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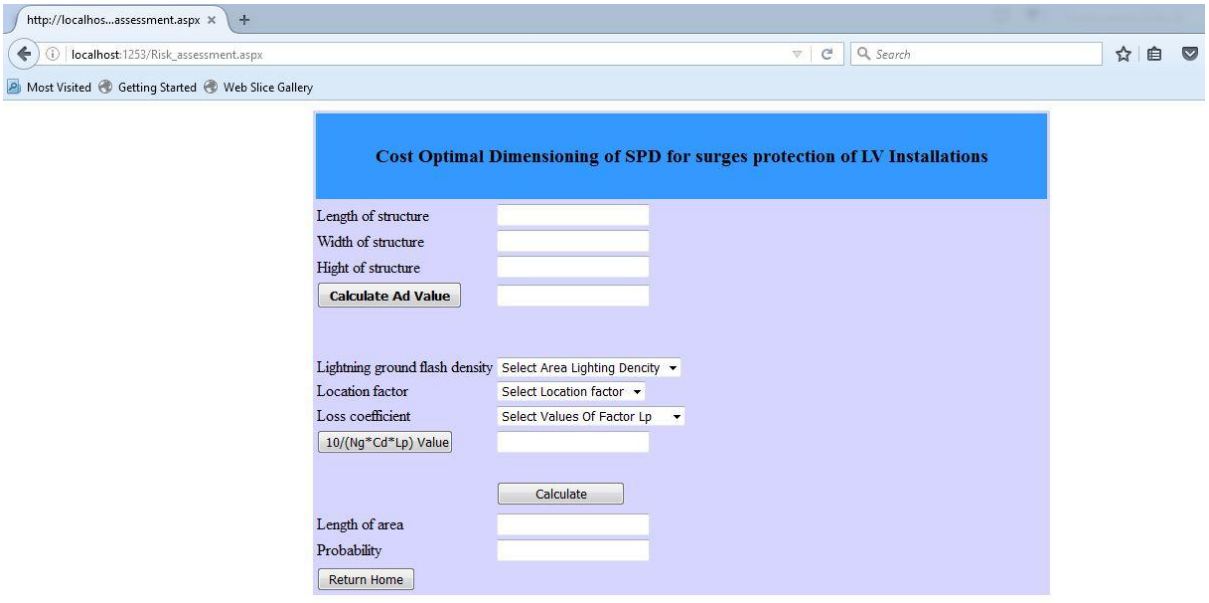
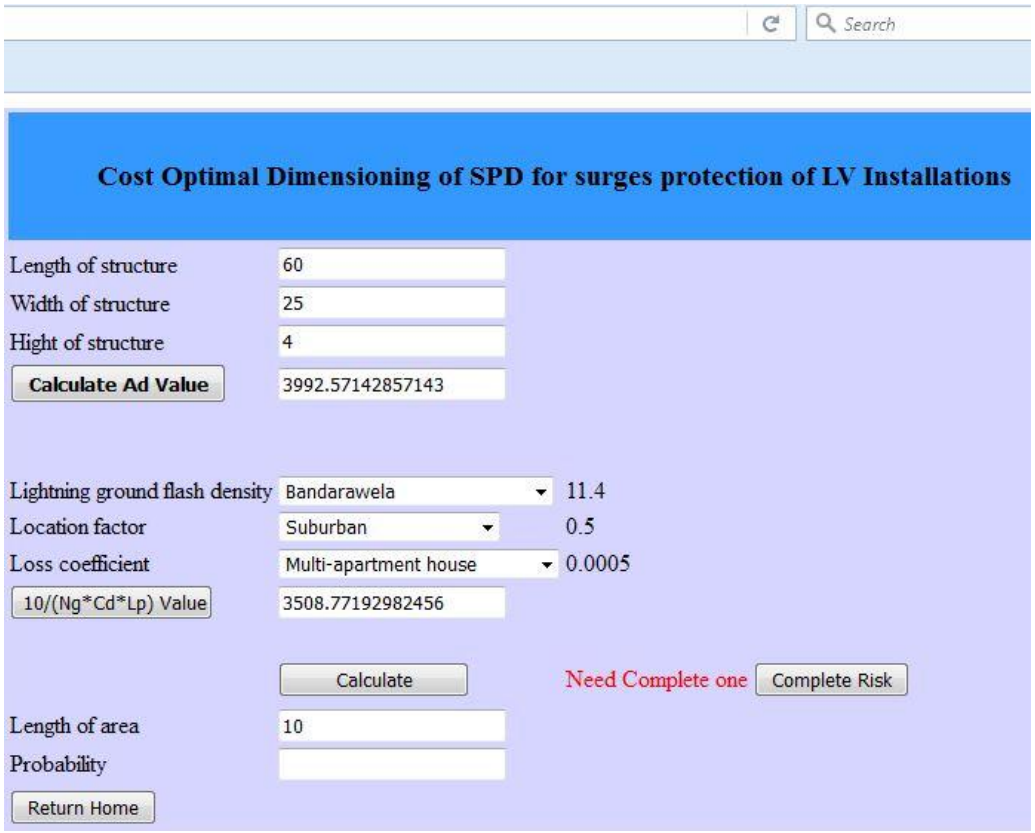
Appendix: A

