

Presented by Ross Willoughby - Convener

Hobart – 15/11/2018

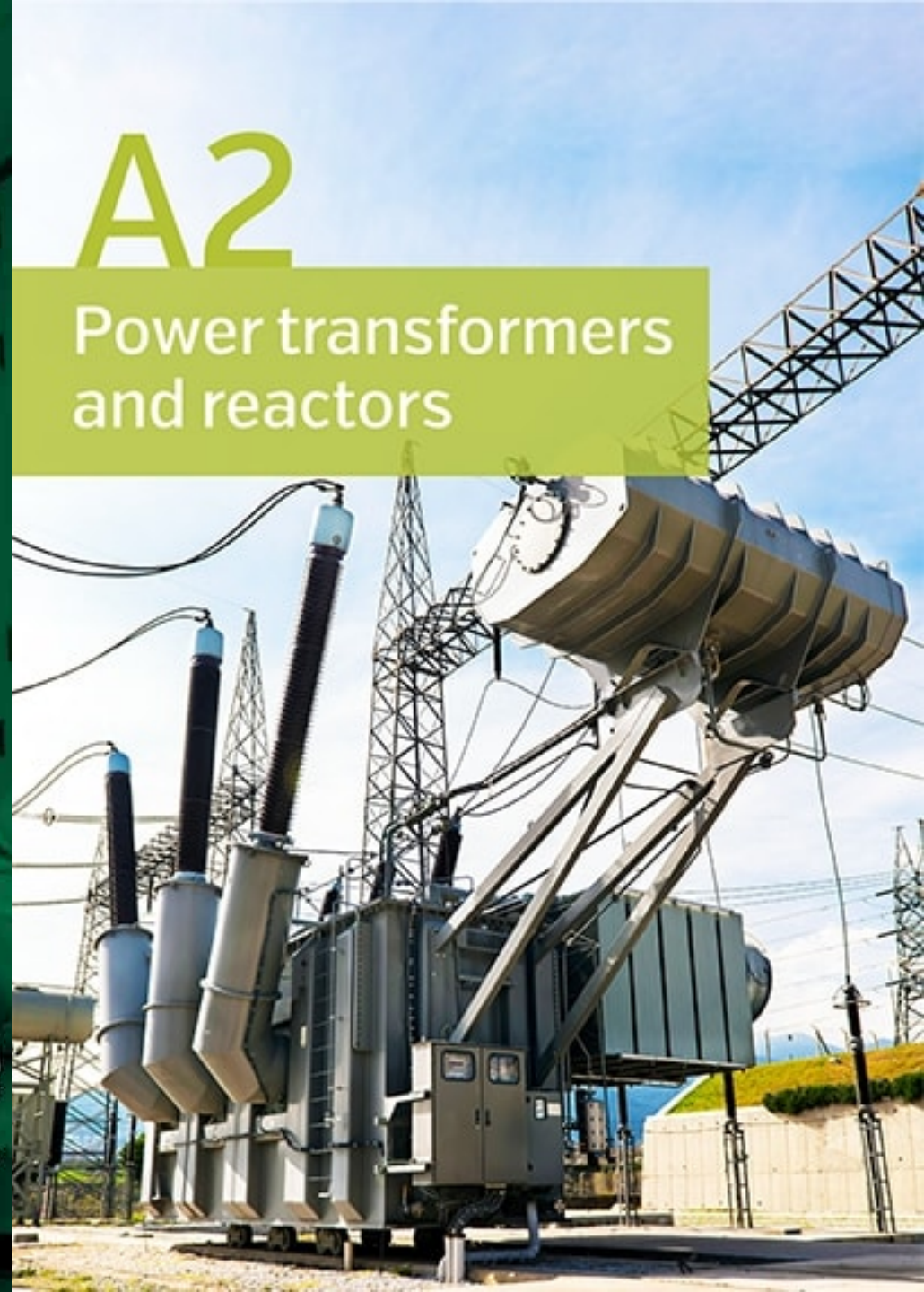


cigre

For power system expertise

A2

Power transformers and reactors



SC A2 Overview

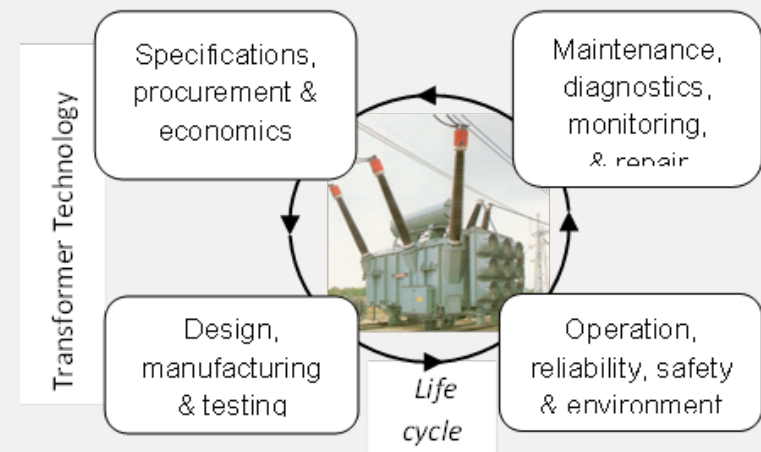
Study Committee Scope

- All kinds of power transformers, including HVDC transformer converter and phase-shifting transformers;
- All kinds of reactors, including shunt reactors, series reactors, and HVDC smoothing reactors;
- All transformer components, including bushings, tapchangers, and other transformer accessories.

Specific Activities of SC A2 :

Covers the life cycle of a transformer in 4 key domains:

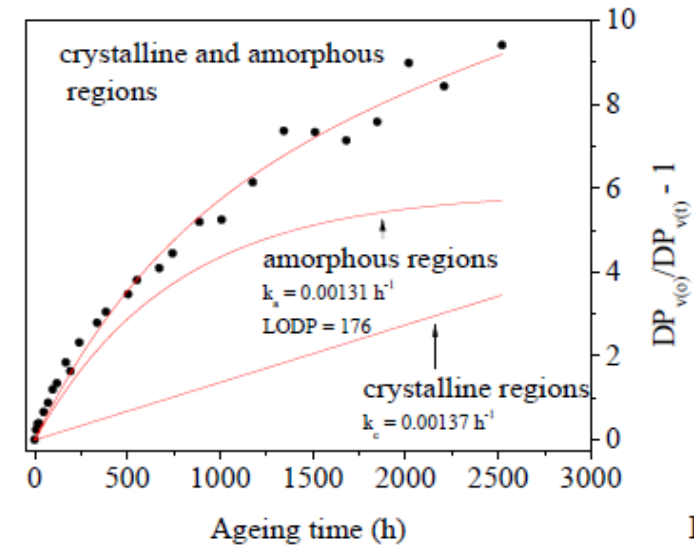
- Specification, procurement and economics
- Design, manufacturing and testing
- Operation, reliability, safety and environmental impact
- Maintenance, diagnostics, monitoring and repair



2018 Paris Session

A2 Tutorial – Transformer Ageing, Failures and Forensics Analysis

- DP as a S/C withstand or remnant life indicator.
- TB 735 “Transformer Post-Mortem Analysis” (SC A2) and TB 738 “Ageing Liquid-Impregnated Cellulose for Power Transformers” (SC D1) provide solid foundation of techniques and interpretation to properly assess ageing
- **BEWARE** the surprisingly dangerous or incorrect disassembly shown in TB



Example of the ageing of a standard kraft paper in their different phases.

