BEFORE THE WASHINGTON

UTILITIES & TRANSPORTATION COMMISSION

WASHINGTON UTILITIES AND TRANSPORTATION COMMISSION,

Complainant,

v.

AVISTA CORPORATION d/b/a AVISTA UTILITIES,

Respondent.

DOCKET NOS. UE-200900 and UG-200901 (*Consolidated*)

PAUL J. ALVAREZ AND DENNIS STEPHENS

ON BEHALF OF THE
WASHINGTON STATE OFFICE OF THE ATTORNEY GENERAL
PUBLIC COUNSEL UNIT

EXHIBIT PADS-27

Avista Supplemental Response to Public Counsel Data Request No. 108, Attachment A

April 21, 2021

AVISTA CORP.
RESPONSE TO REQUEST FOR INFORMATION

JURISDICTION:	WASHINGTON	DATE PREPARED:	02/10/2021
CASE NO.:	UE-200900 & UG-200901	WITNESS:	Heather Rosentrater
REQUESTER:	Public Counsel	RESPONDER:	Kyle Jonas
TYPE:	Data Request	DEPT:	Asset Maintenance
REQUEST NO.:	PC - 108	TELEPHONE:	(509) 495-2695
		EMAIL:	kyle.jonas@avistacorp.com

SUBJECT: Capital Additions, Test Year (Electric)

REQUEST:

RE:
Please refer to Heather L. Rosentrater, Exhibit HLR-11, at 2–13, and the Distribution Grid Modernization program generally.

a) Confirm that the program will address every circuit, feeder, and tap at least once every 60 years. If this cannot be confirmed, please explain.
b) Provide the number of distribution line miles which are overhead, and the number of distribution line miles which are underground, as of 12-31-2020.
c) Provide a list of the types of equipment that are reviewed in the 60-year cycle, such as poles, conductor, transformers, switch cabinets, cable, etc.
d) For each type of equipment listed in response to subpart (c), provide the average age (in years) of that type of equipment on all of Avista's system as of 12/31/2020.
e) For each type of equipment listed in response to subpart (c), provide the age of the newest item of that type of equipment on all of Avista's system as of 12/31/2020.
f) For each type of equipment listed in response to subpart (c), provide the age of the oldest item of that type of equipment on all of Avista's system as of 12/31/2020.
g) Provide the policies, processes, methods, criteria, tests, or other means Avista uses to determine that equipment (conductor, cable, switches, etc.) is "aged" or has reached the end of "its useful life".

RESPONSE:

a) At this time the program will not address every feeder on a 60-year cycle. The 60-year cycle was an initial target at the inception of the program; it has not been scaled to meet that goal.

b) According to the most recent data, there are 7,598.18 overhead circuit miles and 4,457.85 underground circuit miles.

c) The list of equipment reviewed in the program's 60-year cycle is documented in Avista's Distribution Feeder Management Plan (DFMP), provided here as PC-DR-108 Attachment A. These include (but are not limited to) arresters, avian/raptor protection, cross arms, cutouts, devices, fusing, grounds, guying, insulators, overhead conductor, open wire secondary, steel poles, street and area lights, transformers, underground cable, and wood poles.

d) The average ages of wood poles and transformers are approximately 41 years and 21 years, respectively. The age of the remaining equipment listed in subpart (c) is often included as part of larger assemblies of equipment and materials referred to as compatible units (CUs). The age of each compatible unit is not used as a metric for, or tracked by, the Grid Modernization program. When additional information on attached equipment is not available, the Company will consider the age of equipment to be the same as that of the pole.

e) The newest wood pole and attached equipment was installed on December 30, 2020 and the newest transformer on record was installed on December 23, 2020.

f) According to company records, the oldest wood pole is approximately 111 years old, and the oldest transformer is 93 years old.

g) The policies and guidelines Grid Modernization used for determining whether equipment is aged or has reached the end of its useful life can be found in PC-DR-108 Attachment A, and elsewhere in the documents provided in this case, such as the Wood Pole Management program, for example, found in Exh. HLR-11.

SUPPLEMENTAL RESPONSE

Avista has been asked to provide several internal documents that were identified by links in Exh. HLR-11, but which were not available to Public Counsel or the other Parties. Several of these papers refer to the Company's Grid Modernization program and have been provided here as PC-DR-108 Supplemental, Attachments A .

DFMP

Distribution Feeder

Management Plan

System-Wide Programs

Design Criteria Manual

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INTRODUCTION

The Designer shall perform and document the design result from the following in accordance with the DFMP - System-Wide Programs - Process Manual.

Design, install, replace, and maintain the following in accordance with the National Electric Safety Code (NESC), Avista's Distribution Standards, and Avista's Existing Facilities Replacement Modification Guidelines document.

ARRESTERS

- Overhead[1]
  - Design arresters on all overhead transformers regardless of location to conform with Avista's Distribution Standards.[2]
  - Design arresters on each phase of the end of line dead-end structures unless there is a transformer located within two spans to conform with Avista's Distribution Standards.[3] [4]
  - Design a fiberglass standoff bracket for an arrester on single phase overhead construction when no equipment cross arm is available to conform with Avista's Distribution Standards.[5]

- Underground
  - Design arresters at each riser pole location to conform with Avista's Distribution Standards.[6]
  - Design elbow arresters on the first padmount transformer or junction enclosure and the farthest end of underground systems, unless under oil arrester transformers were installed, to conform with Avista's Distribution Standards.[6]
  - Design elbow arresters on the last transformer if it is a pre-2009 transformer (transformers purchased after 2009 have under oil arresters).

[1] Question: Should # 4 copper that is used on existing lightning arresters be changed out for braided wire that creates a visible indication of when a lightning arrester blows? #6 apparently works for this too. Apparently an outage is not needed to change out the #4 wire on a lightning arrester. Is this within scope? (Spokane General Foreman Meeting, Fall, 2014) Answer: No need to change out the #4 on an existing lightning arrester. (Mark Weiss, Jan. 2015)
[2] Reference**:** DO-1.007, 4.146, 4.425
[3] Reference**:** DO-1.007, 4.425
[4] Question: Where should a lightning arrester be placed when located at a double dead end and a 3 phase end off an intersection? (Spokane General Foreman Meeting, Fall, 2014) Answer: Only need to add on one location, not on both, unless arresters are installed nearby. (Mark Weiss, Jan. 2015)
[5] Reference**:** DO-1.007, 2.318, 4.146
[6] Reference: DO-4.425 and DO-1.140

- Do not design for the installation of a feed thru bushing insert and elbow arrester if the first feed thru transformer from the primary dip pole is a pre-2009 transformer (transformers after 2009 have under oil arresters).
- Do not design for the installation of a 5-position module for the sole purpose of adding an elbow arrester in the fifth position if the first JE1 from the riser has all four positions filled. (The standoff capability in the JE1 will be lost).

- Arresters with Other Equipment
  - Design arresters for Viper reclosers on the three single-phase transformers and on the load side of mounting bracket.[7]
  - Design arresters mounted on capacitor banks.[7]
  - Design arresters on the source and load side bushings of midline regulators. Mount surge arresters on the regulator case.[7]

- Other
  - Check, as well as possible from the ground, the required clearances from the arrester.[8] [9]
  - Replace older style arresters that have an external air gap.

[7] Reference: DO-4.425

[8] Question: May arresters be installed above the arm and below the arm—are both acceptable? (Spokane General Foreman Meeting, Fall, 2014) Answer: Yes, arresters may be framed either way provided current standards are met. (Mark Weiss, Jan. 2015)

[9] Reference: DO-2.113, DO-3.324, DO-2.110

Figure 1: Early Expulsion Arrester by Joslyn Supply Co. 1940 Vintage

- Replace cracked porcelain arresters and butyl rubber arresters with signs of chalking.
- Only reframe arresters that are currently framed above the cross arm to below the cross arm if the arrester is "Identified For Replacement".[10]
- Design arrester wildlife protectors on all new overheard transformers.[11]
- Add bushing caps as required.