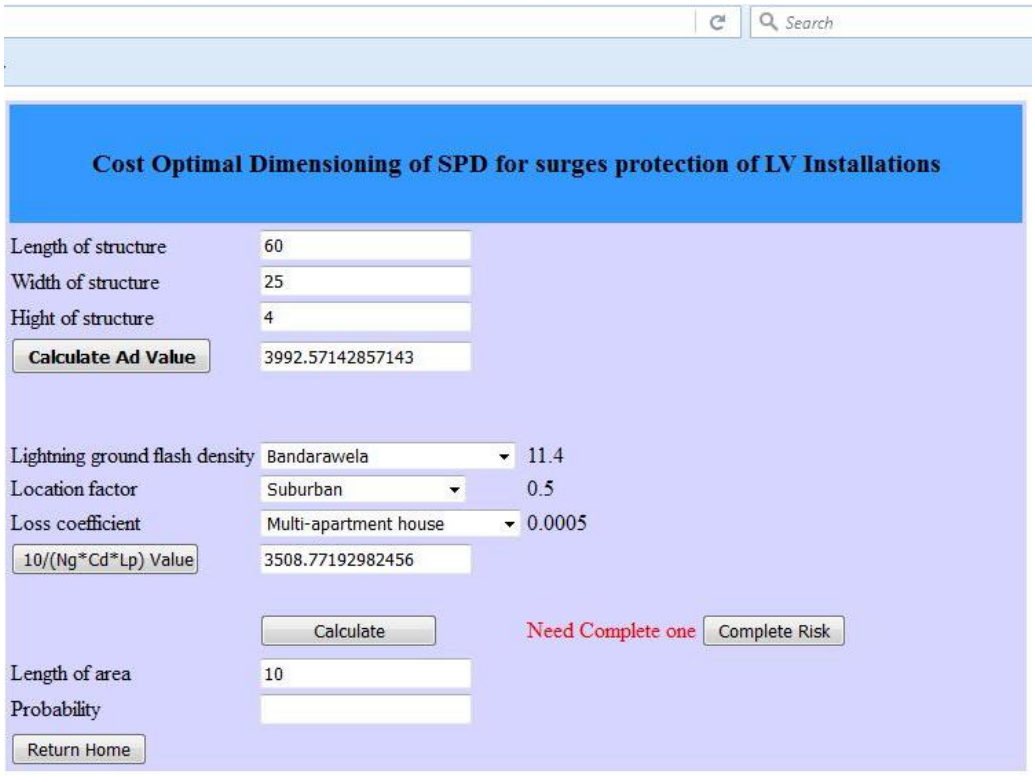
USER FRIENDLY SOFTWARE SOLUTION

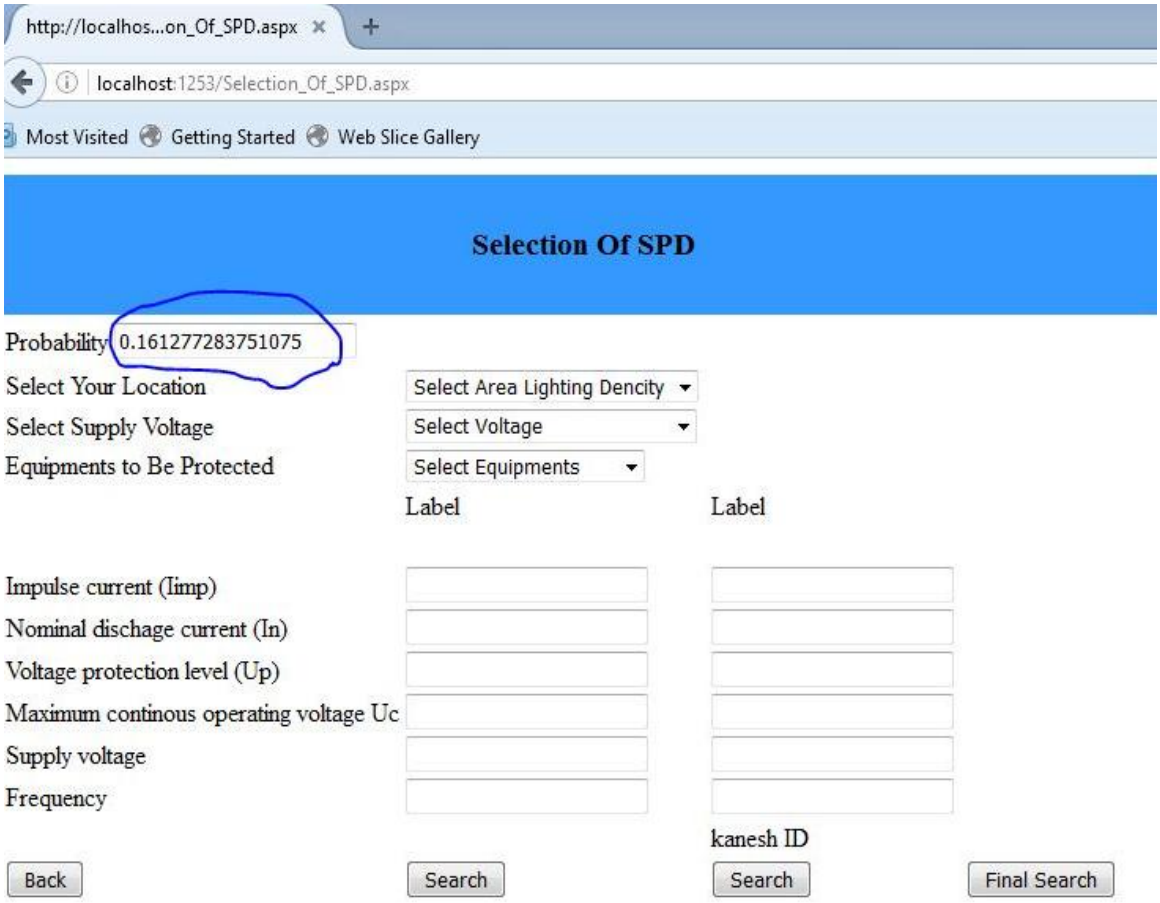
