

# Field Study on the Efficiency of a Lightning Protection System



Presented by:

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Pentair / ERICO



## Participants



**PENTAIR**



**CASE WESTERN RESERVE**  
**UNIVERSITY** EST. 1826



PROTECTION  
ENGINEERS  
GROUP

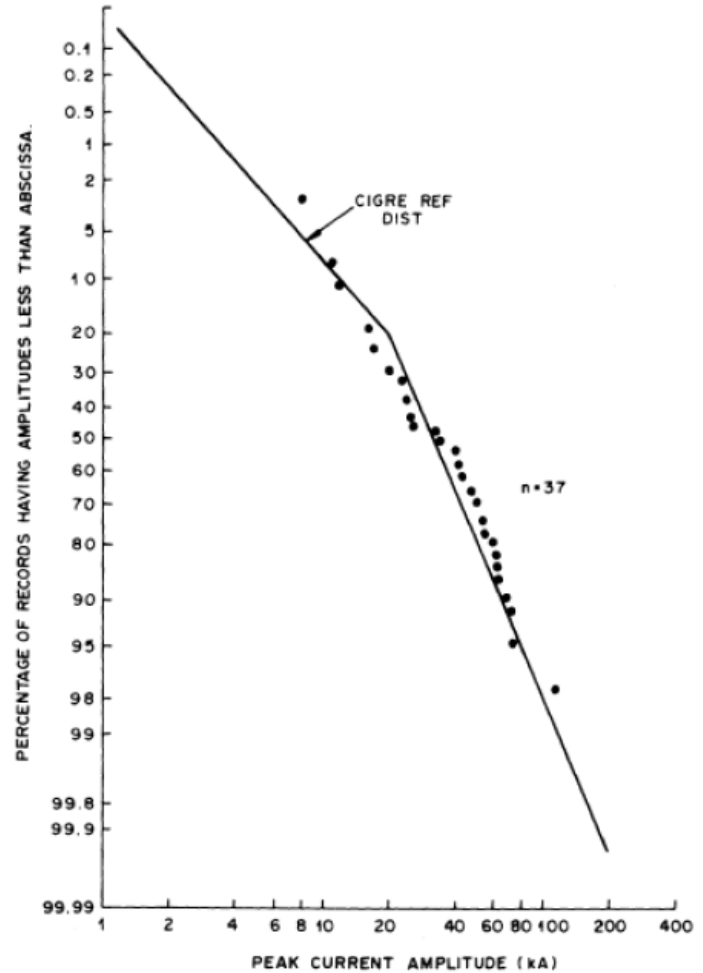
DALLAS, TX - MARCH 14 - 16, 2017



## What is a lightning flash?

- According to IEC 62305-1:2013 a lightning flash is;
  - An electrical discharge of atmospheric origin between cloud and earth consisting of one or more strokes
- A single flash typically has 3-4 strokes with multiple waveforms

# Distribution of lightning peak currents amplitudes recorded during direct strikes over six years



## What is the Collection Volume Method (CVM)?

- Methodology to place air terminals on structures to prevent damage from lightning
- Considers the height of the building and its geometry differently than traditional methods
- Recognized in IEEE 998 as a alternate methodology like the traditional Rolling Sphere Method (RSM)

