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January 31, 2023

Docket Control
Arizona Corporation Commission
1200 West Washington
Phoenix, Arizona 85007

RE: Arizona Public Service Company (APS or Company)
Ten-Year Transmission System Plan
Docket No. E-99999A-23-0016

In compliance with A.R.S. § 40-360.02, enclosed please find Arizona Public Service Company's (APS) 2023-2032 Ten-year Transmission System Plan (Ten-year Plan) for major transmission facilities. These new transmission projects, coupled with additional distribution and sub-transmission investment, will support reliable power delivery in APS's service area, Arizona, and in the western United States.

In this filing, APS includes: (1) Ten-year Plan, marked as Attachment A; (2) Renewable Transmission Action Plan, marked as Attachment B; (3) Technical Study on the Effects of DG/EE on Future Transmission Needs, marked as Attachment C; and (4) Transmission Planning Process and Guidelines, marked as Attachment D.

The technical study report is 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.

Please let me know if you have any questions.

Sincerely,

/s/ Elizabeth Lawrence

Elizabeth Lawrence

EL/agc
Attachment

Attachment A

2023-2032 Ten-Year Transmission System Plan

ARIZONA PUBLIC SERVICE COMPANY
2023-2032
TEN-YEAR TRANSMISSION SYSTEM PLAN

Prepared for the
Arizona Corporation Commission

January 2023

ARIZONA PUBLIC SERVICE COMPANY
2023-2032
TEN-YEAR TRANSMISSION SYSTEM PLAN

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ARIZONA PUBLIC SERVICE COMPANY
2023-2032
TEN-YEAR TRANSMISSION SYSTEM PLAN

GENERAL INFORMATION

Pursuant to A.R.S. § 40-360.02, Arizona Public Service Company (APS) submits its 2023-2032 Ten-Year Transmission System Plan (Ten-Year 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 DG/EE (Attachment C) as required by Decision No. 74785 (October 24, 2014). The Internal Planning Criteria and System Ratings, 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. APS lists underground facilities in the Ten-Year Plan as they are an important part of the transmission system and transmission planning process. There are approximately 29 miles of new 500kV transmission lines, 1 mile of new 345kV transmission lines, 54 miles of new 230kV transmission lines, 11.5 miles of underground 230kV upgrades, 40 miles of 230kV transmission line rebuilds, and 3 miles of 115kV transmission line upgrades described as planned projects in this Ten-Year Plan. In addition, the following equipment is included in the Ten-Year Plan: 27 new transformers, 2 new shunt reactors, 9 new shunt capacitors, 3 transformer replacements, and 1 series capacitor

replacement. 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 $1.498 billion.[1] Table 1 provides an overview of the projects included in this Ten-Year Plan.

Table 1: Ten-Year Plan Project Breakdown

Description	Projects in Ten-Year Plan
500kV transmission lines new	29 miles (approximately)
345kV transmission lines new	1 mile (approximately)
230kV transmission lines new	54 miles (approximately)
230kV transmission lines upgrades	51.5 miles (approximately)
115kV transmission line upgrades	3 miles (approximately)
New Transformers	27
Transformer replacements	3
New Shunt reactors	2
New Shunt capacitors	9
Series capacitor replacements	1
Total Investment	$1.498 billion[2]

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 11.5 miles of underground 230kV and rebuild approximately 40 miles of 230kV 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 dates for projects such as transformer replacements or additions,

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

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 accommodate changes in system topology, new significant loads, retirement of generation, or new generator interconnections. For example, new projects may be identified, or the planned projects may be advanced to serve customers, either single large customers such as new data centers, large master-planned communities, or the rapid advancement of significant electric vehicle adoption. Table 2, Equipment Additions and Replacements, shows a list of the planned substation transformer additions and replacements, reactive devices being installed or replaced, and transmission line upgrades.

Table 2: Equipment Additions and Replacements

Description	Year
Runway 230/69kV Transformer Addition (1 unit) Stratus 230/69kV Transformer Addition (1 unit) Westwing 230/69kV Transformer Addition (1 unit) Saguaro 500/115kV Transformer Replacement (1 unit) West Phoenix 230/69kV Transformer Replacement (1 unit) Runway 230kV Shunt Capacitor Addition (1 unit) Stratus 230kV Shunt Capacitor Addition (1 unit) Moenkopi 500kV Series Capacitor Replacement (1 unit) Boothill to Mural 115kV Transmission Line Upgrade Adams to Boothill 115kV Transmission Line Upgrade	2023
Three Rivers 230/69kV Transformer Additions (3 units) Goodyear 230/69kV Transformer Additions (3 units) Saguaro 500/115kV Transformer Replacement (1 unit) Cholla 345kV Shunt Reactor Additions (2 units) Three Rivers 230kV Shunt Capacitor Addition (1 unit) Country Club to Lincoln Street 230kV Underground Upgrade (3.5mi)	2024
Runway 230/69kV Transformer Addition (3 units) Broadway 230/69kV Transformer Additions (2 units) Contrail 230/69kV Transformer Additions (3 units) Broadway 230kV Shunt Capacitor Addition (1 unit Contrail 230kV Shunt Capacitor Addition (1 unit)	2025
Diamond 230/69kV Transformer Additions (3 units) Diamond 230kV Shunt Capacitor Addition (1 unit) Country Club to Meadowbrook 230kV Underground Upgrade (3mi)	2026

Description	**Year**
TS22 500/230kV Transformer Additions (2 units) TS29 230/69kV Transformer Additions (2 units) Runway 230/69kV Transformer Addition (1 units) Avery 230kV Shunt Capacitor Additions (2 units) Runway 230kV Shunt Capacitor Addition (1 unit) TS29 230kV Shunt Capacitor Addition (1 unit)	2027
Rudd 500/230kV Transformer Addition (1 unit) Meadowbrook to Sunnyslope 230kV Underground Upgrade (5mi)	2028
TS22 500/230KV Transformer Addition (1 unit) TS22 230kV Shunt Capacitor Addition (2 units)	2029
Raceway 230/69kV Transformer Addition (1 unit) Broadway 230/69kV Transformer Addition (1 unit) TS17 230/69kV Transformer Additions (2 units) Sun Valley 500/230kV Transformer Addition (1 unit) Sun Valley 230/69kV Transformer Addition (1 unit) Trilby Wash 230/69kV Transformer Addition (1 unit) Scatter Wash 230/69kV Transformer Addition (1 unit) Lone Peak 230/69kV Transformer Addition (1 unit) Palm Valley 230/69kV Transformer Addition (1 unit) Freedom 230/69kV Transformer Addition (1 unit) Ocotillo 230/69kV Transformer Addition (1 unit) West Phoenix 230/69kV Transformer Addition (1 unit) Avery 230/69kV Transformer Addition (1 unit) TS22 230/69kV Transformer Addition (1 unit) Parkway 230/69kV Transformer Addition (1 unit) Rudd 500/230kV Transformer 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 are provided on pg. 9.

