On line Monitoring with Advanced Systems for Overhead Transmission Towers and Lines

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- Discussion
There are some incidents where damages occurring on transmission towers by removing/stealing parts of the structure thus monitoring is required.

Copper being stolen very often as it is a valuable metal thus monitoring is important.

Install Field RTU in tower structure and integrate Video surveillance, seismic sensors, accelerometers.

Monitor Tower basement failures

Monitor Huge damage to due to high wind, floods around transmission tower area
INTRODUCTION

- Tower grounding connections shall be monitored with Field RTU
- Integrate all the other sensors and communicate to control center through OPGW or with advanced sensors (PMU-Phasor Measurement Units) on overhead lines and communicate with control centres if the transmission lines are more length.
- When a discontinuity of tower angles and earth connection or heavy wind forces acted on transmission line tower which arises, the alarm and trip logic circuits will be initiated by Field RTU system to trip related CBs at local substation protection schemes and remote substations by SPS.
Justification for Transmission line monitoring and Integration of Sensors

- Environment Impact
- Damage
- Injuries
- Process Loss
- Losses

Right Time to Integrate

- Vandals damage to Tower
- Environmental Impact
- Stealing tower parts
- Earth tremors
- Lack of physical stability
- losses
Lack of Information in Transmission line

- Wind force and wind direction
- Rain fall
- Ambient Temperature around the tower area
- Basement supervision
- Earth connection of tower foot
- Aviation Warning Lights status

Less Information may Sabotage System
Transmission line towers status at remote locations affected by storms and theft
Various factors affecting Transmission Towers and Lines

- Stealing of Lattice Tower supports & Angles
- Contamination of insulators
- Wind Force
- Level of Supporting Towers
- Corrosion
- Conductor Sag & Tension
Tower parts Monitoring by Field RTU
Overall setup for transmission lines monitoring system
Various signals integrated with Field RTU

1. Field Effect Voltage Sensor
2. Lattice Angles Digital status signal
3. Weather Transmitter & Camera
4. Accelerometer & Seismic Sensor
Transmission line tower System monitoring with RTU, Weather station and PMU and SAS
Hierarchical Structure

UPPER LAYER
DATA Communication

MIDDLE LAYER
DATA Processing

LOWER LAYER
Sensor  Sensor  Sensor  Sensor
Multi sensor System Integrated

Audio  Video  Others
Human Machine Interface

Integration enhance the system
Crossing the barriers to reach the Goal

Data transmission to control center

Connect with Splice Box

Interface with Optical media

FIELD RTU at transmission tower

Data Signal at Field to Control Center
Transmission line tower monitoring Data Integration process architecture
logic contacts field points with SAS connection diagram
Scalable Architecture

- Interconnections and merging of digital signals (monitoring of lattice steel angles continuity) and analog signals (wind force, wind direction, rain fall, relative humidity, fog) have to be integrated with advanced sensors (PMU) and with Substation Automation System.
- Analogue format signal connection is an ideal solution for IED ports or Analogue cards in case of SCADA RTU system.
- Should be capable of supports with Ethernet Network with Merging Units to give optimum and accurate values from Sensors.
## System Requirement

<table>
<thead>
<tr>
<th>Field RTU GPRS</th>
<th>Module GSM+Ant+Batt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Field Effect Voltage Sensors</td>
<td>Analog /digital</td>
</tr>
<tr>
<td>Accelerometers</td>
<td>Analog /digital</td>
</tr>
<tr>
<td>Seismic Instrument</td>
<td>Analog /digital</td>
</tr>
<tr>
<td>RS232 camera</td>
<td>Module</td>
</tr>
<tr>
<td>Ethernet camera</td>
<td>IP based camera</td>
</tr>
<tr>
<td>Weather transmitter</td>
<td>RS232/RS422/RS485/SDI-12</td>
</tr>
<tr>
<td>Field termination strip</td>
<td>HD PE insulated</td>
</tr>
<tr>
<td>Thin film insulated wire</td>
<td>Flat wire for interconnections</td>
</tr>
</tbody>
</table>
System Design

- Data Communication through OPGW (Single mode) in case small length transmission lines
- Data Communication through **VSAT** in case of very long interstate transmission lines
- Creation of soft Logic Contact for Commands
- SPS – Special Protection Schemes for remote trip
- Solar Power with backup battery
- All sensors design should comply with harsh environment, fog.
Application of Integrated Monitoring

Transmissions sites where:

- Mountainous and valley area
- Dense forest area
- More Steep with dangerous area
- Site Prone to frequent tremors
- Site prone to fogy area
- Site where prone to vandals damage
Significant benefits of Tower Monitoring

- Less maintenance time and expense
- Greater safety for power system
- Improved Asset Management system
- End user is for monitoring long stretches of Transmission lines
- Improved system and equipment fault protection
A. Small length Transmission Lines

- Field RTUs at each 10 Kilometres distance to communicate with PMU at one appropriate location.
- All the monitoring signals and its synchronisation methods for the field RTU and PMU shall be met the requirements of 9-2LE (and hence IEC 61850-5) IRIG-B will still require a separate distribution network.
• **B. Large Length Transmission lines**

- Path compensation for large transmission line towers from BSP substations may have in excess of 15 MUs (according to the requirements of monitoring of connections of line towers)
- Field RTU wireless covering range from 30Km to 50Km and if more distance from control centres, **VAST aided communication** system to be employed to communicate the Data transmission between PMUs at Tower and PMUs at CC
Three Major dimensions can be identified in this integrating project
(1) Technical dimensions
(2) Economical dimensions and
(3) Safe operation dimension
Conclusion

- Integration of Tower monitoring parameters with line parameters enhance Transmission Asset Management (TAM)
- This integration techniques shall be applied for the Monopoles transmission lines and Radio towers
- Power grid operators can respond to power outages quickly, and thus maximize the security of transmission line equipment against loss of lattice steel angles and ground connections and environmental impact
Any questions?

Thank you for Viewing!
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