

3rd SPL Collaboration Meeting
(CERN, 12 November 2009)

Lucija Lukovac (LAL)

RF Conditioning of TTF3 Input Power Couplers & Acceptance Criteria for XFEL



RF conditioning of TTF3 power couplers

- Power coupler specifications
- RF conditioning procedure
- Results

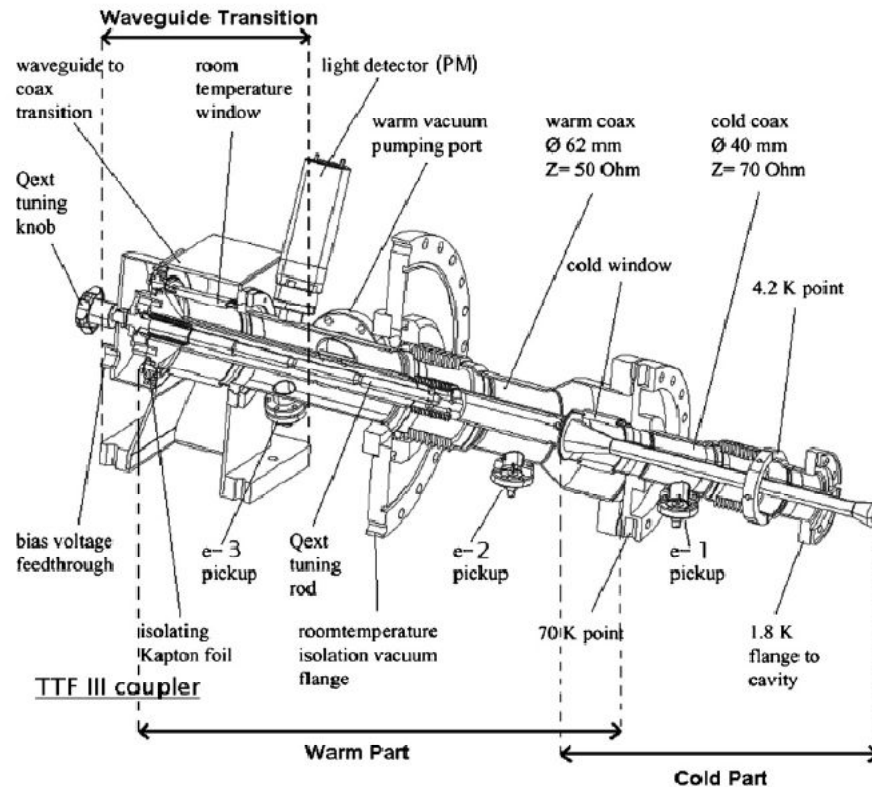
Acceptance criteria for XFEL power couplers

- Power coupler specifications
- Conditioning
- Accepting a coupler : good or excellent?

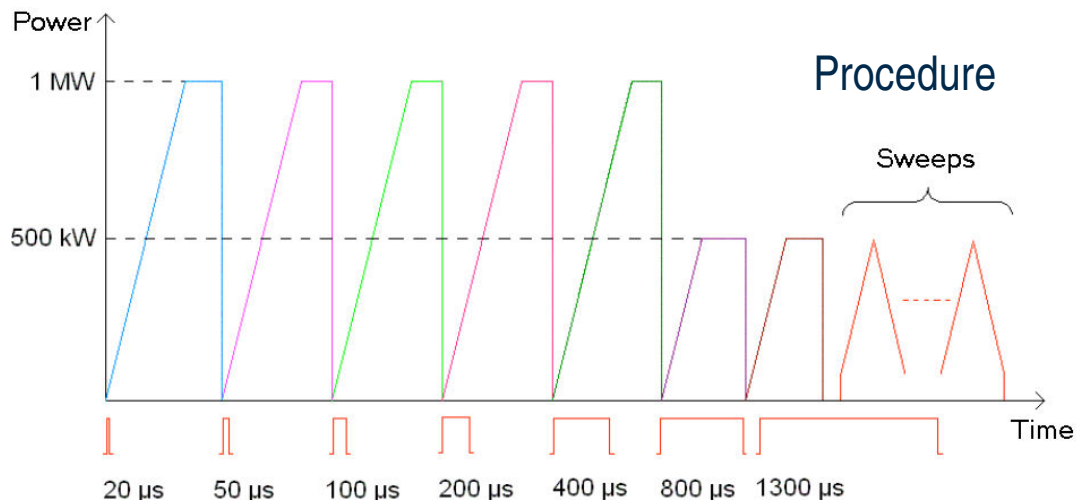
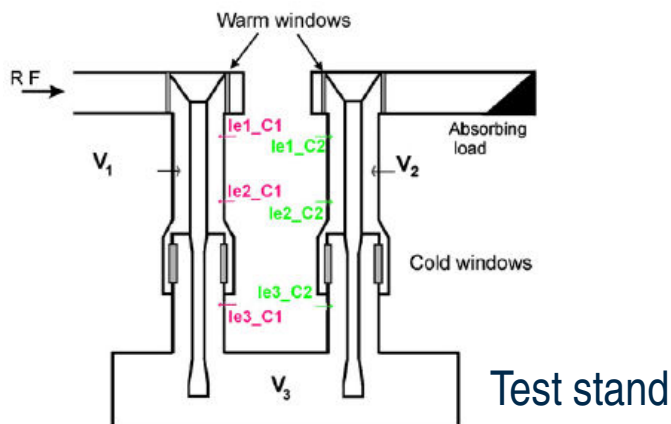
RF conditioning of TTF3 power couplers

TTF3 input power coupler specifications

	Frequency	Operation	Two windows	Heat load	Inner conductor isolated	Peak power + 27% margin	Repetition rate	Average power	Coupling (Q_{ext})
TTF3	1.3 GHz	Pulsed 500 μ s rise time, 800 μ s flat top with beam	<ul style="list-style-type: none"> Safe operation Clean cavity assembly for high gradients 	2 K - 0.06 W 4 K - 0.5 W 70 K - 6 W	Bias voltage, suppressing multipacting	250 kW	10 Hz	3.2 kW	Adjustable ($10^6 - 10^7$)



