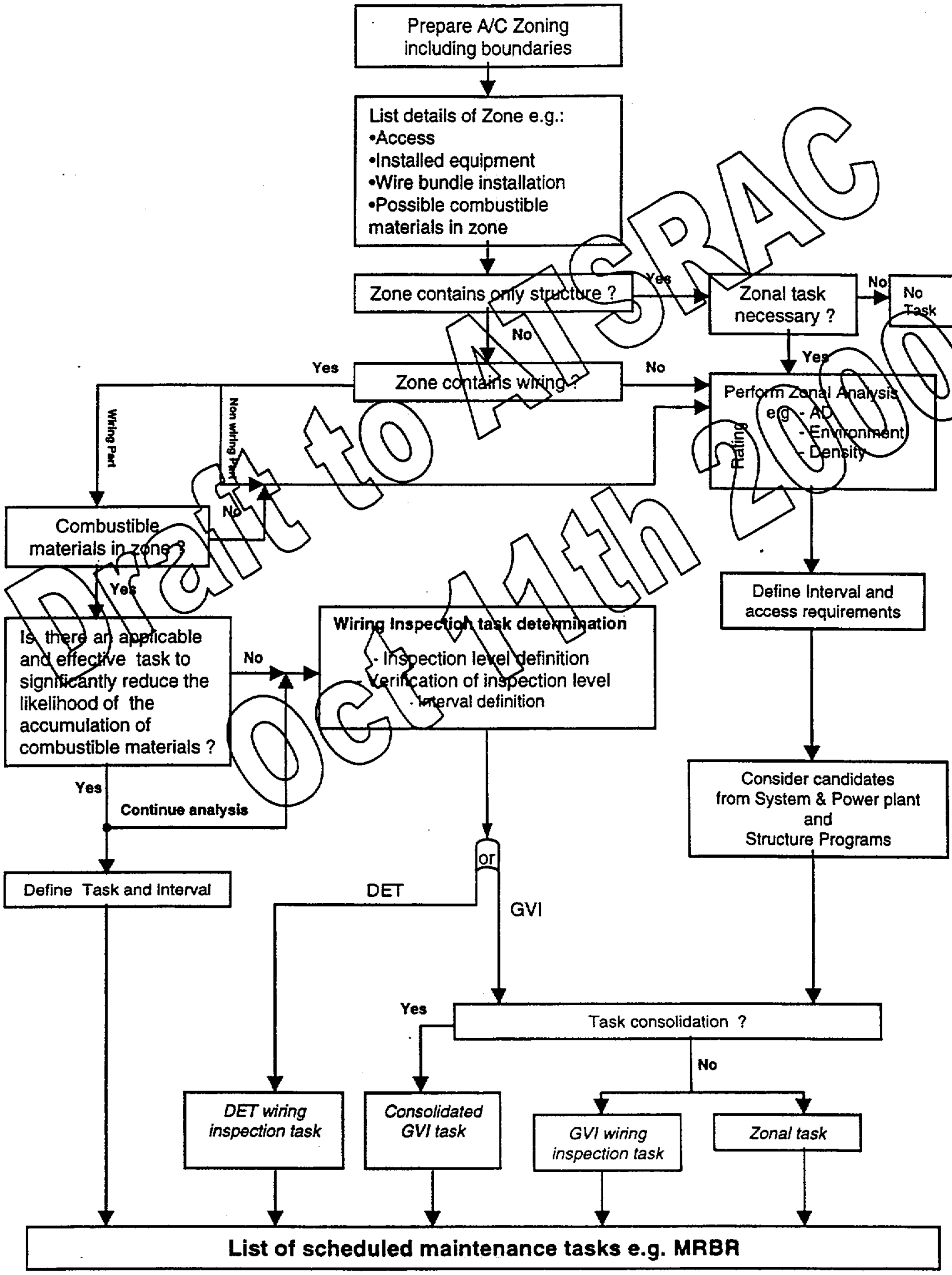
The results of the application of the Enhanced Zonal Analysis Procedure can be a specific task that reduces the likelihood of combustible materials in a particular area of a zone or within the whole zone and inspection tasks with different inspection levels covering the wiring and non wiring part in a zone.

The Enhanced Zonal Analysis Procedure consists of:

- Zonal Analysis (traditional MSG-3 logic)
- Enhanced part addressing wiring consists of
  - Definition of task reducing the likelihood of combustible materials
  - Wiring task definition
    - Inspection Level definition
    - Verification of inspection level
    - Definition of Interval

An applicable rating system has to be developed to allow the definition of the inspection level for installed wiring and also a rating system for the definition of a task interval .The interval could be expressed either in letter checks, calendar time or Flight hours

