



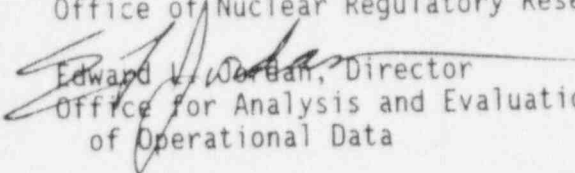
UNITED STATES  
NUCLEAR REGULATORY COMMISSION

WASHINGTON, D.C. 20555-0001

April 7, 1995

Original: Emrit  
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MEMORANDUM TO: Eric S. Beckjord, Director  
Office of Nuclear Regulatory Research

FROM:  Edward L. Jordan, Director  
Office for Analysis and Evaluation  
of Operational Data

SUBJECT: PERIODIC REVIEW OF LOW PRIORITY GENERIC SAFETY ISSUES

In response to your subject memorandum of January 18, 1995, we have reviewed the list of low priority generic safety issues to identify new information which may warrant reassessment of the issue. We identified only one, GI 107, which may be affected by the results of an ongoing AEOD study. We also have planned a study of dc power which will be broader in scope than GI 156.3.6.2.

Generic Safety Issue 107 Main Transformer Failures

AEOD has a study on grid performance in progress. This study includes transformer failures caused by grid problems or grid problems due to transformer failures. Our review of operating experience indicates that transformer failures in the past several years suggest a failure rate that is a factor of about 3 greater than the base case failure frequency used in GI 107.

Generic Safety Issue 156.3.6.2 Emergency DC Power

AEOD has published a program plan for evaluation of dc power systems. The objective of this study would be to evaluate recent operating experience for dc power systems and draw conclusions about the effectiveness of applicable requirements and industry actions for these systems in light of the operating experience. The scope of this program is beyond that in GI 156.3.6.2 which only addresses the concern that safety-related dc power system bus voltage monitoring and annunciation may not adequately notify operators of dc bus status. We provided a copy of our program plan for dc power systems in a March 2, 1995, memo from Charles E. Rossi to Lawrence C. Shao (among others) of your office.

cc: W. T. Russell, NRR  
L. C. Shao, RES  
M. W. Hodges, RES  
T. T. Martin, RGN-I  
S. D. Ebnetter, RGN-II  
J. B. Martin, RGN-III  
L. J. Callan, RGN-IV



UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
WASHINGTON, D.C. 20555-0001  
April 11, 1996

MEMORANDUM TO: **David L. Harrison, Director**  
Office of Nuclear Regulatory Research

FROM: William T. Russell, Director *W. Russell*  
Office of Nuclear Reactor Regulation

SUBJECT: PERIODIC REVIEW OF LOW-PRIORITY GENERIC ISSUES

NRR has reviewed the list containing all low-priority generic safety issues (GSIs) provided in your memorandum dated February 16, 1996, to determine whether there is any new information that would necessitate reassessment of the original prioritization evaluations. The review resulted in recommending that two GSIs be raised in priority to medium, one GSI be closed as resolved, and two GSIs be combined into one. The bases for these recommendations are given below.

**GSI A-38 - TORNADO MISSILES**

This issue should be closed as resolved, based on SECY-93-087, "Policy, Technical, and Licensing Issues Pertaining to Evolutionary and Advanced Light-Water Reactor Designs," April 2, 1993; NUREG-1503, "Final Safety Evaluation Report Related to the Certification of the Advance Boiling Water Reactor Design," July 1994; and NUREG/CR-4661, "Tornado Climatology of the Contiguous United States," May 1986. These documents effectively have reduced the design basis tornado wind speed (which is the intent of A-38) that can be used at all nuclear power plants. See also our safety evaluation (Attachment 1) for WNP-2, which also allowed a reduction in design basis tornado wind speeds.

RECOMMENDATION: ISSUE SHOULD BE CLOSED

**GSI 81 - IMPACT OF LOCKED DOORS AND BARRIERS ON PLANT AND PERSONNEL SAFETY**

Issues 81 and 122.3 have been reviewed, and there is no new information that would necessitate reassessment of these issues. Since these issues are essentially the same, consideration should be given to integrating Issue 122.3 into Issue 81. Issue 122.3 should then be considered closed.

