

Preview: GM revamps big SUVs

General Motors' next generation of full-size sport utility vehicles look, perform, and handle differently than the current lineup. Executives expect the redesigned vehicles will appeal to more buyers, which is especially relevant to an automaker accustomed to selling substantial numbers of full-size SUVs under the **Chevrolet, GMC,** and **Cadillac** nameplates.

"The new SUVs are obviously a very important piece of our product portfolio," said Robert Lutz, GM's Vice President of Global Product Development. Chevrolet Tahoe, GMC Yukon, and

Cadillac Escalade reach the market in the first quarter of 2006 as 2007 models. The second quarter of 2006 will see the release of the 2007 Chevrolet Suburban and Avalanche, GMC Yukon and Yukon XL Denali, and Cadillac Escalade ESV and Escalade EXT.

Inside, alterations focused on the details such as fit and finish. The new Tahoe interior "comes in better looking than the former Escalade interior," Lutz said. Gary White, General Motors North America Vice President and Vehicle Line Executive for the SUVs, said that a 2002 **Audi** interior was the benchmark for the Cadillac Escalade cabin.

All full-size SUVs have brand-specific interior colors in addition to a brand-specific instrument panel trim and gauges. Pillars, seats, and seat tracks reveal no exposed fasteners or hardware. Convenience options spotlight a new power fold-and-tumble rear seat to provide easier ingress and egress to the third-row seat.



The 2007 Chevrolet Tahoe features a domed hood, a more steeply angled windshield, a smoother roofline, and significantly reduced bumper-to-body gaps. A Tahoe fitted with the 5.3-L engine has preliminary unadjusted combined fuel economy ratings of 20.5 mpg with two-wheel drive and 20.1 mpg with four-wheel drive.





The Tahoe interior features a power-release fold-and-tumble second-row seat, first- and second-row heated seats, and DVD rear-seat entertainment with 8-in screen.

Outside, Chevrolet, Cadillac, and GMC differentiation cues include the front-end sheet metal, lamps, and fascias. For the 2007 model year, all brands nixed the use of lower body side cladding. All models have a windshield rake of 57°, which contributes to an aerodynamic performance of 0.363 Cd for short-wheelbase models. Aerodynamic refinement also helps give the new SUVs an additional 0.25-mpg fuel economy improvement as well as reduce wind noise.

Standard power for the 2007 products is by Gen IV Small Block V8s. Iron-block engine offerings are a 4.8-L unit; a 5.3-L with Displacement on Demand (DoD); and a 6.0-L heavy-duty engine with variable valve timing. Aluminum-block units are a

5.3-L with DoD; a 6.0-L with DoD and variable valve timing; and a 6.2-L with variable valve timing. The engines are mated to Hydra-Matic automatic transmissions including a new 6L80 six-speed.

A new fully boxed frame provides a 49% increase in torsion stiffness and a 35% improvement in the beaming frequency compared to previous models. Although pre-2007 models use a boxed frame, "the exception was with the rear bay," said Mark Moussa, Vehicle Performance Manager for Full-Size SUVs.

Front and rear tracks are wider by about 3 in (76 mm) in front and 1 in (25 mm) in the rear. The new vehicles use a new coil-over-shock design for the front suspension. There are larger, firmer brackets on the five-link rear suspension. Also new is rack-and-pinion steering, replacing recirculating ball gear.

Larger standard and available wheel and tire choices are offered. Standard on Chevrolets and GMCs are 17-in wheels, with 18-in units on Cadillacs. Optional are 20-in wheels on Chevrolets and GMCs, and 22-in wheels are available on Escalades. There are larger vented front and rear brake rotors as well as 50% stiffer dual-piston calipers. **Bosch's** next-generation, four-channel 8.0 ABS is standard.

Safety is improved with roof-mounted head curtain side airbags and StabiliTrak electronic stability control system with rollover mitigation technology. It is GM's first-time application of the technology that uses sensors to proactively predict

vehicle "tip up" and apply the appropriate brake forces to prevent a rollover.

Safety upgrades also contribute to improved crush dynamics for the front frame. The vehicles are about 3 in (76 mm) longer than the predecessors, yet there is approximately 17.7 in (450 mm) of additional crush space. "The front frame rail sections have been straightened and the section approximately tripled to gain the significant increase in stiffness," noted Rick Gjestvang, Program Engineering Manager, commenting on the approximately 90% stiffer front section.

