

SCHULTZ - HANFORD AREA
TRANSMISSION LINE PROJECT

ADDENDUM to

APPENDIX I
ELECTRICAL EFFECTS

August 28, 2001

Prepared by
T. Dan Bracken, Inc.

For

Parsons Brinckerhoff

Table of Contents

ADDENDUM.....	A-1
A.1 New configurations	A-1
A.2 Electric-field levels.....	A-1
A.3 Magnetic-field levels.....	A-1
A.4 Audible noise levels	A-1
A.5 Electromagnetic interference	A-1
A.6 Conclusions.....	A-2
List of Preparers.....	A-2

List of Tables

Table A1	Physical and electrical characteristics of additional Schultz-Hanford Area Project configurations.....	A-3
Table A2:	Possible additional segment configurations for Schultz - Hanford Area Project.	A-3
Table A3:	Calculated electric fields for configurations of the proposed Schultz – Hanford/Wautoma 500-kV line operated at maximum voltage. a) Configuration G: Schultz – Hanford/Wautoma 500-kV line and Pacificorp Wanapum – Pomona Heights 230-kV line; Configuration D-1A: Schultz – Hanford/Wautoma 500-kV and Vantage – Midway 230-kV lines	A-4
Table A4:	Calculated magnetic fields for configurations of the proposed Schultz–Hanford/Wautoma 500-kV line operated at maximum current. a) Configuration G: Schultz – Hanford/Wautoma 500-kV and Pacificorp Wanapum – Pomona Heights 230-kV line; Configuration D-1A: Schultz – Wautoma 500-kV and Vantage – Midway 230-kV line.....	A-5
Table A5:	Predicted foul-weather audible noise (AN) levels at edge of right-of-way (ROW) for proposed Schultz – Hanford/Wautoma 500-kV line.	A-6
Table A6:	Predicted fair-weather radio interference (RI) levels at 100 feet (30.5 m) from the outside conductor of the proposed Schultz – Hanford/Wautoma 500-kV line.	A-7
Table A7:	Predicted maximum foul-weather television interference (TVI) levels predicted at 100 feet (30.5 m) from the outside conductor of the proposed Schultz – Hanford/Wautoma 500-kV line.....	A-7

List of Tables

Figure A1:	Additional configurations for proposed Schultz-Hanford Area Transmission Line Project 500-kV line: a) Proposed line with parallel Pacificorp Wanapum – Pomona Heights 230-kV line (Configuration G); and b) Proposed line on double-circuit tower with existing BPA 230-kV line (Configuration D-1A).	A-8/9
------------	--	-------

Figure A2: Electric-field profiles for additional configurations of proposed Schultz – Hanford/Wautoma 500-kV line: a) Proposed 500-kV line parallel to Pacificorp Wanapum – Pomona Heights 230-kV line (Configuration G); and b) proposed 500-kV line on double-circuit tower with existing BPA Vantage – Midway 230-kV line (Configuration D-1A)..... A-10/11

Figure A3: Magnetic-field profiles for additional configurations of the proposed Schultz– Hanford/Wautoma 500-kV line under maximum current conditions: a) Proposed 500-kV line parallel to Pacificorp Wanapum – Pomona Heights 230-kV line (Configuration G); and b) proposed 500-kV line on double-circuit tower with BPA Vantage – Midway 230-kV line (Configuration D-1A)..... A-12/13

ADDENDUM

In the course of evaluating routing options for the proposed Schultz-Hanford Area Transmission Line Project, additional corridor options were identified. These new corridor options entail different configurations than those analyzed in the original Electrical Effects and Health Assessment appendices prepared for the project. The purpose of this addendum is to report the levels of electric fields, magnetic fields, audible noise, radio interference, and television interference anticipated from these new configurations. The calculation methods and impacts related to fields and corona-generated audible noise and electromagnetic interference are discussed in the Electrical Effects appendix.

