

ENCLOSURE 2

M230133

Closed Session Presentation Slides for New Powder Container Meeting

GNF Proprietary Information – Non-Public

PROPRIETARY INFORMATION NOTICE

This enclosure contains proprietary information of Global Nuclear Fuel – Americas, LLC (GNF) and is furnished in confidence solely for the purpose(s) stated in the transmittal letter. No other use, direct or indirect, of the document or the information it contains is authorized. Furnishing this enclosure does not convey any license, express or implied, to use any patented invention or, except as specified above, any proprietary information of GNF disclosed herein or any right to publish the enclosure without prior written permission of GNF.

The header of each page in this enclosure carries the notation “GNF Proprietary Information – Non-Public.” The GNF proprietary information is identified by double square brackets. [[This sentence is an example.^{3}]] Figures and large objects containing proprietary information are identified with double square brackets before and after the object. In each case, the superscript notation ^{3} refers to Paragraph (3) of the Enclosure 4 affidavit, which provides the basis for the proprietary determination.

Discussion with the NRC: NPC Package Revised Technical Basis to Support 8 wt.% U-235

October 24, 2023

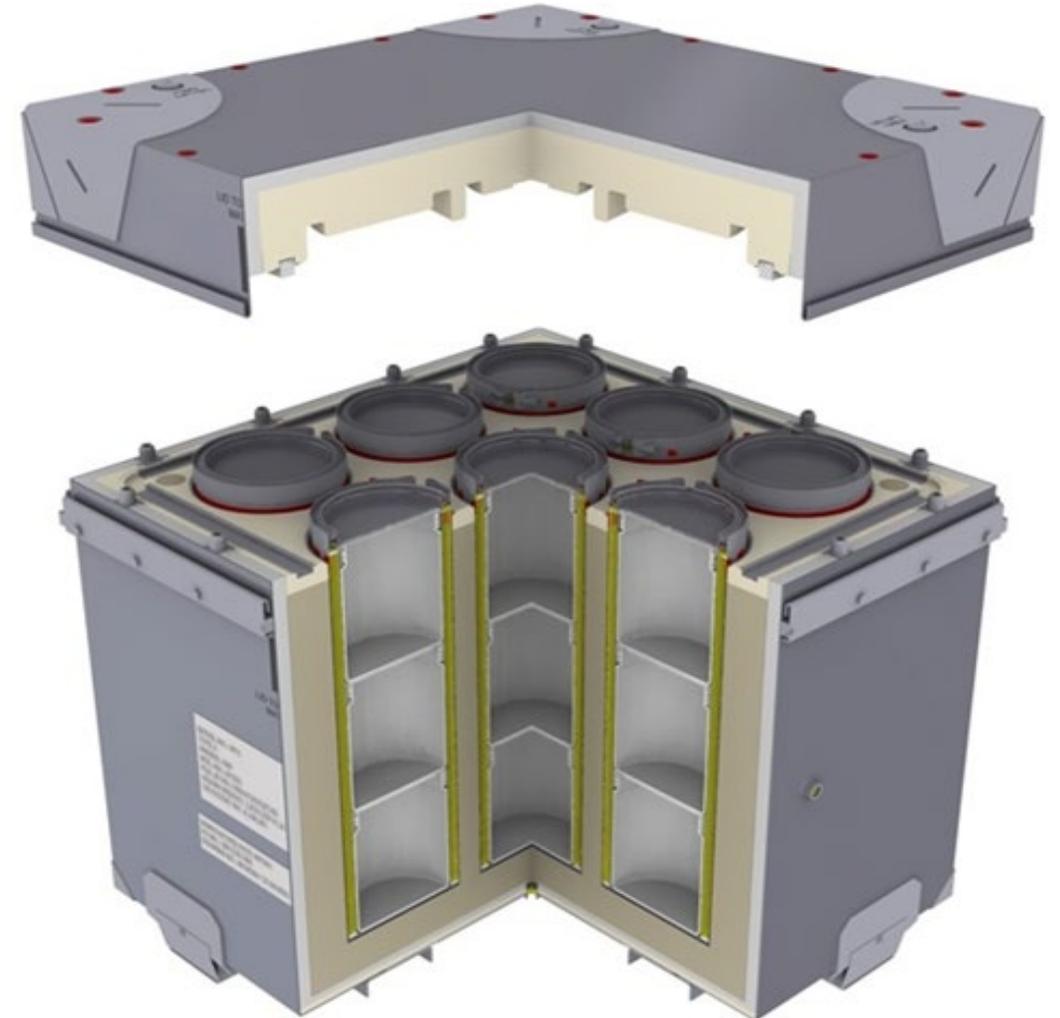


START OF CLOSED SESSION

Overview of Current NPC Certification Testing Basis

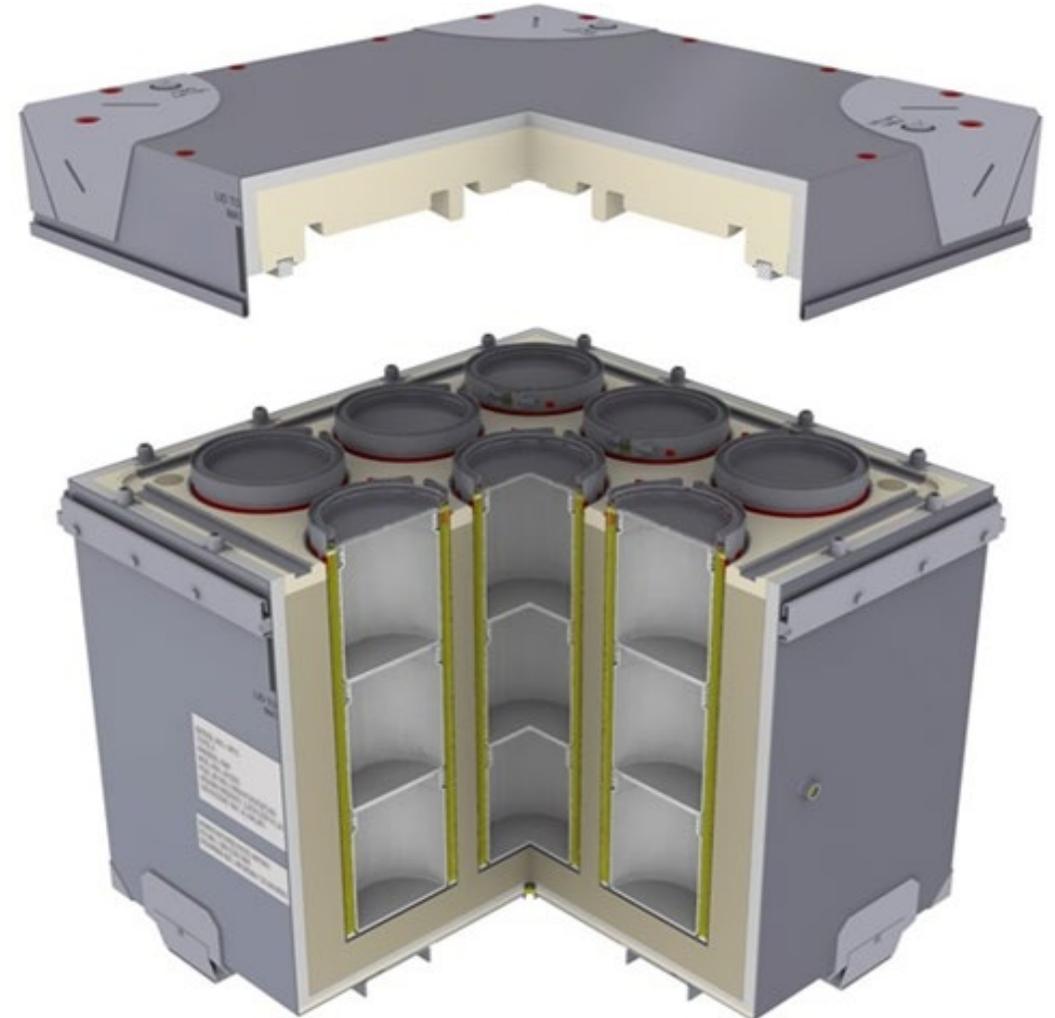
Goal For Today

- NRC feedback on in-progress changes to SAR
 - Basis for credible conditions from HAC testing
 - Revised Chapter 6 evaluation
 - [[Submittal targeted for ~3Q 2024^{3}]]



Proposed Changes to SAR

- Per 10 CFR 71.55 and 71.59, redefine ICCA flooding during HAC based on physical test data documented in Chapters 2 & 3 of the SAR
- Allows transport of up to 8 wt.% U-235 contents without reducing payload or CSI values
- Validation report update to support revised Upper Subcritical Limit (USL) update to [[0.9406^{3}]]



NPC Certification Testing Review

Testing and Results

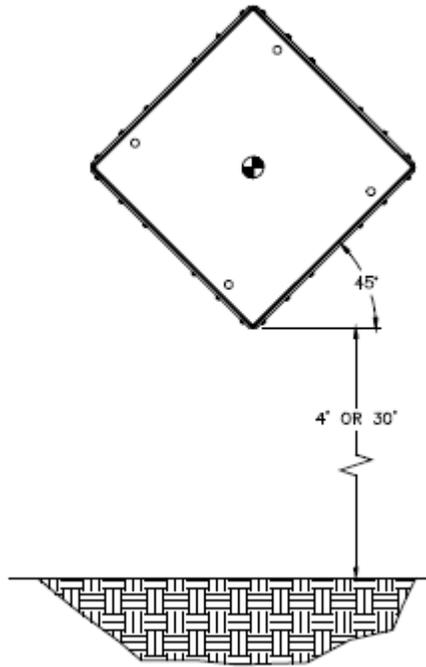
Certification Tests

- Four full-scale NPC Certification Test Units CTU-1 thru CTU-4 tested as follows:
 - Free drop per 10 CFR 71.73(c)(1)
 - Puncture test per 10 CFR 71.73(c)(3)
 - Thermal testing per 10 CFR 71.73(c)(4); (except CTU-4)
 - Immersion testing per 10 CFR 71.73(c)(5) and (c)(6); (except CTU-4)

