

An aerial photograph of a large concrete dam situated in a deep, rugged canyon. The canyon walls are composed of layered, reddish-brown rock. A river flows through the canyon, curving around the base of the dam. The sky is a clear, pale blue. The text "SRP Synchrophasors in Operations" is overlaid in large, white, sans-serif font across the center of the image.

# SRP Synchrophasors in Operations

Matthew Rhodes | April 14, 2022



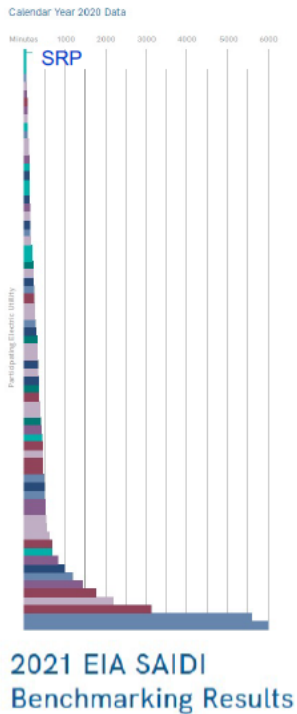
# SRP COMPANY OVERVIEW

SRP is an Arizona based public power serving 1.1 million customers in the Phoenix metro area

Service Area

Service Quality

Power and Financial Data



## Power data FY21

Electric service area	2,800 square miles
Electric customers, year-end	1,093,264
Peak - SRP retail customers	7,615,000 kW
Total electric sales	41,433 GWh

