

QUESTION:

The DEDSTF Lines Subgroup had a question for the TSS members to understand the reason behind why the following values were selected for the listed criteria items/kV levels:

Criteria Items	kV	PJM 2002 TSDS Guidelines
Lightning Trip out Performance (line)	765	Not Specified
	500	1/100 miles (160km) per year
	345	1/100 miles (160km) per year
	230	2/100 miles (160km) per year
	138	3/100 miles (160km) per year
	115	3/100 miles (160km) per year
	69	4/100 miles (160km) per year
Line trip out performance from all other causes	765	Not Specified
	500	1/100 miles (160km) per year
	345	1/100 miles (160km) per year
	230	2/100 miles (160km) per year
	138	3/100 miles (160km) per year
	115	3/100 miles (160km) per year
	69	4/100 miles (160km) per year

RESPONSE from TSS Member:

The Lightning tripout rate is driven by the electrical properties of the structures and the lightning itself. Lightning strikes carry currents between about 10kA and 100 kA which generally follows a normal distribution around an average of about 20 kA. The transmission structures themselves represent a surge impedance of about 40 Ohms. For a 20 kA lightning strike where all of the current flows through the structure impedance of 40 Ohms yields a voltage of about 800,000 volts. The insulators on the structure need to insulate this voltage from the energized phase wire which is energized from a remote location. This surge voltage of 800,000 volts can be easily withstood by a 500 kV insulator string which is sized based on switching surges and generally have critical impulse flashover values around 2,000,000 volts. However, lower voltages like 115 kV are insulated with much smaller insulators that are design to handle lower switching surge levels and have lower critical impulse flashover values like 300,000 volts. This voltage mismatch results in a flashover. While it is technically possible to over insulate a lower voltage line to resist these lightning voltages, it has not been done historically due to the increased economic cost for insulators, taller structures, increased foundation costs, etc. This was used in establishing the values shown.