EXHIBIT 1

2016

INNOVATION PLAN

DENTON MUNICIPAL ELECTRIC

Engineering & Operations Technology
Denton Municipal Electric

July 12, 2016

Table of Contents

Denton Municipal Electric
Engineering & Operations Technology

Executive Briefing

A revolution in the way electric utilities manage and control their field systems is underway. Technology has matured that allows data and operational information to be known, and acted upon, in real time. The marketing term often used for this is "Smart Grid." From the technical viewpoint, it is distribution automation. The increase in the amount of systems utilized to control the field infrastructure has led to two separate, but invariably intertwined, technology management classifications – Information Technology and Operation Technology. The table below shows the separation of those responsibilities. Even though the two classifications may deal with identifiable separate data and technology sets, each must work very closely and collaboratively with the other for overall electric utility success that benefits our customers and organizational objectives.

	Information Technology (IT)	Operation Technology (OT)
Purpose	Transaction systems; business systems, information systems, IT security standards	Control systems, data systems and repository, control or monitor physical processes or equipment, regulatory security standards
Architecture	Infrastructure that relates to business oriented applications	Infrastructure that is event driven, real-time, embedded hardware and software (utility grade)
Interfaces	Operating systems and applications, GUI, Web browser, terminal, and keyboard	Operating systems and applications, Unix, GUI, Web browser, terminal, keyboard, Electromechanical & Digital sensors, actuators, coded displays, PLC, SCADA
Ownership	CIOs, IT/IS, finance and administration departments	Engineers, technicians, operators, and managers
Connectivity	Corporate network, Internet, IP-based	Control networks, fiber and radio networks, hard wired twisted pair, IP-based
Role	Supports business applications and office personnel	Supports control processes, field personnel safety, and electric system reliability

Based on industry research and best practices previous DME implementations are now complete to establish the necessary hardware, software, and applications associated with initiating distribution automation in Denton. Base systems such as SCADA, AMI, and Communications provide the foundation to DME's automation plans. With the foundational system of the electric Geographic Information System, as a core product, working in combination with the Outage Management System, now sets a path for the potential of digital ties and automation of DME's existing and planned field control components such as capacitors, regulators, reclosers, switches, and sensors. These five (5) systems, and many others which exist or are planned, produce an enormous amount of data to be sorted and utilized in a real time production environment for the efficient operation of the City of Denton's extensive electric distribution infrastructure. Distribution automation provides significant benefits for the end use customer including:

1. Facilitates much quicker response and restoration from outages,

2. Facilitates higher reliability and power quality,
3. Provides for access to a greater amount of information regarding their energy usage and spending,
4. Has the potential to enable and support the implementation of large scale demand side management and customer level solar/wind installations, microgrids, or energy storage options as they are applied to our electric distribution system.

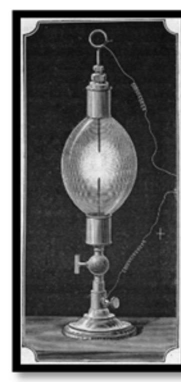
The details included in this Innovation Plan identify systems and applications, along with their associated timeline, which will continue to move DME forward with automation under the Operation Technology definition for electric system control.

Introduction and Background

At the close of the 19th century, two pioneer powerhouses of thought and innovation, Nikola Tesla and Thomas Edison, clashed on the world stage to prove their method for electrification of cities was the best. The battle was alternating current (A/C), championed by Tesla; versus direct current (DC), which was advocated by Edison. Even then, the principal precursor to which method of electricity form would eventually win out was determined by the efficiency to transmit power over large distances. Tesla was the eventual winner and today A/C power literally lights the world.

Technical innovations necessary to produce and distribute power were significant at that time and changed the world. Over the years fuels used for generation became more diverse, knowledge was gained and applications tuned increasing efficiency of power transmission over greater distances utilizing voltage levels and improvements in conductive materials, and construction of power lines and their associated appurtenances for transmission and distribution of the power were refined and became safer for both the public and utility personnel. Advances in methodologies and materials were solid but still stayed within somewhat standardized limits that were well known to the people who designed, built, and operated the electric systems.

For decades, the mostly rural United States focused on providing power to more urbanized areas. Little is recorded about the history of Denton Municipal Electric; but it is known in 1892 the Denton Water, Light, and Power Company built their first power plant to provide electric service to the citizens of Denton. This power plant was purchased by the City of Denton in 1905, and in 1929 the city constructed a new power plant at 414 East Hickory.[1]



Initially, electricity's use was limited to lighting. It was not uncommon for an electric company to shut down their generator at night which meant the availability of electric power was not 24/7. Early adopters of electricity were happy with this level of reliability at that time. As time passed, more devices were invented that utilized electricity such as motors used in manufacturing, farming, and washing clothes; appliances; refrigerators; and air conditioning. Air conditioning allowed the southern United States to accelerate growth and economic development. As the availability of electric power widened, a user having access to electricity on a 24 hour basis became the norm and was expected by the end use customer.

Birth of the Digital Era

It was the technical advancement provided by Jack Kilby's (Texas Instruments) invention of the integrated circuit in 1958 that once again stimulated technology and advanced systems control of an electric utility.

In the late 1960s, digital computers began to be used by electric utilities. Initially, their use was exclusively for accounting and record keeping and customer information systems (CIS) became widely used. At that time electric utilities, historically, trusted their CIS as the foundational data for their operation. The

[1] Georgia Caraway and Kim Cupit (2009). *Images of America – Denton*. Arcadia Publishing. Page 35.

utility's financial component, kept through asset management and financial accounting, allowed the utility to understand their value. The use of mainframe computers did provide greater control and understanding of the value for an electric utility. During this period, the idea of using a graphical user interface for monitoring and control was neither known, nor available, to utility executives or engineers.

In the 1980's computing and data systems grew, seemingly exponentially, in power and memory; while decreasing in physical size and cost. This change allowed a new breed of software developers to create programs that provided a genesis for utilities to store much greater detail (data) related to their assets and other in-field systems. Control systems for field components began to migrate from the analog toward becoming digital. These advancements allowed rudimentary control of in-field devices, remotely, via a central operation point – typically a central dispatch center. Supervisory Control And Data Acquisition (SCADA) is a standard system for today's electric utility. SCADA, the first of three foundational components to future innovation, brings operational data back to a head-end system allowing real time knowledge of the transmission and distribution system's condition with the capability to monitor telemetry and control breakers at substations.

Today, technological advances used by both the electric consumer and utility are much more accessible and more information or data is available. An outcome of this available data, and second foundational component, was a new focus provided for through a Geographic Information System (GIS). GIS is a set of systems, software, and data that allow users to "visualize, question, analyze, and interpret data to understand relationship, patterns and trends"[2]. The data in GIS goes by a number of monikers such as spatial data, geospatial data, or geographic data. GIS is composed of data, applications, and spatial analytics managed by a team of professionals who provide answers to any complex spatial problems. System cost and staff resources vary accordingly: from next to nothing to millions of dollars annually. GIS expedited a utility's ability to move from pure data processing to information and control by facilitating data to be analyzed differently. Spatial data identifies features and boundaries at a point on the Earth. Electric GIS has become the new focus, and core data product, for utility asset management/value and is critical to control schemes for electric distribution systems.

Today's consumers are more interested and educated about their electric usage and many look for avenues and tools to help minimize the dollars they spend on energy. Gamification of energy cost savings is starting to be seen at the consumer level. Not only do consumers want to minimize their cost for energy, they now demand system reliability and power quality to be high. Electric utilities who have implemented Advanced Metering Infrastructures (AMI), combined with new and emerging innovations and technologies, can more efficiently and reliably manage and operate the electric transmission and distribution systems which provides an end result of higher quality of service and practical information to the consumer. Deployment of AMI is the third foundational component in advancing innovation for the consumer and the utility.

SCADA, GIS, and AMI, are now three systems that provide the backbone of daily operations for the electric utility's Engineering, System Operations, Maintenance, and Construction departments. New innovations and methods are being developed on a regular basis. As innovations are developed, DME recognizes the importance of managing them in relation to Engineering, System Operations, Construction and Maintenance. To research, vet, and develop innovation and information portals for the DME consumer

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[2] http://www.esri.com/what-is-gis

and utility, the function of Engineering & Operations (E&O) Technology has been initiated. The Engineering and Operations Technology group will help lead the utility into its innovation future with goals of benefiting and providing added value to the end-user and internal to the utility.

History of Engineering & Operations Technology Resources at DME

Four key departments within DME are Engineering, System Operations, Construction, and Maintenance. Engineering is key to the development and management of staff and resources required to plan, maintain, and design transmission and distribution class resources that serve the citizens of Denton. System Operations is responsible for the daily control and operation of the transmission and distribution systems. Construction extends service to new, or upgrades existing, customers and constructs feeder extensions into previously unserved territory. Maintenance staff maintain and performs field services for the transmission and distribution systems. All four departments are charged with the responsibility of keeping the lights on in Denton.

An initial "technology" implemented at DME was SCADA. Due to state and federal security requirements, the SCADA environment is operated in an isolated domain (SCADA) and remains under the management of City of Denton Technology Services (CODTS) department. At that time, other systems, such as the CIS, the Outage Management System (OMS), JD Edwards, inter- and intranet, E-mail, Laser fiche, Cityworks, Crew Manager, File Sharing, Phone Systems, IVR, etc. were under the management and direction of the CODTS through the City of Denton's Active Directory domain (CODAD) environment and the SCADA network. The DME GIS server was managed by CODTS.

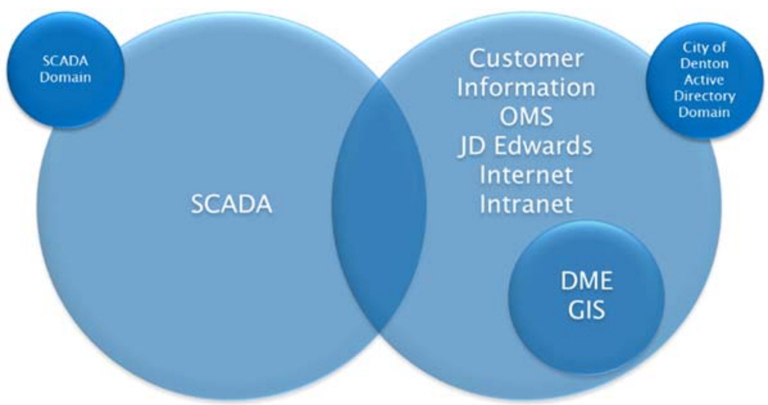

Figure 1 – Pre 2013 Domain Model

DME's GIS was first implemented in the late 1990s with the ESRI Platform and Miner & Miner's ArcFM electric tools. Two (2) GIS Technical Analysts were hired to input and maintain the DME data kept on background hardware and software systems managed in the CODAD domain. As the spatial information stored in DME's GIS grew, its capability, combined with an ever growing valuable graphic interface, increased the importance of the GIS system exponentially as a decision and knowledge base. Somewhere along this timeline, the CIS system – even though still important – no longer was the focus of utility data. CIS has been replaced, in part, with the foundation component GIS and the geospatial information it maintains as the core data repository for electric operations.

DME relied on the expertise and staff of the CODTS to provide it with services to maintain the systems equipment and data administration critical to the utility's operation, such as SCADA and DME GIS, through the maintenance of hardware, software, and data in a state which provides accurate and safety sensitive information. This is critical to DME System Engineering, Operations, Construction and Maintenance personnel. Due to DME operational critical needs, the DME servers for both SCADA and Electric GIS have always utilized separate, stand-alone, servers from City servers and applications.

In 2012, DME identified several concerns and deficiencies regarding the then current GIS application configuration and its associated hardware. The background hardware and software systems vital to support DME had become seriously outdated. When issues arise with the hardware or software operation for mission critical systems such as Electric GIS, quick and rapid response must be provided to trouble shoot and restore critical systems. During discussions regarding these issues, CODTS informed DME leadership they were not the application experts capable of trouble shooting hardware and software issues as needed by DME and they will continue to rely exclusively on outside contractors and service agreements to provide those services to DME. For GIS to be an effective tool, it requires a great deal of institutional knowledge and support for its associated hardware, servers, network, databases, and operating systems. GIS is a resource critical to all departments within DME in the utility's mission to provide cost effective service, safely to the City's customers. GIS must have high availability, reliability, and system confidence.

For the level of service necessary, DME worked with CODTS for DME to build and manage its own isolated domain to achieve the service results required and to adopt a service model of having in-house experts to quickly respond to issues related to critical E&O systems, such as GIS. When asked about this possibility, CODTS management was in agreement with the separation of the critical GIS system to E&O from their domain as long as CODAD was given all of its required protections and system firewall isolations.

The service model adopted by DME E&O was to manage its GIS hardware and software requirements within a separate domain, which allows DME to make administrative and necessary changes to software and hardware. This keeps the critical information systems operating at peak capability for the electric data dependent organization. The management for these critical services landed on existing DME staff, which included the two (2) GIS Analysts and an Engineer with system architecture and database administration experience. These staff members are referred to, in this document, as the "E&O Technology staff."

After DME identified hardware and software systems needing upgrade, DME's E&O Technology staff established, and moved forward, with a plan to upgrade the then current version of GIS software and build, from the ground up, the associated hardware. Tasks associated with this upgrade included planning, development, and construction of an isolated network (from CODAD) with an active directory domain controller server used for DME E&O technology purposes. This active directory domain (DMECODAD) allows DME's E&O Technology staff to properly align processing, application, and licensing requirements for the present and the future.

During the planning stage for the GIS active directory domain, a number of other critical systems were identified as being outdated.

1. The then current Outage Management System (OMS) software used by DME had been given very few updates and upgrades which advanced the system's inability to provide the needed level of service to System Operations, Engineering, Construction, and Maintenance. OMS utilizes the data in the GIS to provide a visual, and written, report of outages on the distribution system. System Operations uses the OMS information to assign crews that investigate, minimize outage time to

customers who can have their power restored through fault isolation, and make any necessary repairs to the system in order to fully restore service. One known requirement for the OMS was for it to be integrated with GIS. This integration is critical and allows System Operators to properly deploy crews for a successful and timely close to an outage event. As the result of DME's investigations and application vetting, Responder® was chosen to replace the old OMS platform due to its capabilities to provide the departments with the data they rely on for restoration of power and system reliability analysis (cause, effect, and solution). The deployment of this software included a number of integrations to existing systems such as the CIS, SCADA, and Interactive Voice Response (IVR).

2. DME installs and maintains an operation critical communication infrastructure with assets (fiber and radio) between substations and other points within the service territory. These assets not only serve DME but provide service to the City of Denton's Fire and Police departments, Libraries, and Parks. The fiber and communications infrastructure had never been mapped to a high level of detail. System connectivity was maintained with a limited number of staff who had worked with the system since its inception and kept paper notes of fiber infrastructure and connections. Since the communication system is critical to electric transmission and distribution operation and regulatory compliance, the need was identified to collect the data for the communication system and input it into the Electric GIS data repository system via the Fiber Manager® GIS data framework.
3. A number of licenses associated with the numerous software used by DME was managed on a one-by-one basis. With an increase in the number of licenses required, and their associated cost, a different approach was identified to better extend the services needed in a more productive and cost effective manner. ArcFM for SilverLight® eliminates the need for individual licenses for every user who needs basic access to data and allows for a standard presentation of information to internal departments of DME. Thus, with the conveyance of these systems and their related hardware to E&O Technology, DME is now better able to manage its critical data and systems and manage costs. As an additional advantage, this application expands the accessibility of the GIS data to the entire DME organization and facilitates real-time map distribution in-house.
4. Preparation was made to provide the end-user with greater access to information which they may be interested in. ArcGIS On-line was added to assist with public facing applications such as the outage map and two in-cue applications for streetlight outage reporting and potentially a customer usage portal.

