



WESTERN ENERGY IMBALANCE SERVICE MARKET

FREQUENTLY CONSTRAINED AREAS 2022 STUDY

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1 EXECUTIVE SUMMARY

The Market Monitor analyzed market data from October 1, 2021 through September 30, 2022 for constraints monitored in the Western Energy Imbalance Service (WEIS) Market. Based on the analysis, the Market Monitor recommends no Frequently Constrained Area (FCA) additions to the WEIS market at this time.

1.1 INTRODUCTION

Frequently Constrained Areas are areas of the market footprint that both experience high levels of congestion and are associated with one or more pivotal suppliers. A supplier is pivotal when some or all of its output is necessary for reliable operation of the electrical system within a defined area. The SPP Western Imbalance Service Tariff¹ defines Frequently Constrained Areas as:

“an electrical area identified by the Market Monitor that is defined by one or more binding transmission constraints that are expected to be binding for at least five-hundred (500) hours during a given twelve (12)-month period and within which one (1) or more suppliers are pivotal.”

The SPP Market Monitor reevaluates the Frequently Constrained Area designations at least annually.² No Frequently Constrained Areas were designated at the start of the WEIS market.

¹ SPP Western Imbalance Service Tariff Att. B Section 3.1.1 (Frequently Constrained Areas)

² SPP Western Imbalance Service Tariff Att. B Section 3.1.1.3 (Changes to Frequently Constrained Area Designation)

The contents of this report include:

- **Executive summary:** an executive summary of the findings and proposals
- **Methodology:** description of the study process or methodology
- **Analysis and Results:** detailed description of the analysis
- **Binding Constraint And Pivotal Supplier Data:** list of constraints and paths with corresponding binding and pivotal supplier hours

