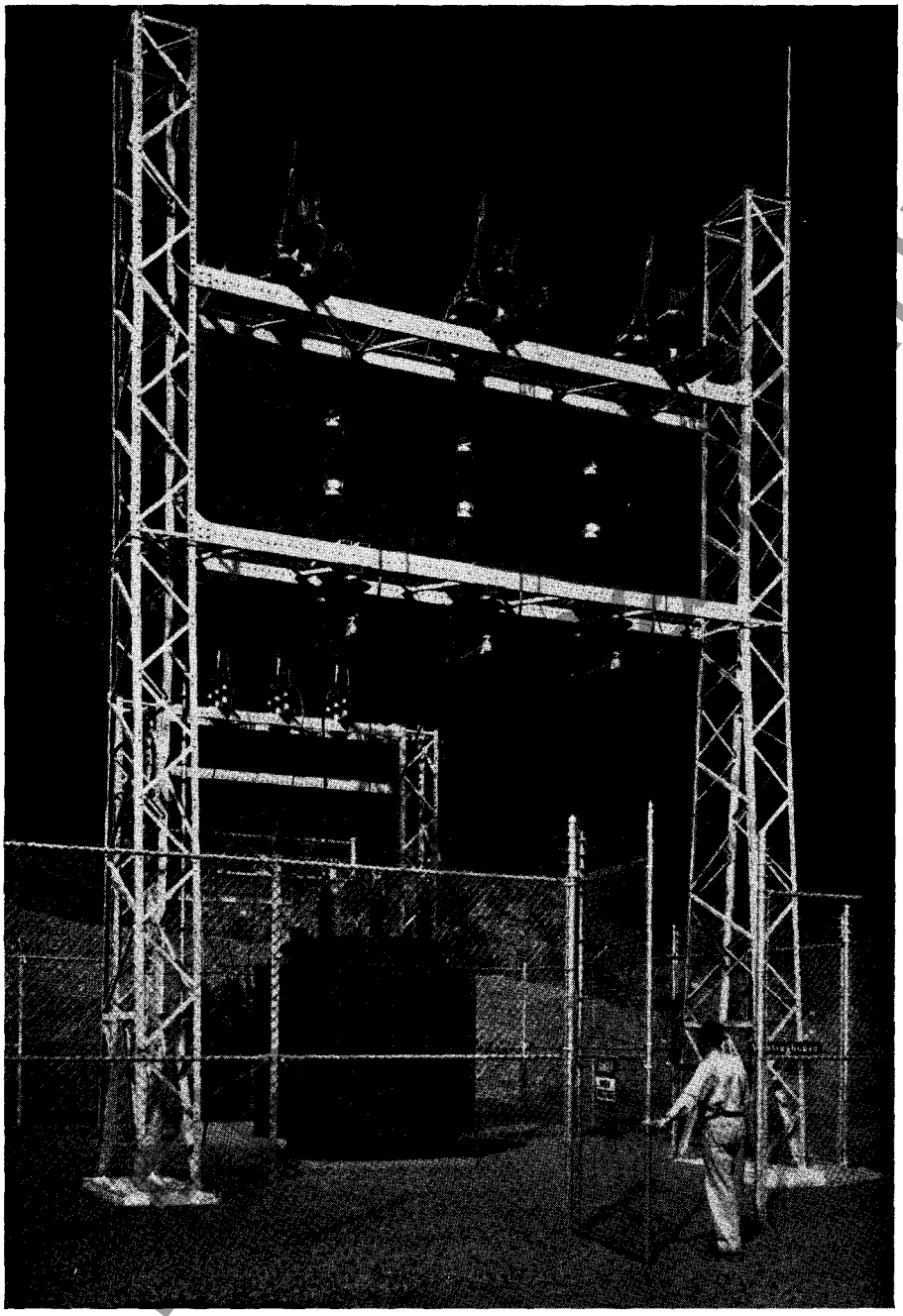
Westinghouse

Standard Outdoor Substation Structures



Features

Economy: Standardized designs require minimum additional engineering and drafting. Use of pre-engineered, standard components assure the best design at the lowest possible cost.

Convenience: Substation structures may be ordered complete from the appropriate bill of material. Time consuming formal drawing approval is eliminated. Single source of supply with single responsibility.

Flexibility: Typical arrangements are included that are adaptable to Utility, Industrial or Rural Systems. Basic apparatus may be deleted or added without affecting standard designs.

Westinghouse substation structures are designed in accordance with applicable NEMA standards and utilize Westinghouse standard apparatus.

Design data tabulations are guides to select minimum size trusses and conductors in accordance with sound design practices for outdoor substations.

Substation structures may be ordered by simple reference to drawing number and title.

For other standardized substation arrangements, furnish the following information to your Westinghouse sales representative.

1. Single line diagram including relative direction of incoming and outgoing lines.
2. Incoming and outgoing line pull and size of conductor.
3. Plot plan.
4. Clearance problems.
5. Short circuit capacity including momentary and short-time currents.

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These standard substation drawings and bills of material cover frequently recurring substation arrangements. The drawings are as follows:

Voltage	Type of Structure	Drawing No.	Page
15 Kv	Straight column line dead end	PSE-101	6
23 Kv	Straight column line dead end	PSE-101	6
34.5, 46 and 69 Kv	Straight column line dead end	PSE-102	8
	Tapered column line dead end	PSE-104	12
	Tapered column line dead end with oil circuit breaker	PSE-117	32
	Single square bay line dead end and switching structure	PSE-108	20
	Single square bay switching structure with two (2) oil circuit breakers, disconnect and by-pass switches	PSE-123	44
	Single square bay substation structure with two (2) oil circuit breakers and station service transformer	PSE-129	56
	Single square bay substation structure with single oil circuit breaker and station service transformer	PSE-130	58
	Double square bay line dead end structure with:		
	A. Switching structure	PSE-110, 111	24
	B. Switching structure with oil circuit breakers	PSE-119	36
	Double square bay switching structure with oil circuit breakers	PSE-122	42
	Line dead end and distribution structure with:		
	A. One (1) incoming line, four (4) transformer bay and four (4) feeder structure (1 phase reclosers)	PSE-106, 107	16,17
	B. One (1) incoming line, four (4) transformer bay and four (4) feeder structure (3 phase reclosers)	PSE-124, 125	46
	C. Combined, transformer bay and four (4) feeder structure	PSE-114	28
	D. Three (3) incoming lines, four (4) transformer bay, and four (4) feeder structure (1 phase reclosers)	PSE-120, 121	38
115 and 138 Kv	Straight column line dead end	PSE-103	10
	Tapered column line dead end	PSE-105	14
	Tapered column line dead end with oil circuit breaker	PSE-118	34
	Single square bay line dead end and switching structure	PSE-109	22
	Double square bay line dead end and switching structure	PSE-112, 113	26
	Low profile with four (4) oil circuit breakers and two (2) transformers	PSE-127, 128	52,53
161 Kv	Low profile with four (4) oil circuit breakers and two (2) transformers	PSE-127, 128	52,53
Various Kv	Air break and disconnect switch racks	PSE-115	30
	Equipment mounting stands	PSE-116	31
196 to 345 Kv	High-voltage switch racks	PSE-126	51

NEMA Standards, pages 3-5
Design Data, pages 60, 61

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Standard Outdoor Substation Structures

NEMA Standards, Part 36 SG6-36.01 Through 36.09

Outdoor Stations
(Structures, Pole-top Frames, etc.)
Manufacturing Standards
SG 6-36.01 Preamble①

A. General

Recognition shall be given to four essential points which characterize structures for outdoor substations.

1. Accuracy and Permanence – Structures shall be accurately fabricated to facilitate erection. Specific consideration shall be given to prevent damage to protective coatings required by certain materials.

2. Rigidity – Consideration shall be given to providing sufficient rigidity so that all equipment, such as air switches, interrupter switches, and circuit interrupting devices, will operate properly and so that deflection of members will not be excessive or exceed the limits specified by the equipment manufacturer.

3. Erection – Outdoor substations are frequently erected by persons with varied levels of experience as structural erectors. This calls for great detail and clearness in drawings, accuracy in fabrications, and care in marking the structural components.

4. Design – Frequently it is necessary to deviate from conventional practices in structural design in order to provide electrical and mechanical clearances or to prevent interference with switch operating mechanisms. Authorized Engineering Information 1-17-1968.

B. Material

The material used shall be suitable for the strength required of the outdoor structure with reference to load, deflections, and stresses. Service conditions will affect the choice of material. The material used shall be of uniform quality and without defects which would affect the strength and service of the structure.

Since most structures are of steel or aluminum, the following requirements shall apply when such materials are used.

1. For steel, the physical properties shall be at least those of ASTM Specifications A 283 (Grade D) and A 306 (Grade 60).

2. For aluminum, the physical properties shall be at least those of the Aluminum Association's Specification 6061-T6. NEMA Standard 1-17-1968.

SG 6-36.02 Loading

Structures shall be designed to withstand apparatus loads, dead loads, wind loads, snow and ice loads, other specified loads, and unusual service conditions.

① Revised

A. Apparatus Loads

Apparatus loads (including conductors) consist of the following:

1. Static Loads
   a. Weight of the apparatus.
   b. Conductor weight (not line tension).
2. Operating and Dynamic Loads
   a. Friction forces, moments, and torques due to mechanical operation of apparatus such as air switches and grounding switches.
   b. Dynamic forces, moments, and torques due to accelerating loads of high-speed circuit-interrupting devices when specified.
   c. Magnetic forces due to short-circuit current.

For specific loads the manufacturer should be consulted.

B. Dead Loads

Dead loads consist of the weight of the structure and line tensions. If strain conductors and static lines are used, the strain load per conductor and line shall be specified by the user. When not specified, the strain load shall be assumed to be 1000 pounds per conductor in a direction of 15 degrees from normal to the face of the structure.

C. Wind Loads

Wind load on the structure and apparatus mounted thereon shall be assumed to be 25 pounds per square foot on the vertical projection of the structural members for the first bent and 12½ pounds per square foot for the second bent. Succeeding bents need not be considered.

For lattice towers, lattice box columns and trusses, the exposed area shall be assumed to be 1½ times the exposed area of the members of one face.

A bent consists of one or more horizontal members supported by two or more columns effectively all in one vertical plane. It includes any bracing between these members.

When wind load is specified in velocity, the following formula shall be used to determine the equivalent loading on flat surfaces:

$$P = 0.004\ V^2$$

Where –
P – pressure in pounds per square foot
V – velocity in miles per hour

For the projected area of cylindrical surfaces, use $P = 0.0025\ V^2$.

D. Ice Loads

Structures shall be designed to withstand ice loading on apparatus, conductors and the structure itself, as dictated by geographical location.

The degree of loading due to ice shall be considered as light, medium or heavy in accordance with the geographical areas shown in the loading map in USA Standard C2.1-1941, and shall be calculated in accordance with the following table. Ice weighs 57 pounds per cubic foot; as a general guide, no ice is equivalent to light load, ¼ inch of ice to medium load, and ½ inch of ice to heavy load.

E. Other Specified Loads

Other loads consist of conductor vibrational forces, and forces caused by thermal expansion and contraction.

F. Unusual Service Conditions

Loads due to hurricanes or earthquake shock shall be considered where such conditions are likely to occur. NEMA Standard 5-20-1968.

SG 6-36.03 Deflections

When apparatus loads, strained conductor loads and wind loads (not including ice as specified in par. D of SG 6-36.02) are considered, the size of the members may be determined by deflection limits rather than stress limits. This is done so that deflections which might be detrimental to the operation of electrical apparatus and cause undesirable stress and vibration in the bus, bus supports and equipment will not occur.

Ice Thickness, Inches	Ice Load as Percent of Weight of Lattice Structures		Ice Load in Pounds for All Other Structures (Including Conductors) and Materials	Ice Load as Percent of Weight of Apparatus②
	Steel	Aluminum		
¼	25	75	1.2 x Ice Area in Square Feet	25
½	50	150	2.4 x Ice Area in Square Feet	50

② Where apparatus such as air switches, grounding switches, interrupter switches, and circuit-interrupting devices are required to operate under iced conditions, the increased friction and dynamic forces shall be considered in apparatus loads.

For example, the lattice structures the weight of ½ inch of ice may be considered to be 50 percent of the weight of the steel structures and 150 percent of the weight of the aluminum structures. Structures made of other materials shall take into account a load in pounds due to ½ inch of ice calculated by multiplying the area of the exposed surface in square feet by 2.4.

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For apparatus loads and dead loads, vertical deflections shall be limited to a maximum of 1/300 of the span and horizontal deflections to 1/200 of the span, except that high-speed circuit-interrupting devices may, where indicated by the manufacturer, require reductions in these deflection limits for proper performance. All deflection limits may require reduction to provide for proper operation of electrical equipment under icing conditions.

The vertical supporting structures shall be so designed that, under maximum loading conditions, they will not deflect more than 1/200 of the height from the top of the foundation to the connecting points of the supporting members of the uppermost apparatus conductor. NEMA Standard 5-20-1968.

SG 6-36.04 Stresses

The allowable stresses for structural members shall be based on a factor of safety of at least 1.65 on minimum yield strength for both steel and aluminum as recommended in the latest edition of the "Aluminum Construction Manual*," and the latest edition of the "Manual of Steel Construction†". Allowable stresses shall be calculated according to the methods outlined in the handbooks of the Aluminum Association and the American Institute of Steel Construction. For materials other than steel and aluminum, the recommended factors of safety and allowable stress calculations shall be in accordance with the appropriate industry standards.

* Copies are available from the Aluminum Association, 420 Lexington Avenue, New York, N.Y. 10017.

† Copies are available from the American Institute of Steel Construction, Inc., 101 Park Avenue, New York, N.Y. 10017. NEMA Standard 1-17-1968.

SG 6-36.05 Service Conditions

If the structure is to be galvanized to meet service conditions, it shall be galvanized in accordance with the latest revisions of ASTM Specification A 123. NEMA Standard 1-17-1968.

SG 6-36.06 Aluminum and Dissimilar Materials

When aluminum is in contact with or fastened to steel or dissimilar material, the following is recommended:

A. Steel

Aluminum surfaces to be placed in contact with steel should be given one coat of zinc chromate primer in accordance with Federal Specification TT-P-645 or the equivalent, or one coat of a suitable nonhardening joint compound which is capable of excluding moisture from the joint during prolonged service. Additional protection can be obtained by applying the joint compound in addition to the zinc chromate primer. The zinc chromate paint should be allowed to dry to hardness before the parts are assembled.

The steel surfaces to be placed in contact with aluminum should be painted with good quality priming paint, such as red lead conforming to Federal Specification TT-P-86B or zinc chromate primer in accordance with Federal Specification TT-P-645, followed by one coat of paint consisting of 2 pounds of aluminum paste pigment (ASTM Specification D 962, Type 2, Class B) per gallon of varnish meeting Federal Specification TT-V-81B, Type 2, or the equivalent. Stainless steel, or aluminized, hot-dip galvanized or electro galvanized steel placed in contact with aluminum need not be painted.

B. Wood

Aluminum surfaces to be placed in contact with wood should be given a heavy coat of an alkali-resistant bituminous paint before installation. The bituminous paint used should meet the requirements of United States Military Specification MIL-P-6883A. The paint should be applied as it is received from the manufacturer without the addition of any thinner.

C. Concrete

Where the surface of concrete in contact with aluminum is subjected to moisture entrapment, the aluminum surface should be treated at the installation site as specified in par. B. Authorized Engineering Information 1-17-1968.

SG 6-36.07 Foundations

Foundation designs and foundations are usually furnished by others. However, the following information is provided as a guide.

A. General

Proper provisions should be made to transmit the stresses to the foundations of the structure. The stresses to be transmitted should include compression, uplift, shear and overturning moment. The foundations should be designed to prevent overturning under maximum loads and should have a safety factor of at least 1½.

B. Earth Values

Soil conditions should be investigated before the foundations are designed. The following earth pressures are intended to be used in the absence of definite information as to soil values.

Earth should be assumed to weigh 90 pounds per cubic foot and, if the foundation is of a suitable design, its weight may be used to resist overturning or uplift. The shearing values or cohesive strength should be considered. Earth pressure should not exceed 4000 pounds per square foot unless otherwise specified.

C. Anchor Bolts

Anchor bolts should be designed to provide resistance to all conditions of tension and shear at the bases of columns. Authorized Engineering Information 1-17-1968.

SG 6-36.08 Detailing and Fabrication

A. Straightening

All members which are bent or out of line after fabrication shall be carefully straightened, without mutilating the material or its finish. H-beam and similar members should have distortions limited to 1/200 of their length, and chord angles and similar members should have distortions limited to 1/100 of their length.

B. Bolt Length

Bolts shall be of sufficient length to assure full thread engagement of the nut.

C. Welding

The welding requirements and techniques recommended by the American Institute of Steel Construction and the Aluminum Association shall be followed in the fabrication of all welded members. Materials other than steel and aluminum shall be joined in accordance with the appropriate industry standards.

D. Erection Marks

All members shall be clearly marked to provide easy identification in the field. Erection drawings shall be included with each shipment.

E. Bolt Spacing

The minimum spacing of bolts shall be two diameters plus ⅜ inch but, in general, spacing should be as follows:

2½ inches for ⅝-inch diameter bolts.
3 inches for ¾-inch diameter bolts.
3½ inches for ⅞-inch diameter bolts.
4 inches for 1-inch diameter bolts.

The distance from the center of a bolt hole to a rolled or sheared edge shall be not less than that in the following Table. NEMA Standard 1-17-1968.

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Diameter of Bolt, Inches	Rolled Edge Distance, Inches	Sheared Edge Distance, Inches
½	⅝	¾
⅝	¾	⅞
¾	1	1⅛
⅞	1⅛	1¼
1	1¼	1⅜

SG 6-36.09 Miscellaneous

A. Shipping

All structures shall be shipped completely "knocked down" unless otherwise specified. All sections shall be properly prepared for shipment so that no damage will result during transit.

Bolts and other similar material shall be shipped in boxes or other suitable containers. When shipment is made, care must be exercised to include all parts required for the complete structure.

B. Field Erection

Since the structural substation design reflects a high degree of engineering skill, substation manufacturers shall be consulted before any changes in the design of the structure are made during erection. NEMA Standard 1-17-1968.

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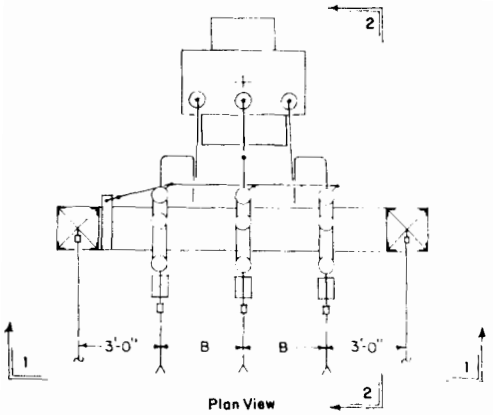
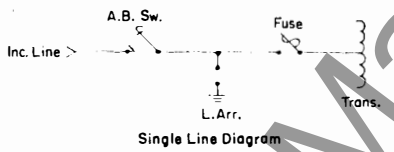
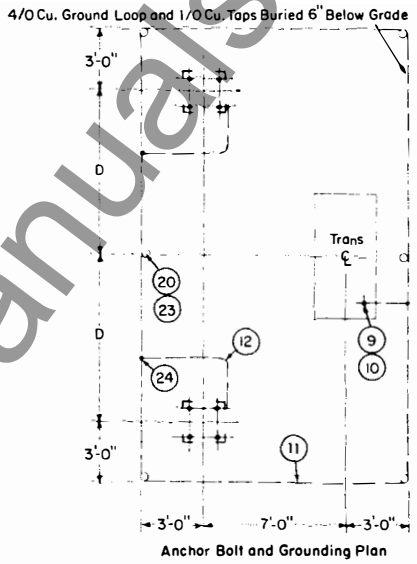
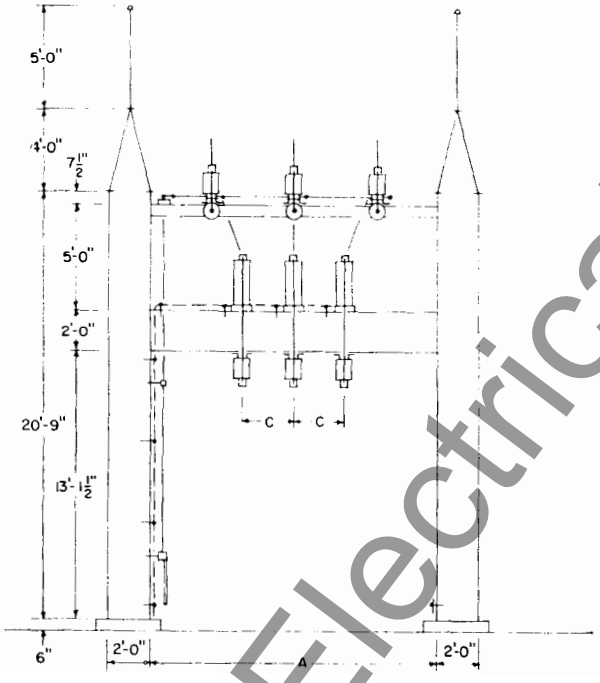
Standard Outdoor Substation Structures

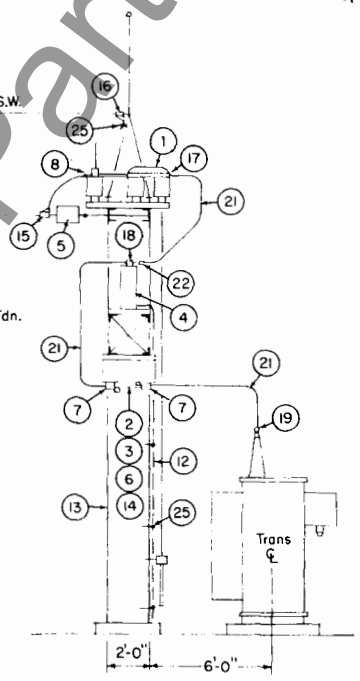
Straight Column Line Dead End Structure, 23 or 15 Kv











Tabulation

	23 Kv	15 Kv
A	12'-0"	10'-0"
B	4'-0"	3'-0"
C	2'-6"	2'-0"
D	7'-0"	6'-0"

Drawing PSE-101

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Standard Outdoor Substation Structures

Lists of Material for 23 or 15 Kv Straight Column Line Dead End Structure per Drawing PSE-101①

A. 23 Kv only:

Item	Req'd	Description
1.	1	Air break switch, type V-3, 23 Kv, 600 amperes, 3 pole, single throw, horizontal mounting, complete with cap and pin insulators, arc horns and TP manual operating mechanism
2.	3	Fuse mounting, type DBA-1, 23 Kv, inverted mounting, with cap and pin insulators
3.	3	Fuse unit, type DBA-1, 23 Kv
4.	3	Lightning arrester, type IVS
5.	9	Strain insulators, 10″ diameter, clevis type (3/string)
6.	1	Hookstick, 8 feet long
7.	6	Terminal lug for ½″ IPS copper tube (2B pad)
8.	3	Terminal lug for #4 wire to 250 MCM copper cable (4B pad)
9.	1	Terminal for 1/0 copper cable (2B pad)
10.	2	½-13 × ⅞ silicon bronze hexagonal head tap bolt #4901-1
11.	80	Feet of 19-.1055 (4/0) .530 diameter bare copper cable #13435AL (M.H.D.)
12.	60	Feet of 7-.1228 (1/0) .368 diameter bare copper cable #13435AL (M.H.D.)
13.	1	Set of galvanized steelwork, based on: Phase wire 1000 lbs. line pull Static wire 1000 lbs. line pull
14.	1	Hookstick container
15.	3	Strain clamp for 1/0 to 250 MCM copper or 1/0 to 266.8 MCM ACSR cable (clevis)
16.	2	Strain clamp for #6 to 2/0 copper or ACSR cable (clevis type)
17.	3	Terminal lug for ½″ IPS copper tube (4B pad)
18.	3	Tee connector for ½″ IPS copper tube run – copper bar tap
19.	3	Expansion terminal – 1⅛-12 stud to ½″ IPS copper tube
20.	6	Copperweld ground rod – ¾″ diameter × 10 feet long
21.	100	Feet of ½″ IPS copper tubing, 5 pieces @ 20 feet long
22.	3	Coupler for ½″ IPS copper tube
23.	6	Ground clamp for ¾″ rod to 4/0 and 1/0 copper cable (2 grooves)
24.	3	Parallel clamp for 4/0 and 1/0 copper cable
25.	11	Ground clamp for #6 to 2/0 copper cable (2 grooves)

B. 15 Kv structure per drawing PSE-101, similar to 23 Kv except with the following item changes as indicated below:

1.	1	Air break switch, type V-3, 14.4 Kv, 600 amperes, 3 pole, single throw, horizontal mounting, complete with cap and pin insulators, arc horns and TP manual operating mechanism
2.	3	Fuse mounting, type DBA-1, 15 Kv, inverted mounting, with cap and pin insulators
3.	3	Fuse unit, type DBA-1, 15 Kv
4.	3	Lightning arrester, type IVS
5.	6	Strain insulator, 10″ diameter, clevis type (2/string)

① When necessitated by shipping schedule, suitable aluminum cable, tubing, and connectors may be substituted for above grade electrical connections.

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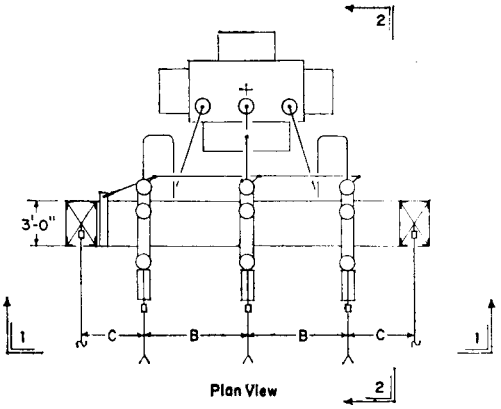
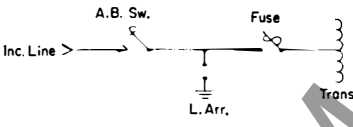
Standard Outdoor Substation Structures

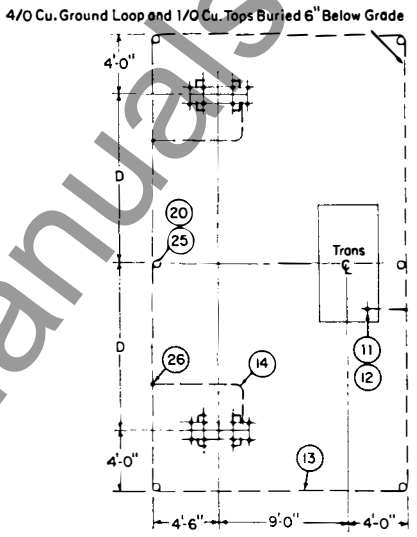
Straight Column Line Dead End Structure, 69, 46, or 34.5 Kv



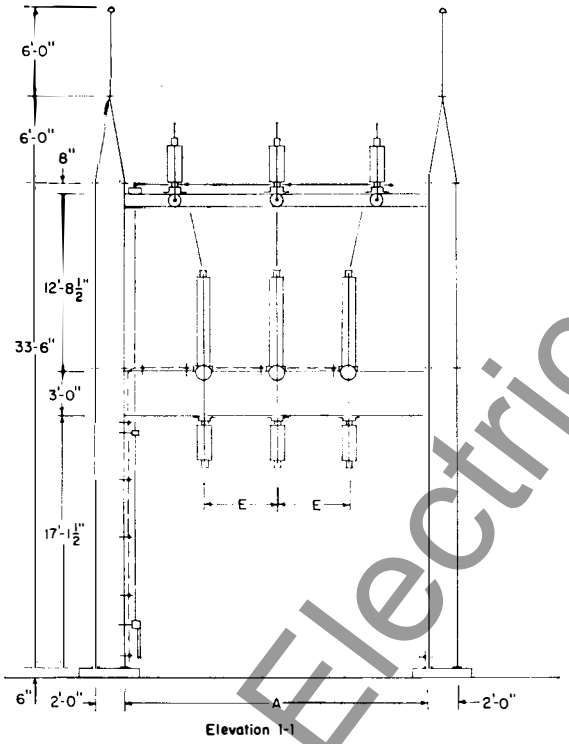
Plan View



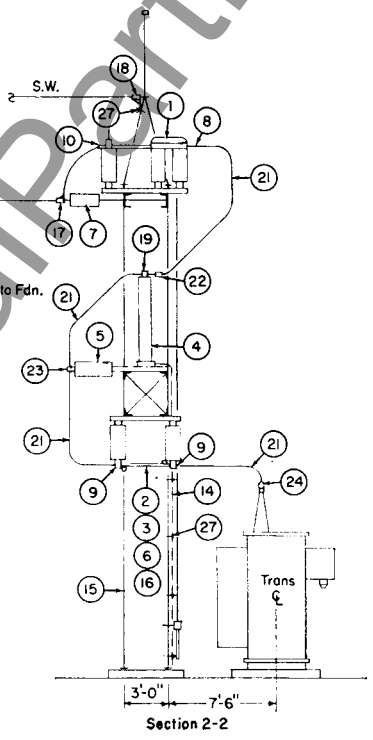
Single Line Diagram



Anchor Bolt and Grounding Plan



Elevation 1-1



Section 2-2

Tabulation

	69 Kv	46 Kv	34.5 Kv
A	21'-0"	18'-0"	15'-0"
B	7'-0"	6'-0"	5'-0"
C	4'-6"	4'-0"	3'-6"
D	11'-6"	10'-0"	8'-6"
E	5'-0"	4'-0"	3'-0"

Drawing PSE-102

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Standard Outdoor Substation Structures

Lists of Material for 69, 46, or 34.5 Kv Straight Column Line Dead End Structure per Drawing PSE-102①

A. 69 Kv only:

Item	Req'd	Description
1.	1	Air break switch, type V-3, 69 Kv, 600 amperes, 3 pole, single throw, horizontal mounting, complete with cap and pin insulators, arc horns and TP manual operating mechanism
2.	3	Fuse mounting, type DBA-1, 69 Kv, inverted mounting, with cap and pin insulators
3.	3	Fuse unit, type DBA-1, 69 Kv
4.	3	Lightning arrester, type IVS
5.	6	Apparatus insulator, 69 Kv stacking unit, 3" bolt circle, cap and pin type (2/stack) (stack TR-16)
6.	1	Hookstick, 12 feet long
7.	15	Strain insulator, 10" diameter, clevis type (5/string)
8.	3	Terminal lug for ¾" IPS copper tube (4B pad)
9.	6	Terminal lug for ¾" IPS copper tube (2B pad)
10.	3	Terminal lug for #4 wire to 250 MCM copper cable (4B pad)
11.	1	Terminal lug for 1/0 copper cable (2B pad) (transformer ground)
12.	2	½-13 × ⅞" silicon bronze hexagonal head tap bolt #4901-1
13.	110	Feet of 19-.1055 (4/0) .530" diameter bare copper cable #13435AL (M.H.D.)
14.	85	Feet of 7-.1228 (1/0) .368" diameter bare copper cable #13435AL (M.H.D.)
15.	1	Set of galvanized steelwork, based on: Phase wire 1000 lbs. line pull Static wire 1000 lbs. line pull
16.	1	Hookstick container
17.	3	Strain clamp for 1/0 to 250 MCM copper or 1/0 to 266.8 MCM ACSR cable (levis)
18.	2	Strain clamp for #6 to 2/0 copper or ACSR cable (clevis type)
19.	3	Tee connector for ¾" IPS copper tube run – bar tap
20.	6	Copperweld ground rod, ¾" diameter x 10 feet long
21.	160	Feet of ¾" IPS copper tubing, 8 pieces @ 20 feet long
22.	3	Coupler for ¾" IPS copper tube
23.	3	Bus support clamp for ¾" IPS copper tubing, 3" bolt circle, cap mounting
24.	3	Expansion terminal, 1½-12 stud to ¾" IPS copper tube
25.	6	Ground clamp for ¾" rod to 4/0 and 1/0 copper cable (2 grooves)
26.	3	Parallel clamp for 4/0 and 1/0 copper cable (ground)
27.	12	Ground clamp for #6 to 2/0 copper cable (2 grooves)

B. 46 Kv structure per drawing PSE-102, similar to 69 Kv except with the following item changes as indicated below:

1.	1	Air break switch, type V-3, 46 Kv, 600 amperes, 3 pole, single throw, horizontal mounting, complete with cap and pin insulators, arc horns and TP manual operating mechanism.
2.	3	Fuse mounting, type DBA-1, 46 Kv, inverted mounting, with cap and pin insulators
3.	3	Fuse unit, type DBA-1, 46 Kv
4.	3	Lightning arrester, type IVS
5.	3	Apparatus insulator, 46 Kv, 3" bolt circle, cap and pin type (TR-13)
7.	12	Strain insulator, 10" diameter, clevis type (4/string)
13.	105	Feet of 19-.1055 (4/0) .530" diameter bare copper cable #13435AL (M.H.D.)

