

TECHNOLOGY TASK FORCE

Advancing Skid Steer Performance Through Scalable Electrohydraulic Architecture

As defined in NFPA's technology roadmaps, there are several machine-level technology trends that are actively shaping the future of the fluid power industry. One such area of development is exploring new system architectures, especially to improve the capabilities of controls, energy, performance, reliability, and safety.

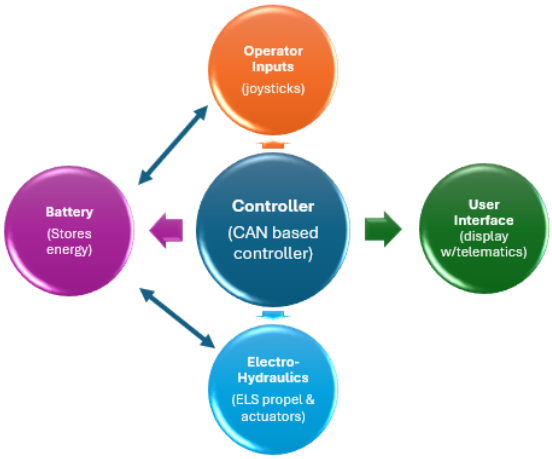
In August 2026, NFPA partnered with the iVT Off-Highway Vehicle Technology Expo to present expert-led programming during the two-day ***Advanced Hydraulics Conference***, which focused on the innovators and engineers exploring the latest technologies advancing the future of equipment and the fluid power industry. One presentation by DJ O'Konek, Engineering Manager for Nott Company, featured an innovative approach to a scalable electrohydraulic system for skid steers. Per his presentation, he describes how his team developed a platform to meet all vehicle sizes and become a test bed for future technologies. DJ reinforced that the overall goal of this machine's design was to keep it very simple but robust. This includes the following system architecture:

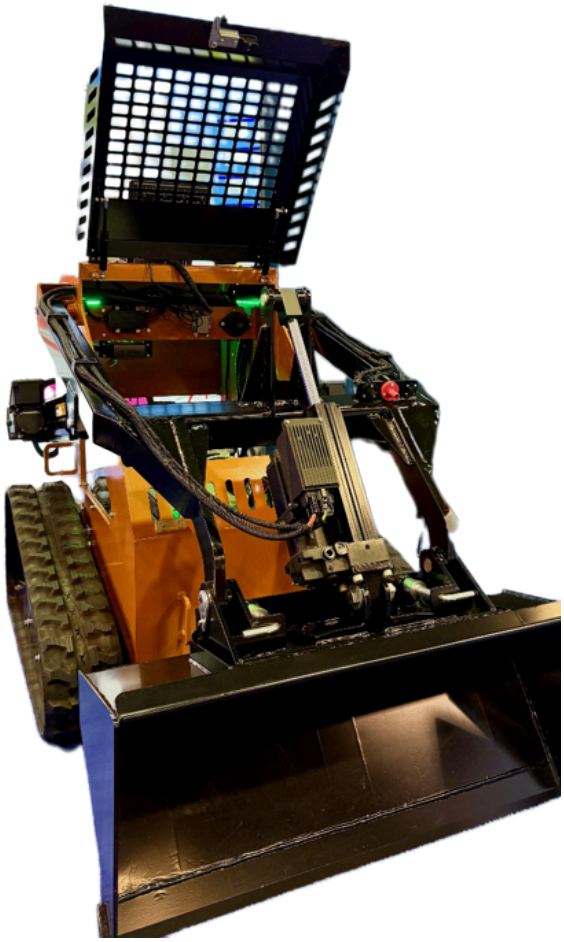
1. **Distributed Hydraulics** – ELS (Electronic Load Sense) Propulsion, Electro-Hydraulic Actuators
2. **Intuitive Operator Interface** – digital display for all operational parameters
3. **Build a Digital Backbone** – controls, display, and telematics coordinate the machine

This case study explores his presentation and expands on key elements of this innovative technology.

What are the core elements of the system?

The skid steer's architecture is based on a simple, coordinated control system involving the following elements: controller (CAN based controller), operator inputs (joysticks), battery (stores energy), electro-hydraulics (ELS propel and actuators), and user interface (display with telematics).





Electrohydraulic Skid Steer

Source: Nott Company

How does the system generate flow only when required?