Enhanced Zonal Analysis Procedure



Wiring Inspection task

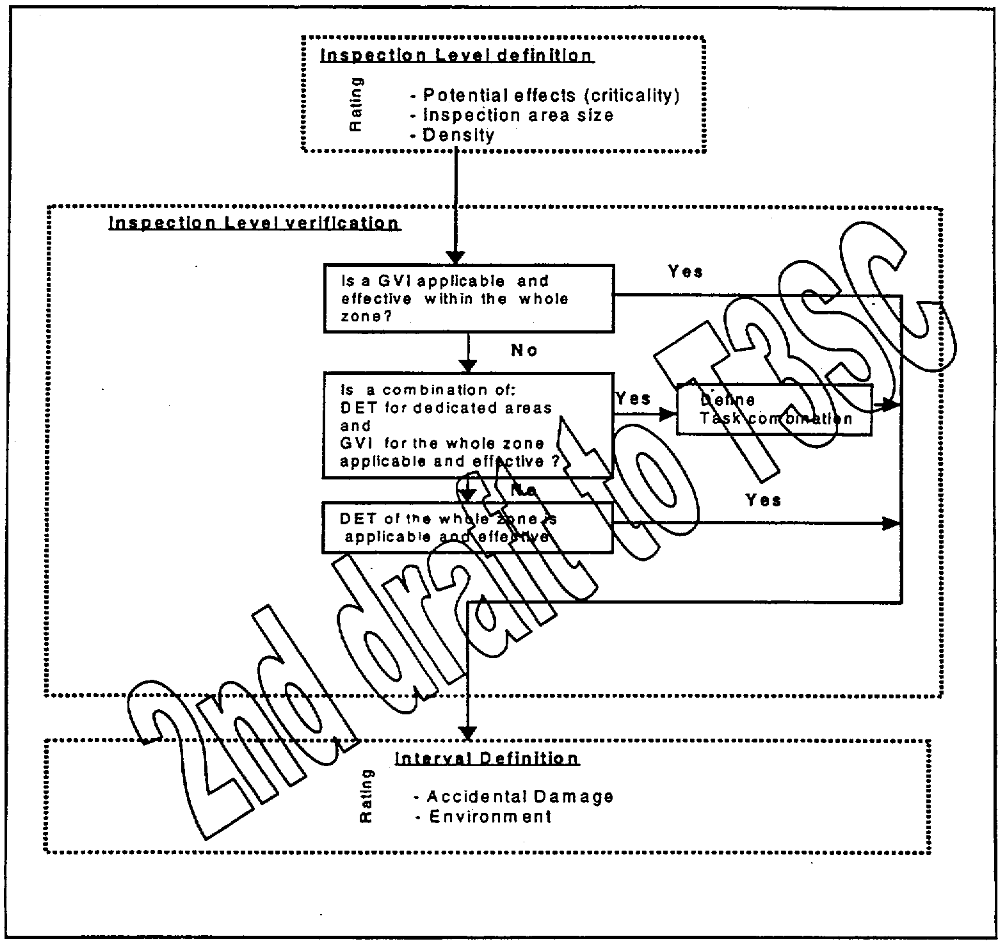


Diagram to provide details of box 'Wiring Inspection task determination'

A) BOX: "Preparation of A/C zoning including boundaries"

The system adopted is based on Specification ATA 100, Chapter 1-6-0 and essentially complies with the rules of this system, varied only to accommodate particular design constructional differences.

The system consists of Major Zones, Major Sub Zones and Zones.

The zones, wherever possible, shall be defined by actual physical boundaries such as wing spars, major bulkheads, cabin floor, control surface boundaries, skin, etc.

B) BOX: " List of Details of zone"

An evaluation will be carried out to identify system installations, significant components, typical power levels in any installed wiring bundles (*), combustible materials (present or possible accumulation) etc.

(*) the analyst should be aware whether the bundle consists primarily of main generator feeder cables, low voltage instrumentation wiring or standard bus wiring. This information will later be used in determining the potential effects of deterioration.

The reference to combustible materials highlights the need to assess whether the zone might contain material that could cause a fire to be sustained in the event of an ignition source arising in adjacent wiring. Examples include the possible presence of fuel vapors, dust/lint accumulation, contaminated insulation blankets.

C) BOX : "Zone Contains only structure ?"

This question serves as a means to eliminate those areas that do not contain any systems installations. Such zones may be covered by the Structures Program and need no Zonal Analysis.

D) BOX : "Zonal Task necessary ?"

The response to this question depends on OEM philosophy. A Zonal Inspection may be identified or a decision may be made that the GVI of the zone is covered by the Structures Program.

E) BOX : "Zone Contains wiring ?"

This question serves as a means to eliminate from the enhanced zonal analysis procedure those areas that do not contain any wiring. Such zones are analyzed using the standard zonal analysis procedure

F) BOX: "Combustible materials in the zone ?"

This question requires an evaluation of whether the zone might contain combustible material that could cause a fire to be sustained in the event of an ignition source arising in adjacent wiring. Examples include the possible presence of fuel vapors, dust/lint accumulation, contaminated insulation blankets.

Note: Today there is no justification to identify uncontaminated wire insulation as combustible.

G) BOX: " Is there an applicable and effective task to significantly reduce the likelihood of accumulation of combustible materials ?"

This question is to evaluate if there is a possible task that can significantly reduce the presence of combustible materials and consequently the concentration of flammable materials within the zone.

Though restoration tasks (e.g. cleaning) are the most likely applicable tasks, the possibility to identify discard tasks is not eliminated.

H) BOX: "Define task and interval ?"

This step will define an applicable task and an effective interval. It shall be included as a dedicated task in the Systems & Powerplant program. Within MRB Reports, this may be introduced under ATA 20 with no Failure Effect Category quoted.

I) BOX: "Wiring inspection task determination"

This box contains 3 sub steps

(1) Inspection level definition

A rating system is used to define the most applicable Inspection level. The exact format of this will be determined by the analyst. The Inspection level characteristics to be included in the rating table are:

- Potential effects of fire on adjacent wiring & systems
- Inspection area size
- Density of installed equipment within the zone

Credit may be taken for the effectiveness of any task selected to minimize the accumulation of combustible material in the zone.

The intention is to conclude that in a zone that both contains wiring and has potential for accumulation of combustible materials a detailed inspection of the wiring may be justified:

- the greater the critically of a localized fire,
- the larger the inspection area and
- the higher the density of the equipment in the zone.

The analyst shall assess the potential effect of a localized fire on adjacent wiring and systems. The rating applied depends on the potential for loss of redundancy such that continued flight and safe landing may not be possible. The analyst does not need to assess the function controlled by the wire that has the deterioration (the effect on system operation would be assessed in standard MSG-3 application).

It is argued that the smaller the zone and the less congested it is, the more likely it is that the inspector will identify deterioration by General Visual Inspection.

The intention is to call for a DET only when justified by these three criteria. This is expected to ensure the appropriate focus and avoid extensive detailed inspection requirements.

(2) Verification of the selected inspection level

The rating tables identify the need for either a Detailed Inspection or a General Visual Inspection of the wiring within a zone. However, there may be justification that within the same zone some wiring may be more vulnerable than others and thus there needs to be a discussion on whether the same Inspection Level is appropriate for all wiring in the zone.

The verification serves to determine an applicable and effective Inspection Level for wiring in the zone. This can be

- General Visual Inspection of all wiring within the whole zone, or
- A combination of a Detailed Inspection for dedicated areas within the zone and a General Visual Inspection for other wiring in zone. In this case an applicable task combination should be selected.
- A Detailed Inspection level of wiring in the whole zone

(3) Definition of interval

The definition of an effective Interval will be carried out using a rating system. The characteristics for wiring to be rated should include:

- Possibility of Accidental Damage
- Environment

The rating tables shall be designed to define increasing inspection frequency with increasing risk of accidental damage and increasing severity of the local environment within the zone.

Note:
At this point the analyst will have determined the inspection level and interval but no decision has yet been made as to whether the GVI (if selected) can be considered accomplished as part of the Zonal Inspection Program.

