European Copper Institute
Copper Alliance

Leonardo ENERGY

GOOD PRACTICE GUIDE CATALOGUE

200 GOOD PRACTICES TO BUILD SUSTAINABLE ENERGY SYSTEMS

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INTRODUCTION

The Good Practice Guide consists of a growing number of publications describing good practices regarding electrical energy. It aims to fill the gap between generalist informative papers and highly technical or academic papers. In other words, it primarily addresses readers who have technical insight and some knowledge of the subject, but are not specialists. Subjects include power quality, energy efficiency, renewable energy systems, electrical networks and electricity for buildings.

DISTRIBUTION NETWORKS AND TRANSFORMERS

MATERIALS FOR ELECTRIC BUSWAYS

David Chapman, Bruno De Wachter, Stefan Fassbinder, August 2012

- When choosing the conductor material for a busway or busbar, the cost over the complete life cycle of the system must be taken into account.
- A copper busway will be smaller and/or more efficient than its aluminium counterpart.
- The use of copper is even more recommended when non-linear loads are to be expected.
- A calculation of the life cycle cost should also take into account the scrap value of the material at the system end-of-life.

TRANSFORMERS IN POWER DISTRIBUTION NETWORKS

Stefan Fassbinder, March 2012

- Transformers should be regarded as potentially large sources of energy savings.
- Knowing the load profile is crucial to know whether to minimize the load losses or the non-load losses.
- Consideration should be given to harmonic currents.

EFFICIENCY AND LOSS EVALUATION OF LARGE POWER TRANSFORMERS

Stefan Fassbinder, May 2013

- Power transformers should be regarded as potentially large sources of energy savings.
- Designing a power transformer for minimum LCC should be approached case by case, based on an estimate of the load profile.
- Simply over-rating the transformer will almost always lead to user benefits.
- Copper is the ideal material for the magnet wires because it has superior electrical conductivity, along with other technological advantages.

DISTRIBUTION TRANSFORMER REPLACEMENT DECISIONS

Bruno De Wachter, November 2013

- Transformers should be replaced by a new and more efficient one if this leads to a lower life cycle cost.
- The Equivalent Annual Cost (EAC) of both the existing and the new transformer should be calculated to assess if replacement makes sense.
- The load pattern and the risk of failure should be estimated with care.

CABLE CONDUCTOR SIZING

Bruno De Wachter, Walter Hulshorst, Rodolfo di Stefano, July 2011

- Energy losses can be reduced by increasing the cross-section of the copper conductor.
- The right methods should be applied for calculating the conductor cross-section for minimum Lifecycle Cost.
- The objective should be to achieve the economic or environmental optimum.

NEUTRAL SIZING IN HARMONIC RICH INSTALLATIONS

Stefan Fassbinder, May 2012

- The harmonic impact on the neutral current can be substantial. Cables have to be over-dimensioned accordingly.
- Assuming that all harmonics accumulate in the neutral results in an approach that falls on the safe side.
- It is good to keep this safety margin, because similar loads can have a very different harmonic behaviour.
- It is also good to provide some reserve for imbalance coming on top of the harmonics.

BUSBAR BOOK

David Chapman, June 2014

- Copper should be used as a conductor material, since its properties match well with the technical requirements for busbars.
- Calculating the current carrying capacity can be simplified by using common busbar configurations and graphical methods.
- Well-chosen busbar profiles can save material, reduce complexity, reduce assembly time, as well as the amount of scrap.
- The quality of joints is crucial to the long term reliability of a busbar system, and can be assessed through thermal imaging.

RENEWABLE ENERGY SYSTEMS

WIND POWER

Ton Van der Wekken, November 2006

- The operating availability of wind turbines is exceptionally high (98%), but its power factor suffers from the variability of the wind. Care should be given not to be overly optimistic in the calculation of the wind climate.
- Wind generation costs have dropped by about 80% in the past 25 years and continue to drop with a few percent each year. This means that wind projects can now be considered in areas where it was previously judged to be uneconomical.

