Southwest Transmission
COOPERATIVE, INC
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January 29, 2010

Mr. Steven M. Olea
Director, Utilities Division
Arizona Corporation Commission
1200 West Washington
Phoenix, AZ 85007

RE: Docket No. E-00000D-09-0020

Dear Mr. Olea:

Enclosed is the Southwest Transmission Cooperative, Inc. (SWTC) Ten Year Plan for the period 2010 – 2019. I have enclosed an original plus thirteen copies pursuant to A.R.S. Section 40-360-02.

In addition, I am enclosing the Cochise County Summary Report, as required by the 5th BTA, Decision #70635. SWTC volunteered to file this document with its Ten Year Plan filing. It carries an ACC Docket No. E-00000D-07-0376, which was originally used for the 5th BTA. I have enclosed an original of this document, along with thirteen copies.

Sincerely,

For

James Rein
Manager of Transmission Planning

enclosures
c/P. Ledger w/o enclosures

Arizona Corporation Commission
DOCKETED
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DOCKETED BY

Southwest Transmission
COOPERATIVE, INC

TEN-YEAR PLAN

2010 – 2019

JANUARY 28, 2010

SOUTHWEST TRANSMISSION COOPERATIVE, INC.

TEN-YEAR PLAN

2010 – 2019

Prepared for the

ARIZONA CORPORATION COMMISSION

TRANSMISSION PLANNING

JANUARY 28, 2010

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SOUTHWEST TRANSMISSION COOPERATIVE, INC.

TEN-YEAR PLAN

GENERAL INFORMATION

This Ten-Year Plan is submitted to the Arizona Corporation Commission ("Commission") to satisfy the requirements of section 40-360.02 of the Arizona Revised Statutes ("A.R.S."), relating to power plant and transmission line siting requirements. It outlines the plans of Southwest Transmission Cooperative, Inc. ("SWTC") to install electric facilities required to meet anticipated system load growth of its Distribution Cooperative Members (Member) and other network and point to point customers.

This report contains transmission projects that SWTC anticipates may be constructed over the next ten-year period. As noted in A.R.S. section 40-360.02.F, the plans contained in this report are tentative information only and are subject to change at any time at the discretion of SWTC. SWTC anticipates that any changes to this plan will likely be due to changes in load forecasts, environmental constraints, economic considerations and/or regulatory and legal developments. All projects are subject to a peer-review by SWTC's Class A Operating Committee ("CAOC") prior to submittal to the SWTC Board for approval. Meetings of the CAOC are held quarterly and changes to these projects are reviewed as necessary to meet the Member needs. This process concludes with the preparation of a Construction Work Plan ("CWP") that is then submitted to the SWTC Board for approval. Once the CWP is approved, the projects are considered by SWTC as "planned" projects that have a high likelihood of being constructed. Projects that have been studied for this ten-year plan horizon that have not been approved and placed into a CWP for approval by the SWTC Board are considered as "conceptual" meaning that they are still undergoing review by the CAOC and do not yet have a high likelihood for being constructed. Changes of any significance that occur prior to the next Ten-Year Plan filing, will be discussed with the Commission Staff.

The report is divided into three sections, as outlined in the Table of Contents on pages 3 and 4. Section I describes planned transmission lines SWTC may construct over the ten-year plan

period, whose nominal rating is equal to or greater than one hundred fifteen thousand volts ("115 kV"). (Included in this section are a few line loop-in projects for load-serving substations for SWTC Members that are planned for service off of the SWTC transmission system. Some of these potential line loop-in projects will not require line siting, but have been listed in case the preferred substation location changes during the land acquisition process, necessitating transmission line extensions to provide service.) Section II contains SWTC's internal planning criteria and facility ratings, pursuant to Commission Decision #63876, dated July 25, 2001. Section III is a Technical Study Report of the planned transmission projects contained in Section I, to satisfy the requirements of paragraph C.7 of A.R.S. Section 40-360.02.

With this filing, SWTC also submits to the Commission, the Cochise County Summary Report, as a separate document. This report is the culmination of studies that were set out in the Commission's 5th Biennial Transmission Assessment ("BTA") Order No. 70635 that states: "APS, SSVEC, TEP are to perform collaborative studies for the next BTA that establishes a long range system plan for Cochise County that is founded on the principle of continuity of service following a transmission line outage. SWTC shall participate in the study effort as SSVEC's current sole transmission service provider. Relevant elements of that plan are to be incorporated in each transmission service provider's respective ten year plans with a defined in-service date and filed with the Commission in January 2010."

APS, SSVEC, SWTC and TEP hired the firm of PDS Consulting to perform the studies and write the summary report. It represents a significant effort throughout 2009, on the part of the study participants and other stakeholders within Cochise County, to jointly develop a long range plan that is expected to provide continuity of service beyond the ten year time horizon and serve a load of approximately 380 MW in the area. As load forecasts change along with transmission system dynamics, further studies by the Cochise County Study Group will refine this summary report. As adjustments are made to continue meeting continuity of service, they will be reported to the Commission in subsequent BTA and ten-year plan filings.

The planned transmission lines that are listed in Section I are needed to maintain system reliability and to the serve load of SWTC Members and other customers. Due to the proximity

of the new lines to the Member load being served, studies conducted show little impact to the overall interconnected system.

REGIONAL PLANNING

SWTC participates in Regional Planning efforts through its involvement in the Southwest Area Transmission ("SWAT") Planning Group. SWTC is involved in the following subcommittees of SWAT, either through active participation or copy interest:

- Arizona-New Mexico Regional Transmission Subcommittee ("AZNM")
- Central Arizona Transmission EHV ("CATS-EHV")
- Central Arizona Transmission HV ("CATS-HV")
- Colorado River Transmission Subcommittee ("CRT")
- Renewable Transmission Task Force ("RTTF")
- Southeast Arizona Transmission Study ("SATS")
- Short-circuit Working Group ("SCWG")

In addition, SWTC continues to monitor the efforts of the Transmission Expansion Planning Policy Committee ("TEPPC") of the Western Electricity Coordination Council ("WECC") and is active within the following subcommittees of WECC: the Operating Committee ("OC"), the Planning Coordination Committee ("PCC") and the Technical Studies Subcommittee ("TSS").

SWTC is also an active participant in WestConnect and was one of the original twelve signatories to the WestConnect Project Agreement for Subregional Transmission Planning ("STP Agreement"). A Planning Management Committee ("PMC"), made up of one representative from each of the signatories to the STP Agreement is tasked with implementation of the subregional planning process. SWTC participates regularly in the PMC meetings or conference calls.

At the WestConnect Annual Planning Workshop and Stakeholder Meeting, held November 3, 2009, SWTC presented its 2010-2019 Ten-Year Transmission Plan for inclusion into the 2009

WestConnect Transmission Plan. The WestConnect plan is scheduled for approval at the February 17, 2010 WestConnect Annual Planning Meeting. The projects that are included in this ten year plan filing to the Commission are based upon the WestConnect Annual Planning Workshop and Stakeholder Meeting and only the in-service dates have been changed to reflect the current economic downturn. All of the projects are subject to change, pending further discussions with the SWTC Members, through ongoing meetings of the CAOC. Notations to this effect are included in the write-up of each of the transmission line project summaries in Section 1.

SATS STUDY REPORT

SWTC is one of the initiating founders of SATS and has therefore been very active in the SATS study effort. The goal of SATS is to have a 20 year transmission plan covering the entire SATS area assuming transmission and distribution facilities are owned and operated as a "single system." Each year, SATS updates its current Study Report which is a culmination of study efforts throughout the year to actively evaluate strategies to increase local load serving capability and evaluate impacts of potential EHV transmission to bring in remote resources into the area to serve the growing loads of Southeast Arizona. Study participants continue to acknowledge the importance of renewable resources in the resource study mix.

The Study Report was developed using power flow base cases for the years 2010 through 2014 and 2019. The cases were developed from the WECC approved heavy summer cases, however, not every year is available or current from WECC. The 2011-2014 cases were developed from the 2013 heavy summer case that was developed for the Cochise County study effort which was initially developed from the WECC 2012 heavy summer (12HS2S) case. The 2019 case was developed from the CATS-HV 2019 heavy summer case which was developed from the WECC 2018 heavy summer (18HS1A) case.

The initial draft of 2009 SATS Study Report was reviewed by SATS participants in a conference call on December 16, 2009 and was provided via e-mail to the SATS participants and was posted on the WestConnect website (www.westconnect.com) for all interested stakeholders within

SWAT and WestConnect. Revised drafts of the Report have been posted on the WestConnect website for review and comment. The final Report was approved by SATS at the January 21, 2010 SATS Meeting and is scheduled for approval by SWAT at the SWAT Oversight Committee on February 16, 2010. TEP is responsible for filing the 2009 SATS Report on behalf of SATS participants.

Pages 20 to 21 of the Report (Conclusions) contain a listing of the proposed projects for the 2010 to 2019 time frame for easy reference that document projects under consideration by SWTC and TEP for the near and long-term planning horizons. Hence, the SATS Study Report is an important part of the overall Regional Study Process within SWAT and WestConnect and forms the basis for the projects that are provided in this ten year plan filing.

The 2009 SATS Study Report also contains information of several coordinated studies that were conducted in sub-areas within the SATS footprint, such as Cochise County and the Tucson metropolitan area. Assumptions used in these studies were tailored to the needs of the load-serving entities and impacted stakeholders in the areas. Further coordinated studies such as these will continue throughout 2010 and beyond.

The following is a brief description of the EHV projects that SWTC either is a participant in, or is evaluating interest in, through the Regional Planning Process, that are contemplated for completion during this Ten-Year Plan Filing (2010-2019) timeframe:

Pinal West to Pinal Central (Formerly Pinal West to Southeast Valley/Browning 500 kV Line)

A CEC (Case No. 126) for this project was issued in August 2005, with an amendment to the CEC approved in November 2005, for construction of a 500 kV line from Pinal West to Browning, with the segment from Santa Rosa to the proposed Pinal Central Substation being proposed as a double-circuit 500/230 kV line, as is a segment of the Pinal Central to the Southeast Valley Substation line. SWTC is a participant in the 500 kV segment from Pinal West

to Pinal Central. SRP is the project manager for this project, which has an anticipated in-service date of 2014.

Pinal Central to Tortolita 500 kV Line

This project contemplates construction of a 500 kV line from the proposed Pinal Central Substation to the TEP Tortolita Substation. SWTC is a participant in Phase 1 of this project. TEP is the project manager for this project, which has an anticipated in-service date of 2014.

Winchester to Vail Double-circuit 345 kV Line

This conceptual project contemplates construction of a double-circuit 345 kV line from Winchester Substation to Vail Substation, following the route of the existing Winchester to Vail 345 kV line. SWTC is evaluating possible participation in this project, as an alternative to the rebuild of the Apache to Butterfield and Butterfield to Bicknell 230 kV lines, in 2016 and 2017, respectively. TEP is the project manager for this project, which has an anticipated in-service date of 2014.

Other Projects

In 2009, SWTC did not enter into any additional EHV project agreements. As a participant in SATS, SWTC will, from time to time, evaluate potential joint participation in EHV projects whose in-service dates have not yet been established and may potentially lie outside of this ten year planning horizon. If, through its involvement in the SATS 2010 Study Plan effort, an EHV project is brought forward that will meet SWTC and its Member's future needs, SWTC will report on it in the next Ten Year Plan filing.

CHANGES FROM 2009 TEN-YEAR PLAN FILING

No new projects have been considered by SWTC for inclusion in this Ten-Year Plan filing over last years (2009-2018) Ten-Year Plan filing. As noted earlier, there are a few minor changes to

in-service dates in this filing, over last year's filing, which are mostly due to the economic downturn that SWTC and its Members are currently experiencing. While some in-service dates have been changed to reflect the economic conditions, some project in-service dates have not changed from last year's ten year plan filing. However, most of the projects in this filing are under review as a result of the economic downturn and may change with next year's 10 year plan filing. The changes are noted below:

Apache/Hayden to San Manuel 115 kV Line. The in-service date for this planned project has changed from 2010 to 2014.

CAP 115 kV Line Loop-in to San Joaquin. As noted in last year's ten year plan filing, this is a reinstated substation project that may or may not require a transmission line extension. Its in-service date has changed from 2010 to 2012.

Marana To Avra Valley 115 kV Line Upgrade. The in-service date for this planned project has changed from 2010 to 2011. In addition, a third party consultant has been commissioned to assist SWTC in re-determining existing line ratings and this data is currently being reviewed.

Marana Tap to Marana 115 kV Line Upgrade. The in-service date for this planned project has changed from 2012 to 2011. In addition, a third party consultant has been commissioned to assist SWTC in re-determining existing line ratings and this data is currently being reviewed.

Pantano to Sahuarita 230 kV Line Loop-in to New Tucson. This is a substation project that may or may not require a transmission line extension. Its in-service date has changed from 2010 to 2011, but is currently under review.

Greenlee 2nd 345/230 kV Transformer. The in-service date for this planned project has changed from 2012 to 2013 to better fit construction scheduling.

Sandario Tap to Three Points 115 kV Line Upgrade. The in-service date for this planned

project has changed from 2011 to 2014. In addition, a third party consultant has been commissioned to assist SWTC in re-determining existing line ratings and this data is currently being reviewed.

Pinal Central 230/115 kV Transformer. The in-service date for this conceptual project has changed from 2013 to 2014. The Southwest Public Power Resources Group ("SPPR") is the project sponsor and SWTC is a participant in the project, however, in the event that SPPR does not move forward with this project, SWTC would likely sponsor a different project.

Pinal West to SEV Project. For this filing, this project is now referred to as the Pinal West to Pinal Central Project. The Project in-service date, has changed from 2013 to 2014. SRP is the Project Manager.

Pinal Central to Tortolita 500 kV Line. This in-service date for this conceptual project has changed from 2013 to 2014. TEP is the Project Manager.

Apache to Butterfield 230 kV Line Upgrade Project. The in-service date for this conceptual project has changed from 2014 to 2016. This is due, in part, to the fact that SWTC has initiated an aggressive study to re-evaluate the line ratings, which have been based on very conservative parameters. The re-rating of the Apache to Butterfield 230 kV line could defer the upgrade of this line from 2014 to 2016. This conceptual project is also under review.

Butterfield to Bicknell 230 kV Line Upgrade. The in-service date for this conceptual project has changed from 2014 to 2016. This is due, in part, to the fact that SWTC has initiated an aggressive study to re-evaluate the line ratings, which have been based on very conservative parameters. The re-rating of the Butterfield to Bicknell 230 kV line could defer the upgrade of this line from 2015 to 2017. This conceptual project is also under review.

CS2 Substation. This conceptual project was proposed as a placeholder for the additional study work that was contemplated within the Cochise County Study Group for 2009. However, the study work for the Cochise County Study Group proposed a long range plan that will satisfy the

needs for continuity of service throughout the ten year planning horizon and the need for this project is now outside of that planning horizon.

Kartchner to CS2 230 kV Line. This conceptual project was proposed as a placeholder for the additional study work that was contemplated within the Cochise County Study Group for 2009. However, the study work for the Cochise County Study Group proposed a long range plan that will satisfy the needs for continuity of service throughout the ten year planning horizon and the need for this project is now outside of that planning horizon.

Pantano to Kartchner 115 kV Line Upgrade. This conceptual project was proposed as a placeholder for the additional study work that was contemplated within the Cochise County Study Group for 2009. However, the study work for the Cochise County Study Group proposed a long range plan that will satisfy the needs for continuity of service throughout the ten year planning horizon and the need for this project is now outside of that planning horizon.

San Rafael to CS2 230 kV Line. This conceptual project was proposed as a placeholder for the additional study work that was contemplated within the Cochise County Study Group for 2009. However, the study work for the Cochise County Study Group proposed a long range plan that will satisfy the needs for continuity of service throughout the ten year planning horizon and the need for this project is now outside of that planning horizon.

SECTION I

SWTC PLANNED TRANSMISSION LINES

SOUTHWEST TRANSMISSION COOPERATIVE, INC.

10 YEAR PLAN

PLANNED TRANSMISSION FACILITIES

Line Designation:		Apache/Hayden to San Manuel 115 kV line
Size:		
a)	Voltage	115 kV
b)	Capacity	123 MVA
c)	Point of Origin	Apache/Hayden 115 kV line near San Manuel Sec. 19 T9S R18E
d)	Point of Termination	APS San Manuel Substation Sec. 29 T9S R17E
e)	Length	Approximately 4.5 miles
Routing:		Apache/Hayden 115 kV line, heading generally west then southwest to San Manuel Substation.
Purpose:		To provide system reliability, increased transfer capability and voltage support for the SWTC system and to provide for anticipated Member load growth.
Dates:		
a)	Construction Start	2013
b)	In-Service Date	2014

Notes: This project was approved by the ACC Line Siting Committee on May 12, 2009 and by the Commission (Case #142, Decision #71218) on July 9, 2009. However, due to the economic downturn, SWTC has deferred this project to 2014.

SOUTHWEST TRANSMISSION COOPERATIVE, INC.

10 YEAR PLAN

PLANNED TRANSMISSION FACILITIES

Line Designation:		CAP 115 kV Line Loop-in to San Joaquin
Size:		
a)	Voltage	115 kV
b)	Capacity	50 MVA
c)	Point of Origin	CAP's Brawley to San Xavier 115 kV line near proposed San Joaquin Substation location Sec. 25 T14S R11E
d)	Point of Termination	San Joaquin Substation Sec. 25 T14S R11E
e)	Length	0 miles
Routing:		CAP's Brawley to San Xavier 115 kV line approximately 2.5 miles northwest of San Xavier Substation.
Purpose:		To provide a new delivery point for Trico and provide for anticipated load growth in the area. The project also increases the reliability of the CAP and SWTC systems.
Dates:		
a)	Construction Start	2012
b)	In-Service Date	2012

Notes: This is an approved, planned project. It is included in this plan in case the preferred substation location changes, necessitating the filing of a CEC application for a transmission extension to serve the substation. However, due to the economic downturn, the project in-service date is under review and is subject to change.

SOUTHWEST TRANSMISSION COOPERATIVE, INC.

10 YEAR PLAN

PLANNED TRANSMISSION FACILITIES

Line Designation:		CAP 115 kV Line Loop-in to SWTC Sandario
Size:		
a)	Voltage	115 kV
b)	Capacity	167 MVA
c)	Point of Origin	CAP Sandario to Brawley 115 kV line near SWTC Sandario Substation Sec. 33 T13S R11E
d)	Point of Termination	Sandario Substation Sec. 32 T13S R11E
e)	Length	Approximately 0.6 miles
Routing:		CAP Sandario to Brawley 115 kV line near Sandario Substation, heading southwest into the Sandario Substation
Purpose:		To provide system reliability, increased transfer capability and voltage support for the SWTC system and to provide for anticipated Member load growth. The project also increases the reliability of the CAP system.
Dates:		
a)	Construction Start	2009
b)	In-Service Date	2010

Notes: This is an approved, planned project. However, due to the economic downturn, the project in-service date is under review and subject to change.

SOUTHWEST TRANSMISSION COOPERATIVE, INC.

10 YEAR PLAN

PLANNED TRANSMISSION FACILITIES

Line Designation:		Marana to Avra Valley 115 kV Line Upgrade
Size:		
a)	Voltage	115 kV
b)	Capacity	219 MVA
c)	Point of Origin	Marana Substation Sec. 26 T11S R10E
d)	Point of Termination	Avra Valley Substation Sec. 11 T13S R10E
e)	Length	Approximately 8.75 miles
Routing:		Marana Substation, south to Avra Valley Substation, following the existing Marana to Avra Valley ROW.
Purpose:		To provide system reliability, increased transfer capability and voltage support for the SWTC system and to provide for anticipated Member load growth.
Dates:		
a)	Construction Start	2010
b)	In-Service Date	2011

Notes: This is an approved, planned project and a certificate will be needed to site this project. However, due to the economic downturn, the project in-service date is under review and subject to change.

SOUTHWEST TRANSMISSION COOPERATIVE, INC.

10 YEAR PLAN

PLANNED TRANSMISSION FACILITIES

Line Designation:		North Loop to Rattlesnake 115 kV Line
Size:		
a)	Voltage	115 kV
b)	Capacity	219 MVA
c)	Point of Origin	Vicinity of North Loop Substation Sec. 9 T12S R12E
d)	Point of Termination	Rattlesnake Substation Sec. 14 T12S R11E
e)	Length	Approximately 5.0 miles
Routing:		Starting in the vicinity of North Loop Substation, crossing I-10 and then heading west then south and then west along Western's 115 kV line ROW to the Rattlesnake Substation.
Purpose:		To provide system reliability, increased transfer capability and voltage support for the SWTC system and to provide for anticipated Member load growth. The project also increases the reliability of the CAP system.
Dates:		
a)	Construction Start	2010
b)	In-Service Date	2010

Notes: This is an approved, planned project. SWTC has filed a CEC application for this project (Case #152) and hearings of the ACC Line Siting Committee are scheduled for February 8-9, 2010. However, due to the economic downturn, the project in-service date is under review and subject to change.

SOUTHWEST TRANSMISSION COOPERATIVE, INC.

10 YEAR PLAN

PLANNED TRANSMISSION FACILITIES

Line Designation:		Pantano to Sahuarita 230 kV Line Loop-in to New Tucson
Size:		
a)	Voltage	230 kV
b)	Capacity	50 MVA
c)	Point of Origin	Pantano to Sahuarita 230 kV Line near the proposed New Tucson Substation Sec. 34 T16S R16E
d)	Point of Termination	New Tucson Substation Sec. 34 T16S R16E
e)	Length	0 miles
Routing:		Pantano to Sahuarita 230 kV line ROW, approximately 8.5 miles west of Pantano Substation.
Purpose:		To provide an additional delivery point for Trico and provide for anticipated load growth in the area.
Dates:		
a)	Construction Start	2011
b)	In-Service Date	2011

Notes: This is an approved, planned project. It is included in this plan in case the preferred substation location changes, necessitating the filing of a CEC application for a transmission extension to serve the substation. However, due to the economic downturn, the project in-service date is under review and subject to change.

SOUTHWEST TRANSMISSION COOPERATIVE, INC.

10 YEAR PLAN

PLANNED TRANSMISSION FACILITIES

Line Designation:		Saguaro to North Loop 115 kV line
Size:		
a)	Voltage	115 kV
b)	Capacity	219 MVA
c)	Point of Origin	Saguaro Substation Sec. 15 T10S R10E
d)	Point of Termination	Vicinity of North Loop Substation Sec. 9 T12S R12E
e)	Length	Approximately 15.0 miles
Routing:		Southeast of the Saguaro Substation along the east side of I-10, following the existing 138 kV line ROW to Tangerine Road and then turning south to North Loop Substation.
Purpose:		To provide system reliability, increased transfer capability and voltage support for the SWTC system and to provide for anticipated Member load growth.
Dates:		
a)	Construction Start	2010
b)	In-Service Date	2010

Notes: This project was approved by the ACC Line Siting Committee on October 7, 2009 and by the Commission (Case #149, Decision #71420) on November 19, 2009. However, due to the economic downturn, the project in-service date is under review and subject to change.

SOUTHWEST TRANSMISSION COOPERATIVE, INC.

10 YEAR PLAN

PLANNED TRANSMISSION FACILITIES

Line Designation:		Valencia to CAP Black Mountain 115 kV line
Size:		
a)	Voltage	115 kV
b)	Capacity	219 MVA
c)	Point of Origin	Valencia Substation Sec. 17 T15S R12E
d)	Point of Termination	CAP Black Mountain 115 kV line, 2 miles South of Black Mountain Substation Sec. 11 T15S R12E
e)	Length	Approximately 2.6 miles
Routing:		Directly east of the Valencia Substation to the turning structure of the 115 kV CAP line that heads directly north 2 miles to the CAP Black Mountain Substation.
Purpose:		To provide system reliability, increased transfer capability and voltage support for the SWTC system and to provide for anticipated Member load growth. The project also increases the reliability of the CAP system.
Dates:		
a)	Construction Start	2009
b)	In-Service Date	2010

Notes: This is an approved, planned project. SWTC contemplates filing a CEC application for this project in the 1st Quarter of 2010. However, due to the economic downturn, the project in-service date is under review and subject to change.

SOUTHWEST TRANSMISSION COOPERATIVE, INC.

10 YEAR PLAN

PLANNED TRANSMISSION FACILITIES

Line Designation:		Avra Valley to Sandario Tap 115 kV Line Upgrade
Size:		
a)	Voltage	115 kV
b)	Capacity	219 MVA
c)	Point of Origin	Avra Valley Substation Sec. 11 T13S R10E
d)	Point of Termination	Sandario Tap Sec. 23 T13S R10E
e)	Length	Approximately 2.8 miles
Routing:		Avra Valley Substation, south to the Sandario Tap turning structure, following the existing Avra Valley to Sandario Tap ROW.
Purpose:		To provide system reliability, increased transfer capability and voltage support for the SWTC system and to provide for anticipated Member load growth.
Dates:		
a)	Construction Start	2011
b)	In-Service Date	2011

Notes: This is an approved, planned project and a certificate will be needed to site this project. However, due to the economic downturn, the project in-service date is under review and subject to change.

SOUTHWEST TRANSMISSION COOPERATIVE, INC.

10 YEAR PLAN

PLANNED TRANSMISSION FACILITIES

Line Designation:		San Rafael 2nd 230/69 kV Transformer
Size:		
a)	Voltage	230 kV
b)	Capacity	TBD
c)	Point of Origin	San Rafael Substation Sec. 17 T22S R21E
d)	Point of Termination	San Rafael Substation Sec. 17 T22S R21E
e)	Length	0 miles
Routing:		None
Purpose:		Provide continuous reliable service to SSVEC under certain N-1 outage conditions in the Sierra Vista area. Note: This project is part of the ongoing Cochise County Study efforts.
Dates:		
a)	Construction Start	2011
b)	In-Service Date	2011

Notes: This is an approved, planned project that has been studied as part of the Cochise County Study Group efforts. No certificate is necessary for the project. The project in-service date is under review and subject to change.

SOUTHWEST TRANSMISSION COOPERATIVE, INC.

10 YEAR PLAN

PLANNED TRANSMISSION FACILITIES

Line Designation:		Sandario Tap to Three Points 115 kV Line Upgrade
Size:		
a)	Voltage	115 kV
b)	Capacity	219 MVA
c)	Point of Origin	Sandario Tap Sec. 23 T13S R10E
d)	Point of Termination	Three Points Substation Sec. 25 T15S R10E
e)	Length	Approximately 13.71 miles
Routing:		Sandario Tap turning structure, south to the existing Three Points Substation, following the existing Sandario Tap to Three Points ROW.
Purpose:		To provide system reliability, increased transfer capability and voltage support for the SWTC system and to provide for anticipated Member load growth.
Dates:		
a)	Construction Start	2013
b)	In-Service Date	2014

Notes: This is a conceptual project and a certificate will be needed to site this project. However, due to the economic downturn, the project in-service date is under review and subject to change.

SOUTHWEST TRANSMISSION COOPERATIVE, INC.

10 YEAR PLAN

PLANNED TRANSMISSION FACILITIES

Line Designation:		Bicknell 345/230 kV Transformer Replacement
Size:		
a)	Voltage	345 kV
b)	Capacity	420 MVA
c)	Point of Origin	Bicknell Substation Sec. 30 T17S R13E
d)	Point of Termination	Bicknell Substation Sec. 30 T17S R13E
e)	Length	0 miles
Routing:		None
Purpose:		Provide increased import capability into the SWTC transmission system.
Dates:		
a)	Construction Start	2012
b)	In-Service Date	2012

Notes: This is an approved, planned project. No certificate is necessary for this project.

SOUTHWEST TRANSMISSION COOPERATIVE, INC.

10 YEAR PLAN

PLANNED TRANSMISSION FACILITIES

Line Designation:		Greenlee 2nd 345/230 kV Transformer
Size:		
a)	Voltage	345 kV
b)	Capacity	193 MVA
c)	Point of Origin	SWTC Greenlee Substation Sec. 29 T5S R31E
d)	Point of Termination	SWTC Greenlee Substation Sec. 29 T5S R31E
e)	Length	0 miles
Routing:		None
Purpose:		Provide increased import capability into the SWTC transmission system.
Dates:		
a)	Construction Start	2013
b)	In-Service Date	2013

Notes: This is an approved, planned project. No certificate is necessary for this project.

SOUTHWEST TRANSMISSION COOPERATIVE, INC.

10 YEAR PLAN

PLANNED TRANSMISSION FACILITIES

Line Designation:		Marana Tap to Marana 115 kV Line Upgrade
Size:		
a)	Voltage	115 kV
b)	Capacity	219 MVA
c)	Point of Origin	Marana Tap Sec. 26 T11S R10E
d)	Point of Termination	Marana Substation Sec. 26 T11S R10E
e)	Length	Approximately 0.2 miles
Routing:		Western's Marana Tap, west to the SWTC Marana Substation.
Purpose:		To provide system reliability, increased transfer capability and voltage support for the SWTC system and to provide for anticipated Member load growth.
Dates:		
a)	Construction Start	2011
b)	In-Service Date	2011

Notes: This is an approved, planned project and a certificate will be needed to site this project. However, due to the economic downturn, the project in-service date is under review and subject to change.

SOUTHWEST TRANSMISSION COOPERATIVE, INC.

10 YEAR PLAN

PLANNED TRANSMISSION FACILITIES

Line Designation:		Pinal Central 230/115 kV Transformer
Size:		
a)	Voltage	230 kV
b)	Capacity	300 MVA
c)	Point of Origin	Pinal Central 230 kV Bus Sec. 6 T7S R8E
d)	Point of Termination	Western 115 kV Bus at ED2 Substation Sec. 6 T7S R8E
e)	Length	0 miles
Routing:		None. Pinal Central will be located adjacent to ED2 Substation.
Purpose:		Required for a path between the 500 kV bus at Pinal Central and the transmission line interconnecting to the SWTC system.
Dates:		
a)	Construction Start	2012
b)	In-Service Date	2013

Notes: SWTC is a participant in this project and SPPR is the project sponsor. (In the event that SPPR does not move forward with this project, SWTC may sponsor a different project.)

SOUTHWEST TRANSMISSION COOPERATIVE, INC.

10 YEAR PLAN

PLANNED TRANSMISSION FACILITIES

Line Designation:		Pinal West to Pinal Central
Size:		
a)	Voltage	500 kV
b)	Capacity	1500 MVA
c)	Point of Origin	Pinal West Substation Sec. 18 T5S R2E
d)	Point of Termination	Pinal Central Substation Sec. 25 T6S R7E
e)	Intermediate Points	None
f)	Length	Approximately 100 miles

Routing: South and east from the Pinal West substation to approximately Teel Road, then east to the Santa Rosa substation. From Santa Rosa easterly to approximately the Santa Rosa Wash, then generally south to approximately a half mile north of I-8 where it turns east again. Then it runs easterly to about the location of the ED2 substation (Sec 25, T6S, R7E) and then to Pinal Central Substation.

Purpose: The Central Arizona Transmission System Study identified a number of system additions necessary to accommodate load growth and access to energy sources in the central Arizona area. This transmission line is the second segment of a series of transmission lines to serve the central Arizona region. This segment will initially provide an interconnection with the Palo Verde market area to bring power to the Phoenix and central Arizona areas, and to accommodate the growth in development and population in Pinal County.

Dates:

a)	Construction Start	2010
b)	In-service Date	2014

Notes: CEC for Case 126 was awarded in 2005 (ACC Decision # 68093 and # 68291) SRP is lead and project manager for the development of this project. Participants include SRP, TEP, SWTC and Electric Districts 2, 3, and 4.

SOUTHWEST TRANSMISSION COOPERATIVE, INC.

10 YEAR PLAN

PLANNED TRANSMISSION FACILITIES

Line Designation:		Pinal Central to Tortolita 500 kV Line
Size:		
a)	Voltage	500 kV
b)	Capacity	1732 MVA
c)	Point of Origin	Pinal Central Substation Sec. 25 T6S R7E
e)	Point of Termination	New Tortolita 500 kV Yard Sec. 23 T10S R10E
f)	Length	Approximately 38.0 miles
Routing:		From Pinal Central Substation to Tortolita Substation following the CAP facilities.
Purpose:		Identified by TEP as necessary to increase TEP System Load Serving Capability from remove resources. The project would provide for increased transfer capability to SWTC loads in Southeast AZ.
Dates:		
a)	Construction Start	2013
b)	In-Service Date	2014

Notes: SWTC is a participant in Phase I of the project; TEP is the project manager

SOUTHWEST TRANSMISSION COOPERATIVE, INC.

10 YEAR PLAN

PLANNED TRANSMISSION FACILITIES

Line Designation:		Apache to Butterfield 230 kV Line Upgrade
Size:		
a)	Voltage	230 kV
b)	Capacity	TBD
c)	Point of Origin	Apache Substation Sec. 10 T16S R24E
d)	Point of Termination	Butterfield Substation Sec. 31 T16S R22E
e)	Length	Approximately 16.0 miles
Routing:		Along the existing SWTC Apache to Butterfield 230 kV line ROW.
Purpose:		Reinforce the existing SWTC 230 kV backbone system to provide continuous reliable service under certain N-1 outage conditions and provide for anticipated Member load growth.
Date:		
a)	Construction Start	2016 (tentative)
b)	In-Service Date	2016 (tentative)

Notes: This is a conceptual project and a certificate will be needed to site this project. However, due to the economic downturn, the project in-service date is under review and subject to change.

SOUTHWEST TRANSMISSION COOPERATIVE, INC.

10 YEAR PLAN

PLANNED TRANSMISSION FACILITIES

Line Designation:		Three Terminal Plan Circuit 1 230 kV line from Santa Rosa/Test Track 230 kV bus to the new ED5 230 kV Switching Station
Size:		
a)	Voltage	230 kV
b)	Capacity	TBD
c)	Point of Origin	Santa Rosa/Test Track Substation Sec. 30 T5S R4E
d)	Point of Termination	New ED5 230 kV Switching Station Sec. 25 T9S R8E
e)	Length	Approximately 23.0 miles
Routing:		The line will consist of two contiguous segments: Segment one will be routed from the Santa Rosa/Test Track to Thornton Road. Segment two will be routed from Thornton Road to a new ED5 230 kV Switching Station.
Purpose:		To deliver Project Power to SPPR members and to enhance the reliability for the region as a whole.
Date:		
a)	Construction Start	TBD
b)	In-Service Date	2014

Notes: SWTC is a participant in the project and SPPR is the project sponsor.

SOUTHWEST TRANSMISSION COOPERATIVE, INC.

10 YEAR PLAN

PLANNED TRANSMISSION FACILITIES

Line Designation:		Three Terminal Plan Circuit 2 230 kV Line from the new ED5 230 kV Switching Station to a new SWTC 230 kV Marana Substation
Size:		
a)	Voltage	230 kV
b)	Capacity	TBD
c)	Point of Origin	New ED5 230 kV Switching Station Sec. 25 T9S R8E
d)	Point of Termination	New SWTC 230 kV Marana Substation Sec. 26 T11S R10E
e)	Length	Approximately 31.0 miles
Routing:		The line route will follow the existing Western 115 kV line from Empire to Saguaro and the Western 115 kV line route from Saguaro to Marana Tap.
Purpose:		To deliver Project Power to SPPR members and to enhance the reliability for the region as a whole.
Date:		
a)	Construction Start	TBD
b)	In-Service Date	2014

Notes: SWTC is a participant in the project and SPPR is the project sponsor.

SOUTHWEST TRANSMISSION COOPERATIVE, INC.

10 YEAR PLAN

PLANNED TRANSMISSION FACILITIES

Line Designation:		Three Terminal Plan Circuit 3 230 kV Line from the new ED5 230 kV Switching Station to the new Pinal Central Substation
Size:		
a)	Voltage	230 kV
b)	Capacity	TBD
c)	Point of Origin	New ED5 230 kV Switching Station Sec. 25 T9S R8E
d)	Point of Termination	New Pinal Central Substation Sec. 25 T6S R7E
e)	Length	Approximately 19.0 miles
Routing:		From the new ED5 Switching Station to Pinal Central. The line will follow the existing Western 115 kV line route from ED5 to ED4 to ED2.
Purpose:		To deliver Project Power to SPPR members and to enhance the reliability for the region as a whole.
Date:		
a)	Construction Start	TBD
b)	In-Service Date	2014

Notes: SWTC is a participant in the project; and SPPR is the project sponsor.

SOUTHWEST TRANSMISSION COOPERATIVE, INC.

10 YEAR PLAN

PLANNED TRANSMISSION FACILITIES

Line Designation:		Winchester to Vail Double Circuit 345 kV Line
Size:		
a)	Voltage	345 kV
b)	Capacity	1195 MVA
c)	Point of Origin	Winchester 345 kV Bus Sec. 28 T14S R21E
d)	Point of Termination	Vail 345 kV Bus Sec. 4 T16S R15E
e)	Length	Approximately 41.0 miles
Routing:		Parallel to the existing Winchester – Vail 345 kV line
Purpose:		Identified by TEP as being needed to increase load serving capability into the SATS area. The project would provide for increased transfer capability and reliability to SWTC loads in Southeast Arizona.
Date:		
a)	Construction Start	TBD
b)	In-Service Date	TBD

Notes: SWTC is evaluating participation in this project as an alternative to the Apache to Butterfield to Bicknell 230 kV Upgrade Projects. TEP is the Project Manager.

SOUTHWEST TRANSMISSION COOPERATIVE, INC.

10 YEAR PLAN

PLANNED TRANSMISSION FACILITIES

Line Designation:		Butterfield to Bicknell 230 kV Line Upgrade
Size:		
a)	Voltage	230 kV
b)	Capacity	TBD
c)	Point of Origin	Butterfield Substation Sec. 31 T16S R22E
d)	Point of Termination	Bicknell Substation Sec. 30 T17S R13E
e)	Length	Approximately 68.7 miles
Routing:		Along the existing SWTC Butterfield to Bicknell 230 kV line ROW
Purpose:		Reinforce the existing SWTC 230 kV backbone system to provide continuous reliable service under certain N-1 outage conditions and provide for anticipated SWTC Member System load growth.
Date:		
a)	Construction Start	2017 (tentative)
b)	In-Service Date	2017 (tentative)

Notes: This is a conceptual project and a certificate will be needed to site this project. However, due to the economic downturn, the project in-service date is under review and subject to change.

SOUTHWEST TRANSMISSION COOPERATIVE, INC.

10 YEAR PLAN

PLANNED TRANSMISSION FACILITIES

Line Designation:		Saguaro to Adonis 115 kV Line Loop-in to Naviska
Size:		
a)	Voltage	115 kV
b)	Capacity	50 MVA
c)	Point of Origin	Saguaro to Adonis 115 kV Line near the proposed Naviska Substation Sec. 25 T10S R10E
d)	Point of Termination	Naviska Substation Sec. 25 T10S R10E
e)	Length	0 miles
Routing:		Saguaro to Adonis 115 kV line near the proposed Naviska Substation, approximately 3.4 miles southeast of the Saguaro Substation.
Purpose:		To provide an additional delivery point for Trico and provide for anticipated load growth in the area.
Date:		
a)	Construction Start	2015 (tentative)
b)	In-Service Date	2015 (tentative)

Notes: This is a conceptual project. It is included in this plan in case the preferred substation location changes, necessitating the filing of a CEC application for a transmission extension to serve the substation. The project in-service date is under review and subject to change.

SOUTHWEST TRANSMISSION COOPERATIVE, INC.

10 YEAR PLAN

PLANNED TRANSMISSION FACILITIES

Line Designation:		CAP 115 kV Line Loop-in to Picture Rocks
Size:		
a)	Voltage	115 kV
b)	Capacity	50 MVA
c)	Point of Origin	CAP's Twin Peaks to Sandario 115 kV line near proposed Picture Rocks Substation location Sec. 28 T12S R11E
d)	Point of Termination	Picture Rocks Substation Sec. 28 T12S R11E
e)	Length	0 miles
Routing:		CAP's Twin Peaks to Sandario 115 kV line approximately 2 miles southwest of Twin Peaks Substation.
Purpose:		To provide a new delivery point for Trico and provide for anticipated load growth in the area. The project also increases the reliability of the CAP and SWTC systems.
Dates:		
a)	Construction Start	2018 (tentative)
b)	In-Service Date	2018 (tentative)

Notes: This is a conceptual project. It is included in this plan in case the preferred substation location changes, necessitating the filing of a CEC application for a transmission extension to serve the substation. The project in-service date is under review and subject to change.

SOUTHWEST TRANSMISSION COOPERATIVE, INC.

10 YEAR PLAN

PLANNED TRANSMISSION FACILITIES

Line Designation:		CS2 Substation
Size:		
a)	Voltage	230 kV
b)	Capacity	TBD
c)	Point of Origin	Tap of proposed Kartchner to CS2 230 kV line Sec. 25 T21S R20E
d)	Point of Termination	CS2 Substation Sec. 25 T21S R20E (Location could change)
e)	Length	0 miles
Routing:		Approximately 2.4 miles west of Kartchner Substation.
Purpose:		Provide continuous reliable service to SSVEC under N-1 outage conditions in the Sierra Vista area. Note: this project will be studied in detail as part of the SATS 2009 Study Plan and as per the 5th BTA Order.
Dates:		
a)	Construction Start	TBD
b)	In-Service Date	TBD

Notes: This is a conceptual project that was studied in the Cochise County Study Group in 2009 to ensure continuity of service in Cochise County. The project was not proposed for a solution to resolving continuity of service issues in Cochise County and therefore lies outside of this ten year plan horizon.

SOUTHWEST TRANSMISSION COOPERATIVE, INC.

10 YEAR PLAN

PLANNED TRANSMISSION FACILITIES

Line Designation:		Kartchner to CS2 230 kV Line
Size:		
a)	Voltage	230 kV
b)	Capacity	TBD
c)	Point of Origin	Kartchner Substation Sec. 33 T21S R20E
d)	Point of Termination	CS2 Substation Sec. 25 T21S R20E (Location could change)
e)	Length	2.0 miles
Routing:		Initially north of the Kartchner Substation then east to CS2 Substation.
Purpose:		Provide continuous reliable service to SSVEC under N-1 outage conditions in the Sierra Vista area. Note: this project will be studied in detail as part of the SATS 2009 Study Plan and as per the 5th BTA Order.
Dates:		
a)	Construction Start	TBD
b)	In-Service Date	TBD

Notes: This is a conceptual project that was studied in the Cochise County Study Group in 2009 to ensure continuity of service in Cochise County. The project was not proposed for a solution to resolving continuity of service issues in Cochise County and therefore lies outside of this ten year plan horizon.

SOUTHWEST TRANSMISSION COOPERATIVE, INC.

10 YEAR PLAN

PLANNED TRANSMISSION FACILITIES

Line Designation:		Pantano to Kartchner 115 kV Line Upgrade
Size:		
a)	Voltage	230 kV
b)	Capacity	TBD
c)	Point of Origin	Pantano Substation Sec. 12 T17S R17E
d)	Point of Termination	Kartchner Substation Sec. 33 T21S R20E
e)	Length	36.0 miles
Routing:		Along the existing Pantano to Kartchner 115 kV line ROW.
Purpose:		Provide continuous reliable service to SSVEC under N-1 outage conditions in the Sierra Vista area. Note: this project will be studied in detail as part of the SATS 2009 Study Plan and as per the 5th BTA Order.
Dates:		
a)	Construction Start	TBD
b)	In-Service Date	TBD

Notes: This is a conceptual project that was studied in the Cochise County Study Group in 2009 to ensure continuity of service in Cochise County. The project was not proposed for a solution to resolving continuity of service issues in Cochise County and therefore lies outside of this ten year plan horizon.

SOUTHWEST TRANSMISSION COOPERATIVE, INC.

10 YEAR PLAN

PLANNED TRANSMISSION FACILITIES

Line Designation:		San Rafael to CS2 230 kV Line
Size:		
a)	Voltage	230 kV
b)	Capacity	TBD
c)	Point of Origin	San Rafael Substation Sec. 17 T22S R21E
d)	Point of Termination	CS2 Substation Sec. 25 T21S R20E (Location could change)
e)	Length	Approximately 8.0 miles
Routing:		San Rafael Substation, north approximately 5 miles and then west to CS2 Substation.
Purpose:		Provide continuous reliable service to SSVEC under N-1 outage conditions in the Sierra Vista area. Note: this project will be studied in detail as part of the SATS 2009 Study Plan and as per the 5th BTA Order.
Dates:		
a)	Construction Start	TBD
b)	In-Service Date	TBD

Notes: This is a conceptual project that was studied in the Cochise County Study Group in 2009 to ensure continuity of service in Cochise County. The project was not proposed for a solution to resolving continuity of service issues in Cochise County and there lies outside of this ten year plan horizon.

SECTION II

SOUTHWEST TRANSMISSION COOPERATIVE, INC.

INTERNAL PLANNING CRITERIA AND FACILITY RATINGS

SWTC's internal planning criteria and facility ratings has been documented in its "Facility Ratings Methodology and Establish and Communicate Facility Ratings (FAC-008-1 and FAC-009-1)," dated February 11, 2009, to meet requirements of the North American Reliability Corporation ("NERC") Planning Standards. Portions of the document are reprinted below, which identify the assumptions and methodologies used by SWTC to determine electrical facility ratings and also describe the electrical load limits for SWTC on the various power system transmission lines, power transformers, and other facility equipment under nominal and emergency operating conditions.

1.0 Introduction

In accordance with North American Electric Reliability Corporation (NERC) and Western Electricity Coordinating Council (WECC) standards, this document sets forth the methodology used by Southwest Transmission Cooperative, Inc. (SWTC) to rate its solely and jointly owned facilities. It is the method by which the Rating of SWTC major Bulk Electric System (BES) equipment is determined.

1.1 The facilities addressed in this document include, but are not limited to, transmission conductors, transformers, relay protective devices, terminal equipment, and series and shunt compensation devices.

1.2 This methodology addresses Normal and Emergency ratings for the facilities that comprise SWTC's Bulk Electric System (BES).

1.3 This Facility Ratings Methodology considers the ratings provided by equipment manufacturers, IEEE and ANSI standards, ambient conditions for solar input, temperature and wind speed, design criteria, operating limitations, and other assumptions, as appropriate.

1.4 The ratings for all of SWTC BES facilities, including but not limited to lines, transformers, and shunt compensation devices shall be equal to the most limiting applicable equipment rating of the individual equipment that comprises the facility.

1.5 This methodology will be made available for inspection and technical review within 15 business days of receipt of a request from SWTC's Loveland Reliability Coordination Center (LLRC), Transmission Planners, Planning Authorities, and any other FERC jurisdictional entity that has responsibility for the area in which the facilities are located. Requests and responses for the methodology will be tracked by the Manager of System Operations at SWTC.

1.6 A written response to any comments regarding this Facility Ratings Methodology will be sent to the commenting entity within 45 calendar days of the receipt of those comments. The response shall indicate whether a change will be made to the Facility Ratings Methodology and, if no change will be made to that Facility Ratings Methodology, the reason why. Comments and responses regarding the methodology will be tracked by the Manager of System Operations at SWTC.

1.7 In cases where a facility is jointly owned, the operator of the facility determines the rating and shares the rating with the other joint owners.

In cases where a facility is owned in segments (such as a transmission line being owned by one party with the breaker being owned by a different party), each owner will determine the rating for their segment and coordinate with the other owners to determine the most limiting segment. The rating for the most limiting segment would be used for the entire facility.

2.0 Facility Rating Methodologies for Transmission Facilities

The following sections describe the rating method for SWTC facilities.

2.1 Generation Facilities

SWTC does not own generation facilities.

2.2 Transmission Lines

SWTC owns transmission facilities. The rating of transmission lines involves comparison of the ratings of all elements which make up the line between the two identified busses, including the terminal equipment. The overall line rating is limited to the rating of the component with the lowest rating or the stability limit of the line, which ever is lower. For those cases where a transmission line is thermally limited, continuous and emergency ratings are defined by levels of current which produce a given conductor temperature for a specified set of assumed weather conditions. Appendix A contains a summary table for transmission line ratings followed by tables that show the individual rating of components that make up each transmission line.

2.2.1 Transmission Line Conductors

The transmission line conductor ratings are calculated using the SWTC written Q-Basic software program, which is based on the standard equations in the ABB Transmission and Distribution Reference Book and the Electric Power Research Institute EHV Book. The following assumptions are used:

TABLE 1: Conductor Rating Parameters		
Parameters Common to All Locations/Conductors		
Parameter	**Continuous Rating**	**Emergency Rating**
Wind Direction	Perpendicular to Line	Perpendicular to Line
Emissivity	0.5	0.5
Absorptivity	0.5	0.5
Date	July 1	July 1
Time	12 PM	12 PM
Latitude and Longitude	32.5° North	32.5° North

TABLE 1: Conductor Rating Parameters		
Elevation	2500 Ft	2500 Ft
Solar Input	Clear	Clear
Allowable Cond. Temp (ACSR)	75°C	110% of Continuous
Wind Speed	2 ft/s	2 ft/s
Ambient Temperature	40°C	40°C

The following items are pertinent with regard to the conductor rating method:

a. The above parameters apply to transmission lines which are thermally limited. Lines which are stability limited (at a value lower than the thermal limit) are rated based on their stability limit.

b. The weather parameters shown in Table 1 were developed based on summer conditions.

c. Emergency ratings are based on allowing operation for no more than a 30 minute time period.

d. Where a transmission line is constructed with more than one size conductor, the line rating is determined by the rating of the most limiting sized conductor. If other equipment (switches, series capacitors, etc) in series with the transmission conductor is more limiting, the lowest limitation defines the transmission line rating.

e. The transmission line rating program is based on the classical House and Tuttle method of line rating which uses a heat balance equation to determine the allowable line current for a specified conductor temperature. This is also the basis for IEEE Standard 738.

f. Rigid Bus and Strain Bus design are determined by the RUS Design Guide for Rural Substations Bulletin 1724E-300 (Bulletin) and National Electric Safety Code as a minimum. The design involves many factors, which are spelled out in the Bulletin.

2.3 Transformers

SWTC owns the following types of power transformers:

a. Load serving transformers with LTC
   - Conventional
   - Auto

b. Tie Autotransformers

The Normal and Emergency Ratings for terminal equipment are determined as follows:

Equipment	Normal Rating	Emergency Rating
SWTC Transformers	100% Manufacturer's Nameplate Rating @45°C or 55°C rise	100% Manufacturer's Nameplate Rating @55°C or 65°C rise

Transformers in the SWTC system have a continuous rating which is based on the manufacturer's nameplate data. Should SWTC wish to evaluate other sources in regard to manufacturer's specifications, it shall consult the latest applicable versions of IEEE Standard C57.13-1993(R2003) or IEEE Std. C57.119-1991. Appendix B contains a table for SWTC transformer data including ratings.

2.4 Relay Protective Devices

None of SWTC BES facilities have ratings that are limited by protective relays. SWTC has completed a review of relay settings to verify that no facilities will trip, with or without time delay, due to normal or emergency load current. Any new facilities are reviewed by the Transmission Technical Services Manager and/or the Transmission O&M Field Engineer to ensure that these loadability requirements are met.

2.5 Terminal Equipment (switches, breakers, etc)

The Normal and Emergency Ratings for terminal equipment are determined as follows:

Equipment	Normal Rating	Emergency Rating
Power Circuit breakers	100% of Manufacturer's Nameplate Rating	100% of Manufacturer's Nameplate Rating
Power Circuit switchers	100% of Manufacturer's Nameplate Rating	100% of Manufacturer's Nameplate Rating
Air Disconnect switches	100% of Manufacturer's Nameplate Rating	100% of Manufacturer's Nameplate Rating
Current transformers	100% of Manufacturer's Nameplate Rating	100% of Manufacturer's Nameplate Rating

SWTC shall consult the most current and applicable IEEE standards as deemed necessary regarding the rating of its terminal equipment: IEEE Std. C37.010-1999, IEEE Std C37.37-1996, IEEE Std. C57.13-1993(R2003), IEEE Std. C93.3-1995, or IEEE Std. 605-1998. Appendix C contains a table for SWTC terminal equipment ratings.

2.6 Shunt Compensation Devices

Appendix D contains a table for SWTC shunt capacitor ratings. The normal and emergency ratings for shunt compensation devices are determined as follows:

Equipment	Normal Rating	Emergency Rating
Shunt Capacitors	100% of Manufacturer's Test Report Rating	100% of Manufacturer's Test Report Rating

3.0 Internal Planning Criteria for Facility Ratings

The factors used to determine equipment ratings were outlined above. They represent criteria that SWTC has used for a number of years, to meet requirements of the NERC, WECC, and the Federal Energy Regulatory Commission (FERC).

The following is SWTC's internal transmission reliability planning criteria as published in the FERC FORM #715 filing:

1) Nominal Operating Limit

- Transmission lines should not be loaded greater than 100% of the thermal rating of the conductors.
- Transformers, circuit breakers, current transformers, and other equipment should not be loaded above their continuous nameplate rating.
- Transmission system voltages should not fall below 0.95 per unit (p.u.) of nominal rating nor rise above 1.05 p.u. of nominal rating.

2) Emergency Operating Limit

- Transmission lines should not be loaded greater than 110% of the thermal rating of the conductors.
- Transmission system voltages should not fall below 0.90 per unit (p.u.) of nominal rating nor rise above 1.10 p.u. of nominal rating.

4.0 Establishment and Communication of Facility Ratings

SWTC establishes the facility ratings for its BES in accordance with the facility rating methodologies described above. SWTC submits its most up-to-date ratings as part of the WECC base case preparation process on a periodic basis as required by WECC. Appendix E contains a table for typical SWTC power flow modeling data.

SWTC shall communicate its ratings for its solely and jointly owned Facilities that are existing Facilities, new Facilities, modifications to existing Facilities and re-ratings of existing Facilities to WECC, its LLRC, its Planning Authority, and to other Transmission Owners, Operators, or Planners as scheduled by such requesting entities.

When SWTC has determined that updated ratings are applicable, it will communicate those ratings as part of the WECC base case preparation process, by email or by telephone, as appropriate. SWTC shall keep all superseded portions of its Facility Ratings Methodology for

12 months beyond the date of the change in that methodology and shall keep all documented comments on the Facility Ratings Methodology and associated responses for three years, in accordance with NERC Standard FAC-008-1.

The locations of Facility Ratings are in the Engineering Files.

SWTC Transmission Line Rating Limits							
Station A From	Station B To	Voltage KV	Normal Limit Amps	Emergency Limit Amps	Normal Limit MVA	Emergency Limit MVA	Limiting Equipment
GREEN-SW	GREENLEE	345	1370	1507	819	901	Conductor
GREENLEE	GREEN-SW	345	1370	1507	819	901	Conductor
BICKNELL	VAIL	345	1370	1507	819	901	Conductor
VAIL	BICKNELL	345	1370	1507	819	901	Conductor
DOSCONDO	HACKBERRY	230	1100	1210	438	482	Conductor
HACKBERRY	DOSCONDO	230	1100	1210	438	482	Conductor
HACKBERRY	MORENCI	230	1100	1210	438	482	Conductor
MORENCI	HACKBERRY	230	1100	1210	438	482	Conductor
GREEN-SW	MORENCI	230	1100	1210	438	482	Conductor
MORENCI	GREEN-SW	230	1100	1210	438	482	Conductor
MORENCI	PD-MORNC	230	920	1012	367	403	Conductor
PD-MORNC	MORENCI	230	920	1012	367	403	Conductor
APACHE	BUTERFLD	230	840	924	335	368	Conductor
BUTERFLD	APACHE	230	840	924	335	368	Conductor
APACHE	RED TAIL	230	1100	1210	438	482	Conductor
RED TAIL	APACHE	230	1100	1210	438	482	Conductor
APACHE	WINCHESTER	230	1100	1210	438	482	Conductor
WINCHESTER	APACHE	230	1100	1210	438	482	Conductor
BUTERFLD	PANTANO	230	840	924	335	368	Conductor
PANTANO	BUTERFLD	230	840	924	335	368	Conductor
BUTERFLD	SAN RAF	230	920	1012	367	403	Conductor
PANTANO	SAHUARITA	230	840	924	335	368	Conductor
SAHUARITA	PANTANO	230	840	924	335	368	Conductor
SAHUARITA	BICKNELL	230	840	924	335	368	Conductor
BICKNELL	SAHUARITA	230	840	924	335	368	Conductor
RED TAIL	DOSCONDO	230	1100	1210	438	482	Conductor
DOSCONDO	RED TAIL	230	1100	1210	438	482	Conductor
DAVIS	RIVIERA	230	600	660	239	263	WAPA Relays wound CT
APACHE	HAYDENAZ	115	600	660	120	132	SRP disconnect switch
HAYDENAZ	APACHE	115	600	660	120	132	
MARANA	MARANATP	115	500	550	100	109	Jumpers
MARANATP	MARANA	115	500	550	100	109	Jumpers
MARANA	AVRA	115	360	396	72	79	Conductor
AVRA	MARANA	115	360	396	72	79	Conductor
AVRA	SANDARIO	115	360	396	72	79	Conductor
SANDARIO	AVRA	115	360	396	72	79	Conductor
SANDARIO	THREEPNT	115	360	396	72	79	Conductor
THREEPNT	SANDARIO	115	360	396	72	79	Conductor
BICKNELL	THREEPNT	115	620	682	124	136	Conductor
THREEPNT	BICKNELL	115	620	682	124	136	Conductor

SECTION III

SOUTHWEST TRANSMISSION COOPERATIVE, INC.

TEN-YEAR PLAN

2010 – 2019

TECHNICAL STUDY REPORT

SUBMITTED TO THE ARIZONA CORPORATION COMMISSION IN FULFILLMENT OF A.R.S. §40-360.02 ¶C.7

TRANSMISSION PLANNING
JANUARY 28, 2010

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SOUTHWEST TRANSMISSION COOPERATIVE, INC.
TEN-YEAR PLAN
2010 – 2019
TECHNICAL STUDY REPORT

INTRODUCTION

This technical report is submitted to the Arizona Corporation Commission ("Commission") pursuant to the Arizona Revised Statutes ("ARS") §40-360.02 ¶C.7, and Decision No. 63876, dated July 25, 2001, regarding the Biennial Transmission Assessment prepared by Commission Utilities Division Staff.

Power flow analyses used for this report were performed in accordance with the NERC criteria for Planning Standards TPL-001-0 through TPL-004-0, such that the reliability of the SWTC transmission system was analyzed within the near-term planning horizon (2010-2014) and the long-term planning horizon (2014-2019). This provided an excellent snapshot of the problems that will be encountered with the most recent forecasted loads used in this Ten-Year Plan Filing. The analyses showed that under a variety of outage conditions, the system performed with minimal violations of the NERC criteria. Mitigation Plans, however, are in place to resolve these minor violations, as noted below.

Post-transient Stability Analyses were recently performed on the summer of 2013 conditions, and the results are reported in the SWTC 2009-2018 Ten Year Plan. Due to the decreased load forecasts, there are not enough significant changes to the system to warrant a new post-transient stability analysis. Impacts to the SWTC transmission system through the addition of planned third-party generation, are unknown at this time, as the studies performed by the third-party entities contemplating the generation, have not been shared with SWTC.

SWTC's current and planned transmission system maps are included in Appendix A, which starts on page 59. The 2010-2019 Contingency Lists are included in Appendix B, which starts on page 64. Selective power flow one-line diagrams are included in Appendix C, which starts on page 71. The power flow diagrams show the entire SWTC system under N-0 conditions for the years 2010, 2014, and 2019 of the Ten-Year Plan. Selective Extra-High Voltage (EHV) and High Voltage (HV) N-1, N-2 and N-n outage simulations for the years 2010, 2014 & 2019 are also shown.

POWER FLOW ANALYSES

Power flow studies were performed using General Electric's Positive Sequence Load Flow ("PSLF") program. The SATS and CATS-HV Power flow cases that were created for the 2010-2019 study period, using the latest base cases from the Western Electricity Coordinating Council ("WECC") are listed below:

SATS 2010HS Case (created from the WECC 09HS3A case) – Load Flow
SATS 2014HS Case (created from WECC 13HS1A1 case) – Load Flow

CATS 2019HS Case (created from WECC 2018HS1A case) – Load Flow

The base cases from SATS and CATS-HV were updated with the latest load projections of SWTC, with representations of the sub-transmission systems of SWTC's members added to the cases as necessary. Base case and single contingency conditions were evaluated using PSLF to determine system impacts and timing of transmission facilities needed to mitigate those system impacts.

Numerous outage simulations were performed for the years 2010, 2014 and 2019. Contingency lists of these outage simulations can be found in Appendix B. The analyses looked at the impact of the most recent projected member system load growth to the interconnected transmission system. The analyses determined where facilities would be placed to most economically serve this projected member system load. It should be noted that the various outage scenarios that were conducted throughout the study period were not performed on existing radial transmission lines in Cochise County. These were studied in detail as part of the Cochise County Study Group, as discussed below.

Near Term Assessment (2010-2014)

The previous (2009-2018) Technical Study Report noted that some Category B (N-1) outages will overload the Greenlee 345/230 kV transformer. This is resolved through operator instructions that have been in place for many years on the SWTC transmission system, to alert a large mine to drop load to protect this transformer, if it begins to overload. However, as noted in this Ten Year Plan filing, a second 345/230 kV transformer is scheduled to be placed at Greenlee in 2012, which resolves this problem for the foreseeable future.

In the 2010 Category B (N-1) analysis, the Marana to Avra Valley 115 kV line slightly overloads for loss of a few HV lines in the immediate area. The Marana to Avra Valley 115 kV line is scheduled to be re-built in 2011, which resolves this problem. No other Category B overloads were noted.

In the 2010 Category C (N-2) analysis, the Marana Tap to Marana, Marana to Avra Valley, and Avra Valley to Sandario115 kV lines slightly overload for loss of a few HV facilities. These lines are scheduled to be re-built in 2011, which resolves this problem.

In the 2014 Category B (N-1) analysis, the Apache to Butterfield 230 kV Line overloads upon the loss of the Winchester to Vail 345 kV line. As of this writing, SWTC is working with a LiDar to re-rate the Apache to Butterfield 230 kV line, which will alleviate this problem. No other Category B overloads were noted.

Additionally, a few Category C (N-2) outages, mostly due to loss of various EHV facilities, continue to show high flows on the Apache to Bicknell 230 kV line. The Apache to Butterfield 230 kV line and the Butterfield to Bicknell 230 kV line are scheduled to be upgraded in 2016 and 2017, respectively. And, as noted in the previous paragraph, SWTC is working with a LiDar to re-rate the Apache to Bicknell 230 kV lines prior to 2016 and 2017, which will alleviate the overload on these lines. However there are additional studies that need to be done to

satisfactorily resolve these issues in a cost-effective manner and SWTC will work through SATS to identify potential solutions to these problems in 2010.

Long Term Assessment (2014-2019)

The study of the 2014-2019 system assumed all of the planned projects prior to 2014 have been completed. All Category B outages performed well on the 2014 system as noted above. All Category B outages performed on 2019 systems solved.

Various Category C outages in 2019, again mostly due to the loss of various EHV facilities, continue to show high flows on the Apache to Bicknell 230 kV line. SWTC looks forward to identifying these issues in the SATS study work for 2010.

The results of these power flow studies show that the efforts taken by SWTC to add system facilities and upgrade older existing facilities, as outlined in this Ten Year Plan filing, show a robust system that will maintain reliability and quality of service for all of its customers throughout the study period.

The list of contingencies used for the 2010-2019 study period are found in Appendix B and the power flow diagrams are found in Appendix C.

FULFILLMENT OF BTA REQUIREMENT

The Commission's Fifth Biennial Transmission Assessment for 2008-2017 ("BTA") ordered that "APS, SSVEC, and TEP shall perform collaborative studies and shall file a report of those studies for the next BTA that establishes a long range system plan for Cochise County that is founded on the principle of continuity of service following a transmission line outage. SWTC shall participate in the study effort as SSVEC's current sole transmission service provider. Relevant elements of that plan shall be incorporated in each transmission service providers respective ten year plans with defined in-service dates and shall be filed with the Commission in January 2010." The Cochise County Study Summary Report has been completed and SWTC has filed the Report along with this Ten Year Plan filing for 2010-2019.

The Cochise County Study Report recommends the following actions to be taken to provide for continuity of service:

- New APS Palominas – SSVEC Hereford 69 kV Line
- Proposed 50 MVA 115/69 kV transformer at Boothill
- Loop Webb – Tombstone 69 kV line through Boothill
- Proposed Fort Huachuca 138 kV – Buffalo solder 69 kV tie (needed in year 2018)
- Operate the following normally open circuits as normally closed circuits:
    - Charleston – Bella Vista 69 kV line
    - Keating Junction – Hawes 69 kV line
    - McNeal – San Pedro 69 kV line
- Install shunt capacitors at the following substations:
    - 13.2 MVAR at Webb 69 kV substation

- 8 MVAR at Ramsey 69 kV substation
- 8 MVAR at Hawes 69 kV substation
- 8 MVAR at Pueblo 69 kV substation
- 6 MVAR at Webb 69 kV substation (needed in year 2018)

This recommended transmission plan is expected to provide continuity of service well beyond the 2018 time frame and to serve about 380 MW of load within Cochise County.

STABILITY ANALYSIS

Since its last ten year plan filing, SWTC has not performed post transient stability analyses for its interconnected transmission system. The results of the SWTC 2013 Study, which is documented in the SWTC 2009-2018 Ten Year Plan Filing, is considered adequate as the load forecast that was used for that study is higher than the current forecasted loads in this Ten Year Plan filing. In addition, no new generation is planned for the foreseeable future on the SWTC system.

Additional generation that is planned for the area, such as the proposed Bowie Project or the SPPR proposed Sawtooth Generation Station, will be studied in detail by the entities that have expressed interest in those projects and will be reported on in future ten year plan filings.

Future ten year plan filings will include stability analyses for generation that may be planned for location on the SWTC transmission system, as they become known.

SOUTHWEST TRANSMISSION COOPERATIVE, INC.

TEN-YEAR PLAN

2010 – 2019

TECHNICAL STUDY REPORT

APPENDICES

APPENDIX A

CURRENT AND PLANNED TRANSMISSION SYSTEM MAPS

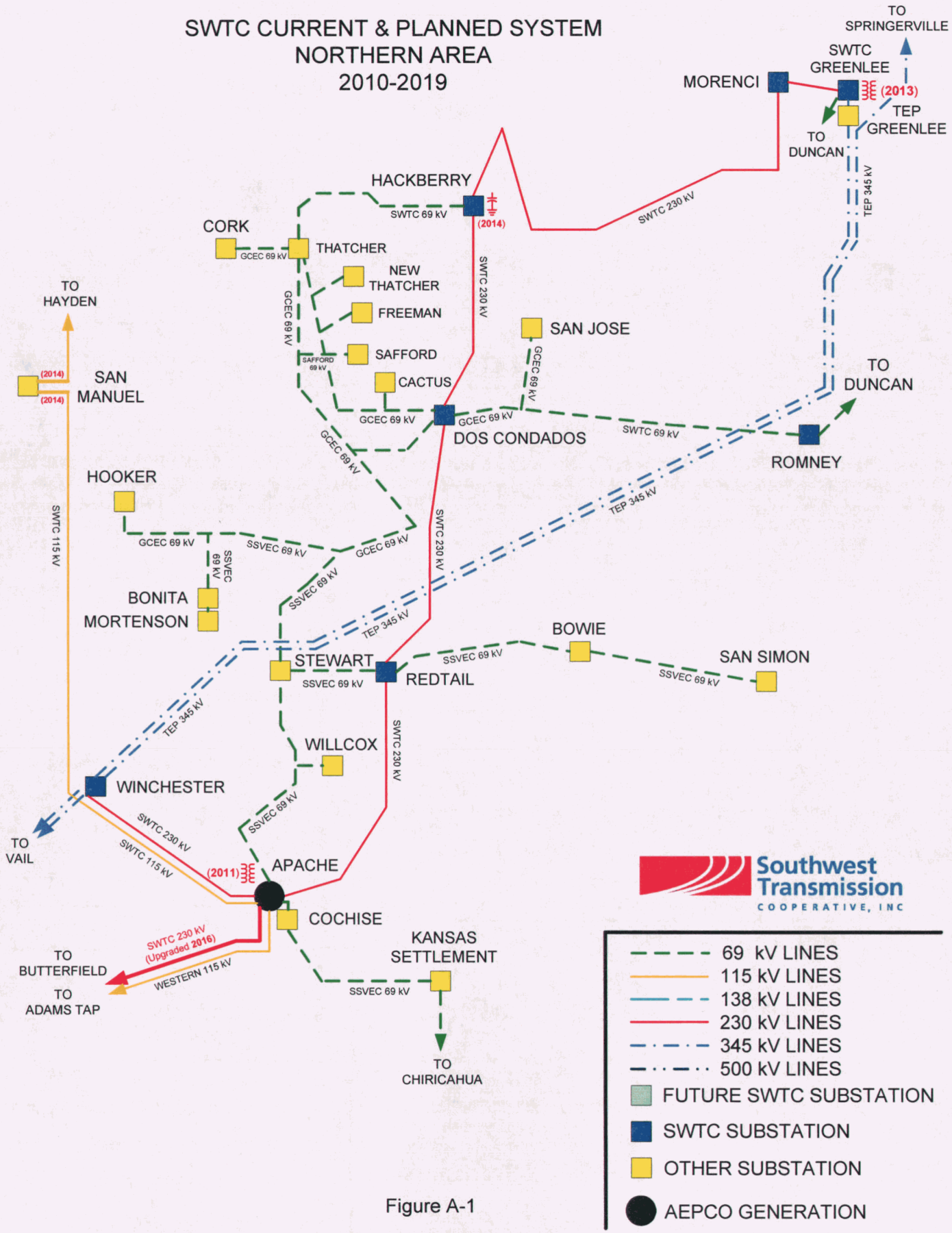

SWTC CURRENT & PLANNED SYSTEM
NORTHERN AREA
2010-2019
TO SPRINGERVILLE
SWTC GREENLEE
(2013)
MORENCI
TEP GREENLEE
TO DUNCAN
TEP 345 kV
SWTC 230 kV
HACKBERRY
SWTC 69 kV
(2014)
CORK
GCEC 69 kV
THATCHER
NEW THATCHER
FREEMAN
SAFFORD
SAFFORD 69 kV
CACTUS
SWTC 230 kV
GCEC 69 kV
SAN JOSE
GCEC 69 kV
GCEC 69 kV
GCEC 69 kV
DOS CONDADOS
SWTC 69 kV
TO DUNCAN
ROMNEY
TEP 345 kV
TO HAYDEN
(2014)
(2014)
SAN MANUEL
SWTC 115 kV
HOOKER
GCEC 69 kV
SSVEC 69 kV
GCEC 69 kV
SSVEC 69 kV
SSVEC 69 kV
BONITA
MORTENSON
SWTC 230 kV
TEP 345 kV
BOWIE
SSVEC 69 kV
SAN SIMON
SSVEC 69 kV
STEWART
SSVEC 69 kV
REDTAIL
TEP 345 kV
WILLCOX
SWTC 230 kV
WINCHESTER
SSVEC 69 kV
TO VAIL
SWTC 230 kV
SWTC 115 kV
(2011)
APACHE
COCHISE
SWTC 230 kV (Upgraded 2016)
WESTERN 115 kV
TO BUTTERFIELD
TO ADAMS TAP
KANSAS SETTLEMENT
SSVEC 69 kV
TO CHIRICAHUA
Southwest Transmission COOPERATIVE, INC
69 kV LINES
115 kV LINES
138 kV LINES
230 kV LINES
345 kV LINES
500 kV LINES
FUTURE SWTC SUBSTATION
SWTC SUBSTATION
OTHER SUBSTATION
AEPCO GENERATION

Figure A-1

SWTC CURRENT & PLANNED SYSTEM
SOUTHERN AREA
2010-2019

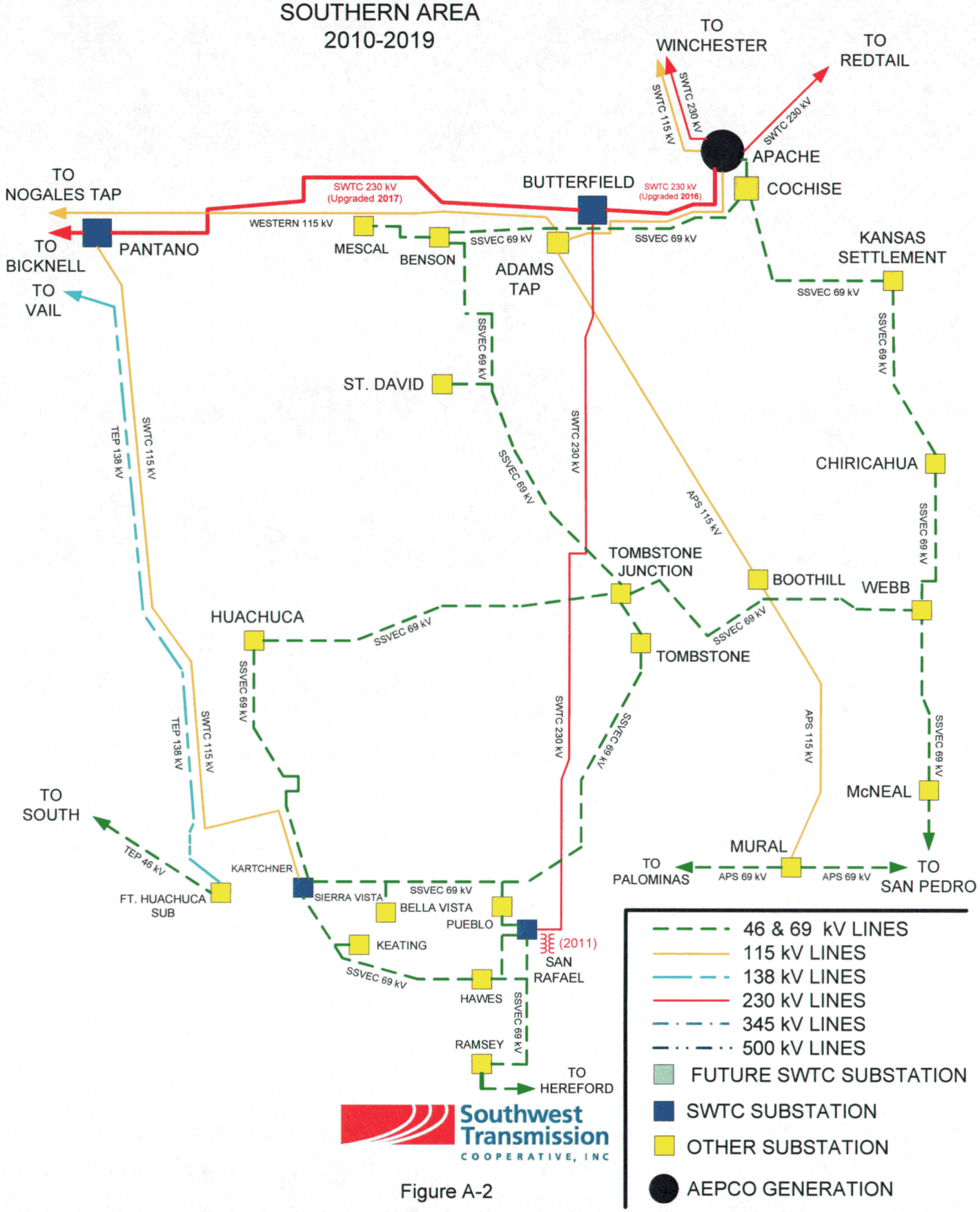


Figure A-2

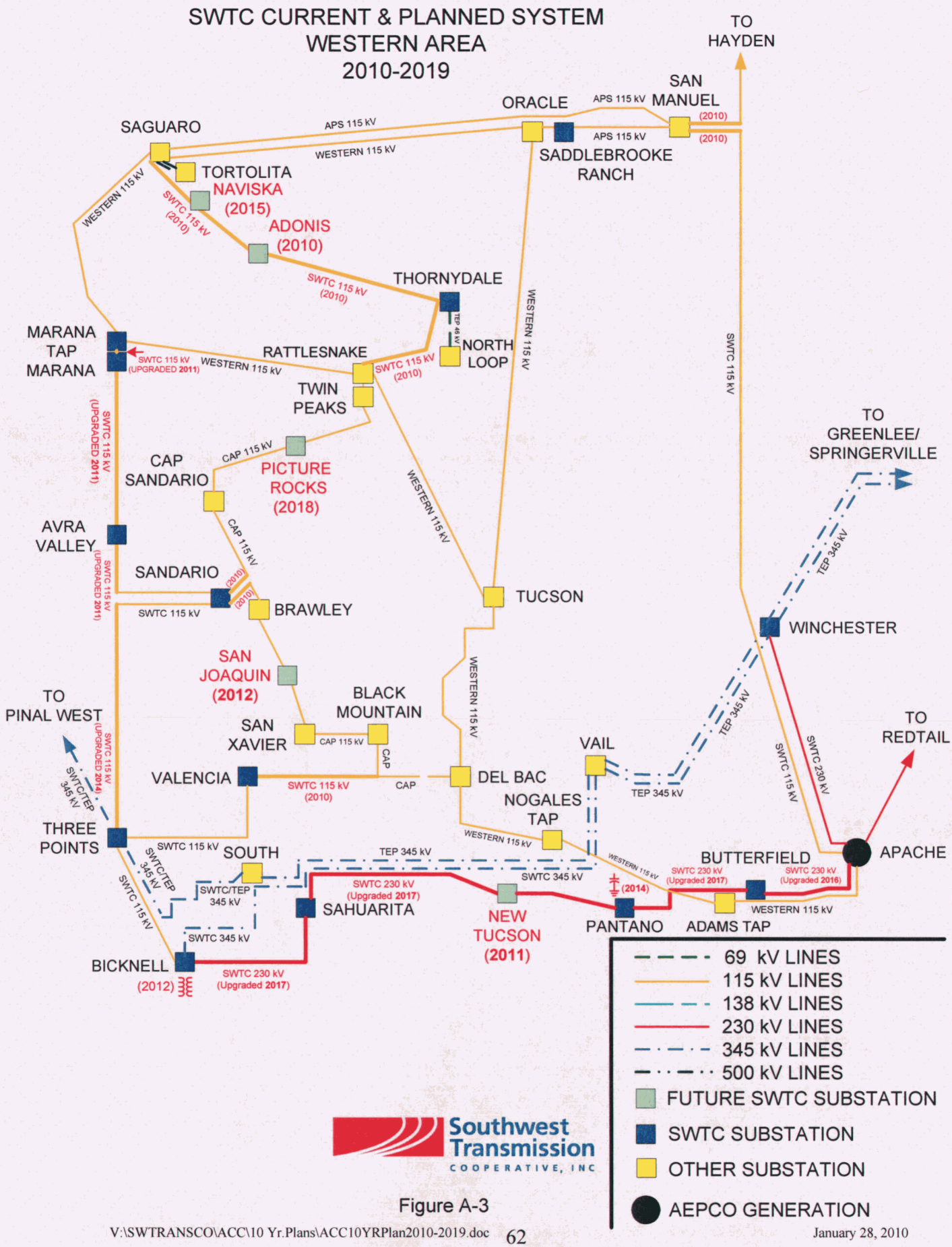

SWTC CURRENT & PLANNED SYSTEM
WESTERN AREA
2010-2019
TO HAYDEN
SAN MANUEL
(2010)
(2010)
ORACLE
APS 115 kV
APS 115 kV
SADDLEBROOKE RANCH
SAGUARO
APS 115 kV
WESTERN 115 kV
TORTOLITA
NAVISKA (2015)
SWTC 115 kV (2010)
WESTERN 115 kV
ADONIS (2010)
SWTC 115 kV (2010)
THORNYDALE
TEP 46 kV
NORTH LOOP
WESTERN 115 kV
MARANA TAP
MARANA
SWTC 115 kV (UPGRADED 2011)
WESTERN 115 kV
RATTLESNAKE
SWTC 115 kV (2010)
TWIN PEAKS
SWTC 115 kV
SWTC 115 kV (UPGRADED 2011)
CAP 115 kV
CAP SANDARIO
PICTURE ROCKS (2018)
WESTERN 115 kV
TO GREENLEE/ SPRINGERVILLE
AVRA VALLEY
CAP 115 kV
SANDARIO
(2010)
(2010)
SWTC 115 kV (UPGRADED 2011)
SWTC 115 kV
BRAWLEY
TUCSON
TEP 345 kV
WINCHESTER
SAN JOAQUIN (2012)
WESTERN 115 kV
TO PINAL WEST
BLACK MOUNTAIN
SAN XAVIER
CAP 115 kV
CAP
VAIL
TEP 345 kV
SWTC 115 kV
SWTC 230 kV
TO REDTAIL
SWTC 115 kV (UPGRADED 2014)
SWTC/TEP 345 kV
VALENCIA
SWTC 115 kV (2010)
CAP
DEL BAC
NOGALES TAP
TEP 345 kV
THREE POINTS
SWTC 115 kV
SOUTH
TEP 345 kV
WESTERN 115 kV
WESTERN 115 kV
BUTTERFIELD
APACHE
SWTC/TEP 345 kV
SWTC 115 kV
SWTC/TEP 345 kV
SWTC 230 kV (Upgraded 2017)
SAHUARITA
SWTC 345 kV
(2014)
SWTC 230 kV (Upgraded 2017)
SWTC 230 kV (Upgraded 2016)
NEW TUCSON (2011)
PANTANO
ADAMS TAP
WESTERN 115 kV
SWTC 345 kV
BICKNELL
(2012)
SWTC 230 kV (Upgraded 2017)
69 kV LINES
115 kV LINES
138 kV LINES
230 kV LINES
345 kV LINES
500 kV LINES
FUTURE SWTC SUBSTATION
SWTC SUBSTATION
OTHER SUBSTATION
AEPCO GENERATION
Southwest Transmission
COOPERATIVE, INC

Figure A-3

SWTC CURRENT & PLANNED SYSTEM
PV-SEV PROJECT AREA
2010-2019

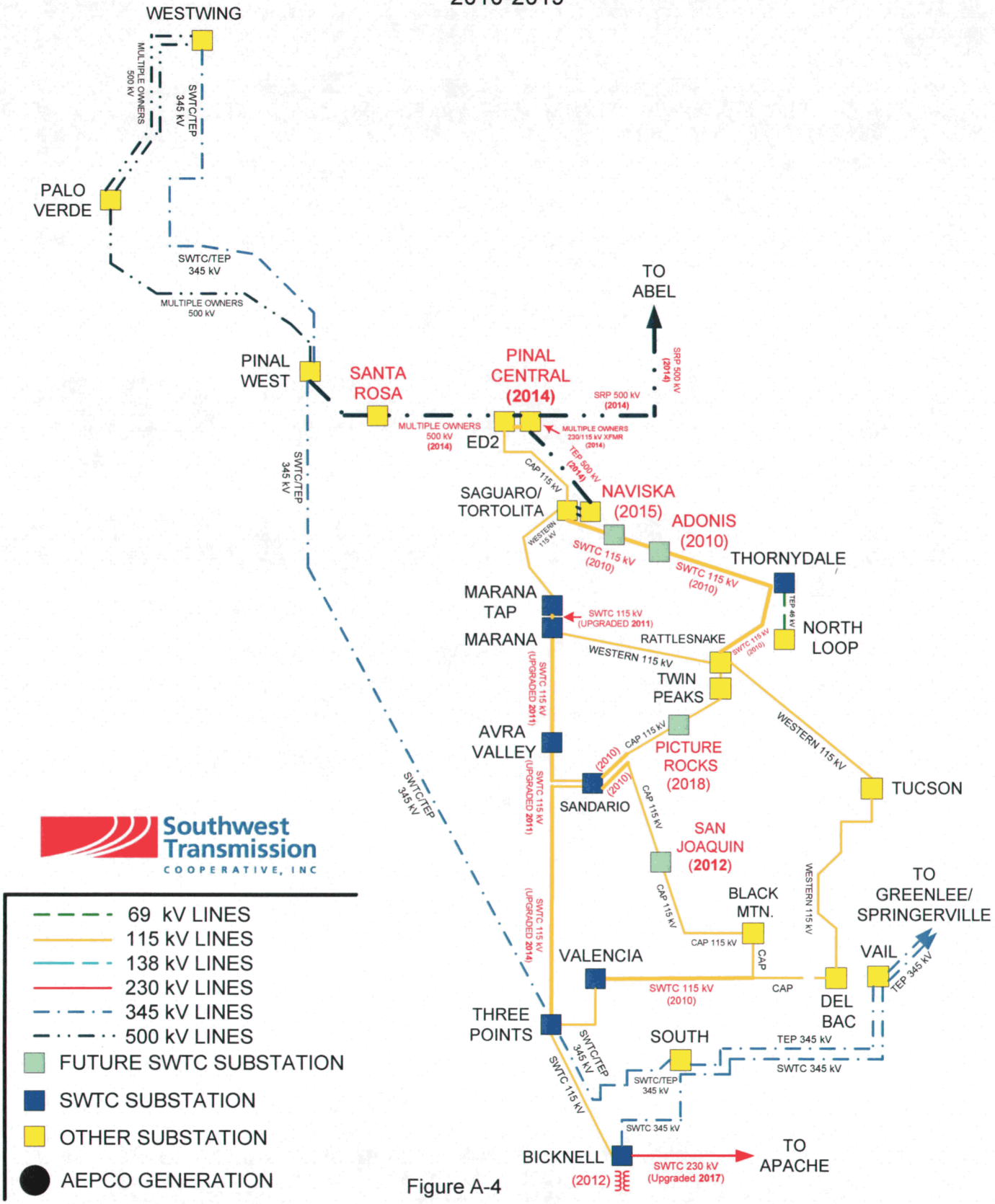


Figure A-4

APPENDIX B

2010-2019 POWER FLOW CONTIGENCY LISTS

2010 CONTINGENCY LIST

line_1	"Line BICKNELL 345.0 to VAIL 345.0 Circuit 1"
line_2	"Line GREENLEE 345.0 to GREEN-AE 345.0 Circuit 1"
line_3	"Line APACHE 230.0 to BUTERFLD 230.0 Circuit 1"
line_4	"Line APACHE 230.0 to RED TAIL 230.0 Circuit 1"
line_5	"Line APACHE 230.0 to WINCHSTR 230.0 Circuit 1"
line_6	"Line BUTERFLD 230.0 to PANTANO 230.0 Circuit 1"
line_7	"Line DOSCONDO 230.0 to HACKBERY 230.0 Circuit 1"
line_8	"Line HACKBERY 230.0 to MORENCI 230.0 Circuit 1"
line_9	"Line MORENCI 230.0 to PD-MORNC 230.0 Circuit 1"
line_10	"Line MORENCI 230.0 to GREEN-AE 230.0 Circuit 1"
line_11	"Line PANTANO 230.0 to SAHUARIT 230.0 Circuit 1"
line_12	"Line RED TAIL 230.0 to DOSCONDO 230.0 Circuit 1"
line_13	"Line SAHUARIT 230.0 to BICKNELL 230.0 Circuit 1"
line_14	"Line ADAMSTAP 115.0 to APACHE 115.0 Circuit 1"
line_15	"Line APACHE 115.0 to SNM1 115.0 Circuit 1"
line_16	"Line SNM1 115.0 to HAYDENAZ 115.0 Circuit 1"
line_17	"Line ADONIS 115.0 to RATTLSNK 115.0 Circuit 1"
line_18	"Line AVRA 115.0 to MARANA 115.0 Circuit 1"
line_19	"Line AVRA 115.0 to SNDARIO 115.0 Circuit 1"
line_20	"Line BICKNELL 115.0 to THREEPNT 115.0 Circuit 1"
line_21	"Line BLACKMTN 115.0 to VALEN-SW 115.0 Circuit 1"
line_22	"Line MARANATP 115.0 to MARANA 115.0 Circuit 1"
line_23	"Line MARANATP 115.0 to RATTLSNK 115.0 Circuit 1"
line_24	"Line ORACLE 115.0 to S.BRKRCH 115.0 Circuit 1"
line_25	"Line S.BRKRCH 115.0 to SNMANUEL 115.0 Circuit 1"
line_26	"Line SAG.EAST 115.0 to MARANATP 115.0 Circuit 1"
line_27	"Line SAG.EAST 115.0 to ADONIS 115.0 Circuit 1"
line_28	"Line SNDARIO 115.0 to BRAWLEY 115.0 Circuit 1"
line_29	"Line SANDARIO 115.0 to SNDARIO 115.0 Circuit 1"
line_30	"Line THREEPNT 115.0 to SNDARIO 115.0 Circuit 1"
line_31	"Line THREEPNT 115.0 to VALEN-SW 115.0 Circuit 1"
tran_32	"Tran BICKNELL 345.00 to BICKNELL 230.00 Circuit 1"
tran_33	"Tran GREEN-AE 345.00 to GREEN-AE 230.00 Circuit 1"
tran_34	"Tran WINCHSTR 345.00 to WINCHSTR 230.00 Circuit 1"
tran_35	"Tran APACHE 230.00 to APACHE 115.00 Circuit 1"
tran_36	"Tran APACHE 230.00 to APACHE 115.00 Circuit 2"
tran_37	"Tran BICKNELL 230.00 to BICKNELL 115.00 Circuit 1"
tran_38	"Tran BICKNELL 230.00 to BICKNELL 115.00 Circuit 2"
line_39	"Line HIDALGO 345.0 to GREENLEE 345.0 Circuit 1"

line_40	"Line SAGUARO 500.0 to TORTOLIT 500.0 Circuit 1"
line_41	"Line SAGUARO 500.0 to TORTOLIT 500.0 Circuit 2"
line_42	"Line GREENLEE 345.0 to WINCHSTR 345.0 Circuit 1"
line_43	"Line GREENLEE 345.0 to COPPERVR 345.0 Circuit 1"
line_44	"Line PINALWES 345.0 to SOUTH 345.0 Circuit 1"
line_45	"Line SPRINGR 345.0 to GREENLEE 345.0 Circuit 1"
line_46	"Line SPRINGR 345.0 to VAIL2 345.0 Circuit 1"
line_47	"Line VAIL 345.0 to SOUTH 345.0 Circuit 1"
line_48	"Line WINCHSTR 345.0 to VAIL 345.0 Circuit 1"
line_49	"Line COPPERVR 230.0 to FRISCO 230.0 Circuit 1"
line_50	"Line PD-MORNC 230.0 to FRISCO 230.0 Circuit 1"
line_51	"Line ADAMSTAP 115.0 to NOGALES 115.0 Circuit 1"
line_52	"Line BLACKMTN 115.0 to SNYDHILL 115.0 Circuit 1"
line_53	"Line BRAWLEY 115.0 to SANXAVER 115.0 Circuit 1"
line_54	"Line DEL BAC 115.0 to NOGALES 115.0 Circuit 1"
line_55	"Line RATTLSNK 115.0 to TUCSON 115.0 Circuit 1"
line_56	"Line RATTLSNK 115.0 to TWINPEAK 115.0 Circuit 1"
line_57	"Line SAG.EAST 115.0 to ORACLE 115.0 Circuit 1"
line_58	"Line SANDARIO 115.0 to BRAWLEY 115.0 Circuit 1"
line_59	"Line SANXAVER 115.0 to SNYDHILL 115.0 Circuit 1"
line_60	"Line TUCSON 115.0 to DEL BAC 115.0 Circuit 1"
line_61	"Line TUCSON 115.0 to ORACLE 115.0 Circuit 1"
line_62	"Line TWINPEAK 115.0 to SANDARIO 115.0 Circuit 1"
tran_63	"Tran COPPERVR 345.00 to COPPERVR 230.00 Circuit 1"
tran_64	"Tran COPPERVR 345.00 to COPPERVR 230.00 Circuit 2"
line_65	"N-2:Line APACHE-BUTERFLD 230kV & APACHE-RED TAIL 230kV"
line_66	"N-2:Line APACHE-BUTERFLD 230kV & AVRA-MARANA 115kV"
line_67	"N-2:Line APACHE-BUTERFLD 230kV & BICKNELL-VAIL 345kV"
line_68	"N-2:Line APACHE-BUTERFLD 230kV & MARANA TAP-MARANA 115kV"
line_69	"N-2:Line APACHE-BUTERFLD 230kV & APACHE-WINCHESTER 230kV"
line_70	"N-2:Line APACHE-BUTERFLD 230kV & GREENLEE 345/230kV XFMR"
line_71	"N-2:Line APACHE-BUTERFLD 230kV & RATT-TWIN PEAKS 115kV"
line_72	"N-2:Line APACHE-BUTERFLD 230kV & TWIN PEAKS-SANDARIO 115kV"
line_73	"N-2:Line APACHE-BUTERFLD 230kV & SANDARIO-SNDARIO 115kV"
line_74	"N-2:Line APACHE-WINCHSTR 230kV & APACHE-RED TAIL 230kV"
line_75	"N-2:Line APACHE-WINCHSTR 230kV & RATT-TWIN PEAKS 115kV"
line_76	"N-2:Line APACHE-WINCHSTR 230kV & TWIN PEAKS-SANDARIO115kV"
line_77	"N-2:Line APACHE-WINCHSTR 230kV & SANDARIO-SNDARIO 115kV"
line_78	"N-2:Line AVRA-MARANA 115kV & APACHE-WINCHSTR 230kV"
line_79	"N-2:Line AVRA-MARANA 115kV & BICKNELL-VAIL 345kV"
line_80	"N-2:Line AVRA-SNDARIO 115kV & THREEPNT-SNDARIO 115kV"
line_81	"N-2:Line BICKNELL to THREEPNT 115.0 kV & AVRA to MARANA 115kV"
line_82	"N-2:Line MARANATP-MARANA 115kV & MARANATP-RATTSNK 115kV"
line_83	"N-2:Line SPRINGR-VAIL2 345kV & WINCSTR-VAIL 345kV"
line_84	"N-2:Line WINCHSTR-VAIL 345kV & PINALWES-SOUTH 345kV"
line_85	"N-n:Line APACHE-BUTERFLD/RED TAIL230&AVRA-MARANA115"

line_86 "N-n:Line APACHE-BUTERFLD/RED TAIL230&SAGUARO-ADONIS115"
line_87 "N-n:Line APACHE-BUTERFLD/RED TAIL230&APACHE-WINCHSTR345"
line_88 "N-n:Line APACHE-BUTERFLD/RED TAIL230&BICKNELL-VAIL345"
line_89 "N-n:Line APACHE-BUTT230&AVRA-MARANA115&BICK-VAIL345"
line_90 "N-n:Common Corridor LINES OUT OF APACHE"
line_91 "N-n:ENTIRE APACHE STATION OUT OF SERVICE"
line_92 "N-n:ENTIRE BICKNELL SUBSTATION OUT OF SERVICE"

2014 CONTINGENCY LIST

line_1 "Line BICKNELL 345.0 to VAIL 345.0 Circuit 1"
line_2 "Line GREEN-AE 345.0 to GREENLEE 345.0 Circuit 1"
line_3 "Line APACHE 230.0 to BUTERFLD 230.0 Circuit 1"
line_4 "Line APACHE 230.0 to RED TAIL 230.0 Circuit 1"
line_5 "Line APACHE 230.0 to WINCHSTR 230.0 Circuit 1"
line_6 "Line BUTERFLD 230.0 to PANTANO 230.0 Circuit 1"
line_7 "Line DOSCONDO 230.0 to HACKBERY 230.0 Circuit 1"
line_8 "Line HACKBERY 230.0 to MORENCI 230.0 Circuit 1"
line_9 "Line MORENCI 230.0 to PD-MORNC 230.0 Circuit 1"
line_10 "Line MORENCI 230.0 to GREEN-AE 230.0 Circuit 1"
line_11 "Line NEWTUCSN 230.0 to SAHUARIT 230.0 Circuit 1"
line_12 "Line PANTANO 230.0 to NEWTUCSN 230.0 Circuit 1"
line_13 "Line RED TAIL 230.0 to DOSCONDO 230.0 Circuit 1"
line_14 "Line SAHUARIT 230.0 to BICKNELL 230.0 Circuit 1"
line_15 "Line ADAMSTAP 115.0 to APACHE 115.0 Circuit 1"
line_16 "Line APACHE 115.0 to SNMANUEL 115.0 Circuit 1"
line_17 "Line SNMANUEL 115.0 to HAYDENAZ 115.0 Circuit 1"
line_18 "Line ADONIS 115.0 to RATTLSNK 115.0 Circuit 1"
line_19 "Line AVRA 115.0 to MARANA 115.0 Circuit 1"
line_20 "Line AVRA 115.0 to SNDARIO 115.0 Circuit 1"
line_21 "Line BICKNELL 115.0 to THREEPNT 115.0 Circuit 1"
line_22 "Line BLACKMTN 115.0 to VALEN-SW 115.0 Circuit 1"
line_23 "Line MARANATP 115.0 to MARANA 115.0 Circuit 1"
line_24 "Line MARANATP 115.0 to RATTLSNK 115.0 Circuit 1"
line_25 "Line ORACLE 115.0 to S.BRKRCH 115.0 Circuit 1"
line_26 "Line S.BRKRCH 115.0 to SNMANUEL 115.0 Circuit 1"
line_27 "Line SAG.EAST 115.0 to MARANATP 115.0 Circuit 1"
line_28 "Line SAG.EAST 115.0 to ADONIS 115.0 Circuit 1"
line_29 "Line SNDARIO 115.0 to BRAWLEY 115.0 Circuit 1"
line_30 "Line SANDARIO 115.0 to SNDARIO 115.0 Circuit 1"
line_31 "Line THREEPNT 115.0 to SNDARIO 115.0 Circuit 1"
line_32 "Line THREEPNT 115.0 to VALEN-SW 115.0 Circuit 1"
tran_33 "Tran BICKNELL 345.00 to BICKNELL 230.00 Circuit 1"
tran_34 "Tran GREEN-AE 345.00 to GREEN-AE 230.00 Circuit 1"
tran_35 "Tran WINCHSTR 345.00 to WINCHSTR 230.00 Circuit 1"

tran_36	"Tran APACHE 230.00 to APACHE 115.00 Circuit 1"
tran_37	"Tran APACHE 230.00 to APACHE 115.00 Circuit 2"
tran_38	"Tran BICKNELL 230.00 to BICKNELL 115.00 Circuit 1"
tran_39	"Tran BICKNELL 230.00 to BICKNELL 115.00 Circuit 2"
line_40	"Line HIDALGO 345.0 to GREENLEE 345.0 Circuit 1"
line_41	"Line SAGUARO 500.0 to TORTOLIT 500.0 Circuit 1"
line_42	"Line SAGUARO 500.0 to TORTOLIT 500.0 Circuit 2"
line_43	"Line GREENLEE 345.0 to COPPERVR 345.0 Circuit 1"
line_44	"Line GREENLEE 345.0 to WILLOW 345.0 Circuit 1"
line_45	"Line PINALWES 345.0 to SOUTH 345.0 Circuit 1"
line_46	"Line SPRINGR 345.0 to GREENLEE 345.0 Circuit 1"
line_47	"Line SPRINGR 345.0 to VAIL2 345.0 Circuit 1"
line_48	"Line VAIL 345.0 to SOUTH 345.0 Circuit 1"
line_49	"Line WINCHSTR 345.0 to VAIL 345.0 Circuit 1"
line_50	"Line WINCHSTR 345.0 to WILLOW 345.0 Circuit 1"
line_51	"Line COPPERVR 230.0 to FRISCO 230.0 Circuit 1"
line_52	"Line PD-MORNC 230.0 to FRISCO 230.0 Circuit 1"
line_53	"Line ADAMSTAP 115.0 to NOGALES 115.0 Circuit 1"
line_54	"Line BLACKMTN 115.0 to SNYDHILL 115.0 Circuit 1"
line_55	"Line BRAWLEY 115.0 to SAN JOAQ 115.0 Circuit 1"
line_56	"Line DEL BAC 115.0 to NOGALES 115.0 Circuit 1"
line_57	"Line RATTLSNK 115.0 to TUCSON 115.0 Circuit 1"
line_58	"Line RATTLSNK 115.0 to TWINPEAK 115.0 Circuit 1"
line_59	"Line SAG.EAST 115.0 to ORACLE 115.0 Circuit 1"
line_60	"Line SAN JOAQ 115.0 to SANXAVER 115.0 Circuit 1"
line_61	"Line SANXAVER 115.0 to SNYDHILL 115.0 Circuit 1"
line_62	"Line TUCSON 115.0 to DEL BAC 115.0 Circuit 1"
line_63	"Line TUCSON 115.0 to ORACLE 115.0 Circuit 1"
line_64	"Line TWINPEAK 115.0 to SANDARIO 115.0 Circuit 1"
tran_65	"Tran COPPERVR 345.00 to COPPERVR 230.00 Circuit 1"
tran_66	"Tran COPPERVR 345.00 to COPPERVR 230.00 Circuit 2"
line_67	"N-2:Line APACHE-BUTERFLD 230kV & APACHE-RED TAIL 230kV"
line_68	"N-2:Line APACHE-BUTERFLD 230kV & AVRA-MARANA 115kV"
line_69	"N-2:Line APACHE-BUTERFLD 230kV & BICKNELL-VAIL 345kV"
line_70	"N-2:Line APACHE-BUTERFLD 230kV & MARANA TAP-MARANA 115kV"
line_71	"N-2:Line APACHE-BUTERFLD 230kV & APACHE-WINCHESTER 230kV"
line_72	"N-2:Line APACHE-BUTERFLD 230kV & GREENLEE 345/230kV XFMR"
line_73	"N-2:Line APACHE-BUTERFLD 230kV & RATT-TWIN PEAKS 115kV"
line_74	"N-2:Line APACHE-BUTERFLD 230kV & TWIN PEAKS-SANDARIO 115kV"
line_75	"N-2:Line APACHE-BUTERFLD 230kV & SANDARIO-SNDARIO 115kV"
line_76	"N-2:Line APACHE-WINCHSTR 230kV & APACHE-RED TAIL 230kV"
line_77	"N-2:Line APACHE-WINCHSTR 230kV & RATT-TWIN PEAKS 115kV"
line_78	"N-2:Line APACHE-WINCHSTR 230kV & TWIN PEAKS-SANDARIO 115kV"
line_79	"N-2:Line APACHE-WINCHSTR 230kV & SANDARIO-SNDARIO 115kV"
line_80	"N-2:Line AVRA-MARANA 115kV & APACHE-WINCHSTR 230kV"
line_81	"N-2:Line AVRA-MARANA 115kV & BICKNELL-VAIL 345kV"

line_82	"N-2:Line AVRA-SNDARIO 115kV & THREEPNT-SNDARIO 115kV"
line_83	"N-2:Line BICKNELL to THREEPNT 115.0 kV & AVRA to MARANA 115 kV"
line_84	"N-2:Line MARANATP-MARANA 115kV & MARANATP-RATTLNK 115kV"
line_85	"N-2:Line SPRINGR-VAIL2 345kV & WINCSTR-VAIL 345kV"
line_86	"N-2:Line WINCHSTR-VAIL 345kV & PINALWES-SOUTH 345kV"
line_87	"N-n:Line APACHE-BUTERFLD/RED TAIL230&AVRA-MARANA115"
line_88	"N-n:Line APACHE-BUTERFLD/RED TAIL230&SAGUARO-ADONIS115"
line_89	"N-n:Line APACHE-BUTERFLD/RED TAIL230&APACHE-WINCHSTR345"
line_90	"N-n:Line APACHE-BUTERFLD/RED TAIL230&BICKNELL-VAIL345"
line_91	"N-n:Line APACHE-BUTT230&AVRA-MARANA115&BICKNELL-VAIL345"
line_92	"N-n:Common Corridor LINES OUT OF APACHE"
line_93	"N-n: ENTIRE APACHE STATION OUT OF SERVICE"
line_94	"N-n: ENTIRE BICKNELL SUBSTATION OUT OF SERVICE"

2019 CONTINGENCY LIST

line_1	"Line BICKNELL 345.0 to VAIL 345.0 Circuit 1"
line_2	"Line GREEN-SW 345.0 to GREENLEE 345.0 Circuit 1"
line_3	"Line APACHE 230.0 to BUTERFLD 230.0 Circuit 1"
line_4	"Line APACHE 230.0 to RED TAIL 230.0 Circuit 1"
line_5	"Line APACHE 230.0 to WINCHSTR 230.0 Circuit 1"
line_6	"Line BUTERFLD 230.0 to SLOAN 230.0 Circuit 1"
line_7	"Line DOSCONDO 230.0 to HACKBERY 230.0 Circuit 1"
line_10	"Line HACKBERY 230.0 to MORENCI 230.0 Circuit 1"
line_11	"Line MORENCI 230.0 to PD-MORNC 230.0 Circuit 1"
line_12	"Line MORENCI 230.0 to GREEN-SW 230.0 Circuit 1"
line_13	"Line NEWTUCSN 230.0 to SAHUARIT 230.0 Circuit 1"
line_14	"Line PANTANO 230.0 to NEWTUCSN 230.0 Circuit 1"
line_15	"Line RED TAIL 230.0 to DOSCONDO 230.0 Circuit 1"
line_16	"Line SAHUARIT 230.0 to BICKNELL 230.0 Circuit 1"
line_17	"Line SLOAN 230.0 to PANTANO 230.0 Circuit 1"
line_18	"Line ADAMSTAP 115.0 to APACHE 115.0 Circuit 1"
line_19	"Line APACHE 115.0 to SNM1 115.0 Circuit 1"
line_20	"Line ADONIS 115.0 to RATTLSNK 115.0 Circuit 1"
line_21	"Line AVRA 115.0 to MARANA 115.0 Circuit 1"
line_22	"Line AVRA 115.0 to SNDARIO 115.0 Circuit 1"
line_23	"Line BICKNELL 115.0 to THREEPNT 115.0 Circuit 1"
line_24	"Line BLACKMTN 115.0 to VALEN-SW 115.0 Circuit 1"
line_25	"Line MARANATP 115.0 to MARANA 115.0 Circuit 1"
line_26	"Line MARANATP 115.0 to RATTLSNK 115.0 Circuit 1"
line_27	"Line NAVISKA 115.0 to ADONIS 115.0 Circuit 1"
line_28	"Line ORACLE 115.0 to S.BRKRCH 115.0 Circuit 1"
line_30	"Line S.BRKRCH 115.0 to SNMANUEL 115.0 Circuit 1"
line_31	"Line SAG.EAST 115.0 to MARANATP 115.0 Circuit 1"
line_32	"Line SAG.EAST 115.0 to NAVISKA 115.0 Circuit 1"

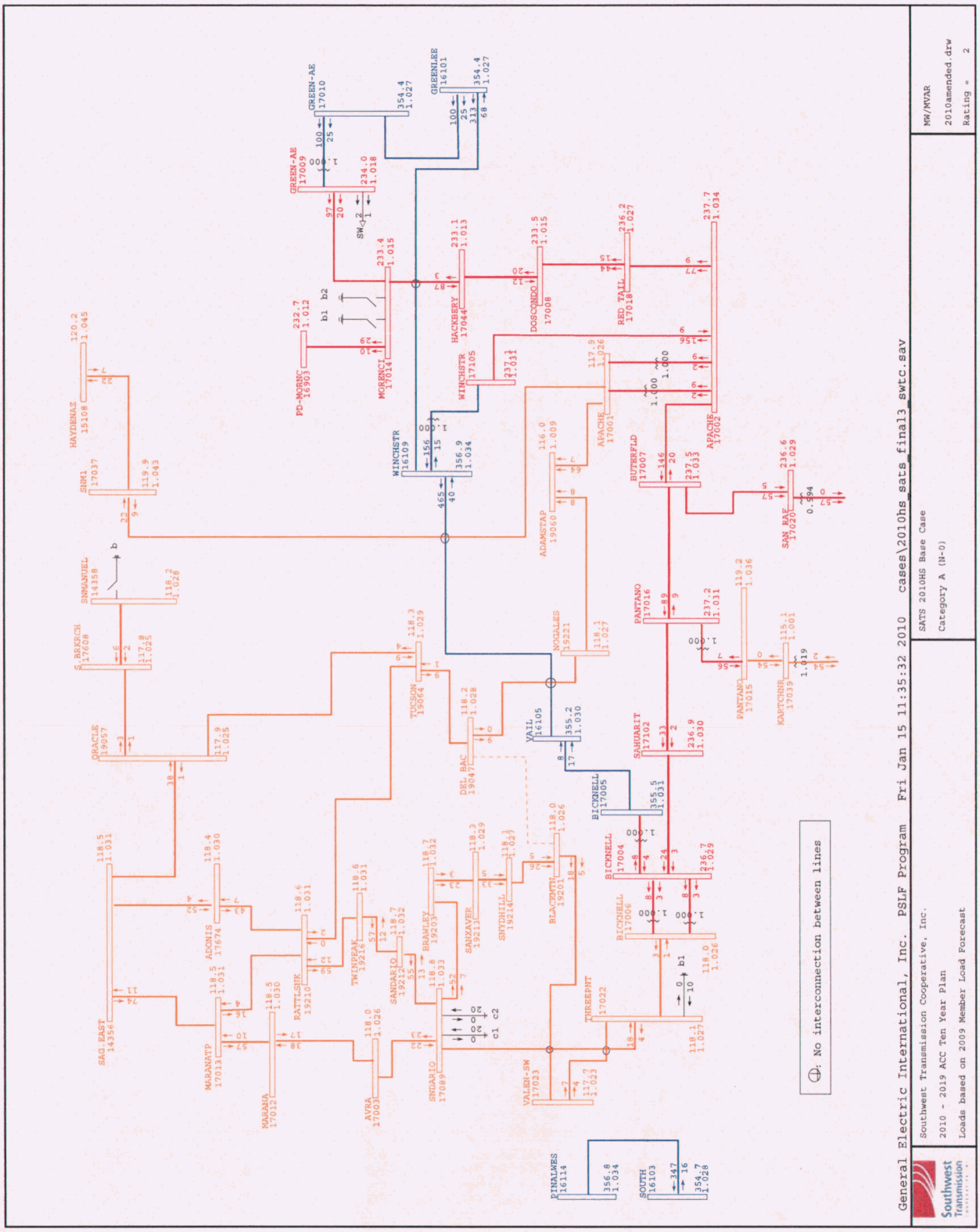
line_33	"Line SNDARIO 115.0 to BRAWLEY 115.0 Circuit 1"
line_34	"Line SANDARIO 115.0 to SNDARIO 115.0 Circuit 1"
line_35	"Line SNM1 115.0 to SNMANUEL 115.0 Circuit 1"
line_36	"Line SNM1 115.0 to HAYDENAZ 115.0 Circuit 1"
line_37	"Line THREEPNT 115.0 to SNDARIO 115.0 Circuit 1"
line_38	"Line THREEPNT 115.0 to VALEN-SW 115.0 Circuit 1"
tran_39	"Tran BICKNELL 345.00 to BICKNELL 230.00 Circuit 1"
tran_40	"Tran GREEN-SW 345.00 to GREEN-SW 230.00 Circuit 1"
tran_41	"Tran GREEN-SW 345.00 to GREEN-SW 230.00 Circuit 1"
tran_42	"Tran WINCHSTR 345.00 to WINCHSTR 230.00 Circuit 1"
tran_43	"Tran APACHE 230.00 to APACHE 115.00 Circuit 1"
tran_44	"Tran APACHE 230.00 to APACHE 115.00 Circuit 2"
tran_45	"Tran BICKNELL 230.00 to BICKNELL 115.00 Circuit 1"
tran_46	"Tran BICKNELL 230.00 to BICKNELL 115.00 Circuit 2"
line_48	"Line HIDALGO 345.0 to GREENLEE 345.0 Circuit 1"
line_49	"Line SAGUARO 500.0 to TORTOLIT 500.0 Circuit 1"
line_50	"Line SAGUARO 500.0 to TORTOLIT 500.0 Circuit 2"
line_51	"Line GREENLEE 345.0 to COPPERVR 345.0 Circuit 1"
line_52	"Line GREENLEE 345.0 to WILLOW 345.0 Circuit 1"
line_53	"Line PINALWES 345.0 to SOUTH 345.0 Circuit 1"
line_54	"Line SPRINGR 345.0 to GREENLEE 345.0 Circuit 1"
line_55	"Line SPRINGR 345.0 to VAIL2 345.0 Circuit 1"
line_56	"Line VAIL 345.0 to SOUTH 345.0 Circuit 1"
line_57	"Line WINCHSTR 345.0 to VAIL 345.0 Circuit 1"
line_58	"Line WINCHSTR 345.0 to WILLOW 345.0 Circuit 1"
line_59	"Line COPPERVR 230.0 to FRISCO 230.0 Circuit 1"
line_60	"Line PD-MORNC 230.0 to FRISCO 230.0 Circuit 1"
line_61	"Line ADAMSTAP 115.0 to NOGALES 115.0 Circuit 1"
line_62	"Line BLACKMTN 115.0 to SNYDHILL 115.0 Circuit 1"
line_63	"Line BRAWLEY 115.0 to SAN JOAQ 115.0 Circuit 1"
line_64	"Line DEL BAC 115.0 to NOGALES 115.0 Circuit 1"
line_65	"Line PICTROCK 115.0 to SANDARIO 115.0 Circuit 1"
line_66	"Line RATTLSNK 115.0 to TUCSON 115.0 Circuit 1"
line_67	"Line RATTLSNK 115.0 to TWINPEAK 115.0 Circuit 1"
line_68	"Line SAG.EAST 115.0 to ORACLE 115.0 Circuit 1"
line_69	"Line SAN JOAQ 115.0 to SANXAVER 115.0 Circuit 1"
line_70	"Line SANXAVER 115.0 to SNYDHILL 115.0 Circuit 1"
line_71	"Line TUCSON 115.0 to DEL BAC 115.0 Circuit 1"
line_72	"Line TUCSON 115.0 to ORACLE 115.0 Circuit 1"
line_73	"Line TWINPEAK 115.0 to PICTROCK 115.0 Circuit 1"
tran_74	"Tran COPPERVR 345.00 to COPPERVR 230.00 Circuit 1"
tran_75	"Tran COPPERVR 345.00 to COPPERVR 230.00 Circuit 2"
line_76	"N-2:Line APACHE-BUTERFLD 230kV & APACHE-RED TAIL 230kV"
line_77	"N-2:Line APACHE-BUTERFLD 230kV & AVRA-MARANA 115kV"
line_78	"N-2:Line APACHE-BUTERFLD 230kV & BICKNELL-VAIL 345kV"
line_79	"N-2:Line APACHE-BUTERFLD 230kV & MARANA TAP-MARANA 115kV"

line_80	"N-2:Line APACHE-BUTT 230kV & MARANA TAP-RATTLESNAKE 115kV"
line_81	"N-2:Line APACHE-BUTERFLD 230kV & APACHE-WINCHESTER 230kV"
line_82	"N-2:Line APACHE-BUTERFLD 230kV & GREENLEE 345/230kV XFMR"
line_83	"N-2:Line APACHE-BUTERFLD 230kV & RATT-TWIN PEAKS 115kV"
line_84	"N-2:Line APACHE-BUTT 230kV & TWIN PEAKS-PICTROCKS 115kV"
line_85	"N-2:Line APACHE-BUTERFLD 230kV & SANDARIO-SNDARIO 115kV"
line_86	"N-2:Line APACHE-WINCHSTR 230kV & APACHE-RED TAIL 230kV"
line_87	"N-2:Line APACHE-WINCHSTR 230kV & MARANA TAP-MARANA 115kV"
line_88	"N-2:Line APACHE-WINCHSTR 230kV & MARANA TAP-RATTSNK 115kV"
line_89	"N-2:Line APACHE-WINCHSTR 230kV & RATT-TWIN PEAKS 115kV"
line_90	"N-2:Line APACHE-WINCHSTR 230kV & TWIN PEAKS-PICROCKS 115kV"
line_91	"N-2:Line APACHE-WINCHSTR 230kV & SANDARIO-SNDARIO 115kV"
line_92	"N-2:Line AVRA-MARANA 115kV & APACHE-WINCHSTR 230kV"
line_93	"N-2:Line AVRA-MARANA 115kV & BICKNELL-VAIL 345kV"
line_94	"N-2:Line AVRA-SNDARIO 115kV & THREEPNT-SNDARIO 115kV"
line_95	"N-2:Line BICKNELL to THREEPNT 115.0 kV & AVRA to MARANA 115 kV"
line_96	"N-2:Line MARANATP-MARANA 115kV & MARANATP-RATTLSK 115kV"
line_97	"N-2:Line SPRINGR-VAIL2 345kV & WINCSTR-VAIL 345kV"
line_98	"N-2:Line WINCHSTR-VAIL 345kV & PINALWES-SOUTH 345kV"
line_99	"N-n:Line APACHE-BUTERFLD/RED TAIL230&AVRA-MARANA115"
line_100	"N-n:Line APACHE-BUTERFLD/RED TAIL230&SAG-MARANATAP115"
line_101	"N-n:Line APACHE-BUTERFLD/RED TAIL230&SAGUARO-NAVISKA115"
line_102	"N-n:Line APACHE-BUTERFLD/RED TAIL230&APACHE-WINCHSTR345"
line_103	"N-n:Line APACHE-BUTERFLD/RED TAIL230&BICKNELL-VAIL345"
line_104	"N-n:Line APACHE-BUTERFLD&SAG-MARANATAP115&SAG-NAVSK115"
line_105	"N-n:Line APACHE-BUTERFLD&AVRA-MARANA115&BICK-VAIL345"
line_106	"N-n:Common Corridor LINES OUT OF APACHE"
line_107	"N-n: ENTIRE APACHE STATION OUT OF SERVICE"
line_108	"N-n: ENTIRE BICKNELL SUBSTATION OUT OF SERVICE"

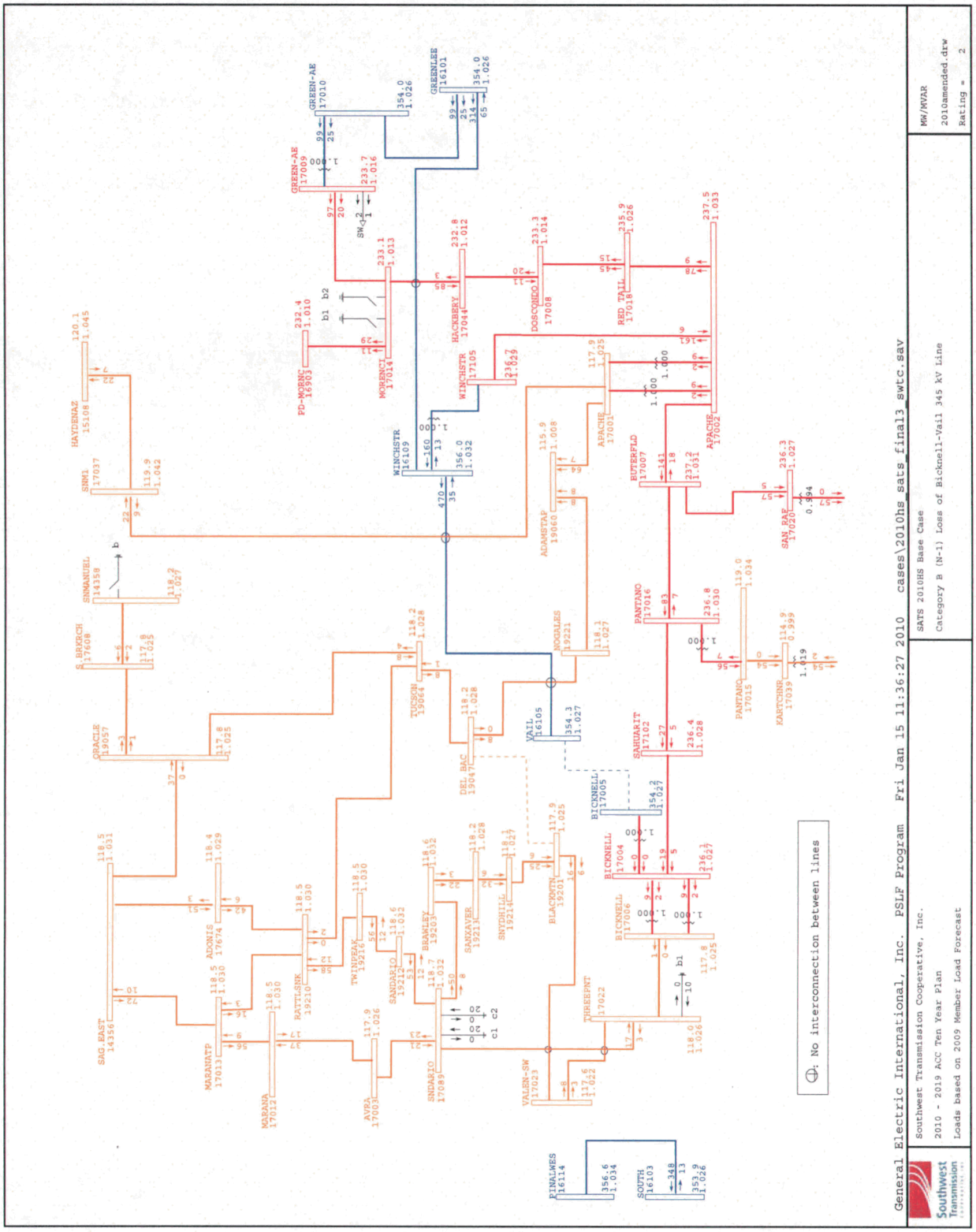
APPENDIX C

POWER FLOW ONE LINE DIAGRAMS

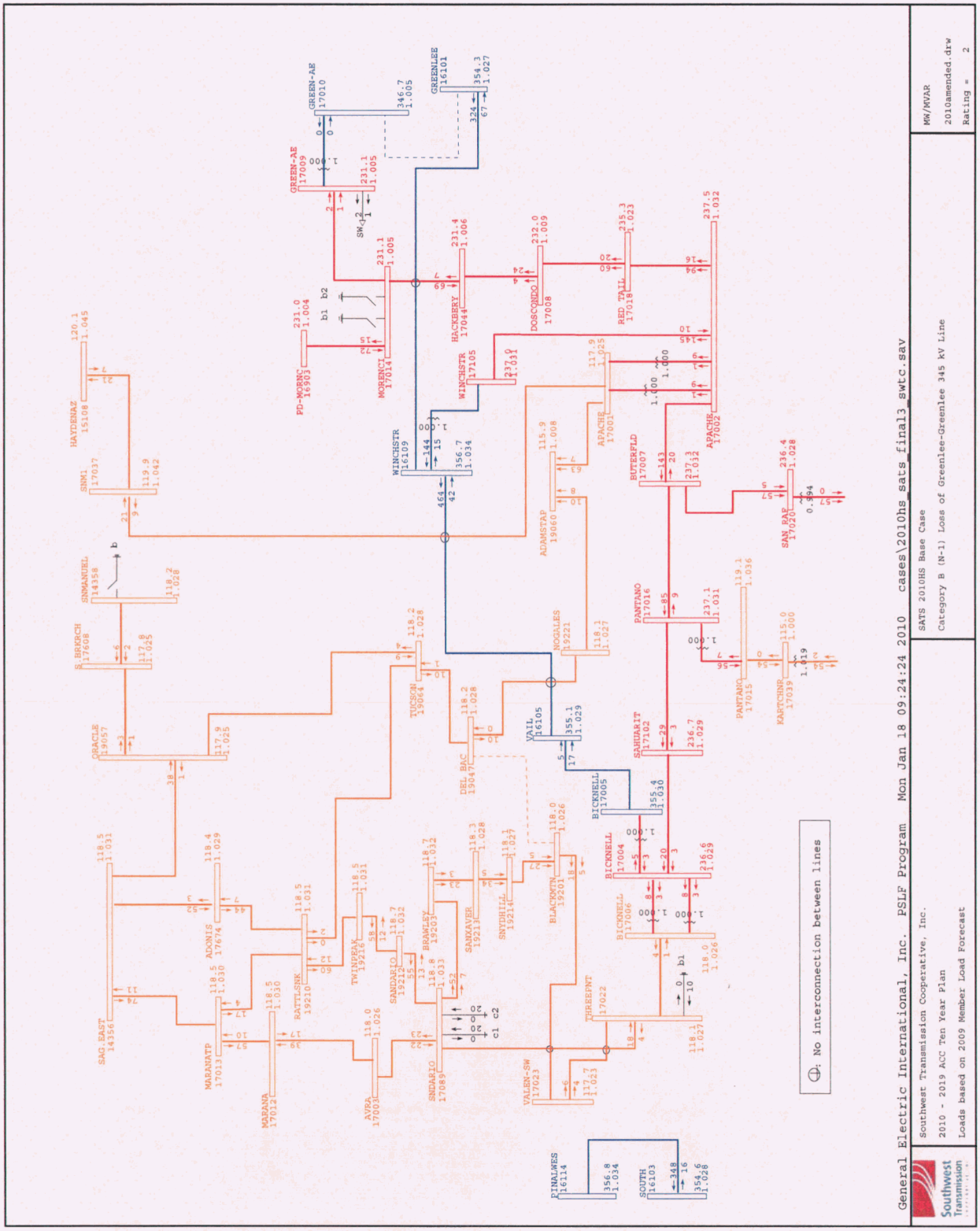
2010HS Southwest Transmission Cooperative Base System



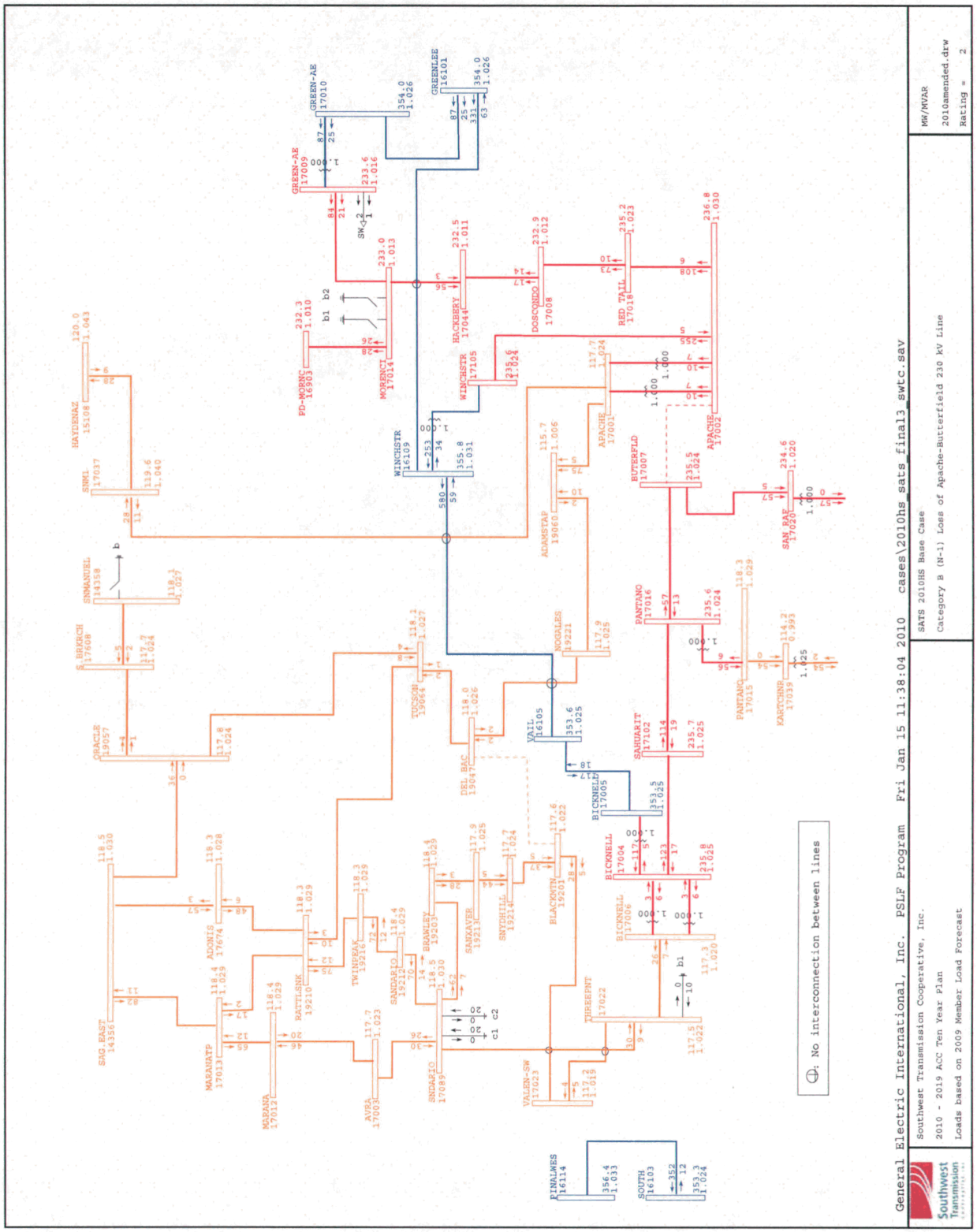
2010HS Southwest Transmission Cooperative Base System with Bicknell to Vail 345 kV Line out of service