J) BOX: "Perform zonal analysis"

This reflects the initial zonal evaluation process and will be carried out using a rating system. The zonal characteristics can be:

- Possibility of accidental damage
- Environment
- Density of installed equipment

K) BOX: "Define Interval and access requirements"

The interval will be selected to be the optimum zonal interval. The selection will be taken in account access requirements and operator practice for similar areas.

L) BOX: "Consider candidates from System & Powerplant and Structure program "

Before a suitable zonal inspection interval can be selected, the MSI/SSI transfer items that are candidates for transfer into the ZIP must be reviewed. Each transferred item/task will already have an interval and access requirement defined by the respective Working Group. The Zonal analyst shall determine whether the task can be considered covered by the GVI tasks identified according to boxes 'J' and 'K'. The Zonal Working Group may chose to reduce the frequency of a task in order for this to be satisfied.

Not all GVIs developed from Structure and System & Powerplant analyses are suitable for combination with the Zonal Inspections. Those that are not are returned to the originating Working Groups to be included as dedicated tasks within their respective programs.

M) BOX: "Task Consolidation ?"

This step in the procedure examines the potential for consolidation between the GVI tasks derived from consideration of wiring (Box I) and the Zonal Inspections determined after application of the Zonal Analysis (Boxes J, K and L).

The result of this step may lead to:

- consolidated Zonal Inspection tasks (ie Wiring GVI included in Zonal GVI)
- standalone GVIs of wiring (not included in Zonal GVI),
- Zonal Inspection tasks (no consolidation with Wiring tasks)

The consolidation of GVI tasks has to take into account the access requirements and the interval of each task. The Working Group may conclude that a standalone GVI of the wiring may be justified if the Zonal GVI of the other systems within the same zone need not have such a frequent inspection.

The DETs of wiring within the whole zone or part of a zone are automatically dedicated tasks.

The Zonal Inspection tasks (whether consolidated or not) will define the Zonal Inspection Program. The standalone GVIs and the DETs will be introduced as dedicated tasks in the Systems & Powerplant program. Within MRB Reports, these may be introduced under ATA 20 with no Failure Effect Category quoted.

Chapter 7

7.0 Expectations of a Zonal GVI

Further to the non-intrusive inspections performed by the ASTF during their accomplishment of ATSRAC Task 1, it was suggested that the majority of findings recorded during their inspections would have (should have) been noticed during performance of a General Visual Inspection. That is to say, though the ASTF may have performed Detailed Inspections to accomplish their review, this level of inspection would not have been necessary to notice the majority of the discrepancies.

In view of this situation, Task 3 SC have concluded that their activity should not stop at defining a General Visual Inspection and its limitations but should also provide some guidance material as to what is expected to be seen and addressed during accomplishment of a zonal GVI. This information may then be used to enhance the training of analysts and inspectors thus helping to ensure a consistent performance and consequent improvement in the condition of the in-service airplanes.

7.1 <u>Guidance for accomplishment of a Zonal GVI</u>

A Zonal GVI requires a visual examination to detect obvious unsatisfactory conditions and discrepancies. It shall be performed from within touching distance unless otherwise noted, that being the distance from the examiner's eye to the area/item being inspected. Though flashlights and mirrors may be required to provide an adequate view of all surfaces, there is no requirement for equipment removal or displacement unless this is specifically called for in the access instructions. Paint and/or sealant removal is not necessary and should be avoided unless condition is suspect. Should unsatisfactory conditions be suspected, items may need to be removed or displaced in order to permit proper assessment.

It is expected that the area to be inspected is clean enough to minimize the possibility that accumulated dirt or grease might hide unsatisfactory conditions that would otherwise be obvious. Any cleaning that is considered necessary should be performed in accordance with approved procedures in order to minimize the possibility of the cleaning process itself introducing anomalies.

In general, the inspector is expected to identify degradation due to wear, vibration, moisture, contamination, excessive heat, aging, etc. and make an assessment as to what actions are appropriate to address the noted discrepancy. In making this assessment, the inspector shall take into account potential influence on adjacent system installations, particularly if these include wiring.

One of the findings from the ATSRAC Task 1 surveys is that some evident discrepancies have either not been addressed or have not been addressed in an appropriate way. These discrepancies would have been expected to be been seen during accomplishment of general visual inspections. More guidance is thus considered necessary to clarify the type of deterioration that constitutes a discrepancy that is expected to be corrected. For this reason, Task 3 SC have developed the following lists that are recommended be included in guidance material as an enhancement to material that addresses inspection of the main system components. It is emphasized that these lists are not intended to be exhaustive and may be expanded as considered appropriate.

Electrical installation
(also refer to AMM Chapter 20 Standard Practices)

Harnesses
- Wire bundle/wire bundle or wire bundle/structure contact/chafing
- Wire bundle sagging or badly secured
- Wires damaged (large scale damage due to mechanical impact, overheat, localized chafing etc)
- Lacing tape and/or ties missing/incorrectly installed
- Wiring protection sheath/conduit deformity or incorrectly installed
- End of sheath rubbing on end attachment device
- Grommet missing or damaged
- Dust and lint accumulation
- Surface contamination by metal shavings / swarf
- Contamination by liquids
- Deterioration of previous repairs

Connectors
- External corrosion on receptacles
- Backshell tail broken
- Rubber pad or packing on backshell missing
- No backshell wire securing device
- Foolproofing chain broken
- Missing or broken safety wire
- Discoloration/evidence of overheat on terminal lugs/blocks
- Torque stripe misalignment

Switches
- Rear protection cap damaged

Ground points
- Corrosion

Bonding braid/bonding jumper
- Braid broken or disconnected
- Multiple strands corroded
- Multiple strands broken

Wiring clamps or brackets
- Corroded
- Broken/missing
- Bent or twisted
- Faulty attachment (bad attachment or fastener missing)
- Unstuck/detached
- Protection/cushion damaged

Supports (rails or tubes/conduit)

- Broken
- Deformed
- Fastener missing
- Missing edge protection on rims of feed through holes
- Racetrack cushion damaged

The following item could be considered to be covered by the ZIP if access to the electrical power center, relay boxes etc are added in the access requirements:

Circuit breakers, contactors or relays
- Signs of overheat

Hydraulic/Fuel/Water Waste/Oxygen/Fire Detection/Fire Suppression system installation

