3.0 Minimum Design Clearances

3.1 The minimum design clearances are given in table 1 below. For standard bus, switch and lightning arrestor spacing refer to section 4.0.

Fig 1

CA-20 (b)
Attachment E

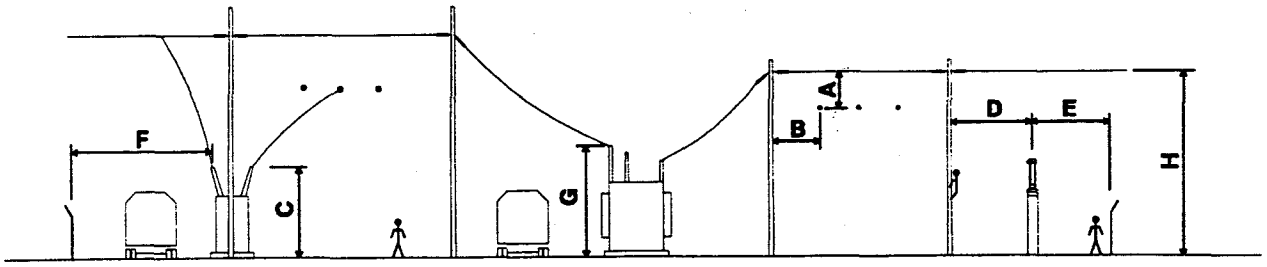

Table 1

System Voltages kV (Ø-Ø) and BIL in parenthesis	Minimum Design Clearance For Substation Layout (mm) (See Figure 1 Above For Pictorial Representation)							
	A	B	C	D	E	F	G	H
15 (110)	220	190	2700	1100	2700	6000	4600	4800
25 (150)	330	280	2800	1300	2800	6000	4700	5200
69 (350)	820	700	3200	1600	3200	6000	5200	5500
138 (650)	1540	1340	3800	1900	3800	6000	5800	5800

A Clearance between live metal surfaces of different phases in any direction

B Clearance between live metal parts to grounded surfaces in any direction.

C Vertical clearance between live metal surface and finished grade accessible to service personnel

D Horizontal working space between live parts and structure

E Horizontal clearance between live metal parts to fence/building accessible to service personnel

F Horizontal separation between fence and structure/guy wire for vehicular traffic

G Vertical clearance between live metal parts and finished grade accessible to service vehicle

H Vertical clearance between conductors and finished grade accessible by vehicles not exceeding 4.15 m

The following were adopted for the derivation of minimum design clearances.

1. Height of service vehicle - 4.15 M.
2. Climbing space - 0.75 M from CAN/CSA C22.3 No. 1-M87
3. Sideways reach of service personnel with arms outstretched - 2.50 m
4. Newfoundland Power Safety Handbook Rule 205 Table 2 Absolute Limit Of Approach
5. Maximum vertical reach of service personnel - 2.50 m
6. Air clearance as per CAN3-C308-M80 table 8.1
7. Minimum vertical design clearance as per CAN/CSA-C22.3 No1-1987 Table 2.
8. 300 mm buffer as per CAN/CSA C22.3 NO. 1-M87.
9. Minimum vertical design clearances between conductors on different support structures as per CAN/CSA-C22.3 NO.1-M87 Table 13 Clause 4.8.1

Derivations of Clearances
(Number In Parenthesis Refers To List Of Assumptions)

A Interpolated from (6) based on the sum of BIL voltage on the conductor with the highest voltage and Ø - N voltage on the other

B Interpolated from (6) based on BIL voltage on the conductor.

C Interpolated from (6) based on BIL voltage on the conductor plus (5)

D (2)+(4)

E (3)+(6)

F Vehicle width plus reasonable room to manoeuvre.

G (1)+(6)+(8)

H (7)

REGISTERED PROFESSIONAL ENGINEER
B.P. VINCENT
SIGNATURE
94/09/19
DATE
PROVINCE OF NEWFOUNDLAND

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PERMIT HOLDER
Class "B"
This Permit Allows
NEWFOUNDLAND POWER
To practice Professional Engineering in Newfoundland and Labrador. Permit No. as issued by APEGN B1105 which is valid for the year 1994

4.0 Standard Bus, Switch and Lightning Arrestor Spacing

4.1 Standard bus, switch and lightning arrestor spacing is shown below in tables 2 and 3.

Table 2

System Voltages kV (Ø-Ø) and BIL in parenthesis	Standard Bus and Lightning Arrestor Spacing			
	Wood Pole Structures		Steel Structures	
	Bus Spacing CL-CL (mm)	Lightning Arrestor Spacing CL-CL (mm)	Bus Spacing CL-CL (mm)	Lightning Arrestor Spacing CL-CL (mm)
15 (110)	610	610	610	610
25 (150)	915	915	915	915
69 (350)	2135(2)	1525	1525	1525
138 (650)	2450	2450	2450	2450

Note: (1) Lightning arrestor spacing is based on required conductor clearances. These clearances may be reduced if required clearance of energized equipment can be reduced. However the phase to phase or phase to ground spacing cannot be reduced below the minimum specified by the manufacturer of the lightning arrestor.

