



# **MISO DPP 2017 August West Area Study Phase 2 Final Report**

January 11, 2021  
Rev 1

**MISO  
720 City Center  
Drive Carmel  
Indiana 46032**  
<http://www.misoenergy.org>

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## 1. Executive Summary

This report presents the results of a System Impact Study (SIS) performed to evaluate the interconnection of the generators in the DPP 2017 August West Area Phase 2 (West Area DPP 2). The study was performed under the direction of MISO and reviewed by an ad hoc study group. The ad hoc study group was formed to review the study scope, methodology, models and results. The ad hoc study group consisted of representatives from the interconnection customers and the following utility companies – American Transmission Company, Ameren, Basin Electric Power Cooperative, CIPCO, Cedar Falls, Dairyland Power Cooperative, Great River Energy, ITC Midwest, Montana-Dakota Utilities, MidAmerican, Minnesota Power, Ottertail Power, SMMPA, and Xcel Energy.

### 1.1. Project List

The original interconnection requests for DPP 2017 August West Area had a total of 27 projects generation projects with a combined nameplate rating of 4126.78 MW (ERIS) & 3596.28 MW (NRIS). The detailed list of West Area DPP 2 is shown below in Table 1, and the 2017 August West cycle originally kicked off on June 12, 2019.

**Table 1: List of DPP August 2017 West Area Phase 1 Projects**

Project	Fuel Type	Transmission Owner	County	State	Service Requested	MW	POI	Interconnection Facility Self Fund Election
J545	Wind	Xcel	Lincoln	MN	NRIS	110	Buffalo Ridge 115 kV	Yes
J580	Wind	MDU	Burleigh	ND	ERIS	298	Wishek-Hesket 230 kV	Yes
J628	Wind	GRE	Grand Forks, Nelson	ND	NRIS	400	Prairie-Ramsey 230 kV	No
J705	Wind	MP	Morton	ND	NRIS	100	Tri-County 230 kV	Yes
J706	Wind	MP	Morton	ND	NRIS	100	Tri-County 230 kV	Yes
J713	Wind	MP	Oliver	ND	NRIS	300	Square-Butte 230 kV	Yes
J720	Wind	ITCM	Jackson	MN	NRIS	200	Lakefield-Raun 345 kV	Yes
J722	Wind	OTP	Codington, Deuel	SD	NRIS	200	Big Stone South 230 kV	Yes
J785	Wind	ITCM	Jackson, Martin	MN	NRIS	105	Lakefield Junction-Huntley 345 kV	Yes
J801	Solar	DPC	Pierce	WI	NRIS	74	Crystal Cave – Rock Elm 161 kV	Yes
J803	Solar	Xcel	Lyon	MN	ERIS	32.5	Tracy-Walnut Grove 69 kV	Yes
J816	Solar	OTP	Cass	ND	NRIS	60	Buffalo 115 kV	Yes
J836	Wind	ITCM	Kossuth	IA	ERIS	200	Ledyard 345 kV	Yes
J840	Wind	MEC	Humboldt	IA	NRIS	150	Kossuth-Webster 345 kV	Yes
J873	Wind	ITCM	Hardin	IA	NRIS	200	Emery-Blackhawk 345 kV	Yes
J874	Solar	Xcel	Murray	MN	NRIS	150	Fenton-Chanarambie 115 kV	Yes
J877	Solar	MEC	Palo Alto	IA	NRIS	250	Palo Alto 345 kV	Yes



Project	Fuel Type	Transmission Owner	County	State	Service Requested	MW	POI	Interconnection Facility Self Fund Election
J885	Wind	ITCM	Freeborn, Worth	IA, MN	NRIS	64	Glenworth 161 kV	Yes
J897	Wind	GRE	Grand Forks	ND	NRIS	190	Ramsey-Prairie 230 kV	No
J898	Wind	DPC	Fillmore, Mower	MN	NRIS	100	Beaver Creek-Rice 161 kV	Yes
J901	Wind	Xcel	Redwood	MN	NRIS	200	Lyon County-Cedar Mountain 345 kV	Yes
J905	Solar	OTP	Cass	ND	NRIS	40	Buffalo 115 kV	Yes
J916	Diesel	ITCM	Cottonwood	MN	E-NRIS	2	Mountain Lake 69 kV	Yes
J926	Wind	Xcel	Saint Croix	WI	NRIS	101.28	Pine Lake – Apple River 161 kV	Yes
J927	Wind	ITCM	Faribault	MN	NRIS	100	Walters 69 kV Substation	Yes
J933	Wind	OTP	Day	SD	NRIS	200	Ellendale-Big Stone South 345 kV	Yes
J946	Solar	Xcel	Cass	ND	NRIS	200	Bison 345 kV	Yes



## 1.2. Project Summary Network Upgrades

J545			
Network Upgrade	NU Cost Estimate (\$)	J545 Cost Estimate (\$)	NU Type
Canby Two Steps of 20 Mvar Capacitor Banks (OTP LPC)	\$1,500,000	\$47,824	OTP Voltage
Dumont 20 Mvar Capacitor Bank (OTP LPC)	\$1,000,000	\$64,248	OTP Voltage
J901 POI 75 Mvar Capacitor Bank (GRE LPC)	\$4,000,000	\$309,196	GRE Voltage
Panther 60 Mvar Capacitor Bank (GRE LPC)	\$2,500,000	\$167,927	GRE Voltage
CCS GRE LPC Voltage NU (GRE LPC)	\$505,270,000	\$1,907,065	GRE Voltage
Astoria-Hazel Creek 345 kV Circuit (SPP AFS)	\$125,000,000	\$6,119,084	SPP AFS ERIS
Reconfigure/Add Breakers at Fort Thompson (SPP AFS)	\$7,500,000	\$212,314	SPP AFS ERIS
Terminal Equipment Upgrades Split Rock-White 345 kV (SPP AFS)	\$1,000,000	\$59,447	SPP AFS ERIS
Second Colby-Killdeer-Quinn-J873-Blackhack-Hazelton 345 kV (SPP AFS)	\$361,000,000	\$8,208,109	SPP AFS NRIS
Upgrade Terminal Equipment S3451-S3454 345 kV (SPP AFS)	\$500,000	\$20,230	SPP AFS ERIS
Second Raun-S3451 345 kV (SPP AFS)	\$102,600,000	\$4,142,139	SPP AFS NRIS
Second Split Rock-Sioux City 345 kV (SPP AFS)	\$126,865,737	\$8,287,457	SPP AFS NRIS
Second Holt-Grand Prairie 345 kV (SPP AFS)	\$50,011,493	\$1,472,581	SPP AFS NRIS
Second Raun-Sioux City 345 kV (SPP AFS)	\$80,000,000	\$4,642,406	SPP AFS NRIS
Rebuild Minn Valley-Granite Falls 230 kV (SPP AFS)	\$5,200,000	\$118,611	SPP AFS NRIS
Rebuild Overton-Sibley 345 kV (SPP AFS)	\$155,350,000	\$5,578,330	SPP AFS NRIS
<b>Total Cost Per Project:</b>		<b>\$41,356,968</b>	

J580			
Network Upgrade	NU Cost Estimate (\$)	J580 Cost Estimate (\$)	NU Type
Merricourt - Wishek 230 kV Rebuild	\$6,000,000	\$6,000,000	ERIS Thermal
Heskett – J302 POI 230 kV Rebuild	\$4,500,000	\$4,500,000	ERIS Thermal
Wishek – J302 POI 230 kV Rebuild	\$4,750,000	\$4,750,000	ERIS Thermal



Heskett – Mandan 230 kV Uprate	\$200,000	\$200,000	ERIS Thermal
Sheyenne – Lake Park 230 kV Uprate	\$1,300,000	\$297,688	ERIS Thermal
Wahpeton-Fergus Falls 230 kV Uprate	\$850,000	\$850,000	ERIS Thermal
Audubon – Lake Park 230 kV Uprate	\$100,000	\$22,899	ERIS Thermal
Six Wahpeton 50 MVar Capacitors	\$9,750,000	\$1,936,563	ERIS Voltage
One Bison 150 MVar Capacitor	\$1,500,000	\$297,933	ERIS Voltage
Three Maple River 50 MVar Capacitors	\$3,000,000	\$595,865	ERIS Voltage
Linton – Wishek 115 kV Rebuild and Operate Normally Closed	\$14,100,000	\$14,100,000	ERIS Stability
Ellendale-Aberdeen Jct 115 kV Uprate (MDU LPC)	\$60,000	\$26,634	MDU Thermal
Foxtail-Ellendale 230 kV Rebuild (MDU LPC)	\$10,500,000	\$10,500,000	MDU Thermal
Merricourt-Wishek 230 kV Rebuild (MDU LPC)	\$6,300,000	\$6,300,000	MDU Thermal
Wishek-J302 POI 230 kV Rebuild (MDU LPC)	\$5,600,000	\$5,600,000	MDU Thermal
Build Mandan-J530 POI 230 kV Circuit (MDU LPC)	\$28,000,000	\$28,000,000	MDU Stability
Add Additional Breaker at Merricourt (MDU LPC)	\$1,500,000	\$1,500,000	MDU Voltage
Hankinson-Wahpeton 230 kV Rebuild (OTP LPC)	\$21,900,000	\$21,900,000	OTP Thermal
Hankinson-Forman 230 kV Uprate (OTP LPC)	\$50,000	\$22,624	OTP Thermal
Brooking County-Astoria 2 <sup>nd</sup> 345 kV Circuit (OTP LPC)	\$36,500,000	\$7,761,997	OTP Voltage
Astoria-J526 POI 2 <sup>nd</sup> 345 kV Circuit (OTP LPC)	\$55,000,000	\$11,742,025	OTP Voltage
Canby Two Steps of 20 Mvar Capacitor Banks (OTP LPC)	\$1,500,000	\$238,861	OTP Voltage
Dumont 20 Mvar Capacitor Bank (OTP LPC)	\$1,000,000	\$105,841	OTP Voltage
J901 POI 75 Mvar Capacitor Bank (GRE LPC)	\$4,000,000	\$350,786	GRE Voltage
Panther 60 Mvar Capacitor Bank (GRE LPC)	\$2,500,000	\$305,691	GRE Voltage
CCS GRE LPC Voltage NU (GRE LPC)	\$505,270,000	\$97,541,455	GRE Voltage
Astoria-Hazel Creek 345 kV Circuit (SPP AFS)	\$125,000,000	\$15,077,809	SPP AFS ERIS
Reconfigure/Add Breakers at Fort Thompson (SPP AFS)	\$7,500,000	\$1,171,642	SPP AFS ERIS
Terminal Equipment Upgrades Split Rock-White 345 kV (SPP AFS)	\$1,000,000	\$96,654	SPP AFS ERIS
Rebuild Ward-Bismarck 230 kV (SPP AFS)	\$3,100,000	\$3,100,000	SPP AFS ERIS
<b>Total Cost Per Project:</b>		<b>\$243,721,325</b>	

J628			
Network Upgrade	NU Cost Estimate (\$)	J628 Cost Estimate (\$)	NU Type
Hubbard – Audubon 230 kV Uprate	\$650,000	\$343,957	ERIS Thermal

Wilton-Bemidji Uprate	\$50,000	\$34,602	ERIS Thermal
Crookston-Fertile Uprate	\$250,000	\$250,000	ERIS Thermal
Crookston-Falconer Uprate	\$25,000	\$25,000	ERIS Thermal
Rebuild J628-Prairie 230 kV Rebuild	\$16,770,000	\$11,844,357	ERIS Thermal
New J628-Prairie 230 kV 2nd Circuit	\$22,360,000	\$11,601,663	ERIS Voltage
Six Wahpeton 50 MVar Capacitors	\$9,750,000	\$1,308,168	ERIS Voltage
One Bison 150 MVar Capacitor	\$1,500,000	\$201,257	ERIS Voltage
Three Maple River 50 MVar Capacitors	\$3,000,000	\$402,513	ERIS Voltage
Mahnomm-Ulrich 115 kV Uprate (OTP LPC)	\$50,000	\$50,000	OTP Thermal
Winger-Fertile 115 kV Uprate (OTP LPC)	\$50,000	\$50,000	OTP Thermal
Crookston-Fertile 115 kV Uprate (OTP LPC)	\$250,000	\$250,000	OTP Thermal
Wilton-Bemidji 115 kV Uprate (OTP LPC)	\$50,000	\$34,611	OTP Thermal
Brooking County-Astoria 2nd 345 kV Circuit (OTP LPC)	\$36,500,000	\$1,537,448	OTP Voltage
Astoria-J526 POI 2nd 345 kV Circuit (OTP LPC)	\$55,000,000	\$2,536,448	OTP Voltage
Canby Two Steps of 20 Mvar Capacitor Banks (OTP LPC)	\$1,500,000	\$92,227	OTP Voltage
J901 POI 75 Mvar Capacitor Bank (GRE LPC)	\$4,000,000	\$133,206	GRE Voltage
Panther 60 Mvar Capacitor Bank (GRE LPC)	\$2,500,000	\$194,370	GRE Voltage
J628-Prairie 230 kV Terminal Upgrades (MPC AFS)	\$500,000	\$339,902	MPC AFS
Stanton-Square Butte 230 kV Terminal Upgrades (MPC AFS)	\$500,000	\$31,071	MPC AFS
Wilton-Scribner 115 kV Terminal Upgrades (MPC AFS)	\$200,000	\$138,250	MPC AFS
Bemidj-Helga 115 kV Terminal Upgrades (MPC AFS)	\$200,000	\$80,634	MPC AFS
Jamestown-Center 345 kV Structure Remediation (MPC AFS)	\$1,000,000	\$146,013	MPC AFS
Grank Forks – Falconer 115 kV Reconductor (MPC AFS)	\$550,000	\$291,977	MPC AFS
Falconer – Oslo 115 kV Reconductor (MPC AFS)	\$2,000,000	\$1,048,188	MPC AFS
Wilton-Winger 230 kV Structure Remediation (MPC AFS)	\$400,000	\$155,542	MPC AFS
Prairie 115/69 kV Transformer #2 Upgrades (MPC AFS)	\$1,500,000	\$1,059,728	MPC AFS
Drayton-Prairie 230 kV Structure Remediation (MPC AFS)	\$200,000	\$98,126	MPC AFS
Prairie-Winger 230 kV Structure Remediation (MPC AFS)	\$500,000	\$272,601	MPC AFS
Mill Road-Master 69 kV Structure Remediation and Terminal Upgrades (MPC AFS)	\$500,000	\$353,520	MPC AFS
Winger 230 kV 30 MVar Capacitor (MPC AFS)	\$1,000,000	\$313,616	MPC AFS
Astoria-Hazel Creek 345 kV Circuit (SPP AFS)	\$125,000,000	\$8,568,836	SPP AFS ERIS
Reconfigure/Add Breakers at Fort Thompson (SPP AFS)	\$7,500,000	\$1,207,752	SPP AFS ERIS
Terminal Equipment Upgrades Split Rock-White 345 kV (SPP AFS)	\$1,000,000	\$120,924	SPP AFS ERIS



Second Grand Forks 230/115 kV Transformer (SPP AFS)	\$6,621,188	\$4,680,436	SPP AFS ERIS
Rebuild Grand Forks-Prairie 230 kV (SPP AFS)	\$300,000	\$212,466	SPP AFS ERIS
Rebuild Sully-Whitlock 230 kV (SPP AFS)	\$19,677,570	\$5,298,553	SPP AFS NRIS
Rebuild Meadow Grove-Fort Randle 230 kV (SPP AFS)	\$74,364,953	\$16,491,841	SPP AFS NRIS
Upgrade Terminal Equipment S3451-S3454 345 kV (SPP AFS)	\$500,000	\$53,654	SPP AFS ERIS
Second Raun-S3451 345 kV (SPP AFS)	\$102,600,000	\$10,631,260	SPP AFS NRIS
Second Colby-Killdeer-Quinn-J873-Blackhawk-Hazleton 345 kV (SPP AFS)	\$361,000,000	\$22,415,640	SPP AFS NRIS
Terminal Equipment Upgrades Antelope Valley-Broadland 345 kV (SPP AFS)	\$3,000,000	\$787,157	SPP AFS NRIS
Second Center-Jamestown-Buffalo-Bison 345 kV (SPP AFS)	\$311,559,097	\$31,355,937	SPP AFS NRIS
Second Split Rock-Sioux City 345 kV (SPP AFS)	\$126,865,737	\$14,742,577	SPP AFS NRIS
Second Holt-Grand Prairie 345 kV (SPP AFS)	\$50,011,493	\$9,161,705	SPP AFS NRIS
Second Raun-Sioux City 345 kV (SPP AFS)	\$80,000,000	\$10,234,543	SPP AFS NRIS
Second Big Stone South-Deuel County 345 kV (SPP AFS)	\$70,000,000	\$7,015,642	SPP AFS NRIS
Second Astoria-Hazel Creek 345 kV (SPP AFS)	\$25,000,000	\$2,041,776	SPP AFS NRIS
Rebuild Overton-Sibley 345 kV (SPP AFS)	\$155,350,000	\$18,006,137	SPP AFS NRIS
<b>Total Cost Per Project:</b>		<b>\$189,676,995</b>	

