Central Waterfront Project – Transmission Line Relocation

Cable Pulling Calculations

Prepared for

City of Seattle, Washington

POWER ENGINEERS

CALCULATION COVER SHEET

Project Name: MA-UN-1&2 **Calculation No.:**

Client Name: Seattle City Light **Number of Sheets:** 5

Project Number: 122724 **Task Number:** 01.02

Title: Pulling Calculations

	Name	Initials
Designed/Calculated By:	Brad Hennessey	BH
Checked By:	Joey Hunter	JH
Approved and Released By:	Garth Vanhorn	GV
Code Related:		
Reviewed By:		
P. E.'s Seal No. (If Required):		**State of:**

Calculation		Responsible Design Engineer (RDE)		Checker		Lead Design Engineer (LDE)		PM/PE
Rev.	**Description**	**By**	**Date**	**Checker**	**Date**	**Approve**	**Date**	**QA/QC**
A	Preliminary	BJH	5-26-11	JWH	5-26-11			

☒ Preliminary Calculation
☐ Final Calculation
☐ Superseded by Calculation Number _____

Pull-Planner™ 3000
Pull Tension Calculations

Pull I.D.: Vault 2 to Vault 4 Rev A

Conduit Inner Diameter: 6.06 Inch(es) Conduit Fill: 56.4 %

Total of 1 Cable(s) of 1 different types being pulled.

Type # 1 1 Cable(s) O.D. of 4.55 Inch(es) Weight of 15.4 lbs/ft

Total Cable Weight: 15.4 lbs/ft

Calculated weight correction factor: 1

Configuration: Single Cable

Jam/Clearance Analysis: Jamming Not Possible

COF = 0.2 Incoming Tension 500 lbs

	Straight Section Angle	Up or Down	Straight Section Length (ft)	Bend Type	Up or Down	Bend Radius (ft)	Bend Angle	Tension (lbs)	Sidewall Pressure (lbs/ft)
Seg 1	--	--	77	H	--	400	2	780	2
Seg 2	--	--	--	VD	D	400	6	893	2
Seg 3	6	D	9	H	--	400	2	950	2
Seg 4	6	D	16	VU	D	400	6	1090	3
Seg 5	--	--	6	VU	U	400	4	1226	3
Seg 6	4	U	48	VD	U	400	4	1547	4
Seg 7	--	--	35	H	--	100	27	1876	19
Seg 8	--	--	3	H	--	100	27	2123	21
Seg 9	--	--	--	VD	D	400	6	2264	6
Seg 10	6	D	6	VU	D	400	6	2417	6
Seg 11	--	--	15	VU	U	400	6	2680	7
Seg 12	6	U	20	VD	U	400	6	2996	7
Seg 13	--	--	98	H	--	100	38	3811	38
Seg 14	--	--	39	VD	D	400	7	4134	10
Seg 15	7	D	--	H	--	100	39	4775	48
Seg 16	7	D	--	VU	D	400	7	4999	12
Seg 17	--	--	12	VU	U	400	11	5589	14
Seg 18	11	U	26	VD	U	400	11	6324	16
Seg 19	--	--	68	VD	D	400	7	6801	17
Seg 20	7	D	26	VU	D	400	7	6802	17
Seg 21	--	--	30	VU	U	400	5	6931	17
Seg 22	5	U	13	H	--	55	21	7524	137
Seg 23	5	U	--	H	--	55	21	8100	147
Seg 24	5	U	32	N	--	--	--	8241	--

Bend Notation: N = No Bend; H = Horizontal Bend; VU = Vertical Concave Up Bend;
VD = Verticle Concave Down Bend; R = Roller/Sheave; PPD = Push/Pull Device

Directional Notation: U = Gravitationally Up; D = Gravitationally Down

Pull-Planner™ 3000
Pull Tension Calculations

Pull I.D.: Vault 2 to Vault 4 Rev A (reversed)

Conduit Inner Diameter: 6.06 Inch(es) Conduit Fill: 56.4 %

Total of 1 Cable(s) of 1 different types being pulled.

Type # 1 1 Cable(s) O.D. of 4.55 Inch(es) Weight of 15.4 lbs/ft

Total Cable Weight: 15.4 lbs/ft

Calculated weight correction factor: 1

Configuration: Single Cable

Jam/Clearance Analysis: Jamming Not Possible

COF = 0.2 Incoming Tension 500 lbs

	Straight Section Angle	Up or Down	Straight Section Length (ft)	Bend Type	Up or Down	Bend Radius (ft)	Bend Angle	Tension (lbs)	Sidewall Pressure (lbs/ft)
Seg 1	5	D	32	H	--	55	21	631	11
Seg 2	--	--	--	H	--	55	21	710	13
Seg 3	5	D	13	VU	D	400	5	830	2
Seg 4	--	--	30	VU	U	400	7	1144	3
Seg 5	7	U	26	VD	U	400	7	1502	4
Seg 6	--	--	68	VD	D	400	11	1903	5
Seg 7	11	D	26	VU	D	400	11	2104	5
Seg 8	--	--	12	VU	U	400	7	2393	6
Seg 9	--	--	--	H	--	100	39	2804	28
Seg 10	--	--	--	VD	U	400	7	3072	8
Seg 11	--	--	39	H	--	100	38	3692	37
Seg 12	--	--	98	VD	D	400	6	4174	10
Seg 13	6	D	20	VU	D	400	6	4388	11
Seg 14	--	--	15	VU	U	400	6	4692	12
Seg 15	6	U	6	VD	U	400	6	4984	12
Seg 16	--	--	--	H	--	100	27	5499	55
Seg 17	--	--	3	H	--	100	27	6073	61
Seg 18	--	--	35	VD	D	400	4	6339	16
Seg 19	4	D	48	VU	D	400	4	6424	16
Seg 20	--	--	6	VU	U	400	6	6483	16
Seg 21	6	U	16	H	--	400	2	6621	17
Seg 22	6	U	9	VD	U	400	6	6995	17
Seg 23	--	--	--	H	--	400	2	7060	18
Seg 24	--	--	77	N	--	--	--	7297	--

