

# Section VI

## ACCESS

Transmission access is the ability to transfer power into, out of, through and within the transmission system without impediments. **External access** is the ability to transfer power from outside the ATC footprint to within the footprint without impediments. **Internal access** is the ability to transfer power within the ATC footprint without impediment, whether from new or existing power plants.

A combination of external access and internal access is needed for customers to operate most efficiently. External access alone is insufficient if the internal system cannot accommodate transfer of power within ATC to where it is needed. Internal access alone is insufficient if power is available outside of ATC's footprint but can't be transferred to ATC customers. A sufficient blend of external and internal access allows ATC's customers to reduce the cost of supplying electricity to their customers. To date, ATC has focused most of its attention on reliability issues and chronic limitations within the ATC system. The projects that ATC has completed that addressed chronic limitations have provided modest increases in transfer capability into the ATC system. ATC is now in a position to focus on identifying projects that are primarily aimed at increasing access.

### **Background**

From 2001 through 2003, numerous projects have been completed to address chronic limitations within the ATC footprint to providing transmission service. Some of these key projects include:

- ❑ Rockdale 345/138 kV transformer (Zone 3)
- ❑ Whitewater-Mukwonago 138 kV line reconductor (Zones 3 and 5)
- ❑ Forest Junction 345/138 kV transformer (Zone 4)
- ❑ Saukville-Granville 138 kV line rebuild (Zone 5)
- ❑ Blackhawk-Colley Road 138 kV line reconductor (Zone 3)
- ❑ Christiana-Kegonsa 138 kV line reconductor (Zone 3)
- ❑ Highway V-Preble 138 kV line uprate (Zone 4)

In addition, ATC is pursuing numerous other projects that will improve transmission system transfer capability and access, both for importing power from neighboring entities and accommodating transactions between utilities within the ATC footprint:

- ❑ Arrowhead-Weston 345 kV line
- ❑ Wempletown-Paddock 345 kV line
- ❑ Plains-Stiles 138 kV line rebuild
- ❑ Hiawatha-Indian Lake 69 kV line rebuild/conversion
- ❑ Morgan-Werner West 345 kV line
- ❑ Lannon Junction-Rockdale 345 kV line
- ❑ Morgan-White Clay 138 kV reconductor
- ❑ Morgan-Stiles 138 kV rebuild

These projects will substantially improve the ability of ATC's customers to transact business in the electricity market. However, from a utility customer perspective, these are interim steps and will not provide sufficient access to markets outside of the ATC footprint for the longer term. Over time, load growth and system changes such as the addition of new power plants will use up gains in transfer capability realized from projects like those listed above. In addition, while strengthening the transmission system within ATC's footprint does, in some cases, improve our customers' ability to import power and transact among themselves, additional ties to neighboring utilities will be needed to provide any substantial gain in ATC system transfer capability.

ATC has been performing initial analyses to address the issue of improving access. In the 2003 10-Year Assessment, ATC provided examples of projects that would increase existing system transfer capability by up to 3,000 megawatts in 1,000-megawatt increments. These examples illustrated the magnitude of projects that would be required to meet the prescribed transfer capability increases. However, the analyses conducted did not address reliability benefits, economic benefits or strategic benefits to customers within the ATC footprint.

### **Access Value Proposition**

The concept of improving access and identifying its value to customers is multi-faceted. First, the issue of defining what access *is* needs be addressed. Second, the issue of what level of access is justified needs to be addressed, based on the value expected to be derived. From there, the issues of defining an appropriate transfer capability target, identifying potential projects to attain that target as well as the costs and benefits and impacts (both environmental and socio-economic) of various alternatives, coordination between state regulatory agencies, and assessing the effect of regional planning and pricing initiatives all follow.

### **Transmission access**

Each component of transmission access – external and internal – is critical to users of the transmission system. They are interrelated. Transmission access implies economic benefits, that is, the ability to buy and sell electricity without impediment, which results in lower energy costs to consumers. However, the process of improving access generally has impacts beyond economic benefits. To the extent transmission facilities are constructed to improve access, in virtually all instances reliability is also improved to some degree. Similarly, certain projects conceived to address reliability issues may also improve external or internal access, or both.

Among ATC customers, the key access issue is gaining greater access to power markets external to ATC. However, internal access must also be improved in order to fully realize anticipated benefits from increasing external access. Bringing power in from outside is of no benefit if it can't be delivered to customers throughout ATC's service territory.

All of the projects ATC has completed to date have been contained within the ATC system footprint. Various projects have been implemented to improve external access by eliminating internal constraints (chronic limiter). Several of those projects have also improved internal transfer capability between ATC customers. However, in order to realize significant improvements in external access, new transmission lines extending across ATC's boundaries, combined with key additional internal projects, will be required. This conclusion leads to the following questions:

- ❑ *What is the appropriate target for improving external access?*
- ❑ *How can this external access target be achieved?*
- ❑ *What specific transmission projects will yield the greatest external access gains?*
- ❑ *What specific transmission projects will yield the greatest economic benefit to our customers?*
- ❑ *What reliability gains can be realized by projects designed to improve external access?*
- ❑ *What efficiency gains can be realized by projects designed to improve external access?*
- ❑ *What strategic benefits are realized by ATC and its customers by implementing specific transmission projects?*

### Value of Increasing Access

The identification of the appropriate target level for external access is a complex issue. An appropriate target level for external access should ultimately be determined by the value associated with expanding the transmission system. However, the value of expanding the transmission system goes well beyond simply increasing access. Increasing access to certain markets may yield greater economic benefits to ATC customers than increasing access to other markets. Also, increasing external access will virtually always result in gains in system reliability and efficiency. Improved reliability and efficiency also provide value to customers. Further, there may be strategic benefits realized by certain expansion projects that can't be realized by other projects.

