

## **Appendix L. Smart Grid**

### **L.1 Overview**

Smart Grid is both a national policy evolving from the Energy Policy Act of 2005 and a set of electric utility industry initiatives. This Appendix describes LADWP's Smart Grid initiatives and its Smart Grid Implementation Project.

### **L.2 Policies and Initiatives**

#### **L.2.1 National Policy Objectives**

Smart Grid is a national policy that grew out of the recognition that the requirements of The Energy Policy Act of 2005, which called for advanced metering, were insufficient to achieve the desired goals of energy conservation, the migration to renewable energy, and the reduction of CO<sub>2</sub> emissions from power plants. The federal Energy Independence and Security Act of 2007 called for the implementation of Smart Grid systems as a "Policy of the United States". The Energy Independence and Security Act of 2007 authorizes \$100 million each year from 2008 through 2012 to be divided among five Smart Grid demonstration projects throughout the nation and matching funds for up to 50 percent of cost of actual deployments of Smart Grid technology. The Department of Energy (DOE) is required to report within one year on the status of Smart Grid deployments and identify any regulatory or government obstacles.

Additionally, utility executives and regulators have become increasingly concerned about multiple issues that can only be addressed through an enterprise wide Smart Grid solution. The three main concerns are: 1) cost and uncertainty about new generation and transmission; (2) environmental impacts (green house gases [GHGs] emitted from fossil fuel power plants and proposed right-of-ways for transmission lines crossing through pristine forests, deserts and wild life areas to service urban areas); and (3) increasing requirements for the use of renewable and distributed generation (wind, solar, geothermal, hydro, and biomass).

Regulated utilities in California are now responding to regulatory direction to submit plans for large-scale Advanced Metering Infrastructure (AMI) and Smart Grid initiatives with full delineation of costs and benefits. This regulatory initiative is an aggressive step, seeking to promote customer awareness of peak load periods and response to peak-sensitive pricing. The Smart Grid deployments and the associated utility customer features are proceeding throughout the State of California.

## L.2.2 LADWP Initiatives

LADWP has several policies and initiatives which advance Smart Grid goals.

### *Renewable Integration*

LADWP has a comprehensive IRP where new wind, solar, and geothermal power plants will be incorporated into the power generation mix. LADWP is in the process of incorporating six wind power plants and various solar installations into its power generation mix.

LADWP is preparing for this new form of generation by researching and installing various energy storage devices to better supply reliable power to its customers.

### *Transmission Automation Initiative*

For years, LADWP has worked in substations to meter the transmission lines and record Phasor Measurement Units (PMU). These measurements are used to determine the health of the electrical system.

LADWP will install PMUs, and upgrade Tie-Line Meters to improve measurement, provide backup metering at Tie Points, collect dynamic reads, and reroute power.

### *Substation Automation Initiative*

For the past seven years, LADWP has implemented a comprehensive program to install a new Power System Substation Automation System (SAS) from the Energy Control Center to the substations, transmission, and generation stations. At present, 70 of the 200 substations and generation stations have been updated to the new SAS, and a new Supervisory, Control, and Data Acquisition (SCADA) system has been implemented. There are approximately 55 more substation automation equipment in the inventory that will be implemented at the 55 various substations over the next two to three years. Approximately, 840 feeders now have remotely controlled circuit breakers and feeder loading. A significant amount of data from the substations that have been automated are already being processed through the SCADA system and are available to the load dispatchers and other personnel on an as needed basis.

The plan for the next three years will be to automate the remaining 55 stations.

### *Distribution Automation Initiative*

There have been several pilot projects for the Distribution Automation relating to devices outside the substation walls (Current's Broadband over Power Line project, Ricochet Spread Spectrum project, and Telemetric Cellular project).

### *Advanced Metering Infrastructure Initiative*

LADWP has been progressing over the past few years with the AMI Initiative.

- As of 1/01/08, the LADWP has installed 64,181 Automatic Meter Reading (AMR) meters.
  - ▼ Residential Meters (F meters) – 37,800 (using radio frequency (RF) Technology and one way communication providing billing information for walk or drive by meter reading)
  - ▼ Small Commercial Demand Meters (FM meters) – 19,100 (using RF Technology and one way communication providing billing information)
  - ▼ Large Commercial Wireless Meters (A meters) – 7,281 (using Cellular Technology and two way communication providing billing information and load profile information)
- AMR meters represent approximately 5.3 percent of the total meters in the system, but over 35 percent of the power revenue.

