Arizona Public Service Company
2025 to 2034
Ten-Year Transmission System Plan

Prepared for the
Arizona Corporation Commission

January 2025

aps

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Overview

General Information

Pursuant to A.R.S. § 40-360.02, Arizona Public Service Company (APS) submits its 2025 to 2034 Ten-Year Transmission System Plan (Ten-Year Plan or Plan), attached as Attachment A. Also included in this filing are the Renewable Transmission Action Plan (RTAP; Attachment B) as required by Arizona Corporation Commission (ACC or Commission) Decision No. 70635 (December 11, 2008), and the Technical Study on the Effects of Distributed Generation and Energy Efficiency (Attachment C) as required by Decision No. 74785 (October 24, 2014). The Internal Planning Criteria, required by Decision No. 63876 (July 25, 2001), are included as Attachment D. The technical study report and system ratings are deemed Confidential Critical Energy/Electric Infrastructure Information (CEII). This confidential information can be made available upon request under separate cover pursuant to a Protective Agreement.

This Ten-Year Plan describes planned transmission lines of 115kV or higher voltage that APS may construct or participate in over the next ten-year period. Pursuant to A.R.S. § 40-360(10), underground facilities are not subject to line siting. However, APS lists underground facilities in the Ten-Year Plan as they are an important part of the transmission system and transmission planning process.

To prioritize reliability and meet substantial growth in residential and commercial energy needs, APS has developed a future-focused, strategic transmission plan. This Ten-Year Plan includes critical transmission projects that comprise the APS strategic transmission portfolio and which represent a significant upgrade to our transmission system. These projects, along with other projects included in this Plan, will support growing energy needs, strengthen reliability, and allow for the connection of new resources.

Included in this Plan are approximately 32 miles of new 500kV transmission lines, 1 mile of new 345kV transmission lines, 578 miles of 345kV transmission line rebuilds, 149 miles of new 230kV transmission overhead lines, 101 miles of 230kV transmission overhead line rebuilds, 1 mile of new 230kV transmission underground lines, 8 miles of underground 230kV line upgrades, and 1 mile of 115kV transmission line upgrades which are described as planned projects in this Ten-Year Plan. In addition, the following equipment is included in the Ten-Year Plan: 40 new transformers, 4 new shunt reactors, 6 new series reactors, 20 new shunt capacitors, 1 new STATCOM, 3 transformer replacements, 1 shunt reactor replacement, and 2 series capacitor replacements. The total investment for the APS projects and the anticipated APS portion of the participation

projects as they are modeled in this filing is estimated to be $6.24 billion.[1] Table 1 provides an overview of the projects included in the Ten-Year Plan.

Table 1: 2025 to 2034 Ten-Year Transmission Plan Project Overview

Lines and Equipment	Total Included in Ten-Year Plan
500kV New Transmission Overhead Lines	Approximately 32 miles
345kV New Transmission Overhead Lines	Approximately 1 mile
345kV Transmission Overhead Line Rebuilds	Approximately 578 miles
230kV New Transmission Overhead Lines	Approximately 149 miles
230kV Transmission Overhead Line Rebuilds	Approximately 101 miles
230kV New Transmission Underground Lines	Approximately 1 mile
230kV Transmission Underground Line Upgrades	Approximately 8 miles
115kV Transmission Overhead Line Rebuilds	Approximately 1 mile
New Transformers	40 transformers
Transformer Replacements	3 transformers
New Shunt Reactors	4 reactors
Shunt Reactor Replacements	1 reactor
New Series Reactors	6 reactors
New Shunt Capacitors	20 capacitors
Series Capacitor Replacements	2 capacitors
New STATCOM	1 STATCOM
Total Investment	$6.24 billion[2]

[1] This value is not comparable to the Capital Expenditures table presented in the "Liquidity and Capital Resources" section of APS's 10-K filing, which also includes other transmission costs for new subtransmission projects (69kV) and transmission upgrades and replacements. This value also does not include the allowance for funds used during construction.
[2] See footnote 1.

Consistent with the Commission's Sixth Biennial Transmission Assessment[3] (BTA), this Ten-Year Plan includes information regarding planned transmission reconductor projects, substation transformer replacements, and reactive power compensation projects. At this time, APS does not plan to reconductor any transmission lines but does have plans to upgrade approximately 8 miles of underground 230kV lines and rebuild approximately 578 miles of 345kV overhead transmission, 101 miles of 230kV overhead transmission, and 1 mile of 115kV overhead transmission.

These types of plans often change as they typically are in direct response to load growth, generator interconnections, and many other factors influencing the interconnected transmission grid. Therefore, in-service years for projects such as transformer replacements or additions, reconductoring transmission lines, and reactive power support may change to reflect the load changes in the local system. Additionally, there may be projects added throughout the course of the planning year to adapt to changes in system topology, serve new large-load customers, mitigate the impacts of generation retirement, or accommodate new generator interconnections. For example, new projects may be identified or planned projects may be advanced to serve customers, either single large customers such as new data centers or large master-planned communities, or to support rapid customer electrification and technology advancement. Table 2: 2025 to 2034 Plan Projected Equipment Additions and Replacements, is a list, by estimated in-service year, of the planned substation transformer additions and replacements, reactive devices being installed or replaced, new transmission lines, and transmission line upgrades.

[3] Decision No. 72031, December 10, 2010.

Table 2: 2025 to 2034 Plan Projected Equipment Additions and Replacements

Equipment	Year
Broadway 230/69kV Transformer Additions (2 units) Contrail 230/69kV Transformer Additions (3 units) Goodyear 230/69kV Transformer Additions (3 units) Saguaro 500/115kV Transformer Replacement (1 unit) Stratus 230/69kV Transformer Addition (1 unit) Three Rivers 230/69kV Transformer Addition (1 unit) Contrail 230kV Shunt Capacitor Addition (1 unit) Dromedary 230kV Shunt Capacitor Additions (4 units) Goodyear 230kV Shunt Capacitor Addition (1 unit) Stratus 230kV Shunt Capacitor Addition (1 unit) Cholla 345kV Shunt Reactor Additions (2 units)	2025
Raptor 230kV Shunt Capacitor Addition (1 unit) Sabre 230kV Shunt Capacitor Additions (2 units) Country Club 230kV Shunt Reactor Additions (2 units) Cholla 500kV Shunt Reactor Replacement (1 unit) Pinnacle Peak 230kV Series Reactor Additions (2 units)	2026
Broadway 230/69kV Transformer Addition (1 unit) Diamond 230/69kV Transformer Additions (3 units) Freedom 230/69kV Transformer Addition (1 unit) Outer Circle 230/69kV Transformer Addition (1 unit) Rudd 500/230kV Transformer Addition (1 unit) Runway 230/69kV Transformer Additions (3 units) Scatter Wash 230/69kV Transformer Addition (1 unit) Sun Valley 500/230kV Transformer Addition (1 unit) Verde 230/69kV Transformer Replacements (2 units) Broadway 230kV Shunt Capacitor Addition (1 unit) Diamond 230kV Shunt Capacitor Addition (1 unit) Panda 230kV Series Reactor Addition (1 unit) Country Club to Meadowbrook 230kV Underground Upgrade (3mi)	2027

Equipment	Year
Avery 230/69kV Transformer Additions (2 units) Bianco 230/69kV Transformer Additions (2 units) Mead Phoenix Project Q01 500/230kV Transformer Addition (1 unit) Ocotillo 230/69kV Transformer Addition (1 unit) TS22 500/230kV Transformer Addition (1 unit) TS31 230/69kV Transformer Additions (2 units) Yavapai 230/69kV Transformer Addition (1 unit) Avery 230kV Shunt Capacitor Additions (2 units) TS31 230kV Shunt Capacitor Addition (1 unit) Willow Lake 230kV Shunt Capacitor Additions (2 units) Pinnacle Peak 230kV Series Reactor Additions (3 units) Meadowbrook to Sunnyslope 230kV Underground Upgrade (5mi)	2028
North Gila 500/230kV Transformer Addition (1 unit) Parkway 230/69kV Transformer Addition (1 unit) TS22 500/230kV Transformer Addition (1 unit) TS22 230kV STATCOM Addition (1 unit)	2029
Hazen 230/69kV Transformer Additions (2 units) Hazen 230kV Shunt Capacitor Addition (1 unit)	2030
Rudd 500/230kV Transformer Addition (1 unit) TS21 500/230KV Transformer Additions (2 units) TS21 230kV Shunt Capacitor Additions (2 units)	2032
Cholla 345kV Series Capacitor Replacements (2 units)	2037

Equipment	Year
Lone Peak 230/69kV Transformer Addition (1 unit) Palm Valley 230/69kV Transformer Addition (1 unit) Raceway 230/69kV Transformer Addition (1 unit) Runway 230/69kV Transformer Addition (1 units) Sun Valley 230/69kV Transformer Addition (1 unit) Trilby Wash 230/69kV Transformer Addition (1 unit) TS17 230/69kV Transformer Additions (2 units) TS22 230/69kV Transformer Addition (1 unit) TS22 500/230KV Transformer Addition (1 unit) TS25 230/69kV Transformer Additions (2 units) Runway 230kV Shunt Capacitor Addition (1 unit) Country Club to Grand Terminal 230kV Underground Upgrade	TBD

Some of the facilities reported in prior Ten-Year Plan filings have been completed. Others have been canceled or deferred beyond the upcoming ten-year period and therefore are not included in this plan. The projects that have "To Be Determined" (TBD) in-service dates are projects that have been identified but are either still outside of the ten-year planning window or the in-service date has not yet been established. They are included in this filing for informational purposes. A summary of changes from last year's Ten-Year Plan is provided on pg. 13.

APS has included planned transmission maps showing the electrical connections and in-service dates for transmission line and substation projects planned by APS for Arizona Extra High Voltage (EHV) and Outer Divisions (pg. 19), the Phoenix metropolitan area (pg. 20), and the Yuma area (pg. 21). Written descriptions of each proposed transmission project are provided on subsequent pages in the expected chronological order of each project. The line routings shown on the system maps and the descriptions of each transmission line are intended to be general, showing electrical connections and not specific routings, and are subject to revision. Specific routings are recommended by the Arizona Power Plant and Transmission Line Siting Committee and approved by the Commission when issuing a Certificate of Environmental Compatibility (CEC) and through subsequent right-of-way acquisition.

APS participates in numerous regional planning organizations, which provide an opportunity for other entities to participate in future planned projects. Through membership and participation in these organizations, the needs of multiple entities and

the region as a whole can be identified and studied, which maximizes the effectiveness and use of new projects. Regional organizations in which APS is a member include the Western Electricity Coordinating Council (WECC), the WestConnect regional planning group, and the Southwest Area Transmission (SWAT) Subregional Planning Group. The plans included in this filing are the result of these coordinated planning efforts.

The Commission's Sixth BTA ordered utilities to include the effects of distributed generation (DG) and energy efficiency (EE) programs on future transmission needs. APS's modeled load, as described in the Technical Study Report on the Effects of Distributed Generation and Energy Efficiency, addresses the requirements of the Commission's Sixth BTA. Additionally, in the Eighth BTA Decision,[4] the Commission directed utilities to conduct or procure a study that would more directly evaluate the effects of DG and EE installations and programs on their future transmission needs. This study is included in this filing as Attachment C.

The Commission's decision in the Seventh BTA[5] remains in effect. This decision suspended the requirement for performing Reliability Must Run (RMR) studies in every BTA and instead only requires that an RMR study be performed if certain criteria are met. The RMR studies were not performed for the 2025-2034 Ten-Year Plan since 2025 is not a BTA study year.

Also, consistent with the Commission's Decision in the Seventh BTA, APS continues to monitor reliability in Cochise County. To improve reliability in Cochise County, APS, Arizona Electric Power Cooperative (AEPCO), and Sulphur Springs Valley Electric Cooperative (SSVEC) have executed agreements[6] to coordinate and jointly participate in a number of projects and upgrades within the Cochise County area. In 2023, APS, AEPCO, and SSVEC completed the final remaining upgrades contained in the Cochise County agreement.

The Commission's Ninth BTA Decision[7] ordered utilities to describe, in general terms, the driving factor(s) for each transmission project in the Ten-Year Plan. This information is included in the project descriptions.

Power flow analysis was conducted to identify thermal overloads under normal and contingency conditions in compliance with North American Electric Reliability Corporation

[4] Decision No. 74785, October 24, 2014.
[5] Decision No. 73625, December 12, 2012.
[6] See Cochise County Mutual Standby Transmission Service Agreement, APS Service Agreement No. 372, filed with the Federal Energy Regulatory Commission (FERC) on May 21, 2019, in FERC Docket No. ER19-1915-000.
[7] Decision No. 75817, November 21, 2016.

(NERC) Reliability Standards and WECC System Performance Criteria. The projects identified in this Ten-Year Plan, with their anticipated in-service dates, will ensure that APS's transmission system meets all applicable reliability criteria for Category P0 and P1 conditions, as defined in NERC Reliability Standard TPL-001-5.1. Changes in regulatory requirements, regulatory approvals, or underlying assumptions such as load forecasts, generation or transmission expansions, economic issues, retirement of generation, changes in the system topology, and other utilities' plans may substantially impact this Ten-Year Plan and could result in changes to anticipated in-service dates or project scopes. Additionally, future federal and regional mandates may impact this Ten-Year Plan specifically and the transmission planning process in general. This Ten-Year Plan contains tentative information only and is subject to change without notice at the discretion of APS in accordance with A.R.S. § 40-360.02(F).