Bend Notation: N = No Bend; H = Horizontal Bend; VU = Vertical Concave Up Bend;
VD = Verticle Concave Down Bend; R = Roller/Sheave; PPD = Push/Pull Device

Directional Notation: U = Gravitationally Up; D = Gravitationally Down

Pull-Planner™ 3000
Pull Tension Calculations

Pull I.D.: Union Sub to Vault 1 Rev A

Conduit Inner Diameter: 6.06 Inch(es) Conduit Fill: 56.4 %

Total of 1 Cable(s) of 1 different types being pulled.

Type # 1 1 Cable(s) O.D. of 4.55 Inch(es) Weight of 15.4 lbs/ft

Total Cable Weight: 15.4 lbs/ft

Calculated weight correction factor: 1

Configuration: Single Cable

Jam/Clearance Analysis: Jamming Not Possible

COF = 0.2 Incoming Tension 500 lbs

	Straight Section Angle	Up or Down	Straight Section Length (ft)	Bend Type	Up or Down	Bend Radius (ft)	Bend Angle	Tension (lbs)	Sidewall Pressure (lbs/ft)
Seg 1	--	--	6	H	--	40	90	801	20
Seg 2	--	--	10	H	--	30	90	1177	39
Seg 3	--	--	--	H	--	30	3	1190	40
Seg 4	--	--	1	VU	U	400	3	1279	3
Seg 5	3	U	16	VD	U	400	3	1429	4
Seg 6	--	--	2	H	--	75	59	1848	25
Seg 7	--	--	--	VD	D	400	4	1945	5
Seg 8	4	D	10	VU	D	400	4	2064	5
Seg 9	--	--	10	VU	U	400	5	2264	6
Seg 10	5	U	--	H	--	50	33	2555	51
Seg 11	5	U	--	VD	U	400	5	2732	7
Seg 12	--	--	36	H	--	35	89	3895	111
Seg 13	--	--	95	H	--	75	22	4534	60
Seg 14	--	--	20	H	--	100	22	4982	50
Seg 15	--	--	20	H	--	400	2	5099	13
Seg 16	--	--	30	H	--	400	2	5248	13
Seg 17	--	--	25	H	--	55	21	5735	104
Seg 18	--	--	--	H	--	55	21	6176	112
Seg 19	--	--	31	N	--	--	--	6271	--

Bend Notation: N = No Bend; H = Horizontal Bend; VU = Vertical Concave Up Bend;
VD = Verticle Concave Down Bend; R = Roller/Sheave; PPD = Push/Pull Device

Directional Notation: U = Gravitationally Up; D = Gravitationally Down

Pull-Planner™ 3000
Pull Tension Calculations

Pull I.D.: Union Sub to Vault 1 Rev A (reversed)

Conduit Inner Diameter: 6.06 Inch(es) Conduit Fill: 56.4 %

Total of 1 Cable(s) of 1 different types being pulled.

Type # 1 1 Cable(s) O.D. of 4.55 Inch(es) Weight of 15.4 lbs/ft

Total Cable Weight: 15.4 lbs/ft

Calculated weight correction factor: 1

Configuration: Single Cable

Jam/Clearance Analysis: Jamming Not Possible

COF = 0.2 Incoming Tension 500 lbs

	Straight Section Angle	Up or Down	Straight Section Length (ft)	Bend Type	Up or Down	Bend Radius (ft)	Bend Angle	Tension (lbs)	Sidewall Pressure (lbs/ft)
Seg 1	--	--	31	H	--	55	21	673	12
Seg 2	--	--	--	H	--	55	21	754	14
Seg 3	--	--	25	H	--	400	2	874	2
Seg 4	--	--	30	H	--	400	2	1010	3
Seg 5	--	--	20	H	--	100	22	1219	12
Seg 6	--	--	20	H	--	75	22	1417	19
Seg 7	--	--	95	H	--	35	89	2359	67
Seg 8	--	--	36	VD	D	400	5	2598	6
Seg 9	--	--	--	H	--	50	33	2928	59
Seg 10	--	--	--	VU	D	400	5	3064	8
Seg 11	--	--	10	VU	U	400	4	3240	8
Seg 12	4	U	10	VD	U	400	4	3429	9
Seg 13	--	--	--	H	--	75	59	4252	57
Seg 14	--	--	2	VD	D	400	3	4359	11
Seg 15	3	D	16	VU	D	400	3	4498	11
Seg 16	--	--	1	H	--	30	3	4549	152
Seg 17	--	--	--	H	--	30	90	6236	208
Seg 18	--	--	10	H	--	40	90	8590	215
Seg 19	--	--	6	N	--	--	--	8608	--

Bend Notation: N = No Bend; H = Horizontal Bend; VU = Vertical Concave Up Bend;
VD = Verticle Concave Down Bend; R = Roller/Sheave; PPD = Push/Pull Device

Directional Notation: U = Gravitationally Up; D = Gravitationally Down

Pull-Planner™ 3000
Pull Tension Calculations

Pull I.D.: Union Sub to Vault 2 Rev A

Conduit Inner Diameter: 6.06 Inch(es) Conduit Fill: 56.4 %

Total of 1 Cable(s) of 1 different types being pulled.

