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American National Standard
Pressure and Temperature Transient Analysis for Light Water Reactor Containments

Secretariat
American Nuclear Society

Prepared by the
American Nuclear Society
Standards Committee
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Foreword

(This Foreword is not a part of American National Standard Pressure and Temperature Transient Analysis for Light Water Reactor Containments, ANSI/ANS-56.4-1983.)

The ANS-56.4 Working Group held its first meeting in September 1982, working with a well-developed draft. This draft did not reflect the lessons learned from the TMI-2 accident. The American Nuclear Society's Nuclear Power Plant Standards Committee (NUPPSCO) suggested that degraded core scenarios be considered by the working group.

The concept of degraded core includes many items, such as core melt, steam explosions, containment melt-through, hydrogen burn, or explosions. It was agreed that the degraded core issues were generally beyond the scope of this document. However, the working group believes that the containment design analysis should address some of these events for completeness. Current models could include these items with little additional sophistication once they are defined. Therefore, no special treatment was warranted.

The working group assumed that the analyst using this standard has computer codes available and therefore, the governing equations would not add significantly to the usefulness of the document.

This standard is intended to aid the analyst in performing an acceptable analysis for determining the pressure and temperature histories in reactor containment during design basis and other events.

During the preparation of this standard, the ANS-56.4 membership was as follows:

N. Weber, Chairman, *Sargent & Lundy*
W. Krotiuk, *Ebasco Services, Inc.*
J. Kudrick, *U.S. Nuclear Regulatory Commission*
P. Linn, *Westinghouse Electric Corporation*
D. Mitchell, *Duke Power Company*
C. Nakayama, *NUTECH Engineers*
K. Shieh, *Babcock & Wilcox Company*
R. Strong, *Echo Energy Services*

The American Nuclear Society's Nuclear Power Plant Standards Committee (NUPPSCO) had the following membership at the time of its approval of this standard.

L. J. Cooper, Chairman
M. D. Weber, Secretary

Name of Representative	Organization Represented
R. G. Benham	G. A. Technologies, Inc. (for the Institute of Electrical and Electronics Engineers, Inc.)
B. M. Rice (Alt.)	Duke Power Company (for the Institute of Electrical and Electronics Engineers, Inc.)
R. V. Bettinger	Pacific Gas and Electric Company
P. Bradbury	Westinghouse Advanced Reactor Division
D. A. Campbell	Westinghouse Electric Company
C. O. Coffer	Pacific Gas and Electric Company
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C. D. Thomas	Yankee Atomic Electric Company
G. P. Wagner	Commonwealth Edison Company
G. L. Wessman	Torrey Pines Technology
J. E. Windhorst	Southern Company Services, Inc.

Contents

Pressure and Temperature Transient Analysis for Light Water Reactor Containments

1. Introduction

The design and licensing of nuclear power plants require that both primary and secondary containments be analyzed for pressure, temperature, and flooding effects. The analyses include pressure and temperature transients to which containment(s) might be exposed as a result of postulated line breaks, including those transients resulting from both normal and abnormal occurrences.

1.1 Purpose. The purpose of this standard is to provide the methods and criteria necessary to perform the pressure and temperature transient analyses required for primary and secondary containment design and equipment qualification.

1.2 Scope. This standard provides criteria and guidance for the analysis of postulated pressure and temperature transients for light water reactor (LWR) containments, including ECCS minimum backpressure analysis. Criteria and guidance are presented for the formulation of input parameters to ensure a suitably conservative design. Interfaces with passive and active systems governing the analysis, such as Emergency Core Cooling System (ECCS), structural heat sinks, containment fan coil units, containment spray systems, and water pressure suppression systems are identified.

This standard does not address:

(1) Degraded Core Scenarios,

(2) BWR Suppression Pool Hydrodynamic Analysis,

(3) Ice Condenser Containment, and

(4) Hydrogen Burn or Combustion.

1.3 Limitations and Interfaces. Hydrogen, as a noncondensible gas, can be accommodated within normal containment design in excess of $10^{v}/_{o}$ without exceeding the design pressure of the containment. This is considerably above acceptable hydrogen concentrations. Therefore, hydrogen, as a noncondensible gas, is not considered within this standard. Hydrogen burn or combustion considerations are beyond the scope of this standard.

This standard does not consider jet forces and associated effects resulting from line breaks, pipe hanger design, or break location. These items are covered in American National Standard Design Basis for Protection of Light Water Reactor Nuclear Power Plants Against the Effects of Postulated Pipe Rupture, ANSI/ANS-58.2-1980 [1].[1] This standard does not treat subcompartment analysis required as a result of line breaks. This topic is covered by American National Standard for Subcompartment Pressure and Temperature Transient Analysis in Light Water Reactors, ANSI/ANS-56.10-1982 [2].

2. Definitions

active failure. A malfunction, excluding passive failures, of a component that relies on mechanical movement to complete its intended function upon demand.

Examples of active failures include the failure of a powered valve or a check valve to move to its correct position, or the failure of a pump, fan, or diesel generator to start.

Spurious operation of a powered component due to a failure originating within its automatic actuation or control systems shall be regarded as an active failure unless specific features or operating restrictions (such as "racking out" a breaker to a motor-operated valve) are incorporated to prevent such spurious operation. An example of spurious operation is the unintended energizing of a powered valve to open or close.

conservative. The margin to compensate for uncertainties in the values of analysis input parameters, analysis models, or results in a manner which will tend to ensure the adequacy of components, systems, or structures to perform their intended function.

control volume. The smallest geometric subdivision for which thermodynamic states are computed.

[1]Numbers in brackets refer to corresponding numbers in Section 7, References.