Working Party on International Nuclear Data Evaluation Co-operation (WPEC) Subgroup 33
Methods and issues for the combined use of integral experiments and covariance data
3rd meeting, NEA, Issy-les-Moulineaux, France, 2 June 2010

BENCHMARK SPECIFICATIONS FOR ZPPR-9, JOYO and JAEA FBR

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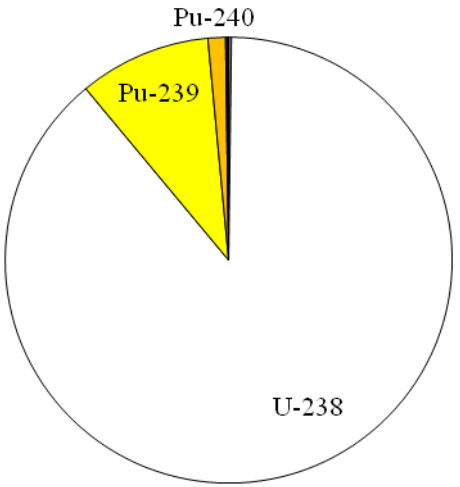
Brief Description of ZPPR-9 and Joyo MK-I

ZPPR-9

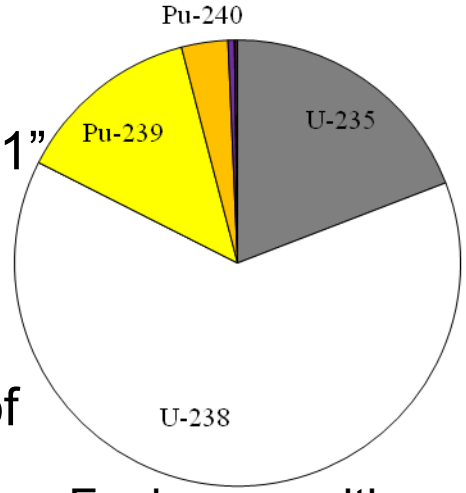
IRPhEP ID: “ZPPR-LMFR-EXP-002”
- Date: May - September 1978
- Size: 4600-liter
- Shape: Cylindrical and clean
- Mock-up type: Conventional mixed-oxide-fueled two-zone liquid metal fast breeder reactors of about 650 MWe



Fuel composition
(Inner core region)

Joyo MK-I

IRPhEP ID: “JOYO-LMFR-RESR-001”
- First criticality: April 24, 1977
- Fuel: Plutonium-uranium mixed oxide (MOX)
- Surrounding: Radial/axial blanket of depleted uranium oxide
- Maximum thermal power: 75 MWt



Fuel composition
(Driver region)

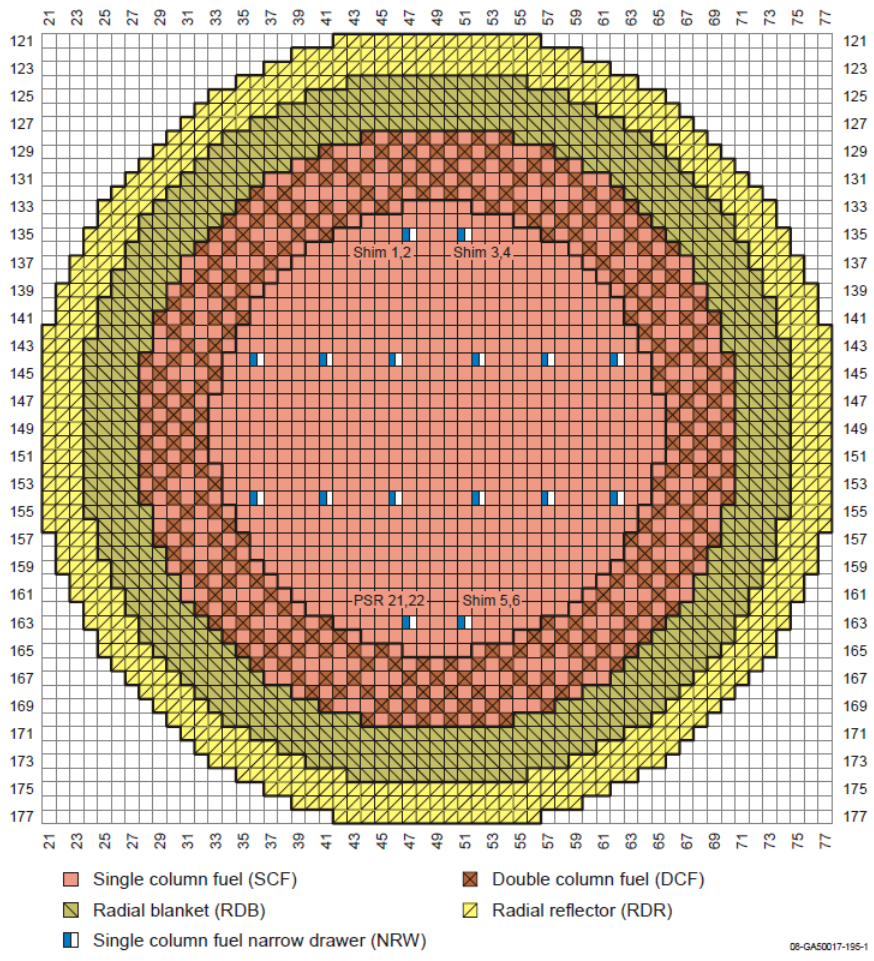


Fig. 1.8 ZPPR-9 Reference Configuration (Half 1)

