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Statistical analysis of lightning-protection levels of substations in Japan

SC C4

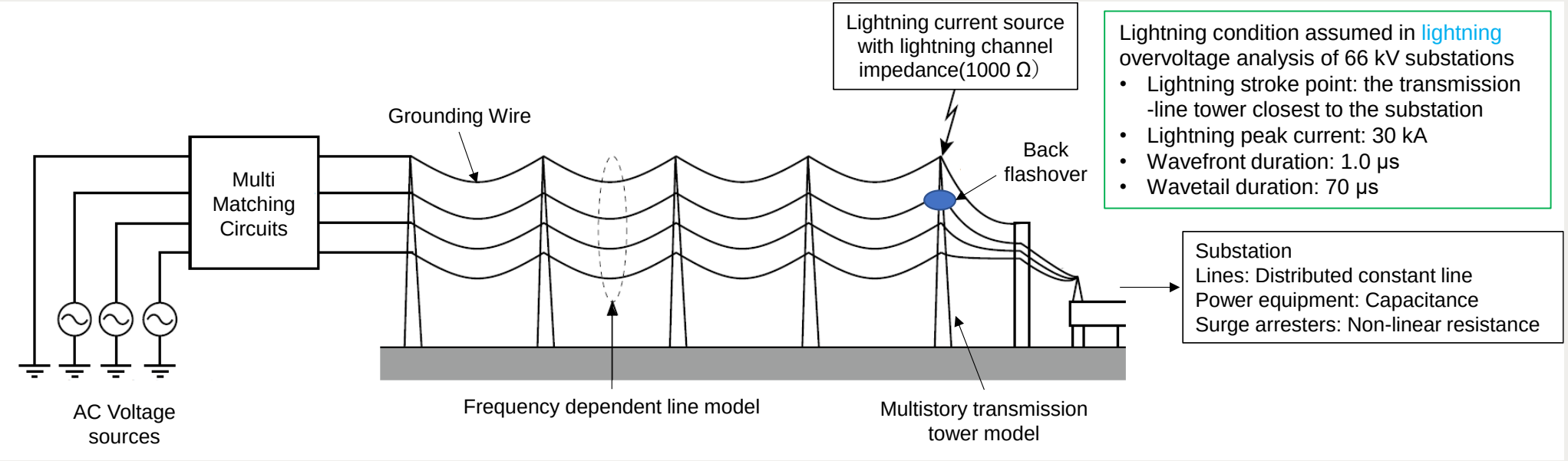
PS2 Question 9

Kazuyuki Ishimoto (Japan)

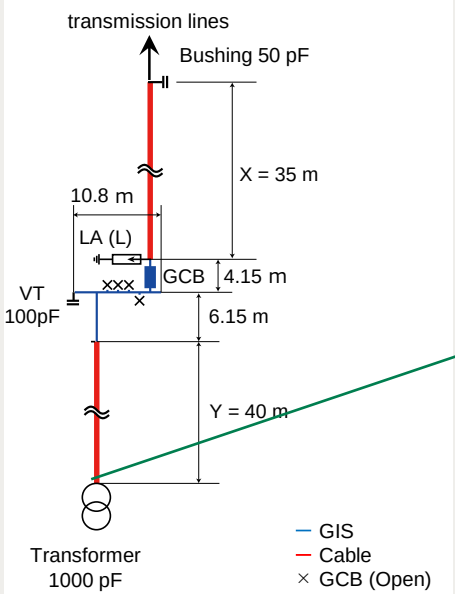
CRIEPI
Central Research Institute of Electric Power Industry