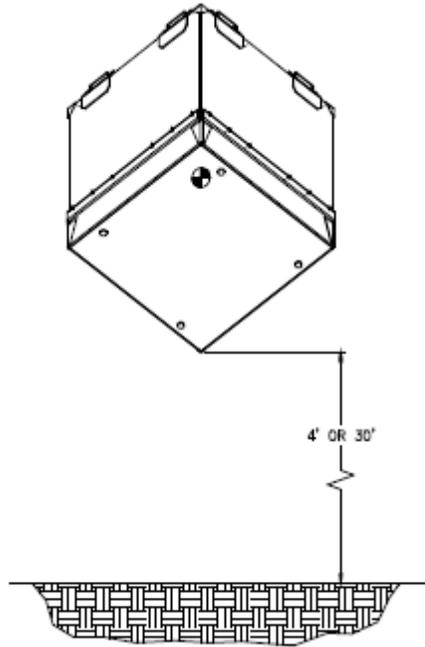
Certification Tests Summary

- Demonstrated compliance to 10 CFR 71
- Demonstrated watertight through immersion testing
 - Documented in SAR but not previously required due to assumed inleakage for criticality evaluation

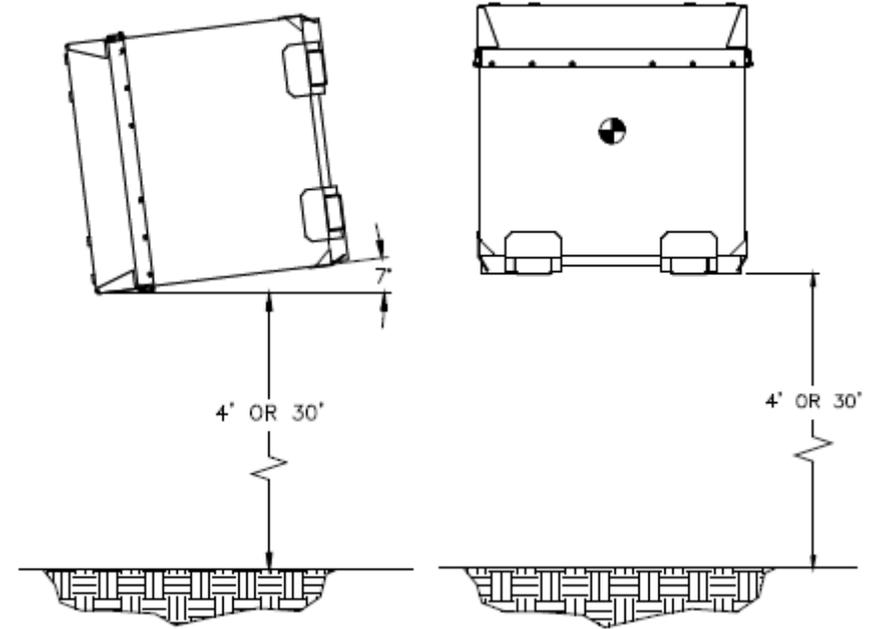
Drop Testing Orientations



CTU-2



CTU-3
CTU-1



CTU-4

Immersion Testing

10 CFR 71.73(c)(5)

- CTU-2 had no evidence of inleakage following 8 hours of 3 ft immersion testing
- CTU-3 and CTU-1 had evidence of limited moderator intrusion in one ICCA each
 - Cause of inleakage was identified and is mitigated through current package design and operation

10 CFR 71.73(c)(6)

- Nine undamaged ICCAs were immersed at 50 ft for 8 hours with no evidence of inleakage



Figure 2.10.1-50 – CTU-2 Post-Test Disassembly; View of ICCAs/Foam Block Structure

Immersion Testing Continued

- CTU-2: No evidence of water intrusion.
- CTU-3: Deformation of OCA lid corner and ICCA closure lid due to drop testing. Evidence of limited water intrusion.
 - Mitigation: Reinforced the corner soffits and tested as CTU-1 (current design).
- CTU-1: Evidence of limited water intrusion due to simulated payload (sand particles) migrating into ICCA closure seal during drop testing.
 - Mitigation: Resolved by procedural handling in Chapter 7. Poly bottles are required for powder uranium compounds.
- CTU-4: No immersion testing performed. No leaked fluorescein identified.



