

## **CASE STUDY: TGA test finds endwinding contamination problem in turbine generator.**

**Company:** Nevada Power Company

**Plant:** Clark County, NV

**Unit:** Clark 5 gas turbine generator

**Ratings:** Air cooled, 94 MVA, 13.8 kV 3600 RPM, Epoxy-Mica

**Manufacturer:** Westinghouse

**Related Info.:** Installed January 1980

**PD Sensors:** Two 80pF couplers per phase installed in 1995

**Details:** When the stator insulation in a sister unit failed in 1993, giving no prior warning and causing stator copper and core melting with a seven-digit repair cost, the management of NPC needed a way to assess the insulation condition of the other units. There was a history of power factor tests that had been done, but these tests had yielded no discernable pattern or trend that indicated any problems. They were also costly in terms of downtime and labor. NPC started to investigate TGA testing. When an analyst reviewing a March 1995 power factor test recommended a rotor-removed visual inspection, capacitive PD couplers were installed for further investigation. Analysis of the results of the first online PD test in October 1995 indicated loose windings and the recommendation to re-wedge and retest before scheduling a rewind was made. The re-wedging was done concurrent with a planned rotor overhaul. Unfortunately another PD test was not run on the unit for two years. In August 1997, online tests were again run, but they could not verify the effectiveness of the repairs due to alarmingly high peak pulse magnitudes. Analysis of the data however did conclude that this high PD did not originate within the slot but rather in the endwindings. A stator cleaning was recommended. Before this could be implemented, a blower fan failure required the opening of the turbine end of the generator. Taking advantage of the forced outage, the winding end turns and ring bus that could be reached was cleaned. When the unit was returned to service in December 1997, on-line PD test data was gathered that showed a sharp reduction in PD activity. Unit 5, after only a partial cleaning, now displays an insulation integrity comparable to its sister unit which was rewound by the OEM in 1994. The value of periodic PD testing and endwinding cleaning have not been lost on this user. Following are three sets of PD test data; before the re-wedge, before the cleaning, and after the cleaning.

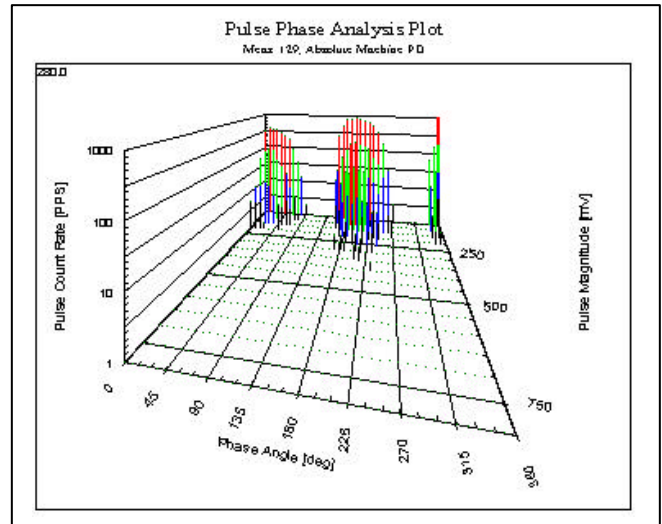
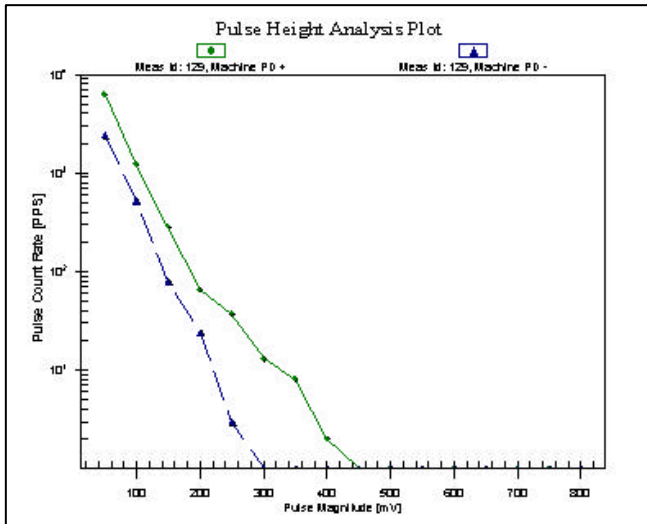


Figure 1 – October 1995 (Classic PD position with positive predominance.)

