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NUCLEAR REGULATORY COMMISSION
OFFICE OF INSPECTION AND ENFORCEMENT
WASHINGTON, D.C 20555

CLASS OF SERVICE:

_____ URGENT

_____ IMMEDIATE

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FACSIMILE SERVICE REQUEST

DATE: 4/10/79

MESSAGE TO: Three Mile Island NRC Office
(Name) (Office/Division - Agency/Company)

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(Name) (Office/Division - Agency/Company)

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NUCLEAR REGULATORY COMMISSION

OFFICE OF INSPECTION AND ENFORCEMENT

WASHINGTON, D.C.

INCIDENT MESSAGE FORM

TO: Regions I, II, III, IV & V
TMI Site
FROM: J.L. Crews

SUBJECT: PRELIMINARY DESCRIPTION OF EVENTS AT THREE MILE ISLAND 2 FACILITY ACCIDENT

Attached is Latest revision of the subject document

DATE: 4/10/79 TIME: 11⁰⁰ p.m.

PRELIMINARY

April 10, 1979

DESCRIPTION OF EVENTS AT THE THREE MILE ISLAND 2 FACILITY ACCIDENT

The following is a summary of the significant events that occurred at the Three Mile Island No. 2 nuclear facility on March 28, 1979, and thereafter. Attached is a detailed chronology of these events listed with the times they each occurred.

At about 4:00 am on March 28, 1979, the secondary (nonnuclear) cooling system of the Three Mile Island facility suffered a malfunction. This system normally pumps water through the plant's steam generators where the water turns to steam which then flows to turn a turbine generator. The water is then condensed back to water, is pumped by a condensate pump through a clean up system, through a feedwater pump, and finally back to the steam generators, and continually flows around this loop.

A malfunction in the main feedwater system caused the feedwater pumps to turn off (trip), which in turn caused the turbine-generator to turn off and stop generating electricity. Since the steam generators were not removing heat due to the stoppage of feedwater flow, the reactor coolant system pressure increased and the pressurizer relief valve opened to reduce reactor pressure. Immediately, the reactor turned off by the rapid insertion of the plant's control rods (scrammed) as designed and the nuclear chain reaction stopped leaving behind only residual, or decay, heat. These events all occurred within the first 30 seconds of the accident.

Up to this point, this sequence is normal and the auxiliary feedwater system should startup and deliver secondary coolant to the plant's two steam generators to remove heat. In addition, the pressurizer relief valve should close as reactor pressure decreases.

All three of the auxiliary feedwater pumps started but were unable to deliver flow because their flow paths were blocked by closed valves. In addition, the pressurizer relief valve failed to close and therefore allowed the reactor coolant system pressure to continue to decrease.

As the reactor pressure reached a preset value (1600 psi), the plant's Emergency Core Cooling System (ECCS) started as designed and began to inject cold water into the reactor about 2 minutes after the event started. An indication of a rapidly rising pressurizer level apparently led the plant operators to terminate the ECCS flow. At this point the Three Mile Island accident had been underway for 10-11 minutes.

Between about 1 and 2 hours into the accident, the operators turned off the four large pumps which circulate the reactor coolant through the reactor. It is following this action that we believe the severe damage to the nuclear fuel began. For the next several hours there was a very large temperature difference across the nuclear core indicating little flow of coolant through the core.

During this several hour period, when severe fuel damage was occurring, primary coolant from the reactor primary coolant system was being dumped onto the reactor containment floor from flow out of the pressurizer relief valve and through the drain tank. This coolant, which contained radioactivity, was partially pumped from the reactor containment building floor to tanks in the auxiliary building. The tanks overflowed permitting radioactivity to be vented from the auxiliary building. This situation lasted until about 9:00 am when the reactor containment was sealed (isolated).

From about 6:00 a.m. until 8:00 p.m., the licensee tried to depressurize the reactor coolant system sufficiently to be able to turn on the residual heat removal system. Since his attempts failed, it was decided to repressurize the system.

After repressurization, one of the main reactor coolant pumps was restarted and flow through the reactor core was re-established.

Since feedwater was being provided to the steam generator, heat was being removed and the reactor system was slowly cooled. Core temperatures decreased over the next several days and stabilized. Reactor cooling has essentially been in this mode since that time.