The architecture replaces a conventional mechanically linked hydraulic control path with a coordinated electrohydraulic system. When the operator moves a joystick, the input is converted into a proportional electronic command and sent over the CAN network to the machine controller. The controller processes that command together with pressure, position, and other available feedback, then regulates the electro-hydraulic actuators and electronic load-sensing propulsion system to deliver the pressure and flow required by each function. This closed-loop control enables precise metering of lift, tilt, auxiliary, and propel functions. It also coordinates simultaneous commands and allows actuator travel or speed to be limited through software. Within the skid steer's design, the reservoir is smaller due to the overall hydraulic system design. Because the electric motor and pump respond to actual hydraulic demand rather than maintaining continuous standby flow, the system also reduces throttling losses, heat generation, and unnecessary battery consumption. **For the operator, the result is smoother and more predictable machine response, finer attachment control, repeatable movements, and easier adjustment of operating characteristics through the digital interface.** The same electronic control layer also provides a scalable foundation for diagnostics, remote operation, and semi-autonomous functions without requiring a fundamental redesign of the hydraulic architecture.

With electronic load sensing, joystick inputs are interpreted by the controller as flow and pressure requests rather than direct mechanical valve commands. The controller continuously compares each request with feedback from pressure sensors and other machine inputs, then adjusts the motor speed, and pump output, to supply only the flow required while maintaining the pressure needed to move the active load. When demand increases, the motor accelerates to support the commanded function. And when demand decreases, it slows down and the machine can stop when no hydraulic function is requested. This closed-loop approach minimizes the

excess pressure differential, or margin pressure, traditionally maintained across a load-sensing valve, reducing throttling losses, heat generation, noise, and battery consumption. **For the operator, electronic load sensing provides more consistent response as loads change, smoother modulation at the joystick, better control when multiple functions are used simultaneously, and longer productive operating time between charges.** Because performance is managed electronically, response rates and pressure limits can also be tuned into software to suit different attachments, tasks, or operator preferences.

During the Conference's presentation, an audience member asked a question about incorporating regenerative energy within the skid steer's system. Regenerative energy technologies are best used when the skid steer is coasting, given the stop-and-go movement of the machine, and it would not add significant battery life.

How many function modes are on the electrohydraulic skid steer?

There are also four function modes on the machine:

General

- No fixed priorities - all functions can operate simultaneously within the allowable current limit. If total demand exceeds that limit, the controller prioritizes the work functions.

Transport

- Power distribution priority is given to the propulsion system.

Precision

- Power distribution priority is given to work function, but propulsion and actuation are slowed.

Customization

- With the full electric architecture custom operation modes can be created.

These four modes demonstrate how an electrohydraulic system architecture can use software to dynamically allocate available electrical and hydraulic power according to the machine's operating objectives. By shifting priority among propulsion, work functions, precision control, and application-specific settings without changing hardware, the system becomes more adaptable and efficient. Overall, the duty cycle is being monitored. For the operator, this means the machine can deliver the appropriate balance of performance, response, controllability, and energy use for each task, while customized modes can further tailor machine behavior to specific attachments, jobs, or preferences.

What are the future development opportunities with this type of machine design?

Future development with the machine includes the following areas:

- **Grade / Slope Control** - adding sensors or integrating into job site telemetry to perform auto grade and slope functions
- **Attachments** - the skid steer framework provides ability to add attachments for testing future technologies
- **Additional Battery Capacity** - ample room to increase battery capacity or install future battery types for testing
- **Semi-autonomous / Remote Control** - with telematics and the CAN backbone it is easy to implement advanced technologies

Together, these future development opportunities show how electrohydraulic architecture can evolve through software, sensing, telematics, modular attachments, and expanded energy storage without requiring a fundamental machine redesign. This flexibility creates a scalable platform for automated grade and slope control, testing new attachment and battery technologies, and implementing semi-autonomous or remote operations. For the operator, these advances can improve precision and productivity, simplify attachment integration, extend operating time, reduce repetitive manual inputs, and enable safer control in demanding or hazardous applications.



Electrohydraulic Skid Steer

Source: Nott Company

Summary

Electrohydraulic system architecture advances fluid power by combining efficient hydraulic power delivery with software-based control, sensing, and machine connectivity. By generating flow only when needed, coordinating multiple functions through a digital backbone, and enabling performance to be expanded without major hardware redesign, this approach can reduce energy losses while improving precision, responsiveness, and adaptability. For the fluid power industry, these system features accelerate future technical innovation while delivering safer, more productive, and more intuitive machines for operators.

Author Acknowledgement

Special thanks to the Nott Company contributor for this Case Study Article:

DJ O'Konek – Engineering Manager

Disclaimer: This resource is offered as an informational example of electrohydraulic and architectural innovations in fluid power systems. Reference to any specific commercial product, process, or service does not constitute or imply the endorsement, recommendation, or favoring by the National Fluid Power Association.

© October 2026 National Fluid Power Association