Offline Motor Electrical Testing

Procedure Contains NMM eB REFLIB Forms: YES ☐ NO ☒

Effective Date	Procedure Owner: Title: Site:		Governance Owner: Title: Site:	
12/12/2011		John Kirkpatrick Maintenance Mgr. IPEC		Samuel Stewart Fleet Maintenance Mgr. HQN

Exception Date*	Site	Site Procedure Champion	Title
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N/A	BRP		
	GGNS	Jeff Houston	Manager, Maintenance
	IPEC	John Kirkpatrick	Manager, Maintenance
	JAF	Michael Reno	Manager, Maintenance
	PLP	Bret Baker	Manager, Maintenance
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	RBS	Lee Kitchen	Manager, Maintenance
	VY	Mike Tessier	Manager, Maintenance
	W3	Brian Lindsey	Manager, Maintenance
N/A	NP		
	HQN	Samuel Stewart	Manager, Maintenance

Site and NMM Procedures Canceled or Superseded By This Revision

None

Process Applicability Exclusion: All Sites: ☐

Specific Sites: ANO ☒ BRP ☐ GGNS ☒ IPEC ☐ JAF ☒ PLP ☒ PNPS ☒ RBS ☒ VY ☐ W3 ☐ NP ☐

Change Statement

Non-Editorial change due to CRs HQN-2011-00276, HQN-2011-00156, and WTHQN-2010-00031 CA102.

1. **Deleted requirement for supervisor initials in Step 1.0[2].**
2. **Clarified supervisor responsibilities in Step 4.2.**
3. **Clarified tagout requirements in Step 5.1[3].**
4. **Added Note prior to Step 5.1[8] to ensure supervisor is notified of failed tests.**
5. **Added Step 5.1[12] regarding off-line testing on submerged motor feeder cables.**
6. **Revised Step 5.9 based on field comments.**
7. **Made various changes in order to remove vagueness and interpretation in all steps.**
8. **Added notes and warnings to protect personnel and equipment.**

*Requires justification for the exception

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1.0 PURPOSE

[1] The purpose of this procedure is to provide instructions for connecting the Baker Instrument Advanced Winding Analyzer (AWA) and, when used, the 30 kV Power Pack (PP30 also PP) Motor Test Equipment for the purpose of gathering performance monitoring data on various motors.

(a) The AWA and PP30 are intended for use in the detection of power circuit problems, ground wall insulation integrity, and turn to turn winding insulation integrity of electric motors by trained professionals. The AWA and PP30 perform the following functions:

(1) Temperature / Resistance Test

(2) Megohm Test

(3) Dielectric Absorption (DA) / Polarization Index (PI) Test

(4) DC High Potential Tests

a. DC High Potential

b. DC Ramp Voltage

c. DC Step Voltage

(5) Surge Test

[2] The sections of this procedure that are required to be performed have been identified by Planning and have been indicated in the Work Order. Initial those sections below.

NOTE

Use of the PP30 may be waived if the motor being tested is rated less than 1000 HP and test voltages are less than 12Kv, or if approved by the Responsible Engineer {Ref. 2.0[9]}.

Initials	Section(s) to be performed	Section Title
	5.4	**Low Voltage Motor** (Rated <600V) or Medium Voltage Motor Testing (Rated >600V) with AWA Only
	5.5 thru 5.8	**Medium to High Voltage Motor** (Rated >600V) Testing Using AWA and PP30
	5.9	**RESTORATION** (Perform section 5.9, if required, for **all** tests)

2.0 REFERENCES

[1] IEEE Std 43, Recommended Practice for Testing Insulation Resistance of Rotating Machinery

[2] IEEE Std 95, Recommended Practice for Insulation Testing of AC Electric Machinery (2300 V and Above) With High Direct Voltage

[3] IEEE Std 400, Guide for Field Testing and Evaluation of the Insulation of Shielded Power Cable Systems

[4] IEEE Std 532, Guide for Testing Turn Insulation of Form-Wound Stator Coils for Alternating-Current Electric Machines

[5] IEEE Std 400.1, Guide for Field Testing of Laminated Dielectric, Shielded Power Cable Systems Rated 5 kV and Above with High Direct Current Voltage

[6] EPRI NP-7502, Electric Motor Predictive and Preventive Maintenance Guide

[7] NEMA Std MG 1, Motors and Generators

[8] CEXI2009-00002, User's Manual Advanced Winding AWA

[9] 71-015 VII EN User's Manual Advanced Winding AWA (AWAIV-6, AWAIV-12)

[10] CR-HQN-2010-00166, Clarify Offline Motor Testing Criteria

3.0 DEFINITIONS

[1] Dielectric Absorption Test (DA) – Similar to a PI test, the DA is a comparison of the IR values after 3 minutes divided by the IR 1 minute values. The PI test can be aborted to a DA test if the megohm value exceeds 5000 meg-ohms after the first minute.

