To reduce maintenance expenses, many utilities are departing from traditional maintenance practices based on in-service time or number of operations, in favor of reliability-centered maintenance and condition-based approaches. Reliability studies have proven that most failures occur in a breaker’s main insulation path to ground, followed by faults in its compressors or pumps, control elements, and interrupting units. Condition monitoring of those areas can effectively improve reliability while reducing expenses.

The CBS Lite CSA (Coil Signature Analysis) combines on-line monitoring of statistically failure prone components with breaker timing functionality, to provide true universal applicability on any manufacturers’ single-pressure SF₆ circuit breakers.

**Coil Signature Analysis**
The CBS Lite CSA captures the coil currents during an operation via either shunts or powered CT’s. The coil signature, independently per coil, is then evaluated to determine the health of both the coil and the breaker’s mechanical system. Specifically, the first time to peak is compared against setpoints defined by test operations to alert the user of any degradation in breaker performance. Also, the coil signature is stored along with the operation record for further evaluation by the user.

**Breaker timing through simulated travel**
Obtaining timing information from various make breakers through custom installation of travel sensors poses a formidable host of technologic and economic challenges. The CBS Lite CSA addresses those concerns by applying patent-pending simulated travel functionality.

Operation of the breaker’s auxiliary switches provides the essential intelligence upon which the CBS Lite CSA reconstructs a travel curve, making it unnecessary to exactly replicate a measured curve. By combining the simulated curve with phase current information, the CBS Lite CSA quantitatively reports accumulated interrupter wear. Moreover, the simulated travel curve provides an illustration of the breaker’s timing, as well as a tool to deduce information about changes in breaker timing.

**Interrupter wear**
On-line monitoring of accumulated interrupter wear enables service to be performed on a proactive basis, eliminating costly unplanned interrupter overhauls, which are known to introduce particles and often lead to catastrophic failures shortly thereafter.

Because of pre-strikes, breaker closing duty is as much a contributor to interrupter wear as is current breaking. The CBS Lite CSA monitors the wear associated with both close and open operations by calculating the "it" value (current-time product) as well as "i²t". Wear is thereby measured from the time of current inception until contact touch, as well as from the time of contact separation until current interruption. Contact touch and separation times are obtained from the simulated travel curve, as well as user-defined settings. Interrupter wear data collected in this manner is far more accurate than relying solely upon operation of the breaker’s “a” auxiliary contacts.

While this approach is applicable to any single-pressure SF₆ circuit breaker, whenever the CBS Lite CSA is installed on an ABB breaker, the more accurate ABB-proprietary interrupter wear algorithm is automatically invoked.

**Close and trip coils**
The CBS Lite CSA monitors the breaker’s close and trip coils, whose failure may not otherwise become evident until called upon to operate. Open as well as shorted coil conditions are monitored, as failure in either mode can result in unplanned outages. Affording such early detection of control coil problems enables scheduling of repairs during off-peak times.
Mechanism charging system
Critical to successful fault current interruption is the breaker’s mechanism, which relies on a charging motor to maintain readiness to operate. The CBS Lite CSA monitors the number of motor starts per day as well as motor run time. It differentiates between motor starts that follow breaker operation from those without operation. Conditions such as worn motor brushes, inefficient pumps or hydraulic leaks can be detected before they result in loss of stored energy.

SF₆ gas monitoring
Sulfur-hexafluoride (SF₆) is essential for maintaining insulation to ground and for abetting current interruption. Any significant loss of the gas can lead to breaker failure, while even small emissions contribute to the greenhouse impact on the environment. Through on-line monitoring, the CBS Lite CSA provides advance warning of performance-affecting leakages as well helps utilities document their SF₆ usage in support of the EPA’s drive to reduce greenhouse gas emissions.

To avoid false alarms resulting from temperature gradients within the breaker interrupting tanks, the CBS Lite CSA maintains gas density histories over five different time spans. Gas densities are derived from separately measured temperatures and pressures that are applied with SF₆ state equations. From that data, five leak rate values are continuously calculated. This method enables the CBS Lite CSA to quantify fast leaks with moderate accuracy, while reporting slow leaks with great accuracy. Identifying gas density trends in this manner serves as an excellent breaker diagnostic tool.

Self-check
The CBS Lite CSA constantly monitors its sensor inputs for plausible readings. If a reading is indicative of a malfunctioning sensor or miswired input, it is treated as questionable, and its value is traced throughout calculations. Monitor problems are thereby distinguished from breaker problems, and they can be corrected as resources allow.

Alarm notification
The CBS Lite CSA presents alarms progressively as two separate tiers. First signaled is a “Caution” alarm, an event worthy of scheduled investigation. A more urgent condition is presented as a “Problem” alarm, which may require immediate attention. Alarm notification can be sent via a relay contact output or through a common network protocol, such as Modbus or DNP3.

Communication
To reduce cost of ownership and maximize freedom in the design of the communications infrastructure, the CBS Lite CSA includes a serial port that interfaces with most third-party communication options and supports protocols such as Modbus and DNP3. In addition, the CBS Lite CSA can communicate via the proprietary CBS protocol, which is most efficient when combined with CB Insight™ user-interface software.

Third-party vendors make available a number of communications options, including:
- Serial (via fiber-optic or copper conductors)
- Ethernet (via fiber-optic or twisted pair conductors)
- RF communication (short range)
- Cellular M2M (long range)

The CBS Lite CSA exports values related to its monitored conditions (DNP points list) as well as operation records (in COMTRADE format).

CB Insight™
CB Insight™ is a user-friendly software program that communicates with the CBS Lite CSA, both locally and remotely.

Advantages
- Design based on proven technology and years of field experience.
- Improved accuracy through advanced algorithms.
- User-friendly software that has been developed and improved over the past ten years.
- Patent pending simulated travel feature provides timing data without the cost or complexity of sensor installation.
- Universal applicability on any manufacturer’s single-pressure SF₆ gas circuit breaker.
- Simple enough to be user-installed, although installation also available through ABB HV Service.

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