Each of these applications; the server systems, upgraded GIS, Responder® OMS, Fiber Manager®, and ArcFM for SilverLight®; were successfully implemented through an assemblage of DME managed hardware and software now referred to as the "DMECODAD" infrastructure. For the purposes of this document, any hardware or software not included with DMECODAD is referred to as "CODAD" – which is managed by CODTS. **Figure 2** shows the current infrastructure for DMECODAD, CODAD, and SCADA. Each active directory domain depends on others yet are managed separately.

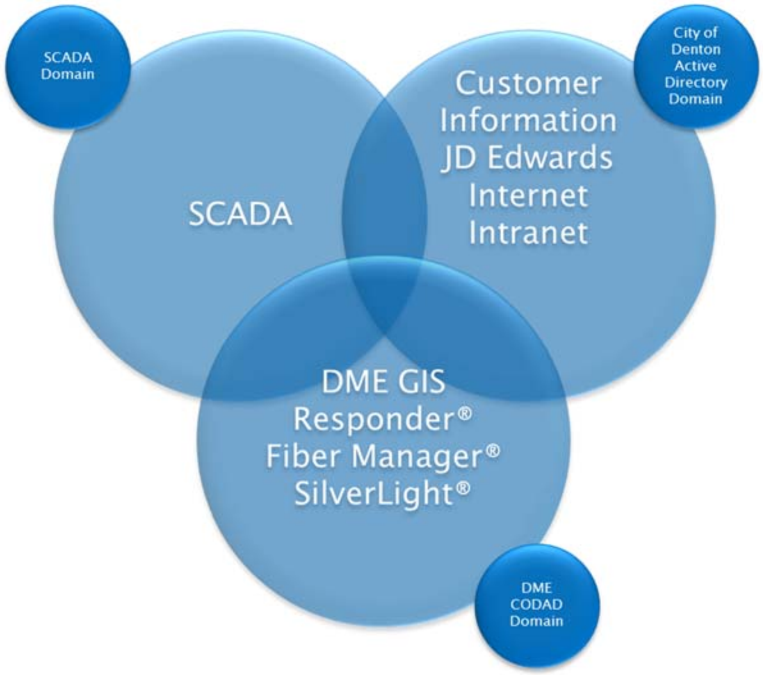

Figure 2 – Post 2013 Domain Model

DME's service model is to have software and hardware related expertise in-house (E&O Technology staff), which has proven to be a key and discernible advantage and provides users with quicker response to requests for assistance. This service model has created a clear interest in DMECODAD which has manifested as a marked increase in demand for emergency response and critical applications and systems to be under DMECODAD. **Figure 3** provides the schematic for DMECODAD.

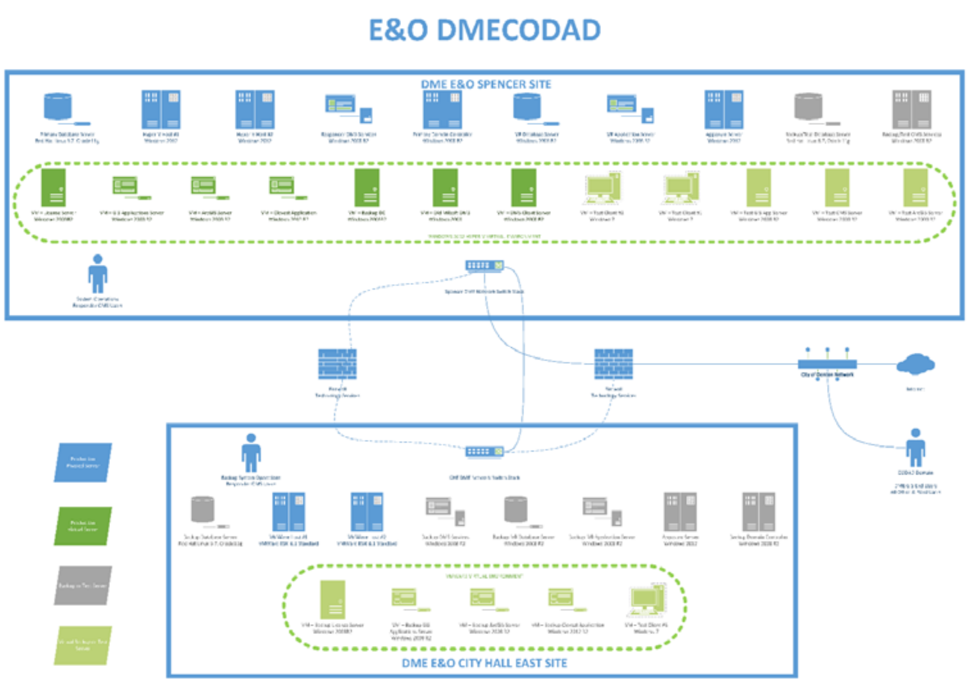

Figure 3 – DMECODAD Domain Architecture

Figure 4 - Technical Systems Management

There is a constant review of the active directory domain to determine inherent weaknesses and it is necessary to assure the management of DMECODAD is within desired limits. **Figure 4** shows the control points used to manage the resultant system as the plan adapts and matures.

Since the implementation of DMECODAD, a number additional needs and concerns were identified by DME Engineering, Operations, Construction, and Maintenance, and acted upon by the E&O Technology Staff. These actions are not all to implementation of innovation or technology; but, provide value through productivity gains.

Post-2013 Actions

- **[IN PROGRESS – CONTINUAL]** Even though the DME GIS system does not currently fall into the formal NERC CIP requirements, it is anticipated that it likely will be some time in the near future. DME's GIS is a level AA system as defined in the *Technology Services Business Continuation Plan* and needs to be restored within 2 hours. This need has been recognized by E&O Technology staff which have planned, designed, and completed implementation of a warm back up system, located at City Hall East, that can be hot within the 2 hour time requirement. In case of a total loss of the main data site on Spencer Road, this backup allows DME's Engineering, System Operation, Construction and Maintenance functions, to begin work associated with electric system restoration.

- **[COMPLETED]** In 2014-15, E&O Technology staff moved forward with the digitization of paper as-built records into the City of Denton's Laser Fiche system.
- **[COMPLETED]** E&O Technology extended DMECODAD to the Field Operations Building from the Engineering and Operations Building. This allowed the display of real-time electric system configuration for improved field crew safety and assists with quicker restoration times.
- **[COMPLETED]** The E&O Technology staff created an in-house outage map for use by the public. It works well, but within this E&O Technology plan includes an upgrade to the outage mapping system for the public which will also upgrade the capability to report street light outages **[PLANNED].**
- **[COMPLETED]** In 2015-16, E&O Technology implemented an additional version upgrade to the GIS software to continue to stay current with the electric industry.
- **[COMPLETED]** E&O Technology worked in conjunction with CODTS personnel to upgrade the laptops of DME field personnel for Maintenance, Operations, Dispatch, Substation, and Communications.
- **[IN PROCESS]** DME uses a work order management system to track the issues called into the Dispatch center for water, wastewater, and electrical service issues. It is the repository of record for calls, assigned crews, and restoration. The current work order management system was encoded by an employee a number of years ago and was based on a Microsoft Access® front end. The employee programmer is no longer with DME, so support and upgrade is not available which has allowed the system to become outdated and experience a number of functional glitches that have stopped it from working properly. E&O Technology has been able to work with the current program to allow it to limp along; however, E&O Technology has begun the process implementing Clevest Mobile Workforce Management® – which is a program to replace the current Access® system. Clevest Mobile Workforce Management is much more robust in its design and flexibility, and will help lead the direction to a paperless program (Mobile Workforce Management) and efficiency improvements in dispatching orders to field personnel.
- **[IN PROCESS]** DME does not currently use a design software to prepare and manage the numerous distribution construction projects. At this time, an Excel® spreadsheet is used to create material lists, FERC code allocations, and costing. Actual designs are done through a manual drafting program called AutoCAD. E&O Technology has begun the process of discovery, with all parties that are affected and/or can benefit, for a design and project management system that provides clearer directions to Construction and Maintenance personnel; accurate material, equipment, and labor requirements; and accurate FERC accounting. The discovery will allow DME to formalize current processes and make needed changes to improve efficiency and communication when a distribution design system is deployed. The result of the discovery process will be used to create a RFP Statement of Work to assure the accuracy of the requirements and responses for a distribution design system. (2.1).
- **[COMPLETED]** The hardware and operating system (Windows 2003) for the Interactive Voice Response (IVR) systems were outdated and out of warranty which meant DME could no longer get

support. DME uses the IVR for notifications to customers when planned work is scheduled for an area as well as call backs after outages. Notifications associated with distribution system operations (scheduled outages, maintenance, etc.) to DME customers are occasionally needed with little turnaround time. Since the business model for DMECODAD is tuned to short term solution and response, it was decided to move the IVR into the DMECODAD domain. The IVR was replaced with a new system and now includes Spanish as a voice option for our customers.

DMECODAD Defined

The resources for DMECODAD can be separated into four classifications: 1) hardware, 2) applications, 3) software and operating licenses, and 4) end-user device management.

Hardware

Prior to 2013, DMECODAD did not exist. All of the hardware associated with DME's GIS application was administered by CODTS and was located at City Hall East with no backup system or servers. Currently, DMECODAD equipment is housed in the DME data center located at 1685 Spencer Road with the fully redundant backup system located at City Hall East adjacent to the backup DME System Control room.

Security and data management for the DMECODAD system starts at the Domain Controller. To provide CODTS with the security they require for CODAD, DME owns a Palo Alto firewall between CODAD and DMECODAD. This firewall, managed by CODTS, provides the desired degree of security CODTS requires and prevents changes to the City domain from impacting DME's Servers. The domain controller is a server that responds to security authentication requests within a Windows Server environment. Authentication is requested through standard processes such as logging in and checking permissions. At Spencer, there are two (2) Hyper-V servers which allow for a number of the applications to be virtualized. A virtual server is dedicated to a single task but has the advantage of sharing computer hardware resources. The chief advantage of this virtualized configuration is it provides cost efficient use of computing resources for applications that do not require dedicated servers. Currently, DMECODAD has nine (9) non mission critical applications virtualized.

Applications that do not fit well within virtualization are provided through dedicated servers. DMECODAD includes ten (10) dedicated servers [six (6) at Spencer-primary, four (4) at CHE-backup] to serve both primary and backup system operations centers.

After the establishment of DMECODAD, the need for backup resources to mimic the critical functions of the primary site at Spencer was planned. Working closely with CODTS, E&O Technology was able to establish a backup center located at City Hall East. The backup site contains a VMWare virtual environment that hosts the Backup License Server, ArcGIS Server (ArcFM for Silverlight/OMS integration backup), and the GIS Application/Replication backup.

Applications

Prior to the development of DMECODAD, the electric GIS applications directly managed within the DME GIS department were non-existent. DME GIS staff was unable to make system administrative modifications or updates necessary to properly maintain, troubleshoot and operate the electric GIS servers and connections to the software clients. Server replicas critical to proper testing and evaluation of the electric GIS system could not be made. The tasks associated with maintaining the licenses were done on an individual basis. This method was costly and did not provide easy access to others whom might need access to the applications and associated data.

DMECODAD added a number of new applications managed by the E&O Technology staff. Home grown applications, such as the Access® faced Mobile Workforce Management program, were transferred, with the agreement of CODTS, to the E&O Technology Staff responsibility. This transfer from CODTS to DMECODAD was principally due to the philosophy of providing in-house expertise versus relying extensively on contractors and contractor schedules. Responsibility for the IVR was also transferred to allow in-house changes to this system quickly when needed. When the IVR system was upgraded in 2014, a Spanish language option was included and the voice prompts were updated to streamline outage reporting for Denton citizens.

Licenses

A software license is the legal authority for the end-user to use the programming available through a specific software package or application. One license from a single vendor does not usually include access to all of the products or services provided through the vendor. Since each of the applications were managed on an instance by instance basis, there was very little management of the licenses required.

DME is experiencing growth in its service territory and staff which requires the availability of the processes and applications within DMECODAD to be maintained with additional capabilities developed. **Table 1** provides a list of the current licenses for systems managed by E&O Technology staff. With this DME made the decision to change to a System User Enterprise License Agreement (SUELA) arrangement for its licensing. This has provided DME costs savings per license as well as a centralized location for licensing to improve global license management.

ESRI/ArcGIS	**ArcFM**	**SynerGi**
• *ArcMap*	• *ArcFM*	**Sag10**
• *Data Reviewer*	• *Geodatabase Replication*	**IVR**
• *Spatial Analyst*	• *Inspector*	**Hyper-V**
• *ArcGIS Online*	• *ArcFM for Silverlight*	**Windows Server 2008**
• *3D Analyst*	• *ArcFM Viewer for Engine*	**Windows Server 2012**
• *Network Analyst*	• *Fiber Manager*	**Redhat Linux Ent 6.4**
• *Publisher*	• *Redliner*	**Oracle dB 11g**
	• *Responder*	**Appasure**
		VMWare

Table 1

End-User Equipment

The responsibility for the replacement of the end-user equipment is a mix between E&O Technology and the CODTS department. However, for all of the applications previously listed, E&O Technology maintains and upgrades both the licenses and applications on these machines. Included with the end-user machines, are four (4) live electric system model monitors used by Engineering, System Operations, Construction, and Maintenance staff for viewing the GIS system live. These monitors replaced printed maps which were typically out-of-date immediately after they were printed. **Figure 5** represents the end-user requirements for all of DME at Spencer with the exception of the System Operations which is shown separately in **Figure 6**.

The hardware at CHE Backup (**Figure 7**) includes software for backup systems of all of the critical services managed under DMECODAD including Responder® OMS, the IVR, and the backup databases for GIS and the IVR. At this point, available services at CHE are limited due to space availability. The backup Dispatch is basically a large closet that has been converted to handle most of the services needed during loss of Spencer or when the Spencer equipment is undergoing maintenance or repairs. These are shown separately for purposes of identifying the span of responsibility of the E&O Technology organization now. The E&O Technology staff is responsible for the general end-user as well as critical Dispatch operations.

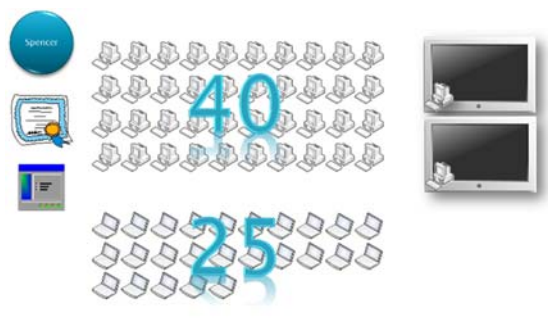

Figure 5 - DME Spencer

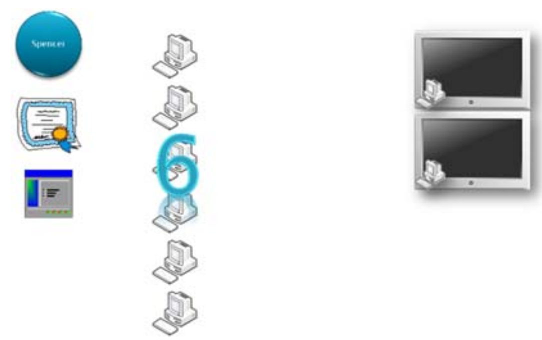

Figure 6 – DME System Operations @ Spencer

Figure 7 - DME System Operations @ CHE

Planning For The Future

During an assessment of systems, applications, and licenses for all DME technical systems – with a focus on DMECODAD, there were two other issues which were identified: 1) vulnerability to severe weather events, 2) data center space availability for the primary and backup locations.

