

# ACCELERATED DISTRIBUTION DEMONSTRATION SYSTEM

## REGULATORY INFORMATION DISTRIBUTION SYSTEM (RIDS)

ACCESSION NBR:9008160148 DOC.DATE: 90/08/09 NOTARIZED: NO DOCKET #  
 FACIL:50-397 WPPSS Nuclear Project, Unit 2, Washington Public Powe 05000397  
 AUTH.NAME AUTHOR AFFILIATION  
 DAVISON,W.S. Washington Public Power Supply System  
 BAKER,J.W. Washington Public Power Supply System  
 RECIP.NAME RECIPIENT AFFILIATION

SUBJECT: LER 90-012-01:on 900527,fire in div one diesel generator  
 caused by generator thrust bearing failure.

W/9 ltr.

DISTRIBUTION CODE: IE28T COPIES RECEIVED:LTR / ENCL / SIZE: 13  
 TITLE: Licensee Event Report (LER) & Part 21 Rept Combination (50 Dkt)

### NOTES:

RECIPIENT ID CODE/NAME	COPIES LTTR ENCL	RECIPIENT ID CODE/NAME	COPIES LTTR ENCL
PD5 LA	1 1	PD5 PD	1 1
ENG,P.L.	1 1		
INTERNAL: ACNW	2 2	ACRS	2 2
AEOD/DOA	1 1	AEOD/DSP/TPAB	1 1
AEOD/ROAB/DSP	2 2	DEDRO	1 1
IRM TECH ADV	1 1	NRR/ADP/DRP14E4	1 1
NRR/ADSP DIR	1 1	NRR/DET/ECMB 9H	1 1
NRR/DET/EMEB9H3	1 1	NRR/DET/ESGB 8D	1 1
NRR/DLPQ/LHFB11	1 1	NRR/DLPQ/LPEB10	1 1
NRR/DOEA/OEAB11	1 1	NRR/DOEA/OGCB11	1 1
NRR/DREP/PRAB10	1 1	NRR/DREP/PRPB11	2 2
NRR/DRIS/RSIB9A	1 1	NRR/DRIS/RVIB9D	1 1
NRR/DST 8E2	1 0	NRR/DST/SELB 8D	1 1
NRR/DST/SICB 7E	1 1	NRR/DST/SPLB8D1	1 1
NRR/DST/SRXB 8E	1 1	NSIC SILVER,E	1 1
<del>REG FILE 02</del>	1 1	REGION 1	1 1
REGION 2	1 1	REGION 3	1 1
REGION 4	1 1	REGION 5	1 1
RES/DSIR/EIB	1 1	RES/DSR/HFB/HFS	1 1
RGN5 FILE 01	1 1		
EXTERNAL: EG&G STUART,V.A	4 4	INPO RECORD CTR	1 1
L ST LOBBY WARD	1 1	LPDR	1 1
NRC PDR	1 1	NSIC MAYS,G	1 1
NSIC MURPHY,G.A	1 1	NUDOCS FULL TXT	1 1

Cert No P085602813

### NOTE TO ALL "RIDS" RECIPIENTS:

PLEASE HELP US TO REDUCE WASTE! CONTACT THE DOCUMENT CONTROL DESK,  
 ROOM P1-37 (EXT. 20079) TO ELIMINATE YOUR NAME FROM DISTRIBUTION  
 LISTS FOR DOCUMENTS YOU DON'T NEED!

FULL TEXT CONVERSION REQUIRED  
 TOTAL NUMBER OF COPIES REQUIRED: LTTR 53 ENCL 52

*Alt*

WASHINGTON PUBLIC POWER SUPPLY SYSTEM

P.O. Box 968 • 3000 George Washington Way • Richland, Washington 99352

Docket No. 50-397

August 9, 1990

Document Control Desk  
U.S. Nuclear Regulatory Commission  
Washington, D.C. 20555

Subject: NUCLEAR PLANT NO. 2  
LICENSEE EVENT REPORT NO. 90-012-01

Dear Sir:

Transmitted herewith is Licensee Event Report No. 90-012-01 for the WNP-2 Plant. This report is submitted in response to the report requirements of 10CFR50.73 and 10CFR21 and discusses the items of reportability, corrective action taken, and action taken to preclude recurrence.

