Attachment Y Study
White Pine Unit 1: 20 MW Natural Gas Retirement
April 16, 2014

ATTACHMENT Y STUDY REPORT FINAL

April 14, 2014

PUBLIC / REDACTED

EXECUTIVE SUMMARY

An Attachment Y Request submitted by White Pine Electric Power LLC (WPEP) was received on October 15, 2013. The request is for Retirement of White Pine Unit 1 starting on April 16, 2014.

After being reviewed for power system reliability impacts as provided for under Section 38.2.7 of the MISO's Open Access Transmission, Energy & Operating Reserve Markets Tariff ("Tariff"), White Pine Unit 1 will be required as a System Support Resource (SSR) until completion of a transmission project by American Transmission Company (ATC) to address the reliability issues caused by the unit change of status.

The appropriate transmission upgrades are still in development, but the solution will likely involve a rebuild of the 75-mile 69 kV transmission path from Lakota Road to Winona or an equivalent project. The transmission solution is expected to require several years of regulatory approval, permitting, and construction time with an estimated in-service date in the 2019-2022 timeframe. The project plan will be vetted through the regularly scheduled stakeholder planning meetings in the FERC Order 890 compliant MTEP process and included in or prior to the 2015 MISO Transmission Expansion Plan.

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I. INTRODUCTION

The purpose of this study was to assess the reliability impacts caused by the Retirement of White Pine Unit 1 located in White Pine, MI. White Pine Electric Power LLC, submitted an Attachment Y to MISO requesting Retirement of White Pine Unit 1 starting on April 16, 2014.

Table 1: Units Requesting Retirement

Control Area	Unit Description	Total MW	Start Date of Retirement
Wisconsin Electric Company	White Pine Unit 1	20	04/16/2014

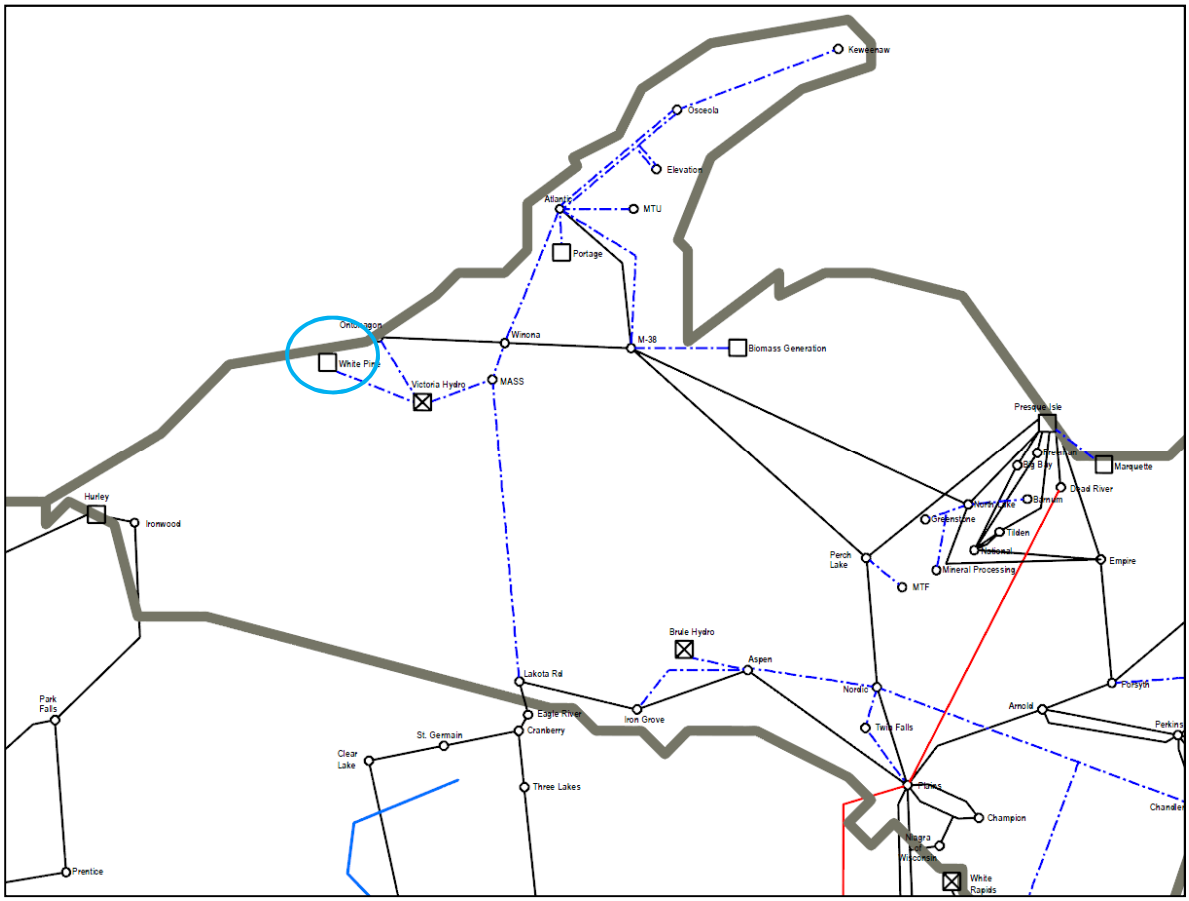

Figure 1: General Location of the White Pine Generation

II. STUDY OBJECTIVES

Under Section 38.2.7 the MISO Tariff, System Support Resource (SSR) procedures provide a mechanism for MISO to enter into agreements with Market Participants (MP) that own or operate Generation Resources or Synchronous Condenser Units (SCUs) that have requested to either Retire or Suspend, but are required to maintain system reliability.

The principal objective of an Attachment Y study is to determine if the unit(s) for which a change in status is requested is necessary for system reliability based on the criteria set forth in the MISO Business Practices Manuals. The study work included monitoring and identifying the steady state branch/voltage violations on transmission facilities due to the unavailability of the Generation Resource or SCU. The relevant MISO Transmission Owner and/or regional reliability criteria are used for monitoring such violations.

III. MODELS AND ASSUMPTIONS

Corresponding to the anticipated retirement of the White Pine Generating Station Unit 1, the following power system analysis models were used for the study:

- 2014 Summer Peak
- 2014 Summer Shoulder
- 2018 Summer Peak
- 2018 Summer Shoulder

Future projects were removed by MISO from the MTEP13 models to represent the April 2014 suspension start date. The MTEP model with the Attachment Y units online and the modelling assumptions included below were used as the "before" model. As there is no other dispatchable generation in the area, the "after" model was manually dispatched with White Pine unit 1 offline. Replacement generation was sourced from remote generators in the MISO footprint.

a. Model Assumptions

2018 Model Assumptions

- 2018 Summer Peak
  - MTEP13 2018 load profile and system topology
- 2018 Summer Shoulder
  - 2014 system topology and projected 2018 Summer Shoulder Load
  - 2014 system topology is appropriate for this model since there are no significant transmission improvements planned for the immediate study area between 2014 and 2018.

2014 Model Assumptions

1. Load

- Study area (ATC Planning Zones 1, 2, and 4) summer shoulder load at approximately 85% of summer peak
    i. ATC supplied load forecast
- Significant Upper Peninsula Mine Loads
    i. Empire Substation: 116.3 MW, 21.2 Mvar
    ii. Tilden Substation: 164.3 MW, 5.7 Mvar
    iii. Total Load: 280.6 MW, 26.9 Mvar
- City of Marquette, Michigan net load: 15 MW
    i. Enforced by adjusting Marquette BTMG

2. Generation
    - Presque Isle Unit 5, 6, 7 and 8 online
    - Approved Attachment Y Units modelled offline
    - Adjacent Wind Units offline
        i. Garden
    - No changes to Michigan UP Hydro Units Pgen
    - Escanaba Generation
        i. Summer Peak: 3 of 3 units online
        ii. Shoulder Peak: 3 of 3 units online
    - West Marinette Generation
        i. Summer Peak: 4 of 4 units online
        ii. Shoulder Peak: 1 of 4 units online
3. System Configuration
    - Michigan UP Split at Mackinaw, open:
        i. Mackinac N – Brevort 138 kV line
        ii. Straits – Pine River 69 kV line
        iii. Straits – Evergreen 69 kV line
4. Transmission Projects
    - Included based on expected In-Service Date (ISD):
        i. Indian Lake – Hiawatha 138 kV line, P333, ISD 10/1/2013
        ii. Mackinac Flow Control Project, P2846, ISD 7/19/2014
            1. The Mackinac VSC project was included in a variation of the 2014 shoulder model with a 40 MW N -> S flow
            2. The UP was closed-in for this case
            3. The adjacent Pine River – Straits 69 kV line rebuild, P3108, ISD 6/1/2014 was included in this variation
        iii. Chandler-18th Road Project; ISD 6/1/2014
    - Excluded based on expected In-Service Date (ISD):
        i. Arnold 345/138 kV Transformer # 1, P3125, ISD 5/1/2015
        ii. Bay Lake Project, P3679, ISD 12/31/2016
        iii. North Appleton – Morgan 138 kV line, P3952, ISD 12/31/2016
        iv. Berryville T-D, P4358, ISD 6/1/2017
        v. Pulliam – Glory Rd Conversion, P3841, ISD 12/1/2016
5. Maintenance
    - Included in system configuration
6. Operating Guides incorporated into the above assumptions:
    - [REDACTED]

- [REDACTED]
- [REDACTED]

b. Table of Models

System Topology	Study Area Load	Dispatch	Source Model	Att Y Gen	VSC	UP Split
2014	2014 SP	SP	MTEP13 2015SP	Off	Not In-Service	Yes
2014	2014 SP	SP	MTEP13 2015SP	On	Not In-Service	Yes
2014	2014 SH	SH	MTEP13 2018SH	Off	Not In-Service	Yes
2014	2014 SH	SH	MTEP13 2018SH	On	Not In-Service	Yes
2014	2014 SH	SH	MTEP13 2018SH	Off	40 MW N -> S	No
2014	2014 SH	SH	MTEP13 2018SH	On	40 MW N -> S	No
2018	2018 SP	SP	MTEP13 2018SP	Off	40 MW N -> S	No
2018	2018 SP	SP	MTEP13 2018SP	On	40 MW N -> S	No
2014	2018 SH	SH	MTEP13 2014SH	Off	40 MW N -> S	No
2014	2018 SH	SH	MTEP13 2014SH	On	40 MW N -> S	No

c. Monitoring and Contingencies

Monitor: WEC, ALTE, WPS, UPPC, METC* Control Areas; XEL_WI Zone 69 kV – 345 kV

*METC Control Area will be monitored only for the case with the VSC in service.