APS has included planned transmission maps showing the electrical connections and in-service dates for all overhead transmission projects planned by APS for Arizona Extra High Voltage (EHV) and Outer Divisions (pg. 12), the Phoenix metropolitan area (pg. 13), and the Yuma area (pg. 14). 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 Southwest Area Transmission Planning (SWAT), and WestConnect. 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, 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 to more directly identify the effects of DG and EE installations and/or programs on their future transmission needs. This study is marked as Attachment C to this filing.

The Commission's decision in the Seventh BTA[5] to suspend the requirement for performing Reliability Must Run (RMR) studies in every BTA unless certain criteria is met to restart such studies is still in effect. The RMR studies were not performed for the 2023 TYP, as it is not a BTA study year. The Commission's Ninth BTA Decision[6] 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.

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[7] to coordinate and jointly participate in a number of projects and upgrades within the Cochise County area. These agreements incorporate, among other things, new and upgraded transmission lines and substations, new transformers, and reconfigurations on the 230kV, 115kV, and 69kV systems to sustain reliable operation in the

[4] Decision No. 74785, October 24, 2014.
[5] Decision No. 73625, December 12, 2012.
[6] Decision No. 75817, November 21, 2016.
[7] *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.

area. Projects in progress include the construction of a tie between the APS Boothill substation and a new AEPCO Schieffelin substation, and the upgrade of the APS Adams-Boothill and Boothill-Mural 115kV lines.[8]

Power flow analysis was conducted to identify thermal overloads under normal and contingency conditions in compliance with North American Electric Reliability Corporation (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-001-4. 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).

[8] Work on the 115kV facilities is estimated to be completed in early 2023.

PROJECT CHANGES FROM 2022-2031 TEN-YEAR PLAN

The following list of projects were removed or changed from APS's January and subsequent August 2022 and October 2022 Supplemental filings to the 2022-2031 Ten-Year Plan:

- The North Gila – Orchard 230kV Circuit #1 project was completed in 2022
- Orchard substation and 230/69kV transformers were completed in 2022
- North Gila substation 500/230kV transformer has been installed and is being tested.
- Runway substation 230kV Lines project was completed in 2022
- Stratus substation 230kV Lines project was completed in 2022
- Avery substation 230kV Substation project was completed in 2022
- The TS2 substation has been renamed Parkway
- AES Energy Storage project interconnection at Westwing 230kV substation project in-service date has moved from 2022 to 2024
- Boothill to Mural 115kV transmission line upgrade has moved from 2022 to 2023
- McFarland Solar Project Generation tie line project in-service date has moved from 2022 to 2023
- The Hashknife Energy Center Generation tie line project in-service date has moved from 2023 to 2025
- The Runway substation 230kV lines project had an intermediate station added
- The Three Rivers substation 230kV transmission line project had an intermediate station added
- The Contrail substation 230kV lines project Point of Origin, Point of Termination, and intermediate points were clarified

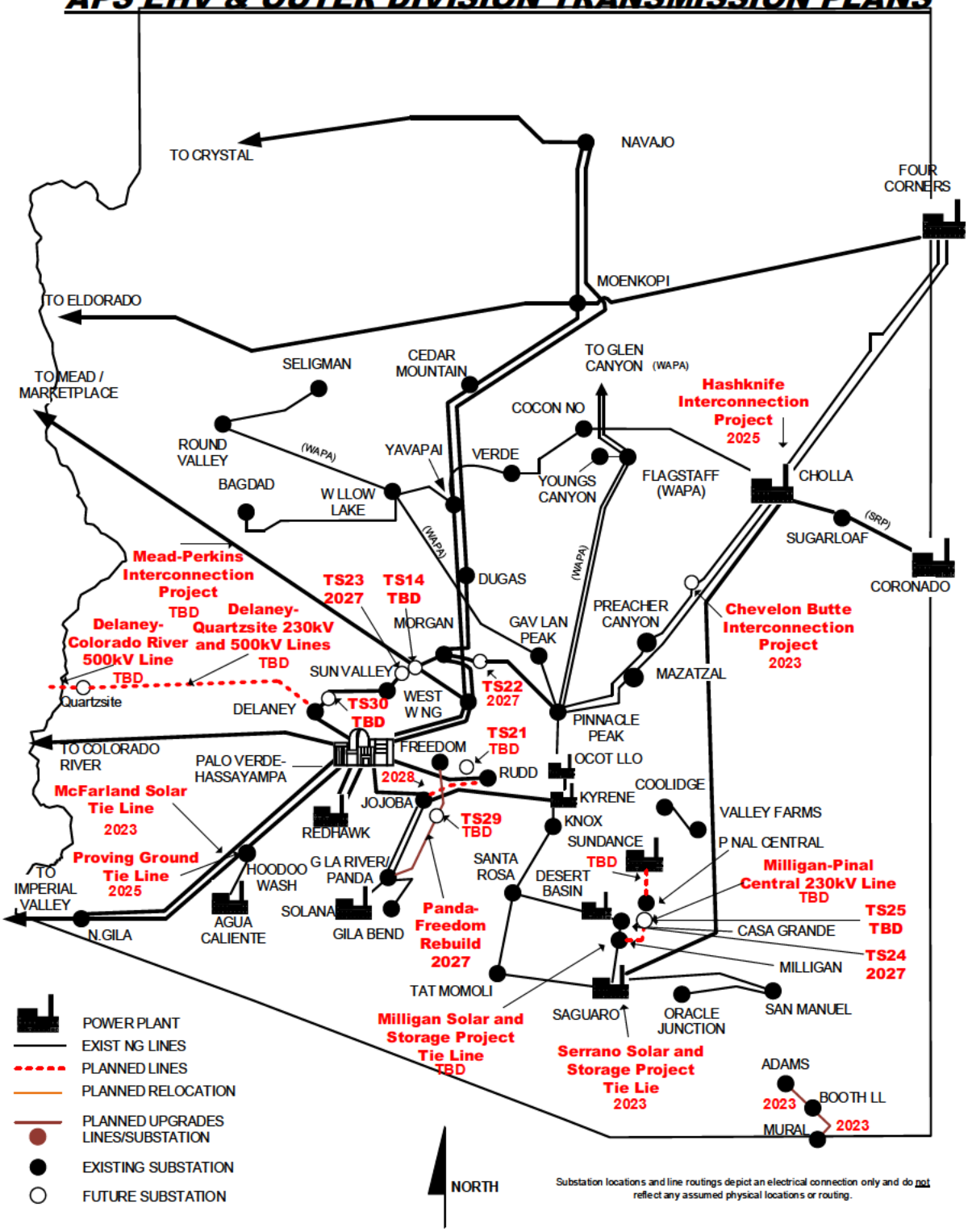
NEW PROJECTS IN THE 2023-2032 TEN-YEAR PLAN