Very truly yours,



J. W. Baker (M/D 927M)  
WNP-2 Plant Manager

JWB:lr

Enclosure:  
Licensee Event Report No. 90-012-01

cc: Mr. John B. Martin, NRC - Region V  
Mr. C. J. Bosted, NRC Site (M/D 901A)  
INPO Records Center - Atlanta, GA  
Ms. Dottie Sherman, ANI  
Mr. D. L. Williams, BPA (M/D 399)

9008160148 900809  
PDR ADCK 05000397  
S PIC

*Cent 20*  
*11-1528*  
*Pos 5602813*

## LICENSEE EVENT REPORT (LER)

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST: 50.0 HRS. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE RECORDS AND REPORTS MANAGEMENT BRANCH (P-530), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

FACILITY NAME (1)

Washington Nuclear Plant - Unit 2

DOCKET NUMBER (2)

0 5 0 0 0 3 9 7 1 OF 1 2

PAGE (3)

TITLE (4) Fire in Division One Diesel Generator Caused by  
Generator Thrust Bearing Failure

EVENT DATE (5)			LER NUMBER (6)			REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)		
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	MONTH	DAY	YEAR	FACILITY NAMES	DOCKET NUMBER(S)	
0	5	2	7	9	0	9	0	0	0	1	2
THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more of the following) (11)											
OPERATING MODE (9)		5									
POWER LEVEL (10)		0 0 0									
20.402(b)		20.405(c)		60.73(a)(2)(iv)		73.71(b)					
20.405(a)(1)(i)		60.38(c)(1)		X 60.73(a)(2)(v)		73.71(c)					
20.405(a)(1)(ii)		60.38(c)(2)		60.73(a)(2)(vii)		X OTHER (Specify in Abstract below and in Text, NRC Form 366A)					
20.405(a)(1)(iii)		60.73(a)(2)(i)		60.73(a)(2)(viii)(A)		10CFR21					
20.405(a)(1)(iv)		60.73(a)(2)(ii)		60.73(a)(2)(viii)(B)							
20.405(a)(1)(v)		60.73(a)(2)(iii)		60.73(a)(2)(x)							

LICENSEE CONTACT FOR THIS LER (12)

NAME

TELEPHONE NUMBER

W. S. Davison, Compliance Engineer

AREA CODE

5 0 9 3 7 7 2 5 0 1

COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)

X 2 7 2 6

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NRC	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NRC
B	E	D	D	G	S	4	0	7	Yes

SUPPLEMENTAL REPORT EXPECTED (14)

EXPECTED SUBMISSION DATE (15)

MONTH DAY YEAR

YES (If yes, complete EXPECTED SUBMISSION DATE)

X NO

ABSTRACT (Limit to 1400 spaces, i.e., approximately fifteen single-space typewritten lines) (16)

On May 27, 1990, at 1742 hours, the Division 1 emergency diesel generator (DG-GEN-DG1) failed approximately six hours into a 24 hour full load run. The failure of the diesel generator slip ring end bearing resulted in a small fire in the area of the bearing itself which was quickly extinguished. An Emergency Classification of Unusual Event was declared by the Shift Manager and the event was reported to the NRC Bethesda Operations Center. During investigation of the failed bearings, it was discovered that both the Division 1 and Division 2 emergency diesel generators had shorted field pole windings which were evaluated as being the result of manufacturing defects.

There were four root causes determined to be responsible for occurrence of the bearing failure event: 1) Equipment - Manufacturing Error - Not made per design - an extra O-ring groove was found machined into the generator thrust bearing bracket which prevented the bearing oil reservoir from obtaining a tight seal. This resulted in oil leakage from the reservoir, oil starvation of the thrust bearing and eventual bearing failure. 2) Equipment - Design Deficiency - Specification less than adequate - the oil level band (3/8") for the oil reservoirs is too narrow to allow practical maintenance of level. 3) Equipment - Design Deficiency - Loss of



LICENSEE EVENT REPORT (LER)  
TEXT CONTINUATION

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST: 60.0 HRS. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE RECORDS AND REPORTS MANAGEMENT BRANCH (P-530), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

