Review of ANSI/ANS-2.21-2012 and DG-1275 Criteria for Assessing Atmospheric Effects on the Ultimate Heat Sink

ANSI/ANS-2.21-2012	Staff Comments and Comparison to DG-1275
1 Scope	
This standard describes atmospheric effects for consideration when designing ultimate heat sinks for safety-related systems at nuclear power units.	• ANS-2.21 does not address all the atmospheric effects associated with designing UHSs because it does not address GDC 2 criteria for severe natural phenomena such as tornadoes and hurricanes.
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.	• DG-1275 has a similar statement: Sufficient conservatism should be provided to ensure that a 30-day cooling supply is available and that design-basis temperatures of safety-related equipment are not exceeded. For UHSs where the water supply may be limited or the temperature of plant intake water from the UHS eventually may become critical (e.g., ponds, lakes, cooling towers, or other UHSs where recirculation between plant cooling water discharge and intake can occur), transient analyses of supply and/or temperature, as appropriate, should be performed.
The standard is intended to apply to new nuclear units or the redesign of the cooling systems at existing nuclear units.	• DG-1275 states NRC applicants and licensees may voluntarily use the guidance in DG-1275 to demonstrate compliance with the underlying NRC regulations; methods or solutions that differ from those described in DG-1275 may be deemed acceptable if they provide sufficient basis and information for the NRC staff to verify that the proposed alternative demonstrates compliance with the appropriate NRC regulations. • DG-1275 states the NRC staff does not expect any existing licensee to use or commit to using the guidance in DG-1275, unless the licensee makes a change to its licensing basis.
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.	• Natural draft cooling towers are unlikely to qualify as acceptable UHSs because they cannot be designed to meet GDC 2 criteria to withstand severe natural phenomena such as earthquakes and tornadoes.
However, the same principles apply to seawater cooling and spray ponds.	• Not sure which aspects of ANS-2.21 are applicable to seawater cooling • “Spray ponds” is confusingly listed in both this sentence and the previous sentence.

ANSI/ANS-2.21-2012	Staff Comments and Comparison to DG-1275
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.	• The first item implies ANS-2.21 does not apply to passive designs, which is also the case for DG-1275. • DG-1275 has an expanded scope as compared to ANS-2.21: o DG-1275 applies to structures and components credited for functioning as a heat sink, such as water retaining structures (e.g., a pond, a reservoir with its dam) and the canals (aqueducts) or piping systems connecting those cooling water sources with the essential or safety-related cooling water intake structure of the nuclear power units. o DG-1275 also addresses: ▪ natural phenomena and site hazard design ▪ defense-in-depth considerations ▪ technical specification provisions ▪ in-service testing, maintenance, and performance testing ▪ water chemistry and microbiological control
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.	• DG-1275 is more explicit in describing critical time periods by stating that sufficient conservatism should be provided to ensure that (1) a safety related water supply for a 30-day cooling capacity is available (e.g., there is a 30-day supply of water available for those UHSs relying on evaporation) and that (2) the design-basis temperatures of safety-related equipment are not exceeded. • Natural draft cooling towers are unlikely to qualify as acceptable UHSs because they cannot be designed to meet GDC 2 criteria to withstand severe natural phenomena such as earthquakes and tornadoes.
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.	• Drift loss is not defined in DG-1275. • This definition appears to be limited to cooling towers; it should be expanded to also apply to spray ponds. • The relevance of the second sentence is unclear. This standard does not address the deposition of dissolved solids from cooling tower plumes.
dry-bulb temperature: The temperature registered by the dry-bulb thermometer of a psychrometer or simply the temperature of the air.	• DG-1275 does not use the term “dry-bulb temperature”
frazil ice: Ice crystals that form in supercooled water that is too turbulent to permit coagulation into sheet ice.	• DG-1275 does not discuss frazil ice; instead, it is addressed in SRP 2.4.7, “Ice Effects.”