C. 34.5 Kv structure per drawing PSE-102, similar to 69 Kv except with the following item changes as indicated below:

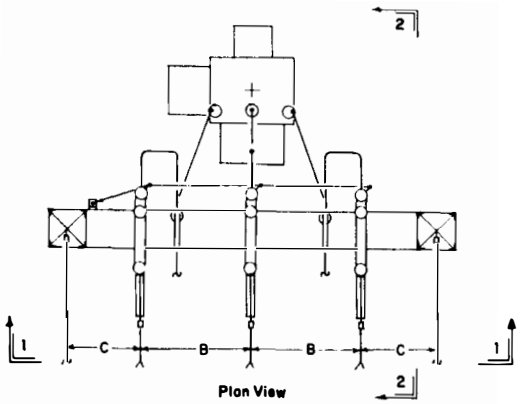
1.	1	Air break switch, type V-3, 34.5 Kv, 600 amperes, 3 pole, single throw, horizontal mounting, complete with cap and pin insulators, arc horns and TP manual operating mechanism
2.	3	Fuse mounting, type DBA-1, 34.5 Kv, inverted mounting, with cap and pin insulators
3.	3	Fuse unit, type DBA-1, 34.5 Kv
4.	3	Lightning arrester, type IVS
5.	3	Apparatus insulator, 34.5 Kv, 3" bolt circle, cap and pin type (TR-10)
7.	12	Strain insulator, 10" diameter, clevis type (4/string)
13.	100	Ft. of 19-.1055 (4/0) .530" diameter bare copper cable #13435AL (M.H.D.)

① When necessitated by shipping schedule, suitable aluminum cable, tubing, and connectors may be substituted for above grade electrical connections.

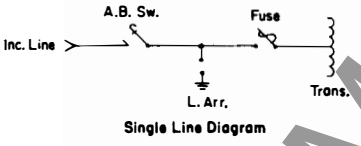
May, 1968
Supersedes AD 36-360 dated June, 1966
E, D, C/1969/DB

Standard Outdoor Substation Structures

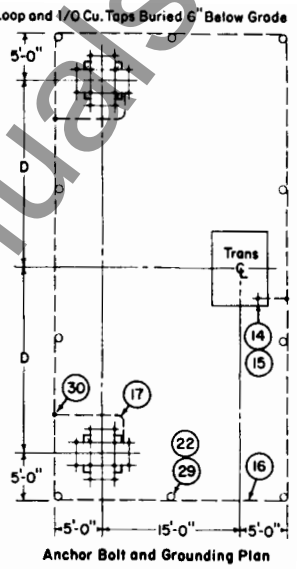
Straight Column Line Dead End Structure, 138 or 115 Kv



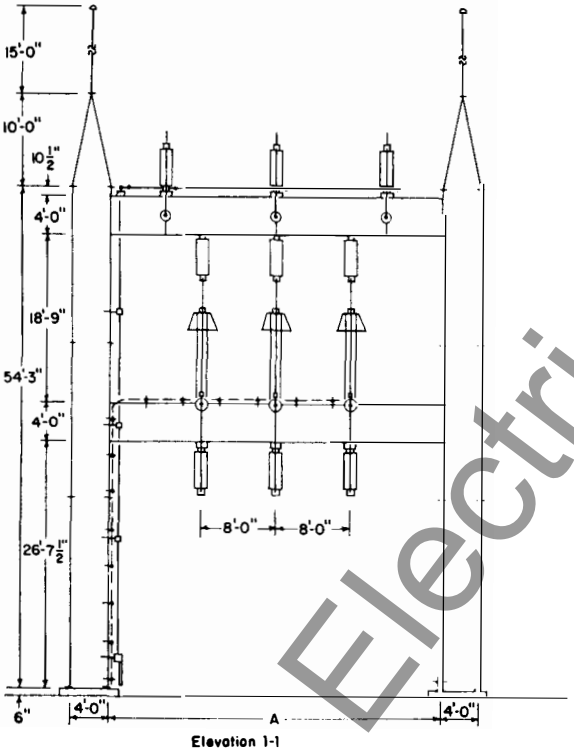
Plan View



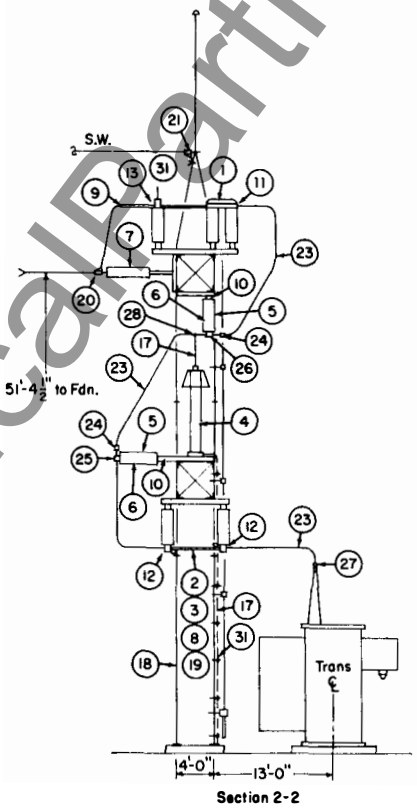
Single Line Diagram



Anchor Bolt and Grounding Plan



Elevation 1-1



Section 2-2

Tabulation

	138 Kv	115 Kv
A	36'-0"	30'-0"
B	12'-0"	10'-0"
C	8'-0"	7'-0"
D	20'-0"	17'-0"

Drawing PSE-103

Westinghouse Electric Corporation
Switchgear Division: Power Switching Equipment, East Pittsburgh, Pa.
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Standard Outdoor Substation Structures

Lists of Material for 138 Kv or 115 Kv Straight Column Line Dead End Structure per Drawing PSE-103①

A. 138 Kv only:

Item	Req'd	Description
1.	1	Air break switch, type V-2, 138 Kv, 600 amperes, 3 pole, single throw, horizontal mounting, complete with cap and pin insulators, arc horns, and TP manual operating mechanism
2.	3	Fuse mounting, type DBA-2, 138 Kv, inverted mounting, with cap and pin insulators
3.	3	Fuse unit, type DBA-2, 138 Kv
4.	3	Lightning arrester, type IVS
5.	12	Apparatus insulators, 138 Kv stacking unit, 5″ bolt circle, cap and pin type (TR-140) (2/stack)
6.	6	Apparatus insulators, 138 Kv stacking unit, 5″ bolt circle, cap and pin type (TR-53) (1/stack)
7.	30	Strain insulators, 10″ diameter, clevis type (10/string)
8.	1	Hookstick, 16 feet long
9.	3	Lead guide, 4 feet long
10.	6	Bus support spacer, 3½″ high, 5″ bolt circle
11.	3	Terminal lug for 1″ IPS copper tube (4B pad)
12.	6	Terminal lug for 1″ IPS copper tube (2B pad)
13.	3	Terminal lug for #4 wire to 250 MCM copper cable (4B pad)
14.	1	Terminal lug for 1/0 copper cable (2B pad)
15.	2	½-13 x ⅞″ silicon bronze hexagonal head tap bolt #4901-1
16.	165	Feet of 19-.1055 (4/0) .530″ diameter bare copper cable #13435AL (M.H.D.)
17.	125	Feet of 7-.1228 (1/0) .368″ diameter bare copper cable #13435AL (M.H.D.)
18.	1	Set of galvanized steelwork, based on: External phase wire 1000 lbs. line pull Static wire 1000 lbs. line pull
19.	1	Hookstick container
20.	3	Strain clamp for 1/0 to 250 MCM copper or 1/0 to 266.8 MCM ACSR cable (clevis)
21.	2	Strain clamp for #6 to 2/0 copper or ACSR cable (clevis type)
22.	10	Copperweld ground rod, ¾″ diameter x 10 feet long
23.	240	Feet of 1″ IPS copper tubing, 12 pieces @ 20 feet long
24.	6	Coupler for 1″ IPS copper tube
25.	3	Bus support clamp for 1″ IPS copper tube, 5″ bolt circle, cap mounting
26.	3	Bus support clamp for 1″ IPS copper tube, 5″ bolt circle, pin mounting
27.	3	Expansion terminal, 1⅛-12 stud to 1″ IPS copper tube
28.	3	Tee connector for 1″ IPS copper tube run – 1/0 copper cable tap
29.	10	Ground clamp for ¾″ rod to 4/0 and 1/0 copper cable (2 grooves)
30.	3	Parallel clamp for 4/0 and 1/0 copper cable
31.	17	Ground clamp for #4 to 2/0 copper cable (2 grooves)

B. 115 Kv structure per drawing PSE-103, similar to 138 Kv except with the following item changes as indicated below:

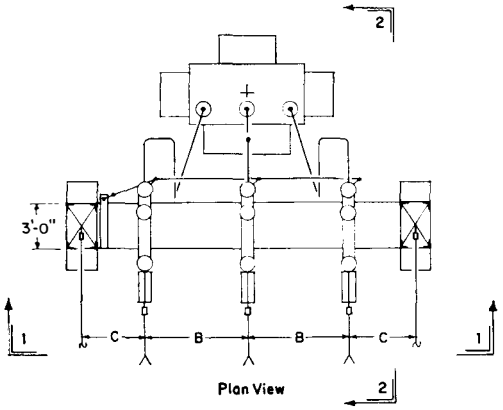
1.	1	Air break switch, type V-2, 115 Kv, 600 amperes, 3 pole, single throw, horizontal mounting, complete with cap and pin insulators, arc horns and TP manual operating mechanism
2.	3	Fuse mounting, type DBA-2, 115 Kv, inverted mounting, with cap and pin insulators
3.	3	Fuse unit, type DBA-2, 115 Kv
4.	3	Lightning arrester, type IVS
5.	18	Apparatus insulator, 115 Kv stacking unit, 5″ bolt circle, cap and pin type (TR-140) (3/stack)
6.	. . .	Not used
7.	24	Strain insulators, 10″ diameter, clevis type (8/string)
16.	150	Feet of 19-.1055 (4/0) .530″ diameter bare copper cable #13435AL (M.H.D.)

① When necessitated by shipping schedule, suitable aluminum cable, tubing, and connectors may be substituted for above grade electrical connections.

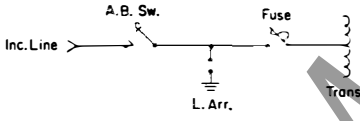
May, 1968
Supersedes AD 36-360 dated June, 1966
E, D, C/1969/DB

Standard Outdoor Substation Structures

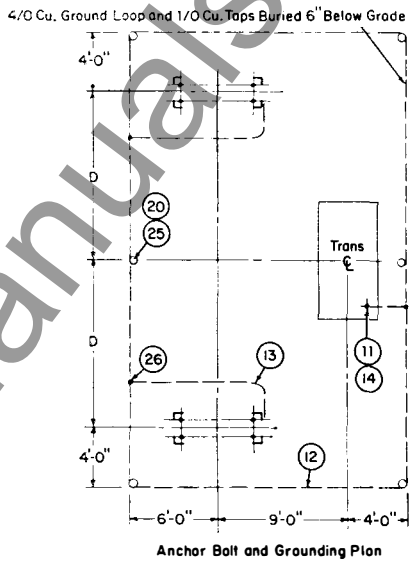
Tapered Column Line Dead End Structure, 69, 46, or 34.5 Kv



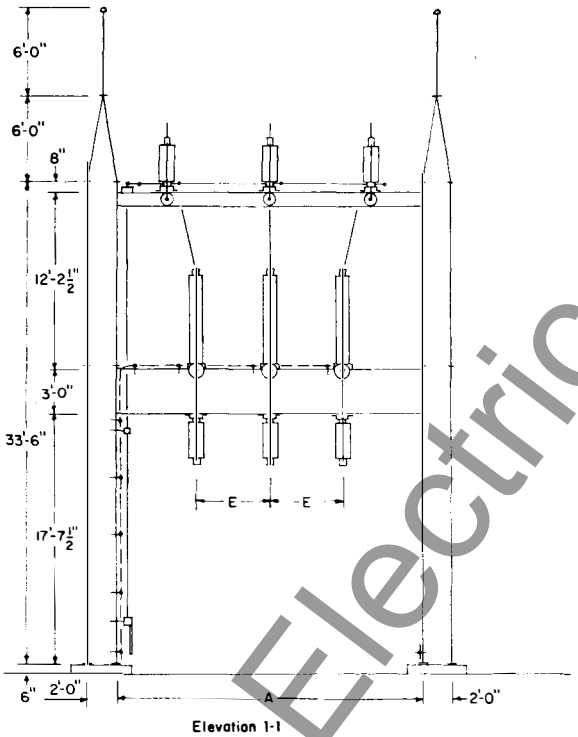
Plan View



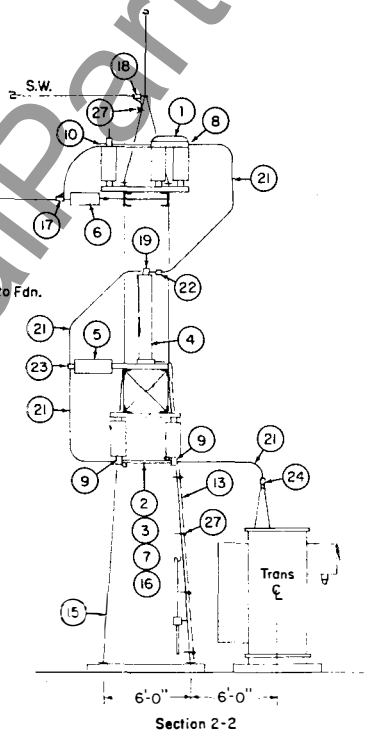
Single Line Diagram



Anchor Bolt and Grounding Plan



Elevation 1-1



Section 2-2

Tabulation

	69 Kv	46 Kv	34.5 Kv
A	21'-0"	18'-0"	15'-0"
B	7'-0"	6'-0"	5'-0"
C	4'-6"	4'-0"	3'-6"
D	11'-6"	10'-0"	8'-6"
E	5'-0"	4'-0"	3'-0"

Drawing PSE-104

Westinghouse Electric Corporation
Switchgear Division: Power Switching Equipment, East Pittsburgh, Pa.
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Westinghouse

Standard Outdoor Substation Structures

Lists of Material for 69, 46, or 34.5 Kv Tapered Column Line Dead End Structure per Drawing PSE-104①

A. 69 Kv only:

Item	Req'd	Description
1.	1	Air break switch, type V-3, 69 Kv, 600 amperes, 3 pole, single throw, horizontal mounting, complete with cap and pin insulators, arc horns and TP manual operating mechanism
2.	3	Fuse mounting, type DBA-1, 69 Kv, inverted mounting, with cap and pin insulators
3.	3	Fuse unit, type DBA-1, 69 Kv
4.	3	Lightning arrester, type IVS
5.	6	Apparatus insulators, 69 Kv stacking unit, 3″ bolt circle, cap and pin type (2-stack) (stack TR-16)
6.	15	Strain insulators, 10″ diameter, clevis type (5/string)
7.	1	Hookstick, 12 feet long
8.	3	Terminal lug for ¾″ IPS copper tubing (4B pad)
9.	6	Terminal lug for ¾″ IPS copper tubing (2B pad)
10.	3	Terminal lug for #4 wire to 250 MCM copper cable (4B pad)
11.	1	Terminal for 1/0 copper cable (2B pad) (transformer ground)
12.	110	Feet of 19-.1055 (4/0) .530″ diameter bare copper cable #13435AL (M.H.D.)
13.	85	Feet of 7-.1228 (1/0) .368″ diameter bare copper cable #13435AL (M.H.D.)
14.	2	½-13 x ⅞ silicon bronze hexagonal head tap bolt #4901-1
15.	1	Set of galvanized steelwork, based on: Phase wire 2000 lbs. line pull Static wire 1000 lbs. line pull
16.	1	Hookstick container
17.	3	Strain clamp for 1/0 to 250 MCM copper or 1/0 to 266.8 MCM ACSR cable (clevis)
18.	2	Strain clamp for #6 to 2/0 copper or ACSR cable (clevis type)
19.	3	Tee connector for ¾″ IPS copper tube run – bar tap
20.	6	Copperweld ground rod, ¾″ diameter x 10 feet long
21.	160	Feet of ¾″ IPS copper tubing, 8 pieces @ 20 feet long
22.	3	Couplers, ¾″ IPS copper
23.	3	Bus support clamp for ¾″ IPS copper tube, 3″ bolt circle, cap mounting
24.	3	Expansion terminal, 1⅛-12 stud to ¾″ IPS copper tube
25.	6	Ground clamp for ¾″ rod to 4/0 and 1/0 copper cable (2 grooves)
26.	3	Parallel clamp for 4/0 and 1/0 copper cable (ground)
27.	12	Ground clamp for #6 to 2/0 copper cable (2 grooves)

B. 46 Kv structure per drawing PSE-104, similar to 69 Kv except with the following item changes as indicated below:

1.	1	Air break switch, type V-3, 46 Kv, 600 amperes, 3 pole, single throw, horizontal mounting, complete with cap and pin insulators, arc horns and TP manual operating mechanism
2.	3	Fuse mounting, type DBA-1, 46 Kv, inverted mounting, with cap and pin insulators
3.	3	Fuse unit, type DBA-1, 46 Kv
4.	3	Lightning arrester, type IVS
5.	3	Apparatus insulators, 46 Kv, 3″ bolt circle, cap and pin type (TR-13)
6.	12	Strain insulators, 10″ diameter, clevis type (4/string)
12.	105	Feet of 19-.1055 (4/0) .530″ diameter bare copper cable

C. 34.5 Kv structure per drawing PSE-104, similar to 69 Kv except with the following item changes as indicated below:

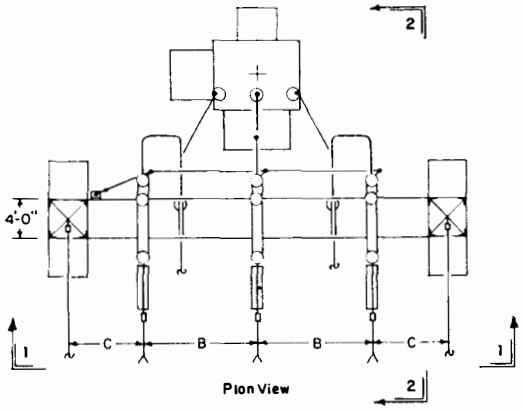
1.	1	Air break switch, type V-3, 34.5 Kv, 600 amperes, 3 pole, single throw, horizontal mounting, complete with cap and pin insulators, arc horns and TP manual operating mechanism
2.	3	Fuse mounting, type DBA-1, 34.5 Kv, inverted mounting, with cap and pin insulators
3.	3	Fuse unit, type DBA-1, 34.5 Kv
4.	3	Lightning arrester, type IVS
5.	3	Apparatus insulators, 34.5 Kv, 3″ bolt circle, cap and pin type (TR-10)
6.	12	Strain insulators, 10″ diameter, clevis type (4/string)
12.	100	Feet of 19-.1055 (4/0) .530″ diameter bare copper cable #13435AL (M.H.D.)

① When necessitated by shipping schedule, suitable aluminum cable, tubing, and connectors may be substituted for above grade electrical connections.

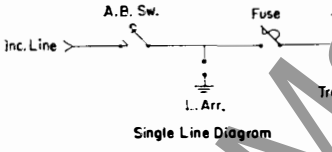
May, 1968
Supersedes AD 36-360 dated June, 1966
E, D, C/1969/DB

Standard Outdoor Substation Structures

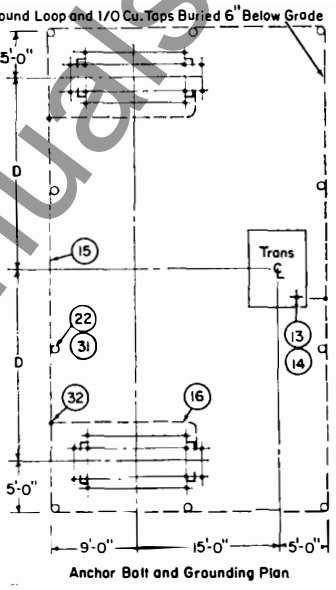
Tapered Column Line Dead End Structure, 138 or 115 Kv



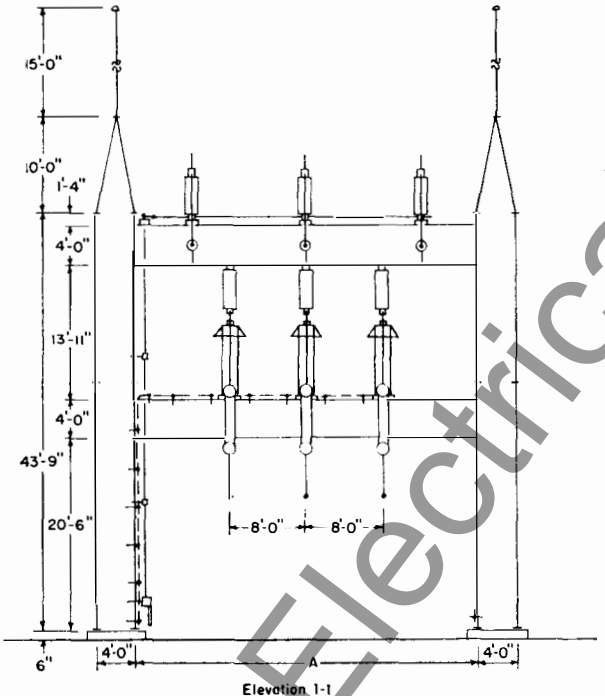
Plan View



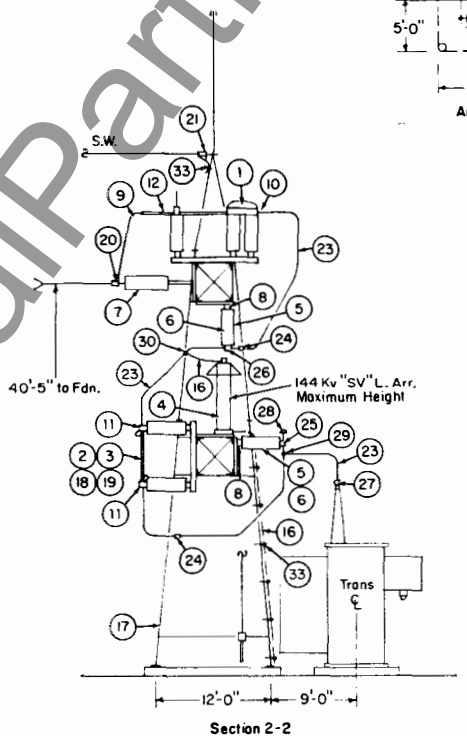
Single Line Diagram



Anchor Bolt and Grounding Plan



Elevation 1-1



Section 2-2

Tabulation

	138 Kv	115 Kv
A	36'-0"	30'-0"
B	12'-0"	10'-0"
C	8'-0"	7'-0"
D	20'-0"	17'-0"

Drawing PSE-105

Westinghouse Electric Corporation
Switchgear Division: Power Switching Equipment, East Pittsburgh, Pa.
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Westinghouse

Standard Outdoor Substation Structures

Lists of Material for 138 Kv or 115 Kv Tapered Column Line Dead End Structure per Drawing PSE-105①

A. 138 Kv only:

Item	Req'd	Description
1.	1	Air break switch, type V-2, 138 Kv, 600 amperes, 3 pole, single throw, horizontal mounting, complete with cap and pin insulators, arc horns and TP manual operating mechanism
2.	3	Fuse mounting, type DBA-2, 138 Kv, vertical mounting, with cap and pin insulators
3.	3	Fuse unit, type DBA-2, 138 Kv
4.	3	Lightning arrester, type SVS
5.	12	Apparatus insulators, 138 Kv stacking unit, 5″ bolt circle, cap and pin type (TR-140) (2/stack)
6.	6	Apparatus insulators, 138 Kv stacking unit, 5″ bolt circle, cap and pin type (TR-53) (1/stack)
7.	30	Strain insulators, 10″ diameter, clevis type (10/string)
8.	6	Bus support spacer, 3½″ high, 5″ bolt circle
9.	3	Lead guide, 4 feet long
10.	3	Terminal lug for 1″ IPS copper tubing (4B pad)
11.	6	Terminal lug for 1″ IPS copper tubing (2B pad)
12.	3	Terminal lug for #4 wire to 250 MCM copper cable (4B pad)
13.	1	Terminal lug for 1/0 copper cable (2B pad)
14.	2	½-13 x ⅞″ silicon bronze hexagonal head tap bolt #4901-1
15.	175	Feet of 19-.1055 (4/0) .530″ diameter bare copper cable #13435AL (M.H.D.)
16.	130	Feet of 7-.1228 (1/0) .368″ diameter bare copper cable #13435AL (M.H.D.)
17.	1	Set of galvanized steelwork, based on: Phase wire 4000 lbs. line pull Static wire 2000 lbs. line pull
18.	1	Hookstick, 24 feet long
19.	1	Hookstick container, 25 feet long
20.	3	Strain clamp, 1/0 to 250 MCM copper or 1/0 to 266.8 MCM ACSR cable (clevis)
21.	2	Strain clamp for #6 to 2/0 copper or ACSR cable (clevis type)
22.	10	Copperweld ground rod, ¾″ diameter x 10 feet long
23.	240	Feet of 1″ IPS copper tubing – 12 pieces @ 20 feet long
24.	6	Coupler for 1″ IPS copper tubing
25.	3	Bus support clamp for 1″ IPS copper tubing, 5″ bolt circle, cap mounting
26.	3	Bus support clamp for 1″ IPS copper tubing, 5″ bolt circle, pin mounting
27.	3	Expansion terminal, 1⅛-12 stud to 1″ IPS copper tubing
28.	3	Corona Bell for 1″ IPS copper tubing
29.	3	Tee connector for 1″ IPS copper tubing run and tap
30.	3	Tee connector for 1″ IPS copper tube run – 1/0 copper cable tap
31.	10	Ground clamp for ¾″ rod to 4/0 and 1/0 copper cable (2 grooves)
32.	3	Parallel clamp for 4/0 and 1/0 copper cable
33.	16	Ground clamp for #6 to 2/0 copper cable (2 grooves)

B. 115 Kv structure per drawing PSE-105, similar to 138 Kv except with the following item changes as indicated below:

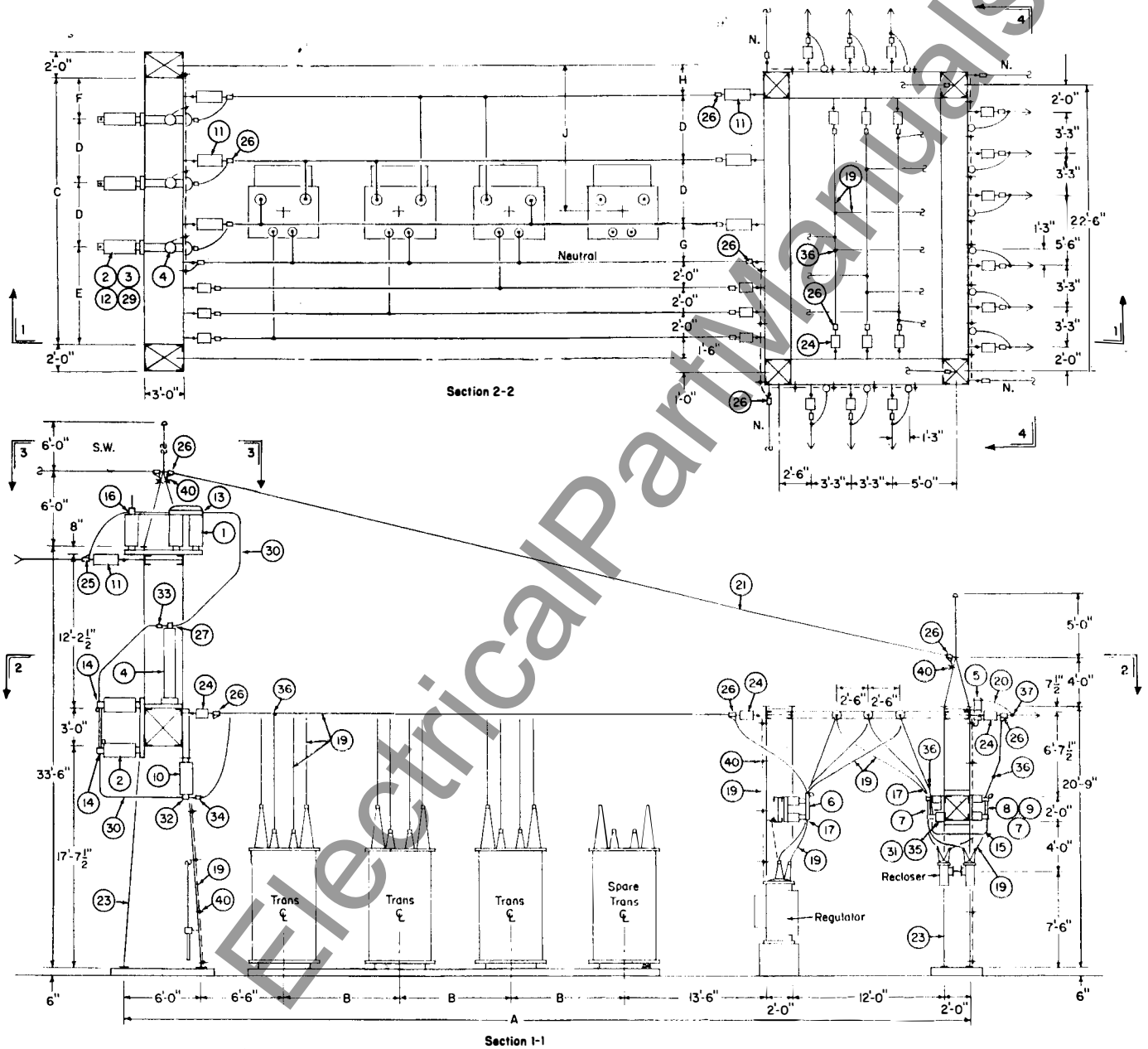
1.	1	Air break switch, type V-2, 115 Kv, 600 amperes, 3 pole, single throw, horizontal mounting, complete with cap and pin insulators, arc horns and TP manual operating mechanism
2.	3	Fuse mounting, type DBA-2, 115 Kv, vertical mounting, with cap and pin insulators
3.	3	Fuse unit, type DBA-4, 115 Kv
4.	3	Lightning arrester, type SVS
5.	18	Apparatus insulators, 115 Kv stacking unit, 5″ bolt circle, cap and pin type (TR-140) (3/stack)
6.	. . .	Not used
7.	24	Strain insulators, 10″ diameter, clevis type (8/string)
15.	160	Feet of 19-.1055 (4/0) .530″ diameter bare copper cable #13435AL (M.H.D.)
33.	15	Ground clamp for #6 to 2/0 copper cable (2 grooves)

① When necessitated by shipping schedule, suitable aluminum cable, tubing, and connectors may be substituted for above grade electrical connections.

May, 1968
Supersedes AD 36-360 dated June, 1966
E, D, C/1969/DB

Standard Outdoor Substation Structures

Line Dead End Structure and Distribution Structure with One (1) Incoming Line Four (4) Transformer Bay and Four (4) Feeder Structure (Single Phase Reclosers) 69/15, 46/15 ro 34.5/15 Kv



Drawing PSE-106 (Continued on Drawing PSE-107)

For list of material see page 19.

