Chopped Wave Testing

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• Prior to 1960 Circuit Breaker Insulation Levels were defined by a series of 1 minute 60 Hz tests and by a series of +/- polarity full wave 1.5/40 microsecond impulse tests known as Basic Impulse Level or BIL

•At the same time Transformer Insulation Levels were defined the same way plus a 3 usec chopped wave at 1.15 times BIL was also required

• Otto Neaf and Carl Asbury write paper on chopped wave testing establishing gap spacings that would not flash over when the breaker was closed and therefore protected by the surge arrestors on the transformer when the breaker was closed. Paper 60-1213 published February 1961

•Switchgear Committee recognizes that the arrester on the transformer provides protection to the breaker if it is close to the breaker in the closed position but does not provide any protection on the line side when the breaker is open

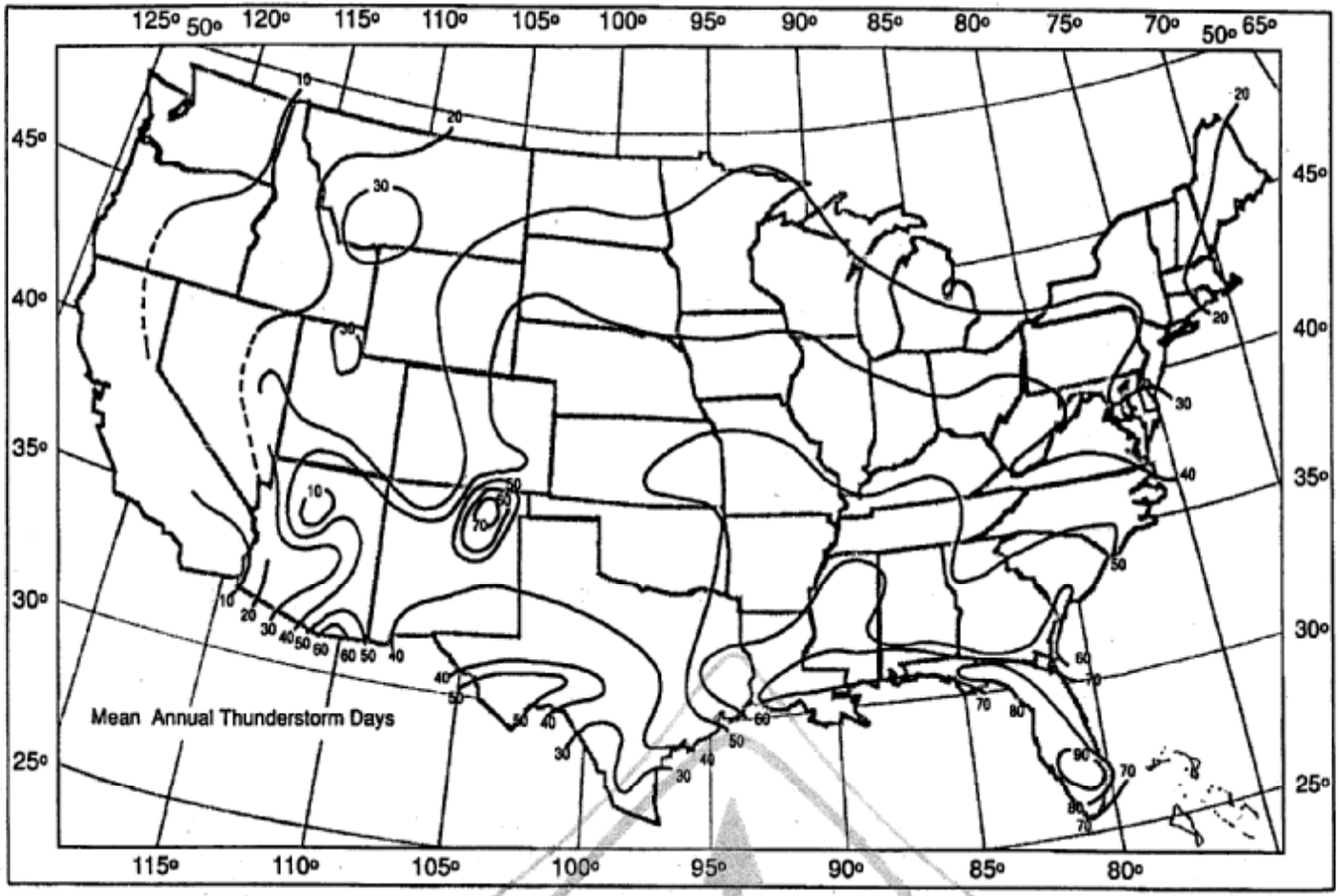
• Switchgear Committee in 1964 adopts chopped wave test requirements of 1.29 at 2 usec and 1.15 at 3 usec times full wave impulse value as standard test requirements for outdoor breakers rated 15 kV and above

•Impulse test waveshape changed from 1.5x40 usec to 1.2x50 usec to harmonize with IEC Standards

- IEC Standards do not require chopped wave testing.

Source: World distribution of thunderstorm days, Part II, published by World Meteorological Organization (1956)

Mean annual thunderstorm days—the world



Source: NOAA

Mean annual thunderstorm days—U.S.

• Up until the early 60's the primary type of breaker used in the US was bulk oil with condenser bushings. This type breaker had inherent voltage withstand characteristics such that an incoming surge would flashover in air across the bushing before an internal fault developed

• At this time compressed air and SF6 started to be added to the systems. These breakers did not have the inherent short time turn up in withstand capability

• In ANSI C37.06 – 2000 the requirement for 3 usec chopped wave testing for outdoor breakers was dropped. For current breaker designs the 2 usec chopped wave test was more severe and is the required test