

## **PUBLIC SERVICE COMMISSION OF WISCONSIN**

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Joint Application of Dairyland Power Cooperative,  
Northern States Power Company-Wisconsin, and  
Wisconsin Public Power, Inc. , for Authority to  
Construct and Place in Service 345kV Electric  
Transmission Lines and Electric Substation Facilities  
]for the CapX Twin Cities-Rochester-LaCrosse  
Project, Located in Buffalo, Trempealeau, and  
LaCrosse Counties, Wisconsin

PSC Docket No. 05-CE-136

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### **NO CAPX 2020 RESPONSE TO NOTICE OF POSSIBLE RECESSION OF ORDER GRANTING PARTY STATUS AND ORDER TO RESPOND**

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NoCapX 2020 has received the “NOTICE OF POSSIBLE RECESSION OF ORDER GRANTING PARTY STATUS AND ORDER TO RESPOND” dated January 9, 2012. No CapX 2020 presumes the title is a typographical error, not economic commentary. No CapX 2020 offers this response.

Pursuant to Wis. Stat. §227.44(2m) and Wis. Admin. Code §2.21, No CapX 2020 petitioned the Wisconsin Public Service Commission to intervene in the above-entitled docket and was granted non-specific full party status with all the responsibilities, rights and obligations of full party status. Now that party status is being questioned, in large part based on a misunderstanding and/or misrepresentation of a statement made in Appendix C, 1(c) of the No CapX 2020 Intervenor Compensation Request.

In the 21<sup>st</sup> century, activism and advocacy is largely based on use of the Internet, technology not available just a short time ago. Communications and action alerts are sent via email, websites provide information and offer suggestions for readers, inquiries are made online, Comment guidance is offered and Comments are made, and filings are filed via ERF and Minnesota’s eDockets. The Commission’s commitment to ERF filings as a matter of practice

reflects this shift. This is a significant change -- bricks and mortar, bulk mailings, dues and membership cards are nearly reduced to history, and nowadays, an important measure of potential effectiveness is the number of emails in an organization's database. As a CapX2020 project specific listserve, No CapX 2020's database is an important resource.

No CapX 2020 indeed made the following statement in its Motion for Intervention:

No CapX's list participants, members and directors have substantial interests that may be affected by any action in the above-captioned docket because the routes proposed could directly affect No CapX members. No CapX members are ratepayers of Xcel Energy a/k/a Northern States Power. No CapX members own land over which the Applicants have proposed transmission lines, and whose land could be taken by eminent domain if routed over their land. No CapX members should be granted intervention as a matter of right.

PSC REF#150324, IC Request, Attachment C, 1(c).

At the time of filing the Intervenor Compensation request, the cover sheet request for numbers of "members" made it clear that the term "members" as used on the cover sheet was different from the definition in the No CapX 2020 Motion for Intervention. Under its Articles of Incorporation, No CapX 2020 has no voting members, and there is no collection of dues or membership cards or certificates or other accoutrements of "membership" in that sense. For this reason, No CapX 2020's Intervenor Compensation Petition clearly spelled out that No CapX 2020 is "not a membership organization," and also that "members" were participants and members of the listserve. See Exhibit A, Attachment C, 1(c).

At no time has No CapX 2020 made a claim to over 700 members. The Order of January 9, 2012 misstates and misrepresents No CapX 2020's statement in Appendix C, 1(c) by stating that "No Capx 2020 claimed 700 members." This is not true. Attached as Exhibit A is a true and correct copy of Appendix C, 1(c). The full statement of Appendix C, 1(c) states:

No CapX 2020 has operated a website focused exclusively on the CapX 2020 transmisson projects, and has a listserve of over 700 members who receive regular

updates and action alerts.

Appendix C, 1(c)(emphasis added). This quote is about the listserve operated by NoCapX 2020, not about group membership. Attached as Exhibit B is a true and correct copy of the cover page of the Yahoogroups site, showing listserve membership. The Yahoogroups listserve denotes those on the list as “members,” and that means members of the listserve, and not members of NoCapX 2020. NoCapX 2020 has made no claims that the people on the listserve are members in any sense other than the listserve.

There is tension regarding “members” because listserve members cannot reasonably be deemed “members” of No CapX 2020 because while some are in alignment with advocacy positions of No CapX 2020, others are not, and some are on the list only for updates on CapX 2020 projects. Some have requested to be included on the list, some have signed up at meetings, some have made comments on the No CapX website, several are utility employees and/or consultants with an interest in No CapX 2020 activities, and others are added to the list by the listserve moderator. Parties are regularly reminded that they will be removed if requested and are in fact removed immediately on request, and are also notified that their emails will not be sold or given to other parties. Those on the listserve may more appropriately be regarded as listserve participants and members.

Should the definition of “member” have been clarified? Perhaps. Perhaps, in light of the Intervenor Compensation question regarding numbers of members, the intervention petition should have stated:

| No CapX’s listserve participants;and members (hereinafter “members”) and directors have substantial interests that may be affected by any action in the above-captioned docket because the routes proposed could directly affect No CapX members. No CapX members are ratepayers of Xcel Energy a/k/a Northern States Power. No CapX members own land over which the Applicants have proposed transmission lines, and

whose land could be taken by eminent domain if routed over their land. No CapX members should be granted intervention as a matter of right.

PSC REF#150324, amended.

This language addresses any discrepancy between filings. **NoCapX 2020 submits the language change above as an amendment to its Motion for Intervention.** Because there is no “discrepancy” in the language of Appendix C, 1(c), No CapX 2020 stands by its statement explaining listserve membership and declaring listserve membership of over 700.

Use of the challenge by NoCapX to the untimely and vague intervention filing of Clean Wisconsin is off point as a basis for objection to alleged discrepancies in NoCapX 2020 filings. The No CapX 2020 challenge to Clean Wisconsin’s out of time Intervention was based on Clean Wisconsin’s failure to expressly state its position and for its failure to address its reasons for its untimely intervention as required by PSC rules, not a challenge of its veracity. Regarding Clean Wisconsin’s failure to address necessary criteria, this court agreed with NoCapX that the petition was lacking in substance, and said:

Although NoCapX 2020 makes a valid point, project at issue raises multiple issues and competing interests and contains an application and supporting materials that remain in flux. Therefore, even though a request for intervention out of time should articulate more with respect to the matter of good cause, in this situation it is not unreasonable to assume the truth of Clean Wisconsin’s assertions of “new information and issues”. Furthermore, in such a significant proceeding, and with an interest in conserving the limited resources of state government, this proceeding shall remain focused on matters of more substance.

Order, October 6, 2011, p. 2.

Mindful of this admonition directed at NoCapX 2020, and the laxity afforded Clean Wisconsin in its pleadings, an Amended Motion for Intervention does not seem necessary, however if addressing an Amended Motion for Intervention is deemed necessary, and a judicious use of resources, NoCapX 2020 offers the language change on the previous page as an

amendment to its Motion for Intervention. Because there is no “discrepancy” in the language of Appendix C, 1(c), No CapX 2020 stands by its statement explaining listserve membership and declaring listserve membership of over 700.

In light of the minor nature of the five word clarification of the term “members” as above, the lack of any requirement or definition regarding “members” in the Intervention criteria or Intervenor Compensation rules, the latitude given Clean Wisconsin, and this Order’s mischaracterization of the claim of No CapX 2020’s statement in Appendix C in producing evidence of “discrepancies,” this does not seem sufficient to call into question the basis for granting No CapX 2020 intervention – it seems instead a search and a stretch for a rationale to remove No CapX 2020 from the proceeding.

Does No CapX lack the “necessary credibility required to promote the disposition of the issues?” Hardly. No CapX 2020 is the party leading the pack in relevant and substantive Data Requests. See attached Exhibit C, Data Requests to Xcel Energy; Exhibit D, Data Requests to ATC; Exhibit E, Data Requests to Dairyland Power Cooperative; Exhibit F, Data Requests to MISO. No CapX 2020 was the only non-agency party to submit Comments on the DEIS.<sup>1</sup> See attached Exhibit G, No CapX 2020 DEIS Comments. No CapX 2020 was also the only Intervenor to respond to the Conway Motion, noting Ms. Conway’s efforts and that the broad issues list was inclusive of Ms. Conway’s issue regarding authority of Dairyland Power Cooperative to participate in this project – a perspective reflected in the January 6, 2012 Order.

In its active participation, No CapX 2020 has demonstrated its “necessary credibility required to promote the disposition of the issues” and its superior ability to inform the record due to its years’ long history of prior interventions. Further, in no way has No CapX 2020 caused

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<sup>1</sup> Clean Wisconsin, the intervenor interested in “environmental” issues did not submit any comments on the DEIS, nor did Citizens Utility Board. CETF Board members submitted comments as individuals, but no comments were filed in CETF’s name.

any delay in the schedule set by the Commission – unlike Clean Wisconsin and MISO, No CapX 2020 has been timely in its submissions, and NoCapX2020 has been ahead of the other intervening parties in the timing and substantive content contained in its Data Requests.

## **CONCLUSION**

No CapX 2020 has accurately described its organization, has offered a five word clarification amendment in the language in its Motion for Intervention. It is No CapX 2020's hope that this response is sufficient, that the meaning of "listserve members" is now clear and that it is understood that a statement of fact that there are over 700 members of a listserve is not a claim that No CapX 2020 has "claimed 700 members." The alleged discrepancies have been addressed and are not sufficient to revoke the Intervention status of No CapX 2020 in this proceeding.

January 12, 2012



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## **Exhibit A**

### **Intervenor Compensation Attachment C, 1(c)**

## **ATTACHMENT C: FINANCIAL INFORMATION**

### **1a. NoCapX 2010 Actual Revenues and Expenses**

NoCapX 2020 had no revenue in 2010, and all expenses of intervention in Minnesota and federal administrative proceedings were paid by joint intervenors. Carol A. Overland, Legalectric, was retained to represent intervening parties, and the NoCapX 2020 share of legal fees was donated by Carol A. Overland (see 1c, below).

### **1b. NoCapX 2020's Current Assets and Liabilities**

NoCapX 2020 has no assets or liabilities.

### **1c. Financial and Nonfinancial Contributions to this Intervention**

NoCapX 2020 is requesting Intervenor Compensation for 2/3 cost of attorneys fees, and all expenses of consultants and other costs associated with intervention.

NoCapX 2020 has had assistance of financial and non-financial contributions paid by joint intervenors in prior interventions. Where a group joins with NoCapX 2020 in intervening, that group pays its share of expenses and legal fees to Legalectric and handles all the support work necessary to the intervention, such as advertising notices for public hearings and group meetings, helping members of the public draft comments for the EIS or the Public Hearing, mailings to group members and interested parties. The NoCapX 1/3 share of legal fees is donated by Carol A.Overland, Legalectric.

NoCapX 2020 has operated a website focused exclusively on the CapX 2020 transmissison projects, and has a listserve of over 700 members who receive regular updates and action alerts.

Because NoCapX is intervening independently and has no joint intervenors in this proceeding, NoCapX 2020 is relying on Intervenor Compensation to cover costs and expenses as there are no contributing intervenors. Carol A. Overland, Legalectric, would again donate 1/3 of legal expenses, and therefore NoCapX is seeking 2/3 of attorneys fees, not the full anticipated \$66,045.00.

## **Exhibit B**

**NoCapX2020 Yahoogroups “Members” page  
731 members**

Hi, Carol Sign Out Help

Yahoo! Mail

YAHOO! GROUPS

Search

Web Search

caoverland · overland@legalelectric.org | Group Owner - [Edit Membership](#)[Start a Group](#) | [My Groups](#)

NoCapX2020 · NoCapX 2020

Search for other groups...

Search

[Home](#)[Messages](#)[Pending](#)[Spam?](#) [\[Delete\]](#)[Post](#)[Attachments](#)[Files](#)[Photos](#)[Links](#)[Database](#)[Polls](#)[Members](#)[Pending](#)[Calendar](#)[Promote](#)[Invite](#)[Management](#)[Groups Labs \(Beta\)](#)[Applications](#)[Chat](#)[Info](#) [Settings](#)**Group Information**

Members: 731

Category: Regions

Founded: Feb 14, 2009

Language: English

**Yahoo! Groups Tips**

Did you know...

Exchange ideas with fellow Moderators. Take me to Moderator Central.

**Best of Y! Groups**

Check them out and nominate your group.

**Members**[Members Help](#)[Invite People](#) | [Remove](#) | [Ban](#) | [Download](#) | [Export](#)**Members**[Moderators](#) | [Bouncing](#) | [Banned](#)

Search Members:

Search

View: Simple | Expanded

1 - 10 of 731 First | &lt; Previous | Next &gt; | Last

[Save Changes](#)

| Member | Yahoo! ID                       | Email Delivery    | Joined       | Remove Member |
|--------|---------------------------------|-------------------|--------------|---------------|
|        | overland@legalelectric....      | Individual Emails | Feb 14, 2009 | (n/a)         |
|        | [Redacted]                      | Individual Emails | Feb 19, 2011 |               |
|        | [Redacted]                      | Individual Emails | Jan 31, 2011 |               |
|        | [Redacted]                      | Individual Emails | Sep 25, 2010 |               |
|        | DavidE -age- Male -location-    | Default           | Feb 16, 2010 |               |
|        | Diane -age- -gender- -location- | Fully Featured    | Jan 3, 2012  |               |

-name- -age-  
 -gender-  
 -location-

Message Format:

Default

-name- -age-  
 -gender-  
 -location-

Message Format:

Default

-name- -age-  
 -gender-  
 -location-

Message Format:

Default

DavidE -age-  
 Male  
 -location-

Message Format:

Default

Diane -age-  
 -gender-  
 -location-

Message Format:

Fully Featured

-name- -age-  
 -gender-  
 -location-

Message Format:

Default

**Group**

Post r  
 NoCap  
 Subsc  
 NoCap  
 subscr  
 Unsub  
 unsub  
 List o  
 NoCap  
 owner

## **Exhibit C**

### **NoCapX2020 Initial Data Requests to Xcel Energy**

**Capx 2020 Hampton - Rochester - LaCrosse 345k V Transmission Project  
PSC Docket 05-CE-136**

**NoCapX 2020 “01 Series” Data Requests to Northern States Power/Xcel Energy**

| <b>DR No.</b> | <b>Reference</b>           | <b>Data Request</b>  |
|---------------|----------------------------|--|
| 01-1          |                            | Please provide NoCapx2020 with a copy of all Data Request responses to all other parties in this proceeding.   |
| 01-02         | CapX 2020 Technical Report | Please provide a copy of “CapX 2020 Technical Update: Identifying Minnesota’s Electric Transmission Infrastructure Needs (October 2005).”  |
| 01-03         | SE MN – SW WI              | Please provide a copy of “Southeastern Minnesota-Southwestern Wisconsin Reliability Enhancement Study (March 13, 2006)   |
| 01-04         | PSC 02-1                   | PSC Staff Data Request 02-1 refers to an early version of Appendix E containing "462 pages." Please provide copy of the 462 page version of Appendix E.  |
| 01-05         | Application Appendix E     | In addition to the PSC Data Request 02-1 referenced Appendix E containing "462 pages referenced above, please provide a copy of: a) the December 21, 2010, Amanda King "DRAFT for Final Review" 277 page version; b) the March 24, 2011, Amanda King "DRAFT for Final Review" 110 page version; c) the June 13, 2011, rothforkm "PCDOCS-_3731105-v2-Xcel_La_Crosse_FINAL_TSSR_Update_March_2011_LISA.DOC" 110 page redline version; and d) the June 27, 2011 rothforkm "PCDOCS-_3731105-v2-Xcel_La_Crosse_FINAL_TSSR_Update_March_2011_LISA.DOC" 110 page version. |
| 01-06         | Application Appendix E     | In addition to the versions of Appendix E above, identify and provide copies of all other versions of Appendix E filed with PSC or provided to PSC Staff. and provide copies of all such versions.   |
| 01-07         | Supplemental Need Study    | Supplemental Need Study refers to MISO State of the Market Report. Provide copy of this report cited and any and all more recent State of the Market Report.   |

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| 01-08 | Transmission Studies                             | Please provide a copy of all electrical, transmission and or market studies by Applicant, ATC, Minnesota Transmission Owners and/or others, referencing the CapX 2020 Hampton-Rochester-LaCrosse transmission line.   |
| 01-09 | Transmission Studies                             | Please provide a copy of all electrical, transmission and or market studies by Applicant, ATC, Minnesota Transmission Owners and/or others, referencing a LaCrosse to Columbia and/or West Middleton transmission line and/or any 345kV transmission line from LaCrosse to eastward terminus.   |
| 01-10 | Transmission Studies                             | Please provide a copy of all electrical, transmission and or market studies by Applicant, ATC, Minnesota Transmission Owners and/or others, referencing transfer capacity of CapX 2020, including but not limited to the Capacity Validation Study (March 31, 2009) and all appendices.   |
| 01-11 | Transmission Studies                             | Please provide a copy of all electrical, transmission and or market studies by Applicant, ATC, Minnesota Transmission Owners and/or others, regarding transmission needs in LaCrosse, WI and surrounding area served by LaCrosse substations listed in Application and Supplemental Need Study.   |
| 01-12 | Transmission Studies                             | Please provide a copy of all electrical, transmission and or market studies by Applicant, ATC, Minnesota Transmission Owners and/or others, regarding energy and/or transmission needs in Rochester, Minnesota and surrounding area served by Roshester area substations discussed in Application, and discussed in Supplemental Need Study, including but not limited to the Baseline Electric Infrastructure Study Phase I (Burns & McDonnell for RPU). |
| 01-13 | Transmission Plans                               | Please provide copies of complete Xcel/NSPI transmission “plans,” “scenario assessments” including but not limited to 10 year Transmission Plan and 20 year Scenario Assessment, and other reports that address Southeast Minnesota and Western Wisconsin transmission, and provide underlying studies supporting such plans and assessment.  |
|       | <b>10 Year Plan, 20 Year Scenario Assessment</b> | <b>Following Questions are regarding NSP 10 Year Plan and 20 Year Scenario Assessment:</b><br><a href="http://www.xcelenergy.com/staticfiles/xcel/Corporate/Corporate%20PDFs/NSP%202010%20transmission%20plan%20-FINAL.pdf">http://www.xcelenergy.com/staticfiles/xcel/Corporate/Corporate%20PDFs/NSP%202010%20transmission%20plan%20-FINAL.pdf</a>   |
| 01-14 | 10 Year Plan                                     | Please provide copy/copies of the underlying plans for Minnesota and Wisconsin (NSP 10 Year Plan and 20 Year Scenario Assessment) and associated studies referred to in the powerpoint referred to above.   |
| 01-15 | Transmission Studies                             | Transmission map on p. 12/85:<br><a href="http://www.xcelenergy.com/staticfiles/xcel/Corporate/Corporate%20PDFs/NSP%202010%20transmission%20plan%20-FINAL.pdf">http://www.xcelenergy.com/staticfiles/xcel/Corporate/Corporate%20PDFs/NSP%202010%20transmission%20plan%20-FINAL.pdf</a> What is date of this map? Provide current full size (3'x5' or so) map of “MAPP map” and MISO transmission grid.  |
| 01-16 | Transmission Assessment                          | Provide the two most recent MN Transmission Assessment and Compliance Team assessment (Minnesota joint utility annual NERC assessment) and similar Wisconsin assessments.   |
| 01-17 | State ordered studies                            | Provide copy of any and all “Corridor” studies.   |
| 01-18 | EIPC/JCP planning                                | Provide copies of EIPC and JCSP studies that reference transmission between Minnesota and Wisconsin.  |
| 01-19 | Transmission Reviews                             | Provide copies of NSP/Xcel internal reliability annual reviews for 2000 to present.   |

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|-------|----------------------------|--|
| 01-20 | Economic Planning          | Provide copies of NSP/Xcel economic planning studies that address Minnesota to Wisconsin transfer capacity, Minnesota to Wisconsin congestion, and energy and demand loss within NSP Minnesota and Wisconsin.  |
| 01-21 | Economic Planning          | Provide copies of transfer capacity studies by others reviewed by NSP, i.e., DOE, MTEP, MAPP SPGs, MTO TACT Study Group, etc.  |
| 01-22 | MISO Congested Flowgates   | p.20 of NSP 10 Year Plan<br>( <a href="http://www.xcelenergy.com/staticfiles/xe/Corporate/Corporate%20PDFs/NSP%202010%20transmission%20plan%20-FINAL.pdf">http://www.xcelenergy.com/staticfiles/xe/Corporate/Corporate%20PDFs/NSP%202010%20transmission%20plan%20-FINAL.pdf</a> ) shows MISO Most Congested Flowgates. Identify congested flowgates on this map that are located near the Minnesota and Wisconsin border.            |
| 01-23 | MISO Congested Flowgates   | p.20 of NSP 10 Year Plan<br>( <a href="http://www.xcelenergy.com/staticfiles/xe/Corporate/Corporate%20PDFs/NSP%202010%20transmission%20plan%20-FINAL.pdf">http://www.xcelenergy.com/staticfiles/xe/Corporate/Corporate%20PDFs/NSP%202010%20transmission%20plan%20-FINAL.pdf</a> ) shows MISO Most Congested Flowgates. Identify congested flowgates on this map that are in Wisconsin west of Lake Michigan.                         |
| 01-24 | MAPP SPG Meetings          | Is a confidentiality and/or non-disclosure agreement necessary to attend MAPP SPG meetings?<br>Is a confidentiality and/or non-disclosure agreement necessary to receive some or all MAPP SPG documents?<br>Is a confidentiality and/or non-disclosure agreement necessary to receive a copy of a current transmission map?<br>If so, please provide basis for any confidentiality requirement and provide a copy of agreement used. |
| 01-25 | MN Biennial Plan           | When were most recent annual Transmission Plan public meetings held? When are next public meetings to be held?   |
| 01-26 | Historic Load Growth       | Provide graph of peak <u>wholesale</u> load over last decade.  |
| 01-27 | Driver – RES Gap           | Is NSP MN on track to meet MN RES? Is NSP WI on track to meet WI RES? For what years have goals been met, but without Renewable Energy Credits and including RECs. In its IRP, how does NSP-MN (Xcel) address RECs in its RES compliance calculations?   |
| 01-28 | MISO Queue                 | Of the projects represented as a MISO Queue Map, Oct. 2010 (p. 29) how many projects, and how many megawatts in North Dakota are coal fuel? How many projects and how many megawatts in South Dakota are coal fuel? How many projects and megawatts in Wisconsin are wind? How many projects and megawatts in Illinois are wind?   |
| 01-29 | Hampton-Rochester-LaCrosse | p.32 Map, what is southern-most blue line from Rochester to LaCrosse?  |
| 01-30 | Potential Projects         | p. 33 - LaCrosse-Madison 345kV line – “Increase Western MN-MISO market transfer 2000MW.” Does that mean increase market transfer by 2,000 MW?  |
| 01-31 | Zone 1                     | p. 36 “345kV transformer capacity maxed out.” Are transformers the limiting factor? What are specs of 345kV ring, conductor specs(size, ACSR or ACSS, bundled or not), amps, MVA? Have those lines been reconducted? If not, why not?  |
| 01-32 | Zone 1                     | p. 36 “Impact of reduced 115kV generation due to high wind generation conditions.” Explain.  |
| 01-33 | Zone 2                     | p. 39 “Max Generation: 2422 MW” Identify generators and MW and location (map).   |
| 01-34 | Zone 2                     | p. 39 “Aging 69kV infrastructure” When was this last reconducted? Transformer uprate? Provide map.   |
| 01-35 | Zone 2                     | p. 40 “2 <sup>nd</sup> 161kV line Byron-West Side Energy Park (SMMPA to build). Is this line going forward? What are specs and capacity (MVA) of this line?  |

|       |        |  |
|-------|--------|--|
| 01-36 | Zone 2 | p.41 "Spring Creek – Lake City 161 kV line" Is this the 69kV line that goes through Florence Township, just off Hwy 61 on the west side of Hwy 61?   |
| 01-37 | Zone 2 | Compare Zone 2 projects listed with CapX 2020 Vision Plan, p. 2-3 of CapX 2020 Technical Update: Identifying Minnesota's Electric Transmission Infrastructure Needs (October 2005). Which of the projects listed for Zone 2 are part of the CapX 2020 Vision Plan. |
| 01-38 | Zone 2 | Identify projects in CapX 2020 Vision Plan that are within Zone 2.   |
| 01-39 | Zone 3 | Compare Zone 3 projects listed with CapX 2020 Vision Plan, p. 2-3 of CapX 2020 Technical Update: Identifying Minnesota's Electric Transmission Infrastructure Needs (October 2005). Which of the projects listed for Zone 3 are part of the CapX 2020 Vision Plan. |
| 01-40 | Zone 3 | Identify projects in CapX 2020 Vision Plan that are within Zone 3.   |
| 01-41 | Zone 4 | Compare Zone 4 projects listed with CapX 2020 Vision Plan, p. 2-3 of CapX 2020 Technical Update: Identifying Minnesota's Electric Transmission Infrastructure Needs (October 2005). Which of the projects listed for Zone 4 are part of the CapX 2020 Vision Plan. |
| 01-42 | Zone 4 | Identify projects in CapX 2020 Vision Plan that are within Zone 4.   |
| 01-43 | Zone 5 | p. 48 "Major transmission expansion underconstruction in Eau Claire" Explain and provide PSC docket number.  |
| 01-44 | Zone 5 | p.48 "Substantial major industrial expansion under consideration in northern Wisconsin." Identify with specificity, including locations.   |
| 01-45 | Zone 5 | What part of Northern Wisconsin in NSP-WI territory?   |
| 01-46 | Zone 5 | p.49 "pumping loads" – for what purpose/industry, what pumping loads are anticipated, in MW and by location.   |
| 01-47 | Zone 5 | Compare Zone 5 projects listed with CapX 2020 Vision Plan, p. 2-3 of CapX 2020 Technical Update: Identifying Minnesota's Electric Transmission Infrastructure Needs (October 2005). Which of the projects listed for Zone 2 are part of the CapX 2020 Vision Plan. |
| 01-48 | Zone 5 | Identify projects in CapX 2020 Vision Plan that are within Zone 5.   |
| 01-49 | Zone 6 | p. 52 – are the three projects proceeding and in service in 2011? Are these upgrades in the models forCapX2020?  |
| 01-50 | Zone 6 | p. 53 – Project 1, what is current capacity of LaCrosse – West Salem? Does LaCrossetransformer#2connect to the LaCrosse-West Salem line?   |
| 01-51 | Zone 6 | Compare Zone 6 projects listed with CapX 2020 Vision Plan, p. 2-3 of CapX 2020 Technical Update: Identifying Minnesota's Electric Transmission Infrastructure Needs (October 2005). Which of the projects listed for Zone 6 are part of the CapX 2020 Vision Plan. |
| 01-52 | Zone 6 | Identify projects in CapX 2020 Vision Plan that are within Zone 6.   |
| 01-53 | Zone 7 | Identify and provide map showing locations of generation in North Dakota, existing, planned with interconnection agreement, and planned retirement, including all types of coal generation, gas, wind and other.   |
| 01-54 | Zone 7 | Identify and provide map showing locations of transmission lines in North Dakota and MVA ratings (identify source of MVA ratings, i.e., modeling assumptions for specific models – if using models, provide most recent model).                                    |
| 01-55 | Zone 7 | Identify all generation interconnection requests for all types in MISO queue for North Dakota and South Dakota (spreadsheet of MISO queue identifying date is sufficient).   |
| 01-56 | Zone 7 | Compare Zone 7 projects listed with "Post CapX 2020 Potential Projects" (p. 33) #4 Ashley-Hankinson and Fargo-Hankinson-BigStone-Brookings. Are any of the Zone 7 projects listed all or part of the #4 Post Capx 2020 Potential                                   |

|       |   |   |
|-------|---|---|
|       |   | Projects?   |
| 01-57 | Zone 7                                    | Compare Zone 7 projects listed with CapX 2020 Vision Plan, p. 2-3 of CapX 2020 Technical Update: Identifying Minnesota's Electric Transmission Infrastructure Needs (October 2005). Which of the projects listed for Zone 7 are part of the CapX 2020 Vision Plan.  |
| 01-58 | 2009 Bridge Study                         | p. 67 - Please provide copy of 2009 Bridge Study Strategic Vision ("a broad regional 20 year vision plan").   |
| 01-59 | Bridge Study                              | p. 69 and 70, explain differences between the Scenario 2 Sub-Regional Renewable plan and the Scenario 3 Non Renewable Long Range plan for the states of North Dakota, South Dakota, Minnesota and Wisconsin.  |
| 01-60 | Green Power Express                       | What is the current employment of Green Power Express' Ingrid Bjorklund?  |
| 01-61 | JCSP                                      | Regarding "Eastern load serving entities" referred to on slide 73, and JCSP plan on p. 83, what letters, testimony and comments are Applicants aware of from "Eastern" sources critical of transmission proposals from the Midwest to the East Coast, i.e., Letter of withdrawal from JCSP announcement by NYISO and ISO-NE; "10 Mid-Atlantic Governors" letters; testimony of New York's Deputy Commissioner of Energy, etc. Provide copies of all critiques of the JCSP plan of which Applicants are aware. |
| 01-62 | RGOS                                      | Provide <u>specific</u> links for RGOS 1 and 2 study and drafts (not "www.midwestiso.org/home").  |
|       | <b>Supplemental Need Study ERF 152526</b> | <b>The following Data Requests are related to the Supplemental Need Study, ERF 152526</b>   |
| 01-63 | Existing Xmsn System                      | When was Xcel's existing transmission system (over 110kV) in Wisconsin last upgraded? From what voltage and MVA to what and when?   |
| 01-64 | Existing Xmsn System                      | What plans are there to upgrade Xcel's existing transmission system (over 110kV) in Wisconsin?  |
| 01-65 | Upgrades                                  | If Hampton-Rochester-LaCrosse 345kV is built, what associated upgrades are part of the project, i.e., Chester line, others not needing CPCN or CoN, in Minnesota or Wisconsin?  |
| 01-66 | Upgrades                                  | The SNS identifies 200 miles of upgrades in the LaCrosse area are needed. Identify those 200 miles of LaCrosse transmission on map, and which are scheduled for upgrade and when? Provide details.  |
| 01-67 | MVP Study                                 | Provide copy of Candidate Multi-Value Projects study (not power point presentation to MISO or ?, but foundational study), hard copy or working link.  |
| 01-68 | MTEP                                      | Provide copy of MTEP 10 Final Report, hard copy or working link.  |
| 01-69 | SNS                                       | Provide any and all other studies cited in and/or relied on for the Supplemental Need Study.  |
| 01-70 | MTEP 11                                   | Provide any and all iterations of MTEP 11 Top Congested Flowgates Study   |
| 01-71 | DOE Money                                 | Provide copies of any and all applications to U.S. Dept. of Energy for funds for any and/or all parts of CapX 2020, and any and all supporting documents, disbursements and record of monies spent.   |
| 01-72 | SNS                                       | p. 2, provide the "[e]arlier cost and engineering analysis" referred to on p. 2, either hard copy or links.   |
| 01-73 | SNS                                       | p. 3, provide most recent Rochester load forecasts referred to on p. 3  |
| 01-74 | SNS                                       | p. 4 – "Addition of the 345kV Project or the La Crosse 161 kV Alternative alone adds 700-850 MW of thermal transfer capability between Minnesota and Wisconsin." Provide underlying study demonstrating this increase in transfer capability.   |

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| 01-75 | SNS              | p. 4. "However, a 345 kV connection is more robust in that it also provides for additional transfer capability as the 345 kV system is extended to the east." This presumes additional transmission eastward. Provide copy of transfer study analysis showing additional capacity could be as high as 1200 MW (depending on eastern terminus).  |
| 01-76 | SNS              | p. 4 – "By increasing transfer capability, the 345kV Project enhances overall regional reliability." Provide copy of study demonstrating that the 345kV Project enhances overall regional reliability."   |
| 01-77 | SNS              | p. 4 – Reduce Congestion – "relieved generation trapped in Minnesota that was identified in 2010 and 2014 models. Does "trapped in Minnesota" mean generation that is stopped from getting into Wisconsin?  |
| 01-78 | SNS              | p. 4 – paragraph refers to "congestion in Wisconsin." The maps in section 2.4.1 show no congestion in Wisconsin predicted for 2014 and blue areas of "congestion" in eastern WI in 2019. The line in at issue in this proceeding ends at LaCrosse. How will this project have an impact on areas on the eastern side of Wisconsin. Provide studies showing this impact.   |
| 01-79 | SNS              | p. 5 – "Part of an Approved Regional Plan." Identify by beginning and terminus and substations in between "The 345kV Project" that was "thoroughly evaluated by MISO and approved." What is basis for MISO "approval." Provide MISO resolutions, decisions regarding this project. Provide underlying studies upon which approval was based.  |
| 01-80 | SNS              | p. 8 – "Reconductor Only Alternative." Why was only LaCrosse and surrounding area selected for a "Reconductor Only Alternative." What transmission lines comprise MWEX and current iteration of Minnesota/Wisconsin transfer? Identify specs for each line (conductor size, type, amps and MVA of conductor and transformers) and identify limiting factor (i.e. King-Eau Claire-Arpin Operating Guide). When was each of these lines reconducted?  |
| 01-81 | SNS              | p. 9 – the lower voltages "provide less load serving capability." What is geographic location of the load serving capability referred to? LaCrosse areas only or LaCrosse and Rochester areas?  |
| 01-82 | SNS              | p. 9 – "these alternatives do not provide the regional reliability benefits of the 345kV project." LaCrosse load is used as local load serving capability "need." Is there a regional reliability benefits need to go to LaCrosse? Explain.   |
| 01-83 | SNS              | p. 9 – "transfer capability between Minnesota and Wisconsin is degraded ... with the 161kV La Crosse Alternative in service." Provide studies demonstrating transfer capability is lower.   |
| 01-84 | SNS              | p. 9 – Explain basis for wanting increased transfer capability, and basis for wanting the various increments of transfer capability.  |
| 01-85 | SNS              | Transfer capacity v. transfer capability – are the two terms interchangeable? If not, explain distinction(s).   |
| 01-86 | SNS              | Provide all transfer capacity and transfer capability studies regarding CapX 2020 and/or this 345 kV Hampton-LaCrosse project, including but not limited to any and all Capacity Validation Studies and Appendices, e.g. MTO's CVS, March 31, 2009 <a href="http://www.minnelectrans.com/documents/capacity-study/cvsreport.pdf">www.minnelectrans.com/documents/capacity-study/cvsreport.pdf</a>   |
| 01-87 | SNS & CVS Report | The Minnesota Transmission Owners Capacity Validation Study (CVS), link above, notes that "Another finding of the study is that the Capx2020 Group I projects appear to provide more outlet capability than had previous been assumed" and that the CapX projects were not studied on a "combined basis" previously and that the "combination of transmission provides more transfer capability." Provide copies of the individual studies and the combined studies referenced.   |
| 01-88 | SNS & CVS Report | CVS Report p. 9-10 – "Further results of the CVS indicate a new transmission line is needed east of Minnesota. In nearly every transmission scenario which sinks to the Midwest ISO footprint, the King-Eau Claire line emerges as the limiting element." The only scenario in which this line is not the limiting element is when a parallel line exists between LaCrosse, Wisconsin and the Madison, Wisconsin area. From the study results, each scenario which contains a new LaCrosse-Madison line provides more transfer capability when sinking to the Midwest ISO than any of the scenarios without this line." Do applicants dispute this Minnesota Transmission Owners report? Why was this MTO CVS not included in the Minnesota |

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|        |                  | Certificate of Need docket filings? Why was this MTO CVS not included in the Wisconsin CPCN docket filings?   |
| 01-89  | SNS & CVS Report | CVS Report, p. 13 – provide the “LaCrosse/Rochester load serving studies” referred to on p. 13.   |
| 01-90  | SNS & CVS Report | CVS Report, p. 14 – provide the “Corridor Study” referenced in the first full paragraph on p. 14.   |
| 01-91  | SNS & CVS Report | CVS Report, p. 14, provide the “transmission study underway to determine the need for anew transmission line from LaCrosse, Wisconsin to an end point in the Madison, Wisconsin area,” including but not limited to the MISO evaluation noted, and the Western Wisconsin Transmission Reliability Study, Final Report, September 20, 2010.                                  |
| 01-92  | SNS & CVS Report | CVS Report, p. 15 notes a “Gap Analysis” of RES compliance and forecasted compliance. There are claims in this docket that the Hampton-LaCrosse transmission line is in part to enable RES compliance. Provide a copy of the Minnesota Gap Analysis referenced, and any other such RES compliance analysis for Wisconsin and other areas of MISO.                           |
| 01-93  | SNS & CVS Report | CVS Report p. 21 – Reference to Center-Arrowhead DC line purchase by MP (along with the Center-Prairie or Maple River 345kV line). If this purchase by Minnesota Power is utilized for wind only, what transmission will the existing generation that was on that line use? CapX 2020?  |
| 01-94  | SNS              | p. 10 – 200 miles of transmission upgrades – is the 100 mile 161kV line starting at Prairie Island the existing 69 kV line that extends over the “Site P” – the proposed Florence Township nuclear waste site?  |
| 01-95  | SNS              | p. 15 – What is the impact of the 345 kV project as applied for on “reliable delivery of power through fair and competitive wholesale electric markets?”  |
| 01-96  | SNS              | p. 17 – Provide documentation of MISO review and coordination of “the 345 kV Project” referenced in 2 <sup>nd</sup> paragraph.  |
| 01-97  | SNS              | p. 17 – What “other expansion concepts underway in Iowa and Wisconsin” are referred to? Identify which, if any, are Capx 2020 Vision Plan projects (see list, p. 2-3, CapX 2020 Technical Update, October 2005).  |
| 01-98  | SNS              | p. 17 – Provide all MISO documentation, studies, etc. that address “the project’s effectiveness and need for community reliability.”  |
| 01-99  | SNS              | p. 17-18 – Provide all MISO documentation, studies, etc. that address whether “these projects were necessary to ensure continued compliance with NERC standards.  |
| 01-100 | SNS              | p. 18 – MISO Market Function – please provide copies of all MISO and MISO commissioned studies, reports and documentation of Market Benefits, including but not limited to ICF’s Independent Assessment of Midwest ISO Operational Benefits and subsequent similar reports.   |
| 01-101 | SNS              | p. 20 – 2.3.1 references Superior Water Light and Power. Is this a Minnesota Power company? Was entity involved in Western Wisconsin transmission planning Minnesota Power or Superior Water Light and Power?   |
| 01-102 | SNS              | p. 20 – isn’t the Arrowhead Transmission line in western Wisconsin owned by American Transmission Company, LLC?   |
| 01-103 | SNS              | p. 20 – “As a result, the transmission system in Western Wisconsin is currently more closely linked with the transmission system in Minnesota than that in eastern Wisconsin.” Please explain. Wasn’t one of the rationales for the Arrowhead Project to provide transmission for WUMS (eastern WI)?  |
| 01-104 | SNS              | p. 20 – regarding the 345kV ring – what is capacity of various sections of the 345kV ring (substation to substation) expressed in amps and MVA. When was 345kV ring last upgraded with conductor and/or transformers that could increase capacity? Please provide Xcel/NSP and/or MISO studies within last 10 years of potential upgrades to existing 345kV infrastructure. |
| 01-105 | SNS              | p. 21 – “ For example, a heavy-duty 115kV line could transmit power up to 400 megavolt ampere (“MVA”) for several miles,  |

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|        |     | whereas a 345kV line could transmit as much as 1, 200 MVA over hundreds of miles.” Isn’t it correct that 115kV lines, equipped with high capacity conductor and transformers to match, could carry well over 400 MVA? Isn’t it correct that the thermal limits for the Chisago Project, as permitted by Wisconsin, was designed with over 800 MVA capacity? Isn’t it correct that the 345kV project at issue in this docket is designed to have thermal limits of 2,050 MVA and twice that if double circuited? (reference MN Certificate of Need testimony).   |
| 01-106 | SNS | p. 22, fn. 12 – Provide studies, plans, documentation regarding the subsequent phase of the Capx 2020 initiative referenced in the footnote.  |
| 01-107 | SNS | p. 23 – Provide examples of “market inefficiencies” caused by congestion.   |
| 01-108 | SNS | p. 24 – This is a transmission line in Wisconsin. Is there congestion noted in Figure G in Wisconsin?   |
| 01-109 | SNS | p. 24 & Figure G – Identify source of 443MW not effectively shared? Is the shaded area in North Dakota, Minnesota and some of South Dakota the source of generation “trapped” in Minnesota? Does the ending of the shaded area on the eastern Minnesota border mean that generation from the west stops at the border? How does this 345kV project at issue in this docket affect this scenario?  |
| 01-110 | SNS | P. 25 & Figure H – How does this 345kV project at issue in this docket affect the scenario depicted in Figure H?  |
| 01-111 | SNS | p. 25, FERC Designated Narrow Constrained Areas – provide map showing these areas. What FERC Designated Narrow Constrained Areas are present in Minnesota? In Wisconsin? What is impact of this 345kV project at issue in this docket on those constrained areas?   |
| 01-112 | SNS | p. 26 – if SE Minnesota, northern Iowa and SW Wisconsin are constrained, why is this not reflected in Figure G and H?   |
| 01-113 | SNS | P. 25-26 – Define “congestion” and “constraint” and compare and contrast the two terms.   |
| 01-114 | SNS | p. 27, regarding “anecdotally, the IMM has declined to reassess the status” of the NCA – isn’t it correct that MISO argued that “With regard to the duration of the NCA, Midwest ISO asserts that the factors necessitating the new NCA are sufficiently clear to permit the IMM to assess the likelihood that congestion levels would persist or abate and thus when it would be appropriate to disband the NCA.” What is the history of Manitoba Hydro exports over last 10 years? Is Manitoba Hydro now exporting at prior levels? Is the A.S. King plant still on its 10-month outage? What other factors have changed?   |
| 01-115 | SNS | Regarding the FERC order ( <a href="http://elibrary.ferc.gov/idmws/common/OpenNat.asp?fileID=11231068">http://elibrary.ferc.gov/idmws/common/OpenNat.asp?fileID=11231068</a> ) isn’t it correct that the Southeast Minnesota constraint was northward from Iowa into Minnesota, from “Tiffin in eastern Iowa to Arnold, to Hazleton, to Adams, to Pleasant Valley, and to Prairie Island in southern Minnesota.” and the other also from Raun in western Iowa to Lakefield, Wilmarth and Blue Lake?” Provide studies, reports, and any and all other documentation that the 345kV project at issue in this docket has an impact on these claimed constraints. Provide any and all documentation that the addition of the 345kV project at issue in this docket will not exacerbate south to north flows on these two paths. |
| 01-116 | SNS | Isn’t it correct that the Mid-American Neal 3 coal-fired generating unit connects directly via the 0.9 mile Neal 3 transmission line to the Raun substation?  |
| 01-117 | SNS | P. 27 & 28 reference the MISO State of the Market Report – provide copies/links to all State of the Market reports, annual and quarterly.   |
| 01-118 | SNS | p. 28 – “... the 345kV project will provide the necessary foundational facilities to increase transfers across the MWEX interface.” Alone, will the 345kV project at issue in this docket increase transfers across the MWEX interface?   |
| 01-119 | SNS | p. 28 – “If the 345 kV Project is constructed, any one of several additional 345 kV connections to the east... would result in a significant MWEX transfer capability increase.” Therefore, an eastern connection is required to see significant increase in MWEX transfer capability?  |

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| 01-120 | SNS | p. 29 reports “new peaks.” Isn’t it correct that Xcel’s SEC 10-k filing reported peak demand of 9,859 in 2006?   |
| 01-121 | SNS | p. 29-30 regarding MISO Multi-Value Projects – what is relationship between MISO’s recommendation of projects as “MVP” projects and the state of Wisconsin’s criterion for determination of need and impacts of transmission infrastructure?   |
| 01-122 | SNS | p. 30 – What load serving entities are enabled, by the LaCrosse-Madison transmission line in meeting their state-mandated renewable energy standards? Has the LaCrosse to Madison line been applied for in this docket? What is impact of the line at issue in this docket, the Hampton-LaCrosse transmission line, on enabling load-serving entities in meeting their state-mandated renewable energy standards? Provide documentation of whether and how these two transmission lines enable load-serving entities in meeting their state-mandated renewable energy standards. |
| 01-123 | SNS | p. 30, fn. 24 – The MVP powerpoint focuses on economic issues, e.g., slide 3, “Conditions Precedent to Increased Transmission Build.” Provide documentation of engineering basis for Multi-Value Projects.   |
| 01-124 | SNS | p. 30, “least-cost delivery of reliable electric power.” Minnesota and Wisconsin have had traditionally low electric rates. If market focus enables distribution of lower-cost power to higher cost states, what will be the rate impact on these traditionally lower cost states? Least cost for who? Where? Hasn’t Xcel/NSP in Minnesota asked for a 37.5% rate increase over 5 years in the latest rate case? What is rate increase Xcel/NSP is seeking in its latest Wisconsin rate case?  |
| 01-125 | SNS | p. 30 – “A central factor in the effectiveness of the LaCrosse to Madison line is the presence of a 354kV connection in the LaCrosse Area that will enable the efficient transfer of energy between Minnesota, western Wisconsin, and eastern Wisconsin.” Is “efficient transfer” meant in engineering sense or economics? Explain relation of “efficient transfer” to “least-cost delivery of reliable electric power.” Explain whether capital cost of transmission build-out reflected in “least-cost delivery” as described here.  |
| 01-126 | SNS | p. 31. The testimony and exhibits in MN Certificate of Need for this 345kV project reflect MVA ranging from 2211-2050 MVA (Kline, Tr. Vol 7, p. 55, l. 23-24 (capacity); Ex. 76, Shedin Attachment J, Applicants’ Response to JI IR No. 3 (2211MVA); Kline, Tr. Vol. 7, p. 57, l. 4 (2050). Are line specifications found in Minnesota record, MVA ranging from 2211-2050 MVA the same as proposed in this Wisconsin docket? Would line be double circuited? If double circuited, would that essentially double the MVA?   |
| 01-127 | SNS | p. 31 - What is engineering basis for line specifications of this magnitude for LaCrosse load?   |
| 01-128 | SNS | p. 31 – provide annual Loss of Load Expectation information for LaCrosse area generators over last decade.   |
| 01-129 | SNS | p. 31 – Provide Genoa generation outages over the last 10 years.   |
| 01-130 | SNS | p. 34-35, Figure K – see attached Exhibit /, Comparison of LaCrosse substation data. Do you agree this is an accurate compilation of information depicted in the MN Certificate of Need docket, the initial CPCN application and the August 2011 Supplemental Need Study(SNS)? For the MN CoN numbers, which are actuals and which are forecast? Are the SNS 2010 numbers in Figure K “actuals?” Why has there been no adjustment of the furthest right column when there has been changes to the MW numbers further to the left over time?                                      |
| 01-131 | SNS | P. 34-35, Figure K – were these forecasts conducted using MISO’s Peak Forecasting Methodology Review? Have they been reviewed by MISO? Result of review?   |
| 01-132 | SNS | p. 34-35, Figure K – How many MW of Demand Response is in affected LaCrosse area? Energy Efficiency?   |
| 01-133 | SNS | p. 34-35, Figure K – Provide narrative summary of non-coincident peak forecast methodology, net energy for load forecast methodology and coincident peak forecast methodology, supporting studies and materials for LaCrosse forecasting.  |
| 01-134 | SNS | p. 36, Figure L – Are the growth estimates in Figure L consistent with growth factors in MISO’s MTEP12 Futures Matrix? See e.g. <a href="http://legalelectric.org/f/2011/10/miso-20111026-pac-mtep12-futures-matrix.pdf">http://legalelectric.org/f/2011/10/miso-20111026-pac-mtep12-futures-matrix.pdf</a>  |

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| 01-135 | SNS  | p. 36-38 – Provide updated table such as Figure K (referenced above) for Rochester substations, as was provided in Certificate of Need proceeding and Testimony of Amanda King.  |
| 01-136 | Redlined CPCN Application p. 2-40 and 2-41 | Regarding LaCrosse forecast, WI CPCN Application pages 2-40 and 2-41, redlined version, column "Load MW 2010" several questions: 1) are the red versions just to the right of the strike-outs the actual "Load MW 2010?"<br>2) is the Holland substation a new substation?<br>3) was load transferred to Holland substation from another substation? If so, which one(s)?<br>4) despite reductions in many of the Actuals, only two "Projected" loads have been altered, for Brice and New Amsterdam. What is basis for changes made?  |
| 01-137 | CPCN App.                                  | Table 2.1-10, for each substation, identify transformers and MVA rating (e.g., Hiawatha Project, MN PUB Docket 10-694, Testimony of Zima, Sched. 3). For transformers, identify percentage of utilization.   |
| 01-138 | CPCN App.                                  | Table 2.1-10, for each substation, identify feeder lines and MVA rating (e.g., Hiawatha Project, MN PUC Docket 10-694, Testimony of Zima, Sched. 2). For feeder lines, identify percentage of utilization.   |
| 01-139 | SNS  | p. 38 – "However, the Minnesota Certificate of Need Order approved a double-circuit capable 345 kV design from the Hampton Substation to the Alma crossing." In addition to the Alma crossing of the Mississippi River was any other location other than Alma presented to the Minnesota Public Utilities Commission by the applicants as an alternative crossing location? In addition to the Alma crossing of the Mississippi River was any other location other than Alma presented to the Wisconsin Public Service Commission by the applicants as an alternative crossing location? |
| 01-140 | SNS  | p. 39, Alternatives Considered. This addresses post 2009 alternatives. What alternatives were considered in the 2004-2005 early CapX 2020 studies? Identify those alternatives not now considered, and of those not now considered as alternatives, why were they eliminated?  |
| 01-141 | SNS  | p. 46-48 PSCW Alternatives – Provide documentation and studies supporting conclusions regarding PSCW Alternatives.   |
| 01-142 | SNS  | Loss Calculations – is the loss calculation based on system losses of this 345kV addition when compared to losses in the Eastern Interconnect?   |
| 01-143 | SNS  | p. 49, Figure R:<br>1) Why is "Term of loss reduction" set at 40 years where "Assumed life, xmsn" is set at 35 years?<br>2) Explain meaning of "Loss Factor 0.30"<br>3) What is basis for assumption of 50% peaking and 50% baseload?<br>4) What is basis for \$/kW attributed to peaking and baseload capacity?   |
| 01-144 | SNS  | p. 50, Figure S – column "System Losses/MW" – if these are the losses, what is the gross MW of which these losses are part?  |
| 01-145 | SNS  | Regarding losses, provide and all losses analysis addressing impacts of double circuiting, including but not limited to MAPP TPSC Economic Planning Studies, System Losses Screening Analysis.   |
| 01-146 | SNS  | p. 55, notes study of 345kV line connecting LaCrosse and Madison – provide copy of this study.   |
| 01-147 | SNS  | p. 55, "The 345k V Project is needed to meet the identified local and regional needs regardless of whether additional facilities are constructed to the east." If further facilities are NOT constructed to the east, what size is justified, i.e., is 345kV line needed, is bundled conductor needed, is double circuited, what amps and MVA of capacity are needed? Provide studies, other documentation as basis for answer.  |
| 01-148 | SNS  | p. 56 – Eau Claire-Aprin special protection system ("SPS") – What is "special protection system." Is this an iteration of the  |

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|        |         | operating guide that limits MW on the transmission line? Provide documentation of "Special protection system"  |
| 01-149 | SNS     | Regarding Eau Claire-Arpin operating guide, provide copies of any and all studies regarding blackout on 6/25/1998 that reference operating guide and NSP operators non-compliance with operating guide, including but not limited to "Northern MAPP/Northwestern Ontario Disturbance, June 25, 1998, Final Report (September 2, 1998)" and NERC's "1998 System Disturbances: Review of Selected Electric System Disturbances in North America" |
| 01-150 | SNS     | P. 56 – under what circumstances would the Eau Claire-Arpin SPS be retired? How could/would a 345kV line to the east eliminate the need for the SPS?   |
| 01-151 | SNS     | RES requirements – what RES requirements are being discussed here, expressed in name of utility, load in kWhr of which a % is to be RE, and % of RES?  |
| 01-152 |         | Applicant Xcel has a RES in Minnesota and Wisconsin. What progress has Xcel made in each state?  |
| 01-153 |         | What progress are individual utilities making toward RES requirements when compared to the 2007 Gap Analysis?  |
| 01-154 | Routing | For routing evaluation purposes, please provide map of Wisconsin transmission lines under 69kV and distribution lines.   |
| 01-155 |         | Provide criteria utilized for any classification of information requested as "Critical Energy Infrastructure Information" and provide for review, and potential execution, agreement regarding CEII information.   |
| 01-156 |         | Provide for review, and potential execution, agreement authorizing confidential release of NSP proprietary information.  |

## **Exhibit D**

### **NoCapX2020 Initial Data Requests to ATC**

**Capx 2020 Hampton - Rochester - LaCrosse 345k V Transmission Project  
PSC Docket 05-CE-136**

**NoCapX 2020 “01 Series” Data Requests to American Transmission Company/ATC Management**

| <b>DR No.</b> | <b>Reference</b>                 | <b>Data Request</b>  |
|---------------|----------------------------------|--|
| 01-1          |                                  | Please provide NoCapx2020 with a copy of all of American Transmission Company and/or ATC Management Data Request responses to all other parties in this proceeding.  |
| 01-02         | Lobbying                         | For all lobbyists retained or employed by American Transmission Company and/or ATC Management since 2000, and for each year, provide:<br>1. Names; lobbyists employer or business organization (i.e. Michael Best & Friedrich, Cullen Weston Pines & Bach), and address;<br>2. Dates registered to lobby for ATC in that legislative session;<br>3. For each, identify other entities retaining each American Transmission Company/ATC Management lobbyist, i.e., Lee Cullen, also lobbying for RENEW Wisconsin, Wind on the Wires, , etc. |
| 01-03         | CEII & Confidentiality Agreement | For any data request responses containing CEII and/or proprietary information, provide confidentiality agreement for execution.  |
| 01-04         | CEII Information                 | For any data request response containing CEII information, provide criteria under which it has been designated CEII.   |
| 01-05         | SE MN – SW WI                    | Please provide a copy of “Southeastern Minnesota-Southwestern Wisconsin Reliability Enhancement Study (March 13, 2006) and subsequent iterations.  |
| 01-06         | Transmission Studies             | Provide any and all transmission studies regarding transmission of 138kV or higher voltage connecting in western Wisconsin from at the north, St. Croix Falls and ranging southward through LaCrosse to the southernmost edge of western Wisconsin, and then headed easterly (in western Wisconsin not within an ATC Zone).  |
| 01-07         | Transmission Studies             | Provide any and all ATC transmission studies regarding transmission connecting at LaCrosse, Alma, or any other location, to the CapX 2020 lines coming from Minnesota.   |
| 01-08         | Transmission Studies             | Please provide a copy of all electrical, transmission and or market studies by Applicant, ATC, Minnesota Transmission Owners and/or others, referencing the CapX 2020 Hampton-Rochester-LaCrosse transmission line.  |
| 01-09         | Transmission Studies             | Please provide a copy of all electrical, transmission and or market studies by Applicant, ATC, Minnesota Transmission Owners and/or others, referencing a LaCrosse to Madison area/Columbia/W. Middleton transmission line.  |
| 01-10         | Transmission Studies             | Please provide a copy of all electrical, transmission and or market studies by or reviewed by ATC referencing transfer capacity of CapX 2020 into Wisconsin, and all study appendices.   |

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| 01-11 | Transmission Studies            | Please provide a copy of all electrical, transmission and or market studies by Applicant, ATC, Minnesota Transmission Owners and/or others, regarding transmission needs in LaCrosse, WI and surrounding area served by LaCrosse substations listed in Application and Supplemental Need Study.   |
| 01-12 | Transmission Studies            | Please provide copies of complete ATC transmission “plans,” “scenario assessments” including but not limited to 10 year Transmission Plan and other reports that address Southeast Minnesota and Western Wisconsin transmission, and provide underlying studies supporting such plans and assessment.   |
| 01-13 | EIPC/JCP planning               | Provide copies of EIPC and JCSP studies that reference transmission through ATC Zones.  |
| 01-14 | Transmission Reliability Review | Provide copies of ATC internal reliability reviews for 2000 to present.   |
| 01-15 | Transmission Reviews            | Provide copies of ATC economic planning studies that address Minnesota to Wisconsin transfer capacity, Minnesota to Wisconsin congestion, and energy and demand loss within Wisconsin.  |
| 01-16 | Economic Planning               | Provide copies of studies and/or reports of transfer capacity, in and through ATC territory, by others that have been reviewed by ATC.  |
| 01-17 | Economic Planning               | Provide copies of economic benefits studies and reports commissioned, drafted, participated, funded, and/or studied, all or in part, by ATC, or addressing benefits associated with transmission through ATC Zones.   |
| 01-18 | Forecasting                     | ATC’s “Load Forecasting Process” is quite different from that of MISO in its “Peak Forecasting Methodology Review.” Has ATC adopted MISO Peak Forecasting Methodology? Has ATC’s Badger-Coulee line utilized either ATC’s “Load Forecasting Process” and/or MISO’s Peak Forecasting Methodology?” Provide documentation.  |
|       |                                 | <b>ATC 10 Year Plan</b>   |
| 01-19 | Transmission planning           | Looking at the ATC planning zones, LaCrosse is not within an ATC planning zone. What is ATC’s basis for proposing a transmission line beginning in an area not within the planning zone?  |
| 01-20 | Transmission Planning           | Please provide a hard copy of the ATC 10 Year Plan – the website is confusing as to what is in plan, what is not, what order it is in, etc.   |
|       |                                 | <b>Western Wisconsin Transmission Reliability Study</b>   |
| 01-21 | Transmission Planning           | Please provide a confidentiality agreement for review and execution and, if executed, both an electronic and hard copy of ATC’s Western Wisconsin Transmission Reliability Study, September 20, 2010.   |
| 01-22 |                                 | p. 1 – The Western Wisconsin Transmission Reliability Study notes that “This Transmission Study is part of a larger ‘combination of benefits’ that takes into account the reliability needs of the study area through this study, the economic savings created by the projects under study and the public policy benefits that would be created by these options.” Regarding that quotation:<br>1. Provide documentation of reliability needs referred to above;<br>2. Identify with specificity “economic savings created by the projects under study” and the “projects under study” and provide any and all studies and/or reports documenting such economic savings;<br>3. Identify with specificity any and all “public policy benefits that would be created by these options.” |
| 01-23 |                                 | Transmission typically has a useful life of at least 35 years – why was an 8-10 year-out time frame selected for this study? Provide any studies with a 35 year or longer year-out time frame.  |
| 01-24 |                                 | Power flow analyses – provide means to access (software, or terminal with software installed), cases in accessible and  |

