Lift & Escalator Industry Association (LEIA) Publication
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Lift Owner News

Subject: **Energy saving by building voltage reduction: Considerations for lifts and escalator products**

The electrical supply in the UK was, until 1 January 1995, 240 volt (V) single phase (415 V for three phase) with a tolerance of ±6% (so 225 V-254 V) while in Europe it was 220 V (380 V for three phase). Since 1 January 1995, the harmonised voltage across Europe is 230 V (400 V three phase) with a tolerance in the UK of -6%/ +10% (216 V-253 V), and a tolerance in continental Europe of -10%/+6% (207 V-244 V).

There are companies in the market offering to reduce the power consumed by a building by reducing the voltage supply to equipment within the building. The voltage is lowered to a value that is within the theoretical range for which *modern* equipment, such as lighting, computers and new lifts/ escalators are designed to operate. Lifts and escalators typically have much longer lives and so there are older installations where there is a risk that the voltage could be reduced below the levels for which they were designed.

Reducing the voltage below the levels for which lifts and escalators were designed might result in the equipment not operating or needing some modification or adjustment before being able to operate. It might also lead to breakdowns where there are further fluctuations in supply voltage when building loads are high and/ or when the lift demand/ loading is greatest; these breakdowns could go beyond inconvenience and may jeopardise the safe operation of the lift or escalator.

The implications on safety of such changes are recognised by British Standard BS 7255:2012 *Code of practice for safe working on lifts* which advises the owner to notify the maintenance contractor before making any modifications to the electrical supply, e.g. voltage reduction systems. The same would apply also to escalators and other lifting devices.

Many lift and escalator power systems regulate the current and voltage to ensure the required power is always provided and so are "voltage independent loads". So if the supply voltage is reduced, the current increases so there is no energy saving from the lift or escalator drive system (although the increased current can cause other problems).

Suppliers of voltage reduction equipment should be able to assist their clients by advising on their approach to lifts and escalators; they should recognise that voltage reduction of lifts and escalators requires specific survey and checks by their maintenance provider; and should propose how to manage the supply transition successfully to avoid problems.

We do not recommend lowering the supply voltage outside of the standard range applicable at time of installation of the lift or escalator unless modernisation work is done to the power and control systems to make it suitable for the new voltage. Our recommendation is therefore to contact either your lift/ escalator maintenance company for advice. Where necessary, we recommend that owners request their maintenance contractors to survey the equipment to assess its suitability for voltage reduction and, for equipment at risk from reduced voltage, to arrange a test after the work has been done with the worst case supply voltages and lift/ escalator loading conditions.

Technical considerations

It is difficult to generalise given the range and age of different equipment in use but the following is intended to highlight some of the potential issues which might be encountered when reducing the supply voltage to existing lifts and escalators and so which need to be checked and managed. However, this list is not exhaustive.

- Lifts and escalators with regulated power systems are generally more tolerant of a reduction in supply voltage because the regulator increases current to compensate. So there is usually no power reduction but losses in the supply cable will increase due to the higher supply current required and reliability might be worsened by the higher currents. Many newer installations use such regulated drives.
- Lifts and escalator motors which are directly connected to the electrical supply are much less tolerant of a reduction in supply voltage. These motors have been designed to run at their nominal voltage (typically 415 V or 400 V). Reducing voltage below the nominal voltage is unlikely to result in significant savings as current increases but will reduce torque available; the loss of torque could lead to malfunction and unsafe operation especially with traction lifts. Many older installations and many hydraulic lifts have motors which run directly from the electrical supply. A better approach to reducing energy and providing other benefits such as smooth starting/ stopping and better levelling is to upgrade using a regulated or variable speed drive.
- Some suppliers are offering voltage reduction units integrated into the drive systems of escalators. Owners are warned that this may affect the continued compliance of the unit to the directives to which it was originally design (Machinery, EMC).
- All lifts and escalators use contactors and many older installations use relay control systems. Reduced voltage (especially on those designed to work at 240 V) can cause contactors and relays to partly energise or fail to energise at all, which could result in unreliable operation and at worst could be dangerous. Relays may be powered by a transformer and rectifier, so it is important to verify that the transformer is set correctly for the new supply voltage, and that any main rectifier is in good condition or replaced.
- Lifts and escalators use electro-mechanical brakes as a vital part of their safety. Lowering the voltage to these might result in the brake not properly lifting causing brake wear and eventual failure with very dangerous possibilities.
- If the voltage reduction is too severe, voltage detection devices could turn off the lift or escalator. This level should be checked to ensure compatibility with the new, reduced supply voltage.
- The addition of voltage reduction equipment can be seen to be an important modification under BS 5655-11/ BS 5655-12. Important modifications should be made only after careful risk assessment and should be followed by testing with loads to check that the equipment works under worst case load, acceleration, voltage.
- The addition of voltage reduction equipment will alter the equipment in relation to its Electromagnetic Compatibility (EMC). A careful check should be made to ensure that the requirements for EMC to which the equipment was installed are still met.

Recommended approach

Although, from the technical issues discussed above, it could be concluded that the risks from voltage reduction are greater on older equipment, this is not always the case.

There can be no substitute for a careful check of the equipment fitted especially in relation to the nominal voltage of the main drive machine, electro-mechanical brake, any transformers, and step-down power supplies and any other equipment fed from the electrical supplies.

In general, a voltage reduction scheme for lifts or escalators should be undertaken only after careful study by the maintenance contractor who might need details from the manufacturer/installing company. This assessment, using the factors discussed above and other factors relevant to the equipment being surveyed, should establish whether the equipment is high medium or low risk of malfunction from a reduced voltage.

In all cases, the changes to the owner's electrical system (including the higher currents likely to be drawn from lift/ escalator equipment) should be checked by the owner's electrical engineers.

As shown above, equipment designed to work on 240/415 V three phase supply is at higher risk from a voltage reduction than newer equipment designed to work at 220/380 V or 230/400 V. Clearly also, the risk level is higher for equipment designed for 415 V when the voltage is being controlled below 225 V. Equipment controlling at 216 V and below clearly presents a higher risk still.

It should be recognised that in some areas, the supply quality is variable and the supply voltage could have been dipping to quite low values prior to voltage reduction without problems being evident. This does not necessarily imply that there will be no problems with a voltage reduction since a number of the technical considerations listed above become a problem only at times of heavy loading of the lift (maximum torque and current) and of the electrical supply in the building (volt drop).

If it is anticipated that where lifts or escalators are likely to be sensitive to a reduction in supply voltage (high risk), it would make sense to take them outside the scope of the voltage reduction. This would be best undertaken by feeding their supply from the incoming building supply ("upstream" of the voltage reduction system) as recommended in BS 5655-6. Whilst the use of devices to step-up the voltage to the original levels, e.g. auto-transformers, might address the voltage issue, they may introduce unintended consequences e.g. in relation to mains harmonics due to the change in supply impedance.

After the voltage reduction scheme has been completed, the equipment should then be tested under worst case voltage, voltage drop (current), loading and acceleration to ensure that the main drive and also the control and safety functions continue to work correctly and reliably for a period at the new voltage.