Appendix D1

West

2016

American Transmission Co. (ATC)

ITC Midwest (ITCM)

MidAmerican Energy (MEC)

Rochester Public Utilities (RPU)

Cedar Falls Utilities (CFU)

Great River Energy (GRE)

Minnesota Power (MP)

Otter Tail Power (OTP)

Montana Dakota Utilities (MDU)

Xcel Energy (XEL)

Missouri River Energy Services (MRES)

Minnkota Power Cooperative (MPC)

Appendix D1: West Planning Region

The West Planning Region includes the upper peninsula of Michigan, Wisconsin, Minnesota, Iowa, portions of Illinois, North Dakota, and South Dakota. MISO identified eight major issues in the West Planning Region that resulted in Baseline Reliability Projects (Figure P-1).

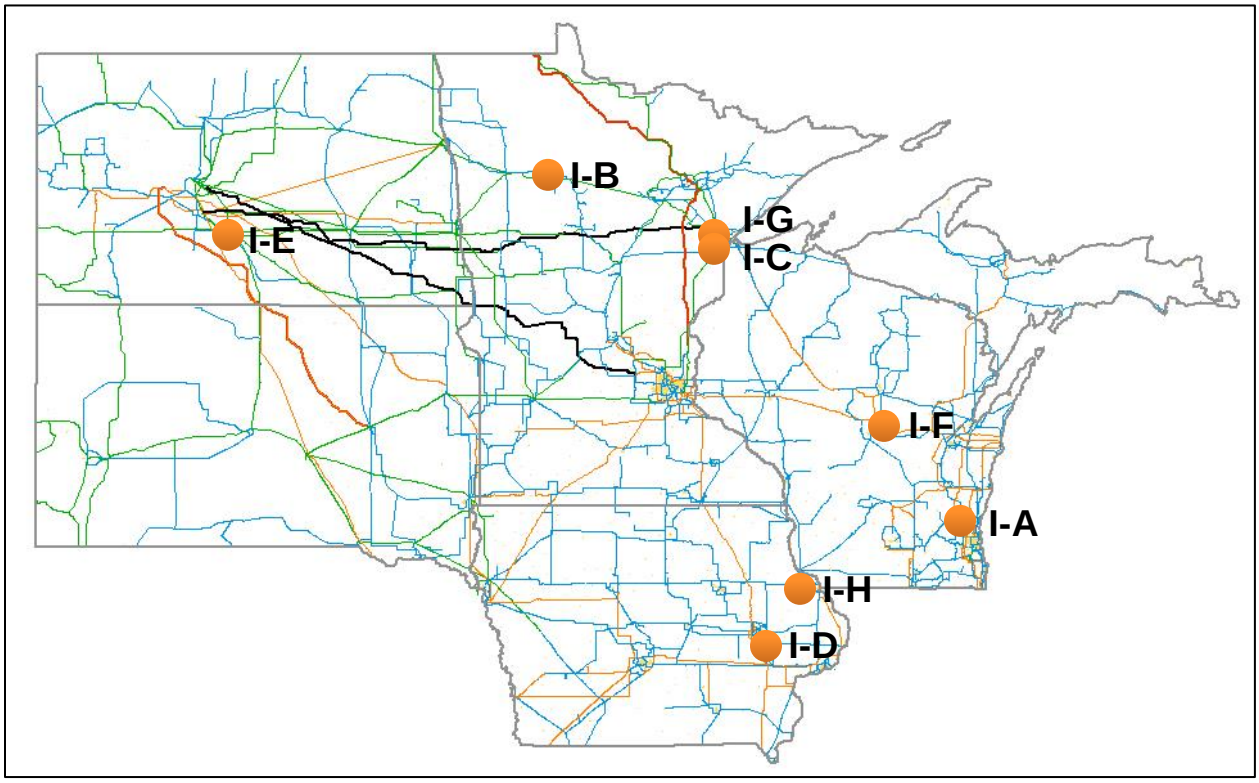

Figure P-1: Top issues map for the West Planning Region

I-A: The Port Washington – Saukville 138 kV line overloads up to 127 percent for single-element contingencies and up to 136 percent for multiple-element single contingencies. The American Transmission Company project 9986 mitigates this overloading by rebuilding this line from a 138 kV single circuit to a 138 kV double circuit. This transmission line is located in Southeast Wisconsin near Milwaukee.

I-B: Several single-element contingencies are resulting in low voltages that violate the 0.95 p.u. criterion and overloading up to 106 percent on the 115 kV system near Winger. The Otter Tail Power project 4813 mitigates these violations with the addition of a new 115 kV line, substation and switching station. These upgrades are located in Northwestern Minnesota near Bemidji.

I-C: The Fond Du Lac – Hibbard 115 kV line overloads for several single-element contingencies on the 115 kV system with the most severe violation being 134 percent overload during Arrowhead substation breaker faults. The Minnesota Power project 7996 mitigates these overloads by rebuilding and reconductoring this transmission line. This transmission line is located in Northeastern Minnesota near Duluth.

I-D: Single element and multiple element contingencies on the 161 kV system between Cedar Rapids and Iowa City are resulting in overloading up to 124 percent on 161 kV facilities in the area. The ITC Midwest project 9668 mitigates the overloading with the addition of two new substations, a new 161 kV line, and multiple upgrades to the 69 kV system in this area. These upgrades are located in Eastern Iowa between Cedar Rapids and Iowa City.

I-E: The Heskett – Mandan 115 kV line overloads up to 103 percent for the loss of the Heskett – NE Bismarck 115 kV line. The Montana Dakota Utilities project 9121 mitigates these overloads by replacing limiting switched in the Heskett substation. The Heskett substation is located in Central North Dakota near Bismarck.

I-F: The Plover – Whiting Avenue 115 kV line overloads up to 114 percent for multiple-element single contingencies. The American Transmission Company project 9423 mitigates this overloading by rebuilding this line. This transmission line is located in Central Wisconsin near Stevens Point.

I-G: Breaker failure events at the Arrowhead substation are causing low voltages that violate the 0.95 p.u. criterion and overloading up to 106 percent on the 115 kV system in this area. The Minnesota Power project 9064 mitigates these violations by reconfiguring the Arrowhead 115 kV bus. The Arrowhead substation is located in Northeastern Minnesota near Duluth.

I-H: Overloading of up to 115 percent occurs on the Lore – Hickory Creek 161 kV line after breaker failure events at the Salam substation. The ITC Midwest project 10269 mitigates the overloading by rebuilding this transmission line. This transmission line is located in northeastern Iowa near Dubuque.

Overview of Projects:

For the MTEP16 cycle there were 159 projects targeted for Appendix A with a total cost of $1,080.9 million. Of these 159 projects: 52 have an estimated cost greater than $5 million, 58 have an estimated cost between $1 million to $5 million, and 49 have an estimated cost lower than $1 million. The designations of project type are as follows: 21 Baseline Reliability, 15 GIP, 1 MEP, 1 TDSP and 121 Other (Figures P-2 and P-3). Some project details such as estimated cost and in-service dates may change between the creation of Appendix D1 and the Board approval date. Refer to Appendix A of this report for the final approval information.

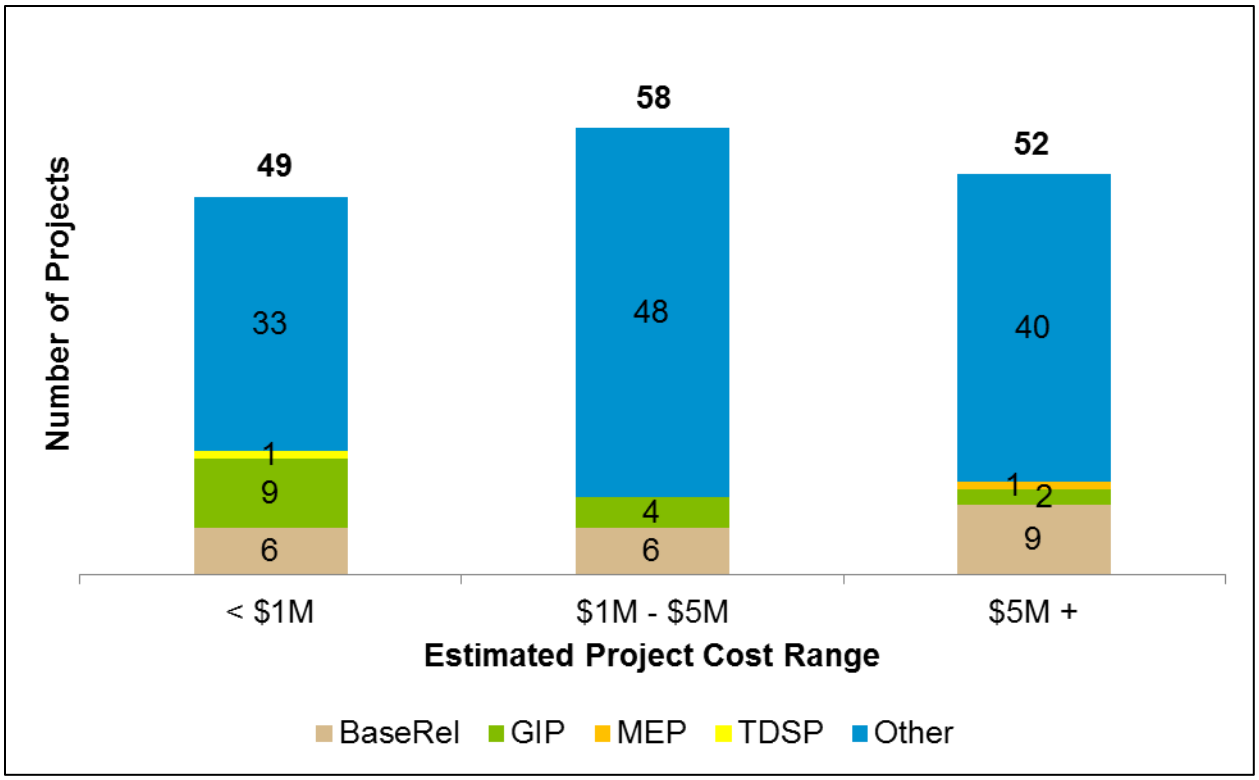

Figure P-2: Graphs of cost range by project type

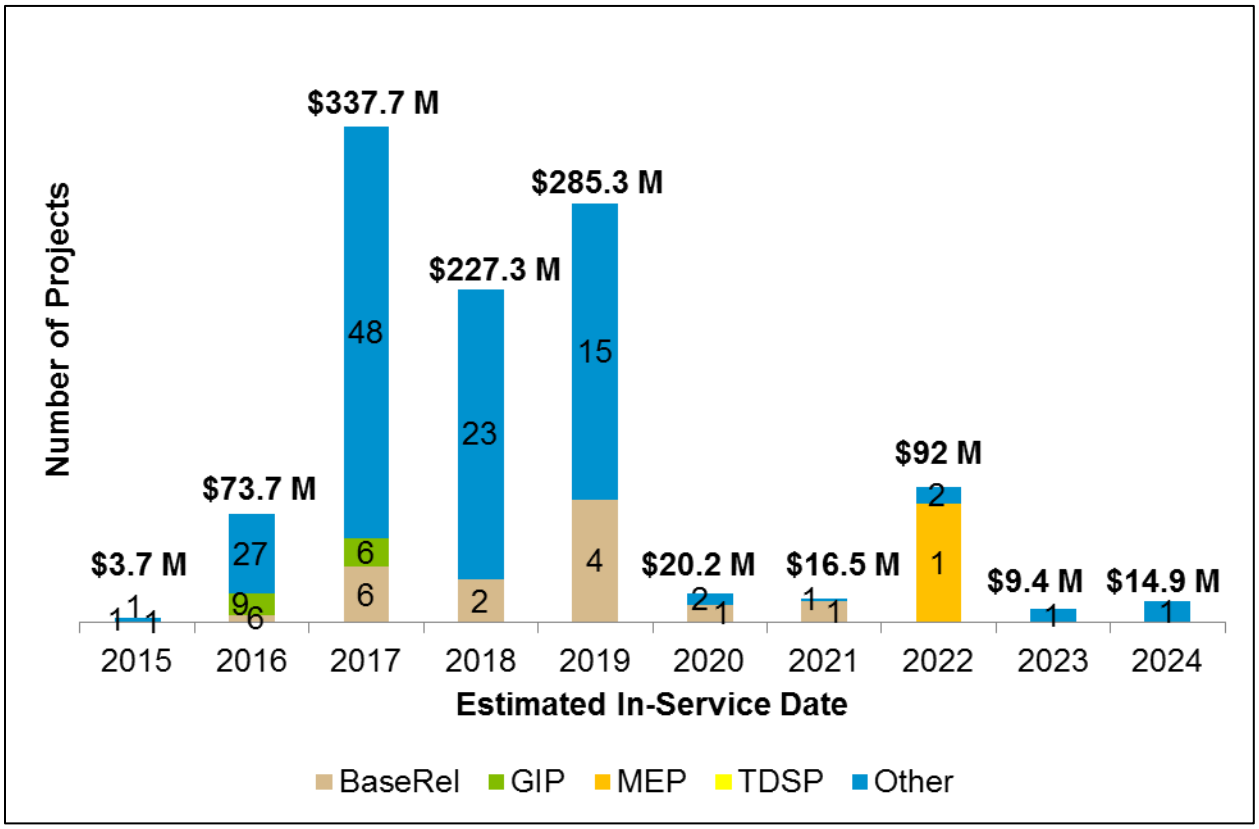

Figure P-3: Estimated in-service date by project type

Transmission Owner: American Transmission Co. (ATC)