Identification of Vulnerabilities for Field Systems and Operations

Outages and service anomalies, whether transient or extended, are events DME understands affects our customers. For some customers, blinks or outages are a nuisance. For others, blinks or outages can literally cost them millions of dollars due to down time and lost production. Weather is a principal contributor to power reliability and a minor contributor to power quality. DME does have systems and personnel in place to respond to severe weather's effect on the transmission and distribution systems. System Operation's dispatch center provides 24/7 hub services for transmission and distribution system operation. In the case of a severe weather event, the dispatch center will initiate emergency response based on the response level needed. Implementation of primary and backup response systems are crucial to the ability for DME to respond to emergencies.

Severe Weather Vulnerability

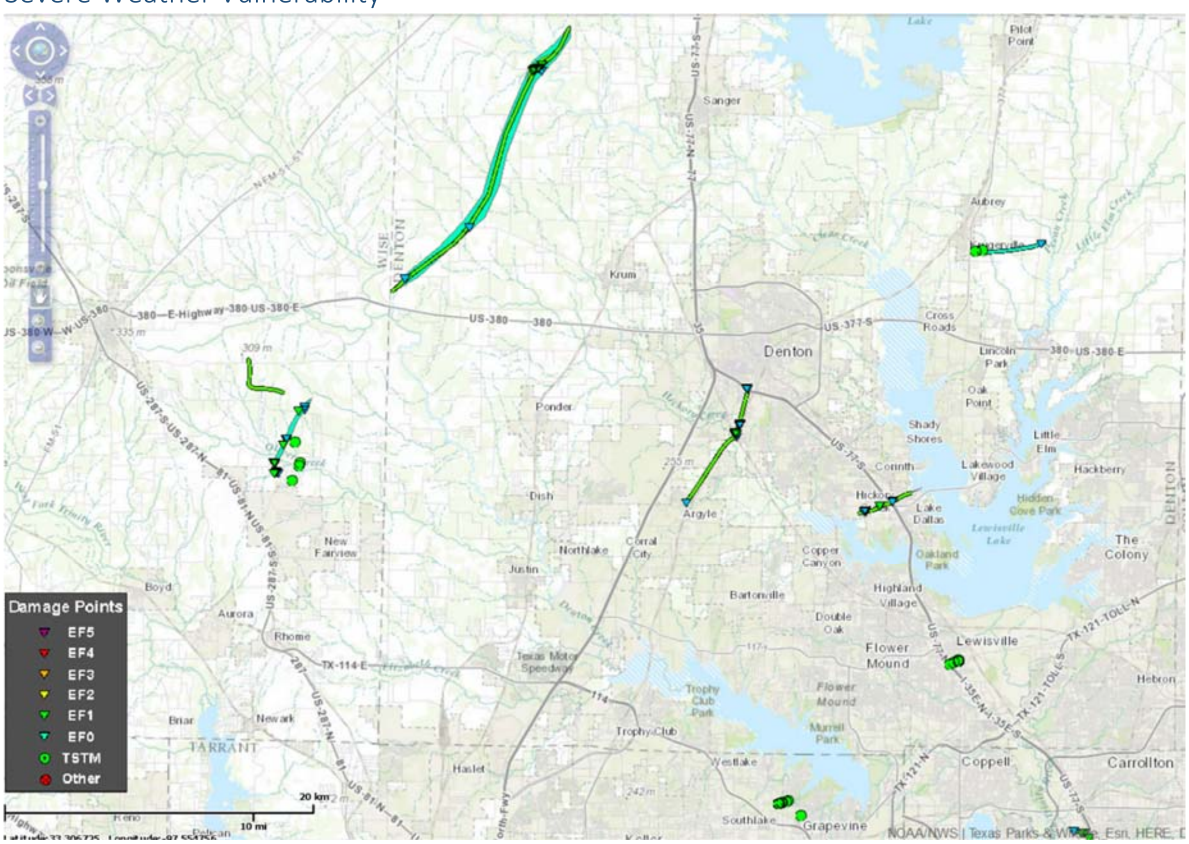

Figure 8 – Tornado Paths

A screen capture, **Figure 8**, from the National Weather Service shows the historic major storms and/or tornados with damage in, or near, the City of Denton from January 1, 2014 to January 28, 2016 (approximately 2 years). The tornado identified along Fort Worth Avenue from Argyle, northeast to I-35E; as well as the tornado in Hickory Creek from Parkridge Drive, east to Lake Lewisville did cause minor damage to the DME system. As a comparison, just west of Krum was a tornado that was larger in its strength and area of destruction. Fortunately, this storm moved through a mostly rural area so large scale damage, as might be seen if it had moved through Denton, was avoided. Denton has been very fortunate it has not been the receiver of significant damage due to storms, tornados, or major ice storms for quite some time. DME designs and builds its distribution facilities to the higher grade NESC Grade B construction which can withstand a good amount of wind and/or ice. This has been evidenced during the recent storms where DME's distribution system fared exceptionally well, with little to no customers out, compared to other area utilities who build a lower grade and experience tens of thousands of customers with lost power on a regular basis. Even with the higher grade of construction and extensive tree trimming activities, it is not a matter of "if" but "when" Denton will suffer catastrophic damage from tornados, severe storms, or ice. DME must prepare to answer the demand of our customers when widespread damage occurs.

Severe weather and the inevitable large scale damage events are serious matters that DME must continuously monitor and improve our restoration and contingency plans. On May 31, 2013 an EF5 rated tornado hit the town of El Reno, Oklahoma. El Reno, Oklahoma is less than 200 miles away from Denton. At its widest, the tornado damage width was 2.6 miles. The path length of the tornado was 16.2 miles. This tornado set records for size and damage. The National Weather Service referred to the Reno Tornado as "…one of the most powerful tornados … and also the widest known tornado on record[3]." No longer can it be said that something of this magnitude could never happen. Once its time of destruction was over, this tornado became a standard for the extent of damage a tornado could do.

DME's E&O staff superimposed that tornado's path onto the City of Denton with the offices of DME, City Hall East, City Hall West, UNT, TWU, Denton's airport, and the Service Center also identified on the map. The results are shown in **Figure 9**.

[3] http://www.srh.noaa.gov/oun/?n=events-20130531, April 23, 2014

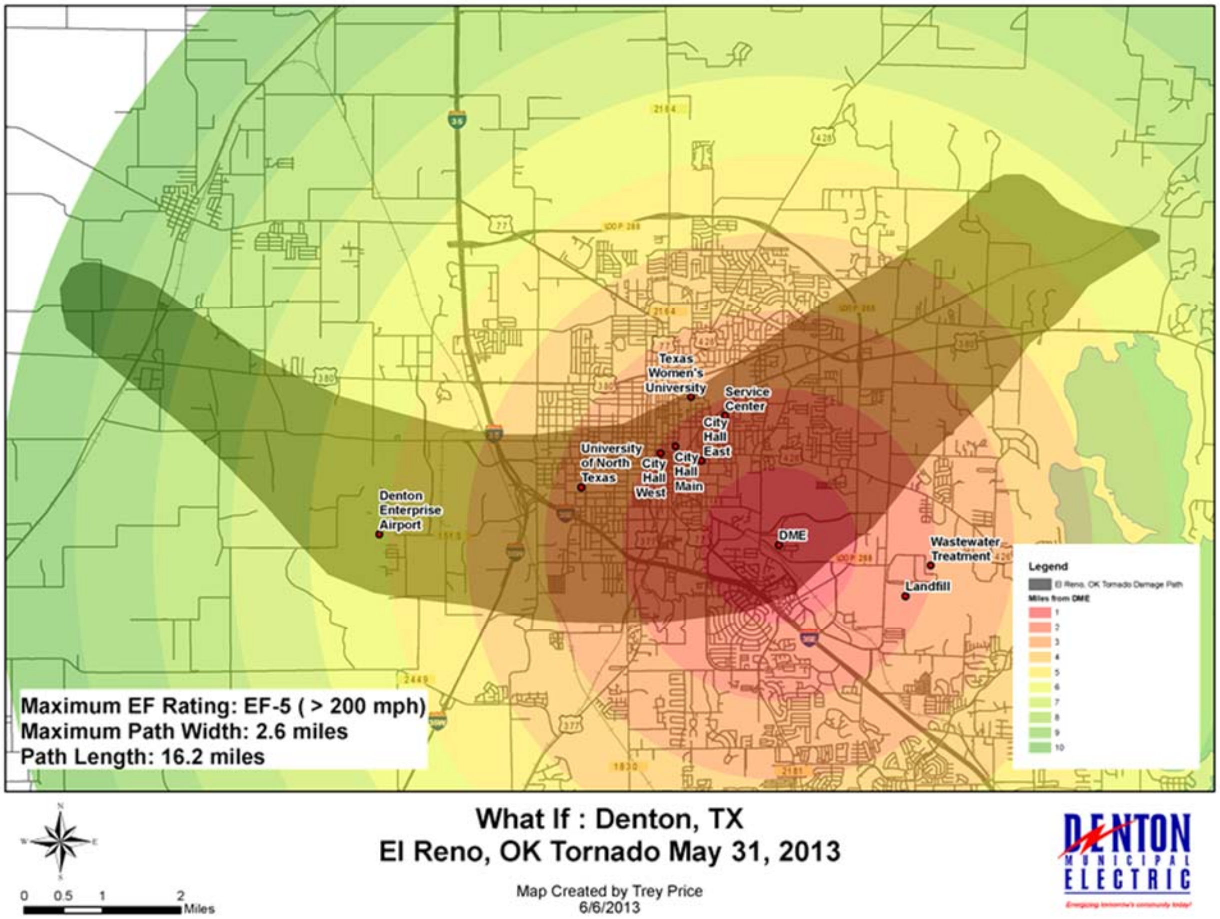

Figure 9 – El Reno Tornado Path overlaid over City of Denton

Findings, with all the City's major support locations identified, plus a ten (10) mile radius layered onto the map, shows if this same storm had gone through Denton, all major control and restoration locations could have been destroyed. There might not be a COD Emergency Response Center; no location where DME could continue operation and restoration of the transmission and distribution systems; and the Service Center (warehouse), which houses much of DME's materials, could have sustained significant damage or been destroyed. This study highlighted potential exposure for the loss of all DME facilities at Spencer that houses Engineering, System Operations, Maintenance, Construction, and the Energy Management Organization (EMO). All of these groups rely on data systems to manage day-to-day operations. The EMO group has established a plan that, if the Spencer site is unusable, their work can be done remotely out of their homes if necessary. Restoration of the electric transmission and distribution systems cannot be done from a home. During restoration, access to these systems is critical to efficient damage evaluation, response planning, and communications (internal and external).

A second study identified potential areas which may be clear of damage, from the current DME location on Spencer Road, using a degree of separation so, if the storm had occurred in Denton, damage to critical restoration and data systems may have been eliminated or minimized. Results for this second study are shown in **Figure 10** and was accomplished by placing additional paths north and south of DME's location.

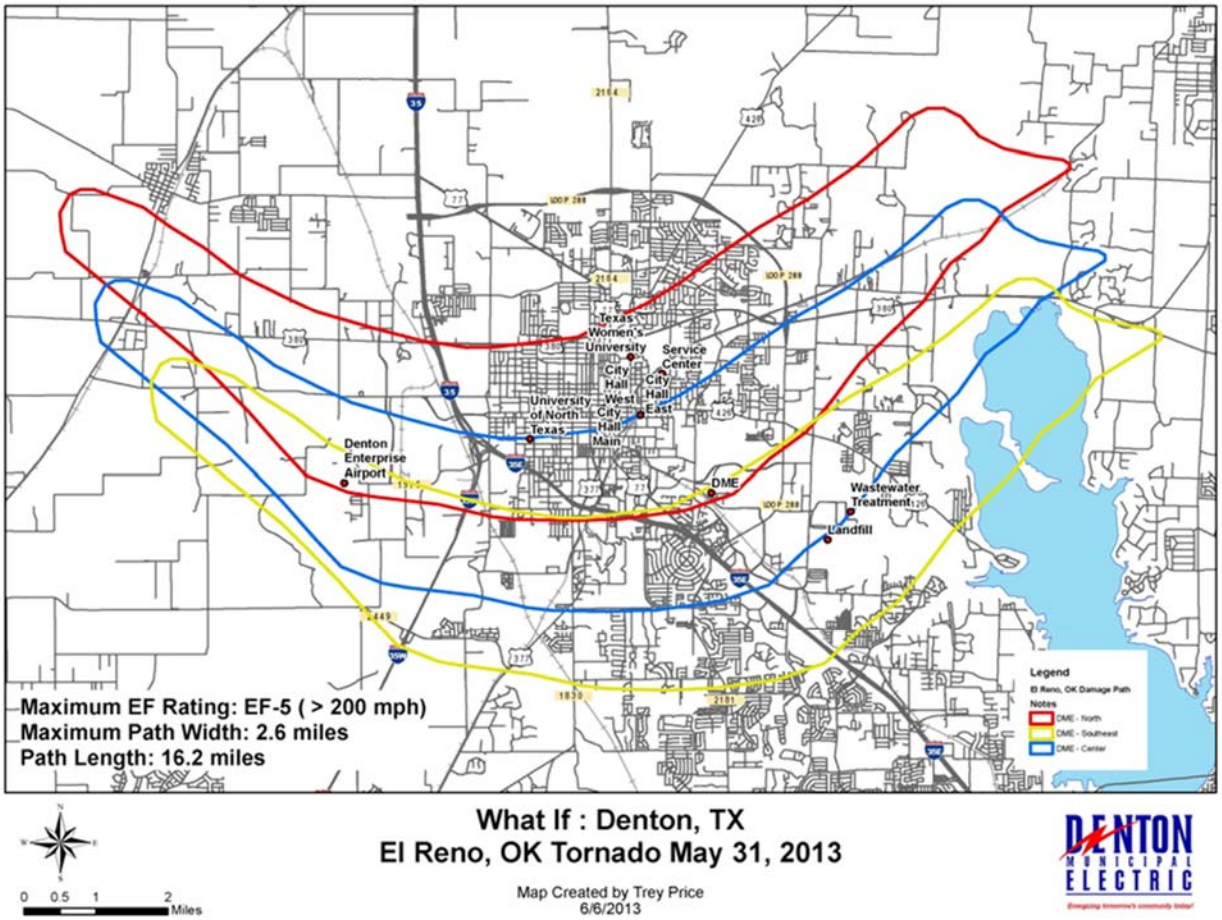

Figure 10 – Three (3) El Reno Tornado Overlaid on City of Denton

In brief, in an emergency the availability of the data systems and access to facilities needed to support System Operations, Engineering, Construction, and Maintenance during restoration are at risk. DME E&O Technology and DME IT have no space to set up and get critical data systems up and connected at the environment at CHE. There exists no sufficient location to fully allow for service restoration for human and physical assets which are mandatory to restoring power to our system and citizens of Denton.

In case of the loss of DME facilities at 1685 Spencer, there has been NO location identified for DME's Engineering, Construction, and Maintenance staff to have access to necessary equipment and information crucial to restoration services. The functionality provided by the E&O Conference Room may not exist, thus hampering restoration and communications.

System Operations Center (SOC) Productivity

The SOC is the focus for restoration efforts whether the event is small or catastrophic. Electric Utilities across the nation are spending more to enhance the capabilities of operation centers so that daily management of, or need for emergency response to, the electric system is faster and more focused due to available systems and tools. As innovation for DME proceeds, the SOC will not only have to manage the transmission and distribution systems, but they will also need access to data and systems that will allow them to manage operations and emergencies through SCADA and automated distribution management. Additional tools such as automatic vehicle location, unmanned aerial systems, and mobile platform systems will not only allow SOC to respond with the correct level of staff and personnel but it will be imperative for engineering, maintenance, and construction personnel to quickly determine need and the path to restoration.

