11-971111-CLN-01

TO: DISTRIBUTION
FROM: C NEUMEYER
SUBJECT: MINUTES OF VIDEO CONFERENCE ON PFCS

A video conference was convened today with the following attendees.

PPPL

G Barnes J Chrzanowski T Egebo P Heitzenroeder C Neumeyer M Ono

ORNL

P Gorenson B Nelson

Following is a summary of the discussions. Please note *ACTION* items indicated.

1.0 Material/Inventory Issues

1.1 Requirements

It was agreed that we need to do a better job of quantifying the material requirements for the various PFC components, now that we will be considering materials other than the FMI 4D. The following table was offered up as a template for this.

	Thermal Cond.		Tensile Strength		Tmax	Qmax
	Normal to Face	Parallel to Face	Normal to Face	Parallel to Face		
	W/m-degC		PSI		deg C	W/cm^2
IW Rail					1200	190
IW Slot					1200	190
IBD Upper Vert					1200	510
IBD Upper Horiz					1200	510
IBD Upper Conicals					1200	510
IBD Lower Vert					1200	700
IBD Lower Horiz					1200	700
IBD Lower Conicals					1200	700
OBD Upper					1200	1710
OBD Lower					1200	1710
Passives					1200	
FMI 4D						
POCO						
ATJ						
Other						

1.2 Options Previously Identified

Options previously identified for recovery from the shortage of FMI materials were discussed as follows...

a. Purchase additional FMI material

Per G Barnes, quote was received from FMI for materials sufficient to do inner wall rail tiles (168 pieces @ 3"x 7"x1") for $248K and 6-7 month delivery

b. Investigate and purchase alternate material

Per G Barnes, quote was received from Allied Signal for materials sufficient to do inner wall rail tiles (168 pieces @ 3"x 7"x 1") for $44K and 6-7 month delivery. Specs previous TPX RFP. Quotes from additional vendors (Carbone and Kaiser) not yet in hand.

c. Use all graphite tiles with no carbon-carbon

Per P Gorenson, there are several options available for building the inner wall using graphite tiles. It would be possible to do this in such a way that all of the pieces (except for the tiles) would be useful later in a retrofit back to the original design. However, it appears that the radial build allowance for the tiles would have to increase from the present ≈ 0.5' to ≈ 1". M Ono noted that this would be highly undesirable in that it would significantly effect the NSTX mission.

Note: Present schedule calls for...

Component	Installation	Lead Time Months
IW Tiles (preinstalled on CS)	8/17	9
IW Tiles (if installed after CS insertion)	11/30	12.5
IBD	11/30	12.5
OBD (if preinstalled on domes)	8/7	8.5
OBD (if installed after VV assembly)	11/30	12.5
Passives (if preinstalled on domes)	8/7	8.5
Passives (if installed after VV assembly)	10/14	11

1.3 Other Options

Other options were discussed as follows...

a. Use stripes on divertors (limit use of Carbon-Carbon Tiles to limited areas)

It was noted that this could prove useful, but would still cost a significant amount of money since a large amount of materials not presently in hand would be required. M Ono was not in favor of this idea.

b. Use all graphite on divertors

This option is the most realistic one, but may not be so limiting as originally thought. It was estimated that, without divertor sweeping, probably the pulse length for the diverted plasmas would have to be reduced from 5 to 2.5 seconds @ 6MW of heating power. Divertor sweeping may permit the full pulse length as originally planned, but this needs to be calculated. An increase in the thickness beyond 1" would not be helpful due to the limited depth of penetration of the heat in 5 seconds.

THE FOLLOWING COURSE OF ACTION WAS DECIDED:

• *Pursue the Allied Signal material or alternative for the inner wall rail tiles (ACTION - G Barnes)*

- *collect information from the other vendors*
- *evaluate characteristics vs. requirements (mechanical, thermal)*
- *perform bakeout tests to check outgassing characteristics*
- *heat flux tests TBD depending on information available from vendors*
- *initiate material procurement ASAP*

• *Check how existing FMI inventory might be used on inboard divertors (all, or part of divertor, upper and lower, or lower only) (ACTION - G Barnes and helper TBD)*

• *Use existing graphite materials on inboard (pending outcome of above item) and outboard divertors and passive plates*

- *determine pulse length limitation w/o sweeping (ACTION - B Nelson)*

- determine mapping of existing inventory into required tile pieces (ACTION - G Barnes and helper TBD)

NOTE: If the outcome of the above is found to be satisfactory then we can anticipate a cost increase over the present budget of ≈ $50K to cover the additional material procurement.

2.0 Geometry/Configuration Issues

2.1 Configuration

The following was agreed to....

Tile location	thick (in)	material	plasma side	back side	toroidal overlap	poloidal overlap
centerstack mid-section	0.551		cylind	cylind	yes	yes
IB divertor, first conical section	1		conical	conical	yes	yes
IB divertor vertical section	1		cylind	cylind	yes	yes
IB divertor, second conical section	1		conical	conical	yes	yes
IB divertor, horizontal section	1		flat	flat	yes	yes
OB divertor	1		flat	flat	yes	yes
Secondary passive plate	1		flat	flat	no	yes
Primary passive plate	1		flat	flat	no	yes

