ASME RAM-2–2016

Reliability, Availability, and Maintainability Program Development Process for Existing Power Plants

AN AMERICAN NATIONAL STANDARD

The American Society of Mechanical Engineers

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FOREWORD

The purpose of this Standard is to provide a program development process to complement the higher-level reliability, availability, and maintainability (RAM) program described in ASME RAM-1. This Standard describes one way to implement a RAM program in an existing power plant.

The concept of RAM is based on the fundamental principle that power plant availability is a necessary goal. Plant personnel are responsible for ensuring availability by protecting the functional performance of critical equipment. This is done by finding the ideal balance between reliable engineering design, proper equipment operations, and effective and efficient maintenance at the best time. The RAM program is designed to address each of these points in a practical way that achieves measurable, real-life availability goals.

By addressing reliability and maintainability, ASME RAM-2 provides a process for developing a complete and effective availability program. It follows a risk-informed, performance-based approach. Risk calculations, expert opinion, and failure experience identify risks inherent with the design, which are then used to develop an effective scheduled maintenance and monitoring program.

Traditional terms addressing RAM-related work include preventive maintenance, scheduled maintenance, operations monitoring, and rounds. This Standard assists those responsible for programs that manage equipment assets by providing directly actionable guidance. This guidance should help power plants develop efficient, effective reliability and maintainability programs. It can also support the development of efficient, reliable maintenance for new designs.

This Standard assumes plant practices follow manuals, industry standards, and related asset management guidance. The RAM program is intended to control practices that influence results, following established industry practices. This RAM Standard does not cover human performance.

ASME RAM-2–2016 was approved by the RAM Standards Committee, under the jurisdiction of the Board on Standardization and Testing, on September 13, 2016, and approved by the American National Standards Institute (ANSI) as an American National Standard on December 2, 2016.

ASME RAM COMMITTEE
Reliability, Availability, and Maintainability of Power Plants

(The following is the roster of the Committee at the time of approval of this Standard.)

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General. ASME Standards are developed and maintained with the intent to represent the consensus of concerned interests. As such, users of this Standard may interact with the Committee by requesting interpretations, proposing revisions or a case, and attending Committee meetings. Correspondence should be addressed to:

Secretary, RAM Standards Committee
The American Society of Mechanical Engineers
Two Park Avenue
New York, NY 10016-5990
http://go.asme.org/Inquiry

Proposing Revisions. Revisions are made periodically to the Standard to incorporate changes that appear necessary or desirable, as demonstrated by the experience gained from the application of the Standard. Approved revisions will be published periodically.

The Committee welcomes proposals for revisions to this Standard. Such proposals should be as specific as possible, citing the paragraph number(s), the proposed wording, and a detailed description of the reasons for the proposal, including any pertinent documentation.

Proposing a Case. Cases may be issued to provide alternative rules when justified, to permit early implementation of an approved revision when the need is urgent, or to provide rules not covered by existing provisions. Cases are effective immediately upon ASME approval and shall be posted on the ASME Committee Web page.

Requests for Cases shall provide a Statement of Need and Background Information. The request should identify the Standard and the paragraph, figure, or table number(s), and be written as a Question and Reply in the same format as existing Cases. Requests for Cases should also indicate the applicable edition(s) of the Standard to which the proposed Case applies.

Interpretations. Upon request, the RAM Standards Committee will render an interpretation of any requirement of the Standard. Interpretations can only be rendered in response to a written request sent to the Secretary of the RAM Standards Committee.

Requests for interpretation should preferably be submitted through the online Interpretation Submittal Form. The form is accessible at http://go.asme.org/InterpretationRequest. Upon submittal of the form, the Inquirer will receive an automatic e-mail confirming receipt.