RECOMMENDATION: INTEGRATE ISSUE 122.3 INTO ISSUE 81 AND CONSIDER  
ISSUE 122.3 CLOSED

CONTACT: Tom Greene, PECB/DRPM/NRR  
(301) 415-1175

April 11, 1996

**GSI 107 - MAIN TRANSFORMER FAILURES**

This issue was very close to being prioritized Medium but further analysis (including consideration of potential benefits from station blackout resolution) resulted in it being given a Low Priority ranking. On March 17, 1996, the Electrical Engineering Branch provided a brief report (Attachment 2) to the Director of ADT on recent events involving transformer failures. This report is being provided to RES for your consideration.

RECOMMENDATION: RAISE PRIORITY TO MEDIUM

**GSI 122.3 - PHYSICAL SECURITY SYSTEM RESTRAINTS**

See GSI 81.

**GSI 152 - DESIGN BASIS FOR VALVES THAT MIGHT BE SUBJECT TO SIGNIFICANT BLOWDOWN LOADS**

A motor-operated valve (MOV) testing program conducted by the Electric Power Research Institute (EPRI) has provided significant information regarding the performance of safety-related gate, globe and butterfly valves. In particular, EPRI found that a high percentage of gate valves were damaged during blowdown testing using hot water and steam and that they were unable to predict the thrust requirements. Although EPRI tested only one globe valve under high temperature and blowdown conditions, the test revealed significantly higher thrust requirements than predicted. EPRI also found that load-sensitive behavior (or rate of loading) can reduce actuator thrust output under dynamic conditions. The Nuclear Energy Institute submitted EPRI Topical Report TR-103237, "EPRI MOV Performance Prediction Program," describing the methodology developed by EPRI to predict dynamic thrust and torque requirements for gate, globe, and butterfly valves without dynamic tests by licensees. The staff has prepared a safety evaluation which approves the topical report for use and reference with certain conditions and limitations.

EPRI has provided the results of its MOV test to licensees through industry meetings. The NRC staff has disseminated the results of the EPRI MOV test program to licensees through notices and public meetings. Some licensees have already incorporated this information into their MOV programs. Based on the EPRI testing indicating the potential damage and high thrust requirements of

valves (principally gate valves), we request that you re-evaluate the priority level of GSI 152, "Design Basis for Valves that might be subject to Significant Blowdown Loads."

RECOMMENDATION: RAISE PRIORITY TO MEDIUM

Attachments:

1. Safety Evaluation for Revised Tornado Design Criteria at Washington Nuclear Power Project No. 2 (WNP 2)(TAC #M88626), memorandum to James W. Clifford, PDIV-2/NRR from Conrad E. McCracken, Plant Systems Branch/NRR dated November 27, 1995
2. Transformer Failures, note to Ashok Thadani, ADT/NRR thru Gus C. Lainas, DE/NRR, from Jose Calvo, EELB/DE/NRR, dated March 7, 1996

MEMORANDUM TO: James W. Clifford, Senior Project Manager  
Project Directorate IV-2  
Division of Reactor Projects III/IV  
Office of Nuclear Reactor Regulation

FROM: Conrad E. McCracken, Branch Chief  
Plant Systems Branch  
Division of Systems Safety and Analysis  
Office of Nuclear Reactor Regulation

SUBJECT: SAFETY EVALUATION FOR REVISED TORNADO DESIGN CRITERIA AT  
WASHINGTON NUCLEAR POWER PROJECT NO. 2 (WNP-2)  
(TAC NO. M88626)

Plant Name: WPPSS Nuclear Power Project No. 2 (WNP-2)  
Licensee: Washington Public Power Supply System (WPPSS)  
Status: Complete

The Plant Systems Branch (SPLB) reviewed the licensee's October 10, 1995 request to revise the tornado design criteria for WNP-2. The licensee's basis for revising the criteria is that the original licensing basis tornado criteria were overly conservative relative to the plant location. As a result of our review we concluded that the licensee's proposed design basis change is acceptable. The attached safety evaluation (Attachment 1) provides the basis for our conclusion. If you have any questions regarding this evaluation please contact Bill LeFave at 425-3285.