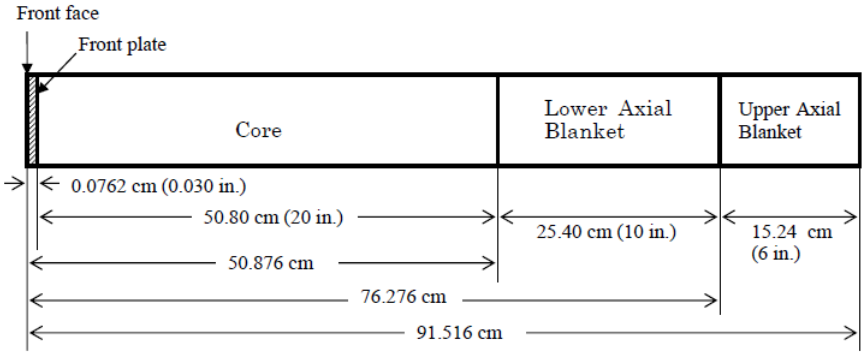


Fig. 1.9 The Relation between Drawer Configuration and Core Length

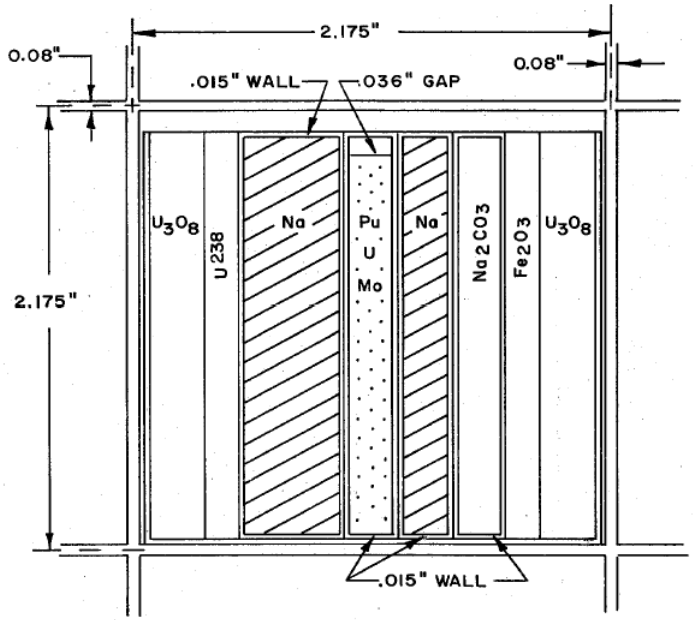
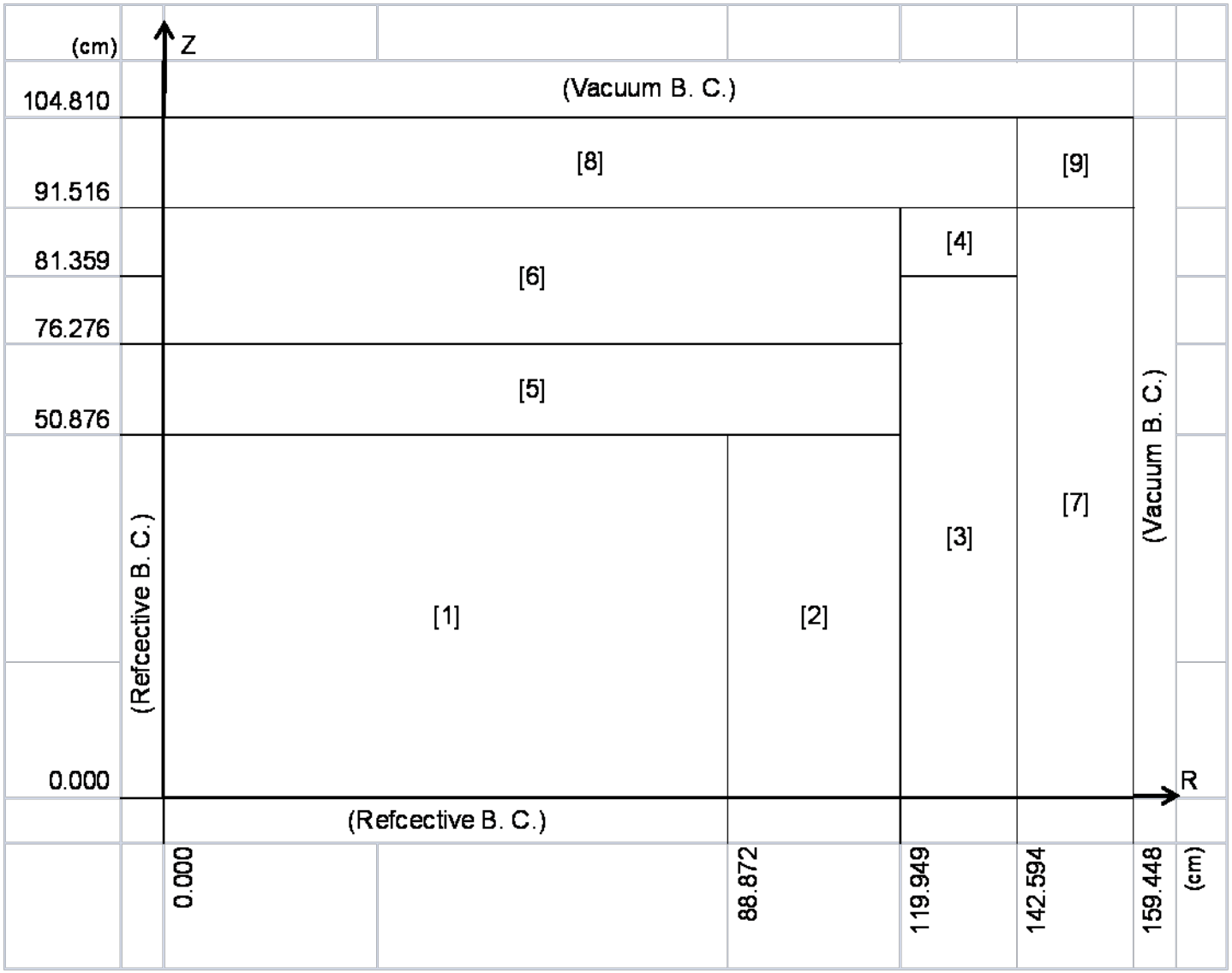


Fig. 1.10 Typical Cross Section of a Drawer in a Matrix Tube (Ref.: "The JUPITER Program: ANL Analysis of ZPPR-9", PNC SA385 85-01, Argonne National Laboratory (Sep. 1980).)

Fig. Configuration of ZPPR-9
(Radial layout, axial layout, cross-section of a drawer)



[1] Inner Core	
[2] Outer Core	
[3] Radial Blanket (Lower)	
[4] Radial Blanket (Upper)	
[5] Axial Blanket (Lower)	
[6] Axial Blanket (Upper)	
[7] Radial Reflector	
[8] Axial Reflector	
[9] Matrix	

Fig. 2-D RZ-geometry modeling of ZPPR-9
(For critical mass)

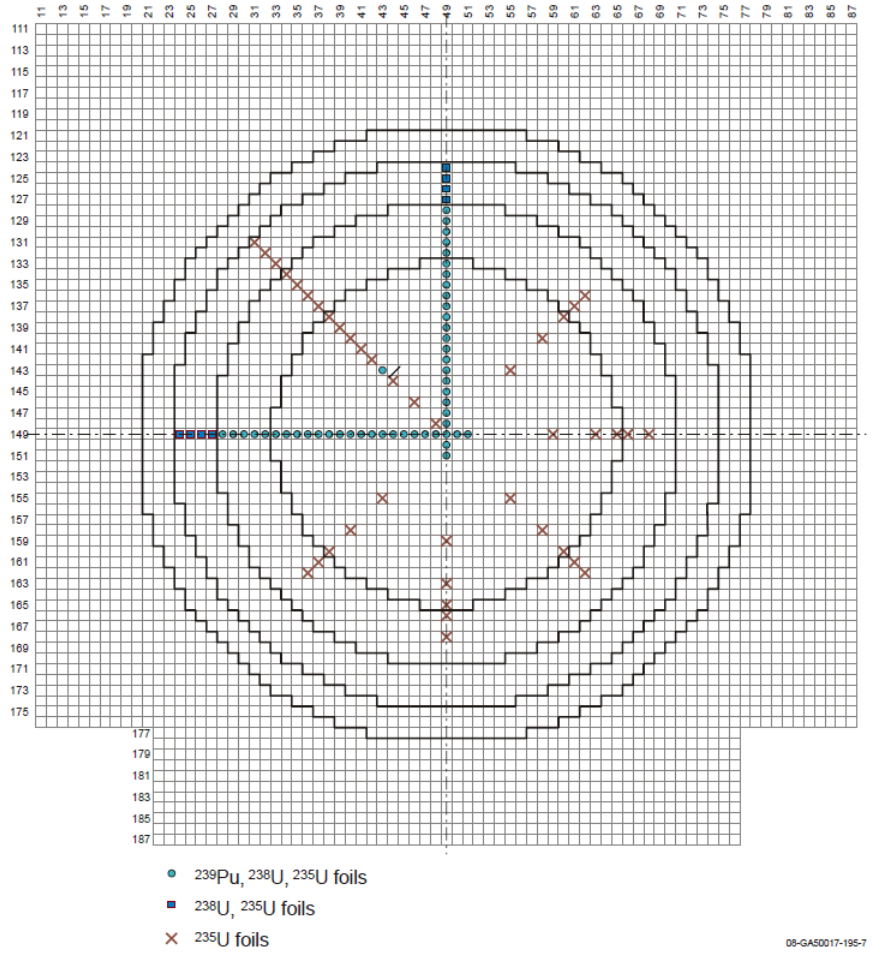


Fig.1.31 Measured Radial Reaction Rate Positions in ZPPR-9 (Ref.; D. N. Olsen, "ZPPR Assembly 9 – Detailed Work Plan No. 3", ZPR-I-306, Argonne National Laboratory (Jun. 1978).)