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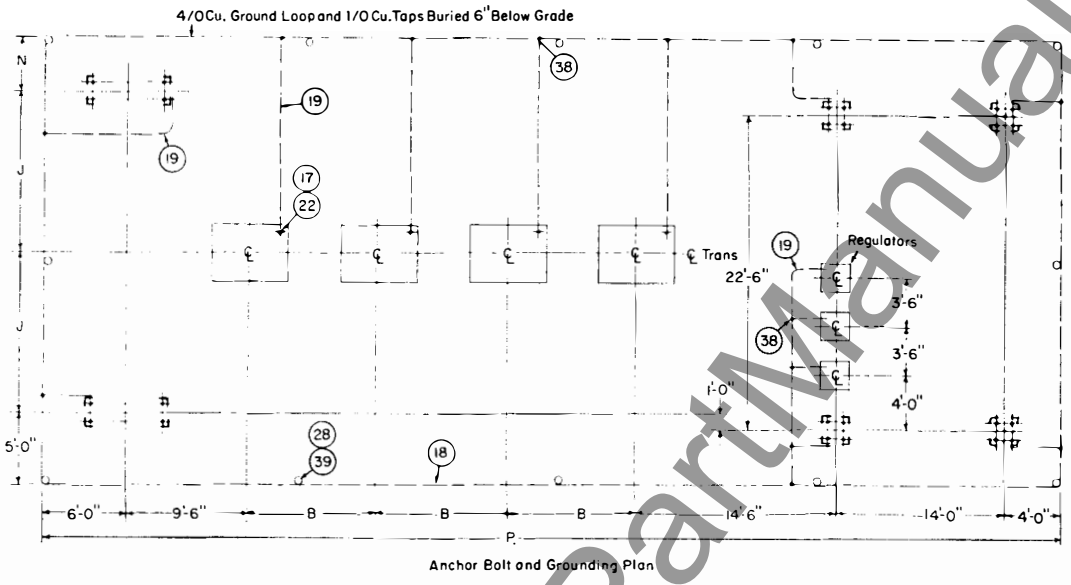
Standard Outdoor Substation Structures

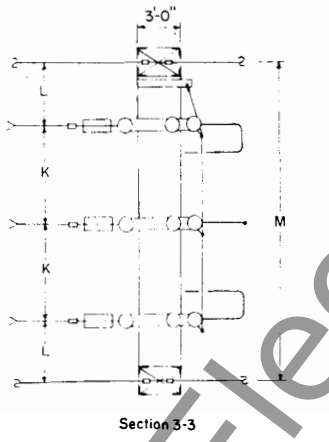
Line Dead End Structure and Distribution Structure with One (1) Incoming Line Four (4) Transformer Bay and Four (4)-Feeder Structure, (Single Phase Reclosers) 69/15, 46/15 or 34.5/15 Kv



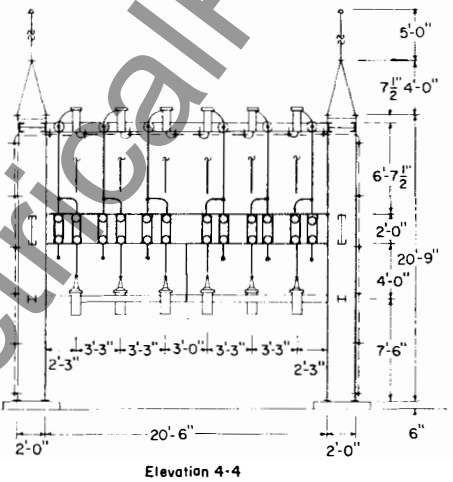
Anchor Bolt and Grounding Plan

Tabulation

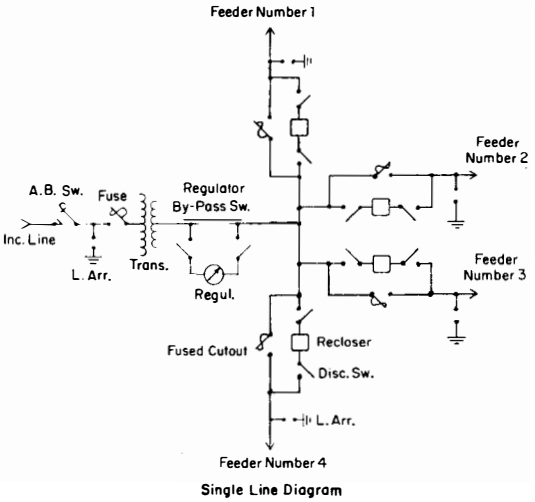
	69-15 Kv	46-15 Kv	34.5-15 Kv
A	72'-0"	66'-0"	66'-0"
B	10'-0"	8'-0"	8'-0"
C	21'-0"	18'-0"	15'-0"
D	5'-0"	4'-0"	3'-0"
E	7'-9"	7'-6"	7'-6"
F	3'-3"	2'-6"	1'-6"
G	3'-0"	2'-6"	2'-0"
H	2'-6"	2'-0"	1'-6"
J	11'-6"	10'-0"	8'-6"
K	7'-0"	6'-0"	5'-0"
L	4'-6"	4'-0"	3'-6"
M	23'-0"	20'-0"	17'-0"
N	4'-0"	5'-6"	8'-6"
P	78'-0"	72'-0"	72'-0"



Section 3-3



Elevation 4-4



Single Line Diagram

Drawing PSE-107 (Continued from Drawing PSE-106)

For list of material see page 19.

May, 1968
Supersedes AD 36-360 dated June, 1966
E, D, C/1969/DB

Standard Outdoor
Substation Structures

Westinghouse Electric Corporation
Switchgear Division: Power Switching Equipment, East Pittsburgh, Pa.
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Standard Outdoor Substation Structures

List of Material for 69/15, 46/15, or 34.5/15 Kv Substation with Line Dead End and Distribution Structure with Four-Transformer Bay, and Four-Feeder Structure (Single Phase Reclosers) per Drawings PSE-106 and PSE-107①

A. 69/15 Kv only:

Item	Req'd	Description
1.	1	Air break switch, type V-3, 69 Kv, 600 amperes, 3 pole, single throw, horizontal mounting, complete with cap and pin insulators, arc horns, and TP manual operating mechanism
2.	3	DBA-1 fuse mounting, 69 Kv, vertical mounting, with cap and pin insulators
3.	3	DBA-1 fuse unit, 69 Kv
4.	3	Lightning arrester, type IVS
5.	12	Lightning arrester, type LV
6.	3	RBO regulator by-pass switch, 15 Kv, 400 amperes, vertical mounting, with cap and pin insulators
7.	24	LDX disconnect switch, 15 Kv, 200 amperes, vertical mounting, channel base
8.	12	LDX cutout, 15 Kv, 200 amperes, vertical mounting, channel base
9.	15	UT fuse link
10.	6	Apparatus insulator, 69 Kv stacking unit, 3" bolt circle, cap and pin (2/stack) (stack TR-16)
11.	45	Strain insulators, 10" diameter clevis type (5/string)
12.	1	Hookstick – two-piece
13.	3	Terminal lug for ¾" IPS copper tubing (4B pad)
14.	6	Terminal lug for ¾" IPS copper tubing (2B pad)
15.	12	Pieces of 1/0 solid copper wire, .313" diameter x 14'-0" long, #2632-1
16.	3	Terminal lug for #4 wire to 250 MCM copper cable (4B pad)
17.	76	Terminal lug for #6 wire to 250 MCM copper cable (2B pad)
18.	245	Feet of 19-.1055 (4/0) .530" diameter bare copper cable #13435AL (M.H.D.)
19.	1350	Feet of 7-.1228 (1/0) .368" diameter bare copper cable #13435AL (M.H.D.)
20.	50	Feet of 7-.0974 (#2) .292" diameter bare copper cable #7421-1 (S.D.)
21.	150	Feet of ⅜" diameter galvanized steel cable #12296-1
22.	8	½-13 x ⅞" silicon bronze hexagonal head tap bolt #4901-1
23.	1	Set of galvanized steelwork, based on: External phase wire 1000 lbs. line pull Internal strain bus 1000 lbs. line pull Static wire 1000 lbs. line pull
24.	48	Strain insulators – 10" diameter, clevis type (2/string)
25.	3	Strain clamp for 1/0 to 250 MCM copper or 1/0 to 266.8 MCM ACSR cable (clevis type)
26.	42	Strain clamp for #6 to 2/0 copper or ACSR cable (clevis type)
27.	3	Tee connector for ¾" IPS copper tube run – copper bar tap
28.	12	Copperweld ground rod – ¾" diameter x 10 feet long
29.	1	Hookstick container
30.	120	Feet of ¾" IPS copper tubing, 6 pieces @ 20 feet long
31.	12	Apparatus insulator, 15 Kv, 3" bolt circle, cap and pin type (TR-4)
32.	3	Bus support clamp – ¾" IPS copper tubing, pin mounting
33.	3	Coupler for ¾" IPS copper tubing
34.	3	Reducer – ¾" IPS copper tubing to 1/0 copper cable
35.	12	Bus support clamp, 1/0 copper cable, 3" bolt circle cap mounting
36.	33	Tee connector for 1/0 copper cable – run and tap
37.	12	Parallel clamp for #2 copper and #4 wire to 4/0 copper cable
38.	13	Parallel clamp for 4/0 copper and 1/0 copper cable (ground)
39.	12	Ground clamp for ¾" rod to 4/0 copper and 1/0 copper cable (2 grooves)
40.	65	Ground clamp for #6 to 2/0 copper cable (2 grooves)

B. 46/15 Kv structure per drawings PSE-106 and PSE-107, similar to 69 Kv except with the following item changes as indicated below:

1.	1	Air break switch, type V-3, 46 Kv, 600 amperes, 3 pole, single throw, horizontal mounting, complete with cap and pin insulators, arc horns and TP manual operating mechanism
2.	3	Fuse mounting, type DBA-1, 46 Kv, vertical mounting, with cap and pin insulators
3.	3	DBA-1 fuse unit, 46 Kv
4.	3	Lightning arrester, type IVS
10.	3	Apparatus insulator, 46 Kv, 3" bolt circle, cap and pin (TR-13)
11.	36	Strain insulators, 10" diameter, clevis type (4/string)
18.	225	Feet of 19-.1055 (4/0) .530" diameter bare copper cable #13435AL (M.H.D.)
19	1200	Feet of 7-.1228 (1/0) .368" diameter bare copper cable #13435AL (M.H.D.)
21.	140	Feet of ⅜" diameter galvanized steel cable #12296-1

C. 34.5/15 Kv structure per drawings PSE-106 and PSE-107, similar to 69 Kv except with the following item changes as indicated below:

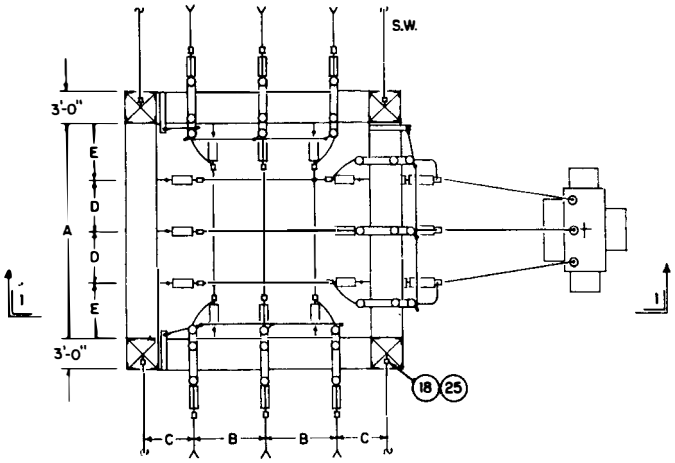
1.	1	Air break switch, type V-3, 34.5 Kv, 600 amperes, 3 pole, single throw, horizontal mounting, complete with cap and pin insulators, arc horns and TP manual operating mechanism
2.	3	DBA-1 fuse mounting, 34.5 Kv, vertical mounting, with cap and pin insulators
3.	3	DBA-1 fuse unit, 34.5 Kv
4.	3	Lightning arrester, type IVS
10.	3	Apparatus insulator, 34.5 Kv, 3" bolt circle, cap and pin (TR-10)
11.	36	Strain insulators, 10" diameter, clevis type (4/string)
18.	225	Feet of 19-.1055 (4/0) .530" diameter bare copper cable #13435AL (M.H.D.)
19.	1200	Feet of 7-.1228 (1/0) .368" diameter bare copper cable #13435AL (M.H.D.)
21.	140	Feet of ⅜" diameter galvanized steel cable #12296-1

① When necessitated by shipping schedule, suitable aluminum cable, tubing, and connectors may be substituted for above grade electrical connections.

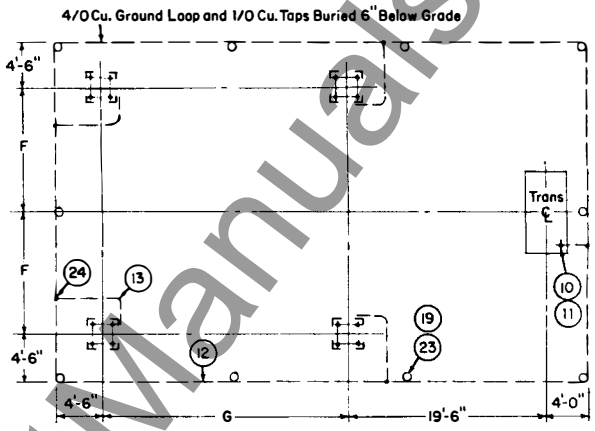
May, 1968
Supersedes AD 36-360 dated June, 1966
E, D, C/1969/DB

Standard Outdoor Substation Structures

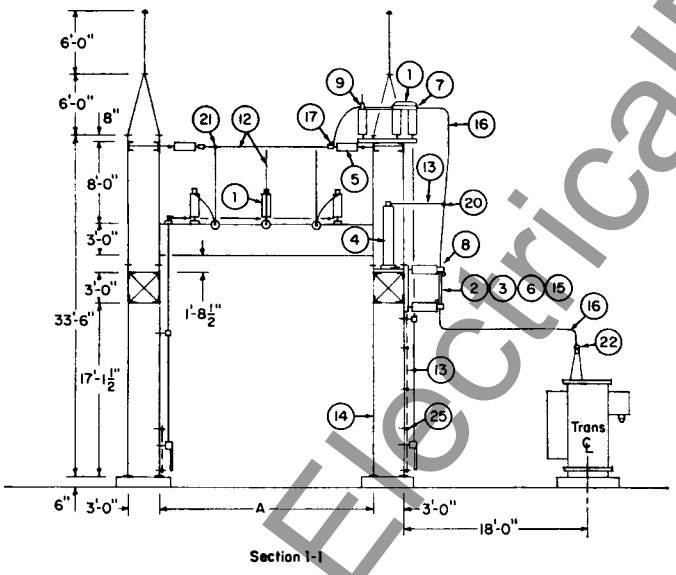
Single Square Bay Line Dead End and Switching Structure, 69, 46, or 34.5 Kv



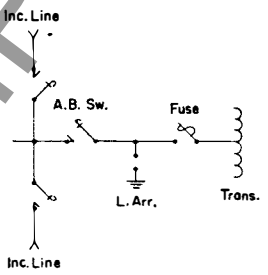
Plan View



Anchor Bolt and Grounding Plan



Section 1-1



Single Line Diagram

Tabulation

	69 Kv	46 Kv	34.5 Kv
A	21'-0"	18'-0"	15'-0"
B	7'-0"	6'-0"	5'-0"
C	5'-0"	4'-6"	4'-0"
D	5'-0"	4'-0"	3'-0"
E	5'-6"	5'-0"	4'-6"
F	12'-0"	10'-6"	9'-0"
G	24'-0"	21'-0"	18'-0"

Drawing PSE-108

Westinghouse Electric Corporation
Switchgear Division: Power Switching Equipment, East Pittsburgh, Pa.
Printed in USA

Westinghouse

Standard Outdoor Substation Structures

Lists of Material for 69, 46, or 34.5 Kv Single Square Bay Line Dead End and Switching Structure per Drawing PSE-108①

A. 69 Kv only:

Item	Req'd	Description
1.	3	Air break switch, type V-3, 69 Kv, 600 amperes, 3 pole, single throw, horizontal mounting, complete with cap and pin insulators, arc horns and TP manual operating mechanism
2.	3	Fuse mounting, type DBA-1, 69 Kv, vertical mounting with cap and pin insulators
3.	3	Fuse unit, type DBA-1, 69 Kv
4.	3	Lightning arrester, type IVS
5.	90	Strain insulator, 10" diameter, clevis type (5/string)
6.	1	Hookstick, 20'-0" long
7.	3	Terminal lug for 1" IPS copper tubing (4B pad)
8.	6	Terminal lug for 1" IPS copper tubing (2B pad)
9.	15	Terminal lug for #4 to 250 MCM copper cable (4B pad)
10.	1	Terminal lug for 1/0 copper cable (2B pad)
11.	2	½-13 x ⅞ silicon bronze hexagonal head tap bolt #4901-1
12.	375	Feet of 19-.1055 (4/0) .530" diameter bare copper cable #13435AL (M.H.D.)
13.	125	Feet of 7-.1228 (1/0) .368" diameter bare copper cable #13435AL (M.H.D.)
14.	1	Set of galvanized steelwork, based on: Phase wire 2000 lbs. line pull Static wire 1000 lbs. line pull
15.	1	Hookstick container
16.	120	Feet of 1" IPS copper tubing, 6 pieces, @ 20'-0" long
17.	18	Strain clamp for 1/0 to 250 MCM copper cable or 1/0 to 266.8 MCM ACSR cable (clevis)
18.	4	Strain clamp for #6 to 2/0 copper cable or ACSR cable (clevis type)
19.	10	Copperweld ground rod ¾" diameter x 10'-0" long
20.	3	Tee connector for 1" IPS copper tube run to 1/0 copper cable tap
21.	6	Tee connector for 4/0 copper cable run and tap
22.	3	Expansion stud connector, 1⅛-12 stud to 1" IPS copper tubing
23.	10	Ground rod clamps for ¾" rod to 4/0 and 1/0 copper cable (2 grooves)
24.	5	Parallel clamp for 4/0 and 1/0 copper cable (ground)
25.	18	Ground clamp for #6 to 2/0 copper cable (2 grooves)

B. 46 Kv structure per drawing PSE-108, similar to 69 Kv except with the following item changes as indicated below:

1.	3	Air break switch, type V-3, 46 Kv, 600 amperes, 3 pole, single throw, horizontal mounting, complete with cap and pin insulators, arc horns and TP manual operating mechanism
2.	3	Fuse mounting, type DBA-1, 46 Kv, vertical mounting, with cap and pin insulators
3.	3	Fuse unit, type DBA-1, 46 Kv
4.	3	Lightning arrester, type IVS
5.	72	Strain insulator, 10" diameter, clevis type (4/string)
12.	350	Feet of 19-.1055 (4/0) .530" diameter bare copper cable #13435AL (M.H.D.)

C. 34.5 Kv structure per drawing PSE-108, similar to 69 Kv except with the following item changes as indicated below:

1.	3	Air break switch, type V-3, 34.5 Kv, 600 amperes, 3 pole, single throw, horizontal mounting, complete with cap and pin insulators, arc horns and TP manual operating mechanism
2.	3	Fuse mounting, type DBA-1, 34.5 Kv, vertical mounting with cap and pin insulators
3.	3	Fuse unit, type DBA-1, 34.5 Kv
4.	3	Lightning arresters, type IVS
5.	72	Strain insulator, 10" diameter, clevis type (4/string)
12.	325	Feet of 19-.1055 (4/0) .530" diameter bare copper cable #13435AL (M.H.D.)

① When necessitated by shipping schedule, suitable aluminum cable, tubing, and connectors may be substituted for above grade electrical connections.

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Supersedes AD 36-360 dated June, 1966
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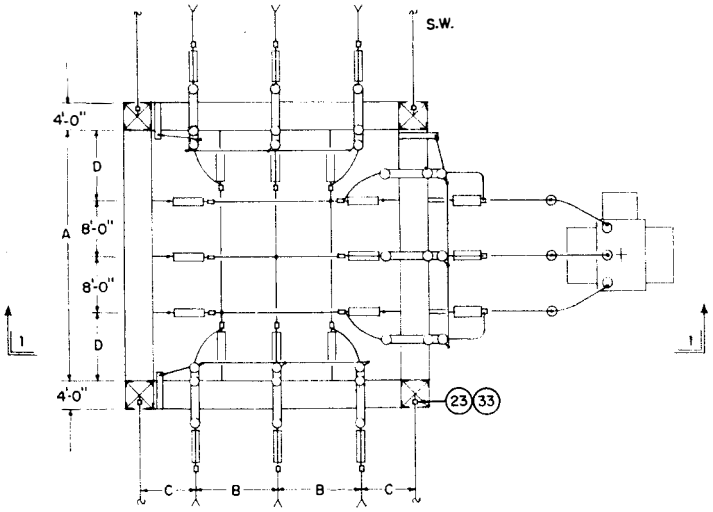
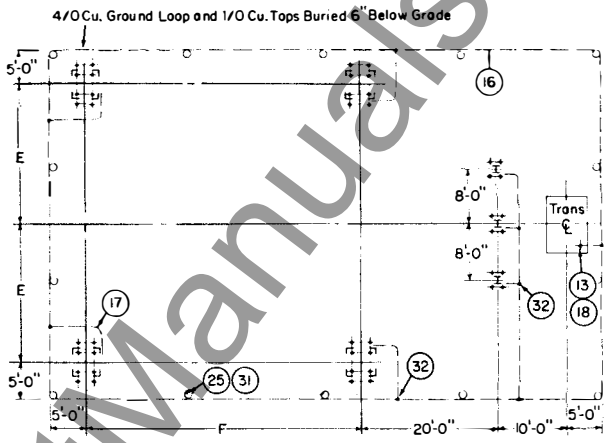
Standard Outdoor Substation Structures

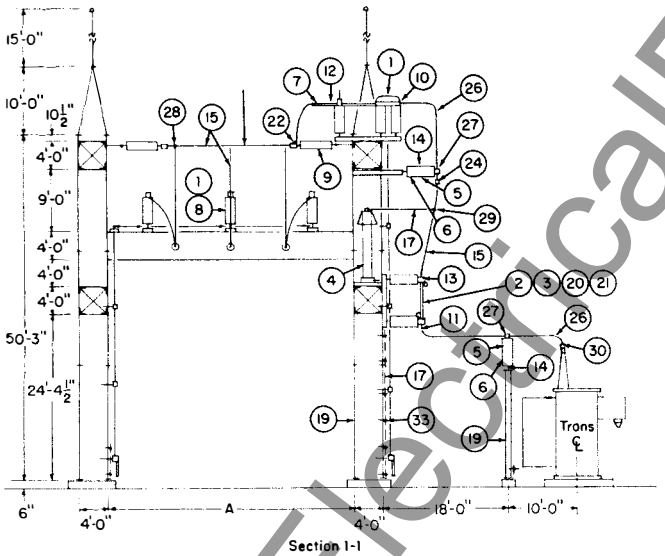
Single Square Bay Line Dead End and Switching Structure, 138 or 115 Kv



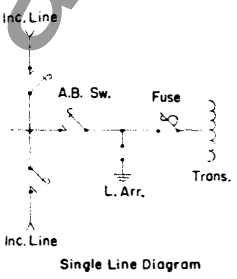
Plan View



Anchor Bolt and Grounding Plan



Section 1-1



Single Line Diagram

Tabulation

	138 Kv	115 Kv
A	36'-0"	30'-0"
B	12'-0"	10'-0"
C	8'-0"	7'-0"
D	10'-0"	7'-0"
E	20'-0"	17'-0"
F	40'-0"	34'-0"

Drawing PSE-109

Westinghouse Electric Corporation
Switchgear Division: Power Switching Equipment, East Pittsburgh, Pa.
Printed in USA

Westinghouse

Standard Outdoor Substation Structures

Lists of Material for 138 or 115 Kv Single Square Bay Line Dead End and Switching Structure per Drawing PSE-109①

A. 138 Kv only:

Item	Req'd	Description
1.	3	Air break switch, type V-2, 138 Kv, 600 amperes, 3 pole, single throw, horizontal mounting, complete with cap and pin insulators, arc horns, and TP manual operating mechanism
2.	3	Fuse mounting, type DBA-2, 138 Kv vertical mounting with cap and pin insulators
3.	3	Fuse unit, type DBA-2, 138 Kv
4.	3	Lightning arrester, type IVS
5.	6	Apparatus insulators, 138 Kv stacking unit (1/stack) 5″ bolt circle (TR-53), cap and pin type
6.	12	Apparatus insulators, 138 Kv stacking unit (2/stack) 5″ bolt circle (TR-140), cap and pin type
7.	9	Lead guide (break end) for copper cable
8.	6	Lead guide (hinge end) for copper cable
9.	180	Strain insulator, 10″ diameter, clevis type (10/string)
10.	3	Terminal lug for ¾″ IPS copper tubing (4B pad)
11.	3	Terminal lug for ¾″ IPS copper tubing (2B pad)
12.	15	Terminal lug for 1/0 wire to 500 MCM copper cable (4B pad)
13.	4	Terminal lug for 1/0 wire to 500 MCM copper cable (2B pad)
14.	6	Spacer, 3½″ high, 5″ bolt circle
15.	375	Feet of 37-.090 (300″MCM) .630″ diameter bare copper cable ⁎13435AL (M.H.D.)
16.	285	Feet of 19-.1055 (4/0) .530″ diameter bare copper cable ⁎13435AL (M.H.D.)
17.	200	Feet of 7-.1228 (1/0) .368″ diameter bare copper cable ⁎13425AL (M.H.D.)
18.	2	½-13 x ⅞ silicon bronze hexagonal head tap bolt ⁎4901-1
19.	1	Set of galvanized steelwork, based on: External phase wire 4000 lbs. line pull Internal strain bus 1000 lbs. line pull Static wire 2000 lbs. line pull
20.	1	Hookstick 24′-0″ long
21.	1	Hookstick container (25′-0″ long)
22.	18	Strain clamp for 4/0 copper to 500 MCM copper cable (clevis type)
23.	4	Strain clamp for ⁎6 to 2/0 copper or ACSR cable (clevis type)
24.	3	Reducer ¾″ IPS to 1/0 – 300 MCM copper
25.	14	Copperweld ground rod ¾″ diameter x 10′-0″ long
26.	135	Feet of ¾″ IPS copper tubing, 3 pieces @ 20′-0″ long and 3 pieces @ 25′-0″ long
27.	6	Bus support clamp for ¾″ IPS copper tubing 5″ bolt circle, cap mounting
28.	6	Tee connector for 300 MCM copper cable run and tap
29.	3	Tee connector for 300 MCM copper cable run – 1/0 copper cable tap
30.	3	Expansion stud connector 1⅛-12 stud to ¾″ IPS copper tubing
31.	14	Ground rod clamp for ¾″ rod to 4/0 and 1/0 copper cable (2 grooves)
32.	8	Parallel clamp for 4/0 and 1/0 copper cable run – 1/0 copper cable tap
33.	26	Ground clamp for ⁎6 to 2/0 copper cable (2 grooves)

B. 115 Kv structure per drawing PSE-109, similar to 138 Kv except with the following item changes as indicated below:

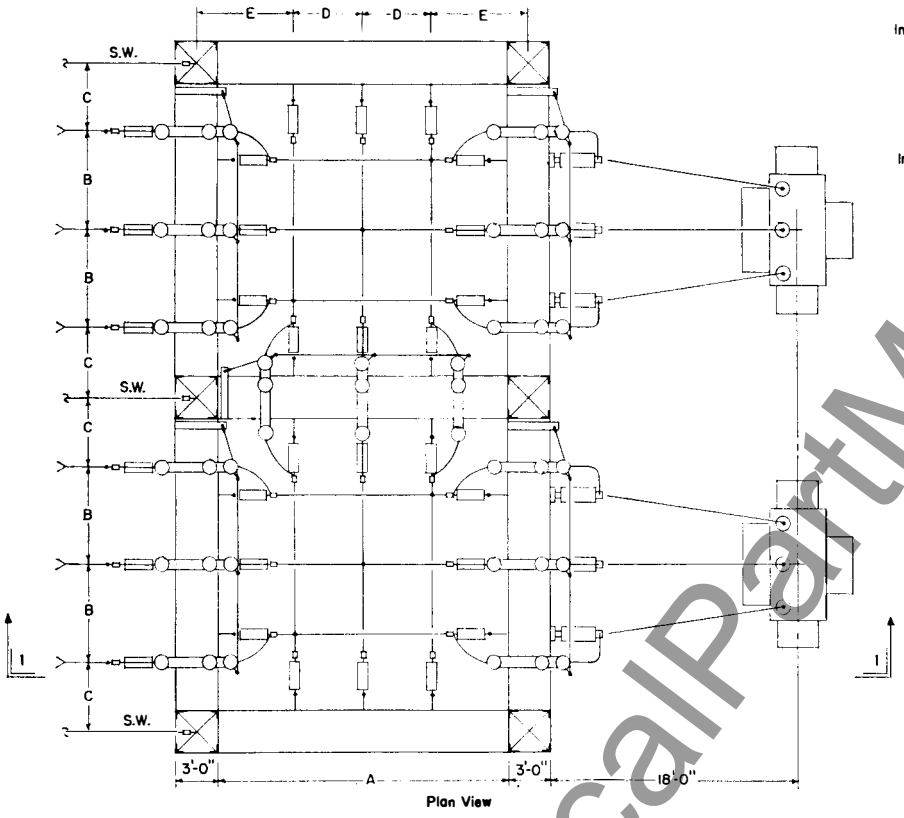
1.	3	Air break switch, type V-2, 115 Kv, 600 amperes, 3 pole, single throw, horizontal mounting, complete with cap and pin insulators, arc horns and TP manual operating mechanism
2.	3	Fuse mounting, type DBA-2, 115 Kv, vertical mounting with cap and pin insulators
3.	3	Fuse unit, type DBA-2, 115 Kv
4.	3	Lightning arrester, type IVS
5.	. . .	Not used
6.	18	Apparatus insulator, 115 Kv stacking unit, 5″ bolt circle, cap and pin type (TR-140) (3/stack)
9.	144	Strain insulators, 10″ diameter, clevis type (8/string)
15.	325	Feet of 37-.090 (300 MCM) .630″ diameter bare copper cable ⁎13435AL (M.H.D.)
16.	260	Feet of 19-.1055 (4/0) .530″ diameter bare copper cable ⁎13435AL (M.H.D.)

① When necessitated by shipping schedule, suitable aluminum cable, tubing, and connectors may be substituted for above grade electrical connections.

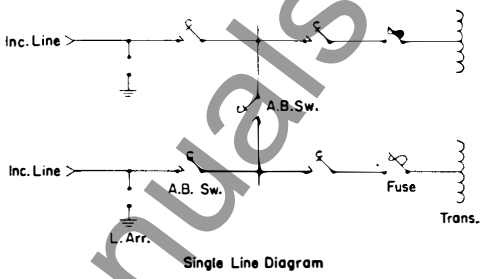
May, 1968
Supersedes AD 36-360 dated June, 1966
E, D, C/1969/DB

Standard Outdoor Substation Structures

Double Square Bay Line Dead End and Switching Structure, 69, 46, or 34.5 Kv



Plan View



Single Line Diagram

Tabulation

	69 Kv	46 Kv	34.5 Kv
A	21'-0"	18'-0"	15'-0"
B	7'-0"	6'-0"	5'-0"
C	5'-0"	4'-6"	4'-0"
D	5'-0"	4'-0"	3'-0"
E	7'-0"	6'-6"	6'-0"
F	24'-0"	21'-0"	18'-0"
G	12'-0"	10'-6"	9'-0"

Drawing PSE-110 (Continued on Drawing PSE-111)

Lists of Material for 69, 46, or 34.5 Kv Double Square Bay Line Dead End and Switching Structure per Drawings PSE-110 and PSE-111①

A. 69 Kv only:

Item	Req'd	Description
1.	5	Air break switch, type V-3, 69 Kv, 600 amperes, 3 pole, single throw, horizontal mounting, complete with cap and pin insulators, arc horns and TP manual operating mechanism
2.	6	Fuse mounting, type DBA-1, 69 Kv, vertical mounting with cap and pin insulators
3.	6	Fuse unit, type DBA-1, 69 Kv
4.	6	Lightning arrester, type IVS
5.	150	Strain insulators, 10" diameter, clevis type (5/string)
6.	6	Terminal lug for 1" IPS copper tube (4B pad)
7.	12	Terminal lug for 1" IPS copper tube (2B pad)
8.	24	Terminal lug for #4 to 250 MCM copper cable (4B pad)
9.	2	Terminal lug for 1/0 copper cable (2B pad)
10.	1	Hookstick, 20'-0" long
11.	650	Feet of 19-.1055 (4/0) .530" diameter bare copper cable #13435AL (M.H.D.)
12.	250	Feet of 7-.1288 (1/0) .368" diameter bare copper cable #13435AL (M.H.D.)
13.	4	½-13 x ⅞ silicon bronze hexagonal head tap bolt #4901-1
14.	1	Set of galvanized steelwork, based on: Internal strain bus 1000 lbs. line pull Phase wire, 2,000 lbs. line pull Static wire, 2,000 lbs. line pull
15.	30	Strain clamp 1/0 to 250 MCM copper or 1/0 to 266.8 MCM ACSR (clevis)
16.	3	Strain clamp for #6 to 2/0 copper or ACSR cable (clevis type)
17.	18	Tee connector for 250 MCM – #4 wire run and tap
18.	12	Copperweld ground rod ¾" diameter x 10'-0" long
19.	240	Feet of 1" IPS copper tubing, 12 pieces @20'-0" long
20.	1	Hookstick container

① When necessitated by shipping schedule, suitable aluminum cable, tubing, and connectors may be substituted for above grade electrical connections.

