ena energynetworks association

POWERING IMPROVEMENT

2017 SHE REVIEW OF PAST INCIDENTS

ASSET MANAGEMENT

POWERING IMPROVEMENT 2015 – 2020

VISON

By 2020 the UK electricity industry will have delivered a sustained improvement in health and safety performance by applying and influencing best practice approaches utilised in the top performing sectors in the UK and beyond.

2017 DELIVERY PLAN

AIM

To promote asset management and maintenance and learning outcomes amongst the workforce to ensure that lessons have been learned and not forgotten as the industry moves forward.

OUTPUT 1

The Powering Improvement Asset Management Subgroup will gather learning from within and outside our sector and produce a suite of case studies highlighting best practice in managing the health and safety risks from asset management and maintenance activities, including lessons learned from both managing equipment failures and failures to manage equipment. The information will be published in 2018 in the form of a new SHE Review of past incidents to help share knowledge and learning outcomes.

CONTENTS

ASSET MANAGEMENT

INTRODUCTION

This is a special SHE Review edition in support of the industry's Powering Improvement health and safety initiative. In 2017 the annual theme was 'Asset Management' and the year focussed on safety issues related to electrical equipment assets. This is comprised of the plant, equipment, cables, lines, poles and towers that make up the industry assets. The focus of this review is therefore on past incidents involving operation and use of the plant and equipment in our industry.

These incidents provide an opportunity to learn lessons from past incidents, both recent events and established case studies. More importantly the aim is to eliminate such failures and prevent the same things from happening again. These types of incidents do not occur frequently, but when they do occur they are unexpected and potentially serious. Like all incidents they are completely preventable, so please take note of the important learning points.

The outcomes in these incidents vary considerably; some are fatalities, some resulted in serious injuries and some are near misses. This highlights the fact that once an incident happens the severity of the outcome is dependent on the particular circumstances at the time, but all represent a failure of asset management systems and the opportunity for someone to be injured.

The type of incidents outlined in this review are thankfully rare and the failure rate of assets and plant is very low. This is due to the integrity of the equipment, the established procedures that are in place, and the competency and skills of the people who operate them. The examples that have been included are comprised of events that have occurred in the last few years, coupled with significant historical case studies. It is important that lessons from the latter continue to be shared within the industry as part of the Powering Improvement commitment to corporate memory.

When you have read this document please keep it for future reference or pass it on to one of your colleagues to help disseminate the learning, especially for new staff who were not in the industry when these incidents occurred.

Please note the photographs used in this review include both those from the incidents described and typical examples of failed and good assets.

Thank you

2017 Powering Improvement
Asset Management Subgroup

INCIDENTS INVOLVING POLES

LINESMAN BADLY INJURED DUE TO POLE COLLAPSE (2017)

Background

As part of a diversion scheme a low voltage terminal pole was to be removed along with a single span of LV overhead line. The overhead line team took the decision to access each pole using climbing irons as their MEWP was in for its regular service; this was despite there being other MEWPs available.

What happened

The terminal pole had been identified as having decay at the pole top but no "D" label was fitted; the pole was over 50 years old. On the day in question the linesman tested the pole using a hammer test and this did not indicate the pole was unsafe to climb. The linesman climbed the pole to disconnect a service span in preparation for recovery of the pole. As he did so the pole failed at a point below ground level and fell to ground with the linesman attached. The linesman suffered two fractured ribs, a chipped vertebra and a minor lower leg injury.

The inquiry concluded that the current pole integrity testing techniques may not be sufficient to identify below ground decay in all cases, and further controls were therefore necessary to reduce the risk of a similar incident of this type occurring in the future.

Learning points

Key recommendations following this incident were:

> All poles over 50 years old or poles of any age which are considered suspect (following inspection and testing), which are positioned where access via a MEWP is reasonably practicable, shall not be climbed under any circumstances;

> Where MEWP access in accordance with the working at height hierarchy is not practicable, all poles greater than

50-years old shall be climbed only after all of the following safety measures are met:

Satisfactory visual inspection and hammer test.

Successful prod test to the pole including at a depth of 300 mm below ground level.

INCIDENTS INVOLVING WET WOOD POLES

Background

In early summer, a company changed pole suppliers and a number of wood poles were delivered and installed as part of an ongoing asset replacement programme.

What happened

A number of staff and contractors reported that they were suffering effects by direct contact and inhalation (vapour) effects with creosote leeching or seeping out from newly installed wood poles and blocks. It became apparent that the issue worsened with the heat of summer; creosote will naturally leech or seep from poles in warmer temperatures. There were also some reports of cross contamination affecting other persons and equipment.

