



E-BUS ECOSYSTEM

KEY INCIDENTS & STANDARD OPERATING PROCEDURES

1. IMPROPER HIGH-VOLTAGE SYSTEM HANDLING

- **Risk:** Electric shock, arc flash, or fire.
- **Cause:** Inadequate training in Lockout/Tagout (LOTO) procedures or misunderstanding of high-voltage components.
- **Example:** Maintenance personnel working on battery packs without isolating power sources.



Responsibility:

Maintenance Team

SOP for High Voltage Handling

- Perform Lockout/Tagout (LOTO) before any maintenance.
- Verify zero voltage using insulated multimeter.
- Use arc-rated PPE (gloves, face shield, boots).
- Maintain High-Voltage Permit System for authorized personnel only

Lockout/Tagout (LOTO) for High-Voltage Systems

- Identify all energy sources (battery, inverter, charger).
- Shut down systems using OEM-recommended sequence.
- Apply lock and tag with technician ID and timestamp.
- Verify zero voltage using insulated multimeter.
- Document and log in maintenance system.

3. CHARGING INFRASTRUCTURE MISMANAGEMENT

- **Risk :** Power surges, electrical faults, or grid instability.
- **Cause:** Lack of coordination between fleet operations and utility providers.
- **Example:** Simultaneous fast charging of multiple buses without load balancing or scheduling.



Responsibility:

Depot Manager

Charging Supervisors



Responsibility

Maintenance Team

Depot Manager

Electrician/ Technician

Depot Supervisor

2. INADEQUATE BATTERY THERMAL MANAGEMENT

- **Risk:** Thermal runaway, fire, or explosion.
- **Cause:** Poor understanding of battery chemistry and cooling requirements.
- **Example:** Management fails to implement proper monitoring systems or ignores temperature thresholds.



Responsibility:

Maintenance Team

Depot Supervisor

Battery Thermal Management

- Monitor battery temperature via BMS continuously.
- Set alarms for abnormal temperature rise.
- Conduct weekly thermal imaging inspections.
- Store damaged batteries in fireproof containers.
- Depot Supervisor: Schedule inspections and monitor alerts.
- Maintenance Team: Perform thermal checks and report anomalies.

Frequency: Continuous monitoring + weekly inspection.

Handling Charging Infrastructure

- Implement smart charging software for load balancing.
- Define charging schedules to avoid peak demand.
- Inspect connectors and cables daily.
- Emergency disconnect switches at every charging point.
- Charging Supervisors: Ensure configuration of load balancing and schedules.
- Depot Manager: Perform daily visual checks.

Frequency: Daily checks + real-time monitoring.

KNOWLEDGE GAPS/ MANAGEMENT LAPSE



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4. EMERGENCY RESPONSE FAILURES

- **Risk:** Delayed evacuation, injury, or escalation of incidents.
- **Cause:** Absence of SOPs or staff unaware of emergency protocols.
- **Example:** Fire in depot with no clear evacuation plan or fire suppression system for lithium-ion batteries.



Responsibility:

Depot Manager

Safety officer

SOP for Emergency Response

- Maintain Depot Evacuation Plan with muster points.
- Conduct quarterly fire drills.
- Install automatic fire suppression systems for Li-ion batteries.
- Keep emergency kits and contact list accessible.
- Safety Officer: Conduct drills and update SOPs.
- Depot Manager: Ensure equipment readiness.
- **Frequency:** Quarterly drills + monthly equipment check.
- **Documentation:** Drill reports and equipment inspection logs.

6. INADEQUATE DRIVER TRAINING

- **Risk :** Accidents, improper regenerative braking or energy management.
- **Cause:** Drivers not trained in e-Bus-specific driving techniques.
- **Example:** Misuse of regenerative braking leading to loss of control on wet roads



Responsibility:

Driver Instructor

SOPs for Driver Training

- Mandatory eBus-specific training on regenerative braking and energy management.
- Simulated driving sessions for emergency scenarios.
- Refresher courses every 2 months, counselling every month and toolbox talks (safety briefings) every day
- Training Coordinator: Schedule and track sessions.
- Drivers: Complete certification.
- **Frequency:** Initial + semi-annual refreshers.
- **Documentation:** Training attendance and certification records



Responsibility

Depot Manager

Safety officer

Driver Instructor

IT Security Lead

Maintenance Team

5. SOFTWARE AND CYBERSECURITY OVERSIGHTS

- **Risk :** Unauthorized access, data breaches, or remote control of vehicles.
- **Cause:** Poor IT governance or lack of cybersecurity awareness.
- **Example:** Fleet management software not updated, exposing vulnerabilities.



Responsibility:

IT Security Lead

SOP for Cybersecurity

- Enforce multi-factor authentication for fleet software.
- Apply regular patches and updates.
- Conduct quarterly penetration tests.
- Isolate critical systems from public networks
- IT Security Lead: Patch systems and monitor threats.
- Fleet Operations Head: Ensure compliance.
- **Frequency:** Continuous monitoring + quarterly tests.
- **Documentation:** Patch logs and security audit reports.

7. POOR MAINTENANCE SCHEDULING

- **Risk :** Unexpected breakdowns or component failures.
- **Cause:** Lack of predictive maintenance or failure to interpret diagnostic data.
- **Example:** Ignoring battery degradation alerts due to lack of technical understanding.



Responsibility:

Technicians

Maintenance Team

SOPs for Maintenance Schedule

- Implement predictive maintenance using telematics data.
- Weekly diagnostic checks for battery health.
- Maintain digital logs for all inspections and alerts.
- Maintenance Planner: Schedule tasks and monitor alerts.
- Technicians: Execute and log inspections.
- **Frequency:** Weekly + real-time alerts.
- **Documentation:** Maintenance logs and predictive analytics reports.