



Near-Final Radial Build and Composition for LiPb/FS/He System

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<http://fti.neep.wisc.edu/aries-cs/builds/build.html>

March 8, 2006

Blanket Concepts

Breeder

Structure

FW/Blanket
Coolant

Shield
Coolant

VV
Coolant

LiPb (reference) **FS**

He/LiPb

He

H₂O

LiPb (back-up) **SiC**

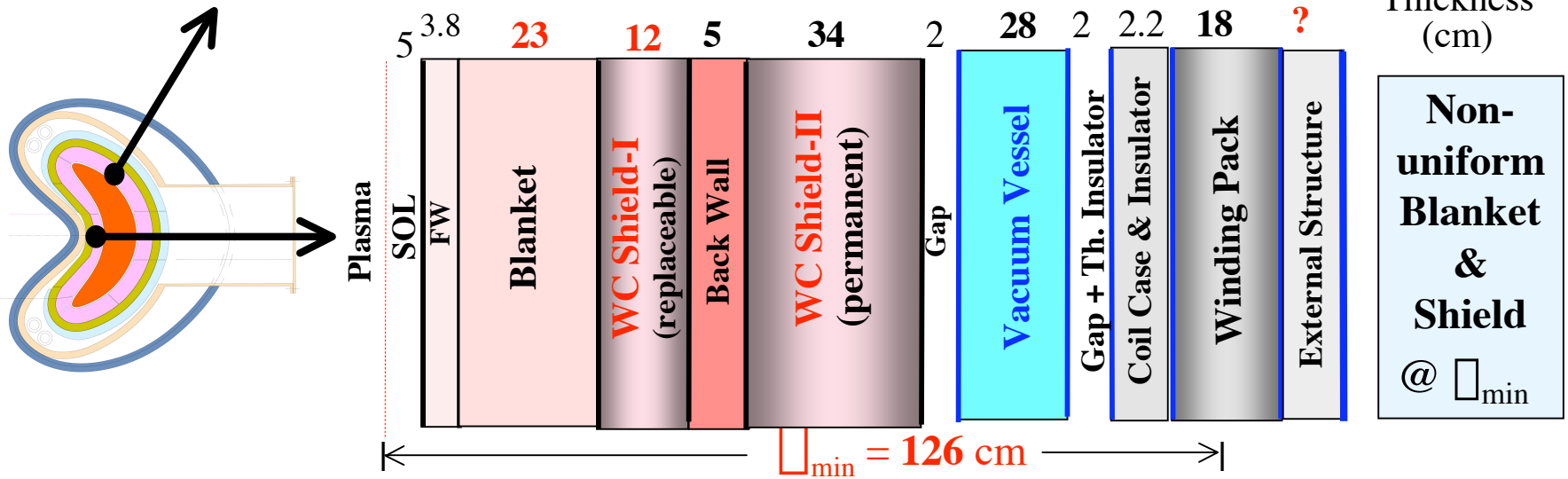
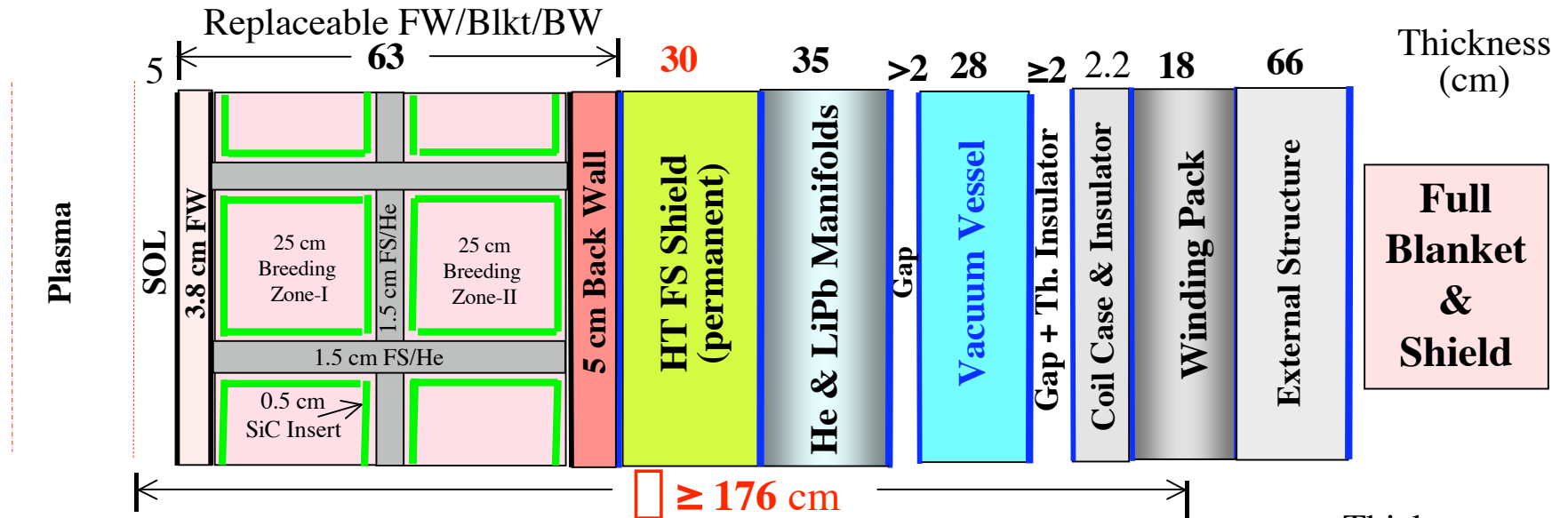
LiPb

