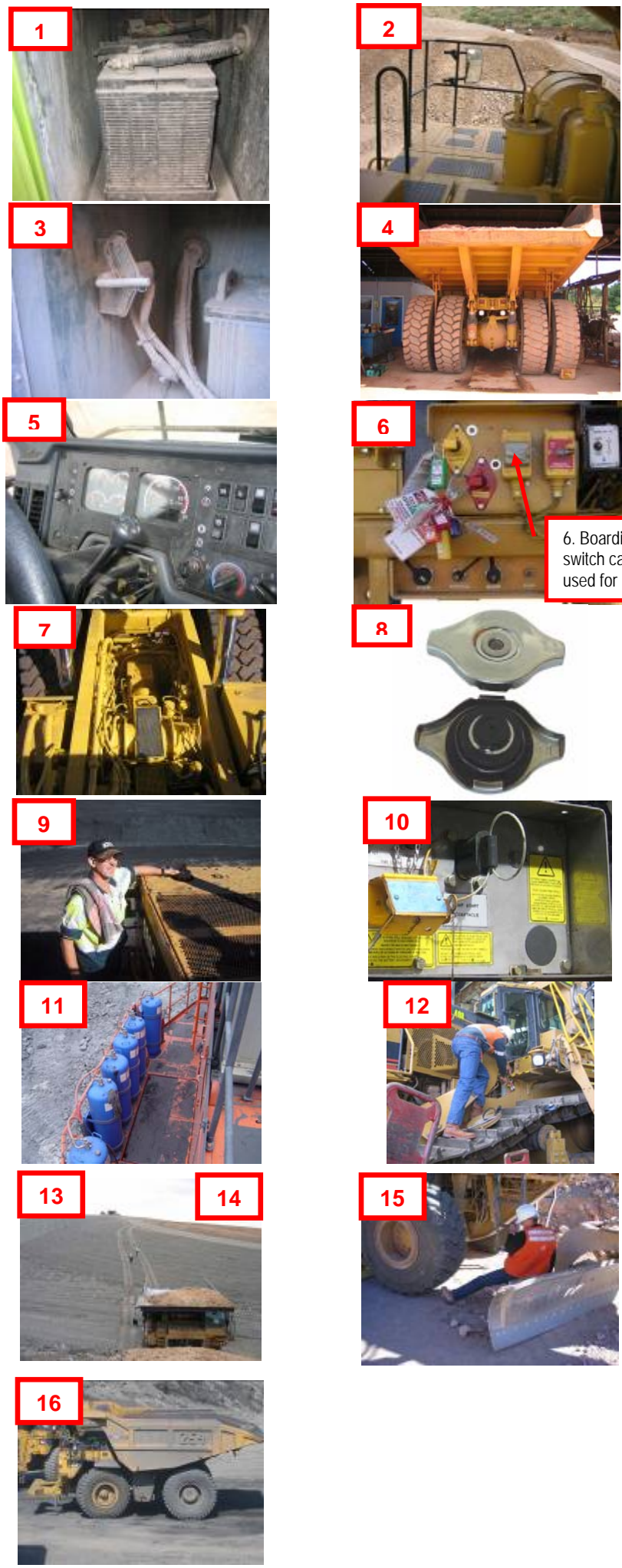


Risks to be mitigated

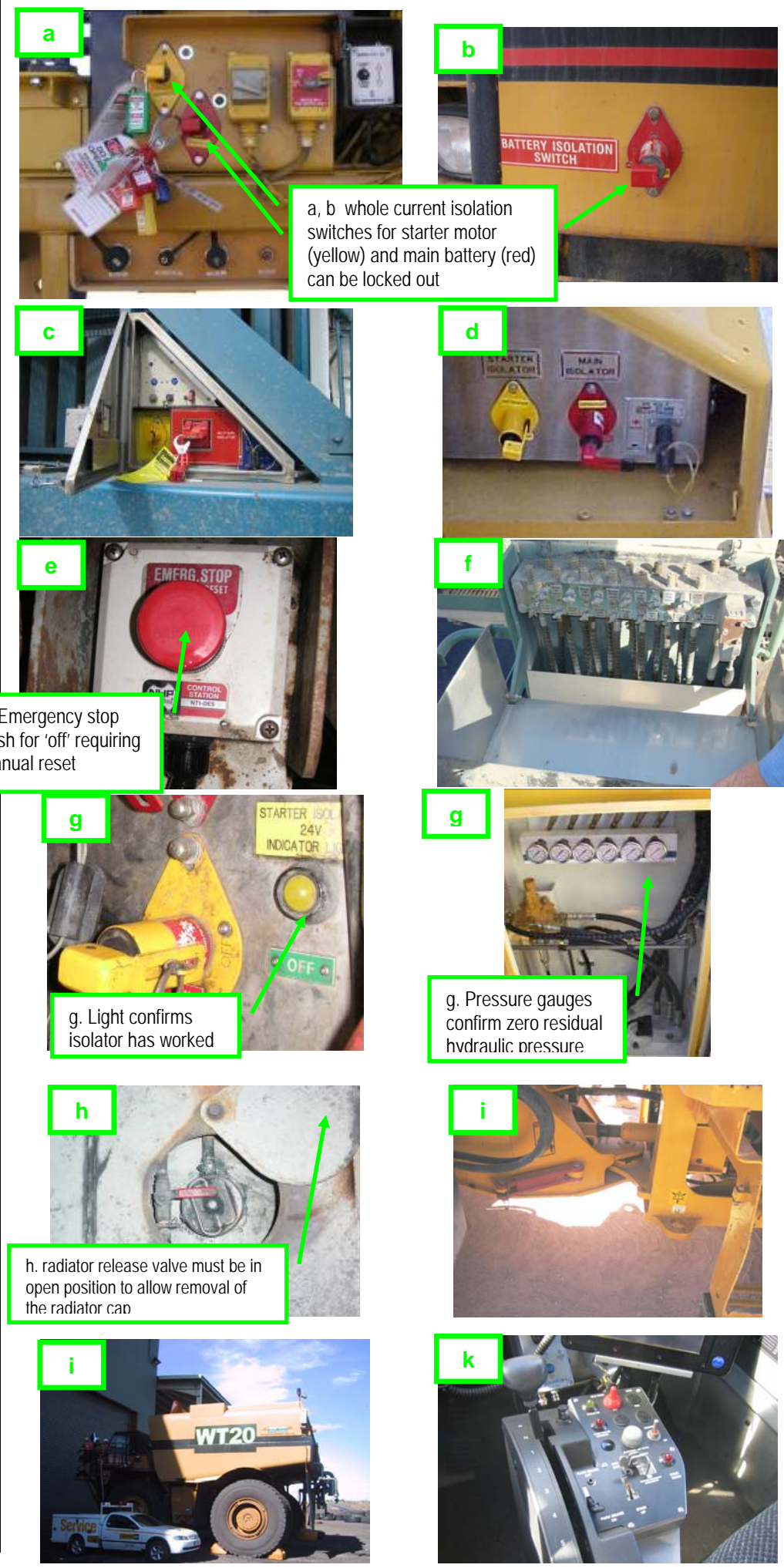


6. Boarding switch can be used for lockout

7. Isolation of energy, including parking

Objective	The objective is to minimise the risks of events related to achieving zero energy state for all vehicle energy sources, including parking (gravity), which might lead to injury, illness, damage, etc. to ALARP, including consideration in design for foreseeable human error.
General outcome	The intended design outcome should provide positive protection and confirmation of the zero energy state through: <ul style="list-style-type: none"> Isolation of the equipment energy systems achieved at the primary and stored energy source (not control circuit) Use of isolation devices that can be locked in the isolated position Provision of a 'try' step or test measurement for zero energy Equipment parking systems shall facilitate fundamentally stable parking where all implements are placed on the ground and the park brake is positively engaged before the operator leaves the cabin.
Risks to be mitigated	The risks to be mitigated include, but are not limited to, <ul style="list-style-type: none"> - For Energy Systems, the risk of: <ol style="list-style-type: none"> No means to achieve positive isolation Stored energy systems, such as accumulators, not able to be isolated or reduced to zero energy Inadvertent defeat of positive isolation e.g. batteries only being isolated on a single pole Raised elements of the machine not secured allowing movement eg 'body-up' Control circuits being used for isolation e.g. ignition switch or boarding switch Control circuits containing same type of device as that used for isolation, which lead to human error in isolation Energy induced in hydraulic systems from cylinders Radiator caps being removed before energy is released No means to verify zero energy state By-passing the isolator to re-energise the machine or circuit e.g. 