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AUTH.NAME AUTHOR AFFILIATION
CURTIS,N.W. Pennsylvania Power & Light Co.
RECIP.NAME RECIPIENT AFFILIATION
BUTLER,W.R. Licensing Branch 2

SUBJECT: Forwards "Susquehanna Single Loop Operation Analysis," in response to request for info.

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Two North Ninth Street • Allentown, PA 18101 • 215 / 770-5151

Norman W. Curtis
Vice President-Engineering & Construction-Nuclear
215/770-7501

AUG 15 1985

Director of Nuclear Reactor Regulation
Attention: Dr. W. R. Butler, Chief
Licensing Branch No. 2
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

SUSQUEHANNA STEAM ELECTRIC STATION
SLO REPORT TRANSMITTAL
ER 100450 FILE 841-8 Docket Nos. 50-387
PLA-2520 50-388

Dear Dr. Butler:

In response to the request from your staff, attached please find the Exxon and GE analyses in support of our April 11, 1985 submittal on Single Loop Operation at Susquehanna SES. If you have any questions on this material, please contact Mr. R. Sgarro at (215) 770-7855.

Very truly yours,

N. W. Curtis
Vice President-Engineering & Construction-Nuclear

Attachments

cc: M. J. Campagnone - USNRC
R. H. Jacobs - USNRC

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SUSQUEHANNA UNIT 1 SINGLE LOOP OPERATION WITH ENC 8X8 FUEL

Analyses have been performed for Susquehanna Unit 1 for normal two pump operation both by the NSSS vendor and Exxon Nuclear Company (ENC). Generally both analyses showed similar results and yielded comparable allowed operating limits. Since the ENC and vendor 8x8 fuel designs are very similar, this result is to be expected.

The ability to operate the Susquehanna reactors with only one recirculation pump running is highly desirable in the event that a recirculation pump or other component maintenance renders one loop inoperative. In order to justify single-loop operation the NSSS vendor has performed additional accident and transient analyses for single-loop operating conditions (GP-84-142). The single-loop operating conditions correspond to a maximum power of 75.6% of rated and a core flow of 60.3% of rated. In some cases the NSSS vendor single-loop operation analysis showed that operation within the full-power operating limits will assure that the safety limit is not violated and that a substantial margin to the safety limit exists for single-loop operation due to the reduced power. For these cases, ENC fuel will likewise experience the benefit of the power reduction.

ROD WITHDRAWAL ERROR

The rod block system is designed to stop rod withdrawal at a minimum critical power ratio (MCPR) higher than the fuel cladding safety limit. For single-loop operation, a procedure has been established for correcting the APRM rod block equation to account for the discrepancy between actual flow and indicated flow in the active loop. This procedure preserves the original relationship between APRM rod block and actual effective drive flow when operating with a single loop. The APRM scram trip settings are flow biased in the same manner as the APRM rod block setting. Modification to the rod block equation and lower power assures the MCPR safety limit is not violated.

TRANSIENT MCPR LIMITS

Operating with one recirculation loop results in a maximum power output which is about 30% below that which is attainable for two pump operation. Therefore, the NSSS vendor single-loop analysis showed that the consequences of abnormal operation transients will be considerably

less severe than those analyzed from a two-loop operational mode. These results are shown in Table 15.C.3-3 of GP-84-142. The limiting transients from an allowed MCPR operating limit of 1.38 gave transient MCPRs of 1.20-1.21 which are well above the required safety limit MCPR of 1.07 with a 0.13-0.14 MCPR margin. For pressurization, flow increase, flow decrease, and cold water injection transients, results for two-loop operation bound both the thermal and overpressure consequences of one-loop operation. It was concluded that the MCPR operating limits established for two-pump operation are also applicable to single-loop operation conditions. This is true even for an increased safety limit MCPR due to increased flow measurement uncertainties.

The single-loop operation at reduced power is also applicable to to ENC fuel. Therefore, the operating MCPR limits established for two-pump operation with ENC fuel will be conservative when applied to single-loop operation for the same reasons as for the vendor fuel.

SAFETY LIMIT MCPR

For single-loop operation, the NSSS vendor found that an increase of 0.01 in the MCPR safety limit was needed to account for the increased flow measurement uncertainties and increased tip uncertainties associated with single pump operation. ENC has evaluated the effects of the increased flow measurement uncertainties on the safety limit MCPR and found that the NSSS vendor determined increase in the allowed safety limit MCPR is also applicable to ENC fuel during single-loop operation. Thus, increasing the safety limit MCPR for Cycle 2 from 1.06 to 1.07 is sufficiently conservative to also bound the increased flow measurement uncertainties for single loop operation.

MAPLHGR LIMITS

The NSSS vendor has also evaluated the changes in the two-loop MAPLHGR limits required to permit single-loop operation. A multiplier of 0.81 is to be applied to the appropriate two-loop MAPLHGR limit to obtain the MAPLHGR limit for single-loop operation. The need to reduce the allowed MAPLHGR results from the conservative assumption of early boiling transition (at 0.1 sec) applied for single-loop operation at reduced core flow.

ENC has performed detailed LOCA-ECCS calculations and determined MAPLHGR limits for two-loop operation using ENC fuel. Generally ENC approved methodology yields allowed MAPLHGR limits somewhat greater than those obtained by the NSSS vendor. Therefore, an ENC analysis performed for single-loop operation would be expected to yield somewhat higher MAPLHGR limits than the vendor results. Application of the lower vendor MAPLHGR limits to ENC fuel for single loop operation is a conservative

means of assuring that the LOCA-ECCS criteria are not exceeded. Therefore, for single- loop operation with ENC fuel a MAPLHGR limit corresponding to 0.81 times the MAPLHGR limits for GE type 8CR233 fuel is recommended.

STABILITY

Susquehanna Unit 1 has adopted a detect and suppress approach to avoid unstable reactor operation. ENC 8x8 fuel is hydraulicly designed to be more stable than the vendor fuel it replaces. Thus, introduction of ENC 8x8 fuel will not adversly affect core stablilty and the detect and suppress criteria will be conservatively applicable to ENC fuel in the Susquehanna Unit 1 reactor.