ANSI/ANS-2.21-2012	Staff Comments and Comparison to DG-1275
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.	• U.S. NRC regulatory guides do not denote "requirements." Methods or solutions that differ from those described in DG-1275 may be deemed acceptable if they provide sufficient basis and information for the NRC staff to verify that the proposed alternative demonstrates compliance with the appropriate NRC regulations.
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.	• Appears to be consistent with DG-1275 which states: The UHS is the system of structures and components and associated assured water supply and atmospheric condition(s) credited for functioning as a heat sink to absorb reactor decay heat and essential station heat loads after a normal reactor shutdown or a shutdown following a design-basis accident (DBA) or transient. This includes those necessary water-retaining structures (e.g., a pond, a reservoir with its dam) and the canals (aqueducts) or piping systems connecting those cooling water sources with the essential or safety-related cooling water intake structure of the nuclear power units. Nonsafety systems (e.g., circulating water supply) may share this safety-related water supply. If cooling towers or portions of cooling towers are required to accomplish the UHS safety functions, they should satisfy the same requirements as the UHS.
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.	• Wet-bulb temperature is not defined in DG-1275.
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.	• DG-1275 has a similar statement in that sufficient conservatism should be provided to ensure that design-basis temperatures of 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.	• Unlike ANS-2.21 which states UHSs shall be designed for the "most adverse meteorological conditions expected for the power plant climatic regime," DG-1275 states that the climatological measurements used to evaluate the UHS design should be the most severe observations from a recent period of record at least 30 years in length. It is not clear as to how to predict "the most adverse meteorological conditions expected for the power plant climatic regime."

ANSI/ANS-2.21-2012	Staff Comments and Comparison to DG-1275
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.	• DG-1275 is a little more prescriptive in that it states that transient analyses of supply and temperature should be performed where the water supply may be limited or the temperature of plant intake water from the UHS may become critical (e.g., ponds, lakes, cooling towers, or other UHSs where recirculation between plant cooling water discharge and intake can occur).
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.	• Appears to be consistent with DG-1275 which states: The … analyses related to the 30-day cooling supply and the minimum cooling should include sufficient information to substantiate the assumptions and analytical methods used. This information should include actual performance data for a similar cooling method operating under load near the specified design conditions, or justification that conservative evaporation, drift loss, and heat transfer values have been used.
NUREG-0693 and NUREG-0733 give detailed instructions on computer programs used in analyzing small cooling and spray ponds, respectively. The techniques presented in these reports outline the ways in which long-term, off-site meteorological records can be (a) scanned to find the most adverse conditions, (b) correlated to on-site data, (c) analyzed statistically, and (d) used to predict the highest temperature and water loss.	• DG-1275 also references these two NUREGs and states that these documents provide “techniques” for evaluating cooling ponds and spray ponds. The staff has been unsuccessful in implementing the computer programs listed in these two NUREGs on a MS Windows PC environment.
Two other examples of ultimate heat sink models are provided in (3) [R. B. CODELL, “Performance Model for Ultimate Heat Sink Spray Ponds,” *J. Energy Engineering*, **112**, *2*, 71 (Aug. 1986).] and (4) [A. J. POLICASTRO, M. WASTAG, W. E. DUNN, J. LEYLAK, F. GAVIN, and R. A. CARHART, “Mathematical Modeling of Ultimate Heat Sink Cooling Ponds,” Argonne National Laboratory (Mar. 1985).].	• These two references are not listed in DG-1275 as the staff is not familiar with these references.
