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Dresden Nuclear Power Station
R. R. #1
Morris, Illinois 60450
May 23, 1975

RECEIVED JUN 2 1975 U.S. ATOMIC ENERGY COMMISSION Regulatory Mail Section

Mr. James G. Keppler, Regional Director
Directorate of Regulatory Operation-Region III
U. S. Nuclear Regulatory Commission
799 Roosevelt Road
Glen Ellyn, Illinois 60137

SUBJECT: REPORT OF ABNORMAL OCCURRENCE PER SECTION 6.6.A OF THE TECHNICAL SPECIFICATIONS
ROLL OF NASHUA TAPE LOST IN THE UNIT 2 REACTOR

References: 1) Regulatory Guide 1.16 Rev. 1 Appendix A

2) Notification of Region III of U. S. Nuclear Regulatory Commission
Telephone: 1045 hours on May 16, 1975

3) Drawing Number M-26

Report Number: 50-237/1975-44

Report Date: May 23, 1975

Occurrence Date: January 16, 1975 (May 16, 1975)

Facility: Dresden Nuclear Power Station, Morris, Illinois 60450

IDENTIFICATION OF OCCURRENCE

A roll of Nashua tape was lost in the Unit-2 reactor. All efforts to retrieve the tape were unsuccessful. This event resulted from inadequate implementation of procedural controls.

CONDITIONS PRIOR TO OCCURRENCE

Unit-2 was shutdown for its third partial refueling outage.

DESCRIPTION OF OCCURRENCE

On January 16, 1975, a roll of Nashua Silver Duct Tape (Type 357), two inches wide and about 6 inches in diameter with a three inch ID. hollow core, was inadvertently dropped into the Unit-2 reactor vessel annulus from the feed-water sparger work platform. It was observed splashing into the water by at

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least two people in the area. Efforts at recovery of the tape were conducted periodically between January 19, 1975 and May 5, 1975 with no success. On May 16, 1975 the decision was made to start-up Unit-2 without recovering the tape. At that point, the event became an incident.

DESIGNATION OF APPARENT CAUSE OF OCCURRENCE (Procedure Violation)

The apparent cause of the occurrence was the violation of the feedwater sparger repair procedure (No. FWSR 9.0). This procedure states in part "...All hand tools and equipment which during use have the potential to be dropped into the RPV shall have lanyards attached....".

ANALYSIS OF OCCURRENCE

The safety concern with the lost duct tape is the potential for flow blockage and subsequent fuel damage.

A detailed study on flow blockage in a BWR has been made in GE Topical Report (NEDO #10174) which is on file in the Public Document Room. As stated in that report, based on analyses of high power density fuel operating at 18.5 Kw/ft*:

a. It would take more than 90% inlet area blockage to cause a MCHFR less than 1.0; therefore, no fuel rod damage would occur unless more than 90% blockage occurs.

b. If the blockage were more than 90%, clad melt and fuel crumbling could occur. This would lead to high radiation sensed by the main steam line radiation monitors which would scram and isolate the reactor. Offsite doses remain less than 10 CRD 20 limits.

c. No damage would occur to any bundle adjacent to the bundle with the flow blocked.

* Unit-2 has a maximum LHGR limit of 17.5 KW/ft.

At the request of the Station, Commonwealth Edison's Operational Analysis Department (OAD) conducted tests on representative samples of duct tape at simulated pressure and temperature. Evidence to date indicates that the missing roll of duct tape may not disintegrate and break into small particles. In light of this evidence, an analysis was considered prudent to justify operation of the unit. The lost roll of tape presents an unlikely but nevertheless potential flow blockage problem.

An inspection of the primary system was made without locating the missing tape.

When the tape was dropped, the recirc. pump suction and discharge valves were closed, "A" shutdown cooling pump was in operation, taking suction from both the "A" and "B" recirc. loops. Since the feedwater sparger repair platform was in place, it can be concluded that the tape was dropped in the vessel-to-shroud annulus. Therefore, the tape is either in the recirc. piping, the shutdown cooling system, or the reactor water cleanup system.

A thorough inspection of the recirc. system was made after opening the recirc. pump suction valves. This inspection was made inside the piping system with a TV camera. The missing tape was not found.

The reactor water cleanup system was not in operation at the time the tape was dropped. Therefore, it is unlikely that the tape is in the cleanup system proper. From the cleanup system, the tape has no path to the reactor vessel; it would be stopped in the demineralizers.