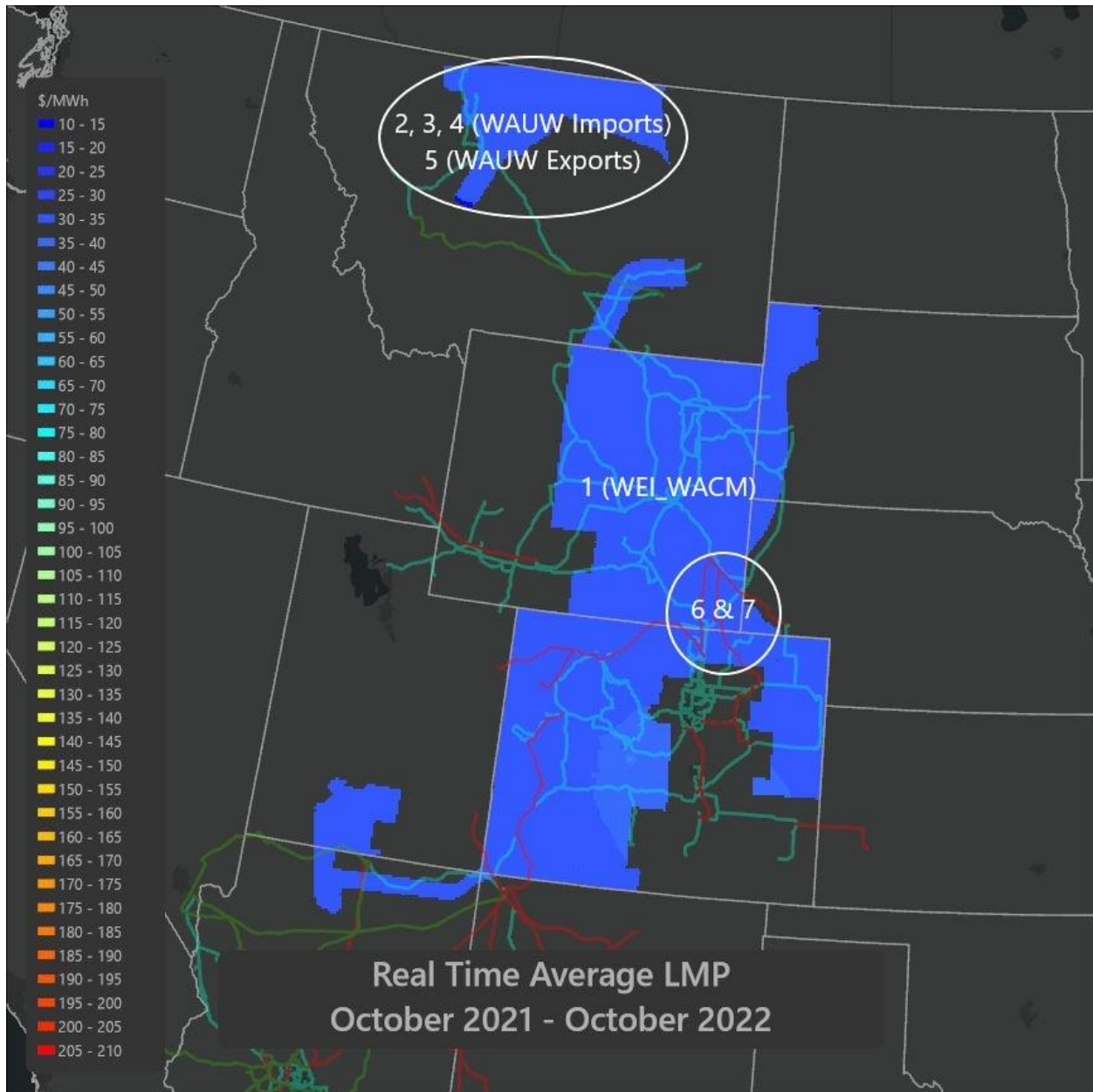
1.2 RESULTS

The MMU analyzed over 25 scenarios with varying primary and secondary constraints as Frequently Constrained Area possibilities in the WEIS market area. The seven areas shown in Figure 1–1 are the scenarios resulting in at least 180 binding hours. The remaining preliminary scenarios resulted in insignificant binding and pivotal supplier hours.

Figure 1–1 Frequently Constrained Area Candidate Designations

Map Reference #	Geographical Area	FCA Candidate Name
1	Colorado & Wyoming	WEI_WACM
2	WAUW/Montana	WSF_TEMP_002
3	WAUW/Montana	WEI_WAUW
4	WAUW/Montana (imports)	WSF_HILN_IMP
5	WAUW/Montana (exports)	WSF_HILN_EXP
6	Laramie, Wyoming – Fort Collins, CO	WTP100_92100
7	Southeast Wyoming	WTP140_92140

Figure 1-2 Frequently Constrained Area Candidates



The simulated binding and pivotal supplier analysis (see Study Process) counts the number of hours³ a constraint is near or above its limit and the number of those hours where at least one

³ Count is by interval. In a five-minute market, a binding interval would count as one-twelfth of an hour.

supplier is pivotal. Binding and pivotal supplier hours for a candidate area is the summation of all hours for the primary constraint and secondary constraints in that area. Simulated binding and pivotal supplier hours gauge the frequency of potential local market power and may differ from actual binding hours. Figure 1–3 provides the binding and pivotal supplier analysis results for these seven candidate areas and the actual binding hours in the WEIS market.

Figure 1–3 Binding and Pivotal Supplier Analysis Results

FCA candidate area	FCA Candidate Area Total		
	Binding (Hrs)	Pivotal supplier (Hrs)	Actual binding (Hrs)
WEI_WACM	434	338	361
WSF_TEMP_002	453	377	325
WEI_WAUW	453	377	325
WSF_HILN_IMP	453	377	325
WSF_HILN_EXP	471	57	196
WTP100_92100	232	100	191
WTP140_92140	183	87	155

No candidate areas exceeded 500 simulated binding hours where there was at least one pivotal supplier with only one candidate area exceeding 350 actual binding hours. The WEI_WACM⁴ candidate area experienced 434 binding hours for the study period with over 75 percent of these hours being pivotal. The WEI_WAUW⁵ candidate area experienced 453 binding hours with

⁴ WEI_WACM is the WEIS market energy imbalance constraint for WACM.

⁵ WEI_WAUW is the WEIS market energy imbalance constraint for WAUW. WSF_TEMP_002 and WSF_HILN_IMP consist of the same candidate resources resulting in identical binding and pivotal supplier hours.

over 80 percent of these being pivotal. The WSF_HILN_EXP candidate area experienced 471 binding hours with only twelve percent of these being pivotal and less than 200 actual binding hours. The last two candidate areas⁶ had under 50 percent of their binding hours result in being pivotal during the study period and each less than 200 actual binding hours.