Wireless meter reading and real-time pricing are available for 7,281 large commercial customers with demand greater than 200 kilowatts (kW).

LADWP will be replacing in the future all of the power meters with new two-way AMI meters. This will include all industrial, commercial, and residential meters. The installation of these meters will allow for real-time pricing, dynamic reads, remote switching, outage management, integration of customers generation, wireless meter reading, power quality measurements, engineering analysis, load balancing, and demand response.

### *Demand Response Initiative*

This initiative is related to working with our customers to control energy and water usage through a combination of price signals (rates) and control capabilities (appliance and heating, air conditioning and ventilation [HVAC] controls). In addition to customer internet access to consumption usage, the concept of automated control of energy and water devices is new to LADWP.

LADWP has had a DR (Demand Response) rate for years for large industrial users. Currently, there is 30 MW of interruptible load.

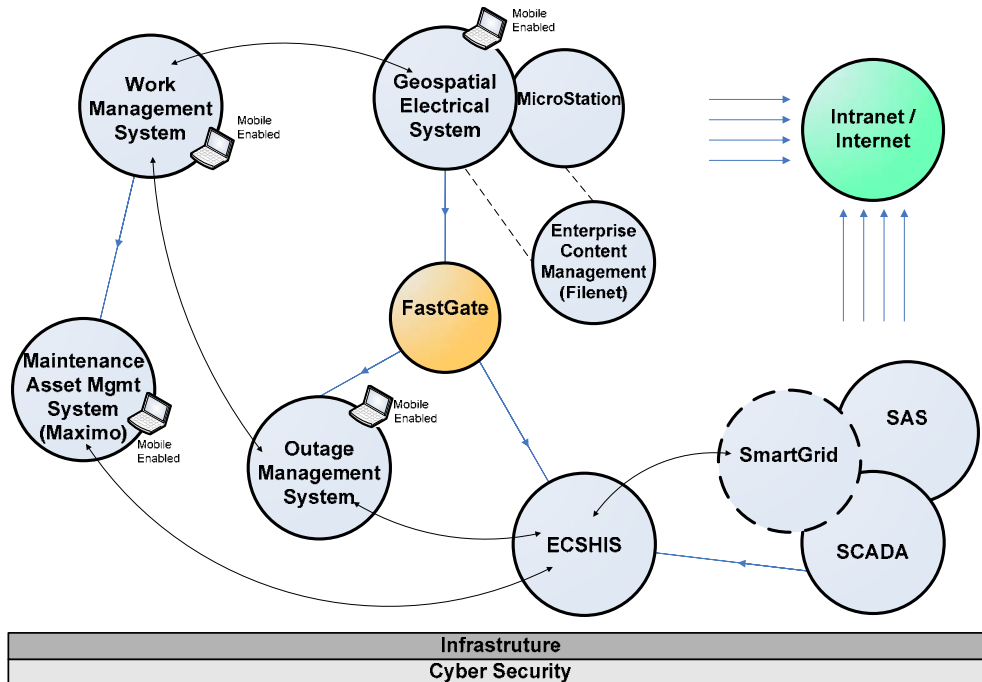
### *Communications Initiative*

The component that pulls all of LADWP's initiatives together is the common communication network. Over the past ten years, hundreds of miles of fiber optic cable have been installed in over 72 substations. The plan is for all substations and major corporate headquarters to have fiber optic connections.

### *System and Data Integration Initiative*

LADWP has made significant progress implementing best of breed systems (see Figure M-1). Some of the systems depicted on the figure include: outage management system, work

management system, asset management system (Maximo), ECS/Historian (OSIsoft), customer information system, Geospatial Electrical System, SCADA, and Java Composite Application Platform Suite (JCAPS). At the same time that these systems are all being integrated, LADWP is also assisting the industry to develop standards and procedures. These systems are the backbone of the business and information processes in the Power System. Additionally, significant integration among these and corporate systems such as customer information system and inventory management systems is in place.



