TATA MOTORS

DEVELOPMENT OF HYDROGEN FUEL CELL BUS

PILOTED TECHNOLOGIES

The Hydrogen Fuel Cell Bus developed by Tata Motors, first in India, is a breakthrough solution for commercial transport as well as the power sector.

THE CONTEXT

The search for cleaner and more sustainable automotive technologies is driven by the growing awareness about impact of vehicle emissions on human health, alongside the concern about fast-depleting fossil fuels. These technologies play a vital role in improving energy efficiency in powertrains and show the way towards cleaner energies for the future.

Batteries and fuel cells with significantly reduced or zero carbon emissions are powering new energy storage and generating devices, and thus, also have a big role in electric vehicles (EVs). One of these is the hydrogen fuel cell power system which converts the stored chemical energy in hydrogen to electrical energy. The energy generated by the cell is used to power the vehicle.

THE INNOVATION

A fuel cell bus system consists of two core elements – an electric traction and an electrical power generation system. The traction system is similar to the one used in EVs. The power is generated through the hydrogen fuel cell system. The fuel cell power system consists of subsystems which are sized to provide the necessary thermo-fluid boundary conditions of air, hydrogen and coolant at the fuel cell stack inlet and outlet. These are critical for the stack to operate reliably and deliver the desired maximum polarisation (voltage vs current) characteristics.

KEY CHALLENGES

THE FUEL CELL POWER SYSTEM DESIGN

This includes the humidification system, air throttle valve, hydrogen pressure regulation system and water recovery unit, and the technology was not readily available with vendors. The Tata Motors team took the initiative to develop this technology in-house, and has registered six international patents.

CONTROL STRATEGY

Developing a control strategy for fuel cell vehicles through suppliers was found to be not cost-effective. To save costs, the team developed an in-house control strategy for integrating the fuel cell system with base vehicle architecture. Ensuring communication and hand-shaking of power sharing strategies was crucial for delivering better vehicle performance.

POTENTIAL IMPACT

With a longer driving range – 300-350 km per fill compared to 200 km per charge for EVs – hydrogen fuel cell powered vehicles are easier to maintain. The fuel cell bus innovation is a zero-emission solution that benefits the transportation sector as well as steady state power generation. The hydrogen fuel cell ensures a smooth transition from fossil fuels to renewable energy sources, which could lead to reduction in fuel imports, savings in foreign exchange and improved energy security for the country. The additional infrastructure created for hydrogen generation, storage and dispensing can help generate new business and employment opportunities.