The details of the model validation are not within the scope of this standard.	• No comment

ANSI/ANS-2.21-2012	Staff Comments and Comparison to DG-1275
Hourly meteorological data representative of the site collected over a minimum period of 10 years and extending to as much as 30 years (if data are available) shall be used to ensure that interannual variability of the weather is captured in the database.	• This statement in ANS-2.21 appears to conflict with DG-1275 which emphasizes the use of 30 years of meteorological data: Climatological measurements … should be based on a recent period of record at least 30 years in length and should be demonstrated to be representative of conditions that might reasonably be expected to occur at the site. If significantly less than 30 years of representative data are available, other historical regional data (including, if available, quality assured onsite meteorological data) should be examined to determine the controlling meteorological conditions for the critical time period(s). If examination of other historical regional data indicate that the controlling meteorological conditions did not occur within the period of record for the available representative data, these conditions should be correlated with the available representative data and appropriate adjustments should be made for site conditions.
On-site data are preferred over off-site National Weather Service (NWS) data. This is particularly important for ultimate heat sink assessments because the extreme conditions that will test the design limits of the ultimate heat sink will not occur every year.	• DG-1275 states climatological measurements should be based on a recent period of record at least 30 years in length and be demonstrated to be representative of conditions that might reasonably be expected to occur at the site. DG-1275 implicitly assumes that offsite data will be used because it is unlikely that 30 years of good quality onsite data will be available. As pointed out previously in ANS-2.21, NUREG-0693 and NUREC-0733 provide techniques which include correlating long-term offsite meteorological records to onsite data.
If a suitable (i.e., 10 years or longer) long-term database cannot be found, it shall be necessary to use expert judgment to construct a meteorological database for the numerical model that contains what are believed to be the most limiting credible set of meteorological conditions that the power plant operators would encounter over the lifetime of the plant.	• DG-1275 implicitly assumes a suitable long-term database can be found. • It is not clear how to determine "the most limiting credible set of meteorological conditions that the power plant operators would encounter over the lifetime of the plant." If it is intended to be related to the 100-year mean recurrence interval discussed later in ANS-2.21, there is a 45% chance that parameters with a 100-year mean recurrence interval will be exceeded during a 60-year license period.
The results of the 10-year–or–longer simulation with several extreme events shall be used to perform extreme value statistical analyses that project the most extreme weather conditions for the expected license period of the power plant, which could be 60 years or more.	• It is not clear how to perform extreme value statistical analysis to project extreme weather conditions when extreme weather conditions represent a set of various independent variables (for example, a combination of dry bulb, dew point, wind speed, and solar radiation parameters are needed to define extreme weather conditions for evaluating cooling pond performance).

ANSI/ANS-2.21-2012	Staff Comments and Comparison to DG-1275
Not included in this standard is ultimate heat sink design that is unrelated to meteorological data such as downstream dam failure.	• DG-1275 has an expanded scope in that it also applies to structures and components credited for functioning as a heat sink, such as water retaining structures (e.g., a pond, a reservoir with its dam) and the canals (aqueducts) or piping systems connecting those cooling water sources with the essential or safety-related cooling water intake structure of the nuclear power units.
4 Critical time period	
The critical time period for plant operation during extreme meteorological conditions varies according to the type of ultimate heat sink being used and the particular parameter being analyzed.	• DG-1275 has a similar statement: The meteorological conditions considered in the design of the UHS should be selected with respect to the controlling parameter(s) and critical time periods unique to the specific design of the UHS.
The large volumes of cooling lakes cause them to respond more slowly to extreme conditions than cooling towers. Thus, the most extreme conditions for cooling tower temperature performance would be a short period of extremely high temperature and humidity, whereas for a cooling lake it will be a longer period that may not have absolute extremes as high as the cooling tower assessment data set but that will have a longer period of adverse conditions.	• DG-1275 expresses a similar sentiment by stating the critical time period for UHS wet cooling towers may be on the order of several hours whereas the pond temperature in a cooling pond used as the UHS may reach a maximum several days following a shutdown.
The U.S. Nuclear Regulatory Commission provides guidance [Regulatory Guide 1.27, "Ultimate Heat Sink for Nuclear Power Plants," Rev. 2, U.S. Nuclear Regulatory Commission, Office of Standards Development (Jan. 1976).] in regard to the critical time period.	• This could result in circular reasoning; a RG references an ANS standard that references an earlier version of the same RG!