Project Changes From the 2024 to 2033 Ten-Year Plan

The following projects were removed, changed, or completed since the January 2024 filing of APS's 2024 to 2033 Ten-Year Plan:

- The Country Club-Lincoln Street 230kV underground line upgrade was placed in-service in 2024.
- The Rabbit Canyon Switchyard and Lines Project was placed in-service in 2024.
- The Three Rivers 230kV Transmission Line Project was placed in-service in 2024.
- The Serrano Solar and Storage Project Generation Tie Line was placed in-service in 2024.
- The projected in-service year for the Parkway 230kV Lines was updated from 2024 to 2025.
- The Hashknife Energy Center Generation Tie Line Project is now called the Hashknife Energy Center Transmission Provider Interconnection Facilities. The projected in-service year was updated from 2026 to 2025. The point of origin for the project was changed from the Hashknife Energy Center substation to the Point of Change of Ownership to accurately reflect the APS-owned portion of the line.
- The Proving Ground Solar and Storage Interconnection is now called the Ironwood Solar and Storage 500kV Interconnection. The projected in-service year for the project was updated from 2026 to 2025. The generation step-up substation, which is the point of origin for the new line, is now called Wildcat.
- The projected in-service year for the West Camp Wind Gen-Tie Project was updated from 2026 to 2025. The intermediate interconnection switchyard on the project, which is being cut into the Cholla-Mazatzal 345kV line, is now called Sitgreaves. The point of origin for the line was changed from the West Camp Wind collector substation to the Point of Change of Ownership to accurately reflect the APS-owned portion of the lines.
- The TS34 switchyard, which is an intermediate point on the Contrail 230kV Lines, is now called Raptor. The projected in-service year for this switchyard was updated from TBD to 2026.
- The projected in-service year for the Sabre 230kV switchyard, which is an intermediate point on the Contrail 230kV Lines, was updated from 2024 to 2026.
- The Sundance to Pinal Central 230kV Line has been updated to the Sundance to Milligan 230kV Line. The termination point for the line has been updated to Milligan substation and the projected construction start year has been updated from 2025 to 2026. The TS25 substation has been added as an intermediate point with a TBD in-service year.

- The projected in-service year for the Runway Additional 230kV Lines was updated from 2026 to 2027.
- The projected in-service year for the Bagdad 230kV Transmission Line was updated from 2027 to 2028.
- The Milligan Solar and Storage Project Generation Tie Line is now called the Q264 Transmission Provider Interconnection Facilities. The projected in-service year for the project was updated from TBD to 2028.
- The projected in-service year for the TS22 Project was updated from 2029 to 2028.
- The projected in-service year for the Meadowbrook to Sunnyslope 230kV Underground Cable upgrade was updated from 2029 to 2028.
- The projected in-service year for the Pinnacle Peak to Ocotillo 230kV Line Rebuilds was updated from 2031 to 2029.
- The projected in-service year for the North Gila-Orchard 230kV Line #2 was updated from TBD to 2029.
- The Panda to Freedom 230kV Line Rebuild is now called the Panda to Freedom 230kV New Line. The projected in-service year for the line was updated from 2031 to 2030.
- The TS29 substation, which is an intermediate point on the Panda to Freedom 230kV New Line, is now called Hazen. The projected in-service year for this substation was updated from TBD to 2030.
- The projected in-service year for the Four Corners to Cholla to Pinnacle Peak 345kV Line Rebuilds has been updated from 2035 to 2037.

Further, changes since the filing of the 2024 to 2033 Ten-Year Plan for equipment listed in Table 2: 2025 to 2034 Plan Projected Equipment Additions and Replacements, starting on pg. 8, are summarized in Table 3 below.

Table 3: Changes to Equipment Additions and Replacements since the 2024 to 2033 Plan

Equipment	2024 to 2033 Plan Projected In-service Year	2025 to 2034 Plan Projected In-service Year
Three Rivers 230/69kV Transformer Additions (2 units)	2024	Completed
Three Rivers 230kV Shunt Capacitor Addition (1 unit)	2024	Completed
Saguaro 500/115kV Transformer Addition (1 unit)	2024	Completed
Runway 230/69kV Transformer Addition (1 unit)	2025	Completed
Runway 230kV Shunt Capacitor Addition (1 unit)	2025	Completed

Equipment	2024 to 2033 Plan Projected In-service Year	2025 to 2034 Plan Projected In-service Year
Three Rivers 230/69kV Transformer Addition (1 unit)	2024	2025
Saguaro 500/115kV Transformer Addition (1 unit)	2024	2025
Cholla 345kV Shunt Reactor Additions (2 units)	2024	2025
Sabre 230kV Shunt Capacitor Additions (2 units)	2025	2026
Broadway 230/69kV Transformer Addition (1 unit)	TBD	2027
Rudd 500/230kV Transformer Addition (1 unit)	2026	2027
Runway 230/69kV Transformer Additions (3 units)	2026	2027
Broadway 230kV Shunt Capacitor Addition (1 unit)	TBD	2027
Avery 230/69kV Transformer Additions (2 units)	TBD	2028
Avery 230kV Shunt Capacitor Additions (2 units)	TBD	2028
Mead Phoenix Project Q01 500/230kV Transformer Addition (1 unit)	2027	2028
Ocotillo 230/69kV Transformer Addition (1 unit)	2027	2028
TS22 500/230kV Transformer Addition (1 unit)	2029	2028
TS31 230/69KV Transformer Additions (2 units)	2027	2028
Willow Lake 230kV Shunt Capacitor Additions (2 units)	2026	2028
Parkway 230/69kV Transformer Addition (1 unit)	TBD	2029
Hazen 230/69kV Transformer Additions (2 units)	TBD	2030
Hazen 230kV Shunt Capacitor Addition (1 unit)	TBD	2030
Cholla 345kV Series Capacitor Replacements (2 units)	2035	2037
TS31 230kV STATCOM Addition (1 unit)	2027	Removed from Plan
TS22 500kV Shunt Reactor Addition (1 unit)	2029	Removed from Plan

Equipment	2024 to 2033 Plan Projected In-service Year	2025 to 2034 Plan Projected In-service Year
TS22 230kV Shunt Capacitor Additions (2 units)	2033	Removed from Plan
Runway 230/69kV Transformer Addition (1 unit)	2027	TBD
Runway 230kV Shunt Capacitor Addition (1 unit)	2027	TBD
TS22 500/230kV Transformer Addition (1 unit)	2033	TBD

New Projects in the 2025 to 2034 Ten-Year Plan

The following new transmission projects were included in the APS 2025 to 2034 Ten-Year Plan:

- The Goodyear 230kV Lines project with a projected in-service date of 2025. Goodyear substation was previously included as an intermediate point on the Three Rivers 230kV Transmission Line Project, which has been placed in-service. The tie-in of Goodyear substation has been listed as a separate project and is projected to be in-service in 2025.
- The Snowflake Solar Transmission Provider Interconnection Facilities with a projected in-service year of 2027.
- The Cholla-Chevelon 345kV Line Cut-In to Sitgreaves with a projected in-service year of 2028.
- The Saguaro Power Campus Upgrades with a projected in-service year of 2029.
- The Agua Fria to Contrail 230kV Line with a projected in-service year of 2030.

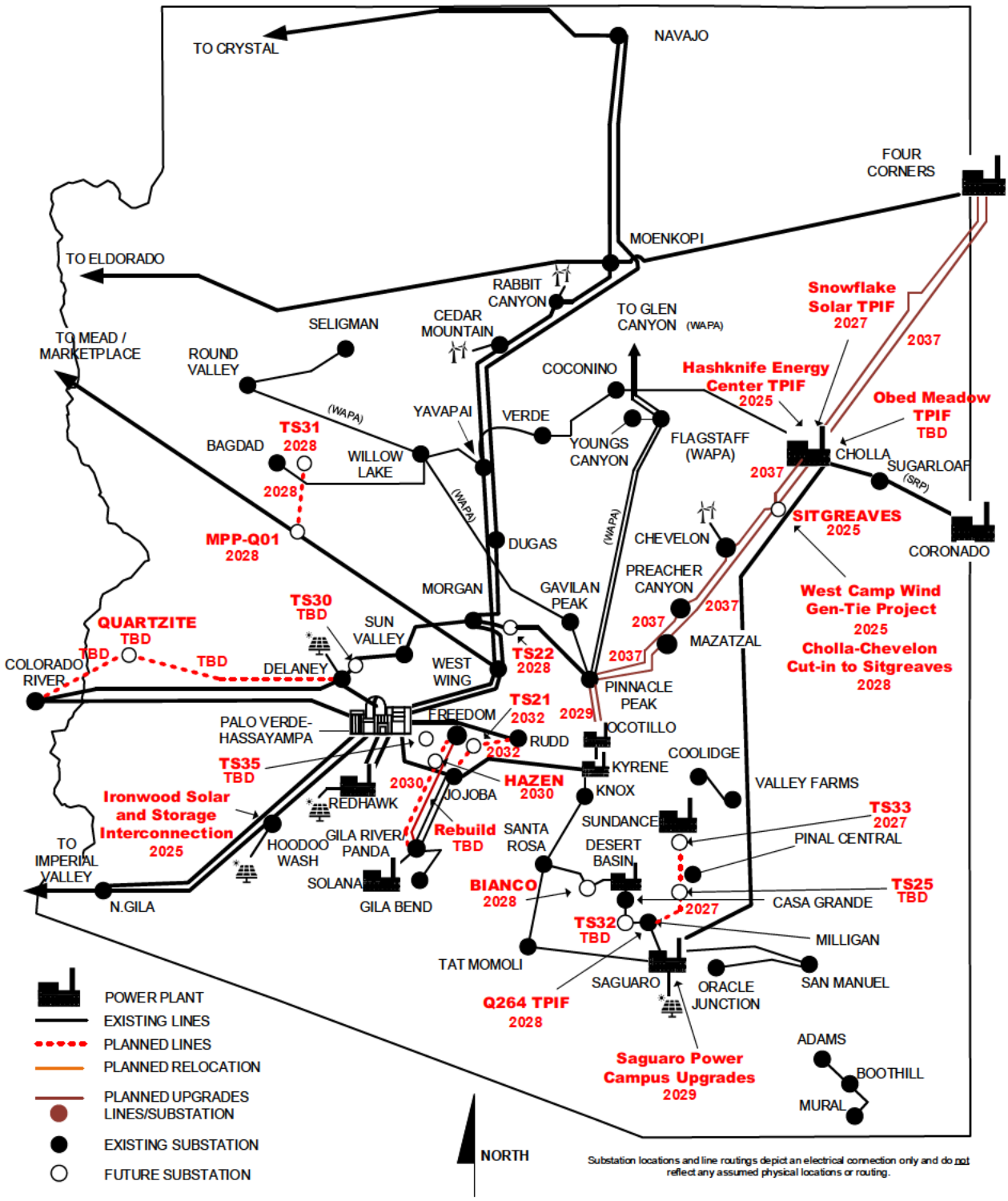
New additions to Table 2: 2025 to 2034 Plan Projected Equipment Additions and Replacements, starting on pg. 8, for the 2025 to 2034 Ten-Year Plan are summarized in Table 4 below.