Baseline Reliability Projects

Project 9423: Rebuild Plover - Whiting Avenue 115 kV line

Project Area Information

This project is located in Central Wisconsin, south of Stevens Point.

Project Need

The contingencies identified that drive the need for this project are P6 multiple contingency events, shown in Table 9423-1. The project will improve public safety and line reliability as well as meet long term minimum rating needs.

Model Year	Season or Sensitivity	Limiting Element	Cont. Type	Post-contingent Loading
2018	Summer Peak	Okray - Whiting Avenue 115 kV	P6	113.3%
2021	Shoulder	Okray - Whiting Avenue 115 kV	P6	100.9%
2021	Summer Peak	Okray - Whiting Avenue 115 kV	P6	113.0%
2026	Summer Peak	Okray - Plover 115 kV	P6	101.2%
2026	Summer Peak	Okray - Whiting Avenue 115 kV	P6	114.4%

Table P9423-1: Project contingency drivers

Project Description

Rebuild approximately 5.8 miles of the B-106 Plover to Whiting Avenue 115 kV line.

The total estimated cost of this project is $6.2 million. The expected in-service date for this project is December 2018.

Alternatives Considered

None

Project 9986: Upgrade transmission capability between the Port Washington and Saukville substations

Project Area Information

This project is located in Southeast Wisconsin, east of West Bend.

Project Need

The contingencies identified that drive the need for this project are P2 bus tie breaker events at Saukville and a P7 common tower event between Port Washington and Saukville, shown in Table 9986-1. The

project will prevent the loss of area load and generation during these events. These system conditions exist currently and as the system moves to more reliance on area generation, the frequency of these system conditions can be expected to increase.

Model Year	Season or Sensitivity	Limiting Element	Cont. Type	Post-contingent Loading
2018	Summer Peak	Port Washington – Saukville 138 kV	P2	127.6%
2018	Summer Peak	Port Washington – Saukville 138 kV	P7	136.7%
2021	Summer Peak	Port Washington – Saukville 138 kV	P2	125.1%
2021	Summer Peak	Port Washington – Saukville 138 kV	P7	133.9%
2021	Winter Peak	Port Washington – Saukville 138 kV	P2	101.1%
2021	Winter Peak	Port Washington – Saukville 138 kV	P7	111.8%
2026	Summer Peak	Port Washington – Saukville 138 kV	P2	124.1%
2026	Summer Peak	Port Washington – Saukville 138 kV	P7	133.2%

Table P9986-1: Project contingency drivers

Project Description

Rebuild Port Washington – Saukville 138 kV line 762 from a single circuit to a 138 kV double circuit.

The total estimated cost of this project is $15 million. The expected in-service date for this project is December 2021.

Alternatives Considered

Two alternatives were considered. Building a new 138 kV substation that loop in Port Washington Riverbend 138 kV line, Port Washington – Rangeline 138 kV line and tie in a new 138 kV line from Saukville. Rebuilding the existing Port Washington – Saukville 138 kV Line and reposition Port Washington – Saukville 138 kV lines at Saukville and the Saukville – Holland 138 kV line.

Other (Reliability) Projects

The following projects address local reliability needs.

Project ID	Project Name	Project Description	In-Service Date	Estimated Cost
3190	Rebuild Sunset Point - Winneconne 69 kV	Rebuild line Y-103 from Sunset Point to Winneconne to SN/SE = 200/300 deg. F.	May 2016	$3.8M
9934	Upgrade Oak Creek - Hayes 138-kV line	Oak Creek - Hayes 138-kV line 811 upgrade and reconfiguration.	Jun 2018	$21M
10403	Uprate Kegonsa - Sun Prairie 69 kV Line	Uprate Y-81 from Kegonsa to Sun Prairie.	Apr 2017	$5.0M
10404	Uprate 9 Mile - Detour 69kV Line	Uprate 6950 Line from 9 Mile to Detour.	Mar 2017	$7.0M
10589	Rerate Whitcomb – Tigerton Tap 69 kV	Rerate Whitcomb – Tigerton Tap 69 kV.	Jun 2017	$1.4M
10683	Uprate Lone Rock – Richland Center 69 kV line	Uprate Lone Rock – Richland Center to max operating temperature.	Jun 2017	$1.7M

Other (Condition) Projects

The following projects are needed due to the age and condition of the facilities. The majority of these projects are transformer replacements

Project ID	Project Name	Project Description	In-Service Date	Estimated Cost
7583	Rebuild Lone Rock - Boscobel 69 kV line	Rebuild Y-124 from Lone Rock to Boscobel.	Dec 2019	$31M
8442	Arnott Substation, Transformer Replacement	Replace existing Arnott 138/69 kV transformer.	Dec 2016	$4.5M
8841	Rebuild Finger Rd - Canal 69 kV line	Rebuild J-10 from Finger Road to Beardsley to Canal.	Jan 2021	$74M
9938	Sunset Point Substation, Transformer Replacement	Replace existing Sunset Point 138/69 kV transformer (T1).	Dec 2016	$6.0M
9944	Erdman Substation, Transformer Replacement	Replace existing Erdman 138/69 kV transformer (T31).	Dec 2017	$6.0M
9954	Lost Dauphin Substation, Transformer Replacement	Replace existing Lost Dauphin 138/69 kV transformer (T1).	Dec 2018	$6.7M
9958	East Krok Substation, Transformer Replacement	Replace existing East Krok 138/69 kV transformer (T1).	Dec 2017	$2.5M
9961	Nelson Dewey Substation, Transformer Replacement	Replace existing Nelson Dewey 138/69kV transformers with single transformer.	Dec 2018	$6.0M
9977	Rebuild Goodman - Caldron Falls 69 kV line	Rebuild J-88 from Goodman to Caldron Falls.	Jun 2020	$35.0M

Other (Distribution) Projects

The following projects are substation upgrades including breaker installations & replacements and bus upgrades.

Project ID	Project Name	Project Description	In-Service Date	Estimated Cost
7983	Canal Substation, Breaker Installation	Install high & low side breakers on Canal 138-69 kV transformer.	June 2017	$5.1M
7985	Canal Substation, Bus Protection Upgrades	Install redundant bus differential protection on the Canal 138-kV buses.	June 2017	$0.2M
8640	City Limits Substation, Bus Upgrades	Replace 138 kV bus at City Limits.	Dec 2017	$0.5M
9896	Lyndon Substation, Breaker Installation	Install 2 – 69 kV breakers to sectionalize existing line.	Dec 2015	$3.1M
9911	Maes Substation, Breaker Installation	Install 2 – 138 kV breakers to sectionalize existing line.	Apr 2016	$1.8M
9917	Bloomington Substation, Breaker Installation	Install 2 – 69 kV breakers to sectionalize existing line.	Dec 2016	$1.6M
9918	Red Maple Substation, Breaker Installation	Install 138 kV bus tie breaker.	June 2016	$1.2M
9921	Birchwood Substation, Breaker Installation	Install 138 kV bus tie breaker.	Dec 2017	$0.7M
9923	Mukwanago Substation, Breaker Installation	Install 138 kV line breaker.	Dec 2017	$0.6M
10703	Jefferson SS, Breaker Replacement	Replace Jefferson SS 138 kV Circuit Breakers and replace 138kV capacitor bank.	Nov 2016	$2.2M

The following projects are T-D projects including new substations and substation expansions.

Project ID	Project Name	Project Description	In-Service Date	Estimated Cost
10484	Eaton Substation, New T-D Interconnection	Construct a new ATC 138KV loop through at Eaton Substation.	Jun 2019	$2.5M
10485	Bay Ridge Substation, New T-D Interconnection	Construct a new ATC 138KV loop through at Bay Ridge Substation.	Jun 2022	$2.0M
10543	Escanaba North Substation, T-D Relocation	Construct T-D Escanaba North Substation (GOAB)	Jan 2017	$1.0M
10563	Oakview Substation, New T-D Interconnection	Construct T -D Oakview Substation	Jun 2018	$4.9M
10603	Springwater Substation, New T-D Interconnection	Construct T - D Springwater Substation.	Dec 2019	$7.1M
10643	St. Martins Substation, T-D Expansion Request	St Martins Bus Expansion, Bus-tie Breaker Addition, Line Relocation, and T-D Transformer Addition.	Jan 2017	$2.3M
10684	Ellinwood Substation, T-D Expansion Request	T-D distribution transformer addition at Ellinwood Substation.	Jun 2017	$0.1M
10685	Tomahawk Substation, T-D Expansion Request	Tomahawk Substation bus-tie breaker addition and T-D distribution transformer addition.	Jun 2017	$0.7M
10686	Roosevelt Road Substation, T-D Expansion Request	ATC bus expansion and T-D distribution transformer addition.	Jun 2018	$0.2M
11223	Townhall Substation, New T-D Interconnection	New T-D Townhall Substation - GOAB on Y-32 and approx. 2 miles of new 69 kV ROW.	Jun 2017	$3.0M
11224	White Lake Substation, T-D Expansion Request	White Lake Distribution Transformer Addition and ATC Line Breaker Addition.	Nov 2017	$0.9M

Transmission Owner: ITC Midwest (ITCM)

Baseline Reliability Projects

Project 9668: Cedar Rapids – North Liberty area – Hills Upgrades

Transmission Owners: ITC Midwest and CIPCO

Project Area Information

The North Liberty area lies between Iowa City to the South and Cedar Rapids to the North. Iowa City is primarily served off of a 161 kV loop owned by MidAmerican (MEC) and supplied from the South by MEC's Hills 345/161/69 kV substation. The Cedar Rapids metro area is served by ITCM and CIPCO transmission in overlapping 161 kV and 115 kV systems. Most of the industrial load is on the southern edge of the metro area, and is served off of the 161 kV system. Major sources in this area come from the Duane Arnold nuclear plant, and from the Hills – Tiffin – Morgan Valley – Arnold 345 kV line, which connects to MEC's Iowa City loop at Tiffin, and to ITCM's 161 kV system at Beverley and Arnold. Stretched between Tiffin and Fairfax at the south end of ITCM's Cedar Rapids system is a network of 69 kV transmission serving Alliant and CIPCO loads. The project area is shown in Figure P9668-1.

