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 FACIL: 50-275 Diablo Canyon Nuclear Power Plant, Unit 1, Pacific Ga 05000275  
 AUTH. NAME AUTHOR AFFILIATION  
 SISK, D. P. Pacific Gas & Electric Co.  
 SHIFFER, J. D. Pacific Gas & Electric Co.  
 RECIP. NAME RECIPIENT AFFILIATION

SUBJECT: LER 88-009-00: on 880720, two of eight steam generator manways discovered leaking & five manways showed indications of seepage. Caused by Flexite Super gaskets experiencing comprehensive creep. Gaskets replaced. W/881027 ltr.

DISTRIBUTION CODE: IE22D COPIES RECEIVED: LTR 1 ENCL 1 SIZE: 9  
 TITLE: 50.73 Licensee Event Report (LER), Incident Rpt, etc.

NOTES:

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	AEDD/DSP/TPAB	1 1	ARM/DCTS/DAB	1 1
	DEDRO	1 1	NRR/DEST/ADS 7E	1 0
	NRR/DEST/CEB 8H	1 1	NRR/DEST/ESB 8D	1 1
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	NRR/DREP/RPB 10	2 2	NRR/DRIS/SIB 9A	1 1
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	RES/DSIR/EIB	1 1	RES/DSR/PRAB	1 1
	RGN5 FILE 01	1 1		
EXTERNAL:	EG&G WILLIAMS, S	4 4	FORD BLDG HOY, A	1 1
	H ST LOBBY WARD	1 1	LPDR	1 1
	NRC PDR	1 1	NSIC HARRIS, J	1 1
	NSIC MAYS, G	1 1		

*A/104cc*



# LICENSEE EVENT REPORT (LER)

FACILITY NAME (1): **DIABLO CANYON UNIT 2** DOCKET NUMBER (2): **08100103123** PAGE (3): **1 OF 08**

TITLE (4): **STEAM GENERATOR MANWAY LEAK FOLLOWING COOLDOWN DUE TO USE OF GASKETS THAT EXPERIENCED COMPRESSIVE CREEP AND LOSS OF RESILIENCY**

EVENT DATE (5):			LER NUMBER (6):			REPORT DATE (7):			OTHER FACILITIES INVOLVED (8):			
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	INVOICE NUMBER	MONTH	DAY	YEAR	FACILITY NAMES			DOCKET NUMBER (S)
07	20	88	88	019	010	07	27	88	DIABLO CANYON UNIT 1			0810010275

OPERATING MODE (9): **5**  
 POWER LEVEL (10): **000**  
 THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR § (11):  
 10 CFR \_\_\_\_\_  
 OTHER (Specify in Abstract Below and in Text, NRC Form 305A) **Voluntary Report**

LICENSEE CONTACT FOR THIS LER (12):  
**DAVID P. SISK, REGULATORY COMPLIANCE ENGINEER**  
 TELEPHONE NUMBER:  
 AREA CODE: **815** NUMBER: **595-7351**

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

CAUSE	SYSTEM	COMPONENT	MANUF TURE	REPORTABLE TO NRC	CAUSE	SYSTEM	COMPONENT	MANUF TURE	REPORTABLE TO NRC

SUPPLEMENTAL REPORT EXPECTED (14):  
 YES IN THE SUPPLEMENTAL REPORT EXPECTED SUBMISSION DATE: \_\_\_\_\_  
 NO  
 EXPECTED SUBMISSION DATE (15): MONTH: \_\_\_\_\_ DAY: \_\_\_\_\_ YEAR: \_\_\_\_\_

ABSTRACT (16):

This report is being voluntarily submitted for information purposes only, as described in item 19 of Supplement Number 1 to NUREG-1022.

Following a cooldown to Mode 5 after 12 months of operation at normal operating temperatures, two of eight steam generator manways were discovered to be leaking and five others showed indications of seepage. Investigation has revealed that the inception of leakage was during or after the cooldown following the manual reactor trip of July 17, 1988.