Supervised by Dr. W.D Asanka Rodrigo

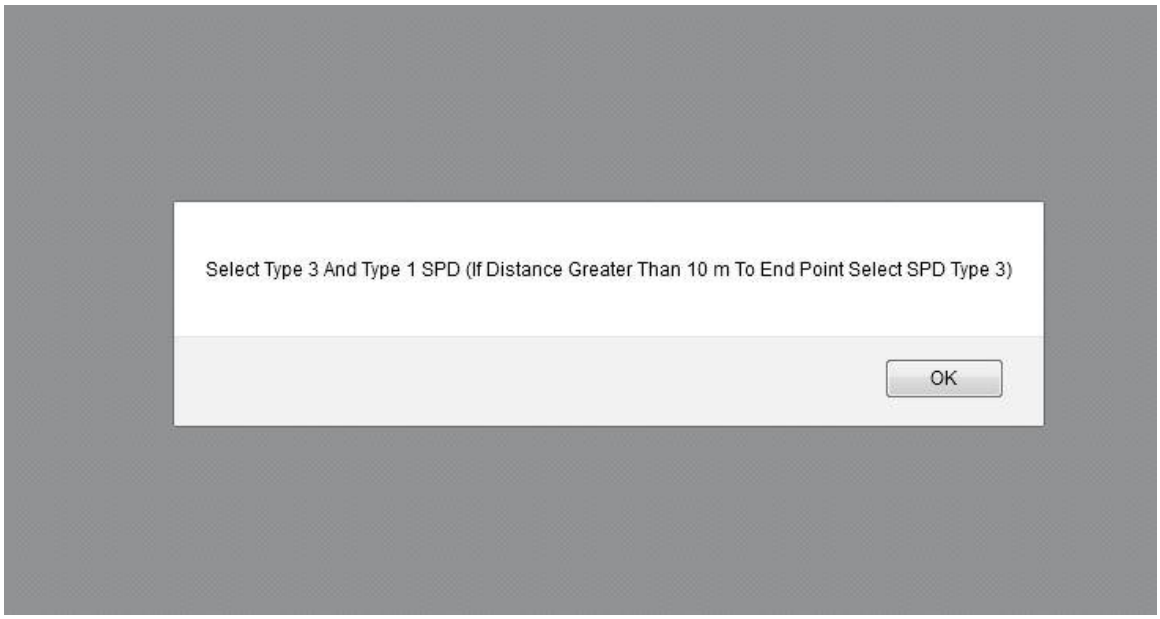
K.K Dadallage
Index No 128857N
MSc/PG Diploma
Electrical Engineering

