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Capital Project Evaluation

PURCHASE NEW METERS AND DISTRIBUTION TRANSFORMERS FOR INVENTORY

Project ID: CSFM99, OVHTR9, TR10MVD

Prepared:
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Purpose

Power Delivery Research & Consulting, Corp. (PDR&C) evaluated the above referenced project to provide an analysis of capital investment decision-making and project execution for Commonwealth Edison Company's (ComEd) management.

Authors

PDR&C consultants assigned to this project were Robert W. Donohue and Ron Williams. Messrs Donohue and Williams have extensive experience in electric utility decision-making and project execution for the wide range of investments made by utilities including projects similar to that discussed in this report. Additionally, as consultants, they have evaluated decision-making and project execution practices at other utilities across the country.

Robert W. Donohue

Mr. Donohue has over 45 years of experience in the electric utility industry. Since 2003, he has provided consulting services, assessments and operational expertise to a variety of utilities across the Country. These services include evaluations of electric distribution systems, including planning, design, construction, maintenance, operation, investment decision-making, and post-event investigations of outage management after significant outage events. Mr. Donohue has served the electric power industry on the Research Advisory Council for the Electric Power Research Institute (EPRI). He was Chair for EPRI's Power Delivery Council, its Distribution Business Council, and is a senior member of the Institute of Electrical and Electronics Engineers. He served as Chairman of EPRI's Power Delivery Reliability Initiative and Vice Chairman of Edison Electric Institute's (EEI) Transmission and Distribution Committee.

Mr. Donohue has held management and senior executive positions for Consolidated Edison Company. Prior to his retirement in early 2003, as Senior Vice President of Electric Operations, Mr. Donohue was responsible for all electric distribution operations, maintenance, engineering, construction, planning, and customer services for Con Edison's territory which serves a population of over 9 million people through nearly 120 thousand miles of underground and overhead line.

Ron Williams

Mr. Williams has over 32 years of experience in the electric utility industry. Since 1998, as Vice President of EXL Consulting, Inc, then as President of PDR&C, Corp., he has consulted

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throughout the United States in the areas of utility reliability, outage management, asset management, and the use of information technologies for electric distribution reliability and efficiency improvement. This includes investigations of investments in distribution infrastructure, practices of distribution operations and maintenance organizations, and evaluations of the performance of utilities during large-scale outage events. Mr. Williams has conducted investigative studies and advised numerous utility clients and served a coalition of thirty utilities as consultant for the Electric Power Research Institute's Power Delivery Reliability Initiative.

Previously, Mr. Williams held various leadership positions at Pacific Gas & Electric Company including Plant Manager of fossil fuel and geothermal power plants, Manager of the San Francisco Division, Manager of PG&E's Electric Distribution Information Technology Program, Manager of Materials and Fleet, Manager of Organization Planning and Development, and Executive in Residence at PG&E's corporate Learning Center.

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Method

Based on their experience and knowledge, PDR&C developed criteria for use during this evaluation. An overall research plan was developed and followed to conduct interviews and reviews of documentation relevant to the evaluation criteria for the project. Management and key technical personnel were interviewed. Documents such as ComEd standards, technical presentations, project authorization overviews, project status reports, and key technical reports were reviewed and, in certain cases, site inspections were conducted. PDR&C consultants then recorded their findings as well as opinions into this report.

Use

This report documents work by the authors who were contracted to provide this report to Commonwealth Edison. The authors' opinions, findings, and conclusions are provided solely for the consideration and use of Commonwealth Edison.

Any statements in this report should not be construed as a Commonwealth Edison position, policy, or decision, unless so designated by other documentation.

The report was based on information available to the authors at the time of publication, and therefore, is subject to change. The use of trade names in this report does not constitute an official endorsement or approval of the use of such commercial products.

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Project Description and Key Dates

Each year, to meet the needs of its customers, ComEd purchases new meters and distribution transformers. These are required to replace failed or obsolete meters and transformers as well as to supply these items to customers for new services or changed services. This report documents the evaluation of ComEd's purchases of meters and distribution transformers for system needs and stores inventory.

