

# eea conference, Auckland NZ

20 June 2018



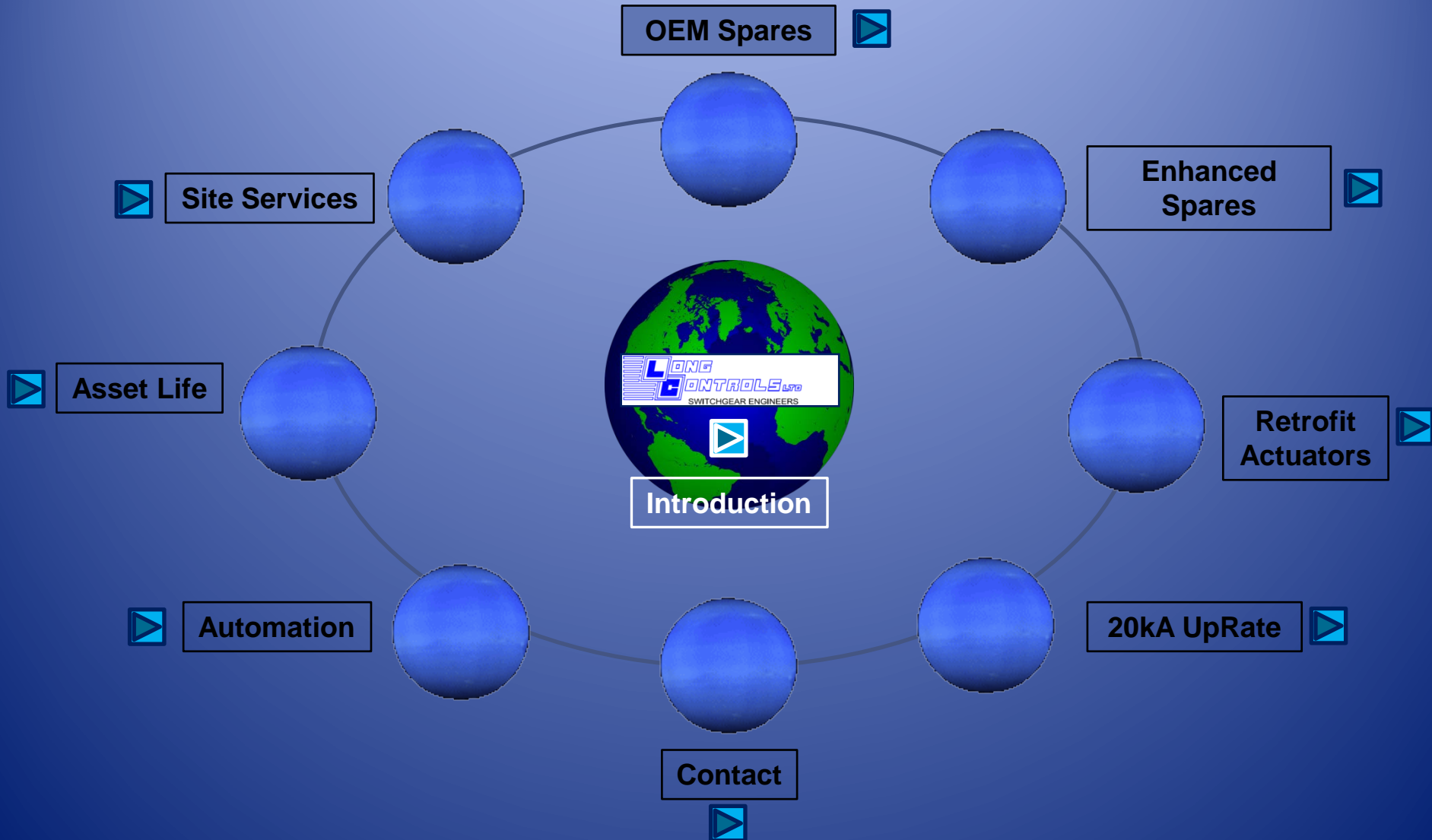
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# Navigation



# Introduction

- Long & Crawford (L&C) closure by GEC Alstom in 1994.
- Long Controls Limited (LCL) opened in 1996 by senior ex-L&C employees to continue the support, service & spares to the world-wide installed L&C base.
- Maintained strong links with the old L&C supply chain, and the only company able to claim genuine Original Equipment Manufacture (OEM) spares.
  - LCL have paid for the refurbishment of original tooling for sole use.
  - Important as the original certified test results are not compromised by ‘copies’!