[2] HiPot Test – Performed using a test voltage that is substantially higher than the megohm Test, but, once again, based on operating voltage of the motor and the appropriate standards/company guidelines. Look for unusually high leakage currents or a leakage current that doesn't stay constant or intermittently jumps up and down. In addition, the current should not double in magnitude. Breakdowns or high leakage currents are an indication of damaged ground wall insulation. The HiPot Test has 3 variations:

(a) HiPot – Ramps the voltage very quickly to target voltage.

(b) Ramp Voltage – Ramps the voltage much slower at user defined rates and causes surface leakage to have less chance to reach a critical level.

(c) Step Voltage – Ramps the voltage up in pre-set steps and holds at these intervals for pre-set times. This allows leakage to stabilize between steps and is the least "stressful" of all high potential tests.

3.0 cont.

[3] Megohm Test (IR) – The test consists of applying a DC voltage, in accordance with IEEE Std 43. The leakage current measurement is taken 60 seconds after the test voltage is reached. Unusually low megohm value when compared to previous measurements or industry accepted limits for the type of insulation in the motor being tested should be investigated prior to performing high potential tests.

[4] Polarization Index Test (PI) – A test performed to quantitatively measure the ability of the ground wall insulation to polarize. The PI test is typically performed at the same voltage as the megohm test and takes 10 minutes to complete. The PI value is calculated by dividing the IR at 10 minutes by the resistance at 1 minute. Both the numerical value of the PI and the profile of the PI curve are used in determining health.

[5] Surge Test – Detects insulation damage between turns within a motor's winding. The test consists of applying a short, fast rise time, high current impulse to a winding. The impulse will induce a voltage difference between adjacent loops of wire within the winding. If degraded an arc will occur which is detected by the test.

[6] Temperature / Resistance Test – Tests for resistance imbalance between phases, discrepancies between measured resistance values, previous measurements, and nameplate values. The coil resistance test consists of injecting a known constant current through the winding, measuring the voltage drop across the winding, and calculating the coil resistance using Ohm's law.

4.0 RESPONSIBILITIES

4.1 Maintenance Manager

[1] Ensuring Maintenance compliance with this procedure.

4.2 Maintenance Supervisor

[1] Ensuring pre-job brief is performed (The Baker Test System can produce lethal currents and voltages).

[2] Ensuring trained/qualified personnel conduct testing.

[3] Ensuring that the equipment is calibrated according to program requirements / manufacturer recommendations.

[4] Includes this procedure with the work package.

[5] Ensuring procedural requirements have been met prior to work package closeout.

[6] Verifying that maintenance craft personnel qualifications are current.

4.3 Maintenance Craft Personnel

[1] Implementing this procedure.

[2] Understanding and adhering to procedural requirements.

[3] Notifying Component Engineer of task completion.

[4] Notifying Component Engineering of failed criteria or conditions off normal.

4.4 Component Engineer or Designee

[1] Obtaining electronic copy of raw data.

[2] Evaluating test data.

[3] Updating offline motor electrical testing trends.

[4] Initiating Condition Reports when reporting degrading trends in accordance with EN-LI-102.

[5] Maintaining a trending database for motor tests.

[6] Setting up initial tests voltages in accordance with those described in Attachment 9.1.

[7] Authorizing performance of test steps in and out of sequence.

5.0 DETAILS

5.1 PRECAUTIONS AND LIMITATIONS

NOTE

Ensure all prejob briefing is performed prior to work. This includes as a minimum:

- FME brief
- High Voltage
- Tagging Verification

[1] Use of a ground truck configured as a test device may be required during performance of this task. Alternatively, bus stab connections or motor t-lead connections may be used. Verify site requirements prior to testing.

