

TITLE

Long Term Maintenance and Care for Reyrolle YMV2

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This document is to be used in conjunction with Installation, Operation and Maintenance Schedule IOMS 946. Its aim is to provide guidance for owners of equipment which has been in service more than 20 years.

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Introduction

During normal every day operation, switchgear works well within its design envelope and therefore, even after many years of service, appears superficially to be OK.

Fault clearance however may require the equipment to work at near maximum performance and substandard equipment will be susceptible to significant damage.

To maintain rating capability key components/functions must be in good operational condition:

The above does not indicate that the product has a limited lifespan, in fact the YMV2 range has proven to be very reliable when well looked after.

We can actually take advantage of the sub-station history of older equipment to design bespoke maintenance, which will not only extend the working life but will reduce the chance of catastrophic damage and can even reduce maintenance costs.

The owner of older equipment (20 years and beyond) should have the information which will allow him to design a maintenance plan to suit his needs. This document will help with that process.

Key Questions

1. How often is the equipment switched?
2. Is this switching duty at full rated current or well below rated current?
3. How often does the system see a fault?
4. What environmental conditions exist within the sub-station? – Is the switchgear dirty or damp or both? (we are concerned here mainly with the primary insulation)
5. Do we know the condition of the primary functional systems of the switchgear –
 - a. Primary Insulation.
 - b. The dynamic operating characteristics of mechanism and contacts.

Points 1 to 4 should be available from historical records and we will look later how we will use this information.

Point 5 is actually our recommended starting point. We feel it is logical to make a condition assessment of the equipment, and instigate any repairs prior to introducing a new maintenance regime. Using the condition assessment approach at suitable intervals will also help ensure full rating capability is maintained.

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Condition Assessment

Recommended site testing For condition assessment of Reyrolle YMV2.

Speed Curving - In house electronic system

Using original test
parameters.



Non-intrusive Discharge Monitoring.

Discharge monitoring is recommended to identify any possible deterioration of filled joints such as the shrouds in the Busbar and Transformer Chambers, surface discharges on primary insulation and similar possible sources.

The system used is non-intrusive. Magnetic probes are attached to the outer skin of the switchgear and are designed to pickup magnetic wave pulses, a phenomenon of electrical discharge. Each probe will pick up a source of discharge but the monitor can determine by time of flight which probe is closest to the source. (see diagrams below) The monitor sweeps the probes approximately every 5 minutes over a period (usually one week) and therefore can determine if the problem is constant, the level and therefore the severity. Recommendations will be given.

Owners of the switchgear can be shown how to transfer monitoring equipment from one board the next and e-mail information to ourselves for analysis.

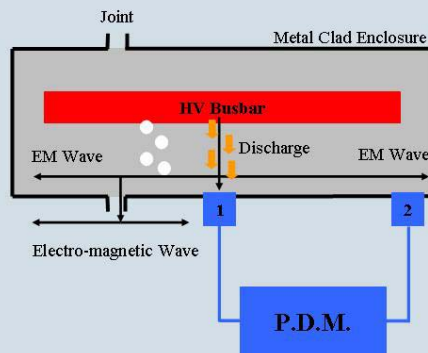
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Partial Discharge Monitoring

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- Charge transferred from HV busbar to earthed enclosure.
- EM waves emanate away from the discharge site.
- EM waves escape through joint in the enclosure and sweep across the surface of the switchgear.
- EM wave detected by the P.D.M.



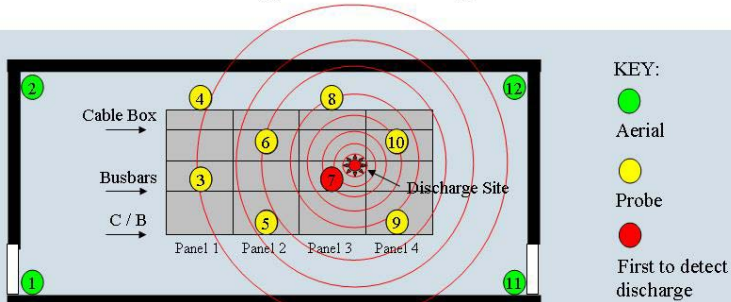
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Partial Discharge Monitoring

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Typical monitoring set-up within a substation (plan view)

- All of the probes detect the discharge from every discharge site on the board.
- The monitor allocates the discharge to the probe at which the discharge arrives first.
- Aerials detect background noise first. Background noise is allocated to aerials.
- The monitor can detect multiple discharge sites within the switchboard.