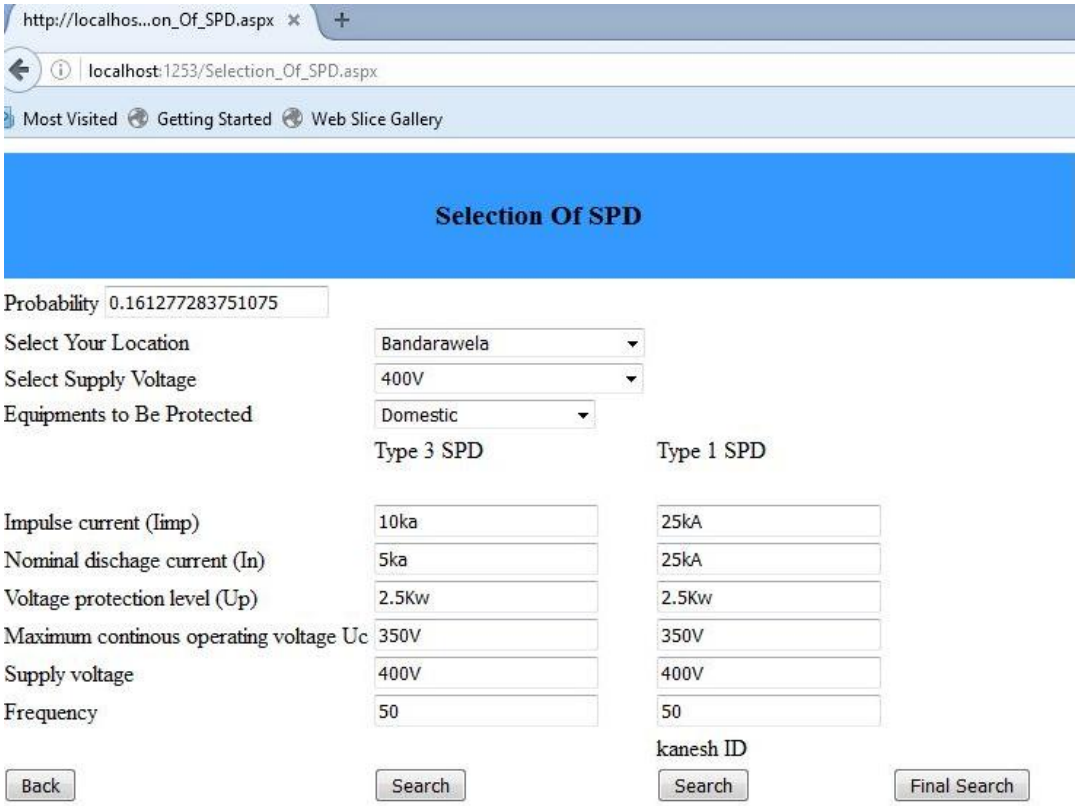


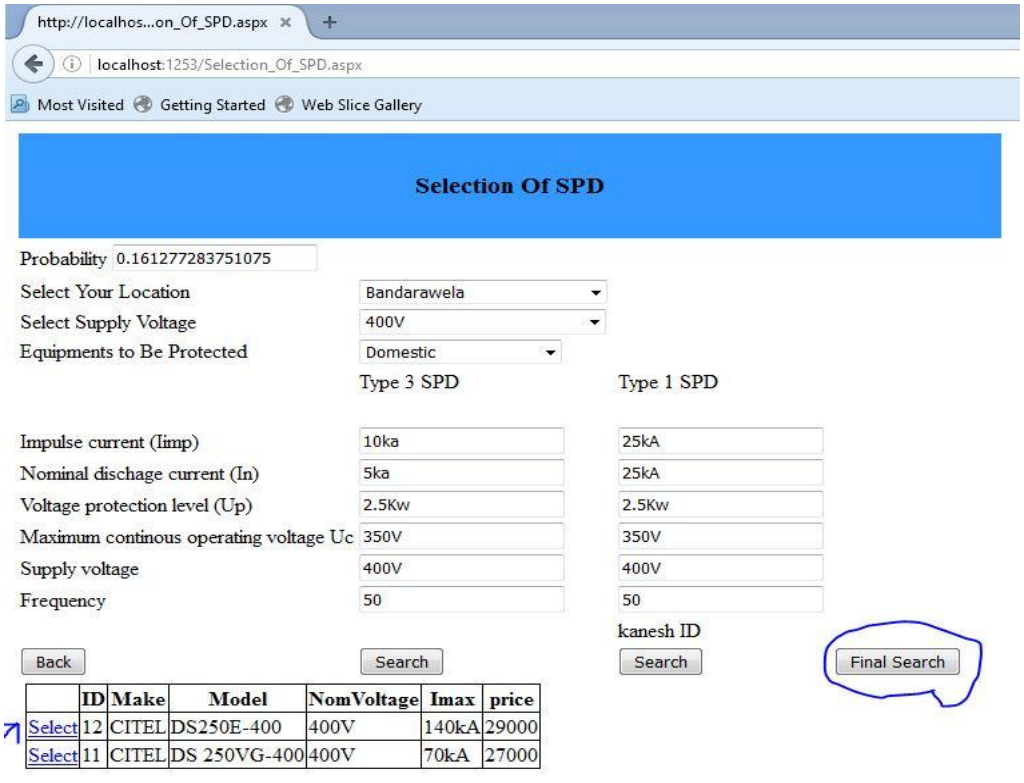

Search
Cost Optimal Dimensioning of SPD for surges protection of LV Installations
Length of structure
60
Width of structure
25
Hight of structure
4
Calculate Ad Value
3992.57142857143
Lightning ground flash density
Bandarawela
11.4
Location factor
Suburban
0.5
Loss coefficient
Multi-apartment house
0.0005
10/(Ng*Cd*Lp) Value
3508.77192982456
Calculate
Need Complete one
Complete Risk
Length of area
10
