2000

TRANSX/DANTSYS   LWR MOX

Application of TRANSX/DANTSYS to LWR MOX Benchmark Calculations

,　　,　　,

150

TRANSX/DANTSYS

PNL30~35   . ENDF/B-VI   NJOY

     MATXS-format   69   .

                                                       , k_{eff}

                        .   ,   Pitch k_{eff}

         Pitch k_{eff} ,

MCNP   .

Abstract

The benchmark calculations with TRANSX/DANTSYS code system was perfomed against PNL30~35 critical experiments to verify the code system's applicability to LWR MOX core. The MATXS library of 69 neutron groups for light-water-reactor problem was generated using NJOY code through processing the recent release of ENDF/B-VI nuclear data. Relative power distributions except outermost lattice fuel rods showed reasonable results, and the calculated k_{eff} of all cases showed good consistency with benchmark-model values or MCNP results. Moreover, calculated results indicate that there is an increase in k_{eff} with increasing lattice pitch, and showed the tendency that k_{eff} value for the borated case was higher than that for the unborated case with the same pitch.

1.

(Evaluated Nuclear Data File)

Los Alamos   NJOY

，   ENDF-6 format

．   (Monte Carlo)   MCNP

                    Reference   ，   (Discrete Ordinates)

            DANTSYS   ，   ．

                                                                        1   ANISN   2   DOT-IV

                                                                    ．   Oak Ridge

                            3   DOORS   ．

            DOORS 3.1   ，1   ANISN   2   DORT,   3   TORT

                    ．   ，ANISN   DORT

                    ．

                ，DANTSYS   Los Alamos   1, 2   3

                                                                                ．   ，NJOY

                                    MATXS-format   TRANSX

DANTSYS   ，1   ONEDANT

            2   3   TRANSX/DANTSYS   ．

                            ，   ．

                            LWR   (MOX)   ENDF/B-VI

                            MATXS-format   TRANSX/DANTSYS   LWR

MOX   ．

2.

            MATXS-format   ENDF/B-VI Release 5[1]

            ，NJOY   [2]   97.95   94.105   ．   NJOY
RECONR, BROADR, HEATR, UNRESR, THERMR, GROUPR, MATXSR

                                                                ，NJOY   97

            MATXSR   ，

            MATXSR   94.105   ．
Source   ．

                                                                    LWR

            ，   WIMS-D   69

        ．ENDF/B-VI   Pointwise Tolerance   0.2%

                ．

3. TRANSX/DANTSYS

3.1 TRANSX

TRANSX [3] MATXS-format (Diffusion)

. , ,

, Adjoint , , , ,

, MATXS / .

2.15 , ASCII CARD, FIDO, ANISN Binary ISOTXS
(Material-Ordered) GOXS(Group-Ordered) . , GOXS-format

Material-Ordered Group-Ordered GIP

.

TRANSX Bondarenko ,

Dancoff .

.

3.2 DANTSYS

DANTSYS[4] Boltzmann

. Input , Solver , Edit ,

1, 2, 3 ONEDANT,
TWODANT, THREEDANT Solver , 2 Mesh
Mesh TWODANT/GQ, TWOHEX Solver . Solver Iteration
Diffusion Synthetic Acceleration Scheme . CCCC (Committee on
Computer Code Coordination) ISOTXS ANISN, FIDO-format
, Quadrature Set . ,

.

4.

Pacific Northwest Laboratory Plutonium Recycle Critical Facility (PRCF) 1975~6
[5] MOX 6 , PNL30~35 .
International Criticality Safety Benchmark Evaluation Project
(ICSBEP) ICSBEP Handbook[6] .

.

MOX Natural UO$_2$-2wt.%PuO$_2$(8%^{240}Pu) , 1.77800cm, 2.20914cm,
2.51447cm Pitch .
1.2827cm MOX 0.0762cm Zircaloy-2 Gap
1.4351cm . 92.964cm 0.5cm
MOX UO$_2$. (Pure Water)
, . 1 PNL30~35

.

5.

5.1

NJOY   MATXS-format
PNL30~35 MOX   TRANSX/DANTSYS
.   .

TRANSX   ONEDANT   TRANSX   TWODANT

TRANSX   NJOY   MATXS
LWR   ,   Equivalent Cell
.   Cell
ONEDANT   MOX   . ONEDANT
TRANSX   ,   Cell
.

TWODANT   TRANSX
,   MOX   Equivalent Cell
ISOTXS-format   .
ISOTXS   TWODANT   ,   (k_{eff})
.

