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SNRC-1583

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U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, D.C. 20555

Temperature Profile Inside Primary Containment
Used For Environmental Qualification
Shoreham Nuclear Power Station - Unit 1
Docket No. 50-322

Reference:
1. LILCO (J.D. Leonard, Jr.) Letter SNRC-1578 dated April 4, 1989 to NRC (Document Control Desk) same subject.
2. USNRC Memorandum from W.V. Johnston to T.M. Novak dated 12/29/82 entitled "Supplement to Safety Evaluation Report for Shoreham Nuclear Power Station Unit 1."

Gentlemen:

This letter supplements the information provided in the referenced letter and provides the results of a recent engineering evaluation which developed a modified environmental qualification (EQ) temperature profile (Figure A). The modified EQ profile shows the temperature remains at 170°F from 4 to 18 days, 160°F from 18 to 35 days, and 150°F for the remainder 180 days. The evaluation was performed to determine the affect of this elevated temperature condition on the qualified post accident operating time of the equipment and is discussed in detail below. As can be seen in Figure A, the modified EQ temperature profile bounds the worst case primary containment (drywell) composite temperature profile, which is the conservative combination of the primary containment temperature response to a main steam line break (MSLB) and a loss of coolant accident with no containment spray, at all times. Thus, LILCO submits that this fact, supported by the following details of the engineering evaluation, resolves the issues described in Section 12.5 of the Operational Readiness Assessment Inspection Report 50-322/89-80.

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Essential Elements of the Engineering Evaluation

The evaluation consisted of the following:

(a) The EQ equipment list was reviewed to identify each Environmental Qualification Documentation Package (EQDP) which qualified equipment installed in the drywell. Thus the scope of the evaluation was established.

(b) For each equipment type, the basis for the qualified operating time was examined. For some EQDPs, the equipment was found to be qualified without the need for additional analysis.

(c) For the EQDPs requiring reanalysis, the modified EQ profile (from 4 to 35 days) was used to determine the effect on the qualified operating time. In essence, this calculation determines the amount of aging experienced by a device due to exposure to both the modified EQ and test profiles so that it can be compared. In all cases, the test subjected the device to harsher accident aging than the modified EQ profile and the equipment was still qualified for the required operating time, with margin.

In summary, all equipment was shown to be qualified for the modified EQ temperature profile for its required post accident operating time. Attachment I to this letter provides additional information concerning the evolution of the modified EQ temperature profile. Details on the use of the Arrhenius methodology are provided in Attachment II. Should you have any additional questions please do not hesitate to call my office.

Very truly yours,

W Cheiger for

J. D. Leonard, Jr.
Vice President - Nuclear Operations

GJG/ap
Attachment

cc: W. Russell
S. Brown
F. Crescenzo

MODIFIED EQ TEMPERATURE PROFILE FOR THE PRIMARY CONTAINMENT DRYWELL SHOREHAM NUCLEAR POWER STATION

I. INTRODUCTION

A modified equipment qualification temperature profile for the drywell has been conservatively established and verified against actual test data. The modification of the EQ temperature profile for the drywell is based on a consideration of the most limiting spectrum of design basis accidents.

The modified EQ profile as shown in Figure A conservatively bounds steam line break and LOCA design basis accidents. Loss of coolant accidents which dominate the long term drywell temperature response were evaluated conservatively with containment sprays and without containment sprays. Use of the no containment spray case for this purpose is considered to be conservative.

II. LIMITING ACCIDENTS

The Design Basis Accident for the drywell atmospheric temperature of the Shoreham Nuclear Power Station is identified in the USAR as a small steam line break; the containment peak temperature occurs in less than 300 seconds into an accident. The drywell long term temperature response is controlled by the containment heat sinks and the RHR heat exchanger capacity. The long term temperature response is typically shown by a double ended rupture of a recirculation suction line (LOCA) as described in section 6.2.13 and shown in Figures 6.2.1-33 and 6.2.1-13 of the USAR.

The accident scenario for the recirculation suction line break is described in the USAR Table 6.2.1-2. The Core Spray system starts to deliver flow from the suppression pool to the reactor vessel at 30 seconds after the accident. Low Pressure Coolant Injection (LPCI) of the suppression pool water into the reactor is initiated at about 45 seconds into the accident. Case C assumes that at about 600 seconds the Containment Spray cooling mode is initiated. Case D assumes that no Containment Spray is actuated.