- CSFM99 – Purchase of Meters
    - From July 2008 through December 2009, ComEd purchased over 180,000 meters for Blanket Project CSFM99 with unit prices varying from under REDACTED CONFIDENTIAL for each residential watt-hour, non-demand meters to over REDACTED CONFIDENTIAL or each demand meter.[1]
- OVHTR9 – Distribution Transformers – Corrective Maintenance
    - From July 2008 through December 2009, ComEd purchased 9,230 distribution transformers equal to or smaller that 10 MVA for Blanket Project OVHTR9 with unit prices varying from approximately REDACTED CONFIDENTIAL for each 5000/6250 KVA three phase transformer with automatic load tap changers to

[1] 2008 Meter CT's .xls / 2009 Meter Ct's .xls – refer to Tab 1

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REDACTED CONFIDENTIAL approximately for each 1 KVA single phase transformer with no load taps.[2]

- TR10MVD – Distribution Transformers – Spare Transformers greater than 10 MVA (High Voltage Distribution Class)
    - During the reporting period, ComEd purchased 13 transformers for Blanket Project TR10MVD with unit prices varying from under REDACTED CONFIDENTIAL for each 24/32/40 MVA, 132-35.5-13.2 KV three phase, standard sound power transformer, to above REDACTED CONFIDENTIAL for each 36/48/60 MVA, 132-35.5-13.2 KVA three phase, low sound power transformer.[3]

During the period July 2008 through December 2009, ComEd invested approximately $13.8 million and $65.4 million (financial cost) in meters and distribution transformers respectively.[4] Those investments were made throughout the reporting period.

The blanket projects discussed in this report are all of the blanket projects within the top twenty blanket projects in terms of total capital charges during July 2008 through end of year 2009, concerning purchasing meters and distribution transformers for stores inventory.

[2] Cat10_Receipts_08_09_Rev. 1 .xls – refer to Tab 2
[3] Purchase Orders, Invoices, and Payment (PassPort Screenshots) for High Voltage Distribution Transformers purchased from July, 2008 through December, 2009 and 2009 ComEd Transformer Delivery Schedule – refer to Tab 3
[4] Top 20 Blanket Plant Addition ID's Q3 2008 to YE 2009 – refer to Tab 4

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Need

New meters were purchased and utilized to satisfy the needs for new and expanded customer services, regulatory requirements, meter replacements and exchanges.

Distribution transformers were purchased and utilized to maintain safe, reliable service to ComEd customers. They are required to provide the proper utilization voltage for new residential and commercial customers, as well as to meet system reinforcements and additional capacity requirements.

New meters and distribution transformer inventories were required to meet ComEd's electric distribution system operational and technical needs such as replacing failed or obsolete equipment as well as meeting new service requirements on a timely basis.

Meters

Electric meters are required at every service point in the distribution system to accurately register customer usage where service is provided to a customer. Therefore, ComEd must maintain approximately 3.8 million electric meters on its distribution system. A wide variety of meters are in-use to meet the needs of many different classifications of customers served and the numerous tariffs offered by ComEd. Approximately 50% of meter purchases are to meet the needs of new residential customers for watt-hour only metering. The remaining purchases are for the specific needs of various other customers who require demand metering to support

certain tariff requirements such as time of day as well as for replacing obsolete and broken or failed meters.[5]

Distribution Transformers

Distribution transformers serve a number of technical purposes on the distribution system. Primarily the transformers are used to transform voltages from higher voltages to lower voltages. Higher voltages, used to more effectively transmit large power requirements, are transformed to lower voltages, used to distribute power. The power is transformed and distributed from substations over sub transmission voltage primary lines at 12 kV or 34 kV, and then it is transformed and distributed to lower voltage secondary lines at 120/240 volts or 120/208 volts. Then finally, the power is transformed and distributed through service lines to individual customers.

Transformers purchased for Blanket Project OVHTR9 were purchased to meet new or additional service requests, system reinforcement, capacity additions, and replacement needs.

Transformers purchased for Blanket Project TR10MVD were purchased for new station requirements and to ensure adequate stocking levels. Adequate stocking levels ensure the ComEd is ready to respond to potential in-service failures of various size transformers. The ability to quickly respond is necessary to maintain system reliability and return the system to normal operations.

[5] 2008 Meter CT's .xls / 2009 Meter Ct's .xls – refer to Tab 1

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ComEd utilizes a variety of different sizes and configurations of distribution transformers to meet its operational and customer requirements. They may be single or three phase units with various kilovolt-ampere ratings, insulation levels, bushing and terminal requirements, and weight limitations. They may require special accessories such as tap changers and pressure relief valves. They may be installed on poles, pads, or in substations.

