

Finding Bushing Problem avoids Emergent Stator Swap



Test Setup

At Pacific Gas & Electric(PG&E), further testing was performed on a motor after it showed very high partial discharge levels. This testing was performed with the Baker AWA during a refueling outage to determine if added emergent work was needed to swap out the stator on the motor. This was to be gauged against waiting until the next outage when the motor was scheduled for its 10 year overhaul. Successful completion of the entire AWA series tests would give the maintenance staff at PG&E confidence that the motor had enough insulation life left to operate

the motor until the planned overhaul, at which time a stator swap would be done with minimal cost, schedule and manpower requirements. An unplanned stator swap during the current outage would have major impact.. The motor testing went excellently until the Step Voltage Test.

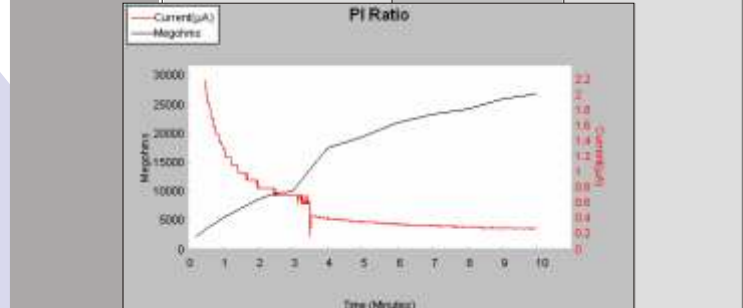
To Step Voltage Test this large motor, (6000 hp, 12KV) it is necessary to use the AWA in conjunction with the PP30 (30kV Power Pack). Testing at this location was logistically challenging. The motor terminal box is located at 117 feet. The closest this equipment could get to the motor for testing was above it

Nameplate Information

Motor ID: RCP1-4
 Unit: Unit One
 Model: CS-VSS
 Serial Number: No Name Plate
 Volts - Rating: 11500
 Amps-Rating: 270
 Insulation:
 RPM: 1180
 Frame: 66-SPL
 LR Code:
 NEMA Design:
 NEMA nom Eff: 0
 Manuf's Type
 System: Reactor Coolant
 Manufacturer: Westinghouse
 HP/KW: 6000
 Volts-Operating: 0
 Amps-Operating: 270
 Enclosure: ODP
 Service Factor: 1
 Freq-Hz: 60
 LR Amps: 0
 Max Amb °C: 40
 Duty Cycle:
 Cont.

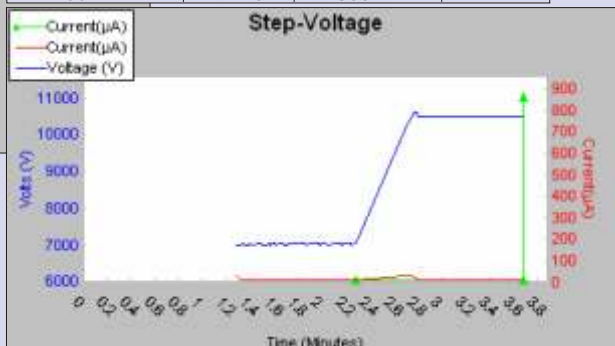
Results Summary Test Date/time: 3/27/2004 10:55:35AM

Temp Status	Tested	PI Status	Pass
Temp	21.0°C 69.8°F RH 70%	Volts (V)	7000
Resist Status	Pass	DA Ratio	2.9
L1-L2 (Ohms)	0.268 Corr: 0.272	PI Ratio	5.0
L2-L3 (Ohms)	0.267 Corr: 0.270	HiPot	No Test
L3-L1 (Ohms)	0.267 Corr: 0.271	Volts (V)	0
Max Delta R%	0.370%	Current (µA)	0
Coil 1 (Ohms)	0.134 Corr: 0.136	Resist (Mohm)	0
Coil 2 (Ohms)	0.134 Corr: 0.136	Surge Status	No Test
Coil 3 (Ohms)	0.133 Corr: 0.135	Peak Volt (V) L1	0
Megohm Status	Pass	Peak Volt (V)L2	0
Volts (V)	7000	Peak Volt (V) L3	0
Current (µA)	1.30	Max P-P EAR%	0% 0% 0%
Resist (Mohm)	5385 at 40°C 1442	EAR 1-2, 2-3, 3-1	0% 0% 0%



