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Structurally Significant Items and their use in Reliability Centred Maintenance schedules for British military aircraft

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Executive summary

The Integrated Logistic Support (ILS) procurement policy of the MOD includes the application of Logistic Support Analysis (LSA). Consequently, the use of Reliability Centred Maintenance (RCM) procedures for the development of aircraft preventive maintenance schedules is a natural progression. The aim of using RCM is to underpin aircraft airworthiness with an effective and affordable maintenance schedule. RCM was initially intended for use primarily at the design stage of an aircraft's development. However, the RCM processes is also applied retrospectively to produce preventive maintenance schedules for in-service aircraft.

One of the key elements of the RCM process is the determination of structurally significant items (SSIs) and their inspection periodicites. In practice, Design Authorities have struggled to identify workable lists of SSIs. Moreover, in the instances where a reasonable SSI list has been produced, the process has often fallen down at the determination of inspection periodicities.

It is perceived that a major cause of this failure has been lack of clarity of the SSI definition. This has been compounded when dealing with safe-life aircraft and the perception, in some quarters, that SSIs are only applicable to aircraft of damage-tolerant [inspection dependent] design. This has resulted in several aircraft having schedules based upon a part-RCM approach without a DA endorsed list of SSIs or inspection periodicities.

It is concluded that the definition of a SSI is basically adequate but does not quite accord with MSG-3. However, additional guidance is needed for the production of SSI lists to ensure attention is focused on those structural items where failure of the item would have a significant effect on aircraft safety. Additionally, obtaining a suitable list of SSIs and their inspection periodicities is best achieved by interaction between the DA and the Service and this would be assisted by the RCM procedures being available in a standard recognized by industry. Furthermore, RAF policy mandates that all at risk safe-life SSIs are to be examined during scheduled maintenance on all aircraft. This policy does not recognize that the inspection of some SSIs is impractical.

Thus it is recommended that the definition of a SSI should be amended slightly to bring it line with MSG-3. Additionally, a series of guidelines are proposed to allow SSI lists to concentrate on those items that could impair safety. Also, a tri-Service policy for the development of preventive maintenance schedules should be considered, based upon AP100C-22. Thereafter the document should be converted into a Defence Standard. Finally, it is recommended that RAF policy that all at risk safe-life SSIs should be inspected by scheduled examination on all aircraft should be reviewed to make provision for the inspection of safe-life SSIs that are at risk but uninspectable during scheduled maintenance.

This paper was endorsed by the 48th Military Aircraft Structural Airworthiness Advisory Group meeting held at DERA Farnborough on 6 October 1999.

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1 Introduction

1.1 The Integrated Logistic Support (ILS) procurement policy of the MOD includes the application of Logistic Support Analysis (LSA) **[Reference 1]**. Consequently, the use of Reliability Centred Maintenance (RCM) procedures for the development of aircraft preventive maintenance schedules for new aircraft procurement projects is a natural progression. The aim of using RCM is to underpin aircraft airworthiness with an effective and affordable maintenance schedule. RCM was initially intended for use primarily at the design stage of an aircraft's development. However, the RAF, and to a lesser extent the other services, have either applied, or are considering the use of, the RCM processes retrospectively to produce preventive maintenance schedules. [The USAF and USN have also retrospectively applied RCM principles to preventive maintenance schedules.] In applying the process retrospectively, the opportunity to redesign an item to counter unsatisfactory maintenance features may no longer be present; however, the use of RCM still provides a valuable basis for the determination of cost-effective maintenance schedules

1.2 The first stage in the production of a RCM-based schedule is the determination of the structurally significant items (SSIs). An analysis of the aircraft's structure is undertaken, to obtain a list of the SSIs, based upon a detailed knowledge of the design of the aircraft, supplemented by information from in-service arisings, as available. Initially, this analysis can only be undertaken with the aircraft Design Authority (DA), as the DA is the only organization with access to the detailed records of the design needed to support the analysis. [The term DA is used in this context to refer to the Design Authority or Original Equipment Manufacturer (OEM)]. For introduction to service of a new aircraft, the DA undertakes the task with the support of the Service Integrated Logistics Support (ILS) team. The ILS team, particularly the on-site contingent, is able to provide advice to the DA on service maintenance procedures and assist with the interpretation of RCM.

