

LICENSEE EVENT REPORT (LER)

FACILITY NAME (1) Calvert Cliffs, Unit 1	DOCKET NUMBER (2) 0 5 0 0 0 3 1 7	PAGE (3) 1 OF 0 8
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TITLE (4) Use of Fasteners (Bolts, Studs, Threaded Rod & Nuts) in ASME Class 1, 2, & 3 Systems without Proper Certification, Special NDE, or Special Marking.

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		
0 4	2 3	8 7	8 7	0 0	9 0	2 0	2 0	3 8	Calvert Cliffs, Unit 2		
									DOCKET NUMBER(S) 0 5 0 0 0 3 1 8		

OPERATING MODE (9) 5	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR § (Check one or more of the following) (11)									
POWER LEVEL (10) 0	20.402(b)	20.405(e)	50.73(a)(2)(iv)	72.71(b)						
	20.405(a)(1)(i)	50.36(e)(1)	50.73(a)(2)(v)	73.7(c)						
	20.405(a)(1)(ii)	50.36(e)(2)	50.73(a)(2)(vi)	OTHER (Specify in Abstract below and in Text, NRC Form 365A)						
	20.405(a)(1)(iii)	50.73(a)(2)(i)	50.73(a)(2)(viii)(A)							
	20.405(a)(1)(iv)	X 50.73(a)(2)(ii)	50.73(a)(2)(viii)(B)							
20.405(a)(1)(v)	50.73(a)(2)(iii)	50.73(a)(2)(k)								

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER
Bruce Montgomery, Senior Engineer	AREA CODE: 3 0 1   2 6 1 0 -   3 9 4 6

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

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NFRDS	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NFRDS

SUPPLEMENTAL REPORT EXPECTED (14)

YES (If yes, complete EXPECTED SUBMISSION DATE)       NO

EXPECTED SUBMISSION DATE (15)      MONTH    DAY    YEAR

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

On April 23, 1987, with the unit in cold shutdown, we determined there were instances where commercial-quality fasteners without the requisite material traceability and certification had been installed in ASME Section XI Class 1, 2, and 3 systems. There are no similar events previously reported in an LER. We reviewed all maintenance work performed on ASME Section XI systems since initial plant operation (approximately 40,000 maintenance requests, or MRs, were involved) and found that commercial quality fasteners had been inappropriately used in 61 cases. These fasteners, totalling over 1600 studs, bolts, and nuts, were removed and replaced with properly certified fasteners. The removed fasteners were tested for strength and chemistry. The testing revealed only 16 fasteners were judged to fail ASTM specifications. However, the results showed that 115 of the fasteners were made of a material different from the material grade that was specified for the locations they were installed. Engineering analyses showed that in all cases the fasteners would have performed their intended functions under accident conditions. The causes of this event have been identified and corrective action has been taken to prevent recurrence.

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TEXT IF more space is required, use additional NRC Form 305A's (17)

On April 23, 1987, with the unit in cold shutdown, we determined there were instances where commercial-quality fasteners without the requisite material traceability and certification had been installed in ASME Section XI Class 1, 2, and 3 systems. There are no similar events previously reported in an LER. We reviewed all maintenance work performed on ASME Section XI systems since initial plant operation (approximately 40,000 maintenance requests, or MRs, were involved) and found that commercial quality fasteners had been inappropriately used in 61 cases. These fasteners, totalling over 1600 studs, bolts, and nuts, were removed and replaced with properly certified fasteners. The removed fasteners were set aside for subsequent testing. The test results are summarized in this report.

In our earlier reports, LERS 87-009-000 and 87-009-001, we concluded that this event was caused by: inadequate precautions placed on repair and replacement planning activities regarding the use of safety-related fasteners purchased by the commercial quality method, an overall lack of awareness of the material quality and traceability requirements for mechanical fasteners used within ASME Section XI boundaries, and the absence of formal, easy-to-use documentation to assist our personnel in the identification of code boundaries during maintenance planning activities.

While these were the primary causes of the event, we now conclude that two additional conditions existed which contributed substantially to the event's severity. The first condition was a lack of specific written instruction to mechanics regarding the proper material grade of fasteners to use on a job. The second condition was the presence of a "free-stock" supply of fasteners inside the plant which had a composition that was highly conducive to error in the selection of fasteners.

The purpose of this supplemental report is to identify the causes and implications of this event and to describe the actions taken to prevent recurrence.