J705			
Network Upgrade	NU Cost Estimate (\$)	J705 Cost Estimate (\$)	NU Type
Six Wahpeton 50 MVar Capacitors	\$9,750,000	\$517,734	ERIS Voltage
One Bison 150 MVar Capacitor	\$1,500,000	\$79,651	ERIS Voltage
Three Maple River 50 MVar Capacitors	\$3,000,000	\$159,303	ERIS Voltage
Coyote Transformer Upgrade	\$5,000,000	\$1,000,000	NRIS
Coyote – Beulah 115 kV Upgrade	\$1,500,000	\$300,000	NRIS



Center – Jamestown 345 kV Uprate	\$25,000	\$5,000	NRIS
Brooking County-Astoria 2 <sup>nd</sup> 345 kV Circuit (OTP LPC)	\$36,500,000	\$680,981	OTP Voltage
Astoria-J526 POI 2 <sup>nd</sup> 345 kV Circuit (OTP LPC)	\$55,000,000	\$1,078,789	OTP Voltage
Canby Two Steps of 20 Mvar Capacitor Banks (OTP LPC)	\$1,500,000	\$40,349	OTP Voltage
J901 POI 75 Mvar Capacitor Bank (GRE LPC)	\$4,000,000	\$76,786	GRE Voltage
Panther 60 Mvar Capacitor Bank (GRE LPC)	\$2,500,000	\$75,875	GRE Voltage
CCS GRE LPC Voltage NU (GRE LPC)	\$505,270,000	\$78,454,265	GRE Voltage
J628-Prairie 230 kV Terminal Upgrades (MPC AFS)	\$500,000	\$3,800	MPC AFS
Stanton-Square Butte 230 kV Terminal Upgrades (MPC AFS)	\$500,000	\$73,594	MPC AFS
Bemidj-Helga 115 kV Terminal Upgrades (MPC AFS)	\$200,000	\$11,029	MPC AFS
Jamestown-Center 345 kV Structure Remediation (MPC AFS)	\$1,000,000	\$154,218	MPC AFS
Grank Forks – Falconer 115 kV Reconductor (MPC AFS)	\$550,000	\$27,066	MPC AFS
Falconer – Oslo 115 kV Reconductor (MPC AFS)	\$2,000,000	\$103,469	MPC AFS
Wilton-Winger 230 kV Structure Remediation (MPC AFS)	\$400,000	\$21,382	MPC AFS
Drayton-Prairie 230 kV Structure Remediation (MPC AFS)	\$200,000	\$9,194	MPC AFS
Prairie-Winger 230 kV Structure Remediation (MPC AFS)	\$500,000	\$21,944	MPC AFS
Install 3rd Center 345/230 kV Transformer (MPC AFS)	\$7,000,000	\$1,400,000	MPC AFS
Winger 230 kV 30 MVar Capacitor (MPC AFS)	\$1,000,000	\$93,830	MPC AFS
Astoria-Hazel Creek 345 kV Circuit (SPP AFS)	\$125,000,000	\$4,028,741	SPP AFS ERIS
Reconfigure/Add Breakers at Fort Thompson (SPP AFS)	\$7,500,000	\$375,193	SPP AFS ERIS
Terminal Equipment Upgrades Split Rock-White 345 kV (SPP AFS)	\$1,000,000	\$31,254	SPP AFS ERIS
Rebuild Grand Forks-Prairie 230 kV (SPP AFS)	\$300,000	\$113,251	SPP AFS ERIS
Rebuild Sully-Whitlock 230 kV (SPP AFS)	\$19,677,570	\$1,733,204	SPP AFS NRIS
Rebuild Meadow Grove-Fort Randle 230 kV (SPP AFS)	\$74,364,953	\$4,877,407	SPP AFS NRIS
Upgrade Terminal Equipment S3451-S3454 345 kV (SPP AFS)	\$500,000	\$13,931	SPP AFS ERIS
Second Raun-S3451 345 kV (SPP AFS)	\$102,600,000	\$2,722,372	SPP AFS NRIS
Second Colby-Killdeer-Quinn-J873-Blackhack-Hazelton 345 kV (SPP AFS)	\$361,000,000	\$5,903,536	SPP AFS NRIS
Terminal Equipment Upgrades Antelope Valley-Broadland 345 kV (SPP AFS)	\$3,000,000	\$276,806	SPP AFS NRIS
Second Center-Jamestown-Buffalo-Bison 345 kV (SPP AFS)	\$311,559,097	\$35,031,318	SPP AFS NRIS



Second Split Rock-Sioux City 345 kV (SPP AFS)	\$126,865,737	\$3,749,028	SPP AFS NRIS
Second Holt-Grand Prairie 345 kV (SPP AFS)	\$50,011,493	\$2,789,217	SPP AFS NRIS
Second Raun-Sioux City 345 kV (SPP AFS)	\$80,000,000	\$2,771,034	SPP AFS NRIS
Second Big Stone South-Deuel County 345 kV (SPP AFS)	\$70,000,000	\$2,154,554	SPP AFS NRIS
Second Astoria-Hazel Creek 345 kV (SPP AFS)	\$25,000,000	\$914,906	SPP AFS NRIS
Rebuild Overton-Sibley 345 kV (SPP AFS)	\$155,350,000	\$4,842,240	SPP AFS NRIS
Rebuild Minn Valley-Granite Falls 230 kV (SPP AFS)	\$5,200,000	\$599,156	SPP AFS NRIS
Upgrade Post Rock 345/230 kV Transformer (SPP AFS)	\$8,302,968	\$1,660,594	SPP AFS NRIS
Rebuild Bismark-ESTBMRK 115 kV (SPP AFS)	\$100,000	\$20,000	SPP AFS NRIS
<b>Total Cost Per Project:</b>		<b>\$158,882,750</b>	

<b>J706</b>			
<b>Network Upgrade</b>	<b>NU Cost Estimate (\$)</b>	<b>J706 Cost Estimate (\$)</b>	<b>NU Type</b>
Six Wahpeton 50 MVar Capacitors	\$9,750,000	\$517,734	ERIS Voltage
One Bison 150 MVar Capacitor	\$1,500,000	\$79,651	ERIS Voltage
Three Maple River 50 MVar Capacitors	\$3,000,000	\$159,303	ERIS Voltage
Coyote Transformer Upgrade	\$5,000,000	\$1,000,000	NRIS
Coyote – Beulah 115 kV Upgrade	\$1,500,000	\$300,000	NRIS
Center – Jamestown 345 kV Uprate	\$25,000	\$5,000	NRIS
Brooking County-Astoria 2 <sup>nd</sup> 345 kV Circuit (OTP LPC)	\$36,500,000	\$680,981	OTP Voltage
Astoria-J526 POI 2 <sup>nd</sup> 345 kV Circuit (OTP LPC)	\$55,000,000	\$1,078,789	OTP Voltage
Canby Two Steps of 20 Mvar Capacitor Banks (OTP LPC)	\$1,500,000	\$40,349	OTP Voltage
J901 POI 75 Mvar Capacitor Bank (GRE LPC)	\$4,000,000	\$76,786	GRE Voltage
Panther 60 Mvar Capacitor Bank (GRE LPC)	\$2,500,000	\$75,875	GRE Voltage
CCS GRE LPC Voltage NU (GRE LPC)	\$505,270,000	\$78,454,265	GRE Voltage
J628-Prairie 230 kV Terminal Upgrades (MPC AFS)	\$500,000	\$3,800	MPC AFS
Stanton-Square Butte 230 kV Terminal Upgrades (MPC AFS)	\$500,000	\$73,594	MPC AFS
Bemidj-Helga 115 kV Terminal Upgrades (MPC AFS)	\$200,000	\$11,029	MPC AFS
Jamestown-Center 345 kV Structure Remediation (MPC AFS)	\$1,000,000	\$154,218	MPC AFS





Grank Forks – Falconer 115 kV Reconductor (MPC AFS)	\$550,000	\$27,066	MPC AFS
Falconer – Oslo 115 kV Reconductor (MPC AFS)	\$2,000,000	\$103,469	MPC AFS
Wilton-Winger 230 kV Structure Remediation (MPC AFS)	\$400,000	\$21,382	MPC AFS
Drayton-Prairie 230 kV Structure Remediation (MPC AFS)	\$200,000	\$9,194	MPC AFS
Prairie-Winger 230 kV Structure Remediation (MPC AFS)	\$500,000	\$21,944	MPC AFS
Install 3rd Center 345/230 kV Transformer (MPC AFS)	\$7,000,000	\$1,400,000	MPC AFS
Winger 230 kV 30 MVar Capacitor (MPC AFS)	\$1,000,000	\$93,830	MPC AFS
Astoria-Hazel Creek 345 kV Circuit (SPP AFS)	\$125,000,000	\$4,028,741	SPP AFS ERIS
Reconfigure/Add Breakers at Fort Thompson (SPP AFS)	\$7,500,000	\$375,193	SPP AFS ERIS
Terminal Equipment Upgrades Split Rock-White 345 kV (SPP AFS)	\$1,000,000	\$31,254	SPP AFS ERIS
Rebuild Sully-Whitlock 230 kV (SPP AFS)	\$19,677,570	\$1,733,204	SPP AFS NRIS
Rebuild Meadow Grove-Fort Randle 230 kV (SPP AFS)	\$74,364,953	\$4,877,407	SPP AFS NRIS
Upgrade Terminal Equipment S3451-S3454 345 kV (SPP AFS)	\$500,000	\$13,931	SPP AFS ERIS
Second Raun-S3451 345 kV (SPP AFS)	\$102,600,000	\$2,722,372	SPP AFS NRIS
Second Colby-Killdeer-Quinn-J873-Blackhack-Hazelton 345 kV (SPP AFS)	\$361,000,000	\$5,903,536	SPP AFS NRIS
Terminal Equipment Upgrades Antelope Valley-Broadland 345 kV (SPP AFS)	\$3,000,000	\$276,806	SPP AFS NRIS
Second Center-Jamestown-Buffalo-Bison 345 kV (SPP AFS)	\$311,559,097	\$35,031,318	SPP AFS NRIS
Second Split Rock-Sioux City 345 kV (SPP AFS)	\$126,865,737	\$3,749,028	SPP AFS NRIS
Second Holt-Grand Prairie 345 kV (SPP AFS)	\$50,011,493	\$2,789,217	SPP AFS NRIS
Second Raun-Sioux City 345 kV (SPP AFS)	\$80,000,000	\$2,771,034	SPP AFS NRIS
Second Big Stone South-Deuel County 345 kV (SPP AFS)	\$70,000,000	\$2,154,554	SPP AFS NRIS
Second Astoria-Hazel Creek 345 kV (SPP AFS)	\$25,000,000	\$914,906	SPP AFS NRIS
Rebuild Overton-Sibley 345 kV (SPP AFS)	\$155,350,000	\$4,842,240	SPP AFS NRIS
Rebuild Minn Valley-Granite Falls 230 kV (SPP AFS)	\$5,200,000	\$599,156	SPP AFS NRIS
Upgrade Post Rock 345/230 kV Transformer (SPP AFS)	\$8,302,968	\$1,660,594	SPP AFS NRIS





Rebuild Bismark-ESTBMRK 115 kV (SPP AFS)	\$100,000	\$20,000	SPP AFS NRIS
<b>Total Cost Per Project:</b>		<b>\$158,882,750</b>	

J713			
Network Upgrade	NU Cost Estimate (\$)	J713 Cost Estimate (\$)	NU Type
Sheyenne – Lake Park 230 kV Uprate	\$1,300,000	\$405,221	ERIS Thermal
Audubon – Lake Park 230 kV Uprate	\$100,000	\$31,171	ERIS Thermal
Hubbard – Audubon 230 kV Uprate	\$650,000	\$306,043	ERIS Thermal
Six Wahpeton 50 MVar Capacitors	\$9,750,000	\$1,371,403	ERIS Voltage
One Bison 150 MVar Capacitor	\$1,500,000	\$210,985	ERIS Voltage
Three Maple River 50 MVar Capacitors	\$3,000,000	\$421,970	ERIS Voltage
Coyote Transformer Upgrade	\$5,000,000	\$3,000,000	NRIS
Coyote-Beulah 115 kV Upgrade	\$1,500,000	\$900,000	NRIS
Center – Jamestown 345 kV Uprate	\$25,000	\$15,000	NRIS
Brooking County-Astoria 2 <sup>nd</sup> 345 kV Circuit (OTP LPC)	\$36,500,000	\$2,042,944	OTP Voltage
Astoria-J526 POI 2 <sup>nd</sup> 345 kV Circuit (OTP LPC)	\$55,000,000	\$3,236,367	OTP Voltage
Canby Two Steps of 20 Mvar Capacitor Banks (OTP LPC)	\$1,500,000	\$121,048	OTP Voltage
J901 POI 75 Mvar Capacitor Bank (GRE LPC)	\$4,000,000	\$230,357	GRE Voltage
Panther 60 Mvar Capacitor Bank (GRE LPC)	\$2,500,000	\$227,625	GRE Voltage
CCS GRE LPC Voltage NU (GRE LPC)	\$505,270,000	\$235,362,796	GRE Voltage
J628-Prairie 230 kV Terminal Upgrades (MPC AFS)	\$500,000	\$11,401	MPC AFS
Stanton-Square Butte 230 kV Terminal Upgrades (MPC AFS)	\$500,000	\$220,782	MPC AFS
Bemidj-Helga 115 kV Terminal Upgrades (MPC AFS)	\$200,000	\$33,086	MPC AFS
Jamestown-Center 345 kV Structure Remediation (MPC AFS)	\$1,000,000	\$462,654	MPC AFS
Grank Forks – Falconer 115 kV Reconductor (MPC AFS)	\$550,000	\$81,199	MPC AFS
Falconer – Oslo 115 kV Reconductor (MPC AFS)	\$2,000,000	\$310,408	MPC AFS
Wilton-Winger 230 kV Structure Remediation (MPC AFS)	\$400,000	\$64,146	MPC AFS
Drayton-Prairie 230 kV Structure Remediation (MPC AFS)	\$200,000	\$27,582	MPC AFS
Prairie-Winger 230 kV Structure Remediation (MPC AFS)	\$500,000	\$65,833	MPC AFS
Install 3rd Center 345/230 kV Transformer (MPC AFS)	\$7,000,000	\$4,200,000	MPC AFS
Winger 230 kV 30 MVar Capacitor (MPC AFS)	\$1,000,000	\$252,932	MPC AFS
Astoria-Hazel Creek 345 kV Circuit (SPP AFS)	\$125,000,000	\$12,086,223	SPP AFS ERIS
Reconfigure/Add Breakers at Fort Thompson (SPP AFS)	\$7,500,000	\$1,125,580	SPP AFS ERIS



Terminal Equipment Upgrades Split Rock-White 345 kV (SPP AFS)	\$1,000,000	\$93,762	SPP AFS ERIS
Rebuild Sully-Whitlock 230 kV (SPP AFS)	\$19,677,570	\$5,199,612	SPP AFS NRIS
Rebuild Meadow Grove-Fort Randle 230 kV (SPP AFS)	\$74,364,953	\$14,632,222	SPP AFS NRIS
Upgrade Terminal Equipment S3451-S3454 345 kV (SPP AFS)	\$500,000	\$41,793	SPP AFS NRIS
Second Raun-S3451 345 kV (SPP AFS)	\$102,600,000	\$8,167,115	SPP AFS NRIS
Second Colby-Killdeer-Quinn-J873-Blackhack-Hazelton 345 kV (SPP AFS)	\$361,000,000	\$17,710,609	SPP AFS NRIS
Terminal Equipment Upgrades Antelope Valley-Broadland 345 kV (SPP AFS)	\$3,000,000	\$830,419	SPP AFS NRIS
Second Center-Jamestown-Buffalo-Bison 345 kV (SPP AFS)	\$311,559,097	\$105,093,955	SPP AFS NRIS
Second Split Rock-Sioux City 345 kV (SPP AFS)	\$126,865,737	\$11,247,084	SPP AFS NRIS
Second Holt-Grand Prairie 345 kV (SPP AFS)	\$50,011,493	\$8,367,652	SPP AFS NRIS
Second Raun-Sioux City 345 kV (SPP AFS)	\$80,000,000	\$8,313,102	SPP AFS NRIS
Second Big Stone South-Deuel County 345 kV (SPP AFS)	\$70,000,000	\$6,463,663	SPP AFS NRIS
Second Astoria-Hazel Creek 345 kV (SPP AFS)	\$25,000,000	\$2,744,717	SPP AFS NRIS
Rebuild Overton-Sibley 345 kV (SPP AFS)	\$155,350,000	\$14,526,721	SPP AFS NRIS
Rebuild Minn Valley-Granite Falls 230 kV (SPP AFS)	\$5,200,000	\$1,797,468	SPP AFS NRIS
Upgrade Post Rock 345/230 kV Transformer (SPP AFS)	\$8,302,968	\$4,981,781	SPP AFS NRIS
Rebuild Bismark-ESTBMRK 115 kV (SPP AFS)	\$100,000	\$60,000	SPP AFS NRIS
<b>Total Cost Per Project:</b>		<b>\$477,096,431</b>	

