Team Global Express

Project Cobra

LESSONS LEARNT REPORTS 1-5
Milestone 1

Project Details

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LESSONS LEARNT REPORT #1 – Electrical Considerations

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EXECUTIVE SUMMARY

The integration of battery electric vehicles (BEVs) also necessitates the careful planning and implementation of BEV charging infrastructure. This report focuses on a number of electrical considerations, with a specific focus on design compliance with Australian standards, grid capacity, power and fleet demands.

KEY LEARNINGS

Lesson Learnt No. 1: Electrical Considerations

Category: Technical

Objective:

1. Overcome barriers to accelerate uptake of BEVs by fleets.
2. Optimise the integration of BEVs into the grid (including smart chargers) to ensure cost effective outcomes.

Detail:

- **Design compliance with Australian standards:**
  It is crucial to ensure compliance with Australian standards in order to ensure safety, efficiency, and seamless operation. When this project began, there were a number of standards that simply did not exist.

  Further, it is essential to thoroughly understand the Australian standards specifically related to electrical design for electric vehicle (EV) charging stations, including:
  - AS/NZS 3000 (Electrical Installations)
  - AS/NZS 3008.1.1 (Electrical Installations – Selection of Cables)
  - AS/NZS 61439 (Low-voltage Switchgear and Control Gear Assemblies).
  - AS/NZS 3820 (Essential Safety Requirements for Electrical Equipment).

  Engaging with experienced electrical designers from the initiation of a project can help to ensure compliance and avoid costly rework or delays later in the project.

- **Grid capacity:**
  It is critical to complete power management assessments at the initiation of a project to assess whether the grid, including the installed capacity and any future capacity upgrades, will remain resilient and reliable. External approvals may be required which can be timely and costly.

- **Design to meet power and fleet demands:**
  Consideration needs to be given to the following:
  - The existing facility power demands, peaks and low demand periods for the normal operations at the site and whether there is a hierarch of priority of supply on the site's normal operations or on the charging facility. This will need to be mitigated from a risk perspective and provide assurance to operational staff.
  - A decision will need to be made as to the balance and capacity of alternating current (AC) and direct current (DC) chargers and their impact on load profiles.
  - Electrical isolation requirements specific to charge locations and individual chargers needs to be understood to support emergency response plans and procedures. This relates to access to isolation points on the charge infrastructure for Emergency Responders.

- The existing availability of on-site renewable energy or the potential to install renewable energy sources or behind the meter solutions.
- Existing electrical infrastructure and the upgrades required may trigger modifications to existing development approvals and this needs to be considered.
- Plan for a potential voltage drop when upgrading facility electrical infrastructure. Australian standards allow for a 4% voltage drop to the charging location, however within the Australian standards, the voltage drop allowance is up to 7% when transformers are installed. It is crucial to conduct a thorough electrical design analysis accounting for voltage drop considerations during the design phase, so potential challenges can be anticipated and mitigated.
- Using appropriately sized cables is essential to minimise voltage drop. Undersized cables increase resistance, leading to higher voltage drops and reduced charging efficiency and potential damage to charging infrastructure. Ensuring the cabling matches or exceeds the recommended specifications by the charging station manufacturer can help address voltage drop challenges.

- **Selecting charge equipment:**
  Consider the following:
  - Purchase lead times – this is becoming more and more lengthy as the world demands faster charging capacity.
  - The potential for harmonic distortion that can lead to failures and losses to connected equipment. The use of power conditioning solutions, such as active harmonic distortion filters or transformers, can be effective in reducing unwanted frequencies. These devices help to maintain power quality by compensating for harmonic distortions caused by the charging station.
  - Compliance with Australian standards – do they exist in what you're trying to do?

Implications for future projects:

1. Planning is key to a successful project. Early engagement with charger suppliers, electrical engineers and a wholesale energy provider identified the necessary information required to select the right location and configuration of charge equipment required to support the BEV fleet. Full optimisation of the fleet and charge infrastructure will be tested throughout the duration of the Project with a view to identifying inefficiencies in design and application.

2. Complete a full site and risk assessment for any proposed infrastructure upgrades. This project experienced substantial delays related to identification of contaminants, further assessments related to complying development and proximity to flood zones, identification of underground services in relation to as-built drawings and even stop work stand downs related to safety considerations for unfamiliar work not covered under SafeWork NSW guidelines for the under-roof cable installation. It was understood that a number of these unknowns could not be tested prior to project implementation and therefore a reasonable contingency needed to be built into the budget.