A.1 New configurations

The new corridor options for the Schultz - Hanford 500-kV line are as follows: 1) a section of Alternative G where the proposed Schultz – Hanford/Wautoma 500-kV line would parallel the existing Pacificorp 230-kV Wanapum – Pomona Heights line just west of the Columbia River crossing into Vantage Substation; and 2) a section of Alternative D1 where the proposed line would be placed on a double-circuit tower with the existing BPA Vantage – Midway 230-kV line. Figure A1 shows these configurations; their physical and electrical characteristics are given in Tables A1 and A2.

A.2 Electric-field levels

Calculated electric fields for the two new configurations are summarized in Table A3 and plotted in Figure A2. The levels in Configuration G are very similar to those in the other configurations (D1 to D4) where the proposed 500-kV line parallels existing 230-kV lines. The calculated maximum electric fields under the proposed double-circuit line in Configuration D-1A are slightly higher than those for other configurations of the proposed 500-kV line and exceed 9 kV/m, the BPA limit for electric fields. The maximum field could be reduced below 9 kV/m by an increase in the minimum conductor height of 0.3 feet. The electric fields at the edge of the right-of-way would be lower for the double-circuit configuration (D-1A) than for the single-circuit delta configuration used elsewhere.

A.3 Magnetic-field levels

Calculated magnetic-field levels for the two new configurations are summarized in Table A4 and plotted in Figure A3. The levels for Configuration G are consistent with those for other configurations that include a single-circuit tower for the proposed 500-kV line. The maximum magnetic field under Configuration G would be 248 mG. Magnetic fields under the proposed double-circuit line of Configuration D-1A are somewhat lower with a maximum field on the right-of-way of 187 mG.

A.4 Audible noise levels

Corona-generated audible noise levels from the new configurations are shown in Table A5. The foul weather L_{50} and L_5 levels predicted for these configurations will be comparable with those for the previously considered configurations. The foul weather L_{50} level at the edge of the right-of-way will not exceed the 50-dBA limit established by BPA.

A.5 Electromagnetic interference

Corona-generated electromagnetic interference levels for the new configurations are shown in Tables A6 and A7 for radio interference (1 MHz) and television interference (75 MHz), respectively. The levels are comparable with those predicted for the other proposed configurations and are within acceptable levels.

A.6 Conclusions

The predicted levels for electric fields, magnetic fields, and corona effects from the new configurations are very similar to those calculated for the original configurations. Therefore, they do not change the basic conclusions of either the Electrical Effects or Health Assessment appendices prepared previously.

List of Preparers

T. Dan Bracken was the principal author of this report. He received a B.S. degree in physics from Dartmouth College and M.S. and Ph.D. degrees in physics from Stanford University. Dr. Bracken has been involved with research on and characterization of electric- and magnetic-field effects from transmission lines for over 27 years, first as a physicist with the Bonneville Power Administration (BPA) (1973 - 1980) and since then as a consultant. His firm, T. Dan Bracken, Inc., offers technical expertise in areas of electric- and magnetic-field measurements, instrumentation, environmental effects of transmission lines, exposure assessment, and project management. Joseph Dudman of T. Dan Bracken, Inc., provided data entry, graphics, and clerical support in the preparation of the report.

Judith H. Montgomery of Judith H. Montgomery/Communications served as technical editor for the report. She holds an A.B. degree in English literature from Brown University, 1966; and a Ph.D. degree in American literature from Syracuse University, 1971. Dr. Montgomery has provided writing, editing, and communications services to government and industry for 20 years. Her experience includes preparation of National Environmental Policy Act documents and technical papers dealing with transmission-line environmental impact assessment and other utility-related activities.

Table A1: Physical and electrical characteristics of additional Schultz-Hanford Area Project configurations.

