Exhibit to Agenda Item #1

Board Energy Resources & Customer Services Committee Meeting and Special SMUD Board of Directors Meeting

Wednesday, July 17, 2019 scheduled to begin at 5:30 p.m.

Customer Service Center, Rubicon Room
Energy Delivery

• Who we are
• What we do
• Safety philosophy & approach
• Improving our operations
• Industry trends
• Risks / Challenges
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~740 people | ~$420 million total 2019 budget
## Energy Delivery

*Frankie McDermott*

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**Board Energy Resources & Customer Services Committee**

Meeting and Special SMUD Board of Directors Meeting

July 17, 2019
The Sacramento Power Academy vision is to provide relevant power utility training for SMUD, other utility companies and our community currently working or seeking to develop skills to prepare for a career in the utility industry.

Several of our craft apprenticeships are California State and Federally certified. Internally we provide comprehensive training to field personnel as well as office and professional staff in Grid Assets and Power Generation.

The Academy currently provides external training courses to other utilities, local agencies and private companies in:

- Pole Climbing
- Electrical Safety
- Live Line

And we are working on additional courses in equipment operations, compliance & safety, etc. as well as offering courses to the general public. Our goal is to be the premier training academy for our region and community.
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Commercial Development Strategy & Key Accomplishments

- Central City Task Force
- Vacant Parcel Assessment Project
- Central City Infrastructure Assessment
- Development Fee Offset Program
- Developer Deferred Payment Rule 16 Agreement
- Active Engagement with External Stakeholders
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Power Generation – Department Overview

• 136 Employees
  – Asset Managers
    • Hydro
    • Thermal
    • Renewables
    • Project Development
  – Resource Managers
    • Engineering
    • Generation Maintenance
    • Regulatory Compliance
    • Administrative Support
    • O&M Contractors
Hydro Generation Assets
688MW Installed Capacity

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<th>Unit</th>
<th>Capacity</th>
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<td>Loon Lake</td>
<td>82MW</td>
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<td>Robbs Peak</td>
<td>29MW</td>
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<td>Jones Fork</td>
<td>12MW</td>
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<td>Union Valley</td>
<td>47MW</td>
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<td>Jaybird</td>
<td>144MW</td>
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<td>Camino</td>
<td>150MW</td>
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<td>White Rock</td>
<td>224MW</td>
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<td><strong>Total UARP</strong></td>
<td><strong>688MW</strong></td>
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Stairway of Power – Water is used multiple times

[Map of Upper American River Project]

July 17, 2019
Thermal Generation Fleet
1,138MW Installed Capacity

Campbell Soup Cogen
173MW
47th Avenue & Franklin Blvd

McClellan Gas Turbine
72MW / Dudley Blvd
(near Watt and Roseville Road)

Cosumnes Power Plant
602MW
Clay East & Twin Cities Road

Procter & Gamble Cogen
184MW
83rd Ave & Fruitridge Road

Carson Ice Cogen
107MW
Laguna Station Road

July 17, 2019
Natural Gas Pipeline
76 Miles of Pipeline in 3 Segments
Renewable Generation – Wind
230MW Installed Capacity – 92MW Pending

Solano Wind Project
230MW Installed
92MW Pending
Renewable Generation – Solar
12MW Installed – 160MW Pending

Photovoltaic (Solar)
12MW Installed
160MW Pending
Nuclear Fuel Storage
IRP Implementation: Solar Development

- IRP in Territory Solar:
  - 1,000 MW by 2040
  - 250MW every 5 years
  - 5,000+ acres
IRP Implementation: Wind Development

- Expansion of Solano Wind Project
  - Phase 4 by 2022
  - Repower in phases
  - Taller
  - More Powerful
  - Fewer
IRP Implementation: Energy Storage

- Demonstration project
  - 4MW/8MWh
  - Decommissioning PV-4 at Hedge

- Siting Study
  - Constructability
  - Grid Support
  - Environmental
  - Cost
Operational Excellence: Flexibility is Key

• Emphasis on Responsiveness and Availability
• Cognizant of Environmental Impacts
• Increased Cycling
• More Capacity value
• Less Energy value
Operational Excellence: Hydro Flexibility

Remote Monitoring and Operation

High Pressure Lift
Operational Excellence: Thermal Flexibility

• Decouple Power Plants from Steam Hosts
  – Auxiliary Boilers
  – Electrification
Operational Excellence: Thermal Flexibility