***Economic value of increasing access:*** The value to ATC customers of increasing access to external markets can be analyzed and evaluated quantitatively. This can be done by employing analytical models that determine the most economic dispatch of generation within transmission system security constraints. These models, referred to here as SCED (Security Constrained Economic Dispatch) models, have the capability to compute a projected cost reduction associated with different system expansion alternatives, different future scenarios, etc. ATC is developing the capability to conduct these types of analyses, in part, so that the cost benefits of various access improvement alternatives can be projected. ATC will be performing and reporting on such analyses as part of the 2004 Assessment activities.

***Value of improving reliability:*** There are numerous potential benefits associated with improving reliability in the course of improving external access. A few examples include:

- ❑ Deferring or eliminating the need for reliability-based investments that would otherwise be required
- ❑ Reducing the need for generation redispatch during maintenance outages or sustained forced outages
- ❑ Reducing or eliminating the need for complex operating guides
- ❑ Providing additional operating margin during unforeseen multiple outages

The value of these benefits must be determined on a case-by-case basis, and except for the first example, is not easily quantified in dollars. These types of benefits should be taken into consideration, however, when evaluating access project alternatives.

Another measure of reliability improvement can be obtained by conducting probabilistic planning studies that measure the expected unserved energy (EUE), or change in EUE, associated with different access project alternatives. This is accomplished with software that determines the

minimum load reduction required to ensure that all thermal and voltage criteria are met for all single contingencies and double contingencies. While there is no definitive way to translate EUE into a monetary value, the EUE measure provides a quantitative measure of the relative reliability benefits of access project alternatives. ATC is developing the capability to perform such analyses. ATC will be performing and reporting on such reliability analyses as part of the 2004 Assessment activities.

***Value of improving system efficiency:*** The benefits associated with improving system efficiency are clear:

- ❑ To the extent transmission system losses at the time of system and control area peak demands are reduced, the amount of installed capacity required to meet those capacity losses plus reserves is reduced. While there is no definitive industry-accepted practice to quantify this benefit, reasonable assumptions about the cost of installed generating capacity provides a reasonable estimate of the value of reducing system losses at peak.
- ❑ To the extent transmission system losses are reduced throughout the year, the amount of energy produced or purchased to meet energy loss requirements is reduced. Again, while there is no definitive industry-accepted practice to quantify this benefit, reasonable projections of the amount of loss reduction at various times during the year and the price of energy during those periods of times can provide a reasonable estimate of the value of reducing system energy losses.

ATC will be performing and reporting on such transmission loss analyses as part of the 2004 Assessment activities.

***Strategic benefits:*** Strategic benefits may be realized with certain access improvement project alternatives, including:

- ❑ Establishing transmission infrastructure in areas where the existing infrastructure is weak and incapable of accommodating any significant load or generation additions. This strategy can potentially enable communities to attract new industry, create jobs and bolster local economies. This strategy also can potentially enable new forms of generation to be developed that are in demand.
- ❑ Facilitating the delivery of certain prospective resources that are in demand by customers (e.g., renewable resources developed outside of ATC's boundaries).
- ❑ Enhancing the value of the existing transmission system by reducing the burden on the system when transferring greater amounts of power into or through the ATC system.
- ❑ Enhancing the value of other planned transmission expansion projects, whether they are external or internal.

### **Preliminary Transfer Capability Analyses**

Since the 2003 10-Year Assessment, ATC has begun to look at the issue of improving access by conducting in-depth analyses that look at how the direction of system expansion affects the transfer capability increase that can be achieved. Results of some initial analyses are described below.

#### *Directional Analysis*

For this Update, ATC took the next step of determining how expansion in various directions compares from the perspective of impact on import capability. ATC expects that the information provided here will begin to identify what is needed to comprehensively address the issue of improving access. The results of this analysis should be considered preliminary and are included to provide the foundation for initial discussions with customers and stakeholders. ATC has not refined any of these proxy alternatives to optimize import capability or system performance.

#### *Methodology*

The analysis presented in this section is limited to five strategic proxy projects representing five potential directions for system expansion:

- ❑ South (Illinois)
- ❑ Southwest (Iowa)
- ❑ West (Minnesota)
- ❑ Northeast (Ontario)
- ❑ East (Michigan)

The proxy projects were developed based on various analyses performed since the release of the 2003 10-Year Assessment.

The cost estimates for these projects and the associated “next fixes” represent general screening level cost estimates. Cost estimates for new transmission lines assumed the use of single-circuit steel poles on new 150-foot rights-of-way. Cost estimates for facilities outside of the ATC footprint were calculated using the same assumptions or were based on preliminary conversations with the affected neighboring transmission owner. Detailed cost estimates for specific projects and routes may differ from these very preliminary figures.