FACILITY NAME (1)

DOCKET NUMBER (2)

LER NUMBER (6)

PAGE (3)

YEAR SEQUENTIAL NUMBER REVISION NUMBER

Washington Nuclear Plant - Unit 2

0 5 0 0 0 3 9 7 9 0 - 0 1 2 - 0 1 0 2 OF 1 2

TEXT (If more space is required, use additional NRC Form 366A's) (17)

Abstract (contd.)

monitoring alertness - the temperature and vibration alarm instrumentation and the oil reservoir sight glass were evaluated as inadequate to provide the operators with sufficient warning to respond to this type of event. 4) Personnel - Management Programs - Failure to heed precursors - Nineteen instances of thrust bearing oil level problems occurred over an approximate five year period. Past attempts to correct the problem were unsuccessful.

Their were two root causes that were determined to be responsible for the occurrence of the shorted generator field pole windings: 1) Equipment - Manufacturing Error - Not Made Per Design. The original generator field pole windings were not wound in accordance with the design requirements in that a polyester resin was used to encapsulate the windings vice the required Armstrong A-701 one-part epoxy resin. 2) Equipment - Design Deficiency - Specification Less Than Adequate. The process used to wind the pole pieces allowed bunching and abrading of the Dacron glass covering on the winding wire and did not provide adequate direction to assure proper encapsulation (wetting) by the epoxy resin.

Further corrective actions for the bearing failure event consisted of: removing the extra O-ring groove from the DG1 generator thrust bearing bracket; reviewing the records to determine possible effects on the remaining diesel generator units, and inspection of the oil reservoir sight glasses for the remaining diesel generators to determine their adequacy; evaluations to explore widening the operating band for the oil reservoirs, propose methods of improving the instrumentation and explore installation of a forced circulation oil system for the generator bearings; continuing the development of a reliability centered maintenance program which will address the issue of detecting equipment problem trends associated with maintenance activity and initiation of corrective actions to preclude failure.

Further corrective actions for the shorted generator field pole winding consisted of: rewinding the field for DG1; establishing a condition monitoring plan to trend DG2 for deterioration; and evaluation of the setting of the slip ring safety gap screw.

The small fire associated with this event was handled quickly and correctly in accordance with approved emergency procedures. This report is also being used to report the failed bearings and the shorted generator field pole windings under the requirements of 10CFR21. This event posed no threat to the safety of Plant personnel or the Public.

\*Plant Conditions

- a) Plant Mode - 5 (Refueling)
- b) Power Level - 0%



LICENSEE EVENT REPORT (LER)  
TEXT CONTINUATION

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST: 60.0 HRS. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE RECORDS AND REPORTS MANAGEMENT BRANCH (P-530), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)		
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER			
Washington Nuclear Plant - Unit 2	0 5 0 0 0 3 9 7	9 0	— 0 1 2	— 0 1 0	3	OF	1 2

TEXT (If more space is required, use additional NRC Form 366A's) (17)

Event Description

On May 27, 1990, at 1742 hours, the Division 1 emergency diesel generator (DG-GEN-DG1) failed approximately six hours into a 24 hour full load run. The load run was part of the Logic System Functional Test for the diesel backed 4.16 KV Division 1 emergency AC electrical power system. The purpose of the test was to demonstrate the ability of the system to respond to design basis accident requirements as mandated by the 18 month Technical Specification surveillance requirements.

At 1742 hours while taking individual cylinder temperature readings, the local diesel system operator noticed a change in pitch of the sound coming from the DG1 engines. Thinking that the Main Control Room had adjusted load, he continued taking readings. Shortly thereafter, he noticed a different smell and heard a rumbling coming from the 1A2 (south side) diesel engine. He proceeded to the control panel to see if there were any changes. While observing the panel the "Generator Stator or Bearing Temperature" alarm sounded. After the alarm was silenced, the operator called the main control room to report the alarm. While on the phone, the operator heard the engine start to rumble again and the "Excessive Vibration Generator" alarm sounded. The Main Control Room operator tripped the diesel generator at that point. At the same time, two maintenance men working in the diesel room reported a fire in the engine area. The diesel operator reported the fire to the Main Control Room and then proceeded to the generator area where he noted fire coming out of the generator slip ring end bearing. The small fire was immediately extinguished with a dry chemical fire extinguisher. The fire re-flashed one time before being completely suppressed.

