DETAILED RISK

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Where are we headed?

- We want to assess the impact of nearby strikes on internal systems
- We want to know the potential for improved construction techniques
- We want to assess the actual individuals at risk
- We want to look at possible economic loss
- We want to look beyond the entrance at the internal needs for surge protection

These are the questions/ variables you will review

- Size of adjacent structure connected by service
- Location of service entrance conductor (aerial or buried), height of aerial entrance, location of transformer.
- Does the structure include shielding, a ground loop, or grounded columns?
- Is wiring in metallic conduit, bonded, shielded?
- What is the lowest withstand voltage of connected hardware?

These are the questions/variables you will review (contd.)

- Does the facility include risk of explosion, life critical systems, or could failure immediately endanger life?
- Are there animals with economic value housed in the structure?
- How many individuals are susceptible to touch and step potential for what period of time?

Risk Components

Events

- Direct strikes
- Near strikes
- Strikes to service
- Strikes near service

Losses

- Injury or death
- Structural damage
- Failure of internal systems

Any Risk = No. of events * Probability factor * Loss factor

$$R_x = N_x * P_x * L_x$$

Tables

Ce = Service Environment Coefficient **Ce**

- Urban with buildings taller than 20 m ……0
- Urban with buildings less than 20 m ……0.1
- Suburban ……0.5
- Rural ……1.0

P_A = probability of direct strike injury (touch & step potential) **P_A**

- No protection measures 1.0
- El. Insulation/isolation of exposed downlead ……0.01
- Effective soil equipotentialization ……0.01
- Warning notices ……0.1

Tables

P_B = Probability direct strike damages structure

	P_B
No protection provided	1.0
LPS per Chapter 4 – NFPA 780	0.1
LPS per Chapter 7 – NFPA 780	0.05
Qualified metal roof w/ continuous frame grnded.	0.001

P_C = probability of near strike damage based on SPD provision

	P_C
No coordinated SPD provision	1.0
SPDs provided according to 4.18 of NFPA 780	0.03

Tables

KS1 & KS2 relate to continuous exterior shielding, column spacing, equip. location

KS4 is withstand of equipment

KS3 as function of internal wiring

Type internal wiring	KS 3
Unshielded wiring routed w/ loops	1.0
Unshielded wiring routed w/out large loops	0.2
Unshielded wiring routed w/out 10 sq.m loops	0.02
Shielded wire w/ resist. 20>=Rs>5 ohm/km	0.001
Shielded wire w/ resist. 5>=Rs>1 ohm/km	0.0002
Shielded wire w/ resist. 1>=Rs ohm/km	0.0001

KS = KS1*KS2*KS3*KS4

PM = internal system failure from near strike

KS	PM
> or = 0.4	1.0
0.15	0.9
0.07	0.5
0.035	0.1
0.021	0.01
0.016	0.005
0.015	0.003
0.014	0.001
< or = 0.013	0.0001

Tables

PU as function of shield & impulse withstand (UW)

UW (kV)	RS >5 ohm/km	5>=RS>1 ohm/km	1 ohm/km>=RS
1.5	1.0	0.8	0.4
2.5	0.95	0.6	0.2
4	0.9	0.3	0.04
6	0.8	0.1	0.02

PZ probability as function of shield & impulse withstand (UW) of equipment

UW (kV)	No shield	Shield but no bond	Shield & bond RS>5	Shield & Bond 5>RS>1	Shield & bond 1>=RS
1.5	1.0	0.5	0.15	0.04	0.02
2.5	0.4	0.2	0.06	0.02	0.008
4	0.2	0.1	0.03	0.008	0.004
6	0.1	0.05	0.02	0.004	0.002

Step & Touch Potential

Injury or Loss of Life =

(No. of people at risk / Total No. of people) *

(Time at Risk activity / Hrs. in year)

$$L = (n_p / n_t) * (t_p / 8760)$$

If no calculation is possible, you may use factors provided

(1 in 10,000 MH inside, or 1 in 100 MH outside)

Tables

Typical mean values of Loss

Type of structure	Loss of life (Lf)	Structural damage (Lf)	System failure (Lo)
All types – persons inside building	0.0001		
All types – persons outside building	0.01		
Hospitals		0.1	0.001
Hotels, civic buildings		0.1	
Industrial, commercial, school		0.05	
Public entertainment, churches, museums		0.02	
Others		0.01	
Risk of explosion			0.1

Tables

r_a = Reduction factor for floor surface

	r_a
Bare earth or concrete	0.01
Marble, Ceramic	0.001
Gravel, Carpets	0.0001
Asphalt, linoleum, wood	0.00001

r_p = reduction factor for fire precautions

	r_p
No provisions or risk of explosion	1.0
Manual extinguishing, alarms, hydrants, fireproof compartments, protected escape routes	0.5
Automatic sprinkler, alarm, < 10 min. response, & over voltage protection	0.2

Tables

rf = Reduction factor for risk of fire

	rf
Explosion	1.0
High	0.1
Ordinary	0.01
Low	0.001
None	0

h_z = value of hazard factor

	h_z
No special hazard	1.0
2 story structure with < 100 people	2.0
Event structure with 100 to 1000 people	5.0
Difficult evacuation (hospitals)	5.0
Event structure > 1000 people	10.0
Hazard to surrounding area	20.0
Contamination to environment	50.0

Risk Comparison

Total calculated risk =

Sum of applicable risk components

$$R = R1 + R2 + R...$$

If calculated total R < tolerable risk (R_T),
then further protection is not needed

Type of Loss	RT / Year
Loss of life or injury	0.00001
Loss of service	0.001
Loss of historical significance	0.001