Contingencies: WEC, ALTE, WPS, UPPC, XEL Control Areas, 69 – 345 kV System Intact (A), NERC Category B, C1, C2, and C5 on peak and shoulder. Additionally, NERC Category C3 contingencies will be analyzed (planned + forced scenarios).

IV. STUDY CRITERIA AND METHODOLOGY

PSS/E and MUST were used to perform AC contingency analysis. Cases were solved with automatic control of LTCs, phase shifters, DC taps, switched shunts enabled (regulating), and area interchange disabled. Contingency analysis was performed on "before" and "after" cases.

The results were compared to find if there were any criteria violations due to the unit(s) change of status.

a. Steady State Thermal and Voltage Criteria

Transmission Owners Planning Criteria

ATC Transmission Planning Criteria applied for thermal analysis:

- For System Intact (Category A), all thermal loadings exceeding 100% of the normal rating for the ATC System
- For Category B and C contingencies, all thermal loadings exceeding 100% of the emergency rating for the ATC System

ATC Transmission Planning Criteria applied for voltage analysis:

- For System Intact (Category A), all substation voltages less than 95% or above 105%
- For Category B and C contingencies, all substation voltages less than 90% or above 110%

Xcel Transmission Planning Criteria applied for thermal analysis:

- For System Intact (Category A), all thermal loadings exceeding 100% of the normal rating for the Xcel System
- For Category B and C contingencies, all thermal loadings exceeding 100% of the emergency rating for the Xcel System

Xcel Transmission Planning Criteria applied for voltage analysis:

- For System Intact (Category A), all substation voltages less than 95% or above 105%
- For Category B and C contingencies, all non-generator substation voltages less than 92% or above 105%
- For Category B and C contingencies, all generator substation voltages less than 95% or above 105%
- For Category C3 contingencies, all generation substation voltages less than 92% or above 105%

ITC Transmission Planning Criteria

ITC Transmission Description	NERC Category	Allowable Load Loss[l]	BES Level[n]	Ratings Used	Load Level[k] (% System Peak)	Minimum Voltages[h,i,r]	Maximum Voltage[h,i,r]
System Normal[e]	A	none	EHV, HV	normal	100%	97%	107%[b]

ITC Transmission Description	NERC Category	Allowable Load Loss[l]	BES Level[n]	Ratings Used	Load Level[k] (% System Peak)	Minimum Voltages[h,i,r]	Maximum Voltage[h,i,r]
Single Generator (no Generators in proximity off in base case)[f]	B1	none	EHV, HV	normal	100%	97%	107%[b]
Single Generator (with other generators in proximity off in base case)[f]	B1	none[a]	EHV, HV	emergency[c]	100%	92%	107%[b]
Single UG Cable[f]	B2	none[a]	EHV, HV	emergency[c]	100%	92%	107%[b]
Single OH Line[f]	B2	none[a]	EHV, HV	emergency[c]	100%	92%	107%[b]
Single Transformer[f]	B3	none[a]	EHV, HV	emergency[c]	100%	92%	107%[b]
Shunt Device[f,o]	B4	none[a]	EHV, HV	emergency[c]	100%	92%	107%[b]
Opening of a line section w/o a Fault[f,o]	B5	none[a]	EHV, HV	emergency[c]	100%	92%	107%[b]
Bus Section[f]	C1	none[a]	EHV	emergency[c]	100%	92%	107%[b]
		100 MW	HV	emergency[c]	100%	92%	107%[b]
Circuit Breaker[f]	C2	none[a]	EHV	emergency[c]	100%	92%	107%[b]
		300 MW	HV	emergency[c]	100%	92%	107%[b]
Shutdown + Contingency[f,m,q]	B1, B2, or B3[k]	none[a]	EHV, HV	emergency[c]	85%	92%	107%[b]
Double Circuit Tower (DCT)[f]	C5	300 MW	EHV, HV	emergency[c]	100%	92%	107%[b]
Double Contingencies[d,f,m,q]		500 MW					
1. After First Contingency (Prior to System Re-Adjustment)	C3	none[a]	EHV, HV	emergency[c]	100%	Variable[g]	107%[b]
2. After First Contingency (After System Re-Adjustment)	C3	none[a]	EHV, HV	normal	100%	Variable[g]	107%[b]
3. After Second Contingency (Prior to System Re-Adjustment)	C3	500MW	EHV, HV	emergency[c]	100%	Variable[g]	107%[b]
Extreme Contingencies[d,f]	D	no	EHV,	emergency[c]	100%	no	no

ITC Transmission Description	NERC Category	Allowable Load Loss[l]	BES Level[n]	Ratings Used	Load Level[k] (% System Peak)	Minimum Voltages[h,i,r]	Maximum Voltage[h,i,r]
		cascading	HV			cascading	cascading

a) There may be some consequential load loss in the event of the loss of a radial circuit, a transformer in direct series with a radial circuit or the loss of a load fed from a radial tap off of a network circuit provided the load lost was served directly by the outaged facility.

b) 110% is the generally applicable system (physical) limit and represents SOLs. For some specific locations a more stringent SOL limit may be applied. System studies should monitor and plan to 105% voltage due to contractual obligations with the Load Serving Entities.

The contractual obligation does not define the SOL.

c) The emergency rating applied shall be of an appropriate duration considering both the piece of equipment limited and the contingency studied.

d) The NERC Planning Standards consider a single category B event followed by operator intervention followed by another category B event as a category C event. The loss of two elements without time between for operator action is interpreted by ITC to be more severe than category C and is treated like an extreme contingency.

e) Normal Conditions include an appropriate set of scenarios that consider appropriate generators not in the dispatch

f) Emergency conditions include an appropriate set of scenarios that consider appropriate generators not in the dispatch in addition to the single, double and multiple transmission element outages. This would typically include at least a single generator dispatched off prior to applying the contingency under study.

g) Minimum voltage during a double contingency or an extreme contingency is determined by the minimum voltage required at power plants to avoid widespread cascading outages. The minimum voltage requirements vary from plant to plant.

h) Some buses have individual voltage limits. These are reviewed on a case by case basis.

i) The voltage limits listed are steady state voltage limits. Voltage control devices (tap changers, switched shunts, phase shifting transformers...) should be set to control during the analysis.

j) In no circumstance should the contingency result in automatic tripping of a circuit or safety violations.

k) The Load Level shown is the maximum load level to which this part of the criteria should be applied. It is also valid at any load level less than that shown, for instance when studying the impact of wind generation dispatched at a load level less than system peak.

l) Allowable load loss is the sum of 1) any load lost directly following the event such as load fed radially off an outaged line and 2) any load shed to get within applicable limits.

m) Appropriate classification for multiple outages involving generators shall depend on the status of other generators in proximity in the starting case. For example, the shutdown of a generator and subsequent contingency shall be considered a “shutdown + contingency” should generation already be off in the proximity in the normal case. If generation is not off in the proximity in the base case, this shall be

considered as a simple contingency.

n) Bulk Electric System (BES) level references include extra-high voltage (EHV) facilities defined as greater than 300 kV and high voltage (HV) facilities defined as the 300 kV and lower voltage systems. The designation of EHV and HV is used to distinguish between stated performance criteria allowances for interruption of firm transmission service and non-consequential load loss.

o) Requirements which are applicable to shunt devices also apply to FACTS devices that are connected to ground.

p) Opening one end of a line section without a fault on a normally networked transmission circuit such that the line is possibly serving load radially from a single source point.

q) A protection system maintenance shutdown or failure would constitute a viable contingency for Category B3 or C3 events.

r) All Nuclear Plant Interface Requirements (NPIRs) applicable to generator plants in the ITCT and METC footprints shall be monitored and upheld.

Wolverine Power Supply Planning Criteria

For normal conditions with all circuits in service, the following conditions should be met:

1. Transmission system voltages should range from 95.0 to 105.0 percent of nominal.

2. Transmission lines should not be loaded above the normal rating of the conductors.

3. Transmission system auto-transformers should not be loaded above their maximum rating at a temperature rise of 65 deg C.

