

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

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AN AMERICAN NATIONAL STANDARD



The American Society of  
Mechanical Engineers



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**ASME RAM-1-2013**

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

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**The American Society of  
Mechanical Engineers**

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# FOREWORD

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

Effective reliability plans must prevent functional failures that affect power plant performance, even though equipment itself fails. For this reason, most power plants are designed to tolerate failures of certain components. However, the design must also address ease of maintenance. It must ensure short downtimes when failures do occur, as well as when planning outage work. Maintaining reliable production requires a strategy supporting equipment monitoring, maintenance, and replacement. Successful maintenance strategies complement the plant design itself. Clear, actionable guidance based upon established strategies should provide effective tools to manage risk. This Standard provides an overview of common reliability program attributes to attain reliability, maintainability, and availability at minimum cost, based upon an experts' consensus approach.

This Standard provides guidance for those who manage high-value production facilities<sup>1</sup> with the reliability, availability, and maintainability 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 references), 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, it helps develop reliability programs, while meeting production schedules to assure commercial success.

ASME RAM-1-2013 was approved by the RAM Standards Committee, under the jurisdiction of the Board on Standardization and Testing, on May 28, 2013, and approved by the American National Standards Institute (ANSI) as an American National Standard on August 28, 2013.

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<sup>1</sup> Managers, engineers, accountants, and executives.



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## Reliability, Availability, and Maintainability of Power Plants

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Subject:	Cite the applicable paragraph number(s) and the topic of the inquiry.
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. 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 this format may be rewritten in the appropriate format by the Committee prior to being answered, which may inadvertently change the intent of the original request.

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

## 1 INTRODUCTION

A RAM program is a structured methodology to identify and deliver the reliability, availability, and maintainability (RAM) requirements of a power plant in the most cost-effective manner. This document is an assurance standard to govern the master planning process for a power plant RAM program. It is intended to provide a methodology to develop and implement a comprehensive availability assurance program for the design, construction, and operation phases of the RAM project. This Standard is applicable to both new and existing facilities.

## 2 SCOPE

This Standard provides the requirements to establish a RAM program for any power-generation facility. The program process includes

- (a) establishment of RAM goals
- (b) requirements for design, construction and commissioning, and operations

This Standard identifies the required RAM program elements and responsibilities.

## 3 PURPOSE

The purpose of this Standard is to meet the owner's power plant RAM performance goals. This Standard 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

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

*criticality*: the relative importance of equipment attributes that range from physical materials and hardware to design functions.

*reliability, availability, and maintainability (RAM)*:

- (a) the process of addressing all the associated concepts of reliability, availability, and maintainability and integrating them to meet the owner's performance objectives

- (b) a set of requirements imposed on a plant, system, or component to ensure that it

- (1) will be ready for use when required
- (2) will successfully perform assigned design-intended functions
- (3) can be maintained operationally over its specified life

## 5 RAM PROCESS

This process provides a procedure to develop and implement a program that is a written, defined, verifiable, and living document that will enable the owner to meet his/her performance goals. The steps in the RAM process are given in paras. 5.1 through 5.4 (see Fig. 5-1).

### 5.1 Predevelopment

The owner shall establish needs by defining required criteria that shall serve to develop objective requirements, goals, validation parameters, and acceptance criteria.

### 5.2 Program Development

The owner shall select a project delivery method, designer, and constructor to build the power plant to the designed program criteria described in para. 5.1.

### 5.3 Program Implementation

The owner shall periodically review the program performance of the plant to determine if the plant is achieving the objectives and goals described in para. 5.1.

### 5.4 Program Revision

The owner shall modify the program described in paras. 5.2 and 5.3 to achieve the goals described in para. 5.1 or with new criteria that the owner establishes. Any owner-established criteria shall at least meet, or exceed, the criteria outlined in this Standard.

## 6 RAM DESCRIPTION

The following describes the steps in the RAM process.

### 6.1 Predevelopment Phase (See Fig. 6.1-1)

The owner shall define the top-level functional requirements for the plant. The output of the predevelopment phase is the BOD document, which will be used