- Seepage/leakage of liquid
- Broken or incorrect wire locking
- Pipes badly secured
- Pipe/pipe or pipe/structure contact (check for chafing and restore separation)
- Missing or broken clamps
- Crushed / damaged pipes
- Broken/disconnected bonding leads / jumpers
- Deterioration of previous repairs
- Obstruction of smoke detectors
- Plugged or damaged distribution nozzles

Air systems installation

- Evidence of leakage on adjacent structure/components
- Crushed/split ducts
- Misaligned, missing or broken clamps
- Ducting badly secured

Mechanical systems installation

- Bent/crushed control rods
- Sagging control cables
- Excessively worn, frayed or kinked control cables
- Excessively worn fairleads
- Extruded bearing liners
- Broken or incorrect wire locking
- Significant corrosion on cables, threads

Cargo Systems

- Split/holed compartment liners
- Seal damage
- Excessively worn rollers (sign of jamming and resultant overheat)
- Missing/damaged stops/latches
- Damaged cargo net restraining attachments

Engines/Pylons

- Blade damage (e.g., nicks, cracks)
- Blades rub (on rubstrip)
- Vane damage
- Cowling damage
- Loose or migrating fasteners and bushings (due to vibration)
- Discoloration (due to heat damage)
- Foreign Object Damage (FOD)
- Damage due to birdstrike/ingestions

General

- Detached sealant
- Obstructed drainage holes
- Illegible labels
- Paint/surface protection in poor condition
- Evidence of lightning strike
- Evidence of FOD/bird strike
- Condensation in windows
- Window crazing
- Oil canning
- Pooled liquids

The above mentioned discrepancies have been written under system headings in order to minimize repetition. Task 3 SC recommends that when this information is provided as guidance to an inspector, it be reformatted according to the aircraft zone to be examined. Thus, for example, an inspector performing a GVI within a landing gear bay will have a single list of items he/she should be looking out for.

Chapter 8

Minimization of Contamination

INTRODUCTION

As defined in Subtask 3.3 of the Draft Aging Transport Systems Rulemaking Advisory Committee Terms Of Reference document dated 1/11/99, Task 3 Subcommittee (Task 3 SC) was tasked as follows:

> 'Establish improved maintenance practices to prevent contamination of wiring and connectors with metal shavings or other harmful solids or fluids during maintenance of other components or modifications and repairs of airplane structure. Include these practices in appropriate maintenance instructions and training. The practices are to be prepared in the form of guidance material by January 2000 and should be considered in the work of Task 5'.

This chapter of the Task 3 SC report is submitted to satisfy the requirements of Subtask 3.3.

Within the Task 3 SC, issues related to the intent of the task were addressed and the results are reflected in this report. One primary issue was that Task 3 SC agreed to expand the scope beyond "maintenance" to include routine servicing tasks. Physical/mechanical damage to wiring from accidental contact or maintenance activity was also included as a concern (in addition to contamination) based on findings identified in the Aging Systems Task Force Aging Transport Systems Task 1 and Task 2 (ASTF) Final Report, Part 1, Non-intrusive Survey Results and Conclusions. Several protections or cautions associated directly with wiring (cleaning or wiring, repair of wiring, etc) were also included in this report based on data in the ASTF Final Report, Appendix A, Non-Intrusive Electrical Survey Summary Forms – Tabulated Results. .

It should be noted that the elements of this report are primarily housekeeping issues - protect and clean up. Based on the ASTF Final Report, Appendix A, this is an area where operators or maintenance providers have been deficient. Task 3 SC believes that the protection and caution recommendations listed herein will likely have the greatest affect through training of personnel performing the related maintenance or servicing task. As indicated in the Recommendations section of this report, this information should be considered within ATSRAC Task 5 Subcommittee for inclusion in improved training programs.

The process used in developing this report is outlined below:

- Task 3 SC established a list of maintenance or servicing tasks where mechanical damage or contamination might occur. This was performed through brainstorming sessions with Task 3 SC members. The results of this are contained in Table 1.
- Task 3 SC members audited their existing resources (maintenance manuals, technical papers, etc.) for documented protection or caution recommendations associated with wiring and related components. Approximately 40 documents directly related to this effort were utilized.

- Protections or cautions from those documents were tabulated against each of the identified maintenance and servicing tasks.
- Task 3 SC evaluated each maintenance and servicing task for sufficient standard protection and caution data and produced standardized wording and additional protection and caution recommendations in some cases.
- Based on discussion and existing precedent, Task 3 SC recommended locations where each protection and caution is to be integrated.
- Based on discussion and existing precedent, Task 3 SC recommended methods by which this information should be implemented.
- The results were tabulated for this report.

RESULTS

Items 1 through 12 contain details related to each maintenance or servicing task which are the basis for recommendations in this report. An explanation of the format is provided in Table 2.

Wet area (galley/lav/door) installation/modification and operation was included in the initial list of maintenance and servicing activities to be reviewed. Upon further analysis, it was determined that these areas are adequately addressed by Item 4 (Inclement Weather) and Item 8 (Servicing, modifying, or repairing waste/water systems).

Application of structural anti-corrosion products was also included in the initial list of maintenance and servicing activities to be reviewed. Upon further analysis by the group, it was determined that additional information regarding the long term effect of these products on wiring was necessary. There was no data from the non-intrusive inspection report that indicated structural anti-corrosion products adversely affect wiring. For this reason, a recommendation to evaluate these products is made in lieu of any specific protections or cautions.

Similar to application of structural anti-corrosion products, a question was raised within the group related to the benefits of pressure washing versus the concerns. Experience has shown that pressure washing is a superior method of cleaning certain areas of aircraft where some water impingement on wiring and electrical components is unavoidable. While Task 3 SC recommends avoidance of direct pressure spray onto wiring and electrical components as a general "best practice", further data needs to be developed toward specific criteria and limitations for pressure washing to minimize adverse effects on wiring and electrical components (i.e. nozzle PSI, cleaning solution pH, and temperature)

As previously noted, for each Item where standardized wording and additional protection and caution statements are recommended, a list of recommended locations for these statements is included. In some cases, the recommendations are specified for "New Products" (aircraft) only. For further clarification, Task 3 SC submits the following example:

> One recommendation is to include specific protection and caution statements in every maintenance manual procedure that removes or installs a component where wiring must be displaced or disconnected/reconnected.

While it is not logistically feasible to do this for existing aircraft, manuals being developed for a new aircraft could easily be tailored to include specific protection and caution statements in every such procedure. Therefore, this recommendation is specified for New Products only. Existing aircraft would have this information placed in Chapter 20, Standard Practices, but not in the individual procedures throughout all chapters of the manual.