A robust action plan was put in place investigating all aspects of creosote and wood pole handling including:

> Visiting the manufacturing sites of pole suppliers;

> Gaining independent health advice in terms of health risks and additional health monitoring required to those affected;

> The creosote used for new poles was independently analysed;

> SHE Bulletin published with recommendations when working with wet wood poles;

> Voluntary survey was published to explore any other further issues working with creosoted wood poles.

Actions Taken

> Investigations revealed that manufacturers were delivering poles to DNOs which had not been left long enough to dry after they had been impregnated with creosote. The process for drying and delivering poles to site has now been reviewed;

> Additional quality checks were agreed with suppliers and these will be regularly audited to ensure compliance;

> The creosote used for new poles was independently analysed and found to only contain the chemicals quoted on the COSHH assessment sheet.

Learning points

When working with creosote wood poles it is recommended that you:

> Try to avoid contact with your skin from contaminated clothing or equipment, such as wiping your face with gloved hands and carrying slings on your shoulder;

> Apply barrier cream or sun screen to exposed skin before work starts;

> Wear safety glasses or visor to protect your eyes;

> Clean your tools and PPE that are contaminated by creosote;

> Wash skin with soap and water as soon as you are aware of the substance;

> Regularly check your coveralls for the retention of creosote and take them to a dry cleaners for cleaning;

> Contaminated clothing MUST NOT be taken home and laundered due to the risk of cross contamination, to prevent your family, friends and members of the public being exposed to creosote;

> Wet wood poles must be returned to the supplier;

> All waste materials must be bagged up and disposed of as hazardous waste.

The correct management and use of creosote poles is especially important in the light of continued regulatory attention on use of this material at both a UK and European level, and the ongoing assessment of its future availability and use through legislative approval.

TAP CHANGER FATALITY (2008)

Background

A fatal incident occurred when an engineer tried to manually operate a high voltage tap changer and the unit exploded, killing the engineer. The direct cause of the incident was the failure of the mechanism in the tap changer leading to an electrical fault, which caused the oil in the unit to ignite and explode.

Underlying and contributory causes included:

- A failure to carry out a modification to the tap changer which had been recommended some years before;
- The failure to understand the significance of repeated tap changer alarms and malfunctions.

The investigation concluded that: “the explosion occurred because sector contacts were unable to full engage following a tap changing operation. The excessive current loading on the reduced contact area caused a temperature rise which eventually led to localised arcing and the rapid decomposition of the oil and spreading dielectric failure. This failure to engage was caused by the seizure of the moving arm of the phase changeover switch, which in turn caused slippage or breakage of the epoxy resin drive shafts at two locations.”

Learning points

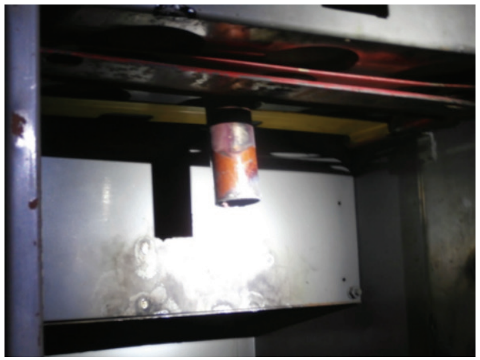
- Alarms and defects on plant should be dealt with by staff who are trained and experienced in the maintenance of that type of plant;
- A robust asset management system is needed to ensure that recommended modifications are recorded, scheduled and carried out, to ensure an accurate equipment and site history is maintained;
- The treatment of protection equipment should be viewed as safety critical, and suitable actions taken based on oil sampling results;
- Repeated alarms should be interpreted as an indication that there may be a more serious underlying problem and trend which needs to be investigated. The alarms should be visible to operational staff;
- Manual live operation of tap changers should be reviewed and risk assessed, with appropriate controls applied;
- Where evidence exists that the internal mechanisms of either the diverter or selector are damaged, then the unit should not be operated live;
- Ensure that staff dealing with alarms and defects on equipment have the knowledge, skills and competency to deal with that equipment.

The Health and Safety Executive (HSE) report emphasised that “fatalities illustrate how dangerous work on or near electrical distribution networks can be, and how imperative it is that employers, large or small, ensure that all activities involving high voltage electrical equipment are properly assessed and that safe systems of work are in place.”

SWITCHGEAR FAILURES (2016)

What happened

During the process of restoring an 11kV circuit at a main substation, a Senior Authorised Person (SAP) came into contact with a live high voltage conductor and subsequently suffered serious injuries. This resulted in the employee suffering serious 25% electrical burns to his body and being off work for a considerable time.



