SPECIAL REPORT CONCERNING
THE TMI-2 ECCS ACTUATION OF 4/23/78

At 1651:23 on 4-23-78, TMI, Unit 2, experienced a reactor trip while at 30% Rated Thermal Power with 3 reactor coolant pumps in operation (RCP-2A secured) due to a noise spike on NI8 power range detector. The reactor tripped because RPS Channel C was already in the tripped state as required by Technical Specification 3.3.1.1 due to the inoperability of NI-7.

When the reactor tripped, the turbine tripped causing a very rapid pressure increase in the B steam generator and a slightly slower pressure increase in the A generator. Four of the six main steam relief valves lifted on the B steam generator and very rapidly blew B side steam pressure down. One main steam relief valve on the A steam generator lifted and also caused a rapid pressure blowdown but about 40 seconds delayed from the B steam generator. The B Turbine Bypass valve received a signal to go full open but almost immediately received a signal to go full closed due to the rapid depressurization in the B steam generator. The A Turbine Bypass valve received a signal to open at the proper pressure but the signal to open the bypass valve was lower in magnitude than it should have been.

The four B side main steam safety valves and the one A side valve failed to properly reseat. The safety valves on the B side started to reseat just prior to two minutes into the event with the remainder of the B safety valves and the A safety valve reseating almost four minutes into the event. The steam generator pressures were between 550 and 600 psig when all safety valves reseated.

The operator took the proper immediate action in manually cutting back feedwater demand, shutting the letdown isolation valve, starting a second makeup pump, and opening the high pressure injection valves on the side of the operating makeup pumps. The operator failed to initially recognize that the feed pump was in manual and did not run the feed pump speed back until approximately 1 minute and 20 seconds had elapsed.

The Integrated Control of the feedwater valves had not yet been initially tuned at the time of the event. Integral vice proportional control was the dominating signal of the feedwater valves and although the valves responded in the proper direction, they responded much slower than the traditionally expected response. Thus, the feedwater valves slowly going shut, rapidly decreasing steam generator pressure and a constant feed pump speed, too much water was fed into the steam generators.

The safety valves failing to reseat at the proper pressure coupled with overfeeding the steam generators caused a rapid depressurization and cooldown of the reactor coolant system. The reactor coolant temperature varied from 583°F to 464°F in 3 minutes. The RCS shrinkage from the cooldown caused the pressurizer volume to drop below the minimum indicated level range approximately one minute after the reactor trip. Due to the rapid depressurization of the R.C.S. SFAS safety injection occurred approximately one minute after the trip. By present design this injected NaOH into the reactor coolant system through the high pressure injection lines.

Pressurizer level was restored two minutes into the event as a result of safety injection, the Turbine Bypass valve going shut and some of the B side Main Steam Relief Valves going shut. Feedwater latch occurred 2½ minutes into the event and terminated feedwater flow to the steam generators. Feedwater latch was the key event in terminating the transient.

The rapid depressurization and cooldown event caused violations of the following Technical Specifications:

1. RCS Cooldown limit of 100°F in any one hour was exceeded (actual 134° in one hour) T.S. 3.4.9.1.

2. Pressurizer cooldown limit of 100°F in any one hour was exceeded (actual 136°F in one hour) - T.S. 3.4.9.2

3. Pressurizer volume was less than that required by Technical Specification 3.4.4.

Calculations were performed immediately after the event and subsequent chemistry analysis showed that the core remained covered at all times throughout the transient.

Evaluations of the excessive cooldown rates on the reactor vessel, reactor coolant piping, pressurizer and steam generators have been performed by Babcock and Wilcox and have been reviewed by Metropolitan Edison. These evaluations conclude that the structural integrity of these reactor coolant system components is acceptable for resuming normal plant operation.

In addition, evaluations have been performed on the reactor coolant pumps, control rod drive mechanisms, and fuel cladding. It has been concluded that these components should continue to perform as designed.

Areas of Corrective Action

1. Prior to criticality, the relief valves will be tested for proper lift pressure and also to ensure that blowdown is not excessive.

2. NI-7 power range detector has been replaced. The source of the noise from NI-8 is being investigated. Tests will continue in order to determine the cause of the intermittent noise.

3. Discussions are underway with the Commission to change the SFAS logic to prevent immediate injection of NaOH through DH-V8A & B upon receipt of a safety injection signal.

4. Tuning of the Integrated Control System will continue throughout initial plant startup to achieve balanced tuning for transient operation.

5. Plant operating procedures will be changed to reflect experience gained as a result of the transient.