Probability
Return Home

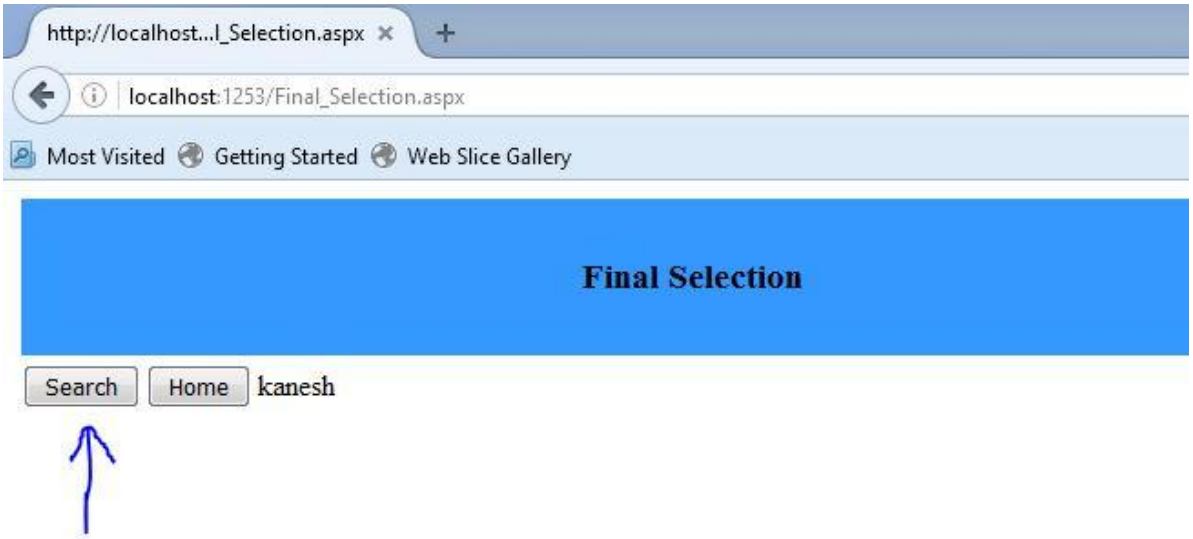

Search
Cost Optimal Dimensioning of SPD for surges protection of LV Installations
Length of structure
60
Width of structure
25
Hight of structure
4
Calculate Ad Value
3992.57142857143
Lightning ground flash density
Bandarawela
11.4
Location factor
Suburban
0.5
Loss coefficient
Multi-apartment house
0.0005
10/(Ng*Cd*Lp) Value
3508.77192982456
Calculate
Need Complete one
Complete Risk
Length of area
10
Probability
Return Home