<b>J720</b>			
<b>Network Upgrade</b>	<b>NU Cost Estimate (\$)</b>	<b>J720 Cost Estimate (\$)</b>	<b>NU Type</b>
Wilmarth – Sheas Lake 345 kV Rebuild	\$39,526,000	\$25,489,315	ERIS Thermal
Crandal – Fieldon 345 kV Rebuild	\$36,775,000	\$36,775,000	ERIS Thermal
Helena – Sheas Lake 345 kV Rebuild	\$11,922,000	\$7,822,283	ERIS Thermal



Canby Two Steps of 20 Mvar Capacitor Banks (OTP LPC)	\$1,500,000	\$5,166	OTP Voltage
Dumont 20 Mvar Capacitor Bank (OTP LPC)	\$1,000,000	\$22,926	OTP Voltage
J901 POI 75 Mvar Capacitor Bank (GRE LPC)	\$4,000,000	\$119,911	GRE Voltage
Panther 60 Mvar Capacitor Bank (GRE LPC)	\$2,500,000	\$21,876	GRE Voltage
CCS GRE LPC Voltage NU (GRE LPC)	\$505,270,000	\$327,627	GRE Voltage
Upgrade Terminal Equipment S3451-S3454 345 kV (SPP AFS)	\$500,000	\$37,926	SPP AFS NRIS
Second Raun-S3451 345 kV (SPP AFS)	\$102,600,000	\$8,058,605	SPP AFS NRIS
Second Colby-Killdeer-Quinn-J873-Blackhack-Hazelton 345 kV (SPP AFS)	\$361,000,000	\$22,693,593	SPP AFS NRIS
Second Split Rock-Sioux City 345 kV (SPP AFS)	\$126,865,737	\$5,380,571	SPP AFS NRIS
Second Holt-Grand Prairie 345 kV (SPP AFS)	\$50,011,493	\$683,688	SPP AFS NRIS
Second Raun-Sioux City 345 kV (SPP AFS)	\$80,000,000	\$1,922,919	SPP AFS NRIS
Rebuild Overton-Sibley 345 kV (SPP AFS)	\$155,350,000	\$9,922,609	SPP AFS NRIS
<b>Total Cost Per Project:</b>		<b>\$119,284,015</b>	

<b>J722</b>			
<b>Network Upgrade</b>	<b>NU Cost Estimate (\$)</b>	<b>J722 Cost Estimate (\$)</b>	<b>NU Type</b>
Canby-Granite Falls 115 kV Rebuild	\$17,700,000	\$8,925,545	ERIS Thermal
Big Stone-Big Stone South 230 kV Circuit 1 Rebuild	\$1,450,000	\$868,142	ERIS Thermal
Big Stone-Big Stone South 230 kV Circuit 2 Rebuild	\$1,400,000	\$812,108	ERIS Thermal
Big Stone-Blair 230 kV Rebuild	\$28,235,800	\$15,119,146	ERIS Thermal
Six Wahpeton 50 MVar Capacitors	\$9,750,000	\$1,636,198	ERIS Voltage
One Bison 150 MVar Capacitor	\$1,500,000	\$251,723	ERIS Voltage
Three Maple River 50 MVar Capacitors	\$3,000,000	\$503,445	ERIS Voltage
Big Stone-Highway 12 115 kV Uprate (OTP LPC)	\$50,000	\$26,427	OTP Thermal
Highway 12-Ortonville 115 kV Uprate (OTP LPC)	\$50,000	\$26,427	OTP Thermal
Canby Two Steps of 20 Mvar Capacitor Banks (OTP LPC)	\$1,500,000	\$442,102	OTP Voltage
Dumont 20 Mvar Capacitor Bank (OTP LPC)	\$1,000,000	\$410,262	OTP Voltage
J901 POI 75 Mvar Capacitor Bank (GRE LPC)	\$4,000,000	\$407,955	GRE Voltage
Panther 60 Mvar Capacitor Bank (GRE LPC)	\$2,500,000	\$342,642	GRE Voltage
CCS GRE LPC Voltage NU (GRE LPC)	\$505,270,000	\$3,351,356	GRE Voltage



Astoria-Hazel Creek 345 kV Circuit (SPP AFS)	\$125,000,000	\$22,974,415	SPP AFS ERIS
Reconfigure/Add Breakers at Fort Thompson (SPP AFS)	\$7,500,000	\$524,972	SPP AFS ERIS
Terminal Equipment Upgrades Split Rock-White 345 kV (SPP AFS)	\$1,000,000	\$125,109	SPP AFS ERIS
Rebuild Aberdeen Junction-Ellendale 115 kV (SPP AFS)	\$710,840	\$223,326	SPP AFS NRIS
Rebuild Aberdeen Junction-ABDNSBT 115 kV (SPP AFS)	\$5,331,300	\$1,674,946	SPP AFS NRIS
Rebuild Forman-WAPA-Forman 115 kV (SPP AFS)	\$1,500,000	\$762,736	SPP AFS NRIS
Rebuild Meadow Grove-Fort Randle 230 kV (SPP AFS)	\$74,364,953	\$7,650,468	SPP AFS NRIS
Upgrade Terminal Equipment S3451-S3454 345 kV (SPP AFS)	\$500,000	\$32,606	SPP AFS NRIS
Second Raun-S3451 345 kV (SPP AFS)	\$102,600,000	\$6,584,788	SPP AFS NRIS
Second Colby-Killdeer-Quinn-J873-Blackhack-Hazelton 345 kV (SPP AFS)	\$361,000,000	\$13,228,198	SPP AFS NRIS
Second Center-Jamestown-Buffalo-Bison 345 kV (SPP AFS)	\$311,559,097	\$522,646	SPP AFS NRIS
Second Split Rock-Sioux City 345 kV (SPP AFS)	\$126,865,737	\$11,908,309	SPP AFS NRIS
Second Holt-Grand Prairie 345 kV (SPP AFS)	\$50,011,493	\$3,716,568	SPP AFS NRIS
Second Raun-Sioux City 345 kV (SPP AFS)	\$80,000,000	\$7,149,593	SPP AFS NRIS
Rebuild Overton-Sibley 345 kV (SPP AFS)	\$155,350,000	\$9,737,602	SPP AFS NRIS
Rebuild Minn Valley-Granite Falls 230 kV (SPP AFS)	\$5,200,000	\$1,738,032	SPP AFS NRIS
Rebuild Minn Valley-Granite Falls 115 kV (SPP AFS)	\$7,950,000	\$4,817,200	SPP AFS NRIS
Second Big Stone South-Deuel County 345 kV (SPP AFS)	\$70,000,000	\$16,601,908	SPP AFS NRIS
Second Astoria-Hazel Creek 345 kV (SPP AFS)	\$25,000,000	\$6,092,883	SPP AFS NRIS
<b>Total Cost Per Project:</b>		<b>\$149,189,783</b>	



Network Upgrade	NU Cost Estimate (\$)	J785 Cost Estimate (\$)	NU Type
Helena – Sheas Lake 345 kV Rebuild	\$11,922,000	\$4,099,717	ERIS Thermal
Wilmarth – Sheas Lake 345 kV Rebuild	\$39,526,000	\$14,036,685	ERIS Thermal
Dumont 20 Mvar Capacitor Bank (OTP LPC)	\$1,000,000	\$9,888	OTP Voltage
J901 POI 75 Mvar Capacitor Bank (GRE LPC)	\$4,000,000	\$55,662	GRE Voltage
Panther 60 Mvar Capacitor Bank (GRE LPC)	\$2,500,000	\$5,698	GRE Voltage
Upgrade Terminal Equipment S3451-S3454 345 kV (SPP AFS)	\$500,000	\$18,399	SPP AFS NRIS
Second Raun-S3451 345 kV (SPP AFS)	\$102,600,000	\$3,913,478	SPP AFS NRIS
Second Colby-Killdeer-Quinn-J873-Blackhack-Hazelton 345 kV (SPP AFS)	\$361,000,000	\$13,390,598	SPP AFS NRIS
Second Split Rock-Sioux City 345 kV (SPP AFS)	\$126,865,737	\$2,800,151	SPP AFS NRIS
Second Holt-Grand Prairie 345 kV (SPP AFS)	\$50,011,493	\$355,926	SPP AFS NRIS
Second Raun-Sioux City 345 kV (SPP AFS)	\$80,000,000	\$1,106,295	SPP AFS NRIS
Rebuild Overton-Sibley 345 kV (SPP AFS)	\$155,350,000	\$5,038,192	SPP AFS NRIS
<b>Total Cost Per Project:</b>		<b>\$44,830,689</b>	

J801			
Network Upgrade	NU Cost Estimate (\$)	J801 Cost Estimate (\$)	NU Type
Terminal Equipment Upgrades Split Rock-White 345 kV (SPP AFS)	\$1,000,000	\$10,821	SPP AFS ERIS
Upgrade Terminal Equipment S3451-S3454 345 kV (SPP AFS)	\$500,000	\$7,035	SPP AFS NRIS
Second Raun-S3451 345 kV (SPP AFS)	\$102,600,000	\$1,459,587	SPP AFS NRIS
Second Colby-Killdeer-Quinn-J873-Blackhack-Hazelton 345 kV (SPP AFS)	\$361,000,000	\$2,546,649	SPP AFS NRIS
Second Split Rock-Sioux City 345 kV (SPP AFS)	\$126,865,737	\$1,743,552	SPP AFS NRIS
Second Holt-Grand Prairie 345 kV (SPP AFS)	\$50,011,493	\$555,249	SPP AFS NRIS
Second Raun-Sioux City 345 kV (SPP AFS)	\$80,000,000	\$990,456	SPP AFS NRIS
Rebuild Overton-Sibley 345 kV (SPP AFS)	\$155,350,000	\$2,202,006	SPP AFS NRIS
<b>Total Cost Per Project:</b>		<b>\$9,515,355</b>	



J803			
Network Upgrade	NU Cost Estimate (\$)	J803 Cost Estimate (\$)	NU Type
Dumont 20 Mvar Capacitor Bank (OTP LPC)	\$1,000,000	\$2,957	OTP Voltage
J901 POI 75 Mvar Capacitor Bank (GRE LPC)	\$4,000,000	\$47,789	GRE Voltage
Panther 60 Mvar Capacitor Bank (GRE LPC)	\$2,500,000	\$25,599	GRE Voltage
CCS GRE LPC Voltage NU (GRE LPC)	\$505,270,000	\$29,208	GRE Voltage
Astoria-Hazel Creek 345 kV Circuit (SPP AFS)	\$125,000,000	\$1,646,766	SPP AFS ERIS
Reconfigure/Add Breakers at Fort Thompson (SPP AFS)	\$7,500,000	\$53,807	SPP AFS ERIS
Terminal Equipment Upgrades Split Rock-Sioux City 345 kV (SPP AFS)	\$1,000,000	\$9,617	SPP AFS ERIS
<b>Total Cost Per Project:</b>		<b>\$1,815,743</b>	

J816			
Network Upgrade	NU Cost Estimate (\$)	J816 Cost Estimate (\$)	NU Type
Sheyenne-Mapleton Rebuild	\$17,600,000	\$5,632,177	ERIS Thermal
Sheyenne – Lake Park 230 kV Uprate	\$1,300,000	\$78,526	ERIS Thermal
Audubon – Lake Park 230 kV Uprate	\$100,000	\$6,040	ERIS Thermal
CSLTNET7-Mapleton 115 kV Uprate (OTP LPC)	\$25,000	\$8,209	OTP Thermal
Brooking County-Astoria 2 <sup>nd</sup> 345 kV Circuit (OTP LPC)	\$36,500,000	\$90,825	OTP Voltage
Astoria-J526 POI 2 <sup>nd</sup> 345 kV Circuit (OTP LPC)	\$55,000,000	\$159,201	OTP Voltage
Canby Two Steps of 20 Mvar Capacitor Banks (OTP LPC)	\$1,500,000	\$7,096	OTP Voltage
J901 POI 75 Mvar Capacitor Bank (GRE LPC)	\$4,000,000	\$12,171	GRE Voltage
Panther 60 Mvar Capacitor Bank (GRE LPC)	\$2,500,000	\$17,887	GRE Voltage
Stanton-Square Butte 230 kV Terminal Upgrades (MPC AFS)	\$500,000	\$19,407	MPC AFS
Bemidj-Helga 115 kV Terminal Upgrades (MPC AFS)	\$200,000	\$6,629	MPC AFS
Wilton-Winger 230 kV Structure Remediation (MPC AFS)	\$400,000	\$14,702	MPC AFS
Drayton-Prairie 230 kV Structure Remediation (MPC AFS)	\$200,000	\$3,560	MPC AFS
Winger 230 kV 30 MVar Capacitor (MPC AFS)	\$1,000,000	\$56,604	MPC AFS
Astoria-Hazel Creek 345 kV Circuit (SPP AFS)	\$125,000,000	\$1,069,461	SPP AFS ERIS
Reconfigure/Add Breakers at Fort Thompson (SPP AFS)	\$7,500,000	\$169,593	SPP AFS ERIS
Terminal Equipment Upgrades Split Rock-White 345 kV (SPP AFS)	\$1,000,000	\$19,806	SPP AFS ERIS



Rebuild Sully-Whitlock 230 kV (SPP AFS)	\$19,677,570	\$746,418	SPP AFS NRIS
Rebuild Meadow Grove-Fort Randle 230 kV (SPP AFS)	\$74,364,953	\$2,437,301	SPP AFS NRIS
Upgrade Terminal Equipment S3451-S3454 345 kV (SPP AFS)	\$500,000	\$8,233	SPP AFS NRIS
Second Raun-S3451 345 kV (SPP AFS)	\$102,600,000	\$1,636,307	SPP AFS NRIS
Second Colby-Killdeer-Quinn-J873-Blackhack-Hazelton 345 kV (SPP AFS)	\$361,000,000	\$3,436,130	SPP AFS NRIS
Terminal Equipment Upgrades Antelope Valley-Broadland 345 kV (SPP AFS)	\$3,000,000	\$102,364	SPP AFS NRIS
Second Center-Jamestown-Buffalo-Bison 345 kV (SPP AFS)	\$311,559,097	\$23,319,633	SPP AFS NRIS
Second Split Rock-Sioux City 345 kV (SPP AFS)	\$126,865,737	\$2,335,806	SPP AFS NRIS
Second Holt-Grand Prairie 345 kV (SPP AFS)	\$50,011,493	\$1,334,266	SPP AFS NRIS
Second Raun-Sioux City 345 kV (SPP AFS)	\$80,000,000	\$1,584,560	SPP AFS NRIS
Rebuild Overton-Sibley 345 kV (SPP AFS)	\$155,350,000	\$2,723,451	SPP AFS NRIS
Second Big Stone South-Deuel County 345 kV (SPP AFS)	\$70,000,000	\$1,192,426	SPP AFS NRIS
Second Astoria-Hazel Creek 345 kV (SPP AFS)	\$25,000,000	\$297,615	SPP AFS NRIS
<b>Total Cost Per Project:</b>		<b>\$48,526,404</b>	

J836			
Network Upgrade	NU Cost Estimate (\$)	J836 Cost Estimate (\$)	NU Type
Dumont 20 Mvar Capacitor Bank (OTP LPC)	\$1,000,000	\$11,075	OTP Voltage
J901 POI 75 Mvar Capacitor Bank (GRE LPC)	\$4,000,000	\$59,575	GRE Voltage
<b>Total Cost Per Project:</b>		<b>\$70,650</b>	

J840			
Network Upgrade	NU Cost Estimate (\$)	J840 Cost Estimate (\$)	NU Type
Canby Two Steps of 20 Mvar Capacitor Banks (OTP LPC)	\$1,500,000	\$6,118	OTP Voltage
Dumont 20 Mvar Capacitor Bank (OTP LPC)	\$1,000,000	\$14,020	OTP Voltage
J901 POI 75 Mvar Capacitor Bank (GRE LPC)	\$4,000,000	\$55,455	GRE Voltage
Panther 60 Mvar Capacitor Bank (GRE LPC)	\$2,500,000	\$12,557	GRE Voltage