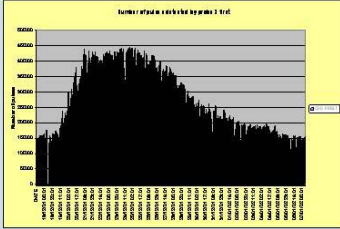
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Our report gives graphical information, explanation and recommendation for repair. Part of the graphical information from a recent report is shown below.

Partial Discharge Monitoring



This is a graph from one of our recent surveys.

The probe is situated on a cable box.

This discharge was active constantly at a dangerously high level.

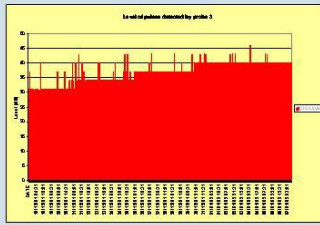
As we can see below, the discharge was getting worse as time went on.

The primary insulation involved here would certainly have failed in the near future if left unattended.

An unplanned outage would have cost this particular customer around £300,000 a day.

This problem would have gone unnoticed if not for the customer requesting a PDM survey.

The cable box was successfully repaired in the shortest time possible. Subsequent PDM surveys have given 'discharge free' results.



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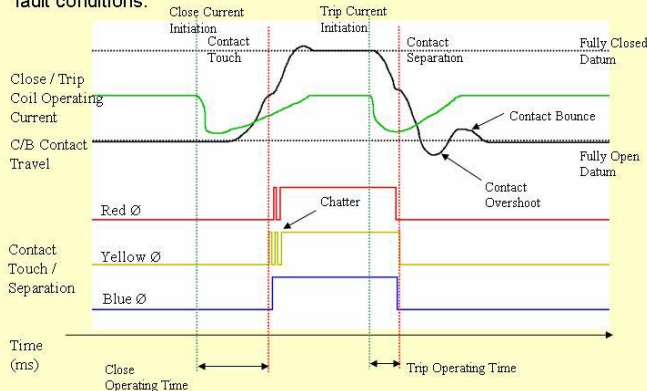
Dynamic Contact and Mechanism Characteristics

When a circuit breaker design passes its short circuit and mechanical operations type tests, certain dynamic characteristics are recorded and used as a profile in all subsequent routine production tests. In other words every production circuit breaker should have the same rating capability. A typical speed curve is shown below.

Speed Curve



Speed curve analysis allows us to look at the operating characteristics of a circuit breaker in order to determine that it will operate correctly under fault conditions.



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BETA ARC FAULT PROTECTION

In the early 1990's the requirement for Internal Arc Protection on all new Primary Switchgear designs became part of IEC and UK EATS specifications.

The driver for introducing this was of course safety for the operator.

Adding design features to cope with the specification is relatively straight forward when starting a new product design. However retrofitting the capability on existing designs is generally not viable.

The advent of the BETA protection device gives us a viable method of achieving the IEC Arc Fault criteria as a retrofit solution on old air insulated chambers.


As a bonus, BETA not only gives enhanced operator safety, but it dramatically reduces the possibility of collateral damage – Faults will be contained in chamber of origin.

BETA protection can be used to protect the following LMT chambers –

- Circuit Breaker
- Busbar
- Current Transformer
- Air insulated cable boxes. (cable boxes may be compound filled)

The principle of BETA operation is shown below.

Services Available – BETA arc prot'n



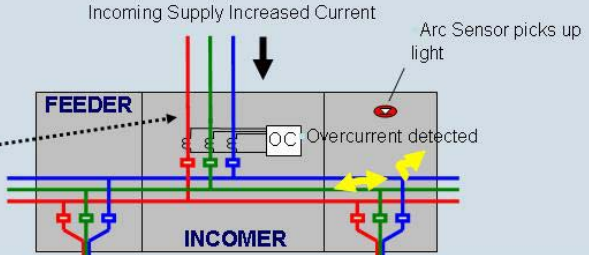
FEATURES

- Busbar protection primarily for distribution air insulated switchgear
- Arc detected by strong light and tripping supervised by overcurrent elements
- Fast operating time, typically 7ms, minimizes damage caused by a busbar fault
- Simple modular construction scalable for different busbar arrangements
- Full self supervision for improved reliability
- Easy to install and commission

Internal Arc Tests
Carried out on a three Panel Board of LMT, fitted with BETA, were all cleared within 50ms.
Because of the short clearance time, damage was minimal.