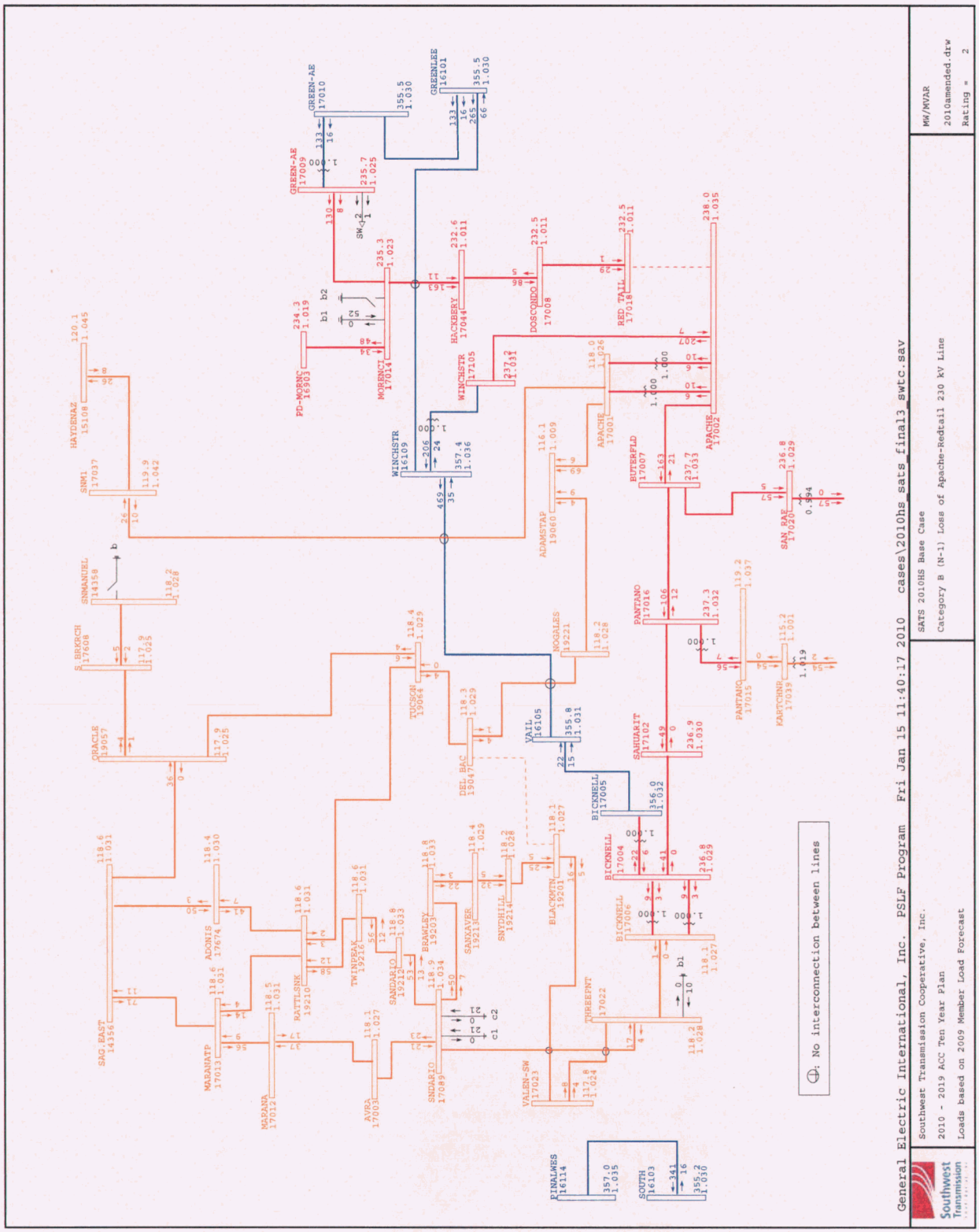
2010HS Southwest Transmission Cooperative Base System with Greenlee to Greenlee 345 kV Line out of service



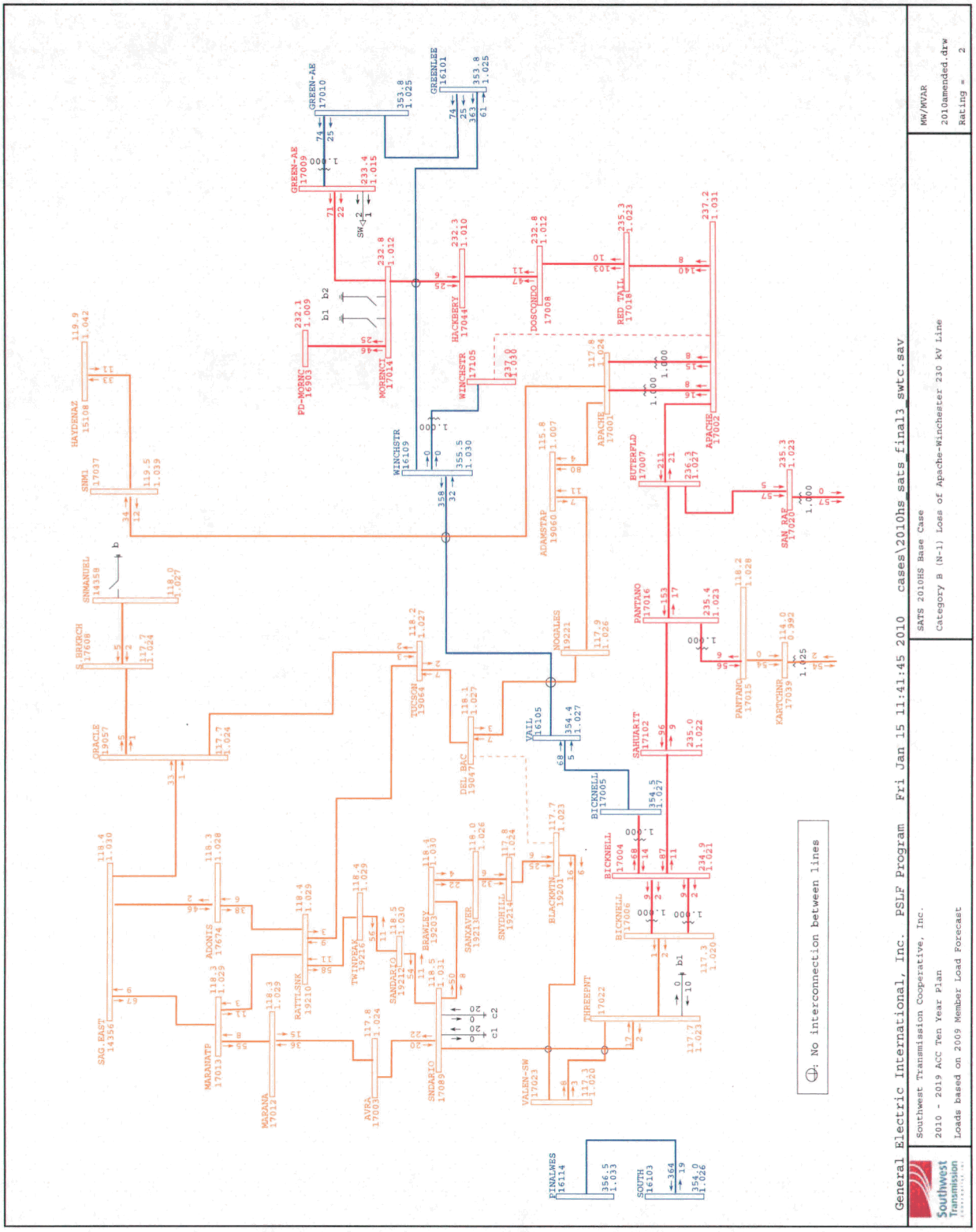
2010HS Southwest Transmission Cooperative Base System with Apache to Butterfield 230 kV Line out of service



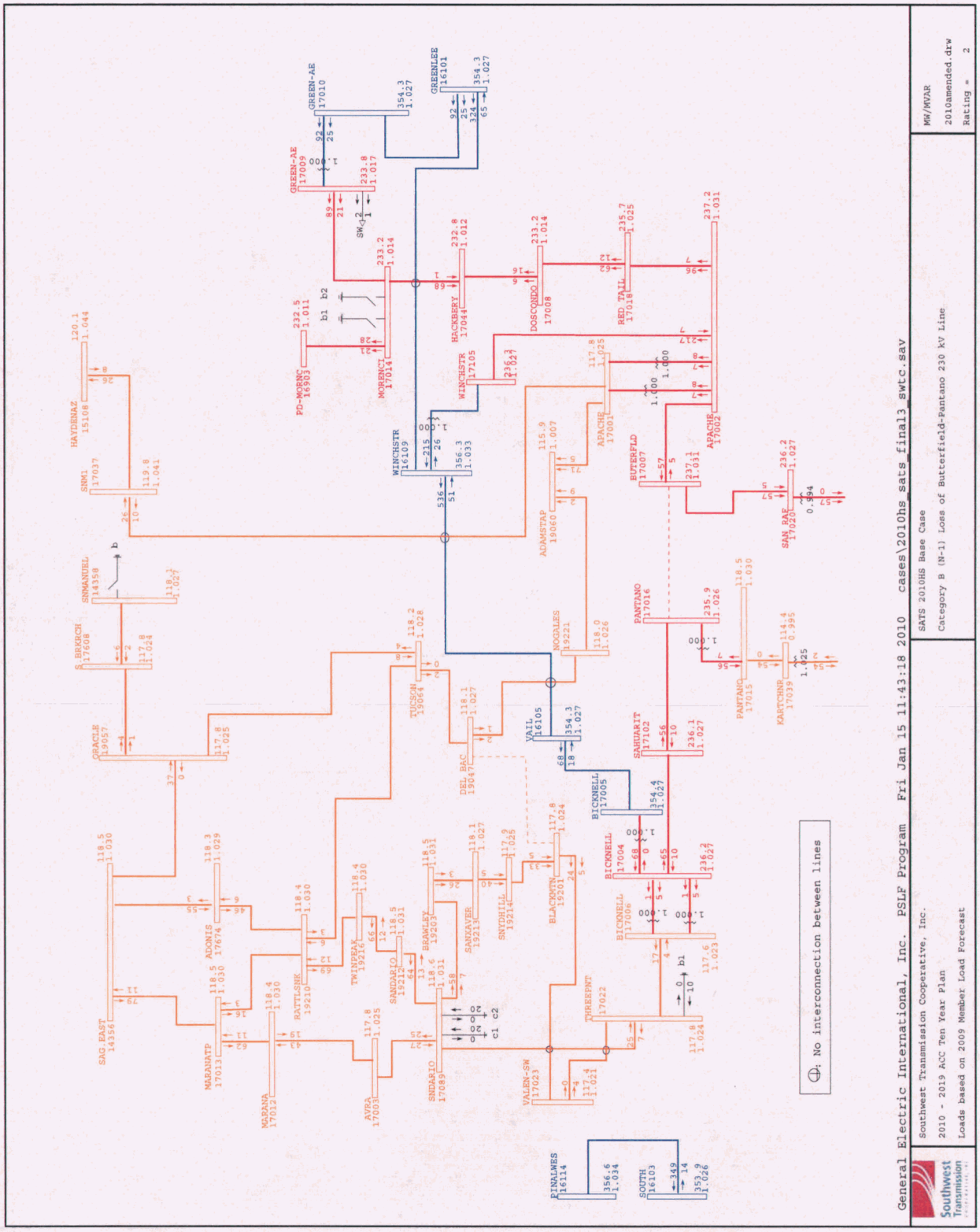
2010HS Southwest Transmission Cooperative Base System with Apache to Redtail 230 kV Line out of service



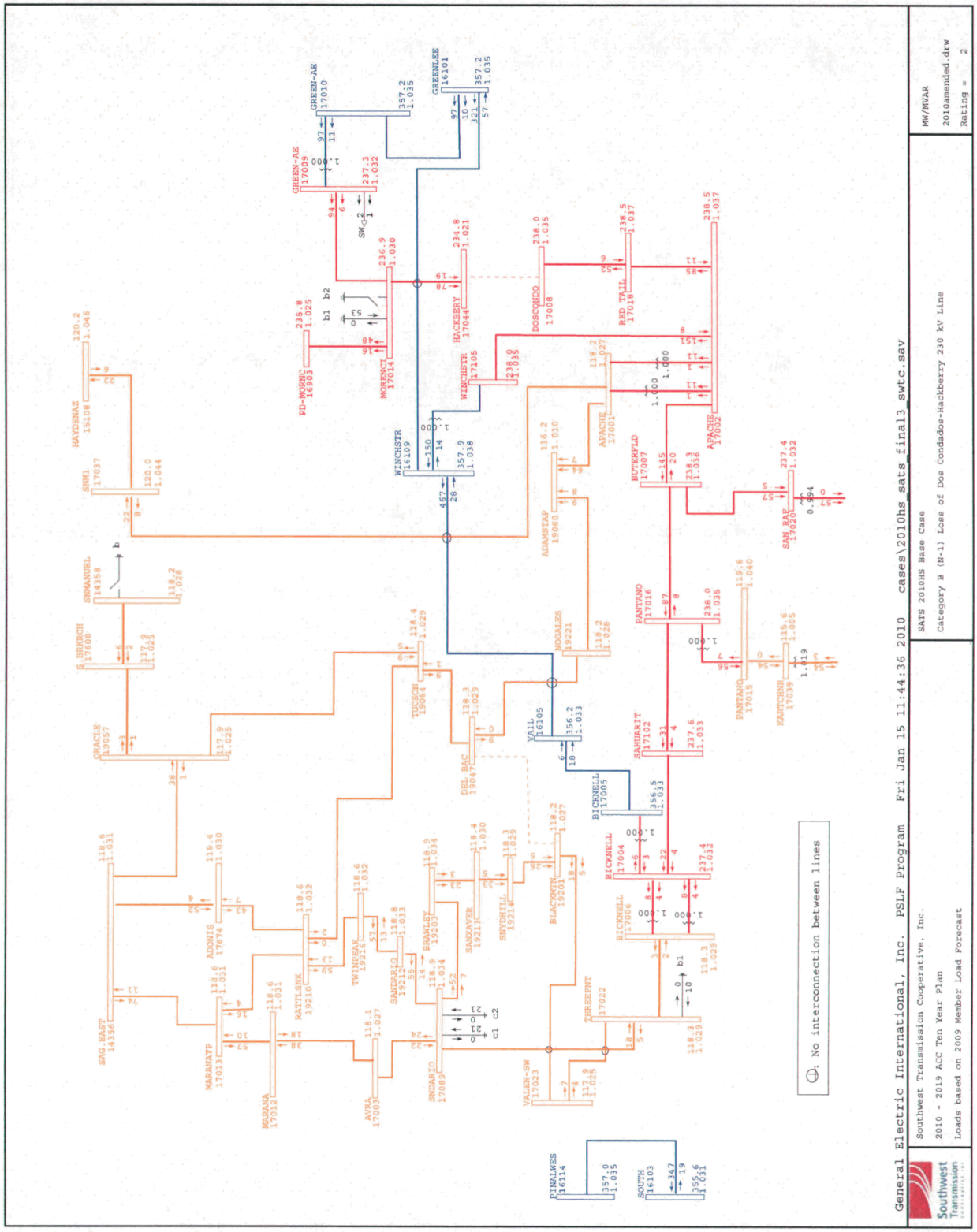
2010HS Southwest Transmission Cooperative Base System with Apache to Winchester 230 kV Line out of service



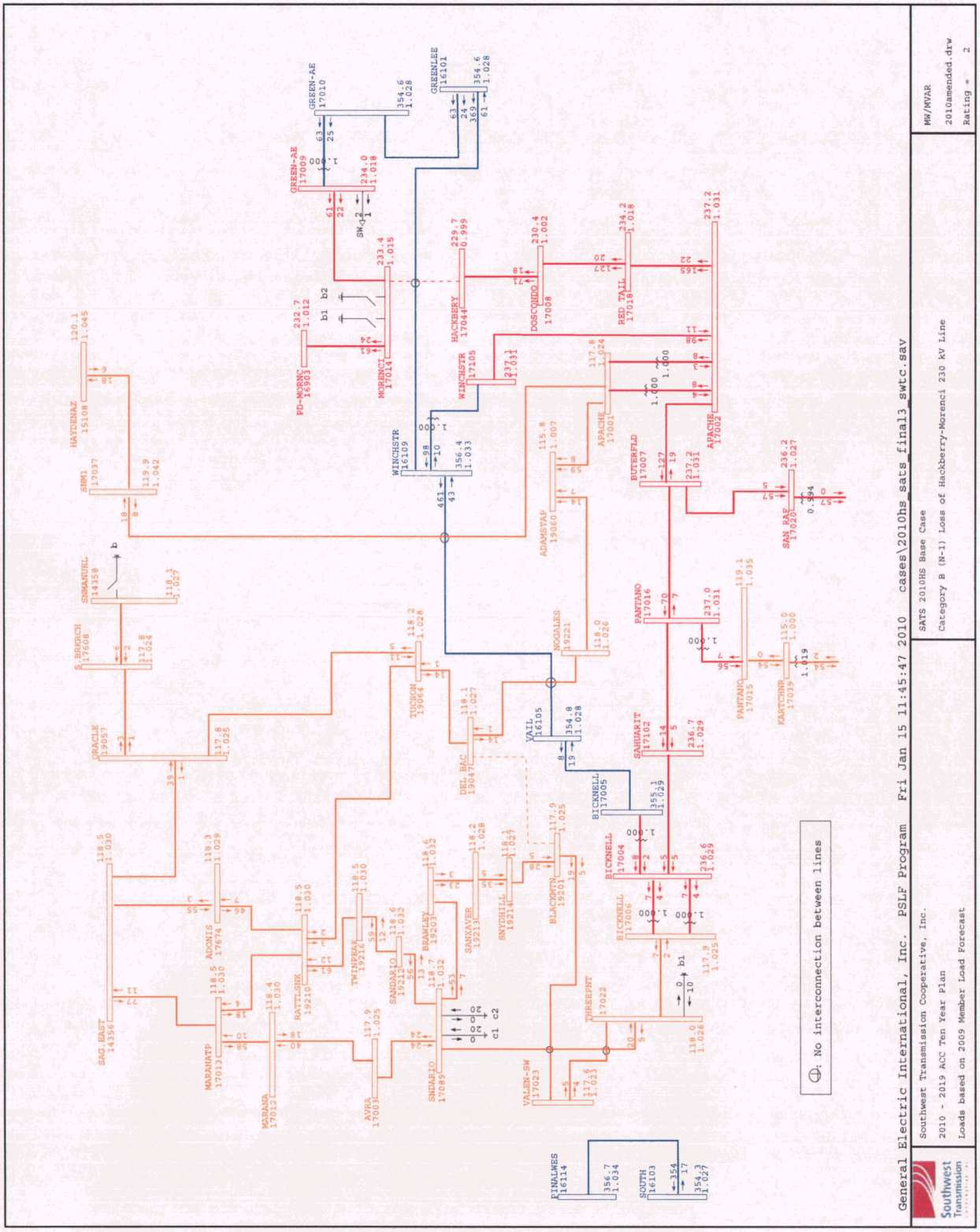
2010HS Southwest Transmission Cooperative Base System with Butterfield to Pantano 230 kV Line out of service



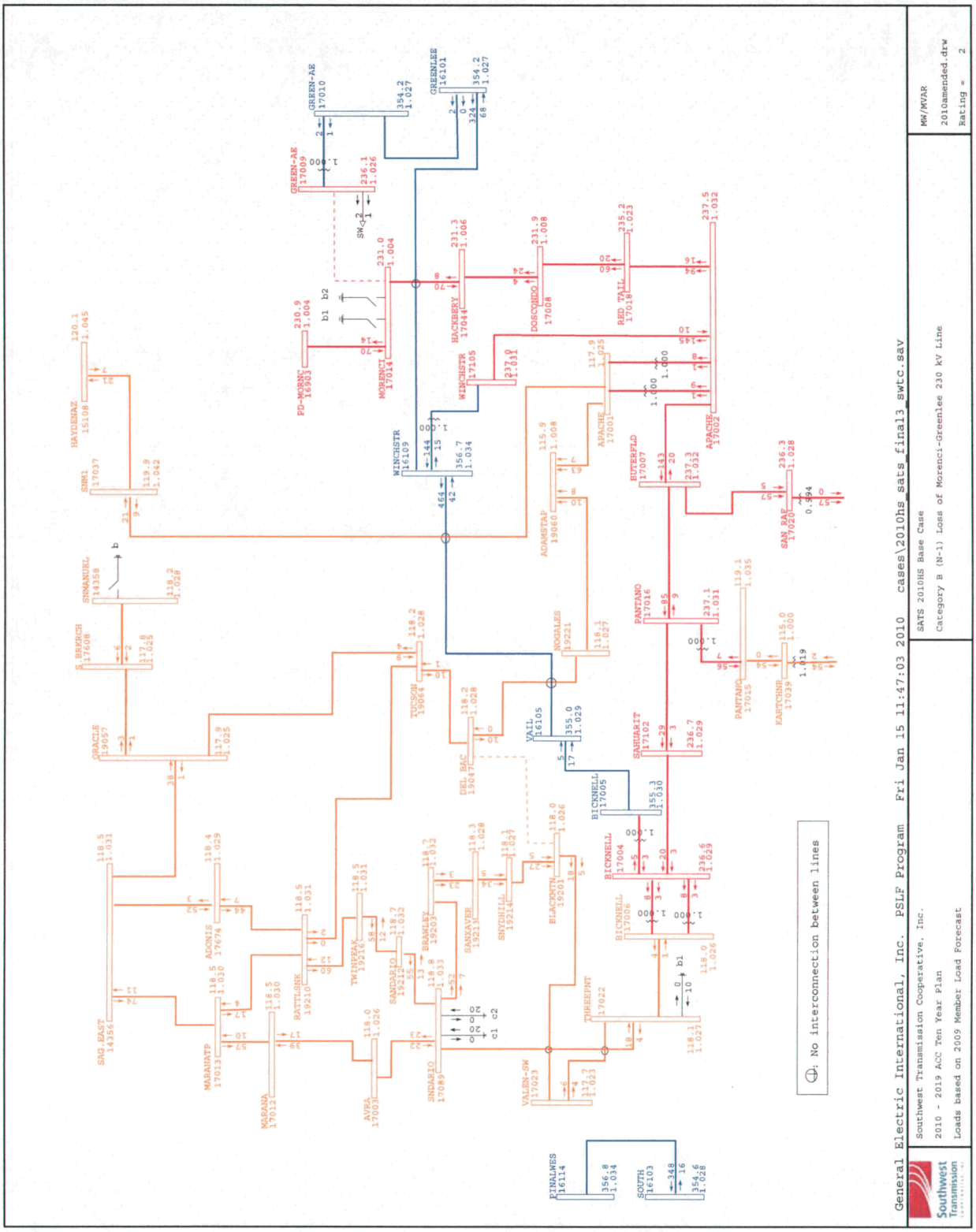
2010HS Southwest Transmission Cooperative Base System with Dos Condados to Hackberry 230 kV Line out of service



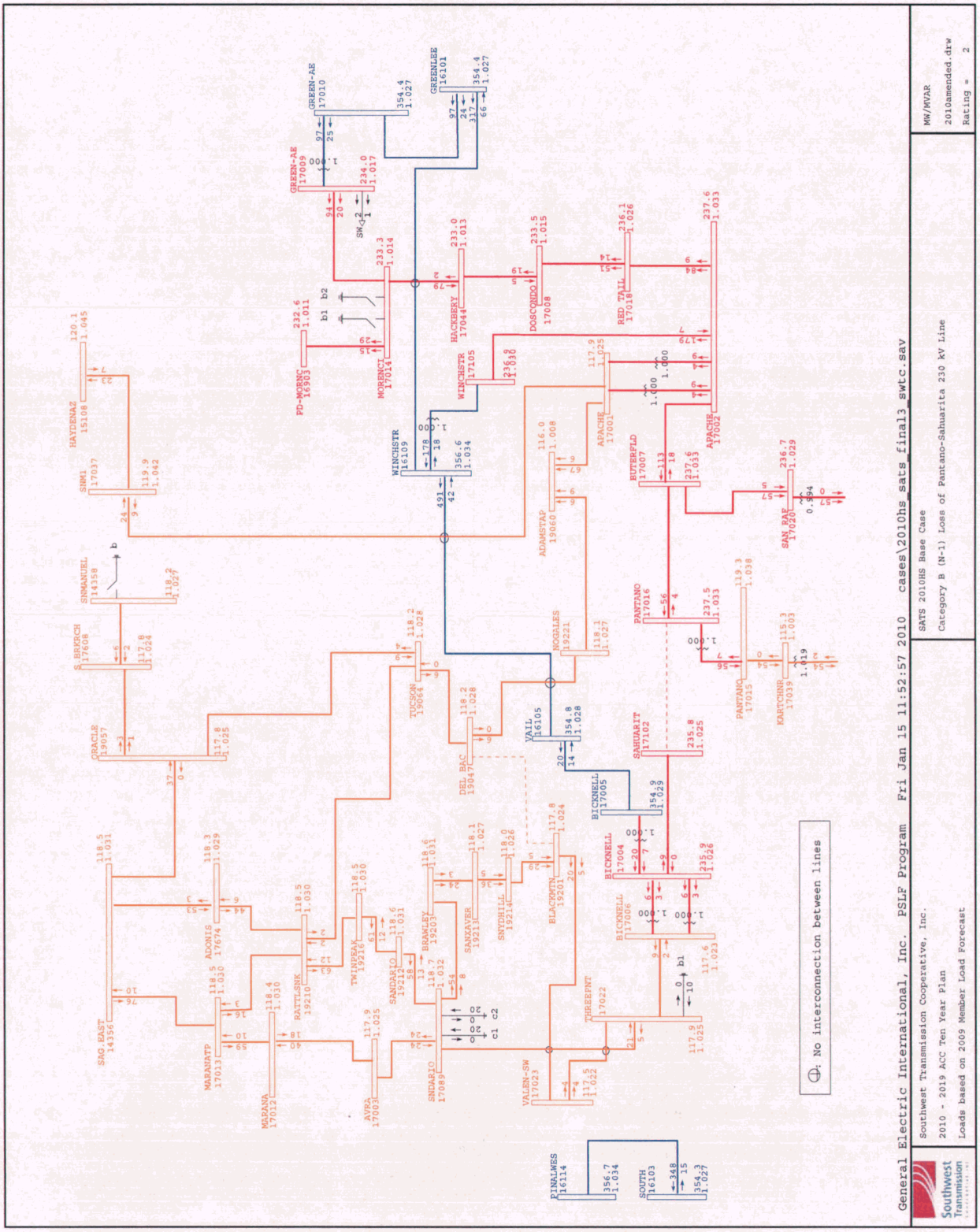
2010HS Southwest Transmission Cooperative Base System with Hackberry to Morenci 230 kV Line out of service



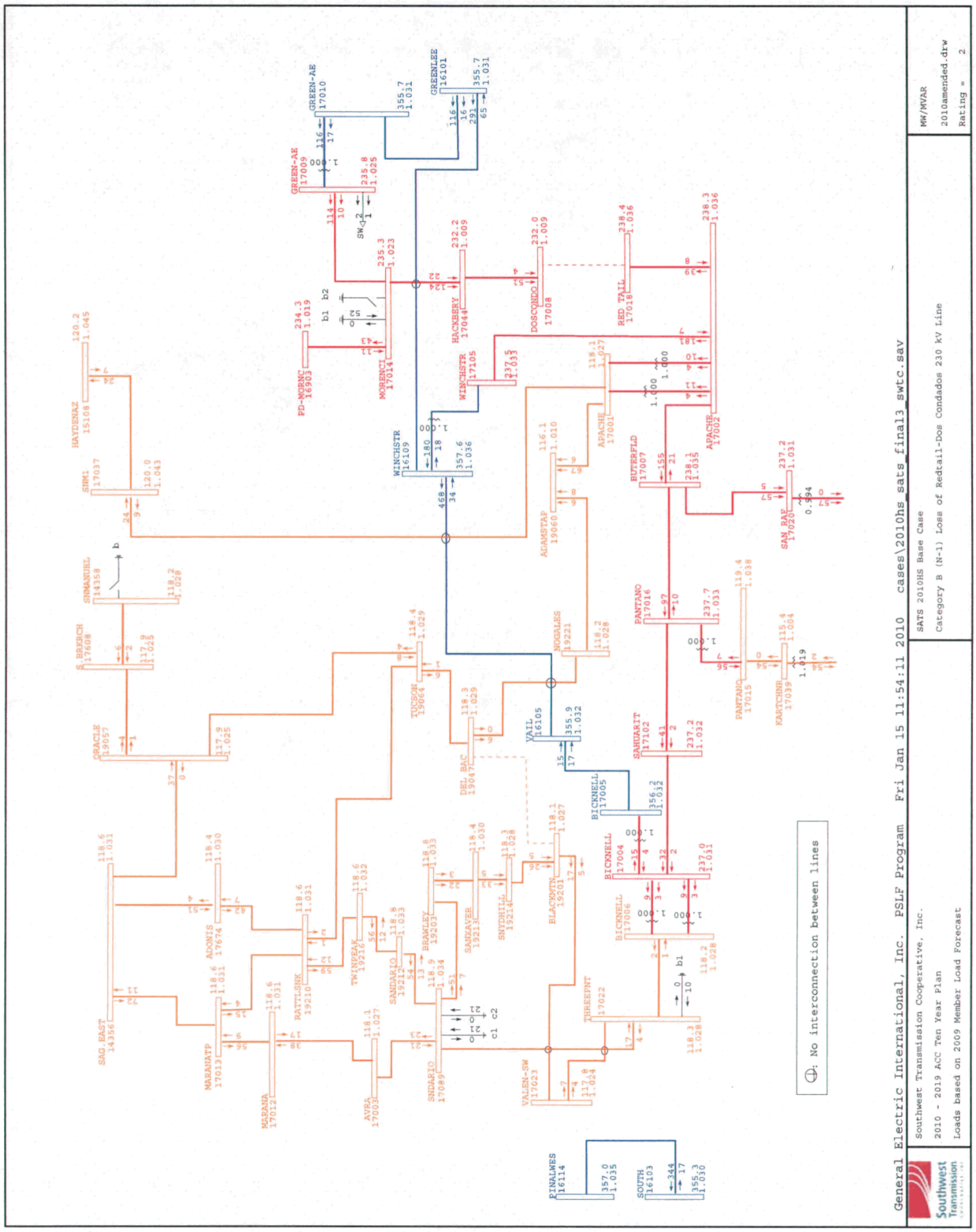
2010HS Southwest Transmission Cooperative Base System with Morenci to Greenlee 230 kV Line out of service



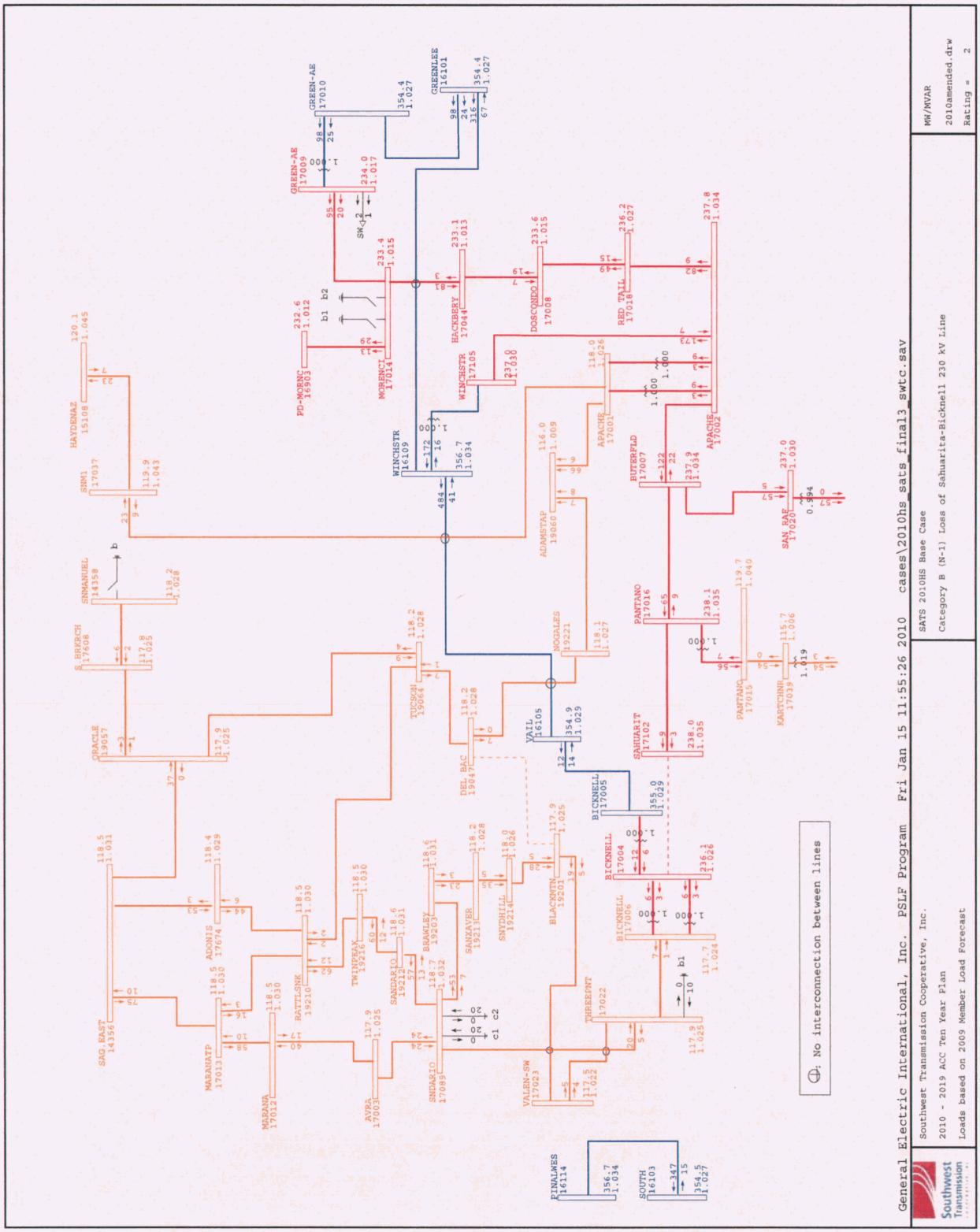
2010HS Southwest Transmission Cooperative Base System with Pantano to Sahuarita 230 kV Line out of service



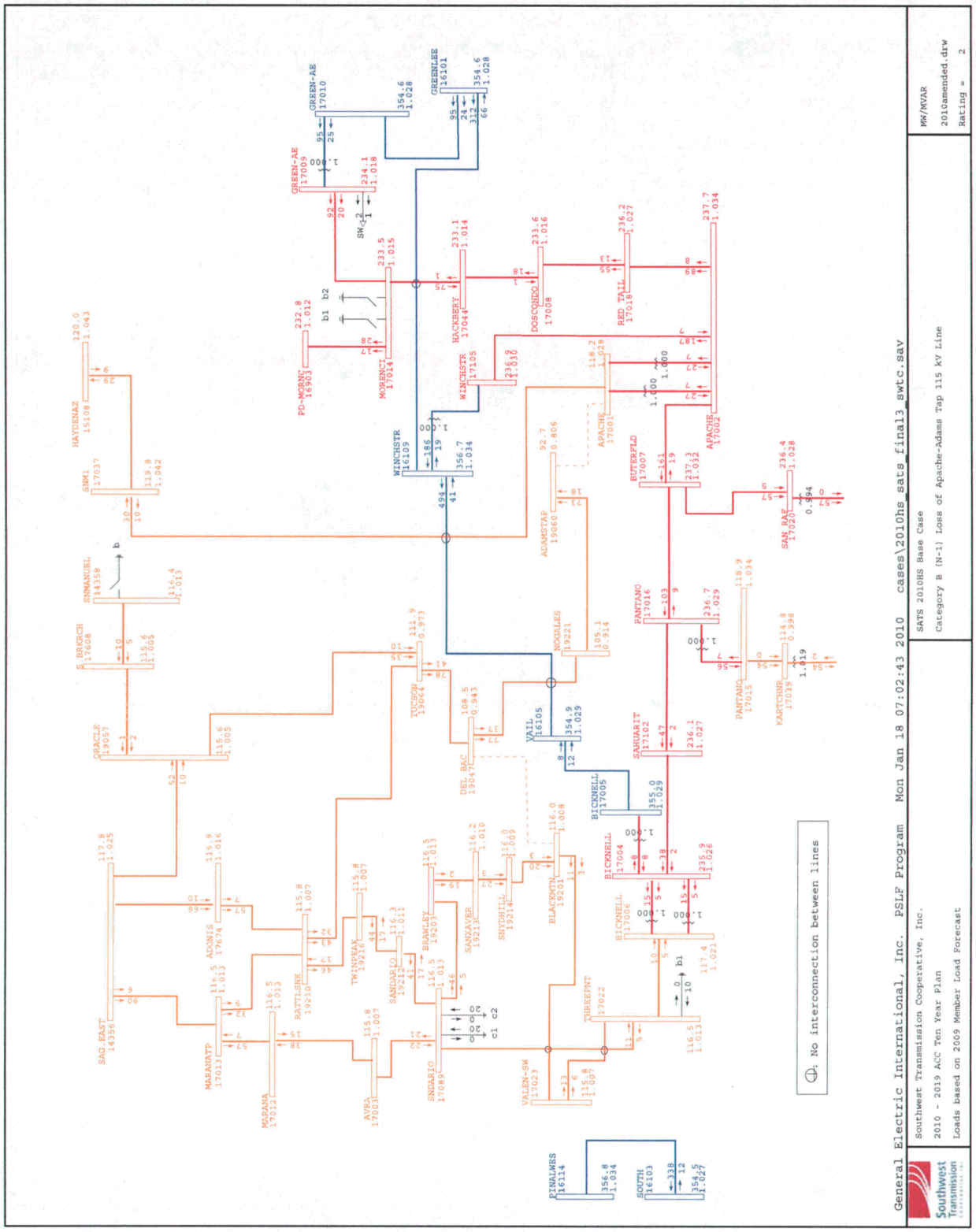
2010HS Southwest Transmission Cooperative Base System with Redtail to Dos Condados 230 kV Line out of service



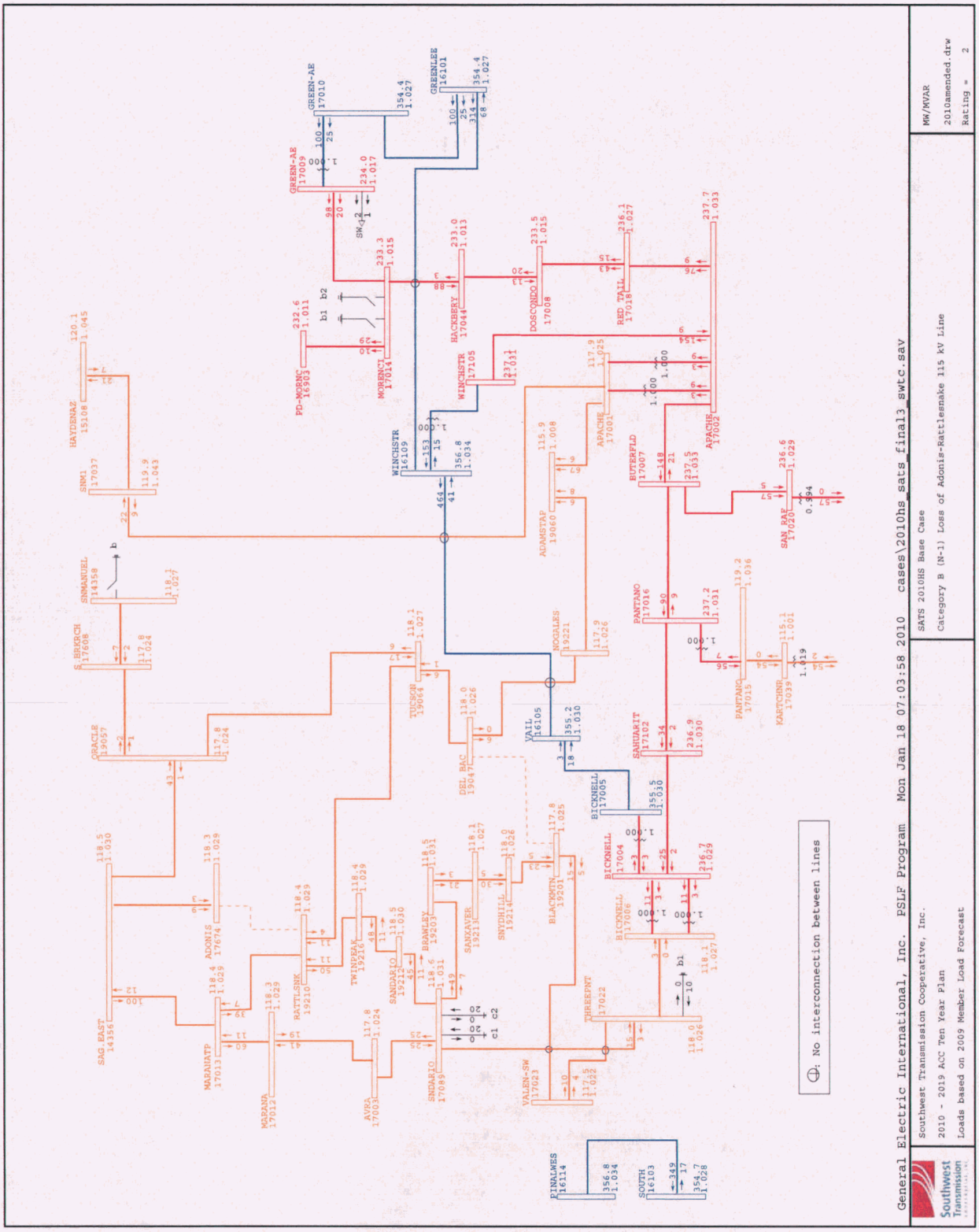
2010HS Southwest Transmission Cooperative Base System with Sahuarita to Bicknell 230 kV Line out of service



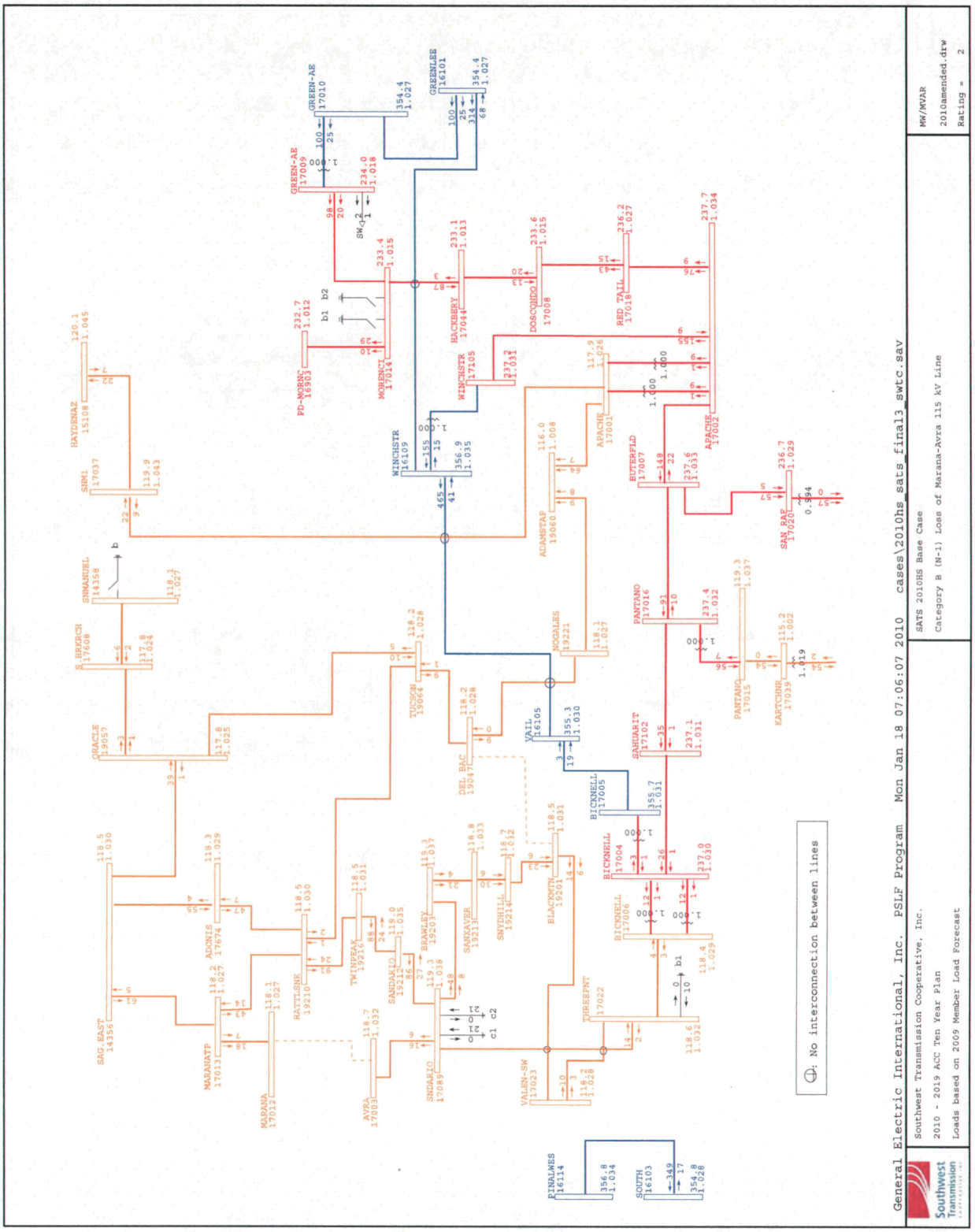
2010HS Southwest Transmission Cooperative Base System with Apache to Adams Tap 115 kV Line out of service



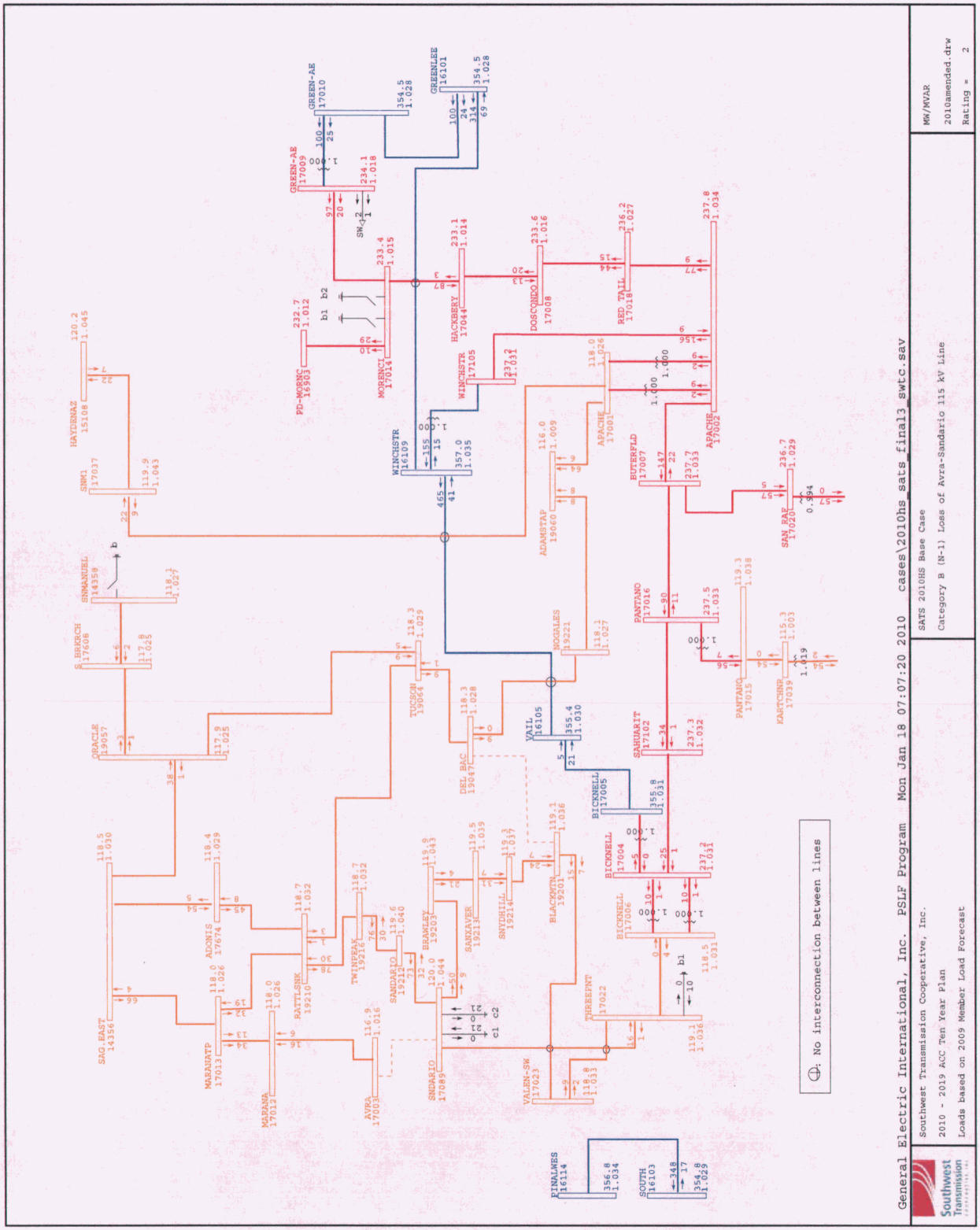
2010HS Southwest Transmission Cooperative Base System with Adonis to Rattlesnake 115 kV Line out of service



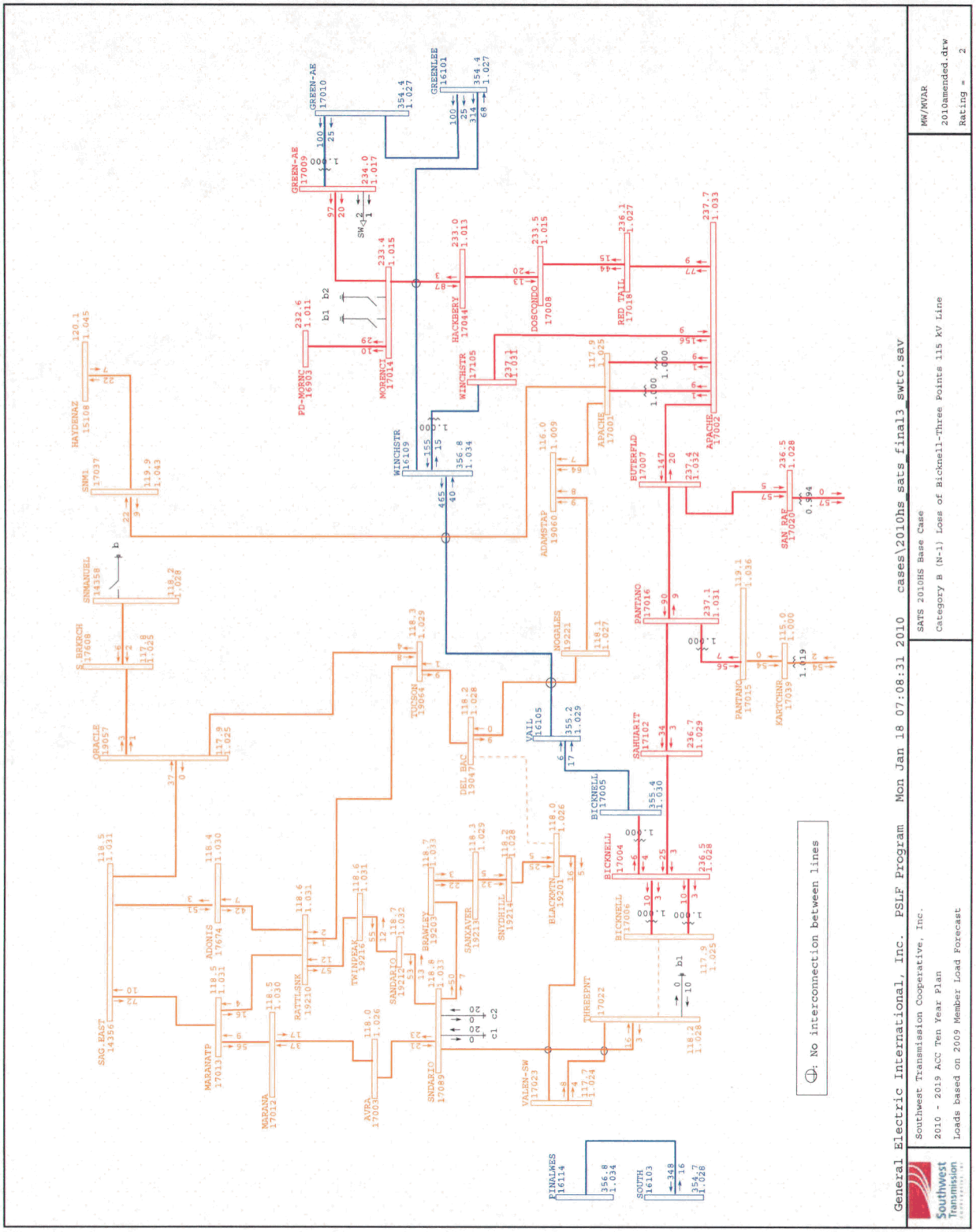
2010HS Southwest Transmission Cooperative Base System with Marana to Avra 115 kV Line out of service



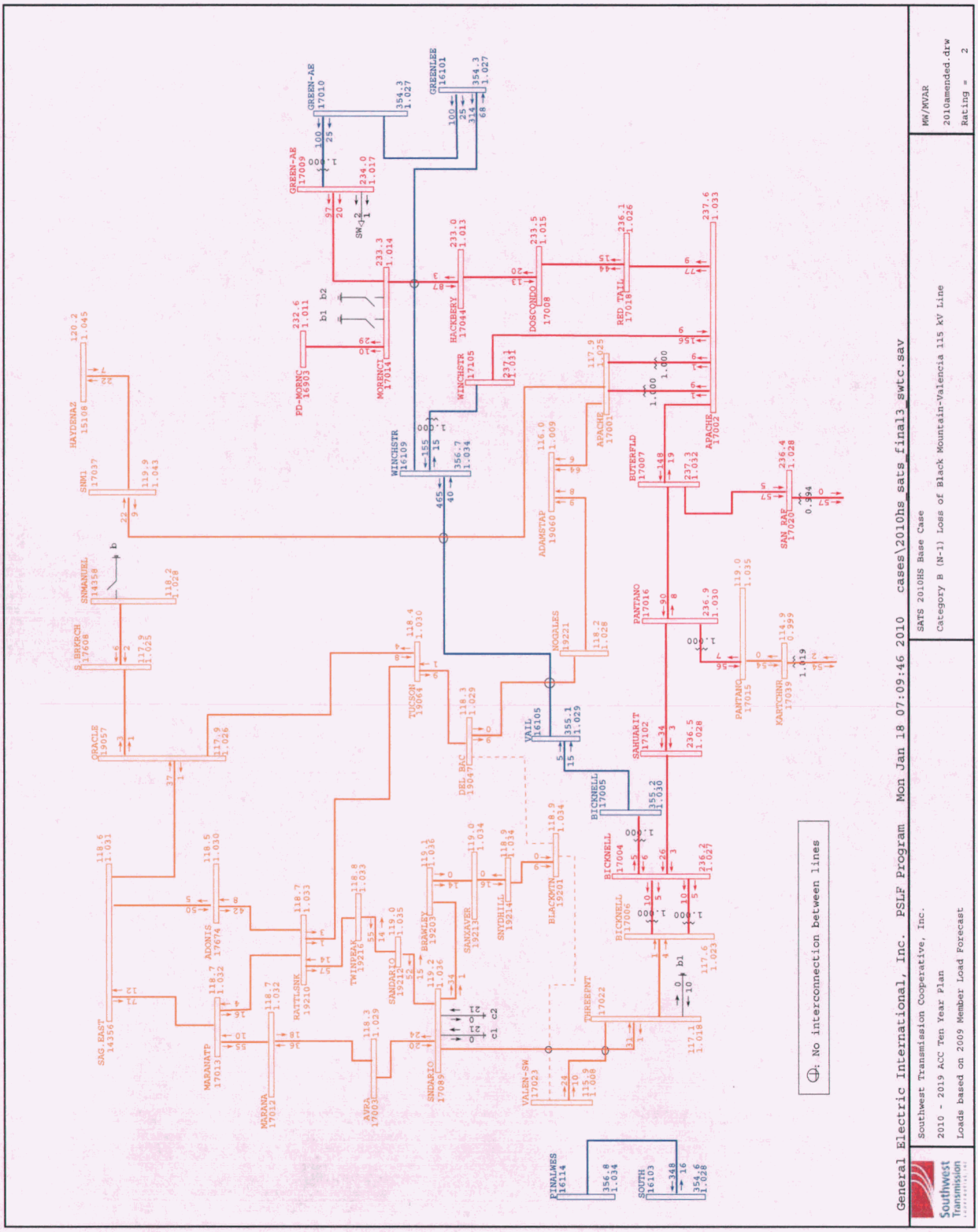
2010HS Southwest Transmission Cooperative Base System with Avra to Sandario 115 kV Line out of service



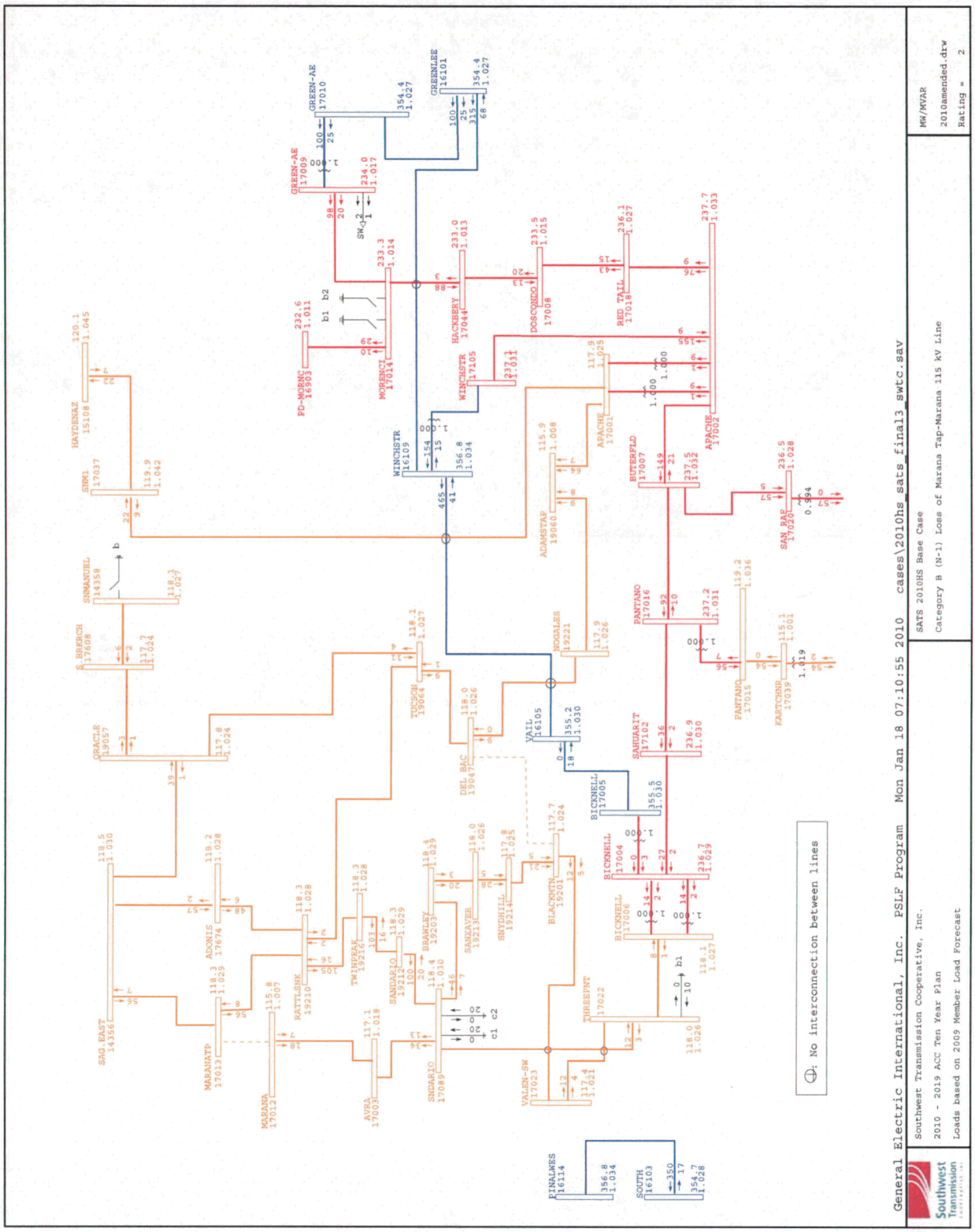
2010HS Southwest Transmission Cooperative Base System with Bicknell to Three Points 115 kV Line out of service



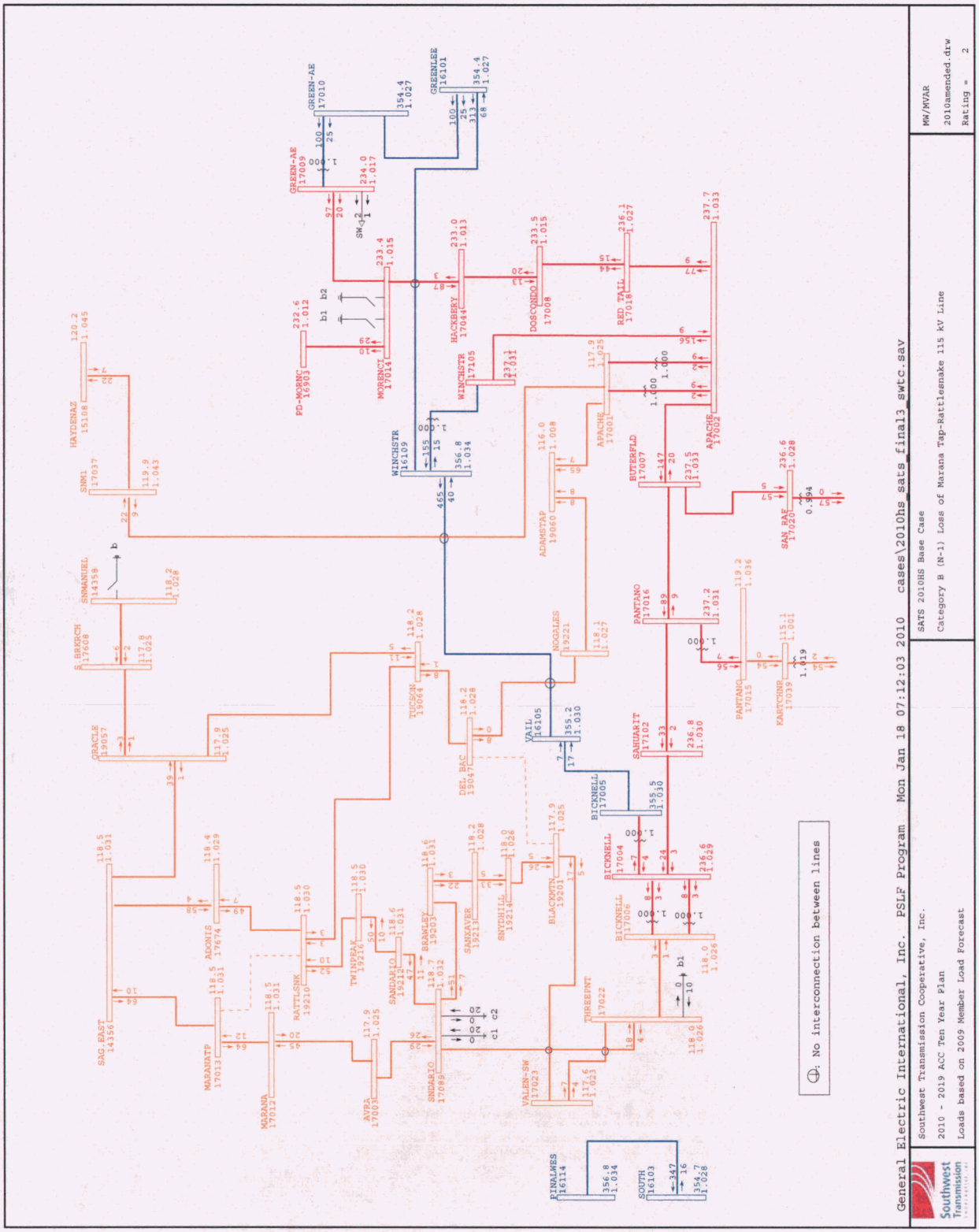
2010HS Southwest Transmission Cooperative Base System with Black Mountain to Valencia 115 kV Line out of service



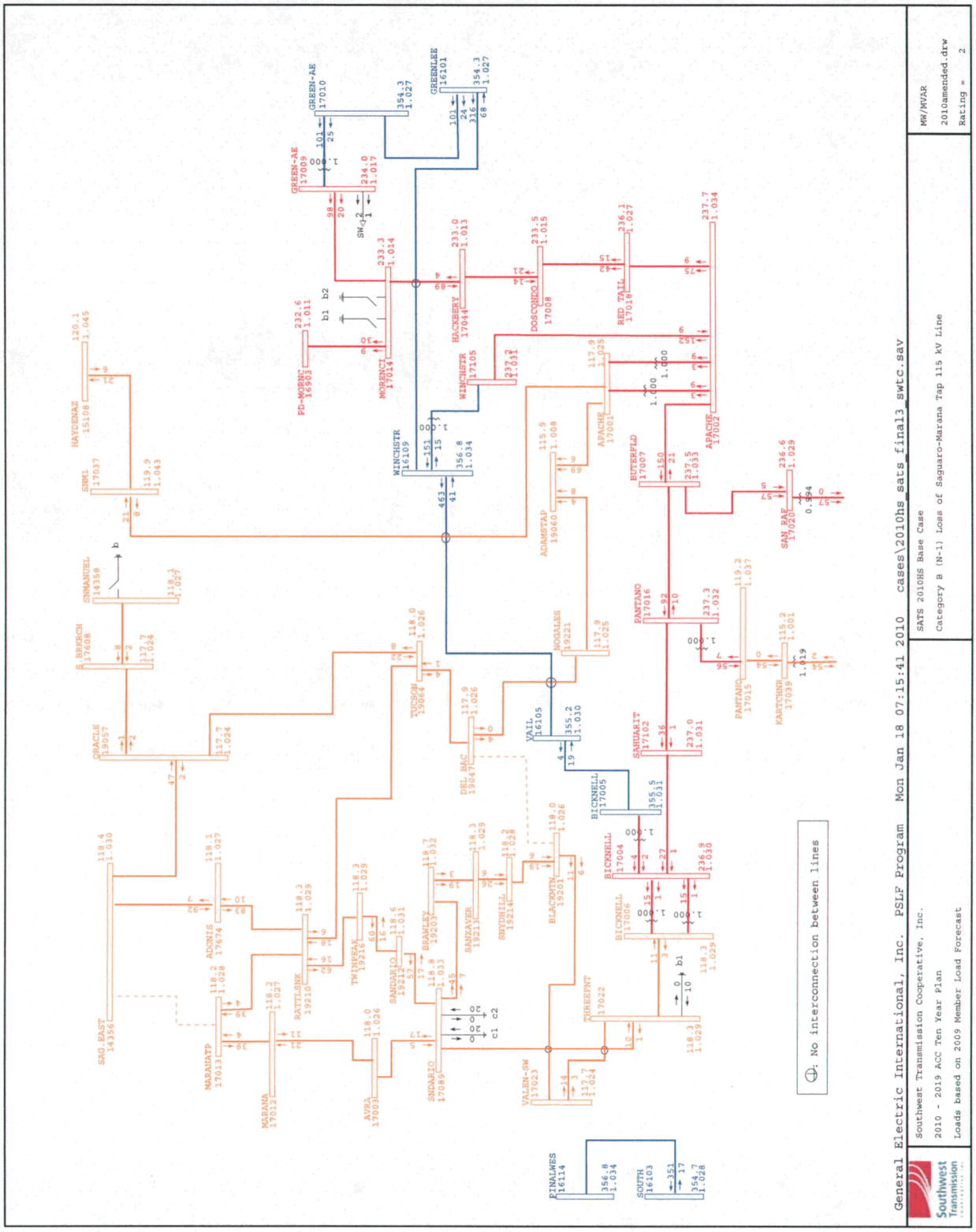
2010HS Southwest Transmission Cooperative Base System with Marana Tap to Marana 115 kV Line out of service



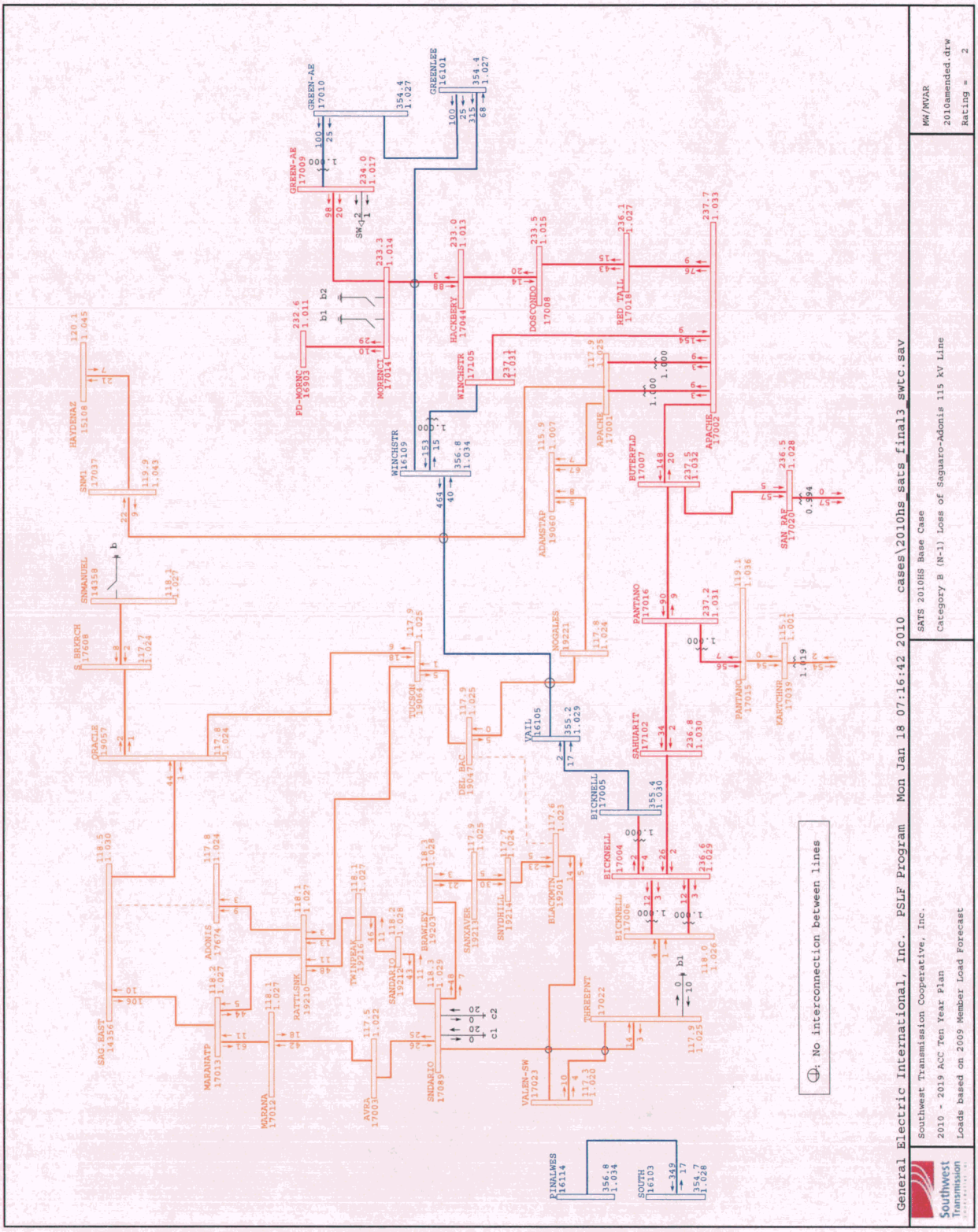
2010HS Southwest Transmission Cooperative Base System with Marana Tap to Rattlesnake 115 kV Line out of service



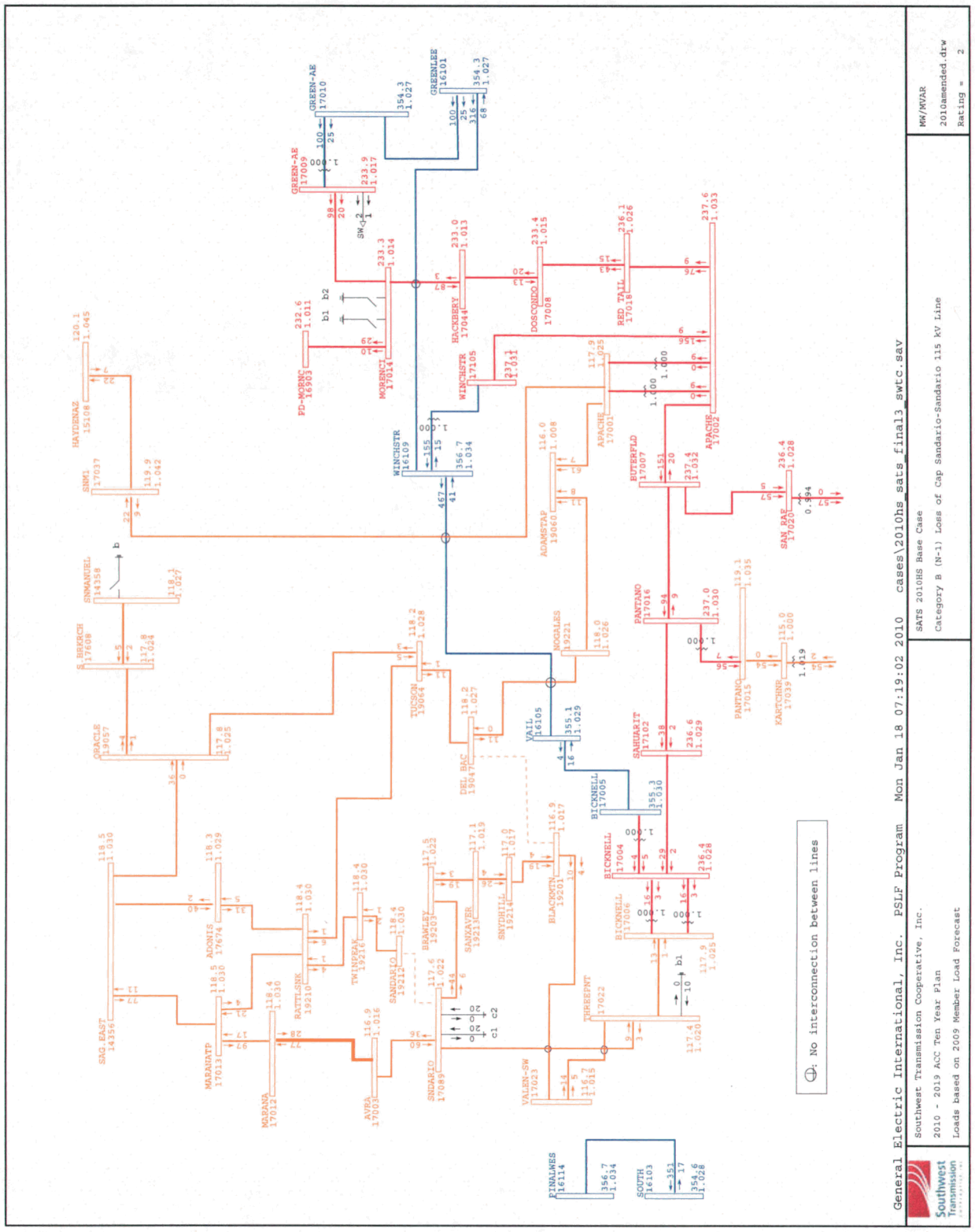
2010HS Southwest Transmission Cooperative Base System with Saguaro to Marana Tap 115 kV Line out of service



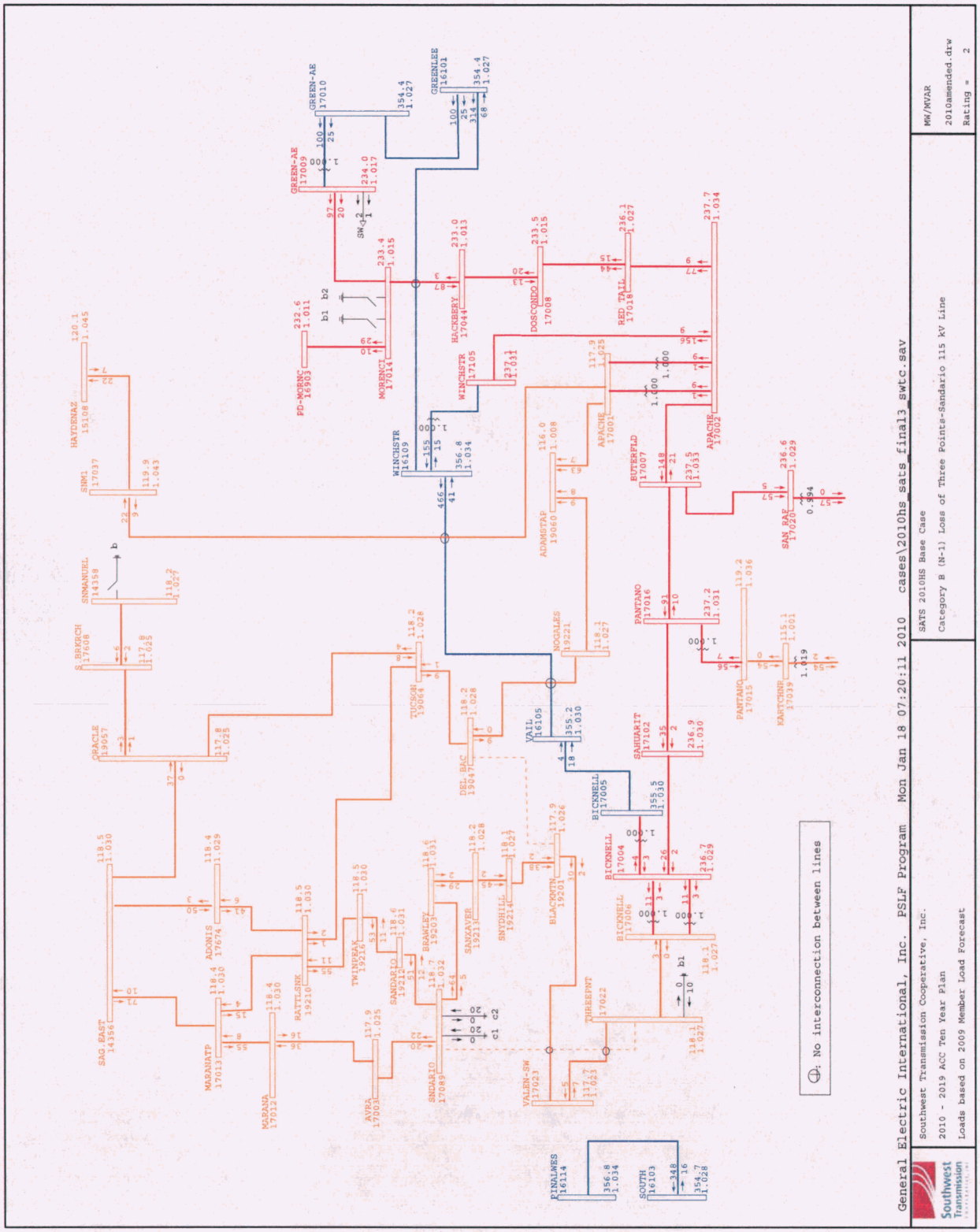
2010HS Southwest Transmission Cooperative Base System with Saguaro to Adonis 115 kV Line out of service



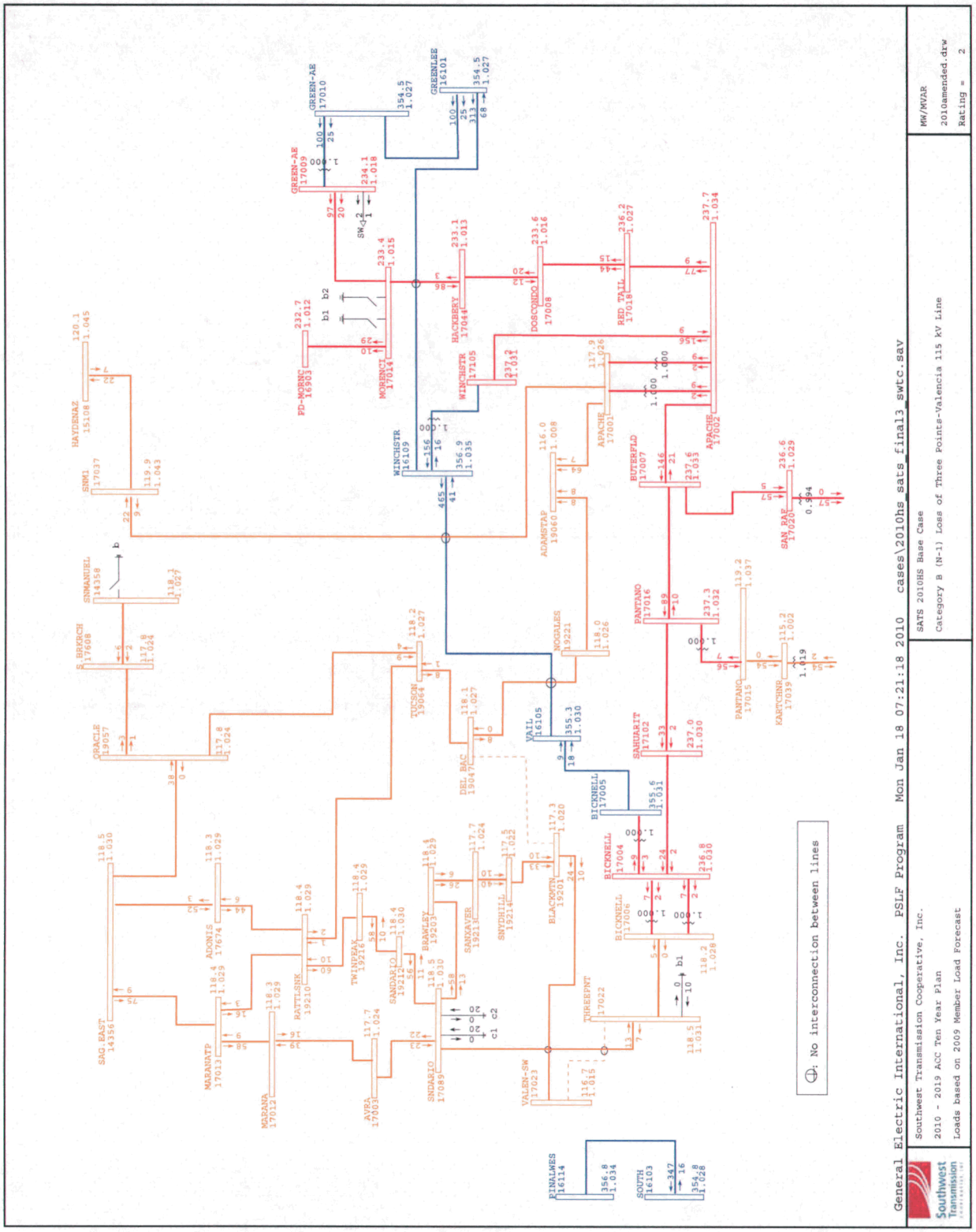
2010HS Southwest Transmission Cooperative Base System with Cap Sandario to Sandario 115 kV Line out of service



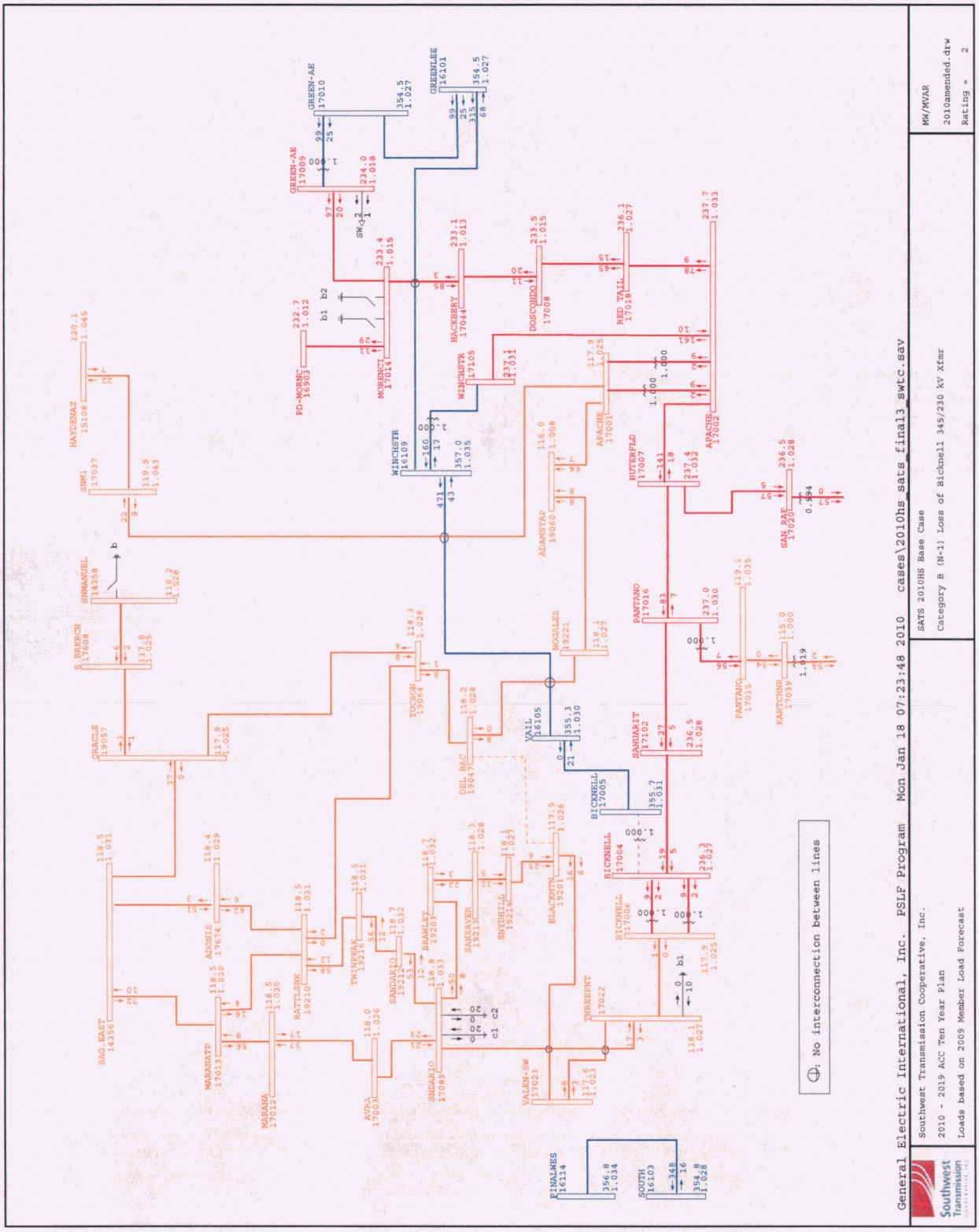
2009HS Southwest Transmission Cooperative Base System with Three Points to Sandario 115 kV Line out of service



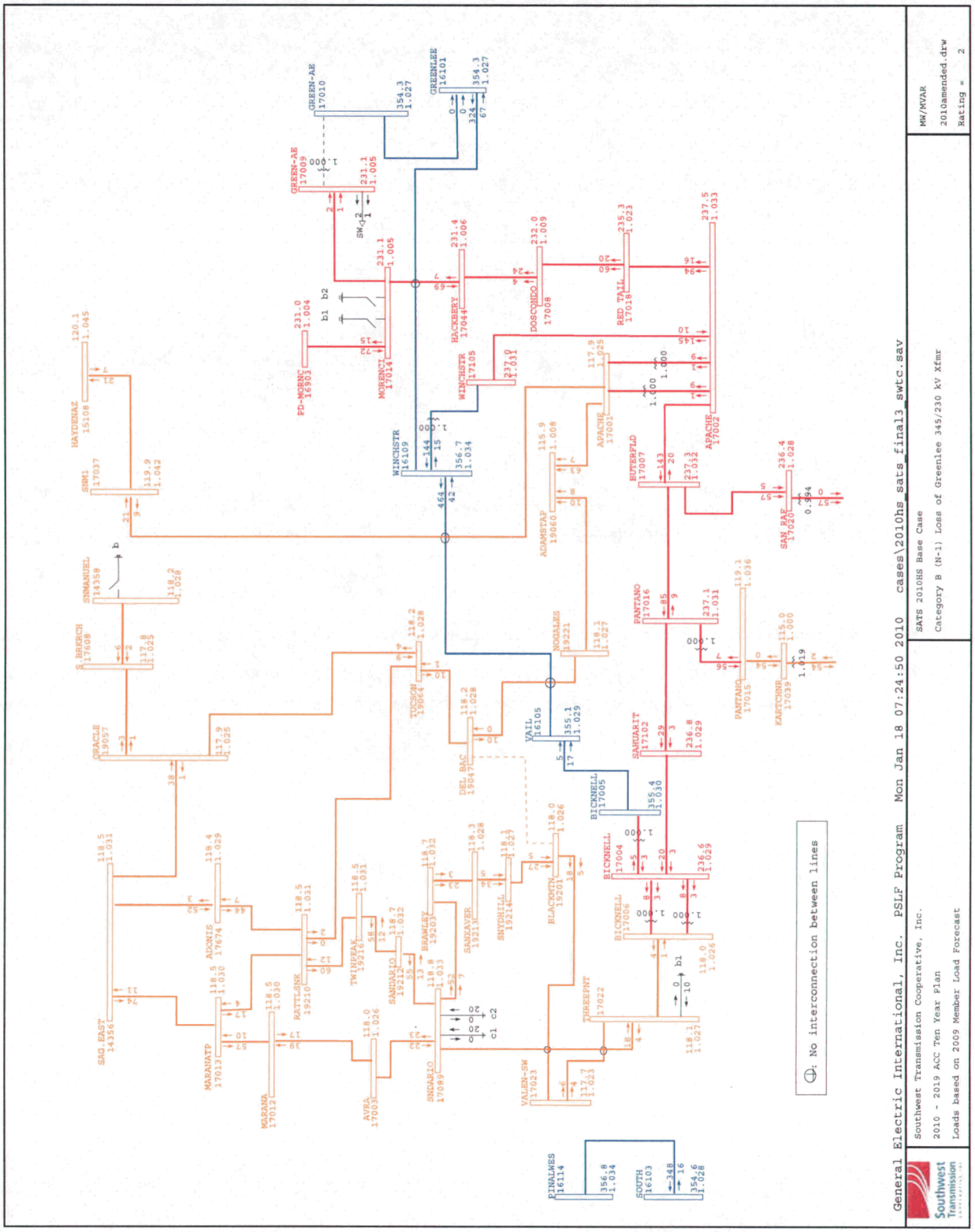
2010HS Southwest Transmission Cooperative Base System with Three Points to Valencia 115 kV Line out of service



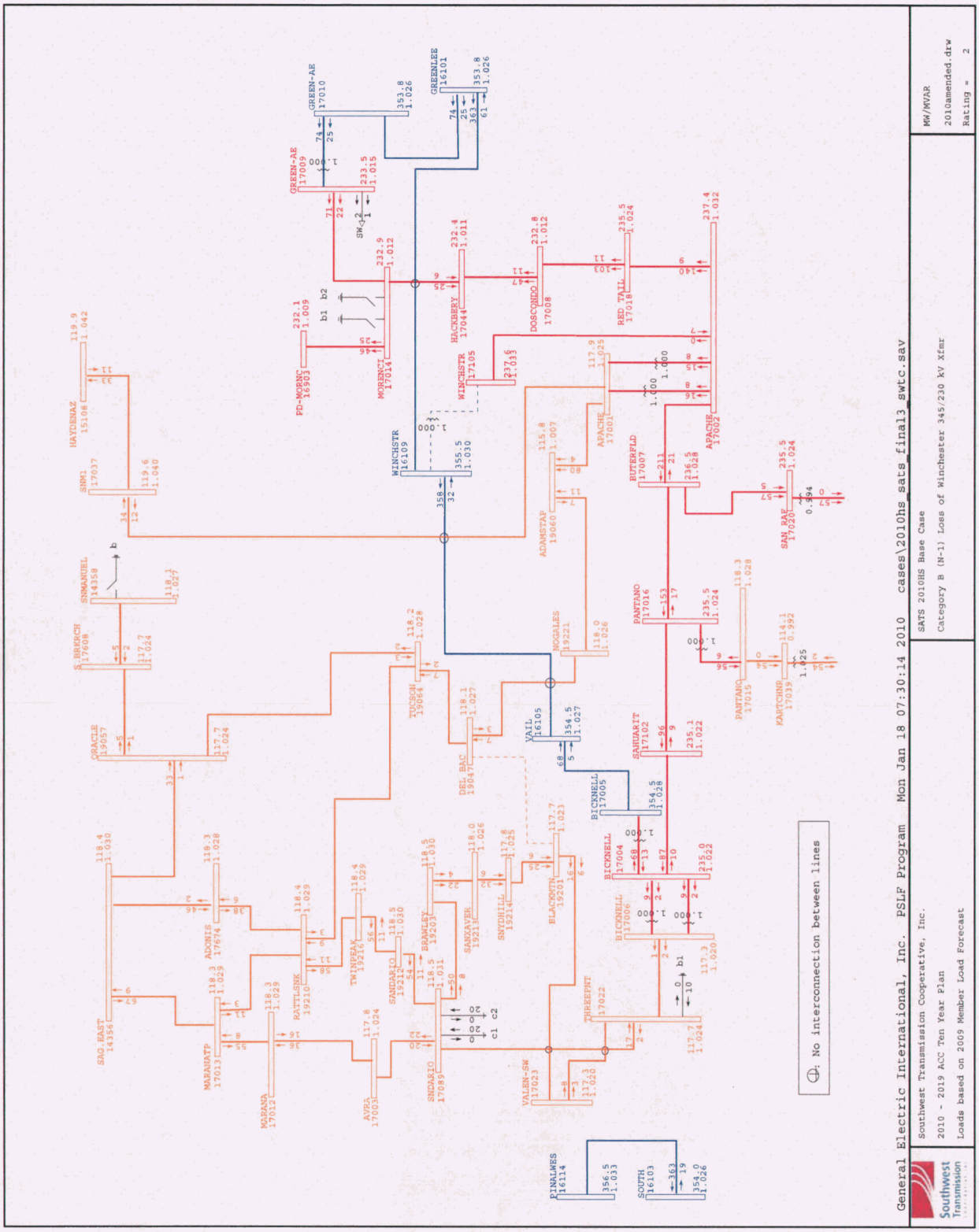
2010HS Southwest Transmission Cooperative Base System with Bicknell 345/230 kV Transformer out of service



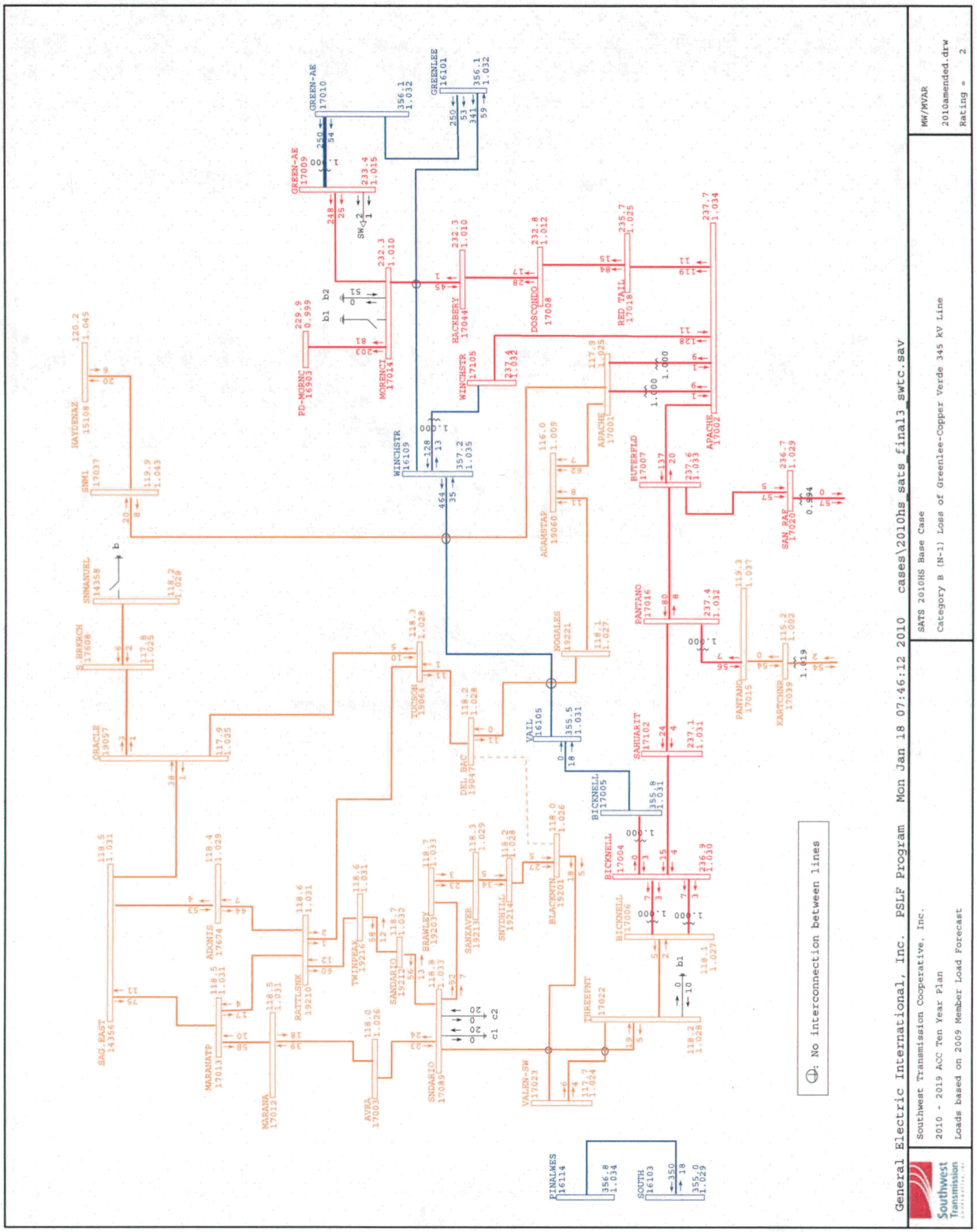
2010HS Southwest Transmission Cooperative Base System with Greenlee 345/230 kV Transformer out of service



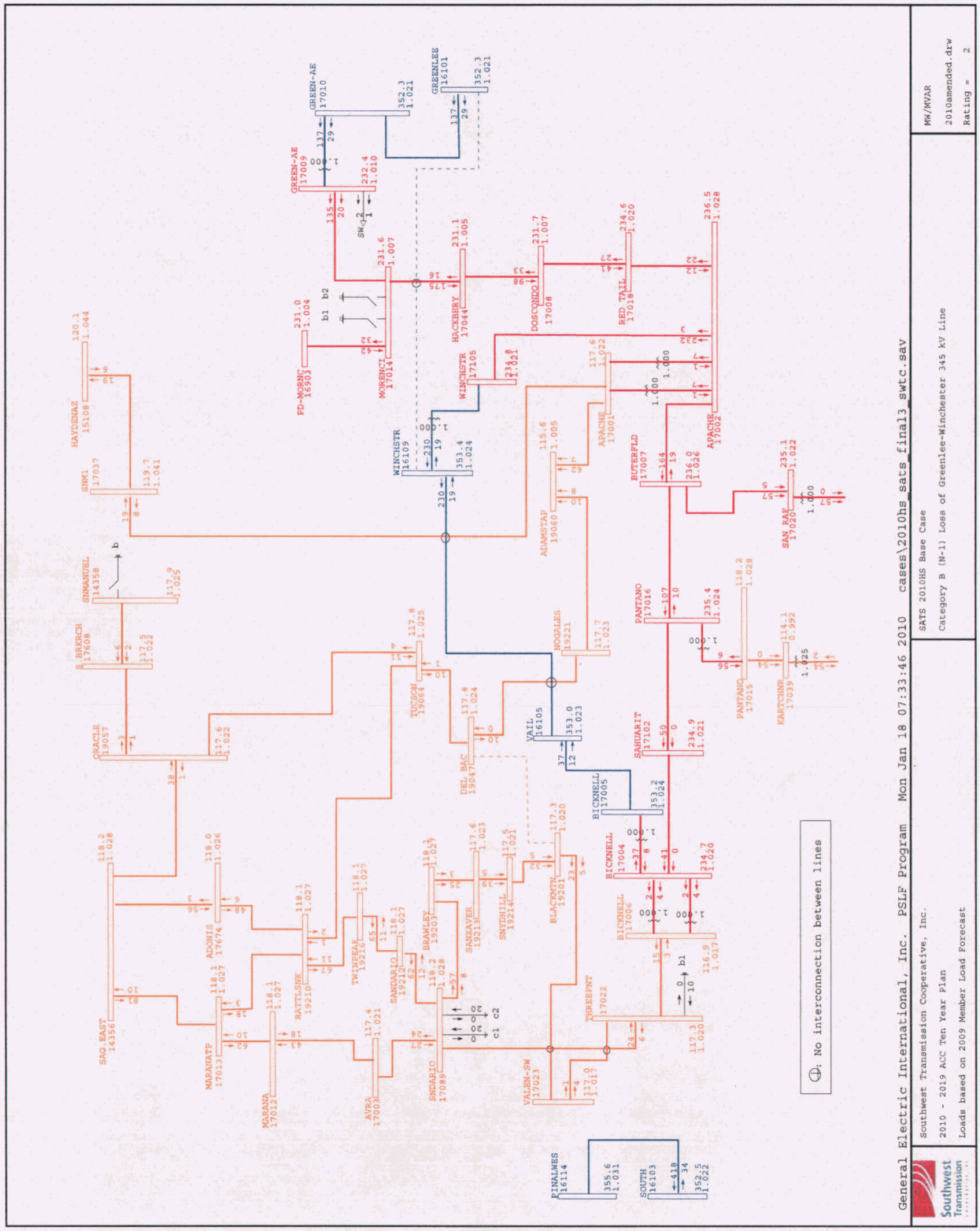
2010HS Southwest Transmission Cooperative Base System with Winchester 345/230 kV Transformer out of service



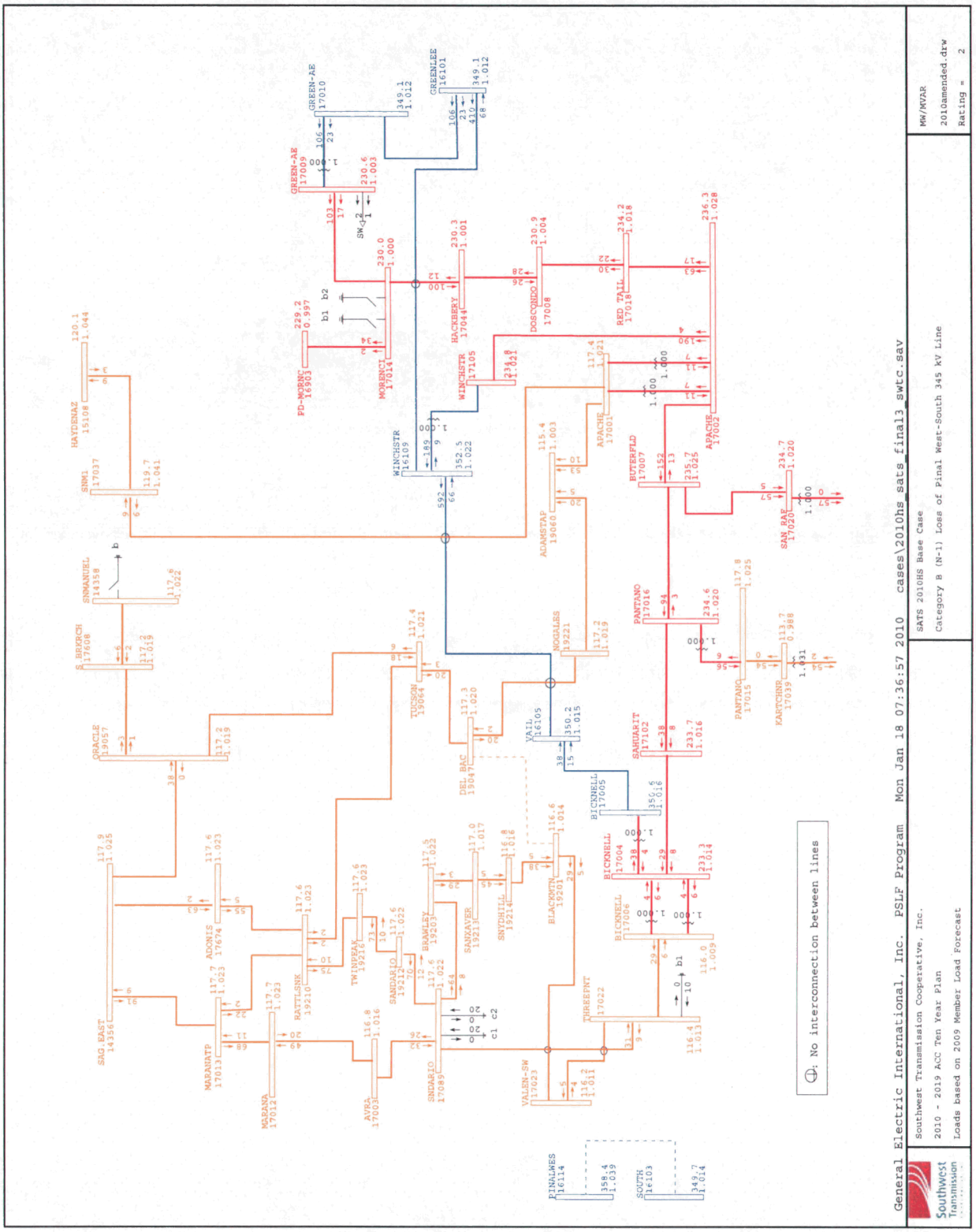
2010HS Southwest Transmission Cooperative Base System with Greenlee to Copper Verde 345 kV Line out of service



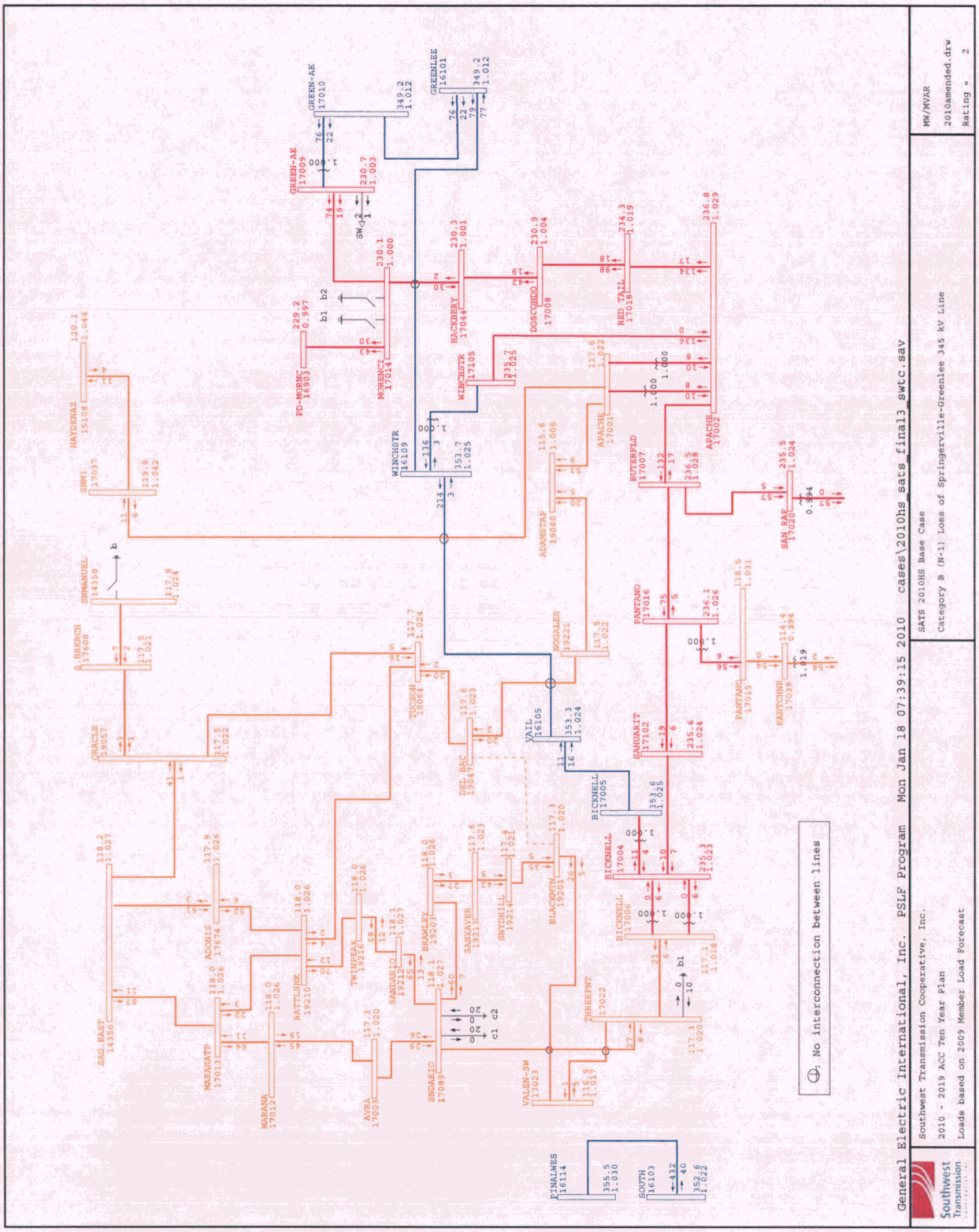
2010HS Southwest Transmission Cooperative Base System with Greenlee to Winchester 345 kV Line out of service



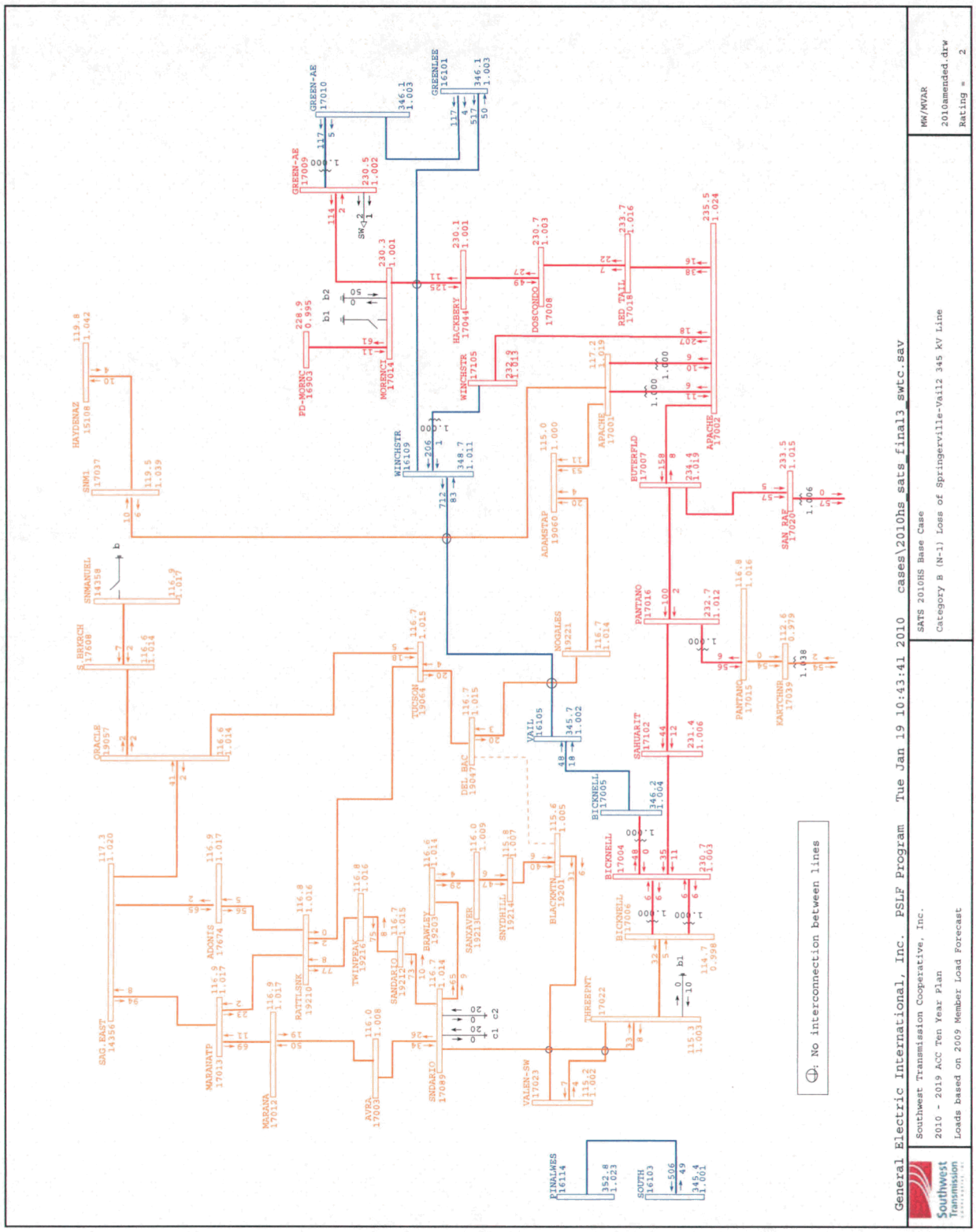
2010HS Southwest Transmission Cooperative Base System with Pinal West to South 345 kV Line out of service



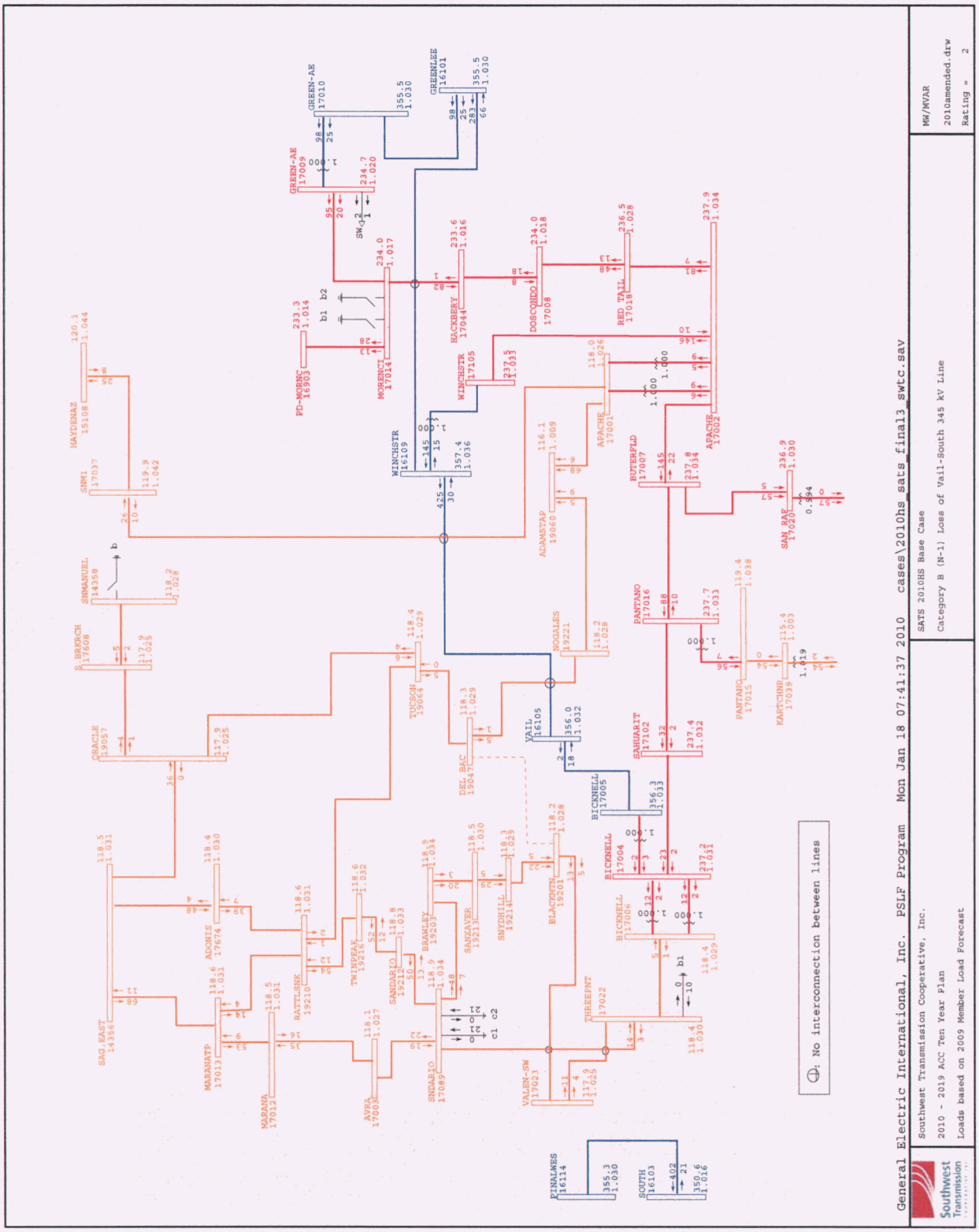
2010HS Southwest Transmission Cooperative Base System with Springerville to Greenlee 345 kV Line out of service



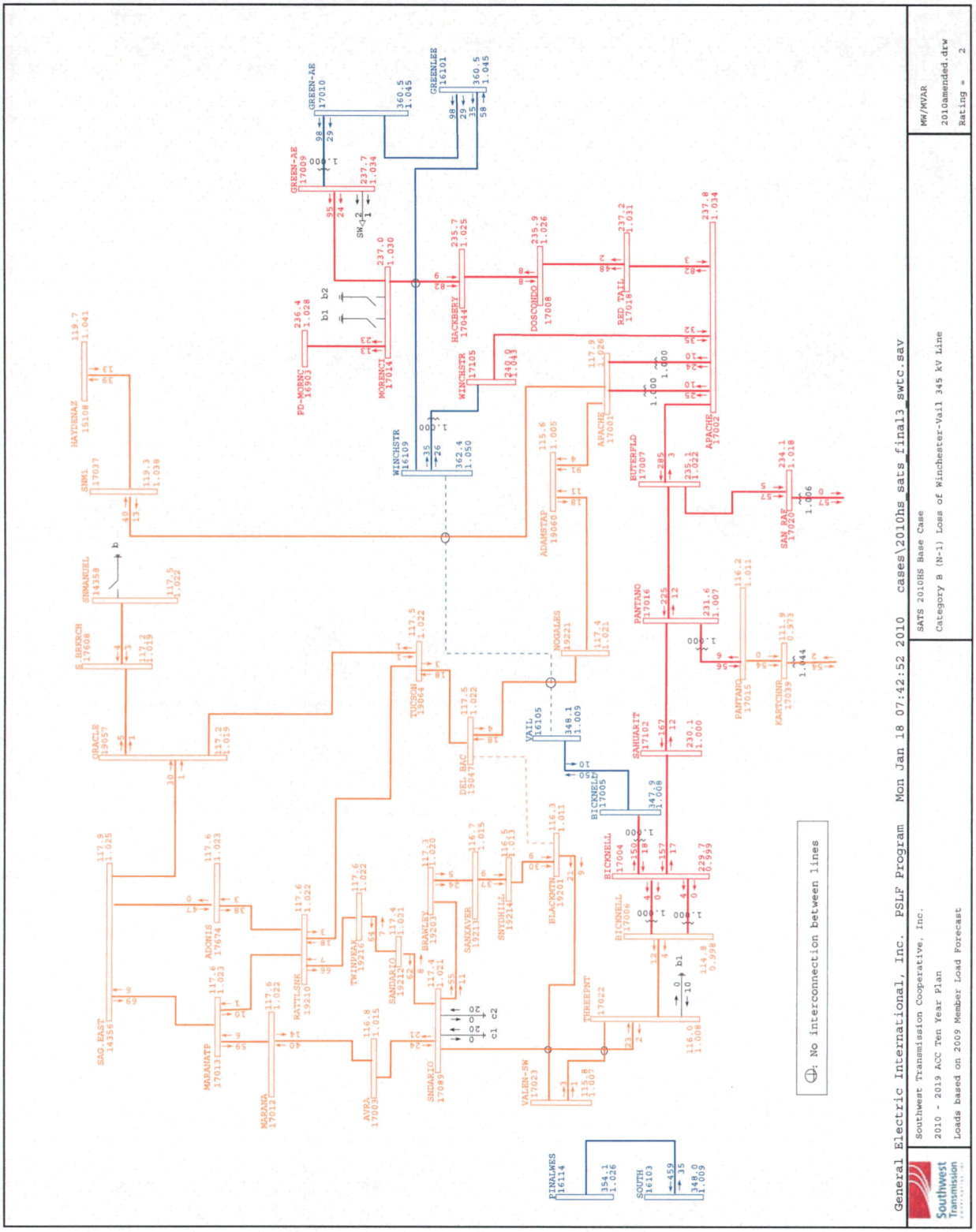
2010HS Southwest Transmission Cooperative Base System with Springerville to Vail2 345 kV Line out of service



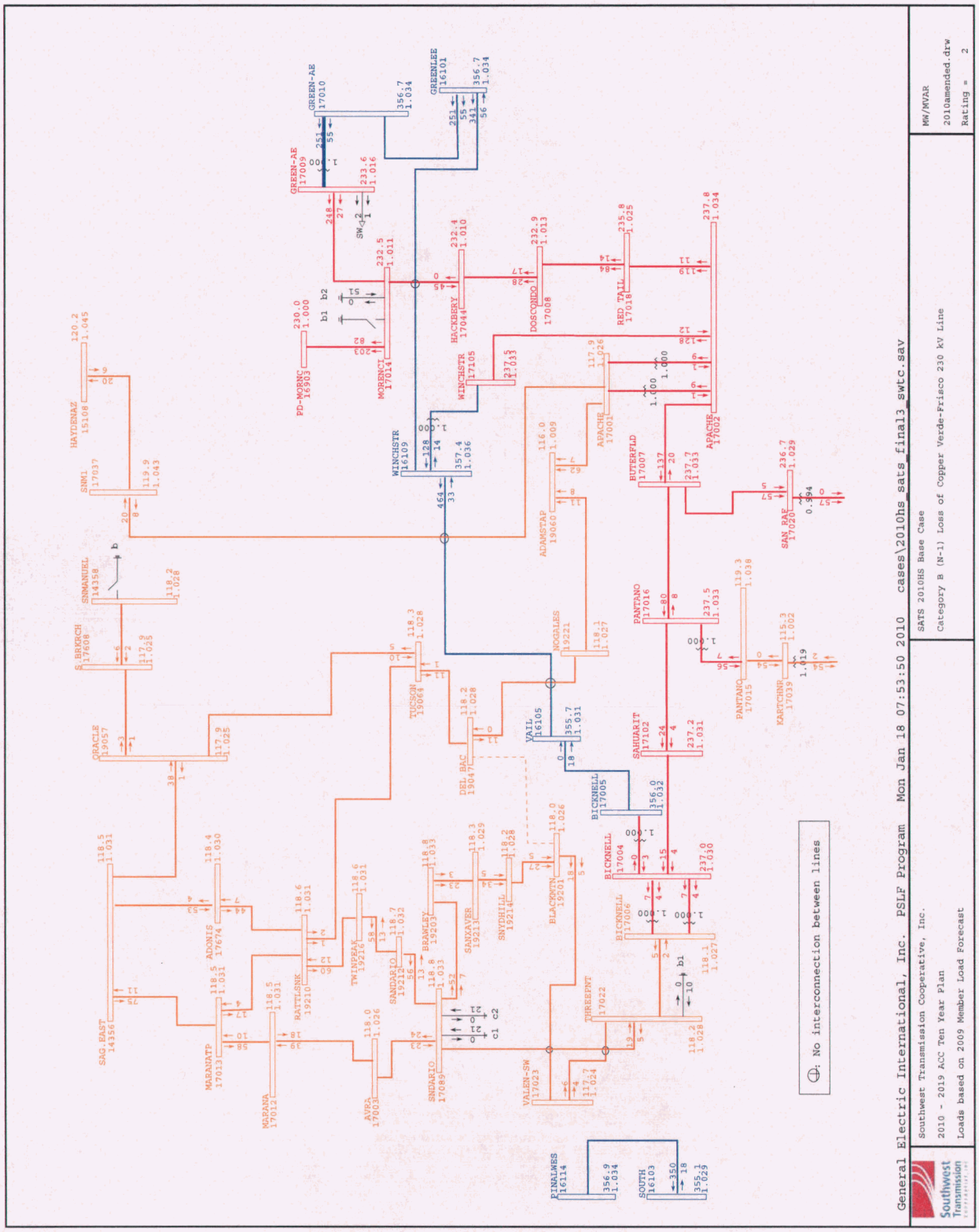
2010HS Southwest Transmission Cooperative Base System with Vail to South 345 kV Line out of service



