OG-01-042
July 9, 2001

WCAP-15604-NP, Rev. 0
Project Number 694

Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Attention: Chief, Information Management Branch,
Division of Inspection and Support Programs

Subject: Westinghouse Owners Group
Response to NRC Request for Additional Information on WCAP-15604-NP, "Limited Scope High Burnup Lead Test Assemblies," (MUHP-1046)

Reference: 1) WOG Letter, OG-00-116, R.H. Bryan to Document Control Desk, "Transmittal of WCAP-15604-NP, Rev. 0, (Non Proprietary), 'Limited Scope High Burnup Lead Test Assemblies'," November 15, 2000.

2) NRC Letter, L.R. Wharton to R.H. Bryan, "Acceptance Review of Westinghouse Topical Report, WCAP-15604-NP, Rev 0. 'Limited Scope High Burnup Lead Test Assemblies' (TAC No. MB0591)," January 25, 2001.

In November 2000 the Westinghouse Owners Group (WOG) submitted Westinghouse topical report WCAP-15604-NP, Rev. 0, "Limited Scope High Burnup Lead Test Assemblies" for NRC review (Reference 1). The NRC Staff has initiated review of the topical report and issued a Request for Additional Information (RAI) (Reference 2). Attachment 1 provides the WOG response to the RAIs. Pending final resolution of these RAIs, the WOG will revise WCAP-15604-NP as necessary.

If you require further information, feel free to contact Mr. Ken Vavrek in the Westinghouse Owners Group Project Office at 412-374-4302.

Very truly yours,

Robert H Bryan

Robert H. Bryan, Chairman
Westinghouse Owners Group

attachment

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*For Distribution to Owners Group Members

Westinghouse Owners Group
Responses to NRC Request For Additional Information on WCAP-15604-NP,
"Limited Scope High Burnup Lead Test Assemblies"

General Comments:

1. Maximum number of lead test assemblies (LTAs) allowed: The numbers proposed are too large and justification for the numbers proposed is not provided. For PWRs, eight might be a reasonable number provided adequate justification is provided. For BWRs, similar justification and maximum number needs to be provided. The subject of additional LTAs (traditional LTAs or LTAs for another purpose) in the core should also be addressed.

   Response:

   For the Limited Scope LTAs, it is desirable to have assemblies with a spread of burnups ranging from the current licensed limits up to the proposed maximum limit. Typical fuel management schemes would have eight assemblies designed to reach a burnup of between 62 – 68 GWD/MTU lead rod average burnups. An additional four assemblies would be designed to reach between 68 – 72 GWD/MTU with only one remaining assembly designed to reach 75 GWD/MTU. (The word "designed" in this case refers to the fuel management considerations and the loading pattern development, not a difference in the mechanical design of the fuel assemblies.) This provides the desired spread in burnup data that will be needed to justify high burnup fuel behavior when the new high burnup limits are established and each vendor will then have to substantiate their fuel performance behavior.

   Since most plants do not currently have fuel management schemes that would be conducive to reaching the mid- to upper end of the high burnup spectrum, and with a reduced number of Limited Scope LTAs permitted to exceed the current licensed limit, it would take substantially longer (on the order of four to six additional years considering eighteen month cycles) to establish a statistically significant database over the entire burnup regime of fuel performance data to justify high burnup limits. However, since the staff considers the currently proposed number of Limited Scope LTAs to be too high, then an alternate proposal would be to allow a maximum of 9 assemblies to be classified as Limited Scope High Burnup assemblies in PWRs and 32 assemblies to be classified as Limited Scope High Burnup assemblies in BWRs.