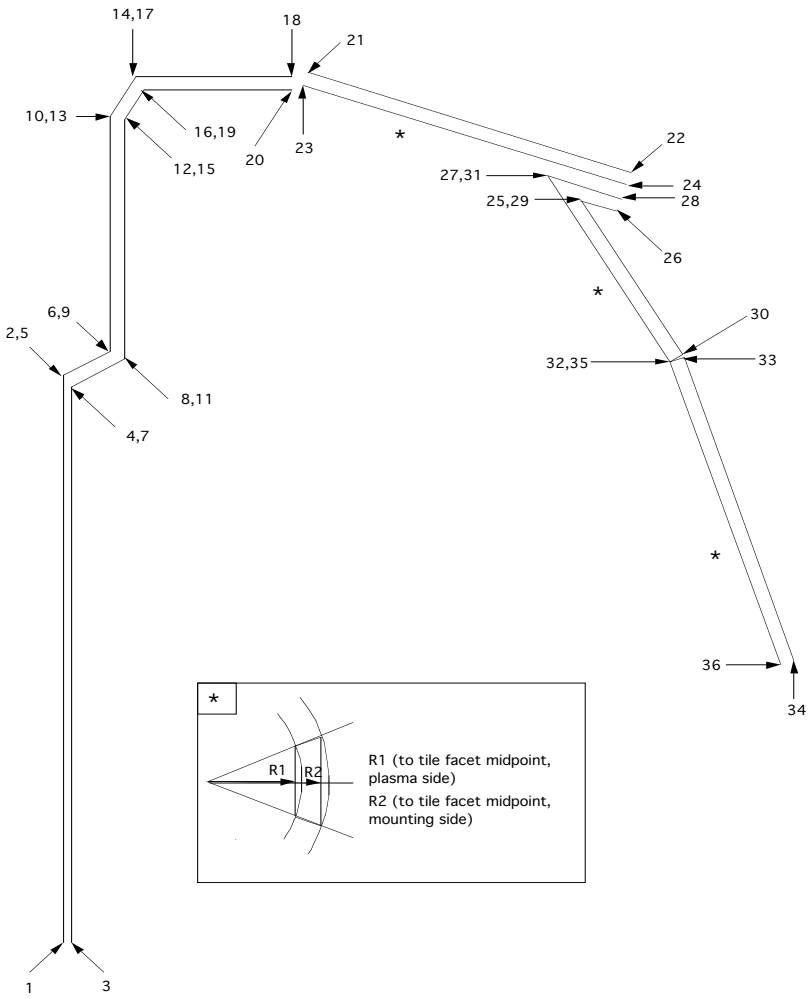
One possible exception is the back side of the conical sections of the inboard divertor. For thermal contact reasons, it may be desirable to make these flat. However, this will increase the machining complexity of the rings which make up these pieces. ACTION - J Chrzanowski to determine if machining of the rings with flats can be obtained without significant cost impact.

2.2 Dimensions

Basic dimensions given in the following figure and table were agreed to. They have been reviewed by physics (S Kaye, R Maingi). Details which need to be added however are as follows...

- *tip at end of slot should have a radius of 1 cm*
- *gap between passive plates should be 1 in*
- *radius on tile at midplane end of primary passive plate should be 1"*

ACTION - C Neumeyer to issue memo to document, and include notes about radii



		#	R (in)	Z (in)	#	R (in)	Z (in)
Inner Wall	Struct	1	6.738	0.000	2	6.738	42.617
	PFC	3	7.289	0.000	4	7.289	41.780
Inner Wall/Inboard Divertor Angled Section	Struct	5	6.738	42.617	6	10.000	44.500
	PFC	7	7.289	41.780	8	11.000	43.923
Inboard Divertor Vertical Section	Struct	9	10.000	44.500	10	10.000	62.125
	PFC	11	11.000	43.923	12	11.000	61.857
Inboard Divertor Vertical/Horizontal Angled Section	Struct	13	10.000	62.125	14	11.732	65.125
	PFC	15	11.000	61.857	16	12.309	64.125
Inboard Divertor Horizontal Section	Struct	17	11.732	65.125	18	22.500	65.125
	PFC	19	12.309	64.125	20	22.500	64.125
Outboard Divertor	Struct	21	23.618	65.438	22	46.004	57.918
	PFC	23	23.300	64.490	24	45.686	56.970
Slot	Struct	25	42.498	55.823	26	45.017	54.977
	PFC	27	40.227	57.641	28	45.335	55.925
Secondary Passive Plate	Struct	29	42.498	55.823	30	49.557	44.175
	PFC	31	40.227	57.641	32	48.702	43.657
Primary Passive Plate	Struct	33	49.651	43.973	34	57.248	21.182
	PFC	35	48.702	43.657	36	56.299	20.866

3.0 Other

3.1 Facets on IBD Conicals?

Per 2.1 above it was agreed that J Chrzanowski will evaluate the cost impact of this and make a recommendation.

3.2 Difference between Upper & Lower IBD tiles

Due to the difference in the pattern and size of the feedthroughs on the upper and lower flanges of the CS casing the upper and lower inboard divertor tile designs will have to be slightly different. Also, the area available for heat transfer is significantly reduced by the feedthroughs. Although this is probably unavoidable, ACTION- G Barnes to review the feedthroughs and try to simplify/reduce.

3.3 Cooling line sizes?

Still need to reach closure with R Parsells (bakeout system) on tube size and heating/cooling performance. ACTION - G Barnes to coordinate this.

3.4 SOW Status

Since plan to recover from inventory problem now established, ACTION - B Nelson to mark up SOW and cost estimate for final review and approval.

3.5 Do we need a face-face visit?

Will convene conference call Tuesday 11/18 1:30 pm. ACTION - G Barnes to coordinate

cc:

G Barnes	J Chrzanowski	T Egebo	P Gorenson	P Heitzenroeder
B Nelson	M Ono	J Schmidt	NSTX File	