In the case of a cooling lake, the lake temperature may reach a maximum in 5 days following a shutdown.	• DG-1275 eliminated reference to a 5-day maximum temperature for a cooling pond. It now states the pond temperature in a cooling pond used as the UHS may reach a maximum "several days" following a shutdown.
Therefore, three critical time periods to be included in the assessment are 5 days, 1 day, and 30 days to ensure the availability of a 30-day cooling supply. The three periods need not occur contiguously but may be combined to produce a synthetic 36-day period that may be used as the design basis for the lake.	• DG-1275 is less prescriptive; it states the maximum pond temperature should be considered to coincide with the most severe combination of controlling meteorological parameters. • This is the first (and rather obtuse) statement in ANS-2.21 that a 30-day cooling supply is required.
In the case of a wet cooling tower, the meteorological conditions resulting in maximum evaporation and drift losses shall be the worst 30-day combination of the controlling parameters such as wet-bulb temperature and wind speed.	• This is the second (and again rather obtuse) statement in ANS-2.2.1 that a 30-day cooling supply is required. • The staff is not sure that cooling tower drift is a function of wind speed.

ANSI/ANS-2.21-2012	Staff Comments and Comparison to DG-1275
The critical time period shall be contained in the 10-year–or–longer database, along with several other periods of weather that are almost as extreme as the critical time period.	• The staff does not understand this sentence. Under what circumstances would the critical time period be in another database other than the 10-year–or–longer database? Constraining the POR to at least 10 years also constrains the possible number of similar scenarios available for evaluation.
The data shall be analyzed using an extreme value probability distribution function such as the Weibull or Fisher-Tippett functions [E. W. WEISSTEIN, *CRC Concise Encyclopedia of Mathematics*, 2nd ed., Chapman & Hall0CRC (2002).] [*2009 ASHRAE Handbook—Fundamentals*, Chapters 1 and 14, American Society of Heating, Refrigerating, and Air-Conditioning Engineers (July 1, 2009).] to obtain parameter values with a mean recurrence interval of 100 years or more.	• Selecting a 100-year mean recurrence interval to represent "the most limiting credible set of meteorological conditions that the power plant operators would encounter over the lifetime of the plant" does not appear to be appropriate in that there is a 45% chance that parameters with a 100-year mean recurrence interval will be exceeded during a 60-year license period. • It is not clear how to perform extreme value statistical analysis to project parameters when extreme weather conditions represent a set of various independent variables (for example, a combination of dry bulb, dew point, wind speed, and solar radiation parameters are needed to define extreme weather conditions for evaluating cooling pond performance). It is also not clear how to estimate a 100-year return period for critical time periods that are on the order of days for one, let alone, more than one variable. • DG-1275 implicitly assumes that the worst meteorological conditions that have occurred during a recent 30-year period of record are appropriate for designing UHSs because of the low probability of a DBA occurring simultaneously with worst-case meteorological conditions.
5 Meteorological data input	
5.1 Cooling lakes/spray ponds	
The meteorological data used as input to the numerical performance model of the heat sink differ, depending on which heat sink is being modeled.	• DG-1275 has a similar statement: The meteorological conditions considered in the design of the UHS should be selected with respect to the controlling parameter(s) and critical time periods unique to the specific design of the UHS.

ANSI/ANS-2.21-2012	Staff Comments and Comparison to DG-1275
For cooling lake and river simulations, the required data shall consist of the following: dry-bulb temperature, dew point temperature, wind speed, wind direction, solar radiation (including cloud cover), atmospheric pressure and profiles of temperature, precipitation, and humidity as a function of height above the ground. These profiles shall be used for more accurate computations of net thermal radiation in the surface energy balance model for the cooling lake air-water interface. One methodology is described in NUREG/CR-4120 [NUREG/CR-4120, "Mathematical Modeling of Ultimate Heat Sink Cooling Ponds," U.S. Nuclear Regulatory Commission (Mar. 1985).].	• NUREG/CR-4120 is a reference that is not included in DG-1275. • NUREG/CR-4120 does not appear to use temperature, precipitation, and humidity profiles as a function of height above ground. • The staff is uncertain as to what is a "precipitation" profile.