   Setting the Limited Scope High Burnup LTAs at the reduced levels above is still beneficial and justifiable for the following reasons:

   - Makes the core design economical enough to offset increased analysis and surveillance costs,
   - Allows for a variety of loading patterns and power histories in order to observe effects that might not be observable with even fewer LTAs,
   - Allows for symmetric locations in the core to be driven to higher burnups and allows for a center assembly to be accommodated,
   - Restricts the total number of assemblies exceeding the lead rod average licensed burnup limit to a value < 10% of the core, which is consistent with many core damage frequency scenarios (e.g., for PWR cores with 121, 157, 177, 193, 204, 217, 241 fuel assemblies, 9 assemblies would be 7.4%, 5.7%, 5.1%, 4.7%, 4.4%; 4.1% and 3.7% respectively; for BWR cores with 560, 724, 764 fuel assemblies, 32 assemblies would be 5.7%, 4.4 % and 4.2% respectively).

   Although 10% is within many core damage frequency scenarios, this topical was prepared for operation of fuel assemblies utilizing approved designs and materials. The only characteristic of these assemblies which is not part of typical operation is the extension of the rod average burnup to values greater than are currently licensed. However, some data already exists for these designs and materials at exposures above the current licensed limits. Based on this performance data, no anticipated shift in performance is expected relative to fuel that is maintained below the current licensed burnup limits. Therefore, there is no significant risk in terms of either fuel integrity or potential core damage in operating this number of assemblies to a slightly higher burnup.

With a maximum of 9 assemblies allowed for PWRs, initially eight assemblies would be able to reach burnups of between 62 – 68 GWD/MTU and one assembly may be able to reach 75 GWD/MTU lead rod average burnup as a central assembly that would be surrounded by feed assemblies. As plants' fuel management schemes move toward the high burnup regime, then four of the eight assemblies may be able to reach the 68 – 72 GWD/MTU region. Currently, it would not be economical for most plants to pursue getting all 9 assemblies to the upper end of the high burnup regime simply due to their fuel management schemes. Simply based on fuel management schemes alone, no more than 1– 5 assemblies would likely reach burnups of 68 – 75 GWD/MTU after the fuel management scheme reach a high burnup equilibrium.

The other part of the general comment was related to the subject of traditional LTAs or LTAs for other purposes in the core with Limited Scope High Burnup LTAs. The Limited Scope High Burnup LTAs are still Lead Test Assemblies with a specialized purpose, high burnup data acquisition. Traditional LTAs are often specialized designs with specialized reviews (i.e., exemptions for alternate advanced cladding material) that are carefully factored into the loading pattern, such that they do not lead the core and are not normally in rodded locations. The traditional LTAs or LTAs for other purposes are also designed to gather data from 0 GWD/MTU up to current licensed lead rod average burnup limits. If the staff wants to limit the total number of LTAs in a core at one time, then it needs to be specified by the staff that this is their position. However, it should be noted that these types of limitations will sacrifice data collection from one program for another program. Thus if it is deemed that an LTA for other purposes is needed in place of the Limited Scope High Burnup LTAs then it will take additional years to obtain a statistically significant database. What is considered reasonable is that in cases where traditional LTAs are present the total number of lead assemblies (traditional or limited scope) that will be exposed to burnups above currently licensed levels will not exceed 9 for PWRs and 32 for BWRs.

2. Pre-characterization of the LTAs: If fuel is to be operated above the current licensed limit, it must be characterized before irradiation above that limit. The amount and type of pre-characterization should be described as well as why the proposed amount is adequate.

Response:

Pre-characterization of Limited Scope LTAs will be conducted for all assemblies taken to burnup limits above that which is currently licensed. The typical fuel parameters that would be subject to pre-characterization were discussed in WCAP-15604-NP, Section 2.1. These typical pre-characterization parameters are: fuel rod cladding oxide thickness, fuel assembly and/or fuel rod growth, and guide thimble and/or assembly/channel bow measurements. The purpose of the pre-characterization is to: 1) obtain data that is useful in understanding the fuel performance based on the known fuel duty, and 2) to ensure that fuel design criteria will not be exceeded in the test cycle.

