

THE REVISION OF A SECTION OF A
SECONDARY DISTRIBUTION SYSTEM

by

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and

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1924

DATA
Losses in Revised System

Trans. No.	Trans. Loss 24 hrs/day	Watt Hrs.	Length Service	Wire Size	I ² R Loss w / hr.	W.Hr. Loss/day	Trans. Copper Loss W.Hr./day	Total Loss
1 1kva	20	480	1600' 1400	4 4	1.6 1.4	4.8 4.2	48	537
2 1½kva	24	576	1500 1200	4 4	4.9 2.7	14.5 8.0	66	665
3 2kva	29	696	1500 2000	4 2	6.0 12.5	18.0 37.0	80	831
4 1½kva	24	576	500 1100	4 4	0.3 1.0	1.0 3.0	66	646
5 2kva	29	696	2200 2300	4 4	5.6 3.5	14.0 7.0	80	797
6 3½kva	35	840	2100 1500	4 4	20.8 17.0	52.0 51.0	163	1106
7 7½kva	60	1368	900 1500	4 4	8.3 .3	20.0 1.0	630	2011
8 3½kva	35	840					325	1165
9 3½kva	35	840					325	1165
10 3½kva	35	840					163	1003
11 2kva	29	696	1600 - 1400	4 4	3.1 9.4	10.0 25.0	100	831
571 10kva	70	1680	1,300 1,500 500 600	6 6 6 6	22.40 9.50 0.75 0.67	67.20 28.50 2.30 2.00	315	2095
1409 3kva	33	792	School				114	906
237 5kva	43	1032	1,200	6	7.00	21.00	328	1381
3000 10kva	70	1680	1,200 1,600	6 6	8.70 168.00	26.10 420.00	280	2406
3002 10kva	70	1680	Feed drug store				350	2030
2383 3kva	33	792 Sign	800	6	38.00	114.00 150.00	304	1360
3007 10kva	70	1680	3,200	6		210.00	210	1890
1377 5kva	43	1032	600	6	6.50	19.50	200	1252
3022 5kva	43	1032	Range 80	4	15.00	45.00	250	1327
1764 7½kva	57	1368	1,000	6	1050.00	3150.00	330	5468
1552 1553	33 33	792 792	Power bank 3kva each				228 228	2040
222 223	43 43	1032 1032	Power bank 5kva each				328 328	2720
Grand total w.hrs./day								34,383

An attempt is made in this thesis to explain the method of revising a secondary distribution system, and to point out the obstacles encountered, giving methods for overcoming these obstacles.

Distribution systems are divided into two classes: first, primary distribution, which covers the transmission of high voltage electric energy to the point or near the point of consumption; and second, secondary distribution, which begins at the transformer or broadly speaking at the end of the primary line, and extends to the consumers outlet.

The second class of distribution is the class considered in this thesis. For the working base of the thesis a section, typical of the mass of secondary systems, of city distribution was chosen. This section includes the distribution of three phase power; single phase two wire, and single phase three wire electric energy.

As the distribution of three phase power is lesser importance from a secondary standpoint due to the location of transposition centers at the point of consumption, only the transformer losses will be considered.

In the single phase distribution, however, a detailed analysis of the revision and the problems encountered will follow.

As this system was built years ago the revision is not merely from an economic standpoint of overcoming line losses, but largely for the supply of the increasing demands for service and the replacement of construction that has been condemned or become obsolete.

Present laws governing secondary distribution are few, but evidence of coming laws necessitate the formation of standards of construction which will meet the demands of the public. These standards are chosen for safety, conservativeness, and uniformity of construction. As pole lines are undesirable at their best, the problem of uniformity of construction becomes important.

The standards set forth for this thesis are derived from the West Penn Power Company hand book, and from practices of the Knoxville Power and Light Company; and are as follows:

1. All poles carrying primary lines or arc circuits must be 35' or more in height, giving a clearance of at least 28 feet.

2. Poles carrying secondary only must be 30 feet or more, giving a minimum clearance of 22 feet.

3. Stubs and trolley guy poles may be 25 feet in height.

4. All poles (except stubs) must be class A creosote

pine.

5. Primary conductors and are conductors will be carried on standard X-arms, using 2300v glass insulators. The framing will be standard cross arm framing.

6. Secondary conductors will be carried on five spod secondary racks, attached with one thru bolt and two lag screws. (On dead ends two thru bolts and dead end straps will be used)

7. Never creep anchors or stubs, properly insulated with strain insulators, must be placed at all points subjected to strains not carried by the line.

8. Transformers will be hung from the following detailed construction.

a. Transformer poles must be framed with double cross arms.

b. A clearance of 6 feet mest be allowed between the top cross arm and the secondary rack.

c. The transformer will be hung so that a clearance of 2 feet exists between the top of the transformer and the secondary rack.

d. All transformers will be hung perpendicular to the street.

e. Each transformer will be protected with two primary cutouts, mounted on the cross arm opposite the transformer; two lightening arresters mounted beside the cutouts; and two choke coils mounted between the double arms.

f. The secondary side of all transformers

must have the neutral grounded with 5' copper ground rods. The connecting wire being covered with moulding for at least 20' above the ground.

g. All poles must be set on property linen adjoining two lots thereby preventing the feeding of service to a customer across another citizens property.

h. Conductor sizes will be determined by by the load carried. (no secondary wire smaller than #4 will used)

With these standards outlined the procedure of the work will be next covered. Duplicate maps were made of the section in question. On map #1 all property lines, houses, and electric circuits were plotted. The legend on the map explains the plotted work. On map #2 the same property lines and houses were shown, and the proposed revision there plotted. The legend of this sheet is self explanatory of the data there plotted. The pole locations were chosen so that all existing houses could be served, and provision was made in the primary circuit routing for systematic extension to property not yet occupied.

The secondary circuit distribution was divided into two classes; first, single transformer installations feeding individual secondary sections; and second, transformers connected in parallel feeding a network of secondary.