Continued

Westinghouse Electric Corporation
Switchgear Division: Power Switching Equipment, East Pittsburgh, Pa.
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Standard Outdoor Substation Structures

Lists of Material for 138 or 115 Kv Single Square Bay Line Dead End and Switching Structure per Drawing PSE-109①

A. 138 Kv only:

Item	Req'd	Description
1.	3	Air break switch, type V-2, 138 Kv, 600 amperes, 3 pole, single throw, horizontal mounting, complete with cap and pin insulators, arc horns, and TP manual operating mechanism
2.	3	Fuse mounting, type DBA-2, 138 Kv vertical mounting with cap and pin insulators
3.	3	Fuse unit, type DBA-2, 138 Kv
4.	3	Lightning arrester, type IVS
5.	6	Apparatus insulators, 138 Kv stacking unit (1/stack) 5″ bolt circle (TR-53), cap and pin type
6.	12	Apparatus insulators, 138 Kv stacking unit (2/stack) 5″ bolt circle (TR-140), cap and pin type
7.	9	Lead guide (break end) for copper cable
8.	6	Lead guide (hinge end) for copper cable
9.	180	Strain insulator, 10″ diameter, clevis type (10/string)
10.	3	Terminal lug for ¾″ IPS copper tubing (4B pad)
11.	3	Terminal lug for ¾″ IPS copper tubing (2B pad)
12.	15	Terminal lug for 1/0 wire to 500 MCM copper cable (4B pad)
13.	4	Terminal lug for 1/0 wire to 500 MCM copper cable (2B pad)
14.	6	Spacer, 3½″ high, 5″ bolt circle
15.	375	Feet of 37-.090 (300″MCM) .630″ diameter bare copper cable ⁄13435AL (M.H.D.)
16.	285	Feet of 19-.1055 (4/0) .530″ diameter bare copper cable ⁄13435AL (M.H.D.)
17.	200	Feet of 7-.1228 (1/0) .368″ diameter bare copper cable ⁄13425AL (M.H.D.)
18.	2	½-13 x ⅞ silicon bronze hexagonal head tap bolt ⁄4901-1
19.	1	Set of galvanized steelwork, based on: External phase wire 4000 lbs. line pull Internal strain bus 1000 lbs. line pull Static wire 2000 lbs. line pull
20.	1	Hookstick 24′-0″ long
21.	1	Hookstick container (25′-0″ long)
22.	18	Strain clamp for 4/0 copper to 500 MCM copper cable (clevis type)
23.	4	Strain clamp for ⁄6 to 2/0 copper or ACSR cable (clevis type)
24.	3	Reducer ¾″ IPS to 1/0 – 300 MCM copper
25.	14	Copperweld ground rod ¾″ diameter x 10′-0″ long
26.	135	Feet of ¾″ IPS copper tubing, 3 pieces @ 20′-0″ long and 3 pieces @ 25′-0″ long
27.	6	Bus support clamp for ¾″ IPS copper tubing 5″ bolt circle, cap mounting
28.	6	Tee connector for 300 MCM copper cable run and tap
29.	3	Tee connector for 300 MCM copper cable run – 1/0 copper cable tap
30.	3	Expansion stud connector 1⅛-12 stud to ¾″ IPS copper tubing
31.	14	Ground rod clamp for ¾″ rod to 4/0 and 1/0 copper cable (2 grooves)
32.	8	Parallel clamp for 4/0 and 1/0 copper cable run – 1/0 copper cable tap
33.	26	Ground clamp for ⁄6 to 2/0 copper cable (2 grooves)

B. 115 Kv structure per drawing PSE-109, similar to 138 Kv except with the following item changes as indicated below:

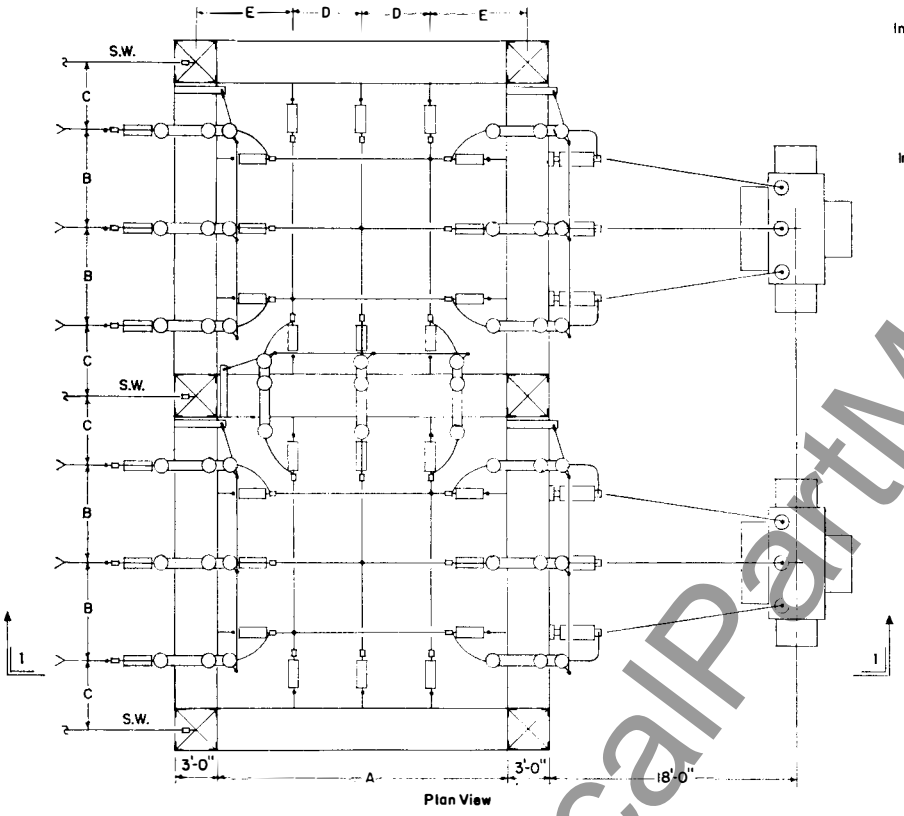
1.	3	Air break switch, type V-2, 115 Kv, 600 amperes, 3 pole, single throw, horizontal mounting, complete with cap and pin insulators, arc horns and TP manual operating mechanism
2.	3	Fuse mounting, type DBA-2, 115 Kv, vertical mounting with cap and pin insulators
3.	3	Fuse unit, type DBA-2, 115 Kv
4.	3	Lightning arrester, type IVS
5.	. . .	Not used
6.	18	Apparatus insulator, 115 Kv stacking unit, 5″ bolt circle, cap and pin type (TR-140) (3/stack)
9.	144	Strain insulators, 10″ diameter, clevis type (8/string)
15.	325	Feet of 37-.090 (300 MCM) .630″ diameter bare copper cable ⁄13435AL (M.H.D.)
16.	260	Feet of 19-.1055 (4/0) .530″ diameter bare copper cable ⁄13435AL (M.H.D.)

① When necessitated by shipping schedule, suitable aluminum cable, tubing, and connectors may be substituted for above grade electrical connections.

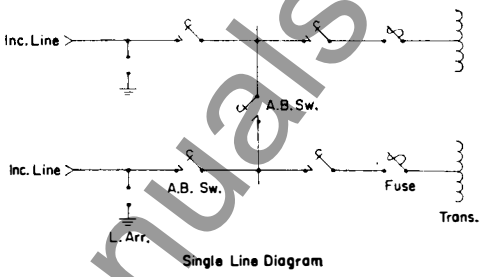
May, 1968
Supersedes AD 36-360 dated June, 1966
E, D, C/1969/DB

Standard Outdoor Substation Structures

Double Square Bay Line Dead End and Switching Structure, 69, 46, or 34.5 Kv



Plan View



Single Line Diagram

Tabulation

	69 Kv	46 Kv	34.5 Kv
A	21'-0"	18'-0"	15'-0"
B	7'-0"	6'-0"	5'-0"
C	5'-0"	4'-6"	4'-0"
D	5'-0"	4'-0"	3'-0"
E	7'-0"	6'-6"	6'-0"
F	24'-0"	21'-0"	18'-0"
G	12'-0"	10'-6"	9'-0"

Drawing PSE-110 (Continued on Drawing PSE-111)

Lists of Material for 69, 46, or 34.5 Kv Double Square Bay Line Dead End and Switching Structure per Drawings PSE-110 and PSE-111①

A. 69 Kv only:

Item	Req'd	Description
1.	5	Air break switch, type V-3, 69 Kv, 600 amperes, 3 pole, single throw, horizontal mounting, complete with cap and pin insulators, arc horns and TP manual operating mechanism
2.	6	Fuse mounting, type DBA-1, 69 Kv, vertical mounting with cap and pin insulators
3.	6	Fuse unit, type DBA-1, 69 Kv
4.	6	Lightning arrester, type IVS
5.	150	Strain insulators, 10" diameter, clevis type (5/string)
6.	6	Terminal lug for 1" IPS copper tube (4B pad)
7.	12	Terminal lug for 1" IPS copper tube (2B pad)
8.	24	Terminal lug for #4 to 250 MCM copper cable (4B pad)
9.	2	Terminal lug for 1/0 copper cable (2B pad)
10.	1	Hookstick, 20'-0" long
11.	650	Feet of 19-.1055 (4/0) .530" diameter bare copper cable #13435AL (M.H.D.)
12.	250	Feet of 7-.1288 (1/0) .368" diameter bare copper cable #13435AL (M.H.D.)
13.	4	½-13 x ⅞ silicon bronze hexagonal head tap bolt #4901-1
14.	1	Set of galvanized steelwork, based on: Internal strain bus 1000 lbs. line pull Phase wire, 2,000 lbs. line pull Static wire, 2,000 lbs. line pull
15.	30	Strain clamp 1/0 to 250 MCM copper or 1/0 to 266.8 MCM ACSR (clevis)
16.	3	Strain clamp for #6 to 2/0 copper or ACSR cable (clevis type)
17.	18	Tee connector for 250 MCM – #4 wire run and tap
18.	12	Copperweld ground rod ¾" diameter x 10'-0" long
19.	240	Feet of 1" IPS copper tubing, 12 pieces @20'-0" long
20.	1	Hookstick container

① When necessitated by shipping schedule, suitable aluminum cable, tubing, and connectors may be substituted for above grade electrical connections.

Continued

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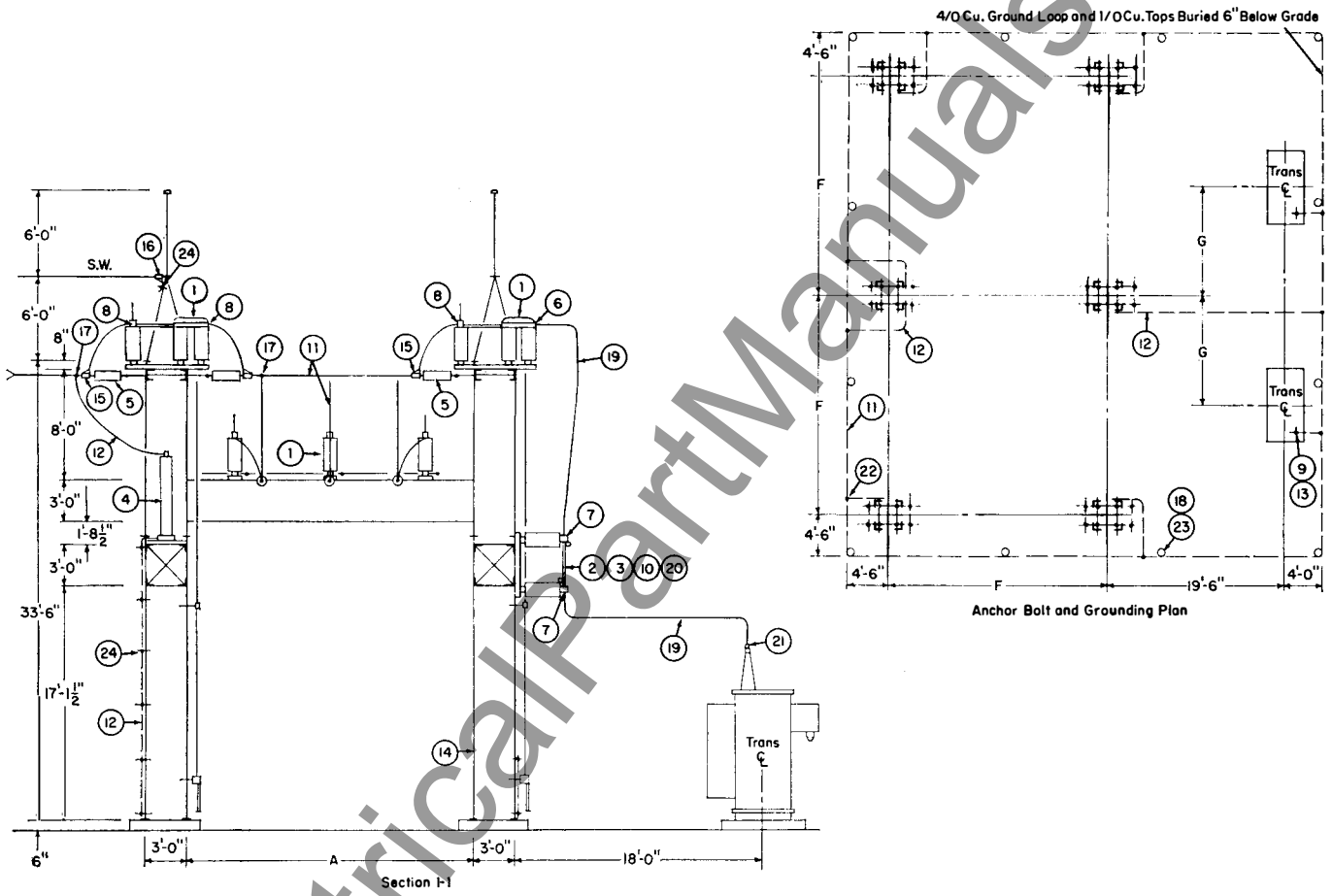
Standard Outdoor Substation Structures

Double Square Bay Line Dead End and Switching Structure, 69, 46, or 34.5 Kv



Drawing PSE-111 (Continued from Drawing PSE-110)①

Item	Req'd	Description
Continued		
21.	6	Expansion stud connectors 1⅛-12 stud to 1″ IPS copper
22.	9	Parallel clamp for 4/0 and 1/0 copper cable (ground)
23.	12	Ground rod clamp for ¾″ rod to 4/0 and 1/0 copper cable (2 grooves)
24.	32	Ground clamp for #6 to 2/0 copper cable (2 grooves)

B. 46 Kv structure per drawings PSE-110 and PSE-111, similar to 69 Kv except with the following item changes as indicated below:

1.	5	Air break switch, type V-3, 46 Kv, 600 amperes, 3 pole, single throw, horizontal mounting, complete with cap and pin insulators, arc horns and TP manual operating mechanism
2.	6	Fuse mounting, type DBA-1, 46 Kv, vertical mounting with cap and pin insulators
3.	6	Fuse unit, type DBA-1, 46 Kv
4.	6	Lightning arrester, type IVS
5.	120	Strain insulators, 10″ diameter, clevis type (4/string)
11.	600	Feet of 19-.1055 (4/0) .530″ diameter bare copper cable #13435AL (M.H.D.)

C. 34.5 Kv structure per drawings PSE-110 and PSE-111, similar to 69 Kv except with the following item changes as indicated below:

1.	5	Air break switch, type V-3, 34.5 Kv, 600 amperes, 3 pole, single throw, horizontal mounting, complete with cap and pin insulators, arc horns and TP manual operating mechanism
2.	6	Fuse mounting, type DBA-1, 34.5 Kv, vertical mounting with cap and pin insulators
3.	6	Fuse unit, type DBA-1, 34.5 Kv
4.	6	Lightning arrester, type IVS
5.	120	Strain insulators, 10″ diameter, clevis type (4/string)
11.	550	Feet of 19-.1055 (4/0) .530″ diameter bare copper cable #13435AL (M.H.D.)

① When necessitated by shipping schedule, suitable aluminum cable, tubing, and connectors may be substituted for above grade electrical connections.

May, 1968
Supersedes AD 36-360 dated June, 1966
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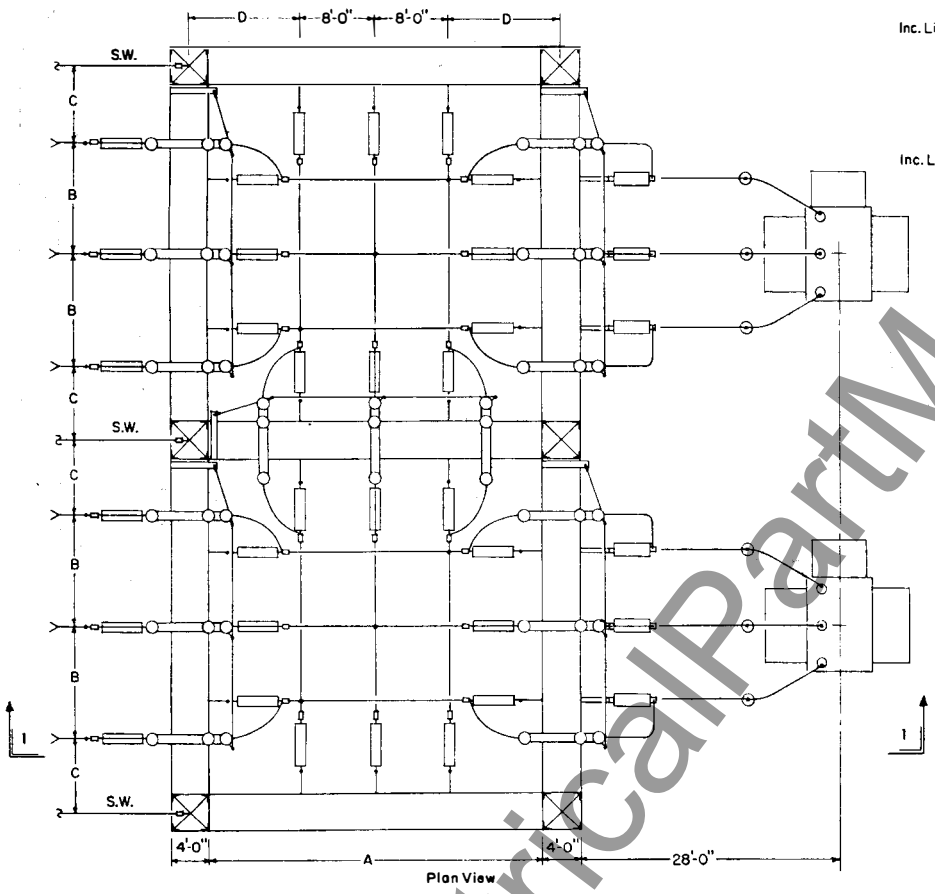
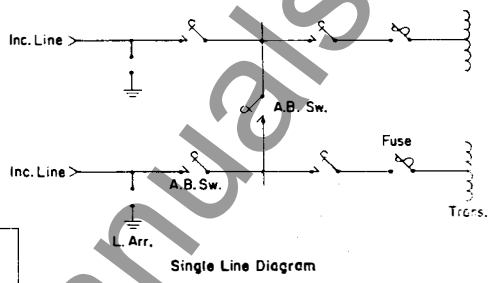
Standard Outdoor Substation Structures

Double Square Bay Line Dead End and Switching Structure, 138 or 115 Kv



Plan View



Single Line Diagram

Tabulation

	138 Kv	115 Kv
A	36'-0"	30'-0"
B	12'-0"	10'-0"
C	8'-0"	7'-0"
D	12'-0"	9'-0"
E	40'-0"	34'-0"
F	20'-0"	17'-0"

Drawing PSE-112 (Continued on Drawing PSE-113)

Lists of Material for 138 or 115 Kv Double Square Bay Line Dead End and Switching Structure per Drawings PSE-112 and PSE-113①

A. 138 Kv only:

Item	Req'd	Description
1.	5	Air break switch, type V-2, 138 Kv, 600 amperes, 3 pole, single throw, horizontal mounting, complete with cap and pin insulators, arc horns and TP manual operating mechanism
2.	6	Fuse mounting, type DBA-2, 138 Kv, vertical mounting
3.	6	Fuse unit, type DBA-2, 138 Kv
4.	6	Lightning arrester, type IVS
5.	300	Strain insulators, 10" diameter, clevis type (10/string)
6.	12	Apparatus insulators, 138 Kv stacking unit, 5" bolt circle, (1/stack), cap and pin type (TR-53)
7.	24	Apparatus insulators, 138 Kv stacking unit, 5" bolt circle, (2/stack), cap and pin type (TR-140)
8.	4	½-13 x ⅞ silicon bronze hexagonal head tap bolt 4901-1
9.	15	Lead guide (break end) for copper cable
10.	9	Lead guide (hinge end) for copper cable
11.	6	Terminal lug for ¾" IPS copper tubing (4B pad)
12.	6	Terminal lug for ¾" IPS copper tubing (2B pad)
13.	24	Terminal lug for 1/0 wire to 500 MCM copper cable (4B pad)
14.	8	Terminal lug for 1/0 wire to 500 MCM copper cable (2B pad)
15.	12	Spacer 3½" high, 5" bolt circle
16.	775	Feet of 37-.090 (300 MCM) .630" diameter bare copper cable #13435AL (M.H.D.)
17.	375	Feet of 19-.1055 (4/0) .530" diameter bare copper cable #13435AL (M.H.D.)
18.	425	Feet of 7-.1228 (1/0) .368" diameter bare copper cable #13435AL (M.H.D.)
19.	1	Set of galvanized steelwork, based on: Internal phase wire 1000 lbs. line pull External phase wire 2000 lbs. line pull Static wire 1000 lbs. line pull
20.	30	Strain clamp for 4/0 copper to 500 MCM copper cable (clevis type)
21.	3	Strain clamp for #6 to 2/0 copper or ACSR cable (clevis type)

① When necessitated by shipping schedule, suitable aluminum cable, tubing, and connectors may be substituted for above grade electrical connections.

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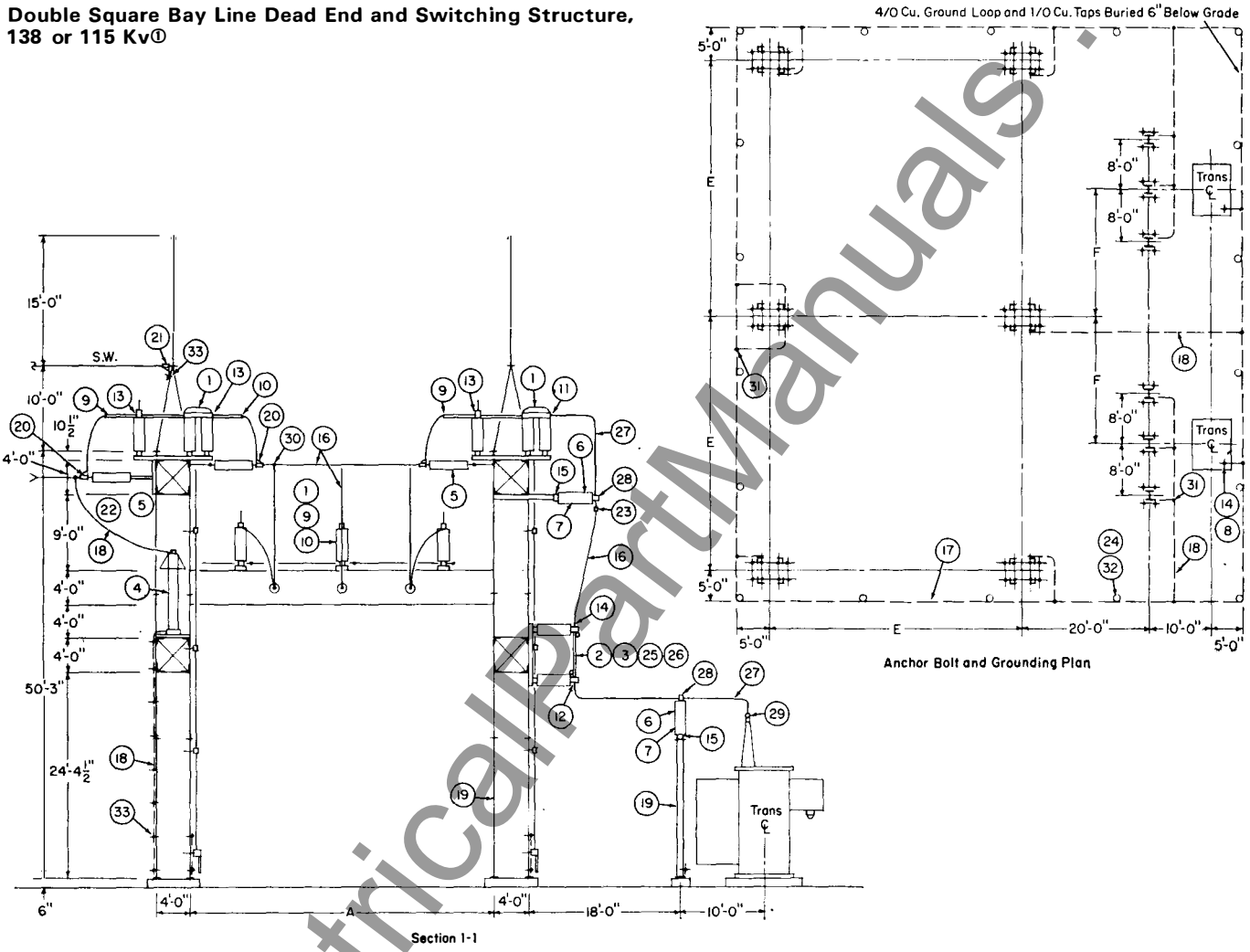
Standard Outdoor Substation Structures

Double Square Bay Line Dead End and Switching Structure, 138 or 115 Kv①



Drawing PSE-113 (Continued from Drawing PSE-112)①

Item	Req'd	Description
Continued		
22.	6	Tee connector for 1/0 wire to 500 MCM copper cable run – #6 wire to 2/0 copper cable tap
23.	6	Reducer ¾" IPS to 1/0 – 300 MCM copper cable
24.	18	Copperweld ground rod ¾" diameter x 10'-0" long
25.	1	Hookstick 24'-0" long
26.	1	Hookstick container (25'-0" long)
27.	270	Feet of ¾" IPS copper tubing, 6 pieces @ 20'-0" long and 6 pieces @ 25'-0" long
28.	12	Bus support clamp for ¾" IPS copper tubing 5" bolt circle, cap mounting
29.	6	Expansion stud connector 1⅛-12 stud to ¾" IPS copper tubing
30.	12	Tee connector for 300 MCM copper cable run and tap
31.	15	Parallel clamp for 4/0 and 1/0 copper cable
32.	18	Ground rod clamp for ¾" rod to 4/0 and 1/0 copper cable (2 grooves)
33.	45	Ground clamp for #6 to 2/0 copper cable (2 grooves)

B. 115 Kv structure per drawings PSE-112 and PSE-113, similar to 138 Kv except with the following item changes as indicated below:

1.	5	Air break switch, type V-2, 115 Kv, 600 amperes, 3 pole, single throw, horizontal mounting, complete with cap and pin insulators, arc horns and TP manual operating mechanism
2.	6	Fuse mounting, type DBA-2, 115 Kv, vertical mounting with cap and pin insulators
3.	6	Fuse unit, type DBA-2, 115 Kv
4.	6	Lightning arrester, type IVS
5.	240	Strain insulators, 10" diameter, clevis type (8/string)
6.	. . .	Not used
7.	36	Apparatus insulators, 115 Kv stacking unit, 5" bolt circle, cap and pin type (TR-140) (3/stack)
16.	725	Feet of 37-.090 (300 MCM) .630" diameter bare copper cable #13435AL (M.H.D.)
17.	335	Feet of 19-.1055 (4/0) .530" diameter bare copper cable #13435AL (M.H D.)
18.	400	Feet of 7-.1228 (1/0) .368" diameter bare copper cable #13435AL (M.H.D.)

① When necessitated by shipping schedule, suitable aluminum cable, tubing, and connectors may be substituted for above grade electrical connections.

May, 1968
Supersedes AD 36-360 dated June, 1966
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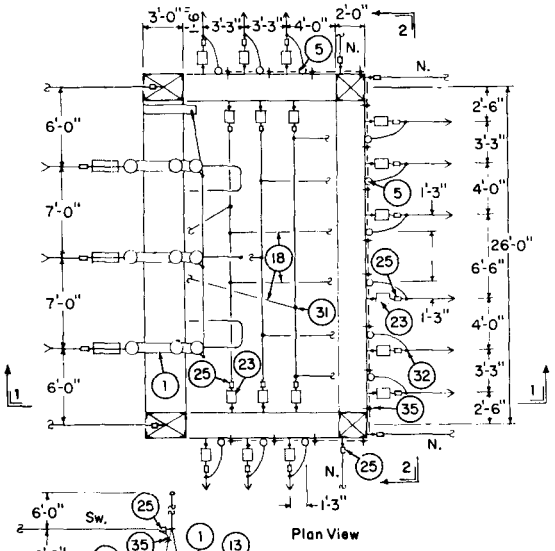
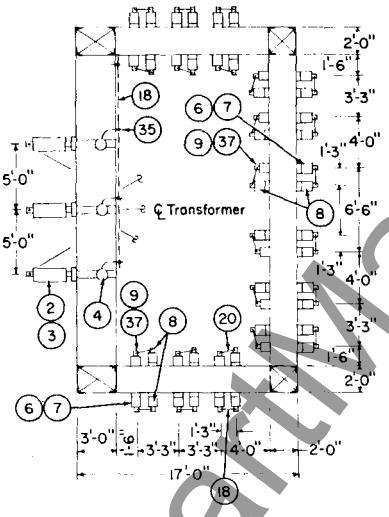
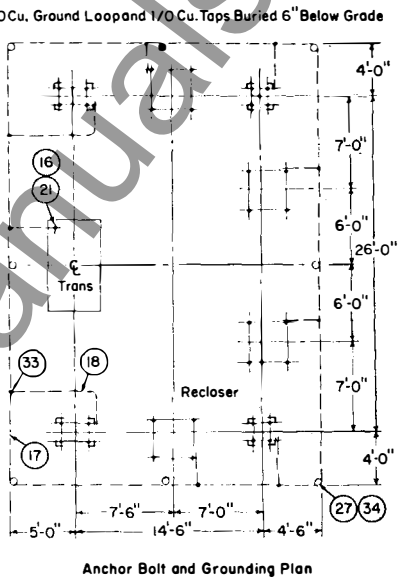
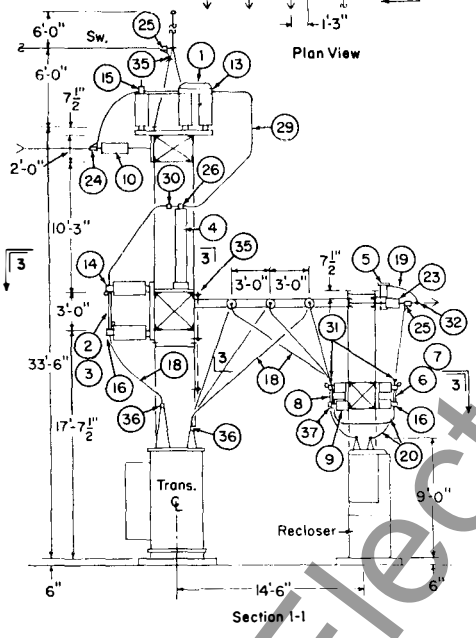
Standard Outdoor Substation Structures

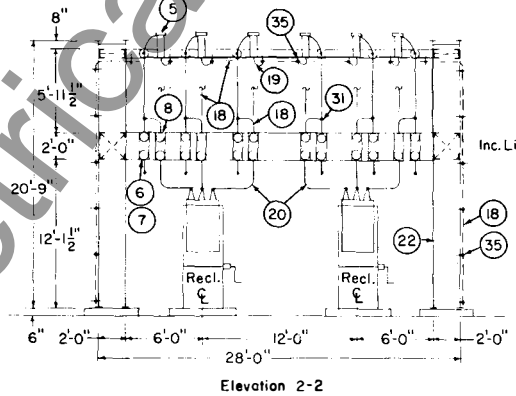
Substation With Combined Line Dead End Structure, Transformer Bay, and Four (4) Feeder Structure, 69/15, 46/15, or 34.5/15 Kv

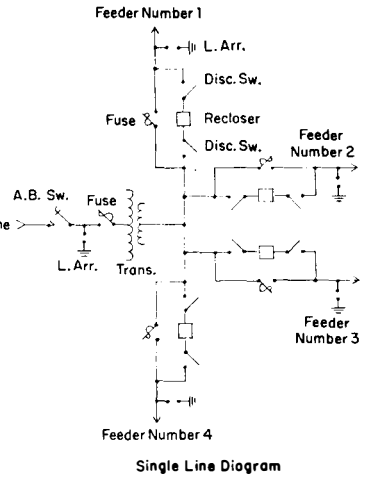












Drawing PSE-114

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Standard Outdoor Substation Structures

List of Material for 69/15, 46/15, or 34.5/15 Kv Compact Substation with Combined Line Dead End Structure, Transformer Bay, and Four (4) Feeder Structure per Drawing PSE-114①

A. 69 Kv only:

Item	Req'd	Description
1.	1	Air break switch, type V-3, 69 Kv, 600 amperes, 3 pole, single throw, horizontal mounting, complete with cap and pin insulators, arc horns and TP manual operating mechanism
2.	3	DBA-1 fuse mounting, 69 Kv, vertical mounting, with cap and pin insulators
3.	3	DBA-1 fuse unit, 69 Kv
4.	3	Lightning arrester, type IVS
5.	12	Lightning arrester, type LV
6.	12	LDX fused cutout switch (channel mounted)
7.	15	UT fuse link (for item 6)
8.	24	LDX cutout switch (channel mounted)
9.	12	Apparatus insulator, 15 Kv, 3" bolt circle, cap and pin type (TR-4)
10.	15	Strain insulator, 10" diameter, clevis type (5/string)
11.	1	Hookstick, 20 feet long (2 pieces)
12.	..	Not used
13.	3	Terminal lug for ¾" IPS copper tube (4B pad)
14.	3	Terminal lug for ¾" IPS copper tube (2B pad)
15.	3	Terminal lug for #4 wire to 250 MCM copper cable (4B pad)
16.	76	Terminal lug for #6 wire to 250 MCM copper cable (2B pad)
17.	150	Feet of 19-.1055 (4/0) .530" diameter bare copper cable #13435AL (M.H.D.)
18.	475	Feet of 7-.1228 (1/0) .368" diameter bare copper cable #13435AL (M.H.D.)
19.	60	Feet of 7-.0974 (#2) .292" diameter bare copper cable #7421-1 (S.D.)
20.	20	Pieces of .375" diameter bare copper wire (2/0) 14 feet long #2632-1
21.	2	½-13 x ⅞" silicon bronze hexagonal head tap bolt #4901-1
22.	1	Set of galvanized steelwork, based on: Phase wire 1500 lbs. line pull Static wire 1000 lbs. line pull Internal strain bus 1000 lbs. line pull Feeder lines 1000 lbs. line pull L.V. neutral 1000 lbs. line pull
23.	36	Strain insulator, 6" diameter, clevis type (2/string)
24.	3	Strain clamp for 1/0 to 250 MCM copper or 1/0 to 266.8 MCM ACSR cable (clevis type)
25.	24	Strain clamp for #6 to 2/0 copper or ACSR cable (clevis type)
26.	3	Tee connector for ¾" IPS copper tube run to copper bar tap
27.	8	Copperweld ground rod, ¾" diameter x 10 feet long
28.	1	Hookstick container
29.	84	Feet of ¾" IPS copper tubing, 3 pieces @ 16 feet long and 3 pieces @ 12 feet long
30.	3	Coupler for ¾" IPS copper tube
31.	33	Tee connector for 1/0 copper cable run – 1/0 copper cable and 2/0 copper wire tap
32.	12	Parallel clamp for #4 wire to 4/0 copper cable
33.	9	Parallel clamp for 4/0 copper and 1/0 copper cable (ground)
34.	8	Ground clamp for ¾" rod to 4/0 copper and 1/0 copper cable (2 grooves)
35.	43	Ground clamp for #6 to 2/0 copper cable (2 grooves)
36.	6	Stud connector for 1⅛-12 stud to 1/0 copper cable
37.	12	Bus support clamp for 2/0 copper wire, 3" bolt circle, cap mounting

B. 46/15 Kv structure per drawing PSE-114, similar to 69 Kv except with the following item changes as indicated below:

1.	1	Air break switch, type V-3, 46 Kv, 600 amperes, 3 pole, single throw, horizontal mounting, complete with cap and pin insulators, arc horns and TP manual operating mechanism
2	3	DBA-1 fuse mounting, 46 Kv, vertical mounting, with cap and pin insulators
3.	3	DBA-1 fuse unit, 46 Kv
4.	3	Lightning arrester, type IVS
10.	12	Strain insulator, 10" diameter, clevis type (4/string)

C. 34.5/15 Kv structure per drawing PSE-114, similar to 69 Kv except with the following item changes as indicated below:

1.	1	Air break switch, type V-3, 34.5 Kv, 600 amperes, 3 pole, single throw, horizontal mounting, complete with cap and pin insulators, arc horns and TP manual operating mechanism
2.	3	DBA-1 fuse mounting, 34.5 Kv, vertical mounting, with cap and pin insulators
3.	3	DBA-1 fuse unit, 34.5 Kv
4.	3	Lightning arrester, type IVS
10.	12	Strain insulator, 10" diameter, clevis type (4/string)

① When necessitated by shipping schedule, suitable aluminum cable, tubing, and connectors may be substituted for above grade electrical connections.