WIND FARM DEVELOPMENT AND OPERATION – A CASE STUDY

Ton Van der Wekken, February 2012

- Even a medium size wind farm requires a substantial area, and many land use restrictions are in force. This should be taken into account from the start.
- Sufficient planning time should be allocated to obtaining a planning permit, a building permit and a network connection contract.
- An accurate energy yield assessment is crucial to achieve the predicted profitability.

WIND POWERED INDUSTRIAL PROCESSES

Aedan Kernan, October 2014

- Operational flexibility is key for an industrial process to be able to be powered by on site wind generation.
- The 'Flexibility Checklist' provides a quick assessment of the degree of flexibility of the process.
- The 'Flexiblilty Audit' is a more comprehensive assessment that enables decision making.
- If circumstances are favourable, wind-powered processes can be a real benefit for industrial companies.

MEDIUM SIZE PV PLANT

María Jesús Báez, August 2013

- Take into account that relatively few types of PV panels, mounting structures, inverters, and storage systems are available on the market, making the technological choice limited.
- When defining the business model, the local system of government incentives should be carefully studied.
- An accurate estimate of the project profitability relies on knowing the EPC contractor cost and the local irradiation level.

PV POWERED BUILDING APPLICATIONS

Eclareon, November 2014

- The investment in a PV system for self-consumption at a commercial level is worthwhile to be considered. It turned out to be profitable in all three cases analyzed.
- Take into account that the shape of the consumer load curve, and how well it matches the generation curve, directly affects the profitability of the PV system.

SMALL HYDRO POWER: INVESTORS GUIDE

Wladyslaw Bodrowicz, February 2012

- Flowing water is not a pure source of revenue. A solid technical and financial analysis should precede each stage of the project implementation.
- The choice of the potential location is based on technical parameters like head and flow, but also on regulation, security, environmental, and financial arguments.
- The right choice of type and number of turbines is crucial to harvest the full energy potential of the site.

Economic analysis of wind projects

Eclareon, October 2013

- Wind investments are worthwhile to be considered. They can provide an attractive risk/return profile, risk diversification, and a hedge against rising fuel prices. The increasing number of PPAs being closed worldwide show that in some cases wind is already cost-competitive against traditional energy sources.
- Conservative assumptions should be used in the financial model and a sensitivity analysis performed.

PV PANELS: CALCULATED PREDICTED ENERGY PRODUCTION

James Bing, January 2015

- Forecast production data can indicate the favorable or unfavorable future financial return of a PV plant.
- Monitoring and simulation systems can determine that immediate servicing is needed for PV plant to avoid loss of revenue.
- PV system forecasts in day-ahead or hours-ahead time frames enable optimization of utility dispatch and informed energy trading.

OPTIMAL CABLE SIZING IN PV SYSTEMS

Lisardo Recio, June 2013

- Oversizing the cross-section of electricity cables is often paid back by the reduction of energy losses inside the cable. This is especially the case in renewable energy installations, since support mechanisms result in a higher allocated electricity price.
- Increasing the cable cross section in PV installations also creates additional technical and environmental benefits.

ELECTRIC MOTOR SYSTEMS

ELECTRIC MOTOR ASSET MANAGEMENT

Bruno De Wachter, February 2015

- By making electric motors subject to a full asset management program, companies can improve performance and gain a competitive advantage.
- Care should be given to how electric motors are purchased, maintained, and replaced, as this can significantly affect profitability.
- When motors are not managed optimally, the result is higher energy losses and reduced reliability and availability.
- Early replacement of an electric motor is often paid back in a very short time. This payback is fed by improved energy efficiency, reduced maintenance costs, and avoidance of unplanned outages.