# Introduction

- LCL have over the past 20-years worked extremely closely with UK REC's to evolve non-intrusive actuator range covering most legacy & current applications, contributing positively to Regulatory Quality of Supply (QoS) targets of CML & CI.
  - 10,000+ in service in the UK today, integrated seamlessly to multiple SCADA manufactures.
- LCL has three revenue streams:
  - **Products division:** Actuators and substation hardware.
  - **Engineering division:** Bespoke substation hardware solutions.
  - **Site Services division:** Maintenance, service & asset life extension of L&C switchgear.



# OEM Spares

- Having maintain links with L&C original Supply Chain, LCL are able to offer genuine OEM spares that use the original certified material & tooling by the OEM.
- Available as either individual components or in tailored Service Packs.
- LCL also have a full stock of recovered L&C units, some going back to 1960's, to fully refurbish to extended existing L&C equipped substations with like L&C plant.
- This section covers OEM spares. LCL have over the last 20-years+ designed and made available service enhanced spares that offer an advantage over the L&C OEM version as a result of time served practical experience covered in a different section.

# OEM Spares

- OEM Spares T3/T4GF3
  - Bushings
  - Dash Pots
  - Gaskets
  - Perspex window/gasket kits
  - Fan labels
  - F/Sw braids (6-pcs)
  - External nameplate labels
  - Replacement operating handles



# Service Enhanced Spares

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# Service Enhanced Spares

- Service enhanced Spares
  - F/Sw Fixed Contacts (6-pcs)
  - Replacement SRBP Fuse Clips
  - S/Stl Top Cover Assy
  - S/Stl Top Cover Fixing Kit (10-pcs)
  - Front Cover Stud Repair Kit
  - S/Stl Ring Switch Box
  - S/Stl Tx tee-off Box & Flange Gasket
  - S/Stl Stand





# Service Enhanced Spares

- Stainless Steel Cable Boxes & Gland Plates
  - T3/T4GF3 Ring Switch Boxes
  - GF3 Cable Box
  - T3/T4GF3 Tx tee-off Box/Gasket



# Actuators – LCL PowerDrive

- **PowerDrive** Platform to facilitate remote-control or automation across many manufacturers, both legacy & current generation plant.
- 100% non-intrusive.
- >10,000 units operational today.
- Interoperable across all RTU manufactures.
- Standard 24Vdc (approx. 4-Amp) operation.
- Fast operation (typically 4-5 seconds).
- Safe six-core operation.
  - No on-board electronics, logic or interposing relays
  - Control with RTU (IEC11631-3)
- Mechanical & Electrical interlocks.



# Actuators – LCL PowerDrive

- Range currently offered:
  - L&C T3/T4GF3
  - L&C J3/J4
  - L&C GF3
  - L&C LCGT
  - L&C R3/R4
  - Reyrolle ROKSS
  - Reyrolle IMS
  - Reyrolle LMI
  - SWS DRT4
  - TAMCO Falcon Beta
  - YSE Ring Master (early RN2)
  - MG RN2
  - MG RN2c (current)
  - MG SE6 & CE6
  - YSE Tyke
  - YSE FMS
  - Lucy FRMU (mk1 & mk2)
  - Lucy VRN2
  - Lucy VRN2a (current)
  - ABS (overhead)

# Actuators – LCL PowerDrive



- Designed on proven GM principles.
- Universal to most ABS switch types.
- Spring independent mechanism.
- Maintains manual 'hook/stick' operation.
- Manual override & locking off facilities.
- Seamless integration to SCADA.