If the Inquirer is unable to use the online form, he/she may mail the request to the Secretary of the RAM Standards Committee at the above address. The request for an interpretation should be clear and unambiguous. It is further recommended that the Inquirer submit his/her request in the following format:

Subject:	Cite the applicable paragraph number(s) and the topic of the inquiry in one or two words.
Edition:	Cite the applicable edition of the Standard for which the interpretation is being requested.
Question:	Phrase the question as a request for an interpretation of a specific requirement suitable for general understanding and use, not as a request for an approval of a proprietary design or situation. Please provide a condensed and precise question, composed in such a way that a "yes" or "no" reply is acceptable.
Proposed Reply(ies):	Provide a proposed reply(ies) in the form of "Yes" or "No," with explanation as needed. If entering replies to more than one question, please number the questions and replies.
Background Information:	Provide the Committee with any background information that will assist the Committee in understanding the inquiry. The Inquirer may also include any plans or drawings that are necessary to explain the question; however, they should not contain proprietary names or information.

Requests that are not in the format described above may be rewritten in the appropriate format by the Committee prior to being answered, which may inadvertently change the intent of the original request.

ASME procedures provide for reconsideration of any interpretation when or if additional information that might affect an interpretation is available. Further, persons aggrieved by an interpretation may appeal to the cognizant ASME Committee or Subcommittee. ASME does not “approve,” “certify,” “rate,” or “endorse” any item, construction, proprietary device, or activity.

Attending Committee Meetings. The RAM Standards Committee regularly holds meetings and/or telephone conferences that are open to the public. Persons wishing to attend any meeting and/or telephone conference should contact the Secretary of the RAM Standards Committee.

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RELIABILITY, AVAILABILITY, AND MAINTAINABILITY PROGRAM DEVELOPMENT PROCESS FOR EXISTING POWER PLANTS

1 INTRODUCTION

A reliability, availability, and maintainability (RAM) program is a structured way to identify and deliver the RAM requirements of a power plant in the most cost-effective manner. This Standard provides guidance for the program implementation portion of the RAM process described in ASME RAM-1. It is intended to implement a comprehensive availability assurance program. This Standard is intended for existing facilities.

2 SCOPE

This Standard amplifies and clarifies the requirements of ASME RAM-1 for implementing a RAM program for a power-generation facility. This Standard assists in developing program goals, identifying a master equipment list (MEL) to load into the enterprise asset management system (EAMS), and populating scheduling systems with finished content as complete work orders that are ready to perform work. A RAM program includes hierarchical breakdown of the facility, tagging of equipment (i.e., components), risk categorization of systems and equipment tags, development of common standards for components, and customization for similar context locations in the plant. This Standard finalizes work organization as task lists in work orders, routes, and rounds. It provides a process to implement ASME RAM-1 based on terminology and methodology used in power plants.

This Standard addresses the following:

(a) equipment assessment for risk
(b) asset tagging
(c) template selection and application
(d) equipment asset management software
(e) development and organization of work (e.g., development of operating procedures, rounds, and work orders)
(f) RAM program plans
(g) training required to implement the program

3 PURPOSE

The purpose of this Standard is to provide information to enable plant personnel to develop an effective RAM process in accordance with ASME RAM-1. An effective RAM program ensures that critical plant equipment performs cost-effectively as intended by design. This Standard provides an all-encompassing RAM support process that develops simple, clearly worded RAM analysis in accordance with ASME RAM-1.

4 DEFINITIONS

The following is a list of terms relating to the implementation and use of RAM programs:

age exploration: systematic examination of the lifetime a component or part can support in an application in-service.

coding scheme: an often mnemonic scheme that assigns equipment codes or tags; the scheme usually embeds the plant, unit, system, component type, numbered sequence of the component and higher-tier equipment of which the component is a part (system), subsystem, and perhaps additional information. Each plant requires a common coding scheme.

complex equipment:

(a) equipment that displays many unique combinations of parts, failure modes, and failure causes, none of which is predominant in failure of its functions.