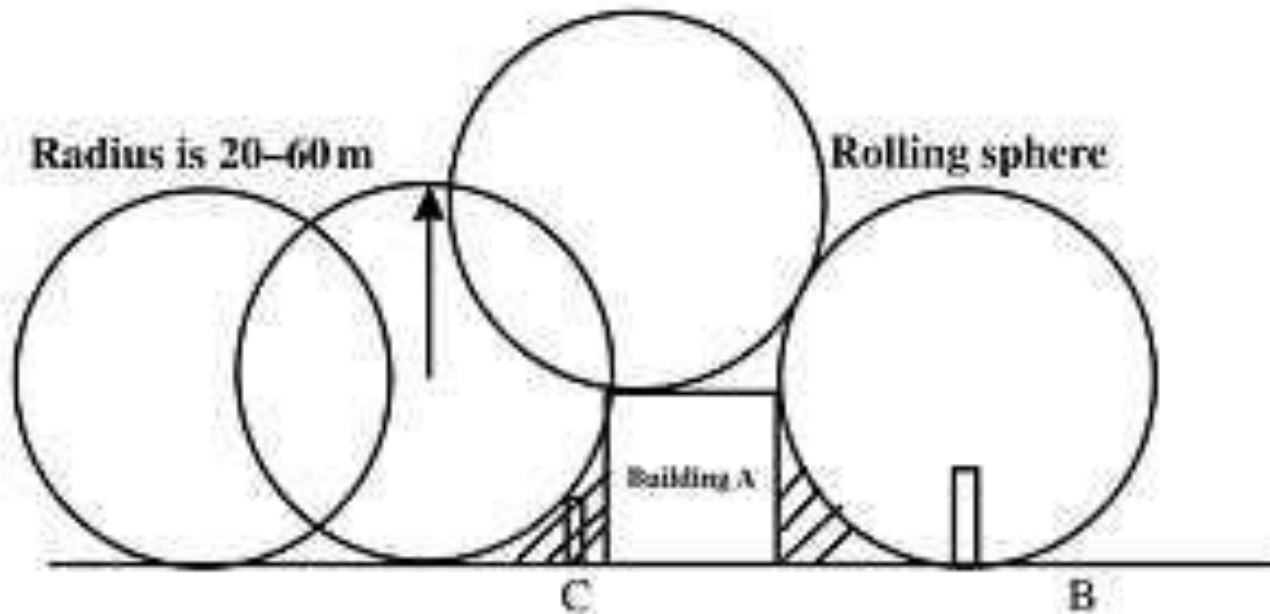
## Attractive Radius

$$N_d = N_g A_{eq} C_d 10^{-6}$$

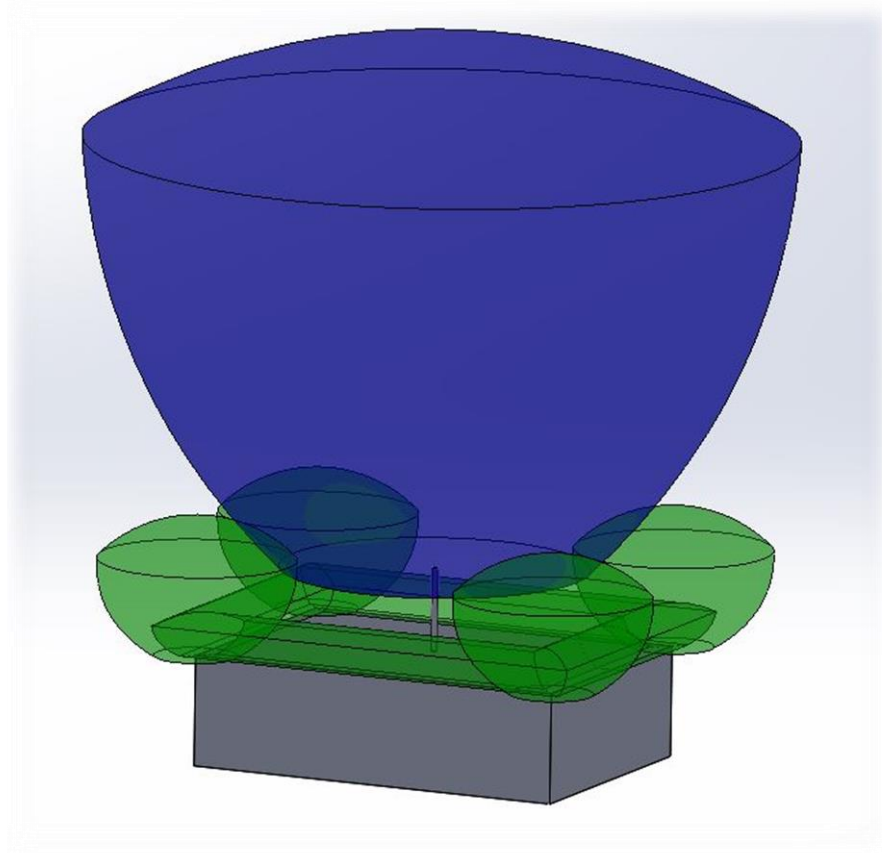
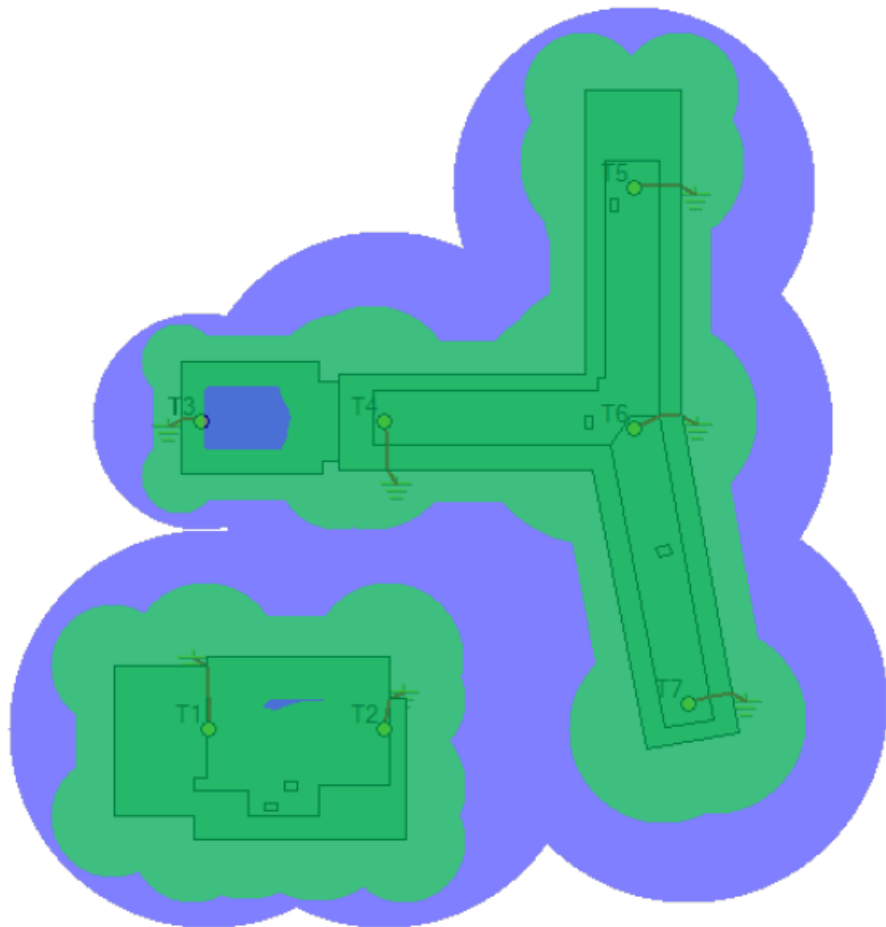
$$A_{eq} = \pi \int_0^{\infty} R_a^2(i, h) f(i) di.$$