Subsequent discussion with the gasket manufacturer (Flexitallic) has disclosed that the gaskets being used, "Flexite Super" gaskets, experience compressive creep and loss of resiliency due to changes in the filler material when exposed to high temperatures (greater than 400 degrees Fahrenheit) for extended periods of time.

Examination of the "Flexite Super" gaskets showed a greater amount of permanent deformation than the asbestos-filled gaskets called for in the initial design of the manways. This permanent deformation resulted in a loss of manway stud preload and in leakage when the manway cooled. The "Flexite Super" manway gaskets have been replaced with asbestos-filled gaskets in all four Unit 2 steam generators.

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

I. Initial Conditions

Unit 2 was in Mode 5 (Cold Shutdown) and Unit 1 was in Mode 1 at approximately 50 percent power during this event.

II. Description of Event

A. Event:

This report is being voluntarily submitted for information purposes only as described in item 19 of Supplement Number 1 to NUREG-1022.

On July 20, 1988, during a mechanical maintenance pre-outage leak-check walkdown inside the Unit 2 containment, a puddle (approximately 10 feet in diameter) of water was observed on the 91 foot level inside the bioshield area. The source of the water was traced to the bottom of the insulation on steam generator (AB)(SG) 2-2.

On July 22, 1988, further investigation of the leak discovered on July 20 disclosed the formation of crystals in the puddle and the flow path from SG 2-2, indicating borated water. Close examination determined the leak to be coming from the area of the two SG 2-2 primary manways (AB)(PEN). Removal of the insulation from the manways confirmed the source of the leakage. The insulation was promptly removed from the other SGs, but no other indication of SG primary manway leakage was found.

On July 23, 1988, a formal investigation team was formed to develop an action plan and determine the cause of the occurrence. Boric acid samples were removed for chemical and radiochemical analysis. The vendor was contacted for a history of similar occurrences and recommendations for corrective actions. Examination of the available data indicated that the leak had started during or after the cooldown following the July 17, 1988 transients. Observations supporting this determination are as follows:

1. No boric acid crystallization was observed when the leakage was first discovered on July 20, 1988.
2. Chemical and radiochemical analysis of the samples showed the crystals to be nearly identical in radioisotopes with that of samples from the RCS, therefore the crystals were fresh (less than a week out of the RCS).
3. The boric acid crystals found were soft. The presence of the hot dry ambient conditions indicated that the boric acid crystals had formed recently.



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4. The unit had been at elevated temperatures from July 4, 1987, to July 18, 1988. Westinghouse stated that due to different coefficients of expansion of the materials in the manway closure, the potential for leakage is greater at low temperatures.
5. The leakage pattern around the two leaking manways showed a slow downward liquid flow pattern. Had the leak been present when the unit was at an elevated temperature and pressure, a steam spray pattern would have been expected. In addition, the presence of boric acid "snow" would have been expected.
6. Containment activity levels since the last refueling showed no significant trends or step increases in activity.

On July 29, 1988, a followup examination of SGs 2-1, 2-3, and 2-4 manways identified leakage on five of the six manways. This leakage had occurred after the initial examination conducted on July 22, 1988.

On July 30, 1988, all Unit 2 SG manway covers were removed and inspected. "Flexite Super" gaskets were replaced with asbestos-filled Flexitallic gaskets.

B. Inoperable structures, components, or systems that contributed to the event:

None

C. Dates and approximate times for major occurrences:

1. July 17, 1988, at 0717 PDT: A manual reactor trip was initiated as reported in LER 2-88-008-00. Unit cooled down to Mode 4 (Hot Shutdown).
2. July 18, 1988, at 1313 PDT: Unit 2 entered Mode 5 (Cold Shutdown) using natural circulation cooldown.
3. July 20, 1988, at 0130 PDT: A puddle of water was observed during a mechanical maintenance pre-outage leak-check walkdown inside the Unit 2 containment.

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4. July 22, 1988: During inspection to locate the leak source, crystallization was observed.
5. July 23, 1988: Boric acid crystal samples were removed from the vicinity of the SG 2-2 manways for chemical and radiochemical analysis.
6. July 29, 1988: Reinspection of SG manways on the other three SGs revealed indication of leakage on five of the six SG manways.
7. July 30, 1988: Initiated removal and inspection of all Unit 2 SG manway covers. Replaced "Flexite Super" gaskets with asbestos-filled Flexitallic gaskets.
8. August 11, 1988: Unit 2 entered Model 1 (Power Operation). No indication of SG manway leakage.

