RURAL TRANSMISSION
DEVELOPMENT
IN
CENTRAL MISSOURI

A thesis submitted to the faculties of
The School of Engineering and the Graduate School
The University of Kansas

For

THE DEGREE OF ELECTRICAL ENGINEER

By

H. R. WADE

1926
The writer recently had the opportunity of observing the addition in one year of 40 miles of rural transmission lines to the system of the Kansas City Power & Light Co. in the Missouri counties of Howard and Chariton. In fact he was more than an observer, as it fell to his lot to handle the engineering in connection with the addition.

With the hope that an account of this work may prove interesting and perhaps even valuable, this thesis is respectfully submitted.

For the purpose of this discussion a rural transmission line is considered as being a single-phase, 6900-volt circuit, linking together two or more towns or communities.

For permission to publish this account the writer wishes to thank Mr. A. E. Bettis, Vice President of the Company. He is indebted also to Mr. Harry Hill, Superintendent of the Central Missouri District, and to Mr. O. T. Lewis, Local Manager at Glasgow, who was in direct charge of operations.
TABLE OF CONTENTS

1. INTRODUCTION ................................................................. 4

II. PREPARATION FOR DEVELOPMENT ........................................ 6

III. DEVELOPMENT
   a. CIRCUIT 43-1119 ......................................................... 10
   b. CIRCUIT 43-1123 ......................................................... 10
   c. CIRCUIT 53-1124 ......................................................... 14
   d. FUTURE EXTENSION OF 43-1123 .................................... 17

IV. CONCLUSION ................................................................. 18

V. SUMMARY ................................................................. 20
LIST OF ILLUSTRATIONS

SUBSTATION DIAGRAMS .................. 21-27

CONSTRUCTION STANDARDS ............. 28-36

CIRCUIT MAPS ......................... 37-47
INTRODUCTION

Prior to April 1, 1925, the Kansas City Power & Light Co. had no rural transmission lines in Howard County, Missouri. Circuit 33-1113, page 37, extending from Glasgow to Armstrong was, and still is, owned by the City of Armstrong and receives primary energy at wholesale rates. Substation 33, page 21, located just outside the east city limits of Glasgow, steps up from the 2300-volt Glasgow distribution to 6600 volts. The primary metering equipment is on the 2300-volt side of the transformer, thus metering the losses in the transformer. Circuit 33-1113 was constructed of No. 8 bare, hard-drawn copper on wood-pin crossarms and 25-ft. cedar poles.

In order to avoid confusion in the mind of the reader, a short explanation is here offered as to the nomenclature of circuits. Taking Circuit 33-1113 for example, the first number, or 33, is the number of the substation feeding the circuit. The 11 refers to the circuit voltage, indicating that it is in the general range of 6600 to 11950 volts. The 13 is the number of the circuit itself in its particular voltage range. Two more examples will suffice. Circuit 11-3309, mentioned later, is fed from Substation 11, its voltage being 33,000 and its number 9. Circuit 24-424, also mentioned later, is fed from Substation 24, its voltage in the 2300/4000 class, and its number 24.
To return to conditions prior to April 1, 1925, the Company had two rural lines in Chariton County, Missouri. Circuit 30-1109, page 38, extends from Brunswick to Triplett and Mendon. Sub-station 30, page 22, is fed from the 2300-volt Brunswick distribution, being located just outside the north city limits of Brunswick. It will be noted that all step-up stations are located outside corporation limits for the purpose of keeping, as much as possible, the higher voltage out of the cities. The city of Triplett purchases primary energy metered on the 6600-volt side of substation 23, page 23, and distributes at 2300 volts. The Company has a 6600-volt line extending beyond this substation and feeding the milling load at Triplett.

The 6600-volt distribution system in Mendon, page 39, is a part of Circuit 30-1109. During the summer of 1925, this system was entirely rebuilt, with new poles, wire, insulators, etc. The number of transformers was increased from three to seven, with the consequent shortening of secondaries and improvement in service. The wood pins in the entire circuit were replaced with steel pins to prevent interruptions due to breakage.

The other original Chariton County line was Circuit 20-1110, page 40, extending from Dalton to Keytesville. Sub-stations 20 at Dalton and 21 at Keytesville are shown on pages
24 and 25 respectively. The distribution system at Dalton, page 41, a part of Circuit 20-1110, will be rebuilt this summer in the same manner as reconstruction was done at Mendon.

