Time saving and simplification of protection testing through the use of the Test Universe Software 2.0 and CM ASB2 switching box at Valorec / Switzerland

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Contents

With the help of an example from practice, this article shall demonstrate the possibilities how test tasks can be made easier and more efficient by using modern test equipment. Based on the description of the environment, first the conventional test method is described in order to compare this method afterwards with the advantages and disadvantages of the new test method.

Introduction

Assuming that a certain task in the company's operation, in our case the recurring tests of protection devices, has to be fulfilled, always the question for the best method to achieve this task comes up. In many cases, the task already exists for a longer time and there is already a method available to solve this task. The success in introducing new procedures and methods depends on different questions regarding the comparison of old and new methods. Here, a difference is made between hard facts (more or less expressible with numbers) and soft facts (factors which rather have to do with the human's nature):

Hard facts:

- Time and resources need
- Simplicity of the method
- Error-proneness
- Standardization
- Repeatability, reproducibility
- Documentation
- Amortization time of the investments
- Outsourcing / keeping the technology in-house
- Technical feasibility

Soft facts:

- Mental stress (How satisfied am I with the existing method?) Properly functioning process? Are there recurring problems?
- Open-mindedness and interest for new methods
- Willingness to learn new things
- Way of work: rather ad hoc or planning ahead and looking ahead
- Readiness to invest more work into automation in order to work more efficient in future
- Fears in connection with programs that increase the efficiency. Do I bite the hand that feeds me?
- Which aims do I want to reach by changing the method? Is it possible to increase the quality with the existing employees? Standardization? Repeatability? Performing in-house / outsourcing? Reintegration of already outsourced tasks?
- Company culture
- …

As you can see from the great number of decisive facts, it is a complex decision and everybody will have to balance the different pros and cons for him/herself.

The following example shows the successful introduction of new systems and methods by means of an example from practice and provides the possibility to examine the effects of a method change afterwards or after some time after the beginning of the change process.

Environment and existing task

In the field of power services, Valorec Services AG in Basel, Switzerland, maintains among other things the protection devices of the medium-high-voltage substations of Novartis, Ciba SC and Syngenta. As a service provider in the field of power supply for industrial companies, Valorec Services AG ensures the reliable provision of power and a low failure probability. Both services are in direct connection with the concept and the reliability of the selective protection technology.

Figure 1: Internet presence of Valorec Services AG / Energy Management area. www.valorec.ch

Apart from some distance protection, line differential protection and transformer differential protection devices as well as generator protection devices, mainly directional and non-directional overcurrent protection is applied. Depending on the location, the medium-high-voltage system with 6 kV, 11 kV, 13 kV and 50 kV is realized either as ring or radial network. Concerning the technology, all relay generators are used, from electromechanical primary relays up to modern numerical protection.

An important task is the periodic test of the more than 200 static time-overcurrent protection relays of the type MC, MCX (BBC). The periodic test has to be performed every 4 years. In the following description, the existing and the new method for the periodic test of the MC, MCX relays is compared.

Conventional method

Up to now, MC and MCX relays have been tested using the 1-phase test equipment Programma Server 650. As the relay settings for the short-circuit protection I>> often reach values in the range of 60 A (secondary) and higher, the test equipment must generate corresponding currents.

Procedure for testing:

- Disconnection of the substation
- Connection of the relay to the test adapter
- Calculation of the test currents from the existing parameters
- Wiring phase L1
- Testing of all setting parameters L1 of the protection relay including step-by-step excitation of the thermal overload protection
- Recording the results
- Nominal/actual assessment
- Wiring phase L2
- Testing of all setting parameters L2 of the protection relay including step-by-step excitation of the thermal overload protection
- Recording the results
- Nominal/actual assessment
- Wiring phase L3
- Testing of all setting parameters L3 of the protection relay including step-by-step excitation of the thermal overload protection
- Recording the results
- Nominal/actual assessment
- Switching relay from test mode to operation mode
- Commissioning the substation

Testing the relay in the conventional way including the disconnection and re-commissioning of the substation takes 2 hours on average. The relay test itself takes approx. 1 hour.

Figure 2: Test adapter for testing MC, QV and IT relays

Advantages of the conventional method:

- No initial effort to create automatic test procedures
- No investments into new test equipment
- No efforts to learn

Disadvantages of the conventional method:

- Time consuming
- Error-prone due to manual calculation steps
- Inaccurate test
- Test cannot be exactly repeated
- Test not standardized
- Error-prone due to many manual single steps and manual wiring
- Danger of destruction of the relay by outputting high test currents too long
- Manual reporting

New method with test automation

In 2004, Valorec Services AG has purchased an OMICRON CMC256 test set with the aim to automate and simplify the test. Among other things, this test set should also help to reduce the tests outsourced to external partners and to perform these tests by the own employees. In addition to the test set, also a switching box CMASB2 has been purchased in order to avoid the tiresome and error-prone change of the wiring when testing with 75 A. Due to the great number of MC, MCX relays to be tested, first an XRIO model for the MC, MCX relay was created. [1]

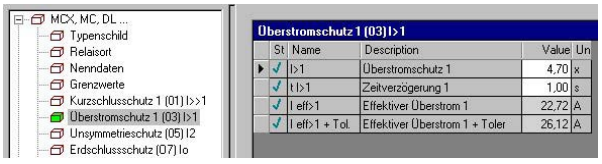

Figure 3: XRIO model for the MC, MCX relay

Based on this XRIO model of the relay, automatic test plans with test points have been created which adapt automatically to the current parameterization (LinkToXRIO). The automatic test includes the automatic phase switch with the switching box CMASB2. [2] The automatic test now allows to test also

parameters without loss of time which couldn't be tested with the conventional method due to time constraints. This increases the test depth and also the quality of the test.

