SYNCWIND'S TYPE 5 WIND TURBINE POWER-TRAIN: A GRID-FORMING ALTERNATIVE TO INVERTER-BASED RESOURCES

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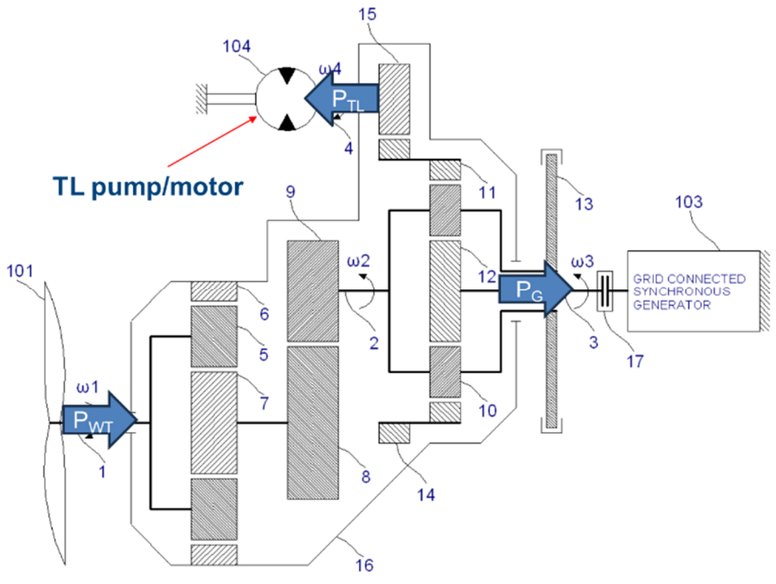
Abstract

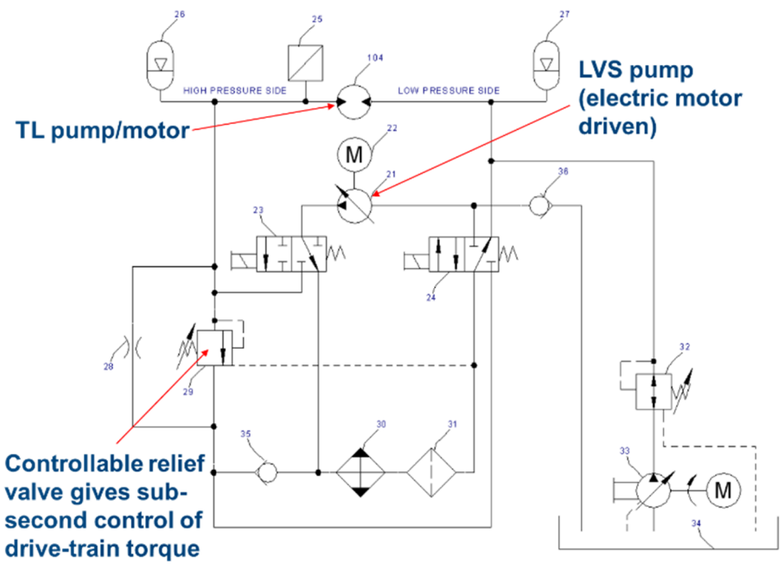
Degradation of system strength because of inverter-based resources (IBRs) is a major concern facing the zero-carbon transition. Blackouts like the one in Iberia on April 28 highlight this. Transmission system operators around the world are requiring new investments in synchronous compensators. This supports the view, shared by SyncWind, that synchronous machines cannot be totally replaced. But new investments in synchronous compensators are not the economic way forward.

The SyncWind Type 5 power-train is a cost-effective and proven way to provide mechanical variable speed, thus enabling synchronous wind power generation, reactive power, voltage control and system strength. It has been running for nearly 20 years and more than 1500 turbine-years track record in a 46 MW wind farm in New Zealand. The next demonstration has been designed as a low-cost modification of a 2.5 MW mainstream 3-bladed turbine in Europe, America, or Asia.