The transformer locations were chosen by calculating the load centers of the respective loads connected. Wire sizes were determined from curves plotted between loads in amperes and distance in feet conducted allowing a 2% drop. The load for both transformers and wire was arrived at by taking the total connected load, multiplying by the diversity factor for the section, and allowing an increase of 100% for expansion. Reference is made to curves #1 for determining conductor sizes. The data for plotting the curves was obtained from the Condulet Handbook.

The cost of the revision is shown in the data section. The saving in the distribution was arrived at by determining the transformer and line losses of both systems. The transformer core losses are constant and continuous. The copper loss is the product of the loss in watts per hour for the conductor used, the length of the conductor, and the time a given load is in use per day. The saving figured in dollars per year is figured using $0.007\frac{1}{2}$ cents per kw. hr. as the cost of power .

The most important part of the saving comes thru decrease in rate of depreciation and the decreased maintenance costs. For this problem the saving estimated ran 10% less in the new system. The total cost of the revision, based on 1925 figures of the Knoxville Power and Light Company, was \$9,702.89. This increase

in capital necessitates an expenditure of $7\frac{1}{2}\%$ or \$727.72 per year in dividends to stockholders. The saving of the new installation being 10% or \$970.29 plus the saving in energy loss of \$36.32 shows a net saving of \$274.89 per year.

DATA
Inventory Sheet

Pole No.	Pine	Chest	6 P.A.	4 P.A.	Ins. 2300v	Anchors	Racks	Arcs
862		30	1		3			
861		30	1		4			
860		30	1		6			
859		30	1		5			
571		35	3	12				
572		35	2	10				
570		30	1		3			
569		30	1		3			
568	30		1		3			
567		30	2		6			
566		30	1		2			
565	30		2	10				
585		40	1		5			
575		30	1		3			
574		30	1		3			
573		25	2		4			
572		35	2	10				
858			1		4	1		
857		30	1		2			
855	30		1		3			
854	30		1		4			
587		35	2		7			
584		30	1		5			
583		30	2		9			
582		25	1		8			
581		30	1		3			
580		30	1		1			
586		35	1		1			
588		30	1		4			
589		30	1		5			
590		30	1		5			
591		30	1		4			
592		30	1		2			
593		35	1		2			
594		35	1		2			
604		35	1		3			
899		30	2		9			
898		30	2		6			
897		30	2		6			
896		30	2		8			
895		30	2		8			
894		30	2		6			

Pole No.	Pine	Chest	6 P.A.	4 P.A.	Ins. 2300v	Anchors	Racks	Arcs
603		35	1		4			
736		30	1		2			
737		30	1		3			
738		30	1		3			
739		30	1		8			
740		30	1		5			
741		30	1		4			
742		30	1		4			
868		35	1		4			
869		35	1		2			
832		30	1		7			
831		35	1		4		1	
834		25						
833		30	1	1	9			
835		30	1		8			
836		25						
837	30		1		6			
838		25						
839		30	1		6			
840	30							
841		30	1	1	7			
842	30		1		4			
843		40	1	1	5		1	
844	30				2			
845		30	1		6			
846	30				2			
847		30	1		7			
849		30	1		6			
848	30							
851		30	1	1	9			
850	30		1		4			
852	30							
853		30	1		4			
755		35	2		4	1	1	
753		30	2		4			
751	30							
887		30	1		2			
888		35	1		2			
873		30	1		4			
874	35		1		5		1	
872		30	1		4			
871		35	1		4			

DATA
Inventory Sheet

Pole No.	Pine	Chest	6 P.A.	4 P.A.	Ins. 2300v	anchors	Racks	Arcs	Pole No	Pine	Chest	6 P.A.	4 P.A.	Ins. 2300v	anchors	Racks	Arcs
720		30	1	2					721		30						
719		30	2	4					716	35		2	9	1	1		
715		30							714		30	2	4				
712		30	2	4					713		30						
711		30		2					710		30	2	5				
709		30							708		30	1	4				
707		30							706		30	1	4				
705		30							704		30	1	5				
703		30							702	30		1	6		1		
701		30		2					700		30	1	8				
699		30							698		30		1	4			
694		40	2	11			1		695	30							
696		35		2	5				697		30						
627		30		2	9				628		30		2				
629		30		1	2				625		30	2	5				
624	30								623		30	2	6				
622		30							621		30	2	5				
620	30			1	2				619		30	2	7				
618		30			2				617		30	1	3				
616		30			2				615		30	2	5				
284		35	1	1	9	1			559		35	2	7				
285		30		1	2				560		35	8	26				
910		35		2	5		1		562		30	1	3				
912		35		2	4		1		561		35	1	4				
914		40		1	2		1		892		35	1	7				
551		35		2			1		889		40	2	7				
550		35	2	1	10		1		890		35	1	6				
549		35	1	4	5				891		35	1	5				
547		35	1	1	4				563		35		1	3			
312		35	4	5	17				564		35	1	3				
909		35		3	12				875		30	1	2				
908		35							876		30	1	2				
907	35		1	1	10				877		30	1	3				
906		35		3	6				878		30	1	2				
905		35		1	6				879		30	1	2				
911		35		1	2		1		880		30	2	8				
904		30		1	4	1			881		30	1	4				
903		30		1	4		1		882		30	1	4				
901		30		2	10		1		883		35	2	7		1	1	
913	30								884	35							
902		30		1	2		1		885		30	1	2				
900		30		2	8				886		30	1	2				