# 20 kA UpRate

- J3 & T3GF3 were the early fore-runners to the current J4 single extensible switch T4GF3 Ring Main Unit.
- J3/T3GF3 short-term current ratings were 13.1 kA/3-secs.
- J4/T4GF3 are 21.9 kA/3-secs.
- 21.9 kA being drive by then BS2631 standard
- Current ratings are 20 kA being drive by current IEC standards.
- ENWL still have inner city urban 6.6 kV networks were J3 & T3GF3 are still in-service.
- Fault level on the 6.6kV and the 13.1 kA rating is causing ENWL concern.

# 20 kA UpRate

- LCL concluded as part of the in-situ Refurbishment process, an uprate to the J3 or T3Gf3 that fall into this category could theoretically be uprated by installing J4 & T4GF3 components.
- Initially the limiting factor was considered to be the 3-Ph mouldings and HV cable connections.
- Limiting factors were the rating of the fixed and moving ring switch contacts.
- Engaging the OEM copper supplier, tooling, jigs and raw material were sourced and the modification proven (mechanically).
- Hardware configuration had never been subjected to BS testing.
- ENWL booked time at KEMA Test Laboratories, NL and subsequently proved and certified this solution to 20kA.

# 20 kA UpRate

- Why did ENWL go to this expense?
  - Same reasons as the Refurbishment in-situ.
    - Time
    - 'Other' costs
    - Down-time
    - Reduction of future HV cable faults
  - A number of these units are in basements of now commercial buildings built over the main substation access.
    - Access limited to typically a stairwell & a single door.
    - This rendering removal of a RMU impossible.
    - Sw//CB/Sw three units
    - Road/Public disruption.



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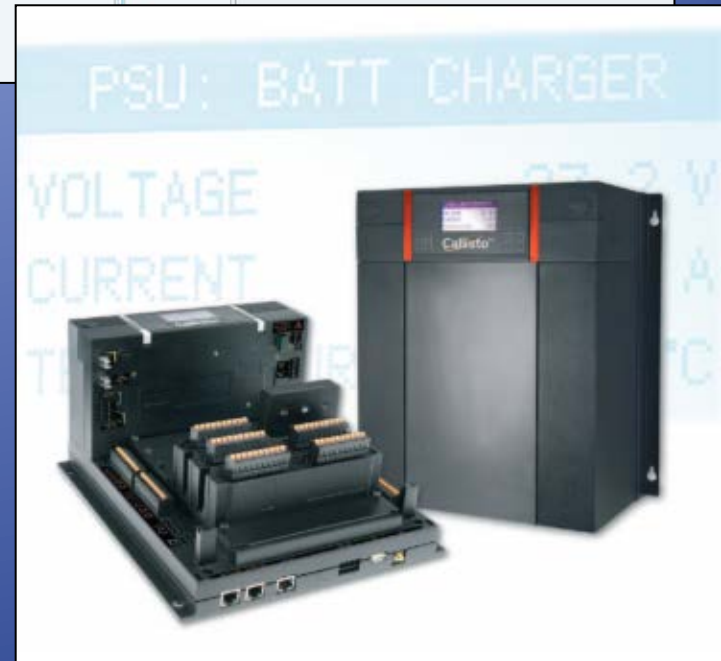
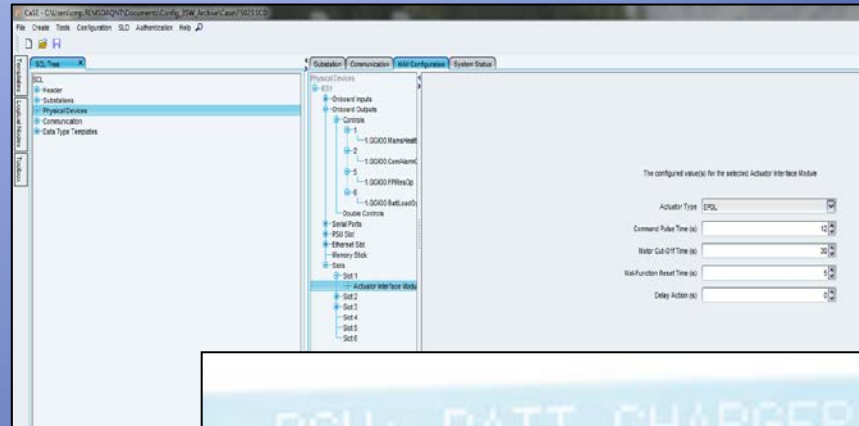