• Stack Dampers help hold heat in a Boiler
  – Reduces damage from cycling
  – Speeds up restart after short dispatch
Operational Excellence: Thermal Flexibility

• Spray Intercooling (Sprint) & Wet Compression
  – 10-15% added capacity value
  – 1-2% better fuel efficiency
  – Fast response for immediate energy needs
Operational Excellence: Wind Turbine Efficiency Improvements

- Vortex Generators/Gurney Flaps
  - Solano phases 2 and 3
  - Improved Aerodynamics
  - Harvest more wind
  - .5 - 1.7% increase in production
Operational Excellence: Water Management

- Increased Offseason Production
  - Holding more water for shoulder months
  - Shorter outage seasons

- More Sophisticated Water Modeling
  - Tighter margins due to carrying more water
  - New license has enhanced release requirements
Operational Excellence: Shrinking Environmental Footprint

- Concentration on Renewables
- Fewer emissions/MWh
- Use of reclaim water
- Cross Compression
Operational Excellence: Hydro Efficiency Improvements

• Runner Upgrades across UARP
  – Improved turbine efficiency
  – Timed with scheduled overhauls
Challenges:

License Implementation

- 32 Ecological, Recreation, or Resource Monitoring and/or Management Plans
- 52 Specific Recreation Measures
  - Includes over 35 existing campground or day use areas, 700 campsites, 7 boat ramps, hiking and biking trails.
- 3 Specific Transportation Measures

DRAFT - License Related O&M and Capital Cost Estimates ($000's)
Challenges: Aging Infrastructure

White Rock Tunnel Rehabilitation

- 10-mile underground tunnel
- Two 5-month outages
- Crews working around the clock
- Takes our largest Hydro plant out of service
- Extensive coordination with Energy Trading

Series of Kodacolor pictures showing jumbo in White Rock Tunnel with hardrock miners standing on jumbo. Pictures are a little fuzzy; believed to be done by moisture on the film.
Challenges: Changing Regulatory Environment

- CalDWR
- SWRCB
- BLM
- NERC
- FERC
- WECC
- CalOSHA
- USFS
- CalDFW
- USFWS
- Local AQMD
- Local DOT
- CDPR
- NWQC
- DOT PHMSA
- CORPS
- CPUC
- NRC
- NERC
- CalDWR

July 17, 2019
Board Energy Resources & Customer Services Committee Meeting and Special SMUD Board of Directors Meeting
## Energy Delivery

**Frankie McDermott**

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Substation, Telecommunication & Metering Assets

- 214 IBEW, OSE and PAS employees
  - Engineers (Electrical, Civil)
  - Engineering Designers, Drafters
  - Project/Program Managers
  - Electricians and Electrical Technicians
  - Network Cable Splicers
  - Telecommunication Technicians
  - Meter Technicians
  - Station Recorders and Substation Maintenance Workers
  - Hazardous Materials Technicians
  - Construction Management Inspectors
  - Cost/Schedulers, Management Analyst
  - Administrative Staff
  - Management/Supervision

4 year State & Federal Certified Apprenticeships
Substation and Network

- SMUD has over 275 Substations that are connected to the transmission or distribution grid by overhead and underground lines
  - Transmission Substations – 14 (230,000 Volts)
  - Distribution Substations – 261 (115,000 Volts to 4,000 Volts)
  - Downtown Network Facilities – 410 transformers and over 300,000 feet of cable (12,000 Volts/480/208 Volts)
- Typical Equipment Includes: Transformers, Circuit Breakers, Capacitors, Switches, Control and Relay Equipment, Batteries, Splices and structures
Substation and Network

• Operation and Maintenance
  ➢ Substation inspections (2,900 annually)
  ➢ Substation preventative and corrective maintenance tasks (8,000 annually)
    ✓ Testing of relays, transformers, circuit breakers
  ➢ Downtown Network inspections and preventative maintenance and corrective maintenance tasks (1,600 annually)
  ➢ Downtown Underground Service Alert (USA) tasks (8,000 annually)
Transmission Substations

- Four new transmission substations under design or construction
  - Franklin Substation (Completed May 2019)
  - Station E (Completion May 2021)
  - Station G (Completion December 2021)
  - Station H (Completion May 2024)
Substation and Network