Our SALP input is also provided as Attachment 2. We consider our efforts on TAC No. M88626 to be complete.

Docket No. 50-397

Attachments: As stated (2)

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\*see previous concurrence

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Attachment 1

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SAFETY EVALUATION  
BY THE OFFICE OF NUCLEAR REACTOR REGULATION  
DIVISION OF SYSTEM SAFETY AND ANALYSIS  
PLANT SYSTEMS BRANCH  
REVISED TORNADO DESIGN CRITERIA  
WASHINGTON PUBLIC POWER SUPPLY SYSTEM NUCLEAR POWER PROJECT NO. 2  
DOCKET NO. 50-397

## 1.0 INTRODUCTION

By letter dated October 10, 1995 Washington Public Power Supply System (WPPSS or the licensee) requested the staff's approval to revise the tornado design criteria for the Nuclear Power Project Unit 2 plant, (WNP-2). The WNP-2 current licensing basis tornado design criteria are for wind speeds of 300 miles per hour (mph) rotational and 60 mph translational. The proposed change, as requested in the October 10, 1995 submittal would revise the criteria to establish the total design basis tornado wind speed at 200 mph (160 mph rotational and 40 mph translational). The request is based on the design basis tornado characteristics (for the tornado intensity region in which WNP-2 is located) accepted by the staff in the Final Safety Evaluation Report Related to the Certification of the Advanced Boiling Water Reactor Design, NUREG-1503, July 1994.

## 2.0 EVALUATION

The current licensing basis tornado design criteria for WNP-2 are based on a Region I plant site as defined in Regulatory Guide (RG) 1.76 "Design Basis Tornado for Nuclear Power Plants." These are excessive criteria for WNP-2 because it is located in Region III as defined in RG 1.76. The licensee's proposed tornado wind speed is also less than the wind speed identified in RG 1.76 for a design basis Region III tornado. This further reduction in tornado design criteria is consistent with the design basis characteristics accepted by the staff in NUREG-1503. Table 2-1 of NUREG-1503 establishes revised design-basis tornado characteristics that are acceptable to the staff. The licensee's proposed revision is consistent with that table.

In NUREG-1503, the staff refers to SECY-93-087, "Policy, Technical, and Licensing Issues Pertaining to Evolutionary and Advanced Light-Water Reactor (ALWR) Designs," dated April 2, 1993, as a basis for revised tornado wind speeds. As described in SECY-93-087, the staff reevaluated the regulatory positions in RG 1.76 using the considerable quantity of tornado data which has become available since RG 1.76 was developed. This reevaluation is discussed in NUREG/CR-4661, "Tornado Climatology of the Contiguous United States," dated May 1986. Based on the updated tornado data and the analysis provided in NUREG/CR-4661, the staff concluded (SECY-93-087) that it is acceptable to reduce the tornado design basis wind speeds to 322 kilometers per hour (km/hr) [200 mph] for states west of the Rocky Mountains, and 482 km/hr (300 mph) for states east of the Rocky Mountains. The staff, therefore, concludes that the licensee's proposed reduction in design basis tornado wind speed to 200 mph is acceptable for WNP-2 which is located west of the Rocky Mountains. The licensee's proposed pressure drop and rate of pressure drop associated with

ATTACHMENT 1



the 200 mph tornado are also acceptable because they are consistent with the design-basis tornado characteristics found acceptable to the staff in Table 2-1 of NUREG-1503.

The licensee has also proposed a new (new to WNP-2) tornado missile spectrum associated with the revised design basis tornado and has calculated the impact velocities based on the reduced wind speed of 200 mph. The licensee has used Missile Spectrum II identified in Section 3.5.1.4 of the Standard Review Plan (SRP). Based on the missile spectrum being consistent with Section 3.5.1.4 of the SRP, the staff concludes that it is acceptable.