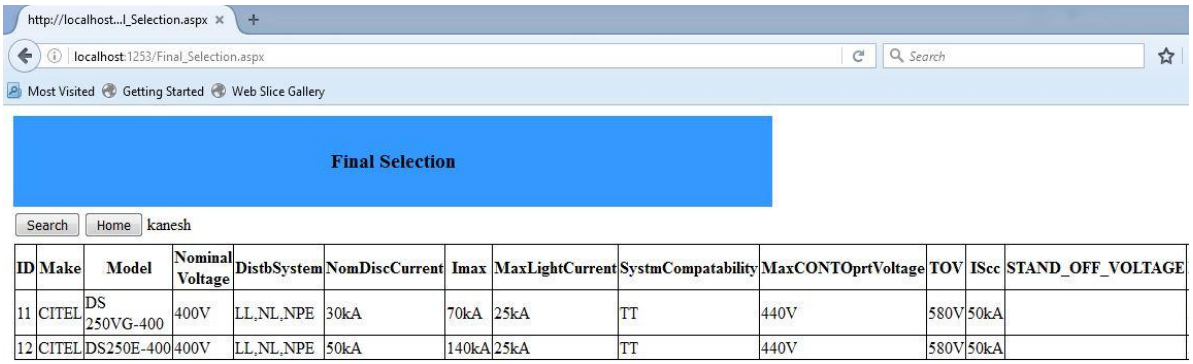

http://localhos...on_Of_SPD.aspx
localhost:1253/Selection_Of_SPD.aspx
Most Visited
Getting Started
Web Slice Gallery
Selection Of SPD
Probability 0.161277283751075
Select Your Location
Select Area Lighting Dencity
Select Supply Voltage
Select Voltage
Equipments to Be Protected
Select Equipments
Label
Label
Impulse current (Iimp)
Nominal dischage current (In)
Voltage protection level (Up)
Maximum continous operating voltage Uc
Supply voltage
Frequency
kanesh ID
Back
Search
Search
Final Search


Select Type 3 And Type 1 SPD (If Distance Greater Than 10 m To End Point Select SPD Type 3)
OK


http://localhos...on_Of_SPD.aspx
localhost:1253/Selection_Of_SPD.aspx
Most Visited
Getting Started
Web Slice Gallery
Selection Of SPD
Probability 0.161277283751075
Select Your Location
Bandarawela
Select Supply Voltage
400V
Equipments to Be Protected
Domestic
Type 3 SPD
Type 1 SPD
Impulse current (Iimp)
10ka
25kA
Nominal dischage current (In)
5ka
25kA
Voltage protection level (Up)
2.5Kw
2.5Kw
Maximum continous operating voltage Uc
350V
350V
Supply voltage
400V
400V
Frequency
50
50
kanesh ID
Back
Search
Search
Final Search

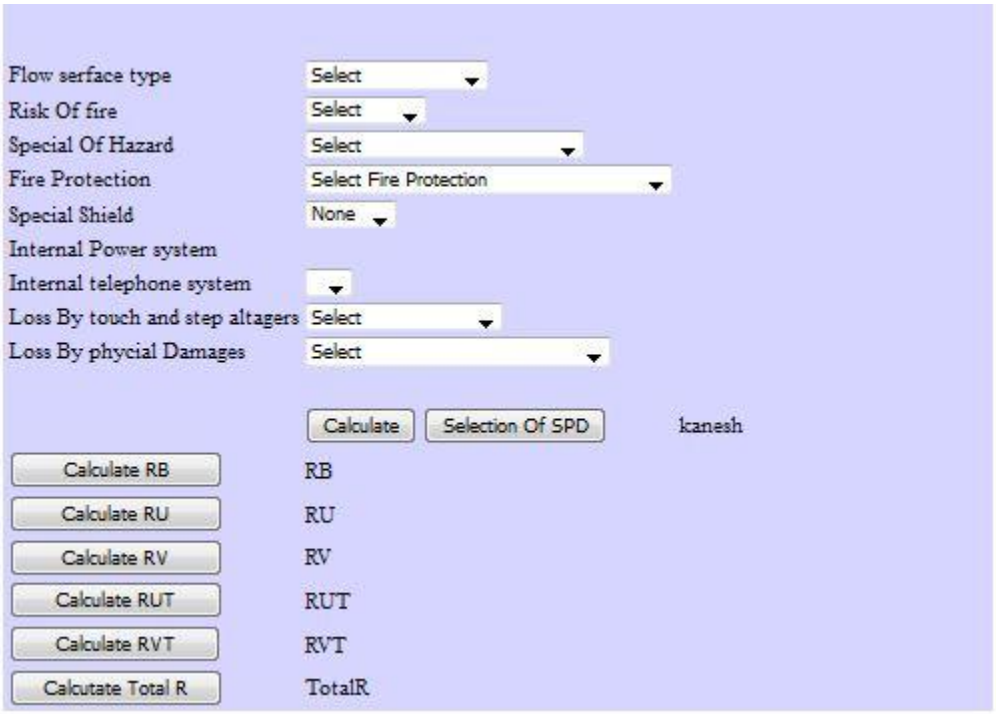

http://localhos...on_Of_SPD.aspx
localhost:1253/Selection_Of_SPD.aspx
Most Visited
Getting Started
Web Slice Gallery
Selection Of SPD
Probability 0.161277283751075
Select Your Location
Bandarawela
Select Supply Voltage
400V
Equipments to Be Protected
Domestic
Type 3 SPD
Type 1 SPD
Impulse current (Iimp)
10ka
25kA
Nominal dischage current (In)
5ka
25kA
Voltage protection level (Up)
2.5Kw
2.5Kw
Maximum continous operating voltage Uc
350V
350V
Supply voltage
400V
400V
Frequency
50
50
kanesh ID
Back
Search
Search
Final Search
ID Make Model NomVoltage Imax price
Select 12 CITEL DS250E-400 400V 140kA 29000
Select 11 CITEL DS 250VG-400 400V 70kA 27000





