

## Fuel Cells for Transportation with Commercially-Viable Reliability and Durability

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PureMotion<sup>®</sup> System Model 120 transit buses produced by UTC Power recently surpassed 12,000 operating hours and over 4 years in real-world service with original cell stacks and no cell replacements. As recently as 2007, the buses were failing as early as 1000 operating hours. In this presentation, the long path UTC Power has traveled to increase bus durability from 1000 hours to over 12,000 hours (and counting) will be described.

Buses in the US are typically operated for 12 years or 36,000 hours. For commercial success, the power plant must achieve durability of ~5 years (> 15,000 operating hours) without any major service overhauls. The necessity of such a long life in transit-bus applications is to avoid cell stack replacements and ensure that life-cycle costs can be at a level comparable to competing technologies (such as diesel-fueled internal-combustion engine/battery hybrids).

UTC Power has systematically identified the physiochemical mechanisms that substantially impact the durability of Polymer Electrolyte Fuel Cells (PEFC), developed and validated associated mathematical models and accelerated test protocols, successfully implemented multiple decay-mitigation technologies and introduced new and advanced materials solutions into UTC Power's fleet of PEFC-based power plants in transit bus applications to achieve world-record performance and durability.

PureMotion<sup>®</sup> System Model 120 PEFC Power Plants produced by UTC Power have demonstrated commercial levels of reliability in real-world transit bus service, which provides the customer increased vehicle availability, and has consistently demonstrated increasing levels of fuel-cell durability. In addition to recently surpassing 12,000 hours of operation, the PureMotion<sup>®</sup> has also consistently maintained 90% fleet average availability over the past three years while concurrently improving miles between road calls from 6,000 to more than 15,000 miles on the original fleet of six buses. The fuel cell has exceeded commercial targets set by the transit-bus industry for engines of 85% availability and 8,000 miles between road calls. Furthermore, the latest model of the PureMotion<sup>®</sup> 120, launched in 2010, has improved on this performance, achieving 30,000 miles between road calls and 96% fleet-average availability on the first nine buses put into service in 2010. As a result of this world-record durability and reliability, UTC Power has been able to reduce warranty reserves for units previously sold and can offer more competitive pricing to customers for the sale of new fuel-cell product and service packages.

The presentation will describe the major barriers resolved in order to improve durability for transportation fuel cells. Several PEFC degradation mechanisms, contributing to earlier failures of UTC Power buses, will be discussed. The mitigation strategies employed, which enabled PureMotion<sup>®</sup> System Model 120 PEFC Power Plant to surpass 12,000 hours, will be described.