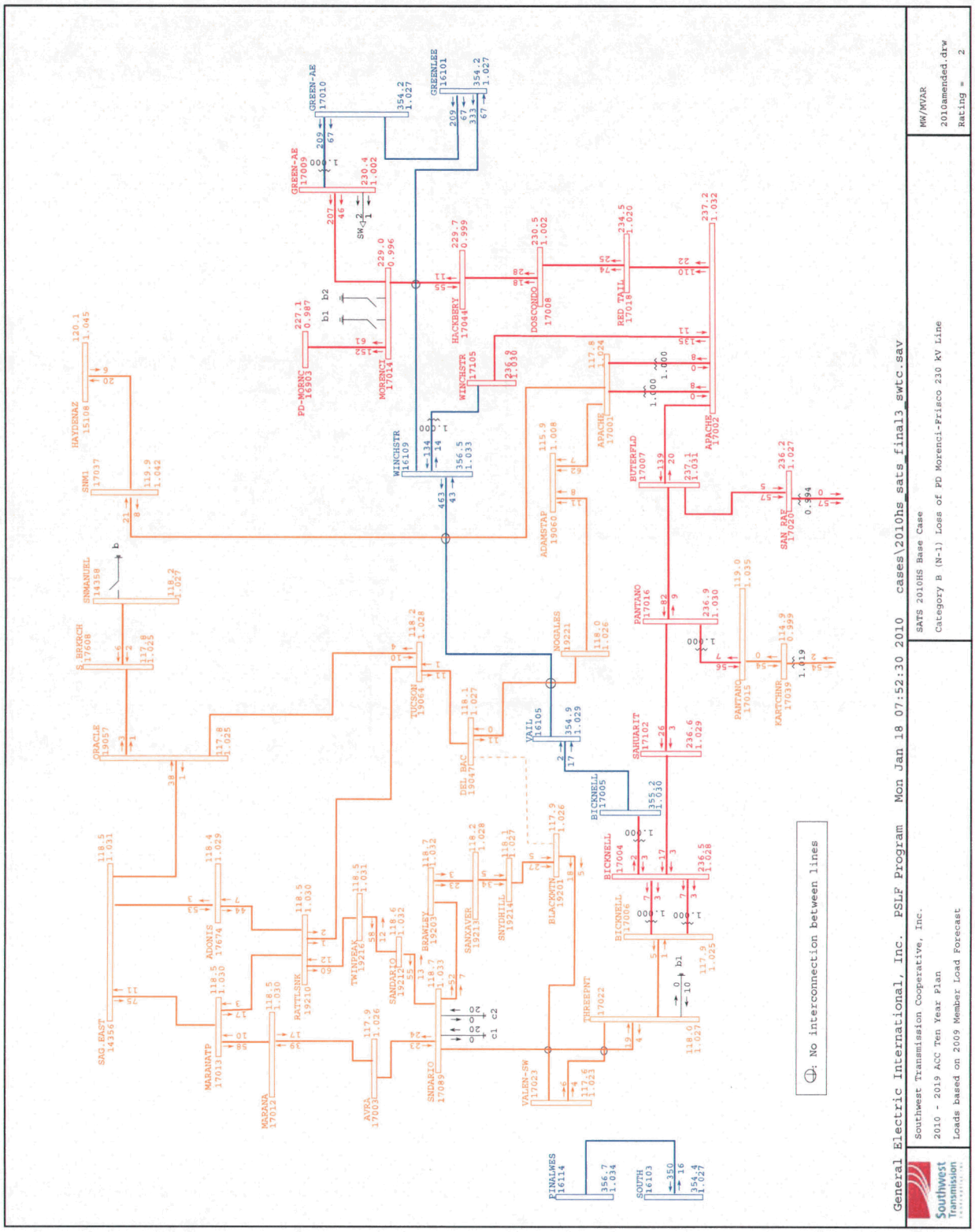
2010HS Southwest Transmission Cooperative Base System with Winchester to Vail 345 kV Line out of service



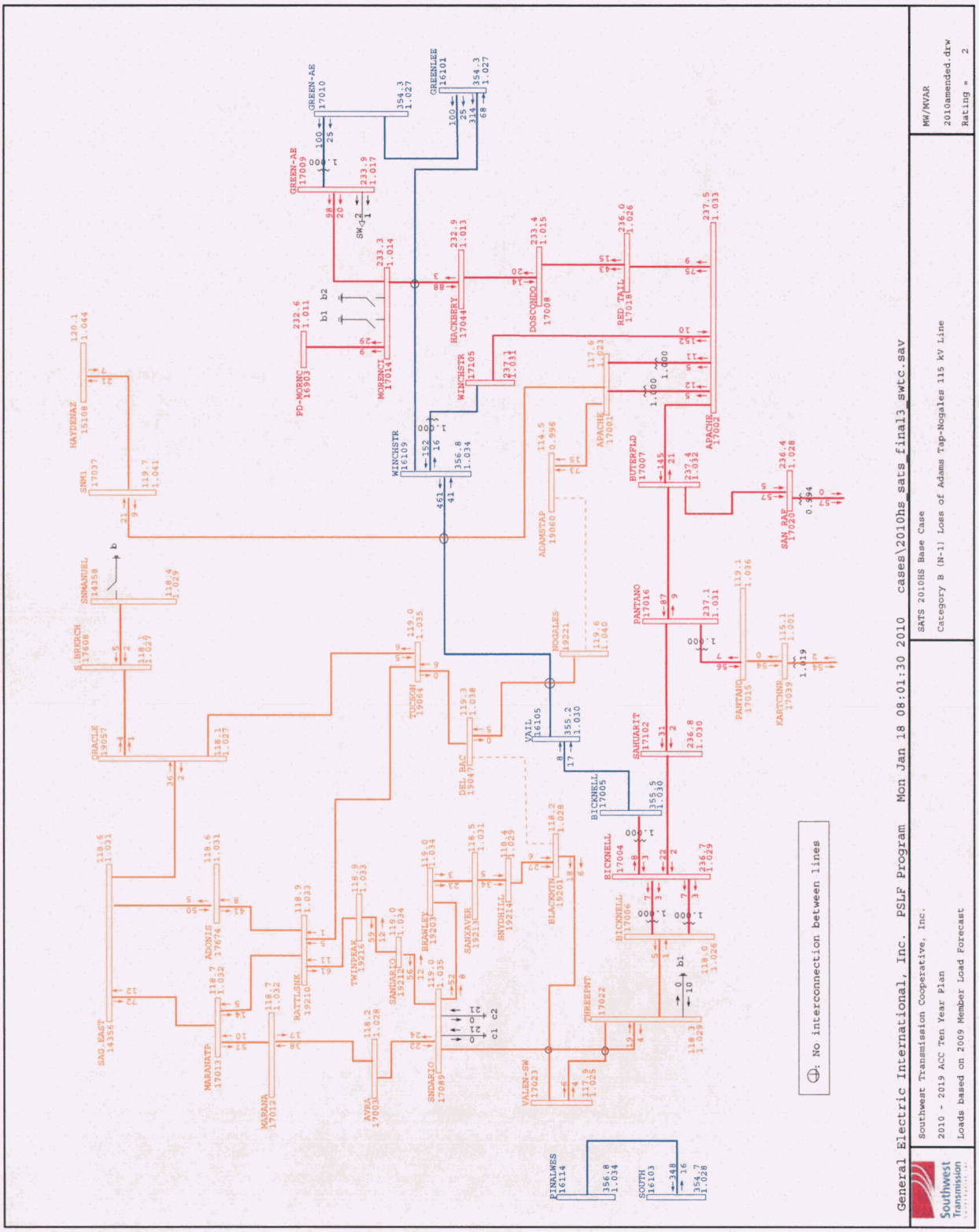
2010HS Southwest Transmission Cooperative Base System with Copper Verde to Frisco 230 kV Line out of service



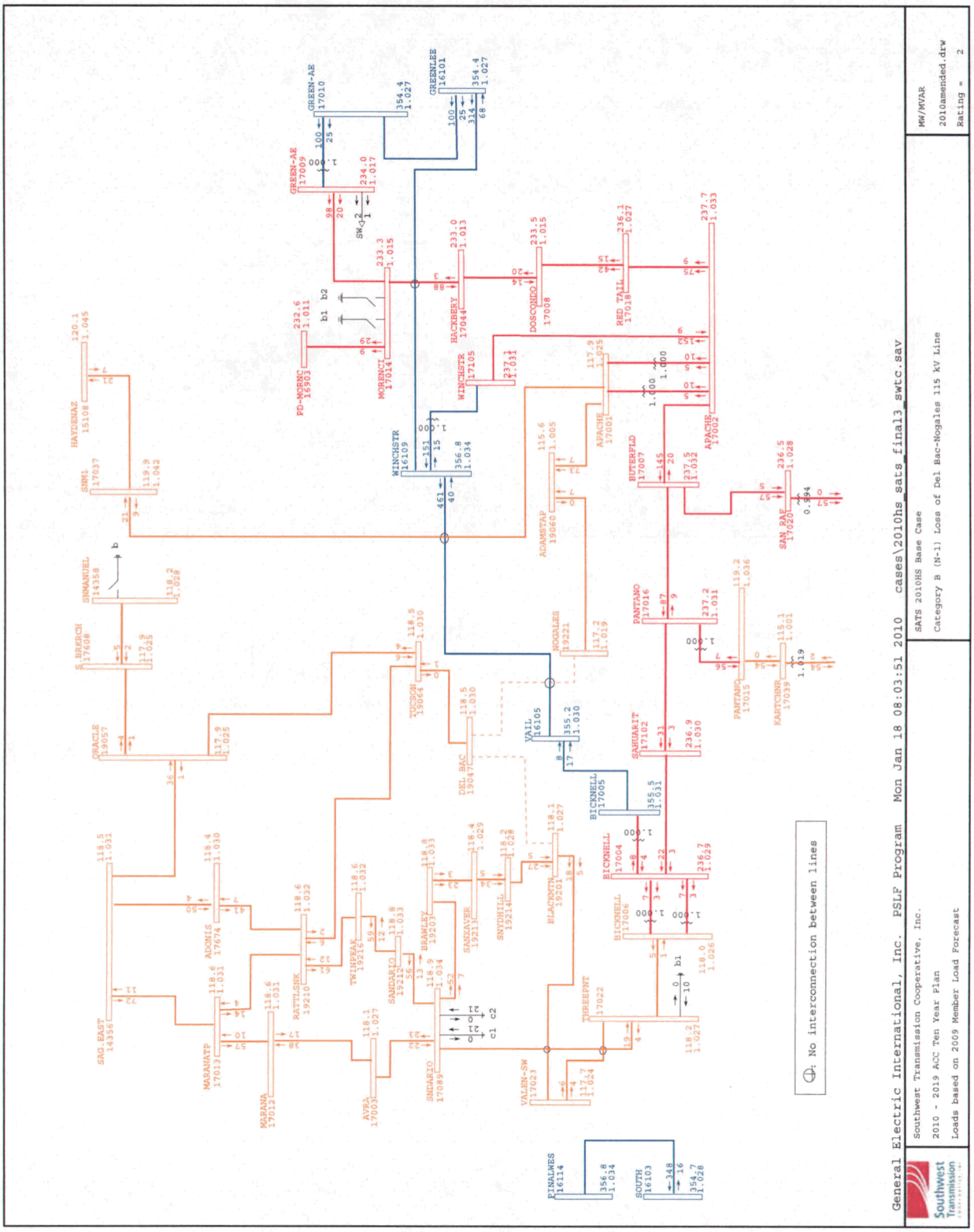
2010HS Southwest Transmission Cooperative Base System with PD Morenci to Frisco 230 kV Line out of service



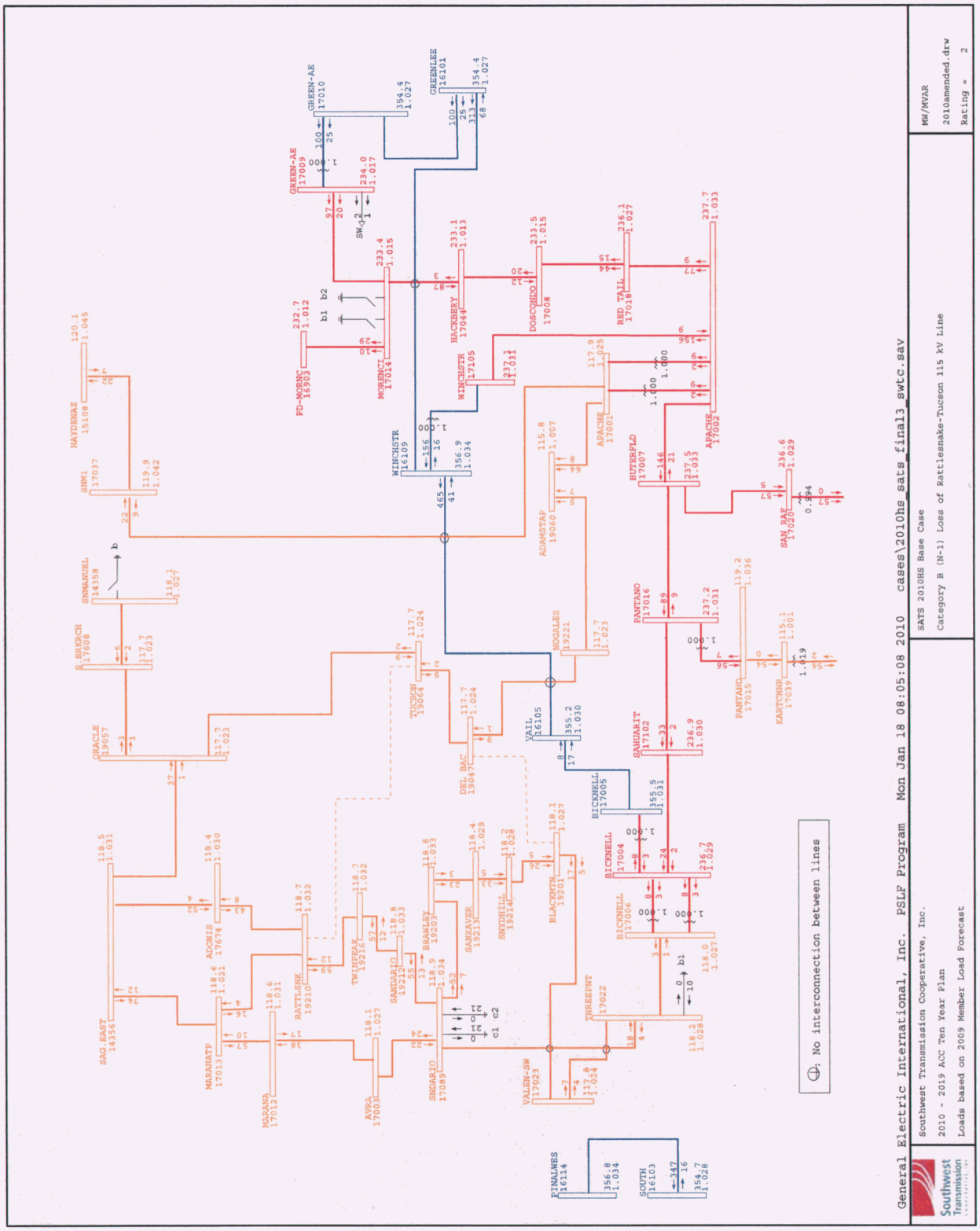
2010HS Southwest Transmission Cooperative Base System with Adams Tap to Nogales 115 kV Line out of service



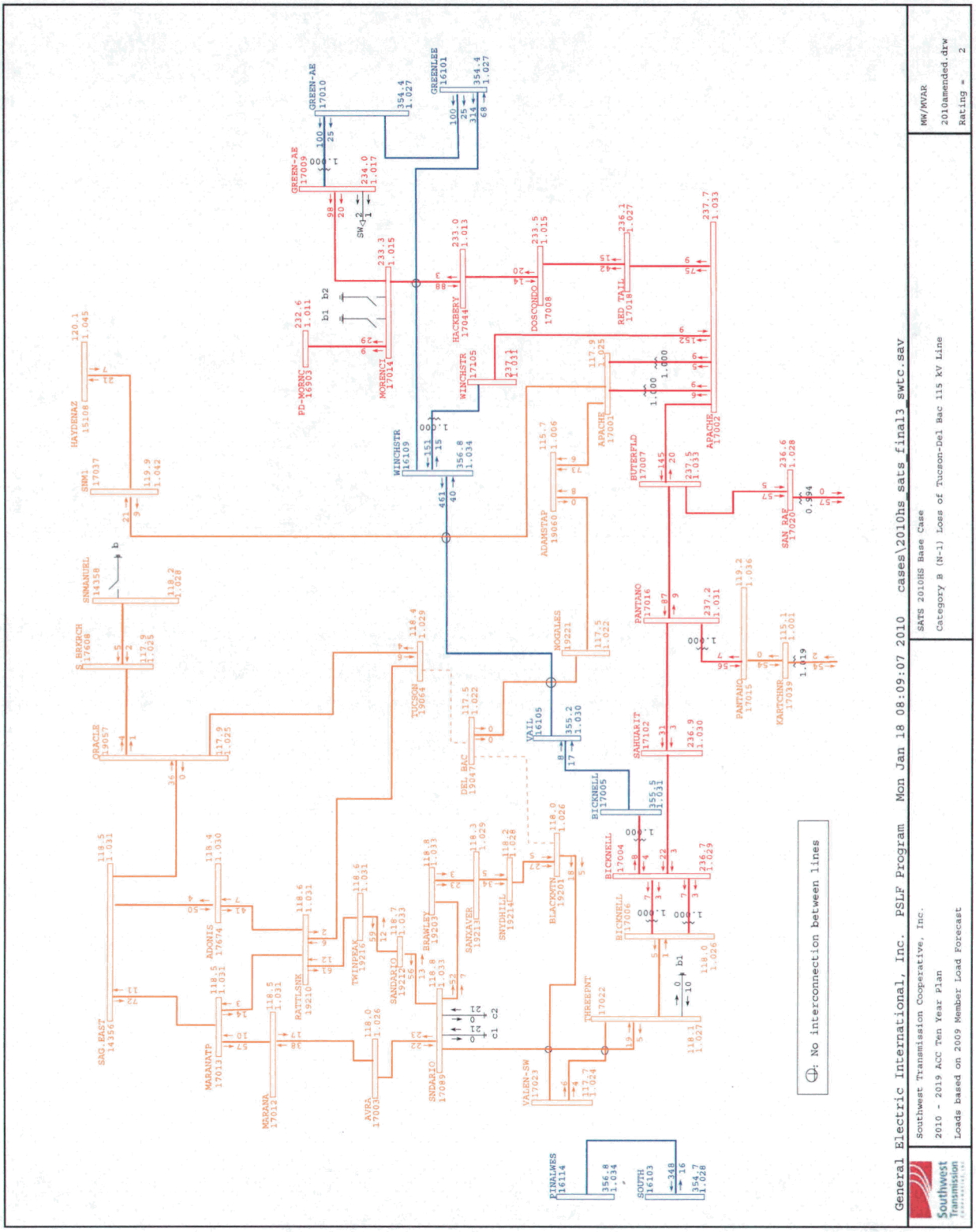
2010HS Southwest Transmission Cooperative Base System with Del Bac to Nogales 115 kV Line out of service



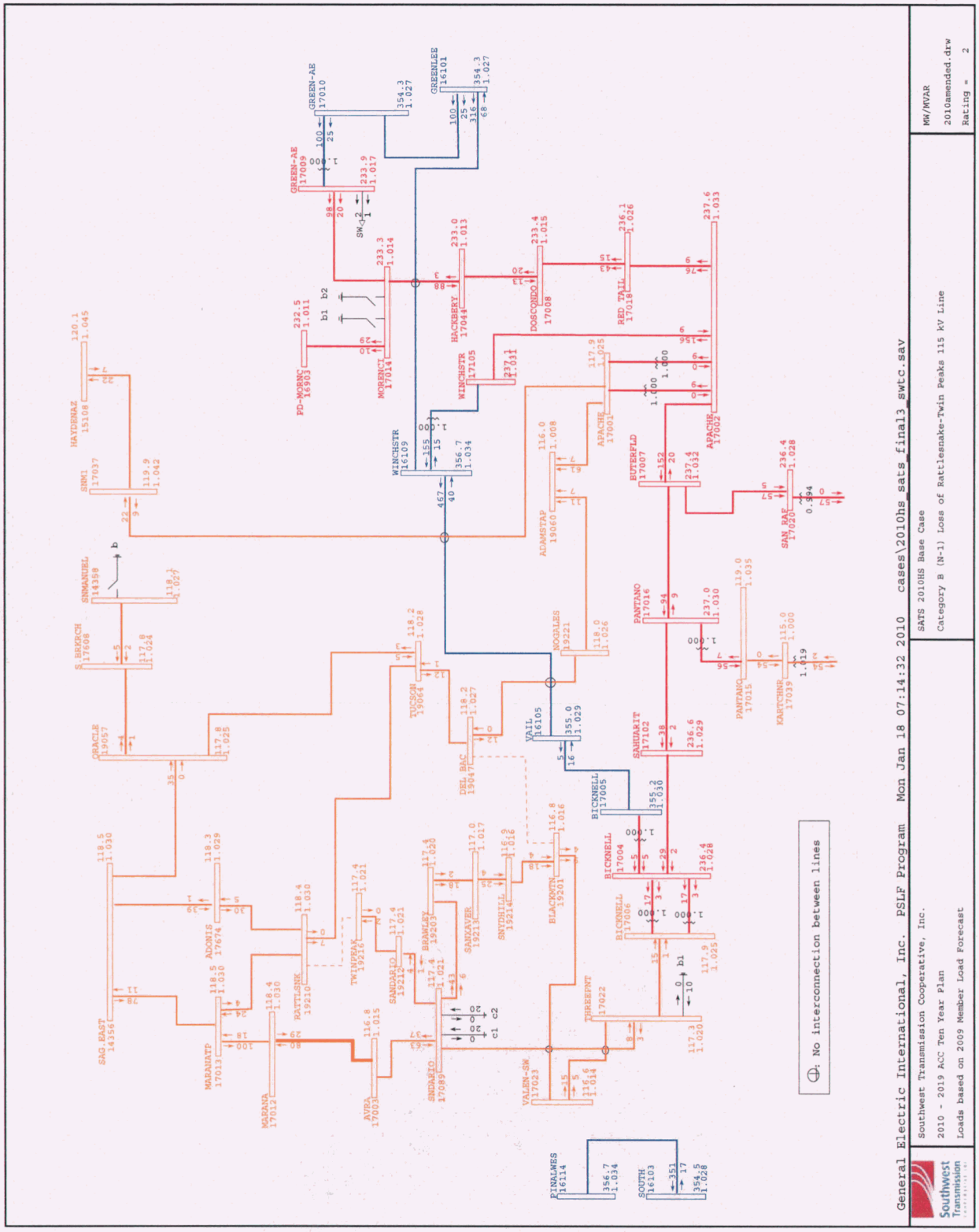
2010HS Southwest Transmission Cooperative Base System with Rattlesnake to Tucson 115 kV Line out of service



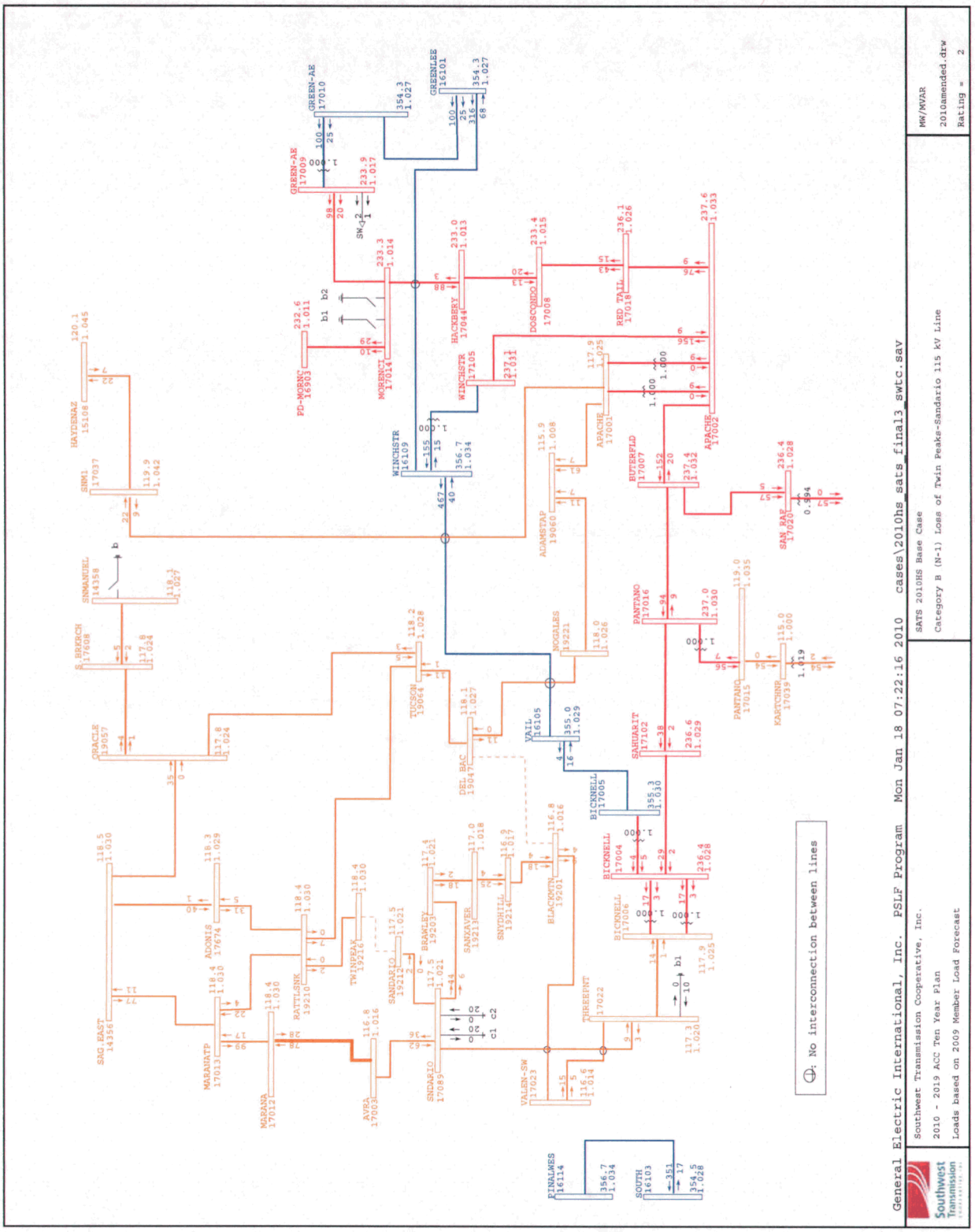
2009HS Southwest Transmission Cooperative Base System with Tucson to Del Bac 115 kV Line out of service



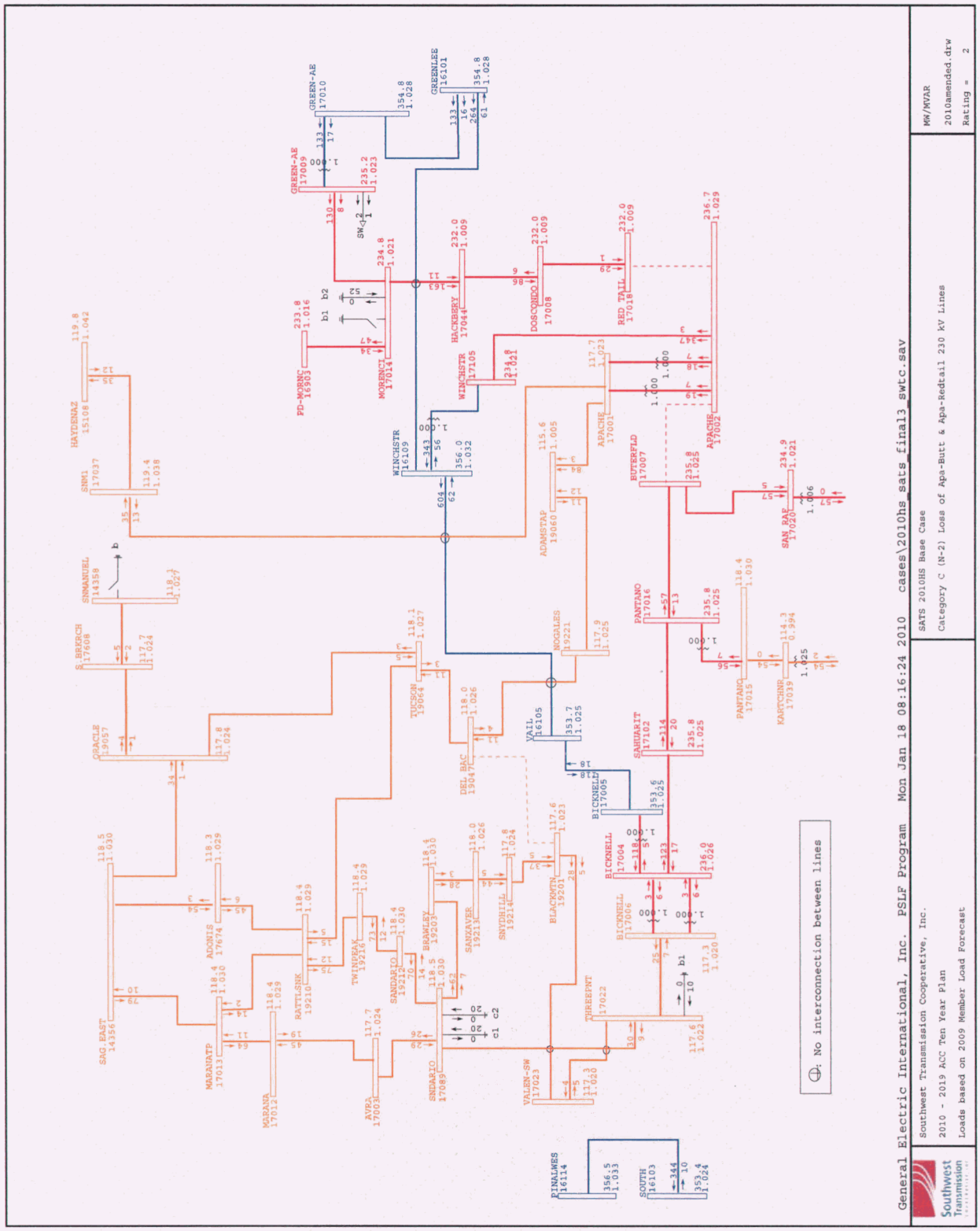
2010HS Southwest Transmission Cooperative Base System with Rattlesnake to Twin Peaks 115 kV Line out of service



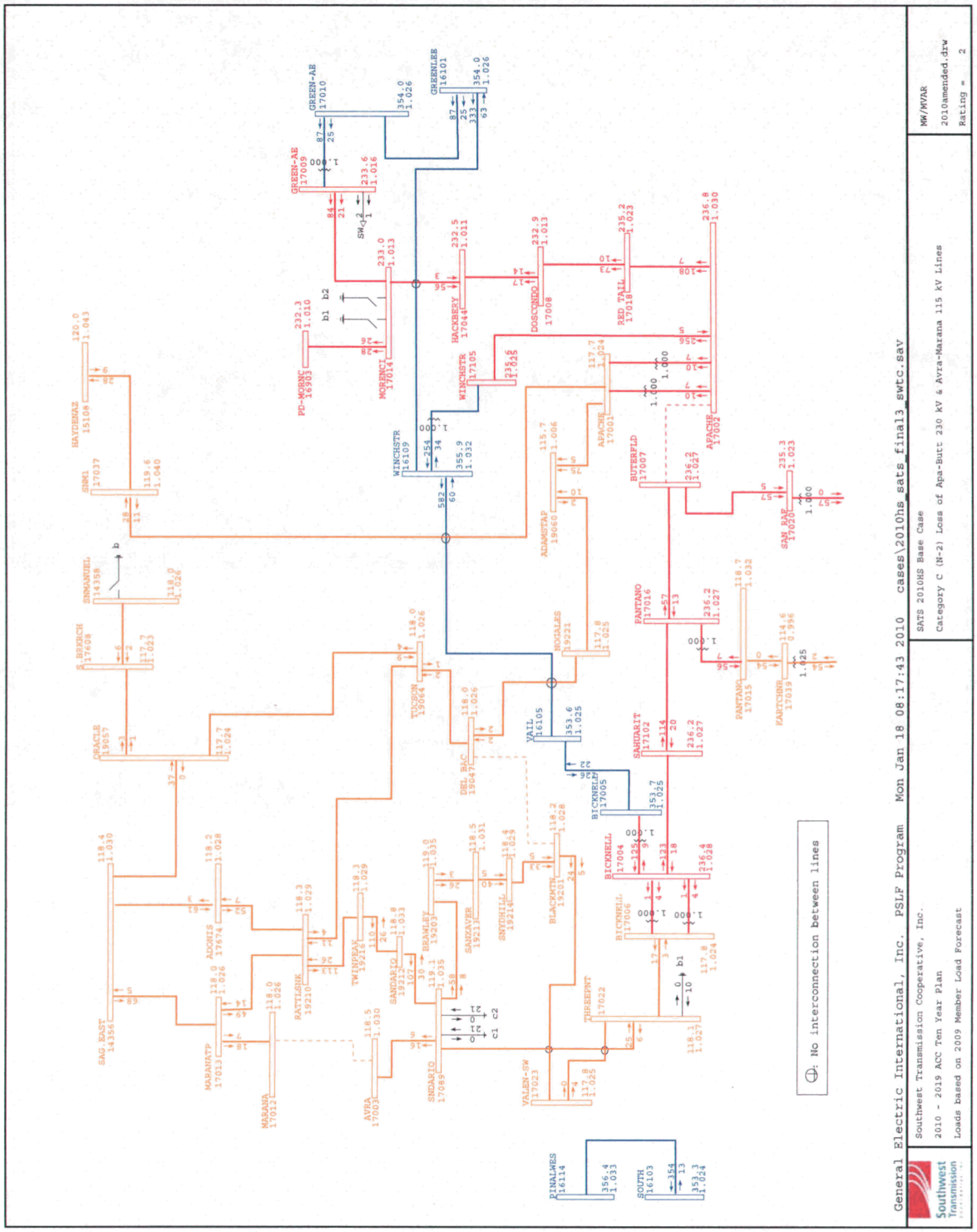
2010HS Southwest Transmission Cooperative Base System with Twin Peaks to Sandario 115 kV Line out of service



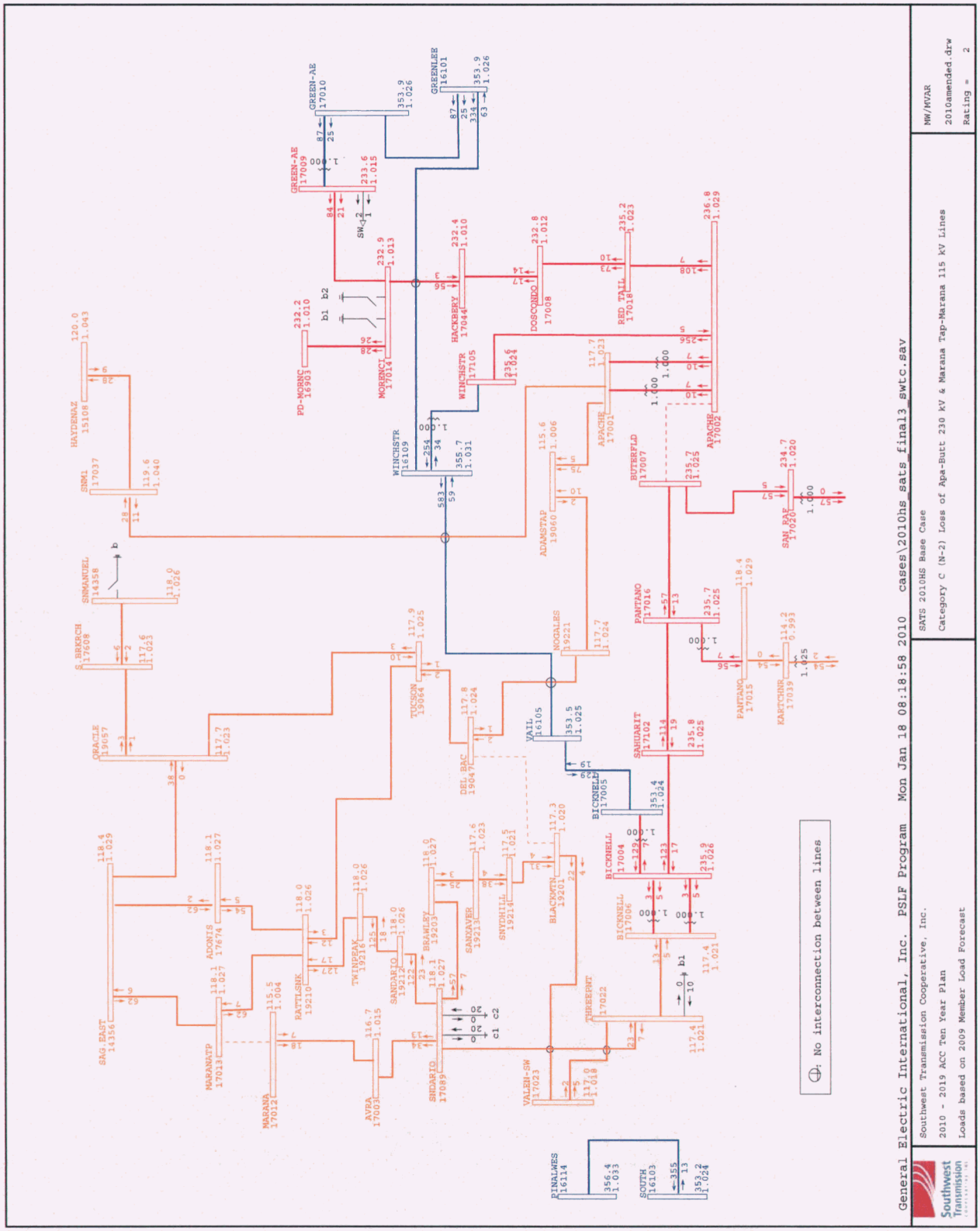
2010HS Southwest Transmission Cooperative Base System with Apache to Butterfield & Apache to Redtail 230 kV Lines out of service



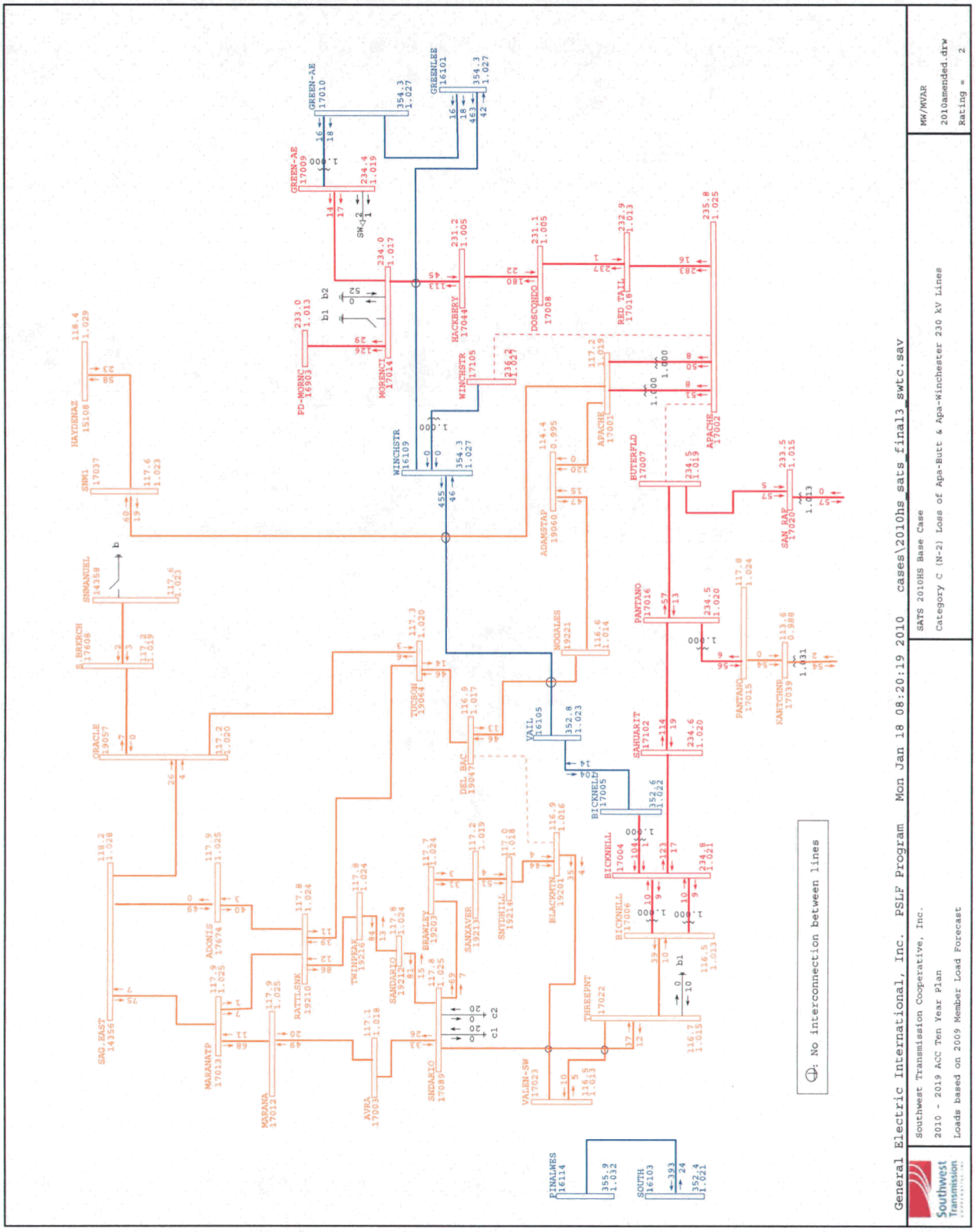
2010HS Southwest Transmission Cooperative Base System with Apache to Butterfield 230 kV & Avra to Marana 115 kV Lines out of service



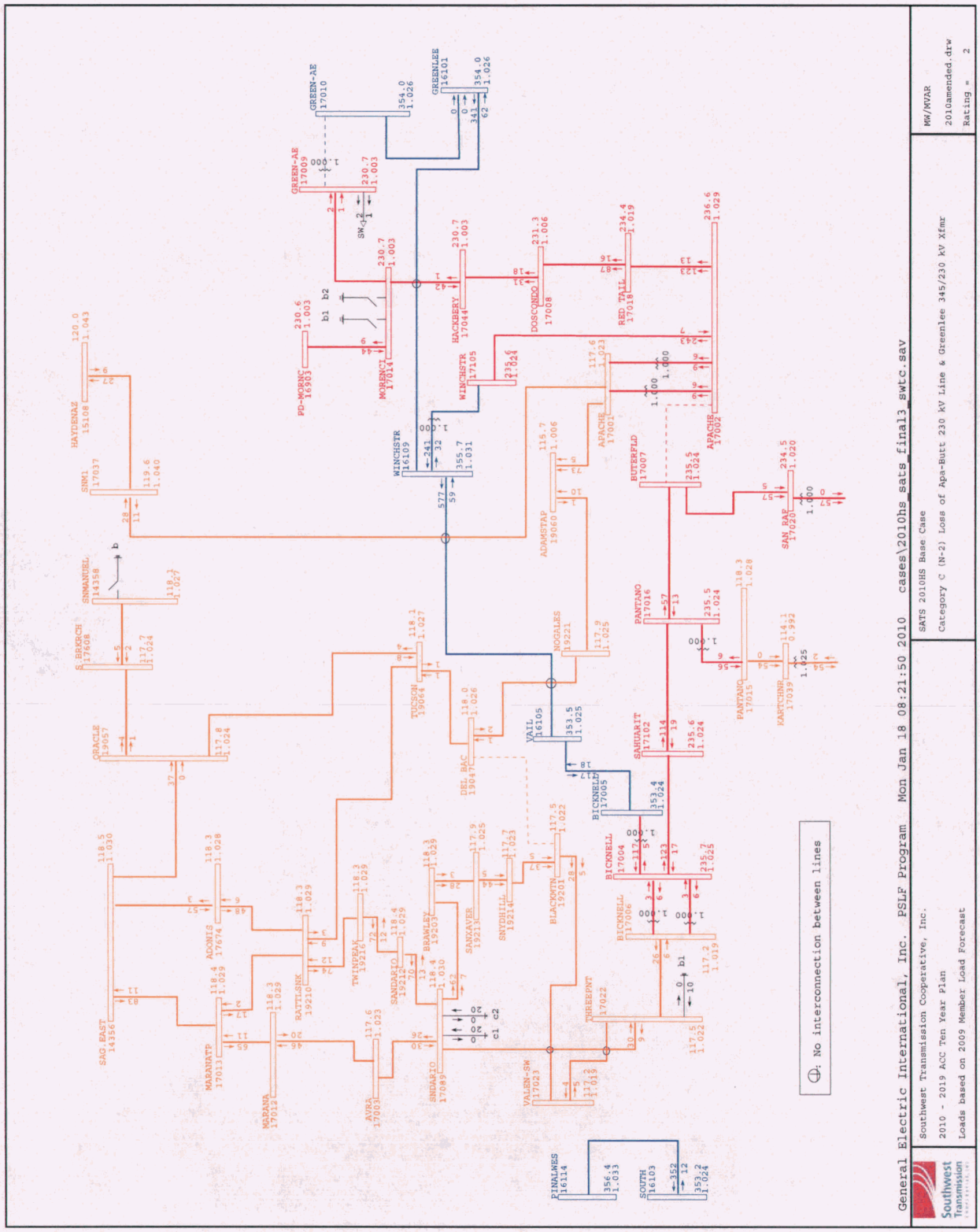
2010HS Southwest Transmission Cooperative Base System with Apache to Butterfield 230 kV & Marana Tap to Marana 115 kV Lines out of service



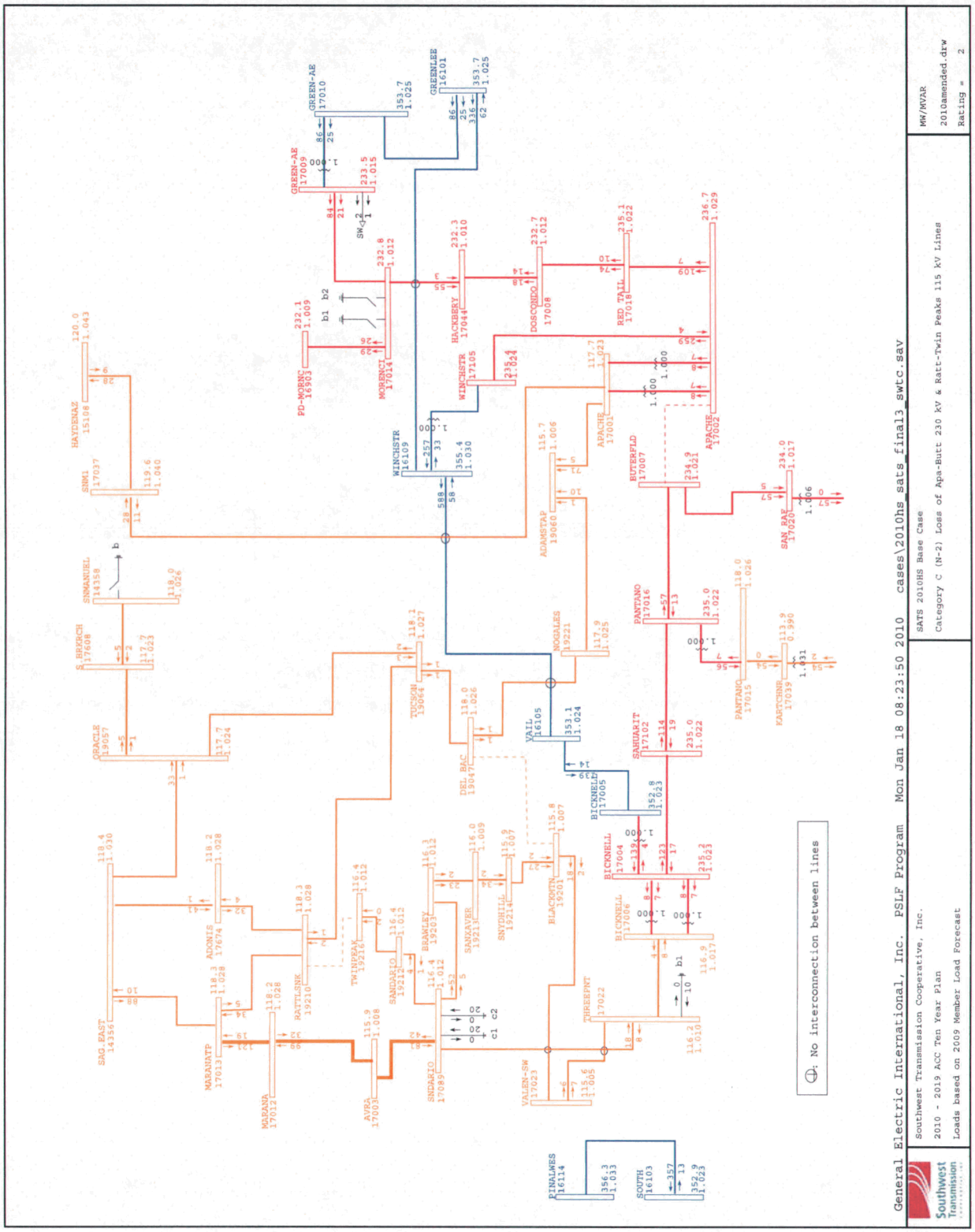
2010HS Southwest Transmission Cooperative Base System with Apache to Butterfield & Apache to Winchester 230 kV Lines out of service



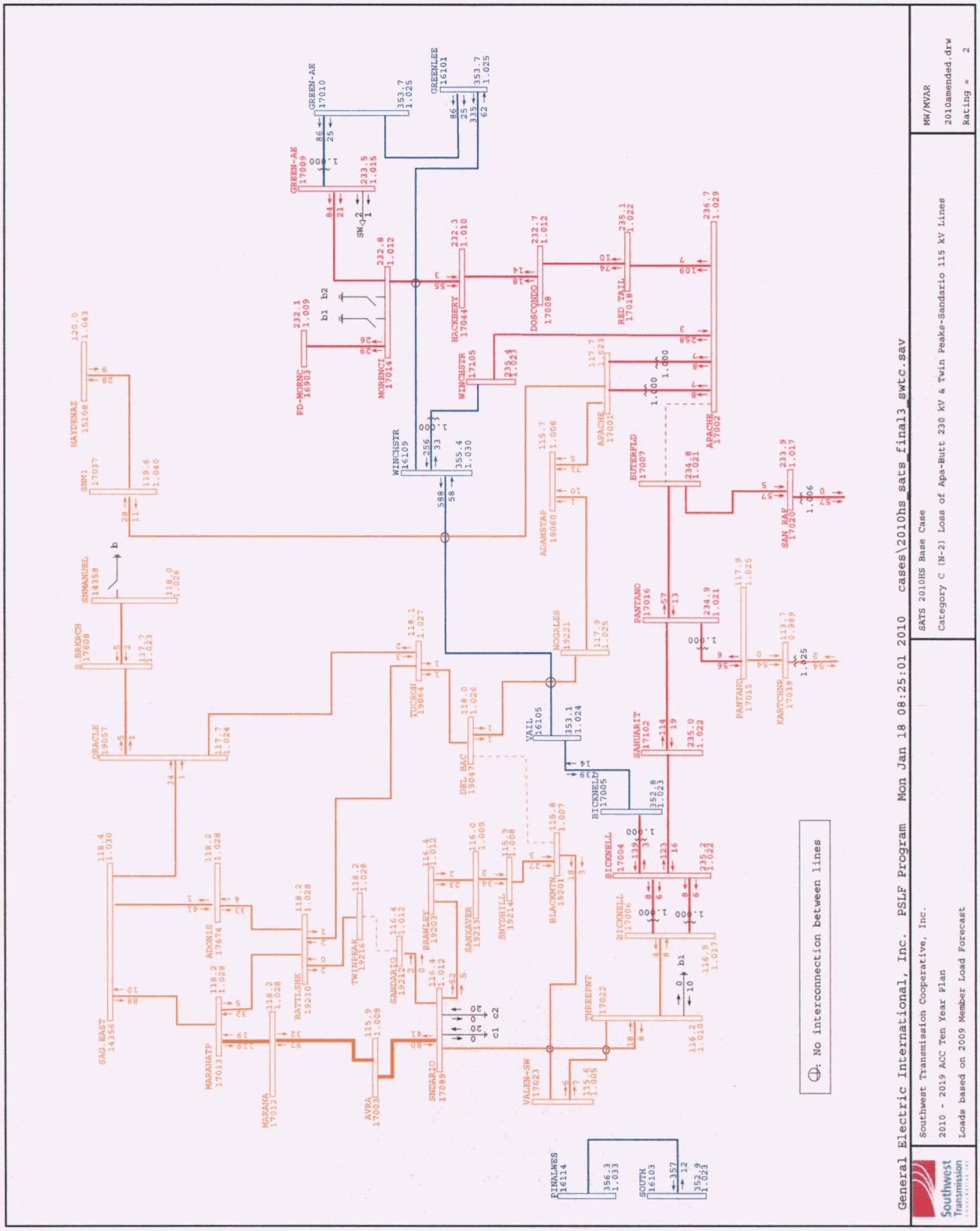
2010HS Southwest Transmission Cooperative Base System with Apache to Butterfield 230 kV Line and Greenlee 345/230 kV Transformer out of service



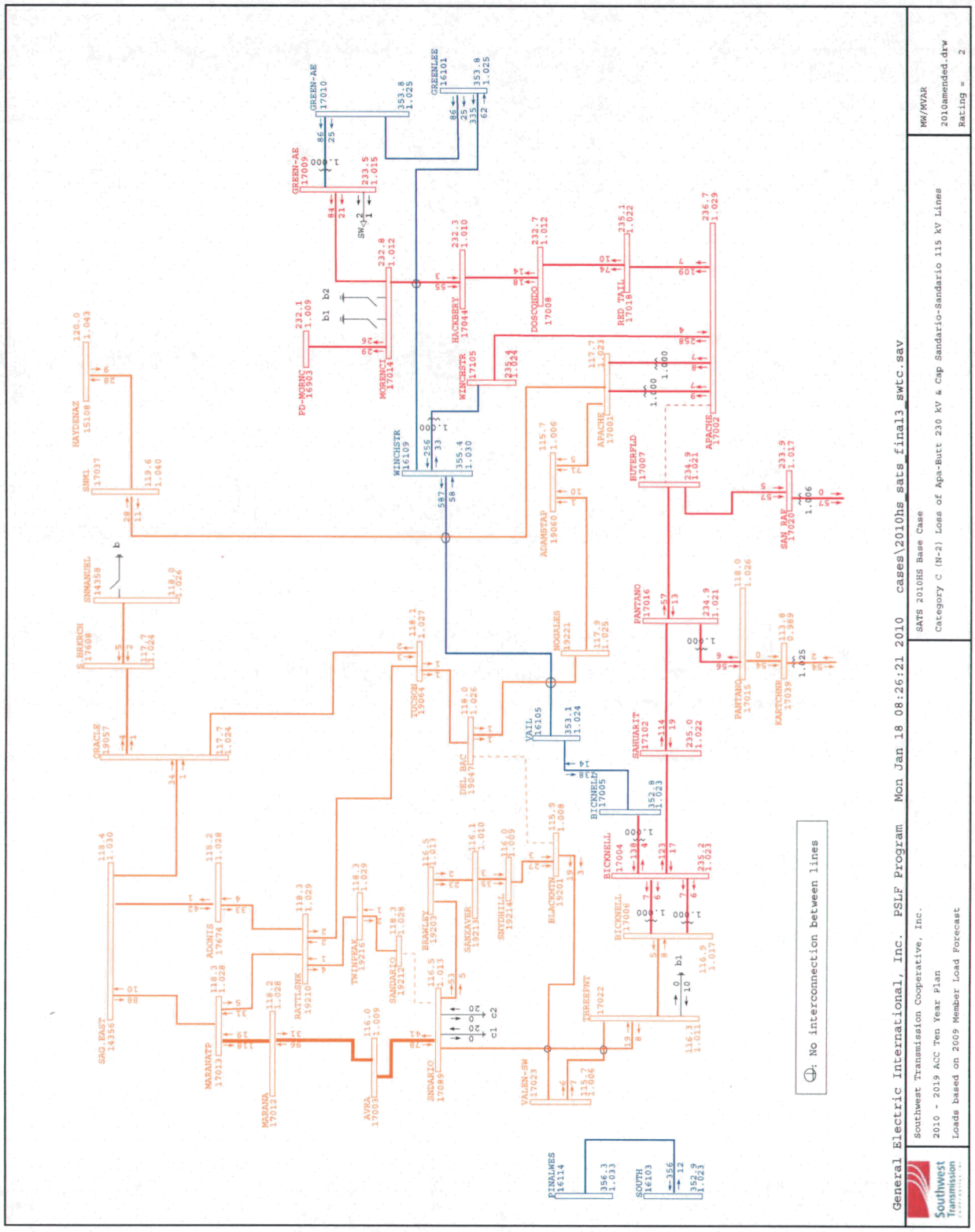
2010HS Southwest Transmission Cooperative Base System with Apache to Butterfield 230 kV & Rattlesnake to Twin Peaks 115 kV Lines out of service



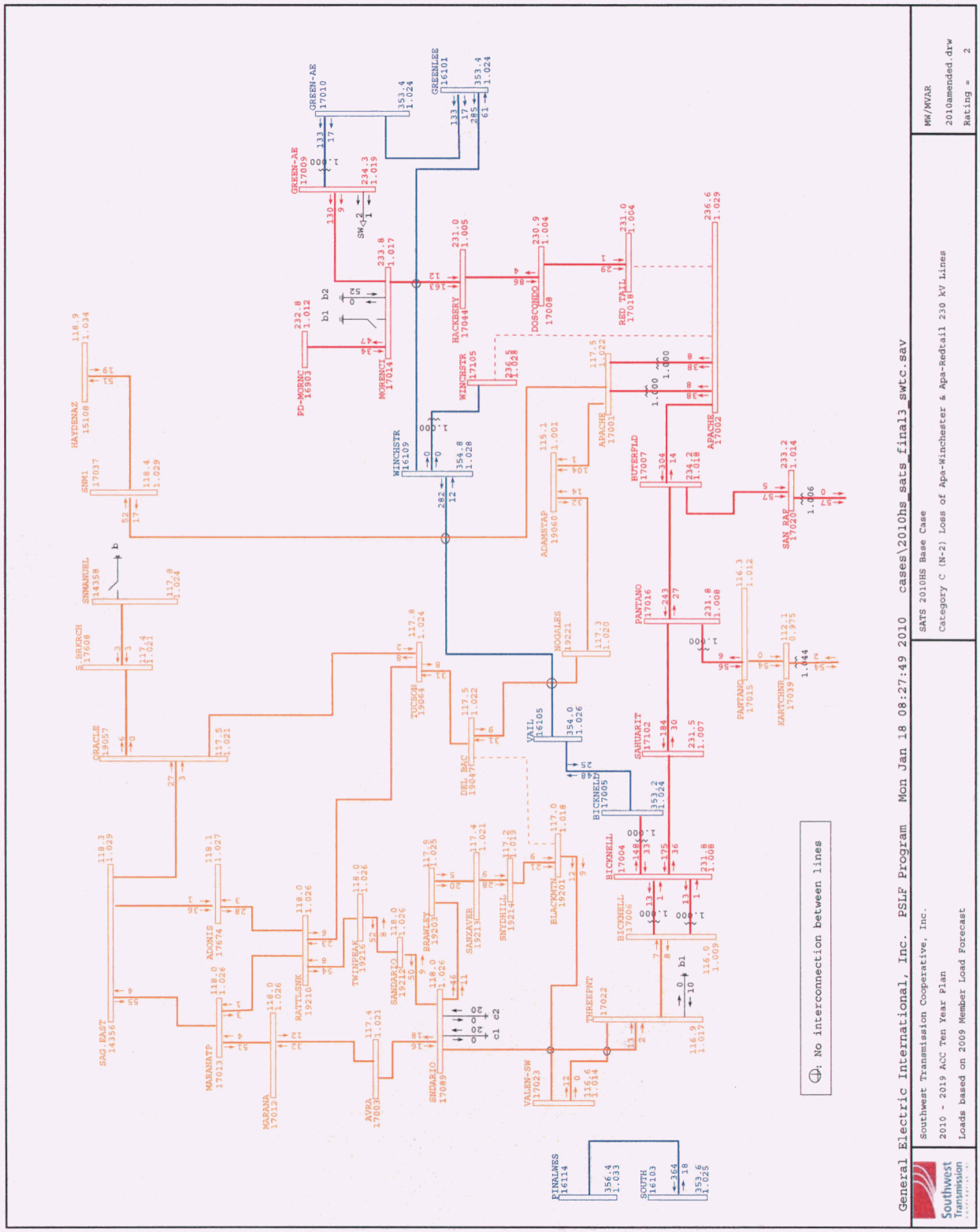
2010HS Southwest Transmission Cooperative Base System with Apache to Butterfield 230 kV & Twin Peaks to Sandario 115 kV Lines out of service



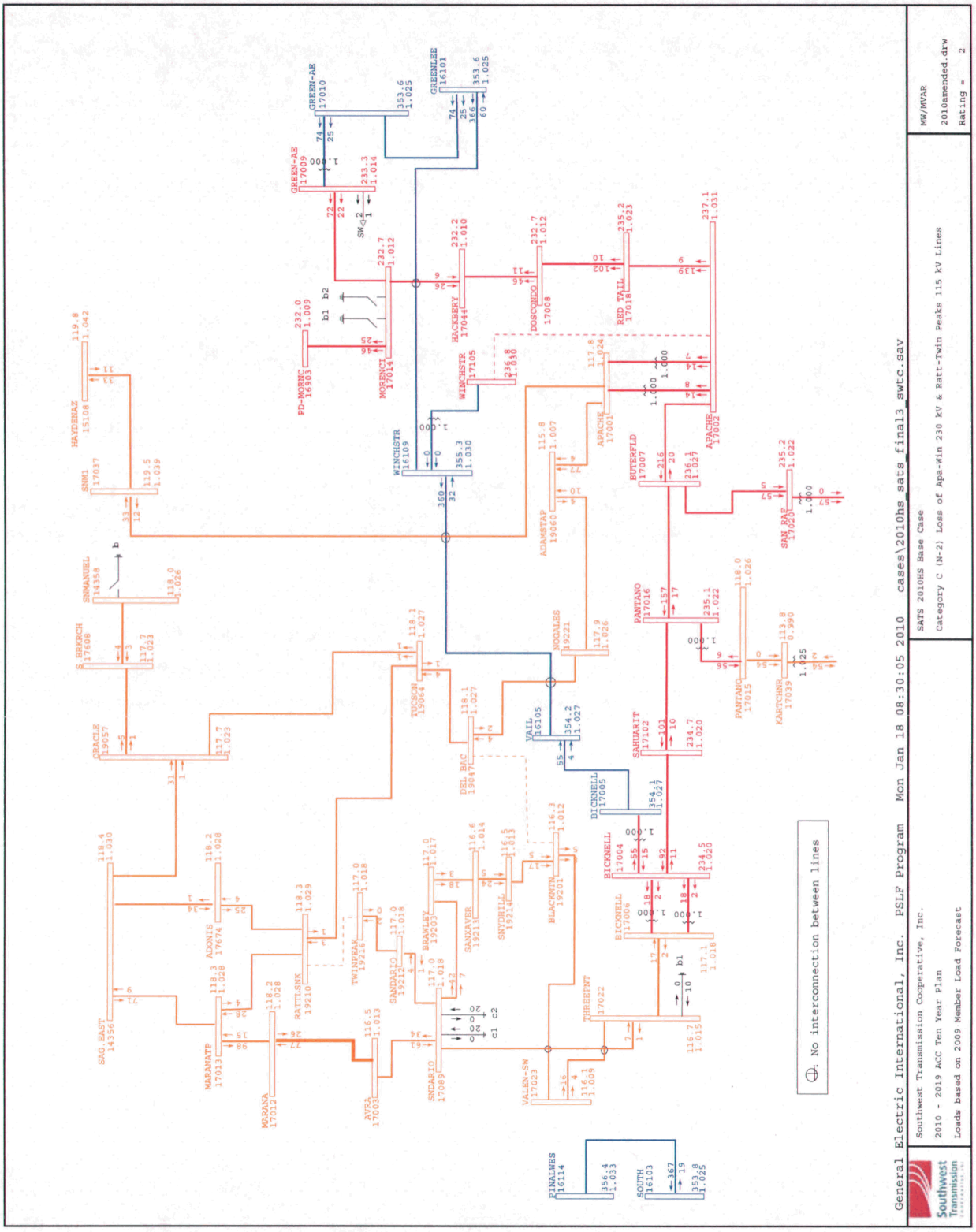
2010HS Southwest Transmission Cooperative Base System with Apache to Butterfield 230 kV & Cap Sandario to Sandario 115 kV Lines out of service



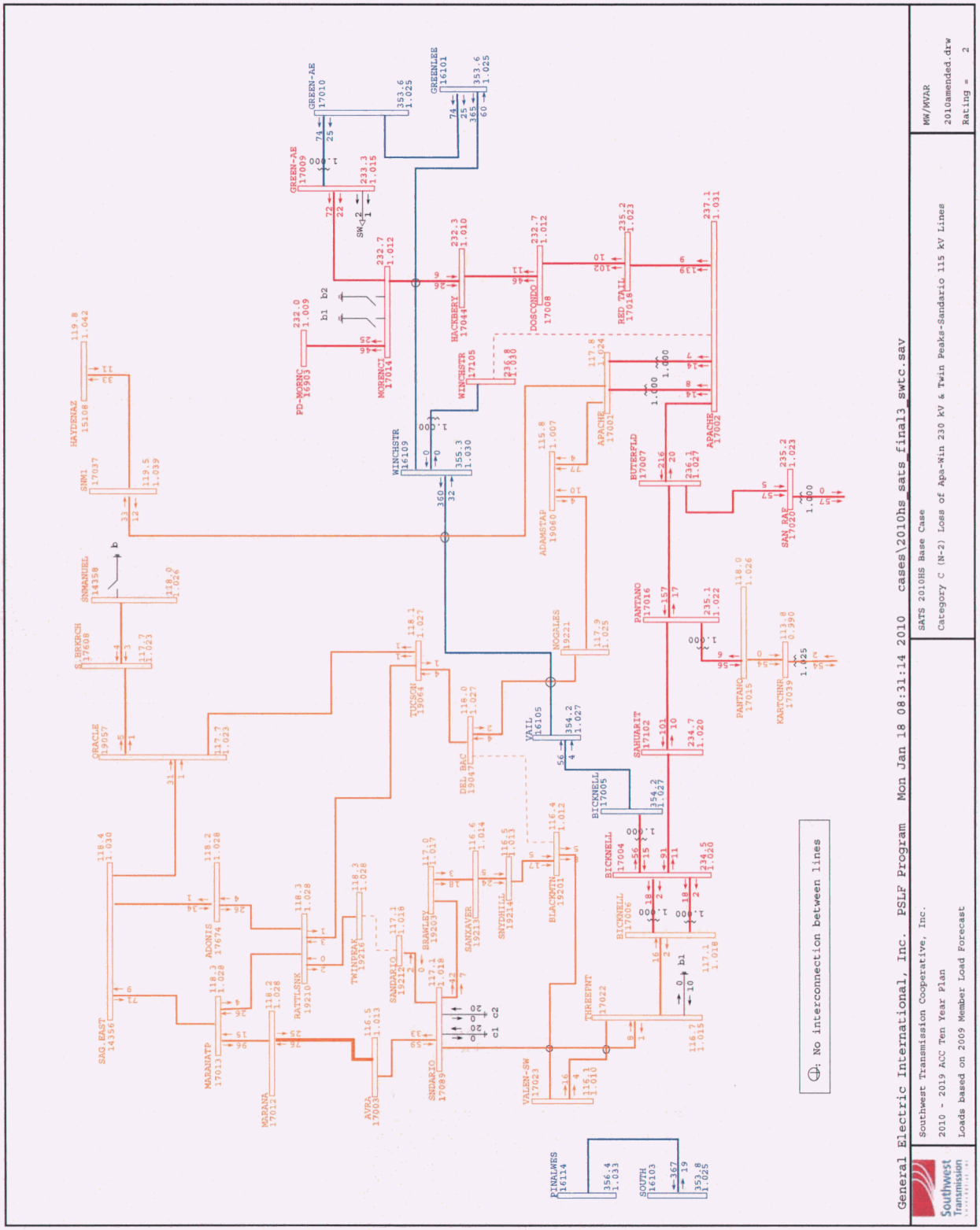
2010HS Southwest Transmission Cooperative Base System with Apache to Winchester & Apache to Redtail 230 kV Lines out of service



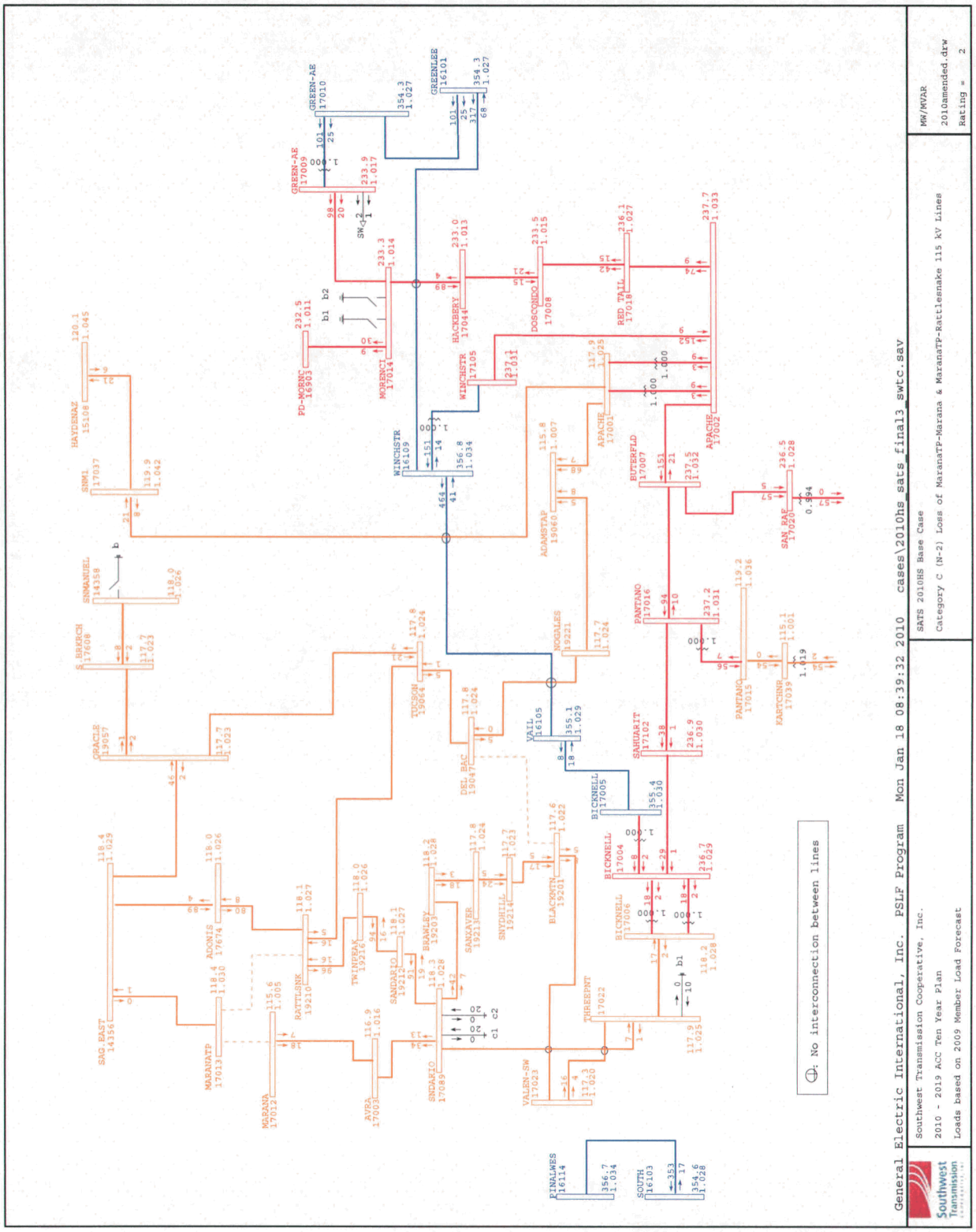
2010HS Southwest Transmission Cooperative Base System with Apache to Winchester 230 kV & Rattlesnake to Twin Peaks 115 kV Lines out of service



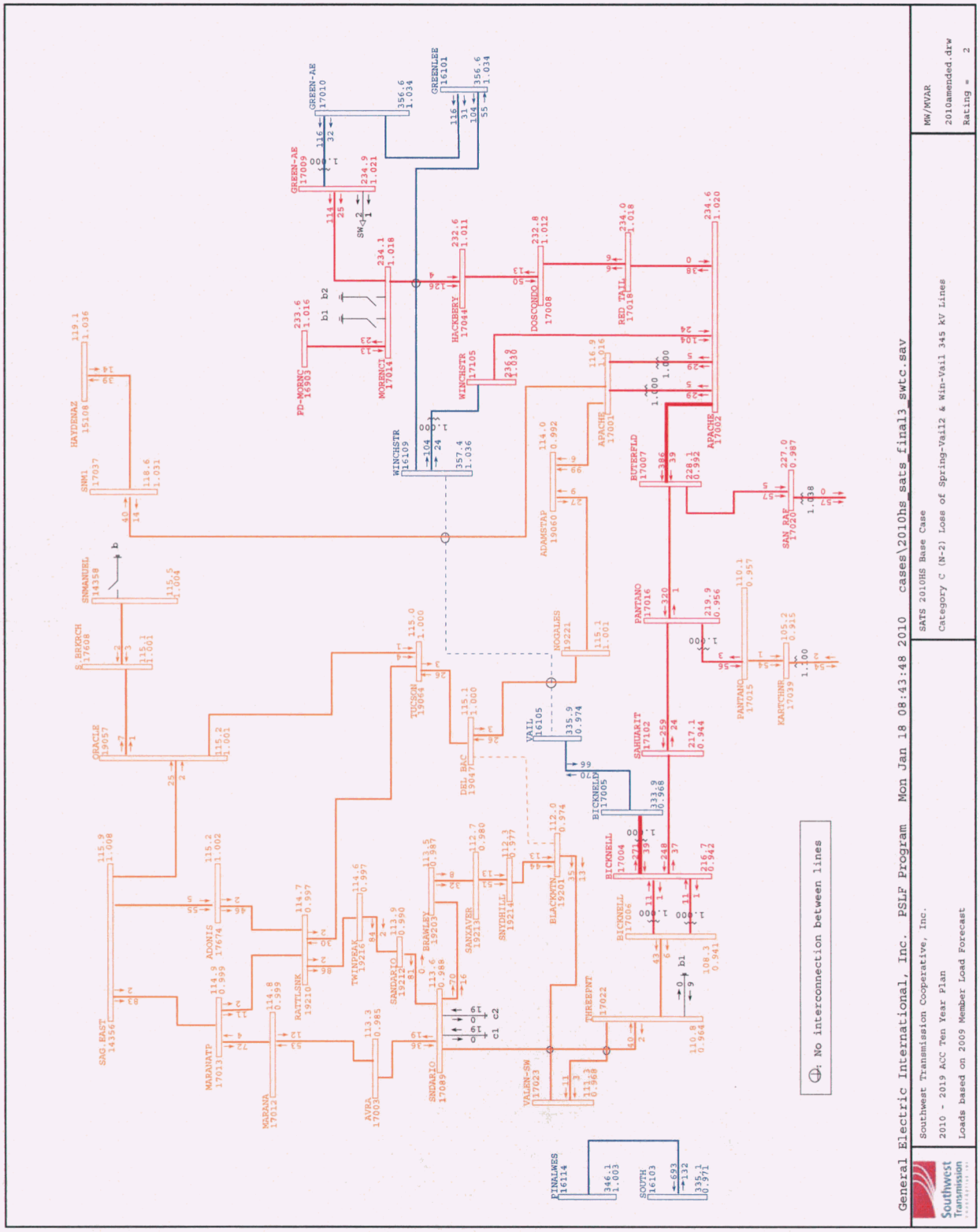
2010HS Southwest Transmission Cooperative Base System with Apache to Winchester 230 kV & Twin Peaks to Sandario 115 kV Lines out of service



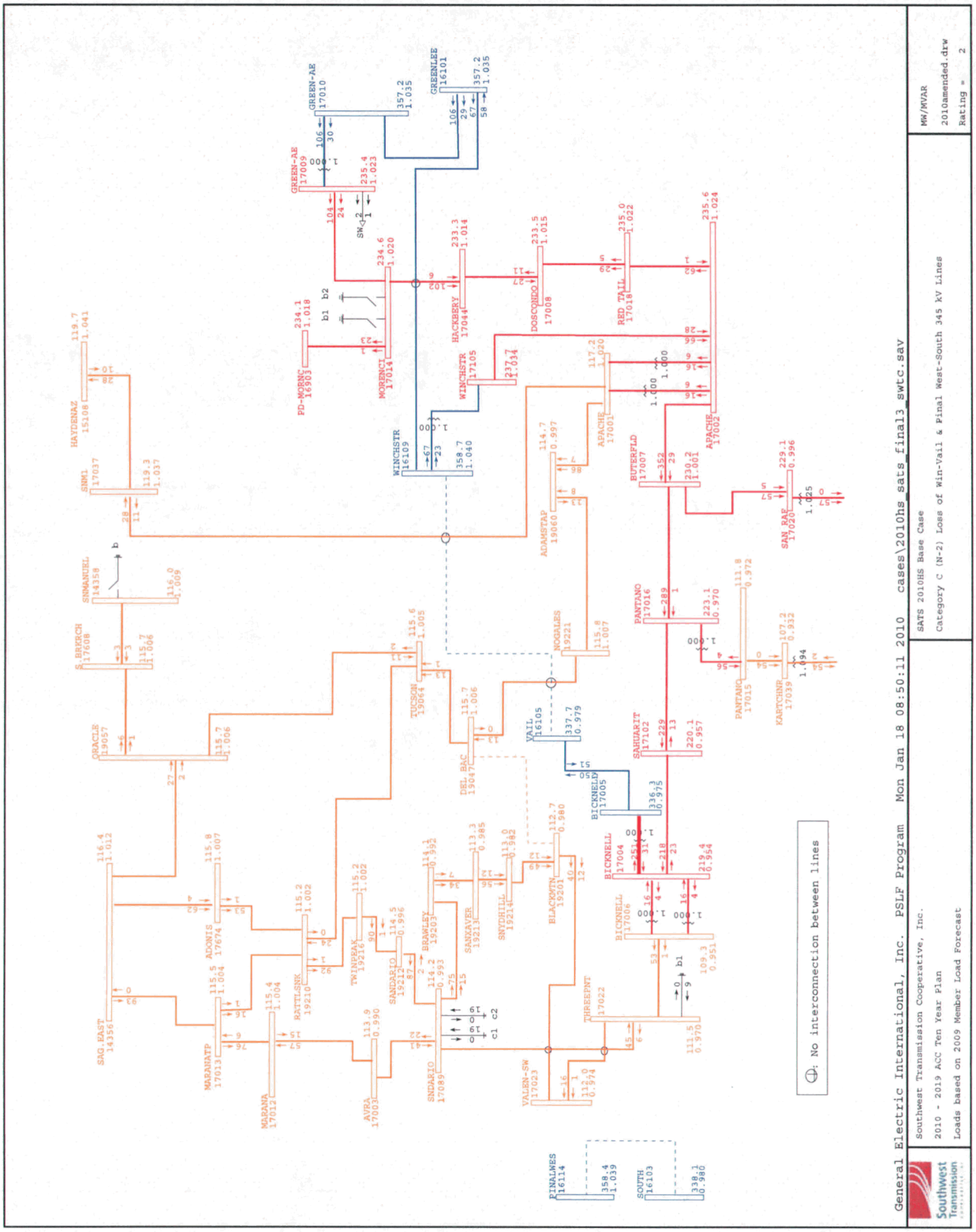
2010HS Southwest Transmission Cooperative Base System with Marana Tap to Marana & Marana Tap to Rattlesnake 115 kV Lines out of service



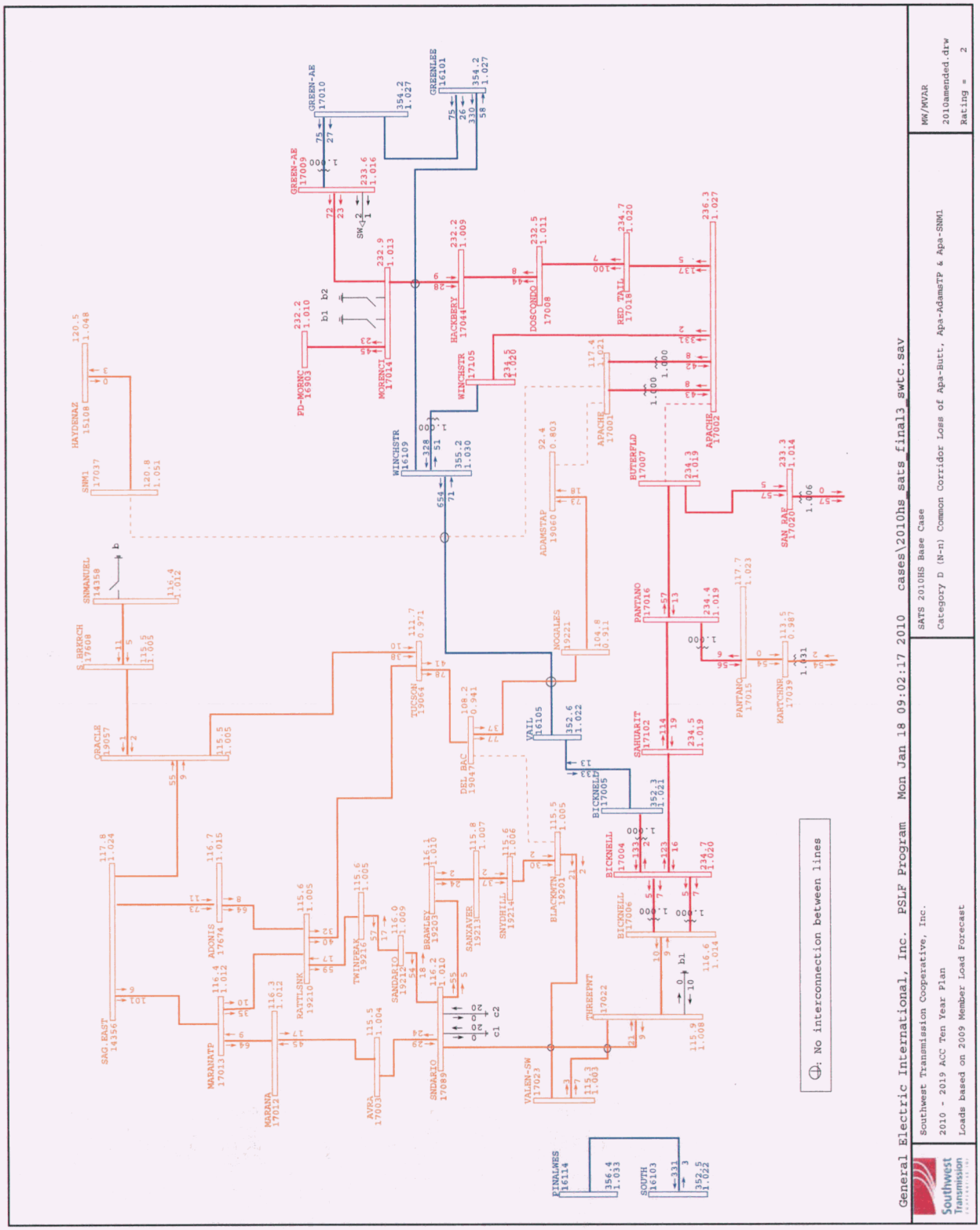
2010HS Southwest Transmission Cooperative Base System with Springerville to Vail 2 & Winchester to Vail 345 kV Lines out of service



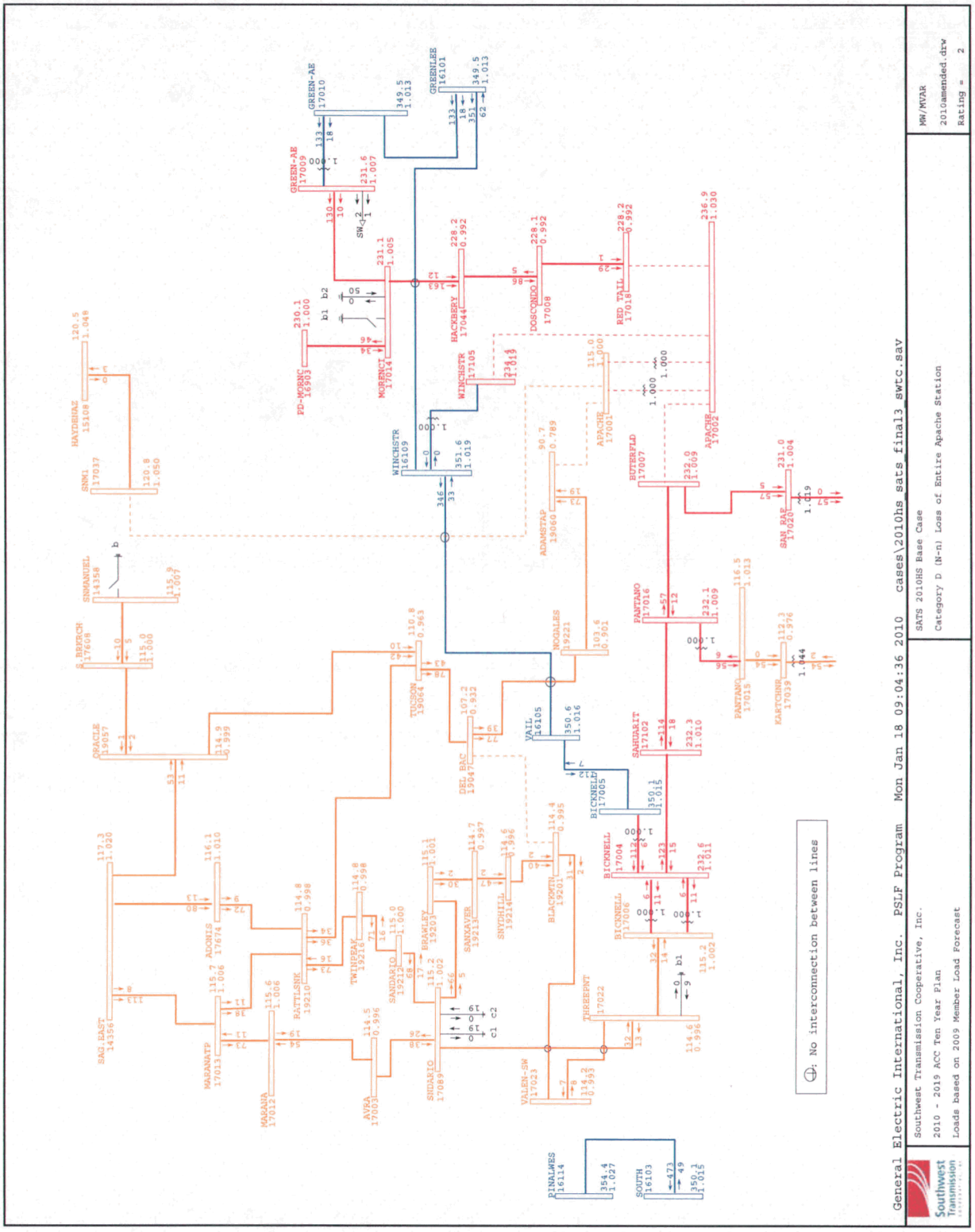
2010HS Southwest Transmission Cooperative Base System with Winchester to Vail & Pinal West to South 345 kV Lines out of service



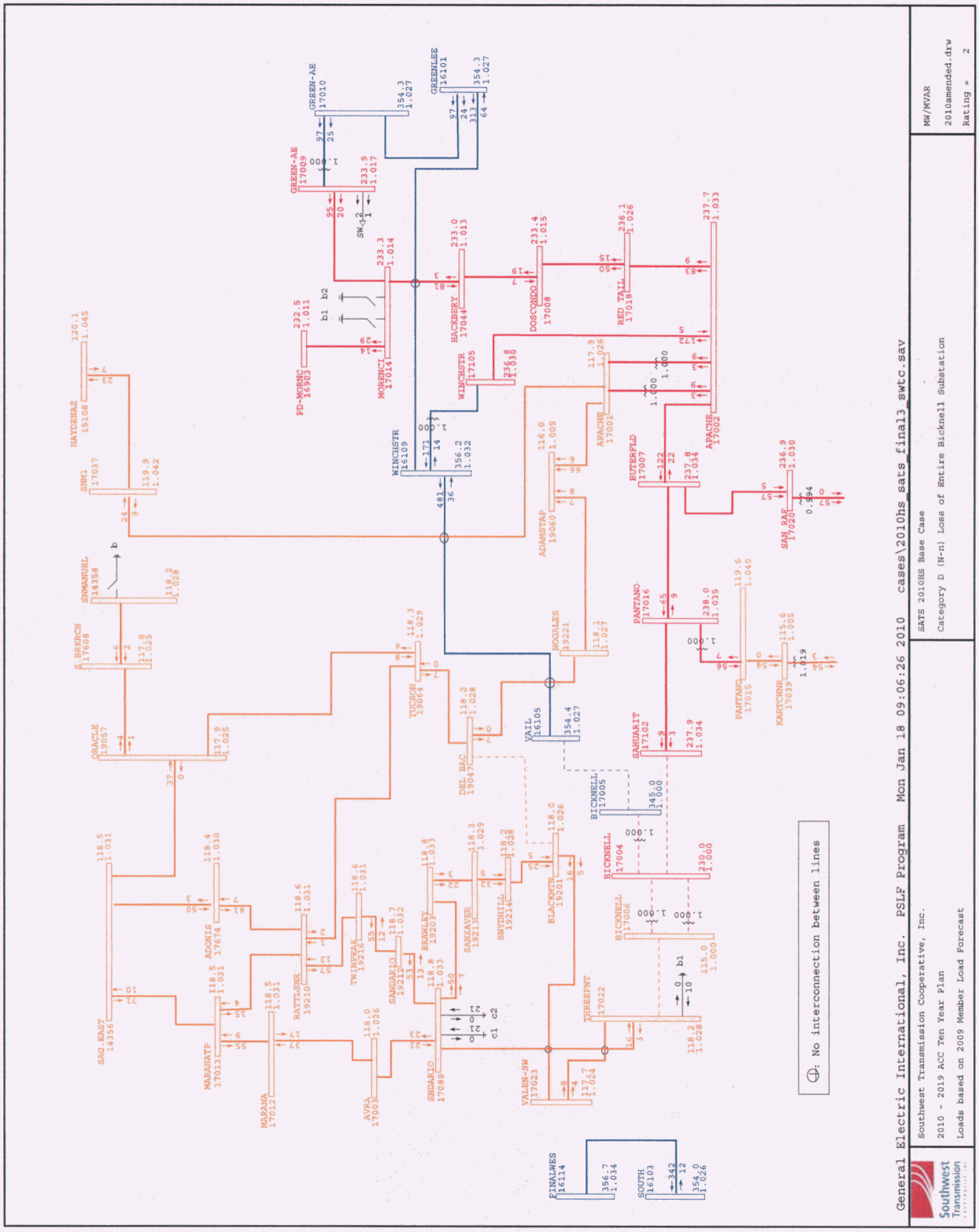
2010HS Southwest Transmission Cooperative Base System with Common Corridor Loss of Apache to Butterfield 230 kV, Apache to Adams Tap 115 kV, and Apache to SNM1 115 kV Lines



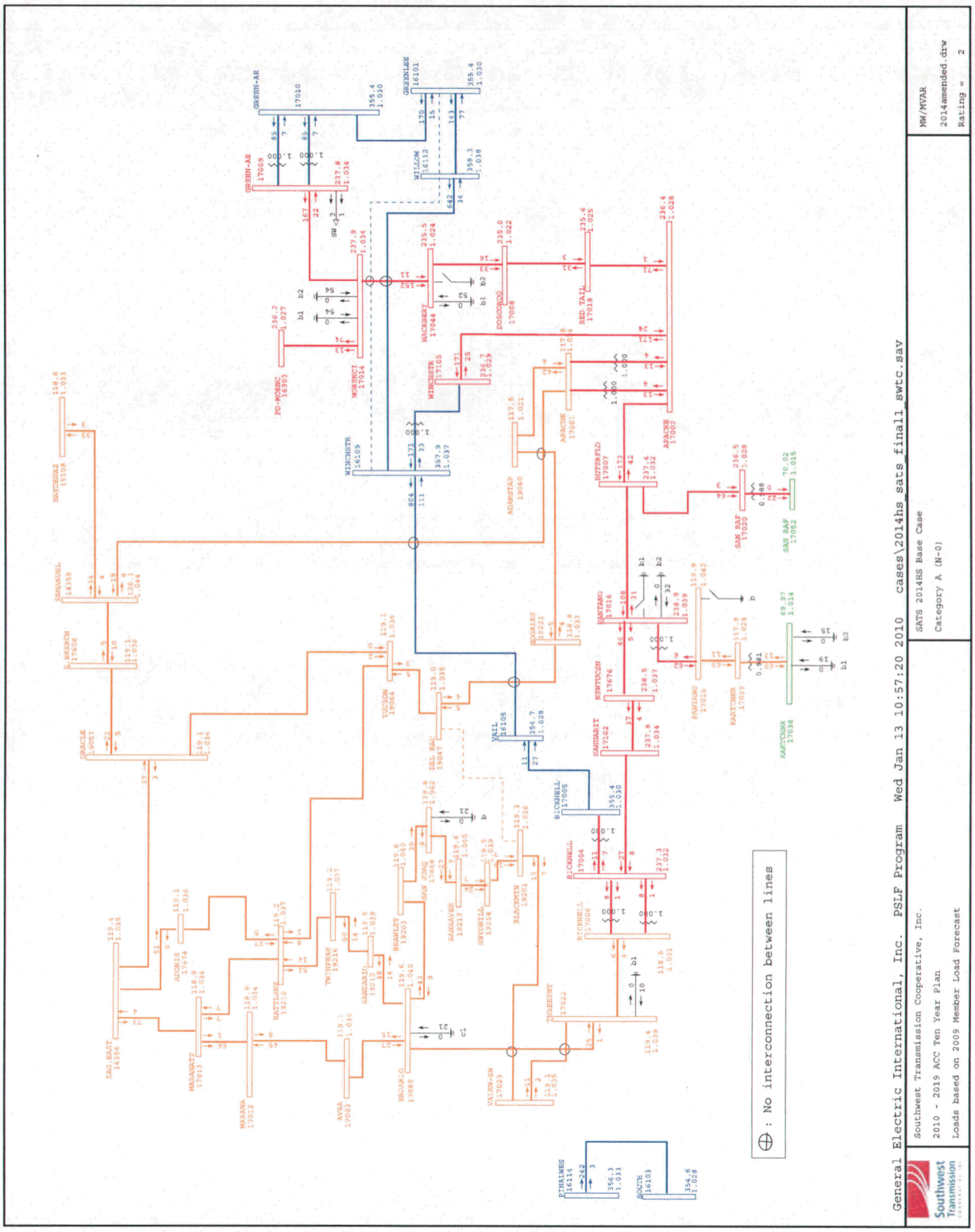
2010HS Southwest Transmission Cooperative Base System with Loss of Entire Apache Station



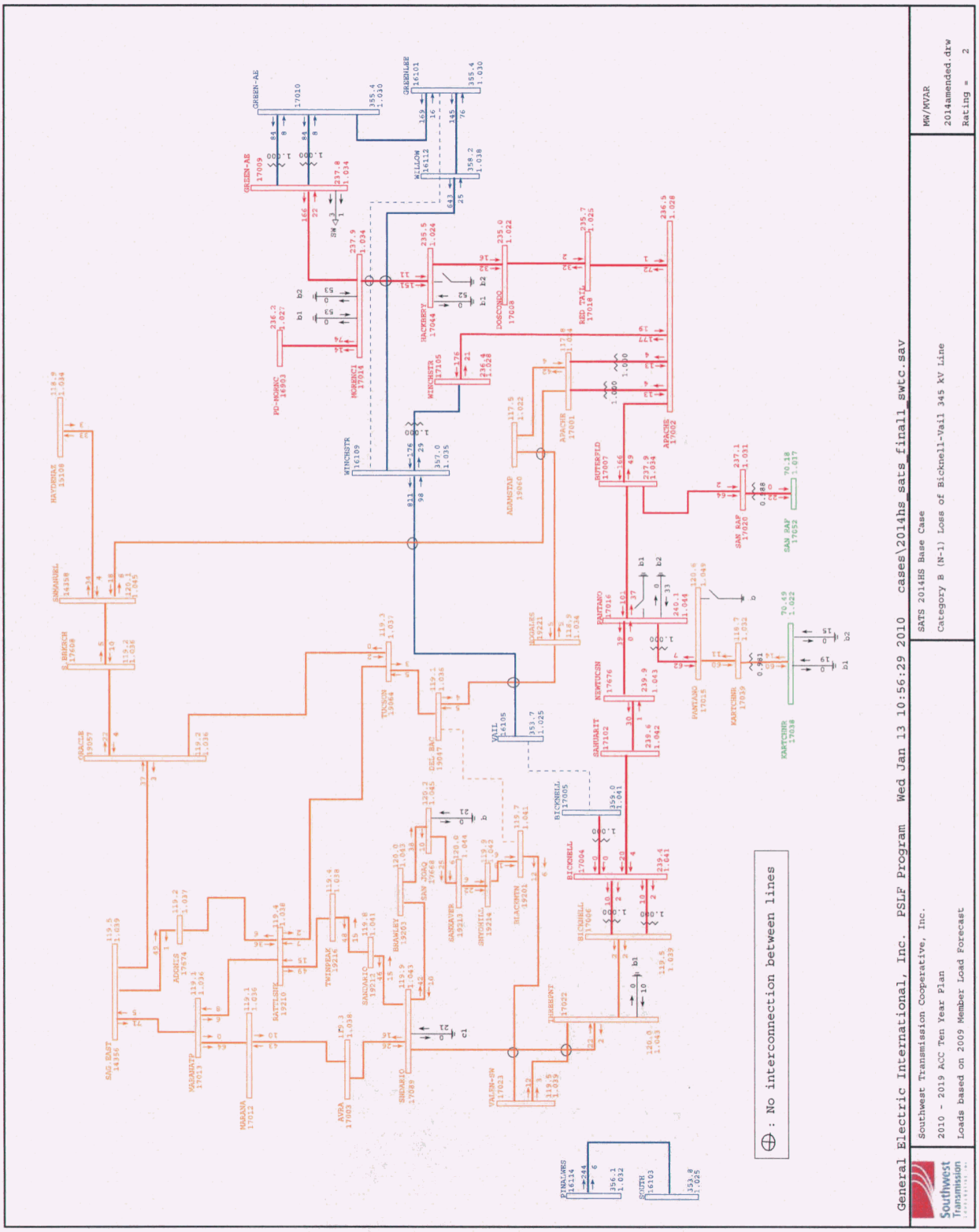
2010HS Southwest Transmission Cooperative Base System with Loss of Entire Bicknell Substation



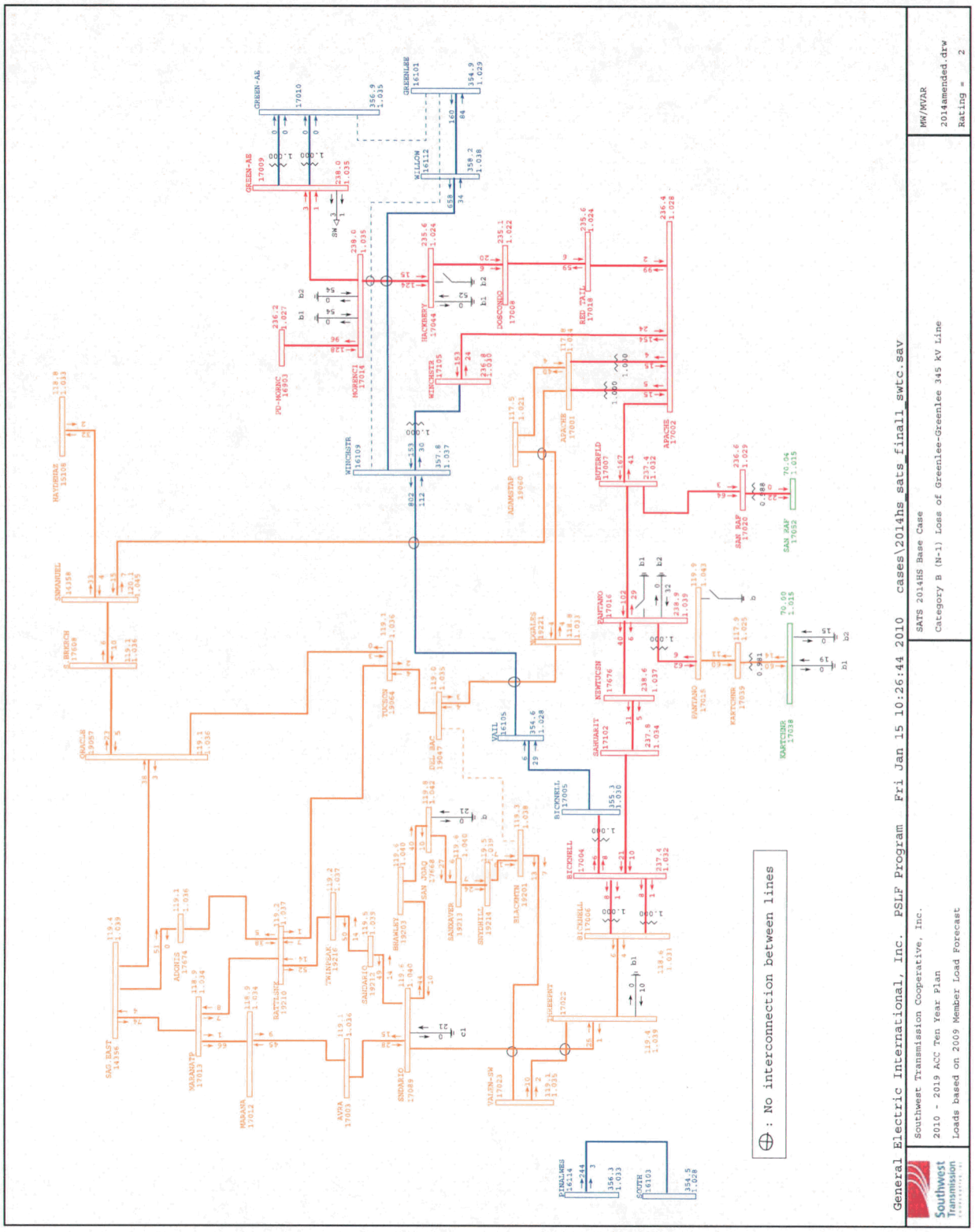
2014HS Southwest Transmission Cooperative Base System



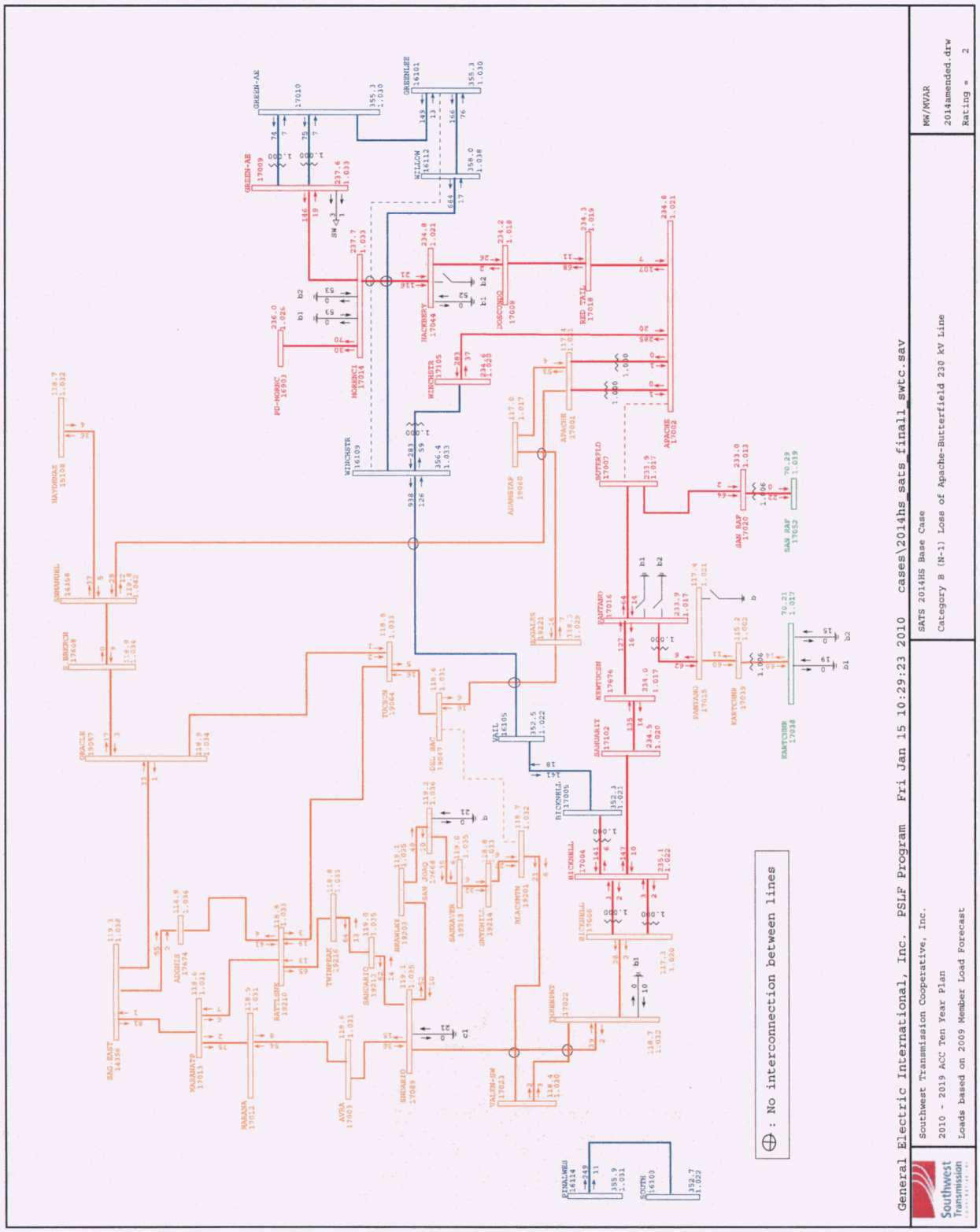
2014HS Southwest Transmission Cooperative Base System with Bicknell to Vail 345 kV Line out of service



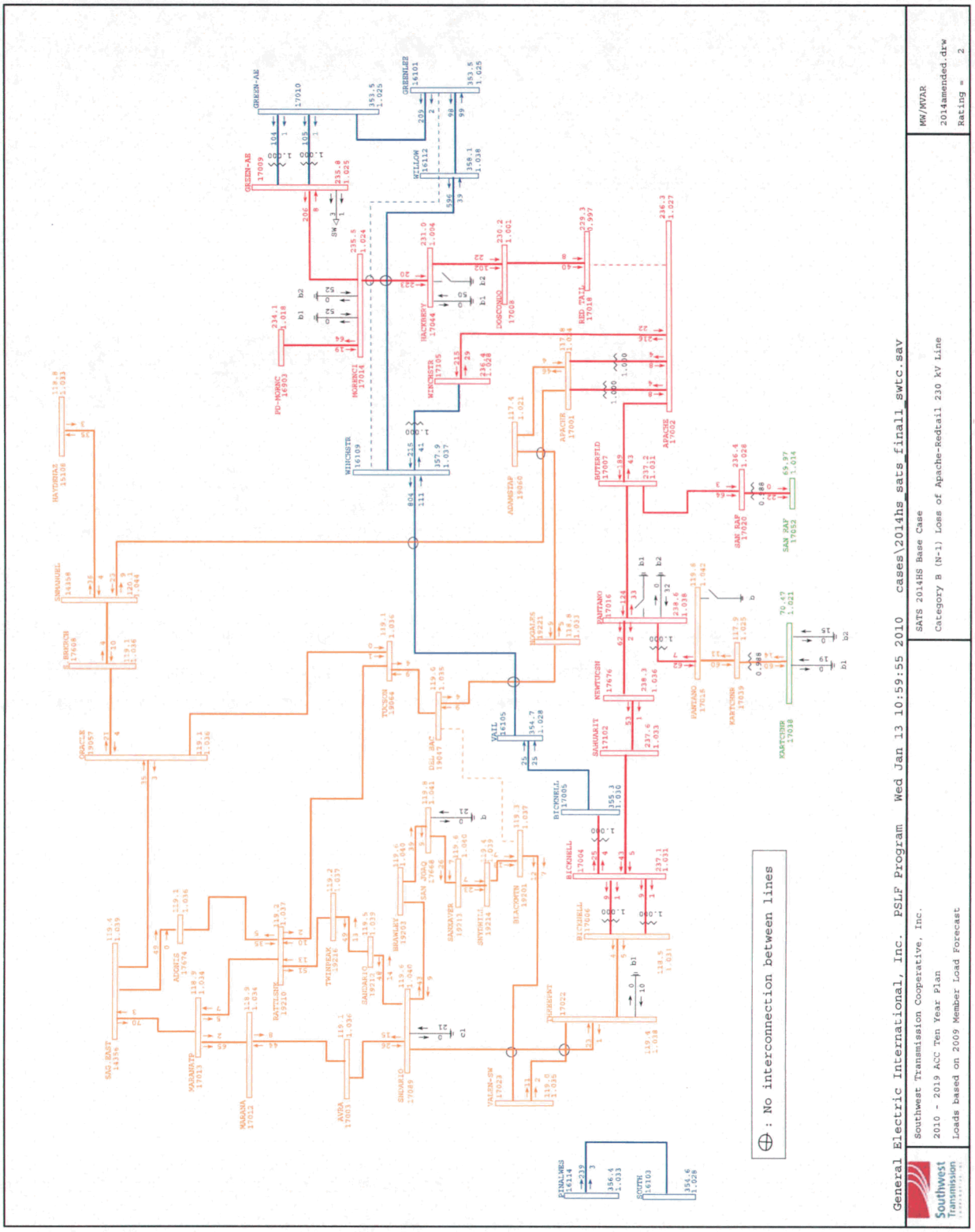
2014HS Southwest Transmission Cooperative Base System with Greenlee to Greenlee 345 kV Line out of service



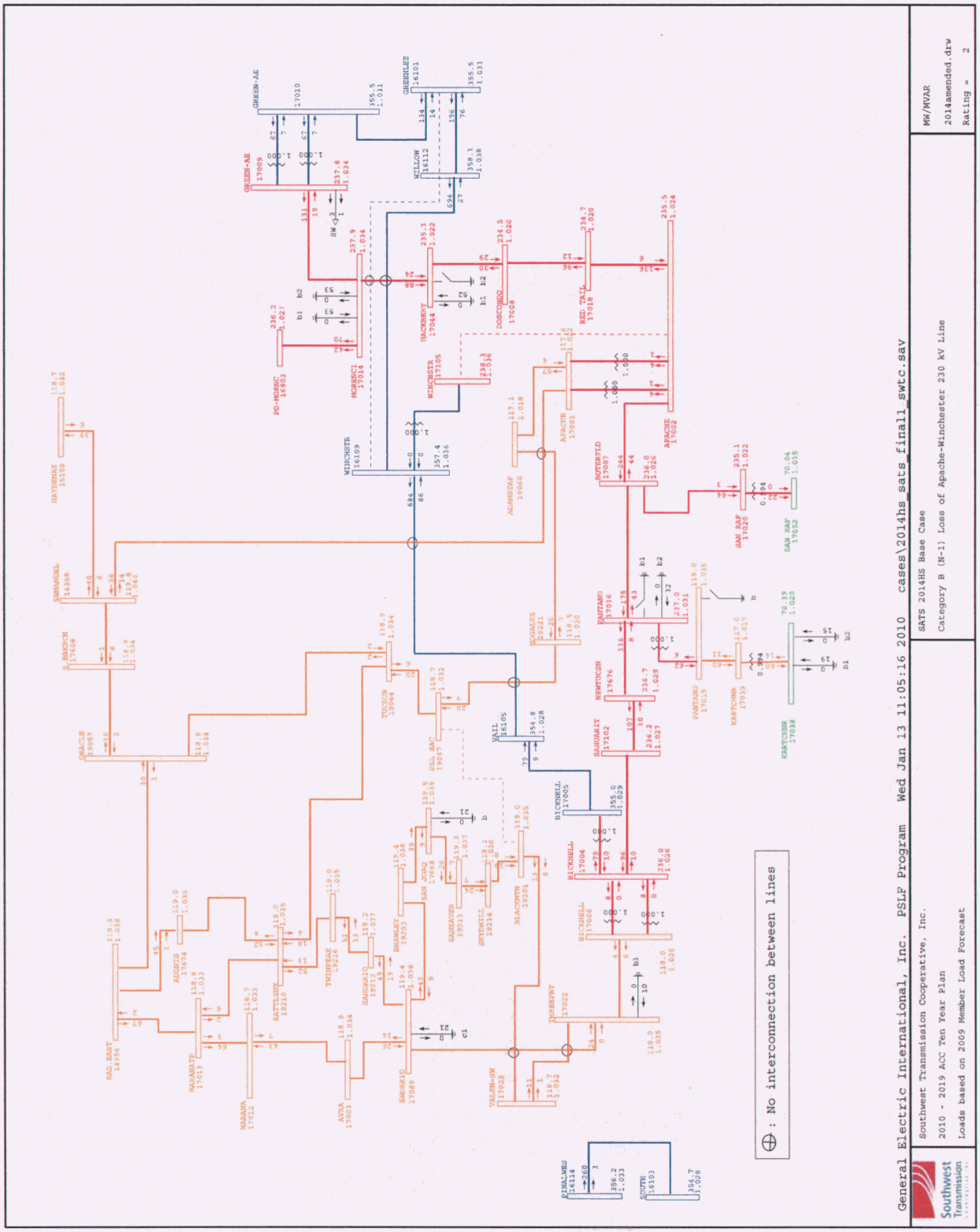
2014HS Southwest Transmission Cooperative Base System with Apache to Butterfield 230 kV Line out of service



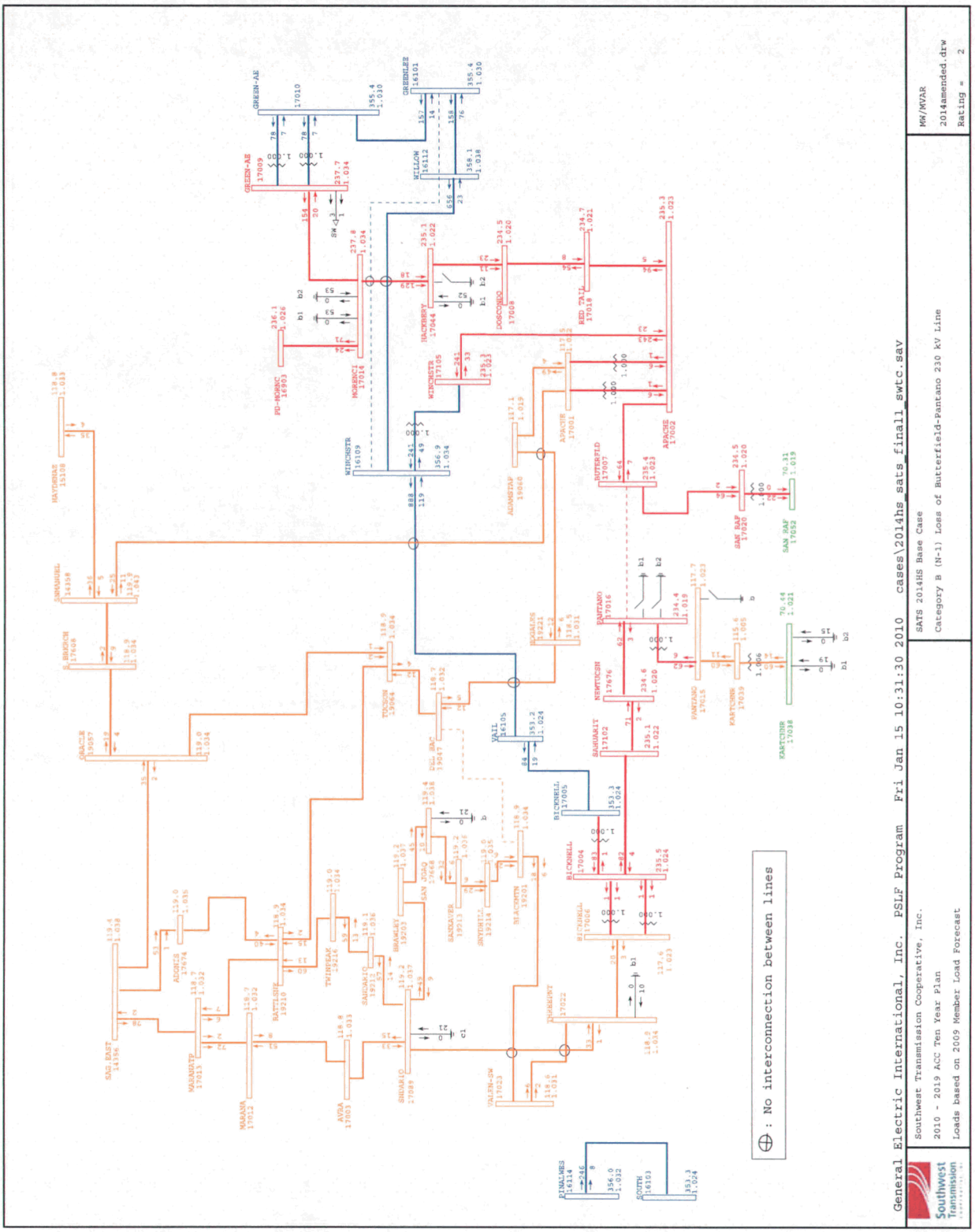
2014HS Southwest Transmission Cooperative Base System with Apache to Redtail 230 kV Line out of service



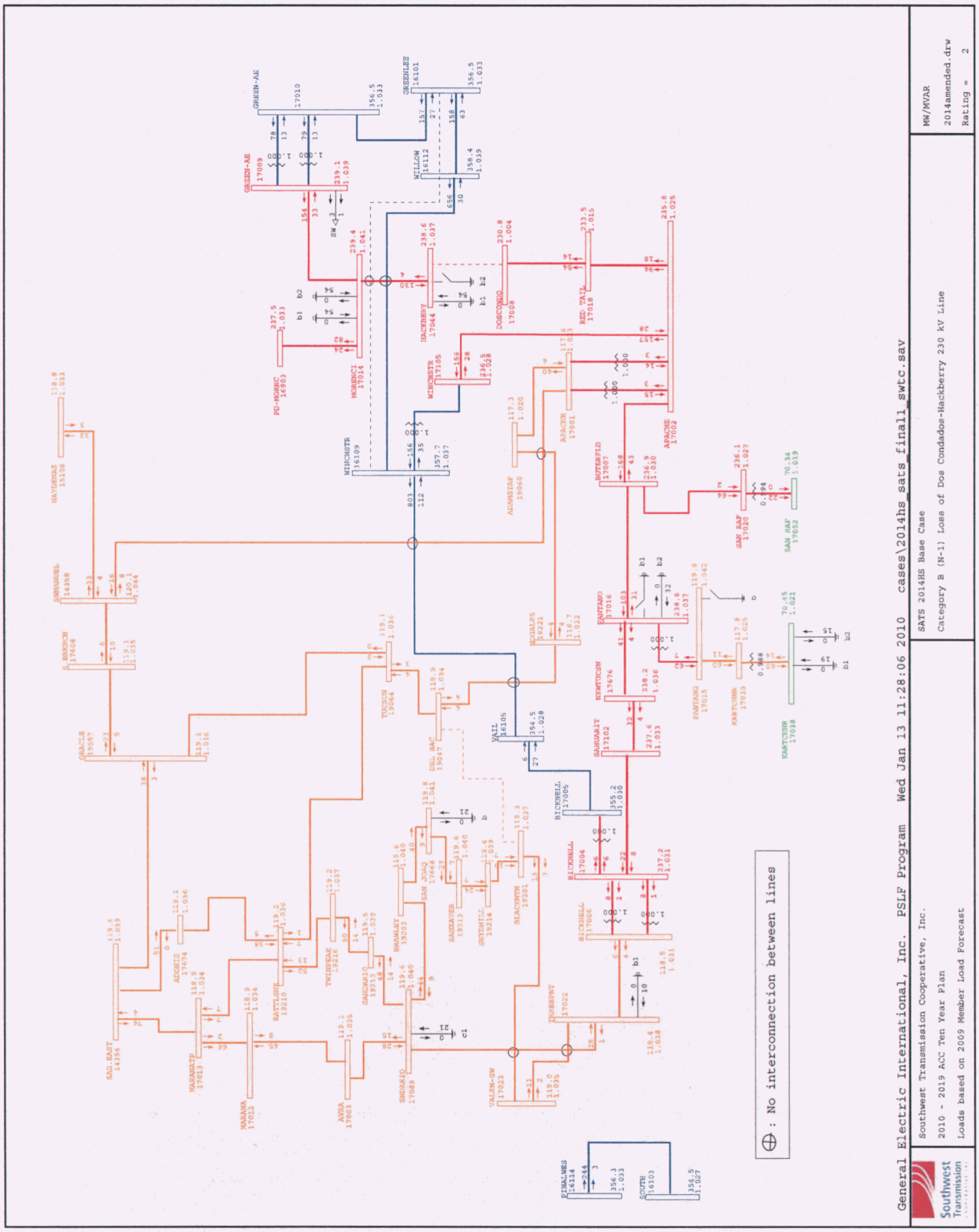
2014HS Southwest Transmission Cooperative Base System with Apache to Winchester 230 kV Line out of service



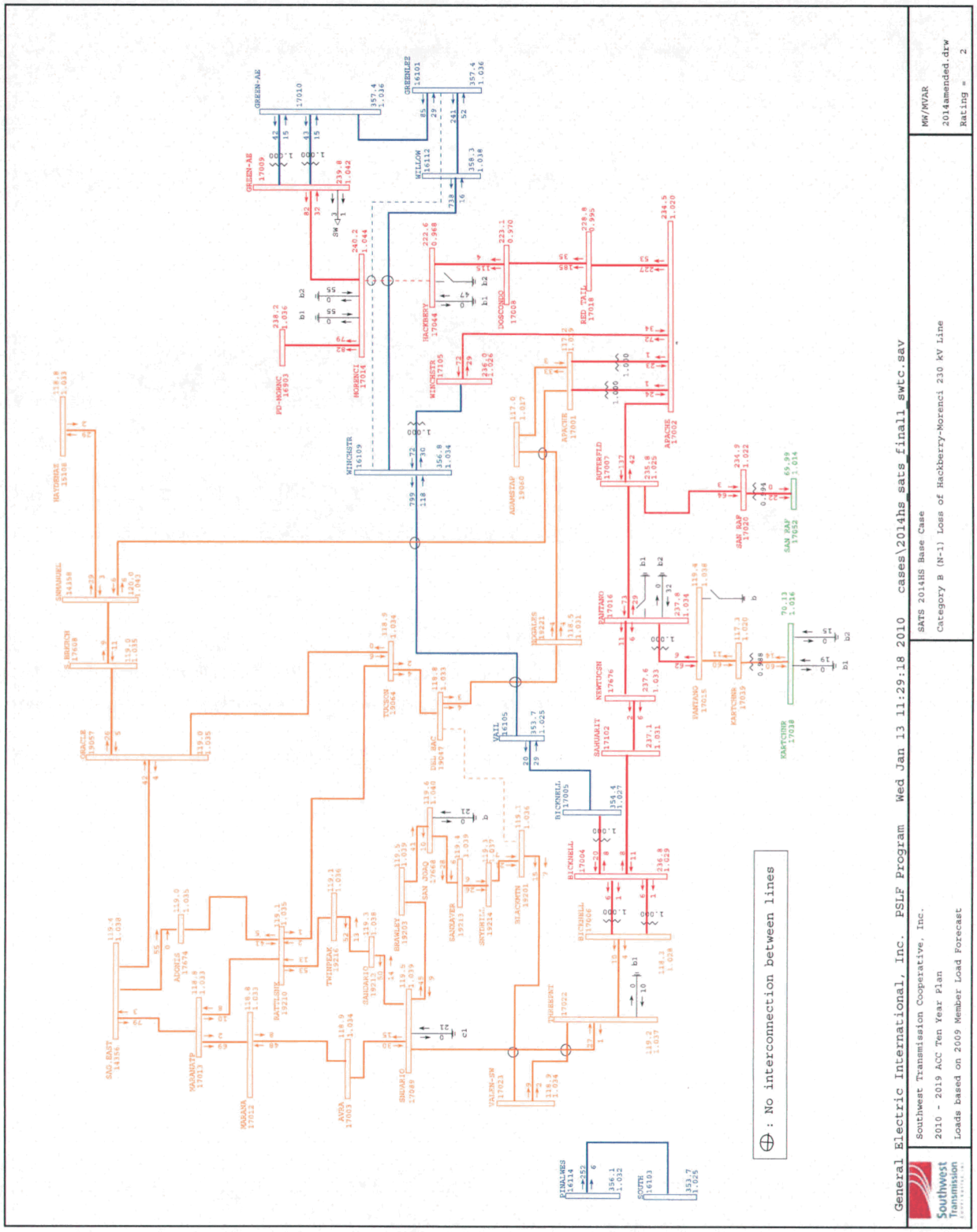
2014HS Southwest Transmission Cooperative Base System with Butterfield to Pantano 230 kV Line out of service



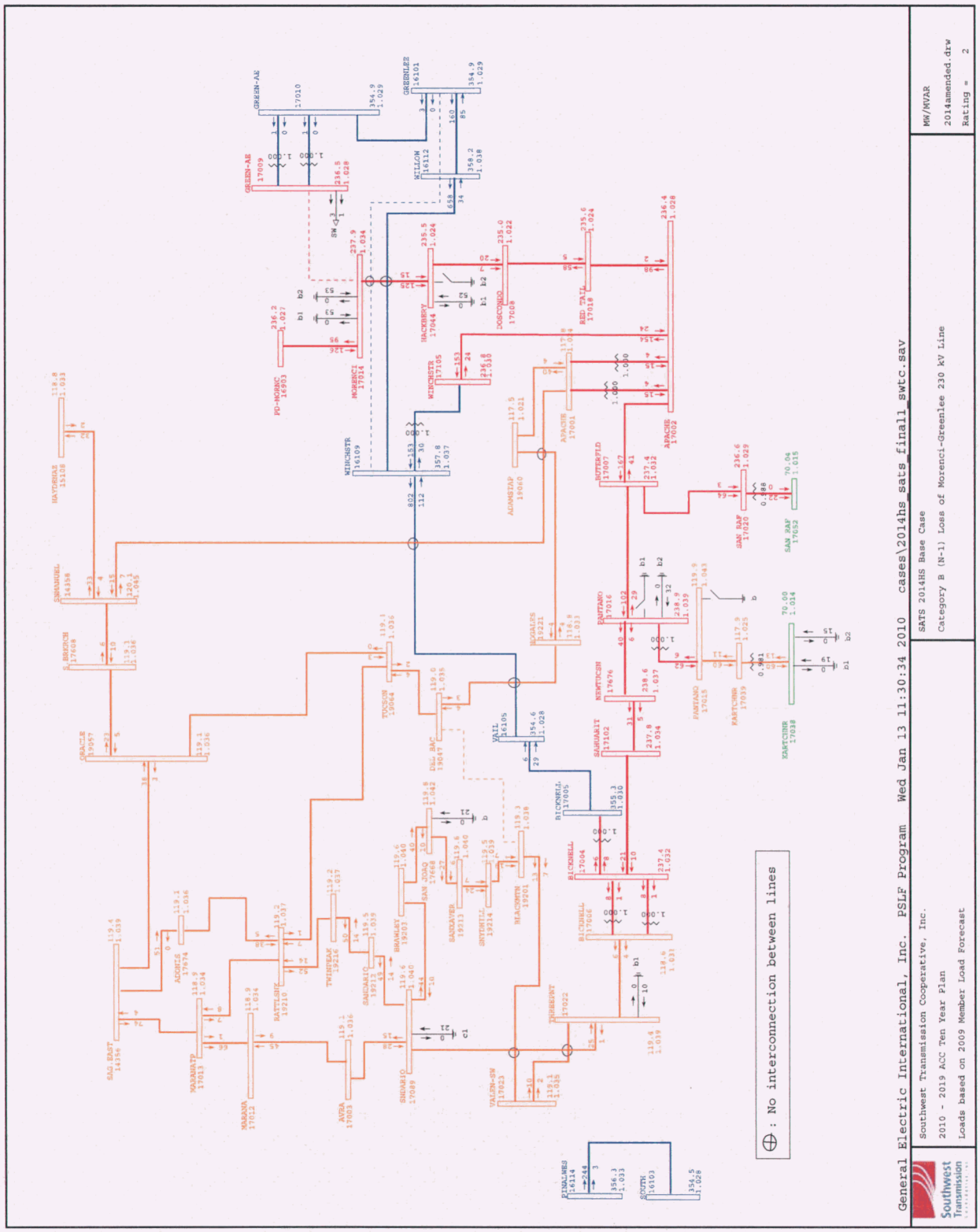
2014HS Southwest Transmission Cooperative Base System with Dos Condados to Hackberry 230 kV Line out of service



