FRAMATOME
TECHNOLOGIES

January 31, 1997
JHT/97-8

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

Subject: RCCA Insertion Issue

Gentlemen:

On December 18, 1996 Framatome Cogema Fuels (FCF) representatives and members of the B&W Owners Group (BWOG) met with the NRC to discuss the issue of RCCA insertability. At the conclusion of that meeting the NRC staff suggested that FCF provide a summary of the meeting to highlight the key information that was presented. That summary is provided in the enclosed letter report. As stated in the meeting FCF has demonstrated with analytical results, measured data, and design comparisons that FCF fuel does not exhibit RCCA/CRA insertion problems or associated root causes, and therefore should not be subject to any core management restrictions.

In accordance with 10CFR2.790, Framatome Technologies Inc. requests that the information in the attached letter report be considered proprietary. An affidavit supporting this request is included as Attachment 1. Attachment 2 is the proprietary version of the report. The proprietary material in Attachment 2 is enclosed in brackets. Attachment 3 is the non-proprietary version.

Very truly yours,

C J McPhatter for

J. H. Taylor, Manager
Licensing Services

cc: R. C. Jones, NRC
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Attachment 1

Proprietary Affidavit for FCF Letter Report to the NRC
RCCA Insertion Issue

AFFIDAVIT OF JAMES H. TAYLOR

A. My name is James H. Taylor. I am Manager of Licensing Services for Framatome Technologies, Inc. (FTI). Framatome Cogema Fuels is administratively responsible to Framatome Technologies, Inc. Therefore, I am authorized to execute this Affidavit.

B. I am familiar with the criteria applied by FTI to determine whether certain information of FTI is proprietary and I am familiar with the procedures established within FTI to ensure the proper application of these criteria.

C. In determining whether an FTI document is to be classified as proprietary information, an initial determination is made by the Unit Manager, who is responsible for originating the document, as to whether it falls within the criteria set forth in Paragraph D hereof. If the information falls within any one of these criteria, it is classified as proprietary by the originating Unit Manager. This initial determination is reviewed by the cognizant Section Manager. If the document is designated as proprietary, it is reviewed again by Licensing personnel and other management within FTI as designated by the Manager of Licensing Services to assure that the regulatory requirements of 10 CFR Section 2.790 are met.

D. The following information is provided to demonstrate that the provisions of 10 CFR Section 2.790 of the Commission's regulations have been considered:

(i) The information has been held in confidence by FTI. Copies of the document are clearly identified as proprietary. In addition, whenever FTI transmits the information to a customer, customer's agent, potential customer or regulatory agency, the transmittal requests the recipient to hold the information as proprietary. Also, in order to strictly limit any potential or actual customer's use of proprietary information, the substance of the following provision is included in all agreements entered into by FTI, and an equivalent version of the proprietary provision is included in all of FTI's proposals:

"Any proprietary information concerning Company's or its Supplier's products or manufacturing processes which is so designated by Company or its Suppliers and disclosed to Purchaser incident to the performance of such contract shall remain the property of Company or its Suppliers and is disclosed in confidence, and Purchaser shall not publish or otherwise disclose it to others without the written approval of Company, and no rights, implied or otherwise, are granted to produce or have produced any products or to practice or cause to be practiced any manufacturing processes covered thereby.

Notwithstanding the above, Purchaser may provide the NRC or any other regulatory agency with any such proprietary information as the NRC or such other agency may require; provided, however, that Purchaser shall first give Company written notice of such proposed disclosure and Company shall have the right to amend such proprietary information so as to make it non-proprietary. In the event that Company cannot amend such proprietary information, Purchaser shall, prior to disclosing such information, use its best efforts to obtain a commitment from NRC or such other agency to have such information withheld from public inspection.

Company shall be given the right to participate in pursuit of such confidential treatment."