'jump start' circuits Inadvertent release of secondary systems e.g. fire system, air bags, springs, etc Isolation devices not accessible from ground level or platform - For Parking Systems, the risk of: <ol style="list-style-type: none"> Park brakes not fully engaged Other brake systems temporarily preventing the machine from 'rollaway', which release over time allowing a 'rollaway' Operator leaving the cabin before the park brake has been engaged Wheel chocks not specified for EME and limits not specified for their use
Examples of industry attempts to mitigate risks	Electrical Isolation <ol style="list-style-type: none"> Lockout style switches for full battery and starter motor isolation provided at the point of primary operator access from ground level Isolation switches / valves fitted with a lockout device that will accept a 6mm shank padlock Main starter switch on the machine that does not isolate the two-way radio; boarding or interior lights, or interrupt any engine shutdown timer fitted. Isolators that open both the positive and negative battery supply Emergency stop switches that are single action push for 'off' (latch) and must be manually reset Other Sources of Energy <ol style="list-style-type: none"> Isolation systems provided for other stored energy sources, such as pneumatic, hydraulic or radiator pressure, where there exists the risk of injury due to unexpected release or activation of stored energy. Bleed/test points that confirm that stored/residual energy is dissipated Effective depressurisation interlock on radiator cap Articulation locks where relevant Provision of wheel chocks Devices that alarm and/or indicate to the operator on leaving the cab that the park brake has not been correctly set

Industry attempts to mitigate risks



a, b whole current isolation switches for starter motor (yellow) and main battery (red) can be locked out

e. Emergency stop push for 'off' requiring manual reset

g. Light confirms isolator has worked

g. Pressure gauges confirm zero residual hydraulic pressure

h. radiator release valve must be in open position to allow removal of the radiator cap

