Westinghouse Comments on Optimized ZIRLO™ SE

TABLE 1: LICENSING AND FUTURE COMPLIANCE ISSUES

Number	Sections	Westinghouse Comment	Staff's Response	Disposition
L1	1.0	The "conditional approval" remark has no regulatory significance.	In the Conclusion section, the staff states: "The staff has approved Optimized ZIRLO™ fuel cladding based upon (1) similarities with Standard ZIRLO™, (2) demonstrated material performance in Addendum 1 and in response to RAIs, and (3) a commitment to provide irradiated data and validate fuel performance models ahead of burnups achieved in batch applications." Similar to L6 and L11, the approval is conditional because of outstanding commitments.	Leave as is.

Number	Sections	Westinghouse Comment	Staff's Response	Disposition
L2	3.1 3.2 3.2.7 3.2.8 3.2.10 3.2.14 3.3.1	SPECIFICATION OF MICROSTRUCTURE Final anneal condition does not define Optimized ZIRLO™ and should be deleted from the regulatory definition. We have provided data and have experience with various final anneals and reduction schemes. Westinghouse wants to add: "Westinghouse will meet regulatory requirements on microstructure by ensuring the final material properties are consistent with their licensed model assumptions". - W wants the staff to delete specific reference to the clad material microstructure.	In the future, a material specification based upon performance-based criteria will be developed. Today, the NRC staff has chosen to define the material based on chemistry and microstructure along with broad statements that the material performance presented in the topical must be maintained. Altering the microstructure has an impact on several material properties including strength and creep. It would be a substantial effort to quantify what is meant by "consistent" material properties since a change in either direction may be detrimental and have synergistic effects. All of the test specimens presented in Addendum 1 were of a single specific microstructure, which means our understanding of its performance is based on this specific microstructure.	Maintain regulatory definition of Optimized ZIRLO™ including specific microstructure.
L3	3.1	Change "Allowable Range" for Tin from 0.6-0.8 wt% to 0.6-0.79 wt%.	Acceptable.	Change.

Number	Sections	Westinghouse Comment	Staff's Response	Disposition
L4	3.2.8 3.3.1 3.7 5.0	Remove any text identifying application of Optimized ZIRLO™ to cladding as opposed to assembly components. Delete text on the future application of ZIRLO™. "Westinghouse will use the appropriate mechanical properties consistent with the unirradiated thermo mechanical properties of the material consistent with the GDC for structures." In a comment under Section 3.5.4, Westinghouse states: "The topical does not request approval for any design-specific applications of Optimized ZIRLO™ components. Design-specific requirements will be addressed as appropriate for the specific application per requirements defined in NUREG 0800 (Section 4.2 of the SRP)."	Westinghouse has provided almost no data to support the application of Optimized ZIRLO™ to assembly components. Of concern are the following 3 SRP items: • Grid cage strength. • Guide tube growth. • Fretting wear due to spring relaxation. Each design is potentially impacted to a different extent by the application of a new material and must be evaluated. Following the initial release of SRXB's Safety Evaluation, Westinghouse decided to remove from Addendum 1 all reference to application of Optimized ZIRLO™ to assembly components other than fuel clad. As a result, the staff's review was solely on the use of Optimized ZIRLO™ as fuel clad material.	Change to clarify staff's position.
L5	3.2.10 3.2.14	When describing Vogtle creep program, remove indication to other "advanced alloys". Westinghouse states that "reference to programmatic aspects of a test not related to the subject topical should be deleted from this SER".	Agree.	Change.

Number	Sections	Westinghouse Comment	Staff's Response	Disposition
L6	3.2.10 3.3.8	"Reference to the timing of data availability from the Vogtle test relative to reload fuel application should be removed unless this is an explicit condition the NRC staff is imposing prior to licensing of Optimized ZIRLO™".	The timing is important. We are accepting this alloy because there are ongoing LTA programs and the ongoing Vogtle creep program. The timing is important because the fuel models will be validated based on these ongoing programs prior to the batch fuel achieving the same burnups.	Leave as is. Added time line to Conditions #6 and #7.
L7	3.2.10	Remove text that PNNL believes it would be prudent to include first cycle profilometry on LTAs. Westinghouse states, "In response to RAI 3b, Westinghouse has stated that profilometry is planned to be performed after completion of the third irradiation cycle on one cycle rods at Byron. This profilometry while planned is not viewed as a condition for approval of Optimized ZIRLO™."	PNNL believes that profilometry after 1 cycle is important to capture true clad creep - prior to pellet clad interaction. PNNL's comment is good background material for future licensing actions. It is not a commitment and the SE clearly indicates that it is not a Condition.	Leave as is.
L8	3.3.5 3.4.1 5.0	Remove text related to hydrides and Conditional hydride limit. Westinghouse also would like a paragraph on corrosion deleted. Delete 3.4.1 Hydriding since "None of the above text has any bearing on acceptability of Optimized ZIRLO™..."	The reduction in ductility is directly related to hydride levels. Even though these level are not readily measured (as are oxide thickness pool-side), it is still important from a design that hydrides are considered. Its important when developing alloys that the hydrogen pickup fraction be measured and a correlation be developed to equate to oxide measurements.	Leave as is.