- Compare the cost of the "Identified For Replacement" components versus the cost of replacing the entire pole using the "Component Versus Pole Replacement Analysis Tool" to determine what should be replaced.[12]

[10] Question: Are the outages associated with squirrels that could result from arrester(s) being framed above the cross arm large enough to support reframing the arrester(s) below the cross arm? (Mark Weiss, DFMP Review Meeting)Answer: No, because Squirrel outages = 262, Total sustained outages = 7,589, squirrel outages as a percentage of overall outages = 3.45% (Reliability Data from Amber Fowler to Reuben Arts, 2014)
[11] Reference: DO-4.176
[12] Reference: DO-1.005

AVIAN/RAPTOR PROTECTION

- Avian protection shall be installed on all poles in the avian protection zone where work is required in the supply space.[13] Appropriate avian protection includes the following:
  - Cutout covers[14]
  - Insulator pin and conductor covers[15]
  - Primary Connection Protection[16]

- Replace double-deadend, wood cross arms with the appropriate fiberglass cross arm if raptor nests are a known problem in the area. Alternatives are:
  - Perch Nesting Deterrents[17]
  - Cross Arm Bird Cover[18]

- Review with Environmental areas that may need a Pole-Mounted Nesting Platform to mitigate locations where birds continue to build nests on facilities or it is very difficult to change the structure.[19]

[13] Reference: DO-2.801
[14] Reference: DO-2.810
[15] Reference: DO-2.820
[16] Reference: DO-2.826
[17] Reference: DO-2.864
[18] Reference: DO-2.860
[19] Reference: DO-2.870

CROSS ARMS

- Determine which cross arms to replace with fiberglass arms. This analysis includes considerations in regards to condition, type, age, length, balanced loading, pin type, leaning, attached equipment and materials, etc.[20]

- Determine the correct length of all cross arms on the feeder to meet horizontal clearance requirements on long spans to conform to Avista's Distribution Standards.[21]

- Replace all primary wood cross arms with the appropriate fiberglass cross arm if any of the following apply:[22]
    - Visible moss covers some area of the cross arm which indicates that the wood treatment has leached out.
    - Contains wood pins that are floating or sinking.

- Replace all double wood cross arms (deadend, tangent, etc.) with the appropriate fiberglass cross arm if either of the following apply:
    - The arms and insulators are NOT in good operating condition.
    - Raptor nests are a known problem in the area.[23] [24]

- If an equipment arm is identified for replacement, relocate the attached hardware to the primary cross arm if feasible.

[20] Cross arm replacement is condition-based (not brand, type, etc.) (Rodney Pickett, DFMP Weekly Review Meeting, 1-14-15)
[21] Reference: DO-2.7 Cross arms & DO-3.3 Clearance
[22] The first steel pin specification was created in 1987. Wood pin hole adapters may have been used in the interim and a plastic version was brought in the 2006 timeframe. Distribution Engineering deleted the hole adapters in 2012, which allowed a steel pin to be installed in a wood pin cross arm. Without the adapters, requires changing the arm out if it previously had wood pins (or using salvaged wood pins). (Mark Weiss, DFMP Weekly Review Meeting, 5-13-15)
[23] Reference: DO-2.8
[24] Reference: AFM Layer – "Avian Protection Zone"

- Cross arms will always be replaced if the pole is being replaced. Fiberglass cross arms that do not have evidence of damage or cracks should be taken to Investment Recovery for evaluation.

- Replace all "California Top" cross arms with the appropriate fiberglass cross arm if any of the following apply
    - Physical damage to cross arm or compromised integrity of the framing attachment.
    - Physical damage to insulators.
    - Physical damage to arm mounted cut-outs or lighting arrestors.
    - Reconductoring or adding primary phase(s).
    - Contains wood pins that are floating or sinking.

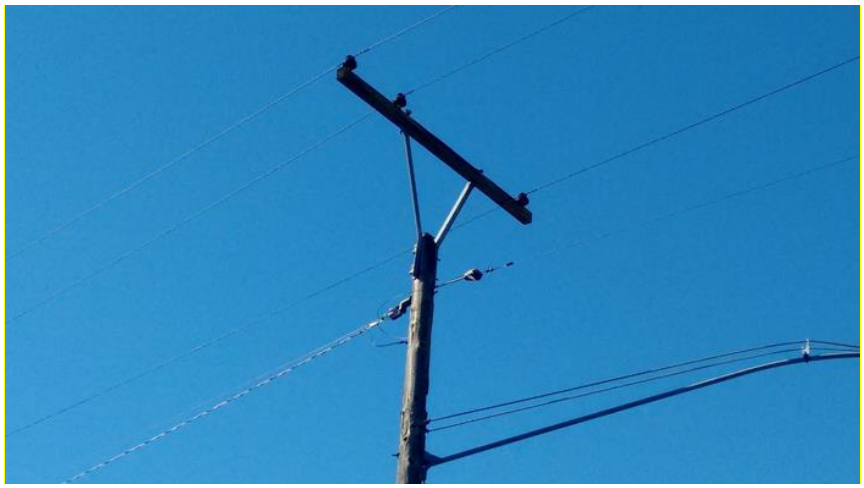

Figure 2: California Top cross arm.

- Compare the cost of the "Identified For Replacement" components versus the cost of replacing the entire pole using the "Component Versus Pole Replacement Analysis Tool" to determine what should be replaced.[25]

[25] Reference: DO-1.005

CUTOUTS

- Porcelain cutouts in operational condition may be changed out at the discretion of the Designer.
    - If the transformer is being replaced, the porcelain cutout shall also be replaced.

- Replace cracked porcelain cutouts and butyl rubber cutouts with signs of chalking.

- Do not replace cutouts based only on age.

- Design Fuse Marking Signs on all poles with a trunk, lateral, riser, or fuse.[26]

- Replace all of the cutouts on a cross arm if one or more require replacement.
    - If cutout(s) located on an equipment arm are identified for replacement, relocate the cutouts to the primary cross arm.

- If replacing cutouts on an existing pole:
    - Install a fiberglass standoff bracket for a cutout on single phase armless overhead construction.[27]

- Replace the following types of cutouts:
    - Chance brand porcelain
    - Porcelain Box
    - Grasshopper
    - Open Link
    - Q-Q

[26] Reference: DO-4.410
[27] Reference: DO-1.007, DO-2.318, and DO-4.146

- Load Break (elephant ear)
- V-shaped, GE Dura-Bute butyl with cast iron top and bottom


Figure 3: Chance


Figure 4: Porcelain Box


Figure 5: V-Shaped


Figure 6: Open Link


Figure 7: Q-Q


Figure 8: Load Break

- Compare the cost of the "Identified For Replacement" components versus the cost of replacing the entire pole using the "Component Versus Pole Replacement Analysis Tool" to determine what should be replaced.[28]

[28] Reference: DO-1.005

DEVICES

- Automation Devices
  - There are multiple standards for Viper and switched capacitor banks. Understand the requirements of the installation to ensure that the correct components and materials are ordered for the specific design location.[29] [30]
  - Determine the system voltage of the circuit being designed. Determine that the materials and equipment being ordered match the voltage of the circuit.[31]
  - Determine the network communication method for the specific automated device location.[32]
  - Determine the appropriate pole height and pole class that is required for each respective device.
    - G&W Viper devices require a minimum 50PCL1[29]
  - Determine the application of the automation line device that is being installed.
    - Radial circuits will not require an additional downstream/load-side micro-pole transformer
    - Loop/interconnected circuits will likely require an additional downstream/load-side micro-pole transformer
    - It is acceptable to use an existing transformer on the downstream/load-side instead of an additional micro-pole transformer if 120/240 service can be provided.
  - The mounting height for the automation device control cabinet shall be no less than 10 feet above ground level.[33]

[29] Reference: DO-4.470, DO-4.753
[30] Reference: DO-4.332, DO-4.746, DO-4.747
[31] Reference: Avista Material Standards 1440.100, 2510.100, 2500.150, 5300.150
[32] Reference: DO-4.764
[33] Reference: DO-4.230, DO-4.470, DO-4.746, DO-4.751, DO-4.753, DO-4.760

- Automation line devices should not be installed on a pole if any of the following apply :
    - Line angle
    - Down guy(s)
    - Open wire secondary districts (three wire and two wire)
    - Dissimilar primary conductors dead-ended on the pole
    - Horizontal/flat-top construction
    - Street or area light
    - Other obstacle in the primary or secondary that is not allowed per the DFMP or Standards.