Table 4: 2025 to 2034 Plan New Equipment Additions and Replacements

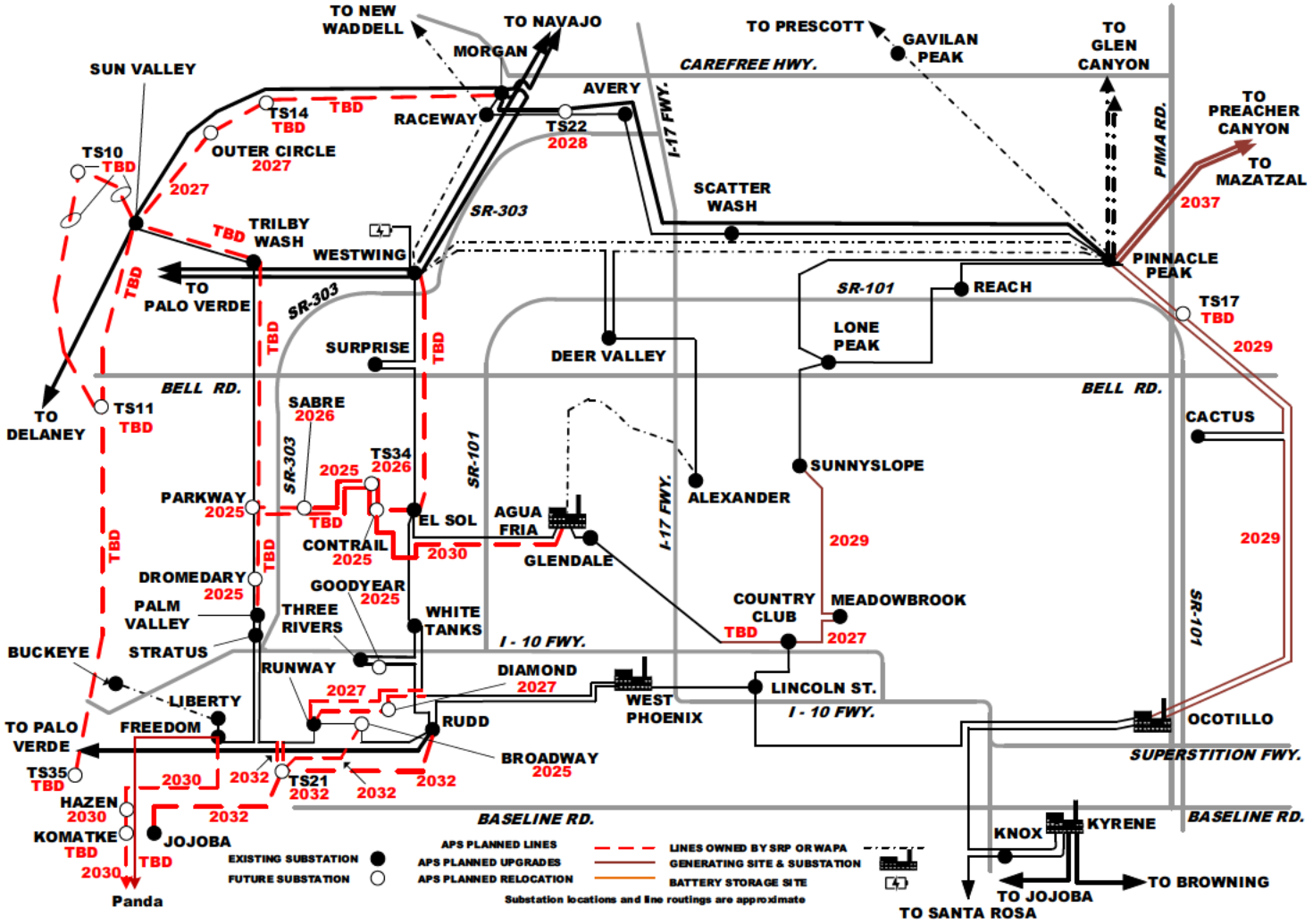
Equipment	Projected In-service Year
Raptor 230kV Shunt Capacitor Addition (1 unit)	2026
Country Club 230kV Shunt Reactor Additions (2 units)	2026
Pinnacle Peak 230kV Series Reactor Additions (2 units)	2026
Panda 230kV Series Reactor Addition (1 unit)	2027
TS31 230kV Shunt Capacitor Addition (1 unit)	2028
Pinnacle Peak 230kV Series Reactor Additions (3 units)	2028
TS22 230KV STATCOM Addition (1 unit)	2029
North Gila 500/230kV Transformer Addition (1 unit)	2029

Planned Transmission Maps

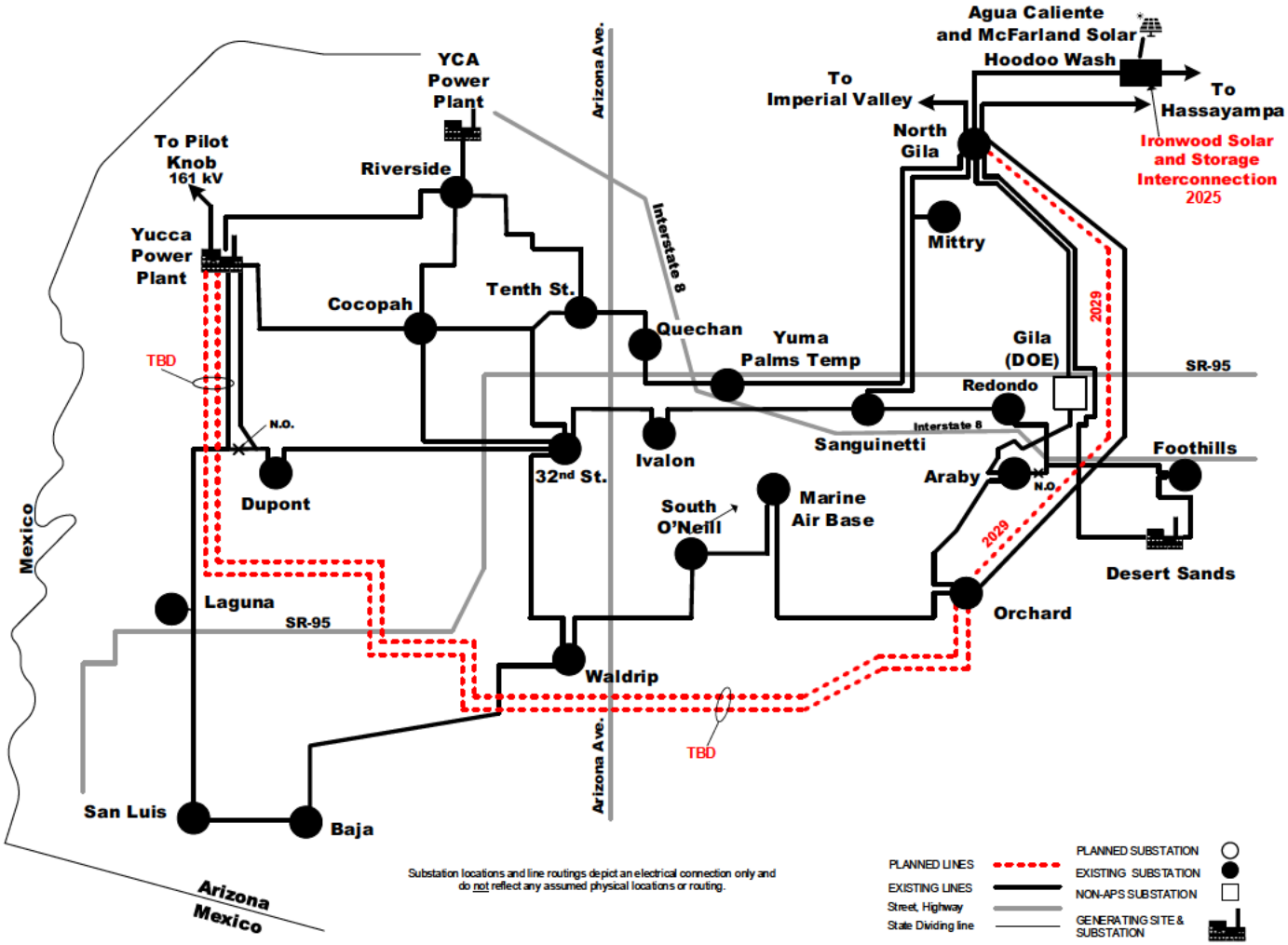
Arizona EHV and Outer Division Transmission Plans



Phoenix Metropolitan Area Transmission Plans



Yuma Area Transmission Plans



Project Descriptions

Goodyear 230kV Lines

Project Sponsor

Arizona Public Service Company

Other Participants

None

Construction Start

2024

Projected In-service Year

2025

Facility Details

Voltage Class	230kV AC
Facility Rating	3000 A
Point of Origin	Rudd-Three Rivers 230kV line
Intermediate Points of Interconnection	None
Point of Termination	Goodyear substation (in-service 2025)
Length	Less than 1 mile

Routing

The Goodyear substation is located south of Van Buren Street and east of Bullard Avenue in Goodyear. The Rudd-Three Rivers 230kV line heads south from Van Buren Street and routes east of Goodyear substation as it heads south and then west to Three Rivers substation. The line will be cut into the new 230kV bus on the southern end of Goodyear substation.

Purpose

To provide electric energy to a high-load customer in the area. In-service date is predicated on ramp rate of customer load.

Permitting and Siting Status

A CEC is not required.

Parkway 230kV Lines

Project Sponsor

Arizona Public Service Company

Other Participants

None

Construction Start

2023

Projected In-service Year

2025

Facility Details

Voltage Class	230kV AC
Facility Rating	3000 A
Point of Origin	Palm Valley-Trilby Wash 230kV line
Intermediate Points of Interconnection	None
Point of Termination	Parkway substation (in-service 2025)
Length	Less than 1 mile

Routing

The Parkway substation will be located adjacent to the Palm Valley-Trilby Wash 230kV line, north of Olive Avenue and between the Loop 303 and Cotton Lane.

Purpose

To provide a switchyard to connect the Contrail 230kV lines into the existing Palm Valley-Trilby Wash 230kV line.

Permitting and Siting Status

CEC issued on 12/22/2003 (Case No. 122, Decision No. 66646, West Valley-South Project). On 6/27/2013, Decision No. 73937 amended the CEC authorizing a term extension to 12/23/2018 for the first circuit of the Project and to 12/23/2028 for the second circuit and other facilities. On 10/2/2020, Decision No. 77761 amended the CEC authorizing an additional substation for a large-load customer. On 1/24/2024, Decision No. 79248 was further amended the CEC authorizing the addition of Dromedary substation to serve a large-load customer.

Broadway 230kV Lines

Project Sponsor

Arizona Public Service Company

Other Participants

None

Construction Start

2025

Projected In-service Year

2025

Facility Details

Voltage Class	230kV AC
Facility Rating	3000 A
Point of Origin	Runway-Rudd 230kV line
Intermediate Points of Interconnection	None
Point of Termination	Broadway substation
Length	Less than 1 mile

Routing

The Broadway substation will be cut into the Runway-Rudd 230kV line. The substation is located on the north side of Broadway Road and adjacent to the Runway-Rudd 230kV line.

Purpose

To provide electric energy to a high-load customer. In-service date is predicated on ramp rate of customer load.

Permitting and Siting Status

CEC issued 11/7/2019 (Case No. 183, Decision No. 77469).

Dromedary 230kV Substation and Lines

Project Sponsor

Arizona Public Service Company

Other Participants

None

Construction Start

2024

Projected In-service Year

2025

Facility Details

Voltage Class	230kV AC
Facility Rating	3000 A
Point of Origin	Palm Valley-Parkway 230kV line
Intermediate Points of Interconnection	None
Point of Termination	Dromedary 230kV substation (in-service 2025)
Length	Less than 1 mile

Routing

The existing Palm Valley-Trilby Wash 230kV line will be cut into the planned Dromedary substation, located at the northwest corner of Camelback Road and Cotton Lane in Glendale, using two double-circuit capable monopole structures. The Palm Valley-Trilby Wash 230kV line will become the Palm Valley-Parkway 230kV line in early 2025, following the completion of Parkway 230kV Lines project and prior to the completion of the Dromedary 230kV substation. The monopoles used for the cut-in of Dromedary substation will be capable of carrying both the existing 230kV line and the planned second circuit between Palm Valley and Parkway substations.

Purpose

To provide electric energy to a new high-load customer.

Permitting and Siting Status

CEC issued on 12/22/2003 (Case No. 122, Decision No. 66646, West Valley-South Project). On 6/27/2013, Decision No. 73937 amended the CEC authorizing a term extension to 12/23/2018 for the first circuit of the Project and to 12/23/2028 for the second circuit and other facilities. On 10/2/2020, Decision No. 77761 amended the CEC authorizing construction of an additional substation for a large-load customer. On 1/24/2024, Decision No.79248 further amended the CEC authorizing the construction of Dromedary substation to serve a large-load customer.

Hashknife Energy Center Transmission Provider Interconnection Facilities

Project Sponsor

Hashknife Energy Center LLC

Other Participants

Arizona Public Service Company

Construction Start

2025

Projected In-service Year

2025

Facility Details

Voltage Class	500kV AC
Facility Rating	TBD
Point of Origin	Point of Change of Ownership
Intermediate Points of Interconnection	None
Point of Termination	Cholla substation
Length	Less than 1 mile

Routing

The APS-owned portion of the line commences at the Point of Change of Ownership (POCO) just outside the Cholla generation plant controlled access boundary. From there, the line heads southeast for approximately 0.3 mile to the point of interconnection at the Cholla substation. A few structures carrying generator tie line will be collocated with the APS Coconino-Cholla 230kV line.

Purpose

To provide the Transmission Provider Interconnection Facility portion of the generator tie line to connect the Hashknife Energy Center Project to the Cholla substation.

Permitting and Siting Status

On 1/22/2021, in Decision Nos. 77888 and 77889 (Case No. 187), the Commission granted CEC-1 and CEC-2, respectively, to Hashknife Energy Center LLC. CEC-1 is for the portion of the Project that originates at the Hashknife Energy Center substation to the POCO, near the Cholla generation plant controlled access boundary. The companion CEC-2 is for the portion of the Project from the POCO to the point of interconnection at the Cholla substation. As of 1/6/2025, CEC-2 was transferred from the interconnection customer to APS.

Ironwood Solar and Storage 500kV Interconnection

Project Sponsor

Arizona Public Service Company

Other Participants

None

Construction Start

2025

Projected In-service Year

2025

Facility Details

Voltage Class	500kV AC
Facility Rating	TBD
Point of Origin	Wildcat substation (in-service 2025)
Intermediate Points of Interconnection	None
Point of Termination	Hoodoo Wash switchyard
Length	Less than 1 mile

Routing

The generation tie line will exit the Wildcat generation step-up substation at 500kV. The 500kV generation tie line will route along the north side of Palomas Road for approximately 3,000 feet, terminating in the Hoodoo Wash switchyard. Approximately 1,000 feet will be collocated on Hassayampa-North Gila 500kV line as it enters the Hoodoo Wash switchyard.

