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Docket No. 50-255
LS05-81-02-061

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U.S. NUCLEAR REGULATORY COMMISSION

Mr. David P. Hoffman
Nuclear Licensing Administrator
Consumers Power Company
1945 W. Parnall Road
Jackson, Michigan 49201

Dear Mr. Hoffman:

SUBJECT: TOPIC III-2 WIND AND TORNADO LOADINGS (PALISADES)

Enclosed is a copy of our draft evaluation of Systematic Evaluation Program Topic III-2. You are requested to examine the facts upon which the staff has based its evaluation and respond either by confirming that the facts are correct or by identifying errors and supplying the corrected information. We encourage you to supply any other material that might affect the staff's evaluation of these topics or be significant in the integrated assessment of your facility.

Your response is requested within 30 days of receipt of this letter. If no response is received within that time, we will assume that you have no comments or corrections.

In future correspondence regarding Systematic Evaluation Program Topics, please refer to the topic numbers in your cover letter.

Sincerely,

Dennis M. Crutchfield, Chief
Operating Reactors Branch #5
Division of Licensing

Enclosure:
As stated

cc w/enclosure:
See next page

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ok, but I think we should develop acceptable Tornado wind Velocities based on Texas Tech/Info ASAP

OFFICE	SEPB:DL DP	SL/SEPB:DL	C/SEPB:DL	ORB#5:DL	C/ORB#5:DL	AD/SA:DL	
SURNAME	DPersinko:dn	RHermann	WRussell	TWambach	DCrutchfield	GLainas	
DATE	2/19/81	2/20/81	2/20/81	2/24/81	2/25/81	2/25/81	

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

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Enclosure:
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cc w/enclosure:
See next page

cc w/enclosure:
M. I. Miller, Esquire
Isham, Lincoln & Beale
Suite 4200
One First National Plaza
Chicago, Illinois 60670

Mr. Paul A. Perry, Secretary
Consumers Power Company
212 West Michigan Avenue
Jackson, Michigan 49201

Judd L. Bacon, Esquire
Consumers Power Company
212 West Michigan Avenue
Jackson, Michigan 49201

Myron M. Cherry, Esquire
Suite 4501
One IBM Plaza
Chicago, Illinois 60611

Ms. Mary P. Sinclair
Great Lakes Energy Alliance
5711 Summerset Drive
Midland, Michigan 48640

Kalamazoo Public Library
315 South Rose Street
Kalamazoo, Michigan 49006

Township Supervisor
Covert Township
Route 1, Box 10
Van Buren County, Michigan 49043

Office of the Governor (2)
Room 1 - Capitol Building
Lansing, Michigan 48913

Director, Criteria and Standards Division
Office of Radiation Programs (ANR-460)
U. S. Environmental Protection Agency
Washington, D. C. 20460

U. S. Environmental Protection Agency
Federal Activities Branch
Region V Office
ATTN: EIS COORDINATOR
230 South Dearborn Street
Chicago, Illinois 60604

Charles Bechhoefer, Esq., Chairman
Atomic Safety and Licensing Board Panel
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Dr. George C. Anderson
Department of Oceanography
University of Washington
Seattle, Washington 98195

Dr. M. Stanley Livingston
1005 Calle Largo
Santa Fe, New Mexico 87501

Resident Inspector
c/o U. S. NRC
P. O. Box 87
South Haven, Michigan 49090

Palisades Plant
ATTN: Mr. J. G. Lewis
Plant Manager
Covert, Michigan 49043

William J. Scanlon, Esquire
2034 Pauline Boulevard
Ann Arbor, Michigan 48103

ENCLOSURE

PALISADES PLANT

Docket No. 50-255

SEP TOPIC III-2, WIND AND TORNADO LOADINGS

I. INTRODUCTION

The safety objective of this review is to assure that seismic Category I structures are adequately designed to resist wind loading, tornado loading and tornado pressure drop loading, and that any damage to structures which are not designed for such loadings will not endanger seismic Category I structures, systems or equipment. Also, tornado effects on emergency cooling ponds are reviewed to assure that tornado winds will not prevent the water in the cooling ponds from acting as a heat sink.