Type # 1 1 Cable(s) O.D. of 4.55 Inch(es) Weight of 15.4 lbs/ft

Total Cable Weight: 15.4 lbs/ft

Calculated weight correction factor: 1

Configuration: Single Cable

Jam/Clearance Analysis: Jamming Not Possible

COF = 0.2 Incoming Tension 500 lbs

	Straight Section Angle	Up or Down	Straight Section Length (ft)	Bend Type	Up or Down	Bend Radius (ft)	Bend Angle	Tension (lbs)	Sidewall Pressure (lbs/ft)
Seg 1	--	--	6	H	--	40	90	801	20
Seg 2	--	--	--	VD	D	400	5	900	2
Seg 3	5	D	--	VU	D	400	5	1001	3
Seg 4	--	--	--	VU	U	400	5	1151	3
Seg 5	5	U	--	VD	U	400	5	1303	3
Seg 6	--	--	10	H	--	30	90	1851	62
Seg 7	--	--	--	H	--	30	3	1871	62
Seg 8	--	--	1	VU	U	400	3	1967	5
Seg 9	3	U	16	VD	U	400	3	2124	5
Seg 10	--	--	2	H	--	75	59	2678	36
Seg 11	--	--	--	VD	D	400	4	2787	7
Seg 12	4	D	10	VU	D	400	4	2918	7
Seg 13	--	--	10	VU	U	400	5	3133	8
Seg 14	5	U	--	H	--	50	33	3526	71
Seg 15	5	U	--	VD	U	400	5	3720	9
Seg 16	--	--	36	H	--	35	89	5239	150
Seg 17	--	--	95	H	--	75	22	5982	80
Seg 18	--	--	20	H	--	100	22	6541	65
Seg 19	--	--	20	H	--	400	2	6666	17
Seg 20	--	--	30	H	--	400	2	6822	17
Seg 21	--	--	120	N	--	--	--	7192	--

Bend Notation: N = No Bend; H = Horizontal Bend; VU = Vertical Concave Up Bend;
VD = Verticle Concave Down Bend; R = Roller/Sheave; PPD = Push/Pull Device

Directional Notation: U = Gravitationally Up; D = Gravitationally Down

Pull-Planner™ 3000
Pull Tension Calculations

Pull I.D.: Union Sub to Vault 2 Rev A (reversed)

Conduit Inner Diameter: 6.06 Inch(es) Conduit Fill: 56.4 %

Total of 1 Cable(s) of 1 different types being pulled.

Type # 1 1 Cable(s) O.D. of 4.55 Inch(es) Weight of 15.4 lbs/ft

Total Cable Weight: 15.4 lbs/ft

Calculated weight correction factor: 1

Configuration: Single Cable

Jam/Clearance Analysis: Jamming Not Possible

COF = 0.2 Incoming Tension 500 lbs

	Straight Section Angle	Up or Down	Straight Section Length (ft)	Bend Type	Up or Down	Bend Radius (ft)	Bend Angle	Tension (lbs)	Sidewall Pressure (lbs/ft)
Seg 1	--	--	120	H	--	400	2	913	2
Seg 2	--	--	30	H	--	400	2	1049	3
Seg 3	--	--	20	H	--	100	22	1260	13
Seg 4	--	--	20	H	--	75	22	1460	19
Seg 5	--	--	95	H	--	35	89	2417	69
Seg 6	--	--	36	VD	D	400	5	2657	7
Seg 7	--	--	--	H	--	50	33	2994	60
Seg 8	--	--	--	VU	D	400	5	3131	8
Seg 9	--	--	10	VU	U	400	4	3308	8
Seg 10	4	U	10	VD	U	400	4	3498	9
Seg 11	--	--	--	H	--	75	59	4336	58
Seg 12	--	--	2	VD	D	400	3	4444	11
Seg 13	3	D	16	VU	D	400	3	4584	11
Seg 14	--	--	1	H	--	30	3	4636	155
Seg 15	--	--	--	H	--	30	90	6355	212
Seg 16	--	--	10	VD	D	400	5	6583	16
Seg 17	--	--	--	VU	D	400	5	6567	16
Seg 18	--	--	--	VU	U	400	5	6598	16
Seg 19	--	--	--	VD	U	400	5	6824	17
Seg 20	--	--	--	H	--	40	90	9352	234
Seg 21	--	--	6	N	--	--	--	9370	--

Bend Notation: N = No Bend; H = Horizontal Bend; VU = Vertical Concave Up Bend;
VD = Verticle Concave Down Bend; R = Roller/Sheave; PPD = Push/Pull Device

Directional Notation: U = Gravitationally Up; D = Gravitationally Down

Pull-Planner™ 3000
Pull Tension Calculations

Pull I.D.: Vault 1 to Vault 3 Rev A

Conduit Inner Diameter: 6.06 Inch(es) Conduit Fill: 56.4 %

Total of 1 Cable(s) of 1 different types being pulled.

