

**CHEMICAL EFFECTS AUTOCLAVE EXPERIMENT TEST
PLAN for Calvert Cliffs Nuclear Power Plant**

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REVISION HISTORY Log

Revision	Description
0	Issue for initial experiment
1	Reduce aluminum concentration to 2x best estimate and revise boron & lithium concentrations to actual maximum concentrations.

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1.0 INTRODUCTION

Calvert Cliffs Nuclear Power Plant (CCNPP) is implementing a risk-informed approach to resolving GSI-191 that includes the performance of a number of chemical effects experiments. These experiments are intended to simulate temperature, pressure, fluid, and debris conditions in containment after a loss of coolant accident (LOCA).

Temperature conditions inside containment during the initial portion of a large break LOCA peak at approximately 280°F. Simulating these temperature conditions in a chemical effects test requires the use of a pressurized test facility. The objective of this autoclave test is to investigate whether the time the containment temperature is over 190°F has a significant effect on the corrosion of materials in the fluid, the production of precipitants, and the potential for precipitation. The results of this test will influence the decision on whether the CCNPP Chemical Effects Head Loss Experiment (CHLE) facility needs to be pressurized (which supports test temperature greater than 190°F) or whether it can be an atmospheric pressure facility (which allows test temperature less than or equal to 190°F).

2.0 PURPOSE

The purpose of this document is to describe the autoclave experiment planned for the CCNPP CHLE program. This plan presents the sequence for performing the experiment and the conditions for each experiment.

3.0 OVERALL EXPERIMENTAL PLAN

The overall concept for the experiment is four 12-hour corrosion experiments, one maintained at 280°F and the other maintained at 190°F, with fluid simulating the post-LOCA fluid solution in containment and corrodible materials expected in containment in the fluid. The identification and concentration of corrosion products and characterization of any precipitates will be compared to determine if there is a significant difference in corrosion in 12 hours at the two temperatures.

Materials used in the test will be representative of the materials submerged in the containment pool or exposed to containment spray and expected to dissolve and contribute to chemical effects in the initial 12 hours of the LOCA. These include destroyed insulation, concrete, latent debris and other miscellaneous materials in containment. The material quantities will be scaled to approximate the ratio of the test fluid volume to the volume of debris materials immersed in the pool fluid or the surface area of solid materials exposed to pool at CCNPP.

The fluid chemistry will be similar to the initial post-LOCA pool chemistry expected at CCNPP. A scaled quantity of NaTB buffer will be allowed to dissolve in the test chamber to simulate the dissolution of buffer in the plant.

4.0 EXPERIMENTAL PARAMETERS

4.1 Debris Quantities

Table 1: Insulation Sample Quantities

Insulations Debris	Test Quantity
Transco Thermal Wrap or NUKON (LDFG)	0.91 gram/Liter (g/L)
Mineral Wool	0.34 g/L
Calcium Silicate	0.001 g/L

4.2 Reactive Material

Table 2: Reactive Material Quantities

Material Description	Test Quantity
Metallic Aluminum	0.02 in ² /L
Galvanized Steel	7.5 in ² /L
Copper	0.1 in ² /L
Exposed Concrete	0.1 in ² /L

4.3 Chemistry Conditions

Table 3: Chemistry Conditions

Purified Water with	
Boron Concentration (H ₃ BO ₃)	2600 ppm
Lithium Hydroxide	0.80 ppm
Initial pH	~4.5

4.4 Buffer

Include 3.5 grams per liter sodium tetraborate decahydrate (NaTB) buffer.

4.5 Temperature Conditions

One experiment will be maintained at 280°F ±5°F and the other maintained at 190°F ±5°F.

4.6 Agitation

The autoclave shall be agitated continuously throughout the experiment to facilitate fluid flow across the contained materials.

5.0 REPEATABILITY

The experiment will be repeated to investigate repeatability of results.

6.0 CHEMISTRY ANALYSIS

Mass spectrometry of the fluid used in the experiment shall be performed:

1. On the purified water prior to addition of the boric acid and lithium hydroxide, and
2. On the fluid solution after each 12-hour experiment.

The relative concentrations between the 280°F and the 190°F experiment of the following elemental species shall be reported:

1. Alumina
2. Boron
3. Calcium
4. Iron
5. Magnesia
6. Phosphorus
7. Silica
8. Sulfur
9. Zinc