[2] Prior to opening any MCC or switchgear, ensure requirements of EN-IS-123 are met including the use of arc-flash protection clothing and appropriate Personal Protective Equipment (PPE).

[3] Ensure the equipment has been tagged out in accordance with EN-OP-102 and the responsible personnel are signed on to the tagout prior to commencing work.

[4] Every connection performed at MCC or switchgear is to be completed while the associated motor is de-energized (heater circuit may be energized).

[5] Do not touch the test leads, winding, or component under test while a test is being conducted.

[6] Test voltages of up to 30 kV may be present during the performance of this task.

[7] Motor space heaters should remain energized during the performance of this task to prevent moisture ingress into the motor winding insulation.

NOTE

Ensure that the supervisor is informed of failed tests.

[8] Test steps may be performed out of sequence at the discretion of the Maintenance Supervisor, Component Engineer, or designee.

[9] Test steps may be repeated at the discretion of the Component Engineer or designee.

5.1 cont.

[10] Individual tests (Megohm, PI, Step Voltage, and Surge) may be performed at the discretion of the Component Engineer or designee.

[11] DC step voltage testing should not be performed on medium voltage motors if the off-line testing is being performed from the switchgear and it is known or suspected that the motor feeder cables are submerged under water.

[12] The PP30 requirement for medium voltage motors may be waived if the motor being tested is rated less than 1000 HP or test voltages are less than 12kV.

(a) In such cases, only AWA (top unit) is required.

(b) The Component Engineer shall be consulted for revised test voltages.

[13] In some cases, the AWA and/or PP30 may not have the energy required to achieve final target voltage.

(a) It is acceptable in such cases to allow test termination at highest achievable test voltage.

(b) Document such occurrences in the work package.

[14] Electrical protection boundaries (danger flagging, signs) shall be provided in accordance with EN-IS-123.

[15] Touching the AWA computer screen while performing motor tests will cause the motor test to abort.

[16] This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the product manual, it may cause harmful interference to radio communications.

5.2 PREREQUISITES

[1] Verify motor and power circuit are de-energized (heater circuit may be energized).

[2] If installed, de-terminate surge capacitors.

[3] **OBTAIN** motor winding or skin temperature using hand held temperature measuring device or computer point.

IF winding or motor skin temperature is not available,
THEN USE an area ambient temperature.

Temperature: _____ **°F**

[4] Setup work area in accordance with EN-IS-123.

[5] Prior to starting work, **RECORD** the following information:

(a) Work Order Number: _____

(b) Motor Component ID: _____

5.3 REQUIRED MATERIALS

[1] Extension Cord.

[2] HHM – Hand held voltmeter, hot sticks or equivalent.

[3] Baker AWA (See Attachment 9.2 Figure 9.2-1).

[4] Baker PP30 as necessary (See Attachment 9.2 Figure 9.2-2).

[5] Temperature Measuring Device (If computer point is not available).

[6] Power line conditions and filter for use with PP30 (i.e. SOLA Cat 63-13-210-6 or equivalent) for applicable units.

5.4 LOW VOLTAGE MOTOR (RATED <600V) AND MEDIUM VOLTAGE MOTOR (RATED >600V) TESTING WITH AWA ONLY.

[1] **VERIFY** the 25 pin interconnect cable that links the AWA to the PP30 is NOT connected.

NOTE

LIVE DEAD LIVE techniques should be used when performing live electrical checks.

CAUTION

Test leads are energized and electrical shock could occur. Do NOT touch test leads when testing is in progress.

CAUTION

Heaters may be energized during the performance of this task. Electrical shock could occur.

[2] **VERIFY** motor is de-energized prior to installing test leads.

[3] Using HHM, **RECORD** induced voltage.

Induced Voltage: _____

NOTE

Any induced voltage may affect the accuracy of the winding resistance readings. Ensure motor shafts are not rotating (e.g., due to reverse fan draft) during test performance.

[4] **IF** induced voltage is greater than 10.5 volts phase to ground, **THEN CONTACT** component engineer for resolution.

[5] **PLUG IN** AWA.

[6] **TURN ON** AWA Power Switch located on the left side (by the power cord) of the machine (wait for windows to complete start-up routine).

[7] **SELECT** the appropriate database.

5.4 cont.

NOTE

In the following step: If the motor is NOT already listed then**,** applicable motor data is to be added as needed. (Contact Engineering and/or Supervisor as needed.)