Warm test stand : travelling wave mode @ LAL



Control parameters

Vacuum	1st threshold (↓ 0.1 dB)	$2 \cdot 10^{-7}$ mbar
	2nd threshold (↓ 0.4 dB)	$4 \cdot 10^{-7}$ mbar
	IL	10^{-6} mbar
e- current IL		5 mA
Light IL		1 lux
Ceramic temperature IL		85° C
WG arc IL		If any
Repetition rate		2 Hz
Control loop duration ↑ 0.1 dB		30 s

Cryomodule - reconditioning : standing wave mode @ DESY

Off resonance = Warm test stand

On resonance 20 μs → 200 μs Pmax = 1 MW

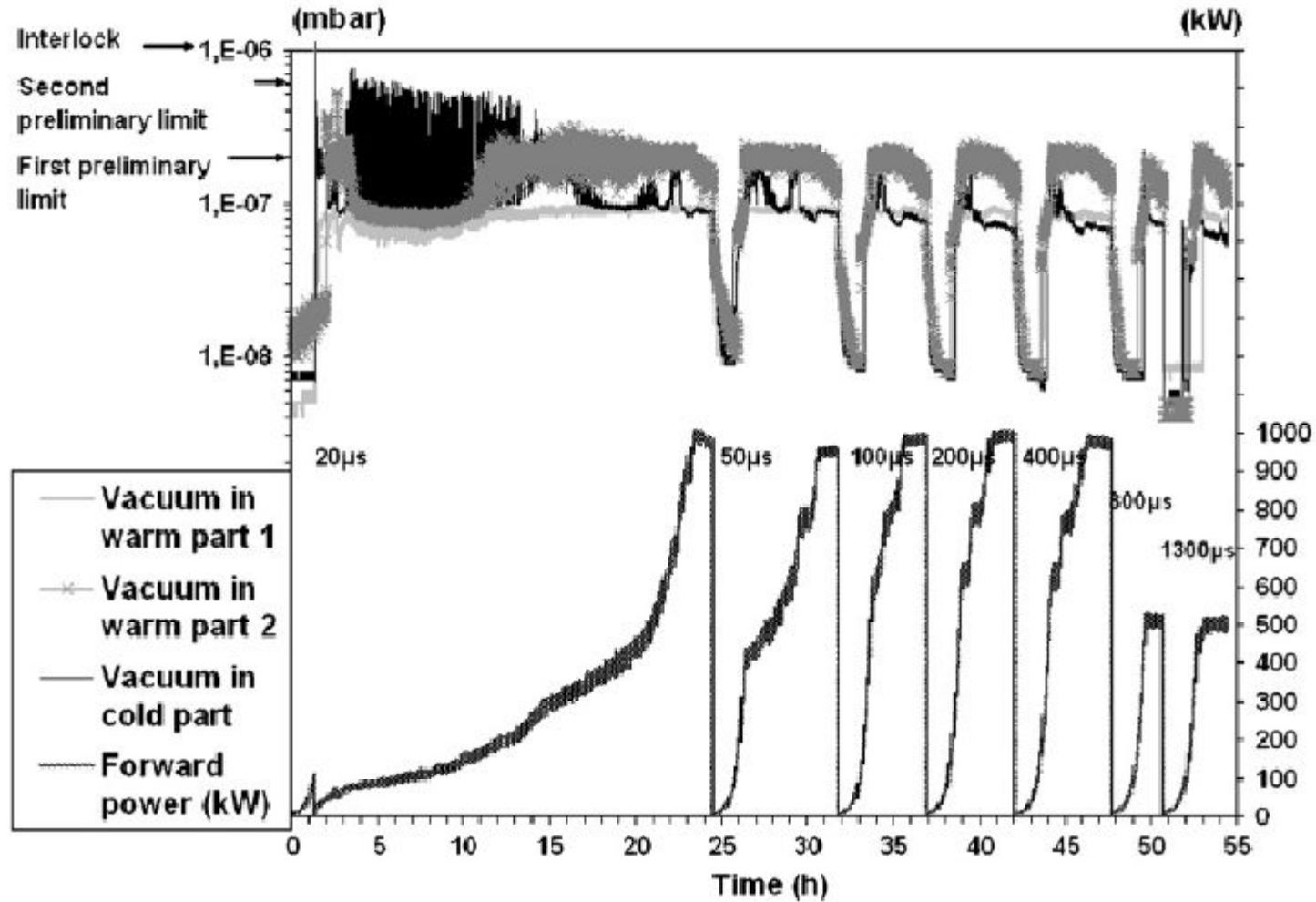
400 μs Pmax = 330 kW

500 μs flat top + flat top 100 μs, 200 μs, 400 μs, 800 μs Pmax = 250 kW

sweeps 500 μs + flat top 800 μs

RF conditioning of TTF3 power couplers

Results from the Warm Test Stand

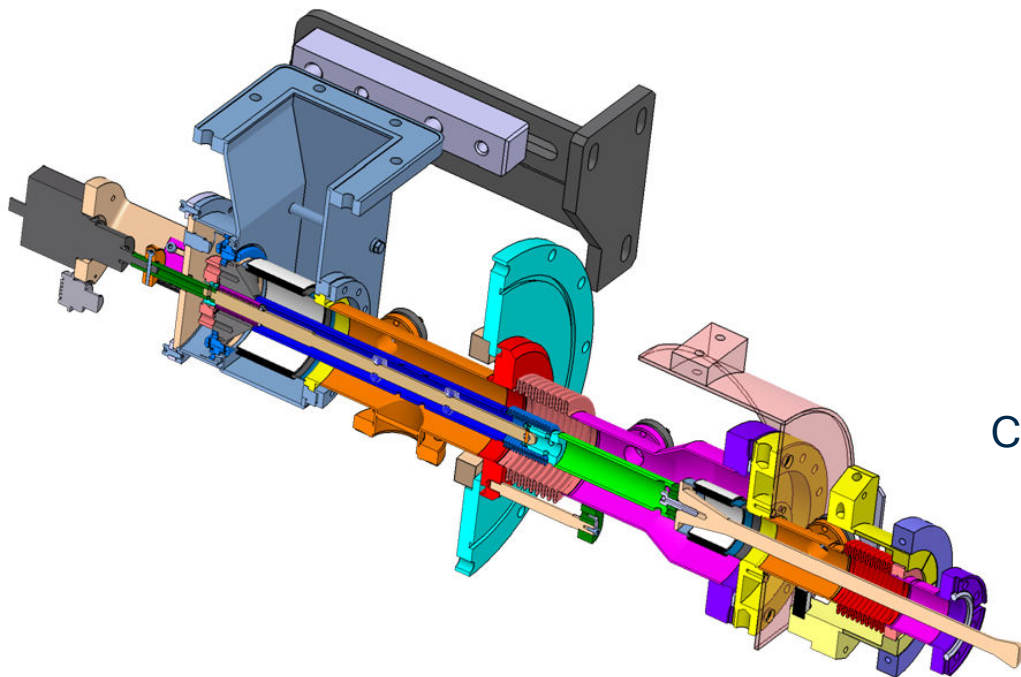


H. Jenhani et al., NIM A 595 (2008)

Acceptance criteria for XFEL power couplers

XFEL input power coupler specifications

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TTF3	1.3 GHz	Pulsed 500 μ s rise time, 800 μ s flat top with beam	<ul style="list-style-type: none"> • Safe operation • Clean cavity assembly for high gradients 	2 K - 0.06 W 4 K - 0.5 W 70 K - 6 W	Bias voltage, suppressing multipacting	250 kW	10 Hz	3.2 kW	Adjustable ($10^6 - 10^7$)
XFEL						120 kW		1.7 kW	Adjustable ($10^6 - 10^7$) 4.6x 10^6 @ 23.6 MV/m



