Commonwealth Edison
1400 Opus Place
Downers Grove, Illinois 60515

September 21, 1990

Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Subject: Information Regarding the Westinghouse ECCS Evaluation Model Power Distribution Issues Impact on Commonwealth Edison's Byron, Braidwood and Zion Nuclear Power Stations.
NRC Docket Nos. 50-295/304, 50-454/455 & 50-456/457

References: 1) Westinghouse letter CWE-90-194, G.P. Toth to D. Elias, "Westinghouse ECCS Evaluation Models Power Distribution Concern", dated June 11, 1990 (enclosed)

2) Westinghouse letter CWE-90-236, G.P. Toth to D. Elias, "Westinghouse ECCS Evaluation Model Power Distribution Assumption Issue [Zion]", dated August 8, 1990 (enclosed).

3) Westinghouse letter CWE-90-237, G.P. Toth to D. Elias, "Westinghouse ECCS Evaluation Model Power Distribution Assumption Issue [Byron and Braidwood]", dated August 8, 1990 (enclosed).

Gentlemen:

Historically, Westinghouse has demonstrated that the chopped cosine power distribution results in the most severe calculated large break LOCA analysis consequences. Based upon recent information, however, power distributions skewed to the top of the core may provide a more limiting peak cladding temperature under certain conditions. The purpose of this letter is to provide you with the status (attached) of recent Commonwealth Edison and Westinghouse efforts to assure that Commonwealth Edison's six PWR units are operating in compliance with the requirements of 10 CFR 50.46 during the period in which Westinghouse is completing the process to resolve this issue.

In summary, it has been determined that the Byron and Braidwood, Units have sufficient LOCA Peak Clad Temperature (PCT) Margin to accommodate this power shape issue. Conversely, Zion Station has insufficient PCT margin; however, Commonwealth Edison has verified that adequate design FQ margin exists with implementation of Westinghouse recommended compensatory actions as discussed in the attachment.

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As the potential decrease in PCT margins at Zion, Byron and Braidwood is due to an interim conservative analysis that will only be required until the issue is resolved and not from a confirmed LOCA model error, and since successful resolution is expected. Edison does not believe that reporting under the provisions of 10 CFR 50.46 (A) (3)(ii) is appropriate. This letter, therefore, is provided for informational purposes only.

Please direct any questions regarding this notification to this office.

Very truly yours,

R.A. Chrzanowski
Nuclear Licensing Administrator

Enclosure

cc: A. Bert Davis-RIII
Resident Inspector-BW
Resident Inspector-BY
Resident Inspector-Z
C. Patel-PM, NRR
T. Boyce-PM, NRR
S. Sands-PM, NRR

/scl:ID297:2

Information Regarding Westinghouse ECCS Evaluation Model Power Distribution Issue

Present Requirements

Appendix K to 10CFR50 requires that the effects of a range of power distribution shapes and peaking factors representing power distributions that may occur over the core lifetime be considered. The power distribution used in the ECCS analysis should be the power distribution which results in the most severe calculated consequences, for the spectrum of postulated breaks and single failures analyzed. In the Westinghouse ECCS Evaluation Model calculations, including the large break LOCA analysis for Commonwealth Edison's Byron, Braidwood, and Zion Stations, a chopped cosine power distribution was assumed. Historically, Westinghouse has demonstrated that the chopped cosine power distribution results in the most severe calculated consequences. Based upon recent information, however, power distributions skewed to the top of the core may result in more limiting peak clad temperature under certain conditions.

Recent Activities

Commonwealth Edison was notified of the issue by Westinghouse in Reference 1. Reference 1 also provided justification that the requirements of 10CFR50.46 continued to be satisfied by taking credit for known model conservatisms. Information regarding this issue was discussed with the Westinghouse Owners Group Analysis Subcommittee on April 17, 1990 and again on July 17, 1990. Information regarding this issue was also presented to the NRC staff in a meeting on July 11, 1990. At the meeting, Westinghouse discussed the procedure which would be used to review specific core designs in order to confirm that limiting skewed power distributions would be precluded by the Technical Specifications and by the core design. The NRC staff agreed that the approach was reasonable. Subsequent to the meeting, the NRC recommended that Westinghouse provide utilities with interim actions which would ensure compliance with the requirements of 10CFR50.46 during the period in which Westinghouse is completing the process for resolution of the issue. Westinghouse described these interim actions to Commonwealth Edison in References 2 and 3.