CCS GRE LPC Voltage NU (GRE LPC)	\$505,270,000	\$1,092,092	GRE Voltage
Upgrade Terminal Equipment S3451-S3454 345 kV (SPP AFS)	\$500,000	\$18,023	SPP AFS NRIS
Second Raun-S3451 345 kV (SPP AFS)	\$102,600,000	\$4,081,497	SPP AFS NRIS
Second Colby-Killdeer-Quinn-J873-Blackhack-Hazelton 345 kV (SPP AFS)	\$361,000,000	\$18,701,103	SPP AFS NRIS
Second Split Rock-Sioux City 345 kV (SPP AFS)	\$126,865,737	\$1,942,593	SPP AFS NRIS
Second Holt-Grand Prairie 345 kV (SPP AFS)	\$50,011,493	\$246,171	SPP AFS NRIS
Second Raun-Sioux City 345 kV (SPP AFS)	\$80,000,000	\$1,867,972	SPP AFS NRIS
Rebuild Overton-Sibley 345 kV (SPP AFS)	\$155,350,000	7,355,406	SPP AFS NRIS
<b>Total Cost Per Project:</b>		<b>\$35,393,007</b>	

<b>J873</b>			
<b>Network Upgrade</b>	<b>NU Cost Estimate (\$)</b>	<b>J873 Cost Estimate (\$)</b>	<b>NU Type</b>
Blackhawk 345/161 kV Transformer Uprate	\$100,000	\$100,000	ERIS Thermal
Two J873 POI 75 MVar SVC's additional Plant Var support	\$22,500,000	\$22,500,000	ERIS Voltage
Dumont 20 Mvar Capacitor Bank (OTP LPC)	\$1,000,000	\$1,622	OTP Voltage
Second Colby-Killdeer-Quinn-J873-Blackhack-Hazelton 345 kV (SPP AFS)	\$361,000,000	\$94,244,425	SPP AFS NRIS
<b>Total Cost Per Project:</b>		<b>\$116,846,047</b>	

<b>J874</b>			
<b>Network Upgrade</b>	<b>NU Cost Estimate (\$)</b>	<b>J874 Cost Estimate (\$)</b>	<b>NU Type</b>
Canby Two Steps of 20 Mvar Capacitor Banks (OTP LPC)	\$1,500,000	\$4,588	OTP Voltage
Dumont 20 Mvar Capacitor Bank (OTP LPC)	\$1,000,000	\$24,363	OTP Voltage
J901 POI 75 Mvar Capacitor Bank (GRE LPC)	\$4,000,000	\$149,624	GRE Voltage
Panther 60 Mvar Capacitor Bank (GRE LPC)	\$2,500,000	\$74,248	GRE Voltage
CCS GRE LPC Voltage NU (GRE LPC)	\$505,270,000	\$865,141	GRE Voltage
Astoria-Hazel Creek 345 kV Circuit (SPP AFS)	\$125,000,000	\$2,359,991	SPP AFS ERIS
Reconfigure/Add Breakers at Fort Thompson (SPP AFS)	\$7,500,000	\$209,470	SPP AFS ERIS
Terminal Equipment Upgrades Split Rock-Sioux City 345 kV (SPP AFS)	\$1,000,000	\$1,000,000	SPP AFS ERIS



Upgrade Terminal Equipment S3451-S3454 345 kV (SPP AFS)	\$500,000	\$29,239	SPP AFS NRIS
Second Raun-S3451 345 kV (SPP AFS)	\$102,600,000	\$6,058,376	SPP AFS NRIS
Second Colby-Killdeer-Quinn-J873-Blackhack-Hazelton 345 kV (SPP AFS)	\$361,000,000	\$13,047,876	SPP AFS NRIS
Second Split Rock-Sioux City 345 kV (SPP AFS)	\$126,865,737	\$11,249,432	SPP AFS NRIS
Second Holt-Grand Prairie 345 kV (SPP AFS)	\$50,011,493	\$1,382,426	SPP AFS NRIS
Second Raun-Sioux City 345 kV (SPP AFS)	\$80,000,000	\$5,940,993	SPP AFS NRIS
Rebuild Overton-Sibley 345 kV (SPP AFS)	\$155,350,000	\$7,738,701	SPP AFS NRIS
Rebuild Minn Valley-Granite Falls 230 kV (SPP AFS)	\$5,200,000	\$117,274	SPP AFS NRIS
<b>Total Cost Per Project:</b>		<b>\$50,251,742</b>	

<b>J877</b>			
<b>Network Upgrade</b>	<b>NU Cost Estimate (\$)</b>	<b>J877 Cost Estimate (\$)</b>	<b>NU Type</b>
Canby Two Steps of 20 Mvar Capacitor Banks (OTP LPC)	\$1,500,000	\$2,719	OTP Voltage
Dumont 20 Mvar Capacitor Bank (OTP LPC)	\$1,000,000	\$11,727	OTP Voltage
J901 POI 75 Mvar Capacitor Bank (GRE LPC)	\$4,000,000	\$54,399	GRE Voltage
Panther 60 Mvar Capacitor Bank (GRE LPC)	\$2,500,000	\$8,722	GRE Voltage
CCS GRE LPC Voltage NU (GRE LPC)	\$505,270,000	\$484,900	GRE Voltage
Upgrade Terminal Equipment S3451-S3454 345 kV (SPP AFS)	\$500,000	\$43,640	SPP AFS NRIS
Second Raun-S3451 345 kV (SPP AFS)	\$102,600,000	\$9,501,517	SPP AFS NRIS
Second Colby-Killdeer-Quinn-J873-Blackhack-Hazelton 345 kV (SPP AFS)	\$361,000,000	\$35,775,755	SPP AFS NRIS
Second Split Rock-Sioux City 345 kV (SPP AFS)	\$126,865,737	\$489,072	SPP AFS NRIS
Second Holt-Grand Prairie 345 kV (SPP AFS)	\$50,011,493	\$37,624	SPP AFS NRIS
Second Raun-Sioux City 345 kV (SPP AFS)	\$80,000,000	\$2,247,184	SPP AFS NRIS
Rebuild Overton-Sibley 345 kV (SPP AFS)	\$155,350,000	\$12,364,336	SPP AFS NRIS
<b>Total Cost Per Project:</b>		<b>\$61,021,595</b>	

J885			
Network Upgrade	NU Cost Estimate (\$)	J801 Cost Estimate (\$)	NU Type
Murphy Creek – Hayward 161 kV Rebuild	\$11,625,000	\$6,368,925	ERIS Thermal
Austin-Murphy Creek 161 kV Rebuild	\$1,875,000	\$1,875,000	ERIS Thermal
Glenworth-Hayward 161 kV Uprate	\$25,000	\$25,000	ERIS Thermal
Adams-Hayward 161 kV Uprate	\$480,000	\$480,000	ERIS Thermal
Upgrade Terminal Equipment S3451-S3454 345 kV (SPP AFS)	\$500,000	\$6,267	SPP AFS NRIS
Second Raun-S3451 345 kV (SPP AFS)	\$102,600,000	\$1,350,692	SPP AFS NRIS
Second Colby-Killdeer-Quinn-J873-Blackhack-Hazelton 345 kV (SPP AFS)	\$361,000,000	\$9,972,306	SPP AFS NRIS
Second Split Rock-Sioux City 345 kV (SPP AFS)	\$126,865,737	\$656,060	SPP AFS NRIS
Second Holt-Grand Prairie 345 kV (SPP AFS)	\$50,011,493	\$173,832	SPP AFS NRIS
Second Raun-Sioux City 345 kV (SPP AFS)	\$80,000,000	\$304,986	SPP AFS NRIS
Rebuild Overton-Sibley 345 kV (SPP AFS)	\$155,350,000	\$2,160,590	SPP AFS NRIS
<b>Total Cost Per Project:</b>		<b>\$23,373,658</b>	

J897			
Network Upgrade	NU Cost Estimate (\$)	J897 Cost Estimate (\$)	NU Type
Rebuild J628-Prairie 230 kV Rebuild	\$16,770,000	\$4,925,643	ERIS Thermal
New J628-Prairie 230 kV 2nd Circuit	\$22,360,000	\$10,758,337	ERIS Voltage
Wilton-Bemidji Uprate	\$50,000	\$15,398	ERIS Thermal
Six Wahpeton 50 MVar Capacitors	\$9,750,000	\$663,964	ERIS Voltage
One Bison 150 MVar Capacitor	\$1,500,000	\$102,148	ERIS Voltage
Three Maple River 50 MVar Capacitors	\$3,000,000	\$204,297	ERIS Voltage
Wilton-Bemidji 115 kV Uprate (OTP LPC)	\$50,000	\$15,389	OTP Thermal
Brooking County-Astoria 2 <sup>nd</sup> 345 kV Circuit (OTP LPC)	\$36,500,000	\$774,839	OTP Voltage
Astoria-J526 POI 2 <sup>nd</sup> 345 kV Circuit (OTP LPC)	\$55,000,000	\$1,271,554	OTP Voltage
Canby Two Steps of 20 Mvar Capacitor Banks (OTP LPC)	\$1,500,000	\$47,631	OTP Voltage
J901 POI 75 Mvar Capacitor Bank (GRE LPC)	\$4,000,000	\$73,508	GRE Voltage

Panther 60 Mvar Capacitor Bank (GRE LPC)	\$2,500,000	\$98,577	GRE Voltage
J628-Prairie 230 kV Terminal Upgrades (MPC AFS)	\$500,000	\$141,096	MPC AFS
Wilton-Scribner 115 kV Terminal Upgrades (MPC AFS)	\$200,000	\$61,750	MPC AFS
Bemidj-Helga 115 kV Terminal Upgrades (MPC AFS)	\$200,000	\$35,932	MPC AFS
Jamestown-Center 345 kV Structure Remediation (MPC AFS)	\$1,000,000	\$82,897	MPC AFS
Grank Forks – Falconer 115 kV Reconductor (MPC AFS)	\$550,000	\$122,690	MPC AFS
Falconer – Oslo 115 kV Reconductor (MPC AFS)	\$2,000,000	\$434,465	MPC AFS
Wilton-Winger 230 kV Structure Remediation (MPC AFS)	\$400,000	\$69,244	MPC AFS
Prairie 115/69 kV Transformer #2 Upgrades (MPC AFS)	\$1,500,000	\$440,272	MPC AFS
Drayton-Prairie 230 kV Structure Remediation (MPC AFS)	\$200,000	\$41,252	MPC AFS
Prairie-Winger 230 kV Structure Remediation (MPC AFS)	\$500,000	\$117,677	MPC AFS
Mill Road-Master 69 kV Structure Remediation and Terminal Upgrades (MPC AFS)	\$500,000	\$146,480	MPC AFS
Winger 230 kV 30 MVar Capacitor (MPC AFS)	\$1,000,000	\$189,189	MPC AFS
Astoria-Hazel Creek 345 kV Circuit (SPP AFS)	\$125,000,000	\$4,335,645	SPP AFS ERIS
Reconfigure/Add Breakers at Fort Thompson (SPP AFS)	\$7,500,000	\$586,989	SPP AFS ERIS
Terminal Equipment Upgrades Split Rock-White 345 kV (SPP AFS)	\$1,000,000	\$57,269	SPP AFS ERIS
Second Grand Forks 230/115 kV Transformer (SPP AFS)	\$6,621,188	\$1,940,752	SPP AFS ERIS
Rebuild Grand Forks-Prairie 230 kV (SPP AFS)	\$300,000	\$87,534	SPP AFS ERIS
Rebuild Sully-Whitlock 230 kV (SPP AFS)	\$19,677,570	\$2,547,775	SPP AFS NRIS
Rebuild Meadow Grove-Fort Randle 230 kV (SPP AFS)	\$74,364,953	\$7,975,785	SPP AFS NRIS
Upgrade Terminal Equipment S3451-S3454 345 kV (SPP AFS)	\$500,000	\$25,543	SPP AFS ERIS
Second Raun-S3451 345 kV (SPP AFS)	\$102,600,000	\$5,053,763	SPP AFS NRIS
Second Colby-Killdeer-Quinn-J873-Blackhawk-Hazelton 345 kV (SPP AFS)	\$361,000,000	\$10,684,583	SPP AFS NRIS
Terminal Equipment Upgrades Antelope Valley-Broadland 345 kV (SPP AFS)	\$3,000,000	\$395,534	SPP AFS NRIS
Second Center-Jamestown-Buffalo-Bison 345 kV (SPP AFS)	\$311,559,097	\$17,243,059	SPP AFS NRIS
Second Split Rock-Sioux City 345 kV (SPP AFS)	\$126,865,737	\$6,986,370	SPP AFS NRIS
Second Holt-Grand Prairie 345 kV (SPP AFS)	\$50,011,493	\$4,451,210	SPP AFS NRIS



Second Raun-Sioux City 345 kV (SPP AFS)	\$80,000,000	\$4,887,625	SPP AFS NRIS
Second Big Stone South-Deuel County 345 kV (SPP AFS)	\$70,000,000	\$3,337,975	SPP AFS NRIS
Second Astoria-Hazel Creek 345 kV (SPP AFS)	\$25,000,000	\$1,028,746	SPP AFS NRIS
Rebuild Overton-Sibley 345 kV (SPP AFS)	\$155,350,000	\$8,608,600	SPP AFS NRIS
<b>Total Cost Per Project:</b>		<b>\$101,068,986</b>	

<b>J898</b>			
<b>Network Upgrade</b>	<b>NU Cost Estimate (\$)</b>	<b>J898 Cost Estimate (\$)</b>	<b>NU Type</b>
Rice-Cresco 69 kV Rebuild	\$10,200,000	\$10,200,000	ERIS Thermal
Rice-Saratoga 69 kV Uprate	\$150,000	\$150,000	ERIS Thermal
Decorah-Madison 69 kV Uprate	\$60,000	\$60,000	ERIS Thermal
Adams 345/161 kV Transformer Upgrade	\$3,000,000	\$3,000,000	ERIS Thermal
Jerico-Howard Tap 69 kV Uprate	\$50,000	\$50,000	ERIS Thermal
Jerico-Alta Vista 69 kV Rebuild (DPC LPC)	\$235,000	\$235,000	DPC Thermal
Jerico-Howard Tap 69 kV Rebuild (DPC LPC)	\$1,200,000	\$1,200,000	DPC Thermal
Nordness Tap-Decorah 69 kV Rebuild (DPC LPC)	\$600,000	\$600,000	DPC Thermal
Saratoga-Rice 69 kV Rebuild (DPC LPC)	\$400,000	\$400,000	DPC Thermal
Saratoga-Howard Tap 69 kV Rebuild (DPC LPC)	\$3,200,000	\$3,200,000	DPC Thermal
Beaver Creek-J898 POI 161 kV Rebuild (DPC LPC)	\$5,000,000	\$5,000,000	DPC Thermal
Beaver Creek-Harmony 161 kV Rebuild (DPC LPC)	\$200,000	\$200,000	DPC Thermal
Second Split Rock-Sioux City 345 kV (SPP AFS)	\$126,865,737	\$1,220,723	SPP AFS NRIS
Second Holt-Grand Prairie 345 kV (SPP AFS)	\$50,011,493	\$354,744	SPP AFS NRIS
Second Raun-Sioux City 345 kV (SPP AFS)	\$80,000,000	\$639,166	SPP AFS NRIS
Rebuild Overton-Sibley 345 kV (SPP AFS)	\$155,350,000	2,819,069	SPP AFS NRIS
Upgrade Terminal Equipment S3451-S3454 345 kV (SPP AFS)	\$500,000	\$8,000	SPP AFS ERIS
Second Raun-S3451 345 kV (SPP AFS)	\$102,600,000	\$1,714,188	SPP AFS NRIS
Second Colby-Killdeer-Quinn-J873-Blackhawk-Hazleton 345 kV (SPP AFS)	\$361,000,000	\$4,161,570	SPP AFS NRIS
<b>Total Cost Per Project:</b>		<b>\$35,212,460</b>	

J901			
Network Upgrade	NU Cost Estimate (\$)	J901 Cost Estimate (\$)	NU Type
Helena-Chub Lake 2nd Circuit	\$34,000,000	\$34,000,000	ERIS Thermal
Blue Lake-Scott County 345 kV Rebuild	\$24,000,000	\$24,000,000	ERIS Thermal
Willmar-Granite Falls 230 kV Rebuild (GRE LPC)	\$7,700,000	\$7,700,000	GRE Thermal
J901 POI 75 Mvar Capacitor Bank (GRE LPC)	\$4,000,000	\$1,275,637	GRE Voltage
Panther 60 Mvar Capacitor Bank (GRE LPC)	\$2,500,000	\$437,354	GRE Voltage
Reconfigure/Add Breakers at Fort Thompson (SPP AFS)	\$7,500,000	\$341,204	SPP AFS ERIS
Terminal Equipment Upgrades Split Rock-White 345 kV (SPP AFS)	\$1,000,000	\$103,827	SPP AFS ERIS
Second Split Rock-Sioux City 345 kV (SPP AFS)	\$126,865,737	\$11,092,929	SPP AFS NRIS
Second Holt-Grand Prairie 345 kV (SPP AFS)	\$50,011,493	\$2,559,888	SPP AFS NRIS
Second Raun-Sioux City 345 kV (SPP AFS)	\$80,000,000	\$6,231,993	SPP AFS NRIS
Rebuild Overton-Sibley 345 kV (SPP AFS)	\$155,350,000	\$9,109,310	SPP AFS NRIS
Upgrade Terminal Equipment S3451-S3454 345 kV (SPP AFS)	\$500,000	\$31,638	SPP AFS ERIS
Second Raun-S3451 345 kV (SPP AFS)	\$102,600,000	\$6,490,013	SPP AFS NRIS
Second Colby-Killdeer-Quinn-J873-Blackhawk-Hazelton 345 kV (SPP AFS)	\$361,000,000	\$13,378,782	SPP AFS NRIS
<b>Total Cost Per Project:</b>		<b>\$116,752,575</b>	