Learning points

- Understand the switchgear you are operating on - If you are unfamiliar with any type of electrical equipment then stop and contact your line manager for advice on what to do next. Never become complacent in what you are doing;
- All practicable steps must be taken to lock off from all points of supply - Including voltage and auxiliary transformers, common neutral earthing equipment and other sources from which the apparatus and conductors may become live. ‘Caution’ notices shall be fixed at all points of isolation;
- Do you know how to apply and secure the earthing set to the type of switchgear you are operating on? - Not all earthing sets or earthing arrangements on switchgear are the same so always ensure you have the correct earthing kit for the switchgear you are operating on. If you don’t have the correct earthing set then stop and contact your line manager for advice on what to do next; it’s never acceptable to make do and mend;
- Do you understand what the instruction remove earth means? Open, rack-out and withdraw from the cubicle, apply safety locks to prevent access to any live parts that are not required to be opened for immediate work and remove and store the earthing set. By doing it this way you confirm that there are no issues before energisation;
- If things have gone wrong then stop and immediately contact the Control Centre - Do not try to remedy the problem until the correct safety systems have been followed;

- Be aware of the hours you and your colleagues are working - Fatigue creeps up and can cause you to work differently to normal. Working excessive hours can also cause health issues which can affect all aspects of your life;

- Location and labelling of shutters and safety locks - On a withdrawable circuit breaker pay particular attention to the relevant sections of the Distribution Safety Rules.

LV BOARD FAILURES

FAILURE OF THE LV BOARD AT A SUBSTATION (2016)

What happened

An incident occurred when an operative was injured following a disruptive failure of the LV board at a substation.
The operative was carrying out the isolation of an LV main to enable an LV cable to be safely excavated to carry out a fault repair. The operative had no burn injuries from the incident but was kept in hospital overnight due to smoke inhalation. He was wearing full PPE which prevented further injuries.

Subsequent investigation revealed that the LV board at the substation had disruptively failed whilst the operative was carrying out an operation to remove fuses on the LV board to isolate a faulty circuit for the jointer to commence work.

Learning points

A specialist electrical consultancy was employed to carry out a forensic examination of the LV board, which was a Lucy open type board, in order to determine the cause of the initial flashover and to explain how the short circuit could have occurred. It was established that there was a split second drop of the fuse carrier caused by a combination of weight of the porcelain fuse and release of contact tension as the fuse was withdrawn. The operator was unaware and unable to react before a phase to earth contact was made.

Following the incident a ban on operating on these type boards was instigated pending an interim solution; this involved the placement of an insulating block under the bottom contact of each fuse to prevent the fuses from falling far enough to cause a short circuit to the steelwork of the LV

board. The permanent solution consisted of removal and replacement of all of this type of LV board.

FLASHOVER ON SPRING CONTACT TYPE LV BOARD (2015)

What happened

A flashover occurred during the removal of a fuse on an open LV board. The fuses on the board were spring contact fuses with tightening lugs. The incident occurred as the toggles on the fuse carrier were being loosened so it could be removed. At this point the fuse carrier dropped making contact between the metal back box of the LV board and a live busbar.

Indication of the direct and contributory causes of the incident

The spring contact on this type of fuse carrier is designed to grip the wedge on the board independently. The toggle on the front on the fuse carrier can then be tightened to increase the grip on the contacts. The investigation into the incident found that over time the spring contact can lose its tension and then relies on the toggle to hold it in place.

Learning points

- Following this incident a decision was taken to replace this particular type of LV board;

- In addition, following a further incident in another DNO, the following restrictions on this type of board were introduced:

  No further live operations on the LV board were permitted;

  All operations shall be done with the LV board made dead via the HV supply to the transformer and the isolation of all other LV in-feeds;

  The fitting and removal of fault management equipment was permitted providing that the above restrictions were complied with. Operation of the equipment once fitted could be carried out with the LV Board live;

  Testing to establish the condition of an LV fuse was permitted with the LV board live;

  Inspections and HV operations could be carried out in the substation with all equipment live.

FLASHOVER AT AN LV DISTRIBUTION BOARD (2016)

Background

A jointer was investigating a report of flickering street lights and, whilst withdrawing an LV fuse controlling the street lights which was installed within a LV pillar, he sustained burns to his hand when a flashover occurred.

What Happened

A jointer checking supplies in an LV distribution board decided to remove a street light cut-out fuse from its holder as there had been reports of street lights flickering in the area.

Appropriate PPE for the task was being worn but, when attempts to remove the fuse failed due to struggling to get a good grip on the fuse, he decided to remove his LV glove and then proceeded to remove the fuse carrier.