In order to demonstrate that plants are currently operating in compliance with the regulations, it is necessary to show either that plants have sufficient PCT margin to the acceptance limit to accommodate the impact of a limiting skewed power shape, were it to occur, or that current operating conditions (such as fuel cycle burnup) preclude such power shapes.

Westinghouse, in Reference 2 and 3 notified Commonwealth Edison that:

1. The LOCA analysis for Byron and Braidwood contains more than 100°F PCT margin to the regulatory limit, which is sufficient to accommodate any impact of limiting skewed power shapes, if they were to occur. At worst, limiting skewed power shapes could increase calculated PCT by 100°F. While margin is reduced, compliance with 10CFR50.46 is maintained.

2. Inadequate PCT margin exists in the LOCA analysis for Zion Station to accommodate the power shape issue unless FQ design margin is further evaluated and recommended compensatory actions implemented.

Compensatory Actions for Zion

Westinghouse has developed an uncertainty factor that accounts for the potential power distributions which may be more limiting than the chopped cosine. By temporarily including a large break LOCA power distribution uncertainty factor in both the design verification that the design complies with LOCA limits (the FAC analysis), and in the normal flux mapping surveillance of the measured peaking factor, FQ(Z), compliance with the requirements of 10CFR50.46 can be assured.

The large break LOCA power distribution uncertainty factor is a function of core elevation such that it equals 1.0 from the bottom of the core to the core midplane (0.0-ft to 6.0-ft), linearly increases from 1.000 to 1.051 from 6.0-ft to 7.0-ft, equals 1.051 from 7.0-ft to 9.5-ft, linearly decreases from 1.051 to 1.0 from 9.5-ft to 10.0-ft, and equals 1.0 from 10.0-ft to the top of the core.

Evaluation of the Impacts of the Compensatory Action at Zion

Commonwealth Edison has performed an engineering evaluation of the analyses of record for the present cycles of Zion Units 1 and 2. The evaluation demonstrated that the design FAC power shapes remain under the peaking factor limits when the LOCA power distribution uncertainty factor is included. Commonwealth Edison will apply the LOCA power distribution uncertainty factor in the design and analysis of each Zion cycle until adequate resolution of the issue is obtained.

Schedule for Resolution

Westinghouse has notified Commonwealth Edison that it expects to confirm that power shapes more limiting than the chopped cosine are precluded from occurring when operating within the current technical specifications and core design limits. Westinghouse expects the issue to be resolved in September of this year.

Westinghouse
Electric Corporation

Energy Systems

Box 355
Pittsburgh Pennsylvania 15230-0355

CWE-90-194
CAE-90-205
CCE-90-216

June 11, 1990

Mr. D. Elias
PWR Projects Manager
Commonwealth Edison Company
1400 Opus Place, Suite 300
Downers Grove, IL 60515

Dear Mr. Elias:

Commonwealth Edison Company
Zion/Byron/Braidwood Stations
Westinghouse ECCS Evaluation Model Power
Distribution Assumption Concern

The purpose of this attachment is to provide you with information regarding the effect of power distributions skewed to the top of the core on the results of Westinghouse Emergency Core Cooling System (ECCS) Evaluation Model analyses performed to demonstrate compliance with the requirements of 10CFR50.46. The evaluation is being performed to determine whether a change to the Westinghouse ECCS Evaluation Model is required.

If you have any questions or require further information, please feel free to contact me.

Very truly yours,

S. A. Putadas for
G. P. Toth, Manager
Commonwealth Edison Projects
Customer Projects Department

Attachment
HT/6081G

cc: J. C. Blomgren
D. Elias
W. J. Feimster W
E. J. Fuerst
G. Groth
J. A. Johnson W
T. P. Joyce
J. P. Leider
F. G. Lentine
P. M. McHale W
M. Pietraszewski
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R. E. Querio
E. D. Swartz
G. P. Wagner
D. B. Wozniak