III. ENVIRONMENTAL QUALIFICATION MODIFIED PROFILE

The modified EQ temperature profile for which the equipment inside the drywell is qualified is obtained from a composite diagram for the short term small steamline break (USAR Figure 6.2.1-33) and the long term Case D (USAR Figure 6.2.1-13). The enveloping curve is shown by dashed lines in Figure A (attached). The EQR temperature profile (Figure D-1 of the EQR) did not envelope the accident profile (Case D only) at all times. The modified EQ temperature profile shown in Figure A (attached) corrects for this. This Figure A will replace the information given in Figure D-1 in the EQR.

IV. SUMMARY CONCLUSION

A decision was made to review and evaluate qualification of the equipment in the drywell to the modified EQ profile. Case D of the USAR Figure 6.2.1-13 was selected as the most upper bound drywell temperature response to a loss of coolant accident, because it does not take credit for operator action to initiate containment sprays following a LOCA.

USE OF ARRHENIUS METHODOLOGY

For the majority of SNPS equipment, the test demonstrated operating time was shorter then the required operating time. In order to establish qualification for 180 days, the testing was supplemented by Arrhenius analysis to demonstrate qualification for the equipment's operating time. The Arrhenius methodology was conservatively applied since no credit was taken for any portion of the test profile which enveloped the transient portion of the accident profile.

The Arrhenius equation is used to determine the amount of aging experienced by the device during testing and the amount of aging the device will experience due to exposure to the modified EQ Profile for the equipment's required operating time. The results are then compared. If the test conditions subjected the device to greater aging degradation than expected in the plant, the test is considered more harsh and the device considered qualified.

For the purpose of this study, the transient portion of the profile is considered to be the first day and the Arrhenius calculations performed for operating time specifically excluded this first day of date. Qualification for at least the first day of the event has been established by type test alone. Arrhenius techniques have been applied only to those portions of the profile after the first day.

Conditions after the first day are not considered transient. After the first day, the containment begins its steady cooldown phase, with the modified EQ profile remaining conservatively at 200°F for 3 days , 170°F for 14 days, 160°F for 17 days, and 150°F for 145 days. Over this period (from 1 day to 180 days), the temperature varies slowly whereas, during the first day, the conditions vary greatly. Thus the 1 to 180 day duration is not considered to be a transient condition.

The following additional conservatisms exist in the analysis:

a) The step function modified EQ profile used in the analysis is more conservative than the accident profile. For example, in the period from 1 day to 4 days after accident initiation, the actual plant temperature slowly recedes from approximately 185°F to 170°F (a 15°F change in three days) but is approximated by a constant temperature of 200°F.

b) Selection of the test data to be input to the calculations was taken from the "back end" of the profiles and used only that portion of the profiles necessary to verify qualification with margin. This allows for qualification to be based, as much as possible, on actual type test and minimized the amount of qualification based on type test supplemented by analysis.

c) In some cases, the analysis assumed that the modified EQ profile remained at a specific plateau for the remainder of the accident. For example, the period from 4 days to 180 days might have been assumed to remain at 170°F for the purpose of the calculation rather than dropping to 160°F.

d) The margin in operating time demonstrated by these analyses was far in excess of the 10% recommended by IEEE 323-1974, and in some cases on the order of hundreds of percent. In addition, SNPS has conservatively assumed a required operating time of 180 days though 100 days is technically defensible and known to be generally accepted by the NRC.

e) After the first day, the test and modified EQ profiles are not transient and are relatively close in temperature. Therefore, the aging effects should be relatively parallel for both cases and the Arrhenius equation will accurately predict material degradation.

Qualification of the GE 200 Series electrical penetrations was performed in a special analysis which has been specifically reviewed and accepted by the NRC as stated in USNRC Memorandum from W.V. Johnston to T.M. Novak, dated 12/29/82 entitled "SUPPLEMENT TO SAFETY EVALUATION REPORT FOR SHOREHAM NUCLEAR POWER STATION UNIT 1." The analysis presented and accepted for this equipment, which previously used Arrhenius methodology for the first day, has been revised to incorporate the modified profile with no effect on its qualification status.