Type # 1 1 Cable(s) O.D. of 4.55 Inch(es) Weight of 15.4 lbs/ft

Total Cable Weight: 15.4 lbs/ft

Calculated weight correction factor: 1

Configuration: Single Cable

Jam/Clearance Analysis: Jamming Not Possible

COF = 0.2 Incoming Tension 500 lbs

	Straight Section Angle	Up or Down	Straight Section Length (ft)	Bend Type	Up or Down	Bend Radius (ft)	Bend Angle	Tension (lbs)	Sidewall Pressure (lbs/ft)
Seg 1	--	--	34	H	--	55	21	683	12
Seg 2	--	--	--	H	--	55	21	765	14
Seg 3	--	--	25	H	--	400	2	885	2
Seg 4	--	--	--	VD	D	400	6	1000	2
Seg 5	6	D	9	H	--	400	2	1057	3
Seg 6	6	D	16	VU	D	400	6	1199	3
Seg 7	--	--	6	VU	U	400	4	1336	3
Seg 8	4	U	48	VD	U	400	4	1658	4
Seg 9	--	--	35	H	--	100	27	1995	20
Seg 10	--	--	3	H	--	100	27	2252	23
Seg 11	--	--	--	VD	D	400	6	2396	6
Seg 12	6	D	6	VU	D	400	6	2552	6
Seg 13	--	--	15	VU	U	400	6	2818	7
Seg 14	6	U	20	VD	U	400	6	3137	8
Seg 15	--	--	98	H	--	100	38	3970	40
Seg 16	--	--	39	VD	D	400	7	4297	11
Seg 17	7	D	--	H	--	100	39	4960	50
Seg 18	7	D	--	VU	D	400	7	5188	13
Seg 19	--	--	12	VU	U	400	11	5785	14
Seg 20	11	U	26	VD	U	400	11	6528	16
Seg 21	--	--	68	VD	D	400	7	7010	18
Seg 22	7	D	26	VU	D	400	7	7016	18
Seg 23	--	--	30	VU	U	400	5	7149	18
Seg 24	5	U	--	H	--	55	21	7696	140
Seg 25	5	U	--	H	--	55	21	8285	151
Seg 26	5	U	21	N	--	--	--	8378	--

Bend Notation: N = No Bend; H = Horizontal Bend; VU = Vertical Concave Up Bend;
VD = Verticle Concave Down Bend; R = Roller/Sheave; PPD = Push/Pull Device

Directional Notation: U = Gravitationally Up; D = Gravitationally Down

Pull-Planner™ 3000
Pull Tension Calculations

Pull I.D.: Vault 1 to Vault 3 Rev A (reversed)

Conduit Inner Diameter: 6.06 Inch(es) Conduit Fill: 56.4 %

Total of 1 Cable(s) of 1 different types being pulled.

