ALLIS ENGINEERING

A Risk Assessment Engineering Corporation

"Because insurance claims is not good business!"

RIVIERA™ Risk Assessment Inspection is a <u>proprietary</u> NDT and pro-active service of Allis Engineering Inc. designed to eliminate about 75% of the causes of electrical interruptions as well as possible catastrophes related to such interruptions. It does not protect against events rooted in transient nature but can also help locate improper conductor sizing, phase unbalance and harmonics.

The **RIVIERA™** Allis Engineering Risk Assessment Inspection **<u>scope</u>** consists of all lower and higher Voltage Switchboard and Switchgear Assemblies, Distribution Panels, Panelboards, Transformers, Disconnects, MCC, Bus Runs, Relay Cabinets, Splice Vaults, A/C and refrigeration controls, main feed connections (before CT at meter), etc. The scope of work shall be exhaustive given sufficient allocation of time, access and while load centers are at maximum circuit potential. This may require evening shifts or energizing circuits as needed.

The Allis Engineering Inc field inspection methodology is as follows:

<u>1.1 Visual and Mechanical Inspections</u>:

1.1.1 Review equipment nameplate data with historical records of equipment on file.
1.1.2 Determine the age of equipment.
1.1.3 Review previous year's information and other inspection reports:
- **1.1.3.1 for trends.**
- **1.1.3.2 to determine accuracy of recommendations.**
- **1.1.3.3 for verification of repairs.**
- **1.1.3.4 to determine areas of concentration.**

1.1.4 Inspect physical, electrical and mechanical condition including evidence of moisture or electrical arcing.
1.1.5 Verify appropriate anchorage of all assemblies. Check for physical damage and correct alignment.
1.1.6 Verify that all compartments, disconnects and individual electrical cabinets are properly labeled.
1.1.7 Verify that a "breaker use chart" is present inside of door of each distribution cabinet and that all closed breakers are listed.
1.1.8 Inspect cables and cable connections. Check for deterioration at point of termination and stress points.
1.1.9 Verify that fuse and/or circuit breaker sizes and types correspond to drawings (if available). Verify the circuit breaker's address for microprocessor-communication packages if applicable.
1.1.10 Compare equipment nameplate data and breaker arrangement with latest single line diagram. Update drawings to reflect any differences found, if available.
1.1.11 Check all feeder terminations for correct lug and termination equipment. Verify aluminum lugs for correct designations.

1.1.12 Observe bus bars for discoloration, oxidation or exfoliation.
1.1.13 Check all fusible disconnects for consistent and correct fuse size.
1.1.14 Check all fuses are of the same manufacturer and series.
1.1.15 Check for proper fuse installation.
1.1.16 Verify proper fuse size by comparing existing fuse with building single line diagram, if available.
1.1.17 Observe all conductor entrances into enclosures for proper insulation bushings to ensure that no conductor is against the metal rim of the conduit.
1.1.18 Check all conductor insulation from the point of connection to the point of conduit entrance for damage and list any deficiencies.
1.1.19 Look for deterioration of insulation on cables near terminations or stress points (formed bends) in the cables.
1.1.20 Check cables for binding against the enclosure platform on all sides.
1.1.21 Inspect insulators for evidence of physical damage or contaminated surfaces.
1.1.22 Verify that filters are in place and vents are clear. Clean if time permits.
1.1.23 Perform visual inspection of all instrument transformers.
1.1.24 Inspect all indicating lights for proper operation.
1.1.25 Inspect control power transformers.
1.1.26 Inspect for physical damage, cracked insulation, broken leads, defective wiring and general condition.
1.1.27 Make adjustment recommendations on the appropriate temperatures of enclosure and rooms for the electrical equipment contained.
1.1.28 Verify that primary and secondary fuse ratings or circuit breakers match drawings.
1.1.29 Check for openings that permit dust, moisture or rodents to enter. Identify all unused openings.
1.1.30 Thoroughly inspect equipment, identify any excessive dirt, dust buildup on any components or surfaces. Alert of presence of rodents and other live or dead intrusions.
1.1.31 Verify that any electric fan incorporated in a cabinet or sub cabinet is properly working.