During the removal of the fuse the tail feeding the cut-out became dislodged unexpectedly and touched the side of the LV board causing a flashover.

Learning Points

All staff and contractors were reminded that they must comply with the following requirements:

- > Never be tempted to remove any PPE for ease of completing a task;
- > Staff to be vigilant as the task progresses and ensure that they are wearing the correct PPE for the task in compliance with company procedures;
- > A continual assessment of the risks associated with the task being carried out is required, and the relevant control measures to minimise the risk of injury determined;
- > All operational staff were briefed and a SHE Bulletin issued.

TEST PRODS AND HV RING MAIN UNITS (1997)

Background

Some of the worst incidents the industry has experienced have involved problems with the test prods used to test cables connected to HV Ring Main Units (sometimes known as test plugs).

These incidents can be very severe because the insulating oil can be ignited by any flashover, leading to a fireball. These prods are designed to be used safely in tanks which may have live conductors in them. They rely on a correct fit to guide them, so correct use of the right prods and in good condition is critical.

What happened

Two engineers were killed and a fitter was seriously injured at a substation when a metal guide rod became detached from a set of test prods on an oil filled ring main unit due to a loose nut, and fell onto the live HV metalwork at the bottom of the tank, causing a flashover and explosion which ignited the oil at a fault level of 180MVA.

In a separate incident an engineer used the wrong set of test prods to make test connections. As they were the wrong test prods they were not guided when they entered the tank, and they made contact with the live busbar bushing on the other side of the tank. This resulted in serious burns to the engineer.

Learning points:

- > All test prods must be subject to a robust system of inspection, identification, and labelling;
- > They must be kept in dry, safe and secure storage;
- > They must be protected from damage when transported, ideally in a box;
- > Test prods must have no removable parts;
- > Staff must have training in the use and care of test prods, including awareness of the hazards involved;
- > Test prods must be clearly identified and marked with the type of switchgear on which they are to be used; if there is any doubt then do not use them;
- > Never attempt to modify or dismantle test prods during use;
- > Consider testing from a location that does not involve test prods;
- > Inspect test plugs every time before use; never use test plugs that are in a poor condition or with any parts that are loose.

METAL CUT-OUT REPLACEMENT

JOINTER FATALITY UNDERTAKING CUT-OUT REPLACEMENT (2013)

Background

A contract jointer was working as part of a two-man team carrying out a routine service job at a customer's property. The job was to replace a single-phase metal-clad cut-out that had been previously identified by a meter operator, and entered onto the cut-out replacement programme as a non-urgent cut-out replacement job. The work was one of many thousands of cut-out replacements undertaken on this programme every year and was an extremely routine and familiar activity to the jointer.

What happened

The jointer had successfully removed the existing metal-clad cut-out and was at a point where he was about to fix the new plastic cut-out to the service cable. It was during this stage of the work that the jointer appears to have come into contact with the live conductor and, despite his colleague's immediate efforts to perform CPR, he died at the scene.

Learning points

The investigation concluded the contractor was not wearing his protective gloves at the time of the incident and had not shrouded all adjacent metalwork.
The investigation did not establish the manner in which the live conductor was contacted. The contractor's mate was criticised for not intervening when the jointer failed to follow the correct live working procedures.

The contract jointer was apprentice trained and had over 40 years jointing experience.

Not related to the incident the cut-out was a metal clad-cut-out, but this had no bearing on the incident. The cut-out had already been removed when the incident happened. However, following the incident the HSE made it clear that they did not approve of any work on metal clad cut-outs so the practice was banned in the company.

CUT-OUT FUSES (2016)

Background

Following a report from a development site of a sign which had been knocked down with no known damage, a jointing team was despatched to investigate. The site was a housing development undergoing realignment of the site access way with a new road layout being formed, and the sign had been knocked down during these works.

What happened

Following a risk assessment the jointer decided to withdraw the cut-out fuse before disconnecting the incoming service. He then attempted to roll the sign over to allow access to the cut-out, and in doing so the internal wiring made contact with the steel body causing it to become energised. This resulted in burns to his left hand and grazing to his head and shoulder as he fell away from the sign.

Further investigations revealed the movement of the sign had caused the tail between the DNO cut-out and authority cut-out to pinch against the sign causing it to become live.

The jointer was wearing arc flame resistant (AFR) overalls, hi-viz jacket, di-electric wellies and helmet, and was not undertaking electrical works at the time of the accident.

Learning Points

- Continually assess the risks associated with the task being carried out and consider the relevant control measures to minimise the risk of injury;
- Although completing a risk assessment, the jointer failed to consider the new potential hazards his actions may have introduced. Since the condition of the internal wiring including the service cable was unknown, movement of the lamp should have been avoided;
- All operational staff were briefed and a SHE Bulletin issued.