In summary, all equipment was shown to be qualified for the revised drywell temperature profile for its required post-accident operating time.

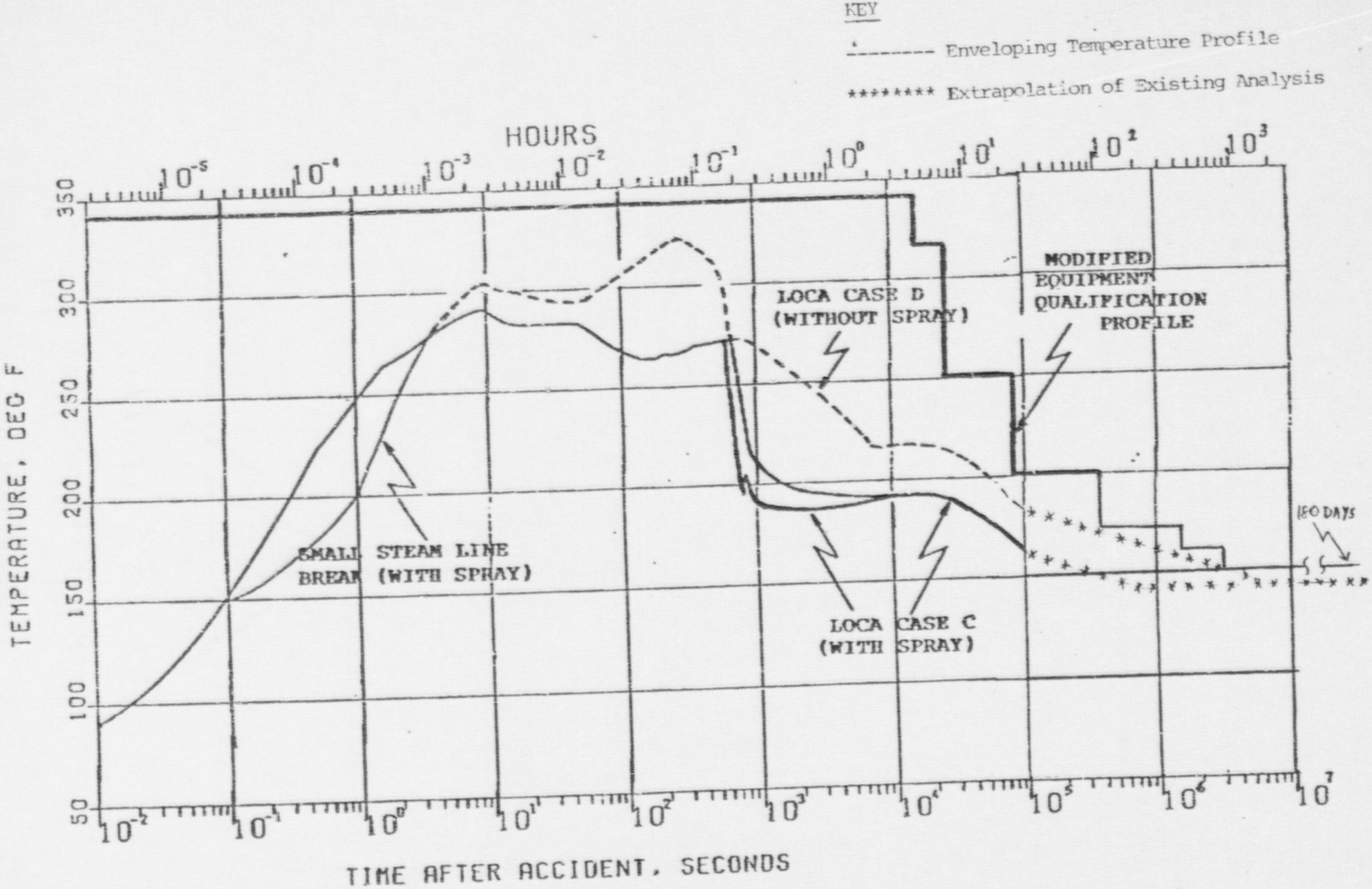

FIGURE A

PRIMARY CONTAINMENT (DRYWELL) COMPOSITE TEMPERATURE PROFILE