Segment-Configuration	Proposed A-1	Existing G	Proposed D-1A	
Line Description	Schultz-Hanford/ Wautoma 500-kV	Wanapum – Pomona Heights 230-kV	Schultz – Hanford/Wautoma & Existing BPA Vantage – Midway 230- kV	
			500-kV	230-kV
Voltage, kV Maximum/Average ¹	550/540	242/235	550/540	242/235
Peak current, A Existing/Proposed ²	— /1436	-640/-640	— /1436	609/593
Electric phasing	BAC	ABC	ABC	CBA
Clearance, ft. Minimum/Average ¹	33/47	30/42	33/47	33/47
Centerline distance/direction from Schultz – Hanford/ Wautoma 500-kV Line, ft.	—	137.5/S	—	
Centerline distance to edge of ROW, ft.	75	62.5	75	
Tower configuration	Delta	Flat	Double-circuit Vertical	
Phase spacing, ft.	40 H, 28.7 V	17.5H	36.5 H, 56.5 H, 36.5 H, 36 V	
Conductor: #/diameter, in.; spacing, in.	3/1.302; 17.04	1/1.38	3/1.302; 17.04	3/1.302; 17.04

1 Average voltage and average clearance used for corona calculations.

2 Minus sign indicates current flow in opposite direction to flow in parallel proposed Schultz – Hanford line.
H = horizontal V = vertical

Table A2: Possible additional segment configurations for Schultz - Hanford Area Project

Segment-Configuration	Description of other lines in corridor with Schultz–Hanford/Wautoma 500-kV line	Miles
G	Pacificorp Wanapum – Pomona Heights 230-kV	6
D-1A	Vantage – Midway 230-kV	8

Table A3: Calculated electric fields for configurations of the proposed Schultz – Hanford/Wautoma 500-kV line operated at maximum voltage.
 Configurations are described in Tables A1 and A2.

a) **Configuration G: Schultz – Hanford/Wautoma 500-kV line and Pacificorp Wanapum – Pomona Heights 230-kV line**

Configuration	Proposed G				Existing G	
ROW width, ft.	275				125	
Line	Schultz – Hanford/ Wautoma 500-kV		Pacificorp Wanapum – Pomona Heights 230-kV		Pacificorp Wanapum – Pomona Heights 230-kV	
Clearance	min.	avg.	min.	avg.	min.	avg.
Peak field, kV/m	8.9	4.9	2.7	1.5	2.7	1.5
Edge of ROW, kV/m	2.0	2.0	1.0	0.9	0.8	0.8

b) **Configuration D-1A: Schultz – Hanford/Wautoma 500-kV and Vantage – Midway 230-kV lines**

Configuration	Proposed D-1A				Existing D-1A	
ROW width, ft.	125				100	
Line	Vantage – Midway & Schultz – Hanford/Wautoma				Vantage – Midway 230-kV	
	230-kV		500-kV			
Clearance	min.	avg.	min.	avg.	min.	avg.
Peak field, kV/m	5.1*	3.4*	9.1	5.0	3.1	1.8
Edge of ROW, kV/m	1.4	1.0	1.2	1.3	2.0	1.5

* At centerline.

Table A4: Calculated magnetic fields for configurations of the proposed Schultz–Hanford/Wautoma 500-kV line operated at maximum current.
Configurations are described in Tables A1 and A2.

a) Configuration G: Schultz – Hanford/Wautoma 500-kV and Pacificorp Wanapum – Pomona Heights 230-kV line

Configuration	Proposed G				Existing G	
ROW width, ft.	275				125	
Line	Schultz – Hanford/ Wautoma 500-kV		Pacificorp Wanapum – Pomona Heights 230-kV		Pacificorp Wanapum – Pomona Heights 230-kV	
Clearance	min.	avg.	Min.	avg.	min.	avg.
Peak field, mG	248	140	130	75	125	70
Edge of ROW, mG	53	44	26	20	29	24

b) Configuration D-1A: Schultz – Hanford/Wautoma 500-kV and Vantage – Midway 230-kV line

Configuration	Proposed D-1A				Existing D-1A	
ROW width, ft.	125				100	
Line	Vantage – Midway & Schultz – Hanford/Wautoma				Vantage – Midway 230-kV	
	230-kV		500-kV			
Clearance	min.	avg.	min.	avg.	min.	avg.
Peak field, mG	167	95	187	103	133	84
Edge of ROW, mG	44	36	64	51	67	49

Table A5: Predicted foul-weather audible noise (AN) levels at edge of right-of-way (ROW) for proposed Schultz – Hanford/Wautoma 500-kV line. AN levels expressed in decibels on the A-weighted scale (dBA). L₅₀ and L₅ denote the levels exceeded 50 and 5 percent of the time, respectively. For the parallel-line configurations¹, the AN level at the edge of the proposed Schultz-Hanford Area Transmission Project ROW is given first.