1.3 PROPOSAL

The MMU recommends adding no Frequently Constrained Areas to the Western Energy Imbalance Services market. The results of this analysis indicates no candidate areas that observed constraints at or near their limits for over 500 hours during the study period. Some candidate areas exceeded 450 simulated binding hours in the analysis, however, none exceeded 400 actual binding hours in real-time. The MMU is required to reevaluate the Frequently Constrained Areas annually and may reevaluate more frequently if conditions change.

⁶ WTP100_92100 is Laramie River to Ault 345kV and WTP140_92140 is Wayne Child to West Archer 230kV both in the southeast Wyoming area.

2 METHODOLOGY

2.1 DATA AND STUDY PERIOD

The study period ran from October 1, 2021 through September 30, 2022. Analysis included WEIS Real-time Balancing Market (WRTBM) congestion and dispatch data, and resource parameter offers for online resources. Real-time transmission system topography is instrumental to the analysis, including but not limited to transmission elements, ratings, effective and termination times, temporary operating conditions, etc.

2.2 STUDY PROCESS

The study proceeded in five steps:

- 1. Binding Hours Computation:** The number of binding hours is computed for each modeled transmission constraint. A constraint is counted as binding in a five-minute interval if the loading on the constraint is within the greater of five megawatts (5 MW) or two percent of the effective constraint limit.
- 2. Pivotal Supplier Analysis:** The number of pivotal supplier hours is computed for each binding transmission constraint. A constraint is counted as having a pivotal supplier during an interval if the supplier can cause a constraint to exceed the limit by decreasing generation on resources that provide congestion relief and by increasing generation on resources that contribute to congestion. The re-dispatch of the potential pivotal supplier's resources is governed by the resource's submitted ramp rates, and economic minimum and maximum capabilities. A thirty-minute re-dispatch period is considered for this analysis. The ability of the market to react to the actions of the potential pivotal supplier is accounted for by allowing a similar re-dispatch of all resources not owned or controlled by the potential pivotal supplier. If the other suppliers cannot offset the additional loading created by the potential pivotal supplier, that supplier is pivotal to

that constraint for that interval. There can be multiple pivotal suppliers to a constraint for each interval.

- 3. Selection of Frequently Constrained Area candidates:** Candidates chosen for designation as a Frequently Constrained Area are based on the binding hours and pivotal supplier analyses. Constraints that are in the same electrical proximity and have the same relieving resources are grouped together. If the aggregate number of binding and pivotal supplier hours is significant, then the area is selected as a Frequently Constrained Area candidate. A primary constraint for the Frequently Constrained Area candidate is generally selected as the constraint with the highest number of binding hours.
- 4. Identify the Frequently Constrained Area candidate resources:** A resource is a Frequently Constrained Area candidate resource if its resource-to-load-distribution-factor (RLDF), or “shift factor”, relative to the Frequently Constrained Area candidate primary constraint is less than or equal to the Frequently Constrained Area candidate shift factor cut-off. To determine the shift factor cut-off, the relief capability of the largest pivotal supplier relative to the primary constraint is calculated. The cut-off is then set at the value corresponding to the 90th percentile of the relief capability. In other words, 90 percent of the largest pivotal supplier’s relief capability has a shift factor less than or equal to the Frequently Constrained Area candidate shift factor cut-off. In cases where the shift factor value corresponding to the 90th percentile is less than negative five percent (-5%), the cut-off is set to negative five percent to prevent the application of mitigation to resources with a very small impact on the primary constraint. This cut-off of negative five percent is consistent with the market power test⁷ for resources’ shift factor relative to binding constraints in a binding non-Frequently Constrained Area.
- 5. Identify the Frequently Constrained Area candidate secondary constraints:** A constraint is eligible to be defined as a secondary constraint for a given Frequently Constrained Area candidate if that Frequently Constrained Area candidate resource

⁷ SPP Western Imbalance Service Tariff Att. B Section 3.1 (Market Power Test)

group (as identified in step four) contributes at least 70 percent of the total relief capability on the constraint. Additional considerations for defining a constraint as a secondary constraint include:

- i. electrical proximity to the candidate resource group identified in step 4;
- ii. an expectation that the constraint is not short-term or temporary; and
- iii. an expectation that the constraint will experience congestion in the upcoming year.