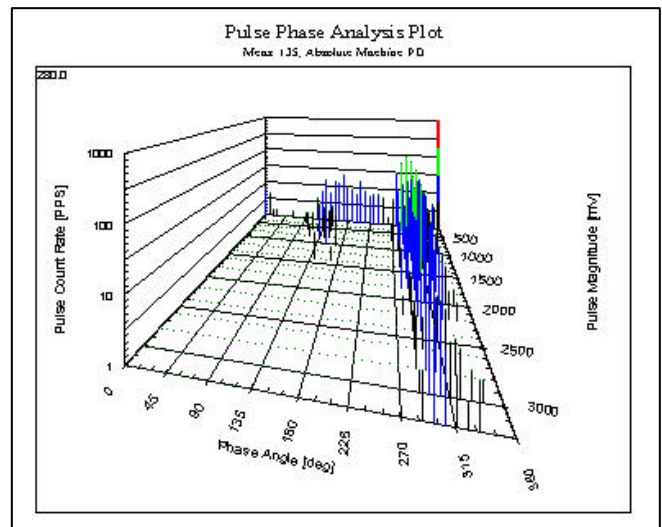
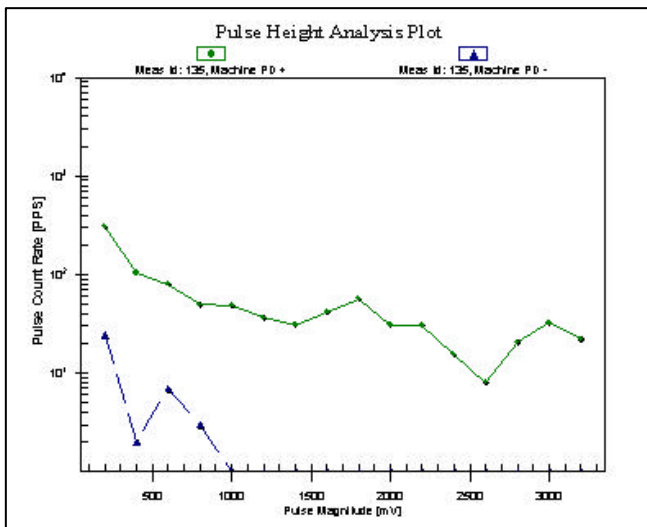


Figure 2 – August 1997 (Note scale and non-classic position indicative of phase-phase activity.)

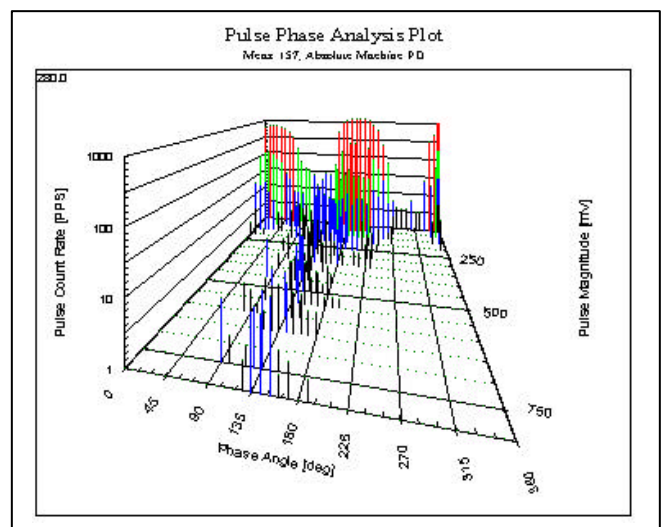
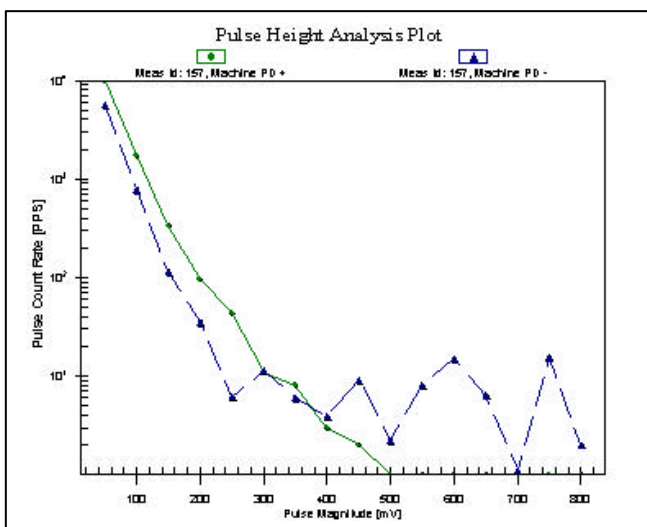


Figure 3 – December 1997 (Still indicating phase-phase but at markedly improved levels. Note the scale change from Figure 2)

Reference: R. Vogel – ‘Partial Discharge Analysis: A Tool For Extending Air-cooled Generator Stator Life’, IRMC - Dallas, TX, 1998.