November 29, 1982

Docket No. 50-155
LS05-82-11-079

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

Dear Mr. VandeWalle:

SUBJECT: SEP TOPIC III-4.A, TORNADO MISSILES
BIG ROCK POINT PLANT

Enclosed is our final evaluation of SEP Topic III-4.A, "Tornado Missiles." This evaluation compares your facility as described in the Safety Analysis Report you supplied on June 16, 1982, other information available on Docket No. 50-155, and information obtained during a site visit with criteria used by the staff for licensing new facilities.

The evaluation concludes that systems and components exist at your facility which are inadequately protected from tornado missiles.

This evaluation will be a basic input to the integrated safety assessment for your facility. This topic may be changed in the future if your facility is modified or if NRC criteria relating to this topic are changed before the integrated assessment is completed.

Sincerely,

Original signed by:

Dennis M. Crutchfield, Chief
Operating Reactors Branch No. 5
Division of Licensing

Enclosure:
As stated

cc w/enclosure:
See next page

SE04
DSU USE 18
ADD: GARY STALEY

8212020266 821129
PDR ADOCK 05000155
P PDR

OFFICE	SEPB	SEPB	SEPB	SEPB	ORB#5	ORB#5	AD:SA:DL
SURNAME	DPersinko:bl	BSchoff	RHermann	WRussell	REmch	DCrutchfield	FMiraglia
DATE	10/20/82	10/27/82	10/29/82	10/12/82	10/22/82	10/29/82	10/ /82

NRC FORM 318 (10-80) NRCM 0240 OFFICIAL RECORD COPY USGPO: 1981--335-960

Mr. David J. VandeWalle

cc
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

Joseph Gallo, Esquire
Isham, Lincoln & Beale
1120 Connecticut Avenue
Room 325
Washington, D. C. 20036

Peter W. Steketee, Esquire
505 Peoples Building
Grand Rapids, Michigan 49503

Alan S. Rosenthal, Esq., Chairman
Atomic Safety & Licensing Appeal Board
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Mr. John O'Neill, II
Route 2, Box 44
Maple City, Michigan 49664

Mr. Jim E. Mills
Route 2, Box 108C
Charlevoix, Michigan 49720

Chairman
County Board of Supervisors
Charlevoix County
Charlevoix, Michigan 49720

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

Herbert Semmel
Counsel for Christa Maria, et al.
Urban Law Institute
Antioch School of Law
2633 16th Street, NW
Washington, D. C. 20460

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

Peter B. Bloch, Chairman
Atomic Safety and Licensing Board
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Dr. Oscar H. Paris
Atomic Safety and Licensing Board
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Mr. Frederick J. Shon
Atomic Safety and Licensing Board
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Big Rock Point Nuclear Power Plant
ATTN: Mr. David Hoffman
Plant Superintendent
Charlevoix, Michigan 49720

Christa-Maria
Route 2, Box 108C
Charlevoix, Michigan 49720

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

Resident Inspector
Big Rock Point Plant
c/o U.S. NRC
RR #3, Box 600
Charlevoix, Michigan 49720

Hurst & Hanson
311 1/2 E. Mitchell
Petoskey, Michigan 49770

Mr. David J. VandeWalle

cc
Dr. John H. Buck
Atomic Safety and Licensing Appeal Board
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Ms. JoAnn Bier
204 Clinton Street
Charlevoix, Michigan 49720

Thomas S. Moore
Atomic Safety and Licensing Appeal Board
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

James G. Keppler, Regional Administrator
Nuclear Regulatory Commission, Region III
799 Roosevelt Road
Glen Ellyn, Illinois 60137

SAFETY EVALUATION REPORT
BIG ROCK POINT
SYSTEMATIC EVALUATION PROGRAM
TOPIC III-4.A, "TORNADO MISSILES"

I. INTRODUCTION

Tornado generated missiles could cause sufficient damage to a plant so that the actual safety of the plant is reduced. Topic III-4.A is intended to review the plant design to assure that those structures, systems and components important to safety can withstand the impact of an appropriately postulated spectrum of tornado generated missiles. The review of safety related items include those required to assure:

1. The integrity of the reactor coolant boundary
2. The capability to shutdown the reactor and maintain it in a safe shutdown condition, and
3. The capability to prevent accidents which could result in unacceptable offsite exposures.

Scope of Review

The scope of the review is outlined in the Standard Review Plan (SRP) Section 3.5.1.4, "Missiles Generated by Natural Phenomena," Revision 1.