PRELIMINARY CHRONOLOGY OF THE MARCH 28, 1979 ACCIDENT AT THREE MILE ISLAND

Time (approximate)	Discussion of Events
Before 4:00 a.m.	TMI operator working on Feedwater System
4:00 a.m.	The loss of all (main and auxiliary) feedwater flow occurred while the reactor was operating at 98% power. The transient was initiated by a loss of condensate pumps. The turbine tripped.
3-6 sec later	An electromatic relief valve opened to relieve pressure in the RCS* (2255 psi).
9 sec after start of event	The Reactor tripped on high RCS pressure (2355 psi) to terminate the nuclear reactor and reduce power generation to decay heat alone.
12-15 sec after start of event	The RCS pressure decayed to the point (2205 psi) where the relief valve should have reclosed. The RCS continued to depressurize for about the next two hours.
14 sec after start of event	The auxiliary feedwater pumps in both safety trains (1 turbine driven pump and 2 electrically driven pumps) were started and were running at pressure ready to inject water into the steam generators and remove the residual heat produced in the reactor core. No water was injected since the discharge valves were closed.
15 sec after start of event	The temperature in the RCS hot leg peaks at about 610°F with a pressure of about 2150 psi.

*Throughout, RCS denotes "reactor coolant system."

Time (approximate)	Discussion of Events
4:01 a.m.	The pressurizer level indication began to rise rapidly. The steam generators, A and B, had low levels of water and were drying out.
4:02 a.m.	The ECCS was initiated as the RCS pressure decreased to 1600 psi.
4:03 a.m.	The pressurizer level indication went offscale high.
4:04-4:11 a.m.	The operator manually tripped the first HPI pumps at about 4:05:15 and the second at about 4:11:01.
4:06 a.m.	Water in the RCS flashed to steam as the pressure bottoms out at 1350 psi. The hog leg temperature was about 584°F.
4:07-4:08 a.m.	The Reactor building sump pump came on.
4:08 a.m.	The operator opened the valves at the discharge of the auxiliary feedwater pump allowing water to be injected into the steam generators.
4:12-4:13 a.m.	The operator restarted the ECCS to inject water into the RCS to control pressurizer level.
4:11 a.m.	The pressurizer level indication comes back on scale.
4:15 a.m.	The RC Drain (Quench) tank rupture disk blew at 190 psig due to continued discharge of the relief valve that had failed to close.
4:20-5:00 a.m.	The RCS parameters stabilized at a saturated condition of about 1015 psi and 550°F.
5:14 a.m.	The operator tripped both RC pumps in Loop B and one pump in Loop A.
5:27 a.m.	Operator isolated "B" Steam generator.
5:41 a.m.	The operator tripped the second RC pump in Loop A.

Time (approximate)	Discussion of Events
5:45-6 a.m.	The reactor core began a heatup transient. The RCS hot leg temperature went offscale at 620 degrees F within 14 minutes and the cold leg temperature dropped to near the temperature of high pressure injection water (150 degrees F).
6:20 a.m.	The failed open relief valve was isolated by the operator by closing a block valve.
7:00 a.m.	The RCS pressure had increased to 2150 psi and the relief valve was opened to relief RCS pressure.
7:15 a.m.	A pressure spike of 5 psig occurred in the RC drain tank due to steam from the relief valve.
7:45 a.m.	A pressure spike of 11 psig occurred in the RC drain tank and the pressure in the RCS was at 1750 psi.
9:00 a.m.	The pressure in containment peaked at 4.5 psig.
9:00-11:00 a.m.	The RCS pressure increased from 1250 psi to 2100 psi.
11:30 a.m.	The operator opened the pressurizer relief valve to depressurize the RCS in an attempt to initiate RHR cooling at 400 psi.
12:00 a.m.-1:00 p.m.	The RCS pressure decreased to about 500 psi and the core flooding tanks partially discharged. The relief capacity was not sufficient to vent enough to reach 400 psi.
2:00 p.m.	The pressure in the containment spikes at 28 psig causing containment sprays to be initiated. The operator stopped the spray pumps after about 2 minutes of operation.