Conclusion:

Implementing electric vehicle charging requires careful planning and attention to compliance with Australian standards, grid capacity assessments and careful selection of charging equipment. By considering these learnings, project stakeholders can ensure a successful and efficient operation of charging infrastructure for BEV trucks.

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LESSONS LEARNT REPORT #2 – Safety In Design

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EXECUTIVE SUMMARY

The installation of charging facilities for battery electric vehicles (BEVs) requires a focus on human-centred design to ensure a safe and efficient operation. This report focuses on the safety of our personnel, safe operation of our equipment and efficient operation of our fleet.

KEY LEARNINGS

Lesson Learnt No.2: Safety In Design

Category: Social / Regulatory / Risk

Objectives:

1. Overcome barriers to accelerate uptake of BEVs by fleets.
2. Increase skills, capacity and knowledge relevant to BEV technologies.

Detail:

- **Current refuelling of vehicles:** the use of our existing diesel fleet is a simple stop, fill up and go process. Charge station facilities need to consider the difference in time required for vehicle charging and any externalities such as fire risk, vehicle movements, interactions with cabling and the like.

- **Pedestrian safety:** Planning for the layout of charging stations should delineate pedestrians from traffic flow wherever possible and allow for suitable access/egress to the vehicle and ease of use of charging equipment.

- **Truck manoeuvres:** Trucks necessitate a very different consideration to light commercial and passenger fleets. Consideration must be given to swing sizes in planning, pedestrian access around them, whether they need to turn in front or reverse into chargers, and width sizes.

- **Lighting requirements:** Australian Standard AS/NZS 1158.1 does not include standards for large scale charge stations. Until specific lighting standards are established, operators of electric charging stations should adhere to general best practices for lighting and should consider seeking professional guidance from lighting experts, electrical engineers, and safety consultants to assess the specific task requirements of charging locations and provide tailored lighting solutions that meet safety, user experience, and operational needs. Our selected lighting produces a lux level of 160 which was determined by researching public fuel stations lighting requirements and task specific activities. Consider solar, Light-emitting diode (LED) and timers/sensors to reduce energy consumption and cost.

- **Improved user experience and safe operation:** Ensure the charging locations are strategically positioned for easy access and visibility. Choose suitable colours (e.g. safety yellow) for the charging pedestals to enhance visibility and reduce the risk of vehicle impact. Install protective bollards and wheel stops around the charging infrastructure to prevent accidental damage from vehicles. Review traffic inflow and outflow points to facilitate smooth and safe movement of vehicles within the charging station area.

  When designing the layout, keep in mind driver access/egress to the cab, and reduce manual handling requirements for operators. Minimise the need for heavy lifting or

awkward manoeuvres by installing charging equipment at accessible heights and providing adequate space for manoeuvrability.

Remember that trucks charge in a different area to cars – being predominantly at the front, behind the driver's door. Carefully determine the optimal length of the charging cable to avoid excessive cable handling, drag of the cable on the ground and unnecessary hazards.

Clearly define and designate bays for vehicles to prevent congestion and ensure smooth traffic flow.

Consider the design of the refuelling stations at layouts such as Costco that allow vehicles to exit the line at mid and rear positions along the bowsers.

Traffic/pedestrian interaction at charging locations: Clear and visible signage should be placed at key points and intersections to guide drivers towards the charging facilities and highlight areas to avoid. It is crucial to recognise that the traffic flow and pedestrian interaction at electric vehicle (EV) charging stations may evolve over time. Therefore, continuous monitoring and flexibility for improvements are recommended.

Regular assessments should be conducted to identify any safety concerns, with appropriate adjustments made to enhance the overall user experience and safety.

Implications for future projects:

1. Early engagement of key stakeholders and subject matter experts, both internal and external, will help identify safety considerations early in the planning and design stage. This will build a solid scope of work and establish an achievable project schedule. Additional work required to achieve a safe operating environment included traffic management lights, sensors and alarms, lighting for the charge locations and barrier protection for both people and charge infrastructure.
2. Safety considerations for the management of battery fires is subject to an increasing focus from emergency responders, insurance underwriters and the general public. Whilst the potential for an EV or Battery Energy Storage System (BESS) fire is very low, consideration should be given to future design requirements that may be imposed or are currently provided in guidelines.

