> *The cooperation with Hitex was excellent.*
>
> Dr. Yauheni Veryha, Product / project manager, ABB Automation Products GmbH, Heidelberg, Germany.

The TESSY User: ABB

ABB is a global leader in power and automation technologies. Based in Zurich, Switzerland, the company employs 145,000 people and operates in approximately 100 countries. ABB stands as the largest supplier of industrial motors and drives, the largest provider of generators to the wind industry, and the largest supplier of power grids worldwide.

Software Module Testing for Safety Programmable Logic Controllers (PLCs)

Two software module testing projects were accomplished for ABB by Hitex using TESSY. The first project tested the software of the Safety I/O modules and the second project tested the software of the Safety CPU. Both software testing projects aimed for a certification according to IEC 61508:2010 (SIL 3), IEC 62061 (SIL CL 3) and EN ISO 13849-1 (PL e).

ABB Safety PLC

The software for the ABB Safety PLC consists of three Safety I/O modules (one for analog inputs, one for digital inputs, and one for digital inputs / outputs) and one Safety CPU module. The Safety CPU module is equipped with two microcontrollers.

All functions were module tested with TESSY.

Code Coverage Measurement

During testing, three different measures of code coverage were measured with TESSY: (1) Branch Coverage, (2) Modified Condition / Decision Coverage (MC/DC), and (3) Multiple Condition Coverage (MCC). The latter is not mentioned by IEC 61508, but was used because it provides the highest reliability with respect to condition coverage. [MCC subsumes MC/DC; MCC exercises all possible input combinations for Boolean expressions.] For all coverage measures a percentage of 100% or near 100% (> 98%) was reached. When 100% was not reached, Hitex manually checked and verified that the code was actually unreachable. The paramount reason for unreachable code was defensive programming.

Test Case Specification

For all test objects requiring more than a single test case, the tests were specified by Hitex using the Classification Tree Method. The method is based on analysis of the requirements and also incorporates equivalence partitioning and boundary value analysis. The big advantage of this method is the visualization of the testing ideas. This makes it easy for the other party to understand the rationale behind each test case and to check that all test relevant aspects were covered by the test specification. This eased the communication between the project partners ABB and Hitex a lot.

Project Considerations

The test projects were accomplished from July 2011 to December 2012. The testing team of Hitex had up to nine testers in the course of the project; with an average of about four testers assigned to the project all the time. During testing development still continued, hence the test objects were not stable (i.e. a moving target). However, this could be handled by a well-defined communication process between Hitex and ABB. From earlier projects Hitex had learned the lesson that it is advantageous to route the communication between the project partners through a single point of contact (i.e. an identified person) in each company. This guarantees quick response and avoids dangling questions. More than 500 issues were raised during the project and got clarified quickly and efficiently.

Conclusion

As the TÜV safety certification of ABB Safety PLC products is achieved and ensured a successful project completion Hitex and ABB are willing to continue their cooperation in new development projects as well.