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|       |  | usable format, and for review power flow analyses.  |
| 01-25 |  | p. 1 – “Total wind generation in Minnesota, Iowa and Wisconsin within the MISO region is 10,006 MW, which is approximately the amount of wind needed to meet the RPS requirements of Minnesota, Wisconsin and Iowa in 2020.” Do you agree that these states can meet their RPS requirements?  |
| 01-26 |  | From the p. 1 statement above, p. 2 jumps into 7 transmission options. Explain the transition from a purpose of identifying and documenting reliability needs to 7 specific transmission proposal options. What is the purpose of each of these transmission options? What reliability needs does each transmission proposal address?   |
| 01-27 |  | p. 2 - Three transmission options in this study connect to the 345kV line proposed in this docket. If the CapX 2020 345kV line is not built to LaCrosse, is there any reason to propose a LaCrosse-Cardinal transmission line? If the CapX 2020 345kV line is built only to Alma, would the proposals for Wisconsin begin at Alma? Explain.   |
| 01-28 |  | Identify distinctions between this ATC Western Wisconsin Transmission Reliability Study and that which produced the North LaCrosse-Columbia line in the CapX 2020 Vision Plan? See CapX 2020 Technical Update: Identifying Minnesota’s Electric Transmission Infrastructure Needs (October 2005); Figure 1-9: Geographic Scope of CapX 2020, CapX 2020 Certificate of Need Application, Three 345kV Projects (August 16, 2007).   |
| 01-29 |  | Please refer to WRAO (1998) (online at: <a href="http://www.arrowhead-weston.com/pdf/report1.pdf">http://www.arrowhead-weston.com/pdf/report1.pdf</a> ). How is the ATC Western Wisconsin Transmission Reliability Study different from that which produced the Wisconsin portions of the Lakefield-Columbia and/or Prairie Island-Columbia in the WRAO and WIREs studies? Provide documentation of the distinctions that are beyond that contained within the Western Wisconsin Transmission Reliability Study.  |
| 01-30 |  | One of the purposes of the WRAO-WIREs study was to determine how to increase transfer capacity into Wisconsin and the amount of transfer capability is similar in both. Did the transmission project recommended in WRAO and built achieve that amount of transfer capacity? Is the transfer capability anticipated in the Western Wisconsin Transmission Reliability Study that same 2,000+MW or is this in addition to the transfer capacity of WRAO-WIREs? See WIREs Table 1, p. 19 at <a href="http://www.arrowhead-weston.com/pdf/report1.pdf">http://www.arrowhead-weston.com/pdf/report1.pdf</a> ).      |
| 01-31 |  | Regarding quotation in 1-20 above, compare with that on p. 4, “ATC has been analyzing the combined reliability, economic, and policy benefits of these options for approximately two years and has determined that a 345kV project from the LaCrosse area to the greater Madison area (the Badger Coulee Project) would provide multiple benefits. ATC has recently announced its intention to finalize its evaluation of these combined benefits and to begin public outreach on the Badger Coulee Project.” Provide the finalized evaluation of the combined benefits referred to on p. 4 but not documented. |
| 01-32 |  | Does selection of the Badger Coulee Project rely on approval and construction of the CapX 2020 Hampton-Rochester-LaCrosse transmission line at issue in this docket? Does selection of the Badger Coulee Project rely on a 345kV transmission line into LaCrosse from the west?   |
| 01-33 |  | p. 5, Table ES-2 and Appendix A: Transmission Option details. Are the costs associated with Options inclusive of the itemized listings under each, or are the itemized listings the “Supporting Facilities” in Table ES-2, or those in Appendix D? If in Table ES-2, or Appendix D, are there additional “supporting facilities” required that are not listed?  |
| 01-34 |  | p.6 (map) – is the Hampton-Rochester-LaCrosse transmission line at issue in this docket (05-CE-136) depicted on this map?   |
| 01-35 |  | p. 9 – “The CapX 2020 Group I project Hampton Corners – North Rochester – North LaCrosse 345kV line... addresses the load serving needs in the Rochester and LaCrosse areas. It was anticipated that extending this 345 kV line to interconnect with the existing Wisconsin 345 kV network will be beneficial to regional reliability as well as the western Wisconsin area.” Is this statement referencing the CapX 2020 Vision Study? Anticipated by what entity, when, why, on what basis?   |

|       |                               |   |
|-------|-------------------------------|---|
| 01-36 |                               | p. 9 provides a list of “Transmission Owners” and includes “CapX 2020.” In what state is CapX 2020 incorporated, address of headquarters, and provide names of all “CapX 2020” personnel participating in this study.   |
| 01-37 |                               | p. 12 – states that “[t]he non-wind types of future/conceptual generating units sited inside the study area were removed.” Why were non-wind types of generating units in the study area removed? How many MW were removed? Identify these generating units by “common name,” MISO queue number, location and MW. Under what scenario would these “future/conceptual” generating units not be built? Does RES/RPS prohibit or limit future/conceptual non-wind generating units? Explain.   |
| 01-38 |                               | p. 13 – Does the list of generation in Table 2.1 contain all the Wind generation in MISO expected to be added by 2018? What is source of information in Table 2.1?  |
| 01-39 |                               | p. 13 – Does the list of generation in Table 2.2 contain all the Wind generation in MISO expected to be added by 2018? Yes or no, and please explain why these “future wind units” were selected. What is source of information in Table 2.2?   |
| 01-40 |                               | p. 14 – What is the reason for including only existing, planned and future wind generation on this map and in the study model? Is there no other generation existing, planned or future? Will this ATC transmission project carry only electrons generated by wind?   |
| 01-41 |                               | p. 15-16 – Where the study area, Monitored Facilities Subsystem and Contingent Facilities Subsystem affect a wide geographic area, why was the Big Stone II generation and transmission facilities not removed from the model?  |
| 01-42 |                               | p. 16 – What is basis for inclusion of Hampton Corner – North Rochester – North LaCrosse 345kV line in the model? Has this project received a Certificate of Convenience and Public Necessity in Wisconsin?   |
| 01-43 |                               | p. 16 – If the models are run without inclusion of the projects not approved (Brookings generation and transmission; Hazel Creek-Panther-McLeod-Blue Lake (Minnesota “Corridor” project) and the Hampton Corner – North Rochester North LaCrosse project, what would impact be, individually and in combination? If any of these scenarios have been run, provide results.  |
| 01-44 |                               | p. 17 – Where 3,150 in generation is added, what is basis for selection of this generation? Is this list consistent with the MISO queue for generation interconnection requests in these three control areas (694, 600, 627)?   |
| 01-45 |                               | p. 19-20 – “These results indicate potential voltage collapse conditions under the three single event Category C contingencies in the base case without a transmission option included.” Is it correct that this means that the potential voltage collapse conditions were present before running any of the options listed in Table 4.1 (p. 19)?   |
| 01-46 |                               | p. 19-20 – Was a sensitivity analysis of the base model run with and without individual and/or combinations of the “Major Planned or Proposed Projects Included in the Base Models” listed on p. 16?  |
| 01-47 | <b>Xcel/GRE Press Release</b> | See attached Press Release 4/3/09, which states, “Utility transmission planning engineers – representing transmission owners in Iowa, Minnesota, North Dakota, South Dakota, Wisconsin and Manitoba – were consulted to gather information on new generation data and the accuracy of transmission modeling through 2016.” Were ATC personnel part of this effort? What studies did ATC participate in that are referred to in this press release? Provide copies of studies referred to.   |
| 01-48 |                               | The Xcel/GRE press release states, “Without a line to the east of Minnesota, the transmission system will reach a “tipping point” where reliability is compromised, according to the studies.” Is the “tipping point” referenced in this press release related to the “potential voltage collapse conditions” referred to on p. 19-20 of the Western Wisconsin Transmission Reliability Study? If not, are you aware of studies and/or reports demonstrating the premise that “without a line to the east of Minnesota, the transmission system will reach a tipping point where reliability is compromised?” |
| 01-49 | Green Power Express           | Regarding transfer capacity and capability into and through Wisconsin, what letters, testimony and comments are Applicants aware of from “Eastern” sources critical of transmission proposals from the Midwest to the East Coast, i.e., Letter of   |

|       |                      |   |
|-------|----------------------|---|
|       |                      | withdrawal from JCSP announcement by NYISO and ISO-NE; “10 Mid-Atlantic Governors” letters; testimony of New York’s Deputy Commissioner of Energy, etc. Provide copies of all critiques of the JCSP plan of which Applicants are aware.                               |
|       | <b>ATC Zones</b>     | What is the extent of ATC’s jurisdiction and/or planning regarding the western part of Wisconsin not in an ATC Zone?  |
| 01-50 | Existing Xmsn System | What plans are there to upgrade Xcel’s existing transmission system (over 110kV) in Wisconsin?  |
| 01-51 | Existing Xmsn System | If the CapX 2020 Hampton-Rochester-LaCrosse 345kV is built, what associated upgrades or supporting facilities are necessary in Wisconsin?   |
| 01-52 | Upgrades             | The CapX 2020 SNS identifies 200 miles of upgrades in the LaCrosse area are needed. Identify which upgrades ATC is involved in planning or construction. Identify those LaCrosse transmission projects on map, and identify which are scheduled for upgrade and when. |
| 01-53 | ATC Studies          | Provide any and all other studies cited in and/or relied on in the ATC 10 year Plan and Western Wisconsin Transmission Reliability Study.   |
| 01-54 | DOE Money            | Provide copies of any and all applications by ATC to U.S. Dept. of Energy for funds for any and/or transmission in Western Wisconsin, and any and all supporting documents, disbursements and record of monies spent.   |
| 01-55 | Proliferation        | For routing evaluation purposes, please provide map of Wisconsin transmission lines 69kV and under and distribution lines.  |

**From:** Sandok, Mary R [<mailto:Mary.R.Sandok@xcelenergy.com>]  
**Sent:** Friday, April 03, 2009 9:50 AM  
**To:** undisclosed-recipients  
**Subject:** News Release: Upper Midwest Utilities Identify Electric Transmission Upgrades To Meet Renewable Energy Standard Milestones

**Contact Information**  
**Randy Fordice, Great River Energy**  
(o)763-445-5713  
(c)612-865-1366  
**Mary Sandok, Xcel Energy**  
(o) 612-215-5329  
(media line) 612-215-5300

**News Release**  
**April 3, 2009**

## **Upper Midwest Utilities Identify Electric Transmission Upgrades To Meet Renewable Energy Standard Milestones**

### **Improvements Necessary in Wisconsin to Maintain System Stability**

MINNEAPOLIS —Upper Midwest utilities have identified improvements needed in the region's high-voltage electricity transmission system to ensure they can deliver the renewable energy necessary to meet Minnesota's renewable energy milestones beginning in 2016.

Minnesota's 2007 Next Generation Energy Act requires that utilities increase renewables on their systems in increments and by 2025 deliver 25 percent of their energy from renewable sources (Xcel Energy is required to deliver 30 percent by 2020). It's estimated that 4,000 to 6,000 megawatts of renewable energy will be needed to meet Minnesota's Renewable Energy Standard. North Dakota, South Dakota and Wisconsin have 10 percent by 2015 renewable energy targets.

The utilities identified transmission needs in studies published this week. The studies can be downloaded at [www.minnelectrans.com](http://www.minnelectrans.com).

The studies confirmed that replacing a 60-year-old 230-kilovolt line that runs between Granite Falls and Shakopee with a double-circuit 345-kilovolt line would unlock up to 2,000 megawatts of transmission capacity from wind-rich areas in southern and western Minnesota, North Dakota and South Dakota.

"Upgrading the 230-kilovolt line is the most cost-effective way to meet the 2016 renewable energy standard milestone," said Kent Larson, transmission vice president at Xcel Energy. "The upgrade will optimize capacity from the CapX2020 Group 1 lines, which are moving through the permitting processes, and serve as the next phase of our regional transmission build out to efficiently deliver wind power to our customers."

The 125-mile line would cost an estimated \$350 million, with an additional \$110 million for underlying system improvements.

The studies also found that further upgrades in Minnesota and the Dakotas (beyond the 230-kilovolt line upgrade) will not provide significant benefit prior to installation of a high-voltage transmission line between the La Crosse, Wis., area and the Madison, Wis., area. Without a line to the east of Minnesota, the transmission system will reach a "tipping point" where reliability is compromised, according to the studies. The studies found that the combination of the new 345-kilovolt double circuit line between Granite Falls and Shakopee and a new Wisconsin line would increase the transmission system transfer capability by 1,600 megawatts for a total increase -- with the 2,000 megawatts from the new 345-kilovolt line in Minnesota -- of approximately 3,600 megawatts.

A joint transmission planning study now under way by several utilities aims to determine the need for a new transmission line between La Crosse and Madison. The study is expected to be completed by 2010.

"The renewable energy requirements of states in the Upper Midwest will be efficiently met with further 345-kilovolt transmission line expansion," said Will Kaul, transmission vice president at Great River Energy. "Policy changes, such as the passage of a national renewable energy standard, may lead to the consideration of a 765-kilovolt overlay. However, the 345-kilovolt projects identified in the studies conducted by the Upper Midwest transmission-owning utilities are still required as a foundational component of a 765-kilovolt overlay."

## Study Details

- The studies were sponsored by Minnesota load-serving utilities, including: Basin Electric Cooperative (also representing East River Electric Power Cooperative and L&O Power Cooperative), Central Minnesota Municipal Power Agency, Dairyland Power Cooperative, Great River Energy, Heartland Consumers Power District, Minnesota Municipal Power Agency, Minnesota Power, Minnkota Power Cooperative, Missouri River Energy Services (also representing Hutchinson Utilities Commission and Marshall Municipal Utilities), Northern States Power Co.-Minnesota, an Xcel Energy company, Otter Tail Power Company, Rochester Public Utilities, Southern Minnesota Municipal Power Agency, and Willmar Municipal Utilities.
- The study teams conferred with the state Office of Energy Security's technical review committee, which includes representatives from the Minnesota Department of Commerce, Office of Energy Security staff, wind advocacy organizations, the Midwest Independent Transmission System Operator and other regional transmission planners.
- Utility transmission planning engineers – representing transmission owners in Iowa, Minnesota, North Dakota, South Dakota, Wisconsin and Manitoba – were consulted to gather information on new generation data and the accuracy of transmission modeling through 2016.
- For the purposes of Minnesota Renewable Energy Standard compliance, the study teams assumed that wind-energy generation would be the primary source of generation developed.

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Also found on Xcel Energy's website:

<http://www.xcelenergy.com/Company/Newsroom/Pages/NewsRelease2009-04-03UpperMidwestUtilitiesIdentifyElectricTransmissionUpgrades.aspx>

## **Exhibit E**

### **NoCapX2020 Initial Data Requests to Dairyland Power Cooperative**

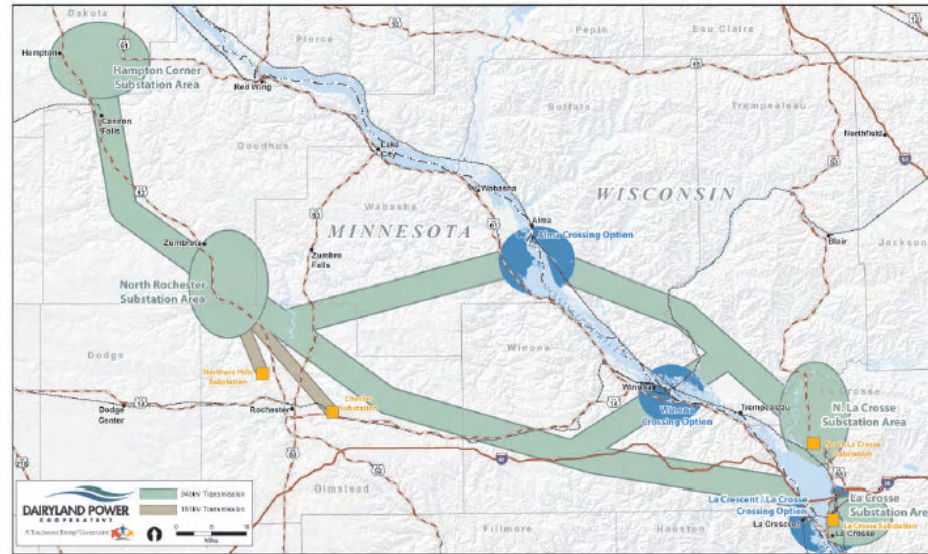
**Capx 2020 Hampton - Rochester - LaCrosse 345k V Transmission Project  
PSC Docket 05-CE-136**

**NoCapX 2020 “01 Series” Data Requests to Dairyland Power Cooperative**

| <b>DR No.</b> | <b>Reference</b>                 | <b>Data Request</b>   |
|---------------|----------------------------------|---|
| 01-01         |                                  | Please provide NoCapx2020 with a copy of all of Dairyland Power Cooperative Data Request responses to all other parties in this proceeding.   |
| 01-02         | CEll & Confidentiality Agreement | For any data request responses containing CEll and/or proprietary information, provide confidentiality agreement for execution.   |
| 01-03         | CEll Information                 | For any data request response containing CEll information, provide criteria under which it has been designated CEll.  |
| 01-04         | Transmission Studies             | Provide any and all transmission studies regarding transmission of 138kV or higher voltage connecting in western Wisconsin from at the north, St. Croix Falls and ranging southward through LaCrosse to the southernmost edge of western Wisconsin, and then headed easterly. |
| 01-05         | Transmission Studies             | Provide any and all Dairyland transmission studies, produced by Dairyland or in which Dairyland has participated, regarding transmission connecting at LaCrosse, Alma, or any other location, to the CapX 2020 lines coming from Minnesota.                                   |
| 01-06         | Transmission Studies             | Please provide a copy of all electrical, transmission and or market studies by Dairyland and/or others, referencing the CapX 2020 Hampton-Rochester-LaCrosse transmission line.   |
| 01-07         | Transmission Studies             | Please provide a copy of all electrical, transmission and or market studies by Dairyland and/or others, referencing a LaCrosse to Madison area/Columbia/W. Middleton transmission line.   |
| 01-08         | Transmission Studies             | Please provide a copy of all electrical, transmission and or market studies by or reviewed by Dairyland referencing transfer capacity of CapX 2020 into Wisconsin, and all study appendices.  |
| 01-09         | Transmission Studies             | Please provide a copy of all electrical, transmission and or market studies by Dairyland and/or others, regarding transmission needs in LaCrosse, WI and surrounding area served by LaCrosse substations listed in Application and Supplemental Need Study.                   |
| 01-10         | Transmission Studies             | Please provide copies of complete Dairyland transmission “plans,” “scenario assessments” including but not limited to reports that address Southeast Minnesota and Western Wisconsin transmission, and provide underlying studies supporting such plans and assessment.       |
| 01-11         | Transmission Reliability Review  | Provide copies of Dairyland internal reliability reviews for 2000 to present.   |

|       |                      |   |
|-------|----------------------|---|
| 01-12 | Transmission Reviews | Provide copies of Dairyland economic planning studies that address Minnesota to Wisconsin transfer capacity, Minnesota to Wisconsin congestion, and energy and demand loss within Wisconsin.  |
| 01-13 | Economic Planning    | Provide copies of studies and/or reports of transfer capacity, in and through Dairyland territory, by others that have been reviewed by Dairyland.  |
| 01-14 | Economic Planning    | Provide copies of economic benefits studies and reports commissioned, drafted, participated, funded, and/or studied, all or in part, by Dairyland, or addressing benefits associated with transmission through Dairyland's "territory" in Minnesota and/or Wisconsin.   |
| 01-15 | Forecasting          | Provide copies of Dairyland system load forecasting from 2000 to present. Has Dairyland adopted MISO Peak Forecasting Methodology? Has Dairyland system forecasting been reviewed by MISO? If so, provide documentation. If not, why?   |
| 01-16 | Forecasting          | Provide copies of Dairyland load forecasting for Rochester area and LaCrosse area from 2000 to present.   |
|       |                      | <b>USDA RUS Financing and Environmental Review – see Notice of Intent attached.</b>   |
| 01-17 | RUS                  | The Notice of Intent (NOI), attached, states that "Dairyland Power Cooperative is requesting RUS to provide financing for its portion of the proposed project." Provide copy of Dairyland's application/request to USDA/Rural Utilities Service and subsequent filings. If Dairyland claims that the application/request contains "CEII" or "proprietary" information, provide specific basis for such designation, and provide confidentiality agreement for review and execution.   |
| 01-18 | RUS                  | Provide copies of correspondence, emails and notes between Dairyland and RUS representatives, including but not limited to Stephanie Strength.  |
| 01-19 | RUS                  | The NOI states that an Alternative Evaluation Study (AES) and Macro Corridor Study (MCS) were prepared by Dairyland Power. Provide hard copy and link of the Alternative Evaluation Study (AES) and Macro Corridor Study (MCS) referenced and any and all subsequent iterations.  |
| 01-20 | RUS                  | The Minnesota Certificate of Need application proposed four Mississippi River crossings, at Alma, Winona, Trempealeau, and LaCrescent (PUC Docket 06-1115, Application p. 1.2). The Minnesota Transmission Routing application for the Capx 2020 Hampton-Rochester-LaCrosse transmission project proposed only one Mississippi River crossing, at Alma (PUC Docket 09-1448). Likewise, the Wisconsin CPCN application for CapX 2020 Hampton-Rochester-LaCrosse proposes only one Mississippi River crossing, at Alma (PSC 05-CE-136, Application, Figure 8, Map). Identify the number and locations of Mississippi River crossings proposed for review in the Dairyland application/request to RUS, in the AES (Figure 3.3 below) and MCS of May 2009, and the Mississippi River crossings proposed in any subsequent filings with RUS. If the Mississippi River crossings in the WI PSC CPCN application, one crossing proposed at Alma, are different from those in the Dairyland application/request to RUS, in the AES and MCS, explain the differences. For example, reference the AES Figure 3.3 below: |

**Figure 3-3  
Hampton–Rochester–La Crosse 345 kV Project, Proposed Configuration**



|       |                            |   |
|-------|----------------------------|---|
| 01-21 | Mississippi River Crossing | Provide documentation of discussions and input from USFWS and WDNR regarding Mississippi River crossings referenced in DEIS, p. 35.   |
| 01-22 | Mississippi River Crossing | Provide all correspondence regarding the potential locations of a Mississippi River crossing, including but not limited to those letters cited in narrative and footnotes in DEIS on p. 35-37.                        |
| 01-23 | Mississippi River Crossing | As a Co-Applicant, what is Dairyland's basis for inclusion of only one Mississippi River crossing in the Wisconsin CPCN application?  |
| 01-24 | DOE Money                  | Provide copies of any and all applications by ATC to U.S. Dept. of Energy for funds for any and/or transmission in Western Wisconsin, and any and all supporting documents, disbursements and record of monies spent. |
| 01-25 | Proliferation              | For routing evaluation purposes, please provide map of Wisconsin transmission lines 69kV and under and distribution lines.  |

and the original wooden bridge stringers and deck are beginning to fall into the stream channel. Constructing the bridge so the structure does not impede water flow, particularly during periods of high water, will be beneficial to the aquatic habitats. As part of the proposed action the West Fork Blacks Fork bridge will be replaced to provide access to salvage the lodgepole pine stands in Section 18, which are heavily infested by mountain pine beetles. Over the long term, it would provide access for the private property owner while allowing fire access, and other types of administrative uses on the National Forest by the Forest Service. This road has been gated for many years and this would continue if the bridge were replaced. The road would be periodically maintained to prevent erosion and deterioration of the road prism. The execution of easements would establish legal access and also provide for future maintenance.

There are five basic techniques that will be used to contain prescribed fire in the treatment units. Fire will be used alone or in conjunction with commercial timber harvest to achieve a mosaic of burned and unburned patches within some of the units. Specific methods of line control will be specified in the burn plan. Construction of line will use the minimum necessary disturbance. The following estimates of miles of each kind of fire line are approximate, but represent the upper end (most line construction) for control lines. It is likely that firing techniques will be utilized more and constructed lines less than the estimates given.

At least 3.9 miles of unit perimeter will utilize terrain features in conjunction with the firing patterns to selectively burn portions of the units. Natural features such as rock outcrops, openings, and wet riparian/stream corridors, will serve as anchors for utilizing firing techniques. In particular, Blacks Fork will function as the west fireline for most of the eastern burn unit. Created features such as areas where timber has been harvested may also be appropriate for control lines, depending on fuel conditions.

Up to about 0.3 miles of handline (averaging 24 to 36 inches wide and cleared to mineral soil) will be built and rehabilitated. Where vegetation is short and light, such as in sage and grass, fireline constructed by hand will be used to anchor the burning. Line will be appropriately rehabilitated (by mulching, seeding, and/or water barring, as needed) following completion of the burning to prevent erosion.

Approximately 1.0 miles of machine line could be used. Heavy equipment will be used to construct fireline where fuels are larger than feasible for handline, and natural features/firing techniques are not adequate for control. Line will average 72 to 96 inches in width and be cleared to mineral soil. Possible equipment includes (but is not limited to) bulldozers, rubber tired skidders, trail cats, and tracked excavators. Following burning, the lines will be rehabilitated (seeded and water barred as needed, and where available woody debris may be scattered along for microsite protection).

Approximately 0.9 miles of skid trails (including incidental machine line) will be used as fire containment lines. In timber sale units that have burning as secondary treatments skid trails for log removal will be placed along the perimeter and used also for containment of the fire. Skid trails are generally about 96 inches in width and have mineral soil exposed throughout much of their surface. As in the machine line, these will be rehabilitated following burning to prevent erosion. In small portions where it is not feasible to skid along the boundary then machine line will be built.

Approximately 4.1 miles of Forest System Road will be used for fire containment. Where existing roads coincide with burn unit boundaries these will be used as fire lines, such as along the eastern boundary of the eastern burn unit.

#### **Possible Alternatives**

In addition to the Proposed Action, a no action alternative will be considered. This alternative would simply continue current management without the actions of this proposal. Other alternatives may be developed in response to issues generated during the scoping process.

#### **Responsible Official**

Evanston-Mountain View District Ranger.

#### **Nature of Decision To Be Made**

The decision to be made is whether or not to implement vegetation treatments in the Blacks Fork project area, and if so, to what degree and where.

#### **Preliminary Issues**

Preliminary issues are the effects of treatments on wildlife habitat, and the effects of insect and disease outbreaks on current forest health.

#### **Scoping Process**

This notice of intent initiates the scoping process, which guides the

development of the environmental impact statement.

It is important that reviewers provide their comments at such times and in such manner that they are useful to the agency's preparation of the environmental impact statement. Therefore, comments should be provided prior to the close of the comment period and should clearly articulate the reviewer's concerns and contentions. The submission of timely and specific comments can affect a reviewer's ability to participate in subsequent administrative appeal or judicial review.

Dated: May 19, 2009.

**Stephen M. Ryberg,**

*District Ranger.*

[FR Doc. E9-12124 Filed 5-27-09; 8:45 am]

**BILLING CODE 3410-11-M**

## **DEPARTMENT OF AGRICULTURE**

### **Rural Utilities Service**

#### **Dairyland Power Cooperative, Inc.: Notice of Intent To Prepare an Environmental Impact Statement and Hold Public Scoping Meetings**

**AGENCY:** Rural Utilities Service, USDA.

**ACTION:** Notice of Intent To Prepare an Environmental Impact Statement and Hold Public Scoping Meetings.

**SUMMARY:** The Rural Utilities Service (RUS) intends to prepare an Environmental Impact Statement (EIS) and hold public scoping meetings and in connection with possible impacts related to a project proposed by Dairyland Power Cooperative in the CapX 2020 Hampton-Rochester-La Crosse Transmission Line Project. The proposal consists of the construction of a 345-kilovolt (kV) transmission line and associated infrastructure between Hampton, Minnesota and the La Crosse area in Wisconsin. The project also includes construction of new 161-kV transmission lines and associated facilities in the area of Rochester, Minnesota. The total length of 345-kV and 161-kV transmission lines associated with the proposed project will be approximately 150 miles. Proposed and alternate transmission segments and locations for proposed and alternate associated facilities have been identified by Dairyland Power Cooperative. Dairyland Power Cooperative is requesting RUS to provide financing for its portion of the proposed project.

**DATES:** RUS will conduct six public scoping meetings in an open-house format followed by a discussion period:

June 16, 2009, Plainview-Elgin-Millville High School, 500 West Broadway, Plainview, Minnesota; June 17, 2009, Wanamingo Community Center, 401 Main Street, Wanamingo, Minnesota; June 18, 2009, City of St. Charles Community Meeting Room, 830 Whitewater Avenue, St. Charles, Minnesota; June 23, 2009, La Crescent American Legion, 509 N. Chestnut, La Crescent, Minnesota; June 24, 2009, Centerville/Town of Trempealeau Community Center, W24854 State Road 54/93, Galesville, Wisconsin; and June 25, 2009, Cochrane-Fountain City High School, S2770 State Road 35, Fountain City, Wisconsin. All meetings will be held between 6–8:00 PM local time. Comments regarding the proposed project may be submitted (orally or in writing) at the public scoping meetings or in writing to RUS at the address listed in this notice no later than June 29, 2009.

**ADDRESSES:** To send comments or for further information, contact Stephanie Strength, Environmental Protection Specialist, USDA, Rural Utilities Service, Engineering and Environmental Staff, 1400 Independence Avenue, SW., Stop 1571, Washington, DC 20250–1571, telephone: (202) 720–0468 or e-mail: [stephanie.strength@usda.gov](mailto:stephanie.strength@usda.gov).

An Alternative Evaluation Study (AES) and Macro Corridor Study (MCS), prepared by Dairyland Power Cooperative, will be presented at the public scoping meetings. The reports are available for public review at the RUS address provided in this notice and at Dairyland Power Cooperative, 3251 East Avenue, South, La Crosse, WI 54602. In Addition, the reports will be available at RUS' Web site, <http://www.usda.gov/rus/water/ees/eis.htm> and at the following repositories:

Alma Public Library, 312 North Main Street, Alma, WI 54610, Phone: 608–685–3823.

Arcadia Public Library, 406 E Main Street, Arcadia, WI 54612, Phone: 608–323–7505.

Blair-Preston Library, 122 Urberg Street, Blair, WI 54616, Phone: 608–989–2502.

Campbell Library, 2219 Bainbridge Street, La Crosse, WI 54603, Phone: 608–783–0052.

Cannon Falls Library, 306 West Mill Street, Cannon Falls, MN 55009, Phone: 507–263–2804.

Dairyland Power Cooperative, 500 Old State Highway 35, Alma, WI 54610, Phone: 608–685–4497.

Galesville Public Library, 16787 South Main Street, Galesville, WI 54630, Phone: 608–582–2552.

Hokah Public Library, 57 Main Street, Hokah, MN 55941, Phone: 507–894–2665.

Holmen Area Library, 16787 South Main Street, Galesville, WI 54630, Phone: 608–526–4198.

Kenyon Public Library, 709 2nd Street, Kenyon, MN 55946, Phone: 507–789–6821.

Riverland Energy Cooperative, N28988 State Road 93, Arcadia, WI 54612, Phone: 608–323–3381.

Rochester Public Library, 101 2nd Street SE., Rochester, MN 55963, Phone: 507–328–2309.

Shirley M. Wright Memorial Library, 11455 Fremont Street, Trempealeau, WI 54650, Phone: 608–534–6197.

St. Charles Public Library, 125 W 11th Street, St. Charles, MN 55927, Phone: 507–932–3227.

Tri-County Electric, 31110 Cooperative Way, Rushford, MN 55971, Phone: 507–864–7783.

La Crescent Public Library, 321 Main Street, La Crescent, MN 55947, Phone: 507–895–4047.

La Crosse Public Library, 800 Main Street, La Crosse, WI 54601, Phone: 608–789–7109.

Onalaska Public Library, 741 Oak Avenue, South, Onalaska, WI 54650, Phone: 608–781–9568.

People's Cooperative Services, 3935 Hwy 14 E, Rochester, MN 55903, Phone: 507–288–4004.

Plainview Public Library, 115 SE 3rd Street, Pine Island, MN 55963, Phone: 507–534–3425.

Van Horn Public Library, 115 SE 3rd Street, Pine Island, MN 55963, Phone: 507–356–8558.

Winona Public Library, 151 West 5th Street, Winona, MN 55987, Phone: 507–452–4582.

Xcel Energy, 5050 Service Drive, Winona, MN 55987, Phone: 800–422–0782.

Xcel Energy, 1414 West Hamilton Avenue, Eau Claire, WI 54701, Phone: 715–839–2621.

Zumbrota Public Library, 100 West Avenue, Zumbrota, MN 55992, Phone: 507–732–5211.

#### **SUPPLEMENTARY INFORMATION:**

Preliminary proposed transmission line corridors and siting areas for substations have been identified. The EIS will address the construction, operation, and management of the proposed project, which includes a 345-kV transmission line and associated infrastructure between Hampton, Minnesota and the La Crosse area of Wisconsin; 161-kV transmission lines in the vicinity of Rochester, Minnesota; construction and maintenance of access roads for all proposed transmission lines;

construction of up to three new substations, and expansion of up to three existing substations. Total length of the transmission lines for the proposed project will be approximately 150 miles. The project study area includes part or all of the following counties in Minnesota: Dakota, Goodhue, Wabasha, Winona, Houston, Olmsted, Rice, and Dodge. In Wisconsin, the project area includes parts of the following counties: La Crosse, Trempealeau, and Buffalo.

Among the alternatives RUS will address in the EIS is the No Action alternative, under which the project would not be undertaken. In the EIS, the effects of the proposed project will be compared to the existing conditions in the area affected. Alternative transmission line corridors and substation locations will be refined as part of the EIS scoping process and will be addressed in the Draft EIS. RUS will carefully study public health and safety, environmental impacts, and engineering aspects of the proposed project and all related facilities.

RUS will use input provided by government agencies, private organizations, and the public in the preparation of the Draft EIS. The Draft EIS will be available for review and comment for 45 days. A Final EIS that considers all comments received will subsequently be prepared. The Final EIS will be available for review and comment for 30 days. Following the 30-day comment period, RUS will prepare a Record of Decision (ROD). Notices announcing the availability of the Draft EIS, the Final EIS, and the ROD will be published in the **Federal Register** and in local newspapers.

Any final action by RUS related to the proposed project will be subject to, and contingent upon, compliance with all relevant federal, state, and local environmental laws and regulations and completion of the environmental review requirements as prescribed in the RUS Environmental Policies and Procedures (7 CFR part 1794).

Dated: May 22, 2009.

**Mark S. Plank,**

*Director, Engineering and Environmental Staff, USDA/Rural Utilities Service.*

[FR Doc. E9–12407 Filed 5–27–09; 8:45 am]

**BILLING CODE P**

## **Exhibit F**

### **NoCapX2020 Initial Data Requests to MISO**

**Capx 2020 Hampton - Rochester - LaCrosse 345k V Transmission Project  
PSC Docket 05-CE-136**

**NoCapX 2020 “01 Series” Data Requests to Midwest Independent Transmission System Operator**

| <b>DR No.</b> | <b>Reference</b>        | <b>Data Request</b>   |
|---------------|-------------------------|---|
| 01-01         |                         | Please provide NoCapx2020 with a copy of all of Midwest Independent Transmission System Operator Data Request responses to all other parties in this proceeding.  |
| 01-02         | CEII & Proprietary Info | For any data request responses containing CEII and/or proprietary information, provide confidentiality agreement for execution.   |
| 01-03         | CEII                    | For any data request response containing CEII information, provide criteria under which it has been designated CEII.  |
| 01-04         | MISO Queue              | <p>Please provide, in Excel format, a listing of all active and inactive interconnection requests in the MISO queue for North Dakota, South Dakota, Minnesota, Iowa, Wisconsin, Illinois and Indiana, including:</p> <ol style="list-style-type: none"> <li>1. date of interconnection request;</li> <li>2. all types of generation, identifying fuel source</li> <li>3. state and county location</li> <li>4. megawatts</li> <li>5. links to studies completed</li> <li>6. status – active, hold, inactive, etc.</li> <li>7. labeled with date of compilation</li> </ol> <p>A downloaded Excel spreadsheet of the MISO queue will suffice.</p> |
| 01-05         | FERC                    | Please provide a listing of FERC dockets participated in by MISO from 2004-present regarding congestion in the Minnesota and/or Wisconsin area, including but not limited to tariffs that would address congestion. Provide docket number and name and link to FERC docket.   |
| 01-06         | FERC                    | Please provide a listing of FERC dockets participated in by MISO from 2004-present that address cost allocation for the CapX 2020 Phase I projects and the Hampton-LaCrosse line. Provide docket number and name and link to FERC docket.   |
| 01-07         | NCA                     | The Xcel Supplemental Need Study references “Narrow Constrained Areas.” Please provide all background documentation for the FERC designation of SE Minnesota, Northern Iowa and SW Wisconsin as a Narrow Constrained Area (NCA). See Xcel Supplemental Need Study, p. 26.   |

|       |                          |  |
|-------|--------------------------|--|
| 01-08 | NCA                      | Please provide all background documentation for the MISO “Independent Market Monitor” designation of SE Minnesota, Northern Iowa and SW Wisconsin as a Narrow Constrained Area (NCA). See Xcel Supplemental Need Study, p. 26.   |
| 01-09 | NCA                      | SNS, p. 26: “Analysis by the MISO IMM shows that two transmission lines in the Minnesota/Iowa/Wisconsin NCA were constrained for more than 15% of the hours during a one-year period (November 2005 through October 2006).” Please provide MISO IMM analysis subsequent to October 2006 regarding constraints in the region.   |
| 01-10 | MISO Interests           | MISO states in its intervention Motion “Statement of Interest” that it has an interest in interrelated issues of construction and operation of generation facilities, management of demand response and energy efficiency and functioning of the MISO energy markets. MISO states that these interests are different from those of the general public.<br>A. Identify MISO’s Wisconsin members and Wisconsin stakeholders.<br>B. How might these issues affect MISO’s Wisconsin members and Wisconsin stakeholders?<br>C. How are the interests of MISO’s Wisconsin members and Wisconsin stakeholders similar and distinct?<br>D. How are the interests of MISO’s Wisconsin members and Wisconsin stakeholders similar and distinct from those of the MISO members and stakeholders generally?  |
| 01-11 | MISO Interests           | MISO states in its Intervention Motion that it “meets the requirements of the good cause standard because MISO will be able to provide the Commission its perspective on day-to-day operations of the regional transmission under its control and will thereby promote the proper disposition of issues to be determined in this docket.”<br>A. In which MTEP did MISO first include the CapX 2020 Hampton-Rochester-LaCrosse line?<br>B. Was MISO an active intervenor in the Minnesota Certificate of Need proceeding?<br>C. On what date was the MISO Intervention Petition filed in Minnesota?<br>D. What are MISO’s reasons for failing to intervene before the intervention deadline established in June, 2011?<br>E. MISO has, without question, much information on the day-to-day operations of the regional transmission under its control. Identify in detail what new information and/or issues that have been raised as of November 7, 2011, that were not present as of the Intervention deadline in June, 2011. |
| 01-12 | MISO Interests           | MISO has a dual responsibility as reliability coordinator and as manager of an energy market. Identify MISO’s reliability-based interests as a reliability coordinator in this transmission proceeding.  |
| 01-13 | MISO Interests           | Identify MISO’s energy market-based interests in this transmission proceeding.   |
| 01-14 | MISO Interests           | What are the estimates of annual transmission revenue (all applicable tariffs) of the Hampton-Rochester-LaCrosse transmission line as a stand-alone project?   |
| 01-15 | MISO Interests           | What are the estimates of annual transmission revenue (all applicable tariffs) of the Hampton-Rochester-LaCrosse transmission line if the Badger-Coulee line is connected to the Hampton-Rochester-LaCrosse transmission line?   |
| 01-16 | MISO State of the Market | The following questions reference the <b>2010 State of the Market Report for the MISO Electricity Markets</b>  |
| 01-17 | MISO State of the Market | The Supplemental Need Study filed by Xcel in this docket references the 2010 State of the Market Report for the MISO Electricity Markets, June 2011 (“SOTM”). Provide a copy and/or link to the 2010 State of the Market Report, and any and all MISO State of the Market Reports from 2005 to present, including annual and quarterly reports.  |
| 01-18 | MISO State of the Market | Are higher electric prices based on congestion evidence of a functional market for electricity? If not, explain.   |

|       |                           |  |
|-------|---------------------------|--|
| 01-19 | MISO State of the Market  | What are the advantages of internalizing the cost of congestion?   |
| 01-20 | MISO State of the Market  | Does increased market use of transmission line increase reactive power requirements?   |
| 01-21 | MISO State of the Market  | Where commitments are made to “manage local voltage” what is purpose? Is it necessary to manage local voltage to assure stability of the system?   |
| 01-22 | MISO State of the Market  | There are multiple references to a relationship between natural gas prices and electrical prices in the SOFM. Is the natural gas price at issue the price for long-term contracts, spot market price, or something in between? Are natural gas generating plants typically operating on long-term contracts? What is the average term of a natural gas contract that a typical natural gas generator would utilize?  |
| 01-23 | MISO State of the Market  | The SOTM notes 28-37% planning reserve margins (p. iii). Provide MISO's most current planning reserve margin forecasts and date of forecasts.  |
| 01-24 | MISO State of the Market  | Where reserve margins are addressed, is the SOTM consistent with actuals and forecasts in NERC Reliability Assessments? 2010 NERC Long-Term Reliability Assessment: <a href="http://www.nerc.com/files/2010%20LTRA.pdf">http://www.nerc.com/files/2010%20LTRA.pdf</a> NERC Long-Term Reliability Assessment provides Summer and Winter reserve margin forecasts for 2010, 2014 and 2019. Are the reserve margins forecast for 2014 and 2019 consistent with those forecast by MISO? If not, explain distinctions. In addition, if MISO and MRO participants/jurisdictions are different, explain impact on reserve margins.  |
| 01-25 |                           | Where the SOTM notes that benefits can be achieved by importing to PJM, geographically, does “PJM” refer to the Illinois PJM or to points further east, or both? If both, what are the respective import goals?  |
| 01-26 | MISO State of the Market  | SOTM refers to “Steam Turbine” and “steam units.” See e.g. p. 63. What is fuel for these generators?   |
| 01-27 | MISO Operational Benefits | The following questions reference the ICF's <b>Independent Assessment of Midwest ISO Operational Benefits</b> , February 28, 2007, and <b>Addendum to the Independent Assessment of Midwest ISO Operational Benefits</b> , May 1, 2007.  |
| 01-28 | MISO Operational Benefits | The Hampton-Rochester-LaCrosse Application and Supplemental Need Study frequently state that the project will provide benefits. Please provide copy of ICF's <b>Independent Assessment of Midwest ISO Operational Benefits</b> , February 28, 2007, and <b>Addendum to the Independent Assessment of Midwest ISO Operational Benefits</b> , May 1, 2007, and any similar subsequent assessments of theoretical maximum potential benefits, percentage of benefits achievable, and benefits actually achieved.  |
| 01-29 | MISO Operational Benefits | <p>The above ICF report states on p. 9:</p> <p><i>This analysis was designed to focus on a subset of operational benefits available from Day-2 RTO operation which are quantifiable using commercially available models that simulate unit commitment and dispatch of electric generation. The focus was on production cost savings associated with centralized operations, and hence, primarily reflects estimation of the displacement of relatively more expensive generation with relatively less expensive generation made possible by centralized operation. In most cases the simulation indicated the potential displacement of gas-fired generation with coal-fired generation. This inter-fuel optimization is particularly important in the Midwest because the natural gas generation fleet includes a disproportionate level of expensive gas-fired peaking units as opposed to intermediate or less costly gas-fired combined cycle or gas-steam facilities. Further, Midwest ISO coal plants have very low operating costs even compared to other</i></p> |

*US coal-fired powerplants. Thus, any displacement of natural gas generation with coal generation can greatly decrease operating costs. Put another way, the use of a gas plant when somewhere else inside or outside of the Midwest ISO a coal plant with spare capacity and the needed transmission is available to displace the gas plant would increase costs significantly. As such, an important goal of grid optimization is to minimize these occurrences.*

- A. How is “spare capacity” defined as used above?
- B. To what extent is there “spare capacity” in the MISO region?
- C. SOTM for 2010 claims 28-37% reserve margins – to what extent to reserve margins reflect “spare capacity?”
- D. To what extent is the “needed transmission” available to effectuate this plan to reap operational benefits?
- E. To what extent would the Hampton-Rochester-LaCrosse provide additional “needed transmission?”
- F. Is the entire Capx 2020 Vision Plan necessary to provide these operational benefits?
- G. Is the Badger-Coulee line or some other 354kV transmission project extending eastward from the Hampton-Rochester-LaCrosse terminus necessary to provide “needed transmission?”

# **Exhibit G**

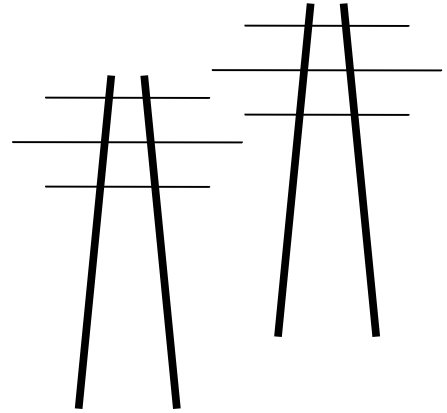
## **NoCapX2020 DEIS Comments**

# Legalelectric, Inc.

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December 23, 2011

William Fannucchi  
Docket Coordinator  
Public Service Commission  
P.O.Box7854  
Madison, WI 53707-7854

via email: [william.fannucchi@wisconsin.gov](mailto:william.fannucchi@wisconsin.gov)

RE: NoCapX Comments on DEIS  
CapX 2020 **Hampton-Rochester-LaCrosse** Transmission Project  
PSC Docket No.: 05-CE-136

Dear Mr. Fannucchi:

Thank you for the opportunity to submit comments on this Draft Environmental Impact Statement for the CapX 2020 Hampton-Rochester-LaCrosse Transmission Project.

Cover page - Starting with the title page of the DEIS, the project as named on the DEIS is not consistent with the name of the project applied for. The Application is for the “Hampton-Rochester-LaCrosse” transmission project. Please correct the title page. Labeling it as the “Alma-LaCrosse” transmission project can be misleading about the character and purpose of the application.

Executive Summary (recognizing that this is a summary, the meat is later)

p.XV – Project description must include the specs and capacity of the line. Aff of McKay, Ex. B, IR 3.

P. XV – To the extent that the statement of three purposes of the project is “need” it should more accurately reflect the three need claims of applicant (see Application, i-1, and p. 1-8 – 1-12):

- 1) Community Reliability Needs for LaCrosse-Winona and Rochester area
- 2) Regional Reliability
- 3) Generation Outlet/Renewable Energy Support

p.XVI – Regarding “final ownership” it should state that “Applicants have not disclosed final ownership of the project.” It is implied, but not stated. Assessment of cost and rate implications is impossible without disclosure of ownership.

p. XVI – Need, 1<sup>st</sup> paragraph, community load serving needs, there is a list of communities, including counties and cities and “surrounding rural areas” that the EIS claims will be served. However, Applicants have couched “local load serving needs” in terms of LaCrosse and Rochester (see Applicants, Figure 6 for “Affected Area.” There is no plan for a substation near Alma, and the area would not be served.

p. XVI – population growth in LaCrosse/Winona and peak load growth – this should reference most recent EIA projections (demand projected to be down). The MISO Rate of 0.78% is overstated.

p.XVII – Table ES-2 – It is my understanding that the Genoa Unit 3 is off line more than on, and that the Alma plant may be shut down. This table should have column with capacity factor percentages, design and actual, and date of shut down, if any.

p. XVIII – first partial paragraph, “The applicants also state that neither DSM nor the addition of local generation can provide the bulk transmission capability across the Minnesota/Wisconsin border that could enable future power transfers into Wisconsin...” should address how “bulk transmission capability” that “could enable future power transfers” is related to any of the three need claims.

p. XVIII – references to biomass should address emissions, particularly formaldehyde and NOx.

p.XIX – Table ES-3 - Transmission Losses Cost, the losses cost for the 345kV is not accurate, losses cost is not zero. There are losses associated with this project, with any transmission project that should be disclosed. Line losses are inherent in any project. Losses for the project should be calculated for the full length of the project, as applied for, Hampton-Rochester-LaCrosse, with the double circuited 345kV bundled 954 kcmil conductor running at 75% capacity at the very least (based on desire for 3-5,000 MW transfer capacity).

p. XXII – Table ES-4 – “New ROW (acres)” and “Percent of ROW Length Shared)” should be clarified as to what types of ROW, how ROW is defined. If p. 7, 1.2.2.3 defines ROW, i.e., a, b, c are regarded as corridor, and d is “New corridor” that would be helpful. Is a recreational rail ROW?

p. 1 – The first and second paragraphs are grossly misleading. As above, the Application is for the “Hampton-Rochester-LaCrosse” transmission project. The Applicants call it the Hampton-Rochester-LaCrosse” project. Labeling it as the “Alma-LaCrosse” or “LaCrosse” transmission project is misleading about the character and purpose of the application. Please correct the title page.

p. 10 – Provide link to WisDOT’s Policy of Utility Accommodation.

p. 11 – RUS Environmental Information – the RUS Macro Corridor Study and Alternative Evaluation Study should be included and incorporated into the PSC’s EIS:

AES (March 2009): <http://www.usda.gov/rus/water/ees/pdf/Dairyland%20CapX2020%20345%20AES%200509.pdf>

MCS (May 2009): <http://www.usda.gov/rus/water/ees/pdf/Dairyland%20CapX%202020%20MCS%200509.pdf>

p. 12 – the ALJ’s report is overdue and the MPUC’s decision will not be in 2011. Please update

p. 15 – as with ES-2, the table should have additional columns for expected capacity factor and actual capacity factor – it is my understanding that these plants are frequently off line.

p. 15-16 – Area load forecast – this should compare the area load forecast of the Certificate of Need with the various iterations provided to the PSC. The basis for this project, the study work, was conducted in 2004-2005 and much has changed since then.

p. 16 "... the projected annual percentage peak load growth rate of 1.7 percent used in the CPCN application is high." This cries out for a modifier, i.e., "too" high, or "unreasonably" high.

p. 19 – needs section **2.6.3 Impact of project on system stability**" and a discussion of the need for Badger-Coulee transmission eastward from LaCrosse if this project is built, to preserve system stability, prevent thermal overload, and provide outlet for trapped generation. The Western Wisconsin Reliability Study demonstrates that the Hampton-Rochester-LaCrosse does not provide reliability, instead, it brings system instability to LaCrosse, necessitating extension of transmission eastward.

See Western Wisconsin Reliability Study:

[ATC's Western Wisconsin Transmission Reliability Study - September 20, 2010](#)

See April 3, 2009 Press Release.

<http://nocapx2020.info/wp-content/uploads/2011/11/atc-xmsnstudy-pcdocs-3993093-v1-xcella-crosseattachment-52b-1-nocapx2.pdf>

See ATC's Western Wisconsin Reliability Study Powerpoint:

<http://www.atc10yearplan.com/documents/2011StakeholderReliabilityPresentation-011911.pdf>

- Without the addition of the Badger Coulee 345 kV line, the above Reactive Support would be needed to prevent voltage collapse. At a cost of \$82.7M. (p. 12)
- Without the addition of the Badger Coulee line the ten transmission lines above, in ATC's area, would need to be rebuilt for thermal overload support. Cost = \$54.7M. (p. 13)

p. 19 – needs section **"2.7 Market Drivers"** to explain economic dispatch, increasing transfer capacity, and market drivers for this project.

p. 20 – Alternatives – The applicants also state that neither DSM nor the addition of local generation itself can provide "foundation bulk transmission facilities across the Minnesota/Wisconsin border to enable future power transfers into Wisconsin" to support generation development elsewhere." The purpose of an alternatives analysis is to determine what options there are, individually or in combination, to address a claimed need. That should be stated. The statement by applicants is a moving target, stating that alternatives that can obviate one type of need don't provide what they really want, which is "foundation bulk transmission facilities" which is NOT a type of need.

p. 21 – Load reduction: "no regulatory authority" and "no mechanism has been identified that would ensure adequate participation over time." The FEIS should state that "load reduction can effectively reduce demand and that regulatory authority and/or mechanism to ensure adequate participation over time should be identified."

p. 21 – cost of load reduction – should state "load reduction is recognized as the most economic of alternatives, because the least costly megawatt is the one you don't generate." Specific cost estimates for a MW of load reduction are readily available online.

p. 21 – wind power variability. This must address siting wind near gas peaking generation to utilize existing transmission infrastructure, existing transmission reservations, and for use as backup to firm wind generation.

p. 22 – Solar power – solar power should be considered, not large central station facilities, but widely broadcast rooftop solar on the many buildings in area where electricity is "needed."

p. 23 – 3.2.3.3 Biomass. This section should address the feedstock problems with "biomass plants" and the significant air emissions and permit violations. See e.g.:

Fibrominn: [Poop Power in the WSJ](#);

Laurentian (Hibbing): [Laurentian "biomass" Air Permit Draft \(second time around\)](#)

“Biomass” violates air permit - fines likely

Powerpoint on emissions of biomass plants:

Muller - Saying NO! to permits for Kandiyohi’s Midtown Burner

(Air emissions info on slide 22)

p.23 – 3.2.3.4 Landfill gas – this is methane. The EIS should reflect that landfill gas is methane, and that methane is an extremely potent greenhouse gas.

p. 24 – the DEIS states that “applicants also emphasize that the proposed project would prove pivotal for future expansion...” This section must disclose the full “CapX 2020 Vision Plan” together with the map showing the Phase I CapX 2020 projects and the chart of the CapX 2020 Vision Plan:

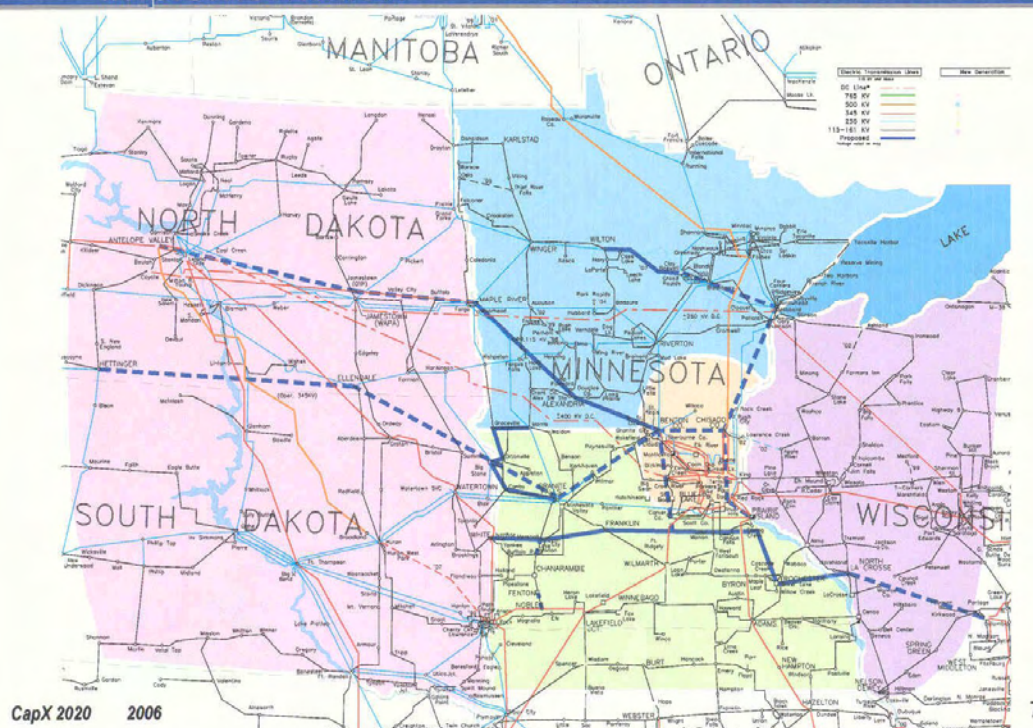
| <b>Facility Name</b>                     |                                      |                   |              |                      |
|--|--------------------------------------|-------------------|--------------|----------------------|
| <b>From</b>                              | <b>To</b>                            | <b>V olt (kV)</b> | <b>Miles</b> | <b>Cost (\$M)</b>    |
| Alexandria, MN                           | Benton County<br>(St. Cloud, MN)     | 345               | 80           | 60                   |
| Alexandria, MN                           | Maple River<br>(Fargo, ND)           | 345               | 126          | 94.5                 |
| Antelope Valley<br>(Beulah, ND)          | Jamestown, ND                        | 345               | 185          | 138.75               |
| Arrowhead<br>(Duluth, MN)                | Chisago County<br>(Chisago City, MN) | 345               | 120          | 90                   |
| Arrowhead<br>(Duluth, MN)                | Forbes<br>(Northwest Duluth, MN)     | 345               | 60           | 45                   |
| Benton County<br>(St.Cloud, MN)          | Chisago County<br>(Chisago City, MN) | 345               | 59           | 44.25                |
| Benton County<br>(St. Cloud, MN)         | Granite Falls, MN                    | 345               | 110          | 82.5                 |
| Benton County<br>(St. Cloud, MN)         | St. Bonifacius, MN                   | 345               | 62           | 45.5                 |
| Blue Lake<br>(Southwest Twin Cities, MN) | Ellendale, ND                        | 345               | 200          | 150                  |
| Chisago County<br>(Chisago City, MN)     | Prairie Island<br>(Red Wing, MN)     | 345               | 82           | 61.5                 |
| Columbia, WI                             | North LaCrosse, WI                   | 345               | 80           | 60                   |
| Ellendale, ND                            | Hettinger, ND                        | 345               | 231          | 173.25               |
| Rochester, MN                            | North LaCrosse, WI                   | 345               | 60           | 45                   |
| Jamestown, ND                            | Maple River<br>(Fargo, ND)           | 345               | 107          | 80.25                |
| Prairie Island<br>(Red Wing, MN)         | Rochester, MN                        | 345               | 58           | 43.5                 |
| <b>TOTAL</b>                             |                                      |                   | <b>1620</b>  | <b>\$1,215 (\$M)</b> |

Exhibit 17, Portion of the 2005 Biennial Report Filed by Transmission Utilities, p. 36; Ex. 1, Application, App. A-1, Technical Update October 2005; see also Exhibit 12, CapX 2020 Update, June 14, 2006; Rogelstad, Vol. 2A, p. 69-74; Rogelstad, Direct Testimony p. 17; Rogelstad, Tr. Vol 2A, p. 39 et seq.