CUT-OUTS AND SERVICE TERMINATIONS

UNPROTECTED 3-PHASE CUT-OUT AND SERVICE (2017)

What happened

A site technician visited a site to carry out a service alteration and new connection survey. During the visit he identified the existing service cable and 3-phase cut-out was exposed, open to the elements and accessible on the driveway. He covered the cut-out with a red blast blanket, called dispatch to request jointers to attend as soon as possible and left site. The local scheduler was on leave that day and 4 others were filling in for the day. There was a breakdown in communication between dispatch and the local schedulers.

Three months later the customer at the same site called to report a damaged cable. An engineer was dispatched and reported the same exposed service cable and 3-phase cut-out. Consequently, members of the public had been put at risk with access to the exposed service cable and 3-phase cut-out for a period of 75 days. No injury or property damage was reported.

Learning points:

- Consider how your role impacts on the safety of the public;
- If you receive a call from the public highlighting a dangerous situation ensure you bring it to the attention of the right people;
- Consider how you would raise awareness amongst the key public risk groups.

LOW OVERHEAD LINES (2015)

What happened

A combine harvester made contact with a low (4.85m) live 11kv overhead line (OHL). The OHL conductors were found to be low due to a damaged stay wire. The subsequent investigation revealed there had been opportunities to rectify the low line before the incident occurred, but the company had failed to act in time to prevent the incident.

The immediate impact was damage to the combine harvester and the OHL. Fortunately, nobody was hurt in this incident but there was a real potential for injury, or even a fatality.

This incident was reported to HSE under Regulation 31 of the Electricity Safety, Quality and Continuity Regulations (2002) (ESQCR). Subsequent dialogue with HSE resulted in the company urgently re-inspecting over 2,100 more suspect low lines. From these inspections, 800 low lines were identified and rectified accordingly.

Additionally, a SHE Bulletin was produced detailing specific measures that need to be taken when inspecting overhead lines.

In terms of the original incident, the line had been inspected in February 2015. The inspector noted the low line, but did not correctly raise a defect either for the low line or the damaged stay wire in the system. This meant that the defect was never progressed for repair.

In addition there was anecdotal evidence to suggest that local field staff were aware for some time of the damaged stay wire and resultant low conductors at this particular site, but nothing could be substantiated through a review of the company reporting system and other records.

Subsequent actions after the incident have highlighted that the discovery of low conductors in this instance was not an isolated event. Several hundreds more were identified across the whole region and remedial action taken.

Learning points

Clearly this case served as a reminder that incidents of this nature can be prevented, and that everyone has a collective responsibility to ensure that the networks are safe, not just for employees but also the wider public.

The importance of stay wires should not be underestimated as these are an integral part of the OHL system. It is essential that if you find or suspect a low line then you must report it immediately via the reporting system and your line manager for further action.

Low lines can be caused by, but not restricted to:

- Missing, broken or damaged stay wires;
- Damaged poles;
- Poles leaning more than 10 degrees;
- Ground levels being altered reducing the clearance.

CABLES ASSUMED TO BE DEAD

LV MAINS FLASHOVER (2016)

Background

A craftsman jointer was tasked with carrying out a mains service joint behind an existing running end on a new development. The installation of the new mains cable had been fragmented so actual site conditions did not correspond to records or work plans. The majority of the other site work had been completed by another jointing team.

What happened

On arrival on site it was established that a running end had not been completed and a manufacturer's sealed end was still in place. The jointer assumed the mains cable to be dead and continued with the service joint. During jointing a flashover occurred between two phases and neutral as the mains cable was live. The craftsman suffered burns to his index and middle finger. He also suffered mild symptoms of arc eye and his AFR trousers were damaged.

Learning Points

- The presence of a manufacturer's sealed end and record plans do not prove that a cable is dead;
- All cables should be treated as live until proved dead as per company procedures;
- Clear work instructions need to be issued and confirmed as complete;
- Before a cable is energised for the first time, pre-commissioning checks should be carried out, including walking the route if reasonably practicable;
- All jointing staff were briefed and reminded of correct procedures for proving cables dead;
- All staff were reminded of the potential implications of energising a new section of network without carrying out the necessary checks beforehand.

