FRAMATOME COGEMA FUELS

June 11, 1996

Mr. Steven M. Matthews (Mail Stop 0-9A1)
Vendor Inspection Section, Special Inspection Branch
Nuclear Regulatory Commission
11555 Rockville Pike
Rockville, Maryland 20852-2738

Dear Steve:

Attached is a summary of the April 17 meeting held in Washington, DC, concerning the one NRC Audit Team identified weakness dealing with the DCP observed at Three Mile Island. This summary was prepared by Bill Brunsen of FCF Fuel Engineering.

This is being sent to you for your information and we would appreciate any comments you may have regarding our position.

We look forward to seeing you in July.

Very truly yours

R. L. Gardner

R. L. Gardner
Manager, Quality
Framatome Cogema Fuels

Attachment

110100

ID 9R-13 vendor Inspection

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In the April 17 conti   inspection meeting in Washington D.C., we discussed additional information concerning the DCP observed at Three Mile Island and Crystal River l and several "weaknesses" that the audit team perceived at FCF. FCF takes exception to one of the "weaknesses". Specifically, we believe that the association of weakness with the FCF design process because the unforeseeable was not foreseen is unwarranted, especially since FCF acknowledged that new performance issues might arise and put in place a program to inspect the fuel after the cycle.

As presented, the Audit Teams premise concerning the design process was as follows:

> ***The nuclear, thermal-hydraulic, and material design was weak because high boron, high pin peaking, and low flow were allowed to occur in combination. As a result, crud formation was increased leading to cladding thinning and in some cases failure. Associated with the preceding are certain contributing factors.***
>
> *Chemistry (Inadequate pH guidance)*
> - ***Low pH, due to high boron and low lithium resulted in transport of corrosion products/crud to the fuel,***
> - ***Suspected high crud levels at TMI***
>
> *Nuclear*
> - ***Minimal BP that resulted in high boron, and***
> - ***Lattice/core design that resulted in high peaking in lower flow regions***
>
> *Thermal-hydraulic*
> - ***High clad surface temperatures in a lower velocity region which might lead to subcooled boiling***
>
> *NEMO/CASMO*
> - ***"T" & "L" loading patterns for fresh fuel probably stressed the methods***

FCF has reviewed, and is continuing to review, the TMI-1, cycle 10 core design in comparison to other core designs for similar plants. The cycle design was optimized to maximize core lifetime yet remain with in all reload design criteria. One aspect of the optimization is minimal use of burnable poison resulting in minimal residual absorber poisoning.

Power distributions and fuel assembly outlet temperatures for cycle 10 of TMI-1 were consistent with recent designs and are bounded by a similar plant which operates at a slightly higher total power level. This is illustrated in Figure 1. The figure is a plot of the beginning of cycle relative assembly power distribution in one-eight core

geometry versus fuel assembly outlet temperature. Five cycles are included in the plot as described in the legend. Note that TMI-1 cycle 10, Crystal River III cycle 10, and TMI-1 cycle 9, are all consistent one to the other and are bounded by Davis Besse cycles 9 and 10. The typicality of TMI cycle 10 is further supported by the performance of TMI cycles 8 and 9. Both of these cycles had a "T" type arrangement of the fresh fuel and similar interface power peaking. DCP did not occur in either TMI cycle 8 or 9. In general, conditions for TMI 1 cycle 10 were well within FCF and industry accepted design criteria. The results demonstrate that the TMI-1 cycle 10 design was not overly aggressive relative to FCF and industry design and performance experience.

The characteristics of TMI-1 cycle 10 which were not typical were the beginning of cycle boron concentration which was FCF's highest and the large pH swing during the first six months of operation.

FCF has expended great effort to avoid leaking fuel and believes that the actions recommended by FCF concerning water chemistry will prevent a reoccurrence of DCP and associated clad thinning. FCF is continuing to study the circumstances surrounding the occurrence of DCP to determine if additional actions or recommendations are necessary. The objective of one of these studies is to determine if there are credible limitations that should be imposed in the design process in view of the possible occurrence of the DCP. In the interim, on a reasonable and prudent basis, FCF is developing and following guidelines that are intended to avoid a reoccurrence of DCP.

The detailed mechanism that led to clad thinning and in a few cases clad failure is unknown. The evidence points to high boron concentration, large pH increase at the beginning of the cycle, and crud as key factors. The importance of other environmental factors such as peaking and flow remains to be determined. Thus, at the present time it is unclear how design factors may have contributed to the occurrence of DCP.

The issue of pH is not a simple one. It is well known that elevated lithium can result in degradation of the Zircaloy-4 alloy and that lower pH can result in increased transport of corrosion products. FCF recommendations for pH control balanced the two concerns, and because of the unknowns associated with the increased cycle length and higher boron concentration recommended an appropriate surveillance program. This program, expanded as a result of the occurrence of DCP, has recently been completed.

During TMI 1 cycle 10 operation, an evaluation of radiochemistry data predicted that six to eight fuel rods were leaking in first burn fuel. As a consequence, an ECHO ultrasonic and visual inspection campaign was initiated to identify and replace the leaking fuel rods. This inspection resulted in the detection of the DCP phenomena. FCF is continuing to support surveillance activities as a part of our effort to understand the occurrence of DCP. Fuel has been examined at Three Mile Island, Crystal River III, and recently at Davis-Besse. The only DCP-related failures occurred at TMI, only very slight DCP was observed at CR III, and no DCP was observed at Davis-Besse.

FCF's examination and surveillance programs demonstrate a continuing commitment to fuel performance monitoring, in particular in those circumstances where our data base is being extended.

The occurrence of the DCP at TMI-1 and Crystal River III, and the related fuel rod failures at TMI-1, are a significant concern for FCF. A thorough root cause investigation is in progress, intended to determine, and eliminate, the cause of the DCP. At this point in time, none of the evidence indicates a weakness in FCF's core design process.

It is suggested that, rather than characterizing the design effort as weak, the audit report would be more useful to both NRC and industry if it used this occurrence as an opportunity to emphasize the need to consider carefully extensions to existing experience boundaries, taking small steps and gathering data along the way to reduce the possibility of adverse effects just as was done at TMI-1.

Figure 1
Power verses Temperature, BOC