And the 2005 big picture map of these lines above that includes the Hampton-Rochester-LaCrosse and Badger-Coulee lines:



Continuing work refines the plan, but the first project group is ready for implementation



The Hampton-Rochester-LaCrosse transmission project is but a small part of a much larger picture, and evaluation of just a small piece without addressing the larger context is misrepresentation of the nature and impacts of this project.

p. 24, Section 3.3 Transmission Alternatives – Descriptions. Transmission alternatives presumes transmission is necessary and that presumption has not been established.

p. 24, 3.3.1 - as above, the description of the project must include the specifications and capacity of the line, i.e., double circuited bundled 954 kcmil ACSS – MVA 2,050 per circuit x 2 = 4,100 MVA.

p. 24 – 3.3.1 – the statement that “the proposed project would serve the LaCrosse/Winona area load up to 750 MW and up to 890MW with the operation...” is absurd in light of the potential capacity for this project and the stated desire of 3-5,000MW of transfer capacity. The potential MVA for this line should be stated in this paragraph, and that the 790MW is a very small portion of this capacity, that the project as proposed is unreasonable in light of need claimed, not to mention demonstrated.

p. 25 - 3.3.2 – Reconductor Option. The “reconductor option” is too limited in scope. The point of this project is increasing transfer capacity into Wisconsin. The Reconductor Option section should address a “345k V reconductoring option,” reconductoring the 345kV lines that make up that export interface, the

King-Eau Claire-Airpin; Prairie Island-Byron-Adams; and Arrowhead-Weston. If those lines were reconducted with double circuit bundled 345kV 954 kcmil with potential capacity of ~4,100 MVA, what would impact be on regional reliability, transfer capacity, etc.

p. 25 – 3.3.3 – 161kV Red Wing-LaCrosse transmission line option. The FEIS should note that “the route of the 161kV Red Wing-LaCrosse transmission line option would cross “Site P,” the site NSP chose in Florence Township for nuclear waste.” Increasing voltage and capacity of this transmission line through Florence Township would encounter opposition beyond Xcel Energy’s wildest nightmares.

p. 27, Table 3.4-1 – as above regarding Table ES-3 - Transmission Losses Cost, the losses cost for the 345kV is not accurate, losses cost is not zero. There are losses associated with this project, with any transmission project that should be disclosed. Line losses are inherent in any project. Losses for the project should be calculated for the full length of the project, as applied for, Hampton-Rochester-LaCrosse, with the double circuited 345kV bundled 954 kcmil conductor running at 75% capacity at the very least (based on desire for 3-5,000 MW transfer capacity).

p. 35 – 4.3 Title must be corrected – a “Hampton-Rochester-LaCrosse” transmission project has been applied for, delete “Project Endpoint” from the heading.

p. 35 – description of the Alma crossing – this should state that there is no substation planned for Alma.

p. 36 – Minnesota Environmental Review – this section contains a paragraph that is false and bizarre, with no relation to history, the record, or any other documentation:

*The applicants’ decision on the proposed crossing was reinforced during the state of Minnesota EIS scoping process in the spring of 2010. The Minnesota Office of Energy Security (OES) convened two advisory task forces and a public scoping comment period on the issues and route alternatives that should be evaluated in the Minnesota EIS. If the comments from the task forces and the public did not indicate that the LaCrosse crossing should be reevaluated in addition to the Alma crossing, then the scope of the Minnesota EIS would include the Alma crossing as the only crossing. The OES scoping decision in August 2010 confirmed the Alma crossing as the one to be carried through the two states’ review processes. See appendix D, the Executive Summary of the Minnesota EIS, page 1<sup>1</sup>.*

First, the statement that “*If the comments from the task forces and the public did not indicate that the LaCrosse crossing should be reevaluated in addition to the Alma crossing, then the scope of the Minnesota EIS would include the Alma crossing as the only crossing*” **is not true and is a gross misrepresentation of the Minnesota record** Also, this statement is not supported by the DEIS citation to the FEIS Executive Summary, “Section 6” and/or any documents in the record in Minnesota. Many comments were made requesting that more than one Mississippi River crossing be considered. These comments are documented below.

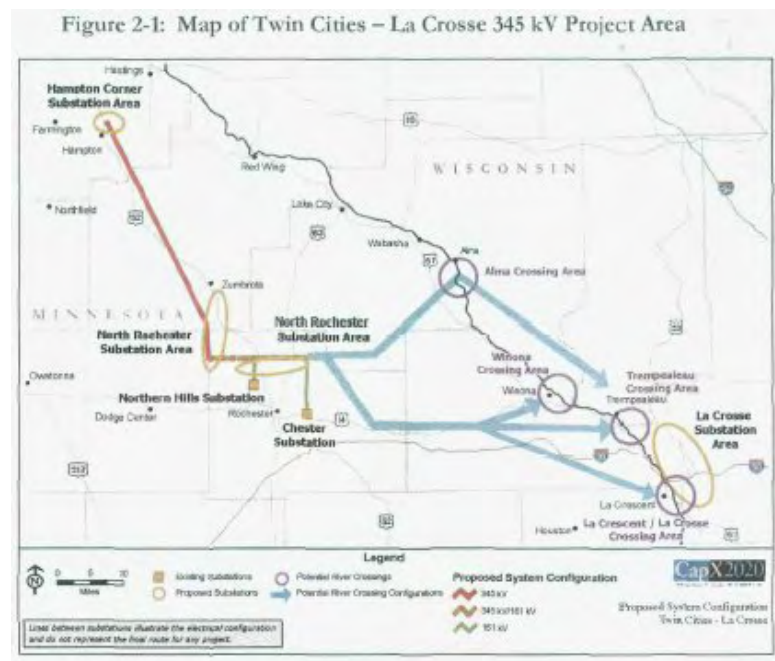
Second, the statement that “*The OES scoping decision in August 2010 confirmed the Alma crossing as the one to be carried through the two states’ review processes*” is **false** in two ways. First, the OES scoping decision does not “confirm” anything, it is a decision as to the scope of the EIS. See FEIS, Executive Summary, p. 1 (“...Director of EFP **finalized** the scope...”.) Secondly, the scoping decision does not in any way determine what will occur in “two states’ review process.” The OES scoping

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<sup>1</sup> Section 6 of the Minnesota OES EIS discusses the factors supporting the “Kellogg Crossing” at Alma in detail. It also discusses alternative crossing methods. CapX Hampton-Rochester-LaCrosse 345kV and 161kV Transmission Lines Project Environmental Impact Statement, August 2011. (footnote from PSC DEIS, p. 36)

decision addresses what is to be included in Minnesota. It has nothing to do with Wisconsin. Wisconsin makes its own scoping decisions and makes its own determinations as to whether an application with only one Mississippi River crossing is complete.

When this project was granted a Certificate of Need, four river crossings were proposed for consideration, Alma, Winona, Trempealeau and LaCrosse:



Source: Certificate of Need Application, p. 2.4 (August 2007).

In the RUS Macro-Corridor Study for the Hampton-Rochester-LaCrosse Transmission Project, crossings were proposed for Alma, Winona, and LaCrosse:



Source: RUS MCBS Figure 7-1: Final Macro-Corridors

Below is a list of many statements in the record regarding the need for more than one river crossing in the project proposal and to be evaluated by the state in the EIS and project review (see also comment of Joyce Osborn, United Citizens Action Network):

### **Completeness Determination**

#### **February 23, 2010 NoCapX 2020 and U-CAN Comments on Completeness**

*Under Minn. Stat. § 216E.03, Subd. 3, the January 19, 2010 application is not complete because there are not two distinct corridors. The Applicants have not met one of the most basic application criteria. NO CAPX 2020 and United Citizens Action Network (U-CAN) request that the Commission declare the Application incomplete unless and until at least two separate and distinct routes are provided.*

#### **February 24, 2010 Maccabee Comments on Completeness**

*I have represented Citizens Energy Task Force in the certificate or need proceedings pertaining to the CapX2020 La Crosse Project. I am writing herein as a member of the public to request that the Public Utilities Commission reject the route permit application in the above-captioned matter as incomplete and in violation of Minnesota Statutes 216E.03, Subd. 3 and Minnesota Rules 7850.1900, Subp. 2.C mandating the following:*

*Any person seeking to construct a large electric power generating plant or a high-voltage transmission line must apply to the commission for a site or route permit. The application shall contain such information as the commission may require. The applicant shall propose at least two sites for a large electric power generating plant and two routes for a high-voltage transmission line. (Minn. Stat. 216E.03, Subd. 3) An application for a route permit for a high voltage transmission line shall contain the following information:*

*C. at least two proposed routes for the proposed high voltage transmission line and identification of the applicant's preferred route and the reasons for the preference. (Minn. R. 7850, Subp. 2).*

*In the Application for a Route Permit for the CapX2020 La Crosse Project, the failure to provide at least two proposed routes for the high voltage transmission line is a very substantial deviation from legal requirements. The proposed overhead route at Alma is within the Upper Mississippi River National Wildlife and Fish Refuge and would place migratory birds, nesting eagles and habitat at risk. Yet there is only one route proposed at this critical Mississippi River crossing.*

**March 9, 2010 PUC Completeness determination:** Order by Commission for ATFs, upon Motion that more than one is necessary, two were established, one that shall “*examine issues at the Mississippi River crossing*” (#3). Also, the Commission stated in the order:

- V. *In light of the expressed and anticipated public interest in the Mississippi River crossing issues and due to the sensitivity of the environment and inter-governmental issues raised by any such crossing, the charge of at least one of the task forces should consist of or include examination of the issues surrounding the line's Mississippi River crossing to Wisconsin, above ground, underground, at Alma, or elsewhere.*

**March 10, 2010 Mississippi River Revival and Citizens Energy Task Force** request for task force regarding Mississippi River crossing:

2) *The charge of this Advisory Task Force, consistent with previous communications from the US Fish and Wildlife Service to Xcel Energy on February 19, 2008 and May 4, 2009, would be to conduct a comprehensive examination of an underground alternative to minimize impacts on the River, the Refuge and flora and fauna of concern. The Task Force would obtain information on impacts of overhead transmission lines on birds using the Mississippi River Flyway as well as visual and other environmental impacts on the River, Refuge and surrounding communities. The Task Force would review benefits and costs of underground crossings at any point along the river from Alma to La Crescent. Staff would seek information on underground crossings from sources other than the Applicants, including contractors with experience in constructing underground transmission lines in sensitive environmental locations.*

**20103-47862-01** PUBLIC 09-1448 TL MISSISSIPPI RIVER REVIVAL AND CITIZENS ENERGY TASK FORCE LETTER 03/10/2010

### **EIS Scoping Comments**

**June 3, 2010 North Rochester-Mississippi Advisory Task Force.** Comments on the Applicants preferred 345 kv route:

*Only one location for the crossing of Mississippi River proposed by Applicant; **need to look at additional options**; going underground (a line was placed under the St. Croix Wild and Scenic Riverway); additional crossing points for the Mississippi River need to be considered.*

### **MINNESOTA EIS SCOPING COMMENTS REFERENCING RIVER CROSSING OPTIONS**

(online at: <http://energyfacilities.puc.state.mn.us/resource.html?Id=28492>):

Pg 5- Mississippi River Parkway Commission of MN- “underground river crossing should not be ruled out as a possibility”.

Pg 8- MN DNR. Comment page 4. ‘A thorough analysis of underground engineering of possible crossings is recommended. This analysis may include locations other than previously described aerial crossings if engineering for underground configuration is more practical at another location.’ Jamie Schrenzel. April 29, 2011

Pg 11- MN DNR. Comment page 4. “The DEIS should include a robust description of possible underground crossings of the Mississippi River.....Underground route crossing options discussed in the DEIS should not only include an underground crossing at the location(s) best suited for considering aerial crossings, but should include an underground route at the location(s) best suited for engineering an underground route, which may or may not be in the same location as the Alma crossing. ...A comparison of impacts and mitigation should be included for aerial and underground crossings of the Mississippi ..... It would be informative if the DEIS contained a brief discussion of the possible extent of impacts in Wisconsin, particularly related to how the choice of the Mississippi River crossing location affects routing in Wisconsin and Minnesota....” Jamie Schrenzel. May 10, 2010.

**SCOPING MEETINGS: May, 2010 – Comments regarding River Crossings** (available online at: <http://energyfacilities.puc.state.mn.us/resource.html?Id=28492>)

#### **May 4. Plainview. 6:30 PM.**

Laura Kreofsky. Questioning why Alma? In comparison to other crossings? Hillstrom lengthy explanation of why Alma chosen by Applicants

Steve Walker. LaCrosse now too expensive to “buy” trucking company on industrial land. At one time the route was going 90 to LaCrosse

**May 6.Cannon Falls 1:30.**

Michael Collins. Why not use 52 to I-90 into LaCrosse using path already cut (check RPA Appendix for I-90 to LaCrosse route study...)

**APPEAL OF SCOPING DECISION**

NoCapX 2020 and U-CAN appealed the Scoping Decision, specifically regarding its failure to include more than one Mississippi River crossing:

**2. The EIS must include analysis of more than one river crossing**

The scoping decision includes only one river crossing, the solitary Alma river crossing proposed by applicants. This is not sufficient alternatives analysis under MEPA. A project this large, with impacts legally acknowledged as significant, must include additional alternatives. This request for review and analysis additional options to be included in the EIS was raised in the Task Force that covered the river crossing, yet I cannot find any alternative to the Alma crossing in the scoping decision. This is such an obvious scoping flaw that it’s difficult to see a need for additional words! The RUS EIS is analyzing at least three locations, in Alma, Winona, and LaCrosse, and technical alternatives as well – this information is available online, at the link cited above. The Scoping decision should include river crossing options included in the RUS EIS.

[20108-53324-01](#) PUBLIC 09-1448 TL NOCAPX 2020 AND UCAN OTHER--APPEAL OF EIS SCOPING DECISION 08/09/2010

**DEIS Comments**

**FEIS-DEIS COMMENTS/TESTIMONY: 2011** (See MOES’ FEIS Appendix O)

ID#1- Appendix O. Dept. of Interior. “All three river crossings.....” paragraph 2

ID # 123. Pg O-282. Denise Leedham. Utilize highway 52 and I-90.

ID# 162. Pg. O-362. Lee Naus. Utilize Highways 52 & I-90 (across Mississippi).

ID# 168. Pg. O-379. US Dept of Interior. 2008. First and second choices of Mississippi crossing..... Also the “I-90 corridor” on second page of this letter...

ID# 168. Pg. O-399. NoCAPX and UCAN . Multiple crossings....168E.

ID# 204. Pg. O-477. Patricia Steffes. Utilize Hwy. 52 & I-90, facility in LaCrosse.

ID# 211. Pg. O-493. Tina Trihey Porter. Utilize I-90 (across Mississippi).

ID# 216. Bob Wallace. Pg. O-500. Assumed that I-90 corridor was being considered....

ID# 224. Joe Morse. Pg. O-517. More than one Mississippi River crossing.

ID# 238. Mike Collins. Pg. O-550. Utilize Hwy. 52 to I-90, and east (across Mississippi to LaCrosse...)

ID# 242. Kia Hackman. Pg. O-557. Utilize Highways 52 & 90 (across Mississippi)..

ID# 251. Larry Paul. Pg. O-577. Utilize Hwy 52 & I-90 to LaCrosse (across Mississippi)..

ID# 263. Carolyn Campbell. Pg. O-606. Thought the alternate route was Interstate 90.

ID# 271. Alan Muller. Pg. O-648. No build alternative. I never got this before, and thought this was good! After review of RUS.....

**Comments at hearings**

**ALJ PUBLIC HEARINGS: 2011** (available online at:

<http://energyfacilities.puc.state.mn.us/documents/25731/CapX%20DEIS%20Comment%20Spreadsheets%2020110513.pdf>)

Dave Sykora, MN/DOT. June 15. Pine Island. 6:30. Starts on Pg 69. “I have a general sense there is a feeling among many people in the community that the reason this route doesn’t go down to I-90 and over to LaCrosse is because MNDOT said you can’t go there. And I’d like to clarify that. That did not happen.” Continues to talk about using the I-90 corridor... So in the meetings, he, too, was hearing about I-90 across the Mississippi River to LaCrosse.....

June 14. Plainview. 1:30. Robert Wallace. Pg 59. “I hear of this project over a year ago, but at the time routes being considered were along the I-90 corridor in the Winona and Houston County area...”

June 14. Plainview. 6:30. Pat Melvin. “I support the transmission line from the 52 corridor to the I-90 to LaCrosse corridor...”

Barb Stussy. June 15. Pine Island 1:30. Pg 66. First USDA rural development. It was a macro corridor study...”

As noted above ad nauseum, there were many comments requesting more than one Mississippi River be considered and analyzed. The paragraph on p. 36 should be deleted in its entirety, and something true be put in its place.

+++++

Back to the DEIS:

p. 37 – Cost of undergrounding – the \$90 million for 1.3 miles should also be expressed in an percentage cost increase with the cost measured over the full Hampton-Rochester-LaCrosse route (miles and cost).

p. 37 – Evaluation and analysis of underground should be more detailed, including information on conditions that add weight to undergrounding as an option, at what point do the benefits outweigh costs, is the largest migratory flyway in North America significant enough to warrant undergrounding, if not, why not.

p. 39 – “No landscaping is anticipated at the proposed East or West sites.”

- Why is no landscaping anticipated?
- The EIS should disclose the sound levels that are anticipated.
- Lighting of the substation should be addressed.
- A photo of similar substation should be provided and aesthetics addressed.
- Figure 4.4.1 shows several positions open. The type and use and plans for the open positions should be discussed.

p. 40 – The EIS should take salvage value into account.

p. 41- Discussion of exclusion of “pre-certification costs.” Should include a discussion of “Construction Work in Progress” available to utilities in Wisconsin (and Minnesota due to Minnesota portion of this project).

p. 42 – “Other Costs” should also include breakdown of these costs by local units of government.

p.43 – have local governments (counties, towns, villages, cities) been notified of potential for and estimated amounts of One-Time fee under Wis. Admin. Code §ADM 46.05, and Annual fees.

p. 44 – Cost Allocation – the EIS should include a table showing dollar amounts of cost and distribution for the 20% on basis of load ratio shares, and the distribution of cost for the 80% between recipient utilities using Line Outage Distribution Factor methodology.

p. 45 – EIS should disclose per-tree cost of trees according to WisDOT, not Applicants.

p.55- the DEIS must address visual impacts from the Mississippi River as provided by Wis. Stat. ch. 30.

p. 55 – “Aesthetics are to a great extent based on individual perceptions.” Aesthetic evaluation is a known and quantifiable process, and this improperly dismisses aesthetic concerns. The EIS must include a thorough aesthetic evaluation of the length of the route, with additional attention to those areas in and near scenic easements, scenic areas, visible from scenic lookouts, and in and near the Great River Road.

p. 55 and Appendix B – the discussion on EMF is inadequate. I don’t see any information on what levels of magnetic fields are anticipated. The EMF charts in the application, Appendix U, are misleading at best, because magnetic fields are based on current in the line, and the amps used in modeling are grossly understated. See Affidavit of McKay, and Exhibits, Attached, for estimates of magnetic fields associated with the Hampton-Rochester-LaCrosse project.

NoCapX 2020 adopts as if fully related here the many comments of the WisDOT regarding scenic easements. Scenic easements were a determinative issue in the CapX 2020 Brookings case, where Applicants proposed a route that, due to scenic easements, was not permissible, and this was not openly part of the record until a very late date in the process, during public hearings just before the evidentiary hearing, long after discovery had been done. MN/DOT comments were not readily available and the existence of these easements was not disclosed. Upon public entry of the scenic easement in question into the record, the Applicants tried to introduce a new route option (Myrick Road) despite failure to include it in the EIS scope, no environmental review, and inadequate notice to landowners. NoCapX urges consideration of the issues raised by the WisDOT so as not to end up in a “Brookings” situation.

In this case, it appears that new route options were introduced at this late date by Applicants in their DEIS comments. NoCapX 2020 reserves the right to submit additional comments if necessary upon review.

- Landowners must be notified of the new routes and notices filed.
- Landowners must be given adequate time to learn what this means and intervene in this docket.
- PSC staff must be given time to adequately review these options prior to acceptance as a “route.”

Thank you for the opportunity to submit Comments on the DEIS.

Very truly yours,



Carol A. Overland  
Attorney at Law

cc: ERF and email to Parties

**STATE OF MINNESOTA  
OFFICE OF ADMINISTRATIVE HEARINGS  
FOR THE PUBLIC UTILITIES COMMISSION**

In the Matter of the Route Permit Application  
by Xcel Energy, Dairyland Power Cooperative,  
Souther Minnesota Municipal Power Agency,  
Rochester Public Utilities , and WPPI Energy for  
a 345 kV Transmission Line from Hampton,  
Minnesota, to Rochester, Minnesota, to  
La Crosse, Wisconsin

OAH DOCKET NO. 3-2500-21181-2  
PUC DOCKET NO. E002/TL-09-1448

**AFFIDAVIT OF BRUCE McKAY, P.E.**

Bruce McKay, P.E., after affirming or being duly sworn on oath, states and deposes as follows:

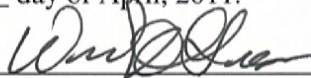
1. My name is Bruce McKay. I am an electrical engineer, and licensed Professional Engineer, in the state of Minnesota.
2. My experience is primarily in the areas of industrial power distribution and industrial automation and control. I have 16 years experience in these areas as a licensed Master Electrician, followed by 14 years as a licensed Professional Engineer to date.
3. I am a landowner near Henderson, MN, and therefore am not directly affected by the proposed Hampton-Rochester-La Crosse 345 kV Transmission Project.
4. I have participated in CapX2020 Task Force meetings held in Henderson, attended one day of PUC hearings in St. Paul, and attended, including making comments and submitting statements, all but one of the Public Hearings held in the Le Sueur-Henderson area over the last few years.
5. Attached as Exhibit A is a true and correct copy of the CapX2020 Engineering, Design, Construction, and Operational Characteristics, Section 3.1.1 Hampton-Rochester-La Crosse 345 kV Transmission Line, found on page 3-3 of the January 15, 2010, Route Permit Application for the Hampton-Rochester-La Crosse 345 kV Transmission Project, wherein it states that "Two 954 Aluminum Conductor Steel Supported (ACSS) conductors will be used per phase."
6. Attached as Exhibit B is a true and correct copy of Direct Testimony of Larry L. Schedin, Attachment J, showing various conductor specifications, including:
  - a. In the chart on page 3, Summer Thermal Ratings for a Twin bundled 954 kcm 54/19 ACSS, 345 KV, of 3700 amps and 2211 MVA.
  - b. In the chart on page 5, Winter Thermal Ratings for a Twin bundled 954 kcm 54/7 ACSS, 345 KV, of 4064 amps and 2428 MVA.

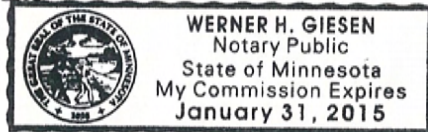
- c. For the purposes of this Affidavit, I am using the Summer Ratings, but it should be noted that Winter Ratings are approximately an additional 9.8% higher than the Summer Ratings.
7. The first purpose of this statement is to point out the fact that the CapX2020 Magnetic Field tables and charts that I've been able to find in Hampton-Rochester-La Crosse 345 kV Transmission Project documents all fail to address the full potential Magnetic Field along the transmission lines. Each table and chart that I've seen displays Magnetic Field data calculated from estimated Peak and estimated Average System Conditions (Current (Amps)) rather than from transmission line design capacities. An example of such a table is presented in the attached Exhibit C, a true and correct copy of the CapX2020 Engineering, Design, Construction, and Operational Characteristics, Table 3.6-2: Calculated Magnetic Fields (mG) for Proposed 345 kV Transmission Line Designs (3.28 Feet Aboveground), found on pages 3-28 and 3-29 of the January 15, 2010, Route Permit Application for the Hampton-Rochester-La Crosse 345 kV Transmission Project.
8. The second purpose of this statement is to point out the fact that a table such as Exhibit C underestimates the Magnetic Field that would be created if the transmission line was utilized to its full potential capacity, or to 80% of its full potential capacity. The attached Exhibit D is a true and correct copy of "McKay Magnetic Field Calculations" which presents an example of Magnetic Field calculations based on estimated transmission line currents as compared to Magnetic Field calculations based on future potential (design) transmission line currents.
  - a. By following through STEPS 1, 2, 3-Single Circuit, and 4-Single Circuit in Exhibit D, you can see that with one Circuit in Service, for 2015 PEAK, the Calculated PEAK MAGNETIC FIELDS increase by 1323% and for 2015 AVERAGE, the Calculated AVERAGE MAGNETIC FIELDS increase by 1323% when design capacities are used for the calculations rather than using estimated load currents.
  - b. By following through STEPS 1, 2, 3-Double Circuit, and 4-Double Circuit in Exhibit D, you can see that with two Circuits in Service, for 2015 PEAK, the Calculated PEAK MAGNETIC FIELDS increase by 2646% and for 2015 AVERAGE, the Calculated AVERAGE MAGNETIC FIELDS increase by 2646% when design capacities are used for the calculations rather than using estimated load currents.
  - c. Please Note: Exhibit D is presented as a conceptual example. Actual design capacities and associated Magnetic Field calculations would need to be and should be provided by the Applicants.
9. The third purpose of this statement is to stress that right-of-way widths to protect the health and safety of those along the proposed transmission line need to be based on Calculated Magnetic Field's derived from design capacities, NOT on Calculated Magnetic Field's derived from estimated transmission line currents. A right-of-way based on the Applicant's low transmission line current estimates does not sufficiently protect people near the transmission lines.
10. Please feel free to contact me with any comments or questions you have.

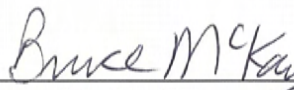
Further your affiant sayeth naught.

Dated: April 20, 2011

Signed and sworn to before me this  
20 day of April, 2011.

  
\_\_\_\_\_  
Notary Public



  
\_\_\_\_\_  
Bruce McKay, PE  
e-mail: [bmckay.aces@gmail.com](mailto:bmckay.aces@gmail.com)  
cell: 612-386-5983

# **EXHIBIT A**

## **Line Configurations and Specifications**

Hampton-LaCrosse Application

Section 3 Project Description

p. 3-3

### ***3.1.1 Hampton–Rochester–La Crosse 345 kV Transmission Line***

For the Project's proposed 345 kV line, the Applicant proposes primarily to use single-pole, self-weathering steel, double-circuit capable structures. Self-weathering steel alloys were developed to eliminate the need for painting and are commonly used by the Applicant and throughout the industry. The steel alloy develops a stable, rust-like appearance (dark reddish-brown color) when exposed to the weather for several years. The wetting and drying cycles cause rust to form a protective layer on its surface, preventing further rusting. The layer develops and regenerates continuously when subjected to the influence of the weather.

These single-pole steel structures would range from 130 to 175 feet in height. Spans could range from 600 to 1,000 feet, but would typically be 700 to 1,000 feet. In some areas, only one circuit would be strung and the other side of the pole would be available for adding a second circuit in the future, when conditions warrant. In other areas, the unused side of the 345/345 kV structure would be used to carry a lower voltage line on the second set of arms until a second 345 kV circuit is needed. Tubular steel pole structures are typically placed on large pier foundations of cast-in-place, reinforced concrete.

Two 954 Aluminum Conductor Steel Supported (ACSS) conductors will be used per phase. One or two shield wires will be used to protect the conductors from lightning strikes. One of these shield wires will incorporate fiber optic to facilitate relay control communications between substations and between substations, utility offices such as control centers. Fiber optics will be used only for utility purposes.

Figure 3.1-1 depicts a representative double-circuit 345 kV single pole structure.

The Mississippi River presents unique considerations that will require the use of multiple-circuit, specialty structures. A portion of this crossing is on Upper Mississippi River Wildlife Refuge lands managed by the USFWS. A Special Use Permit will be required to cross the Refuge and the Applicant will work closely with the USFWS to identify the most appropriate structure design.

An existing double-circuit transmission line crosses the Mississippi River and Refuge at the Project's proposed crossing location. The existing line crosses approximately 0.5 mile of Refuge lands and includes two structures on Refuge property. The line is constructed on a 180-foot-wide permitted ROW. An area approximately 125 feet wide and 1,900 feet long is maintained cleared of trees. The two main river crossing structures are 180 feet tall.

# **EXHIBIT B**

## **Amps and MVA for Line Configurations and Specifications**

Direct Testimony of Larry L. Schedin, Attachment J  
CapX 2020 Certificate of Need  
PUC Docket E002, ET2/CN-06-1115

- ☐ **Non Public Document – Contains Trade Secret Data**  
☐ **Public Document – Trade Secret Data Excised**  
☒ **Public Document**

Xcel Energy

Docket No.: E002, ET2/CN-06-1115

Response To: Elizabeth Goodpaster                      Information Request No.     3  
                  and Mary Marrow  
                  MCEA/Wind on the Wires

Date Received: March 27, 2008

Question:

With reference to the Application Volume I, Sec. 2.4 (pages 2.9) entitled "Transmission Line Characteristics" and Applicants' response to DOC/OES Information Request No. 2, please provide thermal MVA ratings, surge impedance loadings (SIL), MVA and thermal ampere capacity ratings (amplacities) under summer normal, summer emergency, winter normal and winter emergency conditions for the following conductors and voltages:

- (a) Single 795ACSR, 115 KV
- (b) Single 795 ACSS, 115 KV
- (c) Twin bundled 795 ACSR, 115 KV
- (d) Twin bundled 795 ACSS, 115 KV
- (e) Single 954 ACSS, 115 KV
- (f) Single 795 ACSS, 161 KV
- (g) Single 954 ACSS, 161 KV
- (h) Single 795 ACSR, 230 KV
- (i) Single 795 ACSS, 230 KV
- (j) Single 954 ACSS, 230 KV
- (k) Twin bundled 795 ACSR, 345 KV
- (l) Twin bundled 954 ACSS, 345 KV
- (m) Triple bundled 954 ACSS, 500 KV
- (n) Triple bundled conductor as used on the Forbes – Chisago 500 KV line

In your response, please define the conditions for summer normal, summer emergency, winter normal and winter emergency conditions (ambient temp, wind speed, degree rise, allowable sag. etc.), and specify the regulatory authority setting the foregoing standards and the reference to applicable rules.

Response:

The thermal ratings of the requested conductors and voltages are noted in the table below. Conductor ratings are based on the “IEEE Standard for calculation of Bare Overhead Conductor Temperature and Ampacity Under Steady-State Conditions,” ANSI/IEEE Standard 738. Alcoa SAG10 Ratekit was used to calculate conductor ratings.

A regulatory authority does not set the conductor steady state thermal rating variables. The CapX2020 Member Utilities Transmission Line Standards Committee (“Committee”) developed the conductor steady state thermal rating variables for summer ratings based upon member utilities’ standard of practice..

The summer steady state thermal rating variables are as follows:

- Conductor orientation relative to north: 90 degrees
- Atmosphere: Clear
- Air Temperature: 40 degrees C for Summer
- Wind Speed: 2 ft/sec
- Wind angle relative to conductor: 90 degrees
- Elevation above sea level: 1000 ft
- Latitude: 45 degrees N
- Date: July 8
- Solar time: 12 hours
- Coefficient of emissivity: 0.7
- Coefficient of absorption: 0.9
- 200 degrees C maximum operating temperature for ACSS
- 100 degrees C maximum operating temperature for ACSR

The Committee defined the Emergency Line Rating as equal to the steady state thermal rating.

The Committee specified that conductors meet minimum clearances to ground based upon voltage and nature of surface under the conductor (*i.e.*, roads, interstate highway, railroads, etc.). The minimum specified clearances were chosen to assure that the final constructed lines meet or exceed the National Electrical Safety Code (“NESC”) minimum clearances. Conductor sags are to be calculated based upon conductor size, conductor temperature, span length, design tension, structure heights and loading conditions. Vertical clearances shall be applied to the greatest sag resulting from either the maximum operating temperature of 200°C (for the ACSS

conductor) and 100°C (for the ACSR conductor) or the maximum loaded condition (ice plus wind).

| <b><u>Conductor</u></b>  | <b><u>Summer Thermal Ampacity Rating</u></b> | <b><u>Summer Thermal MVA Rating</u></b> |
|--|--|---|
| Single 795 kcm 26/7 ACSR, 115 KV   | 965 amps                                     | 192 MVA                                 |
| Single 795 kcm 26/7 ACSS, 115 KV   | 1655 amps                                    | 330 MVA                                 |
| Twin bundled 795 kcm 26/7 ACSR, 115 KV   | 1930 amps                                    | 384 MVA                                 |
| Twin bundled 795 kcm 26/7 ACSS, 115 KV   | 3310 amps                                    | 659 MVA                                 |
| Single 954 kcm 54/19 ACSS, 115 KV  | 1850 amps                                    | 368 MVA                                 |
| Single 795 kcm 26/7 ACSS, 161 KV   | 1655 amps                                    | 462 MVA                                 |
| Single 954 kcm 54/19 ACSS, 161 KV  | 1850 amps                                    | 516 MVA                                 |
| Single 795 kcm 26/7 ACSR, 230 KV   | 965 amps                                     | 384 MVA                                 |
| Single 795 kcm 26/7 ACSS, 230 KV   | 1655 amps                                    | 659 MVA                                 |
| Single 954 kcm 54/19 ACSS, 230 KV  | 1850 amps                                    | 737 MVA                                 |
| Twin bundled 795 kcm 26/7 ACSR, 345 KV   | 1930 amps                                    | 1153 MVA                                |
| Twin bundled 954 kcm 54/19 ACSS, 345 KV  | 3700 amps                                    | 2211 MVA                                |
| Triple bundled 954 kcm 54/19 ACSS, 500 KV  | 5550 amps                                    | 4806 MVA                                |
| Triple bundled conductor as used on the Forbes – Chisago 500 KV line (Triple bundled 1192.5 kcm 45/7 ACSR) | 3648 amps                                    | 3159 MVA                                |

The Committee did not develop steady state thermal rating variables for winter ratings. Xcel Energy – NSP Operating Territory uses 0°C for the winter rating air temperature for calculating the rating during the winter operating season of November 1 to April 30. The April 30 date produces the lowest allowable line rating of the winter rating period, so it is used in the following table. The April 30 date and 0°C air temperature were used in conjunction with the other steady state thermal

rating variables developed by the Committee to develop the following winter rating table.

The winter steady state thermal rating variables used for the following Xcel Energy – NSP Operating Territory/ CAPX2020 Member Utilities Transmission Line Standards Committee rating table are as follows:

- Conductor orientation relative to north: 90 degrees
- Atmosphere: Clear
- Air Temperature: 0 degrees C for Winter
- Wind Speed: 2 ft/sec
- Wind angle relative to conductor: 90 degrees
- Elevation above sea level: 1000 ft
- Latitude: 45 degrees N
- Date: April 30
- Solar time: 12 hours
- Coefficient of emissivity: 0.7
- Coefficient of absorption: 0.9
- 200 degrees C maximum operating temperature for ACSS
- 100 degrees C maximum operating temperature for ACSR

| <b><u>Conductor</u></b>                | <b><u>Winter (April 30)<br/>Thermal<br/>Ampacity Rating</u></b> | <b><u>Winter (April 30)<br/>Thermal MVA<br/>Rating</u></b> |
|--|---|--|
| Single 795 kcm 26/7 ACSR, 115 KV       | 1286 amps   | 256 MVA  |
| Single 795 kcm 26/7 ACSS, 115 KV       | 1819 amps   | 362 MVA  |
| Twin bundled 795 kcm 26/7 ACSR, 115 KV | 2572 amps   | 512 MVA  |
| Twin bundled 795 kcm 26/7 ACSS, 115 KV | 3638 amps   | 725 MVA  |
| Single 954 kcm 54/7 ACSS, 115 KV       | 2032 amps   | 405 MVA  |
| Single 795 kcm 26/7 ACSS, 161 KV       | 1819 amps   | 507 MVA  |
| Single 954 kcm 54/7 ACSS, 161 KV       | 2032 amps   | 567 MVA  |
| Single 795 kcm 26/7 ACSR, 230 KV       | 1286 amps   | 512 MVA  |

| <b><u>Conductor</u></b>  | <b><u>Winter (April 30)<br/>Thermal<br/>Ampacity Rating</u></b> | <b><u>Winter (April 30)<br/>Thermal MVA<br/>Rating</u></b> |
|--|---|--|
| Single 795 kcm 26/7 ACSS, 230 KV   | 1819 amps   | 725 MVA  |
| Single 954 kcm 54/7 ACSS, 230 KV   | 2032 amps   | 809 MVA  |
| Twin bundled 795 kcm 26/7 ACSR, 345 KV   | 2572 amps   | 1537 MVA   |
| Twin bundled 954 kcm 54/7 ACSS, 345 KV   | 4064 amps   | 2428 MVA   |
| Triple bundled 954 kcm 54/7 ACSS, 500 KV   | 6096 amps   | 5279 MVA   |
| Triple bundled conductor as used on the Forbes –<br>Chisago 500 KV line (Triple bundled 1192.5 kcm 45/7<br>ACSR) | 4875 amps   | 4222 MVA   |

### **Surge Impedance**

The following table shows typical ranges of surge impedances found on the CapX2020 member systems. Designs for the proposed CapX2020 transmission lines are not far enough along to provide more accurate surge impedances for these lines.

### **Conductor Configuration**

### **Surge Impedance**

|  |                |
|--|----------------|
| Single Bundled Conductor – 115, 161 & 230 KV<br>Configurations a, b, f & h | 350 – 375 Ohms |
| Twin bundled Conductor - 115 KV<br>Configurations c & d                    | 250 - 300 Ohms |
| Twin bundled Conductor - 345 KV<br>Configurations k & l                    | 270 –285 Ohms  |
| Triple bundled Conductor - 500 kV<br>Configuration n                       | 250 – 300 Ohms |
| Configurations e, g, i, j and m  | Not Used       |

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# **EXHIBIT C**

## **Applicant Magnetic Field Calculations**

Table 3.6-2: Calculated Magnetic Fields for Proposed 345kV Transmission Line Designs

Hampton-LaCrosse Project Routing Application p. 3-28 - 3-29

Table 3.6-2:  
Calculated Magnetic Fields (mG) for Proposed 345 kV Transmission Line Designs (3.28 Feet Aboveground)

| Structure Type  | Geographical Segment  | System Condition | Current (amps) | -300 | -200 | -100 | -75   | -50   | 0     | 50    | 75    | 100   | 200  | 300  |
|---|---|------------------|----------------|------|------|------|-------|-------|-------|-------|-------|-------|------|------|
| Single- Pole Davit Arm 345/345 kV Double-Circuit with one Circuit In Service        | Preferred Route: Hampton to Cannon Falls; Non-US-52 segments Zumbrota area to North Rochester | 2015 Peak        | 140 A          | 0.38 | 0.79 | 2.35 | 3.41  | 5.24  | 13.58 | 9.64  | 5.88  | 3.77  | 1.04 | 0.46 |
|   |   | 2015 Average     | 112 A          | 0.30 | 0.63 | 1.88 | 2.73  | 4.19  | 10.87 | 7.71  | 4.71  | 3.01  | 0.83 | 0.37 |
|   | Alternate Route: Hampton to North Rochester   | 2025 Peak        | 132 A          | 0.36 | 0.74 | 2.22 | 3.22  | 4.94  | 12.81 | 9.09  | 5.55  | 3.55  | 0.98 | 0.43 |
|   |   | 2025 Average     | 106 A          | 0.29 | 0.60 | 1.78 | 2.58  | 3.97  | 10.29 | 7.30  | 4.45  | 2.85  | 0.79 | 0.35 |
| Single-Pole Davit Arm 345/345 kV with 69 kV Underbuild with 1 Active 345 kV Circuit | Preferred Route: US-52 segments Cannon Falls to Zumbrota area                                 | 2015 Peak        | 140/325        | 0.74 | 1.65 | 6.20 | 10.42 | 20.73 | 70.89 | 8.50  | 3.77  | 2.51  | 1.01 | 0.52 |
|   |   | 2015 Average     | 112/260        | 0.59 | 1.32 | 4.96 | 8.33  | 16.58 | 56.71 | 6.80  | 3.02  | 2.01  | 0.81 | 0.41 |
|   |   | 2025 Peak        | 132/328        | 0.73 | 1.62 | 6.14 | 10.36 | 20.71 | 71.85 | 8.89  | 3.92  | 2.54  | 0.99 | 0.50 |
|   |   | 2025 Average     | 106/262        | 0.58 | 1.30 | 4.91 | 8.28  | 16.55 | 57.37 | 7.09  | 3.12  | 2.03  | 0.79 | 0.40 |
| Single-Pole Davit Arm 345/345 kV Double-Circuit with one Circuit in Service         | N. Rochester to Alma  | 2015 Peak        | 403 A          | 1.12 | 2.33 | 6.97 | 10.11 | 15.54 | 40.27 | 28.58 | 17.44 | 11.17 | 3.09 | 1.35 |
|   |   | 2015 Average     | 322 A          | 0.87 | 1.81 | 5.41 | 7.85  | 12.06 | 31.24 | 22.17 | 13.53 | 8.67  | 2.40 | 1.05 |
|   |   | 2025 Peak        | 415 A          | 1.12 | 2.33 | 6.97 | 10.11 | 15.54 | 40.27 | 28.58 | 17.44 | 11.17 | 3.09 | 1.35 |
|   |   | 2025 Average     | 332 A          | 0.90 | 1.87 | 5.57 | 8.09  | 12.43 | 32.21 | 22.86 | 13.95 | 8.94  | 2.47 | 1.08 |

Hampton ▪ Rochester ▪ La Crosse 345 kV Transmission Project

Table 3.6-2:

Calculated Magnetic Fields (mG) for Proposed 345 kV Transmission Line Designs (3.28 Feet Aboveground)

| Structure Type                                    | Geographical Segment              | System Condition | Current (amps) | -300 | -200 | -100 | -75  | -50  | 0     | 50   | 75   | 100  | 200  | 300  |
|---|-----------------------------------|------------------|----------------|------|------|------|------|------|-------|------|------|------|------|------|
| Single-Pole<br>Davit Arm<br>161 kV Single-Circuit | N. Rochester to<br>Northern Hills | 2015 Peak        | 95 A           | 0.20 | 0.43 | 1.50 | 2.42 | 4.39 | 14.29 | 5.41 | 2.79 | 1.65 | 0.42 | 0.18 |
|   |                                   | 2015 Average     | 76 A           | 0.16 | 0.34 | 1.20 | 1.94 | 3.51 | 11.43 | 4.33 | 2.23 | 1.32 | 0.33 | 0.14 |
|   |                                   | 2015 Peak        | 96 A           | 0.20 | 0.43 | 1.52 | 2.45 | 4.43 | 14.44 | 5.47 | 2.82 | 1.66 | 0.42 | 0.18 |
|   |                                   | 2015 Average     | 77 A           | 0.16 | 0.34 | 1.22 | 1.96 | 3.56 | 11.58 | 4.38 | 2.26 | 1.33 | 0.34 | 0.15 |

# **EXHIBIT D**

## **McKay Magnetic Field Calculations**

Calculated Magnetic Field Tables for Proposed 345 kV Transmission Line Designs

| STEP 1  |                                     |                  |                |       |       |       |      |      |       |      |      |      |      |      |
|---|-------------------------------------|------------------|----------------|-------|-------|-------|------|------|-------|------|------|------|------|------|
| THIS TABLE CONTAINS THE COLUMN HEADINGS AND DATA FROM THE TOP ENTRY IN THE TABLE FROM EXHIBIT C                       |                                     |                  |                |       |       |       |      |      |       |      |      |      |      |      |
| TABLE 3.6-2:<br>Calculated Magnetic Fields (mG) for Proposed 345 kV Transmission Line Designs (3.28 Feet Aboveground) |                                     |                  |                |       |       |       |      |      |       |      |      |      |      |      |
| STRUCTURE TYPE  | GEOGRAPHICAL SEGMENT                | SYSTEM CONDITION | CURRENT (AMPS) | -300' | -200' | -100' | -75' | -50' | 0'    | 50'  | 75'  | 100' | 200' | 300' |
| SINGLE- POLE<br>DAVIT ARM<br>345/345 kV DOUBLE-<br>CIRCUIT WITH ONE CIRCUIT<br>IN SERVICE                             | PREFERRED ROUTE:                    | 2015 PEAK        | 140.00         | 0.38  | 0.79  | 2.35  | 3.41 | 5.24 | 13.58 | 9.64 | 5.88 | 3.77 | 1.04 | 0.46 |
|   | HAMPTON TO<br>CANNON FALLS;         | 2015 AVERAGE     | 112.00         | 0.30  | 0.63  | 1.88  | 2.73 | 4.19 | 10.87 | 7.71 | 4.71 | 3.01 | 0.83 | 0.37 |
|   | NON-US-52<br>SEGMENTS               |                  |                |       |       |       |      |      |       |      |      |      |      |      |
|   | ZUMBROTA AREA TO<br>NORTH ROCHESTER |                  |                |       |       |       |      |      |       |      |      |      |      |      |
|   | ALTERNATE ROUTE:                    |                  |                |       |       |       |      |      |       |      |      |      |      |      |
|   | HAMPTON TO NORTH<br>ROCHESTER       |                  |                |       |       |       |      |      |       |      |      |      |      |      |
|   |                                     |                  |                |       |       |       |      |      |       |      |      |      |      |      |
|   |                                     |                  |                |       |       |       |      |      |       |      |      |      |      |      |

| STEP 2  |                        |
|---|------------------------|
| MVA CALCULATED FROM THE<br>CURRENTS IN TABLE 3.6-2: |                        |
| 345.00 kV   |                        |
| 140.00 Amps PEAK ESTIMATED                          |                        |
| 1.73 3 Phase  |                        |
| 83.56   | MVA PEAK CALCULATED    |
|   |                        |
| 345.00 kV   |                        |
| 112.00 Amps AVERAGE ESTIMATED                       |                        |
| 1.73 3 Phase  |                        |
| 66.85   | MVA AVERAGE CALCULATED |

| STEP 4- SINGLE CIRCUIT  |                                     |                  |                |       |       |       |       |       |        |        |       |       |       |      |
|---|-------------------------------------|------------------|----------------|-------|-------|-------|-------|-------|--------|--------|-------|-------|-------|------|
| THIS TABLE CONTAINS DATA SCALED FROM THE TABLE IN STEP 1 USING CURRENTS CALCULATED IN STEP 3- SINGLE CIRCUIT  |                                     |                  |                |       |       |       |       |       |        |        |       |       |       |      |
| TABLE 3.6-2 SCALED for SINGLE CIRCUIT DESIGN CAPACITY:<br>Calculated Magnetic Fields (mG) for Proposed 345 kV Transmission Line Designs (3.28 Feet Aboveground) |                                     |                  |                |       |       |       |       |       |        |        |       |       |       |      |
| STRUCTURE TYPE  | GEOGRAPHICAL SEGMENT                | SYSTEM CONDITION | CURRENT (AMPS) | -300' | -200' | -100' | -75'  | -50'  | 0'     | 50'    | 75'   | 100'  | 200'  | 300' |
| SINGLE- POLE<br>DAVIT ARM<br>345/345 kV DOUBLE-<br>CIRCUIT WITH ONE CIRCUIT<br>IN SERVICE   | PREFERRED ROUTE:                    | 2015 PEAK        | 1852.22        | 5.03  | 10.45 | 31.09 | 45.11 | 69.33 | 179.67 | 127.54 | 77.79 | 49.88 | 13.76 | 6.09 |
|   | HAMPTON TO<br>CANNON FALLS;         | 2015 AVERAGE     | 1481.78        | 3.97  | 8.34  | 24.87 | 36.12 | 55.43 | 143.81 | 102.00 | 62.31 | 39.82 | 10.98 | 4.90 |
|   | NON-US-52<br>SEGMENTS               |                  |                |       |       |       |       |       |        |        |       |       |       |      |
|   | ZUMBROTA AREA TO<br>NORTH ROCHESTER |                  |                |       |       |       |       |       |        |        |       |       |       |      |
|   | ALTERNATE ROUTE:                    |                  |                |       |       |       |       |       |        |        |       |       |       |      |
|   | HAMPTON TO NORTH<br>ROCHESTER       |                  |                |       |       |       |       |       |        |        |       |       |       |      |
|   |                                     |                  |                |       |       |       |       |       |        |        |       |       |       |      |
|   |                                     |                  |                |       |       |       |       |       |        |        |       |       |       |      |

| STEP 3- SINGLE CIRCUIT   |                         |
|--|-------------------------|
| CURRENT CALCULATED FROM SINGLE<br>CIRCUIT MVA DESIGN CAPACITY: |                         |
| 345.00 kV  |                         |
| 1.73 3 Phase   |                         |
| 1852.22  | Amps PEAK CALCULATED    |
|  |                         |
| 884.40   | **MVA AVERAGE DESIGN    |
| 345.00 kV  |                         |
| 1.73 3 Phase   |                         |
| 1481.78  | Amps AVERAGE CALCULATED |

| STEP 4- DOUBLE CIRCUIT  |                                     |                  |                |       |       |       |       |        |        |        |        |       |       |       |
|---|-------------------------------------|------------------|----------------|-------|-------|-------|-------|--------|--------|--------|--------|-------|-------|-------|
| THIS TABLE CONTAINS DATA SCALED FROM THE TABLE IN STEP 1 USING CURRENTS CALCULATED IN STEP 3- DOUBLE CIRCUIT  |                                     |                  |                |       |       |       |       |        |        |        |        |       |       |       |
| TABLE 3.6-2 SCALED for DOUBLE CIRCUIT DESIGN CAPACITY:<br>Calculated Magnetic Fields (mG) for Proposed 345 kV Transmission Line Designs (3.28 Feet Aboveground) |                                     |                  |                |       |       |       |       |        |        |        |        |       |       |       |
| STRUCTURE TYPE  | GEOGRAPHICAL SEGMENT                | SYSTEM CONDITION | CURRENT (AMPS) | -300' | -200' | -100' | -75'  | -50'   | 0'     | 50'    | 75'    | 100'  | 200'  | 300'  |
| SINGLE- POLE<br>DAVIT ARM<br>345/345 kV DOUBLE-<br>CIRCUIT WITH ONE CIRCUIT<br>IN SERVICE   | PREFERRED ROUTE:                    | 2015 PEAK        | 3704.45        | 10.05 | 20.90 | 62.18 | 90.23 | 138.65 | 359.33 | 255.08 | 155.59 | 99.76 | 27.52 | 12.17 |
|   | HAMPTON TO<br>CANNON FALLS;         | 2015 AVERAGE     | 2963.89        | 7.94  | 16.67 | 49.75 | 72.24 | 110.88 | 287.66 | 204.03 | 124.64 | 79.65 | 21.96 | 9.79  |
|   | NON-US-52<br>SEGMENTS               |                  |                |       |       |       |       |        |        |        |        |       |       |       |
|   | ZUMBROTA AREA TO<br>NORTH ROCHESTER |                  |                |       |       |       |       |        |        |        |        |       |       |       |
|   | ALTERNATE ROUTE:                    |                  |                |       |       |       |       |        |        |        |        |       |       |       |
|   | HAMPTON TO NORTH<br>ROCHESTER       |                  |                |       |       |       |       |        |        |        |        |       |       |       |
|   |                                     |                  |                |       |       |       |       |        |        |        |        |       |       |       |
|   |                                     |                  |                |       |       |       |       |        |        |        |        |       |       |       |

| STEP 3- DOUBLE CIRCUIT   |                         |
|--|-------------------------|
| CURRENT CALCULATED FROM DOUBLE<br>CIRCUIT MVA DESIGN CAPACITY: |                         |
| 345.00 kV  |                         |
| 1.73 3 Phase   |                         |
| 3704.45  | Amps PEAK CALCULATED    |
|  |                         |
| 1769.00  | **MVA AVERAGE DESIGN    |
| 345.00 kV  |                         |
| 1.73 3 Phase   |                         |
| 2963.89  | Amps AVERAGE CALCULATED |

- NOTES:
1.  $MVA = (kV * Amps * 1.73) / 1000$
  2.  $Amps = (MVA * 1000) / (kV * 1.73)$
  3. For a given physical and electrical configuration, milligauss at one location is proportional to current (Amps) (for example, double the current and the milligauss level also doubles).
  4. For a given physical and electrical configuration and constant current, the milligauss level changes as the inverse square of the distance from away from the source (for example, move 2 times as far away and the milligauss level decreases to 1/4 of what it was).
- \*. MVA PEAK DESIGN CAPACITY IS FROM A COMBINATION OF THE DATA PRESENTED IN EXHIBITS A, B, AND C.  
\*\*. MVA AVERAGE DESIGN CAPACITY WAS CHOSEN TO BE ABOUT 80% OF PEAK DESIGN CAPACITY

**Public Version**



# **Western Wisconsin Transmission Reliability Study**

## **Final Report**

**September 20, 2010**

**By:  
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**Transmission – Transmission Planning Analysis  
Attachment FF- ATCLLC of the  
Midwest ISO Tariff**

## Public Version

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## EXECUTIVE SUMMARY

This Transmission Study assesses the reliability needs of the western Wisconsin area, shown in Figure I, which has unique reliability-related characteristics. It includes several load centers such as Rochester, Minneapolis and St. Paul in Minnesota, La Crosse, Eau Claire, Madison, Stevens Point, Wisconsin Rapids and Wisconsin Dells in Wisconsin, and Dubuque in Iowa. This Transmission Study is part of a larger “combination of benefits” analysis that takes into account the reliability needs of the study area through this study, the economic savings created by the projects under study and the public policy benefits that would be created by these options.

The transmission facilities located in western Wisconsin are important to reliably serve load and to facilitate reliable power transfers between and through these upper Midwest states. The reliable operation of the existing transmission facilities can be impacted by heavy power through-flows in various directions especially the flow of power from west to east, often referred to as the “west to east bias.” This flow bias causes additional stress to the area’s transmission network. The west to east transfer capability of the existing transmission facilities through the Minnesota-Wisconsin Export (MWEX) interface is presently limited due to voltage stability and transient voltage recovery limitations. Wind-powered generation has been and will continue to be added in the upper Midwest to meet state Renewable Portfolio Standard (RPS) requirements in the geographical region and beyond. These generation additions will most likely increase the levels of the west to east flows, particularly during off-peak load periods.

The purpose of the Western Wisconsin Transmission Reliability Study is to identify and document the reliability needs in the western Wisconsin area in the eight- to ten-year-out time frame and also to evaluate the extent to which different transmission options would meet these needs using various reliability measures.

The steady-state power flow analyses used three 2018 Summer Peak and Off-peak (70% peak load) models. The existing, planned and future wind generation included in the Midwest ISO (MISO) region in the study models is 13,277 MW. Total wind generation included in North Dakota (ND) and South Dakota (SD) within the MISO region is 583 MW. Total wind generation included in Minnesota (MN), Iowa (IA) and Wisconsin (WI) within the MISO region is 10,006 MW, which is approximately the amount of wind needed to meet the RPS requirements of the Minnesota, Wisconsin and Iowa in 2020<sup>1</sup>. The steady-state power flow analyses include power flow AC contingency analysis, First Contingency Incremental Transfer Capability (FCITC) analysis and Power-Voltage (PV) stability analysis. The study also includes a transient stability analysis using a 2014 light load model.

This study includes two phases: the initial screening and the detailed analysis. The initial screening evaluated the base case and 15 different transmission options using AC contingency analysis. Options that did not have significant and positive impact on the reliability of the

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<sup>1</sup> Based on Midwest ISO Regional Generation Outlet Study (RGOS) Phase I & II survey data (with modifications to correct the data anomalies identified by American Transmission Company, LLC) .

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western Wisconsin study area were excluded from further detailed analysis. Of the 15 different transmission options that were initially evaluated, seven provided sufficient impact on the reliable operation of the transmission system in the study cases to warrant further detailed evaluation. These are the seven transmission options evaluated in detail:

- Option 1: North La Crosse – Hilltop – Spring Green – Cardinal 345 kV project
- Option 1a: North La Crosse – Spring Green – Cardinal 345 kV project
- Option 1b: North La Crosse – North Madison – Cardinal 345 kV project
- Option 8: Dubuque – Spring Green – Cardinal 345 kV project
- Option 7c: North La Crosse – North Madison – Cardinal and  
Dubuque – Spring Green – Cardinal 345 kV projects
- Low Voltage Option: a collection of 69 kV, 138 kV and 161 kV facilities
- 765 kV Option: Genoa – North Monroe 765 kV project and supporting 345kV<sup>2</sup>

Full descriptions of the seven transmission options studied in the detailed analysis can be found in Appendix A. Three of the options (Options 1, 1a, and 1b) connect to the CapX2020<sup>3</sup> “Group 1” Hampton Corners – North La Crosse 345 kV line, which has a targeted in-service date between 2013 and 2015, to the Cardinal substation (formerly named West Middleton) in Middleton, Wisconsin, forming network interconnections with the 345 kV facilities in the Madison area. Hilltop is an existing substation in the ATC area with multiple 69 kV lines.

The results as summarized in Table ES-1 show that the Low Voltage Option has the lowest rankings for all aspects of the reliability performance evaluated using non-monetized measures. These aspects include system voltage performance under Category B and C contingencies, severe local low voltages under a Category C2 contingency, voltage stability and robustness and system transient stability. These rankings are further described within the report at their respective sections.

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<sup>2</sup> As stated in Appendix A, supporting 345kV facilities for the 765kV option include a N. LaCrosse-Genoa 345kV, Adams-Genoa 345 kV, double circuit N. Monroe-Paddock 345 kV lines and transformers at Genoa and N. Monroe

<sup>3</sup> CapX2020 is a joint initiative of 11 transmission-owning utilities in Minnesota and the surrounding region to expand the electric transmission grid to ensure continued reliable and affordable service. [www.capx2020.com](http://www.capx2020.com)

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Table ES.1 – Summary of non- monetized reliability performance measures

| Rankings of benefits not captured by cost analysis<br>(1=Lowest, 5=Highest) | Low Voltage | NLAX-HLT-SPG-CDL<br>(1) | NLAX-SPG-CDL<br>(1a) | NLAX-NMA-CDL<br>(1b) | DBQ-SPG-CDL<br>(8) | NLAX-NMA-CDL +<br>DBQ-SPG-CDL (7c) | Genoa-NOM 765 kV |
|---|-------------|-------------------------|----------------------|----------------------|--------------------|------------------------------------|------------------|
| Voltage performance under Cat-B contingencies                               | 1           | 4                       | 4                    | 4                    | 4                  | 5                                  | 3                |
| Voltage performance under converged Cat-C contingencies                     | 1           | 5                       | 4                    | 3                    | 4                  | 5                                  | 2                |
| Alleviate Cat-C2 severe local low voltages                                  | 1           | 5                       | 5                    | 1                    | 5                  | 5                                  | 1                |
| Support voltage stability and robustness                                    | 1           | 3                       | 2                    | 2                    | 3                  | 5                                  | 4                |
| Support system transient stability  | 1           | 3                       | 1                    | 4                    | 1                  | 5                                  | 1                |

For these aspects, the Low Voltage Option consistently performs at inferior levels compared to the EHV options. As shown in Table ES.2 below, for the reliability aspects evaluated using the monetized measure, the Low Voltage Option is less costly than the EHV options. However, because of their advantages in supporting system voltages, voltage stability and transient stability, the EHV options are preferred over the Low Voltage Option.