Number	Sections	Westinghouse Comment	Staff's Response	Disposition
L9	3.3.8	Remove a conditional statement, “there is no difference between compressive and tensile irradiation creep of either of these materials”. Westinghouse states: “ZIRLO™ use is not currently limited under the assumption that tensile and compressive creep are equal, rather that there is sufficient margin in the PAD code to account for differences if they exist”.	During the approval of ZIRLO™, the staff questions tensile versus compressive creep rates. Westinghouse stated that a test program was underway which would quantify both creep rates. The staff accepted ZIRLO™ with this in mind (although not a condition). Once again, the NRC staff is relying upon the ongoing program to validate the creep models. The comment implies that W has different models for tensile and compressive creep. W does not have different models which were the main issue in the review of their creep model.	Change to clarify staff’s position.
L10	3.5.1 5.0	Remove statement concerning lack of high temperature oxidation data. Remove Condition which limits high temperatures in the Locked Rotor event.	Westinghouse has a cladding temperature limit for the Locked Rotor event. High temperature oxidation tests for Optimized ZIRLO™ were limited. As such, there is no basis for stating that acceptable oxidation kinetics are maintained beyond test measurements.	Leave as is.

Number	Sections	Westinghouse Comment	Staff's Response	Disposition
L11	3.6	Westinghouse wants to acknowledge that the LTA data is the property of Westinghouse and the Licensees. Further, Westinghouse wants a statement added that indicates that delay in the LTA measurements and validation of the models will “in no way invalidate this SER”.	Similar to L6. Timing is important. The NRC staff is relying on the ongoing LTA programs which are 2 cycles ahead of any batch application to validate models prior to achieving burnups in batch. We do not want Westinghouse to cancel or delay measurements. A reasonable delay is acceptable, but without data we have no basis for models which are impacted by prolonged exposure.	Add a condition that LTA data and confirmation of models be done prior to batch burnups.
L12	3.6 4.0	Remove statement “The NRC staffs approval of Optimized ZIRLO™, with its lack of an adequate irradiated database, should in no way represent an acceptable licensing path for future alloys.	Staff SEs often include guidance for future reviews. Similar to warning in approval of ZIRLO™ which stated that future alloys would need to update models (not rely on Zr4 properties).	Leave as is.
L13	5.0	Westinghouse objects to the statement: "The licensee is required to ensure that Westinghouse has fulfilled the following commitment" [related to supplying the staff with irradiated properties].	These SE conditions are aimed at the licensees. When a licensee adopts Optimized ZIRLO™, a licensing amendment will be submitted which will include a response to each of these commitments. The NRC reviewer will ensure that each condition has been satisfied.	Leave as is.

Number	Sections	Westinghouse Comment	Staff's Response	Disposition
L14	5.0	Westinghouse wants to remove the statement: "Furthermore, the NRC staff strongly recommends that for future evaluations, Westinghouse update all computer models with Optimized ZIRLO™ specific material properties." Westinghouse claims that this statement could be misinterpreted by licensees as a requirement for approval.	It is poor book-keeping to maintain Zr4, ZIRLO™, and OPTIN material properties when modeling Optimized ZIRLO™. In meetings, Westinghouse has stated that they expect to update models in the future, but has only committed to update the specific heat in the LOCA models. We do "recommend" that all models be updated.	Leave as is. Added words to indicate that its not a condition.
L15	5.0	Remove condition limiting fuel duty until data is available. "This requirement is already self-imposed based on our licensed corrosion models that limit the fuel duty possible for any plant implementing ZIRLO™ or Optimized ZIRLO™. Since the models make no distinction between ZIRLO™ and Optimized ZIRLO™, it is not possible for any plant to use Optimized ZIRLO™ at a higher duty than currently possible with ZIRLO™ without first licensing a new corrosion model. Therefore, this condition should be removed."	Agree.	Remove.

Number	Sections	Westinghouse Comment	Staff's Response	Disposition
L16	3.6 5.0	Change: "Westinghouse has committed to provide the NRC staff with irradiated data from...." To: "Westinghouse has committed to provide the NRC staff with a summary of the irradiated test results from..." Specify Vogtle data as "data summary reports or presentations".	The staff needs to see the irradiated data and confirmation of the models predictions. This is clearly stated in the Condition. Westinghouse has a point that we may not necessarily want to see large quantities of "raw data". However, its important that an adequate amount of information is presented to allow the staff to independently verify the models. Delete "or presentations" from proposed text.	Change.
L17	5.0	Westinghouse wants to replace “validate” with “confirm applicability with” currently approved models.	No objection.	Change.