(ii) The following criteria are customarily applied by FTI in a rational decision process to determine whether the information should be classified as proprietary. Information may be classified as proprietary if one or more of the following criteria are met:

a. Information reveals cost or price information, commercial strategies, production capabilities, or budget levels of FTI, its customers or suppliers.

b. The information reveals data or material concerning FTI research or development plans or programs of present or potential competitive advantage to FTI.

c. The use of the information by a competitor would decrease his expenditures, in time or resources, in designing, producing or marketing a similar product.

d. The information consists of test data or other similar data concerning a process, method or component, the application of which results in a competitive advantage to FTI.

e. The information reveals special aspects of a process, method, component or the like, the exclusive use of which results in a competitive advantage to FTI.

f. The information contains ideas for which patent protection may be sought.

The document(s) listed on Exhibit "A", which is attached hereto and made a part hereof, has been evaluated in accordance with normal FTI procedures with respect to classification and has been found to contain information which falls within one or

more of the criteria enumerated above. Exhibit "B", which is attached hereto and made a part hereof, specifically identifies the criteria applicable to the document(s) listed in Exhibit "A".

(iii) The document(s) listed in Exhibit "A", which has been made available to the United States Nuclear Regulatory Commission was made available in confidence with a request that the document(s) and the information contained therein be withheld from public disclosure.

(iv) The information is not available in the open literature and to the best of our knowledge is not known by Combustion Engineering, EXXON, General Electric, Westinghouse or other current or potential domestic or foreign competitors of Framatome Technologies, Inc.

(v) Specific information with regard to whether public disclosure of the information is likely to cause harm to the competitive position of FTI, taking into account the value of the information to FTI; the amount of effort or money expended by FTI developing the information; and the ease or difficulty with which the information could be properly duplicated by others is given in Exhibit "B".

E. I have personally reviewed the document(s) listed on Exhibit "A" and have found that it is considered proprietary by FTI because it contains information which falls within one or more of thecriteria enumerated in Paragraph D, and it is information which is customarily held in confidence and protected as proprietary information by FTI. This report comprises information

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AFFIDAVIT OF JAMES H. TAYLOR (Cont'd.)

utilized by FTI in its business which afford FTI an opportunity to obtain a competitive advantage over those who may wish to know or use the information contained in the document(s).

James H. Taylor

JAMES H. TAYLOR

State of Virginia)
) SS. Lynchburg
City of Lynchburg)

James H. Taylor, being duly sworn, on his oath deposes and says that he is the person who subscribed his name to the foregoing statement, and that the matters and facts set forth in the statement are true.

James H. Taylor

JAMES H. TAYLOR

Subscribed and sworn before me
this 31st day of January 1997.

Donita R. Hill

Notary Public in and for the City
of Lynchburg, State of Virginia.

My Commission Expires 12/31/2000

EXHIBITS A & B

EXHIBIT A

FCF Letter Report to the NRC RCCA Insertion Issue

EXHIBIT B

The above listed document contains information which is considered Proprietary in accordance with Criteria c and d of the attached affidavit.

Attachment 3

Non-Proprietary Version of FCF Letter Report to the NRC
RCCA Insertion Issue

FRAMATOME COGEMA FUELS
FRAMATOME TECHNOLOGIES

FCF Letter Report To The NRC
RCCA Insertion Issue

ABSTRACT

Framatome Cogema Fuels (FCF) and its fuel customers met with the NRC on December 18, 1996 in Rockville, Md. to present information specific to the FCF fuel designs as they pertain to the Westinghouse RCCA insertion issue. This ***NON-PROPRIETARY*** *report is a written summary report of material presented during the meeting.*

At the meeting, it was demonstrated with analytical results, measured data, and design comparisons that FCF fuel does not exhibit RCCA/CRA insertion problems or associated root causes, and therefore should not be subject to any core management restrictions.

FRAMATOME COGEMA FUELS
FRAMATOME TECHNOLOGIES

Table of Contents

FRAMATOME COGEMA FUELS
FRAMATOME TECHNOLOGIES

1.0 CONCLUSION

The data presented at the December, 1996 meeting in addition to that summarized herein support the conclusion that FCF fuel is not susceptible to the RCCA/CRA insertion problem. FCF fuel performance data do not show adverse trends at higher burnups, and burnups greater than 50000 MWD/mtU have already been successfully achieved. FCF proposes to proceed to the fuel assembly burnups consistent with the methods established in the Mark-B and Mark-BW topicals, BAW-10179 and BAW-10172. The supporting bases are: 1) the design differences noted make the FCF fuel less susceptible to the problem; 2) the key FCF fuel performance data is well behaved compared to licensed models; 3) future cycle design burnups represent only a small increment from existing burnups; 4) the additional resulting axial load is less than 5% of total load experienced; and 5) 100% successful RCCA insertion data and RCCA drag data within allowable limits validate the FCF fuel designs.

