





# HL-LHC R2E Power Converter Strategy

On behalf of TE-EPC

- 1. Scope**
- 2. Current LHC Converters**
- 3. HL-LHC Converters / Status of Projects**
- 4. HL-LHC Radiation Levels**
- 5. Converter Lifetime / Failures**

## **Review of converters in radiation areas**


Current status, future relocation, on-going and planned projects




## **Review of the radiation levels, radiation lifetime/failure estimations**




All lifetime and failure estimations exclude electrical failures  
and focus on radiation reliability only

**Existing converters and new developments outside of radiation areas  
are excluded from this presentation**

EPC Item / type	Location Run 2	HL-LHC comments
<b>ARC</b>	752x LHC60A-08V	
<b>UL14/16</b>	10x LHC120A-10V 16x LHC600A-10V 4x LHC4-6-8kA-08V	UL14/16 relocated to the new UR during LS3
<b>RR13/17</b>	36x LHC120A-10V 28x LHC600A-10V 30x LHC4-6-8kA-08V	
<b>RR73/77</b>	20x LHC120A-10V 48x LHC600A-10V	
<b>RR53/57</b>	36x LHC120A-10V 28x LHC600A-10V 30x LHC4-6-8kA-08V	
<b>UA/J, TZ76, UJ33, UL557, USC55</b>	Different converters "sea level" radiation expected	UL557 and USC55 relocated to the new UR during LS3

EPC Item / type	Status	TID [Gy]	SEE XS [cm <sup>2</sup> ]	DD [/cm <sup>2</sup> ]	Available	Deployed
<b>FGClite</b> 	Production	200 <i>tested</i>	<1E-13 <i>tested</i>	>1E12 <i>tested</i>	EYETS	<b>ARC:</b> EYETS <b>RR1/5/7:</b> LS2




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<b>FGClite</b> 	Production	200 <i>tested</i>	<1E-13 <i>tested</i>	>1E12 <i>tested</i>	EYETS	<b>ARC:</b> EYETS <b>RR1/5/7:</b> LS2
<b>R2E-LHC 600A-10V</b> 	Design	200 <i>target</i>	<5E-12 <i>target</i>	>1E12 <i>target</i>	LS2	<b>RR1/5/7:</b> LS2
<b>R2E-LHC 4-6-8kA-08V</b> 	Design	200 <i>target</i>	<5E-12 <i>target</i>	>1E12 <i>target</i>	LS2	<b>RR1/5/7:</b> LS2




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<b>FGClite</b> 	Production	200 <i>tested</i>	<1E-13 <i>tested</i>	>1E12 <i>tested</i>	EYETS	<b>ARC:</b> EYETS <b>RR1/5/7:</b> LS2
<b>R2E-LHC 600A-10V</b> 	Design	200 <i>target</i>	<5E-12 <i>target</i>	>1E12 <i>target</i>	LS2	<b>RR1/5/7:</b> LS2
<b>R2E-LHC 4-6-8kA-08V</b> 	Design	200 <i>target</i>	<5E-12 <i>target</i>	>1E12 <i>target</i>	LS2	<b>RR1/5/7:</b> LS2
<b>HL-LHC 60A-08V</b>	Planned (WP6B)	<i>Not defined</i> <i>Same as FGClite?</i>			LS3	<b>RR1/5/7:</b> LS3
<b>HL-LHC 120A-10V</b>	Planned (WP6B)	<i>Not defined</i> <i>Same as R2E-LHC600A-10V?</i>			LS3	<b>RR1/5/7:</b> LS3



Location	Converters	$\Phi_{HEH}$ [cm <sup>2</sup> /y]	$\Phi_{neq}$ [cm <sup>2</sup> /y]	Dose [Gy/y]
ARC	752x HL-LHC60A-08V	1E9	1E9	2
RR13/17	36x HL-LHC120A-10V 28x R2E-LHC600A-10V 30x R2E-LHC4-6-8kA-08V	1E10	1E11	10
RR53/57	36x HL-LHC120A-10V 28x R2E-LHC600A-10V 30x R2E-LHC4-6-8kA-08V	1E10	1E11	10
RR73/77	20x HL-LHC120A-10V 48x R2E-LHC600A-10V	1E8	1E9	0.01

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EPC Item / type	TID Lifetime	SEE Failures [ /y ]	DD Lifetime
<b>FGCLite</b> 	20 years	< 1 Beam Dump <i>On all 1000x units</i>	10 years in RR >20 years in ARC <i>Optocoupler</i>
<b>R2E-LHC 600A-10V</b> 	20 years	6 Beam Dump <i>On all 110x</i>	10 years <i>Optocoupler</i>
<b>R2E-LHC 4-6-8kA-08V</b> 	20 years	3 Beam Dump <i>On all 60x</i>	10 years <i>Optocoupler</i>

EPC Item / type	TID Lifetime	SEE Failures [ /y ]	DD Lifetime
<b>FGCLite</b> 	20 years	< 1 Beam Dump <i>On all 1000x units</i>	10 years in RR >20 years in ARC <i>Optocoupler</i>
<b>R2E-LHC 600A-10V</b> 	20 years	6 Beam Dump <i>On all 110x</i>	10 years <i>Optocoupler</i>
<b>R2E-LHC 4-6-8kA-08V</b> 	20 years	3 Beam Dump <i>On all 60x</i>	10 years <i>Optocoupler</i>
<b>HL-LHC 60A-08V</b>	<i>Not estimated</i> <i>Depends on future target. Same as FGCLite?</i>		
<b>HL-LHC 120A-10V</b>	<i>Not estimated</i> <i>Depends on future target. Same as R2E-LHC600A-10V?</i>		

**R2E designs available in LS2 comply with the HL-LHC availability requirements**

## **Planned HL-LHC60A & HL-LHC120A (WP6B):**

Initially supposed to be Rad-Tol power converters.

At the same time replacement addresses aging of equipment.

Radiation levels are 10x lower than foreseen but still requiring rad-tol design ( $\Phi_{\text{HEH}} > 1\text{E}7$ )

**Estimations of radiation levels have huge impact  
on HL-LHC on-going and future projects**