Purpose

To connect the Ironwood Solar and Storage 500kV interconnection project to the Hoodoo Wash switchyard.

Permitting and Siting Status

CEC was issued 4/17/2023 (Case No. 214, Decision No. 78914, Proving Ground Solar and Storage Project). CEC 214 authorized a 0.6 mile 500kV transmission line to connect the Ironwood Solar and Storage Project to the Hoodoo Wash 500kV switchyard. The Decision also amended CEC 135 (Case No. 135, Decision No. 70127, Palo Verde to North Gila) to authorize the use of a new structure on the Hassayampa-North Gila 500kV line to facilitate the interconnection of the new Ironwood Solar and Storage Project 500kV line into Hoodoo Wash.

West Camp Wind Gen-Tie Project

Project Sponsor

West Camp Wind Farm, LLC

Other Participants

Arizona Public Service Company

Construction Start

2024

Projected In-service Year

2025

Facility Details

Voltage Class	345kV AC
Facility Rating	TBD
Point of Origin	Point of Change of Ownership
Intermediate Points of Interconnection	Sitgreaves switchyard (in-service 2025)
Point of Termination	Cholla-Mazatzal 345kV line
Length	Less than 1 mile

Routing

The line will extend from the Point of Change of Ownership (POCO) between West Camp Wind and APS, located on the first structure of the West Camp Wind generation tie line outside of the new APS Sitgreaves interconnection switchyard. Sitgreaves is located south of the Cholla-Mazatzal 345kV line. Lines will be extended from the switchyard to the Cholla-Mazatzal 345kV line to cut the line in and out of the new switchyard.

Purpose

To connect the West Camp Wind Farm generation project to the Cholla-Mazatzal 345kV line.

Permitting and Siting Status

On 12/15/2022, the Commission granted CEC-206-1 (Case No. 206, Decision No. 78810) and CEC-206-2 (Case No. 206, Decision No. 78811) to West Camp Wind Farm, LLC. CEC-206-1 is for the lines from the collector substations to POCO outside the planned APS switchyard. CEC-206-2 is for the new APS 345kV interconnection switchyard and ties to the Cholla-Mazatzal 345kV line and will be transferred to APS in the future.

Contrail 230kV Lines

Project Sponsor

Arizona Public Service Company

Other Participants

None

Construction Start

2024

Projected In-service Year

2025

Facility Details

Voltage Class	230kV AC
Facility Rating	3000 A
Point of Origin	El Sol substation
Intermediate Points of Interconnection	Contrail substation, Raptor switchyard (in-service 2026), and Sabre switchyard (in-service 2026)
Point of Termination	Parkway substation (in-service 2025)
Length	Approximately 9 miles

Routing

A single circuit line will originate at the El Sol substation and will head generally west and connect into the Contrail substation, located on the southeast corner of Olive Avenue and Dysart Road. From Contrail substation, the line will head north to Peoria Avenue along the 127th Avenue alignment. The future Raptor switchyard will connect into the line along this alignment. The line will head west on Peoria Avenue to Litchfield Road and then generally south and west until it terminates at the future Parkway substation. The future Sabre switchyard will tie into the line along Olive Avenue near the 147th Avenue alignment. All structures are planned to be double-circuit capable.

Purpose

To provide electric energy to high-load customers in the area. In-service date is predicated on ramp rate of customer load.

Permitting and Siting Status

CEC issued 4/28/2022 (Case No. 198, Decision No. 78543). On 11/15/2024, Decision No. 79601 amended the CEC authorizing the addition of the Sabre switchyard to serve a large-load customer. APS anticipates filing an application to amend CEC 198 in 2025 to request authorization for construction of the Raptor switchyard.

Runway Additional 230kV Lines

Project Sponsor

Arizona Public Service Company

Other Participants

None

Construction Start

2026

Projected In-service Year

2027

Facility Details

Voltage Class	230kV AC
Facility Rating	3000 A
Point of Origin	White Tanks-West Phoenix 230kV line
Intermediate Points of Interconnection	Diamond substation (in-service 2027)
Point of Termination	Runway substation
Length	Approximately 4.2 miles

Routing

The new double circuit 230kV line to Runway substation will cut into the existing White Tanks-West Phoenix 230kV line just north of West Buckeye Road. It will generally head southwest along an existing transmission corridor and then west to the Diamond 230kV substation, spanning approximately 2.5 miles. From Diamond substation it will head north along Litchfield Road to Lower Buckeye Road, then west on Lower Buckeye Road to Maricopa County Road 85. The line will head southwest along Maricopa County Road 85 before turning south to Runway substation. Diamond substation will be cut into the future Runway-West Phoenix 230kV line, which will be located on the south side of the new double circuit structures.

Purpose

To provide electric energy to high-load customers. The in-service date is predicated on the ramp rate of customer load.

Permitting and Siting Status

CEC issued 1/23/2023 (Case No. 209, Decision No. 78834).

Snowflake Solar Transmission Provider Interconnection Facilities

Project Sponsor

Snowflake Solar, LLC

Other Participants

Arizona Public Service Company

Construction Start

2026

Projected In-service Year

2027

Facility Details

Voltage Class	500kV AC
Facility Rating	TBD
Point of Origin	Point of Change of Ownership Pole
Intermediate Points of Interconnection	None
Point of Termination	Cholla substation
Length	Approximately 1.5 miles

Routing

The APS-owned portion of the line will begin at the point of change of ownership (POCO) located south of Cholla Lake and east of the Cholla-Snowflake 69kV line. The line will extend northwest between Cholla Lake and the Burlington Northern Santa Fe (BNSF) Railway from the POCO to Cholla substation.

Purpose

To provide the Transmission Provider Interconnection Facility portion of the generation tie line to connect the Snowflake Solar Project to the Cholla substation.

Permitting and Siting Status

CEC pending Commission action (anticipated in February 2025). The Line Siting Committee approved CEC 240-A for the portion of the project from the Snowflake Solar Facility substation to the POCO and CEC 240-B for the construction of the APS-owned portion of the line from the POCO to Cholla substation. At a future date, prior to construction, CEC 240-B will be transferred to APS.

Sun Valley to Outer Circle 230kV Line

Project Sponsor

Arizona Public Service Company

Other Participants

None

Construction Start

2026

Projected In-service Year

2027

Facility Details

Voltage Class	230kV AC
Facility Rating	3000 A
Point of Origin	Sun Valley substation
Intermediate Points of Interconnection	None
Point of Termination	Outer Circle substation (in-service 2027)
Length	Approximately 17 miles

Routing

The line would originate at the Sun Valley Substation and head north to the existing Sun Valley-Morgan 500kV alignment. From there, the line will head generally north and east, utilizing the open circuit position on the existing Sun Valley-Morgan 500kV line structures. The line will terminate at the Outer Circle substation, located on the southeast corner of the 235th Avenue alignment and Grand Avenue, northwest of the City of Surprise.

Purpose

To provide electric energy to growing load demands in the northwest Surprise and Wittmann areas, including proposed new logistics and industrial loads. In addition, this new 230/69kV source substation will reduce loading constraints and provide greater reliability for the Wickenburg, Morristown, Wittmann and Surprise areas.

Permitting and Siting Status

CEC issued (Case No. 138, Decision No. 70850, amended by Decision Nos. 71645 and 75092, TS5-TS9 500/230kV Project). This CEC allows for the addition of the 230kV line collocated with the Sun Valley-Morgan 500kV line.

Sundance to Milligan 230kV Line

Project Sponsor

Arizona Public Service Company

Other Participants

Electrical District #2

Construction Start

2026

Projected In-service Year

2027

Facility Details

Voltage Class	230kV AC
Facility Rating	TBD
Point of Origin	Sundance to Faul 230kV line
Intermediate Points of Interconnection	TS33 substation (in-service 2027), TS25 substation (in-service TBD)
Point of Termination	Milligan substation
Length	Approximately 23 miles

Routing

Approximately one quarter mile of the Sundance to Pinal Central 230kV line has been constructed from Sundance switchyard to the Electrical District #2 Faul 69kV Substation. A new APS substation, TS33, will be cut into this line within the Sundance Generation Plant property and along the approved alignment of the project. From TS33, an initial single-circuit line will be extended south to Randolph Road. From Randolph Road, the line will head west to the Curry Road alignment. The line will then head south on the Curry Road alignment to the south side of the Duke-Pinal Central 500kV line right of way. From that point, the line will head east, paralleling the Duke-Pinal Central 500kV line, passing by Pinal Central substation. From there, the line will head generally east, crossing State Route 87 and will then head south to the vicinity of Milligan Road. The line will then head generally west to Milligan substation. Single-circuit lines will be constructed to be capable of a future second circuit.

Purpose

To provide an alternative route for Sundance generation to be delivered to APS load, to increase operational flexibility, and to support future load growth in Pinal County.

Permitting and Siting Status

The section of the project from Sundance to Pinal Central is authorized by CEC 136. This CEC was issued 4/29/2008 (Case No. 136, Decision No. 70325, Sundance to Pinal South 230kV Transmission Line project). On 12/17/2024, Decision No. 79619 amended the CEC authorizing a term extension to 4/29/2035. APS anticipates filing an application in 2025 for a new CEC for the section of the project from Pinal Central to Milligan.

Bagdad 230kV Transmission Line

Project Sponsor

Arizona Public Service Company

Other Participants

None

Construction Start

2027

Projected In-service Year

2028

Facility Details

Voltage Class	230kV AC
Facility Rating	3000 A
Point of Origin	Mead Phoenix Project Q01 substation (in-service 2028)
Intermediate Points of Interconnection	None
Point of Termination	TS31 substation (in-service 2028)
Length	Approximately 14 miles

Routing

The Mead Phoenix Project Q01 substation will tap the Mead-Perkins 500kV line approximately 4 miles southeast of the intersection of US 93 and SR 97. From Mead Phoenix Q01, a new 230kV line will proceed northwest for approximately 1 mile, parallelling the Perkins-Mead 500kV line, and will then proceed generally north to the new TS31 substation, which will be adjacent to the existing Willow Lake-Bagdad 115kV transmission line and approximately 1 mile east of the town of Bagdad.

Purpose

To provide electric energy to a high-load customer and increase reliability in the Bagdad area.

Permitting and Siting Status

CEC issued 12/31/2024 (Case No. 238, Decision No. 79645, Bagdad 230kV Transmission Line Project).

Bianco 230kV Lines

Project Sponsor

Arizona Public Service Company

Other Participants

None

Construction Start

2027

Projected In-service Year

2028

Facility Details

Voltage Class	230kV AC
Facility Rating	TBD
Point of Origin	Santa Rosa-Desert Basin 230kV line
Intermediate Points of Interconnection	None
Point of Termination	Bianco substation (in-service 2028)
Length	Approximately 4 miles

Routing

The future Bianco substation, located east of Bianco Road and between Clayton Road and SR 84 in Casa Grande, will be cut in and out of the of existing Santa Rosa-Desert Basin 230kV line. The new section of the Santa Rosa-Bianco 230kV line will head generally south from the existing line to Bianco substation paralleling Bianco Road. The new section of the Desert Basin-Bianco 230kV line will head generally south from the existing line in a new alignment between Bianco Road and Ethington Road. The new line sections will be constructed with capability to add a future second circuit.

Purpose

To support continued load growth in Pinal County, including new manufacturing and industrial customers in the Casa Grande area. Significant load increases in the Pinal County area over the past several years, coupled with anticipated continued growth will result in thermal overloads on Pinal County 69kV lines. The projected overloads will be resolved through the addition of Bianco substation. The Bianco project will also resolve existing paired element limitations at the Casa Grande substation.

Permitting and Siting Status

APS anticipates filing an application in 2025 for a new CEC.

Q264 Transmission Provider Interconnection Facilities

Project Sponsor

Arizona Public Service Company

Other Participants

Q264 Solar and Storage Project

Construction Start

2027

Projected In-service Year

2028

Facility Details

Voltage Class	230kV AC
Facility Rating	TBD
Point of Origin	Point of Change of Ownership
Intermediate Points of Interconnection	None
Point of Termination	Milligan Substation
Length	Approximately 1 mile each (1 new and 1 upgraded circuit)

Routing

Starting at the Point of Change of Ownership (POCO), approximately one mile south of Milligan substation, the APS portion of the Q264 Solar and Storage generation tie line will extend approximately one mile north to Milligan substation. The APS portion of the generation tie line will be collocated with the existing APS Saguaro-Milligan 230kV line, which will be rebuilt as a double-circuit line from the POCO to Milligan substation.

Purpose

To provide the Transmission Provider Interconnection Facility portion of the generation tie line to connect the Q264 generation project to Milligan substation.

Permitting and Siting Status

CEC issued 7/31/1979 (Case No. 44, Decision No. 50341, Santa Rosa to Saguaro). APS anticipates filing an application to amend the CEC to authorize a second circuit on the section of the line from the POCO to Milligan substation.

