

Colt Industries



**Fairbanks Morse
Engine Division**
701 Lawton Avenue
Beloit, Wisconsin 53511-5492
Telephone: 608/364-4411
Telecopier: 608/364-0382

June 5, 1985

Dr. Thomas E. Murley
U.S. Nuclear Regulatory Commission
Region 1
631 Park Avenue
King of Prussia, PA 19406

Subject: 10 CFR 21 Report, Generator Failure
Baltimore Gas and Electric - Calvert Cliffs

Reference: A) Louis Allis (H. Leusink) Letter of May 29, 1985 to
U.S.N.R.C. (T. Murley)

Enclosure: 1) Louis Allis (H. Leusink) Letter of June 3, 1985
to Colt Industries (M. Moriarty) with attachments

Gentlemen:

Reference A) indicated Louis Allis would be forwarding a report on the subject incident to Colt for our corrective action.

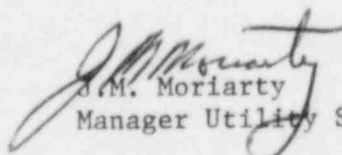
The Enclosures contains Louis Allis's analysis of the incident and their recommended course of action. Colt concurs with Louis Allis's opinion.

It is Colts recommendation that the interpolar connectors be removed from the units at the 4 affected sites as outlined in procedure No. 1 on the bottom of Page 2 of the enclosed letter.

A copy of this letter is being sent to the affected utilities who in some cases have taken corrective action.

If you have any questions or require additional information please advise.

Yours very truly,


M. Moriarty
Manager Utility Sales

JMM/j1

8506140498 850605
PDR ADOCK 05000271
S PDR

June 5, 1985

cc: with enclosures:

Baltimore Gas & Electric
P.O. Box 1475
Baltimore, MD 51203
Attn: Mr. Richard Buttner

Vermont Yankee Co.
P.O. Box 1
Vernon, VT
Attn: Don Dyer
Communications Quality Coordinator

Philadelphia Electric Co.
2610 South Delaware Ave.
Philadelphia, PA 19148
Attn: Mr. Bruce Allshouse

GPO Nuclear
3 Mile Island
P.O. Box 480
Middletown, PA 17057
Attn: Mr. Paul Levine
(Trailer 137)

Louis Allis
427 E. Stewart St.
Milwaukee, WI 53201
Attn: Mr. Harland Leusink

U.S. Nuclear Regulatory Commission
EEW-359
Washington, D.C. 20555
Attn: Kamalakar R. Naidu

June 3, 1985

Mr. Michael Moriarty
Colt Industries
Fairbanks Morse Engine Division
701 Lawton Avenue
Beloit, Wisconsin 53511

Subject: 10CFR 21
Calvert Cliffs Nuclear Station
Alternator Failure/Colt Order #205706

Dear Mr. Moriarty:

In my communication to Chuck Ankrum on May 29, 1985 I reported Louis Allis was waiting for a trip report from a service representative who had visited the site to analyze the failure. His report is attached for your review.

In the design of synchronous machines there is a winding in the rotor called an "amortisseur circuit". It consists of several copper bars imbedded into the face of the main pole face, commonly called a damper bars. A copper strap brazed to the damper bars forming the damper circuit, and an interpolar connector connects the damper circuit of each of the main field poles together. In the design of alternators, the inclusion of the interpolar connector is not always necessary.

In our opinion it will be difficult to pin down the exact cause of the failure on the subject unit, however it is probably linked to work hardening of the material at the time of original fabrication of the shorting strap or assembly of the shorting strap to the interpolar connector, however not all are interconnected.

The inclusion of interpolar connectors into the design of an alternator of this type is usually a result of a specification requirement. All of the diesel engine driven generators manufactured by Colt, its successor Beloit Power Systems, and now Louis Allis for nuclear applications have damper circuits located in the main field pole face.

*correction by H. Leusink by phone
6/4/85*

There are two principle functions of an amortisseur winding:

1. They provide some damping in voltage (and power) fluctuations caused by transient load disturbances and are beneficial in reducing power pulsations caused by reciprocating prime movers where dissimilar generating units are involved. So far as we could see, neither of these conditions exist in the nuclear standby environment.
2. They reduce the harmonic voltage present on three phase generators, and the subsequent heating, during operation under unbalanced load conditions. This is seldom of concern except on very small units since unbalanced loads in excess of 10% are not generally encountered on larger units. Nuclear backup service does not involve unbalanced loads of any significance.