MOTORS AND VARIABLE SPEED DRIVES

Stefan Fassbinder, February 2012

- Opting for a high efficient motor system will often pay itself back in less than a year.
- The obstacle of split budgets should be overcome (in medium to large companies, the electricity bill is often paid by a different cost center than that which pays the new motor).

MOTOR TESTING FOR PERFORMANCE AND RELIABILITY

Hugh Falkner, March 2014

- Motor condition monitoring reduces the risk of premature failures and optimizes the maintenance interventions.
- To determine the appropriate level of condition monitoring, the criticality of each motor needs to be understood.
- The benefits of condition monitoring should be balanced against the risk of failure resulting from intrusive interventions.
- Nowadays, the most common source of motor faults is the bearings; they should receive major attention.

COMPRESSED AIR

Hugh Falkner, June 2015

- When operating a compressed air system, it is worthwhile to tackle easy to identify energy saving opportunities. They can save up to 25% of the systems' energy consumption.
- Compressed air is a convenient energy carrier, but its cost is often overlooked. For many uses, lower cost alternatives should be considered.

HEATING / COOLING

SUSTAINABLE HEATING AND COOLING

James Parker, Reginald Brown, June 2013

- Currently available technologies can significantly reduce the energy consumption of heating systems in both new and existing buildings. This will reduce the operating costs and carbon emissions.
- Low carbon heating systems can be introduced, e.g. solar thermal, heat pumps, …
- The environmental performance of existing systems can be improved, e.g. heat recovery, efficient fans and pumps, …

INTRODUCTION TO INDUSTRIAL ELECTRICAL HEATING

Bruno De Wachter, April 2012

- Electro-heat technologies generate heat within the target material, facilitating process control and end-use energy efficiency.
- Electro-heat technologies can be very useful in particular niche domains for very specific advantages.
- New application domains for electro-heating need to be explored. Industry is not yet exploiting its full potential.

INDUSTRIAL HEAT PUMPS

Bohdan Soroka, January 2015

- Each type of heat pump has different operating characteristics and different temperature ranges. Technical and economic process criteria should determine the most suitable type for a particular application.
- The initial procedure should identify a few possible installation alternatives, so that the detailed project calculations can concentrate on a limited number of options.
- It is crucial to investigate possibilities for decreasing the installation costs, as they directly influence the payback period.

INDUSTRIAL COOLING

Nico Van den Broek, October 2011

- Cooling consumes 7% of electrical energy in the EU and this figure is rising. Large energy savings can be achieved.
- It is crucial to choose the right cooling technique and to keep the temperature differentials low.
- Carefully selecting and dimensioning equipment is of equal importance.

DIELECTRIC HEATING

Jean Callebaut, October 2014

- Dielectric heating is advantageous when the heating needs to be rapid and/or applied selectively.
- It should be applied on products with regular, simple shape.
- It is particularly suitable for plastic welding, drying veneer, and the vulcanization of rubber.

INFRARED HEATING

Jean Callebaut, October 2014

- The desired energy transfer of infrared heating is dependent on the emissivity and shape coefficients.
- Advantages are high energy density, rapid heating, and ease of installation and maintenance.
- It is particularly suitable for metal processing and local workspace heating.

INDUCTION HEATING

Jean Callebaut, October 2014

- For maximum efficiency of induction heating, use electrolytic copper for the inductor, reduce the distance between the windings, and limit the air gap.
- Compensation of reactive power is required.
- If the inductor is water cooled, heat recuperation should be considered.
- It is particularly suitable for melting, brazing or hardening of metals.

HEAT PUMPS FOR LARGER BUILDINGS

Keeran Jugdoyal, April 2013

- If care is given to selection, installation and operation, the life cycle cost of a heat pump is often favourable, in particular for new buildings in a temperate climate.
- For ground-source heat pumps, special attention should go to a mitigation of the installation cost.
- For air-source heat pumps, special attention should go to optimizing the energy efficiency.
- The heat exchanger, compressor, motor and refrigerant should be selected on energy efficiency grounds rather than initial capital costs.