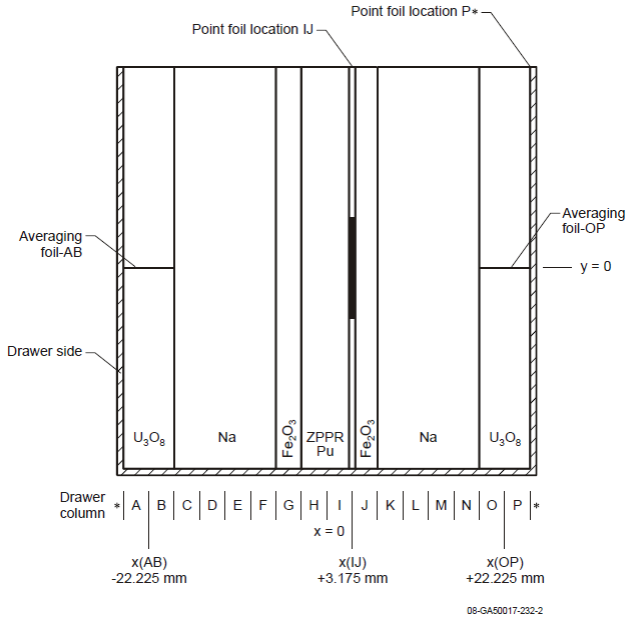
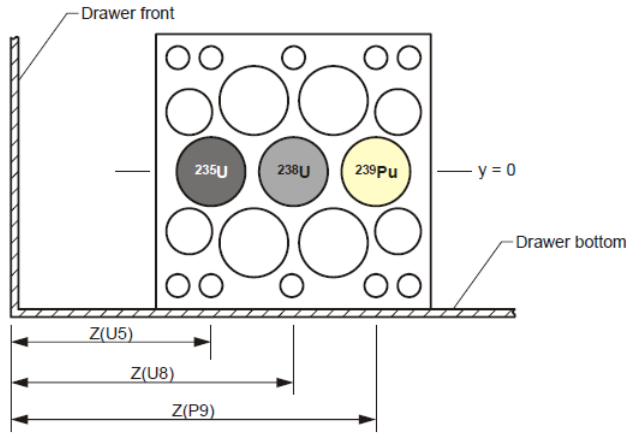


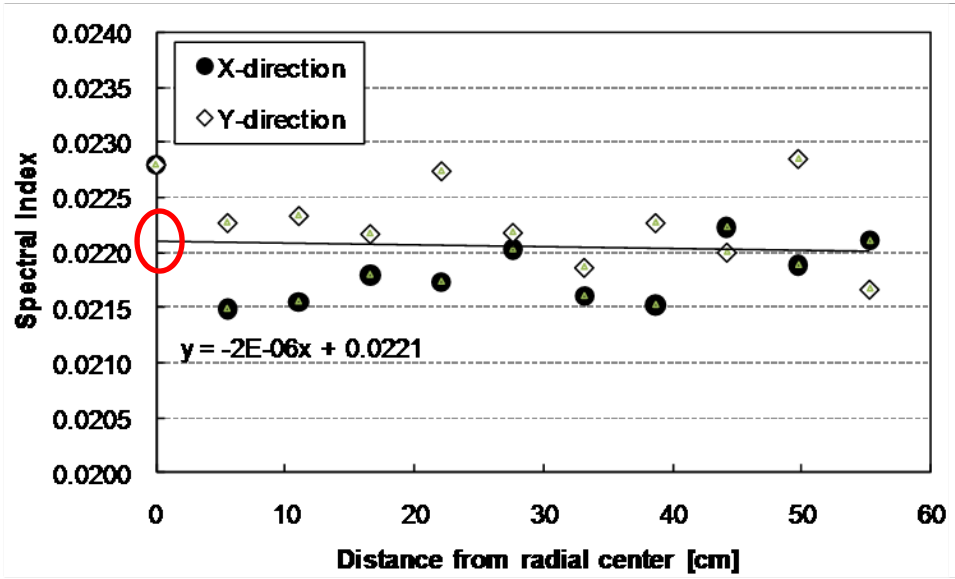
Fig.1.33 Foil Locations in a Drawer (view from front)



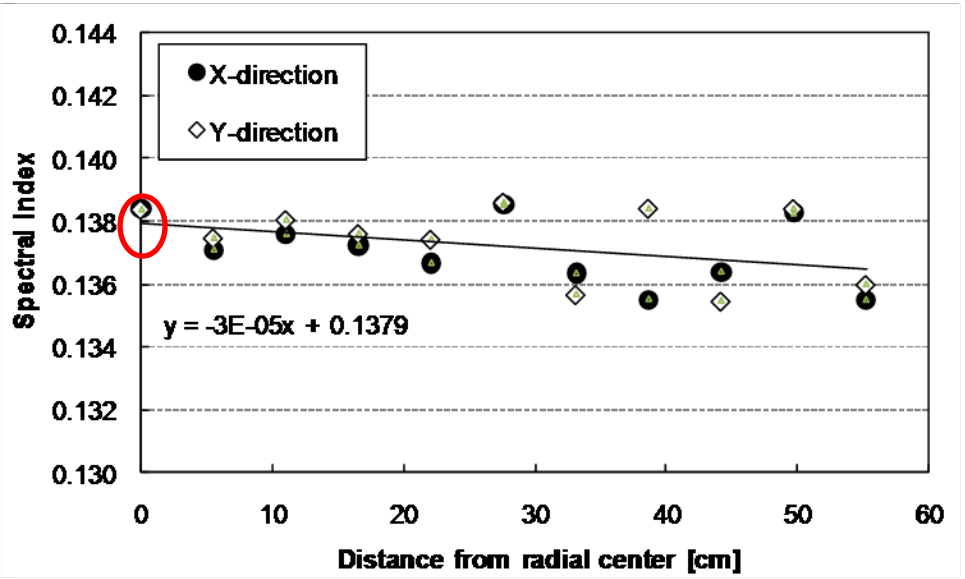
Holder Orientation R

Fig. Measurement of reaction rate in ZPPR-9

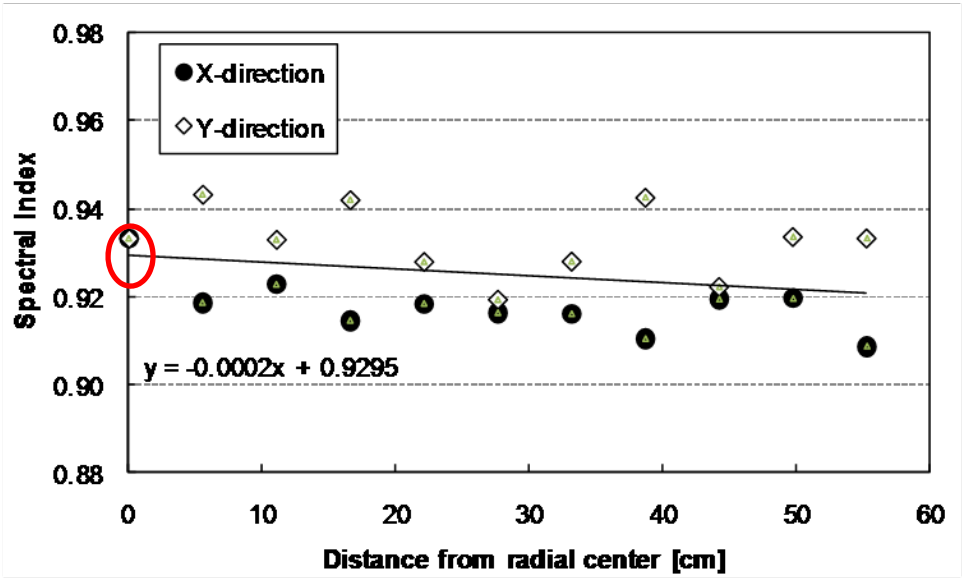
(Radial layout, cross-section of a drawer with irradiation foils)