Type # 1 1 Cable(s) O.D. of 4.55 Inch(es) Weight of 15.4 lbs/ft

Total Cable Weight: 15.4 lbs/ft

Calculated weight correction factor: 1

Configuration: Single Cable

Jam/Clearance Analysis: Jamming Not Possible

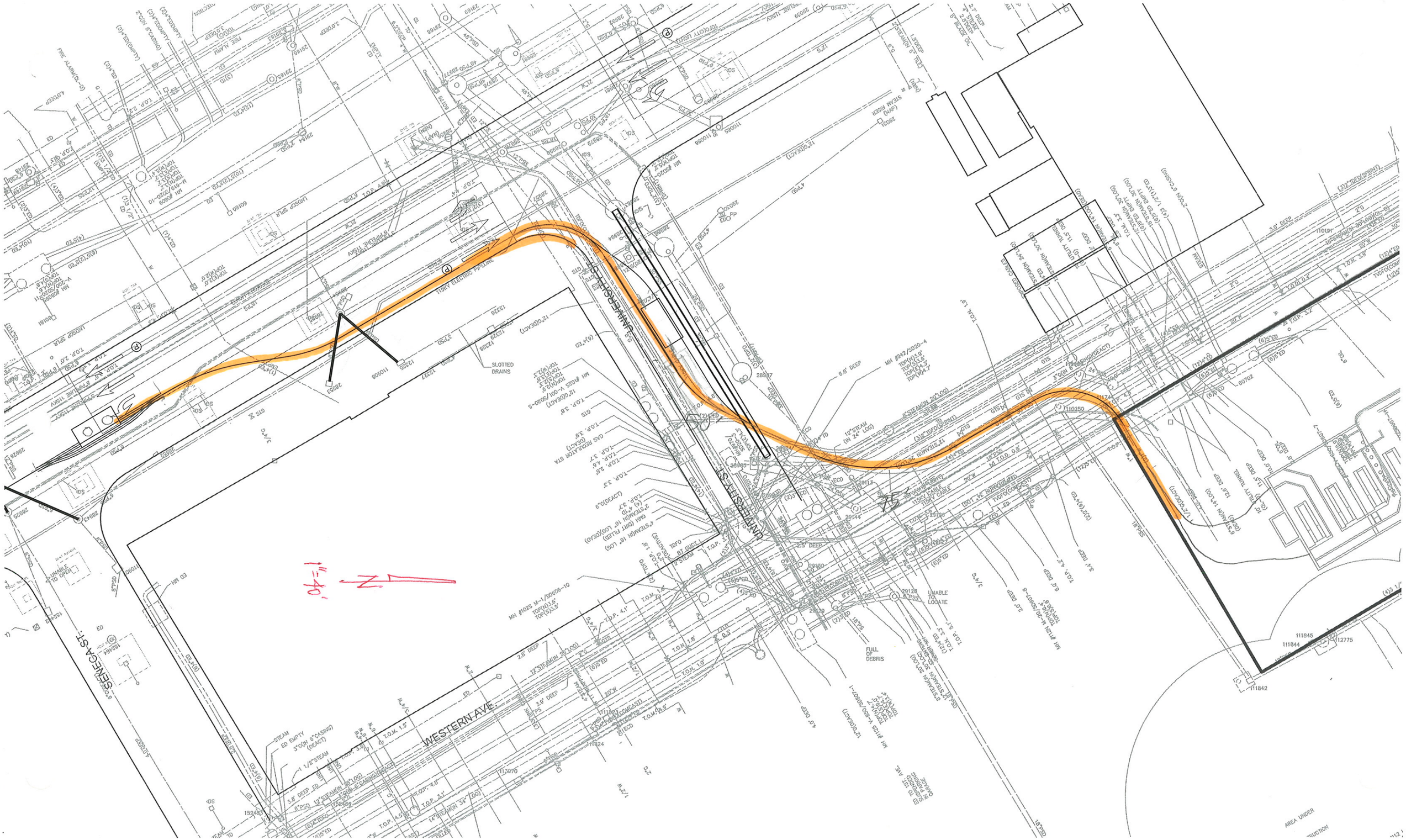
COF = 0.2 Incoming Tension 500 lbs

	Straight Section Angle	Up or Down	Straight Section Length (ft)	Bend Type	Up or Down	Bend Radius (ft)	Bend Angle	Tension (lbs)	Sidewall Pressure (lbs/ft)
Seg 1	5	U	21	N	--	--	--	593	--
Seg 2	--	--	--	H	--	55	21	670	12
Seg 3	--	--	--	H	--	55	21	751	14
Seg 4	--	--	--	VU	D	400	5	849	2
Seg 5	--	--	30	VU	U	400	7	1163	3
Seg 6	7	U	26	VD	U	400	7	1522	4
Seg 7	--	--	68	VD	D	400	11	1924	5
Seg 8	11	D	26	VU	D	400	11	2126	5
Seg 9	--	--	12	VU	U	400	7	2415	6
Seg 10	--	--	--	H	--	100	39	2829	28
Seg 11	--	--	--	VD	U	400	7	3098	8
Seg 12	--	--	39	H	--	100	38	3721	37
Seg 13	--	--	98	VD	D	400	6	4204	11
Seg 14	6	D	20	VU	D	400	6	4419	11
Seg 15	--	--	15	VU	U	400	6	4724	12
Seg 16	6	U	6	VD	U	400	6	5017	13
Seg 17	--	--	--	H	--	100	27	5535	55
Seg 18	--	--	3	H	--	100	27	6112	61
Seg 19	--	--	35	VD	D	400	4	6379	16
Seg 20	4	D	48	VU	D	400	4	6464	16
Seg 21	--	--	6	VU	U	400	6	6524	16
Seg 22	6	U	16	H	--	400	2	6662	17
Seg 23	6	U	9	VD	U	400	6	7037	18
Seg 24	--	--	--	H	--	400	2	7102	18
Seg 25	--	--	25	H	--	55	21	7729	141
Seg 26	--	--	--	H	--	55	21	8320	151

	Straight Section Angle	Up or Down	Straight Section Length (ft)	Bend Type	Up or Down	Bend Radius (ft)	Bend Angle	Tension (lbs)	Sidewall Pressure (lbs/ft)
Seg 27	--	--	34	N	--	--	--	8425	--

Bend Notation: N = No Bend; H = Horizontal Bend; VU = Vertical Concave Up Bend;
VD = Verticle Concave Down Bend; R = Roller/Sheave; PPD = Push/Pull Device

Directional Notation: U = Gravitationally Up; D = Gravitationally Down


WESTERN AVE.
SENECA ST.
UNIVERSITY ST.
SLOTTED DRAINS
FULL OF DEBRIS
UNABLE TO LOCATE
AREA UNDER
1" = 40'

CABLE PULL TENSION WORK SHEET

JOB MA-US 1&2
JOB NO. 120332
DATE: 4/4/11
LOCATION P. VAULT 1 TO UNION SUB
BY: BA

SEGMENT	FROM	TO	ANGLE FROM HORIZONTAL	STRAIGHT SECTION LENGTH	BEND TYPE	RADIUS	ANGLE	RISE	RUN
1	PV1	HB1	—	29'	H	100'	22°		
2	HB1	HB2	—	21'	H	75'	22°		
3	HB2	HB3	—	93'	H	35'	89°		
4	HB3	HB4	—	62'	H	50'	33°		
5	HB4	HB5	—	53'	H	75'	53°		
6	HB5	HB6	—	39'	H	30'	90°		
7	—	—	—	—	H	30'	2°		
8	HB6	SUB	—	49'	—	—	—		

PULL-PLANNER™ 2000

PULL I.D.: MAUS_V1SUB

CONDUIT INNER DIAMETER: 6.62 INCHES CONDUIT FILL: 48 %

'AL OF 1 CABLES OF 1 DIFFERENT TYPES BEING PULLED.