Beta - principle of operation

Incoming CB tripped if Arc & Over Current detected Simultaneously



Incoming Supply Increased Current

Arc Sensor picks up light

OC Overcurrent detected

FEEDER

INCOMER

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Recommended Care Program – Appendix 1

As suggested earlier an alternative program of care to that shown in IOMS 946 should be introduced when the equipment has been in service longer than 20 years.

Spares for normal maintenance needs – Appendix 2

These spares are recommended for the normal wear and aging of the equipment.

Site Issues – Appendix 3

VT Primary Contacts
Interrupter Contact Springs

Factory based Overhaul

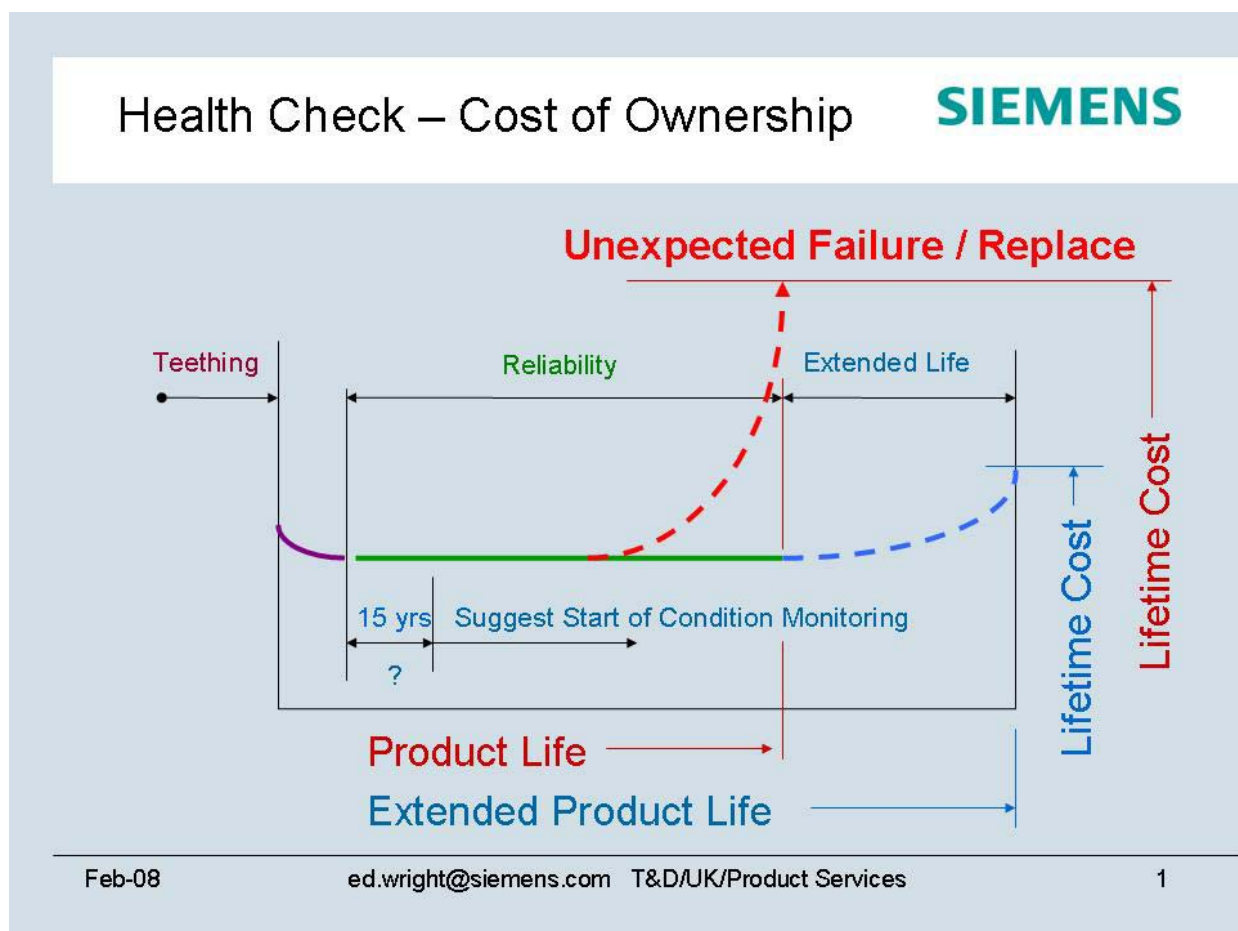
When site based maintenance procedures cannot achieve consistent and correct circuit breaker operation. Our factory based overhaul service is designed to bring a circuit breaker back to full rating capability with the minimum work. This is achieved by a process of an initial test and inspection to establish work to be done and an agreement with the customer to proceed.

