SALT RIVER PROJECT AGRICULTURAL IMPROVEMENT AND POWER DISTRICT BOARD MEETING NOTICE AND AGENDA

JOINT MEETING OF THE
BOARD OF DIRECTORS AND COUNCIL
WORK STUDY SESSION
Tuesday, January 31, 2023, 9:30 AM
PERA Training and Conference Center
1 E. Continental Drive, Tempe, AZ 85288

Roll Call
Safety Minute

1. Call to Order .......................................................... PRESIDENT DAVID ROUSSEAU

2. Overview of the Electric Distribution System and How it Reliably Supports SRP Customers .......................................................... CHRIS CAMPBELL, VANESSA KISICKI, and WAYNE WISDOM
   - Foundational concepts
   - Integration into SRP’s power system
   - Key asset investments to maintain reliability
   - Support of system growth
   - Discussion on transformation to the grid of the future

3. Adjourn .......................................................... PRESIDENT DAVID ROUSSEAU

The Board may vote during the meeting to go into Executive Session, pursuant to A.R.S. §38-431.03 (A)(3), for the purpose of discussion or consultation for legal advice with legal counsel to the Committee on any of the matters listed on the agenda.

The Board may go into Closed Session, pursuant to A.R.S. §30-805(B), for records and proceedings relating to competitive activity, including trade secrets or privileged or confidential commercial or financial information.

Visitors: The public has the option to attend in-person or observe via Zoom and may receive teleconference information by contacting the Corporate Secretary’s Office at (602) 236-4398. If attending in-person, all property in your possession, including purses, briefcases, packages, or containers, will be subject to inspection.
ELECTRIC DISTRIBUTION SYSTEM OVERVIEW
SRP BOARD & COUNCIL WORK STUDY SESSION
INTRODUCTORY SUMMARY

January 31, 2023

In this work study session, SRP staff will provide an overview of SRP’s electric distribution system and business operations. Topics that will be covered include:

- Introduction to fundamental distribution system concepts,
- The role of distribution in the Power System,
- How the distribution system is planned and managed, and
- How the distribution system is transforming to accommodate distributed energy resources and electric vehicles.

In advance of the work study session, a review of the 2022 Grid Performance Report is recommended, which was distributed at the January 2023 Board and Council meetings. A link to an electronic copy of the report is included below as well. This report is published annually and provides an excellent summary of the distribution system’s reliability performance. While this report will not be discussed in detail during the work study session, the topics covered in the report nicely augment the discussion planned for the Session.

Please note that while the Grid Performance Report covers both transmission and distribution topics and outcomes, this work study session will focus only on distribution system topics. A separate transmission workshop was previously held in August of 2020.

Board & Council
Electric Distribution System Overview

Work Study Session
Chris Campbell, Vanessa Kisicki & Wayne Wisdom

January 31, 2023
Unexpected discovery: stop – evaluate – adjust

- **STOP** – What is that?

- **EVALUATE** – Tailboard again
  - Identify hazards
  - Determine tasks involved
  - Consider changes for emergency notification
  - Ensure each person understands

- **ADJUST** – Implement needed changes
  - Different precautions or PPE
  - Call in other skills or equipment
SRP Organizational Roles

**Primary Roles**
- Power System
  - Planning
  - Operations
  - Engineering
  - Substation Construction
  - Substation Maintenance
- Customer Operations
  - Line Construction
  - Line Maintenance

**Other Key Contributors**
- Land
- Supply-chain
- Transportation
- Power Delivery Technology Services
- Protection Automation & Control
- Telecom Systems
- Information Technology Services
- Customer Services
- Distribution Services
Agenda

• Welcome & Introduction  John Coggins
• Distribution System Overview  Chris Campbell
• Distribution System Plan
  – Asset Management  Wayne Wisdom
  – System Growth  Vanessa Kisicki
  – Distribution Enablement  Chris Campbell
• Closing Comments  Chris Campbell
Distribution System Overview
SRP’s Electric Service Territory