PLANT FAILURES INVOLVING INJURY/ ASSET FAILURES

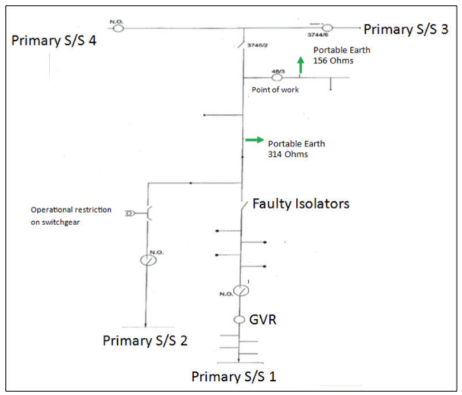
PAST SERIOUS INCIDENT INVOLVING A FATALITY (2001)

Background

Work was programmed to replace a set of line section isolators with the work scheduled to be carried out using local control. On the day of the incident the engineer in charge of the work switched out the section of network to be released to local control under the instruction of the control engineer. The section of overhead line had three points of in-feed with one of them being isolated via a set of overhead line isolators. During the opening of this set of isolators an upstream connected auto-recloser operated and the control engineer attributed this to an imbalance due to the contacts of the isolators not opening exactly at the same moment.

What happened

Following isolation, the section of network was released into the control of the site engineer (local control). The site engineer did not apply all the earths required to allow work to be carried out at the point of work, and did not use an available rated device due to there being an embargo on its live operation. Earthing was provided via two portable overhead line earths, one applied remote from the point of work and one adjacent to the line section isolators to be worked on. The portable earth remote from the point of work was not installed correctly with only a token effort made to drive it into the ground.



As work progressed the control engineer decided to have the auto-reclose that had previously tripped reclosed ready for restoring the network to normal. On reclosing the auto-recloser the linesman working at the point of work received a fatal electric shock. Equipotential bonding had not been carried at the point of work.

It was discovered that the centre phase of the isolators used as a point of isolation had not in fact opened, and this resulted in the centre phase voltage being applied to all three phases of the section of network being worked on when the auto-recloser was closed.

Previously the engineer had confirmed to the control engineer that the isolators had opened but he had clearly not carried out a thorough check. There was a significant amount of vegetation around the isolators which hindered the engineer's view.

Learning points

Aside from the clear operational failures, failure to isolate and earth in accordance with the safety rules and failure to check correct operation of switchgear, there were issues around the management of the assets, namely:

> Maintenance of isolators;

> Vegetation management around network assets;

> Management of switchgear defects.

Following this incident the practice of local control was withdrawn, the process for the management of switchgear subject to operational restrictions reviewed, and the policy on vegetation management reviewed.

DISRUPTIVE FAILURE OF A FUSE-SWITCH (2013)

What happened

Following routine maintenance of a fuse-switch, the 11kV plant, associated transformer and low voltage switchboard suffered a disruptive failure. The failure occurred approximately 30 seconds after the unit was remotely re energised. The explosion demolished the entire substation and all assets within the building.

The investigation into the incident identified the most likely cause of the switchboard failure was due to contact pitting, incorrect contact alignment between the fixed and moving contacts on the switch fuse, and the rising busbar being out of its correct vertical plain leading to local overheating and thermal runaway. The previous plant maintenance policy did not require checking of the contact alignment.

Learning points from the incident

> A Dangerous Incident Notification (DIN) and Suspension of Operational Practice (SOP) was issued via the Energy Networks Association (ENA) to all member companies notifying them of the Fuse Switch Failure;

> The DIN was an instant benefit for scheme members to immediately review the incident and, if deemed appropriate, instigate an immediate prohibition of live operations;

> An Operational Instruction (OI) was applied when operating the equipment as summarised below, outlining the procedure to adopt in such circumstances:

All operations of the fuse when any part of the unit or switchboard is live were banned;

Prior to energisation of the switchgear, all automatic means of re-energisation of the restricted equipment were inhibited on the 11/6.6kV feeder involved, and only restored 30 minutes after the re-energisation;

Switchgear was re-energised from a remote substation and no persons were to be present in the substation during re-energisation;

A 3m exclusion zone was implemented around the switchgear;

The exclusion zone remained for 30 minutes following re-energisation;

The units were placed under modification, once completed the OI was lifted;

Plant maintenance procedures were amended to include a further plant modification to check alignment of the contacts;

All fitting staff were retrained on the new plant maintenance procedure and modification;

The Operational Restriction was only removed once this plant modification was confirmed as being completed;

Maintenance teams continued to work on maintenance of the plant population to remove the operational restriction; long term all switchgear will be maintained in line with the new procedure and the OI removed.

LINK BOX FAILURES

Background

In the years from 2010 link box failures were increasing across the UK DNOs. Some of these failures were also disruptive and expelled energy into the street or surrounding of the asset. Disruptive events posed a risk to the public with DNO link boxes generally being installed in pavements.