DATA
Inventory Sheet

Pole No.	Pine	Chest	6 P.A.	4 P.A.	Ins. 2300v	Anchors	Racks	Arcs	Pole No.	Pine	Chest	6 P.A.	4 P.A.	Ins. 2300v	Anchors	Racks	Arcs
830		30		1	3				816		30		1	4			
829		30		1	4				813	30			1	4			
828		30		1	5				754	30			1	4			
827		35		2	8				752		35	2	1	14			
826	30			1	4				750		40	1		7			1
822	25			2	8				749		30		1	4			
823		30		1	4				746		30		1	4			
824		30		1	4				748		30						
825		30		1	4				747		30			2			
812	30			1	3				743		30		3	10			
810	35			2	6			1	742		30		1	4			
811	30								744	30			2	6			
809		35		1	4				745	30							
808		35		1	5				746		30		1	4			
807		35		2	10			1	727		30			2			
806	35			1	2		1		728		30		1	4			
805	35			1	2		1		729		30		1	4			
804	35			1			1		730		35		1	4			
803	35			1	2		1		731	30						1	
802	35			1	2		1		732	30					1	1	
801	35			1	2		1		733		30		1	2			
800	35			1	2				734		35		1	6			
799	35			1	2				735		30		1	4			
762	30			2	7				602		35	1	1	10			
763	30			2	5				601		40		1	4			1
746	35		1		5		1		600		30		1	3			
765	30						1		599		30		1	4			
766	35			1	4		1	1	598		30		1	2			
767	30						1	1	597		30		1	3			
761		30		3	8			1	596	30					1	1	
760		30		1	4				605		35		2	7			
759		35		1	4				607		35		1	2			
758		30		1	3			1	608		30		1	2			
757		35		2	6				609		30		1	2			
821		25		1	3				610		30		1	2			
820		25		1	3				611		30		1	2			
819	25			1	4				606		35		1	4			
818		40		1	4			1	724		30		3	10			
817	30			1	4				725		30		2	4			
814	30			2	7				722		30		1	5			
815	30			1	4				723		30						

Trans. No.	Location	No. Ser.	Amps. per ser.	Diver. Factor	Length cond.ft.	Total Amps.	Alwd Lg.ft.	Size Cond.	Trans. Amps.	Volts	Watts	Trans. Size	Remarks
1	Wilson Ave.	7	2.5	0.20	750	4.0	1000	4	7.5	110	825	1	Light load at end line. Small drop.
		8	2.5	0.20	700	3.5	1200	4					
2	Alley N. of Wilson Ave.	12	2.5	0.20	600	8.0	500	4	14	110	1540	1½	
		16	2.5	0.20	750	6.0	700	4					
3	Alley N. of Louise Ave.	16	2.5	0.20	750	8.0	500	4	18.5	110	2035	2	
		21	2.5	0.20	1000	10.5	640	2					
4	Ben Hur Ave.	4	3.5	0.25	250	3.5	1200	4	14	110	1540	1½	Use no sec. wire smaller than #4
		12	3.5	0.25	550	10.5	640	4					
5	Doll Ave.	19	2.5	0.20	600	9.5	460	4	19	110	2090	2	Negro settlement #4 sufficient
		19	2.5	0.20	1000	9.5	460	4					
6	Kyle St. S. of McCalla Ave.	28	2.5	0.20	1000	14.0	300	4	33.5	110	3690	3½	Trans. change pos. #2 suf. load split
		22	3.5	0.25	600	19.5	350	2					
7	McCalla Ave.	13	2.5	0.25	450	18.1	500	4	30.0	110	3300	7½	Ltg plus 3½ K.W.Pr. 220 (Store-no sec.)
8&9	McCalla Ave.					(7,8&9 form power bank-10 kw demand- 8&9 3½kw each- Delta con.)							
10	Alley S. of Park View W. of Spruce							4 (Four spans)				3½	Range and 4 res.
11	Alley S. of Park View at Church	13	2.5	0.30	700	9.5	460	4	15	110	1650	2	Church adds 10% to diversity factor
		7	2.5	0.30	800	5.0	800	4					
12	Cor. Chestnut Alley N. of P.V.	26	2.5	0.20	700	18.0	400	2	24.5	110	2700	3	
		13	2.5	0.20	700	6.5	640	4					
13	Park City H.S.					(Use 3kw trans as present installation for Park City H.S.)							
14	Olive at Linden	32	2.5	0.25				4 (Low type load)	2200			2½	32 res. 20 A. load
15	Alley N. Mag. E. of Chestnut.	15	3.0	0.30		13.5		4	13.5	110	1500	5	Range add load

DATA
Inventory Sheet

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Pole No.	Pine	Chest	6 P.A.	4 P.A.	Ins. 2300v	Anchors	Racks	Arcs	Pole No.	Pine	Chest	6 P.A.	4 P.A.	Ins. 2300v	Anchors	Racks	Arcs
893		35		2	6				870		25						
552		35	4	3	18				867		35		2	12			1
553		35		2	9				881		30		1	4			
554		35		2	8				866		30		1	5			
555		35		2	7				865	35							
556		35		2	7				864	30			2	8			
557		35		2	7				856		40	1		5			1
558		35		2	8				863		35		1	4			
1		30	1	1	5				315	35		1	1	5			
2		30	1	1	5				316	35		1	1	5			
3		30	2	2	14				317	35		2	3	9			
4		30	1	1	5				318	35		1	1	5			
5		30	2	2	14				319	35		1	1	5			
6		30	1	1	5				320	35		1	1	5			
7	35		1	1	5				24	35		1		5			
8	35		1	1	5				25	35		1		5			
9		30	1	1	5				26	30		1		5			
10	35		1	1	5				27		30	1		5			
11	35		1	1	5				28		30	1		5			
12	35		1	1	5				29		30	1		5			
13		35	1	1	5				30		30	1		5			
14		35	1	1	5				31		30	1		5			
15	35		1	1	5				32		30	1		5			
16	35		1	1	5				33	30							1
17	35		1	1	5				34	30							1
18		35	1	1	5				35	30							1
19	35		1	1	5				36	30					1	1	
20	35		1	1	5				37		25		1	2			
21	35		1	1	5				38		25		1	2			
22	35		1	1	5				39	30							1
23	35		1	2	7				40	30							1
313	35		1	1	5				41	30							1
314	35		1	1	5				42	30					1	1	