Configuration ¹	Foul-weather AN					
	Proposed			Existing		
	ROW ft. (m)	L ₅₀ , dBA	L ₅ , dBA	ROW ft. (m)	L ₅₀ , dBA	L ₅ , dBA
G	275 (84)	48, 45	52, 49	125	39	42
D-1A	125 (38)	49, 48	53, 52	100 (30)	43	46

1 Configurations are described in Tables A1 and A2.

Table A6: Predicted fair-weather radio interference (RI) levels at 100 feet (30.5 m) from the outside conductor of the proposed Schultz – Hanford/Wautoma 500-kV line. RI levels given in decibels above 1 microvolt/meter (dB μ V/m) at 1.0 MHz. L₅₀ denotes level exceeded 50 percent of the time. For the parallel-line configurations, the RI level on the side of the proposed Schultz – Hanford Area Transmission Line Project ROW is given first.

Configuration ¹	Fair-weather RI	
	Proposed	Existing
	L ₅₀ , dBmV/m	L ₅₀ , dBmV/m
G	38, 29	26
D-1A	41, 38	30

1 Configurations are described in Tables A1 and A2.

Table A7: Predicted maximum foul-weather television interference (TVI) levels predicted at 100 feet (30.5 m) from the outside conductor of the proposed Schultz – Hanford/Wautoma 500-kV line. TVI levels given in decibels above 1 microvolt/meter (dB μ V/m) at 75 MHz. For the parallel-line configurations, the TVI level on the side of the proposed Schultz – Hanford Area Transmission Line Project ROW is given first.

Configuration ¹	Foul-weather TVI	
	Proposed	Existing
	Maximum (foul), dBmV/m	Maximum (foul), dBmV/m
G	24, 12	13
D-1A	24, 19	17

1 Configurations are described in detail in Tables A1 and A2.

Figure A1: Additional configurations for proposed Schultz-Hanford Area Transmission Line Project 500-kV line: a) Proposed line with parallel Pacificorp Wanapum – Pomona Heights 230-kV line (Configuration G); and b) Proposed line on double-circuit tower with existing BPA 230-kV line (Configuration D-1A). (2 pages)

- a) Proposed 500-kV line parallel to Pacificorp Wanapum – Pomona Heights 230-kV line (Configuration G) (not to scale)