From 1970 to 1973 Colt Industries supplied diesel generator sets for ten (10) nuclear plants with essentially the same main field pole construction as Calvert Cliffs, however only four (4) of these installations have field pole construction with interpolar connectors. The installations are as follows:

| <u>INSTALLATIONS</u> | <u>COLT ORDER #</u> | <u># OF UNITS</u> | <u>FRAME</u> | <u>POLAR CONNECTORS</u> |
|---|---------------------|-------------------|--------------|-------------------------|
| 1. Vermont Yankee Vernon, VT | 205668 | 2 | U1-30 | Yes |
| 2. Peach Bottom 2 & 3 Philadelphia Electric | 205700 | 4 | U1-30 | Yes |
| 3. Calvert Cliffs 1 & 2 Baltimore Gas & Electric | 205706 | 3 | U1-30 | Yes |
| 4. Three Mile Island #1 Metropolitan Edison | 205672 | 2 | U1-30 | Yes |
| 5. Arnold #1 Iowa Power & Light | 205836 | 2 | U1-30 | No |
| 6. Crystal River #3 Florida Power Corp. | 205713 | 2 | U1-30 | No |
| 7. North Anna 1 & 2 Virginia EEP | 205857 205858 | 4 | U1-30 | No |
| 8. Farley #1 Alabama Power | 205917 | 2 | U1-30 | No |
| 9. Arkansas Nuclear Arkansas Power | 205925 | 2 | U1-30 | No |
| 10. Three Mile Island #2 Jersey Central | 205732 | 2 | U1-30 | No |

Based on the views expressed in the "principle functions" discussion above, and in view of the above listed installations, it is the recommendation of Louis Allis that the interpolar connectors be removed from the units at Installations 1-4 as noted above.

The procedure for removal will be one of the following:

1. Since the shorting strap under the damper bars is made of soft material, it may be possible to reach into the generator with a bolt cutter and cut the connector and part of the shorting bar in two and remove the connector. Care must be taken not to allow chips or slivers from the severed part to drop into the machine.
2. Disassemble the rotor from the unit and proceed with Item 1 above.



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Calvert Cliffs Nuclear Station
Page 3
June 3, 1985

Enclosed is a sketch #53085 indicating where the shorting bar should be severed.

Louis Allis has been requested by the NRC for a copy of the trip report enclosed. I assume you will forward if you want to respond to that request. The gentleman requesting the report is:

Kamalakar R. Naidu
United States Nuclear Regulatory Commission
EW-359
Washington D.C. 20555