The following new transmission projects are included APS's 2023-2032 Ten-Year Plan:

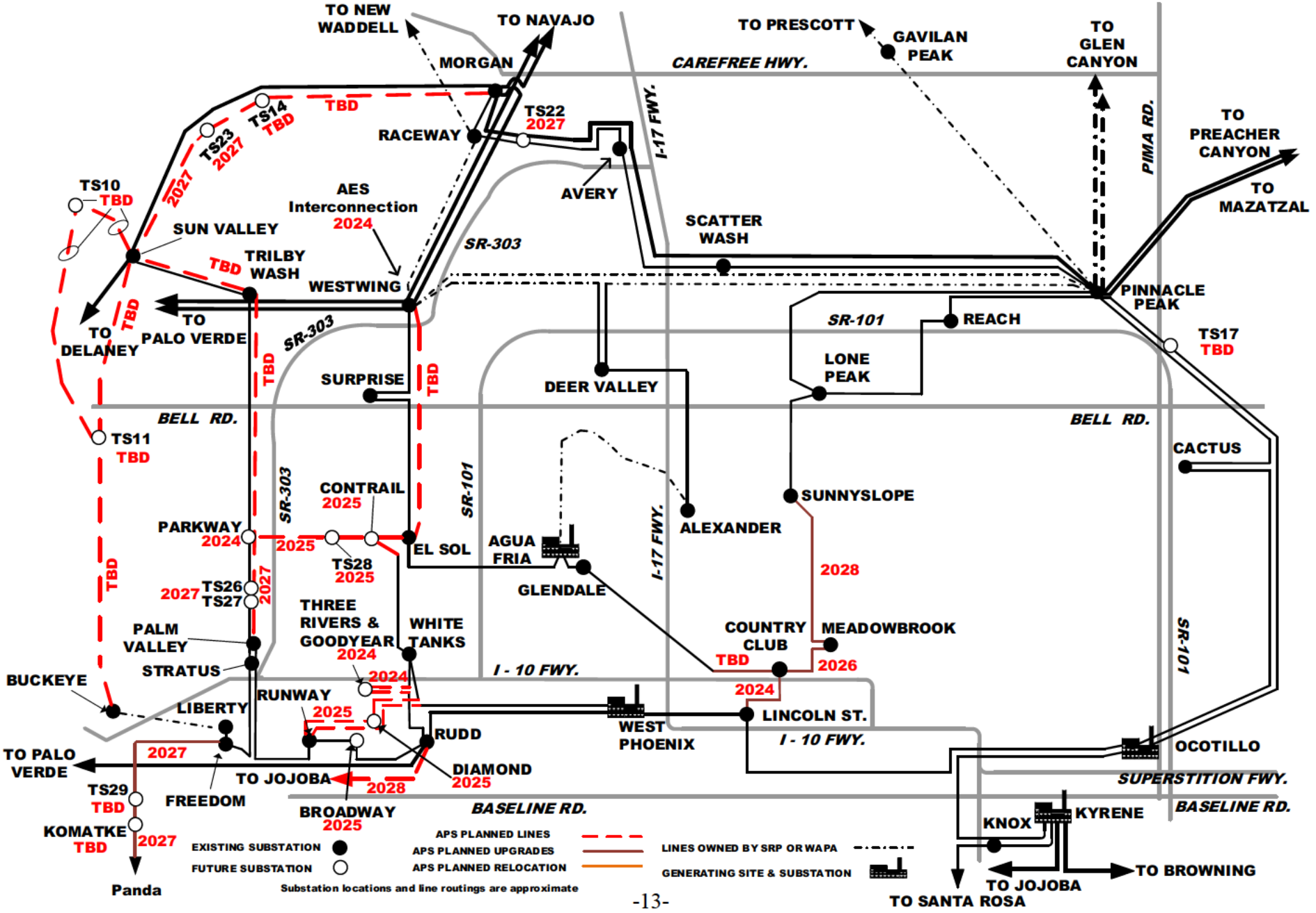
- Proving Ground Solar and Storage 500kV interconnection at the Hoodoo Wash switchyard in 2025
- Panda to Freedom 230kV transmission line rebuild in 2027
- TS26 and TS27 230kV switchyards on the Palm Valley to TS2 transmission line in 2027
- Palm Valley to TS2 230kV transmission line #2 in 2027
- TS24 230kV substation project at Casa Grande in 2027
- TS29 230kV substation project interconnecting to the Panda to Freedom 230kV transmission line in TBD
- Milligan to Pinal Central 230kV line project with a TBD date
- Delaney to Quartzsite 500kV and 230kV transmission lines with a TBD date
- Quartzsite to Colorado River 500kV transmission line with a TBD date

PLANNED TRANSMISSION MAPS

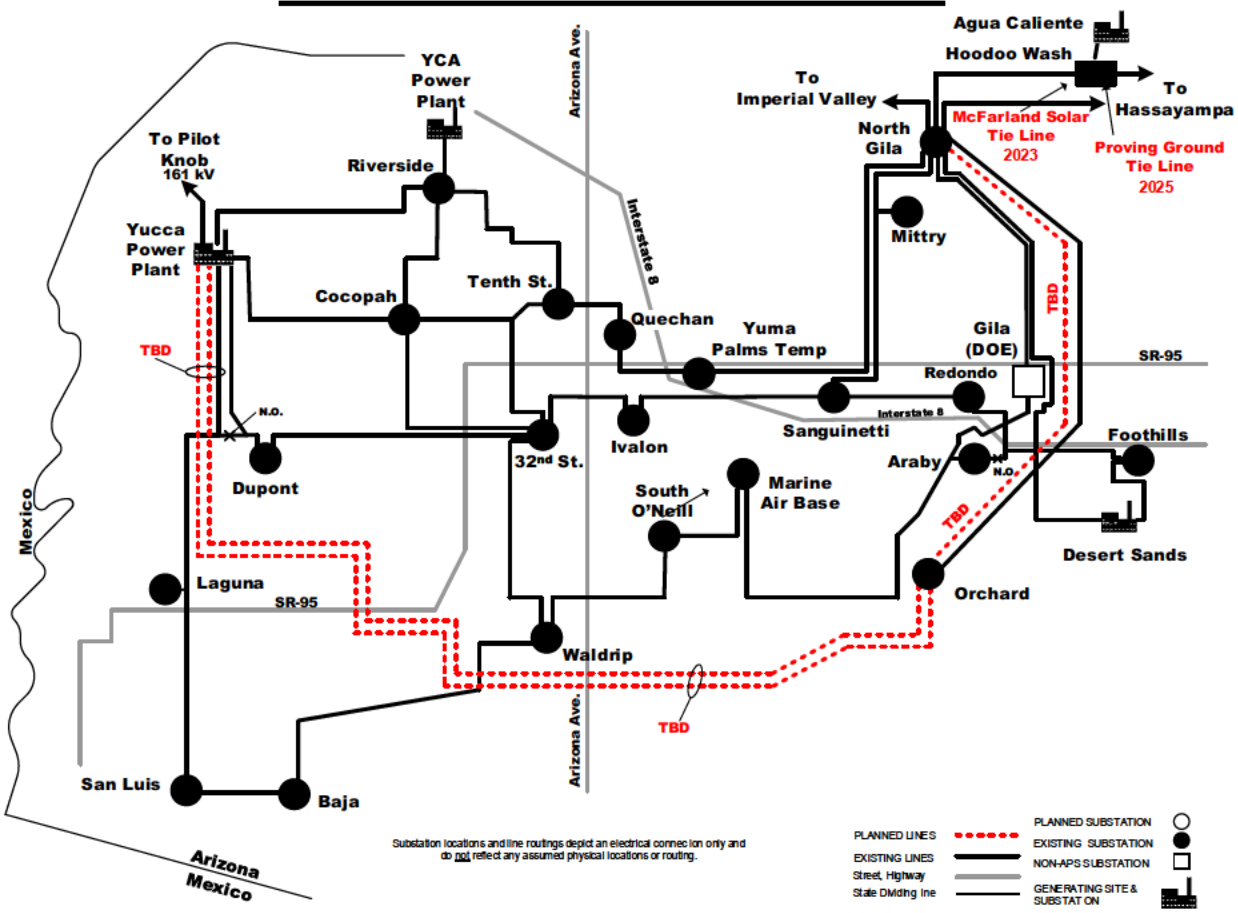
APS EHV & OUTER DIVISION TRANSMISSION PLANS



