

JAN 24 1983

Mr. E. P. Rahe, Manager  
Nuclear Safety Department  
Westinghouse Electric Corporation  
P. O. Box 355  
Pittsburgh, Pennsylvania 15230

Dear Mr. Rahe:

Subject: Supplemental Acceptance Number 2 for Referencing of Licensing  
Topical Report WCAP-9401/9402

The Nuclear Regulatory Commission (NRC) accepted for referencing Westinghouse Electric Corporation licensing topical report WCAP-9401/9402 entitled "Verification Testing and Analyses of 17x17 Optimized Fuel Assembly" by letter from R. L. Tedesco to T. M. Anderson dated May 7, 1981.

The NRC review, which culminated in the acceptance of the report WCAP-9401/9402 for referencing, considered a core containing only Optimized Fuel Assemblies (OFA's). The review of the use of OFA's mixed with standard assemblies had not been completed at that time. One of NRC's concerns regarding mixed cores of standard and optimized assemblies involved the effects on diversion crossflow between assemblies due to different axial pressure losses. NRC expected to evaluate this consideration for mixed core reloads in conjunction with its review of WCAP-9272 entitled "Westinghouse Reload Safety Evaluation Methodology."

Westinghouse in their letter from E. P. Rahe to L. S. Rubenstein on August 11, 1981 indicated a desire to further demonstrate generically that analyses for a full core of standard fuel and for a full core of optimized fuel bound all mixed core combinations. The Westinghouse March, 1982 letter from E. P. Rahe to J. R. Miller provided the results of several mixed core loading configurations and concluded that allowable limits are not exceeded for any of the plants encompassed by the verification testing and analysis program of WCAP-9401/9402.

We have completed our review of the diversion crossflow effects considerations provided in the above submittals. Our safety evaluation is enclosed.

Based on our review of the information provided in the above submittals and our independent audit, we conclude that the adjustment to the departure from nucleate boiling ratio (DNBR) limit and the method used to thermal-hydraulically analyze mixed cores of 17x17 OFAs and 17x17 standard assemblies are acceptable. For transition cores containing different fuel arrays, e.g., 14x14 or 15x15, the DNBR adjustment must be re-analyzed or Westinghouse must demonstrate that the present adjustment bounds these other fuel types.

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As a result of our review, we find that Westinghouse licensing topical report WCAP-9401/9402 is acceptable for referencing in mixed cores license applications with respect to diversion crossflow effects considerations. It should be noted that this acceptance pertains to the crossflow considerations previously stated in the introduction to the Safety Evaluation Report on WCAP-9500 relative to mixed cores. The structural reservations expressed in that SER have been previously addressed in supplemental acceptance number 1 and physics considerations will be addressed on a case by case basis.

We do not intend to repeat the review of the safety features described in the topical report as augmented by responses to staff questions and found acceptable in the attachment. Our acceptance applies only to the features described in the topical report and the auxiliary documents, and under the conditions described in the enclosure.

In accordance with established procedure (NUREG-0390), it is requested that Westinghouse Electric Corporation publish an accepted version of this report, proprietary and non-proprietary. The accepted version is to incorporate this letter, including the attached topical report evaluation, following the title page and thus just in front of the abstract. The report must appropriately include all supporting information submitted relevant to NRC's mixed core structural concerns. The report identifications of the approved reports are to have a -A suffix.

Should NRC criteria or regulations change, such that our conclusions as to the acceptability of the report are invalidated, Westinghouse Electric Corporation and/or the applicants referencing the topical report will be expected to revise and resubmit their respective documentation, or submit justification for the continued effective applicability of the topical report without revision of their respective documentation.

Sincerely,

*CT*  
Cecil O. Thomas, Chief  
Standardization & Special  
Projects Branch  
Division of Licensing

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Enclosure: As stated

cc: Mr. Bruce Lorenz  
Nuclear Safety Department  
P.O. Box 355  
Pittsburgh, Pennsylvania 15230

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## 1.0 Thermal-Hydraulic Design

### 1.1 Introduction

From a thermal-hydraulic standpoint, the staff required in our WCAP-9401 safety evaluation report (Rubenstein, April 1981) that Westinghouse provide additional submittals which quantified the effects on interbundle diversion crossflow of the different grid heights and fuel pin diameters and the consequential effects on departure from nucleate boiling. In response to this requirement, Westinghouse performed a series of sensitivity studies which were intended to address the staff's concern on a mixed core reload, (Rahe; August 17, 1982). As a result of these analyses, Westinghouse has recommended an adjustment to the OFA departure from nucleate boiling ratio (DNBR) limit when there is a mixed core configuration. This penalty would conservatively bound the hydraulic incompatibility of fuel assemblies having different axial pressure loss profiles and the increase in the uncertainty of the THINC-IV code (WCAP-7956) when it is used to predict the local coolant conditions in a mixed core.