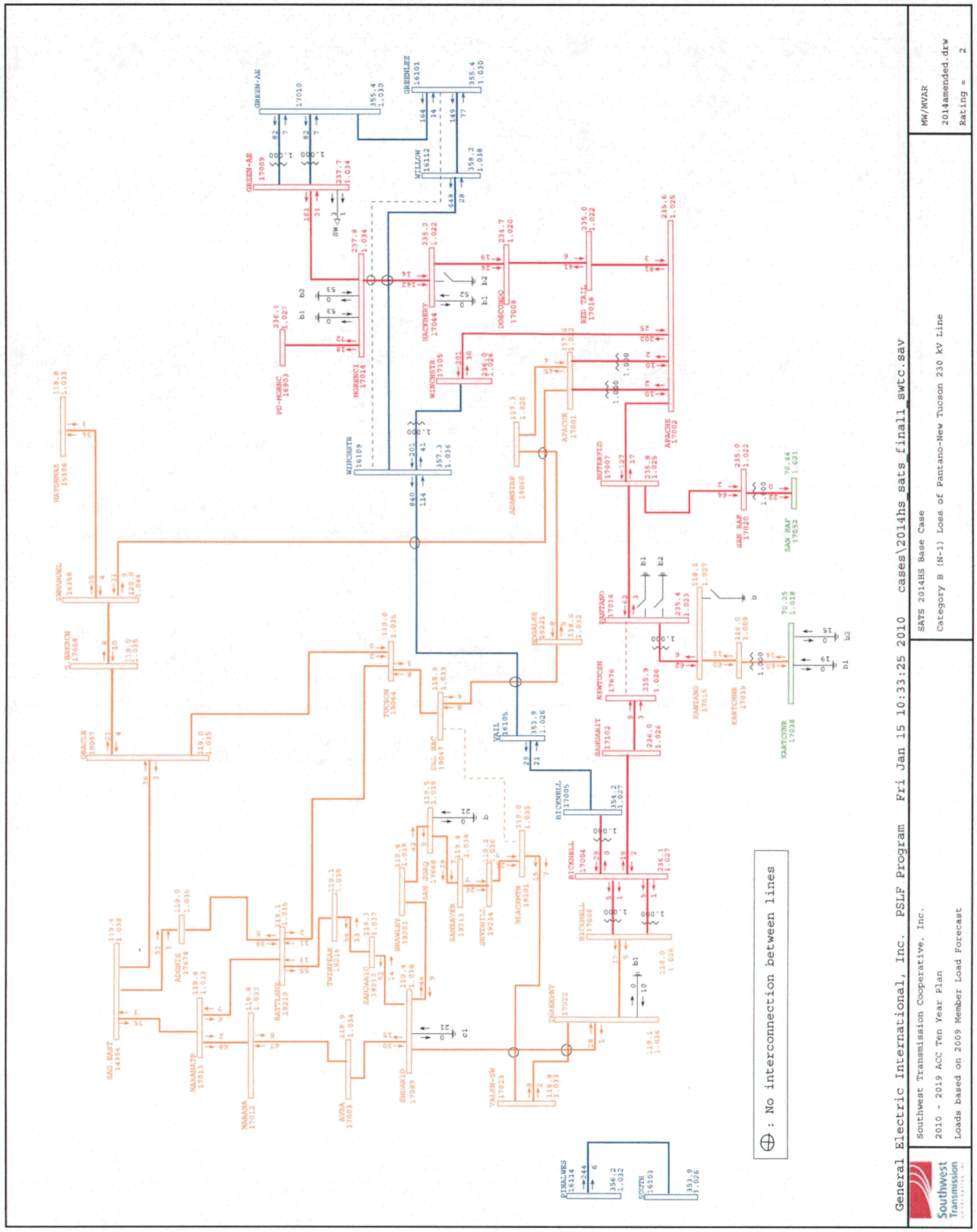
2014HS Southwest Transmission Cooperative Base System with Hackberry to Morenci 230 kV Line out of service



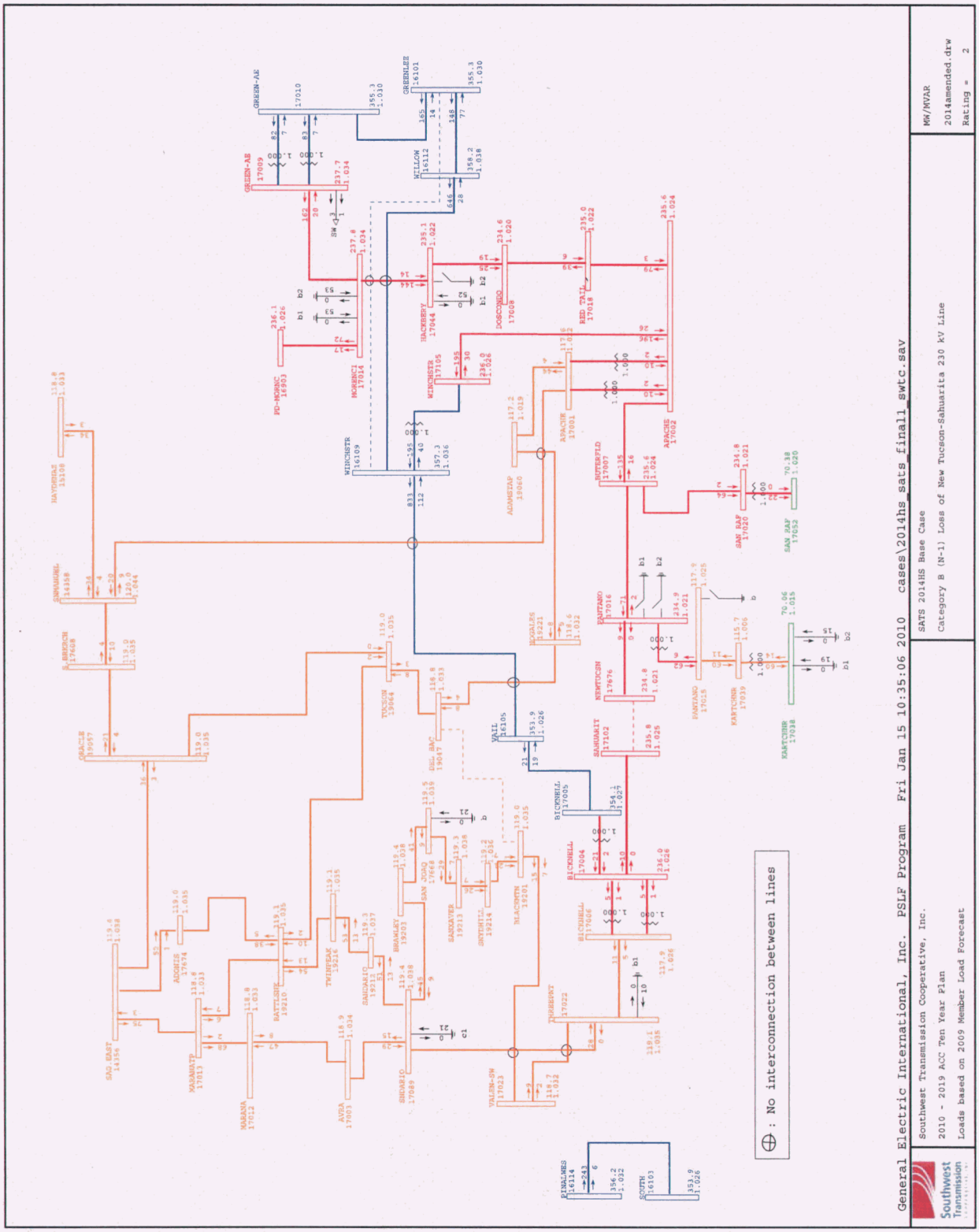
2014HS Southwest Transmission Cooperative Base System with Morenci to Greenlee 230 kV Line out of service



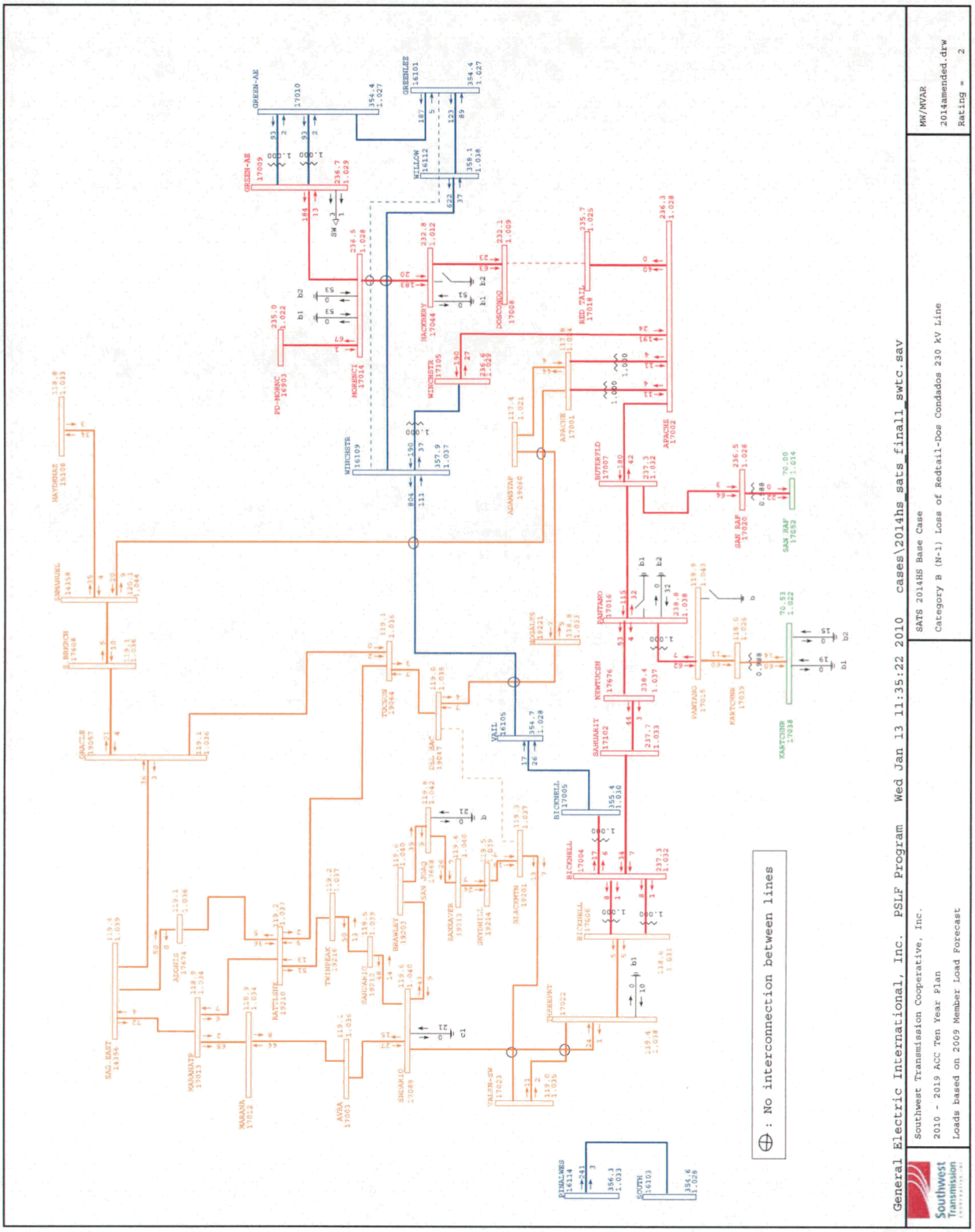
2014HS Southwest Transmission Cooperative Base System with Pantano to New Tucson 230 kV Line out of service



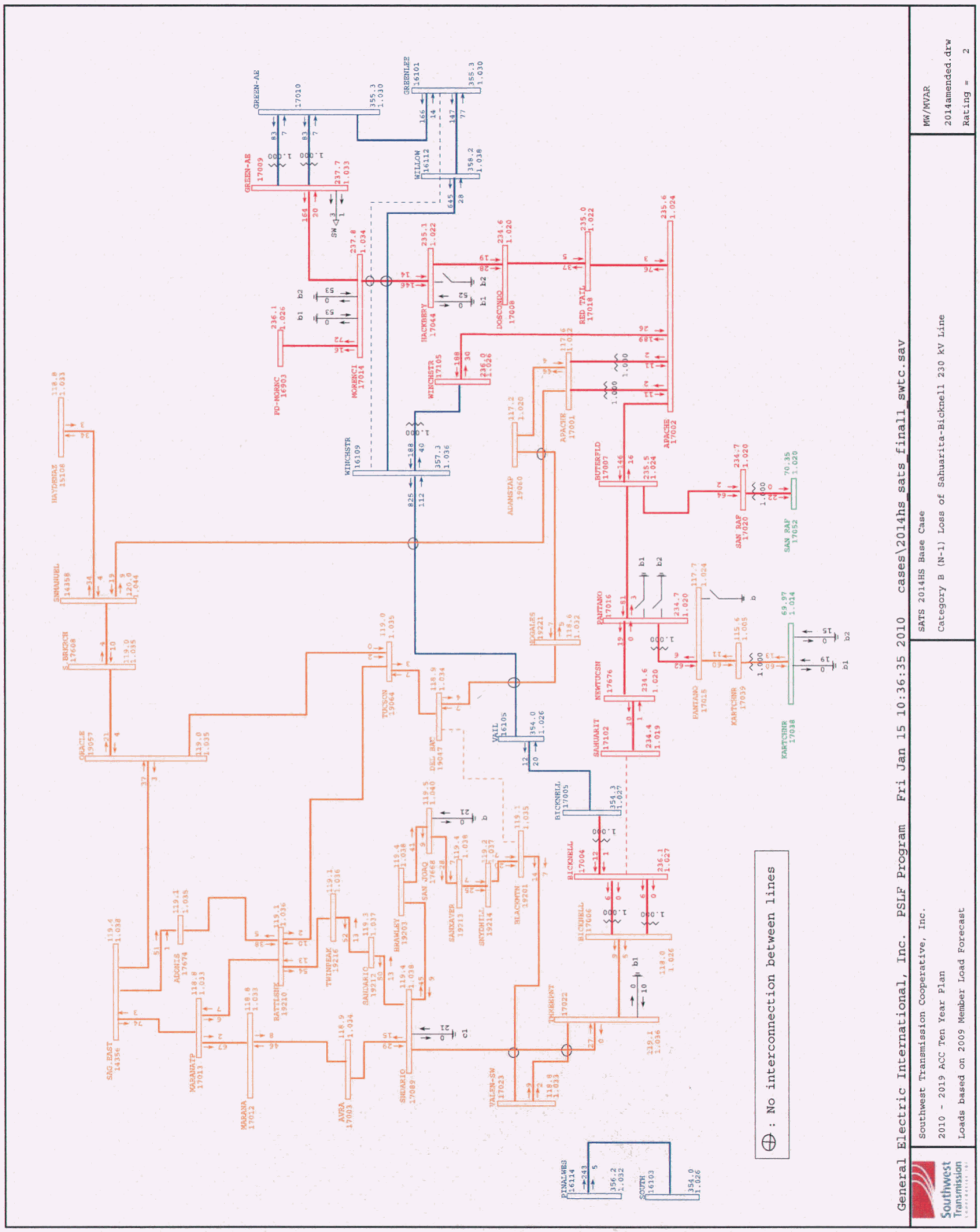
2014HS Southwest Transmission Cooperative Base System with New Tucson to Sahuarita 230 kV Line out of service



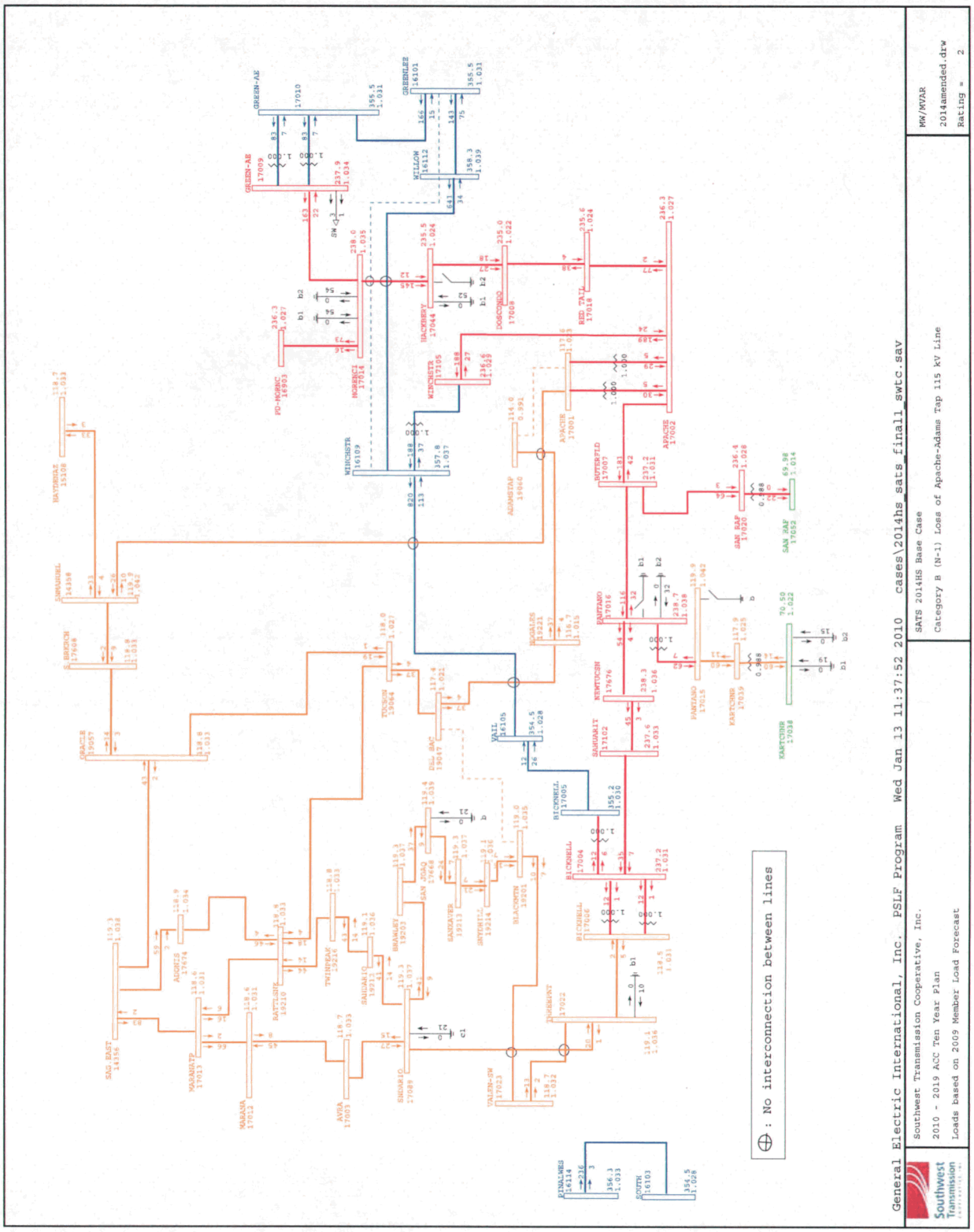
2014HS Southwest Transmission Cooperative Base System with Redtail to Dos Condados 230 kV Line out of service



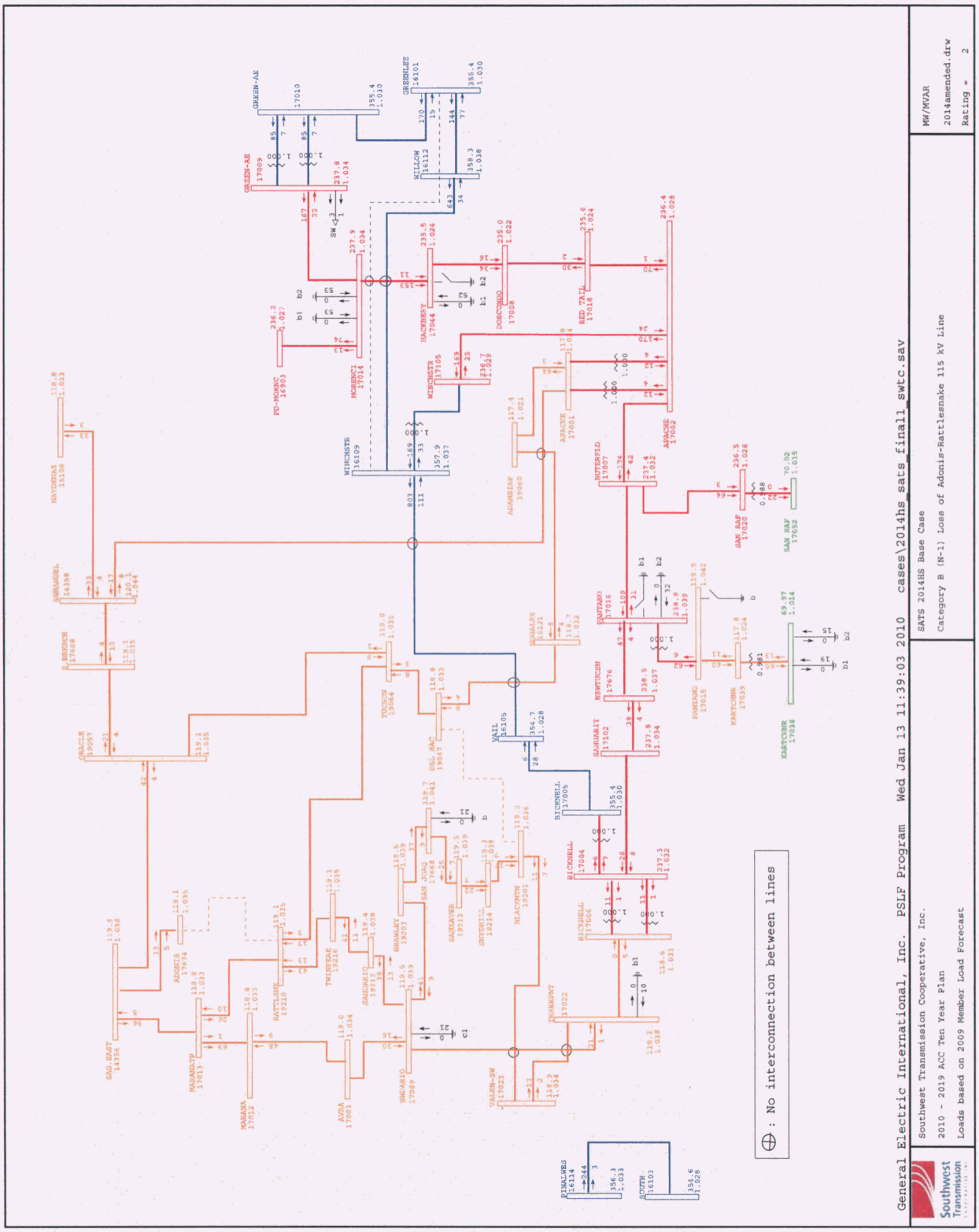
2014HS Southwest Transmission Cooperative Base System with Sahuarita to Bicknell 230 kV Line out of service



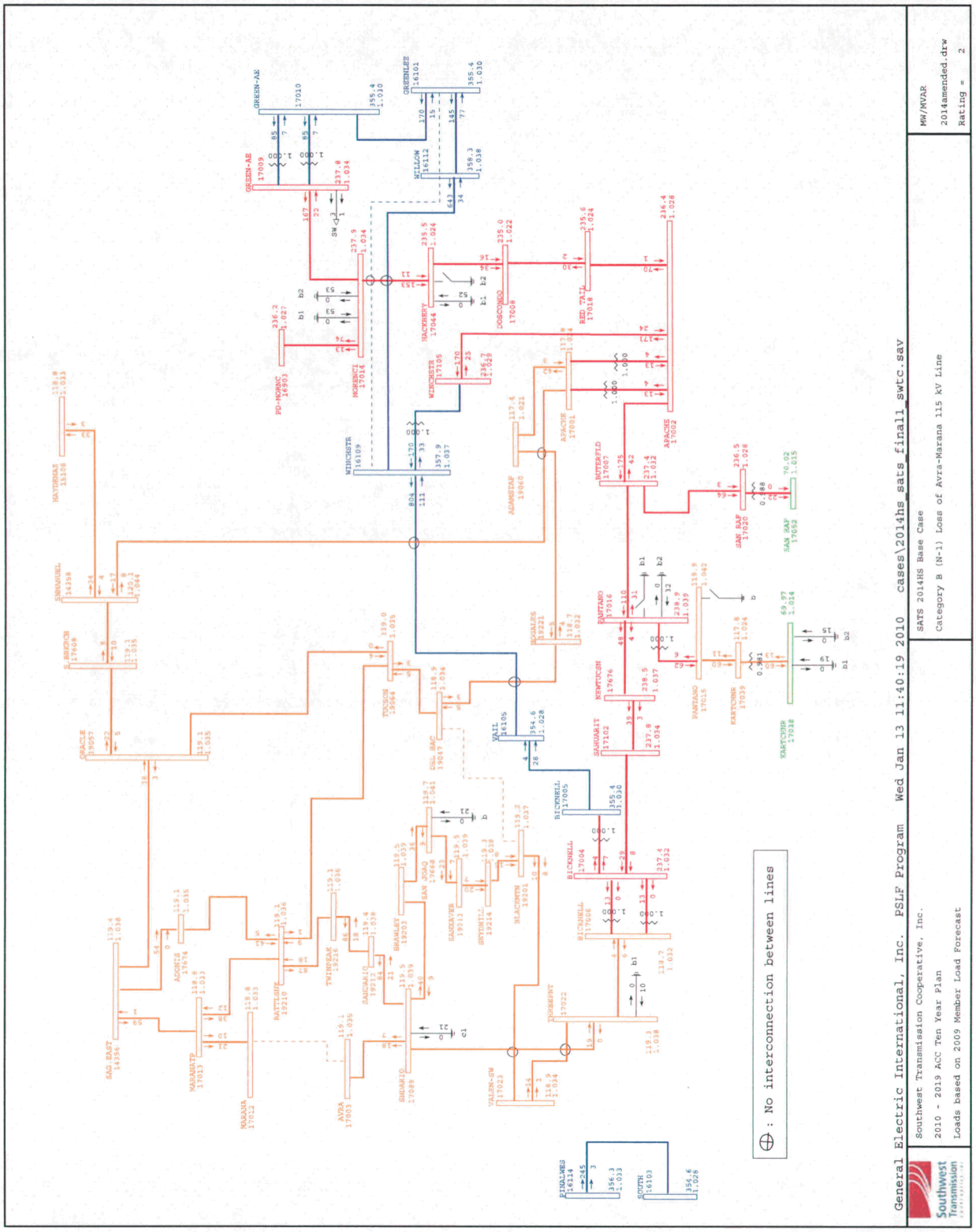
2014HS Southwest Transmission Cooperative Base System with Apache to Adams Tap 115 kV Line out of service



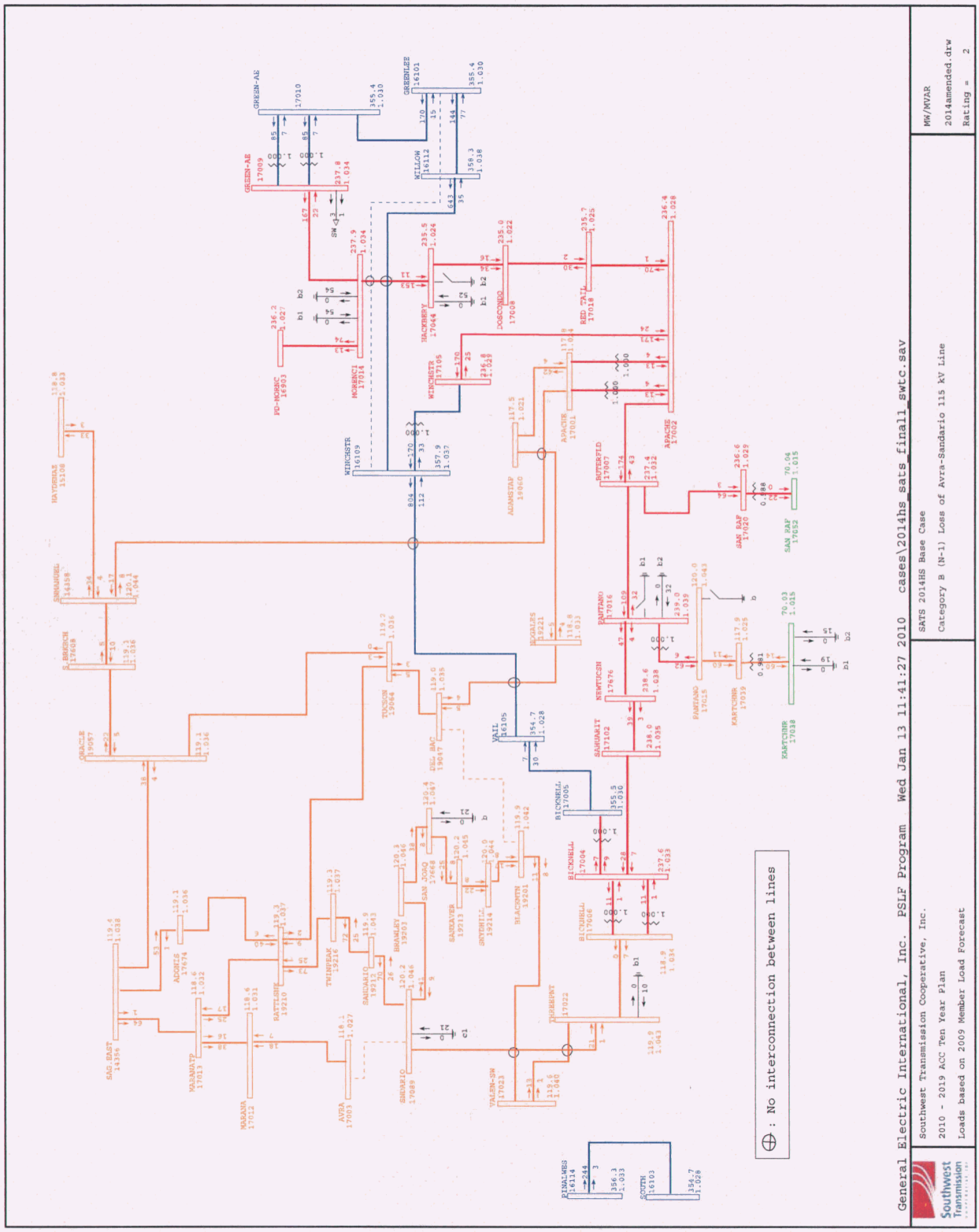
2014HS Southwest Transmission Cooperative Base System with Adonis to Rattlesnake 115 kV Line out of service



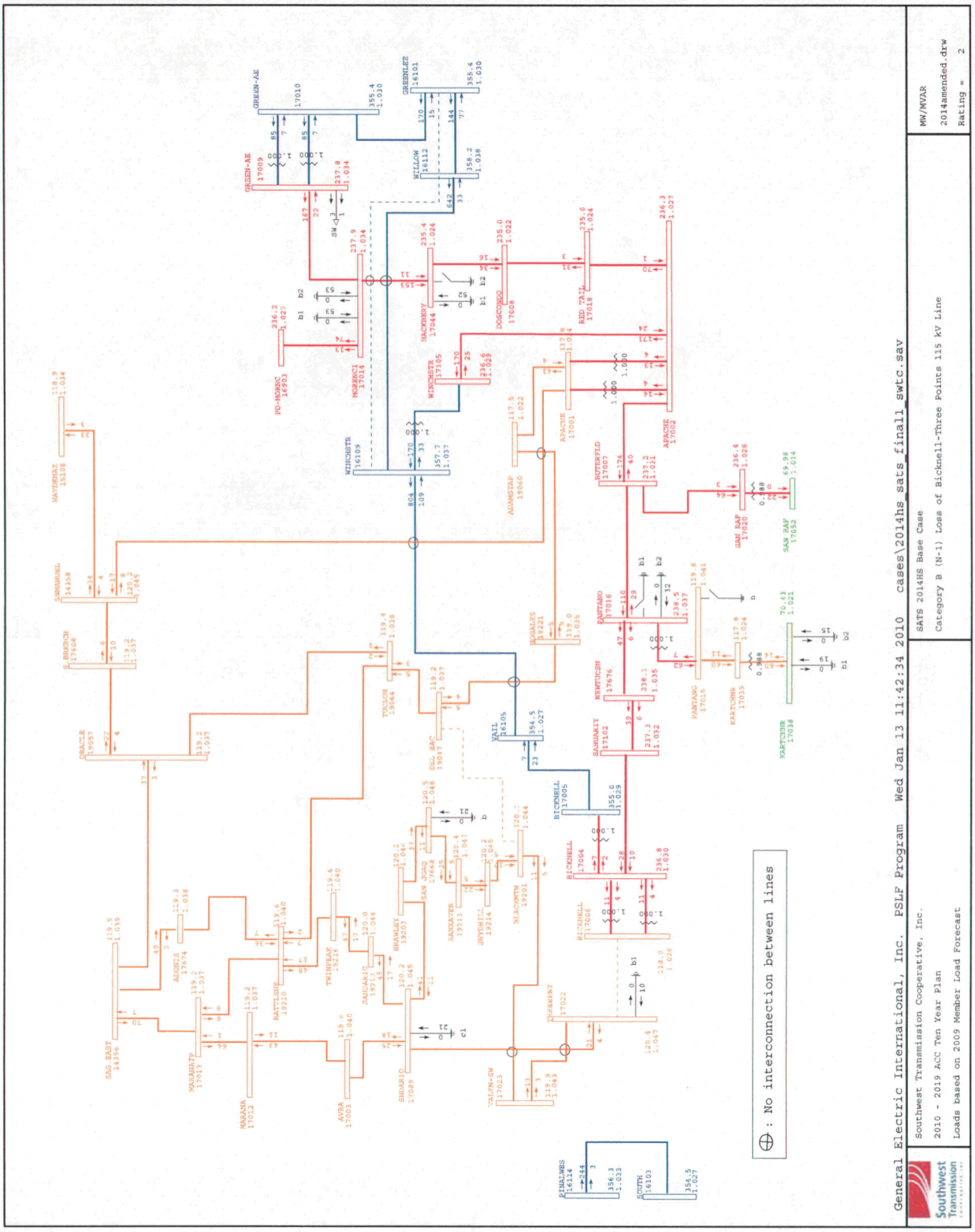
2014HS Southwest Transmission Cooperative Base System with Avra to Marana 115 kV Line out of service



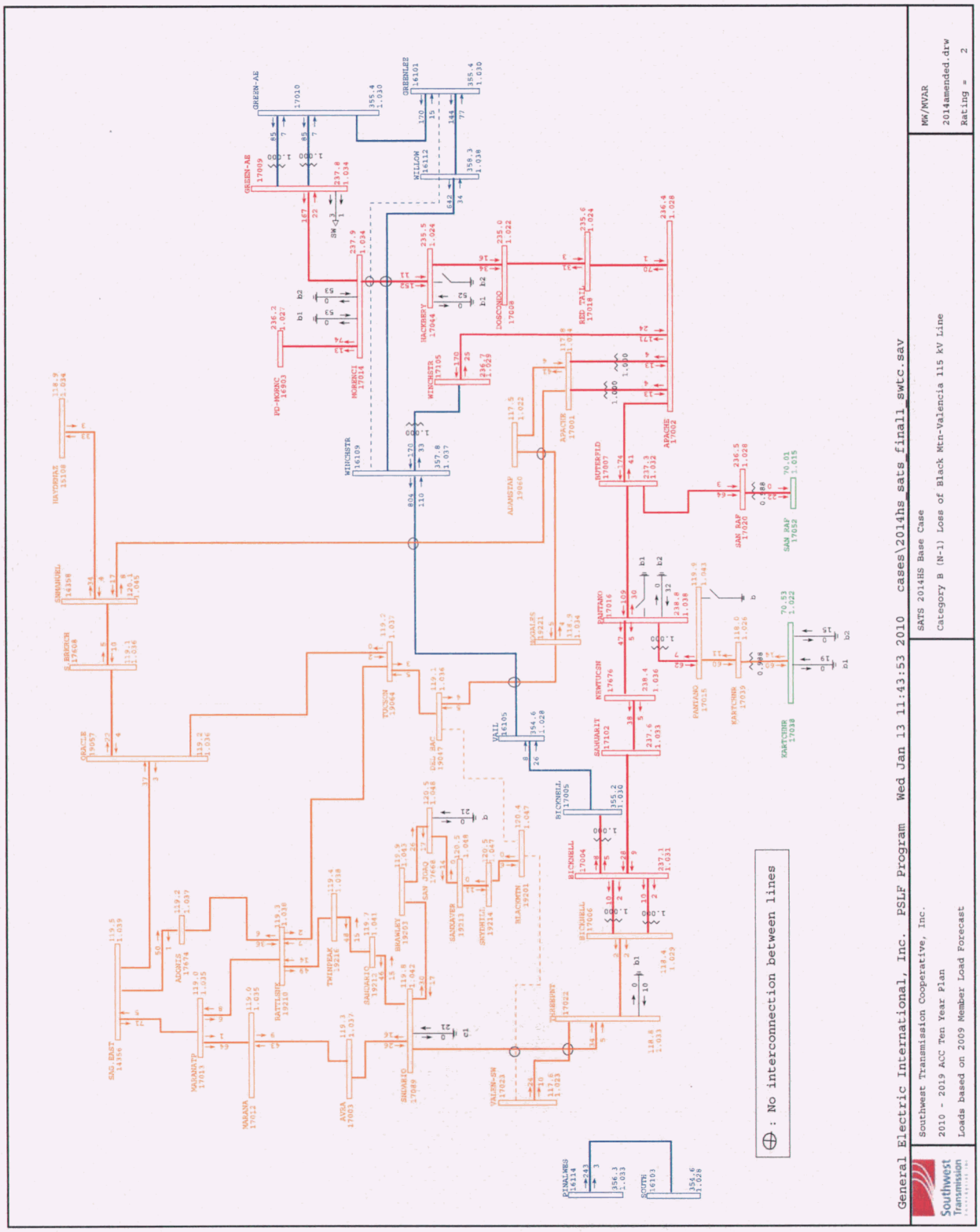
2014HS Southwest Transmission Cooperative Base System with Avra to Sandario 115 kV Line out of service



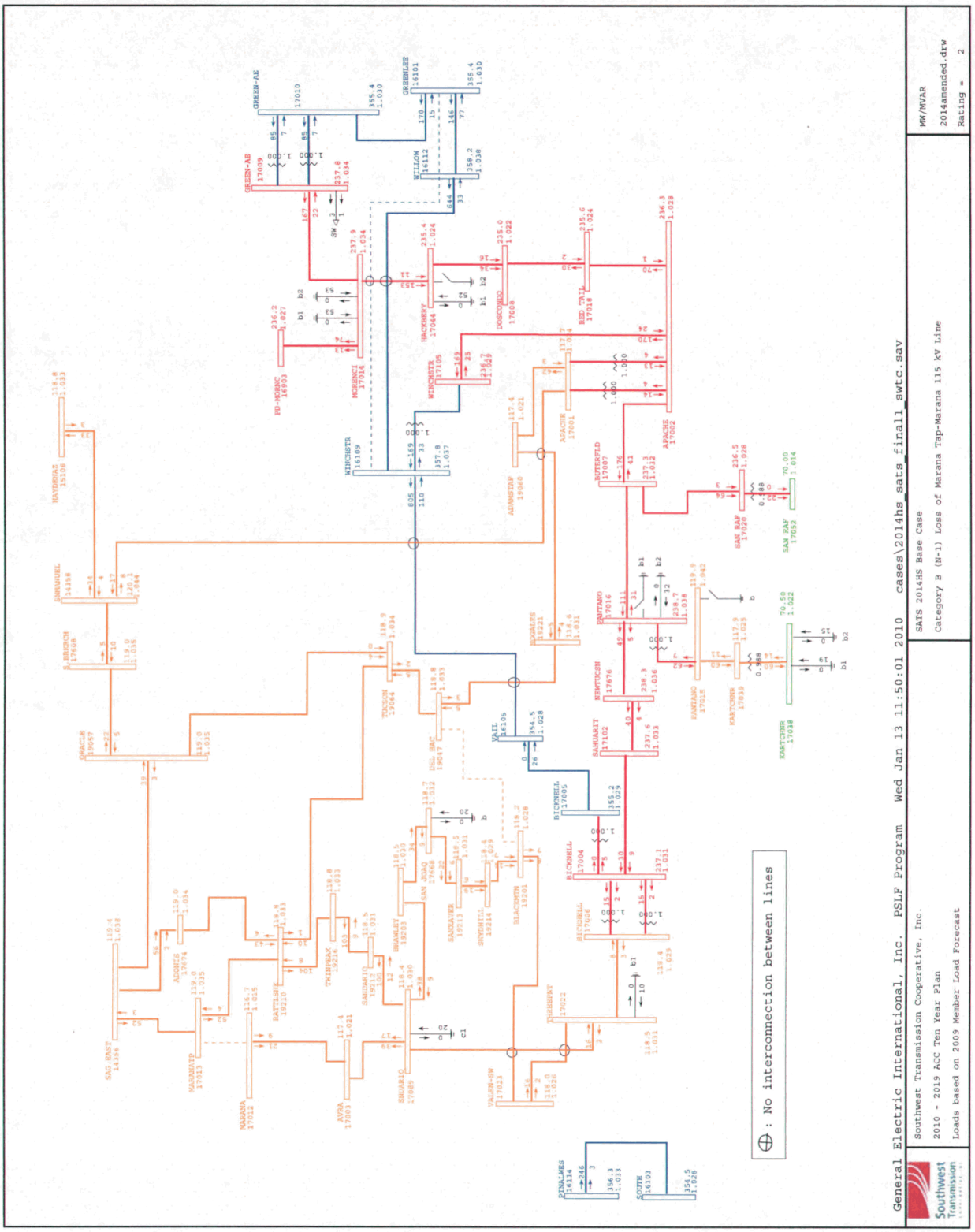
2014HS Southwest Transmission Cooperative Base System with Bicknell to Three Points 115 kV Line out of service



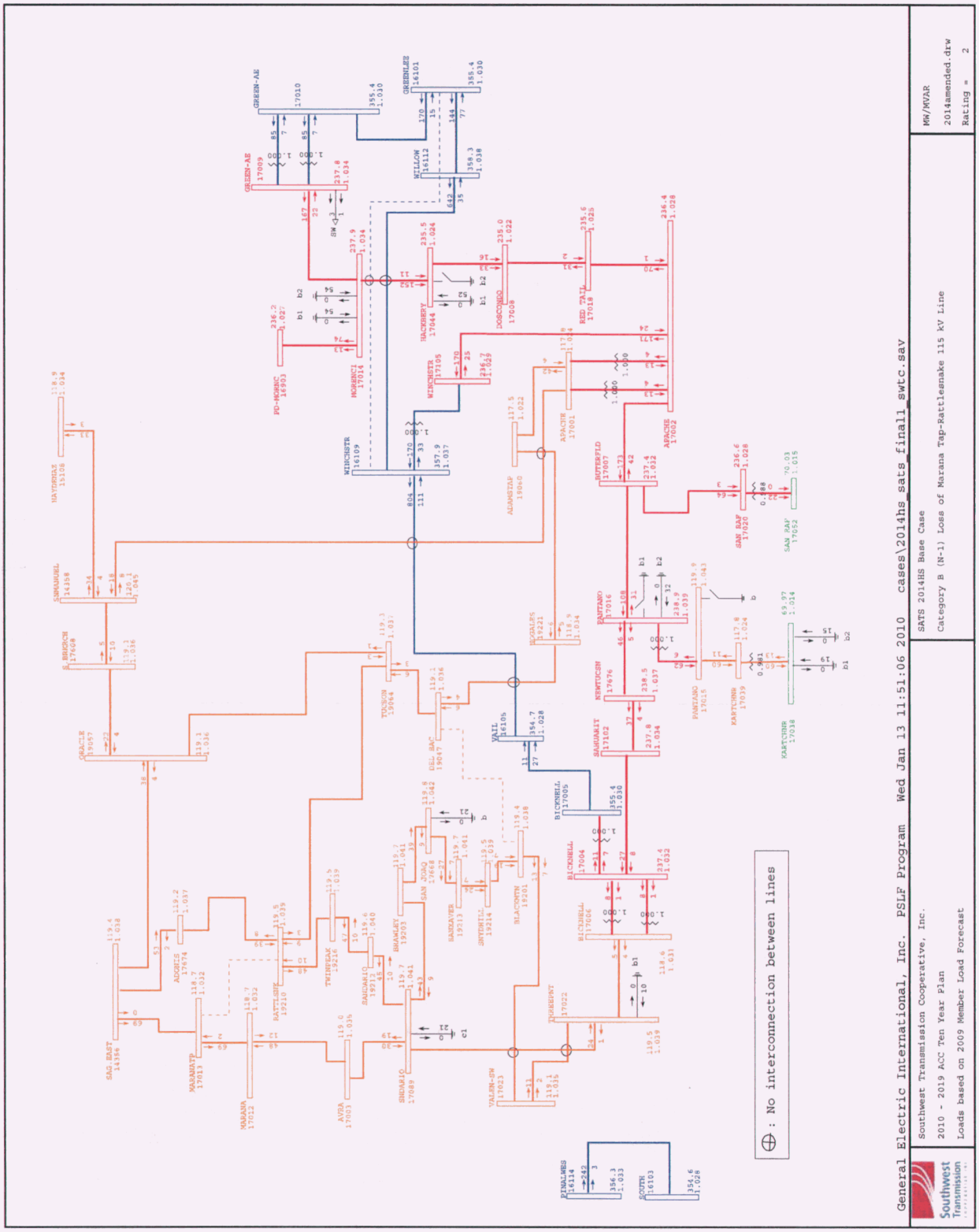
2014HS Southwest Transmission Cooperative Base System with Black Mountain to Valencia 115 kV Line out of service



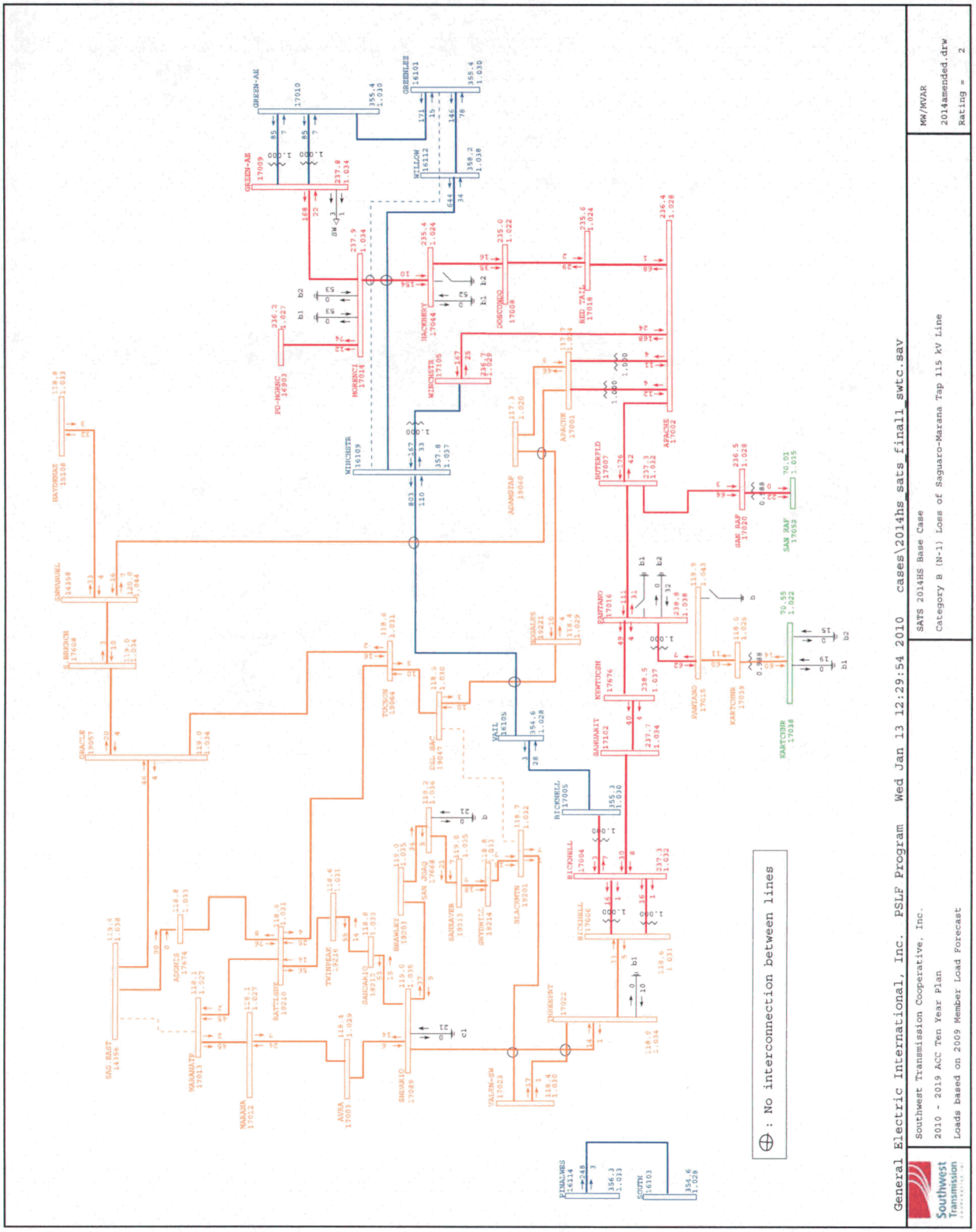
2014HS Southwest Transmission Cooperative Base System with Marana Tap to Marana 115 kV Line out of service



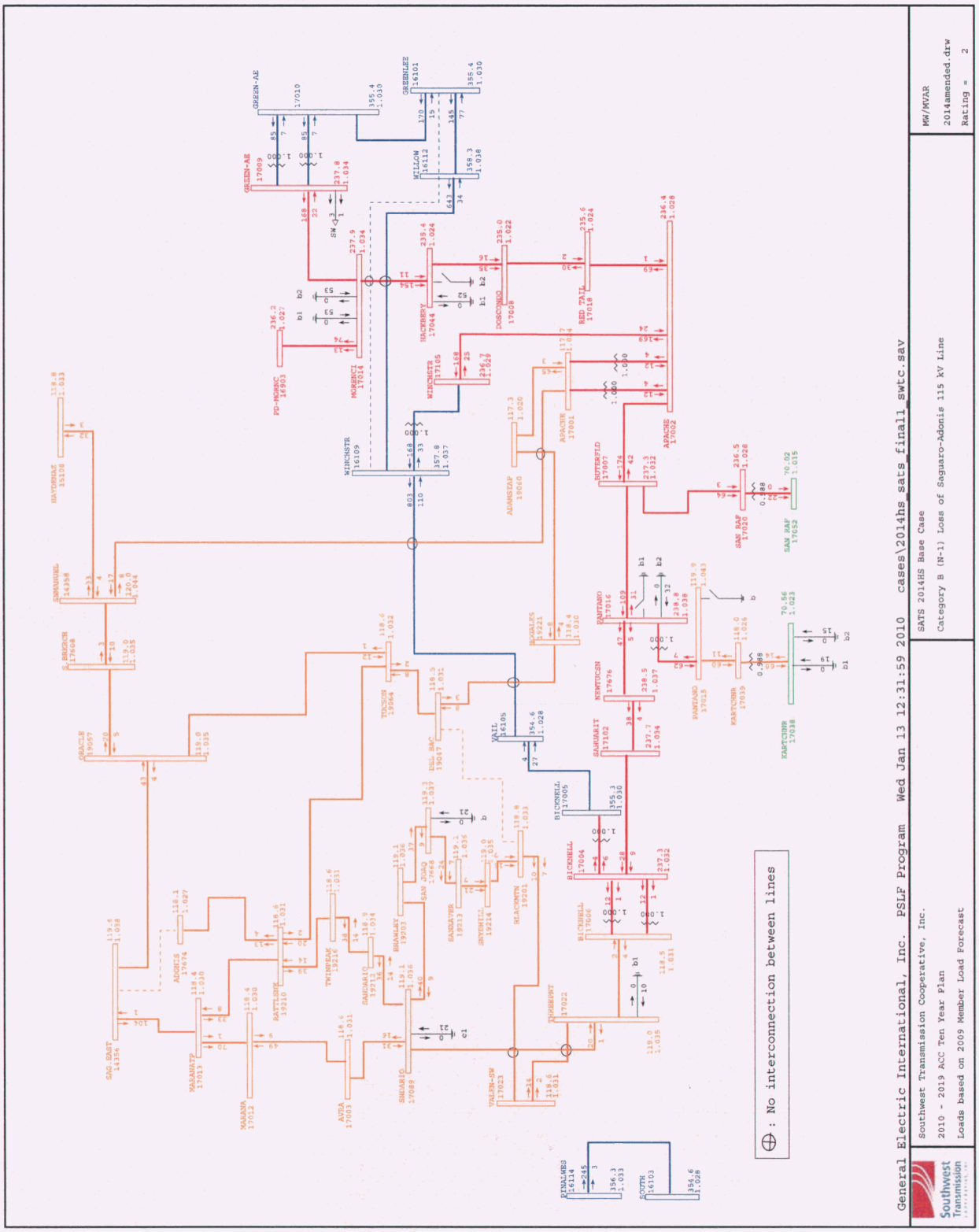
2014HS Southwest Transmission Cooperative Base System with Marana Tap to Rattlesnake 115 kV Line out of service



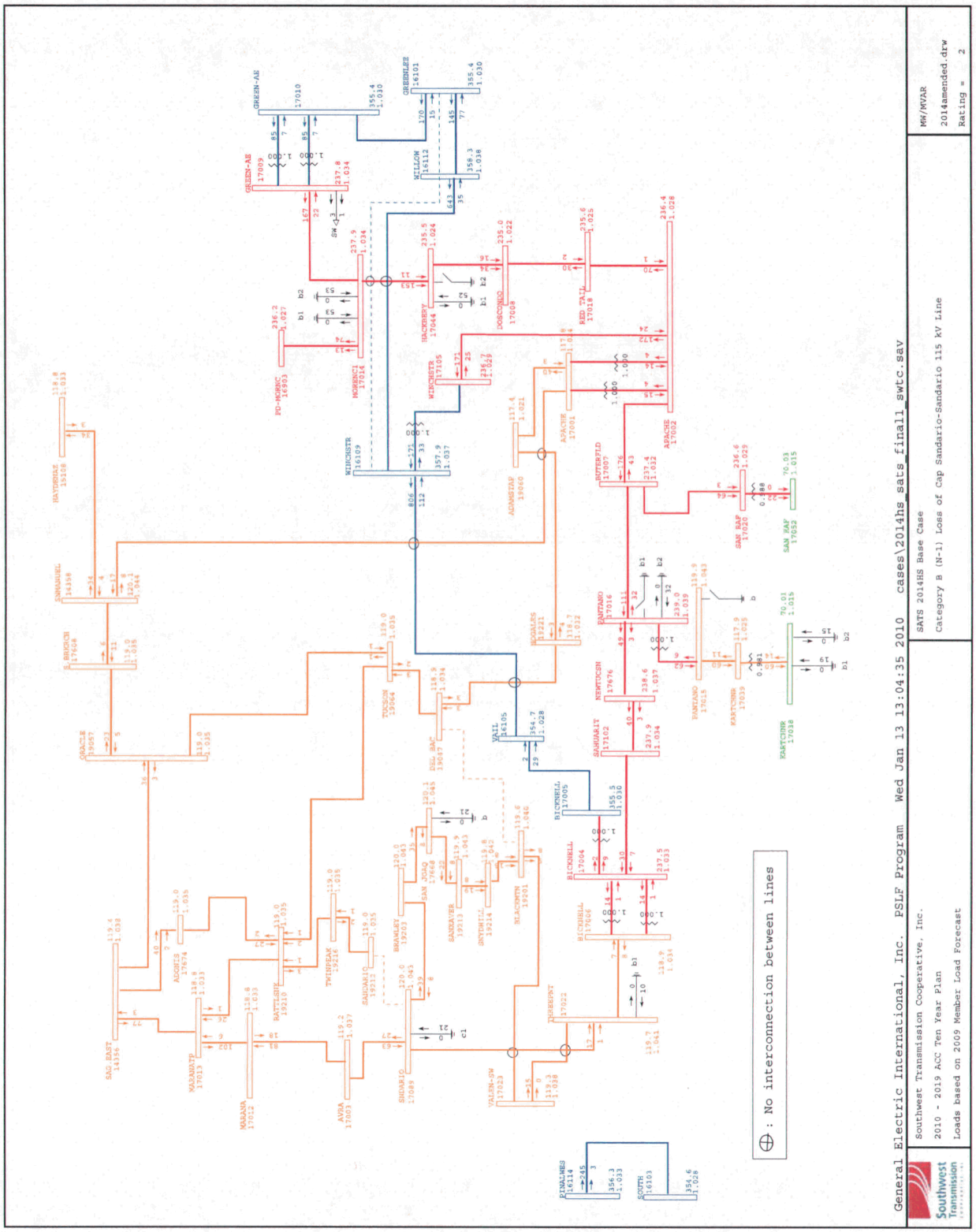
2014HS Southwest Transmission Cooperative Base System with Saguaro to Marana Tap 115 kV Line out of service



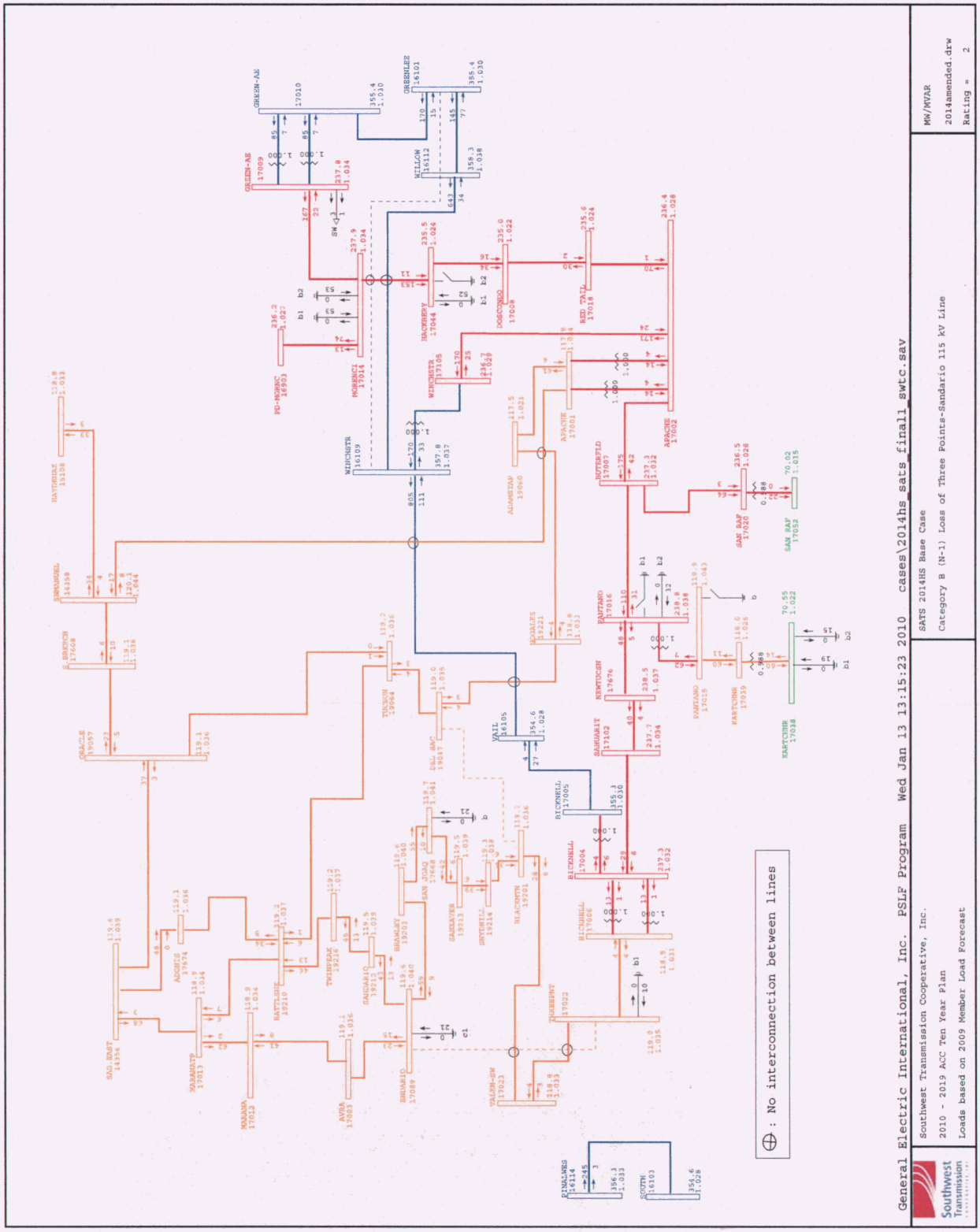
2014HS Southwest Transmission Cooperative Base System with Saguaro to Adonis 115 kV Line out of service



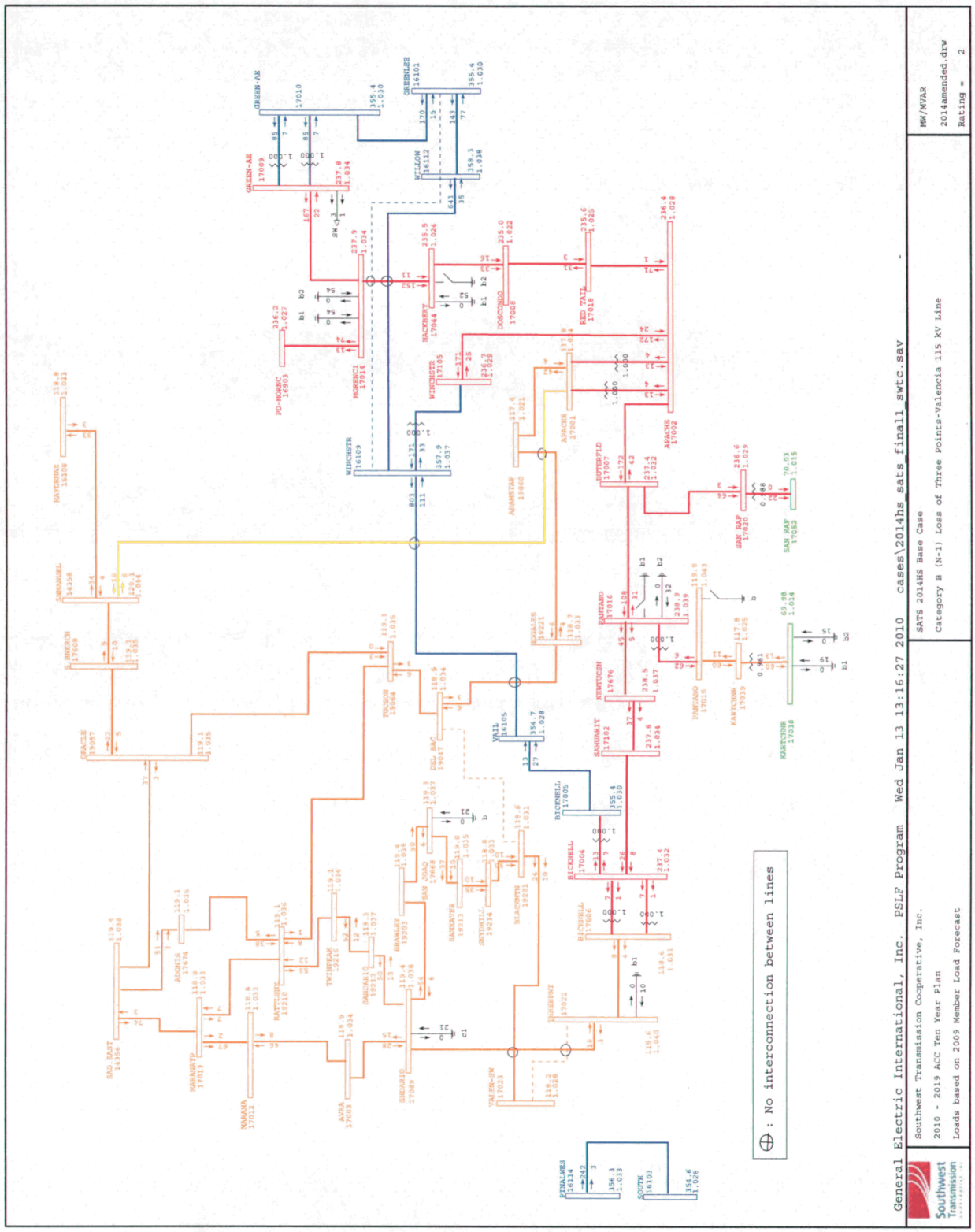
2014HS Southwest Transmission Cooperative Base System with Cap Sandario to Sandario 115 kV Line out of service



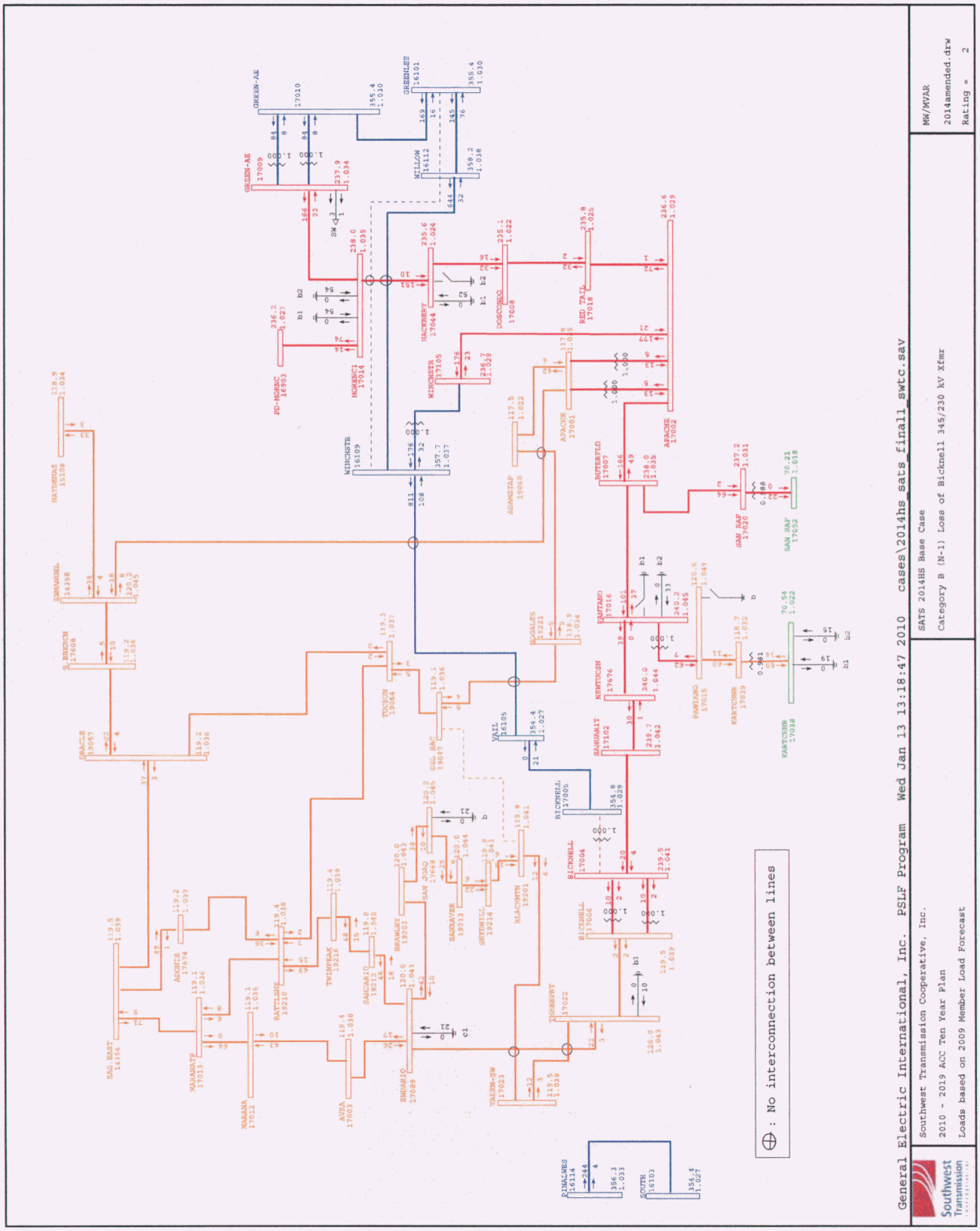
2014HS Southwest Transmission Cooperative Base System with Three Points to Sandario 115 kV Line out of service



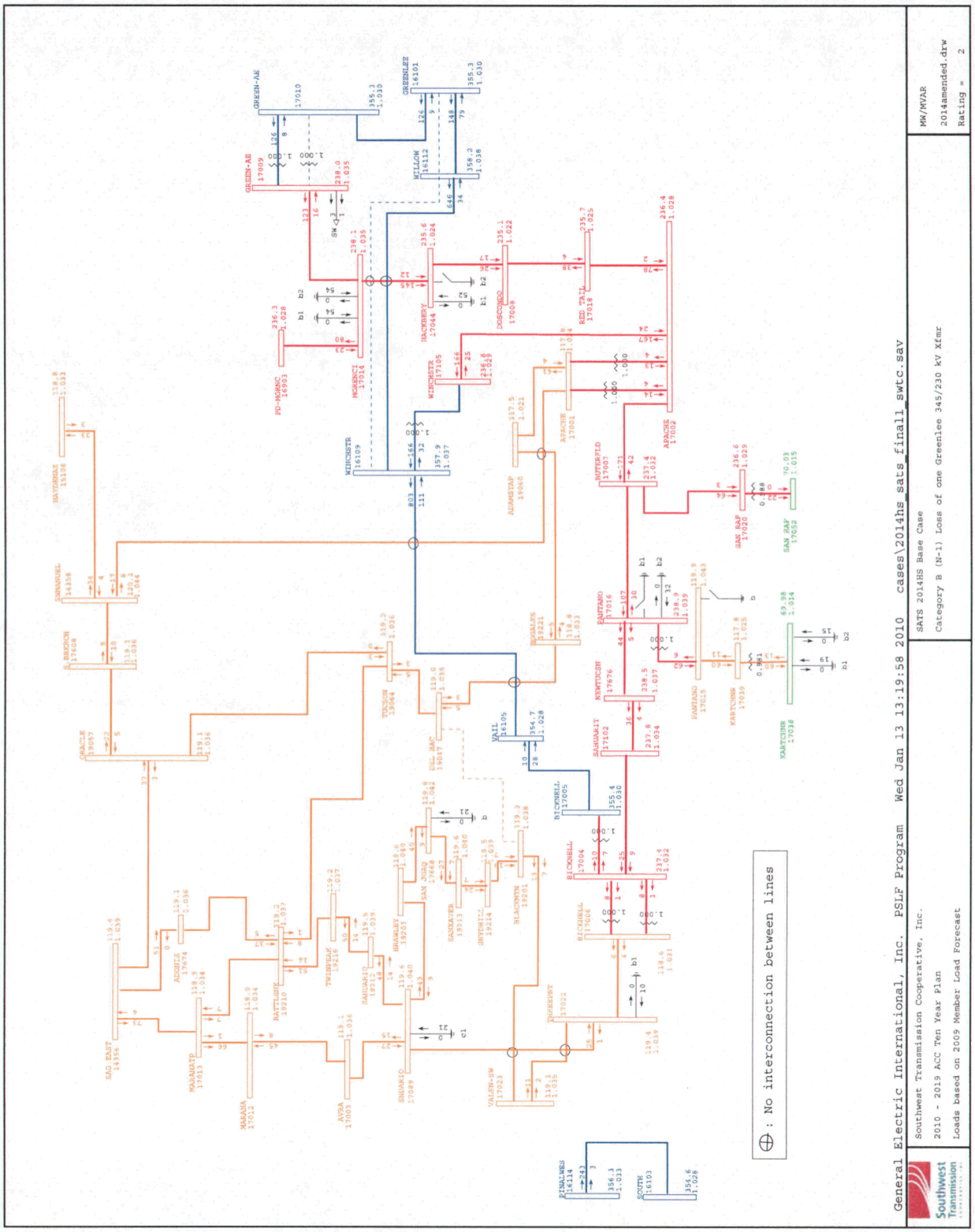
2014HS Southwest Transmission Cooperative Base System with Three Points to Valencia 115 kV Line out of service



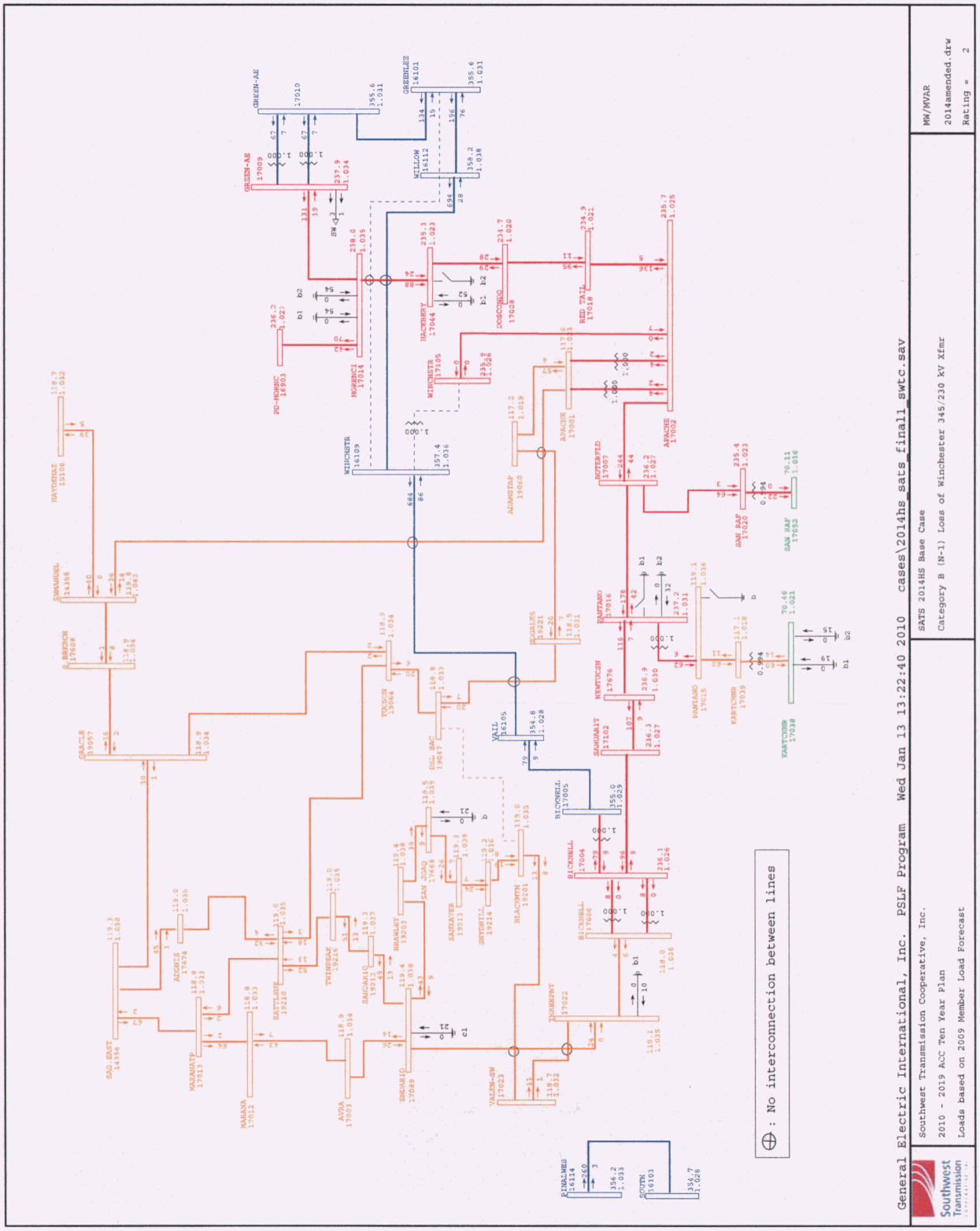
2014HS Southwest Transmission Cooperative Base System with Bicknell 345/230 kV Transformer out of service



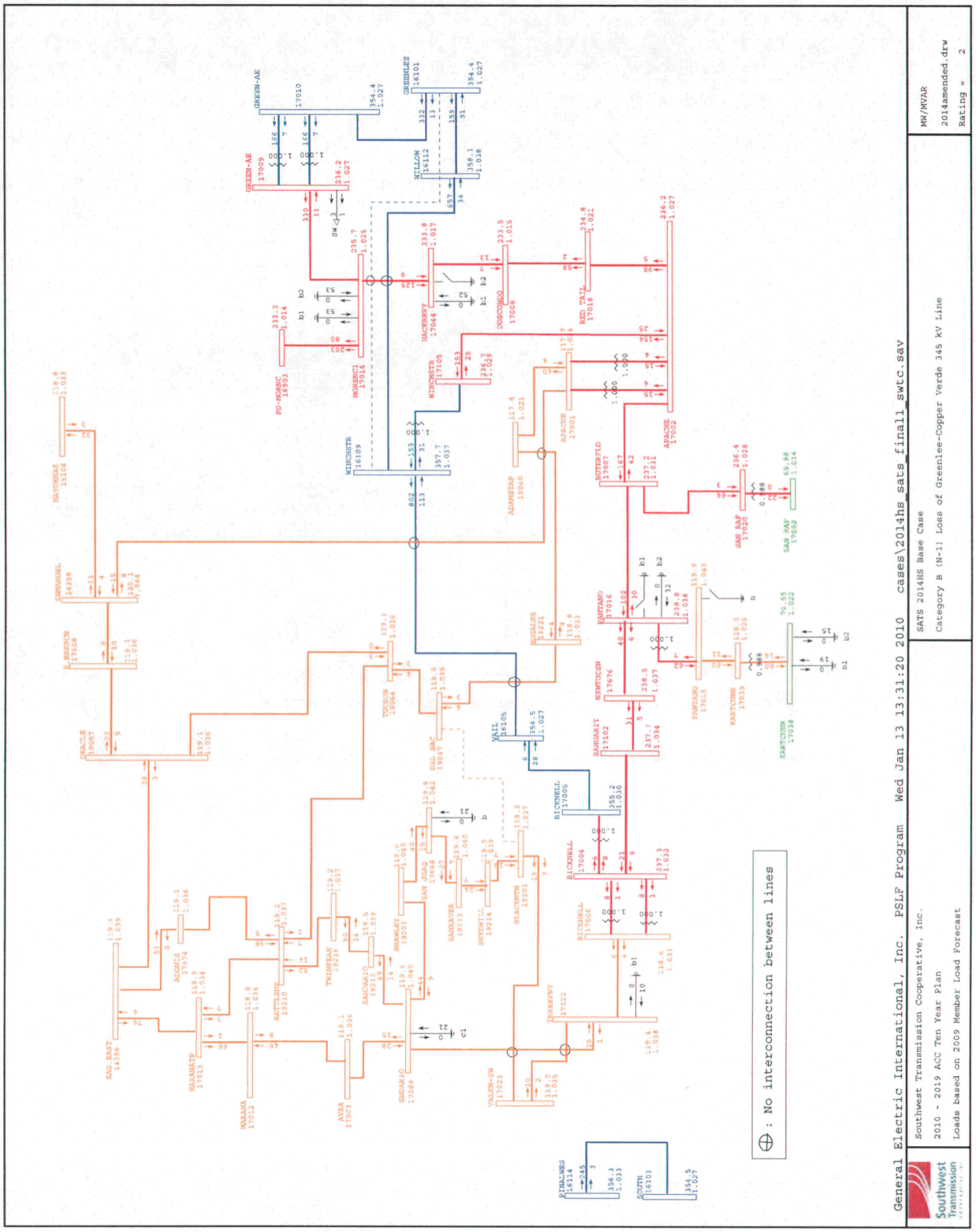
2014HS Southwest Transmission Cooperative Base System with one Greenlee 345/230 Transformer out of service



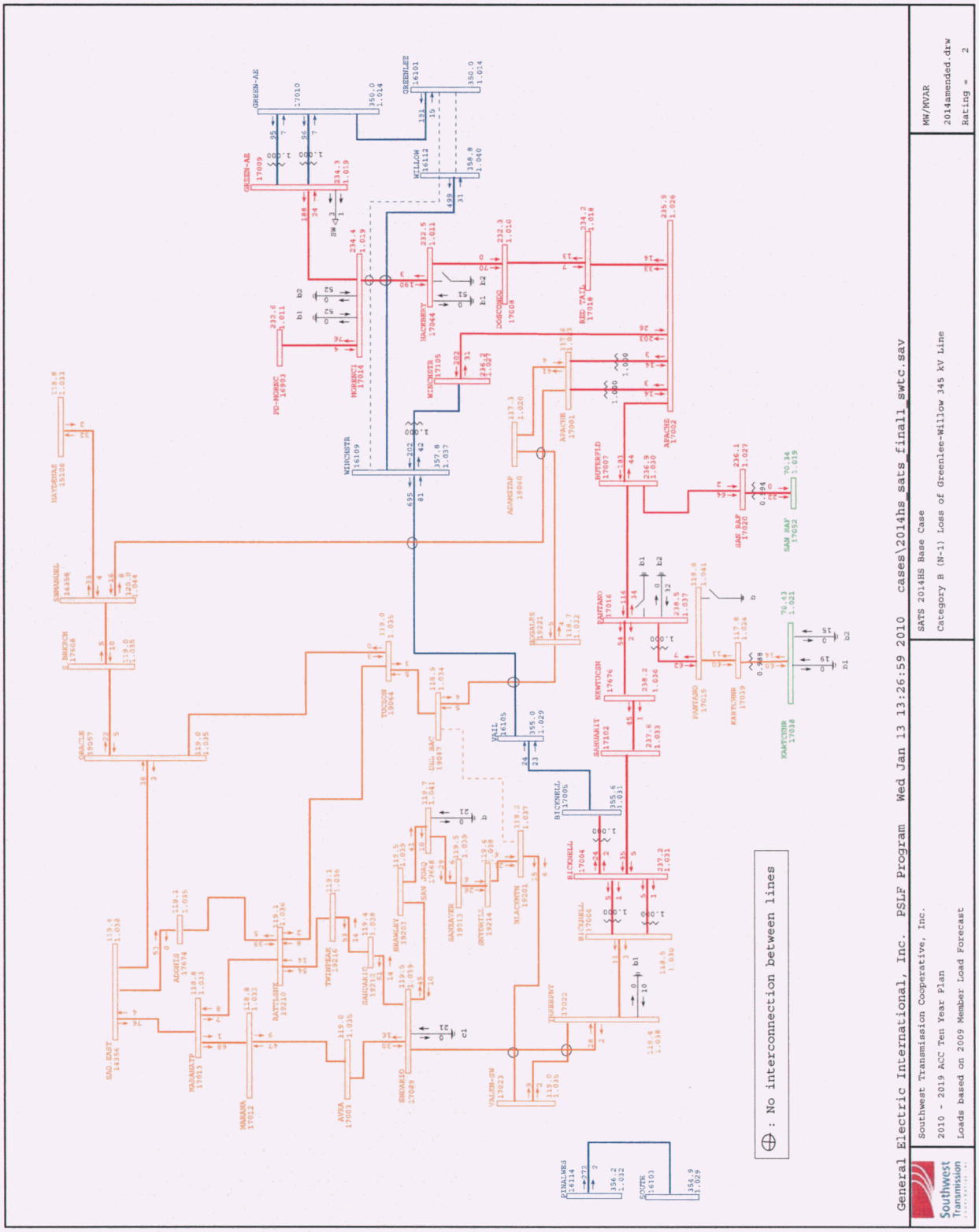
2014HS Southwest Transmission Cooperative Base System with Winchester 345/230 kV Transformer out of service



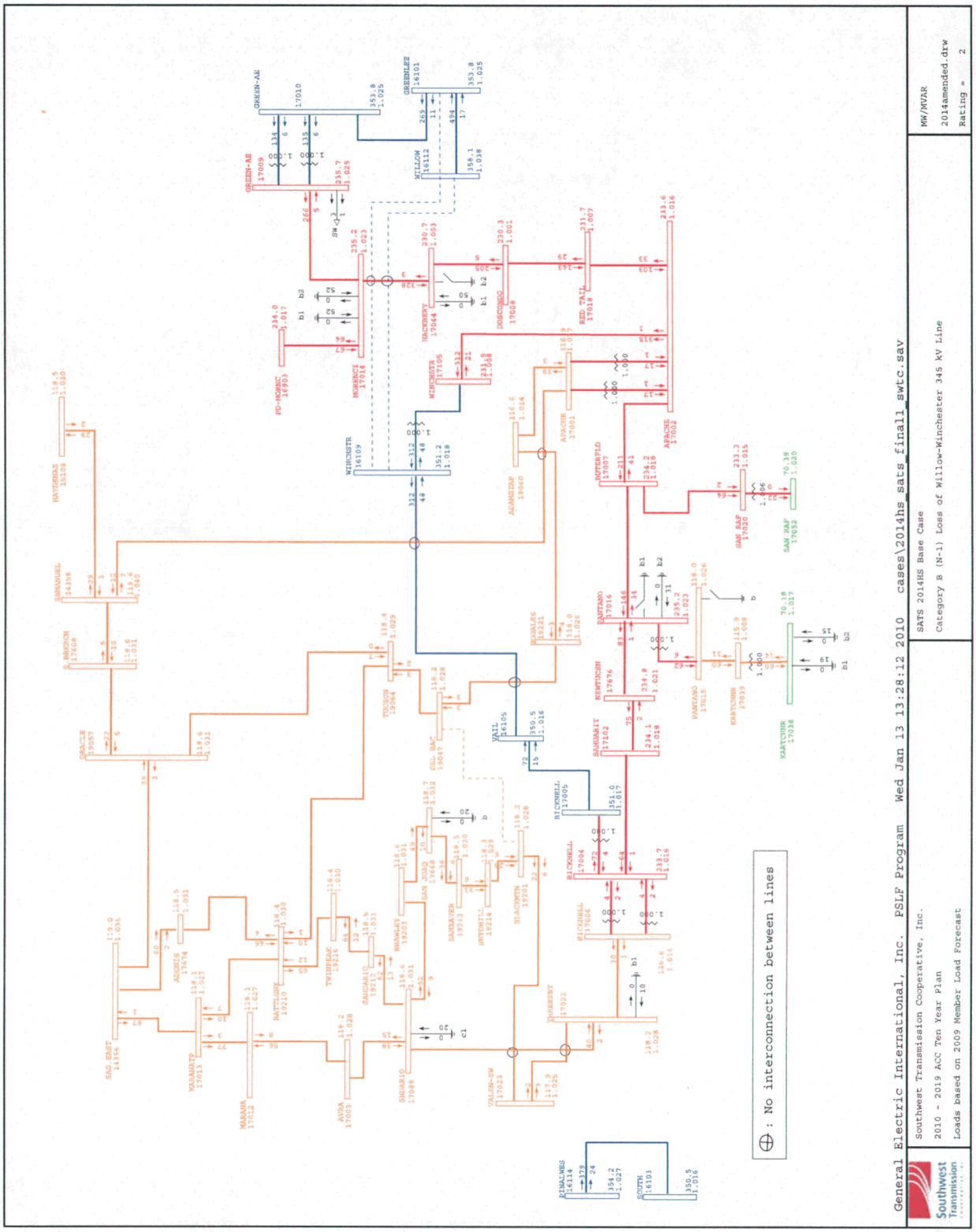
2014HS Southwest Transmission Cooperative Base System with Greenlee to Copper Verde 345 kV Line out of service



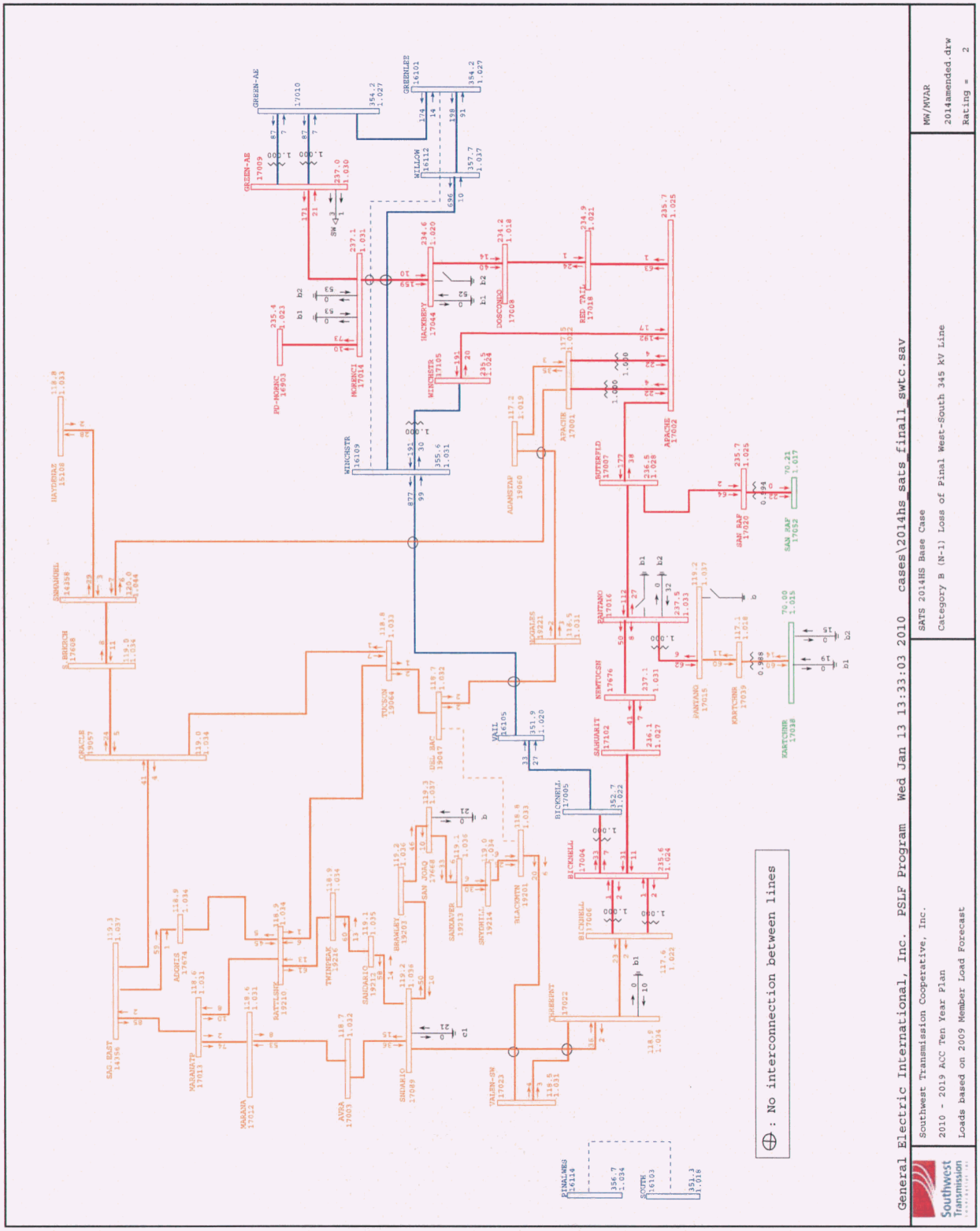
2014HS Southwest Transmission Cooperative Base System with Greenlee to Willow 345 kV Line out of service



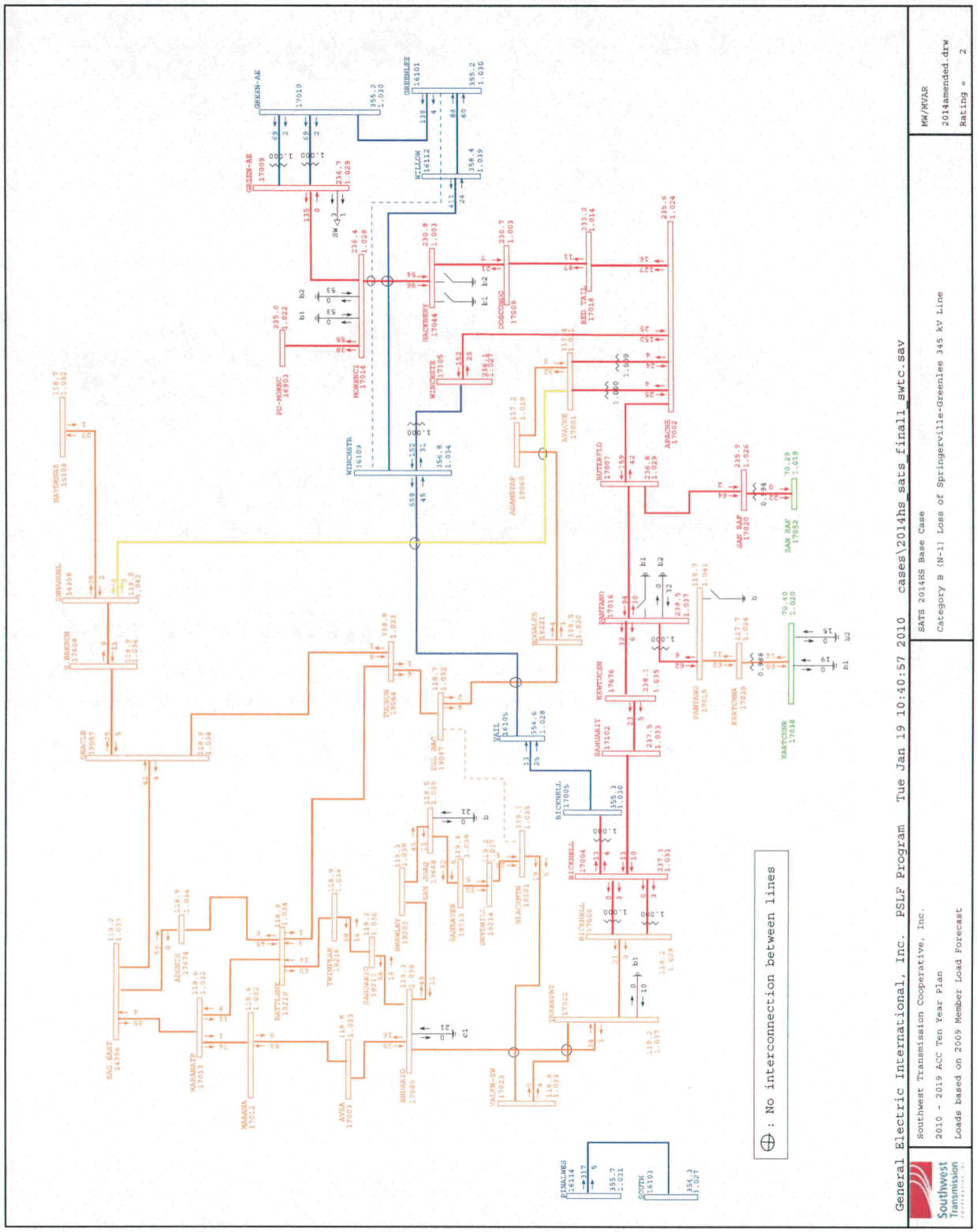
2014HS Southwest Transmission Cooperative Base System with Willow to Winchester 345 kV Line out of service



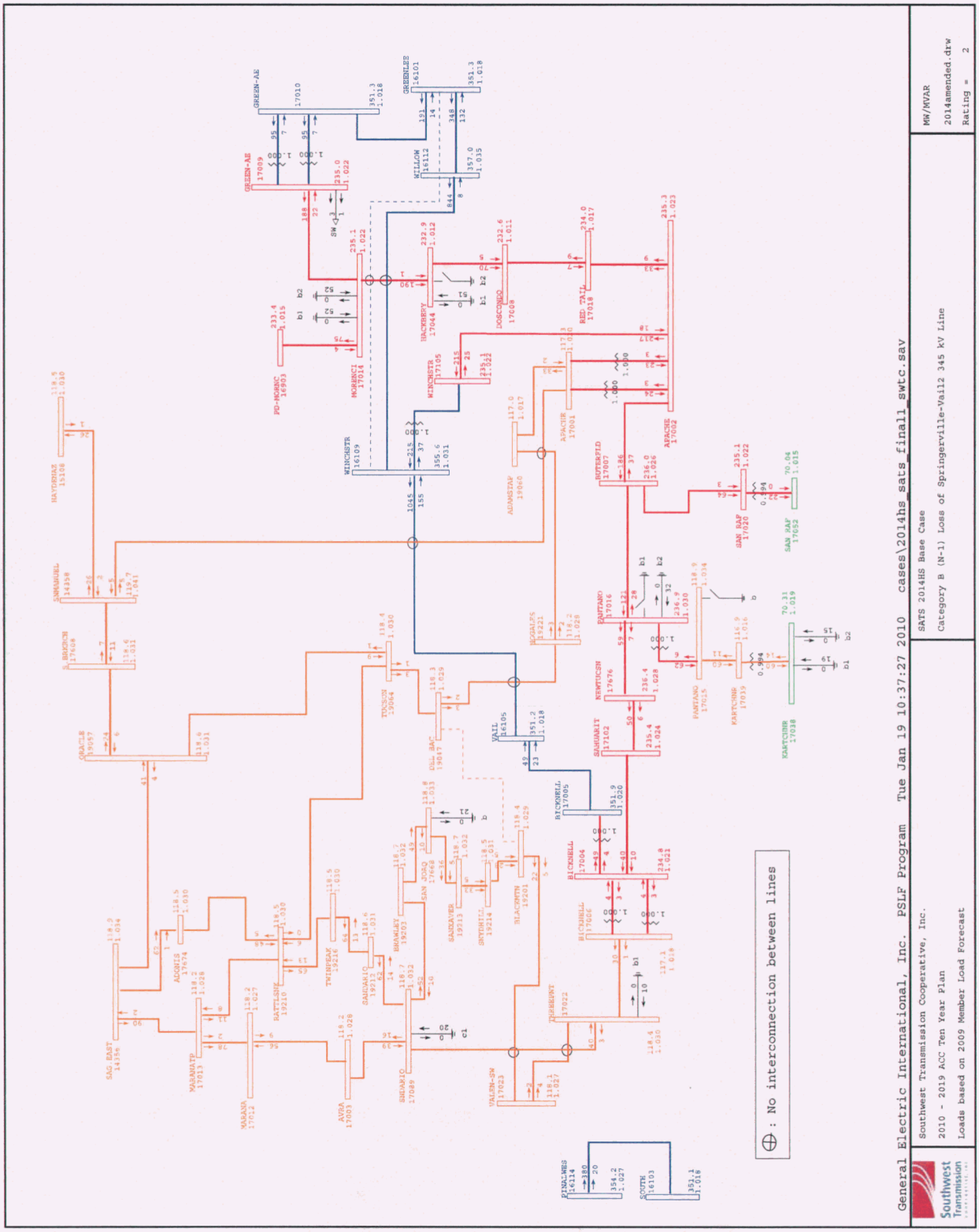
2014HS Southwest Transmission Cooperative Base System with Pinal West to South 345 kV Line out of service



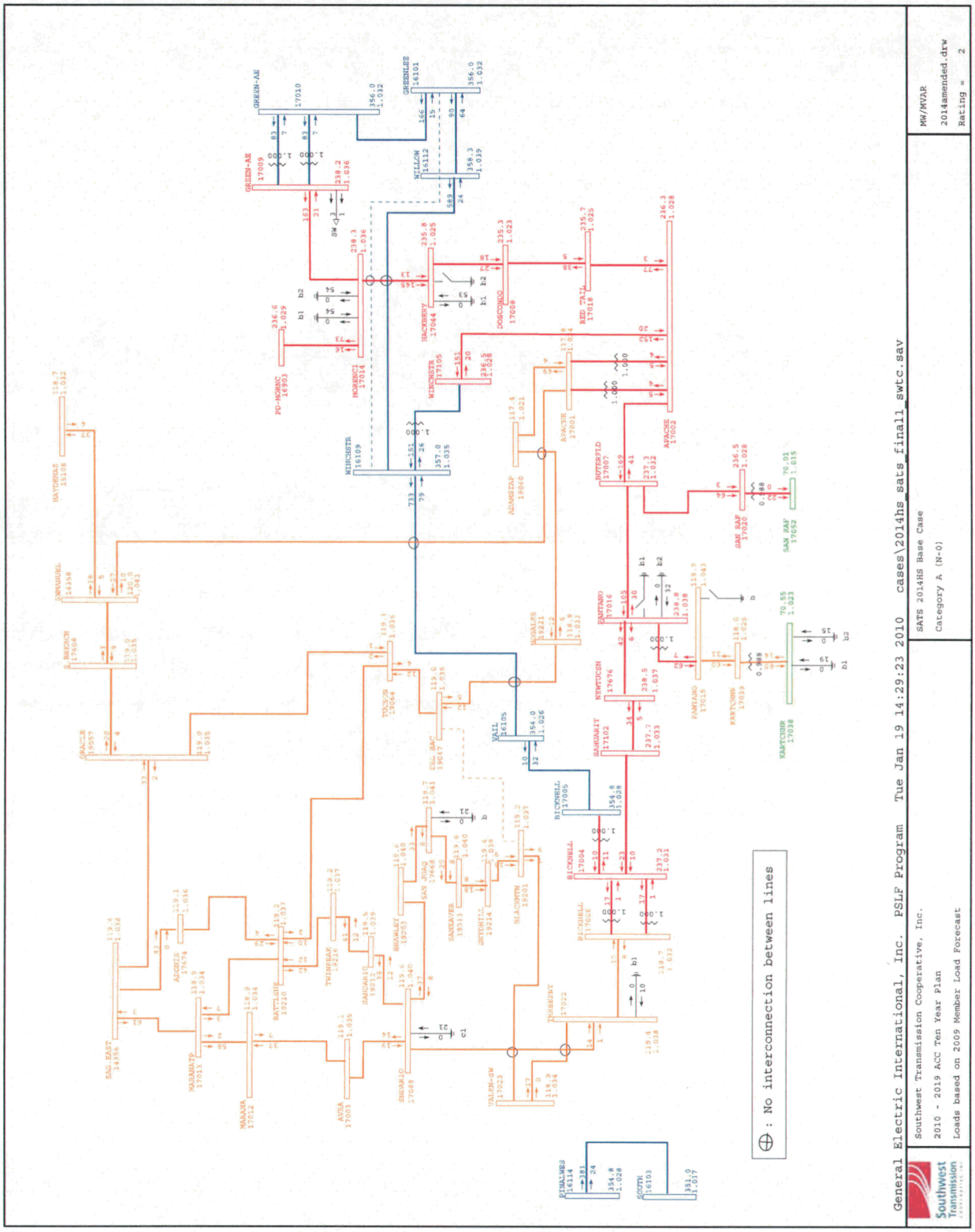
2014HS Southwest Transmission Cooperative Base System with Springerville to Greenlee 345 kV Line out of service



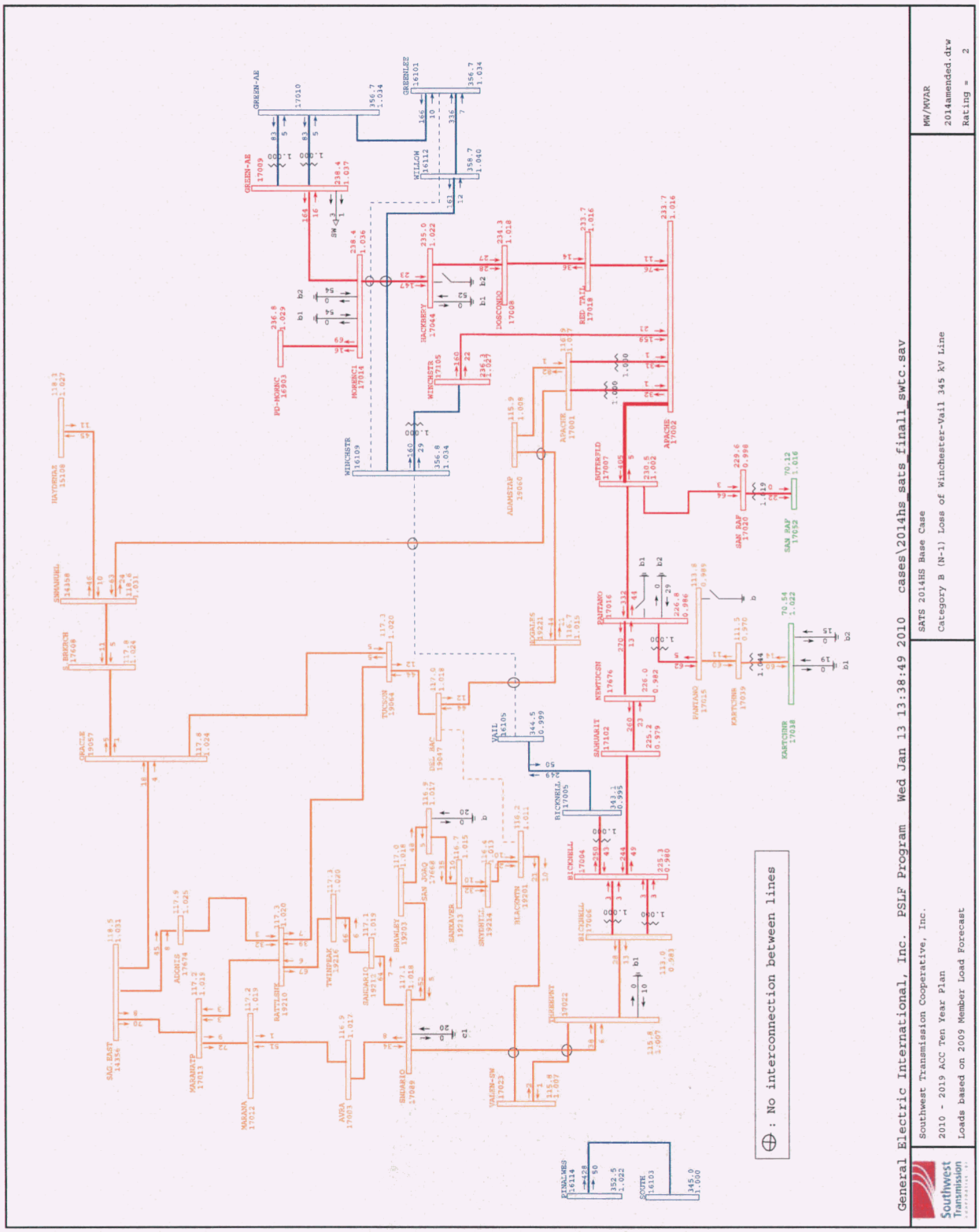
2014HS Southwest Transmission Cooperative Base System with Springerville to Vail2 345 kV Line out of service



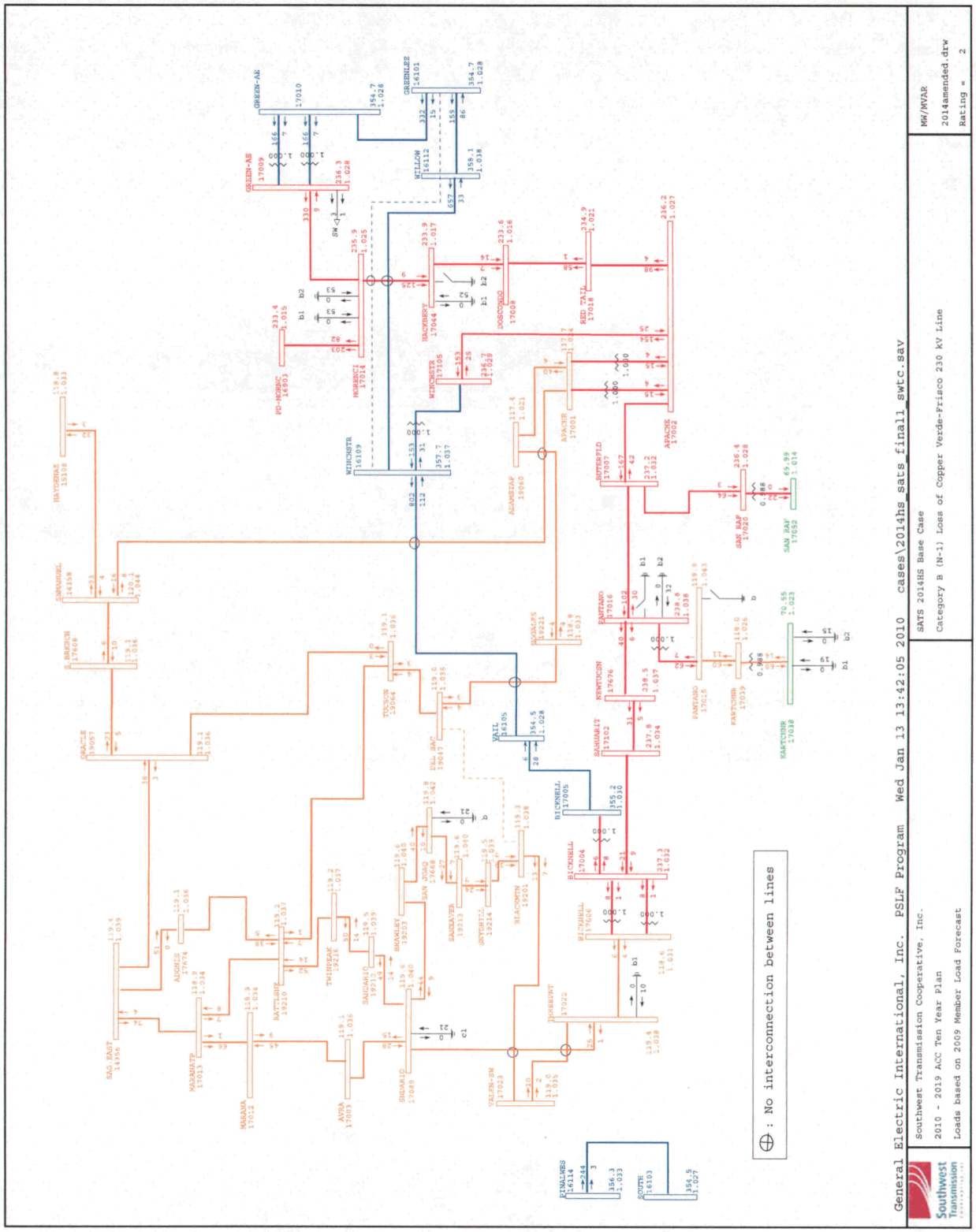
2014HS Southwest Transmission Cooperative Base System with Vail to South 345 kV Line out of service



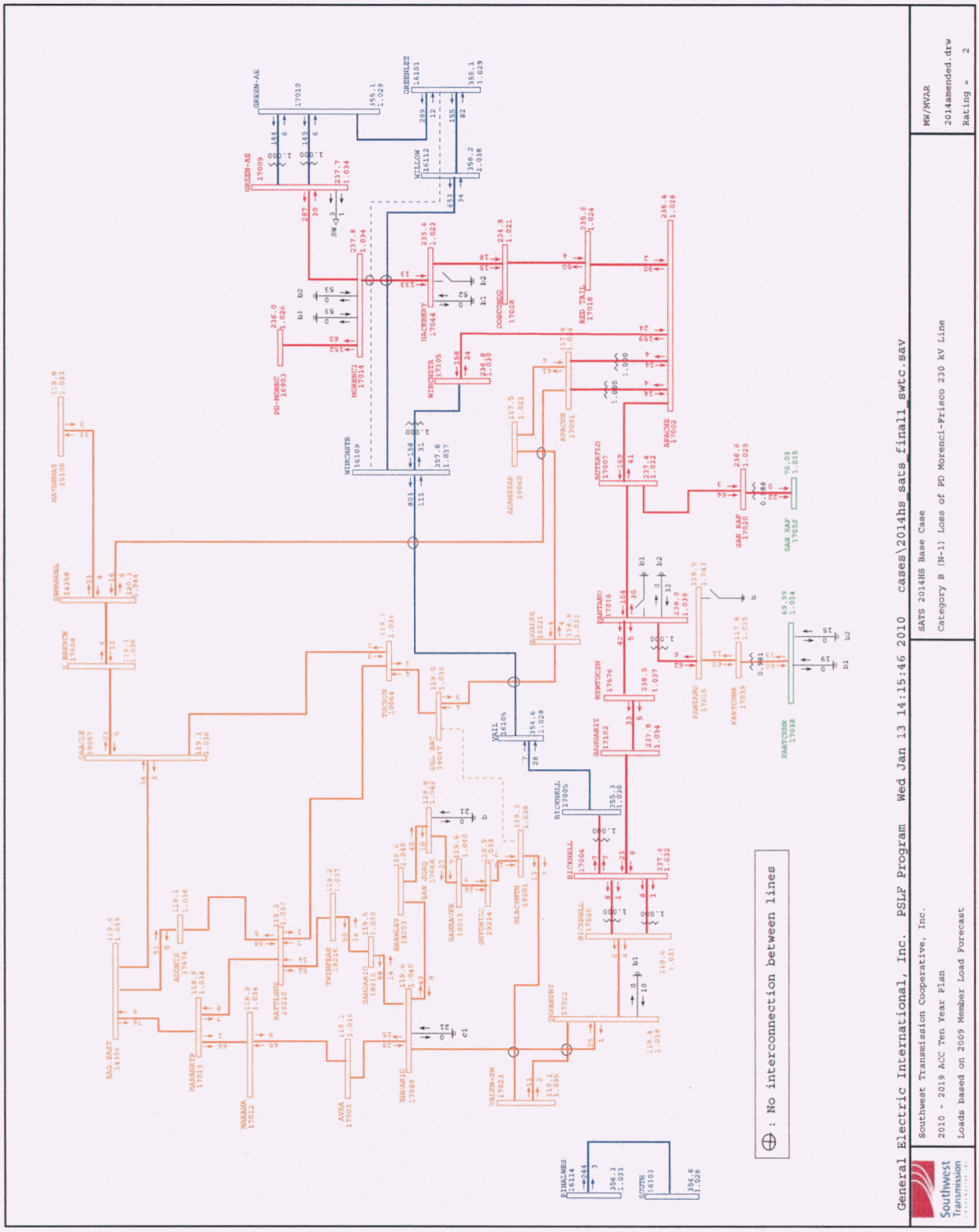
2014HS Southwest Transmission Cooperative Base System with Winchester to Vail 345 kV Line out of service



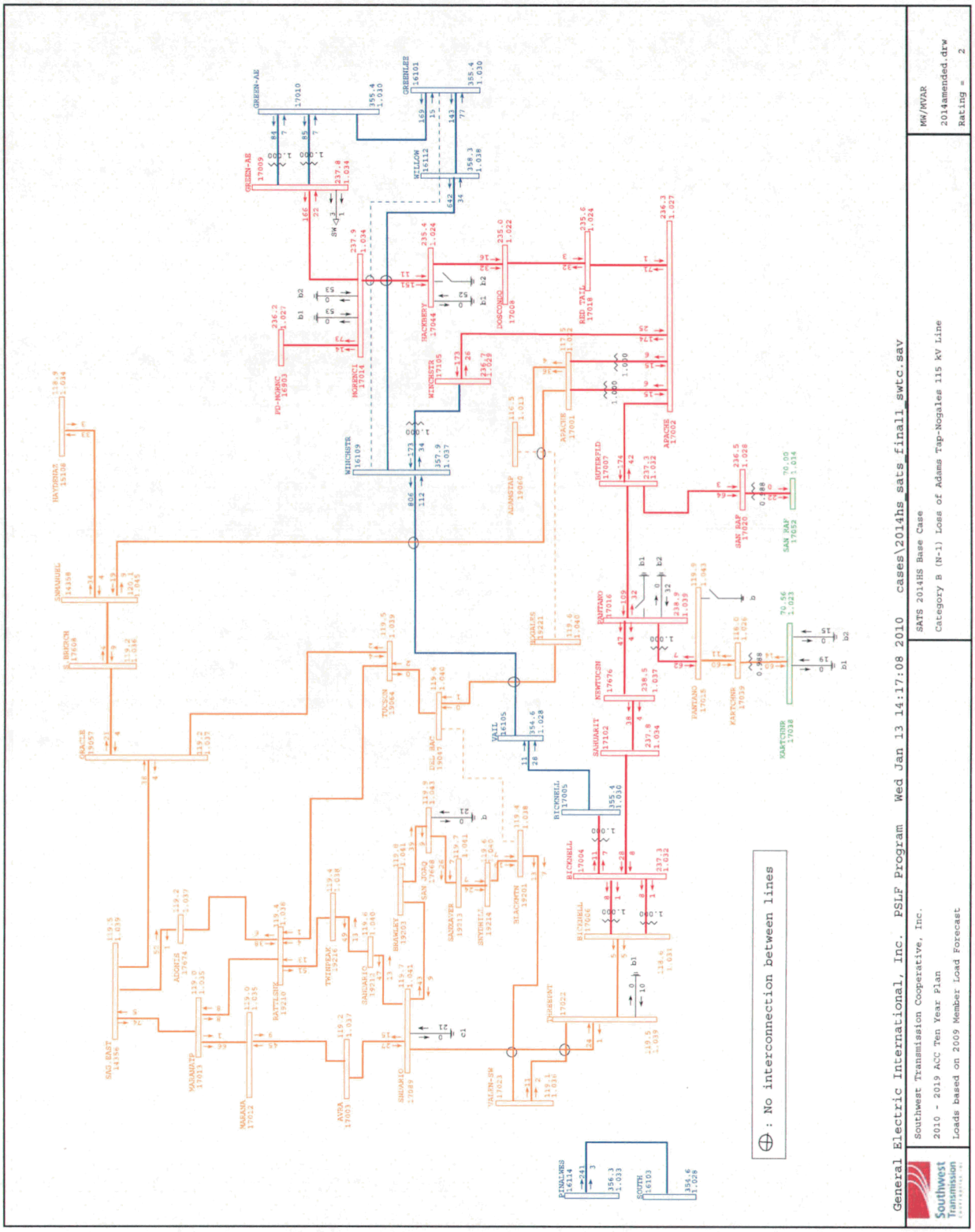
2014HS Southwest Transmission Cooperative Base System with Copper Verde to Frisco 230 kV Line out of service



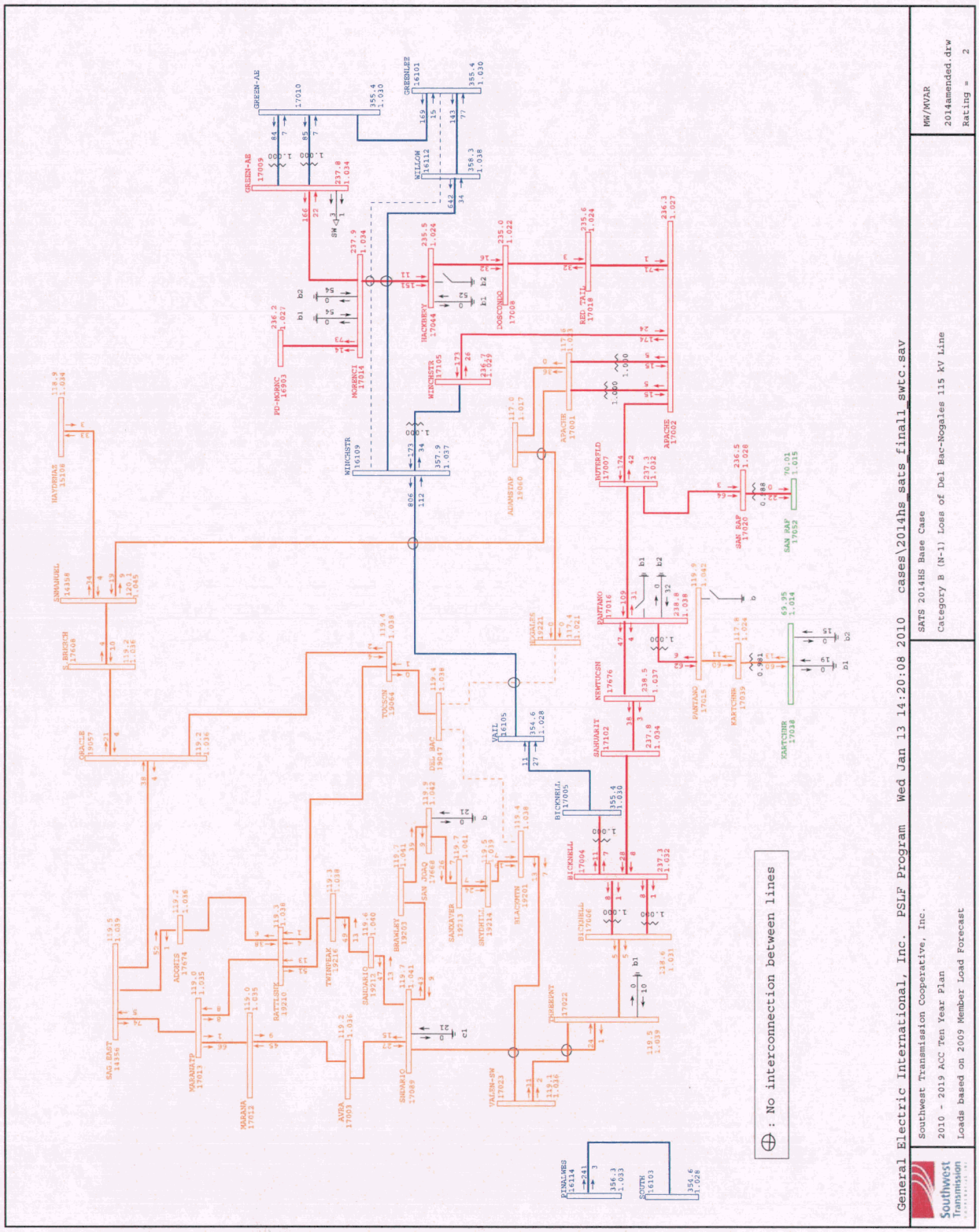
2014HS Southwest Transmission Cooperative Base System with PD Morenci to Frisco 230 kV Line out of service



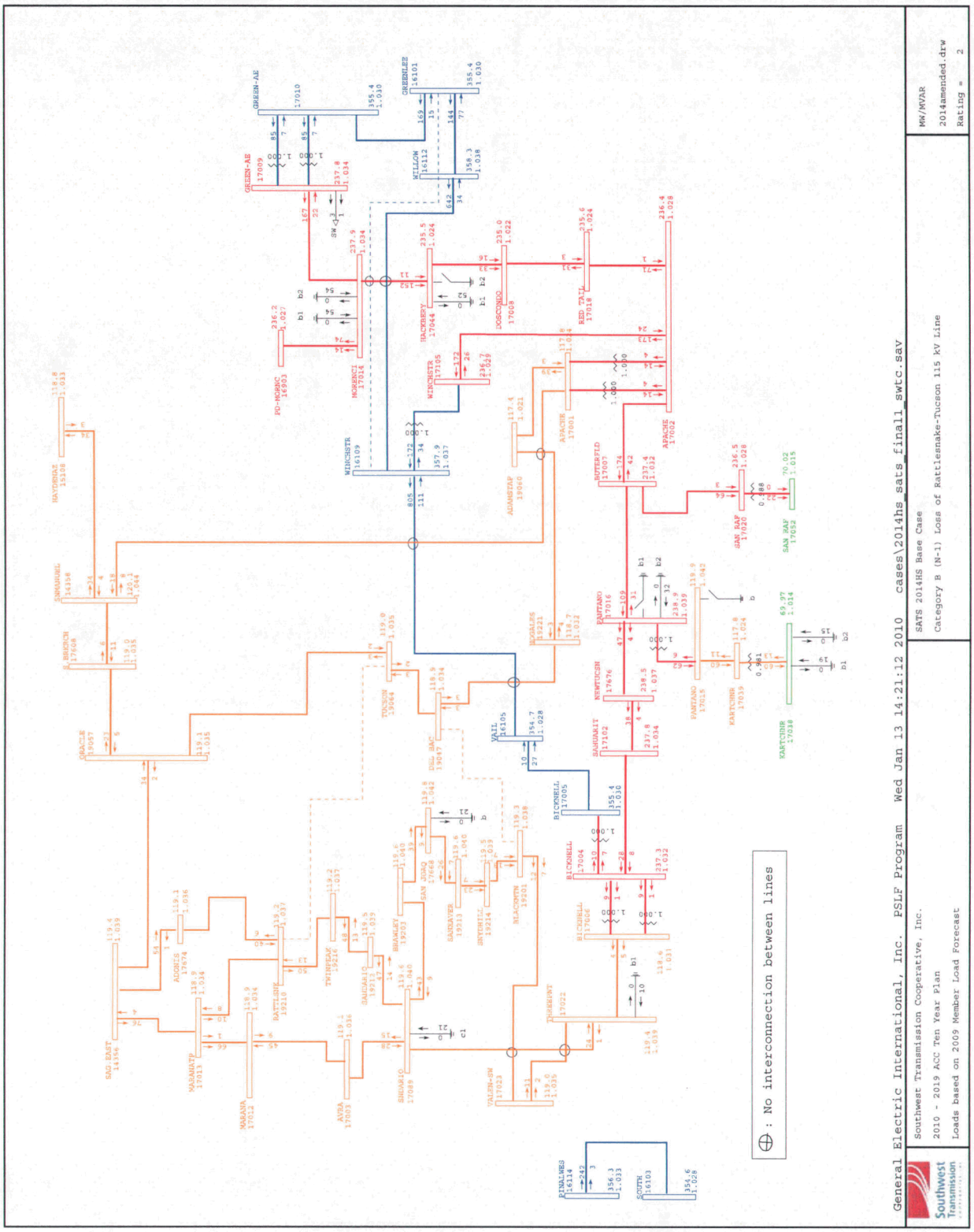
2014HS Southwest Transmission Cooperative Base System with Adams Tap to Nogales 115 kV Line out of service