PHOENIX METROPOLITAN AREA TRANSMISSION PLANS



YUMA AREA TRANSMISSION PLANS



PROJECT DESCRIPTIONS

Arizona Public Service Company
2023 - 2032
Ten-Year Plan
Planned Transmission Description

2023

Project Name	McFarland Solar Project Generation Tie Line
Project Sponsor	Arizona Public Service Company
Other Participants	San Diego Gas & Electric and Imperial Irrigation District
Size	
(a) Voltage Class	500kV AC
(b) Facility Rating	TBD
(c) Point of Origin	McFarland Solar Project substation to be in service 2023
(d) Intermediate Points of Interconnection	None
(e) Point of Termination	Hoodoo Wash switchyard
(f) Length	Less than 1 mile
Routing	The new transmission line would originate at the McFarland Solar Project substation and head northeast along the south side of Palomas Road for one span and then cross Palomas to the north before dropping into Hoodoo Wash switchyard. The entire route will be 0.5 miles and co-located with the Hoodoo Wash-North Gila 500kV line.
Purpose	Driving Factor(s): To connect the McFarland Solar Project substation to Hoodoo Wash switchyard.
Date	
(a) Construction Start	2022
(b) Estimated In-Service	2023
Permitting / Siting Status	*CEC issued 9/3/1981 (Case No. 52, Decision No. 52428, Palo Verde-North Gila Line, amended on 9/7/1982 by Case No. 60, Decision No. 53208). CEC Case No. 52 was amended on 3/24/2022 (Case No. 50, Decision No. 78512) for this project. authorizing the replacement of two structures and construction of the generator tie line, which will be co-located with a short segment of the Hoodoo Wash-North Gila 500kV line.*

Arizona Public Service Company
2023 - 2032
Ten-Year Plan
Planned Transmission Description

2023

Project Name	Chevelon Butte Wind Generation Tie Line Project
Project Sponsor	Chevelon Butte RE LLC
Other Participants	Arizona Public Service Company
Size	
(a) Voltage Class	345kV AC
(b) Facility Rating	TBD
(c) Point of Origin	Chevelon switchyard to be in service 2023
(d) Intermediate Points of Interconnection	None
(e) Point of Termination	Cholla-Preacher Canyon 345kV line
(f) Length	Approximately 1 mile
Routing	From the Chevelon switchyard, a double-circuit transmission line will connect the switchyard to the Cholla-Preacher Canyon 345kV line.
Purpose	Driving Factor(s): To connect the Chevelon Butte Wind Generation project to the Cholla-Preacher Canyon 345kV line.
Date	
(a) Construction Start	2022
(b) Estimated In-Service	2023
Permitting / Siting Status	*CEC issued 10/28/2019 (Case No. 182, Decision No. 77436, amended by Decision No. 78388, 12/28/2021).*

Arizona Public Service Company
2023 - 2032
Ten-Year Plan
Planned Transmission Description

2023

Project Name	Serrano Solar and Storage Project Generation Tie Line
Project Sponsor	Solar Pepper Power, LLC
Other Participants	Arizona Public Service Company
Size	
(a) Voltage Class	230kV AC
(b) Facility Rating	TBD
(c) Point of Origin	Serrano Solar and Storage Project substation
(d) Intermediate Points of Interconnection	None
(e) Point of Termination	Saguaro substation
(f) Length	Approximately 6.75 miles
Routing	The route commences near the Solar and Storage Project substation and travels along Pinal Airpark Road and Interstate 10 for approximately 5 miles before crossing Interstate 10. Shortly after crossing Interstate 10, the line will cross the Saguaro generation plant-controlled access boundary and ownership will transfer to APS. From there, the line will travel an additional 0.75 miles to the point of interconnection at Saguaro substation.
Purpose	Driving Factor(s): To connect the Serrano Solar and Storage Project substation to the Saguaro substation.
Date	
(a) Construction Start	2023
(b) Estimated In-Service	2023
Permitting / Siting Status	*On 1/31/2022 the Commission granted CEC-1 and CEC-2, respectively, to Solar Pepper Power, LLC (Case No. 196). CEC-1 is for the portion of the project that originates at the Solar and Storage Project substation up to the Point of Change of Ownership (POCO) near the Saguaro generation plant-controlled access boundary. CEC-2 is for the portion of the project from the POCO to the point of interconnection at Saguaro substation. At a future date, prior to construction, the Interconnection Customer intends to transfer CEC-2 to APS.*

Arizona Public Service Company
2023 - 2032
Ten-Year Plan
Planned Transmission Description