A total of 1689 uncertified fasteners (studs, bolts and nuts) were removed from ASME Section XI Class 1, 2, and 3 systems and were bagged and tagged for testing. Of these, 50 pieces were misplaced or mislabeled and 100 pieces could not be decontaminated. Consequently, these 150 fasteners could not be tested. The remaining 1539 fasteners were tested to determine their physical and chemical properties relative to the strength and material composition requirements specified for the systems in which they were installed. The results of this testing program are summarized in Table 1.

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TEXT (if more space is required, use additional NRC Form 385A's) (17)

TABLE 1

Summary of Material Testing  
on Uncertified Fasteners<sup>(1)</sup>

	<u>EVALUATION</u> <u>CATEGORY</u>	<u>NUMBER</u> <u>OF PIECES</u>
a.	Within specified strength and chemistry	1194
b.	Within specified strength, slight deviations in chemistry	174
c.	Within 10% of strength, within or very close to specified chemistry	40
d.	Significant deviations in strength and/or chemistry	131 <sup>(2)</sup>

(1) Each piece received a surface examination, a hardness test and a chemical analysis. Bolt heads and studs also received a magnetic particle test. Test results were compared against the ASTM standard applicable to the system or component the piece was removed from. In the majority of cases the applicable standard was ASTM-193, Grade B7 for studs and bolts, and ASTM-194, Grade 2H for nuts.

(2) Most of these bore no markings.

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TEXT (If more space is required, use additional NRC Form 305A's) (17)

The 131 pieces which did not meet specification had been installed in 25 different locations within the plant. Using the measured strength of each piece, an engineering evaluation specific to each location was performed to determine whether system structural integrity had been compromised. In all cases the actual material strength properties were more than adequate to assure system integrity. Because the unit had operated across its full range (0-100% power), including transients, these fasteners were subjected to the full range of operating conditions. Additionally, the analyses that were performed indicate that the fasteners would have performed their intended function under accident conditions. Therefore, there is no safety significance associated with this event.

A detailed investigation was conducted to determine the specific circumstances which led to 131 pieces being out-of-specification (O.O.S.). Each piece was visually re-examined for markings or any other physical attributes that are characteristic of material grade. The chemistry and hardness test results were also closely re-examined. Based on this re-evaluation it was determined that the majority of the 131 fasteners in question were out-of-specification because they were made from a different material. Whereas ASTM-193-B7/ASTM-194-2H (for bolts/nuts, respectively) was normally the material specified for use, these pieces were predominantly ASTM-307-B/ASTM-563-A material. The results of this evaluation are presented in Table 2.

TABLE 2

RE-EVALUATION OF 131 O.O.S. FASTENERS

<u>DEVIATION CATEGORY</u>	<u>ITEM</u>	<u>NUMBER OF PIECES</u>
a. <u>Other Material</u>		
* Stainless Steel	Studs	8
	Nuts	9
* ASTM-307-B	Studs/ Bolts	2
* ASTM-563-A	Nuts	96
	TOTAL	<u>115</u>

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TEXT (if more space is required, use additional NRC Form 308A's) (17)

TABLE 2 (continued)

DEVIATION CATEGORY	ITEM	NUMBER OF PIECES
b. <u>Manufacturing Deficiencies</u>		
* <u>Forging Laps</u>	Bolts	1
	Nuts	3
* Other (possible manufacturing process deficiencies)	Bolts/ Studs	12
	TOTAL	<u>16</u>
	GRAND TOTAL	<u>131</u>

During this review a very strong correlation was found between the presence of ASTM grade markings and passing test results. The only exceptions to this were the four forging laps and 12 failures attributed to possible manufacturing process deficiencies. An even stronger correlation was found to exist between pieces that bore no markings and those that were determined to be ASTM-307-B/ASTM-563-A material (mostly A-563 nuts). This should not be unexpected as the ASTM standard does not specify any unique marking for this class of low carbon steel, and it is normal and customary industry practice to supply this material without markings.

A-307/A-563 material is a low carbon steel with a lower tensile strength relative to A-193/A-194 (which is a medium alloy steel), and is normally specified for use at Calvert Cliffs in lower stress bolting applications. These applications include flanged connections in certain low pressure fluid systems, some piping supports, miscellaneous structural applications, etc. These applications encompass many of those which are classified safety-related but which fall outside ASME Section XI boundaries.

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

Another investigation was then conducted to determine how A-307/A-563 material became installed in systems where A-193/A-194 material was specified. We reviewed the original maintenance orders under which these particular fasteners were installed, and found in virtually all of them that instructions regarding fasteners were either insufficient or absent. In many cases the maintenance planner focused on providing guidance for other aspects of the job and may have assumed that the mechanic would know which fasteners to use. In other cases, such as with the simple replacement of gaskets, the planner apparently did not foresee the possibility that new fasteners could be needed. In each of these cases, the mechanic was left without specific written guidance, and apparently the mechanic did not request that this guidance be provided before starting the job.

