NCSX PF Fabrication Material Cost Estimate

		Trim1	Trim2	Trim3	Trim4
Winding geometry					
radius	m	0.522	0.522	0.522	0.522
bundle dr	mm	28.80	28.80	28.80	28.80
bundle dz	mm	28.80	28.80	28.80	28.80
no. of turns		4	4	4	4
packing fraction		0.75	0.75	0.75	0.75
length per turn	m	4.62	3.08	5.60	3.41
total length of cu per coil	m	18.47	12.31	22.40	13.64
turn height	mm	13.00	13.00	13.00	13.00
turn width	mm	13.00	13.00	13.00	13.00
coolant hole dia.	mm	0.00	0.00	0.00	0.00
corner radii	mm	1.02	1.02	1.02	1.02
conductor area	mm^2	168.11	168.11	168.11	168.11
calculated coil Cu wt.	kg	26.64	17.76	32.31	19.67
Cu density	######				

NCSX PF Fabrication Material Cost Estimate

Trim Coil Material Estimate

		Trim1	Trim2	Trim3	Trim4
II. Materials M&S					
Number of Coils		**6**	**12**	**6**	**12**
Copper Cost Per Meter		**$28**	**$28**	**$28**	**$28**
copper cost per coil	**$**	**$526**	**$345**	**$627**	**$382**
misc matl -$ per lb of Cu in coils	2.0	$/kg	$/kg	$/kg	$/kg
glass insul width	mm	25.4	25.4	25.4	25.4
turn insul.: length/meter of cond./layer	m/m	2.05	2.05	2.05	2.05
turn ins. Tape Thickness	mm	0.19	0.19	0.19	0.19
No. half lapped layers	#	2	2	2	2
meters of ins. /roll	m	182.00	182.00	182.00	182.00
no. rolls/coil	#	0.8	0.6	1.0	0.6
insulation waste factor	multiplier	1.3	1.3	1.3	1.3
total rolls of turn ins. reqd.per coil	#	1.1	1.4	2.6	1.6
turn insulation cost per roll	$/roll	728	728	728	728
insul width	mm	25.4	25.4	25.4	25.4
turn insul. length/meter of cond./layer	m/m	2.05	2.05	2.05	2.05
turn ins. Tape Thickness	mm	0.19	0.19	0.19	0.19
No. half lapped layers	#	2	2	2	2
meters of ins. /roll	m	182.00	182.00	182.00	182.00
no. rolls/coil	#	0.8	0.6	1.0	0.6
insulation waste factor	multiplier	1.3	1.3	1.3	1.3
total rolls of turn ins. reqd N Coils	#	6.5	8.6	7.9	9.6
turn insulation cost per roll	$/roll	728	728	728	728
turn insulation cost per coil	**$**	**$787**	**$524**	**$954**	**$581**
Length of Kapton	m	38	25	46	28
Cost per Meter of Kapton	$/m	1.26	1.26	1.26	1.26
Kapton Cost per Coil	$	**$48**	**$32**	**$58**	**$35**
ground wall tape thickness	mm	0.38	0.38	0.38	0.38
No. half lapped layers	#	4.00	4.00	4.00	4.00
total ground wall thick.	mm	3.04	3.04	3.04	3.04
ground wall tape width	cm	6	6	6	6
gw tape length reqd.	m	35	24	43	26
meters of ins. /roll	m	10	10	10	10
no. rolls/coil	#	4	2	4	3
insulation waste factor	multiplier	1.30	1.30	1.30	1.30
no. rolls of GW insulation, for all coils	#	28	37	34	41
GW tape cost per roll	$	50	50	50	50
GW insulation cost per coil	**$**	**$231**	**$154**	**$280**	**$170**
Epoxy volume reqd. (15% void fraction)	l	0.57	0.38	0.70	0.42
Epoxy cost/liter	$/l	150	150	150	150
Epoxy cost per coil	**$**	**$86**	**$57**	**$105**	**$64**
		0	0	0	0
		$0	$0	$0	$0
Material Costs Inuslation per Coil		**$1,151**	**$735**	**$1,338**	**$815**
Material Cost Including Copper Condutor per Coil		**$1,676**	**$1,080**	**$1,965**	**$1,197**
Material Costs Inuslation Total		**$6,904**	**$8,823**	**$8,027**	**$9,776**
Material Cost Including Copper Condutor Total		**$10,057**	**$12,959**	**$11,791**	**$14,359**