CABLE # 1 1 CABLES O.D. OF 4.63 INCHES WEIGHT OF 15.2 LBS/FT

TOTAL CABLE WEIGHT: 15.2 LBS/FT

CALCULATED WEIGHT CORRECTION FACTOR: 1

CONFIGURATION: SINGLE CABLE

JAM/CLEARANCE ANALYSIS: JAMMING NOT POSSIBLE

COF= 0.15 INCOMING TENSION= 500 LBS

	STRA SECT ANGL	Up OR Down	STRA SECT LEN(ft)	BEND TYPE	Up OR Down	BEND RAD(ft)	BEND ANGLE	TENSION(lbs)	SW PRES (lbs/ft)
SEG 1	0	NA	29	HZTL	NA	100	22	661	7
SEG 2	0	NA	21	HZTL	NA	75	22	787	10
SEG 3	0	NA	93	HZTL	NA	35	89	1292	37
SEG 4	0	NA	62	HZTL	NA	50	33	1579	32
SEG 5	0	NA	53	HZTL	NA	75	58	2031	27
SEG 6	0	NA	39	HZTL	NA	30	90	2695	90
SEG 7	0	NA	0	HZTL	NA	30	2	2709	90
SEG 8	0	NA	49	NONE	NA	0	0	2821	90

CLIENT NAME:	**Seattle City Light**	PREPARED BY:	Garth VanHorn
PROJECT NAME:	**MA-US 1&2**	DATE:	6/2/2011
SYSTEM:	**115kV, XLPE**	CHECKED BY:	Joey Hunter
PROJECT NUMBER:	**122724**	DATE:	6/3/2011
		CHECKED BY:	
		DATE:	

Manhole Length (ft)	20
Riser Sweep Radius (ft)	10

***Preliminary* CABLE CUT LENGTHS MA-US 1&2**

SEGMENT & PHASE	STA-STA LENGTH	HORIZ. SWEEP	RISER SWEEP	STRUCTURE	TERMINATION	VAULT	VERTICAL CONT	CONTINGENCY	TOTAL
Union to Vault 1, A	854		10	15	12	40	8	40	979
Union to Vault 1, B	854	-8	10	15	12	40	8	40	971
Union to Vault 1, C	854	-16	10	15	12	40	8	40	963
Vault 1 to Vault 3, A	1203					40	8	40	1291
Vault 1 to Vault 3, B	1203					40	8	40	1291
Vault 1 to Vault 3, C	1203					40	8	40	1291
Union to Vault 2, A	945		10	15	12	40	8	40	1070
Union to Vault 2, B	945	-8	10	15	12	40	8	40	1062
Union to Vault 2, C	945	-16	10	15	12	40	8	40	1054
Vault 2 to Vault 4, A	1203					40	8	40	1291
Vault 2 to Vault 4, B	1203					40	8	40	1291
Vault 2 to Vault 4, C	1203					40	8	40	1291
Spare Reel	1291	**TOTAL CABLE**		**15136**					

CLIENT NAME:	**Seattle City Light**	PREPARED BY:	Garth VanHorn
PROJECT NAME:	**MA-US 1&2**	DATE:	6/15/2011
SYSTEM:	**115kV, XLPE**	CHECKED BY:	Nathan Scott
PROJECT NUMBER:	**122724**	DATE:	6/20/2011
		CHECKED BY:	
		DATE:	

Manhole Length (ft)	20
Riser Sweep Radius (ft)	10

***Preliminary* CABLE CUT LENGTHS MA-US 1&2 - Yesler to King**

SEGMENT & PHASE	STA-STA LENGTH	HORIZ. SWEEP	RISER SWEEP	STRUCTURE	TERMINATION	VAULT	VERTICAL CONT	CONTINGENCY	TOTAL
Yesler to King, 1A	2000		20	40		40	8	100	2208
Yesler to King, 1B	2000		20	40		40	8	100	2208
Yesler to King, 1C	2000		20	40		40	8	100	2208
Yesler to King, 2A	2000		20	40		40	8	100	2208
Yesler to King, 2B	2000		20	40		40	8	100	2208
Yesler to King, 2C	2000		20	40		40	8	100	2208
Spare Reel	2208	**TOTAL CABLE**		**15456**					

NOTES

1. Sta to Sta length is from bent 122 to bent 92
2. Structure footage is for the vertical section of the viaduct
3. Riser sweep is the footage to sweep on and off the viaduct
4. Total includes spare cable, when cable is ordered the longest reel length is recomended.

Currently spare is added in Union to Yesler and Yesler to Kng segments.