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Alternatives

Meters and transformers are critical components of ComEd's electric distribution system. They are essential components of the electric distribution system and ComEd has no reasonable alternative but to purchase meters and transformers to meet system operational, technical and customer needs. However, there are alternatives to the manner in which meters and transformers are purchased and supplied.

The basic supply chain begins with an engineering design of the distribution system. The design will call for certain components with specific characteristics to ensure compatibility with other components to create a highly reliable, well-coordinated system. Those specific requirements and characteristics are delineated in a document called a material or technical specification. [6, 7]

Manufacturers, whose production capabilities meet those specifications, are invited to submit competitive bids to meet the supply needs and provide the specified components to the utility.[8] Utility engineers and procurement analysts evaluate bid responses on various criteria such as production capabilities, quality programs, financial stability, and past performance.[9] Manufacturers are added to the list of qualified bidders based on the outcome of the evaluation.

[6] Example: Distribution Dry Type Transformers Single and Three Phase – refer to Tab 5
[7] Example: Meter Department Guide No. MDG-34 Specification for Electric Revenue Meter – refer to Tab 6
[8] Example: Exelon Request for Proposals (Event 2142 and Event 2662) – refer to Tab 7
[9] Example: Exelon Meter Blanket (response matrix) – refer to Tab 8

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Meters and Distribution Transformers are considered strategic commodities because of the critical functions they provide in the distribution system and because of the high supply costs.

Suppliers of strategic commodities are important business partners and critical for ComEd's success to manage effectively. Since relationship management is important, contracts to supply strategic commodities are:

- Put out to bid infrequently
- Awarded to one or a limited number of suppliers
- Are generally longer term contracts

Successful bidders are awarded contracts and purchase orders are issued to meet the systems operational and customer requirements.[10]

Procurement controls are established to ensure prudent accountability.[11] Inventory levels are established to meet routine and emergency needs.

Each step in the supply chain represents a series of choices by the utility, which will directly affect supply cost, material availability, operational reliability, responsiveness to customers, and life cycle costs of components purchased. ComEd assures those choices align with its financial and service objectives through the use of detailed

[10] Example: Purchase Order 01065963 to Howard Industries – refer to Tab 9
[11] Example: Authorization to Contract with Suppliers, SM-AC-4013 Revision 7 – refer to Tab 10

material specifications, clear assignment of duties, and explicit supply chain management processes.

The following statements from a ComEd transformer supply contract provide an example of ComEd's intent to effectively minimize the costs of materials for its customers:[12]

- "Contractor agrees that in the event that, prior to the delivery of any particular item of Material hereunder, it offers or charges prices to any other customer for such item of Material that are less than the prices charged to Exelon under this Agreement (in each case, after taking into consideration all discounts, allowances, rebates and other types of price and fee reduction mechanisms), the prices charged under this Agreement for such item of Material shall be deemed automatically revised to equal such lower prices and that in the event that Exelon shall be entitled to such lower prices but shall have made payment at any prices in excess thereof, Contractor shall promptly refund the difference in price to Exelon."

- "If, during the term of the Agreement, Exelon receives a bona fide offer from a third party to provide the Material (or any portion thereof) or the Services at prices that are less than the prices charged to Exelon under the Agreement, the parties agree to meet to negotiate in good faith an adjustment to the prices charged to Exelon under the Agreement; provided, however, that if Contractor does not agree to reduce its prices to a level at or below the prices offered by such third party,

[12] Services and Materials Agreement – Central Moloney, Incorporated Dated January 30, 2009 – refer to Tab 11

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> Exelon may thereafter terminate the agreement upon five-days' written notice to Contractor."

This type of non-ambiguous contract language provides ComEd and their supplier with clear direction and specific performance goals.