$$R_a = 0.84 i_p^{0.74} h^{0.6}$$

# Rolling Sphere Method







## Lighting Event Counters\*



**\*The number of flashes are converted from the number of strokes recorded by the lightning event counters**

# The Study

- **Objective:**

- Verify methodology used for CVM  
(Collection Volume Method)

- **Location:**

- Kuala Lumpur, Malaysia

- **Time Frame:**

- 2010 through 2012

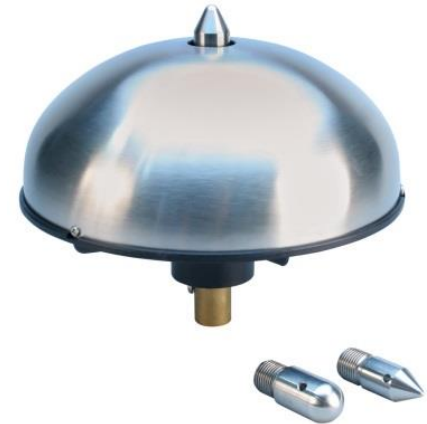
- **Participants:**

- Pentair, ERICO brand
- TÜV-Hessen
- Case Western Reserve University



- **Data:**

- 24 sites
- Collected by TÜV-Hessen
- System 3000 installations
  - Dynasphere
  - ERICORE
  - Lightning Event Counters
- Designs developed utilizing ERICO LPSD 3.0



- **Tenaga Nasional Berhad (TNB)**
  - Malaysian national utility
    - Operates a lightning detection network across Malaysia
  - Average number of ground flashes per square kilometer provided in different areas during this study
  - Data was correlated to the study to confirm accuracy of the recorded LEC events

