How does your agency manage vehicles in contact with electricity?

Darren Zeller - 24/11/09

Different agencies seem to have different policies and procedures for managing electrical contact with vehicles. We are looking to develop a consistent process that provides guidance in the following situations:

- What should the driver do if they are in situ?
- What should the driver do if there is fire or arcing involved?
- How should the driver dismount safely?

- What are the safety considerations for emergency service personnel?
- How do you determine if the power is active or not?
- Who is responsible for removing the cable from the vehicle?
- What are the PPE requirements?
- How do you determine when it is safe to move the vehicle?
- What is the risk of tyres exploding?

Tim Fox - 24/11/09

The NSWFB has developed the attached Electrical Hazards Awareness Manual which outlines our policies and procedures in this area.

Peter Rootes - 27/11/09

Gentlemen,

Electricity is both complex and simple - depending on the context and level of understanding of persons involved

The attached document sourced from the NSWFB is quite detailed and covers many situations encountered as part of 'everyday' emergency incidents

Establishing a 'generic' catchall policy and procedure requires very clear guidelines as to what is to be achieved and conveyed to the end user in an emergency incident involving electricity

In the emergency incident context electricity is very likely to be the 'silent killer' of the unwary and yet valuable 'rescue' time can be lost through excessive caution - finding the balance is key

Electricity behaves differently depending on several factors present or absent from the situation, some of those factors include but are not

limited to the following - level of voltage LV or HV; ground conditions; value of circuit resistance; condition of damaged or defective equipment; weather; etc

The questions posed as part of the discussion forum can be answered in simplistically, but are best addressed in a specific context once the basic behaviour of electricity (at different values of voltage) has been conveyed and understood

There are answers to the questions - how much detail would you like? :-)

regards

Peter Rootes

Electrical Fitter Mechanic (by trade)
Learning Resource Developer
Workplace Trainer Assessor (Electrotechnology and ESI)

Peter Rootes - 18/12/09

What should the driver do if they are in situ?

All electrical conductors (wires, lines, mains) are to be assumed to be 'ALIVE' unless isolated, proved de-energised, (and in the case of HV earthed and short circuited), by an approved means by authorised Network Operator personnel.

Persons in situ (within the vehicle in contact with 'Live' electrical conductors) are to remain wholly within the vehicle until such time that the electricity has been isolated and proven de-energised and the conductors removed from the situation (conditions apply).

Whilst the person stays wholly within the vehicle they are at the same potential as the vehicle and not at risk of receiving an electric shock - no difference of potential no electric shock.

Conditions - vehicle not on fire, vehicle not at risk of becoming involved in fire, absence of excessive and dangerous arcing of conductors, persons not at risk of further injury due to other situational hazard - falling
branch, tree or electrical apparatus.

If any other situational hazard is assessed as being a higher risk level than the presence of 'Live' electrical conductors then a decision needs to be made about extracting the person from the vehicle (conditions apply).

Conditions - person in situ able to self-extricate, 'jump' clear of vehicle in one motion and then kangaroo hop away from the involved vehicle - if person at risk of falling over when 'jumping clear or hopping' then they

are to remain in situ (person at risk of touch & step potential electric shock) until the electrical conductors have been 'made safe' by authorised personnel.

What should the driver do if there is fire or arcing involved?

In the event that there is fire or arcing the fire hazard is to be mitigated by the application and appropriate use of an applicable fire extinguisher or suppression method, say Dry Chemical (all personnel are to remain 8m from the involved vehicle until the electrical conductors have been 'made safe' by authorised personnel - manages risk of electric shock).

Fire personnel have 'safe' techniques for dealing with fires involving electricity, which if available can be used to suppress the fire until such time that the electrical conductors have been made safe by authorised
Network Operator personnel.

How should the driver dismount safely?

In the event that the driver is required and able to dismount from the vehicle, (involved with Live electrical conductors), then they are to do so by 'jumping', (with feet together), clear of the vehicle in one motion,
making no simultaneous contact with the ground and the vehicle (manages risk of 'touch potential' electric shock) and then 'kangaroo' or 'bunny' hop a distance of at least 8m from the involved vehicle (manages risk of 'step potential' shock).

What are the safety considerations for emergency service personnel?

Emergency personnel are to remain 8 metres distant from the involved vehicle (manages risk of electric shock), until such time that the electrical conductors have been 'made safe' by authorised personnel - all fire and other 'rescue' or medical attention activities are to be carried out at the 8m distance until it has been deemed safe to approach.

The identification of the voltage level associated with the 'fallen' conductors may not be able to be definitively determined as both High and Low voltage conductors may be involved, both at the incident scene or at another location out of view of the emergency personnel - only authorised Network Operator personnel are trained to deem the electrical conductors have been 'made safe'.

How do you determine if the power is active or not?

There are a variety of electrical testing devices used by authorised Network Operator personnel to determine if an electrical conductor is de-energised, most are based on detecting the presence of voltage (inductive) and not current flow (electromagnetic).
The basic safety rule
is that ALL electrical conductors are to be assumed to be ALIVE unless isolated, proved de-energised, and in the case of HV conductors, earthed and short-circuited, so even if emergency personnel have an approved test device they are not in a position to have ISOLATED the 'supply' and then proved it de-energised. The situation is that the

electricity supply might have be 'tested' and shown to be 'off' only to have it come back on due to the operation of an automatic protection device known as a Recloser or Circuit Breaker, (which can attempt to turn the electrical supply back on, up to four (4) times before 'locking out').