Conclusion:

The new battery electric vehicle fleet and the existing diesel fleet may be doing the same job but need to be considered in a completely different way.

Engaging the relevant stakeholders and putting real people at the centre of this process we were able to identify practical solutions to the problems raised by the development of two separate charging locations.

Maintaining a strong focus on safety and the protection of people and assets, the industry can create efficient, safe, and user-friendly charging station environments that promote the adoption of electric vehicles.

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LESSONS LEARNT REPORT #3 – Regulatory Change

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EXECUTIVE SUMMARY

There were two main regulatory issues to be overcome in advance of the battery electric vehicle (BEVs) project proceeding. It is to be noted that the two issues could have been overcome by Performance Based Standards changes for the Team Global Express (TGE) fleet only and would not have stopped the project proceeding. However, in the interests of the industry, TGE felt that these issues should be overcome as a wider issue; the key elements being:

- An Australian Design Rules (ADR) approval to be granted to allow for an increase in the cab width from 2.50m to 2.55m
- A Heavy Vehicle Rest Areas (HVRA) approval to allow for a steer axle increase to 7.5 tonnes.

KEY LEARNINGS

Lesson Learnt No.3: Regulatory Change

Category: Regulatory

Objective:

1. Overcome barriers to accelerate uptake of BEVs by fleets.

Detail:

- **Changes to Australian Design Rules (ADR) – Volvo eFL width increase**
  Our selection of original equipment manufacturer (OEM) solutions readily available in the European Union (EU) and other countries necessitated a change to the Australian Design Rules (ADR), being a set of national standards and regulations that outline the minimum safety and performance requirements for vehicles in Australia. These rules are regularly reviewed and updated to align with advancements in technology and industry practices.

  In recent developments, the Australian Government has implemented a change to the ADR, allowing for an increase in width limit of the cab from 2.50 to 2.55 metres for new trucks, as long as they are fitted with safety features such as side guards and devices to limit blind spots. Note: the cab increases in width, not the trailers.

  In the United States of America, the truck width limit is 2.6 metres and in the EU the limit is 2.55 metres. The update aligns the ADR with international standards, facilitating greater harmony with vehicles produced and imported from other countries. This allows for improved international trade and the exchange of technologies while maintaining safety standards.

- **Steer axle mass increase**
  Our selection of OEM solutions also necessitated a change to the steer axle limits on trucks, being that internationally available fleet such as Volvo and Mercedes Benz required a change to the National Heavy Vehicle Regulator's position on steer axles – allowing for 7.5 tonnes on the front steer axle. Each state except for Western Australia is now allowing for this in state-based transport and infrastructure laws.

  As the demand for electric trucks increases, it becomes crucial to address the unique design and performance requirements associated with their implementation.

The concept of increasing the steer axle mass for BEV trucks stems from the inherent differences in electric powertrain technology compared to traditional internal combustion engines (ICE).

Electric powertrains are characterised by the presence of heavy battery packs that result in additional weight exerted on the front axle. Consequently, adhering to conventional steer axle mass limits may put the safety and stability of Electric Vehicle (EV) trucks at risk.

Electric trucks must maintain stability during cornering, braking, and acceleration. Increasing the steer axle mass allows for better weight distribution, reducing the risk of understeer or oversteer, and improving overall vehicle handling and control in various road conditions.

The braking system in EV trucks relies heavily on regenerative braking, which can transfer a significant amount of weight to the front axle. Adapting the steer axle mass to account for this increased weight ensures optimum braking performance and minimises the risk of accidents.

Electric vehicle battery packs are often integrated into the chassis, typically in the front or underneath the cargo area. Increasing the steer axle mass allows for better integration and balance of the overall vehicle weight distribution, maximising battery capacity and range.

While increasing the steer axle mass for BEV trucks offers numerous benefits, it is essential to consider certain factors:

- Existing road infrastructure may not be designed to accommodate heavier electric vehicles. Adequate road design, load capacity assessments, and bridge structural redesigns may be necessary to ensure the safe operation of heavier EV trucks.
- Increased axle mass may require modifications to tyre specifications, including load ratings and pressures, to ensure optimal performance and safety.