LiPb

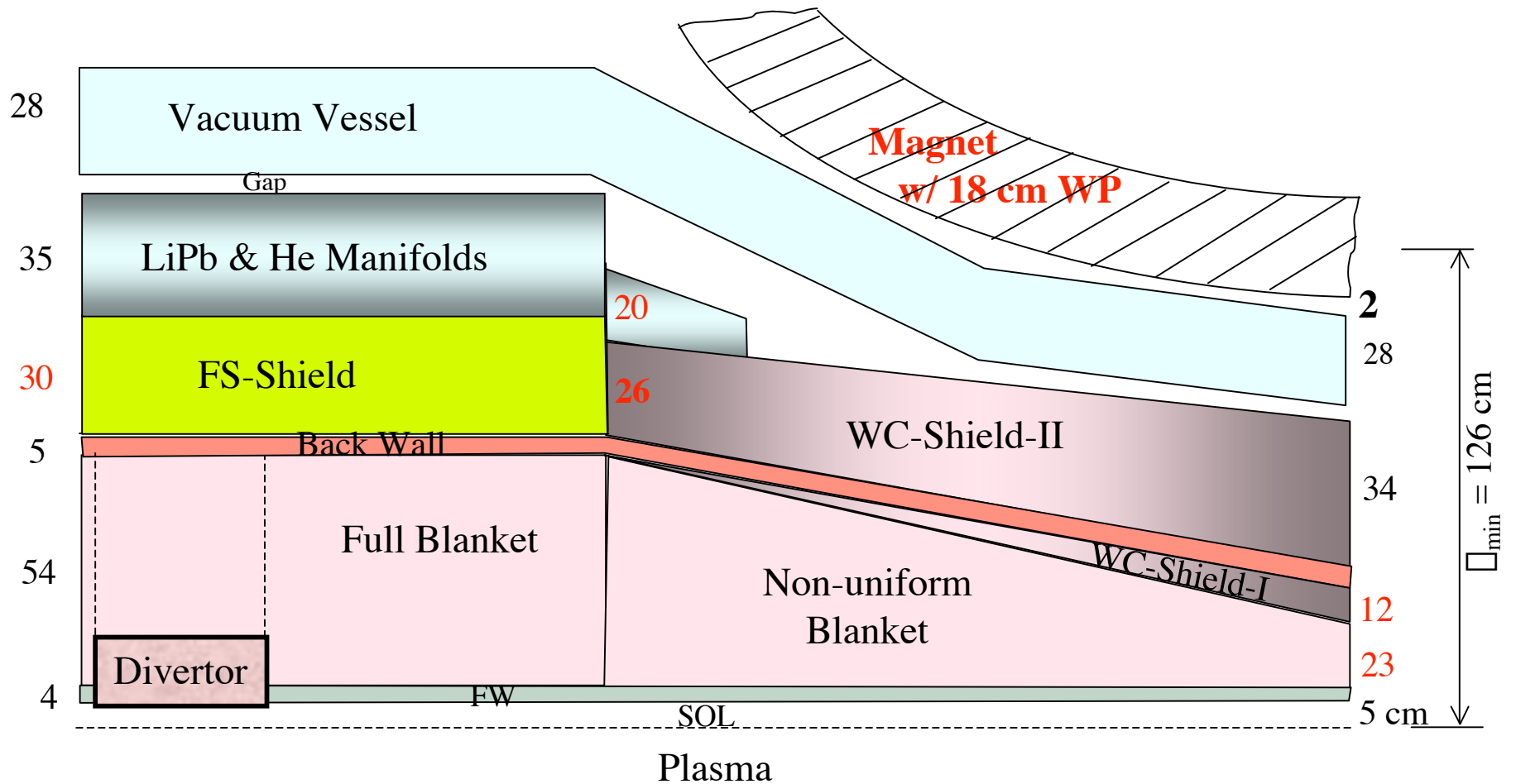
H₂O

- 3 FP configuration
- Major Radius ≈ 7.5 m
- Peak $\square \approx 4.5$ MW/m²
- Average $\square \approx 3$ MW/m²
- Internal VV (located inside magnets)
- Port maintenance approach.

Near-Final Radial Build (4.5 MW/m² peak $\dot{q}$)