800 couplers to be delivered over 2 years

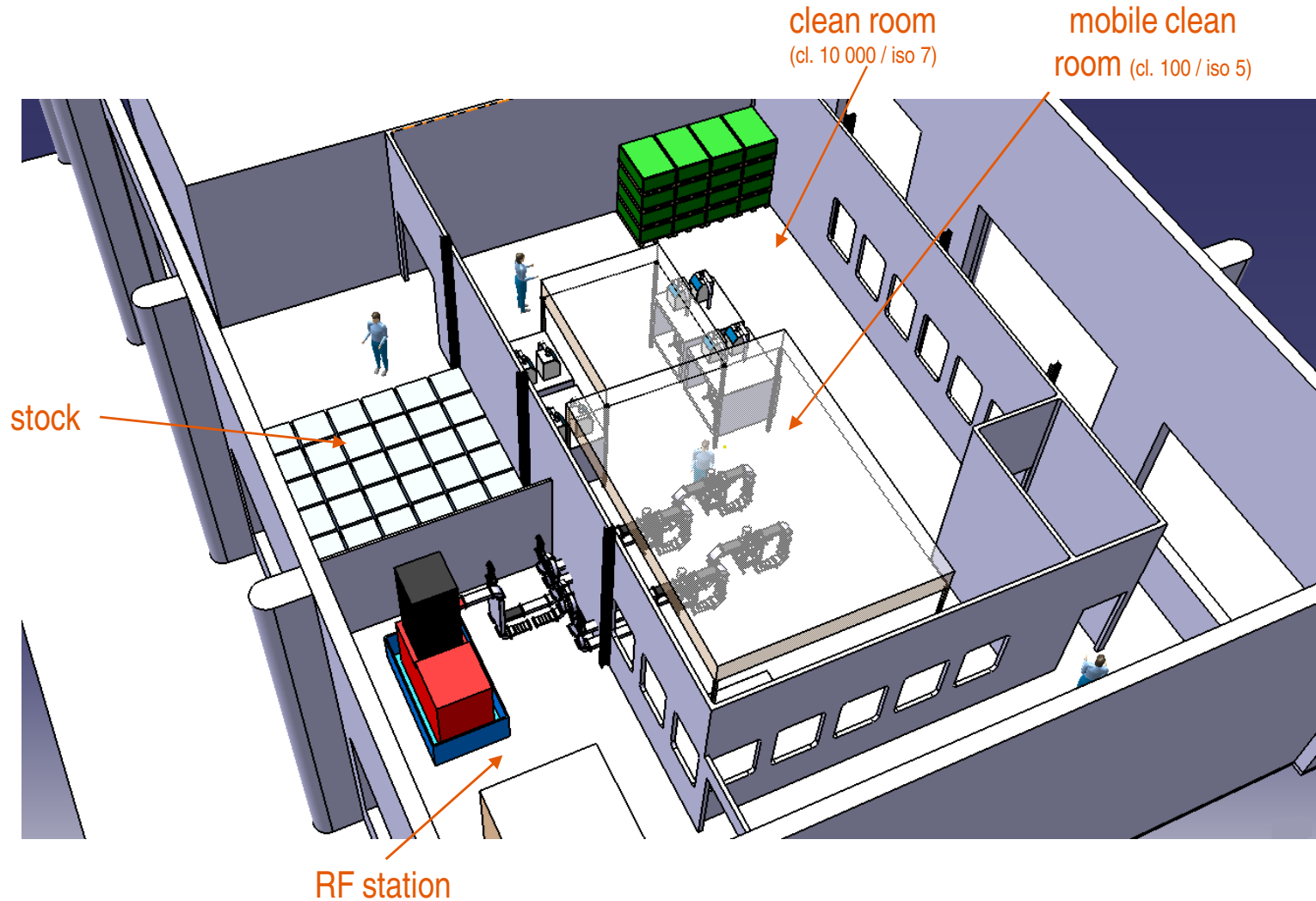
↪ 8 couplers per week



Constrains on **TOTAL CONDITIONING TIME**

Acceptance criteria for XFEL power couplers

