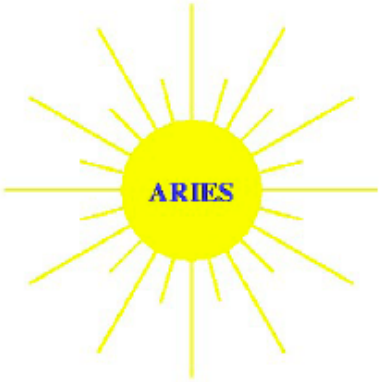

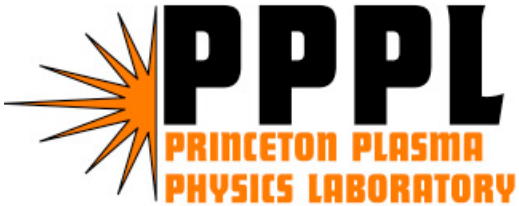

Systems Code – Hardwired Numbers for Review

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ARIES Project Meeting, July 29-30, 2010

Examine hardwired numbers for both the 4 corners study, and FNS-PA studies in the future

$f_{div,\ rad}$ = 0.9 (SiC) and 0.95 (DCLL); fraction of power to divertor that is radiated

$f_{aux,\ func}$ = 0.04; power plant auxiliary functions power fraction

M_n = 1.1 (SiC) and 1.15 (DCLL); neutron power multiplier in blanket and divertor

$f_{rad,edge}$ = 0.9; fraction of radiated power in the divertor that is deposited in the divertor

η_{pump} = 0.9; pumping efficiency

$\eta_{CD,wall\ plug}^{generic}$ = 0.5; wall plug efficiency for generic CD source

$\eta_{CD,wall\ plug}^{NB}$ = 0.68; neutral beams
$\eta_{CD,wall\ plug}^{LH}$ = 0.68; lower hybrid
$\eta_{CD,wall\ plug}^{IC}$ = 0.84; ion cyclotron
$\eta_{CD,wall\ plug}^{NB}$ = 0.43; electron cyclotron

Continuing….

$P_{aux,func}$ = 50 MW; power for plant auxiliary functions

P_{cryo} = 2 MW (LTSC) or 0.5 MW (HTSC); cryoplant power

$\eta_{heat,wall\ plug}$ = 0.43; wall plug efficiency on plasma heating (no CD)

$f_{Nw}^{peaking}$ = 2.0-1.5 function of A = 1.7-4.0; neutron wall load peaking factor
*these are different for DCLL

$f_{FW,rad}^{peaking}$ = 1.25; peaking factor on FW radiation

$f_{ncf,outboard}$ = 0.6; fraction of neutron power/radiated power going to outboard

$f_{ncf,\ inboard}$ = 0.4; fraction of neutron power/radiated power going to inboard

$f_{FW,blanket}$ = 0.9; fraction of neutron power deposited in FW/blanket zone

f_{shield} = 0.1; fraction of neutron power deposited in shield

Continuing…

$f_{div,\ plates}$ = 0.5; fraction of neutron power in divertor plates
$f_{div,\ blanket}$ = 0.4; fraction of neutron power in divertor blanket
$f_{div,\ shield}$ = 0.1; fraction of neutron power in divertor shield

Pumping power calc is different between DCLL and SiC, do not understand

$f_{div,up/down}$ = 0.6; fraction of total power to the divertor assumed in each divertor for up/down symmetry

$f_{div,cond,outboard}$ = 0.8; fraction of conducted power to the divertor on outboard
$f_{div,cond,inboard}$ = 0.2; fraction of conducted power to the divertor oninboard
Same for power radiated in the divertor

Flux_exp = 10; flux expansion from outboard midplane to strike point on divertor plate

η_{th} = f(<N_w>,q_{FW}) for DCLL and SiC
f_{pump} = f(<N_w>,q_{FW}) for DCLL and SiC

Continuing…

SiC Inb radial build:

0.07 m; SOL
0.075 m; FW
0.01 m; gap
0.35 m; blanket
0.01 m; gap
0.24+0.067ln(<N_w>/3.3) m; shield
0.01 m; gap
0.40 m; VV
0.01 m; gap
TF calculated
0.01 m; gap
PF calculated

Outboard radial builds are similar

DCLL Inb radial build: (reading a file?)

0.05 m; SOL
0.038 m; FW
0.0 m; gap
0.362 m; blanket
0.0 m; gap
0.05 m; backwall
0.0 m; gap
0.15+0.075ln(<N_w>/3.3) m; HT shield
0.20 m; skeleton ring
0.02 m; gap
0.31 m; VV
0.02 m; gap
TF calculated
0.01 m; gap
PF calculated

Multiple routines for Nb_3Sn and YBCO magnets???

Nb_3Sn @ 4.2K

B_{Tmax} = 6 – 18 T; max toroidal field
j_{CSmax} = 1520 – 130 MA/m^2; maximum SC current density at max field
j_{Cu} = 224 MA/m^2; max current density in Cu
σ_{sheath} = 800 MPa; stress allowable on sheath
σ_b = 400 or 600 MPa; stress allowable on structure
σ_m = 900 MPa; stress allowable on structure
f_{He} = 0.25; fraction of He in TF coil (area or volume?)
f_{ins} = 0.1; fraction of insulator in TF coil
I_{TF} = 40,000; maximum current per turn in TF coil
N_{TF} = 16; number of TF coils

YBCO @ 75K

B_{Tmax} = 6 – 18 T; max toroidal field
j_{CSmax} = 900 – 462 MA/m^2; maximum SC current density at max field
$j_{Cu} = j_{SCmax}/2$; max current density in Cu
σ_{sheath} = 1600 MPa; stress allowable on sheath
σ_b = 400 or 600 MPa; stress allowable on structure