With regards to obtaining data that is useful in understanding the fuel performance, based on known fuel duty, pre-characterization will provide pre-test cycle values for the parameters measured. The Post Irradiation Examinations (PIEs) provide the post-test cycle values. Comparison of pre and post cycle values will yield the incremental effects that the final cycle of exposure has on the Limited Scope High Burnup LTAs. This provides a measure of whether an unknown phenomenon exists and is occurring in the high burnup LTAs. It also provides a very accurate measure of how well the predictive fuel performance models are behaving for this last cycle of exposure. However, the incremental effects are only part of the equation. Integral results (e.g., as-fabricated conditions to end-of-life) are also necessary. The integral results from a traditional LTA provides an overall measure of the fuel performance model accuracy (e.g., it establishes the error bands for the performance model). Integral results from a Limited Scope High Burnup LTA also provides an overall measure of the fuel performance model behavior; however, the accuracy is sacrificed since nominal as-fabricated measurements would be used. This sacrifice in accuracy is outweighed by the amount of data obtained from Limited Scope LTAs. By having a statistically significant database of fuel performance measurements and then using traditional LTA results with incremental pre and post test cycle measurements on Limited Scope High Burnup LTAs, the overall fuel performance model capability is demonstrated and substantiated. It should be noted that in comparing fuel performance model results to the measured results, the models are run in a best estimate mode. For cycle design calculations and licensing purposes, the fuel performance models results would be a bounding value that would be compared to design limits (e.g., uncertainty analysis results would be included with the best estimate results such that the bounding results would be on a 95/95 basis). The design limits that would be used for the Limited Scope LTAs are the current design limits for licensed fuel. As part of other industry programs, the current design limits are being reviewed for high burnup application and will not be discussed herein.

The other purpose of the pre-characterization is to ensure that current design criteria are not violated. Since the fuel performance models are being extrapolated to burnups that have not been licensed, the pre-characterization provides a measure of how much margin exists for a given design criteria to its limit, based on model predictions compared to the pre-characterization measurement. Thus, pre-characterization is necessary and provides valuable information. However, as noted above, extensive amounts of pre-characterization are not necessary since the Limited Scope High Burnup LTAs were conceived to obtain statistical significant amounts of data to demonstrate fuel performance models. Limited pre-characterization measurements and traditional LTAs provide model accuracy.

Since this report was written to address all the fuel vendors, it was accounting for the needs of all the vendors. Several vendors have advanced cladding materials that show significantly less growth characteristics than Zircaloy-2 or Zircaloy–4 alloys. Therefore, based on model predictions, most of the assemblies that would be considered for a Limited Scope LTA program would have more than sufficient growth margin to accommodate an additional cycle of irradiation. Since there would be less growth, there would also be less assembly distortion. Thus, a need to force a pre-characterization of fuel rod/fuel assembly growth, guide thimble and/or assembly/channel bow measurements, would not necessarily be warranted, especially if the structural assembly is also fabricated with advanced materials designed to have substantially less growth than Zircaloy alloys. The one pre-characterization that would be universal to all the vendors would be cladding oxidation.

From a fuel rod design standpoint, the design criteria that are limiting at end-of-life and could be potentially challenged for these Limited Scope High Burnup fuel assemblies are: cladding oxidation, rod internal pressures, fatigue and growth. As noted above, growth may be the least limiting of these criteria, especially if advanced alloys are being used. Fatigue analyses typically show 30 – 50% margin to the cumulative fatigue usage factor of 1.0. Thus, fatigue is not the limiting criterion at these high burnup levels. Rod internal pressures for current generation PWR fuel are typically licensed to exceed system pressure and thus a potential of pellet to clad lift-off exists, albeit small, depending upon the rod internal pressure and the corresponding pressure limit characteristics of the cladding material. Again, this criteria can vary from vendor to vendor, as far as being limiting, depending upon the constituent makeup of the internal gases and cladding material characteristics and the corresponding pressure limit characteristics. The one factor that can lead to significantly increased fuel rod internal pressures is the oxidation on the cladding outer surface. Above certain oxidation levels, the impacts on rod internal pressure and the significant impacts on the cladding pressure limit characteristics would results in the rod internal pressure criterion being exceeded. Thus, by ensuring that the oxidation is kept to a minimum, then the fuel rod internal pressure criterion is less limiting than simply the oxidation criterion by itself. Also, with higher levels of oxidation, spalling of the oxide layer can occur that could lead to hot spots forming on the bare cladding surface. These hot spots would lead to additional oxidation of the bare cladding and a potential through-wall hole could be created due to the metal-wastage effects of the oxidation on the cladding material. In addition to oxidation causing increases to rod internal pressures, crud deposition has a similar effect due to its poor thermal conductivity. Thus ensuring that crud deposition is kept to a minimum, also reduces the impacts on rod internal pressures.

