

PROLIFIC'S SUBSTATION SWITCHYARD HEALTH REPORTING SYSTEM (PSHRS)

Need of PSHRS

- Due to ever growing demand of power supply, evolving complexity of power system networks and criticality of delivering reliable and uninterrupted power supply to consumers, the equipments in the electrical system need to operate 24 x 7 under demanding operating conditions; and therefore are subjected to different electrical and mechanical stresses in the process.
- For satisfactory performance, effectiveness and reliable operation of equipments, a regular check- up of their operating conditions and their timely maintenance is important. This helps in early detection of faults and prevention of failures which may otherwise lead to power failure and even widespread disturbances.
- Power transformers and circuit breakers are critical and costly equipments and their condition monitoring is essential.
- PSHRS helps render trouble-free service during the lifetime of equipments. It helps to avoid faults/failures/disturbances by virtue of sufficient, periodic and regular supervision/maintenance/health check-ups using diagnostic tests and condition assessment techniques.

PSHRS scope

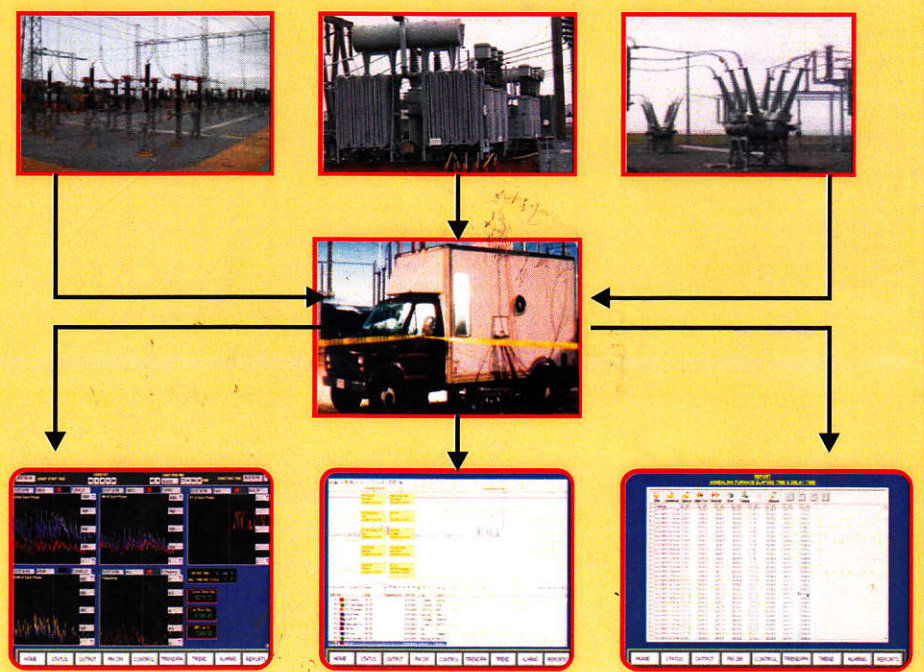
- Testing of substation equipments on-line/off-line
- Generating test reports including expert comments on health of equipments and solutions to the problem.
- Record keeping and report data updating for future analysis & trends.

Equipments Covered under PSHRS

- Transformers
- CVT / PTs
- Breakers
- CTs
- Lighting Arrester (LA) / Surge Arrester (SA)
- Isolator
- Earthing

Benefits To Substation Owner

- Increased Life & Safety of equipments as deficiencies are noted and corrected before they fail & pose hazard.
- Increased efficiency & reliability of equipments, as conditions that ultimately increase the equipment failure can be corrected at an early stage.
- As impending failures are discovered; the repair work can be scheduled during off-peak hours, reducing the amount of inconvenience, expenses & increase the availability of the equipments/systems.
- Equipment-wise history-sheet helps maintaining them for longer period.
- Reduces the testing time & equipment handling, thereby reduce shutdown period & increase availability, with the use of mobile van equipped with automated test-set up.
- Diagnostic techniques & condition based monitoring provide valuable /reliable database & helps in planning for maintenance & to detect early symptoms of developing faults, ageing development & other problems.