Cholla-Chevelon 345kV Line Cut-In to Sitgreaves

Project Sponsor

Arizona Public Service Company

Other Participants

None

Construction Start

2027

Projected In-service Year

2028

Facility Details

Voltage Class	345kV AC
Facility Rating	TBD
Point of Origin	Cholla-Chevelon 345kV line
Intermediate Points of Interconnection	None
Point of Termination	Sitgreaves switchyard (in-service 2025)
Length	Less than 1 mile

Routing

This project will cut the Cholla-Chevelon 345kV line in and out of the Sitgreaves switchyard.

Purpose

To provide more flexibility in operating the generation and loads within the corridor from Cholla to Pinnacle Peak and ensure reliable output of the West Camp Wind generation.

Permitting and Siting Status

The need for a CEC has not yet been determined.

TS22 Project

Project Sponsor

Arizona Public Service Company

Other Participants

None

Construction Start

2027

Projected In-service Year

2028

Facility Details

Voltage Class	230kV AC and 500kV AC
Facility Rating	TBD
Point of Origin	Raceway-Avery 230kV line and Morgan-Pinnacle Peak 500kV line
Intermediate Points of Interconnection	None
Point of Termination	TS22 substation (in-service 2029)
Length	Approximately 1 mile (500kV overhead and 230kV underground)

Routing

The TS22 substation is planned to be located generally northeast of the intersection of 51st Avenue and Dove Valley Road and will be on the south side of the double-circuit transmission poles carrying the Raceway-Avery 230kV line and the Morgan-Pinnacle Peak 500kV line. The project will cut the new substation in and out of the existing 230kV and 500kV lines. The 500kV lines will be brought overhead into the new substation and the 230kV lines will be brought into the substation underground.

Purpose

To provide electric energy to a high-load customer and support planned growth in the Biscuit Flats area of north Phoenix.

Permitting and Siting Status

CEC issued 2/20/2007 (Case No. 131, Decision No. 69343, Morgan-Pinnacle Peak 500kV/230kV Transmission Line Project). Decision No. 78251, on 9/29/2021, amended the CEC authorizing the cut-in and construction of a third substation (TS22) along the lines.

Saguaro Power Campus Upgrades

Project Sponsor

Arizona Public Service Company

Other Participants

None

Construction Start

2028

Projected In-service Year

2029

Facility Details

Voltage Class	115kV AC and 230kV AC
Facility Rating	TBD
Point of Origin	Saguaro-Milligan 230kV line, Saguaro-Santa Rosa 230kV line, and Saguaro-Serrano Solar 230kV line
Intermediate Points of Interconnection	None
Point of Termination	Saguaro Substation
Length	Approximately 1 mile per line (four lines)

Routing

The 230kV yard within Saguaro substation will be relocated to an expanded footprint in an area directly west of the existing 500kV yard. The Saguaro-Milligan, Saguaro-Santa Rosa, and Saguaro-Serrano Solar 230kV lines will need to re-routed and extended to the north and east by 0.5 to 1 mile each to connect into the new 230kV yard. Similarly, the ties to the Saguaro 230/115kV transformers will also need to be routed into the new yard and the existing 500/115kV transformers will be transferred to the 230kV yard, utilizing the available 500/230kV windings. Approximately 0.5 mile of the Saguaro-San Manuel 115kV line will need to be relocated to facilitate the construction of the new 230kV yard.

Purpose

To reduce fault duty at the Saguaro 115kV yard, which is approaching the limitations of the existing equipment. The project will also increase capacity by directly connecting the Saguaro 500kV and 230kV yards and will allow for the connection of future 230kV lines to allow for generation interconnections or the expansion of the Pinal County network, improving ability to serve growth in Pinal County and Metro Phoenix.

Permitting and Siting Status

Applications for new CECs and CEC amendments have not been filed.

Pinnacle Peak to Ocotillo 230kV Line Rebuilds

Project Sponsor

Arizona Public Service Company

Other Participants

None

Construction Start

2028

Projected In-service Year

2029

Facility Details

Voltage Class	230kV AC
Facility Rating	TBD
Point of Origin	Pinnacle Peak substation
Intermediate Points of Interconnection	TS17 substation (in-service TBD), Cactus substation, Brandow substation (SRP), and Ward substation (SRP)
Point of Termination	Ocotillo substation
Length	Approximately 25 miles per line (4 lines)

Routing

Rebuild the two sets of double-circuit lines using similar structures between Pinnacle Peak and Ocotillo substations. The APS Pinnacle Peak-Ocotillo 230kV line, Pinnacle Peak-Cactus 230kV line, and Cactus-Ocotillo 230kV line will be rebuilt along with the SRP lines sharing the structures (the SRP Pinnacle Peak-Brandow and Brandow-Ward 230kV lines). The lines will be rebuilt in the existing alignment and with structures that are of a similar type and height. Existing conductor will be replaced with a new, higher rated conductor.

Purpose

To replace the existing structures between Pinnacle Peak and Ocotillo. This project will replace aging towers to ensure continued reliability and safety for the Metro Phoenix load pocket and will also support future load increases.

Permitting and Siting Status

These lines do not have a CEC as they were constructed in the 1960's. APS will monitor project development and permitting needed, if any.

North Gila-Orchard 230kV Line Circuit #2

Project Sponsor

Arizona Public Service Company

Other Participants

None

Construction Start

2028

Projected In-service Year

2029

Facility Details

Voltage Class	230kV AC
Facility Rating	3000 A
Point of Origin	North Gila substation
Intermediate Points of Interconnection	None
Point of Termination	Orchard substation
Length	Approximately 13 miles

Routing

The second North Gila-Orchard 230kV line will be constructed as a second circuit on the poles supporting the existing North Gila-Orchard 230kV line. The line exits North Gila, heading generally south. It routes to the east of the WAPA Gila substation and then heads southwest along the canal to State Route 195. It then heads south, paralleling State Route 195 to the County 13½ Street Alignment where it heads west to the Avenue 5½ E alignment and then south to Orchard substation.

Purpose

To provide additional capacity to support the connection of a new solar and storage generation facility at Orchard substation.

Permitting and Siting Status

CEC issued 2/2/2012 (Case No. 163, Decision No. 72801, North Gila to TS8 to Yucca 230kV Transmission Line Project). The CEC allows for a second 230kV circuit collocated with the existing North Gila-Orchard 230kV line.

Agua Fria to Contrail 230kV Line

Project Sponsor

Arizona Public Service Company

Other Participants

None

Construction Start

2028

Projected In-service Year

2030

Facility Details

Voltage Class	230kV AC
Facility Rating	TBD
Point of Origin	Agua Fria substation (SRP)
Intermediate Points of Interconnection	None
Point of Termination	Contrail substation
Length	Approximately 10 miles

Routing

The new line will exit Agua Fria substation and head west for approximately 4.6 miles to the transmission corridor parallelling the 111th Avenue alignment. Along this route, the new line will share structures with the existing Agua Fria-El Sol 230kV line. The line will then head south for approximately 1.4 miles, sharing structures with the existing El Sol-White Tanks 230kV line. At Glendale Avenue, the line will head west along a new alignment along Glendale Avenue and then west and north to Contrail substation, which is located south of Olive Avenue between El Mirage Road and Dysart Road.

Purpose

To support load growth and maintain the reliability of the 230kV network in the western part of the Phoenix Metropolitan area.

Permitting and Siting Status

An application for a CEC has not been filed.

Panda to Freedom 230kV New Line

Project Sponsor

Arizona Public Service Company

Other Participants

None

Construction Start

2029

Projected In-service Year

2030

Facility Details

Voltage Class	230kV AC
Facility Rating	3000 A
Point of Origin	Panda 230kV substation
Intermediate Points of Interconnection	Komatke substation (in-service TBD) and Hazen substation (in-service 2030)
Point of Termination	Freedom 230kV substation
Length	Approximately 40 miles

Routing

Heading north from Panda substation to Jojoba substation, the line will be constructed in a new alignment west of the existing Gila River-Jojoba 500kV lines. The line will be constructed using monopoles capable of supporting a second future 500kV line. From Jojoba to the Gila River, the line will be built in a new alignment adjacent to the existing line. In this section the new line will share structures with the planned Jojoba-TS21 500kV line. North of the Gila River, the Panda-Freedom 230kV line will be cut into the Hazen substation, to be located at the northwest corner of Hazen Road and the 255th Avenue alignment in Buckeye. From there, the Panda-Freedom 230kV line and Jojoba-TS21 500kV line will head east on shared structures in a new alignment generally paralleling the Gila River. From a point generally south of Freedom substation, the new Panda-Freedom 230kV line will head north in a new alignment, terminating at Freedom and separate from the Jojoba-TS21 500kV line route. This final section will utilize monopole structures capable of carrying a future second 230kV circuit.

Purpose

To alleviate projected loading constraints on the existing Panda-Freedom line due to load growth in Metro Phoenix and generation additions in the vicinity of the Gila River and Panda substations. The line will also support continued customer growth in the Buckeye area and increase access to diverse generation resources.

Permitting and Siting Status

An application for a CEC has not yet been filed.

Jojoba-Rudd 500kV Line

Project Sponsor

Arizona Public Service Company

Other Participants

Salt River Project

Construction Start

2029

Projected In-service Year

2032

Facility Details

Voltage Class	500kV AC
Facility Rating	TBD
Point of Origin	Jojoba switchyard
Intermediate Points of Interconnection	TS21 substation (in-service 2032)
Point of Termination	Rudd substation
Length	Approximately 28 miles

Routing

The Jojoba-Rudd 500kV line will exit Jojoba substation and join with the new Panda-Freedom 230kV line, sharing double-circuit structures with that line. Both lines will head generally north, paralleling the existing Panda-Freedom 230kV alignment until they reach the area north of the Gila River. From there, the lines will head generally east, staying north of the Gila River until a point south of Freedom substation, where the lines will split. From this point, the Jojoba-Rudd line will head generally northeast to the future TS21 substation, targeted in an area south of the Palo Verde-Rudd 500kV line corridor and west of Cotton Lane. Between the split with the Panda-Freedom 230kV line and TS21, the new line will be constructed using structures capable of a future second 230kV circuit. From TS21, the line will head generally east to Rudd, paralleling the Palo Verde-Rudd corridor. Circuit arrangement in the corridor from TS21 to Rudd has not yet been determined.

Purpose

To provide an additional EHV source to the Phoenix Metropolitan area, which is experiencing rapid economic development. This line ensures reliable operation of the Phoenix Metropolitan transmission network and supports load growth. In addition, this new source will provide customers greater access to a diverse mix of resources from around the region.

Permitting and Siting Status

An application for a CEC has not yet been filed.

Runway-Stratus 230kV Line Cut-In to TS21

Project Sponsor

Arizona Public Service Company

Other Participants

None

Construction Start

2029

Projected In-service Year

2032

Facility Details

Voltage Class	230kV AC
Facility Rating	3000 A
Point of Origin	Runway-Stratus 230kV line
Intermediate Points of Interconnection	None
Point of Termination	TS21 substation (in-service 2032)
Length	Approximately 1 mile

Routing

New 230kV lines will be extended south from the Runway-Stratus 230kV line to the TS21 substation to cut the line in and out of TS21. The location of TS21 is targeted in an area south of the corridor containing the Runway-Stratus 230kV line and Palo Verde-Rudd 500kV line and west of Cotton Lane.

Purpose

To support the growing demand from high-load data center customers in the West Valley by connecting the TS21 substation into the 230kV network. The TS21 500/230kV substation and 230kV lines will relieve loading constraints on the Rudd substation and other 230kV lines in the West Valley.

Permitting and Siting Status

An application for a CEC has not yet been filed.

TS21 to Broadway 230kV Line

Project Sponsor

Arizona Public Service Company

Other Participants

None

Construction Start

2029

Projected In-service Year

2032

Facility Details

Voltage Class	230kV AC
Facility Rating	3000 A
Point of Origin	TS21 substation (in-service 2032)
Intermediate Points of Interconnection	None
Point of Termination	Broadway substation
Length	Approximately 6 miles

Routing

A new 230kV line will be extended generally northeast from the future TS21 substation to Broadway Road. From Broadway Road, the line will head east to Broadway substation, paralleling the WAPA 230kV line corridor. The line will be capable of a future second 230kV circuit and 69kV underbuild.

Purpose

To support the growing demand from high-load data center customers in the West Valley by connecting the TS21 substation into the 230kV network. The TS21 500/230kV substation and 230kV lines will relieve loading constraints on the Rudd substation and other 230kV lines in the West Valley.

Permitting and Siting Status

An application for a CEC has not yet been filed.

Four Corners to Cholla to Pinnacle Peak 345kV Line Rebuilds

Project Sponsor

Arizona Public Service Company

Other Participants

None

Construction Start

2032

Projected In-service Year

2037

Facility Details

Voltage Class	345kV AC
Facility Rating	3000 A
Point of Origin	Four Corners substation
Intermediate Points of Interconnection	Cholla substation, Sitgreaves switchyard (in-service 2025), Chevelon switchyard, Preacher Canyon substation, and Mazatzal substation
Point of Termination	Pinnacle Peak substation
Length	Approximately 289 miles per line (2 lines)

Routing

Rebuild the two existing circuits between Four Corners substation and Pinnacle Peak substation. For most of the route, lines will be rebuilt out of lead to avoid extended system outages.