D. Other systems or secondary functions affected:

None

E. Method of Discovery:

On July 20, 1988, during a mechanical maintenance pre-outage leak-check walkdown inside the Unit 2 containment, a puddle (approximately 10 feet in diameter) of water was observed on the 91 foot level inside the bioshield area. The source of the water was traced to the bottom of the insulation on SG 2-2. On July 22, 1988, during an inspection to locate the source of the leak, crystallization was observed. Further observation determined the leak to be from the area of the SG 2-2 primary manways. Removal of the insulation from the manway covers confirmed an approximately two drop per second leak. The insulation was then removed from the other three Unit 2 SGs. Visual inspection of the manways on the other three SGs showed no evidence of leakage.

F. Operator actions:

None

G. Safety system responses:

None

III. Cause of Event

A. Immediate cause:

Examination of the gasket showed the "Flexite Super" gaskets to have experienced a greater amount of permanent deformation than the

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asbestos-filled flexitallic gaskets called for in the initial design of the manways. This permanent deformation caused a reduction in manway stud preload and resulted in leakage when the manway cooled.

B. Root Cause:

PG&E conducted an extensive investigation of the potential causes of this event using a multidisciplinary Event Investigation Team.

Following a cooldown to Mode 5 after 12 months of operation at normal operating temperatures, two of eight steam generator manways were discovered to be leaking and five others showed indications of seepage. Investigation has revealed that the inception of leakage was during or after the cooldown. Westinghouse, the NSSS vendor, has indicated that, due to the construction of the manway closure, leakage is more likely to occur in a cooled condition than a hot condition. Subsequent discussion with the gasket manufacturer (Flexitallic) has disclosed that the gaskets being used, Flexitallic "Flexite Super" gaskets, experience compressive creep and loss of resiliency due to changes in the filler material when exposed to high temperatures (greater than 400 degrees Fahrenheit) for extended periods of time. The Flexitallic "Flexite Super" manway gaskets have been replaced with asbestos-filled gaskets in all four Unit 2 steam generators.

The Event Investigation Team evaluated potential root causes as follows:

1. Material degradation

Examination of studs, gaskets, and the flange face failed to provide any indication of failure or degradation of these components.

However, examination of the gasket showed the "Flexite Super" gaskets to have experienced a greater amount of permanent deformation than the asbestos-filled Flexitallic gaskets called for in the initial design of the manways. This permanent deformation caused a reduction in manway stud preload and resulted in leakage when the manway cooled. Discussions with the gasket manufacturer (Flexitallic) has disclosed that the gaskets being used, Flexitallic "Flexite Super" gaskets, experience compressive creep and loss of resiliency due to changes in the filler material when exposed to high temperatures (greater than 400 degrees Fahrenheit) for extended periods of time. The Flexitallic "Flexite Super" gaskets have been replaced with asbestos-filled gaskets.

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2. Design

Investigation has shown that the initial design of the manway was adequate. However, a design change was made to replace the originally designed asbestos-filled Flexitallic gasket with a new "superior performing" replacement gasket, Flexite Super, also manufactured by Flexitallic. It has been the practice of the plant to purchase such gaskets as commercial grade, and to apply appropriate dedication activities (in this case, verification of receipt of the purchased gasket, and verification of no leakage).

At the present time, Flexitallic Company has not been qualified as a safety-related vendor under the PG&E QA program; however, Flexitallic has stated that they have been supplying gaskets to other utilities under their QA programs.

Flexitallic representatives had full knowledge and concurred with the decision to install the "Flexite Super" gasket in the manway closures. However, their recent experience over the past year or two has led them to conclude that this type of gasket is unsuitable for use in this type of closure, although it is an acceptable substitute for less flexible closures such as pipe flanges.

