Ground Fault Testing And Lessons Learned:
Superwind 350 Railway Installations

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Date: April 12, 2018

Commissioned by Mission Critical Energy

This paper discusses ground fault testing for the Superwind 350 turbine generators when installed for rail industry system use.

INTRODUCTION

Superwind 350 turbines have been used to charge batteries in a wide variety of industrial and commercial applications. The first known installation of a SW350 for Rail Industry application was in 2008. That and all subsequent installations were reported by the end user as being a success, however it was also known that the end user developed and implemented their own custom and confidential integration procedures.

In early 2017 a Superwind 350 turbine generator was installed for use at a remote railway location for a new rail industry customer by their own installation team – assisted by their equipment supplier. During system operational verification testing of the newly installed turbine, rail system technicians discovered an apparent ground fault issue in which the turbine appeared to place a ground on the battery. The impact of such a ground fault would be that the turbine could potentially induce a voltage onto the earth ground. This could in turn incapacitate or show false railway signaling or railway traffic detection, potentially causing an accident. The turbine was therefore left installed at the site, but not connected or commissioned until the issue could be further studied and additional test procedures developed.

INITIAL TESTING SYNOPSIS

Initial ground testing at the remote installation site indicated a ground fault issue between the positive turbine lead and chassis ground and to a lesser extent the negative turbine lead to chassis ground.
The ground fault test equipment used by the railway technicians was a Model 360-4 Ground Finder from S&C Distribution Company, a device that sends approximately 22 VDC into the isolated subject test wire/material/case.
Ground fault tests (labeled test “1”, “2” and “3” for the purpose of this paper) were then conducted by railway technicians.

Test “1”
During test 1, railway technicians at the site disconnected the turbine Positive (+) and Negative (-) terminal leads at the control box (a pair of wires coming from the turbine, through the mast and conduit, ending in the control box) and then connected the two wires together, thus shorting the turbine as if it were in “stop mode”. The technicians then conducted the ground fault test and found the results were below the acceptable threshold, meaning the system passed and there was no ground fault issue.

Test “2”
During test 2 (at the same test point) the Positive and Negative wires were disconnected and no longer shorted. This allowed the turbine to be in both “run mode” as well as in an unloaded state during testing. The ground fault test unit was then connected with the Negative lead through the ground fault detector to the case. This test resulted in a higher than threshold level “failure”, however the voltage noted was near or below 22 VDC.

Test “3”
During test 3 (at the same test point) the Positive and Negative wires were disconnected and no longer shorted. This allowed the turbine to be in both “run mode” as well as in an unloaded state during testing. The ground fault test unit was then connected with the Positive lead through the ground fault detector to the case. This test again resulted in a higher than threshold level “failure”. Of note was that the voltage noted was above 22 VDC and erratic.

Follow on testing of a like turbine and installation was conducted at the Superwind factory in Germany by engineering staff. This additional testing showed no ground fault, but did show an AC ripple effect during an open circuit test, which could read as a false positive to some ground impedance testers. This interpretation was then discussed and confirmed by S&C Distribution Company, manufacturer of the Model 360-4 Ground Finder. It was their opinion that, while an industry expert should be consulted for the final ruling, test “1” above was a credible test that would indicate the turbine could be safely used.

CONCLUSION

After additional testing and consultation between Superwind and the various parties involved, the conclusion is that the Superwind 350 turbine generators do not induce a ground fault. Test 1 is a valid procedure for testing the system for a ground fault, however tests 2 and 3 are not credible tests in this regard. On behalf of the rail client, S&C Distribution Company created new procedures for their testing device regarding the use of SW350 technology for the rail industry. The correct way to test the turbine is not while the unit is in an “open circuit” state. Additionally, the turbine stop switch must be installed correctly for accurate results.

For proper ground fault testing, the turbine stop switch must be placed in the STOP position, at which point the turbine is shorted and the batteries and charge controller are disconnected.

If the turbine is to be tested while operational and in a loaded state (i.e., with the charge controller and batteries connected) the turbine stop switch must be placed in the RUN position to achieve accurate test results.

Additional Resources:

1. S&C Distribution Company, Procedure Report Dated 23 March, 2017
2. MCE Technical Report 20170323 (page 5)

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Technical Report 20170323

Railroad Applications: *'USING THE 360 GROUND FINDER AT LOCATIONS WITH WIND TURBINES'*.

1. This document is to be used in conjunction with S&C Procedure Report Dated 23 March 2017 and is only valid for a Superwind 350 or Superwind 353 wind turbine (as no other brands participated in the study, nor are commercially rated with the same attributes of the Superwind turbine). Therefore, do NOT use the following procedure with any other brand of wind turbine!

2. As properly identified in the 2017.03.23 document 'USING THE 360 GROUND FINDER AT LOCATIONS WITH WIND TURBINES', there are indeed many types if micro-wind turbines in the market, ranging widely in quality, some with "wild AC" output, some with DC output but requiring a ground (third wire run), and some with only a two wire DC output (as is the case with the SW350). The procedures for testing these various types of wind turbines must of course be different. The SW350, being classified as a two wire ('+' & '-') 'DC output' (the final electrical power delivered from the ever-loaded™, offset stator based wind turbine to the charging system, coming from a RF Gain Dampened 6 Pulse Bridge Rectifier) should be tested as generally mentioned in the S&C document in the first variant mentioned: ***Some wind turbine manufacturers recommend shorting the turbine leads once they have been separated from the bungalow (control cabinet).*** To be more specific, Superwind recommends that the positive and negative leads coming from the turbine (if just testing the turbine only), or, the positive and negative leads from the wire run terminating (after coming from the turbine, through the mast, etc, to test the turbine plus the wire run) before the safety switch (turbine "RUN/STOP" control), BE SHORTED ('+' & '-' connected together), thus stopping the turbine and thus allowing the test to be made. Caution must be used as if the wind turbine is spinning during the creation of the shorted leads - there may be current possible until the turbine stator stops producing power. This occurs within a second. Also recommended: It would be safest to initially turn off the wind turbine by way the "Stop/Run" switch - and then short the leads to perform the test.

Please do not hesitate to call our technical support group at +1 (716) 276-8465 regarding this procedure.

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