4. No loss of demand or curtailed firm transfers.

5. No cascading outages.

Event(s) resulting in the loss of a single element, unplanned outage of a single circuit, circuit breaker, or auto-transformer, the following conditions should be met:

1. Transmission system voltages should range from 92.0 to 106.0 percent of nominal.

2. Transmission lines should not be loaded above the emergency rating of the conductors.

3. Transmission system auto-transformers should not be loaded above their maximum rating at a temperature rise of 65 deg C or as determined by the IEEE loading guidelines established in IEEE Std. C57.91.

4. Transmission facility must not exceed the emergency rating of that facility.

5. Planned or controlled interruption of electric supply to radial customers or some local network customers connected to or supplied by the faulted element or by the affected area, may occur in certain areas. This shall not impact the overall reliability of the interconnected transmission system. Curtailment of contracted firm (non-recallable reserved) electric power transfers may be required to prepare for the next contingency.

6. No cascading outages.

Event(s) resulting in the loss of two or more (multiple) elements, unplanned outage of a bus section,

breaker failure, or delayed clearing, the following conditions should be met:

1. Transmission system voltages should range from 90.0 to 106.0 percent of nominal.

2. Transmission lines should not be loaded above the emergency rating of the conductors.

3. Transmission system auto-transformers should not be loaded above their maximum rating at a temperature rise of 65 deg C or as determined by the IEEE loading guidelines established in IEEE Std. C57.91.

4. Transmission facility must not exceed the emergency rating of that facility.

5. Controlled interruption of electric supply to some local network customers, removal of generators, and/or the curtailment of firm (non-recallable reserved) electric power transfers may occur in order to maintain the overall reliability of the interconnected transmission system.

6. No cascading outages.

7. Controlled interruption of electric supply to some local network customers, removal of generators, and/or the curtailment of firm (non-recallable reserved) electric power transfers may occur in order to maintain the overall reliability of the interconnected transmission system.

8. No cascading outages.

Under category C contingencies, for the valid thermal and voltage violations as specified above, generation re-dispatch, system reconfiguration, and/or load shedding will be considered if applicable.

b. MISO Transmission Planning BPM - SSR Criteria

As specified in the MISO BPM-020-r9, the System Support Resource criteria for determining if an identified facility is impacted by the generator change of status is:

- Under system intact and category B contingencies, branch thermal violations are only valid if the flow increase on the element in the "after" retirement scenario is equal to or greater than:
  a) 5% of the "to-be-retired" unit(s) MW amount (i.e. 5% PTDF) for a "base" violation compared with the "before" retirement scenario, or
  b) 3% of the "to-be-retired" unit(s) amount (i.e. 3% OTDF) for a "contingency" violation compared with the "before" retirement scenario.
- Under system intact and category B contingencies, high and low voltage violations are only valid if the change in voltage is greater than 1% as compared to the "before" retirement voltage calculation.

c. Contingencies

A subset of the MISO Transmission Expansion Plan (MTEP) contingencies in ATC and the neighboring control areas were used for AC contingency analysis.

The following NERC Categories of contingencies were evaluated:

1. Category A when the system is under normal conditions.
2. Category B contingencies resulting in the loss of a single element.
3. Category C contingencies resulting in the loss of two or more (multiple) elements.

d. Steady State Performance Analysis

AC contingency analysis was performed using Siemens PSS/E.

Contingency analysis was performed on "before" and "after" cases. Results were compared to determine if there were any criteria violations due to the retirement of the studied unit.

V. STUDY RESULTS

a. Branch Results (Appendix A, Table 1)

Appendix A, Table 1 contains contingent conditions causing branch criteria violations without White Pine Unit 1 online. No overloads were observed in the 2014 summer peak study for NERC Category B events while several Category C overloads were observed. In the 2014 shoulder case with the UP split, a pre-existing NERC Category B overload is made worse by the unit retirement and a number of events involving a planned outage followed by a NERC Category B contingency result in thermal overloads with some severe overloads exceeding 150% of the emergency rating. In the 2014 shoulder case with the Mackinac Flow Control in service three new and one pre-existing thermal overloads resulting from NERC Category B events are aggravated by the retirement of the unit. Several events involving a planned outage followed by a NERC Category B contingency caused a large number of branch violations including a significant overload exceeding 156% of the emergency rating. The 2018 summer peak analysis identified no Category B overloads and several Category C issues. In the 2018 shoulder analysis there are three new events involving a NERC Category B contingency leading to thermal violations caused by the unit retirement and numerous pre-existing events involving a planned outage followed by a NERC Category B contingency that led to overloads made worse by the retirement of the unit.

b. Voltage Results (Appendix A, Table 2)

Appendix A, Table 2 contains contingent conditions causing voltage criteria violations without White Pine Unit 1 online. The 2014 summer peak analysis identified no voltage violations for system intact and NERC Category B events and one violation due to a Category C event. In the 2014 shoulder analysis with the UP split, no Transmission System voltage violations were observed for system intact, NERC Category B, or planned outages followed by a NERC Category B contingency. With the Mackinac Flow Control in service, no NERC Category B violations were identified, but several voltage violations occurred for three events involving planned outages followed by a NERC Category B contingency. No voltage violations were identified in the 2018 summer peak analysis. In the 2018 shoulder analysis there are two pre-existing voltage violations due to events involving a planned outage followed by a NERC Category B contingency that are aggravated by the unit retirement.

The most severe event involving an outage of the [REDACTED] line followed by an outage of the [REDACTED] line in the 2014 shoulder model leads to post contingent flow that is 155% of the time limited emergency rating of the remaining path into the study area, the 69 kV line from Conover-Mass. An overload of this magnitude exceeds the Transient Thermal Rating (100% for ATC 69kV facilities) of the overloaded line causing it to trip almost instantaneously which results in voltage collapse of the area.

VI. SSR COST ALLOCATION

Table 2: SSR Agreement LBA/Pricing Zone Shares

Area/PricingZone	Cumulative Load Shed (MW)	Share
ATC	15	100%

VII. ALTERNATIVES ANALYSIS

a. New Generation or Generation Redispatch

Further analysis of the pre-existing thermal overloads included the re-dispatch of the Presque Isle Plant to utilize the larger units and to consider the commitment of all five units to support planned outages. The results indicated that the additional generation alleviates the thermal violations for all the pre-existing constraints except the Maine – Hilltop 115kV circuit which is alleviated with redispatch of Weston generation. Appendix B, Table 1 shows the results of the re-dispatch analysis.

The Presque Isle re-dispatch does not address all the new constraints that are caused by the retirement. The White Pine generator is located in a load pocket (approximately 70MW at shoulder peak) and with White Pine Unit 1 offline an outage of the [REDACTED] line in conjunction with an outage of the [REDACTED] line leads to a single remaining 69 kV transmission line to support the majority of the area load.

MISO evaluated the possible use of the UPPCo 20MW Portage CT which is equivalent in size and located in the western UP load pocket. While the unit provides sufficient relief for the 69 kV thermal overloads that result from an outage of the [REDACTED] lines, the unit is reserved for emergency-only use and has a limited number of starts available due to the condition of the unit. Since a transmission emergency would not be declared to support planned outages, the Portage CT would be required to be made available for the duration of the outage. Moreover, pre-contingent commitment would be required to avoid any overload that would quickly trip the 69 kV circuit. The number of starts and potential for long run times during the facility outages would decrease the life expectancy of the unit and reduce the availability of the unit for unplanned and forced outage events. UPPCo did not pursue further interest in offering the unit to accommodate the planned outage needs. With the limited amount of other generation in the load pocket already dispatched to full output, no further options exist to provide mitigation by redispatch.

b. System Reconfiguration and Operation Guidelines

Analysis was performed utilizing the Mackinac Voltage Source Converter (VSC) Flow Control device. Under prior outage conditions adjustment of the VSC can provide improvements to

address many of the thermal violations. However, there is limited transmission to serve the load pocket around the White Pine Plant, and no System Reconfiguration or Operating Guide alternative is available. A number of planned outages are required on the area facilities over the next several years. With the unit in permanent retirement and no transmission reinforcements expected in the near term, no feasible options exist to reschedule outages to avoid the potential voltage collapse issue that results from a planned outage followed by a NERC Category B event.

c. Demand Response or Load Curtailment

The study included an optimal load shed analysis to estimate the amount of hypothetical load shed needed to resolve the reliability issues. To fully address all the remaining thermal overloads, the amount of contracted demand response needed was estimated to be 12MW as an alternative to White Pine Unit 1 in order to support outages. Additionally, the demand response would be necessary on a pre-contingent basis anytime one of the [REDACTED] or [REDACTED] circuits is out. Further load curtailment beyond the contracted 12MW demand response would likely result from outages occurring in higher load periods. Appendix B, Table 2 contains the load shed value for the worst constraint identified.

d. Transmission Projects

No short term transmission project is available to be in service prior to the requested date of the White Pine Unit 1 Retirement. Although appropriate transmission upgrades are still in development, the solution will likely involve a rebuild of the 75-mile 69 kV transmission path from Lakota Road to Winona or an equivalent project. The transmission solution is expected to require several years of regulatory approval, permitting, and construction time with an estimated in-service date in the 2019-2022 timeframe.

VIII. CONCLUSION

The analysis of the White Pine Unit 1 Attachment Y request indicated that voltage collapse can result from the concurrent outage of the [REDACTED] line and the [REDACTED] line in shoulder load conditions. The severe overload that occurs on the Conover – Mass 69kV line and the Mass-Winona 69 kV line exceeds the Transient Thermal Rating of both facilities and would result in immediate tripping which causes voltage collapse. With the retirement of White Pine Unit 1 planned maintenance under shoulder load conditions could not be scheduled since the planned outage followed by a NERC Category B event would result in the voltage collapse due to the trip of the 69kV source. Additionally, a NERC Category C3 event involving the same two [REDACTED] lines during summer peak load leads to voltage collapse of the area unless both Units 1 and 2 at White Pine and the Portage CT are running.