- 3-bushing style capacitor banks should be left in service if they are accurately sized and are in good operational condition. The 3-bushing style capacitor banks can be removed from service if any of the following apply:[i]
    - The pole is being changed out or removed
    - The capacitor bank is being moved
    - The capacitor bank is no longer the appropriate size
    - Shall remove and replace existing three bushing capacitors with blown fuses[34]
    - Shall replace fixed banks with blown fuses with a new bank[34]

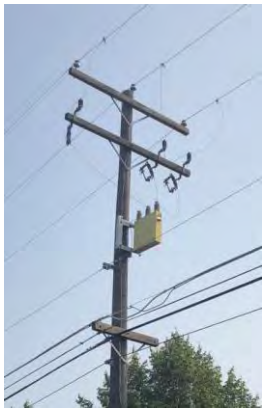

Figure 9

[34] Reference: DO-4.340

FUSING

- General
  - Install a new fuse of the correct size when replacing and installing a new pole, cross arm, or cutouts.
  - Consult the Area or Program Engineer to provide the following:
    - Recommendations for fusing within the design.
    - The correct fuse size if an unknown (UNK in AFM) fuse size is encountered.[35]
  - Identify if the feeder uses the Fuse Save Protection Scheme or Fuse Blow Protection Scheme.
  - Fuse all laterals off of the trunk longer than one span, unless communicated otherwise by the Area Engineer.[36]

- Transformers
  - Determine the recommended fuse size for transformers on the feeder.[37]

- Capacitors
  - Determine the recommended size for capacitors on the feeder, while ensuring proper fuse coordination.[38]

- Other
  - Design Fuse Marking Sign on all poles with a trunk, lateral, riser, or fuse.[39]

[35] Reference: DO-4.415
[36] Reference: DO-1.007
[37] Reference: DO-4.143, DU-2.500 to DU-2.502
[38] Reference: DO-4.340
[39] Reference: DO-4.410

GROUNDS

- Design pole grounds and ground rods on existing primary poles to ensure feeders have at least four ground rod connections in each rolling 1-mile section of overhead or underground line.[40]

- Design pole grounds and ground rods at each new installed primary pole location.[41]

- Design ground wire and ground rods on all poles with primary devices and equipment.[42]

- Identify and replace pole grounds in the following situations:
    - Cut or damaged pole grounds, or
    - Pole grounds wrapped around the pole butt, or
    - Ground rod is within 2 feet of the pole butt, or
    - Pole grounds with more than one splice per ground

- Repair pole grounds with the following problems:
    - If splice underneath theft deterrent, then relocate splice above the theft deterrent.
    - Remove all obstructions that interfere with the theft deterrent.
    - If ground rod is above soil line, it should be driven into the ground.

- Identify and report to Joint Use Administrator all independent (foreign-owned) grounds that are on the same pole as an Avista pole ground.[43]

[40] Reference: DO-1.007, DO-3.500
[41] Reference: DO-3.510, DO-3.512
[42] Reference: DO-3.500
[43] Reference: DO-1.419

- Compare the cost of the "Identified For Replacement" components versus the cost of replacing the entire pole using the "Component Versus Pole Replacement Analysis Tool" to determine what should be replaced.[44]

[44] Reference: DO-1.005

GUYING

- Evaluate and ensure all (primary, neutral, secondary districts and Joint Use positions) existing, new, or to be replaced guy wires and anchors are sized to conform with Avista's Distribution Standards.[45] [46] [47]

- Existing anchors may be re-used if in good condition. Replace anchors if any of the following apply:
  - The eye nut is damaged
  - The anchor rod is bent
  - The anchor is rusted or severely pitted
  - The anchor has pulled out of the ground more than two inches
  - There are anchors closer than three feet apart
  - More attachments to the anchor/eye than the eye is rated to hold
  - The anchor eye is buried beneath the ground line (Anchor extension 485-5005 option can be used for non-plate anchors with a screw on anchor eye)[48] [49]

- Existing guy wires may be re-used if in good condition. Evaluate slacked guy wires to determine cause and evaluate for corrective action. Replace guy wires if frayed, have broken strands, or are bent.

- Replace existing guy wires if the guy insulator is broken, damaged, or not intact.

[45] Guying requirements have been basically the same for the last 50 years, so guying must meet current standards and is not grandfathered. (M. Weiss, DFMP Review Team Meeting, 7-1-15)
[46] Reference: Avista Distribution Engineering – "Avista Existing Facilities Replacement Modification Guidelines"
[47] Reference: DO-2.520, DO-2.507, and DO-2.564
[48] Corrosion, dissimilar metals, and not being able to see the condition are reasons why the anchor eye being buried beneath the ground line is a reason to change.
[49] Reference: DO-2.516

- Replace existing Johnny Ball or Pineapple guy insulators with guy rope/strain insulators.[50]

- Review and design guy rope/strain insulators in all new guy wire installations or where work is required in the supply space or on poles where Joint Use and/or all types of secondary (open wire secondary districts, multi-plex, risers included, etc.) are present.[51]

- Install guy wire markers on all Avista guy wires.

- Notify Joint Use if there are missing down guys, missing guy wire markers, or anchors that apply only to Joint Users.

- Use a bollard or fiberglass crossarm along with guy markers in farmed fields.
    - Do not use pole butts or timbers in farmers' fields to protect guying.[52]

- Guying and anchoring into buildings or structures should be replaced with standard guying unless approved by Distribution Engineering and reviewed by the Program Engineer.

- Consider alternatives to replacing existing anchors and guy wires:
    - Span guying or slack spans are acceptable alternatives to changing existing guying or anchoring.[53]
    - Alternative may be to use a partial self-supporting structures or partial self-supporting structures guyed in only full tension direction (DE buck DE).[54]

[50] Reference: DO-2.501
[51] Reference: DO-2.502
[52] Wood used as bollards will decay.
[53] DO-2.392, DO-2.555-2.560
[54] DO-2.392

- All 9 Iron span guys shall be replaced with the appropriate size guy wire and properly insulated.

- Look for alternatives to the use of existing push braces when possible. New push brace installations should be avoided.[55]

- Evaluate the cost effectiveness of the identified for replacement components versus the cost effectiveness of replacing the pole using "Component Versus Pole Replacement Analysis Tool".

[55] Reference: DO-2.501

INSULATORS

- Avista's current standard is the vise top plastic pin insulators on wood and fiberglass cross arms.[56]

- Use 8kV vise top pin insulators for neutral on cross arm at all voltages.[57]

- Avista's current standard deadend insulator is polymer insulators on pole deadends, wood and fiberglass deadend arms.[58]

- Avista's current standard deadend neutral insulator is 8kV glass insulators for pole deadends, wood or fiberglass deadend arms.[59]

- Design a neutral deadend insulator to replace existing spools on AAC and ACSR conductors.[60] [61]

- Only use deadend insulators underneath the cross arm on older construction slack spans. All new construction slack/full spans should adhere to the current standard.[62]

- Replace eye bolts with dead ended neutral insulators when working in the supply space on a pole.