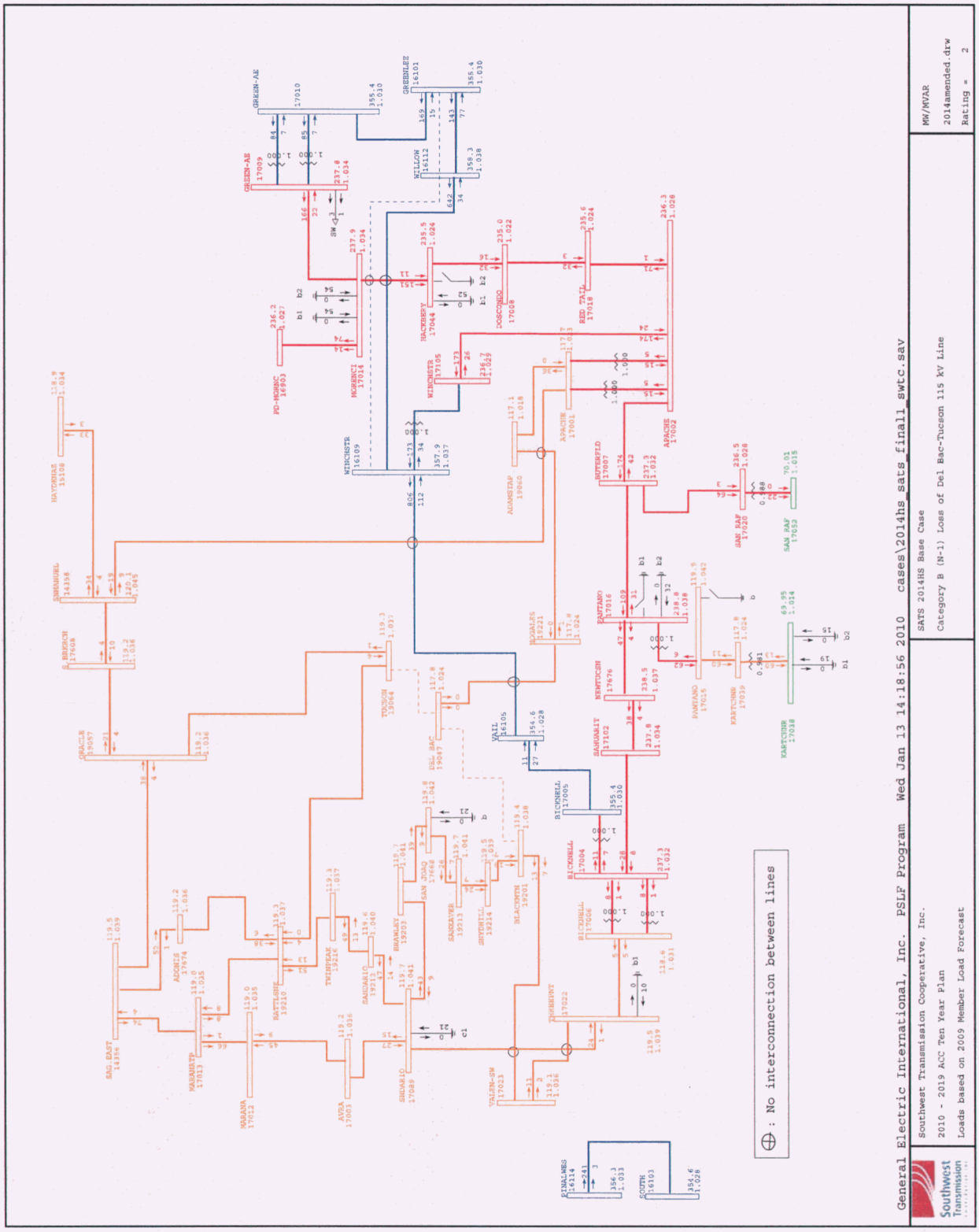
2014HS Southwest Transmission Cooperative Base System with Del Bac to Nogales 115 kV Line out of service



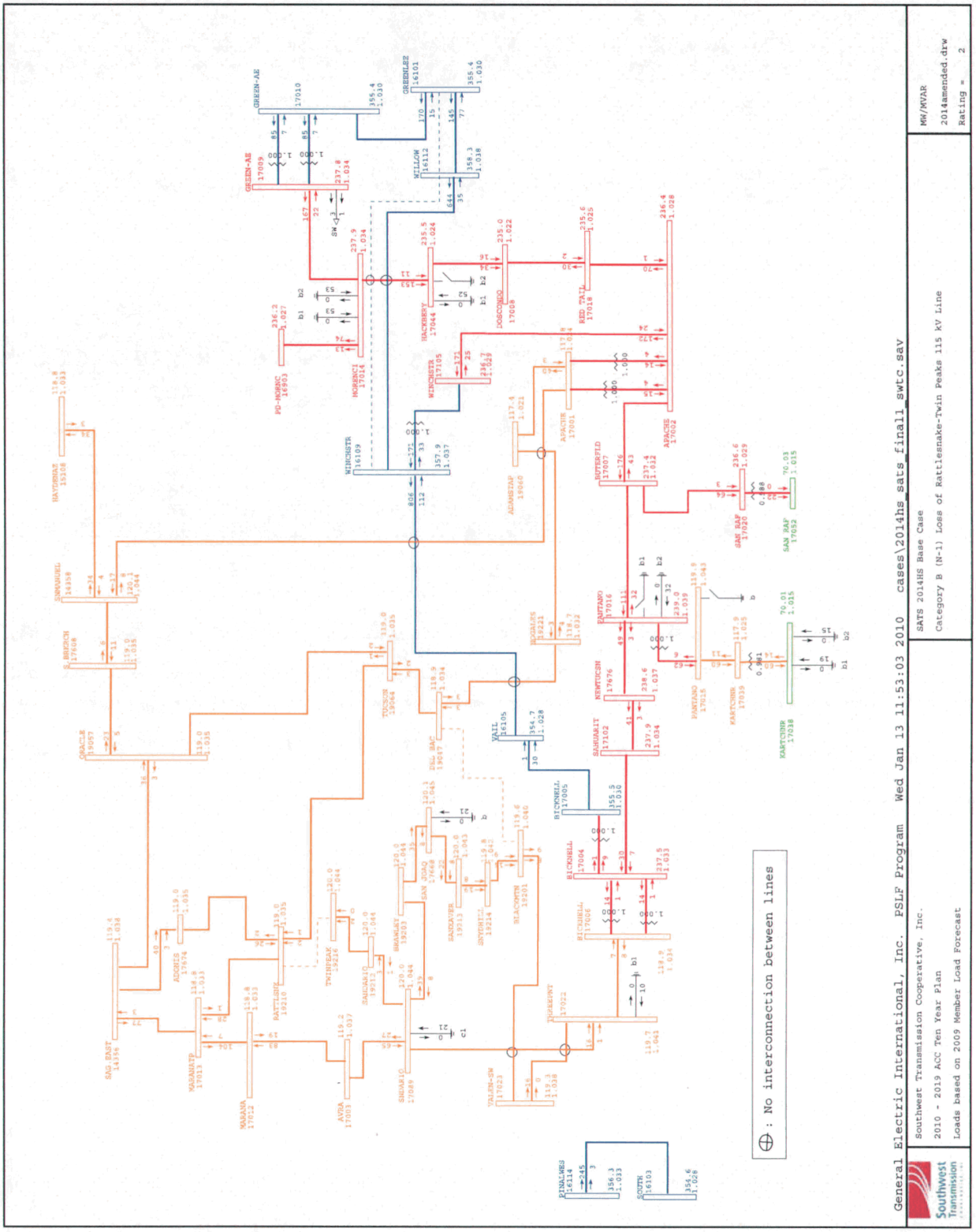
2014HS Southwest Transmission Cooperative Base System with Rattlesnake to Tucson 115 kV Line out of service



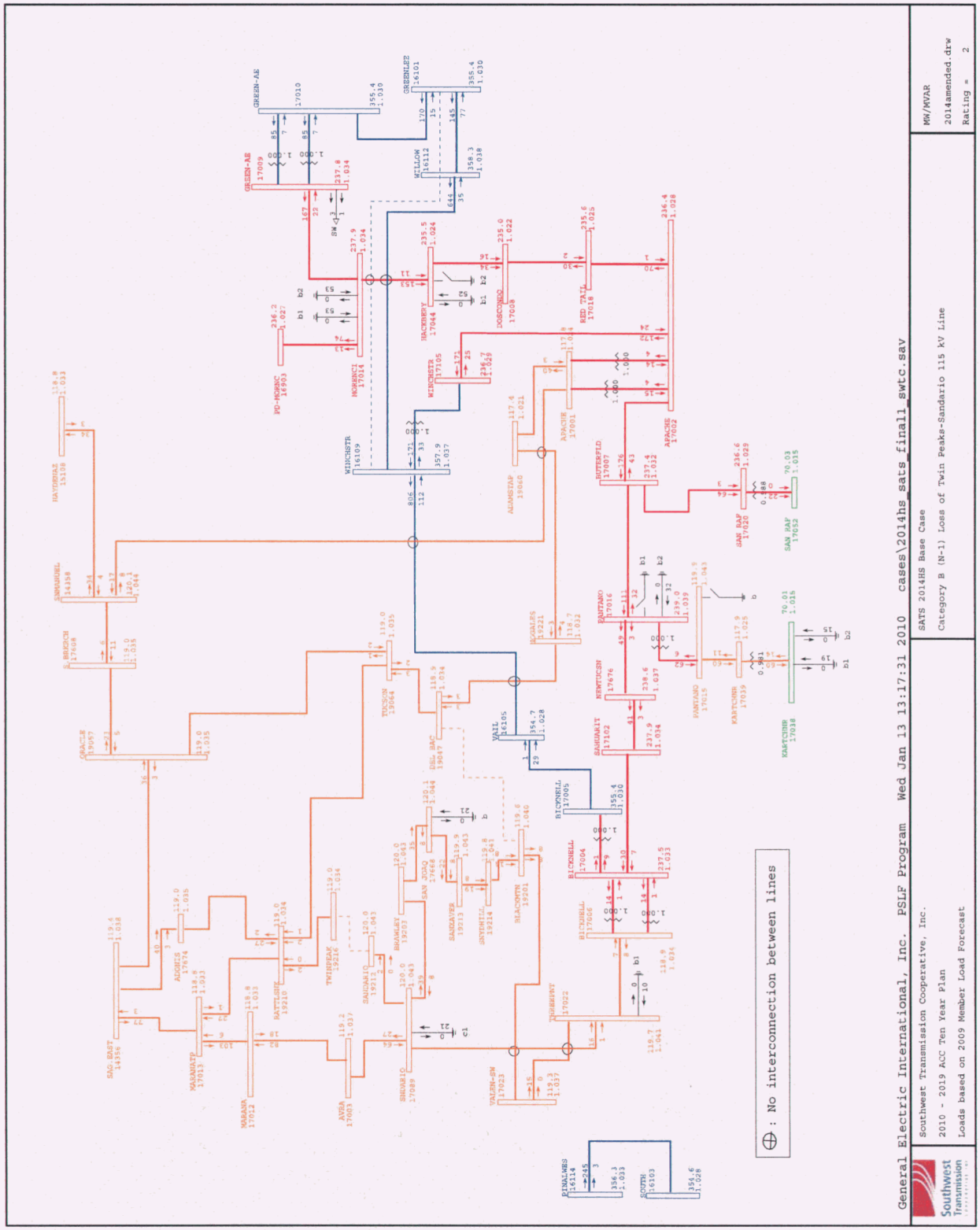
2014HS Southwest Transmission Cooperative Base System with Del Bac to Tucson 115 kV Line out of service



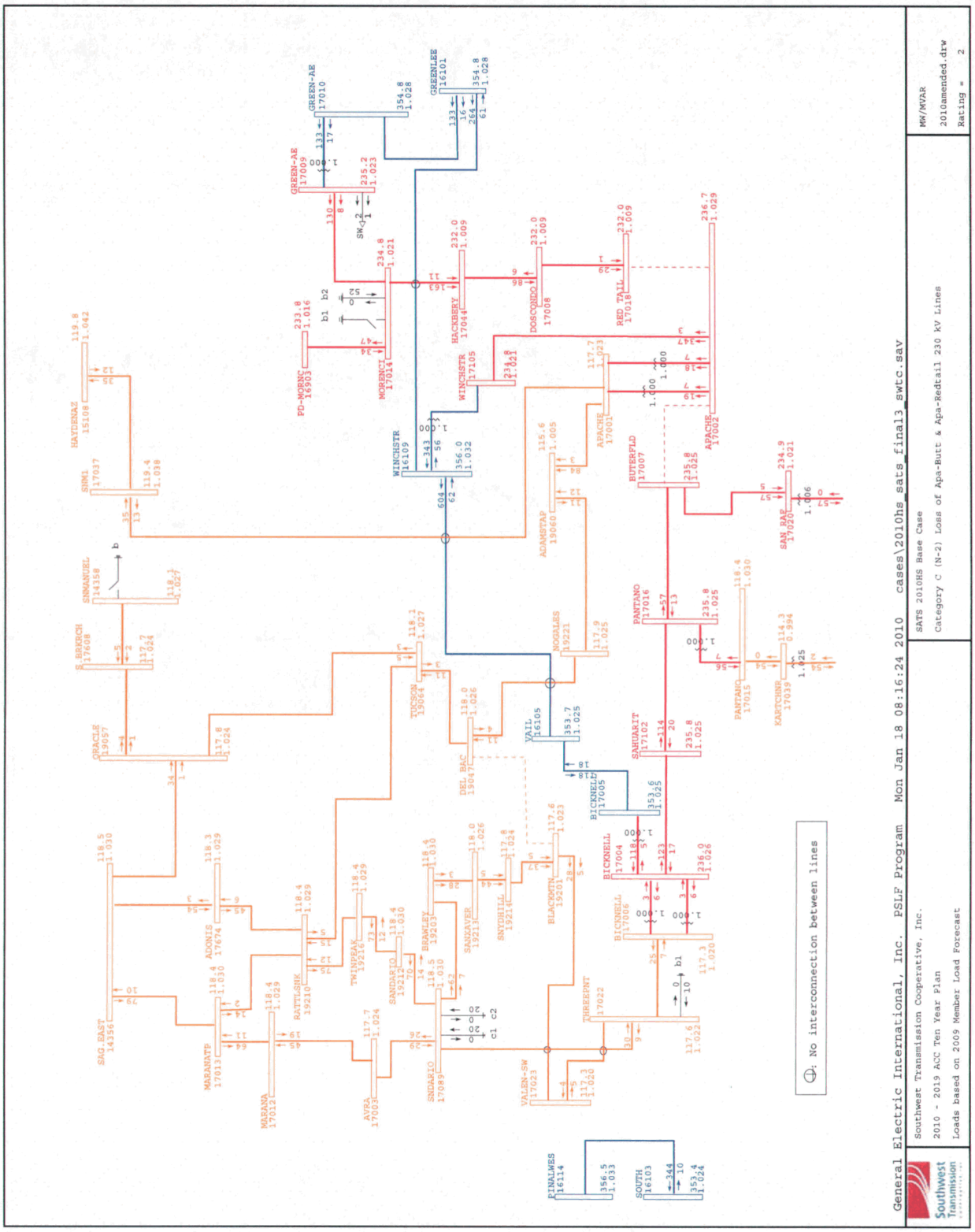
2014HS Southwest Transmission Cooperative Base System with Rattlesnake to Twin Peaks 155 kV Line out of service



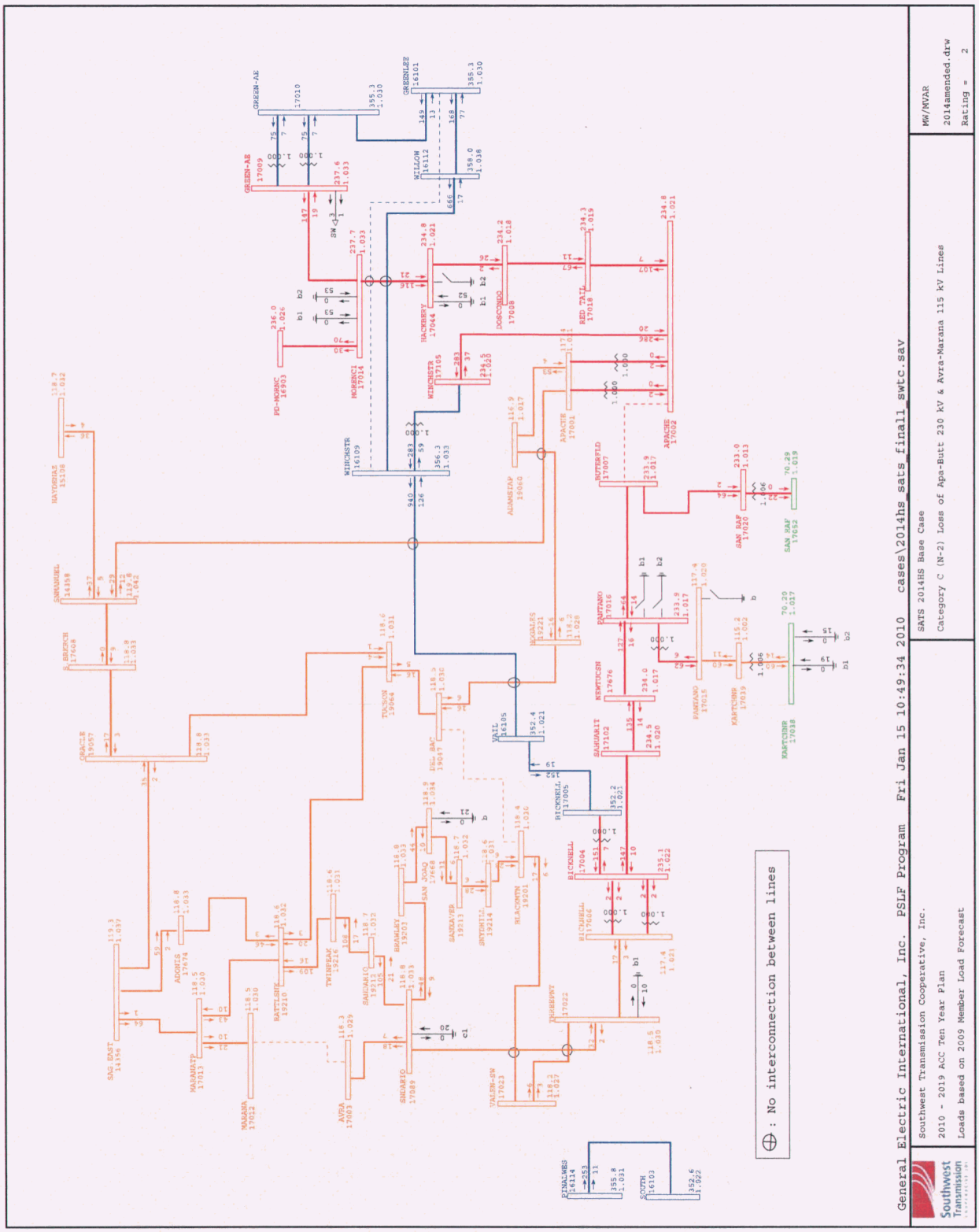
2014HS Southwest Transmission Cooperative Base System with Twin Peaks to Sandario 115 kV Line out of service



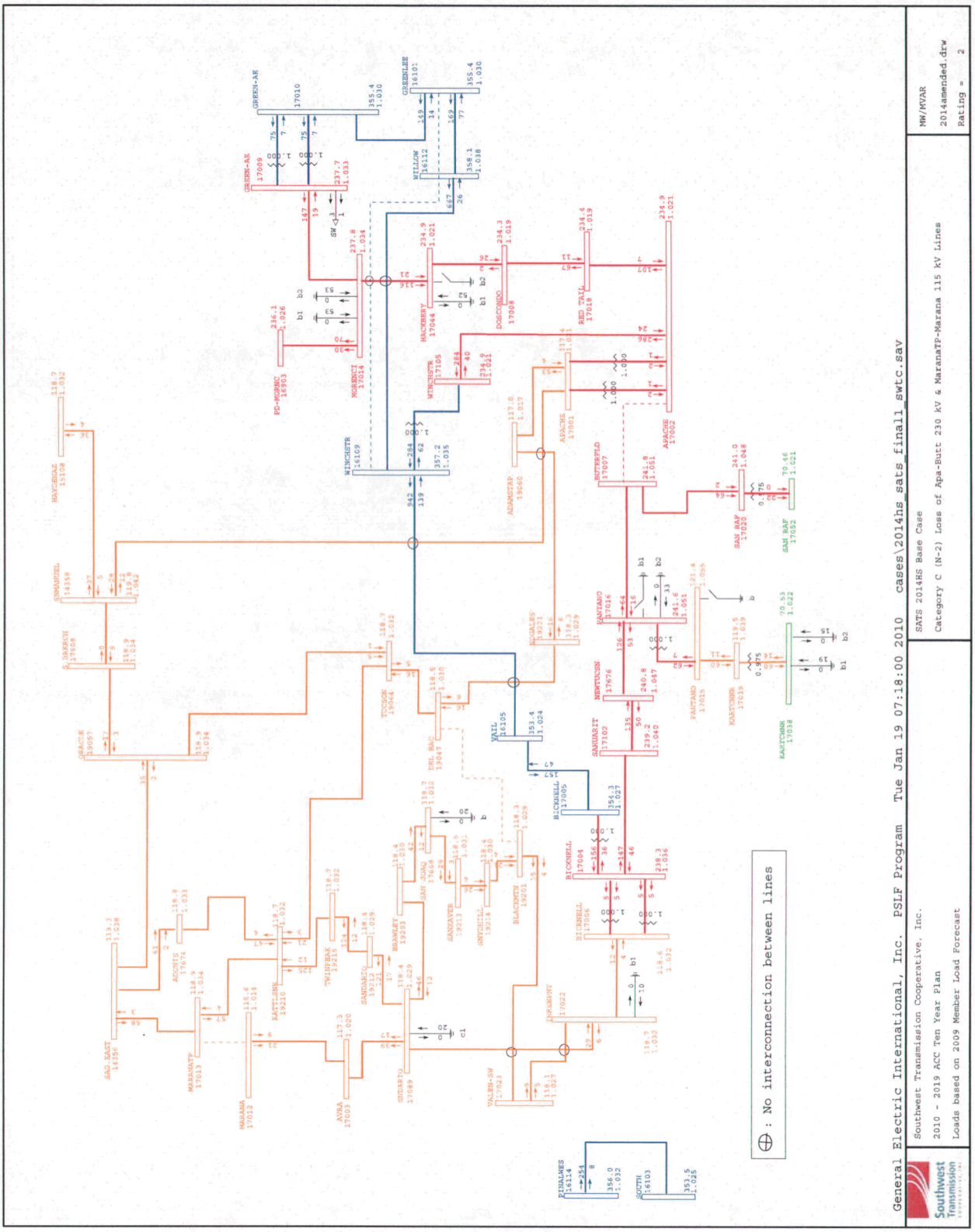
2014HS Southwest Transmission Cooperative Base System with Apache to Butterfield & Apache to Redtail 230 kV Lines out of service



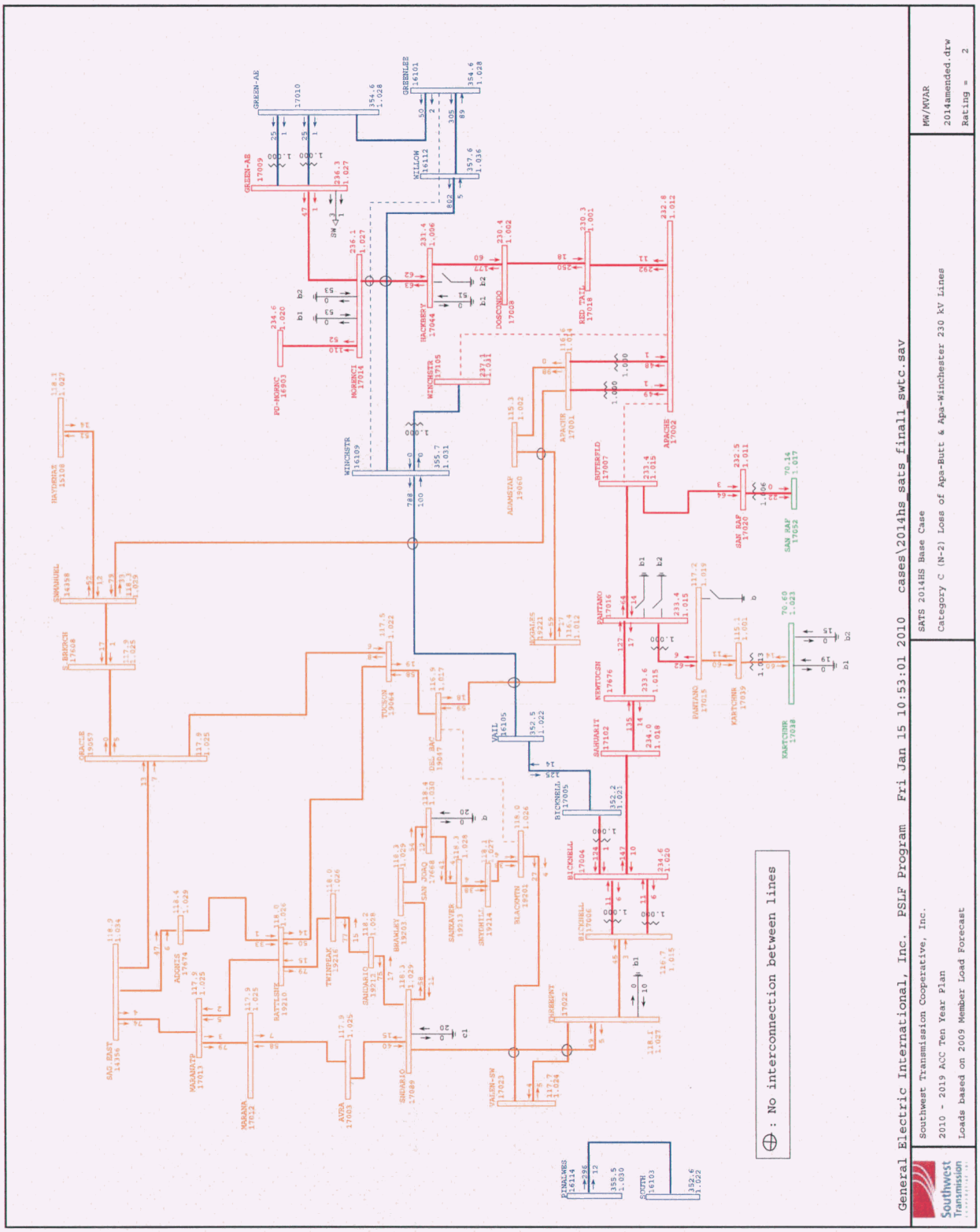
2014HS Southwest Transmission Cooperative Base System with Apache to Butterfield 230 kV & Avra to Marana 115 kV Lines out of service



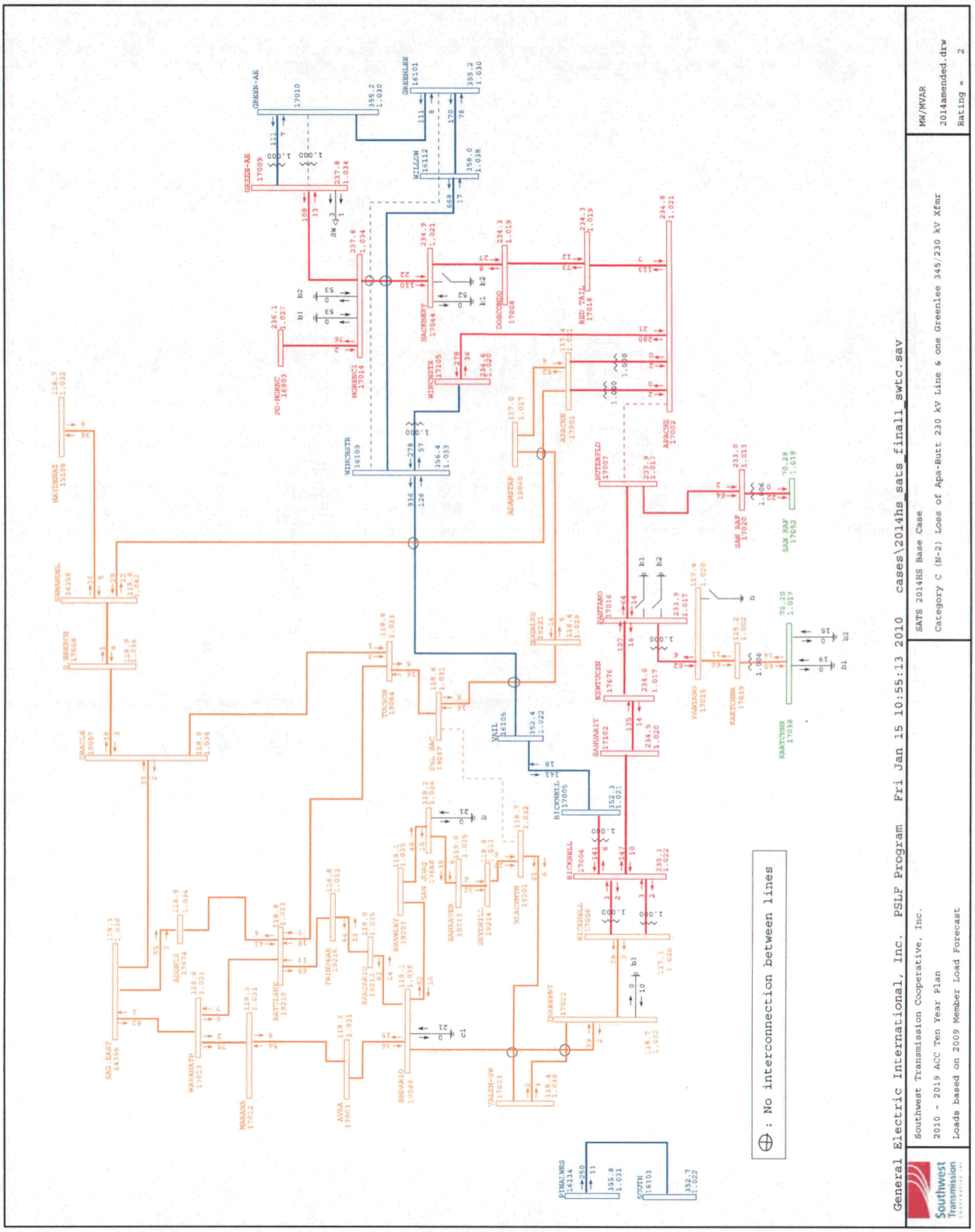
2014 HS Southwest Transmission Cooperative Base System with Apache to Butterfield 230 kV & Marana Tap to Marana 115 kV Lines out of service



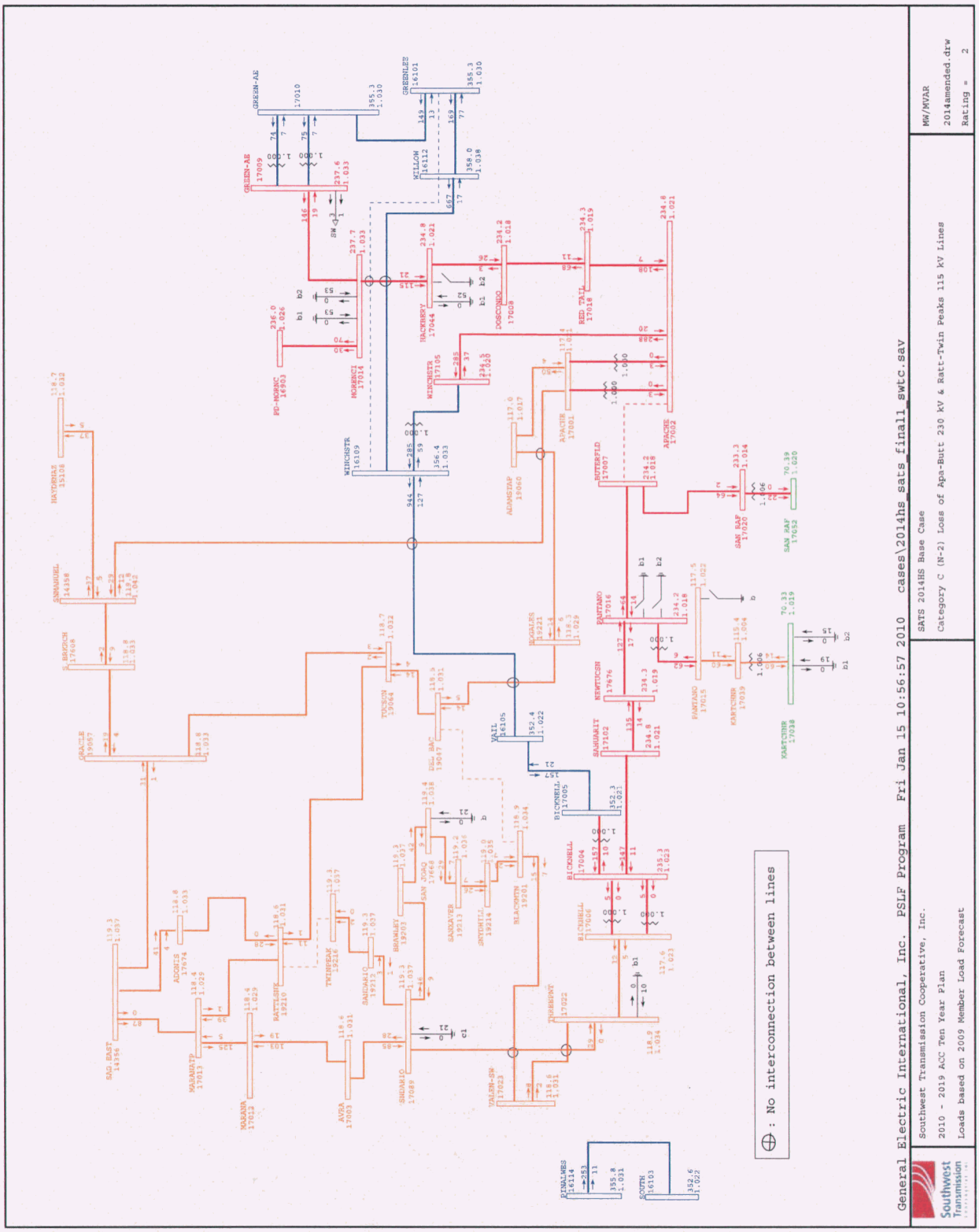
2014HS Southwest Transmission Cooperative Base System with Apache to Butterfield and Apache to Winchester 230 kV Lines out of service



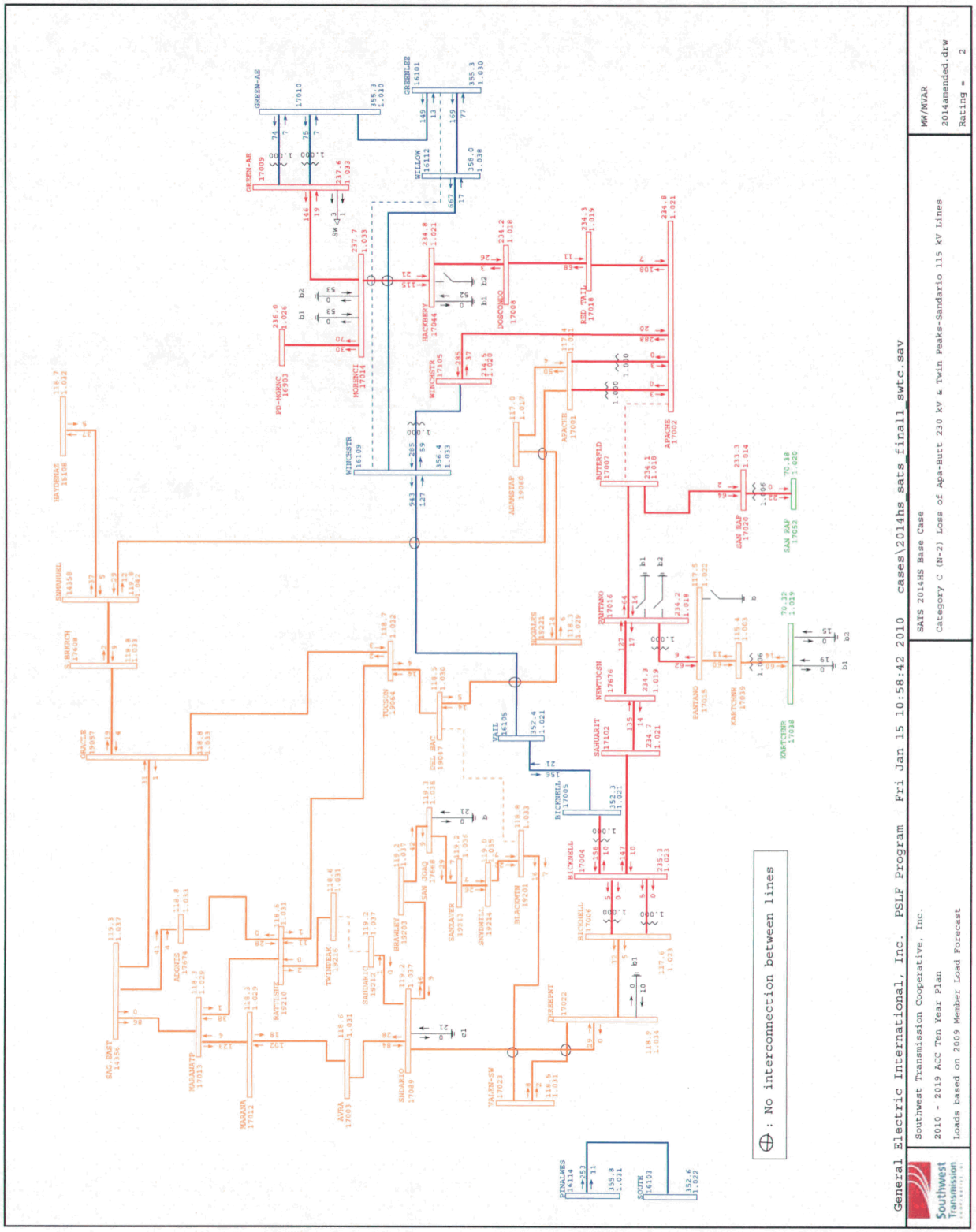
2014HS Southwest Transmission Cooperative Base System with Apache to Butterfield 230 kV Line & one Greenlee 345/230 kV Transformer out of service



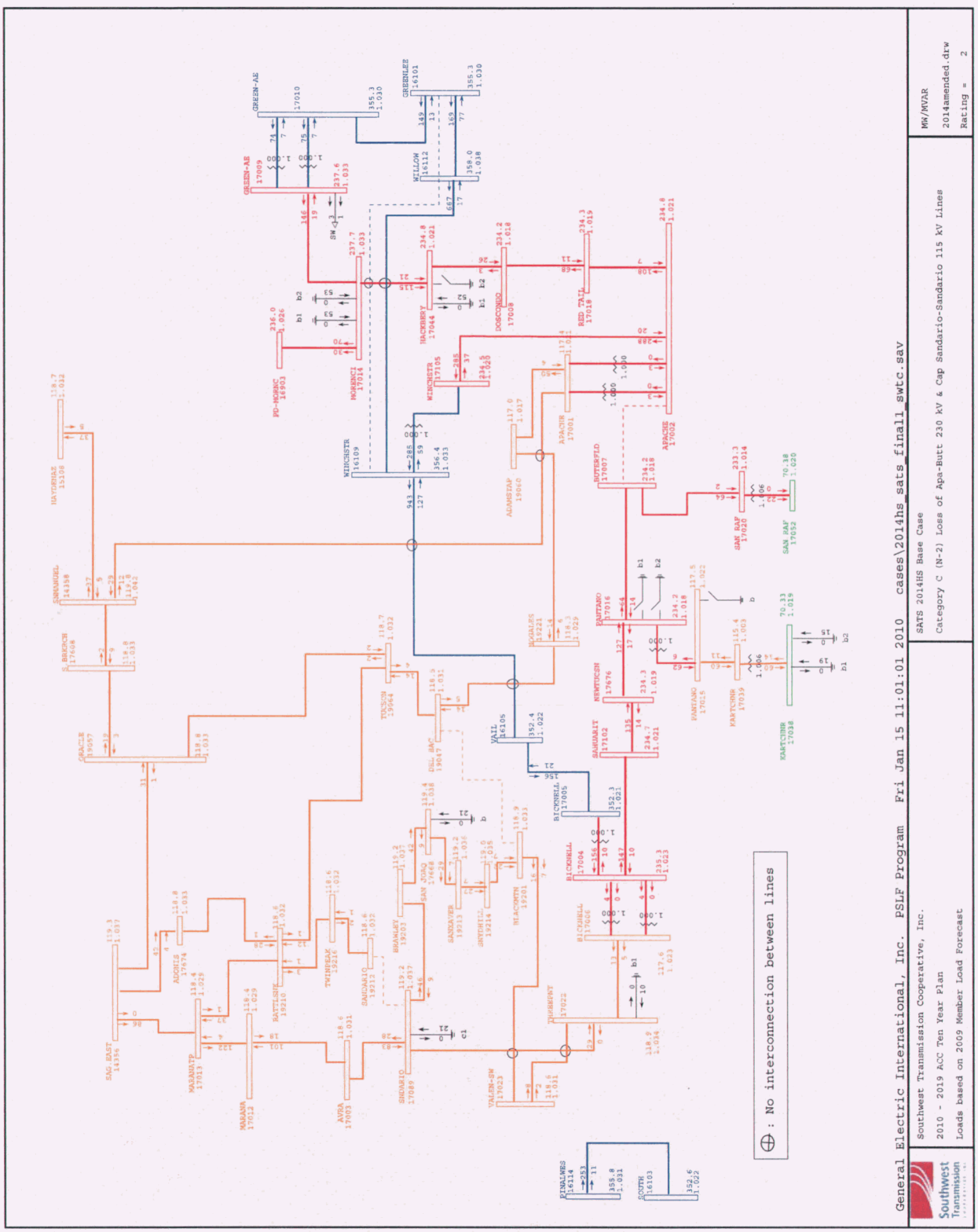
2014HS Southwest Transmission Cooperative Base System with Apache to Butterfield 230 kV & Rattlesnake to Twin Peaks 115 kV Lines out of service



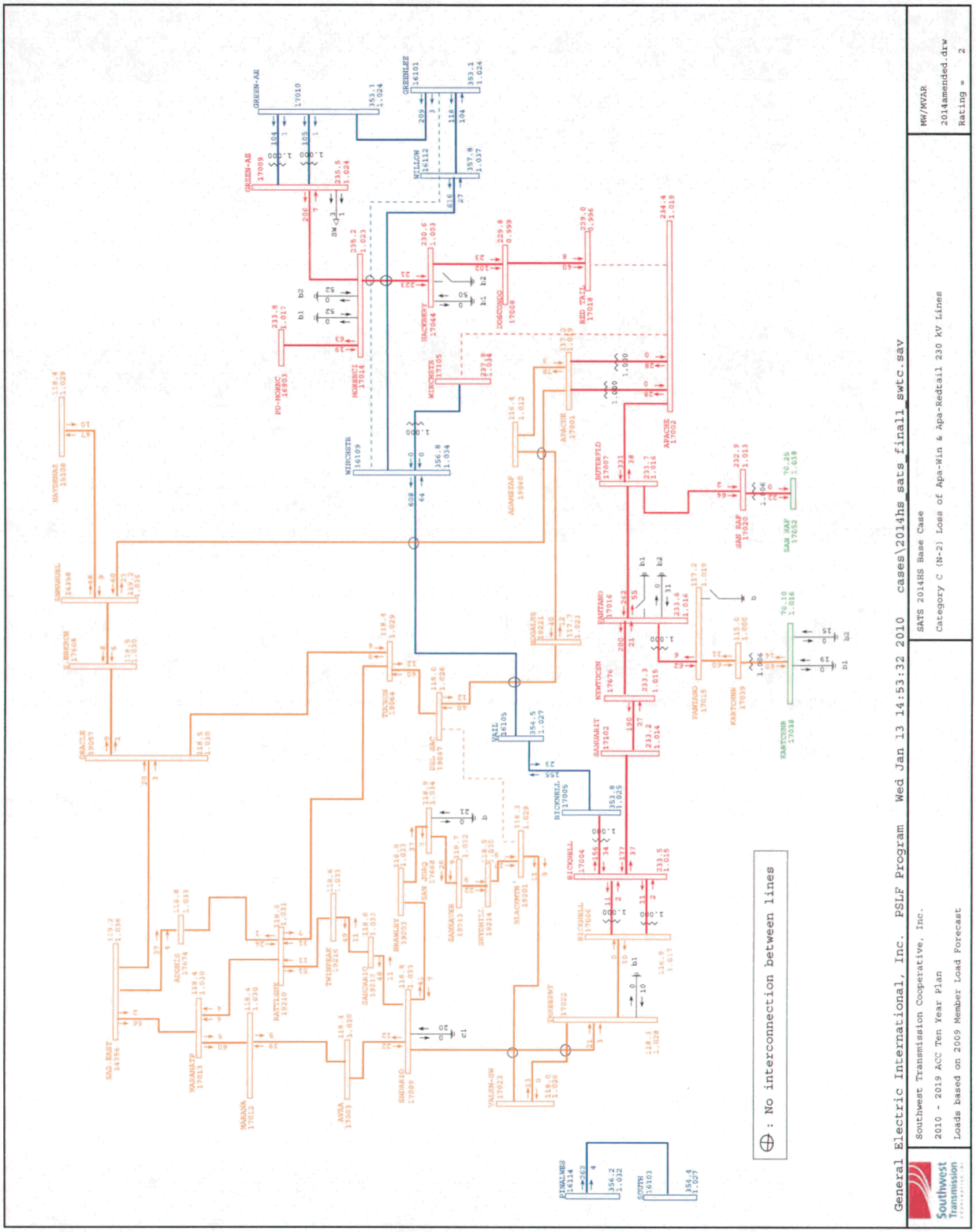
2014HS Southwest Transmission Cooperative Base System with Apache to Butterfield 230 kV & Twin Peaks to Sandario 115 kV Lines out of service



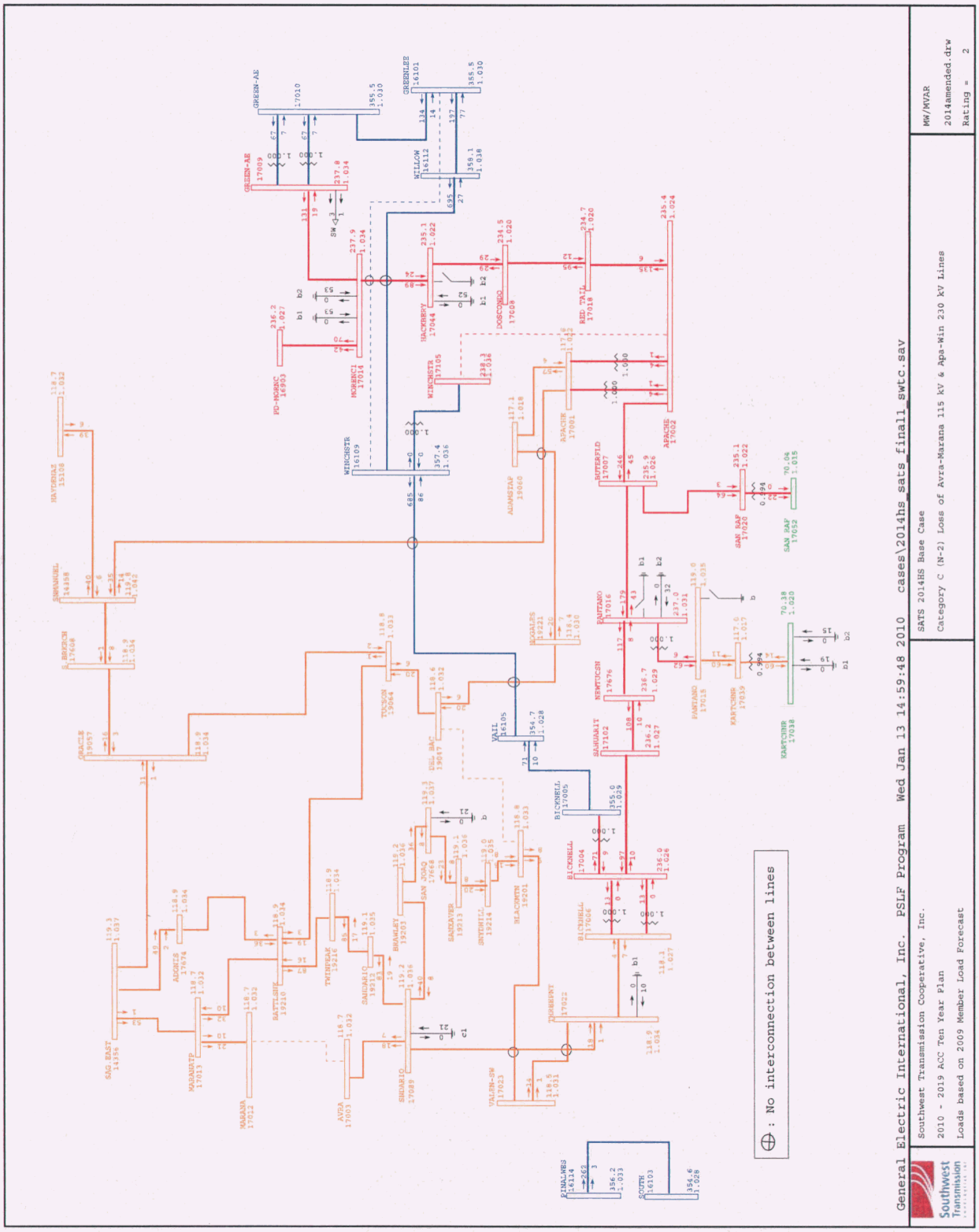
2014HS Southwest Transmission Cooperative Base System with Apache to Butterfield 230 kV & Cap Sandario to Sandario 115 kV Lines out of service



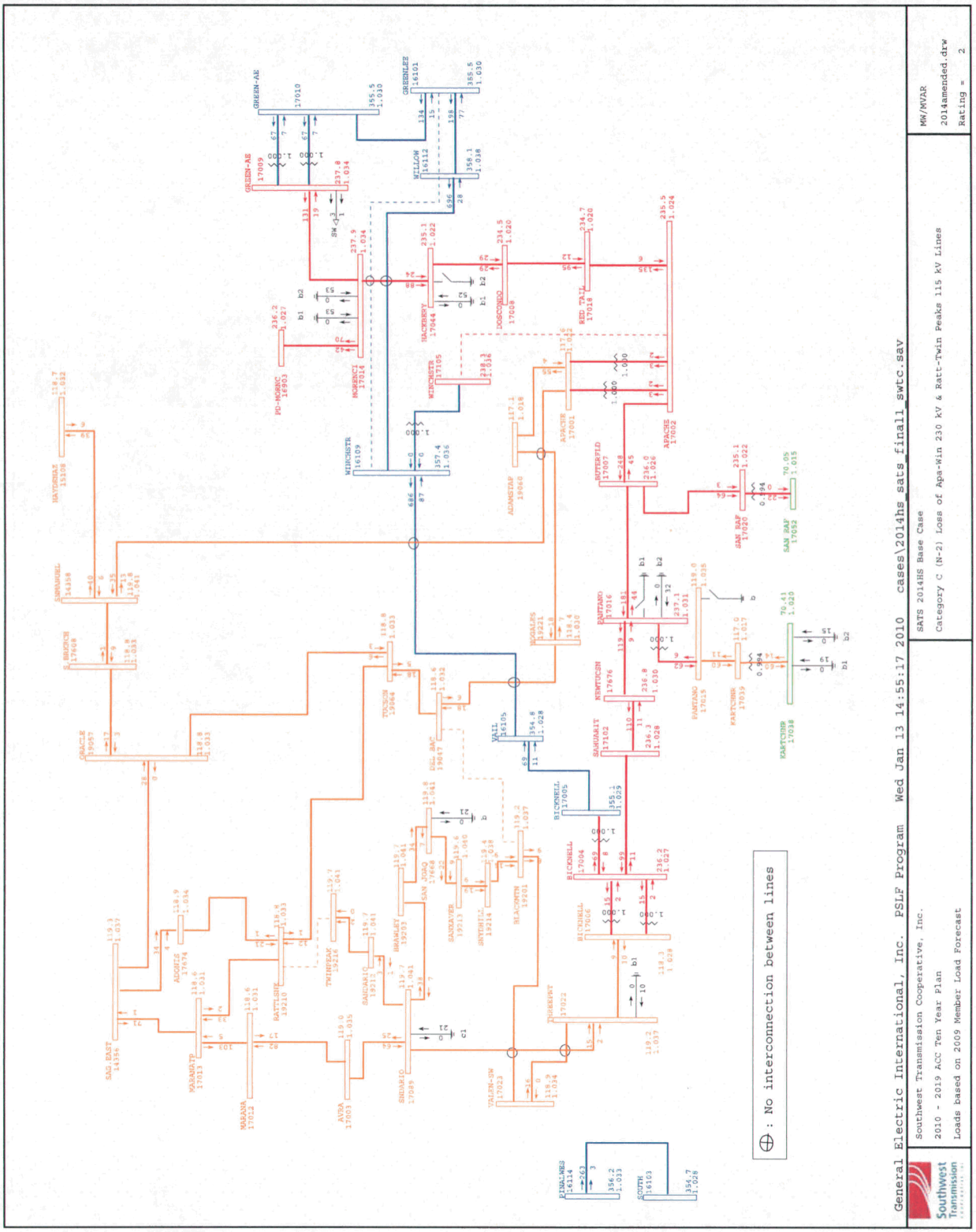
2014HS Southwest Transmission Cooperative Base System with Apache to Winchester & Apache to Redtail 230 kV Lines out of service



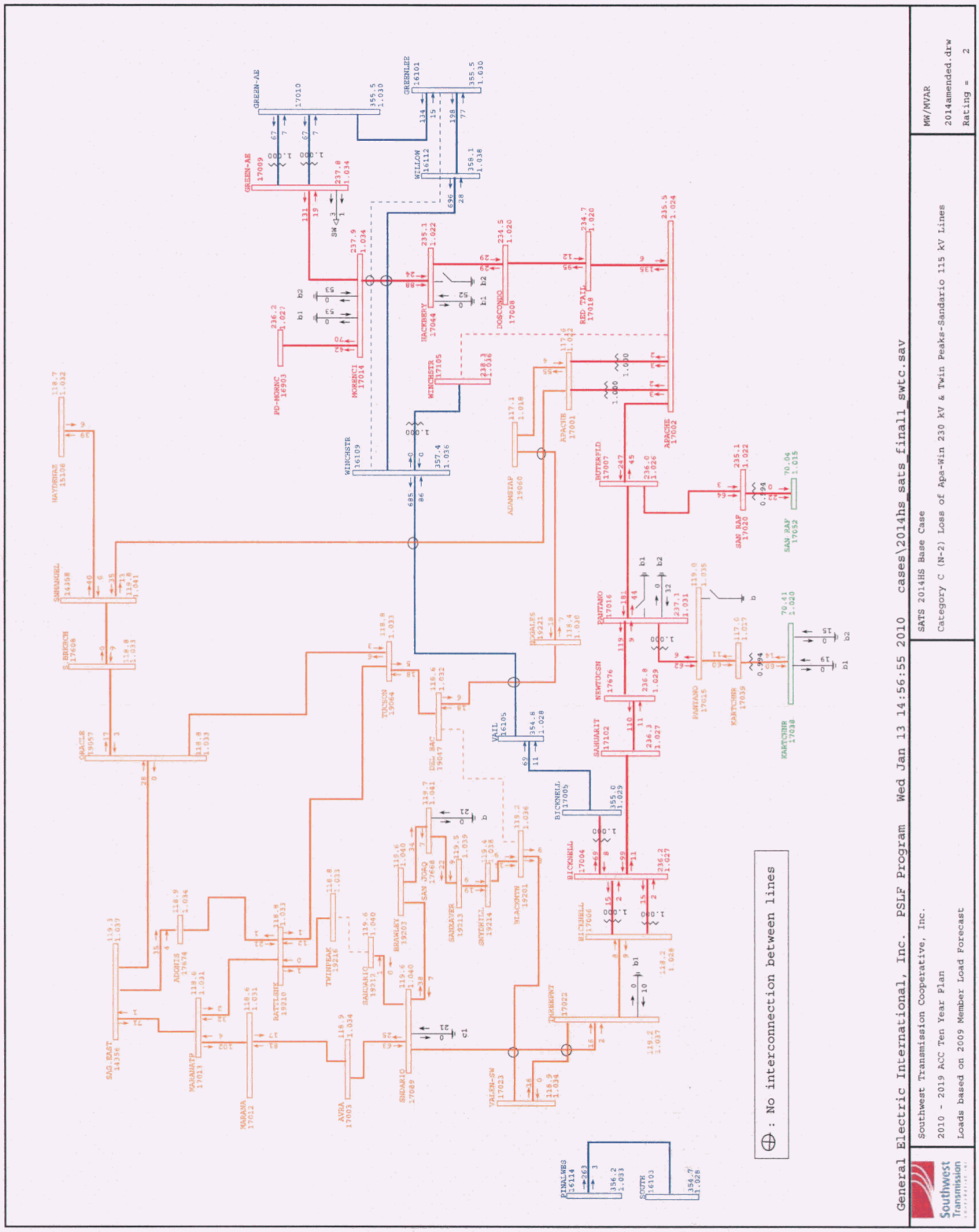
2014HS Southwest Transmission Cooperative Base System with Avra to Marana 115 kV & Apache to Winchester 230 kV Lines out of service



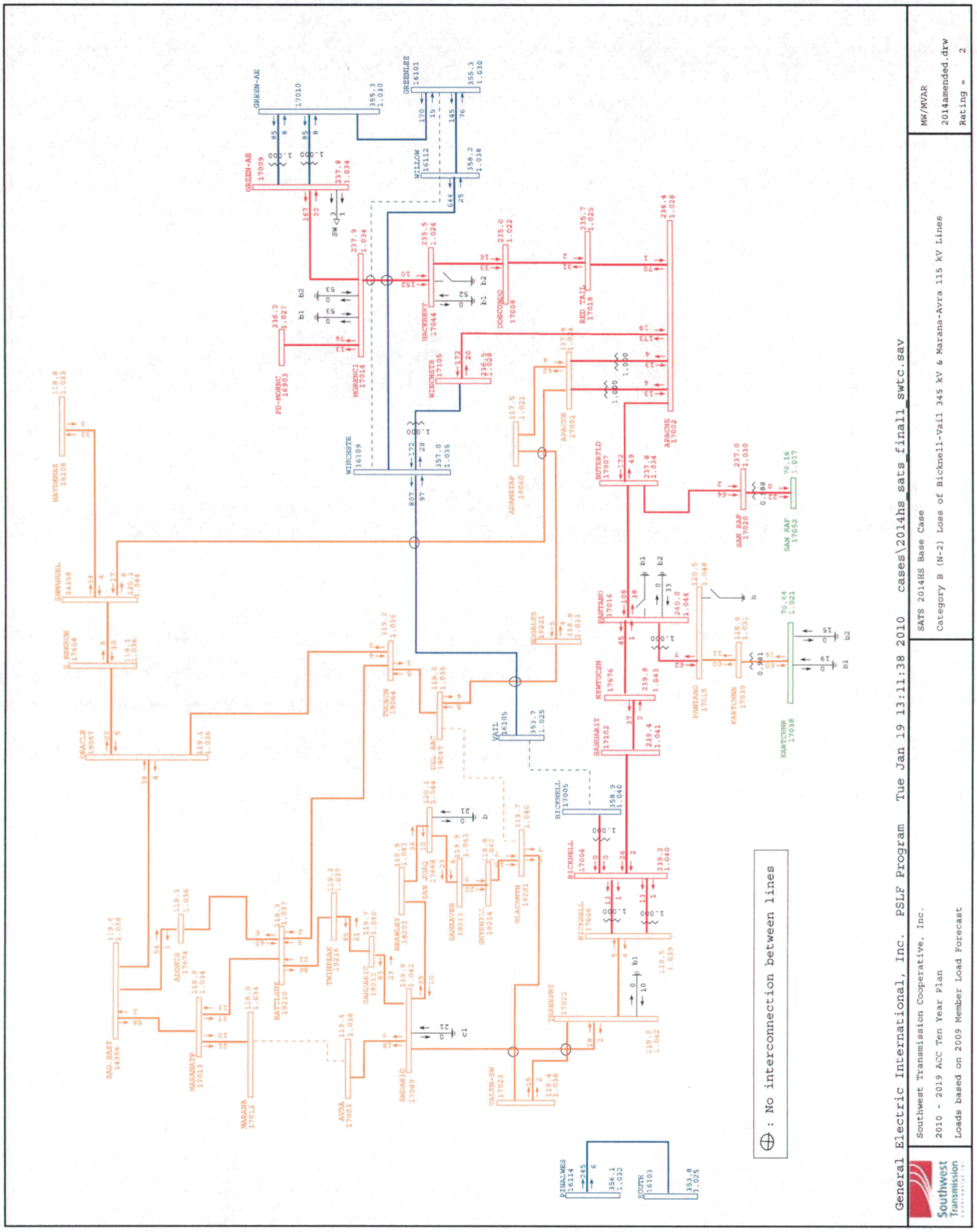
2014HS Southwest Transmission Cooperative Base System with Apache to Winchester 230 kV & Rattlesnake to Twin Peaks 115 kV Lines out of service



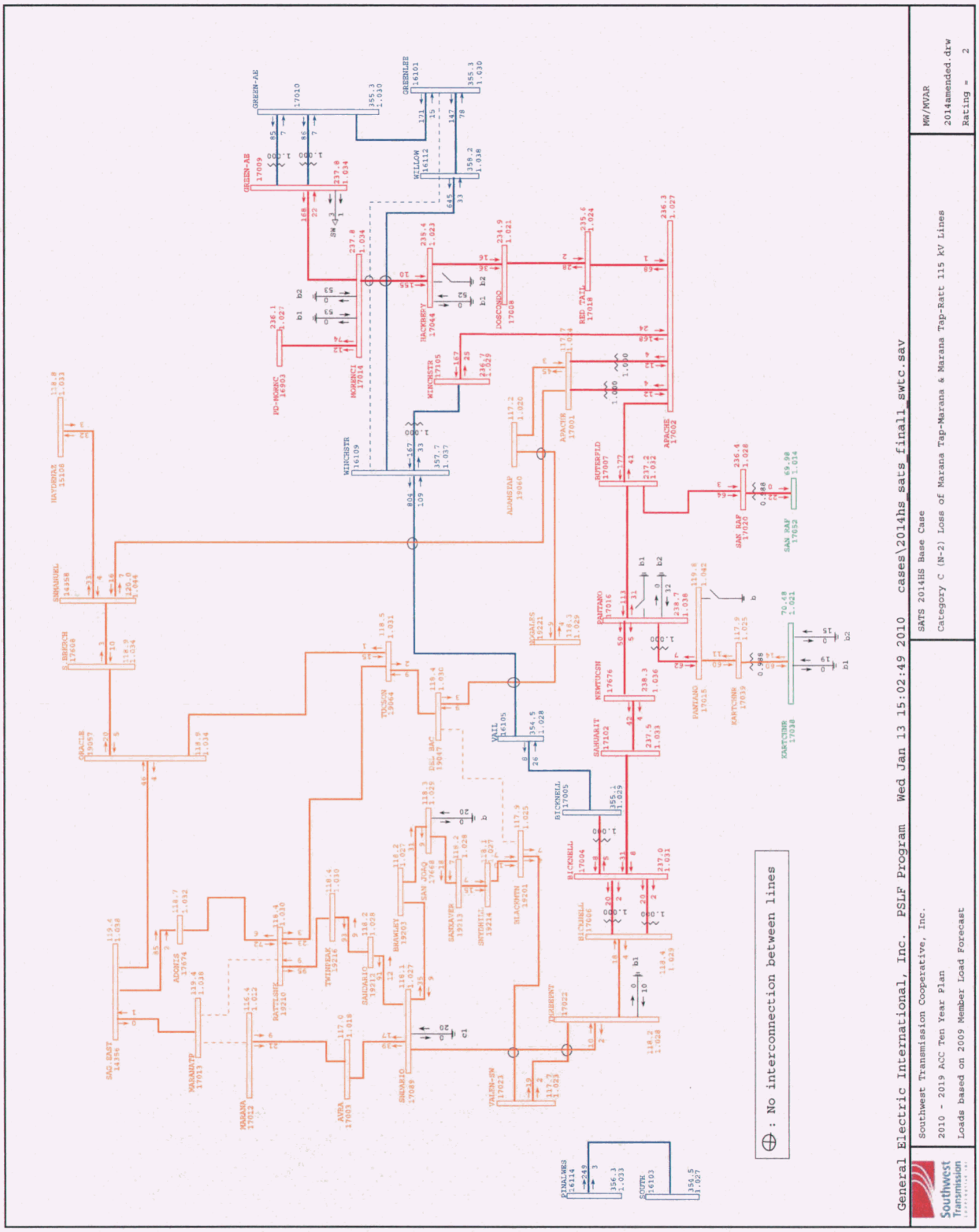
2014HS Southwest Transmission Cooperative Base System with Apache to Winchester 230 kV & Twin Peaks to Sandario 115 kV Lines out of service



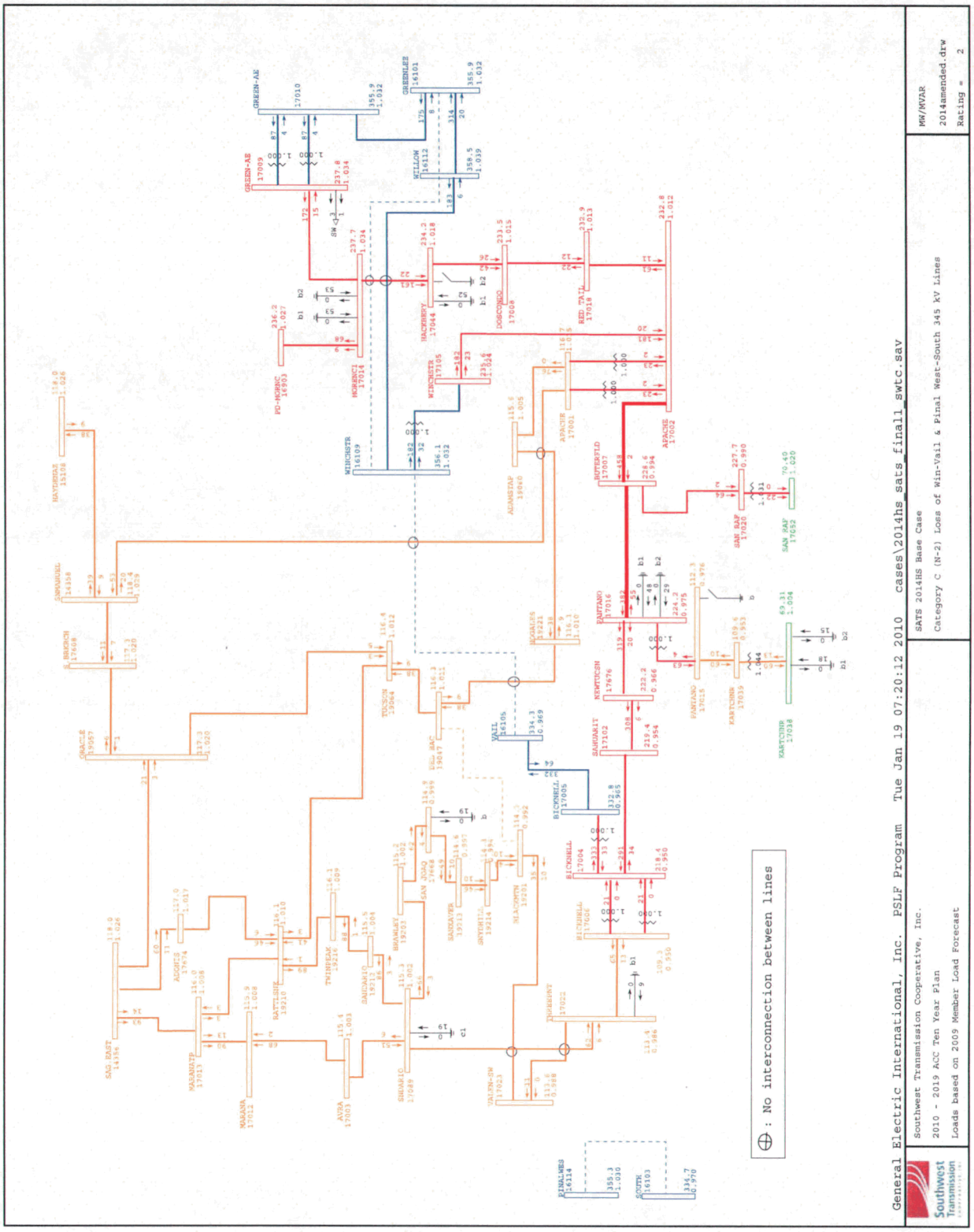
2014HS Southwest Transmission Cooperative Base System with Bicknell to Vail 345 kV & Avra to Marana 115 kV Lines out of service



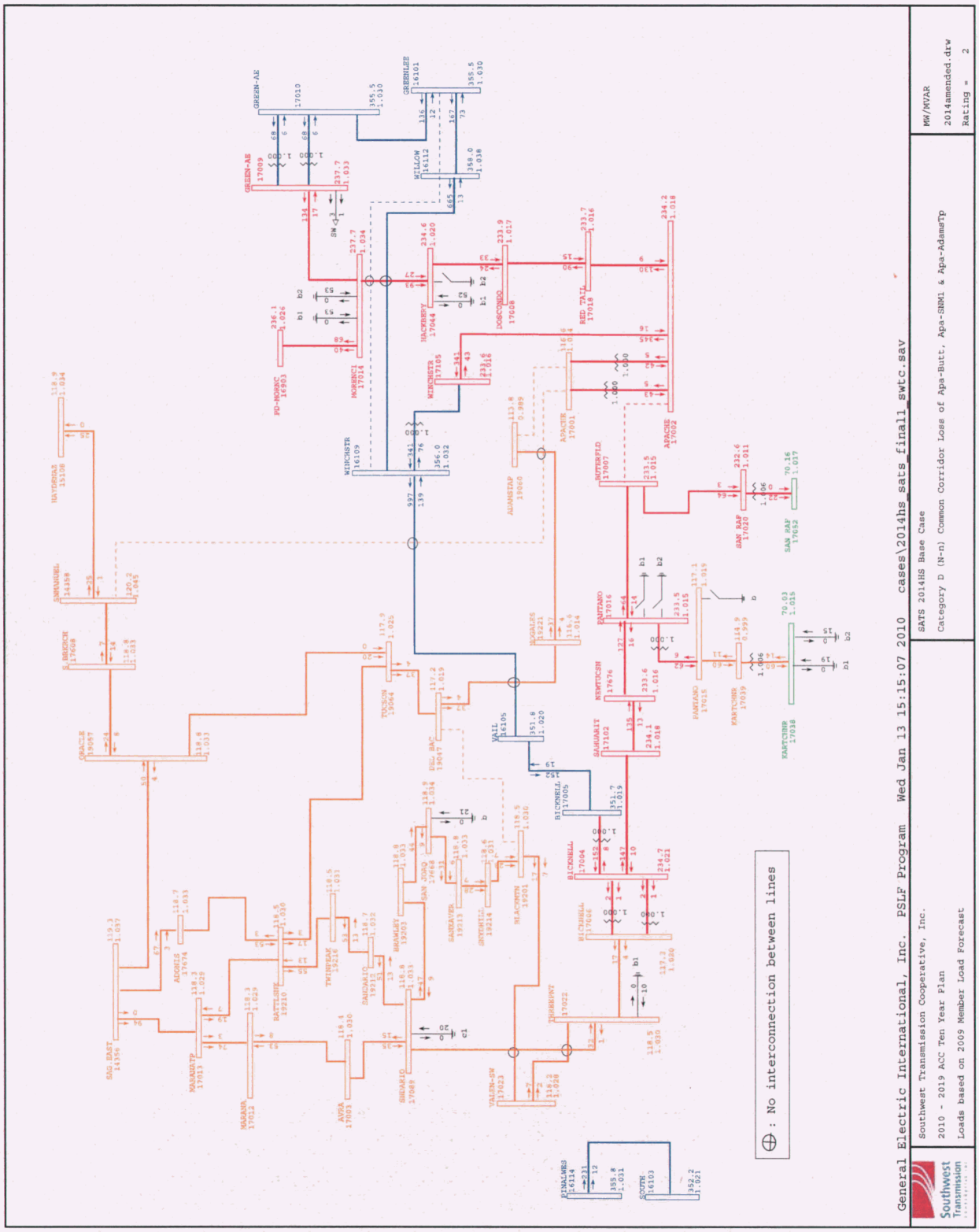
2014HS Southwest Transmission Cooperative Base System with Marana Tap to Marana & Marana Tap to Rattlesnake 115 kV Lines out of service



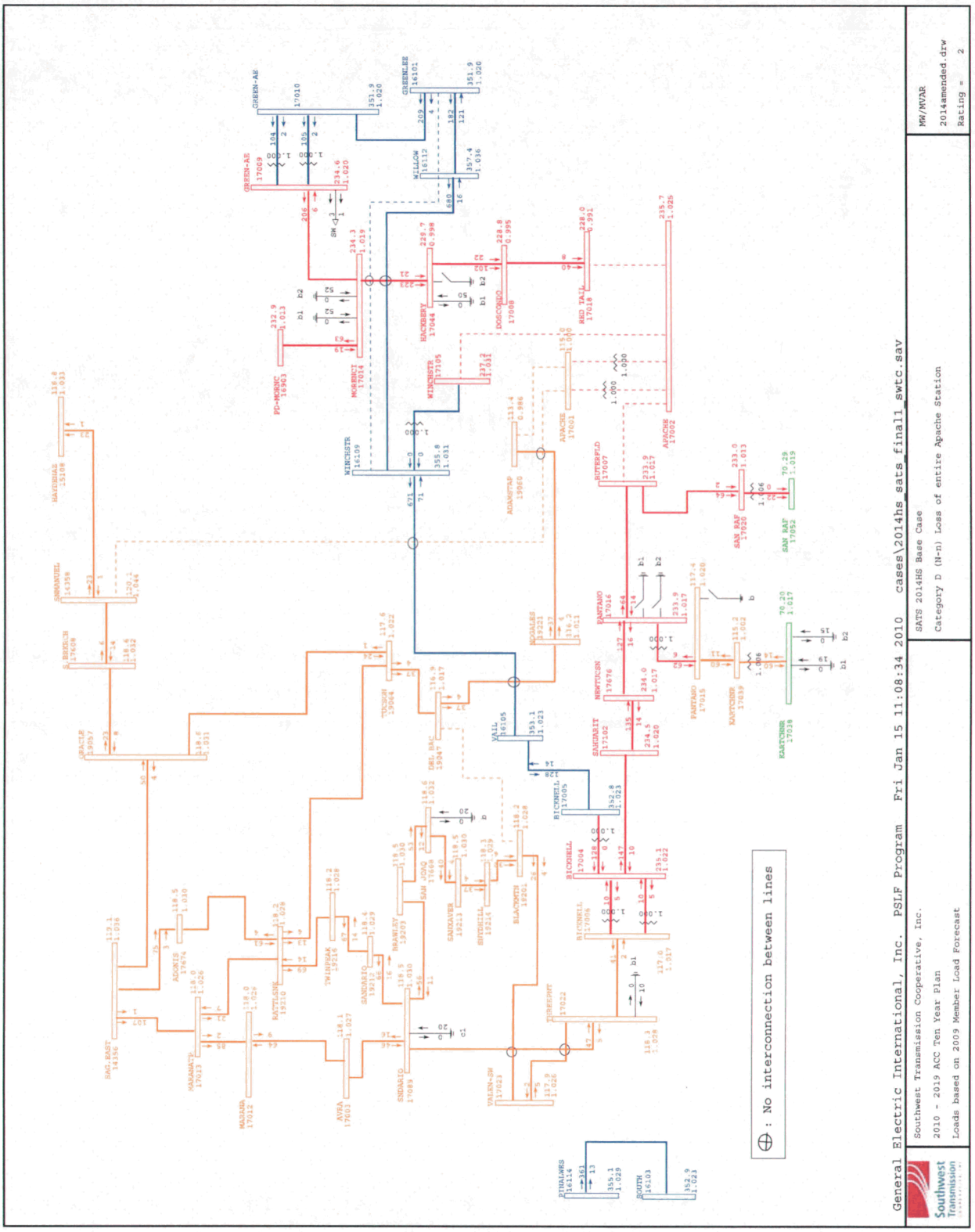
2014HS Southwest Transmission Cooperative Base System with Winchester to Vail & Pinal West to South 345 kV Lines out of service



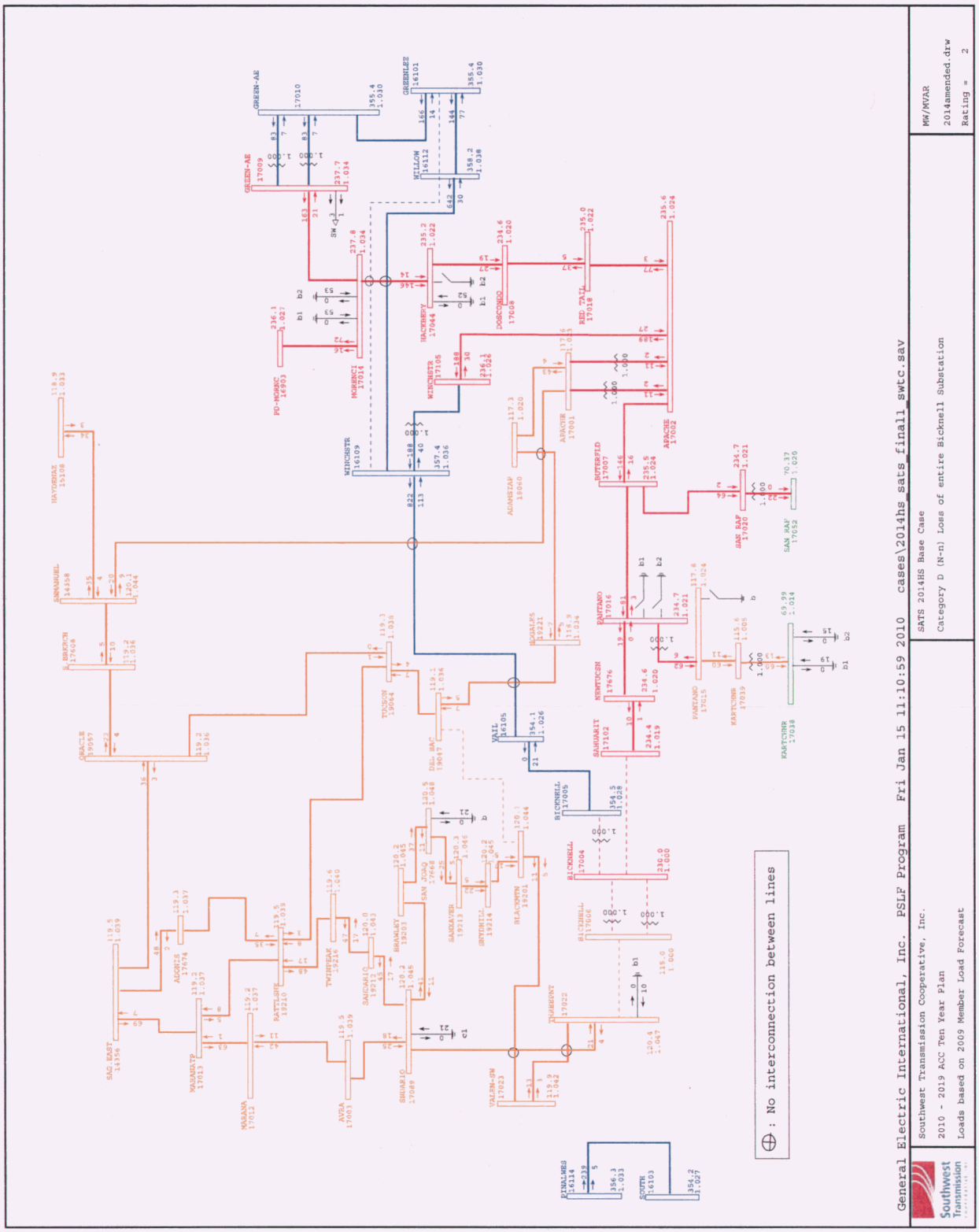
2014HS Southwest Transmission Cooperative Base System with Common Corridor Loss of Apache to Butt 230 kV, Apache to Adams Tap 115 kV, and Apache to San Manuel 115 kV Lines



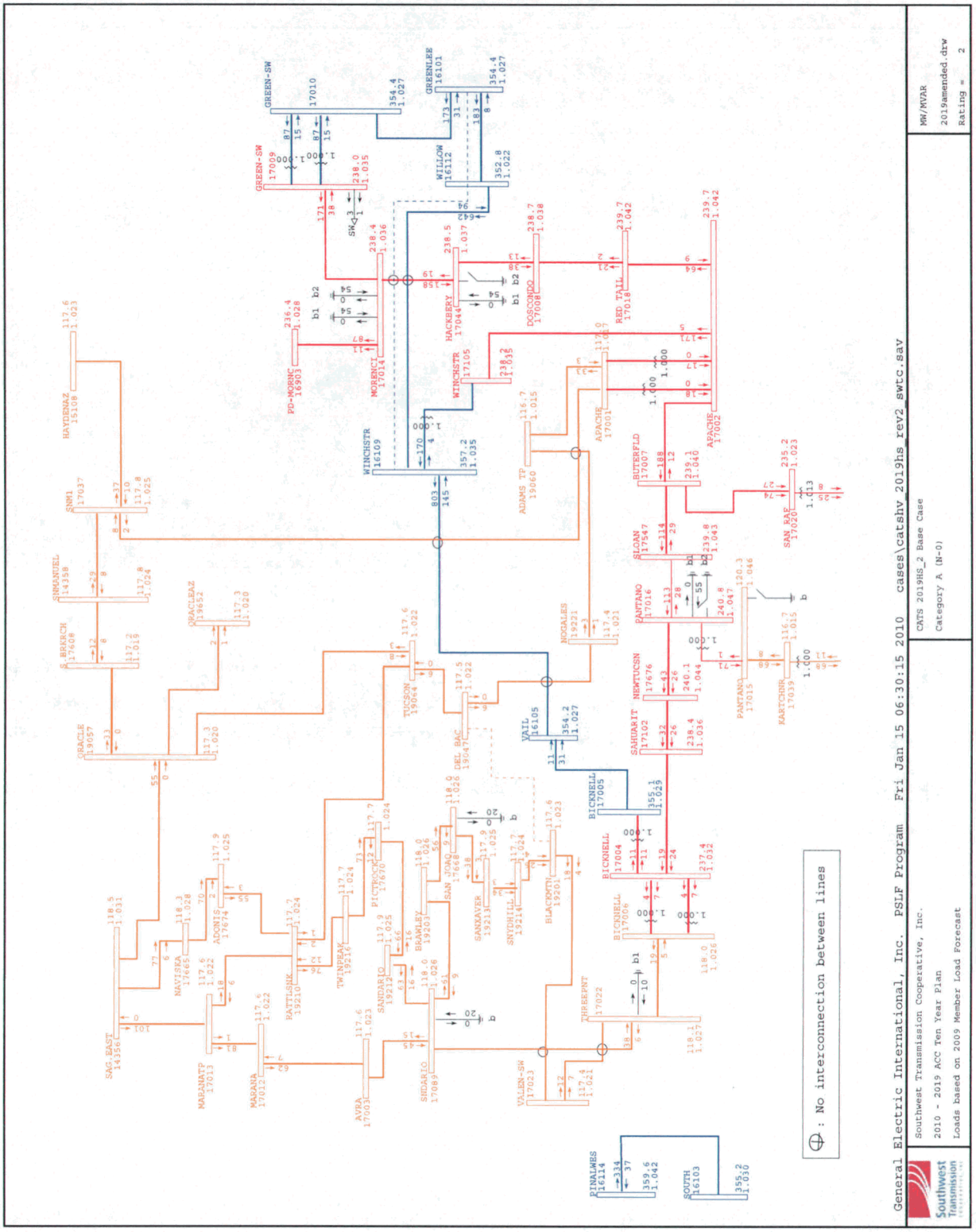
2014HS Southwest Transmission Cooperative Base System with Loss of Entire Apache Station



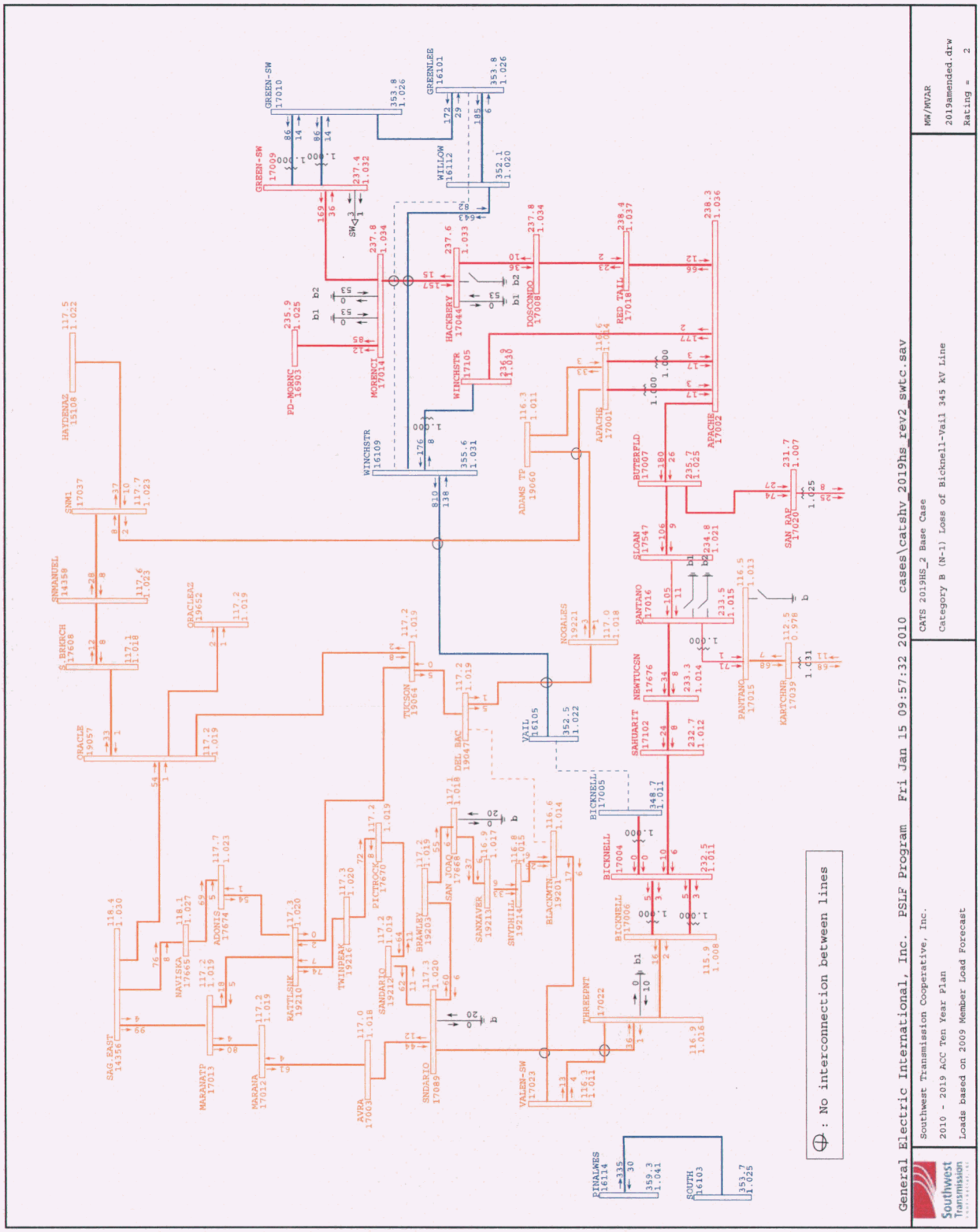
2014HS Southwest Transmission Cooperative Base System with Loss of Entire Bicknell Substation



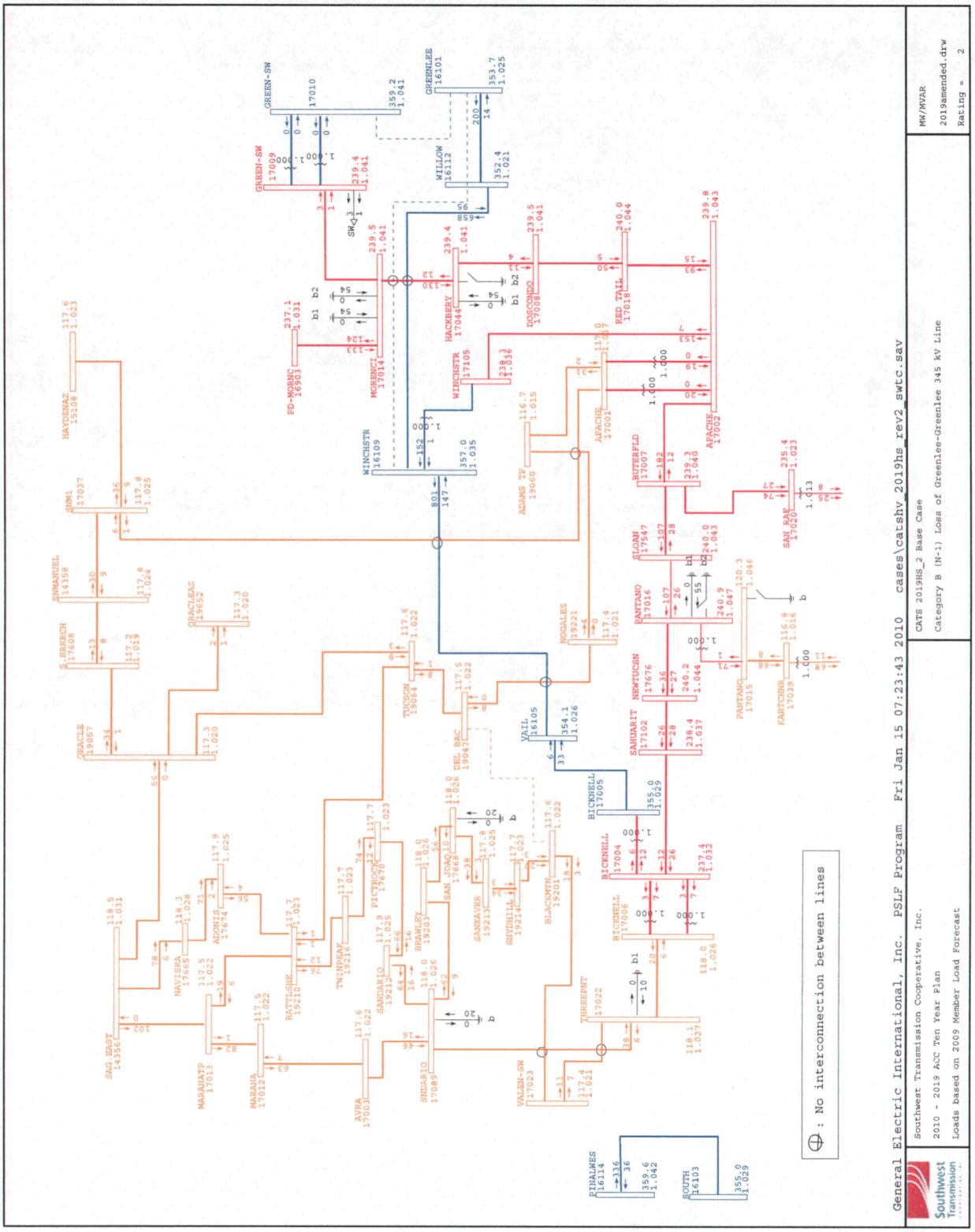
2019HS Southwest Transmission Cooperative Base System



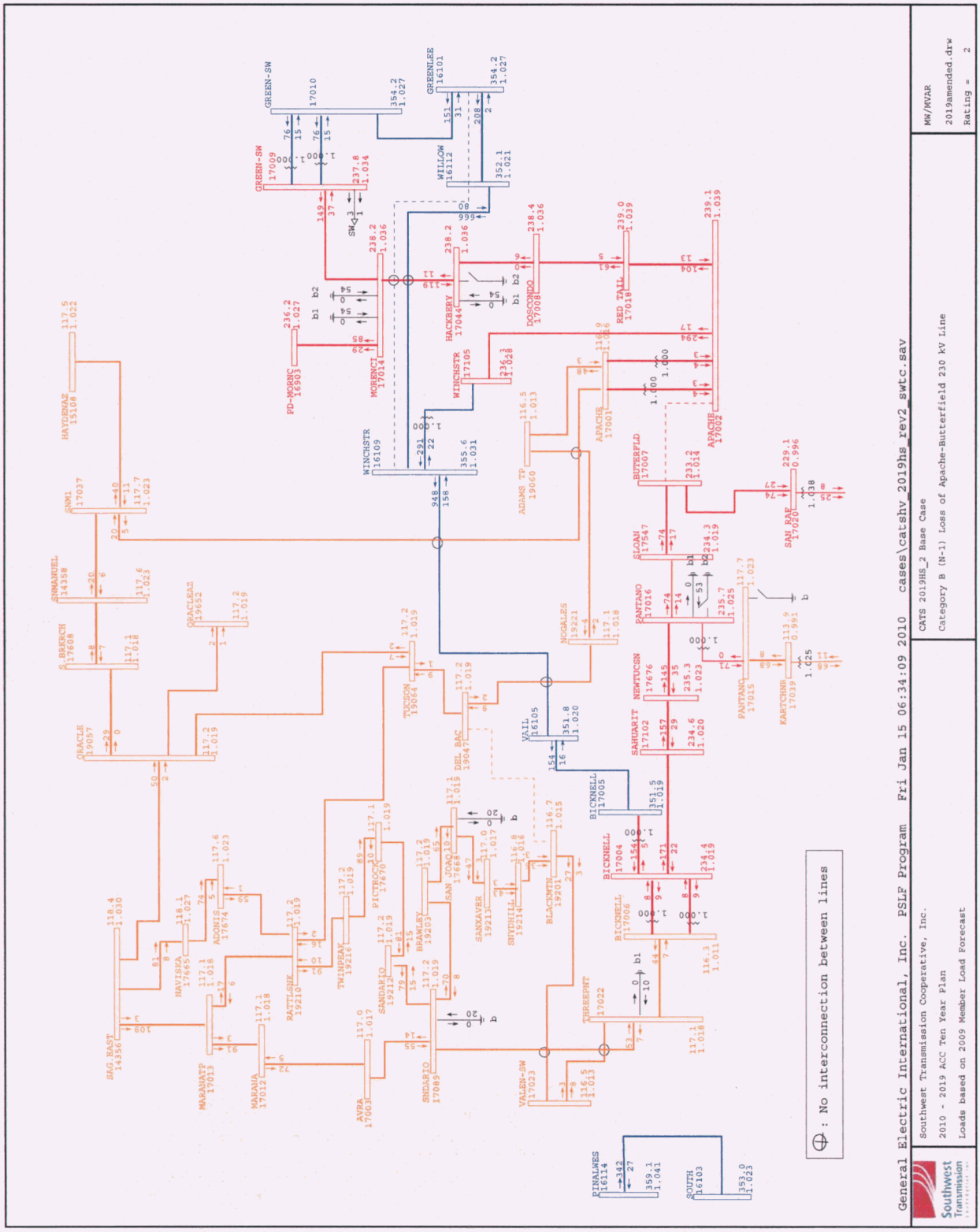
2019HS Southwest Transmission Cooperative Base System with Bicknell to Vail 345 kV Line out of service



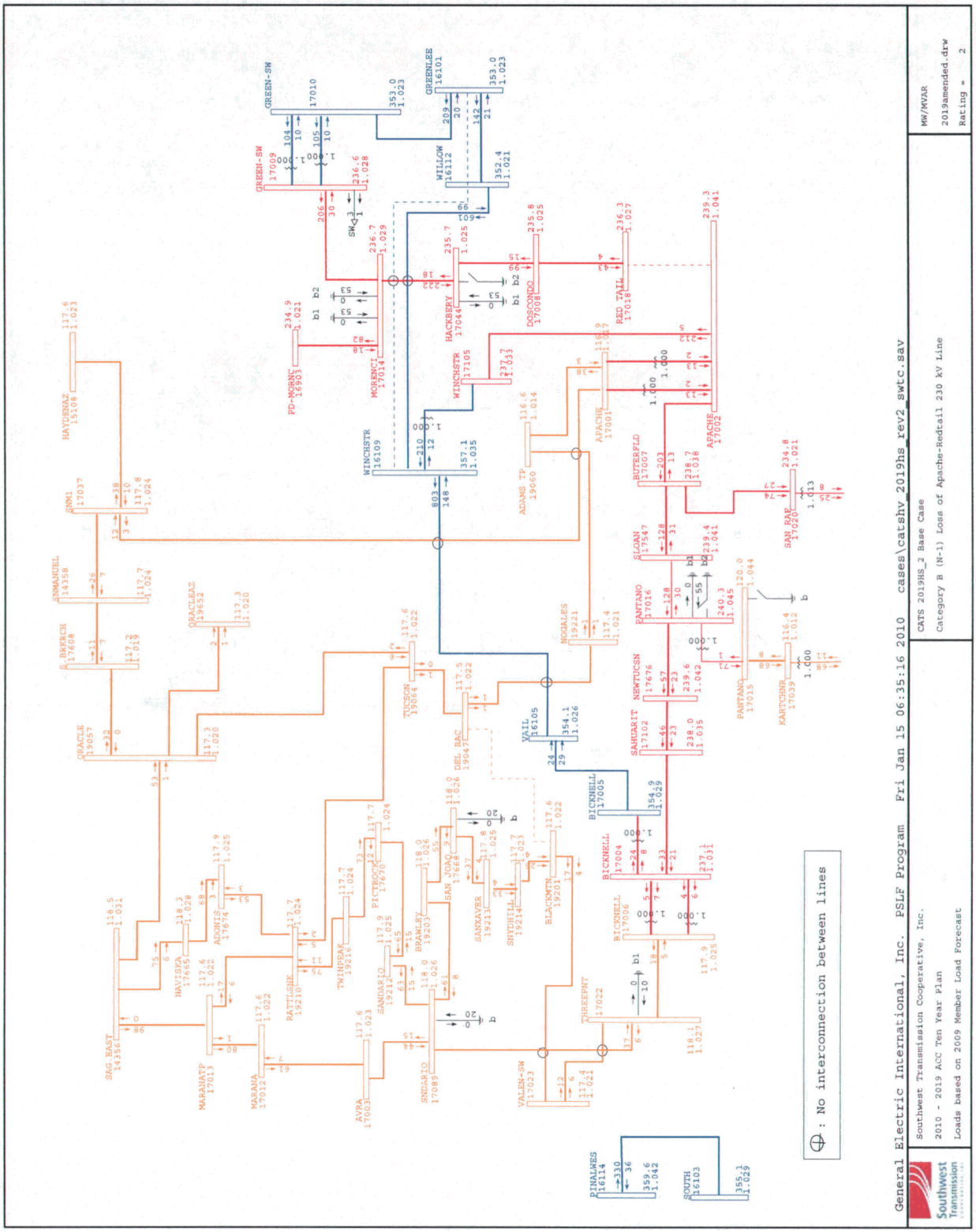
2019HS Southwest Transmission Cooperative Base System with Greenlee to Greenlee 345 kV Line out of service



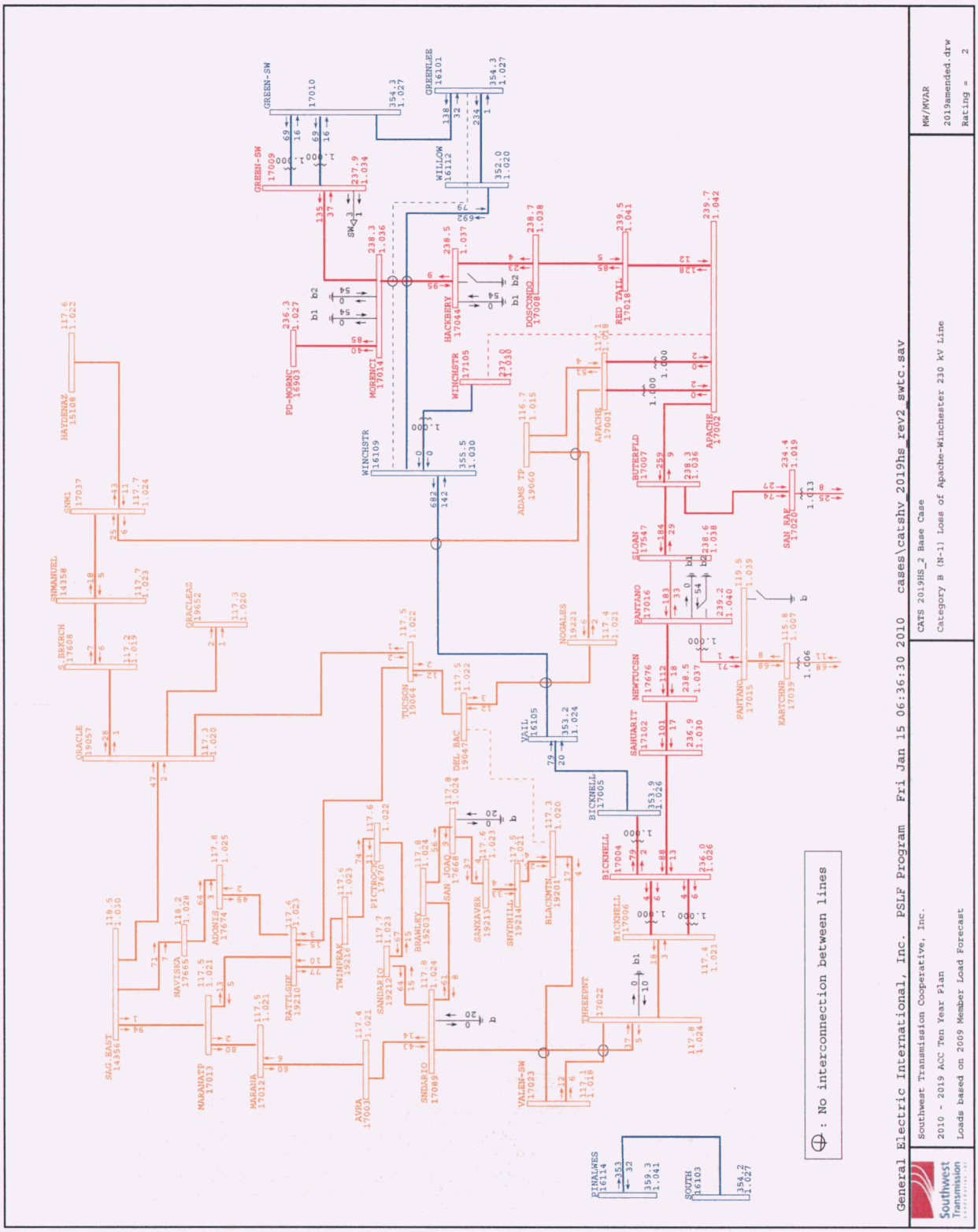
2019HS Southwest Transmission Cooperative Base System with Apache to Butterfield 230 kV Line out of service



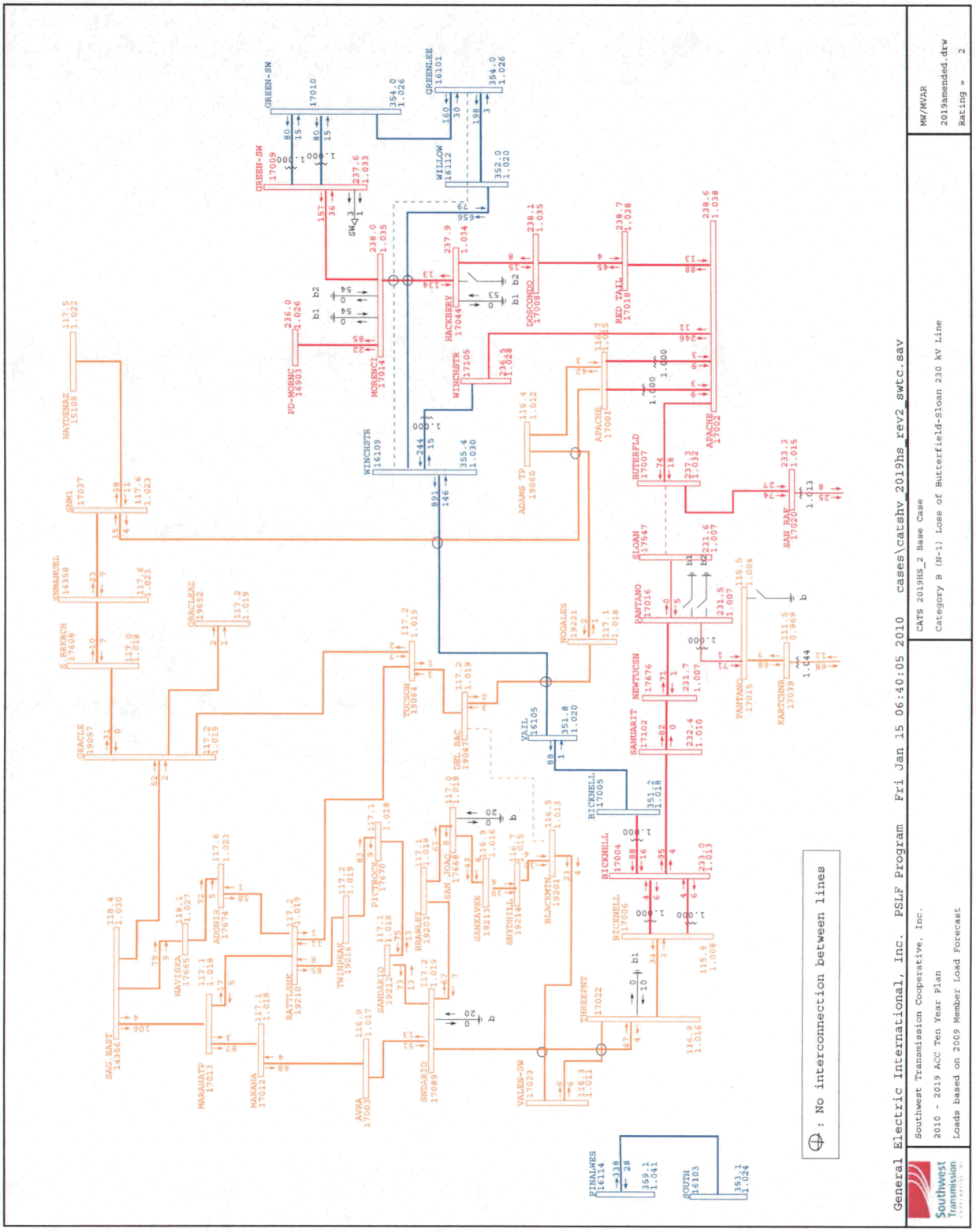
2019HS Southwest Transmission Cooperative Base System with Apache to Redtail 230 kV Line out of service



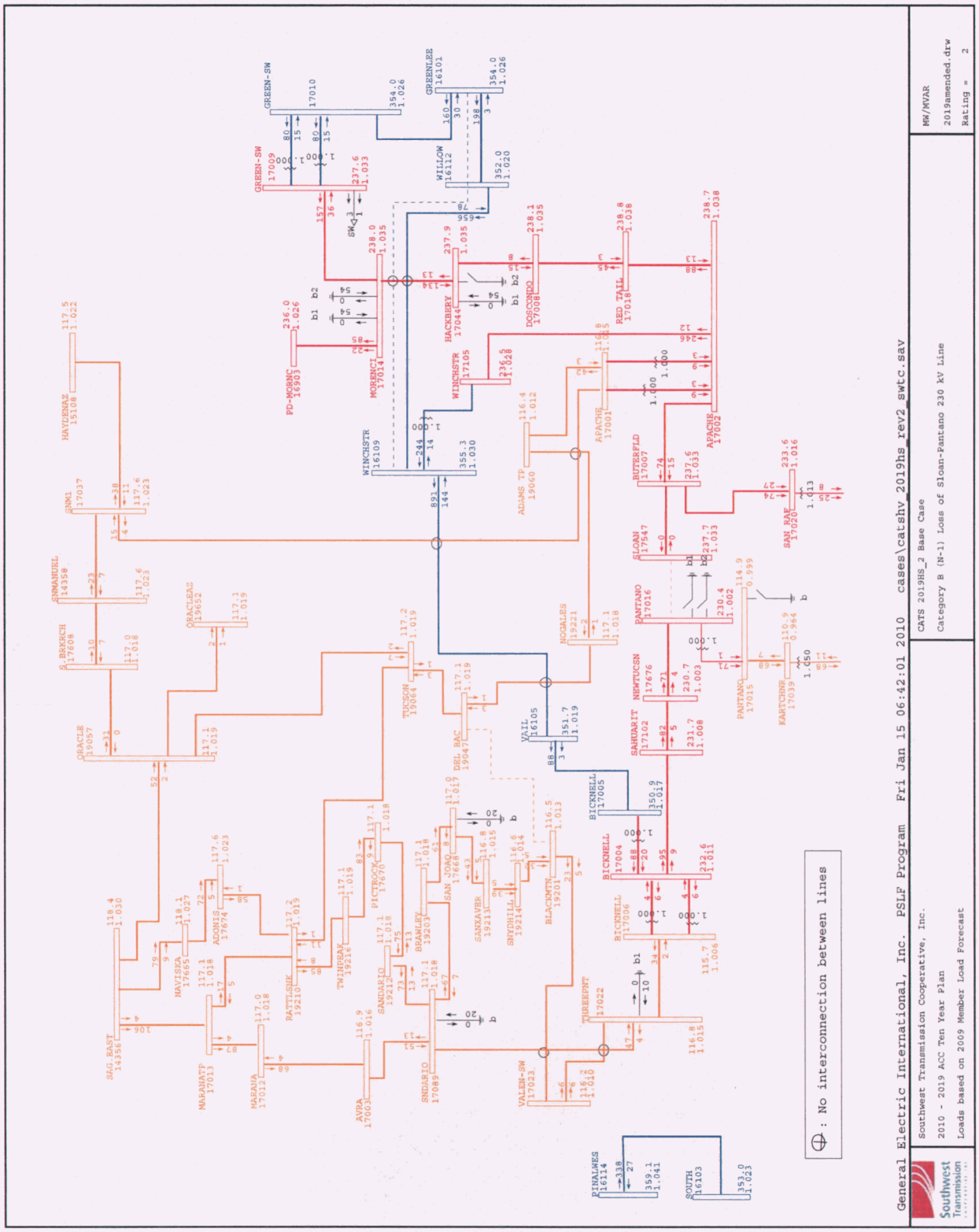
2019HS Southwest Transmission Cooperative Base System with Apache to Winchester 230 kV Line out of service



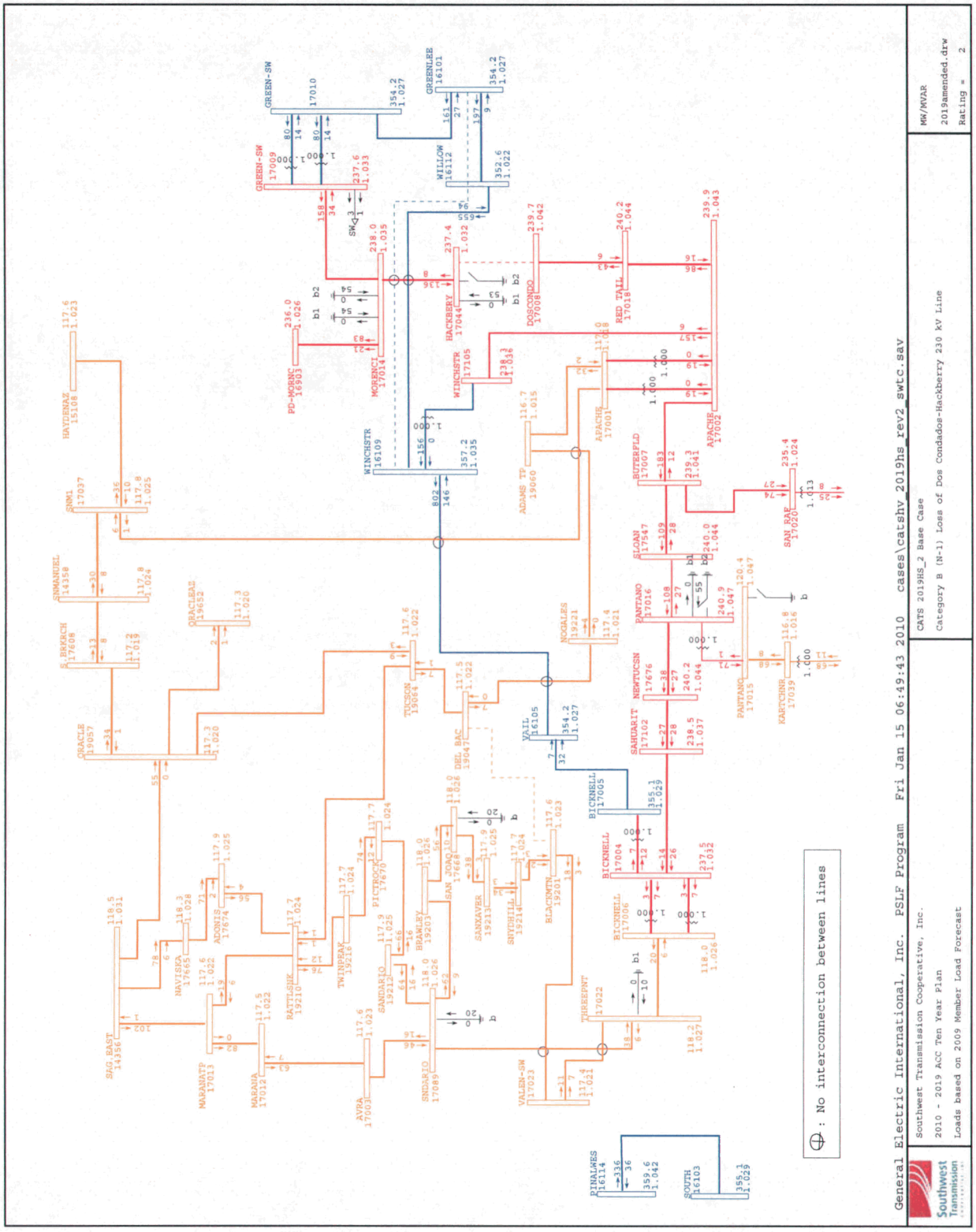
2019HS Southwest Transmission Cooperative Base System with Butterfield to Sloan 230 kV Line out of service



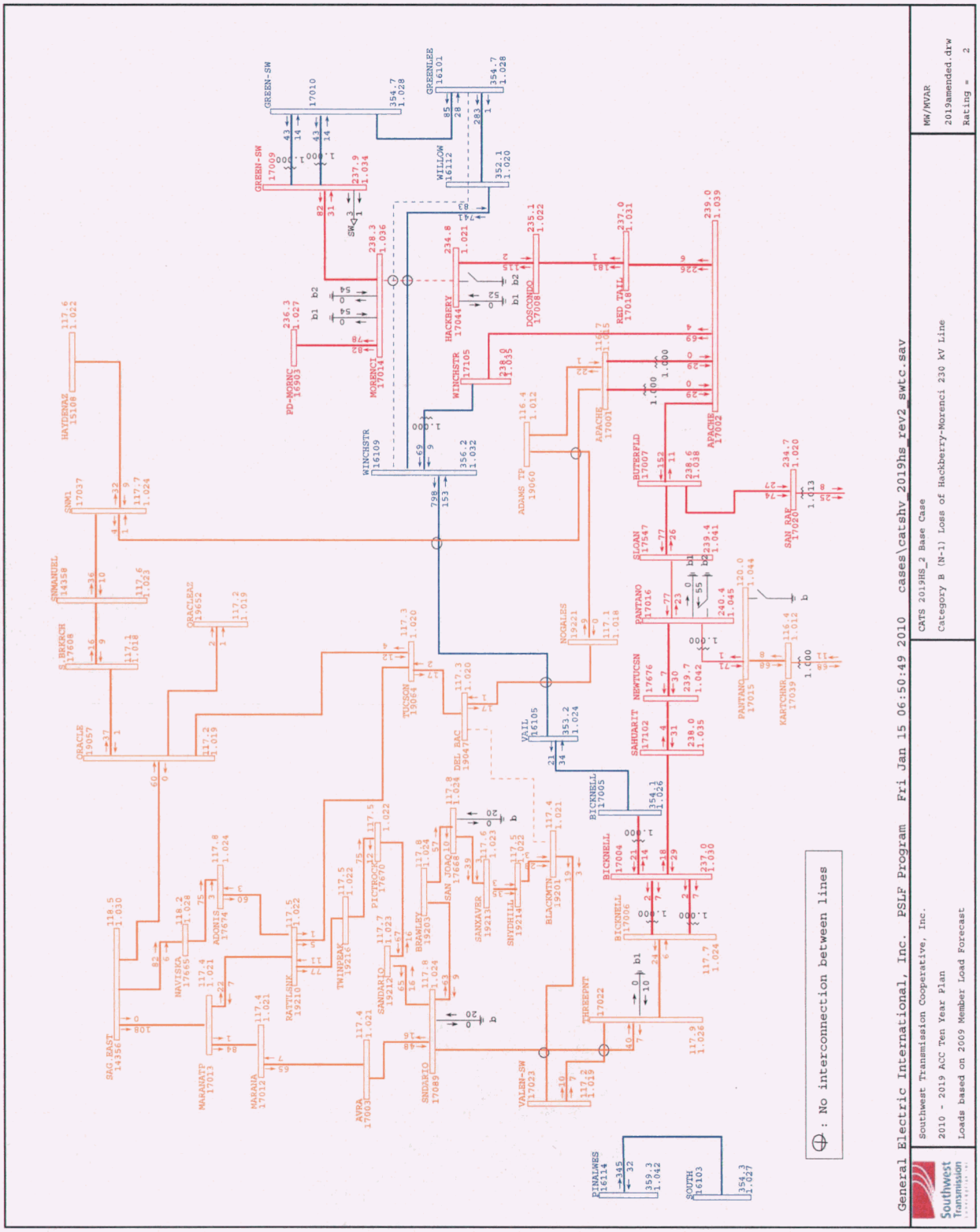
2019HS Southwest Transmission Cooperative Base System with Sloan to Pantano 230 kV Line out of service



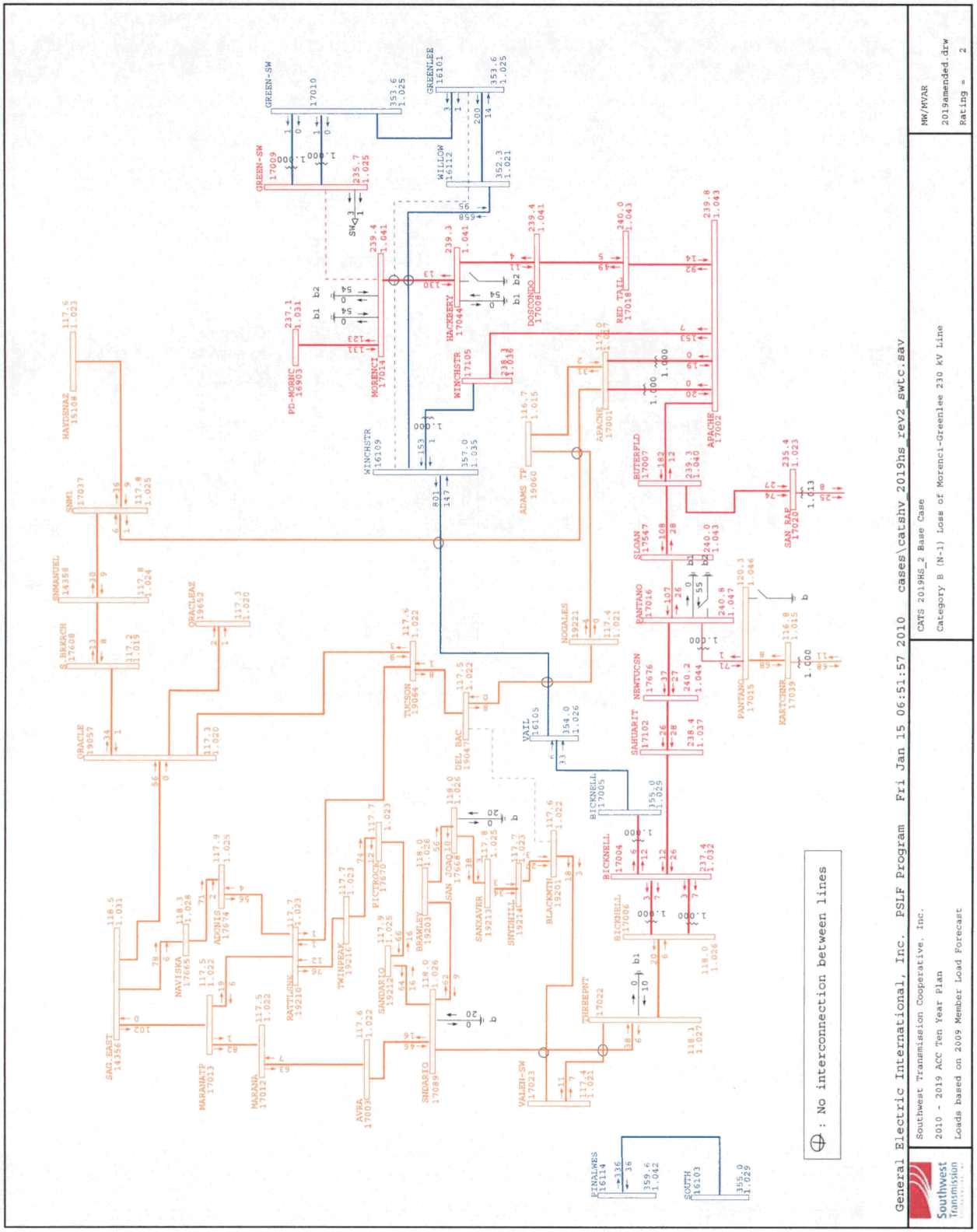
2019HS Southwest Transmission Cooperative Base System with Dos Condados to Hackberry 230 kV Line out of service



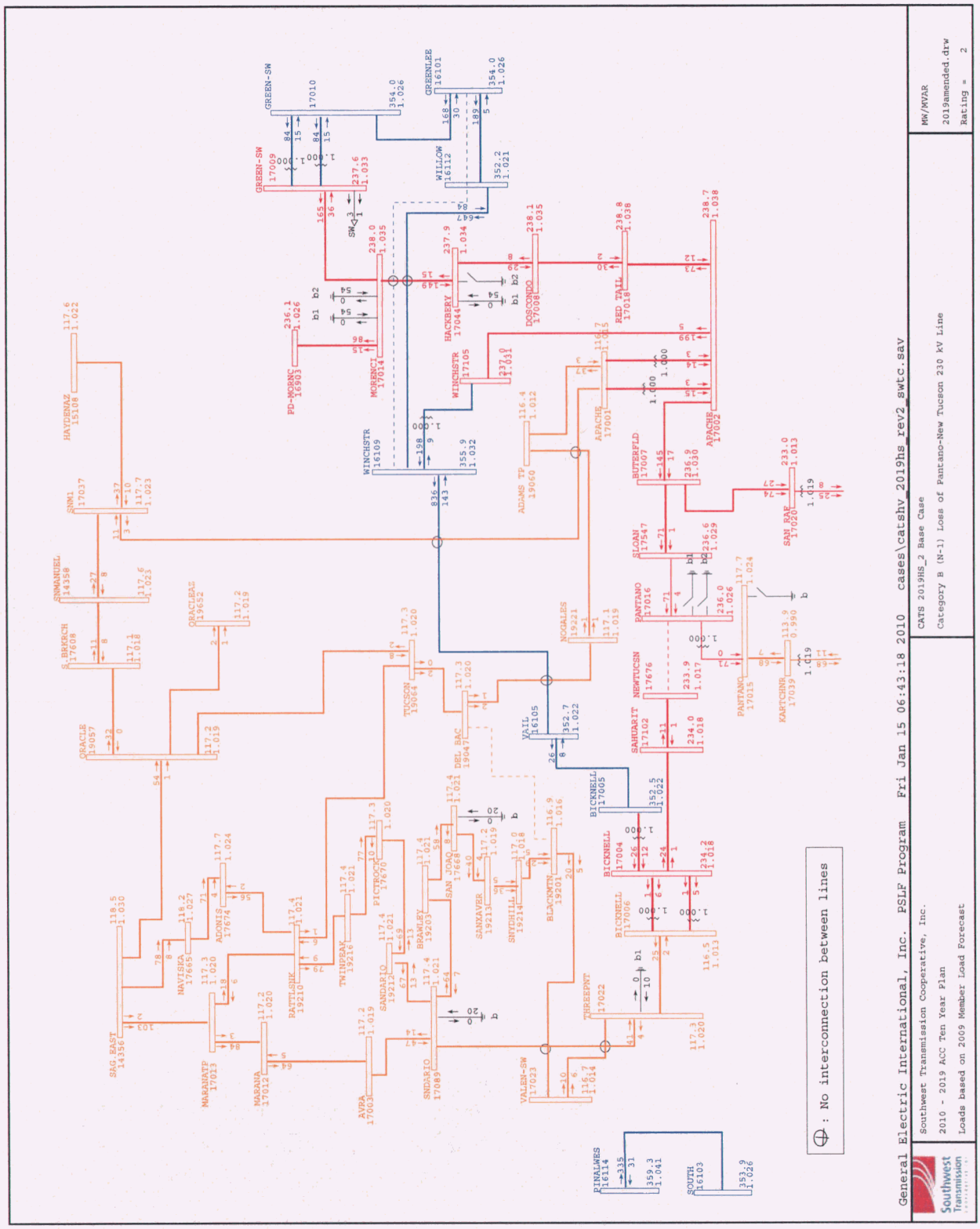
2019HS Southwest Transmission Cooperative Base System with Hackberry to Morenci 230 kV Line out of service



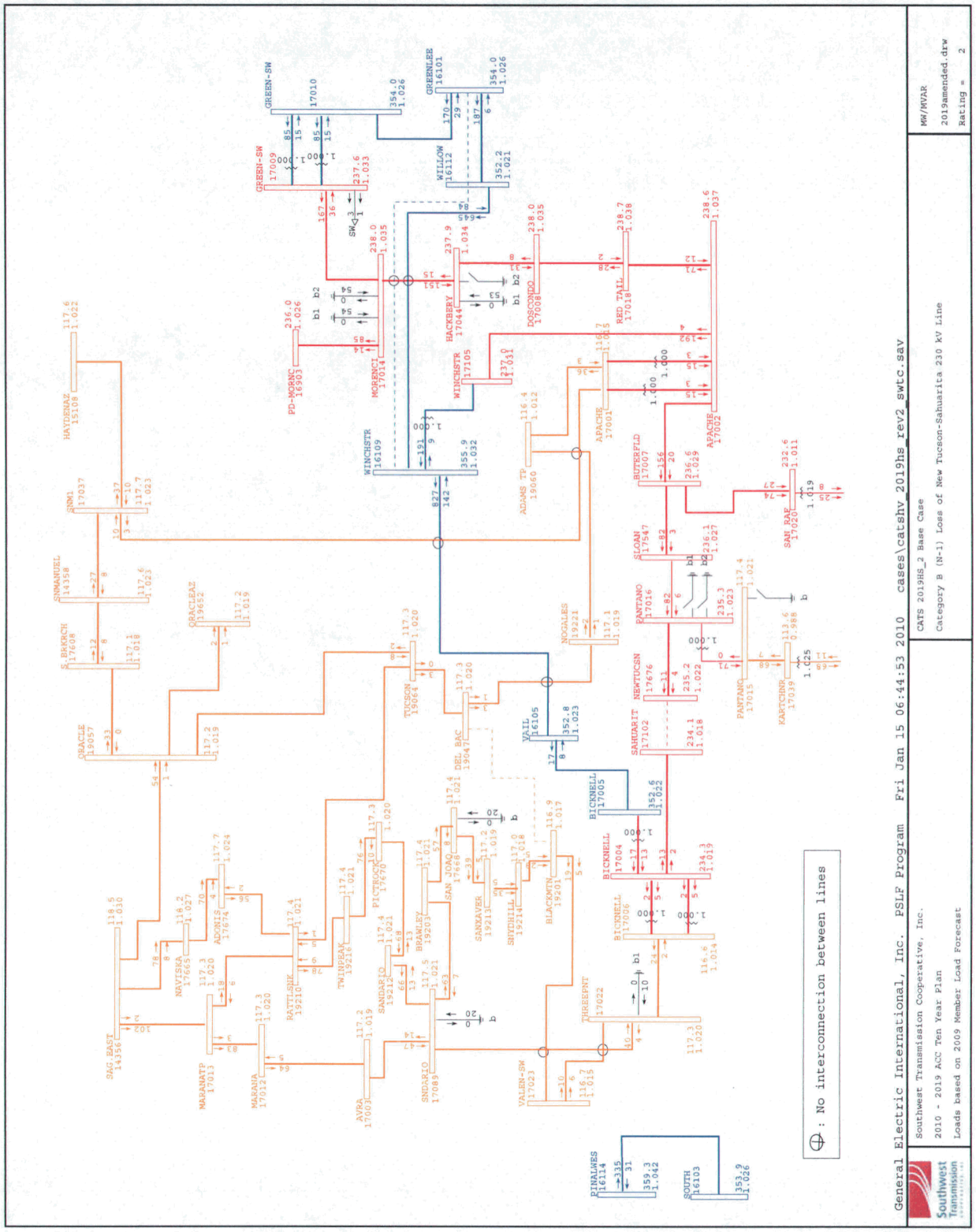
2019HS Southwest Transmission Cooperative Base System with Morenci to Greenlee 230 kV Line out of service