RECOMMENDATIONS

It is the Subcommittee's recommendation that the following actions be accomplished as a result of the this activity in response to ATSRAC Task 3.3.

As indicated in Items 1 through 12, protections or cautions should be added to the specified locations for each of the maintenance or servicing tasks listed.

Exceptions:

Those locations identified as "New Products" do not require retroactive incorporation of these recommendations on existing documents. Documents produced in the future should have these recommendations incorporated.

General Notes:

- Some deviation from the wording in these tables is acceptable provided the intent is satisfied.
- Locations listed may be generic terms for common industry documents and are not intended to exclude other documents used for the same purpose.
- There is no implied significance of the terms "protection" and "caution".
- It is recommended that Air Transport Association's Spec 100/iSpec2200 standards be used for publishing where possible.
- Task 4 SC should provide guidance to the OEM on implementation for those locations identified as "Wiring Practices Manuals".

Standards for producing documents listed in the "Locations" section of Item 1 through 12 should be updated to ensure appropriate protection and caution information is incorporated into future documents. One example of a standard is ATA Spec 100/iSpec2200.

Ownership to comply with the two above mentioned recommendations (in bold) should exist as:

OEM: .... Service Bulletins, Maintenance Manuals, Structural Repair Manuals, Wiring Practices Manuals.

Operator/MRO: .... Engineering Orders, Ground Operations Manuals, De-Icing/Anti-Icing Manuals

Air Transport Association: .... Specification (Spec) 117

ATSRAC T5WG:................... Training Documents

FAA .... Advisory Circular (AC) 43.13-1B, Supplemental Type Certificate (STC) Guidance Material

The FAA should be tasked with evaluating current structural anti-corrosion products for long-term affects on wiring. The results should be recommendations for, or against, the use of specific products on wiring given the high probability that wiring and electrical components will always be subject to some level of contamination by these products. CIC manufacturers should be encouraged to adjust their products to minimize detrimental effects on wiring while preserving the highest levels of corrosion protection possible.

OEMs should be tasked with providing specific guidance for pressure washing to minimize adverse effects on wiring and electrical components (i.e., maximum pressures, minimum nozzle-to-surface distance, maximum cleaning solution pH, maximum temperatures of water, maximum air temperature, and rinse requirements). The results should be in the form of internationally accepted standards.

The following table lists the issues for which recommended cautions or protection practices have been developed to minimize the risk of contamination or accidental damage to wiring installations.

ITEM Number	Maintenance or Servicing Task
1	Installation, repair, or modification (to wiring)
2	Repair or modification (to structure)
3	Application of anti-icing or de-icing
4	Inclement weather
5	Component removal/installation (relating to attached wiring)
6	Pressure washing
7	Cleaning of wiring components
8	Servicing waste/water systems (& repair)
9	Servicing oil systems (& repair)
10	Servicing hydraulic systems (& repair)
11	Gaining access
12	Component removal/installation (relating to adjacent wiring)
	Application of structural anti-corrosion products (*)
	Wet area (galley/lav/door) installation and operation (*)

(*) considered but subsequently deleted.

Table 1

The following table explains the format of the Task 3 SC recommendations

Maintenance/Servicing Procedure:

This section identifies the issue in Table 1 for which applicable maintenance or servicing recommendations are made

Protections or Cautions:

This section lists individual protection or caution instructions applicable to the issue listed in the section above.

Individual entries are not specifically classified as either a "Protection" or "Caution". That classification is left to the discretion of the organization incorporating the item.

All protections or cautions listed are intended to be applied to all document locations identified below, unless noted otherwise.

Location:

Manuals, documents, etc. where the protections or cautions listed above are to be integrated.

Table 2

Protection and caution recommendations

Item 1

Maintenance/Servicing Procedure:

Installation, repair, or modification to wiring

Protections or Cautions:

Wiring and its associated components (protective coverings, connectors, clamping provisions, conduits, etc.) often comprise the most delicate and maintenance sensitive portions of an installation or system. Extreme care must be exercised and proper procedures used during installation, repair, or modification of wiring to ensure safe and reliable performance of the user system.

Proper wire selection, routing/separation, clamping configurations, use of splices, repair or replacement of protective coverings, pinning / de-pinning of connections, etc., must be performed in accordance with the applicable sections of the Aircraft Maintenance Manual, Wiring Practices Manual, or other approved documents. In addition, special care must be taken to minimize disturbance of existing adjacent wiring during all maintenance activities.

Location:

Wiring Practices Manual, Chapter 20
Aircraft Maintenance Manual, Chapter 20
Training Documentation
ATA Specification 117
STC Guidance Material
AC 43.13-1B

Protection and caution recommendations

Item 2

Maintenance/Servicing Procedure:

Structural repairs or modifications

Protections or Cautions:

Wiring and its associated components (protective coverings, connectors, clamping provisions, conduits, etc.) often comprise the most delicate and maintenance sensitive portions of an installation or system. Structural repair or modification activity inherently introduces tooling and residual debris that is harmful to aircraft wiring.

Displacement / Removal / Reinstallation of Wiring for Structural Access

Structural repairs or modifications often require displacement (or removal) of wiring to provide access to the work area. Even minor displacement of wiring, especially while clamped, can damage wire insulation which can result in degraded performance, arcing, or circuit failure.

If wiring must be displaced (or removed) for work area access, it must be adequately released from it's clamping (or other restraining provisions) to allow movement without damage.

Protection From Mechanical Damage

Extreme care must be exercised to protect wiring from mechanical damage by tools used in structural repairs or modification.

Wiring located adjacent to drilling or riveting operations should be carefully displaced or covered to reduce the possibility of mechanical damage.

Protection from Structural Debris

Structural debris such as drill shavings, liberated fastener pieces, broken drill bits, etc., must not be allowed to contaminate wiring or electrical components. This type of contamination can cause severe damage to insulation and potential arcing by providing a conductive path to ground or between two (2) or more wires of different loads. Once contaminated, removal of this type of debris from wire bundles is extremely difficult.

Before initiating structural repairs or modification activity, the work area must be carefully surveyed to identify all wiring and electrical components that may be subject to contamination. All wiring and electrical components in the debris field must be covered to prevent contamination.