DATA
Losses in the Present System

Trans. No.	Trans. Loss 24 hrs/day	Watt Hrs.	Length Service	Wire Size	I ² R Loss w / hr.	W. Hr. Loss/day	Trans. Copper Loss W.Hr./day	Total Loss
241 5kw	43 w.	1032	27,600'	6	8.55	17.10	164	
			2,270	6	14.60	29.20		
			1,730	6	7.20	14.40		
			770	6	1.20	2.40		
			1,200	6	1.94	3.88		<u>1263</u>
232 1½kw	24	576	1,500	6	5.41	10.82	66	
			600	6	0.21	0.42		<u>653</u>
1783 3kva	33	792	1,300	6	7.81	15.62	114	<u>922</u>
1526 1½kw	24	576	1,030	6	1.36	2.72	66	
			1,000	6	4.56	9.12		<u>654</u>
226 1kva	20	480	1,920	6	19.00	38.00	48	
			400	6	1.00	2.00		
			1,400	6	2.50	5.00		<u>573</u>
1087 5kva	43	1032	2,300	6	61.60	154.00	205	
			800	6	12.80	38.50		<u>1430</u>
221 10kva	70	1680	900	6	12.80	44.80	280	
			1,200	6	5.00	15.00		
			1,600	6	5.70	17.10		
			1,400	6	14.30	28.60		<u>2323</u>
2270 3kva	33	792		6			156	<u>948</u>
1848 5kva	43	1032	3,500	6	22.6	59.00	164	<u>1257</u>
12 3kva	33	792	1400	4	4.3	13.0	143	
			1400	4	28.2	85.0		1033
13 3kva	33	792			1.2	3.0	130	925
14 2½kva	32	768	1900	4	35.0	80.0	153	
			700	4	3.0	10.0		1011
15 5kva	43	1032	1000	4	2.8	8.0	328	1368
16 15kva	95	2280					672	2952
17 3kva	33	792					200	992
18 10kva	70	1680					600	2280
19 15kva	95	2280					800	3080
20 3kva	33	792					228	1020
21 3kva	33	792					228	1020
Total Loss W. Hrs./Day								<u>26,438</u>

DATA

Transformers for Network

Trans #19

29 res.	5 a. load	0.35 div. fac.	50 a. total load
16 "	4 a. "	0.35 " "	22 a. " "
Sign			5 a. " "
Store			60 a. " "
Total			<u>137</u>

Trans size

$$137 \times 110 = 15,070 \text{ w. Hang 15kw transformer.}$$

Trans #20 & #21

Serving power service-use present installation of
2-3kw trans. open delta.

Trans #17

22 res.	4 a. load	0.30 div. fac.	26.4 a. total load
Church			<u>10.0 a. " "</u>
Total			<u>36.4</u>

Trans size

$$36.4 \times 110 \times 0.75 = 3000 \text{ w. Hang 3kw trans.}$$

(0.75 is the div. fac. of the res. and church)

Trans #16

22 res.	4 a. load	0.30 div. fac.	26.4 a. total load
10 res.	3 a. load	0.25 div. fac.	<u>7.5 a. total load</u>
Total			<u>33.9</u>

4 ranges connected require 10 kw in trans.

Trans size

$$33.9 \times 110 = 3740 \text{ w. 15 kw trans required for total load.}$$

Trans # 18

35 res.	5 a. load	0.35 div. fac.	61a. total load
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1 range requiring $3\frac{1}{2}$ kw trans

Trans size

$$61 \times 110 = 6710 \text{ w. Hang 10kva trans for total load.}$$

DATA
Revision Cost

Article	Amt.	Unit Price	Cost	Total
35' Pine poles	251	\$11.98	\$3006.98	
30' Pine poles	87	9.64	838.68	
6 pin X-arm	53	0.98	51.94	
4 pin X-arm	288	0.66	829.44	
X-arm braces	576	0.15	86.40	
Machine bolts	576	0.08	46.08	
Locust pins	1030	0.03	30.90	
Lag screws	753	0.04	30.12	
Secondary racks	252	1.61	405.72	
Thru bolts	317	0.08	25.36	
Washers	1003	0.03	30.09	
Dead end straps	122	0.13	15.86	
Anchors	24	2.50	60.00	
Eye bolts	24	0.26	6.24	
Guy clamps	94	0.23	21.62	
Guy protectors	24	1.75	42.00	
Guy wire	2355'	0.02	46.70	
Guy thimbles	24	0.04	0.96	
Guy strain plates	36	0.15	5.40	
Guy hooks	36	0.08	2.88	
Stubs	17			
Concrete	2yds.	8.00	16.00	
				\$5599.37
Pole holes	268	1.50	402.00	
Setting poles	268	1.00	268.00	
Transporting poles	258	0.50	129.00	
Removing poles	344	0.75	258.00	
Setting anchors	24	1.50	36.00	
				1093.00
Insulators 2300v	1030	0.27	278.10	
Strain insulators	47	0.25	11.75	
#6 wire 69,290'	7760#	0.18	1396.80	
#4 wire 27,760'	4553#	0.18	819.54	
#2 wire 9,790'	2007#	0.18	361.26	
#2/0 wire 10,780	5552#	0.18	999.36	
				3865.88
Line labor installing	19872#	0.04	794.88	
Line labor removing	11677#	0.04	467.08	
				1261.96
Total				\$11820.21