No new core management restrictions outside those specified in the existing NRC approved topicals are required for the FCF Mark-B and Mark-BW fuel.

2.0 SUMMARY

FCF fuel consists of Mark-B (15x15) fuel which is supplied to Babcock & Wilcox designed reactors, and Mark-BW (17x17) fuel which is supplied to Westinghouse designed reactors. FCF fuel designs are distinctly different from Westinghouse fuel designs. FCF fuel designs have exhibited no RCCA/CRA insertion problems attributed to the following:

1) Significant margin for axial buckling and significantly lower axial loads than the Vantage 5H fuel assemblies throughout the design life
2) Consistent and as predicted fuel assembly growth data in high and low temperature plants
3) Guide thimble measurements which show little creep deformation
4) Guide thimble corrosion data which is as expected, does not correlate with growth data, and is conservatively accounted in the design analyses

Cumulatively, these results demonstrate that no RCCA/CRA insertion problems should exist for FCF fuel.

The following outlines the FCF supporting arguments based on 1) root causes, 2) fuel design differences, 3) RCCA insertion parameters, 4) RCCA insertion history, and 5) planned surveillance.

3.0. ROOT CAUSES

Root cause conclusions identified publicly to date by Westinghouse comprise: 1) excessive compressive loads, 2) unusual fuel assembly growth, and 3) oxide accumulation in high temperature plants with certain types of power histories. To demonstrate that FCF fuel is less susceptible to the RCCA insertion problem, design comparisons are made with the Westinghouse Vantage 5H fuel assembly since this particular design exhibited the RCCA insertion problems.

- No evidence of excessive axial compressive loads has been observed for the FCF fuel. Worst case load calculations provide considerable margin to critical buckling for Mark-BW and Mark-B fuel. The total axial compressive loads for the FCF designs are much less than those for the Vantage 5H. The Mark-BW fuel assembly holddown loads are considerably less than those of the Vantage 5H. Although the Mark-B fuel assembly has effectively the same holddown load per guide thimble, the guide thimble has higher load carrying capability than that of the Vantage 5H design due to its larger diameter. In addition to less holddown load, the FCF guide thimbles are not subjected to the fuel rod weight since fuel rods are seated on the bottom nozzle. This design feature significantly reduces the axial load compared to the Vantage 5H design, which uses lifted rods. As a result, minimal guide thimble distortion has been measured for burnups greater than 50000 MWD/mtU for Mark-BW fuel. The corresponding axial load for this burnup amounts to ~95% of the total load expected for the licensed burnup. Successful RCCA trips with insignificant effect on trip times have been observed for burnups as high as 58400 and 53140 MWD/mtU for the Mark-B and Mark-BW fuel assemblies, respectively.

- No unusual fuel assembly growth has been observed for the same maximum burnups reported above. The data is well-behaved and as expected. The data are shown to be linear with burnup with no anomalies. No statistical differences exist between the Mark-BW and Mark-B growth data, which represent "hot" and "cold" reactor operating experience respectively. Therefore no significant temperature effect is observed.

- No excessive guide thimble corrosion has been observed to date. The maximum guide thimble oxide thicknesses measured are as expected. Low tin zircaloy is currently used for all FCF guide thimbles which provides considerable improvement in corrosion rates compared to high tin (1.5 weight %) zircaloy. Conservative single-sided corrosion is accounted in establishing the guide thimble buckling strength. No corrosion-driven fuel assembly growth has been

observed.