PSHRS Schematic

Testing Tools

Prolific has special mobile van comprising PC based test bench & compatible testing instruments for checking and reporting the health of substation equipments.

Various Tests covered in PSHRS

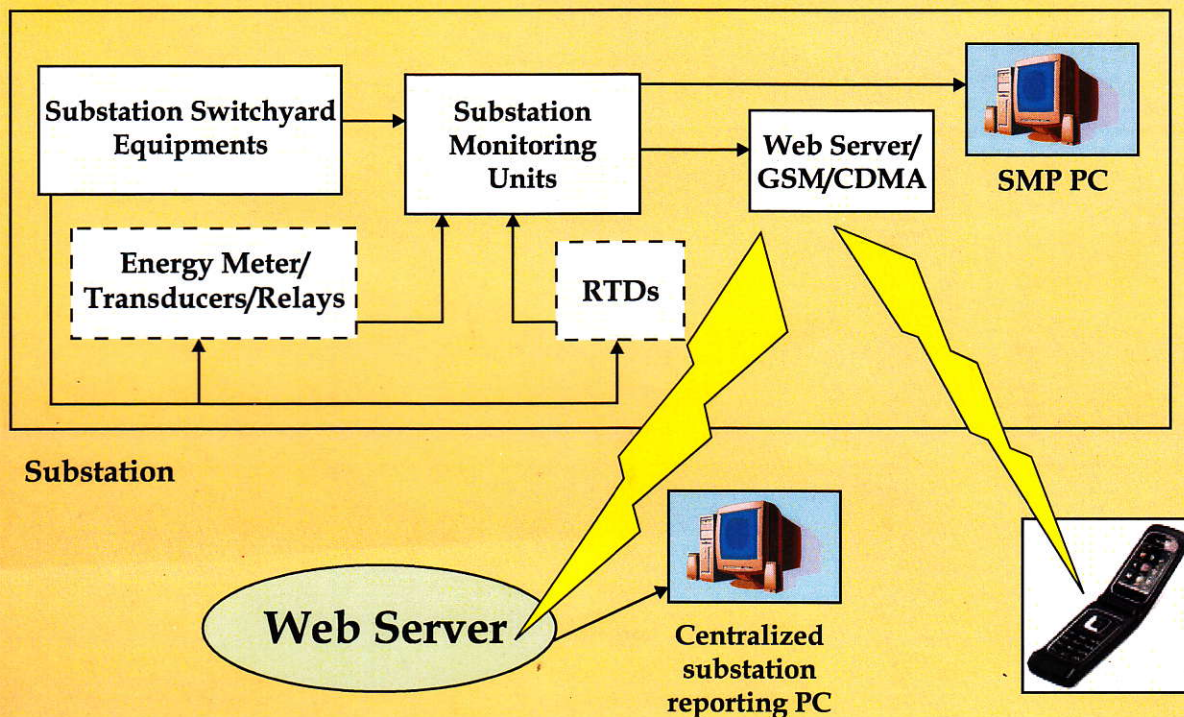
SN.	Measurement	Application
Tests for Transformer		
1.	Insulation Resistance (IR)	Indicates contamination (dirt/ moisture), stress, insulation degradation
2.	C&Tan-delta of bushing & winding	Assesses oil degradation / contamination, insulation condition (dry/wet) of bushing/winding, water content
3.	Turn-ratio	Indicates problems in winding & verifies tap changer's connection & operation
4.	Winding resistance	Detects problems in broken sub-conductors, winding contact joints, tap changer connections, contacts & diverter switch operation
5.	Swept Frequency Response Analysis(SFRA)	Detects winding movement/distortions & changed clamping pressure by measuring impedance over wide range of frequencies.
6.	Leakage reactance	Indicates winding movement, structural problems (displaced winding, buckling).
7.	Infrared Thermography	Identifies incipient faults in bushings /joints & oil flow restrictions.
8.	Oil Parameters 1. Break down voltage 2. Moisture & acidity 3. Fusion phenol & Cresol 4. Other tests as per IS std.	Indicates particles present in oil. Indicates oil condition Indicates occurrence of solid ageing in paper barrier insulator/packing . Check for healthiness of oil
Optional Tests for Transformer		
9.	Excitation / Magnetization current test	Locates faults in magnetic core structure (shorted laminates, core bolt insulation break down, shorted turns due to insulation failure)
10.	Magnetic balance test	Checks healthiness of Magnetic path (core)
11.	Short circuit test	Winding check
12.	Dielectric response test	Detects moisture content /ageing of insulation
13.	Partial Discharge (PD)	Detects contaminated insulation/winding & damaged core.
14.	Dissolved Gas Analysis (DGA)	Provides early warning of incipient faults in transformer oil
15.	Vibration & spectrum analysis	Detects change in winding state, mechanical looseness of clamps on core/winding, pump/fan-bearing wear.
16.	Harmonic analysis	Measures the power quality
17.	On-line temperature monitoring	Monitors continuously hot spot temperature to control loading patterns & thermal ageing. Healthiness of cooling system.
18.	Furfuraldehyde analysis of oil	Detects ageing of cellulose material without sampling.
19.	Photo-Acoustic Spectrography	Measures moisture, diagnoses algorithm.
20.	On-line moisture	Monitors moisture content in oil.
21.	Polarization spectrum /recovery voltage	Indicates moisture in insulation, paper ageing & oil condition.
22.	On-line hydrogen	Detects gas built earliest & alerts for detailed laboratory analysis.
23.	On-line vibro-acoustic	Evaluates residual clamping pressure in core/winding, observes dynamic behavior /movement in structure.
Tests for Breakers		
24.	Insulation- Resistance(IR)	Checks healthiness of insulation of breaker
25.	Time Measurement	Checks closing, tripping & CO, PD timing per phase/per break, Healthiness of closing & tripping coils & operating mechanism, Contact travel
26.	Contact Resistance (CRM)	Identifies wear & tear of power contacts, contact firmness between fixed & moving contacts.
Optional Tests for Breakers		
27.	Dynamic Contact Resistance (DCRM)	Checks for contact travel, operating mechanism & bouncing.
28.	Dew Point Analysis -	Measures moisture in SF6
Tests for CT/PT/CVT		
29.	Insulation- Resistance(IR)	Checks healthiness of insulation of primary winding and secondary winding.
30.	Ratio error and phase angle error	Measures the accuracy of CT./PT/CVT
31.	Knee point voltage test	Indicates CT saturation limit
32.	Capacitance & Tan delta	Assesses insulation condition of winding.
Tests for LA		
33.	Insulation- Resistance(IR)	Check healthiness of insulation of stacks
34.	Leakage current test	Healthiness of LA
Tests for Isolator		
35.	Insulation- Resistance(IR)	Checks healthiness of insulation of isolator
36.	Contact Resistance(CRM)	Checks firmness of contact between male & female connector.
Tests for Earthing		
37.	Earth resistance test	Checks healthiness of earthing systems of substation equipments.