DATA
Maintenance Cost

Article	Amt.	②	Cost	Total
1-kw transformer	1			
1½-kw transformer	2			
2-kw transformer	3			
2½-kw transformer	1			
3-kw transformer	4			
3½-kw transformer	5			
5-kw transformer	1			
7½-kw transformer	1			
10-kw transformer	1			
15-kw transformer	2			
Lightening arresters	42	\$5.21	\$218.82	
Primary cutouts	42	1.48	62.16	
Ground rods	84	1.00	84.00	
Moulding	840'	0.03	25.20	
Labor hanging trans				
up to 5-kw	17	3.50	59.50	
over 5-kw	4	5.00	20.00	
Labor removing trans	26	1.50	39.00	
Total				\$508.68
Less salvage to maintenance				239.12
Net total				270.56
10% Incidentals				27.06
Total				297.62
7½% Engineering				22.32
Grand total to maintenance				\$319.94

Maintenance Salvage

1-kw trans.	1			
1½-kw trans.	2			
3-kw trans.	6			
5-kw trans.	8			
7½-kw trans.	1			
10-kw trans.	5			
Primary cutouts	46	\$1.48	\$68.06	
Lightening arresters	24	5.21	125.04	
Ground rods	46	1.00	46.00	
Total				\$239.12

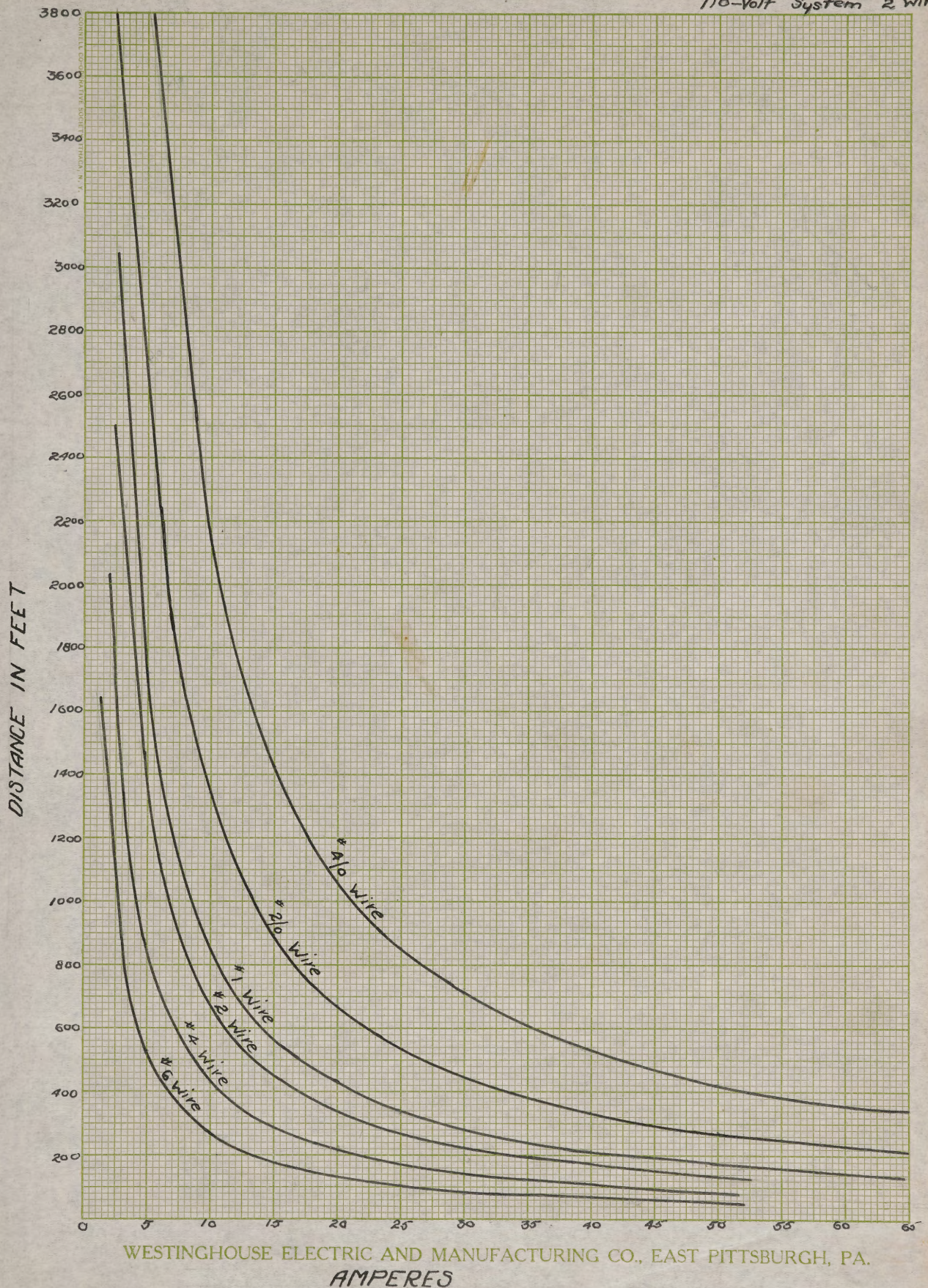
DATA
Salvage

17

Article	Amt.	@	Cost	Total
35' pine poles	36	\$11.98	\$431.28	
30' pine poles	44	9.64	424.16	
6 pin X-arms	99	0.98	97.02	
4 pin X-arms	325	0.66	214.50	
X-arm braces	848	0.15	127.20	
Carriage bolts	848	0.08	67.84	
Secondary racks	39	1.61	62.79	
Thru bolts	60	0.08	4.80	
Lag screws	463	0.04	18.52	
Washers	872	0.03	28.16	
Anchors	4	2.50	10.00	
Eye bolts	4	0.26	1.04	
Guy clamps	8	0.23	1.84	
Guy wire	970'	0.02	19.40	
Guy thimbles	8	0.04	0.32	
Guy hooks	16	0.08	1.28	
Guy Plates	16	0.15	2.40	
				\$905.47
Insulators 2300v	1390	0.25	347.50	
Strain insulators	8	0.25	2.00	
#6 wire 103,125'	11549#	0.18	2007.66	
#4 wire 780'	128#	0.18	23.04	
				2987.28
Total				\$3,892.75
Total cost of revision				\$11,820.21
Less salvage				3,892.75
Net total				\$ 7,927.46
10% Incidentals				792.75
				8,720.21
7½% Engineering				662.74
Grand total				\$ 9,382.95
Grand Total Cost of System				
System cost				\$9,382.95
Maintenance Cost				319.94
Grand total of Revision				\$9,720.89