# Automation

- LCL PowerDrive's seamless integration to multiple manufacturers SCADA RTU's.
- LCL actuator simple operating principle.
  - Six cores
  - No interposing relays
  - No 'on-board' logic or software
- Six cores (LCL):
  - 1 & 2: Power +24Vdc or -24Vdc
  - 3 & 4: 'OPEN'
  - 5 & 6: 'CLOSE'
- **PowerDrive** Renders all operation and control with the IED - RTU.

# Automation

- SCADA
  - Remsdaq Callisto<sup>nx</sup> has LCL **PowerDrive** control options already built into their Case<sup>nx</sup> editor software.
  - Proven LCL/Remsdaq pedigree at many thousands of UK REC DA installations.
- Significant financial savings installing non-intrusive actuators



# Automation

- Conclusion:

*‘Just because the switchgear is old,  
doesn’t mean it cannot be automated  
or integrated into the REC  
SmartGrid road map!’*



# Asset Life

- UK Regulator (OFGEM) current Distribution Price Review (RIIO-ED1) – April 2015 thru March 2023.
- First 8-year period (previously 5-year)
- SLC51 Part D has introduced regulatory reporting requirements for all DNO's to report information relating to both Asset Health & Criticality.
  - Known as HI (Health Index) & CI (Criticality Index)
- Determined by a common methodology, determining:
  - PoF – Probability of Failure
  - CoF – Consequences of Failure
- OFGEM are economists rather than engineers!

# Asset Life

- This common methodology produces a Risk Index and a resultant risk delta versus Capital spend.
- Resulting in asset refurbishment versus that of replacing with new to achieve the same risk delta versus lower spend.
- During the current ED1, OFGEM are allowing the DNO to retain c.50% of the savings achieved by refurbishment in-situ versus the cost of replacing with new.
- LCL are now in contract with ENWL (N.West England) to refurbish c.1,200 of their aging L&C assets to maximise on the above.

# Asset Life

- UK REC – ENWL (Manchester) have concluded Long & Crawford oil insulated distribution switchgear is:
  - Extremely robust.
  - Safe & easy to operate.
  - Ability to maintain, OEM spares available & repair if necessary.
  - Cease the purchase of SF<sup>6</sup> RMU's.
    - Unable to maintain/repair
    - Environmental/safety issues
- ENWL are the biggest UK user of L&C switchgear:
  - R3/R4 (1967), J3/J4 (1966), GF3 (1969) & T3/T4GF3 (1969) population.
  - c.9,000 operational today.
  - ENWL (NORWEB) initial units installed in the 1960's.

# Asset Life

- ENWL acknowledging LCL specialist knowledge & time served skill set have embarked on a unique 8-year+ project to address UK Regulatory 'Asset' issues by extending asset life, rather than un-necessary replacement.
  - ***'Just because its old, doesn't mean it needs to be replaced!'***
- Ultimate goal:
  - Improving QoS (Quality of Supply)
  - Maximising project profitability versus Regulatory RIO funding
- Covering three L&C Site Services work disciplines:
  - 1. Maintenance
  - 2. Refurbishment
  - 3. Upgrade (fault level)

