

## Study Committee B1

Title of Study Committee Insulated cable systems

10691\_2022

### A Study of Quality Management System for Underground Transmission Lines by Japanese Transmission System Operators

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#### Introduction

- In Japan, the breakdown rate of 66 kV XLPE cables is reported to be about 0.05[/100 km.cct.year] while the global rate in 60 - 109 kV reported to be about 0.0939[/100 km.year].

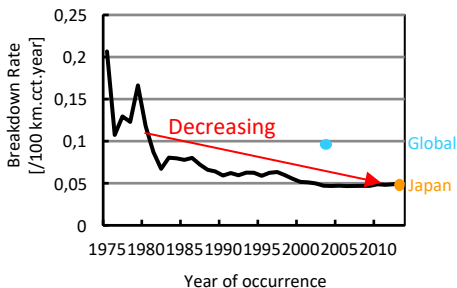


Fig.1 Breakdown rate of 66 kV XLPE cables in Japan

One of the reasons for the low breakdown rate in Japan even after AC and DC high voltage commissioning test has been discontinued since the early 2000's, would be the quality management system (QMS) of Japanese transmission system operators (TSOs).

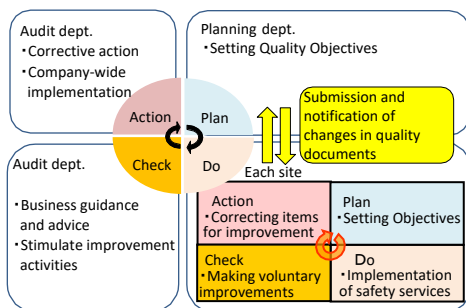


Fig.3 Improvement Activities Based on the PDCA Cycle

#### QMS activities at 4 stages

QMS activities can be categorized into 4 stages: "Design", "Manufacturing", "Construction" and "Operation".

#### Stage1 Design

- QMS mainly works on two points: clarification of design content, and thorough examination.

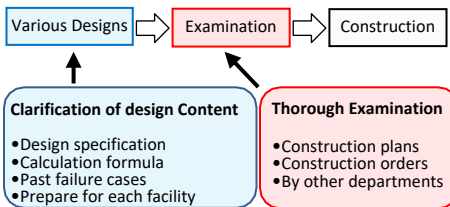


Fig.4 Design and Examination Process

Japanese TSOs can maintain and improve design quality through the rigid rules in QMS.

#### Stage2 Manufacturing

- A type approval system allows for TSOs to reduce costs by omitting detailed design and unifying specifications, and for Manufacturers to omit inspection items.

✓ Type Approval System  
 This is a system in which quality tests are conducted in advance for products that are installed in important equipment, are frequently used as common products.

#### Outline of QMS

- Japanese TSOs establish their QMS in addition to ISO 9001 or other national/international standards.

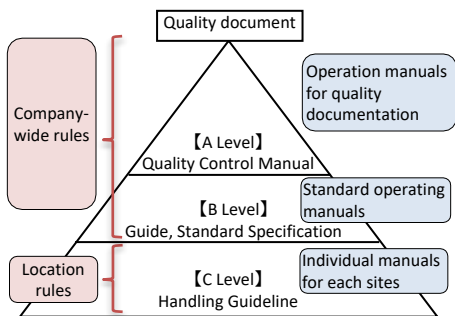


Fig.2 Documented Clarification in QMS

- Japanese TSOs continuously maintain and improve the quality of transmission lines based on PDCA cycle.

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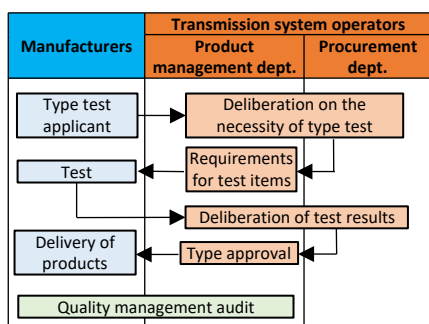


Fig.5 Flow of type approval system

Japanese TSOs can supply high quality products, and increases operational efficiency for both TSOs and manufacturers.

### Stage3 Construction

- Japanese TSOs can maintain and improve construction quality by introducing a jointer qualification system and quality confirmation to construction company.

<ul style="list-style-type: none"> <li>Jointer Qualification System</li> <li>Cable jointing work in a local construction companies is performed by workers who have attended lectures by the manufacturer and passed assembly tests.</li> </ul>
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Table.1 Contents of the jointer qualification test

Test contents	Evaluation contents
Lecture	Structure of joint box
Assembly test	Assembly dimensions
Electrical test	Partial discharge and Withstand voltage test

<ul style="list-style-type: none"> <li>Quality Confirmation to Construction Company</li> <li>The procurement dep. selects an appropriate construction company based on the scale of the construction by checking their quality control capabilities.</li> </ul>
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Japanese TSOs construction can be performed by companies and workers with guaranteed construction performance level.

### Stage4 Operation

- TSOs have created manuals for dealing with equipment malfunctions and implemented various initiatives to prevent accidents and respond quickly in the event of a failure.

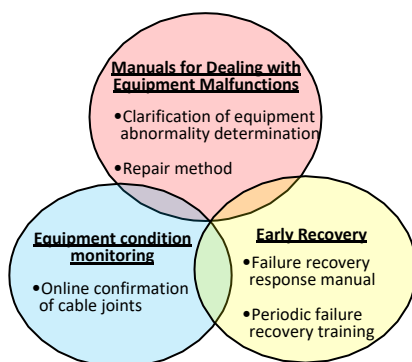


Fig.6 Initiatives to prevent accidents and early recovery

Japanese TSOs can respond appropriately and quickly to equipment failure.

### Quality Improvement through the Cooperation between Japanese TSOs

Each of Japan 10 TSOs improves quality by working together

- When a fault occurs, the cause is thoroughly investigated, and measures to prevent recurrence are shared among Japanese TSOs.
- Information on spare materials for accident countermeasures possessed by each Japanese TSO is shared among TSOs, and a system for exchanging spare materials in an emergency is also under consideration.

Japanese TSOs and manufacturers work together to ensure a stable supply of electricity.

### Conclusion

- In QMS activities, Japanese TSOs are improving the quality of their power systems on a daily basis by clarifying rules and improving operations through the PDCA cycle.
- QMS activities play an important role in the improvement of technological capabilities and the succession of lessons learned.
- TSOs and manufacturers work together to ensure a stable supply of electricity.

In conclusion, QMS largely contributes to the low failure rate of underground transmission lines in Japan.