F28/F25



C28/F25



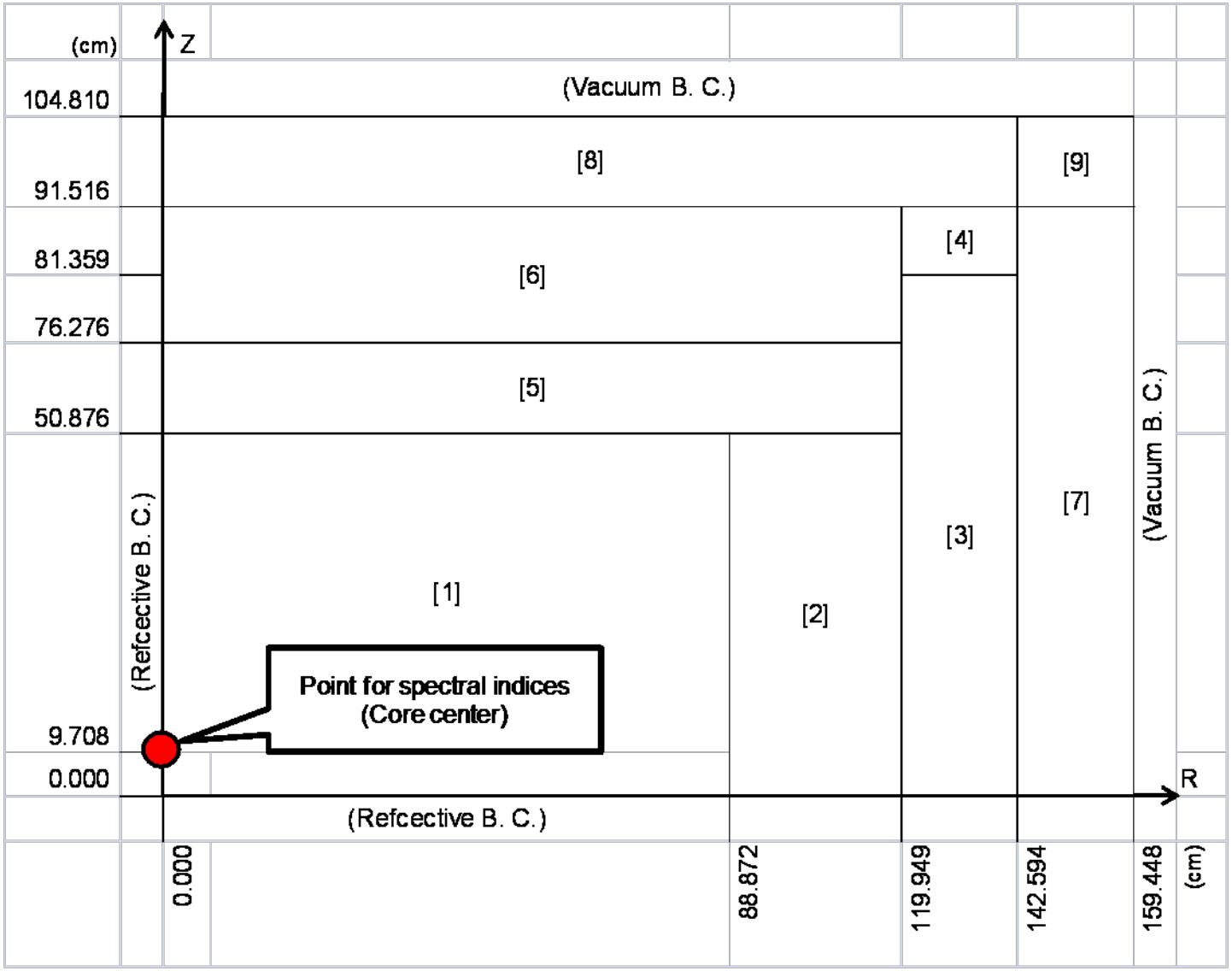
F49/F25

Table Experimental values

Spectral index	New	Previous	
	Core center	Inner core average	Outer core average
F28/F25	0.02210	0.02230	0.02682
F49/F25	0.9295	0.9289	0.9600
C28/F25	0.1379	0.1373	0.1350

REPLACEMENT

Fig. Experimental values of spectral indices on ZPPR-9



[1] Inner Core
[2] Outer Core
[3] Radial Blanket (Lower)
[4] Radial Blanket (Upper)
[5] Axial Blanket (Lower)
[6] Axial Blanket (Upper)
[7] Radial Reflector
[8] Axial Reflector
[9] Matrix

REPLACEMENT

Fig. 2-D RZ-geometry modeling of ZPPR-9
(For spectral indices)

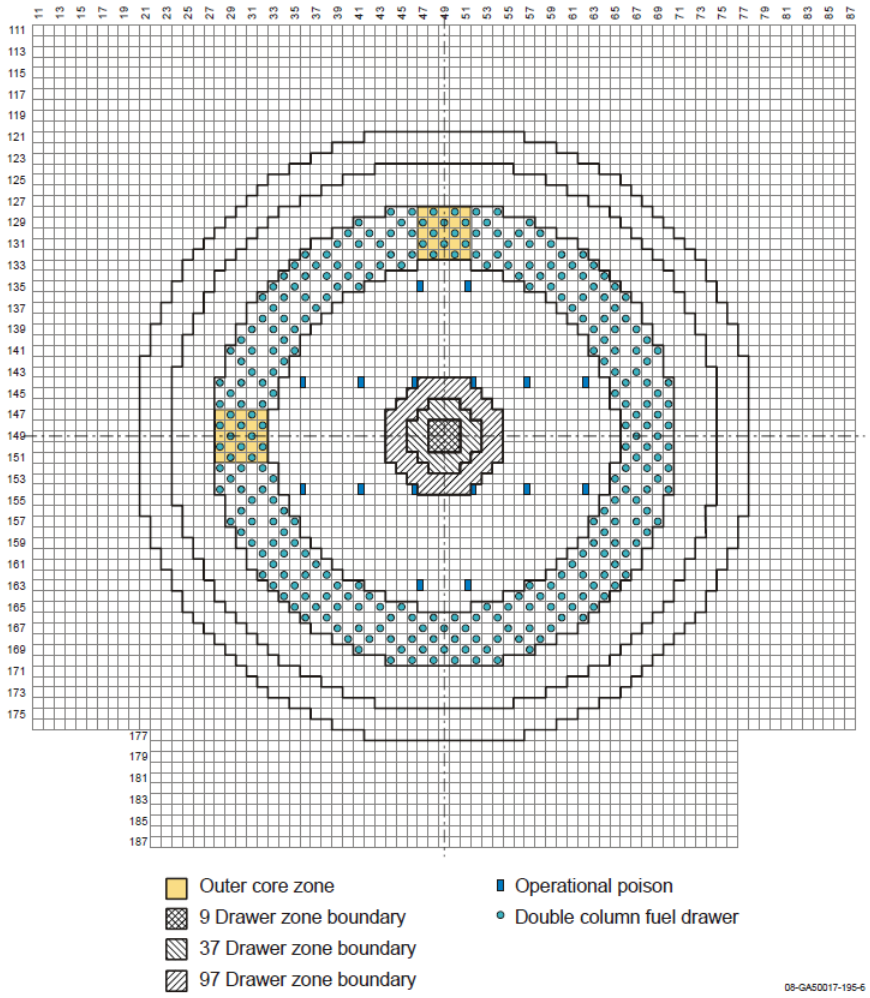


Fig.1.25 ZPPR-9 Sodium Void Zones (Ref.: "ZPPR-9 Monthly Report for October 1978", ZPR-TM-329, Argonne National Laboratory (Oct. 1978).)