[56] Reference: DO-1.007
[57] Reference: DO-2.460
[58] Reference: DO-2.440
[59] Reference: DO-2.435
[60] There is no specific NESC requirement to insulate the neutral; however, it is common practice to install insulators. (M. Weiss, DFMP Review Team Meeting, 4-29-15)
[61] Reference: DO-2.109
[62] Reference: DO-2.116

- Replace any insulators that show signs of damage (chips), tracking, or deterioration (chalking).

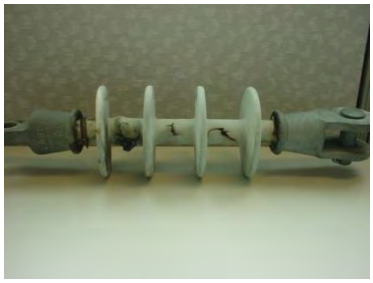

Figure 10: Damaged Insulator

Figure 11: Damaged Insulator

- Replace insulators that do not meet the required level of insulation. Consultation with the Avista local construction office is required to identify areas where the voltage level may have been changed.

- Replace all non-vice top existing insulators, including the pole top insulator, as part of a cross arm replacement.[63]

- Replace all Chance brand insulators.

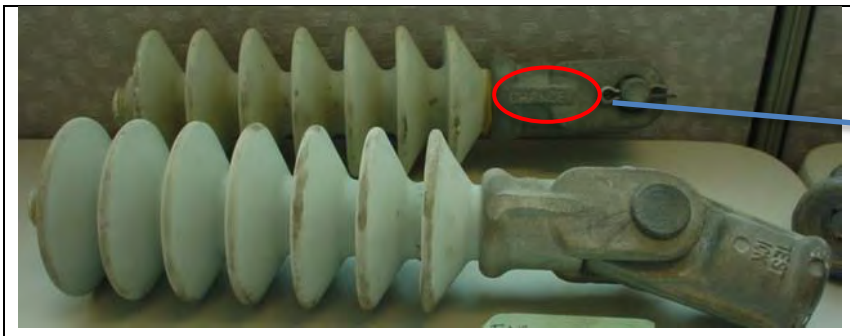

Figure 12: Chance Brand Insulators

[63] Another reason to not reuse non-vice top insulators is that there are no new ties available and preformed ties cannot be reused. (D. Labau, DFMP Review Team Meeting, 3-18-15)

- Vertical clamp top insulators can be used for uplift construction up to 10 degrees. Vertical angles greater than 10 degrees should use deadend-deadend construction.[64]

- Replace 34.5 kV Epoxilator deadend insulators that show signs of damage (chips), tracking, or deterioration (chalking).

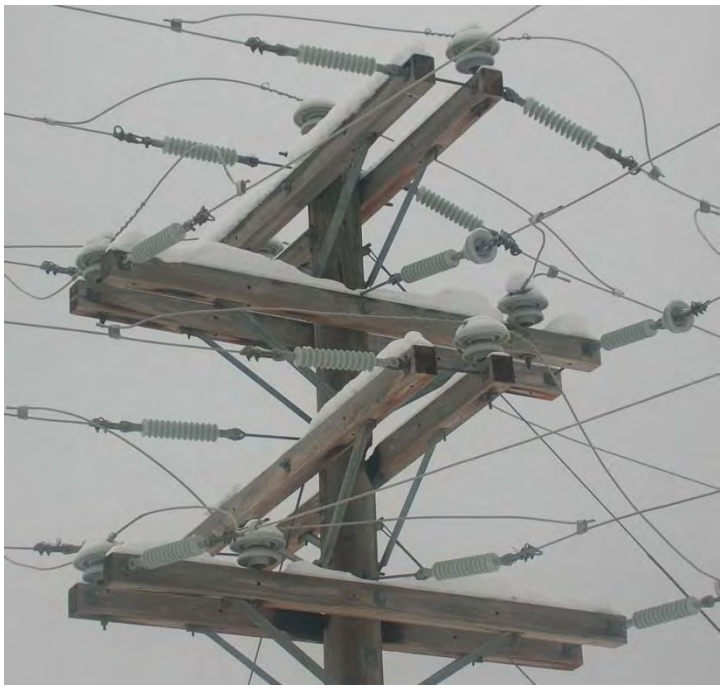

Figure 13: Pole with Charring at Cross Arms Indicating 34.5 kV Epoxilator Deadend Insulator Deterioration

- Evaluate the cost effectiveness of the identified for replacement components versus the cost effectiveness of replacing the pole using "Component Versus Pole Replacement Analysis Tool".

[64] Reference: DO-2.397

OVERHEAD CONDUCTOR

- All new installations should comply with the current construction standards, but must adhere to the requirements when a structure is modified with the addition of additional physical loading. Structure must also comply with the Communication Worker Safety Zone (CWSZ) (40" minimum rule) requirements regardless when it was constructed.[65]

- Consult the Area or Program Engineer to provide the following:
  - Recommendations for primary conductor sizing within the design.
  - Any primary reconductor proposals from field observations that were not outlined by the Area or Program Engineer.

- When calling out for replacement of primary overhead conductor, do so with standard sizes.[66]

- Install the correctly sized neutral to match the phase conductor(s). Replace neutral sizes that are less than 20% of the ratio between the phase and neutral resistances. Alternatively, install pole grounds or ensure that existing pole grounds meet the current standard (no pole ground butt wraps or ground rods up against the poles) on all of the main line poles.

[65] Reference: DO-1.005
[66] Reference: DO-3.105

Neutral size vs. Phase[67]			
Phase Conductor	DO-3.150	75° phase resistance	Ratio of phase to neutral resistance (%)
556 AAC	2/0 ACSR	0.0383	22
336 AAC	2/0 ACSR	0.0630	36
2/0 ACSR	2/0 ACSR	0.1760	100
1/0 ACSR	#2 ACSR	0.2160	64
#2 ACSR	#2 ACSR	0.3380	52
#4 ACSR	#4 ACSR	0.5160	100

- Clearance
  - Adhere to all vertical and horizontal clearance requirements.[68]
  - Replace or repair overhead conductor whose sag violates clearance requirements, or install poles of the appropriate height to conform with Avista's Distribution Standards.[69]
  - The Real Estate Department shall be contacted for all secondary or primary conductors that cross a property or properties that are different than the property being served (i.e. aerial trespass).
  - The Real Estate Department shall be contacted for all primary conductors that overhang a property or properties due to overhead poles or facilities being located near the edge of an easement or right-of-way (i.e. overhang trespass).

- Slack Spans
  - Remove all automatic dead ends and sleeves in slack spans.[70]
  - Slack spans should only be used when typical guying cannot be utilized.[71]
  - Considerations should be given for the height, class, and setting depth of a pole based on soil conditions. Contact Distribution Engineering with any design related questions on slack spans.

[67] Reference: DO-3.150, Millwood 12F2 Neutral Conductor Discussion-Weiss 6-15-2015, and UEP Bulletin 1724E-104
[68] Reference: DO-1.407 and DO-3.302 to DO-3.374
[69] Reference: DO-3.314 and DO-6.210
[70] Reference: DO-2.116
[71] Reference: DO-2.116 and DO-2.392

- Splices
    - Replace all primary and neutral overhead conductors if there are more than two splices in a single span.