The source of supply in these two counties is Circuit 11-3309, page 42, ending at Glasgow with Substation 24, page 26. Energy is generated at Northeast Power House in Kansas City, transmitted 75 miles to Carrollton at 66,000 volts, stepped down there at Substation 11 to 33,000 volts, and then transmitted 50 miles over Circuit 11-3309 to Glasgow. Most of the developed territory discussed in these pages is fed indirectly from Sub-station 24 at Glasgow, and lies in Chariton County.

PREPARATION FOR DEVELOPMENT

Prior to the development the 2300-volt, three-phase line from Glasgow to Lewis Mill, page 43, was a part of the Glasgow distribution, Circuit 24-418, and was mounted on the 30-ft. poles of Circuit 11-3309 below the latter circuit. This arrangement allowed insufficient ground clearance, because 11-3309 consisted of two crossarms and 24-418 of one. The pole line crossing back and forth over the highway made the scant clearance doubly objectionable. It was desired to reinsulate the 2300-volt circuit for an ultimate voltage of 6900/11950. Not wishing to incur the ex-
pense of a new pole line, the Company decided to raise Circuit 11-3309 to ridge-pin construction as shown on page 28, and then to raise Circuit 24-418 to the position formerly occupied by the lower arm of Circuit 11-3309. This plan would allow the removal of one crossarm with the consequent additional ground clearance of five feet.

To interrupt service was out of the question. Hence it was necessary to do all the above outlined work with the circuits alive. Two gangs were engaged in this work. One gang, consisting of experts, went on ahead and raised Circuit 11-3309 by the use of "hot sticks". The other, using rubber gloves, followed and raised and reinsulated Circuit 24-418. The latter circuit was then separated from the Glasgow distribution and given its present number of 24-424, page 43.

Pending the time when it should be desirable to change 24-424 to a 6900/11950 volt circuit, it was decided to install a 2300 to 6900 step-up substation at Lewis Mill. At this point, which might be described as the base of operations, was constructed a pole-type Substation, No. 43, page 27.

It might be interesting to insert here a little local history of the Lewis Mill community. In the early days of Missouri River navigation a river town called Chariton flourished here and rivaled St. Louis for leadership. The
fates favored St. Louis and Chariton died out. Today there is little more than a siding, a mill, a garage and a house or two. The mill is named for its founder, the grandfather of the Company's Glasgow manager, Mr. O. T. Lewis. In digging holes for poles in this neighborhood, Mr. Lewis frequently encounters substantial brick foundations as reminders of the almost forgotten town of Chariton.

Before proceeding with an account of the construction of the various transmission lines radiating from Lewis Mill, it might be well to describe the financial basis on which the Company builds such lines. It is allowed by the rules of the Public Service Commission of Missouri to expend $50.00 for each new lighting customer to be served. In case of both lighting and cooking load it can spend $125.00 for each new customer. A single-phase 6900-volt rural line built according to the Company's construction standards costs in the neighborhood of $750.00 per mile. These figures do not include the cost of transformer stations. This cost is handled under a separate account and is not charged against customers' extensions. In other words, for voltages not exceeding 6900, the Company furnishes all transformer equipment.

From the above figures can be easily determined just how many new customers are needed to make a certain ex-
tension pay for itself. In cases where new customers are not numerous enough to warrant the building of a line, the Company can build it anyhow if the available customers care to stand the remaining expense. The necessary number of contracts must be signed or the proper amount of cash be deposited to pay for the line before construction starts. In any event all completed lines and transformer equipment must be the property of the Company, which assumes all expenses incurred by the liability and maintenance thereof.

The standards of 6900/11950 volt construction are shown on pages 29 to 35, inclusive. The dimensions of standard crossarms are shown on page 36.

