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JUN 29 1979

MEMORANDUM FOR: Roger Mattson, Director
Division of System Safety

THRU: L. S. Tong, Assistant Director
for Water Reactor Safety Research

THRU: W. V. Johnston, Chief
Fuel Behavior Research Branch

FROM: D. A. Hoatson
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SUBJECT: LESSONS LEARNED FROM THE TMI-2 ACCIDENT

Copy to:
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In response to your memo of May 31, 1979, I have a few thoughts I'd like to pass on although I suspect you have heard them all before:

Lesson #1: Keep the core covered and maintain the coolant flow.

The reactor operated surprisingly well through the multiple insults of loss of feedwater; stuck open relief valve; and operating for an hour and a half near saturation conditions. Fuel damage appears to only have occurred after the pumps were turned off and the water boiled away below the top of the core.

Lesson #2: Better methods of knowing the primary coolant inventory are needed.

The high pressurizer levels led the operator to assume that the primary system was water-filled. It wasn't. The steam generators were boiling dry on the primary side and they had no obvious way of knowing this (refer to G. P. Marino, FBRB, to Files, April 25, 1979, Attachment II). There have been frequent suggestions of adding reactor vessel level instruments, but a much earlier warning of the problem would have come from a steam generator level indicator. Both seem to be necessary, at least on once through steam generator plants. In U-tube steam generators, the primary system steam bubble might form in the reactor vessel head under similar conditions (and then what happens . the plant continues to depressurize?).

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Lesson #3: Keep some hydrogen in the coolant.

There were serious concerns over whether radiolysis was occurring in the TMI primary system. It is credible that the hydrogen initially dissolved in the coolant could have been depleted by the boiling that was going on. It was certainly being depleted by the loss of primary water. If such an accident involved stuck rods and there were a neutron flux present, some radiolysis would be probable if the hydrogen was reduced below 3-5 ccH_2 (STP) per kg of water. Under decay gamma only (rods inserted as at TMI) radiolysis can also occur, but the rate would be substantially lower. Maintaining a minimum hydrogen concentration in the coolant will prevent net decomposition of water from occurring and avoid the creation of explosive H_2/O_2 gas mixtures in the primary system.

Lesson #4: Better sampling and analysis are needed.

The chemical condition of the primary system is important to know under emergency conditions. Drawing primary coolant samples from a plant at high radiation levels; handling and analyzing samples that are highly radioactive; avoiding sample contamination; handling steam samples from lines normally water-filled; etc. - are all situations that might be encountered. Perhaps an emergency sampling and analysis system is required at each plant. Perhaps in-line instrumentation for analysis, at least of boron, hydrogen, oxygen, and gross gamma, is required for emergency use. Perhaps sample bombs and shielded shipping containers at each site are needed. Perhaps a lead laboratory(ies) for emergency analysis is required.

Lesson #5: Some prior thinking on how to handle a bubble of hydrogen is required.

Licensees should be required to show how they would handle a bubble of hydrogen (say from 50% of the core zirconium reacting) if one should ever appear in their plant.

Those are the lessons I think I've learned from TMI-2. I will be most interested in the other ones your task force comes up with.

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Enclosures: As stated

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