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November 22, 1988

Enclosure 2

Mr. Thomas E. Murley, Director
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Attn: Document Control Desk

Subject: Braidwood Units 1 and 2
Limitorque Operator Lubrication
NRC Docket No. 50-456 and 50-457

Reference: (a) NUREG-1002, Safety Evaluation Report, Supplement #6, dated May, 1988
(b) August 26, 1988 S.C. Hunsader letter to T.E. Murley
(c) September 2, 1988 S.C. Hunsader letter to T.E. Murley
(d) October 6, 1988 S.P. Sands letter to H.E. Bliss

Dear Mr. Murley:

To verify that the as-found grease mixtures at Braidwood Station would have performed their intended function, mixtures of SUN 50 EP and Exxon Nebula EPO/EP1 greater than 5% were radiation tested. The results of that testing were provided to the NRC staff in references (b) and (c). It was Commonwealth Edison's (Edison) position that the samples of Exxon Nebula EPO/EP1 mixed with SUN 50 EP had not changed enough to compromise the Limitorque's operating function. Under a radiation exposure condition, Edison believes that the grease would perform its intended lubricating function.

In reference (d) the NRC Staff provided their evaluation of Edison's submittals, and concluded that there was insufficient information to make a determination on the post accident operability of the Limitorque value operators. In response to this, Edison requested that Dr. Robert O. Bolt perform an independent review of references (b), (c), and (d), and give his assessment. Attachment "A" provides the results of his review, which Edison believes addresses the NRC Staff's concerns regarding operability. In summary, Dr. Bolt states that for the worse case sample presented in Attachment "A" to reference (b), operability is not compromised by the harder grease since it is similar to that in other operators that have been demonstrated to be operable under similar irradiation conditions.

Please address any questions concerning this matter to this office.

Very truly yours,

S.C. Hunsader

S.C. Hunsader
Nuclear Licensing Administrator

/scl

cc: S. Sands-NRR
J. Hinds-RIII
J. Liebermann (Office of Enforcement)
Braidwood Resident Inspector

5323K-1

ATTACHMENT "A"

EVALUATION OF EDISON MIXED GREASE TESTING

BY Dr. R. O. Holt

The following provides a summary of a review of information provided in Commonwealth Edison letters dated August 26, 1988 and September 2, 1988, and in the NRC letter dated October 6, 1988.

A. Data and Conclusions Regarding Grease Mixtures

In the case of greases, the active ingredients for lubrication purposes are the oil together with its soluble additives. The gelling agent that changes an oil into a grease acts with a "sponge" effect that releases the oil to the affected parts on demand. The additives in the oil enhance the lubricating properties of the oil. For high quality lubes, these additives include oxidation inhibitors, rust inhibitors, and load-carrying improvers (EP additives). The last two have been specifically required by Limitorque. Thermal and hydraulic stabilities are also required by Limitorque.

Consistency (penetration) and melting point (dropping point) values are not necessary measurements of lubricating ability, but rather, are a means to measure the ability of a lube to remain in place. In some applications, where retention of the grease is necessary for lubrication purposes, this "remaining in place" is very important. However, this is not as important in the case of Limitorque operators, because the lubricant is contained in a gear box which provides the retention function. When gear boxes are used, the most common lubricants are oils. Greases have been specified by Limitorque in order to reduce leakage through seals, thus decreasing maintenance requirements.

The greases Edison tested (as presented in the August 26, 1988 letter) have these properties specified above. In fact, all the greases listed in EPRI NP 4916 (except for the three footnoted) have these properties and would meet Limitorque lubrication requirements. The Sun 50 EP is not listed because it is currently an obsolete product. However, it does provide satisfactory lubrication for this application.

The test results that Edison has obtained are what would be expected for the greases tested (ie, an appreciable softening on radiolysis and a tendency toward static hardening [softening on working]). Grease softening is of no significance with Limitorque operators, unless massive leaks take place. Routine maintenance inspection would identify this problem so that appropriate action can be taken.

There is an unexpected hardening of the mixtures at the 2 x $10^5$ rad dose for both Exxon Nebula EP-O and EP-1. This affect carries over to some of the mixtures that include SUN 50 EP. The cause of the hardening is likely the Nebula product because the results of testing on the Sun 50 EP are as expected without noticeable hardening. There is no evidence of incompatibility between the Sun 50 EP and the Exxon Nebula EP-0/EP-1 greases. The irradiation does not adversely affect the lubrication function, particularly at the relatively low doses seen in the Edison tests. There is abundant evidence (EPRI NP 4735) that irradiation improves the load-carrying capacity of lubricants. Slight oxidation takes place (irradiation accelerates oxidation), forming polar compounds that enhance lubrication qualities.

B. Comments on NRC Staff Conclusions

The NRC Staff raised a question on the effect of temperature. A decrease in dropping point is evidenced in the test data in Attachment A when the Sun product is involved. This would cause greases to soften and possibly liquefy if the dropping point is appreciably exceeded. The imposition of 300°F in the accident scenario would cause more fluidity because it would break down the grease gel structure. As already discussed, this is not a problem with Limitorque operators because an oil lube will function acceptably in the gear box.

The softening of greases on irradiation has not been cited by the NRC staff as a problem with the Limitorque operators. However, the hardening was cited by the staff as a problem with the key factor being whether the equipment will operate with this grease.

The worst case hardening from the data in Attachment A to the August 26, 1988 Edison letter is the 25% Sun/75% Nebula EP-1 mixture after exposure to 2 X $10^5$ rads. The test results give penetration values of unworked (UW) 159/Worked (W) 241. A similar case has been observed from a penetration test result of W152 for grease from a Limitorque that was operating satisfactorily, but was taken out of service by Washington Public Power Supply System. In this case, thickening of the grease was caused by a loss of the oil component. There was no significant degradation in chemical composition due to irradiation. Also, a grease of UW 200/W 256 was taken from a Limitorque operator by Alabama Power because of an indication of mixture with another grease. No equipment failure was involved (after some seven (7) years of operation). Discussions of the above with Mr. T. Cadlub of MOVATS, who has done maintenance work on Limitorque operatious, has confirmed many instances of operation with thick greases without failure of the Limitorque operators.

These cases are examples of verifiable data illustrating the operation of Limitorques with thick greases. In reviewing the test results from the August 26, 1988, Edison letter, the worst case hardening condition is not considered to be enough to prevent the Limitorque operators from functioning.

/scl