The analysis was performed using a linear analysis tool in the Power Technologies, Inc. Managing and Utilizing System Transmission software. This software used industry-wide for transfer capability simulations. In this analysis, a transfer distribution factor was used to determine whether facility overloads are affected by increased power transfers from one of the directions above into the ATC service territory.

The transfer distribution factor impact limits used in this analysis were:

- ❑ 3% for all facilities in the network analysis
- ❑ 3% for MISO-monitored single outage flowgates
- ❑ 5% for MISO-monitored no outage flowgates

A list of relevant impacts on MISO-monitored flowgates is supplied for each proxy project and the base case scenario (i.e. no strategic project added). Transfers were not examined on a control area to control area basis; therefore, the results obtained for specific source-sink pairs may be different.

The power flow model used in this analysis was developed from the Summer 2012 base case from the 2003 10-Year Assessment. For the first valid limit to power transfers identified for each proxy project, an appropriate transmission solution was developed and the analysis was rerun with the solution implemented to determine the next limit. For each scenario, the first two valid limits were identified and solutions were developed to mitigate these limits. The final run for each scenario included the two transmission solutions, and the subsequent new valid limit was identified.

#### Key Assumptions

The base case contains all planning projects needed to mitigate Summer 2012 overload and voltage violations except as noted below. The import capabilities identified in this analysis are dependent on the inclusion of these projects.

The base case was modified to reflect updated information for load forecasts, control area interchange and major transmission projects. One major project was eliminated from the model to avoid unduly biasing certain directions, and nine major projects were added to the base case power flow model. These changes include facilities required for confirmed transmission service requests included in the model. The following facilities were either excluded from or added to the 2012 base case from the 2003 10-Year Assessment:

Facilities excluded:

- ❑ West Middleton-Rockdale 345 kV line with a 345/138 kV transformer at West Middleton
- ❑ Duplicate Blount-Ruskin 69 kV circuit

Facilities added:

- ❑ Second Wempletown-Paddock 345 kV circuit
- ❑ Weston-Central Wisconsin 345 kV line
- ❑ Rockdale-Lannon Junction 345 kV line
- ❑ Fox Energy Generation interconnected to the Point Beach-N. Appleton 345 kV line and Fox Energy-Forest Junction 345 kV line
- ❑ West Marinette-White Rapids 69 kV line conversion to 138 kV and White Rapids-Amberg 138 kV line rebuild
- ❑ Plains-Stiles 138 kV line rebuild
- ❑ Cranberry-Conover 138 kV line with a 138/115kV transformer at Cranberry
- ❑ Conover-Twin Lake-Iron River-Plains 69 kV line conversion to 138 kV and a 138/69 kV transformer at Conover