Frequently Constrained Area candidate areas that are expected to have 500 annual hours with at least one pivotal supplier are recommended to be designated as Frequently Constrained Areas. The resulting, more stringent mitigation applied under the WEIS Tariff⁸ prohibits a pivotal supplier from accruing significant benefits by pursuing a withholding strategy in a Frequently Constrained Area.

⁸ SPP Western Imbalance Service Tariff Att. B Section 3 (Mitigation Measures for Economic Withholding – Market Power in the Western Energy Imbalance Service Market)

3 ANALYSIS AND RESULTS

3.1 FREQUENTLY CONSTRAINED AREA CANDIDATES

The initial phase of the study identified the following seven candidates for the Frequently Constrained Area designation:

- (1) WEI_WACM (Colorado and Wyoming)
- (2) WSF_TEMP_002 (WAUW Montana)
- (3) WEI_WAUW (WAUW Montana)
- (4) WSF_HILN_IMP (WAUW Montana imports)
- (5) WSF_HILN_EXP (WAUW Montana exports)
- (6) WTP100_92100 (Laramie, WY – Fort Collins, Co)
- (7) WTP140_92140 (Southeast Wyoming)

These seven areas measured the most binding hours in the SPP Western Interconnection reliability footprint during the study period. Some candidate areas have overlap where secondary constraints and candidate resources may appear in multiple areas. The candidate areas two, three, and four⁹ are identical areas with the same transmission constraints and candidate resources resulting in the same number of binding and pivotal hours. The remainder of this report depicts these candidate areas as the WEI_WAUW candidate area. Figure 3–1 lists the top constraints with at least ten binding hours for the study period along with pivotal supplier hours and FCA candidate area.

⁹ WSF_TEMP_002, WEI_WAUW, and WSF_HILN_IMP candidate areas

Figure 3-1 Top Binding Constraints

Constraint Name	Monitored Element or Description	Binding Constraint Hours	Pivotal Supplier Hours	FCA Candidate Area(s) Primary (P) Secondary (S)
WSF_HILN_EXP	Restrictions to respect rights of non-participants in the market region	471	57	WSF_HILN_EXP (P)
WEI_WACM	WEIS market energy imbalance constraint for WACM	434	338	WEI_WACM (P)
WSF_TEMP_002	Restrictions to respect rights of non-participants in the market region	359	310	WSF_TEMP_002 (P) WEI_WAUW (S) WSF_HILN_IMP (S)
WTP044_92044	Alcova – Miracle Mile 115kV	113	50	WTP140_92140 (S)
WEI_WAUW	WEIS market energy imbalance constraint for WAUW	93	67	WEI_WAUW (P) WSF_TEMP_002 (S) WSF_HILN_IMP (S)
WTP132_93132	Arickaree – Anton 115kV	89	0	WTP100_92100 (S)
WTP140_92140	Wayne Child – Archer 230kV	39	37	WTP140_92140 (P) WTP100_92100 (S)
WTP100_92100	Laramie River – Ault 345kV	36	34	WTP100_92100 (P)
WTP125_92125	Willoby - Kersey 115kV	32	0	WTP100_92100 (S) WTP140_92140 (S)
WTP083_92083	Deering Lake – Otis 115kV	16	0	
WTP101_92101	Nixon – Kelker 230kV	14	6	WTP100_92100 (S)
WTP004_92004	Casper – Alcova 115kV	11	7	

The most binding constraint (WSF_HILN_EXP) observed had over 470 binding hours with only twelve percent being pivotal. This low percentage of pivotal supplier hours indicates there is adequate supply from multiple suppliers to relieve congestion on this constraint in most cases.

The WEI_WACM energy imbalance constraint was also over 400 binding hours but almost 78 percent of these hours were pivotal indicating at least one supplier with potential local market power relative to this area.

The WEI_WAUW energy imbalance constraint and the WSF_TEMP_002 constraint combined for over 450 binding hours and 377 pivotal supplier hours. This high percentage of pivotal supplier hours indicates the potential for local market power when this area is constrained.