The 765 kV Option would represent the first 765 kV element in the western Wisconsin area. The results show that the overall reliability rankings are lower for the 765 kV Option than the 345 kV options for those aspects evaluated using non-monetized measures. For the reliability aspects evaluated using the monetized measure, the 765 kV Option is shown to have the highest cost.

Three of the seven options are in the corridor between North LaCrosse to Madison. These options (Options 1, 1a, and 1b) are comparable from an overall reliability performance perspective and Option 1b (North LaCrosse-North Madison-Cardinal) has the lowest overall cost of the three options. A 345kV line in this corridor provides the voltage stability and interconnection to Minnesota which is one of the desired benefits of this study.

Option 8 (Dubuque-Spring Green-Cardinal) also performs well from a reliability perspective. It has a slightly lower cost than Option 1b (North LaCrosse-North Madison-Cardinal) but does not provide the transient stability that is desired. Option 7c – the combination North La Crosse-North Madison-Cardinal and Dubuque-Spring Green-Cardinal 345 kV project – performed the best across all aspects of the reliability analyses. Option 7c also provides additional benefits over and above the single 345 kV options such as providing the highest level of transfer capability for wind generation in Minnesota and Iowa.

The conclusion of this study is that Option 7c provides the most reliability benefit to the western Wisconsin area; Option 1b provides a portion of the benefit realized in Option 7c and includes the additional interconnection to Minnesota. Option 8 provides significant reliability benefits to western Wisconsin as well but not the needed reinforcements for Minnesota

The transmission maps of the western Wisconsin study area, and Options 1b and 7c are shown in Figures I, II and III. Transmission maps for all studied options can be found in Appendix B.

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The summary presented below in Table ES-2 is also found in Section 6, Conclusions.

Finally, it is critical to note that this study evaluates only the reliability benefits of the projects under study. It does not take into account any other benefits of these options, including energy and loss savings, and other economic and policy benefits such as the ability to integrate and deliver renewable energy. ATC believes that the total combination of benefits versus costs, as well as information from the Midwest ISO's Regional Generator Outlet Study, should be taken into account in making a choice to pursue any of the options listed above. ATC has been analyzing the combined reliability, economic, and policy benefits of these options for approximately two years and has determined that a 345 kV project from the La Crosse area to the greater Madison area (the Badger Coulee Project) would provide multiple benefits. ATC has recently announced its intention to finalize its evaluation of these combined benefits and to begin public outreach on the Badger Coulee Project.<sup>4</sup>

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<sup>4</sup> Further information about this announcement is located at: <http://www.atc-projects.com/BadgerCoulee.shtml>

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Table ES.2 – Summary of the comparisons of the reliability performance using monetized measures

| Summary of project costs in 2010 dollars                          |                |                           | Low Voltage          | NLAX-HLT-SPG-CDL (1) | NLAX-SPG-CDL (1a)    | NLAX-NMA-CDL (1b)    | DBQ-SPG-CDL (8)      | NLAX-NMA-CDL + DBQ-SPG-CDL (7c) | Genoa-NOM 765 kV       |
|---|----------------|---------------------------|----------------------|----------------------|----------------------|----------------------|----------------------|---------------------------------|------------------------|
| EHV projects  |                |                           | Opt LV               | Opt1                 | Opt1a                | Opt1b                | Opt8 <sup>1</sup>    | Opt7c                           | Opt 765                |
|   |                |                           | \$0                  | \$454,492,920        | \$377,454,200        | \$357,590,989        | \$304,187,200        | \$672,785,400                   | \$880,598,000          |
|   |                |                           |                      |                      |                      |                      |                      |                                 |                        |
| <b>Category B Supporting Facilities</b>                           | <b>Loading</b> | <b>ATC Facilities</b>     | \$173,768,164        | \$118,661,663        | \$131,603,921        | \$119,001,306        | \$101,420,588        | \$86,326,549                    | \$136,878,643          |
|   | <b>Loading</b> | <b>Non-ATC Facilities</b> | \$95,397,350         | \$38,281,800         | \$52,036,800         | \$69,696,850         | \$103,972,600        | \$57,625,100                    | \$43,168,200           |
|   |                | <b>Total</b>              | <b>\$269,165,514</b> | <b>\$156,943,463</b> | <b>\$183,640,721</b> | <b>\$188,698,156</b> | <b>\$205,393,188</b> | <b>\$143,951,649</b>            | <b>\$180,046,843</b>   |
|   |                |                           |                      |                      |                      |                      |                      |                                 |                        |
| <b>Category C Supporting Facilities</b>                           | <b>Loading</b> | <b>ATC Facilities</b>     | \$0                  | \$0                  | \$0                  | \$0                  | \$0                  | \$0                             | \$0                    |
|   | <b>Voltage</b> | <b>ATC Facilities</b>     | \$82,758,813         | \$0                  | \$0                  | \$0                  | \$0                  | \$0                             | \$0                    |
|   | <b>Loading</b> | <b>Non-ATC Facilities</b> | \$0                  | \$0                  | \$0                  | \$0                  | \$0                  | \$0                             | \$0                    |
|   | <b>Voltage</b> | <b>Non-ATC Facilities</b> | \$0                  | \$0                  | \$0                  | \$0                  | \$0                  | \$0                             | \$0                    |
|   |                | <b>Total</b>              | <b>\$82,758,813</b>  | <b>\$0</b>           | <b>\$0</b>           | <b>\$0</b>           | <b>\$0</b>           | <b>\$0</b>                      | <b>\$0</b>             |
|   |                |                           |                      |                      |                      |                      |                      |                                 |                        |
| <b>Category B &amp; C Supporting Facilities</b>                   |                | <b>ATC Facilities</b>     | \$256,526,977        | \$118,661,663        | \$131,603,921        | \$119,001,306        | \$101,420,588        | \$86,326,549                    | \$136,878,643          |
|   |                | <b>Non-ATC Facilities</b> | \$95,397,350         | \$38,281,800         | \$52,036,800         | \$69,696,850         | \$103,972,600        | \$57,625,100                    | \$43,168,200           |
|   |                | <b>Total</b>              | <b>\$351,924,327</b> | <b>\$156,943,463</b> | <b>\$183,640,721</b> | <b>\$188,698,156</b> | <b>\$205,393,188</b> | <b>\$143,951,649</b>            | <b>\$180,046,843</b>   |
|   |                |                           |                      |                      |                      |                      |                      |                                 |                        |
| <b>Total cost estimates for project packages (main + support)</b> |                |                           | <b>\$351,924,327</b> | <b>\$611,436,383</b> | <b>\$561,094,921</b> | <b>\$546,289,145</b> | <b>\$509,580,388</b> | <b>\$816,737,049</b>            | <b>\$1,060,644,843</b> |

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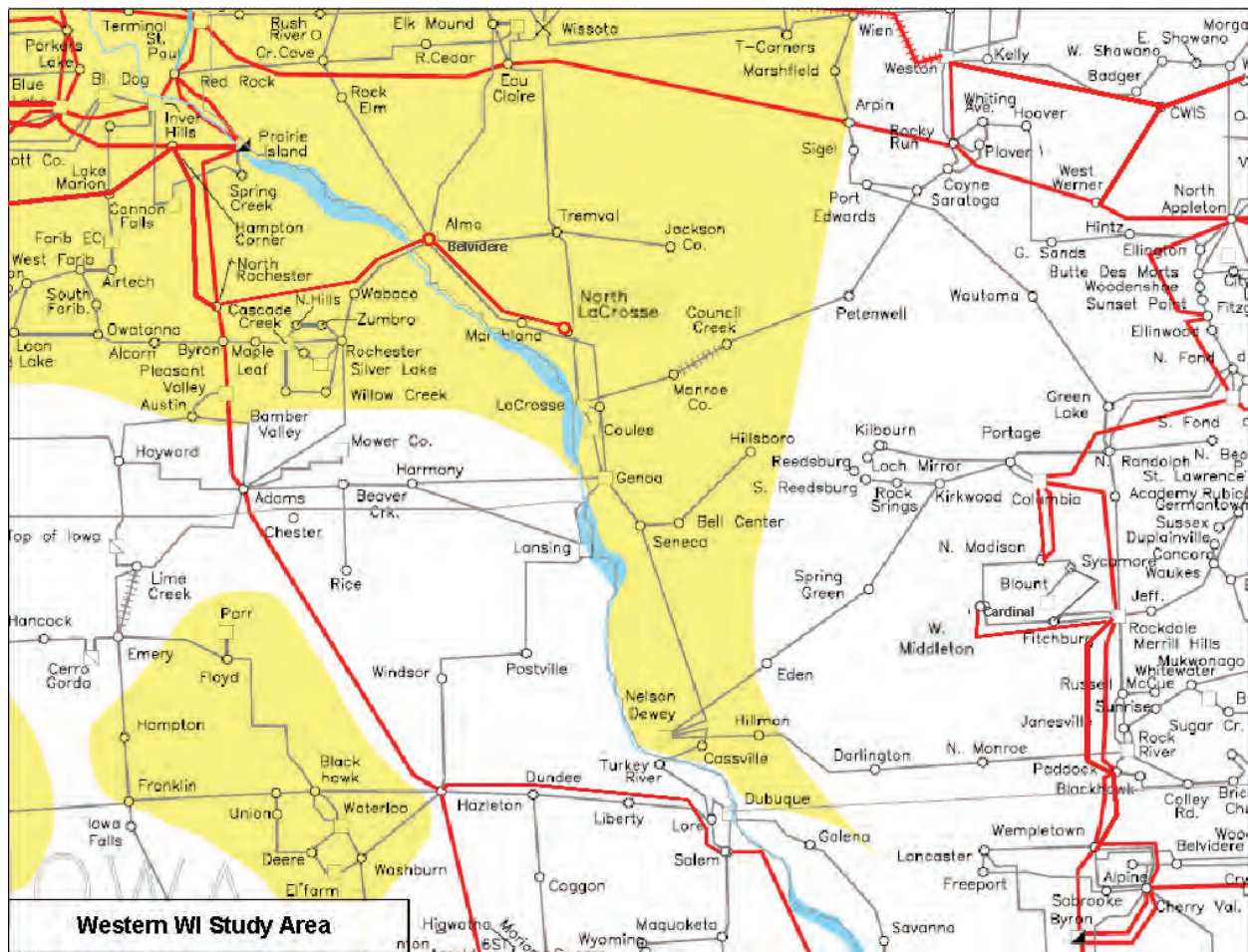


Figure I – Western Wisconsin study area<sup>5</sup>

<sup>5</sup> Yellow shaded area on Option maps represents the Mid-Continent Area Power Pool (MAPP) region.

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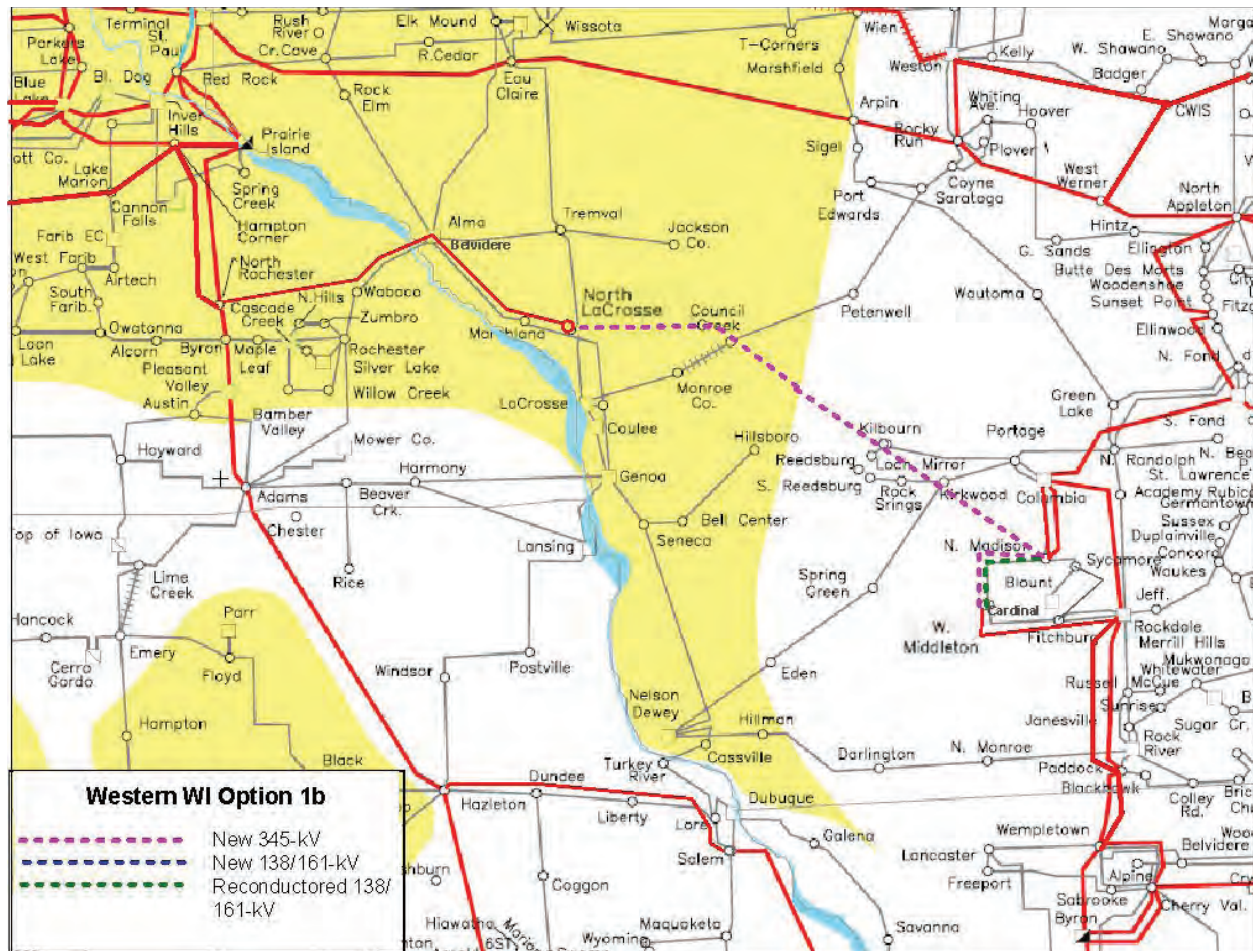


Figure II – North La Crosse - North Madison – Cardinal 345 kV project (Option 1b)<sup>6</sup>

<sup>6</sup> Yellow shaded area on Option maps represents the Mid-Continent Area Power Pool (MAPP) region.

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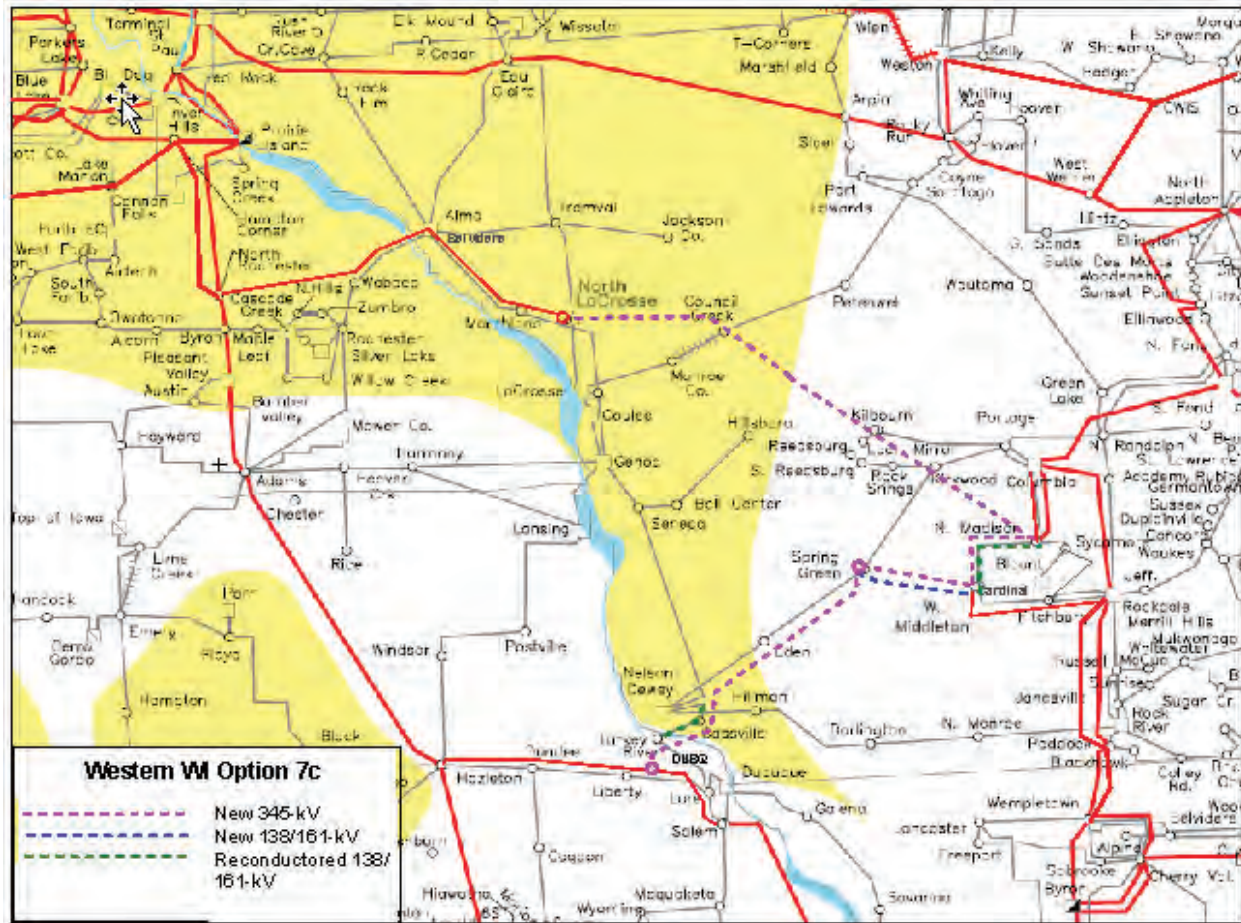


Figure III – North La Crosse-North Madison-Cardinal and Dubuque-Spring Green-Cardinal 345 kV project (Option 7c)<sup>7</sup>

<sup>7</sup> Yellow shaded area on Option maps represents the Mid-Continent Area Power Pool (MAPP) region.

# 1. Introduction

## 1.1 Background

The CapX2020 Group I project Hampton Corners – North Rochester – North La Crosse 345 kV line (targeted in-service date 2013 – 2015) addresses the load serving needs in the Rochester and La Crosse areas. It was anticipated that extending this 345 kV line to interconnect with the existing Wisconsin 345 kV network will be beneficial to regional reliability as well as the western Wisconsin area.

The western Wisconsin area, shown in Figure I, has unique characteristics. It includes several load centers such as Rochester, Minneapolis and St. Paul in Minnesota; La Crosse, Eau Claire Madison, Stevens Point, Wisconsin Rapids and Wisconsin Dells in Wisconsin; and Dubuque in Iowa. The western Wisconsin area interconnects the transmission network between Minnesota, Iowa and Wisconsin. A robust transmission network in the area is important to reliably serve the load and also to facilitate reliable power transfers between and through these upper Midwest states.

The western Wisconsin area can be impacted by heavy power flows in various directions; particularly well noted is the west to east flow bias. These flow biases cause additional stress to the area's transmission network. The west to east transfer through the Minnesota-Wisconsin Export (MWEX) interface is currently limited due to voltage stability and transient voltage recovery limitations. Wind-powered generation has been and will continue to be added in the upper Midwest to meet the state Renewable Portfolio Standard (RPS) requirements in the geographical region and beyond. These additions will most likely increase the levels of the west to east flows, particularly during off-peak load periods.

The purpose of the Western Wisconsin Transmission Reliability Study is to identify and document the reliability needs in the eight- to 10-year time frame and also to identify potential transmission solutions to meet the reliability needs.

Several Transmission Owners (TOs) whose existing transmission facilities could be potentially impacted by transmission additions in the western Wisconsin area initiated a joint transmission reliability study. The study is led by American Transmission Company, LLC (ATC). The following Transmission Owners and the Midwest ISO participated in the study:

- CapX2020 (CapX)
- Dairyland Power Cooperative (DPC)
- Great River Energy (GRE)
- International Transmission Company, Midwest (ITCM)
- Southern Minnesota Municipal Power Agency (SMMPA)
- Xcel Energy (Xcel)

The TO group coordinated the model building efforts with the Midwest ISO. The Midwest ISO assisted in creating the Security Constrained Economic Dispatches (SCED) for the study models. Also, it should be noted that the study participants collaborated on this regional transmission

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planning study in accordance with the regional planning coordination requirement of FERC Order No. 890<sup>8</sup> and in accordance with ATC's planning requirements under Attachment FF-ATCLLC of the Midwest ISO Tariff.<sup>9</sup>

## 1.2 Scope

This reliability study includes AC power flow contingency analysis of NERC Category A, Category B and Category C contingencies; First Contingency Incremental Transfer Capability (FCITC) analysis to identify thermal constraints under increasing levels of west to east transfers; P-V voltage stability analysis to evaluate voltage stability and robustness under increasing levels of west to east transfers; transient stability analysis; and an analysis of the estimated comparative costs of the transmission options. The three study models used for steady state power flow analysis are 2018 Summer Peak, 2018 Summer Off-peak (70% Load) with 35-45% wind output, and 2018 Summer Off-peak (70% Load) with 90% wind output. The transient stability analysis used a 2014 light load model.

## 1.3 Studied Options

This study includes two phases: the initial screening and the detailed analysis. The initial screening evaluated the base case and 15 different transmission options using AC contingency analysis. These options are listed in Table 1.1. Further details of all studied transmission options can be found in Appendix A. The transmission maps for all studied options are included in Appendix B.

The initial screening showed that some of the options did not have notable impact on the western Wisconsin study area and these options were excluded from further detailed analysis. Options that were evaluated in further detail are highlighted in yellow in Table 1.1.

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<sup>8</sup> See *Preventing Undue Discrimination and Preference in Transmission Service*, Order No. 890, 118 FERC ¶ 61,119 (2007) at PP 523 and 528. FERC put in place the "Regional Participation" principle that states that "each transmission provider will be required to coordinate with interconnected systems to (1) share system plans to ensure that they are simultaneously feasible and otherwise use consistent assumptions and data and (2) identify system enhancements that could relieve congestion or integrate new resources..." The coordinated regional planning must "address both reliability and economic considerations."

<sup>9</sup> Midwest ISO FERC Electric Tariff, Fourth Revised Volume No. 1, Original Sheet No. 3387

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Table 1.1 – List of studied options

| Option # | Option Name  |
|----------|--|
| Opt 1    | North La Crosse–Hilltop–Spring Green–Cardinal 345 kV project   |
| Opt 1a   | North La Crosse–Spring Green–Cardinal 345 kV project   |
| Opt 1b   | North La Crosse–North Madison–Cardinal 345 kV project  |
| Opt 8    | Dubuque–Spring Green–Cardinal 345 kV project   |
| Opt 7c   | North La Crosse–North Madison–Cardinal 345 kV and<br>Dubuque–Spring Green–Cardinal 345 kV project          |
| Opt 765  | Genoa–North Monroe 765 kV project  |
| Opt LowV | Low Voltage option   |
| Opt 2    | North La Crosse–Dubuque 345 kV project   |
| Opt 2a   | North La Crosse–Genoa–Dubuque 345 kV project   |
| Opt 3    | Eau Claire–North La Crosse 345 kV project  |
| Opt 4    | North La Crosse–Hilltop–Spring Green–Cardinal 345 kV and<br>Eau Claire–North La Crosse 345 kV project      |
| Opt 5    | North La Crosse–Hilltop–Spring Green–Cardinal 345 kV and<br>North La Crosse–Dubuque 345 kV project         |
| Opt 6    | North La Crosse–North Cassville–Dubuque 345 kV and<br>North Cassville–Spring Green–Cardinal 345 kV project |
| Opt 7    | North La Crosse–Hilltop–Spring Green–Cardinal 345 kV and<br>Dubuque–Spring Green 345 kV project            |
| Opt 7a   | North La Crosse–Spring Green–Cardinal 345 kV and<br>Dubuque–Spring Green 345 kV project                    |
| Opt 7b   | North La Crosse–Spring Green–Cardinal 345 kV and<br>Dubuque–Spring Green–Cardinal 345 kV project           |

## 2. Study Assumptions, Methodology and Criteria

### 2.1 Steady State Power Flow Analyses

#### *Study Models*

The base models (starting points) for the steady state power flow analyses are the 2018 summer peak and off-peak models developed for the Midwest ISO Transmission Expansion Plan 2008 (MTEP08). The model is described in MTEP08 report in the following manner: “The regional resource forecasted units developed for the Reference Generation Portfolio future” (through the first two steps in the MTEP08 economic study process) “are sited in the models. The 2018 off peak model has 70% of summer peak load level in Midwest ISO footprint and has the same transmission topology as the 2018 summer peak model. Generation dispatch in Midwest ISO footprint was based on Security Constrained Economic Dispatch (SCED) to mitigate all possible N-1 constraints in Midwest ISO 200 kV and above systems. Wind generation in the Midwest ISO footprint is dispatched at 15% of its capacity in 2018 summer peak model and 100% of its capacity in 2018 off peak model.”<sup>10</sup>

System topologies and load in the original models were updated for the western Wisconsin study area. The non-wind types of future/conceptual generating units sited inside the study area were removed. The following three study models were created including the Security Constrained Economic Dispatches (SCED) that was created. The Minnesota-Wisconsin Export Interface (MWEX) flow, the ATC western interface flow, the MRO export and the ATC import in these three study models are as follows:

- 2018 Summer Peak (SUPK)
  - Wind generation at 20% of nameplate capacity
  - MWEX interface = 485 MW
  - ATC Western Interface = 540 MW Import
  - MRO Export = 1175 MW
  - ATC Import = 1218 MW
- 2018 Summer Off-peak (70% of peak load) (SUOP)
  - Wind generation at 35-45% of nameplate capacity (45% in ND, SD, MN and IA; 35% for the rest of the MISO region)
  - MWEX interface = 928 MW
  - ATC Western Interface = 1330 MW Import
  - MRO Export = 1150 MW
  - ATC Import = 1318 MW
- 2018 Summer Off-peak (70% of peak load) with 90% wind output (SUOP90)
  - Wind generation at 90% of nameplate capacity
  - MWEX interface = 1029 MW
  - ATC Western Interface = 1440 MW Import
  - MRO Export = 1585 MW
  - ATC Import = 1263 MW

<sup>10</sup> MTEP08 Report, Section 4.3.2 <http://www.midwestiso.org/page/Expansion+Planning>

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It can be observed that the west to east flows through the MWEX interface and the ATC western interface are higher in the off-peak cases than in the summer peak case. Also, the west to east flows are higher in the 90% wind output case than in the 35-45% wind output case. Since many wind units are located in the western part of the Midwest ISO region, increasing wind unit output resulted in increased west to east flows. Note that the above documented west to east flows are for the base cases without addition of any studied transmission options. It was observed that with the addition of a 345 kV or 765 kV option, the west to east flow through the ATC western interface increases, although in general flows on the existing facilities of the interface are reduced to a certain extent.

The total amount of existing, planned and future wind generation included in the study models is 13,277 MW for the Midwest ISO region. Most of the wind units are sited in the western part of the Midwest ISO region. Table 2.1 summarizes total wind generation by locations within the Midwest ISO region included in the study models. Table 2.2 summarizes the locations and sizes of the future wind units in Minnesota, Iowa and Wisconsin within the Midwest ISO region included in the study models. The existing, planned and future wind units in the western part of the Midwest ISO region are also marked on a transmission map as shown in Figure 2.1.

Table 2.1 – 2018 wind generation included in the Midwest ISO region

| <b>Location</b>                 | <b>Wind generation, MW</b> |
|---------------------------------|----------------------------|
| SD                              | 0                          |
| ND                              | 583                        |
| IA                              | 2,401                      |
| WI                              | 2,823                      |
| MN                              | 4,782                      |
| <b>Sub-total for study area</b> | <b>10,006</b>              |
| <b>Total in MISO region</b>     | <b>13,277</b>              |

Table 2.2 – Future wind units included in the Midwest ISO region

| <b>Substation</b>        | <b>Control Area</b> | <b>Wind generation MW</b> |
|--------------------------|---------------------|---------------------------|
| Burlington 138 kV        | WEC 295             | 100                       |
| Hillman 138 kV           | ALTE 694            | 100                       |
| Rocky Run 345 kV         | WPS 696             | 300                       |
| South Fond du Lac 345 kV | ALTE 694            | 800                       |
| Adams 345 kV             | XEL 600             | 1000                      |
| Wilmarth 345 kV          | XEL 600             | 500                       |
| Lakefield 345 kV         | ITCM 627            | 400                       |
| Magnolia 161 kV          | ITCM 627            | 350                       |
| <b>Total</b>             |                     | <b>3550</b>               |

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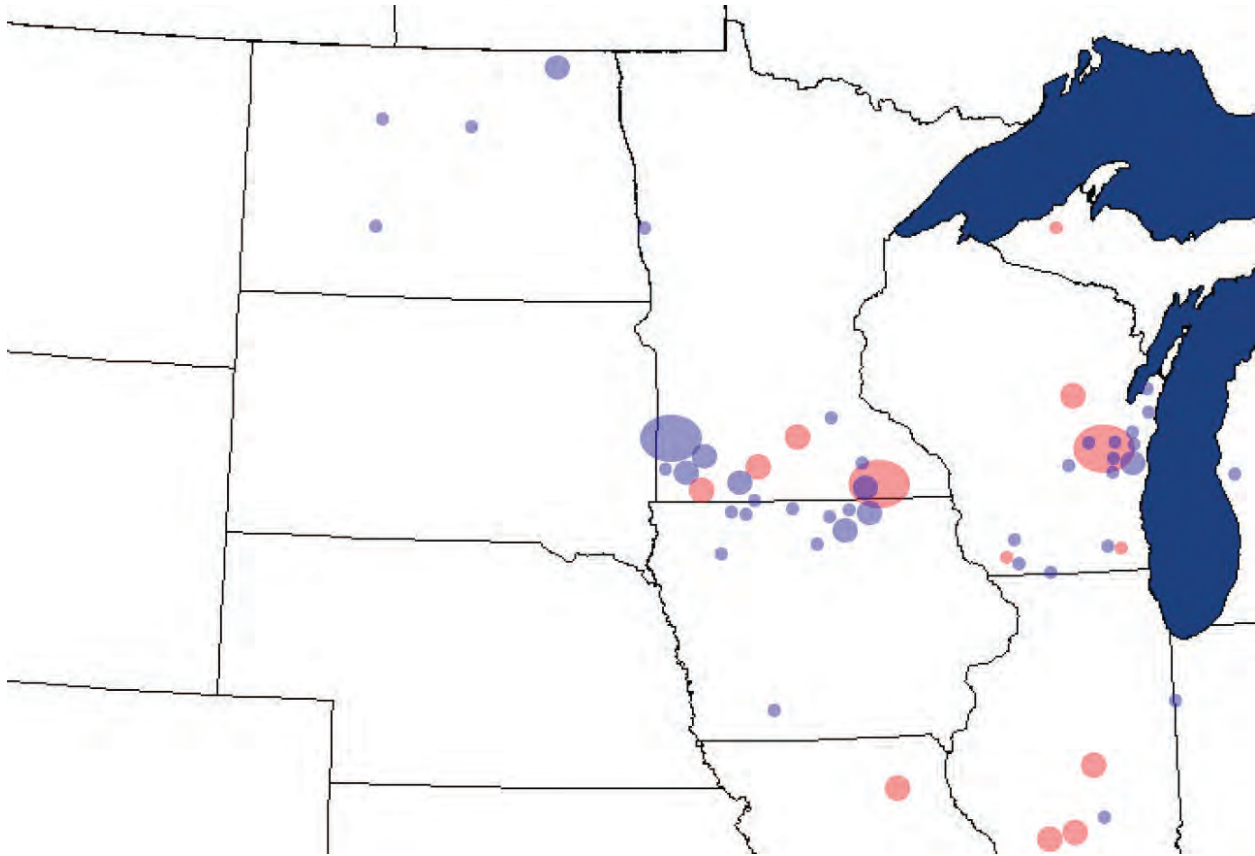


Figure 2.1 – Existing, planned and future wind generation included in the study models  
for the western part of the MISO region

Blue = existing/proposed, Red = Conceptual

Small/Medium/Large Ovals = 0-200, 201-750, 751-1000 MW

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## **Study Area**

The study area, as shown in Figure I, is defined according to the following:

- Xcel Energy facilities from the Twin Cities south and east in Minnesota
- Xcel Energy facilities from the Hayward area south (Stone Lake Substation) in Wisconsin
- ITC Midwest facilities in southeast Minnesota and northern Iowa
- MEC facilities in northern Iowa
- DPC facilities in Minnesota, Wisconsin, Iowa and Illinois
- GRE facilities in southeast Minnesota
- SMMPA facilities in southeast Minnesota
- ATC facilities from Wausau south and west of North Appleton
- RPU facilities in Minnesota

The Monitored Facilities Subsystem includes the following facilities:

- SMMPA Zone 631 69 kV – 345 kV facilities
- SMMPA Area 613 69 kV – 345 kV facilities
- XEL-MN Zone 601 69 kV – 345 kV facilities
- XEL-WI Zone 604 69 kV – 345 kV facilities
- DPC Area 680 69 kV – 345 kV facilities
- GRE Area 615 100 kV – 345 kV facilities
- ITCM Area 627 100 kV – 345 kV facilities
- MEC Area 635 100 kV – 345 kV facilities
- ATC Zone 1696 69 kV – 345 kV facilities<sup>11</sup>

The Contingent Facilities Subsystem includes the following facilities:

- SMMPA Zone 631 69 kV – 345 kV facilities
- SMMPA Area 613 100 kV – 345 kV facilities
- XEL-MN Zone 601 100 kV – 500 kV facilities
- XEL-WI Zone 604 100 kV – 345 kV facilities
- DPC Area 680 100 kV – 345 kV facilities
- GRE Area 615 100 kV – 345 kV facilities
- ITCM Area 627 100 kV – 345 kV facilities
- MEC Area 635 100 kV – 345 kV facilities
- ATC Zone 1696 69 kV – 345 kV facilities
- ATC Zone 1686 230 kV – 345 kV facilities<sup>12</sup>
- ComEd Area 222 345 kV – 765 kV facilities

## **Types of Contingencies Studied**

Category B contingencies:

- All contingencies specified by study participants
- All single elements defined in the Contingent Facilities Subsystem
- All 100 kV -765 kV ties to the defined Contingent Facilities Subsystem

<sup>11</sup> ATC Zone 1696 was defined to represent the ATC region in the western Wisconsin study area.

<sup>12</sup> ATC Zone 1686 includes all 230 kV and above facilities in ATC region and ties to ATC region.

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Specified Category C contingencies:

- 1,141 study participant specified Category C1, C2 and C5 contingencies. Most N-2 contingencies include the outage of at least one generator.

Enumerated N-2 contingencies:

- N-2 combinations of transmission lines and transformers in Minnesota, Iowa, northern ComEd and ATC regions:
  - 5,995 northern ComEd 345 kV and above transmission line and transformer pairs.
  - 861 Iowa transmission line and transformer pairs consisting of Area 680 and 627 345 kV facilities, transformers from 345 kV to 230/161/138/115 kV and the studied transmission option segments.
  - 6,105 Minnesota transmission line and transformer pairs consisting of Area 613, 615, 680 and Zone 601 and 604 345 kV facilities, transformers from 345 kV to 230/161/138/115 kV and the studied transmission option segments.
  - 7,626 ATC region transmission line and transformer pairs consisting of ATC 345 kV facilities, ATC transformers from 345 kV to 230/161/138/115 kV and the studied transmission option segments.

***Major Planned or Proposed Projects Included in the Base Models***

The following major transmission line projects within or in proximity to the study area are included in the study base models<sup>13</sup>:

- Gardner Park – Highway22 – Werner West 345 kV (ATC)
- Highway22 – Morgan 345 kV (ATC)
- Paddock – Rockdale – Cardinal 345 kV (ATC)
- Fargo – Twin Cities 345 kV project (CapX2020)
- Hampton Corner – North Rochester – North La Crosse 345 kV (CapX2020)
- Brookings County – Lyon County – Cedar Mountain (Franklin) – Helena – Lake Marion– Hampton Corner 345 kV (CapX2020)
  - Lyon County-Cedar Mountain-Helena are double circuited
- Hazel Creek-Panther-McLeod-Blue Lake 345 kV (Minnesota “Corridor” project)
  - Double circuited, second line Hazel Creek-Blue Lake 345 kV
  - McLeod 345/115 kV Transformer #1
  - Panther 345/69 kV Transformer #1
  - Remove Hazel Creek-Minn Valley Tap 230 kV
- Byron-Pleasant Valley 161 kV (Xcel)
- Pleasant Valley 345/161/13.8 kV transformer #2 (Xcel)
- Hazelton-Salem 345 kV (ITCM)
- Arpin-Rocky Run 345 kV line rebuild (ATC)
- Monroe Co-Council Creek 161 kV (ATC)

<sup>13</sup>The Big Stone II 670 MW generation and transmission facilities were included in the study cases. The study cases were created before the Big Stone II generation project cancellation announcement, on November 2, 2009. Since these facilities are far away from the western Wisconsin study area, the study participants did not think removing these facilities from the study cases would have notable impact on the study results.

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### **Study Methodology and Criteria**

Siemens PTI, PSS™ MUST version 8.3.2 was used for the AC power flow contingency analysis. This software was also used for the First Contingency Incremental Transfer (FCITC) analysis. A 3% Distribution Factor (DF) threshold was used for the FCITC analysis. The PowerTech Labs VSAT program was used for voltage stability analysis. See *Section 4* and *Section 5* for further details of the methodologies used in various reliability analyses performed in this study. The study results were evaluated in accordance with the NERC TPL Standards. ATCs' Planning Criteria was used for this study, neighboring Transmission Owners may have a different criteria than what was evaluated in this study.

**Thermal Loading Criteria:** For intact system facility Normal Ratings (Rate A) were used. Under contingencies facility Emergency Ratings (Rate B) were used.

**Steady State Voltage Criteria:** The acceptable voltage range is 95 percent to 105 percent of nominal voltage in the intact system and 90 percent to 110 percent under contingencies.

## **2.2 Transient Stability Analysis**

### **Study model**

The base model (starting point) for the transient stability analysis is the MTEP09 2014 Light Load (40% of peak load) stability model and data set<sup>14</sup>. This model includes 6,000 MW of wind generation. The following modifications were made to the starting model to fit the purpose of this study:

- Major planned and proposed projects included in the power flow models for steady state analysis as discussed in *Section 2.1* are also verified or included in the 2014 light load model for transient stability analysis.
- An additional 3,150 MW of future wind generation was added to the starting model. Total wind generation included in the stability model is 9,150 MW in the Midwest ISO region. The locations and sizes of the future wind generation included in the stability case are shown in Table 2.3. Part of the added wind generation was offset by re-dispatching non-wind generation in the same control areas in which the future wind generation was added. Part of the added wind generation was offset by export generation to the eastern part of the MISO region.

Table 2.3 – Future wind units added to the stability case

| <b>Substation</b>        | <b>Control Area</b> | <b>Wind generation (MW)</b> |
|--------------------------|---------------------|-----------------------------|
| Hillman 138 kV           | ALTE 694            | 100                         |
| South Fond du Lac 345 kV | ALTE 694            | 800                         |
| Adams 345 kV             | XEL 600             | 1000                        |
| Wilmarth 345 kV          | XEL 600             | 500                         |
| Lakefield 345 kV         | ITCM 627            | 400                         |

<sup>14</sup> See MTEP09 Report, Section 6.1.3 for MTEP09 model building methodology.  
<http://www.midwestiso.org/page/Expansion+Planning>

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|                 |          |             |
|-----------------|----------|-------------|
| Magnolia 161 kV | ITCM 627 | 350         |
| <b>Total</b>    |          | <b>3150</b> |

### **Study Methodology and Criteria**

The transient stability analysis was performed using the Dynamics Simulation and Power Flow modules of the Power System Simulation/Engineering-30 (PSS/E, Version 30.5.1) program from Power Technologies, Inc (PTI).

#### **Angular Stability Criteria**

Critical Clearing Time (CCT) is a period relative to the start of a fault, within which all generators in the system remain stable (synchronized). CCT is obtained from simulation. Maximum Expected Clearing Time (MECT) determines a period of time that is needed to clear a fault using the existing system facilities. MECT is dictated by the existing system facilities. In any contingency, if the computed CCT is less than the MECT plus a margin determined by a Transmission Owner, it is considered an unstable situation and is unacceptable. Otherwise, it is considered acceptable transient stability performance. The ATC Planning Criteria requires 1.0 cycle margin for studies using estimated generator data and 0.5 cycle margin for studies using confirmed generator data. The 0.5 cycle margin is applicable to the generating units in the ATC region for this study. The 1.0 cycle margin is used as a proxy for generating units outside of the ATC region. Further refinement can be made to the 1.0 cycle margin based on additional information from the TO participants.

#### **Transient Voltage Recovery**

According to ATC Planning Criteria, voltages of all transmission system buses must recover to be at least 70% of the nominal system voltages immediately after fault removal and 80% of the nominal system voltages in 2.0 seconds after fault removal. Transient voltage recovery was checked for generation units in the ATC region using this criterion. This criterion was also used as a proxy for checking generation units outside the ATC region but located in the study area. Further refinement can be made based on additional information from the Transmission Owner participants.

## **3. Overall Approach for the Reliability Analysis**

This study includes two phases: the initial screening and the detailed analysis. The initial screening evaluates the base case and 15 different transmission options using AC contingency analysis of Category B and specified Category C contingencies (see *Section 2.1.2* for discussions of the studied contingencies). Options that did not show positive notable impacts on the western Wisconsin study area were excluded from further detailed analysis. The detailed analysis further compares seven selected transmission options using results of AC contingency analysis, FCITC analysis, voltage stability analysis, transient stability analysis and the costs of constructing the transmission options.

## 4. Initial Screening

The initial screening evaluated the base case and 15 different transmission options using AC contingency analysis of Category B and specified Category C contingencies. These 15 transmission options are listed in Table 4.1 below. Further details on and the transmission maps of these options can be found in Appendix A and B respectively. The three study cases, as discussed in *Section 2.1.1*, are used in this evaluation.

Table 4.1 – Transmission options evaluated in initial screening

| Option # | Abbreviated Name             | Full Name   |
|----------|------------------------------|---|
| Opt 1    | NLAX-HLT-SPG-CDL             | North La Crosse–Hilltop–Spring Green–Cardinal 345 kV project  |
| Opt 1a   | NLAX-SPG-CDL                 | North La Crosse–Spring Green–Cardinal 345 kV project  |
| Opt 1b   | NLAX-NMA-CDL                 | North La Crosse–North Madison–Cardinal 345 kV project   |
| Opt 8    | DBQ-SPG-CDL                  | Dubuque–Spring Green–Cardinal 345 kV project  |
| Opt 2    | NLAX-DBQ                     | North La Crosse–Dubuque 345 kV project  |
| Opt 2a   | NLAX-GENOA-DBQ               | North La Crosse–Genoa–Dubuque 345 kV project  |
| Opt 3    | EAU-NLAX                     | Eau Claire–North La Crosse 345 kV project   |
| Opt 4    | NLAX-HLT-SPG-CDL & EAU-NLAX  | North La Crosse–Hilltop–Spring Green–Cardinal 345 kV and Eau Claire–North La Crosse 345 kV project      |
| Opt 5    | NLAX-HLT-SPG-CDL & NLAX-DBQ  | North La Crosse–Hilltop–Spring Green–Cardinal 345 kV and North La Crosse–Dubuque 345 kV project         |
| Opt 6    | NLAX-NCAS-DBQ & NCAS-SPG-CDL | North La Crosse–North Cassville–Dubuque 345 kV and North Cassville–Spring Green–Cardinal 345 kV project |
| Opt 7    | NLAX-HLT-SPG-CDL & DBQ-SPG   | North La Crosse–Hilltop–Spring Green–Cardinal 345 kV and Dubuque–Spring Green 345 kV project            |
| Opt 7a   | NLAX-SPG-CDL & DBQ-SPG       | North La Crosse–Spring Green–Cardinal 345 kV and Dubuque–Spring Green 345 kV project                    |
| Opt 7b   | NLAX-SPG-CDL & DBQ-SPG-CDL   | North La Crosse–Spring Green–Cardinal 345 kV and Dubuque–Spring Green–Cardinal 345 kV project           |
| Opt 7c   | NLAX-NMA-CDL & DBQ-SPG-CDL   | North La Crosse–North Madison–Cardinal 345 kV and Dubuque–Spring Green–Cardinal 345 kV project          |
| Opt 765  | GENOA-NOM 765 kV             | Genoa–North Monroe 765 kV project   |

Three single event Category C contingencies (C5 or C2), were found to cause divergence or converged to severe low voltages for some of the studied cases.

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These results indicate potential voltage collapse conditions under the three single event Category C contingencies in the base case without a transmission option included. The results also indicate that Option 2 (NLAX-DBQ), Option 2a (NLAX-GENOA-DBQ), and Option 3 (EAU-NLAX) are not effective in controlling the identified voltage collapse conditions.

## 4.2 Severity Index

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## **4.3 Initial Screening Results**

### ***Category B Thermal Loading Results***

The Severity Index evaluation of the AC contingency analysis thermal loading results under Category B contingencies are shown in the charts below.

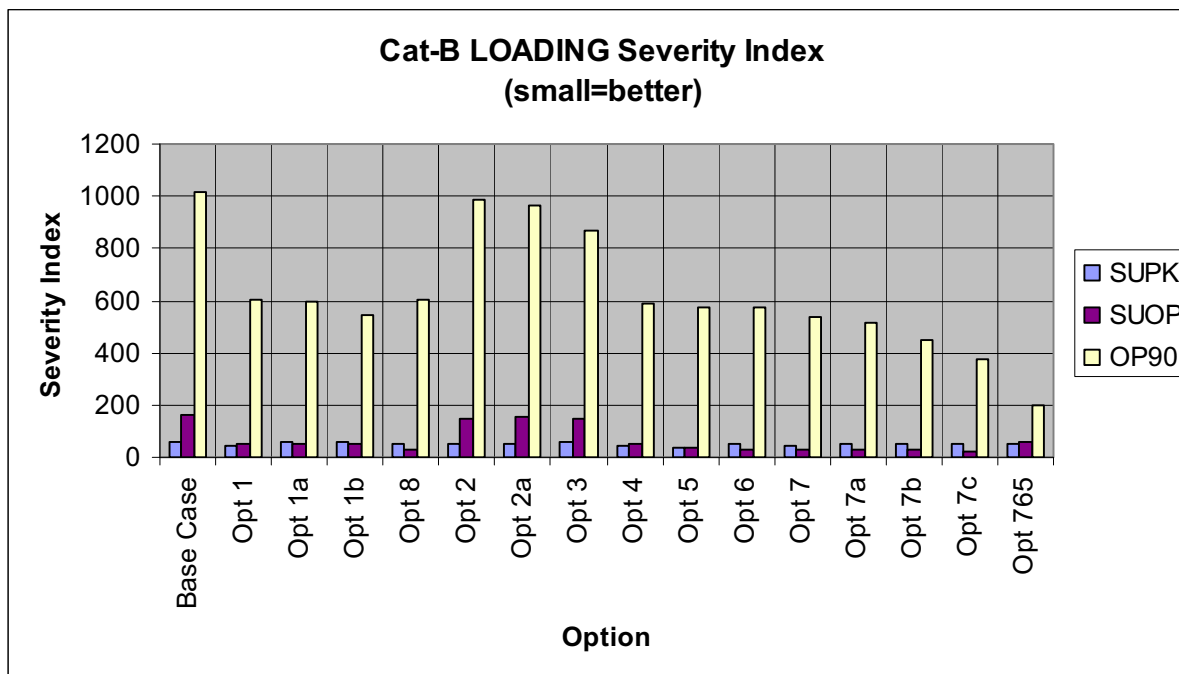


Figure 4.1 – Category B thermal loading results Severity Index review

Figure 4.1 shows the thermal loading Severity Indices for the base case and the cases with the studied transmission options under Category B contingencies for all three study models. It shows that compared to Summer Peak (SUPK) and Summer Off-Peak (SUOP) model overall thermal limitations are worst in the Off-Peak with 90% (OP90) wind output model, which has the most west to east flow bias through the western Wisconsin study area (see *Section 2.1.1* for discussions of the three study models).

Figure 4.2 shows all positive thermal loading Severity Index changes comparing the option cases to the base case for all three study models. This indicates that overall the transmission options reduce the thermal loading limitations under the studied Category B contingencies. The varying values of the Severity Index change indicate varying degrees of the effectiveness of the transmission options.

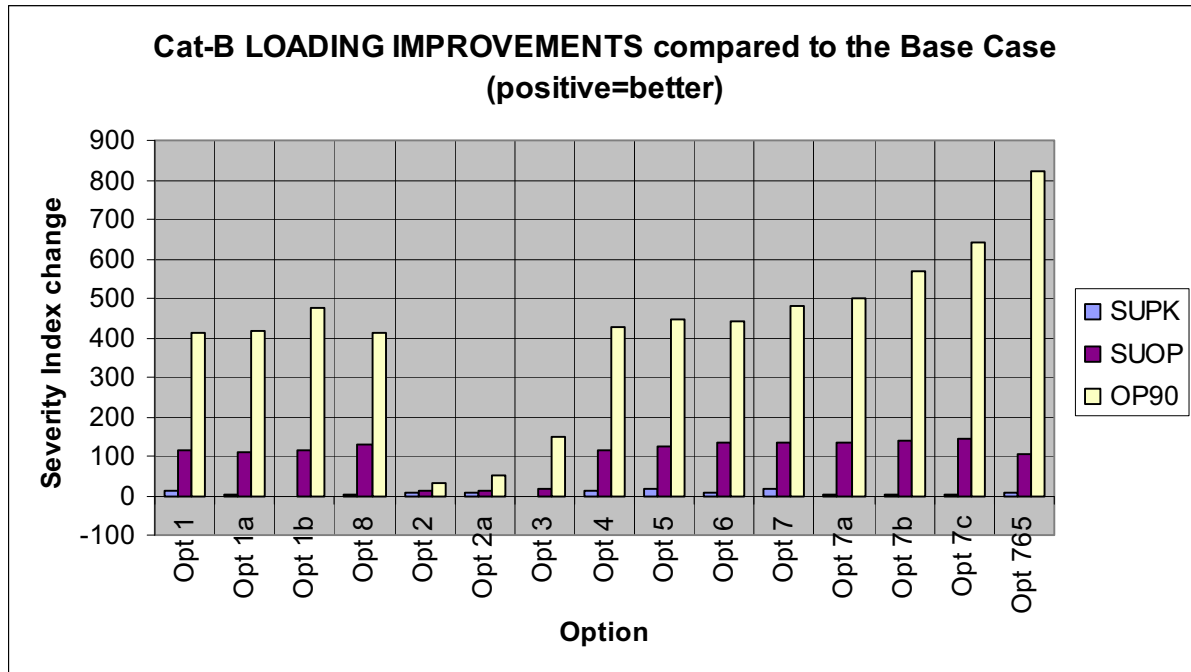


Figure 4.2 – Category B thermal loading results Severity Index review

The Category B thermal results were also reviewed using a measure that compares the loading difference between the base case and an option case for unique monitored elements. This analysis applies to facility loadings of 90% and above. A 10% loading difference threshold was applied in the results shown in Figure 4.3. This means that the loading difference between the base case and an option case needs to be at least 10% (in either direction) in order to be captured in the analysis result. Figure 4.3 shows a number of unique monitored elements, the loading of which are increased or decreased by at least 10% comparing an option case and the base case. A positive number is associated with a reduction in loadings in an option case compared to the base case. A negative number is associated with an increase in loadings in an option case compared to the base case. The 10% threshold used in this result captures relatively large changes in loadings between the base case and an option case. It shows that overall the studied transmission options have a positive impact in reducing the loadings, some options more effectively than others. The studied transmission options are also shown to have some negative impact to facility loadings, but to a much lesser extent when compared to the positive impact.

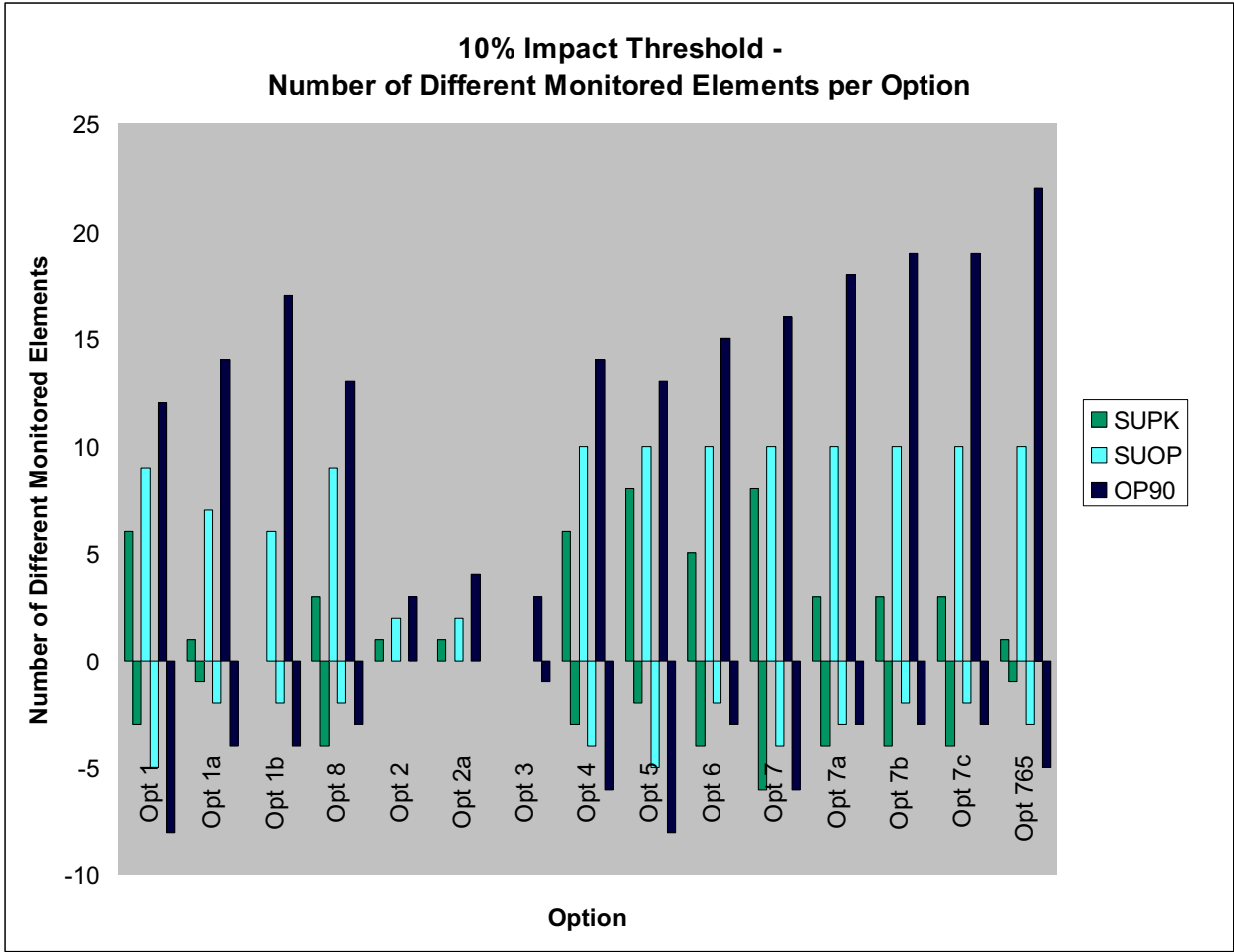


Figure 4.3 – Loading difference between the base case and option cases using 10% threshold for unique monitored elements

**Category B voltage performance results**

Only minor low voltage violations were identified under Category B contingencies in the Summer Peak and Off-peak models. No valid low voltage violations were identified in the Off-peak with 90% wind output model. No valid high voltage violations under Category B

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Table 4.5 – Category B worst low voltage violations in the base case and Summer Peak model

| Base case low voltages |         |         |          |     |      |         |          |  |
|------------------------|---------|---------|----------|-----|------|---------|----------|--|
| From Area              | To Area | Bus Num | Bus Name | KV  | Area | Voltage | Worst of |  |
| 697                    | 697     | 698136  | PLV 138  | 138 | 694  | 0.8949  | 4        |  |

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Table 4.6 – Category B worst low voltage violations in the base case and Off-peak model

|   |           |         | Base case low voltages |          |     |      |         |          |
|---|-----------|---------|------------------------|----------|-----|------|---------|----------|
|   |           |         | Bus Num                | Bus Name | KV  | Area | Voltage | Worst of |
| Contains Critical Energy Infrastructure Information | From Area | To Area | 699048                 | BLK 138  | 138 | 694  | 0.8963  | 4        |

Figure 4.4 shows mostly positive voltage Severity Index changes comparing the option cases to the base case for all three study models.

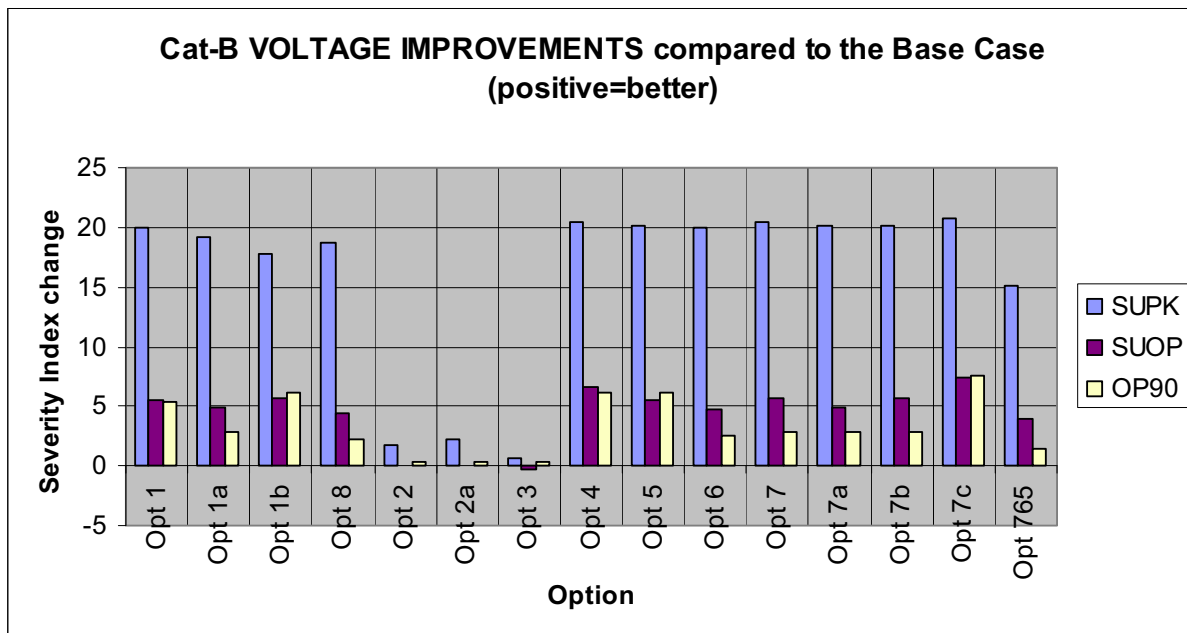


Figure 4.4 – Category B voltage performance results Severity Index review

### Category C Thermal Loading Results

For the specified Category C contingencies, the thermal limitations were observed to be worse in the Off-peak models than in the Summer Peak model and worst in the Off-peak with 90% wind output model. This is similar to what was observed from the Category B thermal results. Note that non-converged contingencies were excluded equally from the Severity Index review of each option. Figure 4.5 shows mostly positive thermal loading Severity Index changes comparing the option cases to the base case. This indicates that overall the transmission options reduce the thermal loading limitations under the specified Category C contingencies. The varying values of the Severity Index change indicate varying degrees of the effectiveness of the transmission options.