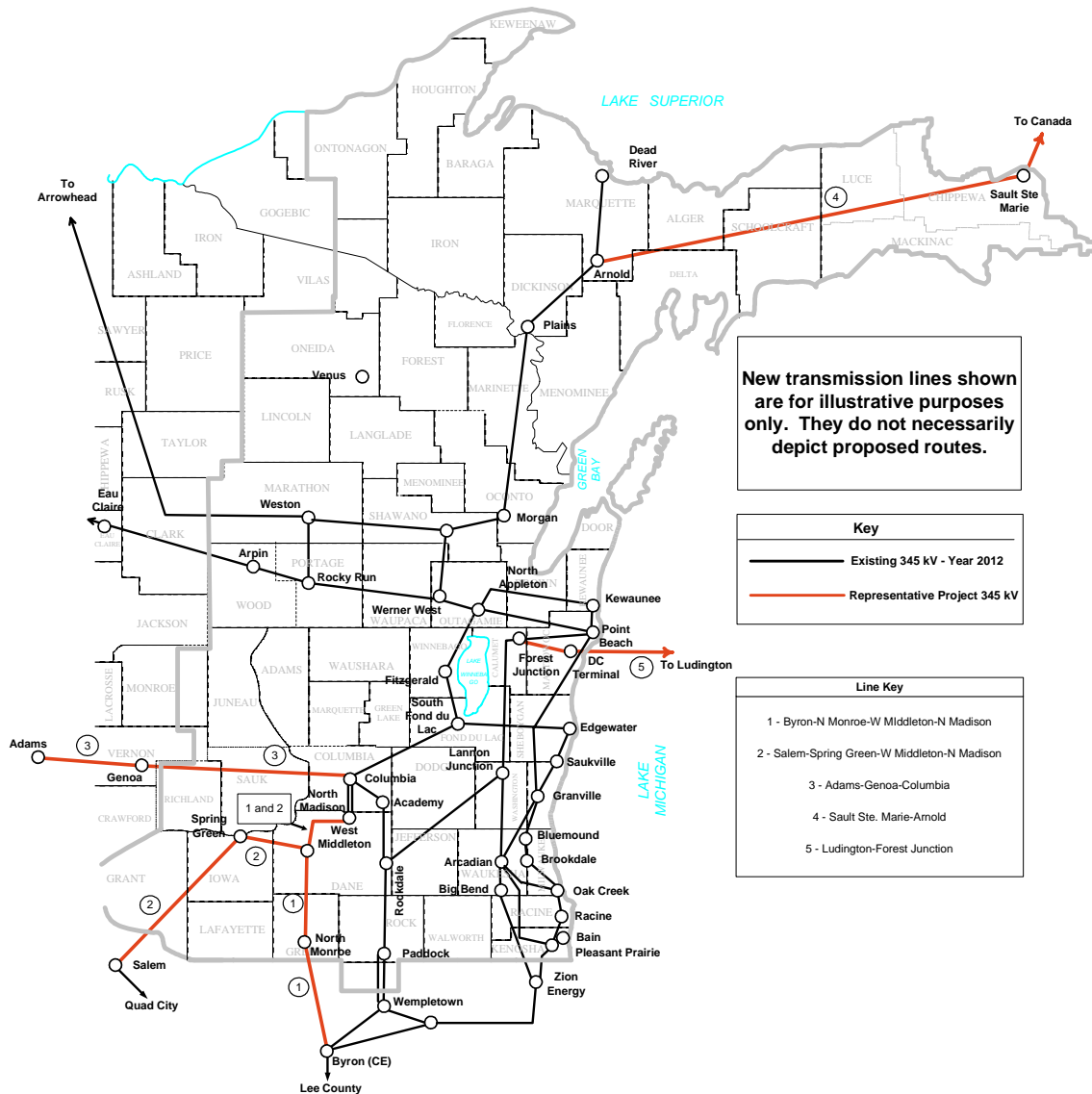
- Morgan-White Clay 138 kV line

Description of Representative Proxy Projects

The five projects examined in this section correspond to five geographic directions ATC could reasonably pursue for a new extra-high voltage (typically 345 kV) transmission interconnection. Only extra-high voltage projects were considered for the major projects in this analysis. However, ATC recognizes that extra-high voltage facilities are not the only alternatives available to meet future import requirements. Relevant alternatives to extra-high voltage facilities will be examined in the analysis performed for the 2004 10-Year Assessment.

Figure VI-1

Representative Access Projects



The five representative proxy projects, as shown on the map in Figure VI-1 are :

1. **South:** Byron–North Monroe–West Middleton–North Madison 345 kV
2. **Southwest:** Salem–Spring Green–West Middleton–North Madison 345 kV
