ATTACHMENT 2

LIMERICK GENERATING STATION

UNIT 1

DOCKET NO. 50-352

LICENSE NO. NPF-39

TECHNICAL SPECIFICATIONS CHANGE REQUEST

NO. 97-03-1

LIST OF AFFECTED PAGES

<u>UNIT 1</u>

2-1

B 2-1

2.0 SAFETY LIMITS AND LIMITING SAFETY SYSTEM SETTINGS

2.1 SAFETY LIMITS

THERMAL POWER, Low Pressure or Low Flow

2.1.1 THERMAL POWER shall not exceed 25% of RATED THERMAL POWER with the reactor vessel steam dome pressure less than 785 psig or core flow less than 10% of rated flow.

APPLICABILITY: OPERATIONAL CONDITIONS 1 and 2.

ACTION:

With THERMAL POWER exceeding 25% of RATED THERMAL POWER and the reactor vessel steam dome pressure less than 785 psig or core flow less than 10% of rated flow, be in at least HOT SHUTDOWN within 2 hours and comply with the requirements of Specification 6.7.1.

THERMAL POWER, High Pressure and High Flow

2.1.2 The MINIMUM CRITICAL POWER RATIO (MCPR) shall not be less than ~~1.09~~ 1.12 for two recirculation loop operation and shall not be less than ~~1.11~~ 1.14 for single recirculation loop operation with the reactor vessel steam dome pressure greater than 785 psig and core flow greater than 10% of rated flow.

APPLICABILITY: OPERATIONAL CONDITIONS 1 and 2.

ACTION:

With MCPR less than ~~1.09~~ 1.12 for two recirculation loop operation or less than ~~1.11~~ 1.14 for single recirculation loop operation and the reactor vessel steam dome pressure greater than 785 psig and core flow greater than 10% of rated flow, be in at least HOT SHUTDOWN within 2 hours and comply with the requirements of Specification 6.7.1.

REACTOR COOLANT SYSTEM PRESSURE

2.1.3 The reactor coolant system pressure, as measured in the reactor vessel steam dome, shall not exceed 1325 psig.

APPLICABILITY: OPERATIONAL CONDITIONS 1, 2, 3, and 4.

ACTION:

With the reactor coolant system pressure, as measured in the reactor vessel steam dome, above 1325 psig, be in at least HOT SHUTDOWN with the reactor coolant system pressure less than or equal to 1325 psig within 2 hours and comply with the requirements of Specification 6.7.1.

FEB 2 0 1998

2.0 INTRODUCTION

The fuel cladding, reactor pressure vessel and primary system piping are the principal barriers to the release of radioactive materials to the environs. Safety Limits are established to protect the integrity of these barriers during normal plant operations and anticipated transients. The fuel cladding integrity Safety Limit is set such that no fuel damage is calculated to occur if the limit is not violated. Because fuel damage is not directly observable, a step-back approach is used to establish a Safety Limit such that the MCPR is not less than ~~1.09~~ 1.12 for two recirculation loop operation and ~~1.11~~ 1.14 for single recirculation loop operation. MCPR greater than ~~1.09~~ 1.12 for two recirculation loop operation and ~~1.11~~ 1.14 for single recirculation loop operation represents a conservative margin relative to the conditions required to maintain fuel cladding integrity. The fuel cladding is one of the physical barriers which separate the radioactive materials from the environs. The integrity of this cladding barrier is related to its relative freedom from perforations or cracking. Although some corrosion or use related cracking may occur during the life of the cladding, fission product migration from this source is incrementally cumulative and continuously measurable. Fuel cladding perforations, however, can result from thermal stresses which occur from reactor operation significantly above design conditions and the Limiting Safety System Settings. While fission product migration from cladding perforation is just as measurable as that from use related cracking, the thermally caused cladding perforations signal a threshold beyond which still greater thermal stresses may cause gross rather than incremental cladding deterioration. Therefore, the fuel cladding Safety Limit is defined with a margin to the conditions which would produce onset of transition boiling, MCPR of 1.0. These conditions represent a significant departure from the condition intended by design for planned operation.