- FCF fuel has operating experience in high temperature plants and with power histories as challenging as those experienced at Wolf Creek, which experienced the RCCA insertion problem. A total of 1421 and 3604 (since 1990) successful insertions have been made for the Mark-BW and Mark-B fuel designs respectively. From these, a total of 81 and 180 successful insertions have been above 40,000 MWD/mtU burnup for the Mark-BW and Mark-B designs respectively. The maximum burnups achieved are 53140 and 58400 MWD/mtU for the Mark-BW and Mark-B fuel designs respectively. The successful RCCA insertion history is coupled with no anomalies in guide thimble corrosion, growth, and deformation and with fuel designs that provide lower axial compressive loads and higher buckling strength.

Therefore the root causes identified publicly to date by Westinghouse have not been observed nor do they apply to FCF fuel for the licensed burnup.

4.0 DESIGN DIFFERENCES

Distinct design differences between the FCF and Westinghouse Vantage 5H fuel designs serve to prevent the FCF fuel from being affected by these root causes.

A summary of these differences as compared to the Vantage 5H fuel is provided below:

1) The Mark-BW fuel assembly is **shorter** than the Vantage 5H, thus allowing for **40% more** fuel assembly growth and resulting in lower operating compressive loads due to the holddown spring. The Mark-B fuel assembly has **80% more** available gap for fuel assembly growth as compared to the Vantage 5H fuel assembly.

2) The Mark-BW fuel assembly has **less holddown force** at BOL compared to the Vantage 5H design. This difference is attributed to a) the shorter fuel assembly length and thus less spring compression and b) less holddown spring preload. While this difference in holddown decreases with each cycle of operation (assuming that the fuel assembly-to-core plate gap is closed at end-of-life (EOL) due to assembly growth for both designs), zircaloy creep is an integral relationship , driven by time, temperature, and stress. Given the lower guide thimble axial loads due to less holddown force and no fuel rod weight load on the guide thimbles due to seated fuel rods (see item 4 below), the Mark-BW fuel is not as compressively stressed as the Vantage 5H fuel. It has been shown

with the guide thimble deformation measurements, that the Mark-BW fuel has minimal creep deformation, resulting from the lower compressive stresses over the life of the fuel. While the Mark-B has holddown load per guide thimble comparable to the Vantage 5H, the Mark-B guide thimbles also do not experience the fuel rod weight load, thus the total guide thimble axial load is less. In addition, the Mark-B guide thimble **buckling strength is greater** than that of the Vantage 5H thus providing greater margin.

3) The Mark-BW upper guide thimble diameter is **0.008 inch larger** than the Vantage 5H, allowing for more control rod clearance and also providing slightly higher buckling strength. The larger clearance provides more coolant flow in the guide thimble/control rod annulus. This would serve to reduce the guide thimble local temperatures thereby reducing guide thimble corrosion as compared to the Vantage 5H design. The Mark-B guide thimble has **no dashpot**, allowing for more control rod clearance and thus also lowering guide thimble corrosion. In addition, the lack of a dashpot precludes any strength related issues associated with the reduced cross section of the dashpot.

4) Both the Mark-BW and Mark-B fuel designs use **fuel rods seated on the bottom nozzle.** Compressive loads from the weight of the fuel rods bypass the guide thimbles and are directly applied to the bottom nozzle thus reducing the guide thimble loads significantly. As a result, Mark-BW and Mark-B guide thimble **compressive loads are substantially less** as compared to the Vantage 5H design. (The lower compressive load is in addition to the holddown load difference reported above). The Vantage 5H design uses lifted rods with a BOL gap. Seating of fuel rods in the Vantage 5H design occurs later in life. At this point in time, a change in fuel assembly growth due to the change in the distribution of the fuel rod slip load and fuel assembly weight in the guide thimbles would also occur. In general, lifted rods, as in the Vantage 5H fuel, would result in a more highly compressive guide thimble structure over the life of the fuel.