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Recommendation to achieve Life Extension and Low Cost of Ownership.

The process recommended in Appendix 1, a combination of Refurbishment, Condition Assessment and Bespoke Maintenance will extend the working life of the equipment. The logic of this is shown diagrammatically below. The process of targeted or bespoke maintenance also has the potential to reduce maintenance cost.



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New Units

The full range of YMV2 products are still available for Replacement, Extensions or creating New Boards.



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APPENDIX 1 – Recommended Maintenance Regime for YMV2 in service over 20 years.

Interval	Circuit Breaker	Enclosure
25 years	Overhaul Mechanism & Reset VI contacts. Speed Curve	Discharge Monitoring

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8 year	Discharge Monitoring Speed Curve	Discharge Monitoring Clean and Lubricate Touch-up paint if necessary
4 year – <u>Only required for poor environments</u> (8 year report may suggest additional tests)	Clean and Lubricate (Discharge Monitoring)	Clean and Lubricate Touch-up paint if necessary (Discharge Monitoring)
Every 2000 operations.	Clean, lubricate and inspect mechanism.	
Yearly if CB not operated	Electrical Close & Trip several times.	

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Appendix 2 – Maintenance Spares

Description	Voltage	Article No	No per Panel
Trip Coil	24V dc	1321A1175Y	Up to 4
Trip Coil	30V dc	1321A297Y	Up to 4
Trip Coil	50V dc	1321A399Y	Up to 4
Trip Coil	110V ac	1321A296Y	Up to 4
Trip Coil	240V dc	1321A295Y	Up to 4
Trip Coil	5 Amps	1321A1143Y	Up to 4
Trip Coil	2 Amps	1321A1238Y	Up to 4
Trip Coil	110V ac	1321A295Y	Up to 4

Description	Voltage	Article No
Close Coil	24V dc	1321A1175Y
Close Coil	30V dc	1321A297Y
Close Coil	50V dc	1321A399Y
Close Coil	110V ac	1321A296Y
Close Coil	240V dc	1321A295Y

Description	Voltage	Article No
Motor	110V ac/dc	975A977
Motor	240V ac/dc	975A976

Description	Voltage	Article No
VT Fuse	All Arrgts	2741-49337C

Appendix 3 – Site Issues

VT Primary Fuse Contacts. (IOMS 946 FIG. 10)

A small number of fuse assemblies (<1%) have suffered from discharge at the contact interface with the primary circuit.

The problem appears to have been caused by damage to the contacts during insertion or removal.

It is suggested that the fuse assemblies are removed for inspection at a maintenance outage. The contacts should be examined for tell tale signs of pitting or discoloration associated with discharge.

If discharge is evident, it is recommended that complete phase assemblies are replaced and the transformer chamber thoroughly cleaned.

Make note of the Enclosure Serial No. and contact our spares department, quoting this number to ensure the correct replacement assembly can be supplied.

Interrupter Contact Spring Assembly (IOMS 946 FIG 35)

A small number of springs have fractured across one or more coils. Metallurgic investigation has indicated surface cracking, instigated by corrosion as the probable failure starting point.

Fracture of a coil of this spring will not reduce normal current carrying or fault clearance capability of the circuit breaker. It is advised however that if a damage spring is found it should be replaced in case there is further deterioration.

Our spares department can supply the spring in its housing with a method statement for correct assembly.