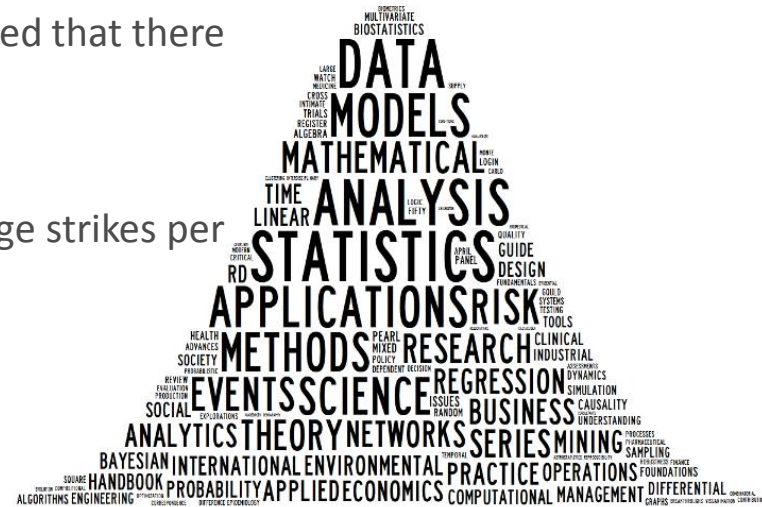
- **Flash Density:**

- Average ground flash density for the locations in the area of the study

Area	$N_g$ in flashes/km <sup>2</sup> /year
KL Sentral	20 to 28
Shah Alam, Selangor	24 to 32
Subang Jaya, Selangor	28 to 32
Putrajaya	20 to 24

- **Considerations:**

- For a valid statistical analysis a minimum of 30 data points are required. This would be impractical to study a single building for 30+ years.
- Data from the 24 sites was combined into one data set to achieve the equivalent of 37 years of exposure to a single building.
- After adjusting to the above conditions the results indicated that there were 3 bypasses in 32.3 observed lightning events.
- Fractional Poisson process model for predicting the average strikes per year was utilized for the study





Description	Result
Number of sites	24
Weighted average height of buildings, $h_{\text{weighted}}$	70.1 meters
Total exposure time, $t_{\text{total}}$	37 years
Average exposure times, $\bar{t}_{\text{total}}$	1.54 years
Sum of individual number of flashes, $F_{\text{observed}}$	29.3
Sum of individual number of bypasses, $B_{\text{observed}}$	3
Sum of individual number of events, $\sum N_{\text{d-observed}}$	32.3
Average number of events per year, $N_{\text{d-observed}}$	0.873

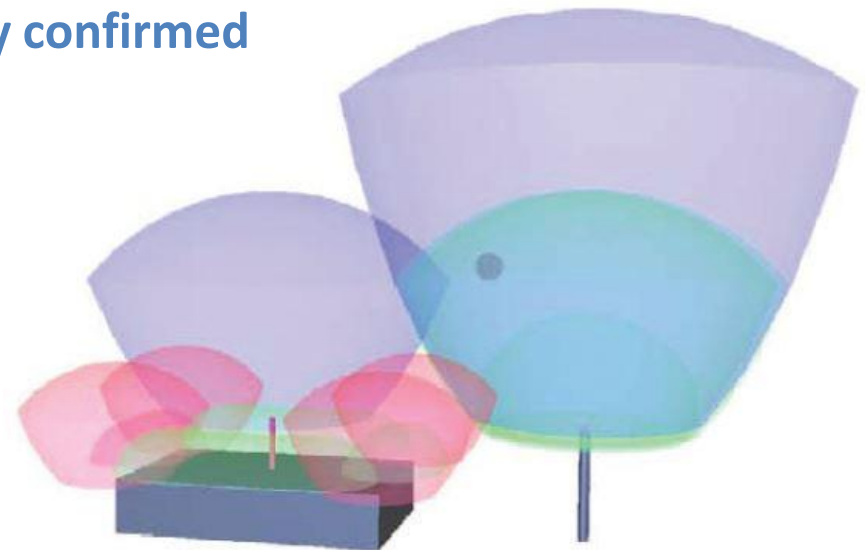
## Observed vs. Theoretical

90.7%      90.9%

**0.2% Error!**



- Confirmation of past studies
- Incredible results
- Fractional Poisson distribution improves predicted lightning strike data
- Collection Volume Method independently confirmed



...شكرا...Dankeshön...Dziękuję Ci...Gracias...Grazie...  
Merci...Obrigado...Takk...Thank you

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