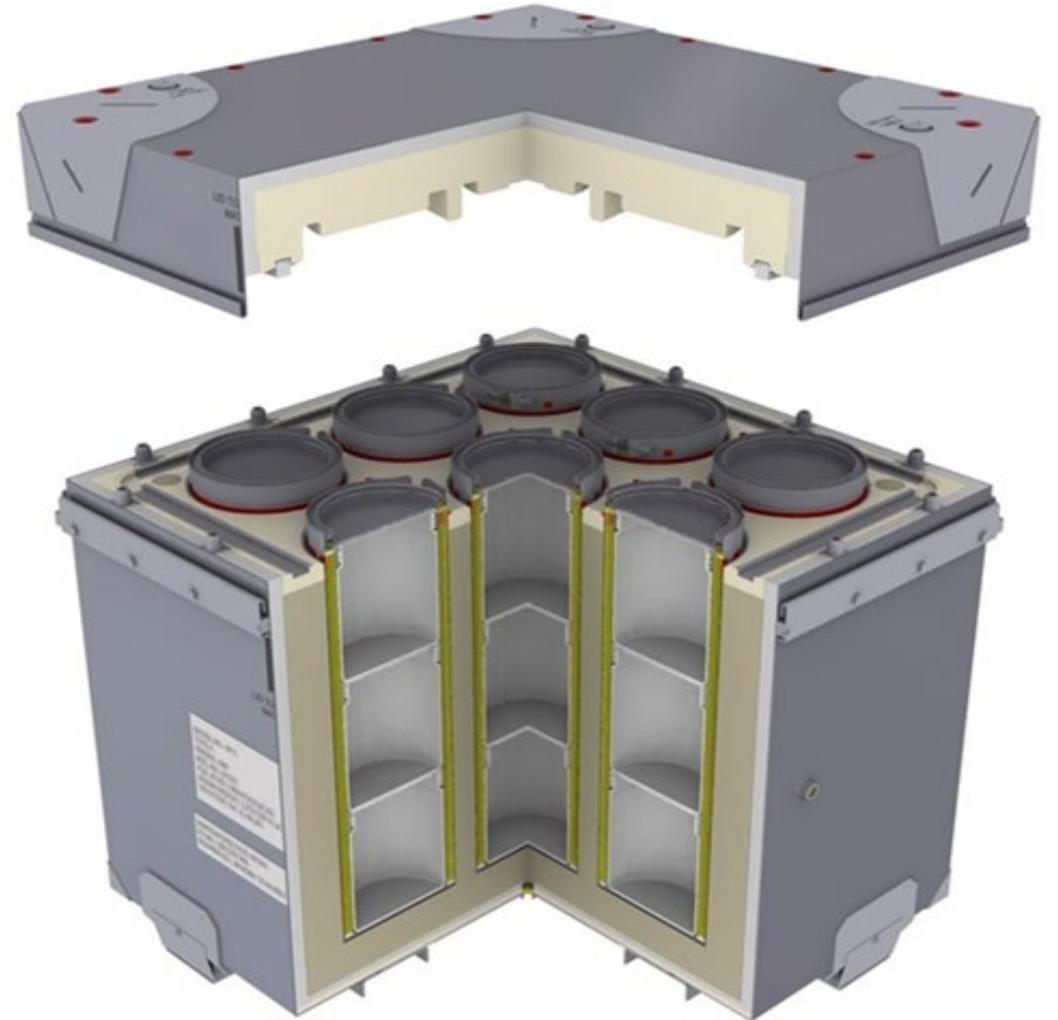
Figure 2.10.1-74 – CTU-3 Post-Test Disassembly; Close-up View of Damaged ICCA Closure Lid



Figure 2.10.1-26 – CTU-1 Post-Test Disassembly; View of ICCAs/Foam Block Structure

Testing Summary

- Damaged package remains watertight following free drop, puncture and fire testing demonstrated by 10 CFR 71.73(c)(5) immersion testing
- Undamaged ICCAs remain watertight demonstrated by 10 CFR 71.73(c)(6) immersion testing
- 10 CFR 71.73(c)(5) and (c)(6) immersion testing data will be used to justify modifications to inleakage assumptions in the criticality analysis