In Summer Peak cases, there are consistent strong power flows from the South to the North into Cedar Rapids. There are few transmission links between Iowa City and Cedar Rapids. The 161 kV loop through Iowa City and the 69 kV lines north of Tiffin are quite sensitive to outages of the Hills – Tiffin 345 kV and Tiffin – Morgan Valley 345 lines.

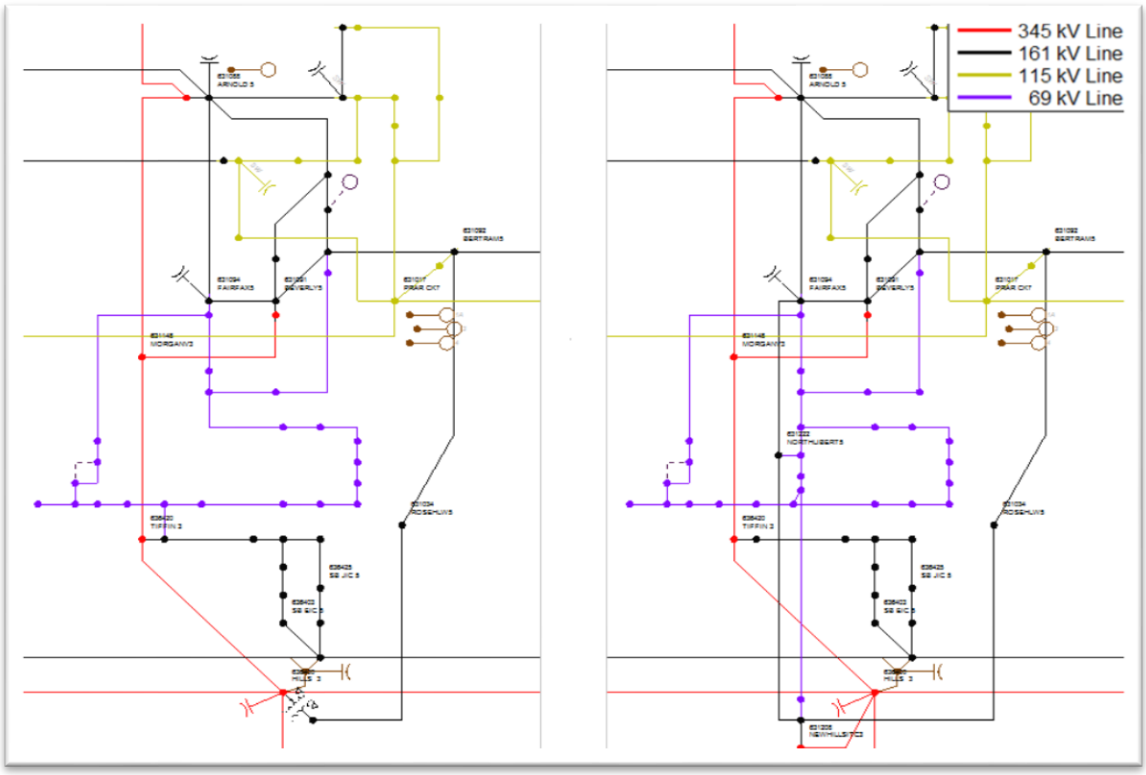

Figure P9668-1: Iowa City – Cedar Rapids area 345/161/69 kV system

Project Need

ITC Midwest identifies multiple drivers for this project, including not only BES reliability issues, but also reliability issues on the lower voltage system and localized load growth.

Summer peak load models consistently show high levels of power transfer from the Hills area south of Iowa City into the Cedar Rapids area. Hills-Tiffin-MorganValley 345 kV carries much of this power. Outages of this line shift the flow onto the Iowa City 161 kV system and up through Tiffin onto the 69 kV system, as well as onto Hills-RoseHollow-Bertram 161 kV. The outage of Duane Arnold can also significantly increase all these flows. The following BES violations are observed in the MTEP16 2026SUM model, where Project 9668 is not included (Table P9668-1). Similar violations can be seen in MTEP15 power flow models.

Model	Limiting Element	Event	Event Type	Rating MVA	Post-Contingent MVA	Percent Loading
MTEP16 2026SUM	PCI - Bertram 161 kV	[Arnold Gen] + [Morgan Valley - Tiffin 345 kV]	P3	240	254	106%
MTEP16 2026SUM	PCI - Bertram 161 kV	[Arnold Gen] + [Hills - Tiffin +TiffinSPS 345 kV]	P3	240	259	108%
MTEP16 2026SUM	Hills - Sub E 161 kV	[Tiffin - Morgan Valley] + [Hills - Sub J 161 kV]	P6	247	253	102%

Table P9668-1: Project BES contingency drivers

The 69 kV network between Tiffin and Fairfax is often heavily loaded, because of its near proximity to the strong 345 kV source at Tiffin, and its parallel path with Tiffin-MorganValley 345 kV between the two metro areas. A wide variety of multiple outage events will cause thermal violations on the Tiffin 161/69 kV transformer and on downstream 69 kV lines.

The following Non-BES violations are observed in the MTEP16 2026SUM model, where Project 9668 is not included (Table P9668-2).

Model	Limiting Element	Event	Event Type	Rating MVA	Post-Contingent MVA	Percent Loading
MTEP16 2026SUM	Tiffin 161/69 kV	Morgan Valley - Tiffin 345 kV	P1.2	90	92	102%
MTEP16 2026SUM	Tiffin 161/69 kV	[Arnold Gen] + [Morgan Valley - Tiffin 345 kV]	P6.1	90	96	107%
MTEP16 2026SUM	Tiffin 161/69 kV	[Arnold Gen] + [Hills - Tiffin + TiffinSPS 345 kV]	P6.1	90	98	108%
MTEP16 2026SUM	Tiffin 161/69 kV	[Morgan Valley - Tiffin 345 kV] + [PCI - Bertram 161 kV]	P6.1	90	98	108%
MTEP16 2026SUM	Tiffin 161/69 kV	[Morgan Valley - Tiffin 345 kV] + [Rose Hollow - Bertram 161 kV]	P6.1	90	99	110%
MTEP16 2026SUM	Tiffin 161/69 kV	[Morgan Valley - Tiffin 345 kV] + [Hills - Rose Hollow 161 kV]	P6.1	90	100	111%
MTEP16 2026SUM	Tiffin 161/69 kV	[Morgan Valley - Tiffin 345 kV] + [Rock Creek - Salem 345 kV]	P6.1	90	107	119%
MTEP16 2026SUM	Tiffin 161/69 kV	[Morgan Valley - Tiffin 345 kV] + [Quad Cities - Rock Creek 345 kV]	P6.1	90	107	119%
MTEP16 2026SUM	Tiffin 161/69 kV	[Morgan Valley - Tiffin 345 kV] + [Tiffin - Coral Ridge 161 kV]	P6.1	90	95	106%
MTEP16 2026SUM	CIPC Tiffin - ALTW Tiffin 69 kV	[Arnold Gen] + [Morgan Valley - Tiffin 345 kV]	P6.1	76	80	105%
MTEP16 2026SUM	CIPC Tiffin - ALTW Tiffin 69 kV	[Arnold Gen] + [Hills - Tiffin + TiffinSPS 345 kV]	P6.1	76	81	107%
MTEP16 2026SUM	CIPC Tiffin - ALTW Tiffin 69 kV	[Morgan Valley - Tiffin 345 kV] + [PCI - Bertram 161 kV]	P6.1	76	81	107%
MTEP16 2026SUM	CIPC Tiffin - ALTW Tiffin 69 kV	[Morgan Valley - Tiffin 345 kV] + [Rose Hollow - Bertram 161 kV]	P6.1	76	82	108%
MTEP16 2026SUM	CIPC Tiffin - ALTW Tiffin 69 kV	[Morgan Valley - Tiffin 345 kV] + [Hills - Rose Hollow 161 kV]	P6.1	76	83	109%
MTEP16 2026SUM	CIPC Tiffin - ALTW Tiffin 69 kV	[Morgan Valley - Tiffin 345 kV] + [Rock Creek - Salem 345 kV]	P6.1	76	87	115%
MTEP16 2026SUM	CIPC Tiffin - ALTW Tiffin 69 kV	[Morgan Valley - Tiffin 345 kV] + [Quad Cities - Rock Creek 345 kV]	P6.1	76	87	115%
MTEP16 2026SUM	CIPC Tiffin - ALTW Tiffin 69 kV	[Morgan Valley - Tiffin 345 kV] + [Tiffin - Coral Ridge 161 kV]	P6.1	76	80	105%
MTEP16 2026SUM	CIPC Tiffin - KansasREC 69 kV	[Morgan Valley - Tiffin 345 kV] + [Rock Creek - Salem 345 kV]	P6.1	77	83	108%
MTEP16 2026SUM	CIPC Tiffin - KansasREC 69 kV	[Morgan Valley - Tiffin 345 kV] + [Quad Cities - Rock Creek 345 kV]	P6.1	77	83	108%

Table P9668-2: Project Non-BES contingency drivers

In addition to reliability concerns, both Alliant and CIPCO see a high rate of load growth in the North Liberty area, and CIPCO is working to add lines to enable load interconnection. For this reason, CIPCO is looking to build a new 161/69 kV substation in North Liberty. ITC Midwest worked with both CIPCO and Alliant to develop this project together, and several of the lines in this project would be built by CIPCO.

Project Description

Project 9668 prescribes building a new 345/161/69 kV substation near the existing Hills substation, in order to obtain enough room to have enough space to build the rest of this project. The New Hills substation will connect to Hills at the same terminal that now houses the ITCM Hills 345/161 kV transformer. The ITCM Hills 345/161 kV transformer will be moved to New Hills, and Hills – Rose Hollow 161 kV will be re-terminated at New Hills. The following facilities are included in this project.

- New Hills area 345/161 kV substation (ITC)
- New Hills area 161/69 kV substation (CIPCO)
- New North Liberty – Hills 161 kV and Hills – Clear Creek 69 kV double circuit line (CIPCO – 161 kV line, ITC – 69 kV line)
- New North Liberty 161/69 kV substation (CIPCO)
- New Fairfax – North Liberty 161 kV line with a 69 kV double circuit from Tharp - Fairfax (ITC)
- Upgrades at Fairfax substation (ITC)
- New Clear Creek – North Liberty 69 kV line (CIPCO)
- New Conroy – Homestead 69 kV line (CIPCO)
- New Heartland 69 kV switching station (CIPCO)
- New Homestead 69 kV switching station (ITC)
- New Conroy 69 kV switching station (ITC)
- Retirement of the Tiffin 161/69 kV transformer

The total estimated cost for the parts of this project to be built by ITC Midwest is $74M. The New Hills – North Liberty portion of this project is due in service by December 2019, the circuit up to Fairfax is due in service by December 2022, and the 69 kV Conroy-Heartland tie is due in service December 2025.

With all these facilities in service, all of the observed BES and Non-BES thermal overloads are mitigated.

Project 10269: Lore – Hickory Creek 161 kV

Transmission Owner: ITC Midwest

Project Area Information

Lore 161 kV is located Northwest of Dubuque near the Eastern edge of Iowa. To the West, it connects to Hickory Creek, Liberty, Dundee, and Hazleton. To the Northwest, it connects to Turkey River and feeds into Wisconsin. Hickory Creek is a 345/161 kV substation just west of Lore, and serves as one of two 345 kV ties into Dubuque. It will also be the point of interconnection for the lower segment of MVP#5 Hickory Creek – Eden – N. Cardinal 345 kV, when that line goes into service. Figure P10269-1 shows this region.