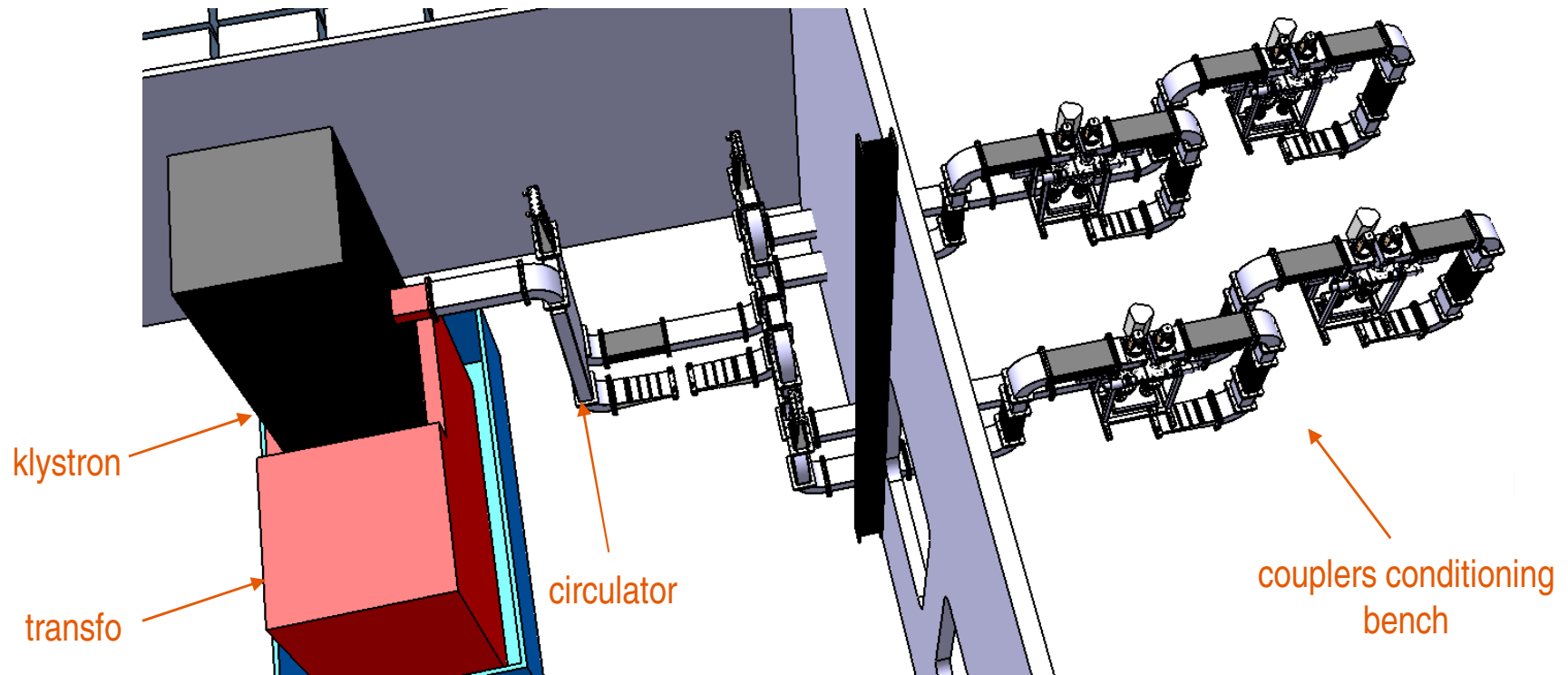
Conditioning : Infrastructure



Managed by E. Genesseau (LAL)

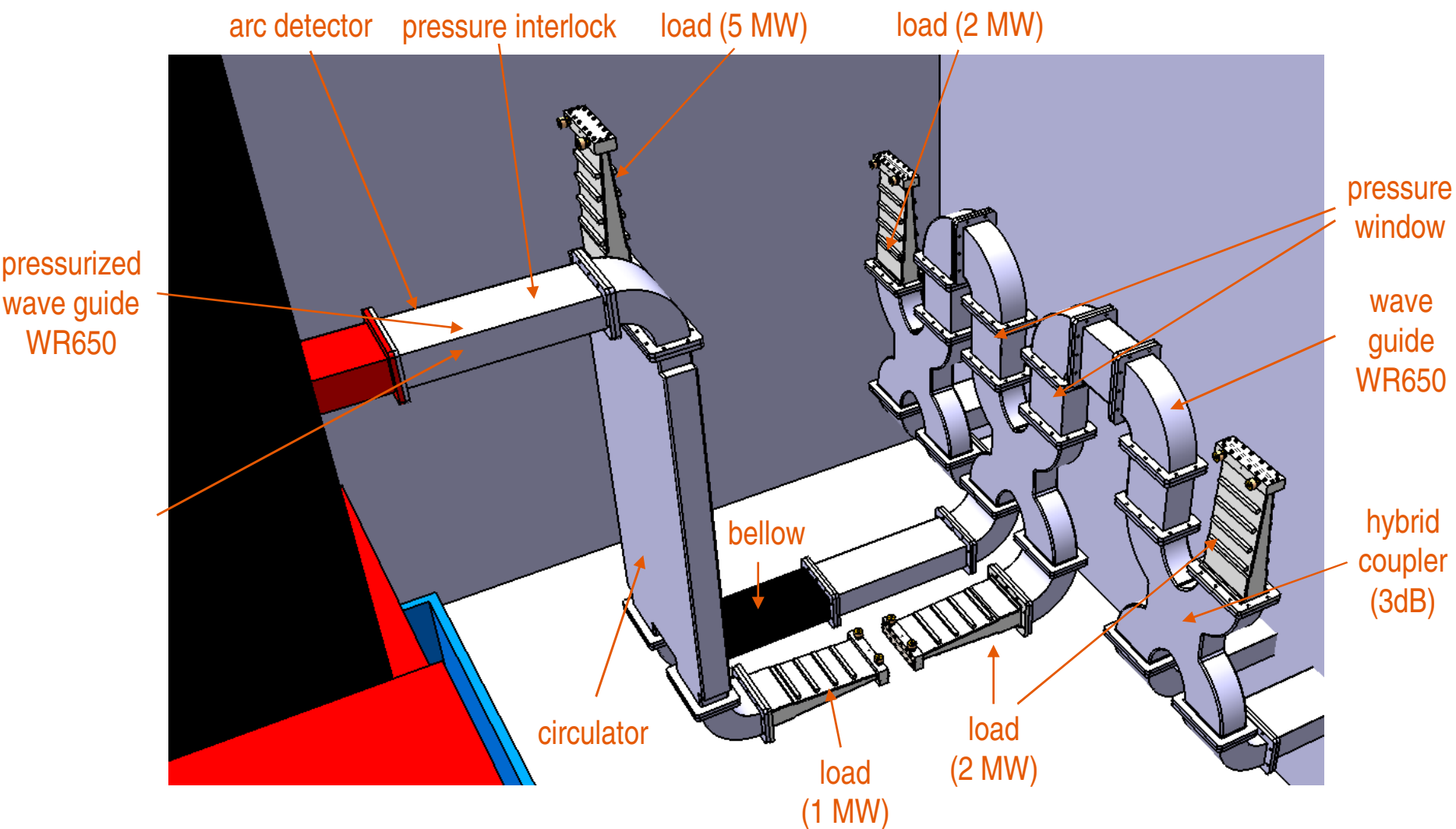
Acceptance criteria for XFEL power couplers