After being reviewed for power system reliability impacts as provided for under Section 38.2.7 of the MISO's Open Access Transmission, Energy & Operating Reserve Markets Tariff ("Tariff"), White Pine Unit 1 will be required as a System Support Resource (SSR) unit until completion of a transmission project by American Transmission Company (ATC) to address the reliability issues caused by the unit change of status.

The appropriate transmission upgrades are still in development, but the solution will likely involve a rebuild of the 75-mile 69 kV transmission path from Lakota Road to Winona or an equivalent project. The transmission solution is expected to require several years of regulatory approval, permitting, and construction time with an estimated in-service date in the 2019-2022 timeframe. The project plan will be vetted through the regularly scheduled stakeholder planning meetings in the FERC Order 890 compliant MTEP process and included in or prior to the 2015 MISO Transmission Expansion Plan.

IX. APPENDICES

Appendix A:

Table 1 - Steady-State AC Contingency Branch Results

Table 2 - Steady-State AC Contingency Voltage Results

Appendix B: Alternatives Analysis

Table 1 – Redispatch of Presque Isle on Pre-existing Constraints

Table 2 – Estimate of Demand Response (Hypothetical)

Appendix A

Steady-State AC Contingency Analysis Results

MISO WPEP Unit 1 Attachment Y Study - Compare Branch Results

			White Pine 1 Off			White Pine 1 On				
Model	Limiting Element	Rating	Cont. Flow	Base Flow	Loading	BF.Cont. Flow	BF.Base Flow	BF.Loading	Contingency	Comments
WhitePine_2014SH	699003 LAND O L 69-699005 CON 69 1	35	54.4	8.1	155.4%	21.8	6.3	62.3%	[REDACTED]	SSR constraint
WhitePine_2014SH	698999 WATERSM 69-699003 LAND O L 69 1	35	48.5	4.1	138.6%	17.8	3.3	50.9%	[REDACTED]	SSR constraint
WhitePine_2014SH	698997 BRUCE CR 69-698999 WATERSM 69 1	35	44.4	1.6	126.9%	14.9	3.2	42.6%	[REDACTED]	SSR constraint
WhitePine_2014SH	698995 MASS 69-698805 LAKE MIN 69 1	32	40.2	12.3	125.6%	31.5	20.2	98.4%	[REDACTED]	SSR constraint
WhitePine_2014SH	698995 MASS 69-698997 BRUCE CR 69 1	35	42.4	2.9	121.1%	13.1	5.3	37.4%	[REDACTED]	SSR constraint
WhitePine_2014SH	698740 WINON TI 69-698805 LAKE MIN 69 1	37	40.3	12.2	108.9%	31.4	20.1	84.9%	[REDACTED]	SSR constraint
WhitePine_2014SH	698561 SUMMITLK 115-699782 ARORA ST 115 1	150	150.5	62.7	100.3%	148.7	61.7	99.1%	[REDACTED]	SSR constraint
WhitePine_2014SH	699532 FALLS WE 138-699570 MORGAN 138 1	335	363.3	182.6	108.4%	356.7	181.8	106.5%	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2014SH	699569 PLAINS 138-699581 ARNOLD 138 1	173	187.2	85.7	108.2%	176.9	84.4	102.3%	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2014SH	698800 MAINE115 115-699703 HILLTP 115 1	205	214	133.6	104.4%	212.5	132.6	103.7%	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2014SH	694082 WERNER W B4 345-694066 ROCKY RN B6 345	771	786.9	449.4	102.1%	785.2	448.7	101.8%	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2014SH	694082 WERNER W B4 345-694066 ROCKY RN B6 345	771	775.2	449.4	100.5%	773.1	448.7	100.3%	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2014SH	699532 FALLS WE 138-699570 MORGAN 138 1	335	360	182.6	107.5%	353.5	181.8	105.5%	[REDACTED]	SSR Constraint; existing constraint, aggrevated by study unit retirement. Mgn plains, presque use 6,7,8,9
WhitePine_2014SH_VSC	699003 LAND O L 69-699005 CON 69 1	35	54.7	9.1	156.2%	22.3	6.6	63.7%	[REDACTED]	SSR constraint
WhitePine_2014SH_VSC	698999 WATERSM 69-699003 LAND O L 69 1	35	50.5	5.1	144.3%	18.4	3.1	52.6%	[REDACTED]	SSR constraint
WhitePine_2014SH_VSC	698997 BRUCE CR 69-698999 WATERSM 69 1	35	46.3	2.3	132.3%	15.5	2.1	44.3%	[REDACTED]	SSR constraint
WhitePine_2014SH_VSC	699569 PLAINS 138-699581 ARNOLD 138 1	173	175.3	114.6	101.3%	170.7	113.4	98.7%	[REDACTED]	SSR constraint
WhitePine_2014SH_VSC	699569 PLAINS 138-699581 ARNOLD 138 1	173	175.3	114.6	101.3%	171.6	113.4	99.2%	[REDACTED]	SSR constraint
WhitePine_2014SH_VSC	699569 PLAINS 138-699581 ARNOLD 138 1	173	175.3	114.6	101.3%	171.2	113.4	99.0%	[REDACTED]	SSR constraint
WhitePine_2014SH_VSC	699569 PLAINS 138-699581 ARNOLD 138 1	173	177	114.6	102.3%	172.9	113.4	99.9%	[REDACTED]	SSR constraint
WhitePine_2014SH_VSC	699569 PLAINS 138-699581 ARNOLD 138 1	173	176.3	114.6	101.9%	172.1	113.4	99.5%	[REDACTED]	SSR constraint
WhitePine_2014SH_VSC	699569 PLAINS 138-699581 ARNOLD 138 1	173	176.2	114.6	101.8%	172.1	113.4	99.5%	[REDACTED]	SSR constraint

WhitePine_2014SH_VSC	699569 PLAINS 138-699581 ARNOLD 138 1	173	175.9	114.6	101.7%	171.6	113.4	99.2%	[REDACTED]	SSR constraint
WhitePine_2014SH_VSC	699569 PLAINS 138-699581 ARNOLD 138 1	173	175.9	114.6	101.7%	171.7	113.4	99.2%	[REDACTED]	SSR constraint
WhitePine_2014SH_VSC	699569 PLAINS 138-699581 ARNOLD 138 1	173	175.9	114.6	101.7%	171.7	113.4	99.2%	[REDACTED]	SSR constraint
WhitePine_2014SH_VSC	699569 PLAINS 138-699581 ARNOLD 138 1	173	175.9	114.6	101.7%	171.7	113.4	99.2%	[REDACTED]	SSR constraint
WhitePine_2014SH_VSC	699569 PLAINS 138-699581 ARNOLD 138 1	173	176	114.6	101.7%	171.8	113.4	99.3%	[REDACTED]	SSR constraint
WhitePine_2014SH_VSC	699569 PLAINS 138-699581 ARNOLD 138 1	173	176	114.6	101.7%	171.8	113.4	99.3%	[REDACTED]	SSR constraint
WhitePine_2014SH_VSC	699569 PLAINS 138-699581 ARNOLD 138 1	173	176	114.6	101.7%	171.8	113.4	99.3%	[REDACTED]	SSR constraint
WhitePine_2014SH_VSC	699569 PLAINS 138-699581 ARNOLD 138 1	173	176	114.6	101.7%	171.8	113.4	99.3%	[REDACTED]	SSR constraint
WhitePine_2014SH_VSC	699569 PLAINS 138-699581 ARNOLD 138 1	173	176	114.6	101.7%	171.8	113.4	99.3%	[REDACTED]	SSR constraint
WhitePine_2014SH_VSC	699569 PLAINS 138-699581 ARNOLD 138 1	173	176	114.6	101.7%	171.9	113.4	99.4%	[REDACTED]	SSR constraint
WhitePine_2014SH_VSC	699569 PLAINS 138-699581 ARNOLD 138 1	173	175.9	114.6	101.7%	171.8	113.4	99.3%	[REDACTED]	SSR constraint
WhitePine_2014SH_VSC	699569 PLAINS 138-699581 ARNOLD 138 1	173	175.9	114.6	101.7%	171.8	113.4	99.3%	[REDACTED]	SSR constraint
WhitePine_2014SH_VSC	699569 PLAINS 138-699581 ARNOLD 138 1	173	175.9	114.6	101.7%	171.8	113.4	99.3%	[REDACTED]	SSR constraint
WhitePine_2014SH_VSC	699569 PLAINS 138-699581 ARNOLD 138 1	173	175.9	114.6	101.7%	171.8	113.4	99.3%	[REDACTED]	SSR constraint
WhitePine_2014SH_VSC	699569 PLAINS 138-699581 ARNOLD 138 1	173	175.9	114.6	101.7%	171.8	113.4	99.3%	[REDACTED]	SSR constraint
WhitePine_2014SH_VSC	699569 PLAINS 138-699581 ARNOLD 138 1	173	175.9	114.6	101.7%	171.8	113.4	99.3%	[REDACTED]	SSR constraint
WhitePine_2014SH_VSC	699569 PLAINS 138-699581 ARNOLD 138 1	173	175.9	114.6	101.7%	171.8	113.4	99.3%	[REDACTED]	SSR constraint
WhitePine_2014SH_VSC	699569 PLAINS 138-699581 ARNOLD 138 1	173	175.9	114.6	101.7%	171.8	113.4	99.3%	[REDACTED]	SSR constraint
WhitePine_2014SH_VSC	699569 PLAINS 138-699581 ARNOLD 138 1	173	175.9	114.6	101.7%	171.8	113.4	99.3%	[REDACTED]	SSR constraint
WhitePine_2014SH_VSC	699569 PLAINS 138-699581 ARNOLD 138 1	173	175.9	114.6	101.7%	171.8	113.4	99.3%	[REDACTED]	SSR constraint
WhitePine_2014SH_VSC	699569 PLAINS 138-699581 ARNOLD 138 1	173	175.9	114.6	101.7%	171.8	113.4	99.3%	[REDACTED]	SSR constraint
WhitePine_2014SH_VSC	699569 PLAINS 138-699581 ARNOLD 138 1	173	175.9	114.6	101.7%	171.8	113.4	99.3%	[REDACTED]	SSR constraint
WhitePine_2014SH_VSC	699569 PLAINS 138-699581 ARNOLD 138 1	173	175.9	114.6	101.7%	171.8	113.4	99.3%	[REDACTED]	SSR constraint