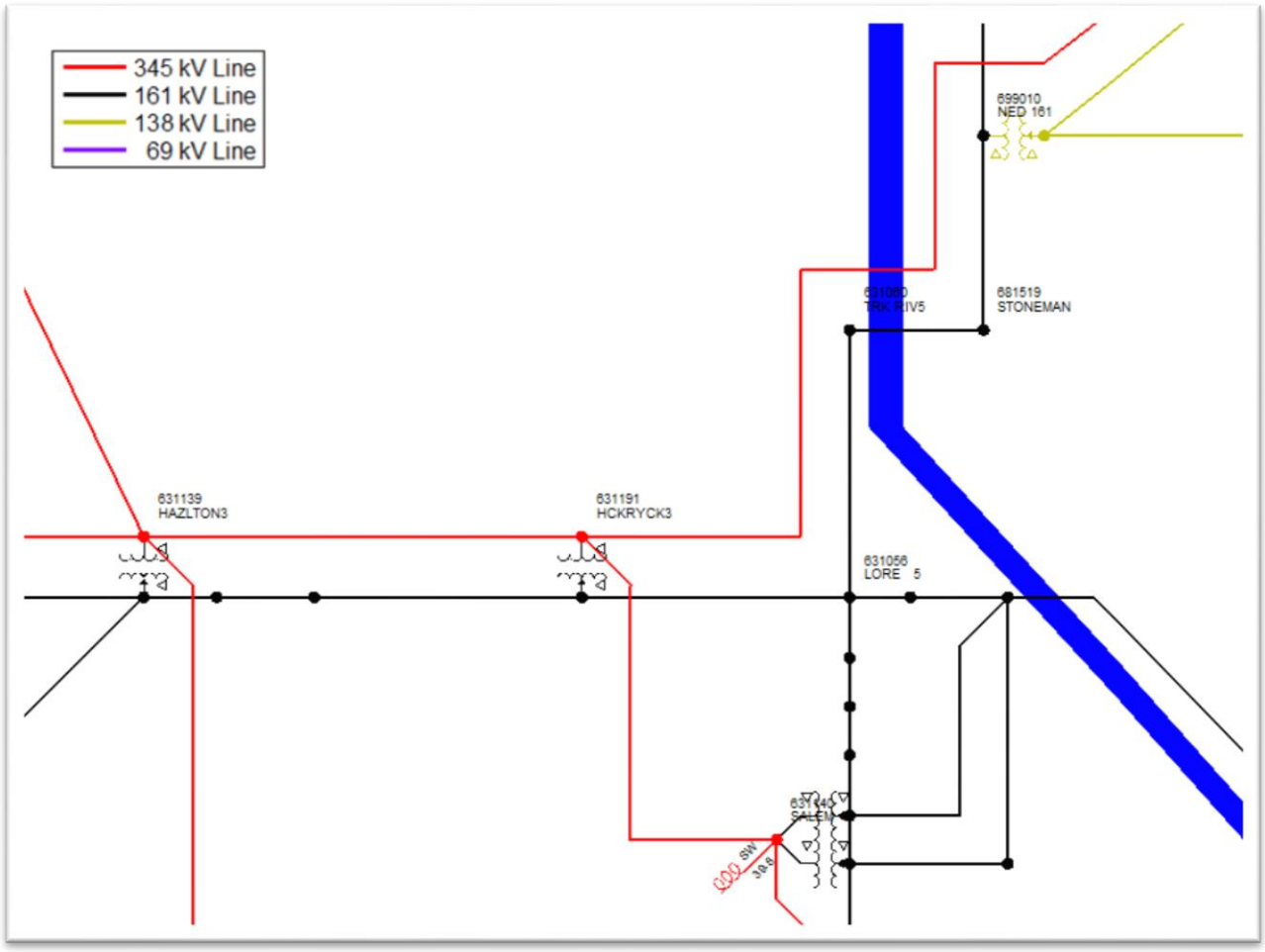

Figure P10269-1: Lore – Hickory Creek 161 kV Rebuild Project Area

Project Need

The Dubuque area has little generation, so most of its load is served from external sources. The two major sources are the Hazleton – Hickory 345 and 161 kV corridor and the 161 kV and 345 kV lines coming into Salem from the South. A bus 161 kV tie fault at Salem has the effect of opening both 345/161 kV transformers at Salem and disconnecting the 161 kV line to the South, leaving most of the load to be served from Hickory Creek. As well, in summer peak cases, power tends to flow from South to North through this area, into SW Wisconsin. Prior to the completion of the MVP#5 Hickory Creek – Eden

345 kV segment, Lore – Turkey River 161 kV is the only route out of this region into Wisconsin. The in-service date of MVP#5 was recently pushed out to 2023 due to regulatory hurdles. Thus, this issue would be expected to be seen in the 2021 cases as well. This issue can be seen not just in summer peak but also shoulder cases, where Hickory Creek – Eden 345 kV is not yet in service.

In addition to this peak case issue, a similar issue is seen in the high wind shoulder sensitivity case, while Hickory Creek – Eden 345 kV is not in service. Several contingencies that outage Hickory Creek – Salem 345 kV without opening Salem – Rock Creek 345 kV result in power being forced through the Dubuque 161 kV system while also relying on Lore – TurkeyRiver 161 kV, as an outlet. Together, these drivers heavily load the 161 kV line. All of these issues are shown in Table P10269-1.

Model	Event	Event Type	Rating MVA	Post-Contingent MVA	Percent Loading
MTEP16 2018SUM	Salem 161 kV Bus Tie Breaker Fault	P2.4	265	223	119%
MTEP16 2021SUM w/o HckCk-Eden	Salem 161 kV Bus Tie Breaker Fault	P2.4	234	223	105%
MTEP16 2021SH90 w/o HckCk-Eden	Hickory Creek - Salem 345 kV Fault	P1.2	242	223	109%
MTEP16 2021SH90 w/o HckCk-Eden	Salem 161 kV Bus Tie Breaker Fault	P2.4	253	223	114%
MTEP16 2021SH90 w/o HckCk-Eden	Salem 345 kV Line Breaker 2735 Fault	P2.3	247	223	111%
MTEP16 2021SH40 w/o HckCk-Eden	Salem 161 kV Bus Tie Breaker Fault	P2.4	225	223	101%

Table P10269-1: Project contingency drivers

Project Description

For project 10269, 6.8 miles of the existing Lore – Hickory Creek 161 kV line will be rebuilt, at a cost of $12.5M, and terminal equipment at Lore and Hickory Creek will be replaced at a cost of about $230k. Combined, these steps will increase the summer emergency rating of the line to 325 MVA, significantly above what is needed to relieve these overloads. All of these upgrades will be in service by December 2017.

Other Projects

Local Reliability Projects

These are ITC Midwest projects that address reliability needs that are either not related to NERC TPL criteria or not a part of the Bulk Electric System.

Project ID	Project Name	Project Description and Need	Estimated Cost	In-Service Date
9667	Wapello County Substation Reliability Rebuild	Rebuild the Wapello County 161kV to breaker and 1/2 design and upgrade the 69 kV ring bus. Limits impact of certain faults, and replaces control enclosures and circuit breakers that are in poor physical condition. With upgrades, allows proper testing without taking extensive outages.	$10.1 M	Dec 2017
9711	Traer 161 kV Ring Bus	Convert to a ring bus design. Prevents customer outages if local 69 kV and 34.5 kV system operating radially during faults	$5.1 M	Dec 2017
9712	BGS Substation Upgrades	Modify 161 kV configuration, replace circuit switcher with breaker. Present substation topology is outdated, does not adequately limit contingency impact, and can't accommodate PRC-005 maintenance testing.	$3.1 M	Jun 2017
9904	Appanoose 161 kV Rebuild	Rebuild the substation to a ring bus. Replace the 161/69 transformer with a LTC transformer of higher rating. LTC improves 69 kV voltage support, and rebuild improves reliability.	$4.9 M	Dec 2019
9670	Columbus Junction 69 kV Breaker Addition	Add a 69 kV breaker at Columbus Junction substation	$930 k	Dec 2020
9671	Amber Creamery Capacitor	Add a 69 kV Cap bank at the Amber Creamery substation	$515 k	Dec 2016
10268	Dubuque 8th Street Distribution Transformer	Rearrange terminal positions of substation equipment to allow the replacement of two 69 kV distribution transformers	$1.6 M	Apr 2017

Local Distribution Projects

These are ITC Midwest driven by individual customer loads or new load interconnections.

Project ID	Project Name	Project Description	Estimated Cost	In-Service Date
9669	St Ansgar Industrial	New 69 kV distribution substation. Tap 69kV line and install new 69kV breakers for new substation.	$2.5 M	Nov 2017
11163	Devils Creek	New 69 kV distribution substation near Ft Madison, tapped in and out with line breakers. Facilitates a new load interconnection, and allows consolidation of Alliant load in the area (Approved at June PAC under expedited review)	$2.0 M	Dec 2017
11164	Oelwein Hub Distribution Sub	New 69 kV distribution substation, tapped in and out with line breakers, to serve a new Alliant customer. (Approved at June PAC under expedited review)	$6.3 M	Apr 2017

Generator Interconnection Projects

These are projects that are required by generator interconnection agreements.

Project ID	Project Name	Project Description	Estimated Cost	In-Service Date
9937	J233 Network Upgrades	Replace 161/69 transformers at Jasper, Newton, and Fernald Uprate Marshalltown-Blairstown Junction115 kV to 90 MVA Uprate Jasper-Laurel 161 kV to 361 MVA Remove sag limit from Jasper-Newton 161 kV , new rating 276 MVA Rebuild ITCM portion of Newton-Prairie City 69 kV to T2-4/0 ACSR	$17.7 M	Mar 2017
9939	H009 Jasper-Aurora 69 kV	Rebuild Jasper – Aurora Heights 69 kV with T2-477 ACSR	$3.7 M	Dec 2016
9941	H021 Traer-Traer Tap 69 KV	Upgrade Traer terminal to increase Traer – Traer Tap 69 kV rating to 61 MVA	$293 k	June 2016

Age and Condition Projects

ITC Midwest is engaged in a long-term effort to convert the existing 34.5 kV equipment in their system to 69 kV or higher. The 34.5 kV system is aged and in poor condition, and it is unable to serve new loads in many areas. The plan, established between ITC Midwest and their stakeholders, maximizes the number of 34.5 kV line miles that can be retired, while maximizing the number of stations that can receive two-way service. The upgraded system will increase available capacity and decrease system losses. The projects that follow are all related to this long-term project. This cycle, a larger set of 161 kV projects was submitted in order to support this effort.

Williamsburg Area Rebuild

Project 9985: Newhall – Williamsburg 161 kV Rebuild

Project 9988: Newhall 161 kV Breaker Station

Project 10303: Williamsburg Temp Conversion

Project Area Information

The Williamsburg area 34.5 kV system is served from a radial 115 kV line tapped at Blairstown off of the Marshalltown – Prairie Creek 115 kV line. As part of the 34.5 kV conversion project, a stronger and more reliable source is needed at Williamsburg.

Project Description

In order to facilitate the rebuilding of the existing Blairstown – Williamsburg 115 kV line, the Williamsburg substation will need a new source. For Project 10303, the high side of the Williamsburg substation will be converted to 161 kV operation, a 161/36 kV transformer will be installed to serve the existing 34.5 kV system, and a new 8 mile 161 kV line will be built from the Parnell substation north to Williamsburg.

The Marshalltown – Stoney Point 161 kV line runs parallel to Marshalltown – Blairstown – Prairie Creek 115 kV. A new 161 kV breaker station will be built on this line, just north of the Blairstown switch. The existing Blairstown – Williamsburg line will be rebuilt to 161 kV standard, with T2-795 conductor, and will be extended north from Blairstown to the new Newhall substation.

Together, this series of projects increases the strength of the source at Williamsburg, and provides the area with two-way service. A diagram of the project is shown in Figure P9985/P9988/P10303-1.

The Parnell-Williamsburg 161 kV line and Williamsburg substation rebuild will be complete by December 2017, and the Newhall-Williamsburg rebuild should be complete by December 2018, at a combined cost of $49.6M.