**Figure M-1: Power System Technology Architecture**

### L.3 LADWP Smart Grid Implementation Project

LADWP has a Business Plan which will define the objectives for the Smart Grid Implementation Project. The Project continues LADWP's efforts to implement the technology with the goal of increasing its Power System monitoring, control, and reliability while decreasing operating costs and gaining significant efficiencies. The subsection below describe Smart Grid Implementation Project Phases, related projects, procurement process, schedule and critical milestones and budget.

### L.3.1 Smart Grid Implementation Project Phases

The scope of the Smart Grid Implementation Project includes the following three overlapping phases described below:

#### *Short Term Plan (One Year Horizon)*

This plan includes the following coordinated activities:

- Implementation of high speed data storage systems (Pi/Historian)
- Integration of the planned two way meters to the Pi/Historian other software systems
- Integration of two way meters to the Pi/Historian and other software systems
- Development of an electric model for both 4.8 and 34.5 kV and correction of the customer to transformer connections
- Integration of the Pi Historian to the Outage Management System for the use by Electric Trouble Dispatch (ETD) and Customer Service (CS) representatives

#### *Mid Term Plan (Up To Five Years Horizon)*

This plan includes the following coordinated activities:

- Implement the balance of the substation automation system project to automate all generation, substation, and transmission stations
- Implement a new Customer Information System (CIS) and Supply Chain System

#### *Full Smart Grid Features (up to 10 years)*

This plan implements full citywide implementation of the “Smart Grid”.

The full functionality of the Smart Grid could include all of the following aspects:

1. Outage Notifications
2. Transformer Monitoring
3. Capacitor Controls
4. Line Switch Controls
5. Automatic Meter Reading
6. Load Control of Residential and Commercial Devices (Demand Side Management [DSM] Program)
7. Video Surveillance via Smart Grid
8. Fault Management
9. Transformer Deterioration
10. Transformer Overloading
11. Current Monitoring
12. Cable Management

13. Surge Protection
14. Lighting Control
15. Weather
16. Municipal Applications
17. Other Applications as They Become Available

Other features could include:

- Installation of Smart Grid equipment in the City of Los Angeles (City) Facilities
- Installation of Smart Grid equipment and potential replacement of all of the water meters
- Access to Broadband Services (Internet access, VoIP, video) for City Municipal information
- Access to City Municipal Information via Broadband Connections
- Establishment of an Internal LADWP Organization to Maintain and Operate the Smart Grid Equipment
- Maintenance, Installation, and Operation of the Smart Grid Equipment Through the Following Organization and Service Components:
  1. Services
  2. Customer Response Center
  3. Network Operation Center

### L.3.2 Related Projects

The following projects are related to the Smart Grid as follows:

1. Substation Automation System: Extension and upgrade of the remaining switching, receiving, and distribution systems.
2. Telecommunications System: Extension and upgrade of the telecommunications to support the Power System operations.
3. Subtransmission and Distribution Switches: Automation of subtransmission and distribution switches implementing line monitoring, line switch control, and 4.8 kilovolt (kV) line capacitor bank control.
4. Fault and Outage Detectors: Installation of remotely monitored fault and outage detectors which would provide a means to locate faults and outages on selected 4.8 kV distribution lines.
5. Operating Orders, Procedures and Processes: Reengineering of related operating orders and process as required to reflect monitoring and control changes of the Power System.

L.3.3 Procurement Process

The Smart Grid implementation Project will utilize the procurement process as follows:

1. Determination of requirements
2. Preparation of RFP(s)
3. Vendor(s) Selection
4. Preparation of Agreements
5. Initial Implementation – Phase 1
6. Phase 1 Evaluation
7. Multi-phase Implementation over the next 10 years.

L.3.4 Schedule and Critical Milestones

The timing of LADWP’s Smart Grid Implementation coincides with Smart Grid implementation initiatives by other major U.S. utilities. Additionally, DOE is encouraging utilities to invest in Smart Grid by offering grants and the regulatory environment seems to support Smart Grid as an alternative to the existing utility issues.

The Smart Grid Implementation Project assumes 1-year, 5-year, and 10-year overlapping phases, as shown in Table L-1.