May, 1968
Supersedes AD 36-360 dated June, 1966
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Standard Outdoor Substation Structures

Air Break and Disconnect Switch Racks, Various Kv

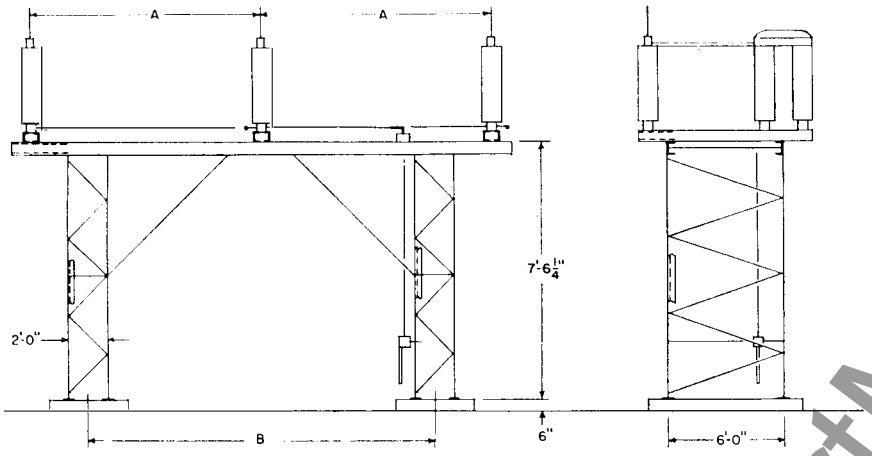


Figure1

Disconnect Spacing

Kv	A	B	C	Fig. No.
34.5	3'-0"	—	3'-0"	2
46	4'-0"	—	4'-0"	2
69	5'-0"	—	4'-0"	2
115	7'-0"	—	6'-0"	2
138	8'-0"	12'-0"	6'-0"	1 and 2
161	9'-0"	14'-0"	6'-0"	1 and 2

Air Break Spacing

Kv	A	B	C	Fig. No.
34.5	5'-0"	—	3'-0"	2
46	6'-0"	—	4'-0"	2
69	7'-0"	—	4'-0"	2
115	10'-0"	14'-0"	6'-0"	1 and 2
138	12'-0"	16'-0"	—	1
161	14'-0"	22'-0"	—	1

Note: Height of either type stand can be changed in 2'0" increments

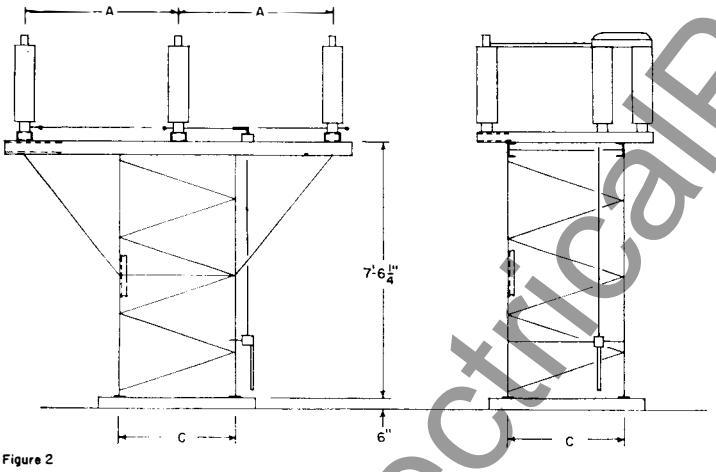
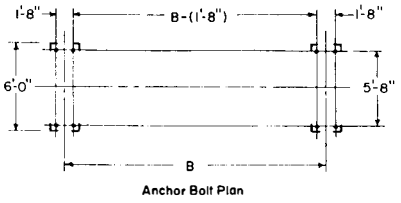
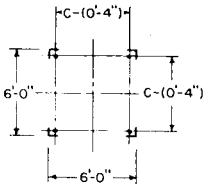


Figure 2



Anchor Bolt Plan



Anchor Bolt Plan

Drawing PSE-115

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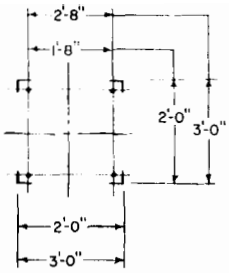
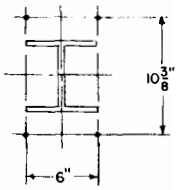
Standard Outdoor Substation Structures

Equipment Mounting Stands, Various Kv



Anchor Bolt Plan



Anchor Bolt Plan

Note: Height of equipment stands shown in figures 1, 2 and 3 can be changed in 2'0" increments.

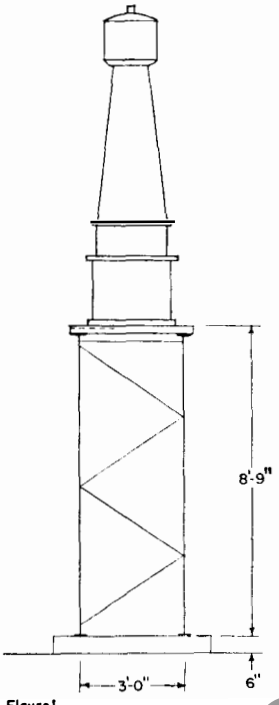


Figure1
Potential Transformer Stand

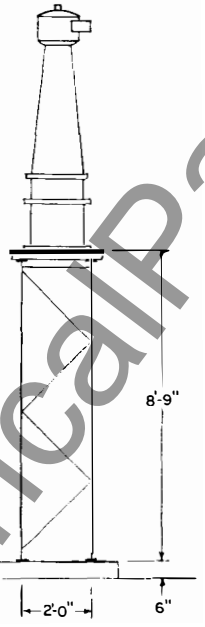


Figure 2
Current Transformer Stand

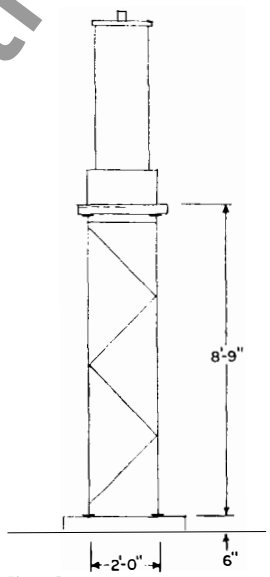


Figure 3
Lightning Arrester Stand

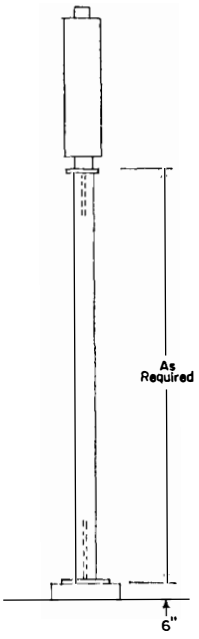


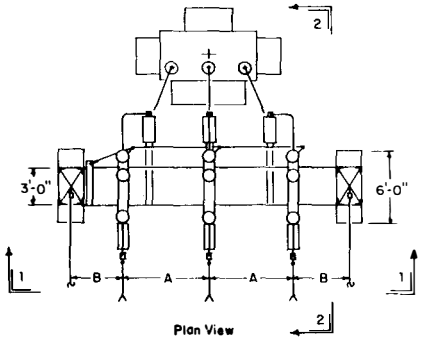
Figure 4
Bus Support Pedestal

Drawing PSE-116 (No Bill of Material)

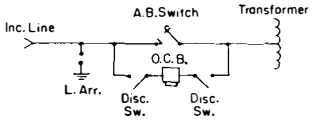
May, 1968
Supersedes AD 36-360 dated June, 1966
E, D, C/1969/DB

Standard Outdoor Substation Structures

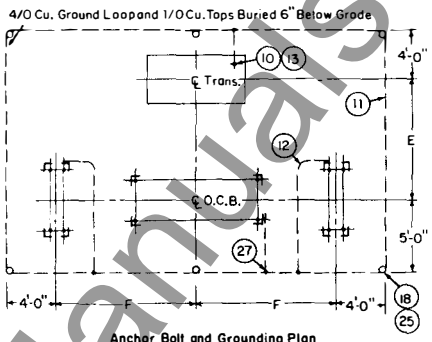
Tapered Column Line Dead End Structure with Oil Circuit Breaker, 69, 46 and 34.5 Kv



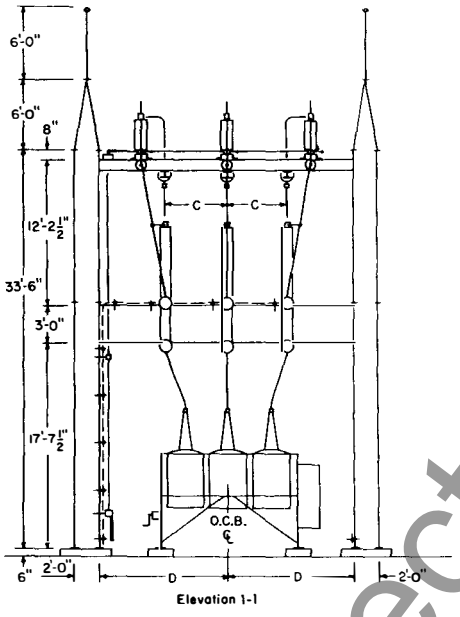
Plan View



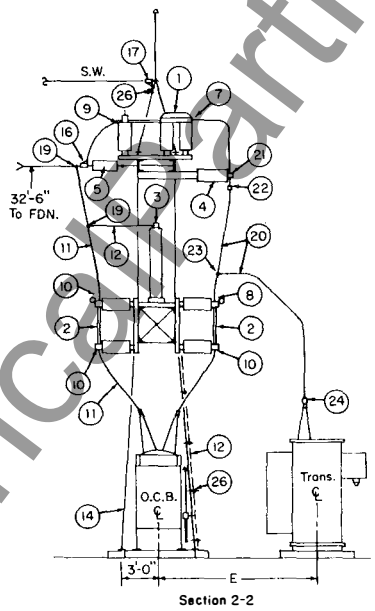
Single Line Diagram



Anchor Bolt and Grounding Plan



Elevation 1-1



Section 2-2

Tabulation

	69 Kv	46 Kv	34.5 Kv
A	7′-0″	6′-0″	5′-0″
B	4′-6″	5′-6″	5′-0″
C	5′-0″	4′-0″	3′-0″
D	10′-6″	10′-6″	9′-0″
E	13′-0″	10′-0″	9′-0″
F	11′-6″	11′-6″	10′-0″

Drawing PSE-117

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Standard Outdoor Substation Structures

List of Material for 69, 46 or 34.5 Kv Line Dead End Structure with Oil Circuit Breaker per Drawing PSE-117①

A. 69 Kv only:

Item	Req'd	Description
1.	1	Air break switch, type V-3, 69 Kv, 600 amperes, 3 pole single throw, horizontal mounting, complete with cap and pin insulators, arc horns and TP manual operating mechanism
2.	6	Disconnect switch, type LCO, 69 Kv, 600 amperes, 1 pole single throw, vertical mounting, complete with cap and pin insulators
3.	3	Lightning arrester, type IVS
4.	6	Apparatus insulator, 69 Kv stacking unit, 3" bolt circle, cap and pin style (stack TR-16) (2/stack)
5.	15	Strain insulator, 10" diameter, clevis type (5/string)
6.	1	Hookstick, 20 feet long (2-piece)
7.	3	Terminal lug for 1" IPS copper tubing (4B pad)
8.	3	Terminal lug for 1" IPS copper tubing (2B pad)
9.	3	Terminal lug for #4 solid to 250 MCM copper cable (4B pad)
10.	10	Terminal lug for 4/0 copper and 1/0 copper cable (2B pad)
11.	225	Feet of 19-.1055 (4/0) .530" bare copper cable, #13435AL (M.H.D.)
12.	125	Feet of 7-.1228 (1/0) .368" bare copper cable, #13435AL (M.H.D.)
13.	2	½-13 x ⅞" silicon bronze hexagon head tap bolt #4901-1
14.	1	Set of galvanized steelwork, based on: Phase wire, 2,000 lbs. line pull Static wire, 1,000 lbs. line pull
15.	1	Hookstick container
16.	3	Strain clamp, 1/0 to 250 MCM copper cable or 1/0 to 266.8 MCM ACSR cable (clevis type)
17.	2	Strain clamp, #6 to 2/0 copper or ACSR cable (clevis type)
18.	6	Copperweld ground rod, ¾" diameter x 10'-0" long
19.	6	Tee connector, #4 solid to 250 MCM copper cable, run and tap
20.	120	Feet of ¾" SIPS copper tubing, 6 pieces at 20'-0" long
21.	3	Bus support clamp for 1" IPS copper tube, 3" bolt circle, cap mounting
22.	3	Coupler for 1" IPS copper tube
23.	3	Tee connector for 1" IPS copper tube, run and tap
24.	3	Expansion terminal for 1⅛-12 stud to 1" IPS copper tube
25.	6	Ground clamp for ¾" rod to 4/0 and 1/0 copper cable (2 grooves)
26.	12	Ground clamp for #6 to 2/0 copper cable (2 grooves)
27.	4	Parallel clamp for 4/0 and 1/0 copper cable (ground)

B. 46 Kv structure per drawing PSE-117, similar to 69 Kv except with the following item changes as indicated below:

1.	1	Air break switch, type V-3, 46 Kv, 600 amperes, 3 pole single throw, horizontal mounting, complete with cap and pin insulators, arc horns and TP manual operating mechanism
2.	6	Disconnect switch, type LCO, 46 Kv, 600 amperes, 1 pole single throw, vertical mounting, complete with cap and pin insulators
3.	3	Lightning arrester, type IVS
4.	3	Apparatus insulator, 46 Kv, 3" bolt circle, cap and pin style (TR-13)
5.	12	Strain insulator, 10" diameter, clevis type (4/string)

C. 34.5 Kv structure per drawing PSE-117, similar to 69 Kv except with the following item changes as indicated below:

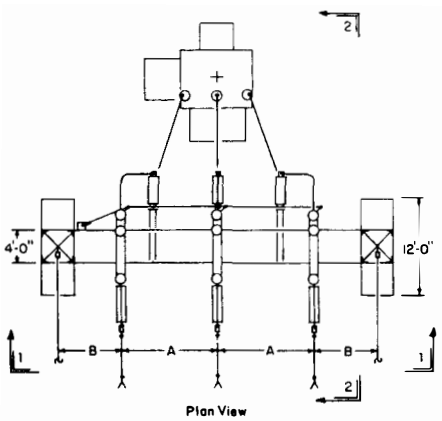
1.	1	Air break switch, type V-2, 34.5 Kv, 600 amperes, 3 pole single throw, horizontal mounting, complete with cap and pin insulators, arc horns and TP manual operating mechanism
2.	6	Disconnect switch, type LCO, 34.5 Kv, 600 amperes, 1 pole single throw, vertical mounting, complete with cap and pin insulators
3.	3	Lightning arrester, type IVS
4.	3	Apparatus insulator, 34.5 Kv, 3" bolt circle, cap and pin style (TR-10)
5.	12	Strain insulator, 10" diameter, clevis type (4/string)

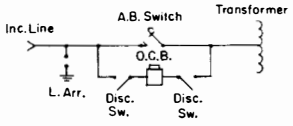
① When necessitated by shipping schedule, suitable aluminum cable, tubing, and connectors may be substituted for above grade electrical connections.

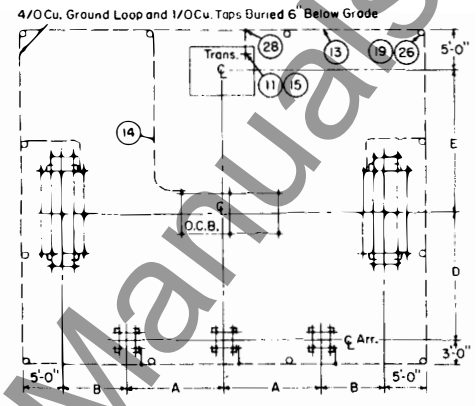
May, 1968
Supersedes AD 36-360, dated June, 1966
E, D, C/1969/DB

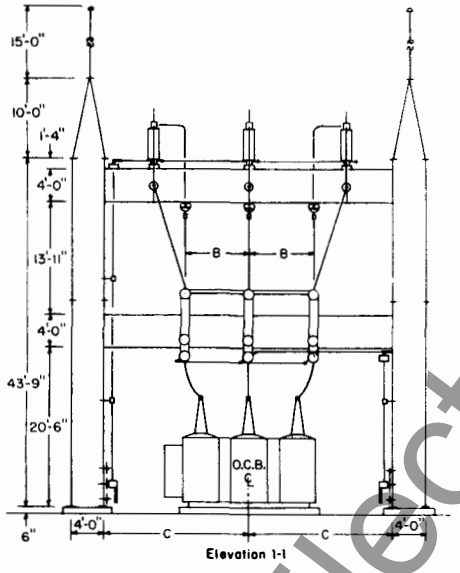
Standard Outdoor Substation Structures

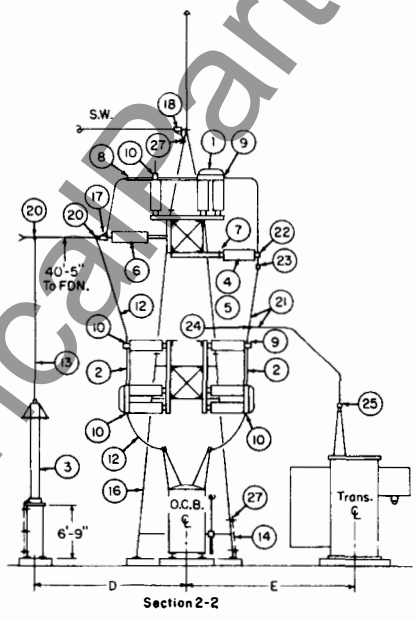
Tapered Column Line Dead End Structure with Oil Circuit Breaker, 138 and 115 Kv











Tabulation

	138 Kv	115 Kv
A	12'-0"	10'-0"
B	8'-0"	7'-0"
C	18'-0"	15'-0"
D	19'-0"	17'-0"
E	21'-0"	18'-0"

Drawing PSE-118

Westinghouse Electric Corporation
Switchgear Division: Power Switching Equipment, East Pittsburgh, Pa.
Printed in USA

Westinghouse

Standard Outdoor Substation Structures

List of Material for 138 Kv, 115 Kv Line Dead End Structure with Oil Circuit Breaker per Drawing PSE-118①

A. 138 Kv only:

Item	Req'd	Description
1.	1	Air break switch, type V-2, 138 Kv, 600 amperes, 3 pole single throw, horizontal mounting, complete with cap and pin insulators, arc horns and TP manual operating mechanism
2.	2	Disconnect switch, type V-2, 138 Kv, 600 amperes, 3 pole single throw, vertical mounting, complete with cap and pin insulators and TP manual operating mechanism
3.	3	Lightning arrester, type IVS
4.	6	Apparatus insulator, 138 Kv stacking unit, 5" bolt circle, cap and pin style (TR-140) (2/stack)
5.	3	Apparatus insulator, 138 Kv stacking unit, 5" bolt circle, cap and pin style (TR-53) (1/stack)
6.	30	Strain insulator, 10" diameter, clevis type (10/string)
7.	3	Bus support spacer, 3½" high, 5" bolt circle
8.	3	Lead guide, 4'-0" long
9.	6	Terminal lug for 1" IPS copper tubing (4B pad)
10.	12	Terminal lug for 1/0 solid to 500 MCM copper cable (4B pad)
11.	1	Terminal lug for 1/0 copper cable (2B pad)
12.	100	Feet of 37-.090 (300 MCM) .630" bare copper cable, #13435AL (M.H.D.)
13.	300	Feet of 19-.1055 (4/0) .530" bare copper cable, #13435AL (M.H.D.)
14.	125	Feet of 7-.1228 (1/0) .368" bare copper cable, #13435AL (M.H.D.)
15.	2	½-13 x ⅞" silicon bronze hexagon head tap bolt #4901-1
16.	1	Set of galvanized steelwork, based on: Phase wire, 4,000 lbs. line pull Static wire, 2,000 lbs. line pull
17.	3	Strain clamp for 4/0 to 500 MCM copper cable (clevis type)
18.	2	Strain clamp for #6 to 2/0 copper or ACSR cable (clevis type)
19.	12	Copperweld ground rod, ¾" diameter x 10'-0" long
20.	6	Tee connector for 1/0 solid to 500 MCM copper cable, run and tap
21.	156	Feet of 1" SIPS copper tubing, 6 pieces at 20'-0" and 3 pieces at 12'-0" long
22.	3	Bus support clamp for 1" IPS copper tube, 5" bolt circle, cap mounting
23.	3	Coupler for 1" IPS copper tube
24.	3	Tee connector for 1" IPS copper tube, run and tap
25.	3	Expansion terminal for 1⅛-12 stud to 1" IPS copper tube
26.	12	Ground clamp for ¾" rod to 4/0 and 1/0 copper cable (2 grooves)
27.	17	Ground clamp for #6 to 2/0 copper cable (2 grooves)
28.	4	Parallel clamp for 4/0 and 1/0 copper cable (ground)

B. 115 Kv structure per drawing PSE-118, similar to 138 Kv except with the following item changes as indicated below:

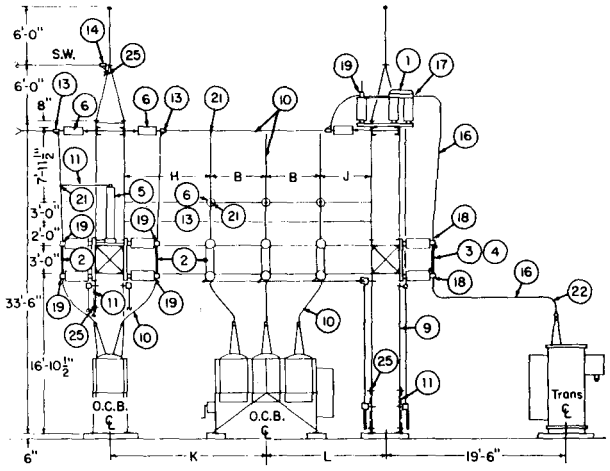
1.	1	Air break switch, type V-2, 115 Kv, 600 amperes, 3 pole single throw, horizontal mounting, complete with cap and pin insulators, arc horns and TP manual operating mechanism
2.	2	Disconnect switch, type V-2, 115 Kv, 600 amperes, 3 pole single throw, vertical mounting, complete with cap and pin insulators and TP manual operating mechanism
3.	3	Lightning arrester, type IVS
4.	9	Apparatus insulator, 115 Kv stacking unit, 5" bolt circle, cap and pin style (TR-140) (3/stack)
5.	. . .	Not used
6.	24	Strain insulator, 10" diameter, clevis type (8/string)
13.	275	Feet of 19-.1055 (4/0) .530" bare copper cable, #13435AL (M.H.D.)

① When necessitated by shipping schedule, suitable aluminum cable, tubing, and connectors may be substituted for above grade electrical connections.

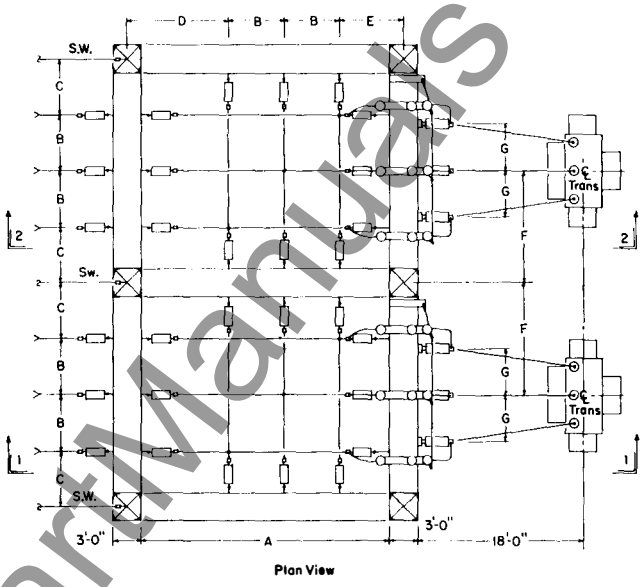
May, 1968
Supersedes AD 36-360 dated June, 1966
E. D. C/1969/DB

Standard Outdoor Substation Structures

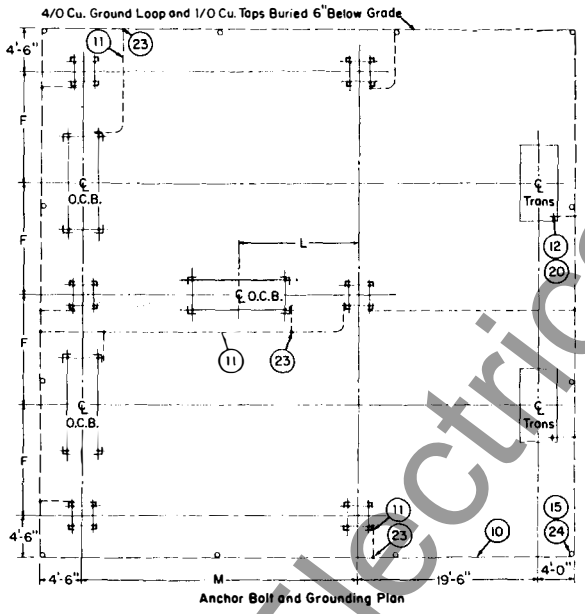
Double Square Bay Line Dead End Structure and Switching Structure with Oil Circuit Breakers 69, 46 and 34.5 Kv



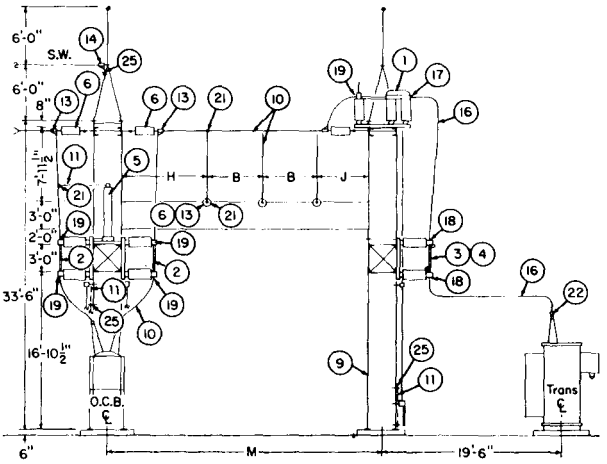
Section 1-1



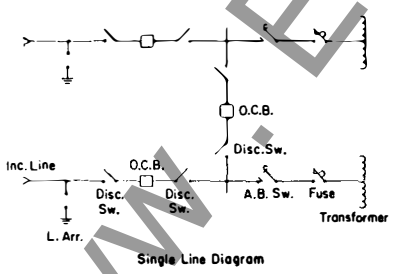
Plan View



Anchor Bolt and Grounding Plan



Section 2-2



Single Line Diagram

Tabulation

	69 Kv	46 Kv	34.5 Kv
A	27'-0"	21'-0"	21'-0"
B	6'-0"	5'-0"	4'-0"
C	6'-0"	5'-6"	6'-6"
D	11'-0"	8'-0"	9'-0"
E	7'-0"	6'-0"	7'-0"
F	12'-0"	10'-6"	10'-6"
G	5'-0"	4'-0"	3'-0"
H	9'-6"	6'-6"	7'-6"
J	5'-6"	4'-6"	5'-6"
K	17'-0"	13'-0"	13'-0"
L	13'-0"	11'-0"	11'-0"
M	30'-0"	24'-0"	24'-0"

Drawing PSE-119

Westinghouse Electric Corporation
Switchgear Division: Power Switching Equipment, East Pittsburgh, Pa.
Printed in USA

Westinghouse

Standard Outdoor Substation Structures

List of Material for 69, 46, or 34.5 Kv Double Square Bay Line Dead End and Switching Structure with Oil Circuit-Breakers per Drawing PSE-119①

A. 69 Kv only:

Item	Req'd	Description
1.	2	Air break switch, type V-3, 69 Kv, 600 amperes, 3 pole, single throw, horizontal mounting, complete with cap and pin insulators, arc horns and TP manual operating mechanism
2.	6	Disconnect switch, side break type RL-2, 69 Kv, 600 amperes, 3 pole, single throw, vertical mounting, complete with cap and pin insulators and TP manual operating mechanism
3.	6	Fuse mounting, type DBA-1, 69 Kv, vertical mounting with cap and pin insulators
4.	6	Fuse unit, type DBA-1, 69 Kv
5.	6	Lightning arrester, type IVS
6.	150	Strain insulator, 10" diameter, clevis type (5/string)
7.	1	Hookstick, 20 feet long (2-section type)
8.	1	Hookstick container
9.	1	Set of galvanized steelwork, based on: Internal strain bus, 1,000 lbs. line pull Phase wire, 2,000 lbs. line pull Static wire, 2,000 lbs. line pull
10.	800	Feet of 19-.1055 (4/0) .530" diameter bare copper cable ※13435AL (M.H.D.)
11.	300	Feet of 7-.1228 (1/0) .368" diameter bare copper cable ※13435AL (M.H.D.)
12.	4	½-13 x ⅞" silicon bronze hexagonal head tap bolt ※4901-1
13.	30	Strain clamp for 1/0 to 250 MCM copper or 1/0 to 266.8 MCM ACSR cable (clevis type)
14.	3	Strain clamp for ※6 to 2/0 copper or ACSR cable (clevis type)
15.	12	Copperweld ground rod, ¾" diameter x 10'-0" long
16.	240	Feet of 1" IPS copper tubing, 12 pieces at 20'-0" long
17.	6	Terminal lug for 1" IPS copper tubing (4B pad)
18.	12	Terminal lug for 1" IPS copper tubing (2B pad)
19.	42	Terminal lug for ※4 to 250 MCM copper cable (4B pad)
20.	2	Terminal lug for 1/0 copper cable (2B pad)
21.	18	Tee connector for ※4 solid wire to 250 MCM copper cable, run and tap
22.	6	Expansion connector for 1⅛-12 stud to 1" IPS copper tube
23.	11	Parallel clamp for 4/0 and 1/0 copper cable (ground)
24.	12	Ground clamp for ¾" rod to 4/0 and 1/0 copper cable (2 grooves)
25.	43	Ground clamp for ※6 to 2/0 copper cable to flat (2 grooves)

B. 46 Kv per structure drawing PSE-119, similar to 69 Kv except with the following item changes as indicated below:

1.	2	Air break switch, type V-3, 46 Kv, 600 amperes, 3 pole, single throw, horizontal mounting, complete with cap and pin insulators, arc horns and TP manual operating mechanism
2.	6	Disconnect switch, side break type RL-2, 46 Kv, 600 amperes, 3 pole, single throw, vertical mounting, complete with cap and pin insulators and TP manual operating mechanism
3.	6	Fuse mounting, type DBA-1, 46 Kv, vertical mounting with cap and pin insulators
4.	6	Fuse unit, type DBA-1, 46 Kv
5.	6	Lightning arrester, type IVS
6.	120	Strain insulator, 10" diameter, clevis type (4/string)
10.	750	Feet of 19-.1055 (4/0) .530" diameter bare copper cable ※13435AL (M.H.D.)