1.3 In practice, for several aircraft, particularly for those aircraft designed using safe-life principles, DAs have struggled to identify workable lists of SSIs, particularly when applied retrospectively. Moreover, in the instances where a reasonable SSI list has been produced, the process has often fallen down at the determination of inspection periodicities.

1.4 The failure to produce a workable SSI list is often blamed on a perceived lack of clarity of the SSI definition. This tends to be compounded when dealing with safe-life aircraft and the perception, in some quarters, that SSIs are purely defined against fatigue criteria and are, hence, only applicable to aircraft of damage-tolerant [inspection dependent] design. This has resulted in several aircraft having schedules based upon a part-RCM approach without a DA endorsed list of SSIs or inspection periodicities.

1.5 The aim of this paper, therefore, is to provide guidance on how the term SSI should be interpreted and recommend any improvement in procedures that would assist in the application of RCM to British military aircraft, particularly those of safe-life design.

2 Reliability Centred Maintenance

2.1 The Origins of Reliability Centred Maintenance

2.1.1 Early engineering preventive-maintenance programmes were based upon the belief that all engineering components would wear out eventually. Consequently, preventive maintenance programmes were constructed around periodic overhaul of components to assure operational safety. However, analysis undertaken by commercial airlines in the mid-1960s indicated that scheduled overhaul of complex equipment had little effect on the reliability of that equipment. This analysis and the increasing commercial pressures on the airlines resulted in a new maintenance philosophy.

2.1.2 The commercial airlines and aircraft/engine manufacturers formed a Maintenance Steering Group (MSG) with the aim of deriving the initial preventive maintenance schedule for the Boeing 747 aircraft. The group developed decision logic and procedures entitled 'Handbook: Maintenance Evaluation and Program Development' [usually referred to as MSG-1]. MSG-1 was published in 1968 but was soon updated in light of experience gained in developing the Boeing 747 schedules; moreover, the Boeing 747 specific information was removed and the revised document was published in 1970 as 'MSG-2, Airline/Manufacturer Maintenance Program Planning Document'. In 1979, the Air Transport Association task force reviewed MSG-2 to take account developments from the military perspective [see below] and MSG-3 was published in 1980.

2.2 US Military Developments

2.2.1 In 1972 the US Navy was the first military organization to use the maintenance logic principles developed by the civil aerospace industry. The US Navy revised its preventive maintenance programmes for the P-3A and S-3A, using MSG-2 techniques. Later, the F-4J schedules were revised using the same techniques. Thereafter, the US Navy revised the preventive maintenance schedules for most of its in-service aircraft. Although the use of MSG-2 was now firmly established in the US, much of the underpinning philosophy behind the civil and US Navy approaches was not written into the MSG-2 documents. Therefore, the US Department of Defense (Air Force Department) sponsored United Airlines to write a thesis on the relationship between maintenance, reliability and safety. The document produced – 'Reliability-centred Maintenance' by Nowlan and Heap **[Reference 2]** was published in 1978. This publication became the basis for modern maintenance philosophy, for civil and military aircraft and also a wide range of engineering applications. Nolan and Heap realized that the application of RCM logic would have the greatest impact during the design phase of a project where there was considerable scope for design changes to eliminate designs with poor maintenance implications. Additionally, however, they also recognized that RCM logic could be applied to in-service equipment, albeit with lesser benefits as the options for design changes become far more limited.

2.2.2 The US Navy used Nolan and Heap's thesis to produce a new RCM handbook; however, this was superseded by Mil-Std-2173(AS) in 1986. In addition, Nolan and Heap's thesis formed the basis of the MSG-3 document **[Reference 3]**, from which the US Air Force developed its own maintenance planning manual – Mil-Std-1843(USAF) **[Reference 6]**.

