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Criteria for Assessing Atmospheric Effects on the Ultimate Heat Sink

An American National Standard

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Foreword

(This foreword does not contain any requirements of American National Standard "Criteria for Assessing Atmospheric Effects on the Ultimate Heat Sink," ANSI/ANS-2.21-2022, but is included for informational purposes.)

The Ultimate Heat Sink (UHS) constitutes the source of essential service water supply necessary to safely operate, shut down, and cool a nuclear plant during normal and accident conditions. *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 the 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 their safety functions. The UHS is the complex of water sources, including necessary retaining structures (e.g., a pond or river with its dam) and any canals or conduits, that connects to, but does not include, the cooling water system intake structures for a nuclear power unit.

ANS-2.21 was originally written in 2012 and reaffirmed in 2016. However, there is a continuing need to provide consistency to calculations of atmospheric effects on UHSs at nuclear facilities and for designs to consider potential impacts from climate change. The need for a revision to ANS-2.21 was identified in 2018, to address technical issues and current UHS modeling methods.

This revision of ANS-2.21 considers off-site and/or remotely monitored meteorological data sources, in addition to on-site meteorological data, to improve the spatial representativeness of UHS modeling inputs. It also addresses issues raised in September 2018 by the U.S. Nuclear Regulatory Commission (NRC) to the American Nuclear Society Environmental and Siting Consensus Committee chair by recognizing that this standard does not apply to natural draft cooling towers or to the passive cooling systems of newer reactor designs. Potential impacts from climate change are addressed, and critical time periods are acknowledged to be dependent on various system designs. This standard establishes criteria for the use of meteorological data that are both validated and representative of a nuclear facility, and it identifies supporting hydrological information to evaluate effects on UHS performance due to atmospheric conditions. Meteorological input parameters may include dry-bulb temperature, wet-bulb temperature, dewpoint, cloud cover, relative humidity, precipitation, wind speed and direction, incoming shortwave solar radiation, incoming longwave radiation, surface water temperature, and station atmospheric pressure.

Nuclear power plant operators, design professionals, nuclear facility owners, and nuclear vendors/consultants will benefit from an awareness of the inherent limitations of meteorological data collection, as well as potential data resources described in this revision. Examples of applying deterministic and risk-informed, performance-based approaches to developing input data for UHS performance modeling are provided in Appendix A. Appendix B provides examples of adjusting data for representativeness and gap filling. Appendix C provides a listing of additional online resources for meteorological data that will evolve with advances in monitoring technology.

The NRC's Regulatory Guide 1.27 (Rev. 3), "Ultimate Heat Sink for Nuclear Power Plants," relies on the design engineer to decide what critical periods in UHS performance are to be evaluated, based on a specific design's limitations. At the time of this standard's approval, the NRC was not working on any updates to NUREG-0693, "Analysis of Ultimate

Heat Sink Cooling Ponds," or NUREG-0733, "Analysis of Ultimate-Heat-Sink Spray Ponds," originally published in 1980 and 1981 respectively. These methods remain acceptable to the NRC. However, there is a continued need for life-of-plant monitoring and tracking of UHS water temperatures to identify and address any degrading performance of the UHS system, in order to provide sufficient cooling capacity to handle changing environmental conditions now and in the future.

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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