2024

Project Name	AES Energy Storage Project Interconnection at Westwing 230kV Substation
Project Sponsor	Arizona Public Service Company
Other Participants	AES
Size	
(a) Voltage Class	230kV AC
(b) Facility Rating	TBD
(c) Point of Origin	Westwing substation
(d) Intermediate Points of Interconnection	None
(e) Point of Termination	AES Battery Energy Storage Project
(f) Length	Less than 1 mile
Routing	The transmission line is planned to proceed 0.45 miles north from Westwing substation and be co-located with an existing APS 69kV sub-transmission line from Westwing substation to the property boundary of the Energy Storage Project. From this point, the line will proceed for 0.07 miles northwest to the point of interconnection within the Energy Storage Project substation, located north of Westwing substation.
Purpose	Driving Factor(s): To connect the Battery Energy Storage Project to the Westwing 230kV substation.
Date	
(a) Construction Start	2023
(b) Estimated In-Service	2024
Permitting / Siting Status	*On 11/5/2021, in Decision Nos. 78303 and 78304, the Commission granted CEC-1 and CEC-2, respectively (Case No. 190). CEC-1 is for the portion of the Project that will be owned by APS and extends from Westwing substation to the Point of Demarcation (POD). The POD is outside the energy storage project. The companion CEC-2 is for the portion of the project from the POD to the energy storage project substation. At a later date, prior to construction, APS intends to transfer CEC-2 to the Interconnection Customer.*

Arizona Public Service Company
2023 - 2032
Ten-Year Plan
Planned Transmission Description

2024

Project Name	Three Rivers 230kV Transmission Line Project
Project Sponsor	Arizona Public Service Company
Other Participants	None
Size	
(a) Voltage Class	230kV AC
(b) Facility Rating	TBD
(c) Point of Origin	Rudd-White Tanks 230kV line
(d) Intermediate Points of Interconnection	Goodyear substation to be in service 2024
(e) Point of Termination	Three Rivers substation to be in service 2024
(f) Length	Approximately 8 miles
Routing	The Three Rivers substation will be located approximately three and a half miles to the west of the Rudd-White Tanks 230kV line on the southwest corner of Van Buren Street and Bullard Avenue. The project consists of a single 230kV transmission line connecting the Rudd-White Tanks 230kV line to the Three Rivers substation and a second independent 230kV single-circuit transmission line connecting Three Rivers substation to the Goodyear substation and then back to the Rudd-White Tanks line.
Purpose	Driving Factor(s): To provide electric energy to a new high load customer in the area. In-service date is predicated on ramp rate of customer load.
Date	
(a) Construction Start	2023
(b) Estimated In-Service	2024
Permitting / Siting Status	*CEC issued 12/3/2021 (Case No. 193, Decision No. 78318).*

Arizona Public Service Company
2023 - 2032
Ten-Year Plan
Planned Transmission Description

2024

Project Name	Parkway 230kV Lines
Project Sponsor	Arizona Public Service Company
Other Participants	None
Size	
(a) Voltage Class	230kV AC
(b) Facility Rating	TBD
(c) Point of Origin	Palm Valley-Trilby Wash 230kV line
(d) Intermediate Points of Interconnection	None
(e) Point of Termination	Parkway substation to be in service 2024
(f) Length	Less than 1 mile
Routing	The Parkway substation will be located adjacent to the Palm Valley-Trilby Wash 230kV line. The substation will be located north of Olive Avenue between the Loop 303 and Cotton Lane.
Purpose	Driving Factor(s): To provide electric energy to a new high load customer in the area. In-service date is predicated on ramp rate of customer loads.
Date	
(a) Construction Start	2023
(b) Estimated In-Service	2024
Permitting / 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.*

Arizona Public Service Company
2023 - 2032
Ten-Year Plan
Planned Transmission Description

2025

Project Name	Runway Additional 230kV Lines
Project Sponsor	Arizona Public Service Company
Other Participants	None
Size	
(a) Voltage Class	230kV AC
(b) Facility Rating	TBD
(c) Point of Origin	White Tanks-West Phoenix 230kV line corridor
(d) Intermediate Points of Interconnection	Diamond substation to be in service by 2025
(e) Point of Termination	Runway substation
(f) Length	Approximately 4.5 miles
Routing	The new double circuit 230kV line 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 proceed west approximately 2 more miles to the Runway 230kV substation.
Purpose	Driving Factor(s): To provide service to a new high load customer and additional redundancy to new and existing high load customers in the area. In-service date is predicated on ramp rate of customer load.
Date	
(a) Construction Start	2023
(b) Estimated In-Service	2025
Permitting / Siting Status	*CEC issued 1/23/2023 (Case No. 209, Decision No.78834).*

Arizona Public Service Company
2023 - 2032
Ten-Year Plan
Planned Transmission Description

2025

Project Name	Contrail 230kV Lines
Project Sponsor	Arizona Public Service Company
Other Participants	None
Size	
(a) Voltage Class	230kV AC
(b) Facility Rating	TBD
(c) Point of Origin	El Sol substation
(d) Intermediate Points of Interconnection	Contrail substation to be in service 2025
(e) Point of Termination	Parkway substation to be in service 2024
(f) Length	Approximately 7 miles
Routing	The Contrail substation will be located on the southeast corner of Olive Avenue and Dysart Road. Two circuits will originate from the El Sol-White Tanks 230kV line near El Sol substation and will head generally west and interconnect at the Contrail substation to tie White Tanks and El Sol substations into Contrail. A single-circuit line will then continue from Contrail substation and head generally west and terminate at the future Parkway substation. The line structures are planned to be double-circuit capable.
Purpose	Driving Factor(s): To provide electric energy to a new high load customer in the area. In-service date is predicated on the ramp rate of customer load.
Date	
(a) Construction Start	2023
(b) Estimated In-Service	2025
Permitting / Siting Status	*CEC issued 4/28/2022 (Case No. 198, Decision No. 78543).*

Arizona Public Service Company
2023 - 2032
Ten-Year Plan
Planned Transmission Description

2025

Project Name	Broadway 230kV Lines
Project Sponsor	Arizona Public Service Company
Other Participants	None
Size	
(a) Voltage Class	230kV AC
(b) Facility Rating	TBD
(c) Point of Origin	Runway-Rudd 230kV line
(d) Intermediate Points of Interconnection	None
(e) Point of Termination	Broadway substation to be in service 2025
(f) Length	Less than 1 mile per circuit
Routing	The Broadway substation will be cut into the Runway-Rudd 230kV line. The Broadway substation will be on the north side of Broadway Road and adjacent to the Runway-Rudd 230kV line.
Purpose	Driving Factor(s): To provide electric energy to a new high load customer in the area. In-service date is predicated on ramp rate of customer load.
Date	
(a) Construction Start	2023
(b) Estimated In-Service	2025
Permitting / Siting Status	*CEC issued 11/7/2019 (Case No. 183, Decision No. 77469).*

Arizona Public Service Company
2023 - 2032
Ten-Year Plan
Planned Transmission Description