2.3 UK Military Developments

2.3.1 In 1986 the RAF used MSG-3 as the basis for the first issue of AP100C-22 – Procedures for Developing Preventive Maintenance **[Reference 4]**, which replaced the Datum Servicing List (DSL) (AP100C-21). The Datum Servicing List specified the preferred maintenance for components considered common to most aircraft types. This was considered an outdated and inefficient maintenance philosophy, which led to unnecessary and costly preventive-maintenance programmes.

2.3.2 AP100C-22 has been developed since then to take into account the requirements of Logistics Support Analysis (LSA), Failure Modes and Effects Analysis (FMEA) and Age Exploration (AE). Additionally, the document has incorporated improved procedures for other aspects of RCM, based upon Mil Std 2173, RCM by Nolan and Heap and RCM II by John Moubrey.

2.3.3 The Navy and Army use RCM/MSG-3 for the development of preventive maintenance schedules for new procurement aircraft and are considering the use of AP100C-22 as the basis of a schedule review for the Lynx helicopter.

2.4 Civil Procedures

2.4.1 Although civil procedures, such as JAR 25 do not mandate the use of RCM-based preventive maintenance schedules, the logic is well accepted by the major airline manufacturers and is the method of choice.

3 Development of an RCM schedule

3.1 The RCM Process

3.1.1 Select significant items [these will be either structurally significant items (SSI) or functionally significant items (FSI)], based upon their consequences of failure.

3.1.2 Identify significant engineering failure modes for each significant item.

3.1.3 Evaluate the maintenance actions that will protect each significant item from the consequences of the engineering failure modes, and select only those actions that will satisfy these requirements.

3.1.4 Identify those significant items for which no applicable and effective maintenance actions can be found and either recommend design changes or defer a decision until further information becomes available.

3.1.5 Select intervals for each action.

3.1.6 If necessary, establish an age-exploration programme to provide the information necessary to revise initial decisions.

3.2 Selection of Structurally Significant Items

3.2.1 The selection of significant items is pivotal to the RCM process. [Although this paper is concerned with the structurally significant items, it applies equally to functionally significant items]. The RCM procedure provides a decision algorithm to assist in the selection of SSIs. A 'top down' functional breakdown is used to partition structure into descending orders of complexity where each level of complexity is termed an indenture level. Each item identified in the breakdown is subject to a series of questions that form the decision logic for selecting SSIs.

3.3 SSI Analysis

3.3.1 Structural rating factors (SRF) are obtained by assessing the design characteristics of the SSIs in terms of their sensitivity to threats from environmental damage (ED) and accidental damage (AD). Composite structures and metallic structures respond differently to ED and AD and are, therefore, assessed using different rating scores.

3.3.2 The fatigue damage assessment of a SSI is dependent on whether it is determined to be a safe-life or damage-tolerant SSI. Safe-life SSIs are those designed to be safe-life and which have been substantiated by a fatigue test, calculation and/or operational experience. Safe-life SSIs are not subject to assessment for fatigue. This is because the safe-life fatigue substantiation process will have identified any items requiring modification or replacement in order to achieve the required service lives [hard time tasks in RCM terms]. Damage-tolerant SSIs are either structure which was designed and demonstrated to be damage tolerant, or fail-safe, or structure which was designed to be safe life but which has subsequently failed on test or in service and which the structural integrity can be assured using an inspection-based regime. Damage-tolerant SSIs are subject to a fatigue assessment.

3.3.3 Therefore, safe-life SSIs are subject only to ED and AD analyses. These analyses are essential because the safe fatigue life can be adversely affected by both environmental deterioration and accidental damage and thus their occurrence must be detected promptly.