Conditioning : Infrastructure



Acceptance criteria for XFEL power couplers

Conditioning : Infrastructure



Managed by E. Genesseau (LAL)

Cleaning & Assembly

- Class 10 clean room
- US bath cleaning with detergent + high temperature
- Drying with filtered N2 and under laminar flux
- Particle count
- Leak test

Cleaning & assembly procedure @LAL



To be performed by the manufacturer !

Follow the procedure

 Nouvelle procédure montage conditionnement.doc Date : 07/01/2009

Etape 4 Comptage de particules / jus assemblage des parties froides / structure Classe 10

Préparation

N'oubliez pas que le bouchon d'entrée à l'intérieur de la salle blanche est ouvert et dirigé vers le bas.

Matériel nécessaire

Les pièces de la type précédente

Tâches

Noter les références du montage

Contrôle initial :

- Effectuer un contrôle visuel des pièces livrées

Contrôle de particules des parties froides :

- Souffler les parties froides avec l'air tamisé, capturer de particules en face (Position 1)
- Lancer l'acquisition du compteur de particules
- Si au bout d'une minute il compte moins de 10 particules de taille >0.3µm, la partie contrôlée est considérée comme propre dans le cas contraire, le compteur réalise un cycle de mesure.
- Si au bout de 9 cycles, il compte toujours plus de 10 particules de taille >0.3µm, la pièce contrôlée sera alors considérée comme salle étanche de une être re-nettoyée.
- Recommencer les étapes précédentes pour les 3 positions suivantes :





- Impulser le tube de comptage
- Contrôler de la même façon la seconde partie froide

Contrôle de particules de la transition de test :

- Placer les tubes filtrés sur la transition de test après

Attention ! Le peson doit être placé à l'opposé du port de pompe

- Faire le contrôle de particule de la transition dans les 3 positions suivantes :

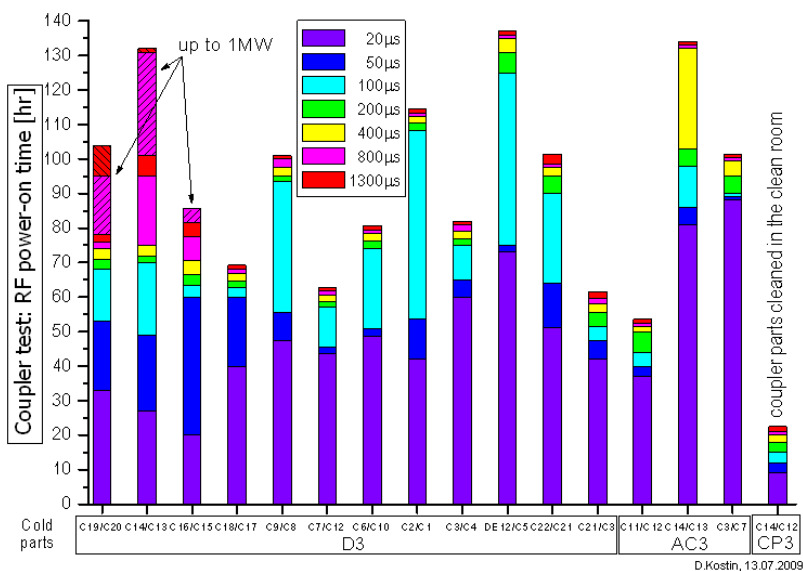




Rédigé par : M.Lacroix 10 / 98

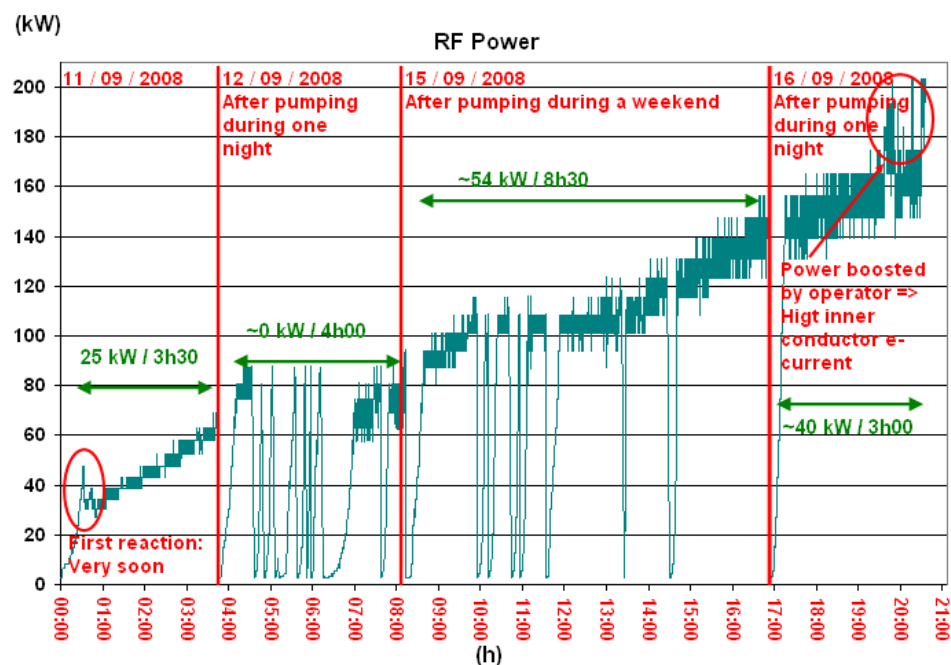
Cleaning & Assembly

Coupler test stand (2 couplers) conditioning:



Conditioning times @DESY
on the warm test stand

Conditioning of the Toshiba XFEL
prototype pair @LAL

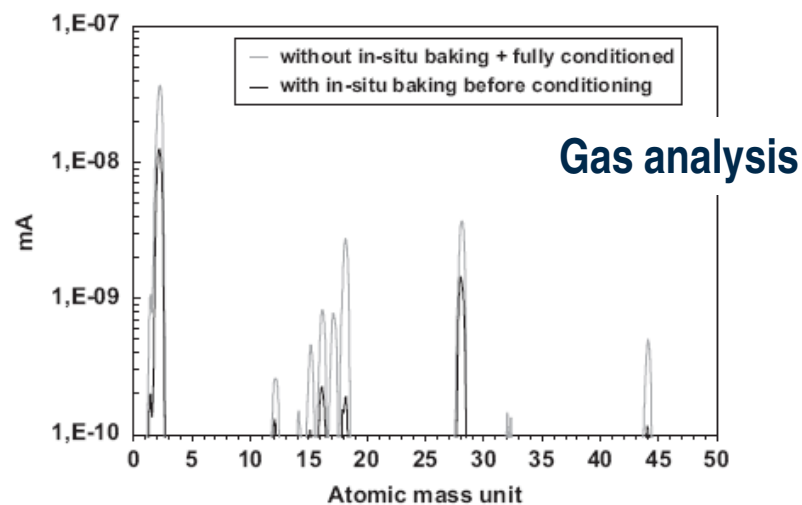
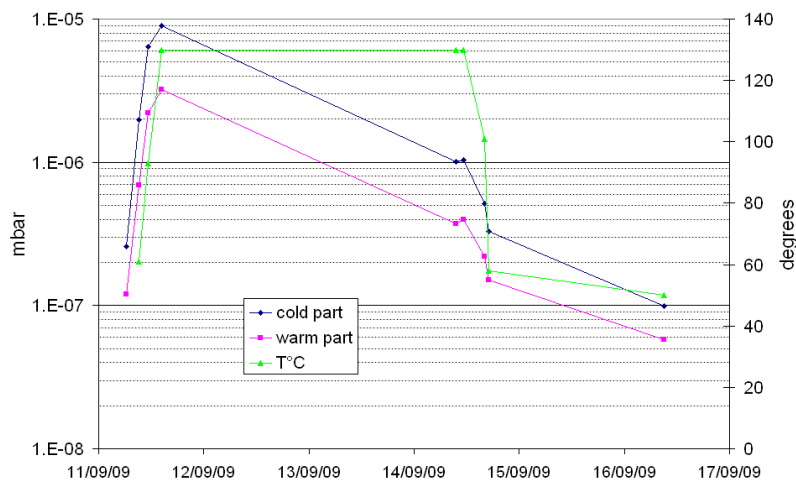
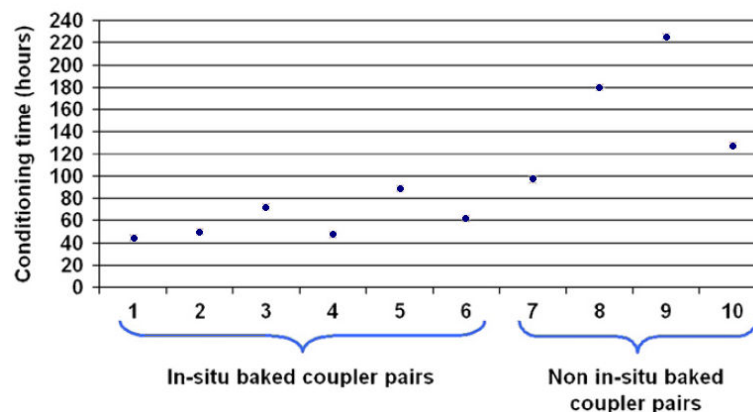
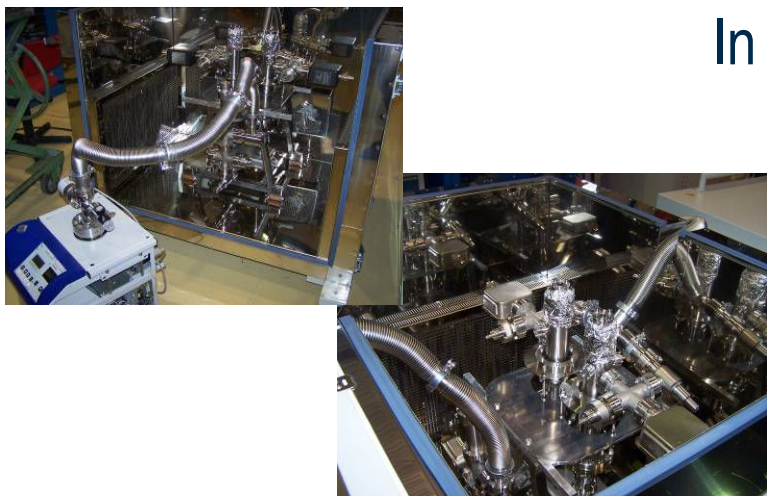


