What are the management challenges to maintaining existing substations in both the short term and long term.

- Reducing cost of substation equipment including capital cost, operating and maintenance costs.
- Risk of system failure (service interruptions) due aging equipment reaching end of service life.
- Aging equipment requiring higher intervals of maintenance that impacts system availability and reliability.
- Lack of sufficient visibility of online substation assets for tracking, monitoring, and assessment.

What new ideas and concepts will provide insight on asset life extension and reduced cost while improving reliability?

Integration of…
- Logical schematic and geospatial topology technologies (Electrical Digital Twin)
- Intelligent analytics and predictive tools
- Scalable energy and power management systems
- Smart automation and remote controls with embedded edge connectivity, mobility, and cyber security
- Machine-Learning with condition-based maintenance to gain predictive, preventive, and ultimately prescriptive maintenance of substation assets.

Real-time detection, diagnostics, and analysis of derogating equipment / components (through IoT sensors with embedded / connected predict analytics software) to provide insight in timely assessment of the current condition and prediction of the remaining life.

Development and application of prognostic algorithm (AI-based analytics) for predicting and prescribing the remaining life of substation assets.

Predictive Maintenance
Maintaining production uptime and reducing operating and maintenance costs are key drivers for utility. Alerting when the equipment is operating outside its normal range can provide sufficient time to react and correct the problem before an unplanned outage occurs. Based on the severity of the alert, engineers and maintenance personnel will be able to make sound decisions as to whether it is appropriate to correct the problem right away or to postpone the correction until a planned maintenance outage. This is the concept of “predictive maintenance” that allows personnel to strike a balance between safety, plant uptime and operating cost.

is cybersecurity can be considered as challenging when upgrading old equipment /automation ?

Indeed, this can be a concern for some of the utilities as they decided to upgrade to new equipment which are natively connected and more open. Although, many sensors and platforms bridging the IT/OT space have already or are in the process of addressing the cybersecurity concerns (adhering to the Cybersecurity standards, regulations / required certification) and also the accessibility of the data on the private cloud (vendor or customer or hybrid

Examples :

On the topic of substation asset monitoring and diagnostic, Schneider Electric's EcoStruxure Asset Advisor offers such a solution via connected field devices and sensors. As an example, Partial Discharge (PD) sensors can detect early signs of insulation deterioration for CBs and Cables. There are also external PD for indicating overheating connections using UHF PD survey scanners that are utilized in the field.

For people who are familiar with Cigre 858 reference on Asset health Indices for Equipment in existing Substations; Schneider Electric Asset Advisor can offer Level 5 solution where offline measurement and online monitoring are combined to offer comprehensive diagnostic strategy. In fact, our offering goes a step beyond by integrating the data-driven analytics with the electrical digital twin model to provide a new insight for assessing and predictive the health and state of substation assets and the system.

For reference, here is an excerpt from Cigre 858 on the above:

"Level 5: Advanced Strategy – added continuous online monitoring
The addition of offline diagnostics and selected online systems should produce the most comprehensive diagnostic strategy, matching all failure modes with a diagnostic indicator, and in some case cater for cases where rapid changes in condition can occur. For completeness it would also include outage testing identified in Level 4. There has been a long history with online dissolved gas monitors and bushing power factor systems. Partial discharge monitoring is becoming more widespread after many years use in GIS. Some see further developments to cover more failure modes on equipment throughout a substation. Data can be TB 858 - Asset Health Indices for Equipment in Existing Substations 30 fed back and combined with operational data extracted from Historian servers to allow a dynamic indication of AHI. Over recent years the reliability and longevity of monitoring systems have improved. Site data management and hardware have improved, with fiber networks and IEC 61850 protocols enabling greater access between vendor systems. Access to operational data is improving with an asset management data file being incorporated into the Common Information Model (CIM) by IEC TC 57."