- Expansion of Rancho Seco Switchyard for the new 160MW SolarShares project (Completion October 2020)
- Doubling the size of two existing 230kV Capacitor Banks (Completion April 2020)
- Misc. Reliability and Compliance Projects
- Network New Service Connections
- Installation/Maintenance of Distributed Automation equipment
Field Metering and Power Quality

- Ongoing Maintenance of over 655,000 meters (3,400 Corrective Maintenance tasks annually)
- Ongoing Maintenance of System Metering programs and Metering Data
- Solar and commercial metering installation (5,000 meters installed each year)
- Field investigation of commercial and residential power quality issues (120 investigations each year)
Field Metering and Power Quality

- Meter integration into the Energy Imbalance Market (EIM)
- Metering and reporting of power interchange with Western Area Power Administration (WAPA) and California Independent System Operator (Cal-ISO)
- Meter Data Analysis in Support of:
  - Revenue Protection
  - Voltage Imbalance
  - Billing Data Accuracy
Telecommunications

- Overhead and underground fiber optic cable (300 miles)
- Microwave installations (18 locations)
- 2-Way Radio communication system (500 radios)
- Security, cameras and badging
- Hydro Met Communication System
- Communication for Metering, Gas Pipeline and Distributed Automated Equipment
- Security badging system
- Over 2,000 Preventative and Corrective Maintenance Tasks per year
Civil Engineering, Construction Management Inspection and Survey

- Civil Engineering: structural engineering, grading and drainage
- Construction Management of large SMUD contracted work:
  - Substations, Buildings, Roads, Roofs, Structures, Underground Systems, Campgrounds, Powerhouses
- Survey of SMUD real property, easements and facilities
- LiDAR Surveys
Transmission Engineering

• Electrical and Structural Engineering support for Transmission Line Overhead and Underground Assets

• Review of Transmission Line right-of-way encroachment requests

• Significant Projects:
  ➢ Reconductor of 7 miles of Procter and Gamble – Hurley 230kV T/L
  ➢ Transmission Line splice inspections
  ➢ Transmission Line pole paint coating repair
Operational Excellence

- Initiatives
  - Substation Scheduling
  - Substation Job Changes
  - Entry level Bridging Program
  - Sulfur Hexafluoride (SF6) Gas Monitoring and Replacement
  - Substation Fire Risk Mitigation
  - Survey Drones
  - LiDAR
  - Remote Transformer Monitoring
  - Network SCADA
Substation – Scheduling

- Substation Maintenance/Construction Office
  - Centralized scheduling of all Substation Maintenance/Construction Activities
  - Scheduling of 16 crews and over 15 individual performers
  - Coordinates planned outages with Distribution System Operations (DSO), Power System Operations (PSO) and other groups
Workforce Optimization – Scheduling

• Benefits
  ➢ Improved Outage Coordination
  ➢ Better resource availability
  ➢ More work accomplished
  ➢ Better visibility of work

• Next Steps
  ➢ Continued Change Management
  ➢ Technology Enablers
  ➢ Rollout of centralized scheduling to other work groups
Workforce Optimization – Job Changes

Substation Inspection and Maintenance

Before
- 2-Person Electrician Crew
- Station Recorders
- Perform Substation Inspections, Electrical and Non-Electrical Maintenance and Testing
- Perform Substation Inspections and provides reports to office

Now
- Substation Maintenance Worker
- Electricians
- Station Recorder
- Perform Substation Inspections, Non-Electrical Maintenance and Testing
- Perform Substation Inspections and provides reports to office

July 17, 2019
Workforce Optimization – Job Changes

• Benefits
  ➢ Reassignment of highly skilled Electricians to more complex work
  ➢ Substation Maintenance Workers complete non-electrical inspections & testing and some corrective maintenance when found
  ➢ Lower unit cost of certain maintenance tasks
  ➢ Providing entry-level opportunities

• Next Steps
  ➢ Complete Work Procedures
  ➢ Complete Training
Workforce Optimization – Entry Level Bridging Program

• Program Objective
  ➢ Select and place (6-8) 18-19 year old, post high school, under-represented, lower socio-economic candidates into entry level limited term positions.
  ➢ Prepare these employees for a competitive SMUD field force entry level job selection process (Apprentice Positions: Network, Substation, Metering and Telecom)

• Partnered with American River College & PG&E to sponsor a 13-week program
  ➢ 5 days per week
  ➢ Classroom instruction & group projects
  ➢ Physical training
Workforce Optimization – Entry Level Bridging Program

• After successfully completing the 13-week course, six candidates were selected for SMUD Utility Assistant positions
• Over a two-year period, the employees were rotated through Substation & Network Crews and assigned to Telecom and Metering Technicians
• Five of the employees passed SMUD’s Electrical Apprentice test. One employee passed SMUD’s Telecom Apprentice test.