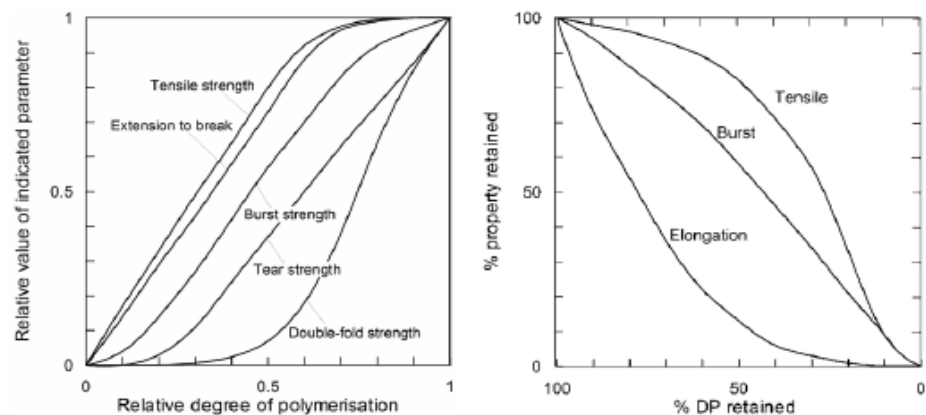


Figure 31: (a) Relative decrease of mechanical parameters with decrease of DP of cellulose

ATC Seminar 2018

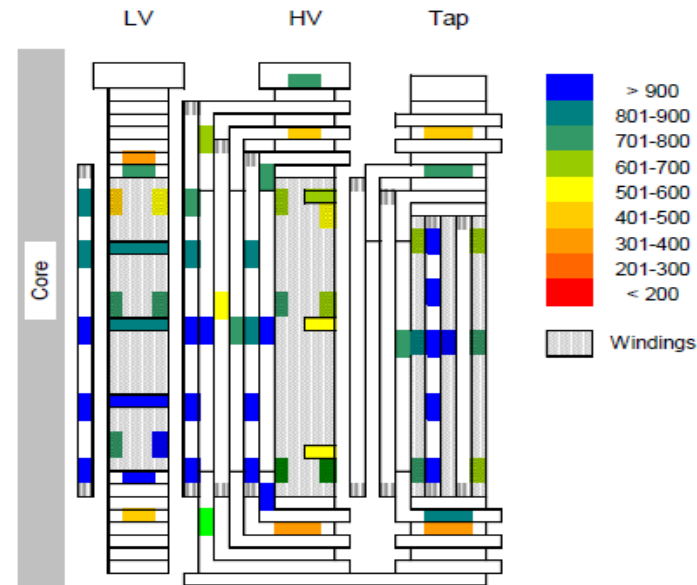
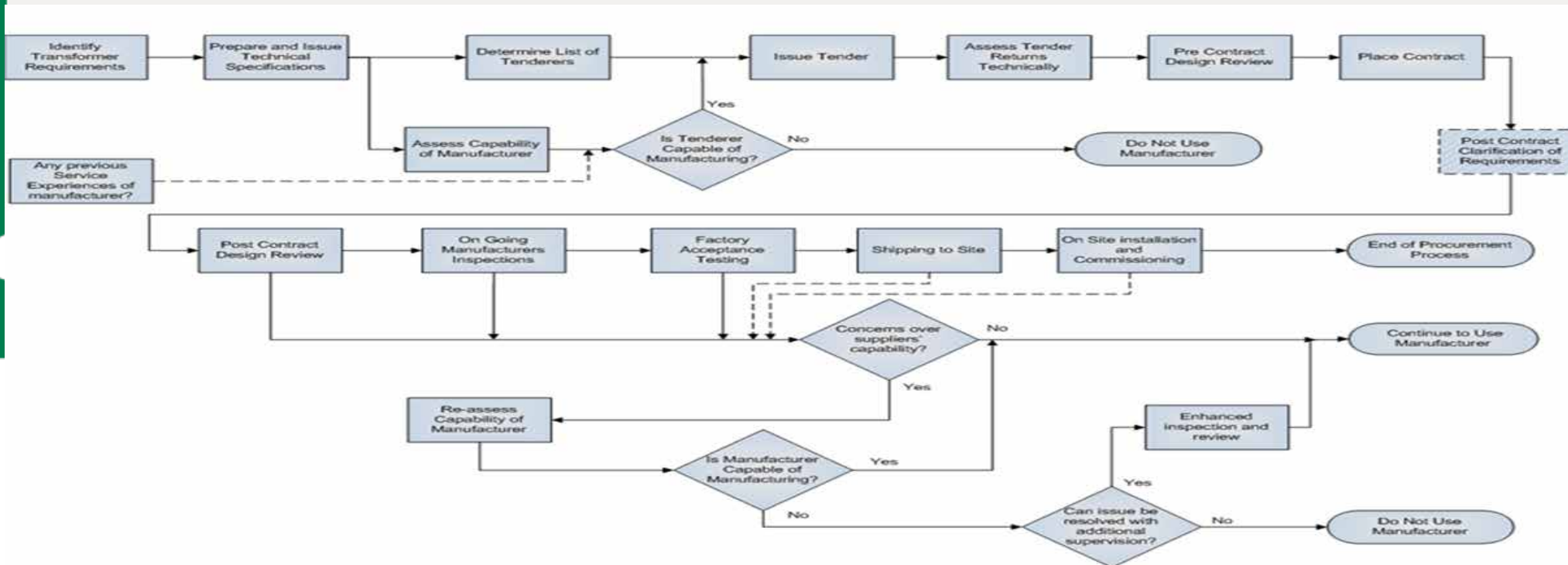


