IE Circular 77-06
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Date:

EFFECTS OF HYDRAULIC FLUID ON ELECTRICAL CABLES

DESCRIPTION OF CIRCUMSTANCES:

Commonwealth Edison Company, by letter to the NRC dated April 1, 1976, (copy enclosed), described the circumstances under which fire resistant hydraulic fluid had a deleterious effect on the insulation and jacketing of electrical cables. While the solvent characteristics of phosphate-ester fire resistant fluids are well documented in literature, it appears that this information may not be generally available to nuclear power plant operating staffs. Our evaluation of this occurrence emphasizes the importance of:

1. Reviewing design and operating procedures for systems containing synthetic hydraulic fluids and other potentially aggressive fluids to minimize the probability of leakage, overflow or inadvertant spill or fluid.

2. Reviewing housekeeping practices to assure that they provide for prompt cleanup of spills or leakage of any type of fluid.

Enclosure:
Letter from Commonwealth Edison Co.
to J. Keppler, Director, Region III
dtd. 4/1/76

Commonwealth Edison
Quad-Cities Nuclear Power Station
Post Office Box 216
Cordova, Illinois 61242
Telephone 309/654-2241

Similar - Data Unit already provided

NJK-76-118

April 1, 1976

J. Keppler, Regional Director
Office of Inspection and Enforcement
Region III
U. S. Nuclear Regulatory Commission
799 Roosevelt Road
Glen Ellyn, Illinois 60137

Reference: Quad-Cities Nuclear Power Station
Docket No. 50-265, DPR-30, Unit 2

In response to your Inspection Report No. 050-265/76-04, the following report concerning possible generic problems related to Electro-Hydraulic Control (EHC) system oil migrating to the cable tunnel area is being submitted.

On October 9, 1975, station personnel were cleaning up EHC fluid which had been dripping on the Unit 2 cable tunnel floor. It was noticed not only had the EHC fluid been leaking onto the floor but also it had been leaking onto the cables in the surrounding cable pans. Closer inspection of the cables revealed puffing and plasticization of cables that the EHC fluid had made contact with. At the time of discovery, Unit 2 was in the cold shutdown condition.

Cables in the Unit 2 cable tunnel were utilized for both safety related and non-safety related functions. The EHC fluid leak had not rendered any safety or non-safety related systems inoperable.

The immediate action taken was to determine the extent of plasticization of the affected cables. All the cables and cable pans in the affected area of the Unit 2 cable tunnel were cleaned with a soap and water solution as recommended by information from the EHC fluid manufacturer. The cleaning of EHC fluid from the cables should eliminate further effects of plasticization. A small section of control cable, which was hand traced to identify its function, was cut out and analyzed. It was discovered that only the overall jacketing material had been affected by the EHC fluid.

Various cable manufacturers and the manufacturer of EHC fluid were consulted as to the effects of EHC fluid on various polymers used for cable. Polyvinylchloride (PVC) and neoprene were found to be affected severely by EHC fluid and not recommended for use around EHC fluid. Other polymers such as polyethylene, teflon, silicone rubber, nylon, and butyl rubber were acceptable for use around EHC fluid.

The next course of action was to determine the types of cable in the Unit 2 cable tunnel that were affected by the EHC fluid. The types of cable construction were categorized as follows:

1. Control & Power (low voltage): Individual or multiconductor PVC jacketed; mylar wrapped, PVC over butyl rubber insulated conductors.

2. Instrumentation: PVC jacketed, shielded, mylar wrapped, polyethylene insulated conductors.

3. Instrumentation: Single and multiconductor PVC jacketed, polyethylene insulated, mylar wrapped and shielded twisted pairs.

4. Instrumentation: PVC jacketed, polyethylene insulated, coaxial cable.

The control and power cables comprised approximately 80% of all cables in the Unit 2 cable tunnel. Close inspection revealed that the EHC fluid had not permeated through the PVC overall jacket. Since butyl rubber is not affected by EHC fluid, it was recommended that these cables be cleaned and left in place after the cable pans were cleaned out.

The instrumentation cables as described above in cases 2 and 3 revealed that some saturation through the overall PVC jacketing resulted. However, in no cases had the EHC fluid permeated through the mylar shielding covering. It was recommended that the plasticized sections of jacketing be removed and a suitable jacketing tape be applied.

Case 4 as described above, consisted of coaxial nuclear instrumentation cables. The coaxial cables' overall jacketing is very thin and consequently suffered greatly from the effects of plasticization. Plasticization had exposed the shielding conductor, such that possible electrical interference could result. The coaxial cables' functions were as follows:

1. Local Power Range Monitoring (LPRM)

2. Intermediate Range Monitoring (IRM)

3. Source Range Monitoring (SRM)

Since there were only 90 coaxial cables affected by the EHC fluid, it was recommended to splice in new coaxial cable sections and not tape over the shielding. Splicing in this case was considered more acceptable than taping. All coaxial cables were identified and labeled before splicing was permitted. The coaxial cables were tested against acceptable electrical properties after being spliced.