[8] **SELECT** appropriate motor to test from EXPLORE tab (Left hand portion of screen).

[9] **SELECT** TEST tab which lists test to be performed.

(a) **SELECT** appropriate test profile from drop down box on test ID.

(1) EXAMPLE: 480V w/Rotor<100HP Step

[10] **REFER** to the scope of testing included in the work order package AND **VERIFY** all tests to be performed are enabled as indicated by GREEN ON buttons.

[11] **INSTALL** AWA low resistance test leads. (i.e. A-1, B-2, C-3)

(a) Indicate Location of the installed test leads:

☐ **MCC/Switchgear Cubicle**

☐ **Motor Leads**

☐ **Other:** _____

[12] **VERIFY** appropriate phase relationship between test leads and connection points (i.e. A-1, B-2, C-3).

[13] **SELECT** "RUN AUTO TEST" option and follow on screen directions to start test.

START OF AWA RESISTANCE TEST

[14] **OBTAIN** motor winding or skin temperature using hand held temperature measuring device or computer point.

IF winding or motor skin temperature is not available,
THEN USE an area ambient temperature.

Temperature: _____ **°F**

5.4 cont.

NOTE

If the test fails in the following step, then, the on screen prompts are to be followed to either re-run or abort test. The following step will start the test.

[15] Manually **ENTER** motor temperature **AND SELECT** "ACCEPT".

(a) **After** Temperature/Resistance test has finished.

THEN, **REMOVE** the AWA Low Resistance Test Leads.

CAUTION

Always connect the Ground Cable FIRST.

START OF AWA HIGH VOLTAGE TESTS

[16] **INSTALL AWA** high voltage test leads. (i.e. A-1, B-2, C-3).

[17] **VERIFY** appropriate phase relationship between test leads and connection points (i.e. A-1, B-2, C-3).

[18] **CLICK** "**OK**" and follow on screen directions to start Megger, PI, DC Step Voltage, and Surge Test.

CAUTION

Always disconnect the Ground Cable LAST.

[19] **REMOVE** AWA High Voltage Test Leads following completion of Surge Test.

[20] **PERFORM** Foreign Material Exclusion (FME) closeout.

[21] **PROCEED** to the next section(s) as directed in step 1[2].

5.5 MEDIUM TO HIGH VOLTAGE MOTOR (RATED >600V) TESTING USING AWA AND PP30

NOTE

LIVE DEAD LIVE techniques should be used when performing live electrical checks.

WARNING

Test leads are energized and electrical shock could occur. Do not touch test leads when testing is in progress. Grounds shall be applied for test equipment installation and removed for testing in accordance with site procedures.

WARNING

Heaters may be energized during the performance of this task. Electrical shock could occur.

AWA and PP30 SETUP

[1] **VERIFY** Motor is de-energized prior to installing test leads.

NOTE

Any induced voltage may affect the accuracy of the winding resistance readings.

[2] **ENSURE** motor shafts are not rotating (e.g., due to reverse fan draft) during test performance.

[3] Using HHM / Hot Sticks, **RECORD** induced voltage.

Induced Voltage: _____

(a) **IF** induced voltage is greater than 10.5 volts phase to ground, **THEN CONTACT** component engineer for resolution.

[4] **IF** surge capacitors are installed, **THEN DE-TERMINATE** the surge capacitors

(a) Surge Capacitors Installed? (YES / NO) Circle

(b) Surge Capacitors De-Terminated? (YES / NO / N/A) Circle

5.5 cont.

[5] **IF** required *(See Precautions and Limitations Section 5.1)*, **THEN CONFIGURE** ground truck as a test device in the switchgear cubicle of the motor under test in accordance with site procedures.

Ground Truck Required? (Yes / No) Circle

NOTE

25-pin interconnect cable is directional sensitive and the cable is marked on each site. **The plug in the end marked HOST should be installed into the auxiliary port (AUX) on the front of the AWA and the end marked 30 kV should be installed into the auxiliary port (AUX) on the front of the PP30.** At some sites, the host end of the cable is labeled P1 and the 30KV end is labeled P2 or power pack.

[6] **SETUP** AWA, PP30, grounded power conditioner (SOLA) and foot switch (as desired) in work area.

[7] **TURN ON** the SOLA, AWA and PP30 (wait for windows to load).

