GENERAL STAKING GUIDELINES

1. SCOPE:

1.1 The purpose of this document is to provide detailed guidelines for both internal and contracted persons performing staking duties that are not defined within other internal PRECorp documents or which are in excess of RUS standards.

2. DOCUMENTS:

2.1 RUS Bulletin 1728F-803 Specifications and Drawings for 24.9/14.4 KV Line Construction

2.2 RUS Bulletin 1728F-806 Specifications and Drawings for Underground Electric Distribution

2.3 RUS Bulletin 1724E-153 Electric Distribution Line Guys and Anchors

3. GENERAL:

3.1 All staking must meet or exceed all applicable NESC and RUS requirements as a minimum unless otherwise specified within this or the referenced documents.

3.2 Perform staking operations according to RUS heavy loading tables and charts.

3.3 Lightening arrestors are to be placed every mile (3∅ VP1.3R).

3.3.1 Arrestors should not be placed on double cross arm units.

3.4 Use a Driven Ground Rod (H1.1) on all equipment and meter poles, and as per NESC guidelines (4 per running mile). All other poles are per P2.1.

3.5 Utilize vertical angle units for all angles exceeding VC2 type units. Double buck arm angles must be approved by PRECorp Engineering.

3.6 The pole will be staked two feet into the bisect angle on VC3.1 and VC3.2L assemblies.

3.7 Use poles at least forty feet long in cultivated areas and road crossings.

3.8 Acquire permission from the landowner to enter their property to survey or for any other reason.

3.9 Provide landowner's legal names as it appears on the Warranty Deed and their current address as it appears on tax documents.

3.9.1 Verify all landowner's names.

3.9.2 Provide PRECorp with power line easement in Powder River Energy Corporation's name. Any non-standard language additions or clauses attached as part of easement must have prior approval by PRECorp representatives in Engineering or Operations.

3.9.2.1 Minimum easement without approval is thirty (30) feet for above ground line installation for Right-of-way.

3.9.2.2 Minimum easement without approval is twenty (20) feet for underground line installation for Right-of-way.

3.10 As required, removal staking sheets will be generated.

3.10.1 Existing poles will be recorded as Class 5 or greater.

3.11 Permits shall be provided for county roads, highways, interstates, and railroads crossings as applicable.

3.11.1 An under build crossing permit for transmission line crossing is required pending the owner's requirements.

3.12 Transmission lines, fences, edge of road, center line, and nearest pole location must be profiled.

3.13 Sectionalizing requirements: Taps in length of one (1) mile or greater, requires sectionalizing review of the design.

3.14 'Adds lights' should be notated on the staking sheets in the comments section when required.

3.15 All overhead distribution lines will be designed to RUS 1728F-803 Construction Assemblies regardless of system voltage.

3.16 Existing take-off poles that are forty years or older, as identified by the pole brand or other data, shall be retired and replaced with a pole and current construction assemblies.

4. <u>EASEMENTS & RIGHT-OF-WAY EXHIBITS</u>

4.1 Property Boundaries

4.1.1 Demarcation between landowners – the DDT is to record a minimum of two points that will be used to establish the property boundaries. Acceptable points includes lot pins, monuments, brass caps, and surveyor set/established points. If these points can't be found or do not exist then the DDT is to gather support evidence that may be used to establish property boundaries such as fence lines fence corners preferred, center of roads and reproduced points referenced from recorded plats and/or property deeds.

4.1.2 If a lot pin, monument, bras cap or surveyor set points are found the DDT is to record all information include on the cap, if any, the type and size of the cap, rebar, etc.

4.2 Anchor & Guy Locations

4.2.1 Guy & Anchor Exception Points are to be label with alpha characters, starting at the origin and sequential increasing along the alignment to the termination point. The first exception point is to be labeled P-A, followed by P-B, P-C …… P-Y, P-Z, P-AA, P-AB, P-AC ……. P-AY, P-AZ, P-BA, P-BB etc.

4.2.2 The DDT is to label each exception point and record the longest guy lead at that location

4.2.3 The Easement area surrounding the anchor and guys will extend an additional ten (10) feet beyond the longest guy lead at this location rounded up to the nearest five (5) feet increment.