An assessment of the adequacy of a plant to withstand the impact of tornado missiles includes:

1. Determination of the capability of the exposed systems, components and structures to withstand key missiles (including small missiles with penetrating characteristics and larger missiles which result in an overall structural impact); and

2. Determination of whether any area of the plant requires additional protection.

II. REVIEW CRITERIA

The plant design was reviewed with regard to General Design Criterion 2, "Design Bases for Protection Against Natural Phenomena" which requires that structures, systems and components essential to safety be designed to withstand the effects of natural phenomena such as tornadoes and General Design Criterion 4, "Environmental and Missile Design Bases" which requires that these same plant features be protected against missiles. The plant was also reviewed against the guidance contained in Regulatory Guide 1.13, "Spent Fuel Storage Facility Design Bases," 1.27, "Ultimate Heat Sink for Nuclear Power Plants," 1.117, "Tornado Design Classification," and 1.76, "Design Basis Tornado for Nuclear Power Plants" with regard to plant protection against tornado missiles.

III. RELATED SAFETY TOPICS

Topic II-2.A, "Severe Weather Phenomena" describes the tornado characteristics for the plant. Topic III-2, "Wind and Tornado Loadings" reviews the capability of the plant structures, systems and components to withstand wind loadings. Topic VII-3, "Systems Required for Safe Shutdown" reviews those systems needed to achieve and maintain the plant in a safe shutdown condition.

IV. REVIEW GUIDELINES

The review was performed in accordance with SRP 3.5.1.4. This SRP states that the assessment of possible hazards due to missiles generated by the natural phenomena is based on the applicant having met the requirements of General Design Criteria 2 and 4 by: (1) meeting Regulatory Guide 1.76, Positions C.1 and C.2 and (2) meeting Regulatory Guide 1.117, Positions C.1 and C.2. SRP 3.5.1.4 further states that plants which were not required at the construction permit stage to design to the missile spectrum in Revision 0 of the SRP should show the capability to withstand the two postulated missiles discussed below.

The following missiles are described in SRP 3.5.1.4 as being appropriate for evaluating OL applications for plants which were not required to be protected against the full tornado missile spectrum during the CP stage:

1. Steel Rod, 1" dia., 3' long, 8 lbs., horizontal velocity = 0.6 x total tornado velocity; and
2. Utility Pole, 13 1/2" dia., 35' long, 1490 lbs., horizontal velocity = 0.4 x total tornado velocity.

The systems, structures and components required to be protected because of their importance to safety are identified in the Appendix to Regulatory Guide 1.117.

V. EVALUATION

A. Tornado Event Description

In accordance with Regulatory Guide 1.76, the Big Rock Point plant is in Tornado Region I. Accordingly, the design basis tornado is characterized by a maximum wind speed of 360 miles per hour, a maximum translational wind speed of 70 mph and a maximum pressure change of 3.0 psi. The tornado characteristics described in SEP Topic II-2.A "Severe Weather Phenomena" for the Big Rock Point Plant site are of similar severity.

In accordance with SRP 3.5.1.4, Revision 0 and SEP Topic II-2.A, the total horizontal velocities for the two postulated missiles are:

1. Steel Rod, 316 feet per second; and
2. Utility Pole, 211 feet per second.

These missiles are considered to be capable of striking in all directions with vertical speeds equal to 80% of the horizontal speeds listed above.

B. Structural Considerations

In our evaluation, we have considered the adequacy of the following structures for tornado missile protection:

1. Reactor Building,
2. Turbine Building,
3. Service Building,
4. Turbine Building Passageway,
5. Screen House/Diesel Generator Room/Discharge Structure, and
6. Core Spray Equipment Room

In order to assess the adequacy of tornado missile protection of these structures, we have compared their wall and roof thickness to the current NRC requirements for the two postulated missiles for the Region I design basis tornado. Based on an extrapolation of the full scale tornado missile test data (EPRI Report NP 440) and an analysis by the staff on the required reinforced concrete barrier thickness to prevent penetration and spalling, the following criteria were obtained and used for this review.

a) A thickness of 8 inches of reinforced concrete is required to provide protection against the 1" steel rod tornado missile;

b) A thickness of 12 inches of reinforced concrete is required to provide protection against the utility pole tornado missile; and

c) Concrete block walls do not provide adequate resistance against tornado missiles.

C. <u>System Considerations</u>

The following systems and components were identified by the licensee in his SAR for Topic III-4.A as being the minimum required to achieve and maintain reactor shutdown:

1. Emergency Condenser
2. Firewater Suppression System
3. Station Batteries
4. Reactor Protection System
5. Reactor Depressurization System
5. Control Rod Drive Pumps
7. Emergency Diesel Generators
8. Power, Controls and Instrumentation Associated With the Above Systems.

