NAME: Norikazu FUSE (CRIEPI)
COUNTRY: Japan
REGISTRATION NUMBER: DLG6497

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Q1) CIGRE TB 765 reviewed the several possible causes of corrosion. Paper 10646 addresses detecting corrosion invisible to the naked eye using a new imaging technique.

A) Corrosion control in the electronic industry relates to the management of obsolete equipment in the generating and outdoor electric systems. The fundamental corrosion types and mechanisms were comprehensively reviewed in TB-765. The TB also argued the necessity to exhibit more specific cases in the industrial aspect. Anticorrosion coating (i.e., paint) is often applied to steels used in electric transmission lines. The steel equipment is hot-dip galvanized to inhibit atmospheric corrosion when they are installed. The coating is applied when the galvanizing is worn out after long-term operation. However, the applied coating also suffers some degradation. Therefore, maintenance is essential not only for the steel but also for the coating. Another issue presented was that the corrosion is hard to recognize because the coating is opaque. Thus far, the corrosion in coated steels is often noticed after the coating degrades and the resultant rust fluid is observed.

Q2) What are the other methods being applied or developed to detect hidden corrosion?

A) Several methods can be used for walk-around checks and simple examinations to evaluate the integrity of the coated steels. Many focus on blistering and loss of adhesiveness in the coatings because such degradations directly impact the extent of corrosion. ISO 4628 specifies the procedure for classifying the blistering level by comparing digital camera snapshots with boundary samples. Adhesiveness test procedures are also specified in ISO 16276. Such methods require a certain level of expertise, and the result often relies on the subjective opinion of inspectors. The method employed allows objectivity and continuity, even considering workforce reductions. The electrochemical impedance method is a promising field technique, requiring only a handy LCR meter. The capacitance and conductance of the coating are determined using the degradation index. Japanese research frequently refers to the criteria stated by the Federation of Electric Power Companies of Japan.

Q3) Are any other novel imaging techniques being applied to detect hidden corrosion?

A) Regarding the two-dimensional visualization of corrosion under opaque film, fundamental studies frequently use the scanning vibrating electrode technique, called “SVET.” The detection of the corrosion current can be reconstructed to visualize the corrosion state under the coating. Due to the scanning probe microscopy, wide-range observation in a short duration is often difficult. Recently, CRIEPI has employed deep learning techniques for aerial imaging of transmission towers to rank their degradation level. Since the analytic approach was automated for judgment and extraction of the tower parts from the snapshots, the technique is anticipated to be used for images captured by drones. However, this method is only applicable to uncoated steels. The motivation for our study 10646 originates from the fact that electromagnetic waves can effectively detect degraded regions hidden by the coatings. Related techniques are already adopted for highway roads and bridges, where deformed or foreign matter in the concretes can be visualized using radio wave reflection. Underfilm corrosion requires only several 100 μm of exploration depth, corresponding to the wavelength of in the far-infrared region. Millimeter wave technologies are particularly promising and can be used for two-dimensional visualization because the module is already available in drones for collision avoidance.