TRANSX   Bell-Hansen-Sandmeier   ,
Dancoff   Saurer   .   69
.   Legendre P_3,   Quadrature
S_8 . TWODANT   Pitch   9   16
Mesh   ,   30cm   .
Inner   Outer Iteration 10^{-5} ,   TWODANT
Edit   Mesh   . TWODANT
Buckling Height   .

5.2

2   TRANSX/TWODANT   ICSBEP
Handbook   MCNP   .   ,

(Benchmark Model)   .
Pitch k_{eff} ,   Pitch
k_{eff} .
MCNP   ,   Hatice Akkurt[7]
ESADA
TWODANT   .

C/E

(Calculation to Experiment Ratio)   1~6   .

(Pin Number)   ,

.   [8]   HELIOS

. PNL30   PNL31

. PNL32

1/4   , PNL32

.

, PNL34   . PNL33

,   HELIOS   MCNP

.

PNL35   .

6.

ENDF/B-VI Release 5   LWR   69

TRANSX/DANTSYS   PNL30~35

. k_{eff} .   ,   Pitch k_{eff}

k_{eff} MCNP

.   ,

.   .

.

[1] Cross Section Evaluation Working Group, "ENDF-102 Data Formats and Procedures for the Evaluated Nuclear Data File ENDF-6," BNL-NCS-44945 (1990)

[2] R. E. MacFarlane and D. W. Muir, "The NJOY Nuclear Data Processing System Version 91," LA-12740-M (1994)

[3] R. E. MacFarlane, "TRANSX 2 : A Code for Interfacing MATXS Cross-Section Libraries to Nuclear Transport Codes," LA-12312-MS (1993)

[4] Ray. E. Alcouffe et al., "DANTSYS : A Diffusion Accelerated Neutral Particle Transport Code System," LA-12969-M (1995)

[5] R. I. Smith and G. J. Konzek, "Clean Critical Experiment Benchmarks for Plutonium Recycle in LWR's," EPRI-NP-196, Volume I (1976)

[6] Hyung-Kook Joo,   "Rectangular Arrays of Water-Moderated UO$_2$-2Wt.%PuO$_2$(8%^{240}Pu) Fuel

Rods," MIX-COMP-THERM-002, ICSBEP Handbook (1997)

[7] Hatice Akkurt and Naeem M. Abdurrahman, "Benchmark Calculations of the ESADA Single-Region Mixed-Oxide Critical Experiments," *Nucl. Technol.*, **127**, 301 (1999)

[8]   ,   , "PNL30-35   HELIOS   ," '99
   ,   (1999)

1. PNL

Experiment Number	Pitch (cm)	Number of Fuel Rods	Boron Concentration (ppm)	Axial Buckling Height (cm)	Temperature ( )
PNL30	1.77800	469	1.7	104.19432	20.98
PNL31	1.77800	761	687.9	102.57117	21.90
PNL32	2.20914	195	0.9	102.89525	22.75
PNL33	2.20914	761	1090.4	101.99654	22.66
PNL34	2.51447	161	1.6	100.14014	22.15
PNL35	2.51447	689	767.2	102.03419	23.40

