

**Exercise 3: Redesigning Power Take Off Controls for Safety Using the Proximity
Compatibility Principle (PCP)**

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Current Layout Assessment

The current control cluster (**Figure 1.1, J2**) of the John Deere tractor includes a mixture of tactile, *high proximity* controls—hydraulic levers, electrical toggles, and the Power Take Off (PTO) toggle. The PTO toggle engages or disengages attached mechanisms and is differentiated by its John Deere Yellow hue (Hex #FFDE00) and unique shape compared to the other controls that surround it. This initial examination might conclude that the toggle's placement, shape, and color make it sufficient for safe operation. However, a brief analysis of the operator's task behavior reveals areas where this design can be optimized for improved safety and ease of use.

Operator Task Behavior Analysis

One may assume tractor operators frequently engage in divided attention tasks—steering with one hand while manipulating hydraulic controls with the other—this is not entirely reflective of real-world usage. Typically, the operator engages a control, such as lowering a mower deck or activating a baler, and then continues driving without further interaction with the controls for a significant amount of time. Once the machinery is activated, the operator's primary focus shifts to steering the tractor and monitoring the ground ahead. As a result, their attention moves away from the control cluster, including the PTO toggle, which is often located outside their peripheral vision.

In situations where quick PTO disengagement is required—such as an emergency where an attached implement must be immediately shut down—the current toggle location poses a safety challenge. The operator may fumble to find the PTO toggle, forcing them to either divert their attention from driving or operate the controls by feel alone. This delays their response time, as the operator must simultaneously locate the PTO toggle, engage the clutch or brake, and slow

the tractor down. In critical moments, these extra seconds could increase risk to both the operator and the equipment. Based on this analysis, a more intuitive PTO control solution can mitigate these risks.

Proposed PTO Stalk Schema

To address these safety concerns, we propose a redesigned PTO control schema inspired by John Deere's consumer line of riding mowers—a steering column-mounted PTO stalk (**Figure 1.2, J1**). Not only does this provide a cost-effective solution by leveraging existing components and engineering plans, but it also aligns more closely with the natural task motions of the operator, offering several safety advantages.

1. **Proximity to Operator's Hand:** Relocating the PTO control to the steering column positions it within easy reach of the operator's hands while navigating, ensuring quicker and more intuitive access in the event of an emergency. Unlike the current design where the PTO toggle is co-located with the hydraulic controls, this separation makes operating the PTO a distinct action that can be performed independently of other controls.
2. **Intentional Operation:** The PTO stalk requires the operator to pull down with deliberate force to engage the mechanism, offering tactile feedback. This ensures that the operator is fully aware when the PTO is engaged, reducing the likelihood of accidental activation. Moreover, the stalk's disengagement mechanism—requiring only a light flick upwards—provides a similarly intuitive motion for shutting off the PTO without requiring excessive hand movement.
3. **Improved Safety:** The PTO stalk's location on the steering column makes it more accessible without requiring the operator to take their eyes off the road or their hand off

the steering wheel. In contrast to the current toggle, which forces the operator to reach behind and around and potentially lose focus, the stalk allows the operator to maintain better control of the tractor during PTO engagement or disengagement.

4. **Ergonomic Design:** The end of the PTO stalk would be designed with a John Deere Yellow bulb, featuring relevant iconography to aid quick identification in low-light or hazardous conditions. The bulb-shaped end would allow the operator to grip and manipulate the stalk even when wearing gloves, a common requirement when farming.

Conclusion

By adopting a steering column-mounted PTO stalk, we introduce an intuitive, ergonomic, and safety-focused design that addresses the limitations of the current toggle configuration. This redesign not only makes the PTO control more accessible in critical moments but also enhances the operator's overall task efficiency. Leveraging pre-existing designs from John Deere's product lineup reduces implementation costs while improving operational safety for this tractor model.

Fig. 1.1 - Abbreviated Current Configuration

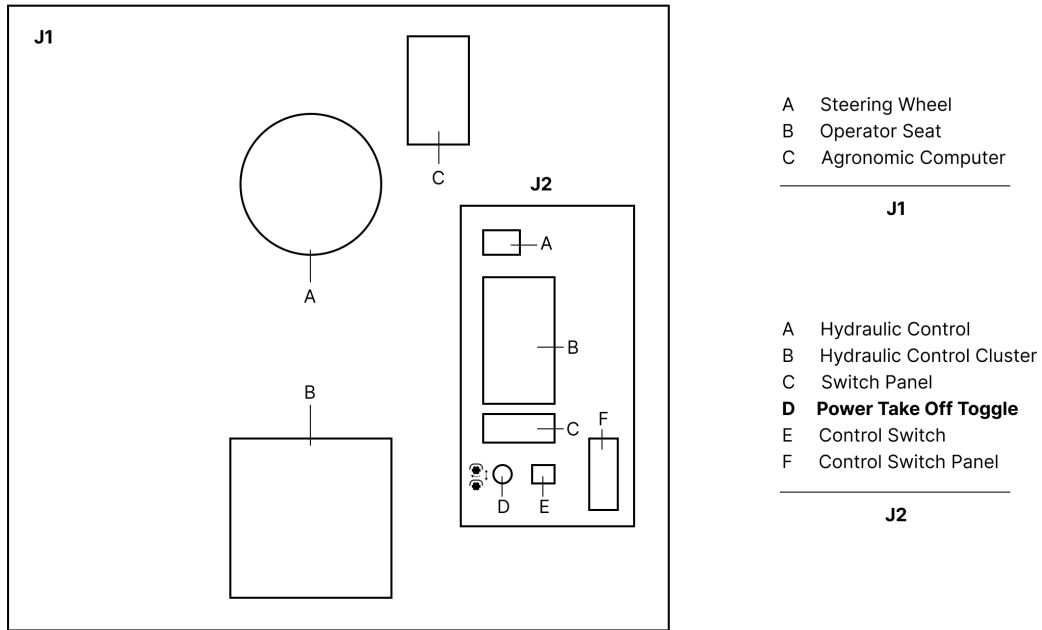


Fig. 1.2 - Abbreviated New Configuration

