Moisture Separator Reheaters

PERFORMANCE TEST CODES

ASME PTC 12.4–1992

REAFFIRMED 2019

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THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

United Engineering Center 345 East 47th Street New York, N.Y. 10017

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This Standard will be revised when the Society approves the issuance of a new edition. There will be no addenda or written interpretations of the requirements of this Standard issued to this edition.

FOREWORD

(This Foreword is not part of ASME PTC 12.4-1992.)

Moisture Separator Reheaters (MSRs) were introduced to steam power cycles after the advent of commercial nuclear power. A moisture separator, with no reheat was first added to nuclear power cycles to minimize the low pressure (LP) turbine erosion caused by wet steam prevalent in those cycles and improve turbine cycle performance. Steam reheat was added later to reduce further the quantity of moisture in the steam passing through the LP turbine and to increase further the efficiency of the LP turbine.

The first MSRs were susceptible to many modes of failure. Great technological advances have occurred over the past 30 years with respect to MSR design and operation. These advances increased the reliability and enhanced the performance of the MSR which provided the momentum and justification for MSR upgrades.

During the 1970s and early 1980s an increasing number of utilities were involved in MSR upgrades which included replacing portions of or their entire MSRs. The ASME Board on Performance Test Code was notified in June 1984 that no code existed for the testing and analysis of MSRs. PTC-6 (1982) on steam turbines treated the MSR as an integral part of a turbine generator, which it is when purchased as a package. The Board authorized the formation of a new performance test code committee to develop a code for the treatment of the MSR as a separate component.

A new committee was formed and first met in December 1985. Numerous drafts were developed over the next 4 years, each more detailed than the previous. Upon the completion of appendices containing a set of sample calculations and a complete uncertainty analysis, the draft was released for the industry review in July of 1990. The comment resolution process, completed in April 1991, strengthened the document. The committee was balloted and approved the code draft in July 1991. The Board on Performance Test Codes approved the code in January 1992. This test code has been approved as an American National Standard by the ANSI Board of Standards Review on November 24, 1992.

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In addition to the above personnel, the Committee is deeply indebted to Mr. Peter Bird, Mr. Al Smith, Mr. Clement Tam, and Mr. Richard Harwood for their contributions in the development of this Code.

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SECTION 0 — INTRODUCTION

0.1

A Moisture Separator Reheater (MSR) is a nuclear power plant component located between the high and low pressure turbines. Its purpose is to remove moisture and add superheat to the cycle steam before the steam enters the low pressure turbine. It consumes throttle steam, and may also consume high pressure extraction steam in the heating process. The MSR introduces an additional pressure drop in the turbine expansion while accomplishing these functions. The use of a properly designed and adequately performing MSR will result in a cycle heat rate improvement.

0.2

One of the purposes of this test Code is to consider the separate functions of moisture separation and either one or two stages of steam reheat. This procedure can be employed to combine the effects of the performance of the individual MSR components. Therefore, the test results will describe the performance of either individual MSR components or the entire MSR.

0.3

PTC 1-1991, the Code on General Instructions, should be studied thoroughly before formulating the procedures for testing an MSR. The Code on Definitions and Values, PTC 2-1980 (R1985), defines technical terms and numerical constants which are used throughout this Code. Unless otherwise specified, instrumentation should comply with the appropriate supplements of the PTC 19 Series of codes on Instruments and Apparatus. PTC 6-1976, Steam Turbines, should be consulted for isolation and verification methods.

SECTION 1 — OBJECT AND SCOPE

1.1 OBJECT

This Code provides the procedures, direction, and guidance for the accurate testing of Moisture Separator Reheaters (MSRs) which includes moisture separating and steam reheating components located between the high pressure and low pressure steam turbine. The purpose of the Code is to determine the performance of the MSR and to provide guidance in the evaluation of its performance effect on the turbine cycle heat rate with regard to:

(a) Moisture Separator Outlet Quality;

(b) Reheater Terminal Temperature Difference (TTD) per stage;

(c) Cycle Steam pressure drop across applicable component(s); and

(d) Excess heating steam flow.

1.2 SCOPE

Requirements are specified by this Code for application on MSR testing in the following areas:

(a) Pretest arrangements and agreements;

(b) Instrumentation types and accuracies;

(c) Instrumentation applications and methods of measurement;

(d) Testing and calculational techniques; and

(e) Information contained in the test report.

1.3 EXPECTED MEASUREMENT UNCERTAINTY

By satisfying the instrument accuracy criteria specified in Section 4 and complying with the balance of procedural requirements of this Code, a test will generally provide 95 percent or greater confidence that the measurement of the required performance parameters will yield results for which the bounds of the difference between the final test results and the true value is within $\pm$ 10.0 Btu/kW-hr.

Utilizing techniques specified in PTC 19.1, Measurement Uncertainty, the overall measurement uncertainty is based on the prescribed instrument accuracies and example precision indices for MSR testing. An outline of the calculations conducted to establish the expected overall measurement uncertainty value, noted above, is covered in Appendix B. Users of this Code should determine the quality of a Code test by performing a post test uncertainty analysis utilizing PTC 19.1.