CIGRE Study Committee A2

PROPOSAL FOR THE CREATION OF A NEW WORKING GROUP[1]

WG N° A2.58	**Name of Convenor: Ross WILLOUGHBY (Australia)**
Strategic Directions #[2]: 1	**Technical Issues #[3]: 8 and 10**
The WG applies to distribution networks[4]: Yes / ~~No~~	
Potential Benefit of WG work #[6]: 1, 2, 3, 5 and perhaps also 6	
Title of the Group: Installation and Pre-Commissioning of Transformers and Shunt Reactors	

Scope, deliverables and proposed time schedule of the Group:

Background:

Transformers are expensive assets that play an important role in the overall reliability and availability of the electrical network. In order to fulfil their expected service life and maintain a requisite high reliability, it is essential that these assets are installed correctly.

Any experienced installer knows that installing identical transformers in different locations always involves new challenges. However, the task often remains constrained to a generic project schedule and project cost. An appreciation of the intricacies of the installation process and the allowances and improvisations sometimes necessary to perform site testing are important for pragmatic specification, execution and documenting of these activities.

This guide will cover the full scope of the activities involved in the installation, testing, functional checking and pre-commissioning of transformers and reactors (ready for handing over to others for final switchyard commissioning – an important distinction). The guide provides a methodology for all stakeholders - asset managers, specification writers, installation practitioners, project managers and technical experts. That methodology has to define adequately, yet comprehensively, the important stages, tasks, deliverables, risks and competencies for these site activities. The ultimate goal is to assist all stakeholders realize consensus on the required expectations.

Scope:

1. Consider transformers and reactors installed into switchyards, power stations and substations including small power, medium power and large power transformers of all voltage levels above 11kV primary voltage, recognising that different levels of activity may be required for each type. Various termination arrangements are considered. However, small power (auxiliary) distribution transformers (which are usually complete and operational prior to their transportation), kiosk and pole mounted transformers will not be considered by this WG.
2. Exclude site assembly and heavy-duty site testing (eg HV dielectric tests) as this subject will be the scope of another working group. For the purpose of demarcating the scope of this WG, site assembly is defined to involve special installation where assembly work on the core and winding assembly is required. Furthermore, pre-commissioning tests are confined to those tests which can be made using standard portable test equipment suitable for transport in a standard light vehicle with test equipment housed in transport boxes or cases and AC test voltages would normally be limited to 15kV. Such site acceptance testing (SAT) serves to complement (and

not replicate) factory acceptance testing (FAT) with the primary purposes of SAT being to prove satisfactory transportation and site installation of the transformer or shunt reactor, and to benchmark results for use with future off-line site electrical tests

3. Review existing CIGRE documents and other literature that relate to this subject; especially the Technical Brochures relating to transformer diagnostics, specifications, monitoring, life management, transport, maintenance, fire safety and economics. Where appropriate, these documents would be referenced in the Technical Brochure. Review IEEE C57.93 Installation and Maintenance of Power Transformers (under revision).
4. Define the fundamental steps and processes involved with site installation and testing of transformers to ready them for commissioning. Discuss varied practices used for a spare transformer. Discuss precautions for spare parts management. Discuss importance of good commissioning practices. Discuss trial operation of the transformer in the period immediately after energization and for the ongoing warranty period, propose appropriate checks and tests to be made during the warranty period.
5. Consider the methods for checking for possible moisture ingress during transport and erection is regarded an important issue and the test method and criteria is important if it is a contractual issue. Review the methods for measuring the dryness of the paper insulation on site with pros and cons of each method. Surface moisture and moisture ingress or even equalization in solid insulation can result in measured site results which can be quite different to FAT results.
6. Propose a structured method to:
    a. Deliver, handle and position the main tank and transformer accessories
    b. Beware of readiness of civil works and site access/resources/interfaces, define the demarcation between installation and other site activities
    c. Manage dielectric liquid handling and proper filling of the transformer, including all aspects associated with the different types of dielectric liquids
    d. Ensure the transformer is ready for service
    e. Consider tasks and items often overlooked in site installation, risks, competencies
    f. Consider specialised transformer accessories, electrical connections, monitoring
    g. Perform inspection and test plans, understand the roles of factory and site testing, and adopt recommended site tests
    h. Benchmark for tests and condition monitoring
    i. Prepare documentation for final substation integration testing / commissioning to integrate the new transformer/reactor into the substation and its secondary systems. It is very important to have documentation which precisely shows what pre-commissioning was done and how. There needs to be a minimum standard of information and format of the handover manuals, document(s) / drawings etc.
    j. Prepare or train substation operators in transformer controls, accessories, functions and how to interpret their performance. There may even be new technology incorporated into the transformer which the customer did not specify. This could even be in the form of instrumentation or primary trip devices thought necessary by the transformer manufacturer to suit the special application of the transformer.
    k. Consider using a no-load ‘soak’ period following first energization and precautions to be observed in this period
    l. Consider staged load increase and what additional checks or tests should be made during this period
    m. consider requirements for the warranty period and what additional checks or tests should be made during this period
7. Conduct a survey for best practice amongst utilities, industry, transformer manufacturers and service providers.