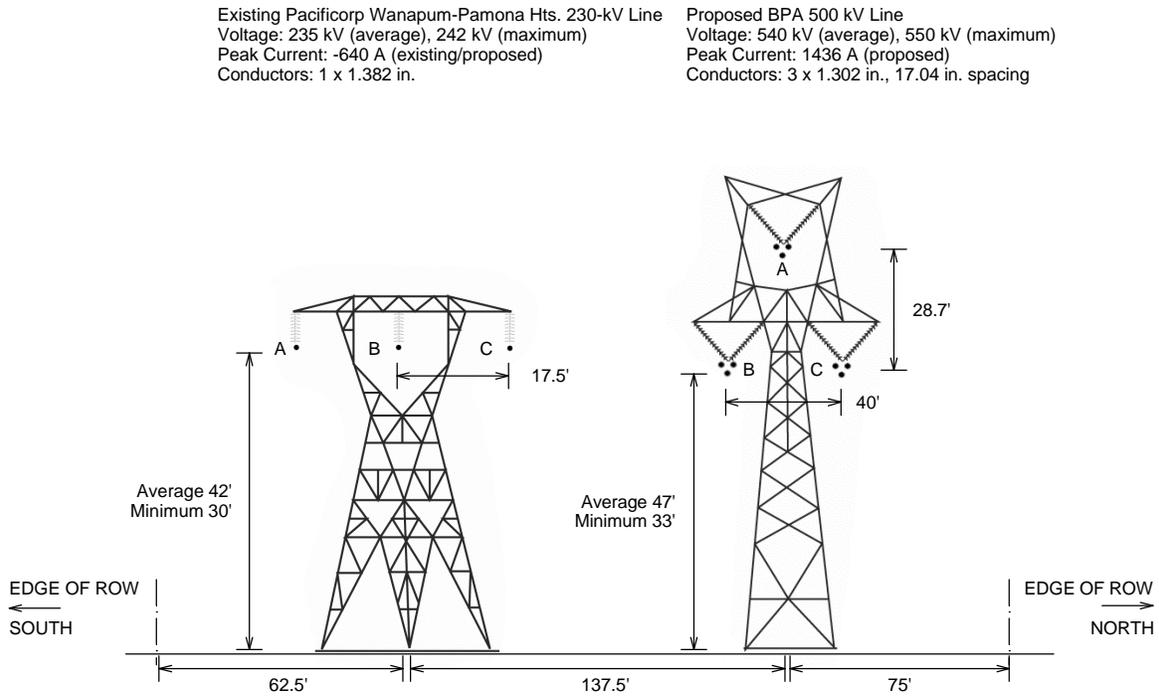


Figure A1, continued

- b) Proposed 500-kV line on double-circuit tower with existing BPA Vantage – Midway 230-kV line (Configuration D-1A) (Not to scale)

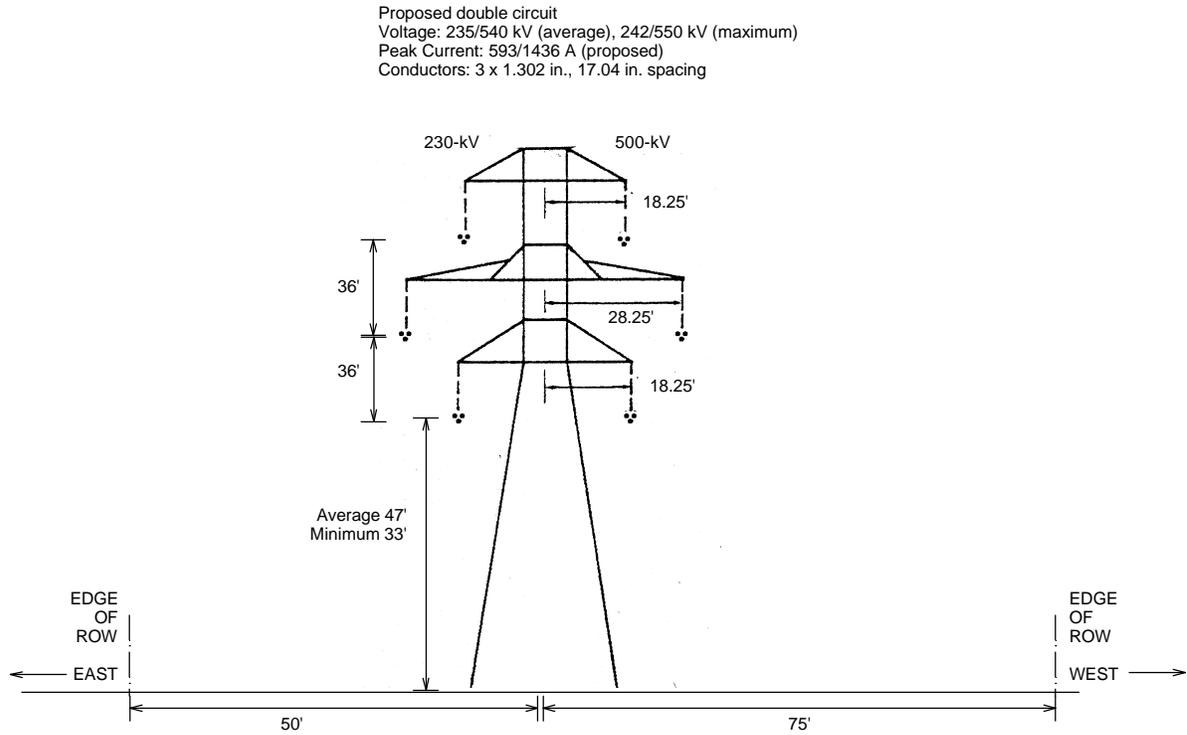


Figure A2: Electric-field profiles for additional configurations of proposed Schultz – Hanford/Wautoma 500-kV line: a) Proposed 500-kV line parallel to Pacificorp Wanapum – Pomona Heights 230-kV line (Configuration G); and b) proposed 500-kV line on double-circuit tower with existing BPA Vantage – Midway 230-kV line (Configuration D-1A). Fields for maximum voltage and minimum clearances are shown. (2 pages)

a) Proposed 500-kV line parallel to Pacificorp Wanapum – Pomona Heights 230-kV line (Configuration G).