Radial / Toroidal Xn

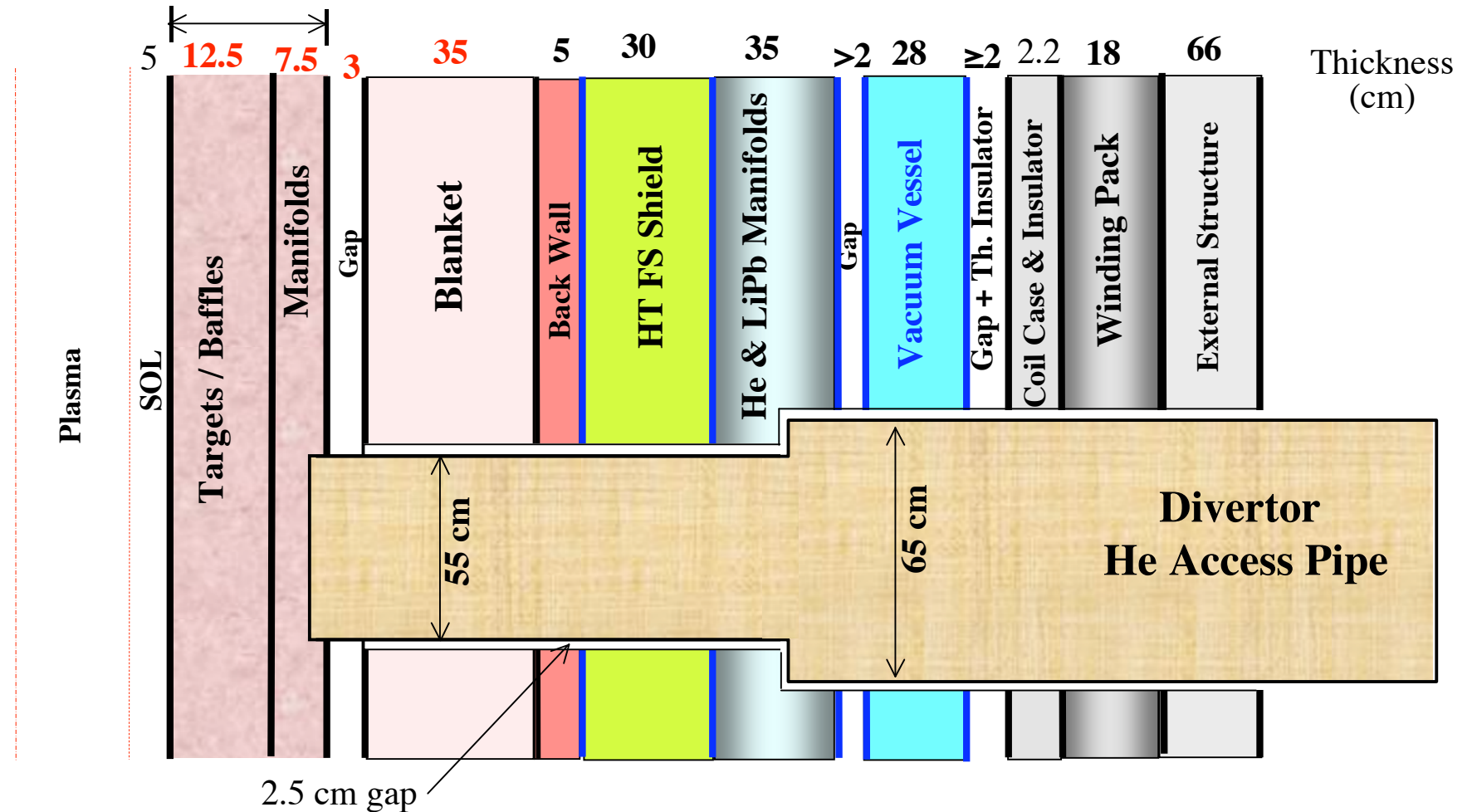


Full Blanket/shield and Divertor
(72% of FW area)

Non-uniform Blanket/Shield
(28% of FW area)

Xn through Divertor System

20 cm Divertor System



Damage at shield/manifolds TBD. It depends on $\square$ at divertor and streaming through pipe



Compositions and Coverage Fractions (R= 7.5 m)

<u>Component</u>	<u>Thickness</u>	<u>Coverage Fraction</u>	<u>Composition</u>
FW*	3.8 cm	90%	34% FS Structure 66% He Coolant
Divertor System*	20 cm	10%	32.6% FS Structure 4.0% W 63.4% He Coolant
Blanket behind Divertor*	35 cm	10%	75% LiPb (90% enriched Li) 9% SiC Inserts 8% FS Structure 8% He Coolant
Non-uniform Blanket*	23-54.3 cm	28%	76% LiPb (90% enriched Li) 8% SiC Inserts 8% FS Structure 8% He Coolant
Full Blanket*	54.3 cm	62%	79% LiPb (90% enriched Li) 7% SiC Inserts 6% FS Structure 8% He Coolant
Back Wall*	5 cm	100%	80% FS Structure 20% He Coolant
FS Shield	30 cm	72%	15% FS Structure 10% He Coolant 75% Borated Steel Filler
Manifolds	35 cm	75%	52.0% FS Structure 22.7% LiPb (90% enriched Li) 24.0% He Coolant 1.3% SiC Inserts

* Replaceable component.



Compositions and Coverage Fractions (Cont.)