2025

Project Name	Proving Ground Solar and Storage 500kV Interconnection
Project Sponsor	Arizona Public Service
Other Participants	Strata Clean Energy
Size	
(a) Voltage Class	500kV AC
(b) Facility Rating	TBD
(c) Point of Origin	Proving Ground Solar and Storage Project Step-Up substation to be in service 2025
(d) Intermediate Points of Interconnection	None
(e) Point of Termination	Hoodoo Wash Switchyard
(f) Length	Less than 1 mile (500kV lines)
Routing	The new generation tie line would originate at the Proving Ground Solar and Storage project substation and be energized at 69kV. The 69kV lines would run north approximately 1.0 mile. Then the lines will route east for approximately 3.5 miles to the north side of Palomas Road. The lines will then route along the north side of Palomas Road for approximately 1.0 mile terminating in a step-up substation. The generation tie line will exit the step-up substation at 500kV. The 500kV generation tie line will route on 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. The Project includes the 500kV lines only.
Purpose	Driving Factor(s): To connect the Proving Ground Solar and Battery Storage project to the Hoodoo Wash switchyard.
Date	
(a) Construction Start	2023
(b) Estimated In-Service	2025
Permitting / Siting Status	*An application for a CEC was filed on 1/5/2023. which included a request to amend CEC 135 (Decision No. 70127) authorizing new structure type.*

Arizona Public Service Company
2023 - 2032
Ten-Year Plan
Planned Transmission Description

2025

Project Name	Hashknife Energy Center Generation Tie Line Project
Project Sponsor	Hashknife Energy Center LLC
Other Participants	Arizona Public Service Company
Size	
(a) Voltage Class	500kV AC
(b) Facility Rating	TBD
(c) Point of Origin	Hashknife Energy Center project substation to be in service 2025
(d) Intermediate Points of Interconnection	None
(e) Point of Termination	Cholla substation
(f) Length	Less than one mile
Routing	The APS owned portion of the line commences at the Cholla generation plant-controlled access boundary. From there, the line heads southeast for approximately 0.3 miles to the point of interconnection at the Cholla substation.
Purpose	Driving Factor(s): To connect the Hashknife Energy Center project to the Cholla substation.
Date	
(a) Construction Start	2024
(b) Estimated In-Service	2025
Permitting / 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 point of future ownership change, the Point of Physical Demarcation (POPD), near the Cholla generation plant-controlled access boundary. The companion CEC-2 is for the portion of the Project from the POPD to the point of interconnection at the Cholla substation. At a future date, prior to construction, the Interconnection Customer intends to transfer CEC-2 to APS.*

Arizona Public Service Company
2023 - 2032
Ten-Year Plan
Planned Transmission Description

2026

Project Name	TS24 230kV lines
Project Sponsor	Arizona Public Service Company
Other Participants	None
Size	
(a) Voltage Class	230kV AC
(b) Facility Rating	TBD
(c) Point of Origin	Desert Basin - Santa Rosa 230 kV line
(d) Intermediate Points of Interconnection	None
(e) Point of Termination	TS24 substation to be in service 2026
(f) Length	Less than 1 mile
Routing	The TS24 Project is a rebuild of the existing Casa Grande 230kV substation in a breaker-and-a-half configuration. The existing 230kV lines to Desert Basin and Milligan will be terminated at this new substation.
Purpose	Driving Factor(s): To provide electric energy to new high load customers in the area, as well as to continue to provide reliable service for the continued load growth in Pinal County. The TS24 Project will also fix existing paired element limitations at Casa Grande substation.
Date	
(a) Construction Start	2025
(b) Estimated In-Service	2026
Permitting / Siting Status	*An application for a CEC has not yet been filed.*

Arizona Public Service Company
2023 - 2032
Ten-Year Plan
Planned Transmission Description

2027

Project Name	TS22 Project
Project Sponsor	Arizona Public Service Company
Other Participants	None
Size	
(a) Voltage Class	230kV AC and 500kV AC
(b) Facility Rating	TBD
(c) Point of Origin	Raceway-Scatter Wash 230kV line and Morgan-Pinnacle Peak 500kV line
(d) Intermediate Points of Interconnection	None
(e) Point of Termination	TS22 substation to be in service 2027
(f) Length	Less than 1 mile
Routing	The TS22 substation is planned to be adjacent to the double-circuit transmission line carrying Raceway-Avery 230kV line and Morgan-Pinnacle Peak 500kV line and generally northwest of the intersection of 51st Avenue and Dove Valley Road. The project will cut the new substation in and out of the existing 230kV and 500kV lines.
Purpose	Driving Factor(s): To provide electric energy to a new high load customer in the area. In-service date is predicated on ramp rate of customer load.
Date	
(a) Construction Start	2025
(b) Estimated In-Service	2027
Permitting / 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).*

Arizona Public Service Company
2023 - 2032
Ten-Year Plan
Planned Transmission Description

2027

Project Name	Panda – Freedom 230kV Line Rebuild
Project Sponsor	Arizona Public Service Company
Other Participants	None
Size	
(a) Voltage Class	230kV AC
(b) Facility Rating	3000 A
(c) Point of Origin	Panda 230kV substation
(d) Intermediate Points of Interconnection	TS29 230kV to be in service TBD
(e) Point of Termination	Freedom 230kV substation
(f) Length	Approximately 40 miles
Routing	The line will follow the same alignment as the current Panda-Freedom 230kV line. The structures will be double-circuit capable to 500kV standards. Only the rebuilt 230kV Panda-Freedom line will be installed. TS29 substation will be located by Rt. 85 and Baseline Rd., about 28 miles north of Panda.
Purpose	Driving Factor(s): To provide electric energy to a new high load customer in the area. The project will also be used to provide system reliability and serve numerous large load customers near Freedom with electric energy. This project will have double-circuit capability with one circuit in service in 2027 and the second circuit in service TBD.
Date	
(a) Construction Start	2025
(b) Estimated In-Service	2027
Permitting / Siting Status	*An application for a CEC amendment (Case No. 26, Decision No. 46865) has not yet been filed.*

Arizona Public Service Company
2023 - 2032
Ten-Year Plan
Planned Transmission Description

2027

Project Name	Palm Valley – Parkway Switchyards
Project Sponsor	Arizona Public Service Company
Other Participants	None
Size	
(a) Voltage Class	230kV AC
(b) Facility Rating	TBD
(c) Point of Origin	Palm Valley 230kV substation
(d) Intermediate Points of Interconnection	TS26 switchyard and TS27 switchyard to be in service 2027
(e) Point of Termination	Parkway 230kV substation to be in service 2024
(f) Length	Less than 1 mile.
Routing	The two new switchyards will be served by the existing and planned Palm Valley 230kV circuits #1 and #2. Both lines will be looped-in to each switchyard. The switchyards will be located along Cotton Lane, just south of W. Bethany Home Road. The new substations will be located approximately 0.5 and 1.0 miles north of Palm Valley substation, respectively.
Purpose	Driving Factor(s): To provide electric energy to new high load customers in the area. In-service date is predicated on ramp rate of customer loads.
Date	
(a) Construction Start	2026
(b) Estimated In-Service	2027
Permitting / 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. An application for an additional CEC amendment (Case No. 122) is expected to be filed in 2023.*