# Asset Life

- Approx. 1,750 ENWL L&C units have reached an age profile that previously normal asset replacement policy would dictate change for new (SF<sup>6</sup>).
- In reality there is nothing wrong with the asset, just requires a robust maintenance regime to achieve many more years service or a full refurbishment to extend asset life by another 20-25-years+.
- UK Regulator (Ofgem) has introduced a new HI (Health Index) measure for the current review period (2015/2023) and beyond.
  - HI= 1 – New plant
  - HI= 2 to 5 – Refurbished plant (sliding scale)



# Asset Life

- ENWL have concluded a complete refurbishment to 'as-new' by LCL will deliver a HI = 2 by Regulatory measures.
- Cost differential to deliver HI=1 & HI=2 is in the ratio of £20/25k versus £6k, taking into account the SAP, jointing, loading, temp. generation, carding and down-time to replace with new.
- By performing the Refurb 'in-situ' negates the need to disturb the cables/cable connections. Thereby reducing the risk of future HV cable faults and resultant expensive £/CI/CML costs by not disturbing the cable/radius etc.
- Refurbishment includes Maintenance scope plus addressing any abnormal/suspect parts, ring switch & earth contact wear, pitting & alignment issues.
  - Also includes a complete cosmetic overhaul to look out of factory gates 'as-new'!

# Asset Life

- Independent 3<sup>rd</sup> party studies have also confirmed ENWL conclusion on L&C equipment and has proven over time to be:
  - Extremely Robust
  - Fit for Purpose
  - Easy to Operate
  - Easy to Maintain
  - Easy to Repair
  - Availability of OEM spares (same supply chain to that of the factory)
- ENWL has therefore concluded a 22-year L&C oil gear maintenance regime is sufficient.
  - Note: all other legacy oil insulated manufactures are @ 12-years.

# Asset Life - Scope

## Maintenance (Oil)

- Top Covers/gaskets(4)
- Drain Oil
- ON/OFF  
Windows/Gaskets
- Fuse Clips/pins
- F/Sw Fixed Contacts
- F/Sw Briads
- Internal clense & new Oil

## Refurbishment

- As Maintenance, plus:
- Ring/Earth Contact alignment & operation
- Fan Labels (if necessary)
- Leaking front cover studs
- Dash Pots (if necessary)
- Cable Boxes (if dry type)
- Complete external paint prep & paint.
- New external nameplates and labels.

# Asset Life – Summary of Services

- OEM Spare Parts
  - Service Packs (bespoke to REC)
  - Individual component parts
- Training
  - At clients premises or LCL UK factory
  - Fitter Maintenance training
  - Competency assessment post training ‘real’ site
- Plant (L&C) Maintenance
- Plant (L&C) Refurbishment
- Plant (L&C) J3+ & T3GF3+ 20kA UpRate
  - All of above in-site (substation) or recovered to LCL works

# Asset Life

## Switchgear Oil Diagnostics

## Optimise Maintenance intervals with Live Tank Oil Sampling (LTOS)

Live Tank Oil Sampling (LTOS) is a unique and cost effective technique for sampling switchgear units, offering significant benefits in minimising switching requirements

### ELECTRICAL REVIEW (1)

## Feature switchgear - Checking switchgear is



ARTICLES / FEATURES  
(/features/7531-119737)

*There is no legal requirement to replace aged oil filled switchgear with modern vacuum types. The fact is most switchgear, of any if properly maintained is both safe and reliable. oil filled switchgear has been with us a long time and has proven to work well. In which case why does there remain an imperative to upgrade oil filled equipment? There are safety, reliability and cost considerations that belie the above statements, as Tony Harris the PBSI Group explains*