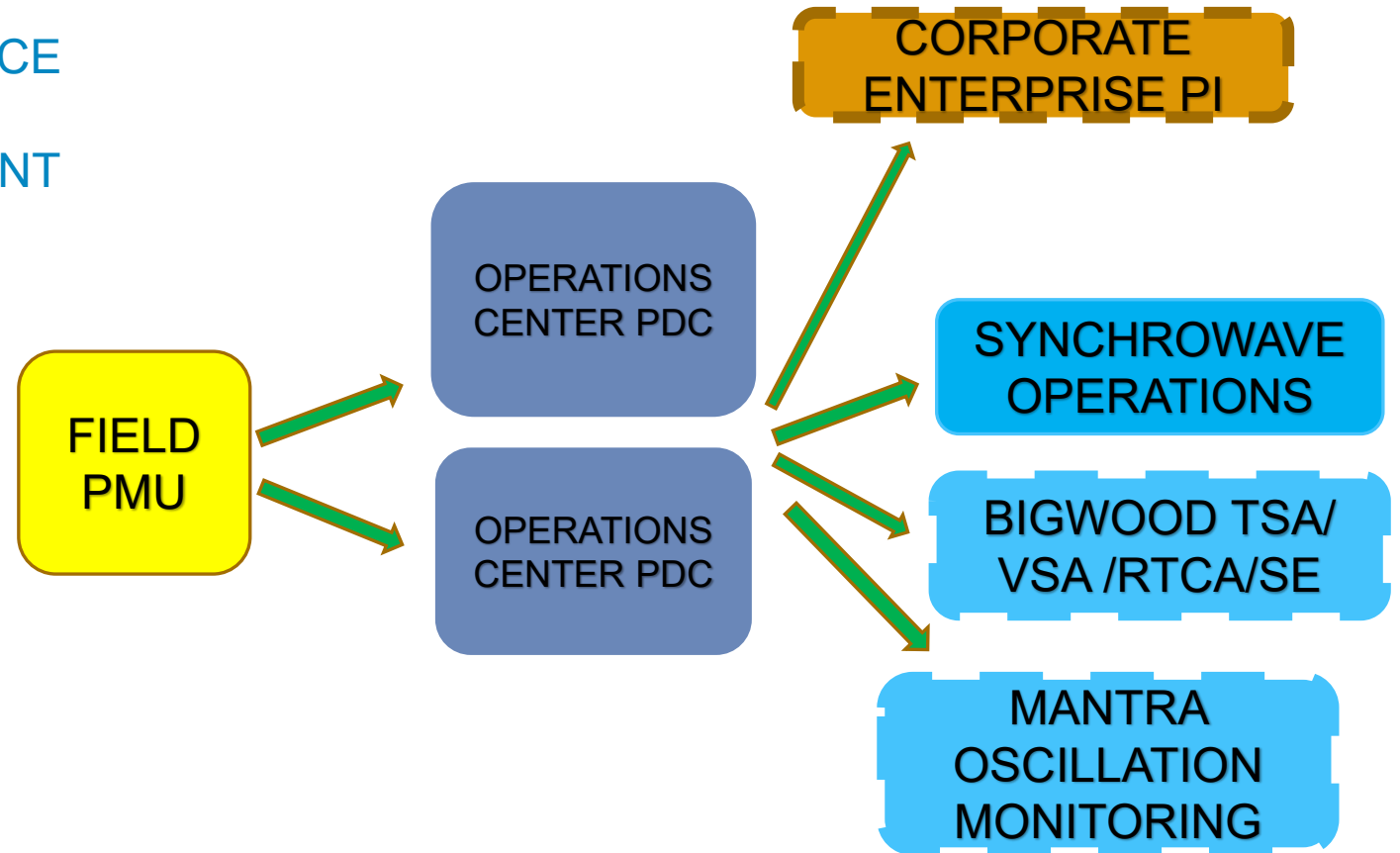
## Financial data FY21

Total operating revenues	\$3,475,507,000
Total operating expenses	\$3,045,280,000
Net revenues for the year	\$577,052,000
Utility plant, gross	\$17,305,702,000
Electric revenue contributions to support water operations	\$65,202,000
Taxes & tax equivalents	\$170,610,000
Debt ratio	44.3
Debt service coverage ratio	4.0
Employees, year-end	4,846

SRP operates on a fiscal year of May 1 through April 30.

# SRP SYNCHROPHASOR SYSTEM

- APPROXIMATELY 500 PMUS IN SERVICE
- CLOSE TO 900 PMUS AVAILABLE
- ONLY ONE PMU PER SYSTEM ELEMENT (MULTIPLE AVAILABLE)
- PMU DEVICES
  - SEL411L
  - SEL735
  - GE L90
  - Tesla DFR
- SYSTEM COVERAGE
  - 90% OF 500KV
  - 70% OF 230KV
  - 30% OF 115KV
  - 30% OF 69KV
  - <10% OF 12KV DISTRIBUTION
- GENERATION PMU

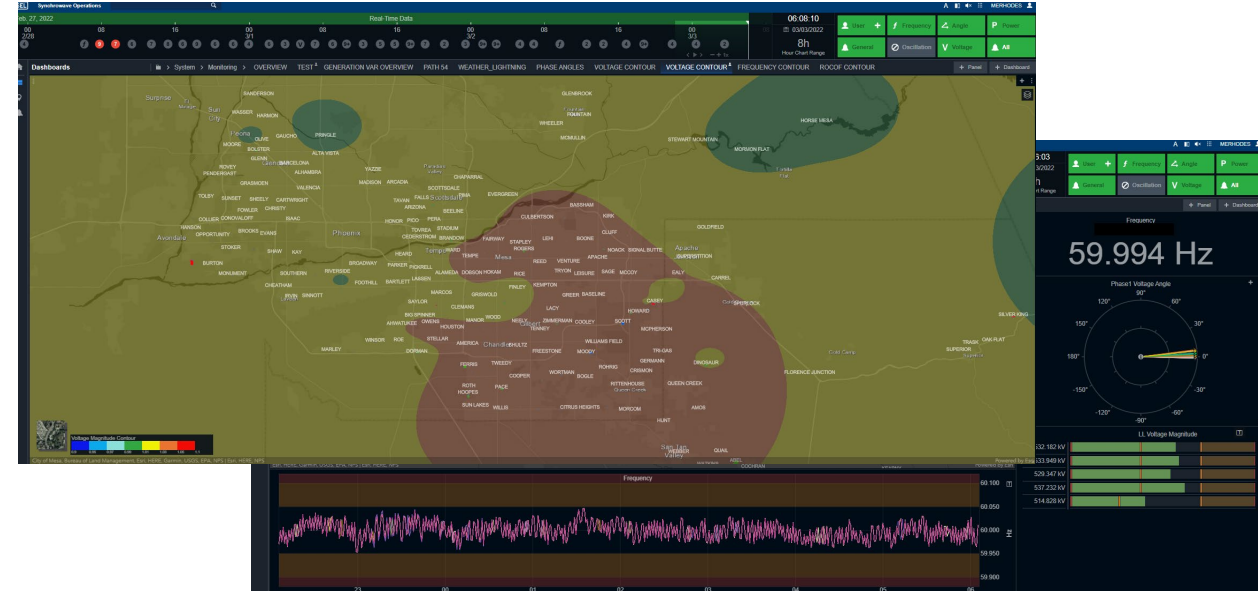


PMU INSTALLATIONS DRIVEN BY FIELD DEVICE UPGRADES.

