

Advanced Maintenance Technology – Rational Operation of Electric Facilities –

Brief Overview

To contribute to total cost reduction and ensuring reliability on electric facility arrangement to maintenance technology from power generation to transmission and distribution, we developed facility diagnostic technology and operation maintenance supporting technology applying at the power business site immediately.

For power generating facilities, we applied internal pressure bending creep tests for full-scale piping weld specimen to establish life assessment method of aged power generating components and steel structures through crack detection closely related to the life and clarified changes in failed conditions at the weld heat affected zones after 3,000 hours long period operation.

For transmission and distribution facilities, aiming at construction of maintenance standard for aged facilities we developed the component deterioration diagnostic technology to verify that abnormal phenomena such as partial discharge and conductor contact failure expected at aged gas-insulated switchgear (GIS) can be detected by using accumulation of SF₆ decomposite gas.

Achievements by Research Theme

Advanced maintenance technology of power generating facilities

- Gas turbine hot gas path parts maintenance
 - Practical operation of the X ray CT scanning system has been started, and the system was applied to the measurement of used parts.
 - Improvement in reliability of operating temperature distribution estimates has been made for film-cooled and TBC-coated blades.
*TBC; thermal barrier coating.
- Power generating plant performance diagnostics
 - We promoted to distribute diagnostics method to power plants by establishing support system of the thermal efficiency analysis program for power generation systems and by enhancing function to increase convenience to program users.
- Status diagnostics on power generation components
 - We developed high-speed simulation program for ultrasonic flaw detection to shorten the current prediction time for ultrasonic propagation behavior nearly to 1/10. (Fig.1 Table1)
 - We conducted internal pressure bending creep test for full-sized piping weld specimen to determine changes in failed condition of weld heat affected zone due to long time operation (after 3,000 hours).

Advanced maintenance technology of power distribution facilities

- Establishment of maintenance standards for aged electric facilities
 - We verified that abnormal phenomenon of aged gas-insulated switchgear (GIS) was be able to detect applying accumulated decomposite gas of SF₆.
 - We verified diagnostics method possible for detection of water tree degradation and location causing aged deterioration of XLPE power cables.
- Management measures for power distribution facilities
 - We developed fundamental model assessing the effect of power transmitting congestion mitigation and avoidance of supplying troubles.
- Asset management of power network
 - We were developing a support tool to level transmission equipment replacements over long planning horizon. Essential parts including reliability assessment and procedures to develop replacement plan were implemented.
- Asset management support technology
 - Maintenance management plan support tools developed by CRIEPI were remodeled to a general-purpose model to apply to various power components with different performance in aged deterioration. (Fig.2)

Advanced maintenance technologies for electric power facilities

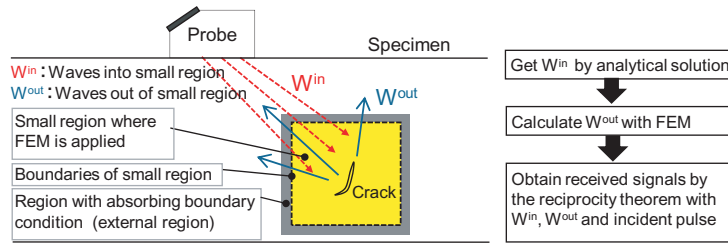
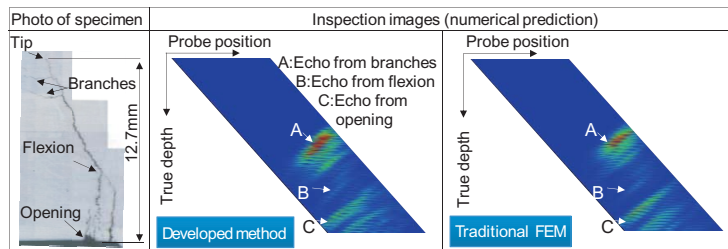
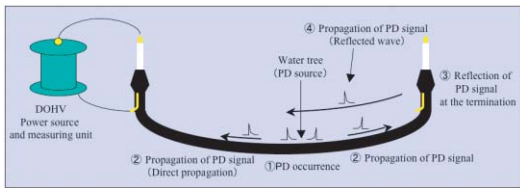


Fig.1 Development of hybrid method for high speed simulation of wave propagation based on the combination of analytical solution and the finite element method

Table 1 In comparison with traditional FEM, computation time by developed method decreases to one tenth and results are almost the same

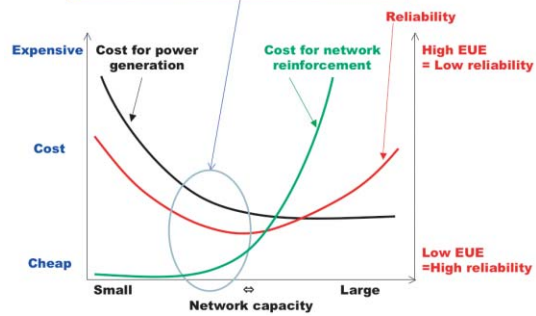


Advanced maintenance technology of power distribution facilities

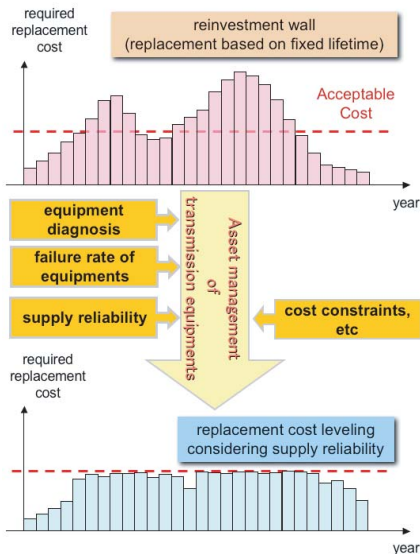


Concept of PD source location with Oscillating Wave High Voltage Testing Method

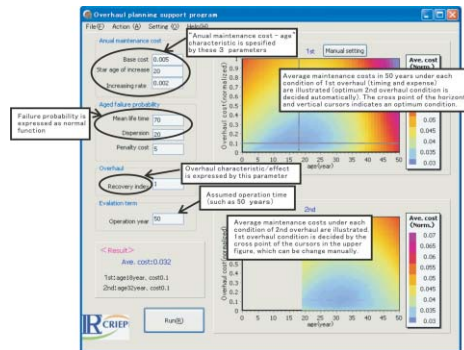
Optimum Solution: reasonable combinations of reliability, network capacity, and required cost.



Conceptual output of asset management support tool of network construction in competitive circumstances



Conceptual output of Network Asset Management Support tool



Display of support program for overhaul planning (Costs are normalized by an install cost of an equipment)

Fig.2 New Diagnostic Method and Asset Management Decision Support Tools