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PRELIMINARY RESULTS OF THE TMI-2 RADIOACTIVE-IODINE MASS-BALANCE STUDY*

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Analysis of samples taken from the Three Mile Island Unit 2 (TMI-2) reactor building following the 1979 accident[1,2,3,4] indicates the fraction of the radioactive iodine (radioiodine) inventory in the core released to the building atmosphere is smaller than assumed in Regulatory Guide 1.4.[5] This summary presents analytical results supporting this conclusion.

While the first sampling of the reactor coolant system (RCS), auxiliary building atmosphere, and reactor building (RB) atmosphere occurred in the three days immediately following the March 28, 1979 accident, the first RB basement liquid samples were not obtained until August 28, 1979. Also in August, additional samples were obtained from the RCS, the auxiliary building atmosphere, and the RB atmosphere. Table 1 summarizes results of analyses performed on samples taken during August 1979.

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DISCLAIMER

Analytical models were used to estimate how much radioiodine was present in various locations from the time of the March accident through August 1979. The analytical models contained empirical coefficients, determined by comparing the models with data from the accident and other experimental data. The models were used to estimate the amount of radioiodine in the RCS, on RB surfaces, in the RB atmosphere, and in the basement.

The analytical models used to estimate amounts of radioiodine in the RCS accounted for fission product release rates from the fuel, plateout on reactor vessel internals, concentration of fission products in the reactor coolant, and discharge of coolant from the RCS. Results of RCS calculations of drain tank relief valve and rupture disk reactor coolant flow, iodine concentrations, and enthalpy were used as input to the RB radioiodine transport calculations. Analytical techniques were used to model radioiodine transport processes in the reactor building. These processes included deposition on and resuspension from surfaces; gaseous and liquid iodine transport; mass transfer controlled by partitioning; chemical reactions on surfaces; and transport in condensate.

Figure 1 presents results of the transport calculations. The maximum calculated RB atmosphere radioiodine concentration represents 0.2% of the core inventory. The transport calculation was normalized to the maximum measured value of surface contamination, which represents 0.7% of the core inventory. Based on the calculations and sensitivity studies, much of the radioiodine released into the RB was most likely discharged directly to the basement and was not airborne. Transport calculation results indicate that

airborne and surface activities measured after the accident did not evolve from the basement following the accident but resulted from releases directly into the RB atmosphere during the accident. Based on the measured iodine activity in the RB atmosphere 75 hours after the accident and the known behavior of organic iodine, an upper bound of 0.009% of the core radioiodine inventory for airborne organic iodine was established.

Sample analyses and calculations based on those analyses revealed information pertinent to understanding radioiodine release, transport, and deposition during an accident involving core damage in a full-size pressurized water reactor. Specifically:

1. Results indicate that about five months following the accident between 17 and 28% of the radioiodine fuel inventory could be accounted for in the reactor and auxiliary buildings and RCS.

2. The highest measured concentration of radioiodine in the RB atmosphere represented 0.03% of the core inventory, whereas the highest calculated concentration represented 0.2% of the core inventory. Both values are much less than the 25% of core inventory value assumed for the design basis accident in Regulatory Guide 1.4.

3. The maximum possible concentration of organic radioiodine activity represents 0.009% of the core inventory, which is much less than the 1% value specified in Regulatory Guide 1.4 or the 0.7% value used in WASH-1400.