Clean electrical components and wiring after completion of work per applicable AMM procedures

Protection and caution recommendations

Item 2 (continued)

Location:

Structural Repair Manual, Chapter 51
Service Bulletins (applicable, New Products)
Training Documentation
Operator/Repair Station Engineering Orders (applicable, New Products)
ATA Specification 117
AC 43.13-1B

Protection and caution recommendations

Item 3

Maintenance/Servicing Procedure:

Aircraft De-Icing or Anti-Icing

Protections or Cautions:

To prevent damage to exposed electrical components and wiring in areas such as wing leading & trailing edges, wheelwells, and landing gear, care must be exercised when spraying de/anti-icing fluids. Direct pressure spray can lead to contamination or degradation of electrical components and wiring and thus should be avoided.

Locations:

Aircraft De-Icing or Anti-Icing Manual
Training/Qualification for De-Icing or Anti-Icing personnel
ATA Specification 117

Protection and caution recommendations

Item 4

Maintenance/Servicing Procedure:

Inclement weather

Protections or Cautions:

Structure and systems in areas such as doorways, floors, access panels, servicing bays are prone to corrosion or contamination due to their exposure to the elements. Make sure that snow, slush, or excessive moisture is removed from these areas before closing doors or panels.

Remove deposits of snow/slush from any items (e.g. cargo containers) before loading in the aircraft.

During inclement weather, keep doors/panels closed as much as possible to prevent ingress of that snow, slush, or excessive moisture.

Locations:

Aircraft Maintenance Manual, Chapter 12
Ground Operations Manual
Training Documentation
ATA Specification 117

Protection and caution recommendations

Item 5

Maintenance/Servicing Procedure:

Component removal/installation (relating to attached wiring)

Protections or Cautions:

Wiring and its associated components (protective coverings, connectors, clamping provisions, conduits, etc.) often comprise the most delicate and maintenance sensitive portions of an installation or system. Excessive handling and movement during removal and installation of components may be harmful to aircraft wiring.

Use connector pliers to loosen coupling rings that are too tight to be loosened by hand. Alternately pull on the plug body and unscrew the coupling ring until the connector is separated. Do not use excessive force, and do not pull on attached wires.

When reconnecting, special care should be taken to ensure the connector body is fully seated, the jam nut is fully secured, and no tension is on the wires.

Use protective caps on all connectors (plug or receptacle) when equipment is disconnected to prevent contamination or damage of the contacts. Sleeves or plastic bags may be used if protective caps are not available. Use of sleeves or plastic bags should be temporary because of the risk of condensation. It is recommended to use a humidity absorber with sleeves or plastic bags.

Displacement (or removal) of wiring to provide access to the work area is often required. Even minor displacement of wiring, especially while clamped, can damage wire insulation potentially leading to degraded performance, arcing, or circuit failure. If wiring must be displaced (or removed) for work area access, it must be adequately released from its clamping (or other restraining provisions) to allow movement without damage.

Locations:

Wiring Practices Manual, Chapter 20
Aircraft Maintenance Manual, Chapter 20
Aircraft Maintenance Manual, all procedures for removal and installation of components with attached wiring (New Products)
Training Documentation
ATA Specification 117
STC Guidance Material
AC 43.13-1B

Protection and caution recommendations

Item 6

Maintenance/Servicing Procedure:

Pressure Washing

Protections or Cautions:

To prevent damage to exposed electrical components and wiring in areas such as wing leading and trailing edges, wheelwells, and landing gear, care must be exercised when spraying water or cleaning fluids. Direct high-pressure spray can lead to contamination or degradation of electrical components and wiring and should be avoided.

Water rinse should be used to remove cleaning solution residue after washing. Breakdown of wire insulation may occur with long term exposure of wiring to cleaning solutions.

Locations:

Aircraft Maintenance Manual, Chapter 12
Training Documentation
ATA Specification 117

Protection and caution recommendations

Item 7

Maintenance/Servicing Procedure:

Cleaning of wiring components (in situ)

Protections or Cautions:

Wiring and its associated components (protective coverings, connectors, clamping provisions, conduits, etc.) often comprise the most delicate and maintenance sensitive portions of an installation or system. Extreme care must be exercised and proper procedures used during cleaning to ensure safe and reliable performance of the user system.

Care must be taken to avoid displacement or disturbance of wiring during cleaning.

Clean only the area and items that have contamination. Before cleaning, make sure that the cleaning materials and methods will not cause more contamination.

If a cloth is used, make sure that it is clean, dry, and lint-free

A connector must be completely dry before mating. Any fluids remaining on a connector can have a deteriorating affect on the connector or the system or both.

Locations:

Wiring Practices Manual, Chapter 20
Aircraft Maintenance Manual, Chapter 20
Training Documentation
ATA Specification 117
AC 43.13-1B

Protection and caution recommendations

Item 8

Maintenance/Servicing Procedure:

Servicing, modifying, or repairing waste/water systems.

Protections or Cautions:

Structure and systems in areas adjacent to waste/water systems are prone to contamination with subsequent corrosion from those systems. Care must be exercised to prevent any fluids from reaching electrical components and wiring while servicing, modifying, or repairing waste/water systems.
(1)

Structure and systems in areas adjacent to waste/water systems are prone to corrosion or contamination from those systems. Cover exposed electrical components and wiring during waste/water system modification or repair.
(2)

Locations:

(1) Aircraft Maintenance Manual, Chapter 12
(2) Aircraft Maintenance Manual, Chapter 38 (New Products)
(1&2) Training Documentation
(1&2) ATA Specification 117
(1&2) STC Guidance Material

Protection and caution recommendations

Item 9

Maintenance/Servicing Procedure:

Servicing, modifying, or repairing oil systems

Protections or Cautions:

Structure and systems in areas adjacent to oil systems are prone to contamination from those systems. To minimize the attraction and adhesion of foreign material, care must be exercised to avoid any fluids from reaching electrical components and wiring while servicing, modifying, or repairing oil systems. Oil and debris in combination with damaged wiring can present a fire hazard.
(1)

Structure and systems in areas adjacent to oil systems are prone to contamination from those systems. Cover exposed electrical components and wiring during oil system modification or repair.
(2)

Locations:

(1) Aircraft Maintenance Manual, Chapter 12
(2) Aircraft Maintenance Manual, Chapter 70, 71, & 79 (New Products)
(1&2) Training Documentation
(1&2) ATA Specification 117
(1&2) STC Guidance Material
(1&2) AC 43.13-1B

Protection and caution recommendations

Item 10

Maintenance/Servicing Procedure:

Servicing, modifying, or repairing hydraulic systems

Protections or Cautions:

Structure and systems in areas adjacent to hydraulic systems are prone to contamination from those systems. To minimize the attraction and adhesion of foreign material, care must be exercised to avoid any fluids from reaching electrical components and wiring while servicing, modifying, or repairing hydraulic systems. (1)

Structure and systems in areas adjacent to hydraulic systems are prone to contamination from those systems. Cover exposed electrical components and wiring during hydraulic system modification or repair. (2)

Locations:

(1) Aircraft Maintenance Manual, Chapter 12
(2) Aircraft Maintenance Manual, Chapter 27, 29, 32, &71 (New Products)
(1&2) Training Documentation
(1&2) ATA Specification 117
(1&2) STC Guidance Material
(1&2) AC 43.13-1B

Protection and caution recommendations

Item 11

Maintenance/Servicing Procedure:

Gaining access (entering zones)

Protections or Cautions:

When entering or working on the aircraft, care must be exercised to prevent damage to adjacent or hidden electrical components and wiring, including wiring that may be hidden from view (i.e. covered by insulation). Use protective boards or platforms for adequate support and protection. Avoid using wire bundles as handholds or support.

If wiring must be displaced (or removed) for work area access, it must be adequately released from its clamping (or other restraining provisions) to allow movement without damage and returned after work is completed.

Locations:

Aircraft Maintenance Manual, Chapter 20
Training Documentation
ATA Specification 117
STC Guidance Material

Protection and caution recommendations

Item 12

Maintenance/Servicing Procedure:

Component removal and installation (relating to equipment adjacent to electrical components and wiring)

Protections or Cautions:

Wiring and its associated components (protective coverings, connectors, clamping provisions, conduits, etc.) often comprise the most delicate and maintenance sensitive portions of an installation or system. Excessive handling and movement during removal and installation of components may be harmful to aircraft wiring.

Component removal and installation often require displacement (or removal) of adjacent wiring to provide access to the work area. Improper displacement of wiring, especially while clamped, can damage wire insulation potentially leading to degraded performance, arcing, or circuit failure.

If wiring must be displaced (or removed) for work area access, it must be adequately released from its clamping (or other restraining provisions) to allow movement without damage and be subsequently returned after work is completed.

Locations:

Aircraft Maintenance Manual, Chapter 20
Training Documentation
ATA Specification 117
Service Bulletins (applicable, New Products)
STC Guidance Material

Chapter 9

9.0 Awareness enhancement

(to be written)

The following text provides some initial thoughts on what should be included in this chapter. It is not the final wording or necessarily the full extent of the subject.

The on aircraft inspections performed by ASTF highlighted that much of the improvement in the condition of wiring installations will come only with a revised attitude towards what is acceptable and what is not. Much of what has been found is clearly evident by general visual inspection and thus must have been considered acceptable deterioration.

Introducing new or revised repetitive maintenance tasks and updating maintenance practice guidelines can only result in improved levels of airworthiness if they are heeded and performed as recommended. The revisions proposed are logical and need no high level of understanding from the person performing the inspection. However, both accomplishment and any necessary corrective action require time. Time is frequently the one criterion that is not available to the inspector. Thus, whatever improvements are made in training and documentation, if the pressure of the workplace remains high, these remain only potential improvements and never get reflected in the condition of the airplane.

Task 3SC has identified a need to improve awareness throughout airline management of the importance of adequate performance of visual inspections, particularly those on wiring. Only when this has succeeded will sufficient time be allocated for task accomplishment and, where necessary, appropriate corrective action. This issue is applicable not only to operators but also to 3rd party maintenance organizations. Indeed, the intense competition amongst the latter has exacerbated the issue with aircraft possibly being returned 'on time' only due to truncation of the time consuming visual inspections.

It is recognized that a whole new culture needs to be put in place. This will not be achieved purely at the recommendation of one OEM or one Regulatory. It can only be reached if all operators have to embody the recommendations on all aircraft types simultaneously thus minimizing the impact on competitiveness.

The first accomplishments of the enhanced inspections are expected to highlight discrepancies requiring corrective action that had previously been considered as acceptable. Since the extent of these is likely to depend on the time in service, the older the airplane is the more corrective action is likely to be necessary. Similarly, the new cleaning (restoration) tasks will likely cause significant additional work for their first performance. Both the enhanced inspections and the new tasks will undoubtedly lead to a one-off increased downtime. However, once the condition of all airplanes is restored, the application of the repeat tasks is not expected to significantly increase the downtime. Additional resources may be required but all operators will be affected in the same way.

The purpose of this chapter is to highlight the need to encourage airline management to understand the importance of performing the enhanced zonal inspections, so they will give their inspectors sufficient time to accomplish them. Recommendations are provided to assist in the implementation of an enhanced awareness within the management structure.

The obvious recommendation is to provide awareness training to airline management to emphasize the importance of doing zonal inspections using the additional guidelines. This training would not need to cover the same level of details that the inspector training would provide, but should provide at a minimum:

* Definitions of GVI, Detailed Inspection, and Special Detailed Inspections,
* Reasons why zonal inspections should be done properly,
* General overview of what to look for during a zonal inspection.

The airline management's primary concern most likely will be that the inspectors will find more non-routine items as a result of doing the zonal inspections more thoroughly. This will result in higher maintenance costs and may slow down production. To mitigate this concern it is recommended to have the airline management review their non-routine write-ups (findings) which were discovered as a result of zonal inspections. It is likely that they will find these non-routine write-ups are similar to the types of items listed in the guidance material for zonal inspections which was developed by the Task 3 SC (e.g., bundles sagging or badly secured, corroded receptacles on connectors, seepage/leakage of fluid, etc.). As a result of airline management reviewing their non-routine write-ups, they will realize that they are already finding these items and it will not impact their maintenance costs or production schedule.

Chapter 10

10.0 Continuous Airworthiness of Single Element Dual Load Path design in flight controls

This chapter provides the results of the revised task 3.4 assigned to the Task 3 SC by the Aging Transport Systems Rulemaking Advisory Committee. This was considered as 'Product 3' with the following objectives:

Based on task 3.4 (as modified by ATSRAC on Jan 19Th, 2000), develop guidelines to permit appropriate attention be given to flight control dual load path design during development of the instructions for continued airworthiness. Propose a methodology that may be applied retrospectively to such features on in-service models.