3.3.4 SSIs classified as damage tolerant are subject to assessments for ED and AD as well as fatigue in order to ensure that the thresholds [times to first fatigue inspection] and periodicities of fatigue-related inspections have not been undermined. Subject to protection from ED and AD, the time to first fatigue-related inspection should correspond approximately to the safe life and should ideally be demonstrated by test or should incorporate substantial factors to allow for uncertainty in calculation as well as scatter. The damage-tolerance fatigue assessment relies on materials data, design information and load spectra to determine crack propagation rates and critical crack sizes. Inspection periodicity is a function of the chosen inspection techniques. The maintenance schedule is then identified for each SSI using data from the 3 assessments. Typically, damage-tolerant SSIs will have inspections designed to detect fatigue cracks, based on aircraft usage, and inspections designed to detect structural deterioration, based upon calendar periodicity.

4 Difficulties with the Application of RCM to British Military Aircraft

4.1 Definition of a SSI

4.1.1 The failure to produce a workable SSI list is often blamed on a perceived lack of clarity of the SSI definition. The definition of a SSI used in AP100C-22 **[Reference 4]** is promulgated in AP100A-01 Leaflet 315 **[Reference 5]** as:

> "*Structurally Significant Item (SSI) is defined as a structural detail, element or assembly which is judged significant because the consequence of its failure would be a loss of residual strength or structural function*"

4.1.2 This definition is very similar to that used in MSG-3 **[Reference 3]:**

> "*Structurally Significant Item (SSI) is defined as a structural detail, element or assembly which is judged significant because of the reduction in aircraft residual strength or loss of structural function which are consequences of its failure.*"

4.1.3 Additionally, the definition used in Mil-Std-1843 (USAF) **[Reference 6]** for a SSI is:

> "*A structural detail, structural element or structural assembly which is judged significant because the consequence of its failure could be a reduction in aircraft/engine residual strength or function to the extent that safety or mission is adversely impacted.*"

4.1.3 Therefore, the definition of a SSI detailed in AP100A-01 Leaflet 315 is broadly consistent with that used in other RCM procedures and the difference between the definition in Leaflet 315 and that used in MSG-3 is not significant. Moreover, the MSG-3 definition is considered adequate. However, there has been confusion in the past, particularly when RCM has been applied retrospectively to an in-service aircraft. DAs have produced SSI lists using their own pragmatic interpretation of what was intended and this has resulted in lists based upon vulnerability to environmental or accidental damage, or highly stressed parts, rather than failure which would have a significant effect on safety. The result of deviating from defining a SSI by the consequences of failure, in terms of safety, is that the SSI list will grow. This can result in a significant increase in the cost of the analysis and a potential increase in the content of the maintenance schedules. Therefore, the process needs to include additional guidelines for use in compiling a list of SSIs.

4.1.4 Therefore, it is recommended that the existing definition of a SSI should be changed slightly to accord with that used in MSG-3. [This could make the read-across to civil variants a little easier]. Also, additional guidelines are needed to provide direction in the production of the SSI list.

4.2 Use of Grade A Parts for Selection of SSIs

4.2.1 Having recognized that the existing definition of a SSI is largely adequate but that support or guidelines for selection of SSIs could be provided, it is necessary to identify how this selection process could best be improved. It has been suggested that the list of Grade A parts could be used as a starting point for determining SSIs. On the face of it, the Grade A part definition in Def Stan 00-970 Volume 1 and 2 Chapter 400 **[References 7 and 8]** encompasses a SSI.

> *"A part shall be Grade A if the deformation or failure of the part would result in one or more of the following:*
>
> *(i) structural collapse at loads up to and including the design ultimate load,*
>
> *(ii) loss of control,*
>
> *(iii) failure of motive power,*
>
> *(iv) unintentional operation of, or inability to operate, any systems or equipment essential to the safety or operational function of the aeroplane,*
>
> *(v) incapacitating injury to any occupant,*
>
> *(vi) unacceptable unserviceability or maintainability. (Vol 1 only; however, Leaflet 400/1 para 3.7 of Vol 2 does refer to (vi)).*