Since each of the vendors have slightly different needs, the one criterion that would be universal to all the vendors would be the cladding oxidation. Based on further telephone discussions with the staff, it is understood that at a minimum, clad oxidation, rod/assembly growth and visual examinations would be considered appropriate as a minimum set of pre-characterization exams. With the consideration that the Limited Scope High Burnup LTAs were conceived to attract plants into pursuing LTA programs and thus generating a substantial database of fuel characteristics behaviors; additional pre-characterization testing without a warranted need would simply add to the plant's outage schedule. This potential impact on a plant's outage schedule, whether real or only perceived, would deter the plants from pursing Limited Scope LTAs and thus would defeat the objective of gathering valuable fuel characteristics data. Therefore, it is agreeable to establish the minimum set of pre-characterization exams for the Limited Scope LTAs that will be done prior to the test cycle as: clad oxidation, rod/assembly growth and visual examinations.

3. Post irradiation examinations of the LTAs: The description of the post-irradiation program should include a minimum set of examinations that will be performed and justification for why this set is adequate, as well as details for deciding which types of LTAs require additional testing. In addition, the type of LTAs and/or examination results that trigger hot-cell examinations should be stated.

Response:

The types of Post Irradiation Examinations (PIEs) that would be performed were described in WCAP-15604-NP, Section 2.2.1. It was noted that "as a minimum, each Limited Scope LTA program will measure at least one of the following parameters: cladding oxidation, fuel assembly/fuel rod growth, or channel bow measurements". Since this report was written to address all the fuel vendors, it was accounting for the needs of all the vendors. As noted in Section 2.2.1, "the particular measured parameters [for PIEs] will vary based on the data needs of the particular vendors and the amount of data accumulated from previous LTA programs". The rationale for this statement and why it was inappropriate to specify more PIEs in the minimum set is based on the following.

Each one of the PWR vendors need to carefully measure and monitor corrosion effects in the high burnup regime; however, for BWRs, channel bow would tend to be more limiting than corrosion. To specify more than just a single parameter is now getting into the specific needs of each of the vendors with regards to the amount of data that would be needed to substantiate individual fuel performance criteria. One vendor may need a substantial amount of growth data to demonstrate both fuel performance behavior and to demonstrate that their current growth model is excessively conservative. Another vendor may need a substantial amount of data with regards to assembly grid growth relative to the fuel rod as it would be associated with fuel rod vibration. Another vendor may be developing a new advanced cladding alloy and will need substantial amounts of data in all areas to demonstrate the performance capability of the alloy. However, it was perceived that to specify more than what was stated in the topical report in Section 2.2.1 would be unduly placing additional burden on the various vendors who already have a substantial amount of data in certain areas. Thus it came down to the fuel assembly/fuel rod designs of each vendor and the amount of data that they already had to substantiate various fuel performance models versus what they needed. In addition, it was noted that certain vendors may need unique data that the others would not.