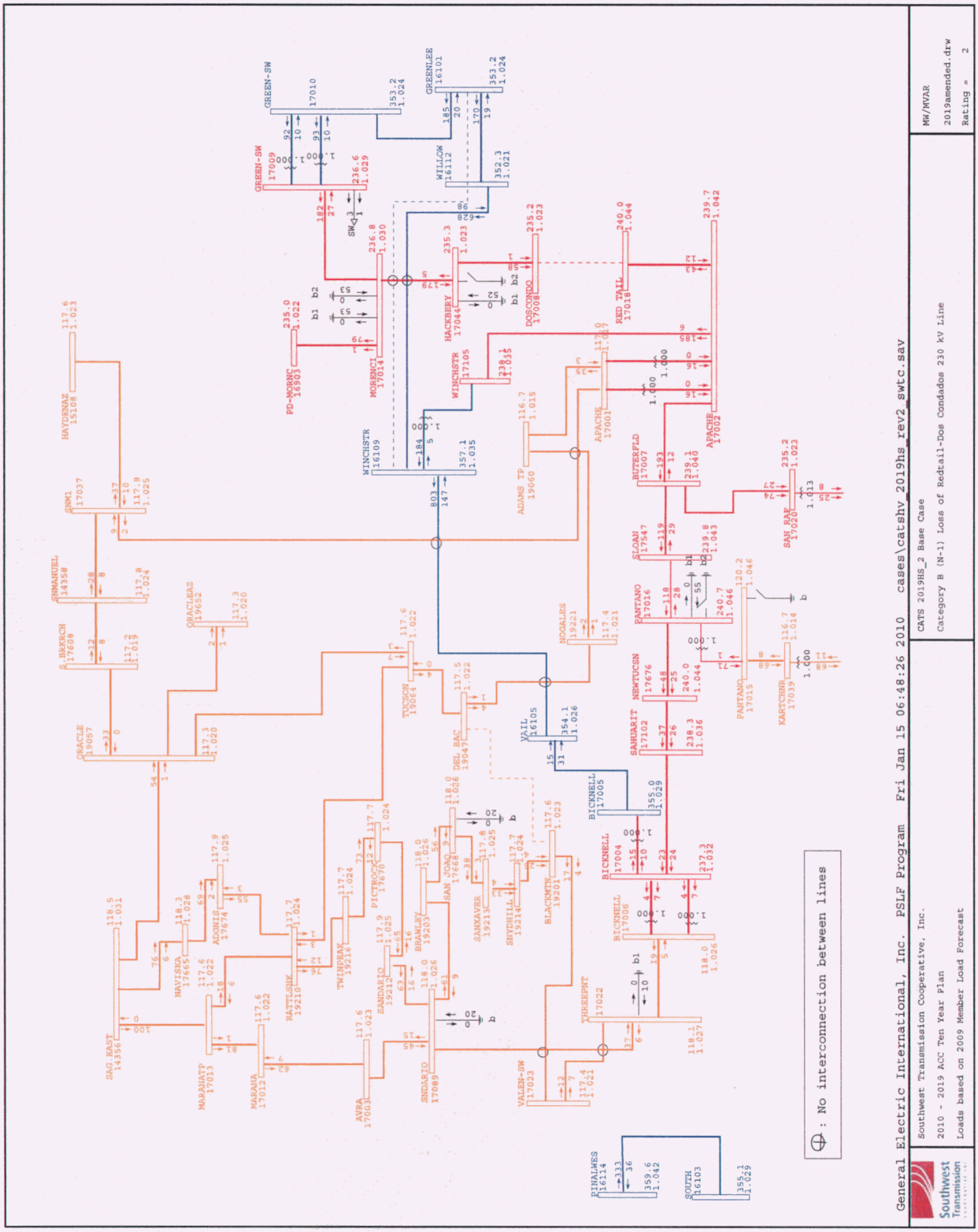
2019HS Southwest Transmission Cooperative Base System with Pantano to New Tucson 230 kV Line out of service



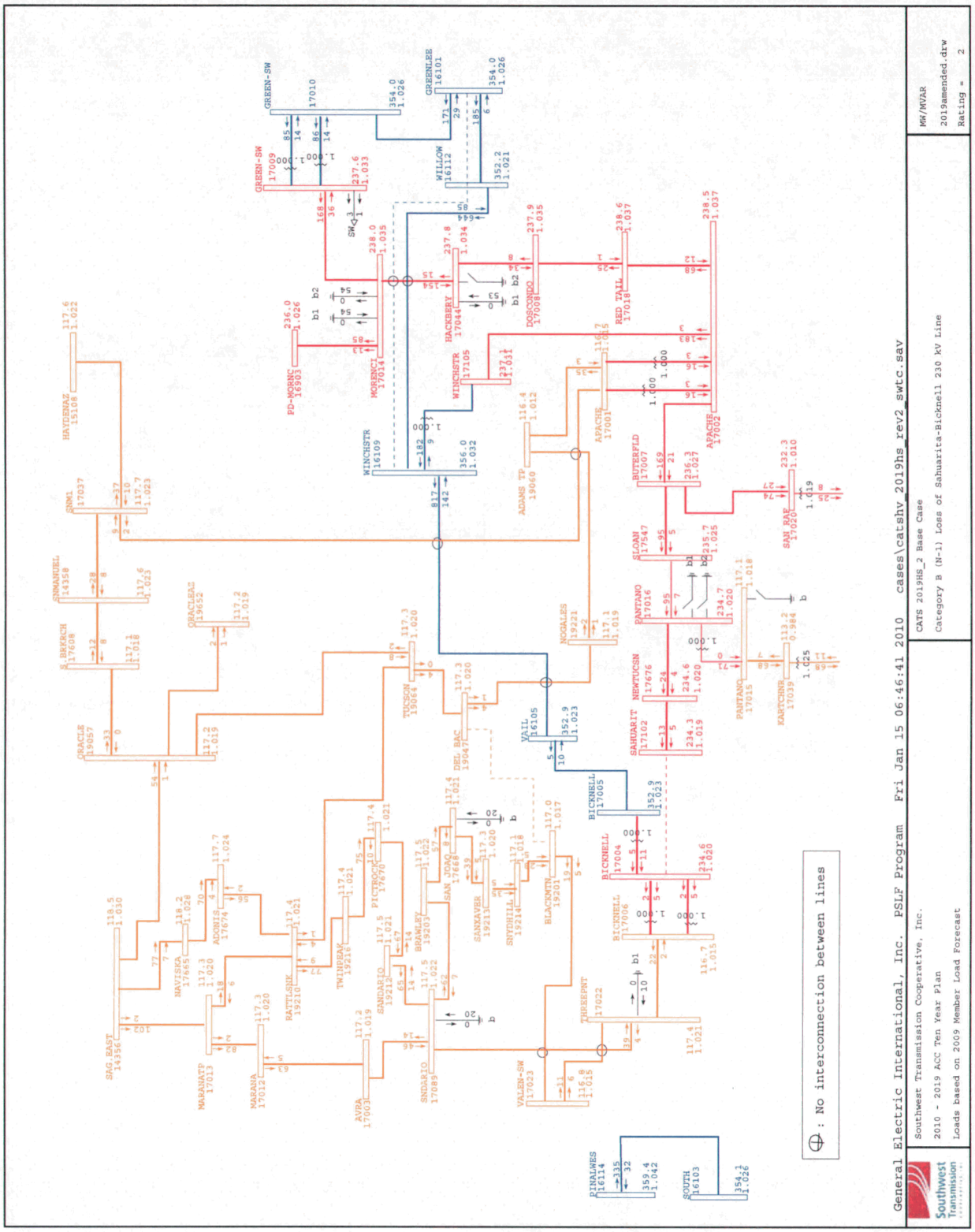
2019HS Southwest Transmission Cooperative Base System with New Tucson to Sahuarita 230 kV Line out of service



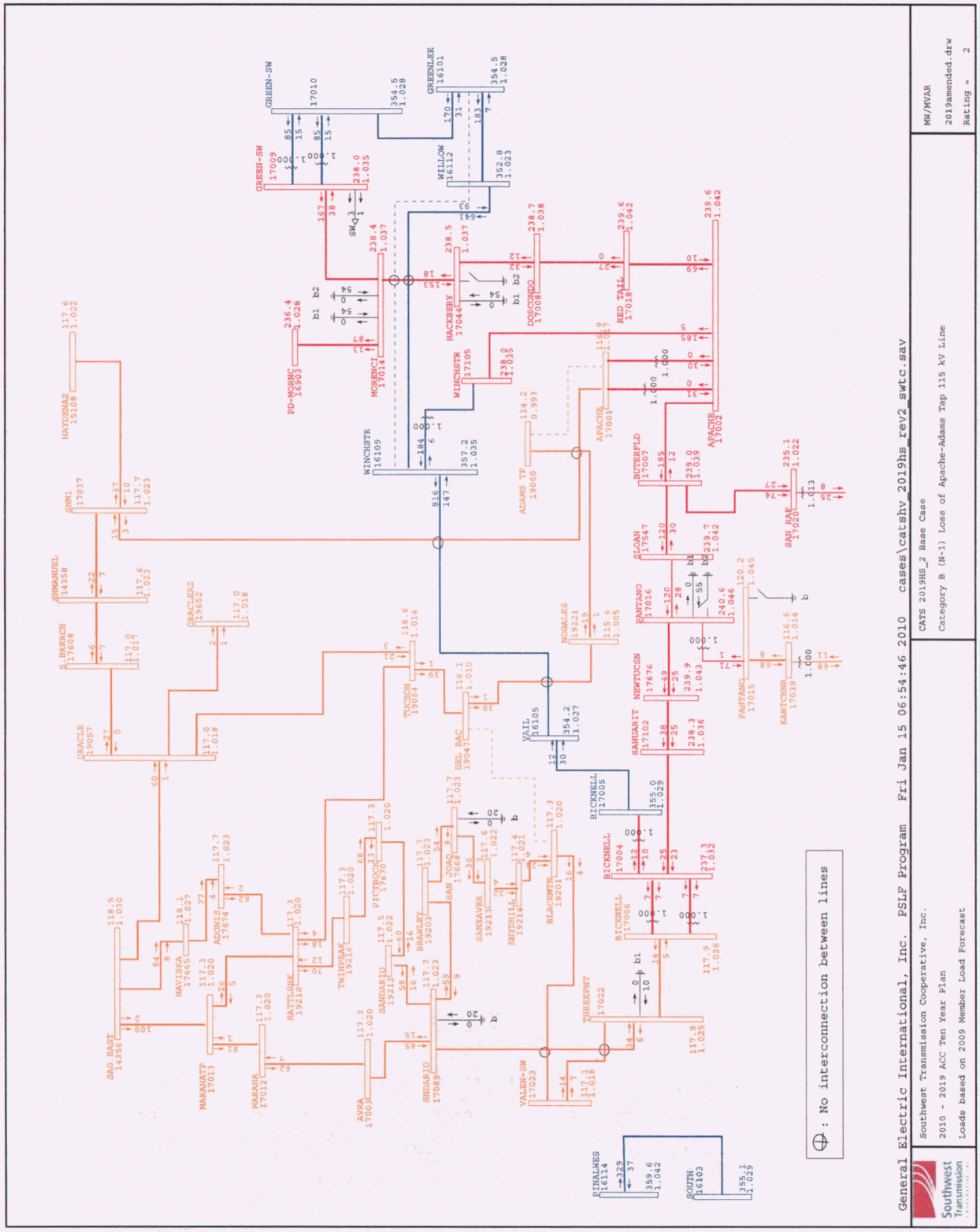
2019HS Southwest Transmission Cooperative Base System with Redtail to Dos Condados 230 kV Line out of service



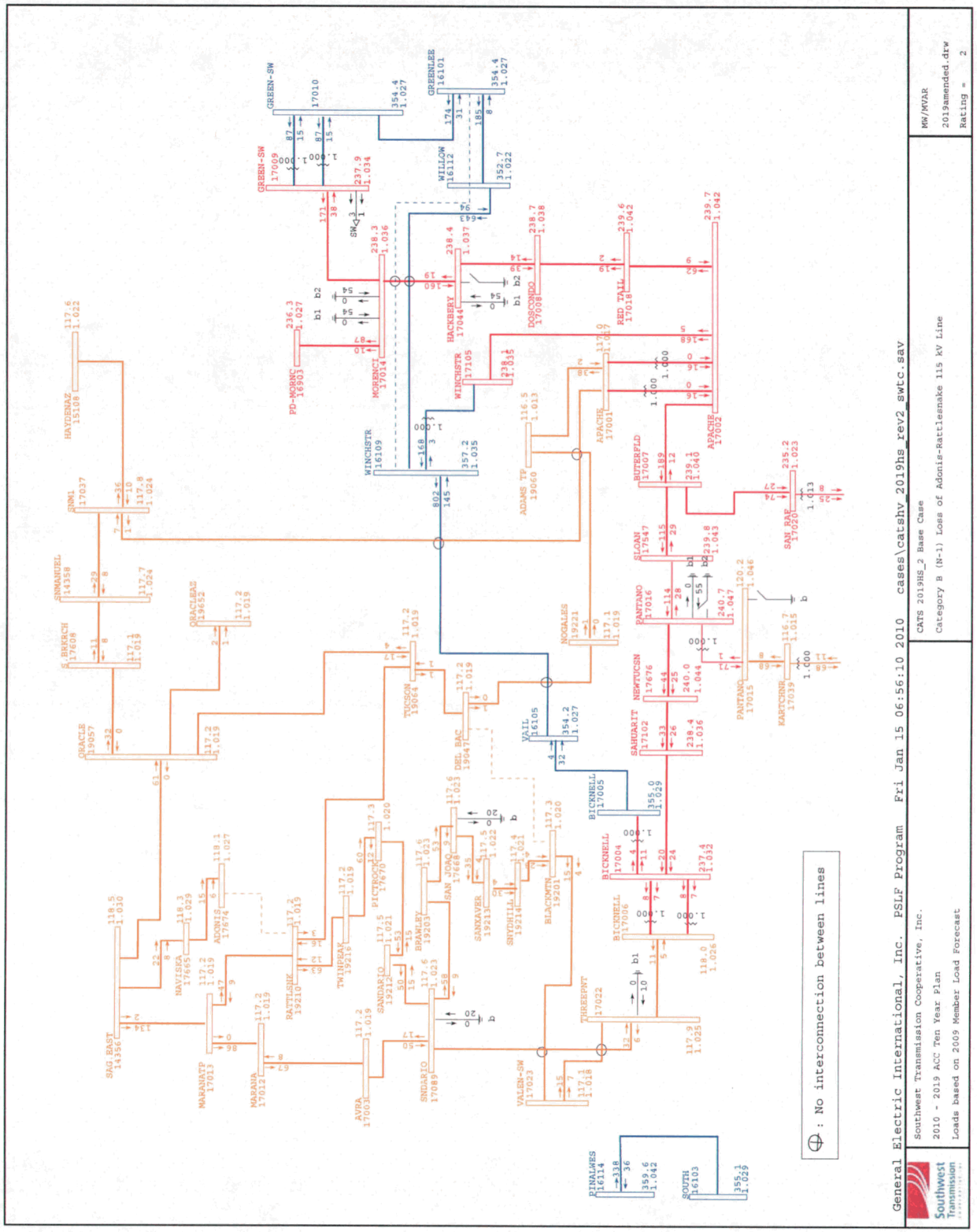
2019HS Southwest Transmission Cooperative Base System with Sahuarita to Bicknell 230 kV Line out of service



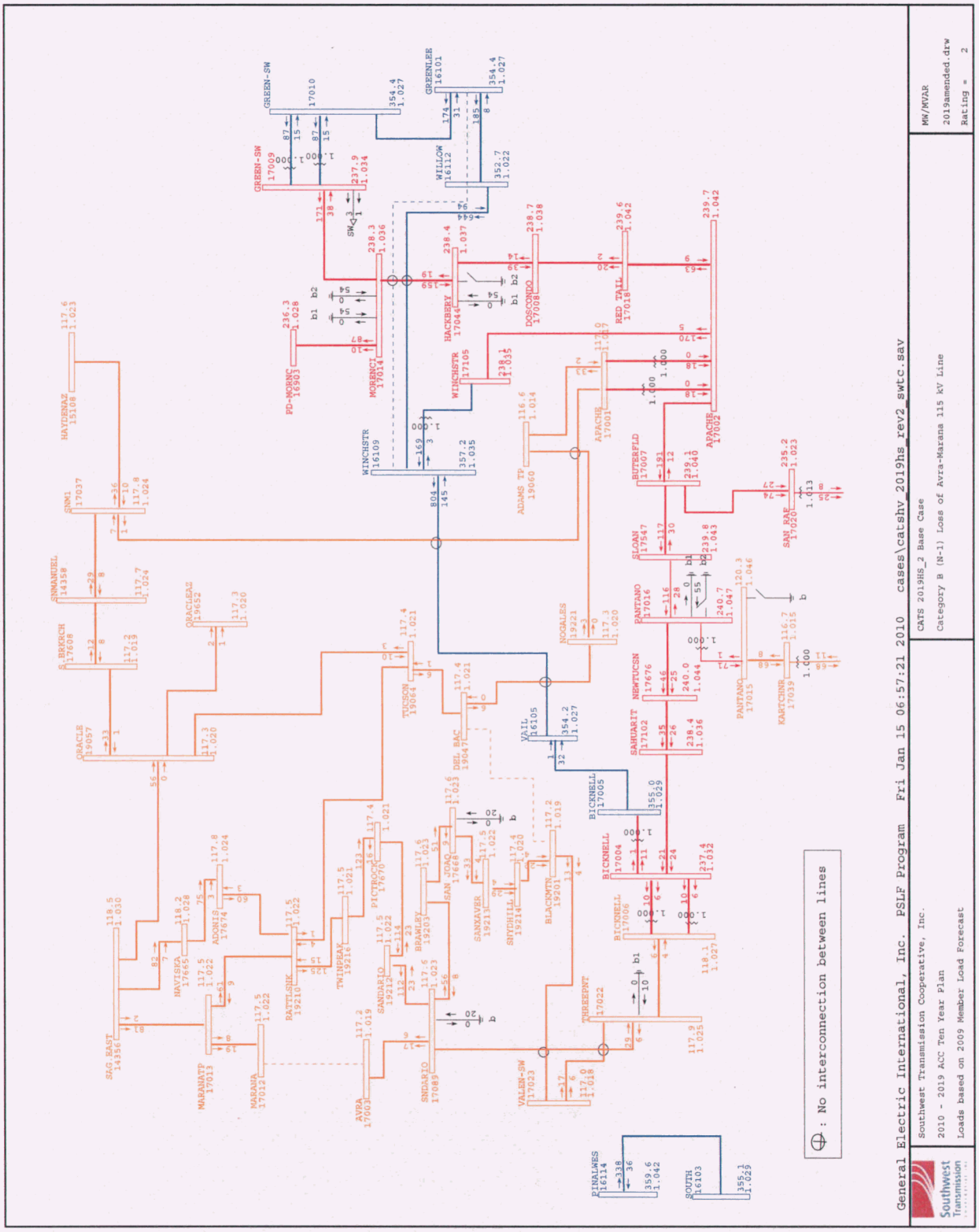
2019HS Southwest Transmission Cooperative Base System with Apache to Adams Tap 115 kV Line out of service



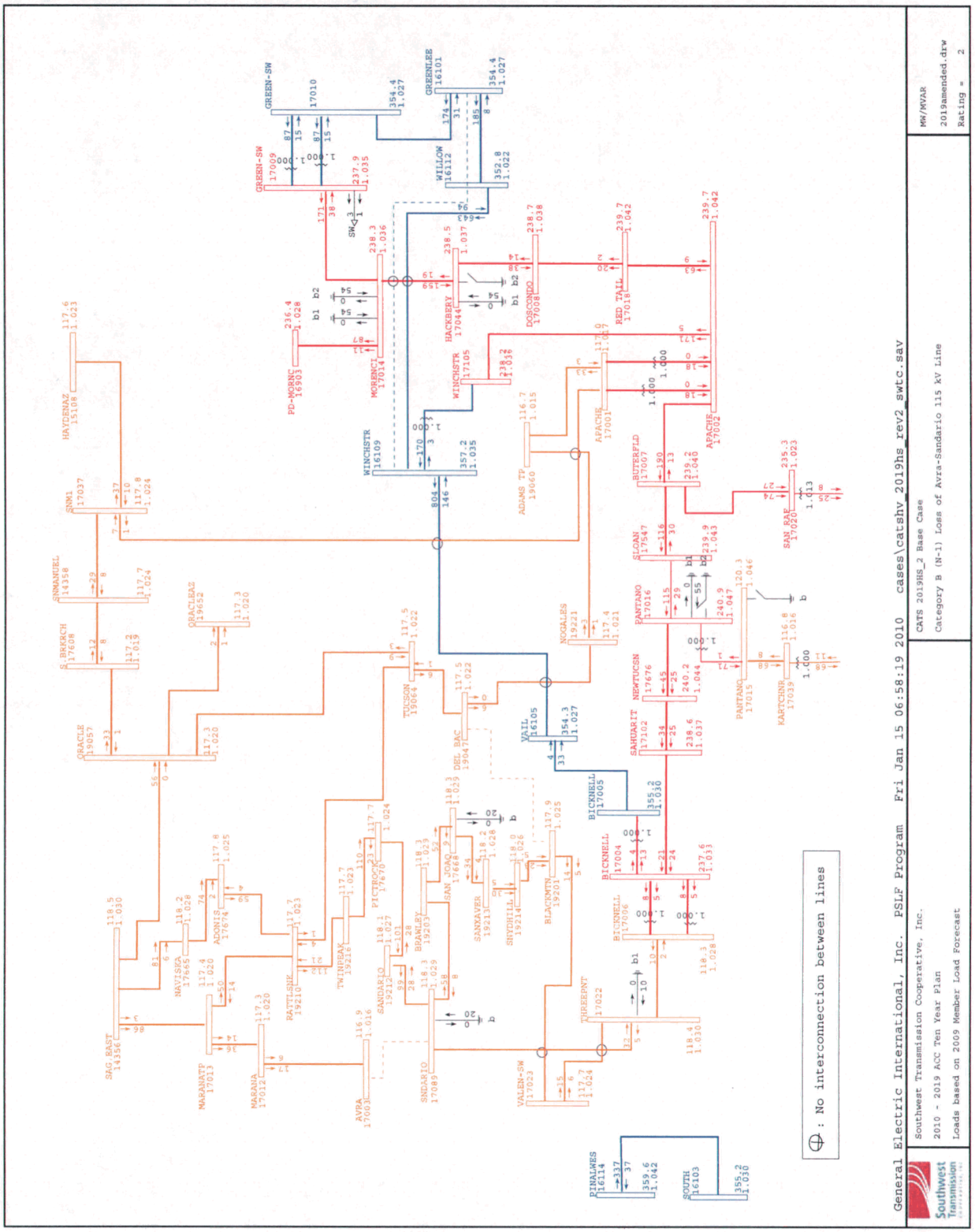
2019HS Southwest Transmission Cooperative Base System with Adonis to Rattlesnake 115 kV Line out of service



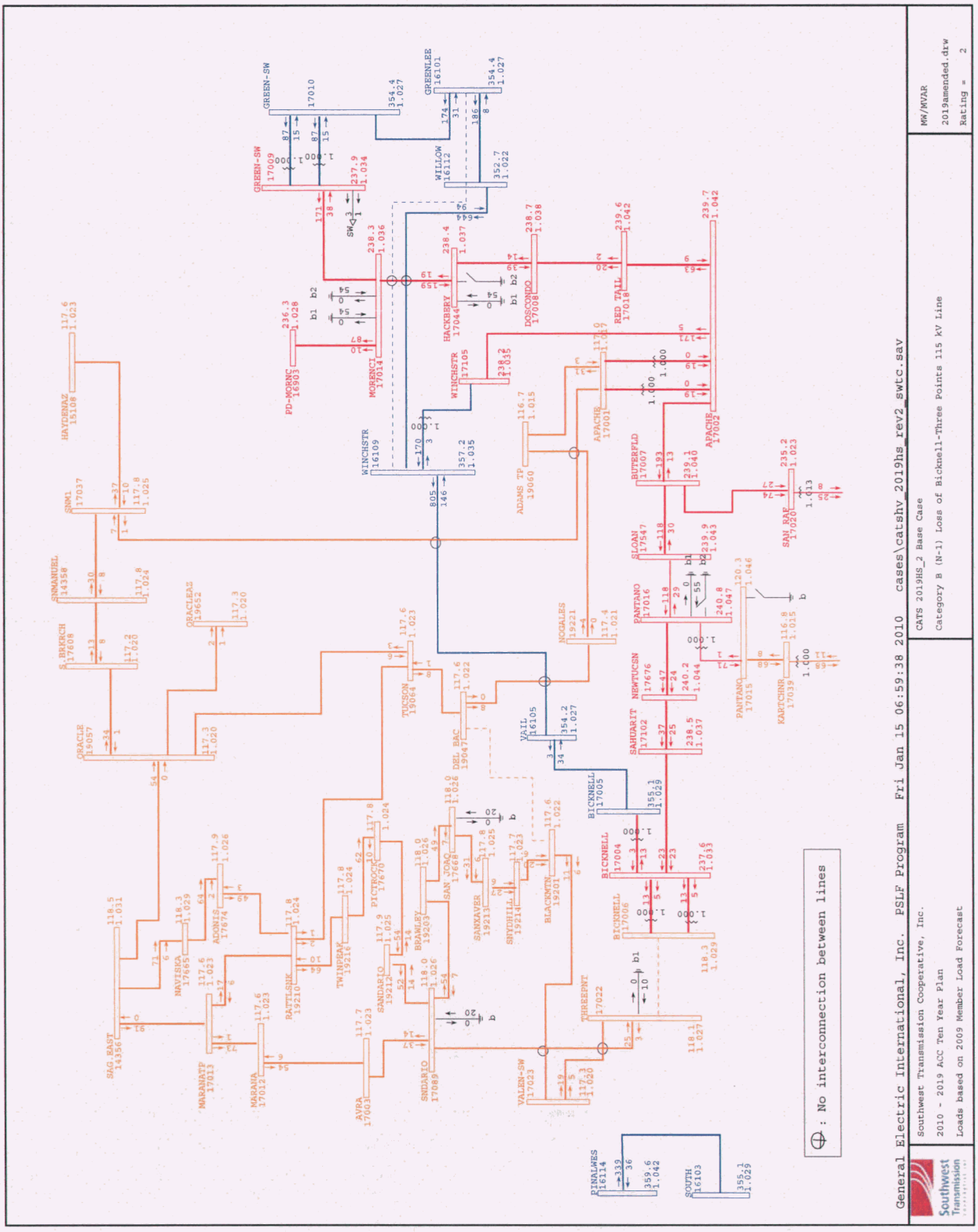
2019HS Southwest Transmission Cooperative Base System with Avra to Marana 115 kV Line out of service



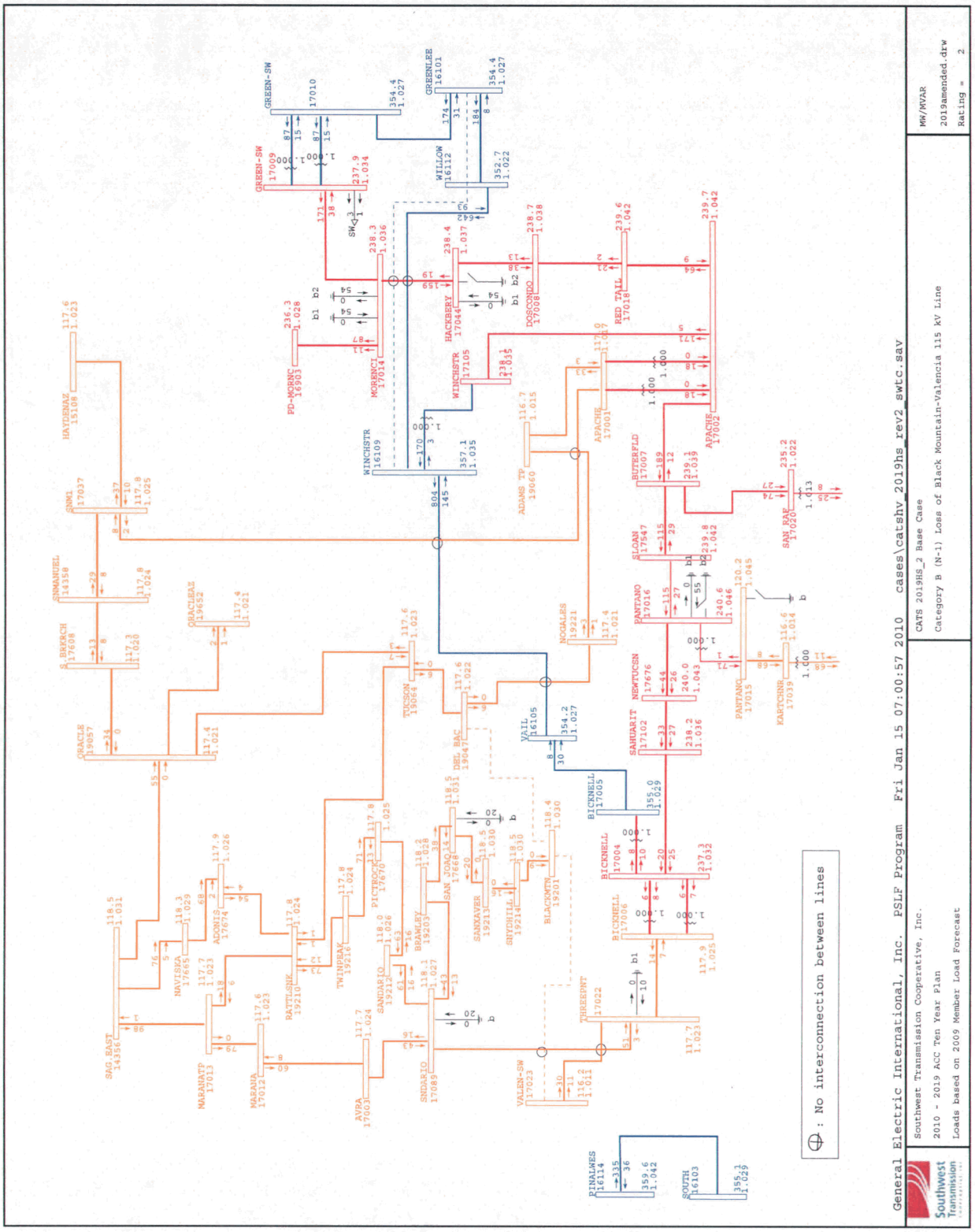
2019HS Southwest Transmission Cooperative Base System with Avra to Sandario 115 kV Line out of service



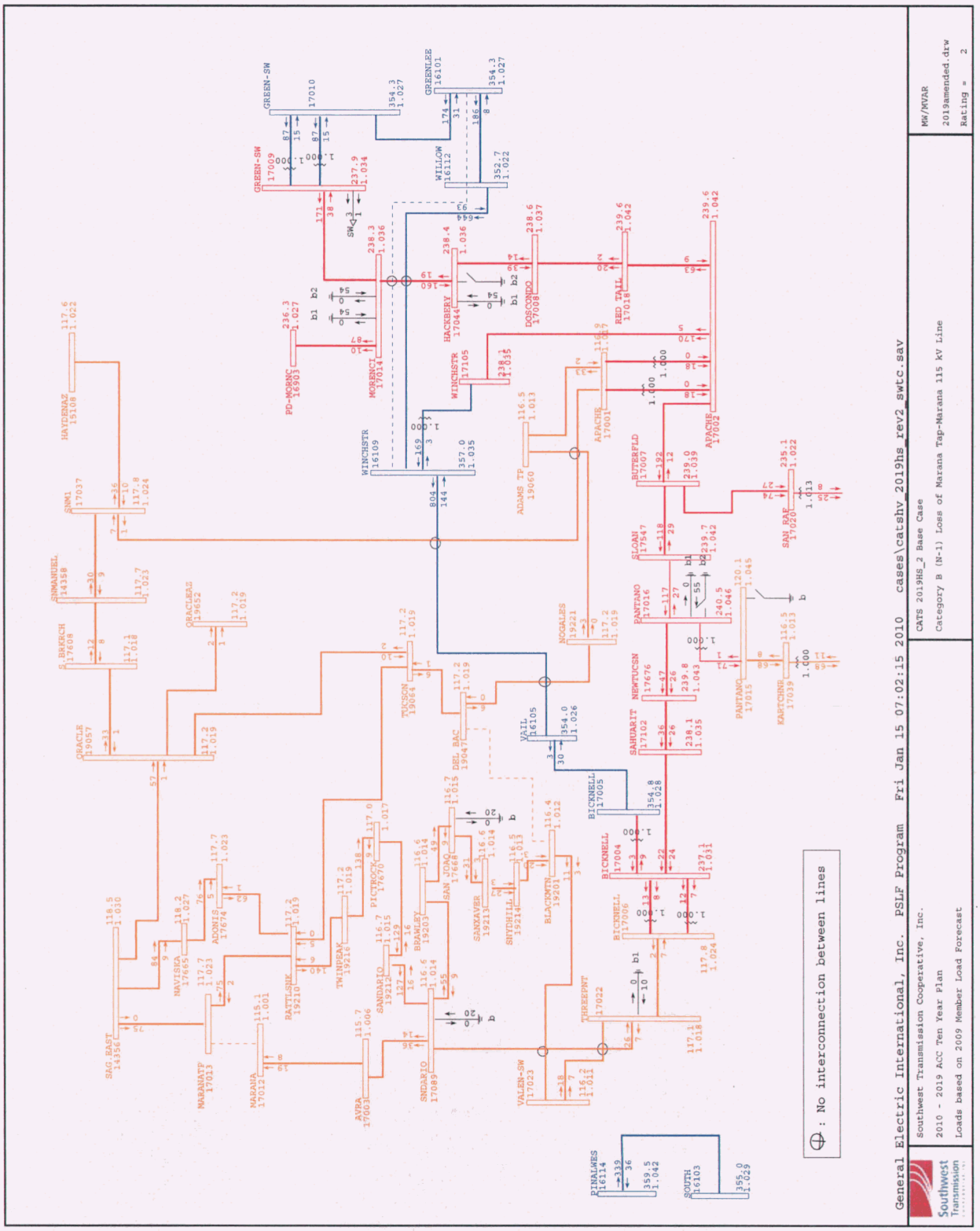
2019HS Southwest Transmission Cooperative Base System with Bicknell to Three Points 115 kV Line out of service



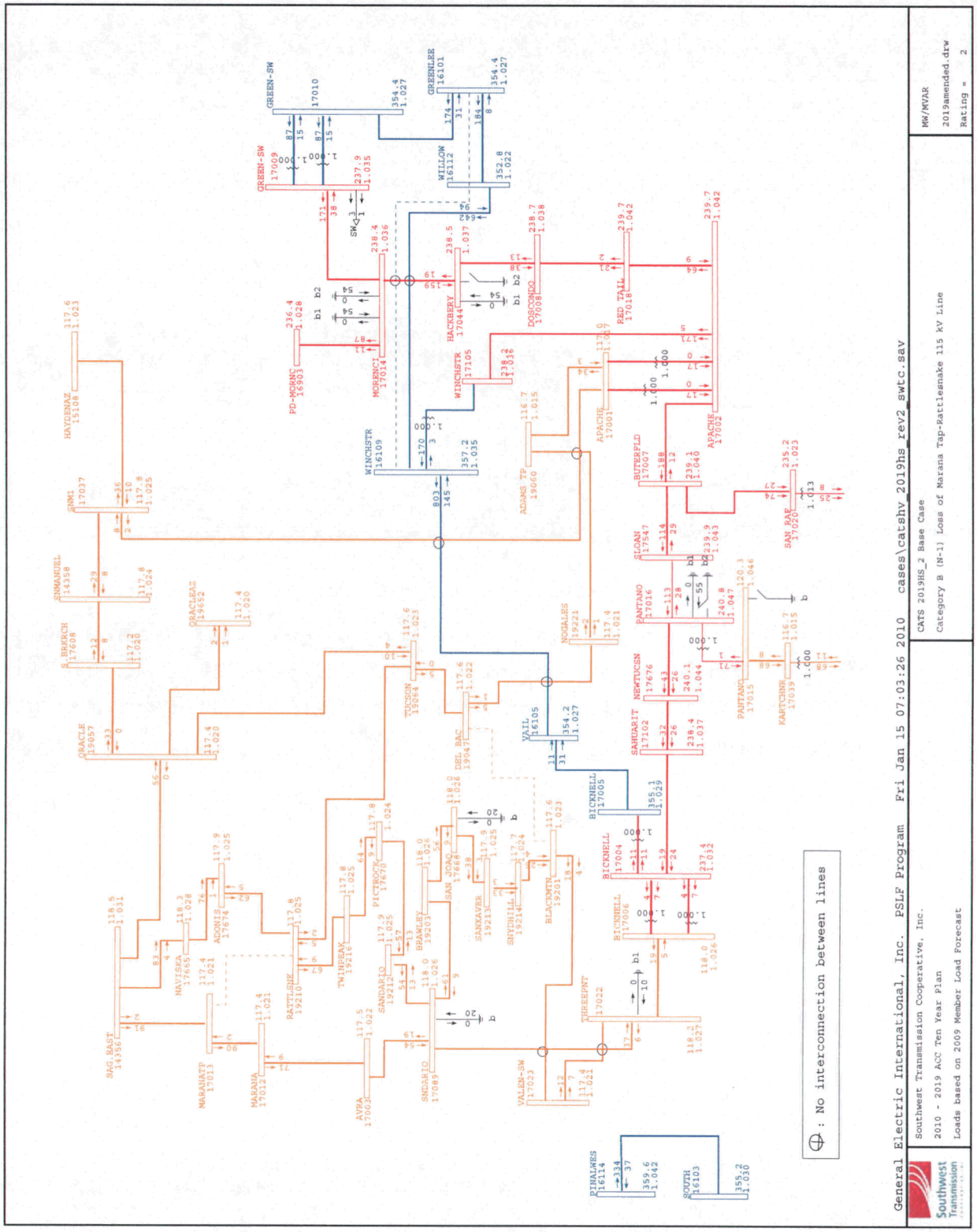
2019HS Southwest Transmission Cooperative Base System with Black Mountain to Valencia 115 kV Line out of service



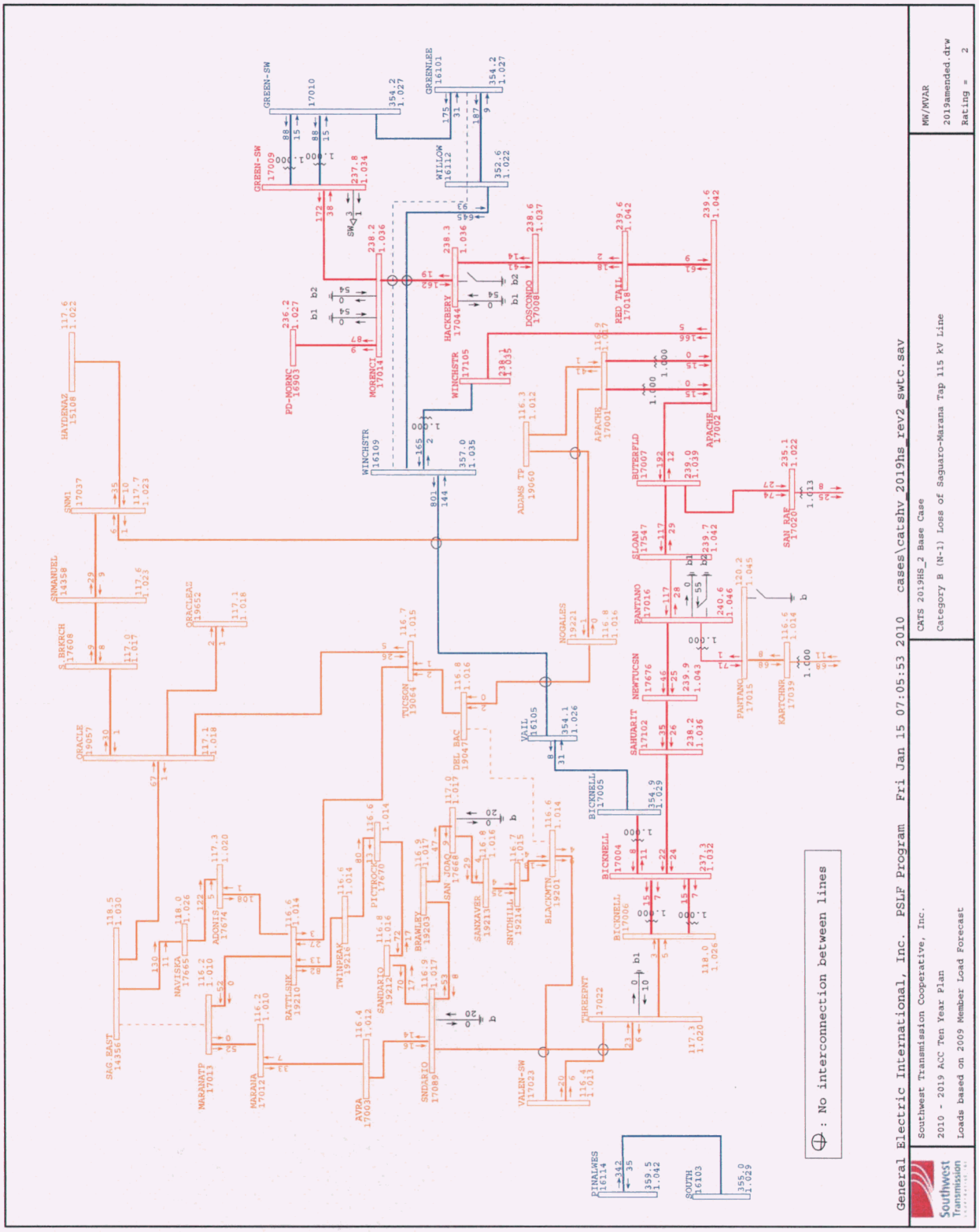
2019HS Southwest Transmission Cooperative Base System with Marana Tap to Marana 115 kV Line out of service



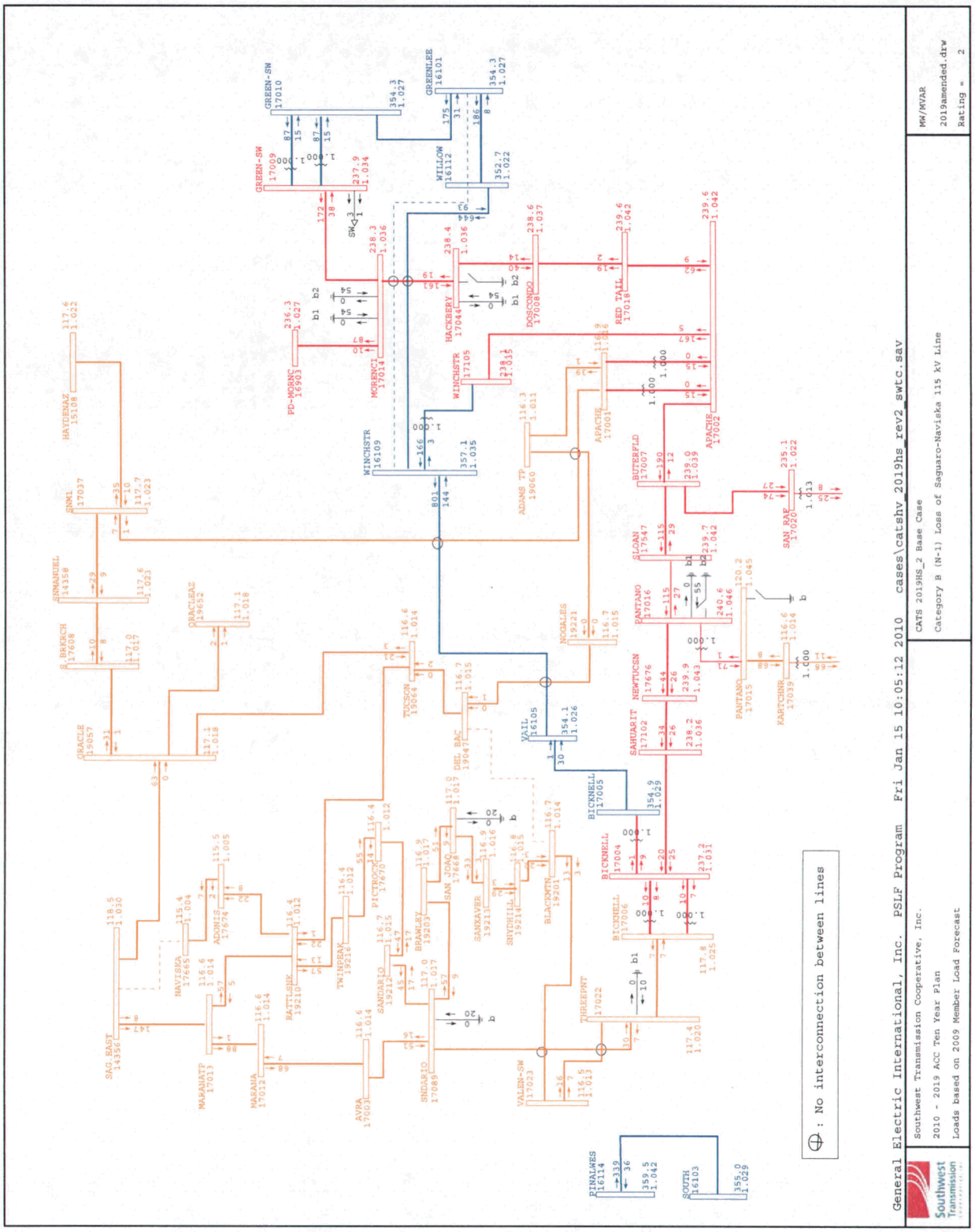
2019HS Southwest Transmission Cooperative Base System with Marana Tap to Rattlesnake 115 kV Line out of service



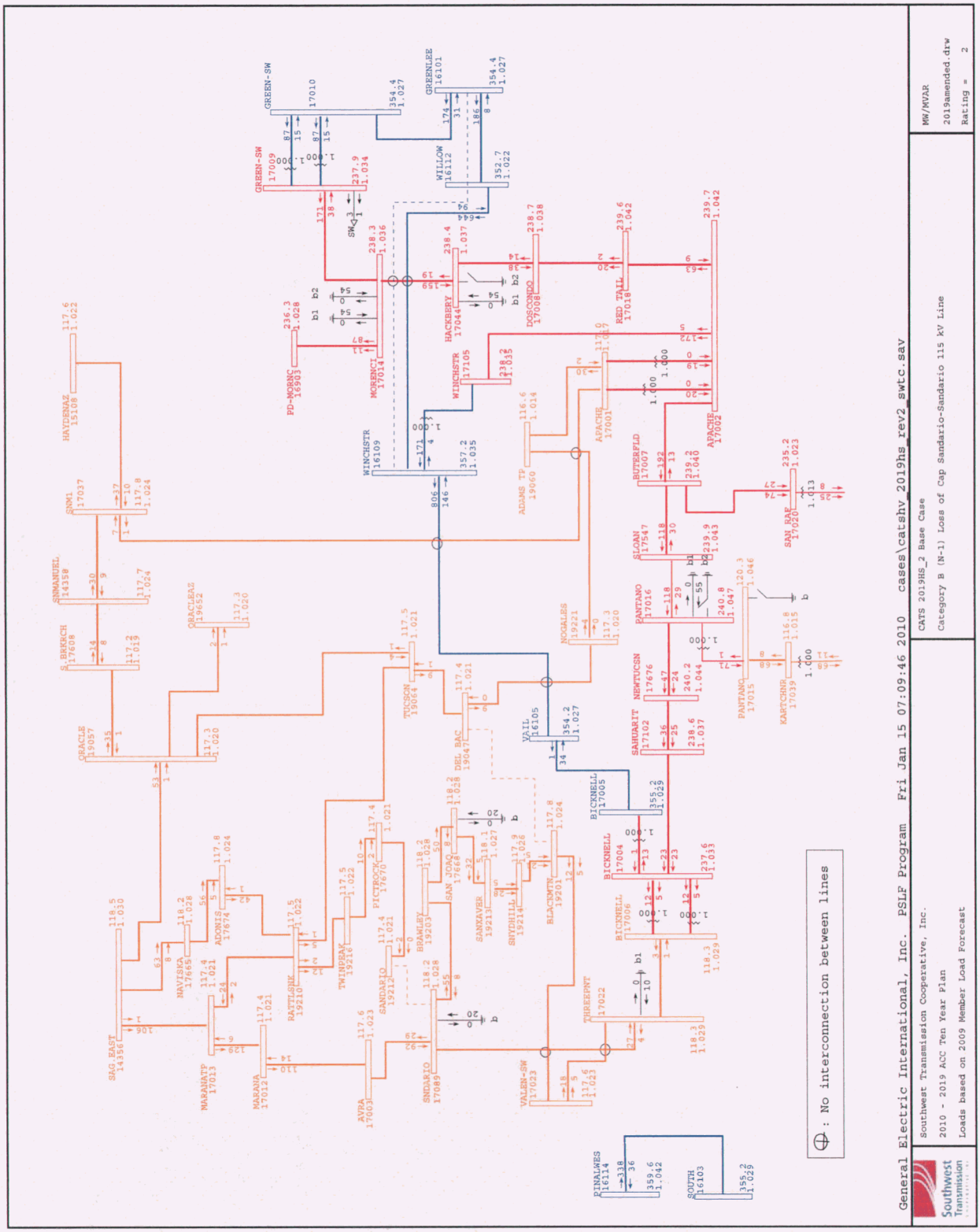
2019HS Southwest Transmission Cooperative Base System with Saguaro to Marana Tap 115 kV Line out of service



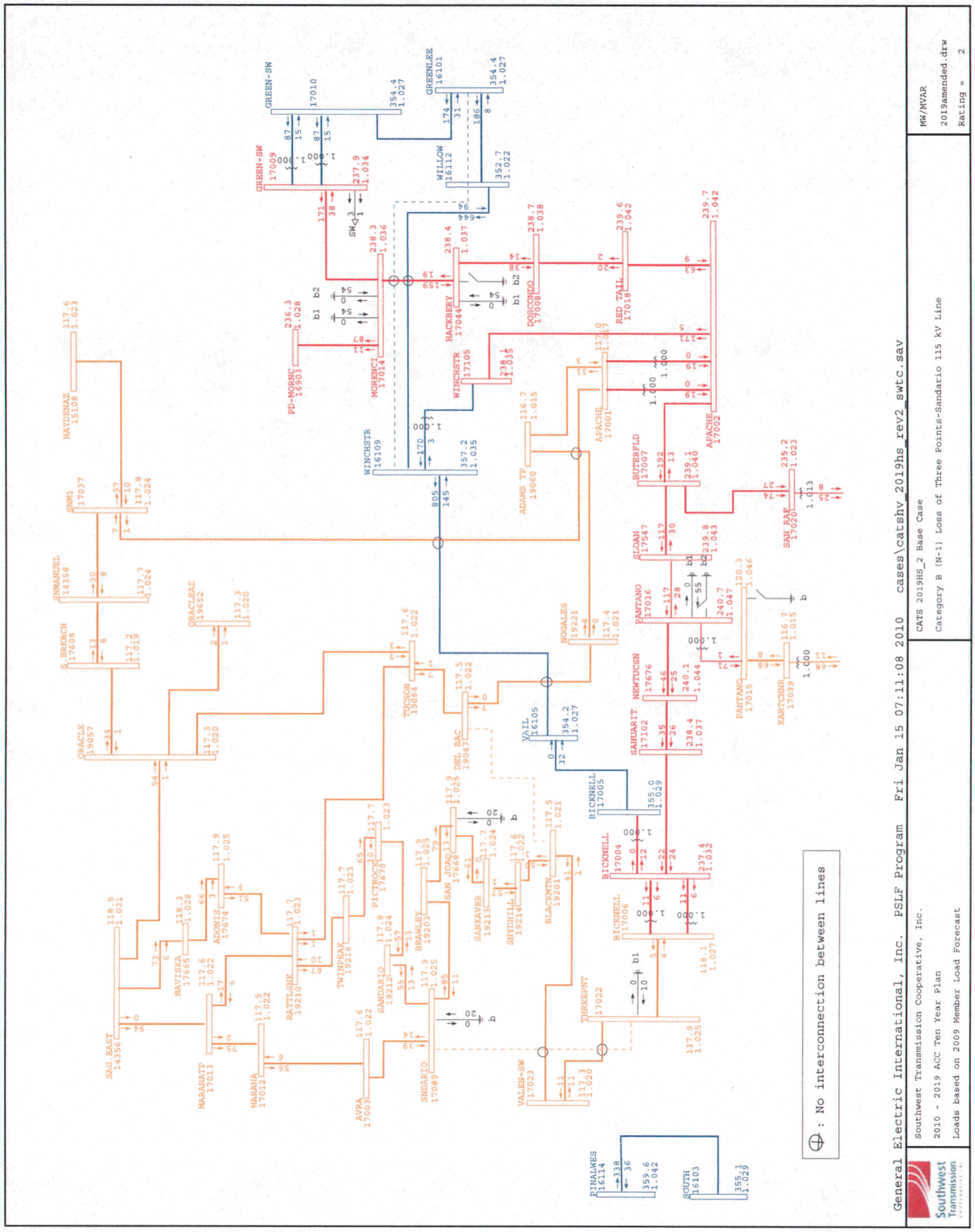
2019HS Southwest Transmission Cooperative Base System with Saguaro to Naviska 115 kV Line out of service



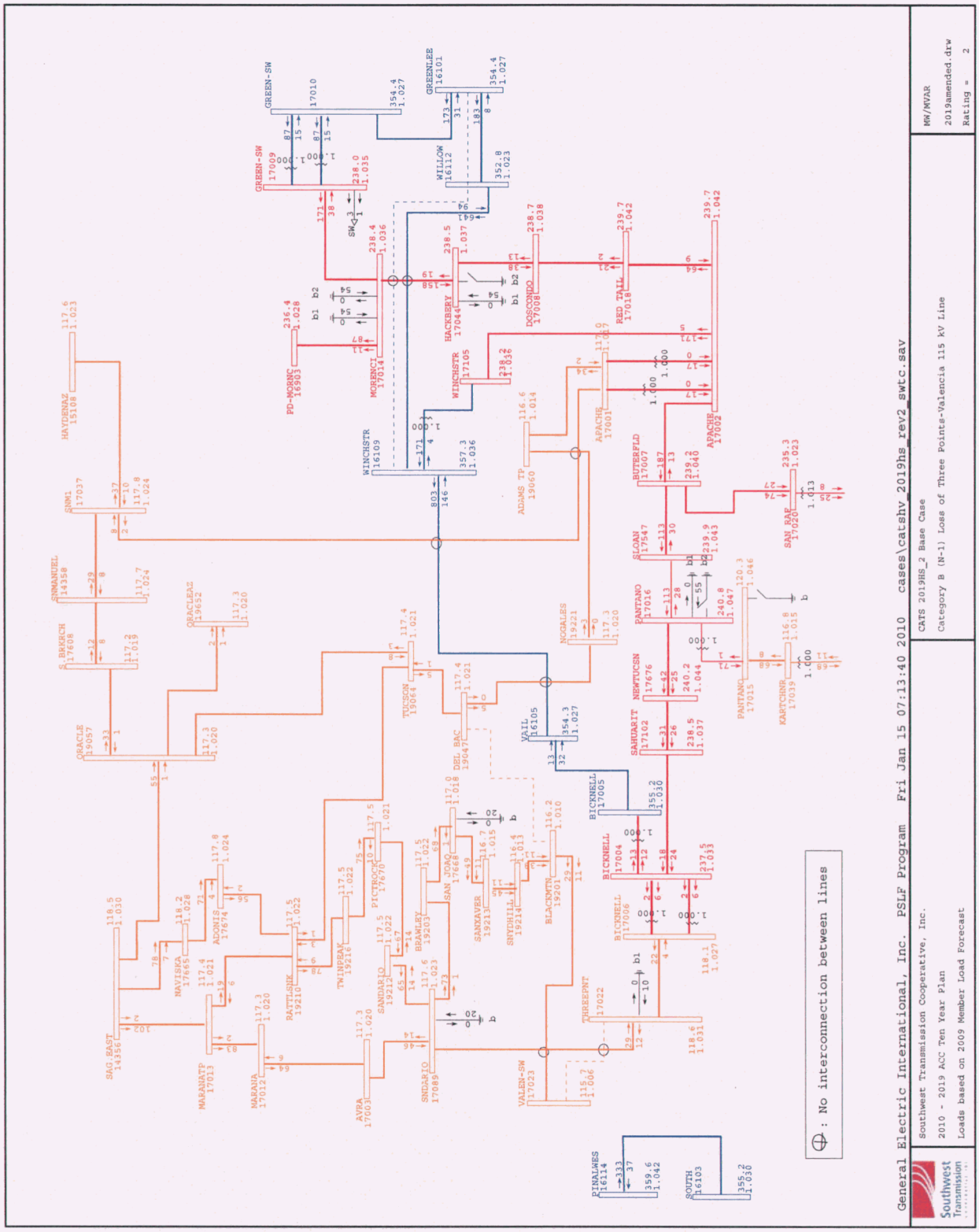
2019HS Southwest Transmission Cooperative Base System with Cap Sandario to Sandario 115 kV Line out of service



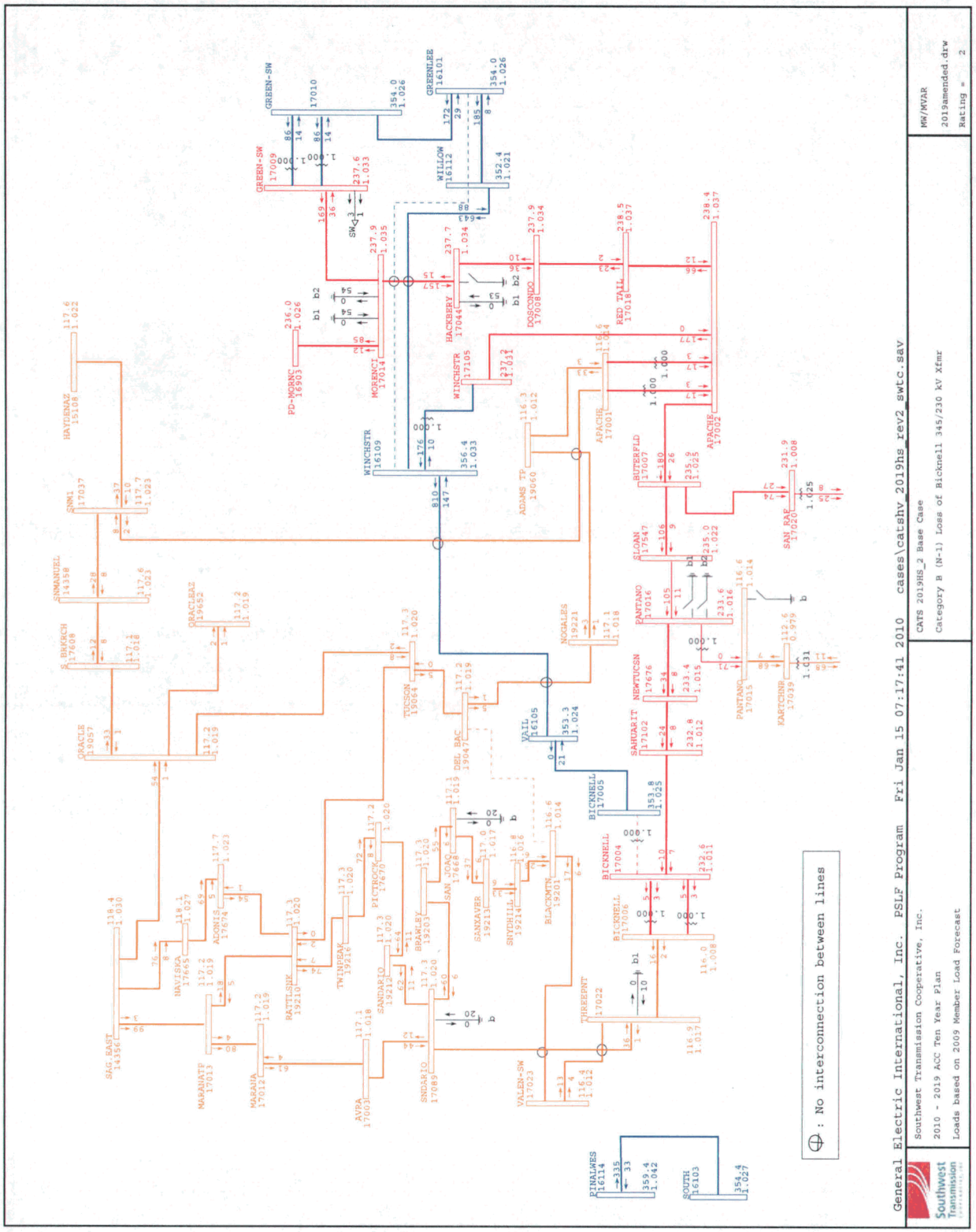
2019HS Southwest Transmission Cooperative Base System with Three Points to Sandario 115 kV Line out of service



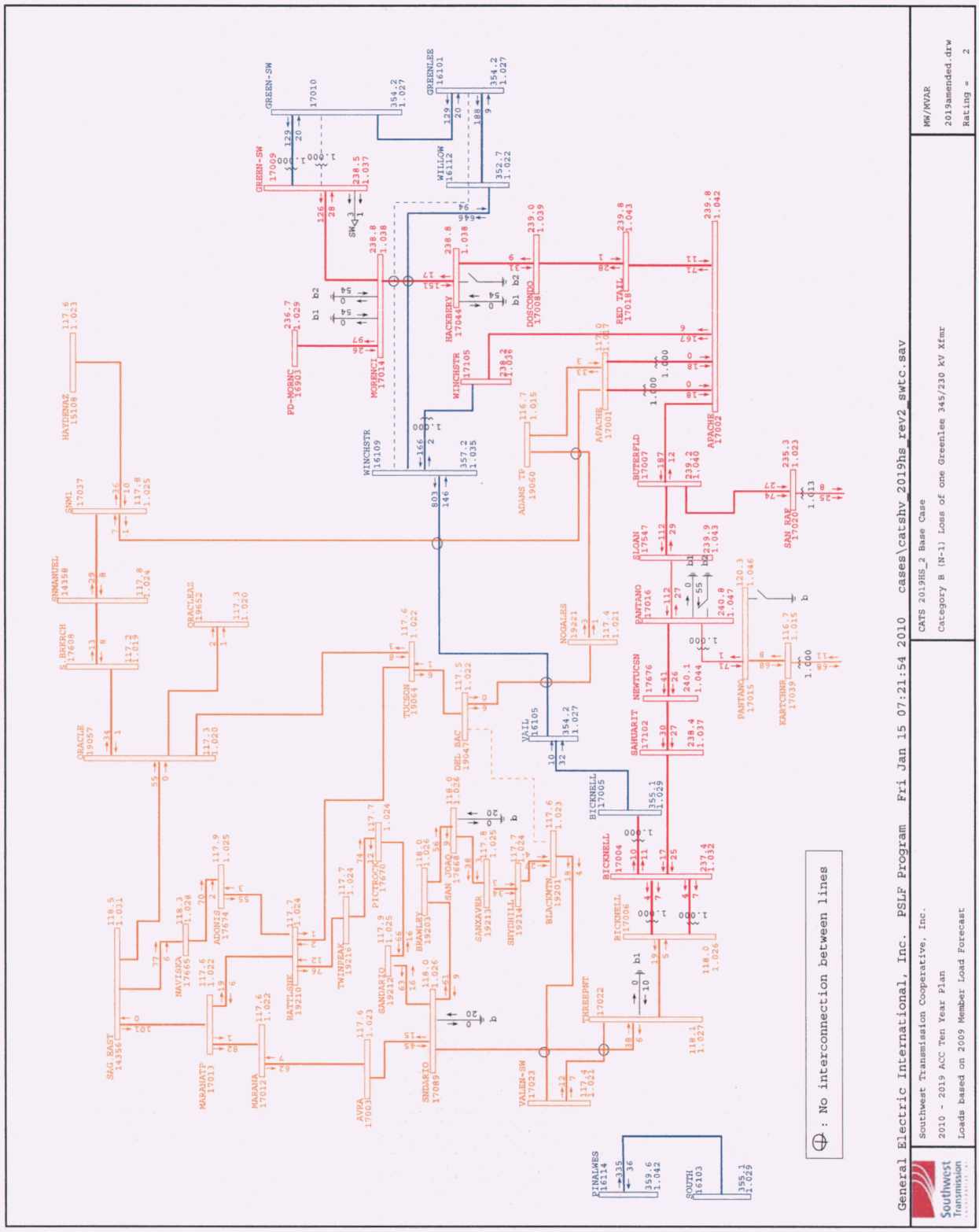
2019HS Southwest Transmission Cooperative Base System with Three Points to Valencia 115 kV Line out of service



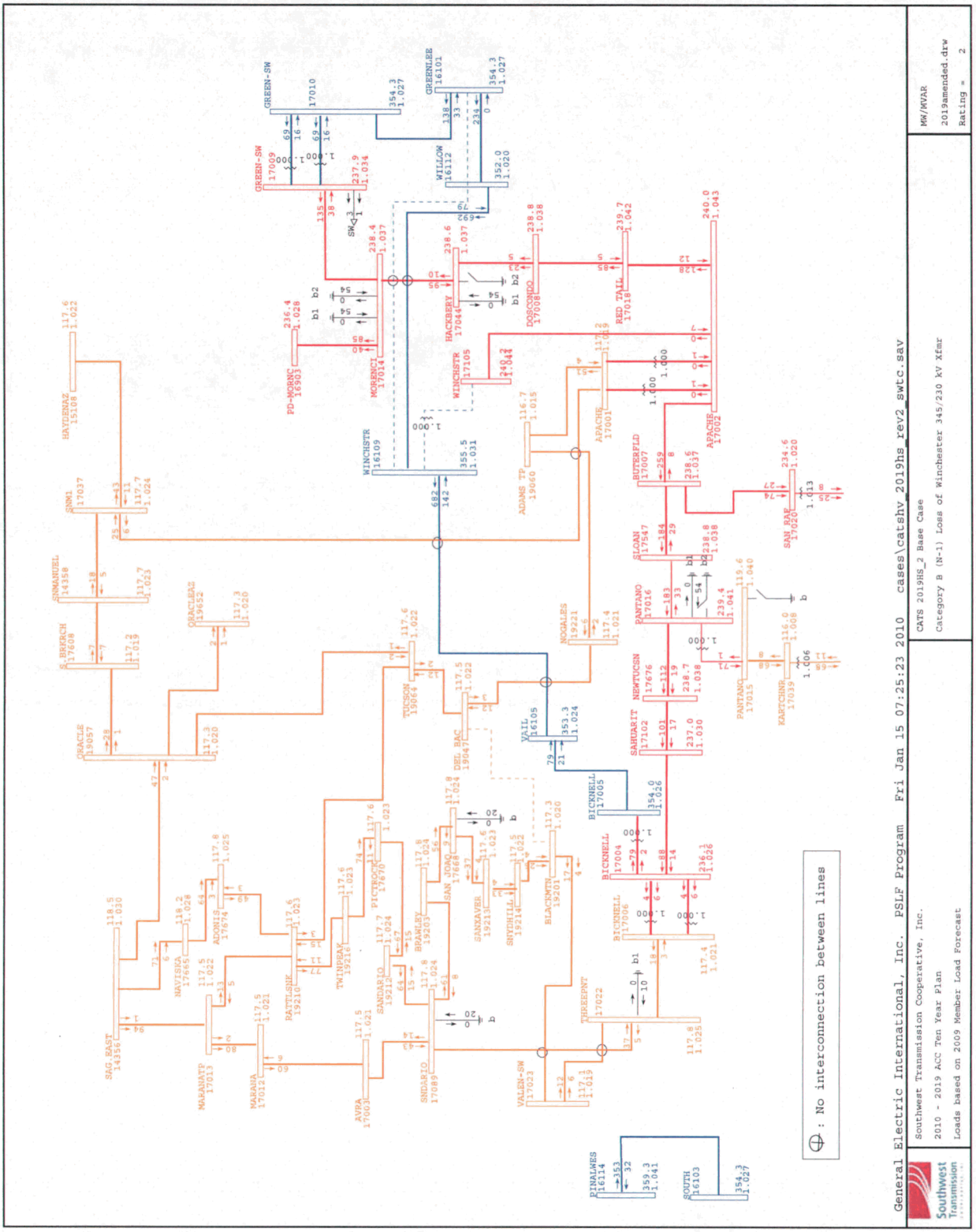
2019HS Southwest Transmission Cooperative Base System with Bicknell 345/230 kV Transformer out of service



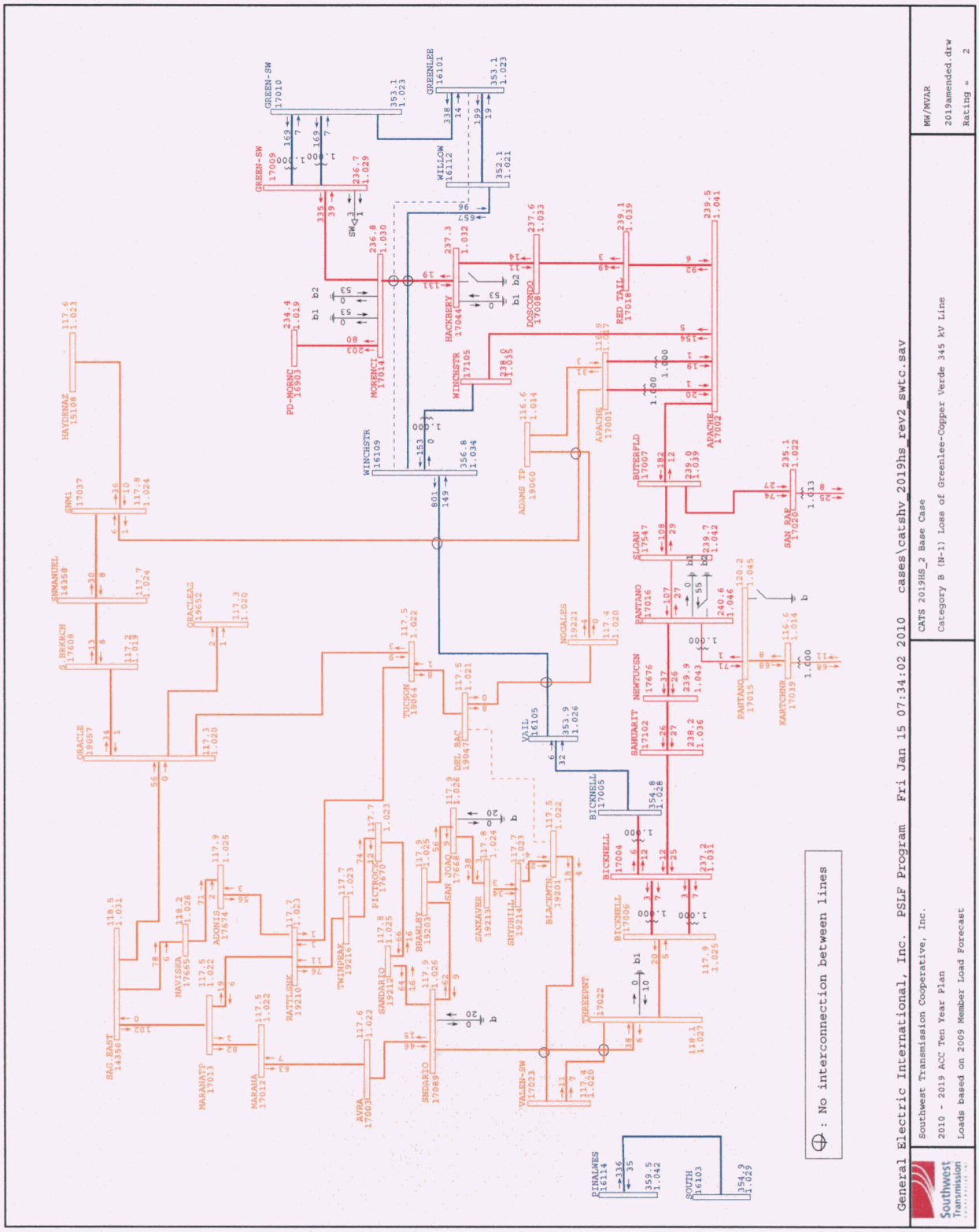
2019HS Southwest Transmission Cooperative Base System with one Greenlee 345/230 kV Transformer out of service



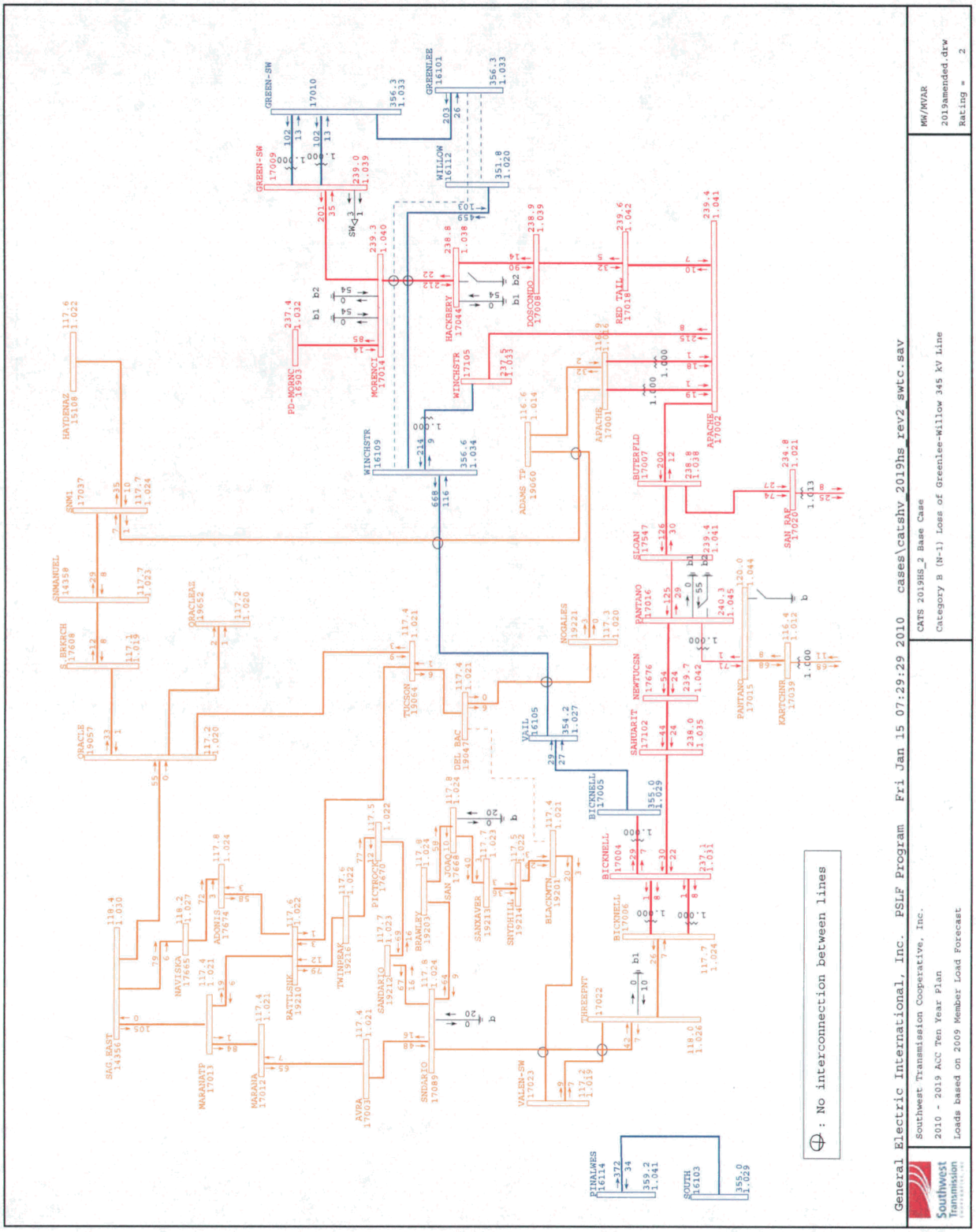
2019HS Southwest Transmission Cooperative Base System with Winchester 345/230 kV Transformer out of service



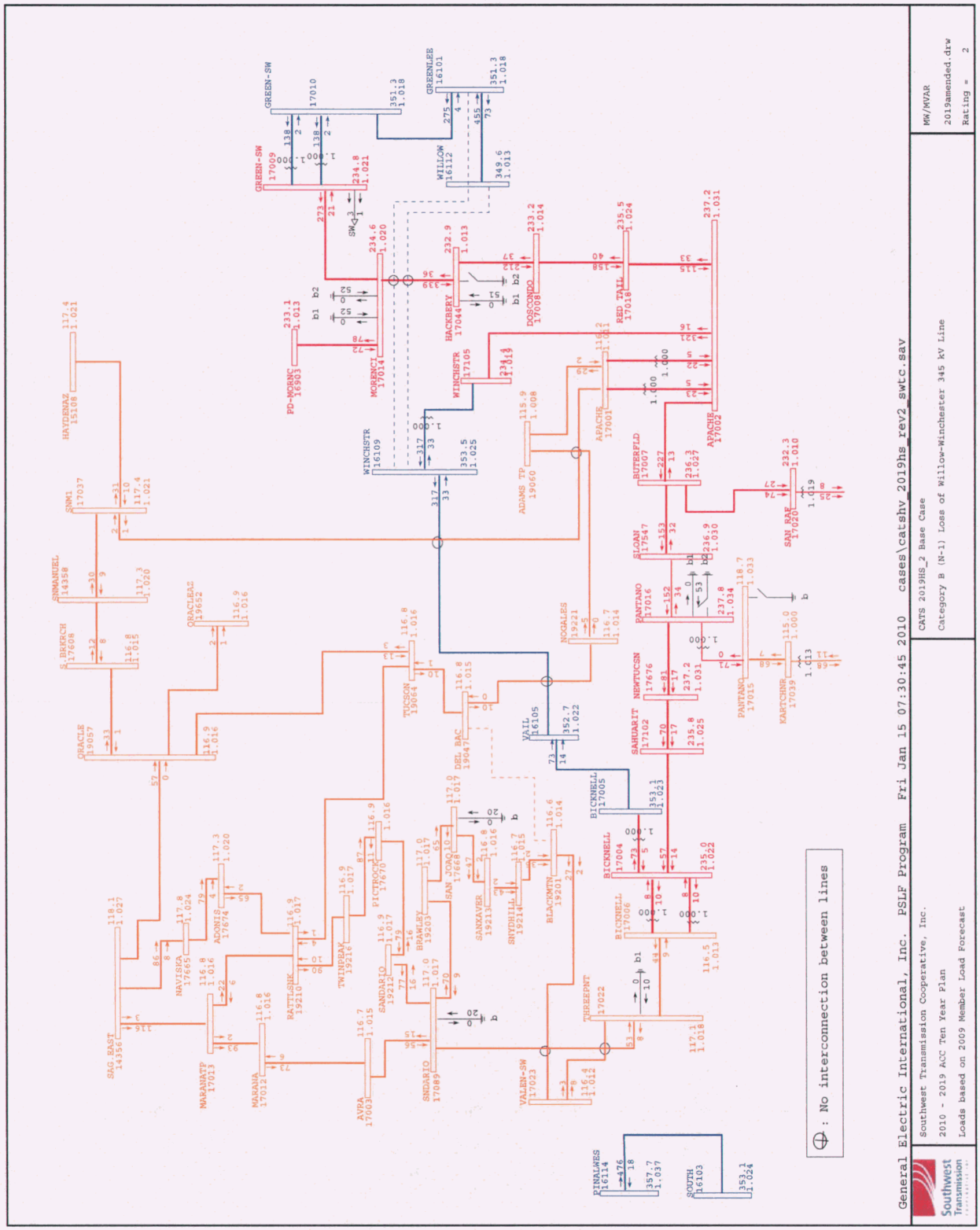
2019HS Southwest Transmission Cooperative Base System with Greenlee to Copper Verde 345 kV Line out of service



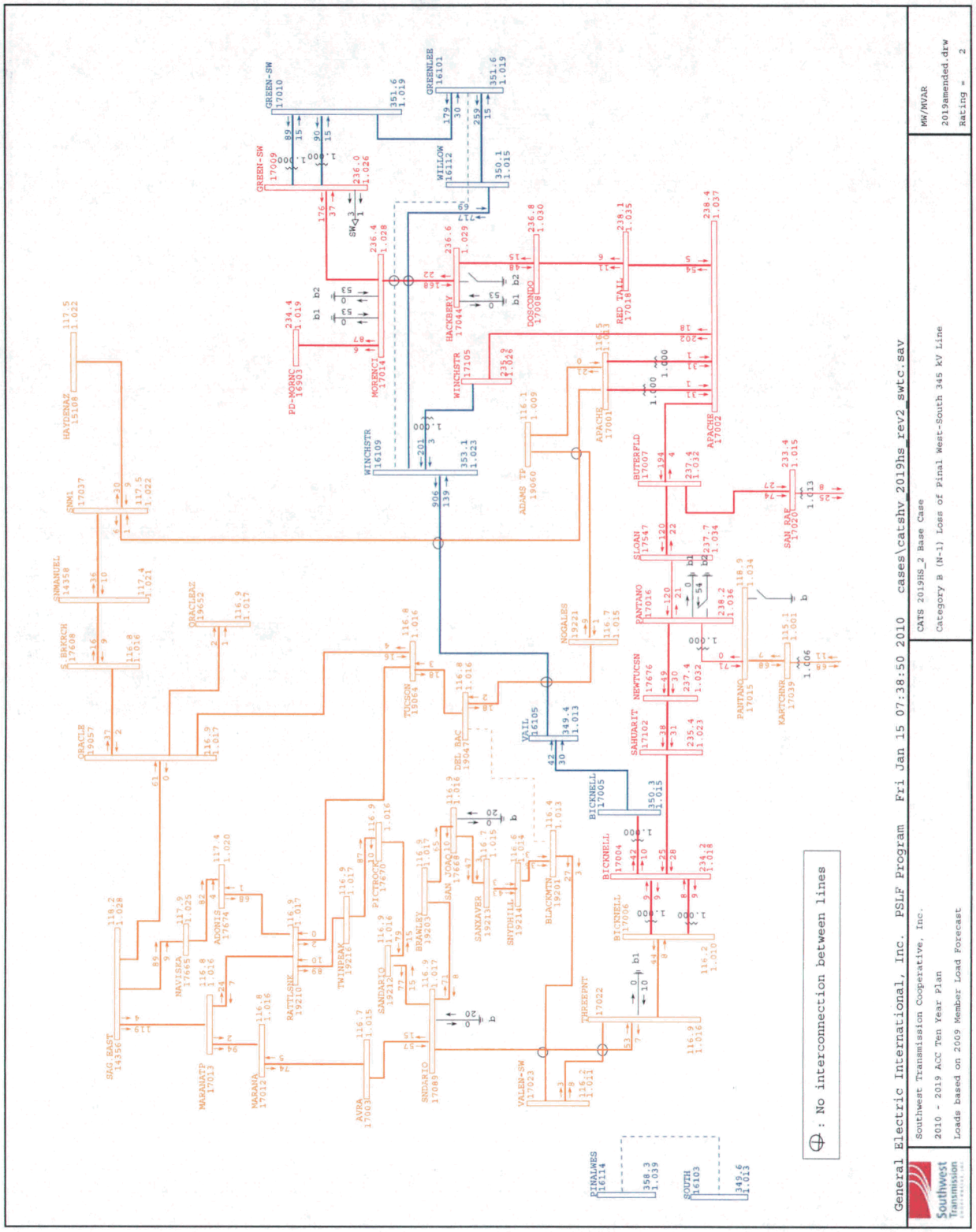
2019HS Southwest Transmission Cooperative Base System with Greenlee to Willow 345 kV Line out of service



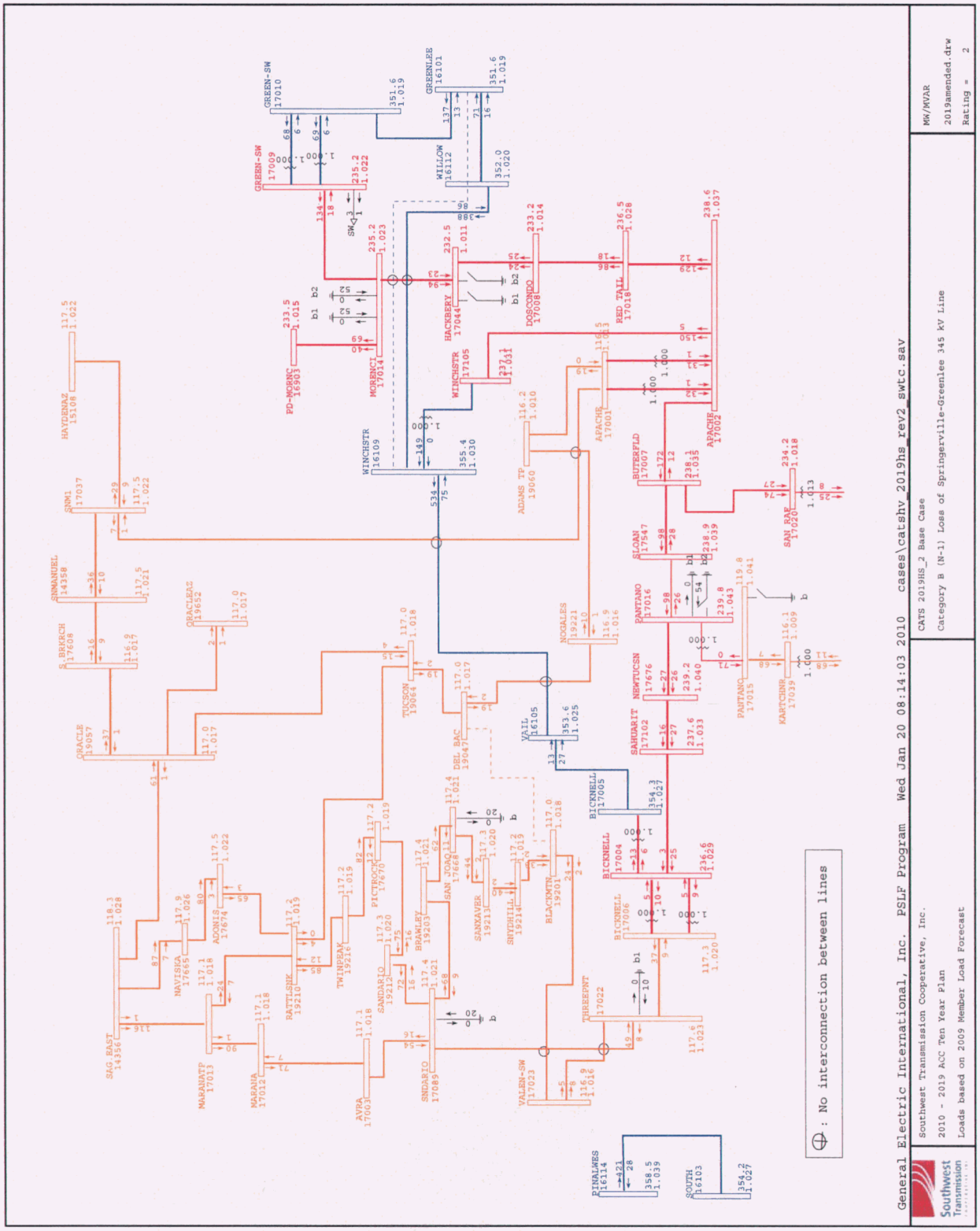
2019HS Southwest Transmission Cooperative Base System with Willow to Winchester 345 kV Line out of service



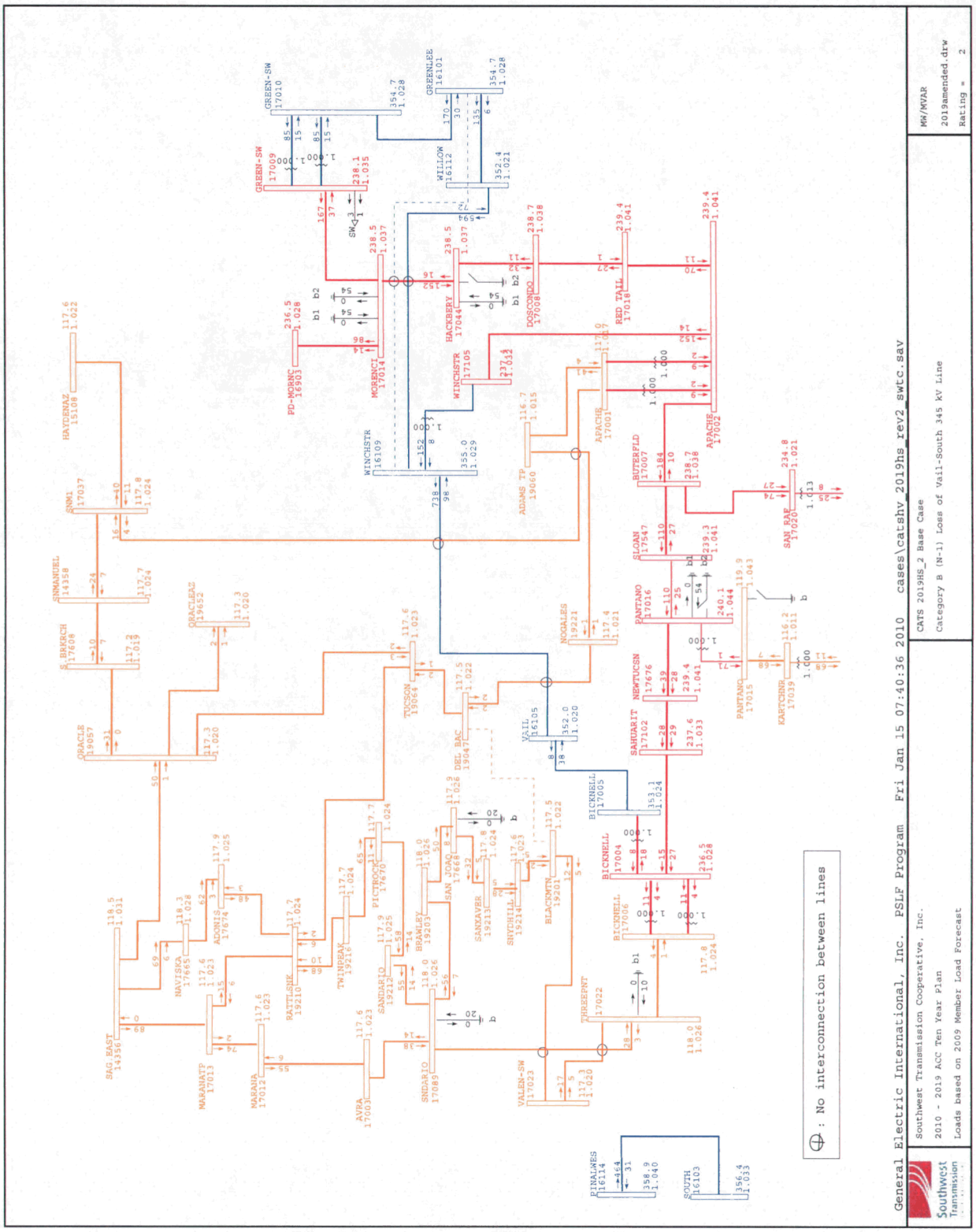
2019HS Southwest Transmission Cooperative Base System with Pinal West to South 345 kV Line out of service



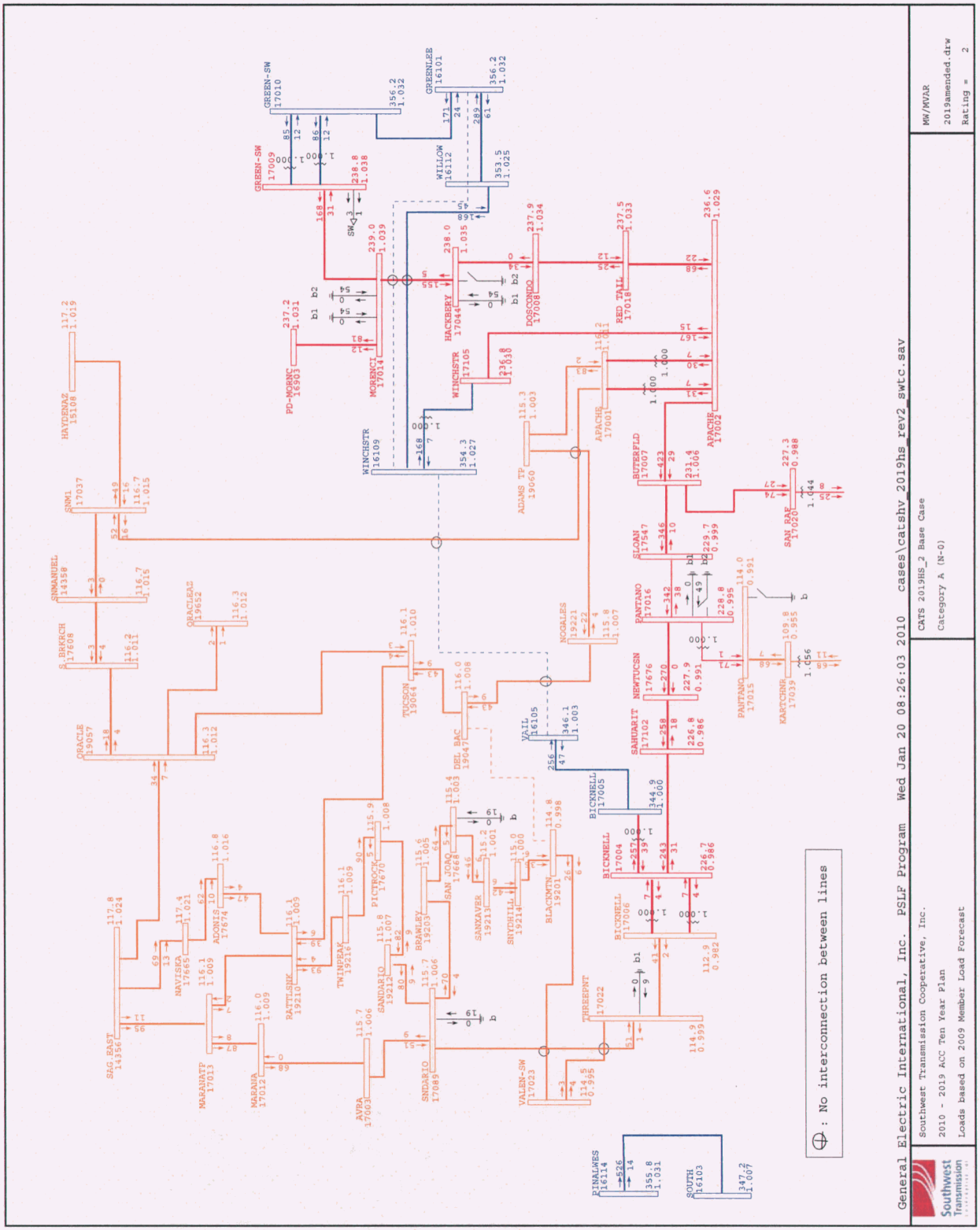
2019HS Southwest Transmission Cooperative Base System with Springerville to Greenlee 345 kV Line out of service



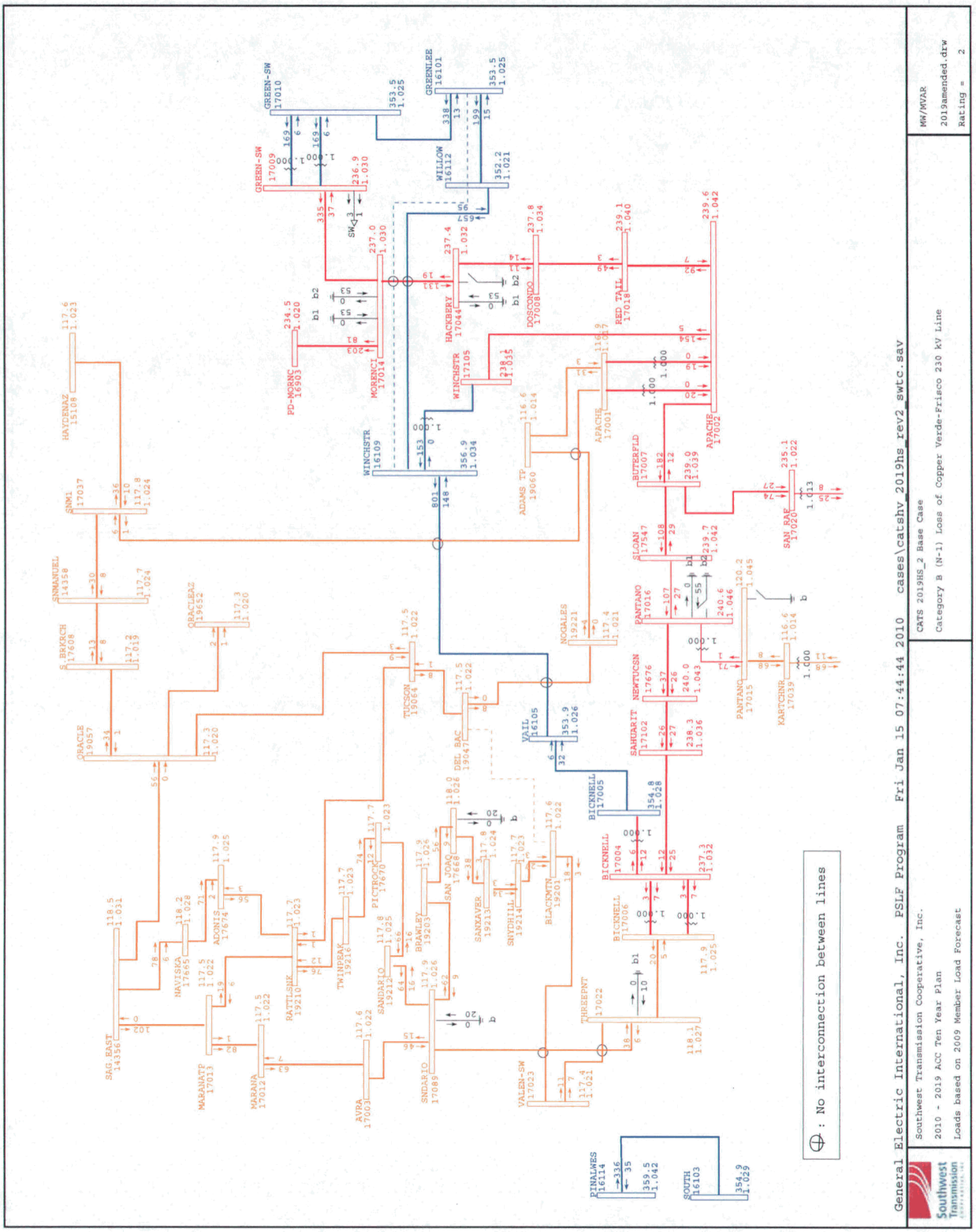
2019HS Southwest Transmission Cooperative Base System with Vail to South 345 kV Line out of service



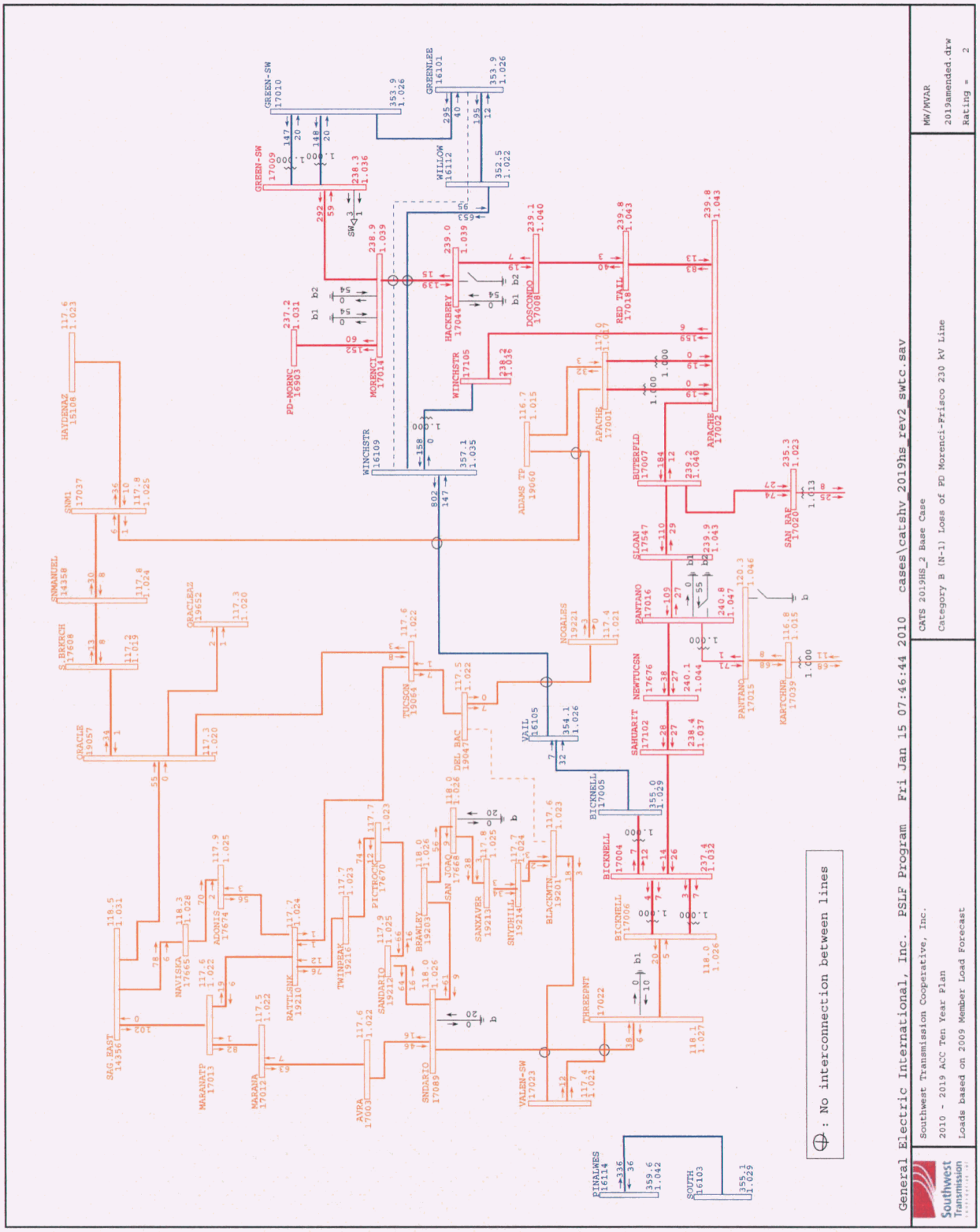
2019HS Southwest Transmission Cooperative Base System with Winchester to Vail 345 kV Line out of service



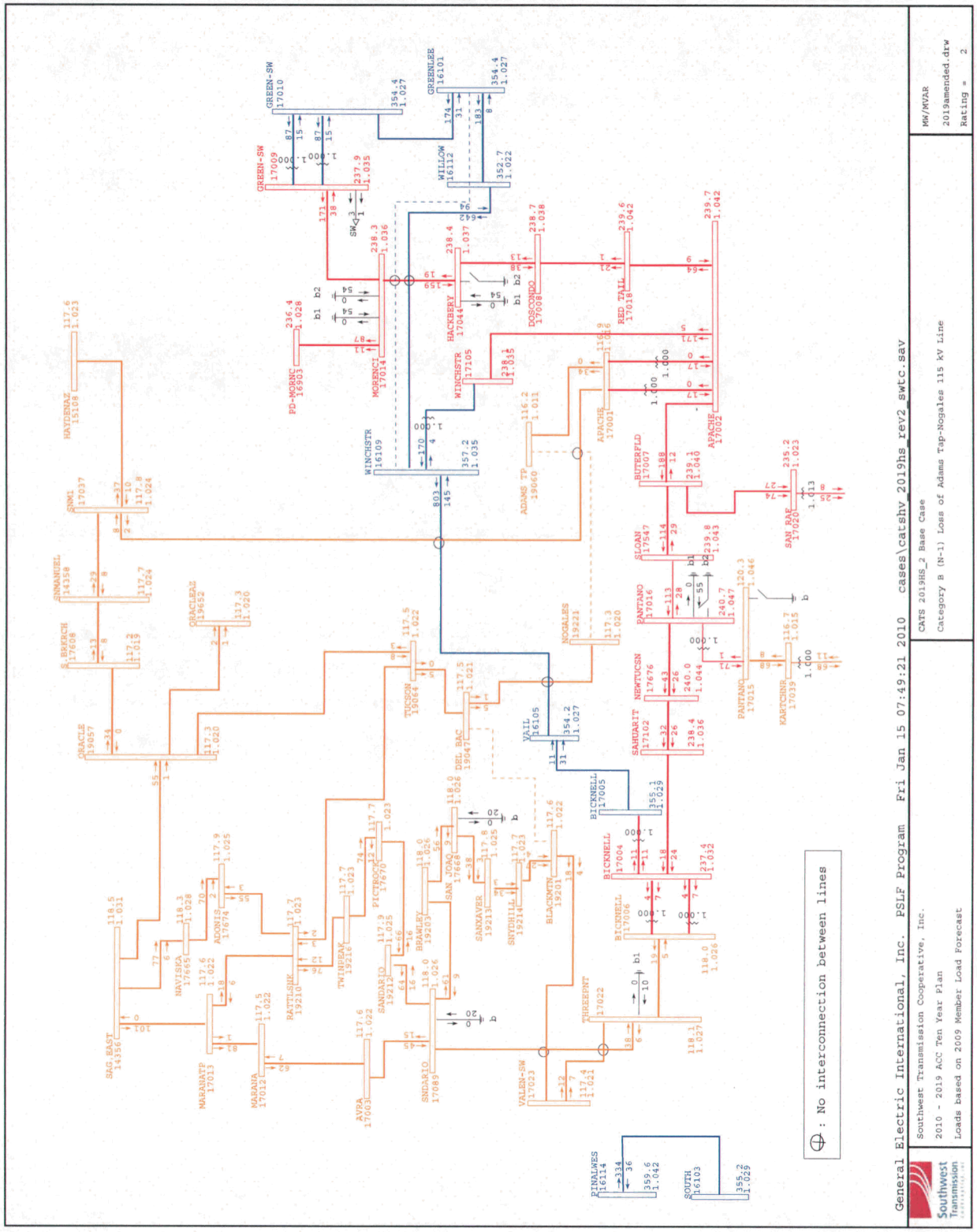
2019HS Southwest Transmission Cooperative Base System with Copper Verde to Frisco 230 kV Line out of service



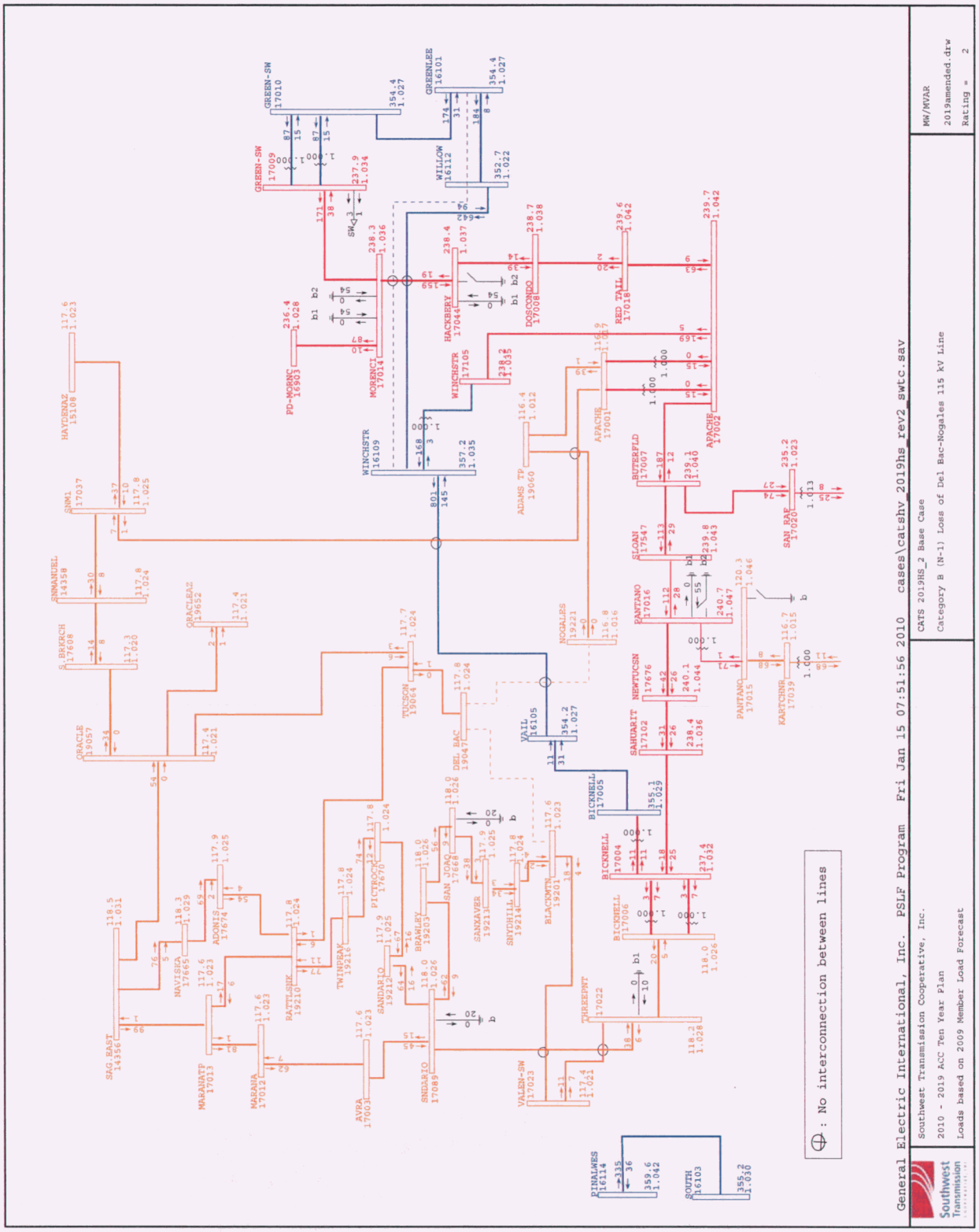
2019HS Southwest Transmission Cooperative Base System with PD Morenci to Frisco 230 kV Line out of service



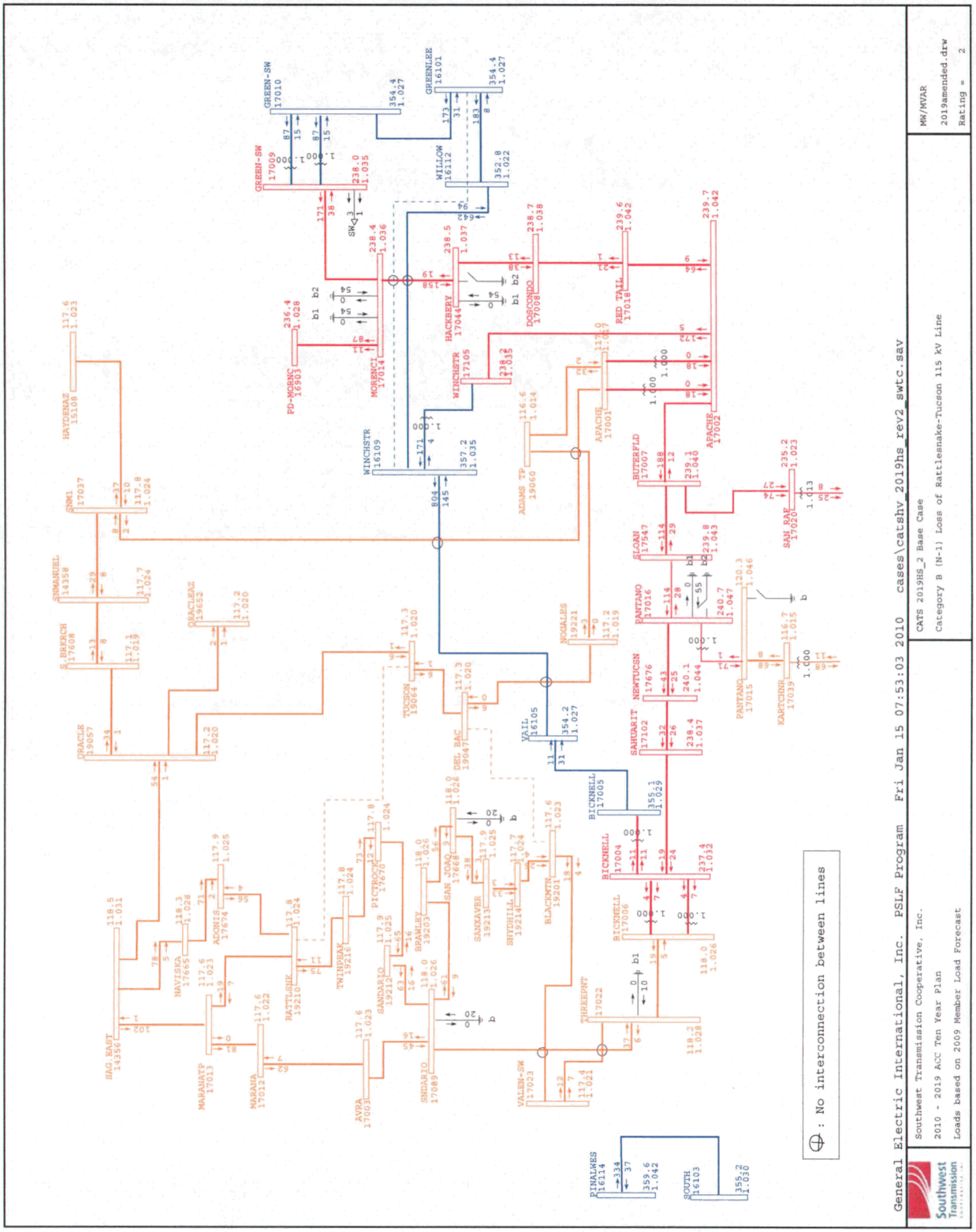
2019HS Southwest Transmission Cooperative Base System with Adams Tap to Nogales 115 kV Line out of service



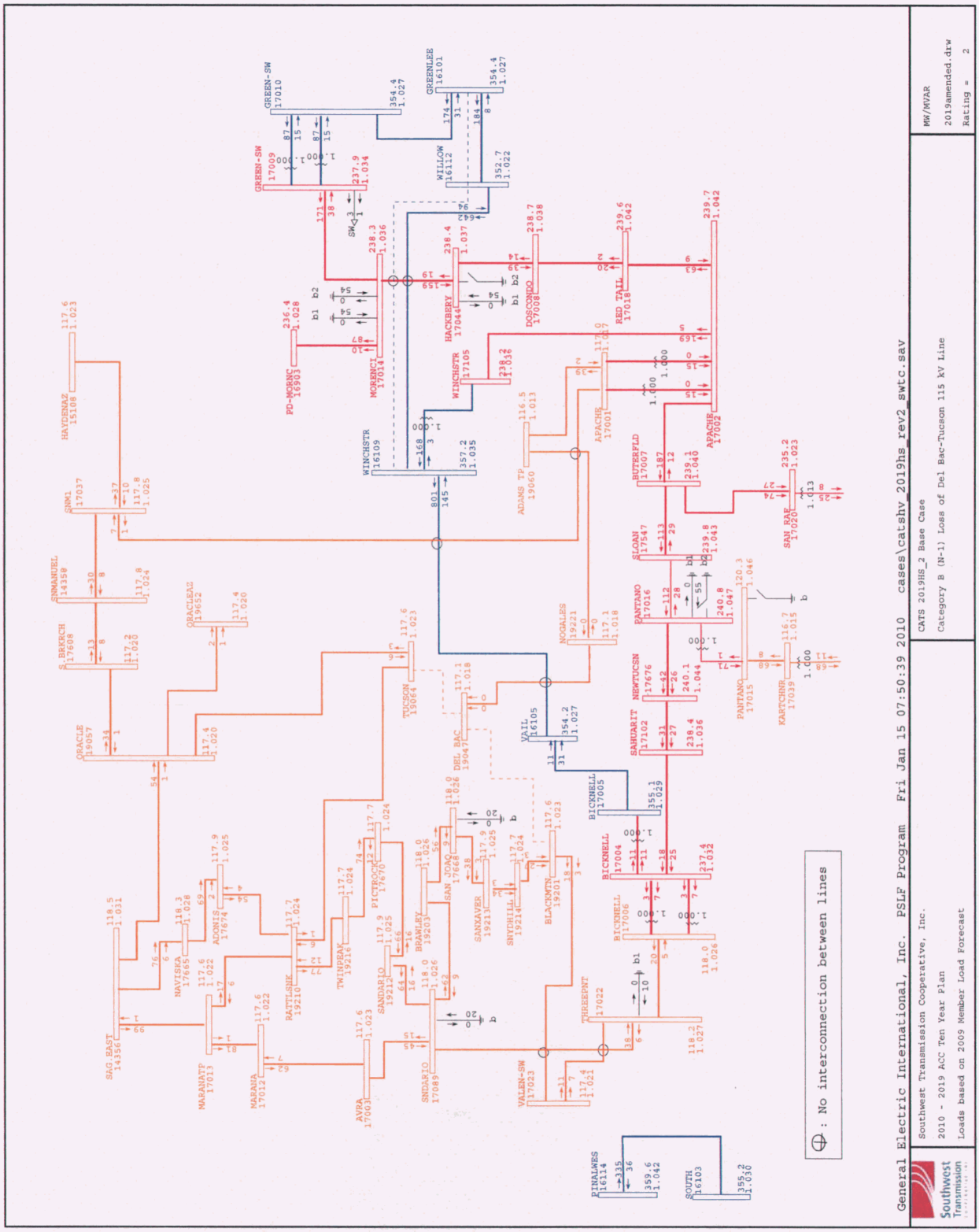
2019HS Southwest Transmission Cooperative Base System with Del Bac to Nogales 115 kV Line out of service



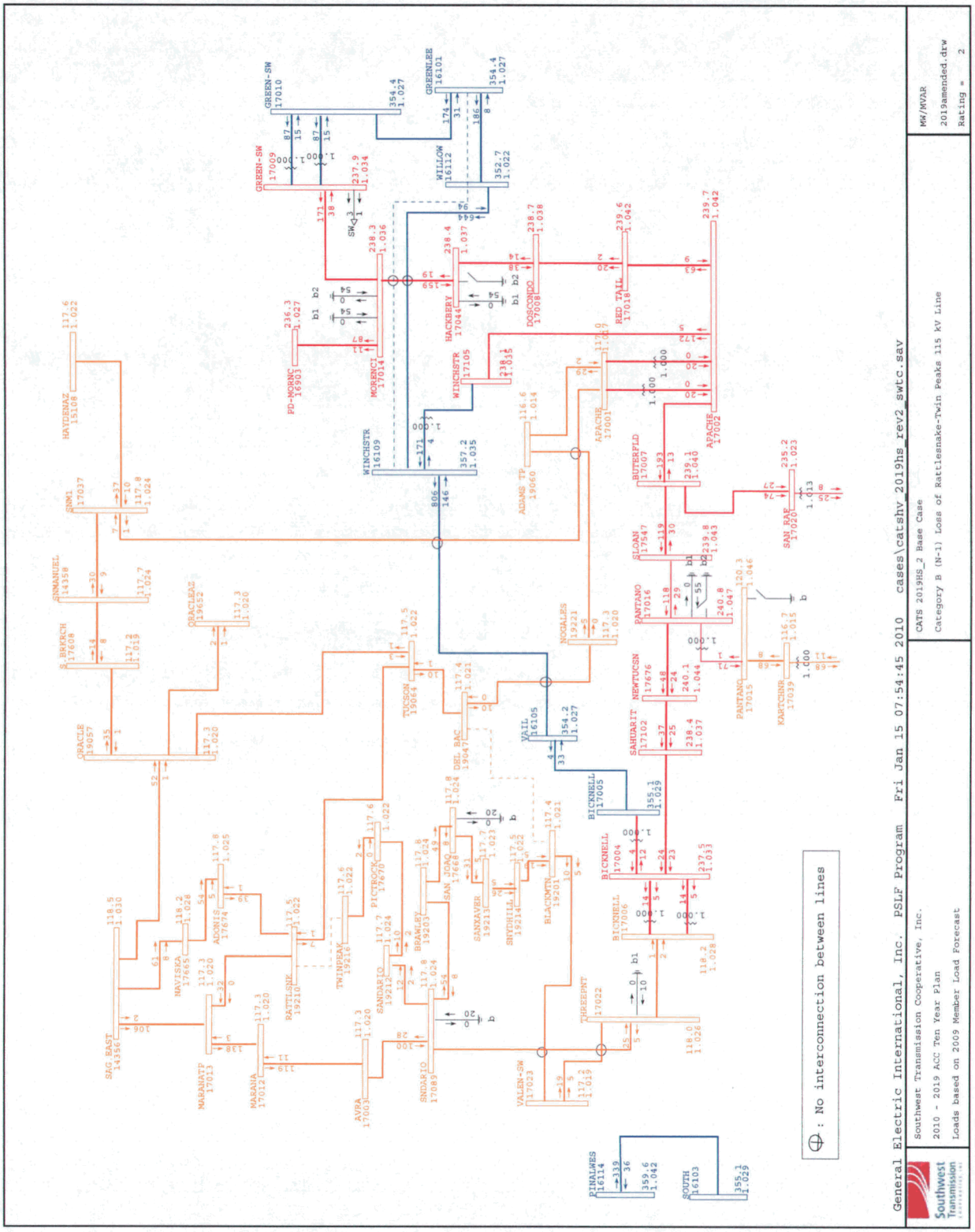
2019HS Southwest Transmission Cooperative Base System with Rattlesnake to Tucson 115 kV Line out of service



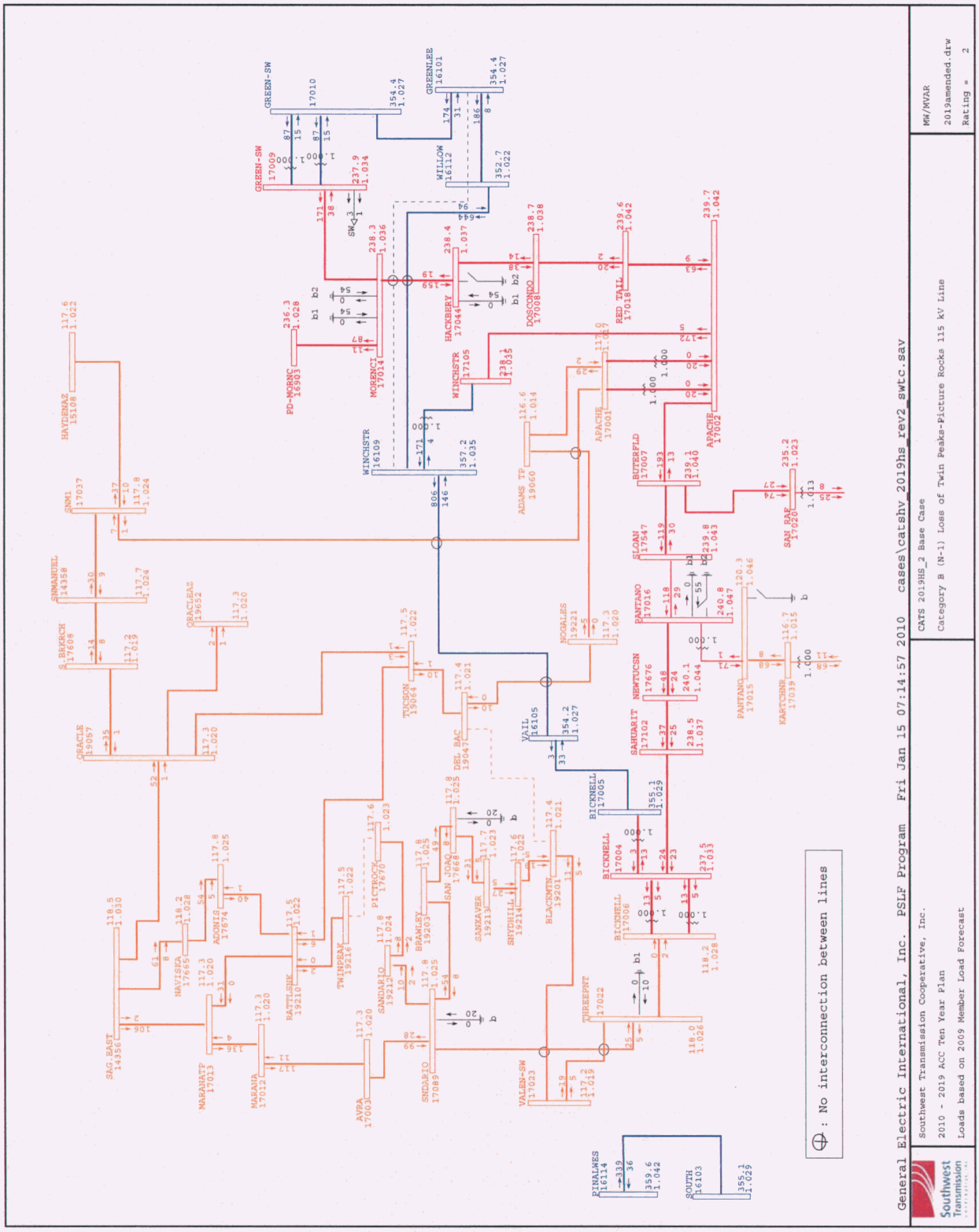
2019HS Southwest Transmission Cooperative Base system with Del Bac to Tucson 115 kV Line out of service