REFERENCES

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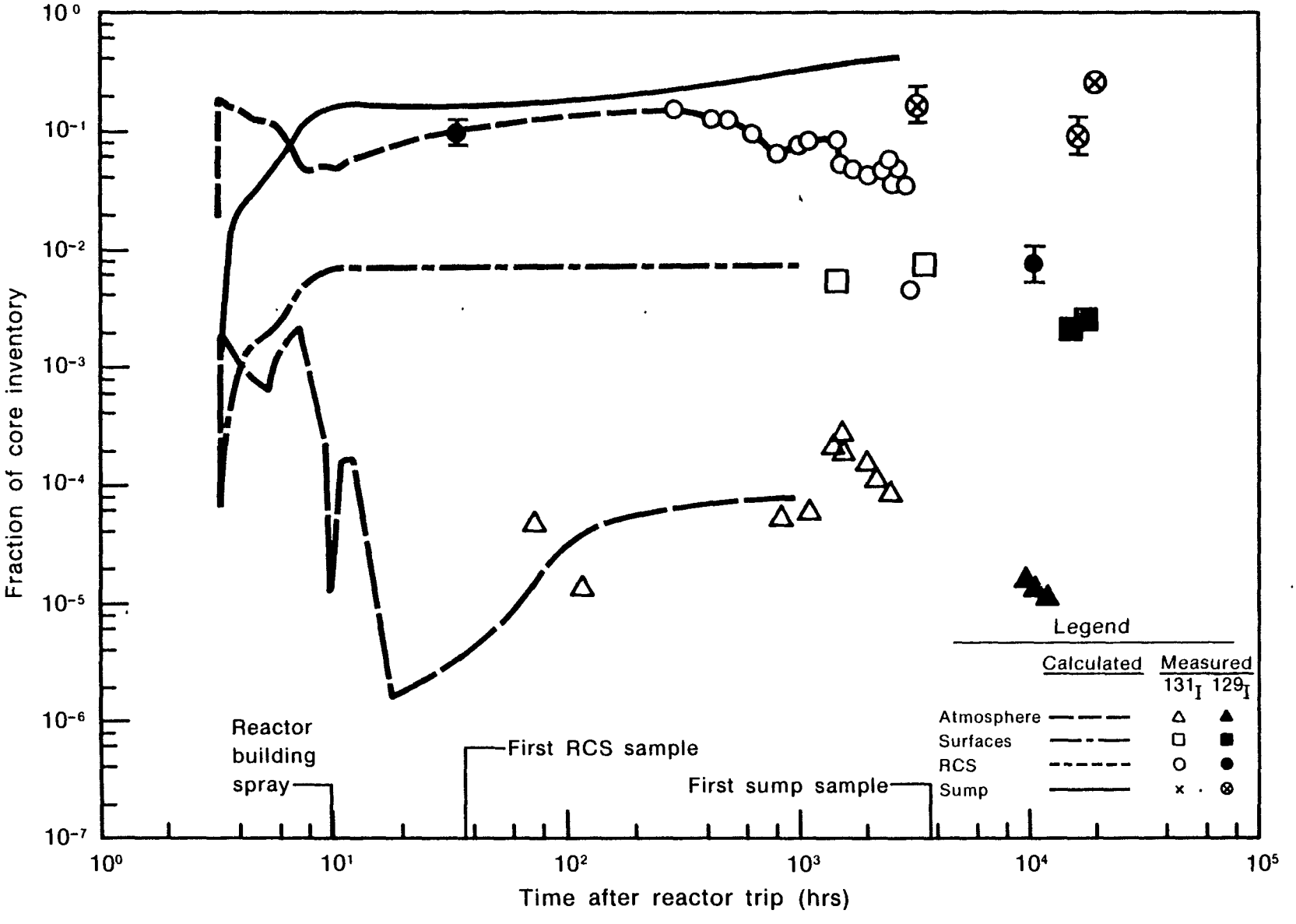
5. U.S. Atomic Energy Commission, "Assumption Used for Evaluating the Potential Radiological Consequences of a Loss of Coolant Accident for Pressurized Water Reactors," Regulatory Guide 1.4, Revision 2, June 1974.

TABLE 1. SUMMARY OF MEASURED RADIOIODINE INVENTORIES FIVE MONTHS AFTER ACCIDENT (August 28, 1979)

Location	Percent of Initial Core Iodine Inventory
Reactor coolant system	2-3
Reactor building sump	12-19
Reactor building atmosphere	0.002-0.003
Reactor building surfaces	0.5-0.7
Auxiliary building liquids	2-5
TOTAL ACCOUNTED FOR	17-28



Calculated and measured iodine quantities