10.1 Summary

The task was as follows:

1. Determine if the existing maintenance and inspection criteria adequately addresses Single Element Dual Load Path design, including possible lack of awareness of a second load path and the accompanying difficulty in inspecting the second load path.
2. Make recommendations, if required, for enhanced maintenance inspection criteria.

This included reviewing the definition of Single Element Dual Load Path (SEDLP), determining where SEDLP parts are used, reviewing existing MSG-3 for SEDLP parts, and if necessary, suggesting how to update MSG-3 to better suit SEDLP items.

Task 3 SC found that the current MSG-3 logic permits adequate evaluation of the SEDLP items. However, in order to improve the application of this logic Task 3 SC recommend:

i) the addition of a note to the Aircraft Systems/Powerplant Analysis Method instructions for MSG-3, item 2.3.4.1 Evident or Hidden Functional Failure, and

ii) the addition of an example MSG-3 analysis to the MSG-3 guidelines document (or user's handbook) to address the function of dual load paths in flight controls

To ensure that existing maintenance programs adequately address SEDLP features, Task 3 SC recommend

iii) a review of existing MSG-3 analyses, and/or performance of new MSG-3 analysis, on SEDLP components to ensure the dual load path function has been identified and analyzed with new awareness of the design principle.

10.2 Purpose

The purpose of this chapter is to provide the results of Task Product 3 of the Task 3 SC. The tasks were to:

1. Determine if the existing maintenance and inspection criteria adequately addresses Single Element Dual Load Path issues.
2. Make recommendations if required for enhanced maintenance inspection criteria.

This included reviewing the definition of Single Element Dual Load Path (SEDLP), determining where SEDLP parts are used, reviewing existing MSG-3 for SEDLP parts, and if necessary, suggesting how to update MSG-3 to better suit SEDLP items.

10.3 Review the definition of Single Element Dual Load Path (SEDLP)

For the purposes of the ATSRAC activity, the definition of SEDLP is:

An assembly having a primary and secondary load path, where both paths are an integral part of a single component (element).

Dual load path design in airplane flight controls is introduced to satisfy FAR 25.671 or equivalent design requirements. This implies that loss of both load paths may lead to loss of capability to perform continued safe flight and landing. Use of multiple components (e.g. parallel links) or single components may achieve such design principles.

Examples of single components include rod assemblies (with one path being an inner tube and the other being an outer tube) and plate assemblies (with one load path attached to the second path "back-to-back"). For this review, the only SEDLP parts of concern are those that MSG-3 defines as hidden safety i.e. Failure Effect Category (FEC) 8. However since many of these parts were designed prior to MSG-3, all flight control SEDLP parts shall be considered using FEC8 logic unless individual analysis shows otherwise.

During Task 3 SC research, an additional type of part was found in some flight control systems that had an inner and outer rod similar to the one described above, except that the inner rod is the only load carrying path and the outer rod acts as a retainer. The retainer avoids a failed component falling into another system with potential for causing a jam. The failure of both the inner and outer components for this type of part may also result in an FEC8/hidden safety issue, and may thus need to be considered like the SEDLP parts discussed above.

By their design, SEDLP parts may not be easy to inspect visually by maintenance personnel.

10.4 Where SEDLP parts may be used

All examples of SEDLP found to date have been in the flight controls. Examples include input rods and bolts, and rudder feel and centering units. On newer model airplanes many of the SEDLP parts have been eliminated by newer design methods.

10.5 Review existing MSG-3 for SEDLP parts

MSG-3 was used to evaluate sample SEDLP parts and Task 3 SC found that, providing the function is correctly described, the existing logic can adequately evaluate the SEDLP items. Below is an example:

Failure effect questions from MSG-3 and sample answers for SEDLP parts:

1. Is the occurrence of a functional failure evident to the operating crew during the performance of normal duties? No, the system functions normally with the loss of <u>one</u> load path. The loss of one path is not evident to the flight crew. Go to question 3.
2. Not applicable with a "No" in question 1.
3. Does the combination of a hidden functional failure and one additional failure of a system related or backup function have an adverse effect on operating safety? Yes, the hidden functional failure i.e. the loss of one load path, and one additional failure, i.e. the loss of the remaining load path (or retainer clip), has an adverse effect on safety.
4. Not applicable due to previous answers.

This example identifies this part as a hidden safety item (FEC8). After that has been determined, the type of maintenance task for the part needs to be identified. Possible inspection of the parts could include general visual inspection, detailed inspection, special detailed (e.g. with borescope or equivalent), restoration (overhaul) or discard. The determination of the most appropriate task(s) will be dictated by the specific design and, where feasible, should be agreed by an OEM/airline working group.

It is recognized that some SEDLP designs may not be fully inspectable without disassembly. Since the disassembly process may result in damage that prevents reuse of some parts, Task 3 SC propose that similar to structural inspections, an inspection of visible areas may, exceptionally, be assessed as adequate to satisfy the MSG-3 logic in those areas. Examples of this are "back-to-back" parts.

10.6 Recommendation to ATSRAC for SEDLP items

Update MSG-3 to better address SEDLP items.

Even though the current MSG-3 logic is able to handle SEDLP items, if the person doing the evaluation does not understand that there is a secondary path and that this path may not be inspectable by a general visual inspection, they may fail to identify appropriate scheduled maintenance requirements. Task 3 SC recommends the following:

- A note is added to the Aircraft Systems/Powerplant Analysis Method instructions for MSG-3, item 2.3.4.1 Evident or Hidden Functional Failure.

Note: Defining some functional failures may require a detailed understanding of the system and its design. For example, Single Element Dual Load Path parts may have concentric or back to back load paths. The degradation and/or failure of an individual path may not be evident. The function of both paths should be analyzed individually.

- An example MSG-3 analysis is added to the MSG-3 guidelines document to address the function of dual load paths in flight controls. This should be introduced when the concept of a 'user's handbook' is developed.

Perform MSG-3 analysis on the dual load path functions of SEDLP components.

- Review existing MSG-3 analyses, and/or perform new MSG-3 analysis, on SEDLP components to ensure the dual load path function has been identified and analyzed.

Chapter 11

11.0 Recommendations

(to be written)

Each Chapter will, where applicable, quote related recommendations. These will then be summarized in this chapter

Chapter 12

12.0 Conclusions

(to be written. This Chapter will include Task 3 SC proposal for implementation of the recommendations – if this has not already been decided by ATSRAC)