

**NCSX June 2007 ETC  
TABLE V - Basis of Estimate**

**WBS Number: 132  
WBS Title: PF Coils  
Job Numbers: 1302 and 1352  
Job Title: PF Coil Design (1302) and PF Coil Procurements (1352)  
Job Manager: Mike Kalish**

**M&S Estimate Backup**

Internal Estimate of Materials - based on quotes (Outokumpo), past procurements, & engineering

**NCSX PF Fabrication Material Cost Estimate**

PF Coil Manufacturing Cost Details				
B. Materials M&S				
		PF4	PF5	PF6
Copper extrusion cost		\$/kg	\$/kg	\$/kg
Copper order factor		factor	factor	factor
Copper cost / coils		\$	\$29,812	\$38,174
misc matl - \$ per lb of Cu in coils		2.0	\$/kg	\$/kg
glass insul width		mm	25.4	25.4
turn insul - length/meter of cond./layer		m/m	3.15	3.15
turn ins. Tape Thickness		mm	0.19	0.19
No. half lapped layers		#	2	2
meters of ins. /roll		m	10.00	10.00
no. rolls/coil		#	330.4	422.1
insulation waste factor		multiplier	1.3	1.3
total rolls of turn ins. reqd. 2 coils		#	858.9	1097.6
turn insulation cost per roll		\$/roll	4	4
Kapton insul width		mm	25.4	25.4
turn insul - length/meter of cond./layer		m/m	3.15	3.15
turn ins. Tape Thickness		mm	0.19	0.19
No. half lapped layers		#	1	1
meters of ins. /roll		m	10.00	10.00
no. rolls/coil		#	155.2	211.1
insulation waste factor		multiplier	1.3	1.3
total rolls of turn ins. reqd. 2 coils		#	429.5	548.8
turn insulation cost per roll		\$/roll	40	40
turn insulation total cost. 2 coils		\$	\$29,376	\$37,537
ground wall tape thickness		mm	0.38	0.38
No. half lapped layers		#	2.00	2.00
total ground wall thick		mm	1.52	1.52
ground wall tape width		cm	6	6
gw tape length reqd		m	96	240
meters of ins. /roll		m	10	10
no. rolls/coil		#	10	24
insulation waste factor		multiplier	1.30	1.30
no. rolls of GW insulation, pair of coils		#	25	69
GW tape cost per roll		\$	50	50
GW insulation cost. 2 coils		\$	\$1,880	\$4,716
Epoxy volume reqd. (15% void fraction)		l	23	33
Epoxy cost/ liter		\$/l	30	30
Epoxy cost for pair of coils		\$	\$2,066	\$2,963
Leads and coolant connections/tool		\$	2500	2500
Leads & coolant coils, pair of coils		\$	\$7,550	\$7,550
<b>Material Costs Insulation and Leads Only, Coil Pair</b>			<b>\$40,902</b>	<b>\$52,786</b>
<b>Total Material Cost Including Copper Conductor</b>			<b>\$70,714</b>	<b>\$90,940</b>

From: B. Umbenhaur [bumbenhaur@eversontesla.com]  
Sent: Tuesday, December 05, 2006 10:52 AM  
To: Michael R. Kalish; Rodney D. Templon  
Cc: jstafiniak@eversontesla.com  
Subject: PF Coils

Hi Mike,  
For the PF Coil Budgetary, please use the following numbers based on some assumptions. The costs shown are for the coils only and no shipping or facilities related costs are included. The shipping costs will have an impact at the coils are so large. The coils are a little too large for the current configuration of the clean space we are using to wind the TF coils.

The coils are also too large for our ovens so we would plan to use steam to cure the coils during the VPI process. We have done this successfully in the past.

We have a material supply configuration as on the TF coils where the conductor and insulation is supplied by PPPL.

The current winding specification calls for a difficult winding scheme.