However, based on further telephone discussions with the staff, it is understood that at a minimum, clad oxidation, rod/assembly growth and visual examinations would be considered appropriate as a minimum set of PIEs. Since PIEs need to be carefully planned and scheduled with the respective plants, and since the plant supplies personnel in an auxiliary role, it is desirable to obtain all the necessary data in one PIE rather then several separate PIEs. Therefore, even though a minimum set of PIEs is defined and agreed to above, numerous other inspections and measurements will most likely be done during the PIE since repeated PIEs are costly, inefficient and an ALARA concern.

The second part of the question asks which LTAs require additional testing and what inspections results would trigger possible hot cell examinations. As noted above, any LTA that is introducing a new design feature would most likely require a complete set of PIEs that are applicable to the specific feature. For example, a new cladding material would need corrosion measurements, profilometry, growth measurements, and rod-to-rod spacing measurements. A new guide thimble material would need OD/ID corrosion measurements, guide thimble distortion measurements, and assembly bow measurements. A new grid design would need corrosion measurements, grid cell sizing measurements, and grid width measurements. As far as hot cell examinations, a change in the fuel pellet (e.g., density, diameter, or burnable absorber) would normally require a hot cell examination. Other instances that would normally trigger a possible hot cell examination would be anomalous profilometry measurements than what were expected; anomalous fuel rod growth measurements, etc. As noted in Section 2.2 of the topical report, the hot cell examinations are done when deemed appropriate by the vendor/utility. Unless there is a specific need for a hot cell examination, such as in the case of obtaining fuel pellet information, hot cell examinations are not normally planned in advance. Most hot cell examinations are planned after the pool side PIEs are completed and a determination is made that an anomalous condition exists that warrants further investigation.

4. Reporting: The intent to irradiate LTAs and the results of post irradiation examinations (PIEs) need to be reported to the NRC. A reporting template would serve as a model for each of these reports. The schedule for these reports should be specified. The specific purpose for the LTAs should be part of the initial report.

Response:

The intent to irradiate an LTA to higher burnups or for other purposes is currently reported to the NRC staff by the fuel vendors. This has been done during fuel performance update meetings with the staff by fuel vendors and by teleconferences with the staff by fuel vendors. It is also highly suggested, by the vendors, that the utility notify their respective resident inspector and PM of any LTA programs. In this fashion, the NRC is informed of LTA programs from both directions.

For the Limited Scope High Burnup LTAs, if it is desired that a formal written notification be made to the staff (for information purposes), then the following information is suggested to be included in such notification:

- Utility Name,
- Plant Name,
- Cycle in which the Limited Scope High Burnup LTAs will be inserted,
- Anticipated number of LTAs intended to be inserted,
- Anticipated pre and post cycle burnups of each LTA,
- What planned PIEs are anticipated which would specify the purpose of the Limited Scope High Burnup LTAs, and
- An estimate of when the PIE will occur along with an estimate of when the PIE data will be available to share with the staff.

This letter would be for information only since it would be done early in the process (e.g., 9-12 months prior to the cycle) before all analyses were necessarily completed.

As for the PIEs, they are normally done after the test cycle has been completed and the subsequent cycle has started up and is off critical path with regards to the outage. This is scheduled between the vendor and the utility. Thus it would be difficult to specify a definitive schedule at this time. An anticipated date for the PIE would be provided in the initial notification letter to the staff. As for the

PIE report itself, each vendor would have their own forms and the content of the report would vary based on the PIEs that are anticipated. However, as a minimum, the field report should specify:

- Utility Name,
- Plant Name,
- Fuel Assembly Identification Number,
- Specific Measurements,
- Environmental Conditions,
- Test Equipment used including accuracy,
- Calibration dates of test equipment used, and
- A comment section.

A formal PIE report would be compiled from the field report with essentially the same information along with an engineering assessment of the data.

5. Safety Assessment: Analytical models used to evaluate the LTAs will likely need to be used beyond the currently approved limits for the models. Justification for use of these models beyond approved limits needs to be provided.