A-pillar reinforcement and roof rails are made of high-strength steel primarily "to improve offset deformable barrier performance," according to Gjestvang. High-strength steel also debuts in a brace added to the front floor structure. "The addition of this structure allows us to maintain the current floor structure and meet the stiffness and strength goals for the next-generation utilities. The brace stiffens the floor and works in concert with other structure enhancements in the frame and body to maintain a more intact passenger compartment during certain barrier events," said Gjestvang.

The next-generation SUVs will feature three body styles as well as light- and heavy-duty models in two-, four-, and all-wheel-drive models. The vehicle will be assembled at plants in Arlington, TX; Janesville, WI; and Silao, Mexico.

Kami Buchholz

Jeep 'Commands' attention

On the outside, the 2006 **Jeep** Commander looks somewhat familiar: its design cues were inspired in part by the discontinued, boxy Cherokee. Underneath, the new seven-passenger SUV has the same underpinnings as the new-for-'05 Grand Cherokee.

With the common underbody, the main engineering of the Commander was performed during the development of the Grand Cherokee, noted Tom Cowing, Senior Manager of Vehicle Development. "The Commander could have been released first," he said. The combined Grand Cherokee/Commander team came together in the 2001 to 2002 time frame.

"You are going to see as we go forward that everything old is in fact new again," Jeff Bell, Vice President – Jeep,

said during the Commander's press launch in Philadelphia in late summer. "As we grow the Jeep brand in the next 18 months, you're going to see new incarnations of products that we've had in our past. So in some ways, today we begin back to the future."

That doesn't mean the Commander is merely a rehash of other products; especially inside, the Commander is like no other Jeep. It is the first Jeep vehicle with three rows of seats. To help make room for the third row, the SUV is 2 in (51 mm) longer and nearly 4 in (102 mm) taller than the Grand Cherokee on the same 109.5-in (2781-mm) wheelbase.

According to John Sgalia, Director, Jeep Design Studio, the Commander was designed from the inside out. That is to

say, the major goal of providing seven passengers with the most interior space possible largely drove the vehicle's "relatively square" exterior look. For example, the SUV's windshield is more vertical than the Grand Cherokee's to help create more room inside, he said.

A stepped roof, partially concealed from the outside by a standard roof rack rail, raises 3.15 in (80 mm) beginning over the second row to provide more headroom for occupants in the second and third rows. This feature also allows for stadium-style seating in which each row is higher than the one in front of it, enhancing forward visibility for passengers.

Also providing a more spacious feeling inside are CommandView skylights located



Jeep demonstrated in Pennsylvania's Pocono Mountains that the Commander is Trail Jeep Rated and "the most capable seven-passenger 4x4," while also having refined on-road ride and handling.

A stepped roof raises 3.15 in (80 mm) beginning over the second row to provide more headroom for occupants in the second and third rows. Also providing a more spacious feeling inside are CommandView skylights located above the second row.

above the second row. These two fixed, tinted-glass skylights, supplied by **PPG Industries**, are packaged with an available power sunroof above the front row. Each CommandView skylight has a roller shade that can be pulled to block out light.

The second row splits 40-20-40 and the seatbacks recline. The third row splits 50-50 and is available with a rear heating and air-conditioning system. Both rows fold forward to provide a flat load floor for maximum utility. Cargo volume with the second- and third-row seats folded is 68.9 ft³ (1950 L); with only the third row folded, 36.4 ft³ (1030 L); and behind the third row, 7.5 ft³ (212 L).

A storage bin located in the load floor behind the third-row seats features a top panel that is removable and reversible. One side of the panel is carpeted and level with the third row, while the opposite side is molded-in plastic with a diamond-plate texture for wet, dirty, or muddy items.

Safety was a critical area for engineers, and that attention extended to the third-row seats, which are tucked in close to the tailgate. Third-row passengers are protected by seats that securely lock in place, integral headrests, and standard side-curtain airbags with a roll-detection system for all three rows.

