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AUTH. NAME	AUTHOR AFFILIATION
HYLTON, C.L.	Limitorque Corp.
RECIP. NAME	RECIPIENT AFFILIATION
	Document Control Branch (Document Control Desk)

SUBJECT: Informs that results of testing of failed worm shaft clutch sleeves returned by DPC, ONS indicated that matl & metallurgical quality of clutch sleeves not factor contributing to failure & not reportable per 10CFR21.

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March 10, 1995

U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

ATTENTION: Document Control Desk

SUBJECT: Limitorque Corporation 10 CFR Part 21, Evaluation #52'
Worm Shaft Clutch Gears Assembly, #0901-161

Date of Discovery -- January 16, 1995

Limitorque Corporation is submitting a report relative to the subject evaluation.

Duke Power Company, Oconee Nuclear Station returned (2) worm shaft clutch gear assemblies from (2) Limitorque SB-2 Valve Actuators, serial nos. L366900 & L366901. The clutch sleeves, #60-573-0007-2 which constitute part of the worm shaft gear assemblies was the failed component.

The two failed clutch sleeves were sent by Limitorque Corporation for an independent metallurgical and failure analysis. The results of this testing indicated that the material and metallurgical quality of the clutch sleeves were not a factor in contributing to this failure. Further the report stated that both failures were the result of a single overload event.

Limitorque notified Duke Power Company on February 21, 1995 concerning the above results. In addition, we requested that Duke provide additional information, if available, concerning these failures. Duke Power Company was not able to provide any additional information.

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March 10, 1995

Limatorque Corporation 10 CFR Part 21, Evaluation #52
Worm Shaft Clutch Gears Assembly, #0901-161

Refer to the attached correspondence to Duke Power Company dated 2/21/95 and 12/2/83 to support our conclusion.

Limatorque Corporation is closing this evaluation as non-reportable pursuant to the requirements of 10 CFR Part 21.

Signed:

A handwritten signature in cursive script, appearing to read "Charles L. Hylton".

Charles L. Hylton
Vice President of Engineering

WJM/lab

cc: Duke Power Company
10 CFR 21 - Evaluation #52 File



10CFR21
Evel #52

C.C.
W. M. [unclear]

February 21, 1995

Duke Power Company
Attn: Lew Beck, Nuclear Production Eng., Valve Engineering
Oconee Nuclear Station
P. O. Box 1439
Seneca, SC 29679-1439

Reference: Your 1-11-95 letter

Subject: Failure of Worm Shaft Clutch Gears
SB-2/40, S/O #3J3096C, S/N's 366900 & 366901
Duke tag no. 3-LP-21 & 3-LP-22

Dear Lew,

The two failed clutch sleeves were sent by Limitorque Corporation for an independent metallurgical and failure analysis. Conclusions of this report indicate that the material and metallurgical quality of the components were proper. Further, the report stated that both failures were the result of a single overload event.

Attached is our Dec. 2, 1983 letter to Duke that outlines previous history and details the mechanics that could lead to a single overload failure. This letter also provides recommendations for a possible gear ratio change.

Since the trippers have been removed manual declutching with the motor energized and subsequent release of the declutch lever or the inadvertent energization of the motor during manual operation with subsequent release of the declutch lever provide possibilities for single overload events.

Lew, please investigate the above mentioned occurrences and possibly proceduralize steps to prevent these occurrences. Please advise Limitorque Corporation of your findings since we are evaluating for potential 10CFR21 applicability and our interim report is due approximately 2nd week of March.

Also, please provide instructions for the return of the components to Duke Power Company.

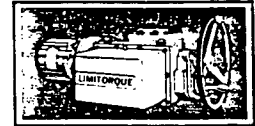
Very truly yours,

LIMITORQUE CORPORATION

P. G. McQuillan
Manager Nuclear/Special Projects

LIMITORQUE CORPORATION

5114 Woodall Road • P. O. Box 11318 • Lynchburg, Virginia 24506
Telephone—804-528-4400 • Telex—82-9448



December 2, 1983

Duke Power Company
General Offices
422 South Church Street
Charlotte, NC 28242

Attention: S. K. Blackley, Jr., Chief Engineer
Mechanical and Nuclear Division

Gentlemen:

Reference: Your October 17, 1983, Letter to G. Cusack

Subject: Oconee Nuclear Station, Unit 2
Replacement L.C. Operators
2LP-21, 2LP-22 MPSCO Order J-27672-73
L.C. 3J3096-B SB2-40-3600 RPM 56 Frame Motor
File 0S-161

Limitorque Corporation has completed an engineering review of clutch sleeve failure addressed in your referenced letter. Investigation revealed that failure occurred when the worm shaft clutch lugs engaged the clutch sleeve lugs during transition from manual to electric motor operation. (Attached Appendix A describes this operation.) The results of our study are as follows:

1. Dimensional inspection of the failed component indicated that the component was manufactured dimensionally correct per engineering specifications.
2. Independent laboratory analysis verified that failed material samples were of the correct material and heat treated to engineering specifications.
3. Clutch sleeve failure was the result of high impact forces associated with clutch sleeve/clutch lug engagement. This impact force was generated by coupling a "high acceleration rate" motor to a step-up (increaser) gear set which in turn rotates the clutch sleeve prior to lug engagement. Certain terms require definition, i.e.:
 - a. "High acceleration rate" - The motors accelerate to no load speed (3600 R.P.M.) in a short period of time. The motor design in question exhibits acceleration characteristics that are greater than twice other motor designs.

- b. "Step-up gear set" - A gear combination that increases input speed. A 0.8/1 gear set will produce an output speed 1.25 greater than input speed. The actuators in this application were fabricated with a 0.78/1 gear set.
 - c. "Impact force" - This is a function of the relative rotational velocity of the clutching lugs.
4. Testing determined the unacceptable range of gear ratios to be 0.78/1 through 1.12/1 when coupled with the 40 foot pound-3600-56 frame motor.
 5. Additional testing verified the problem does not exist with other motor sizes regardless of the gear ratio utilized.

Resolution of this phenomena can be accomplished in either of two methods, i.e.:

1. Removal of the clutch trippers as was field accomplished on LLP-21 and LLP-22, Limitorque 3J3096-A.
2. Usage of an acceptable motor/gear ratio combination. (Previous discussions indicated that the valve closure time is critical and cannot be increased.) Valve closure time does not increase if the overall gear ratio in the actuator does not increase. Units are fabricated with an overall gear ratio of 26.24/1 (33/1 worm gear set and 0.78/1 motor gear set). Gearing could be modified to produce an overall gear ratio of 25.55/1 (13 1/3/1 worm gear set and 1.92/1 motor gear set). It should be noted that this method results in a worm/worm gear set which may allow the torque switch electrical contacts to remake after their initial opening control function. The plant control scheme must not utilize a maintained contact to energize the motor starter or repeated motor energization will occur as the torque switch contacts cycle from open to close electrically.

Please advise the writer of your preference for resolution. This also affects 3LP-2 and 3LP-22, Limitorque 3J3096-C, which are tentatively scheduled for late January, 1984, delivery.

As a further note, Limitorque Corporation has reviewed our records and determined that this unique combination of unit/motor and motor gear ratios has not been previously supplied to Duke Power Company or any other customer of Limitorque Corporation's.

Should you have any other questions, please do not hesitate to contact the writer.

Very truly yours,

LIMITORQUE CORPORATION



P. G. McQuillan
Q. A. Administrator

jhb

cc: J. Knost/Duke Power
G. Cusack/Charlotte

bcc: T. S. Mignogna
F. K. Denham
W. J. Denkowski
R. J. Kornsey
I. E. Wilkinson
D. S. Warsing
C. Hylton
W. Miluszusky

SB-2 CLUTCHING MECHANISM

The SB-2 actuator is equipped with a clutching mechanism which allows the actuator to be shifted from motor to manual or manual to motor operation. In motor operation (see Figure 1) the lugs of the clutch and clutch sleeve are engaged. Torque is transmitted from the motor pinion (via the motor clutch gear, clutch sleeve and clutch lugs) to the worm shaft. Input torque from the handwheel shaft is uncoupled from the worm shaft. When the declutch fork is rotated through actuation of the external manual declutch lever, the clutch is moved along the worm shaft until the clutch/handwheel pinion clutch lugs are engaged. The declutch fork is held in the manual position by a latching interface between the declutch fork and clutch tripper. Torque can be transmitted from the handwheel gear (via the handwheel clutch pinion/clutch lugs) to the worm shaft. In this position, the motor pinion torque interface is decoupled from the worm shaft. When the motor pinion is energized with the declutch fork in the manual position, rotation of the clutch sleeve causes the clutch sleeve pin to strike the clutch trippers which release the declutch fork from its manual position. When the clutch trippers release the declutch fork, the clutch compression spring pushes the clutch along the worm shaft until the clutch/clutch sleeve lugs engage allowing for transmission of motor torque.