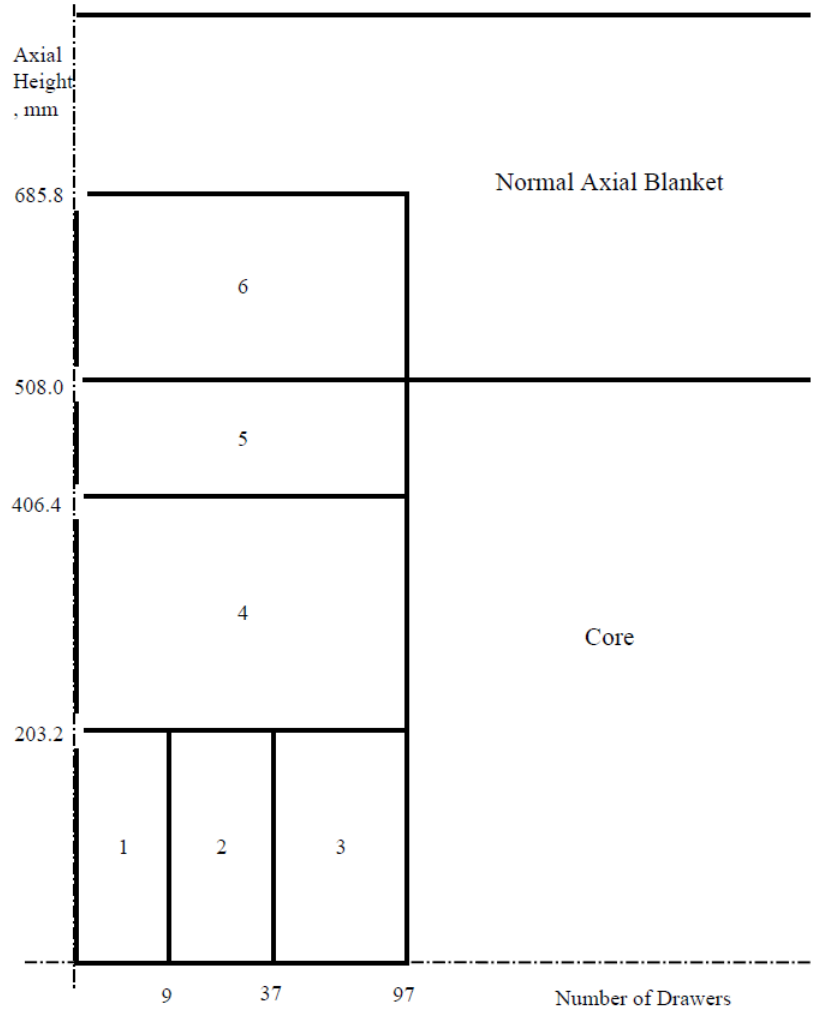
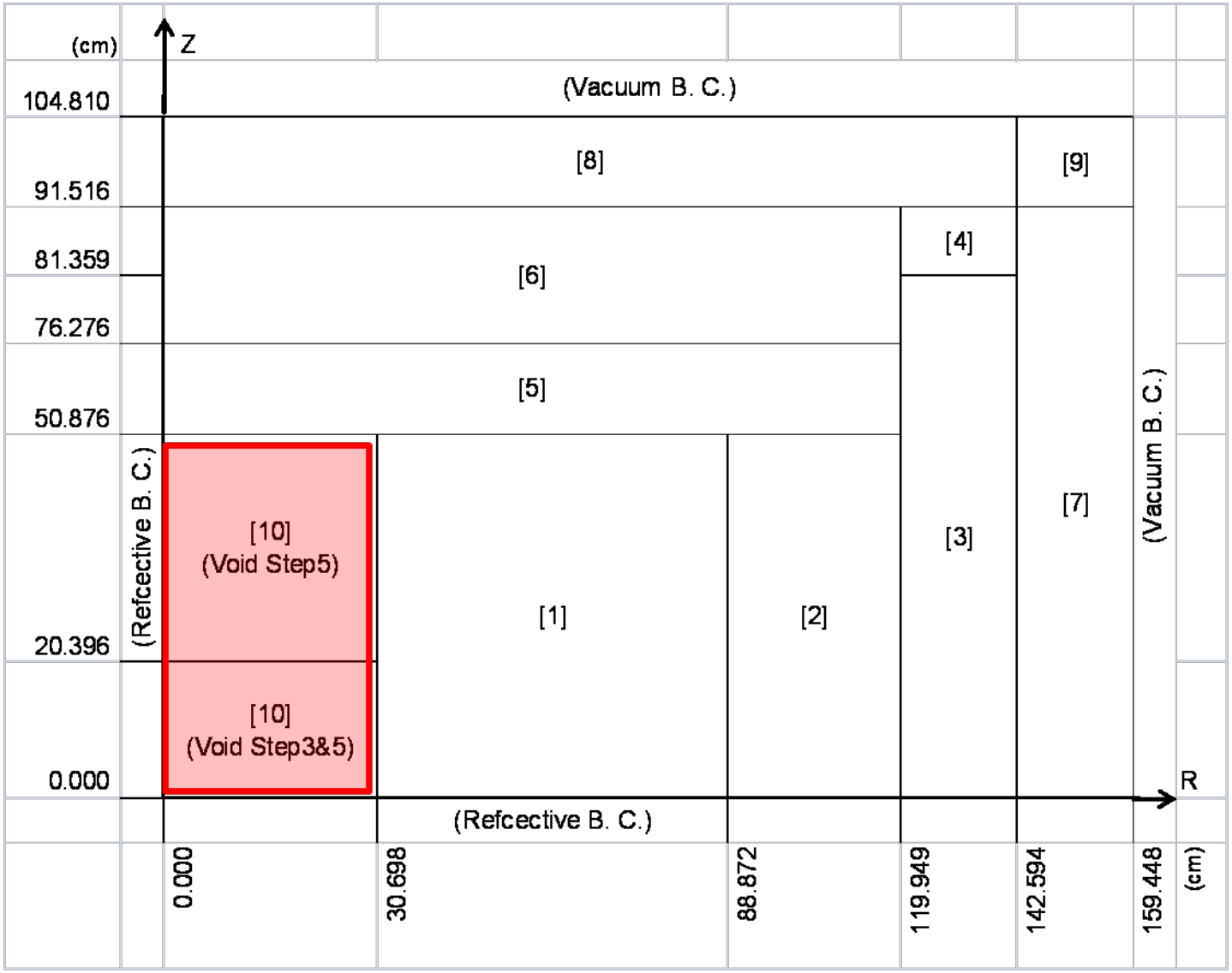


Fig. 1.26 Sequence for Zone Voiding in ZPPR-9 (Ref.: "ZPPR-11 Monthly Report for February 1980", ZPR-TM-361, Argonne National Laboratory (Feb. 1980).)