Figure 1 shows the approximate locations where EHC fluid accumulated. Figure 2 illustrates the postulated path of EHC fluid migration from the EHC fluid reservoir to the Unit 2 cable tunnel area. The accumulation of EHC fluid around the EHC fluid reservoir foundation, and subsequent migration between the finish floor and rough slab, via small cracks in the concrete, is the postulated cause of the EHC fluid problem.

The rough slab serves as the ceiling in the Unit 2 cable tunnel and minor small cracks in the ceiling served as a leak path out of the concrete and onto the cable trays and floor. Portions of cables within these trays thus became saturated with the EHC fluid.

The upper cable trays did not contain all of the EHC fluid, even though the pans in the cable tunnel were of solid bottom construction. This was because the EHC fluid had leaked through the cable pan connecting joints and thus all the cable pans below were subjected to the EHC fluid. The cables closest to the bottom of the cable pans were most affected by the EHC fluid because these cables were in constant saturation with EHC fluid.

At the present time, all the cables in the affected area of the Unit 2 cable tunnel are being protected from the continuing EHC fluid leakage. The leakage has subsided and once it has stopped the ceiling area will be cleaned and a protective sealer will be applied to prevent any possible leakages.

The EHC fluid reservoir foundation must also be sealed with the same protective sealer once leakages have been resolved. The sealer has been ordered from the Carboline Company, type 187 HFP, which is a recommended EHC fluid sealant.

The station's technical staff has been performing a weekly inspection of the Unit 2 cable tunnel to assure that there is no leaking onto the cables.

A representative from the Region III, U. S. Nuclear Regulatory Commission reviewed the work package associated with the repairs and discussed his findings with the station.

If further information is desired, please contact the station.