Time needed to achieve given power level

Acceptance criteria for XFEL power couplers

Conditioning : lessons learned from TTF3 couplers

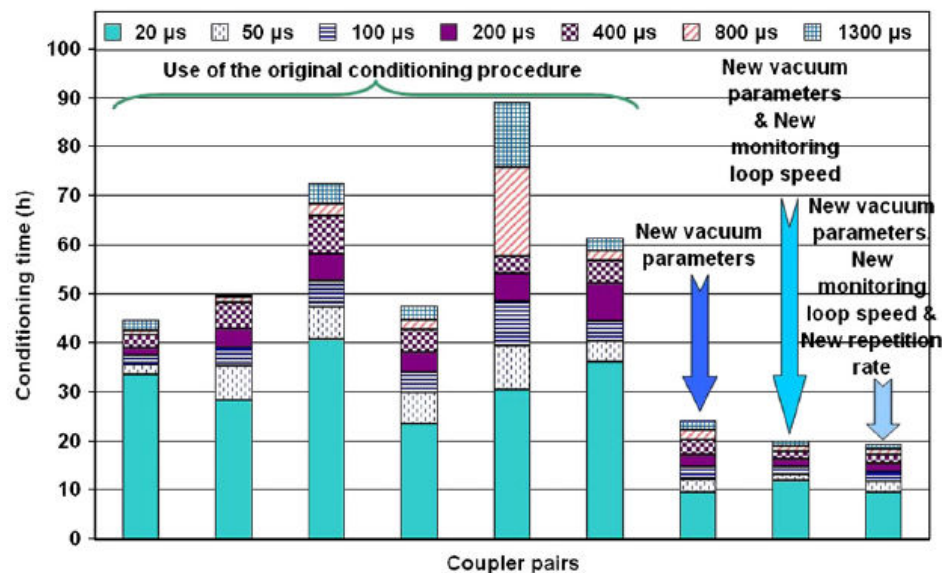
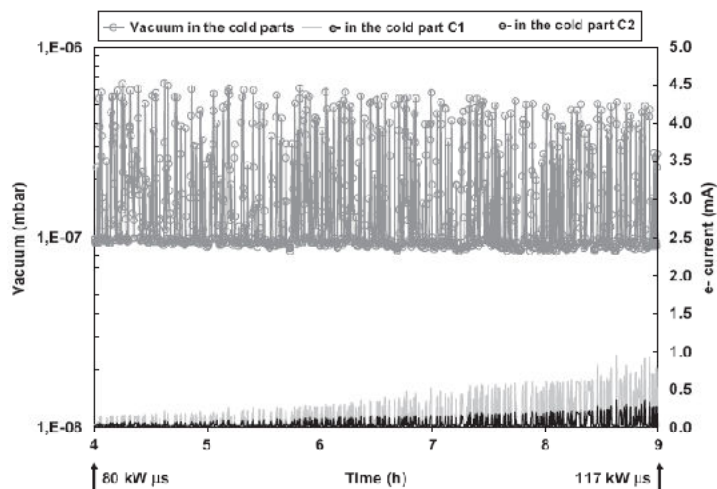
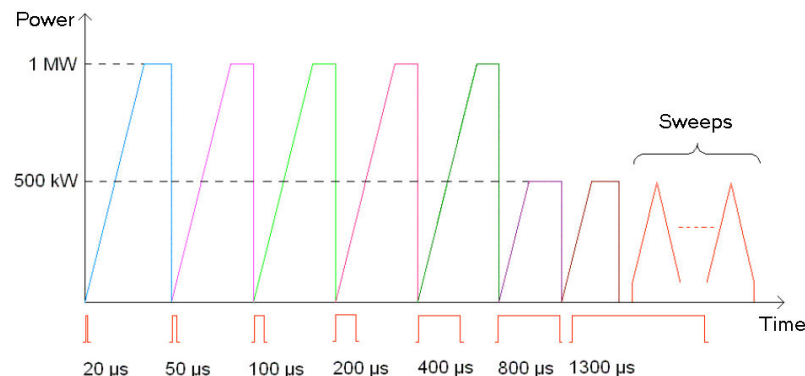
In situ baking



H. Jenhani et al., NIM A 595 (2008)

Conditioning procedure

		Original parameters	Optimised parameters
Vacuum	1st threshold (↓ 0.1 dB)	$2 \cdot 10^{-7}$ mbar	$6 \cdot 10^{-7}$ mbar
	2nd threshold (↓ 0.4 dB)	$4 \cdot 10^{-7}$ mbar	10^{-6} mbar
	IL	10^{-6} mbar	$5 \cdot 10^{-6}$ mbar
e- current IL		5 mA	
Light IL		1 lux	none
Ceramic temperature IL		85 C	
WG arc IL		If any	
Repetition rate		2 Hz	4 Hz
Control loop duration ↑ 0.1 dB		30 s	15 s



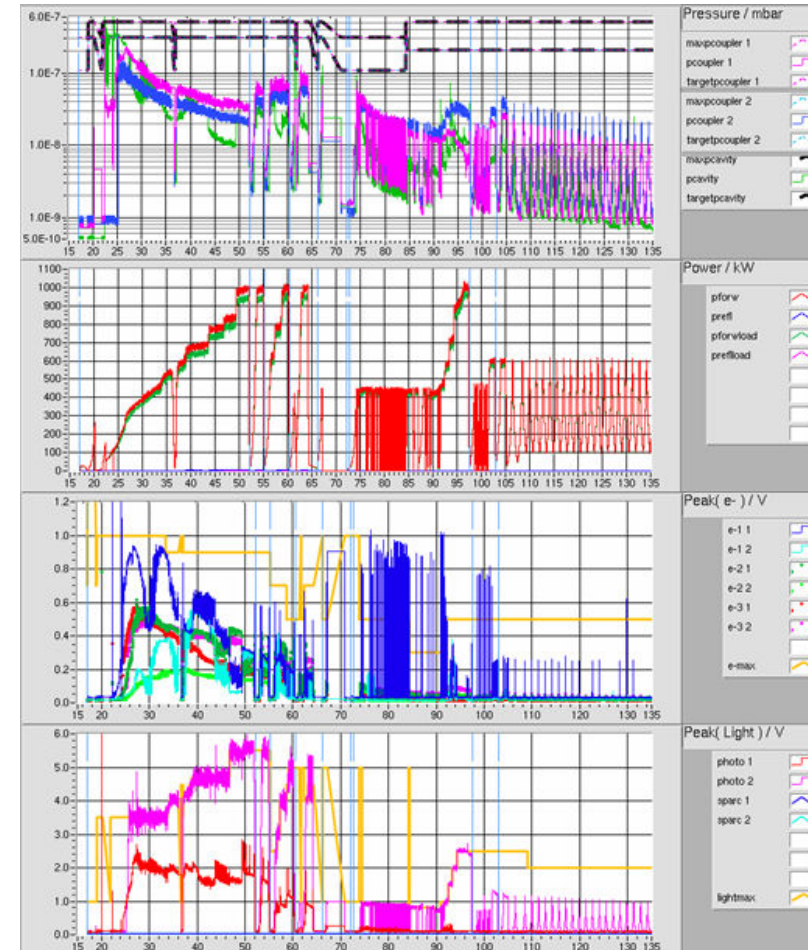
H. Jenhani et al., NIM A 595 (2008)

Acceptance criteria for XFEL power couplers

Accepting a coupler : good or excellent?