Asset Management

Life Cycle Costing – the basics

Forte, June 2015

- A basic and feasible LCC analysis will empower you to quantify the economic potential of Energy Efficiency Projects from a long-term perspective.
- Starting from a limited set of input parameters, LCC can still make a good-enough estimate to make an informed decision.

Asset and Energy Management

Martin van den Hout, December 2014

- *ISO55001* is a standard for asset management that covers the entire life cycle of an asset and includes all types of performance, risk and cost. Because *ISO55001* covers such a broad range of topics, it is written in very general terms. Whether to go for full certification depends on the circumstances, but it is always advisable to follow the basic principles of this standard.
- Once an organization has implemented one standard, it will require less effort to implement the next. Therefore, ISO55001 is often worthwhile if you have already other ISO certifications or if you are planning more certifications in the near future. The new high level structure of ISO will streamline the process of implementing more standards by creating a plug-in model.

Investing in long-life EE and RES

Eclareon, April 2014

- Renewable Energy and Energy Efficiency assets are attractive for long-term investors since they hold low technological risk and lead to predictable cash flows.
- Risk assessment must be one of the foundation stones of long-term investments.
- The best tool for risk assessment is Due Diligence (DG).
- A number of hedging instruments can be employed to mitigate risk.

Advanced LCC

Forte, July 2012

- A Monte Carlo Simulation is a powerful method to build and run a stochastic LCC model.
- It allows you to identify variabilities (sensitivity analysis) and uncertainties (risk analysis). Choosing a suitable distribution type for each of the input parameters is crucial.
- Tornado and spider plots identify the input parameters that contribute most to the output variation.

LCC case studies

José Ignacio Briano, July 2014

- Alternative financing options such as leases or performance contracting can be attractive.
- Large infrastructure companies will most likely choose project finance due to its high leverage and off-balance sheet terms.
- Only the LCC approach can truly assess all costs across the asset´s lifetime.

Energy Management and Energy Efficiency

Energy efficiency self-assessment: industry

Didier Wijnants (Forte), Bert Wellens (3E), May 2013

- An energy efficiency self-assessment can result in a better understanding and uncover hidden saving opportunities.
- A self-assessment does not conflict with an assessment by an external consultant.
- Operators generally have a much greater insight into their systems than external advisors.
- External consultants can conduct more accurate and comprehensive assessments in a later phase.

Energy efficiency self-assessment: buildings

James Parker, February 2012

- Many energy efficiency issues in buildings can be spotted by someone with limited technical knowledge. A systematic approach should yield benefits in the form of cash savings, energy savings, and a reduction of the environmental impact.
- To calculate savings, you must first have good understanding of the operating costs associated with the system.

Options to decarbonize industrial plants

Ignacio Martin (Circe), January 2015

- Improving efficiency and mitigating GHG emissions will be essential for European industries to survive.
- A system optimization is required. The best energy efficiency for a site is not always equal to the sum of optimum energy efficiencies in the components.
- Systematic energy management is one of the most effective approaches.
- Platforms should be developed through which sectors can learn from each other.

Building automation and energy efficiency (EN15232)

Angelo Baggini, May 2012

- Building automation and control systems (BACS) can provide significant energy savings.
- EN 15232 introduces a system for classifying buildings according to their level of BACS. Efficiency factors provide a quick estimate of the savings expected by upgrading the BACS level.
- The EU EPB Directive also incorporates a methodology for classifying the energy efficiency of buildings.
- Together, EPBD and EN 15232 provide a comprehensive set of tools for planning and assessing the impact of BACS.

Thermal Energy Scanning

Paul De Potter, January 2014

- Infrared scanning provides you with good images of the condition of an electrical installation without having to switch off the power or even touching the components.
- The thermal images make you discover wasted energy and upcoming faults.
- Infrared scanning has the best Return on Investment (ROI) of any of the available electrical inspection tools.