"Everything in life is a series of trade-offs, and we just were very reticent to make a bigger vehicle, for fuel-economy reasons as well as one of Jeep's traits of not being too big [for off-road maneuverability]," said Bell. "If you're going to have an efficient exterior package, then you're going to have a tight [third row],



The Commander has the same underpinnings as the Grand Cherokee, but its suspension has been tuned "slightly differently" for a softer ride.



The Commander is the first Jeep to have three rows of seats. To help make room, the SUV is 2 in (51 mm) longer and nearly 4 in (102 mm) taller than the Grand Cherokee on the same 109.5-in (2781-mm) wheelbase.

and you're going to have to put the things in place to make it safe."

One trade-off engineers made was sacrificing some rearward visibility by adding the third-row headrests for safety purposes. To help compensate, a ParkSense rear park-assist system is standard, warning the driver if something or someone is behind the vehicle.

According to Cowing, the Commander includes the highest level of

safety and security technology ever offered on a **Chrysler** Group vehicle. In addition to the aforementioned standard equipment, Electronic Stability Program (ESP), supplied by **Continental Teves**; Electronic Roll Mitigation, which is "an extension of ESP," said Cowing; advanced ABS; all-speed Traction Control System; Brake Assist; and multi-stage airbags with Occupant Classification System for the front passenger are some of the many



Both the second and third rows fold forward to provide a flat load floor with a cargo volume of 68.9 ft³ (1950 L).

standard features on the Commander.

According to the Chrysler Group, all of its SUVs will be equipped with standard ESP in the U.S. in 2006.

Like the Grand Cherokee, the Commander offers three full-time four-wheel-drive systems (Quadra-Trac I, Quadra-Trac II, and Quadra-Drive II), two transfer cases offering Brake Traction Control System and electronic limited-slip differentials, two five-speed automatic transmissions, and three engines.

The standard 3.7-L SOHC V6 produces 210 hp (157 kW) at 5200 rpm and 235 lb-ft (319 N·m) at 4000 rpm; the 4.7-L SOHC V8 offers 235 hp (175 kW) at 4500 rpm and 305 lb-ft (414 N·m) at 3600 rpm; and the 5.7-L Hemi V8 with Chrysler

Group's cylinder-deactivation system, MDS, produces 330 hp (246 kW) at 5000 rpm and 375 lb-ft (509 N·m) at 4000 rpm.

The Commander also shares the same fundamental suspension architecture—-independent front suspension, rack-and-pinion steering, and five-link rear suspension including a track bar—with the Grand Cherokee, but it has been tuned “slightly differently” for unique ride and handling characteristics, said Cowing.

Ryan Gehm

Lexus packs IS with high-tech punch

A new fuel injection system is foremost among the new advanced technologies showcased in the redesigned **Lexus IS**, but certainly not the only one.

“I can't think of any car in our lineup that has been so thoroughly redefined in only its second generation,” said Lexus Group Vice President and General Manager Bob Carter in a July media presentation. “In size, in refinement, in performance, the new IS is something special.”

When Lexus decided to install a V6 engine in the new IS (and the IS's big brother, the GS) rear-drive models, replacing an I6, it didn't just adapt the transverse V6 and rotate it 90°. And although the 4.0-L V6 in the **Toyota** 4Runner and Tacoma is north-south for rear drive, it merely provided basic architectural guidelines. Toyota and Lexus wanted a more advanced line of direct-injection V6s in displacements of 2.5 to 3.5 L. While the GS gets a 3.0-L version, the IS has 2.5-

results in some stratification, but a lean overall mixture, raising combustion temperatures for faster catalytic converter warm-up and, therefore, lower emissions. The new V6 units meet ULEV (ultra-low-emissions vehicle) limits, with the 2.5-L and 3.5-L achieving ULEV-level 2.

When the engine is warm, the latent heat from vaporization of fuel that is injected early in the intake stroke cools air on the compression stroke. Thus the engines inhale a greater charge (and use a higher compression ratio for greater efficiency). The V6 compression ratios are in the range of 11.5:1 to 12:1; that compares with the 10.5:1 compression ratio for the port-fuel 3.5-L V6 in the Toyota Avalon.

All three versions of the new V6 have intelligent variable intake and exhaust valve timing. The direct injection-only 2.5 and 3.0 also have both a tuning valve in the intake manifold and swirl control valves (butterflies) in the ports of alternate intake valves. The 3.5-L V6 has neither; it adds the port fuel system to one of the two intake valve ports of each cylinder, and it uses a modified strategy for both port fuel and direct injection to get even better performance.