Fig. Measurement of sodium void reactivity in ZPPR-9
(Radial layout, axial layout)



[1] Inner Core
[2] Outer Core
[3] Radial Blanket (Lower)
[4] Radial Blanket (Upper)
[5] Axial Blanket (Lower)
[6] Axial Blanket (Upper)
[7] Radial Reflector
[8] Axial Reflector
[9] Matrix
[10] Na voided Inner Core

Fig. 2-D RZ-geometry modeling of ZPPR-9
(For sodium void reactivity)

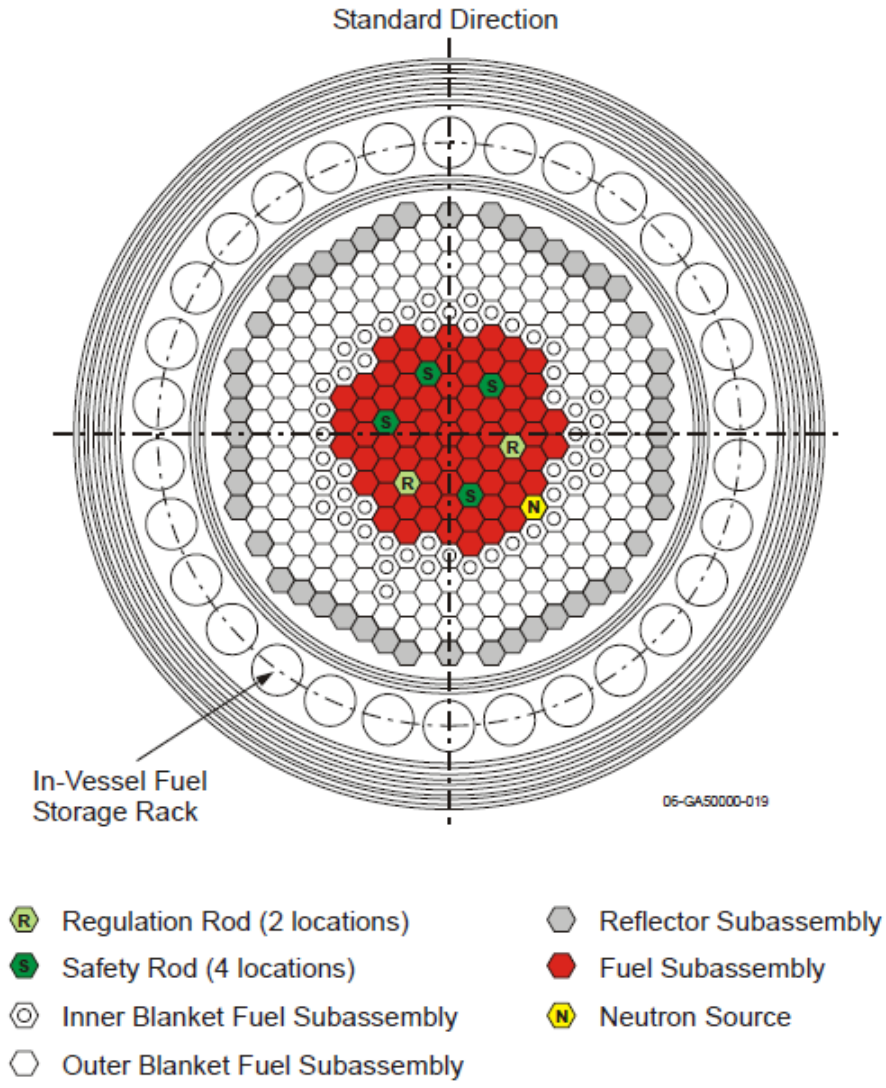


Figure 1.4. Horizontal Cross-section of JOYO MK-I Core.

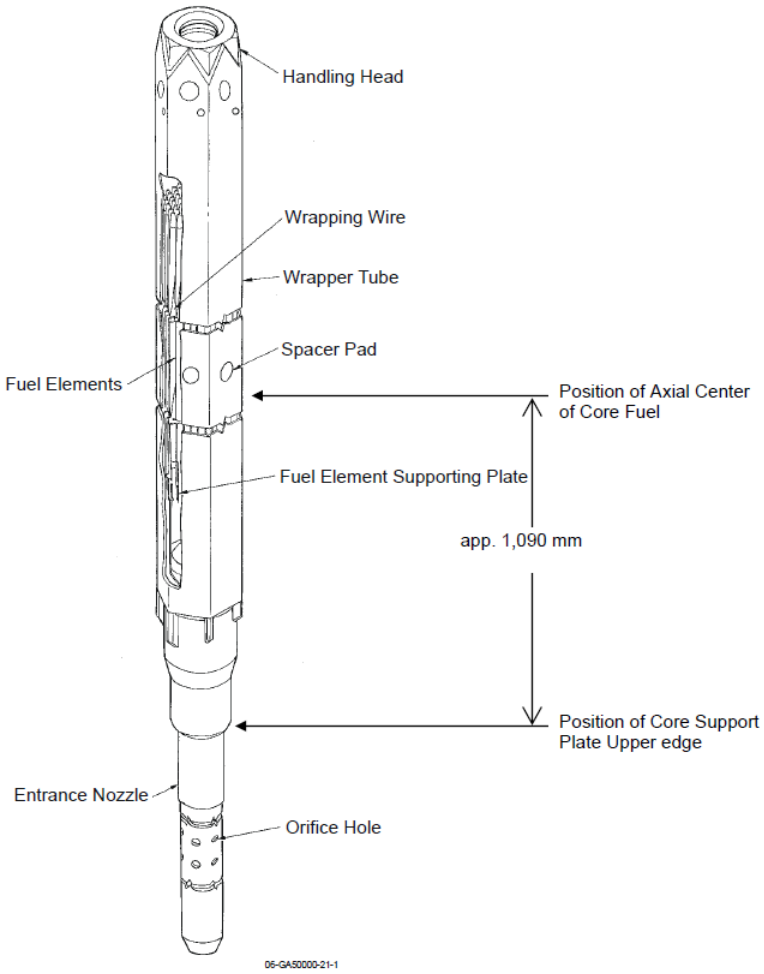


Figure 1.6. Schematic View of Core Fuel Subassembly.

Fig. Configuration of Joyo MK-I
(Radial layout, schematic view of fuel subassembly)