Purpose

To replace existing lattice towers along the entire route. This rebuild will replace aging towers to ensure continued reliability and safety, improve deliverability into the Metro Phoenix area, and increase import capability to the Metro Phoenix area from the Cholla substation and the Four Corners region. The increase in capacity of the rebuilt lines will improve access to a diverse mix of resources from the Four Corners region and the southwest. The lines will be constructed to accommodate potential conversion to 500kV operation in the future.

Permitting and Siting Status

An application for a CEC has not yet been filed.

To Be Determined Projects

List of To Be Determined Projects

Table 5: To Be Determined Projects

Project Name	Permitting and Siting Status
El Sol to Westwing 230kV Line	CEC issued (Case No. 9, Docket No. U-1345).
Palo Verde to Saguaro 500kV Line	CEC issued (Case No. 24, Decision No. 46802).
Komatke 230/69kV Substation	CEC issued (Case No. 102, Decision No. 62960).
Palm Valley-Dromedary-Parkway 230kV Line Circuit #2	CEC issued (Case No. 122, Decision No. 66646, amended by Decision Nos. 73937, 77761 and 79248 West Valley-South 230kV Transmission Line Project).
Sun Valley to Trilby Wash 230kV Line Circuit #2	CEC issued (Case No. 127, Decision No. 67828, amended by Decision Nos. 74955 and 75045, West Valley North 230kV Transmission Line project).
Trilby Wash to Parkway 230kV Line Circuit #2	CEC issued (Case No. 127, Decision No. 67828, amended by Decision Nos. 74955 and 75045, West Valley North 230kV Transmission Line project).
El Sol-Contrail-TS34-Sabre-Parkway 230kV Line Circuit #2	CEC issued (Case No. 183, Decision No. 77469, amended by Decision No. 79601, West Valley Central CEC).
Morgan to Outer Circle 230kV Line	CEC issued (Case No. 138, Decision No. 70850, amended by Decision Nos. 71645 and 75092, TS5-TS9 500/230kV Project).
Orchard to Yucca 230kV Lines	CEC issued (Case No. 163, Decision No. 72801, North Gila to TS8 to Yucca 230kV Transmission Line Project).
TS35-TS11-Sun Valley 230kV Line	An application for a CEC has not yet been filed.
Sun Valley-TS10-TS11 230kV Line	An application for a CEC has not yet been filed.
Delaney to Quartzsite 500kV and 230kV Lines	An application for a CEC has not yet been filed.
Quartzsite to Colorado River 500kV Line	An application for a CEC has not yet been filed.

Project Name	Permitting and Siting Status
TS14 230KV Lines	An application for a CEC has not yet been filed.
TS17 230kV Lines	An application for a CEC has not yet been filed.
TS30 500/230kV Substation and Lines	An application for a CEC has not yet been filed.
TS32 230kV Lines	An application for a CEC has not yet been filed.
TS35 Substation and Lines	An application for a CEC has not yet been filed.
Obed Meadow Transmission Provider Interconnection Facilities	CEC issued (Case No. 222, Decisions No. 79187 and 79188). CEC 222-B will be transferred to APS at a future date.
Panda-Freedom 230kV Line Upgrade	CEC issued (Case No. 26, Decision No. 46865, Liberty to Gila Bend).

Attachment B

Renewable Transmission Action Plan

Arizona Public Service Company
Renewable Transmission Action Plan
January 2025

In the Fifth Biennial Transmission Assessment (BTA) Decision, (Decision No. 70635, December 11, 2008), the Arizona Corporation Commission (ACC or Commission) ordered Arizona Public Service Company (APS or Company) to file a document identifying their top potential Renewable Transmission Projects (RTPs) that would support the growth of renewable resources in Arizona. As such, on January 29, 2010, APS filed with the Commission its top potential RTPs, which were identified in collaboration with the Southwest Area Transmission planning group (SWAT) and its subgroups, other utilities and stakeholders. In its filing, APS included a Renewable Transmission Action Plan (RTAP), which included the method used to identify RTPs, project approval and financing of the RTPs.

On January 6, 2011, the Commission approved APS's first RTAP (Decision No. 72057, January 6, 2011[1]), which allows APS to pursue the development steps indicated in the APS RTAP. The Decision, in part, ordered:

> *IT IS FURTHER ORDERED that the timing of the next Renewable Transmission Action Plan filing shall be in parallel with the 2012 Biennial Transmission Assessment process.*
>
> *IT IS FURTHER ORDERED that Arizona Public Service Company shall, in any future Renewable Transmission Action Plans filed with the Commission, identify Renewable Transmission Projects, which include the acquisition of transmission capacity, such as, but not limited to, (i) new transmission line(s), (ii) upgrade(s) of existing line(s), or (iii) the development of transmission project(s) previously identified by the utility (whether conceptual, planned, committed and/or existing), all of which provide either:*
>
> 1. *Additional direct transmission infrastructure providing access to areas within the state of Arizona that have renewable energy resources, as defined by the Commission's Renewable Energy Standard Rules (A.A.C. R14-2-1801, et seq.), or are likely to have renewable energy resources; or*
> 2. *Additional transmission facilities that enable renewable resources to be delivered to load centers.*

Over the last decade across the country, and specifically within APS's generation interconnection queue, there is significant activity to interconnect renewable energy projects. These projects have ranged from large scale projects connecting into the Bulk Electric System, down to smaller scale projects connecting into the local sub-transmission and distribution systems. The development of renewable energy projects is now the overwhelming majority of interconnection requests that are received and are an important source of energy to meet future resource needs.

Two of the three RTPs that APS filed in its original RTAP have been completed. The remaining RTP that APS filed in its original RTAP continues to be viable and is being developed as reliability and resource needs have been identified within the planning horizon. Described below is the current status of the proposed development

[1] *Commission Decision No. 72057 found that APS's 2010 RTAP process and Plan is appropriate and consistent with the Commission's Fifth Biennial Transmission Assessment final order.*

plan for a Palo Verde to Liberty and Gila Bend to Liberty projects (approved by the Commission in Decision No. 72057).

> The Palo Verde to Liberty and Gila Bend to Liberty projects were conceptual in nature when they were proposed. APS's 2025-2034 Ten-Year Transmission System Plan contains projects that closely resemble those proposed projects, but in an updated and more appropriate form for the existing transmission system. These projects include the Jojoba-Rudd 500kV Line project and the Panda to Freedom 230kV New Line project.
>
> The Jojoba-Rudd 500kV Line project accomplishes the goals of the conceptual Palo Verde hub to Liberty project. While Jojoba is not within the Palo Verde hub it does connect directly to the Palo Verde hub and will help to increase the deliverability of resources from the Palo Verde hub into Phoenix.
>
> The second project is the Panda to Freedom 230kV New Line project. The new line will provide a significant increase in the capability to deliver resources from the Gila Bend area.
>
> Both of these projects are in the planning phase.

The APS 2025-2034 Ten-Year Transmission System Plan does not show a need for additional RTPs beyond what the Commission approved in Decision No. 72057. As a result, in this RTAP APS is not proposing new RTPs. APS will explore new renewable transmission opportunities when appropriate.

Attachment C

Technical Study on the Effects of Distributed Generation/Energy Efficiency on Fifth Year Transmission Plan

Arizona Public Service Company Technical Study on the Effects of Energy Efficiency and Distributed Generation on Future Transmission Needs

Prepared for the Arizona Corporation Commission

January 2025

aps

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Executive Summary

In Decision No. 74785 (October 24, 2014), during the Eighth Biennial Transmission Assessment (Eighth BTA), the Commission ordered Arizona utilities with retail load to study the effects of Energy Efficiency (EE) and Distributed Generation (DG) on their future planned transmission systems in their fifth planning year (the Study).

To perform the Study, Arizona Public Service Company (APS) used a 2029 Heavy Summer base case, which was reviewed and updated by APS, Salt River Project (SRP), Tucson Electric Power (TEP), UNS Electric (UNSE), Arizona Electric Power Cooperative (AEPCO), and Western Area Power Administration (WAPA) (Arizona entities).

- The first case is the base case containing typical system peak planning load, which includes the effects of EE/DG offset to peak load.
- The second case is the base case with the projected increases in EE/DG over the next five (5) years backed out of the load forecast.
- The projected increases of EE and DG in APS's footprint for 2025 to 2029 that are backed out of the forecast for this case total 771 MW, which includes 598 MW for EE and 173 MW for DG.
- The projected increases of EE and DG in SRP's footprint for 2025 to 2029 that are backed out of the forecast for this case total 215 MW, which includes 158 MW for EE and 57 MW for DG.

The Study indicated that the delayed or non-implemented EE and DG over APS and SRP's combined footprint causes no additional thermal overloads or voltage violations on 115kV and above transmission facilities.

Introduction

In Decision No. 74785 (October 24, 2014), during the Eighth Biennial Transmission Assessment (Eighth BTA), the Commission ordered Arizona utilities with retail load to study the effects of Distributed Generation (DG) and Energy Efficiency (EE) installations and programs on their future planned transmission systems. The Decision states:

> The technical study should be performed on the fifth year transmission plan by disaggregating the utilities' load forecasts from effects of EE/DG and performing contingency analysis with and without the disaggregate EE/DG. The technical study should at a minimum discuss EE/DG forecasting methodologies and transmission loading impacts. The study should monitor transmission down to and including the 115 kV level. Alternative methodologies or study approaches will be acceptable on condition that the study results satisfy the minimum requirements [above].[1]

Study Requirements and Assumptions

Study Requirements

To fulfill the requirement from the Eighth BTA, the Study looks at two load scenarios outlined in Table 1 below. The first case uses the forecasted load including the effects of EE/DG per the typical planning process. The second case uses the forecasted load excluding the effects of projected increases in EE and DG between 2025 and 2029. This scenario is equivalent to "disaggregating the utilities load forecasts from effects of EE/DG.[2]"

Table 1: Summary of Cases

Case	Scenario	Load	EE	DG	Utility Solar
1	Base	Peak	On	On	On
2	EE/DG	Peak	Pre-2025 Only	Pre-2025 Only	On

[1] Decision No. 74785 at 9:22-27 and 10:1-2.
[2] *Id.* at 9:22-24.

Because of the interconnected nature of the APS and SRP transmission systems, APS coordinated with SRP to obtain the projected increases in EE and DG within the SRP system between 2025 and 2029 in addition to the impacts projected within the APS system. These respective impacts were backed out of the SRP and APS load forecasts in the EE/DG scenario identified in Table 1 above.

The Study monitored the loading impacts to the transmission system and performed reliability analysis in the same manner as the ten-year planning process. For the two cases, APS and SRP transmission facilities greater than 115kV were monitored to ensure there are no thermal or voltage criteria violations. These facilities were monitored with all lines in-service and for all single contingencies.

Studied Case Assumptions

The Study used a 2029 heavy summer power flow case, which included the planned projects in SRP's and APS's 2024 to 2033 Ten-Year Plans and was jointly developed by Arizona entities for use in planning studies during 2024. This 2029 planning case became the base case for the Study.

To develop the EE/DG scenario case used in the Study, the APS and SRP loads in the base case were increased to model a scenario where no additional EE or DG contributions beyond 2024 were included in the peak load forecast. Available generation within Arizona was increased to account for the increase in load. Large industrial loads were not scaled based on limited EE or DG impacts from these customers.

EE and DG Forecasting Methodology Description

EE and DG estimates were developed to determine each program's role at the time of the system peak in 2029. The combined total EE and DG impacts at peak on APS's transmission system in 2029 are estimated to be an additional 771 MW, compared to 2024. SRP's forecasting group estimated EE and DG would contribute an additional 215 MW in 2029 compared to 2024. The details of the EE and DG estimates are described below.

Energy Efficiency Impact

Table 2 provides the projected increase in EE for APS and SRP at peak hour in 2029 compared to 2024.

Table 2: APS and SRP Energy Efficiency Forecast

	2029
APS EE Impact to Peak	598 MW
SRP EE Impact to Peak	158 MW

The contribution of EE programs (net of demand response curtailment) to APS peak load was forecasted using projections identified in the APS 2023 IRP. As shown in Table 2, the increase in EE programs coincident to peak load was 598 MW. Of that amount, 75% of the EE contributions at peak were estimated to be from metro Phoenix load areas, while 25% of the EE contributions were estimated to be from areas outside metro Phoenix.

The increased contribution of EE programs forecasted by SRP from 2024 to 2029 was 158 MW, which was almost entirely within the metro Phoenix load areas.

Distributed Generation Impact

The forecasted increase for APS and SRP of DG during peak hour in 2029 compared to 2024 is provided in Table 3.

Table 3: APS and SRP Distributed Generation Forecast

	2029
APS DG Impact to Peak	173 MW
SRP DG Impact to Peak	57 MW

Within the APS service territory, the increased contribution of DG installations during peak hour in summer 2029 was 173 MW more than in 2024, as seen in Table 3. Of this amount, 77% of the contributions were estimated to be from metro Phoenix load areas, while 23% of the contributions were estimated to be from areas outside metro Phoenix.

The 57 MW increase in contributions to peak load due to DG installations within the SRP service territory was almost entirely within the metro Phoenix load areas.

