

Product Test Report

ThermalRate™ Monitor by Shaw Energy Delivery Services, Inc.

Performed by
Electric Power Research Institute
Lenox, MA USA

Prepared by



David J Childs

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Executive Summary

Introduction

The ThermalRate™ Monitor (TRM) is a dynamic thermal line rating device developed by Shaw Energy Delivery Services, Inc (EDS). In November 2005, EDS contracted the Electric Power Research Institute (EPRI) to perform laboratory testing of the TRM to evaluate the TRM's ability to determine overhead line rating over a number of different operating conditions. The testing was performed at EPRI's Lenox, MA test facility. This report documents the results of that test program.

Background

The thermal rating of an overhead transmission line is the maximum current that the line can transfer without exceeding a specified conductor temperature. The rating is dependent on weather conditions such as wind speed and direction, sunlight, and ambient temperature.



The ThermalRate™ Monitor (TRM)

The Institute of Electrical and Electronics Engineers (IEEE) has developed a methodology (IEEE-738) which serves as the industry standard for calculating a line's rating given a set of line characteristics and weather conditions. At present, transmission owners typically determine and use a static rating for each line. These static ratings are determined using the IEEE-738 methodology with conservative weather assumptions of high ambient temperature and low wind speed. These conservative assumptions are necessary to reduce the probability of operating the line above its maximum operating temperature, but they result in the line being rated well below its capacity for much of the time the line is in operation.

The TRM allows the transmission owner to capture this unused capacity by continuously determining the thermal rating of the line. The TRM is installed in the vicinity of the line and uses a conductor replica technique to determine environmental cooling conditions and then uses IEEE-738 formulas to determine the actual line rating.



Wind Tunnel Testing

Test Program

The purpose of the testing was to evaluate the TRM's ability to determine the maximum current that a conductor can transfer over a number of different environmental conditions. This was accomplished by placing the TRM in an environment where ambient temperature, wind, and simulated sunlight could be controlled. A length of overhead conductor was placed in the same environment. The conductor was energized with full rating current, and the conductor temperature was

monitored. The conductor rating determined using the IEEE-738 methodology was compared to the TRM rating and the actual conductor rating current.

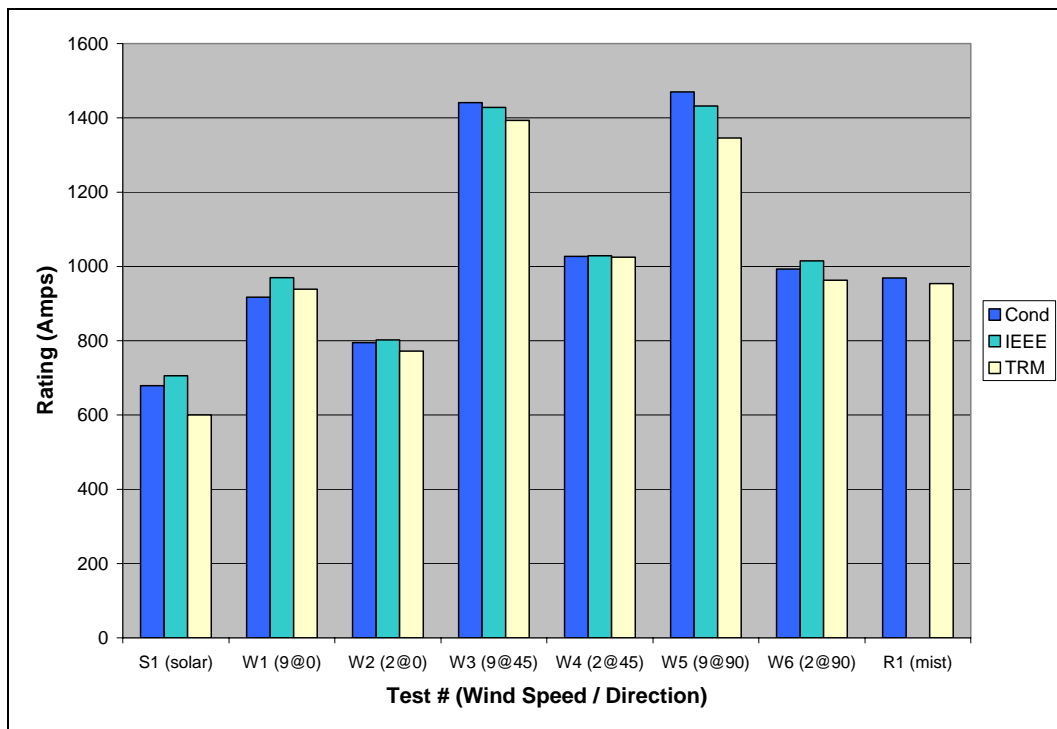
Eight different environmental tests were performed. Tests W1-W6 evaluated the rating over six different wind conditions. Test S1 evaluated solar effects, and Test R1 evaluated the rating during rain and mist conditions. Test E1 evaluated the TRM's ability to withstand high electric fields.

Results

The results of the eight environmental tests are summarized in the following plot. For each test, the plot shows the rating of the line as determined by:

- 1) the actual temperature of the test conductor,
- 2) the IEEE-738 calculations using the measured environmental conditions, and
- 3) the output of the TRM.

(Test R1 does not include IEEE-738 results because the IEEE methodology does not include precipitation effects).



Conclusions

The TRM performed well at determining the conductor rating. The ratings appeared to be conservative in almost all cases, so the risk of overestimating rating is minimal. Ratings were within acceptable limits when compared to the many unknowns of the outdoor environment and a transmission line.

Neither magnetic nor electric fields had any impact on the rating results. The TRM device appeared to be field hardened. The overall packaging appeared neat and reasonable.