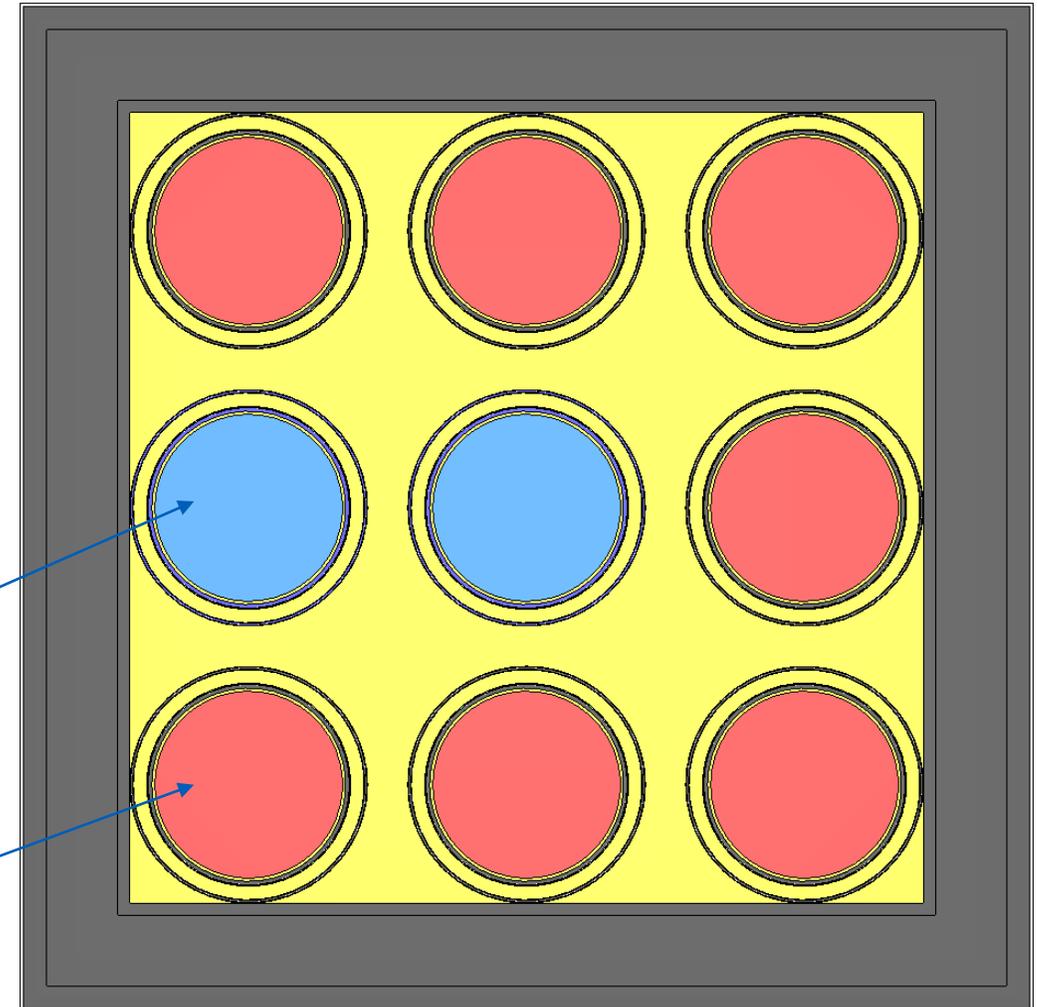
Criticality Study - Scoping

Conservative Assumption

- With the mitigating measures noted, it is credible that no ICCAs will flood during HAC
- For conservatism, up to two ICCAs in each NPC are assumed to leak (allow moderator intrusion with no material loss)

Flooded Fuel ICCA

Dry Fuel ICCA

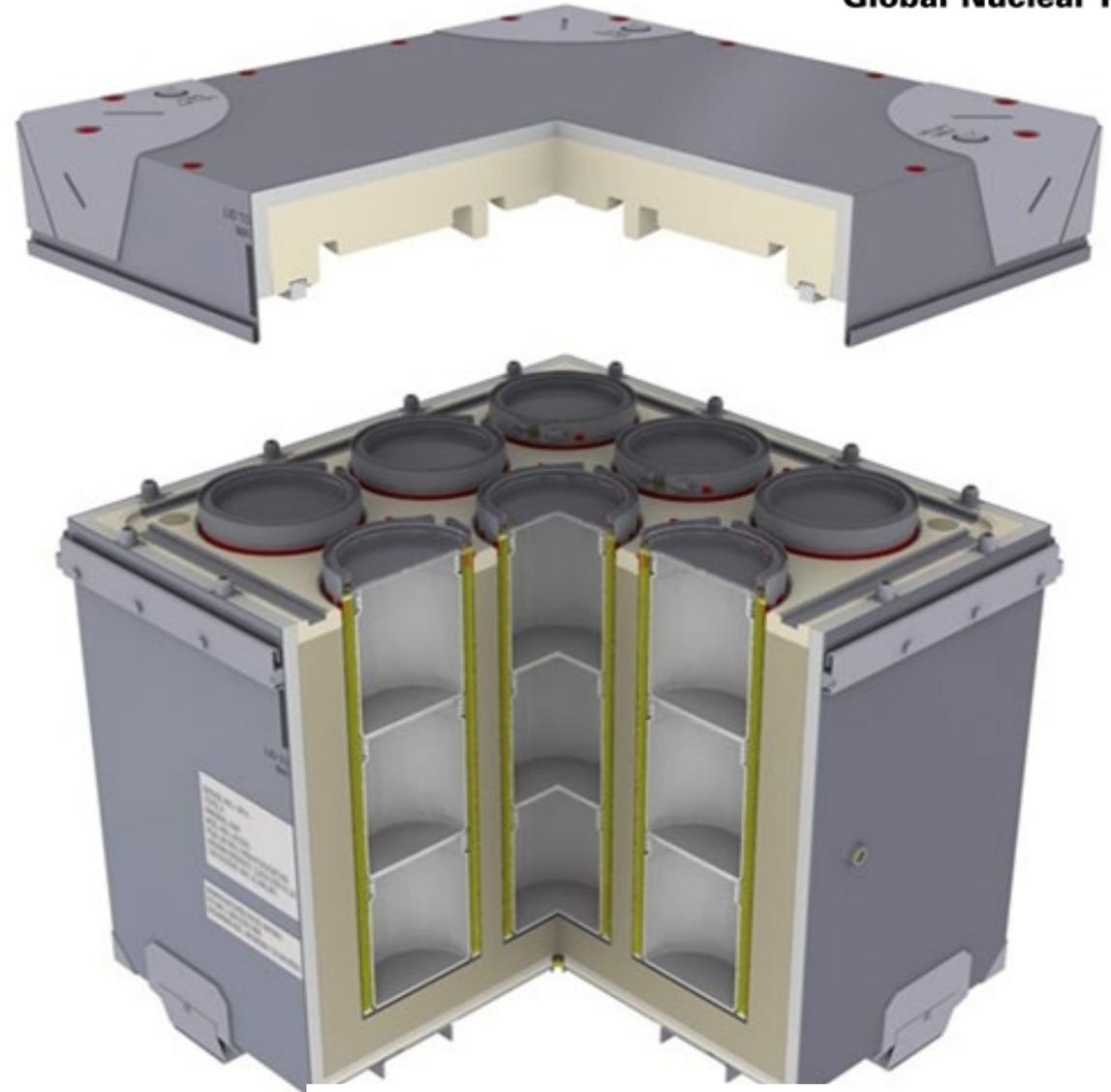


NPC package Keno model showing two flooded ICCAs

{3}]