II. REVIEW CRITERIA

The currently accepted design criteria for wind and tornado loadings on structures is outlined in the Standard Review Plan (SRP) Section 3.3.1 and Section 3.3.2 and in Regulatory Guides 1.76 and 1.117. Tornado wind load is the governing wind load and is specified in Regulatory Guide 1.76 as 360 mph maximum wind speed and a pressure drop of 3 psi at a rate of 2 psi per second for the Palisades Plant. Blow out panels were not used at this plant to mitigate differential pressure.

III. RELATED SAFETY TOPICS AND INTERFACES

1. Tornado missile protection is evaluated under SEP Topic III-4.A.

2. Structures which are to be considered as tornado resistant are designated under SEP Topic III-1.

3. Wind and tornado velocities are evaluated under SEP Topic II-2.A.

IV. REVIEW GUIDELINES

Pressures, load combinations, configurations and design features which were used in the original construction of the plant, as outlined in the FSAR and other docket files, are compared with the currently accepted criteria as described above.

V. EVALUATION

According to Appendix A of the Palisades Plant FSAR, all seismic Category I structures were designed to withstand a 360 mph tornado wind load, which translates to a maximum externally applied design pressure of 2.3 psi. In addition the structures were designed for an internally applied pressure of 3 psi. This criteria is essentially the same as that outlined in Regulatory Guide 1.76, which is the currently accepted criteria for this loading.

Blowout panels were not used as a design feature in this plant and therefore the structures were stated as designed to resist the full differential pressure.

The structure design pressures for the various buildings are as follows:

STRUCTURE	WALL PRESSURE - psf (psi)
Auxiliary Building	662 (4.6)
Auxiliary Building Addition	600 (4.2)
Electrical Penetration Room	432 (3.0)
Intake Structure	432 (3.0)
Containment	No value given. Licensee states "seismic load controls"
Auxiliary Feed Pump Enclosure	Licensee states "No calculations available but this structure is below grade."
Control Room Enclosure	922 (6.4)*

*This structure was designed for 360 mph tornado loading and then analyzed for the loading shown.

No pressure gradient in the vertical direction was used in the design and this is consistent with respect to current criteria.

The containment building structure is more substantial than the other structures for which a load value is provided and therefore, by comparison, has satisfactory tornado resistance.

Therefore, the structures listed above meet or exceed the current NRC requirements for tornado wind loading.

The safety injection storage water (SIRW) tank is located on top of the auxiliary building and is exposed to tornado wind loading. No data is available to demonstrate the resistance of this tank to tornado loading. The supply and exhaust piping for the emergency diesel generators are also located on an open area of the auxiliary building and will be subject to direct tornado loading. If it is considered necessary to erect structural barriers in order to protect these or other Category I items, the Structural Engineering Branch will provide guidance to the licensee on a case-by-case basis concerning design requirements for the barriers.

No assessment of the structural adequacy of the steel frame enclosure over the spent fuel pool was found except for the statement in paragraph 5.2.1 of the FSAR that both the steel frame enclosure and the SIRW tank were not designed to withstand tornado loading. The steel frame should be analyzed to determine its loading capacity and an assessment of the consenquences of failure on Category I structures, systems or components should be performed in order to determine corrective actions, if any.

VI CONCLUSION

The tornado loading criteria used for the design of the Palisades Plant structures are, in general, in accordance with currently accepted standards. However, the steel frame enclosure over the spent fuel pool is apparently vulnerable to tornado loading. This structure should be analyzed to determine if additional protection is required and then appropriate actions should be taken to provide such protection if necessary. In addition, it may be necessary to erect structural barriers in order to protect exposed Category I items.

Except for the items noted above, it can be concluded that in the event of a design basis tornado, the structural integrity of plant structures identified above will not be impaired and, in consequence, safety related systems and components located within these structures will be adequately protected and may be expected to perform necessary safety functions as required.