WESTINGHOUSE ECCS EVALUATION MODEL POWER DISTRIBUTION ASSUMPTION CONCERN

BACKGROUND

Westinghouse is currently evaluating a concern which has been identified regarding the power distribution assumed in the emergency core cooling system (ECCS) Evaluation Model analyses performed to demonstrate compliance with the requirements of 10CFR50.46. An evaluation of this potential deviation is being performed to determine whether a change to the Westinghouse ECCS Evaluation Model is required. However, ample information is available to allow Westinghouse to conclude that a Substantial Safety Hazard does not exist based on the effect on off-site dose for the large break LOCA. Westinghouse has informed the NRC of this issue on a generic basis. Information regarding this issue was also provided to the Westinghouse Owners Group (WOG) Analysis Subcommittee on April 17, 1990. Information is being provided at this time because information in the final safety analysis report (FSAR) for your plant may be affected by resolution of the issue. Westinghouse plans to provide the NRC with additional information regarding the evaluation of the concern in June 1990. Further information and details of the resolution will be provided at that time.

REGULATORY REQUIREMENT AND TECHNICAL DESCRIPTION

Appendix K to 10CFR50 requires that the effects of a range of power distribution shapes and peaking factors representing power distributions that may occur over the core lifetime be considered. The power distribution used in the ECCS analysis should be the power distribution which results in the most severe calculated consequences, for the spectrum of postulated breaks and single failures analyzed. In the Westinghouse ECCS Evaluation Model calculations, including the large break LOCA analysis for your plant, a chopped cosine power distribution was assumed. Historically, Westinghouse demonstrated that the chopped cosine power shape results in the most severe calculated consequences. This information was reviewed and approved by the NRC. Subsequent sensitivity studies performed with the newer generation of computer codes continued to validate the earlier result. However, recent efforts to determine the most limiting power distribution for plants with relatively low technical specification peaking factors resulted in new information regarding the effect of power distributions skewed to the top of the core. Power distributions skewed to the top of the core may provide more limiting calculations of the peak cladding temperature in certain plants.

Application of this new information could potentially result in an increase in the calculated peak cladding temperature (PCT) of up to 150°F in plants which are affected. A penalty of this magnitude could be offset by the use of the 1979 ANS decay heat model which generally provides benefits in the range of 100°F to 300°F. This serves as a justification for interim operation while this issue is being resolved. Resolution of this issue may result in a change to the values associated with the power distribution technical specification limits (K(z), FQT, and F-delta-H). If resolution of the concern does not involve a change to the methodology, the need for specific NRC approval of a

change to the technical specification values will not be necessary if these values are contained in a Core Operating Limits Report (COLR) as recommended in NRC generic letter 88-16.

CONCLUSIONS

In summary, Westinghouse has determined that this potential deviation does not represent a Substantial Safety Hazard under 10CFR21. Westinghouse efforts to resolve this issue should be completed in June 1990 at which time additional information will be provided regarding the effect of the resolution of the issue on the large break LOCA analysis for your plant. Westinghouse has informed the NRC of this issue on a generic basis. Thus, it is Westinghouse's judgement that no additional action regarding reportability is required at this time. It is recommended that any safety evaluations under consideration which may reduce currently available margins to the acceptance limit for the large break LOCA consider the potential adverse effect of this concern.

Westinghouse Electric Corporation Energy Systems

Box 355
Pittsburgh Pennsylvania 15230-0355

August 8, 1990
CWE-90-237

Mr. D. Elias
PWR Projects Manager
Commonwealth Edison Company
1400 Opus Place, Suite 300
Downers Grove, IL 60515

Dear Mr. Elias:

Commonwealth Edison Company
Zion Units 1 & 2
Westinghouse ECCS Evaluation Model
Power Distribution Assumption Issue

Westinghouse is currently evaluating an issue regarding the power distribution assumed in the emergency core cooling system (ECCS) Evaluation Model analyses performed to demonstrate compliance with the requirements of 10CFR50.46. An evaluation of this potential deviation is being performed to determine whether a change to the Westinghouse ECCS Evaluation Model is required. Westinghouse records indicate that information found in the FSAR for your plant is based upon calculations performed using the Westinghouse large break LOCA ECCS Evaluation Model methodology, and therefore the information in the FSAR could be affected by the resolution of the Westinghouse evaluation. Information regarding this issue was discussed with the Westinghouse Owners Group Analysis Subcommittee on April 17, 1990 and again on July 17, 1990. Information regarding this issue has been discussed with representatives of NRC in a meeting on July 11, 1990. The NRC subsequently recommended that Westinghouse suggest interim actions that could be taken to ensure that affected plants remain in compliance with the requirements of 10CFR50.46 while Westinghouse is examining the issue.