The standards allow the choice of two methods of pole spacing in the extension of a new rural line. One method is the use of No. 6 A.C.S.R. (aluminum cable steel reinforced) on 25-ft. poles spaced 176 ft., or 30 spans per mile. The other is No. 4 A.C.S.R. on 30-ft. poles spaced 264 ft., or 20 spans per mile. The latter method is generally used because it is cheaper, provides more load capacity and allows better ground clearance. In cases where the later addition of a 33,000 volt circuit is probable, 35-ft. poles are used so as to allow space on top for three-phase ridge-pin construction as shown on page 28. Steel pins are always used.
CIRCUIT 43-1119

Circuit 43-1119, the first line to be extended from Lewis Mill, was to the unincorporated community of Aholt, and is detailed on page 44. This was built for the most part on the poles of Circuit 11-3309, the numbers of which are shown on the map. As the latter circuit seldom crosses the highway between Lewis Mill and Aholt, it was unnecessary to raise it to ridge-pin construction before adding the new circuit. The average spacing of these poles being 150 ft., No. 6 A. C. S. R. was used for that portion of the circuit. The conductors were mounted below the 33,000 volt circuit on 2-pin standard crossarms. For the balance of the circuit was used No. 4 A. C. S. R. with 2-pin arms and 30-ft. cedar poles spaced 26 1/4 ft. 17,000-volt No. 584 Lapp insulators on No. 1080 Peirce steel pins were used throughout. As may be noted on the map, this circuit serves not only Aholt but also farmers along the route. The type of construction for transformer stations is shown on page 34.

CIRCUIT 43-1123

Before discussing the construction of Circuit 43-1123 from Lewis Mill to Forest Green, it might be well to
Outline the purpose of this line.

In 1919, an association was formed of farmers living between Salisbury and Forest Green and in the adjacent territory. This association incorporated and then entered into a 20-year contract with the City of Salisbury for the latter to furnish the former with 6600-volt energy to be metered at the west city limits of Salisbury. The Salisbury distribution being at 1100 volts, a step-up substation belonging to the association was erected just outside the city limits. Primary metering equipment belonging to the city was installed within the city limits and on the 1100-volt side of the transformer.

The association built a 6600-volt transmission line from Salisbury to Forest Green, with various branches, and installed the necessary transformers. Distribution systems were built in the towns of Forest Green and Shannondale. The materials used in the transmission line were 25-ft. cedar poles, No. 8 bare hard-drawn copper, 6600-volt brown porcelain insulators and 2-pin crossarms with wood pins.

The association operated satisfactorily for a period of five years and then began having the troubles common to lines on which no maintenance work has been done. Lightning arresters, and consequently transformers, failed; poles leaned; insulators were cracked by lightning and small boys.
One of the most constant and annoying sources of trouble was the breaking of the wood pins, which allowed the conductors to drop to the crossarms or to swing hazardously over the road. In wet weather this condition caused the burning off of several pole tops and crossarms because the substation was over-fused. The expense of paying the City of Salisbury to maintain their line began to appall the farmers. As a way out of the difficulty, they commenced to look around for a buyer.

Being in a position to handle the farmers' load, the Kansas City Power & Light Co. purchased their property and assumed their contract with the City of Salisbury. The Company was thus placed in the position of buying primary energy from a municipal plant, with 14 years of the contract yet to run. How this point was handled will be mentioned later.

Hence the purpose of the 4-mile extension from Lewis Mill to Forest Green.

There being no highway between these communities, choice was made of the east side of the Wabash right-of-way as the best and shortest route to be followed. The materials again included No. 4 A. C. S. R., Lapp insulators with Peirce steel pins, and 26 1/2-ft. spans. This time, however, 35-ft. cedar poles were used in order to leave pole space
for a possible future 33,000-volt, three-phase circuit on ridge-pin construction. Also, 6-pin standard crossarms were used to leave pin space for two additional conductors in case it should later be desired to change Circuit 43-1123 to 6900/11950 volts, three-phase star. The latter type of construction is shown on pages 31 to 33, inclusive.

Referring to the circuit map of 43-1123 on page 45, the new extension from Lewis Mill to Forest Green is seen to be of No. 4 A. C. S. R., as mentioned above. The remainder of the circuit is the property purchased from the farmers' association and is of No. 6 bare hard-drawn copper.

Should future conditions warrant, Circuit 24-424 from Glasgow to Lewis Mill may be changed to a 6900/11950 volt, grounded system. In this case, Sub-station 43 at Lewis Mill will be eliminated and Circuits 43-1119 and 43-1123 will be consolidated with 24-424. Another possibility is that of replacing Substation 43 with a 33,000-volt step-down substation.