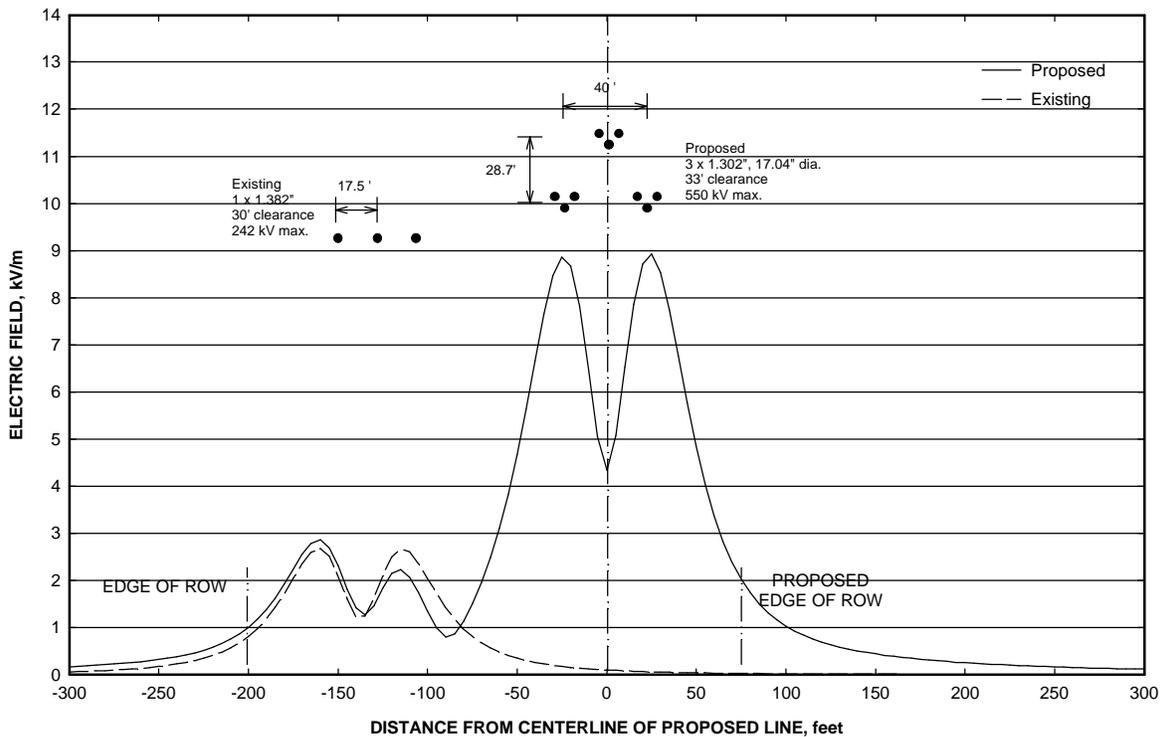


Figure A2, continued

- b) Proposed 500-kV line on double-circuit tower with existing BPA Vantage – Midway 230-kV line (Configuration D-1A)