### 1.2 Summary of Submittal

The sensitivity studies on a mixed core reload were performed using the THINC-IV computer code and the methodology presented in WCAP-9500. Twenty-six different analyses were performed on an analogous core model using different loading patterns, pressures, inlet temperatures, powers, flows and axial power distributions. In addition, an investigation on the effects of the different rod diameters on the lateral friction factor and the resultant crossflow was performed.

Based on the results of these analyses, Westinghouse has requested an adjustment to the DNBR limit of the 17x17 OFA when it is placed in a transition core. This adjustment is intended to encompass any additional uncertainties which may be present in a mixed core reload.

Finally, Westinghouse presented their approach to analyzing mixed core reloads.

### 1.3 Staff Review

Since the methodology and analytical tools used to perform the sensitivity analyses have been previously approved by the staff (Rubenstein; May 15, 1981) our review centered mainly on the proposed adjustment and method of analyzing mixed cores.

During our review, the staff orally requested that Westinghouse justify the cases used in assessing the DNBR penalty. Westinghouse responded that the axial power distributions used were those expected throughout a transition core and the range of parameters varied were consistent with previously approved submittals.

We also asked Westinghouse to justify using the model reported. Their response was that the model was sufficient to define the adjustment and a full core model was too detailed and could not be constructed.

As part of the review effort the staff performed an audit calculation of a full core OFA and a mixed core with an OFA as the limiting assembly. The COBRA-IV code was used in the analyses and the results of these calculations are presented in Table 1. The difference in the full and mixed core MDNBRs is (approximately 1.7%) well within the adjustment proposed by Westinghouse.

Table 1  
Comparison of Staff Audit Calculations

| Case       | Elevation<br>(inches) | MDNBR<br>(-) | Enthalpy<br>(BTU/lbm) | Mass Flux<br>(Mlb/hr-ft <sup>2</sup> ) |
|------------|-----------------------|--------------|-----------------------|--|
| Full Core  | 101.9                 | 2.642        | 658.37                | 2.4404                                 |
| Mixed Core | 101.9                 | 2.596        | 659.09                | 2.4180                                 |

Based on our review of the additional information submitted by Westinghouse to address our WCAP-9401 concerns and our audit calculations using COBRA-IV, we conclude that the methodology and the adjustment to the DNBR limit described in August 17, 1982 submittal is acceptable for 17x17 transition cores. Transition cores containing different fuel rod arrays must be re-analyzed or Westinghouse must demonstrate that the present adjustment for a 17x17 transition core bounds these different fuel designs.

#### 4.0 References

##### 4.1 Topical Reports

WCAP-7956, "THINC-IV--An Approved Program for Thermal-Hydraulic Analysis of Rod Bundle Cores," Westinghouse Electric Corporation, June 1973.

WCAP-9500, "Reference Core Report 17x17 Optimized Fuel Assembly," Westinghouse Electric Corporation, July 1973.

##### 4.2 Other References

Letter, E. P. Rahe (Westinghouse) to James R. Miller (NRC), Subject: Supplement to WCAP-9500 and WCAP-9401/9402 NRC Safety Evaluation Report (SER) Mixed Core Compatibility Items - Supplemental Information," August 17, 1982.

Memorandum, L. S. Rubenstein, to Robert L. Tedesco, Subject: "Review of Topical Report WCAP-9500," August 23, 1981.

Memorandum, L. S. Rubenstein to Robert L. Tedesco, Subject: "Safety Evaluation Report on WCAP-9500," May 13, 1981.

Memorandum, L. S. Rubenstein to Robert L. Tedesco, Subject: "Review of Topical Report WCAP-9401," April 23, 1981.