Who is responsible for removing the cable from the vehicle?

The physical act of removing the 'cable' can be performed by any suitably trained emergency service person, under direct instruction and supervision of the Network Operator personnel, however, the most appropriate person who should take responsibly for removing the electrical conductor (cable) would be the authorised Network Operator person who effected the isolation and proved the conductor de-energised - best to leave the task to them.

What are the PPE requirements?

PPE is the lowest control measure for hazard and risk mitigation - the higher level of control is the isolation and proving de-energised of the electrical conductor after which time the most appropriate PPE would include but not be limited to the following items -- safety boots, neck to
ankle to wrist clothing (buttoned up and tucked in), safety helmet, safety glasses, and a LV insulation glove on each hand. Cables would be removed using an insulated and periodically tested switching stick.

Electrical cables not isolated and proven to be de-energised are deemed to be ALIVE and as such should not be handled by emergency personnel unless specifically trained and authorised in the appropriate procedures for
dealing with and handling energised electrical conductors.

How do you determine when it is safe to move the vehicle?

If a vehicle is involved with 'fallen' electrical conductors then it is not to be moved until such time that the 'fallen' electrical conductors have been isolated, proven de-energised, (and in the case of HV earthed & short-circuited) and removed by authorised Network Operator personnel.

What is the risk of tyres exploding?

Tyres on vehicles which have become or been involved with energised High Voltage are at risk of 'exploding' as the HV electricity has often 'found' a path to earth via the tyres (which can become conductive especially if the value of voltage is high enough). The tyres may not necessarily 'explode' during the time of 'contact' with the energised conductor (dependant on voltage level and nature of contact) but at a time later, so all vehicles subjected to energised contact with electrical conductors are to be thoroughly inspected by an approved mechanic or vehicle specialist, before being allowed to regain the road.

Note: The responses made are those of the author, as an individual, as one interested and involved in the ESI industry, training and volunteer rescue and not of any one organisations standard operating procedures (SOP's)

Daryl Rush - 23/12/09

Thanks for your comments Peter, these present points for both the electrical supply and distribution network, and vehicle electrical systems. In my discussions with automotive industry technicians, they identify DC voltages in vehicles above 32 volts as a high voltage. Operating voltages in DC voltage systems appear to start at 120 volts, and slightly higher, while AC systems can range up to and above 600 volts.

In the context of electrical systems in vehicles, these extra points you have raised below may assist rescuers as an extra guide:

'The higher voltages associated with electric vehicles are not likely to create step or touch potential electric shock (no reference to the general mass of earth) but will give rise to an increased risk of arcing (spark generation) and of electric shock if emergency service personnel were to become part of the vehicles electrical circuit (personnel would have to be in contact with a difference of potential to receive an electric shock).'

'Subject to confirmation, the CEV and Hybrid vehicles are likely to best addressed as being a 'portable generator' (which are not to be earthed) - a person will only receive an electric shock if they are in contact with the energised active and the neutral/earth of the generator (electric vehicle) system simultaneously (conditions apply).'

'In vehicles comprising AC systems (230 / 650vAC), whether single phase or three phase, the increased hazard is more to do with the increased risk of fire initiation (arcing/sparking) and burns that might result from being in close proximity to the inboard electrical system 'short circuiting' whilst emergency personnel are performing their relevant tasks. This would especially apply to rescue personnel involved in accessing a casualty, but no more so than already exists by way of SRS equipment.'

As further details become available on this subject, further information will be posted. If you or a member of your agency attends a collision involving Converted Electrical Vehicles, or Hybrid Vehicles; if possible, any lessons learned, or unique experiences can be communicated back through to ARRO, this may assist in documenting any real or potential issues with responses to these vehicles.

Peter Rootes - 04/01/10

As is often the way the more technical or complicated things are thought of first, so in the interest of 'keeping it simple' and adding an initial consideration before escalating the issue -

In the event of a vehicle (car, truck, crane, EWP) coming into contact with energised (Live, Alive) electrical conductors, and the vehicle is not otherwise damaged or rendered inoperative and the driver / operator is not injured or incapacitated then having the

driver / operator drive or move the vehicle away from the situation (contact with the energised electrical conductors) is an option to be considered (the KISS Principle) - standard operational procedures regarding safety (safe approach distances) apply to the fallen, damaged or contacted energised electrical conductors until it has been confirmed as being 'made safe' by authorised network operator personnel.

In addition, bear in mind the effect of moving the vehicle in regards to the energised electrical conductors, the released conductors may 'whip', 'curl away', 'come together', fall to the ground, etc and therefore anticipatory precautions need to be taken, especially maintaining a safe distance for all persons at the incident site - emergency personnel, work crew members, bystanders, on-lookers, etc.

Note: The 'higher' the value of voltage the greater the safe approach distance required, that is, the greater the gap required between the energised electrical conductor and the vehicle before the risk of 'arcing' or 'flashover' over is eliminated or minimised to the point of not being able to occur - general 'rule of thumb' the 'higher' the voltage value the 'bigger, larger or longer' the insulators will be that support the electrical conductors (conditions apply).