5) FCF grid designs are **substantially taller** than the Vantage 5H, which increases the guide thimble span end fixity. This fixity can affect the compressive load carrying capability of a guide thimble span. The Mark-BW and Mark-B guide thimbles are laterally restrained by a slip fit with the guide thimble grid cell over the full height of the grid. The result is an end condition almost equivalent to a fixed-fixed end condition, which provides a high rotational restraint and thus a high buckling load carrying capability. In addition, FCF fuel designs use a **floating grid design which uncouples** the fuel rod/intermediate grid slip loads from the guide thimble structure. The grids are allowed to slip over the guide

thimbles until sufficient relaxation of the grid spring occurs thus minimizing the fuel rod slip loads on the guide thimbles.

Therefore the cumulative distinct design differences serve to preclude the RCCA insertion problem for FCF fuel.

5.0 RCCA INSERTION PARAMETERS

The following focuses on each primary parameter related to the RCCA insertion issue and provides discussion of results which support the conclusion that FCF fuel designs should exhibit no RCCA/CRA insertion problems.

5.1 COMPRESSIVE AXIAL LOAD

The Mark-BW and Mark-B fuel designs provide significantly lower axial compressive loads over the life of the fuel assembly. This is achieved by the use of seated fuel rods, lower holddown spring preload, and shorter fuel assembly length.

Both the Mark-BW and Mark-B fuel designs use seated fuel rods to ensure that the weight of the fuel rods is distributed directly to the bottom nozzle and not the guide thimbles. Therefore the Mark-BW and Mark-B guide thimble compressive loads are substantially less compared to the Vantage 5H design. The Vantage 5H design uses lifted rods with a BOL gap. Seating of fuel rods in the Vantage 5H design is expected to occur later in life. In general, lifted rods would result in a more highly compressive loaded guide thimble structure over the life of the fuel.

FCF has measured data from the Vantage 5H holddown spring system. The measured data show that the Mark-BW spring has a lower preload compared to the Vantage 5H spring. Fuel assembly length measurements on the Vantage 5H design also confirm that the Mark-BW fuel assembly is shorter nominally, which serves to reduce the holddown load also. The reduction in holddown load for the Mark-BW design compared to the Vantage 5H is considerable.

The Mark-B fuel assembly total holddown load is less than that of the Vantage 5H, however the Mark-B design uses 16 guide thimbles as opposed to 24. Therefore the Mark-B holddown load per guide thimble (with the cruciform leaf spring) is about the same as the Vantage 5H. The Mark-B guide thimble however has a larger diameter which results in greater load carrying capability. Earlier Mark-B designs use a helical holddown spring, which provides less holddown per guide thimble than the Vantage 5H.

In total, the axial loads are substantially less for the Mark-B and Mark-BW as compared to the Vantage 5H for much of the fuel assembly life. Therefore, the resulting guide thimble creep deformation is expected to be much less for the FCF fuel.

5.2 FUEL ASSEMBLY GROWTH

FCF has taken considerable fuel assembly growth measurements for its Mark-BW and Mark-B fuel designs. Fuel assemblies have been measured with a broad range of burnups including burnups of almost 60000 MWD/mtU. The Mark-BW data base comprises measurements taken at plants, which have core outlet temperatures of 622°F. (These temperatures will be reduced in the future to 616.6°F with change out of steam generators). The McGuire and Catawba plants are characterized as "hot" plants and are comparable in temperature to Wolf Creek. Cycle designs and power histories for rodded fuel assemblies are as challenging as those used at Wolf Creek.

The Mark-B data base comprises measurements taken at Oconee 1 and 2, which have a core outlet temperature of 601.5°F. Davis-Besse has the highest core outlet temperature of all Mark-B plants, which is 606°F. The Mark-B plants would be characterized as "cold" plants relative to other plants. Cycle designs and power histories are even more challenging than those at Wolf Creek with radial power higher for second burned assemblies with comparable burnups.

The Mark-BW and Mark-B fuel assembly growth data behave linearly with burnup. No accelerated growth or growth anomalies have been observed in the FCF data. The most recent Mark-BW growth data are consistent with previous data accumulated. Although the two FCF fuel designs operate in different type of reactors, i.e., "cold" versus "hot", no statistical difference is observed between the Mark-BW and Mark-B growth rates. Therefore FCF fuel assembly growth shows no temperature effect within the present range of operation. When taken separately, the Mark-BW growth data provide a slightly more conservative growth model. Therefore, in evaluating the Mark-BW fuel design, its specific growth data are used. In evaluating the Mark-B fuel design, the complete (Mark-BW and Mark-B) growth data are used.