PROLIFIC'S SUBSTATION SWITCHYARD REMOTE MONITORING & CONTROL SYSTEM (PSRMS)

Need of PSRMS

- Prolific's Substation switchyard Remote Monitoring & Control System (PSRMS) is a versatile, PC based system with Substation Monitoring Pro (SMP), an intelligent substation monitoring & control software, at its heart. PSRMS- A comprehensive hardware-software suite with SCADA functionality fully interfaced with Energy meters or Transducers and communicating over LAN/WAN/GSM/CDMA.
- Due to several reasons such as equipment failures, lightning strikes, accidents and natural catastrophes, power disturbances and outages occur in substations and often result in long service interruptions.
- PSRMS ensures a highly reliable, self-healing power system that rapidly responds to real time events with appropriate actions, ensures to maintain uninterrupted power services to the end users.
- PSRMS is for managing, controlling & protecting a power system. This is accomplished by obtaining real-time information from the substation, having powerful local, remote control and advanced electrical protection.
- PSRMS is applicable to electrical power network at large, from high voltage transmission network, to medium voltage network, to low voltage reticulation network.
- The PSRMS renders not only to devise strategies for an unmanned operation of substations, but also to supplement the operator with more knowledge, data and facilities and to help him to be more effective in his operations.
- Using PSRMS, the scheduling and maintenance engineers achieve following:
 - ⊙ Altering the alarm limits
 - ⊙ Modifying the description texts
 - ⊙ Retrieval of
 1. Special measurements
 2. Fault and disturbance records
 3. Event records
 4. Daily log sheets
 - ⊙ Modify load shedding schemes
 - ⊙ Control of breakers and switches
 - ⊙ Periodic/on-demand report generation
 - ⊙ Trending (real-time and historical)
 - ⊙ Central/Local overview display
- ⊙ The operator views the data in many forms such as tables, charts, trends, schematics.