Constraints in this list without a primary or secondary designation were included in preliminary scenarios but did not result in producing an area with a significant amount of binding hours and pivotal supplier hours.

The preliminary screening analyzed over 25 scenarios with differing primary and secondary constraint/path combinations. The candidate areas in this report represent the areas resulting in the most significant binding hours and pivotal supplier hours from the preliminary screening. These scenarios in the preliminary screening will be helpful in identifying changes in congestion patterns affecting the WEIS system over the years.

Figure 3–2 shows the primary constraint and the shift factor cut-off for each Frequently Constrained Area candidate. The primary constraint for each candidate area is typically the constraint with the most binding hours and the cut-off is used to identify the candidate resources associated with the Frequently Constrained Area candidate. If a cut-off is calculated to be greater than negative five percent then the cut-off is capped to negative five percent.

Figure 3–2 Primary Constraints and Shift Factor Cut-Offs

FCA Candidate	Primary Constraint	Binding Hours	Pivotal Supplier Hours	Shift Factor Cut-off
WEI_WACM	WEI_WACM	434	338	-3.3%*
WEI_WAUW	WEI_WAUW	93	67	-96.5%
WSF_HILN_EXP	WSF_HILN_EXP	471	57	-2.7%*
WTP100_92100	WTP100_92100	36	34	-5.4%
WTP140_92140	WTP140_92140	39	37	-5.0%

* Shift factor cut-off capped to negative five percent

The shift factor cut-offs are used to identify the candidate resources associated with the Frequently Constrained Area candidates. Any resource with a shift factor that is equal to or less than the cut-off is a Frequently Constrained Area candidate resource. For example, the candidate resource group for the WTP100_92100 candidate area consists of all resources that have a shift factor corresponding to the primary constraint that is less than or equal to negative 5.4 percent. Figure 3–3 shows the number of resources included in each Frequently Constrained Area candidate and the corresponding capacity¹⁰ in each candidate area.

¹⁰ Based on registered capacity.

Figure 3–3 Candidate Resource Summary

FCA Candidate	Number of Resources	Total Capacity (MW)
WEI_WACM	0	0
WEI_WAUW	2	116
WSF_HILN_EXP	0	0
WTP100_92100	41	3,726
WTP140_92140	18	1,540

The WEI_WACM and WSF_HILN_EXP candidate areas resulted in no resources since the shift factor cut-off is capped to negative five percent and no resources fall below this value. The Market Monitor may raise the shift factor cut-off should candidate areas exceed 500 binding hours with pivotal supplier hours.

The next step in the process is to identify the secondary constraints for each Frequently Constrained Area candidate. The identification of secondary constraints is necessary because congestion in tightly constrained areas generally affects a group of constraints. Operators may activate a constraint in close proximity to the designated primary constraint instead of activating the primary constraint due to different loading patterns given varying situations. Without the designation of the secondary constraints, the market power mitigation logic will fail to recognize that the Frequently Constrained Area is binding and may not adequately apply stricter thresholds to resources' offers. For a constraint to be defined as secondary it must be determined that the Frequently Constrained Area candidate resource group makes up more than 70 percent of the total relief capability on the constraint. For example, if the total relief capability on constraint XYZ is 1,000 megawatts and the resource candidate group corresponding to a candidate area contributes 725 relief megawatts, then the 70 percent threshold is exceeded and constraint XYZ may be included as a secondary constraint for that area. Additional considerations for including a constraint as secondary include:

- i. electrical proximity to the candidate resource group,

- ii. the expectation that the constraint is not a short-term in duration, and
- iii. the potential for the constraint to experience significant congestion in the future.

The secondary constraint summary for each Frequently Constrained Area candidate is shown in Figure 3–4.

Figure 3–4 Frequently Constrained Area Candidate Secondary Constraint Summary

FCA Candidate	Number of Secondary Constraints
WEI_WACM	0
WEI_WAUW	2
WSF_HILN_EXP	0
WTP100_92100	10
WTP140_92140	2

The WEI_WACM and WSF_HILN_EXP candidate areas produced no secondary constraints since there are no resources with a shift factor of negative five percent or less. The other three candidate areas produced at least one secondary constraint that was active at one time during the study period. This study includes binding hours, pivotal supplier hours, and impact sensitivity hours for current and terminated constraints. Primary and secondary constraint candidates, including terminated, indicate congestion in the area and impact the same set of candidate resources. Terminated constraints may be the most limiting constraint in an area during certain outages or loading conditions and then congestion resumes on other nearby active constraints under normal conditions.