We are getting slightly ahead of our story. When the new extension to Forest Green was completed, the farm line was opened at a point just west of Shannondale. Then the load east and south of that point was picked up on the new extension from Lewis Mill. Before proceeding with
further extensions the Company deemed it best to rehabilitate the properties just purchased from the farmers. Consequently the lines were given a complete overhauling which consisted of straightening poles, pulling slack, rebuilding all transformer stations to the standard previously referred to, replacing with steel pins all wood pins and replacing all other defective equipment. The distribution systems in Forest Green and Shannondale were entirely rebuilt with new copper, poles, transformers, etc. By this time the service had been improved to such an extent that all other work had to be stopped in order to connect to the lines new customers who were clamoring for service.

CIRCUIT 53-1124

The next projected line to be constructed was to the inland village of Prairie Hill, Chariton County, east of which the Company has 10,000 acres of undeveloped coal rights. This village being 30 miles by road from Substation 24, at Glasgow, the distance was too great for a 6900-volt line. Salisbury lies between Prairie Hill and Glasgow, 10 miles from the former. The simplest solution to the problem was to tap the Prairie Hill line on to the line then being fed from the City of Salisbury. With that purpose in view, construction
was begun at the Prairie Hill end.

The winter of 1925-1926 had set in by this time and with it a great many attendant difficulties. The roads, all dirt, became impassable for the Company cars and trucks. In mild weather they were bottomless mud pits, and in freezing weather they were unspeakably rough. Prairie Hill being an inland town, as mentioned above, it must have some sort of connection with a railroad in order to exist. This connection is a fleet of freight trucks plying steadily between Prairie Hill and Salisbury in spite of all kinds of roads and weather. As it was impossible to postpone construction until the following summer, use was made of this truck line for distributing poles and other material along the road. The foreman hired a wagon and team to use instead of a line truck, and the gang secured board and rooms at convenient farm houses. Persons living along the route of the line and in the village were so pleased with the prospect of electric lights that they were eager to cooperate in any way possible.

Thus the work proceeded under many handicaps, one of the worst of which was setting poles in frozen ground. It will be necessary to straighten most of the poles when weather and roads clear up this summer. The materials selected for this line were No. 4 A. C. S. R., 2-pin standard crossarms with steel pins, Lapp insulators and 30-ft. cedar
poles spaced 264 ft.

With the new circuit completed from Prairie Hill to a point near the line purchased from the farmers, it was necessary to negotiate and construct a railroad crossing over the Wabash right-of-way in order to tap on to the latter circuit. The method of building this crossing is shown on page 35. The required rail clearance made it necessary to use a 50-ft. pole on the north side and 45-ft. pole on the south side of the right-of-way.

The Salisbury substation was rebuilt and numbered 53. The new line from Salisbury to Prairie Hill was numbered 53-1124. Before the new circuit was tied to the old, two sectionalizing switches were installed as shown on the circuit map on page 46. Circuit 43-1123 was disconnected from Substation 53 by means of switch No. 1, and then closed at the point just west of Shannondale. Thus the entire circuit purchased from the farmers' association is now normally being fed from Substation 43 at Lewis Mill, as shown on page 45. Switch No. 2 was then closed and Circuit 53-1124 energized from Salisbury. In this way a load is kept on the Salisbury plant by the Kansas City Power & Light Co. according to the terms of the contract. No change was made in the line immediately leaving Substation 53.

By means of the two sectionalizing switches it is possible, in case of emergency, temporarily to feed Circuits
43-1123 and 53-1124, either or both, from Substation 43 at Lewis Mill or from Substation 53 at Salisbury.

Following the completion of Circuit 53-1124, the distribution system in Prairie Hill was constructed and the customers connected to the line. The citizens declared a holiday in order fitly to celebrate what to them was so great an event as the coming to their village of electricity.

The circuit was next extended a mile or so east of town to the farmhouse on the Company's property. Farmers living along the route of the line had then become so insistent for service that the construction gang had to proceed with the installation of the transformers necessary to serve them.