1

2.1.1 THERMAL POWER, Low Pressure or Low Flow

The use of the (GEXL) correlation is not valid for all critical power calculations at pressures below 785 psig or core flows less than 10% of rated flow. Therefore, the fuel cladding integrity Safety Limit is established by other means. This is done by establishing a limiting condition on core THERMAL POWER with the following basis. Since the pressure drop in the bypass region is essentially all elevation head, the core pressure drop at low power and flows will always be greater than 4.5 psi. Analyses show that with a bundle flow of 28 x 10^3 lb/h, bundle pressure drop is nearly independent of bundle power and has a value of 3.5 psi. Thus, the bundle flow with a 4.5 psi driving head will be grater than 28 x 10^3 lb/h. Full scale ATLAS test data taken at pressures from 14.7 psia to 800 psia indicate that the fuel assembly critical power at this flow is approximately 3.35 MWt. With the design peaking factors, this corresponds to a THERMAL POWER of more than 50% of RATED THERMAL POWER. Thus, a THERMAL POWER limit of 25% of RATED THERMAL POWER for reactor pressure below 785 psig is conservative.

The MCPR values for both dual-loop and single loop operation listed above, are valid only for Cycle 8 operation.

FEB 2 0 1996

ATTACHMENT 4

LIMERICK GENERATING STATION

UNIT 1

DOCKET NO. 50-352

LICENSE NO. NPF-39

TECHNICAL SPECIFICATIONS CHANGE REQUEST

NO. 97-03-1

Letter: R. M. Butrovich (GE) to K. W. Hunt (PECO Energy)

"Limerick Unit 1 Cycle 8 Safety Limit MCPR"

dated January 20, 1998

(NON-PROPRIETARY VERSION)

Attachment **Additional Information Regarding the 1.12 Cycle Specific SLMCPR for Limerick Unit 1 Cycle 8** **January 20, 1998**

References

[1] *General Electric BWR Thermal Analysis Basis (GETAB): Data, Correlation and Design Application*, NEDO-10958-A, January 1977.

[2] *General Electric Standard Application for Reactor Fuel (GESTAR II)*, NEDE-24011-P-A-11, November 1995.

[3] *General Electric Standard Application for Reactor Fuel (GESTAR II)*, NEDE-24011-P-A-13, August 1996.

[4] *General Electric Fuel Bundle Designs*, NEDE-31152-P, Revision 6, April 1997.

[5] *Methodology and Uncertainties for Safety Limit MCPR Evaluations*, NEDC-32601P, Class III, December 1996.

[6] *R-Factor Calculation Method for GE11, GE13 and GE13 Fuel*, NEDC-32505P Revision 1, June 1997.

Control Rod Pattern Development for the Limerick Unit 1 Cycle 8 SLMCPR Analysis

Projected control blade patterns for the rodded burn through the cycle were used to deplete the core to the cycle exposures to be analyzed. At the desired cycle exposures the bundle exposure distributions and their associated R-factors were utilized for the SLMCPR cases to be analyzed. The use of different rod patterns to achieve the desired cycle exposure has been shown to have a negligible impact on the actual calculated SLMCPR. An estimated SLMCPR was obtained for an exposure point near beginning of cycle (BOC), middle of cycle (MOC), and the end of cycle (EOC) in order to establish which exposure points would produce the highest (most conservative) calculated SLMCPR.

The Safety Limit MCPR is analyzed with radial power distributions that maximize the number of bundles at or near the Operating Limit MCPR during rated power operation. This approach satisfies the stipulation in Reference 1 that the number of rods susceptible to boiling transition be maximized. GENE has established criteria to determine if the control rod patterns and resulting radial power distributions are acceptable based on importance parameters described later. Different rod patterns were analyzed until the criteria on the above parameter was satisfied. The rod pattern search was narrowed by starting from a defined set of patterns known from prior experience to yield the flattest possible MCPR distributions. This was done for the two most limiting exposure points in the cycle since the BOC point was excluded by criteria as non-limiting based on the value from the estimation procedure. A Monte Carlo analysis was then performed for the MOC peak hot excess point and the EOC-1.1 GWd/STU exposure point to establish the maximum SLMCPR for the cycle.