In summary, the candidate areas including the WAUW import and export constraints¹¹ and the energy imbalance constraints for WACM and WAUW¹² experienced most of the congestion

¹¹ WSF_HILN_IMP and WSF_HILN_EXP

¹² WEI_WACM and WEI_WAUW

hours in the WEIS market. The WAUW export candidate area resulted in only twelve percent of the binding hours being pivotal while the WAUW import candidate area resulted in over 80 percent of the binding hours being pivotal. The candidate areas including the WACM and WAUW energy imbalance constraints also resulted in about 80 percent of binding hours being pivotal. However, no areas reached the 500-hour threshold of pivotal supplier hours during the study period. In addition, all of these areas also fell below 400 hours of actual binding hours¹³ in the WEIS market during the study period resulting in no Frequently Constrained Areas additions.

¹³ A constraint binding during a five-minute market interval is one-twelfth of an actual binding hour. A constraint that is within the greater of five megawatts (5 MW) or two percent of the effective constraint limit during a five-minute market interval is one-twelfth of a simulated binding hour.

4 APPENDIX

4.1 BINDING CONSTRAINT AND PIVOTAL SUPPLIER DATA

Constraint/Path Name	Monitored Element(s)	Binding Hours	Pivotal Supplier Hours
WSF_HILN_EXP	Restrictions to respect rights of non-participants in the market region	471	57
WEI_WACM	WEIS market energy imbalance constraint for WACM	434	338
WSF_TEMP_002	Restrictions to respect rights of non-participants in the market region	359	310
WTP044_92044	Alcova – Miracle Mile 115kV	113	50
WEI_WAUW	WEIS market energy imbalance constraint for WAUW	93	67
WTP132_93132	Arickaree – Anton 115kV	89	0
WTP140_92140	Wayne Child – West Archer 230kV	39	37
WTP100_92100	Laramie River – Ault 345kV	36	34
WTP125_92125	Willoby - Kersey 115kV	32	0
WTP083_92083	Deering Lake – Otis 115kV	16	0
WTP101_92101	Nixon – Kelker 230kV	14	6
WTP004_92004	Casper – Alcova 115kV	11	7
WTP080_92080	Stegall – West Archer 230kV	7	7
WSF_TEMP_001	Restrictions to respect rights of non-participants in the market region	7	5

Constraint/Path Name	Monitored Element(s)	Binding Hours	Pivotal Supplier Hours
WTP097_92097	North Yuma – Story 230kV	6	6
WTP050_92050	Cameo – Uintah 230kV	5	5
WSF_TEMP_003	Restrictions to respect rights of non-participants in the market region	5	5
WTP048_92048	Ault transformer 345/230kV	4	4
WTP040_92040	Pawnee – Story 230kV	2	2
WTP111_92111	Curecanti – South Canal 115kV	2	2
WSF_P36_TOT3	Path 36	1	1
WTP094_92094	Beaver Creek – Adena 115kV	1	0
WSF_HILN_IMP	Restrictions to respect rights of non-participants in the market region	1	0
WTP120_92120	Stegall – West Archer 230kV	1	1
WTP047_92047	Hayden sub – Oak Creek tap 138kV	1	1
WTP060_92060	Beaver Creek – Brush tap 115kV	1	0

The data and analysis provided in this report are for informational purposes only and shall not be considered or relied upon as market advice or market settlement data. All analysis and opinions contained in this report are solely those of the SPP Market Monitoring Unit (MMU), the independent market monitor for Southwest Power Pool, Inc. (SPP). The MMU and SPP make no representations or warranties of any kind, express or implied, with respect to the accuracy or adequacy of the information contained herein. The MMU and SPP shall have no liability to recipients of this information or third parties for the consequences that may arise from errors or discrepancies in this information, for recipients' or third parties' reliance upon such information, or for any claim, loss, or damage of any kind or nature whatsoever arising out of or in connection with:

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