Immediate Corrective Action

The plant operators utilized the emergency operating procedures to successfully deal with the small fire at the DG1 generator slip ring end bearing. An Emergency Classification of Unusual Event was declared by the Shift Manager and the event was reported to the NRC Bethesda Operations Center by telephone at 1810 hours. The DG1 unit was shutdown and danger tagged by plant operators.

Further Evaluation and Corrective ActionA. Further Evaluation

1. Revision 0 of this LER was written to document this event as a voluntary report and to document a manufacturing defect discovered in the generator of DG1 as reportable per the requirements of 10CFR21. This defect consisted of the existence of an additional O-ring groove in the generator thrust bearing bracket.





LICENSEE EVENT REPORT (LER)  
TEXT CONTINUATION

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST: 500 HRS. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE RECORDS AND REPORTS MANAGEMENT BRANCH (P-530), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

FACILITY NAME (1)  Washington Nuclear Plant - Unit 2	DOCKET NUMBER (2)  0 5 0 0 0 3 9 7	LER NUMBER (6)			PAGE (3)		
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER			
		9 0	— 0 1 2	— 0 1 0	4	OF	1 2

TEXT (If more space is required, use additional NRC Form 366A's) (17)

Revision 1 is written to document the fact that, during the process of investigating the generator bearing failure, another defective condition was identified. Both the Division 1 Emergency Diesel Generator and the Division 2 Emergency Diesel Generator have been determined to contain another manufacturing defect. During the reassembly of DG1 after repair of the generator bearings, a Plant Technical engineer discovered that the results of the AC Voltage Pole Drop Test for the field windings indicated the existence of shorted turns. Further testing indicated the existence of shorted turns in the field windings for DG2 as well. This additional defect of shorted generator field pole windings in both the Division 1 and the Division 2 machines was evaluated as reportable per 10CFR21 and 10CFR50.73(a)(2)(v). The required information pertaining to both of the Part 21 reports is listed below in paragraphs 2 and 3.

## 2. DIVISION 1 EMERGENCY DIESEL GENERATOR BEARING FAILURE

- a. Name and address of the individual or individuals informing the Commission.

Washington Nuclear Plant - Unit 2  
3000 George Washington Way  
Richland, Washington 99352

- b. Basic Component which contains a defect.

Division 1 Emergency Diesel Generator (E-DG-1)  
4000 KW 4160 Volt AC Generator  
Type L-11011 Serial Number 17310 200

- c. Identification of firm supplying the component.

Stewart & Stevenson Services Inc.  
P. O. Box 637  
Houston, Texas 77001

- d. Nature of the defect and the safety hazard which is created.

Failure analysis results concluded that the diesel generator failure was due to loss of lubrication to the generator thrust bearing which was caused by leakage of oil from the bearing oil reservoir which supplies the bearing. The oil leakage was caused by an inadequate O-ring seal between the walls of the thrust bearing bracket and the generator housing which form the oil reservoir. The inadequate

LICENSEE EVENT REPORT (LER)  
TEXT CONTINUATION

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST: 60.0 HRS. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE RECORDS AND REPORTS MANAGEMENT BRANCH (P-530), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

FACILITY NAME (1)

DOCKET NUMBER (2)

LER NUMBER (6)

PAGE (3)

YEAR SEQUENTIAL NUMBER REVISION NUMBER

Washington Nuclear Plant - Unit 2

0 5 0 0 0 3 9 7

9 0 - 0 1 2 - 0 1 0 5 OF 1 2

TEXT (If more space is required, use additional NRC Form 366A's) (17)

O-ring seal was caused by the existence of an extra O-ring groove machined into the generator housing adjacent to the thrust bearing bracket which prevented the O-ring from being compressed to obtain a tight seal. This extra groove does not appear on the design drawings. The existence of this extra O-ring groove in the generator housing is a DEFECT.