DME's SOC came on-line in February 2012. The center is split into two different uses; one-half of the center provides dispatch services for the City of Denton utilities of water, wastewater, and solid waste; and the second half of the center provides dispatch services for both DME's transmission and distribution operations. When the SOC came on line, it was equipped with the then-current technology for that time.

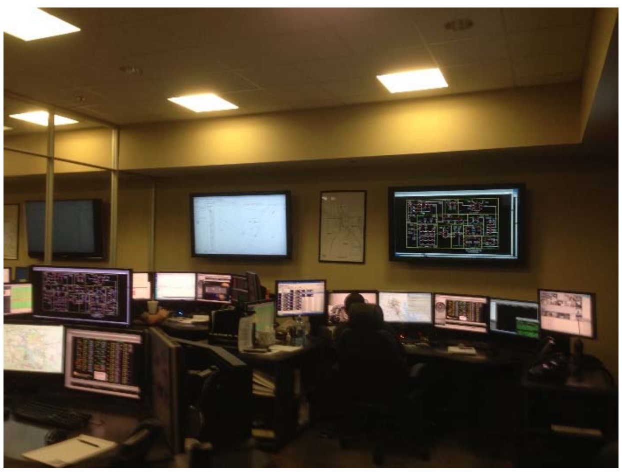

Figure 11 – System Operations Control Center

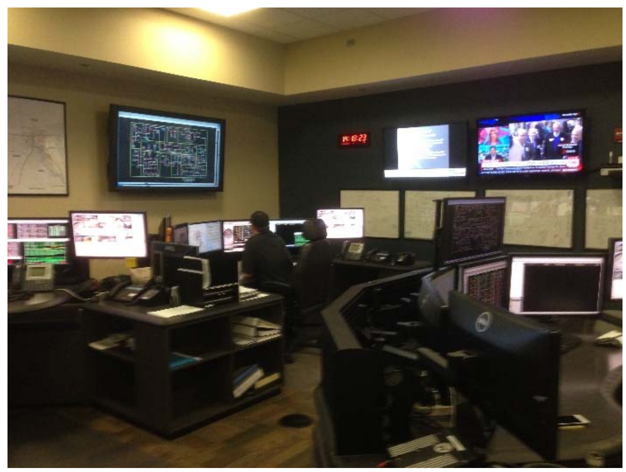

Figure 12 – System Operations Control Center

On the electric side of the SOC, **Figure 11** shows the arrangement of two main monitors in the front. These two monitors display SCADA or the distribution one-line (GIS). **Figure 12** shows two additional wall monitors that display a news channel and the system information board. A fifth large screen, which is not shown in any of the Figures, is located at the back of the SOC and displays the OMS. There are three desks on the electric side with up to seven (7) additional monitors on them. System Operators and Dispatchers have to manage up to twelve (12) monitors, all at different locations, throughout the center.

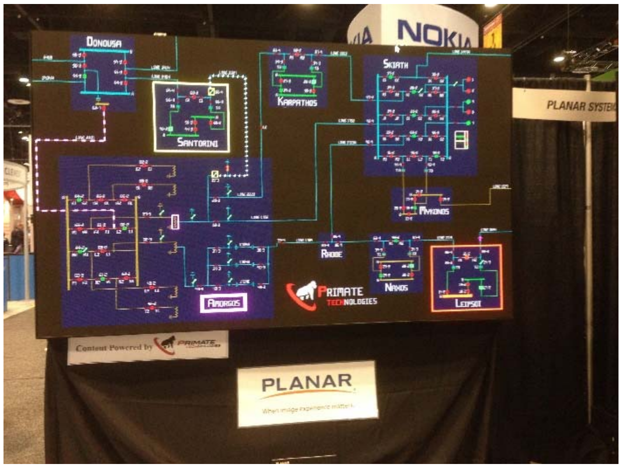

Figure 13 – Large Scale Video Wall

Knowing the criticality of the SOC, DME E&O Technology continues to research technologies / systems / applications to assist System Operations personnel with effective management and oversight of the energized transmission and distribution systems. One such consideration for technology improvement is implementation of a video wall as shown in **Figure 13**. Today, equipment is available providing a single screen across the entire width of the Operation Center to provide current system one-lines plus a myriad of other needed informational pieces such as GIS, SCADA, OMS and television feeds. There are three different applications available. One application is purely LED with a second being a hybrid that includes LCD. The third is a video wall utilizing video projectors. The third technology does not provide the high-resolution needed, and desired, for staff that depend on the visual to make decisions. One of the largest benefits of the video wall technology is dispatch personnel will be able to allocate space on the video wall, for each application needed giving them a full visual to the electric systems directly in front of them. By properly applying technology, it is possible to enhance the function and operability of dispatch personnel by allowing all staff to work from a single view. Additionally, software is available to allow information to be sent through the city data network to remote locations such as City Hall, the COD Emergency Response Center, and the E&O Conference Room. This level of information for these locations would be much greater than the current provision via the public outage map on the internet. The use of single monitor screens should not be ruled as they can contribute to the effectiveness of dispatch situational understanding and communication.

During an emergency event such as severe weather or large scale service restoration, key personnel within DME and the city will be extremely interested in the status of the system and will be developing the restoration plan. It is during these times, the personnel in SOC will need to be focused on their tasks of gaining situational awareness and responding to field situations. What this means is the System Operations Center will have no time to respond to numerous requests for information except from the key restoration management staff (System Operations/Engineering/Maintenance/Construction). Within the Engineering and Operations Building on Spencer is the Engineering & Operations (E&O) Conference Room. This conference room has purposely been equipped with a high level of information and control capability as it will become the emergency response center for DME and will provide space for non-critical electric restoration personnel thus freeing the System Operations Center staff to perform their restoration tasks.

DME understands there will be a need for DME Senior Staff, Public Relations, Key Accounts, and the COD Emergency Center to have situational intelligence of the electric transmission and distribution systems. All damage evaluation and restoration functions will be managed from the E&O conference room by key personnel for DME and this conference room will be the focus for information and action dissemination. This will allow the SOC to focus on their tasks at hand.

Data Center Space Limitations

The Data Center at Spencer is approximately 580 square feet; however, 120 square feet of space is reserved for a six-wall NERC security compliance area which leaves 460 square feet of space for data systems. This 460 square feet houses all of the racks and equipment necessary for the City of Denton back-up systems, DMECODAD primary systems, UPS control, air-conditioning, backup air-conditioning, and the power conditioning equipment. **Figures 14 through 18** show the current space usage.

Figure 14 – DME Spencer Road Data Center

Figure 15 – DME Spencer Road Data Center

Figure 16 – DME Spencer Road Data Center

Figure 17 – DME Spencer Road Data Center

Figure 18 – DME Spencer Road Data Center (NERC Compliance Cage)

Available space in the Spencer datacenter; which houses the primary system for DME, backup systems for the City of Denton, and the NERC secure area and equipment; is near physical space capacity. The newly formed Energy Management Organization (EMO) required dedicated equipment which added to space limitations at the Spencer datacenter space. As applications, functions, and resources grow to keep DME current with technology and provision of reliable and quality power, the Spencer Data Center will not have enough space available to support the addition of hardware. At a recent meeting between CODTS leadership and DME leadership, it was mutually agreed the space in the Spencer data center will likely last two (2) years at the most.

DME does have backups to both the DMECODAD domain as well as dispatch operations. Nevertheless, the sufficiency of the backups deserve some comment. If the E&O building located on Spencer is destroyed, the DMECODAD domain, SOC, and restoration staff requirements will shift to the backup location at City Hall East (CHE).

Figure 19 – DME Data Center Backup - CHE

The backup to DMECODAD domain, as well as dispatch operations, are located on the second floor of CHE at separate locations within that building. DMECODAD has a single rack area of space for the totality of its backup systems (**Figure 19**). DME E&O Technology understands there is no more area for additional racks which could be made available for expansion. This same area is shared with the EMO. From a system restoration perspective (Engineering, Construction, and Maintenance), there is no space to house computers, printers, or other necessary components which would be required in case of a loss of Spencer.

Some consideration was given to a backup area for the SOC. **Figures 20** and **21** provide an overview of the area SOC staff would have to use in an emergency such as the loss of Spencer.

The Figures show the area, though functional, is tight and there is space for one to two Dispatch Operators only. In a full disaster, there is concern this space will not sufficiently allow DME SOC staff to perform the many tasks that will be required of them at that time.

Figure 20 – DME System Operations Backup - CHE

Figure 21 – DME System Operations Backup - CHE

DME E&O Technology recommends consideration for the establishment of a DME Restoration facility with datacenter space to fully backup DME's principal and critical data systems and include room for growth. To increase the facilities functionality, a suggestion is for this facility to have enough space, in its data center, to house the City of Denton's primary or backup systems. Plans for this facility should include a fully functional System Operation Center providing for full restoration of system monitoring services, space (working, materials staging, etc.) and equipment necessary for Engineering, Construction, and maintenance crews to facilitate damage evaluation and system restoration in case of a loss of 1685 Spencer Road. Weather is unpredictable so, of course, there is no promise a major storm would not damage both facilities (Spencer and the recommended backup site) in a catastrophe. That being said, the location of this facility should be such it is potentially clear of any damage if a storm removes the Spencer site from viability.

Innovations for the Electric Utility Industry

An electric utility uses a number of methods to manage its systems operating within numerous regulatory, security, and customer satisfaction requirements. Three key systems, already in place, allow DME to plan and implement for existing and emerging technology to provide higher reliability and strengthen power quality.

1. SCADA brings key operational data back to a central location with instantaneous notification when major devices, such as substation breakers, operate.
2. Advanced Metering Infrastructure (AMI) provides a cost-effective method of gathering billing data and provides flexibility to a customer by allowing remote service restoration in the case of service disconnect.
3. DME installs and maintains a fiber optic and radio communication network to tie its substations together for the purpose of transmitting operational data back to SCADA and AMI. The fiber network is the backbone of the AMI network once information is passed from the gateways.

These systems serve the fundamental purpose for their deployment and, are the base for a much greater vision of system functionality, reliability, power quality, and customer service.

The "Smart Grid" is a term which has been floating around the electric utility industry for a number of years. It was intended to express growth in innovation that advanced the capabilities of the electric grid. The truth is, many of the innovations associated with the "Smart Grid" have been available for decades. Today all devices used by an electric utility already possess the electronics, or "smarts", to turn on or off, adjust their operation based on load or temperature, buck or boost monitored levels, transfer load, or signal errors. But each device typically operates independent of other devices.

Software, systems, and other innovations allows these same devices to work together in sync, with programmed intelligence; to execute complex service restoration actions normally accomplished in hours in mere seconds. Field personnel safety is still the first priority. Safety considerations for line crews with lock out or tag out remain in place. New technology allows for a field device, in lock out or tag out status, to communicate back to the headend system preventing programmed actions which could endanger field personnel. System intelligence is able to identify potential locations of a fault or system failure, isolate it, and then restore power to as many customers as possible. Reduction in time and/or customers affected due to an event helps the standard reliability indices of System Average Interruption Duration Index, Customer Average Interruption Duration Index, System Average Interruption Frequency Index, and Average System Availability Index.

Automatic Vehicle Location (AVL)

AVL technology will allow System Operations to have real time awareness of the location of operations, construction, and maintenance vehicles. This information can be overlaid on the OMS display for System Operators to efficiently dispatch available resources to a trouble area. By sending available resources nearest to the potential cause, faster restoration is possible and an increase in reliability indices can be realized. AVL also has a degree of safety related to its use. If contact with a field personnel is lost, or field personnel do not respond when radioed, System Operations has a good idea of their last location and can send help or someone to investigate. AVL can be disconcerting for staff due to "Big Brother" implications. Therefore, any implementation of the technology should be done with up front knowledge. To help with a possible transition, DME System Operations will participate in a pilot project to verify the value to DME. If value is seen, then full implementation of an AVL system may be executed.

Distribution Management Systems (2.12a)

Working in unison with the SCADA system, a Distribution Management System (DMS) analyzes inputs from AMI, OMS, GIS, and field devices to maintain a real time awareness of the distribution system's health and operational compliance. When an event occurs on the system, such as a power outage, the DMS will react, based on programmed actions, to restore service to as many customers as possible while isolating the fault and maintaining operational compliance. DMS can coordinate bringing field devices on-line/off-line or change their operational parameters in order to meet service objectives.

Additional cost benefits of a DMS can be realized through controlled utilization of devices to implement actions such as Conservation Voltage Reduction (CVR) or Conservation Volt VAR Reduction (CVVR). Very similar in philosophy, but different in application, both CVR and CVVR control a reduction in voltage – but still maintain voltage within regulatory requirements. Due to the electric relationship of kilowatts, kilovars, and kilovolt-amps, system energy demand costs are reduced for system demand. The end result is cost savings on energy purchases by DME.

A third example of the benefits associated with DMS is provision of a sharper end-user focus during load sheds. DMS is a part of the ERCOT Emergency Electric Curtailment Plan (EECP). A DMS and automated equipment will give DME load shed application flexibility. Currently, when ERCOT calls for execution of EECP, DME HAS TO RESPOND and accomplishes its load shed share through opening substation breakers. Opening a substation breaker effectively shuts off power to an entire feeder servicing large areas. Critical customers such as hospitals, emergency/first responders, or life support are, of course, avoided as much as possible. But reality is, the distribution system is dynamic and assurance critical customers are avoided may not always be possible. A DMS allows, with proper placement of automated switches, to focus the load shed of specific areas. This should allow DME to avoid, as much as possible, critical customers while providing a track for DME to meet required load shed levels dictated, and in the required timeframe, by ERCOT.

DME's will utilize and grow its existing fiber or radio networks to provide the communication requirements between field devices and headend systems. Fiber is considered the most flexible and reliable method for transmitting data or communications. The existence of the fiber system will allow DME to be a best-practices organization related to our communications systems for distribution management.

Unmanned Aerial Systems (UAS) (2.12b)

Yes, the "bloodcurdling" name for these is **drone**. UASs have the potential to be a valuable tool for the electric utility; and as such, DME is watching, participating in discussions and committees through input with American Public Power Association (APPA), and evaluating timing for UASs when they would be a helpful and cost-effective tool for the utility. Several electric utilities already use drones such as:

- Tennessee Valley Authority (TVA)
- Arizona Public Service (APS), and
- San Diego Gas & Electric
- Xcel Energy

In an article published in the electronic version of *Transmission & Distribution World*, the authors described in detail the components used by APS with their program[4]. The methods and practices, APS uses appears to be very similar to many other utilities and may be considered best practices in relation to UAS usage.

APS uses an octodrone which has eight propellers. This UAS can carry equipment that has weight to it such as still, video, and thermal imaging cameras. The crew associated with the UAS includes a Pilot in Command and an Observer. The Pilot in Command is in control of the movement of the UAS; whereas, the Observer looks at the video feed from the UAS and makes note of anomalies or guides the Pilot in Command to locations where issues may be or for further investigation. These two staff are referred to as the Aerial Operations Crew and are used in lieu of a bucket truck, and its personnel, or a lineman climbing the pole. The video feed from the UAS can be relayed back to System Operations or Engineering for assessment or additional perspectives for development of an action plan. The UAS is able to quickly put "eyes" on the assets in question and assist service or restoration teams with making decisions on how to proceed.

There are multiple uses a utility should consider for UAS program. These include substation inspections, right-of-way planning, vegetation management, storm assessments, and transmission tower and distribution component evaluation.