DATA
SUMMARY OF COST

Total cost	\$9,702.89
Dividends to Stockholders @7½%	\$ 727.72
Savings due to decreased depreciation @10%	\$970.29
Total watt hours saved per day	7,945
Total Kw. hrs. saved per year	2,900
Total saving per year @7½ mills.	\$ 36.32
Total Saving 970.29 - 36.32	\$1006.61
Interest	727.72
Net Saving	<u>\$ 274.89</u>



WESTINGHOUSE ELECTRIC AND MANUFACTURING CO., EAST PITTSBURGH, PA.

AMPERES

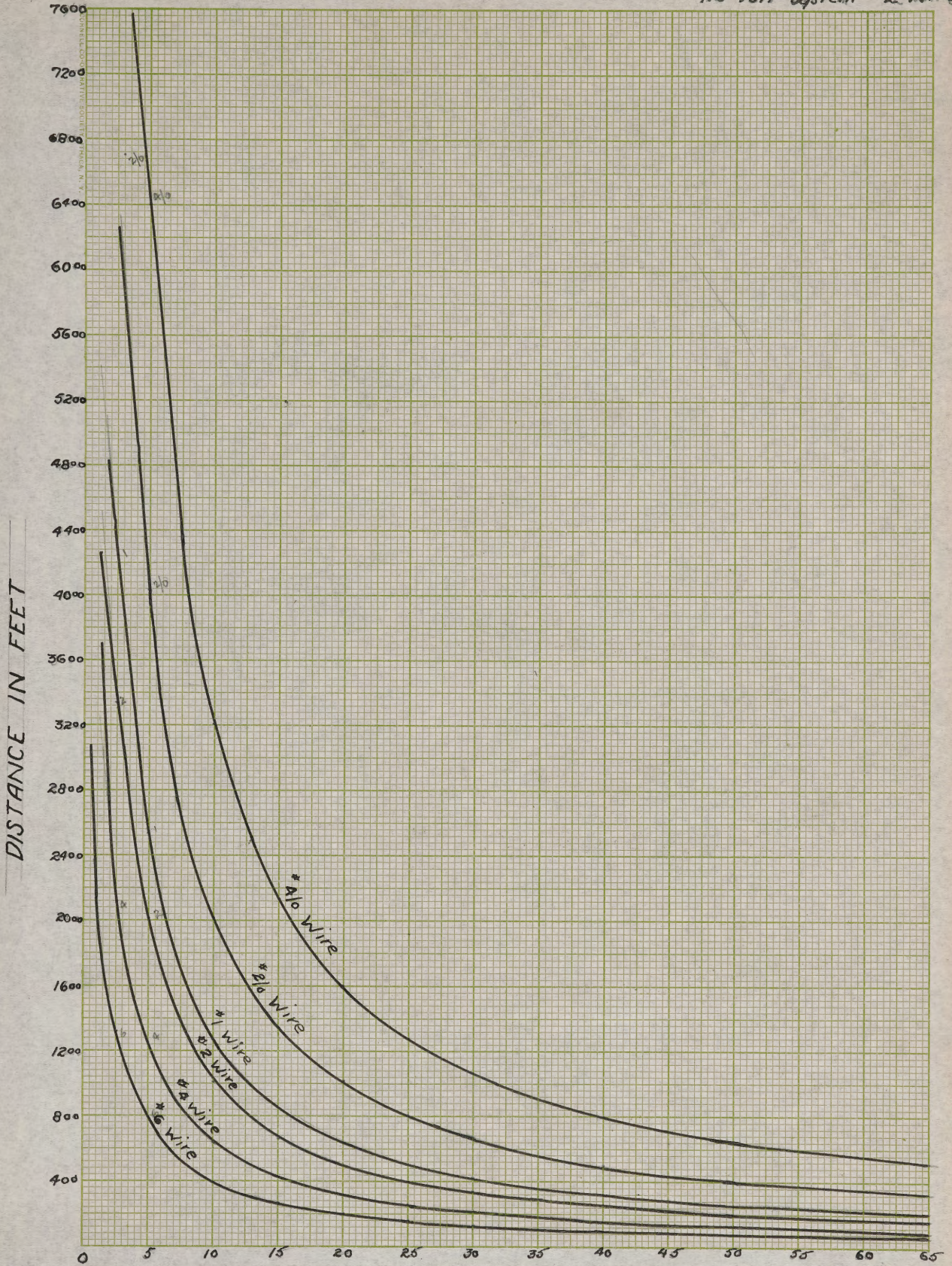
Curve No. 2% Drop

Signature

Date

Curve # 1.