The attached information is being provided at this time to enable a demonstration, with reasonable assurance, that operation is in compliance with the acceptance criteria of 10CFR50.46 until the issue is resolved. This may be accomplished by showing either that there is sufficient ECCS analysis margin to the acceptance limits to accommodate the effect of a limiting skewed power distribution, were it to occur, or that current operating conditions (such as fuel cycle burnup) preclude such power distributions. Operation may

be demonstrated to be in compliance with the 10CFR50.46 acceptance criteria by including a large break LOCA power distribution uncertainty factor, L(z), during the normal full core flux map surveillance.

Westinghouse has been able to determine that inclusion of the large break LOCA power distribution uncertainty surveillance factor would not be expected to result in violation of the limits for most plants. Since Westinghouse is not responsible for the core design, we are not able to make that determination for your plant. Since these actions are taken as temporary measures and not permanent changes to the Westinghouse ECCS Evaluation Model results, it is Westinghouse judgement that a report under the requirements of 10CFR50.46(3)(ii) is not necessary at this time.

As Westinghouse continues efforts to resolve the issue by September 1990, further information and details of the resolution will be provided.

We recognize that you will need to be fully informed on the issues as we move toward resolution. Since this is one of a few LOCA-related issues which have arisen with respect to the ECCS Evaluation Models recently, we would therefore like to invite you to a one day meeting in Pittsburgh to update you on these issues and answer any questions you might have. At this meeting, we would also propose to describe to you the process we use to identify and resolve these issues and in turn hear from you so that we can better understand how you must deal with this information.

If you should have any questions or require further information, please feel free to contact me.

Very truly yours,

TF Woodhouse

G. P. Toth, Manager
Commonwealth Edison Projects
Customer Projects Department

Attachment
HT/6504G

cc: J. C. Blomgren
D. Elias
W. F. Naughton
E. J. Fuerst
T. P. Joyce
J. P. Leider
F. G. Lentine
K. A. Ainger
M. Pietraszewski
J. A. Johnson W
G. P. Wagner

WESTINGHOUSE ECCS EVALUATION MODEL
POWER DISTRIBUTION ASSUMPTION ISSUE

BACKGROUND

Westinghouse is currently evaluating an issue which has been identified regarding the power distribution assumed in the emergency core cooling system (ECCS) Evaluation Model analyses performed to demonstrate compliance with the requirements of 10CFR50.46. An evaluation of this potential deviation is being performed to determine whether a change to the Westinghouse ECCS Evaluation Model is required.

Information regarding this issue was discussed with the Westinghouse Owners Group Analysis Subcommittee on April 17, 1990 and again on July 17, 1990. Information regarding this issue was also discussed with the NRC staff in a meeting on July 11, 1990. Subsequent to the meeting, the NRC recommended that Westinghouse suggest interim actions which would ensure compliance with the requirements of 10CFR50.46 for the potentially affected plants during the period in which Westinghouse is completing the process for resolution of the issue.

Westinghouse is providing information at this time to enable a demonstration, with reasonable assurance, that plant operation is in compliance with the acceptance criteria of 10CFR50.46 until the issue is resolved. This may be accomplished by showing either that there is sufficient ECCS analysis margin to the acceptance limits to accommodate the effect of a limiting skewed power distribution, were it to occur, or that current operating conditions (such as fuel cycle burnup) preclude such power distributions. Operating conditions may be demonstrated to be in compliance by including a large break LOCA power distribution uncertainty factor, L(z), during the normal full core flux map surveillance.

Westinghouse plans to continue evaluations and efforts to resolve the issue by September 1990. Further information and details of the resolution will be provided at that time.