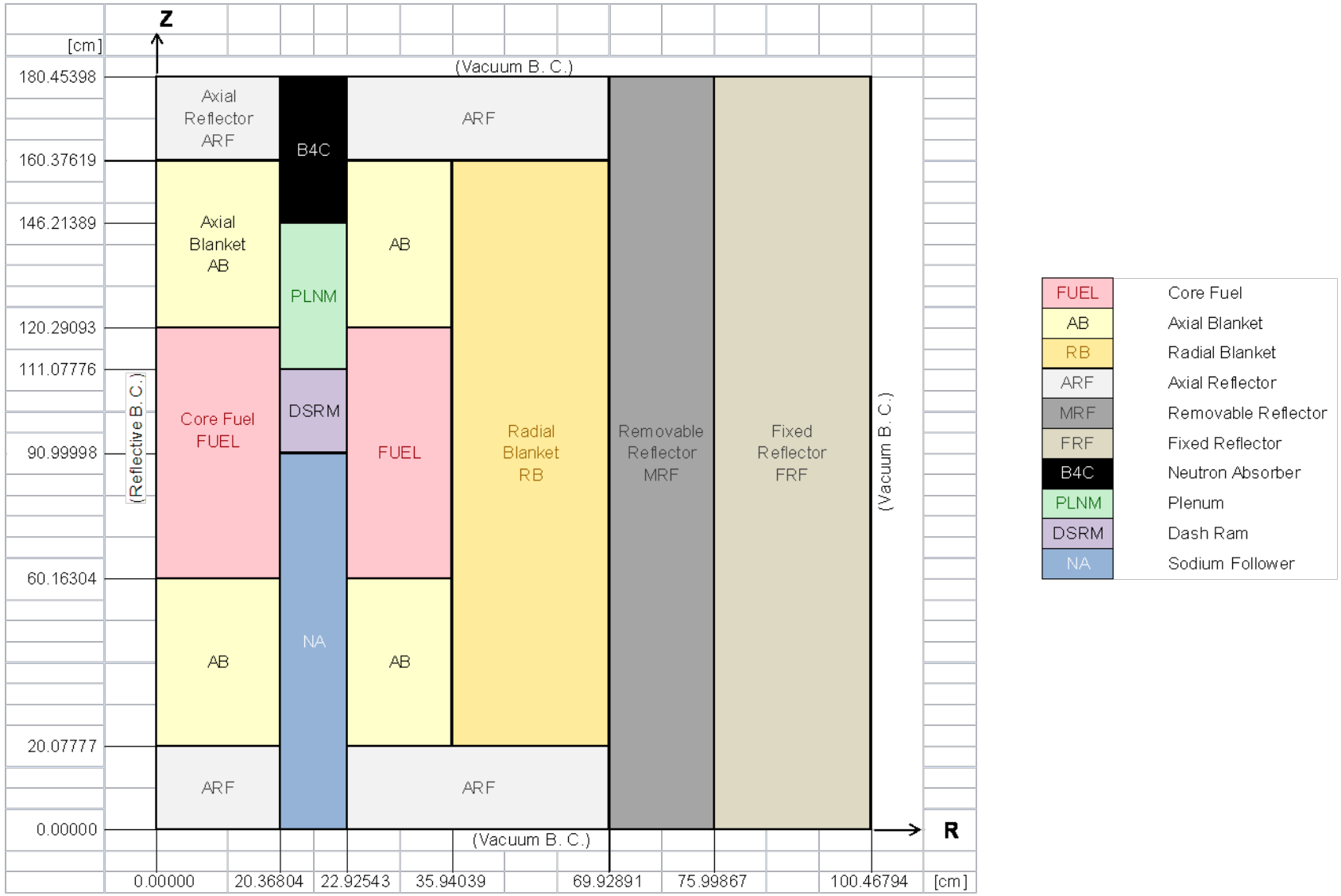
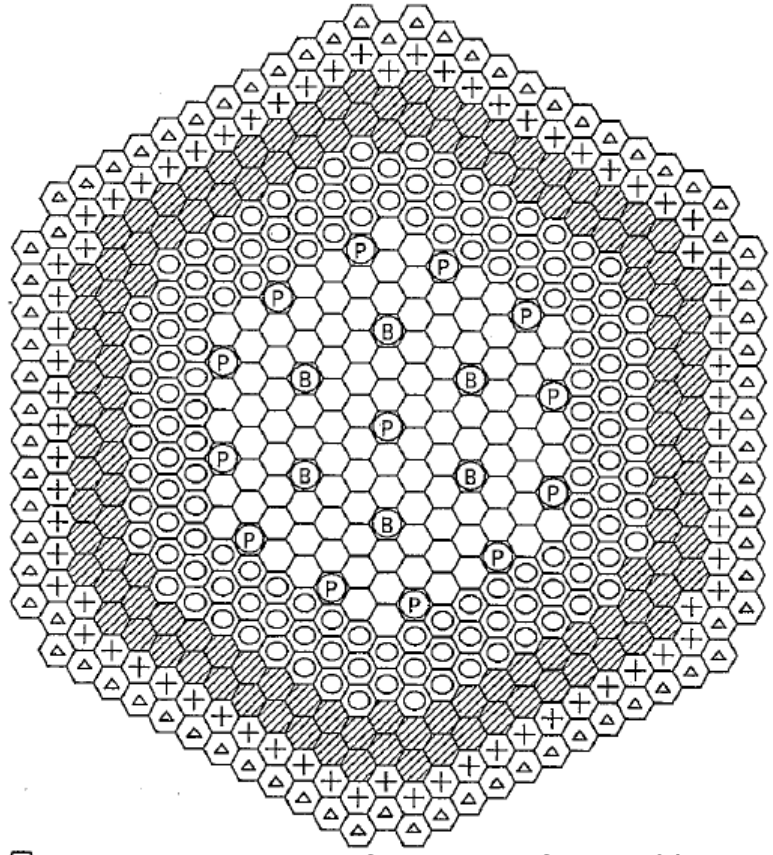


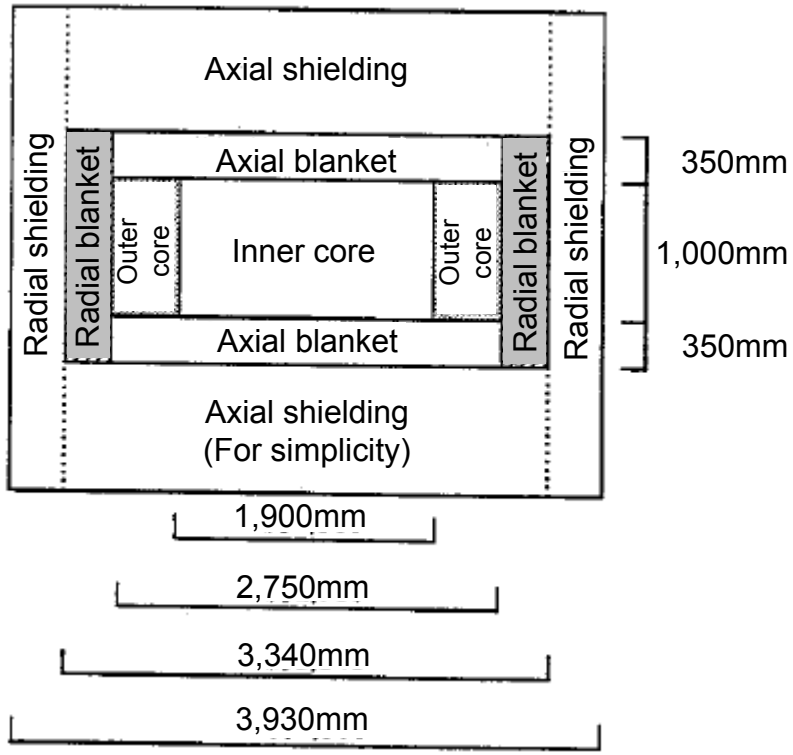
Fig. 2-D RZ-geometry modeling of Joyo MK-I
(For critical mass)

Brief Description of JAEA FBR (600MWe FBR Core)



- Inner core (Pu* fraction of 17wt%)
- Outer core (Pu* fraction of 21wt%)
- Radial blanket
- Stainless steel shielding
- B_4C shielding
- Primary control rod
- Back-up control rod

**Pu isotopic composition: 3/53/25/12/7wt% (238/239/240/241/242)*



Major specification

Thermal / Electric power: 1,600MWt / 600MWe
Fuel type: Plutonium-uranium mixed oxide
Operation cycle length: 375 days
Refueling batch (core): 3
Discharge burnup (core): 86GWd/t
Burnup reactivity swing: 2.7%Δk/kk'
Breeding ratio: 1.2