[8] **START** AWA SOFTWARE by double clicking the AWA icon (if required).

[9] **SELECT** the appropriate database.

NOTE

In the following step: If the motor is NOT already listed then, applicable motor data is to be added as needed. (Contact Engineering and/or Supervisor as needed.)

[10] **SELECT** appropriate motor to test from EXPLORE tab (Left hand portion of screen).

[11] **SELECT** TEST tab which lists tests to be performed.

[12] **REFER** to the scope of testing included in the work order package AND **VERIFY** all tests to be performed are enabled as indicated by GREEN ON buttons.

[13] **INSTALL** AWA low resistance test leads. **INDICATE** Location:

- ☐ **MCC/Switchgear Cubicle**
- ☐ **Motor Leads**
- ☐ **Other: _____**

5.5 cont.

[14] **VERIFY** appropriate phase relationship between test leads and connection points (A-1, B-2, C-3).

[15] **OBTAIN** motor winding or skin temperature using hand held temperature measuring device or computer point.

IF winding or motor skin temperature is not available,
THEN USE an area ambient temperature.

Temperature: _____ **°F**

[16] **SELECT** "RUN AUTO TEST" option and follow on screen directions to start test.

NOTE

Temperature/Resistance test will begin when "ACCEPT" has been selected.

[17] Manually **ENTER** motor temperature **AND SELECT** "ACCEPT."

[18] **REMOVE** AWA low resistance test leads following Temperature/Resistance tests.

5.6 MEGGER / PI TESTS

CAUTION

Always connect the Ground Cable FIRST.

[1] **INSTALL** AWA high voltage test leads.

[2] **VERIFY** appropriate phase relationship between test leads and connection points (i.e. A-1, B-2, C-3).

[3] **CLICK** "OK" and follow on screen directions to start the Megger and PI Tests.

(1) **If** Test gives "Failed Data Screen"
Then, **RECONNECT** leads **AND PERFORM** the Test again.

5.6 cont.

CAUTION

Always disconnect the Ground Cable LAST.

[4] **REMOVE** AWA high voltage test leads following completion of the PI test.

5.7 STEP VOLTAGE TEST

CAUTION

Always connect the Ground Cable(s) FIRST
(Attach the Flat Ground Cable "Station Ground").

[1] **INSTALL** PP30 Test Leads.

[2] **VERIFY** appropriate phase relationship between test leads and connection points (i.e. A-1, B-2, C-3).

NOTE

When the PP30 "function" knob is moved, the unit will energize an internal relay causing a "thumping" noise.

[3] **MOVE** PP30 "FUNCTION" knob to "HIPOT" 100µA/Div position.

[4] **MOVE** PP30 "TEST SELECT" knob *"CCW"* to "HIPOT" position.

[5] **MOVE** PP30 "OUTPUT CONTROL" to "MIN" (CCW) position.

[6] **CLICK** "CONTINUE".

[7] **PRESS AND HOLD** footswitch or test pushbutton to begin step voltage test.

[8] After a momentary delay to allow the PP30 to cycle internally, **RAMP** (slowly) the voltage to the specified (on screen) test voltage level using the "Output Control" knob.

5.7 cont.

CAUTION

Failure to reset the PP30 "FUNCTION" knob to the 100 µA/Div position prior to ramping the voltage to the next step will result in failure of the test.

[9] **IF**, current falls below 10 µA:

THEN, **ADJUST** the PP30 "FUNCTION" knob to the 10 µA/Div position.

When the designated time (AWA computer screen) has elapsed.

Then, **ADJUST** the PP30 "FUNCTION" knob to the 100 µA/Div position.

[10] **REPEAT** preceding steps as necessary and while following test progress indications until the step voltage test is complete.

[11] **WHEN** test is complete

AND voltage is discharged from circuit.

THEN, **RELEASE** footswitch or PP30 test pushbutton.

[12] **DISREGARD** the on screen Prompt at this time *(it will be utilized in a later step).*

5.8 SURGE TEST

[1] **MOVE** PP30 "TEST SELECT" knob CW to "LEAD 1" position.

[2] **MOVE** PP30 "OUTPUT CONTROL" to "MIN" position.

[3] **MOVE** PP30 "FUNCTION" knob to "SURGE" position.

[4] **CLICK** "CONTINUE".