8. Provide a catalogue of real cases, illustrating different solutions implemented for typical and special cases

Deliverables:

The brochure will be a guide for implementing a structured methodology for site installation, site testing and functional checks of transformers and reactors. Recommendations are offered for formulating pragmatic specifications and installation programmes, execution of effective and efficient site processes, performing adequate site inspection and test plans, and most importantly, ensuring the transformer is prepared correctly for fulfilling a long and reliable service life.

The brochure will also present practical case studies illustrating major families of problems.

☒ Technical Brochure and Executive summary in Electra

☒ Electra report

☒ Tutorial[5]

Time Schedule: start: January 2017 **Final Report**: August 2020

Approval by Technical Committee Chairman: M. Waldron

Date: 06/02/2017

Notes: [1] or Joint Working Group (JWG), [2] See attached Table 2, [3]See attached Table 1, [4] Delete as appropriate, [5] Presentation of the work done by the WG, [6] See attached table 3

Table 1: Technical Issues of the TC project “Network of the Future” (cf. Electra 256 June 2011)

1	Active Distribution Networks resulting in bidirectional flows
2	The application of advanced metering and resulting massive need for exchange of information.
3	The growth in the application of HVDC and power electronics at all voltage levels and its impact on power quality, system control, and system security, and standardisation.
4	The need for the development and massive installation of energy storage systems, and the impact this can have on the power system development and operation.
5	New concepts for system operation and control to take account of active customer interactions and different generation types.
6	New concepts for protection to respond to the developing grid and different characteristics of generation.
7	New concepts in planning to take into account increasing environmental constraints, and new technology solutions for active and reactive power flow control.
8	New tools for system technical performance assessment, because of new Customer, Generator and Network characteristics.
9	Increase of right of way capacity and use of overhead, underground and subsea infrastructure, and its consequence on the technical performance and reliability of the network.
10	An increasing need for keeping Stakeholders aware of the technical and commercial consequences and keeping them engaged during the development of the network of the future.

Table 2: Strategic directions of the TC (ref. Electra 249 April 2010)

1	The electrical power system of the future
2	Making the best use of the existing system
3	Focus on the environment and sustainability
4	Preparation of material readable for non-technical audience

Table 3: Potential benefit of work

1	Commercial, business or economic benefit for industry or the community can be identified as a direct result of this work
2	Existing or future high interest in the work from a wide range of stakeholders
3	Work is likely to contribute to new or revised industry standards or with other long term interest for the Electric Power Industry
4	State-of-the-art or innovative solutions or new technical direction
5	Guide or survey related to existing techniques. Or an update on past work or previous Technical Brochures
6	Work likely to have a safety or environmental benefit