ENERGY MANAGEMENT

Paul De Potter, January 2014

- Energy, in all its forms, should be regarded as a resource, not unlike any other resource used by the organization.
- Management commitment is essential to successful energy management.
- The challenge is to get the right people together and to start questioning the status quo.
- Gaining proper insight in the energy streams can lead to reduced consumption and optimized energy contracts.

POWER QUALITY

INTRODUCTION TO POWER QUALITY

David Chapman, February 2012

- It is unlikely that a single solution will be effective for a site suffering from poor power quality.
- Careful design of a solutions mix is needed.
- This mix should be tailored to the problems and based on a detailed understanding of their causes.

THE COST OF POOR POWER QUALITY

Roman Targosz, May 2012

- It is worthwhile investigating whether an industrial production site is suffering from poor power quality, especially in sensitive sectors.
- No two companies, even when operating in the same sector, will be equally vulnerable to PQ disturbances; individual checks are therefore needed.

PASSIVE FILTERS

Stefan Fassbinder, November 2014

- Dominant harmonics can be mitigated easily together with the mitigation of reactive power.
- Even with filtering, harmonics should still be taken into account for the up-sizing of neutral wires and for the rating of cables and other equipment.
- Keeping the system's impedance low is of vital importance, with or without filtering.

VOLTAGE SAGS

Marcel Didden, December 2011

- Standard extrusion machines have hardly any sag immunity. Retrofitting existing textile extrusion lines is sometimes possible.
- Retrofitting should always start with a proper data collection.
- Whether immunization is best realized within the process, between the process and the grid, or within the grid, is case specific.

NUISANCE TRIPPING (TRUE RMS)

David Chapman, March 2014

- Many measurement instruments, even modern ones, use an averaging technique that does not measure harmonics correctly. Circuit breakers and cable sizes may be underrated as a result. True RMS meters, which take the complete distorted waveform into account, should be used instead.

NEW LOADS ON OLD SWITCHES, RELAYS AND CONTACTORS

Stefan Fassbinder, October 2014

- Electricians have to verify the right tables to know the maximum number of lamps that can be connected.
- In residential installations, they have to be alert for the overload of relays.
- In tertiary and industrial applications, they have to verify the characteristics of contactors.
- Fabricators may be confronted with challenges when a substantial part of lighting will go to LED.

VOLTAGE FLUCTUATIONS IN POWER NETWORKS

Zbigniew Hanzelka, November 2014

- Voltage fluctuations cause flickering lights (= “flicker”). The source of voltage fluctuations can be found among fluctuating loads of which the short circuit capacity at the network connection point is insufficient. The severity of this phenomenon depends both on the characteristics of those fluctuations and on the lighting type.
- Voltage fluctuations should be mitigated, since they have negative effects on rotating electrical machines, increase energy losses, and reduce the performance of electrolysis and electrical heating equipment.

HARMONICS: CAUSES AND EFFECTS

David Chapman, November 2011

- A range of design strategies and mitigation techniques are available to mitigate the effects of harmonics.
- The four main mitigation solutions are passive shunt filters, passive series filters, isolation transformers, and active harmonic conditioners.
- Good design practice, the right electrical equipment, and good maintenance are the keys to preventing future problems.

INTERHARMONICS

Zbigniew Hanzelka, February 2012

- Do not search for coherent standards concerning interharmonics – they do not exist.
- Values and frequencies of interharmonics are mostly stochastic, depending on complex parameters of transient processes, and should therefore be assessed for each particular process separately.

EN50160 STANDARD ON PQ

Antoni Klajn, March 2013

- It is the task of the electricity regulator to set a minimum quality level that is achievable by the supplier without the need to raise prices.
- If the customer has higher requirements, he should foresee in his own mitigation measures, or negotiate a separate agreement with the supplier.