The Mark-BW and Mark-B fuel assemblies provide 40% and 80% respectively more available growth allowance compared to the Vantage 5H fuel.

5.3 GUIDE THIMBLE CORROSION

Guide thimble corrosion measurements confirm expected levels of oxide thickness and

hydrogen pickup based on hot cell examinations made on Mark-BW fuel. Oxide thickness measurements made at each grid span showed increasing thickness proceeding from the bottom to top spans. This trend was as expected with the increasing fluid temperature profile. Hydrogen pickup coincided with oxide thickness and also increased along the fuel assembly length.

No anomalies have been observed with Mark-BW guide thimble corrosion. No corrosion-induced guide thimble growth has been observed.

The measured corrosion data are well within the design limits for guide thimble strength and ductility. Low tin zircaloy is currently used for all FCF guide thimbles which provides a considerable improvement in corrosion rates compared to high tin zircaloy.

The maximum expected single-sided corrosion is accounted in establishing the guide thimble buckling strength. The Mark-B guide thimble corrosion would be even lower given the lower core outlet temperature and the strong relationship between temperature and corrosion. In addition, as noted earlier, FCF guide thimble design provides more control rod clearance which provides more coolant flow in the guide thimble/control rod annulus. This would serve to reduce the guide thimble local temperatures thereby reducing guide thimble corrosion as compared to the Vantage 5H design.

5.4 GUIDE THIMBLE DESIGN/STRENGTH

Guide thimble design parameters which affect RCCA insertion are strength (or resistance to deformation) and physical clearances. Parameters that affect guide thimble strength include thickness, diameter, span length, span end fixity, material, and initial deflection.

The FCF and Vantage 5H guide thimble thicknesses and materials are similar, i.e. same thickness and fully recrystallized zircaloy 4 material. However, the guide thimble diameters are different. The Mark-BW upper guide thimble inside diameter is .008 inch larger than the Vantage 5H (0.450 vs 0.442 inch). This provides more clearance for the control rod and increases the strength of the guide thimble slightly. The guide thimble dashpot dimensions are the same for the Mark-BW and Vantage 5H designs. The 15x15 Mark-B design, which uses 16 guide thimbles instead of 24, also has a larger inside diameter. The Mark-B guide thimble comprises one continuous diameter, i.e., there is no dashpot. (The damping of the RCCA during a trip is performed by the control rod drive mechanism itself). This increased diameter provides more strength as compared to the 17x17 Vantage 5H design and also provides more than 3 times the

control rod clearance in the lower 2 feet of the guide thimble.

The FCF design allowable buckling loads are based on worst case assumptions. The design assumptions are: 1) maximum EOL corrosion, 2) maximum tube eccentricity, 3) worst case tolerances, and 4) maximum allowable span deflection . Using the maximum axial loads on the fuel assembly, the minimum margins to buckling are shown to be considerable. Note that this margin corresponds to that axial load which would cause an acceptable amount of lateral guide thimble deflection such as not to hinder RCCA insertion. This is to ensure that lateral guide thimble deflections are minimized to preclude any RCCA/CRA interference. The FCF allowable buckling load is conservative since it is based on a limiting lateral span deflection criterion as opposed to a stress limiting criterion, which would result in a higher allowable load than that used.

All FCF fuel assembly designs uncouple the fuel rod/intermediate grid slip loads from the guide thimble structure. The FCF grid design, which is substantially taller than the Vantage 5H, also presents a different guide thimble span fixity at the grid elevations. This fixity affects the compressive load carrying capability of a guide thimble span. The Mark-BW and Mark-B guide thimbles are laterally restrained by a slip fit with the guide thimble grid cell over the full height of the grid. The result is an end condition almost equivalent to a fixed-fixed end condition, which provides a high rotational restraint and thus a high buckling load carrying capability.