What it is

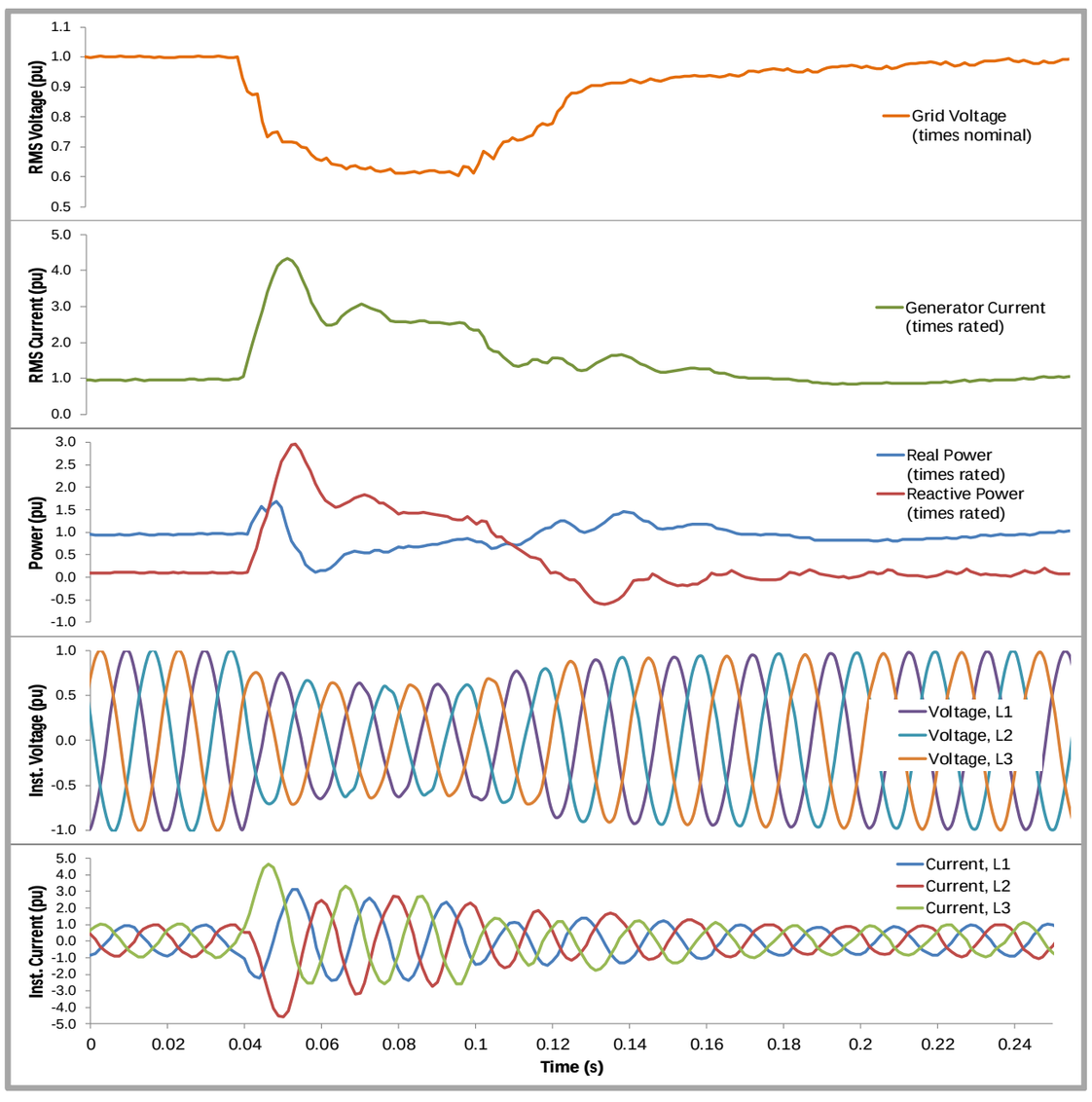
A patented torque limiting gearbox (TLG) - which provides hydrostatic torque reaction and low variable-speed (LVS) capability:





What it does

- **Protects the gearbox & generator from torque transients**
- **Provides system strength (massive fault current and some synchronous inertia) to support the grid during faults, not merely ride-through, for example September 2012 (NZ).**



How it is controlled

Controlled Parameter	Actuator	Type of control
1. Wind turbine speed		
a) LVS mode (60-100% Ns)	LVS pump flow	PI v1
b) Between modes (100-101%)	None	None
c) TLG mode (101-105% Ns)	Blade pitching	PI v2
2. Wind turbine torque		
a) LVS mode	None	None
b) Between modes	None	None
c) TLG mode	TL relief valve	Force balance
3. Wind turbine power		
a) LVS mode	None	None
b) Between modes	None	None
c) TLG mode	See 1c) & 2c)	See 1c) & 2c)
d) Operating reserves	TL relief valve	Set point step
e) Ramping performance	TL relief valve	Set point step
4. Grid frequency		
a) synchronous inertial response	Electromagnetism	Grid connection
b) fast frequency response	TL relief valve	Set point step
5. TL pump/motor speed (rpm)		
a) LVS mode	LVS pump flow	PI v1
b) Between modes	None	None
c) TLG mode	Blade pitching	PI v2
6. Voltage (V)		
a) LVRT and FPFAPR	Electromagnetism	None
b) steady pf (cosϕ)	AVR	Set point step
c) steady VAR export/import	AVR	Set point step
d) terminal-voltage and droop	AVR	Set point step

Why it has lower LCOE than a Type 3 turbine

- **No inverters**
- **Lighter gearbox and generator**
- **TLG-LVS system handles max 5% of turbine power**

The zero-carbon future needs synchronous wind.

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