Study Results

The 2029 base case and the case with delayed or non-implemented EE and DG showed no APS or SRP thermal violations on the monitored elements for an all lines in-service condition. No thermal violations were identified on the APS system for single contingency outages. However, SRP ties with WAPA between Duke and Test Track substations and between Rudd and Liberty substations were overloaded in the 2029 base case for certain single contingency outages. Upgrades to address these overloads are being evaluated by SRP. No other thermal violations were identified. The 2029 base case has no APS or SRP voltage violations for all lines in-service or following single contingency outages.

The results for the case with delayed or non-implemented EE and DG over the entire APS and SRP combined footprint show no new overloads on the 115kV and above transmission system of either company. The pre-existing overloads identified in the base case did not significantly increase once the impacts of EE and DG were backed out. Additionally, no new voltage violations on the 115kV and above transmission system were observed in this analysis.

Conclusion

The Study indicates that delayed or non-implemented EE and DG has no adverse impact on the reliability of the APS or SRP 115kV and above transmission systems as currently planned in 2029. It should be noted that this study only addresses the impacts to the APS and SRP 115kV and above transmission systems and there may be some impacts at the sub-transmission level due to changes in the quantity and timing of EE or DG implementation.

Attachment D

APS's Transmission Planning Process and Guidelines

TRANSMISSION PLANNING PROCESS AND GUIDELINES

APS Transmission Planning
January 25, 2019

Table of Contents

I. INTRODUCTION AND PURPOSE

The Transmission Planning Process and Guidelines (Guidelines) are used by Arizona Public Service Company (APS) to assist in planning its Extra High Voltage (EHV) transmission system (345 kV and 500 kV) and High Voltage (HV) transmission system (230 kV and 115 kV). In addition to these Guidelines, APS follows the Western Electricity Coordinating Council's (WECC) System Performance Criteria (TPL-001-WECC-CRT-3) in addition to NERC Table 1 in the TPL-001-4 standard.

II. PLANNING METHODOLOGY

A. General

APS uses a deterministic approach for transmission system planning. Under this approach, system performance should meet certain specific criteria under normal conditions (all lines in-service), for any single contingency condition and for selected double contingency conditions as defined under TPL-001-WECC-CRT-3. In general, an adequately planned transmission system will:

- Provide an acceptable level of service that is cost-effective for normal, single and selected double contingency conditions.
- Maintain service to all firm loads for any single or selected double contingency outages; except for radial loads.
- Not result in overloaded equipment or unacceptable voltage conditions for single or selected double contingency outages.
- Not result in cascading for single or selected double contingency outages.
- Provide for the proper balance between the transmission import capability and local generation requirements for an import limited load area.

Although APS uses a deterministic approach for transmission system planning, the WECC reliability planning criteria provides for exceptions based on methodologies provided by the WECC RPEWG. Historical system reliability performance is analyzed on a periodic basis and the results are used in the design of planned facilities.

These planning methodologies, assumptions, and guidelines are used as the basis for the development of future transmission facilities. Additionally, consideration of potential alternatives to transmission facilities (such as distributed generation or new technologies) is evaluated on a case-specific basis.

As new planning tools and/or information become available revisions or additions to these guidelines will be made as appropriate.

B. Transmission Planning Process

APS's transmission planning process consists of an assessment of the following needs:

- Provide adequate transmission to access designated network resources in-order to reliably and economically serve all network loads.
- Support APS's and other network customers' local transmission and sub-transmission systems.
- Provide for interconnection to new resources.
- Accommodate requests for long-term transmission access.

During this process, consideration is given to load growth patterns, other system changes affected by right-of-way, facilities siting constraints, routing of future transportation corridors, and joint planning with neighboring utilities, governmental entities, and other interested stakeholders (*see* APS Open Access Transmission Tariff (OATT) Attachment (E)). Finally, all EHV and HV substations will be CIP substations.

1. EHV Transmission Planning Process

APS's EHV transmission system, which consists of 500 kV and 345 kV, has primarily been developed to provide transmission to bring the output of large base-loaded generators to load centers, such as Phoenix. Need for new EHV facilities may result from any of the bullet items described above. APS's annual planning process includes an assessment of APS's transmission capability to ensure that designated network resources can be accessed to reliably and economically serve all network loads. In addition, Reliability Must-Run (RMR) studies are selectively performed to ensure that proper balance between the transmission import capability and local generation requirements for an import limited load area are maintained.

2. 230 kV Transmission Planning Process

APS's 230 kV transmission system has primarily been developed to provide transmission to distribute power from the EHV bulk power substations and local generators to the distribution system and loads throughout the load areas.

Planning for the 230 kV system assesses the need for new 230/69 kV substations to support local sub-transmission and distribution system growth and the reliability performance of the existing 230 kV system. This process takes into account the future land use plans that were developed by government agencies, Landis aerial photo maps, master plans that were provided by

private developers, and APS's long-range forecasted load densities per square mile for residential, commercial, and industrial loads.

3. Transmission Facilities Required for Generation/Resource Additions

New transmission facilities may also be required in conjunction with generation resources due to (1) a "merchant" request by an Independent Power Producer (IPP) for generator interconnection to the APS system, (2) a "merchant" request for point-to-point transmission service from the generator (receipt point) to the designated delivery point, or (3) designation of new resources or re-designation of existing units to serve APS network load (including removal of an older units' native load designation). These studies/processes are performed pursuant to the APS OATT.

C. Ten Year Transmission System Plans

Each year APS uses the planning process described in section B to update the Ten Year Transmission System Plan. The APS Ten Year Transmission System Plan identifies all new transmission facilities, 115 kV and above, and all facility replacements/upgrades required over the next ten years to reliably and economically serve the load.

D. Regional Coordinated Planning

1. Western Electric Coordinating Council (WECC)

APS is a member of the WECC. The focus of the WECC is promoting the reliability of the interconnected bulk electric system. The WECC provides the means for:

- Developing regional planning and operating criteria.
- Coordinating future plans.
- Establishing new or modifying existing WECC Path Ratings through procedures.
- Compiling regional data banks, including the BCCS, for use by the member systems and the WECC in conducting technical studies.
- Assessing and coordinating operating procedures and solutions to regional problems.
- Establishing an open forum with interested non-project participants to review the plan of service for a project.
- Through the WECC Transmission Expansion Policy Committee, performing economic transmission congestion analysis.

APS works with WECC to adhere to these planning practices.

2. Technical Task Force and ad-hoc Work Groups

Many joint participant projects in the Desert Southwest rely on technical study groups for evaluating issues associated with their respective projects. These evaluations often include studies to address various types of issues associated with transfer capability, interconnections, reliability and security. APS actively participates in many of these groups such as the Western Arizona Transmission System Task Force and the Four Corners Technical Task Force.

3. Sub-Regional Planning Groups

Southwest Area Transmission (SWAT) and other sub-regional planning groups provide a forum for entities within a region, and any other interested parties, to determine and study the needs of the region as a whole. It also provides a forum for specific projects to be exposed to potential partners and allows for joint studies and participation from interested parties.

4. WestConnect

APS and the other WestConnect members executed the WestConnect Project Agreement for Subregional Transmission Planning in May 2007. This agreement promotes coordination of regional transmission planning for the WestConnect planning area by formalizing a relationship among the WestConnect members and the WestConnect area sub-regional planning groups including SWAT. The agreement provides for resources and funding for the development of a ten year integrated regional transmission plan for the WestConnect planning area. The agreement also ensures that the WestConnect transmission planning process will be coordinated and integrated with other planning processes within the Western Interconnection and with the WECC planning process.

5. Joint Studies

In many instances, transmission projects can serve the needs of several utilities and/or IPPs. To this end, joint study efforts may be undertaken. Such joint study efforts endeavor to develop a plan that will meet the needs and desires of all individual companies involved.

E. Generation Schedules

For planning purposes, economic dispatches of network resources are determined for APS's system peak load in the following manner:

- Determine base generation available and schedule these units at maximum output.
- Determine resources purchased from other utilities, IPPs, or power marketing agencies.
- Determine APS's spinning reserve requirements.

- Schedule intermediate generation (oil/gas steam units) such that the spinning reserve requirements, in section (c) above, are met.
- Determine the amount of peaking generation (combustion turbine units) required to supply the remaining system peak load.

Phoenix area network resources are dispatched based on economics and any existing import limitations. When possible, spinning reserve will be carried on higher cost Phoenix area network generating units.

Generation output schedules for interconnected utilities and IPPs are based upon consultation with the neighboring utilities and IPPs or as modeled in the latest data in WECC coordinated study cases.

F. Load Projections

APS substation load projections are based on the APS Corporate Load Forecast. Substation load projections for neighboring interconnected utilities or power agencies operating in the WECC area are based on the latest data in WECC coordinated study cases. Heavy summer loads are used for the Ten Year Transmission System Plans.

G. Alternative Evaluations

1. General

In evaluating several alternative plans, comparisons of power flows, transient stability tests, and fault levels are made first. After the alternatives are found that meet the system performance criteria in each of these three areas comparisons may be made of the losses, transfer capability, impact on system operations, and reliability of each of the plans. Finally, the costs of facility additions (capital cost items), costs of losses, and relative costs of transfer capabilities are determined. A brief discussion of each of these considerations follows.

2. Power Flow Analyses

Power flows of base case (all lines in-service) and single contingency conditions are tested and should conform to the system performance criteria set forth in Section IV of these Guidelines. Double or multiple contingencies are also examined in the context of common mode and common corridor outages. Normal system voltages, voltage deviations, and voltage extreme limitations are based upon operating experience resulting in acceptable voltage levels to the customer. Power flow limits are based upon the thermal ratings and/or sag limitations of conductors or equipment, as applicable.

3. Transient Stability Studies

Stability guidelines are established to maintain system stability for single contingency, three-phase fault conditions. Double or multiple contingencies are also examined in the context of common mode and common corridor outages.

4. Short Circuit Studies

Three-phase and single-phase-to-ground fault studies are performed to ensure the adequacy of system protection equipment to clear and isolate faults.

5. Reactive Power Margin Analyses

Reactive Power Margin analyses are performed when steady-state analyses indicate possible insufficient voltage stability margins. V-Q curve analyses are used to determine post-transient voltage stability.

6. Losses Analyses

A comparison of individual element and overall transmission system losses are made for each alternative plan being studied. The losses computed in the power flow program consist of the I^2R losses of lines and transformers and the core losses in transformers, where represented.

7. Transfer Capability Studies

In evaluating the relative merits of one or more EHV transmission plans, non-simultaneous ratings are determined using methodologies consistent with WECC Path Rating Procedures as defined in the *WECC Project Coordination and Path Rating Processes* manual and NERC Standard MOD-029. In addition, simultaneous relationships are identified that can either be mitigated through use of nomograms, operating procedures or other methods.

8. Subsynchronous Resonance (SSR)

SSR phenomenon result from the use of series capacitors in the network where the tuned electrical network exchanges energy with a turbine generator at one or more of the natural frequencies of the mechanical system. SSR countermeasures are applied to prevent damage to machines as a result of transient current or sustained oscillations following a system disturbance. SSR studies are not used directly in the planning process. SSR countermeasures are determined after the transmission plans are finalized.

9. Flexible AC Transmission System (FACTS)

FACTS devices are a recent application of Power Electronics to the transmission system. These devices make it possible to use circuit reactance, voltage magnitude and phase angle as

control parameters to redistribute power flows and regulate bus voltages, thereby improving power system operation.

FACTS devices can provide series or shunt compensation. These devices can be used as a controllable voltage source in series or as a controllable current source in shunt mode to improve the power transmission system operations.

FACTS will be evaluated as a means of power flow control and/or to provide damping to dynamic oscillations where a need is identified and it is economically justified. Examples include DSTATCOM for powerfactor correction and the DVR for dynamic voltage regulation for distribution loads.

10. Economic Evaluation

In general, an economic evaluation of alternative plans consists of a cumulative net present worth or equivalent annual cost comparison of capital costs.

III. PLANNING ASSUMPTIONS

A. General

1. Loads

Loads used for the APS system originate from the latest APS Corporate Load Forecast. In most cases, the corrected power factor of APS loads is 99.5% at 69 kV substations.

2. Generation and Other Resources

Generation dispatch is based on firm power and/or transmission wheeling contracts including network resources designations.

3. Normal Voltage Levels

Nominal EHV design voltages are 500 kV, 345 kV, 230 kV, and 115 kV. Nominal EHV operating voltages are 535 kV, 348 kV, 239 kV, and 119 kV, with exceptions at certain buses.

4. Sources of Databases

APS currently relies on WECC cases and internal data listings as their depository of EHV and HV system data and models.

5. Voltage Control Devices

Devices which can control voltages are shunt capacitors, shunt reactors, tap-changing-under-load (TCUL) and fixed-tap transformers, static Volt Ampere Reactive (VAR) compensators, and machine VAR capabilities. If future voltage control devices are necessary, these devices will be evaluated based upon economics and the equipment's ability to obtain an adequate voltage profile on the EHV and HV systems. Currently, APS has TCULs on only its 500 kV

autotransformers except for a few transformers. Other than operator control, the TCUL transformers do not automatically regulate voltages.