What happened

An ENA group was set up to consider actions that could be taken to address the problem. The group looked at the whole lifecycle of a link box and considered the specification, manufacture, installation, operation and maintenance of the asset.

The group created a risk assessment for the risk posed to the public by link boxes; the greatest risk to the public was locational in so far as the probability of public risk increased in areas where high levels of footfall were seen. The risk assessment also considered the likely causes of failure and appropriate methods of mitigation.

Using the risk assessment the group developed ENA SHE Position Paper 08 'Management of Link Boxes and Cable Pits on LV Distribution Networks', which considered the management of risk for link boxes. Mitigation measures included the use of protection blankets, increased inspection regimes and link tightening checks.

One failure mechanism highlighted was the mechanical failure of the structure of a link box when the surrounding ground is backfilled and reinstated. The group revised the ENA specification for link disconnecting boxes to include specification details and a test regime to ensure that new boxes are resilient to the forces applied by installation.

Learning points

> As a result of the work of the group all DNOs will now use the new specification when their supply contracts are due for renewal;

> DNOs have amended their inspection regimes and frequencies to take account of the SHE Position Paper;

> Based on the limited volume of data available after these changes have been made, it appears that the measures have helped reduce the likelihood of disruptive failure and risk to the public.

ASSET DEFECTS

FALL THROUGH WOODEN TRENCH COVER (2017)

Background

A craftsperson (fitter) was undertaking routine inspection of a battery charger in a customer owned substation.

What happened

The craftsperson noticed the wooden cover before he started the works on site. The cover itself looked dry and suitable to support his weight. The inspection commenced on site and, while moving his left foot onto the cover and applying his full weight, one of the wooden supports below the cover collapsed allowing the cover itself to fall. The craftsperson's left leg fell into the hole grazing his left shin during the fall. Upon further examination the wooden support was found to be rotten.

Learning Points

> The visual examination of the wooden cover as part of a dynamic risk assessment was not sufficient enough to indicate any structural issues with the cover;

> Always fully assess any trench/ manhole covers before standing on them; if found to be unsafe arrange to be replaced or barriered off immediately;

> The timber supports and wooden cover were replaced;

> Fitters and asset inspectors were reminded to inspect trench covers as part of substation inspection.

CUSTOMER'S SUBSTATION (2017)

What happened

The fitting team attended site to carry out a pre-work inspection. When they entered the outdoor substation a fitter walked around the site, trod on a wooden trench cover and his foot went through it causing minor bruising to his lower leg and knee.

Learning Points

> The fitter should have made a better assessment of the site and been aware that these wooden trench covers may not be as solid as they look;

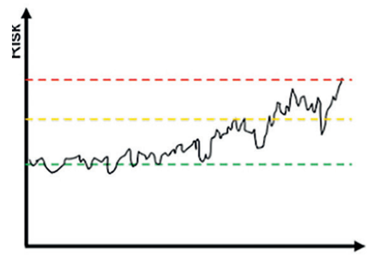
- > Relevant staff were briefed on the need for greater care to be taken when entering customer's substations;
- > The customer was made aware of the incident and requested to fill in the trench and remove the wooden covers.

CREEPING CHANGE CASE STUDY (2015)

LESSONS FROM ANOTHER SECTOR

Background

An interesting aspect of asset management, and more broadly effective health and safety management, is a phenomenon that has been labelled 'Creeping Change'. A project undertaken by Centrica focussed on this issue in the context of managing change within an engineering environment, which if not recognised can result in incidents from 'creeping change' occurring in asset integrity, particularly in the case of ageing assets that are also subject to a change in their use and demand.



- > Creeping change can sneak up on you;
- > Often not managed or even recognised;
- > Particularly prevalent on ageing assets (of any sort) with changing use demand;

For example creeping change can occur in:

- > Ageing, degradation or obsolescence of assets;
- > Process and procedural changes;
- > Equipment and infrastructure changes;
- > Changes in management and company ownership;
- > Change in workforce make up;
- > Loss of skills and experience;
- > Industry and company safety culture.

What happened

In 2015 a potential multiple fatality incident involving the ignition of flammable petroleum at a gas processing terminal was avoided, but root cause analysis showed that creeping change in the condition of the assets and the process employed was a dominant cause of this near miss.

Specifically:

- > Fluid flow rates had changed leading to an accumulation of particulate matter in pipework;
- > Fluid densities had changed, but recording instruments had not been re-calibrated;
- > Dissolved CO_2 levels had increased causing acid corrosion.