This defect would most probably result in the failure of DGI to perform its emergency function of supplying power to the 4160 VAC emergency electrical bus (SM-7) during accident conditions (a LOCA with a simultaneous loss of offsite power). The inability of DGI to reliably perform its emergency function is a major degradation of safety-related equipment and as such constitutes a SUBSTANTIAL SAFETY HAZARD.

- e. The date on which the information of defect was obtained.

June 20, 1990

- f. The number and location of affected components in use.

The only affected component at WNP-2 is DGI which located in the DGI room of the Diesel Generator Building.

- g. Corrective Action.

The faulty O-ring groove was corrected under the direction of WNP-2 Technical Staff at the Eastern Electric repair shop in Spokane, Washington, by June 11, 1990.

3. DIVISION 1 AND DIVISION 2 EMERGENCY DIESEL GENERATOR SHORTED FIELD WINDINGS

- a. Name and address of the individual or individuals informing the Commission.

Washington Nuclear Plant - Unit 2  
3000 George Washington Way  
Richland, Washington 99352

LICENSEE EVENT REPORT (LER)  
TEXT CONTINUATION

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST: 50.0 HRS. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE RECORDS AND REPORTS MANAGEMENT BRANCH (P-530), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

FACILITY NAME (1)  Washington Nuclear Plant - Unit 2	DOCKET NUMBER (2)  0 5 0 0 0 3 9 7	LER NUMBER (6)			PAGE (3)		
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER			
		9 0	— 0 1 2	— 0 1 0	6	OF	1 2

TEXT (If more space is required, use additional NRC Form 366A's) (17)

## b. Basic Components which contain the defects.

Division 1 Emergency Diesel Generator (E-DG-1)  
4000 KW 4160 Volt AC Generator  
Type L-11011 Serial Number 17310 200  
and  
Division 2 Emergency Diesel Generator (E-DG-2)  
4000 KW 4160 Volt AC Generator  
Type L-11011 Serial Number 17310 201

## c. Identification of firm supplying the components.

Stewart & Stevenson Services Inc.  
P. O. Box 637  
Houston, Texas 77001

## d. Nature of the defect and the safety hazard which is created.

Emergency diesel generator number 1 (E-DG-1) and number 2 (E-DG-2) both have been found to contain shorted generator field pole windings. Examination and root cause analysis have evaluated the shorted windings as being the result of manufacturing errors. The diesel generators are basic components of the Emergency AC Electrical Power System which functions to supply electrical power to ECCS loads in the event of a Design Basis Accident.

Failure analysis results concluded that the shorted windings were the result of manufacturing errors. The original generator field pole windings were not wound in accordance with the design requirements in that a polyester resin was used to encapsulate the windings vice the required Armstrong A-107 one-part epoxy resin. The process used to wind the pole pieces also allowed bunching and abrading of the Dacron glass covering on the winding wire and did not provide adequate direction to assure proper encapsulation (wetting) by the epoxy resin. The combination of these errors resulted in two generator field poles in E-DG-1 containing shorted windings and one pole in E-DG-2 containing shorted windings. The shorted field pole windings have been evaluated as being a direct result of the manufacturing errors.

The shorted field pole windings could follow a degradation trend which may eventually lead to failure. If not discovered and corrected, this defect may have resulted in the failure of DG1 and DG2 to perform their emergency function of supplying power to the 4160 VAC emergency buses during accident conditions. The possibility of DG1 and DG2 not being able to reliably perform their emergency function could present a major degradation of safety-related equipment and as such constitutes a substantial safety hazard.



LICENSEE EVENT REPORT (LER)  
TEXT CONTINUATION

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST: 50.0 HRS. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE RECORDS AND REPORTS MANAGEMENT BRANCH (P-530), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

FACILITY NAME (1)  Washington Nuclear Plant - Unit 2	DOCKET NUMBER (2)  0 5 0 0 0 3 9 7	LER NUMBER (6)			PAGE (3)		
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER			
		9 0	— 0 1 2	— 0 1 0	7	OF	1 2

TEXT (If more space is required, use additional NRC Form 365A's) (17)

- e. The date on which the information of defect was obtained.

