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**Safety Criticality Analysis**  
**FCC4 Fuel shipping casks**  
**Justification of the enlarged neutronic cavity section**

**ADDITIONAL INFORMATION:**

PROJECT		DISTRIBUTION TO	PURPOSE OF DISTRIBUTION
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REVISIONS

REVISION	DATE	NOTES
1.0	See 1st page	New document


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## REFERENCES

- [1] FFDC00817EN Rev.B  
Safety Criticality study of FCC3 and FCC4 containers –15x15 and 17x17 Assemblies, 17x17XL, 17x17EPR™, 16x16 and 18x18 Assemblies
- [2] Technical note SEC/T/2006-425 indice A  
Synthèse et analyse des résultats de validation de l'installation chez AREVA NP des codes du formulaire CRISTAL V1.1 à la charge du SEC
- [3] FFDC00561 E2 Rev.4.0 :  
Safety-Criticality Study - Fresh UO<sub>2</sub> fuel transportation casks -Determining the uncertainties to apply to the criticality studies performed using CRISTAL

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## 1. INTRODUCTION

The safety criticality justification for the FCC3 and FCC4 containers is the subject of the note [1].

The goal of the present study is to justify the expansion of the neutronic cavity section from ■■■ x ■■■ (mm x mm) to ■■■ x ■■■ (mm x mm) in the FCC4v1 containers loaded with 17x17XL or 17x17EPR™ assemblies.

## 2. CODES AND VERSIONS

Calculations are performed with the CRISTAL V1.1 package made up of:

- CIGALES version 3.1 (computer version)
- APOLLO2 version 2.5.5
- MORET4 version 4.B.3

The version of the APOLLO2 built into this package uses sets of microscopic cross-sections based on the JEFF2.2 European evaluation.

The verification of CRISTAL V1.1 installation on our servers and computers is documented in the note [2].

The use of the CRISTAL package is qualified for the present study by applying an uncertainty of ■■■ to the calculated  $K_{eff}$  ( $K_{eff}^{cal}$ ), according to report [3]. In the present report, all the given reactivity values take this uncertainty into account.

## 3. COMPUTATION AND MODELLING HYPOTHESES

The different configurations in this study are:

- An array of 10x16x1 (N=80) damaged packages under Accident Conditions of Transport (ACT) with ■■■■ (penalizing case cf. §5.3.2 of [1]).

The detailed geometric description is given in [1]. The principal characteristics of the package and the assemblies taken from the report [1] are:

- FCC4 v1b container under ACT (cf. §4.1 of [1]), with a neutronic cavity section enlarged to ■■■ x ■■■ (mm x mm) instead of ■■■ x ■■■ (mm x mm),
- 17x17XL et 17x17EPR™ assemblies under ACT, with an enrichment of 5% in  $^{235}\text{U}$  (cf. §4.3 of [1]), with :
  - Maximal pellet diameter : ■■■ mm (cf. table 2 of [1]),
  - Minimal cladding outside diameter : ■■■ mm (cf. table 2 of [1]),
  - Non expanded fissile section (2/3 of the assembly length): ■■■ x ■■■ (mm x mm),
  - Expanded fissile section (1/3 of the assembly length): ■■■ x ■■■ (mm x mm) instead of ■■■ x ■■■ (mm x mm),
- Resin under ACT (cf. §4.2 of [1]).

4. RESULTS

All the calculations are realized with a statistical uncertainty of [REDACTED]  
The results for the 10x16x1 array of packages (N=80) under ACT are given in the table hereunder:

Proprietary table

Nota :  $K_{eff_{max}} = K_{eff}^{cal} + [REDACTED]$

The results obtained with the [REDACTED] x [REDACTED] (mm x mm) section are consistent with those given in the paragraph §5.3.2 of [1] where the statistical uncertainty was [REDACTED] ([REDACTED]) (cf. [3]).

5. CONCLUSION

This study justifies that the enlargement of the neutronic cavity section from [REDACTED] x [REDACTED] (mm x mm) to [REDACTED] x [REDACTED] (mm x mm) does not modify the conclusions of the report [1], The safety-criticality criterion ( $K_{eff_{max}} \leq 0.95$ ) is still met.