All these changes had gradually occurred over several years and had not been identified, even though a management of change process was in place. The result was that subtle differences in material properties and in asset integrity had occurred that had not been detected, leading to an increased level of risk in the operation of these assets.

Centrica initiated a programme of work in partnership with HSL and the Energy Institute to investigate creeping change, and establish methods to detect and evaluate this issue. A technical report was published and its principles applied to Centrica assets in a series of pilot studies. The report, 'Guidance on Creeping Change Hazard Identification (CC-HAZID) Methodology (First Edition, May 2017)', is available from the Energy Institute web site.

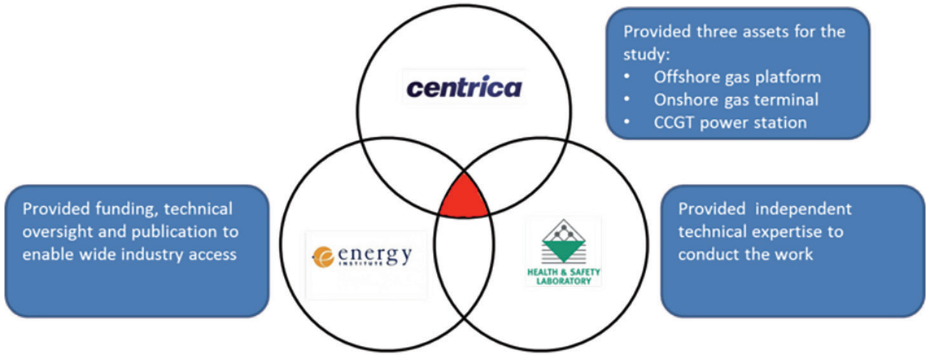
> The work developed a methodology to identify creeping changes, including a set of keywords;

> The methodology could be applied to any ageing plant or to plant with many or compound changes;

> Whilst piloted in high hazard industries it can be applied wherever there is a reliance on ageing equipment;

> The methodology is not solely for safety risks; it is also applicable to environmental and business risks;

> It relies on the combined experience and expertise of asset and operations managers, front line workers and safety professionals using a structured process.



Its key findings are that:

> Creeping change is the accumulation of small changes that are gradual in nature, unseen and not planned, but which can add up to a significant change;

> These changes are difficult to detect and monitor using conventional hazard identification studies and risk assessments;

OVERALL LESSONS

The incidents in this review show that a failure to safely manage assets at any stage of their lifetime can lead to injury.

Key issues to remember include:

> Asset management starts at the planning and design stage of a project or programme; the level of risk can be eliminated or significantly reduced at this stage;

> Select the right equipment and ensure it is suitable for the purpose intended;

> Install it correctly and carry out all necessary testing, commissioning and recording;

> Operate the asset correctly, use it for what it was intended for, and operate it within its rating;

> Inspect it regularly and ensure warning indicators are recorded and acted upon;

> Follow maintenance procedures at all times;

> All modifications to equipment must be approved and carried out by technically competent staff;

> Ensure robust procedures are in place and implemented for reporting defects. Programme any modifications required and ensure their timely completion. Monitor progress to ensure risks remain low;

> Always follow the company safety rules and procedures;

> Ensure any incidents are thoroughly investigated, and that any remedial actions required are implemented and lessons learned are shared with staff;

> Where appropriate share details with other electricity companies through ENA.

FINALLY . . .

If you are involved with work in support of any of these stages, then make sure you are familiar with the requirements; if in doubt ASK. If your team is responsible for any of these tasks, then make sure they are competent through having the right training, experience and technical knowledge.

The accidents in this review do not mean that the operation of electricity assets is inherently dangerous. The incidents described have occurred over many years, and the failure rates of the industry's assets are very low. However, the aim of this review is to remind everyone of the risks that are present within the industry, and the collective efforts that are required to help eliminate such failures and prevent anyone from being injured.

POWERING IMPROVEMENT

For further information see
www.poweringimprovement.org

PARTNERS

Energy Networks Association (ENA) is the voice of the Networks. The industry body for the UK electricity transmission and distribution companies.

Energy UK is the trade association for the UK electricity generation companies.

TRADE UNIONS:

GMB
Prospect
Unison
Unite

GOVERNANCE

Powering Improvement is managed and directed by National Health, Safety and Environment Committee (HESAC) comprising representatives from Energy UK and ENA member companies, the industry trade unions (GMB, Prospect, Unison and Unite) and HSE.

Executive decisions on behalf of ENA member companies rest with the ENA SHE Committee and ultimately the ENA Board.

Executive decisions on behalf of Energy UK companies rest with the Energy UK Safety Leaders Group

Energy UK

ena energynetworks association