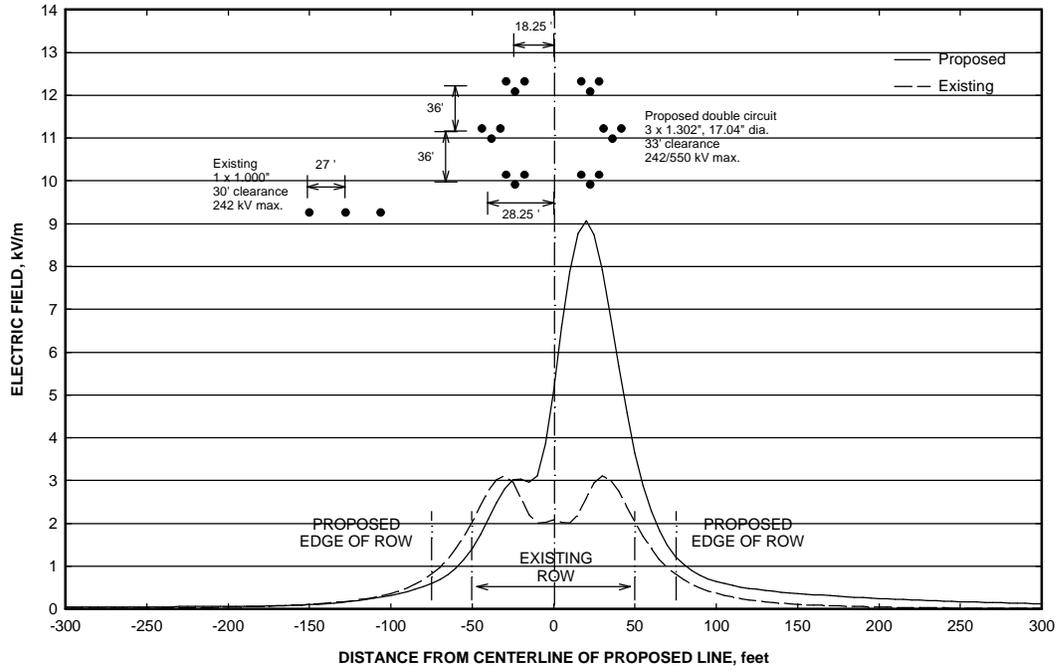


Figure A3: Magnetic-field profiles for additional configurations of the proposed Schultz-Hanford/Wautoma 500-kV line under maximum current conditions:
a) Proposed 500-kV line parallel to Pacificorp Wanapum – Pomona Heights 230-kV line (Configuration G); and b) proposed 500-kV line on double-circuit tower with BPA Vantage – Midway 230-kV line (Configuration D-1A). (2 pages)

a) Proposed 500-kV line parallel to Pacificorp Wanapum – Pomona Heights 230-kV line (Configuration G).

