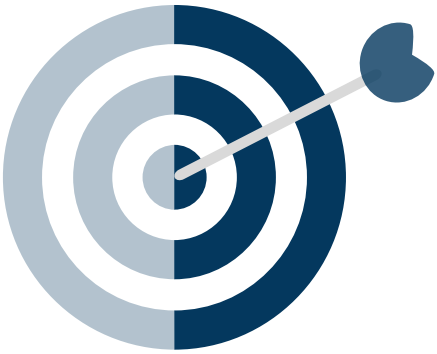
EMESRT

Earth Moving Equipment Safety Round Table

DESIGN PHILOSOPHY 3

EXPOSURE TO HARMFUL ENERGIES



Objective

The objective is to prevent harm related to exposure to moving machine parts, failure of hydraulic equipment or systems, or other energy sources, such as compressed gases, heat, electricity, electromagnetic fields and gravity to as low as reasonably practical, including consideration in design for foreseeable human error.

General outcome

The intended design outcome should include/consider the following:

- Prevent intentional or unintentional contact with moving machine parts; hot components or fluids; electric currents; radiation; compressed air or gas; and high-pressure fluids including hydraulic fluids
- Minimise the likelihood of failure, during operation or maintenance, of equipment and equipment components, that transmit harmful energies - including hydraulic hoses and fittings; compressed air and gas lines; and electrical wires and components
- Designs that prevent short circuit, current flow or cell damage during maintenance through tool or body in a reasonable range of motion
- Enable isolation of equipment energy systems to be achieved at the primary, easily accessible, interrelated and stored energy source including capacitative discharge units (i.e. not at the control circuit)
- Provide partial system isolation that facilitates maintenance activities
- Isolation devices require minimal activation force and are safely accessible, appropriately labelled, of limited complexity, and can be locked in the isolated position
- Energy systems fail to a de-energised state, and present no hazard when disengaged or through the charging or replacement process
- Provide a means to verify zero energy
- How to carry out safe work on the power source i.e. upstream of the main isolator
- Information is provided on hazardous effects for medical implants
- Emergency response and recovery - In the event of an incident, emergency response teams require information on the potential hazards that could initiate a fire, electric shock or chemical burn

3.1 Causal Pathways

Harm from exposure to energies such as: heat; electricity; radiation; compressed air; high pressure fluids, including hydraulic fluids; and falling objects.

3.2 Causal Pathways

Friction burns, injection or other harm due to exposure to uncontrolled release of fluids under pressure. Typical exposures occur in the following examples:

- Maintenance for intervention for tuning, fault finding and calibration
- During normal operations personnel are in the proximity of fluid release



3.3 Causal Pathways

Entanglement in rotating parts including engine fans, pulleys, drive belts, gears, drive drums, rollers and rotating shafts, including drill rods and steels.



3.4 Causal Pathways

Harm from being struck by a release of inadequately secured moving or rotating equipment or components.



3.5 Causal Pathways

Entrapment, entanglement, and/or crushing from moving equipment such as: arms, jaws, gates, doors, pull down ropes/chains, winches and foot clamps.



3.6 Causal Pathways

Scalding or burning from exposure to accessible hot surfaces including but not limited to, engines, hot exhaust, engine components, braking components, cooling systems, hydraulic components, an regenerative systems.



3.7 Causal Pathways

Electrocution or burning from contact with unshielded stored power sources, electrical switches, wires or devices.



3.8 Causal Pathways

Harm from exposure to:

- Energy induced in hydraulic systems from cylinders
- Energy inadvertently released by secondary systems e.g. fire systems, air bags.
- Residual energy retained after isolation and apparent de-energisation e.g. in springs, ropes, conveyor systems, accumulators, receiver tanks and fire systems
- Energy released from pressure vessels that have not been safely depressurised, including premature removal of radiator caps

3.9 Causal Pathways

Loss of containment control of energy source due to:

- Monitored power storage systems are unable to monitor thermal runaway due to isolation of control system
- Charging systems don't have the capacity to manage the battery monitoring function and respond
- Power storage systems continue to supply power when faulty
- Failure of a battery causes fire
- Failure of battery releases caustic material and gases

3.10 Causal Pathways

Unintended consequence resulting in exposure to operator or first responder in potential energy release:

- Harm to operator or responding ground personnel due to exposure to energies arising from unmonitored and unintended events, including damage to equipment, energy systems, or isolation devices
- Failure/runaway short circuit or loss of power, cable/hose damage, mechanical/operator error