August 3, 1990

- f. The number and location of affected components in use.

Division 1 Emergency Diesel Generator and Division 2 Emergency Diesel Generator are both located in the Diesel Generator Building.

- g. Corrective Action.

DG1 generator field was rewound during the 1990 refueling outage. DG2 has been evaluated as operable for the next operating cycle. Further maintenance action will be evaluated based on the results of a monitoring program which was initiated to trend the condition of DG2 generator field.

4. There were no structures, components or systems that were inoperable at the start of this event that contributed to the event.
5. The root cause analysis is subdivided to address the two different aspects of the emergency diesel generator problems and are currently still in progress. Any substantive changes in cause or corrective action will be addressed in a supplemental report if necessary.
6. A failure analysis was performed for the bearing failure event. The analysis resulted in the following observations and conclusions:
- a. The small fire was caused by excessive heat generated when the generator slip ring end bearing failed. This bearing failed due to extreme misalignment caused by axial thrust applied from the opposite end of the generator as the thrust bearing failed. This led to an overload failure of the slip ring end bearing.
  - b. The thrust bearing oil reservoir allowable level band is only 3/8 inch from top to bottom, or about one pint of oil. Operating with oil level too low causes loss of lubrication to the bearing. Operating with level too high promotes undesirable foaming of the oil.
  - c. The oil level in the slip ring end bearing was high enough to provide adequate lubrication to the bearing during and after the failure.
  - d. The application of unacceptable axial thrust to the generator slip ring end bearing, which resulted in its failure, was caused by catastrophic failure of the generator thrust bearing.



LICENSEE EVENT REPORT (LER)  
TEXT CONTINUATION

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST: 50.0 HRS. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE RECORDS AND REPORTS MANAGEMENT BRANCH (P-530), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

FACILITY NAME (1)  Washington Nuclear Plant - Unit 2	DOCKET NUMBER (2)  0 5 0 0 0 3 9 7	LER NUMBER (6)			PAGE (3)		
		YEAR 9 0	SEQUENTIAL NUMBER 0 1 2	REVISION NUMBER 0 1 0		OF	1 2

TEXT (If more space is required, use additional NRC Form 366A's) (17)

- e. The generator thrust bearing failed due to loss of lubricant. Nineteen instances of inability to maintain proper oil level in the bearing reservoir have occurred over a five year period and were evaluated as event precursors. These problems were not solved in time to prevent the low oil event which led to total failure of the thrust bearing.
- f. The long term leakage from the thrust bearing oil reservoir was caused by an extra O-ring groove improperly machined into the generator bearing bracket adjacent to the thrust bearing cover. The only O-ring groove present should have been the one machined into the thrust bearing bracket itself. This extra groove allowed excessive space for the O-ring and precluded proper ring compression, thus, allowing a slow oil leak to exist.
7. There were four root causes determined to be responsible for occurrence of the bearing failure event:
- a. Equipment - Manufacturing Error - Not made per design. It was determined that an extra "O" ring groove was machined into the generator thrust bearing bracket (the oil reservoir is contained in the bracket) which was not in accordance with the design drawings. No groove should have been present. The second groove prevented the O-ring from being compressed to produce an adequate seal to prevent oil leakage from the bearing oil reservoir. This oil leakage ultimately led to failure of the generator thrust bearing.
- b. Equipment - Design deficiency - Specification less than adequate. The prescribed operating band for the generator thrust bearing oil level is only 3/8 inch. This was evaluated as impractical and very difficult to maintain.
- c. Equipment - Design Deficiency - Loss of monitoring alertness. The temperature alarm instrumentation, the vibration alarm instrumentation and the oil sump level indicators on DGI are all deficient in their ability to perform the intended function of alerting the operating personnel to abnormal conditions. The vibration alarms were evaluated as not being sensitive enough to predict an event as experienced. The diesel operator did not have sufficient time to respond to the vibration alarm and secure the machine prior to the occurrence of catastrophic damage. The temperature alarms should also have given sufficient warning of impending bearing failure to allow the operator to secure the machine prior to the occurrence of catastrophic damage. The thrust bearing oil reservoir level indicator contained three different marks, any one of which could have been interpreted to be the minimum oil level indication.