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Reports and Other Documentation

Material Specifications

Electric distribution system engineers prepare material specifications for meters and distribution transformers. This ensures that the materials purchased meet the ComEd distribution system technical requirements and conform to the latest standards approved by the Institute of Electrical and Electronics Engineers (IEEE). Conformance to IEEE standards is good utility practice and assures that ComEd materials are consistent with other utilities. The IEEE standards apply the latest consensus of professional engineers regarding designs, materials, and construction used in electric distribution systems. Assuring conformance, results in improved standardization across the utility industry, which also helps to drive down manufacturing and other costs. Another benefit is that in times of extremely high demand such as during recovery from storms or natural disasters, increased standardization will result in a higher probability that equipment from another utility will be compatible with ComEd's equipment. This will enable equipment to be transferred from other utilities as a way of increasing delivery speed and therefore service restoration.

ComEd's material specifications include clear descriptions of the types of materials it purchases. For example, the material specification for conventional single and three phase distribution transformers includes specific materials and make-up as well as testing, packaging, and inspection requirements. Additionally, the specification includes general provisions such as specifying that the contractor shall be liable for all costs incurred for product that is refused or rejected as a result of its failure to pass certain testing

procedures.[13] Requirements unique to the ComEd electrical distribution system such as insulation levels are designated in the design purchase specifications.

Assignment of Duties

Material procurement is a transactional process involving many individuals, real property, and capital. Appropriately, ComEd has established a segregation of duties for critical steps in the process requiring that:[14]

- "Employees can not have the following conflicting authorizations:
    - Add/change vendor master file and perform receiving
    - Add/change vendor master file and approve purchase orders or contracts
    - Add/Change vendor master file and approve vouchers
    - Add/Change vendor master file and approve invoices
    - Approve a Requisition and approve a Contract for the same transaction
    - Add/Change Purchase Order and perform receiving from the same purchase order

[13] Procedure EM13031, Single and Three Phase Distribution Transformers Conventional Type, Dated 05-01-08 – refer to Tab 12
[14] Procedure SM-AC-4014 Rev. 2, Segregation of Duties – refer to Tab 13

- Add/Change Purchase Order / Contract and approve invoices for the same purchase order / contract

- Add/Change Purchase Order / Contract and approve vouchers for the same purchase order / contract

- Add/Change Contract and approve contract payment authorizations (CPS) for the same contract"

These key safeguards and controls are reinforced through security contained in ComEd's work management system (PassPort). That system will only allow issuance of procurement related documents such as contracts and invoices in accordance with ComEd's segregation of duties policy.

Supply Chain Process

ComEd required prospective suppliers to competitively bid for its procurement contracts. Since Meters and Distribution Transformers are strategic commodities, ComEd designated a strategic buyer (Category Manager) to implement its Materials Procurement Procedure, which included development and issuance of the Request for Proposal (RFP).[15]

RFP's are universally used in the industry for this type of procurement activity and the contents of ComEd's RFP for transformers for example, are consistent with good utility industry practices. It provides prospective bidders information on the basic and specific requirements of the types of transformers ComEd intends to purchase as well as commercial terms and conditions.

[15] Procedure SM-AC-401 Rev. 6, Materials Procurement Procedure – refer to Tab 14

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ComEd received bids from multiple suppliers in response to the RFP previously discussed and evaluated those bids through a qualitative and quantitative valuation process prior to selecting their preferred suppliers.[16, 17]

The provisions in the RFP that required continuous improvement, of costs at all points of the supply chain including manufacturing, freight, material handling, inventory, administrative, as well as other life-cycle costs through simplification and standardization. Those improvements, ultimately, will benefit customers.

Waukesha Electric Systems, Delta-Star, GE-Prolec, Pennsylvania Transformer, ABB Power T&D, Howard Industries, Central Moloney, and Carte, are ComEd's primary suppliers of distribution transformers.

Inventory

ComEd establishes its inventory levels through use of its "Inventory Optimization Guide."[18] The guide provides a detailed process for use in establishing inventory minimums and maximums as well as emergency reserves for critical components. The guide directs supply managers to "make stock level decisions based on methodology, independent of existing inventory levels. Stocking decisions must be driven by item criticality and demand." That guidance compares favorably with standard practices in the utility industry and assures ComEd that its investment in inventory is

[16] Distribution Transformers Business Plan (Abridged), February 5, 2009 – refer to Tab 15
[17] Distribution Transformer Sourcing Update, January 22, 2009 – Global Power Transformer RFP Project Status August 20, 2009 – Samples: supplier response matrix and bid summary – refer to Tab 16
[18] Procedure SM-AC-4006 Rev. 5, Inventory Optimization Guide – refer to Tab 17

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driven by current intelligence of operational and customer demand for materials in inventory.