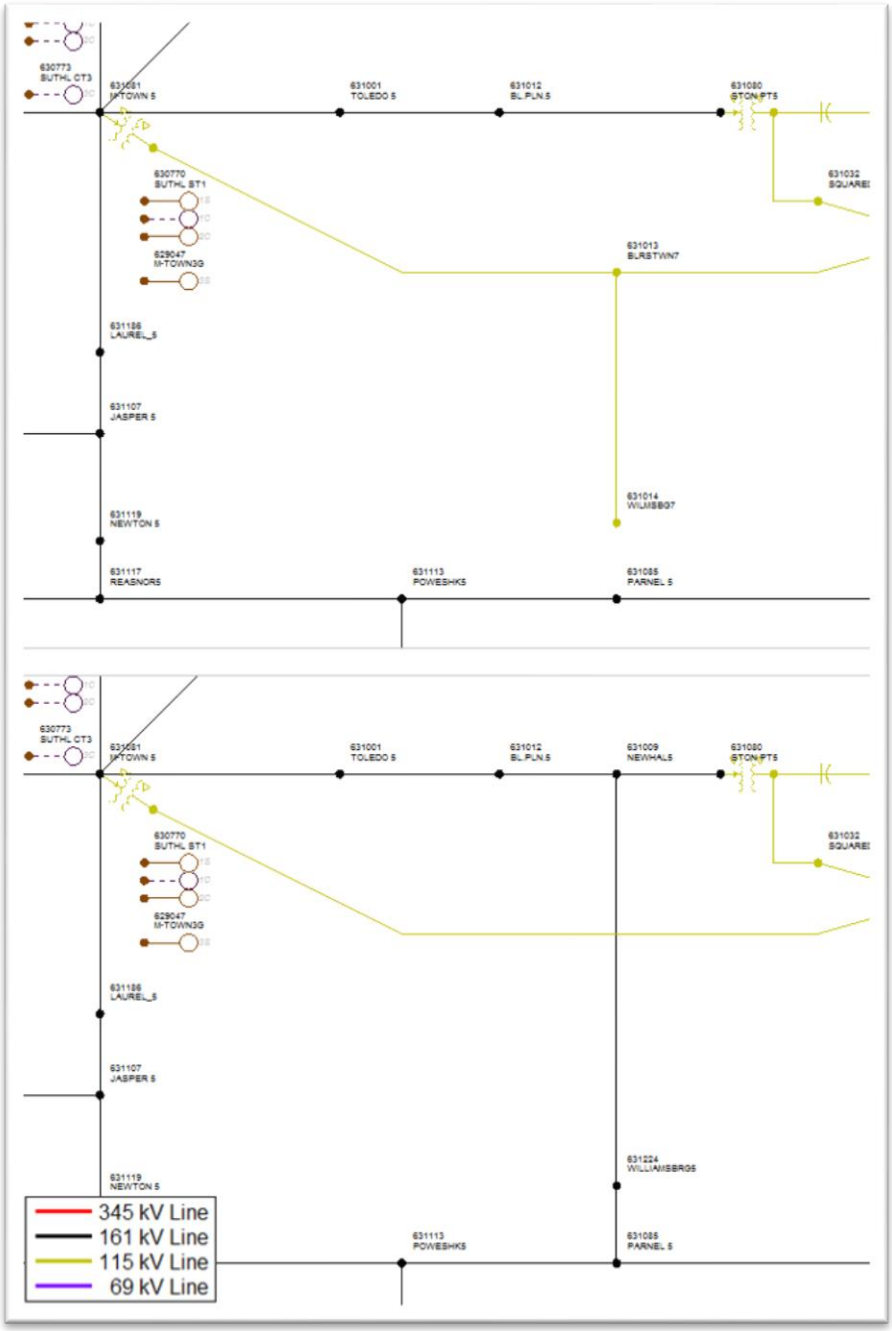

Table P10269-1: Project contingency drivers

Other Age and Condition Projects

The descriptions of ITC Midwest's 34.5 kV uprate and Age and Condition projects are listed in below, and their locations are shown in Figure AgeAndCondition-1.

Project ID	Project Name	Project Description	Estimated Cost	In-Service Date
9664	Guthrie-White Pole Rd-Panora 34 to 69 kV Conversion	Convert 34.5 kV system between Guthrie - White Pole Rd (new breaker station) - Menlo - Redfield - Panora - Guthrie to 69 kV operation	$3.4 M	Dec 2017
9665	PCI-Oak Hill 34 to 69 kV Conv	Convert 34.5 kV system between PCI and Oak Hill to 69 kV operation	$34 k	Dec 2017
9666	Emerald Isle-Beverly 34 to 69 kV Conv	Convert 34.5 kV system between Beverly and Emeral Isle to 69 kV operation.	$5.1 M	Dec 2018
9672	76th AVE SW Substation	New 4 terminal, 4 breaker 69 kV substation southeast of Cedar Rapids, Iowa in order to eliminate the coordination and system protection issues. The existing PCI – Tharp 69 kV transmission line will be tapped and re-routed into the new substation. The existing Prairie Creek Ckt. 0210 will be re-routed and terminated into the new substation when the area is converted as well. A 13.2 MVAR capacity bank will be installed at the new substation to provide voltage support for the area.	$4.1 M	Dec 2019
9714	Doud-Lyon 34 to 69 kV Conv	Construct a new 69 kV breaker station near Lyon with 3 line terminals. The station should be laid out to accommodate a future additional breaker position for an Alliant Energy distribution transformer. Re-connect or extend 69 kV taps to the connected distribution substations and convert to 69 kV operation from the new station near Lyon to Doud.	$4.6M	Dec 2019
10022	PCI-Mt.Vernon-Lisbon-76th AVE Conv	ITC will be converting the PCI to Mt. Vernon to Lisbon North to 76th Ave. substation from 34.5 kV operation to 69 kV operation. To accommodate the conversion, a 69 kV breaker and associated equipment will be installed at the PCI substation, two (2) 69 kV breakers and associated equipment will be installed at the Lisbon North substation, approximately 0.6 mile of new 69 kV transmission line will be constructed to complete the PCI to 76th Ave circuit and OPGW will need to be installed.	$5.8M	Dec 2019
9706	Huntley 69 kV Maintenance	Relocate the 161/69 kV T1 transformer and replace the 161/69 kV T2 transformer with the Adams 161/69 kV 75 MVA transformer and the 69 kV breakers at the new proposed Huntley substation.	$9.1 M	Dec 2016

9901	Mount Ayr 69 kV Substation Rebuild	Complete rebuild of the substation with all new equipment was proposed. Due to space limitations at the existing site, a new Kneedler (Mt. Ayr) 69kV breaker station will be constructed just north of the Mt. Ayr site. The existing 8.1MVAr cap will be replaced with a 3-stage 8.4MVAr (25.2MVAr total) capacitor bank at the Kneedler sub site.	$4.3 M	Dec 2018
9907	Summit to Dovray 69 kV Rebuild	Phase 1: Rebuild ~12.9 miles of old line to new T2-4/0 ACSR	$9.2 M	Dec 2022
9908*	Dovray to Fulda 69 kV Rebuild	Rebuild ~14.5 miles of old line to new T2-4/0 ACSR. *GRE has expressed desire to work with ITCM to find an alternative project that would benefit multiple parties.	$9.4 M	Dec 2023
9910*	Fulda to Heron Lake 69 kV Rebuild	Rebuild ~20.14 miles of old line to new T2-4/0 ACSR *GRE has expressed desire to work with ITCM to find an alternative project that would benefit multiple parties.	$15.0 M	Dec 2024

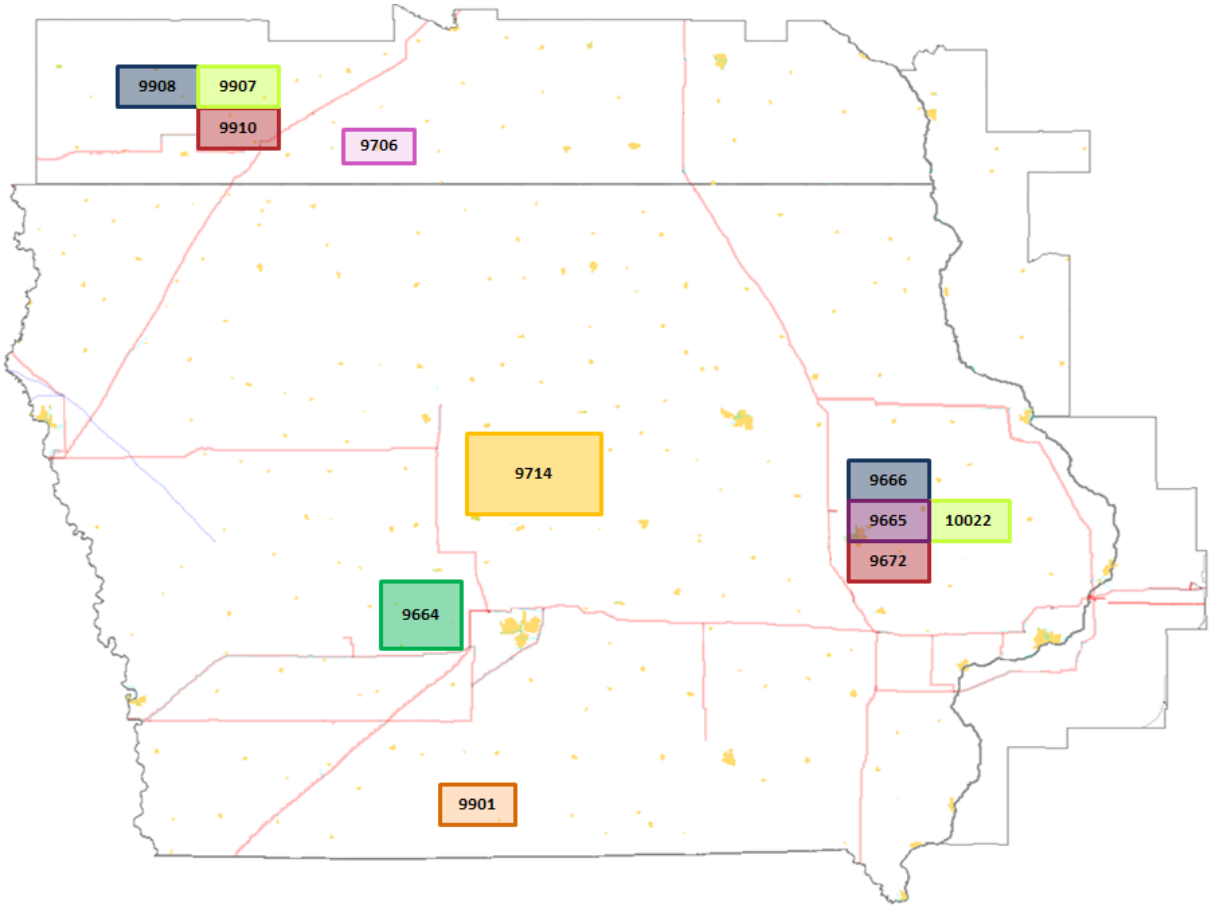

Figure AgeAndCondition-1: ITC Midwest 34.5 kV conversion and Age and Condition project locations

System-Wide Projects

The following projects describe annual costs for various maintenance and upkeep efforts in ITC Midwest's system. Costs listed are totals for all the years listed.