Response:

As part of the process in assessing Limited Scope High Burnup LTAs, detailed evaluations will be conducted to determine their acceptability. The results of these evaluations are normally documented in an LTA report that serves as the technical basis for a 10 CFR 50.59 evaluation. As noted previously, from a fuel rod design standpoint, the design criteria that are limiting at end-of-life and could be potentially challenged for these Limited Scope High Burnup fuel assemblies are: cladding oxidation, rod internal pressures, fatigue and growth. As noted previously, growth may be the least limiting of these criteria, especially if advanced alloys are being used. Fatigue analyses typically show 30 – 50% margin to the cumulative fatigue usage factor of 1.0. Thus, fatigue is not the limiting criterion at these high burnup levels. Rod internal pressures for current generation PWR fuel are typically licensed to exceed system pressure and thus a potential of pellet to clad lift-off exists, albeit small, depending upon the rod internal pressure and the corresponding pressure limit characteristics of the cladding material. Again, this criteria can vary from vendor to vendor, as far as being limiting, depending upon the constituent makeup of the internal gases and cladding material characteristics and the corresponding pressure limit characteristics. The one factor that can lead to significantly increased fuel rod internal pressures is the oxidation on the cladding outer surface. Above certain oxidation levels, the impacts on rod internal pressure and the significant impacts on the cladding pressure limit characteristics would results in the rod internal pressure criterion being exceeded. Thus, by ensuring that the oxidation is kept to a minimum, then the fuel rod internal pressure criterion is less limiting than simply the oxidation criterion by itself. Also, with higher levels of oxidation, spalling of the oxide layer can occur that could lead to hot spots forming on the bare cladding surface. These hot spots would lead to additional oxidation of the bare cladding and a potential through-wall hole could be created due to the metal-wastage effects of the oxidation on the cladding material. Therefore, the one fuel rod design criterion that stands out as potentially the most limiting is corrosion.

As noted before, the use of developmental models that accurately model the specific fuel performance parameter based on data obtained to date is done so in a best estimate fashion. If the developmental model is predicting previous data accurately and then uncertainties are added to the results, the model will be bounding for the reload analysis. These bounding results would be compared to current design limits since revised limits have not yet been defined. This method is an incremental approach that is based on real data and is less of an extrapolation then using the current licensed models with their uncertainties. The developmental models typically yield more bounding results than the current licensed models.

As for the other functional areas, nuclear, thermal-hydraulic, transient analyses and LOCA analyses are typically beginning-of-life limiting. The one exception to this would be the LOCA total localized oxidation limit of 17% which is end-of-life limiting. As noted above, the fuel rod criterion that tends to be the most limiting is corrosion or oxidation. By using a developmental model that was originally based on a licensed model, but has been modified to accurately model high burnup data, then the bounding results from that added into the LOCA analysis will yield a bounding evaluation of the 17% limit.

By taking currently licensed models and creating developmental models and factoring in the data of PIEs as it become available, ensures that the models are accurately modeling the fuel performance behavior. Adding uncertainties to these best estimate results and using this as a comparison tool in making final decisions on whether the LTAs are acceptable is less of an extrapolation then simply using the licensed models, especially when the developmental models may be more conservative.

Specific Comments:

1. 2nd bullet of Executive Summary: "data from post irradiation examinations (PIEs)..." This statement needs to state that data will be reported to the NRC.

   Response:
   This statement will be revised to state that the data will be reported to the NRC for informational purposes. It should be noted that this data will be marked as proprietary by the vendors. It will also be supplied as informational in nature. When each vendor applies for their increased burnup limits, this will be the data that will be submitted to justify design criteria and limits.

2. 3rd bullet of Executive Summary: First sentence needs to be modified to state that fuel will be characterized before operation above the current licensed rod average burnup.

   Response:
   The third bullet will be modified to read as follows:

   "The fuel will be typical production fuel with pre-characterization before operation above the current licensed lead rod average burnup limit. The fuel may also be an LTA, which was characterized during fabrication and was designed to test other aspects of the fuel assembly but was not initially identified as a high burnup LTA."