**Table L-1: Schedule Milestones:**

| Milestone or Event                             | Significance                                  |
|--|---|
| Smart Grid Business/Project Plan Presentation  | Get concurrence from Management               |
| Setup of Smart Grid Project Organization       | Establish project organization                |
| Preparation of Smart Grid Project Requirements | Establish project requirements                |
| Advertise Request for Proposals                | Request for Proposals                         |
| Vendors Selection                              | Selection of qualified bidder                 |
| Board Approval                                 | Contract approval by LADWP                    |
| City Council Approval                          | Contract approval by City of Los Angeles      |
| Contracts Award                                | Execution of contract award                   |
| Implementation Phase 1                         | Implement Smart Grid Phase 1 (Pilot Programs) |
| Evaluation of Phase 1                          | To continue Full Implementation               |
| Begin full deployment                          | Implement city wide                           |

L.3.5 Budget

Smart Grid equipment costs are expected to continue to drop due to technology advances and significant market changes. As RFPs are produced and responses are received, LADWP will have a better idea as to the cost of these types of systems and process.

Figure L-2 depicts the estimated cost in millions of six different categories of the Smart Grid.

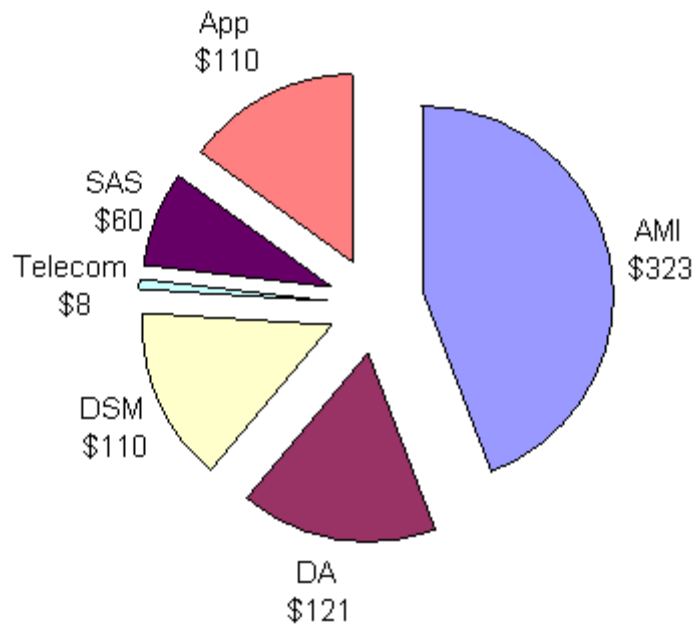


Figure L-2: Estimated Costs

## L.4 LADWP's Smart Grid Demonstration Project

In December of 2009, LADWP was awarded a \$60.2 Million dollar Department of Energy, America Reinvestment and Recovery Act Grant for Smart Grid Demonstrations. As a result of the award, LADWP is managing a consortium of Los Angeles metropolitan area research institutions with established energy and technology transfer programs to jointly carry out the LADWP Smart Grid and Electric Vehicle Demonstration Project. Together, the team is carrying out a regionally unique demonstration, using innovative technology test beds located at LADWP's partners' university campus properties and technology transfer laboratories, to prove out the viability of the demonstration technology. Additionally, behavioral studies, also employing a test bed structure, use a multi-tiered approach to address the diversity of customers at the scale and complexity of operations of the LADWP. The regional demonstration project includes four interrelated project initiatives.

1. A fully integrated demonstration of Smart Grid operation and technology as applied to Demand Response.

2. A comprehensive portfolio of behavioral studies employing a unique test bed structure to identify the behavioral determinants essential for successful adoption of Smart Grid technologies and improved energy usage patterns.
3. Demonstration of next-generation cyber security technologies using the Regional Project as the driving source of specific system architecture and models.
4. The integration of electric vehicles into the LADWP-managed grid, addressing solutions to overcome both technical and social impediments.

The partnership between LADWP, the Jet Propulsion Laboratory (JPL), University of California Los Angeles (UCLA), and the University of Southern California (USC) provides a unique multi-dimensional understanding of smart grid technologies.