3. **West:** Adams–Genoa–Columbia 345 kV
4. **Northeast:** Sault Ste. Marie–Arnold 345 kV
5. **East:** Ludington–Forest Junction combined DC and 345 kV AC project

Project number 4 above would include either a DC tie or a phase shifting transformer at or near Sault Ste. Marie. However, for this analysis, the system in Ontario was not included in the model and the Sault Ste. Marie bus was modeled as an injection point for the transfers. For project number 5, a special source subsystem was created to mimic the DC sink and DC source points in the interconnected system.

Network Analysis

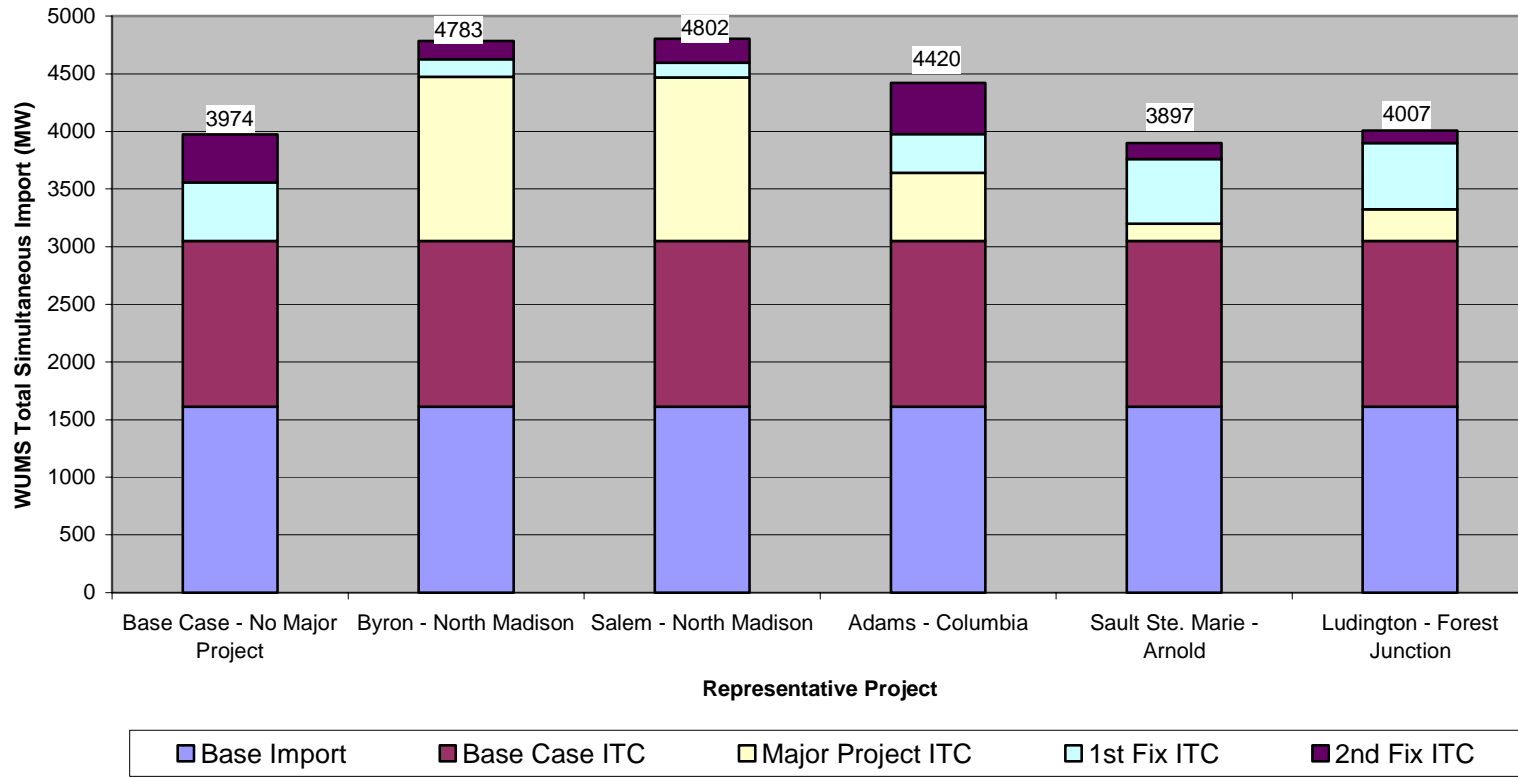
The results presented in Figures VI-2 and VI-3 reflect the relative performance of the proxy projects. Figure VI-2 gives a visual representation of the increased import capability for each scenario. Figure VI-3 provides a comparison of the improved import capability versus the project cost. Table VI-1, below, summarizes this information.