The 2.5-L base engine in the IS produces 204 hp (153 kW), and the 3.0-L in the GS300 develops 245 hp (183 kW)—both having the same power density of 81.6 hp/L (61 kW/L). However, the 3.5-L (actually only 3456 cm³) produces 306 hp (231 kW) for a power density of 88.5 hp/L



Lexus takes on the BMW 3 Series with its second-generation IS, shown here rounding a turn at the Willing Springs road course near Los Angeles.

That became evident moments after Carter's presentation in a media ride and drive through the hills of Los Angeles and on the nearby Willow Springs road course, where there seemed to be forces beyond gravity and friction keeping the car upright and on the asphalt.

Technology will do that for you.

and 3.5-L variants. The 3.5-L has a novel dual-injection scheme using port injection.

Direct injection permits simultaneous control of both injection timing and volume. Immediately after a cold start, some of the fuel is injected in the last half of the compression stroke. This strategy



Both port and direct fuel injection are used in the IS. Shown is a cutaway of the 3.5-L V6 engine.



DuPont plastic spacers for the open-deck block direct most coolant flow to the upper part of the block.



Paddle shifters on the steering column are one element of a redesigned IS cockpit.

(66.8 kW/L). According to Toyota, the 3.5-L V6 improvement is solely from the addition of port fuel injection and the elimination of manifold tuning and swirl control valves.

Lexus said power figures were established in accordance with SAE's recently tightened power rating standard.

The manifold tuning valve improves mid-range, high-load torque. And swirl valves block one of the two intake ports, causing airflow to accelerate through the other, which improves air-fuel mixing at low rpm. However, despite the use of large ports, the two devices also pose a restriction in the intake system that affects high-end power. The 3.5-L V6 eliminates them (as well as a cold-start injector in the intake manifold plenum). The port fuel system injects some of the fuel into one intake port per cylinder both during cold starts and at appropriate times during the intake and compression strokes in warm operation. The throttle body is retained (so manifold vacuum is available). However, performance numbers of the overall low intake restriction Toyota 3.5-L V6 are more than competitive with engines that eliminate the throttle plate in favor of intake valve throttling, but include intake manifold tuning valves.

The direct fuel injection operates at 4-13 MPa (0.6-1.9 ksi).

The new V6 is an open-deck design block that contains a DuPont-developed plastic insert made of Zytel HTN (a high-performance polyamide) to provide precise regulation of coolant flow in the block. The insert directs most of the coolant to the upper part of the block to reduce cylinder temperatures close to the combustion chamber, while temperatures rise in the lower part of the block. The result is a more uniform top-to-bottom cylinder temperature, which improves fuel economy by 1% (approximately 0.3 mpg), according to Lexus.

Estimated fuel-efficiency figures for the IS 250 rear-wheel-drive model are 24/32 (city/highway) mpg; for the IS 250 all-wheel drive it is 22/28 mpg; for the IS 250 rear-wheel drive with six-speed manual transmission it is 20/29; and for the IS 350 it is 21/28. The IS 250 2.5-L delivers 185 lb-ft (251 N·m), and the IS 350 3.5-L 277 lb-ft (376 N·m), both at 4800 rpm. Standard in the IS 250 rear-drive is a new six-speed manual transmission. A new six-speed sequential-shift automatic transmission is standard on the IS 250 AWD and on the IS 350; both feature steering-wheel-mounted paddle shifters.

The IS follows the RX 400h and the GS from earlier this year in providing a high-tech stability control system called VDIM (Vehicle Dynamics Integrated Management System). Deployed in its most aggressive form in the IS, the technology allows the driver to take the car "deeper into the limits of stability" compared to the RX 400h and GS. Employing a variety of traction-control systems such as ABS and VSC, VDIM (offered in the 350 only) fires those systems in a measured and "nearly invisible" way as threatening dynamics add up. The more dangerous the dynamics, the greater the VDIM intervention.

Contributing to vehicle stability is the car's aerodynamics (0.28 Cd), including a smooth underbody for minimal lift.