Comparison of the Limerick Unit 1 Cycle 8 SLMCPR to the Generic GE13 SLMCPR Value

Table 1 summarizes the relevant input parameters and results of the SLMCPR evaluation for both the generic GE13 and the Limerick Unit 1 Cycle 8 core. The generic evaluation and the plant/cycle specific evaluations all were performed using the methods described in GETAB[1]. The evaluations yield different calculated SLMCPR values because the inputs that are used are different. The quantities that have been shown to have some impact on the determination of the safety limit MCPR (SLMCPR) are provided. Much of this information is redundant but is provided in this case because it has been provided previously to the NRC to assist them in understanding the differences between plant/cycle specific SLMCPR evaluations and the generic values calculated previously for each fuel product line. [[]]

Prior to 1996, GESTAR II[2] stipulated that the SLMCPR analysis for a new fuel design be performed for a large high power density plant assuming a bounding equilibrium core. The GE13 product line generic SLMCPR value was determined according to this specification and found to be 1.09. Later revisions to GESTAR II[3] that have been submitted to the NRC describe how plant/cycle specific SLMCPR analyses are used to confirm the calculated SLMCPR value on a plant/cycle specific basis using the uncertainties defined in Reference [4].

The Limerick Unit 1 Cycle 8 core is a mixed core with GE11, GE13 and ex-Shoreham GE6 fuel. The latest reload consists of GE13 fuel making up [[]] of the total bundles in the core. The fresh GE13 fuel has an average bundle enrichment of [[]], as compared to a core average enrichment of [[]]. By way of comparison, the generic GE13 equilibrium core has batch and core average enrichments of [[]]. Higher enrichment in the fresh GE13 fuel for the Limerick Unit 1 Cycle 8 core (compared to the average of the core) produces slightly higher power in the fresh bundles relative to the rest of the core. [[]]

[[]]

[[]]

[[]]

The core MCPR distribution for the Limerick Unit 1 Cycle 8 analysis is by all measures much flatter than the MCPR distribution assumed for the generic GE13 evaluation. [[]]

[[]]

[[]] From this comparison [[]] **it can be concluded that the core MCPR distribution for Limerick Unit 1 Cycle 8 is flatter overall than the MCPR distribution evaluated generically for GE13 and that based on this reason alone the calculated SLMCPR for Limerick Unit 1 Cycle 8 should be higher than the 1.09 generic GE13 SLMCPR.**

The uncontrolled bundle pin-by-pin power distributions were compared between the Limerick Unit 1 Cycle 8 bundles and the bundles used for the generic GE13 evaluation. The pin-by-pin power distributions for the bundles used in the the Limerick Unit 1 Cycle 8 SLMCPR evaluation were also compared. Pin-by-pin power distributions are characterized in terms of R-factors using the methodology defined in Reference [6]. [[]]

The flatness of the pin R-factor distribution within a particular bundle is characterized [[]]

[[]]

Table 1 Comparison of Generic GE13 and Limerick Unit 1 Cycle 8 Core and Bundle Quantities that Impact the SLMCPR [[]]

Summary

The calculated nominal 1.12 Monte Carlo SLMCPR for Limerick Unit 1 Cycle 8 is consistent with what one would expect [[]] the 1.12 SLMCPR value is appropriate.

Various quantities [[]] have been used over the last year to compare quantities that impact the calculated SLMCPR value. These other quantities have been provided to the NRC previously for other plant/cycle specific analyses using a format such as that given in Table 1. These other quantities have also been compared for this core/cycle [[]] **The key parameters in Table 1 support the conclusion that the Limerick Unit 1 Cycle 8 core/cycle has a much flatter radial power distribution than was used to perform the GE13 generic SLMCPR evaluation. This fact is significant enough to more than compensate for the fact that the Limerick Unit 1 Cycle 8 bundles are less flat than the bundles used for the generic GE13 SLMCPR evaluation.**

Based on all of the facts, observations and arguments presented above, it is concluded that the calculated SLMCPR value of 1.12 for the Limerick Unit 1 Cycle 8 core is appropriate. It is reasonable that this value is higher than the generic GE13 SLMCPR evaluation.

For single loop operations (SLO) the safety limit MCPR is 0.02 greater than the two-loop value. [[]]

Prepared by:

A.W. Austin
Technical Program Manager
Nuclear Fuel Engineering

Verified by:

B.R. Fischer
Technical Program Manager
Nuclear Fuel Engineering