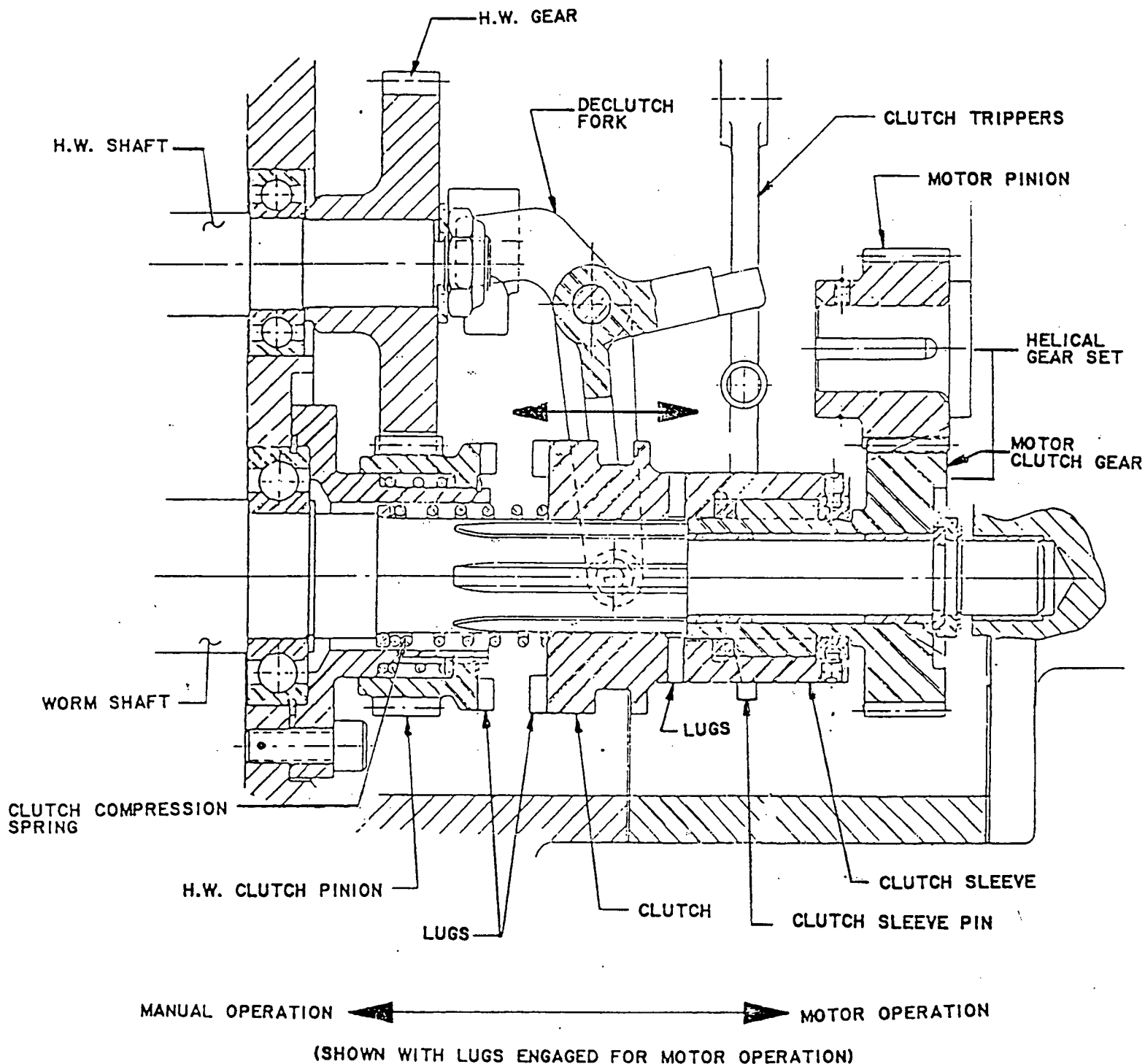


FIGURE 1, SB-2 CLUTCHING MECHANISM