4.2.2 However, Grade A parts would encompass all significant items [functionally significant items (FSI) as well as SSIs]. Nevertheless, if a concise list of Grade A parts was available for an aircraft it would be a useful starting point for the determination of SSIs. There are, however, 2 impediments to this. Firstly, designation of a part as Grade A can tend to be an umbrella which includes all heavily stressed items. Secondly, although Def Stan 00-970 Volume 1 and 2 Chapter 400 [**References 7 and 8]** identify that parts shall be designated Grade A or Grade B, Leaflet 400/1 para 2.3 states:

> *"provided that the grading requirements are met, there is no need for the grade to be identified on the drawing."*

Hence, there is no guarantee that a list of Grade A parts can be collated. Nor is there any guarantee that it could be obtained from the aircraft drawings.

4.2.3 Therefore, for retrospective application of RCM, if a list of Grade A parts is already available it may be useful in determining the SSIs. However, for the introduction to service of new aircraft it would probably be more effective to develop the list of SSIs directly without the added complication of generating a list of Grade A parts for inclusion in the analysis.

4.3 Interaction between DA and ILS Team in Selecting SSIs for New Aircraft

4.3.1 The key to developing a taught SSI list is for the DA to undertake the analysis in conjunction with the Service ILS Team. The ILS Team can then provide the DA with the advice it needs on maintenance practices and assist in interpreting RCM policy. In practice this probably needs to be an iterative process with the ILS Team playing 'devil's advocate'. Such a process has been employed on aircraft projects and has been successful in reducing the SSI list down a manageable level. However, it is not clear to what extent this process has been guided by the need to focus on those items that would have a significant impact on safety. There is no doubt that DAs have not found the production of SSI lists and inspection periodicities and easy task. The methodologies used are alien to their day-to-day work. In essence, designers are being asked to make engineering assessments that must be, to a certain extent, subjective. This is where the maintenance experience and RCM knowledge of the ILS Team becomes so useful.

4.4 Interaction between the DA and Service for Retrospective Application of RCM

4.4.1 When a Service decides to apply RCM retrospectively to an aircraft, there is unlikely to be a Service ILS Team in place. Therefore, the interaction between the Service and the DA is more difficult to achieve. However, several aircraft projects have been able to obtain lists of SSIs and their inspection periodicities from DAs with the use of RAF Logistics Support Services (LSS) structures personnel advising the DA in RCM procedures and fulfilling the role played by the ILS Team in new procurement. Unless the DA has experience in producing RCM schedules for the Services, it is highly likely that such an arrangement will be required.

4.5 SSIs for Safe-Life Aircraft

4.5.1 The preceding sections in this paper have covered how RCM is applied to produce a preventive maintenance schedule. There is no doubt that the application of RCM to safe life aircraft has caused confusion in the past, although the proposed caveat to the definition will assist in clarifying the procedure. SSIs are determined by the consequences of failure. They are then identified as either safe life or damage tolerant. Safe-life SSIs are assessed for vulnerability to environmental and accidental damage and damage-tolerant SSIs are assessed for fatigue, environmental and accidental damage. Before a SSI is determined to be safe life it will have had its declared safe life demonstrated by fatigue test, calculation, or possibly in-service experience. It is noteworthy that aircraft that are "safe life" can have damage-tolerant SSIs and visa versa. In truth many of our safe-life aircraft have significant area of structure cleared by inspection-based means often resulting from failures on fatigue tests. The fatigue assessment of these damage-tolerant SSIs will have, effectively, already been undertaken before a clearance by inspection was initiated.