J905			
Network Upgrade	NU Cost Estimate (\$)	J905 Cost Estimate (\$)	NU Type
Canby Two Steps of 20 Mvar Capacitor Banks (OTP LPC)	\$1,500,000	\$8,695	OTP Voltage
Dumont 20 Mvar Capacitor Bank (OTP LPC)	\$1,000,000	\$11,681	OTP Voltage
J901 POI 75 Mvar Capacitor Bank (GRE LPC)	\$4,000,000	\$56,217	GRE Voltage
Panther 60 Mvar Capacitor Bank (GRE LPC)	\$2,500,000	\$30,532	GRE Voltage
CCS GRE LPC Voltage NU (GRE LPC)	\$505,270,000	\$346,739	GRE Voltage
Astoria-Hazel Creek 345 kV Circuit (SPP AFS)	\$125,000,000	\$2,225,121	SPP AFS ERIS
Reconfigure/Add Breakers at Fort Thompson (SPP AFS)	\$7,500,000	\$77,205	SPP AFS ERIS



Terminal Equipment Upgrades Split Rock-White 345 kV (SPP AFS)	\$1,000,000	\$21,617	SPP AFS ERIS
Second Split Rock-Sioux City 345 kV (SPP AFS)	\$126,865,737	\$3,013,621	SPP AFS NRIS
Second Holt-Grand Prairie 345 kV (SPP AFS)	\$50,011,493	\$535,484	SPP AFS NRIS
Second Raun-Sioux City 345 kV (SPP AFS)	\$80,000,000	\$1,688,148	SPP AFS NRIS
Rebuild Overton-Sibley 345 kV (SPP AFS)	\$155,350,000	\$2,028,484	SPP AFS NRIS
Upgrade Terminal Equipment S3451-S3454 345 kV (SPP AFS)	\$500,000	\$7,356	SPP AFS ERIS
Second Raun-S3451 345 kV (SPP AFS)	\$102,600,000	\$1,506,232	SPP AFS NRIS
Second Colby-Killdeer-Quinn-J873-Blackhawk-Hazelton 345 kV (SPP AFS)	\$361,000,000	\$2,984,767	SPP AFS NRIS
Rebuild Minn Valley-Granite Falls 230 kV (SPP AFS)	\$5,200,000	\$43,131	SPP AFS NRIS
<b>Total Cost Per Project:</b>		<b>\$14,585,030</b>	

J916			
Network Upgrade	NU Cost Estimate (\$)	J916 Cost Estimate (\$)	NU Type
Second Split Rock-Sioux City 345 kV (SPP AFS)	\$126,865,737	\$66,889	SPP AFS NRIS
Second Holt-Grand Prairie 345 kV (SPP AFS)	\$50,011,493	\$10,492	SPP AFS NRIS
Second Raun-Sioux City 345 kV (SPP AFS)	\$80,000,000	\$35,689	SPP AFS NRIS
Rebuild Overton-Sibley 345 kV (SPP AFS)	\$155,350,000	\$95,947	SPP AFS NRIS
Upgrade Terminal Equipment S3451-S3454 345 kV (SPP AFS)	\$500,000	\$348	SPP AFS ERIS
Second Raun-S3451 345 kV (SPP AFS)	\$102,600,000	\$73,059	SPP AFS NRIS
Second Colby-Killdeer-Quinn-J873-Blackhawk-Hazelton 345 kV (SPP AFS)	\$361,000,000	\$220,867	SPP AFS NRIS
<b>Total Cost Per Project:</b>		<b>\$503,292</b>	

J926			
Network Upgrade	NU Cost Estimate (\$)	J926 Cost Estimate (\$)	NU Type
Terminal Equipment Upgrades Split Rock-White 345 kV (SPP AFS)	\$1,000,000	\$15,627	SPP AFS ERIS



Second Split Rock-Sioux City 345 kV (SPP AFS)	\$126,865,737	\$2,456,053	SPP AFS NRIS
Second Holt-Grand Prairie 345 kV (SPP AFS)	\$50,011,493	\$804,217	SPP AFS NRIS
Second Raun-Sioux City 345 kV (SPP AFS)	\$80,000,000	\$1,406,496	SPP AFS NRIS
Rebuild Overton-Sibley 345 kV (SPP AFS)	\$155,350,000	\$3,042,528	SPP AFS NRIS
Upgrade Terminal Equipment S3451-S3454 345 kV (SPP AFS)	\$500,000	\$9,745	SPP AFS ERIS
Second Raun-S3451 345 kV (SPP AFS)	\$102,600,000	\$2,017,137	SPP AFS NRIS
Second Colby-Killdeer-Quinn-J873-Blackha k-Hazelton 345 kV (SPP AFS)	\$361,000,000	\$3,563,939	SPP AFS NRIS
<b>Total Cost Per Project:</b>		<b>\$13,315,742</b>	

<b>J927</b>			
<b>Network Upgrade</b>	<b>NU Cost Estimate (\$)</b>	<b>J927 Cost Estimate (\$)</b>	<b>NU Type</b>
Walters-Alden 69 kV Rebuild	\$4,700,000	\$4,700,000	ERIS Thermal
Alden-Aleawst 69 kV Rebuild	\$5,100,00	\$5,100,000	ERIS Thermal
Murphy Creek – Hayward 161 kV Rebuild	\$11,625,000	\$5,256,075	ERIS Thermal
Second Split Rock-Sioux City 345 kV (SPP AFS)	\$126,865,737	\$1,388,964	SPP AFS NRIS
Second Holt-Grand Prairie 345 kV (SPP AFS)	\$50,011,493	\$306,011	SPP AFS NRIS
Second Raun-Sioux City 345 kV (SPP AFS)	\$80,000,000	\$602,699	SPP AFS NRIS
Rebuild Overton-Sibley 345 kV (SPP AFS)	\$155,350,000	\$3,767,917	SPP AFS NRIS
Upgrade Terminal Equipment S3451-S3454 345 kV (SPP AFS)	\$500,000	\$11,795	SPP AFS ERIS
Second Raun-S3451 345 kV (SPP AFS)	\$102,600,000	\$2,529,388	SPP AFS NRIS
Second Colby-Killdeer-Quinn-J873-Blackha k-Hazelton 345 kV (SPP AFS)	\$361,000,000	\$13,937,198	SPP AFS NRIS
<b>Total Cost Per Project:</b>		<b>\$37,600,047</b>	

<b>J933</b>			
<b>Network Upgrade</b>	<b>NU Cost Estimate (\$)</b>	<b>J933 Cost Estimate (\$)</b>	<b>NU Type</b>
Canby-Granite Falls 115 kV Rebuild	\$17,700,000	\$8,774,455	ERIS Thermal



Big Stone-Big Stone South 230 kV Circuit 1 Rebuild	\$1,450,000	\$581,858	ERIS Thermal
Big Stone-Big Stone South 230 kV Circuit 2 Rebuild	\$1,400,000	\$587,892	ERIS Thermal
Big Stone-Blair 230 kV Rebuild	\$28,235,800	\$13,116,654	ERIS Thermal
Big Stone-Twin Brooks 2 <sup>nd</sup> Circuit	\$54,500,000	\$54,500,000	ERIS Voltage
Six Wahpeton 50 MVar Capacitors	\$9,750,000	\$1,798,237	ERIS Voltage
One Bison 150 MVar Capacitor	\$1,500,000	\$276,652	ERIS Voltage
Three Maple River 50 MVar Capacitors	\$3,000,000	\$553,304	ERIS Voltage
Ellendale-Aberdeen Jct 115 kV Uprate (MDU LPC)	\$60,000	\$33,366	MDU Thermal
Big Stone-Highway 12 115 kV Uprate (OTP LPC)	\$50,000	\$23,573	OTP Thermal
Highway 12-Ortonville 115 kV Uprate (OTP LPC)	\$50,000	\$23,573	OTP Thermal
Hankinson-Forman 230 kV Uprate (OTP LPC)	\$50,000	\$27,376	OTP Thermal
Big Stone South 345/230 kV Transformer 1 Upgrade (OTP LPC)	\$4,600,000	\$4,600,000	OTP Thermal
Big Stone South 345/230 kV Transformer 2 Upgrade (OTP LPC)	\$4,600,000	\$4,600,000	OTP Thermal
Brooking County-Astoria 2 <sup>nd</sup> 345 kV Circuit (OTP LPC)	\$36,500,000	\$22,655,405	OTP Voltage
Astoria-J526 POI 2 <sup>nd</sup> 345 kV Circuit (OTP LPC)	\$55,000,000	\$33,409,040	OTP Voltage
Canby Two Steps of 20 Mvar Capacitor Banks (OTP LPC)	\$1,500,000	\$373,584	OTP Voltage
Dumont 20 Mvar Capacitor Bank (OTP LPC)	\$1,000,000	\$309,390	OTP Voltage
J901 POI 75 Mvar Capacitor Bank (GRE LPC)	\$4,000,000	\$420,321	GRE Voltage
Panther 60 Mvar Capacitor Bank (GRE LPC)	\$2,500,000	\$321,730	GRE Voltage
CCS GRE LPC Voltage NU (GRE LPC)	\$505,270,000	\$7,053,091	GRE Voltage
Astoria-Hazel Creek 345 kV Circuit (SPP AFS)	\$125,000,000	\$37,334,338	SPP AFS ERIS
Reconfigure/Add Breakers at Fort Thompson (SPP AFS)	\$7,500,000	\$520,396	SPP AFS ERIS
Terminal Equipment Upgrades Split Rock-White 345 kV (SPP AFS)	\$1,000,000	\$137,337	SPP AFS ERIS
Second Split Rock-Sioux City 345 kV (SPP AFS)	\$126,865,737	\$12,595,357	SPP AFS NRIS
Second Holt-Grand Prairie 345 kV (SPP AFS)	\$50,011,493	\$3,551,737	SPP AFS NRIS
Second Raun-Sioux City 345 kV (SPP AFS)	\$80,000,000	\$7,418,664	SPP AFS NRIS
Rebuild Overton-Sibley 345 kV (SPP AFS)	\$155,350,000	\$9,810,872	SPP AFS NRIS
Upgrade Terminal Equipment S3451-S3454 345 kV (SPP AFS)	\$500,000	\$33,302	SPP AFS ERIS
Second Raun-S3451 345 kV (SPP AFS)	\$102,600,000	\$6,741,372	SPP AFS NRIS
Second Colby-Killdeer-Quinn-J873-Blackhawk-Hazleton 345 kV (SPP AFS)	\$361,000,000	\$13,478,990	SPP AFS NRIS
Rebuild Aberdeen Junction-Ellendale 115 kV (SPP AFS)	\$710,840	\$487,514	SPP AFS NRIS
Rebuild Aberdeen Junction-ABDNSBT 115 kV (SPP AFS)	\$5,331,300	\$3,656,354	SPP AFS NRIS
Rebuild Forman-WAPA-Forman 115 kV (SPP AFS)	\$1,500,000	\$737,264	SPP AFS NRIS
Rebuild Meadow Grove-Fort Randle 230 kV (SPP AFS)	\$74,364,953	\$7,416,652	SPP AFS NRIS
Rebuild FLANDRU-Aurora-Brookings 115 kV (SPP AFS)	\$17,219,822	\$17,219,822	SPP AFS NRIS



Rebuild Minn Valley-Granite Falls 230 kV (SPP AFS)	\$5,200,000	\$187,173	SPP AFS NRIS
Rebuild Minn Valley-Granite Falls 115 kV (SPP AFS)	\$7,950,000	\$3,132,800	SPP AFS NRIS
Second Big Stone South-Deuel County 345 kV (SPP AFS)	\$70,000,000	\$27,172,064	SPP AFS NRIS
Second Astoria-Hazel Creek 345 kV (SPP AFS)	\$25,000,000	\$10,032,242	SPP AFS NRIS
<b>Total Cost Per Project:</b>		<b>\$315,703,751</b>	

<b>J946</b>			
<b>Network Upgrade</b>	<b>NU Cost Estimate (\$)</b>	<b>J946 Cost Estimate (\$)</b>	<b>NU Type</b>
Sheyenne-Mapleton Rebuild	\$17,600,000	\$11,967,823	ERIS Thermal
Sheyenne – Lake Park 230 kV Uprate	\$1,300,000	\$518,565	ERIS Thermal
Audubon – Lake Park 230 kV Uprate	\$100,000	\$39,890	ERIS Thermal
CSLTNET7-Mapleton 115 kV Uprate (OTP LPC)	\$25,000	\$16,791	OTP Thermal
Brooking County-Astoria 2 <sup>nd</sup> 345 kV Circuit (OTP LPC)	\$36,500,000	\$274,580	OTP Voltage
Astoria-J526 POI 2 <sup>nd</sup> 345 kV Circuit (OTP LPC)	\$55,000,000	\$487,787	OTP Voltage
Canby Two Steps of 20 Mvar Capacitor Banks (OTP LPC)	\$1,500,000	\$21,643	OTP Voltage
J901 POI 75 Mvar Capacitor Bank (GRE LPC)	\$4,000,000	\$34,661	GRE Voltage
Panther 60 Mvar Capacitor Bank (GRE LPC)	\$2,500,000	\$55,214	GRE Voltage
Stanton-Square Butte 230 kV Terminal Upgrades (MPC AFS)	\$500,000	\$81,551	MPC AFS
Bemidj-Helga 115 kV Terminal Upgrades (MPC AFS)	\$200,000	\$21,662	MPC AFS
Wilton-Winger 230 kV Structure Remediation (MPC AFS)	\$400,000	\$53,602	MPC AFS
Drayton-Prairie 230 kV Structure Remediation (MPC AFS)	\$200,000	\$11,092	MPC AFS
Astoria-Hazel Creek 345 kV Circuit (SPP AFS)	\$125,000,000	\$3,144,829	SPP AFS ERIS
Reconfigure/Add Breakers at Fort Thompson (SPP AFS)	\$7,500,000	\$548,690	SPP AFS ERIS
Terminal Equipment Upgrades Split Rock-White 345 kV (SPP AFS)	\$1,000,000	\$65,676	SPP AFS ERIS
Rebuild Sully-Whitlock 230 kV (SPP AFS)	\$19,677,570	\$2,418,803	SPP AFS NRIS
Rebuild Meadow Grove-Fort Randle 230 kV (SPP AFS)	\$74,364,953	\$8,005,869	SPP AFS NRIS
Upgrade Terminal Equipment S3451-S3454 345 kV (SPP AFS)	\$500,000	\$27,366	SPP AFS ERIS
Second Raun-S3451 345 kV (SPP AFS)	\$102,600,000	\$5,444,743	SPP AFS NRIS
Second Colby-Killdeer-Quinn-J873-Blackha k-Hazelton 345 kV (SPP AFS)	\$361,000,000	\$11,411,240	SPP AFS NRIS
Terminal Equipment Upgrades Antelope Valley-Broadland 345 kV (SPP AFS)	\$3,000,000	\$330,913	SPP AFS NRIS
Second Center-Jamestown-Buffalo-Bison 345 kV (SPP AFS)	\$311,559,097	\$63,961,232	SPP AFS NRIS
Second Split Rock-Sioux City 345 kV (SPP AFS)	\$126,865,737	\$7,764,111	SPP AFS NRIS
Second Holt-Grand Prairie 345 kV (SPP AFS)	\$50,011,493	\$4,371,589	SPP AFS NRIS



Second Raun-Sioux City 345 kV (SPP AFS)	\$80,000,000	\$5,242,444	SPP AFS NRIS
Second Big Stone South-Deuel County 345 kV (SPP AFS)	\$70,000,000	\$3,907,214	SPP AFS NRIS
Second Astoria-Hazel Creek 345 kV (SPP AFS)	\$25,000,000	\$932,209	SPP AFS NRIS
Rebuild Overton-Sibley 345 kV (SPP AFS)	\$155,350,000	\$9,028,713	SPP AFS NRIS
<b>Total Cost Per Project:</b>		<b>\$140,190,502</b>	

### 1.3. Total Network Upgrades

The cost allocation of Network Upgrades for the projects in the DPP 2017 August West Phase 1 reflects responsibilities for mitigating system impacts. The total cost of network upgrades is listed in Table 2 below. The costs for Network Upgrades are planning-level estimates and subject to revision in the facility studies.