The most likely place for the tape is in the shutdown cooling system since it was in operation at the time the tape was dropped. It is possible that the tape was missed during inspection of the annulus region. Therefore, in order to reach the reactor, the tape would have to pass through either the shutdown cooling pump or the ("A" or "B") recirc. pump.

The tape residual would have a maximum O.D. of three inches if passing through the recirc. system or one inch if passing through the shutdown cooling system. The jet pump nozzle orifices are three inches in diameter and the shutdown cooling system heat exchanger tubes are one inch in diameter.

OAD tests have indicated that the tape breaks down into a glutinous substance after heating to 545°. Therefore, the possibility exists that such a tape residual (no greater than three inches in diameter) could be deposited in the lower plenum.

Again, based on the thorough inspection of the annulus area, it is unlikely that the tape entered the recirc. system. The shutdown cooling pump suction and the heat exchangers have also been inspected. But since the shutdown system was in operation when the tape was dropped, it is concluded that any tape residue would most probably be limited to a one inch O.D., extruded from the shutdown cooling system.

In either case (i.e., three inch or one inch O.D.), the residue entering the lower plenum has to proceed along the intricate path through the guide tubes before reaching the channel inlet. The guide tubes leave a minimum gap one and one-half inches and a maximum gap of four and one-half inches. The actual configuration is illustrated on page 9 of NEDO-10174. The tests run at OAD indicate a propensity for the tape residue to stick to anything with which it comes in contact. The tenacity of the residue, the high turbulence in the area, and the heat of the reactor environment would likely force the residual into smaller parts. Furthermore, if a three inch residue gets through the jet pump nozzle, the high downward velocity component will tend to keep it on the bottom of the reactor vessel. The factor that will determine whether any residue will be swept up off the bottom is dependent on the radial component of the velocity and the component's density. Calculations of the average vertical and radial velocity components were made for Dresden 2 (NEDO-10174, table 3.1).

While it is possible for the tape residue to be swept up toward the bundle entrance, the following factors tend to reduce the impact of this fact: (a) There are very few locations where the radial velocity would be high enough to sweep the piece off the floor of the vessel. These locations are directly in line with the recirculation line outlet near the periphery of the guide tubes and the narrow one and one-half inch gap between guide tubes. (b) If in this particular instance the residue were swept upward, it is very unlikely that it could contact or block the fuel assembly orifices since they are vertically oriented, i.e., they are perpendicular to the flow of any residual matter. (c) Any residue which contacts an orifice would probably be in such a physical state that it would extrude through or (due to further disintegration) simply pass through the orifice. The residue would then approach the nosepiece guards which offer three separate paths to the lower tie plate. Any residue which reached the nosepiece guards could not be large enough to block all three paths. Therefore, cooling water will always have access to the full bundle. (d) If the residue were to block the 3/8" holes of the lower tie place just above a portion of the nosepiece, cooling flow could still reach the affected fuel assemblies through adjacent tie plate holes.

It is possible, nevertheless, for a tape residue to reach the lower tie plate of a fuel bundle. Whether the residue partially clogs the tie plate, deposits as crud on some fuel assemblies, or is stopped on the first fuel bundle spacer, the worst case is local critical heat flux and overheating, damaging the cladding on four fuel rods or less. Since residue could not significantly reduce the flow in one entire bundle, it would not cause degradation of the heat transfer conditions in other areas of the fuel bundle.

Therefore, even though it is possible for minor blockages to occur if the tape residue reaches the tie plate and/or enters the fuel bundle, only the life of a few fuel assemblies could be affected.

The final disposition of the dropped tape residue is through the reactor water cleanup system which provides continuous purification of the recirculation flow. The reactor water cleanup system maintains high reactor water purity to limit chemical and corrosive action, thereby limiting fouling and deposition on heat transfer surfaces.

The basic conclusion that can be drawn from the preceding discussion is that it is highly improbable that the tape residue could cause flow blockage of any given fuel assembly of 90%. Blockages greater than 90% must result before critical heat flux first occurs. G.E. NEDO-10174 (page 3) states that in the unlikely event that blockage of greater than 90% occurs, consequences to off-site doses are negligible since this would lead to high radiation in the main steam line radiation monitors which would scram and isolate the reactor before off-site dose limits approaching 10CFR20 were experienced.

As a result of this analysis, it is concluded that it is not only safe to start up, but that full power reactor operation to 100% is not precluded as a result of the missing tape.

FAILURE DATA

None.

B. B. Stephenson
Superintendent

BBS:smp

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