WhitePine_2014SH_VSC	699569 PLAINS 138-699581 ARNOLD 138 1	173	175.9	114.6	101.7%	171.8	113.4	99.3%	[REDACTED]	SSR constraint
WhitePine_2014SH_VSC	699569 PLAINS 138-699581 ARNOLD 138 1	173	175.9	114.6	101.7%	171.8	113.4	99.3%	[REDACTED]	SSR constraint
WhitePine_2014SH_VSC	699569 PLAINS 138-699581 ARNOLD 138 1	173	175.7	114.6	101.6%	171.4	113.4	99.1%	[REDACTED]	SSR constraint
WhitePine_2014SH_VSC	699569 PLAINS 138-699581 ARNOLD 138 1	173	175.7	114.6	101.6%	171.5	113.4	99.1%	[REDACTED]	SSR constraint
WhitePine_2014SH_VSC	699569 PLAINS 138-699581 ARNOLD 138 1	173	175.8	114.6	101.6%	171.7	113.4	99.2%	[REDACTED]	SSR constraint
WhitePine_2014SH_VSC	699569 PLAINS 138-699581 ARNOLD 138 1	173	175.8	114.6	101.6%	171.7	113.4	99.2%	[REDACTED]	SSR constraint
WhitePine_2014SH_VSC	699569 PLAINS 138-699581 ARNOLD 138 1	173	175.7	114.6	101.6%	171.6	113.4	99.2%	[REDACTED]	SSR constraint
WhitePine_2014SH_VSC	699569 PLAINS 138-699581 ARNOLD 138 1	173	175.7	114.6	101.6%	171.6	113.4	99.2%	[REDACTED]	SSR constraint
WhitePine_2014SH_VSC	699569 PLAINS 138-699581 ARNOLD 138 1	173	175.6	114.6	101.5%	171.5	113.4	99.1%	[REDACTED]	SSR constraint
WhitePine_2014SH_VSC	699569 PLAINS 138-699581 ARNOLD 138 1	173	175.5	114.6	101.4%	171.3	113.4	99.0%	[REDACTED]	SSR constraint
WhitePine_2014SH_VSC	699569 PLAINS 138-699581 ARNOLD 138 1	173	175.4	114.6	101.4%	171.3	113.4	99.0%	[REDACTED]	SSR constraint
WhitePine_2014SH_VSC	699569 PLAINS 138-699581 ARNOLD 138 1	173	176.7	114.6	102.1%	172.5	113.4	99.7%	[REDACTED]	SSR constraint
WhitePine_2014SH_VSC	698907 EMPIRE6 138-699904 PRESQ IS 138 1	170	171.8	104.2	101.1%	169.9	103.7	99.9%	[REDACTED]	SSR constraint
WhitePine_2014SH_VSC	699569 PLAINS 138-699581 ARNOLD 138 1	173	173.3	114.6	100.2%	169.2	113.4	97.8%	[REDACTED]	SSR constraint
WhitePine_2014SH_VSC	699569 PLAINS 138-699581 ARNOLD 138 1	173	173.3	114.6	100.2%	169.2	113.4	97.8%	[REDACTED]	SSR constraint
WhitePine_2014SH_VSC	699569 PLAINS 138-699581 ARNOLD 138 1	173	175.9	114.6	101.7%	171.8	113.4	99.3%	[REDACTED]	SSR constraint
WhitePine_2014SH_VSC	699569 PLAINS 138-699581 ARNOLD 138 1	173	175.9	114.6	101.7%	171.9	113.4	99.4%	[REDACTED]	SSR constraint
WhitePine_2014SH_VSC	699569 PLAINS 138-699581 ARNOLD 138 1	173	175.9	114.6	101.7%	171.9	113.4	99.4%	[REDACTED]	SSR constraint
WhitePine_2014SH_VSC	699569 PLAINS 138-699581 ARNOLD 138 1	173	239.5	114.6	138.4%	228.6	113.4	132.1%	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2014SH_VSC	699569 PLAINS 138-699581 ARNOLD 138 1	173	215.2	114.6	124.4%	207.6	113.4	120.0%	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2014SH_VSC	699569 PLAINS 138-699581 ARNOLD 138 1	173	197.2	114.6	114.0%	193.1	113.4	111.6%	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2014SH_VSC	698907 EMPIRE6 138-699904 PRESQ IS 138 1	170	180	104.2	105.9%	178.7	103.7	105.1%	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2014SH_VSC	699569 PLAINS 138-699581 ARNOLD 138 1	173	182.4	114.6	105.4%	176.6	113.4	102.1%	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement

WhitePine_2014SH_VSC	699545 LAWN RD 138-699586 WH CLAY1 138 1	204	213.8	36.3	104.8%	209.7	35.2	102.8%	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2014SH_VSC	699569 PLAINS 138-699581 ARNOLD 138 1	173	181.2	114.6	104.7%	177.2	113.4	102.4%	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2014SH_VSC	699569 PLAINS 138-699581 ARNOLD 138 1	173	179.7	114.6	103.9%	176.8	113.4	102.2%	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2014SH_VSC	699569 PLAINS 138-699581 ARNOLD 138 1	173	179.5	114.6	103.8%	175.6	113.4	101.5%	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2014SH_VSC	699569 PLAINS 138-699581 ARNOLD 138 1	173	179.3	114.6	103.6%	175.3	113.4	101.3%	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2014SH_VSC	699569 PLAINS 138-699581 ARNOLD 138 1	173	178.7	114.6	103.3%	174.4	113.4	100.8%	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2014SH_VSC	699569 PLAINS 138-699581 ARNOLD 138 1	173	178.7	114.6	103.3%	174.5	113.4	100.9%	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2014SH_VSC	699569 PLAINS 138-699581 ARNOLD 138 1	173	178.6	114.6	103.2%	174.5	113.4	100.9%	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2014SH_VSC	694082 WERNER W B4 345-694066 ROCKY RN B6 345	771	795.5	451.8	103.2%	793.4	451.1	102.9%	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2014SH_VSC	699569 PLAINS 138-699581 ARNOLD 138 1	173	178	114.6	102.9%	174	113.4	100.6%	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2014SH_VSC	699569 PLAINS 138-699581 ARNOLD 138 1	173	178.1	114.6	102.9%	174.4	113.4	100.8%	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2014SH_VSC	699569 PLAINS 138-699581 ARNOLD 138 1	173	177.9	114.6	102.8%	173.9	113.4	100.5%	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2014SH_VSC	698561 SUMMITLK 115-699782 ARORA ST 115 1	150	154.2	64.9	102.8%	152.4	63.9	101.6%	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2014SH_VSC	699569 PLAINS 138-699581 ARNOLD 138 1	173	177.7	114.6	102.7%	173.6	113.4	100.3%	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2014SH_VSC	699569 PLAINS 138-699581 ARNOLD 138 1	173	177.6	114.6	102.7%	173.5	113.4	100.3%	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2014SH_VSC	699569 PLAINS 138-699581 ARNOLD 138 1	173	177.7	114.6	102.7%	173.7	113.4	100.4%	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2014SH_VSC	699569 PLAINS 138-699581 ARNOLD 138 1	173	177.4	114.6	102.5%	173.2	113.4	100.1%	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2014SH_VSC	699569 PLAINS 138-699581 ARNOLD 138 1	173	177.4	114.6	102.5%	173.2	113.4	100.1%	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2014SH_VSC	699569 PLAINS 138-699581 ARNOLD 138 1	173	177.4	114.6	102.5%	173.4	113.4	100.2%	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2014SH_VSC	699569 PLAINS 138-699581 ARNOLD 138 1	173	177.2	114.6	102.4%	173	113.4	100.0%	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2014SH_VSC	698907 EMPIRE6 138-699904 PRESQ IS 138 1	170	174.1	104.2	102.4%	172.8	103.7	101.6%	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2014SH_VSC	699569 PLAINS 138-699581 ARNOLD 138 1	173	176.4	114.6	102.0%	173.4	113.4	100.2%	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2014SH_VSC	699569 PLAINS 138-699581 ARNOLD 138 1	173	175.9	114.6	101.7%	171.9	113.4	99.4%	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement

WhitePine_2014SH_VSC	694082 WERNER W B4 345-694066 ROCKY RN B6 345	771	784.2	451.8	101.7%	782.1	451.1	101.4%	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2014SH_VSC	694082 WERNER W B4 345-694066 ROCKY RN B6 345	771	778.6	451.8	101.0%	776.5	451.1	100.7%	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2014SH_VSC	694082 WERNER W B4 345-694066 ROCKY RN B6 345	771	774.6	451.8	100.5%	771.8	451.1	100.1%	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2014SH_VSC	699532 FALLS WE 138-699570 MORGAN 138 1	335	393.5	187.6	117.5%	388.4	186.6	115.9%	[REDACTED]	SSR Constraint; existing constraint, aggrevated by study unit retirement.
WhitePine_2014SH_VSC	699532 FALLS WE 138-699570 MORGAN 138 1	335	390.5	187.5	116.6%	383.6	186.6	114.5%	[REDACTED]	SSR Constraint; existing constraint, aggrevated by study unit retirement.
WhitePine_2014SH_VSC	698800 MAINE115 115-699703 HILLTP 115 1	205	217	136.4	105.9%	215.5	135.3	105.1%	[REDACTED]	SSR Constraint; existing constraint, aggrevated by study unit retirement.
WhitePine_2014SP	699569 PLAINS 138-699581 ARNOLD 138 1	173	233.2	103.1	134.8%	221.8	101.8	128.2%	[REDACTED]	SSR Constraint, Cat-C event, can be mitigated by load shed
WhitePine_2014SP	699569 PLAINS 138-699581 ARNOLD 138 1	173	207.7	103.1	120.1%	200.1	101.8	115.7%	[REDACTED]	SSR Constraint, Cat-C event, can be mitigated by load shed
WhitePine_2014SP	698800 MAINE115 115-699703 HILLTP 115 1	205	237.8	149.2	116.0%	236.4	148.1	115.3%	[REDACTED]	SSR Constraint, Cat-C event, can be mitigated by load shed
WhitePine_2014SP	698561 SUMMITLK 115-699782 ARORA ST 115 1	150	164.1	69.1	109.4%	162.7	68.1	108.5%	[REDACTED]	SSR Constraint, Cat-C event, can be mitigated by load shed
WhitePine_2014SP	698653 LSUAMICO 138-699589 PULLIAM EST 138 1	204	220.9	27.5	108.3%	214.5	26	105.1%	[REDACTED]	SSR Constraint, Cat-C event, can be mitigated by load shed
WhitePine_2014SP	699619 EAST KRK 138-699620 KEWAUNEE 138 1	272	294.3	192.8	108.2%	293.2	192.3	107.8%	[REDACTED]	SSR Constraint, Cat-C event, can be mitigated by load shed
WhitePine_2014SP	698897 STILES5 138-693883 PULLIAM WST 138 2	204	220.4	26.5	108.0%	214	24.9	104.9%	[REDACTED]	SSR Constraint, Cat-C event, can be mitigated by load shed
WhitePine_2014SP	699667 ANTIGO 115-699784 BLACK BK 115 1	180	194.3	104.5	107.9%	193	103.6	107.2%	[REDACTED]	SSR Constraint, Cat-C event, can be mitigated by load shed
WhitePine_2014SP	699569 PLAINS 138-699581 ARNOLD 138 1	173	184.4	103.1	106.6%	180.4	101.8	104.3%	[REDACTED]	SSR Constraint, Cat-C event, can be mitigated by load shed
WhitePine_2014SP	698800 MAINE115 115-699733 PINE 115 1	205	218.2	131.6	106.4%	216.8	130.5	105.8%	[REDACTED]	SSR Constraint, Cat-C event, can be mitigated by load shed
WhitePine_2014SP	699575 STILES4 138-698653 LSUAMICO 138 1	204	214.5	24.4	105.1%	208.5	22.8	102.2%	[REDACTED]	SSR Constraint, Cat-C event, can be mitigated by load shed
WhitePine_2014SP	699667 ANTIGO 115-699782 ARORA ST 115 1	180	187.1	97.8	103.9%	185.8	96.9	103.2%	[REDACTED]	SSR Constraint, Cat-C event, can be mitigated by load shed
WhitePine_2014SP	699545 LAWN RD 138-699586 WH CLAY1 138 1	204	211.1	59.9	103.5%	206.9	58.8	101.4%	[REDACTED]	SSR Constraint, Cat-C event, can be mitigated by load shed
WhitePine_2014SP	698561 SUMMITLK 115-699780 VENUS 115 1	150	154	63.3	102.7%	152.6	62.3	101.7%	[REDACTED]	SSR Constraint, Cat-C event, can be mitigated by load shed
WhitePine_2014SP	699569 PLAINS 138-699581 ARNOLD 138 1	173	174	103.1	100.6%	167.8	101.8	97.0%	[REDACTED]	SSR Constraint, Cat-C event, can be mitigated by load shed
WhitePine_2018SH_PXY	698907 EMPIRE6 138-699904 PRESQ IS 138 1	170	171.5	104.9	1.009	169	102.6	0.994	[REDACTED]	SSR constraint
WhitePine_2018SH_PXY	699569 PLAINS 138-699581 ARNOLD 138 1	173	177.1	116.6	1.024	172.8	115.3	0.999	[REDACTED]	SSR constraint

WhitePine_2018SH_PXY	699569 PLAINS 138-699581 ARNOLD 138 1	173	177.1	116.6	1.024	172.8	115.3	0.999	[REDACTED]	SSR constraint
WhitePine_2018SH_PXY	699003 LAND O L 69-699005 CON 69 1	35	53.2	9.5	1.52	22.9	6.9	0.654	[REDACTED]	SSR constraint
WhitePine_2018SH_PXY	698999 WATERSM 69-699003 LAND O L 69 1	35	46.8	5.4	1.337	18.6	3.2	0.531	[REDACTED]	SSR constraint
WhitePine_2018SH_PXY	698997 BRUCE CR 69-698999 WATERSM 69 1	35	41.9	2.5	1.197	15.3	1.8	0.437	[REDACTED]	SSR constraint
WhitePine_2018SH_PXY	698995 MASS 69-698997 BRUCE CR 69 1	35	38.4	2.6	1.097	13.2	4.2	0.377	[REDACTED]	SSR constraint
WhitePine_2018SH_PXY	698907 EMPIRE6 138-699904 PRESQ IS 138 1	170	182.3	104.9	1.072	180.9	102.6	1.064	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2018SH_PXY	698907 EMPIRE6 138-699904 PRESQ IS 138 1	170	176.6	104.9	1.039	175.2	102.6	1.031	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2018SH_PXY	698800 MAINE115 115-699703 HILLTP 115 1	205	219	136.9	1.068	217.5	135.8	1.061	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2018SH_PXY	699010 NED 161 161-681519 STONEMAN 161 1	221	270.2	178.3	1.223	268.6	177.9	1.215	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2018SH_PXY	698800 MAINE115 115-699733 PINE 115 1	205	213.6	123.4	1.042	211.9	122.2	1.034	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2018SH_PXY	698800 MAINE115 115-699703 HILLTP 115 1	205	231.4	136.9	1.129	229.7	135.8	1.12	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2018SH_PXY	699010 NED 161 161-699020 NED 138 138 1	286	306.1	208.2	1.07	304.4	207.7	1.064	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2018SH_PXY	698561 SUMMITLK 115-699782 ARORA ST 115 1	150	154.9	65.3	1.033	153	64.2	1.02	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2018SH_PXY	698907 EMPIRE6 138-699904 PRESQ IS 138 1	170	173.7	104.9	1.022	171.7	102.6	1.01	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2018SH_PXY	694082 WERNER W B4 345-694066 ROCKY RN B6 345	771	785.7	452.5	1.019	783.5	451.5	1.016	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2018SH_PXY	694082 WERNER W B4 345-694066 ROCKY RN B6 345	771	780	452.5	1.012	777.8	451.5	1.009	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2018SH_PXY	694082 WERNER W B4 345-694066 ROCKY RN B6 345	771	797.4	452.5	1.034	794.7	451.5	1.031	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2018SH_PXY	694082 WERNER W B4 345-694066 ROCKY RN B6 345	771	776	452.5	1.006	773.2	451.5	1.003	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2018SH_PXY	699569 PLAINS 138-699581 ARNOLD 138 1	173	183.4	116.6	1.06	180.4	115.3	1.043	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2018SH_PXY	699569 PLAINS 138-699581 ARNOLD 138 1	173	180.1	116.6	1.041	176.9	115.3	1.023	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2018SH_PXY	699569 PLAINS 138-699581 ARNOLD 138 1	173	181.7	116.6	1.05	178.1	115.3	1.029	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2018SH_PXY	699569 PLAINS 138-699581 ARNOLD 138 1	173	178.9	116.6	1.034	175.2	115.3	1.013	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2018SH_PXY	699569 PLAINS 138-699581 ARNOLD 138 1	173	183.1	116.6	1.058	179.3	115.3	1.036	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement

WhitePine_2018SH_PXY	699569 PLAINS 138-699581 ARNOLD 138 1	173	201.6	116.6	1.165	197.6	115.3	1.142	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2018SH_PXY	699569 PLAINS 138-699581 ARNOLD 138 1	173	183	116.6	1.058	179	115.3	1.035	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2018SH_PXY	699569 PLAINS 138-699581 ARNOLD 138 1	173	182.4	116.6	1.054	178.3	115.3	1.031	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2018SH_PXY	699569 PLAINS 138-699581 ARNOLD 138 1	173	181.7	116.6	1.05	177.6	115.3	1.027	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2018SH_PXY	699569 PLAINS 138-699581 ARNOLD 138 1	173	181.2	116.6	1.047	177.1	115.3	1.024	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2018SH_PXY	699569 PLAINS 138-699581 ARNOLD 138 1	173	180.6	116.6	1.044	176.5	115.3	1.02	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2018SH_PXY	699569 PLAINS 138-699581 ARNOLD 138 1	173	179.6	116.6	1.038	175.5	115.3	1.014	[REDACTED]	SSR Constraint; existing constraint, aggrevated by study unit retirement.
WhitePine_2018SH_PXY	699569 PLAINS 138-699581 ARNOLD 138 1	173	179.6	116.6	1.038	175.5	115.3	1.014	[REDACTED]	SSR Constraint; existing constraint, aggrevated by study unit retirement.
WhitePine_2018SH_PXY	699569 PLAINS 138-699581 ARNOLD 138 1	173	179.6	116.6	1.038	175.5	115.3	1.014	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2018SH_PXY	699569 PLAINS 138-699581 ARNOLD 138 1	173	179.4	116.6	1.037	175.3	115.3	1.013	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2018SH_PXY	699569 PLAINS 138-699581 ARNOLD 138 1	173	179.1	116.6	1.035	175	115.3	1.012	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2018SH_PXY	699569 PLAINS 138-699581 ARNOLD 138 1	173	182.5	116.6	1.055	178.3	115.3	1.031	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2018SH_PXY	699569 PLAINS 138-699581 ARNOLD 138 1	173	181.7	116.6	1.05	177.5	115.3	1.026	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2018SH_PXY	699569 PLAINS 138-699581 ARNOLD 138 1	173	181.5	116.6	1.049	177.3	115.3	1.025	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2018SH_PXY	699569 PLAINS 138-699581 ARNOLD 138 1	173	181.1	116.6	1.047	176.9	115.3	1.023	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2018SH_PXY	699569 PLAINS 138-699581 ARNOLD 138 1	173	181.2	116.6	1.047	177	115.3	1.023	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2018SH_PXY	699569 PLAINS 138-699581 ARNOLD 138 1	173	181.1	116.6	1.047	176.9	115.3	1.023	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2018SH_PXY	699569 PLAINS 138-699581 ARNOLD 138 1	173	179.6	116.6	1.038	175.4	115.3	1.014	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2018SH_PXY	699569 PLAINS 138-699581 ARNOLD 138 1	173	179.6	116.6	1.038	175.4	115.3	1.014	[REDACTED]	SSR Constraint; existing constraint, aggrevated by study unit retirement.
WhitePine_2018SH_PXY	699569 PLAINS 138-699581 ARNOLD 138 1	173	179.6	116.6	1.038	175.4	115.3	1.014	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2018SH_PXY	699569 PLAINS 138-699581 ARNOLD 138 1	173	179.6	116.6	1.038	175.4	115.3	1.014	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2018SH_PXY	699569 PLAINS 138-699581 ARNOLD 138 1	173	179.6	116.6	1.038	175.4	115.3	1.014	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2018SH_PXY	699569 PLAINS 138-699581 ARNOLD 138 1	173	179.6	116.6	1.038	175.4	115.3	1.014	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement

WhitePine_2018SH_PXY	699569 PLAINS 138-699581 ARNOLD 138 1	173	179.6	116.6	1.038	175.4	115.3	1.014	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2018SH_PXY	699569 PLAINS 138-699581 ARNOLD 138 1	173	179.6	116.6	1.038	175.4	115.3	1.014	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2018SH_PXY	699569 PLAINS 138-699581 ARNOLD 138 1	173	179.6	116.6	1.038	175.4	115.3	1.014	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2018SH_PXY	699569 PLAINS 138-699581 ARNOLD 138 1	173	179.6	116.6	1.038	175.4	115.3	1.014	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2018SH_PXY	699569 PLAINS 138-699581 ARNOLD 138 1	173	179.6	116.6	1.038	175.4	115.3	1.014	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2018SH_PXY	699569 PLAINS 138-699581 ARNOLD 138 1	173	179.6	116.6	1.038	175.4	115.3	1.014	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2018SH_PXY	699569 PLAINS 138-699581 ARNOLD 138 1	173	179.7	116.6	1.039	175.5	115.3	1.014	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2018SH_PXY	699569 PLAINS 138-699581 ARNOLD 138 1	173	179.6	116.6	1.038	175.4	115.3	1.014	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2018SH_PXY	699569 PLAINS 138-699581 ARNOLD 138 1	173	179.6	116.6	1.038	175.4	115.3	1.014	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2018SH_PXY	699569 PLAINS 138-699581 ARNOLD 138 1	173	179.6	116.6	1.038	175.4	115.3	1.014	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2018SH_PXY	699569 PLAINS 138-699581 ARNOLD 138 1	173	179.6	116.6	1.038	175.4	115.3	1.014	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2018SH_PXY	699569 PLAINS 138-699581 ARNOLD 138 1	173	179.6	116.6	1.038	175.4	115.3	1.014	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2018SH_PXY	699569 PLAINS 138-699581 ARNOLD 138 1	173	179.6	116.6	1.038	175.4	115.3	1.014	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2018SH_PXY	699569 PLAINS 138-699581 ARNOLD 138 1	173	179.6	116.6	1.038	175.4	115.3	1.014	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2018SH_PXY	699569 PLAINS 138-699581 ARNOLD 138 1	173	179.6	116.6	1.038	175.4	115.3	1.014	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2018SH_PXY	699569 PLAINS 138-699581 ARNOLD 138 1	173	179.6	116.6	1.038	175.4	115.3	1.014	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2018SH_PXY	699569 PLAINS 138-699581 ARNOLD 138 1	173	179.6	116.6	1.038	175.4	115.3	1.014	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2018SH_PXY	699569 PLAINS 138-699581 ARNOLD 138 1	173	179.5	116.6	1.038	175.3	115.3	1.013	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2018SH_PXY	699569 PLAINS 138-699581 ARNOLD 138 1	173	179.5	116.6	1.038	175.3	115.3	1.013	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2018SH_PXY	699569 PLAINS 138-699581 ARNOLD 138 1	173	179.5	116.6	1.038	175.3	115.3	1.013	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2018SH_PXY	699569 PLAINS 138-699581 ARNOLD 138 1	173	179.5	116.6	1.038	175.3	115.3	1.013	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2018SH_PXY	699569 PLAINS 138-699581 ARNOLD 138 1	173	179.5	116.6	1.038	175.3	115.3	1.013	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2018SH_PXY	699569 PLAINS 138-699581 ARNOLD 138 1	173	179.5	116.6	1.038	175.3	115.3	1.013	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement

WhitePine_2018SH_PXY	699569 PLAINS 138-699581 ARNOLD 138 1	173	179.1	116.6	1.035	174.9	115.3	1.011	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2018SH_PXY	699569 PLAINS 138-699581 ARNOLD 138 1	173	181.4	116.6	1.049	177.2	115.3	1.024	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2018SH_PXY	699569 PLAINS 138-699581 ARNOLD 138 1	173	180.3	116.6	1.042	176.1	115.3	1.018	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2018SH_PXY	699569 PLAINS 138-699581 ARNOLD 138 1	173	179.9	116.6	1.04	175.7	115.3	1.016	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2018SH_PXY	699569 PLAINS 138-699581 ARNOLD 138 1	173	179.9	116.6	1.04	175.7	115.3	1.016	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2018SH_PXY	699569 PLAINS 138-699581 ARNOLD 138 1	173	179.3	116.6	1.036	175.1	115.3	1.012	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2018SH_PXY	699569 PLAINS 138-699581 ARNOLD 138 1	173	182.7	116.6	1.056	178.4	115.3	1.031	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2018SH_PXY	699569 PLAINS 138-699581 ARNOLD 138 1	173	179.7	116.6	1.039	175.4	115.3	1.014	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2018SH_PXY	699569 PLAINS 138-699581 ARNOLD 138 1	173	179.7	116.6	1.039	175.4	115.3	1.014	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2018SH_PXY	699569 PLAINS 138-699581 ARNOLD 138 1	173	179.6	116.6	1.038	175.3	115.3	1.013	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2018SH_PXY	699569 PLAINS 138-699581 ARNOLD 138 1	173	179.6	116.6	1.038	175.3	115.3	1.013	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2018SH_PXY	699569 PLAINS 138-699581 ARNOLD 138 1	173	179.2	116.6	1.036	174.9	115.3	1.011	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2018SH_PXY	699569 PLAINS 138-699581 ARNOLD 138 1	173	185	116.6	1.069	180.7	115.3	1.045	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2018SH_PXY	699569 PLAINS 138-699581 ARNOLD 138 1	173	180.9	116.6	1.046	176.6	115.3	1.021	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2018SH_PXY	699569 PLAINS 138-699581 ARNOLD 138 1	173	179.3	116.6	1.036	175	115.3	1.012	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2018SH_PXY	699569 PLAINS 138-699581 ARNOLD 138 1	173	186.3	116.6	1.077	180.4	115.3	1.043	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2018SH_PXY	699569 PLAINS 138-699581 ARNOLD 138 1	173	220.3	116.6	1.273	212.7	115.3	1.229	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2018SH_PXY	699569 PLAINS 138-699581 ARNOLD 138 1	173	246.2	116.6	1.423	234.4	115.3	1.355	[REDACTED]	SSR constraint, Cat-C event, existing constraint, aggravated by study unit retirement
WhitePine_2018SH_PXY	699569 PLAINS 138-699581 ARNOLD 138 1	173	179.1	116.6	1.035	174.5	115.3	1.009	[REDACTED]	SSR constraint; existing constraint, study unit retireme
WhitePine_2018SH_PXY	699532 FALLS WE 138-699570 MORGAN 138 1	335	398	188.3	1.188	390.7	187.3	1.166	[REDACTED]	SSR constraint; existing constraint, study unit retireme
WhitePine_2018SP	698800 MAINE115 115-699703 HILLTP 115 1	205	245	146.6	119.5%	243.6	145.6	118.8%	[REDACTED]	SSR Constraint, Cat-C event, can be mitigated by load shed
WhitePine_2018SP	698800 MAINE115 115-699703 HILLTP 115 1	205	233.8	146.6	114.0%	232.5	145.6	113.4%	[REDACTED]	SSR Constraint, Cat-C event, can be mitigated by load shed
WhitePine_2018SP	698800 MAINE115 115-699733 PINE 115 1	205	225.1	128.7	109.8%	223.6	127.6	109.1%	[REDACTED]	SSR Constraint, Cat-C event, can be mitigated by load shed