Project ID	Project Name	Project Description	Estimated Cost	Year
10023	ITC Midwest Asset Replacement Program	Equipment that is past its expected design life, utilizes outdated functionality or whose failure rates and maintenance have increased potential for miss-operations and higher maintenance costs associated with their ongoing use.	$37.2 M $37.2 M $37.2 M	2017 2018 2019
10024	ITCM Customer Interconnects with short lead time	These projects are being done at the request of an interconnection customer in order to facilitate new load, re-distribute existing load, improve the performance of the sub-transmission and distribution systems, or to accommodate a new Transmission-to-Transmission connection request.	$2M	2019

Transmission Owner: MidAmerican Energy (MEC)

Baseline Reliability Projects

Project 10005: Plymouth 161 kV Circuit Breaker

Project 10006: Sycamore Substation: Replace 3 161 kV breakers

Project 10009: Bondurant: Replace 161 kV breaker

Transmission Owner: MidAmerican Energy

Project Area Information

These three projects all describe circuit breaker replacements at 161 kV substations. The Plymouth substation is located at the North end of the Sioux City system. Sycamore and Bondurant are both located on the North side of the Des Moines metro area, with Bondurant located further to the East. The locations of these projects are circled in Figure P10005/P10006/P10009-1

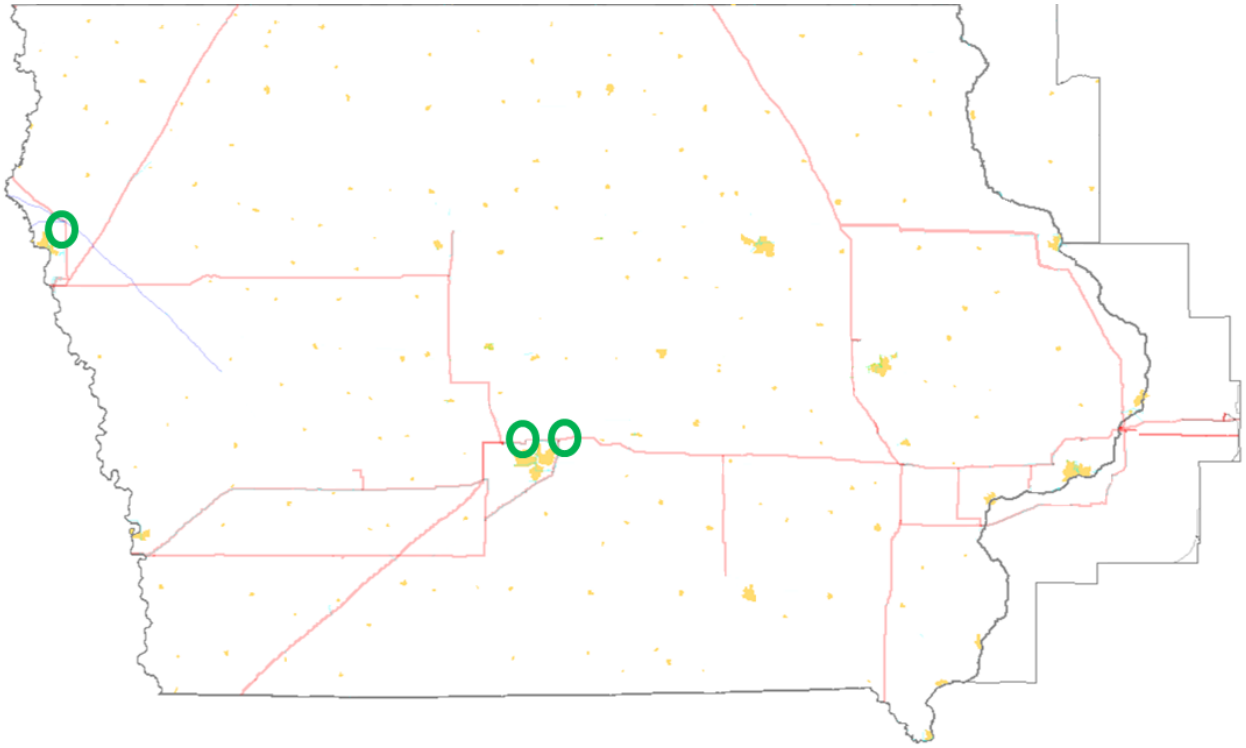

Figure P10005/P10006/P10009-1: Circuit Breaker Replacement Project Locations

Project Need

These three projects are needed in order to achieve adequate short circuit interrupting capability at the substations in which they are located.

Project Description

At Plymouth, 161 kV breaker 9160 (Plymouth-Morningside 161 kV) was replaced at a cost of $264k, in December of 2015. At Sycamore, 161 kV breakers AG805 (between Sycamore-Ankeny 161 kV and one of the 345/161 kV transformers), AG812 and AG816 (each of the 161/69 kV transformers) will be replaced by December of 2016, at a cost of $685k. At Bondurant, breaker AH810 (on the high side of the distribution transformer) was replaced in October of 2016, at a cost of $325k.

Other Projects

Local Reliability Projects

These are MEC projects that address reliability needs that are either not related to NERC TPL criteria or not a part of the Bulk Electric System.

Project ID	Project Name	Project Description	Project Need	Estimated Cost	In-Service Date
8108	Sub 73 - Dupont 69 kV Line Upgrade	Replace structures to allow a higher operating temperature for the line.	N-1-1 thermal overloads in MTEP14 models	$40 k	6/1/2017
8110	Sub 73 - Elvira Tap 69 kV line upgrade	Replace structures on the Sub 73-Elvira 69 kV line to allow a higher operating temperature.	N-1-1 thermal overloads in MTEP14 models	$50 k	6/1/2017
8112	Buffalo Bill Tap - Elvira Tap 69 kV line upgrade	Replace structures to allow a higher conductor operating temperature.	N-1-1 thermal overloads in MTEP14 models.	$25 k	6/1/2017
10002	Sub 39 second 161-69 kV transformer	Install a second 125 MVA 161-69 kV transformer at Sub 39.	Driven by N-1-1 contingencies.	$960 k	6/1/2019
10004	Sub 18 replace transformer 8T3	Replace 161-69 kV transformer 8T3 at Sub 18 with a 167 MVA unit.	Driven by N-1-1 contingencies.	$1.08 M	6/1/2018
10803	Sub J 161 kV Reduce Cap Bank	Reduce the size of existing 50.4 Mvar capacitor bank to 37.8 Mvar	Increased operational flexibility during local N-1-1 operating conditions	$300k	12/1/2016
9976	Avoca transformer 69 kV circuit breaker	Add a 69 kV circuit breaker on the low side of Avoca 161-69 kV transformer 8T1.	Eliminates additional 69 kV equipment from tripping for faults on 161-69 kV transformer 8T1 and mitigate post-contingent low voltage levels.	$415 k	10/1/2016
9980	Teakwood 34.5 kV Reactors	Add two 10 MVAr 34.5 kV reactors at Teakwood Substation.	Mitigates post contingent high voltage at Teakwood Substation.	$850 k	12/1/2016
9981 9982	Sub 701-Honey Creek-Missouri Valley 69 kV Line	Rebuild the Sub 701-Honey Creek and Honey Creek – Missouri Valley 69 kV lines	Mitigates single & N-1-1 contingency line overloads by rebuilding the line & replacing limiting terminal equipment.	$3.25 M $6.0M	6/1/2017 12/1/2018
9992	Lake Cornelia-Coulter 69 kV Upgrade	Replace limiting structures on the Lake Cornelia-Coulter 69 kV line to increase line rating.	Mitigates overloads for N-1-1 sub-BES contingencies.	$59 k	7/1/2016
9993	Humboldt East-Thor 69 kV Upgrade	Upgrade the Humboldt East-Thor 69 kV line by replacing limiting structures.	Mitigates overloads for N-1-1 sub-BES contingencies	$61 k	4/13/2016
10503	Tate&Lyle 161 kV Bus Tie Breaker	Add a bus tie breaker	Limit impact of bus fault contingency on local load	$443k	7/21/2016

Local Distribution Projects

These are MidAmerican projects driven by individual customer loads or new load interconnections.

Project ID	Project Name	Project Description	Estimated Cost	In-Service Date
9947	Polk City Substation and Lines	Build a new 33 MVA 161-13 kV distribution substation near Polk City, Iowa with 161 kV line taps connecting to the Bittersweet-NE Ankeny 161 kV line.	$7.0 M	Jun 2020
9987	Johnston 161-13 kV Substation	Construct a new Johnston 33 MVA 161-13 kV distribution substation.	$2.13 M	Nov 2016
10663	Willow Creek Substation Expansion	Expand substation to accommodate a new 50 MVA 161-13 kV transformer. Add three new 161 kV circuit breakers and convert substation to breaker and one half configuration	$120k	Dec 2016
10664	34th Avenue 3rd Transformer	Install a third 161-13 kV 62 MVA transformer and associated equipment at the 34th Avenue Substation	$90k	Dec 2016
9973	Manawa Second Transformer	Add a second 33 MVA 161-13 kV transformer at the Manawa Substation.	$1.1 M	Oct 2017
9996	Eagle Grove Second 69-13 kV transformer	Install a second 69-13 kV Transformer & 69 kV bus tie breaker at the Eagle Grove Substation	$2.44 M	Dec 2017

Generator Interconnection Projects

These are projects that are required by Generator Interconnection Agreements.

Project ID	Project Name	Project Description	Estimated Cost	In-Service Date
11143	Creston – Macksburg 161 kV Uprate	Replace structures to increase rating, for J274 Macksburg.	$175 k	12/1/2016
11146	Clarinda-Brooks 161 kV Uprate	Replace structures to increase emergency rating to 167 MVA	$200 k	6/1/2017
11283	Clarinda-Maryville 161 kV Uprate	Replace three structures to increase emergency rating to 199 MVA, for J343 Adams County	$100 k	6/1/2017
11284	Clarinda Substation: Replace 161 kV Switch 803L	On the line terminal to Maryville, install a new 161 kV line disconnect switch, replace line drops and jumpers, and remove existing switch, for J343 Adams County	$81 k	6/1/2017
11103	Black Hawk: Install 2-69 kV Cap Banks	Add two 69 kV 15 Mvar capacitor banks at Black Hawk substation. Upgrade costs shared by multiple projects.	$1.18 M	11/15/2016
11285	Beacon 161 kV Line Drops, Poweshiek	Replace line drops at Beacon Substation on the Beacon–Poweshiek 161 kV line terminal to increase the line to at least 325 MVA, for J344 wind project in Mahaska County	$25 k	9/1/2017

Transmission Owner: Rochester Public Utilities (RPU)

Local Distribution Project

Project 10443: Douglas Trail Substation

Project Need

A customer of RPU is interconnecting to the Northern Hills – Zumbro 161 kV line.

Project Description

A new substation named Douglas Trail will be built, with taps and breakers in and out of the substation. This project went into service in April of 2016, at a cost of $7.0M. The location of this project is shown in Figure P10443-1.

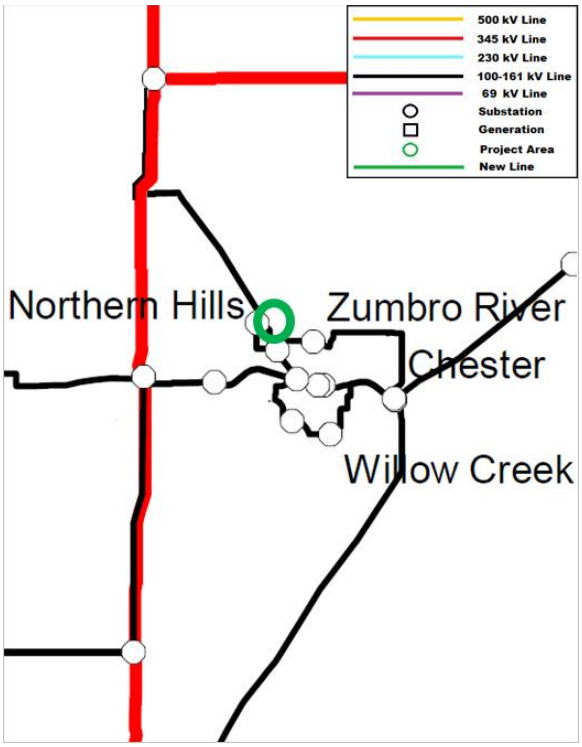

Figure P10443-1: Douglas Trail Substation Location

Transmission Owner: Cedar Falls Utilities (CFU)

Generation Interconnection Project

Project 11383: J329 Network Upgrades

Project Need

Project J329 will interconnect at the Pella West 69 kV substation. Pella West is owned by Pella Municipal Utilities, and is planned under an agency agreement with Cedar Falls Utilities.