**Table 2: Total Cost of Network Upgrades for DPP 2017 August West Phase 1 Projects**

Project	ERIS Network Upgrades (\$)					NRIS Network Upgrades (\$)	Interconnection Facilities (\$)		Shared Network Upgrades (\$)	Total Network Upgrade Cost for Milestone Calculation (\$)	M2 (\$)	M3 (\$)	M4 (\$)
	Steady State	LPC Studies	Stability	Short Circuit	Affected System	Deliverability	TO Network Upgrades	TO – Owned Direct Assigned					
a	b	c	d	e	f	g	h	i	j	k = b+c+d+e+g+h+j		10% of (k) from Phase I- M2	20% of (k) from Phase 2-M2 – M3
J545	\$0	\$2,496,260	\$0	\$0	\$38,860,708	\$0	\$1,005,000	\$1,145,000	\$0	\$3,501,260	\$600,000	\$0	\$100,252
J580	\$19,450,948	\$191,895,913	\$14,100,000	\$0	\$19,446,106	\$0	\$910,000	\$430,000	\$2,068,545	\$228,425,406	\$1,223,600	\$10,282,913	\$34,178,568
J628	\$26,011,517	\$4,878,311	\$0	\$0	\$167,356,004	\$0	\$2,814,490	\$940,127	\$0	\$33,704,318	\$1,600,000	\$13,627,542	\$0
J705	\$756,688	\$80,407,045	\$0	\$0	\$76,414,017	\$1,305,000	\$2,733,601	\$2,378,200	\$0	\$85,202,334	\$400,000	\$1,788,248	\$14,852,219
J706	\$756,688	\$80,407,045	\$0	\$0	\$76,414,017	\$1,305,000	\$2,733,601	\$1,429,441	\$0	\$85,202,334	\$400,000	\$1,802,034	\$14,838,433
J713	\$2,746,793	\$241,221,135	\$0	\$0	\$229,213,501	\$3,915,000	\$1,004,520	\$1,535,220	\$0	\$248,887,448	\$1,200,000	\$4,628,612	\$43,948,878
J720	\$70,086,598	\$497,506	\$0	\$0	\$48,699,911	\$0	\$11,471,897	\$850,434	\$0	\$82,056,001	\$800,000	\$362,178	\$15,249,022
J722	\$28,116,307	\$5,007,171	\$0	\$0	\$116,066,305	\$0	\$1,250,000		\$0	\$34,373,478	\$800,000	\$1,864,413	\$4,210,283
J785	\$18,136,402	\$71,249	\$0	\$0	\$26,623,039	\$0	\$11,417,464	\$1,003,320	\$0	\$29,625,115	\$420,000	\$624,613	\$4,880,410
J801	\$0	\$0	\$0	\$0	\$9,515,355	\$0	\$5,338,631	\$686,054	\$0	\$5,338,631	\$296,000	\$44,000	\$727,726
J803	\$0	\$105,553	\$0	\$0	\$1,710,190	\$0	\$1,112,000	\$888,000	\$0	\$1,217,553	\$130,000	\$0	\$113,511
J816	\$5,716,743	\$295,390	\$0	\$0	\$42,514,272	\$0	\$456,277	\$1,024,649	\$0	\$6,468,410	\$240,000	\$546,310	\$507,372
J836	\$0	\$70,650	\$0	\$0	\$0	\$0	\$1,346,310	\$1,270,398	\$0	\$1,416,960	\$800,000	\$0	\$0
J840	\$0	\$1,180,241	\$0	\$0	\$34,212,765	\$0	\$14,000,000	\$1,250,000	\$0	\$15,180,241	\$600,000	\$856,128	\$1,579,920
J873	\$22,600,000	\$1,622	\$0	\$0	\$94,244,425	\$0	\$14,000,000	\$1,250,000	\$0	\$36,601,622	\$800,000	\$778,552	\$5,741,772
J874	\$0	\$1,117,965	\$0	\$0	\$49,133,775	\$0	\$7,824,000	\$1,233,000	\$0	\$8,941,965	\$600,000	\$464,501	\$723,892

Project	ERIS Network Upgrades (\$)					NRIS Network Upgrades (\$)	Interconnection Facilities (\$)		Shared Network Upgrades (\$)	Total Network Upgrade Cost for Milestone Calculation (\$)	M2 (\$)	M3 (\$)	M4 (\$)
	Steady State	LPC Studies	Stability	Short Circuit	Affected System	Deliverability	TO Network Upgrades	TO – Owned Direct Assigned					
a	b	c	d	e	f	g	h	i	j	k = b+c+d+e+g+h+j	\$10,000/MW	10% of (k) from Phase I-M2	20% of (k) from Phase 2-M2 – M3
J877	\$0	\$562,468	\$0	\$0	\$60,459,128	\$0	\$1,300,000	\$2,500,000	\$0	\$1,862,468	\$1,000,000	\$0	\$0
J885	\$8,748,925	\$0	\$0	\$0	\$14,624,732	\$0	\$0	\$60,000	\$0	\$8,748,925	\$256,000	\$0	\$1,493,785
J897	\$16,669,787	\$2,281,497	\$0	\$0	\$82,117,701	\$0	\$2,814,490	\$940,127	\$0	\$21,765,774	\$760,000	\$10,701,615	\$0
J898	\$13,460,000	\$10,835,000	\$0	\$0	\$10,917,460	\$0	\$5,097,052	\$680,033	\$0	\$29,392,052	\$400,000	\$250,000	\$5,228,410
J901	\$58,000,000	\$9,412,991	\$0	\$0	\$49,339,583	\$0	\$11,759,000	\$2,004,000	\$0	\$79,171,991	\$800,000	\$951,699	\$14,082,699
J905	\$0	\$453,865	\$0	\$0	\$14,131,166	\$0	\$1,005,000	\$1,145,000	\$0	\$1,458,865	\$160,000	\$90,886	\$40,887
J916	\$0	\$0	\$0	\$0	\$503,292	\$0	\$0	\$0	\$0	\$0	\$8,000	\$0	\$0
J926	\$0	\$0	\$0	\$0	\$13,315,742	\$0	\$8,527,000	\$1,222,000	\$0	\$8,527,000	\$405,120	\$694,880	\$605,400
J927	\$15,056,075	\$0	\$0	\$0	\$22,543,972	\$0	\$1,240,212	\$203,652	\$0	\$16,296,287	\$400,000	\$656,027	\$2,203,230
J933	\$80,189,052	\$73,850,447	\$0	\$0	\$161,664,249	\$0	\$13,732,100	\$2,931,800	\$0	\$167,771,599	\$800,000	\$6,919,581	\$25,834,739
J946	\$12,526,278	\$890,675	\$0	\$0	\$126,773,548	\$0	\$3,537,000	\$2,810,000	\$0	\$16,953,953	\$800,000	\$1,245,693	\$1,345,098
Total	\$399,028,801	\$707,939,999	\$14,100,000	\$0	\$1,586,814,963	\$6,525,000	\$131,745,645	\$31,810,455	\$2,068,545	\$1,261,407,990	\$16,698,720	\$59,180,425	\$193,149,706

Analyses performed demonstrate the following transmission facilities are required to reliably interconnect this group of generators to the transmission system. Energy Resource Interconnection Service (ERIS) Network Upgrades and Network Resource Interconnection Service (NRIS) Network Upgrades are shown in Table 3. Shared Network Upgrades are shown in Table 4.

**Table 3: ERIS & NRIS Upgrades (Planning level cost estimates)**

Network Upgrade	TO	GI projects requiring upgrade for ERIS	GI projects requiring upgrade for NRIS	Cost of solution (\$)	Self Fund Election
Murphy Creek – Hayward 161 kV Rebuild	SMMPA	J885, J927		\$11,625,000	No
Austin-Murphy Creek 161 kV Rebuild	SMMPA	J885		\$1,875,000	No
Merricourt-Wishek 230 kV Rebuild	MDU	J580		\$6,000,000	Yes
J302 POI-Heskett 230 kV Rebuild	MDU	J580		\$4,500,000	Yes
J302-Wishek 230 kV Rebuild	MDU	J580		\$4,750,000	Yes
Heskett-Mandan 230 kV Uprate	MDU	J580		\$200,000	Yes
Sheyenne-Lake Park 230 kV Uprate	XEL, OTP, MPC	J580, J713, J816, J946		\$1,300,000	XEL Yes OTP Yes
Sheyenne-Mapleton 115 kV Rebuild	XEL, OTP	J816, J946		\$17,600,000	XEL Yes OTP Yes
Wilton-Bemidji 115 kV Uprate	OTP	J628, J897		\$50,000	Yes

Network Upgrade	TO	GI projects requiring upgrade for ERIS	GI projects requiring upgrade for NRIS	Cost of solution (\$)	Self Fund Election
Crookston-Fertile 115 kV Uprate	OTP	J628		\$250,000	Yes
Crookston-Falconer 115 kV Uprate	OTP	J628		\$25,000	Yes
Blackhawk 345/161 kV Transformer Uprate	MEC	J873		\$100,000	Yes
Hubbard-Audubon 230 kV Uprate	MP, GRE, XEL, OTP	J628, J713		\$650,000	XEL Yes OTP Yes MP Yes GRE No
Walters-Alden 69 kV Rebuild	ITCM	J927		\$4,700,000	Yes
Alden-Aleawst 69 kV Rebuild	ITCM	J927		\$5,100,000	Yes
Rice-Cresco 69 kV Rebuild	ITCM	J898		\$10,200,000	Yes
Rice-Saratoga 69 kV Uprate	ITCM	J898		\$150,000	Yes
Decorah-Madison 69 kV Uprate	ITCM	J898		\$60,000	Yes
Glenworth-Hayward 161 kV Uprate	ITCM	J885		\$25,000	Yes
Adams-Hayward 161 kV Uprate	ITCM	J885		\$480,000	Yes
New J628 POI- Prairie 230 kV 2 <sup>nd</sup> Circuit	GRE	J628, J897		\$22,360,000	No
J628 POI-Prairie 230 kV Rebuild	GRE	J628, J897		\$16,770,000	No
Helena-Chub Lake 2 <sup>nd</sup> Circuit	GRE/CAPX	J901		\$34,000,000	CAPX Yes
Canby-Granite Falls 115 kV Rebuild	OTP	J722, J933		\$17,700,000	Yes
Wahpeton-Fergus Falls 230 kV Uprate	OTP	J580		\$850,000	Yes
Audubon-Lake Park 230 kV Uprate	OTP	J580, J713, J816, J946		\$100,000	Yes
Big Stone-Big Stone South 230 kV Circuit 1 Rebuild	OTP	J722, J933		\$1,450,000	Yes
Big Stone-Big Stone South 230 kV Circuit 2 Rebuild	OTP	J722, J933		\$1,400,000	Yes
Big Stone-Twin Brooks 2 <sup>nd</sup> Circuit	OTP	J933		\$54,500,000	Yes
Big Stone-Blair 230 kV Rebuild	OTP/NWE	J722, J933		\$28,235,800	OTP Yes
Adams 345/161 kV Transformer Upgrade	XEL	J898		\$3,000,000	Yes
Wilmarth-Sheas Lake 345 kV Rebuild	XEL	J720, J785		\$39,526,000	Yes
Blue Lake-Scott County 345 kV Rebuild	XEL	J901		\$24,000,000	Yes
Crandal-Fieldon 345 kV Rebuild	XEL	J720		\$36,775,000	Yes
Helena-Sheas Lake 345 kV Rebuild	XEL	J720, J785		\$11,922,000	Yes
Jerico-Howard Tap 69 kV Uprate	DPC	J898		\$50,000	Yes
J873 POI 75 MVAR SVC Additional Plant MVAR	MEC	J873		\$22,500,000	Yes
Six 50 Mvar Capacitors at Wahpeton 230 kV	OTP	J580, J628, J705, J706, J713, J722, J897, J933		\$9,750,000	Yes
One 150 Mvar Capacitor at Bison 345 kV	XEL	J580, J628,		\$1,500,000	Yes

Network Upgrade	TO	GI projects requiring upgrade for ERIS	GI projects requiring upgrade for NRIS	Cost of solution (\$)	Self Fund Election
		J705, J706, J713, J722, J897, J933			
Three 50 Mvar Capacitors at Maple River 230 kV	MPC	J580, J628, J705, J706, J713, J722, J897, J933		\$3,000,000	N/A
Coyote Transformer Upgrade	MDU		J705, J706, J713	\$5,000,000	Yes
Coyote-Beulah 115 kV Uprate	MDU		J713	\$1,500,000	Yes
Center – Jamestown 345 kV Uprate	OTP		J705, J706, J713	\$25,000	Yes
Rebuild Linton-Wishek 115 kV and operate normally closed	MDU	J580		\$14,100,000	Yes
Ellendale-Aberdeen Jct 115 kV Uprate (MDU LPC)	MDU	J580, J933		\$60,000	Yes
Foxtail-Ellendale 230 kV Rebuild (MDU LPC)	MDU	J580		\$10,500,000	Yes
Merricourt-Wishek 230 kV Rebuild (MDU LPC)	MDU	J580		\$6,300,000	Yes
Wishek-J302 POI 230 kV Rebuild (MDU LPC)	MDU	J580		\$5,600,000	Yes
Build Mandan-J302 POI 230 kV Circuit (MDU LPC)	MDU	J580		\$28,000,000	Yes
Add Additional Breaker at Merricourt (MDU LPC)	MDU	J580		\$1,500,000	Yes
Jerico-Alta Vista 69 kV Rebuild (DPC LPC)	DPC	J898		\$235,000	Yes
Jerico-Howard Tap 69 kV Rebuild (DPC LPC)	DPC	J898		\$1,200,000	Yes
Nordness Tap-Decorah 69 kV Rebuild (DPC LPC)	DPC	J898		\$600,000	Yes
Saratoga-Rice 69 kV Rebuild (DPC LPC)	DPC	J898		\$400,000	Yes
Saratoga-Howard Tap 69 kV Rebuild (DPC LPC)	DPC	J898		\$3,200,000	Yes
Beaver Creek-J898 POI 161 kV Rebuild (DPC LPC)	DPC	J898		\$5,000,000	Yes
Beaver Creek-Harmony 161 kV Rebuild (DPC LPC)	DPC	J898		\$200,000	Yes
CSLTNET-Mapleton 115 kV Uprate (OTP LPC)	OTP	J816, J946		\$25,000	Yes
Big Stone-Highway 12 115 kV Uprate (OTP LPC)	OTP	J722, J933		\$50,000	Yes
Highway 12-Ortonville 115 kV Uprate (OTP LPC)	OTP	J722, J933		\$50,000	Yes
Mahnomn-Ulrich 115 kV Uprate (OTP LPC)	OTP	J628		\$50,000	Yes
Winger-Fertile 115 kV Uprate (OTP LPC)	OTP	J628		\$50,000	Yes
Wilton-Bemidji 115 kV Uprate (OTP LPC)	OTP	J628, J897		\$50,000	Yes
Crookston-Fertile 115 kV Uprate (OTP LPC)	OTP	J628		\$250,000	Yes
Hankinson-Wahpeton 230 kV Rebuild (OTP LPC)	OTP	J580		\$21,900,000	Yes
Hankinson-Forman 230 kV Uprate (OTP LPC)	OTP	J580, J933		\$50,000	Yes
Big Stone South Transformer #1 Upgrade (OTP LPC)	OTP	J933		\$4,600,000	Yes

Network Upgrade	TO	GI projects requiring upgrade for ERIS	GI projects requiring upgrade for NRIS	Cost of solution (\$)	Self Fund Election
Big Stone South Transformer #2 Upgrade (OTP LPC)	OTP	J933		\$4,600,000	Yes
Brooking County-Astoria 2 <sup>nd</sup> Circuit 345 kV (OTP LPC)	OTP	J580, J628, J705, J706, J713, J816, J897, J933, J946		\$36,500,000	Yes
Astoria-J526 POI 2 <sup>nd</sup> Circuit 345 kV (OTP/MDU LPC)	OTP	J580, J628, J705, J706, J713, J816, J897, J933, J946		\$55,000,000	Yes
Canby two steps of 20 Mvar Capacitor Banks (OTP LPC)	OTP	J545, J580, J628, J705, J706, J713, J720, J722, J816, J840, J874, J877, J897, J905, J933, J946		\$1,500,000	Yes
Dumont 20 Mvar Capacitor Bank (OTP LPC)	OTP	J545, J580, J720, J722, J785, J803, J816, J836, J840, J873, J874, J877, J905, J933		\$1,000,000	Yes
Willmar-Granite Falls 230 kV Rebuild (GRE LPC)	GRE	J901		\$7,700,000	No
J901 POI 75 Mvar Capacitor Bank (GRE LPC)	GRE	J545, J580, J628, J705, J706, J713, J720, J722, J785, J803, J816, J836, J840, J874, J877, J897, J901, J905, J933, J946		\$4,000,000	No
Panther 230 kV 60 Mvar Capacitor Bank (GRE LPC)	GRE	J545, J580,		\$2,500,000	No