Arizona Public Service Company
2023 - 2032
Ten-Year Plan
Planned Transmission Description

2027

Project Name	Sun Valley to TS23 230kV Line
Project Sponsor	Arizona Public Service
Other Participants	None
Size	
(a) Voltage Class	230kV AC
(b) Facility Rating	3000A
(c) Point of Origin	Sun Valley Substation
(d) Intermediate Points of Interconnection	None
(e) Point of Termination	TS23 Substation to be in service 2027
(f) Length	Approximately 18 miles
Routing	The line would originate at the Sun Valley Substation and utilize the open circuit position on the existing 500kV Sun Valley to Morgan 500kV structures.
Purpose	Driving Factor(s): To provide electric energy to growing load demands in the Wittmann area. This Project will also bring greater reliability to the Morristown and McMicken areas by adding an additional source to the 69kV system in the area.
Date	
(a) Construction Start	2026
(b) Estimated In-Service	2027
Permitting / Siting Status	CEC issued (Case No. 138, Decision No. 70850, amended by Decision No. 75092, TS5-TS9 500/230kV Project) for the portion of the 230kV line along the Sun Valley – Morgan corridor.

Arizona Public Service Company
2023 - 2032
Ten-Year Plan
Planned Transmission Description

2028

Project Name	Jojoba-Rudd 500kV Line
Project Sponsor	Arizona Public Service Company
Other Participants	None
Size	
(a) Voltage Class	500kV AC
(b) Facility Rating	TBD
(c) Point of Origin	Jojoba substation
(d) Intermediate Points of Interconnection	TS21 substation to be in service TBD
(e) Point of Termination	Rudd substation
(f) Length	Approximately 25 miles
Routing	The Jojoba-Rudd 500kV line will exit Jojoba substation and head generally northeast, paralleling the Jojoba-Kyrene 500kV line until it turns east to follow the corridor of the Palo Verde-Rudd 500kV line. After this, it will generally parallel the Palo Verde-Rudd 500kV line to Rudd substation.
Purpose	Driving Factor(s): To provide an additional source to the west valley to strengthen the EHV sources serving the Phoenix metropolitan area, which is experiencing rapid economic development. Continued load growth, including high-load data center customers and semi-conductor manufacturing, will stress existing infrastructure, requiring a new path to bring generation into the load pocket. Additionally, this new source will provide customers in the area greater access to a diverse mix of resources from around the region.
Date	
(a) Construction Start	2025
(b) Estimated In-Service	2028
Permitting / Siting Status	*An application for a CEC has not yet been filed.*

To Be Determined Projects

Project Name	Permitting/Siting Status
El Sol – Westwing 230kV Line	CEC issued (Case No. 9, Docket No. U-1345)
Palo Verde – 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 – TS2 – Trilby Wash 230kV Line Circuit #2	The Palm Valley-TS2 segment CEC issued (Case No. 122, Decision No. 66646, amended by Decision No. 73937, West Valley-South 230kV Transmission Line Project) The Trilby Wash-TS2 segment CEC issued (Case No. 127, Decision No. 67828, amended by Decision No. 75045, West Valley North 230kV Transmission Line project)
Sun Valley – Trilby Wash 230kV Line Circuit #2	CEC issued (Case No. 127, Decision No. 67828, amended by Decision No. 75045, West Valley North 230kV Transmission Line project)
Pinal Central – Sundance 230kV Line	CEC issued (Case No. 136, Decision No. 70325, Sundance to Pinal South 230kV Transmission Line project)
Morgan – Sun Valley 230kV Line	CEC issued (Case No. 138, Decision No. 70850, amended by Decision No. 75092, TS5-TS9 500/230kV Project)
Orchard – Yucca 230kV Line	CEC issued (Case No. 163, Decision No. 72801, North Gila to TS8 to Yucca 230kV Transmission Line Project)
North Gila – Orchard 230kV Line Circuit #2	CEC issued (Case No. 163, Decision No. 72801, North Gila to TS8 to Yucca 230kV Transmission Line Project)
Sun Valley – TS10 – TS11 230kV Line	An application for a CEC has not yet been filed
Buckeye – TS11 – Sun Valley 230kV Line	An application for a CEC has not yet been filed
TS14 230kV Lines	An application for a CEC has not yet been filed
TS21 500/230kV Substation	An application for a CEC has not yet been filed
Milligan Solar and Storage Project Generator Tie Line	An application for a CEC has not yet been filed
Mead-Perkins 500kV Interconnection Project	An application for a CEC has not yet been filed
Delaney-Quartzsite 230kV and 500kV Lines	An application for a CEC has not yet been filed
Quartzsite-Colorado River 500kV Line	An application for a CEC has not yet been filed
Milligan-Pinal Central 230kV Line	An application for a CEC has not yet been filed
TS17 230kV Lines	An application for a CEC has not yet been filed

Project Name	Permitting/Siting Status
TS30 500/230kV Substation	An application for a CEC has not yet been filed
Four Corners – Cholla 345kV Line Upgrade	An application for a CEC has not yet been filed
Cholla – Pinnacle Peak 345kV Line Upgrade	An application for a CEC has not yet been filed
Pinnacle Peak – Ocotillo 230kV Line Upgrade	An application for a CEC has not yet been filed

Attachment B

Renewable Transmission Action Plan

Arizona Public Service Company
Renewable Transmission Action Plan
January 2023

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. As traditional fossil fuel plants are retiring, these projects are looking to replace those resources and to be the source of energy for 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 will be developed as reliability and resource needs arise. Described below is the current

[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.*

status of the proposed development 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 are conceptual 500kV transmission line projects from the Palo Verde hub and from the Gila Bend/Gila River area to a new substation near the existing Liberty substation located in the west valley. The APS 2023-2032 Ten-Year Transmission System Plan does not currently show a need for these projects in order to enable new renewable resources and, as a result, no further progress on the development plan has been made.

The APS 2023-2032 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 Future Transmission Needs

Technical Study

Effects of Distributed Generation and Energy Efficiency on Future Transmission Needs

FINAL

SALT RIVER PROJECT

ARIZONA PUBLIC SERVICE COMPANY

January 2023

Executive Summary

In Decision No. 74785 (October 24, 2014), 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) on their future planned transmission systems in their fifth planning year (the Study).

To perform the Study, Salt River Project (SRP) and Arizona Public Service Company (APS) used the 2028 Heavy Summer base case, which was reviewed and updated by APS, SRP, Tucson Electric Power (TEP), UNS Electric (UNSE), Arizona Electric Power Co-op (AEPCO), and Western Area Power Administration (WAPA) (Arizona entities).