**Table VI-1**  
**Costs and Import Capability for each Representative Project**

Project	Total Cost (Millions)	Total WUMS Simultaneous Import Capability (megawatts)
Base case – no major project added	\$30	3,974
1 South: Byron – N. Madison	\$142	4,783
2 Southwest: Salem – N. Madison	\$223	4,802
3 West: Adams – Columbia	\$244	4,420
4 Northeast: Sault Ste. Marie – Arnold	\$262	3,897
5 East: Ludington – Forest Junction	\$332	4,007

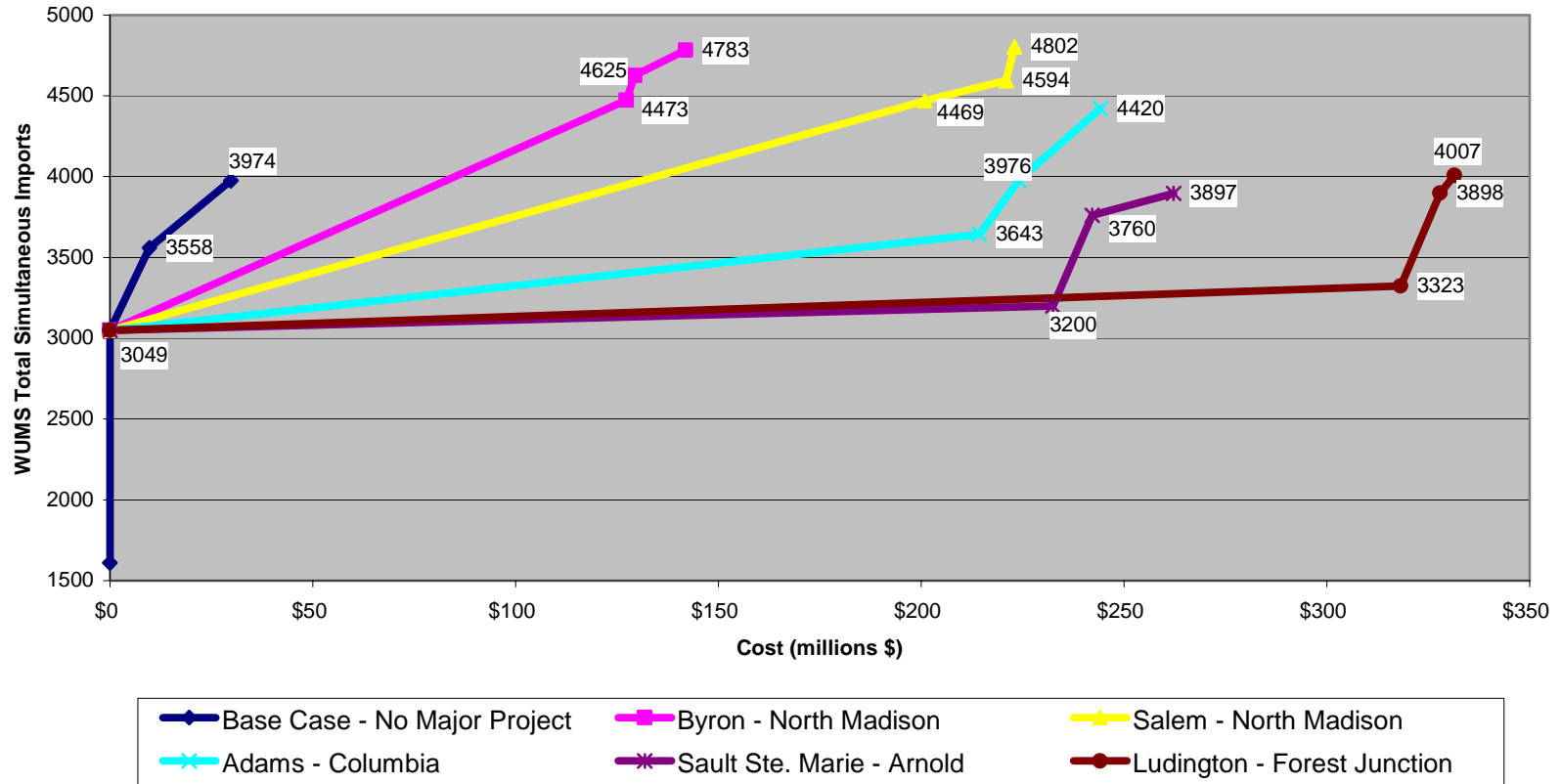
**Figure VI-2**

**Comparison of Representative Projects  
Access Project - Phase I Analysis**



**Figure VI-3**

**Comparison of Representative Projects  
Access Project - Phase I Analysis**



MISO Flowgate Analysis

In addition to the network analysis described before, analysis was also performed on the flowgates MISO incorporates in their Available Flowgate Capacity process. The two tables below list the flowgates that were impacted at greater than 5% for no outage flowgates and 3% for single outage flowgates. Table VI-2 lists the impacted flowgates within ATC’s service territory and Table VI-3 lists the impacted flowgates outside of ATC’s service territory. Although flowgate capability was not calculated due to the long-term horizon considered in this analysis, the flowgate impacts illustrated here may dictate that additional supplementary projects are required to achieve the indicated import capability.

**Table VI-2**  
**Percent Impact of Transfer on MISO Monitored Flowgates (ATC only)**

Chronic TLR Flowgates Highlighted in Yellow

Flowgate	Type	% Base case	% Byron-North Madison	% Salem-North Madison	% Adams-Columbia	% Sault Ste Marie-Arnold	% Ludington-Forest Junction
100:ABGSTLMORPLN	OTDF					3.31	
3006:EAU_ARP_ATC	PTDF	12.07	11.72	11.50	10.51	9.36	9.38
3009:EAUARPWMPPAD	OTDF	12.27	11.85	11.65	10.65	9.55	9.55
3012:PADXFMPADROE	PTDF	8.37	6.95	7.78	8.01	7.74	7.15
3015:NED_T1WEMPAD	OTDF	5.07	4.13	4.14	4.24	4.71	4.57
3016:NED_T1EARP_G	OTDF	5.47	4.89	4.51	4.22	4.94	4.84
3017:CASNEDWEMPAD	OTDF	4.28	3.44	3.19	4.09	3.80	3.53
3018:EAUARPPRIBYR	OTDF	12.11	11.78	11.57	10.78	9.44	9.51
3236:WEMPADZIOARC	OTDF	8.84	7.28	8.19	8.44	8.14	7.45
3237:WEMPADZIOPLP	OTDF	11.55	9.42	10.65	10.99	10.56	9.47
3238:WEMPADCHESIL	PTDF	8.37	6.95	7.78	8.01	7.74	7.15
3239:WEMPADEA_ATC	OTDF	8.80	7.31	8.11	8.28	8.08	7.49
3240:ZIOPLPZIOARC	OTDF	40.65	38.15	38.51	38.87	35.77	28.92
3241:ZIOPLPWP_ATC	OTDF	34.72	32.13	32.92	33.28	30.89	25.59
3242:ZIOARCZIOPLP	OTDF	26.40	24.31	24.69	25.05	23.01	18.26
3243:ZIOARCWEMPAD	OTDF	12.18	11.12	11.40	11.56	10.42	7.98
3527:PLPRACWEMPAD	OTDF	18.80	17.28	17.65	17.88	16.17	12.60
4043:TCRWIEEARP_G	OTDF	4.00	3.88	3.79	3.32	3.06	3.15
4047:NED_T1ARRN_G	PTDF						4.08
4048:WEMPADARRN_G	PTDF	8.37	6.95	7.78	8.01	7.74	7.15
63029:WEMPADEAUARP	OTDF	8.82	7.32	8.13	8.29	8.09	7.50
65031:PLNAMB MORPLN	OTDF					4.99	
65067:PLPARCPLRRAC	OTDF	13.97	12.79	12.99	13.18	11.69	8.55
65068:PLPARCZIOARC	OTDF	9.36	8.53	8.66	8.80	7.72	5.44
Notes:							
OTDF: Contingent flowgate; PTDF: Non-contingent flowgate							