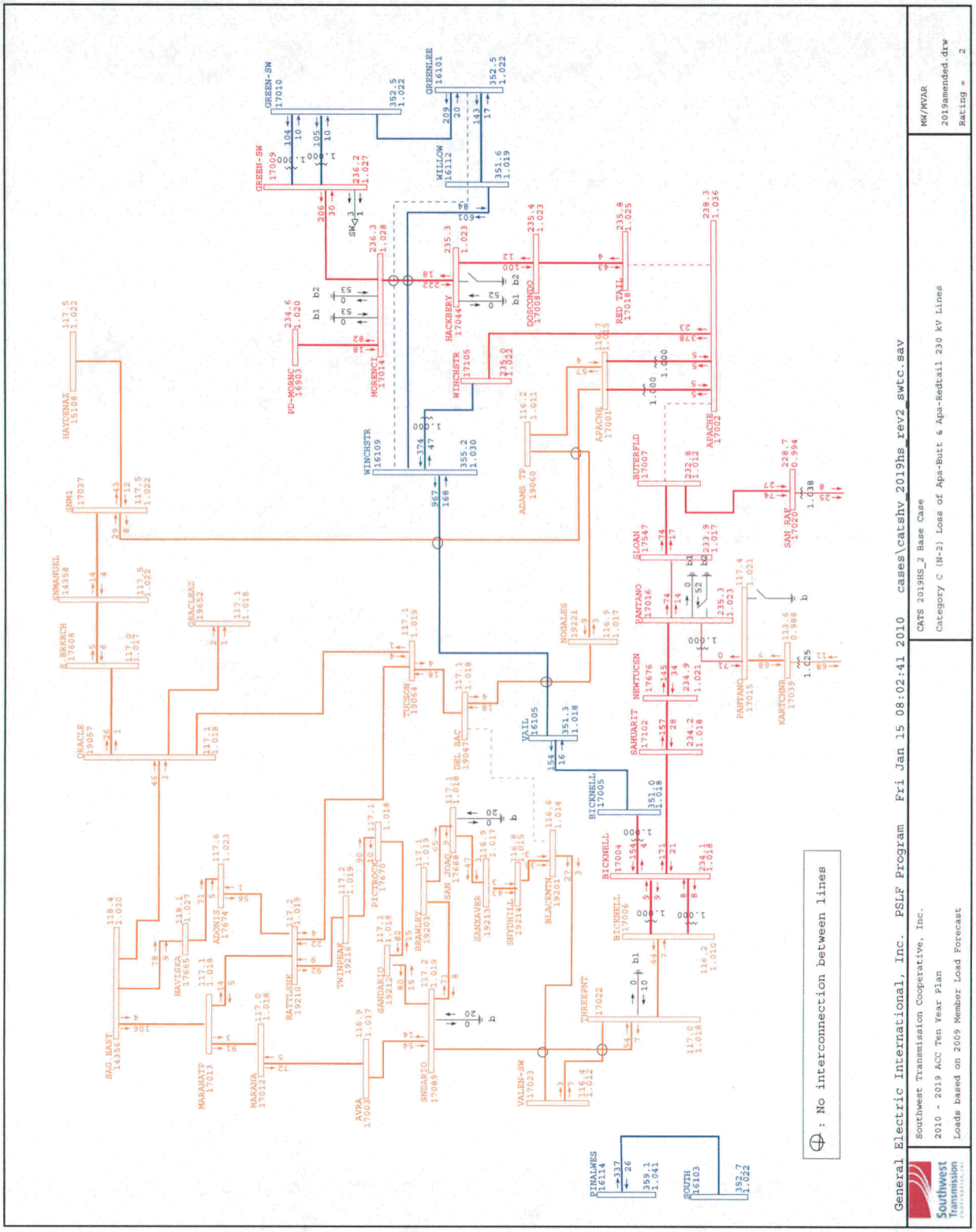
2019HS Southwest Transmission Cooperative Base System with Rattlesnake to Twin Peaks 115 kV Line out of service



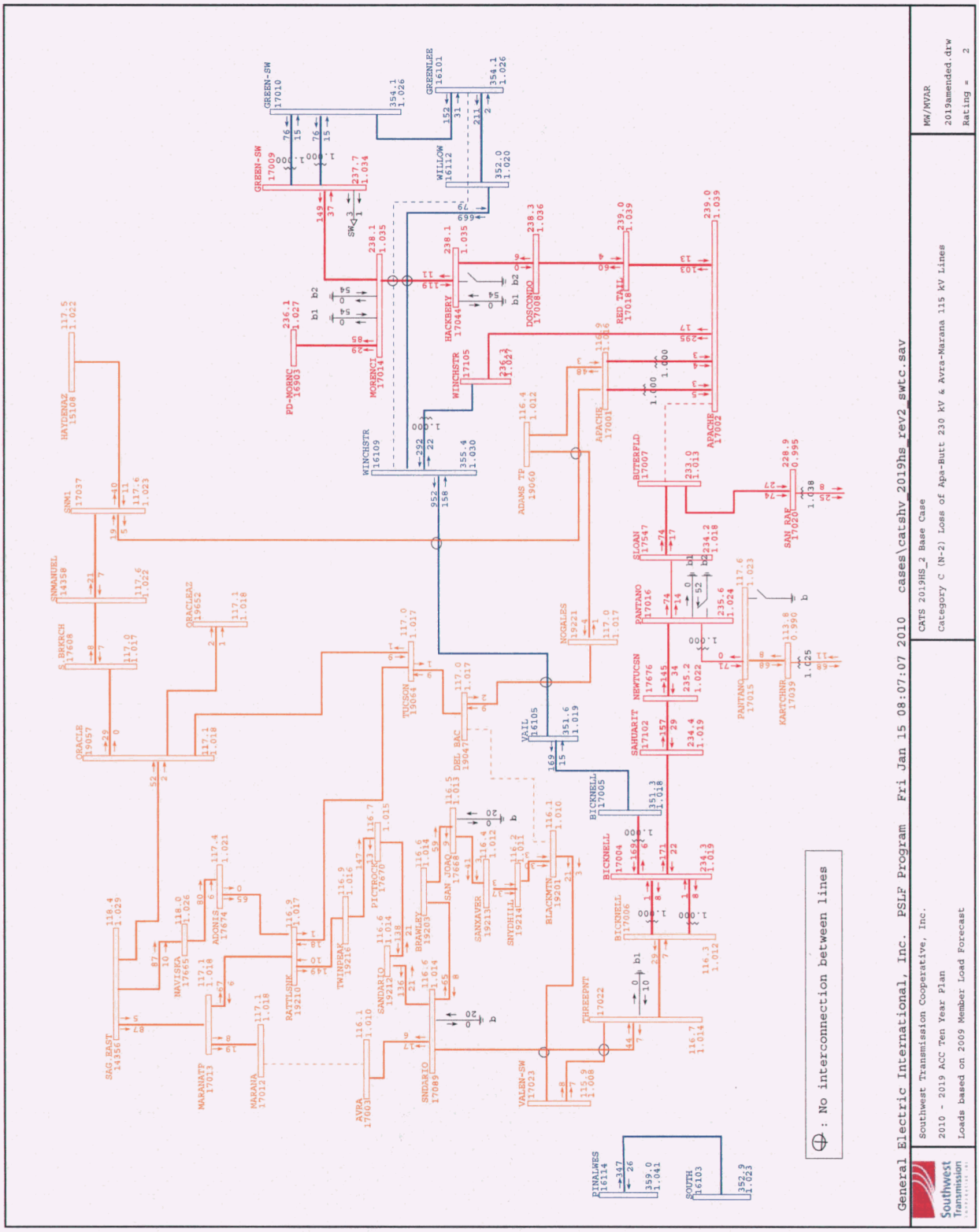
2019HS Southwest Transmission Cooperative Base System with Twin Peaks to Picture Rocks 115 kV Line out of service



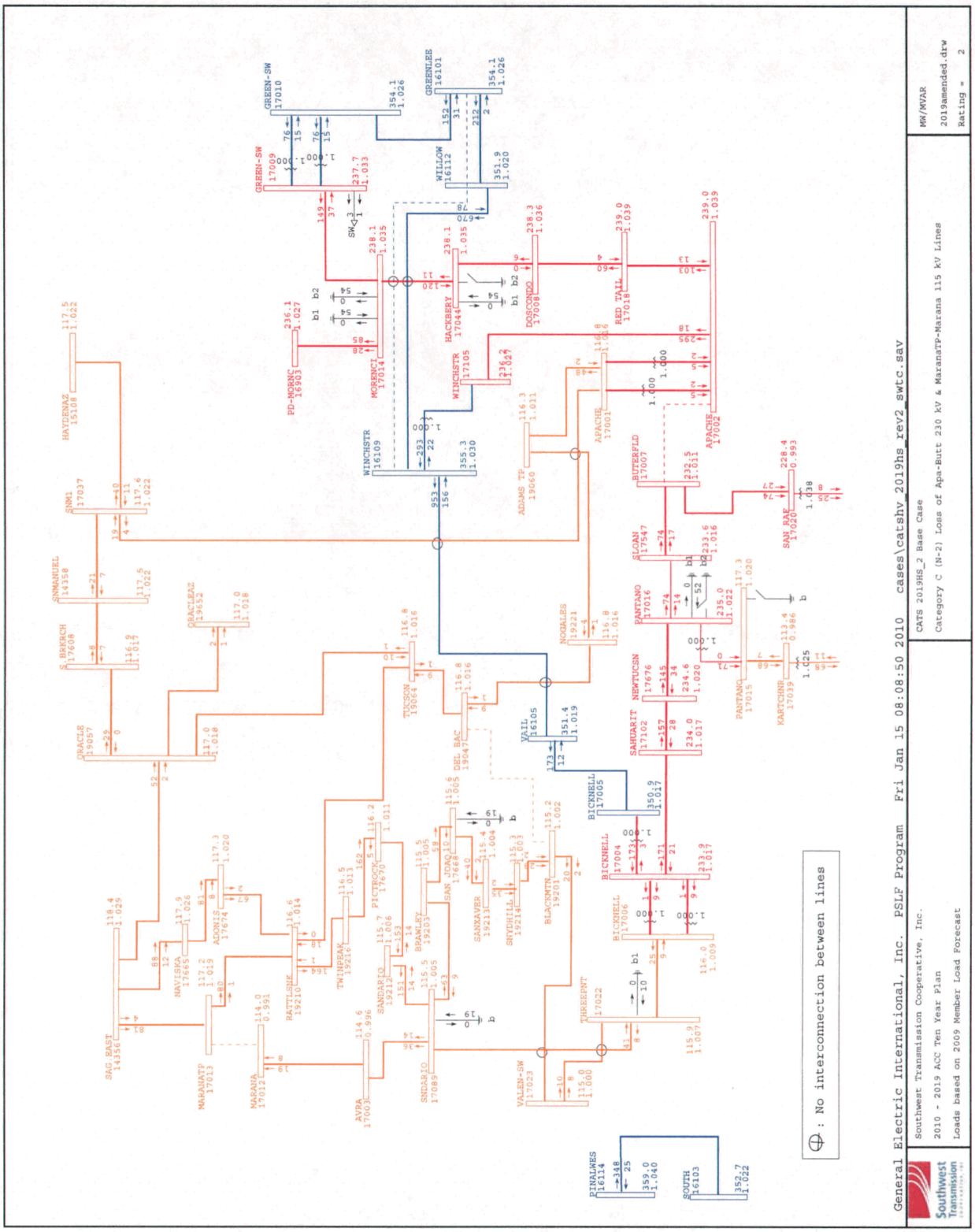
2019HS Southwest Transmission Cooperative Base System with Apache to Butterfield & Apache to Redtail 230 kV Lines out of service



2019HS Southwest Transmission Cooperative Base System with Apache to Butterfield 230 kV & Avra to Marana 115 kV Lines out of service



2019HS Southwest Transmission Cooperative Base System with Apache to Butterfield 230 kV & Marana Tap to Marana 115 kV Lines out of service



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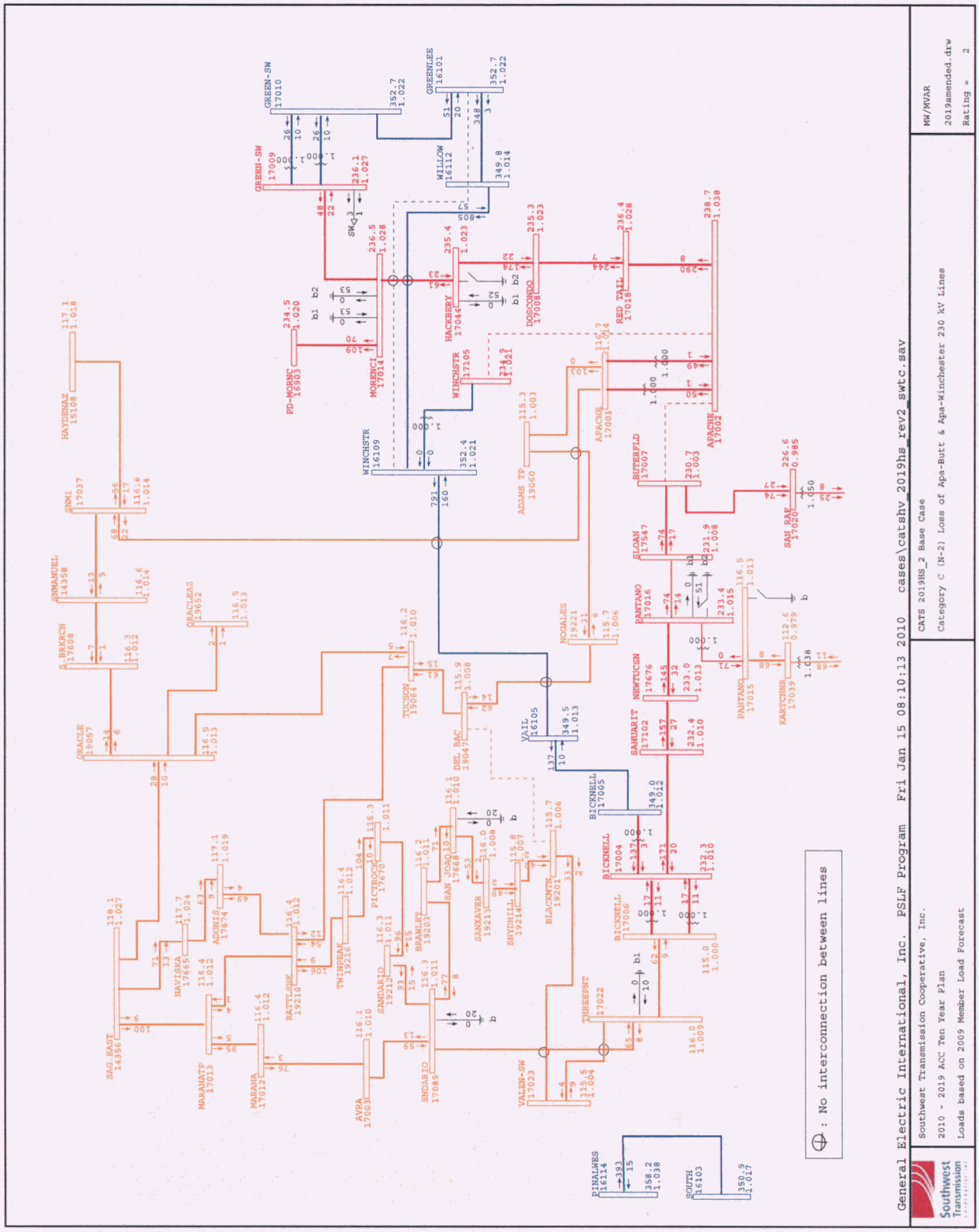
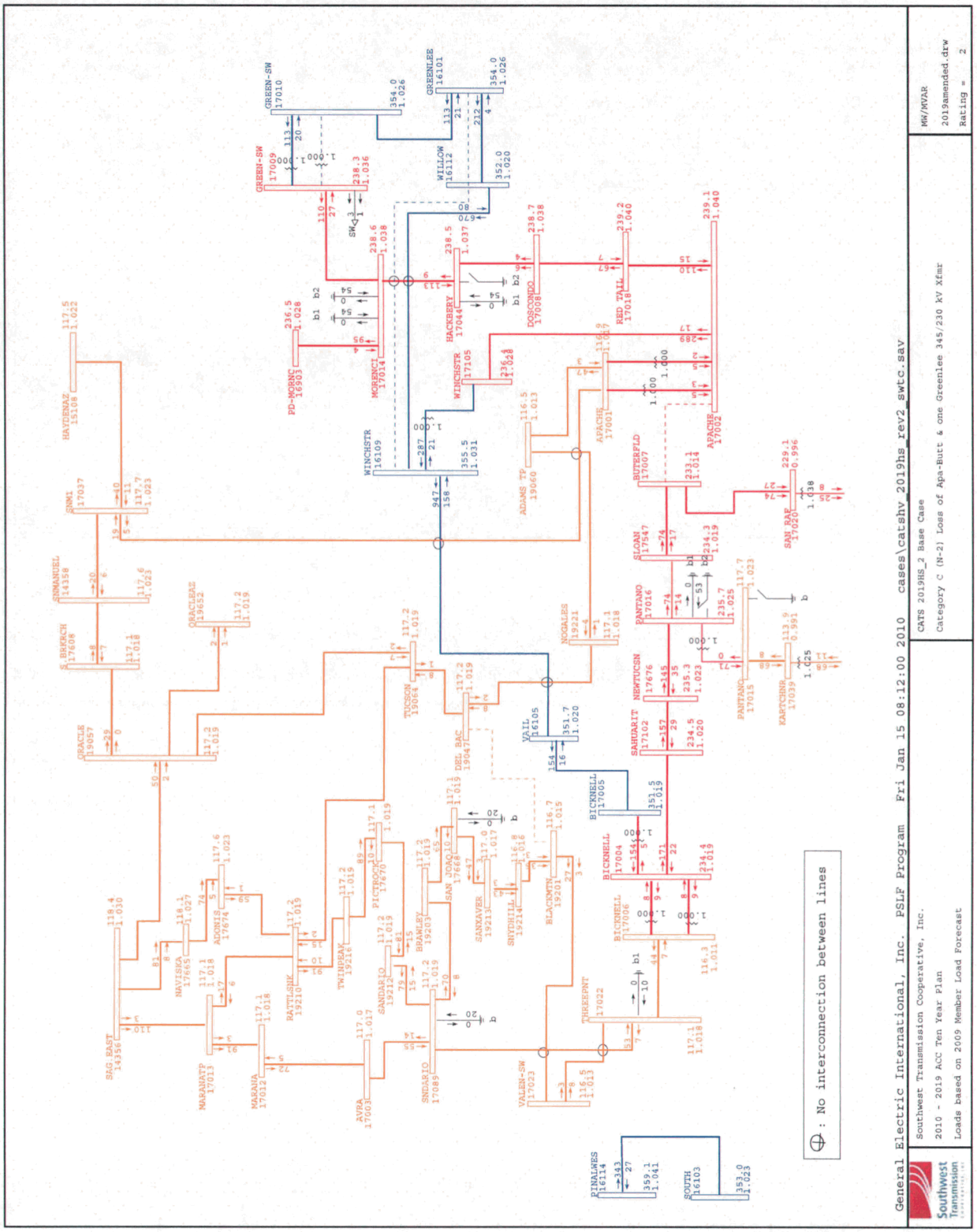


2019HS Southwest Transmission Cooperative Base System with Apache Butterfield 230 kV Line & one Greenlee 345/230 kV Transformer out of service



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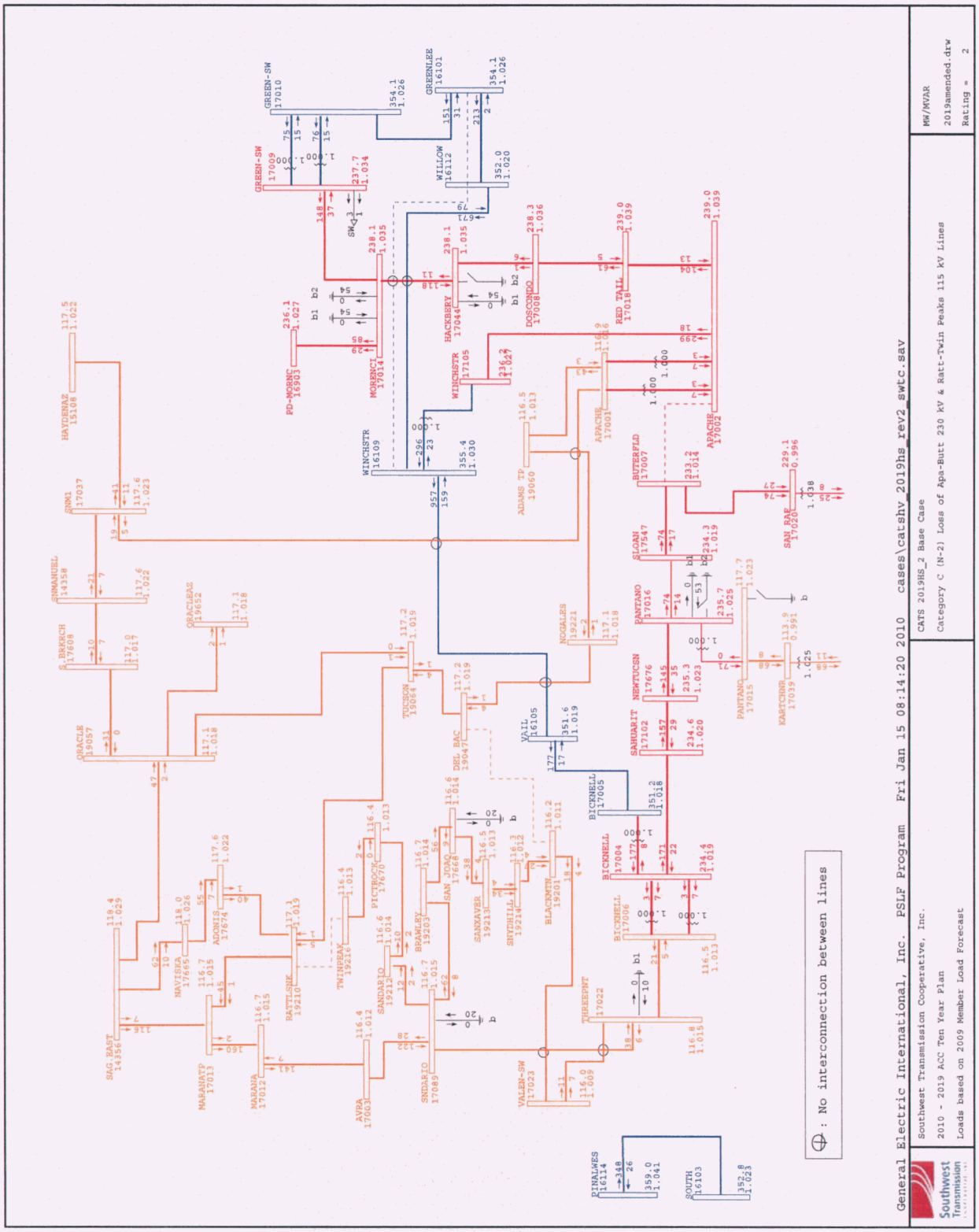

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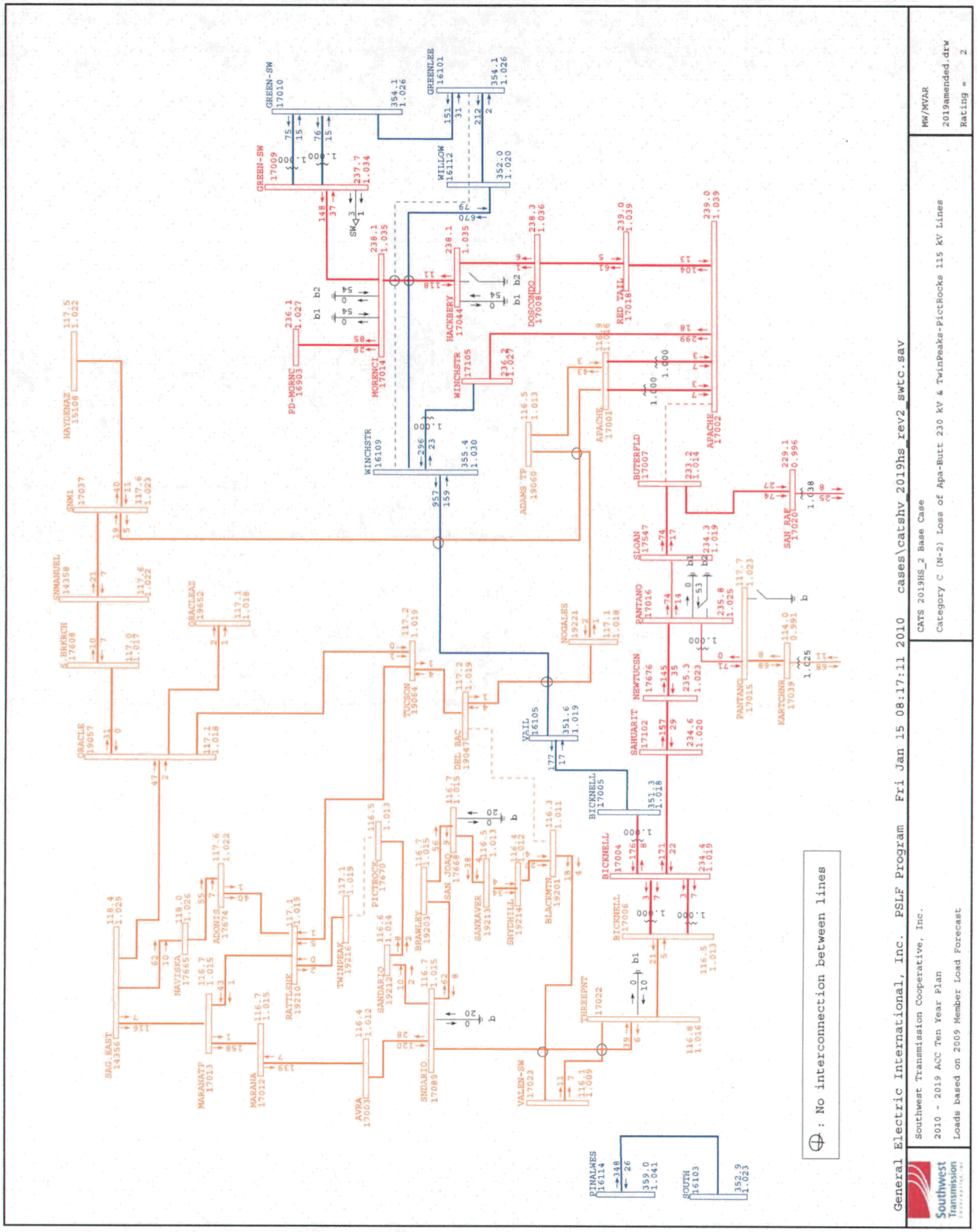

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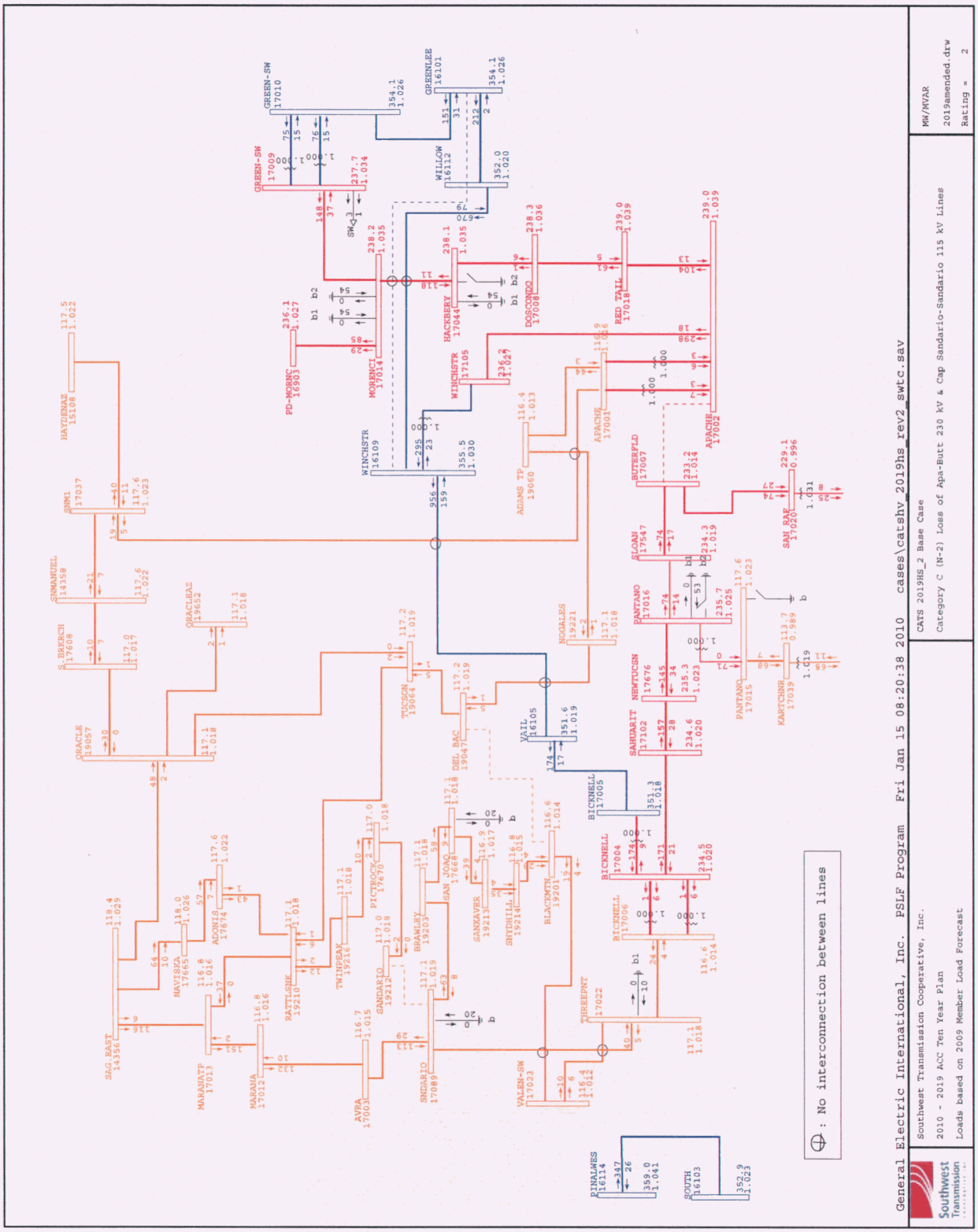
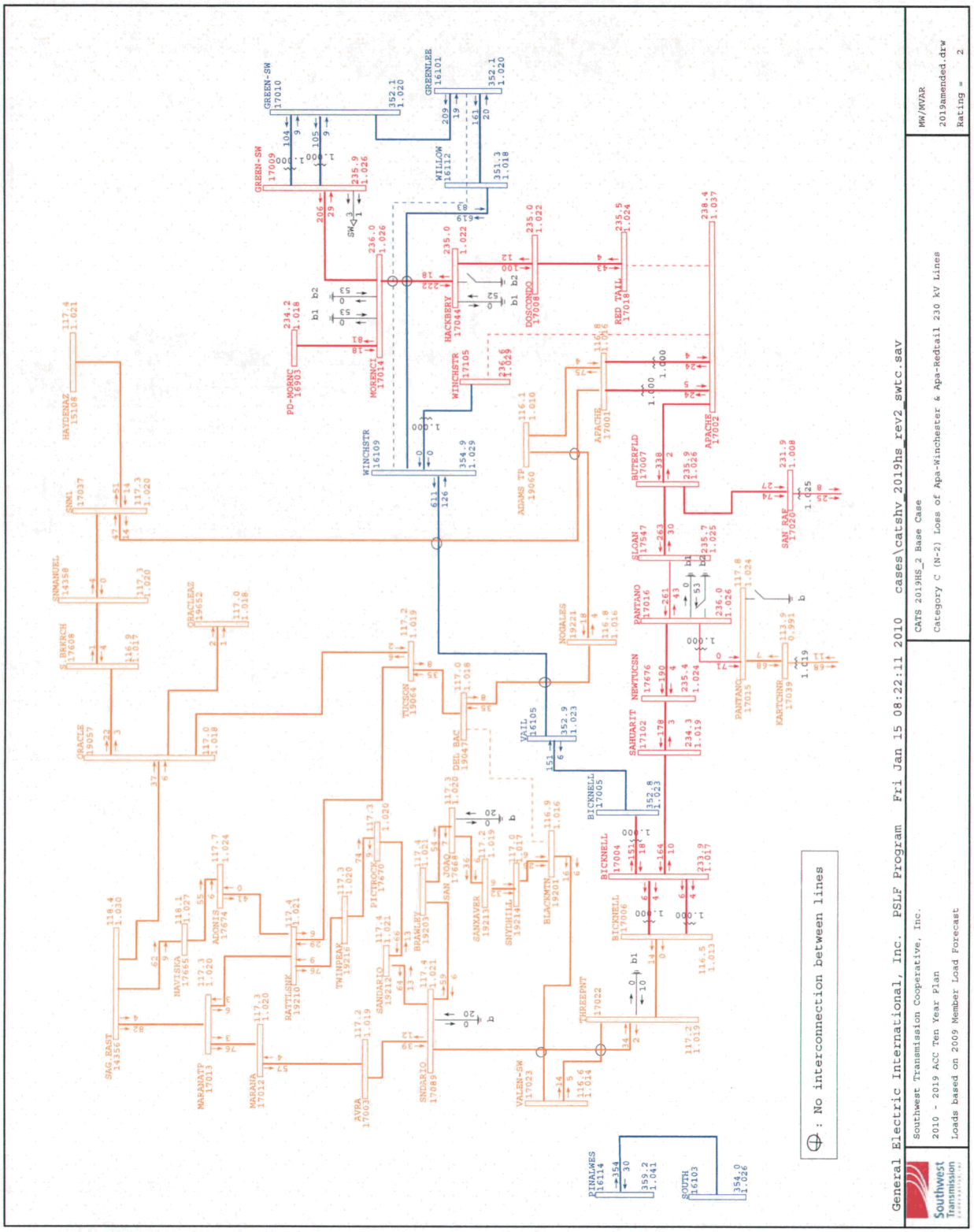


2019HS Southwest Transmission Cooperative Base System with Apache to Winchester & Apache to Redtail 230 kV Lines out of service



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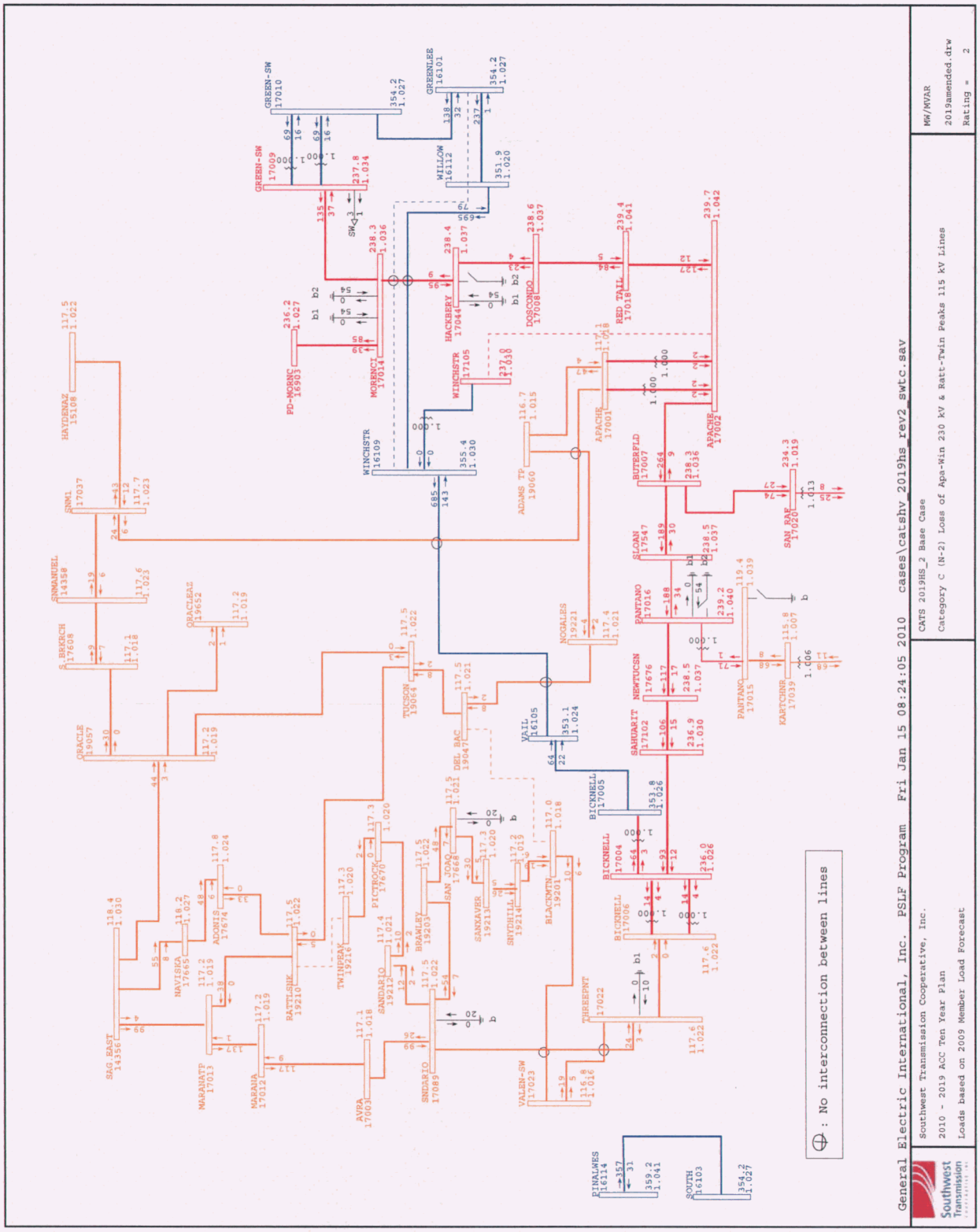

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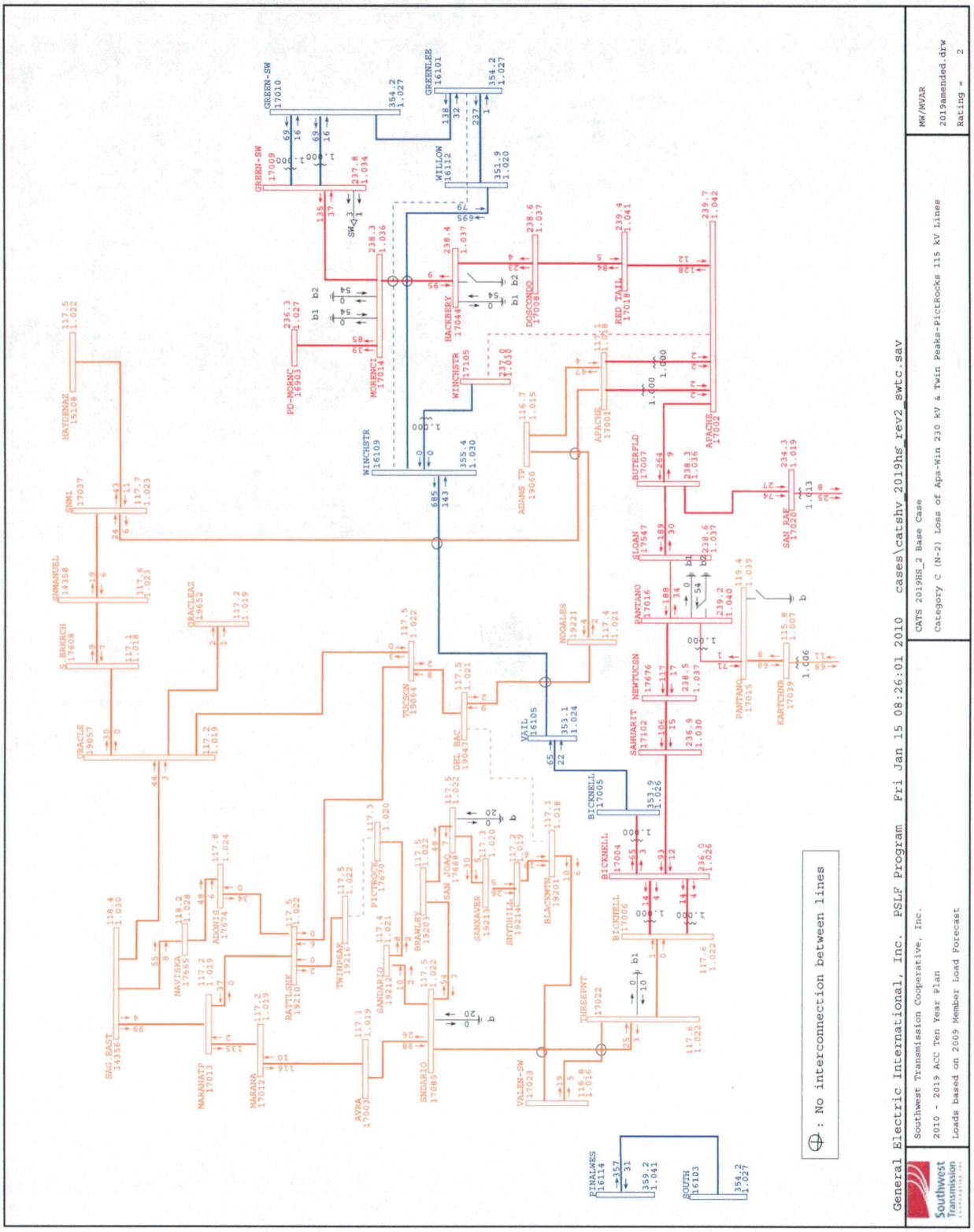

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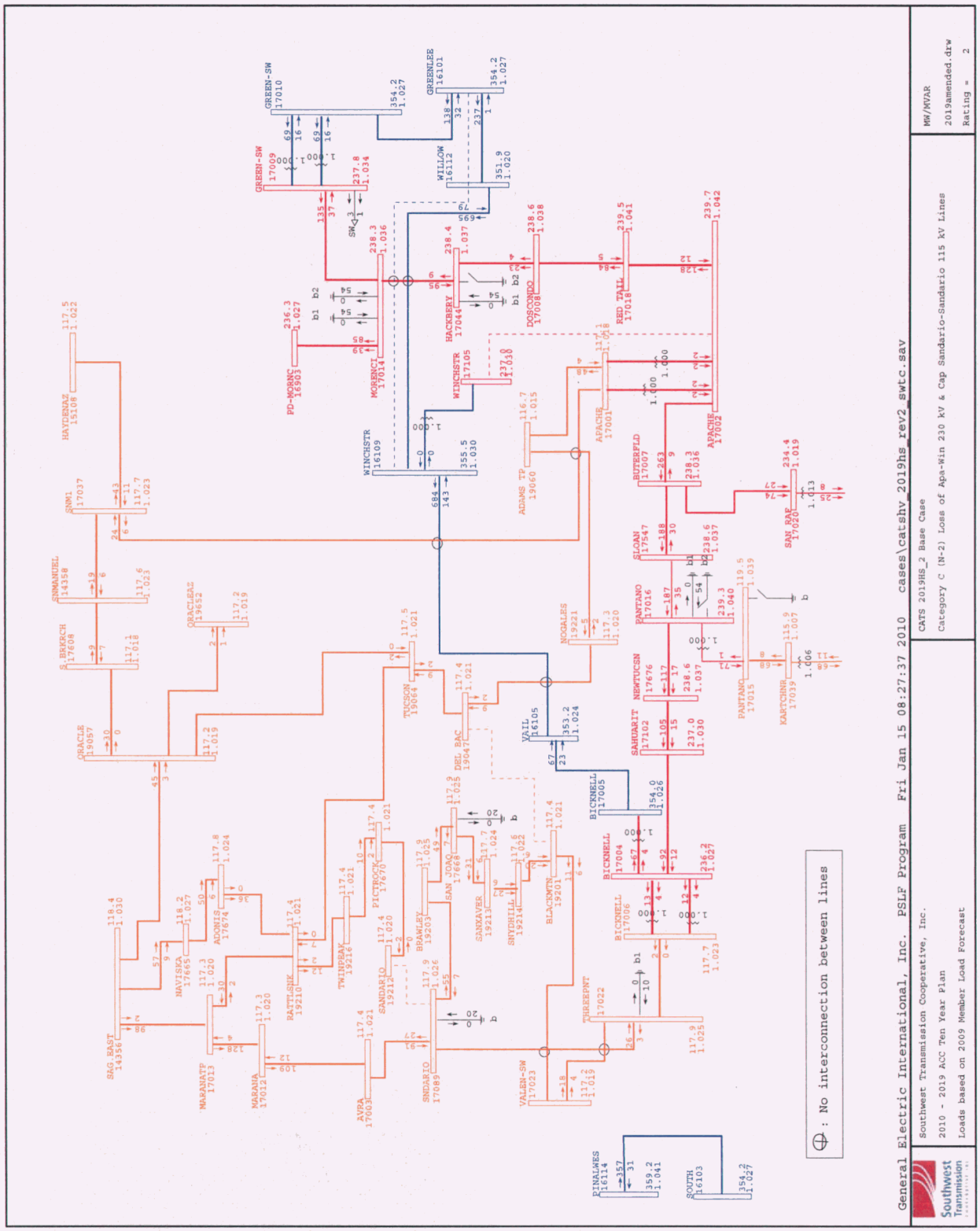
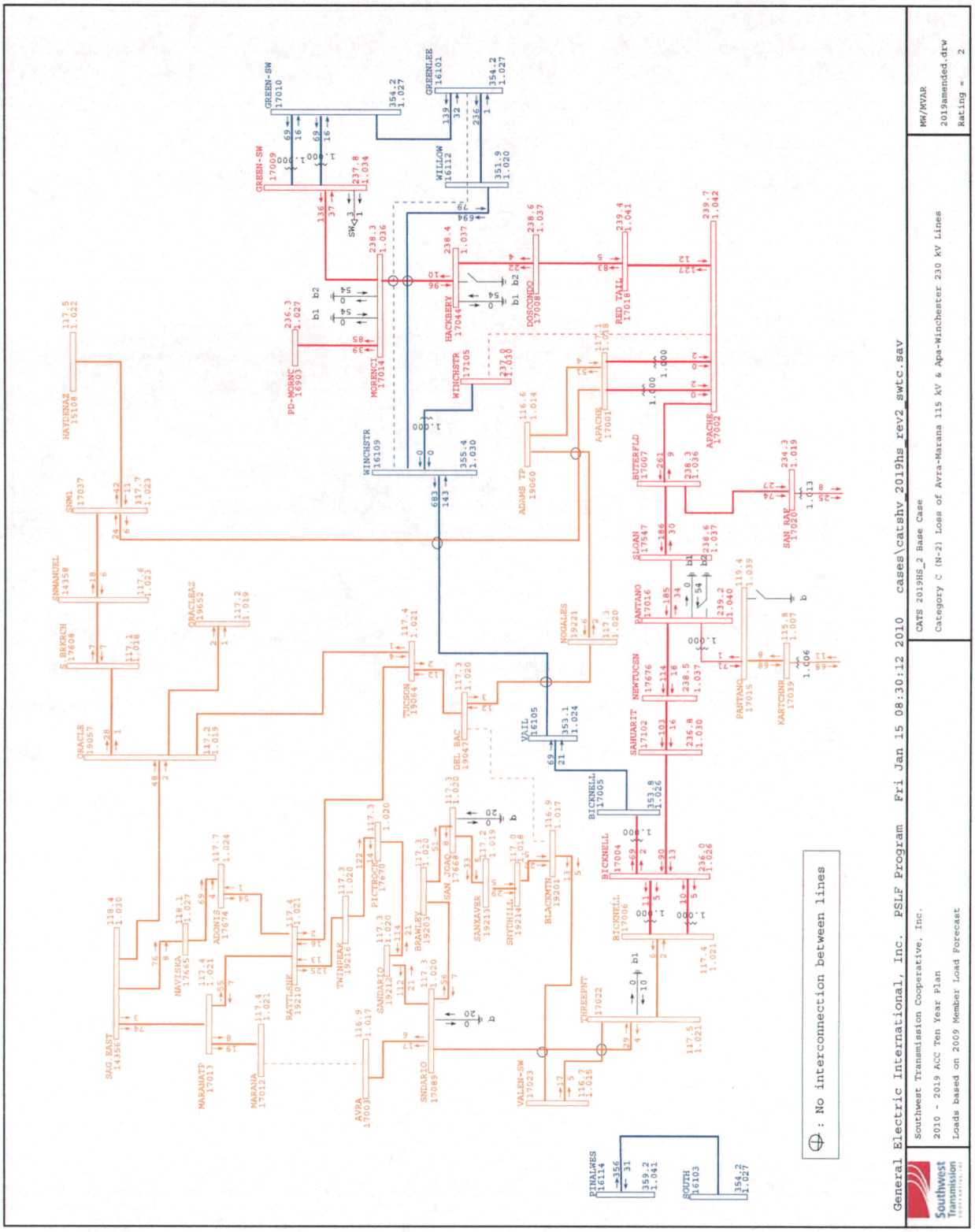


2019HS Southwest Transmission Cooperative Base System with Avra to Marana 115 kV & Apache to Winchester 230 kV Lines out of service



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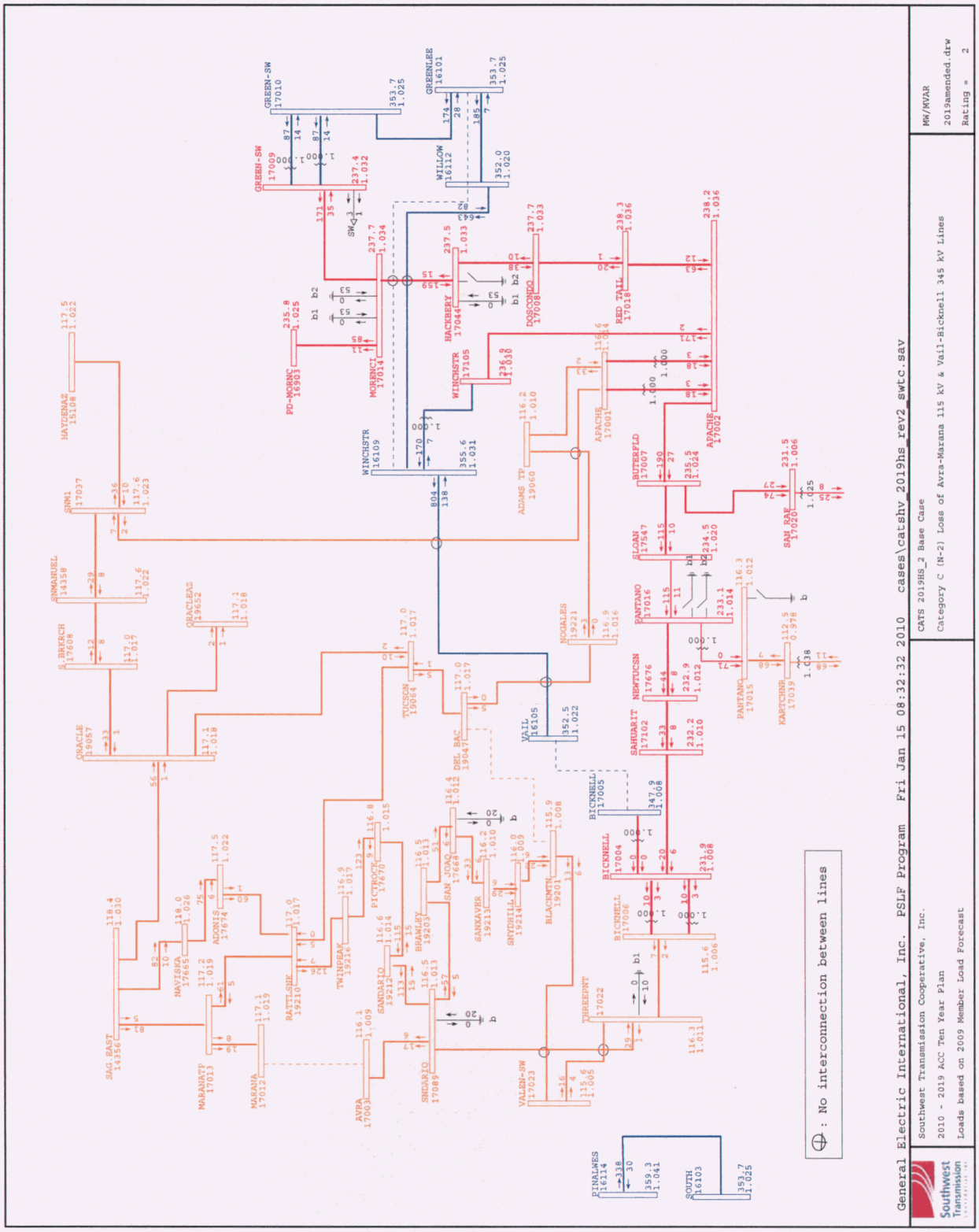
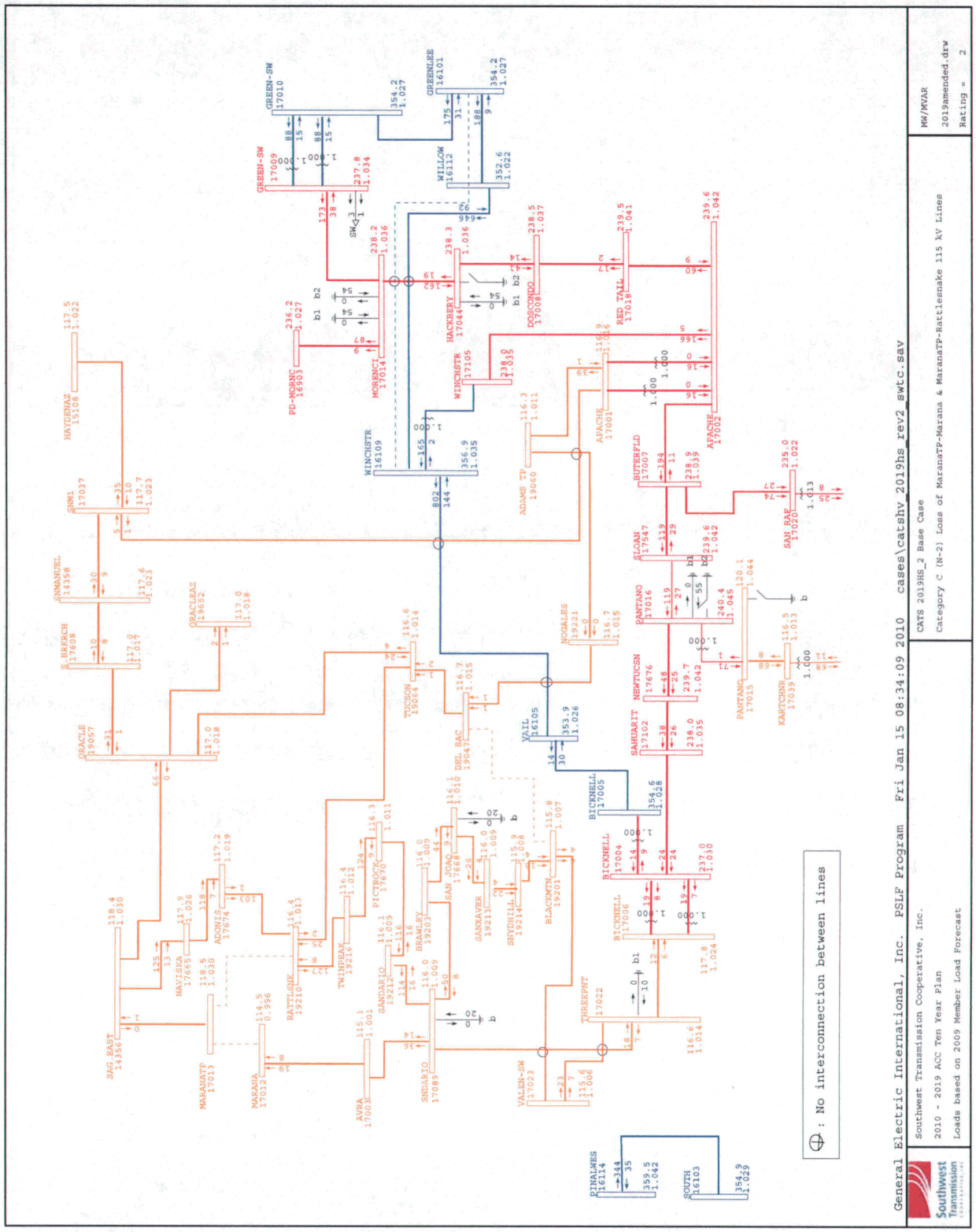


2019HS Southwest Transmission Cooperative Base System with Marana Tap to Marana & Marana Tap to Rattlesnake 115 kV Lines out of service



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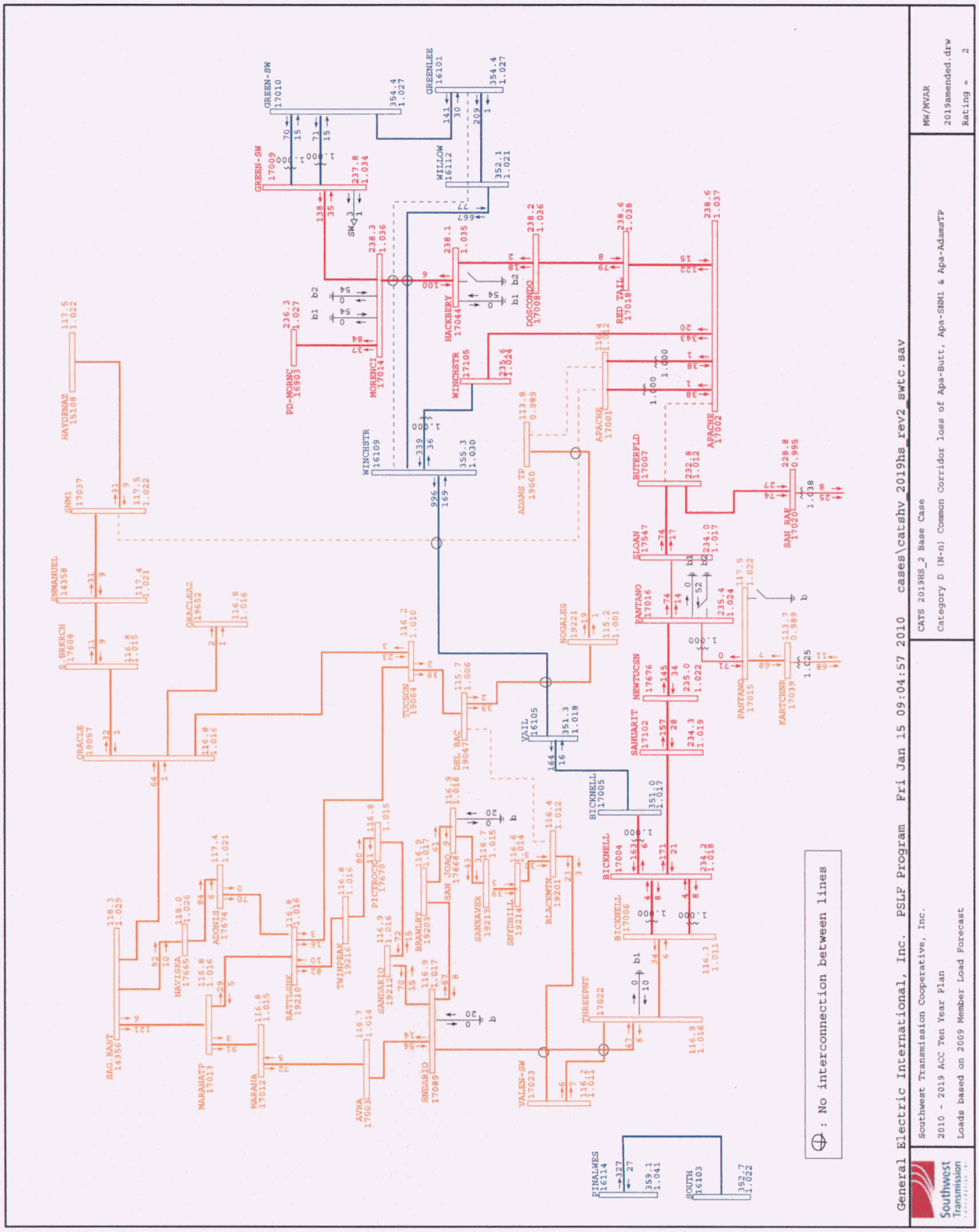
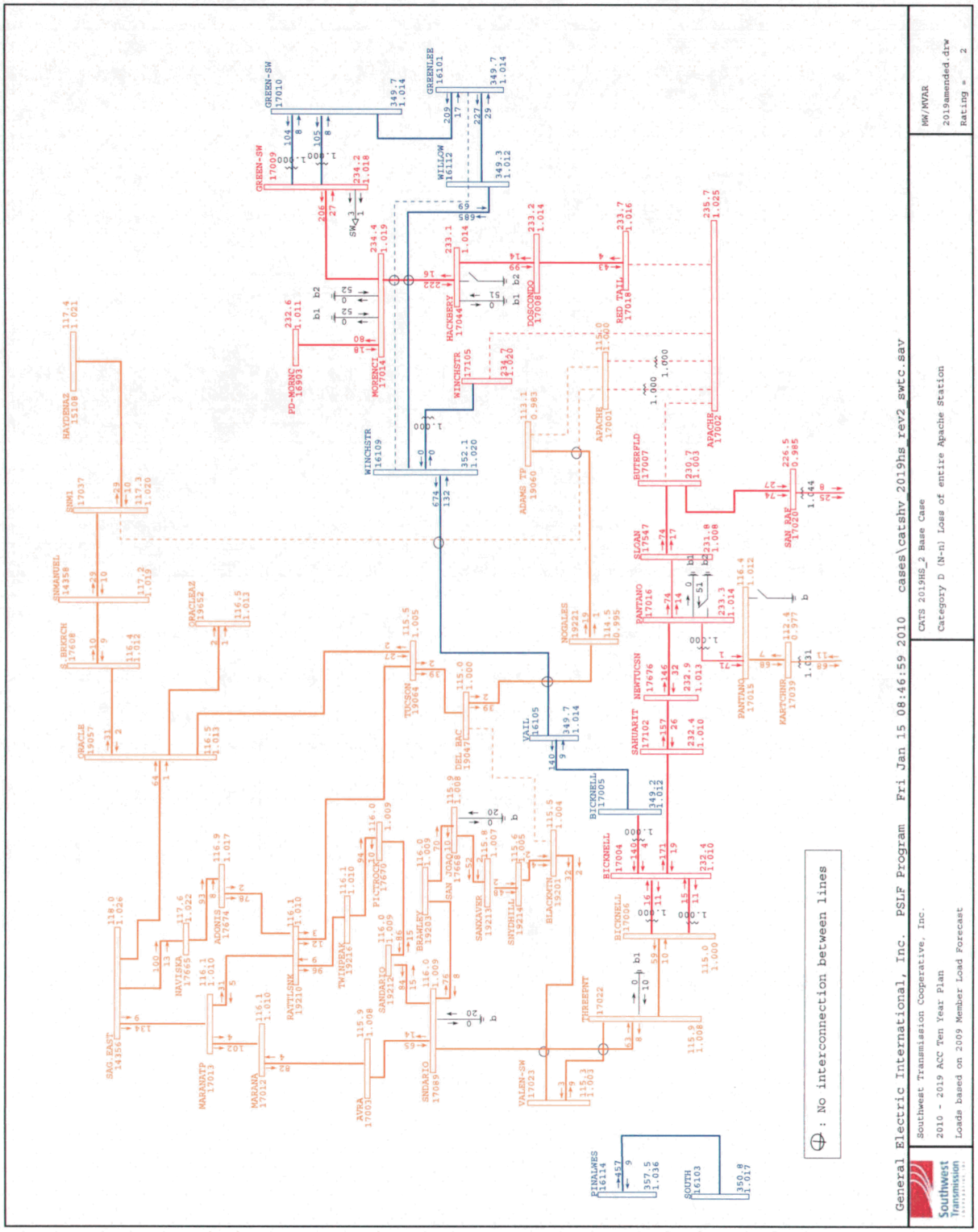
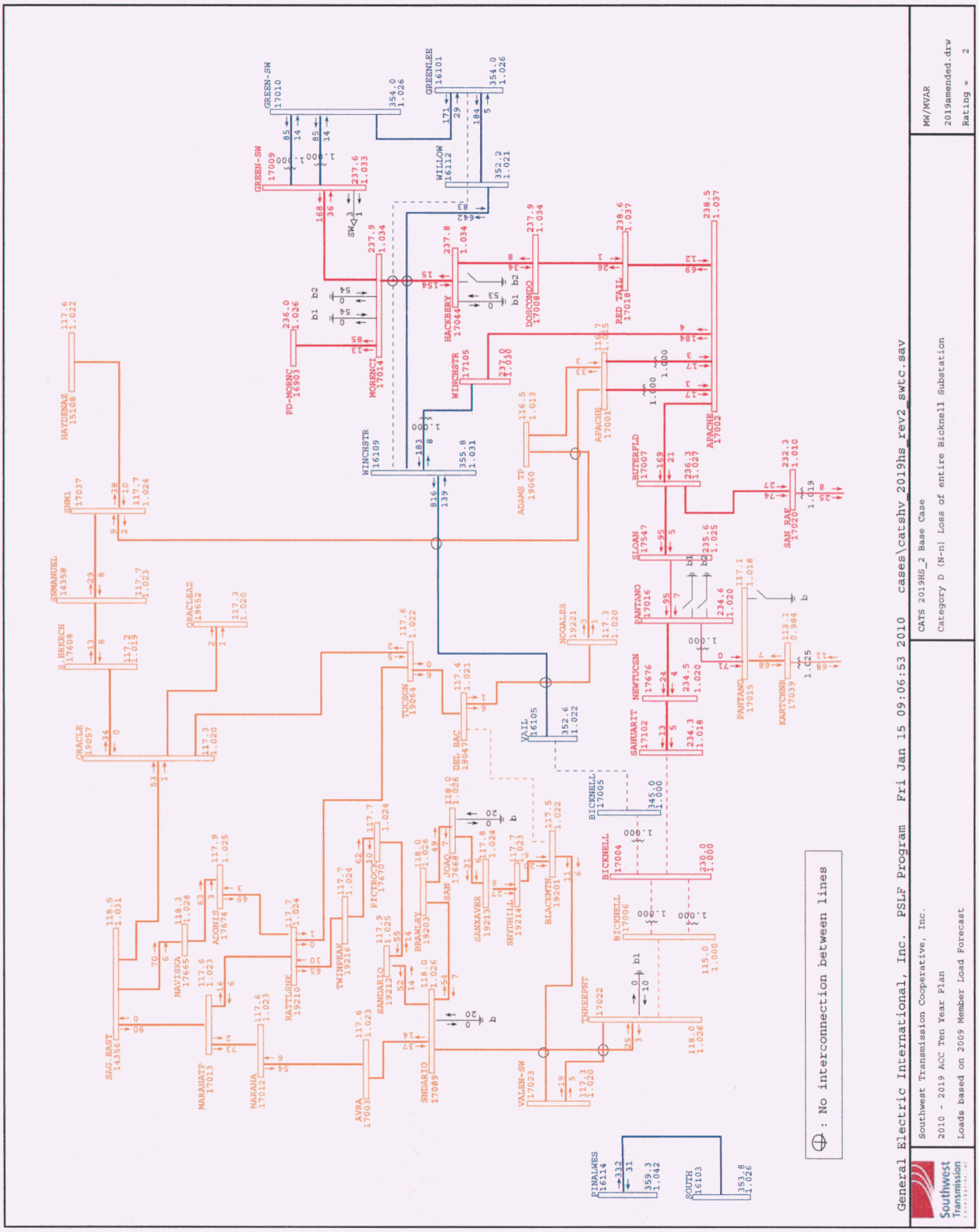


2019HS Southwest Transmission Cooperative Base System with Loss of Entire Apache Station



2018HS Southwest Transmission Cooperative Base System with Loss of Entire Bicknell Substation



A

Summary Report

And

Reference Filing of the

Cochise County Technical Study Report

Final Report

December 2009

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The efforts of the following entities are truly appreciated in preparing and supporting the Cochise County Study Group activities.

Arizona Public Service Company

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The Cochise County Study Group would also like to respectively acknowledge the efforts of their Chairman, Mr. Ken Bagley of Genesee Consulting. Mr. Bagley was instrumental in pulling the group together and building consensus for the various issues facing the CCSG. His integrity leadership, technical knowledge, and his ability to be a calming influence is a tribute to the success of the CCSG and this Report.

INTRODUCTION

This Summary Report of the Cochise County Study Group (CCSG) provides a compilation of activities performed to date and references the Technical Study that has been performed as a collaborative effort amongst the CCSG Participants in response to Arizona Corporation Commission Decision 70635, dated December 3, 2008. The Summary Report includes an Executive Summary, Background, Cochise County Study Group Participants, Summary of the Technical Report, Recommendations and Next Steps, and supporting Appendices.

EXECUTIVE SUMMARY

The technical study, included as Attachment A, concluded that various sections of Cochise County loads cannot be reliably served without interruption following an outage of any one of four critical radial High Voltage (HV) element outages in 2013 and subsequently requiring "restoration of service". The four critical outages that require "restoration of service" included the Adams – Boothill 115 kV line, the Butterfield – San Rafael 230 kV line, the Kartchner 115/69 kV transformer, and the Vail – Fort Huachuca 138 kV line. These outages do not violate applicable North America Electric Reliability Council (NERC) Reliability Standards or Western Electricity Coordination Council (WECC) System Performance Criteria, since the loads are served via radial transmission lines. However, the Arizona Corporation Commission (ACC) found "restoration of service" under the specified conditions to be unacceptable[1], and has subsequently established a Continuity of Service principle to replace "restoration of service". The CCSG agreed that a definition for continuity of service is that loss of any single transmission facility will not result in loss of load that requires subsequent System Operator intervention, either directly or through Energy Management System, to restore service. Specifying without Operator intervention reduces outage time to be within the timeframe that automated schemes typically operate (e.g. seconds to minutes). Implementing existing manual operational procedures could help restore at least partial power to the affected areas but this does not meet the continuity of service principle as defined by the ACC. The CCSG clarification offers significant improvement over historically experienced "restoration of service" by limiting potential interruptions to seconds or minutes versus historical outages lasting hours or days.

[1] Reference 5th Biennial Transmission Assessment (E-00000D-07-0376) (Section 5.1.3, pages 65-67); and Decision No. 70635 (5.d, page 3)

The recommended transmission plan is detailed below and is expected to provide continuity of service well beyond the 2018 time frame and to serve about 380 MW[2] within this area:

- New APS Palominas – SSVEC Hereford 69 kV line
- Proposed 50 MVA 115/69 kV transformer at Boothill
- Loop Webb – Tombstone 69 kV line through Boothill
- Proposed Fort Huachuca 138 kV – Buffalo Soldier 69 kV tie[3] (needed in year 2018[4])
- Operate the following normally open circuits as normally closed circuits:
    - Charleston – Bella Vista 69 kV line
    - Keating Junction – Hawes 69 kV line
    - Mc Neal – San Pedro 69 kV line

- Install shunt capacitors at the following substations
    - 13.2 MVAR at Webb 69 kV substation
    - 8 MVAR at Ramsey 69 kV substation
    - 8 MVAR at Hawes 69 kV substation
    - 8 MVAR at Pueblo 69 kV substation
    - 6 MVAR at Webb 69 kV substation (needed in year 2018)

[2] Cochise County area load is expected to be 308MW by and 348 MW by 2018.

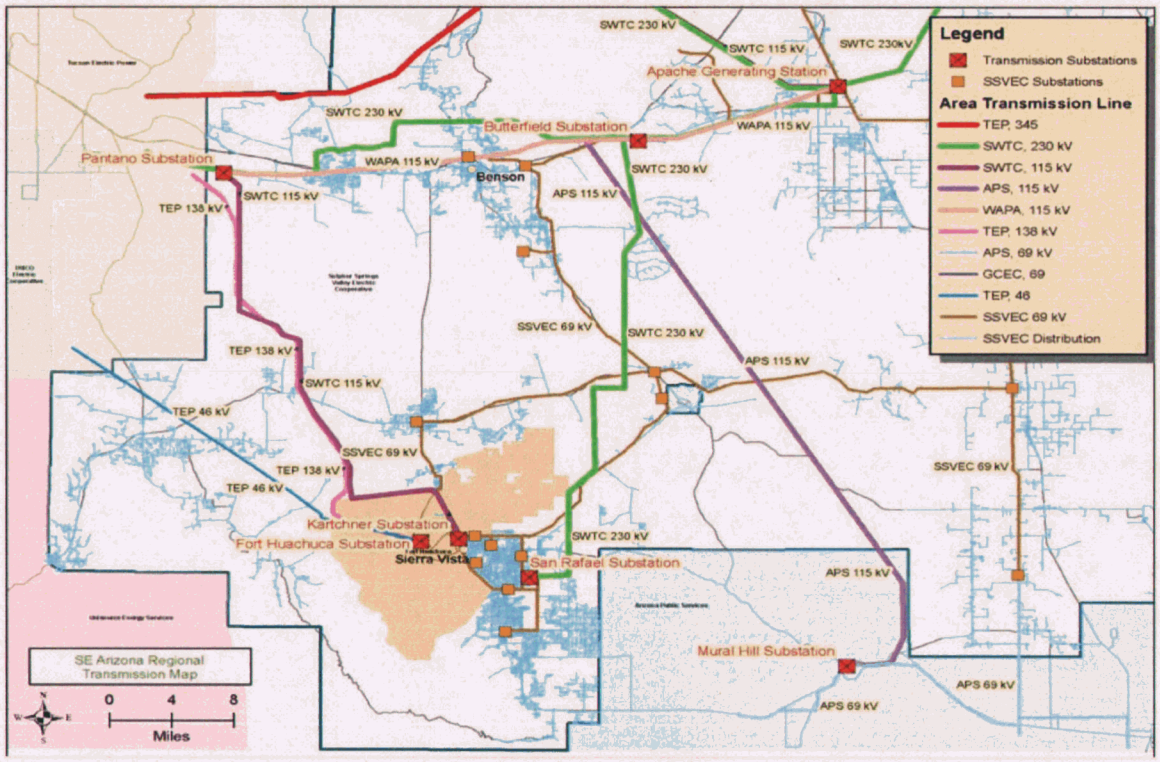
[3] Due to TEP's two-county bonding restrictions this tie would be operated normally open. This tie is also dependent upon Fort Huachuca's approval and funding for the proposed Buffalo Soldier 69 kV substation and connection to the Kartchner substation.

[4] The Fort Huachuca 138kV – Buffalo Soldier 69kV tie option will be evaluated against other alternatives in subsequent Ten-Year Transmission Plan filings.

BACKGROUND

The Cochise County Study Group was formed as a technical review group within the Southeast Arizona Transmission Study group (SATS) in late 2007. This technical review group was tasked with additional technical emphasis on evaluating the load serving requirements in Cochise County, Arizona. Cochise County comprises the southeastern corner of Arizona and bordered by New Mexico on the east and Mexico on the south. Major cities within this region are Benson, Bisbee, Douglas, Sierra Vista, Tombstone, and Willcox. Fort Huachuca, home of the U.S. Army Intelligence Center and the U.S. Army Network Enterprise Technology Command (NETCOM), is immediately adjacent to the City of Sierra Vista. Figure 1 defines the approximate study area that has been included in the analysis of the Cochise County Study.

Figure 1 – Cochise County Study Area



The CCSG was originally formed to address the transmission and load serving concerns specific to the Cochise County study area. Of particular concerns to members of the CCSG was the transmission system serving loads in and surrounding the City of Sierra Vista. The concerns had been raised primarily due to a series of outages experienced in the Sierra Vista area during the October 9th through October 11th of 2007 time frame. Transmission services in most of the Cochise County area consists primarily of radial high voltage lines (115kV through 230kV) that

deliver energy to a receiving station and ultimately a sub-transmission system to serve the loads in a defined area. Most of the sub-transmission system is also radial, with limited back up from the adjacent distribution systems. This configuration is typical in rural areas and less typical as the land uses become more saturated with customers. For most of the Cochise County area, Southwest Transmission Cooperative (SWTC) and Western Area Power Administration (Western) are the high voltage transmission providers while Sulphur Springs Valley Electric Cooperative (SSVEC) and Arizona Public Service (APS) serve individual retail loads within the area. Tucson Electric Power Co. (TEP) serves Fort Huachuca, a TEP retail customer, over a high voltage radial transmission line.

The initial 2007 objective of the CCSG was:

"To determine and recommend transmission solution(s) using 115kV, 138kV and 230kV lines and substations to solve existing N-1 transmission problems within southern Cochise County."[5]

To ensure that Cochise County could maintain service for future load, many options such as upgrading subtransmission, generation, and HV transmission were evaluated. The group decided that only the HV (115kV, 138kV, and 230kV) options would be listed and evaluated for a long term solution. In 2008, the analysis did not specifically pursue the underlying sub-transmission system and generation; however it did examine multiple HV options to meet the objective of the 2008 study effort. There was agreement by the CCSG that a 230kV loop through the Sierra Vista area would be the preferred long-term technical solution. The CCSG did not however come to a conclusion on next steps to implement the long-term solution during the 2008 study effort.

The ACC evaluates on a biennial basis the adequacy of Arizona's transmission system to reliably meet existing and future energy needs of the state. As a component of the ACC 5th Biennial Transmission Assessment (BTA), multiple comments were made related to the adequacy of the transmission system within Cochise County. In particular, the ACC staff concluded after reviewing the BTA that, additional radial transmission solutions would only perpetuate the "restoration of service" practices within Cochise County[6]. The ACC therefore ordered in Decision No. 70635 dated December 3, 2008:

" i. APS, SSVEC, and TEP shall perform collaborative studies and shall file a report of those studies for the next BTA that establishes a long range system plan for Cochise County that is founded on the principle of continuity of service following a transmission line outage. SWTC shall participate in the study effort as SSVEC's current sole transmission provider. Relevant elements of that plan shall be incorporated in each transmission service provider's respective

[5] Reference November 26, 2007 South of SATS (a.k.a. CCSG) meeting notes.
[6] Reference 5th Biennial Transmission Assessment (E-00000D-07-0376) Section 5.1.3; and Decision No. 70635 (5.d, page 3)

ten year plans with defined in-service dates and shall be filed with the Commission in January 20[10]."

Following this order from the ACC, the CCSG thought it would be most effective to have an independent consultant perform the technical studies and provide an assessment of the Cochise County transmission system over a ten-year time frame. In May 2009, PDS Consulting, PLC (PDS) was officially retained to perform the independent technical analysis with the intent of meeting the objective of the ACC Order.

COCHISE COUNTY STUDY GROUP

The CCSG was formed in late 2007 as a technical review group within the Southern Area Transmission Study group (SATS). The CCSG focused its efforts in 2009 to comply with Decision No. 70635, wherein the scope was expanded from the 2008 study plan to examine the HV and the sub-transmission system across the study area in more detail. The study proceeded with technical assistance from PDS, with the intent of providing a recommendation for meeting the expected load serving requirements as well as ensuring continuity of service through the ten-year planning time frame.

The CCSG 2009 study group primarily consisted of transmission planning staff from SSVEC, SWTC, TEP, Western, APS, and Fort Huachuca. The CCSG was involved in the development of base cases, study assumptions, study methodology, and potential transmission and/or generation alternatives for resolving the continuity of service issue. The CCSG held more than 15 (including face-to-face and teleconference) meetings throughout the study period to review the study results and provide input. Additional correspondences through emails were active amongst the members throughout the 2009 time frame.

PDS performed the technical analysis over a period of approximately three months and presented the CCSG with draft reports which was ultimately approved in November 2009 (dated November 19, 2009). The approved technical report is included in Attachment A. The following section provides a summary of the technical report.

TECHNICAL REPORT SUMMARY

Methodology and Study Approach

The Cochise County Study was performed using WECC approved 2013 and 2018 heavy summer power flow models. These power flow models have been reviewed and approved by WestConnect members. The Cochise County Study group updated the power flow models to include ten (10) planned transmission related projects in Cochise County with planned in-service dates prior to summer of 2013. The planned transmission projects include:

- Upgrade of Webb –Tombstone 69 kV line (795 ACSR)
- Upgrade of Tombstone – Charleston Junction 69 kV line (795 ACSR)
- Upgrade of Kansas – Chiricahua 69 kV line (795 ACSR)
- Upgrade of Mural – Don Luis 69 kV line (795 ACSS)
- Upgrade of San Rafael – Ramsey 69 kV line (795 ACSR)
- Proposed Kartchner 115 kV – Buffalo Soldier 69 kV Tie
- Installation of second 230/69 kV transformer at San Rafael
- Installation of 9.4 MVAR shunt capacitor at Benson 69 kV substation
- Installation of 38 MVAR shunt capacitor at San Rafael 230 kV substation
- Installation of 18 MVAR shunt capacitor at Kartchner 69 kV substation

The 2013 power flow model was initially screened through a power flow technical analysis for benchmark purposes.

Four potential transmission and one generation alternative proposed by the CCSG for resolving the continuity of service issue in the Cochise County in 2013 were each modeled and incorporated in the benchmark power flow model to create five post-project power flow models. Power flow analysis was performed on each of the five post-project power flow models and the results were evaluated using NERC Reliability Standards, WECC System Performance Criteria, and other performance evaluation criteria including continuity of service requirement following an outage of a 115 kV or above transmission facility in Cochise County.

The technical performances of the potential 2013 transmission or generation alternatives were evaluated by the CCSG and the two most technically feasible alternatives were recommended for inclusion in 2018 evaluations. Five additional potential transmission alternatives were proposed by the CCSG for a 2018 evaluation. The 2018 alternatives were evaluated following a power flow technical analysis performed on each alternative and the results were appraised using NERC Reliability Standards, WECC System Performance Criteria, and the continuity of service requirement.

The most technically feasible transmission alternative was recommended by PDS to the CCSG. An analysis of the recommended transmission plan showed that it is capable of serving up to 380 MW of load in Cochise County. Forecasted Cochise County demand for 2013 was 308MW and

2018 was 348 MW. It should be noted however that this forecast was conducted prior to the current economic downturn.

Study Group Involvement and Process

The study plan for the Cochise County Study which included the objective and scope was drafted by the CCSG. The CCSG also reviewed the power flow base cases and models for the study. PDS Consulting, PLC was contracted by the CCSG to perform the power flow analysis and provide the results of the analysis to the CCSG. CCSG, assisted by PDS evaluated the results of the power flow analysis. These evaluations were done through conference calls and in-house meetings. CCSG participants provided their reviews and suggestions, most of which were incorporated into subsequent power flow analysis with the intention of achieving acceptable results

.

The technical study report was initially drafted by PDS with inputs from the CCSG. The CCSG reviewed the study report and provided significant comments, most of which were incorporated into the final technical study report.

Summary of Findings and Conclusions

The study showed that various sections of Cochise County loads cannot be served without interruption following an outage of any one of four critical High Voltage (HV) element outages assuming the topology in the 2013 base case. The four critical outages that were identified included the Adams – Boothill 115 kV line, the Butterfield – San Rafael 230 kV line, the Kartchner 115/69 kV transformer, and the Vail – Fort Huachuca 138 kV line. These outages do not violate applicable NERC Reliability Standards or WECC System Performance Criteria, since the loads are served via radial transmission lines. However, the ACC found "restoration of service" as historically experienced in Cochise County to be unacceptable, and therefore established a continuity of service principle to replace the practice of the "restoration of service". For the purposes of this Study, the CCSG agreed that the appropriate definition for continuity of service is that loss of any single HV transmission facility will not cause loss of load that requires subsequent System Operator intervention, either directly or through EMS, to restore service. Thus momentary interruptions within the timeframe that automated schemes typically operate (e.g. seconds to minutes) would be allowed. The CCSG definition offers significant improvement over historically experienced restoration of service by limiting potential interruptions to seconds or minutes versus historical outages lasting hours or days.

Study Recommendation

After a thorough technical analysis of the different potential transmission and /or generation alternatives proposed for resolving the continuity of service issue in the Cochise County, it became apparent that a combination of two or more initial alternatives would be needed to fully resolve the issue. The recommended transmission plan was tested and found to be technically capable of meeting the NERC Reliability Standards and the WECC System Performance Criteria as well as complying with the ACC Order 70635 to provide for continuity of service in Cochise County in both 2013 (or by a 308MW load level) and 2018 (or by a 348MW load level). The recommended transmission plan is detailed below:

- New Palominas – Hereford 69 kV line
- Proposed 50 MVA115/69 kV transformer at Boothill
- Loop Webb – Tombstone 69 kV line through Boothill
- Proposed Fort Huachuca 138 kV – Buffalo Soldier 69 kV tie[7] (needed in year 2018)
- Operate the following normally open circuits as normally closed circuits:
    - Charleston – Bella Vista 69 kV line
    - Keating Junction – Hawes 69 kV line
    - Mc Neal – San Pedro 69 kV line
- Install shunt capacitors at the following substations
    - 13.2 MVAR at Webb 69 kV substation
    - 8 MVAR at Ramsey 69 kV substation
    - 8 MVAR at Hawes 69 kV substation
    - 8 MVAR at Pueblo 69 kV substation
    - 6 MVAR at Webb 69 kV substation (needed in year 2018)

While some components of the recommended subtransmission plan are existing transmission facilities which have to be operated closed, others are transmission projects under consideration by some of the load serving entities in Cochise County. For example, APS and SSVEC have plans to construct a new 69 kV line from Palominas to Hereford by 2013. Also, the Fort has requested funding to construct a 69 kV substation at Buffalo Soldier for reliability purposes in order to serve the Fort's loads.

[7] Due to TEP's two-county bonding restrictions this tie would be operated normally open. This tie is also dependent upon Fort Huachuca's approval and funding for the proposed Buffalo Soldier 69 kV substation and connection to the Kartchner substation.

RECOMMENDED NEXT STEPS

The following steps are recommended in implementing the transmission plan in order to comply with the ACC Order 70635.

1. Filing of the Summary Report which contains the Technical Report

It is the intent of SWTC to file the Summary Report which contains the Technical Report with their January 2010 ACC Ten-Year Plan filing. APS and TEP are expected to reference the SWTC filing.

2. Facility Study

Following the review and concurrence of the ACC, the CCSG recommends that an additional feasibility analysis be conducted to examine the physical constraints and costs of the recommended plan, basically a Facility Study. A key issue is that the utilities did not construct, does not operate, nor is contractually prepared for their transmission and subtransmission facilities to be operated in a normally closed configuration, especially with neighboring utilities. The Facility Study would examine the physical and electrical requirements of the recommended plan, as well as indicative costs and schedule to complete the plan.

For 2010, the CCSG intends to complete the Facility Study of the recommended plan, initiate contract discussions to implement the plan, and update load forecasts to finalize near-term construction schedules.

3. Applicable Agreements

Significant and complex contractual agreements will be required to accomplish the Recommended Plan. Examples of agreements needed are, but limited too; cost responsibility, wheeling arrangements, EPC (engineering, procurement, and construction), Operations and Maintenance (O&M), Load Serving agreement, etc. It is expected that these agreements will take time due to the complexity and approvals required (e.g. governing Boards, ACC, RUS, and/or FERC) to fully execute. The CCSG intends to initiate the negotiations in 2010 with the goal of having all of the necessary contractual agreements in place with adequate time to implement the recommended plan.

4. Construction of Recommended Projects

The Recommended Plan is based on the 2008 Load Forecast available at the time of the study, specifically the facilities identified to serve 308MW load in 2013 are:

- New Palominas – Hereford 69 kV line
- Proposed 50 MVA115/69 kV transformer at Boothill
- Loop Webb – Tombstone 69 kV line through Boothill

- Operate the following normally open circuits as normally closed circuits:
    - Charleston – Bella Vista 69 kV line
    - Keating Junction – Hawes 69 kV line
    - Mc Neal – San Pedro 69 kV line

- Install shunt capacitors at the following substations
    - 13.2 MVAR at Webb 69 kV substation
    - 8 MVAR at Ramsey 69 kV substation
    - 8 MVAR at Hawes 69 kV substation
    - 8 MVAR at Pueblo 69 kV substation

And the additional facilities identified to serve 348 MW of load in 2018 are:

- Proposed Fort Huachuca 138 kV – Buffalo Soldier 69 kV tie
- Install shunt capacitors at the following substations
    - 6 MVAR at Webb 69 kV substation

COCHISE COUNTY ELECTRIC RELIABILITY STUDY

Final Report

November 19, 2009

Prepared for:

Cochise County Study Group

Prepared by:

PDS Consulting, PLC

EXECUTIVE SUMMARY

Introduction

In October 2007, the City of Sierra Vista and its surroundings experienced a series of power outages. These outages amplified the concerns about the reliability of the Cochise County transmission system which has been identified in the Arizona Corporation Commission's (ACC) 5th Biennial Transmission Assessment (BTA). The ACC ordered Tucson Electric Power (TEP), Arizona Public Service (APS) and Sulphur Springs Valley Electric Cooperative (SSVEC) to perform a collaborative study to find a solution to the reliability issue and report their findings in the next BTA. That solution must entail development of a long-range system plan "founded on the principle of continuity of service following a transmission line outage". The principle of continuity of service as ordered by the ACC stipulates that there should not be a loss of load following an outage of single high voltage (100 kV and above) transmission facility. The ACC also ordered Southwest Transmission Cooperative, Inc (SWTC) as a transmission provider to SSVEC to participate in the study effort. In response, the Southeast Arizona Transmission Study (SATS) group created the Cochise County Study Group (CCSG) to perform technical studies to address the transmission and load serving needs in Cochise County. The CCSG contracted with PDS Consulting, PLC (PDS) to assist it to evaluate alternate transmission and/or local generation resource plans for resolving Cochise County continuity of service issues. The CCSG agreed to a clarification that the appropriate definition of "Continuity of Service" should mean, loss of any single transmission facility will not cause loss of any retail load that requires subsequent System Operator intervention, either directly or through EMS to restore service. Thus momentary interruptions within the timeframe that automated schemes typically operate (e.g. seconds to minutes) would be allowed. The CCSG clarification offers significant improvement over historically experienced "restoration of service" by limiting potential interruptions to seconds or minutes versus historical outages lasting hours or days.

CCSG, with PDS assistance, evaluated the performance of the different alternate transmission and/or generation plans using Western Electricity Coordinating Council (WECC) approved 2013 and 2018 heavy summer power flow models. These power flow models have already been reviewed and approved by WestConnect members. Only power flow analysis was conducted. The scope of the technical analysis was to:

- Identify the potential continuity of service issues in Cochise county in 2013.
- Evaluate the electrical performance of alternate transmission and/ or generation plans for resolving the continuity of service issues covering the near-term (1-5 years) and long-term (6-10 years) planning horizon of 2013 to 2018.
- Recommend the most desirable alternative(s) from a technical perspective. Provide a high level estimate of the load level to be supported by the recommended alternative.

Cochise County Continuity of Service Issues in 2013

The study described in this report showed that various sections of Cochise County loads can not be served without interruption an outage of any one of four critical High Voltage (HV) element outages. The four outages identified included the Adams – Boothill 115 kV line outage, the Butterfield – San Rafael 230 kV line outage, the Kartchner 115/69 kV transformer outage and the Vail – Fort Huachuca 138 kV line outage. Although these outages do not violate applicable WECC/NERC reliability standards, since the loads are served via radial transmission lines. However, the ACC found "restoration of service" under the specified conditions to be unacceptable, and has subsequently established a "continuity of service" principle to replace the "restoration of service". The CCSG agreed definition for continuity of service is that loss of any single transmission facility will not cause loss of load that requires subsequent System Operator intervention, either directly or through EMS, to restore service. The CCSG definition offers significant improvement over historically experienced "restoration of service" by limiting potential interruptions to seconds or minutes versus historical outages lasting hours or days.

This study evaluated five potential transmission and/or generation alternatives for resolving the Cochise County electric reliability issues in 2013. Five additional potential transmission plans were evaluated using a 2018 power flow model.

Recommendation

After a thorough technical analysis of the different potential transmission and /or generation alternatives proposed for resolving the continuity of service issue in the Cochise County, it became apparent that a combination of two or more initial alternatives would be needed to fully resolve the issue. The recommended transmission plan has been tested and has been found to be technically capable of meeting the WECC/NERC reliability standards as well as complying with the ACC Order to provide for continuity of service in Cochise County in both 2013 and 2018. The recommended transmission plan is detailed below:

- New Palominas – Hereford 69 kV line
- Operate Mc Neal – San Pedro 69 kV as a normally closed circuit
- Proposed 50 MVA115/69 kV transformer at Boothill
- Loop Webb – Tombstone 69 kV line through Boothill
- Proposed Fort Huachuca 138 kV – Buffalo Soldier 69 kV tie[1] (needed in year 2018)
- Operate the following normally open circuits as normally closed circuits:
    - Charleston – Bella Vista 69 kV line
    - Keating Junction – Hawes 69 kV line

[1] Due to TEP's two-county bonding restrictions this tie would be operated normally open. This tie is also dependent upon Fort Huachuca's approval and funding for the proposed Buffalo Soldier 69 kV substation and connection to the Kartchner substation.

- Install shunt capacitors at the following substations
  - 13.2 Mvar at Webb 69 kV substation
  - 8 Mvar at Ramsey 69 kV substation
  - 8 Mvar at Hawes 69 kV substation
  - 8 Mvar at Pueblo 69 kV substation
  - 6 Mvar at Webb 69 kV substation (needed in year 2018)

While some components of the recommended transmission plan are existing transmission facilities which have to be operated differently, others are transmission projects under consideration by some of the load serving entities in Cochise County. For example, APS and SSVEC have plans to construct a new 69 kV line from Palominas to Hereford by 2013. Also, the Fort has requested SSVEC to construct a 69 kV substation at Buffalo Soldier for reliability purposes in order to serve the Fort's loads under an extreme single element outage condition.

An analysis of the recommended transmission plan shows that it is capable of serving up to 380 MW of load in Cochise County. Forecasted Cochise County demand in 2018 is 348 MW. It should be noted that this forecast was conducted prior to the current economic downturn.

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INTRODUCTION

In October 2007, the City of Sierra Vista and its surroundings experienced a series of power outages. These outages amplified the concerns about the reliability of the Cochise County transmission system which has been identified in the Arizona Corporation Commission's (ACC) 5th Biennial Transmission Assessment (BTA). The ACC ordered Tucson Electric Power (TEP), Arizona Public Service (APS) and Sulphur Springs Valley Electric Cooperative (SSVEC) to perform a collaborative study to find a solution to the reliability issue and report their findings in the next BTA. That solution must entail development of a long-range system plan "founded on the principle of continuity of service following a transmission line outage". The principle of continuity of service as ordered by the ACC stipulates that there should not be a loss of load following an outage of single high voltage (100 kV and above) transmission facility. The ACC also ordered Southwest Transmission Cooperative, Inc (SWTC) as a transmission provider to SSVEC to participate in the study effort. In response, the Southeast Arizona Transmission Study (SATS) group created the Cochise County Study Group (CCSG) to perform technical studies to address the transmission and load serving needs in Cochise County. The CCSG contracted with PDS Consulting, PLC (PDS) to assist it to evaluate alternate transmission and/or local generation resource plans for resolving Cochise County continuity of service issues. The CCSG agreed to a clarification that the appropriate definition of "Continuity of Service" should mean, loss of any single transmission facility will not cause loss of any retail load that requires subsequent System Operator intervention, either directly or through EMS to restore service. Thus momentary interruptions within the timeframe that automated schemes typically operate (e.g. seconds to minutes) would be allowed. The CCSG clarification offers significant improvement over historically experienced "restoration of service" by limiting potential interruptions to seconds or minutes versus historical outages lasting hours or days.

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- Recommend the most desirable alternative(s) from a technical perspective. Provide a high level estimate of the load level to be supported by the recommended alternative.

COCHISE COUNTY TRANSMISSION SYTEM

Cochise County comprises the southeastern corner of Arizona and is bordered by New

Mexico to the east and Mexico to the south. The major cities in the County include Benson, Bisbee, Douglas, Sierra Vista, Tombstone and Wilcox. The County also houses a major U.S. military installation, Fort Huachuca, which is located adjacent to the City of Sierra Vista.

Transmission service in Cochise County consists principally of three radial lines which feed into the underlying sub-transmission system and a fourth dedicated radial line serving Fort Huachuca. Five major electrical entities have transmission and/or load serving obligations in Cochise County. Sulphur Springs Valley Electric Cooperative (SSVEC) is the major load serving entity in Cochise County and owns most of the sub-transmission infrastructure. Southwest Transmission Cooperative (SWTC) provides transmission service to SSVEC, for its Sierra Vista area loads, principally via two radial lines; a 115 kV line from Pantano to Kartchner substations and a 230 kV line from Butterfield to San Rafael substations. SWTC can also provide additional import capacity for SSVEC to serve it Sierra Vista area loads, via the Apache substation provided that SSVEC operates their sub-transmission system in a looped configuration. Western Area Power Administration (WAPA) provides transmission service to Arizona Public Service (APS) which then delivers power, via a radial 115 kV transmission line from the Adams Tap substation to its Mural substation, to serve its loads in the south-central and far southeastern corner of Cochise County. Tucson Electric Power (TEP) serves Fort Huachuca, its retail customer via a radial 138 kV line which emanates from its Vail substation. An alternative path for delivering up to approximately 18 MW for backup service to Fort Huachuca, through an automatic transfer scheme, is provided by a TEP 46 kV sub-transmission line connected to the TEP 138 kV bus at the South Loop substation. TEP also has rights on the SWTC system to provide back up service in the amount of 50 MW for Fort Huachuca. Figure 1 provides a graphical depiction of Cochise County transmission system and service areas.

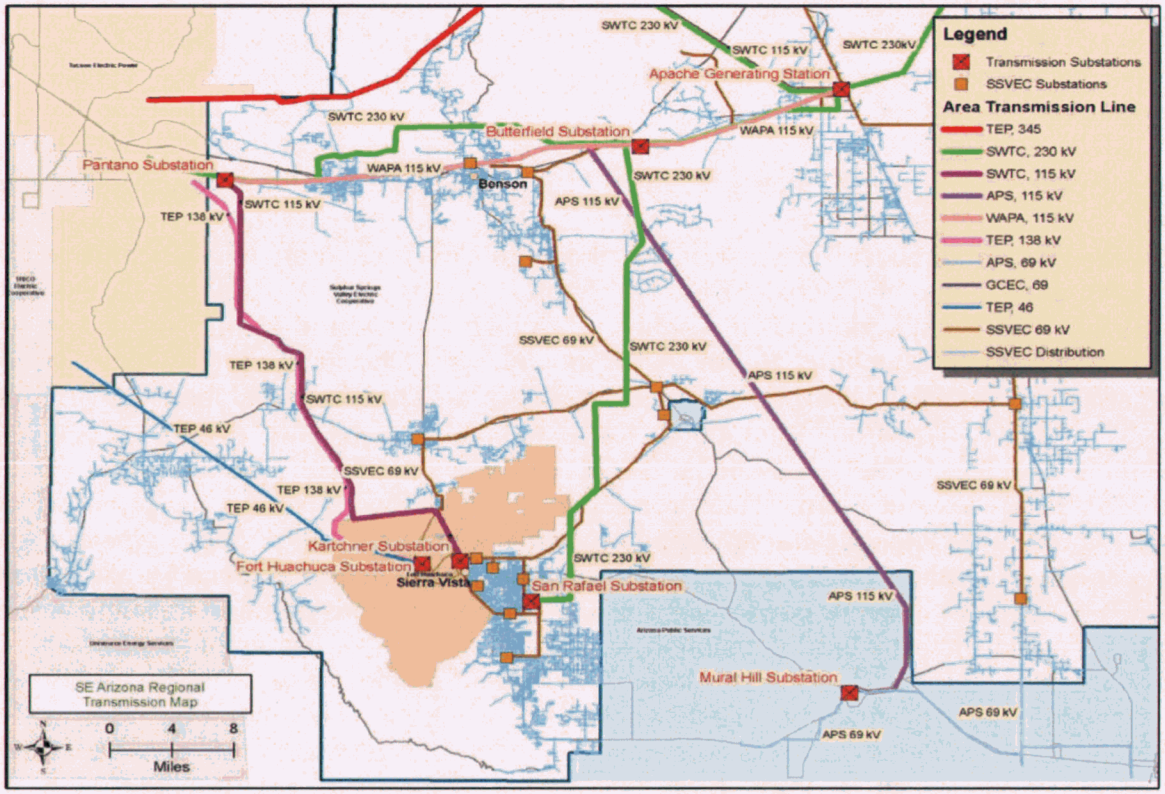


Figure 1: Cochise County Transmission System

POTENTIAL TRANSMISSION/GENERATION ALTERNATIVES

In an attempt to resolve the continuity of service issue in Cochise County, five potential transmission and generation resource plans were considered for evaluation for each of the two study years, 2013 and 2018. The transmission and/or generation resource alternatives evaluated are detailed below.

2013 Potential Transmission /Generation Plans

The 2013 potential alternatives for resolving the electric reliability issues in Cochise County are comprised of the following four transmission alternatives and one local generation resource alternative.

- Alternative 1 (McNeal – San Pedro and Palominas – Hereford 69 kV lines)
  - Construct new Palominas – Hereford 69 kV line
  - Close normally open McNeal – San Pedro 69 kV line

- Alternative 2 (Proposed Fort Huachuca 138 kV – Buffalo Soldier 69 kV tie)
  - New Fort. Huachuca 138 kV – New Buffalo 69 kV tie

- Alternative 3 (Fort. Huachuca 138 kV – Kartchner 115 kV tie)
  - New Fort. Huachuca 138 kV – Kartchner 115 kV tie

- Alternative 4 (Proposed Boothill 115/69 kV transformer & Loop Webb – Tombstone 69 kV line through Boothill)
  - New 115/69 kV substation at Boothill
  - Loop existing Webb –Tombstone 69 kV line through Boothill

- Alternative 5 (35 MW Combustion Turbine (CT) at Kartchner 69 kV bus)
  - Install a 35 MW gas fired generator at Kartchner 69 kV substation

Following the power flow analysis the following two Alternatives were recommended for 2018 screening:

- Alternative 6 (Combines Alternatives 1, 2 & 4)
  - Alt 1: McNeal – San Pedro and Palominas – Hereford 69 kV lines
  - Alt 2: Proposed Fort Huachuca 138 kV – Buffalo Soldier 69 kV tie
  - Alt 4: Proposed Boothill 115/69 kV transformer & Loop Webb – Tombstone 69 kV line through Boothill

- Alternative 7 (Combines alternatives 1, 2 & 5)
  - Alt 1: McNeal – San Pedro and Palominas – Hereford 69 kV lines
  - Alt 2: Fort Huachuca 138 kV – Buffalo Soldier 69 kV tie
  - Alt 5: Install a 35 MW gas fired generator at Kartchner 69 kV substation

2018 Potential Transmission Plans

Five potential transmission plans were evaluated. These transmission plans include:

- Alternative A (Pantano – Kartchner – San Rafael – Butterfield 230 kV loop)
  - Build new 230 kV substation at Kartchner
  - Construct new Pantano – Kartchner 230 kV line
  - Construct new Kartchner – San Rafael 230 kV line
  - Install new 230/69 kV transformer at Kartchner

- Alternative B (Assumes Alternative 1 Plus San Rafael – Mural 230 kV line)
  - Build new 230 kV substation at Kartchner
  - Build new 230 kV substation at Mural
  - Construct new Pantano – Kartchner 230 kV line
  - Construct new Kartchner – San Rafael 230 kV line
  - Construct new San Rafael – Mural 230 kV line
  - Install new 230/69 kV transformer at Kartchner
  - Install new 230/69 kV transformer at Mural

- Alternative C (Convert Adams – Boothill – Mural from 115 kV to 230 kV)
  - Build new 230 kV substation at Adams

- Build new 230 kV substation at Boothill
- Build new 230 kV substation at Mural
- Convert Adams – Boothill 115 kV line to 230 kV line
- Convert Boothill – Mural 115 kV line to 230 kV line
- Install new 230/115 kV transformer at Adams
- Install new 230/69 kV transformer at Boothill
- Install new 230/69 kV transformer at Mural

- Alternative D (Sloan – CS-2 230 kV line)
  - Build new 230 kV substation at CS-2
  - Construct new Sloan – CS-2 230 kV line
  - Install 230/69 kV transformer at CS-2 to tie to Sierra Vista 69 kV system.

- Alternative E (Adams – Boothill – Mural – San Rafael 230 kV line)
  - Build new 230 kV substation at Adams
  - Build new 230 kV substation at Boothill
  - Build new 230 kV substation at Mural
  - Convert Adams – Boothill 115 kV line to 230 kV line
  - Convert Boothill – Mural 115 kV line to 230 kV line
  - Construct new San Rafael – Mural 230 kV line
  - Install new 230/69 kV transformer at Adams
  - Install new 230/69 kV transformer at Boothill
  - Install new 230/69 kV transformer at Mural

STUDY BASE CASE DESCRIPTION AND METHODOLOGY

This technical analysis was conducted using approved WECC 2013 heavy summer and 2018 heavy summer models. Both power flow base cases were reviewed by the CCSG to ensure that the modeled demand reflects forecasted 2013 (308 MW) and 2018 (348 MW) heavy summer operating conditions in Cochise County. Approved transmission projects planned for Cochise County in the respective years were modeled. Approved transmission related projects modeled in the 2013 base case included:

- Upgrade of Webb –Tombstone 69 kV line (795 ACSR)
- Upgrade of Tombstone – Charleston Junction 69 kV line (795 ACSR)
- Upgrade of Kansas – Chiricahua 69 kV line (795 ACSR)
- Upgrade of Mural – Don Luis 69 kV line (795 ACSS)
- Upgrade of San Rafael – Ramsey 69 kV line (795 ACSR)
- Proposed Kartchner 115 kV – Buffalo Soldier 69 kV Tie
- Installation of second 230/69 kV transformer at San Rafael
- Installation of 9.4 MVar shunt capacitor at Benson 69 kV substation
- Installation of 38 MVar shunt capacitor at San Rafael 230 kV substation
- Installation of 18 MVar shunt capacitor at Kartchner 69 kV substation

The 2013 base case served as the benchmark case for initial screening and post-project performance evaluations for this technical analysis. The 2013 benchmark case was initially screened through a power flow analysis for benchmark purpose. Five post-project base cases were developed from the 2013 benchmark base case by modeling each of the five 2013 potential transmission/generation plans described in section "*Potential Transmission/Generation Alternatives*". Detailed descriptions of these base cases are provided in Table 1.

Power flow analysis was performed on each of the post-project base cases. The results of the power flow analysis were evaluated using the performance evaluation criteria described in the next section. The best two performing alternatives (or combination of alternatives) from a technical perspective were recommended for further evaluation using the 2018 power flow model. In this analysis, the two best performing alternatives were designated as Alternative 6 and Alternative 7. The detailed definition of Alternatives 6 and 7 are provided in the *Study Results* section of this report.

Base Cases	Base Case Description
Benchmark Case A	Used WECC approved 2013 heavy summer power flow model. Adjust base case to reflect forecasted 2013 heavy summer operating conditions in Cochise County
Post-Project Case A1	Developed from Benchmark Case A and models potential transmission Alternative 1
Post-Project Case A2	Developed from Benchmark Case A and models potential transmission Alternative 2
Post-Project Case A3	Developed from Benchmark Case A and models potential transmission Alternative 3
Post-Project Case A4	Developed from Benchmark Case A and models potential transmission Alternative 4
Post-Project Case A5	Developed from Benchmark Case A and models Alternative 5. The output of the 35 MW potential generation addition was scheduled to displace merchant generators in the Palo Verde generation hub.
Post-Project Case A6	Developed from Benchmark Case A and models the best performing alternative or combination of Alternatives (Alternative 6).
Post-Project Case A7	Developed from Benchmark Case A and models the second best performing alternative or combination of alternatives (Alternative 7).

Table 1: 2013 Benchmark and Post-project Base Case Description

Two 2018 benchmark cases were developed from the approved WECC 2018 heavy summer base case by modeling each of the two recommended transmission/generation Alternatives 6 and 7. These two 2018 benchmark cases are referenced as Benchmark Case 6 and Benchmark Case 7. Five post-project base cases were developed from

each of the benchmark base case 6 and 7 by modeling each of the five 2018 potential transmission plans described in section "*Potential Transmission/Generation Alternatives*". Detailed descriptions of these base cases are provided in Table 2.

Power flow analysis was performed on all of the base cases summarized in Tables 1 and 2 to determine the performance of the benchmark model and each of the potential transmission / generation plan under normal operating conditions (N-0) and single element outage (N-1) conditions.

The contingencies simulated included:

- All single 69 kV and above transmission circuit outages within Cochise County
- All single transformer outages within Cochise County, excluding transformers serving only distribution load (N-1).
- All single 69 kV and above import transmission lines into Cochise County

The study also focused on outages of the transmission sections of the individual transmission alternatives evaluated. The list of all the outages simulated is provided in Appendix D.

Base Cases	Base Case Description
Benchmark Case 6	Used WECC approved 2018 heavy summer base case and models recommended Alternative 6
Benchmark Case 7	Used WECC approved 2018 heavy summer base case and models recommended Alternative 7
Post-Project case 6A	Developed from Benchmark Case 6 and models 2018 potential transmission Alternative A
Post-Project Case 6B	Developed from Benchmark Case 6 and models 2018 potential transmission Alternative B
Post-Project Case 6C	Developed from Benchmark Case 6 and models 2018 potential transmission Alternative C
Post-Project Case 6D	Developed from Benchmark Case 6 and models 2018 potential transmission Alternative D
Post-Project Case 6E	Developed from Benchmark Case 6 and models 2018 potential transmission Alternative E
Post-Project case 7A	Developed from Benchmark Case 7 and models 2018 potential transmission Alternative A
Post-Project Case 7B	Developed from Benchmark Case 7 and models 2018 potential transmission Alternative B
Post-Project Case 7C	Developed from Benchmark Case 7 and models 2018 potential transmission Alternative C
Post-Project Case 7D	Developed from Benchmark Case 7 and models 2018 potential transmission Alternative D
Post-Project Case 7E	Developed from Benchmark Case 7 and models 2018 potential transmission Alternative E

Table 2: 2018 Benchmark and Post-project Base Case Description

PERFORMANCE EVALUATION CRITERIA

The WECC/NERC planning standards were used to assess the adequacy of the study results for both the transmission and sub-transmission systems. The power flow analysis related evaluation criteria that were used include:

- Pre-contingency 69 kV and above bus voltages must be between 0.95 per unit and 1.05 per unit.
- Maximum voltage deviation allowed at all buses under single element contingency conditions will be (+/-) 5%.
- Pre-disturbance loading to remain within continuous ratings of all equipment and line conductors
- Post-disturbance loading to remain within emergency ratings of all equipment and line conductors.

Other performance evaluation criteria used include:

- Continuity of service in Cochise County required following an outage of any 115 kV and above transmission facility.
- Manual operational procedures for this analysis are not to be utilized as a mitigation plan for contingencies that cause flows in excess of transmission facility emergency ratings.

STUDY RESULTS

Benchmark Case A

The power flow map with all transmission lines in service for the Benchmark Case A is depicted at Appendix A, Figure A1. Key findings from the power flow analysis are:

- No transmission facility overload was identified under normal operating conditions.
- Four critical outages did not initially produce power flow solution. In particular, the Adams – Boothill 115 kV line outage, the Butterfield – San Rafael 230 kV line outage, the Kartchner 115/69 kV transformer outage and the Vail – Fort. Huachuca 138 kV line outage did not result in power flow solutions. Power flow solutions were achieved for two of the four outages following the implementation of the existing (2009) manual operational procedure. The outages that resulted in a power flow solution are:
    - Adams – Boothill 115 kV line outage. Power was restored to the area affected by this outage by operating APS' 16 MW diesel powered generator and closing a normally open 69 kV line between McNeal and San Pedro.
    - Kartchner 115/69 kV transformer outage. Power was restored to the area served by this transmission line by operating the following normally open circuits as closed circuits: Keating Junction – Hawes 69 kV line and Bella Vista – Charleston 69 kV line.
    - Vail – Fort Huachuca 138 kV line outage. Approximately 18 MW of backup service to Fort Huachuca, through an automatic transfer scheme, is provided by a TEP 46 kV sub-transmission line connected to the TEP 138 kV bus at the South Loop substation. Critical Fort loads are protected by UPS and emergency generation. Subsequent operator actions would be required in coordination with the Fort to restore the balance of service. An alternative path for delivering up to 50 MW of additional back up service is planned by 2013.

Restoring power to the areas affected by the outage of the Butterfield – San Rafael 230 kV line at peak load levels was not feasible even after implementing the existing (2009) manual operational procedure.

Post-Project Case A1

The Post-project Case A1 was developed from the Benchmark Case A and modeled the transmission Alternative 1. Power flow map with all transmission lines in service is provided at Appendix A, Figure A2. The power flow analysis showed that though no transmission facility overload was identified during normal operating conditions, three transmission facility single element outages did not initially produce a power flow solution. Provided below are the outages that did not yield a power flow solution.

- Butterfield – San Rafael 230 kV line outage (power flow solution was

achieved by implementing existing manual operational procedure)

- Kartchner 115/69 kV transformer outage (power flow solution was achieved by deploying existing manual operational procedure)
- Vail – Fort Huachuca 138 kV line outage. Approximately 18 MW of backup service to Fort Huachuca, through an automatic transfer scheme, is provided by a TEP 46 kV sub-transmission line connected to the TEP 138 kV bus at the South Loop substation. Critical Fort loads are protected by UPS and emergency generation. Subsequent operator actions would be required in coordination with the Fort to restore the balance of service. An alternative path for delivering up to 50 MW of additional back up service is planned by 2013.

The study showed that to meet the ACC Order to achieve the continuity of service requirement, the following actions would be needed to augment Alternative 1 prescription:

- Operate the following normally open transmission circuits as normally closed circuits:
  - Webb – Tombstone 69 kV line
  - Charleston – Bella Vista 69 kV line
  - Keating Junction – Hawes 69 kV line
- Establish a normally open tie with automatic closing scheme between Fort Huachuca 138 kV and the proposed Buffalo Soldier 69 kV substation
- Install shunt capacitors at the following substations
  - 13.2 Mvar at Webb 69 kV substation
  - 8 Mvar at Ramsey 69 kV substation
  - 8 Mvar at Hawes 69 kV substation
  - 8 Mvar at Pueblo 69 kV substation
- Install additional 115/69 kV 50 MVA transformer at Mural.

Post-Project Case A2

Power flow map with all lines in service for this power flow model can be found at Appendix A, Figure A3. The key findings from the power flow analysis are:

- No transmission facility overload was identified under normal operating (N-0) conditions.
- Two critical single element outages (N-1) did not yield a power flow solution. The outages include:
  - Adams Tap – Boothill 115 kV line (Power flow solution was achieved by deploying existing manual operational procedure).
  - Butterfield – San Rafael 230 kV line (Power flow solution was achieved after implementing existing manual operational procedure).

To achieve continuity of service and meet the ACC Order the following actions would be needed to augment Alternative 2:

- Operate the following normally open transmission circuits as normally closed

circuits:
  - Webb – Tombstone 69 kV line
  - Charleston – Bella Vista 69 kV line
  - Keating Junction – Hawes 69 kV line
  - McNeal – San Pedro 69 kV line
- Construct a new transmission line between Palominas and Hereford
- Install shunt capacitors at the following substations
  - 13.2 Mvar at Webb 69 kV substation
  - 8 Mvar at Ramsey 69 kV substation
  - 8 Mvar at Hawes 69 kV substation
  - 8 Mvar at Pueblo 69 kV substation

Post-Project Case A3

Key findings from the power flow analysis using the Post-Project Case A3 model include:

- No transmission facility overload identified under normal (N-0) operating conditions.
- Two critical N-1 outages did not initially result in a power flow solution. These outages are:
  - Adams Tap – Boothill 115 kV line (Power flow solution was achieved by deploying existing manual operational procedure).
  - Butterfield – San Rafael 230 kV line (Power flow solution was achieved by implementing existing manual operational procedure).

To achieve continuity of service and meet the ACC Order, the following actions would be needed to augment Alternative 3 (See Appendix A, Figure A4 for power flow map of this power flow model):

- Operate the following normally open transmission circuits as normally closed circuits:
  - Webb – Tombstone 69 kV line
  - Charleston – Bella Vista 69 kV line
  - Keating Junction – Hawes 69 kV line
  - McNeal – San Pedro 69 kV line
- Construct a new 69 kV transmission line between Palominas and Hereford
- Install shunt capacitors at the following substations:
  - 13.2 Mvar at Webb 69 kV substation
  - 8 Mvar at Ramsey 69 kV substation
  - 8 Mvar at Hawes 69 kV substation
  - 8 Mvar at Pueblo 69 kV substation

Post-Project Case A4

The Post-project Case A4 was developed from the Benchmark Case A and modeled the transmission Alternative 4. Power flow map with all transmission lines in service is provided at Appendix A, Figure A5. The power flow analysis showed that though no transmission facility overload was identified during normal operating conditions, three transmission facility single element outages did not initially produce a power flow solution. Provided below are the outages that did not yield a power flow solution.

- Adams Tap – Boothill 115 kV line (Power flow solution achieved by deploying the existing manual operational procedure).
- Butterfield – San Rafael 230 kV line (Power flow solution achieved after implementing existing manual operational procedure).
- Vail – Fort Huachuca 138 kV line outage. Approximately 18 MW of backup service to Fort Huachuca, through an automatic transfer scheme, is provided by a TEP 46 kV sub-transmission line connected to the TEP 138 kV bus at the South Loop substation. Critical Fort loads are protected by UPS and emergency generation. Subsequent operator actions would be required in coordination with the Fort to restore the balance of service. An alternative path for delivering up to 50 MW of additional back up service is planned by 2013.

The study showed that to meet the ACC Order and achieve the continuity of service requirement, the following actions would be needed to augment Alternative 4 prescription:

- Operate the following normally open transmission circuits as normally closed circuits:
  - Charleston – Bella Vista 69 kV line
  - Keating Junction – Hawes 69 kV line
  - Mc Neal – San Pedro 69 kV line
- Construct a new Palominas – Hereford 69 kV line
- Establish a tie between Fort Huachuca 138 kV and the proposed Buffalo Soldier 69 kV substation
- Install shunt capacitors at the following substations
  - 13.2 Mvar at Webb 69 kV substation
  - 8 Mvar at Ramsey 69 kV substation
  - 8 Mvar at Hawes 69 kV substation
  - 8 Mvar at Pueblo 69 kV substation

Post-Project Case A5

Power flow map with all lines in service for this power flow model can be found at Appendix A, Figure A6. The key findings from the power flow analysis are:

- No transmission facility overload was identified under normal (N-0) operating

conditions.

- Three critical single element (N-1) outages did not initially result in a power flow solution. These outages are:
  - Kartchner 115/69 kV transformer (Power flow solution was achieved by deploying existing manual operational procedure).
  - Butterfield – San Rafael 230 kV line (Power flow solution was achieved after implementing existing manual operational procedure).
  - Vail – Fort Huachuca 138 kV line outage. Approximately 18 MW of backup service to Fort Huachuca, through an automatic transfer scheme, is provided by a TEP 46 kV sub-transmission line connected to the TEP 138 kV bus at the South Loop substation. Critical Fort loads are protected by UPS and emergency generation. Subsequent operator actions would be required in coordination with the Fort to restore the balance of service. An alternative path for delivering up to 50 MW of additional back up service is planned by 2013.

To achieve continuity of service and meet the ACC Order the following actions would be needed to augment Alternative 5 :

- Operate the following normally open transmission circuits as normally closed circuits:
  - Webb – Tombstone 69 kV line
  - Charleston – Bella Vista 69 kV line
  - Keating Junction – Hawes 69 kV line
  - McNeal – San Pedro 69 kV line
- Construct a new 69 kV line between Palominas and Hereford.
- Establish a normally open tie with automatic closing scheme between Ft. Huachuca 138 kV and the Proposed Buffalo Soldier 69 kV substation
- Install shunt capacitors at the following substations
  - 13.2 Mvar at Webb 69 kV substation
  - 8 Mvar at Ramsey 69 kV substation
  - 8 Mvar at Hawes 69 kV substation
  - 8 Mvar at Pueblo 69 kV substation

Recommended Alternatives for 2018 Evaluation

Following the technical analysis of the potential 2013 transmission and /or generation alternatives, it became evident that none of the alternatives met the ACC Order for the continuity of service requirements by their current proposed configuration. However, the study results showed that a combination of two or more of the potential alternatives could be structured to achieve the goal of resolving the continuity of service issue in Cochise County. Two new alternatives were therefore recommended for further analysis using 2013 power flow model. These alternatives are detailed below:

- Alternative 6 (Combines Alternatives 1, 2 and 4)
  - New Palominas – Hereford 69 kV line (2011)
  - Operate McNeal – San Pedro 69 kV as a normally closed circuit (2013)
  - Boothill 115/69 kV transformer
  - Loop Webb – Tombstone 69 kV line through Boothill
  - Proposed Fort Huachuca 138 kV – Buffalo Soldier 69 kV tie
  - Operate the following normally open circuits as normally closed circuits:
    - Charleston – Bella Vista 69 kV line
    - Keating Junction – Hawes 69 kV line
  - Install shunt capacitors at the following substations
    - 13.2 Mvar at Webb 69 kV substation
    - 8 Mvar at Ramsey 69 kV substation
    - 8 Mvar at Hawes 69 kV substation
    - 8 Mvar at Pueblo 69 kV substation

- Alternative 7 (Combines Alternatives 1, 2 and 5)
  - New Palominas – Hereford 69 kV lines
  - Operate McNeal – San Pedro 69 kV as a normally closed circuit
  - Proposed Fort Huachuca 138 kV – Buffalo Soldier 69kV tie
  - Operate the following normally open circuits as normally closed circuits:
    - Charleston – Bella Vista 69 kV line
    - Keating Junction – Hawes 69 kV line
    - Webb – Tombstone 69 kV line
  - Install shunt capacitors at the following substations
    - 13.2 Mvar at Webb 69 kV substation
    - 8 Mvar at Ramsey 69 kV substation
    - 8 Mvar at Hawes 69 kV substation
    - 8 Mvar at Pueblo 69 kV substation
  - Install 35 MW gas-fired generation at Kartchner 69 kV

Two post-project cases A6 and A7 were developed from the Benchmark Case A by modeling the recommended Alternatives 6 and 7 respectively. Power flow analysis performed on these two cases showed that both alternatives met the ACC Order for the continuity of service requirement. Power flow maps for the Post-project Case A6 and A7 are provided at Appendix A, Figure A7 and A8 respectively.

Benchmark Case 6

The Benchmark Case 6 was developed from the 2018 heavy summer power flow model and modeled recommended transmission Alternative 6. Power flow map with all transmission lines in service is provided at Appendix B, Figure B1. Key findings from the power flow analysis are:

- No transmission facility overload identified under normal (N-0) operating

conditions.

- No transmission facility overload identified under single element (N-1) contingency operations.
- Bus voltage deviation violations were identified at 11 buses under selected single element outages. Table 3 depicts the identified bus voltage deviation violations. Installing an additional 6 Mvar shunt capacitor at Webb 69 kV substation mitigates the identified voltage deviation violations.

Bus #	Bus Name	kV	Vdif	FROM	TO	kV	CKT
84821	FAIRVIEW	69	5.61	MURAL	SAN PEDRO TAP	69	1
84823	SAN PEDRO	69	5.36	MURAL	SAN PEDRO TAP	69	1
84824	SAN PEDRO TAP	69	5.36	MURAL	SAN PEDRO TAP	69	1
17020	SAN RAFAEL	230	5.18	BUTTERFIELD	SAN RAFAEL	230	1
17039	KARTCHNER	115	5.07	BUTTERFIELD	SAN RAFAEL	230	1
17544	HEREFORD TAP	69	5.05	BUTTERFIELD	SAN RAFAEL	230	1
17052	SAN RAFAEL	69	5.09	BUTTERFIELD	SAN RAFAEL	230	1
17511	HAWES	69	5.09	BUTTERFIELD	SAN RAFAEL	230	1
17525	RAMSEY	69	5.05	BUTTERFIELD	SAN RAFAEL	230	1
17526	RAMSEY TAP 1	69	5.09	BUTTERFIELD	SAN RAFAEL	230	1
17527	RAMSEY TAP 2	69	5.08	BUTTERFIELD	SAN RAFAEL	230	1

Table 3: Benchmark Case 6 N-1 Bus Voltage Deviation Violation

Benchmark Case 7

The Benchmark Case 7 was developed from the 2018 heavy summer power flow model and modeled recommended transmission Alternative 7. Power flow map with all transmission lines in service is provided at Appendix B, Figure B2. Key findings from the power flow analysis are:

- No transmission facility overload identified under normal (N-0) operating conditions.
- No transmission facility overload identified under single element (N-1) contingency operations.
- No bus voltage deviation violation identified.

Study Results for Potential 2018 Transmission Alternatives

The power flow results for the potential 2018 transmission alternatives are summarized in Table 4 below.

2018 Post-Project Cases	N-0 Overload	N-1 Overload	Bus Voltage Deviation Violations	Comments
Post-Project Case 6A	None	None	6 buses	See Appendix B, Figure B3 for power flow map
Post-Project Case 6B	None	None	3 buses	See Appendix B, Figure B4 for power flow map
Post-project Case 6C	None	None	7 buses	See Appendix B, Figure B5 for power flow map
Post-Project Case 6D	None	None	4 buses	See Appendix B, Figure B6 for power flow map
Post-Project Case 6E	None	None	5 buses	See Appendix B, Figure B7 for power flow map
Post-Project Case 7A	None	None	None	See Appendix B, Figure B8 for power flow map
Post-Project Case 7B	None	None	3 buses	See Appendix B, Figure B9 for power flow map
Post-project Case 7C	None	None	5 buses	See Appendix B, Figure B10 for power flow map
Post-Project Case 7D	None	None	None	See Appendix B, Figure B11for power flow map
Post-Project Case 7E	None	None	5 buses	See Appendix B, Figure B12 for power flow map

Table 4: Summary of Power Flow Analysis Results for 2018 Potential Transmission Alternatives

RECOMMENDATION

After a thorough technical analysis of the different potential transmission/generation alternatives proposed for resolving the electric reliability issue in Cochise County, it became apparent that a combination of two or more initial alternatives would be needed to fully resolve the reliability issue. The recommended transmission plan has been tested and has been found to be technically capable of meeting the ACC Order to ensure continuity of service in Cochise County in both 2013 and 2018 (See Appendix C for power flow maps of critical outages). The recommended transmission plan (Alternative 6) is detailed below:

- New Palominas – Hereford 69 kV line
- Operate McNeal – San Pedro 69 kV as a normally closed circuit
- Boothill 115/69 kV transformer
- Loop Webb – Tombstone 69 kV line through Boothill
- Proposed Fort Huachuca 138 kV – Buffalo Soldier 69 kV tie
- Operate the following normally open circuits as normally closed circuits:
    - Charleston – Bella Vista 69 kV line
    - Keating Junction – Hawes 69 kV line
- Install shunt capacitors at the following substations
    - 13.2 Mvar at Webb 69 kV substation
    - 8 Mvar at Ramsey 69 kV substation
    - 8 Mvar at Hawes 69 kV substation
    - 8 Mvar at Pueblo 69 kV substation
    - 6 Mvar at Webb 69 kV substation (year 2018)

While some components of the recommended transmission plan are existing transmission facilities which only have to be operated differently, others are transmission projects under consideration by some of the load serving entities in Cochise County. For example, APS has plans to construct a new 69 kV line from Palominas to Hereford in 2011. Also, the Fort has requested that SSVEC to construct a 69 kV substation at Buffalo Soldier for reliability purposes in order to serve the Fort's loads under an extreme single element outage condition.

An analysis of the recommended transmission plan showed that it is capable of serving up to 380 MW of load in Cochise County. Forecasted Cochise County demand in 2018 is 348 MW.