LICENSEE EVENT REPORT (LER)  
TEXT CONTINUATION

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST: 50.0 HRS. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE RECORDS AND REPORTS MANAGEMENT BRANCH (P-530), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

FACILITY NAME (1)  Washington Nuclear Plant - Unit 2	DOCKET NUMBER (2)  0 5 0 0 0 3 9 7	LER NUMBER (8)				PAGE (3)			
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER					
		9 0	- 0 1	2	- 0 1	0	9	OF 1	2

TEXT (If more space is required, use additional NRC Form 366A's) (17)

- d. Personnel - Management Programs - Failure to heed precursors.  
Failure to communicate and act upon long term problems of oil leakage from the generator thrust bearing and difficulties in maintaining levels in the thrust bearing oil reservoir led to the eventual oil starvation of the bearing. Nineteen documented instances of DG1 thrust bearing oil level problems occurred over an approximate five year period. Attempts to correct the problem were unsuccessful. The existence of the second O-ring groove was not discovered nor were sufficient compensatory measures to counteract the oil leakage problem implemented.
8. A failure analysis was performed for the shorted field pole windings using both Supply System staff and industry experts. The analysis resulted in the following observations and conclusions:
- Operation of DG1 and DG2 with minor defects of turn leakage current has not produced any noticeable symptoms during operation and has not indicated any progressive performance deterioration.
  - Re-winding of the DG1 coils after discovery of the defects through AC Voltage pole Drop Test was a conservative action.
  - Disassembly of the machine and root cause analysis determined that the failure mechanism of the pole winding insulation was a manufacturing defect and ruled out aging or operational events as a causative factor.
  - Continued operation of DG2 with one coil that indicates inter-turn leakage is acceptable as long as the vibration and DC field current parameters do not show a trend indicating progressive expansion of the inter-turn leakage current and the performance test criteria required by Plant Technical Specifications and the agreed upon additional testing and monitoring continue to be met with no decrease in generator performance.
  - The process of winding and/or curing of the original pole windings was somehow defective in that the insulation was abraded prior to encapsulation and not fully encapsulated which resulted in an insulation scheme that would not, in localized areas, prevent shorting of the windings. In addition, the adhesive used was not the required material specified by the Engineering Specification in force at the time of manufacture.

LICENSEE EVENT REPORT (LER)  
TEXT CONTINUATION

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST: 50.0 HRS. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE RECORDS AND REPORTS MANAGEMENT BRANCH (P-630), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

FACILITY NAME (1)  Washington Nuclear Plant - Unit 2	DOCKET NUMBER (2)  0 5 0 0 0 3 9 7	LER NUMBER (6)			PAGE (3)	
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER		
		9 0	— 0 1 2	— 0 1	1 0	OF 1 2

TEXT (If more space is required, use additional NRC Form 366A's) (17)

- f. The setting of the slip ring safety gap screw at .080 inches may have resulted in some damage to the DG-1 field windings, however, no indication of arc over on DG-2 could be found. Setting of the safety gap screw at a gap greater than the 1000 volt setting does not seem to be justified by the engineering information available.
9. There were two root causes determined to be responsible for the shorted generator field pole windings:
- Equipment - Manufacturing Error - Not Made Per Design. The original generator field pole windings were not wound in accordance with the design requirements in that a polyester resin was used to encapsulate the windings vice the required Armstrong A-701 one-part epoxy resin.
  - Equipment - Design Deficiency - Specification Less Than Adequate. The process used to wind the pole pieces allowed bunching and abrading of the Dacron glass covering on the winding wire and did not provide adequate direction to assure proper encapsulation (wetting) by the epoxy resin.
10. The failure of DG1 during performance of a technical specification required surveillance was evaluated as a failure during a valid test in accordance with regulatory position c.2.e of NRC Regulatory Guide 1.108 Revision 1 August 1977. The surveillance frequency was not required to be increased since the number of failures did not exceed the criteria listed in WNP-2 Technical Specification paragraph 4.8.1.1.2

B. Further Corrective Action

1. Bearing Failure Event:
- The second O-ring groove in the housing of the DG1 generator was eliminated to bring the machine into compliance with design drawings.
  - A detailed review of the records of the remaining emergency diesel generators was conducted to discover possible effects on the operability of those machines. This review also included examination of photographs of the Division 2 diesel generator taken during a factory repair in 1984. Examination of these photos showed that the Division 2 Diesel Generator housing adjacent to the generator thrust bearing does not contain an additional O-ring groove.
  - The remaining diesel generators were inspected to determine that oil level indicators were readable with the correct indicated level.