It should also be recognized that the tornado design basis requirements have been used in establishing structural requirements (minimum concrete wall thicknesses) for the protection of safety related structures, systems, and components against effects not covered explicitly in review guidance such as RGs or the Standard Review Plan. Specifically, some aviation (general aviation light aircraft) crashes, nearby explosions, and explosion debris or missiles have been reviewed and evaluated routinely by the staff by taking into account the existence of the tornado protection requirements. Therefore, for any new structures that are built using the revised tornado design criteria, the licensee should perform an analysis under 10 CFR Part 50.59, to verify that the structures are adequate (minimum wall thickness) to protect against other postulated site-specific hazards or loads that may have been previously subsumed within the tornado design basis.

### 3.0 CONCLUSION

Based on the above evaluation, the staff concludes that the licensee's proposed revised criteria for the design basis tornado are in accordance with the guidelines of RG 1.76 regarding the missile spectrum and with the staff's revised design-basis tornado characteristics set forth in NUREG-1503. The staff, therefore, concludes that the proposed changes are acceptable.

NOTE TO: Ashok Thadani, ADT/NRR

THRU: Gus C. Lainas, DE/NRR

FROM: José Calvo, EELB/DE/NRR

SUBJECT: TRANSFORMER FAILURES

By a note dated February 6, 1996, you requested DE to investigate and report back findings/recommendations on transformer failures.

The Electrical Engineering Branch (EELB) has searched for events from 1980 through 1995 involving transformer failures through NUDOCS, LERs, preliminary notices, morning reports, event notifications, circulars, bulletins and Information Notices. The events are associated with all types of transformers including high-voltage (main, unit auxiliary and start-up) and low-voltage transformers. In addition, we investigated other information including NSAC-182 (March 1992), "Losses of Offsite Power in Nuclear Power Generating Stations," NUREG-1299 (March 1991), "Review of Licensee's Renewal, Nuclear Plant Aging Research (NPAR)," and NUREG-0933 Issue 107, "Main Transformer Failures." A Table of Events is attached.

The following is the summary by year of the number of transformer failures and consequential reactor trips.

<u>DATES</u>	<u>TRANSFORMER FAILURES</u>	<u>REACTOR TRIPS</u>
1996 thru 3/1/96	3	2
1995	5	3
1994	1	1
1993	1	1
1992	5	3
1991	8	5
1990	0	0
1989	1	1
1988	4	4
1987	2	1
1986	1	1
1985	0	0
1984	1	1
1983	1	0
1980	1	0

CONTACT: Narinder Trehan, EELB/NRR  
415-2777



The following findings were made regarding the transformer related events:

1. In the last 5 months there have been 6 events involving loss of high voltage transformers. (Note: The recent Catawba and Calvert Cliffs events were included in the attached table for information only, however, they did not involve transformer failures and were not counted in the above summary.)
2. In NUREG-1299, "Review of Licensee's Renewal, Nuclear Plant Aging Research (NPAR)," NPRDS showed that 13 percent of the transformer failures were age-related. SRP-11  
Find
3. Transformer failure rates may not be changing when considering events back into the 80s.

With respect to recommendations there is a Generic Issue (GSI-107, "Main Transformer Failures") that was ranked LOW; however it was borderline to MEDIUM. It appears that it was ranked LOW because of the perceived potential benefits of the SBO rule implementation. The prioritization was done around 1990/91. We are currently responding to the RES request to review low-priority generic safety issues. We will provide this information to RES for potential reprioritization of the issue.