Curve No. 3% Drop
110 Volt System 2 Wire



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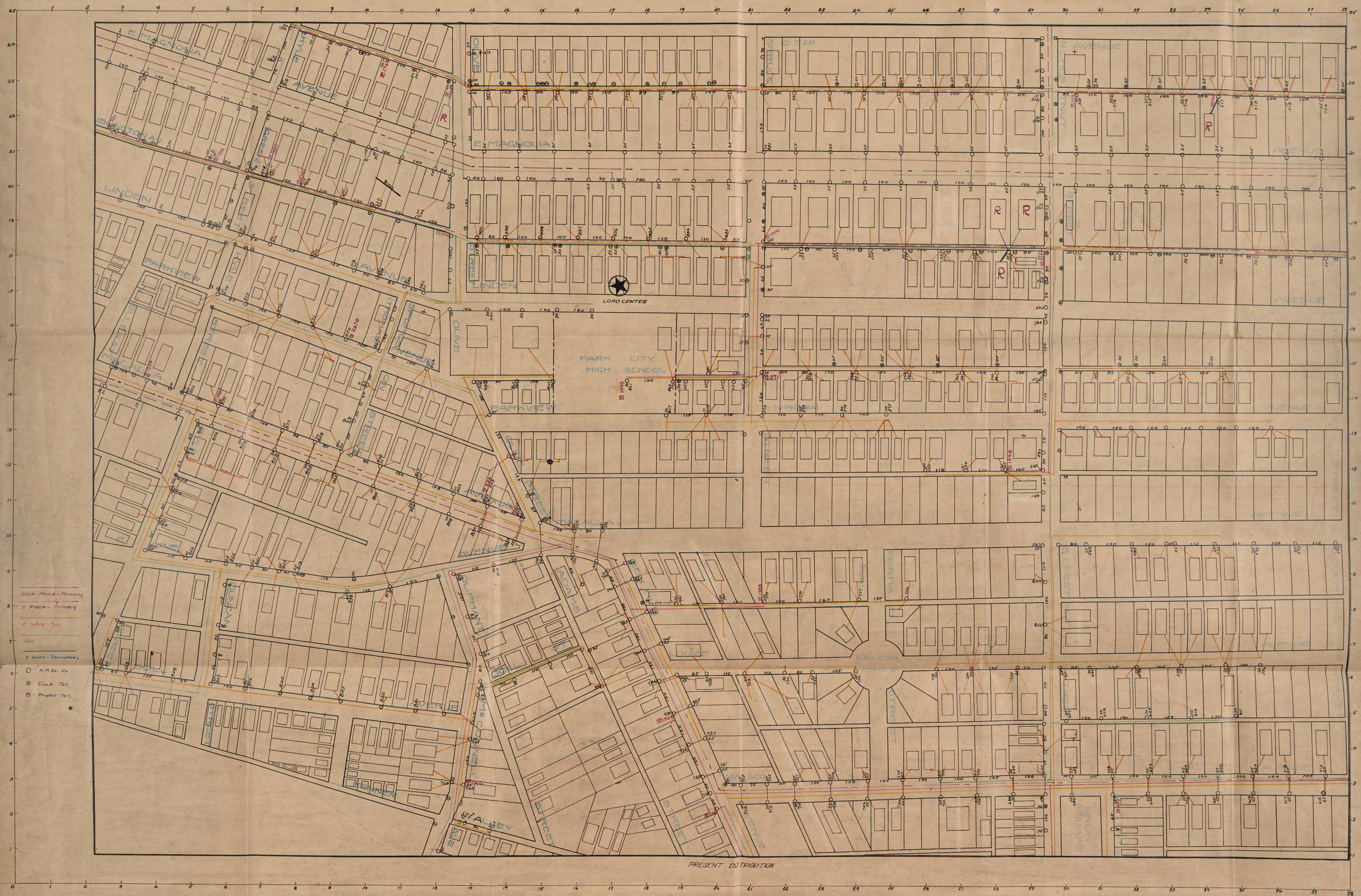
AMPERES