Thermal Imaging

Figures 22 and **23**(Photos: Industrial Aerobotics) are examples of UAS use of thermal imaging equipment. The figures shows anomalies in solar panels and transmission components that would not visible except with thermal imaging equipment. Typical setups for a large area, such as a solar farm, would require a bucket truck crew moving to several different locations to gain insight of the full area. The UAS advantage is, once it is set up, it can cover large areas or territories. Granted, DME does not yet have a large solar farm; but, this same application can be used for substations, transmission lines, and distribution circuits. Identification of "hot spots" and then making necessary repairs will equate into higher reliability for the distribution system and the potential for increasing power quality.

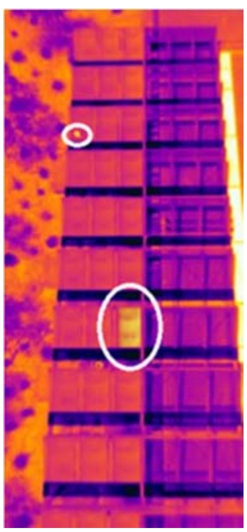

Figure 22 - Thermal Image

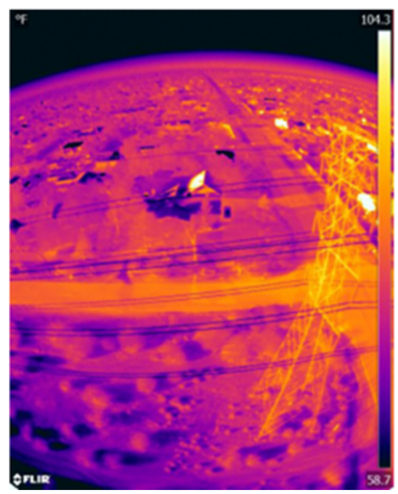

Figure 23 - Thermal Image

[4] Transmission & Distribution World; http://tdworld.com/transmission/drones-next-frontier-utilty-operations; Scott Bordenkircher and Erik Ellis, Arizona Public Service; July 8, 2015.

Chronological Imaging

There is a considerable amount of value in creating a time/image database of critical system components. With scheduled inspections, previous images can be compared to new ones to identify where system components may be starting to fail.

Chronological Imaging is the process for taking images of an area or asset on a regularly scheduled basis, storing it in a database, then making subjective comparisons over time to identify potential issues.

Use of UASs for electric utilities is receiving support by several major trade and research groups such the Electric Power Research Institute (EPRI), Edison Electric Institute (EEI), National Rural Electric Cooperative Association (NRECA) and, more close to DME, the American Public Power Association (APPA) through its APPA Drone Working Group. The APPA supports the municipal electric utility's research arm that delivers support and investigative findings on a number of technical subjects being faced by the municipal electric utility. DME participates in its Drone Working Group.

APPA Survey – March 12, 2015

In March of 2015, the APPA sent out a short survey to municipal electric utilities which queried the utilities on their interest in, and/or current use of, UASs. The results showed many electric utilities; whether municipal, investor-owned, or cooperative were looking into the potential investment of a UAS with its prospective operational and safety benefits. The results showed:

- Current use of UASs (early 2015) is limited, but many respondents see potential in their use. Most of the respondents said they are planning on using then, or would use them, especially if the price point was acceptable.
- There were 5 municipals using UASs to evaluate the technology. This use was not as a normal routine at that time. One respondent was included in EPRI's research.
- When the question was raised to the group "How would you use [UASs]?" the results were:
  - Damage Assessment 83%
  - Circuit rider (inspections) 69%
  - Mapping 48%
- The survey identified potential uses for [UASs]:
  - System Assessment
    - Line running
    - Pole surveys
    - Substations
  - Disaster Response
    - Provide ability to increase productivity during surveys on the distribution and transmission systems. Any out-of-line sight of operator will most likely be on auto-pilot or GPS-based guidance
  - Make better use of crew time

Respondents acknowledged there are concerns with UASs. One major component any utility must consider is the potential for mistrust from the public about UAS use. One respondent stated "We find that using the drone in a crowded neighborhood seems to draw a lot of unwanted attention and also brings up the question of privacy invasion."[5]

To lend more support for the interest the electric utility industry has with UASs and the value they will bring to operations, below are published article quotes from electric utilities or other electric power research organizations specific to, and stating the value of, UASs.

Quotes:

- "'Our research clearly shows that drones may provide utilities a tool that could reduce outage restoration time,' said Matthew Olearczyk, EPRI senior program manager for distribution research. 'Using live streaming video information, utility system operators would be able to dramatically improve damage assessment.'"

  The tests indicated unmanned airborne technologies with sensors, cameras and GPS could be deployed quickly, allowing utilities to evaluate large areas more quickly than ground-based crews, then develop a repair strategy and mobilize repair crews more quickly and effectively."[6]

- "'The most obvious uses for drones would be to look for dangerous trees in our right-of-way using a video camera,' says Josh Hilburn, principal engineer at Power South Energy Cooperative.

  Hilburn points out that transmission lines do not follow highways like distribution lines [this is not necessarily true for DME, we do have distribution lines that are not on highways or paved roads], a fact that raises the ante for preventative maintenance. 'We will also look for trouble spots with an infrared camera' he says. 'This could result in significant time savings, particularly in some areas that are heavily wooded or swampy.'"[7]

- "APPA, EEI and NRECA noted that, together, they provide electric power to almost every home, business, and building in the nation. Providing electricity in the United States 'requires more than 6,000 power plants, nearly 160,000 miles of overhead and below-ground distribution lines,' the three told the FAA in their joint comments. Drones can be extremely helpful in visual inspection of electric equipment, particularly in assessing conditions of long transmission lines in areas that are difficult to get to, they said.

  UAS can do in hours a long-line inspection over mountainous terrain that would take a ground-based crew weeks to accomplish,' said APPA and the others. The costs of purchasing and operating UAS 'are a fraction of the costs to purchase and operate manned aircraft vehicles for comparable services,' they said, adding that UAS equipped with high-resolution cameras 'can

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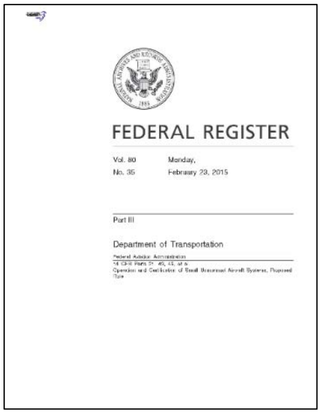
[5] Power Point presentation, APPA Drone Working Group – Issue Overview and Member Listening Session, Mar.12, 2015, no direct reference given for quote.

[6] Electric Light & Power, http://www.elp.com/articles/powergrid_international/print/volume-17/issue-5/departments/notes/epri-drones-can-help-utilities-address-storm-damage.html, EPRI: Drones Can Help Utilities Address Storm Damage (05/01/2012), Feb. 4, 2016.

[7] RE Magazine, http://remagazine.coop/send-in-the-drones/, Send In The Drones (05/04/2014), Eric Cody, Feb. 4, 2016.

provide substantially better information than a crew performing visual inspections either from the ground or after climbing the equipment.'"[8]

Rulemaking


FEDERAL REGISTER
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No. 35 February 23, 2015
Part III
Department of Transportation

The United States Government has exclusive sovereignty of the United States airspace (49 USC 40103(a) (1)). Since UASs use airspace, and can induce excitement through their use, the federal government has charged The Department of Transportation, through its FAA arm, to develop rules around the operations of UASs for private (not federal government) uses. Originally, the FAA was to have their rules in place by the end of 2015, but they stated this timeframe would not be met. However, there are a few knowns. There was a Notice of Proposed Rulemaking (NOPR) published on February 23, 2015 entitled *Operation and Certification of Small Unmanned Aircraft Systems; Proposed Rule*. A copy of the full document can be made available if so desired.

Page 9546 of the NPR identify specifics as to the operational limitations of a UAS (**Figure 24**).

The size, operational requirements, and airspace class conditions are just a few of the provisions.

SUMMARY OF MAJOR PROVISIONS OF PROPOSED PART 107	
Operational Limitations	• Unmanned aircraft must weigh less than 55 lbs. (25 kg). • Visual line-of-sight (VLOS) only; the unmanned aircraft must remain within VLOS of the operator or visual observer. • At all times the small unmanned aircraft must remain close enough to the operator for the operator to be capable of seeing the aircraft with vision unaided by any device other than corrective lenses. • Small unmanned aircraft may not operate over any persons not directly involved in the operation. • Daylight-only operations (official sunrise to official sunset, local time). • Must yield right-of-way to other aircraft, manned or unmanned. • May use visual observer (VO) but not required. • First-person view camera cannot satisfy "see-and-avoid" requirement but can be used as long as requirement is satisfied in other ways. • Maximum airspeed of 100 mph (87 knots). • Maximum altitude of 500 feet above ground level. • Minimum weather visibility of 3 miles from control station. • No operations are allowed in Class A (18,000 feet & above) airspace. • Operations in Class B, C, D and E airspace are allowed with the required ATC permission. • Operations in Class G airspace are allowed without ATC permission • No person may act as an operator or VO for more than one unmanned aircraft operation at one time. • No operations from a moving vehicle or aircraft, except from a watercraft on the water. • No careless or reckless operations. • Requires preflight inspection by the operator. • A person may not operate a small unmanned aircraft if he or she knows or has reason to know of any physical or mental condition that would interfere with the safe operation of a small UAS. • Proposes a microUAS category that would allow operations in Class G airspace, over people not involved in the operation, and would require airman to self-certify that they are familiar with the aeronautical knowledge testing areas.

Figure 24 - UAS Operational Limitations

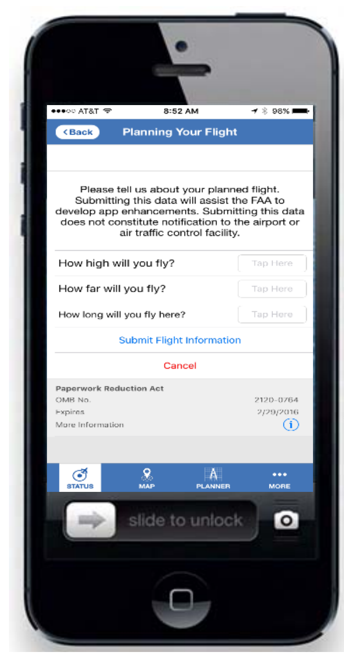
[8] Public Power Daily, http://www.publicpower.org/Media/daily/ArticleDetail.cfm?ItemNumber=43720, FAA should allow expanded use of small drones, say APPA, EEI, and NRECA (04/28/2015), Jeannine Anderson, Feb. 4, 2016.

Certifications for the operator of the AV (**Figure 25**) include a requirement to pass an aeronautical knowledge test, be vetted by the Transportation Security Administration, and be over the age of 17 are just a few of the requirements for the UAS Operator.

Operator Certification and Responsibilities	• Pilots of a small UAS would be considered "operators". • Operators would be required to: ○ Pass an initial aeronautical knowledge test at an FAA-approved knowledge testing center. ○ Be vetted by the Transportation Security Administration. ○ Obtain an unmanned aircraft operator certificate with a small UAS rating (like existing pilot airman certificates, never expires). ○ Pass a recurrent aeronautical knowledge test every 24 months. ○ Be at least 17 years old. ○ Make available to the FAA, upon request, the small UAS for inspection or testing, and any associated documents/records required to be kept under the proposed rule. ○ Report an accident to the FAA within 10 days of any operation that results in injury or property damage. ○ Conduct a preflight inspection, to include specific aircraft and control station systems checks, to ensure the small UAS is safe for operation.

Figure 25 - UAS Operator Certification and Responsibilities

No Drone Zones



There are areas throughout the United States that flying a UAS is illegal or requires notifications. The FAA has a Smartphone App that can be downloaded to allow the user to know any restrictions which may be in place at their current location. The iOS and Android apps are named **B4UFLY**. The software showed that DME's Spencer site was within 5 minutes of an airport that requires notification. The next step in the app is a page titled Planning Your Flight that asks 1) How high will you fly?, 2) How far will you fly?, and 3) How long will you fly? This information is filled out and submitted electronically to the airport requiring notification.

Much is still under consideration by the FAA but it is a known that, due to the large number of UASs being purchased for Christmas presents in 2015, the FAA issued a requirement all drones over a set weight limit and/or cost be registered before used.

As mentioned previously, the APPA's Drone Working Group has been active with it members to help the municipal power family understand the value and benefits for using UASs. The APPA feels the requirements in the NOPR are not conducive to allowing electric utilities to fully apply this technology to its fullest and the benefit of the utility's customers; therefore, the APPA adopted a resolution stating their disappointment of the FAA's NOPR. The title for the resolution is: Southern California Public Power Authority (SCPPA), Resolution 15-02, *In Support of Public Power Utilities: Use of Unmanned Aerial Aircraft in Utility-Related Operations*. SCPPA was an early adopter of considering the possibility of using UASs, and as such, was willing and eager to be the sponsor of the APPA resolution. The APPA adopted this resolution on June 9, 2015 at its annual meeting in Minneapolis, Minnesota. A copy of this resolution has been included in **Appendix B**.

Dated November 18, 2015, the APPA released a document with talking points in support of UAS use by public power utilities. In this document, it states:

- Public power UAS operations to inspect electric power systems is necessary for:[9]
    - National defense[10]; and
    - Disaster and emergency response[11];
    - Mandatory code inspection[12];
    - Public works function, e.g. "dams, waterways, bridges, and roads[13]".
        - No statutory definition of "public works" but generally primary infrastructure components, monopolistic in nature, interdependent, and functioning to deliver needed services to the community.[14]
        - A public power utility is a "public utility"[15]; and
    - Biological resource management (vegetation management).

On February 11, 2016, the House Transportation and Infrastructure Committee began consideration of H.R. 4441, the FAA authorization bill. Even though this bill does not directly order the FAA to consider use of UAS for public power, Committee Chairman Bill Shuster (R-PA) proposed an amendment to "facilitate the expeditious authorization of safe unmanned aircraft system operation in support of service restoration efforts of utilities." No update on this is available at this time.

The following innovations are under consideration for inclusion in the innovation plan. They do offer promise and thought of adding them to the plan should be considered.

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[9] Talking Points in Support of Allowing Public Power Utility Operation of UAS as Public Aircraft. Feb. 9, 2016.
[10] Defense Science Board, Office of the Undersecretary of Defense, "Report of the Defense Science Board Task Force on DoD Energy Strategy" 20 (Feb 2008) (stating that certain defense-related activities that "must function 24/7" are wholly dependent on continued power to the building and equipment involved); and U.S. Department of Homeland Security, "What is critical Infrastructure?," http://www.dhs.gov/what-critical-infrastructure (last visited Aug 3, 2015) (citing electric power delivery to homes as part of the "critical infrastructure [that] is the backbone of our nation's economy, security, and health")
[11] Mary Casey-Lockyer et alia, "Deaths Associated with Hurricane Sandy – October-November 2012" Morbidity and Mortality Weekly Report (Mat 24, 2013) Vol. 62, No. 20 (indicating that at least 6 deaths in the aftermath of Hurricane Sandy were indirectly related to "burn/electric current" and that several factors, including power outages led to "challenging, and sometimes deadly, conditions for residents."); G. Brooke Anderson & Michelle L. Bell, "Lights Out: Impact of the August 2003 Power Outage on Mortality in New York" Toxicology, Vol. 23 No. 2 (2012) (finding 90 deaths directly attributable to the August 2003 Power Outage in the city of New York); and Kristina Hamachi LaCommare & Joseph H. Eto, Ernest Orlando Lawrence Berkeley National Laboratory, "Understanding the cost of Power Interruptions to U.S. Electricity Customers" (Sept. 2004)(developing an economic model which estimated that power outages cost the U.S. economy about $80 billion annually).
[12] Letter from Mark W. Bury, Assistant Chief Counsel, Fed. Aviation Admin., to Gregory R Singer, Associate General Counsel, Tenn. Valley Auth. (June 9 2015) at 2.
[13] *Id.*
[14] Jeffrey E Fulmer, "What in the World is Infrastructure?," Infrastructure Investor, at 32 (July/Aug. 2009)(providing a narrow definition of infrastructure).
[15] Munn v. Illinois, 94 U.S. 113., 126 (1877)(affirming the right to regulate a "public utility" and enumerating criteria for assessing whether a service is a "public utility"0.

