

ASME TDP-1-2023
(Revision of ASME TDP-1-2013)

Prevention of Water Damage to Steam Turbines Used for Electric Power Generation: Fossil-Fueled Plants

AN AMERICAN NATIONAL STANDARD



The American Society of
Mechanical Engineers

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FOREWORD

In the late 1960s, the two major U.S. steam turbine manufacturers issued design recommendations to stem the increasing occurrence of water-induced damage to steam turbines. Consequently, utilities and designers began formulating their own design criteria because of the economic need to keep the generating units in service. Realizing the need for a uniform set of design criteria, the American Society of Mechanical Engineers (ASME) formed the Standards Committee on Turbine Water Damage Prevention (TWDP) to develop recommended practices for the electric-power-generating industry. The TWDP Committee, comprising representatives of utilities, equipment manufacturers, and design consultants, produced TDP-1, which was approved as an ASME standard by the ASME Standardization Committee and the ASME Policy Board, Codes and Standards, on July 26, 1972.

In 1979, the TDWP Committee proposed revising the Standard to include information on condenser steam and water dumps, direct-contact feedwater heaters, and steam generators. The revised Standard was approved by the ASME Standardization Committee on April 25, 1980. Another edition, ANSI/ASME TDP-1-1985, was approved as an American National Standard on September 13, 1985.

In 1994, the ASME Board on Standardization disbanded the TDWP Committee and withdrew ANSI/ASME TDP-1 due to a perceived lack of interest and use by the industry. However, subsequent interest in ANSI/ASME TDP-1 from previous and potential users convinced ASME to reconstitute the TDWP Committee under the Board on Pressure Technology Codes and Standards in June 1997. The re-formed committee revised ANSI/ASME TDP-1-1985, producing ASME TDP-1-1998, which was approved as an American National Standard on June 17, 1998.

Advances in power plant technology, most notably combined-cycle, multiple-steam generators; cycling; cogeneration technology; and modern plant instrumentation and control systems, convinced the TWDP Committee to again revise the Standard. The result was ASME TDP-1-2006, which was approved as an American National Standard on November 6, 2006.

Prompted by the broad acceptance of ASME TDP-1-2006, ASME reissued the Standard in 2013 with mandatory requirements rather than the recommended practices of the previous editions. ASME TDP-1-2013 was approved as an American National Standard on February 5, 2013.

ASME TDP-1-2023 clarifies the safety systems of the integrated control systems shown in the figures, clarifies and adds design guidance on plants with multiple steam drum systems, and adds guidance on selected level measurement devices. This edition also revises the design specification for warm-up lines per current industry practice, clarifies the use of separate controllers for drain valves, addresses in-line level measurements, and adds definitions and device identification abbreviations. ASME TDP-1-2023 was approved as an American National Standard on November 20, 2023.

ASME TWDP COMMITTEE

Turbine Water Damage Prevention

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

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In addition, the committee may post errata on the committee web page. Errata become effective on the date posted. Users can register on the committee web page to receive e-mail notifications of posted errata.

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(a) The most common applications for cases are

(1) to permit early implementation of a revision based on an urgent need

(2) to provide alternative requirements

(3) to allow users to gain experience with alternative or potential additional requirements prior to incorporation directly into the Standard

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(4) the editions of the Standard to which the proposed case applies

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PREVENTION OF WATER DAMAGE TO STEAM TURBINES USED FOR ELECTRIC POWER GENERATION: FOSSIL-FUELED PLANTS

1 SCOPE

This Standard includes required and recommended practices concerned primarily with the prevention of water damage to steam turbines used for fossil-fueled electric power generation. The practices address damage due to water, wet steam, and steam backflow into a steam turbine. The practices are applicable to conventional steam cycle, combined-cycle, and cogeneration plants. The practices cover design, operation, inspection, testing, and maintenance of those aspects of the following power plant systems and equipment concerned with preventing the induction of water into steam turbines:

- (a) motive steam systems
- (b) steam attemperation systems
- (c) turbine extraction/admission systems
- (d) feedwater heaters
- (e) turbine drain system
- (f) turbine steam seal system
- (g) start-up systems
- (h) condenser steam and water dumps
- (i) steam generator sources

Any connection to the turbine is a potential source of water either by induction from external equipment or by accumulation of condensed steam. The sources treated herein specifically are those found to be most frequently involved in causing damage to turbines. Although water induction into the high- and intermediate-pressure turbines has historically been recognized as the most damaging, experience has shown that water induction in low-pressure turbines can cause significant damage and should also be taken seriously.

This Standard is not intended to impose new requirements retroactively for existing facilities.

2 CRITERIA

2.1 Basis

2.1.1 The normal practice to prevent turbine water induction is to

- (a) identify systems that have a potential to allow water to enter the turbine
- (b) design, control, maintain, test, and operate these systems in a manner that prevents accumulation of water

2.1.2 However, since malfunctions do occur, implement one or more of the following steps to prevent turbine damage due to water induction:

- (a) detect the presence of water either in the turbine or, preferably, external to the turbine before the water has caused damage
- (b) isolate the water by manual or, preferably, automatic means after it has been detected
- (c) dispose of the water by either manual or, preferably, automatic means after it has been detected

2.1.3 No single failure of equipment, device, or signal, or loss of electrical power, shall result in water or cold steam entering the turbine.

2.1.4 Steam lines connecting to the steam turbine directly or indirectly shall be designed to ensure that any saturated steam or condensate that may have collected while the line or portion of the line was out of service is drained and warmed adequately prior to being returned to service.

2.1.5 Any automatic control system used to control steam line drain valves identified in these guidelines shall be designed so that the system has a means of initiating automatic valve actuation and a separate means of verifying the appropriateness of the automatic action. For example, if a drain valve is closed automatically based on a timer, something other than the timer, such as a level switch that would alarm if water were still present in the steam line, shall be used to verify that the timer initiation was appropriate. If an inappropriate action is taken, an alarm shall be provided.

2.1.6 An integrated control system (ICS) such as a distributed control system can, by its inherent design, provide additional control and monitoring capability for power plant systems and equipment. Use of an ICS has been considered as an option for control and monitoring potential sources that might allow water to enter the turbine. If an ICS is available, the additional redundancy and availability of that system shall be used as indicated in this Standard. However, if no ICS is provided, following the non-ICS specific requirements is intended to still represent a conservative design for protection from water induction.