

Mutual Consultants

PAS 55-1: Asset Management

Part 1: Specification for the optimised management of
physical assets

and

Reliability-Centred Maintenance (RCM)

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1. Abstract

This paper examines the requirements of **PAS 55-1:2008 Asset Management Part 1: Specification for the optimised management of physical assets** and sets out where Reliability-Centred Maintenance (RCM) can help organisations to comply with PAS 55.

PAS 55 provides a useful framework for all asset-intensive organisations but it only defines *what* needs to be done, not *how*.

The clauses in PAS 55 where RCM can help organisations to comply with the specification are:

- Asset management strategy [Clause 4.3.1]
- Asset management plan(s) [Clause 4.3.3]
- Contingency planning [Clause 4.3.4]
- Training, awareness and competence [Clause 4.4.3]
- Risk identification and assessment [Clause 4.4.7.3]
- Implementation of asset management plan(s) [Clause 4.5]
- Performance assessment and improvement [Clause 4.6].

2. Introduction

PAS (Publicly Available Specification) 55 aims to make sure that an organisation's assets are effectively managed over time. By clarifying and defining what asset management is (and isn't), the specification allows organisations to develop good practices for the sustainable, long-term administration of their assets.

Many organisations have found that carrying out a 'gap analysis' against the requirements set out in PAS 55 has enabled them to identify improvement opportunities and build these into a prioritised improvement plan. This leads to real improvement in the bottom line and demonstrates competent and sustainable asset stewardship to stakeholders.

PAS 55 provides a useful framework for all asset-intensive organisations but it only defines *what* needs to be done, not *how*. This paper examines the requirements of **PAS 55-1:2008 Asset Management Part 1: Specification for the optimised management of physical assets** and sets out where Reliability-Centred Maintenance (RCM) can help organisations to comply with PAS 55.

Background to PAS 55

Maintaining an asset or an asset system correctly is just one part of the overall suite of activities required to manage that asset or system from its initial inception, through its productive life, and on to its final decommissioning.

Ever increasing demands on industries have led to the development of many approaches to help with the care and management of assets throughout their entire life cycle. Although most of these produce good results and achieve their objectives, there was a realisation that even greater benefits could be obtained if a more holistic approach to asset management could be developed.

So, (quoting from PAS 55):

"This PAS was first published in 2004 in response to demand from industry for a standard for asset management. It is applicable to any organisation where physical assets are a key or a critical factor in achieving its business goals."

The requirements of PAS 55 are quickly gaining acceptance within major asset-dependent organisations as a model for best practice within the field of life-cycle asset management.

Paraphrasing PAS 55-1, Clause 0.5 states that it applies to *"any asset intensive business where significant ... resources ... are associated with the ... maintenance ... of assets"*.

Clause 0.5 then goes on to say that the requirements listed in PAS 55 define *what* has to be done, not *how* to do it, and that the methods used to achieve each requirement are the choice of the organisation concerned. This has the advantage of allowing companies to develop effective processes that best suit their industry but can mean that organisations understand the goal but do not have a clear route to follow.

This flexibility of approach means that *PAS 55 does not preclude the use of RCM* (or any other approach) in managing an asset or asset system.

Background to RCM

In response to a demand for greater safety, the civil aviation industry, in the 1960s and 70s, set up a "maintenance steering group" to investigate why maintenance policies of the day appeared to be causing failures rather than preventing them. The end product of years of research, investigation and analysis was a robust equipment maintenance strategy development tool (known internally as MSG).

MSG entered the public domain in 1978 when Nolan and Heap¹ published their paper entitled *"Reliability-centered Maintenance"*.

Since then, RCM has evolved to become applicable to any equipment/assets in any industry anywhere in the world. Applied correctly, its output is the optimum maintenance schedule for the target equipment in its operating context.

RCM has repeatedly demonstrated its ability to deliver optimum maintenance for all kinds of

¹ Nowlan FS & Heap H. *Reliability-centered Maintenance*. Springfield, Virginia: National Technical Information Service, US Department of Commerce. 1978.

assets. In short, with its origins in a very demanding asset-intensive industry (and its subsequent adoption by other industries) RCM dovetails neatly with the requirements of PAS 55.

This paper highlights the clauses in PAS 55 where RCM can help organisations to comply with the specification.

3. Asset Management Strategy [Clause 4.3.1]

This clause states that an organisation should, *“establish, document, implement and maintain a long-term asset management strategy”* which is authorised by the organisation’s top management.

It goes on to say that this strategy should identify the functions of existing assets and the desired future functions of existing and new assets.

