Generator Systems for Tidal Energy

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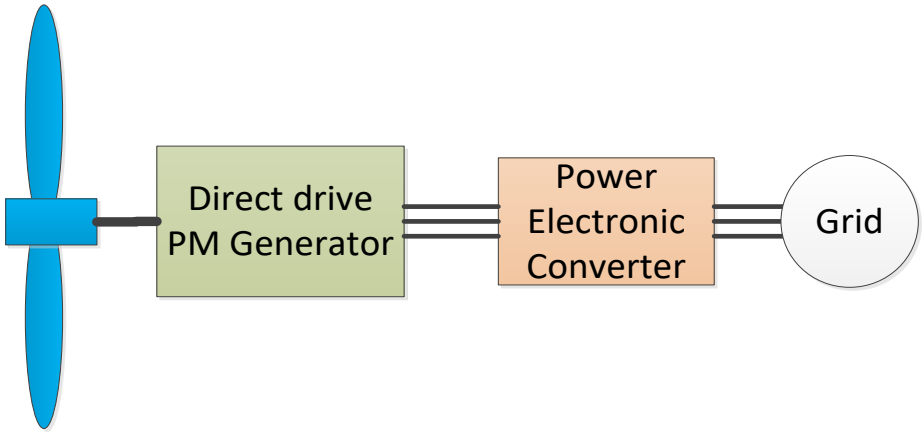
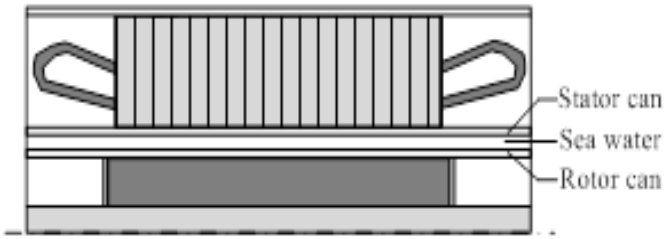
Research Areas

- Horizontal Axis Tidal Turbine systems
- Electromagnetic and thermal design aspects of seawater flooded permanent magnet Generator
- *Focus: Difference from conventional airgap generators in terms of modelling/analysis, structure, types of materials that can be used, etc.*

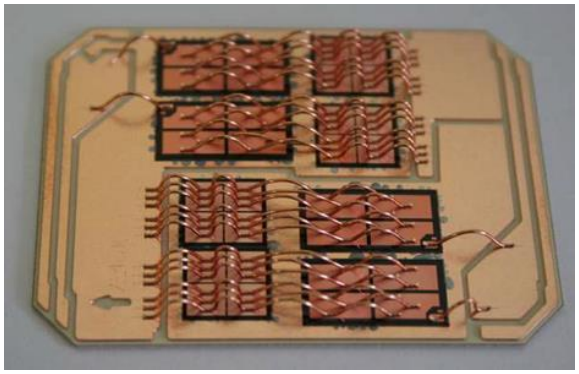


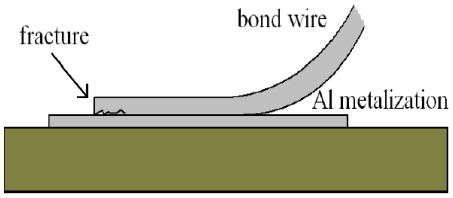


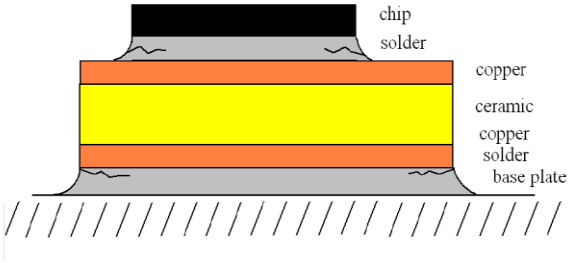
[Source: TiPA Website.]