PF5 Coils (Quantity 2)

\$415,000 for two coils including tooling

PF6 Coils (Quantity 2)

\$485,000 for two coils including tooling

Please let me know if you have any questions or concerns. Thanks.  
Bill

**Everson Quote on PF5 and PF6 Fabrication and Tooling**

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CU Cost Estimate - Internal

Copper Cost Estimate for PF4, PF5 and PF6  
 Note : Includes 25% spare in final cost calculation

CopperPrice := 3.60 dollars

**PF 4** The Weight of the conductor is: PF4Length := 262.4m

$$.323 \frac{\text{lb}}{\text{in}^3} \left[ (.787\text{in})^2 - \pi \left( \frac{.354\text{-in}}{2} \right)^2 \right] \cdot \text{PF4Length} = 1.738 \times 10^3 \text{ lb}$$

$$\text{PF4Weight} := .323 \frac{\text{lb}}{\text{in}^3} \left[ (.787\text{in})^2 - \pi \left( \frac{.354\text{-in}}{2} \right)^2 \right] \cdot \text{PF4Length}$$

For 2 coils using Outo Kumpu Quote

$$\text{PF4Weight} \cdot 2 \cdot 1.25 \left( \frac{3.10 + 1.57}{\text{lb}} \right) = 2.029 \times 10^4 \text{ dollars} \quad \text{at time of quote}$$

$$\text{PF4Weight} \cdot 2 \cdot 1.25 \left( \frac{3.10 + \text{CopperPrice} + .16}{\text{lb}} \right) = 25812 \text{ dollars}$$

inflated to 5/07  
 3.10=engineering  
 3.60=copper  
 .16= silver bearing

**PF 5** The Weight of the conductor is: PFSLength := 336m

$$.323 \frac{\text{lb}}{\text{in}^3} \left[ (.787\text{in})^2 - \pi \left( \frac{.354\text{-in}}{2} \right)^2 \right] \cdot \text{PFSLength} = 2.226 \times 10^3 \text{ lb}$$

$$\text{PF5Weight} := .323 \frac{\text{lb}}{\text{in}^3} \left[ (.787\text{in})^2 - \pi \left( \frac{.354\text{-in}}{2} \right)^2 \right] \cdot \text{PFSLength}$$

For 2 coils using Outo Kumpu Quote

$$\text{PF5Weight} \cdot 2 \cdot 1.25 \left( \frac{3.10 + 1.57}{\text{lb}} \right) = 2.599 \times 10^4 \text{ dollars} \quad \text{at time of quote}$$

$$\text{PF5Weight} \cdot 2 \cdot 1.25 \left( \frac{3.10 + \text{CopperPrice} + .16}{\text{lb}} \right) = 38174 \text{ dollars}$$

inflated to 5/07  
 3.10=engineering  
 3.60=copper  
 .16= silver bearing

CopperPrice = 3.6 dollars

**PF 6** The Weight of the conductor is: PF6Length := 240m

$$.323 \frac{\text{lb}}{\text{in}^3} \left[ (.787\text{in})^2 - \pi \left( \frac{.354\text{-in}}{2} \right)^2 \right] \cdot \text{PF6Length} = 1.59 \times 10^3 \text{ lb}$$

$$\text{PF6Weight} := .323 \frac{\text{lb}}{\text{in}^3} \left[ (.787\text{in})^2 - \pi \left( \frac{.354\text{-in}}{2} \right)^2 \right] \cdot \text{PF6Length}$$

For 2 coils using Outo Kumpu Quote

$$\text{PF6Weight} \cdot 2 \cdot 1.25 \left( \frac{3.10 + 1.57}{\text{lb}} \right) = 1.856 \times 10^4 \text{ dollars} \quad \text{at time of quote}$$

$$\text{PF6Weight} \cdot 2 \cdot 1.25 \left( \frac{3.10 + \text{CopperPrice} + .16}{\text{lb}} \right) = 27267 \text{ dollars}$$

inflated to 5/07  
 3.10=engineering  
 3.60=copper  
 .16= silver bearing

$$(\text{PF6Weight} + \text{PF5Weight}) \cdot 2 \cdot 1.25 \left( \frac{3.10 + 3.14 + .16}{\text{lb}} \right) + 4000 = 6.505 \times 10^4$$

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PRINCETON PLASMA PHYSICS

FAX 609-243-3248  
Tel 609-243-2277

**OUTOKUMPU**

RFQ on copper conductor

1 (1)  
May 9, 2007

Dear Mike,

Outokumpu Quote

Please find our offer as follows:

**Product specification and quantity:**

- \* CDA102 Copper, soft temper
- \* Size 20mm Square with round 9mm ID, Outokumpu tool # 8456
- \* In pancake coils of approximately 100 ft
- \* Qty to be determined later.