Attachment: Transformer Failures Table

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NAME	MKTrehan:jc	DFThatcher	GCLafas	JACalvo	JAL7
E	3/6/96	3/7/96	3/7/96	3/7/96	

# 2  
3/7/96

# TRANSFORMER FAILURES TABLE

DATE	PLANT	Transformer Fail/Rx Trip	DESCRIPTION
2/27/96	Calvert Cliffs 2	No/Yes	Trip occurred while troubleshooting on one of 500 kV breakers in the switchyard was in progress causing loss of all four RCPs. The unit responded as designed except that one of rupture discs on the main turbine ruptured. <u>This event did not involve transformer failure.</u>
2/25/96	Palo Verde 1	Yes/No	Lightning struck Phase C of the Main Power Transformer (MPT). Flames were observed in the bushings and were self extinguished. Turbine tripped and reactor runback to 8%. Two holes were observed in the Isophase bus duct.
2/6/96	Catawba 2	No/Rx T	Ground on phases X & Z of the 22 kV Isophase buses. Resistor wall bushings for phases X & Z used to connect protective relaying Potential Transformers to Isophase buses were damaged. <u>This event did not involve transformer failure.</u>
2/6/96	Perry 1	No/Refuel Outage	Explosion in Start-up (SAT) transformer during refueling and maintenance. Deluge protection operated.
2/4/96	LaSalle 1	Yes/Refuel Outage	Loss of MPT oil cooling due to failure of cable feeding to cooling fans resulting in high oil temperature. A missing cap from conduit carrying cable was missing. Water had frozen resulting in cable failure.
1/18/96	Braidwood 2	Yes/No	One of two SATs as well as high voltage breaker damaged.
12/18/95	South Texas 1	Yes/Rx T	A phase of main power transformer (MPT) had a ground fault.
10/21/95	Diablo Canyon 1	Yes/No	During refueling, an explosion and fire occurred at UAT. A grounding breaker was accidentally left connected to bus causing a ground fault.

DATE	PLANT	Transformer Fail/Rx Trip	DESCRIPTION
8/22/95	Cook 1	Yes/No	Output bushing for Phase 2 on MPT failed. MPT has been installed to replace a previously damaged MPT and was being tested prior to service. A crack in the bushing was found and was replaced.
7/30/95	Grand Gulf	Yes/Rx T	MPT and main generator trip due to failure of CT on A phase of generator output breaker. CT replaced.
6/25/95	South Texas 2	No/Rx T	MPT locked out due to pilot wire relay trouble (failure of capacitor)
6/18/95	Seabrook	Yes/No	13.8 kV non-safety transformer failed due to inadequate design
4/5/94	Braidwood 2	Yes/Rx T	Reactor trip due to a fault on B phase of MPT. Extensive damage. Replaced with spare. Oil sample done every 6 months.
4/3/94	Zion 1	No/No	Replaced MPT and replaced main generator Isophase Bus duct fire.
6/13/93	Quad Cities 2	Yes/Rx T	Internal arcing in MPT - initialed deluge system. Oil was black. MPT replaced.
9/22/92	Fitzpatrick	No/No	Load Center transformer - ground fault. Loss of UPS.
7/4/92	Peach Bottom	Yes/No	230 kV auto transformer failed due to arcing.
9/22/92	Zion	Yes/Rx T	Phase C of MPT, transformer failure with oil fire - Deluge system oper. MPT significantly damaged, isophase bus was significantly damaged from explosion of MPT - bus duct flash over, main gen Phase C bushings were damaged. MPT replaced.
4/24/92	San Onofre 2	Yes/No	Failure of transformer 2B13X. Replaced.
1/9/92	Clinton	Yes/Rx T	Failure of MPT on B phase due to internal fault.
1/4/92	Vogtle	Yes/Rx T	Failure of MPT on B phase due to internal fault. MPT was found smoking heavily. Replaced.
6/16/91	Salem 1	Yes/Rx T	Lightning struck on B phase of MPT.