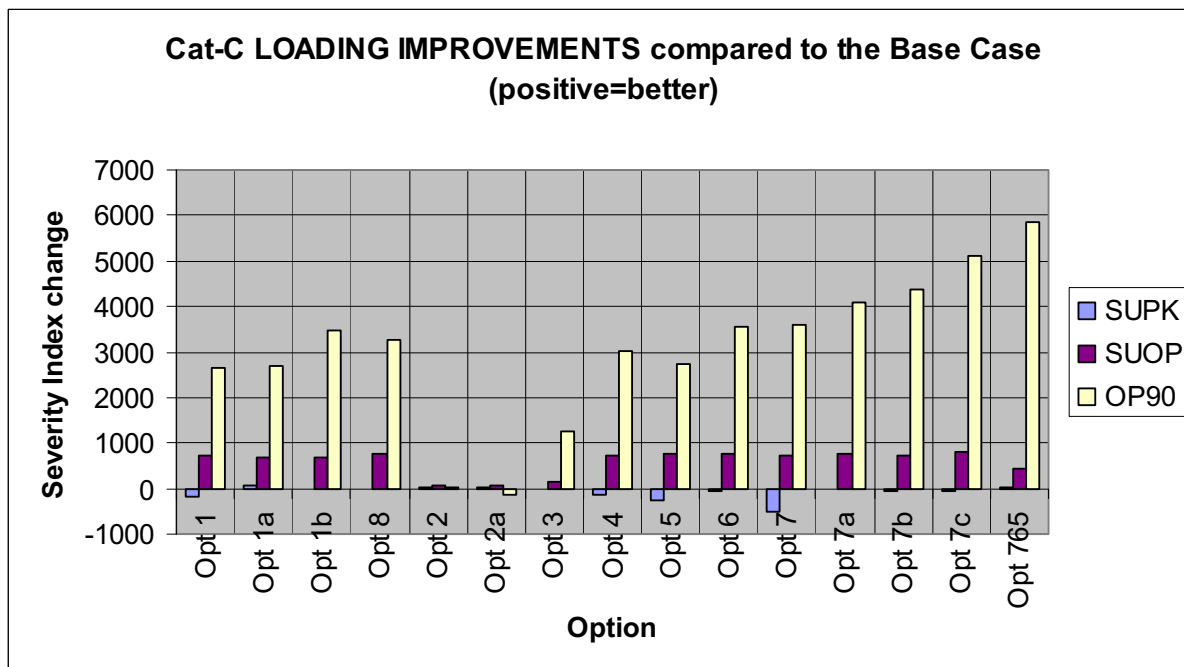


Figure 4.5 – Category C thermal loading results Severity Index review

### Category C voltage performance results

Figure 4.6 shows mostly positive voltage Severity Index changes comparing the option cases to the base case for all three study models.

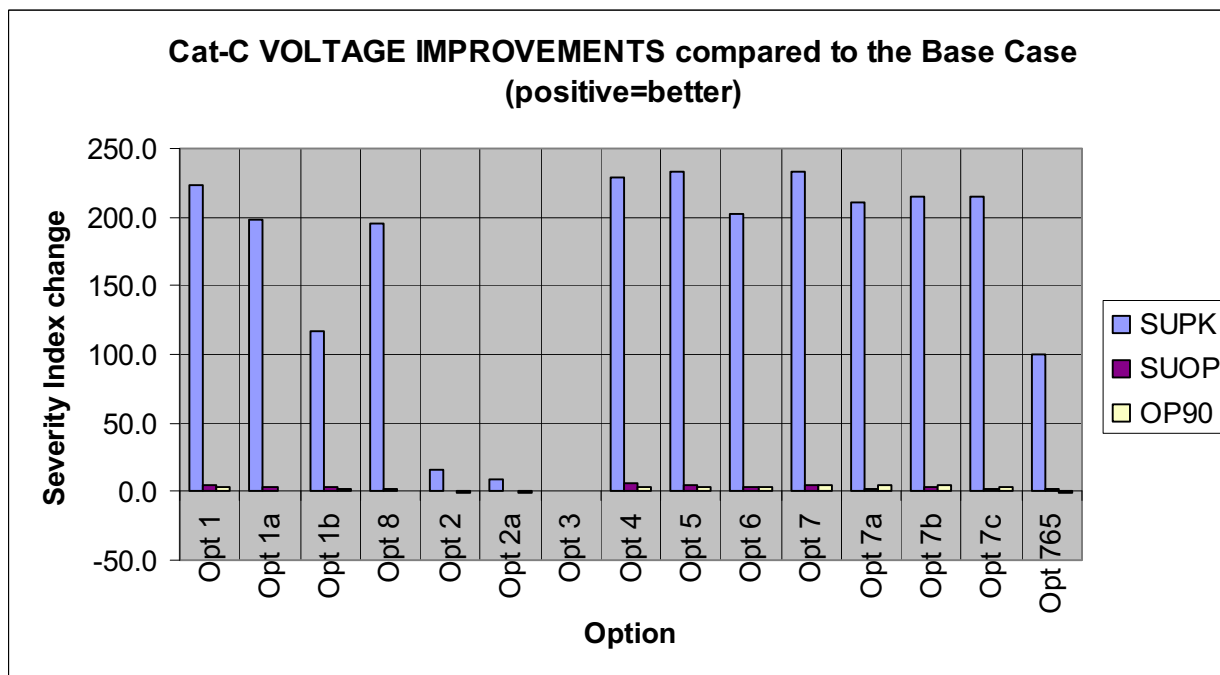


Figure 4.6 – Category C voltage performance results Severity Index review

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### ***Initial Screening Summary***

The initial screening identified thermal loading and voltage performance limitations (including potential voltage collapse) in the base case without any transmission options for the system conditions simulated in the three study models. The base case and the cases with 15 transmission options were evaluated for Category B and specified Category C contingencies. One of the purposes of the initial screening was to select a few options for further detailed analysis. It was identified that out of the single element options (1, 1a, 1b, 8, 2, 2a and 3), Option 2, 2a, 3 (NLAX-DBQ, NLAX-GENOA-DBQ, and EAU-NLAX, respectively) did not seem to be effective in improving the reliability performance in the western Wisconsin study area. Option 7c (NLAX-NMA-CDL & DBQ-SPG-CDL) was shown to be the most effective 345 kV combination option in terms of improving reliability performance. The 765 kV Option was shown to perform positively for most of the reliability analysis categories. Based on the initial screening results, Options 1 (NLAX-HLT-SPG-CDL), 1a (NLAX-SPG-CDL), 1b (NLAX-NMA-CDL, 8 (DBQ-SPG-CDL), 7c (NLAX-NMA-CDL & DBQ-SPG-CDL) and the 765 kV Option (GENOA-NOM 765 kV) were selected for further detailed analysis and comparison.

### ***Low Voltage Option***

Based on the results of Category B thermal limitations, a Low Voltage option was also created. The Low Voltage option eliminates the identified thermal limitations under the Category B contingencies on a piece-by-piece basis. The Low Voltage option is a collection of lower than 345 kV facilities that include a new 161 kV line and upgrades of 48 individual facilities. Details of the Low Voltage option can be found in Appendix A. This option is also evaluated in the detailed analysis.

### ***List of Options to be Evaluated in Detailed Analysis***

All selected options evaluated in the detailed analysis are shown in Table 4.7 below.

Table 4.7 – Transmission options selected for further detailed analysis

| Option # | Abbreviated Name           | Full Name   |
|----------|----------------------------|---|
| Opt 1    | NLAX-HLT-SPG-CDL           | North La Crosse–Hilltop–Spring Green–Cardinal 345 kV project  |
| Opt 1a   | NLAX-SPG-CDL               | North La Crosse–Spring Green–Cardinal 345 kV project  |
| Opt 1b   | NLAX-NMA-CDL               | North La Crosse–North Madison–Cardinal 345 kV project   |
| Opt 8    | DBQ-SPG-CDL                | Dubuque–Spring Green–Cardinal 345 kV project  |
| Opt 7c   | NLAX-NMA-CDL & DBQ-SPG-CDL | North La Crosse–North Madison–Cardinal 345 kV and Dubuque–Spring Green–Cardinal 345 kV project                        |
| Opt 765  | GENOA-NOM 765 kV           | Genoa–North Monroe 765 kV project   |
| Opt LV   | Low Voltage                | A collection of lower than 345 kV facilities that include a new 161 kV line and upgrades of 48 individual facilities. |

## 5. Detailed Analysis

The detailed analysis compares the seven selected transmission options based on costs and reliability performance in the AC contingency analysis, FCITC analysis, voltage stability analysis and transient stability analysis.

### 5.1 Monetized and Non-Monetized Measures

Monetized and non-monetized measures are applied to different aspects of the reliability study results for comparison between the seven options. The monetized measure is based on construction cost estimates and comparison. This type of measure was applied to the Category B thermal loading results, solution divergence under the three single event Category C contingencies and the FCITC results. The basic approach is to identify the supporting facilities that would be needed to address these reliability issues for each option; such that the reliability performance will be comparable between the options including these facilities. Costs are then compared between the options including the main EHV components and the supporting facilities. All costs referenced in this study are in 2010 dollars. Monetized measures were not applied to some aspects of the reliability analysis, such as voltage performance under Category B and converged specified Category C contingencies, voltage stability analysis and transient stability analysis. For each of these aspects of the reliability analyses, quantitative rankings were assigned to the studied options. To be consistent, rankings are all in the range of 1 to 5, with “1” representing the best performance and “5” representing the worst performance. The rankings may not be from 1 to 5 continuously. For example, if the results show a clear divide of better and comparable performance for a sub-group of the seven options, and worse and comparable performance for the rest of the options, then “1” is assigned to the options in the first sub-group and “5” is assigned to the rest of the options. The span of 5 is always used.

In the following sections, comparisons between the options using monetized or non-monetized measures for each studied aspect of the reliability analysis are discussed. At the end of *Section 5*, a summary table is provided that includes comparison of all studied aspects of the reliability analysis using monetized and non-monetized measures.

### 5.2 Construction Cost Estimates for the EHV Options

Cost estimates for the EHV components of the studied options are shown in Table 5.1.

Table 5.1 – Cost estimates for the EHV components

| Options                            | \$ in 2010    |
|------------------------------------|---------------|
| Low Voltage                        | \$0           |
| NLAX-HLT-SPG-CDL (1)               | \$454,492,920 |
| NLAX-SPG-CDL (1a)                  | \$377,454,200 |
| NLAX-NMA-CDL (1b)                  | \$357,590,989 |
| DBQ-SPG-CDL (8)                    | \$304,187,200 |
| NLAX-NMA-CDL +<br>DBQ-SPG-CDL (7c) | \$672,785,400 |
| Genoa-NOM 765 kV                   | \$880,598,000 |

### 5.3 Supporting Facilities to Overcome Category B Thermal Loading Limitations

It should be noted that the EHV components alone in any option do not address all identified Category B thermal limitations. To compare the option costs on a level ground, supporting facilities were identified for each option such that all identified thermal limitations are eliminated in any of the option cases. Thermal loadings above 95% of applicable Ratings were captured in this evaluation; 95% was used instead 100% to capture near misses. For the Low Voltage Option, the facilities that eliminate the Category B thermal limitations were already identified, as shown in Appendix A. Cost estimates for these facilities are also included in Appendix A. The supporting facilities needed to eliminate all identified thermal limitations under Category B contingencies for the EHV options can be found in Appendix D. Cost estimates for these facilities are also included in Appendix D.

Table 5.2 summarizes the costs of the supporting facilities needed for each of the seven options to eliminate the identified Category B thermal limitations. The total cost of the Low Voltage Option also is included. Each EHV option needs supporting facilities, thus, they do not resolve all identified Category B thermal limitations by themselves. However, fewer supporting facilities were needed with the EHV options than those identified in the Low Voltage Option on a piece-by-piece basis. Also, it should be noted that if the only reliability concern is Category B thermal limitations, the Low Voltage Option would seem to be less expensive than the EHV options and the corresponding supporting facilities for each option. However, critical reliability concerns are not limited to just Category B thermal and voltage limitations for the western Wisconsin study area. Evaluations of several of these other key aspects are discussed in the following sections.

Table 5.2 – Costs of the supporting facilities for  
Category B thermal loading limitations

| <b>Options</b>                     | <b>\$ in 2010</b> |
|------------------------------------|-------------------|
| Low Voltage                        | \$269,165,514     |
| NLAX-HLT-SPG-CDL (1)               | \$156,943,463     |
| NLAX-SPG-CDL (1a)                  | \$183,640,721     |
| NLAX-NMA-CDL (1b)                  | \$188,698,156     |
| DBQ-SPG-CDL (8)                    | \$205,393,188     |
| NLAX-NMA-CDL +<br>DBQ-SPG-CDL (7c) | \$143,951,649     |
| Genoa-NOM 765 kV                   | \$180,046,843     |

## 5.4 Voltage Performance under Category B and Specified Converged Category C Contingencies

Figures 5.1 and 5.2 show the voltage performance comparison between the seven options under Category B and specified converged Category C contingencies. It is shown that the 345 kV options are more effective in improving system voltage performance than the 765 kV Option or the Low Voltage Option. The Low Voltage Option showed the worst performance in this evaluation.

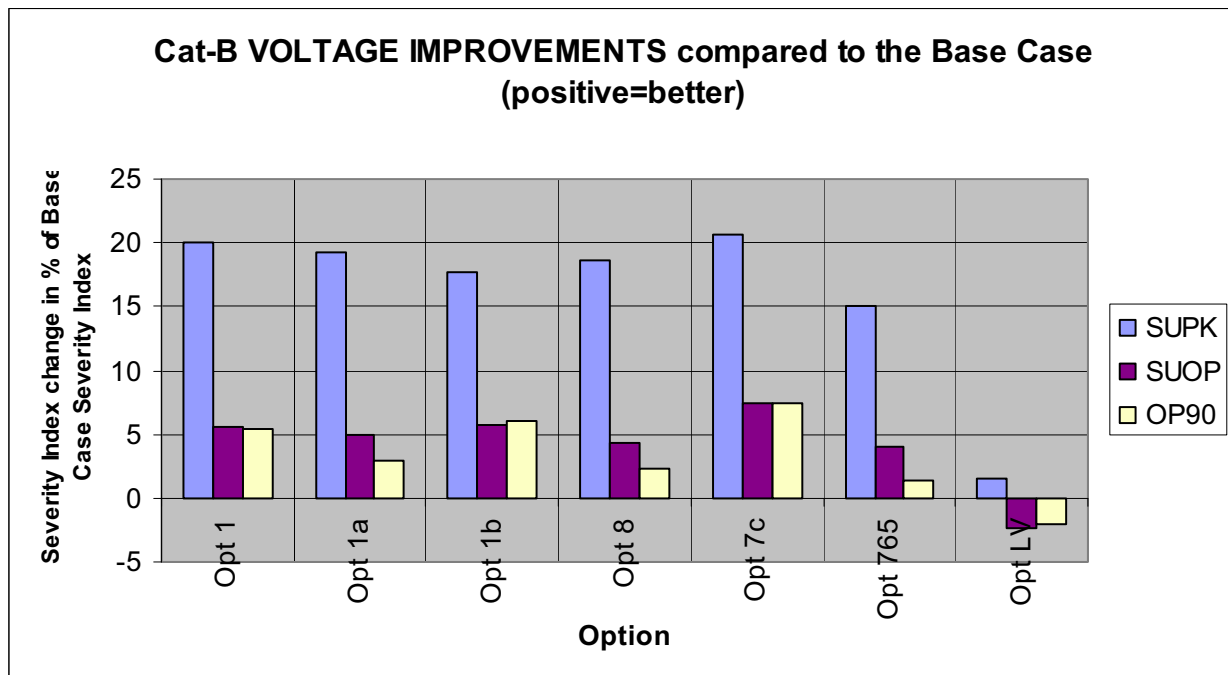


Figure 5.1 – Category B voltage performance results Severity Index review

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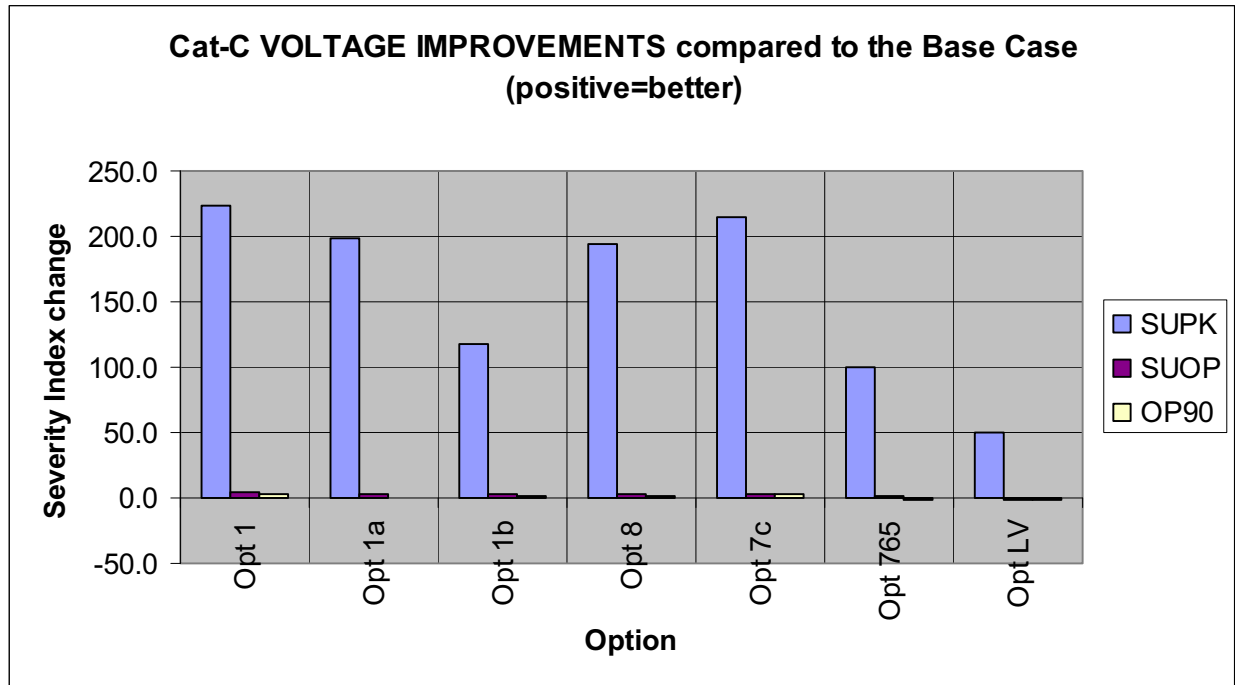


Figure 5.2 – Category C voltage performance results Severity Index review

Based on the results of this evaluation, rankings are given to the seven options, as shown in Table 5.3. A ranking of “1” represents the worst performance and “5” represents the best performance. These rankings were determined using engineering judgment and the charts above, comparing across all options.

Table 5.3 – Option rankings for the voltage performance under Cat-B, Cat-C contingencies

| Options                         | Cat-B Ranking | Cat-C Ranking |
|---------------------------------|---------------|---------------|
| Low Voltage                     | 1             | 1             |
| NLAX-HLT-SPG-CDL (1)            | 4             | 5             |
| NLAX-SPG-CDL (1a)               | 4             | 4             |
| NLAX-NMA-CDL (1b)               | 4             | 3             |
| DBQ-SPG-CDL (8)                 | 4             | 4             |
| NLAX-NMA-CDL + DBQ-SPG-CDL (7c) | 5             | 5             |
| Genoa-NOM 765 kV                | 3             | 2             |

## 5.5 Review of Diverged Category C5 and C2 Contingencies

Three single event Category C contingencies (C5 or C2) were found causing solution divergence or solved with severe low voltages for some of the studied cases. A preliminary discussion was provided in *Section 4.1*. These conditions are indications of voltage collapse. Further evaluation was performed to determine reactive supports needed to control these conditions.

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These contingencies were evaluated for the base case and seven transmission options using all three study models.

Load shedding and opening of facilities were taken into account in this evaluation of potential cascading outages as a result of a multiple contingency. Each multiple contingency was applied and thermal loadings and voltage levels were monitored. The assumed tripping levels due to low voltage or thermal loading are described as follows. If the post contingent voltage of a bus was below 0.87 p.u., it was assumed the load connected to that bus would be automatically shed by relay action. Also, if post contingent thermal loading of a facility was greater than 125% of its emergency rating, that facility would be assumed to trip and be removed from service by either relay action or operator interaction. If both unacceptable low voltage and thermal loading were experienced, then load would be shed first to determine if it improved the voltage and/or the thermal loading. If the voltage was improved but the thermal loading remained, a facility would be opened to remove or reduce the flow. If low voltages remain, additional load connected to buses with voltages below 0.87 p.u. would be shed.

### ***Option 1a (NLAX-SPG-CDL)***

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Contains Critical Energy Infrastructure Information created conditions where the switching criteria as discussed above were met. During the off-peak load conditions, a few facilities experienced thermal loadings greater than 125%. However, the loading concerns were eliminated by opening the facilities of concern. Upon opening of these facilities, all thermal loadings greater than 125% were removed and all voltages were above 0.87 p.u. No low voltage wide area cascading outage conditions were identified under this contingency.

### ***Option 1b (NLAX-NMA-CDL)***

Contains Critical Energy Infrastructure Information

Contains Critical Energy Infrastructure Information created conditions where the switching criteria as discussed above were met. During the off-peak load conditions a few facilities experienced thermal loadings greater than 125%. However, the loading concerns were eliminated by opening the facilities of concern. Upon opening of the facilities, all thermal loadings greater than 125% were removed and all voltages were at least 0.87 p.u. No low voltage wide area cascading outage conditions were identified under this contingency.

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The contingency of Contains Critical Energy Infrastructure Information caused some severe low voltages. These can be mitigated by shedding load in the immediate vicinity of the outage.

Contains Critical Energy Infrastructure Information Alternatively, Contains Critical Energy Infrastructure Information reactive support would be needed to correct the severe local low voltages

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### **Option 8 (DBQ-SPG-CDL)**

For Option 8, the contingency Contains Critical Energy Infrastructure Information created conditions where the switching criteria as discussed above were met. During the off-peak load conditions a few facilities experienced thermal loadings greater than 125%. However, the loading concerns were eliminated by opening the facilities of concern. Upon opening of these facilities, all thermal loadings greater than 125% were removed and all voltages were at least 0.87 p.u. No low voltage wide area cascading outage conditions were identified under this contingency.

The contingency Contains Critical Energy Infrastructure Information caused minor low voltages in the local area, which can be corrected using reactive support:

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### **765 kV Option (Genoa-NOM 765 kV)**

For the 765 kV Option, the contingency Contains Critical Energy Infrastructure Information caused some severe low voltages. These can be mitigated by shedding load in the immediate vicinity of the outage. Contains Critical Energy Infrastructure Information Alternatively, the following reactive support would be needed to correct the severe low voltage condition without load shedding:

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The contingency Contains Critical Energy Infrastructure Information caused minor low voltages in the local area, which can be corrected using the following reactive support:

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### **Low Voltage Option**

For the Low Voltage Option, the contingency Contains Critical Energy Infrastructure Information

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Contains Critical Energy Infrastructure Information of load shed to control voltage collapse. The following reactive supports are needed to control the voltage collapse conditions, without load shedding, caused by the contingency: Contains Critical Energy Infrastructure Information

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Contains Critical Energy Infrastructure Information  
These can be mitigated by shedding load in the immediate vicinity of the outage.

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Alternatively, the following reactive support would be provided without load shedding:

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The voltage issues associated with the contingency are addressed using the reactive supports  
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**Option 1 (NLAX-HLT-SPG-CDL) and Option 7c (NLAX-NMA-CDL + DBQ-SPG-CDL)**

Detailed analysis was not performed for these two options. It was assumed that the reactive support needed for these two options are comparable to Option 1a. Option 1 is comparable to Option 1a since the only difference between the two options is Option 1 has an additional 345/138 kV transformer modeled at the Hilltop substation. Option 7c is comparable to Option 1a since both options have 345/138 kv transformers modeled at the Spring Green substation and an interconnection at the Cardinal substation.

**Reactive Support Summary**

Table 5.4 summarizes the costs of the reactive support needed to control low voltage wide area cascading outages under the identified single event Category C contingencies.

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Table 5.4 – Costs of reactive supports or amount of load shed needed to control voltage collapse under Category C contingencies

| Options                            | Reactive support<br>\$ in 2010 |  |
|------------------------------------|--------------------------------|--|
| Low Voltage                        | \$82,758,813                   |  |
| NLAX-HLT-SPG-CDL (1)               | \$0                            |  |
| NLAX-SPG-CDL (1a)                  | \$0                            |  |
| NLAX-NMA-CDL (1b)                  | \$0                            | Contains Critical Energy<br>Infrastructure Information |
| DBQ-SPG-CDL (8)                    | \$0                            |  |
| NLAX-NMA-CDL +<br>DBQ-SPG-CDL (7c) | \$0                            |  |
| Genoa-NOM 765 kV                   | \$0                            |  |

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Table 5.5 summarizes Contains Critical Energy Infrastructure Information

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Costs of the alternative remedy of reactive supports needed to alleviate the condition are also shown in the table.

Table 5.5 – Amount of of reactive support needed to control severe local low voltages under a Category C contingency

| Options                            |   | Reactive support<br>\$ in 2010 |
|------------------------------------|---|--------------------------------|
| Low Voltage                        | Contains Critical<br>Energy Infrastructure<br>Information | \$54,569,472                   |
| NLAX-HLT-SPG-CDL (1)               |   | \$0                            |
| NLAX-SPG-CDL (1a)                  |   | \$0                            |
| NLAX-NMA-CDL (1b)                  |   | \$53,821,824                   |
| DBQ-SPG-CDL (8)                    |   | \$0                            |
| NLAX-NMA-CDL +<br>DBQ-SPG-CDL (7c) |   | \$0                            |
| Genoa-NOM 765 kV                   |   | \$54,569,472                   |

It could be argued from a cost perspective that local load shedding is preferred over installing SVC's to control severe local low voltages under Category C events. Both remedies are acceptable according to current NERC TPL Standards. To capture the merits of alleviating severe local low voltages using a non-monetized measure, the project options are ranked as shown in Table 5.6. A ranking of "1" represents the worst performance and "5" represents the best performance. Those with needed SVC's or Cap Banks received a ranking of 1 and those without a need received a ranking of 5.

Table 5.6 – Option rankings for alleviating severe local low voltages under a single event Category C contingency

| Options                            | Rankings |
|------------------------------------|----------|
| Low Voltage                        | 1        |
| NLAX-HLT-SPG-CDL (1)               | 5        |
| NLAX-SPG-CDL (1a)                  | 5        |
| NLAX-NMA-CDL (1b)                  | 1        |
| DBQ-SPG-CDL (8)                    | 5        |
| NLAX-NMA-CDL +<br>DBQ-SPG-CDL (7c) | 5        |
| Genoa-NOM 765 kV                   | 1        |

This evaluation shows that the 345 kV options are more effective in controlling the voltage collapse and for alleviating severe local low voltages than the 765 kV or the Low Voltage Option. The Low Voltage Option showed the worst performance in this evaluation.

## 5.6 Non-Converged N-2 Contingencies

The non-converged N-2 contingencies identified in any of the studied cases are listed in Appendix E. No conclusive comparisons have been obtained based on this result. Further analysis is needed in this aspect of the reliability analysis.

## 5.7 First Contingency Incremental Transfer (FCITC) Analysis

The western Wisconsin study area often experiences west to east flow biases that cause additional stress to the transmission system in the area. The FCITC analysis demonstrates the robustness of the system with each transmission option and compares the options with respect to thermal loading characteristics under increasing west to east transfers.

The following three transfer directions were evaluated in detail using the Off-peak with 35-45% wind output model:

- Minnesota to Wisconsin
- Iowa to Wisconsin
- Minnesota and Iowa to the Midwest ISO central and east planning sub-regions

Note that the supporting facilities to eliminate all identified Category B thermal limitations were taken into account in the FCITC analysis. The charts in Figures 5.3 through 5.5 show the FCITC results for the seven options. The results show that the 345 kV options are more effective than the Low Voltage Option in improving the west to east transfer capability. Option 7c is most effective. The 765 kV Option is not as effective as Option 7c, particularly for sub-regional transfers of MN to WI and IA to WI.

Higher FCITC capabilities indicate stronger robustness of the system to cope with thermal loading issues under flow biases. During initial screening, the three east to west transfers (opposite to the west to east transfers listed above) were also simulated. The level of congestion identified was much less compared with the west to east transfers. Therefore the detailed study focused on the west to east transfers.

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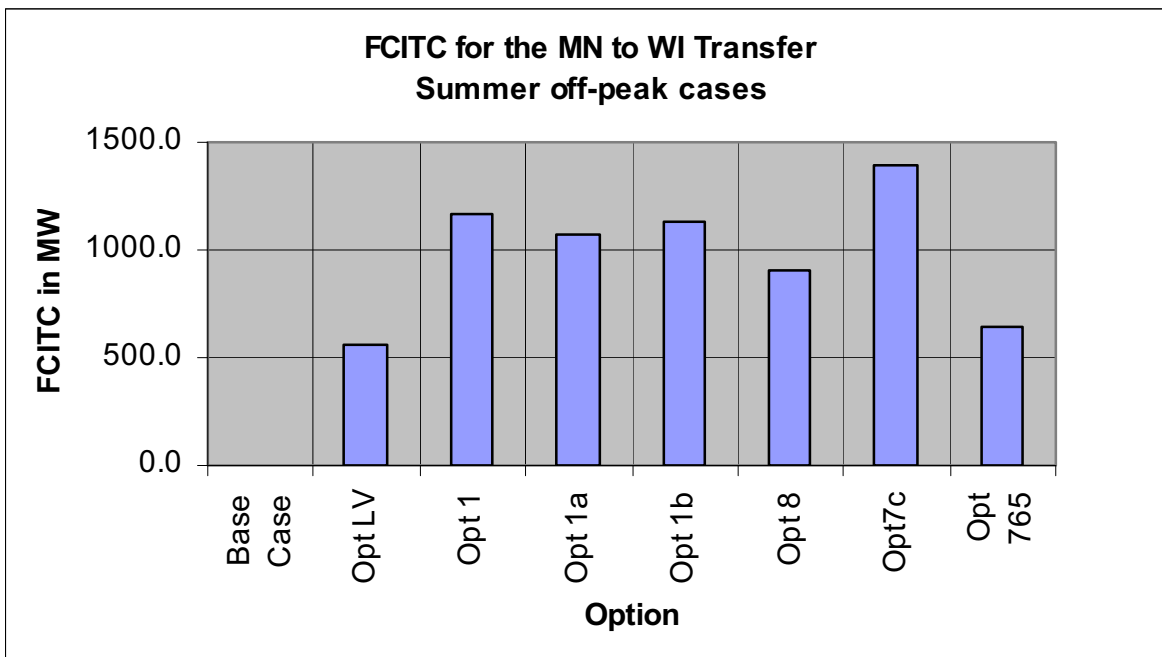


Figure 5.3 – FCITC for the MN to WI transfer

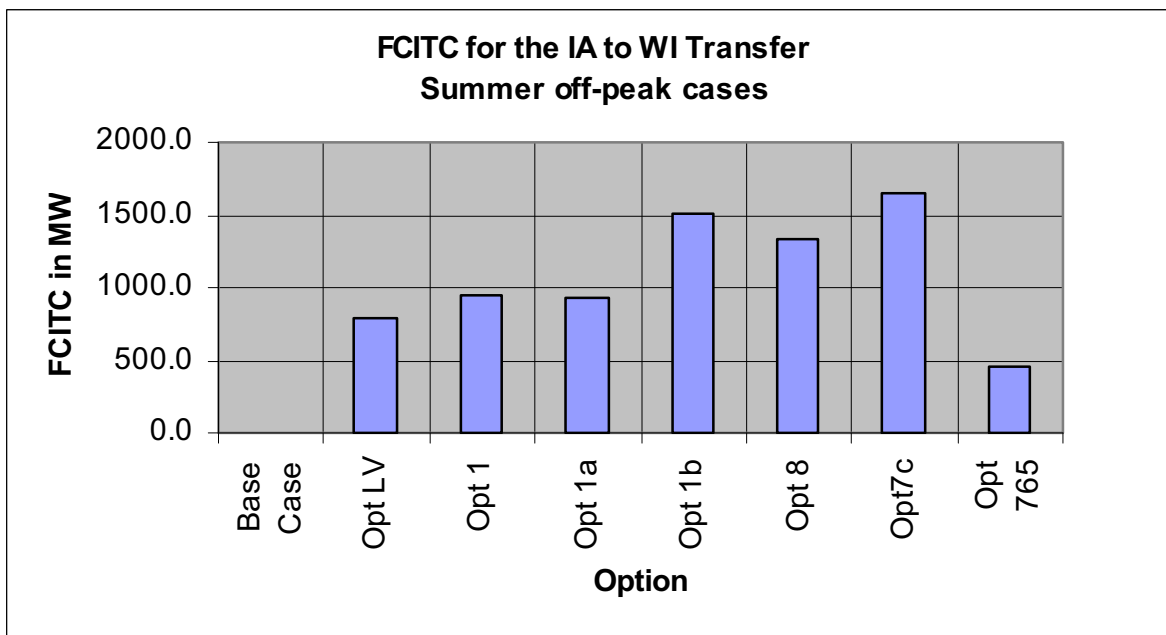


Figure 5.4 – FCITC for the IA to WI transfer

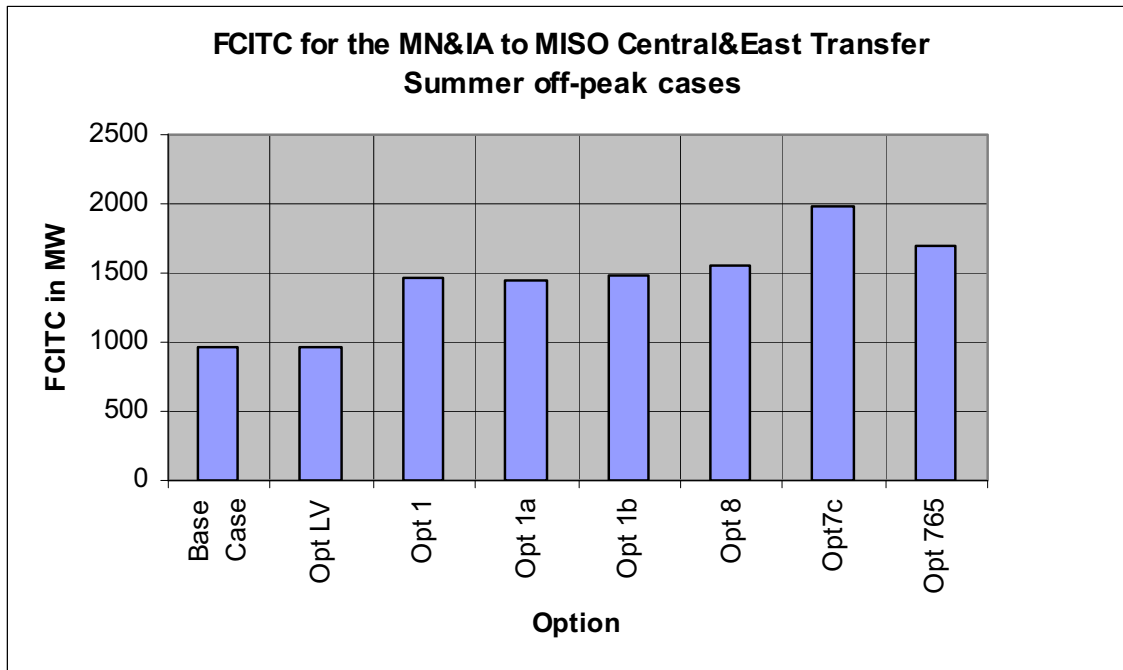


Figure 5.5 – FCITC for the MN&IA to MISO Central and East transfer

### 5.8 P-V Voltage Stability Analysis

Voltage stability is an important issue for the western Wisconsin study area. Currently, the Minnesota – Wisconsin Export interface (MWEX) is limited by voltage stability and transient low voltage recovery. The voltage stability analysis demonstrates the robustness of the system with each transmission option and compares between the options in respect to voltage stability characteristics under increasing west to east transfers.

The voltage stability results should not be interpreted as identifying a set of valid operating ranges. The voltage stability simulations ignore transmission overloads and push power flow transfers to levels where voltages become depressed and collapse. The results do attempt to correlate the characteristic power flow across an interface as an indicator of voltage stability. Demonstrating this is accomplished by means of a set of Power transfer vs. Voltage (PV) charts. For the purpose of this study the produced charts focus on power flow across two interfaces: through the ATC western tie lines, and an interface which includes all ATC tie lines and represents ATC imports. Simulating voltage stability in this manner is consistent with industry practices using such tools.

This study compares simulations with and without the transmission options. For comparison of voltage stability characteristics, the baseline interface flows, voltage, and losses reported in this study are not as significant as the improvements in those values produced by each option.

Power transfer across the study interfaces has the potential to increase real (MW) and reactive (MVAR) losses on the system. Similar to the PV charts, this report will use Power vs. Loss (PL)

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charts to demonstrate how the real and reactive losses are expected to change as power flow increases across the study interfaces.

The various reported results demonstrate the characteristics that each option contributes toward the voltage stability and robustness of the study region.

### ***PV Analysis - Study Conditions***

The voltage stability analysis used two study models - the 2018 Summer Off-peak with 35-45% wind output (SUOP) model and the 2018 Summer Peak (SUPK) model. The voltage stability analysis tested the following:

|                               |  |
|-------------------------------|--|
| Base                          | Base reference starting case   |
| Option 1                      | N. La Crosse-Hilltop-Spring Green-Cardinal 345 kV                                    |
| Option 1a                     | N. La Crosse-Spring Green-Cardinal 345 kV  |
| Option 1b                     | N. La Crosse-North Madison-Cardinal 345 kV   |
| Option 8                      | Dubuque-Spring Green-Cardinal 345 kV   |
| Option 7c                     | N. La Crosse-North Madison-Cardinal 345 kV +<br>Dubuque-Spring Green-Cardinal 345 kV |
| Option HV (765) <sup>15</sup> | Genoa-North Monroe 765 kV and supporting 345 kV                                      |
| Option LV                     | Low Voltage Option   |

Several variations of the transmission options above were also tested with addition of all the reactive supports (SVCs and Capacitors) identified in the Category C reliability analysis, as discussed in *Section 5.5* previously. These are the additional simulations (note that the notation “+caps” refers to capacitor additions and other reactive resource additions such as SVCs):

|                 |         |
|-----------------|---------|
| Base            | (+caps) |
| Option 1b       | (+caps) |
| Option 8        | (+caps) |
| Option HV (765) | (+caps) |
| Option LV       | (+caps) |

The PowerTech Labs VSAT program was used to test voltage stability. To improve the solution convergence and provide a more robust set of results, various small adjustments were made to the study case. For example, some changes could include minor bus tie impedance changes, resolving voltage regulation conflicts. Many of the changes were remote from the study area, but were needed to provide a more robust set of results.

### ***PV Analysis - Monitored Facilities***

Selected buses within the study region were monitored for additional output. Some of these locations are used in the power transfer vs. voltage (PV) charts. A list of the locations is provided in Appendix F.

A number of interfaces were defined to examine the power transfers in the simulations. Examples of interfaces used include monitoring the ATC western WI tie lines, and monitoring an

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<sup>15</sup> Option HV in this section refers to the 765 kV Option as referenced throughout the report.

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ATC import interface consisting of all ATC tie lines. When studying the various transmission options, these interfaces were augmented with any additional lines that are part of an option.

VSAT parameter settings were activated to report information regarding zonal MW and MVAR losses. The loss information is used to produce charts of power transfer vs. losses (PL).

The VSAT program provides additional output that is not discussed in this section, but can be made available as part of the supporting materials upon request.

### ***PV Analysis - Contingencies Tested***

Each VSAT run tested approximately 30-40 contingencies that were considered to be among the most severe for the study region. The tests did not include contingencies that were considered farther from the study area since they would have a poor correlation to the studied transmission options. The contingencies used included significant outages identified in the reliability results. An additional VSAT screening was also performed to include additional contingencies (above 161 kV) that may be significant. Within the study region selected unit outages and capacitor bank outages were also included. When studying the various transmission options, several additional contingencies were included to account for facilities of each option. A complete list of the tested contingencies can be found in Appendix F.

### ***PV Analysis - Stability Settings***

This section describes some of the VSAT program parameters used for each simulation. The simulations are set to ignore pre-contingency and post contingency overloads. The simulations do not attempt to assess or simulate cascading outage conditions. The simulations are not set to perform any operating steps or other overload mitigation methods other than the items mentioned in this report.

These are some of the more significant VSAT solution parameter file settings that are used in the simulations:

|   |                      |
|---|----------------------|
| Limit Generator Reactive Var output within limits | (Always)             |
| Transfer Analysis                                 | (To First Limit)     |
| Contingency Analysis                              | (To First Insecure)  |
| Adjust ULTCs transformers for voltage control     | (In pre-contingency) |
| Adjust phase-shifters for MW flow control         | (In pre-contingency) |
| Adjust discrete switched shunts                   | (Always)             |
| Adjust area interchange                           | (Never)              |

Because the model includes power flow features that model some load outside of its power flow control areas, the area interchange feature cannot readily be turned on in VSAT. Therefore, losses are handled by the system swing located within Tennessee Valley Authority in the east. Adjustments were made to the case to make it more robust so that the swing will not have EHV outlet issues when supplying losses to the system.

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### ***PV Analysis - Phase Shifter Operation***

The Arrowhead phase shifter located near Duluth, Minnesota was set to be in operation in each of the power flow cases. Contains Critical Energy Infrastructure Information

Contains Critical  
Energy Infrastructure  
Information

As mentioned, the simulation parameter was set to allow for pre-contingent adjustment of the phase shifters. Therefore the phase shifter can adjust to keep pre-contingent flow with the selected bandwidth. This is consistent with the description in the operating guide. However to prevent excessive utilization of the phase shifter and to hold back for post-contingent conditions, the phase shifter angle in the case was also limited to +/- 10 degrees.

### ***PV Analysis - Transfer Assumptions***

A full description of the transfer direction participation points can be made available as part of the supporting materials. This section provides a summary of the transfer directions.

The Summer Off-peak (SUOP) case was studied using two transfer directions:

#### **SUOP Transfer 1** (West to East – primarily to ATC load)

**Source:** 70% from western wind (including wind in the ATC region)  
30% from western generation units with reserve

**Sink:** 80% scaling up ATC region load (using constant power factor)  
20% scaling up load in the eastern part of MISO region (using unity power factor)

#### **SUOP Transfer 2** (West to East – primarily to ATC generation)

**Source:** 70% from western wind (including wind in the ATC region)  
30% from western generation units with reserve

**Sink:** 50% follow a back-down order (with turn-off) of selected units within ATC (smaller and less economic)  
20% scaling down of remaining units in ATC region (excluding wind)  
30% scaling down of generation in the eastern part of MISO region

The Summer Peak (SUPK) case was studied using one transfer direction:

#### **SUPK Transfer 3** (West to East – primarily to ATC gas generation)

**Source:** 70% from western wind (excluding wind in the ATC region)  
30% from western generation units with reserve

**Sink:** 35% follow a back-down order (with turn-off) of select units within ATC (gas units excluding combined cycle)  
20% follow a back-down order (with turn-off) of select units within ATC (gas combined cycle)  
15% scaling down of remaining units in ATC region (excluding wind)  
30% scaling down of generation in the eastern part of MISO region

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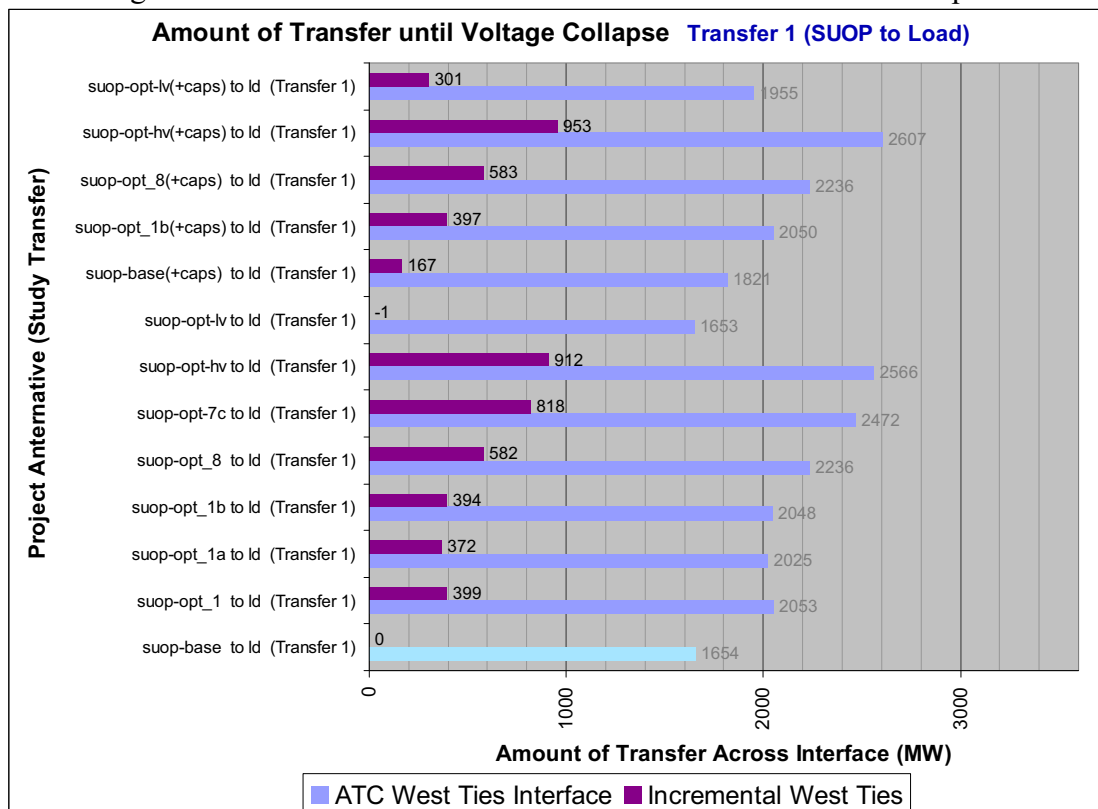
## PV Analysis - Results

### Characteristic Strength during Transfer

The strength of each transmission option can be characterized in a number of ways. One way is by the amount of source to sink transfers achieved before voltage collapse. Another way is by the amount of transfers through an interface such as the ATC Western Ties interface or the ATC import interface achieved before voltage collapse. If a project alternative is effective, it will direct a larger percentage (or shift factor) of the power transfer through the interface as opposed to power flowing around the interface. The following bar charts depict the interface flows achieved before voltage collapse of each test transfer.

It is observed from the bar charts that the single element 345 kV options (1, 1a, 1b) increase the transfers through the ATC West Ties interface by approximately 372-609 MW. Option 8 performed slightly better as a single element 345 kV option (582-772 MW). Option 7c with 2-345 kV lines performed similar to the combined increases of its component projects Options 1b and 8. For example, in Transfer 2, Option 7c increases transfer through the West Ties interface by 1211 MW, compared to its individual components, Options 1b and 8, which had increases of 772 MW and 530 MW. The 765 kV Option performed better than the 345 kV single element options, but not as well as the double 345 kV option, Option 7c

Figure 5.6 - Transfer 1 ATC West Ties Interface Limit for Each Option



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Figure 5.7 - Transfer 1 ATC Import Interface Limit for Each Option

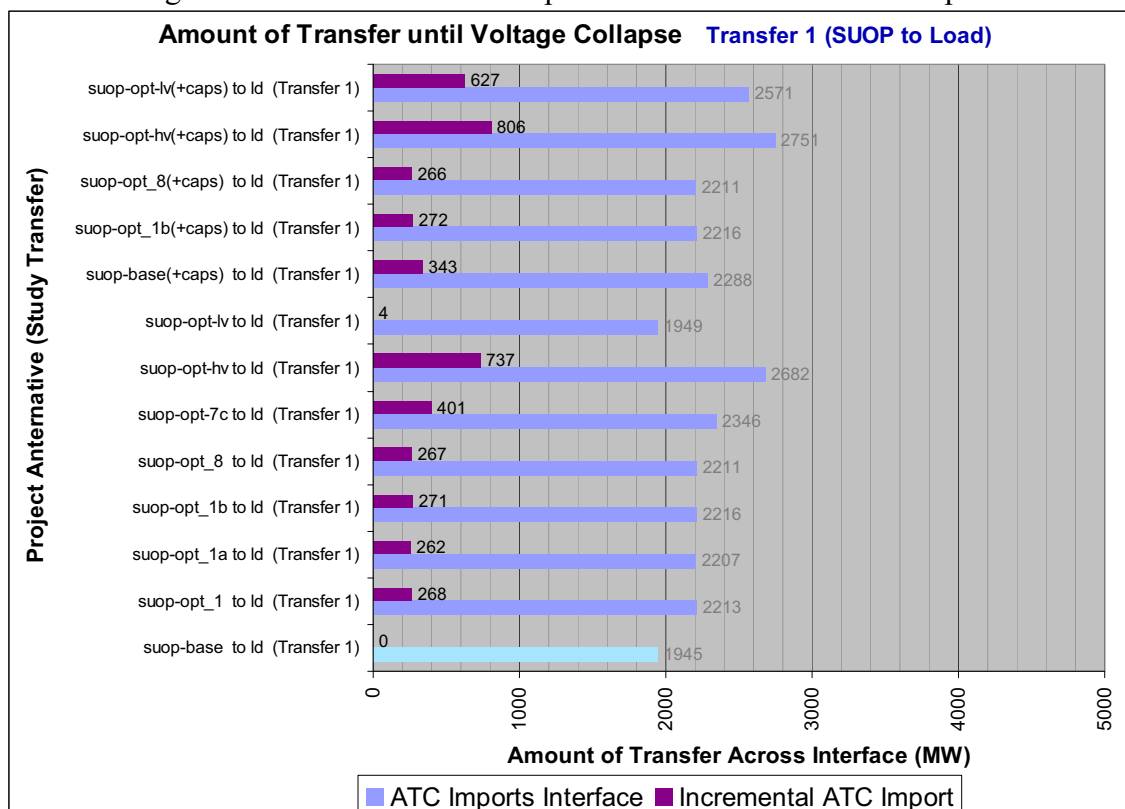
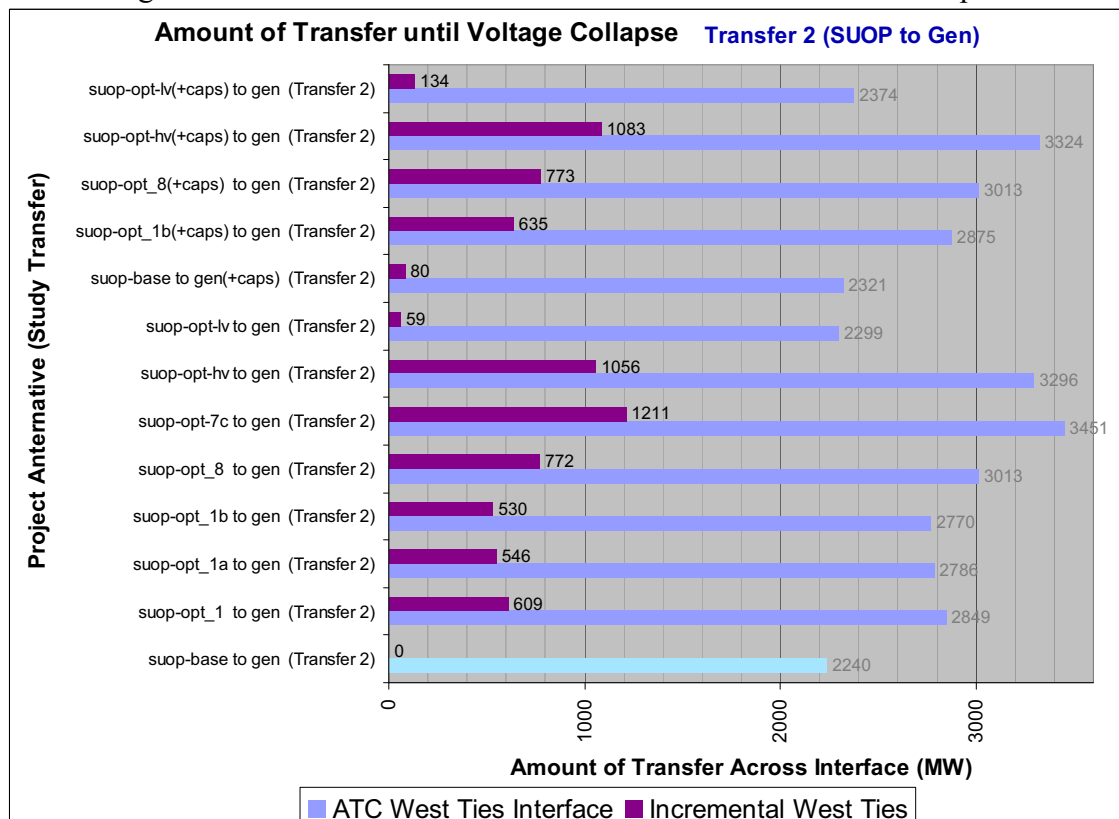


Figure 5.8 - Transfer 2 ATC West Ties Interface Limit for Each Option



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Figure 5.9 - Transfer 2 ATC Import Interface Limit for Each Option

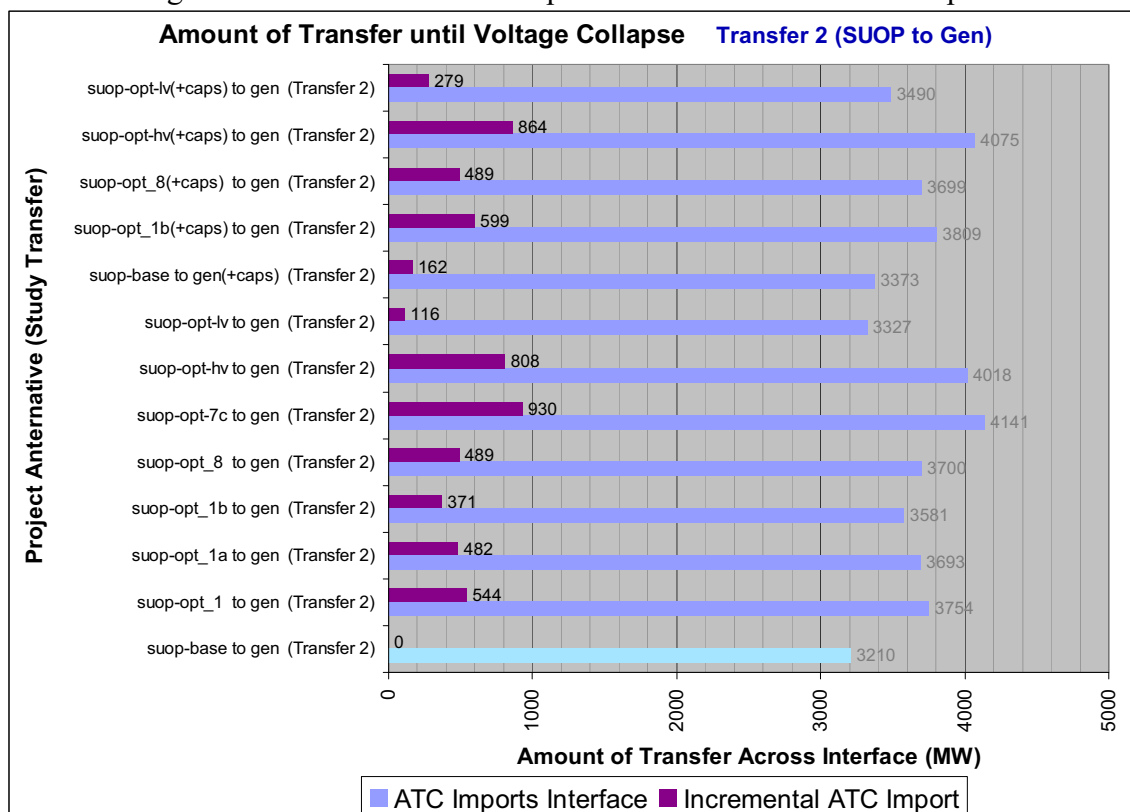
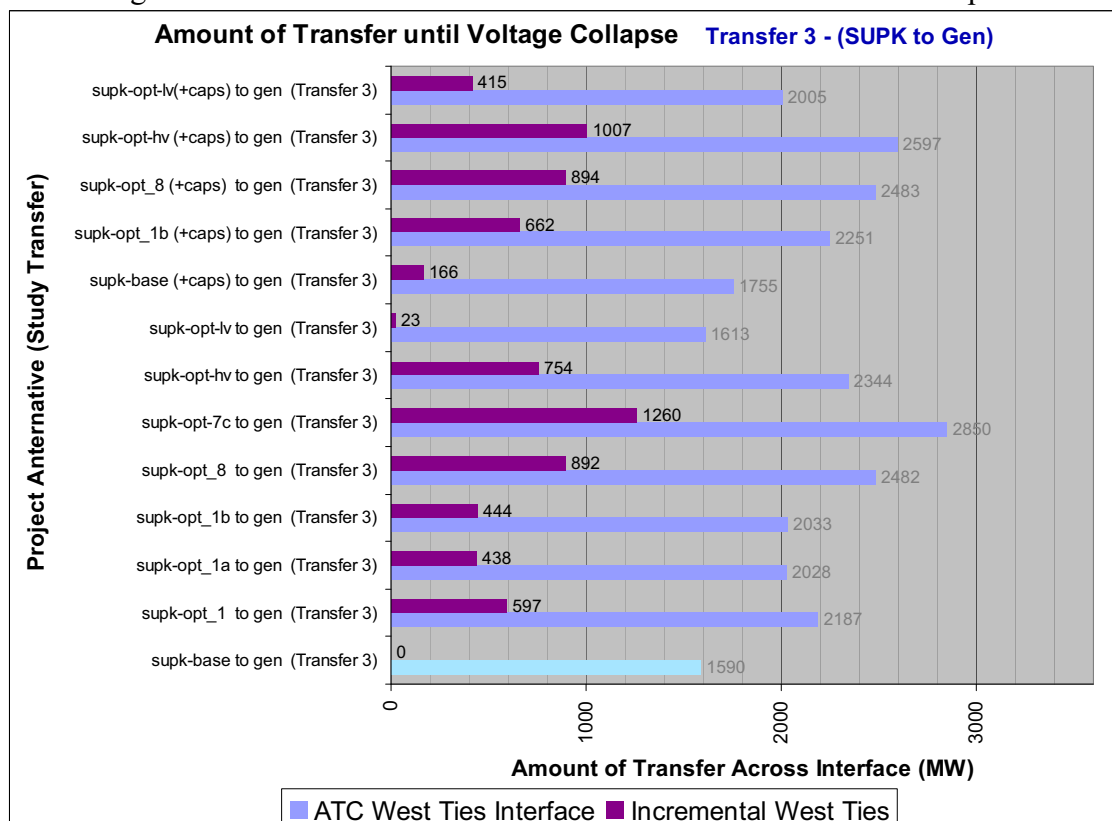
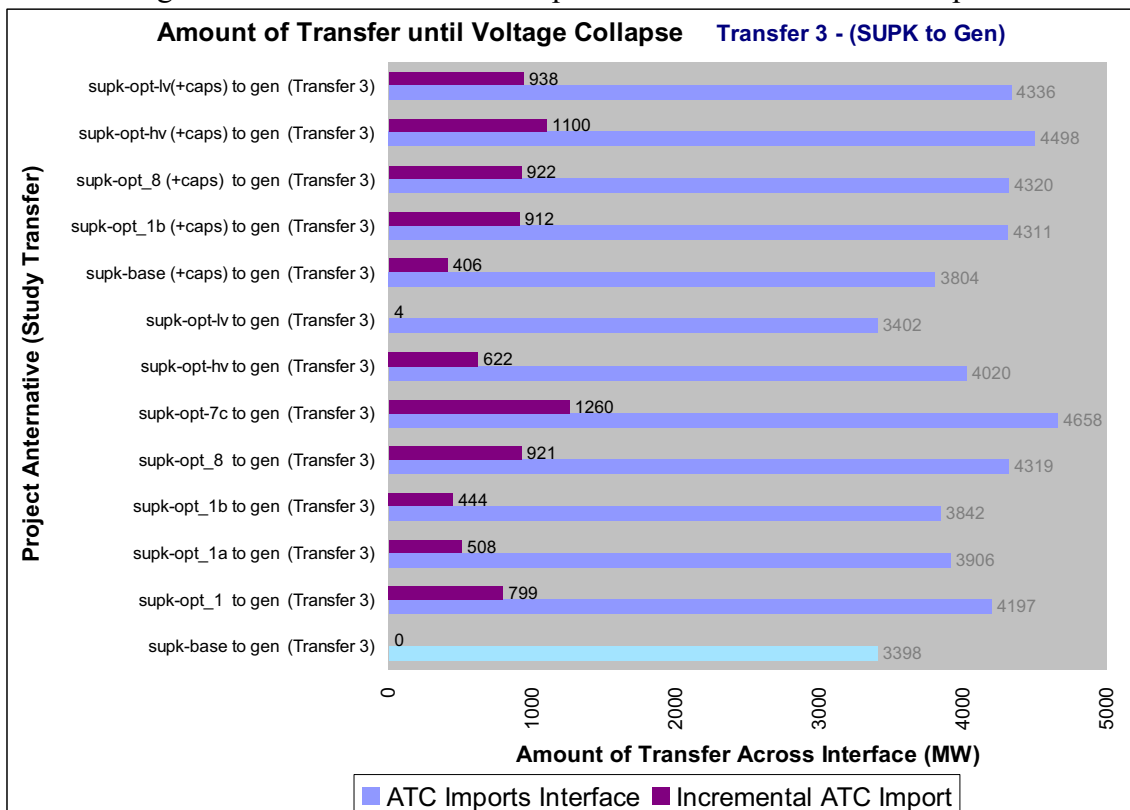


Figure 5.10 - Transfer 3 ATC West Ties Interface Limit for Each Option



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Figure 5.11 - Transfer 3 ATC Import Interface Limit for Each Option



The simulations increment the test transfer until one of the test contingencies or other criterion demonstrates voltage collapse. At that point the simulation is ceased for all contingencies.