**Pricing:**

Fabrication cost:	Up to 500lbs	One lump sum \$3,980 plus copper value
	1,000lbs	FAB \$ 4.90/lb plus copper value
	2,000lbs	FAB \$ 3.10/lb plus copper value

For Silver-bearing copper (CDA 107) add \$0.16/lb

The copper value based on the Comex market for November 2004 shipments is currently \$ 1.57/ lb.

The copper value may be firmed for the month of shipment the day an order is placed, up to two weeks prior to the confirmed ex mill date, or will be automatically firmed at Outokumpu published price the Friday preceding the confirmed ex mill date.

**Payment terms:**

60 days from the date of invoice. Subject to credit approval.

**Lead time and delivery terms:**

Ex mill Pon, Finland, November 4, 2004 plus 4 weeks (estimated) ocean transit. Delivered Duty Paid (DDP Incoterms 2000) to Princeton, NJ.

**Other Terms:**

According to the Outokumpu Poricopper Oy's General Terms for Sales (has been supplied earlier). The interest rate in the USA for overdue payment is 12%.

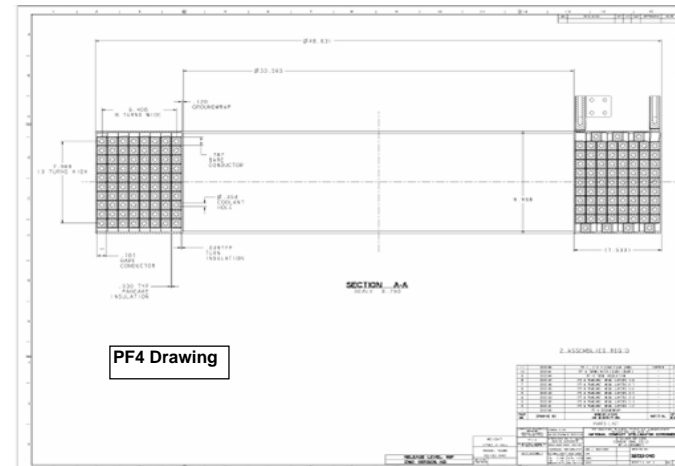
Sincerely,

Outokumpu Copper – Electrical Power & Components

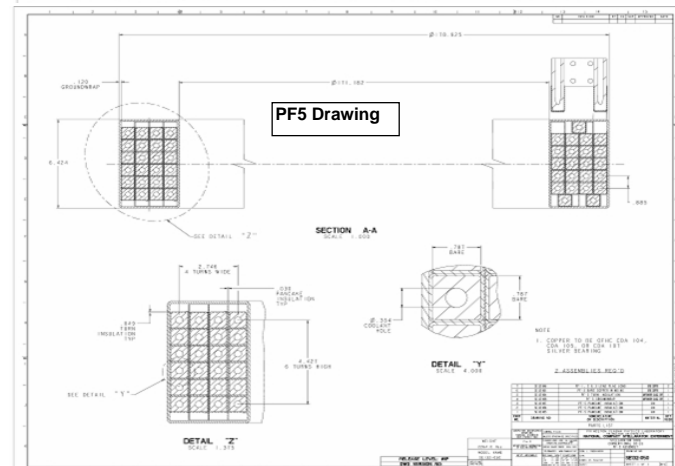
Petri Nordling  
Sales Manager

Cc: Asko Hakkinen, Paivi Nieminen, Denise Nolan

OUTOKUMPU COPPER – EPC Europe Division  
801 Pittsburgh Drive, Delaware OH 43015 / Tel. 740-368-7946 / Fax 740-363-3847



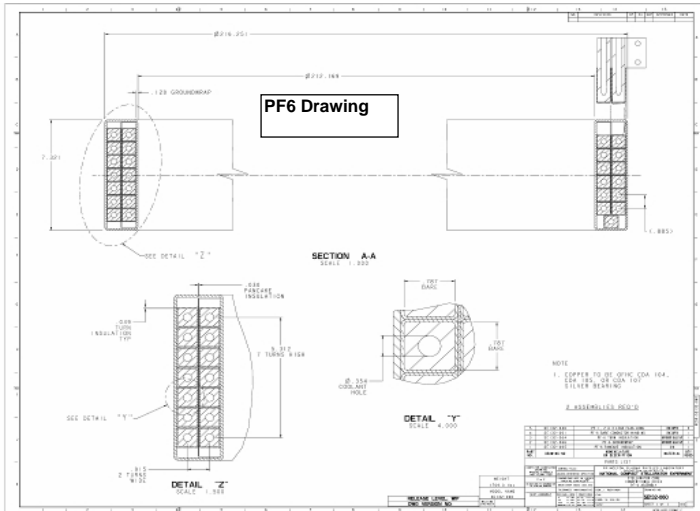
PF4 Drawing



PF5 Drawing

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COMEX Copper High Grade Futures Quotes and Market Prices