DATE	PLANT	Transformer Fail/Rx Trip	DESCRIPTION
4/29/91	Maine Yankee	Yes/Rx T	One of two MPTs had internal fault - fault current caused arcing between neutral bus & neutral bus enclosure - <u>damaged neutral bushing</u> - fire activated deluge system. MPT replaced.
3/20/91	Indian Point 2	Yes/No	Loss of power to all 6.9 kV caused by <u>PT failure</u> - 138 kV normal power lost.
10/11/91	Peach Bottom	Yes/No	Failed static inverter transformer.
8/13/91	Nine Mile Point 2	Yes/Rx T	Reactor scram due to transformer failure, and loss of UPS.
3/13/91	Vermont Yankee	Yes/Rx T	One phase of MPT failed due to short.
2/15/91	Peach Bottom	Yes/Rx T	Failure of MPT due to failure of cooling system which caused transformer overheat, causing sudden pres. trip. Deluge system did not activate. No cooling fans were available due to loss of power. MPT was found smoking. Deluge system was manually started.
8/28/91	Crystal River 3	Yes/No	480 V ESF transformer failed, replaced.
6/25/89	Oyster Creek	Yes/Rx T	Fault in MPT - spare installed.
12/26/88	Nine Mile Point 2	No/No	Explosion of CT in offsite switchyard
10/16/88	Braidwood 1	Yes/Rx T	PT failure on 138 kV offsite line. Reactor tripped on RCP low flow.
8/13/88	Maine Yankee	Yes/Rx T	Fault in MPT.
7/6/88	Palo Verde	Yes/Rx T	138 kV UAT explosion and fire caused by brittle and cracked insulation.
3/29/88	Oconee 2	No/No	SAT CT fault.
1/10/88	Grand Gulf 1	Yes/Rx T	HV WDG. fault on MPT - MPT replaced.
7/20/87	Wolf Creek	Yes/Rx T	PT failure caused partial LOOP.
7/4/87	Palisades	Yes/No	Fault on SAT 1-2.
5/31/86	NA2	Yes/Rx T	Failure of 120-V Vital ac bus transformer, reactor tripped.

DATE	PLANT	Transformer Fail/Rx Trip	DESCRIPTION
12/2/85	Wolf Creek	No/No	Loss of ESF transformer due to PT failure.
6/20/83	Salem 2	No/No	460V transformer fault and fire due to failure of transformer neutral wdg.
11/4/84	Duane Arnold	Yes/Rx T	UAT fault caused by short in the HV wdg.
7/3/83	Three Mile Island 2	Yes/No	Medium Voltage transformer failure due to insulation failure.
1/17/80	Kewaunee	Yes/No	Reserve Aux. Transformer failed. No cause given.

October 7, 1996

PRELIMINARY NOTIFICATION OF EVENT OR UNUSUAL OCCURRENCE PNO-II-96-069

This preliminary notification constitutes EARLY notice of events of POSSIBLE safety or public interest significance. The information is as initially received without verification or evaluation, and is basically all that is known by Region II staff in Atlanta, Georgia on this date.

<u>Facility</u>	<u>Licensee Emergency Classification</u>
Tennessee Valley Authority	X Notification of Unusual Event
Sequoyah 1 2	Alert
Soddy-Daisy, Tennessee	Site Area Emergency
Dockets: 50-327, 50-328	General Emergency
	Not Applicable

Subject: SEQUOYAH POTENTIAL TRANSFORMER EXPLOSION IN THE SWITCHYARD

On October 5, 1996, at 1:13 p.m., a potential transformer (PT) in the Sequoyah 500 kv switchyard exploded, causing a loss of the switchyard Bus 1. Switchyard relays sensed the electrical fault as designed, and power circuit breakers opened to clear the differential fault. The units experienced various control board alarms but no plant equipment was affected. Both Sequoyah units continued to operate at full power. Oil from the faulted PT sprayed onto the gravel in the switchyard and ignited during the event. The fire was extinguished in approximately 16 minutes. There were no injuries. At 2:12 p.m., the licensee declared and exited an Unusual Event due to an explosion within the protected area.

In addition, shrapnel from the explosion damaged the 500 kv to 160 kv Intertie transformer, as well as other components in the switchyard such as insulators.

The licensee has developed plans for damage assessment, repairs, investigation, and root cause analysis. TVA has had some media interest in the event and will respond to further inquiries but does not plan a press release.

The NRC Senior Resident Inspector responded to the site to review immediate licensee activities. Additional NRC review of the issue is ongoing.

The State of Tennessee was notified.

This information is current as of 9:00 a.m., on October 7, 1996.

Contact: Mark S. Lesser  
(404) 331-0342

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