Southwire
HV Solutions

115 kV XLPE - Copper Conductor
Full Wall 800 mil XLPE Cu Corrugated Sheath

Conductor Size in kcmil		750	1000	1250	1500	1750	2000	2500	3000
Dimensional	Nominal								
Conductor Diameter	in	0.97	1.12	1.25	1.37	1.48	1.59	1.77	2.00
	(mm)	(24.7)	(28.5)	(31.8)	(34.8)	(37.6)	(40.4)	(45)	(50.8)
Diameter over Insulation	in	2.64	2.79	2.92	3.04	3.17	3.28	3.46	3.69
	(mm)	(67.1)	(70.8)	(74.2)	(77.3)	(80.6)	(83.2)	(87.9)	(93.7)
Diameter over Sheath	in	3.17	3.33	3.48	3.61	3.75	3.87	4.07	4.32
	(mm)	(80.5)	(84.6)	(88.3)	(91.7)	(95.3)	(98.2)	(103.4)	(109.7)
Overall Jacket Diameter	in	3.48	3.64	3.79	3.92	4.06	4.18	4.38	4.63
	(mm)	(88.4)	(92.5)	(96.3)	(99.6)	(103.2)	(106.2)	(111.3)	(117.6)
Total Weight	lbs/ft	6.2	7.3	8.3	9.2	10.2	11.2	13.1	15.2
Min. Bending Radius (pulling/training)	in	52/35	55/36	57/38	59/39	61/41	63/42	66/44	69/46
Maximum Pulling Tension	lbs	6,000	8,000	10,000	12,000	14,000	16,000	20,000	24,000
Typical Shipping Reel Size									
Flange x Traverse	in	138x95	138x95	138x95	138x95	138x95	138x95	158x95	158x95
Shipping Reel Capacity*	ft	>3,000	>3,000	2,650	2,700	2,550	2,425	2,250	2,150
Electrical									
Electrical Stress @ U_o									
Conductor Shield	kV/mm	5.4	5.2	5.0	4.9	4.7	4.7	4.5	4.4
Insulation Shield	kV/mm	2.1	2.2	2.3	2.3	2.4	2.4	2.4	2.5
Short Circuit for 0.5s**									
Conductor	kA	76.9	102.5	128.1	153.8	179.4	205	256.3	307.5
Sheath	kA	39.7	41.7	43.6	45.2	47	48.4	51	54.1
Conductor Resistance									
DC @ 20° C	Ω/kft	0.014	0.011	0.008	0.007	0.006	0.005	0.004	0.004
DC @ 90° C	Ω/kft	0.018	0.014	0.011	0.009	0.008	0.007	0.005	0.005
Capacitance	pF/ft	41.8	45.7	49.1	52.2	55.5	58.1	62.8	68.5
Charging Current	Amps/kft	1.04	1.14	1.22	1.30	1.38	1.49	1.58	1.72
Ampacity @ 90° C	per circuit								
Typical Single Ductbank***	Amps	740	860	960	1040	1110	1170	1270	1350
Power Rating	MVA	148	172	192	208	222	234	253	269
Typical Double Ductbank***	Amps	630	730	810	870	930	980	1060	1120
Power Rating	MVA	126	146	162	174	186	196	212	224

*Increased shipping reel capacity can be accomodated on request.
**Declared values for 30 mils copper sheath. Thicker sheath can accommodate more current.
***4ft top of duct, 1°C-m/W native, 0.8°C/W ductbank backfill, 25°C Ambient, 75% lf, 9" spacing, single-point or cross bonde

Southwire
HV Solutions

115 kV XLPE Cable

Cable Construction
Reverse Concentric Stranded Copper, Compressed Conductor
Super Smooth Conductor Shield
Super Clean XLPE Insulation
Full Wall - 800 mil XLPE
True Triple Extrusion, Dry Cured and Dry Cooled
Firmly Bonded Insulation Shield
Welded Copper Corrugated Sheath
Polyethylene Jacket with Extruded Semi-Conductive Outer Layer

Cable Data	
Voltage Characteristics (kV)	
Max Voltage Rating	120
BIL Rating	550
Temperatures (°C)	
Nominal Conductor	90
Max. Emergency Conductor	105/130
Short Circuit Conductor	250
Minimum Installation	-10
Design Characteristics	
Design Standards	AEIC, IEC
Typical Test Voltages	200 kV / 15 min.
XLPE Loss Factor	0.0005
Relative Permittivity	2.3

Seattle City Light

MATERIAL STANDARD

115 KV, 2500 KCMIL, 1/C, XLPE INSULATED CABLE

1. Scope

This material standard covers the detailed requirements for 115 kV, 2500 kcmil, cross-linked polyethylene (XLPE), single conductor cable used for the transmission of electric energy.

Industry designation: 1/C

This material standard applies to the following Seattle City Light Stock Number:

Stock Number	**012801**
Size	2500 kcmil

Cable joint and termination requirements are outside the scope of this Material Standard.

Commission testing requirements of installed cable prior to energization are outside the scope of this Material Standard.

2. Application

Cable is intended for use on a nominal 115 kV, three-phase, grounded, wye-connected power system.

	System Characteristics and Design Criteria	Reference
Stock Number	**012801**	SCL
Size	2500 kcmil	various
Frequency	60 Hz	SCL
Operating voltage, ph-ph		
nominal	115 kV	SCL
maximum	121 kV	SCL
Basic impulse voltage (BIL)	550 kV crest	SCL
Fault current		
symmetrical	35 kA	SCL
duration	30 cycles	SCL
Location	wet	SCL

Seattle City Light assumes responsibility for determining the normal ampacity rating of cable.

3. General Requirements

This detailed material standard is to be used in conjunction with the latest revision of Seattle City Light Material Standard 6050.00, "High Voltage, XLPE Insulated Cable – General."

4. Industry Standards

Cable shall meet the requirements of the following industry standards:

AEIC CS9-2006 – Specification for Extruded Insulation Power Cables and Their Accessories Rated Above 46kV through 345 kVAC

ICEA S-108-720-2004 – Standard for Extruded Insulation Power Cables Rated Above 46 through 345 kV

Refer to Material Standard 6050.00 to obtain the appropriate revision date for other referenced industry standards.