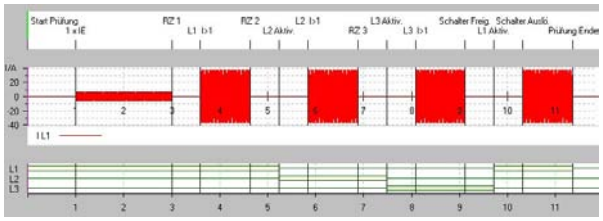

Figure 4: OMICRON State Sequencer sequence for testing the trip time I> with switching of phase L1, L2 and L3 (>26 A).

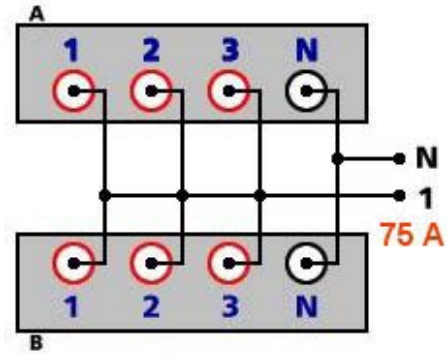

Figure 5: CMC 256 in 75 A mode

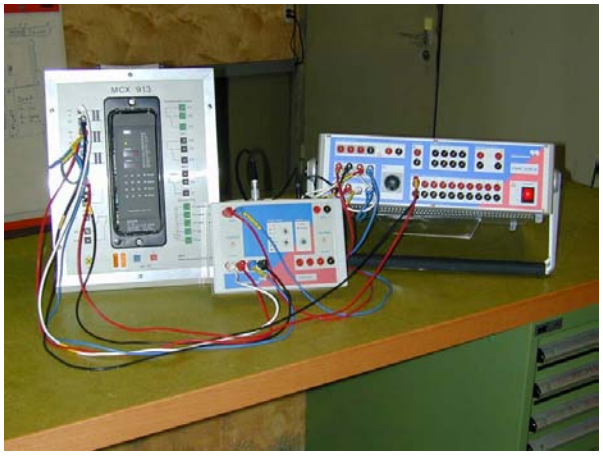

Figure 6: CMC 256 and switching box CMASB2 together with the test object BBC MC, MCX 913

Procedure for testing:

- Disconnection of the substation
- Connection of the relay to the test adapter
- The connection of the test adapter to the test set is normally already done
- Input of the relay parameters into the XRIO model (the required test points, nominal values, etc. are calculated automatically)
- Starting the automatic test
- Checking the test results
- Switching relay from test mode to operation mode
- Commissioning the substation

Figure 7: Automatic test MC with test adapter and CMC256/CMASB2

The automatic test of the relay including the disconnection and re-commissioning of the substation takes only 1 hour, this equates to a time saving of 50 %. The relay test itself including the wiring can now be performed in a few minutes in comparison to the conventional method where the relay test takes approx. 1 hour.

Advantages of the automatic test:

- Great time saving
- Strongly simplified procedures
- Error avoidance due to standardized and automatic procedure
- Error avoidance as the wiring does not have to be changed during the test
- Exact test
- Test can be repeated
- Standardized test
- The test plan ensures that high test currents are output only for a short time in case of a malfunction of the relay and thus there is no danger of destruction of the test object
- Automatically created test protocol including the automatic assessment by means of the tolerances
- Storage of the test protocol either electronically or available as printed version

- Simultaneous measurement of several binary channels
- In addition to the measurement of the switching times at the relay contacts, the test also includes the exact measurement of the switching time of the high-voltage switch
- Graphical representation of the procedures - very important for troubleshooting in case of relay malfunctions
- The depth/quality of the test can be increased without any additional efforts

Disadvantages of the automatic test:

- Initial effort to create automatic test procedures required
- Investments into new test equipment required
- Handling of the new test system must be learned

Summary

Considering as an example the use of the latest testing technology at Valorec Services AG, it can be shown that the use of modern test equipment will pay off very soon. Taking as an example the more than 200 MC, MCX relays, the test equipment will be amortized after one and a half test cycles of only this relay type. Not to be ignored is that with the new test set CMC256 now also more complex protection functions can be tested internally which couldn't be tested with the 1-phase test equipment. In addition, the list of advantages of the automatic test quickly shows that it is not only the much more higher efficiency which can be reached. At the same time, the quality is incredibly increased. Valorec Services AG has gained a strong position in the service provider market through to the recognition and use of the possibilities of modern test equipment. Of course, this example cannot be transferred one-to-one to other companies but it shall provide an incentive to watch the development of the state of the art and to compare existing methods with new methods.

Literature

[1] Neue Möglichkeiten bei der automatischen Prüfung von Schutzrelais, Boris Bastigkeit, Tagungsband OMICRON User Meeting, Friedrichshafen 2004

[2] Automatisches mehrphasiges Prüfen von hochbürdigen elektromechanischen Relais ohne Umverdrahtung mit der neuen Umschaltbox CMASB2, Tobias Schmutzhardt, Tagungsband OMICRON User Meeting, Friedrichshafen 2004