# SRP REAL-TIME OPERATIONS TOOLS

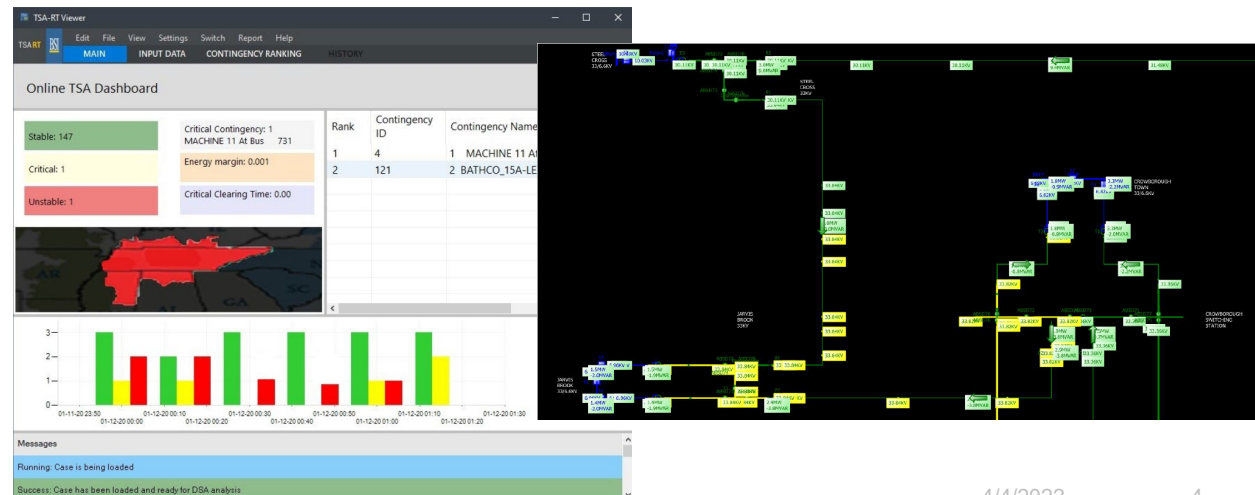
## SYNCHROWAVE OPERATIONS (NO REAL-TIME DECISIONS ALLOWED)

- Transmission Operator system awareness
- Transmission Engineer offline analysis and data extraction
- Distribution pilot to realize initial value of substation distribution PMUs
- **Driver:** Gap of real-time control room system dynamics situational awareness
- *Part of SRP Synchrophasor Roadmap*



# BIGWOOD TSA/VSA AND NON-LINEAR STATE ESTIMATOR

- Real-time Operator transient and voltage stability assessments
- RTCA backup/validation
- PMU-based state estimator for backup/validation
- **Driver:** Gap of real-time voltage and transient stability assessment



# SRP REAL-TIME OPERATIONS TOOLS

## MANTRA OSCILLATION ANALYSIS TOOL

- Transmission Engineer online oscillation monitoring
- Transmission Engineer offline oscillation analysis
- **Driver:** Gap of system dynamic oscillatory mode monitoring
- *Part of SRP Synchrophasor Roadmap*



# OBSTACLES TO DEPLOYMENT/LESSONS LEARNED

- Building the case for discovering system anomalies/issues that are not apparent. *You don't know what you don't know.*
  - ***Solution: Diligence, diligence, diligence***
- Operator acceptance (still slow going, but that is natural)
  - ***Solution: Technology and tool incremental training***
- CIP concerns present on use of any real-time tool. No SOPs developed and system architecture improvements not planned unless desire for real-time is established.
  - ***Solution: Instruction to system operators that situational awareness tools are to be used for situational awareness only.***

**thank you!**