ID	Make	Model	Nominal Voltage	DistbSystem	NomDiscCurrent	Imax	MaxLightCurrent	SystmCompatability	MaxCONTOprtVoltage	TOV	IScc	STAND_OFF_VOLTAGE
11	CITEL	DS 250VG-400	400V	LL,NL,NPE	30kA	70kA	25kA	TT	440V	580V	50kA	
12	CITEL	DS250E-400	400V	LL,NL,NPE	50kA	140kA	25kA	TT	440V	580V	50kA	


Search
Complete Risk Assesment
Height
Width
Length
Number Of People
Shield At Structure
Shield Internal
Line Location Factor
Select Location Factor
LPS
Select LPS
LPS
Label
Soild Resistivity
Length Of Power Line
Cable Lacation
Select Cable Lacation
Height Of Power Line
Transformer
Select
Line Location Factor
Line Environment Factor
Select Location factor
Line Shielding
Select Shield
Internal Wiring Precotions
Withstand Of internal System
Select
Cordination Protection
Select
Length Of Telecom Line
Height Of Telecom Line
Line Location Factor
Select
Line environment Factor
Select Location factor
line Shilding
Select sheild
Internal Wiring Preportion
Widthstand of Internal Syatem
Select
Cordinator SPD Protction


Flow serface type
Select
Risk Of fire
Select
Special Of Hazard
Select
Fire Protection
Select Fire Protection
Special Shield
None
Internal Power system
Internal telephone system
Loss By touch and step altagers
Select
Loss By phycial Damages
Select
Calculate
Selection Of SPD
kanesh
Calculate RB
RB
Calculate RU
RU
Calculate RV
RV
Calculate RUT
RUT
Calculate RVT
RVT
Calcutate Total R
TotalR

APPENDIX B

DATA TABLE FOR RISK CALCULATION

Value of collection area depending on the evaluation method Table A.1

	Graphic method	Structure (Max)	Structure (Min)	Protrusion (Hp)
Structure				
Dimension m				
(L,W,H)				
m^2	Ad	Ad max	Ad min	Ad'

$A_d = L \times W + 6 \times H \times (L + W) + 9 \times \pi \times H^2$

$A_d' = 9 \times \pi \times (H_p)^2$

Length	70
Width	30
Height	40
Ad	71357.14286
Protrusion	40
Ad'	45257.14286

Location factor Cd Table A.2

Location factor	Cd	Comments
Object surrounded by higher objects or tree	0.25	Higher objects
Object surrounded by objects or trees of the same height or smaller	0.5	Same/smaller
Isolated object: no other objects in the vicinity	1	Isolated
Isolated object on a hilltop or a knoll	2	On top hill

Collection area Ai and Al depending on the service characteristics Table A.3

	Aerial	Buried	Aerial
Al	(Lc - 3(Ha + Hb)) 6Hc	(Lc - 3(Ha + Hb)) $\sqrt{\rho}$	Buried
Ai	1000 Lc	25 Lc $\sqrt{\rho}$	

Lc	Length of the service section (m)		1000
Ha	Hight of the structure connected at end "a" (m)		2
Hb	Hight of the structure connected at end "b" (m)		2
Hc	Hight of the service conductors above groung (m)		6
ρ	Resistivity of soil	(mili ohm)	500
Al (Arial)	Collection area of flashes stricking the service		35568
Ai (Arial)	Collection area of flashes to ground near the service		1000000
Al(Buried)	Collection area of flashes stricking the service		494000
Ai (Buried)	Collection area of flashes to ground near the service		559016.9944

Transformer factor Ct Table A.4

Transformer		Ct	Comments
Service with two winding trans former		0.2	Transformer
Service only		1	None

Environment factor Ce Table .5

Environment				Ce
Urban with tall building *				0
Urban				0.1
Suburban				0.5
Rural				1
*	Height of the building higher than 20m			
**	Height of the building ranging between 10m to 20m			
***	Height of the building lower than 10m			

Typical mean values of Lt , Lf and Lo Table C.1

Type of structure	Lt
All type - (persons inside the building)	0.0001
All type - (persons outside the building)	0.01
Type of structure	Lf
Hospital, hotels, civil buildings	0.1
Industrial, commercial, school	0.05
Public entertaintment, churches, museum	0.02
Other	0.01
Type of structure	Lo
Risk of explosion	0.1
Hospitals	0.001

Values of reduction factors ra and ru as a function of the type of surface of soil or floor Table C.2

Type of surface	contact resistance	r_a and r_u
Agricultural, concrete	Lese than 1	0.01
Marble, ceramic	1 to 10	0.001
Graval, moquette, carpets	10 to 100	0.0001
Asphalt, linoleum, wood	Greater than 100	0.00001
Values measured between a 400cm² electrode compressed with force of 500n		