Advanced Grid Analytics

As had been mentioned previously, with the implementation of AMI and SCADA, the availability of data to an electric utility is enormous. This is why many in the industry will say it is data rich and information poor. Advanced Grid Analytics (AGA) allow the electric utility to harness the power of the data, combined with its network model, to improve both the performance and reliability of the distribution grid. With the plethora of data, utility management and leadership could harness the data to provide dashboards and reports which offer timely insights into key operational or status factors of the utility. These dashboards could include modules as reliability indices, real-time system outage/customers affected, energy used vs energy purchased, asset values (i.e. miles of line overhead vs. underground, joint-use attachment counts), budgetary spend, and service project status just to name a few.

From an engineering and system optimization opinion, advanced analytics will allow the utility to maximize its investments in inventory, assets, and the data available. Known capabilities of AGA include:

1. Revenue Protection and Theft. Using the information generated from the AMI and the GIS, identification, and monitoring, of losses on the distribution network can be determined.
2. Asset Loading. Using the information generated from the AMI and the GIS along with asset specifications, identify components on the system that are either being over loaded or underutilized which can translate in cost of use.
3. Voltage Visualization and Monitoring. Using the information generated from the AMI and GIS determine areas where voltage may not be at regulatory or desired levels.
4. Fault Circuit Indicator Optimization. Using the system connectivity model, placement of fault indicators are maximized.
5. Customer Capacity Influence. Using the information generated from the AMI, determine a customer's impact on the system on a daily, monthly, or yearly basis.
6. Reliability. Helps to identify and improve network reliability by assisting with recommendations for system upgrades.
7. Distributed Energy Resource Optimization. If utilized by DME, assists with analysis and recommends placement of distributed resources to provide maximum value.

Research Opportunities

DME's slogan is "***Energizing Tomorrow's Community Today!***" At a recent Smart Cities Round Table (February 10, 2016) Joe Thomas, Emerging Technology Director for Duke Energy Corporation, mentioned Duke utilizes a number of pilot projects to find determine technologies that may be beneficial now or in the future. Use of pilot projects are effective in allowing proper engineering review of a potential technology prior to implementation in the field. There are two (2) potential pilot projects DME E&O Technology will be bringing forward for consideration.

Microgrids

Microgrids are localized grids capable of disconnection from the traditional grid but still operate autonomously and help mitigate grid disturbances to strengthen grid resilience.

The Department of Energy (DOE) has numerous locations throughout the United States (**Figure 26**) where research associated with microgrids and other system operation methods are underway[16].

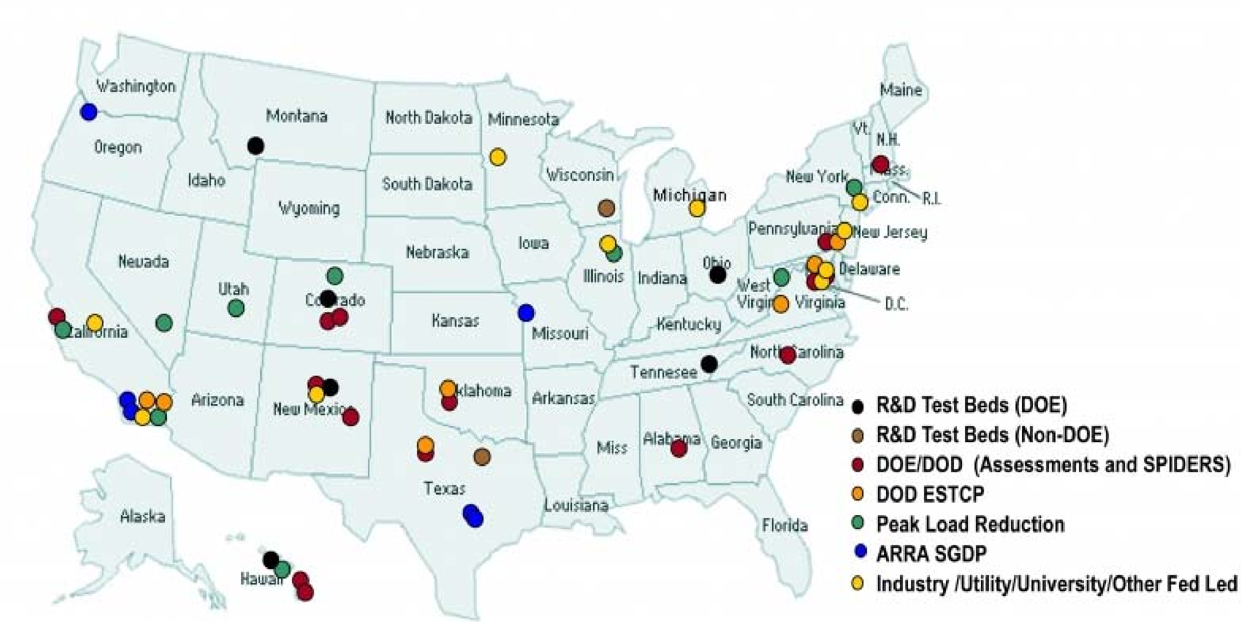

Figure 26 - DOE Test Locations

The DOE research activities, through their National Laboratories, are focused in two areas: 1) planning and design, addressing system architecture, monitoring and analysis, and system design; and 2) operations and control, addressing steady-state control and coordination, transient-state control and protection, and operational optimization. In an ideal situation, microgrids allow autonomous operation for a specific area with preference given to the renewable contribution.

In 2015, Oncor Electric Company opened a microgrid demonstration center near Lancaster, Texas. Based on a real need through experiencing low reliability in the area, Oncor's microgrid is able to provide a percentage of backup power to the site. Microgrids can also be used to help minimize demand on the customer's system or as a tool for the utility. Microgrids may be a viable resource for DME or for some of its customers.

Jerin Thomas, DME Engineering Technician, is a student at UNT studying to earn his Bachelor of Science degree in Mechanical and Energy Engineering. After a recent tour of Oncor's facilities, Jerin provided DME Engineering management a summary of Oncor's microgrid technology. The Oncor microgrid can provide around 2 hours of backup. The components of the microgrid include:

1. Propane power microturbine [65kW] (**Figure 27**)
2. Energy storage in the form of Li-ion batteries [200 kW/400 kWh] (**Figure 28**)
3. Solar carport PV array [106 kW] (**Figure 29**)
4. Solar ground mounted PV array [8 kW]

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[16] http://www.Energy.gov. Microgrid Activities. http://energy.gov/oe/services/technology-development/smart-grid/role-microgrids-helping-advance-nation-s-energy-syst-0. Feb. 17, 2016.

5. Diesel generation [560 kW]
6. Gas generator [45 kW]
7. Community Energy Storage Unit [25 kW/25 kWh]

Figure 27 - Microturbine

Figure 28 - Energy Storage (Tesla Batteries)

Figure 29 - Solar Panels (on top of parking area)

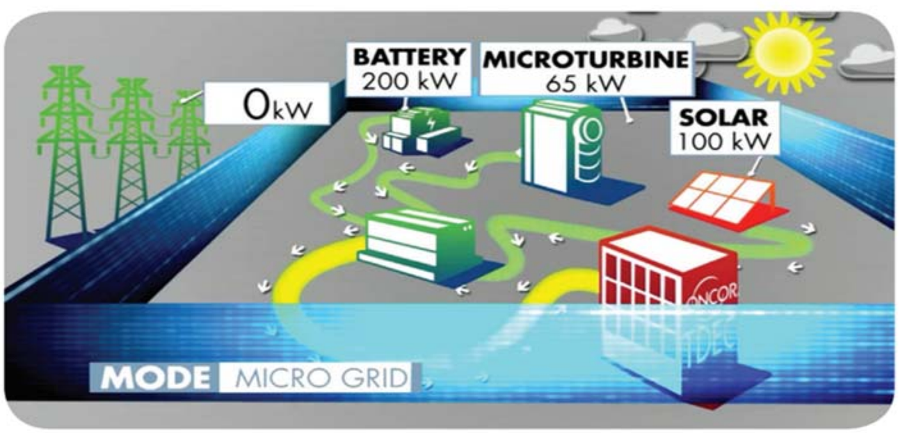

Figure 30 - Oncor Microgrid Diagram[17]

When experiencing an outage or poor power quality, Oncor's microgrid control system automatically islands the facility and brings necessary components on-line, with preference given to renewables and economic dispatch, to serve the load. Jerin's evaluation of the Oncor Microgrid notes that with any new technology there are "bugs" that need to be addressed. Initial cost of the installation was not provided

[17] Rumor is True. Oncor Unveils First-of-King Microgrid, http://microgridknowledge.com/rumor-is-true-oncor-unveils-first-of-a-kind-microgrid/, June 29, 2016

by Oncor, but research tends to lean towards the initial cost was likely substantial. All of the technologies have their draw backs when examined at a utility grade/sized installation. The solar was static which limited its capacity, propane increases costs due to storage requirements, etc. However, one interesting note was the stand-by systems of diesel generators were the most dependable due to the lack of environmental factors (wind, sun, etc.) and capacity (power stored, length of storage capacity) which substantially affect the other technologies. There are valuable takeaways that come with a project such as this. First, if a research project is done in a working relationship with a university, that project can give DME direct access to any research and findings that may be realized; and secondly, these projects can provide a direct interface with the customers and citizens of the City of Denton by providing a physical resource for education and plan development based on facts and viability.

The City of Denton is blessed with two universities. The University of North Texas' School of Engineering offers a number of degrees but one of interest to DME is their program in Mechanical and Energy Engineering. From UNT's College of Engineering website, focus for this degree provides the future engineer with knowledge in renewable energy production, energy storage, and energy efficiency with both undergraduate and graduate studies are available. With this in mind, it appears a natural collaboration between UNT and DME exists. It is proposed DME fund, and work with UNT staff and students, to build and utilize a microgrid. Students can use it as a learning tool, the citizens of Denton can see and get information on emerging technologies associated with microgrids, and DME can use it to vet technologies that are on the cusp of realization.

Solar Farm, Wind Farm, and Battery Storage

Microgrids are not the only research area recommended for DME to consider participation. Today there are a number of technologies worthy of additional investigation to determine if they are viable sources of power for the City of Denton. DME's EMO organization has had conversations with representatives from the University of Texas at Arlington regarding potential mutually beneficial projects to examine the viability of a solar farm, wind farm, or large scale battery storage. The citizens of Denton are learned and have shown interest in assuring DME implements plans that are financially viable as well as provides good environmental stewardship. DME Engineering supports additional research into these systems. They have value to the citizens of Denton and to the overall system and strategic planning for the electric utility. DME Engineering will participate to assure these projects are successful for the citizens. Collaborative projects which provide value to the Citizens of Denton will truly help DME with ***Energizing Tomorrow's Community Today!***

E&O Innovations Moving Forward

Systems such as SCADA, CIS, JDEdwards, MDMS, and AMI are all under the CODTS domain. Two other systems, OMS and Synergi (System Planning Software), are within the DMECODAD domain. All of these systems are legacy and used by DME as part of its core operations. All of the applications and systems under DMECODAD come with support staff that make themselves available 24/7 and are knowledgeable in the devices and applications so immediate needs can be handled promptly. DMECODAD includes applications used by DME's Engineering, Operations, Construction, and Maintenance staff for the planning and daily operation of the transmission and distribution systems.

With components and systems in place for the current needs of DME, E&O Technology researched existing and upcoming innovations and systems for potential future use and to provide benefit. Customer knowledge services, productivity, DMECODAD system strength and security, and reporting are all purposes where additional improvement should be planned for. Moving forward, E&O Technology has planned innovations that provide direct and indirect benefits to customers, as well as DME's overall operational excellence for the transmission and distribution systems. To begin to meet the innovation future, several actions are already in scope or strategically planned. Scoped items include **[Status in green]**:

- *Professional Services Agreement* **[pre-RFP]**. As innovation moves forward, it is recognized the available E&O Technology Staff would need support managing the processes, coordination, and implementation of the innovation plan. DME E&O Technology has developed a Statement of Work for a Professional Services Agreement to provide expertise and assistance with the innovation plan. For the plan components where the assistance of the firm awarded through the PSA will be used, a reference number or code tying the action to the overall statement of work has been included in **(orange)**.
- *Distribution Design* **(2.1)** **[Discovery in final stages]**. Distribution Engineering uses spreadsheets and AutoCAD to produce material lists, cost, and field drawings for all of the active projects. It is important DME maintains its assets accurately, and in proper FERC accounts, through accurate material lists which enable the warehouse to assure needed materials are on hand and order stock when needed. Due to natural differences between Engineering staff, inconsistences in information and quality of field drawings exist. DME has started the process necessary to prepare an RFP, if necessary, for a software system to standardize materials and drawings while assuring the financial components are properly booked. Recently, a third-party vendor assisted DME with existing process discovery through visits and discussions with all departments, within the City of Denton, that need to have input into a design program. These departments included Purchasing, Warehouse, Maintenance, System Operations, Construction, Engineering, Customer Service, Tech Services, Metering, Communications, Key Accounts, and Accounting. This process will deliver an understanding of the existing processes used for service project development. In a second phase, the same departments will review these processes, determine where inefficiencies exist, and create a new process diagram. This information will be crucial in the development of a Statement of Work for a software that provides uniformity and assurances issues or errors are minimized. Upon deployment of the final software, DME will gain much greater understanding of its service projects, increase staff productivity, and be able to report accurately on status or work load.