### Table VI-3

#### Percent Impact of Transfer on MISO Monitored Flowgates (non-ATC only)

Chronic TLR Flowgates Highlighted in Yellow

Flowgate	Type	Control Area	% Base case	% Byron-North Madison	% Salem-North Madison	% Adams-Columbia	% Sault Ste Marie-Arnold	% Ludington-Forest Junction
2008:DUMSTLDUMWIL	OTDF	AEP/NIPS	4.34	4.37	4.19	4.03	4.02	
2336:BTHPALCOOPAL	OTDF	AEP/MECS						4.65
2338:COOPALTBARG	OTDF	AEP/MECS						3.09
2339:BTNPALTBARG	OTDF	AEP/MECS						3.63
3220:PLBELCELCLPR	OTDF	CE	4.55	4.68	4.55	4.39	4.04	
3221:PLRELCELCLPB	OTDF	CE	5.42	5.48	5.31	5.21	4.78	
3225:MUNBURDUMWIL	OTDF	CE/NIPS	3.54	3.56	3.43	3.31	3.25	
3230:GDBLPBGDRLPR	OTDF	CE	7.49	7.42	7.27	7.18	6.62	4.11
3258:QUARCKQUADAV	OTDF	ALTW/CE			4.55			
3707:LORTRKWEMPAD	OTDF	ALTW	3.41			3.35	3.02	
3715:QUARCKCORMOL	OTDF	ALTW/CE			4.82			
4051:WEMPADEA__CE	OTDF	CE/ATC	8.80	7.31	8.11	8.28	8.08	7.49
4052:ZIOPLPWP__CE	OTDF	CE/ATC	34.72	32.13	32.92	33.28	30.89	25.59
4068:AEP-MECS	PDTF	AEP/MECS						8.83
4116:COOBENCOOPAL	OTDF	AEP						3.80
4118:PALBENTWBARG	OTDF	AEP/MECS	3.88	3.90	3.86	3.82	3.57	
4119:COOPALCOOBEN	OTDF	AEP/MECS						3.78
4120:PALCOOTWBARG	OTDF	AEP/MECS	3.30	3.32	3.29	3.25	3.04	
4177:COOPALBENPAL	OTDF	AEP/MECS						4.38
4187:LORTRKWPAD_G	OTDF	ALTW	3.76			3.68	3.32	
4188:TRKCSVWPAD_G	OTDF	ALTW/DPC	4.04	3.14		3.87	3.60	3.23
5050:STJLAKIATSTR	PDTF	KCPL/MPS						4.14
6004:MWSI	PDTF	NSP/ATC	12.48	12.29	12.26	12.95	10.15	10.74
6009:COOPER_S	PDTF	OPPD/NPPD						4.33
9903:EAU_ARP_XCEL	PDTF	NSP/ATC	12.07	11.72	11.50	10.51	9.36	9.38
9905:TRKCASWEMPAD	OTDF	ALTW/DPC	3.69			3.53	3.28	
63007:COLXFMCOLPLO	OTDF	CE	3.39	3.45	3.34	3.21	3.08	
63019:LCOBYRELCNEL	OTDF	CE	13.66	15.51	10.94	11.94	12.17	12.68
63020:LEEBYNEAUARP	OTDF	CE	14.77	17.04	12.09	12.51	12.95	12.65
63026:LBRIADPRLBR	OTDF	CE	8.26	8.01	7.84	7.85	7.30	5.25
63034:LOMD46ITALOM	OTDF	CE	8.35	8.10	7.93	7.94	7.38	5.30
63035:EFRGOOWILDUM	OTDF	CE	5.17	5.16	5.06	4.97	4.60	
63038:GDRLPRKENCLR	OTDF	CE	7.18	7.11	6.94	6.86	6.34	4.21
63039:GDBLPBJOB LPB	OTDF	CE	6.35	6.29	6.17	6.09	5.61	3.43
63040:LOBITBDPBLOB	OTDF	CE	8.17	7.80	7.70	7.75	7.22	5.37
63081:DUMWILJEFROC	OTDF	AEP/CE	7.44	7.50	7.23	6.96	6.84	
63082:DUMWILUPNEFR	OTDF	AEP/CE	9.76	9.81	9.51	9.22	8.85	
63084:MUNBRNWILDUM	OTDF	CE/NIPS	3.61	3.63	3.50	3.37	3.32	
63086:CREEFRWILDUM	OTDF	CE	5.55	5.57	5.44	5.31	4.96	
63103:GOOGOODREELC	OTDF	CE	5.66	5.62	5.52	5.46	4.96	3.89
63117:CORNEL471NEL	OTDF	CE	5.76	6.78		3.94	5.44	5.98
63118:471NELCORNEL	OTDF	CE	5.78	6.81		3.95	5.46	6.00

Notes:

OTDF: Contingent flowgate; PDTF: Non-contingent flowgate

Combined Project Network Analysis

ATC also analyzed the relative performance of constructing two of the representative proxy projects. The results of this analysis are shown graphically in Figure VI-4 and in Table VI-4. Figure VI-4 provides a comparison of the improved import capability versus the project costs for each of the combined projects. Table VI-4, below, summarizes this information.

