ASME RAM-1–2020
(Revision of ASME RAM-1–2013)

Reliability, Availability, and Maintainability of Equipment and Systems in Power Plants

AN AMERICAN NATIONAL STANDARD

The American Society of Mechanical Engineers

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The American Society of Mechanical Engineers
Two Park Avenue, New York, NY 10016-5990

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FOREWORD

Reliable plants meet owner expectations. Understanding these expectations is the first step in designing for reliability. A plan must be developed to achieve the expected goals efficiently, subject to hardware/software constraints and operating configurations and budgets. Such a plan is the basis of a design that will deliver the most consistent production possible.

Effective reliability plans prevent functional failures of power plants even if equipment components fail. To preserve production, most power plants are designed to tolerate these isolated component failures. Therefore, the design must also address ease of maintenance. It must ensure short downtimes when failures do occur, as well as during planned outage work. Maintaining reliable production requires policies and procedures that support equipment monitoring, maintenance, and replacement. Successful maintenance strategies complement the plant design itself. Clear, actionable guidance based upon established strategies provides effective tools to manage risk. This Standard provides an overview of some common approaches to attaining reliability, availability, and maintainability (RAM) at minimum cost, based on a consensus approach of experts.

This Standard provides guidance to managers of high-value production facilities concerning the RAM characteristics expected in an asset management program. It emphasizes program requirements, not implementation methods. Its developers expect that companies with large generating facilities will benefit the most. This Standard considers existing reliability process standards (see Nonmandatory Appendix A), but its use is voluntary. It does not supersede other accepted guidance, but rather it seeks to fill a gap.

This Standard will help those who operate, manage, and support generation facilities of all types. In addition, auditors, lenders, or responsible agencies who determine compliance or provide due diligence may use this Standard. By providing guidance for facilities that must comply with safety and environmental requirements, this Standard helps stakeholders develop reliability programs while meeting production schedules to assure commercial success.

ASME RAM-1-2020 was approved by the RAM Standards Committee, under the jurisdiction of the Board on Standardization and Testing, on February 26, 2020, and approved by the American National Standards Institute (ANSI) as an American National Standard on March 19, 2020.

ASME STANDARDS COMMITTEE FOR POWER PLANT RELIABILITY, AVAILABILITY, AND PERFORMANCE (RAP)

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

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CORRESPONDENCE WITH THE RAM COMMITTEE

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.

Moreover, ASME does not act as a consultant for specific engineering problems or for the general application or understanding of the Standard requirements. If, based on the inquiry information submitted, it is the opinion of the Committee that the Inquirer should seek assistance, the inquiry will be returned with the recommendation that such assistance be obtained.

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. Future Committee meeting dates and locations can be found on the Committee Page at http://go.asme.org/RAPcommittee.

RELIABILITY, AVAILABILITY, AND MAINTAINABILITY OF EQUIPMENT AND SYSTEMS IN POWER PLANTS

1 INTRODUCTION

A RAM program is a structured methodology to identify and meet the reliability, availability, and maintainability (RAM) requirements of a power plant in the most cost-effective manner. This Standard provides requirements to govern the master planning process for a power plant RAM program. It is intended to guide the development and implementation of a comprehensive availability assurance program throughout the design, construction, and operation phases of the RAM project. This Standard is applicable to both new and existing facilities.

2 SCOPE

This Standard identifies the elements and responsibilities required to establish a RAM program for any power-generation facility. The program process includes

(a) establishment of RAM goals

(b) development of requirements for design, construction and commissioning, and operations

3 PURPOSE

The purpose of this Standard is to meet the owner's power plant RAM performance goals. This Standard requires the owner to determine those goals and the criteria to achieve them. To this end, it identifies program requirements that support effective reliability processes in design, construction and commissioning, and operations. It requires a risk-based approach to design and provides requirements to optimize performance effectively throughout the life cycle of the power plant.

4 DEFINITIONS

availability: a measure of the degree to which an item is in an operable state and can be committed at the start of a mission when the mission is called for at an unknown (random) point in time; or the ability of an item to be in a state to perform a required function under given conditions, at a given instant of time or during a given time interval, assuming that the required external resources are provided. Availability is measured by the user and is a function of how often failures occur and corrective maintenance is required, how often preventive maintenance is performed, how quickly indicated failures can be isolated and repaired, how quickly preventive maintenance tasks can be performed, and how much logistics support delays contribute to downtime.

basis of design (BOD): the underlying assumptions and requirements that support the physical plant design.

boundaries: the interfaces that define where each system begins and ends. For a typical plant, the boundaries include physical, mechanical, and electrical isolation physical points, e.g., isolation valves or piping locations, heat exchanger tube bundle interfaces, electrical breakers, or switch or termination points. This Standard requires system boundaries to be defined.

condition assessments: judgements used to assess the state of equipment to determine the need to perform applicable maintenance; also called *predictive activities*.

condition-based response: an initiative taken after a structure, system, or component has failed to function in order to restore it to an acceptable condition. Also called *corrective maintenance*.

condition monitoring: used to trend degrading conditions of a structure, system, or component that is not readily revealed by unavailability, reliability, and plant-level indicators for which advance awareness of degradation is needed. Some types of condition monitoring are vibration characteristics, temperature, acoustics, and electrical parameters.

corrective maintenance: see *condition-based response*

criticality: the relative importance of tasks, equipment, systems, or components and their contributions to the mission.

design basis: see *basis of design*.

failure finding tests: used to assess operational capability (operability) of standby or redundant equipment.

failure mode analysis (FMA): an assessment addressing how a structure, system, or component can fail; what can cause the failure; what the likelihood of failure is; what the consequences of failure are; and ways to mitigate the failure. The means are mainly through detection, maintenance, or design redundancy.

hard-time maintenance: the upkeep of equipment with known time-dependent aging characteristics. These consist primarily of explicit rework or replacement tasks. Hard time can include compound tasks that