5.5 GUIDE THIMBLE DEFORMATION

The Mark-BW PIE performed in December 1996 specifically quantified the guide thimble creep deformation. Results show that minimal guide thimble creep occurs for burnups greater than 50000 MWD/mtU. No burnup dependency is observed. The guide thimble dimensions are nearly identical to the as-built structure with minimal reduction of the effective inside diameter of the guide thimble. These measurements confirm that the guide thimble creep is minimal for axial loads that are ~95% of the maximum expected.

A total of six fuel assemblies were measured for guide thimble distortion. Both the upper and dashpot regions of the guide thimbles were inspected. Plug gages of 3 different lengths were used. The full length gage conservatively simulated a control rod with a 0.385 inch diameter. (The nominal control rod diameter is 0.381 inch). The short gages were used to inspect for local and global restrictions and deformations in the upper guide thimble and dashpot regions. Two of the short gages used were the same as the functional gages used for inspection during fabrication. The span length

gages were used to inspect for global lateral deformations in the upper guide thimble region. These gages were used for the upper guide thimble inspections. Each gage was allowed to pass through the guide thimble only under its own weight during the inspection.

All guide thimbles inspected accepted the full length control rod gage. Guide thimbles accepted the short and span length gages showing minimal reduction in guide thimble free path diameter and minimal lateral deflection of the guide thimble span. The results apply to fuel assemblies with burnups greater than 50000 MWD/mtU and for fuel assemblies experiencing ~95% of its expected axial load. No change is expected for the small increment in burnup projected for the future. Results for Mark-B fuel would be expected to be comparable given the higher load carrying capability of its guide thimble and comparable design features.

5.6 POWER HISTORY COMPARISONS

FCF has compared the following rodded fuel assembly power histories to those of Wolf Creek cycles 7 and 8:

- Oconee 1 and 3
- ANO Unit 1
- Catawba 1 and 2
- McGuire 1 and 2

Results show that the FCF power histories are similar to, and in some cases even more challenging, than those of Wolf Creek where rod insertion problems have been observed. No accelerated fuel assembly growth, guide thimble distortion, unusual guide thimble corrosion, or RCCA/CRA insertion problems have been observed in FCF fuel with these cycle designs.

6.0 RCCA INSERTION HISTORY

The FCF RCCA/CRA insertion history verifies the advantage of the distinct design differences and data noted above. The trip performance is only a final verification of the data that validates a different fuel assembly structural response with burnup, demonstrating that no insertion problem exists for FCF fuel.

Mark-BW insertion and drag data are primarily based on that taken by Duke Power to meet the requirements of the NRC Bulletin 96-01. These results show that 1421

successful insertions have been made with 81 of these for fuel assembly burnups greater than 40000 MWD/mtU. The maximum burnup with successful insertion is 53140 MWD/mtU. All Mark-BW trips have resulted in times well below the Tech Spec limit of 2.2 seconds. No significant trend between trip time and burnup is observed. RCCA drag data taken in the spent fuel pool as part of the 96-01 bulletin show that loads are within the previously established limits.

Mark-B insertion data show that 3604 successful insertions have been made since 1990. Of these, 180 are for fuel assembly burnups greater than 40000 MWD/mtU. The maximum burnup with successful insertion is 58400 MWD/mtU. All Mark-B trips have resulted in times well below the Tech Spec limit of 1.66 seconds. No significant trend between trip time and burnup is observed.

RCCA/CRA insertion, trip, and drag data support the conclusion that no RCCA insertion problem exists for the FCF fuel designs for the licensed burnup.

7.0 SURVEILLANCE PROGRAMS

To ensure the safe operation and to continue to monitor the high burnup performance of its fuel, FCF has planned Post-Irradiation Examination (PIE) programs in the fall of 1997 to supplement the December 1996 PIE recently completed. These programs, which are part of FCF's originally planned surveillance, will continue to monitor fuel assembly growth, fuel assembly bow/guide thimble creep, guide thimble corrosion, and fuel rod growth. Additional data reduction of the December 1996 PIE is also in progress with a report scheduled for completion within the first quarter 1997.

FCF will continue to monitor any trends related to its PIE data and RCCA/CRA trip data to ensure that any anomalies are identified and that action can be taken if needed.