Moreover, the substitution of this gasket was not discussed with the NSSS vendor before the fact. The vendor manway installation procedure was written specifically for using asbestos-filled gaskets. Westinghouse has stated that they would not now concur in the installation of such replacement gaskets in the SG manways.

4. Installation

A review of the installation procedure and the as found condition did not indicate any problems with installation that could have contributed to this event.

5. Maintenance

Preventive maintenance is not performed on the SG manways; however, this fact is not considered to be a contributor to this event.

6. Testing

This event was not caused by a missed, incomplete, or inadequate testing.



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7. End of Life

No component involved in this event deteriorates with age and there are no moving parts to wear out. The compressive creep experienced by the gasket is not considered normal wear.

8. Inappropriate Equipment Operation

The Event Investigation Team did not find any evidence of improper operation of equipment. All temperature and pressure cycles were within Westinghouse provided limits. Although a power-operated relief valve did lift during the pressure transient on July 17, this relief lifts at 2335 psig which is well below the RCS safety limit pressure of 2735 psig.

IV. Analysis of the Event

RCS leakage and containment activity are constantly monitored. This leak was discovered before being significant enough to contribute to RCS leakage or containment activity level. Westinghouse has stated that heating up the manway increases the stud loading, thus the most likely time for a leak would be during or at the end of a plant cooldown.

Had the leak developed at full power, containment activity monitors would have detected the leak and applicable procedures would have been followed prior to the leak increasing sufficiently to affect the reactor coolant system. If the radiation monitors had failed to detect the increased activity, and the leak had increased in volume from the maximum of two drops per second at the time of discovery, the reactor coolant inventory monitoring system would have detected the leak and the plant operators would have followed the applicable procedure to place the unit in a safe shutdown condition. Thus, the health and safety of the public were not affected by this event.

V. Corrective Actions

- A. The "Flexite Super" gaskets in all four Unit 2 SGs have been replaced with asbestos-filled Flexitallic gaskets.
- B. Other "Flexite Super" gaskets being used in systems heated over 400 degrees were located and evaluated. All other "Flexite Super" gasket locations were determined to be acceptable.
- C. The SG manways in Unit 1 will be inspected during the next outage of sufficient duration. A visual inspection of the Unit 1 SGs performed in July, 1988, did not show any sign of leakage.

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D. The SG manway gaskets in Unit 1 will be replaced during the next refueling outage.

VI. Additional Information

A. Failed Components:

Flexitallic gasket: Flexite Super  
 Manufacture: Flexitallic Gasket Company  
 Part Number: 390-A029-H01  
 Description: Gasket, Primary Manway Super Flex 2500 psi

B. Previous LERs on similar events:

None

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Pacific Gas and Electric Company

77 Beale Street  
San Francisco, CA 94106  
415/972-7000  
TWX 910-372-6587

James D. Shiffer  
Vice President  
Nuclear Power Generation

October 27, 1988

PG&E Letter No. DCL-88-256



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

Re: Docket No. 50-275, OL-DPR-80  
Docket No. 50-323, OL-DPR-82  
Diablo Canyon Units 1 and 2  
Licensee Event Report 2-88-009-00 (Voluntary)  
Steam Generator Manway Leak Following Cooldown Due To Use of  
Gaskets That Experienced Compressive Creep And Loss of  
Resiliency

Gentlemen:

PG&E is submitting the enclosed voluntary Licensee Event Report (LER) regarding steam generator manway leaks that occurred during or after a unit cooldown. This report is being submitted for information purposes only, as described in item 19 of Supplement Number 1 to NUREG-1022.

This event has in no way affected the public's health and safety.

Kindly acknowledge receipt of this material on the enclosed copy of this letter and return it in the enclosed addressed envelope.

Sincerely,

A handwritten signature in cursive script, appearing to read 'J. D. Shiffer'. The signature is written in dark ink and is positioned above the printed name.

J. D. Shiffer

cc: J. B. Martin  
M. M. Mendonca  
P. P. Narbut  
B. Norton  
H. Rood  
B. H. Vogler  
CPUC  
Diablo Distribution  
INPO

Enclosure

DC2-88-EM-N083

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