TABLE 2: TECHNICAL ISSUES

Number	Sections	Westinghouse Comment	Staff's Response	Disposition
T1	3.2.10	Reword text. Westinghouse believes that quantitative differences between out-of-reactor and in-reactor creep data to be accurate indicator. PNNL's text should be reworded to indicate this phenomena.	The Westinghouse comment states that there is a direct relationship between the two. If they mean a direct qualitative relationship this does not disagree with our second paragraph. If they mean a direct quantitative relationship, the staff disagrees. The staff's position is that there is no quantitative relationship between out-of-reactor and in-reactor creep.	Leave as is.
T2	3.3.8	Westinghouse wants text deleted which simply state that if irradiation creep were higher than a lower rod pressure limit would be required. Westinghouse states that Vogtle data is now available that indicates similar creep rates.	Statement is true and provides information on the impact "if" irradiation creep were higher. Its too late in the process to issue new RAIs requesting Vogtle creep data which just became available.	Leave as is.

Number	Sections	Westinghouse Comment	Staff's Response	Disposition
T3	3.5.1	Westinghouse believes that the discussion in the SE on LOCA incorrectly paraphrases an RAI response.	The technical explanation as to why specific heat and other clad properties were important during early reflood (when fuel stored energy is high) would also apply to the blowdown period. The limited scoping study did not investigate all possibilities. It is reasonable to infer that both blowdown and early reflood would be sensitive to these material properties.	Leave as is.
T4	5.0	Westinghouse indicates that Condition #8 was incorrectly derived from response to RAI #3 (Oct 29, 2004).	Agree.	Change.

TABLE 3: CLARIFICATION & IMPROVEMENT

Number	Sections	Westinghouse Comment	Staff's Response	Disposition
C1	3.2.7	Delete discussion on tensile strength since it is “not relevant to the acceptability of Optimized ZIRLO™”.	Text contains background and discussion on methods. Keep it.	Leave as is.
C2	3.2.7 3.2.8	Change “implies” to “claims”	Agree.	Change.
C3	3.2.7 3.2.8 5.0	Text is negatively worded. Change “Due to the lack of irradiated properties, ...” to “...until irradiated data for Optimized ZIRLO™ is provided.”	Agree.	Change.
C4	3.2.7 3.3.1	Remove “and contractor’s” from the statement discussing the staff’s concerns.	Agree.	Change.
C5	3.3.2	Remove text on methods since no change is being sought.	Text provides background.	Leave as is.
C6	3.3.4	Remove discussion on fretting wear since it “has no bearing on acceptability of subject topical”. Reword text on fretting “unless explicit requirements related to acceptability of Optimized ZIRLO™ as an approved cladding are contingent upon a defined outcome or expectation of the NRC staff with regard to fretting wear”.	The current text simply states that Westinghouse has indicated no fretting wear on the LTAs to date and that these LTAs will be monitored in the future for signs of fretting wear. I agree that the cladding material has little to do with fretting. Instead it’s the grid design and spring material. No Condition is specified in Section 5.0.	Leave as is. Text on fretting wear modified as agreed by the staff.

Number	Sections	Westinghouse Comment	Staff's Response	Disposition
C7	3.3.8	Rewrite text on reporting requirements for future creep measurements.	The NRC staff wants Westinghouse to notify us if the creep data is “different” than ZIRLO™, not “outside the assumptions used for ZIRLO™”. Any change in creep, in either direction, has an impact. The NRC staff wants Westinghouse to validate the creep models when more creep measurements become available - providing the staff with both the data and the validation.	Leave as is.
C8	3.5.2	Remove text which has no bearing on accepting Optimized ZIRLO™.	Background material describing what the reviewer was considering.	Leave as is.
C9	5.0	Add ZIRLO™ to Condition 5 since both ZIRLO™ and Optimized ZIRLO™ continue to apply the same methodologies for both material definitions.	No objection.	Change.
C10	3.3.5 3.4.6 3.5.1 3.5.2 3.5.3 3.6	Miscellaneous editorial comment. Westinghouse proposed change for clarity.	No objection.	Change.

TABLE 4: PROPRIETARY MATERIAL

Number	Sections	Westinghouse Comment	Staff's Response	Disposition
P1	ALL	Westinghouse has identified numerical values which quantify difference in material performance and test which characterize the final microstructure as proprietary.	Agree.	Change.
P2	Bracketed and Bolded	Westinghouse has identified manufacturing process descriptions which are proprietary.	Agree.	Withheld