- Copper Conductor
    - Replace primary and neutral overhead conductors if:
    - The wire has the older style small bolt (Fargo connectors). These will be some of the oldest installations (see pictures below).
    - There are physical signs of annealing. Physical signs of annealing include:
        - If a span has obvious kinks and bends caused by previous physical and electrical current damage is observed.
        - If wire sags greater than expected because it has been damaged or a section may have been spliced.
        - If more complete verification is needed, a service man can check various sections of the #6 copper wire by attaching a hot tap to the wire and twisting to determine if the wire has been annealed (softened).[72]

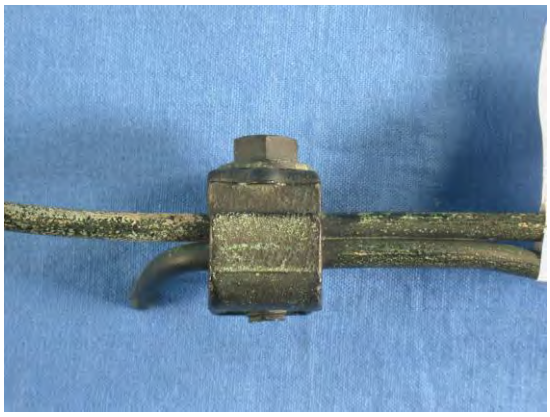

Figure 14: Older Style Small Bolt

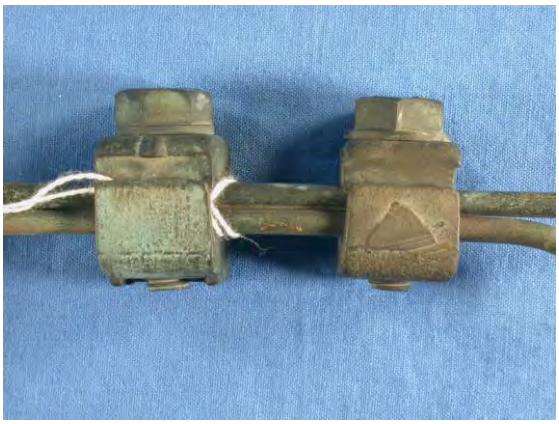

Figure 15: Newer Style Small Bolt

- Consult the Area or Program Engineer regarding the need to replace the conductors in the table below that are greater than 5 ohms per mile:

[72] Reference: #6CU-fieldtests.docx & #6copper_wire-WSUtest.xlsx 1/4/2012

R1 O/mi 50 degrees C	Conductor	Approx. Circuit Miles
16.9941	6Stel	15.67
14.63	6Iron	1.48
12.2981	6CRSol	252.99
11.3914	8CW	50.12
9.258	4BIron	1.87
7.2044	6CW	108.95
5.42	9.5DCW	5.44
4.5734	4CW	0.02
3.8982	6AAC	0.46
3.87	8ACW	120.15
3.8409	8CU	15.58
3.5988	8AMER Cu/St	40.06
2.4590	4ACSR	2542.62
2.44	6ACW	846.47
2.417	6CU	1598.34
2.417	6CUWP	1.97
2.41	6CUStr	25.54
2.2788	6AMER Cu/St	108.2
2.038368	4AWAC2/5	7.93
1.5830	2ACSR	241.79
1.55	4STRCU	1.13
1.545	4ACW	15.56
1.5419	2AAC	0.06
1.5196	4CU	73.75
1.0340	1/0ACSR	75
1.0115	19#9CW	0.66
0.979	2ACW	4.63
0.975	2STRCU	200.49
0.956	2CU	52.7
0.8430	2/0ACSR	507.52
0.7733	1STRCU	2.31
0.6137	1/0STRCU	25.04
0.6103	3/0AAC	0.51
0.5968	1/0CU	9.44
0.5730	4/0ACSR	92.57
0.5534	7S8CU	12.26
0.4866	2/0STRCU	15.84
0.4842	4/0AAC	1.91
0.3863	3/0STRCU	5.76
0.3067	4/0STRCU	8.92
0.3052	336AAC	29.91
0.3027	336ACSR	111.2
0.1855	556AAC	502.44
0.1825	556ACSRP	0.17
0.1311	795AAC	6.47
0.1278	795ACSR	1.44
0.0841	1272AAC	1.15

- Replace overhead conductor with signs of physical or electrical damage. Examples of damage may include: fraying, areas that have rubbed, nicks, kinks, and bends.

- Dissimilar Conductors on the Same Span
    - Calculate clearance sag and blowout when dissimilar conductors on different phases are identified and replace with the appropriately sized conductor when they fail to meet design criteria.
    - Replace overhead conductors spliced mid-span that are different conductor types.

- Dissimilar Conductors on Different Spans
    - Calculate the differential tensions between the two conductor types or sizes to determine if guying is sufficient.[73]

- Add wildlife protective hose as required.

- Hot Line Clamps[74]
    - Use aluminum hot line clamps on aluminum conductors only.[75]
    - Use copper hot line clamps on copper and steel conductors only.[75]
    - Hot line clamps are not to be used to connect main lines or heavily loaded laterals.[76]
    - Hot line clamps may be used when connecting taps of conductor sizes 1/0 copper and smaller. Use Ampacs on all jumpers 2/0 ACSR and larger.[75]

[73] Reference: DO-2.507
[74] Many bi-metallic hot taps were purchased that are used on copper conductors, but the tin material wears through and creates a conductor hot spot (burn downs). (Mark Weiss, DFMP Weekly Review Meeting, 5-13-15)
[75] Reference: DO-3.465
[76] Reference: DO-3.442

- Vegetation Management
    - Designers shall consult vegetation management when applicable for all overhead construction.

- Roof Horses[77]
    - Do not install new roof horses.
    - If service is being performed on the service or primary, mitigate the roof horse.
        - This may involve installing a new service pole or relocating the service connection to the secondary.[78]

- Customer-Owned Meter Poles
    - Do not use customer-owned meter poles to support secondary conductor that continue on to serve additional customers.

- Western Union Style Splices
    - Remove all linemen (western union) style splices, and replace with appropriate standard splice.

Figure 16: "Western Union" Style Splice

- Evaluate the need for mid span primary spacers where conductor slap is an issue.79

[77] It References having to horse the service over the roof to a meter. They also actually observed where someone nailed a saw horse to their roof hence Saw horse/ Roof Horse.
[78] NESC 217B
[79] Reference: DO-2.486

- Evaluate the cost effectiveness of the identified for replacement components versus the cost effectiveness of replacing the pole using “Component Versus Pole Replacement Analysis Tool”.

OPEN WIRE SECONDARY

- Remove all horizontal open wire secondary.

- Remove vertical open wire secondary if any of the following apply:
  - Inaccessible from roadway or alley
  - Vegetation issues cannot be resolved with trimming
  - Open wire secondary district does not provide adequate clearance to Joint Use for the communication worker safety zone.[80]

- Vertical open wire secondary may be left at the discretion of the Designer only if all of the following apply:
  - Easily accessible from roadway or alley
  - Vegetation issues that can be resolved with trimming (customer may need to be contacted to resolve some of the issues)
  - Open wire secondary district provides adequate clearance to Joint Use for the communication worker safety zone.[80]

- Replace all removed open wire secondary districts with the following:
  - Install a transformer on every pole that has services.
  - Replace the services with the appropriate sized multiplex wire.
  - Install a 2/0 ACSR system neutral if one is not present to support the mid-span taps in the secondary district.

- Services should be reviewed for meeting clearance requirements.

[80] Reference: DO-1.407 and DO-1.410

STEEL POLES

- Address unauthorized attachments on Avista facilities.[81]

- Replace or repair steel poles with flaking rust near the base (bottom 5'), rusted or damaged anchor bolts, poles leaning, direction of the overhead secondaries, broken concrete base, pole dings and dents, missing handhole covers, missing pole grounds, and older style green pedestal based poles.

- Consider removing all existing steel service poles depending on condition and replace with appropriate wood equivalent.

- Contact Transmission Engineering when performing work on a transmission pole with distribution underbuild.

[81] Reference: Joint Use's Unauthorized Attachment Guidance Document

Figure 17: Green Pedestal Base Pole

Figure 18: Cracked Concrete, No Cover Missing, Ding

Figure 19: Pole Damage

Figure 20: Rust, No Cover, Damage

Figure 21: Cracked Concrete, Damage, Rust

Figure 22: Cracked Concrete, No Cover

Figure 23: Cracked Concrete, Ding

Figure 24: Pole Rusted

STREET AND AREA LIGHTS

- Replace street and area light fixtures with the appropriate LED fixture and mast on poles where work is occurring in the supply space. The LED Change-Out Program will replace fixtures on poles that are not being replaced or have work being performed in the supply space.