ACTIVE HARMONIC CONDITIONERS

David Chapman, May 2015

- The use of filters against harmonics can improve the power factor and reduce the investment cost of the electrical installation.
- Active filters (AHC) have better performance and better resistance against e.g. frequency variations and overload.
- The AHC is a flexible solution, making it easy to cope with changes of building layout and use.

CAPACITORS IN HARMONIC RICH ENVIRONMENTS

Stefan Fassbinder, September 2011

- Compensating the inductive load should be done properly to avoid over-compensation.
- Variable compensation units should be designed using semiconductor switches and intelligent control algorithms to avoid interference with equipment.
- Compensation capacitors should be detuned in order to avoid resonance with harmonics and overload by high frequency currents.
- Technical and financial arguments can be in advantage of either centralized or dispersed compensation depending on the situation.

TRANSIENTS AND TEMPORARY OVER-VOLTAGES

UIE, July 2015

- The desired level of protection against transient overvoltages and currents can vary greatly depending upon the application.
- Equipment sensitivities should be selected in accordance with the desired protection level.
- Investing in surge protection may be chosen as a conservative approach, ensuring excellent performance while not significantly affecting overall system cost.

RESILIENCE AND RELIABILITY

RESILIENCE, RELIABILITY, REDUNDANCY

G. Marshall, David Chapman, October 2011

- High availability cannot be practically achieved by high system reliability alone.
- Designing and implementing a resilient system should be the first step.
- Proper maintenance procedures are also required.

IMPROVING THE RELIABILITY OF POWER SUPPLY: INTRODUCTION

S. Karve, H. Markiezwicz, A. Klajn, January 2012

- Improving the performance of the network is both difficult and expensive, so it is left to the consumer to take necessary action to mitigate the effects of poor power quality and inadequate resilience.
- There is no single solution – a detailed analysis is necessary to select the most cost effective solution for the particular application and working environment.

DEVELOPING PREVENTIVE MAINTENANCE PLANS WITH RCM

Martin van den Hout, October 2015

- Preventive maintenance should be customised for each individual asset, because every asset works under different circumstances.
- RCM is a generally accepted but very time consuming methodology to select preventive maintenance tasks.
- If assets are less critical, Industrial RCM or PM Set Up may be good alternatives.
- Predetermined maintenance is often not a good strategy, because only some of all failure modes are time related; condition monitoring or function tests can provide better solutions.

RESILIENT POWER SUPPLY IN A MODERN OFFICE BUILDING

Angelo Baggini, Hans De Keulenaer, January 2012

- In order to minimize the Life Cycle Cost, mission-critical loads in a modern office building should have three lines of defense against power cuts.
- Each floor should be supplied by two independent distribution panels.
- The electrical system should be highly flexible for future load growth.

UPS

Shri Karve, August 2012

- Selection of the right UPS must take into account performance, efficiency across the load range, reliability, TCO, weight, size, and ease of maintenance.
- While scalable UPS systems and sleep mode options can significantly raise system efficiency, such solutions are only appropriate if they do not sacrifice system resilience.

GENSETS

Shri Karve, November 2012

- If no power interruption can be tolerated, a standby generator must be installed.
- The size of the genset should take a potential future growth of the load into account.
- The genset should be correctly rated against the critical load (capacity, duty, dynamic performance).
- Over-sizing results in a higher capital cost of the genset itself, but also requires more attenuation and larger fuel and flue systems.
- Once installed, on-going reliability should be assured by a proactive maintenance regime.

EARTHING AND EMC

EARTHING SYSTEMS: FUNDAMENTALS OF CALCULATION AND DESIGN

H. Markiewicz, A. Klajn, November 2014

- An approximation of the earthing resistance can be calculated by assuming the ground to be homogenous and with constant resistivity.
- Rod electrodes have an unfavourable surface potential distribution; meshed electrodes have a much flatter distribution.
- The behaviour of the earthing system for high transient currents should be considered (e.g. high current values and fast current changes).