Figure 4.5 DP-profile of a 31.5 MVA transformer after 48 years of service

2018 Paris Session

- SC A2 has formed new Advisory Group - Green Book on Transformer Procurement
 - The work would amalgamate and develop the existing material used in the trilogy TBs 528-529-530 for procurement process
 - Add the new work of TB 673 Transportation and WG A2.58 Installation, Pre-commissioning & Trial Operation

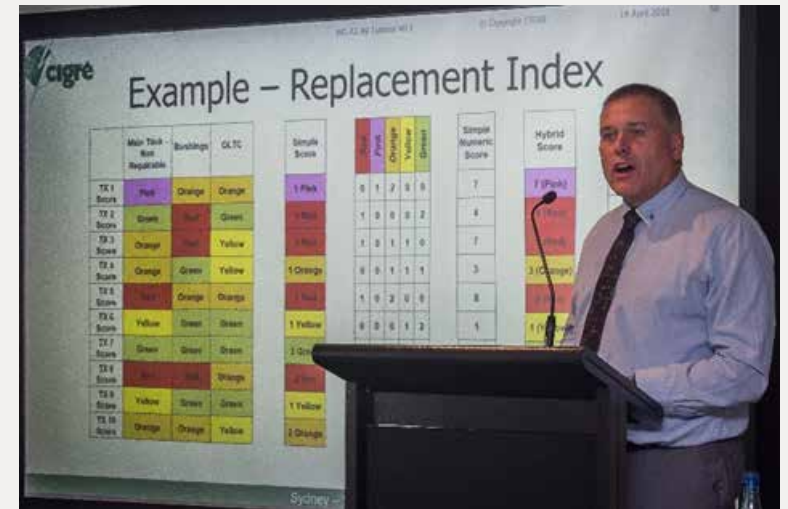


2018 AU/NZ Activities

Cigre Event – 1 Day Workshop

“Transformers – Condition Assessment with a Focus on Bushings – an interactive workshop” was held on 16 April

- ü 6 speakers (2 utilities, 1 WG convener, 1 test equipment vendor, 2 from insurance company)
- ü 84 delegates
- ü 2 Tutorials
- ü Expert Panel
- ü Highly relevant to address bushing risk and avoid expensive failures