- Install the equivalent wattage LED when replacing an existing street or area light (i.e. high pressure sodium, mercury vapor, etc.)[82]

- Install a minimum 4MA (mast arm) on street and area lights. 2.5MA mast arms shall no longer be used, as they do not provide enough separation of the fixture from the pole which can result in a shadow being created behind the pole.[83]

- LED fixtures require bonding to the neutral for overhead applications. Appropriate bonding is critical for the AMI project with antenna attachments to the street light.[84]

- Street and Area Lights should not be attached to a primary distribution pole with line devices, including automated switches, midline reclosers, and capacitor banks.

- Install LED-RES-x in residential applications only, where the posted speed limit is 25 mph or less. The LED-RES-x should not be installed on main arterials roads or intersections.[85]

[82] Reference: DO- 5.370 and DU-8.345
[83] Reference: DO-5.310
[84] Reference: Avista Material Standard 5100.100
[85] Reference: DO-5.210

- Install LEDx00Tx in non-residential street and area light applications only, such as major roadway arterials, streets, and intersections. These lights come in both 100 and 200 W equivalents, and in both Types 3 and 5.[86]

- Install the LED fixtures with the correct distribution light type.[87]
    - Type 2 or 3 LED fixtures are for mid-block applications only, and are ideal for residential streets scenarios.

Figure 25: 100W equivalent- Type 3

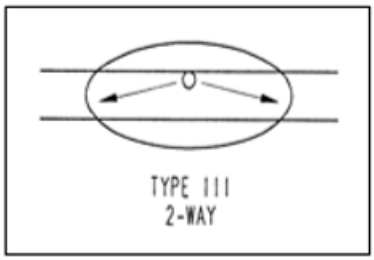

Figure 26: 200W equivalent- Type 3

    - Type 4 or 5 LED fixtures are for street corner and intersections only.

Figure 27: 100W equivalent- Type 5

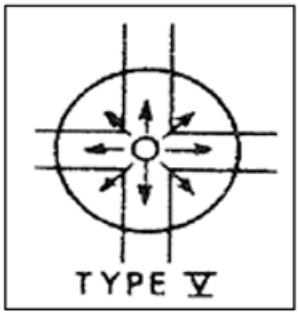

Figure 28: 200W equivalent- Type 5

[86] Reference: DO-5.310
[87] Reference: DO-5.215 and DU-8.215

TRANSFORMERS

- Transformer Sizing
  - Calculate the correct size of all overhead, padmount, and submersible transformers on the feeder.[88] [89]
  - If the transformer is undersized, replace with the correctly sized transformer.
  - If the transformer is oversized use the Oversized Transformer Cost Comparison Tool.

- Identified For Replacement Transformers
  - Replace all overhead, padmount, and submersible transformers identified as having oil leaks.
  - Replace all Pre-1981 overhead, padmount, and submersible transformers.
  - Replace the entire bank if two or more transformers in a bank are "Identified For Replacement" (transformer sizing, oil leaks or Pre-1981). Replace only the transformer "Identified For Replacement" if only one of the transformers in a 3 pot bank is "Identified For Replacement".
  - Re-install 1981 and newer transformers on poles being changed out, unless the transformer(s) is "Identified For Replacement".
  - Replace submersible transformers "Identified For Replacement" with a correctly sized padmount style transformer. The exception to the replacement with a padmount transformer is if any of the following apply to a proposed padmount transformer:
    - Will not physically fit
    - Will not meet clearance requirements to buildings, roadways or curbs

[88] Reference: DO-4.137, DO-4.105, DU-5.002, DU-5.006
[89] Reference: Avista's Residential Design Workbook on AVAnet (Transformer Sizing Tool, Flicker Tool, and Voltage Drop Tool

  - Will cause significant customer dissatisfaction due to aesthetics or physical obstruction.[90]

- Design transformer and arrester wildlife protectors on all new overheard transformers.[91]

- Use the guard on 13, 24 and 34.5 kV transformers or capacitor bushings wherever large birds or climbing animals may cause shorts across bushing insulators.

- Idle or Unused Transformers
  - Remove idle or unused transformers. Verification with the Avista local construction office is required before removal.

- Transformer Fusing
  - Determine the recommended fuse size for transformers on the feeder.[92]

- Application of Seed-Based Oil Filled Transformers
  - Transformers located within 20 feet of a school building are recommended to be replaced with a transformer containing seed-based oil.[93]

[90] Reference: DU-4.206, DU-4.222, DU-4.230, DU-5.020
[91] Reference: DO-4.176
[92] Reference: DO-4.143, DU-2.500 to DU-2.502, DU-5.221, and DU-5.222
[93] Reference: DO-4.105, School Electric Facility Document

- Confirm with the local office if transformers should be ordered with taps or not.

Office	Taps
Coeur d'Alene	No
Colville	Both
Davenport	Both
Deer Park	Both
Grangeville	Both
Kellogg	No
Lewis-Clark	No
Othello	No
Pullman	Both
Sandpoint	Both
Spokane	No
St. Maries	No

- Perform a preconstruction evaluation when replacing padmount to padmount or submersible transformers to padmount to determine:
    - PADMOUNT TO PADMOUNT
        - Measure the existing concrete pad on all 3-phase padmount transformers so that it is known if the new 3-phase padmount will properly fit on the existing concrete pad. If the new 3-phase padmount will not properly fit have a new pad placed w/the appropriate ground sleeve per the standard (extending the old concrete pad is NOT recommended).
        - If first generation cable is used, replace cable (padmount to padmount and sub to padmount).
        - If black plastic pad is damaged, then replace with new box pad.
        - If there is an old sub grade basement or the existing sub grade basement is unserviceable, then put in a new box pad.
        - If terminations can reach, then Polycrete pad can be used instead of new box pad.
        - If varmints and nesting is problem, then consider installing a new box pad

- If padmount is not properly grounded and connecting then call for that to be addressed.

- SUBMERSABLE TO PADMOUNT
  - If submersible vault lid is cracked and falling apart, then lid will need to be removed, a 4" thick Polycrete pad placed on top of the submersible vault, and the new padmount placed on top of the Polycrete pad.
  - If submersible transformers can be replaced with padmount transformers. Padmount transformers require 32" from curb clearance. Otherwise replace with submersible.
  - If there are circumstances that are questionable consult with the Program Engineer or Program Quality Assurance.[94]

- Evaluate the cost effectiveness of the identified for replacement components versus the cost effectiveness of replacing the pole using "Component Versus Pole Replacement Analysis Tool".

- Smart Transformers
  - Leave smart transformers in-service if they are properly sized and not damaged/leaking.
  - Remove undersized in-service smart transformers and replace with appropriately sized traditional non-smart transformers.
  - Remove damaged or leaking in-service smart transformers and replace with appropriately sized traditional non-smart transformers.
  - Do not install a new "smart-transformer".

[94] Reference: DO-4.206

UNAUTHORIZED ATTACHMENTS

- Remove Unauthorized Attachments such as signs, posters, notices. Supporting structures should be kept free from climbing hazards such as tacks, nails, vines, and through bolts not properly trimmed.[95]

Figure 29: Signs or other attachments

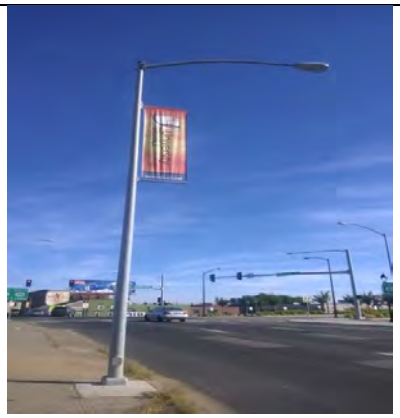

Figure 30: Signs or other attachments

[95] NESC Section 217A

UNDERGROUND

- Call for the replacement of equipment designated in the Underground Inspection Program Report as needing replacement.[96] [97]

- Ensure clearance between padmount equipment and roads or other structures meet ALL requirements based on the original installation date of the equipment.[98]
    - Padmount transformers replacing submersible transformers are to meet the current clearance standards.
    - Pre-1992 equipment is a like for like replacement.
    - Post-1991 equipment must meet the current clearance requirements.[99]

- Call for the replacement of padmount equipment if the exterior cabinet has physical damage or shows signs of having been tampered beyond repair. Call for the padmount equipment to be reset if the cabinet has been moved on the mounting ground sleeve, pad or structure.