The licensee has stated that the adequacy of this list will be addressed under Topic VII-3. The licensee found each of the above systems not to be fully protected. Any systems or components not described below (e.g., demineralized water storage tank, service water system, etc.) may or may not be protected from tornado missiles, but were excluded from the review since the licensee did not consider them essential to achieve and maintain safe shutdown.

The following structures, systems and components as identified in the Appendix to Regulatory Guide 1.117 were evaluated to determine their susceptibility to the postulated tornado generated missiles.

1. Reactor Coolant Pressure Boundary

   The reactor coolant pressure boundary is located within the reactor building and the steam pipe tunnel. The reactor building is a steel, spherical shell, 130 feet in diameter, extending approximately 103 feet above the surrounding grade. The wall thickness of the shell ranges from 0.702 to 0.875 inches.

   The licensee's analysis indicated that the utility pole tornado missile will cause some local buckling of the shell but not penetrate the shell. Based on our calculations using a penetration equation developed by the Ballistic Research Laboratory the steel rod tornado missile will not penetrate the shell for tornado wind speeds less than or equal to 280 miles per hour. However, the steel rod tornado missile will penetrate the shell for the SEP Topic II-2.A tornado wind speed of 360 miles per hour.

Inside the steel shell, the steam drum and steam piping are enclosed in a reinforced concrete structure with a minimum floor and wall thickness of 3'-3." The reactor vessel is enclosed by the concrete biological shield and the reinforced concrete reactor shield plug. The portions of the reactor coolant pressure boundary for the emergency condenser and relief valves are not enclosed by concrete structures and would be vulnerable to the steel rod tornado missile. We conclude that after penetration of the steel spherical shell, the velocity of steel rod tornado missile would not be sufficient to penetrate the emergency condenser or reactor coolant piping. The steam pipe tunnel walls and ceiling consist of reinforced concrete at least 2'-0" thick which is considered to provide adequate protection for the portion of the reactor coolant pressure boundary contained therein.

We conclude that adequate protection against the effects of tornado missiles is provided for the reactor coolant pressure boundary.

2. Reactor Core and Individual Fuel Assemblies

The reactor vessel which houses the core constitutes a portion of the reactor core pressure boundary which is discussed in Item 1 above. The fuel assemblies in the reactor vessel are adequately protected from tornado missile damaged in that the concrete biological shield and the reactor shield plug are sufficient to prevent missiles from reaching the reactor vessel. Protection provided the stored spent fuel assemblies is discussed in Item 4 below.

We conclude that the reactor core and fuel assemblies located within the core are adequately protected from the effects of tornado missiles.

3. Systems or Portions of Systems Required for Attaining Safe Shutdown

The following systems and/or components are required to achieve safe shutdown conditions (cold shutdown):

a. Emergency Condenser

The emergency condenser and its components are located in the upper part of the reactor building. The 14 inch diameter emergency condenser relief stack protrudes through the top of the steel spherical reactor building. As discussed in Item 1 above the reactor building does not provide complete protection against the effects of tornado missiles. The cabling for power and control of t[illegible]gency condenser inlet and outlet valves are vulnerable t[illegible]of the steel rod tornado missile. Additionally, the steel rod tornado missile could strike the emergency condenser relief stack. It is difficult to estimate the amount of damage to the stack (degree of stack closure) consequently we must assume the worse case - the stack is totally closed off. The relief stack is not considered vulnerable to the utility pole tornado missile because the staff does not consider that the utility pole can reach components more than 30 feet above ground level.

Because of the vulnerability of the electrical components controlling the emergency condenser and the emergency condenser stack, we conclude that the emergency condenser and its components are not adequately protected against the effects of tornado missiles.

b. Fire Suppression Water System

The direct diesel driven fire water pump, the electrical fire water pump and their associated controls are located within the screenhouse/diesel generator room/discharge structure. The screenhouse/diesel generator room/discharge structure consist of 10-inch thick reinforced concrete walls and a metal roof. The doorways, ventilation openings, the metal roof and the walls (utility pole tornado missile only) do not provide protection against the effects of tornado missiles.

The piping for the fire suppression water system is located throughout the plant. The fire suppression water system piping contains redundant valves which are capable of manually isolating a break in the line. However, the piping is not protected from the effects of tornado missiles.