Examples: 27 ft. guy would result in a 40 ft. radius (27ft + 10ft = 37ft round up to 40ft)

30 ft. guy would result in a 40 ft. radius (30ft + 10ft = 40ft)

31 ft. guy would result in a 45 ft. radius (31ft + 10ft = 41ft round up to 45ft)

4.3 Reduced/Expanded Easement Widths

4.3.1 Reduced/Expanded Easement Width Exceptions are to be label with alpha characters, starting at the origin and sequential increasing along the alignment to the termination point. The first exception is to be labeled L-A, followed by L-B, L-C …… L-Y, L-Z, L-AA, L-AB, L-AC ……. L-AY, L-AZ, L-BA, L-BB etc.

4.3.2 The DDT is to label each exception and record the reduced easement width along this segment of the alignment.

4.4 Changes in Land Types

4.4.1 The DDT is to label changes in land type along the alignment and recorded the type of land that is being crossed. This information shall include the total distance for each type.

4.4.1.1 The three categories of land are:

4.4.1.1.1 Pastures, Rangelands and Grasslands, common terms used to describe this category are grasslands, shrub lands, deserts, and plains and is land that is occupied by native plants or shrubby vegetation, which is grazed by domestic livestock and/or wild animals. The vegetation ranges may include tallgrass prairies, steppes (shortgrass prairies) and desert shrub lands.

4.4.1.1.2 Cultivated Lands, common terms used to describe this category are cultivated land, plough land, plow land, tillage, farmland, cropland, and tilled lands. This land is typically worked by plowing and sowing, and raising crops.

4.4.1.1.3 Forested Lands, common terms used to describe this category are forest, timber, timberlands, woods, and woodlands.

4.4.1.1.3.1 Land with tree crown cover (or equivalent stocking level) of more than ten (10) percent and area of more than one (1) acre. (1 acre = 43,560 square feet; roughly a 200ft by 200ft square)

4.4.1.1.3.2 The trees should be able to reach a minimum height of fifteen (15) feet at maturity

4.4.1.1.3.3 May consist <u>either</u> of closed forest formations where trees of various heights and undergrowth cover a high proportion of the ground; or open forest formations with a continuous vegetation cover in which tree crown cover exceeds ten (10) percent

4.4.1.1.3.4 Young natural stands and all plantations established for forestry purposes which have yet to reach a crown density of ten (10) percent or tree height of fifteen (15) feet are included under forest, as are areas normally forming part of the forest area which are temporarily unstocked as a result of human intervention or natural causes but which are expected to revert to forest.

5. STAKING SHEETS:

5.1 All staking sheets will be generated using NISC MapWise (FES) software (or otherwise PRECorp approved format) that complies with RUS standard sheets per RUS Bulletin 1728F-803 24.9/14.4 KV Construction.

5.2 Note any change of property ownership in the remarks section.

5.3 Each staking sheet will include a sketch of the power line showing some detail of the area.

5.4 A map will be provided showing the location of power line with takeoff, taps, angles, meter points, and transformer locations. Note existing service location number if applicable.

5.5 Retirement map showing landowners and location of structures to be retired.

5.6 Maps shall provide detail to determine the number of structures/stations to be constructed/retired.

5.7 GPS data of the line will be provided in PRECorp format that shows all structures, meter points, and transformer locations.

5.8 Reference PRECorp revised drawings when applicable (ex. VC1.11LR).

6. CLEARANCES:

6.1 **Street/Road/Highway/Railroad Clearances**

6.1.1 It is the preferred practice to maintain ~22’ minimum on all CBM and Oil roads.

6.1.2 The minimum clearance over all state and federal highways shall exceed the NESC Code minimum by seven (7) feet at all locations for both crossing and encroachments. This minimum will be computed at a maximum conductor or cable sag and shall also apply to under built facilities. This will result in a 25.5-foot minimum clearance for state and federal highways.

6.1.3 Additional minimum clearances are given in Table 1.

Description	Minimum Vertical Clearances (linear feet)
Streets, Driveways	Phase: 18.5 Neutral: 15.5
County Roads	24
State and Federal Highways	25.5
Over Railroads (Class B Construction)	36

Table 1– Minimum Vertical Clearances Over Roads and Railways

6.2 **Structures/Pipelines/Wells**

6.2.1 Table 2 gives minimum horizontal clearances for Pipelines and Wells.

Description	Minimum Horizontal Clearance (linear feet)
Low Pressure Pipeline	10
High Pressure Pipeline	25
CBM Well	100
Stock Well	50

Table 2– Minimum Horizontal Clearances

6.3 **Conductor Crossings**

6.3.1 Table 3 gives the recommend and minimum vertical clearance between wires, conductors, and cables carried on different supporting structures.