Tornado loadings will not prevent the ultimate heat sink from performing its necessary safety function as discussed in the Attachment.

POSITION ON WATER REMOVAL FROM NUCLEAR POWER PLANT EMERGENCY COOLING PONDS BY TORNADOES

PROBLEM: Nuclear Power plants require considerable amounts of water for routine cooling of the reactor and for emergency cooling as the ultimate heat sink. In a large number of cases, the necessary emergency cooling water is stored in large open ponds in the plant vicinity. These large open bodies of water are subject to tornado passages, possibly resulting in removal of some of the water stored therein. The requirement for adequate water in such a pond is emphasized by the fact that it is conceivable that a tornado striking the plant vicinity would cause loss of off-site power thereby necessitating reactor shutdown and use of the cooling water stored in the pond.

METHOD OF ANALYSIS: Although point probabilities of tornado strikes are very small, certain parts of the United States have a relatively high frequency of tornadic events resulting from relatively high frequency of occurrence of the necessary meteorological conditions during certain period of the year. A number of factors are involved in determining water removal from a pond. These factors are:

1. Size of the tornado, i.e. surface contact area,
2. Translation speed of the tornado,
3. Horizontal and vertical wind speeds within the tornado funnel.
4. Path length of the tornado in traversing a pond,
5. Relative size of the tornado to the size of the pond,
6. Volume of water in the pond,
7. Geographical location of the plant.

Thus applying appropriate values to the above factors would provide an estimate of the water removed from a pond under hypothesized "worst tornado" conditions. If we consider the Regulatory Guide 1.76 region I tornado as the "worst tornado" and apply some conservative values to the parameters in equation 1 below, the maximum rate of water removal can be estimated. Also, by choosing a path across a pond, the total water removed can be estimated by equation 2.

$$WRR^{*} = \pi r^2 w \rho \qquad (1)$$

$$WR = (WRR) \left(\frac{x}{u}\right) \qquad (2)$$

*Formulation suggested by R. Davies-Jones in correspondence regarding this topic dated February 11, 1975.

where,

WRR = water removal rate from the pond

r = radius of the tornado

w = vertical velocity in the tornado

p = density of air and removed-water mix in the tornado

WR = total water removed from the pond

x = path length of the tornado across the pond

u = translational velocity of the tornado

However, taking a conservative view of tornado impact we can determine the water removal by assigning conservative values to the variables in equations 1 and 2.

CONSERVATIVE EVALUATION: The input Parameters are:

r = 46m (150 ft as stated in R.G. 1.76)

w = 90 m/s (2/3 of the rotational velocity (300 mph) in R.G. 1.76)

p = mass indicated by hydrostatic head based on R.G. 1.76 pressure drop distributed over tornado volume (150 ft radius x 3280 ft deep)

Thus, the water removal rate (WRR) via equation 1 is 1.2×10^8 g/sec.

If we then assume that a minimum emergency pond size is 100 acre-ft. with an average depth of 10 ft. and its length is twice its width, a translational speed for a tornado of 2.2 m/s (5 mph, as stated in R.G. 1.76) would require 33 seconds to traverse the diagonal length of the pond and would result in removal of 4×10^9 g of water based on equation 2. The total volume of water in this pond is 1.2×10^{11} cm^3 or g. Thus about 3% of the water would be removed.

The factors applied presume a closed system that precludes any water replenishment either through precipitation, gravity or runoff into the pond. In the actual case of a tornado event, precipitation, possibly of an excessive nature, would occur in conjunction with the tornado producing storm in addition to surface runoff that would result.

CONCLUSION: A conservative estimate of water removal from emergency cooling ponds has been made showing a maximum removal of .3% of the water from a minimum sized pond. If larger ponds are used, the fraction of water loss will be less. Therefore, since most emergency ponds are not minimally designed, the effect of water removal by tornadoes does not appear to be a safety concern unless the ponds are minimally designed.