REGULATORY REQUIREMENT AND TECHNICAL DESCRIPTION

Appendix K to 10CFR50 requires that the effects of a range of power distribution shapes and peaking factors representing power distributions that may occur over the core lifetime be considered. The power distribution used in the ECCS analysis should be the power distribution which results in the most severe calculated consequences, for the spectrum of postulated breaks and single failures analyzed. In the Westinghouse ECCS Evaluation Model calculations, a chopped cosine power distribution was assumed. Historically, Westinghouse demonstrated that the chopped cosine power shape results in the most severe calculated consequences. This information was reviewed and approved by the NRC.

Subsequent sensitivity studies performed with the newer generation of computer codes continued to validate the earlier result. However, recent efforts to determine the most limiting power distribution for plants with relatively low technical specification peaking factors resulted in new information regarding the effect of power distributions skewed to the top of the core. Power distributions skewed to the top of the core may provide more limiting calculations of the peak cladding temperature under certain conditions.

To examine and evaluate the effect of the effect of the new information, Westinghouse developed a comprehensive database of more than 40,000 power distributions and performed more than 70 ECCS Evaluation Model analysis calculations for representative 2-loop, 3-loop, and 4-loop plants. Based upon the results of these studies, it was concluded that the peak linear heat rate alone is insufficient to characterize the limiting power distribution in ECCS Evaluation Models which employ mechanistic calculations for the reflood heat transfer coefficient.

Information regarding the issue was presented to the NRC staff in a meeting on July 11, 1990. At the meeting, Westinghouse also discussed the procedure which would be used to review specific core designs in order to confirm that limiting skewed power distributions would be precluded by the technical specifications and by the core design. The information discussed in the meeting with the NRC staff is being documented in Reference 1. Subsequent to the meeting, the NRC recommended that Westinghouse suggest interim actions to the utilities which would provide reasonable assurance of compliance with the requirements of 10CFR50.46 during the period in which Westinghouse is completing the process for resolution of the issue.

In order to demonstrate that plants are currently operating in compliance with the regulations, it is necessary to show either that plants have sufficient ECCS analysis margin to the acceptance limit to accommodate the impact of a limiting skewed power distribution, were it to occur, or that current operating conditions (such as fuel cycle burnup) preclude such power distributions.

It has been determined that, if limiting skewed power distributions were to occur, they would occur between about 6.5 to 10 feet in plants which have core lengths of 12 feet. The absence of these skewed power distributions can be verified by applying a surveillance factor to the normal full core flux map surveillance, as described below.

For plants with normal flux mapping FQ surveillance, the measured peaking factor, $FQ_m(z)$, is increased by the appropriate uncertainty factors, to account for manufacturing tolerances and measurement uncertainties. The resulting product is then compared to the power distribution technical specification limit, FQT*K(z), to verify plant operation is in compliance with the requirements as follows;

$$FQ_m(z) * P * W(z) \leq FQT * K(z)$$

The large break LOCA power distribution uncertainty factor may be defined as a function of core elevation as follows;

Core Elevation	L(z)	
0.0 - 6.0 ft	1.000	Bottom of core to midplane
6.0 - 7.0 ft	Linear increase from 1.000 to 1.051	
7.0 - 9.5 ft	1.051	
9.5 - 10.0 ft	Linear decrease from 1.051 to 1.000	
10.0 - 12.0 ft	1.000	

By including a large break LOCA power distribution uncertainty factor, L(z), as follows, compliance with the requirements of 10CFR50.46 can be reasonably assured while Westinghouse completes resolution of the issue.

$$FQ_m(z) * P * W(z) * L(z) \leq FQT * K(z)$$

For plants with flux mapping Fxy surveillance, the measured peaking factor is compared to the Fxy limit in the core peaking factor limit report. By temporarily including a large break LOCA power distribution uncertainty factor to increase the measured Fxy values for comparison to the Fxy limit, compliance with the requirements of 10CFR50.46 can be reasonably assured while Westinghouse completes resolution of the issue.

At worst, limiting skewed power distributions could result in an increase calculated PCT by 100°F. Westinghouse has examined the results of the ECCS analyses which form part of the plant licensing basis as documented in the FSAR and the results of safety evaluations which Westinghouse has performed to determine that the ECCS analysis does not contain more than 100°F PCT margin to the regulatory limit to accommodate the effect of limiting skewed power distributions, if they were to occur. Therefore, application of the large break LOCA power distribution uncertainty surveillance factor is necessary to assure that compliance with the requirements of 10CFR50.46 is maintained during the interim period while Westinghouse continues to evaluate this issue.