✓ One Employee – Telecom Technician Apprentice Program
✓ One Employee – Network Cable Splicer Apprentice Program
✓ Three Employees – Substation Maintenance Workers
Ongoing Challenges

- Keeping up with Development
- Aging Infrastructure
- Updating work procedures
- Contracting Environment
- Leadership Development
- Compliance
- Work Planning
  - Outage Management
  - Jurisdictional Rule Changes
- Process Changes
- Continuous Improvement
## Energy Delivery

**Frankie McDermott**

<table>
<thead>
<tr>
<th>Strategic Services</th>
<th>Commercial Development</th>
<th>Power Generation</th>
<th>Substation, Telecom &amp; Network</th>
<th>Line Assets</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Jason McAlister</strong></td>
<td><strong>Rob Lechner</strong></td>
<td><strong>Ross Gould</strong></td>
<td><strong>Mike Deis</strong></td>
<td><strong>Attila Miszti</strong></td>
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<td>Business Process &amp; Solutions</td>
<td>Commercial Development</td>
<td>Hydro Generation</td>
<td>Substation Design &amp; Construction</td>
<td>New Services/Local Agency</td>
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<td>Sacramento Power Academy</td>
<td>Home Builders</td>
<td>License Implementation</td>
<td>Line Maintenance</td>
<td>Line Design, Construction, &amp; Replacement</td>
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<td></td>
<td>Brokers</td>
<td>Thermal Generation</td>
<td>Field Metering &amp; Power Quality</td>
<td>Vegetation Management</td>
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<td>Renewable Generation</td>
<td>Civil Engineering &amp; Const. Management Inspection</td>
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<td>Gas Pipeline</td>
<td>Transmission Engineering</td>
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<td>Regulatory Compliance</td>
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<td>Rancho Seco</td>
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<td>Fuel Storage</td>
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<td></td>
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<td>Project Development</td>
<td></td>
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</tbody>
</table>
Line Assets – Department Overview

- 315 Employees, IBEW, OSE, PAS
  
  16 Line Crews  
  6 Service Crews  
  6 Fault Crews  
  
  25 Line Inspectors  
  9 cable locators  
  
  13 Utility Compliance Specialists  
  40 Engineering Designers  
  17 Vegetation Planners
# Department Overview – Line Assets

<table>
<thead>
<tr>
<th>Device</th>
<th>Estimated Quantities</th>
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</thead>
<tbody>
<tr>
<td>Transmission Circuit</td>
<td>484 miles</td>
</tr>
<tr>
<td>Primary Distribution Circuit</td>
<td>10,388 miles</td>
</tr>
<tr>
<td>- Overhead</td>
<td>3,861</td>
</tr>
<tr>
<td>- Underground</td>
<td>6,527</td>
</tr>
<tr>
<td>Number of Feeders</td>
<td>809</td>
</tr>
<tr>
<td>- 69kV</td>
<td>64</td>
</tr>
<tr>
<td>- 21kV</td>
<td>36</td>
</tr>
<tr>
<td>- 12kV</td>
<td>689</td>
</tr>
<tr>
<td>- 4kV</td>
<td>20</td>
</tr>
<tr>
<td>Distribution Transformers</td>
<td>80,316</td>
</tr>
<tr>
<td>Total Number of Poles</td>
<td>142,828</td>
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</tbody>
</table>
Department Overview – Line Assets

• T&D Vegetation Management
  – Manage 200k+ trees in service territory + UARP
  – Maintain 80k+ trees per year
Department Overview – Line Assets

- T&D Corrective Maintenance
  - 50,000 Detailed Line Inspections (DLI)
  - Replace 1,200 poles
  - Replace 360k feet of U.G. cable
  - Respond / repair 200+ car vs. asset events
  - Repair 800 underground faults
  - General break / fix 600+
  - Storm response & restoration
Department Overview – Line Assets

• Call 811 before you dig!
• Over 60k underground utility field calls
New Business