## L.5 Impacts

The Smart Grid equipment will impact several areas within LADWP. Table L-2 shows some potential impacts on these organizations:

**Table L-2: Potential Impacts Within LADWP**

| Area within LADWP                       | Nature of Impact  |
|---|---|
| Meter Reading                           | Automated method reading of electric meters   |
| Control System Operations               | May gain capability to control devices at all levels  |
| Customer Service                        | Establish direct communications with customer   |
| Electric Trouble Dispatch               | Will process trouble calls using Smart Grid information   |
| Engineering Design                      | Power network design process (OH/UG)  |
| Distribution Line Crews                 | Maintain and operate new Smart Grid equipment   |
| ITS                                     | Provides support of Smart Grid network equipment  |
| Water Meters                            | Automated method of reading water meters  |
| Energy Control Center                   | Will use SAS for real-time data instead of current RTU  |
| Electric Trouble Center                 | Will use real-time data   |
| Plant Control System Operations         | Will use real-time data access and archived data  |
| Substation Operations                   | Selected station status information will be available   |
| Substation Maintenance                  | Will access intelligent relay settings and logs without having to connect directly to the devices |
| ITS                                     | Provides support of ECS WAN network.  |
| Power Systems Operation and Maintenance | Provides support of SAS application software and hardware   |
| Engineering                             | Will use archived data  |

Table L-3: shows some potential impacts on organizations that are external to LADWP:

**Table L-3: Potential Impacts external to LADWP**

| Area external to LADWP     | Nature of impact   |
|----------------------------|--|
| City of Los Angeles        | Gain broadband infrastructure                            |
| Broad Band Companies       | May perceive competition from LADWP and receive services |
| Gas Utility                | Opportunities to collaborate with LADWP                  |
| State of California (CPUC) | May encourage Smart Grid installation at Los Angeles     |

*Business Model Strategy*

The overall strategy of the Smart Grid implementation project is to purchase, install, own, and operate the Smart Grid equipment. LADWP envisions a vendor will supply the material, and design of the Smart Grid network, and provide technical support for the Smart Grid equipment. LADWP crews would install, maintain, and operate the Smart Grid equipment through the City. LADWP would in fact be the "network operator".

*Safety*

Smart Grid implementation projects require specific installation, maintenance, and operation procedures on which LADWP personnel will need training. The following are potential operational issues: (1) 24/7 operational support of the Smart Grid equipment and the telecommunications and broadband services and (2) training of crews for the operation and maintenance of the Smart Grid equipment. Additionally, the Smart Grid equipment will require compliance and resolution of issues relating to the following state regulations:

1. California Public Utilities Commission - General Order 128 – Construction of underground electric supply and communication systems.
2. California Public Utilities Commission - General Order 95 – Overhead electric line construction.
3. California Public Utilities Commission - General Order 165 – Inspection Cycles for electric distribution facilities.

The Smart Grid vendors and utilities are currently handling all of these issues with success.

*Operational Issues*

LADWP intends to own and operate the Smart Grid equipment. The ownership entails the support and ability to operate the Smart Grid network by LADWP personnel.

The following are potential operational issues:

- 24/7 operational support of the Smart Grid equipment
- Training of Crews for the operation and maintenance of the Smart Grid equipment
- 24/7 operational support of the telecommunications and broadband Services

## L-6 Project Performance Measures

The critical success factors essential for project success are as shown in Table L-4:

**Table L-4: Critical Success Factors**

| <b>Critical Success Factors</b>         | <b>Measurement Method</b>                                       |
|---|---|
| Project Buy-in from LADWP Board         | LADWP Board approval  |
| Project Buy-in from City of Los Angeles | City Council approval   |
| Appropriate project budget              | Budget approval   |
| Smart Grid Technical Feasibility        | Market proven Smart Grid technology                             |
| Secure staffing resources               | Appropriate resource leveling based on project scope            |
| Regulatory Support for Smart Grid       | City, State legislative approvals for Smart Grid implementation |

The project benefits will be measured as shown in Table L-5:

**Table L-5: Project Benefits**

| <b>Potential Benefits</b>                  | <b>Measurement Method</b>                                 |
|--|---|
| Municipal Broadband Capability             | No. of City of Los Angeles broadband users                |
| Smart Grid Enabled Automated Meter Reading | No. of automated meter reads                              |
| Customer Energy Management Programs        | No. of devices under direct load control                  |
| Improved Reliability                       | No. of utility applications in service                    |
| Additional Revenue Sources                 | Ability to capitalize on revenue generating opportunities |

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