Item 9: Data Center Refresh Update

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Finance & Audit Committee Meeting

ERCOT Public
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ERCOT: Critical Role

- **Grid, Wholesale, Retail and Market Data Transparency functions**
  - Manage 90% of Texas electric load
  - Perform financial settlement for the wholesale bulk power market
  - Administer retail switching for 7+ million premises
  - Up to 1 million reports and extracts delivered daily

- **Requires reliable and secure IT Infrastructure**
  - 400+ business applications
  - 3400+ compute servers
  - 4+ petabytes of storage
  - Redundant high speed fiber networks
  - Wide Area Network (WAN) for MPs
  - 3 active data centers (2 production, 1 test)
• **IT Infrastructure approaching end-of-life and support**
  – Increased risk of failure
  – Vendor support limited
  – Greater risk for compliance and security gaps
  – Higher operating costs

• **Technology refreshes are needed to support reliability**

• **Funding was approved in 2015 with ERCOT’s fee request**

• **Scope defined to replace technology approaching end-of-life and support**
  – Includes Network, Telecommunications, Servers and Storage
**Data Center Refresh: Approach**

- **Governance Established**
  - Executive Steering Committee
  - CIO, COO, CFO and CCO

- **Plan Vetted**
  - Charter, scope and plan reviewed
  - Architected to improve resiliency
  - Third party review
  - Communication Plan

- **Procurement Best Practices Followed**
  - Vendor symposium
  - RFPs from competing vendors
  - Knowledge-based negotiation

- **Migration Process Validated**
  - Tested migration patterns and repeatable workflows
Data Center Refresh: Timeline

Program Governance

- Database Servers (POWER8)
- Core Network
- Telecom Control Room / Grid Ops
- Network Command & Control
- x86 Servers
- x86 App Migrations
- Database Storage
- Remote Access
- Telecom VoIP
- Telecom DC Connectivity

• DC4 made up of 11 projects
  – 60,000+ hrs logged thus far
  – Many coordinated efforts
  – Well managed…dedicated team

= 8 projects in-flight (including governance project)
= 3 projects complete
Data Center Refresh: Status

- **DC4 is tracking to plan**
  - No major risks or issues to report
  - 90% of new technology deployed
  - 85% of systems have been migrated
  - No “unplanned” outages

- **Approved budget is trending favorable**
  - 91% of new technology investments under contract
  - 74% of the $48 million budget spent thru 2017
  - Forecast to be on budget or slightly below budget

- **New technology is performing as expected**
Data Center Refresh: Migration Results

**Improved Performance**

- **Market Management Systems (MMS)**
  - Database Load from 18 to 9 min (50% faster)

- **Credit Monitoring & Management (CMM)**
  - Daily Calculation from 2 hr to 30 min (75% faster)

- **Wholesale (Settlements and Billing)**
  - DAM Settlement from 52 to 33 min (37% faster)
  - RTM Settlement from 30 to 12 min (60% faster)
  - Data Aggregation from 3 to 2 hr (33% faster)

- **Data Integration**
  - Transaction backlogs have been eliminated

- **Market Data Transparency (MDT)**
  - Several data extracts and reports reduced from 8+ to 4 hr (50% faster)

**More Efficient Management**

- **Infrastructure organized by Line-of-Business**
  - Grid, Commercial, Corporate, Mgmt and Telecom

- **Improved configuration management**
  - Hardware and firmware consistent across environments and patching practices simplified

- **Reduced the overall unit cost of hardware**

<table>
<thead>
<tr>
<th>Type</th>
<th>Before ($)</th>
<th>DC4 ($)</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>x86 Server</td>
<td>$1,442</td>
<td>$836</td>
<td>42% reduction</td>
</tr>
<tr>
<td>POWER Server</td>
<td>$25,820</td>
<td>$8,004</td>
<td>69% reduction</td>
</tr>
<tr>
<td>Storage</td>
<td>$6,840</td>
<td>$2,394</td>
<td>65% reduction</td>
</tr>
</tbody>
</table>

- **Reduced the overall hardware footprint**
  - Reduced physical server count by 400+ (we are now 91% virtualized across all environments)
  - Achieved a 2:1 data compression ratio moving to Flash Storage (i.e. solid-state drives)
Data Center Refresh: Floor Space Consolidation

- Test Data Center floor space will be consolidated after migrations
  - Fewer racks and servers
  - Reduced power and cooling requirement
  - Optimized space utilization
  - Increased resiliency and scalability
  - Estimated $40K reduction in annual power costs

<table>
<thead>
<tr>
<th>Metric</th>
<th>TCC1 Before DC4</th>
<th>TCC1 After DC4</th>
<th>Net</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rack Count (#)</td>
<td>161</td>
<td>56</td>
<td>Reduction of 105</td>
</tr>
<tr>
<td>Floor Space (Sq.ft)</td>
<td>5,401 Sq.ft</td>
<td>3,100 Sq.ft</td>
<td>Reduction of 2,301 Sq.ft</td>
</tr>
<tr>
<td>Power (kW) Requirement</td>
<td>165.9 kW</td>
<td>45 kW</td>
<td>120.9 kW reduction</td>
</tr>
<tr>
<td>Cooling (kW) Capacity</td>
<td>592 kW</td>
<td>261 kW</td>
<td>331 kW reduction</td>
</tr>
<tr>
<td>Power Cost (kWh/month)</td>
<td>$14,400 / mo.</td>
<td>$11,000 / mo.</td>
<td>Reduction of $3,400 / mo.</td>
</tr>
</tbody>
</table>
Data Center Refresh: Key Takeaways

- ERCOT plays a critical role and requires reliable technology
  - ERCOT remains committed to its mission and operational excellence

- DC4 is replacing ERCOT’s aging IT Infrastructure
  - Ensuring continued reliability and support
  - Minimizing impact of failures
  - Lowering operating and maintenance costs
  - Supporting future growth and new capabilities

- DC4 is a Success Story!!
  - Tracking on schedule, scope and budget
  - Team continues to successfully deliver on projected results
  - Planning to complete in 2018
Data Center Refresh : Roadmap

2001
DC1 “Zonal”
• 400 physical systems
• DC max out
• Dedicated hardware
• Minimal sharing across lines-of-business

2006
DC2 “Nodal Readiness”
• 1800+ systems
• DC capacity limits
• High % of sharing across lines-of-business
• Wide scale impact during outages

2010
DC3 “Nodal Stabilization”
• 2500+ systems
• Built backup DC
• Failover capability for Commercial systems
• Still a high % of sharing across lines-of-business
• Mitigated impact of outages by implementing cross-site failover

2016
DC4 Program
• 3400+ systems
• Standardize hardware w/ Converged Infrastructure
• Optimize across lines-of-business
• Meet compliance requirements
• Widespread use of virtualization
• More automation capabilities for routine operations

2022
DC5
• Next scheduled technology refresh...

• Finish DC4 in 2018…and start preparing for DC5