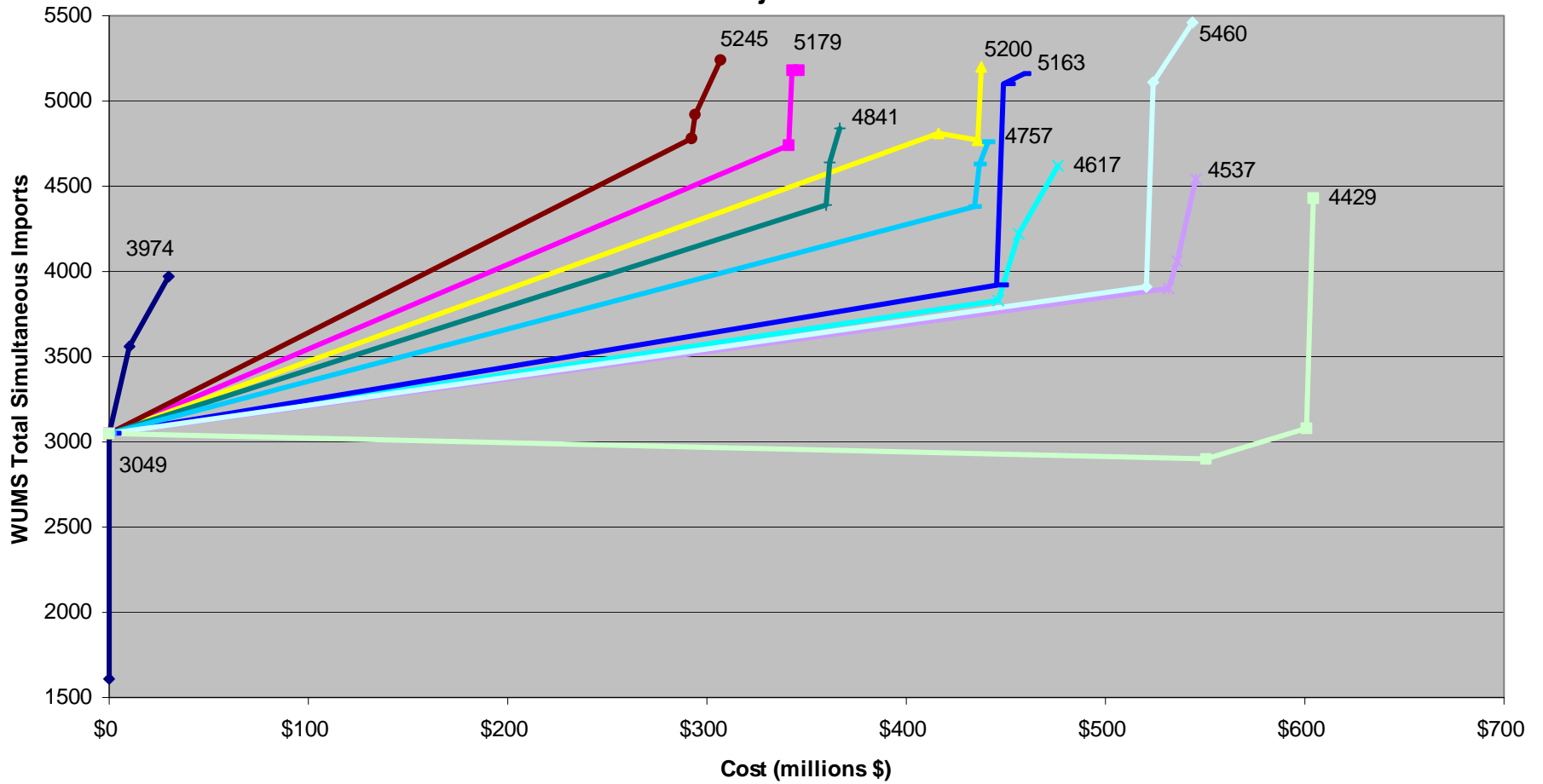
Conclusions – Directional Analysis

- ❑ Achievable import capability gains are very dependent on direction.
- ❑ Representative projects to the south and southwest, individually, appear to provide the largest increases in import capability.
- ❑ Based on the screening-level capital cost estimates, the representative project to the south appears to provide the best value in terms of increasing import capability.
- ❑ If two of the representative projects were constructed, representative projects to the southwest and east appear to provide the largest increase in import capability.
- ❑ Based on capital cost estimates, the representative projects to the south and southwest appear to provide the best value in terms of increasing import capability.
- ❑ Additional analyses will need to be done to confirm these conclusions, and to more fully flesh out the economic impact picture.

**Table VI-4  
Costs and Import Capability from Combined Project Analysis**

Project	Total Cost (Millions)	Total WUMS Simultaneous Import Capability (megawatts)
Base Case – No major project	\$30	3,974
Adams-Columbia and Byron-N. Madison	\$346	5,179
Adams-Columbia and Salem-N. Madison	\$438	5,200
Adams-Columbia and Sault Ste. Marie-Arnold	\$476	4,617
Adams-Columbia and Ludington-Forest Junction	\$546	4,537
Byron-N. Madison and Salem-West Middleton	\$307	5,245
Byron-N. Madison and Sault Ste. Marie-Arnold	\$367	4,841
Byron-N. Madison and Ludington - Forest Junction	\$459	5,163
Salem-N. Madison and Sault Ste. Marie-Arnold	\$441	4,757
Salem-N. Madison and Ludington-Forest Junction	\$544	5,460
Sault Ste. Marie-Arnold and Ludington-Forest Junction	\$604	4,429

**Figure VI-4  
Comparison of Combined Major Alternatives  
Access Project - Phase I**



- ◆ Base Case - No Major Project
- ▲ Adams - Columbia & Salem - North Madison
- ✱ Adams - Columbia & Ludington - Forest Junction
- ◆ Byron - North Madison & Sault Ste. Marie - Arnold
- ◆ Salem - North Madison & Sault Ste. Marie - Arnold
- ◆ Sault Ste. Marie - Arnold & Ludington - Forest Junction
- ◆ Adams - Columbia & Byron - North Madison
- ◆ Adams - Columbia & Sault Ste. Marie - Arnold
- ◆ Byron - North Madison & Salem - West Middleton
- ◆ Byron - North Madison & Ludington - Forest Junction
- ◆ Salem - North Madison & Ludington - Forest Junction