Curve No. 3% Drop

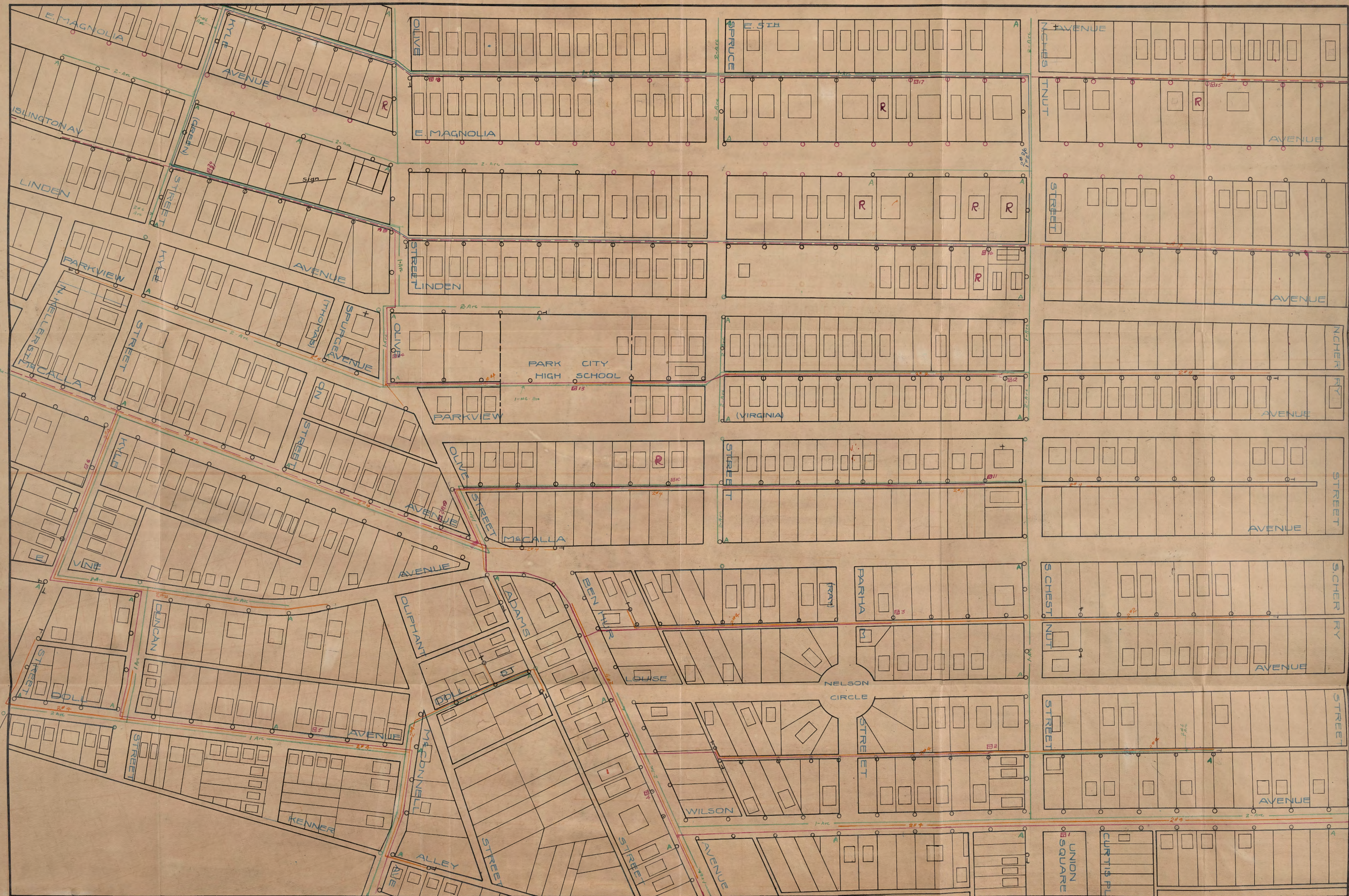
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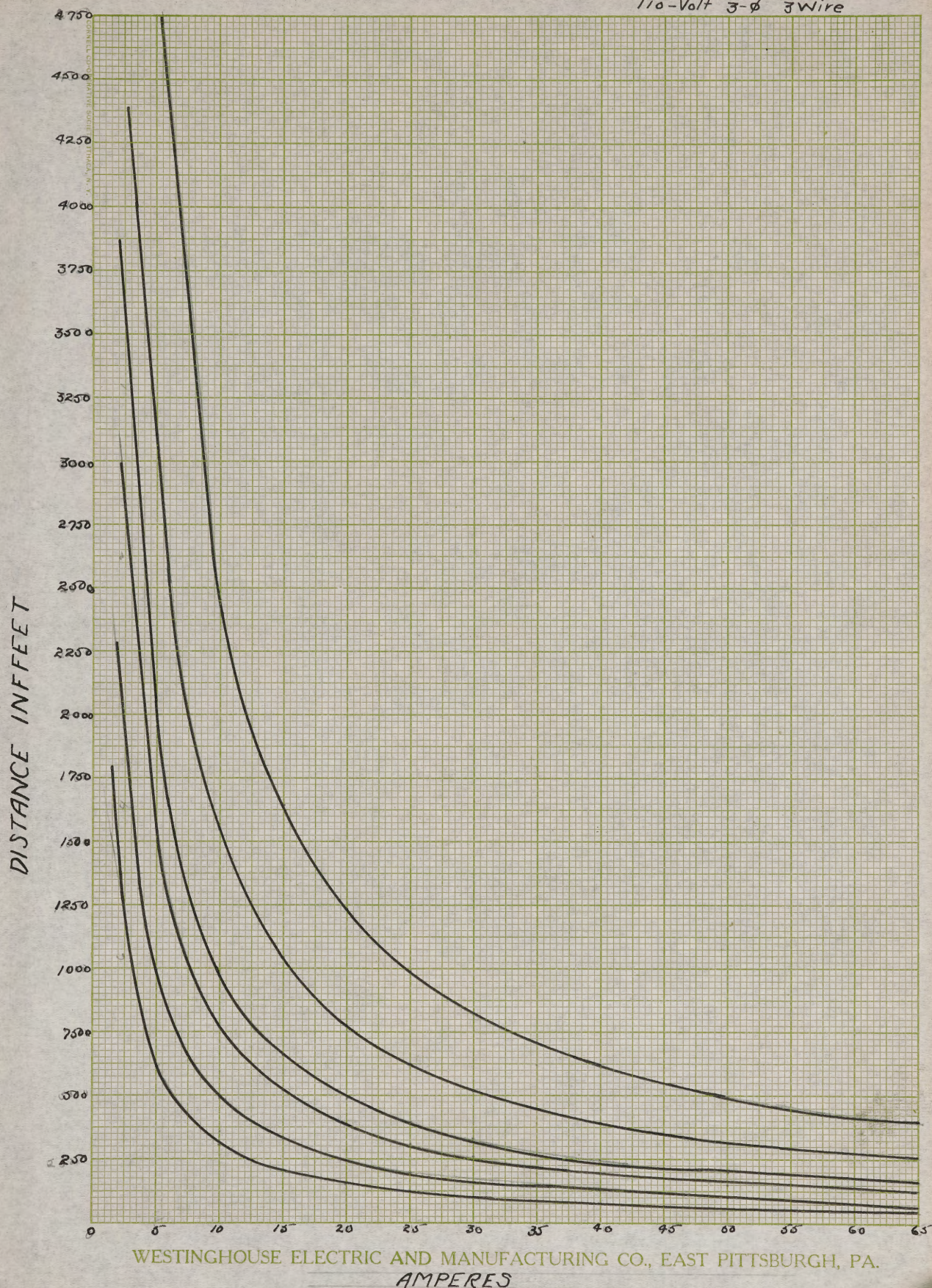
Curve #22



Single Phase - Primary
 3 Phase - Primary
 3 Wire - Secondary
 2 Wire - Secondary
 Poles Remaining
 Stub
 New or Replaced Poles
 Anchors



Curve No. 2% Drop
110-Volt 3- ϕ 3 Wire



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AMPERES

Curve No.

Signature

Date

Curve # 3

*APPROVAL

The foregoing thesis is hereby approved as a creditable study of an engineering subject, carried out and presented in a manner sufficiently satisfactory to warrant it's acceptance as a prerequisite to the degree for which it has been submitted. It is to be understood that by this approval the undersigned does not necessarily endorse or approve any statement made, opinions expressed, or conclusions drawn therein, but approves the thesis only for the purpose for which it is submitted.

Name Chas A Perkins

Title Professor
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