C. 34.5 Kv structure per drawing PSE-119, similar to 69 Kv except with the following item changes as indicated below:

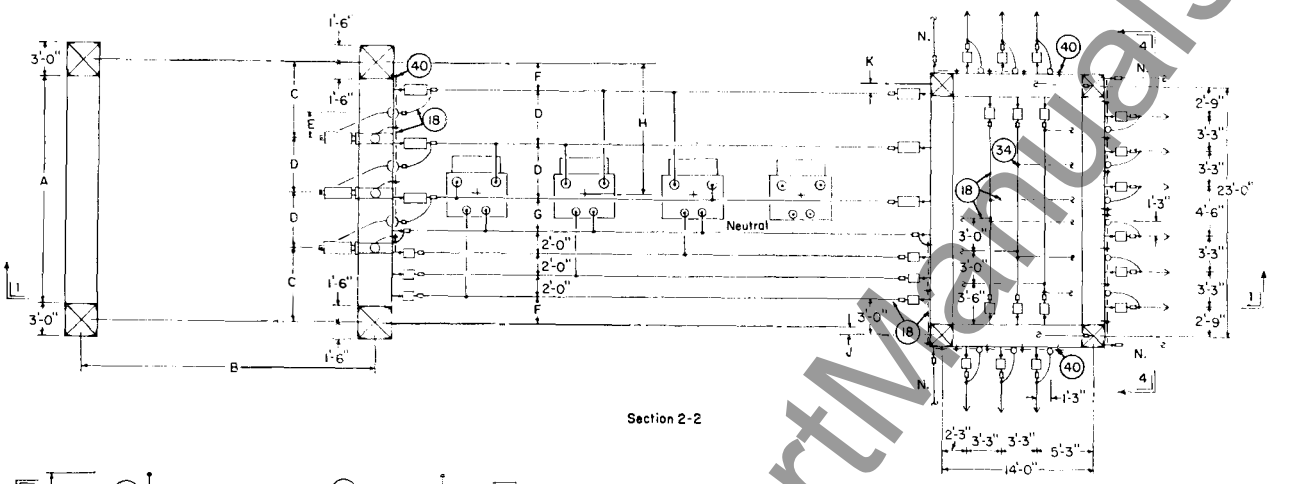
1.	2	Air break switch, type V-3, 34.5 Kv, 600 amperes, 3 pole, single throw, horizontal mounting, complete with cap and pin insulators, arc horns and TP manual operating mechanism
2.	6	Disconnect switch, side break type RL-2, 34.5 Kv, 600 amperes, 3 pole, single throw, vertical mounting, complete with cap and pin insulators and TP manual operating mechanism
3.	6	Fuse mounting, type DBA-1, 34.5 Kv, vertical mounting with cap and pin insulators
4.	6	Fuse unit, type DBA-1, 34.5 Kv
5.	6	Lightning arrester, type IVS
6.	120	Strain insulator 10" diameter, clevis type (4/string)
10.	700	Feet of 19-.1055 (40) .530" diameter bare copper cable ※13435AL (M.H.D

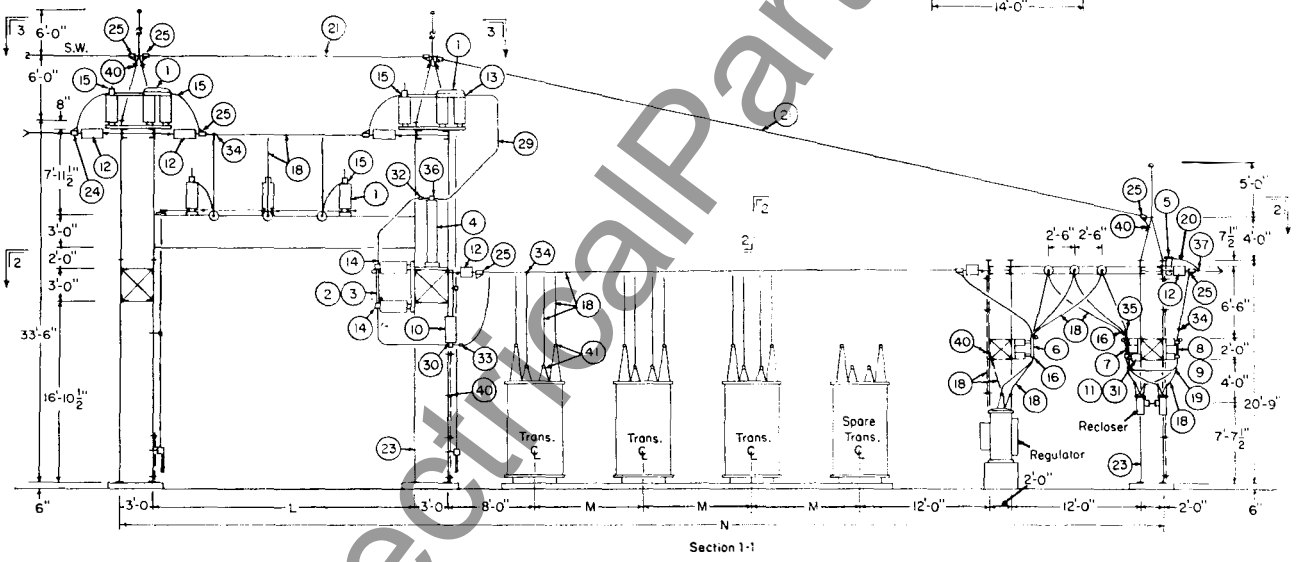
① When necessitated by shipping schedule, suitable aluminum cable, tubing, and connectors may be substituted for above grade electrical connections.

May, 1968
Supersedes AD 36-360 dated June, 1966
E, D, C/1969/DB

Standard Outdoor Substation Structures

Line Dead End and Distribution Structure with Three (3) Incoming Lines, Four (4) Transformer Bay, and Four (4) Feeder Structure (Single Phase Reclosers), 69/15, 46/15 and 34.5/15 Kv



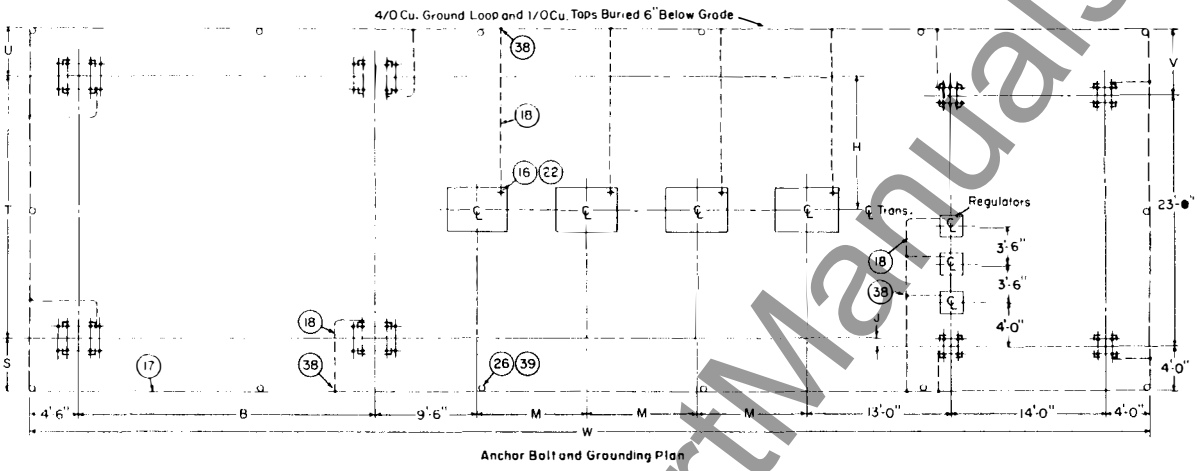


Drawing PSE-120(Continued on Drawing PSE-121)

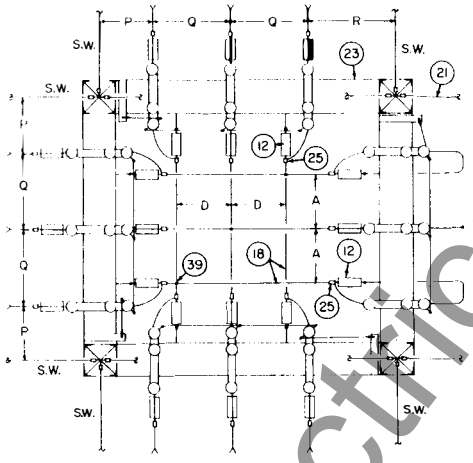
Westinghouse

Standard Outdoor Substation Structures

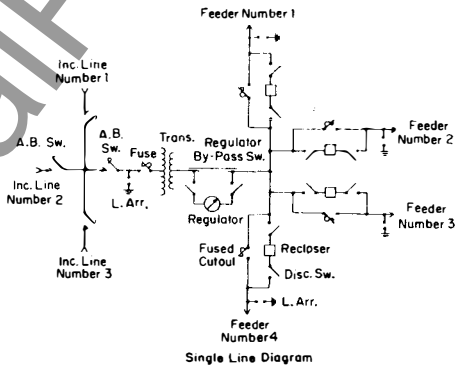
Line Dead End and Distribution Structure with Three (3) Incoming Lines, Four (4) Transformer Bay, and Four (4) Feeder Structure (Single Phase Reclosers) 69/15, 46/15 and 34.5/15 Kv



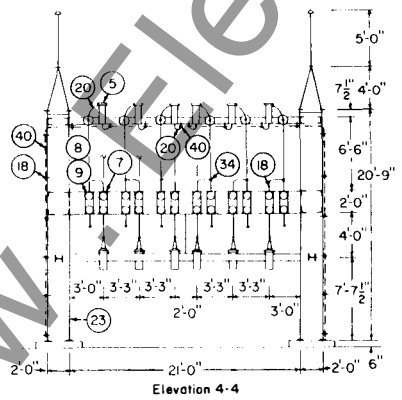
Anchor Bolt and Grounding Plan



Section 3-3



Single Line Diagram



Elevation 4-4

Tabulation

	69 Kv	46 Kv	34.5 Kv
A	21'-0"	18'-0"	15'-0"
B	27'-0"	21'-0"	18'-0"
C	7'-0"	6'-6"	6'-0"
D	5'-0"	4'-0"	3'-0"
E	2'-6"	2'-0"	1'-6"
F	2'-6"	2'-3"	2'-0"
G	3'-0"	2'-6"	2'-0"
H	12'-0"	10'-6"	9'-0"
J	6"	9"	1'-0"
K	10"	3'-6"	6'-0"
L	24'-0"	18'-0"	15'-0"
M	10'-0"	8'-0"	8'-0"
N	96'-0"	84'-0"	81'-0"
P	5'-0"	4'-6"	4'-0"
Q	7'-0"	6'-0"	5'-0"
R	8'-0"	4'-6"	4'-0"
S	4'-6"	4'-9"	5'-0"
T	24'-0"	21'-0"	18'-0"
U	4'-6"	5'-3"	8'-0"
V	6'-0"	4'-0"	4'-0"
W	102'-0"	90'-0"	87'-0"

Drawing PSE-121 (Continued from Drawing PSE-120)

May, 1968
Supersedes AD 36-360 dated June, 1966
E, D, C/1969/DB

Standard Outdoor
Substation Structures

Westinghouse Electric Corporation
Switchgear Division: Power Switching Equipment, East Pittsburgh, Pa.
Printed in USA

Westinghouse

Standard Outdoor Substation Structures

List of Material for 69/15, 46/15, or 34.5/15 Kv Substation with Dead End Structure and Distribution Structure for Three (3) Incoming Lines, Four (4) Transformer Bay, and Four (4) Feeder Structure, (Single Phase Reclosers) per Drawings PSE-120 and PSE-121①

A. 69/15 Kv only:

Item	Req'd	Description
1.	4	Air break switch, type V-3, 69 Kv, 600 amperes, 3 pole, single throw, horizontal mounting, complete with cap and pin insulators, arc horns and TP manual operating mechanism
2.	3	Fuse mounting, type DBA-1, 69 Kv, vertical mounting with cap and pin insulators
3.	3	Fuse unit, type DBA-1, 69 Kv
4.	3	Lightning arrester, type IVS
5.	12	Lightning arrester, type LV
6.	3	Regulator by-pass switch, type RBO, 15 Kv, 400 amperes, vertical mounting with cap and pin insulators
7.	24	Disconnect switch, type LDX, 15 Kv, 200 amperes, vertical mounting with channel base
8.	12	Fused cutout, type LDX, 15 Kv, 200 amperes, vertical mounting with channel base
9.	15	Fuse link, type UT
10.	6	Apparatus insulator, 69 Kv stacking unit, 3" bolt circle, cap and pin type (2/stack) (Stack TR-16)
11.	12	Apparatus insulator, 15 Kv, 3" bolt circle, cap and pin type (TR-4)
12.	183	Strain insulator, 10" diameter, clevis type (5 and 2/string)
13.	3	Terminal lug for ¾" IPS copper tubing (4B pad)
14.	6	Terminal lug for ¾" IPS copper tubing (2B pad)
15.	21	Terminal lug for #4 copper wire to 250 MCM copper cable (4B pad)
16.	88	Terminal lug for #6 copper wire to 250 MCM copper cable (2B pad)
17.	295	Feet of 19-.1055 (4/0) .530" diameter bare copper cable #13435AL (M.H.D.)
18.	1425	Feet of 7-.1228 (1/0) .368" diameter bare copper cable #13435AL (M.H.D.)
19.	12	Pieces of 1/0 solid copper wire, .313" diameter x 14'-0" long, #2632-1
20.	50	Feet of 7-.0974 (#2) .292" diameter bare copper cable #7421-1 (S.D.)
21.	210	Feet of ⅜" galvanized steel cable #12296-1
22.	8	½-13 x ⅞" silicon bronze, hexagonal head tap bolt #4901-1
23.	1	Set of galvanized steelwork, based on: HV phase wires, 2,000 lbs. line pull Static wire, 1,000 lbs. line pull Internal strain bus, 1,000 lbs. line pull Feeder lines, 1,000 lbs. line pull LV neutral, 1,000 lbs. line pull
24.	9	Strain clamp for 1/0 to 250 MCM copper or 1/0 to 266.8 MCM ACSR cable (clevis type)
25.	62	Strain clamp for #6 to 2/0 copper or ACSR cable (clevis type)
26.	14	Copperweld ground rod, ¾" diameter x 10'-0" long
27.	1	Hookstick, 20 feet long (1 section 12'-0" long, 1 section 8'-0" long)
28.	1	Hookstick container, 5⅞" diameter x 13'-0" long
29.	120	Feet of ¾" IPS copper tubing, 6 pieces at 20'-0" long
30.	3	Bus support clamp for ¾" IPS copper tubing, pin mounting, 3" bolt circle
31.	12	Bus support clamp for 1/0 solid copper wire, cap mounting, 3" bolt circle
32.	3	Coupler for ¾" IPS copper tubing
33.	3	Reducer for ¾" IPS copper tube to 1/0 copper cable
34.	39	Tee connector for 1/0 copper cable, run and tap
35.	12	Tee connector for 1/0 copper cable run, 1/0 solid copper wire tap
36.	3	Tee connector for ¾" IPS copper tube run, bar tap, 2 bolts, NEMA drilling
37.	12	Parallel clamp for #2 copper cable and #4 solid copper wire to 4/0 copper cable
38.	15	Parallel clamp for 4/0 and 1/0 copper cable (ground)
39.	14	Ground clamp for ¾" diameter rod to 4/0 and 1/0 copper cable (2 grooves)
40.	82	Ground clamp for #6 to 2/0 copper cable (2 grooves)
41.	12	Stud connector for 1⅛-12 stud, #6 to 4/0 copper cable

B. 46/15 Kv structure per drawings PSE-120 and PSE-121, similar to 69/15 Kv except with the following item changes as indicated below:

1.	4	Air break switch, type V-3, 46 Kv, 600 amperes, 3 pole, single throw, horizontal mounting, complete with cap and pin insulators, arc horns and TP manual operating mechanism
2.	3	Fuse mounting, type DBA-1, 46 Kv, vertical mounting, with cap and pin insulators
3.	3	Fuse unit, type DBA-1, 46 Kv
4.	3	Lightning arrester, type IVS
10.	3	Apparatus insulator, 46 Kv, 3" bolt circle, cap and pin type (TR-13)
12.	156	Strain insulator, 10" diameter, clevis type (4 and 2/string)
17.	265	Feet of 19-.1055 (4/0) .530" diameter bare copper cable #13435AL (M.H.D.)
18.	1350	Feet of 7-.1228 (1/0) .368" diameter bare copper cable #13435AL (M.H.D.)
21.	185	Feet of ⅜" galvanized steel cable #12296-1

C. 34.5/15 Kv structure per drawings PSE-120 and PSE-121, similar to 69/15 Kv except with the following item changes as indicated below:

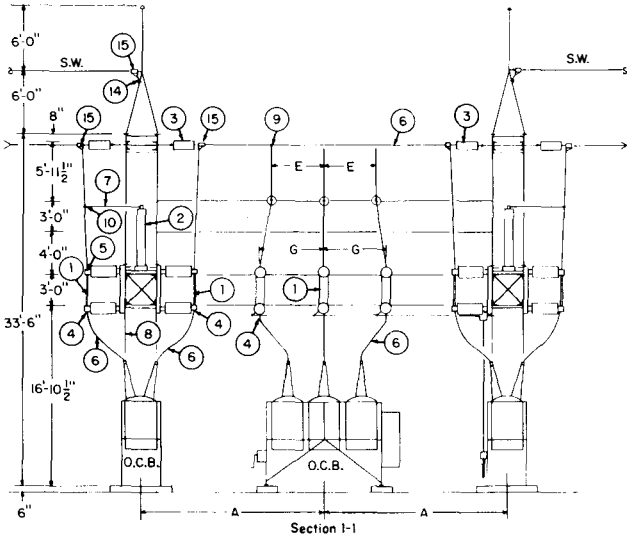
1.	4	Air break switch, type V-3, 34.5 Kv, 600 amperes, 3 pole, single throw, horizontal mounting, complete with cap and pin insulators, arc horns and TP manual operating mechanism
2.	3	Fuse mounting, type DBA-1, 34.5 Kv, vertical mounting, with cap and pin insulators
3.	3	Fuse unit, type DBA-1, 34.5 Kv
4.	3	Lightning arrester, type IVS
10.	3	Apparatus insulator, 34.5 Kv, 3" bolt circle, cap and pin type (TR-10)
12.	156	Strain insulator, 10" diameter, clevis type (4 and 2/string)
17.	260	Feet of 19-.1055 (4/0) .530" diameter bare copper cable #13435AL (M.H.D.)
18.	1325	Feet of 7-.1228 (1/0) .368" diameter bare copper cable #13435AL (M.H.D.)
21.	175	Feet of ⅜" galvanized steel cable #12296-1

① When necessitated by shipping schedule, suitable aluminum cable, tubing, and connectors may be substituted for above grade electrical connections.

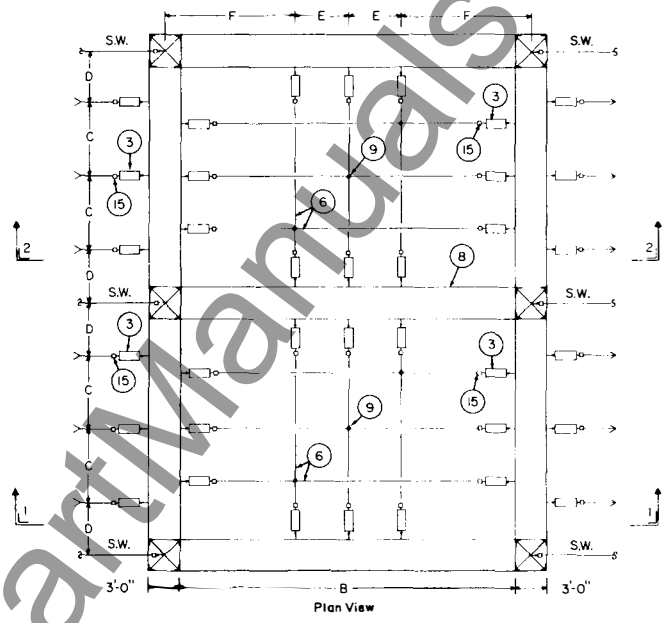
May, 1968
Supersedes AD 36-360 dated June, 1966
E, D, C/1969/DB

Standard Outdoor Substation Structures

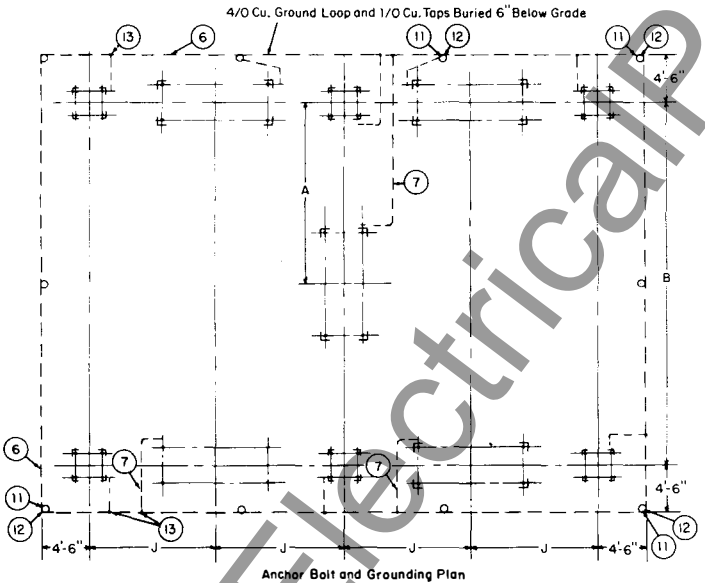
Double Square Bay Switching Structure with Oil Circuit Breakers, 69, 46 and 34.5 Kv



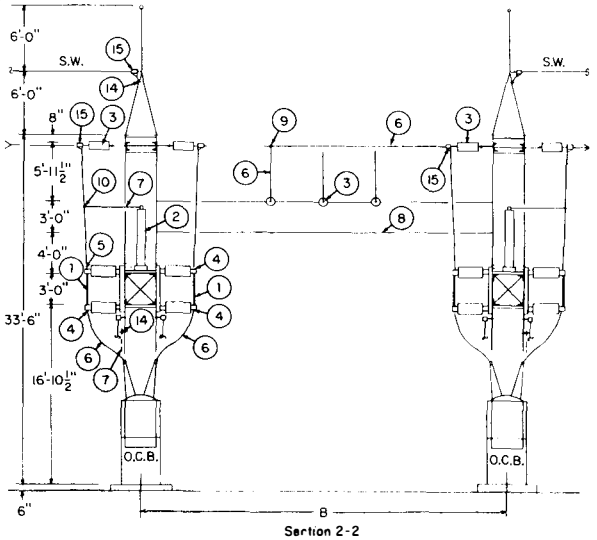
Section 1-1



Plan View



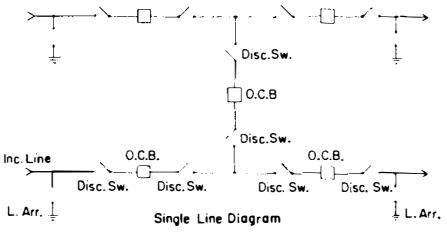
Anchor Bolt and Grounding Plan



Section 2-2

Tabulation

	69 Kv	46 Kv	34.5 Kv
A	16'-6"	13'-6"	13'-6"
B	30'-0"	24'-0"	24'-0"
C	7'-0"	6'-0"	5'-0"
D	5'-0"	4'-6"	5'-6"
E	5'-0"	4'-0"	3'-0"
F	12'-6"	9'-6"	10'-6"
G	6'-0"	5'-0"	4'-0"
J	12'-0"	10'-6"	10'-6"



Single Line Diagram

Drawing PSE-122

Westinghouse Electric Corporation
Switchgear Division: Power Switching Equipment, East Pittsburgh, Pa.
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Standard Outdoor Substation Structures

List of Material for 69, 46, or 34.5 Kv Double Square Bay Switching Structure with Oil Circuit Breakers per Drawing PSE-122①

A. 69 Kv only:

Item	Req'd	Description
1.	10	Side break switch type RL-2, 69 Kv, 600 amperes, 3 pole, single throw, vertical mounted, complete with cap and pin insulators and TP operating mechanism
2.	12	Lightning arrester type IVS
3.	180	Strain insulators, 10" diameter clevis type (5/string)
4.	48	Terminal lug for 4/0 copper wire to 250 MCM copper cable (4B pad)
5.	12	Terminal lug for #4 to 4/0 ACSR cable (4B pad.)
6.	900	Feet of 19-.1055 (4/0) .530" diameter bare copper cable #13435AL (M.H.D.)
7.	500	Feet of 7-.1228 (1/0) .368" diameter bare copper cable #13435AL (M.H.D.)
8.	1	Set of galvanized steelwork, based on: Phase wire, 2,000 lb. line pull Static wire, 1,000 lb. line pull
9.	12	Tee for 4/0 copper cable run and tap
10.	12	Tee for 4/0 ACSR run to 1/0 cu tap
11.	10	Copperweld ground rod ¾" diameter x 10'-0" long
12.	10	Ground rod, clamps, for ¾" diameter rod to 1/0 and 4/0 copper cable (2 grooves)
13.	9	Parallel clamp for 4/0 and 1/0 copper cable
14.	66	Ground clamps for #6 to 2/0 copper cable (2 grooves)
15.	42	Strain clamp for 1/0 to 266 MCM ACSR (clevis type)

B. 46 Kv structure per drawing PSE-122, similar to 69 Kv except with the following item changes as indicated below:

1.	10	Side break switch type RL-2, 46 Kv, 600 amperes, 3 pole, single throw, vertical mounted, complete with cap and pin insulators and TP operating mechanism
2.	12	Lightning arrester, type IVS
3.	144	Strain insulators, 10" diameter clevis type (4/string)

C. 34.5 Kv structure per drawing PSE-122, similar to 69 Kv except with the following item changes as indicated below:

1.	10	Side break switch type RL-2, 34.5 Kv, 600 amperes, 3 pole, single throw, vertical mounted, complete with cap and pin insulators and TP operating mechanism
2.	12	Lightning arrester, type IVS
3.	144	Strain insulators, 10" diameter clevis type (4/string)

① When necessitated by shipping schedule, suitable aluminum cable, tubing, and connectors may be substituted for above grade electrical connections.

May, 1968
Supersedes AD 36-360 dated June, 1966
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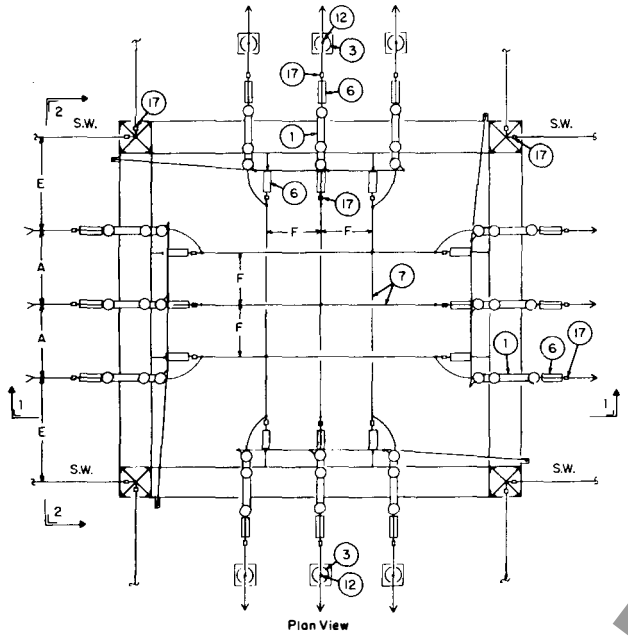
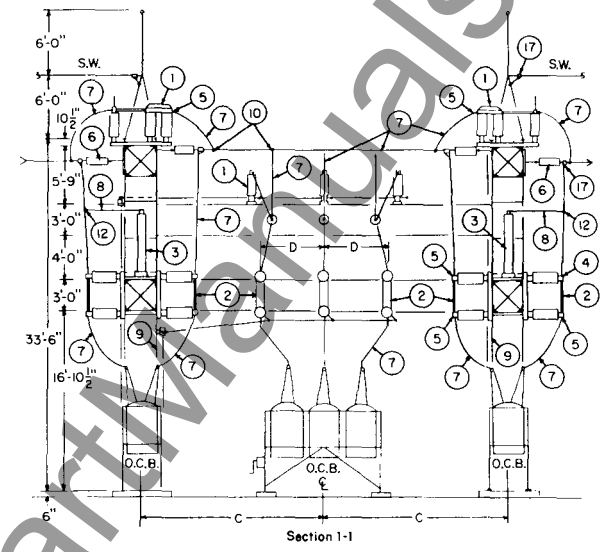
Standard Outdoor Substation Structures

Single Square Bay Switching Structure with Two (2) Oil Current Breakers, Disconnect and By-pass Switches, 69, 46 and 34.5 Kv.



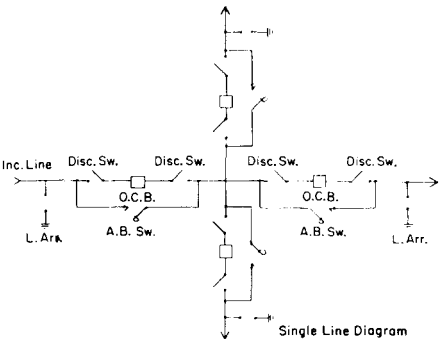
Plan View



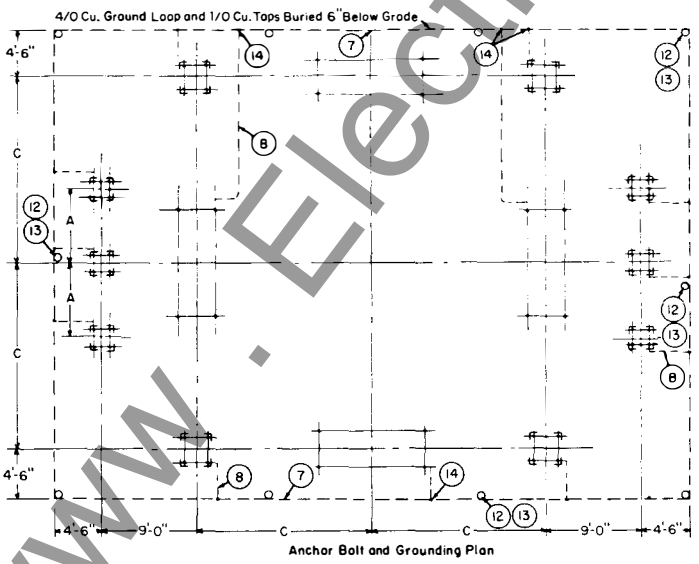
Section 1-1

Tabulation

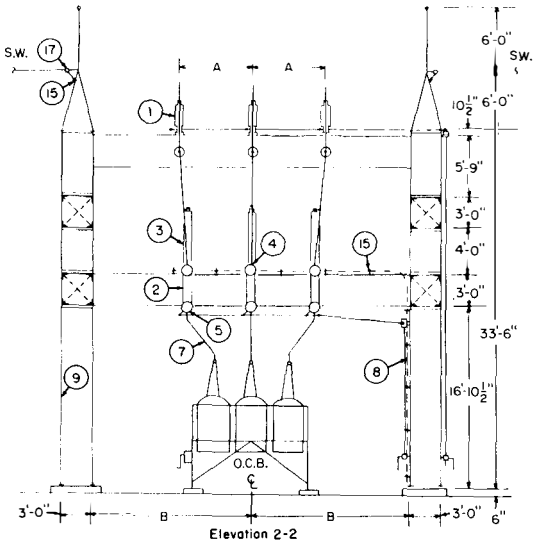
	69 Kv	46 Kv	34.5 Kv
A	7'-0"	6'-0"	5'-0"
B	15'-0"	13'-6"	13'-6"
C	16'-6"	15'-0"	15'-0"
D	6'-0"	5'-0"	4'-0"
E	9'-6"	9'-0"	10'-0"
F	5'-0"	4'-0"	3'-0"



Single Line Diagram



Anchor Bolt and Grounding Plan



Elevation 2-2

Drawing PSE-123

Westinghouse Electric Corporation

Switchgear Division: Power Switching Equipment, East Pittsburgh, Pa.