The new suspension system is based on that of the GS, with some modifications, and features double-wishbone in front and multilink in back. New mono-tube shock absorbers with rebound spring are used front and back. Steering and brake systems also are all-new.

A voice-activated navigation system and adaptive front lighting system are among the high-tech features that, according to Lexus, greatly outnumber those of competitor vehicles.

Patrick Ponticel and Paul Weissler

Ford adds LCF to commercial fleet

The tilt-cab market, which is expected to grow from 24,000 units/year currently to 40,000 by the end of the decade, recently received a new competitor as **Ford** introduced its 2006 LCF (Low Cab Forward).

Designed with maneuverability as a top consideration, the LCF has what Ford claims to be the tightest turning radius and diameter in the segment. The LCF's wheels cut 53°.

"The reason that maneuverability and turning radius are so important on this is the majority of these vehicles are sold and maneuvered in inner-city areas where you need to have the opportunity to get in and out of traffic," said Joe Castelli, Ford Division Commercial Truck Director.

The cab, in which drivers sit above the engine, features a large windshield, which helps aid visibility needed for maneuvering tight situations. Various second-unit bodies are attached to the vehicle to fit different applications, including landscaping, construction, and towing.

The LCF was developed as part of the Blue Diamond joint venture (JV) established in 2001 by Ford and **Navistar International**. This project took on increased complexity as it was a global endeavor. The cab was engineered and built in Japan by **Mazda** and shipped to the JV's Escobedo, Mexico, facility, where the vehicles are being assembled.

The project was also an exercise in coordination as Ford and International shared responsibilities.

Bentley convertible

Bentley chose to release details of the convertible version of its all-wheel-drive Continental GT just after the Frankfurt Motor Show had closed.

The GTC is scheduled for launch late next year and will follow the Arnage-based convertible Azure, on sale in the spring. The 2+2 GTC joins the coupe GT, introduced in 2003, and the Continental Flying Spur sedan, which entered production this year.

The GTC will have a seven bow soft fabric roof that folds to be concealed beneath a hide-covered tonneau. Performance claims include a top speed of at least 304 km/h (189 mph). Like the GT, the GTC will have all-wheel drive



The Ford LCF was built as part of the Blue Diamond joint venture with Navistar International. It is being assembled at Blue Diamond's facility in Escobedo, Mexico.

Tilt cabs offer advantages in visibility and maneuverability over conventional cabs. The cab is lifted easily through the use of a latch system.

"The engineering is done through International. We add our differentiation, like the grille and other features of the vehicle, but the way we did the venture is very efficient for both companies because we supply a parts bin to try to keep the investment down on that vehicle," said Frank Davis, Vehicle Program Director for Trucks and Commercial Vehicles.

"If you look at the total market, one manufacturer dominates, and that's **Isuzu** and its peripherals," said Davis. "We want to go after that market and own a little bit of market share."

International supplied the LCF with its PowerStroke 4.5-L V6 diesel engine. The unit produces 200 hp (149 kW) at 3000 rpm and 440 lb-ft (597 N·m) at 1850 rpm.

Ford provided its TorqShift five-speed

electronic automatic transmission with tow/haul mode, which automatically adjusts shift points for hauling loads up and down steep grades. The transmission was built at Ford's Sharonville, OH, plant.

The LCF's 34-in (864-mm) wide frame is based on the Ford Super Duty chassis. Crossmembers joined by Huck bolts help give the LCF what Ford claims to be the segment's strongest standard frame.

The LCF has four axle-to-frame choices, five cab-to-axle options, and five wheelbase lengths, ranging from 113 to 185 in (2870 to 4700 mm).

Customers also have a choice in fuel capacity, with capacities ranging from 35 to 70 gal (132 to 265 L). A 40-gal (151-L) tank is standard.

Matt Monaghan



Bentley takes the lid off the GT coupe to create the GTC, due in production late next year with all-wheel drive and a W12 engine.

and a twin-turbo 6.0-L W12 engine producing 411 kW (551 hp) at 6100 rpm and 650 N·m (479 lb-ft) from 1600 rpm, driving through a six-speed gearbox. Suspension includes progressive air springs.

Although no further details have so far been released, like the Azure, the car may incorporate carbon-fiber bracing to achieve required structural stiffness levels.

Stuart Birch