WhitePine_2018SP	698561 SUMMITLK 115-699782 ARORA ST 115 1	150	159.6	66.8	106.4%	158.1	65.9	105.4%	[REDACTED]	SSR Constraint, Cat-C event, can be mitigated by load shed
WhitePine_2018SP	699667 ANTIGO 115-699784 BLACK BK 115 1	180	190.2	102.5	105.7%	188.9	101.7	104.9%	[REDACTED]	SSR Constraint, Cat-C event, can be mitigated by load shed
WhitePine_2018SP	698800 MAINE115 115-699733 PINE 115 1	205	213.8	128.7	104.3%	212.4	127.6	103.6%	[REDACTED]	SSR Constraint, Cat-C event, can be mitigated by load shed
WhitePine_2018SP	699667 ANTIGO 115-699782 ARORA ST 115 1	180	182.9	95.7	101.6%	181.6	94.9	100.9%	[REDACTED]	SSR Constraint, Cat-C event, can be mitigated by load shed

MISO WPEP Unit 1 Attachment Y Study - Compare Voltage Results

						White Pine 1 Off		White Pine 1 On			
Model	Bus Number	Bus Name	kV	LV Li	HV Lin	Cont. Voltag	Base Volt	BF.Cont.	BF.Base Volt	Contingency	Comments
WhitePine_2014SH	605019	BAYFRT88	88	0.92	1.05	1.0552	1.0419	1.0451	1.042	[REDACTED]	Cat-C event, can be mitigated by load shed
WhitePine_2014SH_VSC	699343	OLD MEAD RD	138	0.9	1.1	1.1129	1.0063	1.0627	1.0061	[REDACTED]	Cat-C event, can be mitigated by load shed
WhitePine_2014SH_VSC	699343	OLD MEAD RD	138	0.9	1.1	1.1205	1.0063	1.0908	1.0061	[REDACTED]	Cat-C event, can be mitigated by load shed
WhitePine_2014SH_VSC	605019	BAYFRT88	88	0.92	1.05	1.0575	1.0414	1.0451	1.0415	[REDACTED]	Cat-C event, can be mitigated by load shed
WhitePine_2014SH_VSC	605101	FALUN 8	69	0.92	1.05	1.0649	1.0465	1.0547	1.0469	[REDACTED]	Cat-C event, can be mitigated by load shed
WhitePine_2014SH_VSC	605513	FALUNTP8	69	0.92	1.05	1.0649	1.0465	1.0547	1.0469	[REDACTED]	Cat-C event, can be mitigated by load shed
WhitePine_2014SH_VSC	605184	FREDRIC8	69	0.92	1.05	1.0643	1.0459	1.0541	1.0463	[REDACTED]	Cat-C event, can be mitigated by load shed
WhitePine_2014SH_VSC	605500	FREDRICG	34.5	0.95	1.05	1.0629	1.0445	1.0527	1.0448	[REDACTED]	Cat-C event, can be mitigated by load shed
WhitePine_2014SP	699343	OLD MEAD RD	138	0.9	1.1	1.1234	1.0197	1.1542	1.0197	[REDACTED]	Cat-C event, can be mitigated by load shed
WhitePine_2018SH_PXY	699343	OLD MEAD RD	138	0.9	1.1	1.136	1.0028	1.1054	1.0027	[REDACTED]	pre-existing violation, aggravated by study generator retirement
WhitePine_2018SH_PXY	699343	OLD MEAD RD	138	0.9	1.1	1.1205	1.0028	1.1055	1.0027	[REDACTED]	pre-existing violation, aggravated by study generator retirement
WhitePine_2018SH_PXY	605019	BAYFRT88	88	0.92	1.05	1.0578	1.0413	1.0452	1.0415	[REDACTED]	88 kV bus, not under MISO function control
WhitePine_2018SH_PXY	605019	BAYFRT88	88	0.92	1.05	1.0574	1.0413	1.045	1.0415	[REDACTED]	88 kV bus, not under MISO function control
WhitePine_2018SH_PXY	605019	BAYFRT88	88	0.92	1.05	1.0572	1.0413	1.0449	1.0415	[REDACTED]	88 kV bus, not under MISO function control
WhitePine_2018SH_PXY	605019	BAYFRT88	88	0.92	1.05	1.0572	1.0413	1.0449	1.0415	[REDACTED]	88 kV bus, not under MISO function control

MISO WPEP Unit 1 Attachment Y Study - Compare Voltage Results

						White Pine 1 Off		White Pine 1 On			
Model	Bus Number	Bus Name	kV	LV Li	HV Lin	Cont. Voltag	Base Volt	BF.Cont.	BF.Base Volt	Contingency	Comments
WhitePine_2018SH_PXY	605019	BAYFRT88	88	0.92	1.05	1.057	1.0413	1.0448	1.0415	[REDACTED]	88 kV bus, not under MISO function control
WhitePine_2018SH_PXY	605019	BAYFRT88	88	0.92	1.05	1.0556	1.0413	1.0441	1.0415	[REDACTED]	88 kV bus, not under MISO function control

Appendix B

Alternatives Analysis Results

Redispatch of Presque Isle Generation

Table 1a - Generation Redispatch

with Presque Isle 9 online (77MW) and Presque Isle 5 offline

									White Pine 1 Off			White Pine 1 On			
Model	BusNo	BusName	kV	BusNo	BusName	kV	Ckt	Rating	Post Ctg	Pre-Ctg	Pct Loading	Post Ctg	Pre-Ctg	Pct Loading	Contingency
WhitePine_2014SH	699532	FALLS WE	138	699570	MORGAN	138	1	335	352.4	181.9	105.2%	345	181.1	103.0%	[REDACTED]
WhitePine_2014SH	699569	PLAINS	138	699581	ARNOLD	138	1	173	168.7	82.9	97.5%	158.7	81.6	91.7%	[REDACTED]
WhitePine_2014SH	698800	MAINE115	115	699703	HILLTP	115	1	205	215	132.8	104.9%	213.6	131.8	104.2%	[REDACTED]
WhitePine_2014SH	694082	WERNER W B4	345	694066	ROCKY RN B6	345	1	771	783.7	452.9	101.6%	781.6	452.2	101.4%	[REDACTED]
WhitePine_2014SH	694082	WERNER W B4	345	694066	ROCKY RN B6	345	1	771	770.2	452.9	99.9%	769.3	452.2	99.8%	[REDACTED]
WhitePine_2014SH	699532	FALLS WE	138	699570	MORGAN	138	1	335	350.1	181.9	104.5%	343.1	181.1	102.4%	[REDACTED]

Table 1b - Generation Redispatch

with all units at Presque Isle online (additional Presque Isle 9 on (77MW))

									White Pine 1 Off			White Pine 1 On			
Model	BusNo	BusName	kV	BusNo	BusName	kV	Ckt	Rating	Post Ctg	Pre-Ctg	Pct Loading	Post Ctg	Pre-Ctg	Pct Loading	Contingency
WhitePine_2014SH	699532	FALLS WE	138	699570	MORGAN	138	1	335	322.7	180	96.3%	316.1	179.1	94.4%	[REDACTED]
WhitePine_2014SH	699569	PLAINS	138	699581	ARNOLD	138	1	173	121.6	75.2	70.3%	112	73.9	64.7%	[REDACTED]
WhitePine_2014SH	698800	MAINE115	115	699703	HILLTP	115	1	205	211.7	130.6	103.3%	210.3	129.6	102.6%	[REDACTED]
WhitePine_2014SH	694082	WERNER W B4	345	694066	ROCKY RN B6	345	1	771	771.3	448.2	100.0%	769.1	447.6	99.8%	[REDACTED]
WhitePine_2014SH	694082	WERNER W B4	345	694066	ROCKY RN B6	345	1	771	758.9	448.2	98.4%	756.6	447.6	98.1%	[REDACTED]
WhitePine_2014SH	699532	FALLS WE	138	699570	MORGAN	138	1	335	320.9	180	95.8%	314.7	179.1	93.9%	[REDACTED]

Table 2 - Demand Response Estimate (Hypothetical)

analysis includes adjustment to curtail flow on the Straits VSC

Model	Limiting Contingency	Type	Incremental Load Shed*
2014SH_after	Contingency '[REDACTED]'	new	11.71
		Total	11.71

*Based on the assumption that load can be shed at specific locations