(2) Horizontal bus spacing is increased on 66 kv wood pole structures to place the tension of the bus on the poles rather then on the crossarms. Vertical clearance between the upper and lower bus is maintained at 1525 mm.

Table 3

System Voltages kV (Ø-Ø) and BIL in parenthesis	Switch Spacing CL-CL (mm)					
	Horn Gap Switches(2)	Vertical Break Switch	Hookstick Switch (3)	SideBreak Switch	Centre Break Switch	Minimum Metal-Metal Distance (mm)
15 (110)	915	610	760	760		305
25 (150)	1220	760	915	1220(3)		380
69 (350)	2135	1525		1830		790
138 (650)	3660(4)	2450		3350	2745	1600

NOTES:

(1) For switches not shown above refer to ANSI C37.32 or Nema SG-6 for standard spacing.

(2) Horn gap switches are switches supplied with arcing horns either sidebreak or vertical break switches. ANSI C37.32-1972 does not differentiate between airbreaks or sidebreaks with arcing horns.

(3) Spacing larger then specified in ANSI standard C37.32.

(4) Spacing increased to 4000 mm for wood pole structures.

5.0 Temporary Installations

The installation of temporary structures may be required to restore power during emergency conditions or to facilitate the installation or maintenance of equipment and structures. For the purposes of this standard a temporary installation is a installation which is in service for a period of not more then two (2) consecutive months.

Generally at system voltages below 138 kV the required electrical separation is equal to the separation required to withstand lightning surges. Since the exposure of temporary structures to lightning is limited due to the short in service time, clearances for temporary structure have been reduced to values closer to the switching surge separation requirement. Standard electrical separations for temporary installations is outlined below in table 4. These clearance are to be used only when minimum clearances cannot be maintained.

Fig 2

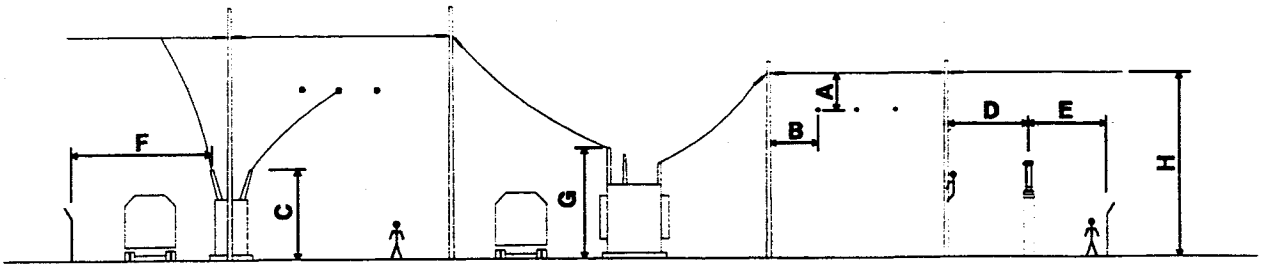

Table 4

System Voltages kV (Ø-Ø) and BIL in parenthesis	Temporary Design Clearance For Substation Layout (mm) (See Figure 2 Above For Pictorial Representation)							
	A	B	C	D	E	F	G	H
15 (110)	150	120	2600	1100	2700	6000	4600	4800
25 (150)	290	230	2700	1300	2800	6000	4700	5200
69 (350)	620	480	3100	1600	3200	6000	5200	5500
138 (650)	1200	900	3400	1900	3800	6000	5800	5800

A Clearance between live metal surfaces of different phases in any direction

B Clearance between live metal parts to grounded surfaces in any direction.

C Vertical clearance between live metal surface and finished grade accessible to service personnel

D Horizontal working space between live parts and structure

E Horizontal clearance between live metal parts to fence/building accessible to service personnel

F Horizontal separation between fence and structure/guy wire for vehicular traffic

G Vertical clearance between live metal parts and finished grade accessible to service vehicle

H Vertical clearance between conductors and finished grade accessible by vehicles not exceeding 4.15 m

Notes: Clearance between finished grade and energized conductors in areas where access by vehicles or employees has been restricted by means of a barrier may be reduced to the values in columns c and b respectively.

Clearances required to allow work to be carried out on energized structures (Column D) and clearances which are required for vehicular movement around structures (column F) may be reduced to the clearances in columns E and B respectively if work on the structure is done with the structure de-energized and grounded and the vehicular traffic is prohibited around the structure.