Project Description

Relays and terminal equipment, as well as a capacitor bank will be installed at this substation. These upgrades will go into service in August 2017, at a total cost of $1.05M. The location of this project is shown in Figure P10443-1.

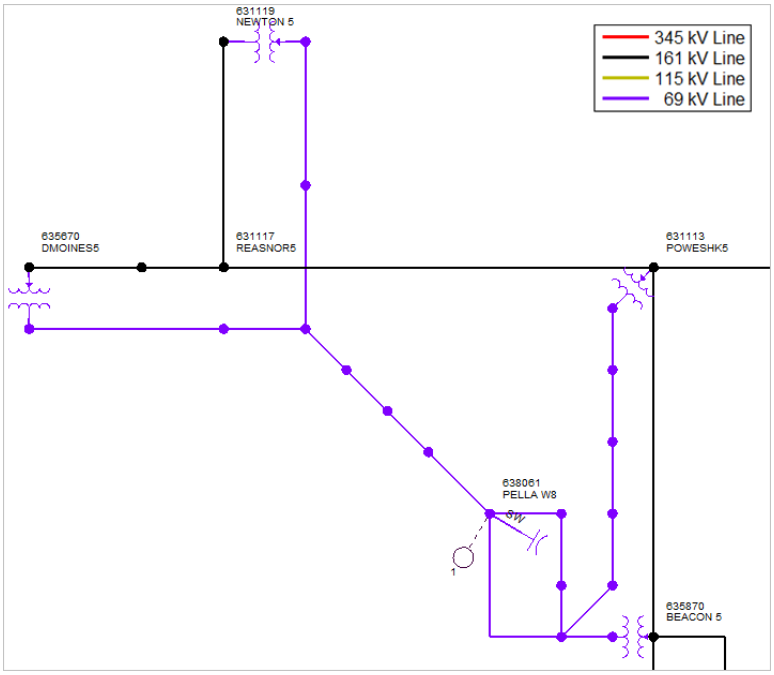

Figure P11383-1: Pella West Substation Location

Appendix D1: West Planning Region

Transmission Owner: Great River Energy (GRE)

Other (Reliability) Projects

Project 7884: Riverview 345/115/69 kV Substation

Project Area Information

This project is located in Minnesota, in the area bounded by Douglas County, Paynesville, Wakefield and West St. Cloud.

Project Need

The extensive 69 kV transmission system bounded by Douglas County, Paynesville, Wakefield and West St. Cloud 115/69 kV sources requires additional capacity to serve existing load as well as new loads that may come to the area. Load serving can become problematic due to voltage concerns and equipment and line overloads during contingency plus maintenance outage scenarios.

Project Description

This project involves the construction of a new 345/115/69 kV substation directly off the CapX 345 kV line between the Melrose East and Millwood 69 kV substation. This substation will initially have two 345 kV line terminating breakers, a single 345 kV breaker on the high side of the transformer, two 69 kV line termination breakers in addition to a low side 69 kV breaker. The substation should be designed for future development and be laid out for nine 345 breaker (3 rows of 345 kV breakers in a breaker and half scheme), six 115 kV (2 rows of 115 kV breakers in a breaker and half scheme), and four 69 kV breakers in a straight bus configuration.

The total estimated cost of this project is $20.1 million with an expected in-service date of December 2018.

Project 4378: Menahga Area Project

Project Area Information

This project is located in Central Minnesota.

Project Need

Growing load is exceeding the capability of the 34.5 kV system in the area new 115 kV sources need to be established at multiple load points.

Project Description

Construct a new 115 kV circuit from Hubbard to Blueberry to Red Eye substations.

The total estimated cost of this project is $29.4 million with an expected in-service date of April 2017.

Other (Distribution) Projects

Local Load-Serving and Distribution Projects

The following GRE projects are being built to accommodate new load and distribution level interconnections.

Project ID	Project Name	Project Description	In-Service Date	State	Estimated Cost ($million)
10423	Randolph Distribution Substation	Construct approximately 0.25 mile in and out 115 kV line from the NSP 0822 line (Empire to Colville) for a DEA distribution substation.	March 2017	MN	$0.5
10424	Savage Distribution Substation	Construct approximately 0.5 mile in and out 115 kV line from the NSP 5539 line (Black Dog to Blue Lake) for an MVEC distribution substation.	July 2017	MN	$1.0
7896	Fish Trap Pumping Station	Construct a new 115 kV transmission line from the Dog Lake to Scearcyville (#24 Line) 115 kV transmission line to Koch Pipeline's new Fish Trap pumping substation (approximately 20 miles)	August 2017	MN	$10.9

Generator Interconnection Projects

Project 11463: C023 – Stanton 31RB3

Project Area Information

This project is located in Central North Dakota at the GRE-Stanton substation

Project Need

Accommodate MPC generator interconnection request C023.

Project Description

Replace jumps inside the Stanton Substation at breaker 31RB3

The total estimated cost of this project is $33,000 with an expected in-service date of November 2016.

Transmission Owner: Minnesota Power (MP)

Baseline Reliability Projects

Project 9064: Arrowhead 115 kV Bus Reconfiguration

Project Area

This project is located at the Arrowhead substation in Northeastern Minnesota.

Project Need

NERC category P2.3 bus tie breaker failure event and category P4.6 bus section fault plus stuck breaker events are producing low post-contingent voltages and thermal overloads on several 115 kV system buses and branches. Violations are observed at Two Harbors, Colbyville, Haines Road, Hoyt Lakes and other surrounding area buses. Worst-case overloads were observed in the 2021 Summer Peak models, with loading as high as 106%, while low voltages and convergence issues were present on all peaking models years.

Project Description

This project will reconfigure the Arrowhead 115 kV bus by moving Arrowhead-Colbyville and Arrowhead – Haines Road off of adjacent buses, thereby reducing the severity contingencies involving a failure of the 115 MW breaker.

The total estimated cost of this project is $600,000 with an expected in-service date of December 2017.

Project 7996: 15 Line Upgrade

Project Area

This project addresses issues in northeastern Minnesota.

Project Need

Several post-contingent power flow violations can be observed following a P1.2 transmission circuit fault and P2 breaker failure events. Some of the worst case overloads are displayed in tables P7996-1

Limiting Element	Voltage	NERC Event	Year	Season or Sensitivity	Post-contingent Loading
Fond Du Lac – Hibbard	115 kV	P1.2	2018	Summer	141%
Fond Du Lac – Hibbard	115 kV	P2.2	2026	Summer	156%
Fond Du Lac – Hibbard	115 kV	P2.3	2026	Summer	134%

Table P7996-1: Worst Case Loading (%) for contingent events

Project Description

To mitigate these post contingent violations, MP will rebuild & re-conductor the Fond Du Lac - Hibbard 115 kV Line to a summer emergency rating of 134.2 MVA

The total estimated cost of this project is $5.5 million. The expected in-service date for this project is December 2017.

Project 7910: 5 Line Upgrade

Project Area

This project addresses issues in northeastern Minnesota, near the city of Brainerd.

Project Need

Several post-contingent power flow violations can be observed following a contingency involving the loss of Riverton – Mud Lake 230 kV. System need was identified during the MTEP15 reliability study, with violations present during North Flow Winter Peak sensitivities (not modeled in MTEP16). Some of the worst case overloads are displayed in tables P7996-1.

Limiting Element	Voltage	NERC Event	Year	Season or Sensitivity	Post-contingent Loading
Brainerd – Mud Lake	115 kV	P1	2020	Winter Peak North Flow	125%
Brainerd – Mud Lake	115 kV	P2	2020	Winter Peak North Flow	130%

Table P7910-1: Worst Case Loading (%) for contingent events

Project Description

To mitigate these post contingent violations, MP will increase the capacity of the Brainerd – Mud Lake 115 kV Line (5 line) by re-conductoring with 636 ACSR @100C.

The total estimated cost of this project is $1.9 million. The expected in-service date for this project is November 2019.

Project 10284: 28 Line Upgrade

Project Area

This project addresses issues in northern Minnesota, near the city of Grand Rapids.

Project Need

Post-contingent power flow violations can be observed in several MTEP cases following a common tower loss (P7.1) contingency involving Boswell-Blandin and Boswell-Grand Rapids 115 kV circuits. Some of the worst case overloads are displayed in tables P10284-1.

Limiting Element	Voltage	NERC Event	Year	Season or Sensitivity	Post-contingent Loading
Canisteo – 28L Tap	115 kV	P7	2018	Summer Light Load	112%
Boswell – 28L Tap	115 kV	P7	2021	Summer	113%

Table P10284-1: Worst Case Loading (%) for contingent events

Project Description

MP will replace terminal equipment and increase the operating temperature from 65C and 75C of the Boswell – Canisteo 115 kV line to achieve an emergency rating of at least 150 MVA.

The total estimated cost of this project is $1.5 million. The expected in-service date for this project is June 2017.

Other (Reliability) Projects

The following projects are needed for local reliability or other system needs that do not meet the definition of Baseline Reliability.

Project ID	Project Name	Project Description	System Need	In-Service Date	Estimated Cost
9622	83 Line Upgrade	Replace limiting elements at Boswell & Blackberry to restore 100C rating	Restore capacity on generator outlet line after derate per NERC-mandated equipment audit	June 2019	$0.5M
9623	95 Line Upgrade	Replace limiting elements at Boswell & Blackberry to restore 100C rating	Restore capacity on generator outlet line after derate per NERC-mandated equipment audit	June 2019	$0.5M
9625	Nemadji 115 kV Project	New switching station on Gary - Stinson 115 kV Line near Enbridge's Superior Terminal and115 kV line development around the Superior Terminal	Reduce system exposure to a large industrial customer	December 2017	$8.7M

Other (Condition) Projects

The following projects are being performed due to age or condition of existing MP facilities:

Project ID	Project Name	Project Description	In Service Date	Estimated Cost
10383	Laskin-Tac Harbor Voltage Conversion	Remove single points of failure - aging 138/115 kV transformers at Tac Harbor and Laskin with no viable spare. Avoid purchase of new 138/115 kV transformers. Add voltage support in absence of Tac Harbor generation	December 2017	$2.5M
7997	15th Avenue West Modernization	Rebuild & modernize existing 15th Avenue West Substation, including new 14 kV switchgear, one new 115/14 kV transformer, replace 3 115 kV breakers and other 115 kV equipment, and miscellaneous site improvements	December 2018	$10M
9624	Bear Creek 69/46 kV Transformer	Install 69/46 kV transformer at Great River Energy's existing Bear Creek Substation and remove existing Sandstone 69/46 kV distribution station	December 2017	$2.0M

Transmission Owner: Otter Tail Power (OTP)

Other (Reliability) Projects

41.6 kV Relay Upgrades

The following OTP projects are being performed to increase capacity on the 41.6 kV system to accommodate load growth:

Project ID	Project Name	Project Description	In-Service Date	Estimated Cost
9990	Devils Lake East 41.6 kV	41.6 kV relay upgrades	December 2016	$0.04M
9995	Devils Lake SW 41.6 kV	41.6 kV relay upgrades	December 2017	$0.04M

41.6 kV Breaker Additions

The following projects are being built to enhance reliability on the 41.6 kV system in North Dakota by adding sectionalizing capability, reducing exposure and adding operational flexibility. OTP performed analysis on the sub-BES system and no system degradation was observed as a result of these breaker additions. While no MTEP modeling topology changes were required for these projects, the shifting of load from the BES perspective was reviewed by MISO and no system degradation was observed in the MTEP16 model series.