Therefore, we conclude that inadequate protection against the effects of tornado missiles is provided for the fire suppression water system.

c. Control Rod Drive System

The control rod drive pumps are located on the lower elevation of the reactor building. These pumps are protected from tornado missiles by the reinforced concrete floors of the reactor building. The piping for the control rod system is located in the reactor building, the steam pipe tunnel, and the turbine building. Additionally, the operation of the control rod drive pump required the operation of the control rod drive booster pump which is located in the turbine building. The steam pipe tunnel walls and ceiling consist of reinforced concrete at least 2'6" thick. The turbine building consists of a combination of either unreinforced concrete masonry block or metal siding. The masonry block walls and metal siding are not sufficient to protect against tornado missiles.

We, therefore, conclude that inadequate protection against the effects of tornado missiles is provided for that portion of the control rod drive piping and the control rod drive booster pump located in the turbine building.

d. Shutdown Cooling System

The shutdown cooling pumps, piping, heat exchangers and components are located within the reactor building. The interior reinforced concrete walls and floor of the reactor building provide protection against tornado missiles.

We, therefore, conclude that adequate protection against the effects of tornado missiles is provided for the shutdown cooling system.

e. Reactor Cooling Water System

The reactor cooling water pumps, piping, heat exchangers and components are located within the reactor building. The interior reinforced concrete walls and floor of the reactor building provide protection against tornado missile. However, portions of the heat exchangers extend beyond the floor and would be vulnerable to tornado missiles penetrating the reactor building steel spherical shell. However, we conclude that after penetrating the steel spherical shell, the velocity of the steel rod tornado missile would not be sufficient to penetrate the heat exchangers.

We, therefore, conclude that adequate protection against the effects of tornado missiles is provided for the reactor cooling water system.

f. Station Batteries

The station batteries provide the vital dc power for control of the electrical equipment. The station batteries are located on the first floor of the service building. The service building consists of unreinforced concrete masonry walls, reinforced concrete floors and a metal roof, The unreinforced concrete masonary walls are not sufficient to protect against tornado missiles.

Therefore, we conclude that inadequate protection against the effects of tornado missiles is provided for the station batteries.

g. Emergency Diesel Generators

One emergency diesel generator is located in a separate room of the screenhouse/diesel generator room/discharge structure. This structure consists of 10-inch thick reinforced concrete walls and a metal roof. The doorway, ventilation openings, the metal roof, and the walls (utility pole tornado missile only) do not provide protection against the effects of tornado missiles.

The other emergency diesel generator is located near the well water pumphouse. Tornado missile protection is not provided for this emergency diesel generator.

Therefore, we conclude that inadequate protection against the effects of tornado missiles is provided for the emergency diesel generators.

h. Power, Controls, and Instrumentation Associated with the Above Systems

The power, controls and instrumentation circuitry are located within the switchgear room, the electrical penetration room of the turbine building passageway and the control room. The switchgear room is an interior room of the service building. The service building consists of unreinforced concrete masonry walls, reinforced concrete floors and a metal roof. The reinforced concrete walls and metal roof are not sufficient to protect against tornado missiles.

The electrical penetration room is the link between the control room and the reactor building. The reactor building provides the north wall of the electrical penetration room and the service building provides the south wall (minimum 12" of reinforced concrete) of the room. The west wall (24" of reinforced concrete) of electrical penetration room is shared with the steam pipe tunnel. The east outer wall of the electrical penetration room consist of insulated metal siding. The ceiling of the electrical penetration room is the 4-1/2" thick second floor of the turbine building. The metal siding of the east wall and the 4-1/2" thick second floor of the turbine building are not sufficient to protect against tornado missiles.

The control room consists of reinforced concrete walls: 4'-6" thick on the northside, 3' thick on the west side, and 1'-0" thick on the east side. The south wall which consists of a 1/2 inch thick steel plate cover over a partition wall is an interior wall to the service building. The south wall contains two windows and a door. The south wall is not sufficient to protect against tornado missiles.

Therefore, we conclude that inadequate protection against the effects of tornado missiles is provided by the switchgear room, electrical penetration room and the control room for the power, controls and instrumentation associated with the above systems.

4. Systems Whose Failure May Result in the Release of Unacceptable Amounts of Radioactivity

a. Waste Tank Vaults

The waste tank vaults are located in a reinforced concrete structure below ground level. The roof of the structure consists of a minimum of 21 inches of reinforced concrete.

