Difference Engine: Volt farce

For General Motors, a good deal of the company's recovery from its brush with bankruptcy is riding on the Chevrolet Volt, its plug-in hybrid electric vehicle launched a year ago. Not that GM expects the sleek four-seater to be a cash cow. Indeed, the car company loses money on every one it makes. But the $41,000 (before tax breaks) Chevy Volt is a "halo" car designed to show the world what GM is capable of, and to lure customers into dealers' showrooms — to marvel at the vehicle's ingenious technology and its fuel economy of 60 miles per gallon (3.9litres/100km) — and then to drive off in one or other of GM's bread-and-butter models.

So, it is no surprise that GM should bend over backwards to mollify customers concerned by recent news of the Volt's lithium-ion battery catching fire following crash tests. GM is offering to loan cars to Volt owners worried about their vehicle's safety while an official investigation is underway and modifications made if deemed necessary. The company has even offered to buy vehicles back from owners who have lost confidence in the technology.

There have not been many takers. As of December 5th, fewer than three dozen owners — out of 6,400 Volts sold to date in North America — had requested loan cars. And only a couple of dozen had asked for their Volts to be bought back. At a suitable price, your correspondent would have welcomed the chance to buy one of those secondhand buy-backs for himself, had they not already been snapped up by employees. Dan Ackerson, GM's chief executive, is believed to have bought one for his wife.

The trouble all started last May, when the National Highway Traffic Safety Administration (NHTSA) carried out a routine 20 mph (32km/h) crash test on a Volt — to simulate a sideways impact with a tree or telegraph pole followed by a rollover. Three weeks after the test, the car's 16 kilowatt-hour battery pack caught fire in NHTSA's car park, destroying the vehicle and several others nearby.

Shortly thereafter, both NHTSA and the carmaker repeated the side-impact and rollover test on at least two other cars, all to no effect. However, in subsequent tests — carried out in November by experts from the energy and defence departments as well as GM — the investigators deliberately damaged the battery packs and ruptured their coolant lines. One battery pack behaved normally. Another emitted smoke and sparks hours after it was flipped on its back. And a third exhibited a temporary increase in temperature, but then burst into flames a week later.

GM claims the initial fire in June would never have happened if the NHTSA's engineers had drained the Volt's battery immediately after the impact. It is odd that they did not. When crash testing a conventional petrol-powered car, the standard procedure is to drain the fuel tank to prevent any chance of fire. It would seem reasonable to do the equivalent with an electric vehicle.

But, then, GM did not adopt a "depowering" protocol for the Volt until after the June fire. Even when it did, it failed to share the procedure with the safety agency until embarking on the November tests. In the wake of the latest findings, GM is now working with the Society of Automotive Engineers, NHTSA and other vehicle manufacturers, as well as fire-fighters, tow-truck operators and salvage crew, to implement an industry-wide standard for handling battery-powered vehicles involved in accidents.

Toyota ran into similar troubles when its Prius hybrid car was introduced over a decade ago. Though the Prius's battery pack is considerably smaller than the Volt's, fire-fighters and other first-responders had to learn how to disarm the vehicle following an accident — by removing fuses from under the bonnet and pulling a catch beneath the rear storage area to isolate the high-voltage system. Until they had done so, they were warned, they were on no account to take a metal cutter to an overturned Prius to extricate trapped occupants. Lurking beneath the floor was a big orange cable carrying a heavy current that would have fried anyone slicing though it.

The lithium-ion cells used in the Volt's battery pack have many virtues. They are much lighter and operate at a higher voltage than other rechargeable cells — and can therefore store more energy for a given weight. In addition, they have no "memory effect" (the tendency to accept less and less charge each time they are recharged) and can also hold their charge far longer than, say, the nickel-metal hydride cells used in the Prius. For good reason, all plug-in electric vehicles, including the Nissan Leaf and the forthcoming Ford Focus Electric plus Toyota's long-awaited plug-in Prius, have embraced lithium-ion chemistry.

But lithium is a highly reactive element. If overcharged, physically damaged or allowed to get too hot, lithium-ion cells can experience thermal "runaway" and even explode—as has happened on numerous occasions with the lithium-ion batteries in laptop computers and mobile phones. Also, if allowed to drain completely, they can short-circuit and make recharging dangerous. For these reasons, all lithium-ion rechargeable batteries contain circuitry that shuts them down when their voltage rises above or falls below a certain level.

To help keep the Volt's 435lb (197kg) battery pack at the right temperature, GM designed a sophisticated thermal-management system. This is separate from the main radiator system, which cools the range-extending motor-generator and feeds the car's heater. The battery pack, mounted in a T-shaped steel tray with a plastic cover, runs down the centre of the vehicle.

GM believes the Volt's battery problem was caused by malfunctioning sensors rather than chemical reactions going haywire within the cells themselves. The company is currently developing fixes to make the battery's control systems sturdier. One proposal is to laminate the electrical circuitry. Another involves beefing up the cooling lines. A third is to reinforce the tray containing the battery modules.

Outsiders note that the lithium-ion pack in the Nissan Leaf — the only other mass-produced electric car currently on sale in the United States — is encased in a rigid steel box rather than a plastic framework. The Leaf has come through its crash-testing programme with flying colours. Interestingly, its battery pack manages without any additional cooling system.

Despite GM's experience with the ground-breaking EV1 electric vehicle in the 1990s, the company still has much to learn about the public-safety issues associated with powerful batteries. For instance, both GM and NHTSA kept their mouths shut about the Volt's initial fire for the best part of six months, claiming they needed time to assess the results and to carry out further tests. Others suspect they colluded to protect the Volt's fragile sales. GM hoped to

sell 10,000 Volts in its first year, but will be lucky to achieve three-quarters of its goal.

In November, when GM finally went public about the Volt's fire problems, it warned owners, dealers and first-responders of the need to drain the car's battery pack after a crash. The OnStar communications system onboard every Volt should allow the company to dispatch an engineer to drain a battery anywhere in the country within 48 hours. For its part, NHTSA has now opened a formal safety investigation into the crash-worthiness of the Volt's battery system. Meanwhile, a congressional committee that oversees NHTSA is to hold hearings early in the new year to find out why it took nearly six months for the matter to be made public, and why the committee was not kept informed.

What is left unsaid in all this is the fact that conventional cars with a tank full of petrol are far greater fire hazards than electric cars will ever be. More than 250,000 vehicles catch fire in America each year, with some 500 people dying as a consequence. But, then, people have been living with the hazard of petrol for over a century. Irrationally, electric-vehicle fires are perceived as somehow more worrisome simply because they are new.

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