PSRMS Schematic



PSRMS's working is combination of following processes

- **Process level function**
PSRMS consist of Intelligent Electronics Devices (IED) or Substation Monitoring Unit (SMU), relays and/or Remote Terminal Unit (RTU) they receive analog input from the Current Transformers (CT) ,Voltage Transformers and Transducers in the various switchgear panels, as well as digital input from auxiliary contacts, other field devices.
- **Interface function**
The communication network serves as the interface between the bay level and the SCADA station level, which might be a SCADA master station in substation itself, or remotely in central control room. With the help of LAN/WAN/CDMA/GMS.
- **Control, Monitoring & Analysis level**
The SCADA master receives data and information from the field, what to do with it, store it (directly or after some processing) and issues request and/or commands to the remote devices.

PSRMS performs following function

❖ **Electrical protection**

Electrical protection is essential for any electrical switchgear panel, in order to protect the equipment and personnel, and to limit damage in case of an electrical fault.

❖ **Control**

Control includes local and remote control. Local control consists of actions the control device can logically take by itself. (Bay interlocking, switching sequence and synchronizing check)

This reduces human intervention and error. The controlling involves opening and closing of breakers

Changing Relay's setting obtaining certain information about equipments.

❖ **Measurement**

Measurement involves measuring various parameters and their display at central control room.

Electrical measurements (Voltage, Current, Power, Power factor & harmonics).

Analog measurement such as Oil level, Oil temperature & winding temperature.

Disturbance recording for fault analysis.

The huge amount of real-time information collected can assist tremendously in doing network studies like load flow analyses, planning ahead and preventing major disturbances in the power network, causing huge production losses.

❖ **Monitoring**

Monitoring can be used effectively to improve the efficiency of the power system and the protection.

1. Sequence of Event Recordings.
2. Status and condition monitoring, including maintenance information, relay setting etc.

❖ **Data Communication**

Data communication forms the core of PSRMS and it is virtual connecting link that holds entire system together.

Features of PSRMS

- Integration of Energy meter, Transducer & Relays in a single system.
- Provides Local access for troubleshooting.
- Instant error-free report generation & printing.
- Retrieves relevant data for enhancing maintenance, operating functions and predictability in various power network situations.
- Connectivity with ERP system.
- SMS alert / Alarm about critical parameter at substation.
- Measured data of loadings, reactive power, earth current and power quality at the substation.

Benefits to substation owner

- Effective management of the capacity of the substation and load shedding
- Advance disturbance and event recording capabilities aiding in detail fault analyses.
- Measurements to provide relevant data for enhancing maintenance and operating functions and predictability in various power network situations.
- Accurate and real-time information on substation such as loading and on-site conditions including intrusion.
- Increases the functionality and reliability of operation of distribution networks.
- Display warnings and alarms in real time which will be used to troubleshooting of the substation system.
- Continuous monitoring detects early warning signs of incipient failures and also builds your knowledge base for confident decision making to reduce future risk.
- Remote switching and advanced supervisory control over the power network. It will maintain safe distance from the power equipment.
- Obtain unmanned operation at some times.
- Display of real time substation information in a centralized control cable.
- Authentic energy quality information through registration of voltage dips and spikes according to standards
- Increases the integrity and safety of electrical power network including interlocking function.

PROLIFIC SYSTEMS & TECHNOLOGIES PVT. LTD.

An ISO 9001 Certified Company

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