SRP provides electricity to over 1.1 million customer meters in a 2,900 square-mile area in parts of 3 counties (Maricopa, Gila & Pinal) and 15 municipalities.
Sub-Transmission vs Distribution

Substations & 69kV Lines

12kV Distribution Circuits
The Electric Distribution Grid

Sub-Transmission Lines (69kV)

Distribution Substation 69/12kV

Distribution 12kV Circuits

Residential Service

Industrial/Commercial Service
Distribution Substations – Street View

Potter Substation

Alameda Substation
Distribution Substation Layout & Components

- Incoming 69kV lines
- Circuit breakers
- Transformer
- Switchgear
- Cell site
- Underground 12kV circuits
- Control house
Anatomy of an Electric Distribution Circuit

Distribution Primary (12kV)

Substation

Switch

Conduit

Wire/Cable

Capacitor

Poles

Fuse

Transformer

Customer Meters

Distribution Secondary (240/120V)
Anatomy of an Electric Distribution Circuit

Distribution Primary (12kV)  Distribution Secondary (240/120V)

- Substation
- Switch
- Conduit
- Wire/Cable
- Capacitor
- Poles
- Transformer
- Customer Meters
- Fuse

- 191 Distribution Substations
- 1,424 Distribution Circuits
- 39,634 Switches

- 21,431 Primary Circuit Miles
- 10,323 Secondary Miles
- 131,599 Poles

- 180,000 Service Transformers
- 4,000 Capacitor Banks
- 1,100,000+ Meters/Customers
Overhead Distribution Lines
Underground Distribution Lines
Distribution (aka Service) Transformers

Pad Mount Transformer

Overhead Transformer
Distribution Switches

Pad-mounted Switch

Overhead Switch
Distribution Capacitor Banks

Pad-mounted Capacitor  Overhead Capacitor
Automation of Electric Distribution

Wide-Area Network

Field-Area Network

Meter Network

Substation

Automated Switches

Fault Indicators

Capacitor Controller

Customer Meters

Protection & Control

Fault Location/Automated Switching

Voltage Management

Meter Awareness
SRP Distribution - Historical Highlights

• 1922 – Rural electrification begins (start of valley T&D)
• 1948 – SRP hires Southern Cal Edison managers and engineers
• 1963 – System Design Criteria Established
  • Underground distribution (Direct buried cable)
  • Open-looped distribution design
• 1993 – Transition to “all-conduit” underground distribution
• 2004 – First generation smart meter rollout begins
• 2004 – Electronic-based Outage Management System (OMS) deployed
• 2014 – Second generation smart meter rollout begins
Reliability Indices

System Average Interruption Duration Index (SAIDI)

System Average Interruption Frequency Index (SAIFI)

SRP Target = 73 minutes

SRP Target = 0.8 events per customer
What Makes the SRP Distribution Grid Unique?

Industry Leading Reliability & Customer Service

Reliability Contributors

- Underground versus overhead lines
- System design & equipment standards
- Proactive planning, operations and maintenance programs
Distribution Open-Loop Design

**Typical System**
- Feeders ~10 to 20 miles
- Fixed
- Higher losses
- More voltage challenges

**SRP Looped System**
- Feeders ~2 to 5 miles
- Flexible, configurable
- Lower losses
- Fewer voltage challenges
- Higher hosting potential/complexity
Distribution Operations Overview

Manage Grid Connectivity
- Planned & unplanned outages
- Direction of switching activities
- Customer outage communications
- Scheduling

Manage Service Capacity/Quality
- Monitor system conditions
- Allocate load to avoid limits
- Manage voltage & triage issues
- Manage load shed
Distribution Operations Safety

- Conduct Tailboards
- Address Hazards
- Direct Switching Activities
- Provide Clearances & Hold Tags
- Emergency Radio Procedure
Unplanned Outage Causes

- Weather
- Vegetation
- Construction dig-ins
- Automobile accidents
- Equipment failures
- Wildlife
Distribution System Outage Activity

