

ATTACHMENT 2
SE No. 123094-002

GPU NUCLEAR CORPORATION

LOOSE OTSG

WESTINGHOUSE ROLLED PLUGS

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1.0 PURPOSE

It has been determined that a total of six Westinghouse-design rolled tube plugs were dislodged from the lower OTSG tubesheets into the primary reactor coolant system.

The purpose of this evaluation is to identify the potential damage effects of a small population of loose plugs on all reactor core and reactor coolant system components with which the plugs can interact and to investigate the possible safety consequences of those effects.

2.0 SYSTEMS AFFECTED

The systems potentially affected by the loose plugs include the reactor vessel and RCS pressure boundary, RC pumps, RV internals, fuel assemblies, control elements, core and RCS instrumentation, OTSG tubesheets, and all other core and RV components and RCS connecting systems with which the plugs can possibly interact or enter.

Reactor core and RCS components are described in the following sections of the TMI-1 FSAR:

RV Internals	3.2.4.1
Fuel Assemblies	3.2.4.2.1.1
Control Rods	3.2.4.2.2, 3.2.4.2.3
CR Drive Mechanisms	3.2.4.3
Incore Instrumentation	7.3.3
Vent Valves	3.2.4.1.2.8
Reactor Coolant System	4.2.1
Reactor Vessel	4.2.2.1
Steam Generators	4.2.2.2
Pressurizer	4.2.2.3
RC Piping	4.2.2.4
RC Pumps	4.2.2.5
RCS Instrumentation	7.3.2
RCS Connecting Systems:	
. Decay Heat System	6.1.2.1, 9.5
. Core Flood System	6.1.2.1.
. Makeup & Purification	6.1.2.1, 9.1
. High Point Vents	4.2.3.9

3.0 SAFETY CRITERIA

The safety functions and limits of the systems described in 2.0 and as related to loose plugs effects are defined in the following documents:

	<u>FSAR</u>	<u>Tech Specs</u>
RV Internals	3.1.2.4.1	-
Fuel Assemblies	3.1.2.3, 3.1.2.4.2.1 3.2.3, 3.2.4.2.1.2	2.1, 2.3, 3.1.4
Control Rods	3.1.2.2, 3.1.2.4.2.2 3.2.2, 3.2.4.2.2; 14.1.2.3, 14.1.2.7	2.1, 2.3 3.5.2, 4.7.1
CR Drive Mechanisms	3.1.2.4.3.1	4.7.1
Incore Instrumentation	7.3.3	3.5.4
Vent Valves	3.2.3.2.5	3.1.11, 4.16
Reactor Coolant System	4.2.3.8, 4.3.10.2, 4.3.10.3	3.1.4, 3.1.6
Reactor Vessel	4.1.3.1	3.1.6
Steam Generators	4.1.3.1	3.1.6
Pressurizer	4.1.3.1	3.1.6
RC Piping	4.1.3.2	3.1.6
RC Pumps	4.1.3.3	3.1.6
RCS Instrumentation	7.1.2, 7.1.3	2.3, 3.5.1
RCS Connecting Systems:		
. Decay Heat System	6.1.2.1, 9.5	3.3.1.1
. Core Flood System	6.1.2.1	3.3.1.2
. Makeup & Purification System	6.1.2.1, 9.1	3.3.1.1
. High Point Vents	4.2.3.9	2.2

4.0 EFFECTS EVALUATION

In-depth evaluations to investigate the potential damage and safety effects of a small population of loose OTSG Inconel 600 plugs in the reactor vessel and primary coolant system were performed by GPUN (Ref. 3) and B&W (Ref. 4).

The evaluations examined potential effects of plug impact, wedging, wear, and flow blockage. Results demonstrated that likely effects on all fuel, control rod, and other RCS components and connecting systems will be limited to minor impacts and flow blockage. Even unlikely effects were determined to create no significant operating problems or new safety concerns.

These conclusions would not change for loose plug populations an order of magnitude larger than six.

Specifically, the plugs cannot attain impact energies large enough to damage pressure boundaries, fuel, instrumentation, or other RV and RCS components. The small size and population of plugs cannot cause flow blockages that would degrade DNBR or fuel assembly holddown margins. Nor is there any likelihood of an intact plug affecting control rod movement or causing any new safety concerns regarding the functions of connecting systems to the RCS. Small fragments that could cause fuel rod fretting or restrict control rod motion are unlikely to form due to the high strength, ductility, and toughness of the Inconel 600 plug material. In the very unlikely event of fuel damage or control rod interference existing plant radiation monitoring limits and safety analyses assure safe shutdown.

In summary, no credible effects due to the loose plugs were identified that could place the plant in a configuration that would exceed existing safety analyses envelopes or prevent safe reactor shutdown and core heat removal capability. The likelihood of any significant degradation to the proper functioning of the fuel and all other primary system components is extremely low. No Tech Spec safety margins have been reduced. The plugs do not introduce any significant increase in the probability of occurrence of events previously analyzed in the safety analyses nor any increase in the consequences of those events. No potential for an accident or malfunction different than those previously analyzed has been created. Thus no unreviewed safety questions have been created. These judgements are based on:

- . the small size and mass of the plugs,
- . the small loose plug population
- . the expected randomness of plug flow paths in the RV
- . the minor consequences of all credible effects

5.0 CONCLUSIONS

Based on the evaluations described above it is concluded that operation of TMI-1 with six loose OTSG plugs represents a very small operational risk and does not raise any new safety concerns.

It is further concluded that TMI-1 can be operated safely with a small population of loose OTSG plugs in the RCS with reasonable assurance of no significant increases of undue risk to the health and safety of the public or plant personnel.

6.0 REFERENCES

1. TMI-1, Final Safety Analysis Report (Updated Version), Docket #50-289
2. TMI-1, Technical Specifications
3. J. D. McCarthy, J. P. Logatto, "GPUN Evaluation of Potential Effects of Loose OTSG Plugs in the TMI-1 RCS", September, 1984.
4. B&W Task 375, Doc. #51-1152985-00, "Operation with Loose OTSG Tube Sheet Plugs", September 4, 1984.

B&W DOCUMENT 51-1152985-01