

Fluence Issues for PWR Internals

Public Meeting on MRP-227, Rev.1
March 31, 2015

Background

- MRP-227-A screening for aging mechanisms based on neutron fluences estimated by expert panel
- Plant-specific applicability depends on these estimates being representative for individual plants
- Action Item 1 requires verification of applicability

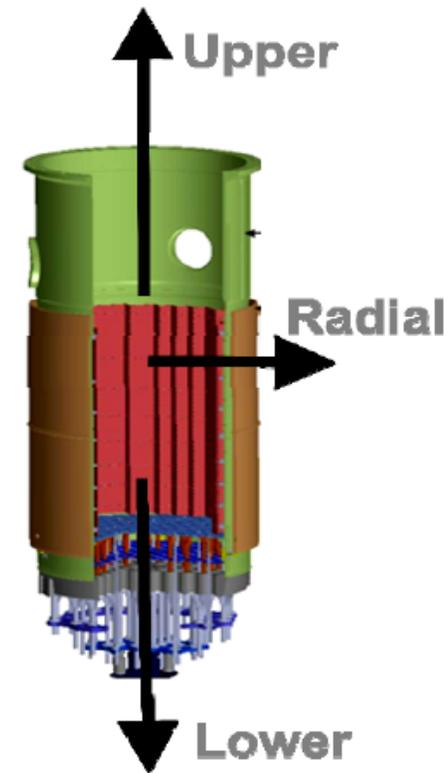
Background



- To close Action Item 1, EPRI issued:
 - MRP 2013-025, “MRP-227-A Applicability Guidelines for Combustion Engineering and Westinghouse Pressurized Water Reactor Designs”
- MRP 2013-025 specifies quantitative applicability criteria related to core power density and geometry
- NRC staff approved guidance of MRP 2013-025; evaluation dated 11/7/14 (ML14309A484)

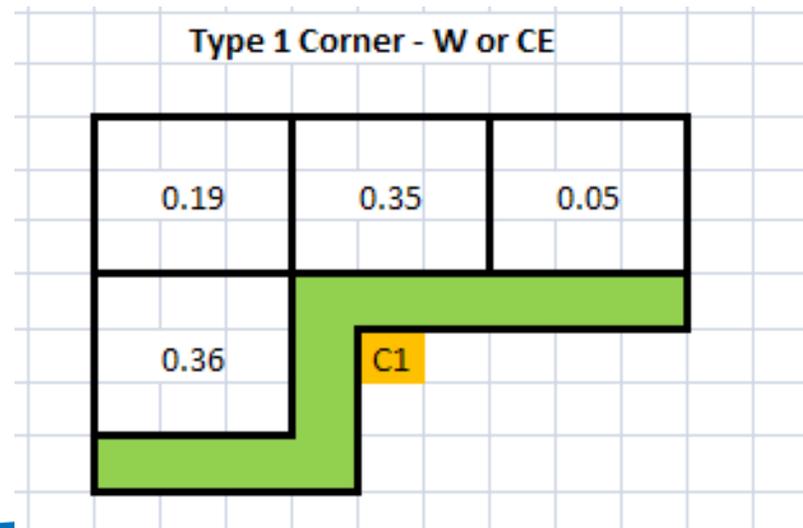
Additional NRC Staff Issues - Bases for MRP 2013-025 criteria

- Method of determination of the generic fluence estimates
- Basis for reliance on core average power density as a figure of merit,
- Basis for scaling with only the peripheral assembly power (as opposed to 2 or 3 assemblies in) for determining figure of merit “F” related to radial component applicability



Radial Heat Generation Figure of Merit, F

- $F = P_{avg} (W1 \cdot R1 + W2 \cdot R2 + W3 \cdot R3 + W4 \cdot R4)$
- Where:
 - P_{avg} = average core power density
 - W_i = generic inside corner weighting factor (Figures 1 and 2)
 - R_i = relative fuel assembly power



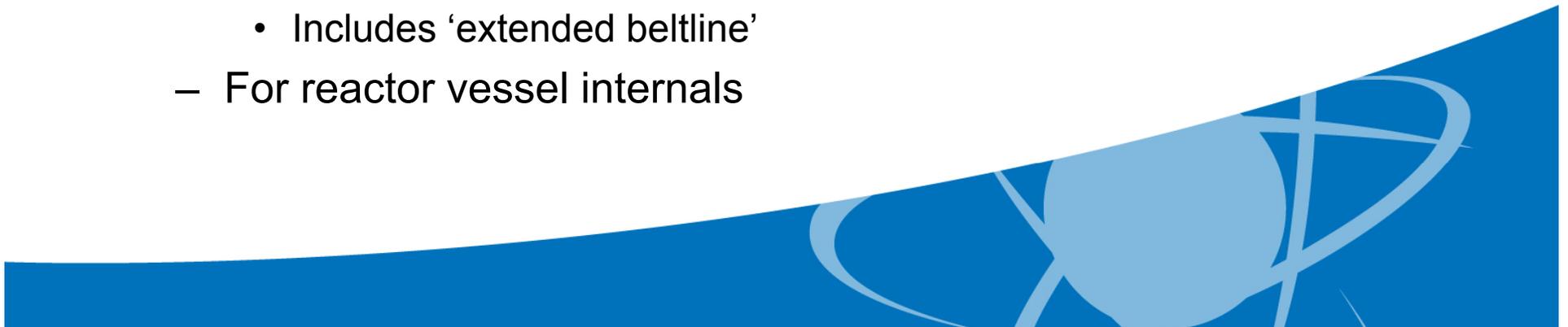
Outcome of Dec. 8, 2014 Discussion with Industry



- Core power density is a rough measure to ensure core design falls within general norms
- Core power density limits for W and CE represent the upper bound for these fleets
- Core power density is not intended to correlate directly with fluence
- Use of core power density is adequate for general applicability
- If plants exceed MRP 2013-025 limits, plant-specific fluence estimates for RVI may be necessary for aging management evaluations (several plants have done)

Fluence Issues for RVI

- No staff guidance for neutron transport analysis of RVI
- RG 1.190 is applicable only to RPV beltline region
- Few benchmarks for RVI fluences
- **Need to determine uncertainty of RVI fluence estimates**
- NRC User Need Request will focus on fluence calculations outside the reactor vessel beltline, e.g.:
 - For vessel locations significantly above or below the active fuel region of the core
 - Includes ‘extended beltline’
 - For reactor vessel internals



Conclusions/Discussion Items

- More work is needed to determine:
 - Uncertainty of RVI fluences
 - Appropriate uncertainty allowance for RVI fluence estimates
- Are benchmarks for RVI fluence needed?
- Guidance for RVI fluence is probably needed
- What is MRP plan to address?