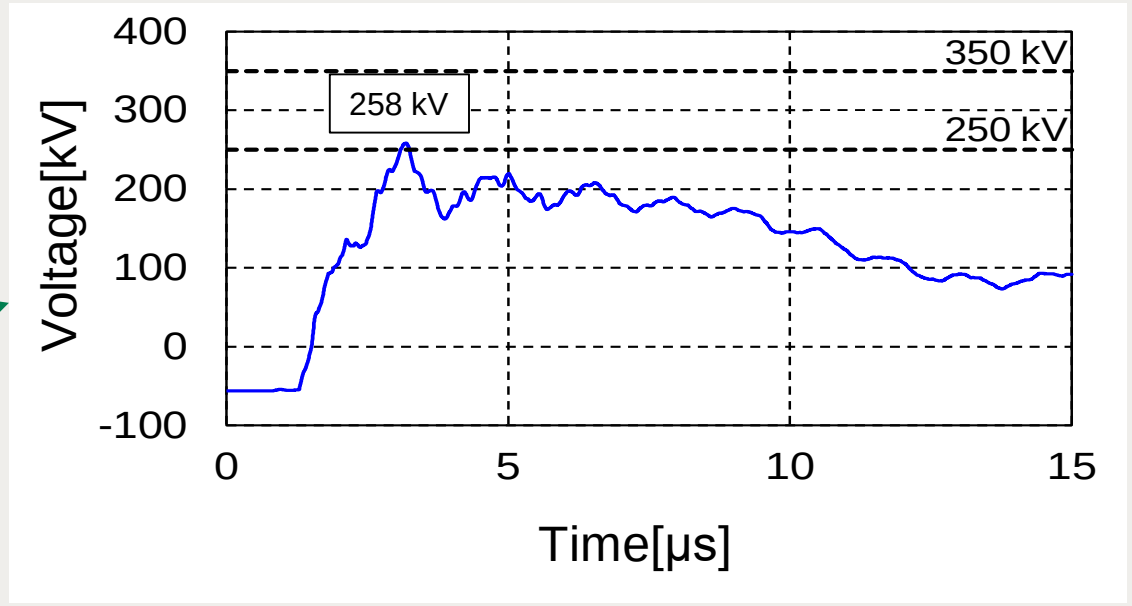
Deterministic Lightning-Protection Design of Substations in Japan

- Deterministic methods are used for designing the lightning protection of substations in Japan. In these methods, the required withstand voltage is determined by lightning overvoltage analysis of substations assuming sufficiently severe lightning parameters.



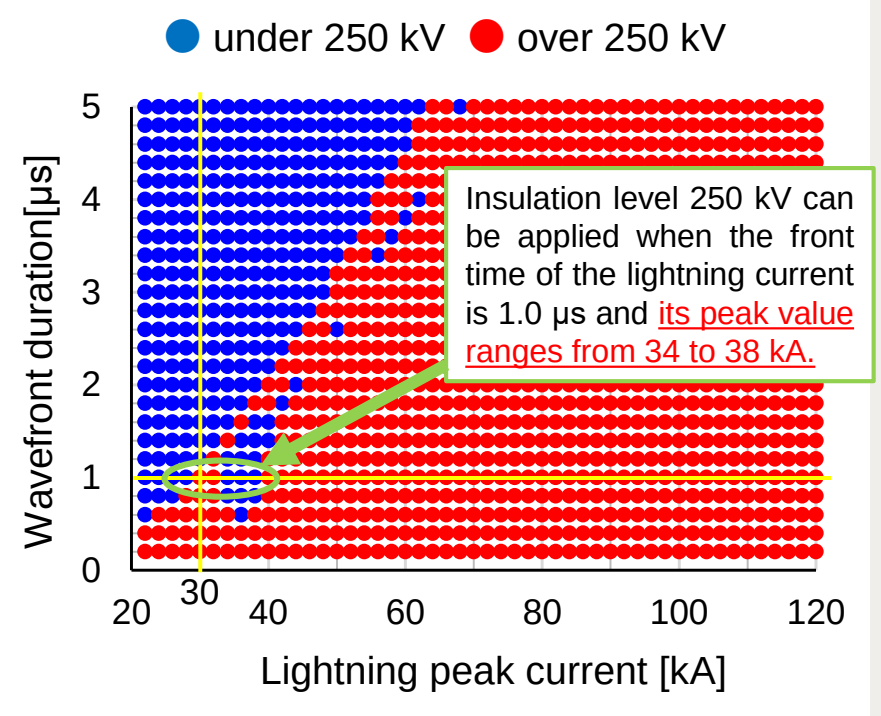
An Example of Lightning Overvoltage Analysis of a 66 kV GIS Substation





- The insulation levels of 66 kV substations against lightning specified in the Japanese Electrotechnical Committee standard are 250 kV or 350 kV.
- In this case, if the lightning protection is designed using deterministic methods, the required insulation level should be 350 kV or overvoltages should be suppressed by installing additional surge arresters.

Reassessment of Insulation Levels Using Statistical Methods



Lightning overvoltage for the same substation by changing the peak value and front duration of the lighting current as simulation parameters

	Deterministic Methods	Statistical Methods
Lightning - accident rates*	occurence probability of lightning larger than that obtained on the basis of the aformentioned assumed lightinng-current parameters ↓ 49.4%	Calculated from the results shown on the left figure ↓ 22.4 %
Insulation Level	350 kV or 250 kV (with additional surge arresters)	250 kV

*Lightning -accident rates when lightning strikes the substation closest to the substation