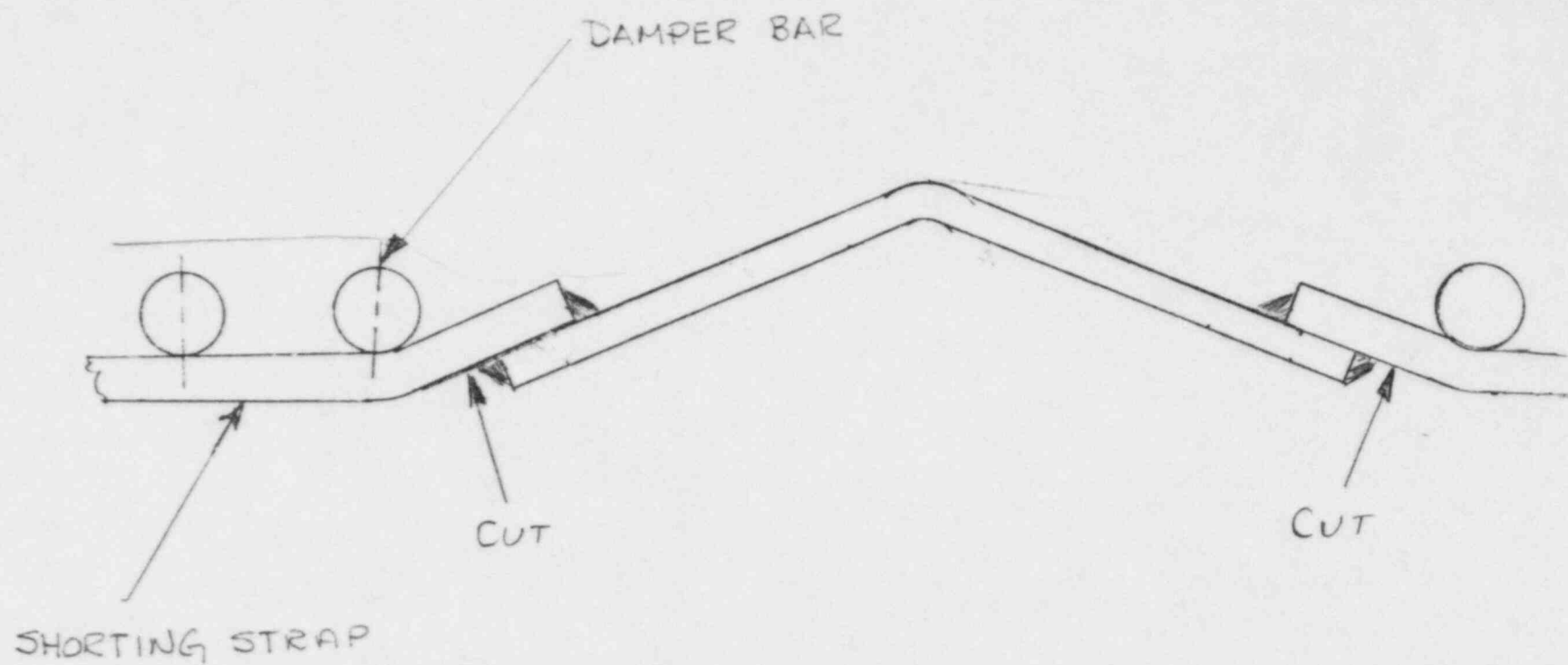
Sincerely,

H. H. Leusink
Vice President, Engineering

HHL:sd
Enclosure

cc: Louis Allis
E. Klessig
J. Borman
A. Giesecke
H. Schreiber

Colt Industries
C. Ankrum
B. Saylor



DAMPER BAR, SHORTING STRAP & INNER POLAR
CONNECTOR FORM THE AMORTISSEUR CIRCUIT
OF THE ROTOR

FDG 53085



A Division of Magnetek Inc.

DATE May 30, 1985
FROM C. Anderson
TO Bruce Albertson
cc: H. Leusink
H. Schreiber
D. Gaylord

SUBJECT Service Trip to Calvert Cliffs Nuclear
Power Plant, Lusby, Maryland

Arrived Martha Washington Motel in Waldorf, Maryland
approximately 3:45 p.m., Monday, May 20, 1985.

Unable to contact Gary Pavis, but made contact with
Joe Crunkleton (301-260-4933), Engineering Analyst for BG&E,
and made arrangements to meet at plant Tuesday morning 5/21/85.
Also same phone conversation, was informed new unit (our 275851)
was on site, and a receiving insp check indicated grounded
bearing insulation. I was not concerned at this time, as it
is difficult to have rotor in proper alignment in shipping skid
to prevent shaft from touching inner closure.

Arrived at plant approximately 7:30 a.m., Tuesday, 5/21/85.
Mr. Crunkleton and I were joined by Phil Hebrank of Electrical
Engineering Department. It is requested that any Engineering
decisions from Louis Allis be directed to Phil Hebrank, P. O. Box
1475, Baltimore, Md 21203, or phone at (301)-234-7113.

Keystone Electric of Baltimore is the service shop they have
been in contact with in regard to this unit, which is S/N
502564R1.

Unit was running on an overspeed test after normal tear down
and inspection of engine had been accomplished. Part that failed
was interpolar connector between two poles. BG&E feel that the
"ear" broke off the pole first, which flew out into stator winding and
catching, then ripping connector off the adjacent pole. The "ear"
was still attached to the pulled off interpolar connector. They
heard a clicking or tapping noise before it started "banging".
When unit stopped, part was found in bottom of unit and rather
bent and beat up. Part is presently in Metallurgical Lab in
Baltimore, but will be sent to Louis Allis, attention Dave Gaylord.

Completely unofficial "thought" from Lab is possibly "flutter"
induced by windage and/or magnetic field, of high frequency
causing a possible fatigue fracture.

Had a short conversation with a Mr. Bond of BG&E, saying
they are planning on running Eddy Current tests on remainder of
connectors for further checks of cracks, followed up by radiograph
inspection on any suspect parts. They anticipate the Eddy Current
checks to be completed this week. I asked that we be informed of
results. If not notified, suggest calling and inquiring next
Monday or Tuesday.

C. Anderson' Service Trip to
Calvert Cliffs Nuclear Power Plant
Lusby, Maryland 5/20/85

Mr. Hebrank and Mr. Crunkleton expressed interest in possibility of removing interpolar connectors from units, and request full information of any limitation of operation of units after removal of connectors, in the case our Engineering Department should issue a directive to do so.

Collector ring grooving, predominantly on positive ring, Mr. Hebrank asks if possible to occasionally reverse the polarity of the D.C. input to main rotor. He feels this would help this situation. Q.A. won't allow them to do this as there is nothing in our operating procedure to allow this. Possible revision of operating procedure? Also asked if Engineering from Louis Allis might be able to recommend a different grade of brush for better ring wear.

Mr. Hebrank would also like to know how many nuclear service alternators of similar size and type that have been supplied to other utilities, and if there have been any other failures of this type? Also, have there been any furnished without interpolar connectors?

Failure was on engine end and several pictures taken of failed area and other connections on that end. Also have pictures of one connector on connection end that at least shows a varnish crack in center of connector at the "V" bend. Also a picture to enable tying in failure location with keyway in rotor.

Charles Anderson
Charles Anderson