**IME** maintenance & asset management

## Effective Condition Assessment of Medium Voltage Switchgear

**Abstract**

There is a general trend within electricity distribution companies and operators of large private electricity networks to extend maintenance periods for medium voltage (MV) switchgear. This brings with it a need for interim condition assessment and the application of diagnostic techniques to give confidence in the continuing safety and reliability of the equipment. There are a number of techniques available for assessing the condition of insulation and the mechanical operation of circuit breakers. Appropriate use of these tools provides valuable data that can effectively target maintenance and ensure resources are more efficiently deployed during outage periods. The most appropriate techniques for assessment of MV switchgear are described and also how data can be collated to provide the best possible information on the condition of such equipment



Chris Lowley



Neil Davies



Dawn Miller

The starting point in developing a condition assessment programme must be the analysis of historical fault and failure information for similar types of equipment. This will help assess the cause of problems and ensure appropriate weighting is placed on techniques that deal with these causes. Spending 80% of a condition assessment budget to tackle a failure mode that contributes to 9% of failures will not be the most appropriate use of funds.

### MV SWITCHGEAR FAULT CAUSES

It is sometimes difficult to obtain definitive information on the causes of faults of MV switchgear, however, some information is available and can be used as a guide to typical problems encountered. Figure 1 shows a breakdown of the causes of faults for MV vacuum switchgear operating on electricity distribution networks within the UK [1]. The fault information shown includes defects identified during operation or maintenance as well as disruptive failure of the switchgear.

Figure 1 shows that for vacuum switchgear (which will in general have air insulated chambers) the biggest contributor to faults is mechanical problems, accounting for 30% of the total, and when mal-operation is included in this the figure rises to 38%. The second largest fault cause was associated with partial discharge activity (26%). It should also be noted that faults reported on cable termination boxes (6%), voltage transformers (VTs) (9%) and current transformers (CTs) (3%) will often be associated with partial discharge activity

SWITCHGEAR TECHNOLOGY

EA Technology suggests industry should follow the example of the electricity companies and switch to condition-based maintenance for its oil-filled switchgear.

## Maintaining switchgear the supply industry way

Many things have changed since the government privatised the UK electricity supply industry in 1990 – and some of these changes have not been seen for the previously engineering-led companies to accept.

Since privatisation, distribution network operators (DNOs) have been under pressure to generate profits for their shareholders by keeping expensive maintenance to a minimum, while simultaneously satisfying industry regulator Ofgem that they are doing their best to maintain reliable networks.

According to its proponents, condition-based management of assets such as switchgear can help DNOs meet these apparently contradictory aims, and CBM has become increasingly popular in the electricity supply industry over the past decade. "Probably all of the DNOs are now using condition-based asset management to maintain their HV

switchgear," says Anne McInnes, lead consultant on materials and failure investigations at EA Technology.

### GOOD CONDITION

Condition based maintenance is just one of four ways to manage the upkeep of engineering assets. The first is simply to run your plant until it breaks down and then tackle the maintenance. There is little support for this in an industry attempting to improve the security of its supplies.

The next approach is to schedule maintenance at regular intervals – scheduled, or time based, maintenance. Although it is still popular outside the electricity supply, TBM is best suited to equipment that operates continuously and is subject to a predictable amount of wear and tear between visits from the maintenance staff.

In contrast, condition based maintenance is more suitable for equipment that operates occasionally – even only once or twice a year. Technicians measure a parameter that indicates the condition of the equipment to determine the best interval between maintenance visits. In the case of oil-filled switchgear, they take a small sample of oil and analyse it for the products of oxidation or wear. CBM does not, however, take account of the extent of



# LCL Site Services



- New dedicated LCL division – 2017.
- Staffed by ex-L&C time served engineers and trained LCL staff.
- UK acknowledged centre of excellency for Long & Crawford knowledge.
- Complimented by sole availability of OEM spares.
- Specialist vehicles



# LCL Site Services

- LCL Fitters ability to offer practical site 'hands-on' Fitter Maintenance training at Customers or LCL premises.
- Non-site time refurbishing recovered units at LCL factory on behalf of clients given their willingness and commitment to re-use/re-deploy L&C units.
- Recognised and acknowledged by the UK Regulator (OfGem) as the only acceptable OEM replacement.