Network Upgrade	TO	GI projects requiring upgrade for ERIS	GI projects requiring upgrade for NRIS	Cost of solution (\$)	Self Fund Election
		J628, J705, J706, J713, J720, J722, J785, J803, J816, J840, J874, J877, J897, J901, J905, J933, J946			
Two Jamestown 75 Mvar Capacitor Banks (GRE LPC) *	OTP	J545, J580, J705, J706, J713, J720, J722, J803, J840, J874, J877, J905, J933		\$8,000,000	Yes
250 Mvar Jamestown SVC (GRE LPC) *	OTP	J545, J580, J705, J706, J713, J720, J722, J803, J840, J874, J877, J905, J933		\$44, 370,000	Yes
Two Alexandria 75 Mvar Capacitor Banks (GRE LPC) *	MRES	J545, J580, J705, J706, J713, J720, J722, J803, J840, J874, J877, J905, J933		\$8,000,000	No
Twin Brooks – Alexandria 345 kV (GRE LPC) *	OTP/MRES	J545, J580, J705, J706, J713, J720, J722, J803, J840, J874, J877, J905, J933		\$242,400,000	OTP Yes MRES No
Alexandria 200 Mvar SVC (GRE LPC) *	MRES	J545, J580,		\$60,000,000	No



Network Upgrade	TO	GI projects requiring upgrade for ERIS	GI projects requiring upgrade for NRIS	Cost of solution (\$)	Self Fund Election
		J705, J706, J713, J720, J722, J803, J840, J874, J877, J905, J933			
Wahpeton 200 Mvar SVC (GRE LPC) *	OTP	J545, J580, J705, J706, J713, J720, J722, J803, J840, J874, J877, J905, J933		\$25,000,000	Yes
Ellendale 150 Mvar SVC (GRE LPC) *	MDU	J545, J580, J705, J706, J713, J720, J722, J803, J840, J874, J877, J905, J933		\$24,370,000	Yes
Big Stone South 200 Mvar SVC (GRE LPC) *	OTP	J545, J580, J705, J706, J713, J720, J722, J803, J840, J874, J877, J905, J933		\$50,000,000	Yes
Prairie 300 Mvar SVC (GRE LPC) *	MPC	J545, J580, J705, J706, J713, J720, J722, J803, J840, J874, J877, J905, J933		\$20,000,000	N/A
J628-Prairie 230 kV Terminal Upgrades (MPC AFS)	MPC	J628, J705, J706, J713, J897		\$500,000	N/A
Stanton-Square Butte 230 kV Terminal Upgrades	MPC	J628, J705,		\$500,000	N/A

Network Upgrade	TO	GI projects requiring upgrade for ERIS	GI projects requiring upgrade for NRIS	Cost of solution (\$)	Self Fund Election
(MPC AFS)		J706, J713, J816, J946			
Wilton-Scribner 115 kV Terminal Upgrades (MPC AFS)	MPC	J628, J897		\$200,000	N/A
Bemidj-Helga 115 kV Terminal Upgrades (MPC AFS)	MPC	J628, J705, J706, J713, J816, J897, J946		\$200,000	N/A
Jamestown-Center 345 kV Structure Remediation (MPC AFS)	MPC	J628, J705, J706, J713, J897		\$1,000,000	N/A
Grank Forks – Falconer 115 kV Reconductor (MPC AFS)	MPC	J628, J705, J706, J713, J897		\$550,000	N/A
Falconer – Oslo 115 kV Reconductor (MPC AFS)	MPC	J628, J705, J706, J713, J897		\$2,000,000	N/A
Wilton-Winger 230 kV Structure Remediation (MPC AFS)	MPC	J628, J705, J706, J713, J816, J897, J946		\$400,000	N/A
Prairie 115/69 kV Transformer #2 Upgrades (MPC AFS)	MPC	J628, J897		\$1,500,000	N/A
Drayton-Prairie 230 kV Structure Remediation (MPC AFS)	MPC	J628, J705, J706, J713, J816, J897, J946		\$200,000	N/A
Prairie-Winger 230 kV Structure Remediation (MPC AFS)	MPC	J628, J705, J706, J713, J897		\$500,000	N/A
Install 3 <sup>rd</sup> Center 345/230 kV Transformer (MPC AFS)	MPC	J705, J706, J713		\$7,000,000	N/A
Mill Road-Master 69 kV Structure Remediation and Terminal Upgrades (MPC AFS)	MPC	J628, J897		\$500,000	N/A
Winger 230 kV 30 MVar Capacitor (MPC AFS)	MPC	J628, J705, J706, J713, J816, J897		\$1,000,000	N/A
Reconfigure/Add Breakers at Fort Thompson (SPP AFS)	WAPA	J545, J580, J628, J705,		\$7,500,000	N/A

Network Upgrade	TO	GI projects requiring upgrade for ERIS	GI projects requiring upgrade for NRIS	Cost of solution (\$)	Self Fund Election
		J706, J713, J722, J803, J816, J874, J897, J901, J905, J933, J946			
Astoria-Hazel Creek 345 kV Circuit (SPP AFS)	OTP/XEL	J545, J580, J628, J705, J706, J713, J722, J803, J816, J874, J897, J905, J933, J946		\$125,000,000	OTP Yes XEL Yes
Second Grand Forks 230/115 kV Transformer (SPP AFS)	WAPA	J628, J897		\$6,621,188	N/A
Rebuild Ward-Bismarck 230 kV (SPP AFS)	WAPA	J580		\$3,100,000	N/A
Terminal Equipment Upgrades Split Rock-Sioux City 345 kV (SPP AFS)	WAPA	J874		\$1,000,000	N/A
Terminal Equipment Upgrades Split Rock-White 345 kV (SPP AFS)	WAPA	J545, J580, J628, J705, J706, J713, J722, J801, J803, J816, J897, J901, J905, J926, J933, J946		\$1,000,000	N/A
Rebuild Grand Forks-Prairie 230 kV (SPP AFS)	WAPA/MPC	J628, J897		\$300,000	N/A
Second Colby-Killdeer-Quinn-J873-Blackha k-Hazelton 345 kV (SPP AFS)	MEC/ITCM		J545, J628, J705, J706, J713, J720, J722, J785, J801, J816, J840, J873, J874, J877, J885, J897, J898, J901, J905, J916, J926, J927,	\$361,000,000	MEC Yes ITCM Yes

Network Upgrade	TO	GI projects requiring upgrade for ERI	GI projects requiring upgrade for NRIS	Cost of solution (\$)	Self Fund Election
			J933, J946		
Second Center-Jamestown-Buffalo-Bison 345 kV (SPP AFS)	MPC/OTP/XEL		J628, J705, J706, J713, J722, J816, J897, J946	\$311,559,098	OTP Yes XEL Yes
Upgrade Post Rock 345/230 kV Transformer (SPP AFS)	MIDW		J705, J706, J713	\$8,302,968	N/A
Rebuild Sully-Whitlock 230 kV (SPP AFS)	BEPC		J628, J705, J706, J713, J816, J897, J946	\$19,677,570	N/A
Rebuild Aberdeen Junction-Ellendale 115 kV (SPP AFS)	NWPS		J722, J933	\$710,840	
Rebuild Aberdeen Junction-ABDNSBT 115 kV (SPP AFS)	NWPS		J722, J933	\$5,331,300	
Rebuild Forman-WAPA-Forman 115 kV (SPP AFS)	OTP/WAPA		J722, J933	\$1,500,000	OTP Yes
Rebuild Meadow Grove-Fort Randle 230 kV (SPP AFS)	NPPD/WAPA		J628, J705, J706, J713, J722, J816, J897, J933, J946	\$74,364,953	N/A
Upgrade Terminal Equipment S3451-S3454 345 kV (SPP AFS)	OPPD		J545, J628, J705, J706, J713, J720, J722, J785, J801, J816, J840, J874, J877, J885, J897, J898, J901, J905, J916, J926, J927, J933, J946	\$500,000	N/A
Second Raun-S3451 345 kV (SPP AFS)	OPPD/MEC		J545, J628, J705, J706, J713, J720, J722, J785, J801, J816,	\$102,600,000	MEC Yes

Network Upgrade	TO	GI projects requiring upgrade for ERI	GI projects requiring upgrade for NRIS	Cost of solution (\$)	Self Fund Election
			J840, J874, J877, J885, J897, J898, J901, J905, J916, J926, J927, J933, J946		
Terminal Equipment Upgrades Antelope Valley-Broadland 345 kV (SPP AFS)	BEPC		J628, J705, J706, J713, J816, J897, J946	\$3,000,000	N/A
Second Split Rock-Sioux City 345 kV (SPP AFS)	XEL/WAPA		J545, J628, J705, J706, J713, J720, J722, J785, J801, J816, J840, J874, J877, J885, J897, J898, J901, J905, J916, J926, J927, J933, J946	\$126,865,737	XEL Yes
Second Holt-Grand Prairie 345 kV (SPP AFS)	NPPD/WAPA		J545, J628, J705, J706, J713, J720, J722, J785, J801, J816, J840, J874, J877, J885, J897, J898, J901, J905, J916, J926, J927, J933, J946	\$50,011,493	N/A
Second Raun-Sioux City 345 kV (SPP AFS)	MEC/WAPA		J545, J628, J705, J706, J713, J720,	\$80,000,000	MEC Yes

Network Upgrade	TO	GI projects requiring upgrade for ERIS	GI projects requiring upgrade for NRIS	Cost of solution (\$)	Self Fund Election
			J722, J785, J801, J816, J840, J874, J877, J885, J897, J898, J901, J905, J916, J926, J927, J933, J946		
Rebuild FLANDRU-Aurora-Brookings 115 kV (SPP AFS)	WAPA		J933	\$17,219,822	
Rebuild Minn Valley-Granite Falls 230 kV (SPP AFS)	XEL/WAPA		J545, J705, J706, J713, J722, J874, J905, J933	\$5,200,000	XEL Yes
Rebuild Minn Valley-Granite Falls 115 kV (SPP AFS)	XEL/WAPA		J722, J933	\$7,950,000	XEL Yes
Rebuild Bismark-ESTBMRK 115 kV (SPP AFS)	WAPA		J705, J706, J713	\$100,000	
Rebuild Overton-Sibley 345 kV (SPP AFS)	AMMO/GMO		J545, J628, J705, J706, J713, J720, J722, J785, J801, J816, J840, J874, J877, J885, J897, J898, J901, J905, J916, J926, J927, J933, J946	\$155,350,000	AMMO Yes
Second Astoria-Hazel Creek 345 kV (SPP AFS)	XEL/OTP		J628, J705, J706, J713, J722, J816, J897, J933, J946	\$25,000,000	OTP Yes XEL Yes
Second Big Stone South-Deuel County 345 kV (SPP AFS)	XEL/OTP		J628, J705, J706, J713, J722, J816,	\$70,000,000	OTP Yes XEL Yes

Network Upgrade	TO	GI projects requiring upgrade for ERIS	GI projects requiring upgrade for NRIS	Cost of solution (\$)	Self Fund Election
			J897, J933, J946		

\*CCS GRE LPC Voltage NU to address voltage collapse

**Table 4: Shared Network Upgrades (Planning level cost estimates)**

Shared Network Upgrade	TO	Higher queued projects associated with SNU	Study projects associated with SNU	Cost of solution (\$)
Forman – Oakes 230 kV Reconductor (Aug-2016 Cycle)	OTP	J302, J503	J580	\$2,068,545

**Note:**

- 1) Details pertaining to upgrades, costs, and the execution plan for interconnection of the generating facility at the POI will be documented in the Facility Study for Interconnecting Generator.
- 2) Facilities that have been included as base case assumptions and the level of interconnection service that would be conditional upon these facilities being in service will be documented in the GIA (Generator Interconnection Agreement) for each respective GI request successfully achieving GIA execution.
- 3) Analysis performed shows that projects J580 met the criteria for Shared Network Upgrade cost allocation.

## 2. FERC Order 827 Compliance Review

The Final Rule of FERC Order 827 “Reactive Power Requirements for Non-Synchronous Generation”, which was issued June 16, 2016, stated that “Under this Final Rule, newly interconnecting non-synchronous generators that have not yet executed a Facilities Study Agreement as of the effective date of this Final Rule will be required to provide dynamic reactive power within the range of 0.95 leading to 0.95 lagging at the high-side of the generator substation.” As such, this Final Rule applies to all non-synchronous projects included in the DPP 2017 August West study cycle.

In this study, the power factor at the high-side of the generator substation for each project was calculated and reviewed. The study method is to set Qgen of each study project at its Qmax, solve the case, then record the P and Q injection on the high side of the generator substation to calculate the lagging power factor (injecting VAR to the system). The same process is then repeated by setting Qgen at Qmin to calculate the leading power factor (absorbing VAR from the system).

The results show that not all projects meet FERC Order 827 requirements. Additional reactive support will be needed for these projects to meet the FERC requirement on reactive power capability prior to the completion of their GIA.

**Table 5: FERC Order 827 Review Results**

Project	Pmax (MW)	Reactive Power Capability (MVar)	Proposed VAR Compensation	VAR Injection			VAR Absorption			Meet FERC Order 827 Requirement?	Add'l VAR Needed (MVar)
				P (MW)	Q (MVar)	Lagging p.f (pu)	P (MW)	Q (MVar)	Leading p.f. (pu)		
J545	110	±37	3 x 6 Mvar Cap	108.4	51.3	0.904	107.9	-50.2	-0.907	Yes	
J580	244	112.404 -80.736	N/A	291.4	69.0	0.973	285.5	-228.5	-0.781	No	26.8
J628	400	±133	6 x 8 MVar Cap	397.5	128.4	0.952	396.2	-145.5	-0.939	No	2.3
J705	105	±50.893	N/A	103.1	34.1	0.949	101.9	-81.9	-0.779	Yes	
J706	105	±50.893	N/A	103.0	36.9	0.941	101.9	-76.4	-0.800	Yes	
J713	300	±100	6 x 6 Mvar Cap	297.0	80.6	0.965	295.3	-185.4	-0.847	No	17.0
J720	200	±66	N/A	199.2	27.9	0.990	198.9	-117.8	-0.860	No	37.6
J722	200	±67	3 x 8 MVar Cap	198.6	56.7	0.962	198.0	-114.9	-0.865	No	8.6
J785	105	±34.5120	3 x 10 MVar Cap	104.0	37.8	0.940	103.0	-91.9	-0.746	Yes	
J801	74	±36.4	N/A	73.1	29.1	0.929	72.8	-46.2	-0.844	Yes	
J803	33	±13.25	N/A	32.5	8.6	0.967	32.4	-21.6	-0.832	No	2.1
J816	62	±20	2 x 4 MVar Cap	61.3	18.9	0.956	61.0	-34.3	-0.872	No	1.2
J836	205	±95.5	N/A	201.7	56.0	0.964	200.2	-169.0	-0.764	No	10.3
J840	150	30.75 -43.725	3 x 15 MVar Cap	143.6	48.6	0.947	141.9	-88.0	-0.850	Yes	
J873	200	41 -58.3	4 x 15 MVar Cap	191.2	60.4	0.953	186.7	-146.3	-0.787	No	3
J874	150	±72.6	N/A	147.6	42.8	0.960	145.6	-129.1	-0.748	No	5.7
J877	250	±121	N/A	247.2	79.5	0.952	245.7	-187.9	-0.794	No	1.8
J885	64	±31	N/A	63.2	20.7	0.950	62.9	-45.4	-0.811	Yes	
J897	190	±43	2 x 8 MVar Cap	188.0	64	.946	185.8	-144.4	-0.793	Yes	
J898	100	±19.72	1 x 8 MVar	99.1	9.9	0.995	98.8	-43.2	-0.916	No	22.7



Project	Pmax (MW)	Reactive Power Capability (MVar)	Proposed VAR Compensation	VAR Injection			VAR Absorption			Meet FERC Order 827 Requirement?	Add'l VAR Needed (MVar)
				P (MW)	Q (MVar)	Lagging p.f (pu)	P (MW)	Q (MVar)	Leading p.f. (pu)		
			Cap								
J901	200	±35.12	2 x 8 MVar Cap	198.1	0.6	1.000	197.4	-103.9	-0.885	No	64.5
J905	41	±13	2 x 3 MVar Cap	40.1	13.7	0.946	40.2	-23.3	-0.865	Yes	
J916	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
J926	102.5	±48.907	1 x 8 MVar Cap	101.3	43	0.921	101.3	-76.2	-0.800	Yes	
J927	200	±66	3 x 8 MVar Cap	196.7	56.9	0.961	195.0	-119.7	-0.852	No	7.8
J933	211	±67	3 x 8 MVar Cap	210.0	69.9	0.949	209.7	-102.1	-0.899	Yes	
J946	210	±69.4	2 x 20 MVar Cap	200	74.4	0.865	124.9	-68.1	-0.878	Yes	

### 3. Model Development and Study Assumptions

#### 3.1. Base Case Models

The origin of the DPP 2017 August West models is based on the MTEP 18 series models with the Bench Cases including all prior-queued projects and their associated network upgrades known through the DPP February West Phase 3 analysis, while the Study Cases contain all of the interconnection requests in DPP 2017 August West Phase 2.