- *Customer Account Interface* **(2.2)** **[RFP].** DME's Key Account department has listened to its customers regarding their information and data needs and will be implementing an application that will provide the information, data, and analytics they have requested. This application will provide secure access of kWh, kW, kVA, and kVAR data (billing) to the customers through a web-based service. The application will allow DME's customers to review and make educated energy use decisions based on near real time data.
- *Outage Map Update* **(2.3)**. The Outage Map DME currently makes available to our customers is good at giving general information regarding an outage; however, the information and detail can be improved. E&O Technology will prepare a Statement of Work for an RFP inviting responses for a web-based system that provides customers with greater detail and information about an outage. As a separate action and software to the shared outage map system, it is desired to identify and deploy a system capable of sending out emails or text messages to notify customers DME is aware of the outage and have begun to implement restoration actions. This notification service will be available to customers whom choose to get the communications.
- *GIS Dashboard* **(2.4)**. DME management, at all levels, often find themselves needing current key information available to them in short notice. Such data can include current electric demand, miles of overhead and underground line, number of joint use attachments, and status of projects just to name a few. Requests for information listed does occur often and E&O Technology staff will have to stop what they are doing to run reports to determine the latest value. A dashboard could provide this real-time information and be automatically updated so access to the key information is current. This also could improve staff productivity. As a part of the Professional Services Agreement, the vendor will help develop this dashboard application to query respective systems and organize the data in a format that is acceptable for a quick check.
- *Recovery & Backup* **(2.5)**. The critical systems under DMECODAD should be evaluated to assure current hardware and systems can indeed provide a useable and sustainable backup when needed. As a part of the Professional Service Agreement, the vendor will help evaluate DMECODAD's recovery and backup to assure it is viable and within best practices.
- *GIS Scheduled Upgrades* **(2.6)**. The E&O Technology plan calls for upgrading the GIS software on a biennially basis. Learning from the past, these upgrades are significant in nature and require substantial resources dedicated to the process to assure this critical system successfully is elevated. As a part of the overall PSA, the awardee will work and assist E&O Technology with the scheduled upgrades.
- *Asset and Inventory Management* **(2.7)**. The City of Denton Warehouse and the DME pole yard manage the purchase and issuance of all of materials needed to build and maintain DME's electric transmission and distribution assets. These materials amounted to over $6.5 million of spend for DME's 2014-15 fiscal year. Discussions with vendors of systems which might be considered have identified two separate, and distinct, functions associated with materials. <u>Asset Management</u> is the control over the equipment while it is in the warehouse and includes factors such as cost, aging, etc. The legacy JDEdwards system is the record of choice for the value of the assets and the GIS is the record of choice for deployed assets. However, there is a need to have greater control and knowledge of the current assets and inventory of DME. Additional functionality such

as Radio Frequency Identification (RFID) on major assets might be valuable. The City's warehouse does maintain an inventory of DME items. This project is NOT a replacement of the warehouse's system, but an enhancement of the data associated with each major item (transformers, switchgears) for DME evaluation and tracking purposes. Inventory Management includes detailed information such as nameplate data, historic location(s), and testing information for examples. This data will allow DME to evaluate failure rates for components or contributors to power quality or reliability issues. If needed, DME will prepare a Statement of Work for an RFP inviting responses for an application that provides both asset and inventory management within DME's requirements.

- *SCADA Reporting* **(2.8)**. With information from the SCADA, GIS and AMI, DME Engineering will have access to an enormous amount of data to evaluate the operation of the distribution system and identify potential issues before they become problematic for the consumer. SCADA is a NERC CIP compliant system. Improper access to the SCADA and its data can threaten the functionality of the electric system causing operational issues; therefore, direct access to its data is concerning to its application owners. Canned reports from the three foundational systems often do not fully provide information as needed for proper evaluation. To solve this issue, a parallel database will be created which collects all historic SCADA data (a copy) and the data collected through AMI into a central location. Software intended to produce reports will be added to the system so data can be pulled in a logical format for operational evaluation – without the potential of interfering the primary SCADA or other foundational systems. This application and associated system should allow for collection and acquisition of data that complies with future system automation and evaluation. DME will prepare a Statement of Work for an RFP inviting responses for an application to logically collect and disseminated data for system operational evaluations.
- *Web Based GIS* **(2.9)**. DME has been notified ArcFM for Silverlight®, which was installed in September 2013, is nearing its life cycle and would no longer be supported after Yr2018. Prior to obsolescence, E&O Technology will need to find a replacement product that will be used to support DME's technology in a mobile environment. Language in the Professional Services Agreement identify that the vendor will assist with deployment of ArcFM Web to replace ArcFM for Silverlight®.
- *DMECODAD System Health* **(2.10)**. It is important to consistently examine and review critical systems such as DMECODAD for potential weaknesses or insufficiencies. Language in the Professional Services Agreement identify that the vendor will assist with inviting responses for a third-party firm to examine and identify weaknesses or exposures and provide best-practices recommendations.
- *Training Materials* **(2.11)**. With all of the current and new resources available to the Engineering, Operations, Construction, and Maintenance departments, it is critical that resources be made available for training first time users or as a reference for more experienced staff. With the assistance of the PSA awardee, DME will begin to prepare, and make available electronically, training and operational materials.
- *Distribution Management Systems & Unmanned Aerial Systems* **(2.12a, 2.12b)**. More detail included in separate sections.

- *GIS/DMECODAD Support Retainer* **(2.13)**. As with any major system, full knowledge and capabilities are not completely available with existing staff. It does not mean the staff do not know what they are doing, but it can be a widget needs to be fixed or a system needs to be tweaked that available time or total expertise is not held within the organization. The retainer is intended to allow E&O Technology staff to have access to more well-rounded support when the need calls for it.
- *Integration of Schneider Electric's Responder OMS with Clevest MWM* **(16-2-3)**. Even though implementation of Clevest is not wholly dependent on this integration, it does need to be done. This project will provide the funding required to prepare the integration between the OMS and Clevest. Language in the Professional Services Agreement identify that the vendor will assist with preparation of a Statement of Work inviting responses for development of an integration between OMS and Clevest.
- *Integration of Schneider Electric's Responder OMS with Trillant AMI* **(16-2-9) [pre-RFP]**. This is a planned project. The benefits associated with AMI can be extended to assist System Operations with greater detail of information associated with an outage. The AMI meter is capable of sending a "last gasp" signal through the system. When fully integrated with the OMS, this data will be populated into the OMS prior to many phone calls that may come from the public. This integration will also assist the analytics of the OMS to better define issue source and has the potential to lessen outage time for the customers. Language in the Professional Services Agreement identify that the vendor will prepare the integration based on the current Statement of Work.
- *ArcGIS Online Public Streetlight Reporting Application* **(16-2-11)**. Reporting a streetlight that is currently out is available via the City of Denton website through DME's page as a link on the left-hand side. The form is simplistic with no spatial reference to streetlights. This lack of reference requires the customer who wants to report a streetlight being out to gather a good deal of information. Just like the Outage Map, this process can be improved. In all likelihood, this will also be a component of, and included with, task **2.3** above. E&O Technology will prepare a Statement of Work for an RFP inviting responses for a web-based system that has a geographic interface to allow a customer to locate the streetlight based on its location on a map.

Figure 31 below is a Hype Cycle to identify the maturity of the innovations listed in this document and others which may be of interest. The placement of innovations along the Hype Cycle were not done with any quantitative analysis performed by DME Engineering Staff. The Hype Cycle placement associated with the innovations in this plan have been placed based on a subjective analysis of the innovation's readiness for mainstream adoption by utilities. Internet research of the Gartner, Inc. website assisted with the placement of technology maturity. The two studies utilized include *Hype Cycle for Utility Industry IT, 2015* (Gartner, Inc., July 2015, G00277732, Analyst: Chet Geschickter) and *Hype Cycle for Smart Grid Technologies, 2015* (Gartner, Inc. July 2015, G002777692, Analyst: Zarko Sumic). More information on Hype Cycles are included in **Appendix C**.

Hype Cycle for E&O Technology Innovation Plan

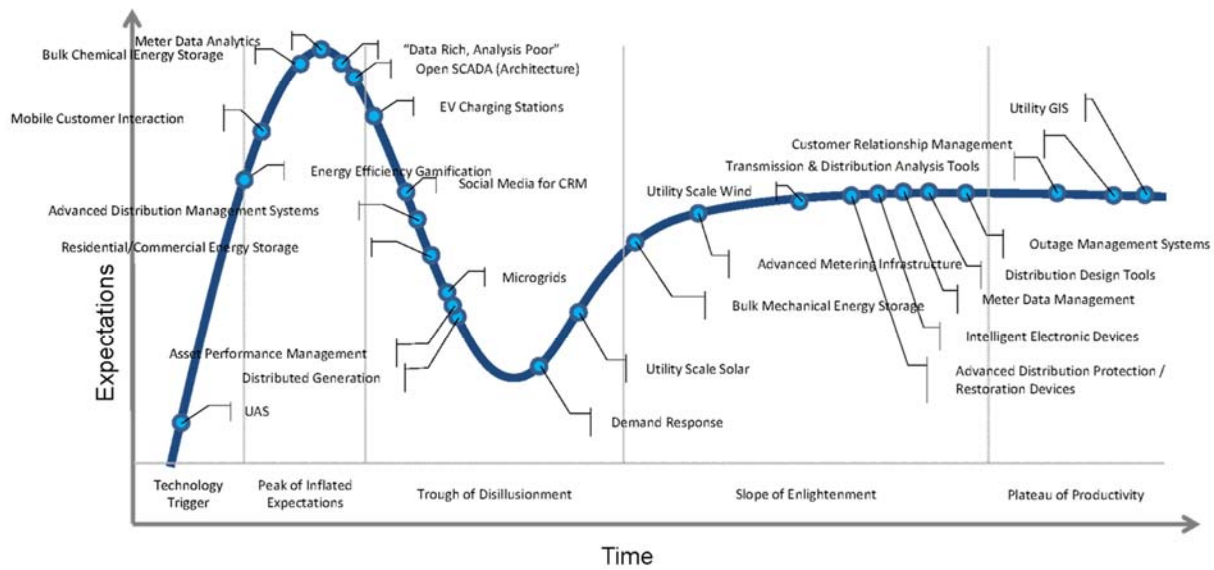

Figure 31 - Hype Cycle

It is the E&O Technology belief that innovations proposed in this plan will be mature enough at their deployment to provide valuable services to end users and DME staff. The exception to this will be any research projects which may be approved. However, if a technology does not appear to be maturing at a pace that is acceptable to DME, its implementation will likely be postponed.

The Innovation Plan

This document has provided a historical narrative of the electric utility industry from its genesis and included innovation milestones that permitted improvements in management, control, and efficiency. DME has implemented of a number of systems which are crucial to advance system functionality for both the consumer and utility. But, as evidenced, with focus only on applications that benefit System Operations, Engineering, Construction, and Maintenance, there are still improvements that can be made. DME prepared this document to identify these improvements, spur discussion, and establish a proposed timeline for implementation of this innovation plan.

One of the main dedications of this document is to show the interdependency between existing systems used for transmission and distribution management. The complexity that exists today will be simplistic compared to the interdependency of the future. **Figure 32** provides a visual of the complexity for the innovation plan. Arrows, which stem from a process on the left, identify process on the left that receive the data. The receiving systems functionality depend on this information. There are a number of ways for the information to be transferred via SCADA, Fiber/Radio, T1 lines, or domain/processor connectivity. It is recognized **Figure 32** is congested and hard to read, thus complexity is confirmed. For clarity, individual process dependencies have been included as **Appendix D**. Even though the systems will be complex in interconnectivity, proper planning, system design, and vetting will allow for the successful implementation the overall system. Additionally, with considerations of cost and staff availability, this system will not be implemented in a short time frame. Recognition of the potential for changes of technology or system plans must be considered regularly and adjusted when justified. City of Denton standard practices regarding purchasing will be followed including presentation to the Public Utility Board and/or City Council as required.

The current innovation plan takes into account existing systems, upgrades for hardware and software, use of current communication arrangements, as well as future enhancements over a five-year period. Each innovation discussed in this document have been included in the timelines shown in **Figures 33** and **34**. **Figure 33** provides a timeline for the systems as they are today; whereas, **Figure 34** shows the current deployment plan for future innovations.

This is a complex plan that will implement a number of new systems under the DMECODAD domain. DMECODAD was established with the agreement of CODTS as the space where systems critical to the daily operation of the electric transmission and distribution systems can reside so flexibility of system parameters and in-house based knowledge can be provided without threat to CODAD – which is the business system for the entire City of Denton. Because of the complexity and need to be structurally organized in deployment, DME recommends support through Professional Services Agreements through the execution of the time frame of this plan.