Scoping Assumptions

- Objective: Find limiting configuration of up to two (2) flooded ICCAs³
 - Up to two (2) ICCAs are considered entirely flooded with full density H₂O³
 - Three (3) Poly bottles are modeled within each ICCA



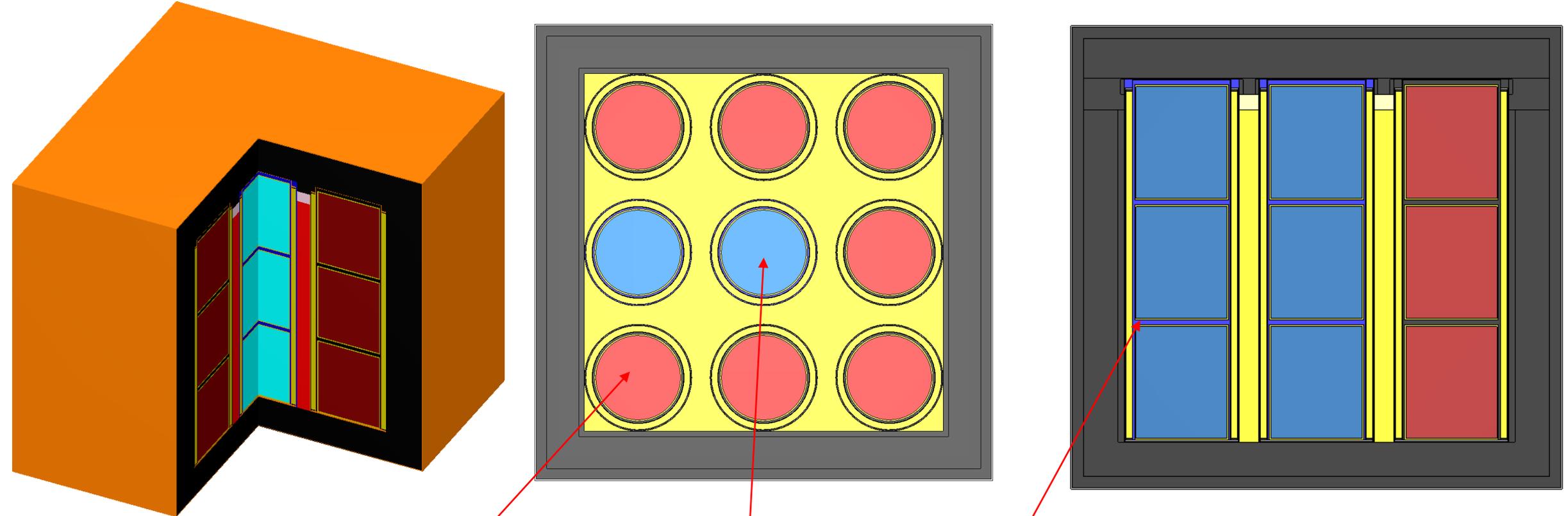
Scoping Results – Example Visualization

[[

Isometric View

Top Cross-Section

Side Cross-Section



Non-flooded fuel region

