



UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
WASHINGTON, D. C. 20555

*H Schierling*

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SUBJECT: ESTIMATE OF GAS AND SOLID DEBRIS FORMATION FROM ZINC,  
ALUMINUM, AND ORGANIC MATERIALS INSIDE CONTAINMENT  
UNDER DBA CONDITIONS FOR DIABLO CANYON, UNITS 1 AND 2

We have evaluated the Diablo Canyon Allegation 100, Diablo Canyon Painters Have No Quality Control Program, from the hydrogen generation and debris formation point of view.

We consider that inside containment, unqualified paints which do not meet the provisions of Regulatory Guide 1.54, Quality Assurance Requirements for Protective Coatings Applied to Water-Cooled Nuclear Power Plants (June 1973), and ANSI N 101.2, Protective Coatings (Paints) for Light Water Nuclear Reactor Containment Facilities (1972), can be a source of hydrogen generation and debris formation. This is a conservative assumption because all unqualified paints would not be affected.

In Table I, we listed the amount of hydrogen expected to be generated from the corrosion of zinc paints, galvanized steel, and aluminum. Table II lists the calculated volume of debris that could be formed.

In our evaluation, the calculation of combustible gas generation rates is consistent with the guidelines of NUREG-0588, with adjustments, to take into account the plant-specific parameters and the effects of post-accident recirculation of sump water inside the containment. We assumed that the cable insulation materials and unqualified paints (paints that do not meet the acceptance criteria of SRP Section 6.1.2) contribute to combustible gas generation, whereas qualified organic paints (paints that meet the acceptance criteria of SRP Section 6.1.2) and other organic materials (charcoal and oil) contribute negligible amounts of combustible gases.

For solid debris formation, we assumed that only unqualified paints form debris under DBA conditions, whereas the qualified paints, charcoal, oil, and cable insulation materials are not expected to form solid debris that can potentially reach the sumps under DBA conditions. With regards to the rate of formation and size distribution of the debris, we are unable to provide quantitative information due to uncertainty in the chemical composition and in the quality control of the application of the unqualified paints.

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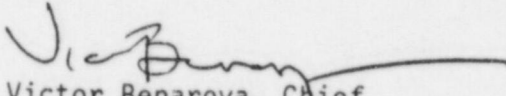
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Discussions with Carboline, one of the principal suppliers of containment protective coatings, indicated that debris from a failed unqualified coating is likely to be small in particle size. Inorganic and organic zinc coatings are predominately zinc particles and any debris released would be in the form of a white powder. Organic coatings will fail by blistering forming a flaky debris. The particle size of these flakes may range from one millimeter to 6 millimeters, and rarely up to 12 millimeters. The possibility of peeling or delamination of large sheets of protective coating is unlikely. Application of a protective coating on an oily surface could lead to delamination or peeling. The amount of debris which can be generated from unqualified paint may total 6400 pounds with a volume of 34 cubic feet. Paint which has been qualified for suitability under design basis accident conditions (meets ANSI 101.2) is not expected to blister. Approximately 330,000 square feet of partially qualified paint has been applied inside containment without Regulatory Guide 1.54 quality control requirements. This paint may to some extent delaminate and separate from the containment surface.

The licensee provided information on the amount of qualified and unqualified protective coatings, but no information was provided on the amount of cable insulation. We used the estimated generation rates of hydrogen for the Grand Gulf plant, since Grand Gulf possesses the largest quantity of organic material that can produce gases under DBA conditions.

  
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Enclosures: As stated

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Table I

## Estimated Combustible Gas Generation Rates Inside Containment

Time	ft. <sup>3</sup> (STP)/min.			Hydrogen Generation		Total
	Radiolysis Cable Insulation	Unqualified Paints	Zinc Paints	Corrosion Galvanized Steel	Aluminum	
1 hr	12.82	1.27	3.73	2.75	1.24	19.06
12 hr	2.65	0.56	0.62	0.46	0.21	4.50
1 day	1.52	0.40	0.37	0.27	0.13	2.69
4 day	0.58	0.20	0.23	0.16	0.08	1.25
10 day	0.32	0.13	0.23	0.16	0.08	0.92
30 day	0.10	0.07	0.23	0.16	0.08	0.64

- Assumptions:
- (1) Source term of NUREG-0588 adjusted for plant-specific parameters and effects of post-accident recirculation of sump water.
  - (2) Cable insulation materials and unqualified paints received 100% airborne and plate-out gamma and 50% airborne and plate-out beta radiation.
  - (3) G value for cable insulation materials = 3.1 molecules/100 e.v. absorbed. G value for unqualified paints = 5.0 molecules/100 e.v. absorbed.
  - (4) All gases generated are combustible.

Table II

Debris Formation from Unqualified Paint

film thickness	1-6 mils
debris density	1.2 - 2.1 gms/cc
debris volume	34 cu. ft. Protective coatings which do not meet ANSI 101.2, Protective Coatings (Paints) for Light Water Nuclear Reactor Containment Facilities and Reg. Guide 1.54. Quality Assurance Requirements for Protective Coatings Applied to Water - Cooled Nuclear Power Plants.

- Assumptions:
- (1) Source term of NUREG-0588 adjusted for plant-specific parameters and effects of post-accident recirculation of sump water.
  - (2) Ratio of debris volume to original volume of unqualified paints = 2.
  - (3) Solid debris formation completed when 90% of radiation energy is released.