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Standard Outdoor Substation Structures

List of Material for 69, 46, or 34.5 Kv Single Square Bay Switching Structure with Two (2) Oil Circuit Breakers, Disconnect and By-pass Switches per Drawing PSE-123①

A. **69 Kv only:**

Item	Req'd	Description
1.	4	Air break switch, type V-3, 69 Kv, 600 amperes, 3 pole, single throw, horizontal mounted, complete with cap and pin insulators, arc horns, and TP operating mechanism
2.	8	Side break switch, type RL-2, 69 Kv, 600 amperes, 3 pole, single throw, vertical mounted, complete with cap and pin insulators and TP operating mechanism
3.	12	Lightning arresters, type IVS
4.	12	Terminal lug for #4 to 4/0 ACSR cable (4B pad)
5.	60	Terminal lug for 4/0 copper wire to 250 MCM copper cable (4B pad).
6.	120	Strain insulator, 10" diameter clevis type (5/string)
7.	850	Feet of 19-.1055 (4/0) .530" diameter, bare copper cable (S#13435AL)
8.	350	Feet of 7-.1228 (1/0) .368" diameter, bare copper cable (S#13435AL)
9.	1	Set of galvanized steelwork based on: Phase wire, 2,000 lbs. line pull Static wire, 1,000 lbs. line pull
10.	18	Tee for 4/0 copper cable, run and tap
11.	12	Tee for 4/0 ACSR run to 1/0 copper cable tap
12.	10	Copperweld ground rod, ¾" diameter x 10'-0" long
13.	10	Ground rod clamps, ¾" diameter rod to 1/0 and 4/0 copper cable (2 grooves)
14.	14	Parallel clamp for 4/0 and 1/0 copper cable
15.	42	Ground clamps for #6 to 2/0 copper cable (2 grooves)
16.	12	Tee for 4/0 ACSR run to 4/0 copper cable tap
17.	32	Strain clamp for 1/0 to 266 MCM ACSR, clevis type

B. **46 Kv structure per drawing PSE-123, similar to 69 Kv except with the following item changes as indicated below:**

1.	4	Air break switch, type V-3, 46 Kv, 600 amperes, 3 pole single throw, horizontal mounted, complete with cap and pin insulators, arc horns, and TP operating mechanism
2.	8	Side break switch, type RL2, 46 Kv, 600 amperes, 3 pole single throw, vertical mounted, complete with cap and pin insulators, and TP operating mechanism
3.	12	Lightning arrester, type IVS
6.	96	Strain insulator, 10" diameter clevis type (4/string)

C. **34.5 Kv structure per drawing PSE-123, similar to 69 Kv except with the following item changes as indicated below:**

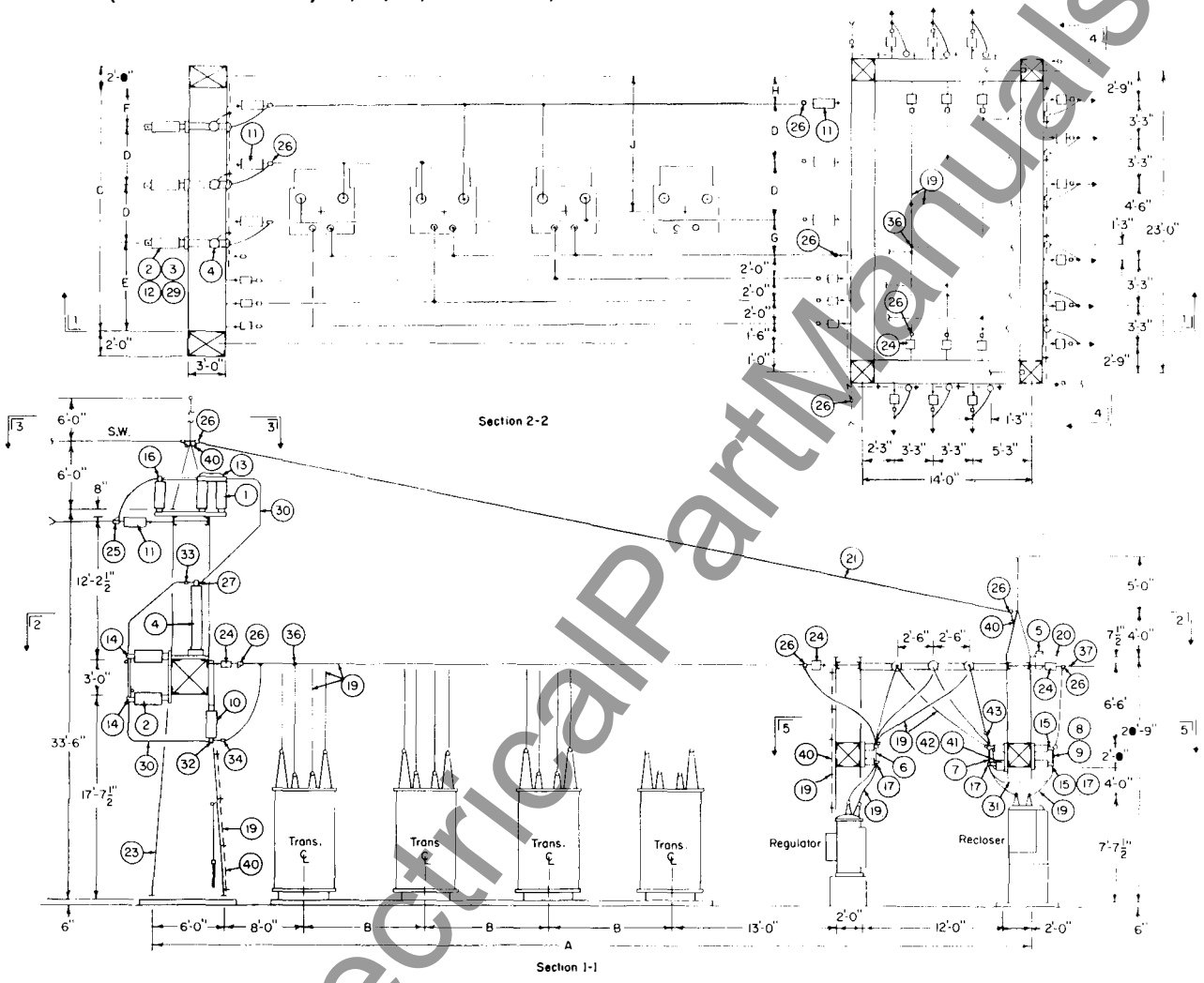
1.	4	Air breaker switch, type V-3, 34.5 Kv, 600 amperes, 3 pole, single throw, horizontal mounted, complete with cap and pin insulators, arc horns, and TP operating mechanism
2.	8	Side break switch, type RL-2, 34.5 Kv, 600 amperes, 3 pole, single throw, vertical mounted, complete with cap and pin insulators, and TP operating mechanism
3.	12	Lightning arrester, type IVS
6.	96	Strain insulator 10" diameter clevis type (4/string)

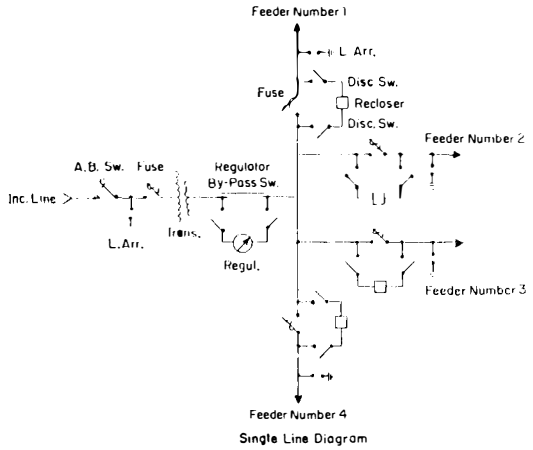
① When necessitated by shipping schedule, suitable aluminum cable, tubing, and connectors may be substituted for above grade electrical connections.

May, 1968
Supersedes AD 36-360 dated June, 1966
E, D, C/1969/DB

Standard Outdoor Substation Structures

Line Dead End and Distribution Structure with One (1) Incoming Line, Four (4) Transformer Bay and Four (4) Feeder Structure (3 Phase Reclosers) 69/15, 46/15 and 34.5/15 kv





Single Line Diagram

Drawing PSE-124(Continued on Drawing PSE-125)

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Switchgear Division: Power Switching Equipment, East Pittsburgh, Pa.
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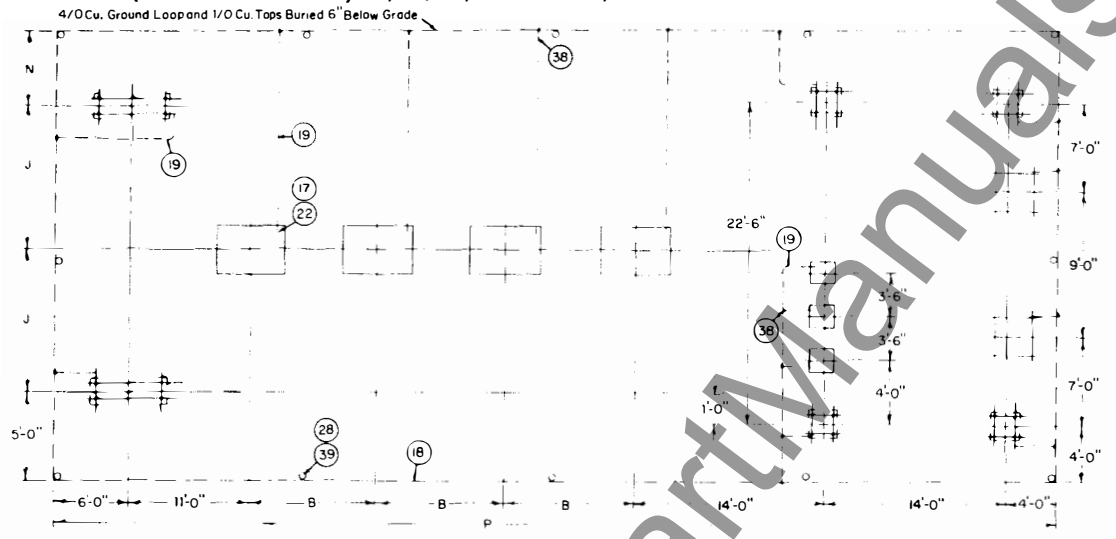
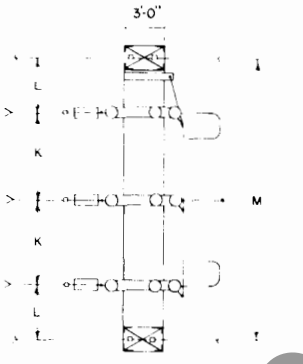
Standard Outdoor Substation Structures

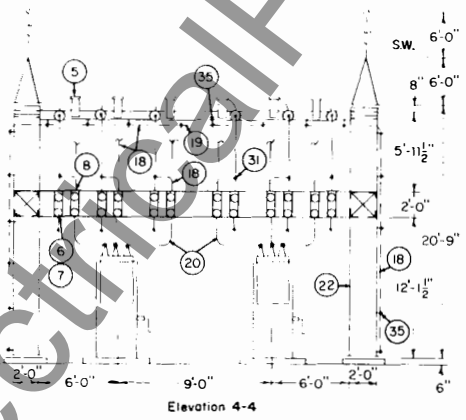
Line Dead End and Distribution Structure with One (1) Incoming Line, Four (4) Transformer Bay and Four (4) Feeder Structure (3 Phase Reclosers) 69/15, 46/15 and 34.5/15 Kv



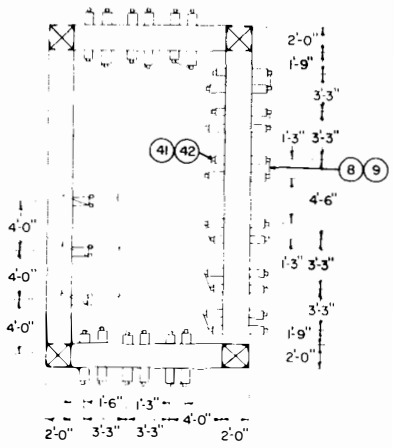
Anchor Bolt and Grounding Plan



Plan View 3-3



Elevation 4-4



Section 5-5

Tabulation

	69-15 Kv	46-15 Kv	34.5-15 Kv
A	73'-0"	67'-0"	67'-0"
B	10'-0"	8'-0"	8'-0"
C	21'-0"	18'-0"	15'-0"
D	5'-0"	4'-0"	3'-0"
E	7'-9"	7'-6"	7'-6"
F	3'-3"	2'-6"	1'-6"
G	3'-0"	2'-6"	2'-0"
H	2'-6"	2'-0"	1'-6"
J	11'-6"	10'-0"	8'-6"
K	7'-0"	6'-0"	5'-0"
L	4'-6"	4'-0"	3'-6"
M	23'-0"	20'-0"	17'-0"
N	4'-0"	5'-6"	8'-6"
P	79'-0"	73'-0"	73'-0"

Drawing PSE-125 (Continued from Drawing PSE-124)

May, 1968
Supersedes AD 36-360 dated June, 1966
E, D, C/1969/DB

Standard Outdoor
Substation Structures

Westinghouse Electric Corporation
Switchgear Division: Power Switching Equipment, East Pittsburgh, Pa.
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Standard Outdoor Substation Structures

List of Material for 69/15, 46/15, or 34.5/15 Kv Substation with Line Dead End and Distribution Structure with One (1) Incoming Line, Four (4) Transformer Bay, and Four (4) Feeder Structure (3 Phase Reclosers) per Drawings PSE-124 and PSE-125①

A. 69/15 Kv only:

Item	Req'd.	Description
1.	1	Air break switch, type V-3, 69 Kv, 600 amperes, 3 pole, single throw, horizontal mounting, complete with cap and pin insulators, arc horns, and TP manual operating mechanism
2.	3	DBA-1 fuse mounting, 69 Kv, vertical mounting, with cap and pin insulators
3.	3	DBA-1 fuse unit, 69 Kv
4.	3	Lightning arrester, type IVS
5.	12	Lightning arrester, type LV
6.	3	RBO regulator by-pass switch, 15 Kv, 400 amperes, vertical mounting, with cap and pin insulators
7.	24	LDX disconnect switch, 15 Kv, 200 amperes, vertical mounting, channel base
8.	12	LDX combination disconnect switch and cutout, 15 Kv, 200 amperes, vertical mounting, channel base
9.	15	UT fuse link (for LDX)
10.	6	Apparatus insulator, 69 Kv stacking unit, 3" bolt circle, cap and pin (2/stack) (stack TR-16)
11.	45	Strain insulators, 10" diameter clevis type (5/string)
12.	1	Hookstick – 20 feet long (2-piece)
13.	3	Terminal lug for ¾" IPS copper tubing (4B pad)
14.	6	Terminal lug for ¾" IPS copper tubing (2B pad)
15.	24	Terminal lug for ½" IPS copper tubing (2B pad)
16.	3	Terminal lug for #4 wire to 250 MCM copper cable (4B pad)
17.	64	Terminal lug for #6 wire to 250 MCM copper cable (2B pad)
18.	245	Feet of 19-.1055 (4/0) .530" diameter bare copper cable #13435AL (M.H.D.)
19.	1,250	Feet of 7-.1228 (1/0) .368" diameter bare copper cable #13435AL (M.H.D.)
20.	50	Feet of 7-.0974 (#2) .292" diameter bare copper cable #7421-1 (S.D.)
21.	150	Feet of ⅜" diameter galvanized steel cable #12296-1
22.	8	½-13 x ⅞" silicon bronze hexagonal head tap bolt #4901-1
23.	1	Set of galvanized steelwork, based on: External phase wire, 1,000 lbs. line pull Internal strain bus, 1,000 lbs. line pull Static wire, 1,000 lbs. line pull
24.	48	Strain insulators – 6" diameter, clevis type (2/string)
25.	3	Strain clamp for 1/0 to 250 MCM copper or 1/0 to 266.8 MCM ACSR cable (clevis type)
26.	42	Strain clamp for #6 to 2/0 copper or ACSR cable (clevis type)
27.	3	Tee connector for ¾" IPS copper tube run – copper bar tap
28.	12	Copperweld ground rod – ¾" diameter x 10'-0" long
29.	1	Hookstick container
30.	120	Feet of ¾" IPS copper tubing, 6 pieces at 20 feet long
31.	96	Feet of ½" IPS copper tubing, 6 pieces at 16 feet long
32.	3	Bus support clamp – ¾" IPS copper tubing, pin mounting for 3" bolt circle
33.	3	Coupler for ¾" IPS copper tubing
34.	3	Reducer – ¾" IPS copper tubing to 1/0 copper cable
35.	12	Tee connector for ½" IPS copper tubing run – 1/0 copper cable tap
36.	21	Tee connector for 1/0 copper cable – run and tap
37.	12	Parallel clamp for #2 copper and #4 wire to 4/0 copper cable
38.	13	Parallel clamp for 4/0 copper and 1/0 copper cable (ground)
39.	12	Ground clamp for ¾" rod to 4/0 copper and 1/0 copper cable (2 grooves)
40.	65	Ground clamp for #6 to 2/0 copper cable (2 grooves)
41.	12	Bus support clamp for ½" IPS copper tubing – pin mounting for 3" bolt circle
42.	12	Apparatus insulator, 15 Kv, 3" bolt circle, cap and pin (TR-4)
43.	12	Tee connector for ½" IPS copper tubing run – 1/0 copper cable tap.

B. 46/15 Kv structure per drawings PSE-124 and PSE-125, similar to 69 Kv except with the following item changes as indicated below:

1.	1	Air break switch, type V-3, 46 Kv, 600 amperes, 3 pole, single throw, horizontal mounting, complete with cap and pin insulators, arc horns and TP manual operating mechanism
2.	3	Fuse mounting, type DBA-1, 46 Kv, vertical mounting with cap and pin insulators
3.	3	DBA-1 fuse unit, 46 Kv
4.	3	Lightning arrester, type IVS
10.	3	Apparatus insulator, 46 Kv, 3" bolt circle, cap and pin (TR-13)
11.	36	Strain insulators, 10" diameter, clevis type (4/string)
18.	225	Feet of 19-.1055 (4/0) .530" diameter bare copper cable #13435AL (M.H.D.)
19.	1200	Feet of 7-.1228 (1/0) .368" diameter bare copper cable #13435AL (M.H.D.)
21.	140	Feet of ⅜" diameter galvanized steel cable #12296-1

C. 34.5/15 Kv structure per drawings PSE-124 and PSE-125, similar to 69 Kv except with the following item changes as indicated below:

1.	1	Air break switch, type V-3, 34.5 Kv, 600 amperes, 3 pole, single throw, horizontal mounting, complete with cap and pin insulators, arc horns and TP manual operating mechanism
2.	3	DBA-1 fuse mounting, 34.5 Kv, vertical mounting with cap and pin insulators
3.	3	DBA-1 fuse unit, 34.5 Kv
4.	3	Lightning arrester, type IVS
10.	3	Apparatus insulator, 34.5 Kv, 3" bolt circle, cap and pin (TR-10)
11.	36	Strain insulators, 10" diameter, clevis type (4/string)
18.	225	Feet of 19-.1055 (4/0) .530" diameter bare copper cable #13435AL (M.H.D.)
19.	1200	Feet of 7-.1228 (1/0) .368" diameter bare copper cable #13435AL (M.H.D.)
21.	140	Feet of ⅜" diameter galvanized steel cable #12296-1

① When necessitated by shipping schedule, suitable aluminum cable, tubing, and connectors may be substituted for above grade electrical connections.

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Supersedes AD 36-360 dated June, 1966
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Standard Outdoor Substation Structures

Westinghouse Electric Corporation
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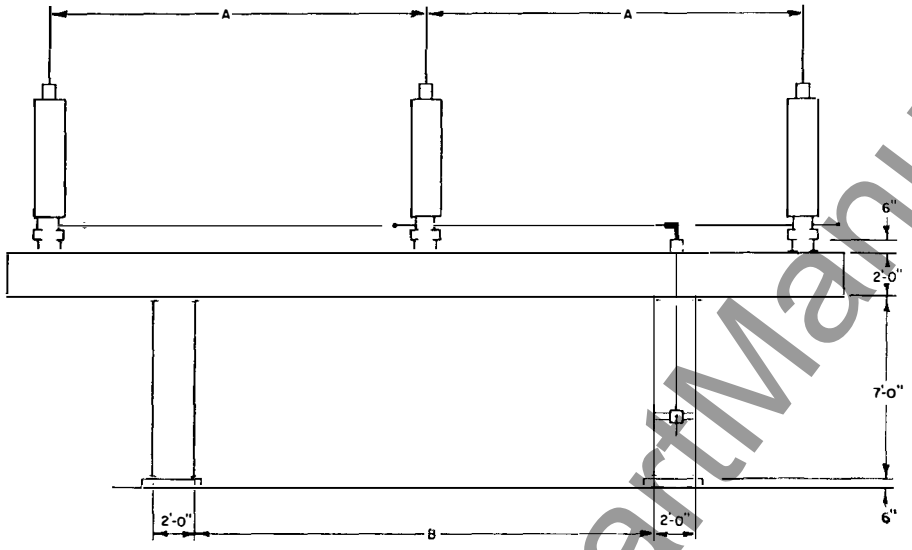
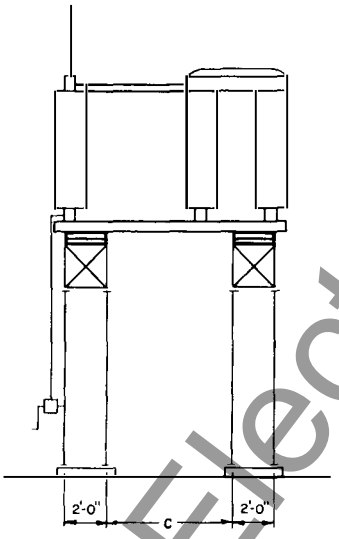
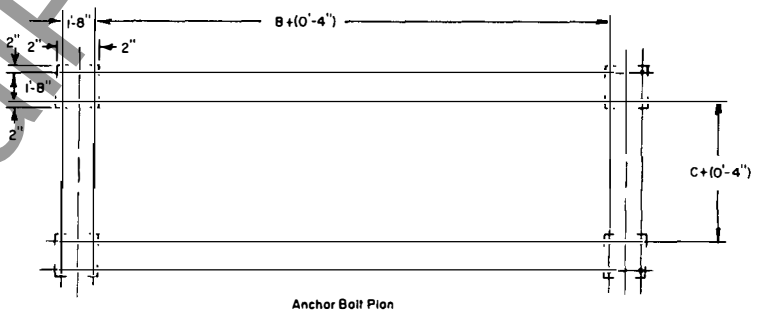
Standard Outdoor Substation Structures

High Voltage Switch Racks, Various Kv







Anchor Bolt Plan

Air Break Spacing

Kv	A	B	C	BIL-Kv
196	16'-0"	20'-0"	6'-0"	900
230	18'-0"	22'-0"	8'-0"	1050
345	20'-0"	26'-0"	10'-0"	1300

Disconnect Spacing

Kv	A	B	C	BIL-Kv
196	11'-0"	12'-0"	6'-0"	900
230	13'-0"	14'-0"	8'-0"	1050
345	14'-6"	16'-0"	10'-0"	1300

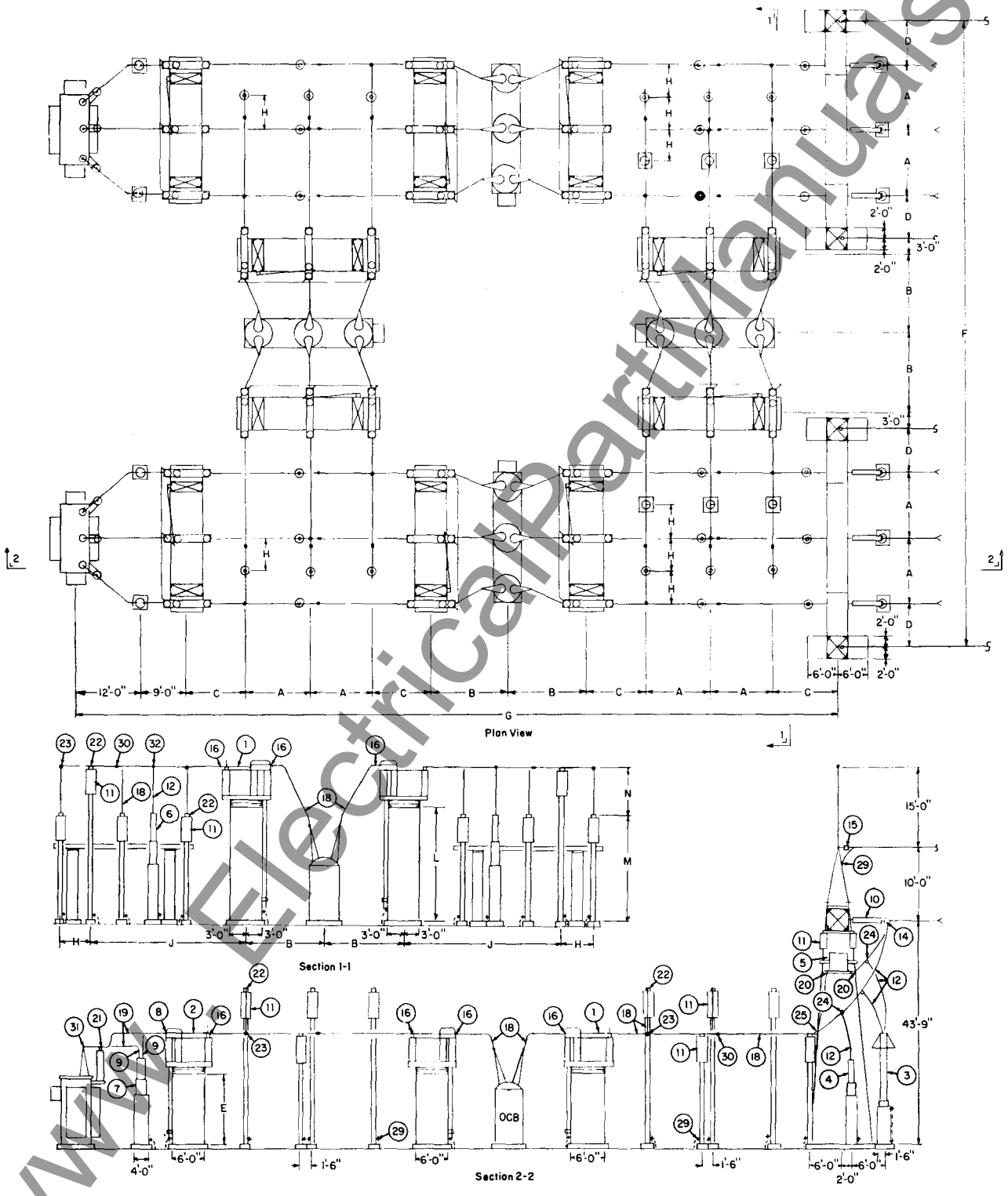
Height can vary in steps of 2'-0"

Drawing PSE-126

May, 1968
Supersedes AD 36-360 dated June, 1966
E, D, C/1969/DB

Standard Outdoor Substation Structures

Low Profile Substation Structure with Four (4) Oil Circuit Breakers and Two (2) Power Transformers, 161, 138 and 115 Kv



Drawing PSE-127 (Continued on Drawing PSE-128)

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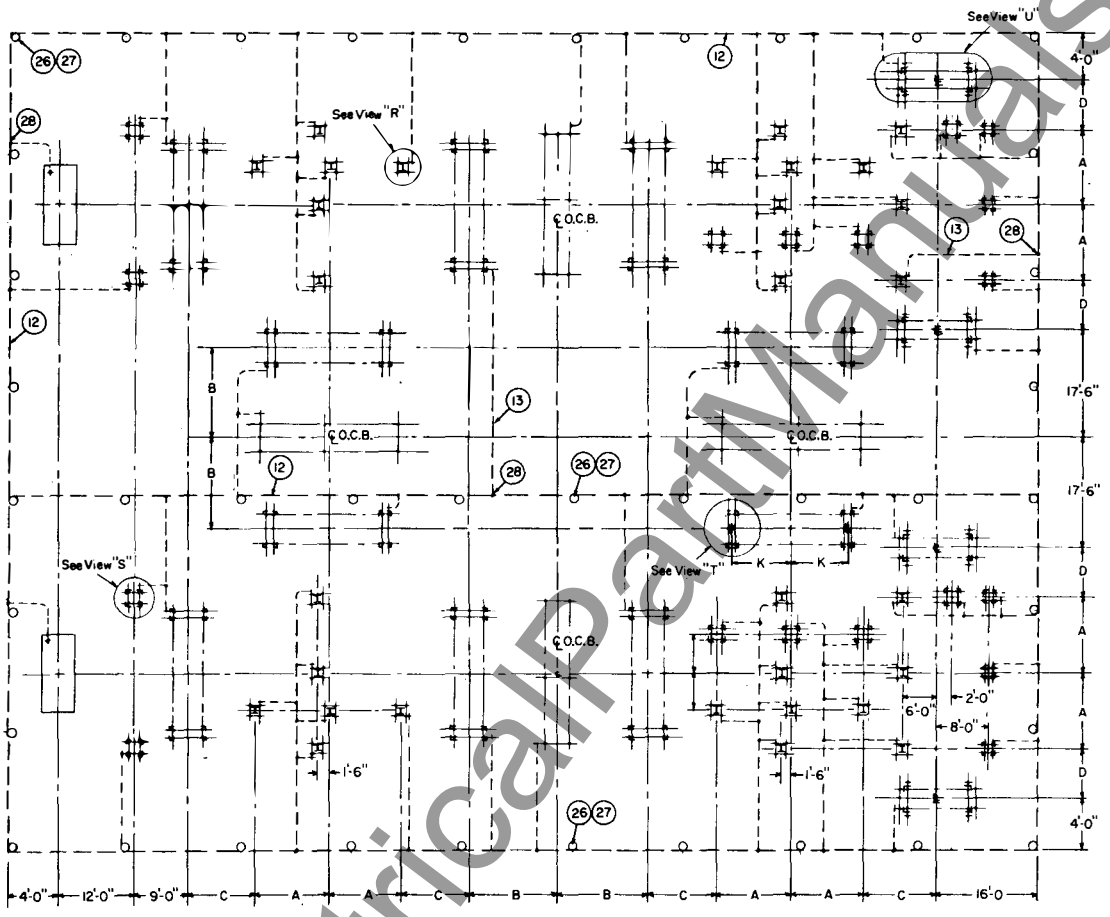
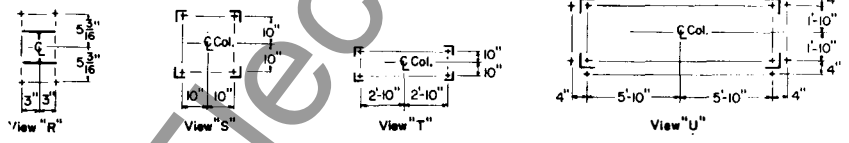
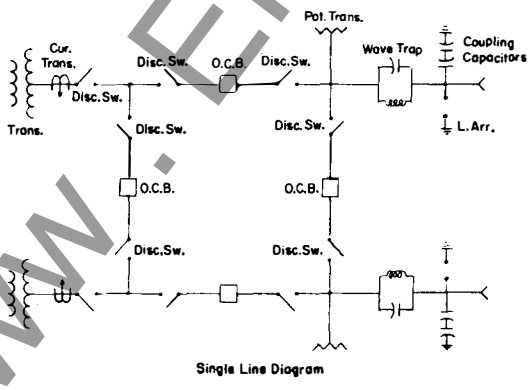
Standard Outdoor Substation Structures

Low Profile Substation Structure with Four (4) Oil Circuit Breakers and Two (2) Power Transformers, 161, 138 and 115 Kv



Anchor Bolt and Grounding Plan





Single Line Diagram

Tabulation

	161 Kv	138 Kv	115 Kv
A	14'-0"	12'-0"	10'-0"
B	14'-6"	14'-6"	14'-6"
C	11'-0"	11'-0"	11'-0"
D	8'-0"	7'-0"	6'-0"
E	8'-9"	6'-9"	6'-9"
F	123'-0"	111'-0"	99'-0"
G	150'-0"	142'-0"	134'-0"
H	7'-0"	6'-0"	5'-0"
J	32'-0"	29'-0"	24'-0"
K	11'-0"	9'-0"	7'-0"
L	16'-9"	14'-9"	14'-9"
M±	15'-11"	13'-3"	12'-9"
N	10'-0"	8'-0"	8'-0"

Note: "E" and "L" Dimensions in steps of 2'-0". Dimensions shown are minimum.

