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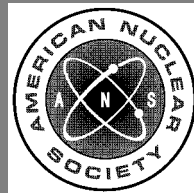
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ANSI/ANS-2.21-2012; R2016

**criteria for assessing atmospheric
effects on the ultimate heat sink**

an American National Standard

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ANSI/ANS-2.21-2012

**American National Standard
Criteria for Assessing Atmospheric
Effects on the Ultimate Heat Sink**

Secretariat
American Nuclear Society

Prepared by the
**American Nuclear Society
Standards Committee
Working Group ANS-2.21**

Published by the
**American Nuclear Society
555 North Kensington Avenue
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Approved June 5, 2012
by the
American National Standards Institute, Inc.

American National Standard

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Foreword (This Foreword is not a part of American National Standard “Criteria for Assessing Atmospheric Effects on the Ultimate Heat Sink,” ANSI/ANS-2.21-2012.)

Code of Federal Regulations, Title 10, “Energy,” Part 50, “Domestic Licensing of Production and Utilization Facilities” (10 CFR 50), Appendix A, “General Design Criteria for Nuclear Power Plants,” Criterion 44, “Cooling Water,” requires suitable redundancy in the cooling water system features of nuclear power plants to ensure that its safety function is accomplished. 10 CFR 50, Appendix A, Criterion 2, “Design Bases for Protection Against Natural Phenomena,” requires that systems, structures, and components important to safety be designed to withstand the effects of natural phenomena without loss of capability to perform its safety function. The redundancy features of the cooling water system of nuclear power plants are referred to as the ultimate heat sink. The ultimate heat sink is the complex of water sources, including necessary retaining structures (e.g., a pond or river with its dam), and the canals or conduits connecting the sources with, but not including, the cooling water system intake structures for a nuclear power unit. The sink constitutes the source of essential service water supply necessary to safely operate, shut down, and cool down a nuclear plant.

There is a need to provide consistency to calculations of atmospheric effects to ultimate heat sinks at nuclear facilities. Existing regulatory guidance (i.e., Regulatory Guide 1.27, “Ultimate Heat Sink for Nuclear Power Plants”) is dated (1970s vintage) and does not provide guidance on how to calculate effects to ultimate heat sinks using atmospheric parameters.

This standard establishes criteria for use of meteorological data collected at nuclear facilities to evaluate the atmospheric effects from meteorological parameters [e.g., dry-bulb temperature/wet-bulb temperature differential, precipitation, wind speed, short wave radiation, incoming solar (i.e., short wave) radiation, surface water temperature, and atmospheric pressure] on ultimate heat sinks.

This standard might reference documents and other standards that have been superseded or withdrawn at the time the standard is applied. A statement has been included in the references section that provides guidance on the use of references.

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Criteria for Assessing Atmospheric Effects on the Ultimate Heat Sink

1 Scope

This standard describes atmospheric effects for consideration when designing ultimate heat sinks for safety-related systems at nuclear power units. Required analyses are provided for a meteorological assessment of the ultimate heat sink to ensure that design temperatures and cooling capacity requirements for the facility are met. The standard is intended to apply to new nuclear units or the redesign of the cooling systems at existing nuclear units. The discussion primarily applies to cooling lakes, spray ponds, rivers, mechanical draft cooling towers, and natural draft cooling towers, which are the heat dissipation systems most commonly used for nuclear power plants. However, the same principles apply to seawater cooling and spray ponds. This standard does not apply to designs that do not rely on external water sources as the ultimate heat sink or to nonmeteorological elements of ultimate heat sink design.

2 Definitions

critical time period: The time frame over which relevant meteorological data are evaluated to determine that a particular type of ultimate heat sink design (e.g., cooling lakes, rivers, spray ponds, mechanical draft cooling towers, and natural draft cooling towers) will be able to perform its critical function.

drift loss: The emission of small water droplets entrained in the cooling tower air flow. The droplets contain the dissolved solids found in the circulating water.

dry-bulb temperature: The temperature registered by the dry-bulb thermometer of a psychrometer or simply the temperature of the air.

frazil ice: Ice crystals that form in supercooled water that is too turbulent to permit coagulation into sheet ice.

shall, should, and may: The word “shall” is used to denote a requirement; the word “should” is used to denote a recommendation; and the word “may” is used to denote permission, neither a requirement nor a recommendation.

ultimate heat sink: The complex of water sources, including necessary retaining structures (e.g., a pond or river with its dam), and the canals or conduits connecting the sources with, but not including, the cooling water system intake structures for a nuclear power unit. The sink constitutes the source of service water supply necessary to safely operate, shut down, or cool down a plant following a design-basis accident.

wet-bulb temperature: The temperature of a wet-bulb thermometer when the heat leaving the wet bulb from evaporative cooling is equal to the heat transferred to the wet bulb by convective heat transfer from the surrounding air.

3 Ultimate heat sink function

The ultimate heat sink function is to ensure that design-basis temperatures of the plant’s safety-related equipment are not exceeded. Ultimate heat sinks shall be designed to have the cooling capacity to provide sufficient cooling water at the maximum allowable inlet temperature under the most adverse meteorological conditions expected for the power plant climatic regime.

Ultimate heat sink design shall be based on development of numerical models of a cooling lake or cooling tower using meteorological data representative of the site taken at or near the power plant. The numerical models shall be validated using data taken at locations with climates similar to the climate of the site of the proposed power plant. NUREG-0693 [1]¹⁾ and NUREG-0733 [2] give detailed instructions on

¹⁾Numbers in brackets refer to corresponding numbers in Sec. 8, “References.”