This is entirely in alignment with the RCM process. RCM is founded on the principle that maintenance is about preserving the functions of the equipment to which it applies. The list of functions established in the application of RCM represents the objectives of the maintenance schedule.

At this point, PAS 55 is referring to assets and asset systems at a much higher level than that at which RCM analyses are performed. However, if an organisation is already thinking about its asset systems in terms of the functions they perform then it will be a natural progression to writing functions at appropriate levels for the RCM analyses and vice versa.

This clause also says that the asset management strategy should *“clearly state the approach and principal methods by which assets and asset systems will be managed”*. This implies that if RCM is chosen as one of those methods to ensure compliance with PAS 55 then RCM is effectively endorsed by the organisation’s top management and should, therefore, be supported.

4. Asset management plan(s) [Clause 4.3.3]

This clause in PAS 55 begins:

“The organisation shall establish, document and maintain asset management plan(s) to achieve the asset management strategy and deliver the asset management objectives across the following life cycle activities:

...
c) maintenance of assets
...”

The clause goes on to specify that the plan(s) should document the *“actions required to optimise costs ... and performance of the assets ... and the means ... by which these actions are to be achieved”*.

Put simply, this means that an organisation should plan to maintain its physical assets in order to optimise costs and performance and it should state exactly how it will do that.

In order to comply with this part of PAS 55, it would not be sufficient to say: *“we will maintain our assets by implementing the asset manufacturer’s maintenance recommendations”* because this makes no mention of optimising asset costs or performance.

It would also be insufficient to say something like *“we will maintain our assets, optimising performance and maintenance costs by performing periodic internal reviews of maintenance activities”*.

The second statement above is an improvement on the first but it is still not clear what methodology will be used to undertake the maintenance reviews.

Compliance with this clause is readily achievable if the plan states that the ‘maintenance development methodology’ to be used is well respected, is in widespread use and complies with recognised standard(s). In this respect, RCM ‘fits the bill’ exactly.

RCM is a proven, well respected maintenance development methodology and is in widespread use throughout the world in most industry sectors. There are many variants of RCM, some more robust and thorough than others. The SAE standard JA1011² can be used to determine whether a maintenance development methodology is a genuine RCM process.

5. Contingency planning [Clause 4.3.4]

This clause requires the organisation to plan for possible emergency situations and specifies that the plan should include *“information on ... the maintenance of any equipment ... that could be required during ... emergency situations”*.

As with Clause 4.3.3 above, the methodology used to determine the maintenance requirements of emergency equipment should be well respected, in widespread use and comply with recognised standard(s).

Again, RCM ‘fits the bill’ perfectly, for the reasons cited earlier.

6. Training, awareness and competence [Clause 4.4.3]

This clause requires the organisation to ensure that anyone involved in asset management (which includes asset maintenance and asset utilization) has a level of competence appropriate to their activities.

The standard suggests the use of a suitable competency requirements framework and provides examples of some in its Bibliography.

² Society of Automotive Engineers, Inc (SAE): *Surface Vehicle/Aerospace Standard JA1011: “Evaluation Criteria for Reliability-centered Maintenance Processes”*: Warrentown, Pennsylvania, 1999.

RCM can also provide some assistance in this area – in three ways:

- When listing failure modes, RCM includes those caused by human error; the output of the decision logic for each of these failure modes is usually some sort of training requirement that will ensure the failure is much less likely to occur again
- A by-product of the way in which RCM analyses are conducted is that RCM is a training aid in itself. At the end of an analysis, all of the review group members know more about the equipment than they did at the start. Many RCM users report that the increase in equipment knowledge and understanding is far superior to that which is usually obtained from a conventional equipment training course
- The output generated during an RCM analysis can be used to support a future training programme for the asset that has been analysed.

7. Risk identification and assessment [Clause 4.4.7.3]

The risk management section of PAS 55 requires the organisation to identify credible risks, to assess their consequences and to implement appropriate control measures for them.

This clause suggests several categories of risks that should be considered, the first two of which, physical failure risks and operational risks, are covered in depth by the RCM process.

RCM considers all credible events that could cause an asset to cease performing any of its desired functions.

The effects of each of these failures are then documented in plain, every-day language. This enables the RCM analysis group to assess the *consequences* of each failure.

The combination of failure *consequences* and failure probability (i.e. *risk*) heavily influences the decisions that are made about *how* to manage each failure.

8. Implementation of asset management plan(s) [Clause 4.5]

Life cycle activities [Clause 4.5.1]

This clause states that having prepared a plan for the maintenance of its assets, the organisation should create and implement processes and/or procedures for the execution of that plan.