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The Transfer 1 simulations terminated at a lower transfer level than experienced for Transfers 2 and 3. Contains Critical Energy Infrastructure Information

Contains Critical Energy Infrastructure Information In the SUOP case, a number of generation reactive resources are not participating due to their economic dispatch for the off-peak period.

### PV Analysis – Plot Interpretation

For this study, the PV charts show the voltage changes versus flows across multi-line interfaces. This report focuses on the flows across the ATC western WI tie lines interface, and the ATC

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import interface. However, as a simpler example, an interface may consist of a single line.  
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As the power transfer increases the reported voltage in the PV chart will eventually progress downward. The largest voltage drops may be seen at the points closest to the critical collapse, but the voltage reductions will also be seen to a lesser extent at other locations on the system. The limited number of charts provided in this report focus on the use of some locations (such as Spring Green) which are considered central to the impacted study region.

The interface flows in the PV chart may or may not start at the same amount. When plotted against ATC import levels, they all start at the same import amount, but when plotted against the ATC West Tie flows they do not. The definition of the West Tie flows is adjusted for each transmission option. The new facilities impact (increase) the starting flows across the interface when compared to the flows experienced in the base case.

For this study, charts are also provided that show changes in MW (or MVAR) losses versus flows across multi-line interfaces. As the power transfers increase, the reported losses will likely increase. Losses can decrease for situations where transfer may reduce flow, but the general trend will likely be upward at higher transfer levels.

The charts may have a less smooth progression that can be attributed to a number of possible conditions including but not limited to: transfers reducing some line flows; transfers reaching levels where some generators may be turned off; activation of switched shunts and capacitors; adjustments of transformer ratios; reaching the maximum range of reactive control devices and phase shifter adjustments. In general, the calculations have more variability to these influences as they approach the collapse transfer limit.

For the loss charts, the notation of “ATC” will denote the facilities within ATC. The notation of “non-ATC (WWI)” denotes the facilities external to ATC that are within the study region identified in the study scope.

### ***PV Analysis - Losses and Voltage Drop***

As power transfers through resistive line impedances, it experiences real MW losses. As power transfers through reactive line impedances, it experiences MVAR losses and is a large contributor toward voltage drop across the line.

Decoupling of power flow equations show that real power flow (MW) is strongly correlated to voltage angle, and reactive power flow (MVAR) is strongly correlated to voltage magnitude.

MW flow through resistive line impedances largely contributes to the real MW losses in proportion to the square of the current times the resistance ( $I^2R$ ). Current is based on MVA flow consisting of MW and MVAR component flows. The MW flow will typically be the largest component of MVA flow. Therefore without decoupling, the actual MW losses are slightly higher when based on the current of MVA flow.

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Similarly, MVAR flow through reactive line impedances are a large contributor toward voltage drop across the line. However, the movement of MVARs is encumbered by the MVAR losses on a line during high power flow. Assuming small MVAR flows, the current from MW flows passing through reactive line impedances largely contributes to the MVAR losses in proportion to the square of the current times the reactance ( $I^2X$ ). Without decoupling, the actual MVAR losses are higher based on the current of MVA flow.

In contrast to MVAR losses, transmission lines also have a line charging characteristic that produces MVARs. The line charging is more significant at higher voltage levels. Depending on overhead construction type, at 345 kV it can be on the order of 0.8 MVAR - 1.0 MVAR per mile for overhead transmission. At 765 kV it can be on the order of 4 MVAR – 5 MVAR per mile for overhead. The line charging helps to support line voltage and offsets some of the reactive MVAR losses on the line. The theoretical point where line reactive losses are equal to the line charging is called the Surge Impedance Loading (SIL). Transfer of power above the SIL implies that the transmission line will need external compensation to help with the line flow. That compensation can come from other sources such as capacitors or generation MVAR support. At high power transfers above SIL, the square function of  $I^2X$  MVAR losses will grow at an increasing rate. Large reactive line losses are one of the characteristics that can lead to voltage collapse conditions. The SIL rating is based on line construction characteristics and is independent of line length. SIL ratings are an engineering line characteristic measure and they are not related to actual operating limits for the line which are usually higher. A typical 345 kV line may have a SIL of approximated 300 MW – 400 MW.

As an example of SIL properties, consider a 100-mile line with a SIL of 300 MW. Such a line may have line charging of about 90 MVAR. Using 100 MVA base, a 300 MVA (or MW) flow will have approximately a 3 per unit current. At 600 MVA (or MW) the per unit current will be about 6. Doubling the current will produce four times the reactive losses. The MVAR losses for the flow above 300 MW will need to be compensated. At 600 MW of flow (2 x SIL), 270 MVAR of external MVAR compensation may be required to serve the reactive line losses. At higher flows, the MVAR losses increase at ever higher rates.

### **PV Analysis - Charts**

Output of the VSAT runs were compiled to produce various chart views that compare results across the various transmission options. Detailed charts are provided in Appendix F for each test transfer. Some charts show voltage performance for power transfer across interfaces. Other charts show how losses change as power flows across the interfaces. The charts provide some insight into the voltage stability simulations.

Contains Critical Energy Infrastructure Information

Contains Critical Energy Infrastructure Information

For each test

transfer, the following Power vs. Voltage (PV) charts can be found in Appendix F:

ATC West Tie Flow (Contains Critical Energy  
Infrastructure Information)  
ATC West Tie Flow (  
ATC West Tie Flow (

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ATC Imports (Contains Critical Energy  
Infrastructure Information)  
ATC Imports (  
ATC Imports (

Real (MW) and reactive (MVAR) losses increase as power flow increases across the Western ties interface or the ATC Import interface. For each test transfer, the following Power vs. Loss (PL) charts can be found in Appendix F:

|  |                  |                  |
|--|------------------|------------------|
| ATC West Tie Flow (Contains Critical Energy<br>Infrastructure Information) | vs. ATC(WWI)     | MW losses        |
| ATC West Tie Flow (  | vs. Non-ATC(WWI) | MW losses        |
| ATC West Tie Flow (  | ) vs. ATC(WWI)   | MW losses        |
| ATC West Tie Flow (  | vs. ATC(WWI)     | MW losses        |
| ATC West Tie Flow (Contains Critical Energy<br>Infrastructure Information) | vs. ATC(WWI)     | MVAR line losses |
| ATC West Tie Flow (  | vs. Non-ATC(WWI) | MVAR line losses |
| ATC West Tie Flow (  | ) vs. ATC(WWI)   | MVAR line losses |
| ATC West Tie Flow (  | vs. ATC(WWI)     | MVAR line losses |
| ATC Imports (Contains Critical<br>Energy Infrastructure )                  | vs. ATC(WWI)     | MVAR line losses |
| ATC Imports (Information )   | vs. Non-ATC      | MVAR line losses |

Contains Critical Energy Infrastructure Information (also located in Appendix F) are samples of the Power vs. S.

Contains Critical Energy Infrastructure Information

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Contains Critical Energy Infrastructure Information

### ***PV Analysis - Integrated Evaluation of Characteristic Strengths***

This report objectively evaluates each transmission option by numerically scoring a sampling of voltage stability characteristic strengths. The characteristic strengths are broken up into three categories: transfer achieved before collapse, voltage performance and loss performance.

Each category is composed of various scores ranging from poorest (score of 0) to best (score of 5). Scoring is based on an improvement in performance compared to the base case. No change in performance is treated as a score of 1. Any decrease in performance is scored as 0. The following scoring tables show various selected characteristic attributes of voltage robustness. Table 5.8 summarizes the results for the Summer Off-Peak Transfer 1. Table 5.9 summarizes the results for the Summer Off-Peak Transfer 2. Table 5.10 summarizes the results for the Summer Peak Transfer 3.

The selected characteristics for scoring provide a balanced mix of characteristics that measure the amount of transfers before collapse, voltage performance at common transfer levels and loss performance. Each summarized characteristic is given a score and it is color coded. Comparing between projects, the high or low deviation from the base case reported values are used to determine the graduated scores from 1 to 5. A score of zero indicates that it performed worse than the base starting case. Voltage was scored slightly different in that some minimum and maximum voltage ranges were applied where results did not exceed those values. Voltage was scored with a low score value based on the lower of 0.95 p.u. and the base case value. Voltage was scored with a high score value based on the higher of the 1.0 p.u. and the best voltage.

The scoring tables evaluate an overall score using the weighting shown for each characteristic. The three scoring categories were chosen to be rather evenly weighted, but with a slightly higher weighting on the transfer capability. Voltage stability limits typically assign facility ratings based on voltage stability under transfer. The overall score places a 40% weighting on the transfer before collapse, a 30% weighting on voltage performance at common transfer levels and a 30% weighting on loss performance.

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Table 5.8 - Summary of SUOP Transfer 1 Results

| Description   |  |                       |                   |   | Score (0=Worse, 1=No Change, 5=Best) |       |        |        |       |        |        |        |              |               |              |               |               |
|---|--|-----------------------|-------------------|---|--------------------------------------|-------|--------|--------|-------|--------|--------|--------|--------------|---------------|--------------|---------------|---------------|
|   | Evaluated Characteristic Improvement     | Interface Or Location | Transfer Level    | Contains Critical Energy Infrastructure Information | Wt                                   | Opt 1 | Opt 1a | Opt 1b | Opt 8 | Opt 7c | Opt HV | Opt LV | Base + claps | Opt 1b + caps | Opt 8 + caps | Opt HV + caps | Opt LV + caps |
| TRANSFER  | Transfer 1 -- SUOP to Load               |                       |                   |   |                                      |       |        |        |       |        |        |        |              |               |              |               |               |
|   | Incremental Transfer                     | Source Transfer       | at collapse level |   | 10                                   | 2.3   | 2.3    | 2.3    | 2.3   | 3.0    | 4.7    | 1.0    | 2.7          | 2.3           | 2.3          | 5.0           | 4.0           |
|   |  |                       |                   |   |                                      |       |        |        |       |        |        |        |              |               |              |               |               |
|   | Transfer Limit                           | ATC West Ties         | at collapse level |   | 10                                   | 2.7   | 2.6    | 2.7    | 3.4   | 4.4    | 4.8    | 0.0    | 1.7          | 2.7           | 3.4          | 5.0           | 2.3           |
|   | Transfer Limit                           | ATC Import            | at collapse level |   | 10                                   | 2.3   | 2.3    | 2.3    | 2.3   | 3.0    | 4.7    | 1.0    | 2.7          | 2.3           | 2.3          | 5.0           | 4.1           |
|   | Differences in Regional Flow Through ATC |                       |                   |   |                                      |       |        |        |       |        |        |        |              |               |              |               |               |
| 40%   | Regional Flow                            | (W. Ties) - (Imports) | at Base collapse  |   | 3.333                                | 2.9   | 2.7    | 3.1    | 3.9   | 5.0    | 4.4    | 0.0    | 1.0          | 3.1           | 3.9          | 4.4           | 0.0           |
|   | Regional Flow                            | (W. Ties) - (Imports) | at Base collapse  |   | 3.333                                | 2.7   | 2.6    | 2.7    | 4.0   | 5.0    | 4.0    | 0.0    | 1.0          | 2.7           | 4.0          | 4.0           | 1.0           |
|   | Regional Flow                            | (W. Ties) - (Imports) | at Base collapse  |   | 3.333                                | 2.8   | 2.6    | 2.8    | 4.0   | 5.0    | 3.9    | 0.0    | 1.2          | 2.8           | 4.0          | 3.9           | 1.2           |
| VOLTA<br>GE<br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><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|  |                       |                   |   |                                      |       |        |        |       |        |        |        |              |               |              |               |               |

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Western Wisconsin Transmission Reliability Study

Table 5.9 - Summary of SUOP Transfer 2 Results

| Description                          |  |                       |                   |   | Score (0=Worse, 1=No Change, 5=Best) |       |        |        |       |        |        |        |              |               |              |               |               |     |
|--------------------------------------|--|-----------------------|-------------------|---|--------------------------------------|-------|--------|--------|-------|--------|--------|--------|--------------|---------------|--------------|---------------|---------------|-----|
| Evaluated Characteristic Improvement |  | Interface Or Location | Transfer Level    | Contains Critical Energy Infrastructure Information | Wt                                   | Opt 1 | Opt 1a | Opt 1b | Opt 8 | Opt 7c | Opt HV | Opt LV | Base + claps | Opt 1b + caps | Opt 8 + caps | Opt HV + caps | Opt LV + caps |     |
| Transfer 2 -- SUOP to Gen            |  |                       |                   |   |                                      |       |        |        |       |        |        |        |              |               |              |               |               |     |
| TRANSFER                             | Incremental Transfer                     | Source Transfer       | at collapse level |   | 10                                   | 3.4   | 3.1    | 2.6    | 3.1   | 5.0    | 4.5    | 1.5    | 1.7          | 3.6           | 3.1          | 4.8           | 2.2           |     |
|                                      | Transfer Limit                           | ATC West Ties         | at collapse level |   | 10                                   | 3.0   | 2.8    | 2.8    | 3.6   | 5.0    | 4.5    | 1.2    | 1.3          | 3.1           | 3.6          | 4.6           | 1.4           |     |
|                                      | Transfer Limit                           | ATC Import            | at collapse level |   | 10                                   | 3.3   | 3.1    | 2.6    | 3.1   | 5.0    | 4.5    | 1.5    | 1.7          | 3.6           | 3.1          | 4.7           | 2.2           |     |
|                                      | Differences in Regional Flow Through ATC |                       |                   |   |                                      |       |        |        |       |        |        |        |              |               |              |               |               |     |
|                                      | Regional Flow                            | (W. Ties) - (Imports) | at Base collapse  |   | 3.333                                | 3.0   | 2.8    | 3.1    | 3.7   | 5.0    | 4.5    | 1.1    | 0.0          | 3.1           | 3.7          | 4.5           | 1.2           |     |
|                                      | Regional Flow                            | (W. Ties) - (Imports) | at Base collapse  |   | 3.333                                | 2.8   | 2.6    | 2.8    | 3.8   | 5.0    | 4.3    | 0.0    | 1.0          | 2.8           | 3.8          | 4.3           | 1.0           |     |
|                                      | Regional Flow                            | (W. Ties) - (Imports) | at Base collapse  |   | 3.333                                | 2.9   | 2.7    | 2.9    | 3.8   | 5.0    | 4.6    | 1.1    | 0.0          | 2.9           | 3.8          | 4.6           | 1.2           |     |
| VOLTAGE PROFILE                      | p.u. Voltage                             | Spring Green 138kV    | at Base collapse  |   | 1                                    | 1.6   | 0.0    | 4.4    | 1.1   | 2.8    | 4.2    | 0.0    | 2.1          | 4.4           | 1.1          | 4.2           | 2.1           |     |
|                                      | p.u. Voltage                             | N. Monroe 138kV       | at Base collapse  |   | 1                                    | 3.7   | 3.0    | 4.2    | 3.7   | 4.5    | 4.5    | 0.0    | 3.8          | 4.2           | 3.7          | 4.5           | 3.2           |     |
|                                      | p.u. Voltage                             | Hilltop 69kV          | at Base collapse  |   | 1                                    | 2.1   | 2.7    | 2.9    | 2.0   | 2.9    | 2.6    | 1.1    | 1.3          | 2.9           | 2.0          | 2.6           | 1.3           |     |
|                                      | p.u. Voltage                             | Boscobell 69kV        | at Base collapse  |   | 1                                    | 3.2   | 3.0    | 2.8    | 3.3   | 3.7    | 2.5    | 1.5    | 0.0          | 2.9           | 3.3          | 2.6           | 1.8           |     |
|                                      | p.u. Voltage                             | Paddock 138kV         | at Base collapse  |   | 1                                    | 2.4   | 2.0    | 2.7    | 2.5   | 3.0    | 2.3    | 0.0    | 2.6          | 2.7           | 2.5          | 2.3           | 2.6           |     |
|                                      | p.u. Voltage                             | Spring Green 138kV    | at Base collapse  |   | 1.25                                 | 1.5   | 0.0    | 4.0    | 1.2   | 3.2    | 3.6    | 0.0    | 1.3          | 4.0           | 1.2          | 3.6           | 2.8           |     |
|                                      | p.u. Voltage                             | Hilltop 69kV          | at Base collapse  |   | 1.25                                 | 2.5   | 3.0    | 3.4    | 2.4   | 3.7    | 3.1    | 0.0    | 0.0          | 3.4           | 2.4          | 3.2           | 1.6           |     |
|                                      | p.u. Voltage                             | Hillsboro 161kV       | at Base collapse  |   | 1.25                                 | 4.5   | 3.8    | 4.2    | 3.6   | 3.6    | 4.0    | 1.2    | 0.0          | 4.2           | 3.6          | 4.0           | 2.2           |     |
|                                      | p.u. Voltage                             | Boscobell 69kV        | at Base collapse  |   | 1.25                                 | 3.4   | 3.0    | 3.1    | 3.1   | 4.0    | 3.1    | 1.2    | 0.0          | 3.1           | 3.1          | 3.1           | 2.2           |     |
|                                      | p.u. Voltage                             | Richland Ctr 69kV     | at Base collapse  |   | 1.25                                 | 3.7   | 3.0    | 3.6    | 3.1   | 3.8    | 3.3    | 0.0    | 0.0          | 3.6           | 3.1          | 3.3           | 2.0           |     |
|                                      | p.u. Voltage                             | Spring Green 138kV    | at Base collapse  |   | 1.25                                 | 2.1   | 1.5    | 3.7    | 1.9   | 3.1    | 4.0    | 0.0    | 2.3          | 3.8           | 1.9          | 3.8           | 3.2           |     |
|                                      | p.u. Voltage                             | Hilltop 69kV          | at Base collapse  |   | 1.25                                 | 2.5   | 3.0    | 3.1    | 2.6   | 3.4    | 3.0    | 0.0    | 1.9          | 3.1           | 2.6          | 2.7           | 2.1           |     |
|                                      | p.u. Voltage                             | Hillsboro 161kV       | at Base collapse  |   | 1.25                                 | 2.6   | 4.2    | 4.4    | 4.1   | 3.1    | 2.3    | 2.1    | 2.6          | 4.4           | 4.1          | 2.0           | 3.2           |     |
|                                      | p.u. Voltage                             | Boscobell 69kV        | at Base collapse  |   | 1.25                                 | 3.2   | 3.1    | 2.9    | 3.4   | 3.9    | 2.9    | 1.4    | 1.4          | 2.9           | 3.3          | 2.8           | 2.7           |     |
|                                      | p.u. Voltage                             | Richland Ctr 69kV     | at Base collapse  |   | 1.25                                 | 3.2   | 3.2    | 3.4    | 3.5   | 3.7    | 2.8    | 1.2    | 2.1          | 3.4           | 3.5          | 2.6           | 2.7           |     |
|                                      | p.u. Voltage                             | Spring Green 138kV    | at Base collapse  |   | 1.25                                 | 1.8   | 1.1    | 4.1    | 1.2   | 2.9    | 4.0    | 0.0    | 2.2          | 4.1           | 1.2          | 4.0           | 2.4           |     |
|                                      | p.u. Voltage                             | Hilltop 69kV          | at Base collapse  |   | 1.25                                 | 2.5   | 2.7    | 2.9    | 2.0   | 2.9    | 2.5    | 1.0    | 1.6          | 2.9           | 1.9          | 2.4           | 1.2           |     |
|                                      | p.u. Voltage                             | Council Cr 138kV      | at Base collapse  |   | 1.25                                 | 2.9   | 4.0    | 4.3    | 3.8   | 4.4    | 4.4    | 1.7    | 2.4          | 4.2           | 3.8          | 4.3           | 1.8           |     |
|                                      | p.u. Voltage                             | Boscobell 69kV        | at Base collapse  |   | 1.25                                 | 3.2   | 3.1    | 2.8    | 3.2   | 3.7    | 2.5    | 1.7    | 0.0          | 2.8           | 3.3          | 2.5           | 1.9           |     |
|                                      | p.u. Voltage                             | Bell Center 161kV     | at Base collapse  |   | 1.25                                 | 2.7   | 3.4    | 3.6    | 3.7   | 3.3    | 2.8    | 1.5    | 1.6          | 3.6           | 3.7          | 2.8           | 2.0           |     |
|                                      | p.u. Voltage                             | Boscobell 69kV        | at Base collapse  |   | 1.25                                 | 2.6   | 2.3    | 2.4    | 3.2   | 3.0    | 2.0    | 0.0    | 0.0          | 2.3           | 3.2          | 2.0           | 1.2           |     |
|                                      | p.u. Voltage                             | Richland Ctr 69kV     | at Base collapse  |   | 1.25                                 | 3.0   | 3.3    | 3.6    | 3.8   | 3.2    | 2.6    | 1.5    | 2.0          | 3.6           | 3.8          | 2.7           | 1.9           |     |
|                                      | p.u. Voltage                             | W. Middleton 138kV    | at Base collapse  |   | 1.25                                 | 2.3   | 1.7    | 3.2    | 1.9   | 3.3    | 1.7    | 1.0    | 2.7          | 3.2           | 1.9          | 2.0           | 2.8           |     |
|                                      | p.u. Voltage                             | Spring Green 138kV    | at Base collapse  |   | 1.25                                 | 1.7   | 0.0    | 4.4    | 1.3   | 3.3    | 3.8    | 0.0    | 2.3          | 4.4           | 1.3          | 4.0           | 2.6           |     |
|                                      | p.u. Voltage                             | Hilltop 69kV          | at Base collapse  |   | 1.25                                 | 2.0   | 2.7    | 3.0    | 2.1   | 3.1    | 2.4    | 0.0    | 1.3          | 3.0           | 2.0          | 2.5           | 1.4           |     |
|                                      | MW & MVAR LOSSES                         | MW loss               | ATC               | w/o transfer  |                                      | 2.5   | 5.0    | 4.3    | 3.9   | 3.2    | 4.6    | 3.4    | 1.8          | 1.1           | 4.0          | 3.3           | 3.4           | 2.0 |
|                                      |  | MW loss               | ATC               | at Base collapse                                    |                                      | 2.5   | 5.0    | 3.6    | 3.7   | 2.9    | 4.1    | 3.7    | 1.3          | 1.4           | 3.7          | 2.9           | 3.7           | 1.8 |
| MW loss                              |  | External_WWI          | w/o transfer      |   | 2.5                                  | 0.0   | 0.0    | 0.0    | 2.0   | 1.3    | 4.9    | 0.0    | 1.1          | 0.0           | 2.0          | 5.0           | 0.0           |     |
| MW loss                              |  | External_WWI          | at Base collapse  |   | 2.5                                  | 2.0   | 2.6    | 2.6    | 1.9   | 3.4    | 5.0    | 0.0    | 1.2          | 2.6           | 1.9          | 5.0           | 0.0           |     |
| MVAR line loss                       |  | ATC                   | w/o transfer      |   | 2                                    | 5.0   | 3.7    | 3.5    | 1.4   | 2.6    | 1.1    | 3.2    | 1.1          | 3.5           | 1.4          | 1.2           | 3.5           |     |
| MVAR line loss                       |  | ATC                   | at Base collapse  |   | 2                                    | 5.0   | 2.1    | 2.1    | 1.4   | 1.7    | 0.0    | 2.3    | 1.6          | 2.1           | 1.4          | 0.0           | 3.0           |     |
| MVAR line loss                       |  | ATC                   | at Base collapse  |   | 2                                    | 5.0   | 1.9    | 2.1    | 1.6   | 2.2    | 0.0    | 2.1    | 1.3          | 2.1           | 1.6          | 0.0           | 3.0           |     |
| MVAR line loss                       |  | ATC                   | at Base collapse  |   | 2                                    | 5.0   | 2.7    | 2.7    | 2.4   | 3.1    | 1.6    | 1.7    | 2.1          | 2.7           | 2.4          | 1.6           | 3.1           |     |
| MVAR line loss                       |  | ATC                   | at Base collapse  |   | 2                                    | 5.0   | 2.3    | 2.2    | 1.5   | 1.9    | 0.0    | 2.3    | 1.8          | 2.3           | 1.5          | 0.0           | 3.0           |     |
| MVAR line loss                       |  | External_WWI          | w/o transfer      |   | 2                                    | 0.0   | 0.0    | 0.0    | 1.7   | 0.0    | 4.8    | 0.0    | 1.2          | 0.0           | 1.7          | 5.0           | 0.0           |     |
| MVAR line loss                       |  | External_WWI          | at Base collapse  |   | 2                                    | 0.0   | 2.3    | 2.2    | 1.9   | 3.1    | 4.9    | 0.0    | 1.3          | 2.3           | 1.9          | 5.0           | 0.0           |     |
| MVAR line loss                       |  | External_WWI          | at Base collapse  |   | 2                                    | 0.0   | 2.3    | 2.2    | 1.8   | 2.7    | 4.9    | 1.1    | 1.1          | 2.3           | 1.8          | 5.0           | 1.2           |     |
| MVAR line loss                       |  | External_WWI          | at Base collapse  |   | 2                                    | 0.0   | 2.3    | 2.2    | 2.0   | 3.2    | 4.9    | 0.0    | 1.3          | 2.3           | 2.0          | 5.0           | 0.0           |     |
| MVAR line loss                       | External_WWI                             | at Base collapse      |                   | 2   | 0.0                                  | 2.6   | 2.5    | 2.2    | 3.2   | 4.9    | 0.0    | 1.4    | 2.6          | 2.2           | 5.0          | 0.0           |               |     |
| Transfer 2 - Transfer Score          |  | Weighted Average      |                   |   | 40                                   | 3.2   | 2.9    | 2.7    | 3.4   | 5.0    | 4.5    | 1.2    | 1.3          | 3.3           | 3.4          | 4.6           | 1.7           |     |
| Transfer 2 - Voltage Score           |  | Weighted Average      |                   |   | 30                                   | 2.7   | 2.5    | 3.5    | 2.7   | 3.4    | 3.1    | 0.7    | 1.5          | 3.5           | 2.7          | 3.1           | 2.2           |     |
| Transfer 2 - Losses Score            |  | Weighted Average      |                   |   | 30                                   | 2.7   | 2.4    | 2.3    | 2.0   | 2.7    | 3.2    | 1.1    | 1.3          | 2.3           | 2.0          | 3.3           | 1.4           |     |
| Transfer 2 TOTAL                     |  | Weighted Average      |                   |   | 100                                  | 2.9   | 2.6    | 2.8    | 2.8   | 3.7    | 3.7    | 1.0    | 1.3          | 3.1           | 2.8          | 3.8           | 1.8           |     |
|                                      |  |                       |                   |   |                                      | 1     | 1a     | 1b     | 8     | 7c     | HV     | LV     | B            | 1b            | 8            | HV            | LV            |     |

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Table 5.10 - Summary of SUPK Transfer 3 Results

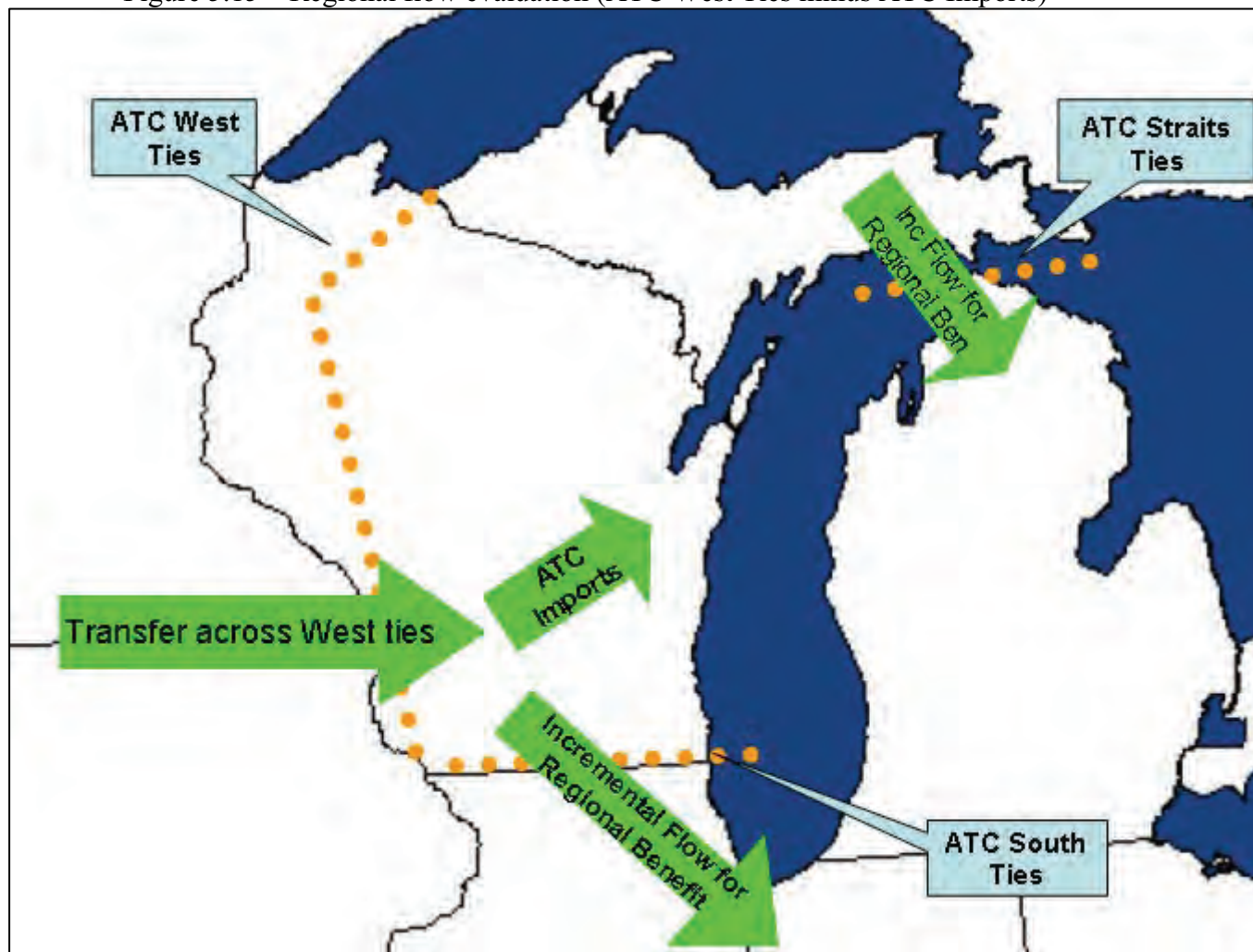
| Description                 |  |                       |                   |   | Score (0=Worse, 1=No Change, 5=Best) |       |        |        |       |        |        |        |               |               |              |               |               |
|-----------------------------|--|-----------------------|-------------------|---|--------------------------------------|-------|--------|--------|-------|--------|--------|--------|---------------|---------------|--------------|---------------|---------------|
|                             | Evaluated Characteristic Improvement     | Interface Or Location | Transfer Level    | Contains Critical Energy Infrastructure Information | Wt                                   |       |        |        |       |        |        |        |               |               |              |               |               |
|                             |  |                       |                   |   |                                      | Opt 1 | Opt 1a | Opt 1b | Opt 8 | Opt 7c | Opt HV | Opt LV | Base + c/caps | Opt 1b + caps | Opt 8 + caps | Opt HV + caps | Opt LV + caps |
| Transfer 3 -- SUPK to Gen   |  |                       |                   |   |                                      |       |        |        |       |        |        |        |               |               |              |               |               |
| TRANSFER                    | Incremental Transfer                     | Source Transfer       | at collapse level |   | 10                                   | 3.5   | 2.6    | 2.5    | 3.9   | 5.0    | 3.0    | 1.0    | 2.3           | 3.9           | 3.9          | 4.5           | 3.9           |
|                             | Transfer Limit                           | ATC West Ties         | at collapse level |   | 10                                   | 2.9   | 2.4    | 2.4    | 3.8   | 5.0    | 3.4    | 1.1    | 1.5           | 3.1           | 3.8          | 4.2           | 2.3           |
|                             | Transfer Limit                           | ATC Import            | at collapse level |   | 10                                   | 3.5   | 2.6    | 2.4    | 3.9   | 5.0    | 3.0    | 1.0    | 2.3           | 3.9           | 3.9          | 4.5           | 4.0           |
|                             | Differences in Regional Flow Through ATC |                       |                   |   |                                      |       |        |        |       |        |        |        |               |               |              |               |               |
|                             | Regional Flow                            | (W. Ties) - (Imports) | at Base collapse  |   | 3.333                                | 2.7   | 2.5    | 2.8    | 4.1   | 5.0    | 4.0    | 1.2    | 1.3           | 2.8           | 4.1          | 4.0           | 1.2           |
| 40%                         | Regional Flow                            | (W. Ties) - (Imports) | at Base collapse  |   | 3.333                                | 2.6   | 2.4    | 2.7    | 4.2   | 5.0    | 3.7    | 1.2    | 1.1           | 2.7           | 4.2          | 3.7           | 1.3           |
|                             | Regional Flow                            | (W. Ties) - (Imports) | at Base collapse  |   | 3.333                                | 2.5   | 2.4    | 2.6    | 4.2   | 5.0    | 3.4    | 1.1    | 1.3           | 2.6           | 4.2          | 3.4           | 1.2           |
|                             |  |                       |                   |   |                                      |       |        |        |       |        |        |        |               |               |              |               |               |
| VOLTA                       | p.u. Voltage                             | Spring Green 138kV    | at Base collapse  |   | 1                                    | 1.9   | 1.3    | 3.3    | 1.0   | 2.7    | 2.9    | 1.6    | 2.0           | 3.3           | 1.0          | 3.1           | 2.2           |
|                             | p.u. Voltage                             | Hilltop 69kV          | at Base collapse  |   | 1                                    | 3.3   | 2.5    | 2.7    | 2.4   | 3.2    | 2.6    | 1.4    | 1.3           | 2.7           | 2.4          | 2.7           | 1.6           |
|                             | p.u. Voltage                             | Boscobell 69kV        | at Base collapse  |   | 1                                    | 3.6   | 3.4    | 3.2    | 3.8   | 4.5    | 3.0    | 2.4    | 1.8           | 3.2           | 3.8          | 3.1           | 2.8           |
|                             | p.u. Voltage                             | Richland Ctr 69kV     | at Base collapse  |   | 1                                    | 4.3   | 3.7    | 4.0    | 4.0   | 4.5    | 3.8    | 3.2    | 3.1           | 4.0           | 4.0          | 4.0           | 3.5           |
|                             | p.u. Voltage                             | Verona 138kV          | at Base collapse  |   | 1                                    | 1.7   | 1.5    | 1.8    | 1.5   | 2.0    | 1.4    | 0.0    | 1.3           | 1.8           | 1.5          | 2.2           | 2.5           |
|                             |  |                       |                   |   |                                      |       |        |        |       |        |        |        |               |               |              |               |               |
|                             | p.u. Voltage                             | Spring Green 138kV    | at Base collapse  |   | 1.25                                 | 1.7   | 1.1    | 3.0    | 1.3   | 2.7    | 2.7    | 0.0    | 1.6           | 3.0           | 1.3          | 2.8           | 2.1           |
|                             | p.u. Voltage                             | Hilltop 69kV          | at Base collapse  |   | 1.25                                 | 3.0   | 2.5    | 2.6    | 2.4   | 3.1    | 2.6    | 1.3    | 1.4           | 2.6           | 2.4          | 2.6           | 1.7           |
|                             | p.u. Voltage                             | Hillsboro 161kV       | at Base collapse  |   | 1.25                                 | 4.0   | 2.8    | 2.9    | 3.0   | 3.6    | 2.9    | 1.6    | 1.7           | 2.9           | 3.0          | 2.9           | 2.0           |
|                             | p.u. Voltage                             | Boscobell 69kV        | at Base collapse  |   | 1.25                                 | 3.5   | 3.3    | 3.3    | 3.7   | 4.3    | 3.1    | 1.9    | 1.6           | 3.3           | 3.7          | 3.1           | 2.5           |
| PROFILE                     | p.u. Voltage                             | Richland Ctr 69kV     | at Base collapse  |   | 1.25                                 | 3.4   | 2.8    | 3.2    | 3.2   | 3.9    | 3.1    | 1.8    | 1.8           | 3.2           | 3.2          | 3.1           | 2.5           |
|                             |  |                       |                   |   |                                      |       |        |        |       |        |        |        |               |               |              |               |               |
|                             | p.u. Voltage                             | Spring Green 138kV    | at Base collapse  |   | 1.25                                 | 3.4   | 3.0    | 3.7    | 3.0   | 3.7    | 3.7    | 1.4    | 2.4           | 3.7           | 3.0          | 3.8           | 3.5           |
|                             | p.u. Voltage                             | Hilltop 69kV          | at Base collapse  |   | 1.25                                 | 3.7   | 3.3    | 3.3    | 3.4   | 3.8    | 3.4    | 1.5    | 2.0           | 3.3           | 3.4          | 3.5           | 2.8           |
|                             | p.u. Voltage                             | Hillsboro 161kV       | at Base collapse  |   | 1.25                                 | 4.4   | 3.4    | 3.5    | 3.8   | 4.2    | 3.5    | 1.7    | 2.0           | 3.5           | 3.8          | 3.6           | 2.8           |
|                             | p.u. Voltage                             | Boscobell 69kV        | at Base collapse  |   | 1.25                                 | 4.1   | 3.9    | 3.7    | 4.2   | 4.5    | 3.7    | 1.9    | 2.2           | 3.8           | 4.2          | 3.8           | 3.4           |
|                             | p.u. Voltage                             | Richland Ctr 69kV     | at Base collapse  |   | 1.25                                 | 4.1   | 3.7    | 3.8    | 4.0   | 4.3    | 3.8    | 2.0    | 2.4           | 3.9           | 4.0          | 3.9           | 3.5           |
|                             |  |                       |                   |   |                                      |       |        |        |       |        |        |        |               |               |              |               |               |
|                             | p.u. Voltage                             | Spring Green 138kV    | at Base collapse  |   | 1.25                                 | 1.6   | 0.0    | 2.9    | 0.0   | 2.3    | 2.5    | 0.0    | 1.7           | 2.9           | 0.0          | 2.7           | 1.8           |
|                             | p.u. Voltage                             | Hilltop 69kV          | at Base collapse  |   | 1.25                                 | 3.2   | 2.1    | 2.4    | 2.2   | 2.9    | 2.3    | 1.1    | 1.2           | 2.4           | 2.2          | 2.3           | 1.4           |
| 30.0%                       | p.u. Voltage                             | Council Cr 138kV      | at Base collapse  |   | 1.25                                 | 3.7   | 4.2    | 4.4    | 4.4   | 5.0    | 4.6    | 3.0    | 3.4           | 4.4           | 4.3          | 4.7           | 3.1           |
|                             | p.u. Voltage                             | Boscobell 69kV        | at Base collapse  |   | 1.25                                 | 3.4   | 3.1    | 2.9    | 3.6   | 4.2    | 2.7    | 1.7    | 1.5           | 2.9           | 3.6          | 2.7           | 2.3           |
|                             |  |                       |                   |   |                                      |       |        |        |       |        |        |        |               |               |              |               |               |
|                             | p.u. Voltage                             | Bell Center 161kV     | at Base collapse  |   | 1.25                                 | 3.8   | 2.9    | 3.0    | 3.5   | 3.7    | 3.0    | 1.5    | 2.1           | 3.0           | 3.5          | 3.0           | 1.8           |
|                             | p.u. Voltage                             | Boscobell 69kV        | at Base collapse  |   | 1.25                                 | 3.2   | 2.8    | 2.8    | 3.4   | 3.8    | 2.6    | 1.1    | 1.4           | 2.8           | 3.4          | 2.6           | 1.6           |
|                             | p.u. Voltage                             | Richland Ctr 69kV     | at Base collapse  |   | 1.25                                 | 3.8   | 3.1    | 3.4    | 3.7   | 4.1    | 3.3    | 1.6    | 2.5           | 3.5           | 3.7          | 3.4           | 2.1           |
|                             |  |                       |                   |   |                                      |       |        |        |       |        |        |        |               |               |              |               |               |
|                             | p.u. Voltage                             | Hilltop 69kV          | at Base collapse  |   | 1.25                                 | 3.5   | 2.2    | 2.3    | 2.1   | 2.5    | 2.4    | 0.0    | 1.1           | 2.4           | 2.2          | 2.4           | 1.1           |
|                             | p.u. Voltage                             | Hillsboro 161kV       | at Base collapse  |   | 1.25                                 | 4.1   | 2.2    | 2.4    | 2.4   | 2.8    | 2.4    | 1.2    | 1.0           | 2.4           | 2.4          | 2.4           | 1.3           |
|                             | p.u. Voltage                             | Spring Green 138kV    | at Base collapse  |   | 1.25                                 | 1.9   | 1.3    | 3.1    | 1.2   | 2.6    | 2.7    | 1.2    | 1.6           | 3.1           | 1.2          | 2.9           | 1.8           |
| MW & MVARS                  | MW loss                                  | ATC                   | w/o transfer      |   | 2.5                                  | 3.8   | 3.5    | 1.7    | 4.7   | 5.0    | 1.6    | 1.7    | 0.0           | 1.8           | 4.7          | 1.8           | 1.5           |
|                             | MW loss                                  | ATC                   | at Base collapse  |   | 2.5                                  | 5.0   | 3.9    | 3.3    | 3.8   | 4.9    | 1.7    | 0.0    | 1.2           | 3.4           | 3.8          | 1.8           | 1.4           |
|                             | MW loss                                  | External_WWI          | w/o transfer      |   | 2.5                                  | 1.3   | 0.0    | 0.0    | 1.7   | 2.0    | 5.0    | 0.0    | 0.0           | 0.0           | 1.7          | 5.0           | 1.0           |
|                             | MW loss                                  | External_WWI          | at Base collapse  |   | 2.5                                  | 1.6   | 1.7    | 1.7    | 2.1   | 2.8    | 5.0    | 1.4    | 1.0           | 1.8           | 2.1          | 5.0           | 1.4           |
|                             |  |                       |                   |   |                                      |       |        |        |       |        |        |        |               |               |              |               |               |
| LOSSES                      | MVAR line loss                           | ATC                   | w/o transfer      |   | 2                                    | 4.4   | 3.7    | 2.0    | 4.8   | 5.0    | 1.2    | 1.4    | 0.0           | 2.0           | 4.7          | 1.5           | 0.0           |
|                             | MVAR line loss                           | ATC                   | at Base collapse  |   | 2                                    | 5.0   | 3.0    | 2.4    | 2.6   | 3.4    | 0.0    | 0.0    | 1.1           | 2.4           | 2.6          | 0.0           | 1.5           |
|                             | MVAR line loss                           | ATC                   | at Base collapse  |   | 2                                    | 5.0   | 3.0    | 2.7    | 3.3   | 3.7    | 0.0    | 1.1    | 1.9           | 2.7           | 3.3          | 0.0           | 1.8           |
|                             | MVAR line loss                           | ATC                   | at Base collapse  |   | 2                                    | 5.0   | 3.9    | 3.6    | 4.1   | 4.6    | 2.5    | 1.5    | 2.4           | 3.7           | 4.1          | 2.6           | 3.1           |
|                             | MVAR line loss                           | ATC                   | at Base collapse  |   | 2                                    | 5.0   | 3.0    | 2.5    | 3.1   | 3.6    | 0.0    | 1.0    | 1.7           | 2.5           | 3.1          | 0.0           | 1.7           |
|                             | MVAR line loss                           | External_WWI          | w/o transfer      |   | 2                                    | 1.2   | 0.0    | 0.0    | 1.2   | 1.6    | 5.0    | 1.2    | 0.0           | 0.0           | 1.3          | 5.0           | 1.2           |
|                             | MVAR line loss                           | External_WWI          | at Base collapse  |   | 2                                    | 0.0   | 1.4    | 1.4    | 2.0   | 2.5    | 5.0    | 1.3    | 0.0           | 1.4           | 2.0          | 5.0           | 1.3           |
|                             | MVAR line loss                           | External_WWI          | at Base collapse  |   | 2                                    | 0.0   | 0.0    | 0.0    | 2.4   | 1.5    | 5.0    | 1.5    | 2.0           | 0.0           | 2.4          | 4.8           | 1.5           |
|                             | MVAR line loss                           | External_WWI          | at Base collapse  |   | 2                                    | 0.0   | 1.9    | 1.8    | 3.1   | 3.0    | 5.0    | 1.4    | 1.4           | 1.9           | 3.1          | 5.0           | 1.9           |
|                             | MVAR line loss                           | External_WWI          | at Base collapse  |   | 2                                    | 0.0   | 1.4    | 1.4    | 2.9   | 2.8    | 5.0    | 1.3    | 1.9           | 1.4           | 2.9          | 5.0           | 1.4           |
| Transfer 3 - Transfer Score |  |                       |                   |   | 40                                   | 3.1   | 2.5    | 2.5    | 4.0   | 5.0    | 3.3    | 1.1    | 1.8           | 3.4           | 4.0          | 4.2           | 2.9           |
| Transfer 3 - Voltage Score  |  |                       |                   |   | 30                                   | 3.3   | 2.7    | 3.1    | 2.9   | 3.6    | 3.0    | 1.4    | 1.9           | 3.1           | 2.9          | 3.1           | 2.3           |
| Transfer 3 - Losses Score   |  |                       |                   |   | 30                                   | 2.7   | 2.2    | 1.8    | 3.0   | 3.3    | 3.0    | 1.0    | 1.0           | 1.8           | 3.0          | 3.1           | 1.5           |
| Transfer 3 TOTAL            |  |                       |                   |   | 100                                  | 3.0   | 2.5    | 2.5    | 3.3   | 4.1    | 3.1    | 1.2    | 1.6           | 2.8           | 3.3          | 3.5           | 2.3           |
|                             |  |                       |                   |   |                                      | 1     | 1a     | 1b     | 8     | 7c     | HV     | LV     | B             | 1b            | 8            | HV            | LV            |

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To be comparable, some characteristics are measured at a common transfer level. The base case collapse transfer amount is considered the highest comparable point. At comparable transfer levels, the ATC import measure will be equivalent for each project, but the ATC West Ties interface flow will differ for each project.

The Transfer category examines the limits before collapse for the ATC West Ties interface, the ATC Import interface and the Source Transfer. The Source Transfer measures the amount of power transferred from source generation to sink location. As described above, the Source Transfer sinks mostly to ATC and partly to systems in the eastern part of the MISO region. A final measure of “ATC West Ties minus the ATC Imports” was included in the Transfer category to give a measure of regional value. This measure was evaluated at the base collapse point to give an indication of the amount of incremental power that can flow through the ATC system and out the ATC southern ties and Upper Peninsula Straits ties. It can also be described as a reduced dependency on the ATC southern (+Straits) ties for serving ATC imports. An ATC southern interface was not directly monitored, but rather it is calculated from the ATC West Ties and ATC Imports interfaces.

Figure 5.15 – Regional flow evaluation (ATC West Ties minus ATC Imports)



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Table 5.11 shows the scoring category breakdown and the overall scoring of each project. Each transfer is weighted equally to determine the overall score.

Table 5.11 - Overall Summary of Voltage Performance

| Description   |                             |                   |        | Score (0=Worse, 1=No Change, 5=Best) |        |        |       |        |        |        |              |               |              |               |               |
|---|-----------------------------|-------------------|--------|--------------------------------------|--------|--------|-------|--------|--------|--------|--------------|---------------|--------------|---------------|---------------|
| Evaluated<br>Characteristic<br>Improvement          | Interface<br>Or<br>Location | Transfer<br>Level | Outage |                                      |        |        |       |        |        |        | Base + claps | Opt 1b + caps | Opt 8 + caps | Opt HV + caps | Opt LV + caps |
|   |                             |                   |        | Opt 1                                | Opt 1a | Opt 1b | Opt 8 | Opt 7c | Opt HV | Opt LV |              |               |              |               |               |
| Transfer 1 - Transfer Score                         |                             | Weighted Average  |        | 2.5                                  | 2.5    | 2.5    | 3.0   | 3.9    | 4.6    | 0.5    | 2.0          | 2.6           | 3.0          | 4.8           | 2.8           |
| Transfer 1 - Voltage Score                          |                             | Weighted Average  |        | 2.9                                  | 2.9    | 3.8    | 3.0   | 3.3    | 3.4    | 1.8    | 2.8          | 3.8           | 3.1          | 3.4           | 2.9           |
| Transfer 1 - Losses Score                           |                             | Weighted Average  |        | 2.6                                  | 2.3    | 2.2    | 2.1   | 2.7    | 3.8    | 1.0    | 1.4          | 2.3           | 2.2          | 3.8           | 1.5           |
| Transfer 1 TOTAL                                    |                             | Weighted Average  |        | 2.7                                  | 2.6    | 2.8    | 2.8   | 3.4    | 4.0    | 1.1    | 2.1          | 2.9           | 2.8          | 4.1           | 2.4           |
| Transfer 2 - Transfer Score                         |                             | Weighted Average  |        | 3.2                                  | 2.9    | 2.7    | 3.4   | 5.0    | 4.5    | 1.2    | 1.3          | 3.3           | 3.4          | 4.6           | 1.7           |
| Transfer 2 - Voltage Score                          |                             | Weighted Average  |        | 2.7                                  | 2.5    | 3.5    | 2.7   | 3.4    | 3.1    | 0.7    | 1.5          | 3.5           | 2.7          | 3.1           | 2.2           |
| Transfer 2 - Losses Score                           |                             | Weighted Average  |        | 2.7                                  | 2.4    | 2.3    | 2.0   | 2.7    | 3.2    | 1.1    | 1.3          | 2.3           | 2.0          | 3.3           | 1.4           |
| Transfer 2 TOTAL                                    |                             | Weighted Average  |        | 2.9                                  | 2.6    | 2.8    | 2.8   | 3.8    | 3.7    | 1.0    | 1.3          | 3.1           | 2.8          | 3.8           | 1.8           |
| Transfer 3 - Transfer Score                         |                             | Weighted Average  |        | 3.1                                  | 2.5    | 2.5    | 4.0   | 5.0    | 3.3    | 1.1    | 1.8          | 3.4           | 4.0          | 4.2           | 2.9           |
| Transfer 3 - Voltage Score                          |                             | Weighted Average  |        | 3.3                                  | 2.7    | 3.1    | 2.9   | 3.6    | 3.0    | 1.4    | 1.9          | 3.1           | 2.9          | 3.1           | 2.3           |
| Transfer 3 - Losses Score                           |                             | Weighted Average  |        | 2.7                                  | 2.2    | 1.8    | 3.0   | 3.3    | 3.0    | 1.0    | 1.0          | 1.8           | 3.0          | 3.1           | 1.5           |
| Transfer 3 TOTAL                                    |                             | Weighted Average  |        | 3.0                                  | 2.5    | 2.5    | 3.3   | 4.1    | 3.1    | 1.2    | 1.6          | 2.8           | 3.3          | 3.5           | 2.3           |
|   |                             |                   |        | 1                                    | 1a     | 1b     | 8     | 7c     | HV     | LV     | B            | 1b            | 8            | HV            | LV            |
| Overall Weighted Average ( of Transfer 1, 2, 3)     |                             |                   |        | 2.9                                  | 2.6    | 2.7    | 3.0   | 3.8    | 3.6    | 1.1    | 1.7          | 2.9           | 3.0          | 3.8           | 2.2           |
| Overall Weighted Average ( of Transfer 2, 3) to Gen |                             |                   |        | 3.0                                  | 2.5    | 2.6    | 3.1   | 4.0    | 3.4    | 1.1    | 1.5          | 2.9           | 3.1          | 3.6           | 2.0           |

For overall evaluation, the scoring is shown with and without the impact of Transfer 1 included.

### PV Analysis - Additional Observations

Option 1 (NLAX-HLT-SPG-CDL) performed well with regard to voltage performance at common transfer levels and losses in the Hilltop area. This can be attributed in part to the Hilltop transformer and Hilltop low voltage outlet facilities. While Option 1 reduces MW and MVAR losses within the ATC portion of the study region, it increases MW and MVAR losses in the study region external to ATC. The external loss differences can be attributed in part to the impact of the additional power that is channeled through the ATC West Ties interface.

For the 765 kV Option, voltage performed well in Transfer 1.

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includes a 765 kV line to North Monroe and double circuit 345 kV from North Monroe to Paddock. Contains Critical Energy Infrastructure Information

The non-ATC MW and MVAR losses for the 765 kV Option performed well, while the ATC MVAR losses in the ATC region performed poorly. Examining the detail of the ATC MVAR losses shows that loss efficiencies at higher voltage levels are partially offset by higher losses on facilities below 100 kV. The higher ATC losses can be attributed in part to some of the losses associated with the 765 kV and 345 kV facilities placed in the ATC region for the analysis and the additional flow pressure that is placed on the 138 kV in the vicinity of North Monroe. The external loss differences can be attributed in part to the additional 345 kV facilities in eastern Iowa that are included as part of the complimentary facilities that channel power into the 765 kV line. In doing so, they likely relieve losses on non-ATC lower voltage facilities.

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The Low Voltage Option mainly consists of rating increases of existing facilities that do not aid in increasing the voltage stability characteristics of the region. Although they may help prevent line overloads, as expected the Low Voltage Option did not perform much better than the base case option. When the Low Voltage Option was tested with additional reactive resources, it performed better, but still not as well as the other options.

Figure 5.8 – 5.11 indicate that the dual 345kV line Option 7C and the 765kV option were among the projects showing the best combined MW and Mvar loss performance. The Hilltop connection to the 69kV and 138 kV in Option 1a was largely responsible for the good MW and Mvar loss performance for that option. The 765kV option performed particularly well under the Mvar loss conditions under pre and post-contingency. The 765kV option performed well for MW losses external to ATC, in part because the option includes additional 345kV connections in Iowa that are not in the other tested options. As anticipated, the Low Voltage option did not reflect good MW performance. The Mvar performance for the Low Voltage option was poor, but improved with ATC with reactive resource additions. Loss evaluation contributes to the ranking reflected in Table 5.12.