4.6 Status of AP100C-22 and SSI Definition

4.6.1 Some of the difficulty experienced in obtaining SSIs has been in making the DA aware of the Service policy. RAF policy is represented in AP100C-22 **[Reference 4]** and AP100A-01 Leaflet 315 **[Reference 5]**. The RN and Army both use MSG-3/RCM for procurement of new aircraft and are considering the use of AP100C-22 for a Lynx schedule review. Therefore, all 3 Services policies for aircraft preventive maintenance are similar, although no tri-Service policy document is promulgated. Part of the difficulty in obtaining SSIs has been the status of the policy documents. MOD procurement policy includes the use of Logistic Support Analysis (LSA). The use of LSA leads naturally to RCM procedures for preventive maintenance. All 3 Services invoke RCM/MSG-3 for procurement. However, RCM does not feature among the extensive suite of Defence Standards. There is no doubt that procurement projects have suffered because no appropriate Defence Standard can be called up in the contract. Even when the DA is given copies of AP100C-22, these are seen as useful internal documents of the customer. If the 3 Services were to agree on a common standard, probably based upon AP100C-22, and this was converted into a Defence Standard, the DA could be contacted to produce a preventive maintenance schedule in accordance with a document of appropriate status. This would also be useful for multinational projects when faced with the added complication of agreeing project standards to meet the demands of several nations. The definition of a SSI would also need to be promulgated within the Defence Standard.

4.7 Safe-Life SSIs Vulnerable to AD or ED

4.7.1 The new fatigue requirements (Chap 201), recently published in Def Stan 00-970, make it clear that safe-life design cannot be used where complete protection cannot be provided from AD or ED. For some existing designs, however, some safe-life SSIs may be susceptible to AD or ED.

4.7.2 To counter this threat, the RCM analysis runs through a decision diagram that considers whether this threat can be monitored by a variety of inspection tasks. If this is not possible then 2 options remain: age exploration (AE), or redesign. In practice, redesign is often not a practicable alternative but should be taken wherever possible. Alternatively, age exploration, or structural sampling as it is more often termed in the UK, is the alternative. Current RAF policy **[Reference 5],** however, states that all at risk safe-life SSIs must be covered by scheduled examination on all aircraft whereas not at risk SSIs may be covered by the sampling programme. Although 'correct' this policy does not cater for uninspectable, at risk, safe-life SSIs.

4.7.3 Structural sampling is usually divided into scheduled sampling, opportunity sampling and teardown examination. If a SSI cannot be normally inspected on scheduled maintenance and it is at risk from AD or ED [in practice, a SSI vulnerable to accidental damage is unlikely to be uninspectable] then a rigourous structural sampling programme must be introduced. It is fair to say that structural sampling, certainly for RAF aircraft, may not have received the attention it should have in the past. This is being rectified with the establishment of Structural Integrity Plans for each aircraft.

4.7.4 If structural sampling is not acceptable to the relevant aircraft authority, possibly on cost or availability grounds, then further analysis of the implications on the safe-fatigue life of the item may be considered feasible. Current policy does not advocate any such methods but research into the effects of corrosion on joints, for example, may provide useful tools in quantifying the effects of corrosion on safe lives.

5 Conclusions

5.1 The existing definition of a SSI is adequate and very similar to that used in MSG-3 and the minor wording difference is not significant.

5.2 Although failures to obtain satisfactory SSI lists and inspection periodicities have been blamed on a lack of clarity in the SSI definition, it is suggested that a lack of understanding by the DA of what was required and a lack of guidance from the MOD/ Services has been the major factor.

5.3 The use of lists of Grade A parts may be useful in developing retrospective SSI lists [although it will also contain FSIs]. However, listing of Grade A parts is not mandatory and, in practice, Grade A can be applied more widely than its strict definition suggests.

5.4 Obtaining a suitable list of SSIs and their inspection periodicities is pivotal to the RCM process. This is best achieved by interaction between the DA and the Service. The DA has the knowledge of the design of the aircraft and may have RCM experience. The Service has the knowledge of maintenance practices and can provide guidance on the interpretation of RCM.

5.5 Safe-life SSIs are those that have had fatigue lives demonstrated by test, calculation or in-service experience. The new fatigue requirements of Def Stan 00-970 make it clear that safe-life design must not be applied to items which are susceptible to accidental damage or environmental damage. Nevertheless, good husbandry dictates that these SSIs should be assessed for vulnerability to accidental or environmental damage. By definition, no fatigue-related inspections are needed.

