

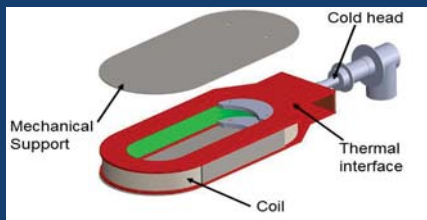
# Design Aspects on Winding an MgB<sub>2</sub> Superconducting Generator Coil

## Superconducting generators – high current densities reduce weight

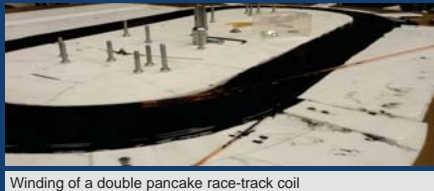
- Superconductors carry dc currents loss-free
- Operational temperature 15 – 40 K
- Current densities 100 times that of copper conductors
- Magnetic flux densities above 2 T reduces space and weight
- MgB<sub>2</sub> is an attractive option with a cost per unit carried current of one tenth of the cost of copper conductors when cooled to 15 – 20 K



Nacelle integration



Superconducting generator pole demonstrator



Winding of a double pancake race-track coil



Cross-section of first double pancake winding trial

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## The INNWIND.EU MgB<sub>2</sub> superconducting pole demonstrator

- Based on a 10 MW design: straight section 2.8 m, inner radii of end sections 0.15 m, cross-section 84 mm x 80 mm
- Straight section shortened to 0.5 m in demonstrator, otherwise identical
- 200 turns of MgB<sub>2</sub> wire
- Wire cross-section 2 mm<sup>2</sup>, current 230 A
- Air gap magnetic flux density ~ 1.5 T, maximum coil flux density 2.5 – 3 T

## Winding of double pancake coils

- The demonstrator coil is built up by 10 double pancake coils
- Each double pancake coil consists of 2 layers with the ends (to be spliced to the next coil) on the outside
- The wet-winding technique is used: a layer of epoxy is applied to the wire while winding
- Winding speed ~ 200 m/h ⇒ one double pancake coil in 3 h

## Removing electrical insulation – saving cost and space

- Electrical turn-to-turn insulation is usually applied to coils
- By using the epoxy applied during winding as the electrical insulation, one step in the process can be omitted
- Contacts between turns may be accepted if the contact resistance is high enough
- Initial tests on a trial winding showed that the turn-to-turn contact resistance throughout the coil was above 10 Ω which is sufficient
- The method saves about 10% in space and 10% of the wire cost