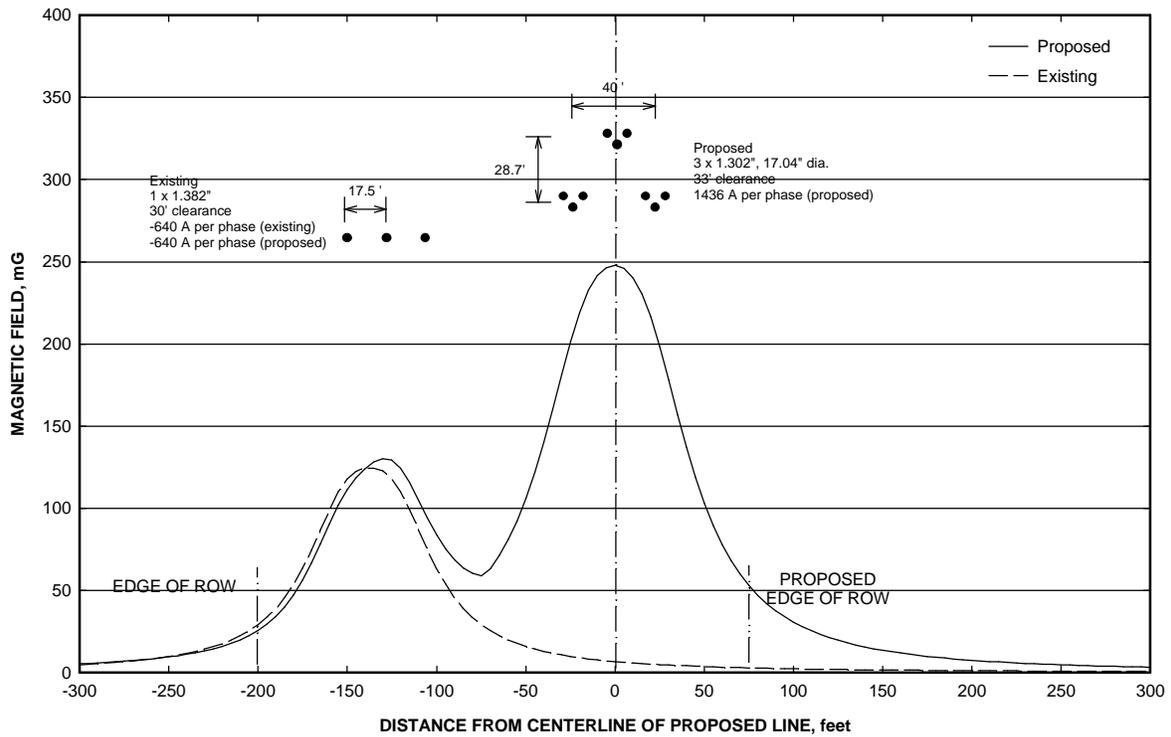
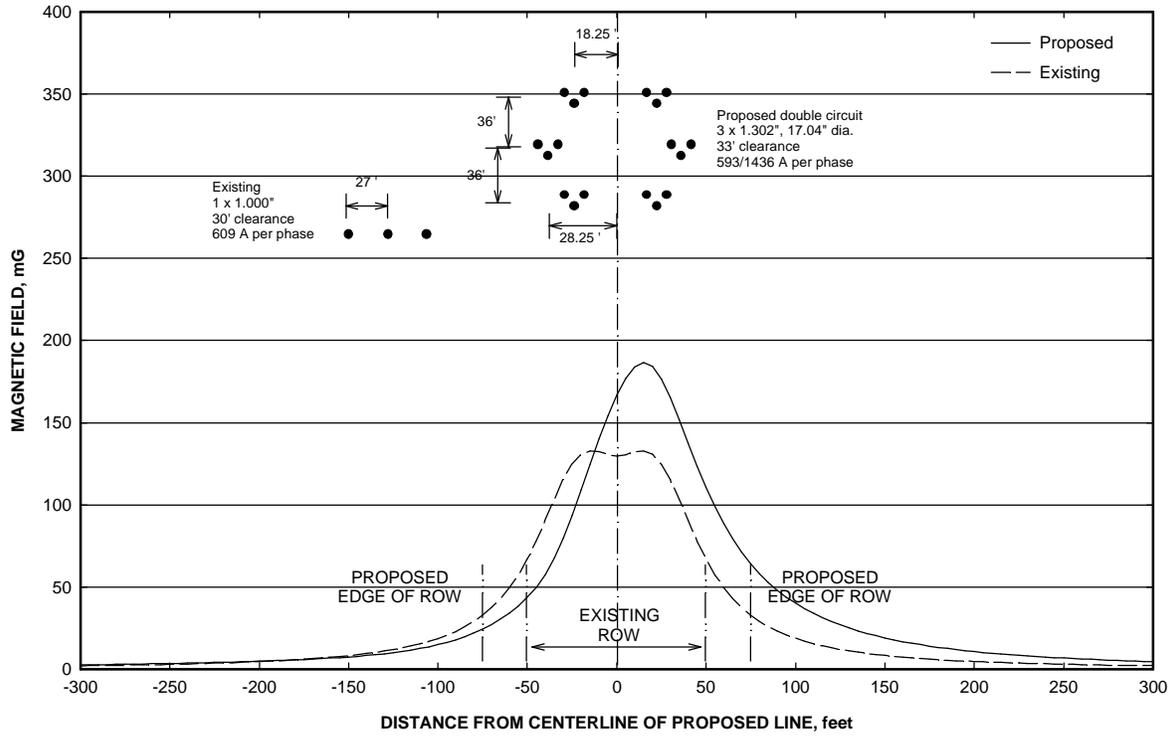


Figure A3, continued

- b) Proposed 500-kV line on double-circuit tower with BPA Vantage – Midway 230-kV line
 (Configuration D-1A)



This page intentionally left blank.