### ***PV Analysis - Conclusion***

Based on the overall scoring shown in Table 5.11, option rankings were created for comparison purposes. The scores for the average of three transfers were used for ranking purposes to take into account all three transfer scenarios. The scores for the EHV options without added reactive supports were used. The score for the Low Voltage Option with the reactive support was considered. Even with the reactive support, the Low Voltage Option still performs much worse than the EHV options. The option rankings for supporting voltage stability and robustness are shown in Table 5.12 below. A ranking of “1” represents the worst performance and “5” represents the best performance.

Table 5.12 – Option rankings for voltage stability and robustness performance

| <b>Options</b>                  | <b>Option rankings</b> |
|---------------------------------|------------------------|
| Low Voltage                     | 1                      |
| NLAX-HLT-SPG-CDL (1)            | 3                      |
| NLAX-SPG-CDL (1a)               | 2                      |
| NLAX-NMA-CDL (1b)               | 2                      |
| DBQ-SPG-CDL (8)                 | 3                      |
| NLAX-NMA-CDL + DBQ-SPG-CDL (7c) | 5                      |
| Genoa-NOM 765 kV                | 4                      |

## 5.9 Transient Stability Analysis

The transient stability analysis was performed using the Dynamics Simulation and Power Flow modules of the Power System Simulation/Engineering-30 (PSS/E, Version 30.5.1) program from Power Technologies, Inc (PTI). This program is accepted industry-wide for dynamic stability analysis. The study model is a 2014 light load model. See *Section 2.1.1* for discussions of the study model.

### ***Stability Analysis - Studied generating stations***

Six generating stations in the western Wisconsin study area were selected for transient stability analysis: Columbia, Nelson Dewey, Prairie Island, Alma, JPM and Arnold.

These are some of the largest non-wind generating stations in the study area. The objective is to investigate the transient stability of these representative units in the study area under the conditions of light load and relatively high wind penetration. These conditions represent the worst system conditions with respect to generator transient stability.

### ***Stability Analysis - Simulated Contingencies***

Category B, C and D contingencies were chosen at the six generating stations for transient stability simulations. Detailed descriptions of these contingencies can be found in Tables G.1, G.2 and G.3 in Appendix G. An outline of the contingencies is provided below.

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Note: Faults are on from end of the listed facilities.

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**Category C contingencies**

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### **Stability Analysis - Simulation Results**

The Critical Clearing Times (CCT's) for the studied Category B, C and D faults and the seven transmission options were obtained through transient stability simulations. The results are listed in Tables G.4 through G.6 in Appendix G.

For the Category B contingencies the system was stable under all simulated faults for all cases with at least a 1.0 cycle stability margin. The results show that for faults near Contains Critical Energy Infrastructure Information Option 7c (NLAX-NMA-CDL + DBQ-SPG-CDL) provided the most stability margins, followed by Option 1b (NLAX-NMA-CDL). The other options seemed to have comparable performance. For some faults near Contains Critical Energy Infrastructure Information, the Low Voltage Option provided better stability margins than the other options, largely due to the added facilities of Contains Critical Energy Infrastructure Information. Option 1b was shown to provide slightly less stability margins than the other 345 kV options for some faults near Contains Critical Energy Infrastructure Information. Since all cases are stable with at least a 1.0 cycle stability margin, no supporting facilities are recommended based on the Category B results.

For the Category C contingencies the system was stable under all simulated faults for all cases with at least a 1.0 cycle stability margin, except for one fault associated with the base case. The same trends identified from the Category B results continued with the Category C results. The results show that for faults near Contains Critical Energy Infrastructure Information, Option 7c provided the most stability margins, followed by Option 1b. The other options seemed to have comparable performance. For some faults near Contains Critical Energy Infrastructure Information, the Low Voltage Option performed better, largely due to the added facilities of Contains Critical Energy Infrastructure Information.

Contains Critical Energy Infrastructure Information. Option 8 (DBQ-SPG-CDL) did show slightly larger stability margins than the other 345 kV options for some faults near Contains Critical Energy Infrastructure Information. Option 1b was shown to provide

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slightly less stability margins than the other options for some faults near . Since all studied transmission options provided stability for all simulated faults with at least a 1.0 cycle margin, no supporting facilities are recommended based on Category C results.

For the Category D contingencies, the system is unstable for . ATC has observed the stability issues in the and is currently performing a separate study for this area, which may lead to recommendations of system reinforcements, such as relay upgrades and/or breakers replacement, that will improve equipment clearing time. It is anticipated that with these potential improvements,

. This is considered an existing system issue. Therefore no supporting facilities will be recommended in this study for the . As a sensitivity test,

. The simulation results are shown in Table G.7 in Appendix G. The results show improvement to CCTs for a number of tested Category B, C and D contingencies. This sensitivity test is for informational purposes only.

Instability issues were also identified for Category D faults in . For the non-transformer fault (D2-01), relay adjustments were identified that will improve the equipment clearing time and will mitigate the instability with at least a 1.0 cycle stability margin for Options 1, 1b and 7c. For the other options (1a, 8, 765 kV and Low Voltage) additional reinforcements are needed to meet the stability criteria. One set of facilities were tested as an example, which includes a

. The simulation results are included in Table G.8 in Appendix G. The results show that with these additions, Options 1a, 8, the 765 kV Option and the Low Voltage Option will meet the stability criteria with at least a 1.0 cycle margin. These fixes are not likely the least expensive fixes solely for the instability issue. This study does not present conclusions on the preferred fixes. Rather, the focus of the stability analysis is comparing between the studied options and is more for informational purposes. For the Category D , 2-cycle breaker replacements would reduce the equipment clearing time and provide at least a 1.0 cycle stability margin for all studied options.

### Stability Analysis - Summary

Based on the study results, the studied transmission options are ranked for their ability to support system transient stability, e.g., improving stability margins. More importance is given to stability at , since unacceptable Critical Clearing Times were identified under two Category D contingencies and small (still acceptable) stability margins were identified for one prior outage Category C contingency in the area. Improvement in stability margins for is shown to be important. The rankings are shown in Table 5.16 below. A ranking of “1” represents the worst performance and “5” represents the best performance.

Table 5.16 – Option rankings for supporting system transient stability

| Options                         | Rankings |
|---------------------------------|----------|
| Low Voltage                     | 1        |
| NLAX-HLT-SPG-CDL (1)            | 3        |
| NLAX-SPG-CDL (1a)               | 1        |
| NLAX-NMA-CDL (1b)               | 4        |
| DBQ-SPG-CDL (8)                 | 1        |
| NLAX-NMA-CDL + DBQ-SPG-CDL (7c) | 5        |
| Genoa-NOM 765 kV                | 1        |

## 6. Conclusions

The Western Wisconsin Transmission Reliability Study identified thermal and voltage limitations (including potential voltage collapse) in the base case without any studied transmission options. Out of the initial 15 transmission options, seven were chosen for detailed analysis. Monetized (costs) and non-monetized measures were used for evaluating different aspects of the reliability performance and for comparing between the seven options. Table 6.1 provides a summary of the comparisons of all aspects discussed in the previous sections, including costs and performance rankings.

The results as summarized in Table 6.1 show that the Low Voltage Option has the lowest rankings for all aspects of the reliability performance evaluated using non-monetized measures. These aspects include system voltage performance under Category B and C contingencies, severe local low voltages under a Category C2 contingency, voltage stability and robustness and system transient stability. For these aspects, the Low Voltage Option consistently performs at inferior levels compared to the EHV options. For the reliability aspects evaluated using the monetized measure, the Low Voltage Option is less costly than the EHV options. However, because of its inability to support system voltages, voltage stability and transient stability, the 345 kV options are preferred over the Low Voltage Option.

The 765 kV Option would represent the first 765 kV element in the western Wisconsin area. The results show that the overall rankings are lower for the 765 kV Option than the 345 kV options for those aspects evaluated using non-monetized measures. For the reliability aspects evaluated using the monetized measure, the 765 kV Option is shown to have the highest cost.

A 345 kV reinforcement in the western Wisconsin area from La Crosse to Madison would strengthen the transmission networks in the area and would be expected to enhance the performance of any potential future 765 kV and/or HVDC facilities through the area should the need drivers for such projects be established.

Three of the seven options were in the corridor between North LaCrosse to Madison. These options (Options 1, 1a, and 1b) are comparable from an overall reliability performance

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perspective and Option 1b (NLAX\_NMA-CDL) option has the lowest overall cost of the three options. A 345kV line in this corridor provides the voltage stability and interconnection to Minnesota which is one of the desired benefits of this study.

Option 8 (DBQ-SPG-CDL) also performs well from a reliability perspective. It has a slightly lower cost than Option 1b (NLAX-NMA-CDL) but does not provide the transient stability that is desired. Option 7c (NLAX-NMA-CDL & DBQ-SPG-CDL) performed the best across all aspects of the reliability analyses, and is expected to provide additional benefits over and above any of the singular 345 kV options including a higher increase in transfer capability for additional wind generation in MN and IA.

The conclusion of this study is that Option 7c provides the most reliability benefit to the western Wisconsin area and that Option 1b provides a portion of the benefit realized in Option 7c and includes the additional interconnection to Minnesota. Option 8 provides significant reliability benefits to western Wisconsin as well but not the needed reinforcements for Minnesota ATC believes that the total combination of benefits versus costs, as well as information from the Midwest ISO's Regional Generator Outlet Study, should be taken into account in making a choice to pursue any of the options listed above. ATC has been analyzing the combined reliability, economic, and policy benefits of these options for approximately two years and has determined that a 345 kV project from the La Crosse area to the greater Madison area (the Badger Coulee Project) would provide multiple benefits. ATC has recently announced its intention to finalize its evaluation of these combined benefits and to begin public outreach on the Badger Coulee Project.<sup>16</sup>

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<sup>16</sup> Further information about this announcement is located at: <http://www.atc-projects.com/BadgerCoulee.shtml>

Table 6.1 – Summary of the comparisons of the reliability performance using monetized and non-monetized measures

|  |         |                    | Low Voltage   | NLAX-HLT-SPG-CDL (1) | NLAX-SPG-CDL (1a) | NLAX-NMA-CDL (1b) | DBQ-SPG-CDL (8) | NLAX-NMA-CDL + DBQ-SPG-CDL (7c) | Genoa-NOM 765 kV |
|--|---------|--------------------|---------------|----------------------|-------------------|-------------------|-----------------|---------------------------------|------------------|
| Summary of project costs in 2010 dollars                   |         |                    |               |                      |                   |                   |                 |                                 |                  |
| EHV projects   |         |                    | Opt LV        | Opt1                 | Opt1a             | Opt1b             | Opt8            | Opt7c                           | Opt 765          |
|  |         |                    | \$0           | \$454,492,920        | \$377,454,200     | \$357,590,989     | \$304,187,200   | \$672,785,400                   | \$880,598,000    |
|  |         |                    |               |                      |                   |                   |                 |                                 |                  |
| Category B Supporting Facilities                           | Loading | ATC Facilities     | \$173,768,164 | \$118,661,663        | \$131,603,921     | \$119,001,306     | \$101,420,588   | \$86,326,549                    | \$136,878,643    |
|  | Loading | Non-ATC Facilities | \$95,397,350  | \$38,281,800         | \$52,036,800      | \$69,696,850      | \$103,972,600   | \$57,625,100                    | \$43,168,200     |
|  |         | Total              | \$269,165,514 | \$156,943,463        | \$183,640,721     | \$188,698,156     | \$205,393,188   | \$143,951,649                   | \$180,046,843    |
|  |         |                    |               |                      |                   |                   |                 |                                 |                  |
| Category C Supporting Facilities                           | Loading | ATC Facilities     | \$0           | \$0                  | \$0               | \$0               | \$0             | \$0                             | \$0              |
|  | Voltage | ATC Facilities     | \$82,758,813  | \$0                  | \$0               | \$0               | \$0             | \$0                             | \$0              |
|  | Loading | Non-ATC Facilities | \$0           | \$0                  | \$0               | \$0               | \$0             | \$0                             | \$0              |
|  | Voltage | Non-ATC Facilities | \$0           | \$0                  | \$0               | \$0               | \$0             | \$0                             | \$0              |
|  |         | Total              | \$82,758,813  | \$0                  | \$0               | \$0               | \$0             | \$0                             | \$0              |
|  |         |                    |               |                      |                   |                   |                 |                                 |                  |
| Category B & C Supporting Facilities                       |         | ATC Facilities     | \$256,526,977 | \$118,661,663        | \$131,603,921     | \$119,001,306     | \$101,420,588   | \$86,326,549                    | \$136,878,643    |
|  |         | Non-ATC Facilities | \$95,397,350  | \$38,281,800         | \$52,036,800      | \$69,696,850      | \$103,972,600   | \$57,625,100                    | \$43,168,200     |
|  |         | Total              | \$351,924,327 | \$156,943,463        | \$183,640,721     | \$188,698,156     | \$205,393,188   | \$143,951,649                   | \$180,046,843    |
|  |         |                    |               |                      |                   |                   |                 |                                 |                  |
| Total cost estimates for project packages (main + support) |         |                    | \$351,924,327 | \$611,436,383        | \$561,094,921     | \$546,289,145     | \$509,580,388   | \$816,737,049                   | \$1,060,644,843  |
|  |         |                    |               |                      |                   |                   |                 |                                 |                  |
| Rankings - benefits not captured by cost analysis          |         |                    |               |                      |                   |                   |                 |                                 |                  |
| Voltage performance under Cat-B contingencies              |         |                    | 1             | 4                    | 4                 | 4                 | 4               | 5                               | 3                |
| Voltage performance under converged Cat-C contingencies    |         |                    | 1             | 5                    | 4                 | 3                 | 4               | 5                               | 2                |
| Alleviate Cat-C2 severe local low voltages                 |         |                    | 1             | 5                    | 5                 | 1                 | 5               | 5                               | 1                |
| Support voltage stability and robustness                   |         |                    | 1             | 3                    | 2                 | 2                 | 3               | 5                               | 4                |
| Support system transient stability                         |         |                    | 1             | 3                    | 1                 | 4                 | 1               | 5                               | 1                |

## **Appendices**

***Appendix A. Details of the Studied Transmission Options***

***Appendix B. Maps of the Studied Transmission Options***

***Appendix C. ATC Severity Index Tool Write-Up***

***Appendix D. Supporting Facilities for the EHV (345 kV and 765 kV) Options- Category B Loading Limitations***

***Appendix E. List of Non-Converged N-2 Contingencies***

***Appendix F. Voltage Stability Tables***

***Appendix G. Transient Stability Analysis Contingencies and Results***

## **Appendix A**

### **Details of the Studied Transmission Options**

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## Appendix A: Transmission option details for Western Wisconsin Transmission Reliability Study

## Notes –

1. Total 15 transmission options.
2. Some of the options did not show to have notable impact to the western Wisconsin study area and were excluded from the detailed analysis. Those transmission options that were evaluated in details are highlighted in Yellow. Cost estimates were obtained for these options.
3. In the Low Voltage Option, facilities highlighted in Green are outside ATC footprint.

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## Appendix A: Transmission option details for Western Wisconsin Transmission Reliability Study

| Num | Option # | Option full names  | Detailed Description   | Mileage | Preliminary Cost Estimates |
|-----|----------|--|--|---------|----------------------------|
| 1   | Opt 1    | North La Crosse–Hilltop–Spring Green–Cardinal 345 kV project |  |         | \$454,492,920              |
|     |          |  | Construct a North La Crosse –Hilltop – Spring Green – Cardinal 345 kV line         | 158     |                            |
|     |          |  | String a Council Creek – Hilltop – Birchwood 138 kV line on the 345kV poles        | 50      |                            |
|     |          |  | Reconductor Kirkwood - Spring Green 138 kV line and string on the 345kV poles      | 26.4    |                            |
|     |          |  | Convert Spring Green – Cardinal 69 kV line to 138 kV and string on the 345kV poles | 30      |                            |
|     |          |  | Install a Spring Green 345-138 transformer   | 500 MVA |                            |
|     |          |  | Install a Hilltop 345-138 transformer  | 500 MVA |                            |
|     |          |  | Install a Hilltop 138-69 transformer   | 187 MVA |                            |
|     |          |  | New 345/138/69 kV sub at Hilltop   |         |                            |
|     |          |  | Modify Spring Green sub to be 345 KV   |         |                            |
|     |          |  | Modify Cardinal sub  |         |                            |
|     |          |  | Modify La Crosse sub   |         |                            |
|     |          |  | Other - balance compared to the PCO final total estimate                           |         |                            |
| 2   | Opt 1a   | North La Crosse–Spring Green–Cardinal 345 kV project         |  |         | \$377,454,200              |
|     |          |  | Construct a North La Crosse – Spring Green – Cardinal 345 kV line                  | 158     |                            |
|     |          |  | Reconductor Kirkwood - Spring Green 138 kV line and string on the 345kV poles      | 26.4    |                            |
|     |          |  | Convert Spring Green – Cardinal 69 kV line to 138 kV and string on the 345kV poles | 30      |                            |
|     |          |  | Install a Spring Green 345-138 transformer   | 500 MVA |                            |
|     |          |  | Modify Spring Green sub to be 345 kV   |         |                            |
|     |          |  | Modify Cardinal sub  |         |                            |
|     |          |  | Modify La Crosse sub   |         |                            |
|     |          |  | Other - balance compared to the PCO final total estimate                           |         |                            |

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## Appendix A: Transmission option details for Western Wisconsin Transmission Reliability Study

|          |               |   |  |         |                      |
|----------|---------------|---|--|---------|----------------------|
| <b>3</b> | <b>Opt 1b</b> | <b>North La Crosse–North Madison–Cardinal 345 kV project</b>  |  |         | <b>\$357,590,989</b> |
|          |               |   | Construct a North La Crosse – North Madison – Cardinal 345 kV line                   | 157     |                      |
|          |               |   | Reconductor North Madison – West Middleton 138 kV line and string on the 345kV poles | 20      |                      |
|          |               |   | Modify North Madison sub   |         |                      |
|          |               |   | Modify Cardinal sub  |         |                      |
|          |               |   | Modify La Crosse sub   |         |                      |
|          |               |   | Other - balance compared to the PCO final total estimate                             |         |                      |
|          |               |   |  |         |                      |
| <b>4</b> | <b>Opt 8</b>  | <b>Dubuque–Spring Green–Cardinal 345 kV project</b>   |  |         | <b>\$304,187,200</b> |
|          |               |   | Construct a Dubuque – Spring Green – Cardinal 345 kV line                            | 103     |                      |
|          |               |   | Reconductor Turkey River - Cassville - Nelson Dewey 161 kV line                      | 5       |                      |
|          |               |   | Convert Spring Green – Cardinal 69 kV line to 138 kV and string on the 345kV poles   | 30      |                      |
|          |               |   | Install a Spring Green 345-138 transformer   | 500 MVA |                      |
|          |               |   | New 345 kV switching station at Dubuque  |         |                      |
|          |               |   | Modify Spring Green sub to be 345 kV   |         |                      |
|          |               |   | Modify Cardinal sub  |         |                      |
|          |               |   | river crossing adder   |         |                      |
|          |               |   | Reconductor Spring Green to 1.1 miles northeast of Nelson Dewey 138-kV line          | 75      |                      |
|          |               |   | Other - balance compared to the PCO final total estimate                             |         |                      |
|          |               |   |  |         |                      |
| <b>5</b> | <b>Opt 7c</b> | <b>North La Crosse-North Madison-Cardinal 345 kV and Dubuque-Spring Green-Cardinal 345 kV project</b> |  |         | <b>\$672,785,400</b> |
|          |               | Note: This Option is Option 1b + Option 8 with minor variations                                       | Construct a North La Crosse – North Madison – Cardinal 345 kV line                   | 156     |                      |
|          |               |   | Construct a Dubuque – Spring Green - Cardinal 345 kV line                            | 103.13  |                      |
|          |               |   | Reconductor North Madison – West Middleton 138 kV line and string on the 345kV poles | 20      |                      |

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|          |                 |  |   |          |                      |
|----------|-----------------|--|---|----------|----------------------|
|          |                 |  | Reconductor Turkey River - Cassville - Nelson Dewey 161 kV line and string on the 345kV poles (does not include Q-2D/E Tap to Nelson Dewey) | 5.23     |                      |
|          |                 |  | Convert Spring Green – Cardinal 69 kV line to 138 kV and string on the 345kV poles  | 30       |                      |
|          |                 |  | Install a Spring Green 345-138 transformer  | 500 MVA  |                      |
|          |                 |  |   |          |                      |
| <b>6</b> | <b>765 Opt</b>  | <b>Genoa–North Monroe 765 kV project</b> |   |          | <b>\$880,598,000</b> |
|          |                 |  | Construct a Genoa – North Monroe 765 kV line  | 136      |                      |
|          |                 |  | 200 Mvar at line end of Genoa 765 kV bus  | reactor  |                      |
|          |                 |  | 200 Mvar at line end of North Monroe 765 kV bus   | reactor  |                      |
|          |                 |  | Genoa 765 kV substation   | new sub  |                      |
|          |                 |  | North Monroe 765 kV substation  | new sub  |                      |
|          |                 |  | Construct a North La Crosse – Genoa 345 kV line   | 18       |                      |
|          |                 |  | Construct North Monroe – Paddock 345 kV Double Circuits   | 32       |                      |
|          |                 |  | Construct an Adams – Genoa 345 kV line  | 73       |                      |
|          |                 |  | Install a Genoa 765-345kV transformer   | 2767 MVA |                      |
|          |                 |  | Install a Genoa 345-161kV transformer   | 336 MVA  |                      |
|          |                 |  | Install a North Monroe 765-345kV transformer  | 2767 MVA |                      |
|          |                 |  | Install a North Monroe 345-138 transformer  | 500 MVA  |                      |
|          |                 |  | Other – pre-cert @ 7%   |          |                      |
|          |                 |  |   |          |                      |
| <b>7</b> | <b>LowV Opt</b> | <b>Low Voltage option</b>                |   |          | <b>\$269,165,514</b> |
|          |                 |  | Construct a Nelson Dewey - Liberty 161 kV tie line  |          | \$28,388,123         |
|          |                 |  | Rebuild following lower voltage facilities  |          |                      |
|          |                 |  | 348915 4E GALESBG N 138 636672 GALESBR5 161 2 <sup>1</sup>  |          | \$0                  |
|          |                 |  | 601043 NLAX 5 161 602026 MAYFAIR5 161 1   |          | \$4,095,000          |
|          |                 |  | 605296 WSTSALE8 69.0 605316 LAX 8 69.0 1  |          | \$3,850,000          |

<sup>1</sup> Far from the center of the study footprint (from, to - MEC, AMIL). Assumed this constraint will be fixed by entities outside study participants.

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## Appendix A: Transmission option details for Western Wisconsin Transmission Reliability Study

|  |  |  |                 |      |                 |                 |                |                |              |
|--|--|--|-----------------|------|-----------------|-----------------|----------------|----------------|--------------|
|  |  |  | 630297 SANDRDG8 | 69.0 | 680066 MENOMINE | 69.0            | 1              |                | \$280,000    |
|  |  |  | 631047 LIME CK5 | 161  | 631048 EMERY    | 5               | 161            | 1              | \$8,868,600  |
|  |  |  | 631056 LORE     | 5    | 161             | 631060 TRK RIV5 | 161            | 1 <sup>2</sup> | \$0          |
|  |  |  | 631057 SALEM N5 | 161  | 631120 JULIAN   | 5               | 161            | 1              | \$5,937,750  |
|  |  |  | 631058 SO.GVW.5 | 161  | 631059 8TH ST.5 | 161             | 1              |                | \$1,246,050  |
|  |  |  | 631058 SO.GVW.5 | 161  | 631061 SALEM S5 | 161             | 1              |                | \$3,082,950  |
|  |  |  | 631059 8TH ST.5 | 161  | 631125 KERPER   | 5               | 161            | 1              | \$1,521,000  |
|  |  |  | 631060 TRK RIV5 | 161  | 681519 CASVILL5 | 161             | 1 <sup>3</sup> |                | \$0          |
|  |  |  | 631095 E CALMS5 | 161  | 631096 GR MND   | 5               | 161            | 1              | \$1,404,000  |
|  |  |  | 631123 ADAMS_S5 | 161  | 681527 BVR CRK5 | 161             | 1              |                | \$8,833,500  |
|  |  |  | 636636 OAKGROV5 | 161  | 636672 GALESBR5 | 161             | 1 <sup>4</sup> |                | \$0          |
|  |  |  | 637191 HAMPTON5 | 161  | 637193 HAMPTON8 | 69.0            | 1              |                | \$3,380,000  |
|  |  |  | 637201 SHEFFLD5 | 161  | 637205 WSHEFFLD | 69.0            | 1              |                | \$3,380,000  |
|  |  |  | 680061 HARRISON | 69.0 | 680067 KAISER   | 69.0            | 1              |                | \$2,485,000  |
|  |  |  | 680061 HARRISON | 69.0 | 680070 LANCASTE | 69.0            | 1              |                | \$2,415,000  |
|  |  |  | 680066 MENOMINE | 69.0 | 680068 T KIELER | 69.0            | 1              |                | \$280,000    |
|  |  |  | 680067 KAISER   | 69.0 | 680068 T KIELER | 69.0            | 1              |                | \$490,000    |
|  |  |  | 680070 LANCASTE | 69.0 | 680079 HURICAN  | 69.0            | 1              |                | \$2,345,000  |
|  |  |  | 680075 BELLCNTR | 69.0 | 680084 T SG     | 69.0            | 1              |                | \$1,785,000  |
|  |  |  | 680079 HURICAN  | 69.0 | 680455 MTHOP TP | 69.0            | 1              |                | \$3,815,000  |
|  |  |  | 680084 T SG     | 69.0 | 680086 BOAZ     | 69.0            | 1              |                | \$3,920,000  |
|  |  |  | 680086 BOAZ     | 69.0 | 680087 DAYTON   | 69.0            | 1              |                | \$420,000    |
|  |  |  | 680242 LUBLIN   | 69.0 | 680505 LAKEHEAD | 69.0            | 1              |                | \$420,000    |
|  |  |  | 680481 LUBLINTP | 69.0 | 680505 LAKEHEAD | 69.0            | 1              |                | \$4,760,000  |
|  |  |  | 681519 CASVILL5 | 161  | 699010 NED      | 161             | 1 <sup>5</sup> |                | \$0          |
|  |  |  | 681523 GENOA    | 5    | 161             | 681531 LAC TAP5 | 161            | 1 <sup>6</sup> | \$0          |
|  |  |  | 681539 ELK MND5 | 161  | 681543 ALMA     | 5               | 161            | 1              | \$26,383,500 |

<sup>2</sup> Use a new NED-LIB 161 kV line<sup>3</sup> Use a new NED-LIB 161 kV line<sup>4</sup> Far from the center of the study footprint (from, to - MEC, MEC). Assumed this constraint will be fixed by entities outside study participants.<sup>5</sup> Use a new NED-LIB 161 kV line<sup>6</sup> DPC comment: this is a DPC planned project

## Public Version

## Appendix A: Transmission option details for Western Wisconsin Transmission Reliability Study

|   |        |  |  |     |              |
|---|--------|--|--|-----|--------------|
|   |        |  | 698003 HLM 69 69.0 699031 HLM 138 138 1  |     | \$2,531,712  |
|   |        |  | 698016 EEN 69 69.0 698017 MIP 69 69.0 1  |     | \$5,575,491  |
|   |        |  | 698032 SME 69 69.0 698033 BRN 69 69.0 1  |     | \$7,307,102  |
|   |        |  | 698033 BRN 69 69.0 699902 JEN 69 69.0 1  |     | \$7,737,848  |
|   |        |  | 698034 WIO 69 69.0 698035 GTT 69 69.0 1  |     | \$3,900,659  |
|   |        |  | 698034 WIO 69 69.0 699902 JEN 69 69.0 1  |     | \$1,912,515  |
|   |        |  | 698114 WKA 69 69.0 698115 BOS 69 69.0 1  |     | \$12,719,751 |
|   |        |  | 698114 WKA 69 69.0 699959 GRANGRAE 69.0 1  |     | \$7,737,848  |
|   |        |  | 698122 PIR 69 69.0 698300 BREWER 69.0 1  |     | \$1,059,979  |
|   |        |  | 698187 RKT 138 138 698941 ART#1 13 138 1   |     | \$6,395,745  |
|   |        |  | 698187 RKT 138 138 699144 KIR 138 138 1  |     | \$9,530,914  |
|   |        |  | 698313 SALT 69 69.0 699940 SAL 69 69.0 1   |     | \$105,998    |
|   |        |  | 698318 LPS 69 69.0 698321 A07 69 69.0 1  |     | \$1,377,973  |
|   |        |  | 698321 A07 69 69.0 698322 MCK 69 69.0 1  |     | \$5,617,890  |
|   |        |  | 698333 HLT 69 69.0 698337 WMT 69 69.0 1  |     | \$879,783    |
|   |        |  | 698351 PET 69 69.0 699808 PETENWEL 138 1   |     | \$3,825,075  |
|   |        |  | 698375 WHB 69 69.0 699699 WHITCOMB 115 1   |     | \$3,825,075  |
|   |        |  | 698660 HARRISON 69.0 699792 HARRISON 138 1   |     | \$3,825,075  |
|   |        |  | 698668 WMD 69 69.0 698674 WTNM 69 69.0 1   |     | \$12,263,239 |
|   |        |  | 698668 WMD 69 69.0 698684 BLKM69 69.0 1  |     | \$3,703,806  |
|   |        |  | 699010 NED 161 161 699021 NLD 2 138 1  |     | \$4,180,636  |
|   |        |  | 699033 DAR 138 138 699036 NOM 138 138 1  |     | \$30,574,914 |
|   |        |  | 699059 PAD 138 138 699141 TOWNLINE 138 1   |     | \$8,791,014  |
| 8 | Opt 2  | North La Crosse-Dubuque 345 kV project       |  |     |              |
|   |        |  | Construct a North La Crosse - Dubuque 345 kV line                                    | 103 |              |
|   |        |  | Reconductor North La Crosse – Turkey River 161 kV line                               | 85  |              |
| 9 | Opt 2a | North La Crosse-Genoa-Dubuque 345 kV project |  |     |              |
|   |        |  | Construct a North La Crosse - Genoa - Dubuque 345 kV line                            | 103 |              |
|   |        |  | Reconductor North La Crosse - Turkey River 161 kV line and string on the 345kV poles | 85  |              |

## Public Version

## Appendix A: Transmission option details for Western Wisconsin Transmission Reliability Study

|    |       |   |  |         |  |
|----|-------|---|--|---------|--|
|    |       |   | Install a Genoa 345-161 kV transformer   | 448 MVA |  |
| 10 | Opt 3 | <b>Eau Claire-North La Crosse 345 kV project</b>  |  |         |  |
|    |       |   | Construct an Eau Claire - North La Crosse 345 kV line                              | 73.2    |  |
|    |       |   | Reconductor Eau Claire - North La Crosse 161 kV line and string on the 345kV poles | 73.2    |  |
| 11 | Opt 4 | <b>North La Crosse-Hilltop-Spring Green-Cardinal 345 kV and Eau Claire-North La Crosse 345 kV project</b> |  |         |  |
|    |       | Note: This Option is Option1 + Option 3   | Construct a North La Crosse –Hilltop – Spring Green – Cardinal 345 kV line         | 158     |  |
|    |       |   | String a Council Creek – Hilltop – Birchwood 138 kV line on the 345kV poles        | 50      |  |
|    |       |   | Reconductor Kirkwood - Spring Green 138 kV line and string on the 345kV poles      | 26.4    |  |
|    |       |   | Convert Spring Green – Cardinal 69 kV line to 138 kV and string on the 345kV poles | 30      |  |
|    |       |   | Install a Spring Green 345-138 transformer   | 500 MVA |  |
|    |       |   | Install a Hilltop 345-138 transformer  | 500 MVA |  |
|    |       |   | Install a Hilltop 138-69 transformer   | 187 MVA |  |
|    |       |   | Construct an Eau Claire - North La Crosse 345 kV line                              | 73.2    |  |
|    |       |   | Reconductor Eau Claire - North La Crosse 161 kV line and string on the 345kV poles | 73.2    |  |
| 12 | Opt 5 | <b>North La Crosse-Hilltop-Spring Green-Cardinal 345 kV and North La Crosse-Dubuque 345 kV project</b>    |  |         |  |
|    |       | Note: This Option is Option1 + Option 2   | Construct a North La Crosse –Hilltop – Spring Green – Cardinal 345 kV line         | 158     |  |
|    |       |   | String a Council Creek – Hilltop – Birchwood 138 kV line on the 345kV poles        | 50      |  |
|    |       |   | Reconductor Kirkwood - Spring Green 138 kV line and string on the 345kV poles      | 26.4    |  |
|    |       |   | Convert Spring Green – Cardinal 69 kV line to 138 kV and string on the 345kV poles | 30      |  |
|    |       |   | Install a Spring Green 345-138 transformer   | 500 MVA |  |

## Public Version

## Appendix A: Transmission option details for Western Wisconsin Transmission Reliability Study

|    |       |   |   |         |  |
|----|-------|---|---|---------|--|
|    |       |   | Install a Hilltop 345-138 transformer   | 500 MVA |  |
|    |       |   | Install a Hilltop 138-69 transformer  | 187 MVA |  |
|    |       |   | Construct a North La Crosse - Dubuque 345 kV line   | 103     |  |
|    |       |   | Reconductor North La Crosse - Turkey River 161 kV line and string on the 345kV poles  | 85      |  |
|    |       |   |   |         |  |
| 13 | Opt 6 | <b>North La Crosse-North Cassville-Dubuque 345 kV and North Casville-Spring Green-Cardinal 345 kV project</b> |   |         |  |
|    |       | Note: This Option is Option 2 + Option 8 with minor variations  | Construct a North La Crosse - Cassville - Dubuque 345 kV line   | 103     |  |
|    |       |   | Construct a North Cassville - Spring Green - Cardinal 345 kV line   | 86.5    |  |
|    |       |   | Reconductor Nelson Dewey - Spring Green 138 kV line and string on the 345kV poles   | 59      |  |
|    |       |   | Reconductor North La Crosse - Turkey River 161 kV line and string on the 345kV poles  | 90.1    |  |
|    |       |   | Convert Spring Green – Cardinal 69 kV line to 138 kV and string on the 345kV poles  | 30      |  |
|    |       |   | Install a Spring Green 345-138 transformer  |         |  |
|    |       |   |   |         |  |
| 14 | Opt 7 | <b>North La Crosse-Hilltop-Spring Green-Cardinal 345 kV and Dubuque-Spring Green 345 kV project</b>           |   |         |  |
|    |       | Note: This Option is Option 1 + Option 8 with minor variations  | Construct a North La Crosse –Hilltop – Spring Green – Cardinal 345 kV line  | 158     |  |
|    |       |   | Construct a Dubuque – Spring Green 345 kV line  | 75.13   |  |
|    |       |   | String a Council Creek – Hilltop – Birchwood 138 kV line on the 345kV poles   | 50      |  |
|    |       |   | Reconductor Kirkwood - Spring Green 138 kV line and string on the 345kV poles   | 26.4    |  |
|    |       |   | Reconductor Turkey River - Cassville - Nelson Dewey 161 kV line and string on the 345kV poles (does not include Q-2D/E Tap to Nelson Dewey) | 5.23    |  |
|    |       |   | Reconductor Nelson Dewey - Spring Green 138 kV line and string on the 345kV poles   | 59      |  |
|    |       |   | Convert Spring Green – Cardinal 69 kV line to 138 kV and string on the 345kV poles  | 30      |  |

## Public Version

## Appendix A: Transmission option details for Western Wisconsin Transmission Reliability Study

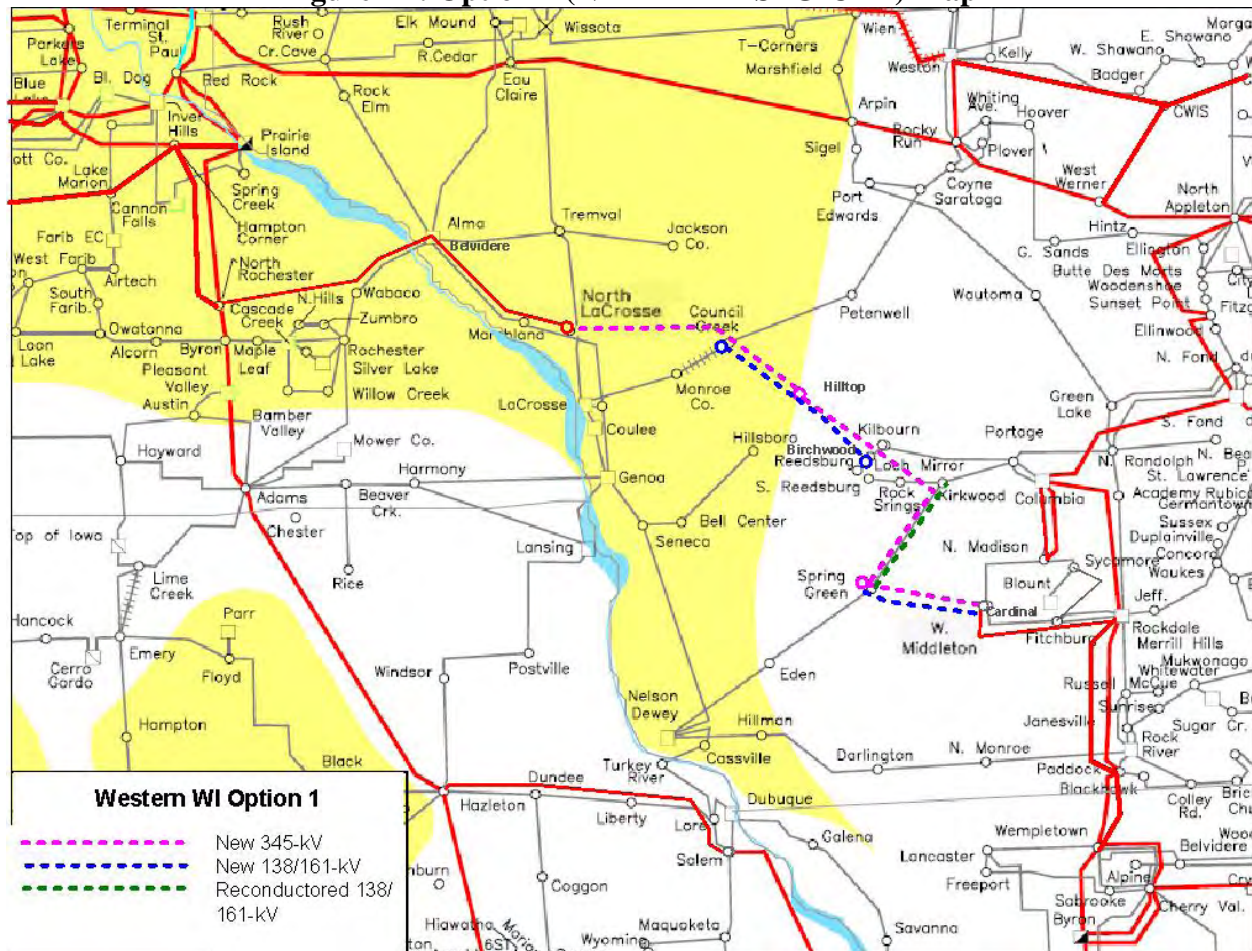
|    |        |  |   |         |  |
|----|--------|--|---|---------|--|
|    |        |  | Install a Spring Green 345-138 transformer  | 500 MVA |  |
|    |        |  | Install a Hilltop 345-138 transformer   | 500 MVA |  |
|    |        |  | Install a Hilltop 138-69 transformer  | 187 MVA |  |
|    |        |  |   |         |  |
| 15 | Opt 7a | <b>North La Crosse-Spring Green-Cardinal 345 kV and Dubuque-Spring Green 345 kV project</b>          |   |         |  |
|    |        | Note: This Option is Option 1a + Option 8 with minor variations                                      | Construct a North La Crosse – Spring Green – Cardinal 345 kV line   | 158     |  |
|    |        | Note: Single 345 kV between Spring Green and Cardinal  | Construct a Dubuque – Spring Green 345 kV line  | 75.13   |  |
|    |        |  | Reconductor Kirkwood - Spring Green 138 kV line and string on the 345kV poles   | 26.4    |  |
|    |        |  | Reconductor Turkey River - Cassville - Nelson Dewey 161 kV line and string on the 345kV poles (does not include Q-2D/E Tap to Nelson Dewey) | 5.23    |  |
|    |        |  | Convert Spring Green – Cardinal 69 kV line to 138 kV and string on the 345kV poles  | 30      |  |
|    |        |  | Install a Spring Green 345-138 transformer  | 500 MVA |  |
|    |        |  |   |         |  |
| 16 | Opt 7b | <b>North La Crosse-Spring Green-Cardinal 345 kV and Dubuque-Spring Green-Cardinal 345 kV project</b> |   |         |  |
|    |        | Note: This Option is Option 1a + Option 8 with minor variations                                      | Construct a North La Crosse – Spring Green – Cardinal 345 kV line   | 158     |  |
|    |        | Note: Double circuit 345 kV between Spring Green and Cardinal  | Construct a Dubuque – Spring Green - Cardinal 345 kV line   | 103.13  |  |
|    |        |  | Reconductor Kirkwood - Spring Green 138 kV line and string on the 345kV poles   | 26.4    |  |
|    |        |  | Reconductor Turkey River - Cassville - Nelson Dewey 161 kV line and string on the 345kV poles (does not include Q-2D/E Tap to Nelson Dewey) | 5.23    |  |
|    |        |  | Convert Spring Green – Cardinal 69 kV line to 138 kV and string on separate 138kV poles   | 30      |  |
|    |        |  | Install a Spring Green 345-138 transformer  | 500 MVA |  |

## **Appendix B**

### **Maps of the Studied Transmission Options**

Public Version

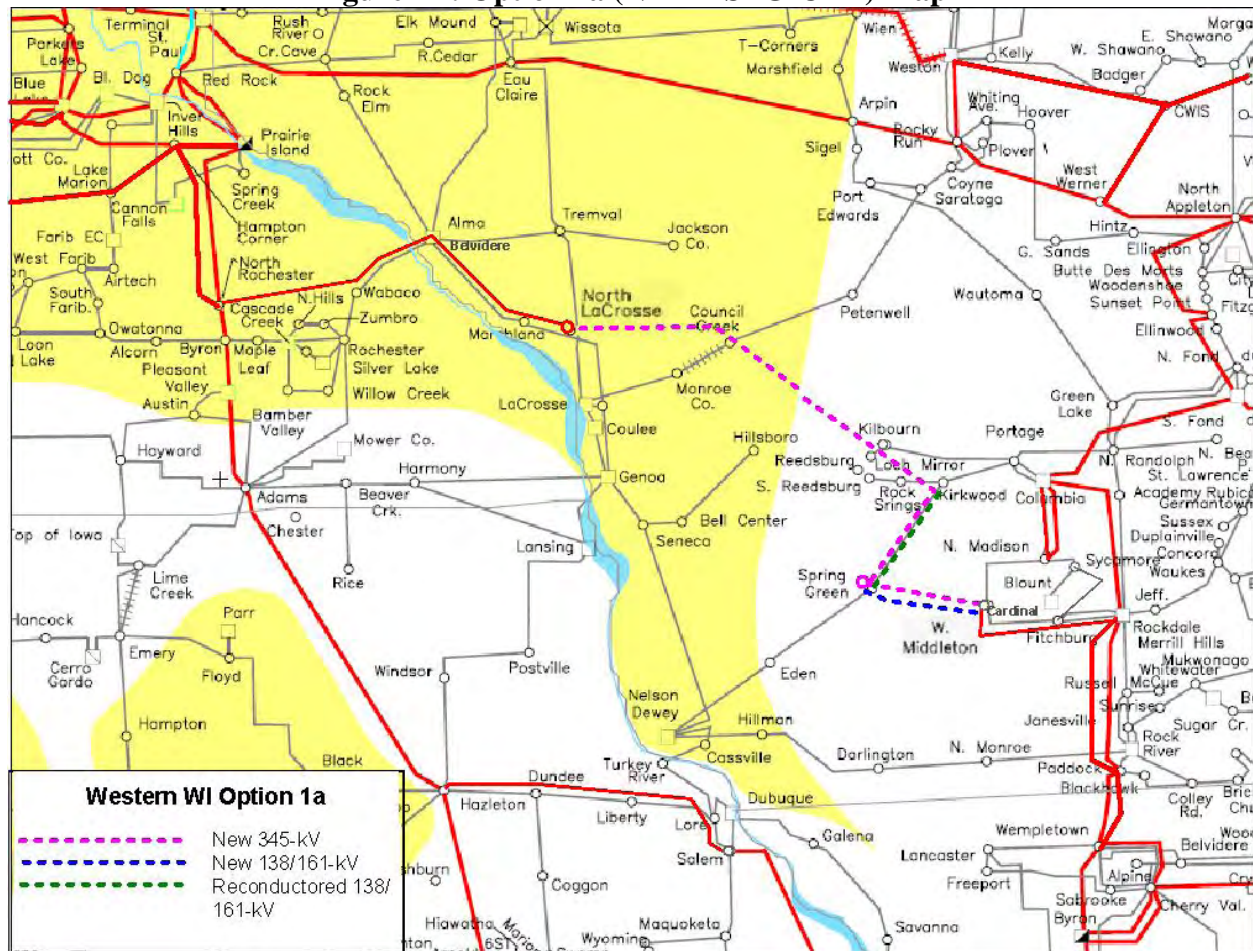
## Appendix B: Maps for the Western Wisconsin Transmission Reliability Study

**Figure B1: Option 1 (NLAX-HLT-SPG-CDL) Map**

Yellow shaded area on maps represents the mid-continent area power pool (mapp) footprint

Public Version

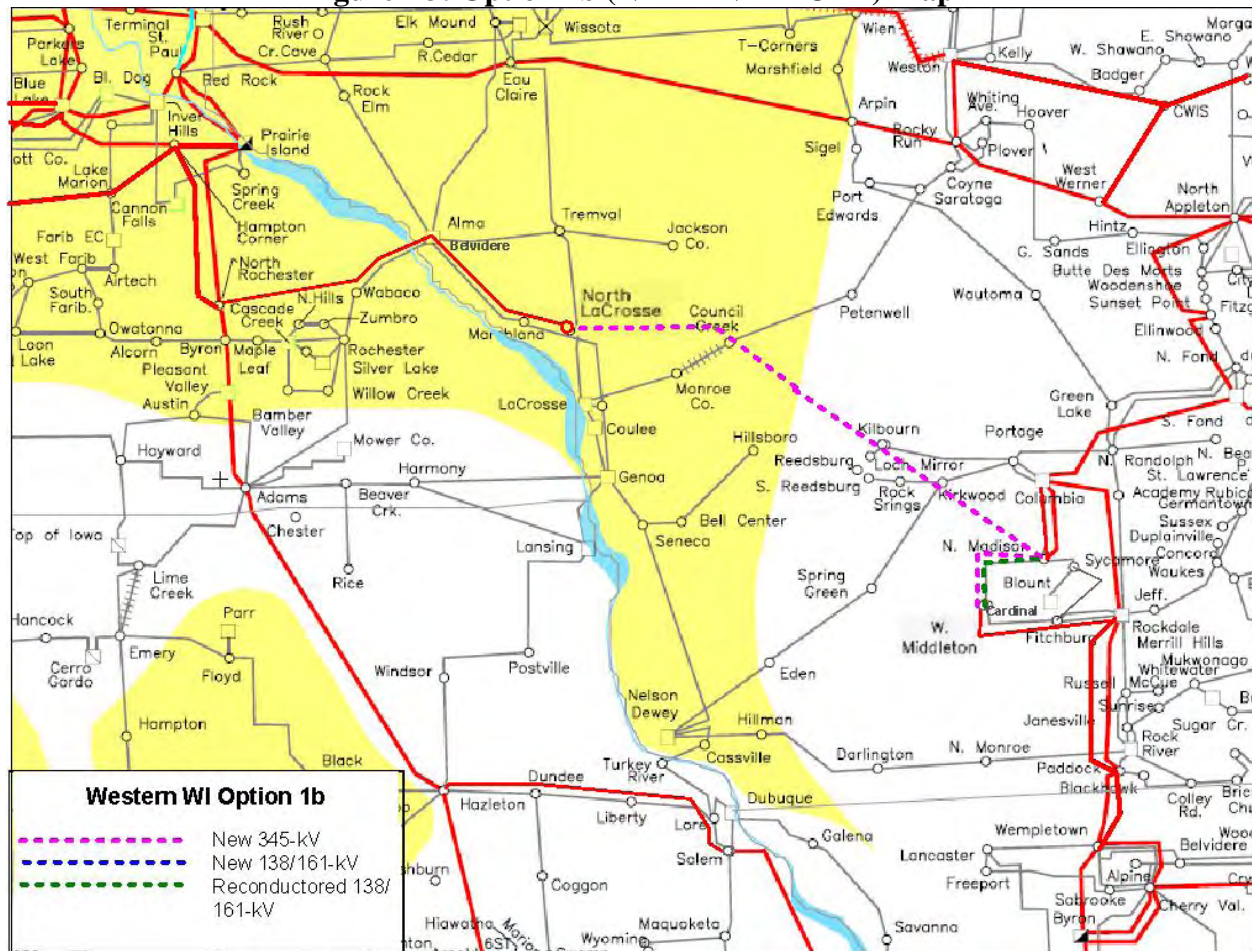
## Appendix B: Maps for the Western Wisconsin Transmission Reliability Study

**Figure B2: Option 1a (NLAX-SPG-CDL) Map**

Yellow shaded area on maps represents the mid-continent area power pool (mapp) footprint

Public Version

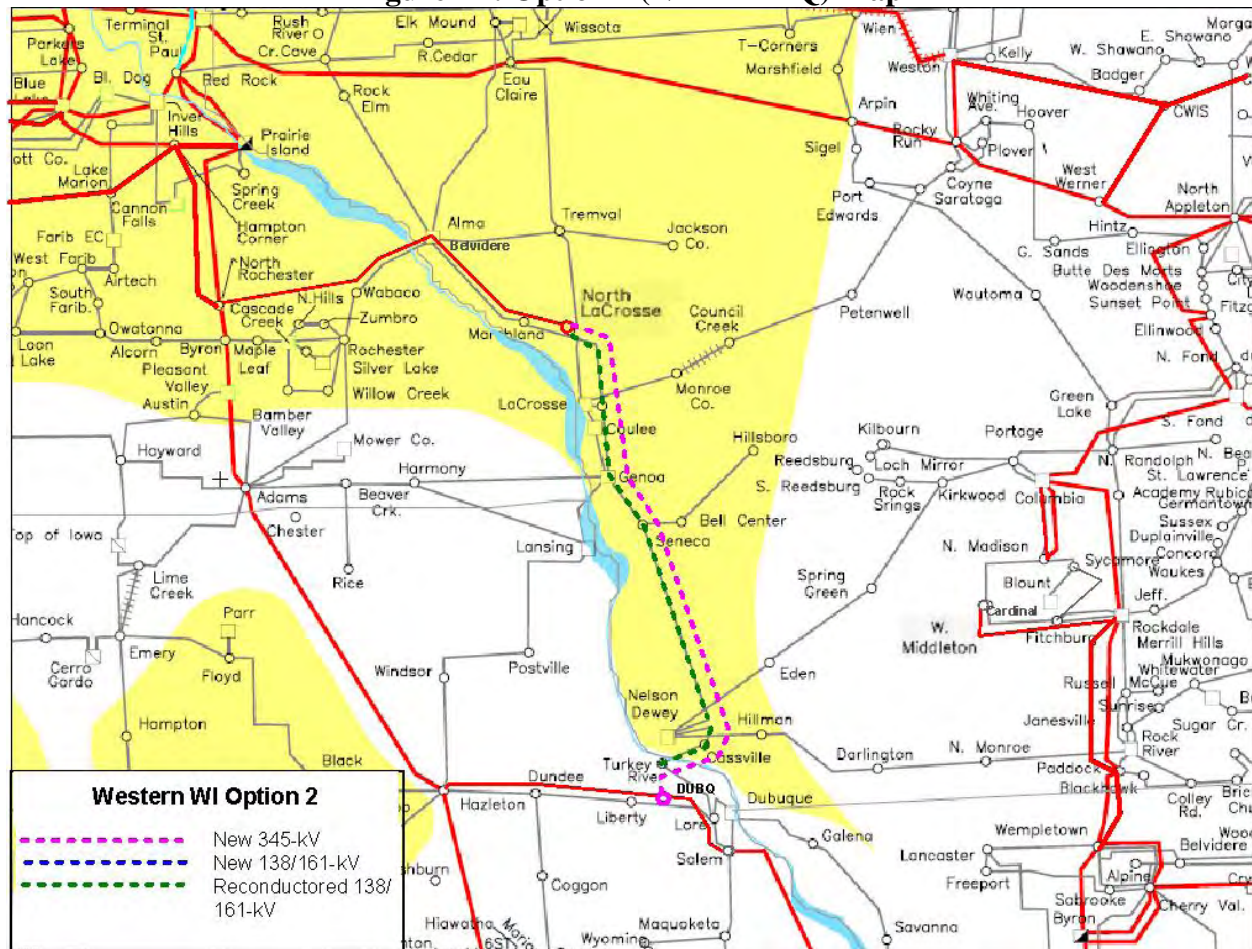
## Appendix B: Maps for the Western Wisconsin Transmission Reliability Study

**Figure B3: Option 1b (NLAX-NMA-CDL) Map**

Yellow shaded area on maps represents the mid-continent area power pool (mapp) footprint

Public Version

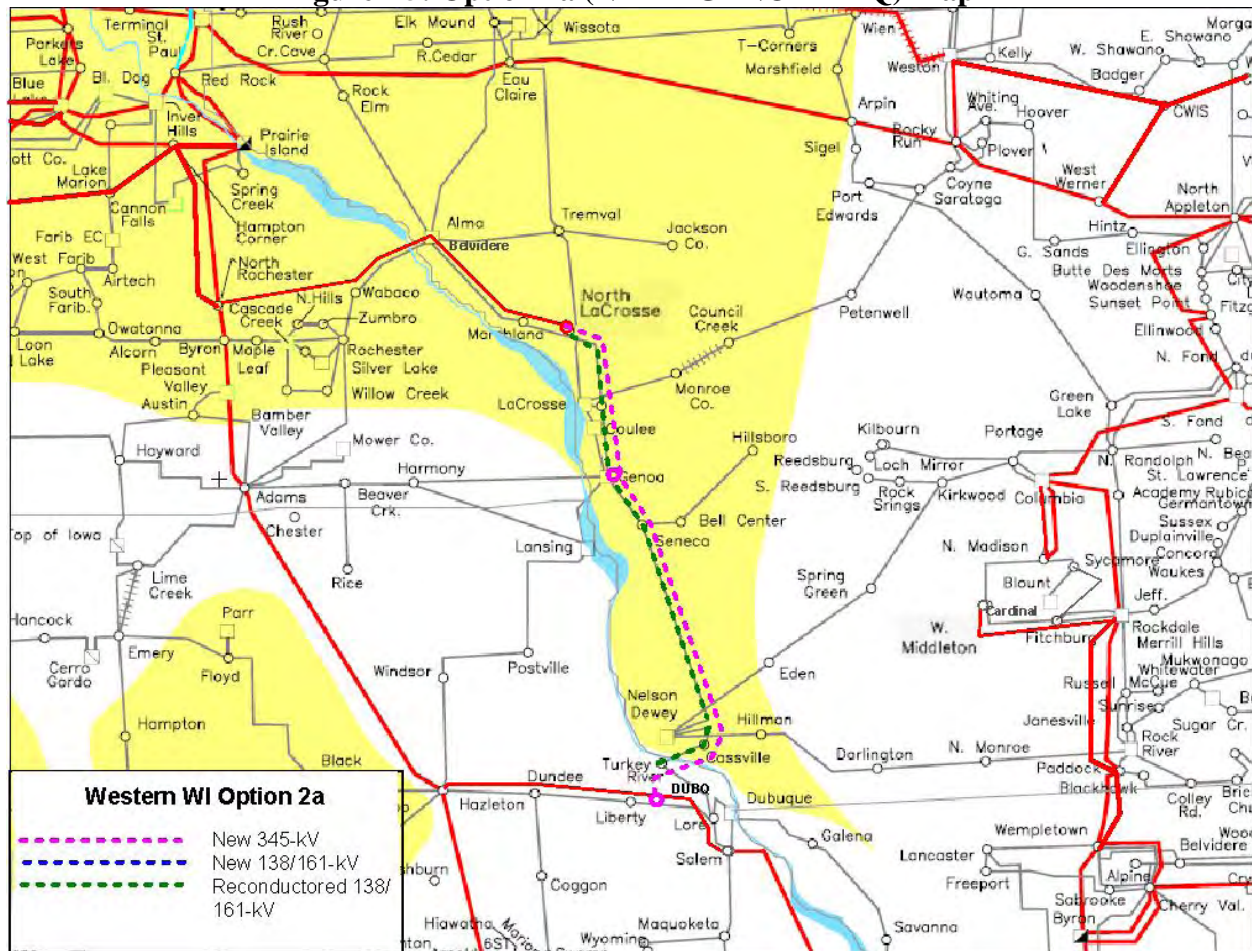
## Appendix B: Maps for the Western Wisconsin Transmission Reliability Study

**Figure B4: Option 2 (NLAX-DBQ) Map**

Yellow shaded area on maps represents the mid-continent area power pool (mapp) footprint