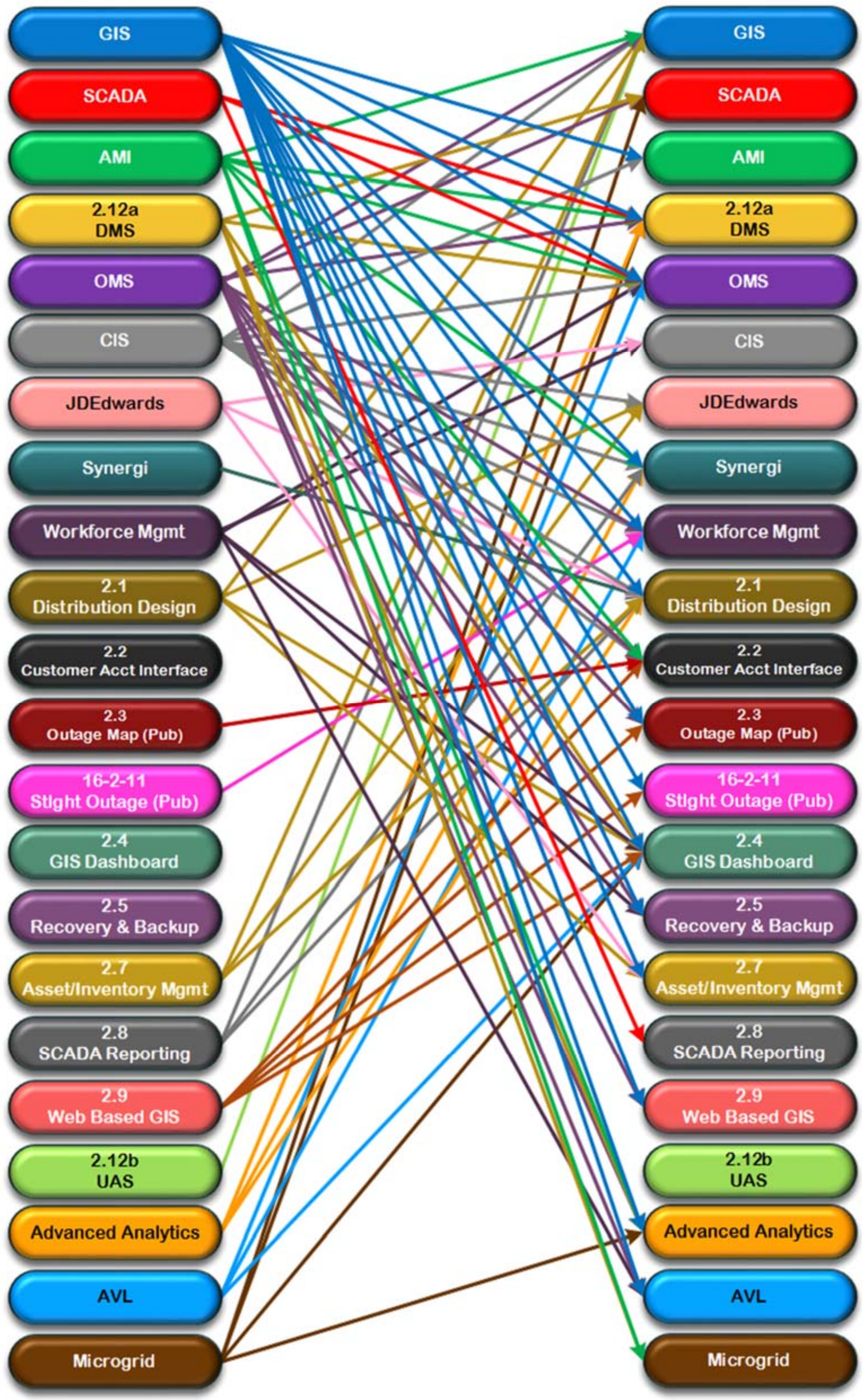

Figure 32 - System Complexity

EXHIBIT 1

2016 Innovation Plan
Denton Municipal Electric

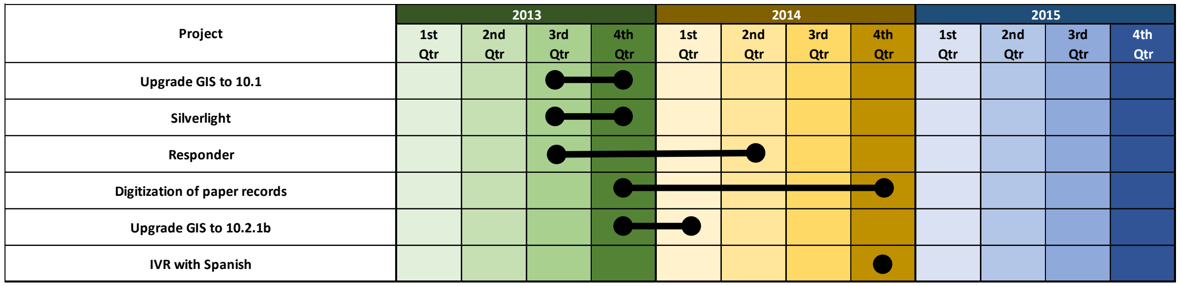

Figure 33 - Post 2013 Timeline

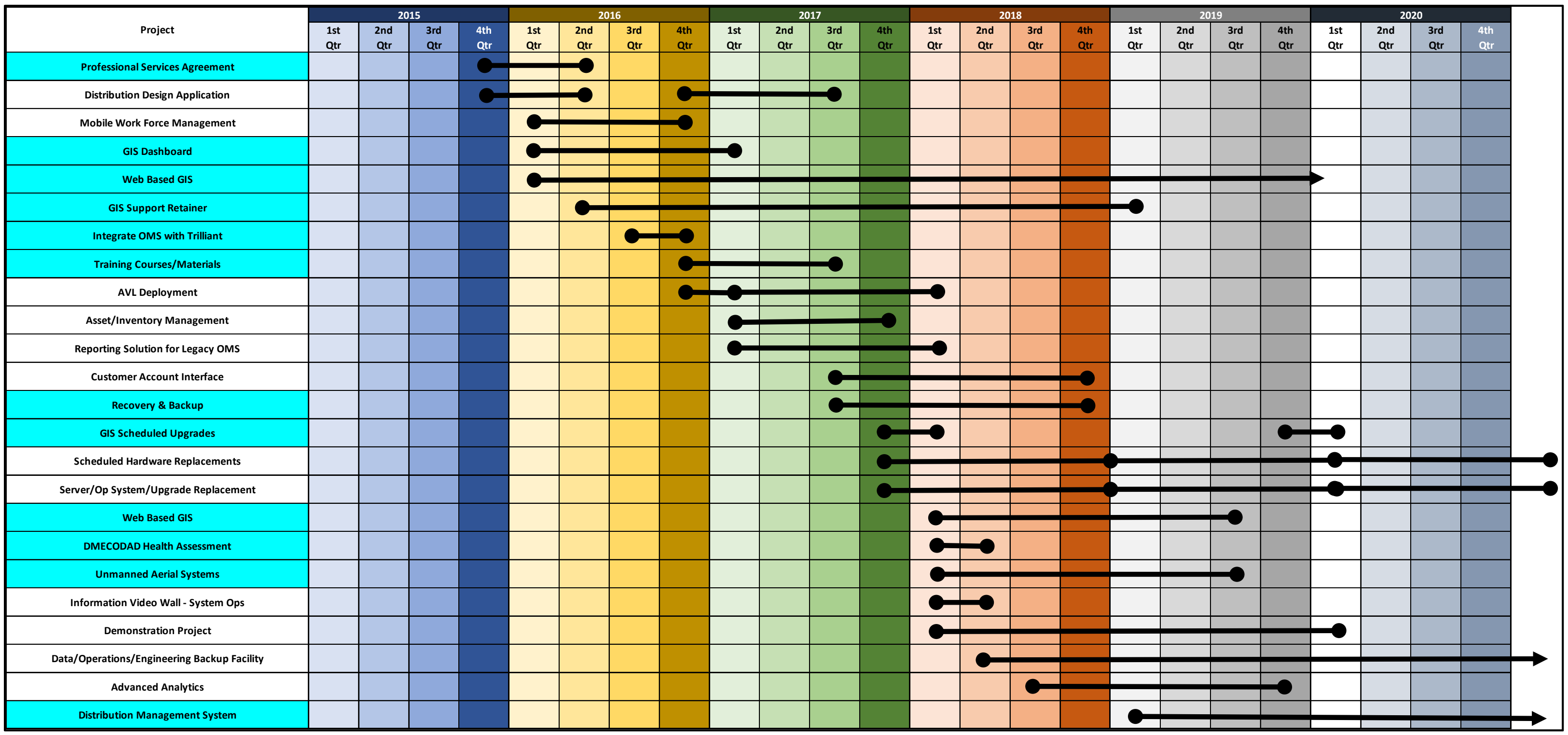

Figure 34 - Innovation Plan Timeline

Conclusion

DME maintains awareness of innovations that benefit our customers; but, considerations have to be vetted and used so that they provide value. This value may not necessarily be related to the cost of energy but should provide increasing reliability, power quality, expeditiously restoring service in minimal time, or provision of information so consumers can make educated decisions on energy usage. As with any critical service, those charged with the responsibility of provision of that service have to be visionary and do their due diligence to assure the electric transmission and distribution systems keep current with growth and maintenance. There are a number of exciting potential applications on the horizon that paves a path for another fundamental change in the generation, transmission, or distribution of electric power to customers. Many of the systems DME already has in place are capable of providing information to allow the energy consumer to be more educated in their use and options for sources.

The information provided in this document outlines what DME E&O has completed to start the progression of the group maintaining data and providing end user services. It also includes the plan to continue to increase the use of technologies in an orderly manner. The components of the plan provide valuable assistance to all of DME. Most importantly, all of the components in this plan provide back-end and front-end benefits to the customer.

Appendix A

Table of Figures

EXHIBIT 1

Appendix C

Hype Cycles

Appendix B

Southern California Public Power Authority (SCPPA), Resolution 15-02

Resolution 15-02
Sponsor: Southern California Public Power Authority

In Support of Public Power Utilities' Use of Unmanned Aerial Aircraft in Utility-Related Operations

Unmanned aerial vehicles, also known as "drones," are aircraft operated with no human pilot aboard. These can include autonomous aircraft and remotely-piloted aircraft. Autonomous drones are not yet technologically developed enough for safe commercial use, but remotely-piloted drones are and show huge potential for use by electric power utilities. Drones can be used to survey electric power equipment, assess damage, and aid in construction and repair. The Federal Aviation Administration (FAA) and federal aviation rules have failed to keep pace with this new technology.

Government-operated (public) aircraft must comply with federal airspace and air-traffic rules, but generally are exempt from civil airworthiness and airman certification requirements. This has eased the use of traditional aircraft by governmental entities. However, drones cannot meet certain airspace rules. For example, a pilot is required to scan the sky from the cockpit to "see and avoid" other aircraft. As a result, the FAA has required governmental entities to obtain an FAA-issued Certificate of Waiver or Authorization (COA) to operate drones. The process is complicated and unpredictable. Media accounts indicate that many public safety departments currently use drones or are beginning to experiment with drone use. The fact that many ignore or are unaware of the COA requirements indicates that the process is too opaque and burdensome and that the FAA itself is incapable of adequately policing these requirements.

The FAA Modernization and Reform Act of 2012 required the FAA to develop a plan to integrate civil unmanned aerial vehicles into the national airspace system and simplify the process for state and local governmental entities seeking a COA.

The FAA on February 1, 2015, published proposed rules providing clear guidelines for civil operations of drones weighing less than 55 pounds, operated within eyesight of the operator, operated only during daylight hours, and flown by "operators" vetted by the Transportation Security Administration and who have passed an FAA-approved aeronautical test. These rules would not change the COA process, but governmental entities could apply to have their operations regulated by these civil drone rules, rather than operating under a COA. The option to adopt these civil drone rules would be of little use in many of the operations where drones would be of most use to public power utilities, including surveying and assessing equipment in remote locations and aiding operations which occur outside daylight hours.

Appendix C

Hype Cycles

Hype is defined as extravagant or intensive publicity or promotion. Technology and innovations are certainly hyped by manufacturers and media in order to gain wide recognition of a product in hopes it will become a mainstay for its target audience. Prior to iPhones being available to the general public, Apple "leaked" details and the public went wild in anticipation of being the first to own a smart phone. Apple's iPhone has continued to set the bar to other smart phones who are trying to catch the same wave that the iPhone has received. Of course, not all stories are of success. In the electric utility industry, one method of AMI data collection that started off with high hopes was broadband over power lines. As mesh networks and 900 MHz radio systems became a more stable avenue for data collection, broadband over power lines seemingly has gone the way of the dinosaurs.

The Hype Cycle, or more accurately the Gartner Hype Cycle, was developed by Gartner, Inc. a research and advisory firm that presents data and information on maturity, adoption, and the social applications of specific technologies. A Hype Cycle identifies the level of maturity for a specific technology in one of five (5) phases along the scales of expectations and time.

1. Technology Trigger – a potential technological breakthrough which starts interest. Proof of Concepts, sometimes in conjunction with media interest, trigger significant promotion. At this stage in the Hype Cycle is it not unusual that no functioning products exist and there is typically no proven commercial viability.
2. Peak of Inflated Expectations – Early publicity and product produces limited success stories and failures. There will be some adopters of the technology or innovation, but for the most part companies are still in a wait and see mode.
3. Trough of Disillusionment – As products tend not to live up fully to their associated hype, products tend to go one of two ways. Products either fail and drop off the chart or garner additional investment or research dollars. Continuance of a product on the hype cycle depends on the satisfaction of the early adopters.
4. Slope of Enlightenment – More proof of the technology benefiting the public or companies start to crystallize and become more widely known. More companies start pilot programs; however, conservative companies remain cautious.
5. Plateau of Productivity – At this level, adoption of the technology is starting to take off. Companies are able to assess viability of a provider. The technology's broad market applicability and relevance are paying off.

The Hype Cycle is a visual representation of innovation (technology) maturity and adoption. Properly placed technologies on a hype cycle can help determine the proper time for making investments into emerging technologies, identify drivers that will allow the technology to be commercially viable, and help balance business benefits with associated risks.

Gartner, Inc. requires a membership ($10,000+) to access any of the full reports they have developed for industry. The figure below, taken from the Gartner, Inc. website (http://www.gartner.com), shows the five (5) cycles along with the technology milestones.

EXHIBIT 1

Appendix C

Hype Cycles

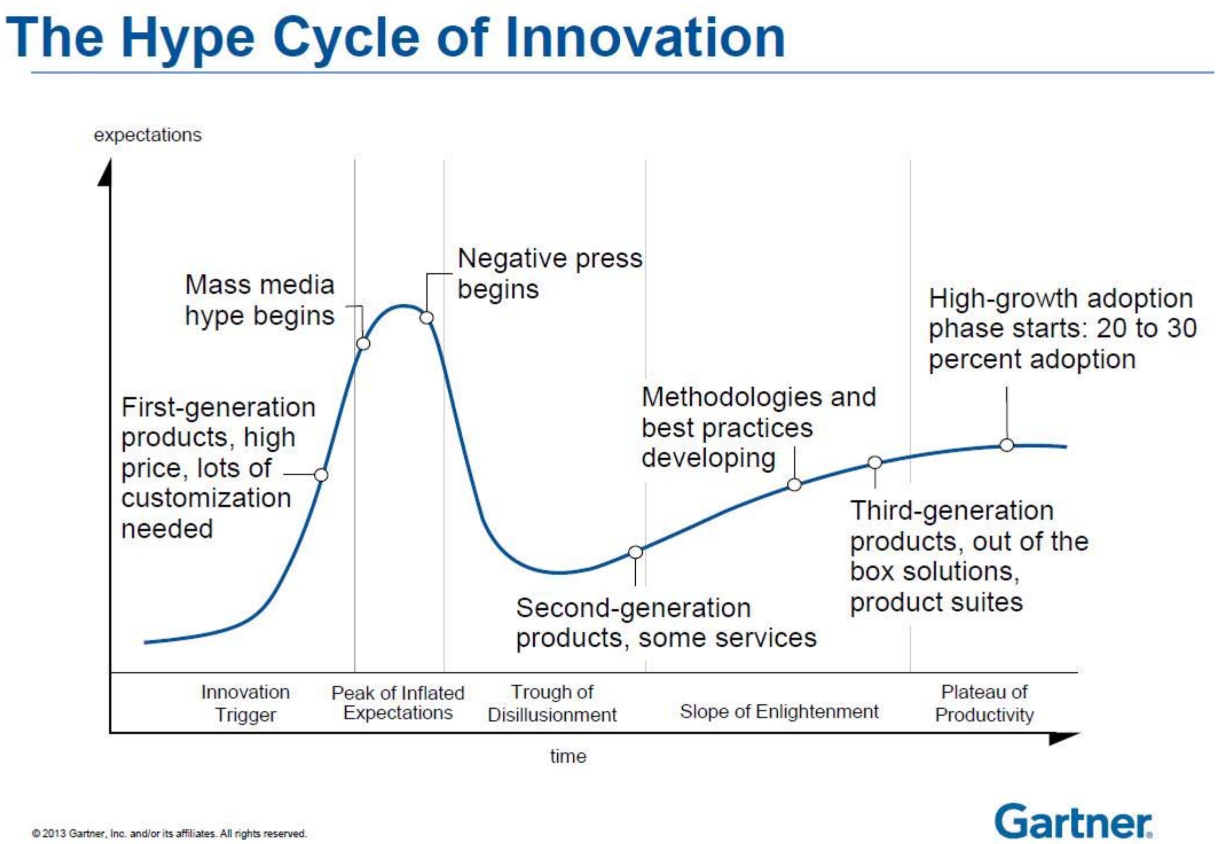

Figure 35 - Gartner Hype Cycle

Appendix D
System Interdependencies

Figure 36 - Geospatial Information Systems

Figure 37 - SCADA

Figure 38 - Advanced Metering Infrastructure

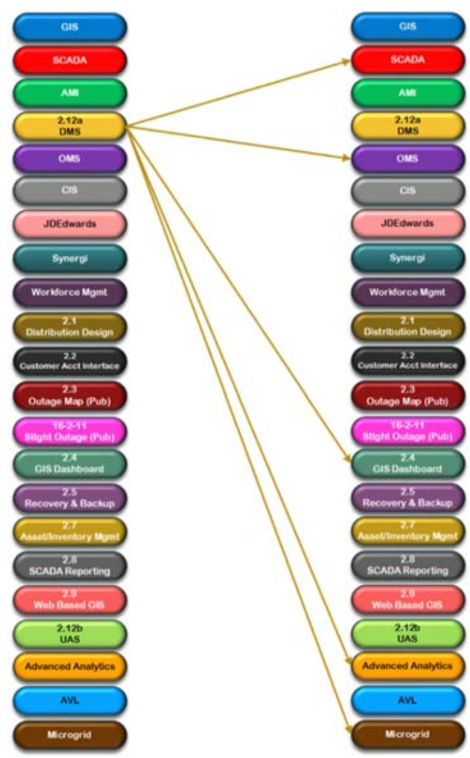

Figure 39 - Distribution Management System

EXHIBIT 1

Appendix D

System Interdependencies

Figure 40 - Outage Management System

Figure 41 - Customer Information System

Figure 42 - JDEdwards (Accounting)

Figure 43 - Synergi

Figure 44 - Workforce Management

Figure 45 - Distribution Design

Figure 46 - Customer Account Interface (Public)

Figure 47 - Outage Map (Public)

Figure 48 – Streetlight Outage (Public)

Figure 49 – GIS Dashboard

Figure 50 - Recovery & Backup Systems

Figure 51 - Asset & Inventory Management

Figure 52 - SCADA Reporting

Figure 53 - Web Based GIS

Figure 54 - Unmanned Aerial Systems

Figure 55 - Advanced Analytics

Figure 56 - Automatic Vehicle Location

Figure 57 - Microgrid