3. 4th bullet of Executive Summary: The maximum number of allowed LTAs stated is too large.

   Response:
   Will be revised to reflect the maximum number as specified in response to General Comment #1.

4. Page 3, 2nd paragraph: Pre-characterization oxide thickness should be limited. No pre-irradiation spallation or blistering should be allowed.

   Response:
   As stated in this paragraph, "... it is not anticipated that any fuel rods would fail in these assemblies due to the fact that they must meet current design criteria even at the higher burnup level, ...". Each vendor has their own design criteria so it would be difficult to specify a single value here. In the past, the staff has recommended that oxidation should be maintained less than 100 microns on a best estimate basis and that spallation and blistering should be avoided. This recommendation can be adopted for the Limited Scope High Burnup LTAs as the criterion to meet pending the eventual revised design criteria that are being established by the Robust Fuel Program Working Group.

5. Page 4, 4th paragraph: More explanation is required for removal of any conservatism, as well as why additional uncertainty is not needed if additional uncertainty is not incorporated.

Response:

As noted in response to General Comment #5, the use of developmental models that accurately model the specific fuel performance parameter based on data obtained to date is done so in a best estimate fashion. If the developmental model is predicting previous data accurately and then uncertainties are added to the results, the model will be bounding for the reload analysis. These bounding results would be compared to current design limits since revised limits have not yet been defined. This method is an incremental approach that is based on real data and is less of an extrapolation then using the current licensed models with their uncertainties. The developmental models typically yield more bounding results than the current licensed models.

However, the situation may exist where a current licensed model is know to be conservative to reality and it is desired that the model be revised to remove some of the excess conservatism. Beginning with the current licensed model and demonstrating that on a best estimate basis, it is conservative to measured data, then creating a developmental model that more accurately reflects measured data is appropriate. The developmental model would still have uncertainties added to it for a formal verification analysis approach. As additional data is obtained, it would be validated against the best estimate calculations using the developmental model. The other aspect of comparing the developmental model with measured data is to determine if the current uncertainties are appropriate or whether the uncertainties would need revised. Again, this would be an incremental controlled process. In this fashion, the NRC would be aware of how the model is performing relative to the data, such that when sufficient data is obtained and a formal model revision is submitted to the staff for review and approval, the staff will be familiar with the model and the associated data. This approach will save the staff significant resource effort in the long run and will promote increased confidence that the models meet the specified design criteria.

6. Page 5: See general comments on pre-characterization.

Response:

Refer to response to General Comment #2.

7. Page 6: See general comments on PIE.

Response:

Refer to response to General Comment #3.

8. Page 8, 3rd paragraph: See comment above on removing conservatism.

Response:

Refer to response to Specific Comment #5.

9. Page 9: Some parameter limits, like oxide thickness, will apply to all fuel. These should be stated, as well as why others do not apply to all fuel.

Response:

Section 3.0 of WCAP-15604-NP was provided to illustrate what would need to be done on a reload basis to demonstrate how the LTAs would be assessed and documented in an LTA report. LTA reports are prepared by the vendors and provided to the utility as the technical basis for a 10 CFR 50.59 evaluation. Section 3.0 <u>was not</u> provided to be all encompassing since each vendor has different reload methods and different design criteria. It would not be feasible to get into that level of detail in this document since much of the vendors' methodology and specifics of their design criteria are proprietary.

Section 3.0 was provided as a sample. It also included an acknowledgment that each vendor would do their appropriate assessments and document it in an LTA report of some type to be provided to the utility in support of 10 CFR 50.59 evaluations.

10. Pages 11 and 12, Sections 3.5.3 and 4.1: These sections need to be expanded and updated to include recent work and discussions on burnup extension.

Response:

Again, Section 3.5.3 and 4.1 were provided to illustrate what would be needed from a general sense. These sections do not necessarily document the most recent data or positions since much of that would be considered proprietary by each vendor. Again, each vendor would document their specific assessments for these areas and document such assessments in an LTA report.