Implications for future projects:
Australia’s policy and regulatory framework for the introduction of low emission vehicles needs to keep pace with the introduction of the technology and use of such internationally. Working closely with government at all levels, along with related government agencies, is important to reinforce Australia's commitment to sustainable transportation.

Conclusion:
The recent change to the ADR allowing for an increase in body width, aims to increase the use of low emissions technology. However, its successful implementation requires collaboration among various stakeholders and careful consideration of the implications, including design adaptations, infrastructure compatibility, vehicle classification, safety standards, and compliance requirements. By addressing these factors, the revised ADR can contribute to the growth and enhancement of low emission technologies.

The increase in steer axle mass for electric trucks represents a necessary and strategic shift in design regulations to ensure the safe and efficient operation of BEVs. By accounting for the unique weight distribution challenges faced by BEVs, this modification allows for improved stability, braking performance, and compliance with safety standards. While addressing infrastructure limitations and considering associated costs pose challenges, the long-term benefits of environmentally friendly transportation options are worth pursuing.

Ultimately, this policy update reinforces Australia's commitment to sustainable transportation and encourages the adoption of electric trucks as a viable alternative to traditional combustion engine vehicles.

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LESSONS LEARNT REPORT #4 – Emergency Response

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EXECUTIVE SUMMARY

As the popularity and adoption of battery electric vehicles (BEVs) continue to rise, it is imperative to consider the following key areas in relation to risk management and emergency response:

- BEV and charge infrastructure selection
- Charger layout and design
- External stakeholder consultation (emergency responders and insurance underwriters)
- Training of site personnel.

Site personnel, BEV operators and emergency responders should be well-prepared and equipped with the necessary knowledge and skills to effectively handle incidents involving BEVs.

Emergency response teams play a critical role in ensuring safety, minimising damage, and providing swift assistance in emergency situations.

Battery thermal runaway is a concern raised on many social media platforms and is now being considered in broader risk management strategies for BEV industry stakeholders. It is also important to consider other sources of battery thermal runaway that are potentially higher risk, such as standalone lithium-ion batteries and items such as power tools and electric bikes.

KEY LEARNINGS

Lesson Learnt No.4: Emergency Response

Category: Technical, Risk

Objectives:

1. Overcome barriers to accelerate uptake of BEVs by fleets.
2. Increase skills, capacity and knowledge relevant to BEV technologies.

Detail:

- **BEV and Charge Infrastructure Selection**
  Engage directly with BEV suppliers and charge infrastructure providers to understand the level of safety considered in the design of their product. Consider the following:
  - maturity of their offering in Australia
  - servicing and maintenance agreements to ensure plant and equipment is maintained through a suitably qualified technician
  - management and monitoring systems that allow for emergency alerts i.e. battery temperature
  - robust design and materials suitable for Australian conditions.

- **Charger Layout and Design**
  Layout and design of your charging stations should consider the following to reduce the risk of fire:
  - availability of fire response equipment
  - proximity to combustible material
  - air quality risk (i.e. underground carparks) in the event of fire
  - accessibility for emergency responders
  - access to isolation points for all electrical equipment and individual isolation (residual current device) for each charger
  - feasibility of barriers or standby areas for at risk BEVs (i.e. battery temperature alert or an event that has caused physical damage to the battery).

- **External Stakeholders**
  We have fostered collaboration between emergency responders, electric vehicle (EV) manufacturers, and industry experts to share knowledge, exchange best practices, and stay updated on emerging technologies. Emergency response should consider external stakeholders such as emergency responders and parties with a financial interest, such as insurance underwriters. Guidelines provided by your insurer may cover specific design or consultation requirements.

  Engage early with local emergency response teams, such as Fire & Rescue NSW, to ensure they understand the scope of your project and any proposed changes to your site's emergency response plans. In particular, the location of any battery energy storage systems and the isolation points available for the charge infrastructure. Subject matter experts such as EV Fire Safe can also be consulted. Their website also provides a lot of helpful information.

  Emergency responders utilise the ANCAP Rescue app to access rescue sheets for a broad range of vehicles in Australia and New Zealand. Ensure your BEVs rescue sheet is available on the ANCAP Rescue app or alternatively attach a visible QR code sticker to provide direct access to the vehicle rescue sheet. The rescue sheet should provide information on potentially dangerous features (high voltage systems, fuel tanks), how to immobilise and disable hazards (electrical isolation), response to fire and water submersion, and the correct process for towing and transportation (disable regenerative braking system).