If RCM has already been chosen as the preferred methodology for reviewing asset maintenance requirements then complying with this Clause is greatly simplified by referring to or re-stating the steps of the RCM process in a procedure. (That procedure will, clearly, also contain other elements, such as how assets will be prioritised

for review and how the outputs of the RCM analyses are to be implemented.)

Tools, facilities and equipment [Clause 4.5.2]

This clause requires the organisation to “ensure that tools, facilities and equipment are maintained and ... calibrated.” Also, “The organisation shall establish ... procedure(s) to control these maintenance and calibration activities”.

As suggested above for Clause 4.5.1, the RCM process can be referenced in the procedure(s) created to comply with this clause.

Furthermore, RCM frequently recommends new tools, facilities or equipment that will be required in order to support the maintenance of the assets under review. (For example, RCM may recommend, or even mandate, the acquisition of specialist equipment for asset condition monitoring.)

9. Performance assessment and improvement [Clause 4.6]

Performance and condition monitoring [Clause 4.6.1]

This clause states the “organisation shall ... monitor ... the performance and/or condition of assets”.

It continues to say “when setting the frequency of ... monitoring, the organisation shall consider ... the costs of monitoring, the risks of failure ... and potential deterioration mechanisms”.

When determining how best to manage each failure mode, RCM looks to establish an on-condition task before considering any other options. In other words, RCM considers monitoring equipment performance/condition *for every failure mode*.

RCM uses the “potential deterioration mechanisms” to determine monitoring frequency. The deterioration mechanism will govern how much time is likely to elapse between the point at which the onset of failure can first be detected to the point at which the item completely fails; this is known as the P-F interval. The task interval must be less than the P-F interval if the organisation wishes to predict the failure successfully. RCM distinguishes between failures that have economic consequences and those with safety or environmental consequences.

For failures which have only economic consequences, the costs of monitoring are weighed up against the economic consequences of failure to determine whether the monitoring is financially justifiable.

For failures which affect safety (or the environment), monitoring tasks are considered worthwhile if they reduce the risk of failure to a tolerable level.

Investigation of asset-related failures, incidents and nonconformities [Clause 4.6.2]

This clause states *“the organisation shall ... implement ... process(es) ... for ... the ... investigation of failures ... associated with assets”* and that *“these process(es) ... shall define responsibility and authority for: ... c) evaluating the need for preventive action(s) to avoid failures”*.

Investigating failures after they have occurred in order to determine how to prevent them occurring again is a reactive process; where safety is concerned it is occasionally referred to as ‘tombstone technology’.

RCM can turn this into a proactive process by determining the necessary actions *before* the failures have occurred. These actions will be either scheduled maintenance tasks (performed by operators as well as maintainers) or one-off redesigns (which can be changes to operating/maintenance procedures, retraining or physical modifications to the equipment).

If RCM is applied correctly, the number of failures, incidents or nonconformities requiring investigation will be minimal. Where an investigation is required, the RCM process provides a structured approach for deciding how best to manage the failure mode in the future.

Improvement actions [Clause 4.6.5]

Corrective and preventive action [Clause 4.6.5.1]

This clause states the *“organisation shall ... implement ... process(es) ... for instigating:*

- a) corrective action(s) for eliminating the causes of poor performance ...*
- b) preventive action(s) for eliminating the potential causes of ... poor performance”*

This clause is also describing a reactive process, so again, RCM can turn it into a proactive process, for the reasons stated above under Clause 4.6.2.

Continual improvement [Clause 4.6.5.2]

This short clause requires the organisation to identify and action opportunities for continual improvement in:

- The optimal combination of costs and asset-related risks
- The performance and condition of assets.

RCM helps here because it is not a ‘one-off’ or ‘fit and forget’ approach. The idea is that an RCM analysis on an asset is a ‘living document’ that evolves with the asset; ie each RCM analysis should be reviewed periodically to ensure that it remains relevant.

Changes to the RCM decisions may be required in response to possible changes in a variety of factors, including:

- The asset’s operating context may change over time
- The asset’s performance expectations (and therefore, it’s functions) may have changed
- Unanticipated failure modes may have occurred
- New maintenance techniques may have become available
- Failure consequences may now be different.

Regular reviews of the asset’s RCM analyses will help to ensure compliance with this clause.

10. Conclusion

Reliability-centred Maintenance will provide any organisation with a ‘head start’ when it comes to the detail of complying with the requirements of PAS 55. In particular, the clauses in PAS 55 where RCM will have the biggest impact are:

- Asset management strategy
- Asset management plans
- Contingency planning
- Training, awareness and competence
- Risk identification and assessment
- Implementation of asset management plans
- Performance assessment and improvement.

11. Further Information

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