Research Areas

- Reliability of submerged power electronic converters
- Focus: Expected lifetime before failure due to thermal stress induced failures in semiconductor devices; other modes of failure
- *Modelling of passively cooled submerged power electronics*
- *Reliable design: Identifying critical load conditions (good characterization of tidal resource), design-for-reliability approach, preventive design for "more likely" failure modes*







Industrial Collaboration

- **TIPA project**

Funded under EU Horizon 2020 R&I programme

INNOVATION Nova Innovation Ltd

SIEMENS Ingenuity for life

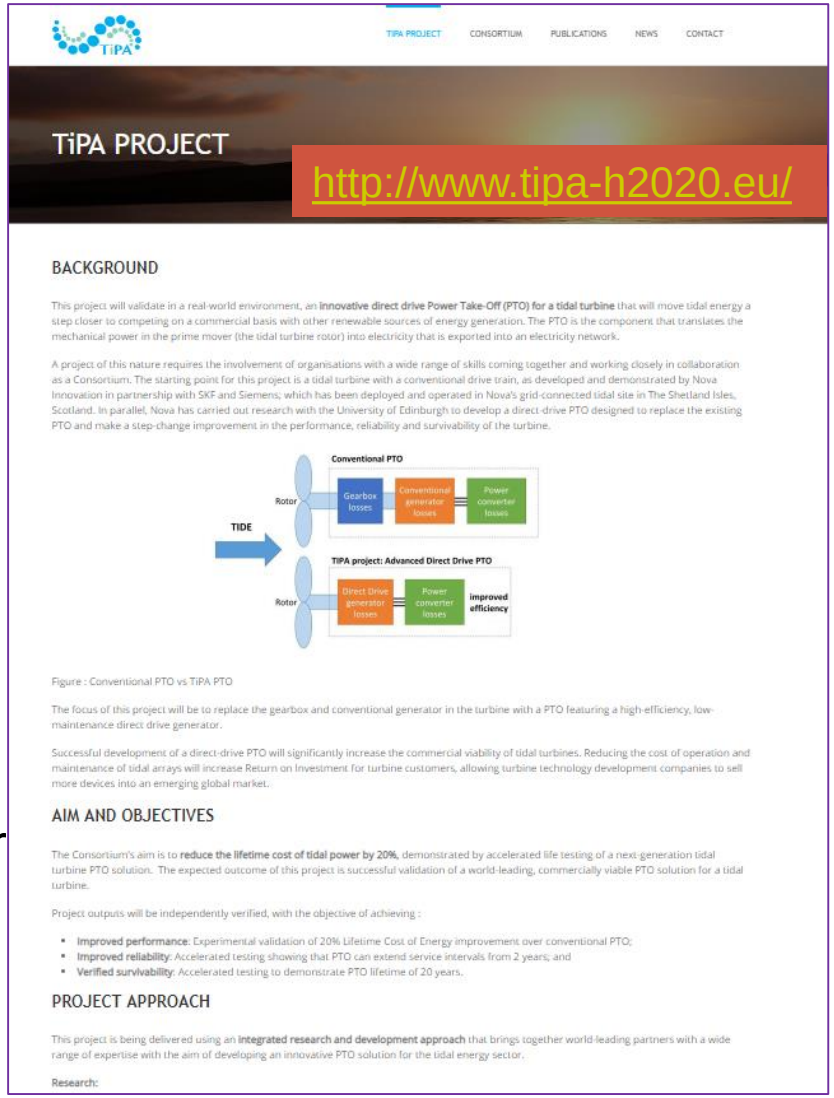
SKF

WOOD GROUP

TU Delft Delft University of Technology

RWTH AACHEN UNIVERSITY

THE UNIVERSITY of EDINBURGH



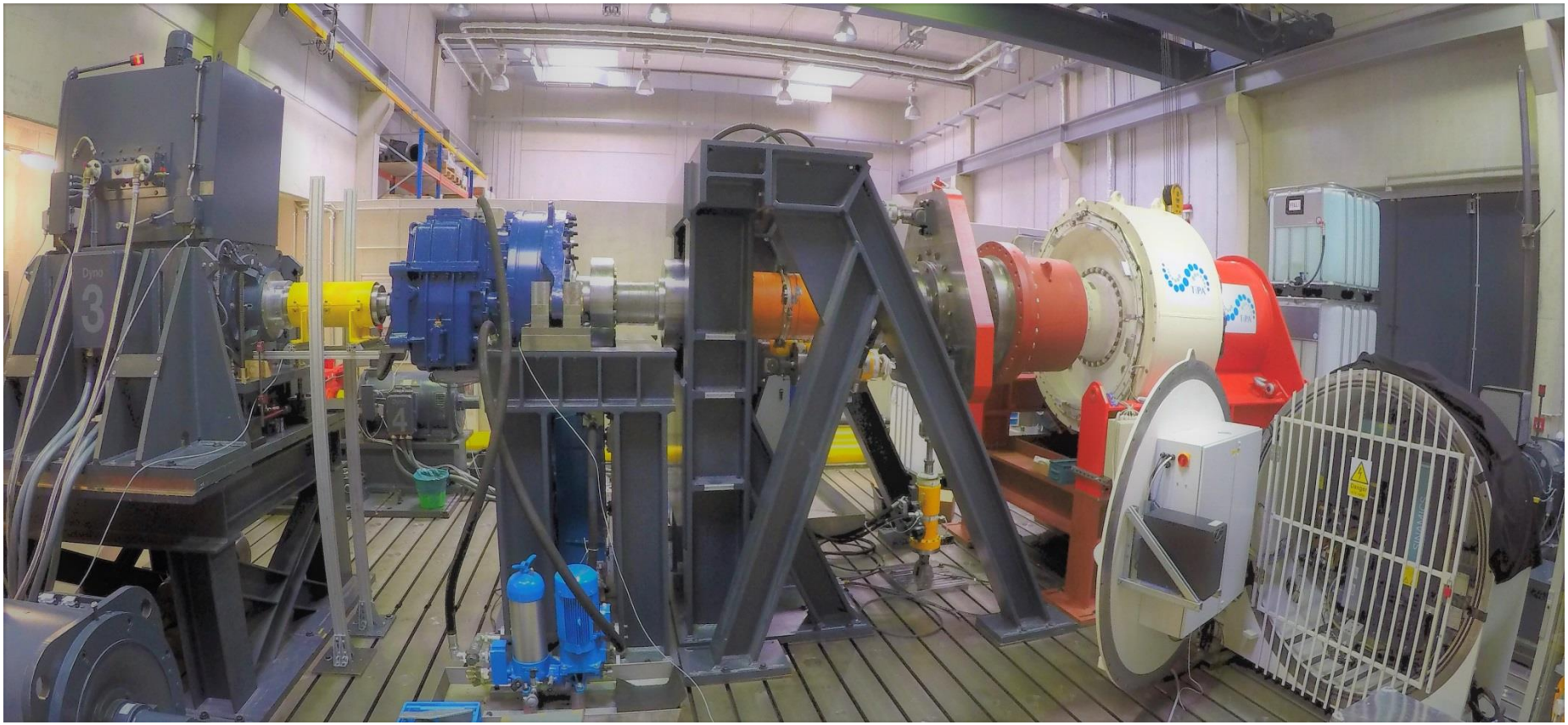
- ❑ Aims at reducing LCOE by 20%
- ❑ Aim Lifetime > 20 years
- ❑ Maintenance interval > 2 years

- ❑ Direct-drive design—flooded generator
- ❑ Submerged Power Electronics

LCOE-Levelized cost of energy

Industrial Collaboration

- **PTO Lab testing (Aachen, Germany)**



[Source: TiPA Website.]

Industrial Collaboration