ComEd management closely monitors its Meter and Transformer inventories. Each year inventory targets are set based on actual work that is planned and other stocking considerations. Budgets are set on the basis of anticipated workload and those budgets are also closely monitored.

Electric utility distribution infrastructure requires ongoing corrective actions including replacing infrastructure components such as distribution transformers to ensure the safety and reliability of the distribution system. Consistent with good utility practice, ComEd minimizes the need for emergency replacement, and therefore minimized the inventory of spare transformers by employing maintenance programs intended to optimize the service life of transformers and prevent in-service failures.

ComEd employs performance-centered, preventive and predictive maintenance programs to ensure safe and reliable operation of electric infrastructure components. Those programs are developed using information from manufacturers, industry associations, ComEd testing and observations.[19]

In addition ComEd also performs an analysis of risk[20] and uses component failure history to identify optimum maintenance intervals and scope.[21] Com Ed has moved forward in adopting a formal

[19] Transformer Maintenance Template, AM-CE-P034-R1019 – refer to Tab 18
[20] Material Condition & Risk, October 10, 2008 – refer to Tab 19
[21] Example: ComEd Power Transformers (>10MVA) Failure History By Year – Totals, and ComEd Power Transformers (>10MVA) Comparison of Transformers Proactively Taken Out of Service vs. Reactively Tripped Out of Service – refer to Tab 20

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program and process that incorporates material condition and risk assessment in it approach versus the more traditional asset management previously used at ComEd and other utilities. One of the objectives of the material condition improvement program is to understand the material condition of the delivery system assets, future replacement rate and cash flow requirements.[22]

The Material Condition and Risk Assessment Process is a multi-level evaluation that considers the Operational and Financial implications of ComEd's assets. This will result in better asset knowledge, longer term investment planning, targeted and more reachable performance goals and a documented and defendable asset sustainment plan. On the financial side it benefits will be better scenario planning decisions with greater transparency, more planned cost and less reactive costs being spent as well as more defensible rate case submissions.[23]

This effort has been adopted by Reliability Engineering who in conjunction with the Planning Department[24] developed and recommended to senior management ComEd's System Performance Program including identification of critical spares[25] and power transformer stocking levels.[26, 27]

A critical part of ComEd's programs is the process for ensuring that results are analyzed and used to drive repair and/or replacement action. That process is discussed in some detail in this report.

[22] Material Condition & Risk, October 10, 2008 – refer to Tab 19
[23] Material Condition & Risk, October 10, 2008 – refer to Tab 19
[24] Interview with Bill Fluhler, March 16,2010
[25] Procedure AM-ED-4002, Critical Spares – refer to Tab 21
[26] DRAFT Risk Scoring – Emergency Spare Transformers 5/6/2008 – refer to Tab 22
[27] Transmission and Substation Engineering Management Review Meeting, February 2010 – refer to Tab 23

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ComEd has taken proactive and effective steps to reduce customer interruptions and to reduce expenditures caused by in-service failures on the ComEd electric distribution system.

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Conclusions

Each year, ComEd purchases new meters and transformers to replace failed or obsolete meters and transformers as well as to meet the needs of its customers for new services or changed services.

A wide variety of meters are in-use to meet the many different classifications of customers served and the many different tariffs offered by ComEd.

ComEd utilizes numerous sizes and configurations of distribution transformers to meet its operational, technical and customer requirements.

PDR&C conducted an independent evaluation of this project and reached the following conclusions:

- ComEd has no reasonable alternative but to purchase meters and distribution transformers to continue to ensure accurate measurement of energy consumption, and optimum transformation of power to meet system operational, technical and customer needs.

- Procurement controls are established to ensure prudent accountability.

- Engineering specifications are thorough and accountability is focused.

- Suppliers are chosen on the basis of their responses to comprehensive request for bids.

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- Inventory levels are established to meet routine and emergency needs.

- Maintenance programs are implemented to optimize life-cycle costs and avoid in-service failures.

- ComEd's engineering specifications, procurement practices, maintenance practices, and supply chain management, ensured that the capitalized costs of meters and distribution transformers were necessary, incurred consistent with good utility practice, and of an amount that would be reasonably expected given the size and capacity requirements of its distribution system.