[5] **PRESS** AND **HOLD** footswitch or test pushbutton to begin surge testing.

[6] After a momentary delay to allow the PP30 to cycle internally, **RAMP** voltage at slow and steady rate to the specified (on screen) test voltage level using the "Output Control" knob. **FOLLOW** on screen directions until surge testing is complete for LEAD 1.

5.8 cont.

[7] Upon completion of Lead 1 Test:

(a) **MOVE** PP30 "TEST SELECT" knob CW to "LEAD 2" position.

(b) **MOVE** PP30 "OUTPUT CONTROL" to "MIN" position.

(c) **PRESS** AND **HOLD** footswitch or test pushbutton to begin surge testing.

(d) After a momentary delay to allow the PP30 to cycle internally, **RAMP** voltage at slow and steady rate to the specified (on screen) test voltage level using the "Output Control" knob. **FOLLOW** on screen directions until surge testing is complete for LEAD 2.

[8] Upon completion of Lead 2 Test

(a) **MOVE** PP30 "TEST SELECT" knob CW to "LEAD 3" position.

(b) **MOVE** PP30 "OUTPUT CONTROL" to "MIN" position.

(c) **PRESS** AND HOLD footswitch or test pushbutton to begin surge testing.

(d) After a momentary delay to allow the PP30 to cycle internally, **RAMP** voltage at slow and steady rate to the specified (on screen) test voltage level using the "Output Control" knob. **FOLLOW** on screen directions until surge testing is complete for LEAD 3.

[9] Upon completion of Lead 3 Test

(a) **MOVE** PP30 "OUTPUT CONTROL" to "MIN" position.

(b) **MOVE** PP30 "TEST SELECT" knob "CCW" to "LEADS GROUND" position.

CAUTION

Always disconnect the Ground Cable(s) LAST.

[10] **REMOVE** PP30 test leads following completion of surge test.

[11] **PERFORM** Foreign Material Exclusion (FME) closeout.

[12] **Proceed** to the next section(s) as directed by supervision in step 1[2]

5.9 RESTORATION

[1] **SAVE** Data to USB Memory Stick, if required by work order and/or component engineer.

(a) **INSERT** USB Memory Stick

(b) **OPEN** AWA, if not already open

(c) **CHOOSE** Database that needs to be archived

(d) **CLICK** "DATABASE"

(e) **SELECT** "DATA TRANSFER"

(f) **SELECT** USB Memory Stick as destination

(g) **CLICK** "ADD" for applicable test(s)

(h) **CLICK** "TRANSFER"

(i) **CLICK** "CLOSE"

[2] **CLOSE AWA** Software.

[3] **SHUT DOWN** the Computer.

[4] **DE-ENERGIZE** AWA and / or PP30.

[5] **If** surge capacitors were de-terminated in step 5.5[4]

Then, RE-TERMINATE surge capacitors.

Surge Capacitors Installed? (YES / NO) Circle

Surge Capacitors Re-Terminated? (YES / NO / N/A) Circle

[6] **NOTIFY** Component Engineer of test completion.

5.10 PROCEDURE COMPLETE

[1] **RECORD** any known CRs generated as a result of testing performed.

List of written CRs: _____

_____

[2] Personnel listed below have performed signoffs in this procedure:

Print Name (First, Last)	Signature	Initials	Date

6.0 INTERFACES

[1] EN-IS-123, Electrical Safety
[2] EN-LI-102, Corrective Action Process
[3] EN-MA-118, Foreign Material Exclusion

7.0 RECORDS

[1] Baker Test Report
[2] Signed Test Procedure

8.0 SITE SPECIFIC COMMITMENTS

None

9.0 ATTACHMENTS

9.1 TEST VOLTAGES
9.2 EQUIPMENT LAYOUT

Megohm, DA and Polarization Index Test Voltages

Table 1 – Guidelines for dc voltages to be applied during insulation resistance test Rated line-to-line voltage for three-phase ac machines, line-to-ground voltage for single-phase machines, and rated direct voltage for dc machines or field windings (from IEEE Std 43-2000).

Winding rated voltage (V)	Insulation resistance test direct voltage (V)
< 1000	500
1000-2399	1000
2400-3999	2500
> 3999	5000

High Potential / Surge Test Voltage / Step Voltage

Table 2 – Guidelines for dc high potential and surge test voltages to be applied at switchgear during routine maintenance. Testing at these potentials may only be performed on successful completion of Megohm and Polarization Index test or under direction of Component Engineering (from Baker Instruments 2E+1kV Based on IEEE 522, EASA, and IEC 34-15).