FUTURE EXTENSION

It was hoped to give an account in these pages of the extension of Circuit 43-1123 east of Forest Green to Roanoke, as shown in red on page 45. This extension and the Roanoke distribution have been platted and authorized and the materials selected, but at the time of writing, work has not been started. The construction data call for No. 4 A.C.S.R., 2-pin standard crossarms with steel pins, No. 5 \( \frac{3}{4} \) Lapp insulators and 30-ft. cedar poles spaced 26\( \frac{4}{4} \) ft.
This work will likely be completed by April 1, 1926, which is one year from the time of the beginning of the development discussed herein.

In making preliminary investigations in Roanoke Mr. Lewis discovered some very unusual facts concerning the history of the village. Although not bearing directly upon the subject in hand, these facts are quite interesting. The village was incorporated during the Civil War by a special act of the State Legislature, which gave the peace officer of the village the right to make arrests anywhere in the State. There have been no village elections or taxes for 10 years. The Mayor, who has held office for 15 years, lives on a farm outside the corporate limits. It is to be hoped that the advent of electricity will not disturb the peace and serenity of this modern Utopia.

CONCLUSION

The question may have arisen in the mind of the reader as to the reasons for numbering poles and transformer stations. With regard to the latter, an accurate card record is kept of the station number, size, location, connected and tested loads, dates installed and removed, cost and complete nameplate data of every transformer belonging to the
Company. This information is valuable for a number of obvious reasons, chief among which is the use for valuation purposes. For the same reason a map record of pole numbers is also important. The chief value of these numbers, however, is in locating any kind of trouble which may be reported by line patrolmen or other parties.

Another interesting and perhaps surprising feature of rural transmission lines is the variety of appliances and equipment connected to these lines. A list of them would read like an inventory of the stock of an electrical jobber. Of course an iron is the first appliance in the mind of the housewife. Then come toaster, grill, percolator, curler, vacuum cleaner and last, but not least, the washer. In the meantime the farmer has been considering a water pump and a general utility motor for saw, grinder, silo, etc. Two of the most popular and desirable appliances, from the standpoint of both the customer and the central station, are electric ranges and electrical refrigerators. Some of the more well-to-do farms are using oil-burning furnaces equipped with motor driven blowers. The radio battery chargers, of course, have the last word.
SUMMARY

The increase in mileage of the rural transmission lines discussed in the foregoing pages, itemized by circuits, is as follows:

<table>
<thead>
<tr>
<th>Circuit</th>
<th>Built</th>
<th>Bought</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>43-1119</td>
<td>4\frac{1}{2}</td>
<td></td>
<td>4\frac{1}{2}</td>
</tr>
<tr>
<td>43-1123</td>
<td>4</td>
<td>19\frac{1}{2}</td>
<td>23\frac{1}{2}</td>
</tr>
<tr>
<td>53-1124</td>
<td>12</td>
<td></td>
<td>12</td>
</tr>
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<td></td>
<td></td>
<td></td>
<td>40</td>
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</tbody>
</table>

The extension of 43-1123 to Roanoke will raise the total mileage in one year to 45.

A "bird's-eye view" of these as well as all other lines fed by the 66,000-volt circuit from Kansas City, may be had by referring to the Key Map of Circuit 9-6601, page 47.
2300 to 6600 Volts (Step-up)

24-418 Cir. Glasgow

20 Amp Lead

1-3.75 KVA Transformer 2300/6600 V

To Armstrong and Steinmetz 33-113 Cir.

K. C. PR & LT CO
Sta. #33 Glasgow, Mo.

DWN Rebook
Date 10-18-23
APPR
APPR
No. L133-43.1
Transformer Station No. 23
Triplett, Missouri
6,600 to 2,300 Volts

30-1109

Kiddle Mills
6,600 Volts

20 AMP Lead

1-15 K.V.A. Transformer 6,600/2,300 Volts

23-408
2,300 Volt
To the City of Triplett

K.C. Power & Light Co.

Sta. #23 Triplett Mo.

Dwn: J.M.O. Cdy.
Date 5-17-23 S.C.A.
Appro.
Appro. J.B. Reeder
No. L12343-I
33000 TO 6900 VOLTS
6900 TO 220 VOLTS

10 AMP S&C.

1-75 KVA TRANSFORMER
33000/6900 VOLTS
2.5% BOOST
25 AMP S&C.