Project ID	Project Name	Project Description	In-Service Date	Estimated Cost
10003	Rugby 41.6 kV Breakers	Install four 41.6 kV Breakers in the Rugby area to re-terminate existing OTP-owned 41.6 kV circuits from CPEC-owned Rugby substation to 230 kV delivery.	Dec 2016	$2.0M
11743	Western ND 41.6 kV Breaker Stations	Western ND 41.6 kV Breaker Stations will consist of 3 Facilities: 1. Coleharbor - Single in-line circuit breaker addition 2. Drake - Single in-line circuit breaker addition 3. Granville Jct. - Three circuit breaker addition	Dec 2016	$1.5M

Other (Condition) Projects

The following OTP projects are being performed due to age or condition of existing facilities:

Project ID	Project Name	Project Description	In Service Date	Estimated Cost
10007	Max to Ryder 41.6 kV Line Upgrade	Replace failing insulation, cross arms and poles identified through inspections from Max, ND to Ryder, ND	December 2018	$1.2M

Transmission Owner: Montana Dakota Utilities (MDU)

Baseline Reliability Projects

Project 9121: Heskett-Mandan 115 kV Upgrade

Project Area Information

Project is located in Southwest North Dakota.

Project Need

Thermal violations were identified following the loss of Heskett-NE Bismarck 115 kV line (P1.2) with loading as high as 103% on the Heskett to Mandan line.

Project Description

This project will replace limiting switches in the Heskett substation on the Mandan 115 kV line to increase the emergency rating to 191 MVA.

The total estimated cost of this project is $0.1 million with an expected in-service date of December 2016.

Transmission Delivery Service Projects

Project Description

To accommodate TSR F109/A634 the Coyote – Beulah 115 kV line will be re-conductor.

The total estimated cost of this project is $0.4 million, and was placed into service in December 2015.

Other (Reliability) Projects

The following projects are needed for local reliability or other system needs that do not meet the definition of Baseline Reliability.

Project ID	Project Name	Project Description	System Need	In-Service Date	Estimated Cost
9120	Leola	New 115 kV transmission line from Ellendale Jct. to New Leola Jct. 115/41.6 kV substation. Substation will connect to existing Ellendale Bowdle 41.6 kV line.	Low voltages and thermal overloads on the 41.6 kV system for various outage conditions	October 2017	$12.8M
4140	Bowdle Jct.	Build a new Bowdle Jct. substation to replace the existing substation	The existing Bowdle Jct. is in a low lying area with potential for water problems	June 2017	$5.5M

Transmission Owner: Xcel Energy (XEL)

Baseline Reliability Projects

Project 10066: Southtown Area Upgrades

Project Area Information

This project is located in Twin Cities metro area of Minnesota.

Project Need

Reliability needs were identified on the 115 kV system surrounding the Twin Cities metro, primarily driven by NERC category P3 and P6 multiple contingency events. Specifically, Cedarvale - Southtown 115 kV line overloads for the loss of Elliot Park-Hiawatha coupled with the loss of the High Bridge source. Additionally, High Bridge – Shepard – Southtown 115 kV experiences overloads for the loss of Elliot Park – Hiawatha and the Black Dog source. Voltage issues are present for the same contingencies but not for the near term time frame. While load shedding is allowed per NERC reliability standards, Xcel Energy planning criteria states that load shed will only be used a temporary measure.

Project Description

This project will upgrade two line segments: The Southtown – Cedarvale 115 kV line to at least a 290 MVA emergency rating and the Southtown – Shepard 115 kV line to at least a 270 MVA emergency rating. Neither upgrade involves a full rebuild, only the upgrade of substation terminal equipment and rectification of clearance issues. Additionally, an 80 MVAR capacitor bank will be added to the Hiawatha substation to remedy voltage issues present in the out-year models.

The total estimated cost of this project is $3.5 million, and the expected in-service date is December 2017.

Other (Reliability) Projects

The following projects are being performed for local (sub-BES) reliability and load serving needs:

Project ID	Project Name	Project Description	In Service Date	Estimated Cost
10045	City of Chaska Interconnection	Build an in-and-out from double circuit 115 kV just south of Bluff Creek to serve City of Chaska's new distribution substation.	April 2017	$3.2M
10062	Tyrone Tap Interconnection	Install a 3-way switch on NSP's St. Thomas Tap to Boright #2 69 kV line. GRE will then construct a radial line from the tap to serve the new MVEC load.	June 2016	$0.4M
10067	MPC Fossum Interconnection	Convert the Prairie Substation to a breaker-in-a-half configuration to accommodate MPC's Fossum 115 kV interconnection request. Fossum will operate radially.	January 2018	$17.3M
10071	Prescott Capacity Upgrade	Install second 69/12.47 kV 28 MVA transformer at Prescott, add additional feeders, and install a second 10 MVAR cap bank.	October 2016	$1.2M
10072	Dean Lake Third Transformer and Ring Bus	Install a 3rd TR at Dean Lake and add 4 new breakers to complete the ring bus.	December 2016	$4.9M
10075	Waconia 2nd Distribution Transformer	Install a 2nd distribution transformer at Waconia substation and associated feeders. This new transformer will require the 69 kV yard to be converted to an in-and-out configuration.	December 2017	$0.4M
10077	GRE St. James Interconnection	Install a new three-way switch with load interrupters to accommodate GRE interconnection on line 0714.	December 2016	$0.4M
10291	New LCO Hydro Transformer	Install single 34.5/23.9 kV TR to connect the Lac Courte Oreilles (LCO) hydro facility to the NCP system near Radisson	December 2018	$0.2M
10069	Twin Creek Breaker Station	Install a 2 or 3 position 69 kV breaker station	November 2019	$2.9M
10063	Rebuild Jackson Co – DPC Merrillan Tap 69 kV	Rebuild 6.1 miles from Jackson Co to DPC Merrillan Tap to 565.3 ACSR/TW.	July 2016	$3.3M
10068	Install Baytown 2nd Transformer	Install a 2nd transformer and switchgear at Baytown substation. This will require an in-and-out design at Baytown.	June 2017	$1.6M
10290	Gravel Island Distribution	Install a 28 MVA distribution TR and associated breaker and bus work	August 2017	$3.0M
10073	GIC Monitoring	Install GIC Monitoring at various substations throughout NSPM/NSPW system. Projects will be modeled after the King GIC monitoring pilot program.	December 2017	$0.6M

Other (Condition) Projects

The following projects are being performed due to the age or condition of existing facilities:

Project ID	Project Name	Project Description	In Service Date	Estimated Cost
4696	Rebuild Prentice-Medford 69 kV	Rebuild this line to 795 ACSR due to age and condition of the line	January 2018	$20.1 M
10074	Airport – Rogers Lake 115 kV Rebuild	This project rebuilds the Airport - Rogers Lake 115 kV line due to age and condition. The new line would be built using 795 ACSS conductor.	November 2019	$4.1 M
10076	West St Cloud – Millwood Tap Rebuild	Rebuild 24 miles of line from West St. Cloud to Millwood Tap. This new line will be built using 477 ACSR conductor.	May 2019	$10.4 M
10288	Osprey 69 kV Expansion	Install 69 kV straight bus with 2 additional 69 kV breakers. Reterminate line from Whitetail Tap and Flambeau into Osprey. Rebuild the last 0.4 miles of 69 kV on the Whitetail Tap line to match the rest of the conductor type	September 2018	$2.9 M
10289	Elmwood - Eau Galle Rebuild	Rebuild the existing 2/0 conductor to 477 ACSR due to age and condition	December 2016	$2.1 M
10065	Rogers Lake Overstressed Breaker Replacement	Replace the four existing gas 40 kA breakers at Rogers Lake with gas 63 kA breakers.	April 2016	$1.0M

Transmission Owner: Minnkota Power Cooperative (MPC)

Minnkota Power Cooperative has a Planning Coordinator (PC) services agreement and participates in reliability planning activities with MISO, but is not a MISO member. MPC has voluntarily elected to provide additional information regarding the new transmission upgrades being performed in the planning horizon. These projects are not listed in Appendix A and do not require MISO board of directors approval, but details are provided in Appendix D1 for transparency.

Project 9650: Maple River – Frontier 69 kV Conversion to 115 kV

Project Area Information

This project is located in Eastern North Dakota to address issues in the Fargo area.

Project Need

Load growth in the Fargo area is driving the need for expansion of the existing 69 kV system.

Project Description

This project will be performed in three phases. Phase 1 will rebuild an existing 69 kV line to accommodate a 69 kV line and 115 kV line from Stanley extending north to a new Veterans Blvd substation. The new line will initially operate at 69 kV and will go into 115 kV service thereafter. Phase 2 will rebuild an existing 69 kV line to accommodate a 69 kV line and 115 kV line from Maple River extending south to the Veterans Blvd substation. A 115 kV bay will be established at Frontier, and the Veterans Blvd-Frontier line and Veterans Blvd sub will be converted to 115 kV. The new Maple River-Veterans Blvd line will either be operated at 69 kV temporarily or be double circuited with dual 115/69 kV operation. Phase 3 will convert the remaining substations along the new Maple River-Veterans Blvd-Frontier line to 115 kV operation.

The total estimated cost of this project is $38.3 million with an expected in-service date of December 2022.

Project 11444: Lake Park Substation

Project Area Information

This project is located in Western MN, near the city of Hawley.

Project Need

Alternate service to the Hawley, MN area is required and load service at the Ulrich substation has become constrained. The supporting 115 kV system is beginning to experience voltage support issues, and capacitors would be needed otherwise.

Project Description

This project will build a new substation that is fed by the Sheyenne-Audubon 230 kV transmission line. Under the initial plan, it will have a transformer (230/69 kV), one 230 kV back-to-back switch, a disconnect on the substation terminus, one 230 kV high-side breaker, and a 69 kV breaker(s) included. Some of the details are subject to change pending a system impact evaluation. This substation is a replacement project of a previous 69 kV project (at least in-part) and the Ulrich substation capacitors.

The total estimated cost of this project is $5.2 million with an expected in-service date of December 2017.

Project 11263: Itasca – MPL Laporte 115 kV Line

Project Area Information

This project is located in North Central MN.

Project Need

A new load interconnection requires a new area source.

Project Description

This project will build a 115 kV line to serve a new load in the Itasca area.

The total estimated cost of this project is $7.2 million with an expected in-service date of October 2017.

Project 9656: Fossum Substation Conversion

Project Area Information

This project is located on the MN/ND border near Grand Forks ND.

Project Need

Prairie 115/69 kV transformers require off-loading.

Project Description

This project will rebuild the existing Prairie to Fossum 69 kV line to 115 kV.

The total estimated cost of this project is $2.5 million with an expected in-service date of Dec 2019.

Transformer Replacement Projects

Project ID	Project Name	Project Description	In-Service Date	Estimated Cost
9651	Moranville Transformer Replacement	Replace two Moranville transformers (1 x 230/115 kV, 1 x 115/69 kV) with a new 230/69 kV transformer. Two 230 kV breakers and a 69 kV breaker are also included.	Dec 2017	$3.1M
9652	Ulrich Transformer Replacement	Increase the capacity of the existing Ulrich transformer.	Dec 2019	$2.5M

Generator Interconnection Projects

The following projects are being built to accommodate new generator interconnections

Project ID	Project Name	Project Description	In-Service Date	Estimated Cost
9648	Pillsbury – Maple River 230 kV Uprate	Re-tap CTs on Maple River 230 kV breakers to increase rating of Pillsbury line to 478 MVA.	Dec 2019	$9,000
11286	Roughrider 230 kV Substation	Add a new Center area 230 kV substation to support a wind farm interconnection.	Dec 2016	$5.5M
11303	Roughrider – Mandan 230 kV Uprate	Increase clearance of Roughrider-Mandan line to 200 deg C by fixing all limiting spans. Increase rating to at least 703 MVA (summer emergency) on Roughrider-Mandan.	Dec 2016	$765,000