5.6 Damage-tolerant SSIs, on the other hand, must be assessed for fatigue, accidental and environmental damage.

5.7 Safe-life aircraft can have SSIs that are deemed damage-tolerant SSIs and, conversely, damage-tolerant aircraft can have safe-life SSIs.

5.8 MOD and the 3 individual Services all use RCM methodology for the procurement of new aircraft and the 3 Services use, or are considering using, RCM for developing preventive maintenance schedules for aircraft already in use. However, the RCM procedures used are not available in a standard recognized by industry.

5.9 RCM mandates that safe-life SSIs that are considered at risk from AD or ED and uninspectable are to be redesigned. In practice, this seldom be practicable, particularly for retrospective application of RCM. Therefore, additional work, including age exploration programmes, and /or corrosion-fatigue testing may be required.

5.10 RAF policy mandates that all at risk safe-life SSIs are to be examined during scheduled maintenance on all aircraft. This policy does not make provision for the inspection of safe-life SSIs at risk but uninspectable during scheduled maintenance.

6 Recommendations

6.1 The definition of a SSI should be reworded slightly to bring it in line with the MSG-3 definition as follows:

> *"Structurally Significant Item (SSI) is defined as a structural detail, element or assembly which is judged significant because of the reduction in aircraft residual strength or loss of structural function which are consequences of its failure."*

6.2 The following guidance, to assist in determining the SSI list, should be included in the appropriate publication for use by the DA and Service.

Guideline 1: *Identify all structural (load bearing) items.*

Guideline 2: *Carry forward, for closer consideration, only those items that satisfy one or more of the following criteria:*

- *(1) fixed flight control support or its local attachment*
- *(2) directed inspection(s) judged to be necessary as a consequence of service experience*
- *(3) exposed to environmental attack*
- *(4) exposed to accidental damage*
- *(5) helicopter dynamic components*
- *(6) subject to significant fatigue loads*
- *(7) single load path*
- *(8) a safe life of the design life or less*
- *(9) a critical static reserve factor*
- *(10) susceptible to stress corrosion*
- *(11) directed inspection(s) have been specified as a condition of airworthiness approval.*

Guideline 3: *Designate items as SSIs, and carry them forward to the 'rating' process, only if they satisfy the following criterion: their failure could be catastrophic or could be expected to cause catastrophic failure of another item*

6.3 A tri-Service policy for the development of preventive maintenance schedules for aircraft should be considered, based upon AP100C-22 and incorporating the above definition of a SSI.

6.3 The agreed tri-Service preventive maintenance policy should then be converted into a Defence Standard.

6.4 The success of projects where the DA and Services interact to produce SSIs lists and inspection periodicities should be formalized as best practice for both new aircraft procurement and retrospective RCM application.

6.5 The RAF policy that all at risk safe-life SSIs should be inspected by scheduled examination on all aircraft should be reviewed to make provision for the inspection of safe-life SSIs that are at risk but uninspectable during scheduled maintenance. This could be achieved by allowing the use of robust structural sampling programmes to provide the required structural integrity assurance.

7 References

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4 AIR PUBLICATION 100C-22 *Procedures for Developing Preventive Maintenance Requirements, 2nd Edition (AL4)*. 2nd Edition May 1995

5 AIR PUBLICATION 100A-01 POLICY AND ORGANIZATION *Leaflet 315 – Structural Integrity of RAF Aircraft – Annex B – Structural Examination (AL271)* September 1998.

6 MIL-STD-1843(USAF) *Reliability Centered Maintenance for Aircraft, Engines and Equipment* 8 February 1985

7 DEFENCE STANDARD 00-970 *Design and Airworthiness Requirements for Service Aircraft – Volume 1 – Aeroplanes (AL14)*

8 DEFENCE STANDARD 00-970 *Design and Airworthiness Requirements for Service Aircraft – Volume 2 – Rotorcraft (AL12)*

9 MASAAG – *Minutes of the 48th Military Aircraft Structural Airworthiness Advisory Group on 6 October 1999 – DERA/MSS/ASD(1)/11/6/4 dated 14 January 2000.*