- The first case is the base case or typical system peak planning load, which includes the effects of DG/EE offset to peak load.
- The second case is the base case with the projected increases in DG/EE over the next five (5) years backed out of the load forecast.
    - The projected increases of DG/EE in APS's footprint for 2023 to 2028 that are backed out of the forecast for this case total 711 MW, which includes 120 MW for DG and 591 MW for EE.
    - The projected impacts of DG/EE in SRP's footprint through 2028 that are backed out of the forecast for this case total 988 MW, which includes 80 MW for DG and 908 MW for EE.

The Study indicated that the delayed or non-implemented DG/EE over APS and SRP's combined footprint causes thermal overloads over some elements in SRP's Bulk Electric System (BES) transmission facilities. SRP is aware of these overloads since comparable sensitivity studies have revealed similar results and initial mitigations are planned. SRP is continually assessing the need and timing of planned mitigations and will install facility mitigations prior to these load level increases.

Table of Contents

1. Introduction

In Decision No. 74785 (October 24, 2014), 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/or 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 DG/EE and performing contingency analysis with and without the disaggregate DG/EE. The technical study should at a minimum discuss DG/EE forecasting methodologies and transmission loading impacts. The study should monitor transmission down to and including the 115kV level. Alternative methodologies or study approaches will be acceptable on condition that the study results satisfy the minimum requirements [above].[1]

2. Study Requirements and Assumptions

2.1. Study Requirements

To fulfill this requirement in 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 DG/EE per the typical planning process. The second case uses the forecasted load excluding the effects of projected increases in DG/EE between 2023 and 2028 This scenario is equivalent to "disaggregating the utilities load forecasts from effects of DG/EE.[2]"

Table 1 - Summary of Cases

Case	Scenario	Load	EE	DG	Utility Solar
1	Base	Peak	On	On	On
2	EE/DG	Peak	Pre 2023 only	Pre 2023 only	On

The Study monitored the loading impacts to the transmission system and performed reliability analysis similar to how SRP and APS analyze the transmission system in the ten-year planning process. For the two cases, BES facilities (>100kV) are examined to ensure there are no

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

thermal or voltage criteria violations. These facilities are examined with all lines in-service and for all single contingencies.

2.2. Studied Cases Assumptions

This Study used the 2028 power flow case, which include the planned projects in SRP's and APS's 2023-2032 Ten-Year Plans. The 2028 heavy summer case was a "seed case" created by Arizona entities for use in planning studies performed in 2022. For the EE/DG scenario case the APS and SRP loads in the 2028 planning case were increased to reflect the absence of DG/EE, as described below.

- For APS, 77% of the MW contributions of DG were estimated to be from metro Phoenix load areas, while 23% of the MW contributions of DG were estimated to be from areas outside the metro area. Similarly, 75% of the MW contributions of EE were estimated to be from metro Phoenix load areas, while 25% of the MW contributions of EE were estimated to be from areas outside the metro area. Identified large industrial loads were not scaled during the process of creating the scenario cases. Available generation within Arizona was increased to account for the increased load.

- SRP's forecasting group estimated EE and DG would contribute 988 MW in 2028 all of which occurred within the Phoenix metro load pocket. For the EE/DG scenario case the SRP load in the 2028 planning case was increased by this value to study its delayed/non-implemented impact. Available generation within Arizona was increased to account for the increased load.

3. Distributed Generation and Energy Efficiency Forecasting Methodology Description

DG/EE estimates were developed to determine what each program's role was at the time of the system peak in 2028. The combined total DG/EE impacts at peak on APS's transmission system in 2028 are estimated to be 711 MW. SRP's forecasting group estimated EE and DG would contribute 988 MW in 2028. The details of the EE and DG estimates are described below.

3.1.Energy Efficiency Impact

To forecast the EE program impact (net of demand response curtailment) on APS's system peak in 2028, several steps were taken. First, efficiency measures in 2023-2028 were forecasted by assuming levels associated with APS's 2020 IRP. Then, when the EE amounts were determined, as defined above, they were assessed to establish the EE programs overall impact coincident to APS's system peak. SRP's EE forecasting included expected impacts through 2028 during system peak. Table 2 provides the projected EE for APS and SRP at peak hour for 2028.

Table 2: APS and SRP Energy Efficiency Forecast 2028

	2028
APS EE impact to peak	591 MW
SRP EE impact to peak	908 MW

3.2.Distributed Generation Impact

The impact to APS and SRP load from DG systems in 2028 was based on projections of new DG system installations. The projection of installations was then applied to each month of the forecast period until 2028 to forecast the total amount of DG on the network. From this, the impacts to the 2028 APS and SRP system coincident peaks from DG were determined. The forecasted incremental DG at peak hour for 2028 is provided in Table 3.

Table 3: APS and SRP Distributed Generation Forecast 2023-2028

	2028
APS DG impact at peak load	120 MW
SRP DG impact at peak load	80 MW

4. Study Results

The 2028 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 all lines in-service condition. Also, under this condition no APS or SRP voltage violations were observed.

The results for the case with delayed or non-implemented EE and DG over the entire APS and SRP combined footprint show the potential for overloads on SRP's BES as detailed in Table 4. No thermal violations were noted on APS's BES with the single contingency power flow analysis. Additionally, no new or significantly exasperated existing voltage violations on the BES were observed in this analysis.

Table 4: Thermal results of base case and EE/DG scenario case in 2028

Contingency	Overloaded Element	Worst 2028 Base case Loading	Worst 2028 EE/DG scenario case Loading	Comments
Browning 500/230kV Transformer Banks 1A & 1B	Browning 500/230kV Transformer Banks 1A & 1B	86.8%	103.4%	SRP facility overloaded[3]
Multiple	Kyrene West – Knox 230kV	88.8%	109.6%	SRP facility overloaded[4]
Orme – Rudd 230kV ckts. #1 & #2	Orme – Rudd 230kV ckts. #1 & #2	83.7%	136.9%	SRP facility overloaded[5]

5. Conclusion

The Study indicates that delayed or non-implemented DG/EE have an effect on the reliability of SRP's BES as currently planned in 2028. SRP is aware of these overloads since comparable sensitivity studies have revealed similar results and initial mitigations are planned. SRP is continually assessing the need and timing of planned mitigations and will install facility mitigations prior to these load level increases.

This Study only addresses APS and SRP's BES and there may be some impacts at the subtransmission level due to variations in timing and quantity of implemented DG/EE.

[3] SRP has initial mitigations planned. SRP is continually assessing the mitigations need and timing options
[4] SRP has initial mitigations planned. SRP is continually assessing the mitigations need and timing options
[5] SRP has initial mitigations planned. SRP is continually assessing the mitigations need and timing options

Attachment D

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.