Total Outages by Year

Operational Activity (Average per year)

<table>
<thead>
<tr>
<th></th>
<th>FY20</th>
<th>FY21</th>
<th>FY22</th>
<th>FY23 (Q1, Q2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Planned Outages</td>
<td>4,648</td>
<td>4,583</td>
<td>4,532</td>
<td>2,551</td>
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<tr>
<td>Total Unplanned Outages</td>
<td>3,733</td>
<td>4,104</td>
<td>4,065</td>
<td>3,009</td>
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</table>

- **68,218** Trouble Calls Received
- **145,376** Switching Steps Performed
- **18,338** Hold Tags Placed
- **8,182** Work Orders Submitted
Distribution System Plans

Grid of Today

Grid of the Future

Asset Management
System Expansion
Distribution Enablement
Distribution System Plan – Asset Management
Distribution Line Construction & Maintenance

**Construction Activities**
- New Business (Residential, Commercial & Small Industrial)
- Relocations (Road Widenings – Municipalities, ADOT)
- OH/UG Conversions (Aesthetics, Subdivisions)
- Load Growth (new feeders, feeder ties, capacitor banks)

**Maintenance Activities**
- Storm & Emergency Damage
- Line Inspections & Patrols
- Vegetation Management
- Blue Stake
- Underground Cable Replacement
- Wood Pole Replacement
Underground Cable Installation

Direct Buried (1960’s to 1993)  All Rigid Conduit System after 1993
30+ Years of Fault History
In 25 Years, SRP has replaced...

FY2022 Direct Buried Primary Distribution Cable (feet)

- Completed (ft): 27,037,695 (50.26%)
- Remaining (ft): 26,753,965 (49.74%)

That's longer than the Amazon River!
Cable Replacement Summary

• **27 million feet** – remaining direct buried underground primary voltage cable (47 million feet of secondary voltage cable)

• **1.1 million feet** – replaced annually

• **$38 million** - annual capital spend (almost all on primary)

• **25 years** – left at current rate of replacement and cost (for primary only)

• **1,600** – primary voltage faults annually (2,400 secondary faults annually)

• **$11 million** – annual O&M for fault repair and site restoration
Wood Pole Program Summary

- **12,000** – wood poles inspected annually (10-year cycle)
- **$430,000** – annual O&M for pole inspections
- **1,600 – 2,100** – poles proactively replaced annually
- **$9-11 million** – annual capital for pole replacement
Wood Pole Inspection Process

1. Sound and Bore
2. Dig and bore below ground line
3. Evaluate
Wood Pole Replacement
Distribution System Plan
– System Expansion
Planning for Distribution

69 kV Transmission Lines

12 kV Distribution Circuits
Distribution Planning Process

**Inputs**
- Load Forecast
- Distribution System Model
- New Customer Load Information
- Hourly Load Shapes
- DER Interconnections
- DER/EV Adoption

**Outputs**
- 6-Year Distribution System Plan
- 6-Year Infrastructure Upgrade Plan
- 10-Year Distribution System Plan
- Summer Switching Plans

01/31/2023 Board & Council Work Study Session, C.W. Campbell, V.P. Kisicki, W.N. Wisdom
Electric Vehicle and DER Growth

**EVs in SRP Service Territory**

- Total Vehicles
- Year: 2010, 2015, 2020, 2025, 2030
- 137,600 in 2030

**Capacity of DER (MW AC)**

- Total Capacity
- Year: 2010, 2015, 2020, 2025, 2030
- 1,135 MW in 2030

01/31/2023 Board & Council Work Study Session, C.W. Campbell, V.P. Kisicki, W.N. Wisdom
The Future of Distribution Planning

Today
- Peak hour of the year
- Load growth
- New infrastructure solutions

Tomorrow
- Every hour of the year
- Load growth and DER & Electrification growth
- Traditional and alternative solutions
Distribution System Plan – Distribution Enablement
## Grid Transformation Drivers

