**Introduction**

Managing an ageing high voltage asset population is a key task for utilities and other asset owners. Differing opinions exist regarding the expected life of substation assets and the factors that dictate this life. However, generally speaking, assets are being expected to remain in service for longer than ever before. At the same time, definitive guidance and recommendations in this field are not readily available. In order to enhance the available guidance in this area, SC A3 has set up a working group to undertake a comprehensive review of experience in the fields of degradation processes, lifetime assessment & life extension techniques, and the role of condition monitoring, refurbishment and re-verification.

**Working Group Scope**

- **Material and equipment deterioration/degradation**
  - Deterioration mechanisms and precise knowledge about materials
  - Forensic analysis of aged equipment
  - Rate of development from material defects to minor/Major Failures and associated risks for equipment
  - Diagnostic methods, evaluation of results, condition assessment
  - Mitigation and maintenance considerations
  - Impact of service stresses (excluding over stressing) on equipment condition

- **Lifetime (residual life) management techniques**
  - Expected total life for different high voltage equipment
  - Life limiting components and useful life of new and reconditioned parts
  - Relation between material deterioration, condition assessment techniques, equipment degradation and performance.
  - Impact of changed situations (for instance changed maintenance policy or large overhaul)

- **Life extension**
  - Experience with life extension
  - Possibilities and problems with re-testing old equipment
  - Impact of life extension on overhaul and expected period between major overhaul

- **Life management for new equipment**
  - Expected life and maintenance intervals for new equipment
  - Requirements for, and value of, testing in relation to life cycle management (endurance tests)

**Ageing**

Ageing is a process that leads to change in equipment properties over its life time. The change in properties may be due to whilst the equipment is exposed to its design service conditions (normal stress) OR due to conditions beyond design service conditions (abnormal/over stress). Design service conditions include overloading but within the limits prescribed by the standards/manufacturer. Working Group A3 is focussed on ageing due to normal stress. Working Group A3.30 is focussed on abnormal stress.

*Cigré WG A3-06 “Reliability of HV Equipment”  
Circuit Breakers: Primary cause for major failure is Ageing*

**Method**

- Describe the ageing processes for different equipment and its components
- Identify possible causes that contribute to ageing
- Identify mitigation techniques to prevent ageing and/or manage ageing

Example: Gas Circuit Breaker Ageing Analysis (abridged version)
DETERIORATION and AGEING OF HV SUBSTATION EQUIPMENT

Outline of Technical Brochure

A Cigré Technical Brochure covering the detection and management of ageing in HV substation equipment will be produced.

1. Executive summary
2. Overview – objectives, motivation, process followed in development of brochure, related Cigré literature and chapter disposition
3. Lifetime management of HV substation equipment
   3.1 Life(s) of substation equipment: technical and non-technical factors that dictate nomination of life of the equipment
   3.2 Concept of ageing process and ageing models and how ageing influences the realised life of substation equipment
   3.3 Methods of equipment life prediction: application of various models – probabilistic, deterministic models for end of life assessment, and how these models can be applied in real life
   3.4 Utilising ageing models as an integral element of risk management
4. Deterioration and ageing of equipment and mitigation techniques
   Detailed individual sub-sections on each equipment type (e.g. CB’s, IT’s)
   4.1 Introduction – defining equipment function, properties and various designs and technologies, detailing equipment components and sub-components
   4.2 Experience from A3.06 reliability survey on ageing and its influence on equipment major and minor failures
   4.3 Modes of ageing for various components and their impact on degradation and detection methods
   4.4 Mitigation techniques to prevent ageing and life extension techniques
   4.5 Mitigation methods for new equipment
5. Summary, recommendations and conclusion

Appendices (Case studies, Feedback from Survey, Glossary, References)

Time lines: August 2014 onwards

Survey on Ageing

As a part of its work, the working group is undertaking a comprehensive review (a survey) of the experience regarding equipment ageing and associated management practices. The survey will assist in providing a view of actual experience in the field. The survey has two focus areas – general question on practices and more detailed questions on ageing phenomenon of specific high voltage equipment ≥60kV namely circuit breakers, disconnectors/earth switches, instrument transformers, surge arrestors, capacitors and post insulators.

The survey is in the form of a very easy to use excel spreadsheet format, and comes with its own user manual. You can get further information on the survey by emailing your contact details on cigrewga329@conedify.com, The survey closes on 1 October 2014

Usefulness to the industry

Knowing the ageing mechanism, it is possible to increase equipment reliability and network availability by application of condition based risk management and reliability centered maintenance techniques. This enables efficient deployment of resources (investment, equipment and labor).

How can the industry support this work?

Participate in the survey (see details above)
- Provide input and supporting evidence/experience
- Expected life time of equipment and their components
- Experiences regarding ageing
- Assessment techniques to identify ageing, application and use
- Asset management decision models & mitigation techniques
- Input into novel techniques under application/review

Related Working Groups & References

Active Working Groups
- WG A3.30: “Impact of overstressing of substation equipment”
- Cigré Technical Brochures
  - TB 509-514: “Reliability of HV Equipment” (Part 1 – Part 6)
  - TB 165: “Lifetime Management of Circuit-Breakers”

Further Information

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