(b) equipment that displays random failure patterns in-service. See also *simple equipment*.

contextual risk map: a map of all master equipment list (MEL) component tag information, customized with component risk information.

critical: likely to cause functional failure directly; failing a high-level performance goal in single fault.

custom template: an application of a standard template based upon one context, e.g., a standard template maintenance plan customized for one location. See *standard template*.

direct failure criteria: criteria limiting criticality risk classification to the failures that, with only a single occurrence, have the ability to affect operating goals. This criteria focuses scheduled maintenance resources and efforts where they will do the most good.

diversity: the use of different methods to achieve functional but not exact physical redundancy within a RAM program.

dominant failure mode (DFM): a likely failure mode of a component or part; it is considered in the design of the component or part and addressed in the maintenance plan.

evident: term used to describe events or failures that experienced operating crews should be expected to notice.

evident failure: a failure that is evident to experienced operating crews and staff (nonspecific to cause). Experienced staff should notice and report the failure, based on general experience with off-normal conditions and failure criteria. Knowing what symptoms operators will be able to see to identify a failure affects mitigation planning for addressing that potential failure. Conversely, when failures are not evident, different mitigation strategies to manage those failures must be used.

failure mechanism: the mode and cause of an equipment failure.

generalized time parameter: a parameter that measures the passage of time and aging of a component, and which may be used as the basis for scheduled maintenance. Number of operations, mileage, rotations, tons moved, and gallons flowed are examples of generalized time parameters.

incipient failure: preexisting, emerging, and developing, though not evident, condition whereby equipment is nearly ready to fail; a hidden failure that is presumed to have existed prior to its becoming evident.

life limit: a limit that ensures the rework or replace task for an aging component or part is performed prior to the component or part reaching its end of life. See *safe life limit*.

maintainability: the ability to access equipment, perform maintenance work, and return the equipment to operation. Access to parts, spare parts, and support tools; availability of trained, skilled personnel; ability to preplan work; and flexibilty of work rules all affect equipment maintainability. Maintainability supports the performance of "on-condition" (condition-directed) maintenance on short notice.

master equipment list (MEL): an equipment registry listing all installed plant equipment.

partitioning: the process of conceptually separating a component into its constituent parts for further evaluation and to differentiate risk; the development of a hierarchy that identifies system, component, and part subassemblies contributing functions. Also called system or component breakdown into constituents.

primary component: the component of direct interest in a failure analysis; the failed component for which mitigation measures are developed. See *secondary component*.

primary failure: a failure of a primary component; a failure within the analysis boundary.

RAM:

(a) reliability, availability, and maintainability.

(b) an ASME RAM program comprising a scheduled maintenance program with rounds and its complementary condition-based maintenance program response.

rounds: tasks performed at short intervals by operators to monitor areas and alarm conditions; these tasks may include routine alarm resets, equipment observations, and equipment realignments. Each round takes the operator on a path through a section of the plant to monitor local conditions.

routes: repetitive work performed on many different applications of the same component by a skilled technician or mechanic in the same way. Repetitive calibrations, for example, may be placed into one route.

safe life limit: a limit that ensures an aging safety-critical component or part provides uninterrupted service before reaching its end of life, or is replaced before reaching its minimum age limit. A safe life limit virtually guarantees items with direct safety risk never age out before a rework or replace task.

scheduled maintenance: planned maintenance tasks, including condition assessments, scheduled based upon a generalized time parameter. Equipment asset management scheduling systems (EAMS) primarily generate scheduled maintenance work orders; operator rounds software installed on personal digital assistants (PDAs) controls rounds. Operator distributed control system (DCS) screen sampling points on visual control screen displays are equivalent to EAMS work orders for operators.

secondary component: a component outside the boundary of the primary component; a separate component from the primary component of consideration.

secondary failure: failure of a secondary component; a failure outside the primary component's boundary, caused by a primary component failure. A secondary failure is external to the primary component, caused by the primary component, and therefore uncontrollable within the secondary component's boundary. Examples include secondary failures caused by fires, load falls from hoists or cranes, and missiles created from disintegrating rotating parts. No amount of scheduled maintenance on a primary component can eliminate the effects of external secondary component failures. Secondary failure can be avoided only by controlling failure at the original primary component itself, where the failure is a primary failure. See *primary failure*.

simple equipment:

(a) equipment that displays few failing parts, failure modes, and failure causes, or equipment for which only a few predominant failures occur.

(b) equipment that displays few dominant failure patterns in-service. Simple equipment is the opposite extreme from complex equipment (see *complex equipment*).

skid: a group of equipment that is purchased or assembled for delivery and /or final installation in the plant.