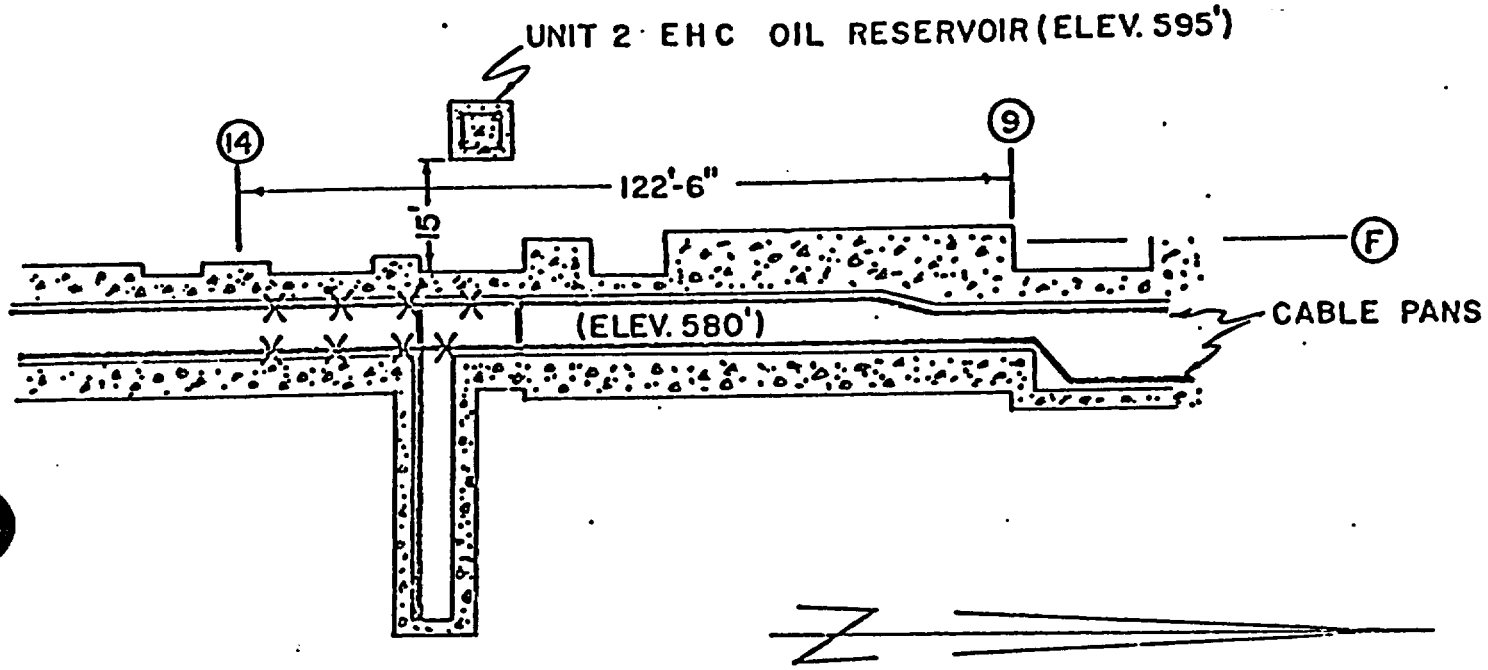
Sincerely yours,

N. J. Kalivianakis
Station Superintendent
Quad-Cities Nuclear Power Station

NJK/LLH/lk

FIGURE. I

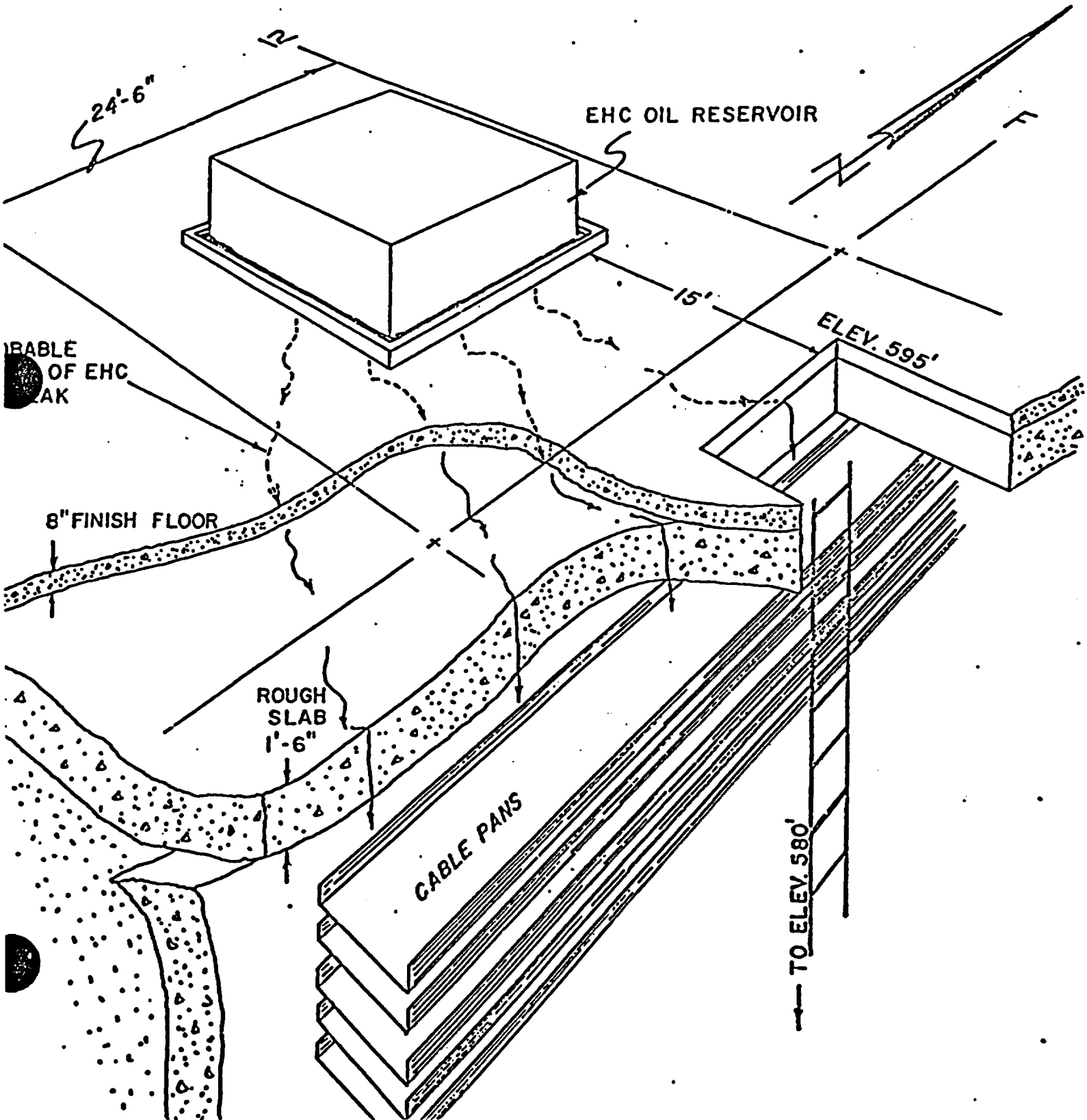
UNIT 2 CABLE TUNNEL
PARTIAL PLAN



X- DENOTES AREAS WHERE THE EHC OIL HAD ACCUMULATED
REFERENCE DRAWING - SARGENT & LUNDY M-5

FIGURE. 2

UNIT 2 CABLE TUNNEL
CUT-AWAY



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