- **Training**
  To alleviate the concerns raised by personnel in the operation of BEVs, it is important to provide accurate information, educate and train our personnel appropriately. The following hazards should be addressed in any emergency response plans, and all relevant personnel trained on the procedures:
  - high voltage system and the isolation process
  - battery thermal runaway
  - BEV rescue sheet
  - incidents that can cause damage to the batteries (i.e. vehicle incident or other impact, and water immersion).

Implications for future projects:

1. As the market share of BEV ownership increases, and with the support of government agencies and national strategies geared towards reducing our emissions, the following fire and impact protection requirements may be introduced:
    - design standards for vehicle safety including battery impact protection, battery monitoring systems, isolation requirements
    - design standards for charging infrastructure including impact protection and isolation requirements
    - design standards for fire response systems.

2. Insurance companies are already providing guidelines for BEV ownership and operation of BEV charging facilities, however you may see an increase in insurance premiums to cover increased cost of repair to BEVs and restrictions on vehicle type and models covered.

Conclusion:

As the use of BEV trucks becomes more prevalent, it is essential for BEV operators and emergency responders to adapt and enhance their knowledge and skills to effectively respond to incidents involving these vehicles.

By incorporating these challenges, emergency response teams can increase their preparedness, efficiency, and overall safety when dealing with EV truck emergencies.

Continuous collaboration, training, and innovation are crucial for maintaining effective emergency response capabilities in this evolving landscape of sustainable transportation.

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LESSONS LEARNT REPORT #5 – Driver Acceptance

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EXECUTIVE SUMMARY

With the growing concern for environmental sustainability and the need to reduce carbon emissions, there has been a significant shift towards battery electric vehicles (BEVs) across various industries. We are embracing this transition by introducing 60 electric trucks at our Bungarribee depot. However, the implementation of electric trucks brings certain challenges, including managing range anxiety and operability constraints among our drivers.

KEY LEARNINGS

Lesson Learnt No.5: Driver Acceptance

Category: Social

Objectives:

1. Overcome barriers to accelerate uptake of BEVs by fleets.
2. Increase skills, capacity and knowledge relevant to BEV technologies.

Detail:

Range anxiety refers to the fear or concern that drivers experience due to the limited range of their vehicles and the availability of charging infrastructure. As electric vehicle (EV) trucks become part of our fleet, addressing range anxiety amongst other interoperability issues has become crucial.

The following open lines of communication were established to facilitate feedback and address concerns promptly:

- regular toolbox talks
- change management workshops to identify concerns from all site personnel
- monthly updates at Health and Safety Representative (HSR) Committee meetings.

Daimler and Volvo, our project partners, facilitated ‘Train the Trainer’ programs to familiarise Team Global Express (TGE) driver trainers with the nuances of electric truck operation, including energy-efficient driving techniques, charging guidelines, and battery management. The TGE Driver Trainers were then able to pass this information on to our BEV fleet drivers.

Provision of a demonstrator FUSO eCanter since February 2023, and a demonstrator Volvo eFL for a 4-week period in Sept/Oct 2023, allowed our drivers and operations teams to gain more confidence in the operation and range of the BEVs ahead of the main fleet delivery.

Upon arrival in September 2023, the BEVs have been assigned the shortest scheduled runs from the depot. This has minimised the risk of running out of charge during the delivery process. The BEVs will continue to be assigned to ever increasing runs to slowly integrate and test their capabilities.

We have also invested in telematics and battery management systems to monitor battery health, charging status, and energy consumption in real-time. This will provide drivers and supervisors with accurate data and enable them to make informed decisions to optimise battery usage.

Implications for future projects:
The introduction of a demonstrator truck ahead of the main fleet delivery enabled our trainers, drivers and operations personnel the opportunity to gain confidence and familiarity with a new technology. The recommendation for any new projects would be to secure a demonstrator truck from your BEV supplier. Ensure the demonstrator truck body is fit for purpose and can be used as a like for like replacement in your existing fleet.

Conclusion:
With the introduction of 60 electric trucks at our Bungarribee Depot, managing range anxiety and driver feedback play critical roles in the successful implementation of this transition.

By addressing range anxiety through driver education and training, route planning, and monitoring battery performance, we can ensure smooth operations and alleviate driver concerns.