- Replace all pre-1982 non-jacketed primary cable.

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[96] Reference: Strawman Paper on Moving to Using 25kV URD Cable for Direct Bury Applications.docx-Weiss

[97] The Underground Inspection Program is expected to be in place at the start of 2016. The Program will (M. Weiss, R. Pickett, DFMP Review Team Meeting, 6-10-15)

- Replace the exterior decals and stencil numbers on all padmount equipment if they are not intact or readable per *s DU-3.201, 5.004*.
- Request to have GIS Editing correct the stencil number in AFM if it does not match the stencil number on the equipment in the field.
- Repair damage such as rust, or graffiti.
- Ensure that the area around the padmount equipment is clear of vegetation, soil, and other material so as to provide proper access for service.
- Send customers letters to have them remove items when equipment is covered with a "fake rock" or similar item per *DU*-5.020.
- Request re-leveling if the padmount mounting structure is more than 2” out of level any direction because oil insulation cover is being compromised.
- Replace the penta-head bolt or padlock if damaged or not intact.

[98] The clearance requirements have been in the OH Standards since 1992 (MAW). ADA requirements were in affect about the same time. (M. Weiss, DFMP Review Team Meeting, 6-10-15)

[99] Reference: DU-4.206, DU-5.020, DU-4.222

Figure 31

Figure 32

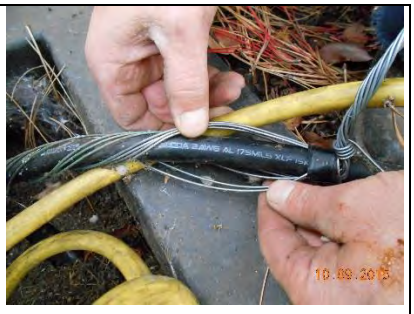

Figure 33

- Replace any primary cable section (padmount equipment to padmount equipment) that has two or more documented failures for either jacketed or non-jacketed primary cable.

- Conduit
  - Conduit is preferred on all underground cable installations.
  - Direct buried or plowed in is an acceptable practice in justifiable situations, however it is not preferred.
  - Sweeps shall be installed on underground cable systems in conduit.
  - Sweeps shall be installed on direct-buried or plowed-in underground cable systems to maintain minimum bend radius.[100]
  - Sweeps shall be installed on all riser and other above ground transition installations.
  - Conduit shall be installed on all three-phase 600 A underground cable systems.
  - Conduit shall be installed on all underground secondary cables.

- Install a Junction Enclosure at the base of a primary riser pole when future feeds may be anticipated. The installation of a Junction Enclosure is preferred to underground primary splices.

[100] "Sweeps are required on cable entrance into box pads and ground sleeves" (per email from Marty Gulsuth, 7-13-17).

- Install a Hand Hole at the base of a secondary riser pole when future services may be anticipated. The installation of a Hand Hole is preferred to underground secondary splices.

- Install each phase of a primary riser in its own conduit. Replace risers with multiple phases in a single conduit that does not meet the current standard.[101]

- Remove all piggyback elbows and replace with a standard elbows and feedthrough bushings.

Figure 34: Standard Elbow

- Evaluate the cost effectiveness of the identified for replacement components versus the cost effectiveness of replacing the pole using "Component Versus Pole Replacement Analysis Tool".

[101] Reference: DU-2.116

WOOD POLES

- Red Tag Poles
  - Replace all Red Tag poles as indicated by Wood Pole Inspections.
  - Foreign-owned Red Tag poles shall be addressed using the Joint Use coordination process (see Joint Use section of DFMP – System-Wide Programs – Design Criteria Manual).[102]

- Yellow Tag Poles
  - Yellow Tag poles shall be stubbed or replaced regardless of age, except in backyards with no truck access where all poles shall be replaced. Collectively evaluate the condition of the pole and other equipment and conductors being replaced to assist in determining whether to ultimately replace a pole that could be stubbed.[103]
  - Request stubbing using Wood Pole Management Stubbing Request Form as soon as each polygon design is complete.[104] [105]
  - Foreign-owned Yellow Tag poles shall be addressed using the Joint Use coordination process.[106]
- Pole Class
  - Evaluate and ensure all existing, new, or to be replaced poles are classed to conform with Avista's Distribution Standards.[107] [108] [109] [110] [111]

[102] Reference: DO-1.426
[103] Source: "Asset Management – "2014.12.23 Pole Top and Crossarm Failure Information Rev. 1.pptx"
[104] Reference: Wood Pole Management Stubbing Request Form
[105] Reference: Specification S-755 – Installation of Steel Stubs on Wood Poles
[106] see Joint Use section of DFMP – System-Wide Programs – Design Criteria Manual
[107] Reference: DO-1.434, DO-1.437, DO-1.440, and DO-2.625
[108] Reference: Avista Distribution Engineering – "Evaluation of Pre-1977 Existing Installations"
[109] Reference: Avista Distribution Engineering – "Avista Existing Facilities Replacement Modification Guidelines"
[110] Reference: DO-2.625 and DO-2.630
[111] Reference: DO-2.620 and DO-4.138

- Pole Height
    - Evaluate the required pole height on all existing, new, or to be replaced poles to ensure all poles have vertical clearances that conform to Avista's Distribution Standards and the NESC Communications Worker Safety Zone Rule 238E. This may require replacing a physically healthy pole with a new pole of the correct height and/or class, due to new attachments, loading, and uplift caused by short spans with different pole heights.[112] [113]

- Pole Age
    - Replace all Cedar and Fir poles older than 60 years from the most recent design date.[114]
    - Replace all Larch/Tamarack poles older than 40 years from the most recent design date inspected.[115]
    - Replacement of poles earlier than their designated replacement age may be necessary dependent upon "critical" structural considerations. "Critical" can include, but not be limited to, reconductoring, large angle poles, poles with devices (switches, reclosers, caps, etc.), dead-end structures, highway/railroad/river crossings, etc.

- Pole Top
    - Evaluate the Pole Top condition to determine if a pole should be replaced.
    - Determine if "topping the pole" and framing down conform to Avista's Distribution Standards. Engineering review and approval is needed for "topping" 40'-45' poles with Joint Use attachments to accommodate vertical clearances.
    - Determine if split bolting conforms to Avista's Distribution Standards.[116]

[112] Reference: DO-2.620
[113] Reference: Avista Distribution Engineering – "Avista Existing Facilities Replacement Modification Guidelines"
[114] Source: Asset Management – "2014.12.23 Pole Top and Crossarm Failure Information Rev. 1.pptx"
[115] Source: Asset Management – "When to Replace Distribution Wood Poles for Grid.pptx"
[116] Reference: DO-2.000

- Leaning Poles
    - Poles leaning more than two feet from the vertical at the top of the pole shall be straightened if pole height and class are adequate (stub if necessary) or replaced with appropriate height and class pole.[117]

- Idle or Unused Poles
    - Remove idle or unused poles. Verification with Avista local construction office and landowner is required before removal.
    - De-energized pole line sections shall be inspected and kept in the same condition as energized lines.
    - De-energized lines should be bonded and grounded to the system neutral at a minimum.

- Wood-Stubbed Poles
    - Remove and replace all existing wood-stubbed poles.
    - Do not install steel stubs in poles located in backyards due to climbing safety issues.