Drawing PSE-128 (Continued from Drawing PSE-127)

May, 1968
Supersedes AD 36-360 dated June, 1966
E, D, C/1969/DB

Standard Outdoor Substation Structures

Westinghouse Electric Corporation
Switchgear Division: Power Switching Equipment, East Pittsburgh, Pa.
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Standard Outdoor Substation Structures

List of Material for 161, 138, and 115 Kv Low Profile Substation Structure with Four (4) Oil Circuit Breakers and Two (2) Power Transformers per Drawings PSE-127 and PSE-128①

A. 161 Kv only:

Item	Req'd	Description
1.	8	Air break switch, type V-2, 161 Kv, 2,000 amperes, 3 pole single throw, horizontal mounted, complete with cap and pin insulators and TP manual operating mechanism
2.	2	Air break switch, type V-2, 161 Kv, 1,200 amperes, 3 pole single throw, horizontal mounted, complete with cap and pin insulators and TP manual operating mechanism
3.	6	Lightning arresters, type SV
4.	2	Coupling capacitor, type PCA-5
5.	2	Line trap, type MS
6.	6	Potential transformer, type APT
7.	4	Current transformer, type ACT
8.	6	Terminal for 1½" IPS copper tubing (4B pad)
9.	8	Terminal for 1½" IPS copper tubing (2B pad)
10.	72	Strain insulator, 10" diameter, clevis type (12/string)
11.	136	Apparatus insulators, 161 Kv, stacking unit cap and pin, 5" bolt circle (TR-140) (4/stack)
12.	820	Feet of 19-.1055 (4/0) .522" dia. bare copper cable
13.	1200	Feet of 7-.1228 (1/0) .368" dia. bare copper cable
14.	6	Strain clamp for 1/0 – 266 MCM ACSR cable, clevis type
15.	4	Strain clamp for #6 stranded cable to 2/0 ACSR cable, clevis type
16.	42	Terminal for 3½" IPS copper tubing (4B pad)
17.	4	Terminal for #4 solid to 250 MCM cable
18.	1200	Feet of 3½" IPS copper tubing
19.	160	Feet of 1½" IPS copper tubing
20.	4	Terminal for 795 MCM ACSR cable (4B pad)
21.	6	Tee connector for 1½" IPS copper tubing run to flat
22.	30	Bus support clamp for 3½" IPS copper tubing for 5" bolt circle
23.	24	Tee connector for 3½" IPS copper tubing, run and tap
24.	8	Tee connector for .795 MCM ACSR cable run to 4/0 copper cable tap
25.	6	Reducer for 3½" IPS copper tubing to .795 MCM ACSR cable
26.	32	Copperweld ground rod, ¾" x 10'-0" long
27.	32	Ground rod clamp for ¾" diameter rod to 4/0 copper cable
28.	58	Parallel clamp for 4/0 copper cable to 1/0 copper cable
29.	80	Ground clamp for 1/0 copper cable to flat
30.	24	Coupler for 3½" IPS copper tubing
31.	6	Stud connector for 1½" IPS copper tubing
32.	6	Tee for 3½" IPS copper tubing run to 4/0 copper cable tap

B. 138 Kv structure per drawings PSE-127 and PSE-128, similar to 161 Kv except with the following item changes as indicated below:

1.	8	Air break switch, type V-2, 138 Kv, 2,000 amperes, 3 pole single throw, horizontal mounted, complete with cap and pin insulators, and TP operating mechanism
2.	2	Air break switch, type V-2, 138 Kv, 1,200 amperes, 3 pole single throw, horizontal mounted, complete with cap and pin insulators, and TP operating mechanism
3.	6	Lightning arrester, type SV
10.	60	Strain insulators, 10" dia., clevis type (10/string)
11.	68	Apparatus insulators, 138 Kv, stacking unit cap and pin, 5" bolt circle (2/stack) (TR-140)
11a.	34	Apparatus insulators, 138 Kv, stacking unit, cap and pin, 5" bolt circle (TR-53) (1/stack)
12.	780	Feet of 19-.1055 (4/0), .522" dia. bare copper cable
18.	1152	Feet of 3½" IPS copper tubing

C. 115 Kv structure per drawings PSE-127 and PSE-128, similar to 161 Kv except with the following item changes as indicated below:

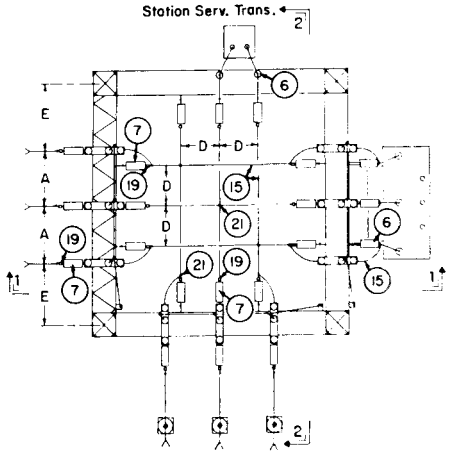
1.	8	Air break switch, type V-2, 115 Kv, 2,000 amperes, 3 pole single throw, horizontal mounted, complete with cap and pin insulators, and TP operating mechanism
2.	2	Air break switch, type V-2, 115 Kv, 1,200 amperes, 3 pole single throw, horizontal mounted, complete with cap and pin insulators, and TP operating mechanism
3.	6	Lightning arrester, type SV
10.	48	Strain insulators, 10" dia., clevis type (8/string)
11.	102	Apparatus insulators, 115 Kv, stacking unit cap and pin, 5" bolt circle, (3/stack) (TR-140)
12.	740	Feet of 19-.1055 (4.0), .522" dia., bare copper cable
18.	1104	Feet of 3½" IPS copper tubing

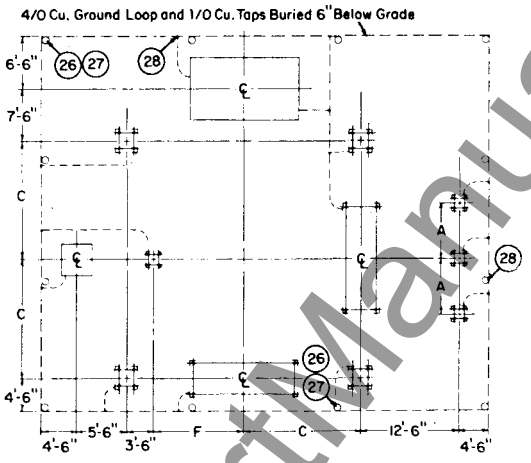
① When necessitated by shipping schedule, suitable aluminum cable, tubing, and connectors may be substituted for above grade electrical connections.

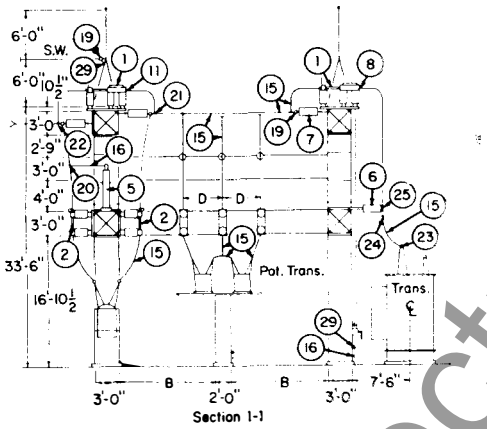
May, 1968
Supersedes AD 36-360 dated June, 1966
E, D, C/1969/DB

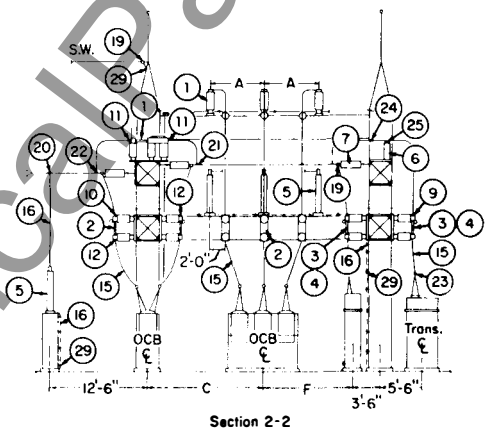
Standard Outdoor Substation Structures

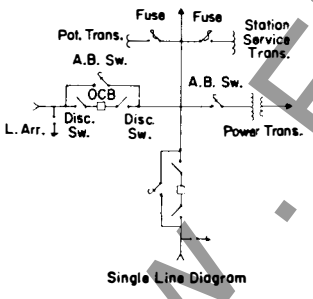
Single Square Bay Substation Structure with Two (2) Oil Circuit Breakers and Station Service Transformer, 69, 46 and 34.5 Kv











Tabulation

	69 Kv	46 Kv	34.5 Kv
A	7'-0"	6'-0"	5'-0"
B	12'-6"	11'-0"	9'-6"
C	15'-0"	13'-6"	12'-0"
D	5'-0"	4'-0"	3'-0"
E	8'-0"	7'-6"	7'-0"
F	11'-6"	10'-0"	8'-6"

Drawing PSE-129

Westinghouse Electric Corporation
Switchgear Division: Power Switching Equipment, East Pittsburgh, Pa.
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Standard Outdoor Substation Structures

List of Material for 69, 46 and 34.5 Kv with Single Square Bay Substation Structure with Two (2) Oil Circuit Breakers and Station Service Transformer per Drawing PSE-129①

A. 69 Kv only:

Item	Req'd	Description
1.	3	Airbreak switch, type V-3, 69 Kv, 600 amperes, 3 pole, single throw, horizontal mounted, complete with cap and pin insulators, arc horns and TP operating mechanism
2.	12	LCO disconnect switch, 69 Kv, 600 amperes, vertical mounting with cap and pin insulators
3.	5	DBA-1 fuse mounting, 69 Kv, vertical mounting with cap and pin insulators
4	5	DBA-1 fuse units, 69 Kv
5.	6	Lightning arrester, type IVS
6.	10	Apparatus insulators, 69 Kv, 3'' bolt circle, cap and pin (2/stack) (stack TR-16)
7.	90	Strain insulators, 10'' diameter, clevis type (5/string)
8.	3	Terminal lug for ¾'' IPS copper tubing (4B pad)
9.	2	Terminal lug for ¾'' IPS copper tubing (2B pad)
10.	6	Terminal lug for #4 to 4/0 aluminum or ACSR cable (2B pad)
11.	15	Terminal lug, for 1/0 copper cable to 500 MCM copper cable (4B pad)
12.	26	Terminal lug, for 1/0 copper cable to 500 MCM copper cable (2B pad)
13.	3	Terminal lug, for #4 solid copper wire to .250 MCM copper cable (2B pad)
14.	6	½-13 x ⅞'' silicon bronze hexagonal head tap bolt, #4901-1
15.	640	Feet of 19-.1055 (4/0) .530'' diameter, bare copper cable, #13435AL (M.H.D.)
16.	90	Feet of 7-.1228 (1/0) .368'' diameter, bare copper cable, #13435AL (M.H.D.)
17.	1	Set of galvanized steelwork based on: External phase wire, 2,000 lbs. line pull Internal strain bus, 1,000 lbs. line pull Static wire, 1,000 lbs. line pull
18.	92	Feet of ¾'' IPS copper tubing
19.	22	Strain clamp for 1/0 copper cable to 266 MCM ACSR (clevis type)
20.	6	Tee for 4/0 ACSR run to 1/0 copper cable tap
21.	18	Tee for 4/0 copper cable run and tap
22.	6	Tee for 4/0 ACSR run to 4/0 copper cable tap
23.	5	Stud connector for 4/0 copper cable to 1⅛-12 stud
24.	5	Reducer for ¾'' IPS copper tubing to 4/0 copper cable
25.	5	Bus support clamp for ¾'' IPS copper tubing (3'' bolt circle)
26.	12	Copperweld ground rods, ¾'' diameter x 10'-0'' long
27.	12	Ground rod clamp for ¾'' rod to 4/0 copper and 1/0 copper cable (2 grooves)
28.	12	Parallel clamp, for 4/0 and 1/0 copper cable (ground)
29.	22	Ground clamps, for #6 copper to 2/0 copper cable to flat (2 grooves)

B. 46 Kv structure per drawing PSE-129, similar to 69 Kv except with the following item changes as indicated below:

1.	3	Airbreak switch, type V-3, 46 Kv, 600 amperes, 3 pole, single throw, horizontal mounted, complete with cap and pin insulators, arc horns, and TP operating mechanism
2.	12	LCO disconnect switch, 46 Kv, 600 amperes, vertical mounted with cap and pin insulators
3.	5	DBA-1 fuse mounting, 46 Kv, vertical mounted with cap and pin insulators
4.	5	DBA-1 fuse units, 46 Kv
6.	5	Apparatus insulators, 46 Kv, 3'' bolt circle, cap and pin (TR-13)
7.	72	Strain insulators, 10'' diameter, clevis type (4/string)
15.	610	Feet of 19-.1055 (4/0) .530'' diameter, bare copper cable, #13435AL (M.H.D.)
16.	80	Feet of 7-.1228 (1/0) .368'' diameter, bare copper cable, #13435AL (M.H.D.)

C. 34.5 Kv structure per drawing PSE-129, similar to 69 Kv except with the following item changes as indicated below:

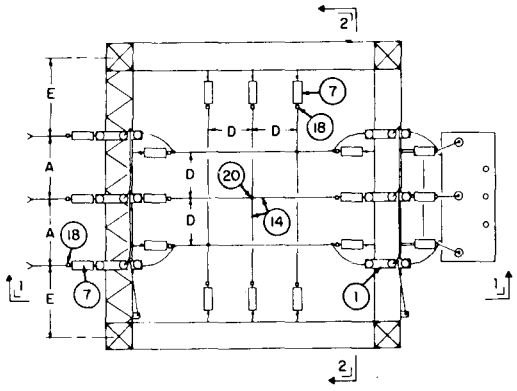
1.	3	Airbreak switch, type V-3, 34.5 Kv, 600 amperes, 3 pole, single throw, horizontal mounted, complete with cap and pin insulators, arc horns and TP operating mechanism
2.	12	LCO disconnect switch, 34.5 Kv, 600 amperes, vertical mounted with cap and pin insulators
3.	5	DBA-1 fuse mounting, 34.5 Kv, vertical mounted with cap and pin insulators
4.	5	DBA-1 fuse units, 34.5 Kv
6.	5	Apparatus insulators, 34.5 Kv, 3'' bolt circle, cap and pin (TR-10)
7.	72	Strain insulators, 10'' diameter, clevis type (4/string)
15.	610	Feet of 19-.1055 (4/0) .530'' diameter, bare copper cable, #13435AL (M.H.D.)
16.	80	Feet of 7-.1228 (1/0) .368'' diameter, bare copper cable, #13435AL (M.H.D.)

① When necessitated by shipping schedule, suitable aluminum cable, tubing, and connectors may be substituted for above grade electrical connections.

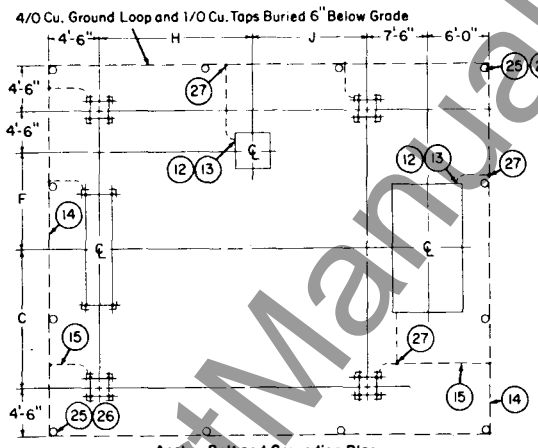
May, 1968
Supersedes AD 36-360 dated June, 1966
E, D, C/1969/DB

Standard Outdoor Substation Structures

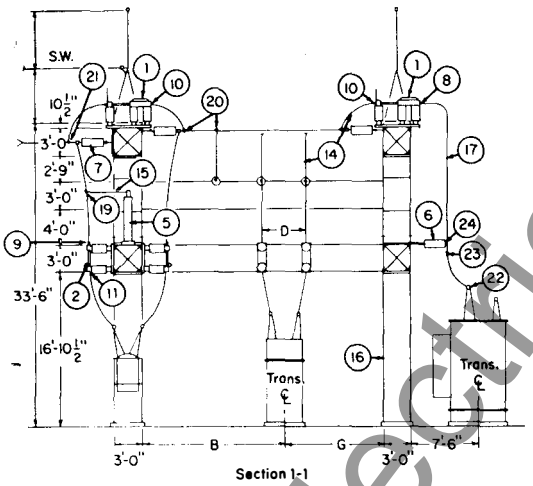
Single Square Bay Substation Structure with Single (1) Oil Circuit Breaker and Station Service Transformer, 69, 46 and 34.5 Kv



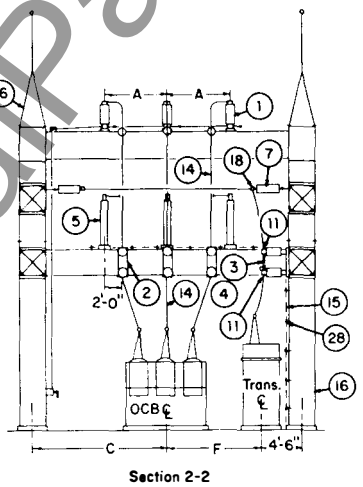
Plan View



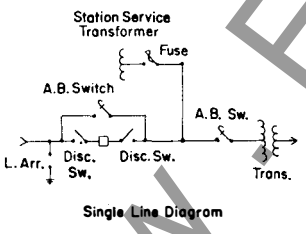
Anchor Bolt and Grounding Plan



Section 1-1



Section 2-2



Single Line Diagram

Tabulation

	69 Kv	46 Kv	34.5 Kv
A	7'-0"	6'-0"	5'-0"
B	16'-0"	14'-0"	12'-0"
C	15'-0"	13'-6"	12'-0"
D	5'-0"	4'-0"	3'-0"
E	8'-0"	7'-6"	7'-0"
F	10'-6"	9'-0"	7'-6"
G	11'-0"	10'-0"	9'-0"
H	17'-6"	15'-6"	13'-6"
J	12'-6"	11'-6"	10'-6"

Drawing PSE-130

Westinghouse Electric Corporation
Switchgear Division: Power Switching Equipment, East Pittsburgh, Pa.
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Standard Outdoor Substation Structures

List of Material for 69, 46 and 34.5 Kv Substation Structure with Single Square Bay Substation Structure with Single Oil Circuit Breaker and Station Service Transformer per Drawing PSE-130①

A. 69 Kv only:

Item	Req'd	Description
1.	2	Airbreak switch, type V-3, 69 Kv, 600 amperes, 3 pole, single throw, horizontal mounted, complete with cap and pin insulators, and arc horns and TP operating mechanism
2.	6	LCO disconnect switch, 69 Kv, 600 amperes, vertical mounted with cap and pin insulators
3.	2	DBA-1 fuse mounting, 69 Kv, vertical mounted with cap and pin insulators
4.	2	DBA-1 fuse units, 69 Kv
5.	3	Lightning arrester, type IVS
6.	6	Apparatus insulators, 69 Kv, 3'' bolt circle, cap and pin (2/stack) (stack TR-16)
7.	75	Strain insulators, 10'' diameter, clevis type (5/string)
8.	3	Terminal lug for ¾'' IPS copper tubing (4B pad)
9.	3	Terminal lug for #4 to 4/0 aluminum or ACSR cable (2B pad)
10.	9	Terminal lug for 1/0 copper cable to 500 MCM copper cable (4B pad)
11.	13	Terminal lug for 1/0 copper cable to 500 MCM copper cable (2B pad)
12.	3	Terminal lug for #4 solid copper wire to 250 MCM copper cable (2B pad)
13.	6	½-13 x ⅞'' silicon bronze hexagonal head tap bolt #4901-1
14.	430	Feet of 19-.1055 (4/0) .530 diameter, bare copper cable, #13435AL (M.H.D.)
15.	90	Feet of 7-.1228 (1/0) .368 diameter, bare copper cable, #13435AL (M.H.D.)
16.		Set of galvanized steelwork based on: External phase wire, 2,000 lbs. line pull Internal strain bus, 1,000 lbs. line pull Static wire, 1,000 lbs. line pull
17.	60	Feet of ¾'' IPS copper tubing
18.	15	Strain clamps for 1/0 copper cable to 266 MCM ACSR cable (clevis type)
19.	3	Tee for 4/0 ACSR cable run to 1/0 copper cable tap
20.	12	Tee for 4/0 copper cable run and tap
21.	3	Tee for 4/0 ACSR cable run to 4/0 copper cable tap
22.	5	Stud connector for 4/0 copper cable to 1⅛-12 stud
23.	3	Reducer for ¾'' IPS copper tubing to 4/0 copper cable
24.	3	Bus support clamp for ¾'' IPS copper tubing (3'' bolt circle)
25.	12	Copperweld ground rods, ¾'' diameter x 10'-0'' long
26.	12	Ground rod clamp, for ¾'' rod to 4/0 copper and 1/0 copper cable (2 grooves)
27.	8	Parallel clamps, for 4/0 and 1/0 copper cable (ground)
28.	12	Ground clamps, for #6 copper to 2/0 copper cable to flat (2 grooves)

B. 46 Kv structure per drawing PSE-130, similar to 69 Kv except with the following item changes as indicated below:

1.	2	Airbreak switch, type V-3, 46 Kv, 600 amperes, 3 pole, single throw, horizontal mounted, complete with cap and pin insulators, arc horns, and TP operating mechanism
2.	6	LCO disconnect switch, 46 Kv, 600 amperes, vertical mounted, with cap and pin insulators
3.	2	DBA-1 fuse mounting, 46 Kv, vertical mounted with cap and pin insulators
4.	2	DBA-1 fuse units, 46 Kv
6.	3	Apparatus insulator, 46 Kv, 3'' bolt circle, cap and pin (TR-13)
7.	60	Strain insulators, 10'' diameter, clevis type (4/string)
14.	425	Feet of 19-.1055 (4/0) .530'' diameter, bare copper cable, #13435AL (M.H.D.)
15.	85	Feet of 7-.1228 (1/0) .368'' diameter, bare copper cable, #13435AL (M.H.D.)

C. 34.5 Kv structure per drawing PSE-130, similar to 69 Kv except with the following item changes as indicated below:

1.	2	Airbreak switch, type V-3, 34.5 Kv, 600 amperes, 3 pole, single throw, horizontal mounted, complete with cap and pin insulators, arc horns, and TP operating mechanism
2.	6	LCO disconnect switch, 34.5 Kv, 600 amperes, vertical mounted, with cap and pin insulators
3.	2	DBA-1 fuse mounting, 34.5 Kv, vertical mounted with cap and pin insulators
4.	2	DBA-1 fuse units, 34.5 Kv
6.	3	Apparatus insulator, 34.5 Kv, 3'' bolt circle, cap and pin (TR-10)
7.	60	Strain insulators, 10'' diameter, clevis type (4/string)
14.	420	Feet of 19-.1055 (4/0) .530'' diameter, bare copper cable, #13435AL (M.H.D.)
15.	80	Feet of 7-.1228 (1/0) .368'' diameter, bare copper cable, #13435AL (M.H.D.)

① When necessitated by shipping schedule, suitable aluminum cable, tubing, and connectors may be substituted for above grade electrical connections.

May, 1968
Supersedes AD 36-360 dated June, 1966
E, D, C/1969/DB

Standard Outdoor Substation Structures

Design Data

Kv	Conductors			Switches Centerline to Centerline				Apparatus Ins. Per Stack	Strain Insulator Per String		BIL Kv
				Vertical Break		Side Break					
	Phase to Phase ①	Phase to Grd. ②	Isolation by Elev. ③	Horiz. Mtg. Air Break ④	Vert. and Horiz. Mtg. Disc.	Horiz. Mtg. Air Break ④	Vert. or Horiz. Mtg. Disc.		No.	Dia.	
7.5	1'-6"	7½"	8'-0"	3'-0"	1'-6"	3'-0"	2'-6"	1	1	6"	95
15	2'-0"	10"	9'-0"	3'-0"	2'-0"	3'-0"	2'-6"	1	2	6"	110
23	2'-6"	12"	9'-3"	4'-0"	2'-6"	4'-0"	3'-0"	1	3	10"	150
34.5	3'-0"	15"	10'-0"	5'-0"	3'-0"	5'-0"	4'-0"	1	4	10"	200
46	4'-0"	1'-6"	10'-0"	6'-0"	4'-0"	6'-0"	5'-0"	1	4	10"	250
69	5'-0"	2'-5"	10'-5"	7'-0"	5'-0"	7'-0"	6'-0"	2	5	10"	350
115	7'-0"	3'-7½"	11'-7"	10'-0"	7'-0"	10'-0"	9'-0"	3	8	10"	550
138	8'-0"	4'-1"	12'-2"	12'-0"	8'-0"	12'-0"	11'-0"	3	10	10"	650
161	9'-0"	4'-10"	14'-0"	14'-0"	9'-0"	14'-0"	13'-0"	4	12	10"	750
196	11'-0"	6'-0½"	15'-0"	16'-0"	11'-0" ⑤	16'-0"	16'-0"	5	14	10"	900
230	12'-0"	7'-3"	16'-0"	18'-0"	13'-0" ⑤	18'-0"	18'-0"	6	16	10"	1050
345	14'-6"	8'-5½"	18'-0"	20'-0"	14'-6" ⑤	20'-0"		7	19	10"	1300

① Centerline to Centerline
② Height of an Insulator Stack
③ National Electrical Code, Table 710-37 for 7.5 to 138 Kv and NEMA SG6 1960 Part 8 Page 5 from 161 to 345 Kv
④ NEMA Standard SG6-1963 Part 3 Page 10
⑤ Horizontal only

Recommended Truss Lengths Per Westinghouse Standards

Voltage Kv	Length		Channel Truss		Depth of Box Truss	
	Air Break	Dis-connect	Air Break	Dis-connect	Air Break	Dis-connect
15	10'-0"	10'-0"	6"-8.2	6"-8.2	2'-0"	2'-0"
23	12'-0"	10'-0"	6"-8.2	6"-8.2	2'-0"	2'-0"
34.5	15'-0"	12'-0"	8"-11.5	6"-8.2	2'-0"	2'-0"
46	18'-0"	12'-0"	8"-11.5	6"-8.2	2'-0"	2'-0"
69	21'-0"	15'-0"	8"-11.5	8"-11.5	2'-0"	2'-0"
115	30'-0"	21'-0"	No Channel Truss	No Channel Truss	3'-0"	3'-0"
138	36'-0"	24'-0"	No Channel Truss	No Channel Truss	4'-0"	3'-0"
161	42'-0"	30'-0"	No Channel Truss	No Channel Truss	4'-0"	3'-0"
196	48'-0"	36'-0"	No Channel Truss	No Channel Truss	4'-0"	4'-0"
230	54'-0"	42'-0"	No Channel Truss	No Channel Truss	6'-0"	4'-0"

Westinghouse Electric Corporation
Switchgear Division: Power Switching Equipment, East Pittsburgh, Pa.
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Standard Outdoor Substation Structures

Design Data *Continued*

Cable

Size AA	Dia. Inches	Amps 30°C Rise	Breaking Strength
Copper Cable			
1/0	0.368	245	4750
2/0	0.414	283	5927
3/0	0.464	332	7366
4/0	0.522	385	9154
250 MCM	0.600	430	11130
300 MCM	0.657	480	13170
350 MCM	0.710	524	15140
500 MCM	0.811	663	21950
750 MCM	0.997	860	33400
1000 MCM	1.151	1025	43830
1250 MCM	1.288	1185	
1500 MCM	1.412	1360	
1750 MCM	1.526	1520	
2000 MCM	1.632	1670	
Aluminum Cable			
1/0	0.368	180	1865
2/0	0.414	220	2350
3/0	0.464	260	2845
4/0	0.522	280	3590
266.8	0.586	350	4525
336.4	0.657	400	5940
397.5	0.724	450	6880
477.5	0.793	500	8090
556.0	0.856	552	9830
636.0	0.918	605	11240
795.0	1.026	690	14330
ACSR Cable			
1/0	0.398	194	4280
2/0	0.447	220	5345
3/0	0.502	252	6675
4/0	0.563	282	8420
266.8 (26/7)	0.609	360	7100
397.5 (26/7)	0.806	462	19980
556.5 (26/7)	0.953	575	27200
636.0 (26/7)	1.019	637	31500
795.0 (26/7)	1.140	720	38400
900.0 (54/7)	1.162	770	32300
1272.0 (54/19)	1.382	965	44800
1590.0 (54/19)	1.543	1125	56000

Tubing

Copper Tubing

Size	Amperes 30°C Rise①	Span 2-Supports ②	Span 3-Supports	Section Modulus	O.D. Inches
½	550	9′	11′	.0404	0.840
¾	680	10′	13′	.0710	1.050
1	860	12′	15′	.1283	1.315
1¼	1130	14′	18′	.2420	1.660
1½	1285	16′	20′	.3347	1.900
2	1585	19′	23′	.5679	2.275
2½	2010	21′	26′	.9991	2.875
3	2560	24′	30′	1.7430	3.500
3½	3040	27′	32′	2.6000	4.000
4	3400	29′	35′	3.3610	4.500
5	4100	34′	41′	5.3050	5.560
6	4750	38′	46′	7.6900	6.625

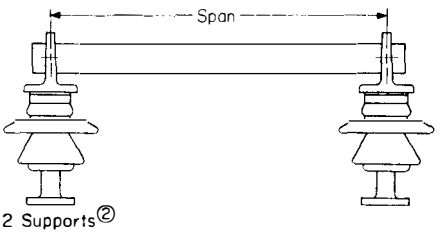
Aluminum Tubing

Size	Amperes 30°C Rise③	Span 2-Supports ②	Span 3-Supports ②	Section Modulus	O.D. Inches
½	405	11′	14′	.0407	.840
¾	495	14′	16′	.0705	1.050
1	650	16′	19′	.1328	1.315
1¼	810	18′	22′	.2346	1.660
1½	925	20′	25′	.3262	1.900
2	1150	22′	29′	.5606	2.375
2½	1550	26′	31′	1.0649	2.875
3	1890	30′	35′	1.7244	3.500
3½	2170	32′	39′	2.3938	4.000
4	2460	34′	41′	3.2141	4.500
5	3185	39′	47′	5.4510	5.560
6	4080	44′	53′	8.4960	6.625

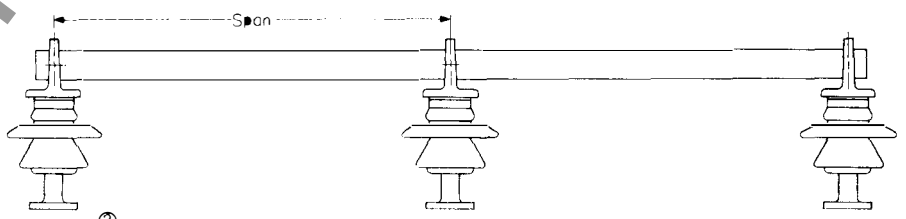
Acceptable Cable and Tubing Size for Corona

Voltage	Tubing	O.D.	Cable	O.D.
7.5 Kv	½ IPS	.840	#2	.320
15	½ IPS	.840	#2	.320
23	½ IPS	.840	#2	.320
34.5	½ IPS	.840	1/0	.368
46	½ IPS	.840	1/0	.368
69	½ IPS	.840	1/0	.368
115	½ IPS	.840	4/0	.522
132	½ IPS	.840	250 MCM	.574
161	½ IPS	.840	350 MCM	.679
196	½ IPS	.840	500 MCM	.813
230	¾ IPS	1.050	750 MCM	.998

① Conductivity – 98% IACS
② Deflection limited to 1/150 of the span for two (2) supports and 1/200 of the span for three (3) supports, assuming buses simply supported. (See drawings below).
Deflection does not include ice, wind, bus tap, or short circuit forces.
③ Conductivity – 53% IACS



2 Supports②



3 Supports②

August, 1969
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