APPENDIX A: 2013 Model Power Flow Maps

Figure A1: Power Flow Map— 2013 Benchmark Case A (All lines-in-service)

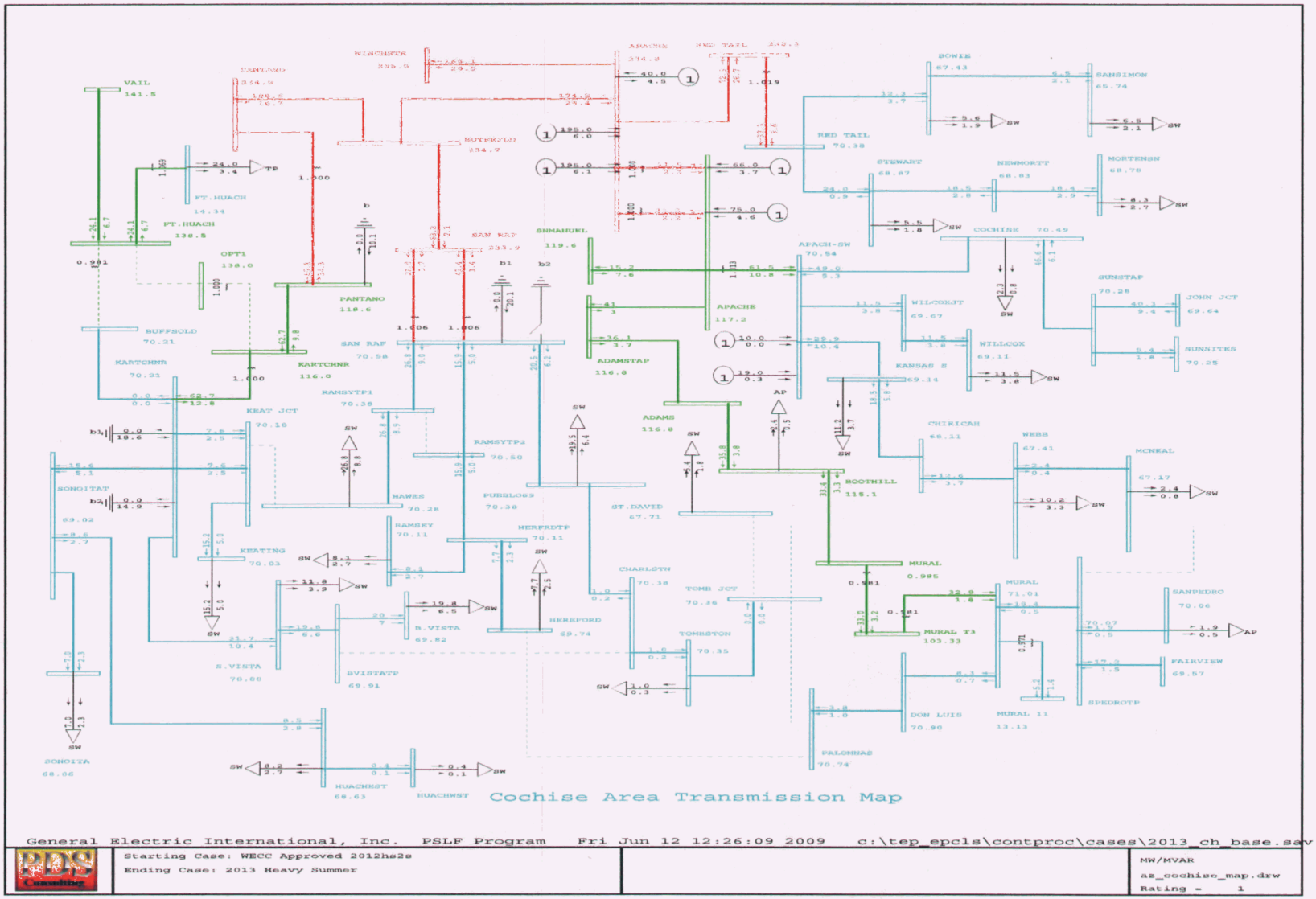


Figure A2: Power Flow Map—2013 Post-Project Case A1 (All lines-in-service)

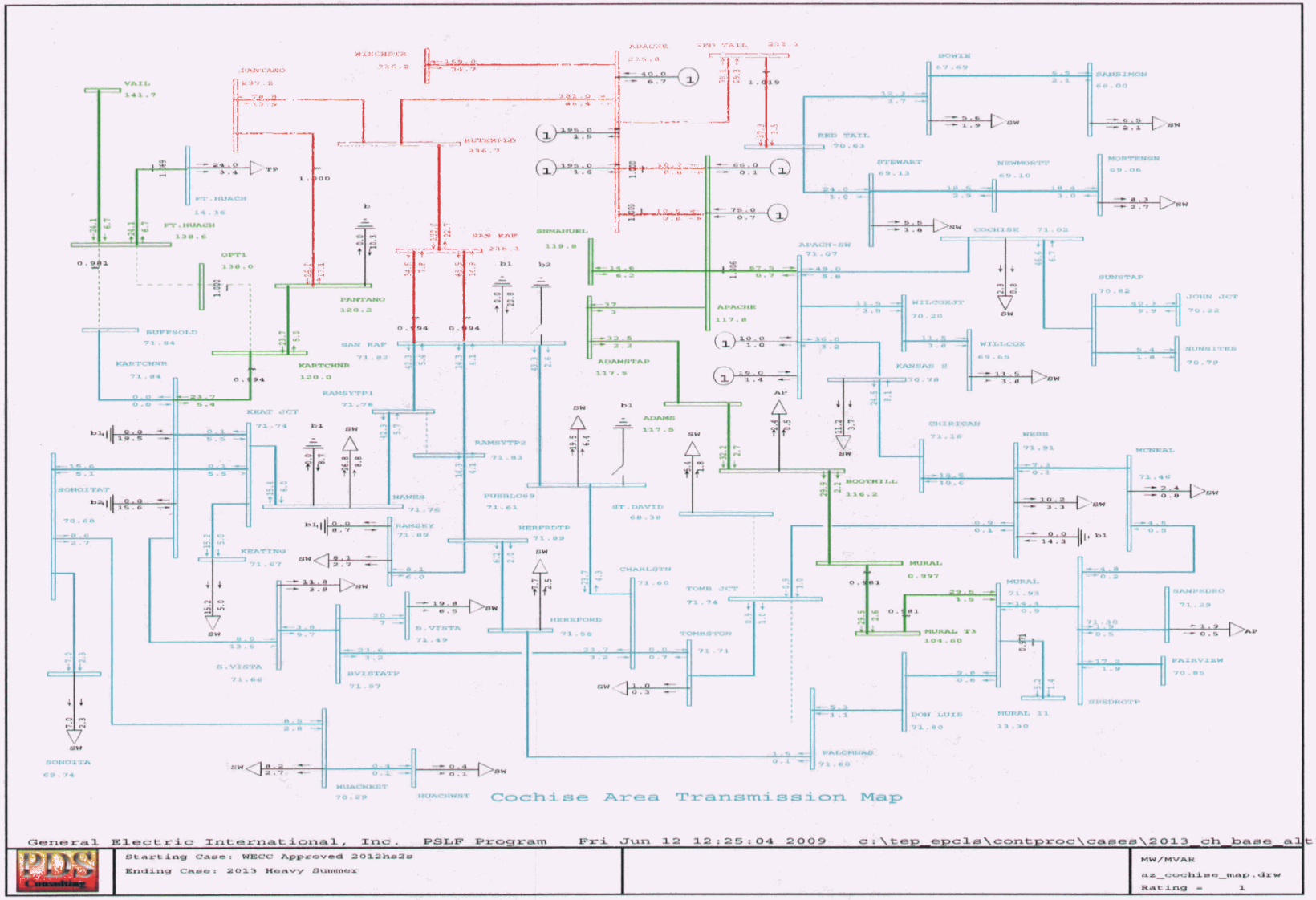


Figure A3: Power Flow Map—2013 Post-Project Case 2 (All lines-in-service)

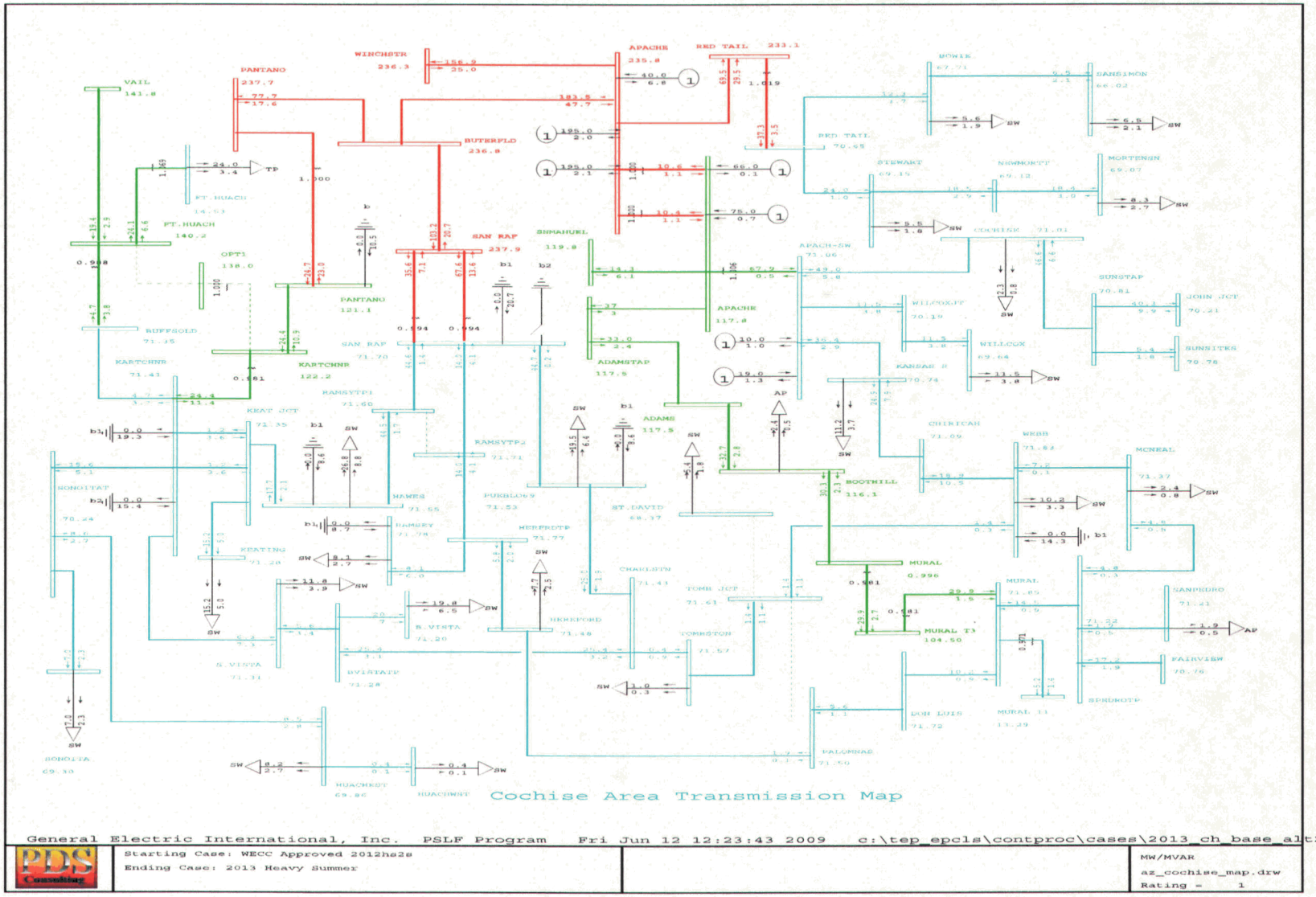


Figure A4: Power Flow Map—2013 Post- Project Case A3 (All lines-in-service)

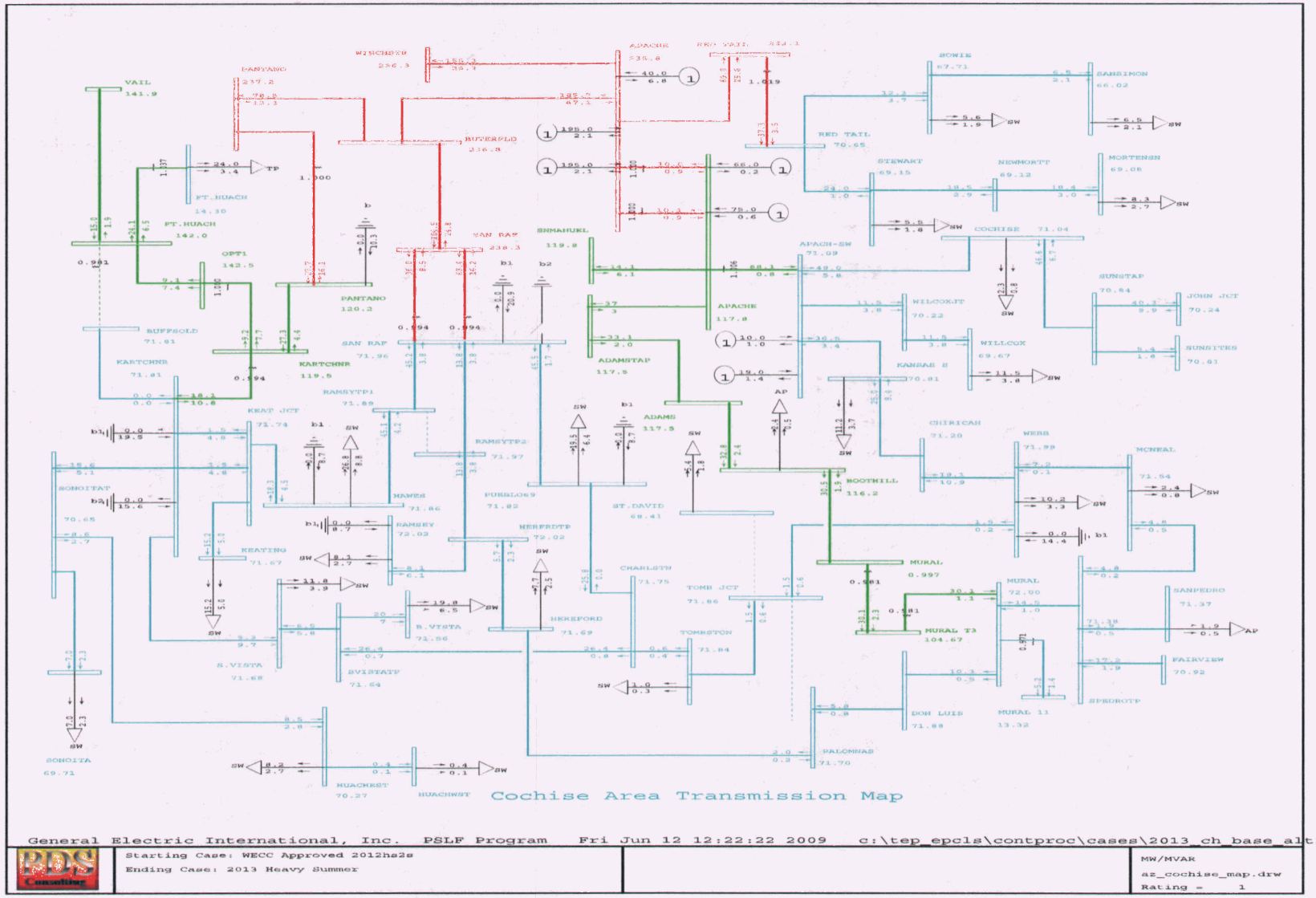


Figure A5: Power Flow Map—2013 Post-Project Case A4 (All lines-in-service)

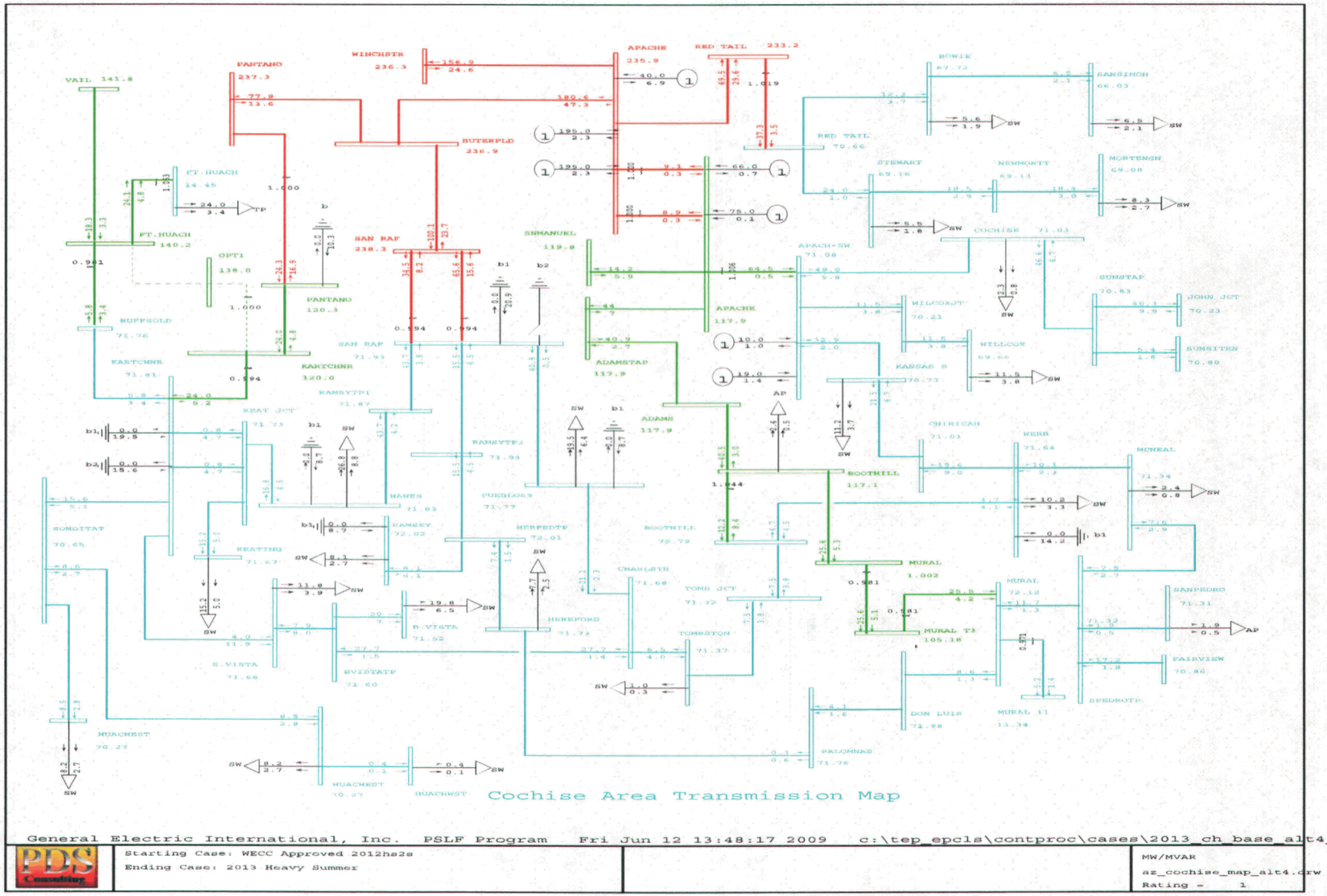


Figure A6: Power Flow Map—2013 Post-Project Case A5 (All lines-in-service)

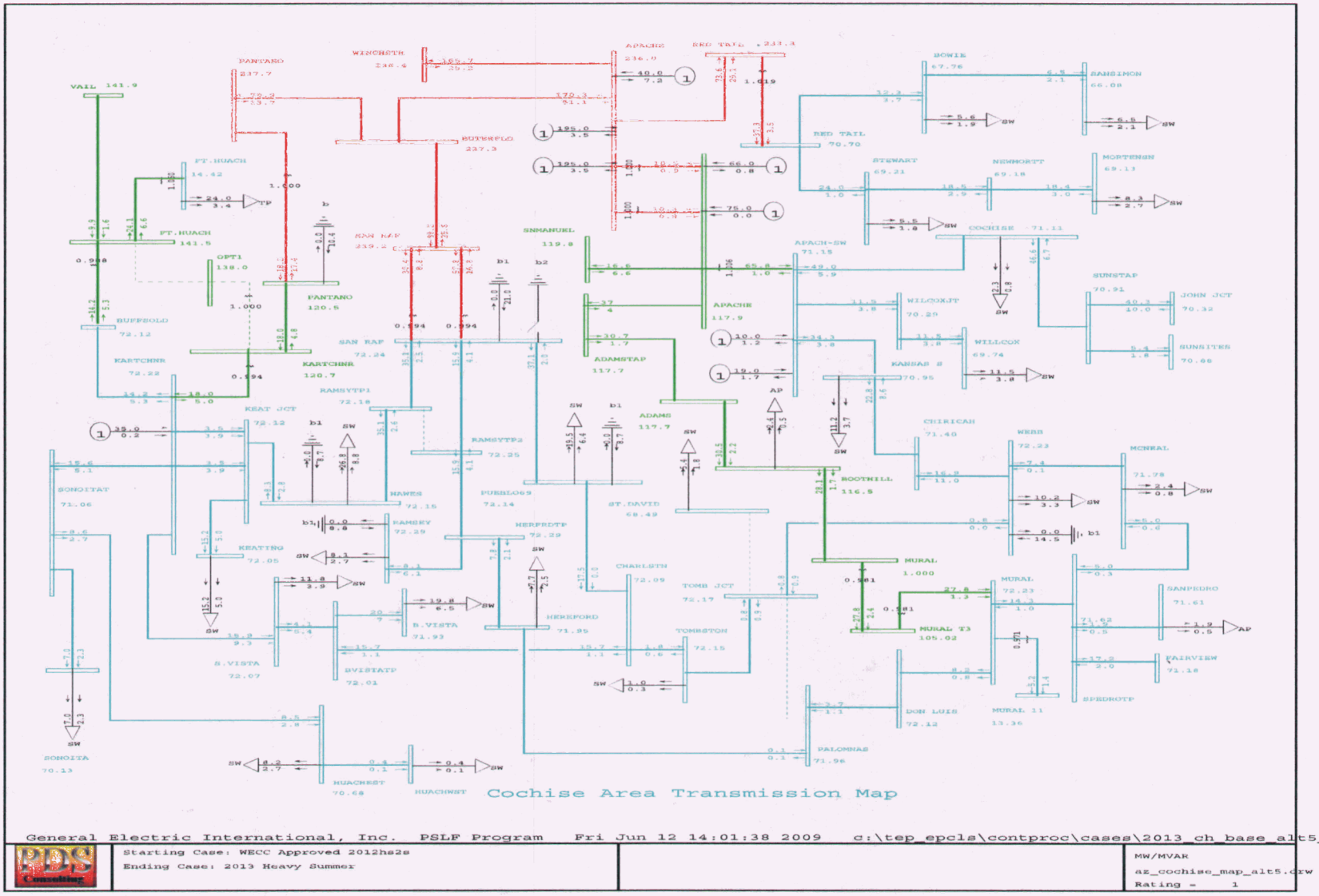


Figure A7: Power Flow Map—2013 Post-Project Case A6 (All lines-in-service)

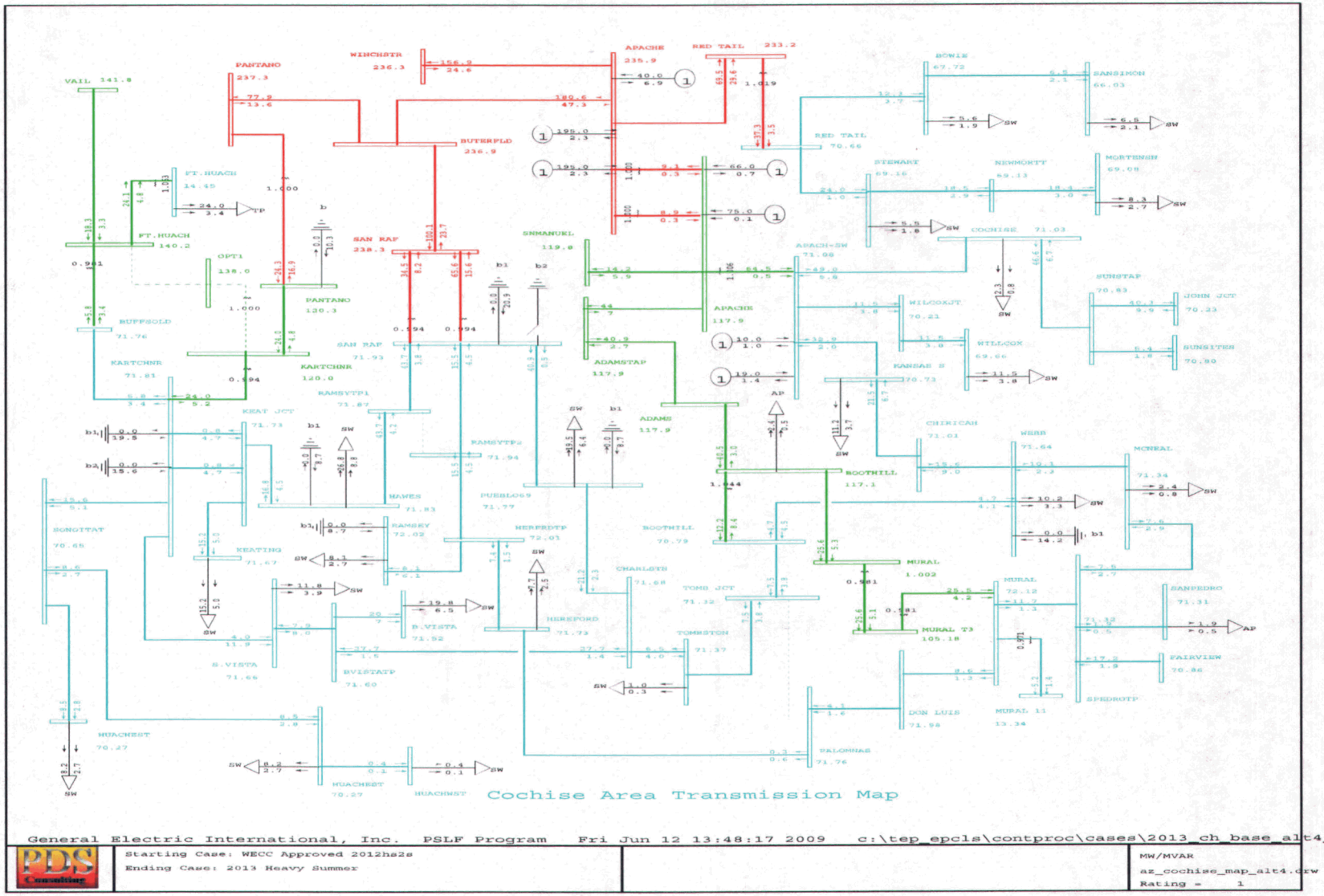
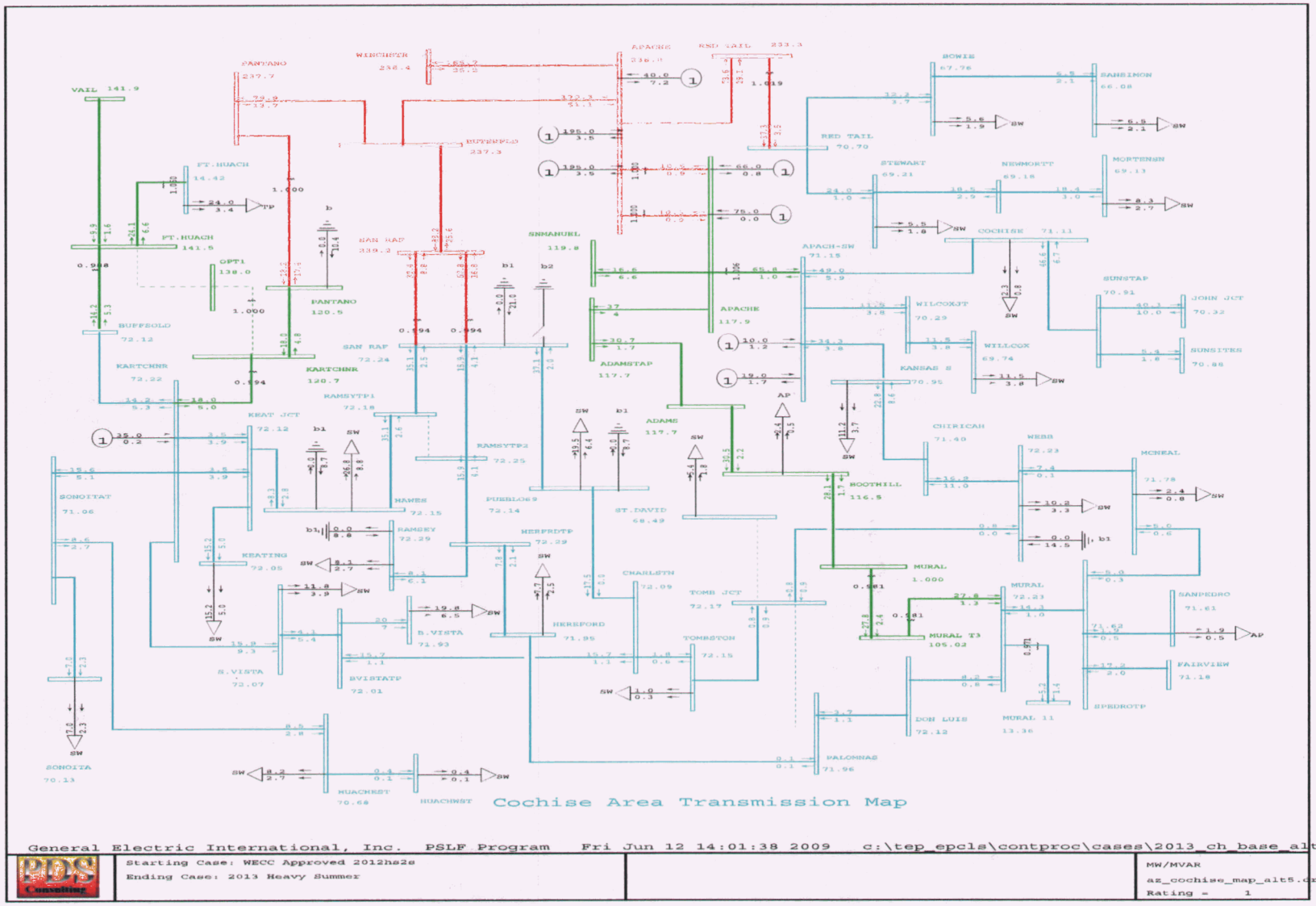


Figure A8: Power Flow Map—2013 Post-Project Case A7 (All lines-in-service)



APPENDIX B: 2018 Model Power Flow Maps

Figure B1: Power Flow Map— 2018 Benchmark Case 6 (All lines-in-service)

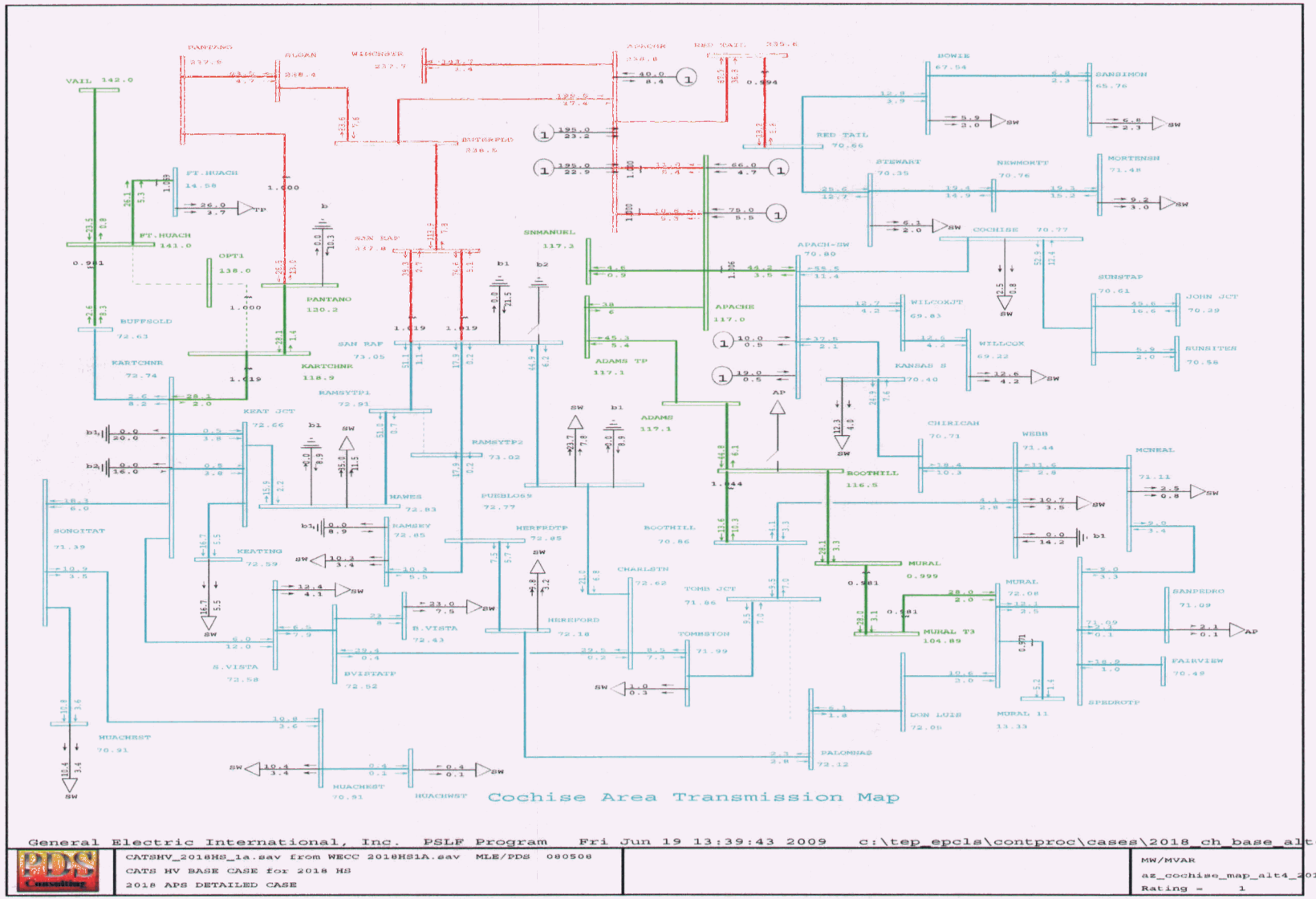


Figure B2: Power Flow Map— 2018 Benchmark Case 7 (All lines-in-service)

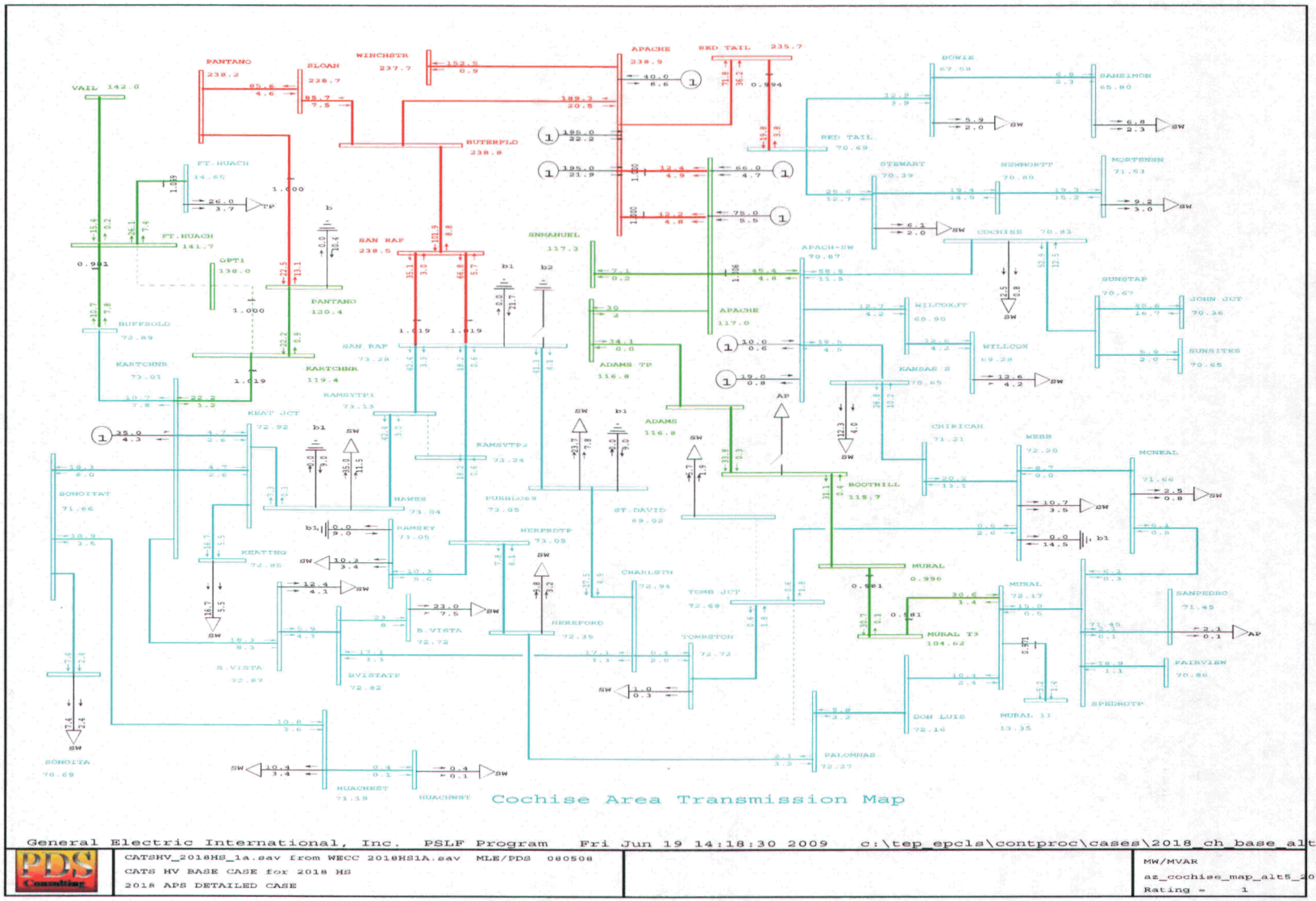


Figure B3: Power Flow Map— 2018 Post-Project Case 6A (All lines-in-service)

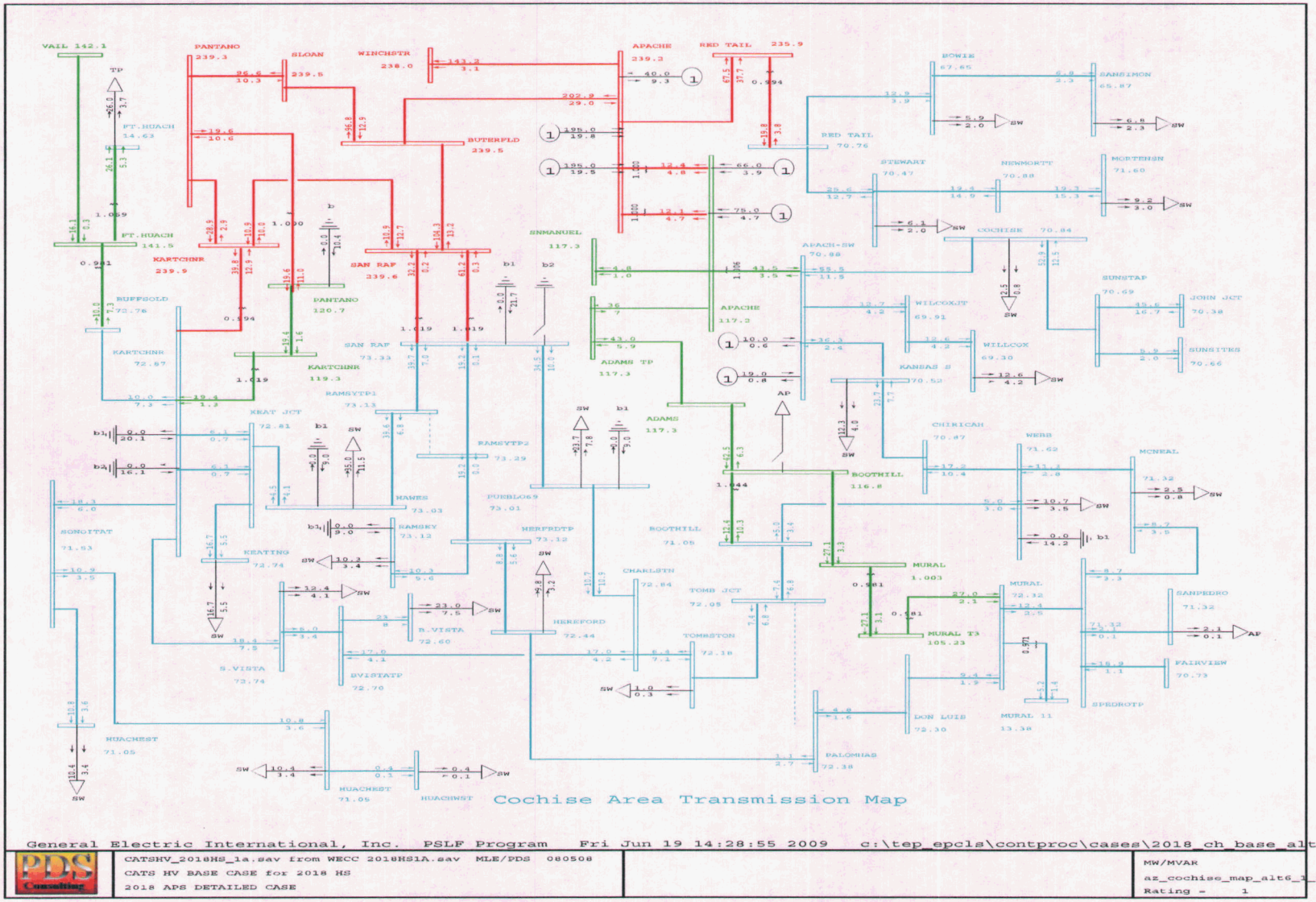


Figure B4: Power Flow Map— 2018 Post-Project Case 6B (All lines-in-service)

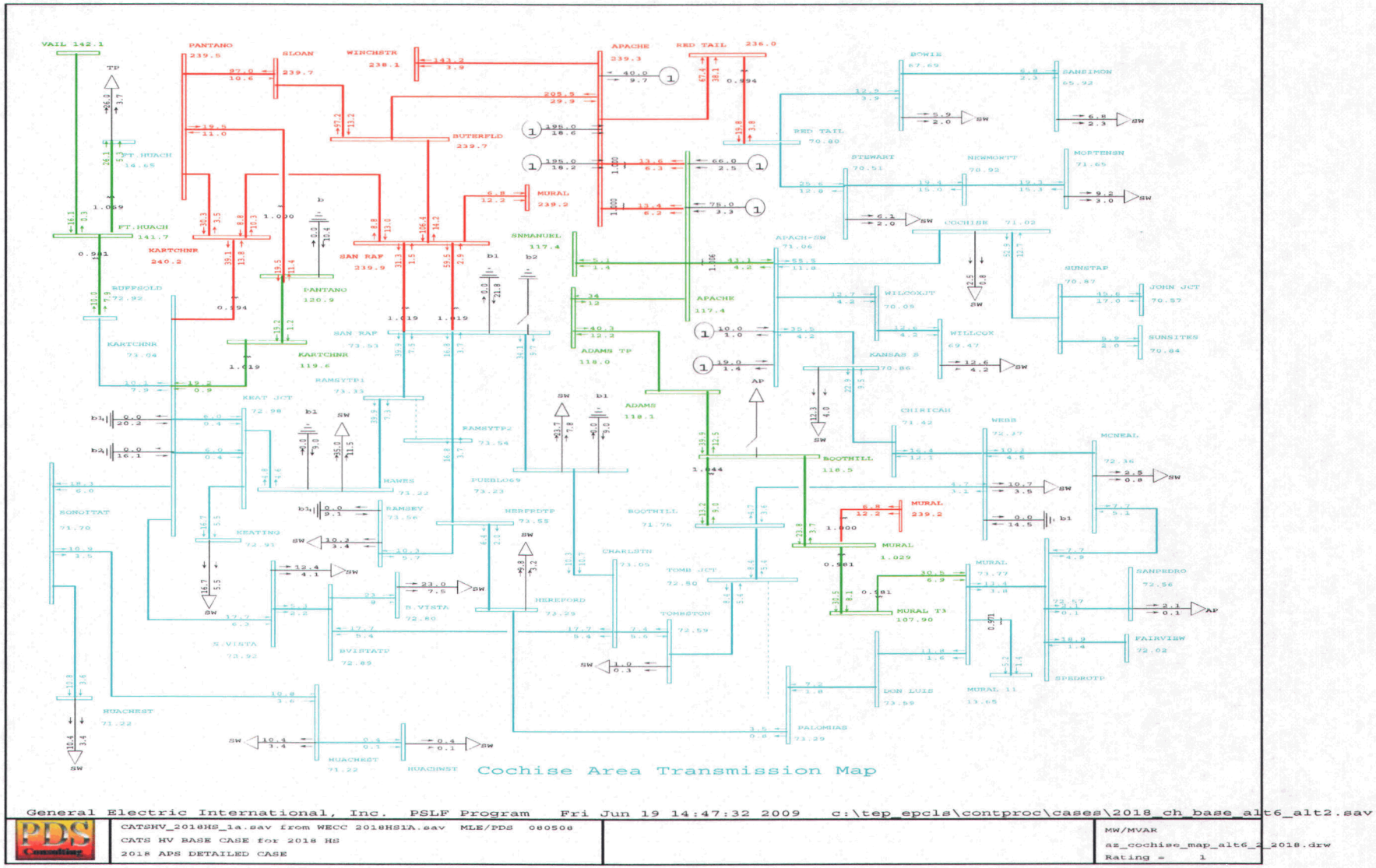


Figure B5: Power Flow Map— 2018 Post-Project Case 6C (All lines-in-service)

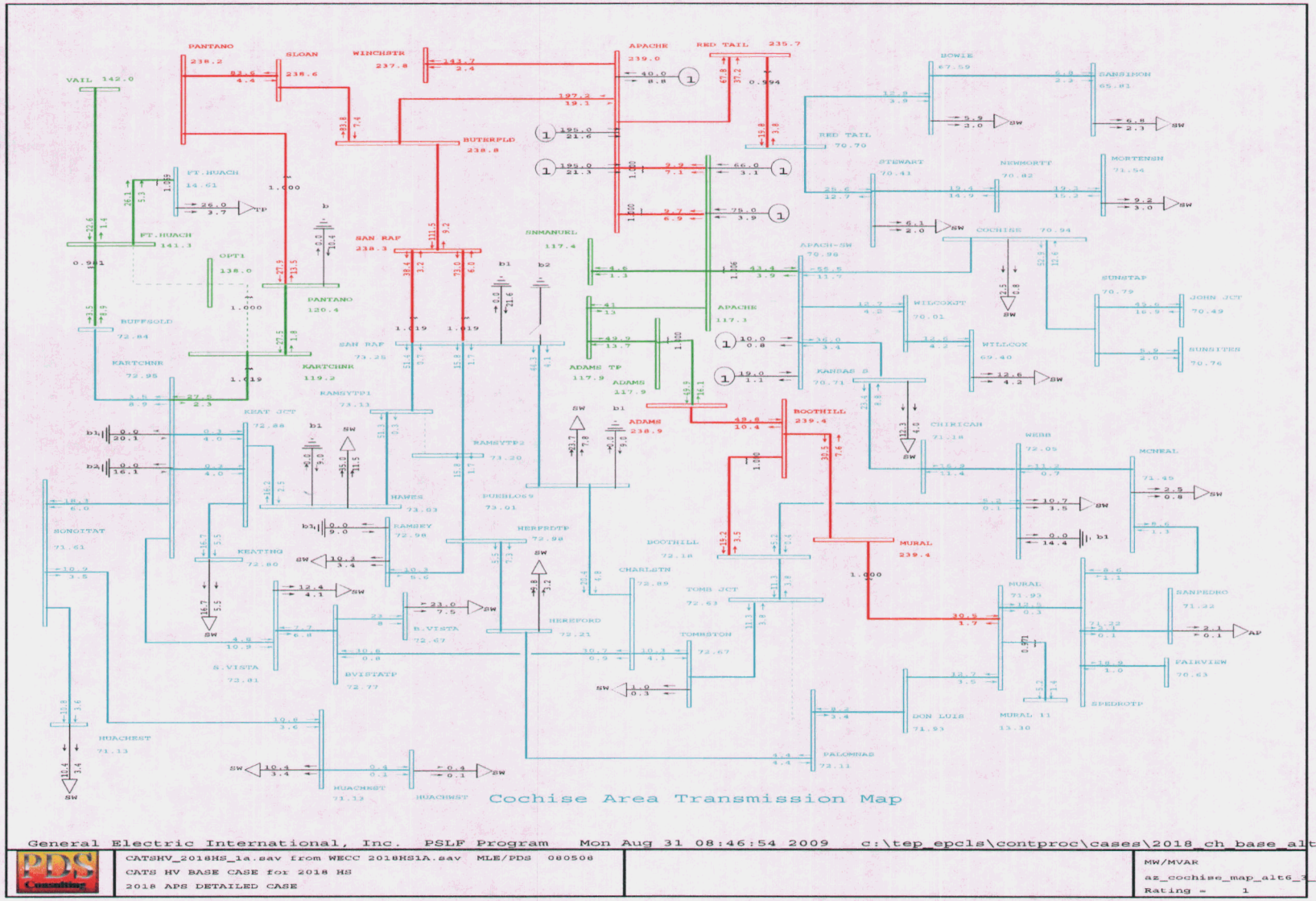


Figure B6: Power Flow Map— 2018 Post-Project Case 6D (All lines-in-service)

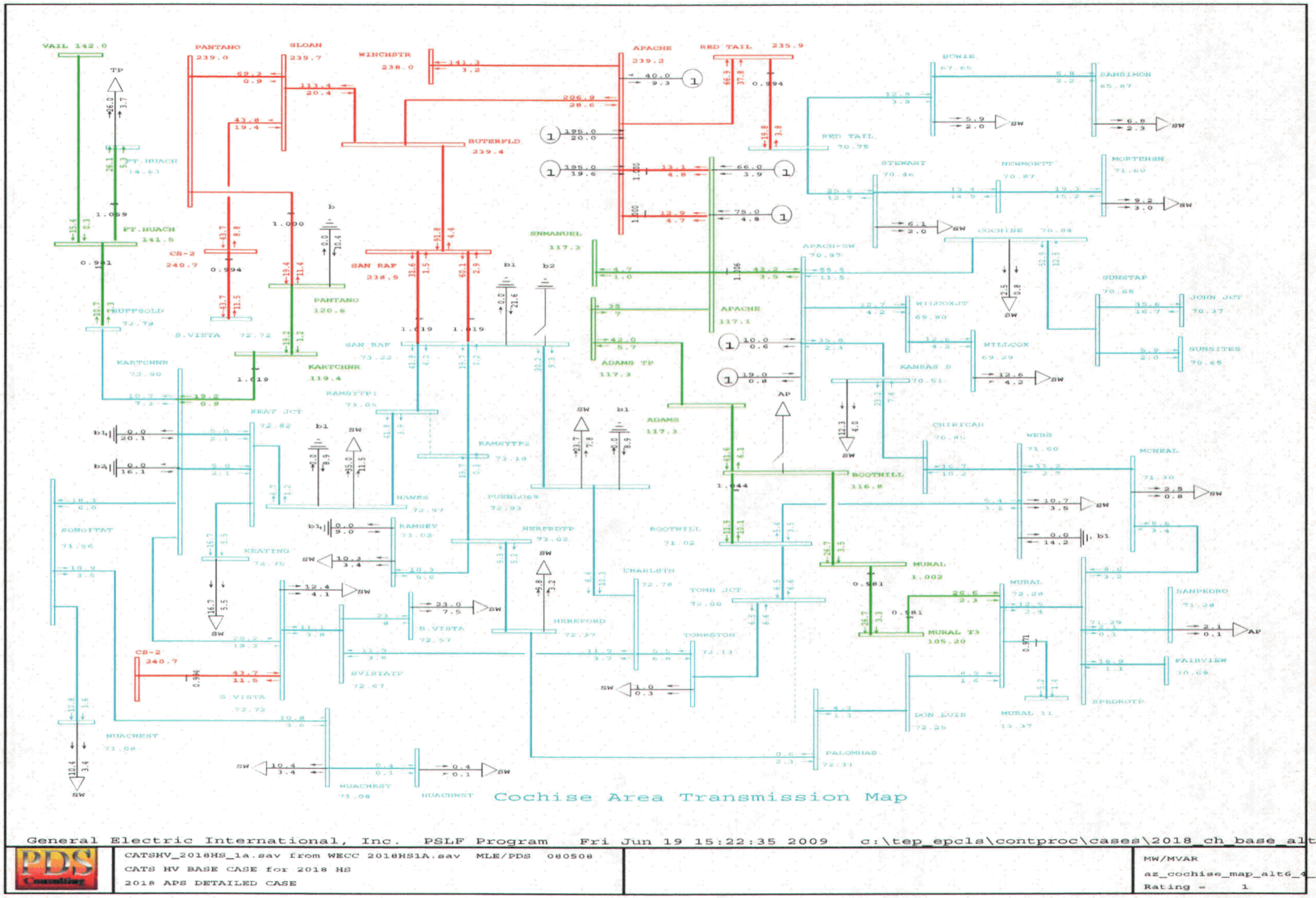


Figure B7: Power Flow Map— 2018 Post-Project Case 6E (All lines-in-service)

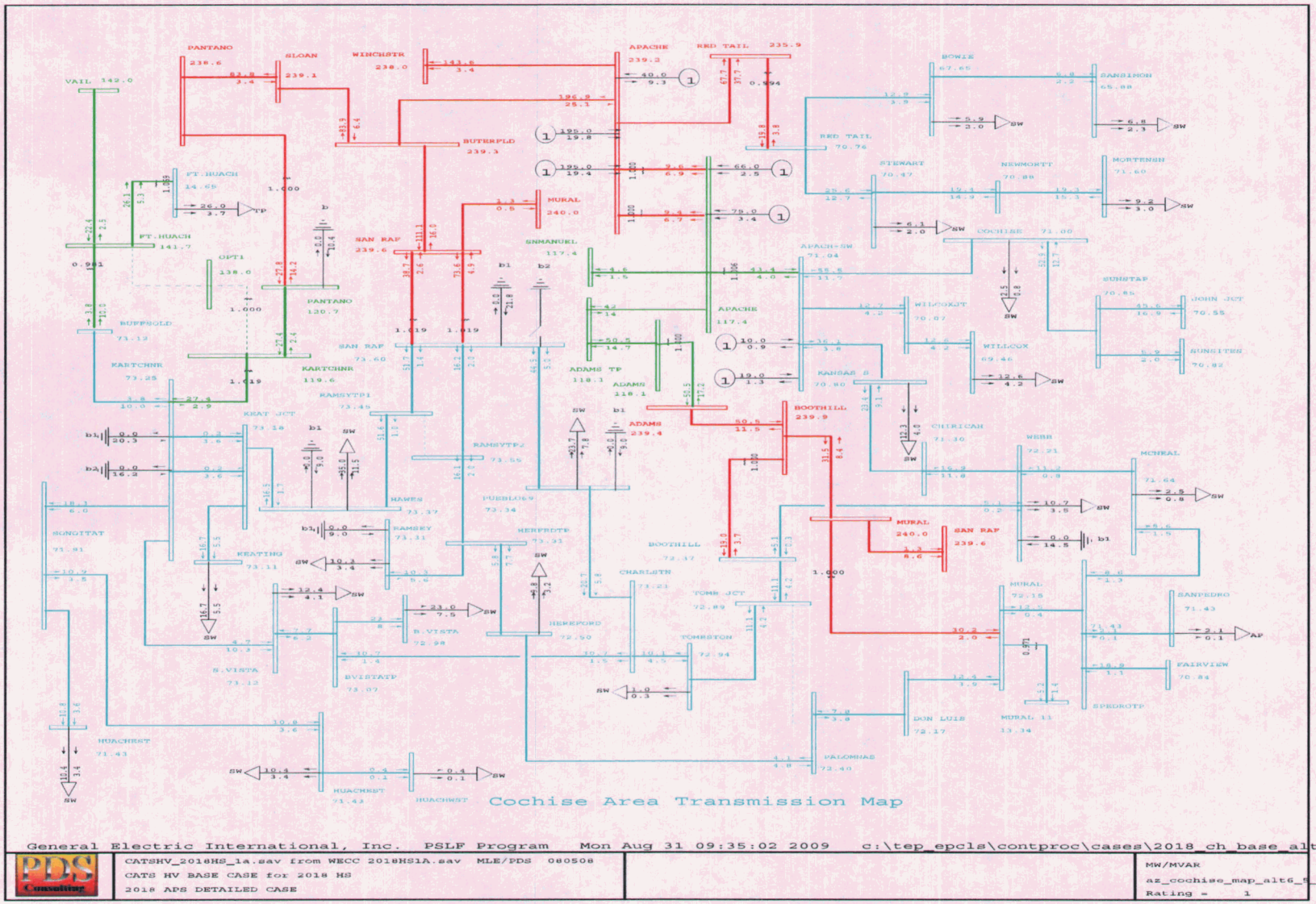


Figure B8: Power Flow Map— 2018 Post-Project Case 7A (All lines-in-service)

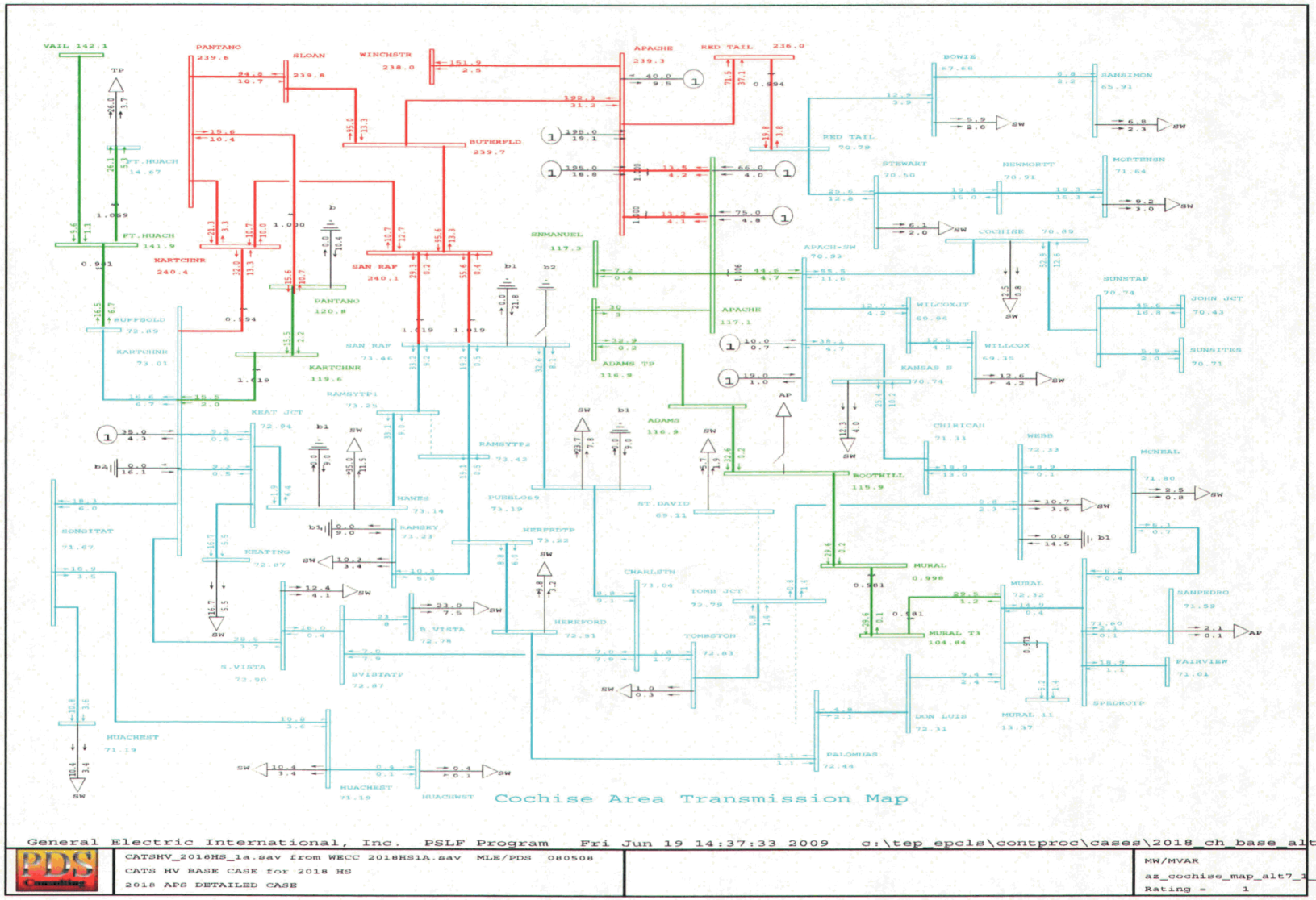


Figure B9: Power Flow Map— 2018 Post-Project Case 7B (All lines-in-service)

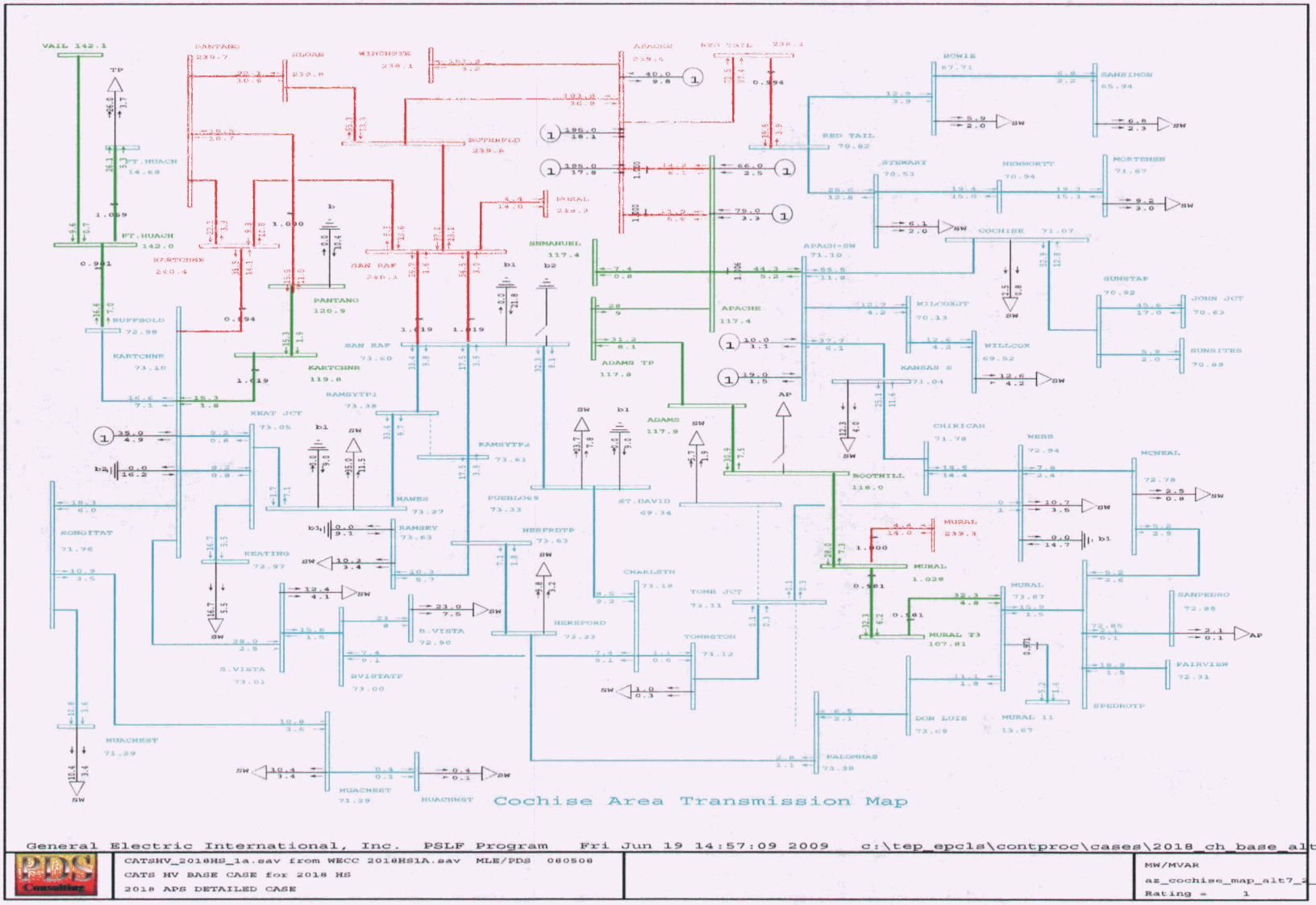


Figure B10: Power Flow Map— 2018 Post-Project Case 7C (All lines-in-service)

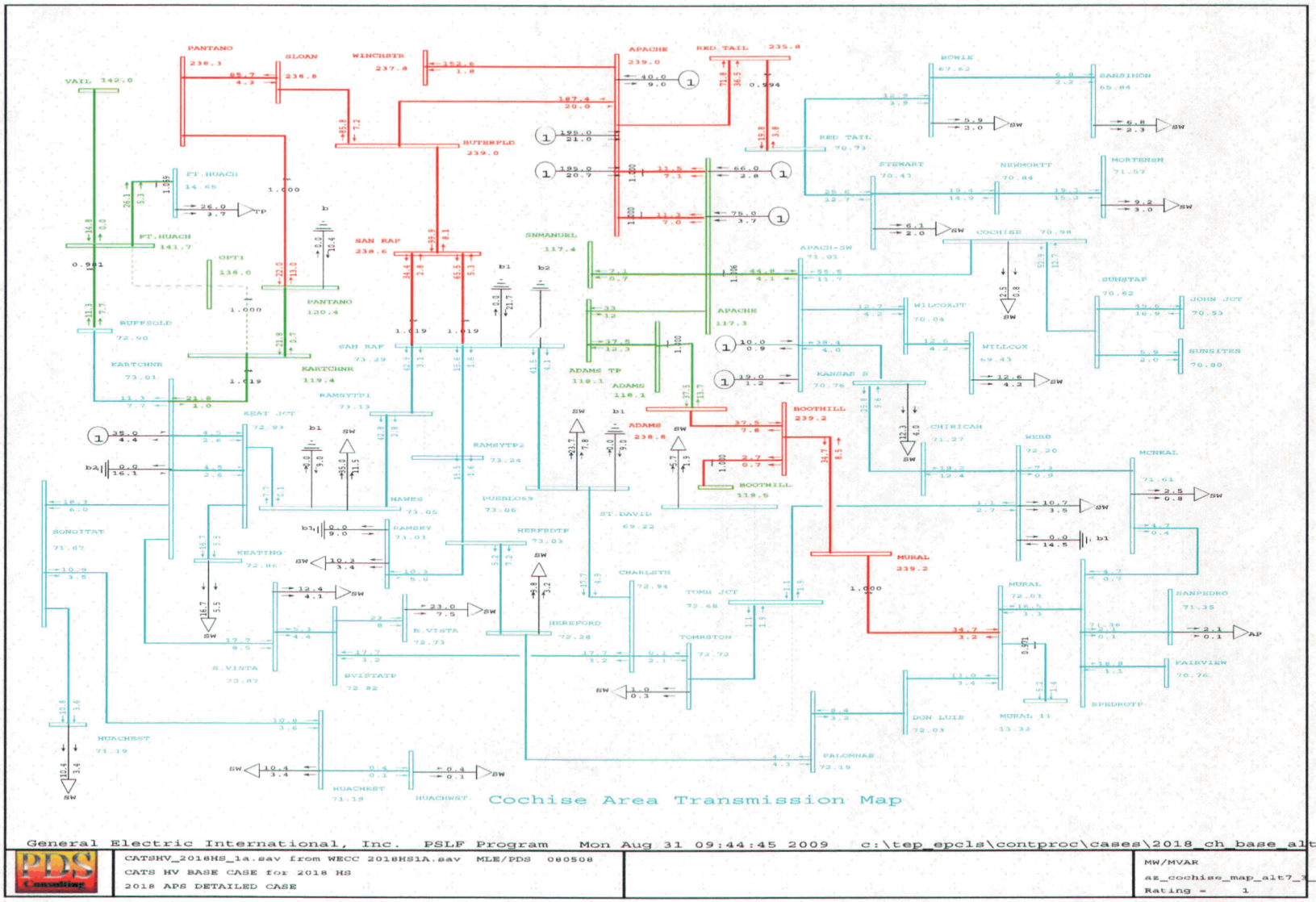


Figure B11: Power Flow Map— 2018 Post-Project Case 7D (All lines-in-service)

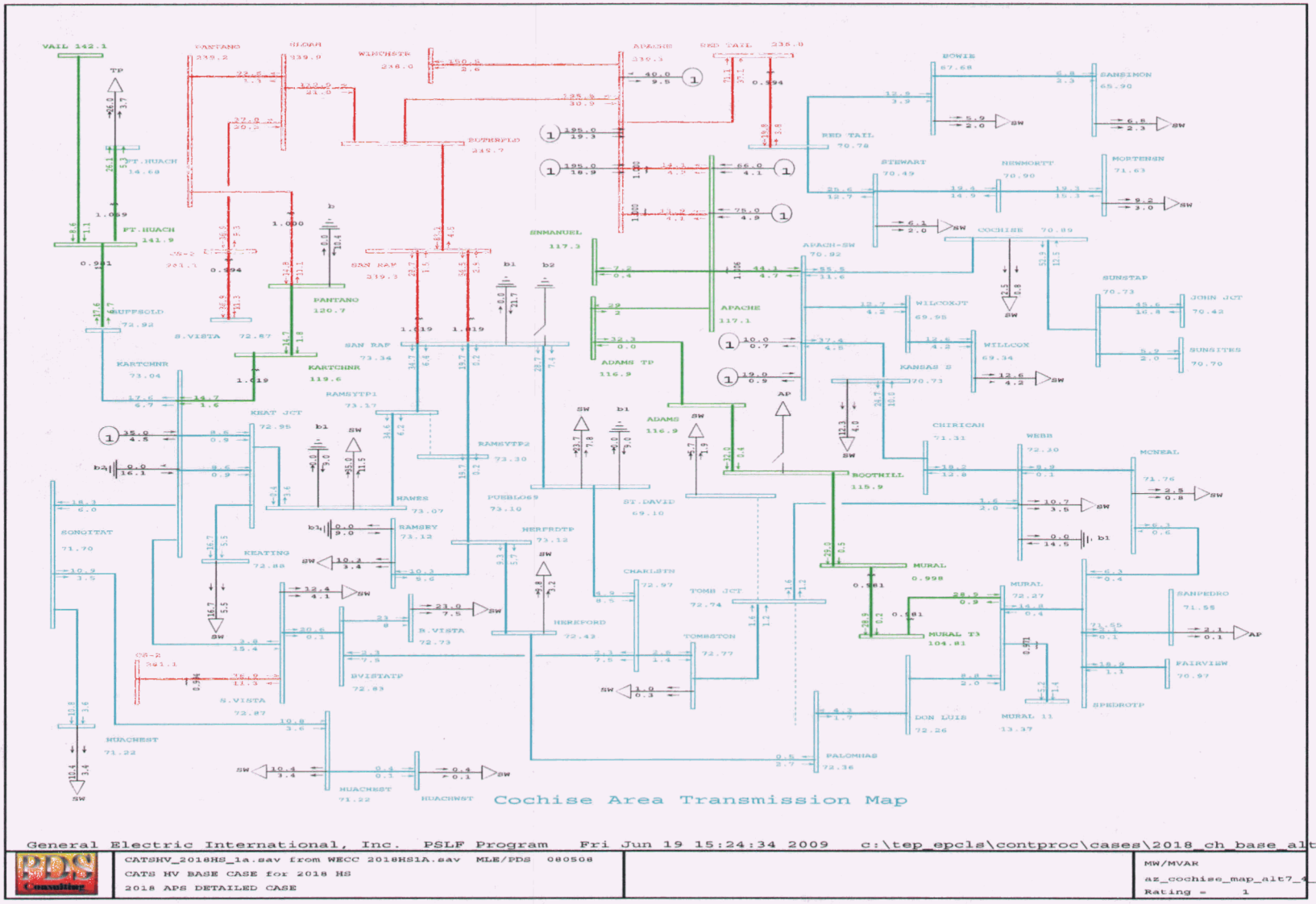
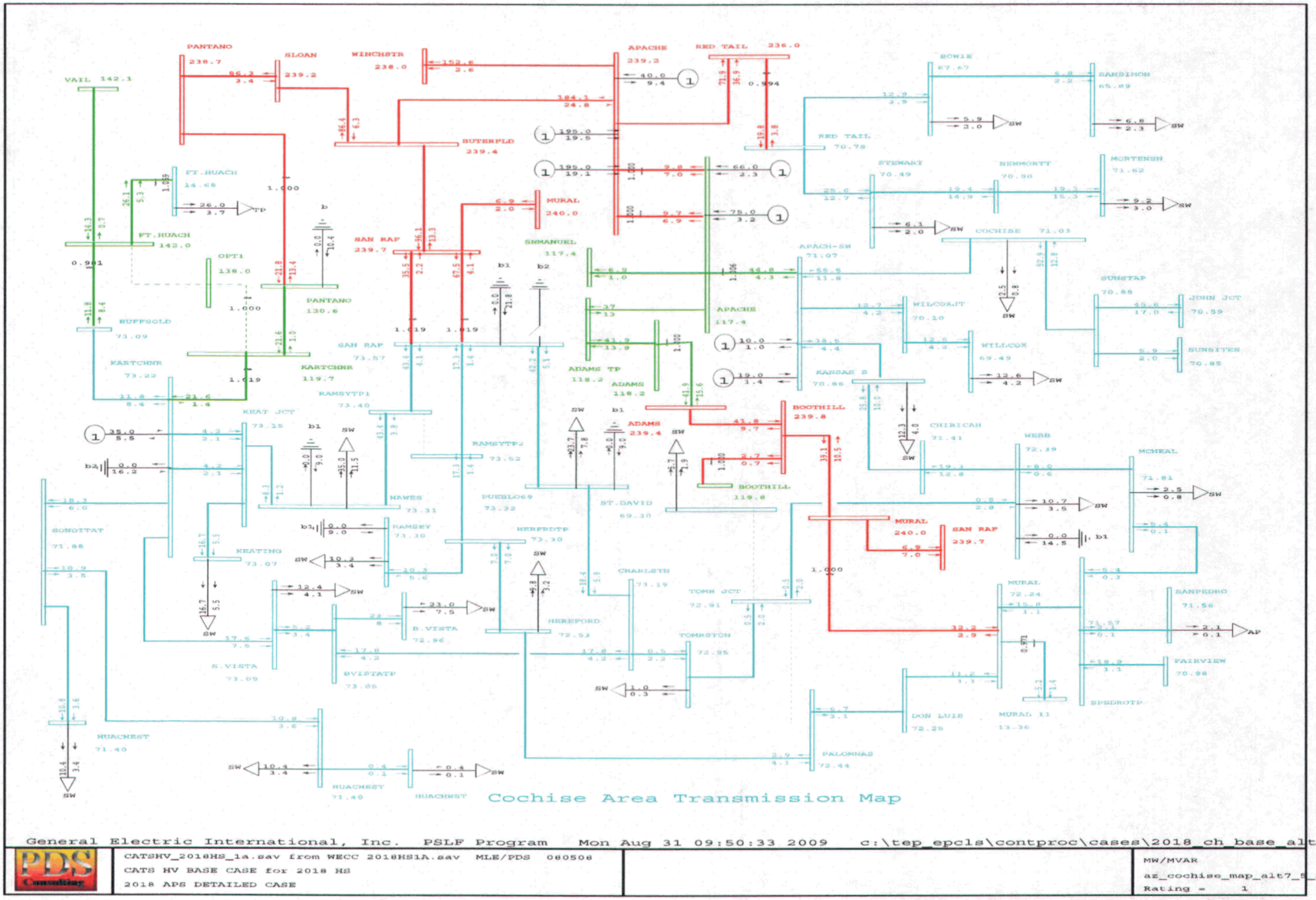


Figure B12: Power Flow Map— 2018 Post-Project Case 7E (All lines-in-service)



APPENDIX C: Power Flow Maps—Recommended Transmission Plan

Figure C1: Power Flow Map— 2013 Post-Project Case 6 (All Lines in Service)

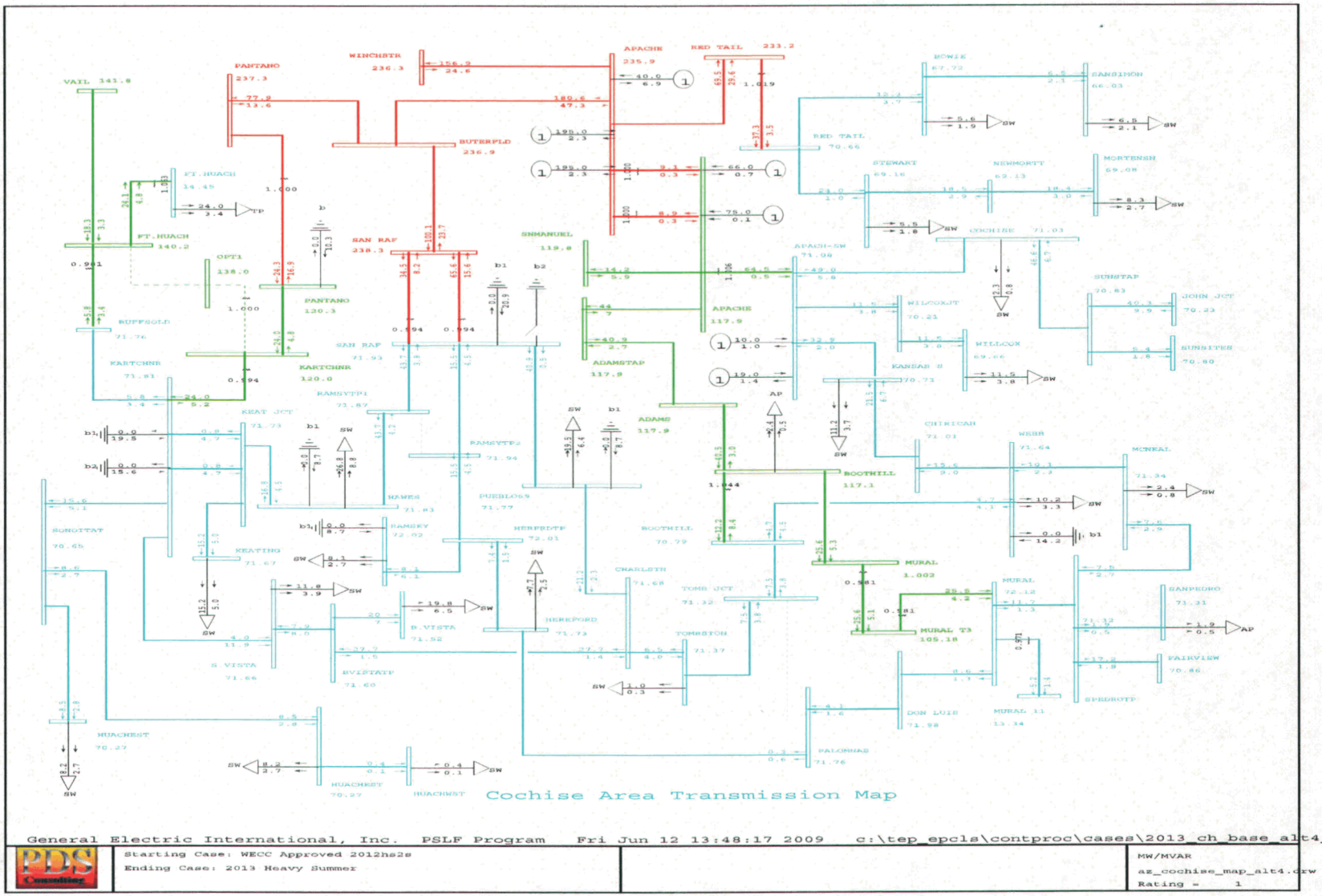


Figure C2: Power Flow Map— 2013 Post-Project Case 6 (Adams- Boothill 115 kV line outage)

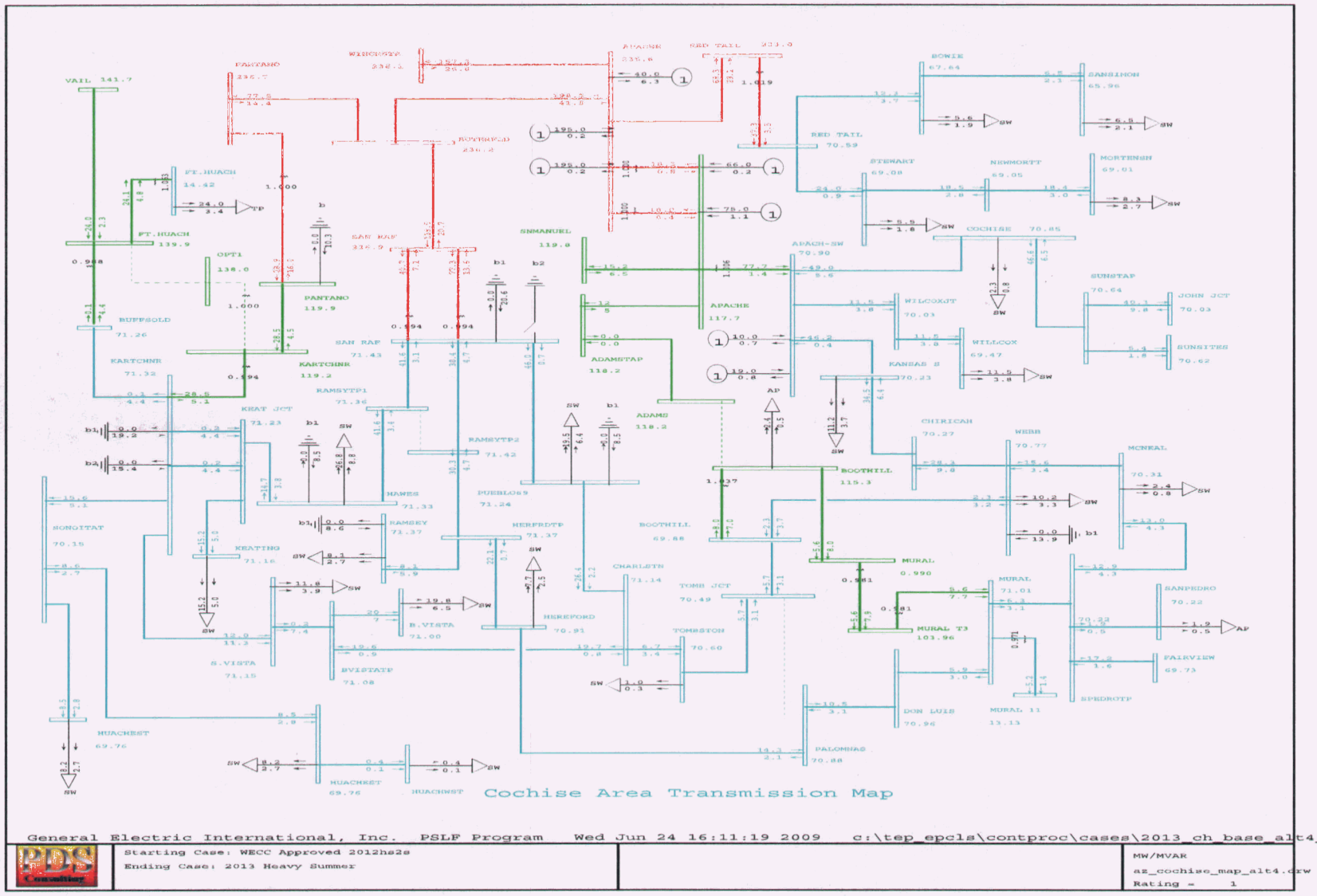


Figure C3: Power Flow Map— 2013 Post-Project Case 6 (Butterfield- San Rafael 230 kV line outage)

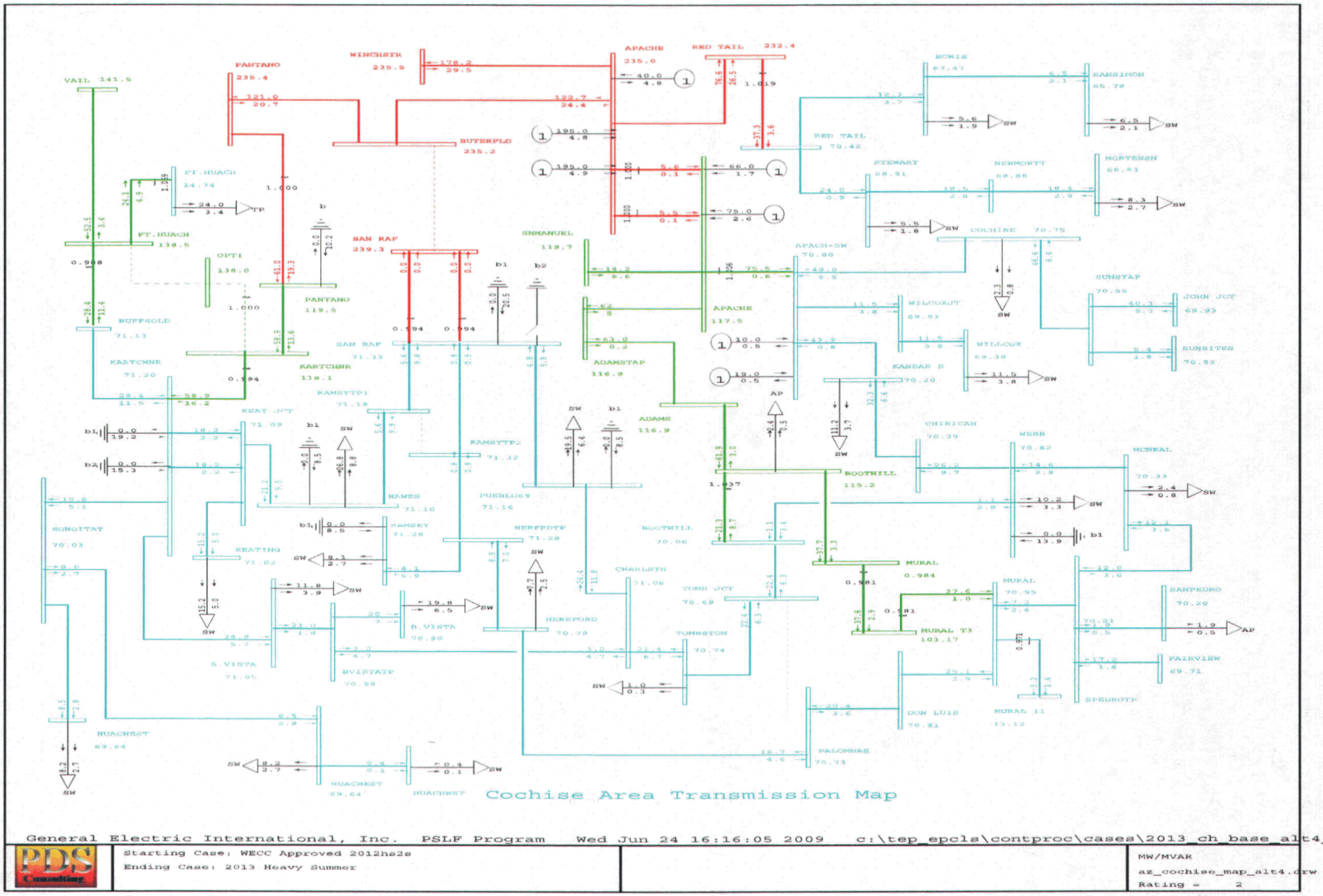


Figure C4: Power Flow Map— 2013 Post-Project Case 6 (Kartchner 115/69 kV transformer outage)

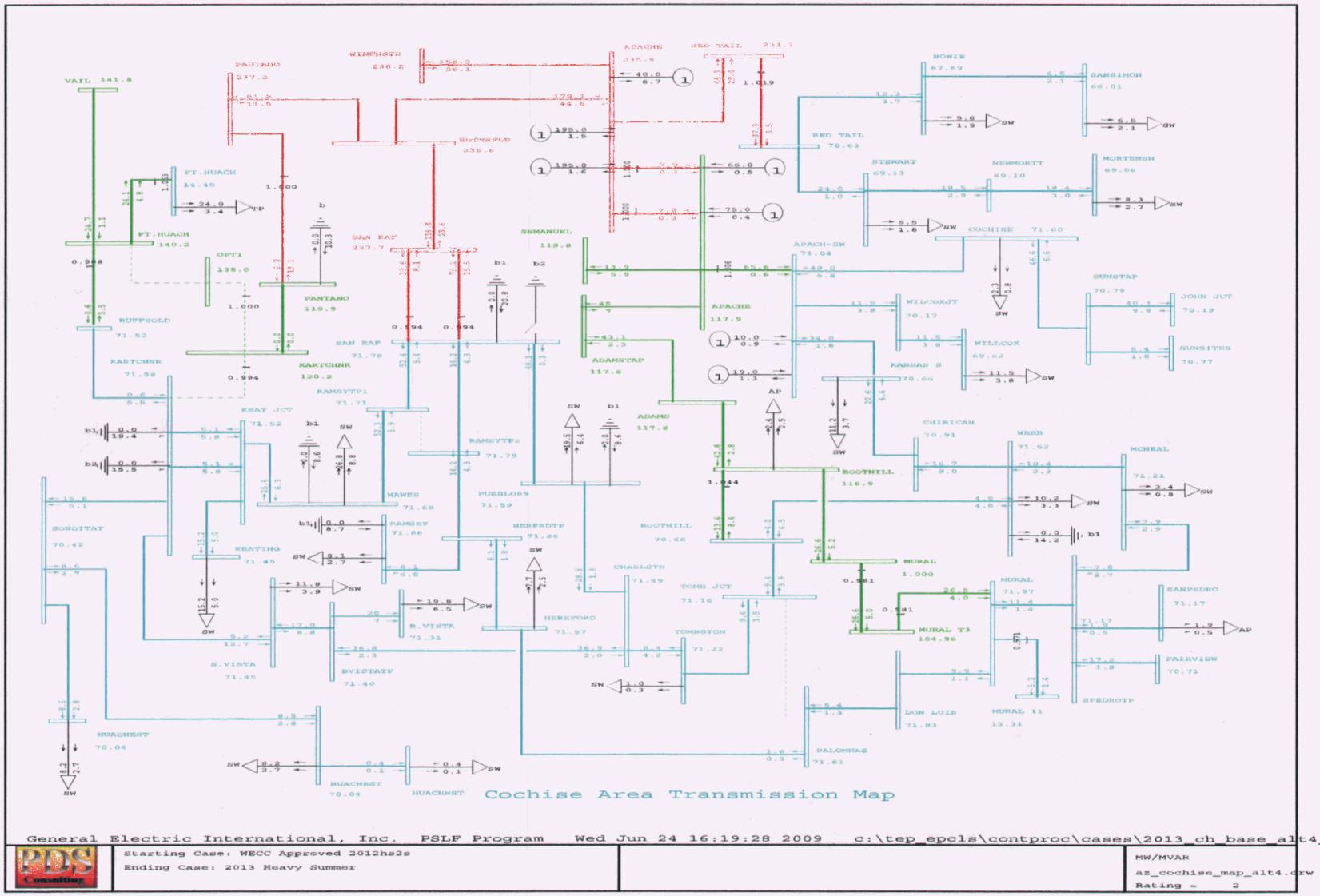


Figure C5: Power Flow Map— 2013 Post-Project Case 6 (Vail-Fort Huachuca 138 kV line outage)

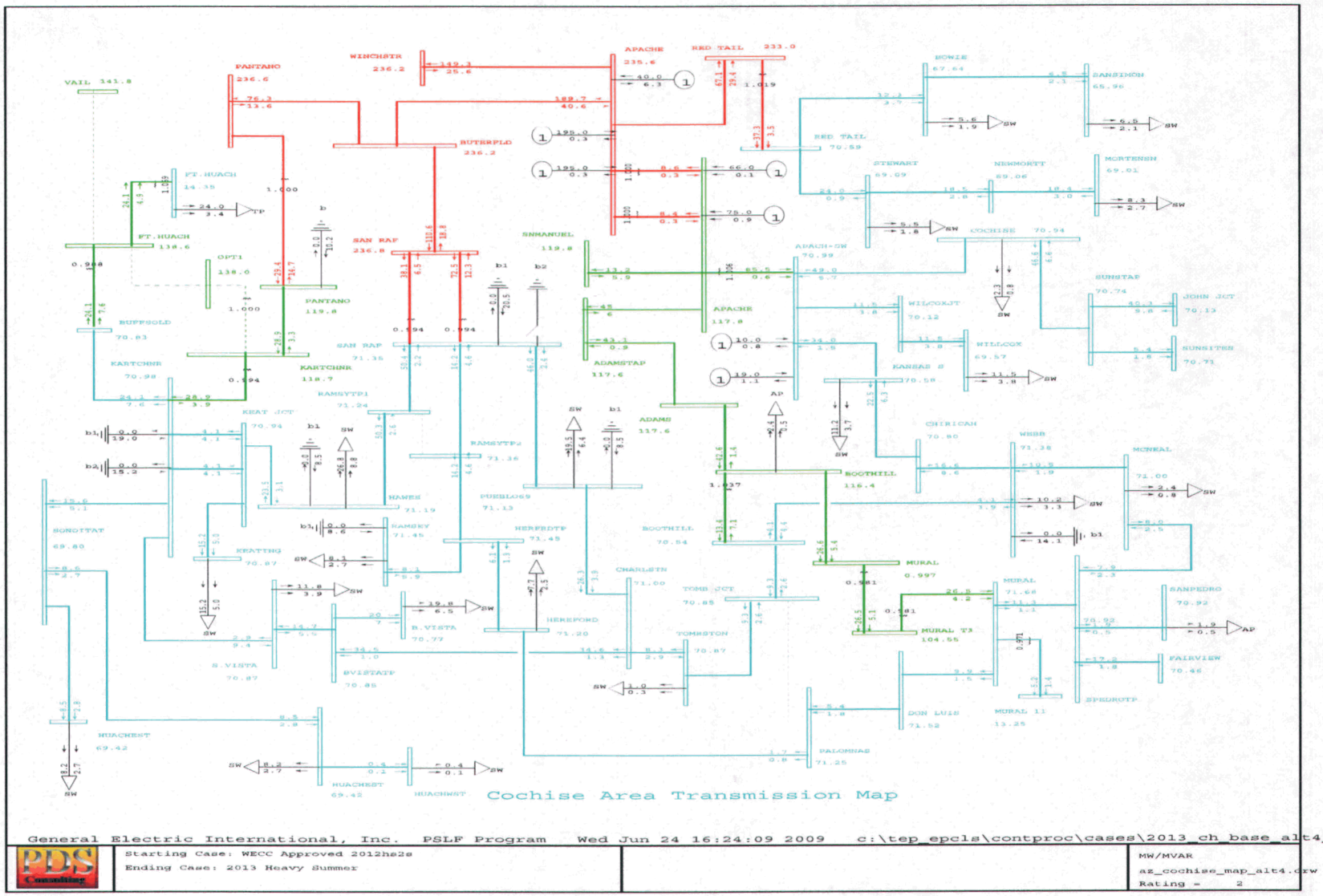


Figure C6: Power Flow Map— 2018 Benchmark Case 6 (All Lines in Service)

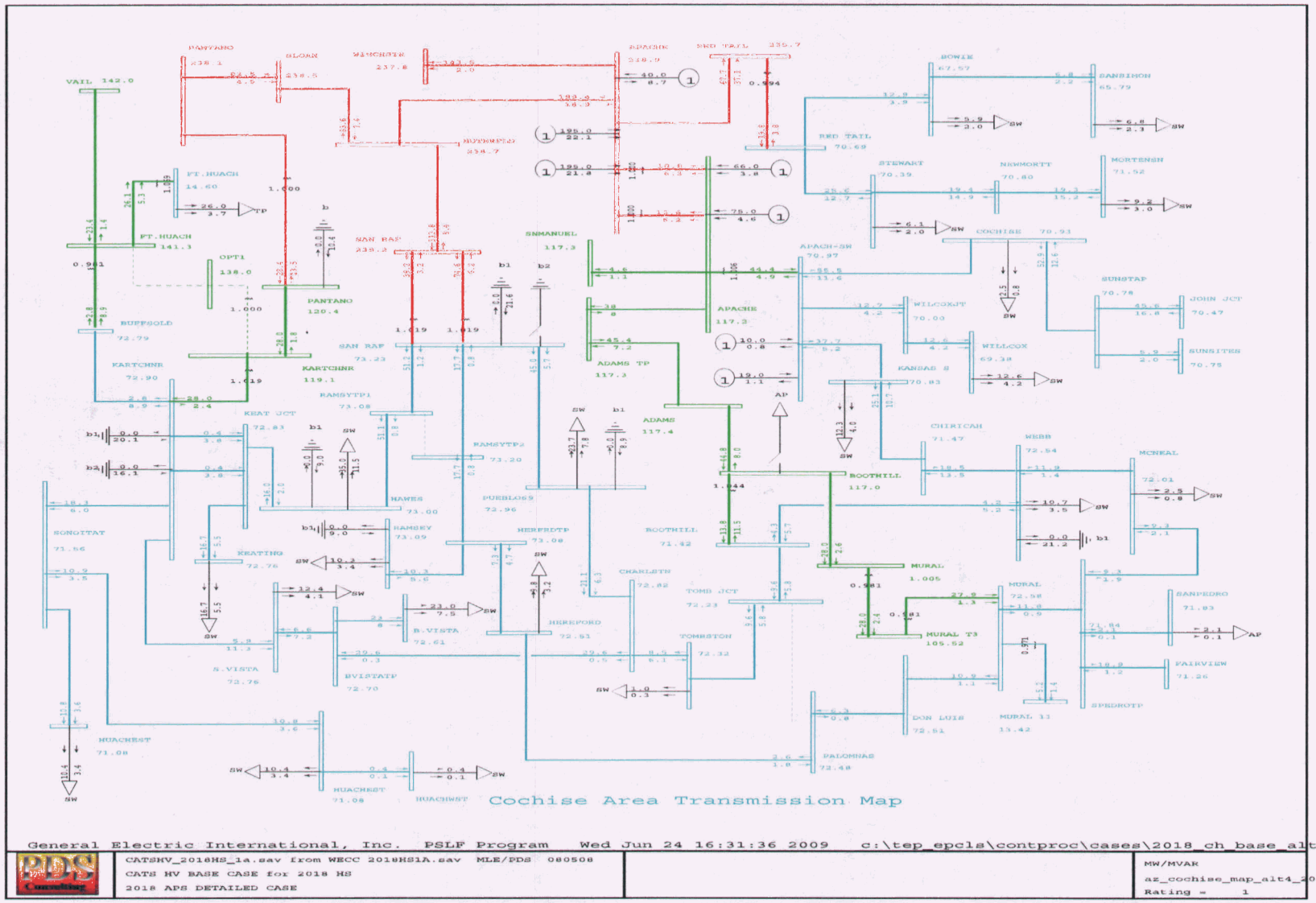


Figure C7: Power Flow Map— 2018 Benchmark Case 6 (Adams- Boothill 115 kV line outage)

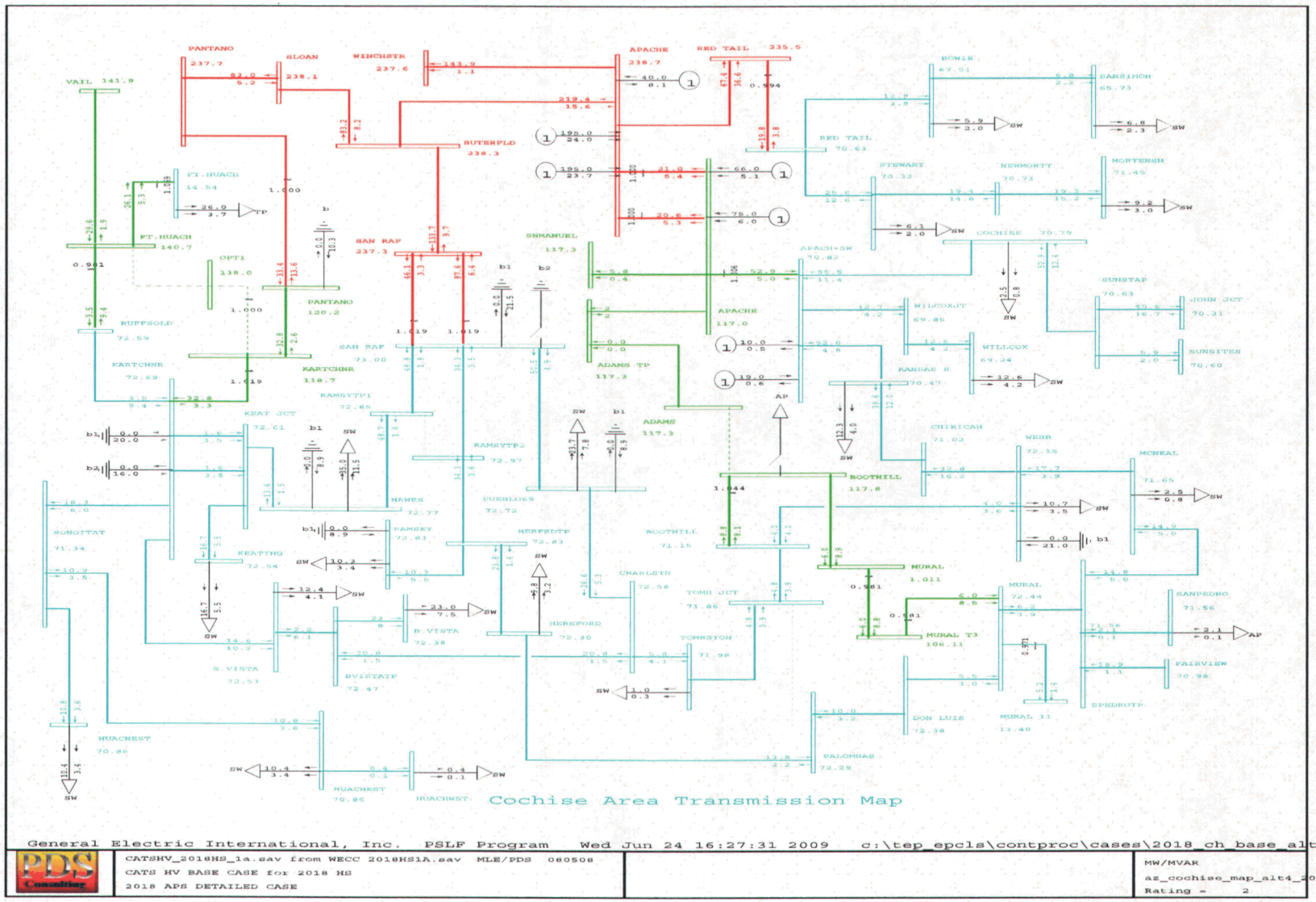


Figure C8: Power Flow Map— 2018 Benchmark Case 6 (Butterfield- San Rafael 230 kV line outage)

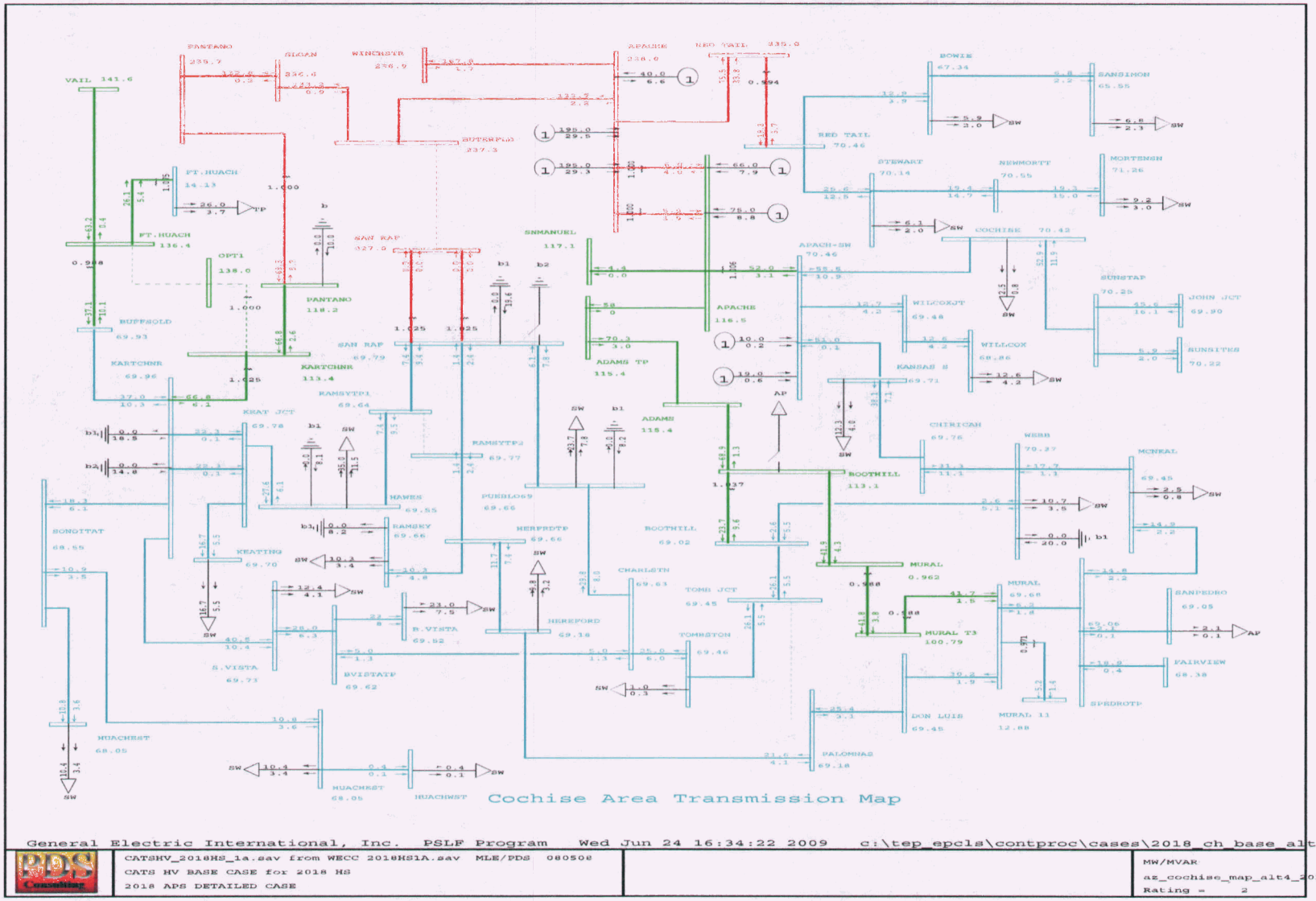


Figure C9: Power Flow Map— 2018 Benchmark Case 6 (Kartchner 115/69 kV transformer outage)

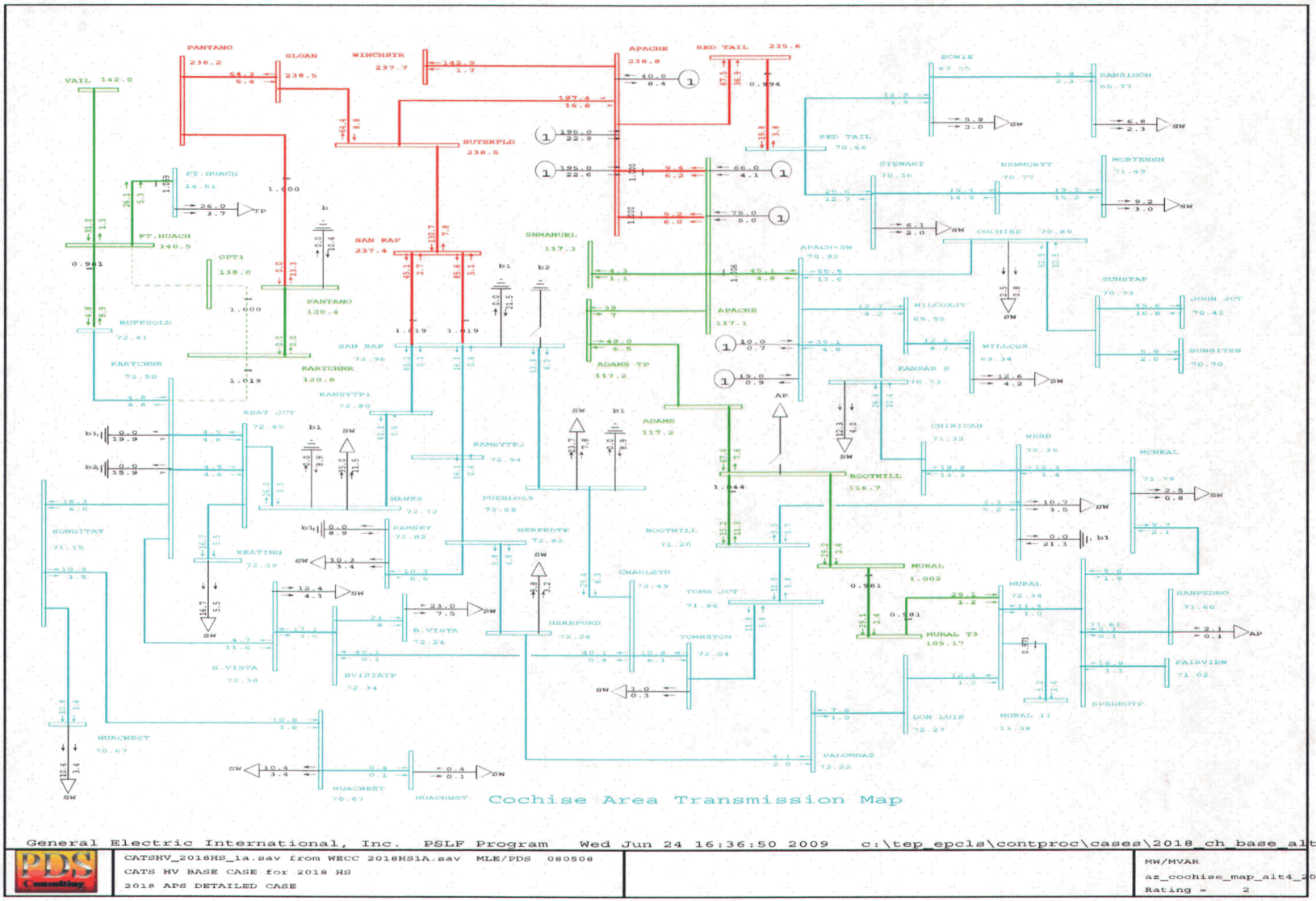
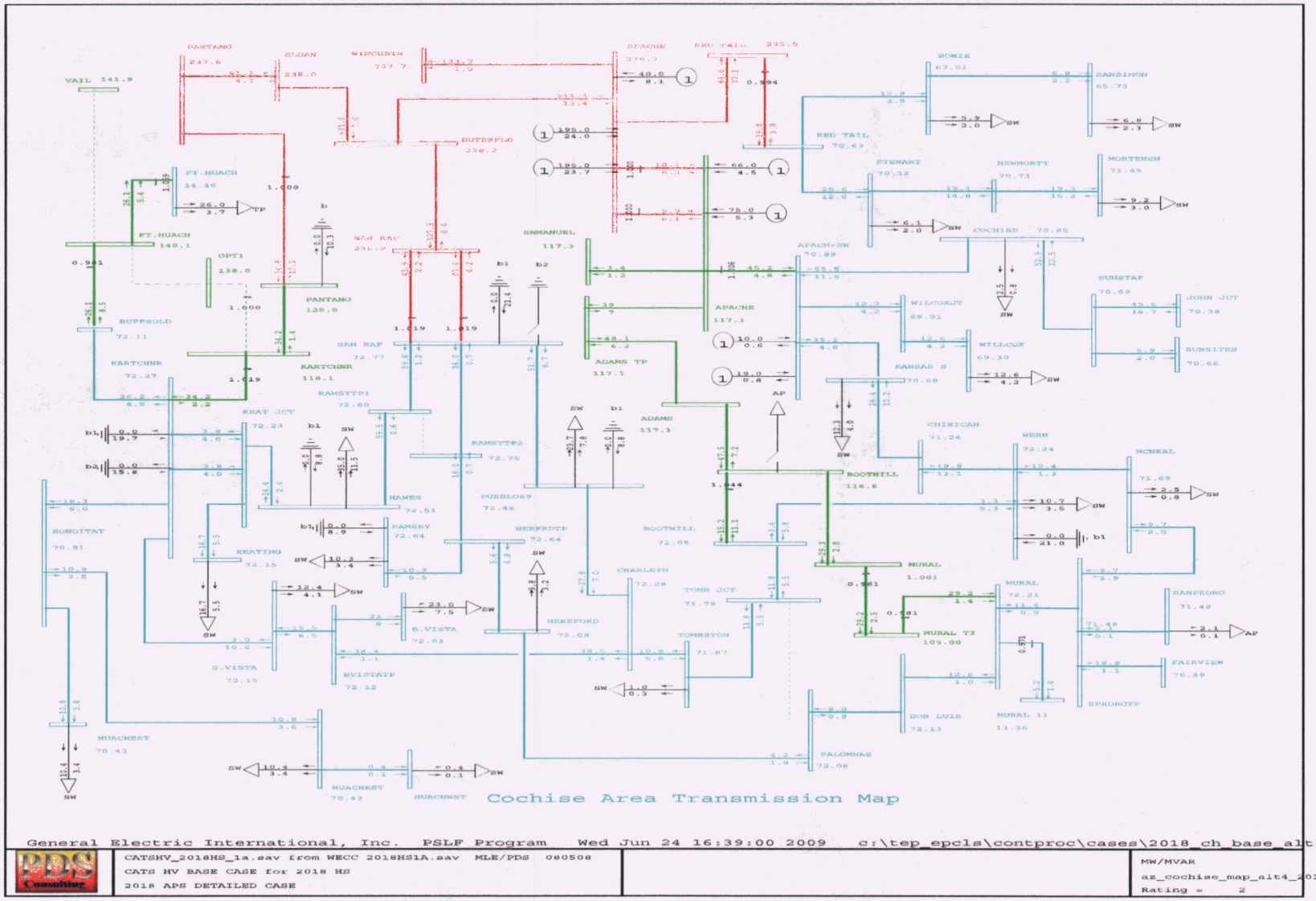


Figure C10: Power Flow Map— 2018 Benchmark Case 6 (Vail-Fort Huachuca 138 kV line outage)



APPENDIX D: Contingency List

```
CATEGORY A
RUN 0
CATEGORY BN
LINE 17000 "APACH-SW" 69.0 17507 "COCHISE " 69.0 1
RUN 1
CATEGORY BN
LINE 17000 "APACH-SW" 69.0 17517 "KANSAS S" 69.0 1
RUN 2
CATEGORY BN
LINE 17000 "APACH-SW" 69.0 17535 "WILCOXJT" 69.0 1
RUN 3
CATEGORY BN
LINE 17038 "KARTCHNR" 69.0 17540 "BUFFSOLD" 69.0 1
RUN 4
CATEGORY BN
LINE 17038 "KARTCHNR" 69.0 17518 "KEAT JCT" 69.0 1
RUN 5
CATEGORY BN
LINE 17038 "KARTCHNR" 69.0 17518 "KEAT JCT" 69.0 2
RUN 6
CATEGORY BN
LINE 17038 "KARTCHNR" 69.0 17528 "S.VISTA " 69.0 1
RUN 7
CATEGORY BN
LINE 17038 "KARTCHNR" 69.0 17556 "SONOITAT" 69.0 1
RUN 8
CATEGORY BN
LINE 17049 "RED TAIL" 69.0 17503 "BOWIE  " 69.0 1
RUN 9
CATEGORY BN
LINE 17049 "RED TAIL" 69.0 17531 "STEWART " 69.0 1
RUN 10
CATEGORY BN
LINE 17052 "SAN RAF " 69.0 17524 "PUEBLO69" 69.0 1
RUN 11
CATEGORY BN
LINE 17052 "SAN RAF " 69.0 17526 "RAMSYTP1" 69.0 1
RUN 12
CATEGORY BN
LINE 17052 "SAN RAF " 69.0 17527 "RAMSYTP2" 69.0 1
RUN 13
CATEGORY BN
LINE 17300 "ARTESIA " 69.0 17512 "HOOKERTP" 69.0 1
RUN 14
CATEGORY BN
LINE 17503 "BOWIE  " 69.0 17529 "SANSIMON" 69.0 1
RUN 15
CATEGORY BN
LINE 17505 "BVISTATP" 69.0 17501 "B.VISTA " 69.0 1
RUN 16
CATEGORY BN
LINE 17505 "BVISTATP" 69.0 17506 "CHARLSTN" 69.0 1
RUN 17
CATEGORY BN
LINE 17506 "CHARLSTN" 69.0 17524 "PUEBLO69" 69.0 1
RUN 18
CATEGORY BN
LINE 17507 "COCHISE " 69.0 17509 "SUNSTAP " 69.0 1
RUN 19
CATEGORY BN
LINE 17509 "SUNSTAP " 69.0 17515 "JOHN JCT" 69.0 1
RUN 20
CATEGORY BN
LINE 17509 "SUNSTAP " 69.0 17510 "SUNSITES" 69.0 1
RUN 21
CATEGORY BN
LINE 17551 "COTTONWD" 69.0 17552 "GUINDANI" 69.0 1
RUN 22
CATEGORY BN
LINE 17512 "HOOKERTP" 69.0 17522 "MORT TAP" 69.0 1
RUN 23
CATEGORY BN
LINE 17513 "HUACHEST" 69.0 17514 "HUACHWST" 69.0 1
RUN 24
CATEGORY BN
LINE 17515 "JOHN JCT" 69.0 17555 "MESCALTP" 69.0 1
RUN 25
```

```
CATEGORY BN
LINE 17517 "KANSAS S"  69.0 17539 "CHIRICAH"  69.0 1
RUN 26
CATEGORY BN
LINE 17518 "KEAT JCT"  69.0 17511 "HAWES   "  69.0 1
RUN 27
CATEGORY BN
LINE 17518 "KEAT JCT"  69.0 17519 "KEATING "  69.0 1
RUN 28
CATEGORY BN
LINE 17522 "MORT TAP"  69.0 17306 "HOOKER  "  69.0 1
RUN 29
CATEGORY BN
LINE 17522 "MORT TAP"  69.0 17550 "BONITA  "  69.0 1
RUN 30
CATEGORY BN
LINE 17504 "NEWMORTT"  69.0 17523 "MORTENSN"  69.0 1
RUN 31
CATEGORY BN
LINE 17544 "HERFRDTP"  69.0 17545 "HEREFORD"  69.0 1
RUN 32
CATEGORY BN
LINE 17545 "HEREFORD"  69.0 84897 "PALOMNAS"  69.0 1
RUN 33
CATEGORY BN
LINE 17526 "RAMSYTP1"  69.0 17511 "HAWES   "  69.0 1
RUN 34
CATEGORY BN
LINE 17526 "RAMSYTP1"  69.0 17527 "RAMSYTP2"  69.0 1
RUN 35
CATEGORY BN
LINE 17527 "RAMSYTP2"  69.0 17544 "HERFRDTP"  69.0 1
RUN 36
CATEGORY BN
LINE 17544 "HERFRDTP"  69.0 17525 "RAMSEY  "  69.0 1
RUN 37
CATEGORY BN
LINE 17528 "S.VISTA "  69.0 17505 "BVISTATP"  69.0 1
RUN 38
CATEGORY BN
LINE 17531 "STEWART "  69.0 17512 "HOOKERTP"  69.0 1
RUN 39
CATEGORY BN
LINE 17531 "STEWART "  69.0 17504 "NEWMORTT"  69.0 1
RUN 40
CATEGORY BN
LINE 17532 "TOMB JCT"  69.0 17513 "HUACHEST"  69.0 1
RUN 41
CATEGORY BN
LINE 17532 "TOMB JCT"  69.0 17533 "TOMBSTON"  69.0 1
RUN 42
CATEGORY BN
LINE 17532 "TOMB JCT"  69.0 17534 "WEBB    "  69.0 1
RUN 43
CATEGORY BN
LINE 17533 "TOMBSTON"  69.0 17506 "CHARLSTN"  69.0 1
RUN 44
CATEGORY BN
LINE 17534 "WEBB    "  69.0 17520 "MCNEAL  "  69.0 1
RUN 45
CATEGORY BN
LINE 17535 "WILCOXJT"  69.0 17531 "STEWART "  69.0 1
RUN 46
CATEGORY BN
LINE 17535 "WILCOXJT"  69.0 17536 "WILLCOX "  69.0 1
RUN 47
CATEGORY BN
LINE 17539 "CHIRICAH"  69.0 17534 "WEBB    "  69.0 1
RUN 48
CATEGORY BN
LINE 17550 "BONITA  "  69.0 17523 "MORTENSN"  69.0 1
RUN 49
CATEGORY BN
LINE 17555 "MESCALTP"  69.0 17502 "BENSON  "  69.0 1
RUN 50
CATEGORY BN
LINE 17555 "MESCALTP"  69.0 17521 "MESCAL  "  69.0 1
RUN 51
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CATEGORY BN
LINE 17556 "SONOITAT"  69.0 17513 "HUACHEST"  69.0 1
RUN 52
CATEGORY BN
LINE 17502 "BENSON  "  69.0 17530 "ST.DAVID"  69.0 1
RUN 53
CATEGORY BN
LINE 17507 "COCHISE "  69.0 17515 "JOHN JCT"  69.0 1
RUN 54
CATEGORY BN
LINE 17530 "ST.DAVID"  69.0 17532 "TOMB JCT"  69.0 1
RUN 55
CATEGORY BN
LINE 17546 "SONOITA "  69.0 17556 "SONOITAT"  69.0 1
RUN 56
CATEGORY BN
LINE 17552 "GUINDANI"  69.0 17530 "ST.DAVID"  69.0 1
RUN 57
CATEGORY BN
LINE 84824 "SPEDROTP"  69.0 17520 "MCNEAL  "  69.0 1
RUN 58
CATEGORY BN
LINE 17538 "OPT1    " 138.0 16230 "FT.HUACH" 138.0 1
RUN 59
CATEGORY BN
LINE 16220 "VAIL    " 138.0 17538 "OPT1    " 138.0 1
RUN 60
CATEGORY BN
LINE 17015 "PANTANO " 115.0 17537 "OPT1    " 115.0 1
RUN 61
CATEGORY BN
LINE 17537 "OPT1    " 115.0 17039 "KARTCHNR" 115.0 1
RUN 62
CATEGORY BN
XFMR 16230 "FT.HUACH" 138.0 17540 "BUFFSOLD"  69.0 1
RUN 63
CATEGORY BN
XFMR 17538 "OPT1    " 138.0 17537 "OPT1    " 115.0 1
RUN 64
CATEGORY BN
XFMR 17528 "S.VISTA "  69.0 17099 "CS-2    " 230.0 1
RUN 65
CATEGORY BN
LINE 84820 "DON LUIS"  69.0 84822 "MURAL   "  69.0 1
RUN 66
CATEGORY BN
LINE 84820 "DON LUIS"  69.0 84897 "PALOMNAS"  69.0 1
RUN 67
CATEGORY BN
LINE 84822 "MURAL   "  69.0 84824 "SPEDROTP"  69.0 1
RUN 68
CATEGORY BN
LINE 84823 "SANPEDRO"  69.0 84824 "SPEDROTP"  69.0 1
RUN 69
CATEGORY BN
LINE 84821 "FAIRVIEW"  69.0 84824 "SPEDROTP"  69.0 1
RUN 70
CATEGORY BN
LINE 84824 "SPEDROTP"  69.0 17520 "MCNEAL  "  69.0 1
RUN 71
CATEGORY BN
LINE 90000 "ADAMS   " 230.0 90001 "BOOTHILL" 230.0 1
RUN 72
CATEGORY BN
LINE 90001 "BOOTHILL" 230.0 90002 "MURAL   " 230.0 1
RUN 73
CATEGORY BN
LINE 90002 "MURAL   " 230.0 17020 "SAN RAF " 230.0 1
RUN 74
CATEGORY BN
XFMR 84897 "PALOMNAS"  69.0 85862 "PALOMNAS"  12.5 1
RUN 75
CATEGORY BN
XFMR 84820 "DON LUIS"  69.0 85803 "DON LUIS"  12.5 1
RUN 76
CATEGORY BN
XFMR 84822 "MURAL   "  69.0 14353 "MURAL   " 115.0 1
RUN 77
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CATEGORY BN
XFMR 84822 "MURAL   " 69.0 85805 "MURAL 11"  12.5 1
RUN 78
CATEGORY BN
XFMR 84823 "SANPEDRO"  69.0 85807 "SANPEDR "  12.5 1
RUN 79
CATEGORY BN
XFMR 84821 "FAIRVIEW"  69.0 84995 "FAIRVIEW"  34.5 1
RUN 80
CATEGORY BN
XFMR 84821 "FAIRVIEW"  69.0 85804 "FAIRVW11"  12.5 1
RUN 81
CATEGORY BN
XFMR 90000 "ADAMS   " 230.0 14350 "ADAMS   " 115.0 1
RUN 82
CATEGORY BN
XFMR 90001 "BOOTHILL" 230.0 14362 "BOOTHILL" 115.0 1
RUN 83
CATEGORY BN
XFMR 90002 "MURAL   " 230.0 14353 "MURAL   " 115.0 1
RUN 84
CATEGORY BN
LINE 17002 "APACHE  " 230.0 17007 "BUTERFLD" 230.0 1
RUN 85
CATEGORY BN
LINE 17007 "BUTERFLD" 230.0 17016 "PANTANO " 230.0 1
RUN 86
CATEGORY BN
LINE 17676 "NEWTUCSN" 230.0 17016 "PANTANO " 230.0 1
RUN 87
CATEGORY BN
LINE 17007 "BUTERFLD" 230.0 17020 "SAN RAF " 230.0 1
RUN 88
CATEGORY BN
LINE 17016 "PANTANO " 230.0 17037 "KARTCHNR" 230.0 1
RUN 89
CATEGORY BN
LINE 16230 "FT.HUACH" 138.0 16220 "VAIL    " 138.0 1
RUN 90
CATEGORY BN
LINE 17001 "APACHE  " 115.0 19020 "ADAMSTAP" 115.0 1
RUN 91
CATEGORY BN
LINE 19221 "NOGALES " 115.0 19020 "ADAMSTAP" 115.0 1
RUN 92
CATEGORY BN
LINE 14362 "BOOTHILL" 115.0 14353 "MURAL   " 115.0 1
RUN 93
CATEGORY BN
LINE 14362 "BOOTHILL" 115.0 14350 "ADAMS   " 115.0 1
RUN 94
CATEGORY BN
XFMR 17016 "PANTANO " 230.0 17015 "PANTANO " 115.0 1
RUN 95
CATEGORY BN
XFMR 17039 "KARTCHNR" 115.0 17038 "KARTCHNR" 69.0 1
RUN 96
CATEGORY BN
XFMR 17020 "SAN RAF " 230.0 17052 "KARTCHNR" 69.0 1
RUN 97
CATEGORY BN
XFMR 17020 "SAN RAF " 230.0 17052 "KARTCHNR" 69.0 2
RUN 98
CATEGORY BN
LINE 17547 "SLOAN   " 230.0 17016 "PANTANO " 230.0 1
RUN 99
CATEGORY BN
LINE 17547 "SLOAN   " 230.0 17007 "BUTERFLD" 230.0 1
RUN 100
CATEGORY BN
LINE 17020 "SAN RAF " 230.0 17037 "KARTCHNR" 230.0 1
RUN 101
CATEGORY BN
LINE 17016 "PANTANO " 230.0 17037 "KARTCHNR" 230.0 1
RUN 101
CATEGORY BN
XFMR 17039 "KARTCHNR" 230.0 17038 "KARTCHNR" 69.0 1
RUN 102
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CATEGORY BN
LINE 17020 "SAN RAF " 230.0 90002 "MURAL   " 230.0 1
RUN 103
CATEGORY BN
XFMR 90002 "MURAL   " 230.0 14353 "MURAL   " 115.0 1
RUN 104
CATEGORY BN
LINE 90001 "BOOTHILL" 230.0 90002 "MURAL   " 230.0 1
RUN 105
CATEGORY BN
LINE 90001 "BOOTHILL" 230.0 90000 "ADAMS   " 230.0 1
RUN 106
CATEGORY BN
XFMR 90001 "BOOTHILL" 230.0 14362 "BOOTHILL" 115.0 1
RUN 107
CATEGORY BN
XFMR 90000 "ADAMS   " 230.0 14350 "ADAMS   " 115.0 1
RUN 108
CATEGORY BN
XFMR 17099 "CS-2    " 230.0 17528 "S.VISTA " 69.0 1
RUN 109
CATEGORY BN
LINE 17547 "SLOAN   " 230.0 17099 "CS-2    " 230.0 1
RUN 110
DONE
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