6. Phase Shifters

For pre-disturbances scenarios, phase shifters may be used to hold flows depending on the objectives of the study. For post-disturbance scenarios, the phase shifters are assumed to not hold flows and are not automatically regulated.

7. Conductor Sizes

APS uses several types of standard phase conductors depending on the design, voltage class and application for new transmission lines. Table 1 lists the current standard conductor sizes for the various voltage levels used for new facilities.

Table 1. Standard conductor sizes.

Class	Conductor
525 kV	3x1780 kcm ACSR Chukar 2x2156 kcm ACSR Bluebird
345 kV	2x795 kcm ACSR Tern
230 kV	1x2156 kcm ACSS Bluebird 1x1272 kcm ACSR Bittern 1x795 kcm ACSR Tern
115 kV	(same as 230 kV construction)
69 kV	1x795 kcm ACSS Tern 1x795 kcm AA Arbutus 1x336 kcm ACSR Linnet

8. 69 kV System Modeling

230 kV facility outages may impact the underlying 69 kV system due to the interconnection of those systems. For this reason, power flow cases may include a detailed 69 kV system representation. Solutions to any problems encountered on the 69 kV system are coordinated with the subtransmission planning engineers.

9. Substation Transformers

- 500 kV and 345 kV Substations

  Bulk substation transformer banks may be made up of one three-phase or three single-phase transformers, depending upon bank size and economics. For larger banks where single-phase transformers are used, a fourth (spare) single-phase transformer will be used in a jack-bus arrangement to improve reliability and

facilitate connection of the spare in the event of an outage of one of the single-phase transformers.

TCULs are typically used on the 525 kV transformers generally with a range of plus or minus 10% of nominal voltage. Primary voltages will be 525 kV or 345 kV, and secondary voltages will be 230 kV or 69 kV and tertiary voltages will be 34.5 kV, 14.4 kV or 12.47 kV.

- 230 kV Substations

For high-density load areas, both 230/69 kV and 69/12.5 kV transformers can be utilized. 230/69 kV transformers will be rated at 113/150/188 MVA with a 65°C temperature rise, unless otherwise specified. 69/12.5 kV transformers will be rated at 25/33/41 MVA with a 65°C temperature rise, unless otherwise specified.

With all elements in service, a transformer may be loaded up to its top Forced Air (ONAF) rating without sustaining any loss of service life. For a single contingency outage (loss of one transformer) the remaining new transformer or transformers may be loaded up to 25% above their top ONAF rating, unless heat test data indicate a different overload capability. The loss of service life sustained will depend on the transformer pre-loading and the outage duration. No-load tap setting adjustment capabilities on 230/69 kV transformers will be ±5% from the nominal voltage setting (230/69 kV) at 2½% increments.

10. Switchyard Arrangements

- 500 kV and 345 kV Substations

Existing 345 kV switchyard arrangements use breaker-and-one-half, main-and-transfer, or modified paired-element circuit breaker switching schemes. Because of the large amounts of power transferred via 500 kV switchyards and the necessity of having adequate reliability, all 500 kV circuit breaker arrangements are planned for an ultimate breaker-and-one-half scheme. If only three or four elements are initially required, the circuit breakers are connected in a ring bus arrangement, but physically positioned for a breaker-and-one-half scheme. The maximum desired number of elements to be connected in the ring bus arrangement is four. System elements such as generators, transformers, and lines will be arranged in breaker-and-one-half schemes such that a failure of a center breaker will not result in the

loss of two lines routed in the same general direction and will minimize the impact of losing two elements.

- 230 kV Substations

Future 230/69 kV substations should be capable of serving up to 452 Megavolt-Amps (MVA) of load. 400 MVA has historically been the most common substation load level in the Phoenix Metropolitan area. Future, typical 230/69 kV substations should accommodate up to four 230 kV line terminations and up to three 230/69 kV transformer bays. Based upon costs, as well as reliability and operating flexibility considerations, a breaker-and-one-half layout should be utilized for all future 230/69 kV Metropolitan Phoenix Area substations, with provision for initial development to be a ring bus. Any two 230/69 kV transformers are to be separated by two breakers, whenever feasible, so that a stuck breaker will not result in an outage of both transformers.

11. Series Capacitor Application

Series capacitors are planned according to the needs of their associated transmission projects and are typically a customized design. Benefits resulting from the installation of series capacitors include but are not limited to improved transient stability, voltage regulating capability and reactive capability. A new series capacitor installation will currently include MOV protection that mitigates fault current levels through the series capacitor for internal faults. A bank will typically bypass for internal faults because there is no benefit to requiring that the bank remain in service when the line is tripped. Depending on the required impedances and ampacity level, new series capacitor banks may be either one to three segment units. The bank ratings should be based upon line's ultimate uses. At a minimum bank should be upgradable to higher ampacity needs in the future. Most 500 kV banks in APS system have a continuous rating of either 1750 A or 2200 A. ANSI standard require that the 30 minutes emergency rating be 135% of the continuous.

12. Shunt and Tertiary Reactor Application

Shunt and/or tertiary reactors may be installed to prevent open end line voltages from being excessive, in addition to voltage control. The open end line voltage must not be more than 0.05 per unit voltage greater than the sending end voltage. Tertiary reactors may also be used for voltage and VAR control as discussed above. EHV reactors are used to adjust pre-disturbance voltages if controlled through a breaker, circuit switcher or motor operated disconnect switch. APS currently does not automatically control its EHV or HV reactors or capacitors.

B. Power Flow Studies

1. System Stressing

Realistic generation capabilities and schedules should be used to stress the transmission system in order to maximize the transfer of resources during the maximum load condition or path rating studies. Existing WECC or regional path ratings and facilities ratings will not be violated pre- or facility ratings post-disturbance.

2. Displacement

In cases where displacements (due to power flow opposite normal generation schedules) may have an appreciable effect on transmission line loading, a reasonable amount of displacement (Generation Units) may be removed in-order to stress a given transmission path. Alternately, no fictitious generation sources may be used to stress paths.

C. Transient Stability Studies

1. Fault Simulation

When studying system disturbances caused by faults, two conditions will be simulated:

- Three-phase-to-ground faults with normal clearing.
- Single-line-to-ground faults with a stuck circuit breaker in one phase with delayed clearing.

2. Margin

- Generation margin may be applied for the contingencies primarily affected by generation.
- Power flow margin may be applied for the contingencies primarily affected by power flow

3. Unit Tripping

Generator unit tripping may be allowed in-order to increase system stability performance if part of a proposed or existing remedial action scheme.

4. Machine Reactance Representation

For transient stability studies, the unsaturated transient reactance of machines with full representation will be used.

5. Fault Damping

Fault damping will be applied to the generating units adjacent to three phase faults. Fault damping levels will be determined from studies that account for the effect of generator amortisseur windings and the SSR filters. Fault damping will be applied on the buses listed in Table 2 for three

phase faults on the nearest EHV or HV bus. If the model does not provide the ancillary signals for applying and removing damping values then a brake can be applied to the terminal bus of the affected generator.

Table 2. Damping levels for three phase faults.

Fault location	Affected units	Percent Damping
Palo Verde 500 kV	1-3	7.25%
Four Corners 500 & 345 kV	4&5	10%
Coronado 500 kV	1&2	12.5%
Cholla 500 kV	2-4	10%

6. Series Capacitor Switching

For APS designed banks, a MOV/by-pass model is employed in transient stability analysis.

D. Short Circuit Studies

Three-phase and single-phase-to-ground faults will be evaluated.

1. Generation Representation

All generation will be represented.

2. Machine Reactance Representation

The saturated subtransient reactance ($X"_d$) values will be used.

3. Line Representation

Unless previously calculated as part of APSs requirement for MOD-032, the transmission line zero sequence impedance (Z_0) is assumed to be equal to three times the positive sequence impedance (Z_1). If a new transmission impedance is required, APS utilizes the CAPE line constant program for determining sequence values.

4. Transformer Representation

The transformer zero sequence impedance (X_0) is assumed to be equal to the positive sequence impedance (X_1). Bulk substation transformers are modeled as auto-transformers. The two-winding model is that of a grounded-wye transformer. The three-winding model is that of a wye-delta-wye with a solid ground.

5. Series Capacitor Switching

Series capacitors, locations to be determined from short circuit studies, will be flashed and reinserted as appropriate.

E. Reactive Power Margin Studies

Using Q-V curve analyses, APS assesses the interconnected transmission system to ensure there are sufficient reactive resources located throughout the electric system to maintain post-transient voltage stability for system normal conditions and certain contingencies.

IV. SYSTEM PERFORMANCE

A. Power Flow Studies

1. Normal (Base Case Conditions)

- Voltage Levels

  a. General

Nominal Voltage Level	Continuous Voltage Limits
525 kV	+/- 5%
345 kV	+/- 5%
230 kV	+/- 5%
115 kV	+/- 5%
69 kV	+/- 5%
Palo Verde	525-525 kV

- Facility Loading Limits

  a. Transmission Lines

  EHV transmission line loading cannot exceed 100% of the continuous rating, which is based upon established conductor temperature limit or sag limitation as defined by APS latest estimates for NERC Standard FAC-008-3.

  b. Underground Cable

  Underground cable loading should not exceed 100% of the continuous rating with all elements in service. This rating is based on a cable temperature of 85°C with no loss of cable life.

  c. Transformers

  For all transformers pre-disturbance flows cannot exceed APS established continuous ratings using methodologies used in reporting ratings under NERC Standard FAC-008-3.

  d. Series Capacitors

  Series Capacitors cannot exceed 100% of continuous rating as determined using methodologies used in reporting ratings under NERC Standard FAC-008-3.

- Interchange of VARS

Interchange of VARs between companies at interconnections will be reduced to a minimum and maintained near zero.

- Distribution of Flow

Schedules on a new project will be compared to simulated power flows to ensure a reasonable level of flowability.

2. Single and selected Double Contingency Outages

- Voltage Levels

Maximum voltage deviation on APS's major buses cannot exceed an 8% voltage dip for single contingencies. APS uses the following formulae to calculate voltage deviations for post-disturbance conditions.

$$\%Deviation = 100x(\frac{Vpre - Vpost}{Vpre})$$

- Facilities Loading Limits

a. Transmission Lines

Transmission line loading cannot exceed 100% of the lesser of the sag limit or the emergency rating (30-minute rating) which is based upon established conductor temperature limits.

b. Underground Cable

Underground cable loading should not exceed the emergency rating during a single-contingency outage. This rating is based on a cable temperature of 105°C for two hours of emergency operation with no loss of cable life.

c. Transformers

For all transformers post-disturbance flows cannot exceed APS established emergency ratings using methodologies used in reporting ratings under NERC Standard FAC-008-3.

d. Series Capacitors

Series Capacitors cannot exceed 100% of emergency rating as determined using methodologies used in reporting ratings under NERC Standard FAC-008-3.

- Generator Units

Generator units used for controlling remote voltages will be modified to hold their base case terminal voltages.

- Impact on Interconnected System

  Single and selected double contingency outages will not cause overloads upon any neighboring transmission system.

B. Transient Stability Studies

Transient stability studies are performed on the 500 kV, 345 kV, and 230 kV systems but may be performed on lower voltage systems depending on the study objectives.

1. Fault Simulation

Three-phase and single-line-to-ground faults initiated disturbances will be simulated according to the guidelines described in NERC TPL-001-4 Table 1 as well as WECC Regional Criteria TPL-001-WECC-CRT-3. Normal clearing times for different voltage levels are given in Table 3 for new facilities. Fault damping will be applied when applicable at fault inception. Breaker failure operation on the 500 kV system has a minimum clearing time of 10 cycles.

Table 3. Normal clearing times for new facilities.

Voltage level	Normal clearing times
500 & 345 kV	4 cycle
230 kV	5 cycle
115 kV	5 cycle
≤69 kV	7 cycle

2. Series Capacitor Switching

All of APS's designed and installed series capacitor units are protected from internal faults using MOV and by-pass elements. For transient stability analysis, models are used to represent the mitigation provided by the MOV components or through by-passing of the series capacitors.

3. System Stability

The system performance will be considered acceptable if the following conditions are met:

- All machines in the system remain synchronized as demonstrated by the relative rotor angles.
- Positive system damping exists as demonstrated by the damping of relative rotor angles and the damping of voltage magnitude swings. For N-1 and N-2 disturbances, APS follows the voltage and frequency performance guidelines as

described in NERC's TPL-001-4 Table 1 and WECC Regional Criteria TPL-001-WECC-CRT-3.

- Cascading does not occur for any category contingency.

4. Re-closing

Automatic re-closing of circuit breakers controlling EHV facilities is not utilized.

5. Short Circuit Studies

Fault current shall not exceed 100% of the applicable breaker fault current interruption capability for three-phase or single-line-to-ground faults.

6. Reactive Power Margin Studies

For system normal conditions or single contingency conditions, post-transient voltage stability is required with a path or load area modeled at a minimum of 105% of the path rating or maximum planned load limit for the area under study, whichever is applicable. For multiple contingencies, post-transient voltage stability is required with a path or load area modeled at a minimum of 102.5% of the path rating or maximum planned load limit for the area under study, whichever is applicable.