- Slack Span
    - Considerations should be given for the height, class, and setting depth of a pole based on soil conditions. Contact Distribution Engineering with any design related questions on slack spans.

- Vegetation Management
    - Designers shall consult vegetation management when applicable for all overhead construction.

[117] Reference: Specification S-755 - Avista Installation of Steel Stubs on Wood Poles

- Customer-Owned Meter Poles
    - Do not use customer-owned meter poles to support secondary conductor that continue on to serve additional customers.

- Foreign Owned Poles
    - Reference operations flip chart for guidance.

- Other
    - When replacing and installing with a new pole, do not re-install the existing insulators, arrestors, or cutouts. Additional materials and equipment can be determined at the designer's discretion based on condition.
    - When performing work on a transmission pole with distribution underbuild that may affect the pole loading, contact Transmission Engineering.
    - Evaluate the necessity of being attached to a foreign owned pole.
    - If abandoning a pole to a customer, use the "Warning/Limitation of Liability" tag and green pole tag for "Other" ownership designation. This practice is acceptable but not preferred.

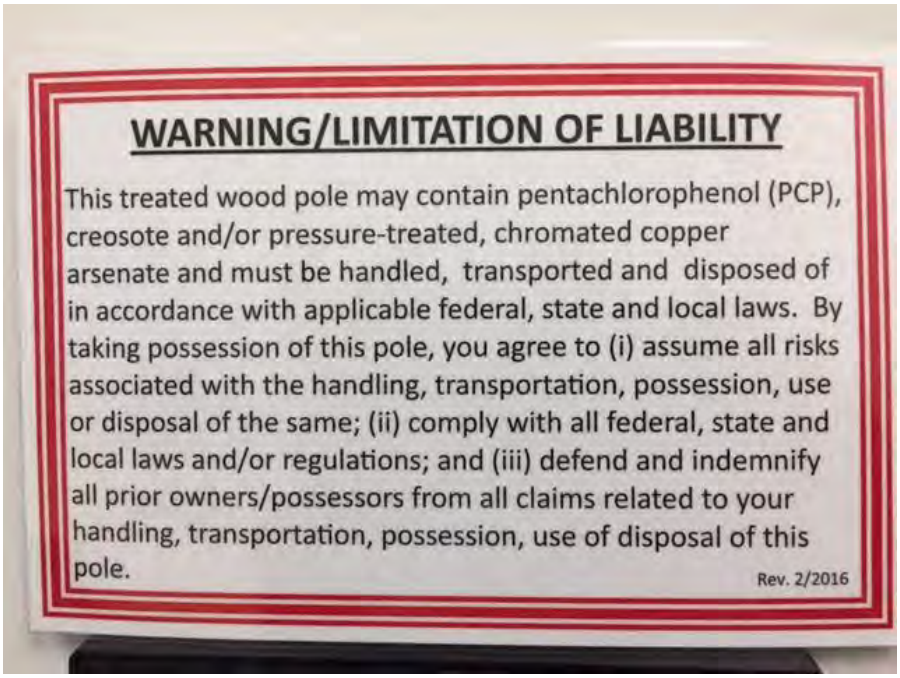

Figure 35: Avista SOP TAG-TREATED POLES

- Address unauthorized attachments on Avista facilities.[118]

- Compare the cost of the "Identified For Replacement" components versus the cost of replacing the entire pole using the "Component Versus Pole Replacement Analysis Tool" to determine what should be replaced.[119]

- General Reference: DFMP – System-Wide Programs - Design Criteria Manual - Joint Use Section for the Notification and Coordination Process document for information on pole issues related with Joint Users.

- General Reference: DFMP – System-Wide Programs - Design Criteria Manual - Vegetation Management Section for process to contact Avista Vegetation Management Administrator to request tree trimming on their projects to establish proper clearance from poles and conductors.

[118] Reference: Joint Use's Unauthorized Attachment Guidance Document
[119] Reference: DO-1.005

Version	Date	Action	Change Tracking
1	October 2018	Steel Poles Remove all existing steel service poles and replace with appropriate wood equivalent. (Even if the steel pole is in good condition? No testing of steel pole? Wood Poles Wood-Stubbed Poles Remove and replace all existing wood-stubbed poles. Do not install steel stubs in poles located in backyards due to climbing safety issues. Customer-Owned Meter Poles Do not use customer-owned meter poles to support secondary conductor that continue on to serve additional customers. Vegetation Management Designers shall consult vegetation management with applicable for all overhead construction. OH Conductor Slack Span Considerations should be given for the height, class, and setting depth of a pole based on soil conditions. Contract Distribution Engineering with any design related questions on slack spans. Customer-Owned Meter Poles Do not use customer-owned meter poles to support secondary conductor that continue on to serve additional customers. Roof Horses[120] Do not install new roof horses. Remove service from roof horse if there is a clearance violation, roof horse is damaged, or work is being performed on the service. This may involve installing a new service pole or relocating the service connection to the secondary.[121] Western Union Style Splices Remove all linemen (western union) style splices, and replace with appropriate standard splice.  *Figure 36 "Western Union" style splice.* Underground Riser When replacing a riser pole that has multiple phases in a single conduit, re-install each phase in its own conduit. Replace risers with multiple phases in a single conduit that does not meet the current standard.[122] Remove all piggyback elbows and replace with a standard elbows and feedthrough bushings.  *Figure 37 Standard elbow*	Revisions

[120] It References having to horse the service over the roof to a meter. They also actually observed where someone nailed a saw horse to their roof hence Saw horse/ Roof Horse.
[121] Reference: NESC 217B
[122] Reference: DU-2.116

[i] Email discussion with Distribution Engineering (Mark Weiss, May 2016)

Shane,

Refer to DO-4.340, Note 2. The three phase units would have been way before 2004, when I started at Avista. What I do remember is discussions between Greg Smith and John Dunlap along with the attached two documents. The capacitor fusing notes are from December of 2004 where John D. worked on the fusing charts in the construction standards.

Greg Smith did some of the very first capacitor bank installations in the early to mid-1980's, which would have been the three bushing variety. These were wye ground connected and no way to un-ground the wye point. In early 2004/2005, there was a lot of concerns and discussion around harmonics causing telephone interference. See capacitor installation guide. So the move to two bushing capacitor banks. Probably before that time, Scott Wilson and Harvey Brown pulled ABB and GE from the specification and went to Cooper exclusively.

Main reason being (as I remember the discussion), is that the ABB and GE capacitor banks had inferior case rupture curves (see fusing notes) and the Cooper units had superior connection technology for the wire leads from the aluminum foil to bushings. That connection from the extremely thin foil to the bushing lead is critical for surge withstand.

As far as I know, there has not been a catastrophic failure of one of the older three phase capacitor units. Pretty sure we have had failures where the fusing protected the capacitor bank and the failure was internal.

I would not change a three phase older style unit that is still functioning and has not had a fuse blow. I would suggest that if we are working (changing) on the pole, would be a good time to change and or relocate (new)?

As a side note. Telephone interference was a product of two issues. First being the feeder voltage was kept up near 129 volts with LDC, which created saturation in the transformer coil/cores (harmonics galore). Second was the lack of bonding between the communications (telephone) companies shield and Avista system neutral. The bonding helps eliminate the harmonic induction on the telephone hard wire pairs. Fiber backhaul really helps that.

Mark A. Weiss PE
Senior Distribution Engineer II

Hi Mark.

I have come across a few 3-Bushing Capacitor Banks in the last few months on the Grid Mod feeders that I am analyzing. I know this likely indicates that the banks are an older vintage, but I am curious if there is justification around replacing these units.

Are you aware of any known reasons to specifically change out these units based solely on the 3-bushing style? I know the local offices don't like them because they are older and not common, but I would like to have more information in order to support changing these out. Thanks for the comments.

Shane Pacini, P.E.
Senior Distribution Engineer