To determine the source of A-307/A-563 fasteners, the warehouse inventory was checked and we found that safety-related A-563 nuts were commonly stocked in significant quantities and in 19 different sizes. A-307 studs and bolts, on the other hand, were found to be stocked in rather limited quantities. An inspection of the commercial quality, safety-related "free-stock" staging area in the plant machine shop revealed that A-563 nuts were readily available to mechanics in all 19 sizes. These nuts were stored in bins adjacent to bins containing A-194-2H nuts. The bins, while marked with size and material stock number, were not marked with the ASTM grade. For cases where mechanics were not given specific instructions on either the applicable ISI Class or material grade, the above situation was highly conducive to the chance use of A-563 fasteners.

It should be noted that none of the fasteners (neither the A-194 nor the A-563 nuts) obtained from the free-stock storage area were appropriate for use in ASME Section XI systems. This is because they were procured by the commercial-quality safety related method and therefore did not have the individual material traceability required for use within Section XI boundaries. The main reason they were mistakenly used was a perception on the part of some of our personnel that these fasteners, because they were safety related, were qualified for use in any safety-related application. Once this error was made and fasteners were drawn from the free stock area, there was a good chance that A-563 nuts would be mistakenly selected when A-194 nuts were called for.

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

Based on the investigation findings summarized above, the following statements can be made regarding the implications of this event:

1. Procurement control or receipt inspection practices did not contribute to this event;
2. No underlying trends were found in the test results to indicate that any manufacturers were supplying substandard, mismarked or fraudulent fasteners. In fact, the test results suggest a consistently high level of material quality;
3. All causes identified were internal to BG&E and pertain to the administrative controls governing the selection and use of fasteners in maintenance work; and
4. No evidence exists that the structural integrity of any safety systems has been compromised by this event.

The following actions have been taken to prevent recurrence of this event and to ensure that mechanical fasteners used in maintenance activities conform to applicable ASME and ASTM requirements:

1. Maintenance planners have been instructed to clearly identify the applicable code class on each maintenance order and to specifically identify any spare parts that may be needed to complete the job. Fasteners are specified by grade, and mechanics have been instructed to check fasteners for proper grade markings prior to use.
2. A color-coded set of P&ID's were developed showing ASME Section XI Class 1, 2, and 3 system boundaries. These P&ID's are used by the maintenance planners to confirm the applicability of code requirements on each job. This will ensure that ASME repair and replacement program requirements are properly applied to maintenance work.
3. An approved repair and replacement program complying with ASME Section XI, Addenda through Summer 1983, has been implemented. Appropriate engineering, maintenance and quality assurance personnel have been trained on the program.
4. All A-563 nuts were removed from the "free-stock" supply area in the plant and returned to the Calvert Cliffs warehouse. This will eliminate the possibility of further errors in the use of A-563 material.

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

The actions described above provide reasonable assurance that material quality and traceability standards applicable to fasteners will be maintained in current and future maintenance activities at Calvert Cliffs. Additional actions will be implemented during 1988 that will greatly simplify and improve control over fastener procurement, storage, and use. These measures will further reduce the potential for error, and will reduce overall costs. They include the development of a standardized fastener program which substantially consolidates the Calvert Cliffs fastener inventory both in terms of quality level and material grade; performing a review of all mechanical procurement specifications to identify original construction code requirements with the objective of extending the benefits of lessons learned from this event to other mechanical components besides fasteners; consolidating all mechanical maintenance and spare parts related information within a comprehensive computer database for use by maintenance planners and engineering personnel; and improving our spare parts inventory database to clearly identify the code class for which parts are qualified.



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NUCLEAR OPERATIONS DEPARTMENT  
CALVERT CLIFFS NUCLEAR POWER PLANT  
LUSBY, MARYLAND 20657

February 3, 1988

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

Docket No. 50-318  
License No. DPR 69

Dear Sirs:

The attached revision to LER 87-09 is being forwarded to you for your information.

Should you have any questions regarding this report, we would be pleased to discuss them with you.

Very truly yours,

J. R. Lemons  
Manager - Nuclear Operations Department

JRL:BSM:wvm

cc: William T. Russell  
Director, Office of Management Information  
and Program Control  
Messrs: W. J. Lippold  
J. A. Tiernan

*Handwritten:* 1022  
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