<u>Component</u>	<u>Thickness</u>	<u>Coverage Fraction</u>	<u>Composition</u>
WC Shield-I*	0-12 cm	28%	15% FS Structure 10% He Coolant 75% WC Filler
WC Shield-II	26-34 cm	28%	15% FS Structure 10% He Coolant 75% WC Filler
VV	28 cm	100%	28% FS Structure 49% Water 23% Borated Steel Filler
Inner Coil Case	2 cm	33%	95% Incoloy-908 Structure 5% LHe Coolant
Winding Pack @ 4K	18 cm	33%	18.5% Incoloy-908 Structure 48.2% Cu 12.8% Nb ₃ Sn 10.0% GFF Polyimide 10.5% LHe Coolant
External Structure	56+10 cm	33%	95% Incoloy-908 Structure 5% LHe Coolant
Inter Coil Structure	35 cm	67%	95% Incoloy-908 Structure 5% LHe Coolant

* Replaceable component.



FS Structure

Composition: Modified F82H Ferritic Steel (8Cr-2WVTaC)

Reference: R. Klueh et al., Impurity effects on reduced-activation ferritic steels developed for fusion applications
Journal of Nuclear Materials 280 (2000) 353-359.

Density: $\sim 7.89 \text{ g/cm}^3$

	wt%
C	0.1
Al	$14\text{e-}4$
V	0.2
Cr	7.5
Fe	90.11586
Co	$28\text{e-}4$
Ni	$474\text{e-}4$
Cu	$100\text{e-}4$
Nb	$3.3\text{e-}4$
Mo	$21\text{e-}4$
Pd	$0.05\text{e-}4$
Ag	$0.1\text{e-}4$
Cd	$0.4\text{e-}4$
Ta	0.02
W	2.0
Os	$0.05\text{e-}4$
Ir	$0.05\text{e-}4$
Bi	$0.2\text{e-}4$
Eu	$0.05\text{e-}4$
Tb	$0.02\text{e-}4$
Dy	$0.05\text{e-}4$
Ho	$0.05\text{e-}4$
Er	$0.05\text{e-}4$
U	$0.05\text{e-}4$

SiC/SiC Composites

- # **Based on:** SUPERSiC (r)
- # **References:** S. Sharafat, IPFR/UCLA, ARIES Study: Materials, Sept. 1993, pg 3.
- # **Density:** 3.217 g/cm³ (64th CRC Handbook of Chemistry and Physics B-135).

wt %		wt %	
C	29.95	Ag	0.002e-4
Na	0.050e-4	Cd	0.004e-4
Si	70.05	In	0.001e-4
K	0.180e-4	Sn	0.076e-4
Sc	0.013e-4	Sb	0.001e-4
Cr	0.017e-4	Cs	0.001e-4
Fe	0.440e-4	Ba	0.047e-4
Co	0.013e-4	La	0.018e-4
Ni	0.074e-4	Eu	0.001e-4
Cu	0.048e-4	Tb	0.001e-4
Zn	0.043e-4	Vb	0.001e-4
Ga	0.005e-4	Hf	0.001e-4
As	0.003e-4	Ta	0.001e-4
Se	0.001e-4	W	0.032e-4
Br	0.001e-4	Ir	0.001e-4
Rb	0.001e-4	Pt	0.542e-4
Sr	0.012e-4	Hg	0.001e-4
Zr	0.236e-4	Th	0.001e-4
Mo	0.041e-4	U	0.001e-4

LiPb Breeder

Reference: S. Malang & K. Schleisiek, "Dual Coolant Blanket Concept",
KFK5424, Karlsruhe, Nov 1994.

Density: 9 g/cm³ @ 580 °C

	wt %
Pb	99.29
Li*	0.7
Zn	10e-4
Fe	10e-4
Bi	43e-4
Cd	5e-4
Ag	5e-4
Sn	5e-4
Ni	2e-4

* 90% Li-6 and 10% Li-7.

Incoloy-908 Steel

Reference: www.specialmetals.com

Density: 8.11 g/cm³

	wt%
B	0.012
C	0.03
Al	1
Si	0.5
P	0.015
S	0.005
Ti	1.5
Cr	4.125
Mn	1
Fe	38.813
Co	0.5
Ni	49
Cu	0.5
Nb	3