Time (approximate)	Discussion of Events
5:30 pm	The pressurizer relief valve was closed in order to repressurize the reactor coolant system.
5:30 - 8 pm	The RCS pressure increased from 650 psi to 2300 psi.
8 pm	RC pump in Loop A was started at which time the hot leg temperature decreased to about 560 degrees F and the cold leg temperature increased to 400 degrees F, indicating flow through the steam generator. Thereafter, the reactor was being cooled by reestablishing condenser vacuum and steaming to the condenser by steam generator A with the RCS cooled to about 280 degrees F and 1000 psi.

March 29

The RCS temperature and pressure was stabilized at about 280 degrees F and 940 to 1020 psi. The maximum reading on the incore thermocouples was 612°F, but several thermocouples were not within range for computer readouts, i.e., the temperatures were higher than about 700 degrees F.

March 30

The RCS temperature and pressure were stable at about 280 degrees F and about 1000 to 1060 psi. Several incore thermocouples were beyond the range for computer readout, the maximum indicated reading was 659 degrees F. The licensee estimated the size of a bubble of non-condensible gas in the RCS to be about 1200 ft^3 at 875 psig.

March 31

The RCS temperature and pressure remained stable at about 280°F and 1000 psi. Slight drop in pressurizer level 251-191". Temperatures in the core as measured from the incore thermocouples were gradually decreasing (maximum indicated about 500°F). The hydrogen recombiner was in an operable status but additional shielding was needed and was being obtained. Two samples of containment atmosphere were analyzed which showed a hydrogen concentration of 1.7% and 1.0%. Licensee estimated the bubble size to be about 620 ft^3 @ 875 psig.

April 1

No substantial change in RCS temperature and pressure
Incore thermocouples continue to show decreased trend.

Licensee continued hookup of hydrogen recombiners and addition of shielding. Licensee calculated valves of bubble size varied. Containment air samples indicate 2.3% hydrogen.

April 2

Reactor pressure stable at about 1000 psi. Incore thermocouples continued to show a decrease with all measurements below 475°F. Inlet and outlet temperatures were still about 280°F. One hydrogen recombiner was put in operation to decrease the hydrogen gas concentration in the containment building.

Analysis indicated that the oxygen generation rate in reactor less than originally estimated. Measurements indicated that the bubble was being significantly reduced by degassing operations.

April 3

Reactor pressure and temperature stable at 1000 psi and 280°F, respectively. Thermocouple readings analyzed- maximum 477°F, only 3 thermocouples were above 400°F. Gas bubble size much reduced. Containment about 1.9% hydrogen. One pressurizer level indicator failed.

April 4

Reactor pressure and temperature stable at 1000 psi and 280°F, respectively. Thermocouple maximum temperature was 466°F. Gas bubble size decreasing. Vent valve on pressurizer intermittently opened and degassing continues through letdown system.

April 5

Reactor pressure and temperature stable at 1000 psi and 280°F, respectively. Maximum thermocouple reading is 462°F. Pressurizer level responding normally to pressure changes indicating a completely full system.

Containment atmosphere indicates 2% hydrogen. One recombiner operating, one in standby. Pressurizer vented to containment about 15 minutes every 6-8 hours.

April 6

Reactor pressure stable at about 1000 psi and temperature about 285°F.

At approximately 1:25 pm, reactor coolant pump 1A tripped and reactor coolant pump 2A was started within about 2 minutes. Shift in thermocouple readings. The three thermocouples previously reading about 400°F are presently reading between 285°F and 315°F. Central thermocouple increased from 375°F to 425°F and is the only one now reading above 400°F.

Containment measurements indicate about 2% hydrogen. Pump-back system for pumping waste gas decay tank volume to containment began.

April 7

Reactor pressure and temperature stable at about 1000 psi and 280°F, respectively.

At about 8:00 pm, the licensee began to slowly lower reactor system pressure in increments of 50 psig. The slow decrease ended when reactor pressure reached 500 psi. This intentional pressure reduction expanded gasses trapped in control rod drive housings above the vessel head so that they could be dissolved or entrained and then be gassed through pressurizer venting and letdown at higher pressures. This degasification process is designed to prevent bubble formation as pressure and temperature decrease during the placement of the reactor cooling system in a long term, shutdown cooling mode.

Hydrogen concentration in the containment is about 1.7%.