LICENSEE EVENT REPORT (LER)  
TEXT CONTINUATION

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST: 50.0 HRS. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE RECORDS AND REPORTS MANAGEMENT BRANCH (P-530), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)		
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER			
Washington Nuclear Plant - Unit 2	0   5   0   0   0   3   9   7	9   0	—   0   1   2	—   0   1   1	1   1	OF	1   2

TEXT (If more space is required, use additional NRC Form 366A's) (17)

- d. Further measurements will be taken on the Division 2 generator to confirm proper oil level indication.
  - e. Widening the level control band for the generator oil reservoirs will be evaluated.
  - f. An evaluation will be performed to propose methods of improving the vibration, temperature, and oil level instrumentation.
  - g. An evaluation will be performed to explore installing of a forced lubrication system for the generator bearings.
  - h. An evaluation will be performed to determine the feasibility of establishing a process to improve the ability to monitor and trend lubricating oil levels in order to correct problems prior to failure.
2. Shorted Generator Field Pole Windings:
- a. The generator for DG1 was rewound to the original factory specifications and reinstalled.
  - b. The generator for DG2 will be monitored to determine the condition of the field windings over time to assure no significant deterioration takes place and to provide basis for any decision to rewind or not to rewind the field poles at some future date.
  - c. The slip ring safety gap screw setting for the Diesel Generators will be evaluated to establish the proper set point.

Safety Significance

At the time of the bearing failure event, the plant was in the Refueling Mode (Operational Conditional 5) and, as a result, DG1 was not required to be operational. Since no common mode failure was identified associated with the bearing failure, even if it had occurred during power operation, the loss of a single diesel generator is within the bounds of the Technical Specification LCO Action requirements. The remaining redundant Division 2 emergency AC electrical power system and associated safety-related equipment was unaffected by the bearing failure event and could have responded to accident conditions. The defect associated with the existence of the extra O-ring groove most probably would have resulted in the failure of DG1 to perform its emergency function of supplying power to the Division 1 safety-related equipment in the event of a Design Basis LOCA accompanied by simultaneous loss of offsite electrical power.



LICENSEE EVENT REPORT (LER)  
TEXT CONTINUATION

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST: 50.0 HRS. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE RECORDS AND REPORTS MANAGEMENT BRANCH (P-530), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

FACILITY NAME (1)  Washington Nuclear Plant - Unit 2	DOCKET NUMBER (2)  0 5 0 0 0 3 9 7	LER NUMBER (6)			PAGE (3)	
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER		
		9 0	0 1 2	0 1	1 2	OF 1 2

TEXT (If more space is required, use additional NRC Form 366A's) (17)

The discovery of shorted generator field pole windings in both the Division 1 and Division 2 Emergency Diesel Generators established the existence of a common mode failure mechanism. If not discovered and corrected, this common mode defect may have resulted in the failure of the diesel generators to perform their emergency function of supplying electrical power to the emergency buses during accident conditions. There are no other systems at WNP-2 which could have performed this function. This type of failure is evaluated as highly unlikely and could only have occurred after significant degradation of the field pole windings in both generators at the same time without being discovered and corrected. The probability of occurrence of this simultaneous degradation is evaluated as very small.

The small fire associated with the bearing failure event was handled quickly and correctly in accordance with approved emergency procedures. This event posed no threat to the safety of Plant personnel or the Public.

Similar Events

No similar events involving the diesel generators have occurred at WNP- 2.

EIIS InformationText ReferenceEIIS Reference

	System	Component
DG-GEN-DG1	ED	DG
Division 1 emergency power system	ED	---
Generator	ED	GEN
Emergency electrical bus SM-7	ED	BU