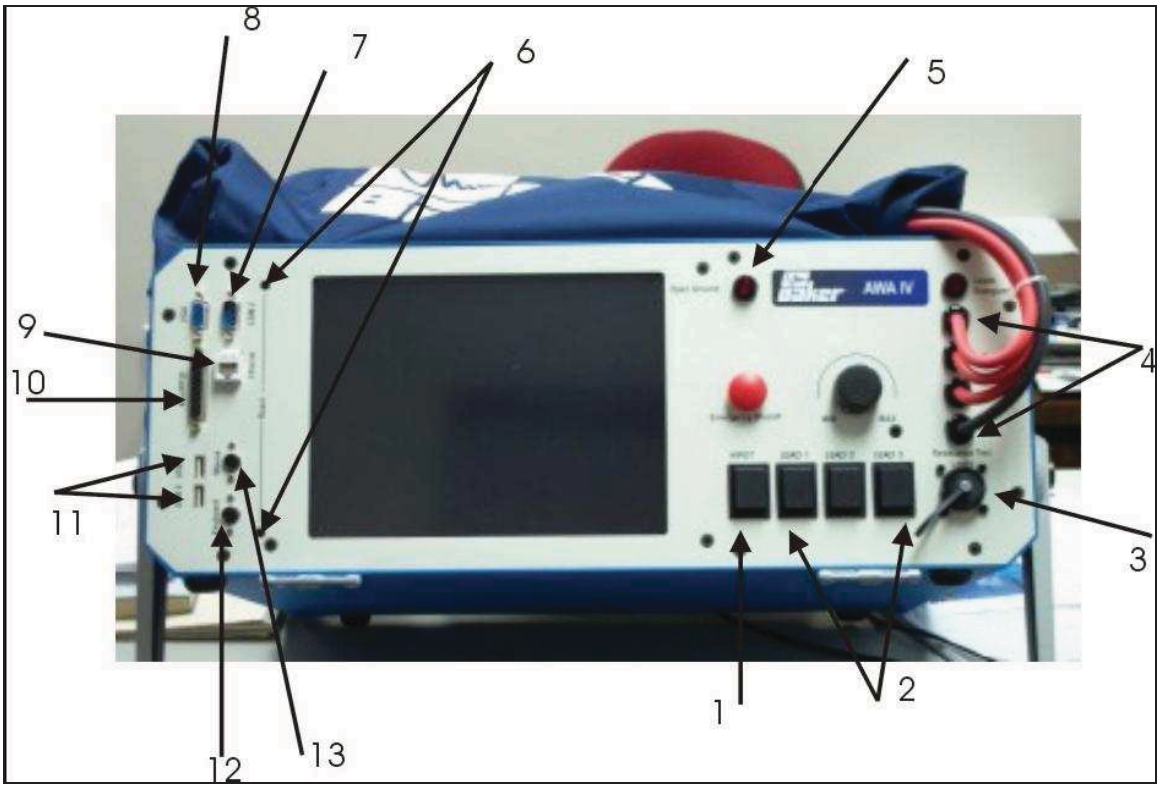
Line Voltage (V)	High Potential / Surge Test Voltage / Step Voltage (V)
480	1960
575	2150
600	2200
2300	5600
4160	9320
6900	14800
13800	28600

ATTACHMENT 9.2 **EQUIPMENT LAYOUT**

Sheet 1 of 2

Hardware / Software Setup

Fig 9.2 - 1: AWA Series IV



1. HiPot Button
2. Leads 1-3 Buttons
3. Resistance Leads Connector
4. Test Leads 1 – 3, Ground
5. Open Ground Light
6. Reset Buttons
7. Com 2
8. VGA
9. Ethernet
10. Aux/PP30
11. USB Ports
12. Keyboard
13. Mouse

Fig 9.2 - 2: PP30 Power Pack (For Voltages > 12kV)

1. Power
2. Auxiliary Port (AUX)
3. Leads Energized Indicator
4. Power Receptacle
5. Test Select Switch
6. Test Push Button
7. Emergency Shut-Off
8. Function Knob
9. Output Control
10. PP30 Test Leads