Westinghouse has determined that inclusion of the large break LOCA power distribution uncertainty surveillance factor would not be expected to result in violation of the limits for most plants. Since Westinghouse is not responsible for the core design, however, a similar determination cannot be made by Westinghouse.

It is anticipated that final resolution of this issue will confirm that limiting power distributions skewed to the top of the core are precluded from occurring with current technical specification and core design limits. Once Westinghouse has presented these results to the NRC and the NRC has concurred with our findings, these temporary constraints may be removed. It is expected that Westinghouse will conclude evaluation of the issue no later than September 1990.

CONCLUSIONS

In summary, Westinghouse is examining the power distribution used in the ECCS Evaluation Model to determine if the ECCS Evaluation Model complies with the requirements of Appendix K to 10CFR50. Temporary application of an additional uncertainty factor to the measured peaking factor as described above will provide reasonable assurance that operation is in compliance with the requirements of 10CFR50.46 during the interim period in which Westinghouse is completing its evaluation of the issue.

As Westinghouse concludes its evaluation efforts, expected in September 1990, additional information regarding the resolution of the issue will be provided.

REFERENCES

1. "Effects of Power Distributions Skewed Toward the Top of the Core in the Westinghouse ECCS Evaluation Model; Information Presented to the Nuclear Regulatory Commission Staff in a Meeting on July 11, 1990," WCAP-12682 (Proprietary), July 1990.

Westinghouse Electric Corporation Energy Systems

Box 355
Pittsburgh Pennsylvania 15230-0355

August 8, 1990
CAE-90-236
CCE-90-249

Mr. D. Elias
PWR Projects Manager
Commonwealth Edison Company
1400 Opus Place, Suite 300
Downers Grove, IL 60515

Dear Mr. Elias:

Commonwealth Edison Company
Byron Units 1 & 2 and Braidwood Units 1 & 2
Westinghouse ECCS Evaluation Model
Power Distribution Assumption Issue

Westinghouse is currently evaluating an issue regarding the power distribution assumed in the emergency core cooling system (ECCS) Evaluation Model analyses performed to demonstrate compliance with the requirements of 10CFR50.46. An evaluation of this potential deviation is being performed to determine whether a change to the Westinghouse ECCS Evaluation Model is required. Westinghouse records indicate that information found in the FSAR for your plant is based upon calculations performed using the Westinghouse large break LOCA ECCS Evaluation Model methodology, and therefore the information in the FSAR could be affected by the resolution of the Westinghouse evaluation. Information regarding this issue was discussed with the Westinghouse Owners Group Analysis Subcommittee on April 17, 1990 and again on July 17, 1990 and has been discussed with representatives of NRC in a meeting on July 11, 1990. The NRC subsequently recommended that Westinghouse suggest interim actions that could be taken to provide assurance that your plant and others remain in compliance with the requirements of 10CFR50.46 while Westinghouse is examining the issue.

The attached information is being provided at this time to enable a demonstration, with reasonable assurance, that operation of your plant is in compliance with the acceptance criteria of 10CFR50.46 until the issue is resolved. This may be accomplished by showing either that there is sufficient ECCS analysis margin to the acceptance limits to accommodate the effect of a limiting skewed power distribution, were it to occur, or that current operating conditions (such as fuel cycle burnup) preclude such power distributions. Operating conditions may be demonstrated to be in compliance by including a large break LOCA power distribution uncertainty factor, $L(z)$, during the normal full core flux map surveillance.

Information available to Westinghouse indicates that margin in the ECCS analysis is available to accommodate the maximum expected PCT penalty associated with this issue for your plant. Since these actions are taken as temporary measures and not permanent changes to the Westinghouse ECCS Evaluation Model results, it is Westinghouse judgement that a report under the requirements of 10CFR50.46(3)(ii) is not necessary at this time. As Westinghouse continues efforts to resolve the issue by September 1990, further information and details of the resolution will be provided.