- New Service and Meter (3,385)
- Subdivision Lots (2,000)
- Commercial/Industrial (200)
- Capacity Projects
Department Overview – Line Assets

- Work Drivers – Cable Replacement

Cable Replaced vs Quantity of Failures

Circuit Feet x 1000 vs # of Failures

Cable Replaced x 1000 (CF) vs Cable Faults

July 17, 2019

Board Energy Resources & Customer Services Committee Meeting and Special SMUD Board of Directors Meeting
Department Overview – Line Assets

• Work Drivers – Pole Replacement

GA Line Programmatic Work
Pole Replacements

<table>
<thead>
<tr>
<th>Year</th>
<th>Pole Replacements</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012 Act</td>
<td>453</td>
</tr>
<tr>
<td>2013 Act</td>
<td>748</td>
</tr>
<tr>
<td>2014 Act</td>
<td>579</td>
</tr>
<tr>
<td>2015 Act</td>
<td>706</td>
</tr>
<tr>
<td>2016 Act</td>
<td>940</td>
</tr>
<tr>
<td>2017 Act</td>
<td>1,127</td>
</tr>
<tr>
<td>2018 Act</td>
<td>1,045</td>
</tr>
<tr>
<td>2019 Plan</td>
<td>1,200</td>
</tr>
<tr>
<td>2020 RC</td>
<td>1,200</td>
</tr>
<tr>
<td>2021 RC</td>
<td>1,200</td>
</tr>
</tbody>
</table>
Department Overview – Line Assets

Mutual Aid

• Sonoma, Puerto Rico, Redding, Navajo Nation
Innovation & Operational Excellence

- Customer Notification Expectations
- Detailed Line Inspection / Route Patrol
- Workforce Optimization / Click
- Digitized Contract Management
- Design Tool Replacement
- GoCanvas
- X-Ray Splice Inspections
- Arial and Stationary LiDAR
- Bottom Line Results
Innovation & Operational Excellence – Proactive Customer Communication

• Prepare customers when SMUD will be working in area/on their property.

• Set customer expectations about what SMUD is doing, why, and how long they will be impacted.

• Ensure SMUD employees know what we’ve communicated to customers and mitigate “calling around” when customer has questions.
Innovation & Operational Excellence – Detailed Line Inspection
Innovation & Operational Excellence – Click Scheduling & Mobility

- Workforce Optimization
Innovation & Operational Excellence – Click Scheduling & Mobility

• Workforce Optimization – Scheduling & Mobility
Innovation & Operational Excellence – Click Scheduling & Mobility
Inspection Process – Past

PAST:

• SMUD Inspector provided Contractor a hand drawn sketch of the work site location.
• Significant time lost by Contractor attempting to locate work site based on a sketch.
• No GPS to find work site.
• No post-job photos to document work completed.

Example Work Site Sketch 1:

Example Work Site Sketch 2:
Inspection Process Improvements – Current

CURRENT:

- Contractor is provided exact work site location GPS coordinates via GoCanvas.
- SMUD Inspectors document work site conditions with pre-job photos.
- SMUD Inspector and Contractor document completed work with post job photos.

Example GPS:

Example Pre-Job Photo:

Example Post-Job Photo:
Improved Inspection Process Benefits

- Pre-job photos capture traffic conditions – contractor able to obtain traffic control services without fielding the job.
- Pole replacement photo confirms asset management approach.
- Multiple post-job photos enable assurance of quality work and enhanced contract management.

Traffic Control Conditions

Pole Butt Photo

Post Fault Job Photos
Innovation & Operational Excellence – X-Ray Splice
Innovation & Operational Excellence – LiDAR

3D Data Set Showing Power Lines, Tree Species and Tree Health

Using Advanced Analytics to Optimize Decision-making

- Category 5 Trees
- Category 4 Species
- Category 3 Species
- IVM Polygon
Innovation & Operational Excellence – Stationary LiDAR

- Slated for Deployment Fall 2019
- Change Detection or Transmission Corridor
- Live Encroachment Notification
- Weather Monitoring
- Pilot Phase
Ongoing Challenges

• Work volume increasing across most work streams
• External labor shortages (lineworker & vegetation)
• State and local agencies increasing restrictions on when and how work can be performed
• Wildfire mitigation
• EVs, storage, distributed generation, indoor cultivation, reshaping infrastructure needs
• Customer property access and communication expectations are driving need for process changes
• Aging infrastructure & workforce