- *Mechanical : dimensions, visual inspection*
- *Material tests (TiN & Cu coatings)*
- Following the cleaning and assembly procedure
- Particle count
- Leak tests
- In situ baking gas analysis
- Time needed to achieve given power level
- Total conditioning time => excellence
- Number of interlocks => refusal

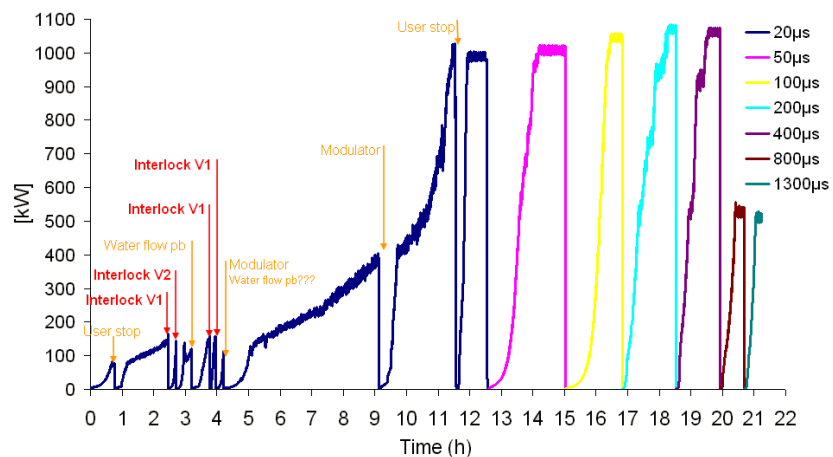
Example of refused coupler



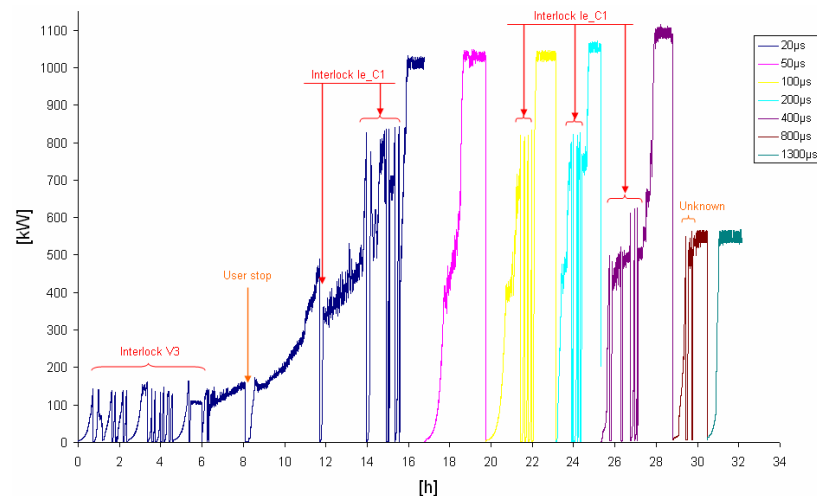
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Accepting a coupler : XFEL prototypes

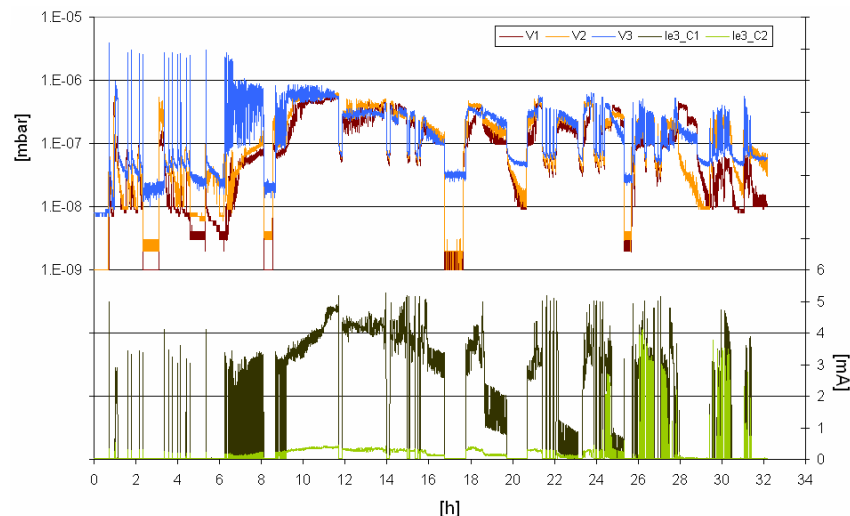
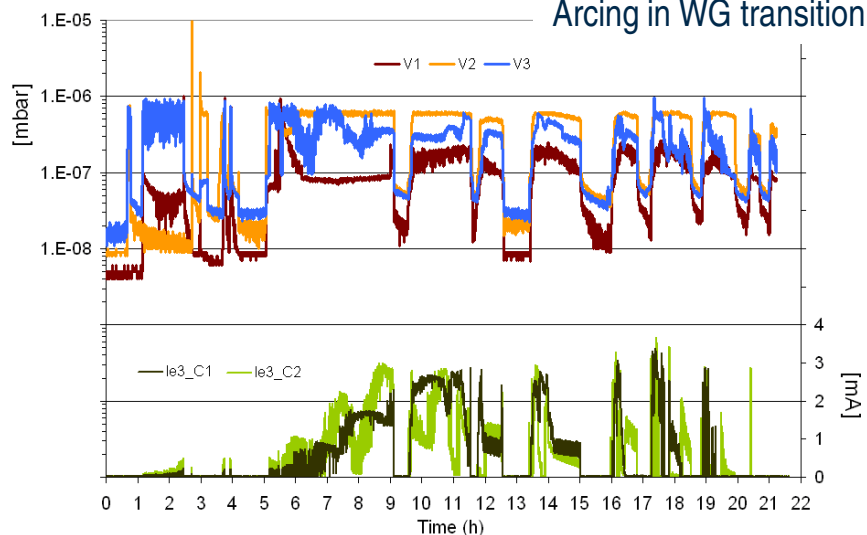
ACCEL – RI



TOSHIBA



Arcing in WG transition



Acknowledgements

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