We realize that this information could ultimately result in additional and unexpected constraints in plant operations, and that you will need to be fully informed on the issues as we move toward resolution. Since this is one of several LOCA related issues which have arisen with respect to the ECCS Evaluation Models recently, we would therefore like to invite you to a one day meeting in Pittsburgh on August 16, 1990, to update you on these issues and answer any questions you might have. At this meeting, we would also propose to describe to you the process we use to identify and resolve these issues and in turn hear from you so that we can better understand how you must deal with this information.

If you should have any questions or require further information, please feel free to contact me.

Very truly yours,

TF Woodhouse for

G. P. Toth, Manager
Commonwealth Edison Projects
Customer Projects Department

Attachment
HT/6501G

cc: J. C. Blomgren
D. Elias
W. J. Feimster W
J. P. Leider
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K. L. Kofron
F. G. Lentine
P. M. McHale W
M. Pietraszewski
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G. P. Wagner
D. B. Wozniak

WESTINGHOUSE ECCS EVALUATION MODEL
POWER DISTRIBUTION ASSUMPTION ISSUE

BACKGROUND

Westinghouse is currently evaluating an issue regarding the power distribution assumed in the emergency core cooling system (ECCS) Evaluation Model analyses performed to demonstrate compliance with the requirements of 10CFR50.46. An evaluation of this potential deviation is being performed to determine whether a change to the Westinghouse ECCS Evaluation Model is required.

Information regarding this issue was discussed with the Westinghouse Owners Group Analysis Subcommittee on April 17, 1990 and again on July 17, 1990. Information regarding this issue was also discussed with the NRC staff in a meeting on July 11, 1990. Subsequent to the meeting, the NRC recommended that Westinghouse suggest interim actions which would assure compliance with the requirements of 10CFR50.46 during the period in which Westinghouse is completing the process for resolution of the issue.

Westinghouse is providing information at this time to enable utilities to demonstrate, with reasonable assurance, that plant operation is in compliance with the acceptance criteria of 10CFR50.46 until the issue is resolved. This may be accomplished by showing either that there is sufficient ECCS analysis margin to the acceptance limits to accommodate the effect of a limiting skewed power distribution, were it to occur, or that current operating conditions (such as fuel cycle burnup) preclude such power distributions. Current operating conditions may be demonstrated to be in compliance by including a large break LOCA power distribution uncertainty factor, L(z), during the normal full core flux map surveillance.

Westinghouse plans to continue evaluations and efforts to resolve the issue by September 1990. Further information and details of the resolution will be provided at that time.

REGULATORY REQUIREMENT AND TECHNICAL DESCRIPTION

Appendix K to 10CFR50 requires that the effects of a range of power distribution shapes and peaking factors representing power distributions that may occur over the core lifetime be considered. The power distribution used in the ECCS analysis should be the power distribution which results in the most severe calculated consequences, for the spectrum of postulated breaks and single failures analyzed. In most Westinghouse ECCS Evaluation Model calculations, a chopped cosine power distribution was assumed. Historically, Westinghouse demonstrated that the chopped cosine power distribution results in the most severe calculated peak cladding temperature. This information was reviewed and approved by the NRC.

Subsequent sensitivity studies performed with the newer generation of computer codes continued to validate the earlier result. However, recent efforts to determine the most limiting power distribution for plants with relatively low

technical specification peaking factors resulted in new information regarding the effect of power distributions skewed to the top of the core. Power distributions skewed to the top of the core may provide more limiting calculations of the peak cladding temperature (PCT) under certain conditions.

To examine and evaluate the effect of the new information, Westinghouse utilized a comprehensive database of more than 40,000 power distributions and performed more than 70 ECCS Evaluation Model analysis calculations for representative 2-loop, 3-loop, and 4-loop plants. Based upon the results of these studies, it was concluded that the peak linear heat rate alone is insufficient to characterize the limiting power distribution in ECCS Evaluation Models which employ mechanistic calculations for the reflood heat transfer coefficient.

Information regarding the issue was presented to the NRC staff in a meeting on July 11, 1990. At the meeting, Westinghouse also discussed the procedure which would be used to review specific core designs in order to confirm that limiting skewed power distributions would be precluded by the technical specifications and by the core design. The information discussed in the meeting with the NRC staff is being documented in Reference 1. Subsequent to the meeting, the NRC recommended that Westinghouse suggest interim actions to the utilities which would provide reasonable assurance of compliance with the requirements of 10CFR50.46 during the period in which Westinghouse is completing the process for resolution of the issue.