Lower Conductors and Cables	Upper Conductors and Cables: Guys, Span Wires, Neutral Conductor Meeting Rule 230E1 & Surge Protection Wires (feet)	Communication Conductors, Cables, and Messengers (feet)	0-750V Covered Cable) (feet)	Open Supply Conductors: Over 750V to 22kV (4.16kV – 34.5kV Ph-to-Ph) (feet)	Open Supply Conductors: 41.8kV (69kV Ph-to-Ph) (feet)	Open Supply Conductors: 139.7kV (230kV Ph-to-Ph) (feet)
Guys, Span Wires, Neutral Conductor Meeting Rule 230E1 & Surge Protection Wires	5.0 (2.0)	5.0 (2.0)	5.0 (2.0)	6.0 (2.0)	8.0 (2.8)	12.0 (6.2)
Communication Conductors, Cables, and Messengers	5.0 (2.0)	5.0 (2.0)	5.0 (2.0)	10.0 (5.0)	11.0 (6.1)	17.0 (11.9)
750V Covered Cable (600V secondary cable)	5.0 (2.0)	5.0 (2.0)	5.0 (2.0)	6.0 (2.0)	8.0 (2.8)	12.0 (6.3)
Over 750V to 22kV (4.16kV – 34.5kV Phase to Phase)				5.0 (2.0)	8.0 (2.8)	12.0 (6.3)
41.8kV (69kV Phase to Phase)					8.0 (3.6)	13.0 (7.0)
139.7kV (230kV Phase to Phase)						16.0 (10.4)

Table 3: Conductor and Cable Crossing Clearances

7. <u>CONDUCTOR SPECIFICS:</u>

7.1 **For 3∅ 1/0 ACSR Conductor:**

7.1.1 Design shall meet NESC Rule 250B Heavy loading.

7.1.2 A ruling span of 300’ shall be used.

7.1.3 Minimum pole class shall be Class 4.

7.1.4 Neutral conductor shall be 1/0 ACSR.

7.1.5 A horizontal takeoff from existing deadend should be assembly VC5.31HT.

7.1.6 Three phase taps should be designated as assembly VC5.31RT. This unit is a fiberglass crossarm with guy attachments per designations of E4.0L (2 EA).

7.1.7 Deadend units should be designated as assemblies VC5.31DR. This unit has a fiberglass cross arm with guy attachments designations of E4.0L (2 EA).

7.1.8 Double deadends should be designated as VC6.21R.

7.2 **For 3∅ 336.4 ACSR Conductor:**

7.2.1 Design shall meet NESC Rules 250B Heavy Loading and Rule 250C Extreme Wind Loading.

7.2.2 A ruling span of 275’ shall be used.

7.2.3 Minimum pole class shall be Class 4, except for:

7.2.3.1 Line angles over ten (10) degrees, which should be a minimum of Class 3 poles,

7.2.3.2 And vertical angle poles should be a minimum of Class 2.

7.2.4 Neutral conductor shall be 4/0 ACSR.

7.2.5 All angles over 20° require vertical construction units. Avoid putting vertical units on hills if possible.

7.2.6 Horizontal takeoffs from existing deadends should be of designation VC5.71HT.

7.3 **Double 3∅ Circuits**

7.3.1 Design shall meet NESC Rules 250B Heavy Loading and Rule 250C Extreme Wind Loading.

7.3.2 A ruling span of 250 feet shall be used for 336.4 ACSR conductor.

7.3.3 Neutral conductor shall be 336.4 ACSR.

7.4 **Underground Wire Add:**

7.4.1 The total footage for underground cable shall be the length of run of cable plus the adder(s) specified in Table 4. (ex. Cable run from a UA1R(35 ft. pole) to UG7 of 300ft run would require a total length of 300+15+35 = 350ft)

Underground Cable Adder per Run of Cable		
	Primary Cable	**Secondary Cable**
Underground Equipment	+15ft	+10ft
Riser	Pole Height	Pole Height

Table 4 – Underground Cable Adder

8. EQUIPMENT:

8.1 **Transformers:**

8.1.1 All transformers 167 kVA and lower can be pole mounted or URD pad-mount. All transformers larger than 167 kVA will be platform mounted or URD pad-mount.

8.1.2 Table 5 gives the minimal pole class for one transformer installed on a single pole.

Trans. (kVA)	5	10	15	25	37.5	50	75	100	167
Pole Class	5	5	5	5	5	5	4	4	3

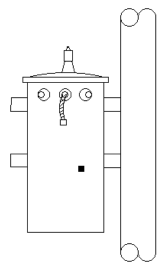

Table 5 – Minimum Pole Class for Single Transformer Mounted on Pole

Table 6 gives the minimal pole class for a bank of two transformers installed on a single pole.

