Howard Smart Transformer Features and Capabilities

General concept: A special distribution transformer with integral capabilities for measuring, analyzing and communicating various parameters to support smart-grid initiatives.

Sensing capabilities:

- Senses the temperature of the transformer using thermocouples
- Measures both low voltage half-winding temperatures via thermocouples embedded in the coils
- Measures top-oil temperature via a thermocouple mounted inside the transformer at top-oil level
- Measures ambient temperature via a thermocouple mounted on the electronics enclosure
- Calculates coil hot-spot temperature using a mathematical model based on measured temperatures
- Measures the temperature inside the electronics enclosure
- Measures both secondary RMS voltages
- Measures both secondary currents
- Measures secondary watts, volt-amps, and power factor
- Measures cumulative kilowatt-hours

Analysis capabilities:

- Estimates the remaining insulation life of the transformer
- Uses ANSI equation for insulation aging, based on hot-spot temperature of coil over time
- Keeps up with percent of insulation life used

Reporting capabilities: The following values can be reported on demand or automatically.

- Temperature of both low-voltage half windings
- Temperature of top-oil
- Temperature of ambient
- Temperature inside the electronics enclosure
- Calculated current hot-spot temperature of the coil
- Peak hot-spot coil temperature recorded
- Minimum hot-spot coil temperature recorded
- Calculated percent insulation life used and remaining life
- Secondary RMS voltages
- Secondary RMS currents
- Secondary watts, volt-amps, and power factor
- Cumulative kW-hours
- Power-fail indication if transformer looses power
- Current date and time
- Serial number of transformer
- Catalog number of transformer
- Primary voltage rating of transformer
- Power rating of transformer in KVA
- Structure number (utility entered)
- Location of transformer (GPS coordinates)
- Firmware version of Smart Transformer circuit board

Controllable/configurable settings:

- Reset peak and minimum temperature readings
- Enable or disable periodic reporting of data
- Change the time interval for periodic data reporting
- Set insulation life consumption value
- Set custom coefficients for the ANSI insulation aging formula
- Set normal expected insulation life value
- Communications retry time interval
- Communications retry attempt count

Hardware/firmware features:

- Low power circuit board that draws its power from the transformer secondary
- Front-end surge suppression to protect the circuit board
- Long-life, industrial-grade circuit components
- Long-life super capacitors are used instead of batteries to temporarily maintain power to electronics board in the event of a power failure, providing a power-fail notification to utility's SCADA system, indicating transformer identity and location.
- Cellular radio board with embedded or external antenna to communicate with utility's cellular network and SCADA system
- Industry-standard DNP3 communications protocol
- Non-metallic, weather-tight electronics enclosure mounted to the exterior of the transformer tank
- Thermocouple wires and power/voltage sense wires routed from the interior of the transformer through a sealed feed-through or connector on the transformer tank wall to the electronics enclosure