PI Results Graph

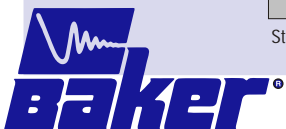
Step Length (Sec)	Volts (V)	Current (µA)	Megohms
60	7070	9	832
60	10500	9	1312
60	9720	863	11

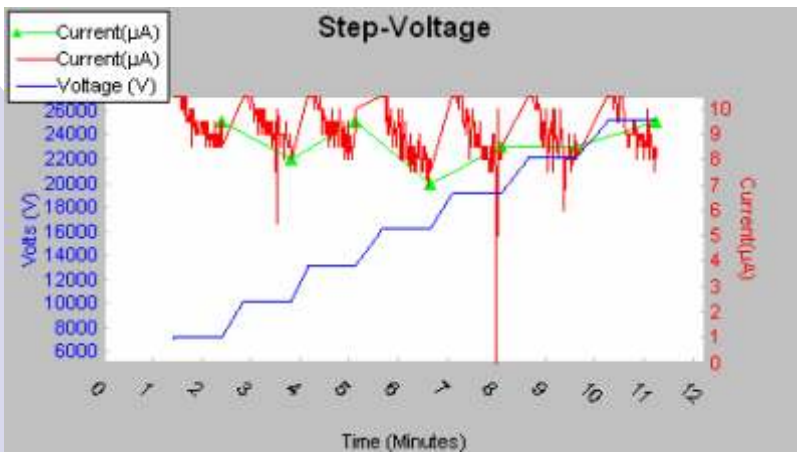


Step Voltage Information prior to repair of bushing.



Damaged Bushing





Step Length (Sec)	Volts (V)	Current (µA)	Megohms
60	7280	10	766
60	10200	8	1275
60	13130	10	1382
60	16160	7	2309
60	19190	9	2258
60	22220	9	2614
60	25250	10	2658

at 140 feet. This required extension leads to be used to apply adequate test voltage to the motor. These leads were purchased with the instrumentation for testing under these specific type of circumstances. The Step Voltage test failed at just under 10,000

Step Voltage Information after bushing repair.

volts. Russ Leatham, Electrical Component Engineer observed the retesting outside the electrical safety boundary at the terminal box. During this retest he observed flashover at the C phase bushing. Testing was stopped, the bushing was inspected and found to be cracked and in fact a piece came loose during handling.

The bushing was replaced and retested with the AWA with good results, including step voltage and surge. Based upon the successful testing the RCP stator swap out was not pursued as emergent work in the current outage (4/2004), but scheduled to coincide with the 10 year overhaul in the next outage (October 2005).

Of the tests that were performed, the Step Voltage test on the AWA, was the only test that revealed the defective bushing. Partial discharge or low voltage testing did not show that there was a problem with the bushing. The final results with the AWA gave us confidence that there was reasonable assurance that the condition of the insulation was such that the stator swap could be performed during the next refueling to coincide with the scheduled overhaul. Because further testing was performed, due to high PD levels, we found a bushing problem that otherwise would have gone undetected. Also, if only low voltage testing were utilized to verify the insulation integrity of this motor, the problem would *not* have been found, since each low voltage test resulted in a passing or good reading. It is possible that a system transient could have occurred resulting in a flashover to the bushing causing a motor trip during operation resulting in an unplanned shutdown. So although the intent of the testing was to verify stator insulation integrity, an unexpected problem in the terminal box was identified and corrected at a much lower cost prior to potential catastrophic failure.



Damaged bushing