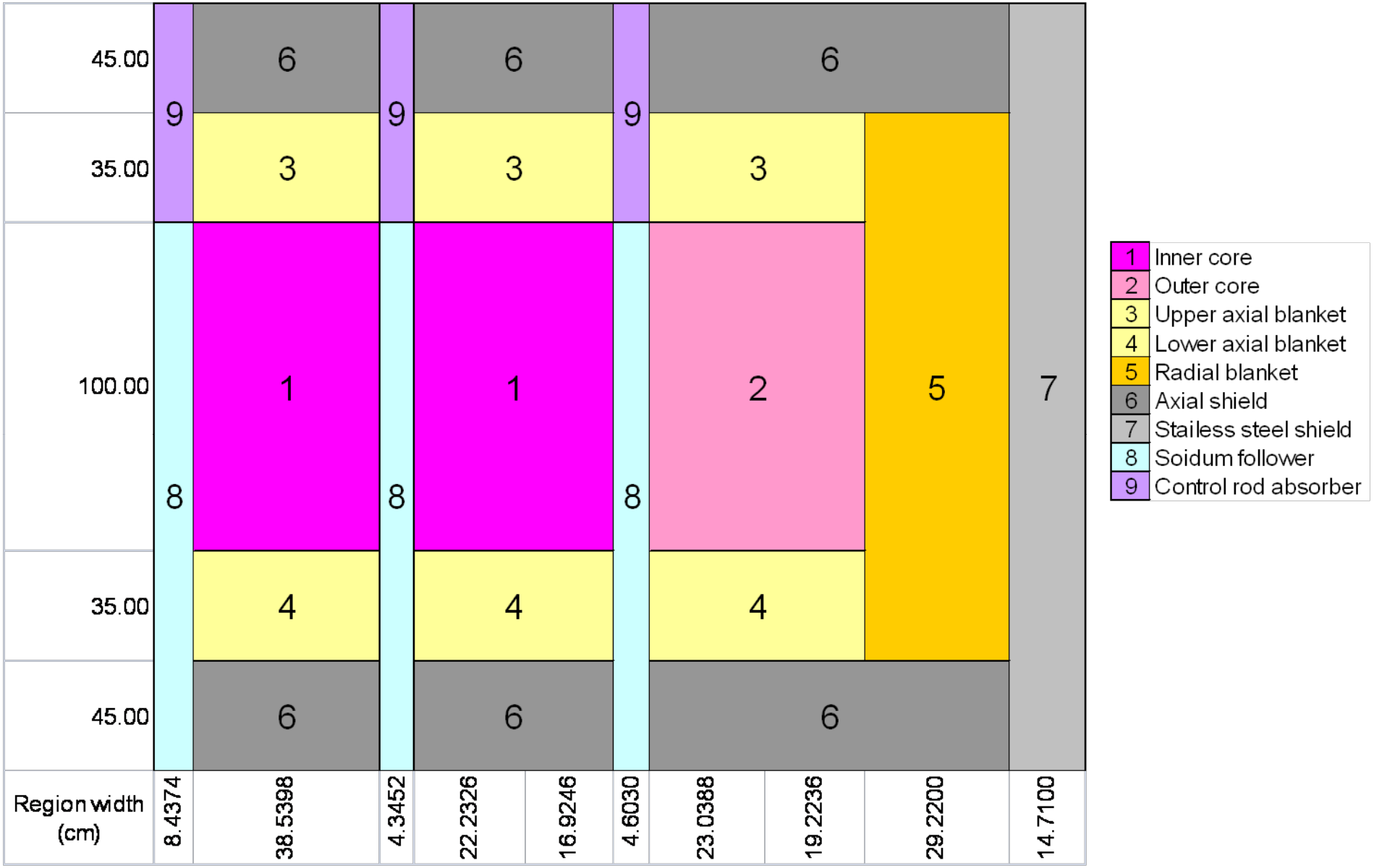


Fig. 2-D RZ-geometry modeling of JAEA FBR
(Reference model)

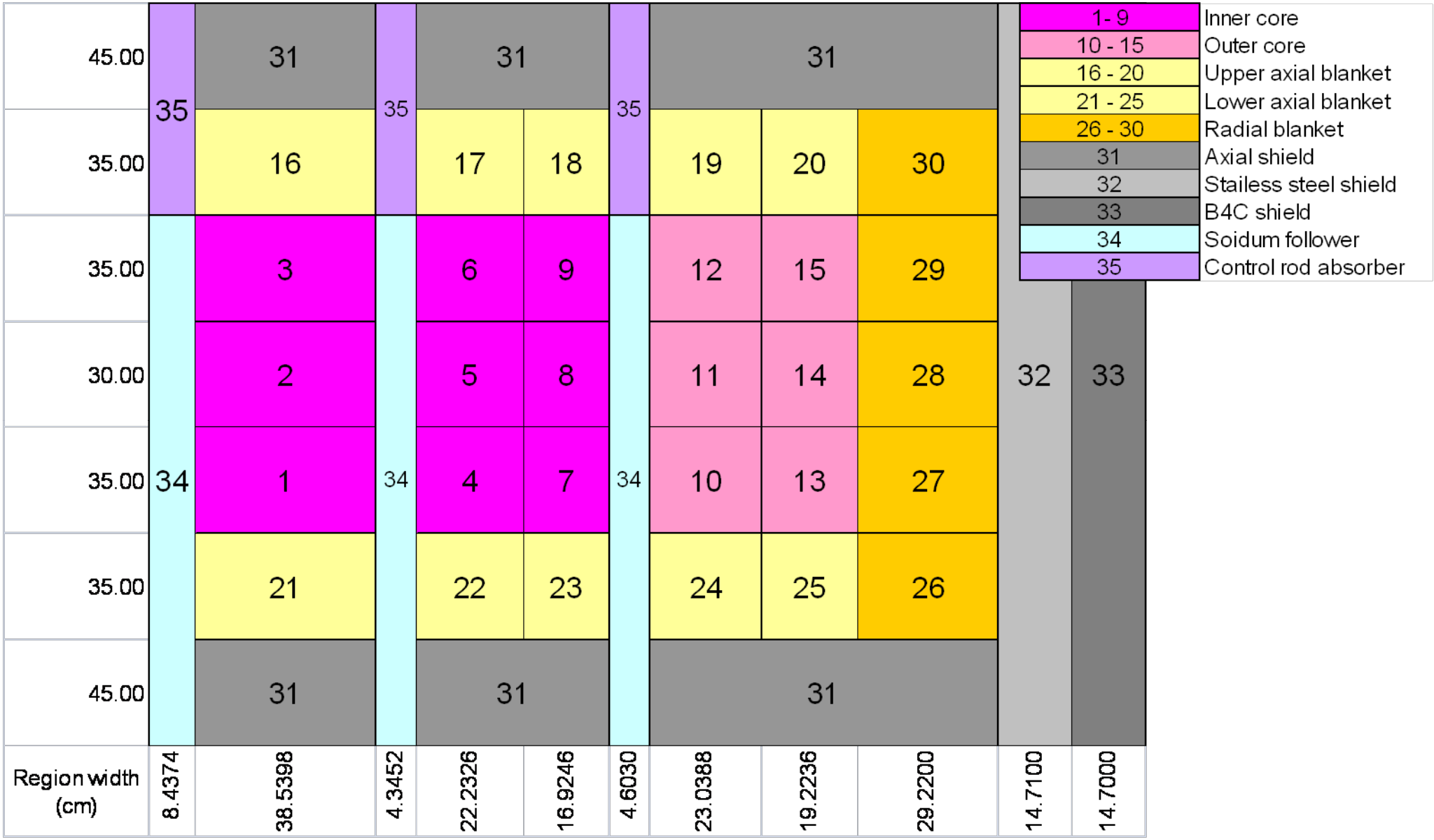


Fig. 2-D RZ-geometry modeling of JAEA FBR
(Detailed model)