5. Construction

5.1 General

Unless indicated otherwise, all values cited below should be consistent with industry standards - they are repeated here for the convenience of the reader. Values or requirements different from industry standards are identified with the symbol ▲. In some situations, the ▲ symbol offers warning that special requirements are located in Material Standard 6050.00.

5.2 Conductor

	Requirements	Reference
Stock Number	**012801**	SCL
Size	2500 kcmil	various
Diameter		
minimum	1.788 in	ICEA S-108-720, Section 2.5
nominal	1.824 in	ASTM B8
maximum	1.860 in	ICEA S-108-720, Section 2.5
Metal	copper	ASTM B49

standards coordinator	*standards supervisor*	*unit director*
John Shipek	John Shipek	Darnell Cola

5. Construction, continued

5.2 Conductor, continued

	Requirements	Reference
Stock Number	**012801**	SCL
Stranding type	concentric-lay	ASTM B8
Class	B	ASTM B8
Number of strands	127	ASTM B8, Table 1
Temper	soft drawn, annealed prior to stranding	ASTM B3
Lay, outer layer	left hand	ASTM B8, Section 5.5.1
Sealant for stranded conductors	not required or desired	ICEA S-108-720, Section 2.2

5.3 Conductor Shield (Stress Control Layer)

	Requirements	Reference
Stock Number	**012801**	SCL
Size	2500 kcmil	various
Thickness, minimum point	30 mil	ICEA S-108-720, Part 3, Table 3.1
Material	formulated with acetylene black ▲	SCL and AEIC CS9, Section 2.2.2

5.4 Insulation

	Requirements	Reference
Stock Number	**012801**	SCL
Size	2500 kcmil	various
Material	crosslinked polyethylene (XLPE) with no mineral fillers	ICEA S-108-720, Section 4.1
Approved material formulations	specified in general Material Standard	SCL 6050.00

5.4 Insulation, continued

	Requirements	Reference
Stock Number	**012801**	SCL
Thickness		
minimum	760 mil	SCL
nominal	800 mil	ICEA S-108-720, Appendix F, Table F-1
maximum	840 mil	SCL
Basic Impulse Level (BIL)	550 kV crest	ICEA S-108-720, Section 4.3, Table 4-6

5.5 Extruded Insulation Shield

	Requirements	Reference
Stock Number	**012801**	SCL
Size	2500 kcmil	various
Material	discharge-free (thermosetting material)	SCL
Thickness		
minimum point	40 mil	ICEA S-108-720, Section 5.2, Table 5-1
maximum point	100 mil	ICEA S-108-720, Section 5.2, Table 5-1

5.6 Metallic Shield/Sheath

	Requirements	Reference
Stock Number	**012801**	SCL
Size	2500 kcmil	various
Metal and type	welded corrugated copper or laminated copper foil longitudinally folded and bonded to the jacket	ICEA S-108-720, Part 6

5. Construction, continued

5.6 Metallic Shield/Sheath, continued

	Requirements	Reference
Stock Number	**012801**	SCL
Radial moisture barrier	required ▲	ICEA S-108-720, Section 6.4
Water blocking components for metallic shield	required ▲	ICEA S-108-720, Section 6.5

5.7 Jacket (Non-Metallic Covering)

	Requirements	Reference
Stock Number	**012801**	SCL
Size	2500 kcmil	various
Material	linear low density polyethylene (LLDPE)	ICEA S-108-720, Section 7.1.1
Color	black	ICEA S-108-720, Section 7.1.1
Thickness		
minimum point	100 mil	ICEA S-108-720, Section 7.2.1, Table 7-5
maximum point	160 mil	ICEA S-108-720, Section 7.2.1, Table 7-5
Semi-conducting coating	required	AEIC CS9, Section 2.6.3
Maximum diameter over jacket	4.32 in ▲	SCL preference

5.8 Assembly and Identification

	Requirements	Reference
Stock Number	**012801**	SCL
Size	2500 kcmil	various
Center strand identification	not required	ICEA S-108-720, Section 8.1.1
Sequential length marking	required ▲	ICEA S-108-720, Section 8.1.2

6. Packaging

	Requirements	Reference
Stock Number	**012801**	SCL
Size	2500 kcmil	various
Reel type	steel fluted	WC 26, Section 2.1.2
Flange diameter, maximum	as specified on purchase order	SCL preference
Outside width, maximum	as specified on purchase order	SCL preference
Drum diameter, minimum	as specified on purchase order	SCL preference
Length per reel, +1.5, -0%	as specified on purchase order	SCL preference

7. Issuance

	Requirements	Reference
Stock Number	**012801**	SCL
Size	2500 kcmil	various
Stock Unit	FT	SCL

8. Approved Manufacturers

Brugg Cables, LLC

General Cable / SILEC

J-Power Systems (JPS)

Prysmian

Southwire Company/Forte Power Systems

9. References

6050.00; "High Voltage, XLPE Insulated Cable – General"; SCL Material Standard

IEC 60840; *Power Cables with Extruded Insulation and Their Accessories for Rated Voltages above 30 kV (Um = 36 kV) up to 150 kV (Um = 170 kV) - Test Methods and Requirements;* International Electrotechnical Commission; April 2004 (Edition 3)

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