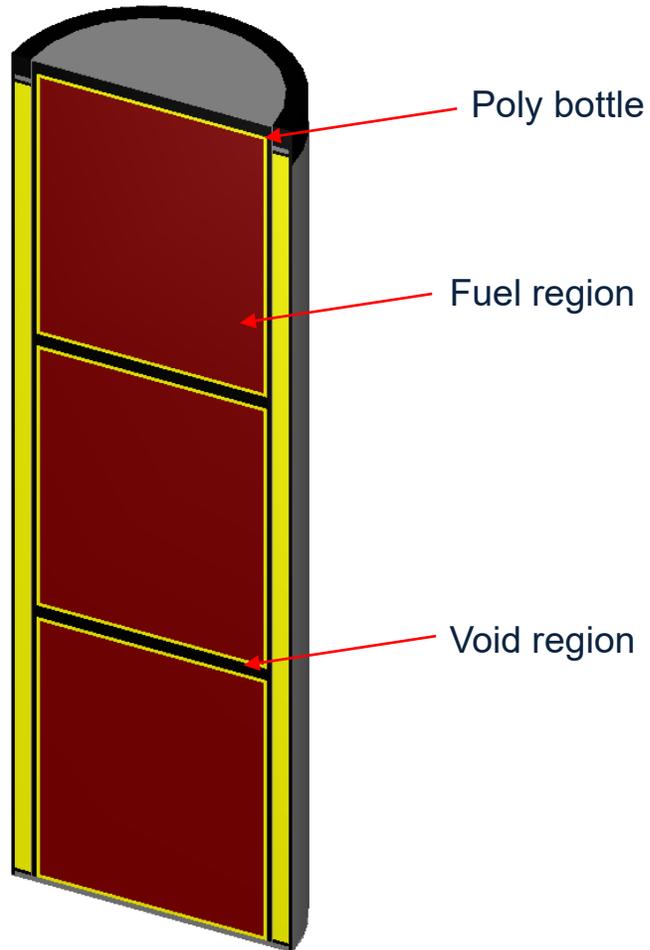
Flooded fuel region

Poly bottle material

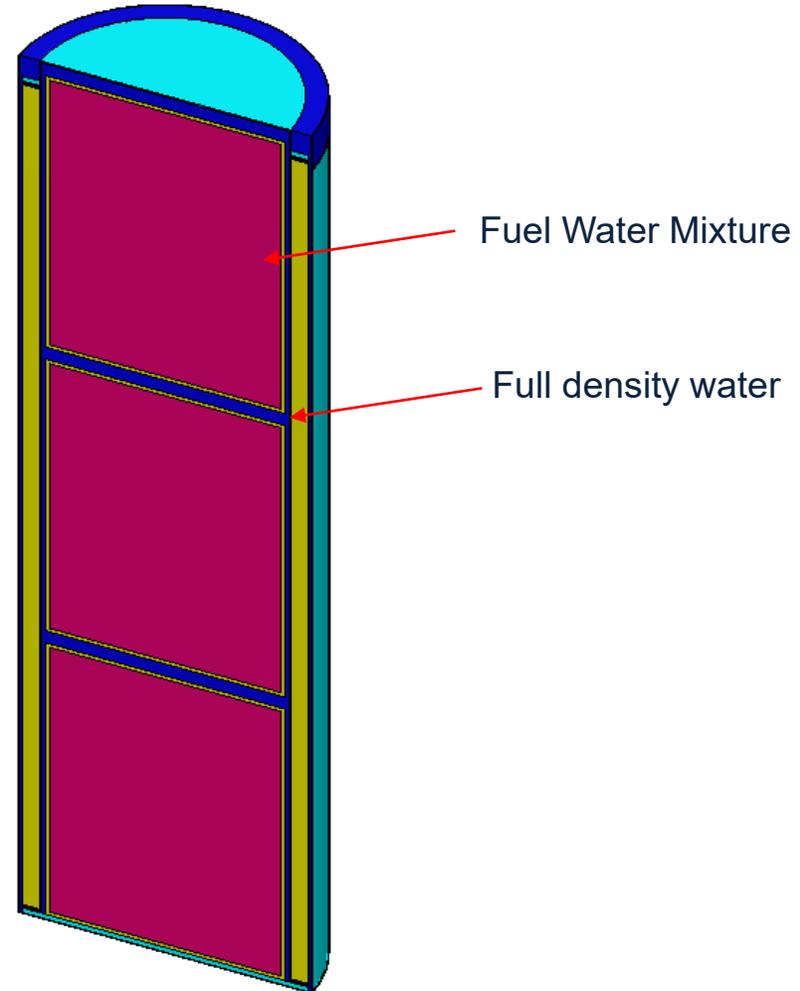
{3}]

Modeling Approaches – Visualizations

Intact Poly Bottles in Dry ICCA



Intact Poly Bottles in Flooded ICCA

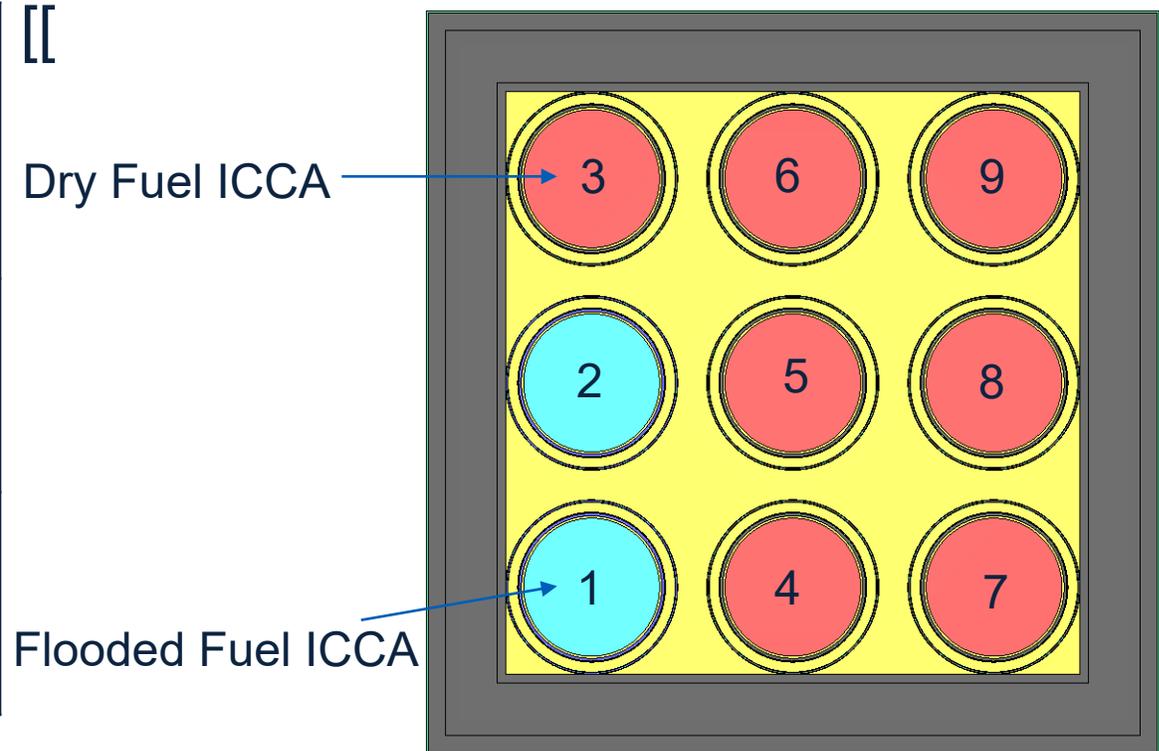


Note that fuel mixture volume is held constant to occupy the full volume of each poly bottle