In order to demonstrate that plants are currently operating in compliance with the regulations, it is necessary to show either that plants have sufficient ECCS analysis margin to the acceptance limit to accommodate the impact of a limiting skewed power distribution, were it to occur, or that current operating conditions (such as fuel cycle burnup) preclude such power distributions.

It has been determined that, if limiting skewed power distributions were to occur, they would occur between about 6.5 to 10 feet in plants which have core lengths of 12 feet. The absence of these skewed power distributions can be verified by applying a surveillance factor to the normal full core flux map surveillance, as described below.

For plants with normal flux mapping FQ surveillance, the measured peaking factor, $FQ_m(z)$, is increased by the appropriate uncertainty factors, to account for manufacturing tolerances and measurement uncertainties. The resulting product is then compared to the power distribution technical specification limit, FQT*K(z), to verify plant operation is in compliance with the requirements as follows;

$$FQ_m(z) * P * W(z) \leq FQT * K(z)$$

The large break LOCA power distribution uncertainty factor may be defined as a function of core elevation as follows:

Core Elevatio	L(z)	
0.0 - 6.0 ft	1.000	Bottom of core to midplane
6.0 - 7.0 ft	Linear increase from 1.000 to 1.051	
7.0 - 9.5 ft	1.051	
9.5 - 10.0 ft	Linear decrease from 1.051 to 1.000	
10.0 - 12.0 ft	1.000	

By including a large break LOCA power distribution uncertainty factor L(z), as shown below, compliance with the requirements of 10CFR50.46 can be reasonably assured while Westinghouse completes resolution of the issue.

$$FQ_m(z) * P * W(z) * L(z) \leq FQT * K(z)$$

For plants with flux mapping Fxy surveillance, the measured peaking factor is compared to the Fxy limit in the core peaking factor limit report. By temporarily including a large break LOCA power distribution uncertainty factor to increase the measured Fxy values for comparison to the Fxy limit, compliance with the requirements of 10CFR50.46 can be reasonably assured while Westinghouse completes resolution of the issue.

Westinghouse has examined the results of the ECCS analyses which form part of the plant licensing basis as documented in the FSAR and the results of safety evaluations which Westinghouse has performed, and has determined that the ECCS analysis contains more than 100°F PCT margin to the regulatory limit, which is sufficient to accommodate the effect of limiting skewed power distributions, if they were to occur. At worst, limiting skewed power distributions could increase calculated PCT by 100°F. Therefore, application of the large break LOCA power distribution uncertainty is not necessary to assure that compliance with the requirements of 10CFR50.46 is maintained during the interim period while Westinghouse continues to evaluate this issue. Instead a temporary reduction in the PCT margin to the 2200°F limit of 100°F can be applied.

It is anticipated that final resolution of this issue will confirm that limiting power distributions skewed to the top of the core are precluded from occurring with current technical specification and core design limits. Once Westinghouse has presented these results to the NRC and the NRC has concurred with our findings, these temporary constraints may be removed. It is expected that Westinghouse will conclude evaluation of the issue no later than September 1990.

CONCLUSIONS

In summary, Westinghouse is examining the power distribution used in the ECCS Evaluation Model to determine if the ECCS Evaluation Model complies with the requirements of Appendix K to 10CFR50. Temporary application of an additional uncertainty factor to the measured peaking factor as described above would provide reasonable assurance that operation is in compliance with the requirements of 10CFR50.46 during the interim period in which Westinghouse is completing its evaluation of the issue. However, the information available to

Westinghouse also indicates that the margin available in the ECCS analysis is sufficient to accommodate the effect of limiting skewed power distributions, if they were to occur. Westinghouse will assume that margin in the ECCS analysis should be allocated in the interim period unless informed otherwise. As Westinghouse concludes its evaluation efforts, which are expected in September 1990, additional information regarding the resolution of the issue will be provided.

REFERENCES

1. "Fffects of Power Distributions Skewed Toward the Top of the Core in the We tinghouse ECCS Evaluation Model; Information Presentec to the Nuclear Re ulatory Commission Staff in a Meeting on July 11, 1990," WCAP-12682 (Proprietary), July 1990.