TO KEYTESVILLE
20-1110
6900 VOLTS

6900/110/220V
1-25 KVA TRANSFORMER

TO THE CITY
OF DALTON

K COPR. & LT. CO.

STA. #20 DALT.

DWN. J.M.D. CHD.
DATE 5-17-23 SCA.
APR. APPL.
APPR. W.S. RITTER
No. L120-43-1
6900 to 2300 Volts

25 Amp S&C
1 Spare at Brunswick
1-25 Kva Transformer
6900/2300 Volts
5% Boost

30 Amp AI

2300 Volts
21-409

To City of Keytesville

K. C. PR. & LT. CO.
STA#21 KEYTESVILLE, MO.
Dwn. Dean CKD
Date: 5-16-23. Scale None
APP.
APP.

No. L121-43-1
To Forest Green.
43-1773 Cir.

10 Amp S&C

25 Amp Al

43-1119 CIR
6600 Volts
to Aholt, Mo.

1 - 25 KVA TRANS.
6600-2300 Volts.
FULL WINDING

24-474 CIR
2300 Volts
to Glasgow.

TRANS. STA. No 43
-STEP-UP- LEWIS MILL MO.
GLASGOW, MISSOURI.
DWN J.S.P. E.G.E. CKD.
DATE 9-11-25 SCALE None
APPR APPR
No. L143-43-1.
Mount ridge iron in position shown on straight line work. On small angle corners that can be turned on pin insulators, turn ridge iron at right angle to the tangent to the line at that pole.

Max. angle to be turned on single pin insulator:
Cond. Tension Angle
4. recess # 25°
2' 1450 # 20°
3/4 2540 # 10°

Minimum clearance at 60°F of conductors on crossing:
Over railway tracks 30 ft.
Over crown of streets & alleys 22 ft.
Along streets and alleys 20 ft.
On fenced right-of-way 18 ft.
Over signal lines 6 ft.
Over other power lines 4 ft.
These clearances must not be increased except in special cases.

**33000 Volt Pole Top Assembly**

List of Material Per Pole

- 3 - Line Insulators
- 2 - Pins
- 1 - Ridge Iron Insulator Pin
- 1 - Ridge Iron
- 2 - 3/8 x 8" Galvanized Machine Bolts
- 1 - 3/8 x 48" x 48" Cross Arm
- 2 - 26" Cross Arm Braces
- 1 - 1" x 4" Galvanized Lag Screw
- 2 - 1/2 x 5" Galvanized Carriage Bolts
- 1 - 1/4 x 13" Galvanized Machine Bolt
- 2 - 24 x 24 x 16 Galv. Square Washer

O.K. J. B. Bass
Supt. of O.H. Construction

K.C. PR. E.LT. CO.
DRAFTING ROOM

DWN. S.E. GOODMEN CKD. 6-12-23
SCALE 1" = 10'
APP'D

No. L62-442-42
6900-11950 Volt Y Construction

Phasing of Wires

N

S

W

E

On Straight Line Construction

Top

A
B
C
N

Bottom

On Suspension Corner Construction

Top

A
B
C
N

Bottom

K.C.P.R. & L.T. CO.
6900/11950 Volt Y Const.
Phasing of Wires

Dwn Bks 10-21-24

Scale None

Appr

Appr

No. 162.442.52
6900 VOLT CONSTRUCTION

TWO WIRE CIRCUITS FOR SINGLE PHASE BRANCH LINES

Minimum clearance of conductor on crossing at 60° F

Over railway tracks 30 ft.
Over crown of streets and alleys 22 ft.
Along streets and alleys 20 ft.
On fenced right of way 18 ft.
Over signal lines 6 ft.
Over other power lines 4 ft.

These clearances must not be increased except in special cases.

SPAN LENGTH

#4 ACSR on 30 ft. pole = 265' span.
#4 ACSR on 25 ft. pole = 175' span.

NOTE: The above span lengths are for Pri. lateral only.

K.C.P.R. & L.T. CO.
DRAFTING DEPT.

DATE: 3-28-23
SCALE: ½" = 1' - 0"
ATHERTON SIGNED

APP. 3-28-23
APP. 4-1-23
APP. AEBERTH

No. L62-442-36
Minimum clearance at 60° F. of conductors on crossing over:

- Over railway tracks: 30 ft.
- Over crown of streets or alleys: 22 ft.
- Along streets and alleys: 20 ft.
- On fenced right of way: 18 ft.
- Over signal lines: 6 ft.
- Over other power lines: 4 ft.