Precipitation is usually reported at NWS stations in the United States and may be added to the cooling lake simulation.	• The analytical models described in NUREG-0693 (which is referenced earlier in ANS-2.21 as an appropriate technique for analyzing small cooling ponds) do not use precipitation as input. Because precipitation can be a localized phenomenon during the summer months (when the critical time periods would occur), it would be best if precipitation was not added to the cooling lake simulation.
However, precipitation typically does not have a significant effect on the performance of the cooling lake, which normally has a stream feeding into it or some other source of makeup water.	• In the case of LaSalle, the UHS consists of an excavated (submerged) pond integral with the cooling lake. The UHS design basis event includes a failure of the cooling lake dike which drains the cooling lake, resulting in the UHS as the remaining source of cooling water to plant safety systems. In this situation, there is no stream or natural source of makeup water for the UHS.
No credit should be taken for makeup water increase in water inventory unless the makeup water system's safety and quality classification is commensurate with the ultimate heat sink classification.	• DG-1275 has similar, more prescriptive, criteria: The UHS complex, whether supplied by single or multiple water sources, should be capable of withstanding, without loss of the UHS safety functions, all of the following events: (1) the most severe natural phenomena expected at the site in accordance with GDC 2, (2) the site-related events (e.g., transportation accident, river diversion) that historically have occurred or that may reasonably be expected to occur during the plant lifetime, (3) reasonably probable combinations of less severe natural phenomena or site-related events, and (4) Failure of reservoirs, dams and other manmade water retaining structures both upstream and downstream of the site including the potential for resultant debris to block water flow.

ANSI/ANS-2.21-2012	Staff Comments and Comparison to DG-1275
The large thermal inertia of cooling lakes ensures that individual errors in the meteorological database have little effect on the results of the numerical simulation.	• The staff agrees with this statement if a value of a meteorological parameter for an isolated hour contains an "individual error" but not if "individual error" includes a bias in one set of parameter values (such as wind speed or solar radiation).
5.2 Cooling towers	
Since cooling towers have low thermal inertia and respond rapidly to extreme weather conditions, meteorological data sets shall be used to simulate cooling tower performance.	• The staff is uncertain as to what this statement means; for example, what else besides meteorological data sets would be used to simulate cooling tower performance?
Quality assurance as described in ANSI/ANS-3.11-2005 [ANSI/ANS-3.11-2005 (R2010), "Determining Meteorological Information at Nuclear Facilities," American Nuclear Society, La Grange Park, Illinois (2005).] and Regulatory Guide 1.23 [Regulatory Guide 1.23, "Meteorological Monitoring Programs for Nuclear Power Plants," Rev. 1, U.S. Nuclear Regulatory Commission, Office of Nuclear Regulatory Research (Mar. 2007).] shall be applied.	• This statement should also apply to meteorological data sets used in numerical models of a cooling lake. • ANS-3.11 and RG 1.23 are two references that are not listed in DG-1275. These two references are applicable to onsite data collection activities at nuclear facilities, whereas DG-1275 assumes that offsite data will be used to analysis UHS performance.
The meteorological data used as input to the numerical performance model of the heat sink required for cooling towers are much more limited, consisting of dry-bulb temperature, dew point temperature, and atmospheric pressure. These three variables shall be used to compute wet-bulb temperature [S. HESS, *Introduction to Theoretical Meteorology*, Holt, Rinehart and Winston, New York (1959).], which is the single atmospheric variable required for cooling tower simulations (along with tower design specifications).	• As an alternative, web bulb could be monitored directly instead of being calculated as a function of dry bulb, dew point, and atmospheric pressure.