Therefore, we conclude that adequate protection against the effects of tornado missiles is provided for the waste tank vault.

b. Spent Fuel Pool

The spent fuel pool and the spent fuel pool cooling system are located within the steel spherical shell reactor building. As discussed in Item 1 above the reactor building does not provide complete protection against the effects of tornado missiles. The spent fuel pool would be vulnerable to the effects of the steel rod tornado missile. The spent fuel pool cooling system is located on a lower elevation of the reactor building and the interior reinforced concrete walls of the reactor building provided protection against the effects of tornado missiles. The power and controls for the spent fuel pool cooling system are in the same areas as discussed in Items 3.g and 3.h above.

We, therefore, conclude that inadequate protection against the effects of tornado missiles is provided for the spent fuel pool cooling system (power and control only).

The effects of the one inch steel rod have been evaluated in previous analyses (e.g., written staff testimony and responses to interrogatories on spent fuel pool protection against tornado missiles for North Anna Units 1 and 2). The results indicate that the potential offsite radiological consequences are well within 10 CFR Part 100 Guidelines. In view of the above considerations, we conclude that the interior of the Big Rock Point spent fuel pool meets the intent of current licensing criteria regarding tornado missile protection.

5. Systems or Portions of Systems Not Required for Safe Shutdown But Serve a Safety Function.

a. Core Spray System

The core spray pumps, heat exchangers, and components are located in the core spray equipment room. The power and controls for the core spray system are in the same areas as discussed in Item 3.g and 3.h above. The core spray equipment room consist of reinforced concrete walls and ceiling with a minimum thickness of 12 inches. The core spray equipment room contains one doorway which is located at the end of a narrow corridor, approximately 11 feet below grade. The remoteness of the door provides sufficient protection against tornado missiles.

We, therefore, conclude that adequate protection against the effects of tornado missiles is provided for the core spray system's equipment.

b. Reactor Depressurization System

The reactor depressurization system components are located in the reactor building and as discussed in Item 1 above are sufficiently protected from tornado missiles. The controls and instrumentation for the reactor depressurization system are in the same areas as discussed in Item 3.h above. The reactor depressurization system is powered by a DC battery source. The reactor depressurization system batteries are located in the service building. The service building consists of unreinforced concrete masonry walls, reinforced concrete floors and a metal roof. The unreinforced concrete walls and metal roofing are not sufficient to protect against tornado missile.

Therefore, we conclude that inadequate protection against the effects of tornado missile is provided for the reactor depressurization system.

c. Post Incident Cooling System (Enclosure Spray)

The post incident cooling system (enclosure spray) equipment is located within the upper part of the reactor building. As discussed in Item 1 above the steel spherical shell reactor building does not provide complete protection against tornado missiles. The piping for the enclosure spray would be vulnerable to the steel rod tornado missile which penetrates the steel shell.

Therefore, we conclude that inadequate protection against the effects of tornado missiles is provided for the post incident cooling system (enclosure spray).

d. Liquid Poison System

The liquid poison system is located within the upper part of the reactor building. As discussed in Item 1 above, the steel, spherical shell reactor building does not provide complete protection against tornado missiles. The piping for the liquid poison system would be vulnerable to the steel rod tornado missile which penetrates the steel shell.

Therefore, we conclude that inadequate protection against the effects of tornado missiles is provided for the liquid poison system.

VI. CONCLUSIONS

Based upon our review we conclude that the following portions of the Big Rock Point plant are adequately protected from the effects of tornado missiles.

1. Reactor coolant pressure boundary;
2. Reactor core and individual fuel assemblies located within the core;
3. Shutdown Cooling System;
4. Reactor Cooling Water System;
5. Core Spray System Equipment; and
6. Spent Fuel Pool Cooling Equipment.

Therefore, the above features meet the requirements of General Design Criteria 2 and 4 with respect to tornado missiles and environmental effects.

However, we conclude that the Big Rock Point plant does not meet the current criteria for tornado missile protection in the following areas:

1. Emergency condenser;
2. Fire Suppression Water System;
3. Control Rod Drive System;
4. Station Batteries;
5. Emergency Diesel Generator;
6. Power, Control and Instrumentation for the Safe Shutdown Systems and other Safety Systems;
7. Spent Fuel Pool;
8. Reactor Depressurization System;
9. Post Incident Cooling System (Enclosure Spray); and
10. Liquid Poison System.

Any systems or components not listed above were not addressed by the licensee since the licensee was addressing the minimum amount of systems required for safe shutdown. The adequacy of the minimum number of systems required for safe shutdown should be coordinated with SEP Topic VII-3 during the integrated assessment. Other systems not listed (e.g., demineralized water storage tank, service water system, etc.) may or may not be protected from tornado missiles, depending on their location and construction. The need for providing additional tornado missile protection to these systems should be evaluated during the integrated assessment for Big Rock Point.