Relevance to Australia

- § SC A2 has produced a long series of TB with very high relevance to the Australian electrical industry.
- § TB 445 Guide for transformer maintenance has one of the highest hits on the e-cigre site for TB downloads
- § 735 Post-mortem Analysis
- § 673 Guide on transformer transportation
- § 655 Technology and utilization of oil-immersed shunt reactors
- § 642 Transformer reliability survey
- § 630 Guide on Transformer intelligent condition monitoring
- § 625 Copper sulphide long term mitigation and risk assessment
- § 537 Guide for transformer fire safety practices
- § 528/529/530 Guides to assess the capability of a transformer manufacturer, design review for power transformers, and preparation of specifications for power transformers

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There are some major changes coming from IEEE, IEC and CIGRE guides and standards on the interpretation of DGA.

Active Australian participation in A2 WGs – both representative members and conveners eg A2.49 and A2.58

NGN interest and involvement too

2018 Deliverables

Technical Brochures

- TB 735 – Transformer Post-mortem Analysis.
- **WGs nearing completion with a TB expected late 2018 or early 2019**
 - WG A2.43 – Bushing reliability
 - WG A2.49 – Condition assessment of power transformers

1. INTRODUCTION.....	4. EXAMINATION AND SAMPLING.....
1.1 POST-MORTEM ANALYSIS.....	4.1 SAMPLING LOCATION(S).....
1.1.1 Definition.....	4.1.1 Solid insulation.....
1.1.2 Goals.....	4.1.2 Magnetic core and flux shunts.....
1.2 OBJECTIVES OF THE WORKING GROUP.....	4.1.3 Current carrying conductors and contacts.....
1.3 ORGANIZATION OF THE BROCHURE.....	4.2 COLLECTING, CONSERVING AND IDENTIFYING THE SAMPLES.....
1.3.1 Procedure.....	
1.3.2 Outline.....	
2. INITIATION AND PREPARATION.....	5. ANALYSIS AND REPORTING.....
2.1 DEFINITION OF OBJECTIVES, SCOPE AND RESOURC.....	5.1 ANALYSIS OF THE MATERIAL SAMPLES.....
2.1.1 Stakeholders.....	5.1.1 Oil analysis.....
2.1.2 Economic aspects.....	5.1.2 Analysis of cellulosic insulation material.....
2.1.3 Policy.....	5.1.3 Elemental Analysis/Chemical characterization.....
2.2 ACCEPTANCE OF THE PROJECT.....	5.2 REPORTING.....
2.3 PROJECT DOCUMENTS.....	6. SUMMARY AND OUTLOOK.....
2.3.1 Project plan.....	6.1 SUMMARY.....
2.3.2 Risk Assessment and Method Statement.....	6.1.1 Initiation and preparation phase.....
2.4 COLLECTION OF RELEVANT DATA.....	6.1.2 Excavation phase.....
2.4.1 Basic collection of data.....	6.1.3 Reporting and close-out phase.....
2.4.2 Moderate collection of data.....	6.2 OUTLOOK.....
2.4.3 Advanced collection of data.....	
3. INSPECTION AND DIAGNOSTICS.....	APPENDIX A. DEFINITIONS.....
3.1 BASIC DIAGNOSTICS.....	APPENDIX B. LINKS AND REFERENCES.....
3.2 MODERATE INSPECTIONS AND DIAGNOSTICS.....	APPENDIX C. TEMPLATES.....
3.2.1 External inspection.....	APPENDIX D. FURTHER RECOMMENDATIONS ON PAPER SAMPLING.....
3.2.2 Electrical measurements.....	APPENDIX E. EXAMPLES TAKEN FROM PUBLISHED RESEARCH AND CASE STUDIES.....
3.3 ADVANCED INSPECTIONS AND DIAGNOSTICS.....	APPENDIX F. EXAMPLE OF SCRAPPING REPORT.....
3.3.1 Internal inspection.....	
3.3.2 Extended electrical measurements.....	