These clearances must not be increased except in special cases.

6900-11950"Y" Volt Construction
Tangent Construction

For construction on corners see drawing L62-442-34.

<table>
<thead>
<tr>
<th>BILL OF MATERIAL</th>
</tr>
</thead>
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<tr>
<td>Required</td>
</tr>
<tr>
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</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>26</td>
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<tr>
<td>2</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>1</td>
</tr>
</tbody>
</table>

K. C. PR. & LT CO
DRAFTING ROOM

DATE 4-19-23 SCARE 2 = 1 Ft
APP R.

No. L62.442.38
CORNER CONSTRUCTION
0° to 5° Use straight line construction
5° to 45° Use 2 arm construction
45° and above use corner construction

6900-11950 Y 2 ARM CORNER CONSTRUCTION
2 Arm Corner 5°-45°

O.K.
Supt. O.H. Construction
K.C. PR & LT CO
2-ARM CORNER CONSTRUCTION
D.W.N.H. I.Krummel CKD C. Kall
DATE 11-22-24
SCALE 1/4 = 10'
APPR
No. L62442.51
**Corner Construction**

0° to 5° Use straight line construction.

5° to 45° Use 2 arm construction.

45° and above Use corner construction.

**Plan of Guying**

**Note:**

Phasing shall be (A) from top to bottom.

**Minimum Clearance at 60° of Conductors on Crossing**

- Over rail road tracks: 30'
- Over crown of streets & alleys: 22'
- Along streets & alleys: 20'
- On fenced right of way: 18'
- Over signal lines: 6'
- Over other power lines: 4'

These clearances must not be increased except in special cases.

**6900 Volt Corner Construction**

Suspension corner for 45° and above.

---

K.C.P.R & LT Co.

Drafting Room

Date: April 14, 1923 Scale: 1/2 = 1 ft

_corrected by CKD_ [1/2/24]

approved by [signature]

approved by [signature]

No L62.442.34
6900 Volt Non-Grounded Construction

Standard Single Phase Transformer Station

Ground Secondary on First Pole away from Trans. Sta.

SWP Copper Wire for Grounding Lightning Arresters. To be Protected by Wood Moulding in Climbing Space.

KCP & LT CO

DWN RL COOK CKD J-10-29
DATE 11-21-29 SCALE 2"=1'
APPR
NO. 162-442-48

Note: Clearance of phase wire to ground to be more than 5 ft. as per National Safety Code.
No splices shall be made in crossing or adjacent spans.

QA insulator #12849 or Victor #6310
Pierce Pins #1080
Adjacent span

A.C.S.R. conductor

26" cross arm braces
Victor strain insulators
No 3337 (or equivalent)

3 bolt clamp #7460

6"-0"

Storm guy 2 ways

3/4 stranded guy

Elevation of 6500-1850 y railway crossing construction.

Minimum clearance at 60° of conductors on crossings:

Over rail road tracks
Over crown of streets & alleys
Along streets & alleys
Encroached rights of way
Over signal lines
Over other power lines

12'-0" minimum

These clearances must not be increased except in special cases.

Plan

Corrected to 1-19-24

Inw. Leading Chd. No.

Date 3-7-23

Scale 1"=50' On plan

 апп. Sign.

No. 662-442-39
8 Pin Standard Cross Arm
6 Pin Standard Cross Arm
4 Pin Standard Cross Arm
2 Pin Standard Cross Arm

2300/4000 Y Volt Construction
Cross Arm Specifications
As per National Electric Light Assn.
CIRCUIT NO. 20-1110
- 6600-VOLT TRANSMISSION -
DALTON TO KEYTESVILLE, MO.
- CHARITON COUNTY -
FROM SUBSTATION NO. 20.
SECTION 2
CIR. NO. 11-3309
33,000 VOLTS
CHARITON CO.
FROM SUB II. CARROLLTON.
-KEY-

-KEY-MAP-

of Transmission Circ. No. 9-6601

and Circuits feeding from

Station No.10, Higginsville,

and Station No.11, Carrollton, Mo.