2. PNL k_{eff}

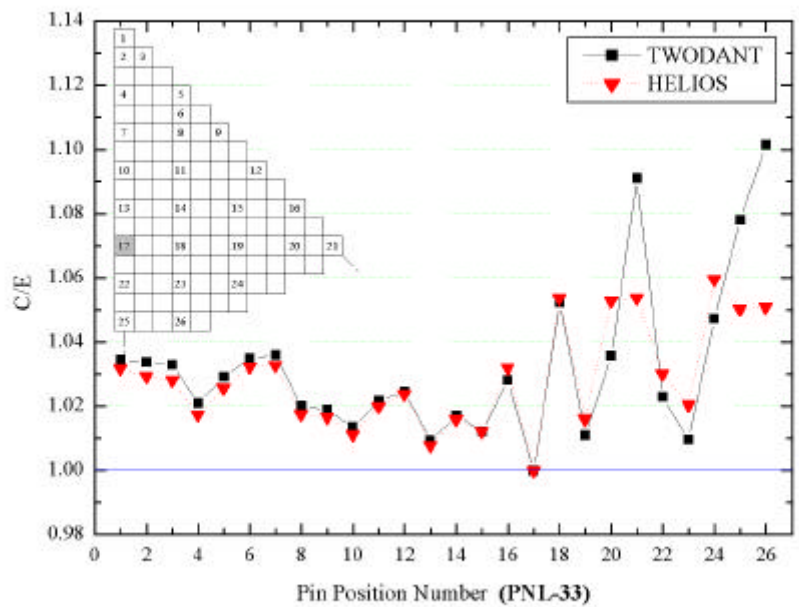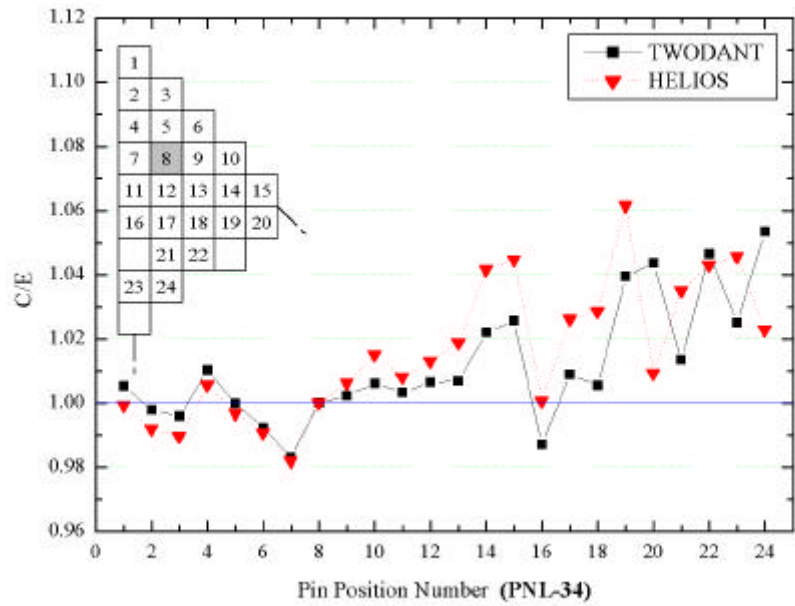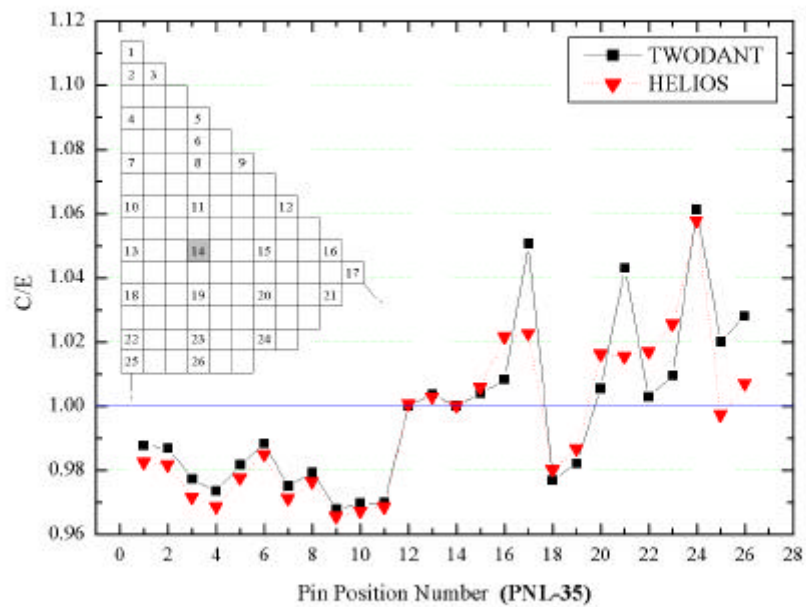| Case	PNL30	PNL31	PNL32	PNL33	PNL34	PNL35
Experiment	1.00018	1.00006	1.00019	1.00022	1.00096	1.00013
Benchmark-Model*	1.0024	1.0009	1.0042	1.0024	1.0038	1.0029
TWODANT	0.98981	0.99321	0.99988	1.00610	1.00489	1.00713
MCNP* (ENDF/B-V)	0.9990 ± 0.0008	0.9996 ± 0.0009	1.0031 ± 0.0009	1.0071 ± 0.0008	1.0061 ± 0.0008	1.0077 ± 0.0008