<table>
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<tr>
<th>Grid Integrity</th>
<th>DER/EV Management</th>
<th>Customer Enablement</th>
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<tbody>
<tr>
<td>• More dynamic grid</td>
<td>• Dispatchable &amp; variable energy resources</td>
<td>• Customer interconnection experience</td>
</tr>
<tr>
<td>• Bi-directional power flow</td>
<td>• Flexible loads</td>
<td>• Enable customer programs</td>
</tr>
<tr>
<td>• New solutions available to address grid issues</td>
<td>• Customer integration</td>
<td>• Customer information</td>
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SRP 2035 Corporate Goal Alignment

CUSTOM

Enable the interconnection of all customer-sided resources, without technical constraint, while ensuring current levels of grid integrity and customer satisfaction.
Anticipate customer demand and plan for the dynamic nature of DERs.

Operate a dynamic grid with increased situational awareness and control.

Enable new products and customer offerings as technology continues to evolve.

Empower future-focused workforce prepared for grid transformation.
Distribution Enablement Strategy & Roadmap

The roadmap is a portfolio of projects organized into 6 initiatives and mapped over a 10 year-period.
FY23 Distribution Enablement Plan Summary

- **Projects Count**: 50
- **Budget Dollars**: $46.7M
- **Resource Hours Total Hours**: 193,200

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<th>Category</th>
<th>Amount</th>
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<td>Capital</td>
<td>$29.2M</td>
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<tr>
<td>O&amp;M</td>
<td>$17.5M</td>
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Advanced Distribution Management System (ADMS)

- ADMS is a software platform that comprises a suite of applications used for real-time management of an electric distribution grid
- The ADMS Foundation project is the initial deployment
  - Launched in November 2020
  - Go-live scheduled for March 2024
  - Replaces existing Outage Management System (OMS) that has been in place since 2004
  - Project cost = $19M
- ADMS Advanced phase will deploy additional functionality
  - Annual release cycle with parallel workstreams
ADMS Architecture

- Enterprise Applications
- Distribution Network Model
- Technology Platform
- Field Devices

- Outage (OMS)
- Distribution (DMS)
- Distributed Energy (DERMS)

Integration Arrows
ADMS Functions

- Outage Management System
  - System isolation/return to normal for planned outages
  - Unplanned outage identification and restoration
  - Timely outage information to customers

- Distribution Management System
  - Real time analysis and control of the grid
  - Analysis of feeder reconfiguration using power flow tool
  - Emergency load shed program

- Distribution Energy Resource Management System
  - Awareness, forecasting, and modelling of DERs
  - Scheduling and control of DERs to support advanced customer programs
ADMS Schedule Summary

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<th>ADMS Foundation</th>
<th>FY23</th>
<th>FY24</th>
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<td>ADMS Advanced Applications</td>
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<td>Power Quality &amp; Reliability Tools</td>
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<td>DERMS Foundation</td>
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<td>Advanced DERMS Applications</td>
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- **R&D Activities**
- **DMS Applications**
- **DERMS Applications**
Establish solid foundation and adjust implementation of advanced applications based on grid reliability, customer rate of adoption, technical maturity, resource availability and value.
Planned R&D activities:

- ADMS development system
- Solar, battery, EV charging
- Advanced customer programs
  Examples: demand response, vehicle to grid charging, microgrids, VPP
Enablement of Advanced Applications

• Storage
• Microgrids
• Electric Vehicle Managed Charging
• Local Demand Response
• Virtual Power Plants (VPP)
• Vehicle to Grid Charging (V2G)
• Market Integration
Closing Remarks
SRP’s Electric Distribution System…

- …has been around over 100 years and plays a key role in supporting SRP customers
- …shrewd practices and design decisions have enabled industry leading reliability
- …requires effective planning, operations, maintenance and investment to remain an industry leader
- …is undergoing unprecedented change requiring proactive strategy, innovation and effective prioritization
Questions?