Values of reduction factor rp as a function of provision taken to reuce the consequence of fire Table C.3

Provision	r_p
No provision	1
One of the following provision: extinguishers; fixed manualy operated	
extinguishing installation; manual alarm installation, hydrants, fire proof	0.5
compartments; protected escape routs	
One of the following provision; fixed aautomatically operated	0.2
extinguishing installations;automatic alarm installations	
Only if protected against overvoltage and other damages and if	
firemen can arrive in less than 10 min	

Values of reduction factor rf as function of risk of fire of structure Table C.4

Risk of fire	r_f		
Explosioin	1		
High	0.1		
Ordinary	0.01		
Low	0.001		
None	0		

KS1 = KS2 = 0.12 * w			
w = Mesh width	9		
KS1	1.08		
Soil resistivity	Assumed 500 Ohm		
KS4=1.5/Uw	Uw = rated implulse withstand voltageof system to be protected		
Uw	2.5		
KS4=	0.6		

Uw (kV)	
Sensitive	0.6
Sensitive	1
Electronic	1.5
Electrical	2.5
Machinery	4
Other	6

Values of probability PA that a flash to the structure will cause injury to living being Table B.1

Protection measures			PA	
No protection measures			1	None
Electrical insullation of expected down conductor			0.01	Down conductor
Effective soil equippotentialization			0.01	Soil equipote
Warning notice			0.1	Notice
			0	Fence

Values of probability PB depending on the protection measures to reduce physical damage Table B.2

Characteristic of structure				Class of LPS	PB
Structure not protected by LSP				None	1
Structure protected by LSP				IV	0.2
				III	0.1
				II	0.05
				I	0.02
Structure with an air terminationsystem confirming to LPS 1 and a continous metal or				Air terminal	0.01
reinforced concrete framework acting as a natural down conductor system					
Structure with a metal roof of an air termination system ,				Metal roof +Air terminal	0.001

Values of the probability PSPD as a function of LPL for which SPDs are designed Table B.3

LPL			P_{SPD}	Comments
No coordinated SPD protection			1	None
III - IV			0.03	III- IV
II			0.02	II
I			0.01	I

Probability PC that with a flash to a structure will cause failure of internal systems PC = PSPD

Value of probability PMS as a function of factor KMS Table B.4

K_{MS}	P_{MS}
0.4	1
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
0.013	0.0001

Value of factor KS3 depending on internal wiring Table B.5

Type of internal wiring	K_{S3}	Comments
Unshielded cable- no routing precaution in order to avoid loop	1	None
Unshielded cable- routing precaution in order to avoid large loop	0.2	Unshielded
Unshielded cable- routing precaution in order to avoid loop	0.02	Unshielded
Shielded cable with shield resistance 5<RS< = 20 ohm/Km	0.001	Shield
Shielded cable with shield resistance 1< RS < = 5 ohm/Km	0.0002	Shield
Shielded cable with shield resistance RS < = 1 ohm/Km	0.0001	Shield

Value of the probability PLD depending on the resistance RS of the cable screen and the impulse withstand voltage UW of the equipment Table B.6

U_W	$S < R_S <= 20$	$1< R_S <= 5$	$R_{S<=} 1$
kV	ohm/km	ohm/km	ohm/km
1.5	1	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
R_S (ohm/km) resistance of the cable shield			

PLD=1 for unshielded cable

Values of factor h increasing the relative amount of loss in presence of a special hazard Table C.5

Kind of special hazard	h
No special hazard	1
Low level of panic (e.g. a structure limited to two floors and the number of	2
persons not greater than 100	
Average level of panic (e.g. structures designed for cultural of sport events with a	5
number of participants between 100 to 1000 persons	
Difficulty of evacuation (e.g. structures with immobilized persons, hospitals)	5
High level of panic (e.g. structured designed for cultural or sport events with a	10
number of participants greater than 1000 person	
Hazard for surroundings or environment	20
Contamination of surroundings or environment	50

Typical mean values of Lf and Lo Table C.6

Type of service	L_f	L_o
Gas, water	0.1	0.01
TV, TLC, Power supply	0.01	0.001

Typical mean values of Lf , Lt and Lo Table C.7

Type of structure	L_t
All type - Inside buildings	0.0001
All type - Outside buildings	0.01
Type of structure	Lf
Hospital, Industrial, museum, agriculture	0.5
Hotel, school, office, church, public entertainment	0.2
economic buildings	
Others	0.1
Type of structure	Lo
Risk of explosion	0.1
Hospital, industrial, office, hotel, economic building	0.01
Museum, agriculture, school, church, public entertainment	0.001
Others	0.0001

APPENDIX C