1.2 Infrared Imaging Inspection:

1.2.1 Use only the most advanced scientific grade infrared imager (no Spectro-Physics, no ISI, no HotShot, no hand-held pyrometer, no Mikron, etc.). This will enable more in-depth results and avoid missing defects.
1.2.2 Use the same infrared imagers for all client sites to ensure identical inspections so that comparisons between site performances are more factual and standardized.
1.2.3 With electrical equipment running at maximum possible load at the time of the inspection, perform an inspection by following the strict Allis Engineering procedural rules for eliciting defects in varied contained or open electrical areas.

1.2.4 On a daily basis perform a calibration check of the infrared instrument using a number of known temperature references including the human skin.

1.2.5 Collect amperage information at both primary and secondary of transformers at least every two years. Ascertain crest factor, harmonics and unbalance.

1.2.6 Check transformers for grounding problems and amperage loading.

1.2.7 Start inspections in each enclosure by tracing incoming power (line) to each breaker and then follow its distribution (load) through each control or protective component. Adjust imager temperature range to capture the proper temperature limits typical of each component (breakers will be cooler than an overheat element or a 110V transformer).

1.2.8 Compare temperatures to Allis Engineering Inc proprietary chart of apparatus temperature ratings for "normal" temperatures against various conditions such as ambient temperature, ampacity, actual amperage ands amperage ratios, NEMA class, manufacturer rating and other specific parameters.

1.2.9 Proper recommended procedure for inspecting larger main breakers consists of removing either top front cover strip or rear panel to give a clear line of sight to infrared instrumentation especially of the rear breaker stabs. If possible site should remove these ahead of the inspection to facilitate a cost effective inspection.

1.2.10 Other specifications for inspecting transformers and other electrical gear apply, but are generally along the same lines as above scope of work.

1.3 Other tests and OSHA/NEC Violations:

1.3.1 Record mV loss from line to load side at each phase for any OCPD found by the infrared imaging to be anomalous, except in cases where the information is superfluous (high temperatures, phase balance at AC induction motor, etc.).

1.3.2 Record amperage on each phase for same. Same exceptions apply.

1.3.3 Check Voltage as needed. Follow IEEE requirement that delta between high and low legs of three-phase system do not exceed 2%.

1.3.4 All transformers with sufficient apparent load to be worthwhile inspecting should have its neutral and ground loads measured against the phase conductors for presence of harmonics, phase unbalance and improper ampacity ratio to phase conductors.

1.3.5 Check for presence of corona with an ultrasonic or other instrument as needed in the presence of higher voltages (>480V).

1.3.6 Report all violations relating to access to electrical gear.

1.3.7 Report the presence of stored materials and flammables/combustibles (such as paper, chemicals, oil, etc.) in areas around any electrical panels and switchgear.

1.3.8 Report violations of NEC 70E and OSHA 1910 with respect to safety clothing.

1.3.9 Generally report any unsafe behavior or conditions at facility inspected.

1.4 Vibration Analysis:

1.4.1 All rotating equipment will be tested with infrared AND vibration analysis.

1.4.2 Rotating equipment name plate shall be recorded for RPM, HP, FLA, type of coupling, configuration, ambient temperature and max. temperature

1.4.3 Vibration shall be collected in no less than ten (10) locations on a two piece drive-train.

1.4.4 Vibration shall be measured in ips overall RMS unfiltered.

1.4.5 If problems are encountered the vibration testing may lead to spectrum analysis to determine the root cause of a problem if one cannot be found.

1.4.6 Each unit shall have been running for no less than 15 minutes prior to testing.

1.4.7 Bearing frequencies and cavitation/recirculation shall also be tested.

1.4.8 Compare vibrations to ISO standards and make recommendations for repairs or remedial action.

1.5 Reports:

1.5.1 All defects must be coded according to severity and the need for timely action.

1.5.2 All "red" code violations must be reported at once to management verbally or in writing while still on site.

1.5.3 Reports shall evidence defects only not normal profiles.

1.5.4 Trending is recommended when shut down is difficult and rate of deterioration needs to be monitored on a frequency.

1.5.5 All data shall be archived for at least one year. Under 3 year contract for 5 years min.

1.5.6 Bar coding and arc flash warning labels when appropriate shall be affixed. Performance labels may be affixed as requested for inspection verification and control.

1.5.7 Customization for clients is encouraged.