	Transformer B (kVA)								
Transformers A (kVA)	5	10	15	25	37.5	50	75	100	167
5	5	5	5	5	5	5	4	4	3
10		5	5	5	5	4	4	4	3
15			5	5	5	4	4	4	3
25				5	4	3	3	3	3
37.5					3	3	3	3	3
50						3	3	3	3
100							3	3	2
167									2

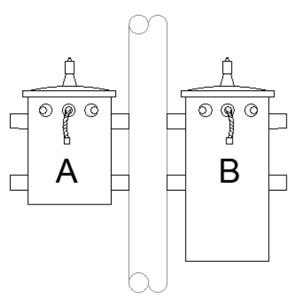

Table 6 – Minimum Pole Class for Two Transformers Mounted on Pole

8.1.3 Table 7 gives the minimal pole class for a bank of three transformers installed on a single pole. A 40 ft. Class 2 pole is the minimal pole length and class for three-phase coal bed methane and oil well services.

Transformers A & C (kVA)*	Transformer B (kVA)								
	5	10	15	25	37.5	50	75	100	167
(2) 5	5	5	*	*	*	*	*	*	*
(2) 10		5	5	*	*	*	*	*	*
(2) 15			4	4	*	*	*	*	*
(2) 25				4	4	3	*	*	*
(2) 37.5					3	3	3	*	*
(2) 50						3	3	2	*
(2) 100							2	2	*
(2) 167								2	2

* The kVA rating of transformer B cannot exceed twice the rating of either transformer A or C.

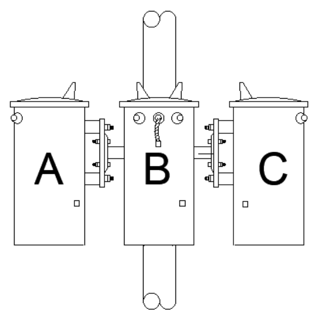

Table 7 – Minimum Pole Class for Three Transformers Mounted on Pole

8.1.4 Transformer sizing for 3∅ 277/480V shall be per Table 8 and designation VG3.4R.

Estimated Load (HP)	Transformer Bank Size (# Units / Individual Rating)
Below 60	3 / 15kVA
60 – 89	3 / 25kVA
90 – 180	3 / 50kVA
181 – 250	3 / 75kVA
251 – 350	3 / 100kVA

Table 8 - 3∅ 277/480V Transformer Sizing

8.1.5 5kVA transformers shall only to be utilized for secondary 100A service.

8.1.6 10kVA and 37.5kVA transformers shall only be staked for pole change outs or engineering approval.

8.2 **Reclosers:**

8.2.1 Single-phase oil circuit reclosers can be installed on a minimum Class 5 pole.

8.2.2 Three-phase oil circuit reclosers can be installed on a minimum Class 5 pole.

8.2.3 Three-phase Electronic (Cooper Triple-Single) can be installed on a minimum Class 4 pole.

9. <u>METERING:</u>

9.1 Each meter site will include a township, range, section numbers, and quarter/quarter location description (ex. 58-83-29 SWNE).

9.2 All 3∅ secondary's shall be a minimum of 4/0 Quad conductor.

9.3 320 class meters are only to be utilized in non-commercial installations.

10. GUYING:

10.1 All guy wire shall be 3/8" High Strength Steel (9720lbs Breaking Strength).

10.2 Only anchors F2.10 shall be used (10,000lb maximum holding power).

10.3 Use RUS Bulletin 1724E-153 Electric Distribution Line Guys and Anchors for tension specifications.

10.4 Use only one guy per anchor.

10.5 Use the E2.1 bolted guy (goat head) designation for 1/0 ACSR conductor.

10.6 For 336.4 ACSR Conductor:

10.6.1 Use 1EA E2.2L pole eye plate guy if the angle is less than 16° and 2EA E2.2L pole eye plate guys if the angle is 16° or greater.

10.6.2 For vertical construction assemblies VC3.2L, use 3EA E2.2L pole eye plates guys. For vertical construction assemblies VC4.2LR, use 8EA E2.2L pole eye plates guys.

10.6.3 Dead-end VC5.71LR assemblies use 1EA E2.2L pole eye plate guys and 2EA E4.0L thimble eye guys for fiberglass arms.