Page 1 of 2



Commodity Futures Price Quotes For  
**COMEX Copper High Grade**

(Price quotes for COMEX Copper High Grade delayed at least 30 minutes as per exchange requirements)

[Click here to refresh data](#)

Month	Session								Pr. Day		Options
	Open	High	Low	Last	Time	Sett	Chg	Vol	Sett	OpInt	
May 07	3.6040	3.6040	3.5820	3.5820	May 10, 08:40	-	-0.0935	583	3.6755	-	Call Put
Jun 07	-	-	-	3.6790 *	May 09, 17:34	-	-	423	3.6790	-	Call Put
Jul 07	3.6275	3.6300	3.5750	3.6080	May 10, 09:21	-	-0.0710	13039	3.6790	-	Call Put
Aug 07	-	-	-	3.6700 *	May 09, 17:34	-	-	-	3.6700	-	Call Put
Sep 07	-	-	-	3.6600 *	May 09, 17:34	-	-	2323	3.6600	-	Call Put
Oct 07	-	-	-	3.6375 *	May 09, 17:34	-	-	-	3.6375	-	Call Put
Nov 07	-	-	-	3.6510 *	May 09, 17:35	-	-	1	3.6150	-	Call Put
Dec 07	-	-	-	3.5925 *	May 09, 17:34	-	-	510	3.5925	-	Call Put
Jan 08	-	-	-	3.6200 *	May 09, 17:35	-	-	-	3.5660	-	Call Put
Feb 08	-	-	-	3.5955 *	May 09, 17:34	-	-	-	3.5390	-	Call Put
Mar 08	-	-	-	3.5100 *	May 09, 17:34	-	-	-	3.5100	-	Call Put
Apr 08	-	-	-	3.3855 *	May 09, 17:34	-	-	-	3.4785	-	Call Put
May 08	-	-	-	3.4755 *	May 09, 17:34	-	-	-	3.4465	-	Call Put
Jun 08	-	-	-	3.4735 *	May 09, 17:34	-	-	-	3.4145	-	Call Put
Jul 08	-	-	-	3.3180 *	May 09, 17:34	-	-	-	3.3825	-	Call Put
Aug 08	-	-	-	2.3330 *	May 09, 17:34	-	-	-	3.3505	-	Call Put
Sep 08	-	-	-	3.1900 *	May 09, 17:35	-	-	-	3.3185	-	Call Put
Oct 08	-	-	-	3.0900 *	May 09, 17:34	-	-	-	3.2865	-	Call Put
Nov 08	-	-	-	3.0400 *	May 09, 17:34	-	-	-	3.2545	-	Call Put
Dec 08	-	-	-	3.1580 *	May 10, 09:22	-	-	-	3.2225	-	Call Put
Jan 09	-	-	-	3.0580 *	May 09, 17:35	-	-	-	3.1905	-	Call Put
Feb 09	-	-	-	2.4875 *	May 09, 17:34	-	-	-	3.1585	-	Call Put
Mar 09	-	-	-	2.6760 *	May 09, 17:34	-	-	-	3.1265	-	Call Put
Apr 09	-	-	-	2.9735 *	May 09, 17:34	-	-	-	3.0945	-	Call Put

[Click here to refresh data](#)

Times indicate exchange local time.

\* An asterisk beside the last price indicates that the price is from a previous session

<http://quotes.tradingcharts.com/futures/quotes/HG.html>

5/10/2007

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Everson Quote on PF Fabrication  
and Tooling

**From:** B. Umbenhour [bumbenhour@eversontesla.com]  
**Sent:** Thursday, April 12, 2007 12:30 PM  
**To:** Michael R. Kalish  
**Subject:** PF4 Coil  
Hi Mike,  
Budgetary pricing for the PF4 Coil

Tooling: - \$72,000  
PF4 Coil - \$20,100/coil (\$40,200 for two coils)

Thanks.  
Bill

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Visit Everson Tesla Inc. on the web at <http://www.eversontesla.com>