INTEGRATED EARTHING SYSTEMS

Rob Kersten, Frans Van Pelt, July 2011

- Protective earthing, functional earthing, and lightning protection should be provided by a single integrated earthing grid to avoid compatibility problems.
- The concept of integrated earthing is included in international standards. Knowledge of those prevailing standards is crucial.

FUNDAMENTALS OF EMC

W. Langguth, June 2014

- Consider EMC from the very beginning of design or refurbishment.
- Generate an "EMC matrix" for planning EMC compliance, in new and refurbished buildings.
- Use EMC certified material, installed by EMC trained staff, supervised by EMC skilled engineers.

EARTHING SYSTEMS: BASIC CONSTRUCTIONAL DESIGN

H. Markiewicz, A. Klajn, November 2014

- Vertical electrodes have high surface potential but can reach deeper earth layers with low and stable resistivity, which often gives them a crucial advantage over other shapes of electrodes.
- The choice of electrode material is usually a compromise between cost and durability (corrosion).

MEASURING EARTH RESISTANCE

E. Hering, June 2015

- Various methods exist to measure earth resistance. Which method is best to use should be assessed case by case by comparing the particular advantages and disadvantages.
- Whether to use a method that draws the current directly from the supply during the measurement, or a method that does not, should also be assessed case by case.

Electrical Safety

Safety in non-residential installations

Paul De Potter, July 2012

- The insulation resistance of transformers, motors, generators and cables should be regularly inspected.
- The installation tester, earth loop impedance tester, RCD tester, earth resistance tester and thermographic camera are other useful inspection instruments.
- Dust, dirt and poor ventilation can cause a device to be unable to give off its heat, which can result in a fire. Employees should be informed of potential hazards and trained to avoid them.

Isolation transformers

Paul De Potter, March 2014

- Isolation transformers provide a degree of protection against electric shock equivalent to that of double insulation.
- They avoid critical equipment from losing power in the case of a first insulation fault, without creating a dangerous situation.
- They protect sensitive equipment from electrical noise. They also create a star point, which some types of equipment require for controlling purposes.

Electricity systems for hospitals

Angelo Baggini, June 2014

- Various essential standards and regulations exist to ensure safety and reliability of a hospital's electrical installation.
- By tackling the energy efficiency of their electrical installations, hospitals can often make large savings on their Total Cost of Ownership.

Fire safety cables

W. Wiatr, Z. Hanzelka, S. Fassbinder, D. Chapman, June 2014

- On the contrary to common practice, the parameters of fire safety cables should be specified for the exceptional conditions of a fire.
- Knowledge of the temperature rise characteristic in areas affected by a fire is essential.
- Correct cable selection includes correct conductor sizing.
- The appropriate cable needs to be installed properly following the manufacturer's restrictions.

Design for electrical safety

Bert Brouwers (Egemin Consulting), June 2014

- Electrical safety is no domain for the hazards of trial and error.
- Engineers should apply the appropriate standards, legislation and good practices to create safe electrical applications.

OTHER TOPICS

WIRELESS ENERGY TRANSMISSION

Stefan Fassbinder, November 2014

- Wireless Energy Transmission Systems should not be used for their supposed high efficiency. The 'lifetime efficiency' of the inductive energy transfer of an electric toothbrush is in the order of 0.5 %.
- MAGLEV trains are not state of the art anymore – their technological advantages have melted away as conventional trains have caught up
- Caution is appropriate when designing wireless energy systems. It is virtually impossible to ensure that emitted magnetic fields end up only at those locations where they are required.

THE PROPERTIES OF LED LIGHTING

Stefan Fassbinder, March 2013

- LED lamps last for an extremely long time, which is particularly advantageous when high costs are involved in changing lights
- LED lamps are not as efficient as fluorescent lamps, but they can be useful for other characteristics: they are compact, highly focusable, work at practically any temperature, start right away and are insensitive to frequent switching