REQUEST FOR ADDITIONAL INFORMATION NO. 129-1673 REVISION 1

12/17/2008

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

SRP Section: 04.02 - Fuel System Design
Application Section: Chapter 4.2

QUESTIONS for Reactor System, Nuclear Performance and Code Review (SRSB)

04.02-1

1. Chapter 4.2 makes no reference to a ZIRLO topical report for material properties and performance. What is the source for the ZIRLO clad properties and performance?

04.02-2

In Table 4.1-2 should the FINDS code be referenced in Loads and Stresses row?

04.02-3

Section 4.4.1 of MUAP-07016 describes oxide thicknesses at an assembly burnup of 60 GWD/MTU. The section is titled Grid Spacer Irradiation Behavior but Appendix B only provides data for guide tube oxidation thicknesses and states that the behavior should be the same for grid spacers because both use recrystallized Zircaloy-4. Hydrogen distribution can be impacted by stress that can significantly reduce ductility. Spacer grids have different stress distributions than guide tubes. Has this assumption of similar behavior been verified by metalograhic examination in terms of hydrogen distribution or mechanical testing of spacer grids? Is the elongation data provided in Figure B.1.3.6-1 total or uniform elongation and what were the hydrogen levels for this data? If the data is total elongation please provide the uniform elongation data because total elongation is not a good measure of ductility to prevent brittle failure.

04.02-4

Do the spacer grid impact test results include the effect of oxide thickness and/or hydrogen pickup and if not why not?

04.02-5

Are guide tube stresses evaluated accounting for oxidation and/or hydrogen pick-up? What oxide thickness and/or hydrogen pick-up values are assumed?

04.02-6

In Section 4.6 of MUAP-07016 the document seems to indicate that the holdown spring undergoes plastic deformation under cold conditions. Is this the correct interpretation? Please clarify.

04.02-7

Section 4.2.3.5.2 states that the guide tubes have a longer region with an enlarged inner diameter in the dashpot to prevent Incomplete Rod Insertion (IRI). This would appear to only move the weak point lower in the assembly. Has a comprehensive analysis for the potential of IRI been performed which includes assembly growth, holdown spring force and assembly lateral stiffness? This is especially important as it appears the holdown spring is designed to undergo plastic deformation. Has this design been compared to assembly designs which have experienced IRI?

04.02-8

In Section 4.2.2.3.1, control rod lifetime is given as 15 years. Is this in calendar years or effective-full-power-years (EFPY)? What data and assumptions were used in determining the 15 year lifetime. (e.g., plant capacity factor, clad fluence values, absorber swelling rate etc.)?

04.02-9

Have control rod neutron-absorbing capabilities been evaluated over the projected lifetime? If so, where is this discussed? If not, what assumptions are made regarding neutron-absorbing capabilities and explain why they are conservative.

04.02-10

In Section 5.1.6.2 of technical report MUAP-07016 it is stated that there is no significant control rod cladding wear over its lifetime. Is there measured data to support this statement? Do the control rods sit in the assembly such that the control tip could wear against the softer Zicraloy-4 guide tube? If so, has guide tube wear due to control vibration been observed or evaluated?

04.02-11

Over what extent (dimension) does the chrome plating cover the control rod?

04.02-12

Has an evaluation been performed examining the potential for guide tube water boiling when the control rods are present? If not, has the impact of possible boiling induced corrosion been evaluated on guide tube integrity?

04.02-13

Oxidation and hydrogen pick-up reduce clad ductility especially at high fuel duties over an extended time period. Does the cladding 1% strain limit include the effect of the maximum oxide thickness and/or the maximum hydrogen pick-up limit? If so, what values were used? If not, explain why it is conservative to not include oxide thickness and/or hydrogen pick-up effects.

04.02-14

In Section 4.2.4.2, mention is made of visually inspecting fuel pellets. Missing pellet surfaces caused by manufacturing deficiencies have lead to PCMI fuel failures and greatly increase the chance of cladding collapse. Are manufacturing (quality assurance) standards in place which limits the amount (area or volume) of missing pellet material?

04.02-15

Provide the data that substantiates the 95/95 uncertainty values for corrosion and hydrogen provided in Table 3.1-2 of MUAP-07016.

04.02-16

Have manufacturing moisture limits been set which eliminate internal hydriding? If so, what are the limits and what manufacturing controls (quality assurance sampling) are in place to limit fuel moisture? If not, explain why no internal moisture limits are necessary to prevent internal hydriding.

04.02-17

Section 4.2.1.2.2 states that the "FINE code evaluates cladding stress, cladding strain, fatigue, fuel temperature, rod internal pressure, etc., using applying the fuel densification model and the swelling model." Wording should be modified by deleting either “using” or “applying”.

04.02-18

In Section 4.2.4.5 it is stated that during normal refueling outages some assemblies will be dimensionally checked. What type of dimensional check will be performed and what criteria will be used to determine re-insertion acceptability?

04.02-19

In Section 4.2.4.5 it is stated that some fuel assemblies loaded in the initial core will be closely examined to confirm their performance. What type of measurements/tests will be performed and what acceptance criteria will be used to judge acceptable performance?

04.02-20

It is unclear how the rod power histories in Section 3.3.2 of MUAP-07016 are used to determine rod internal pressure. A sentence in the third paragraph states that actual core analysis determines rod histories. Within that same paragraph another statement is made that if the clad liftoff pressure limit is exceeded than a rod specific power history is used to show acceptability. Clarify whether a bounding or cycle specific power history is used to determine peak rod internal pressure.