Modeling Results

Modeling Approaches – 8 wt.% U-235 Maximum Content Case Results

ICCAs Flooded	Fuel Loading per ICCA	k-eff	Δk Margin Gained
[[All	60 kg UO ₂	0.99575	-
#1 + #2	60 kg UO ₂	0.83669	0.15906 ^{3}]]

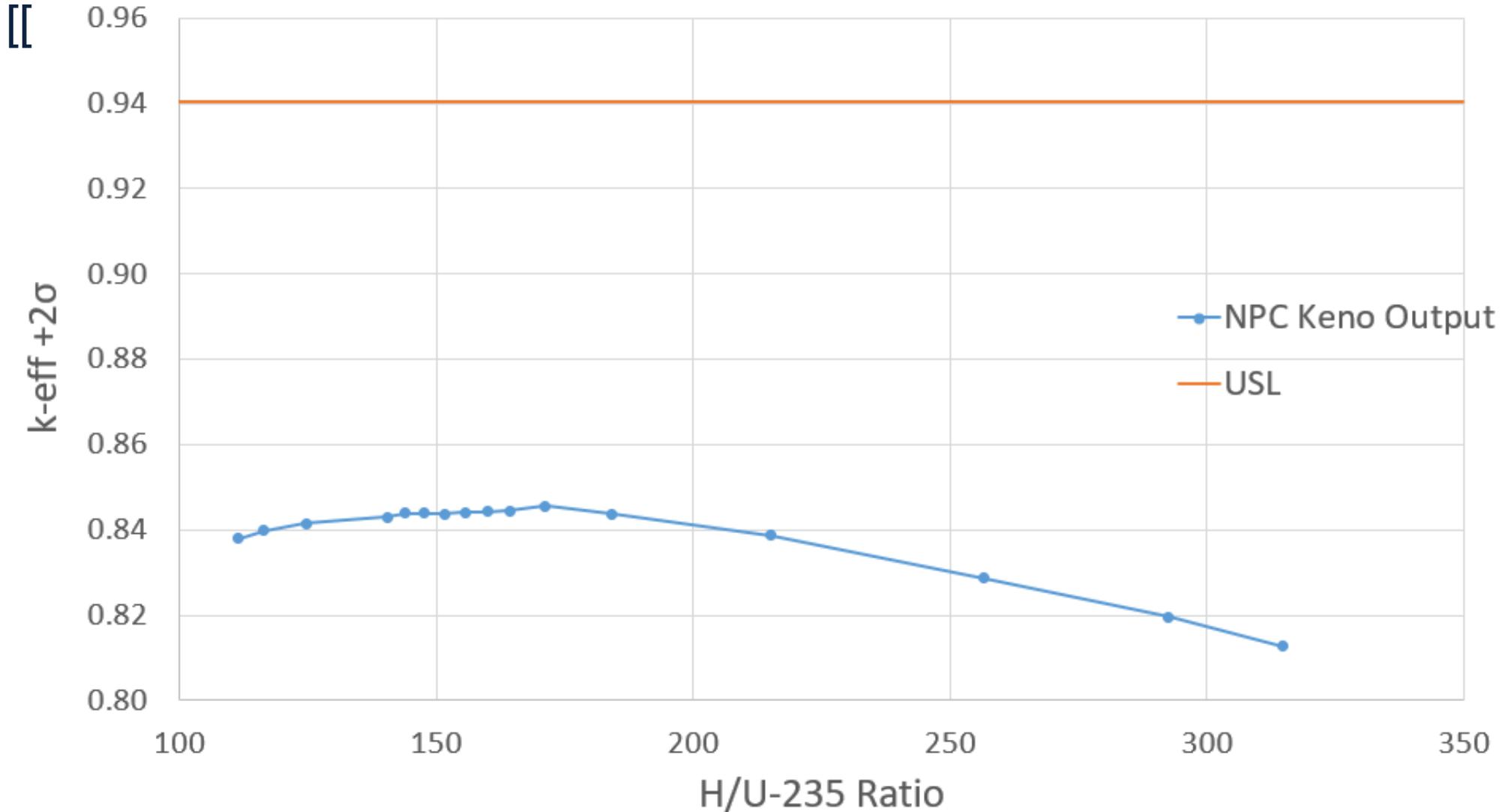


All test cases used the following criteria:

- 5x6x5 array of HAC NPCs
- All NPCs in same orientation

{3}]]

Modeling Approaches – 8 wt.% U-235 Case Results



Note that fuel mixture volume is held constant to occupy the full volume of each poly bottle

{3}]

Summary of Analyses

- Credit results of certification testing documented in SAR NEDO-33881 Revision 7
 - Conservatively model up to $[[2^{3}]]$ ICCAs flooded
- Increase allowed UO_2 enrichment from 5 wt.% to 8 wt.% U-235
- 540 kg content per NPC (60 kg per ICCA) remains below USL of $[[0.9406^{3}]]$ with ample margin
- Submittal $[[\sim 3\text{Q } 2024^{3}]]$

Proposed USA/9294/AF-96 Changes

- Increase fissile material enrichment limitation to 8 wt.% U-235