Prior queued network upgrades are documented in the following System Impact Study reports

MISO DPP 2017 February West Area Phase 3 Study section 4.3

[https://cdn.misoenergy.org/GI-DPP-2017-FEB-West-Phase3\\_System\\_Impact\\_Report\\_PUBLIC391580.pdf](https://cdn.misoenergy.org/GI-DPP-2017-FEB-West-Phase3_System_Impact_Report_PUBLIC391580.pdf)

MISO DPP 2016 August West Area Phase 3 Study section 4.3

<https://cdn.misoenergy.org/GI-DPP-2016-AUG-West-Phase3-Final-Public394324.pdf>

MISO DPP 2016 February West Area Phase 3 Study section 2.8

<https://cdn.misoenergy.org/GI-DPP-2016-FEB-West-Phase3-Final-Public394321.pdf>

- Bench Cases
  - DPP\_AUG17\_West\_2023SH90\_Bench\_FINAL\_191111
  - DPP\_AUG17\_West\_2023SUM\_Bench\_FINAL\_191111
- Study Cases
  - DPP\_AUG17\_West\_2023SH90\_Study\_FINAL\_191111
  - DPP\_AUG17\_West\_2023SUM\_Study\_FINAL\_191111

#### 3.2. Monitored Elements

Under NERC category P0 conditions (system intact) branches were monitored for loading above the normal rating (PSS®E Rating A), and for NERC category P1-P7 conditions branches were monitored for emergency rating (PSS®E Rating B). Voltage limits were specified for system intact and contingent conditions as per applicable Transmission Owner Planning Criteria.

#### 3.3. Contingencies

The following contingencies were considered in the steady state analysis:

- 1) NERC Category P0 (system intact -- no contingencies)
- 2) NERC Category P1 contingencies
  - a. Single element outages, at buses with a nominal voltage of 68 kV and above

- b. Multiple element NERC Category P1 contingencies
- 3) NERC Category P2-P7 contingencies
- 4) For all the contingencies and post-disturbance analyses, cases were solved with transformer tap adjustment enabled, area interchange adjustment disabled, phase shifter adjustment disabled (fixed) and switched shunt adjustment enabled.

### **3.4. Study Methodology**

Non-linear (AC) contingency analysis was performed on the benchmark and study cases, and the incremental impact of the DPP 2017 August West generating facilities was evaluated by comparing the steady state performance of the transmission system in the Bench and Study Cases. Analyses used PSS®E version 33.11.0 and TARA version 1801d.

### **3.5. Performance Criteria**

A branch is considered a thermal constraint if the following conditions are met:

- 1) The generator has a larger than twenty percent (20%) sensitivity factor on the overloaded facilities under post-contingent condition (see NERC TPL) or five percent (5%) sensitivity factor under system-intact condition, or
- 2) The overloaded facility or the overload-causing contingency is at generator's outlet, or
- 3) The megawatt impact due to the generator is greater than or equal to twenty percent (20%) of the applicable rating (normal or emergency) of the overloaded facility, or
- 4) For any other constrained facility, where none of the Study Generators meet one of the above criteria, however, the cumulative MW impact of the group of study generators is greater than twenty percent (20%) of the rating of the facility, then only those study generators whose individual MW impact is greater than five percent (5%) of the rating of the facility and has DF greater than five percent (5%) will be responsible for mitigating the cumulative MW impact constraint, or
- 5) Impacts on Affected Systems would be classified as Injection constraints based on the Affected Systems' criteria, or
- 6) Any other applicable Transmission Owner FERC filed Local Planning Criteria are met.

A bus is considered a voltage constraint if both of the following conditions are met:

- 1) The bus voltage is outside of the applicable normal or emergency limits for the post change case, and
- 2) The change in bus voltage is greater than 0.01 per unit

All generators must mitigate thermal injection constraints and voltage constraints in order to obtain any type of Interconnection Service. Further, all generators requesting Network Resource Interconnection Service (NRIS) must mitigate constraints found by using the Deliverability algorithm, to meet the system performance criteria for NERC category P1 events, if DFAX due to the study generator is equal to or greater than 5%.

## **4. Backbone Network Upgrade Analysis**

An analysis was performed to determine the need for any backbone network upgrades for this cycle. Voltage and thermal issues were not significant enough to justify the inclusion of a backbone upgrade in this analysis.

## **5. Thermal Analysis**

The thermal analysis results for 2017 August West group show generator projects causing constraints. The details pertaining to the thermal analysis can be found in Appendix A – .

## **6. Voltage Analysis**

The voltage analysis results for summer peak models show that the no study generators cause any voltage

constraints. The shoulder peak analysis does indicate that three contingencies result in a voltage collapse condition that will require mitigation by the August 2017 study group. The details pertaining to the voltage analysis can be found in Appendix A – . The shoulder peak analysis identified some voltage constraints in the area of northwest Minnesota. One point of interconnection voltage constraint was identified in Iowa region.

## **7. Stability Analysis**

A voltage stability analysis was performed for the Minnesota-Wisconsin Export Interface (MWEX). The results of that analysis indicate that the August 2017 Study group does not aggravate the interface and no network upgrades were therefore identified. The full analysis is included in appendix C.

Transient stability analysis was performed for the August 2017 Study group. Results of the analysis are included in Appendix E. One network upgrade was identified due to a localized voltage collapse near the J580 point of interconnection.

## **8. Short Circuit Analysis**

Short circuit analysis for the proposed projects are included in appendix F.

## **9. Affected System Impact Study**

Affected System analysis will be performed in the 2017 August West Phase 2 study.

## **10. Deliverability Analysis**

### **10.1. Introduction**

Generator interconnection projects have to pass Generator Deliverability Study to be granted NRIS. If the generator is deemed not fully deliverable, the customer can choose either to change the project to an Energy Resource (ER) project or to proceed with the system upgrades that will make the generator fully deliverable. Generator Deliverability Study ensures that the Network Resources, on an aggregate basis, can meet the MISO aggregate load requirements during system peak condition without getting bottled up. The wind generators are tested at 100% of their maximum output level which then can be used to meet Resource Adequacy obligations, under Module E, of the MISO Transmission and Energy Market Tariff (TEMT).

MISO Generator Deliverability Study whitepaper describing the algorithm can be found in BPM 015 – Generation Interconnection, Appendix C.

### **10.2. Determining the MW Restriction**

If one facility is overloaded based on the assessed “severe yet credible dispatch” scenario described in the study methodology, and the generator under study has a DF greater than 5%, part or all of its output is not deliverable. The restricted MW is calculated as following:

$$(\text{MW restricted}) = (\text{worst loading} - \text{MW rating}) / (\text{generator sensitivity factor})$$

If the result is larger than the maximum output of the generator, 100% of this generator's output is not deliverable.

### **10.3. Deliverability Study Results**

The deliverability analysis assumes all ERIS upgrades as those upgrades are required for the study group to interconnection to the transmission system. With all the MISO analysis ERIS upgrades assumed as well as the prior queued network upgrades, the deliverability analysis determined no new constraints for projects that are requesting NRIS service. If a constraint is identified, the deliverability is calculated by taking the

NRIS Request amount subtracting the calculated shared deductible. The shared deduction is the amount by which each study generator affecting a given flowgate must be scaled down in order to prevent loading violations on the flowgate. The deduction is proportionally taken from each study generator affecting a particular flowgate. If a particular monitored element becomes a flowgate under multiple contingencies, the contingency with the highest total shared deduction is used.

#### 10.3.1. J545

This generator is determined to be fully deliverable for 110 MW, contingent upon the ERIS system upgrades and assumed prior queued network upgrades.

#### 10.3.2. J580

This generator did not request NRIS service, so deliverability was not performed for this interconnection request

#### 10.3.3. J628

This generator is determined to be fully deliverable for 400 MW, contingent upon the ERIS system upgrades and assumed prior queued network upgrades.

#### 10.3.4. J705

This generator is determined to not be deliverable to the full NRIS request amount. Details on the required network upgrades to achieve deliverability are detailed below.

J705 Deliverable (NRIS) Amount in 2023 case: (Conditional on ERIS and IC upgrades and case assumptions)	0 MW (0%)
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Next Upgrade for Higher NRIS Level (cumulative) (i.e. All upgrades must be made for 100% NRIS)	Level of service Attainable (MW)	Distribution Factor	Projects Associated with NRIS Constraint	Upgrade Costs Allocated to Project	Total Cost of Upgrade
Center - Jamestown 345 kV Uprate	0	0.2172	J705, J706, J713	\$4,538	\$25,000
Coyote Transformer Upgrade	13	0.1372	J705, J706, J713	\$1,000,000	\$5,000,000
Coyote - Beulah 115 kV Upgrade	100	0.1012	J705, J706, J713	\$300,000	\$1,500,000

#### 10.3.5. J706

This generator is determined to not be deliverable to the full NRIS request amount. Details on the required network upgrades to achieve deliverability are detailed below.

J706 Deliverable (NRIS) Amount in 2023 case: (Conditional on ERIS and IC upgrades and case assumptions)	0 MW (0%)
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Next Upgrade for Higher NRIS Level (cumulative) (i.e. All upgrades must be made for 100% NRIS)	Level of service Attainable (MW)	Distribution Factor	Projects Associated with NRIS Constraint	Upgrade Costs Allocated to Project	Total Cost of Upgrade
Center – Jamestown 345 kV Uprate	0	0.2172	J705, J706, J713	\$4,538	\$25,000
Coyote Transformer Upgrade	13	0.1372	J705, J706, J713	\$1,000,000	\$5,000,000
Coyote - Beulah 115 kV Upgrade	100	0.1012	J705, J706, J713	\$300,000	\$1,500,000

#### 10.3.6. J713

This generator is determined to not be deliverable to the full NRIS request amount. Details on the required network upgrades to achieve deliverability are detailed below.

J713 Deliverable (NRIS) Amount in 2023 case: (Conditional on ERIS and IC upgrades and case assumptions)	0 MW (0%)
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Next Upgrade for Higher NRIS Level (cumulative) (i.e. All upgrades must be made for 100% NRIS)	Level of service Attainable (MW)	Distribution Factor	Projects Associated with NRIS Constraint	Upgrade Costs Allocated to Project	Total Cost of Upgrade
Center – Jamestown 345 kV Uprate	0	0.2172	J705, J706, J713	\$13,614	\$25,000
Coyote Transformer Upgrade	46.88	0.1372	J705, J706, J713	\$3,000,000	\$5,000,000
Coyote - Beulah 115 kV Upgrade	300	0.1012	J705, J706, J713	\$900,000	\$1,500,000

#### 10.3.7. J720

This generator is determined to be fully deliverable for 200 MW, contingent upon the ERIS system upgrades and assumed prior queued network upgrades.

#### 10.3.8. J722

This generator is determined to be fully deliverable for 200 MW, contingent upon the ERIS system upgrades and assumed prior queued network upgrades.

#### 10.3.9. J785

This generator is determined to be fully deliverable for 105 MW, contingent upon the ERIS system upgrades and assumed prior queued network upgrades.

#### 10.3.10. J801

This generator is determined to be fully deliverable for 74 MW, contingent upon the ERIS system upgrades and assumed prior queued network upgrades.

#### 10.3.11. J803

This generator did not request NRIS service, so deliverability was not performed for this interconnection request.

#### 10.3.12. J816

This generator is determined to be fully deliverable for 110 MW, contingent upon the ERIS system upgrades and assumed prior queued network upgrades.

#### 10.3.13. J836

This generator did not request NRIS service, so deliverability was not performed for this interconnection request.

#### 10.3.14. J840

This generator is determined to be fully deliverable for 150 MW, contingent upon the ERIS system upgrades and assumed prior queued network upgrades.

#### 10.3.15. J873

This generator is determined to be fully deliverable for 200 MW, contingent upon the ERIS system upgrades and assumed prior queued network upgrades.

#### 10.3.16. J874

This generator is determined to be fully deliverable for 150 MW, contingent upon the ERIIS system upgrades and assumed prior queued network upgrades.

**10.3.17. J877**

This generator is determined to be fully deliverable for 250 MW, contingent upon the ERIIS system upgrades and assumed prior queued network upgrades.

**10.3.18. J885**

This generator is determined to be fully deliverable for 64 MW, contingent upon the ERIIS system upgrades and assumed prior queued network upgrades.

**10.3.19. J897**

This generator is determined to be fully deliverable for 190 MW, contingent upon the ERIIS system upgrades and assumed prior queued network upgrades.

**10.3.20. J898**

This generator is determined to be fully deliverable for 100 MW, contingent upon the ERIIS system upgrades and assumed prior queued network upgrades.

**10.3.21. J901**

This generator is determined to be fully deliverable for 200 MW, contingent upon the ERIIS system upgrades and assumed prior queued network upgrades.

**10.3.22. J905**

This generator is determined to be fully deliverable for 40 MW, contingent upon the ERIIS system upgrades and assumed prior queued network upgrades.

**10.3.23. J916**

This generator is determined to be fully deliverable for 2 MW, contingent upon the ERIIS system upgrades and assumed prior queued network upgrades.

**10.3.24. J926**

This generator is determined to be fully deliverable for 101.28 MW, contingent upon the ERIIS system upgrades and assumed prior queued network upgrades.

**10.3.25. J927**

This generator is determined to be fully deliverable for 100 MW, contingent upon the ERIIS system upgrades and assumed prior queued network upgrades.

**10.3.26. J933**

This generator is determined to be fully deliverable for 200 MW, contingent upon the ERIIS system upgrades and assumed prior queued network upgrades.

**10.3.27. J946**

This generator is determined to be fully deliverable for 200 MW, contingent upon the ERIIS system upgrades and assumed prior queued network upgrades.

## **11. Shared Network Upgrades Analysis**

Shared Network Upgrade (SNU) Analysis tests for Network Upgrades driven by higher queued interconnection projects was performed for this System Impact Study. SNUs were identified for DPP 2017 August West Area Projects.

The maximum MW impacts and Shared Network Upgrade (SNU) cost allocations appear in Table 6.

**Table 6: Maximum MW Impact and SNU Cost Allocations**

Network Upgrades	Project Study Cycle	Projects sharing cost	MW Contribution	Total NU Cost (\$)	Cost Responsibility (\$)
620362 OAKES 4 620363 FORMAN 4 1	DPP-2016-AUG	J302	15.7	\$4,861,933	\$1,410,167
	DPP-2016-AUG	J503	15.4		\$1,383,221
	DPP-2017-AUG	J580	23.03		\$2,068,545

## 12. Cost Allocation

The cost allocation of Network Upgrades for the study group reflects responsibilities for mitigating system impacts based on Interconnection Customer-elected level of Interconnection service as of the draft System Impact Study report date.

### 12.1. Cost Assumptions for Network Upgrades

The cost estimate for each network upgrade identified in System Impact Study was provided by the corresponding transmission owning company.

### 12.2. Cost Allocation Methodology

The costs of Network Upgrades (NU) for a set of generation projects (one or more sub-groups or entire group with identified NU) are allocated based on the MW impact from each project on the constrained facilities in the Study Case.

#### Cost Allocation Methodology for Thermal Constraints

1. With all Study Group generation projects dispatched in the Study Case, all thermal constraints are identified.
2. Distribution factor from each project on each constraint is obtained.
3. For each thermal constraint, the maximum MW contribution (increasing flow) from each project is then calculated in the Post Case without any network upgrades.
4. For each thermal constraint, the cost estimates for one or a subset of NU are provided by the corresponding Transmission Owner.
5. Then the cost of each NU is allocated based on the pro rata share of the MW contribution from each project on the constraints mitigated or partly mitigated by this NU. The methodology to determine the cost allocation of one NU is:

$$\text{Cost of NU} = \frac{\text{Project A cost portion of NU} \times \text{Max(Proj. A MW contribution on constraint)}}{\sum_i \text{Max(Proj. i MW contrution on constraint)}}$$

6. The total NU costs for each project are calculated if more than one NU is required.

#### Cost Allocation Methodology for Voltage Constraints

Cost allocation of voltage constraint driven network upgrades will be determined by the pro rata share of the voltage impact each project has on the most constrained bus under the most constraining contingency. The voltage impact of each project will be calculated by locking all voltage regulating equipment in the model and then backing out each GI project one at a time to identify each project's impact to the constraint. In severe instances of voltage collapse where projects cannot be backed out one at a time, they will be added one at a time to determine their impact to the constraint.

As the number and types of constraints increases, mitigating the constraints individually may result in higher overall costs. In instances when mitigation(s) resolve multiple types of constraints (such as thermal + voltage or thermal + voltage + transient stability) the cost is allocated based off the ratio share of the total cost of the independent mitigations in order to equitably allocate the cost to all parties contributing to





constraints. In summary, only the lowest cost mitigation option will be constructed, but for cost allocation purposes the independent mitigations are required.