Public Version

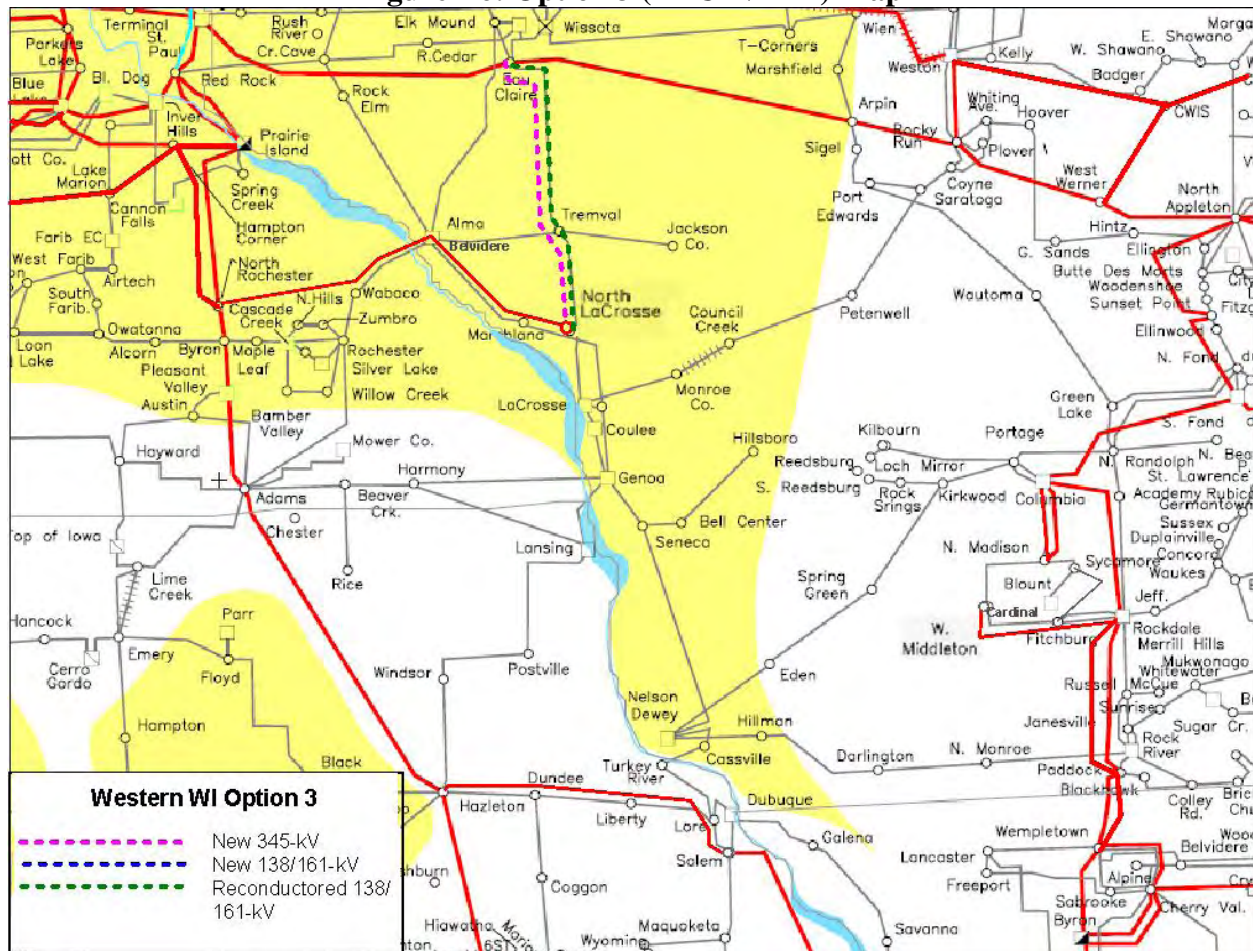
## Appendix B: Maps for the Western Wisconsin Transmission Reliability Study

**Figure B5: Option 2a (NLAX-GENOA-DBQ) Map**

Yellow shaded area on maps represents the mid-continent area power pool (mapp) footprint

Public Version

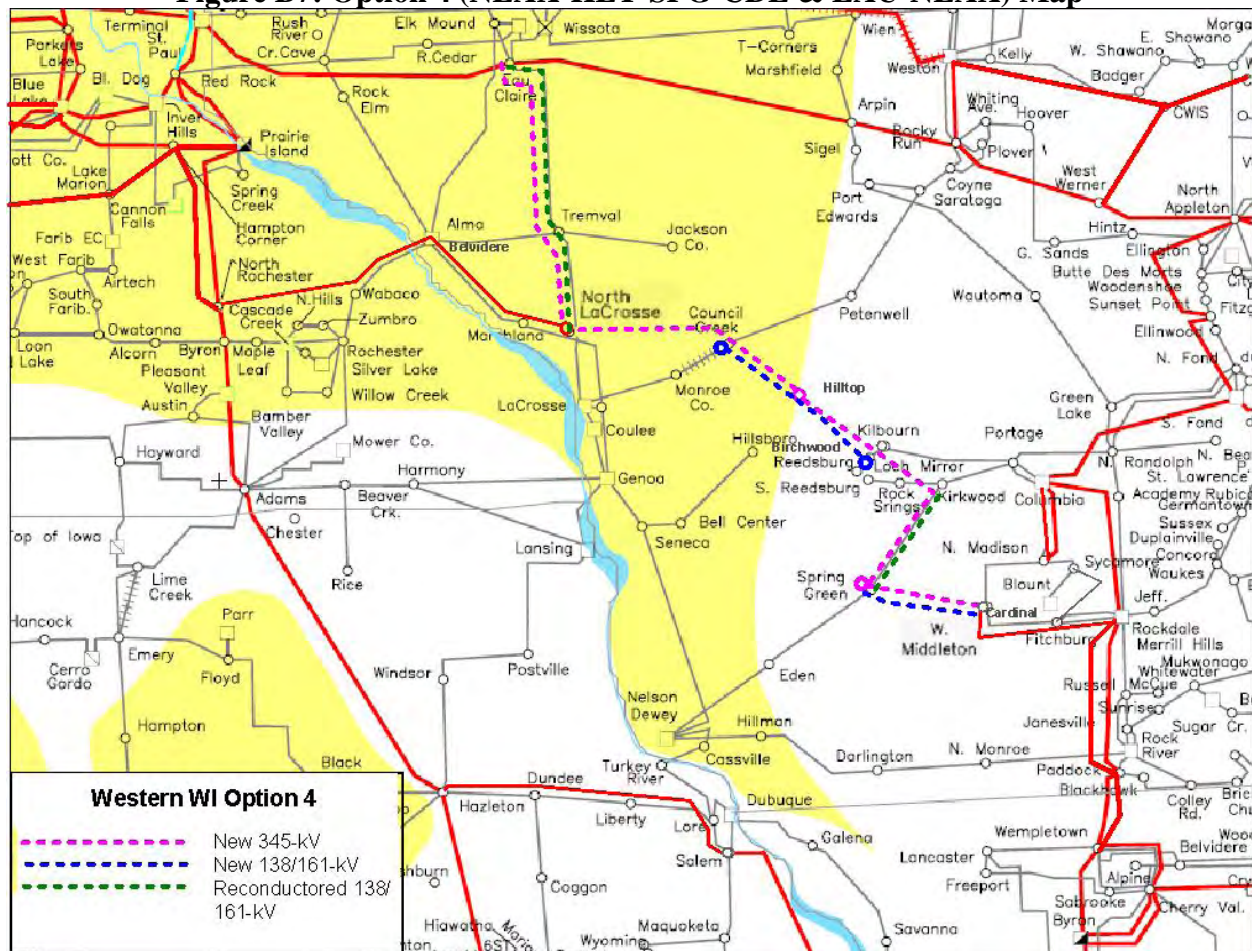
## Appendix B: Maps for the Western Wisconsin Transmission Reliability Study

**Figure B6: Option 3 (EAU-NLAX) Map**

Yellow shaded area on maps represents the mid-continent area power pool (mapp) footprint

## Public Version

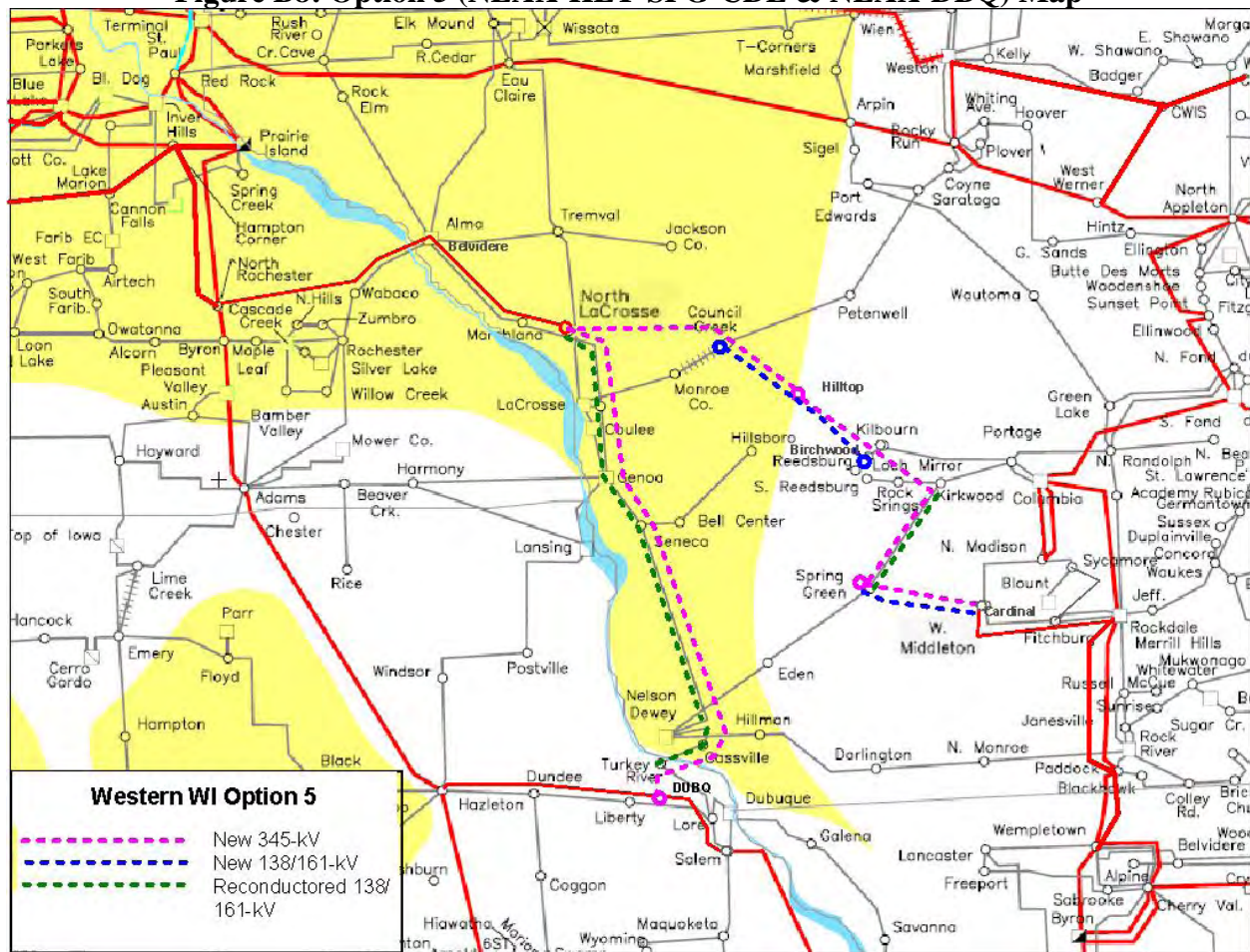
## Appendix B: Maps for the Western Wisconsin Transmission Reliability Study

**Figure B7: Option 4 (NLAX-HLT-SPG-CDL & EAU-NLAX) Map**

Yellow shaded area on maps represents the mid-continent area power pool (mapp) footprint

## Public Version

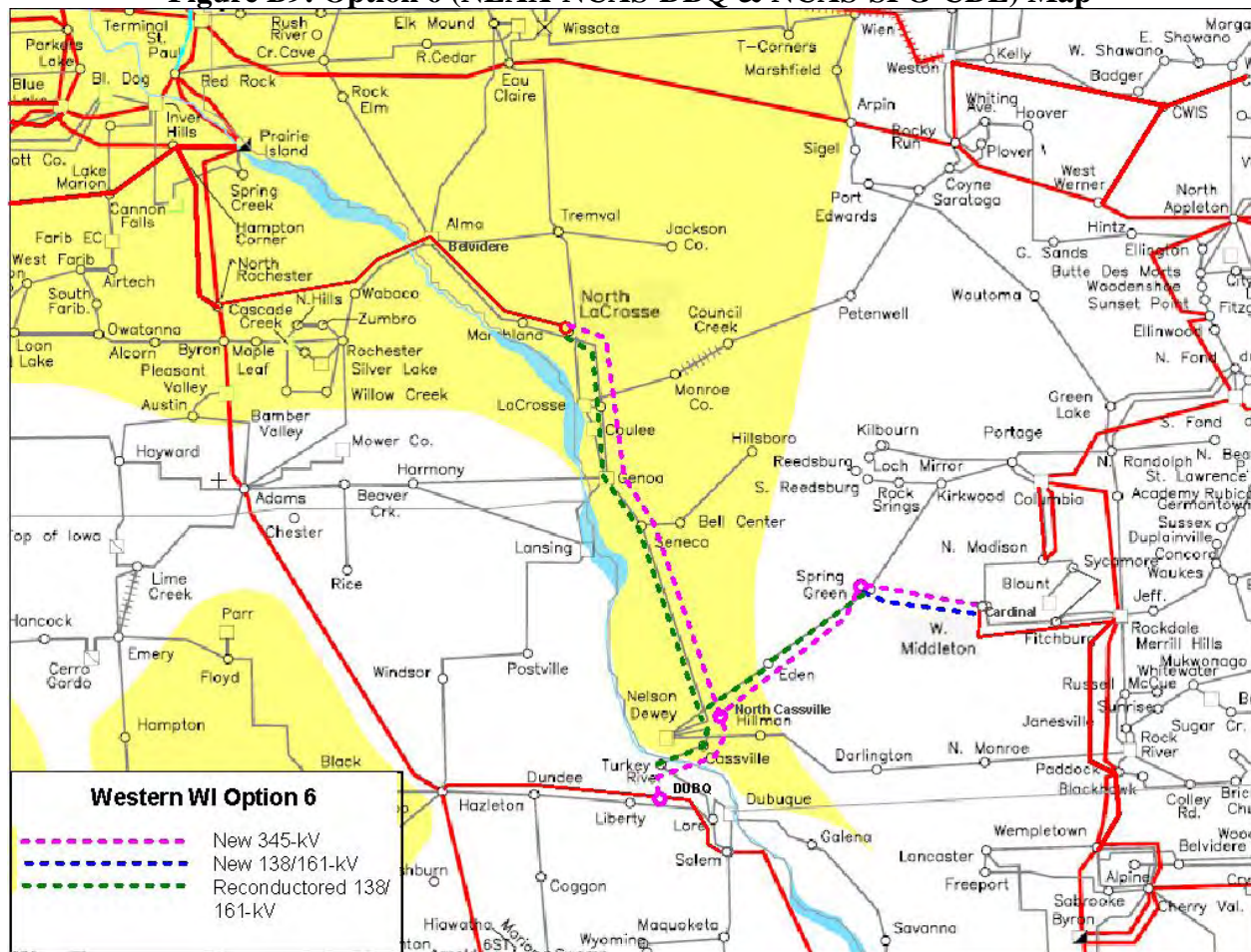
## Appendix B: Maps for the Western Wisconsin Transmission Reliability Study

**Figure B8: Option 5 (NLAX-HLT-SPG-CDL & NLAX-DBQ) Map**

Yellow shaded area on maps represents the mid-continent area power pool (mapp) footprint

## Public Version

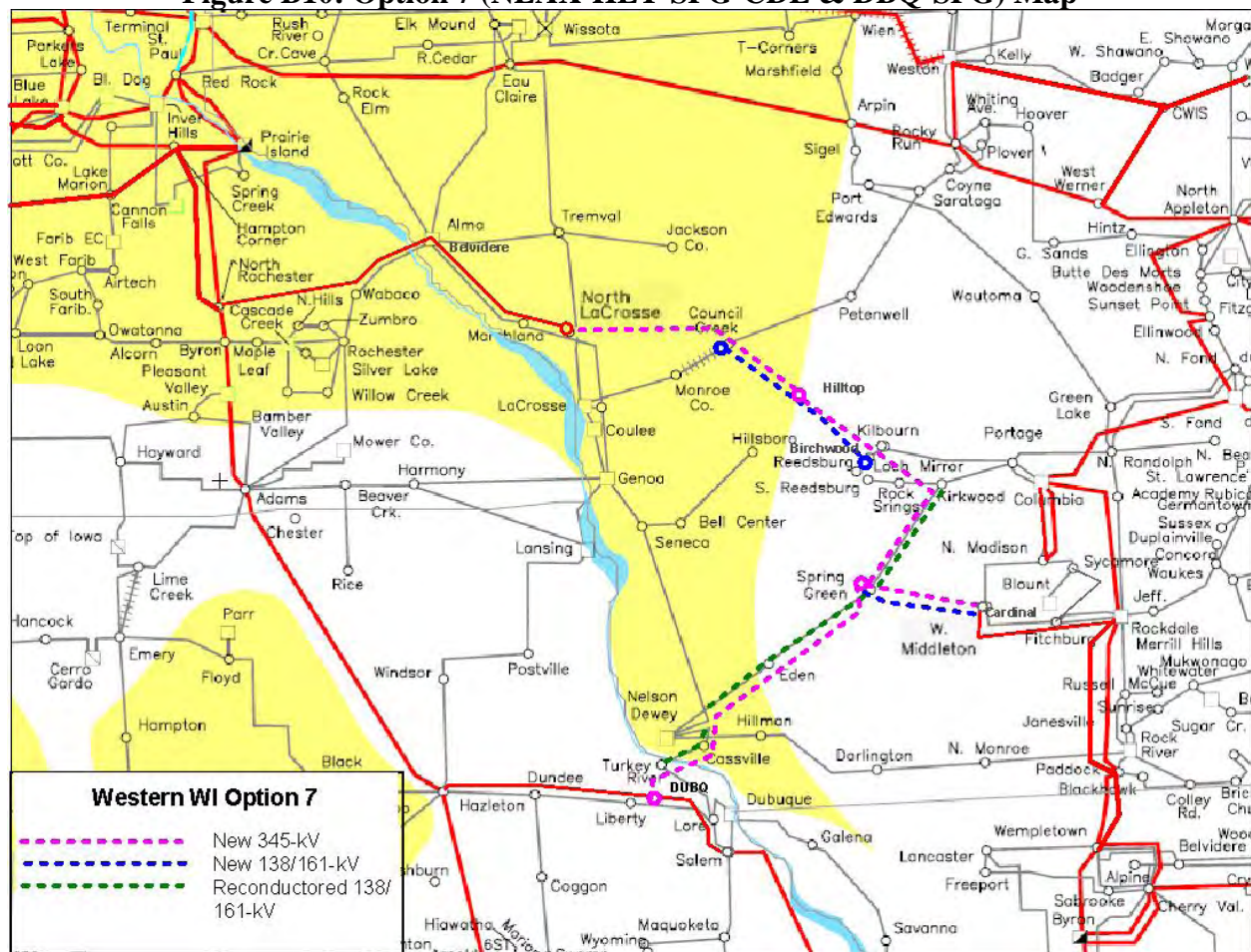
## Appendix B: Maps for the Western Wisconsin Transmission Reliability Study

**Figure B9: Option 6 (NLAX-NCAS-DBQ & NCAS-SPG-CDL) Map**

Yellow shaded area on maps represents the mid-continent area power pool (mapp) footprint

## Public Version

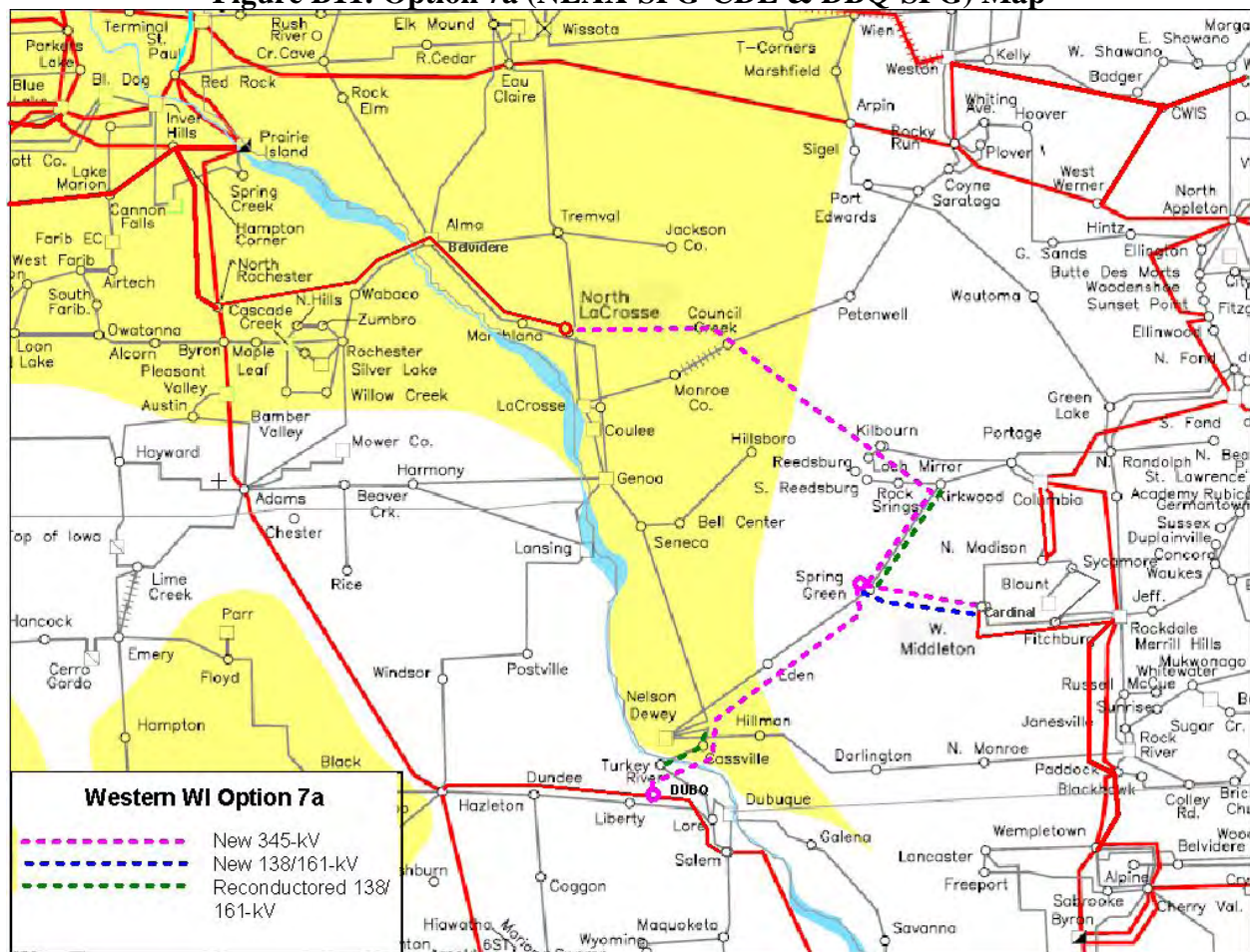
## Appendix B: Maps for the Western Wisconsin Transmission Reliability Study

**Figure B10: Option 7 (NLAX-HLT-SPG-CDL & DBQ-SPG) Map**

Yellow shaded area on maps represents the mid-continent area power pool (mapp) footprint

## Public Version

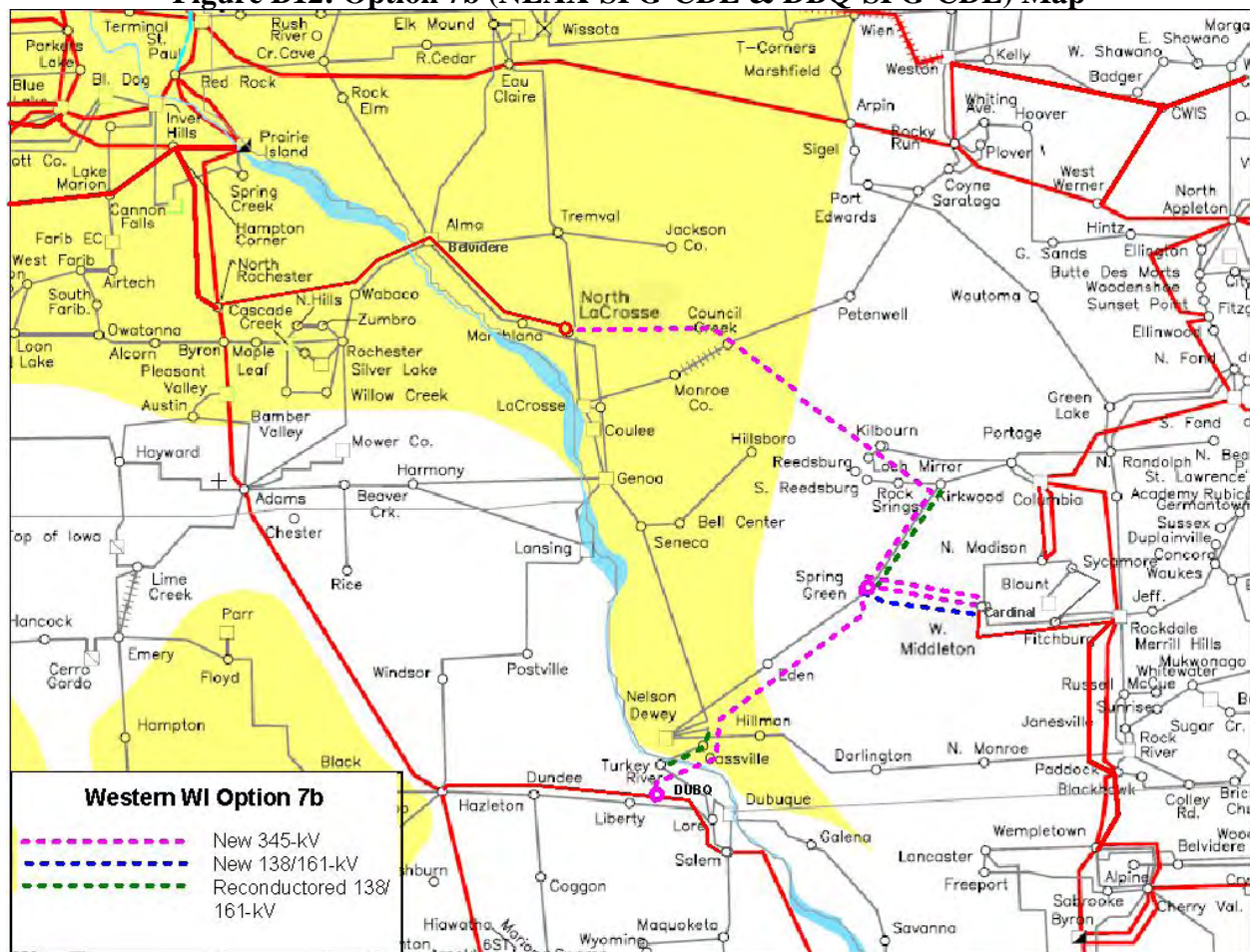
## Appendix B: Maps for the Western Wisconsin Transmission Reliability Study

**Figure B11: Option 7a (NLAX-SPG-CDL & DBQ-SPG) Map**

Yellow shaded area on maps represents the mid-continent area power pool (mapp) footprint

## Public Version

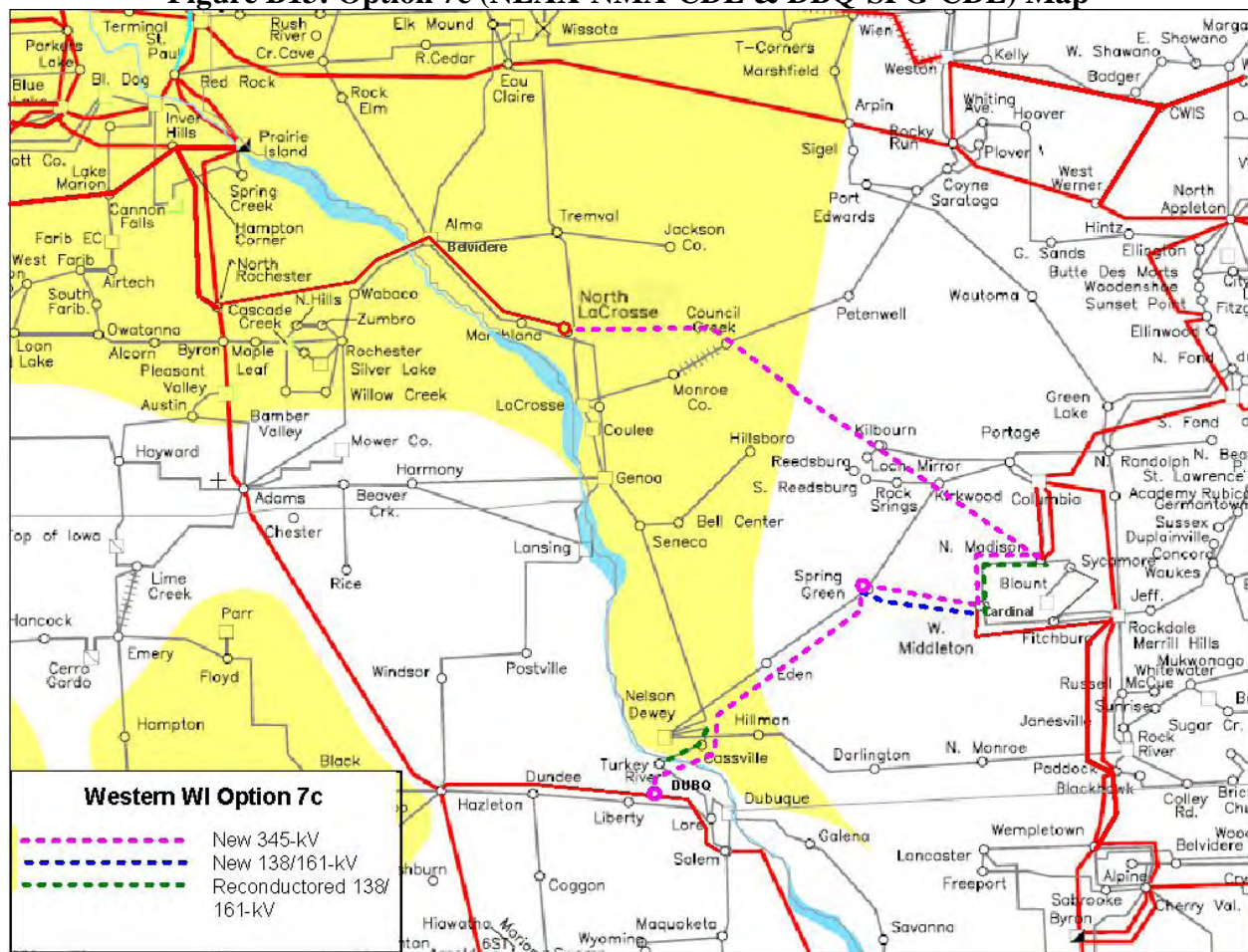
## Appendix B: Maps for the Western Wisconsin Transmission Reliability Study

**Figure B12: Option 7b (NLAX-SPG-CDL & DBQ-SPG-CDL) Map**

Yellow shaded area on maps represents the mid-continent area power pool (mapp) footprint

## Public Version

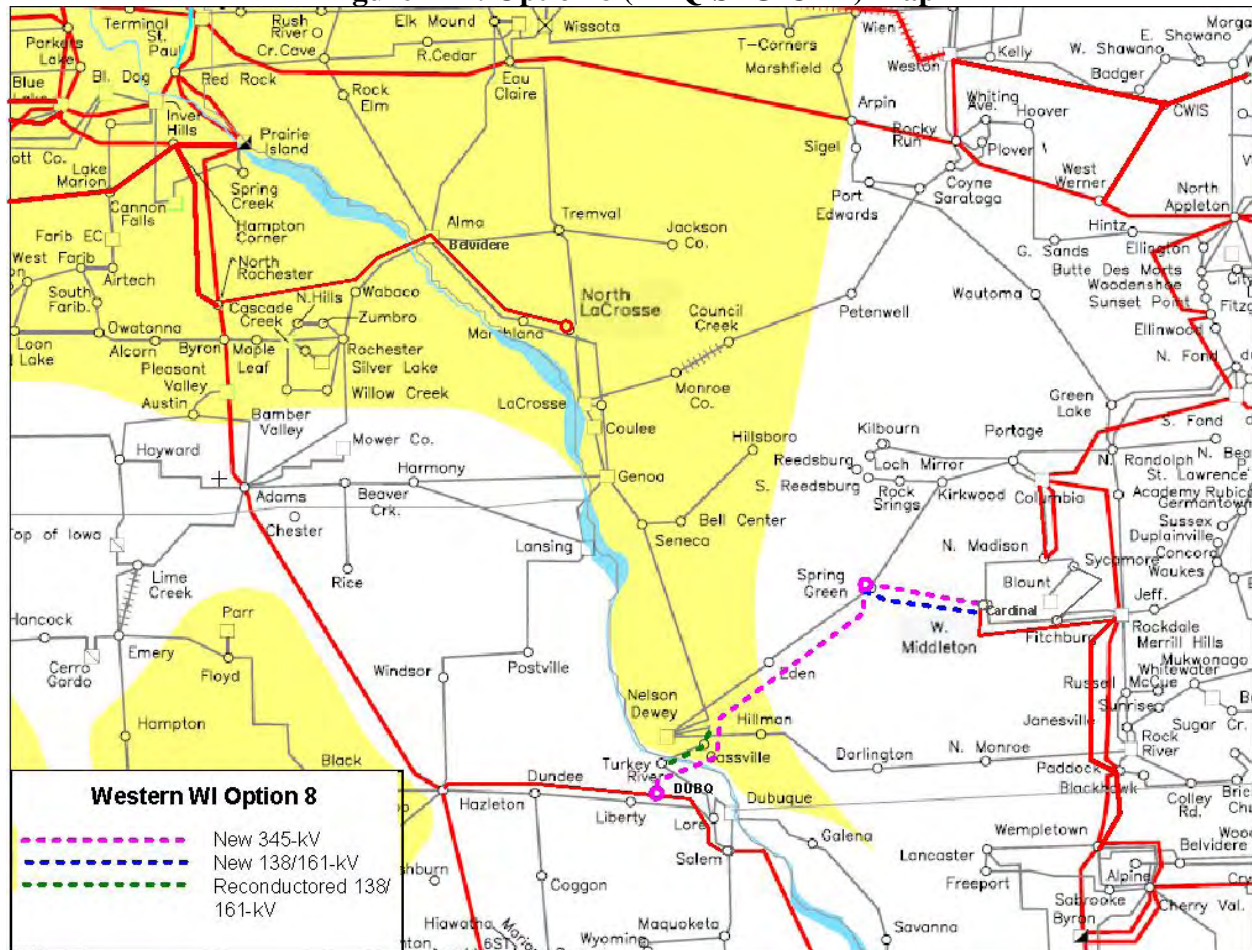
## Appendix B: Maps for the Western Wisconsin Transmission Reliability Study

**Figure B13: Option 7c (NLAX-NMA-CDL & DBQ-SPG-CDL) Map**

Yellow shaded area on maps represents the mid-continent area power pool (mapp) footprint

## Public Version

## Appendix B: Maps for the Western Wisconsin Transmission Reliability Study

**Figure B14: Option 8 (DBQ-SPG-CDL) Map**

Yellow shaded area on maps represents the mid-continent area power pool (mapp) footprint

Posted: 01/13/2011

## **Appendix C**

### **ATC Severity Index Tool Write-up**

Contains Critical Energy Infrastructure Information

Contains Critical Energy Infrastructure Information

Contains Critical Energy Infrastructure Information

Contains Critical Energy Infrastructure Information

## **Appendix D**

### **Supporting Facilities for the EHV (345 kV and 765 kV) Options – Category B Loading Limitations**

## Public Version

## Appendix D: Category B Loading Limits for Western Wisconsin Transmission Reliability Study

## Notes:

1. Blue highlighted rows are facilities outside AC footprint.
2. Costs are in 2010 dollars.
3. Upgrades of the facilities listed in the tables below are rebuilds unless otherwise noted.

Table D.1 – Supporting facilities for NLAX-HLT-SPG-CDL (Opt 1)

| ** From bus *** To bus ** CKT                              | Costs                |
|--|----------------------|
| New Nelson Dewey-Liberty 161 kV Line                       | \$28,388,123         |
| 348915 4E GALESBG N 138 636672 GALESBR5 161 2 <sup>1</sup> | \$0                  |
| 630297 SANDRDG8 69.0 680066 MENOMINE 69.0 1                | \$280,000            |
| 631047 LIME CK5 161 631048 EMERY 5 161 1                   | \$8,868,600          |
| 631056 LORE 5 161 631060 TRK RIV5 161 1 <sup>2</sup>       | \$0                  |
| 631057 SALEM N5 161 631120 JULIAN 5 161 1                  | \$5,937,750          |
| 631058 SO.GVW.5 161 631061 SALEM S5 161 1                  | \$3,082,950          |
| 631060 TRK RIV5 161 681519 CASVILL5 161 1 <sup>3</sup>     | \$0                  |
| 631095 E CALMS5 161 631096 GR MND 5 161 1                  | \$1,404,000          |
| 631123 ADAMS_S5 161 681527 BVR CRK5 161 1                  | \$8,833,500          |
| 636636 OAKGROV5 161 636672 GALESBR5 161 1 <sup>4</sup>     | \$0                  |
| 637191 HAMPTON5 161 637193 HAMPTON8 69.0 1                 | \$3,380,000          |
| 637201 SHEFFLD5 161 637205 WSHEFFLD 69.0 1                 | \$3,380,000          |
| 680066 MENOMINE 69.0 680068 T KIELER 69.0 1                | \$280,000            |
| 680067 KAISER 69.0 680068 T KIELER 69.0 1                  | \$490,000            |
| 680070 LANCASTE 69.0 680079 HURICAN 69.0 1                 | \$2,345,000          |
| 681519 CASVILL5 161 699010 NED 161 161 1 <sup>5</sup>      | \$0                  |
| 681523 GENOA 5 161 681531 LAC TAP5 161 1 <sup>6</sup>      | \$0                  |
| 698003 HLM 69 69.0 699031 HLM 138 138 1                    | \$2,531,712          |
| 698016 EEN 69 69.0 698017 MIP 69 69.0 1                    | \$5,575,491          |
| 698034 WIO 69 69.0 698035 GTT 69 69.0 1                    | \$3,900,659          |
| 698318 LPS 69 69.0 698321 A07 69 69.0 1                    | \$1,377,973          |
| 698321 A07 69 69.0 698322 MCK 69 69.0 1                    | \$5,617,890          |
| 698322 MCK 69 69.0 698332 A13 69 69.0 1                    | \$7,000,439          |
| 698331 CAR 69 69.0 698332 A13 69 69.0 1                    | \$1,286,253          |
| 698375 WHB 69 69.0 699699 WHITCOMB 115 1                   | \$3,825,075          |
| 698660 HARRISON 69.0 699792 HARRISON 138 1                 | \$3,825,075          |
| 698668 WMD 69 69.0 698674 WTNM 69 69.0 1                   | \$12,263,239         |
| 698668 WMD 69 69.0 698684 BLKM69 69.0 1                    | \$3,703,806          |
| 699033 DAR 138 138 699036 NOM 138 138 1                    | \$30,574,914         |
| 699059 PAD 138 138 699141 TOWNLINE 138 1                   | \$8,791,014          |
| <b>Total</b>   | <b>\$156,943,463</b> |

<sup>1</sup> Far from the center of the study footprint (from, to - MEC, AMIL). Assumed this constraint will be fixed by entities outside study participants.

<sup>2</sup> Use a new NED-LIB 161 kV line

<sup>3</sup> Use a new NED-LIB 161 kV line

<sup>4</sup> Far from the center of the study footprint (from, to - MEC, MEC). Assumed this constraint will be fixed by entities outside study participants.

<sup>5</sup> Use a new NED-LIB 161 kV line

<sup>6</sup> DPC comment: this is a DPC planned project

Public Version

## Appendix D: Category B Loading Limits for Western Wisconsin Transmission Reliability Study

Table D.2 – Supporting facilities for NLAX-SPG-CDL (Opt 1a)

| ** From bus *** To bus ** CKT                 | Costs                | Notes                          |
|---|----------------------|--------------------------------|
| New Nelson Dewey-Liberty 161 kV Line          | \$28,388,123         |                                |
| 348915 4E GALESBG N 138 636672 GALESBR5 161 2 | \$0                  | <a href="#">See FN 1 on p1</a> |
| 630297 SANDRDG8 69.0 680066 MENOMINE 69.0 1   | \$280,000            |                                |
| 631047 LIME CK5 161 631048 EMERY 5 161 1      | \$8,868,600          |                                |
| 631056 LORE 5 161 631060 TRK RIV5 161 1       | \$0                  | <a href="#">See FN 2 on p1</a> |
| 631057 SALEM N5 161 631120 JULIAN 5 161 1     | \$5,937,750          |                                |
| 631058 SO.GVW.5 161 631061 SALEM S5 161 1     | \$3,082,950          |                                |
| 631060 TRK RIV5 161 681519 CASVILL5 161 1     | \$0                  | <a href="#">See FN 3 on p1</a> |
| 631095 E CALMS5 161 631096 GR MND 5 161 1     | \$1,404,000          |                                |
| 631123 ADAMS_S5 161 681527 BVR CRK5 161 1     | \$8,833,500          |                                |
| 636636 OAKGROV5 161 636672 GALESBR5 161 1     | \$0                  | <a href="#">See FN 4 on p1</a> |
| 637191 HAMPTON5 161 637193 HAMPTON8 69.0 1    | \$3,380,000          |                                |
| 637201 SHEFFLD5 161 637205 WSHEFFLD 69.0 1    | \$3,380,000          |                                |
| 680066 MENOMINE 69.0 680068 T KIELER 69.0 1   | \$280,000            |                                |
| 680067 KAISER 69.0 680068 T KIELER 69.0 1     | \$490,000            |                                |
| 680070 LANCASTE 69.0 680079 HURICAN 69.0 1    | \$2,345,000          |                                |
| 680075 BELLCNTR 69.0 680084 T SG 69.0 1       | \$1,785,000          |                                |
| 680077 T EAST 69.0 680455 MTHOP TP 69.0 1     | \$3,815,000          |                                |
| 680079 HURICAN 69.0 680455 MTHOP TP 69.0 1    | \$3,815,000          |                                |
| 680084 T SG 69.0 680086 BOAZ 69.0 1           | \$3,920,000          |                                |
| 680086 BOAZ 69.0 680087 DAYTON 69.0 1         | \$420,000            |                                |
| 681519 CASVILL5 161 699010 NED 161 161 1      | \$0                  | <a href="#">See FN 5 on p1</a> |
| 681523 GENOA 5 161 681531 LAC TAP5 161 1      | \$0                  | <a href="#">See FN 6 on p1</a> |
| 698003 HLM 69 69.0 699031 HLM 138 138 1       | \$2,531,712          |                                |
| 698016 EEN 69 69.0 698017 MIP 69 69.0 1       | \$5,575,491          |                                |
| 698032 SME 69 69.0 698033 BRN 69 69.0 1       | \$7,307,102          |                                |
| 698034 WIO 69 69.0 698035 GTT 69 69.0 1       | \$3,900,659          |                                |
| 698122 PIR 69 69.0 698300 BREWER 69.0 1       | \$1,059,979          |                                |
| 698187 RKT 138 138 698941 ART#1 13 138 1      | \$6,395,745          |                                |
| 698187 RKT 138 138 699144 KIR 138 138 1       | \$9,530,914          |                                |
| 698313 SALT 69 69.0 699940 SAL 69 69.0 1      | \$105,998            |                                |
| 698351 PET 69 69.0 699808 PETENWEL 138 1      | \$3,825,075          |                                |
| 698375 WHB 69 69.0 699699 WHITCOMB 115 1      | \$3,825,075          |                                |
| 698660 HARRISON 69.0 699792 HARRISON 138 1    | \$3,825,075          |                                |
| 698668 WMD 69 69.0 698674 WTNM 69 69.0 1      | \$12,263,239         |                                |
| 698668 WMD 69 69.0 698684 BLKM69 69.0 1       | \$3,703,806          |                                |
| 699033 DAR 138 138 699036 NOM 138 138 1       | \$30,574,914         |                                |
| 699059 PAD 138 138 699141 TOWNLINE 138 1      | \$8,791,014          |                                |
| Total   | <b>\$183,640,721</b> |                                |

Public Version

## Appendix D: Category B Loading Limits for Western Wisconsin Transmission Reliability Study

Table D.3 – Supporting facilities for NLAX-NMA-CDL (Opt 1b)

| ** From bus ** ** To bus ** CKT               | Costs                | Notes                          |
|---|----------------------|--------------------------------|
| New Nelson Dewey-Liberty 161 kV Line          | \$28,388,123         |                                |
| 348915 4E GALESBG N 138 636672 GALESBR5 161 2 | \$0                  | <a href="#">See FN 1 on p1</a> |
| 630297 SANDRDG8 69.0 680066 MENOMINE 69.0 1   | \$280,000            |                                |
| 631047 LIME CK5 161 631048 EMERY 5 161 1      | \$8,868,600          |                                |
| 631056 LORE 5 161 631060 TRK RIV5 161 1       | \$0                  | <a href="#">See FN 2 on p1</a> |
| 631057 SALEM N5 161 631120 JULIAN 5 161 1     | \$5,937,750          |                                |
| 631058 SO.GVW.5 161 631059 8TH ST.5 161 1     | \$1,246,050          |                                |
| 631058 SO.GVW.5 161 631061 SALEM S5 161 1     | \$3,082,950          |                                |
| 631059 8TH ST.5 161 631125 KERPER 5 161 1     | \$1,521,000          |                                |
| 631060 TRK RIV5 161 681519 CASVILL5 161 1     | \$0                  | <a href="#">See FN 3 on p1</a> |
| 631095 E CALMS5 161 631096 GR MND 5 161 1     | \$1,404,000          |                                |
| 631095 E CALMS5 161 636616 DAVNPRT5 161 1     | \$10,413,000         |                                |
| 631123 ADAMS_S5 161 681527 BVR CRK5 161 1     | \$8,833,500          |                                |
| 636636 OAKGROV5 161 636672 GALESBR5 161 1     | \$0                  | <a href="#">See FN 4 on p1</a> |
| 637191 HAMPTON5 161 637193 HAMPTON8 69.0 1    | \$3,380,000          |                                |
| 637201 SHEFFLD5 161 637205 WSHEFFLD 69.0 1    | \$3,380,000          |                                |
| 680061 HARRISON 69.0 680067 KAISER 69.0 1     | \$2,485,000          |                                |
| 680061 HARRISON 69.0 680070 LANCASTE 69.0 1   | \$2,415,000          |                                |
| 680066 MENOMINE 69.0 680068 T KIELER 69.0 1   | \$280,000            |                                |
| 680067 KAISER 69.0 680068 T KIELER 69.0 1     | \$490,000            |                                |
| 680070 LANCASTE 69.0 680079 HURICAN 69.0 1    | \$2,345,000          |                                |
| 680075 BELLCNTR 69.0 680084 T SG 69.0 1       | \$1,785,000          |                                |
| 680077 T EAST 69.0 680455 MTHOP TP 69.0 1     | \$3,815,000          |                                |
| 680079 HURICAN 69.0 680455 MTHOP TP 69.0 1    | \$3,815,000          |                                |
| 680084 T SG 69.0 680086 BOAZ 69.0 1           | \$3,920,000          |                                |
| 681519 CASVILL5 161 699010 NED 161 161 1      | \$0                  | <a href="#">See FN 5 on p1</a> |
| 681523 GENOA 5 161 681531 LAC TAP5 161 1      | \$0                  | <a href="#">See FN 6 on p1</a> |
| 698003 HLM 69 69.0 699031 HLM 138 138 1       | \$2,531,712          |                                |
| 698122 PIR 69 69.0 698300 BREWER 69.0 1       | \$1,059,979          |                                |
| 698187 RKT 138 138 698941 ART#1 13 138 1      | \$6,395,745          |                                |
| 698187 RKT 138 138 699144 KIR 138 138 1       | \$9,530,914          |                                |
| 698313 SALT 69 69.0 699940 SAL 69 69.0 1      | \$105,998            |                                |
| 698351 PET 69 69.0 699808 PETENWEL 138 1      | \$3,825,075          |                                |
| 698375 WHB 69 69.0 699699 WHITCOMB 115 1      | \$3,825,075          |                                |
| 698660 HARRISON 69.0 699792 HARRISON 138 1    | \$3,825,075          |                                |
| 698668 WMD 69 69.0 698674 WTNM 69 69.0 1      | \$12,263,239         |                                |
| 698668 WMD 69 69.0 698684 BLKM69 69.0 1       | \$3,703,806          |                                |
| 699010 NED 161 161 699021 NLD 2 138 1         | \$4,180,636          |                                |
| 699033 DAR 138 138 699036 NOM 138 138 1       | \$30,574,914         |                                |
| 699059 PAD 138 138 699141 TOWNLINE 138 1      | \$8,791,014          |                                |
| Total   | <b>\$188,698,156</b> |                                |

## Public Version

## Appendix D: Category B Loading Limits for Western Wisconsin Transmission Reliability Study

Table D.4 – Supporting facilities for DBQ-SPG-CDL (Opt 8)

| ** From bus *** To bus ** CKT                          | Costs                | Notes          |
|--|----------------------|----------------|
| 36384 QUAD3-11 345 631141 ROCK CK3 345 1               | \$9,481,000          |                |
| 605296 WSTSALE8 69.0 605316 LAX 8 69.0 1               | \$3,850,000          |                |
| 630003 LANSING8 69.0 631053 LANSING5 161 1             | \$3,380,000          |                |
| 630234 DECORAH8 69.0 680023 CANOE TP 69.0 1            | \$2,135,000          |                |
| 631047 LIME CK5 161 631048 EMERY 5 161 1               | \$8,868,600          |                |
| 631051 HAZL S 5 161 631101 DUNDEE 5 161 1 <sup>7</sup> | \$0                  |                |
| 631095 E CALMS5 161 631096 GR MND 5 161 1              | \$1,404,000          |                |
| 631095 E CALMS5 161 636616 DAVNPRT5 161 1              | \$10,413,000         |                |
| 631102 TRIBOJI5 161 631124 DKS_N_CO5 161 1             | \$1,398,150          |                |
| 631123 ADAMS_S5 161 681527 BVR CRK5 161 1              | \$8,833,500          |                |
| 637191 HAMPTON5 161 637193 HAMPTON8 69.0 1             | \$3,380,000          |                |
| 637191 HAMPTON5 161 637201 SHEFFLD5 161 1              | \$8,780,850          |                |
| 637201 SHEFFLD5 161 637205 WSHEFFLD 69.0 1             | \$3,380,000          |                |
| 680070 LANCASTE 69.0 680079 HURICAN 69.0 1             | \$2,345,000          |                |
| 680075 BELLCNTR 69.0 680084 T SG 69.0 1                | \$1,785,000          |                |
| 680079 HURICAN 69.0 680455 MTHOP TP 69.0 1             | \$3,815,000          |                |
| 680084 T SG 69.0 680086 BOAZ 69.0 1                    | \$3,920,000          |                |
| 680242 LUBLIN 69.0 680505 LAKEHEAD 69.0 1              | \$420,000            |                |
| 681523 GENOA 5 161 681531 LAC TAP5 161 1               | \$0                  | See FN 6 on p1 |
| 681539 ELK MND5 161 681543 ALMA 5 161 1                | \$26,383,500         |                |
| 698003 HLM 69 69.0 699031 HLM 138 138 1                | \$2,531,712          |                |
| 698016 EEN 69 69.0 698017 MIP 69 69.0 1                | \$5,575,491          |                |
| 698034 WIO 69 69.0 698035 GTT 69 69.0 1                | \$3,900,659          |                |
| 698122 PIR 69 69.0 698300 BREWER 69.0 1                | \$1,059,979          |                |
| 698187 RKT 138 138 698941 ART#1 13 138 1               | \$6,395,745          |                |
| 698187 RKT 138 138 699144 KIR 138 138 1                | \$9,530,914          |                |
| 698321 A07 69 69.0 698322 MCK 69 69.0 1                | \$5,617,890          |                |
| 698351 PET 69 69.0 699808 PETENWEL 138 1               | \$3,825,075          |                |
| 698375 WHB 69 69.0 699699 WHITCOMB 115 1               | \$3,825,075          |                |
| 698660 HARRISON 69.0 699792 HARRISON 138 1             | \$3,825,075          |                |
| 698668 WMD 69 69.0 698674 WTNM 69 69.0 1               | \$12,263,239         |                |
| 698668 WMD 69 69.0 698684 BLKM69 69.0 1                | \$3,703,806          |                |
| 699033 DAR 138 138 699036 NOM 138 138 1                | \$30,574,914         |                |
| 699059 PAD 138 138 699141 TOWNLINE 138 1               | \$8,791,014          |                |
| Total  | <b>\$205,393,188</b> |                |

<sup>7</sup> ITC comment: this line will be rebuilt as part of the Hazelton - Salem 345 kV project

## Public Version

## Appendix D: Category B Loading Limits for Western Wisconsin Transmission Reliability Study

Table D.5 – Supporting facilities for NLAX-NMA-CDL & DBQ-SPG-CDL  
(Opt 7c)

| ** From bus *** To bus ** CKT              | Costs                | Notes          |
|--|----------------------|----------------|
| 36384 QUAD3-11 345 631141 ROCK CK3 345 1   | \$9,481,000          |                |
| 631047 LIME CK5 161 631048 EMERY 5 161 1   | \$8,868,600          |                |
| 631095 E CALMS5 161 631096 GR MND 5 161 1  | \$1,404,000          |                |
| 631095 E CALMS5 161 636616 DAVNPRT5 161 1  | \$10,413,000         |                |
| 631123 ADAMS_S5 161 681527 BVR CRK5 161 1  | \$8,833,500          |                |
| 637191 HAMPTON5 161 637193 HAMPTON8 69.0 1 | \$3,380,000          |                |
| 637201 SHEFFLD5 161 637205 WSHEFFLD 69.0 1 | \$3,380,000          |                |
| 680070 LANCASTE 69.0 680079 HURICAN 69.0 1 | \$2,345,000          |                |
| 680075 BELLCTR 69.0 680084 T SG 69.0 1     | \$1,785,000          |                |
| 680079 HURICAN 69.0 680455 MTHOP TP 69.0 1 | \$3,815,000          |                |
| 680084 T SG 69.0 680086 BOAZ 69.0 1        | \$3,920,000          |                |
| 681523 GENOA 5 161 681531 LAC TAP5 161 1   | \$0                  | See FN 6 on p1 |
| 698003 HLM 69 69.0 699031 HLM 138 138 1    | \$2,531,712          |                |
| 698122 PIR 69 69.0 698300 BREWER 69.0 1    | \$1,059,979          |                |
| 698187 RKT 138 138 698941 ART#1 13 138 1   | \$6,395,745          |                |
| 698187 RKT 138 138 699144 KIR 138 138 1    | \$9,530,914          |                |
| 698351 PET 69 69.0 699808 PETENWEL 138 1   | \$3,825,075          |                |
| 698375 WHB 69 69.0 699699 WHITCOMB 115 1   | \$3,825,075          |                |
| 698660 HARRISON 69.0 699792 HARRISON 138 1 | \$3,825,075          |                |
| 698668 WMD 69 69.0 698674 WTNM 69 69.0 1   | \$12,263,239         |                |
| 698668 WMD 69 69.0 698684 BLKM69 69.0 1    | \$3,703,806          |                |
| 699033 DAR 138 138 699036 NOM 138 138 1    | \$30,574,914         |                |
| 699059 PAD 138 138 699141 TOWNLINE 138 1   | \$8,791,014          |                |
| Total                                      | <b>\$143,951,649</b> |                |

Public Version

## Appendix D: Category B Loading Limits for Western Wisconsin Transmission Reliability Study

Table D.6 – Supporting facilities for GENOA-NOM 765 kV (765 Opt)

| ** From bus ** ** To bus ** CKT             | Costs                | Notes                          |
|---|----------------------|--------------------------------|
| 630297 SANDRDG8 69.0 680066 MENOMINE 69.0 1 | \$280,000            |                                |
| 631057 SALEM N5 161 631120 JULIAN 5 161 1   | \$5,937,750          |                                |
| 631058 SO.GVW.5 161 631061 SALEM S5 161 1   | \$3,082,950          |                                |
| 631060 TRK RIV5 161 681519 CASVILL5 161 1   | \$0                  |                                |
| 631095 E CALMS5 161 631096 GR MND 5 161 1   | \$1,404,000          |                                |
| 631123 ADAMS_S5 161 681527 BVR CRK5 161 1   | \$8,833,500          |                                |
| 636636 OAKGROV5 161 636672 GALESBR5 161 1   | \$0                  | <a href="#">See FN 4 on p1</a> |
| 637191 HAMPTON5 161 637193 HAMPTON8 69.0 1  | \$3,380,000          |                                |
| 637201 SHEFFLD5 161 637205 WSHEFFLD 69.0 1  | \$3,380,000          |                                |
| 680066 MENOMINE 69.0 680068 T KIELER 69.0 1 | \$280,000            |                                |
| 680067 KAISER 69.0 680068 T KIELER 69.0 1   | \$490,000            |                                |
| 680070 LANCASTE 69.0 680079 HURICAN 69.0 1  | \$2,345,000          |                                |
| 680075 BELLCNTR 69.0 680084 T SG 69.0 1     | \$1,785,000          |                                |
| 680077 T EAST 69.0 680455 MTHOP TP 69.0 1   | \$3,815,000          |                                |
| 680079 HURICAN 69.0 680455 MTHOP TP 69.0 1  | \$3,815,000          |                                |
| 680084 T SG 69.0 680086 BOAZ 69.0 1         | \$3,920,000          |                                |
| 680086 BOAZ 69.0 680087 DAYTON 69.0 1       | \$420,000            |                                |
| 698003 HLM 69 69.0 699031 HLM 138 138 1     | \$2,531,712          |                                |
| 698028 NOM 69 69.0 698031 IDH 69 69.0 1     | \$4,345,915          |                                |
| 698028 NOM 69 69.0 699036 NOM 138 138 1     | \$3,393,954          |                                |
| 698122 PIR 69 69.0 698300 BREWER 69.0 1     | \$1,059,979          |                                |
| 698187 RKT 138 138 698941 ART#1 13 138 1    | \$6,395,745          |                                |
| 698187 RKT 138 138 699144 KIR 138 138 1     | \$9,530,914          |                                |
| 698313 SALT 69 69.0 699940 SAL 69 69.0 1    | \$105,998            |                                |
| 698351 PET 69 69.0 699808 PETENWEL 138 1    | \$3,825,075          |                                |
| 698375 WHB 69 69.0 699699 WHITCOMB 115 1    | \$3,825,075          |                                |
| 698660 HARRISON 69.0 699792 HARRISON 138 1  | \$3,825,075          |                                |
| 698668 WMD 69 69.0 698674 WTNM 69 69.0 1    | \$12,263,239         |                                |
| 698668 WMD 69 69.0 698684 BLKM69 69.0 1     | \$3,703,806          |                                |
| 699033 DAR 138 138 699036 NOM 138 138 1     | \$30,574,914         |                                |
| 699036 NOM 138 138 699037 ALB 138 138 1     | \$11,549,963         |                                |
| 699037 ALB 138 138 699897 BASSCRK 138 1     | \$14,898,324         |                                |
| 699059 PAD 138 138 699141 TOWNLINE 138 1    | \$8,791,014          |                                |
| 699141 TOWNLINE 138 699897 BASSCRK 138 1    | \$14,672,591         |                                |
| Total                                       | <b>\$180,046,843</b> |                                |