NCSX PF Fabrication Material Cost Estimate

Estimate Based on Past Job Costs

Total Material Cost All Trim Coils						**$49,167**
Manufacturing Cost per Coil based on Jupiter Coil Cost		$6,500	$5,416	$7,192	$5,650	
Winding Mandrel, Lead Forming, Clamps etc		$13,000	$8,664	$15,766	$9,600	
VPI Mold		$16,250	$10,830	$19,708	$12,001	
Total Cost for Fixtures						**$105,819**
Recurring Costs for N Coils		$49,057	$77,952	$54,940	$82,161	**$264,110**
Total Cost For N Coils		$78,307	$97,447	$90,414	$103,762	
Total Cost All Coils						**$419,096**

Everson Budgetary Estimate

Total Material Cost All Trim Coils						**$49,167**
Manufacturing Cost per Coil based on Jupiter Coil Cost		$4,150	$3,700	$4,300	$4,000	
Total Cost for Fixtures		$35,000	$26,000	$44,000	$34,000	**$139,000**
Recurring Costs for N Coils		$24,900	$44,400	$25,800	$48,000	**$143,100**
Total Cost For N Coils		$74,107	$87,059	$85,891	$100,359	
Total Cost All Coils						**$331,267**

Everson Budgetary Estimate (adjusted for uncertainty)

Fixtures 50% Coils& Materials = 25%

Total Material Cost All Trim Coils						**$61,458**
Manufacturing Cost from Everson Budgetary Estimate		$4,150	$3,700	$4,300	$4,000	
Total Cost for Fixtures		$35,000	$26,000	$44,000	$34,000	**$208,500**
Recurring Costs for N Coils		$24,900	$44,400	$25,800	$48,000	**$178,875**
Total Cost For N Coils		$74,107	$87,059	$85,891	$100,359	
Total Cost All Coils						**$448,833**

Installation Hardware						
$ per lb for plate (316 SS $8/lb AL $5/lb)	8					
Weight per Bracket	5.4					
$ per bracket		$43	$43	$43	$43	
Cost of Material for Brackets		$4,787	$6,382	$5,806	$7,071	
Brackets Spacing meters	0.25					
Brackets per Coil		18	12	22	14	
Total Brackets		111	148	134	164	
Fabrication Cost per Bracket (3weeks of water jet)	$40					
Cost Bracket Fabrication		$4,433	$5,909	$5,376	$6,547	
Cost Bracket Fabrication with Materials		$9,220	$12,290	$11,182	$13,618	
Total Cost Brackets						**$46,311**
Cost for one Compression Plate		10.8	10.8	10.8	10.8	
Cost for all compression plates		$1,197	$1,595	$1,452	$1,768	**$6,011**
G11 Plates		$898	$1,197	$1,089	$1,326	**$4,509**
Hardware Cost per 3/8 Bolt (Inconnel)		12	12	12	12	
Cost for all Bolts and Studs		$7,979	$10,636	$9,677	$11,785	**$40,077**
Weight Support Channels Material lbs per coil		72	48	87	53	
Cost per Channel Material Per Coil		$573	$382	$695	$423	
Cost for Channels For Coil Type		$3,438	$4,583	$4,170	$5,079	**$17,271**
Cost for Mockups of Each Coil		$1,146	$764	$1,390	$846	**$4,147**
Cost For Installation Fixtures		$3,000	$3,000	$3,000	$3,000	**$12,000**
Cost for Hardware						$130,325
Cost for Hardware with adjusted for uncertainty						**$252,576**

Installation Man Hour Estimate						
Tooling / Training / Preperation		20	20	20	20	
Hours to Position Coil and mark locations		8	8	8	8	
Hours per bracket		1	1	1	1	
Hours per coil for brackets		18	12	22	14	
Hours per coil for coil Installation		8	8	8	8	
Metrology for bracket installation		170	198	152	210	
Total Hours for Tech (2 work at once)		454	527	405	559	**1945**
Determine Metrology Procedure and Setup		20	20	20	20	
Interpret Results and Report		20	20	20	20	
Charicterize Coils Before Assembly		2	2	2	2	
Hours to Measure Coil Location per Coil		8	8	8	8	
Total Hours for post Installation Metrology (2 Eng.)		306	430	288	442	**1465**