For both mechanical and natural draft cooling towers, a correction factor shall be added to the ambient design wet-bulb temperature to account for interference effects of nearby towers or other structures. An increase of 1°F to the design wet-bulb temperature for natural draft towers and 2°F for mechanical draft towers is recommended by Ref. 12 ["External Influences on Cooling Tower Performance," Report No. H-004, SPX Cooling Technologies.]. Cooling tower performance is then determined using the adjusted design wet-bulb temperature. One method is described in ["Method for Analysis of Ultimate Heat Sink Cooling Tower Performance," University of Illinois at Urbana-Champaign (Apr. 1986).].	• DG-1275 has been modified to state that UHS cooling towers should be designed to accommodate the potential effects of recirculation and interference. • Natural draft cooling towers are unlikely to qualify as acceptable UHSs because they cannot be designed to meet GDC 2 criteria to withstand severe natural phenomena such as earthquakes and tornadoes.
Wind speed is an important variable for mechanical draft cooling towers running with fans off because it largely determines the amount of heat and mass transfer from water to air inside the tower under those conditions. However, ultimate heat sink assessments assume that the cooling tower fans will be on.	• If UHS assessments assume that the cooling tower fans will be on, it is unclear as to why would we care about wind speed being an important valuable when the cooling tower fans are off.

ANSI/ANS-2.21-2012	Staff Comments and Comparison to DG-1275
The exception to this rule may occur during extreme cold conditions, when water is flowing through the mechanical draft cooling tower but the fans have been turned off to reduce the heat transfer from water to air and prevent icing inside the tower. In this situation, the cooling tower performance model shall be able to realistically simulate the effect of ambient winds on tower thermal performance.	• DG-1275 has been modified to state that UHS mechanical components should be automatically start to support DBA heat loads.
5.3 Hybrid systems	
Some proposed ultimate heat sink designs have included the combination of a mechanical draft cooling tower and a cooling water basin. In this case, consideration shall be given to the meteorological data required to evaluate both cooling tower performance and evaporation potential.	• All UHS mechanical draft cooling towers have water basins.
6 Meteorological phenomena	
Four meteorological phenomena can affect ultimate heat sink performance in addition to the extreme conditions discussed above: icing, freezing, frazil ice formation, and drought.	• DG-1275 does not discuss frazil ice; instead, it is addressed in SRP 2.4.7, "Ice Effects." • DG-1275 does not discuss drought; instead, it is addressed by SRP 2.4.11, "Low Water Considerations."
Icing and freezing are of concern to mechanical and natural draft cooling towers whereas drought can be a problem for cooling towers and lakes, although it is more likely to be a limiting condition for cooling lakes.	• ANS-2.21 does not address the potential for water freezing in a UHS water storage facility. DG-1275 states: The potential for adverse environmental conditions, such as icing, should be considered in determining UHS performance. If applicable, the potential for water freezing in the UHS water storage facility also should be analyzed. The maximum accumulated degree-days below freezing recorded in the site region during the winter (or during the worst-case freezing spell in warmer climates) may be a reasonable conservative site characteristic for evaluating the potential for water freezing in a UHS water storage facility. • Natural draft cooling towers are unlikely to qualify as acceptable UHSs because they cannot be designed to meet GDC 2 criteria to withstand severe natural phenomena such as earthquakes and tornadoes.
Drought conditions can lead to low water flows and increased evaporation rates.	• DG-1275 does not discuss drought; instead, it is addressed by SRP 2.4.11, "Low Water Considerations."
Extreme cold weather (i.e., generally below 0°F) will cause cooling towers to ice up, which can lead to structural damage.	• DG-1275 states that the potential for adverse environmental conditions, such as icing, should be considered in determining UHS performance.