- **In-Sea testing (Edinburgh, UK)**

[Source: TiPA Website.]

Industrial Collaboration

- **TU Delft Contribution**

Design, Reliability and Optimization of Power Take-off System

PUBLICATIONS (So far):

- ✓ *F. Wani, U. Shipurkar, J. Dong and H. Polinder, "A Study on Passive Cooling in Subsea Power Electronics", IEEE Access, 2018.*
- ✓ *F. Wani, J. Dong and H. Polinder, "Fast Rotor Loss Calculations in Fractional-Slot Permanent Magnet Machines", in Proceedings of the International Conference on Electrical Machines, 2018.*
- ✓ *F. Wani, J. Dong, A. Yadav and H. Polinder, "Comparing Different Materials for Rotor-Can in Flooded Generators", in Proceedings of the International Conference on Electrical Machines, 2018.*
- ✓ *F. Wani and H. Polinder, "A Review of Tidal Current Turbine Technology: Present and Future", in Proceedings of the 12th European Wave and Tidal Energy Conference (EWTEC), pp. 1133-1-7, 2017.*

Under progress:

- ➢ *Lifetime Analysis of Passively Cooled Power Electronic Converters Coupled to Tidal Turbines*
- ➢ *Calculation of PWM-Induced Rotor Losses in Flooded Generators*