* Data from ICSBEP Handbook (Ref. 6)
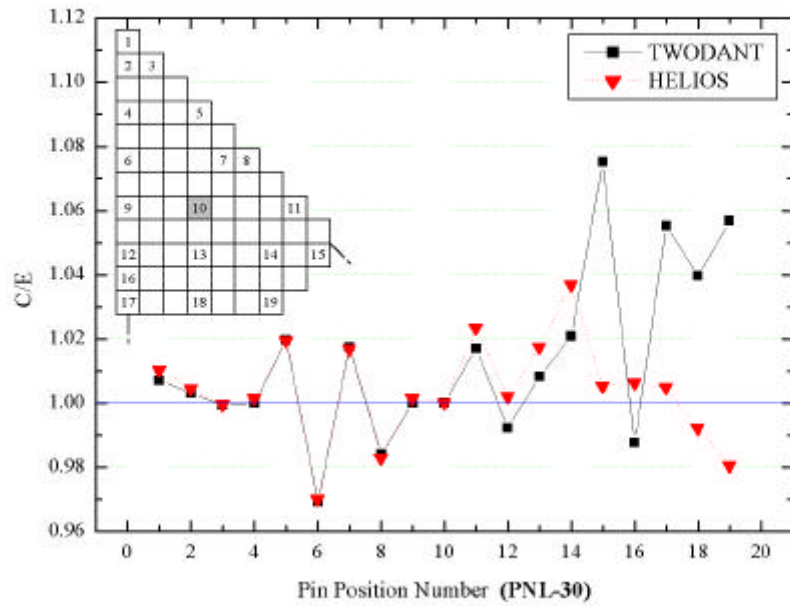
1. PNL30
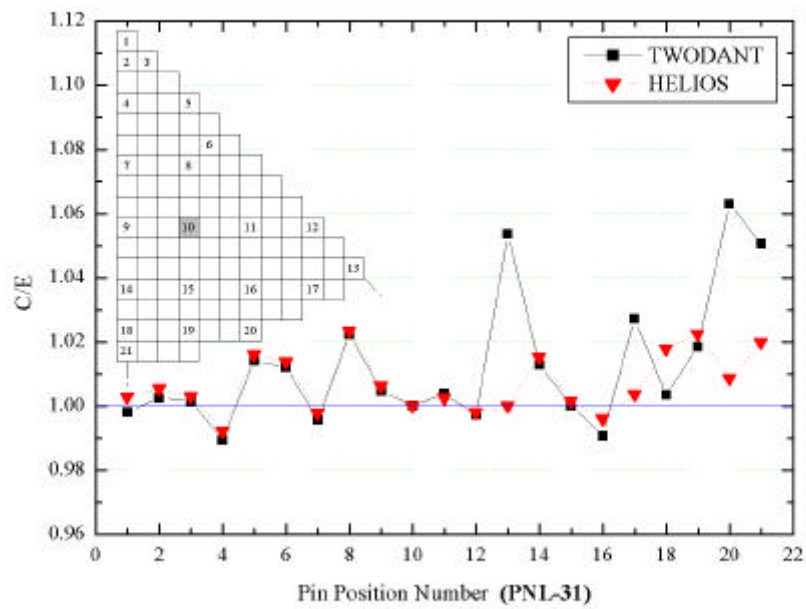
2. PNL31
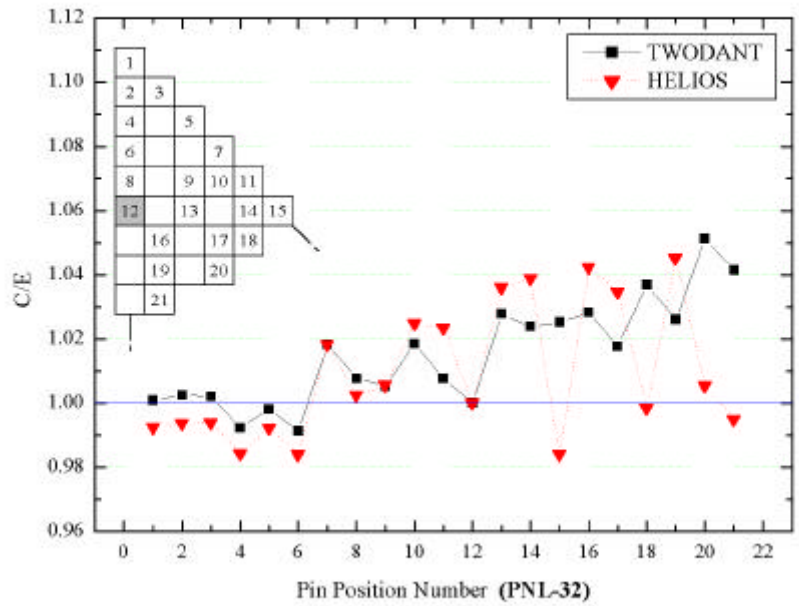
3. PNL32

4. PNL33

5. PNL34

6. PNL35