ANSI/ANS-2.21-2012	Staff Comments and Comparison to DG-1275
For natural draft towers, the air intake at the base can be reduced in area, which reduces heat losses from the water to the air and prevents freezing of the water. For locales with the most extreme cold, cooling water bypasses are used, in which the heated water does not pass through the tower at all but goes directly from the power plant to the basin at the bottom of the tower.	• Natural draft cooling towers are unlikely to qualify as acceptable UHSs because they cannot be designed to meet GDC 2 criteria to withstand severe natural phenomena such as earthquakes and tornadoes.
For mechanical draft cooling towers, fans would not be operated in extreme cold because this also reduces heat transfer from water to air. The frequency of occurrence of extreme cold weather (i.e., generally below 0°F) shall be determined from the meteorological database discussed in Sec. 3. A frequency of occurrence of 1% or more of days with temperatures below 0°F shall implement mitigation of these effects. However, as noted above, in this operating condition the wind speed becomes an important performance assessment variable because it has a major impact on heat transfer when there is no forced airflow.	• DG-1275 has been modified to state that UHS mechanical components should be automatically start to support DBA heat loads. • Needs clarification as to whether a “day” would be one in which any hour met the temperature criterion or if that criterion represents a daily mean value.
Frazil ice formation is a unique phenomenon at submerged pump intakes (including for ultimate heat sinks) where supercooled water contacting the intake screen system (or other submerged structures in the flow path) suddenly generates growing ice formations on the structures including complete flow blockage. Windy conditions, where surface ice formation is discouraged, together with a clear night and cold ambient temperatures are frequently the precursors to this serious condition. The frequency of occurrence of this condition shall be determined from the meteorological database discussed in Sec. 3.A frequency of occurrence of 1% or more of days with concurrent temperatures below 10°F and winds greater than 20 mph shall implement mitigation of these effects.	• DG-1275 does not discuss frazil ice; instead, it is addressed in SRP 2.4.7, “Ice Effects.” • Needs clarification as to whether a “day” would be one in which any hour met the temperature criterion or if that criterion represents a daily mean value.
Drought is usually associated with abnormally hot weather. Therefore, cooling lake assessments shall combine extreme weather with reduced lake volume if that is a possibility for a given site.	• DG-1275 does not discuss drought; instead, it is addressed by SRP 2.4.11, “Low Water Considerations.”
The reduced volume decreases the thermal inertia of the lake making it more susceptible to shorter periods of extreme heat and humidity.	• This is implied by DG-1275 which states the critical time period for a UHS wet cooling tower may be on the order of several hours whereas the water temperature in a UHS cooling pond may reach a maximum in several days.

ANSI/ANS-2.21-2012	Staff Comments and Comparison to DG-1275
Drought can also lower the lake level sufficiently to significantly reduce the flow to the pumps supplying water to the power plant, resulting in reduced cooling water flow and possibly pump cavitation. Drought can also adversely affect the performance of cooling towers given that the sources of makeup water are reduced in volume and may result in higher temperatures. An alternative source of makeup water may address these issues and simplify the ultimate heat sink assessment.	• Drought is addressed by SRP 2.4.11, "Low Water Considerations" instead of DG-1275.
7 Required records	
The following records of calculation of ultimate heat sink performance shall be kept in accordance with [NRC Management Directive 3.53, NRC Records and Document Management Program, Revised (Mar. 15, 2007)]: (1) documentation of ultimate heat sink performance evaluation including methods used, meteorological data used as input, software used and validation, and results; (2) reference documents used; (3) electronic files of meteorological data used in the analysis; (4) software user's manuals and validation documentation.	• It is unclear why an internal NRC Management Directive which is intended to ensure official records made or received by NRC in the course of its official business comply with the regulations governing Federal records management issued by the National Archives and Records Administration (NARA) and the General Services Administration (GSA) would apply to NRC licensee's and applicants. • DG-1275 states nuclear power plant facility licensees and applicants must meet the minimum requirements for quality assurance in Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," to 10 CFR Part 50. A more appropriate statement for ANS-2.21 would be to have the UHS records maintained in accordance with the record retention requirements of the applicant's/licensee's quality assurance program.