BEFORE
THE PUBLIC UTILITIES COMMISSION OF OHIO

In the Matter of the Application of The Dayton Power and Light Company to Supplement its Energy Efficiency and Peak Demand Reduction Program Portfolio with Additional Program	)))))	Case No. 11-6010-EL-POR

APPLICATION OF THE DAYTON POWER & LIGHT COMPANY TO SUPPLEMENT ITS ENERGY EFFICIENCY AND PEAK DEMAND REDUCTION PROGRAM PORTFOLIO WITH ADDITIONAL PROGRAM

The Dayton Power and Light Company ("DP&L" or "Company") respectfully requests approval of its distribution 4 Kilovolt to 12 Kilovolt conversion project ("Project" or "Conversion Project") shown in Appendix A, as a supplement to DP&L's energy efficiency and peak demand reduction program portfolio. DP&L seeks only the Commission's authority to count the results of the Conversion Project as part of its existing program portfolio plan, which will remain otherwise unchanged, for the purposes of complying with the energy efficiency and peak demand reduction benchmarks as set forth in Section 4928.66(A)(1)(a) of the Ohio Revised Code ("O.R.C"). DP&L is not seeking authority at this time to recover the cost of the Conversion Project in this filing. DP&L plans to make a separate filing at a later time and will seek recovery of the costs of the Conversion project in that separate filing. In support of this Application, DP&L states as follows:

1. Applicant the Dayton Power and Light Company is a public utility and electric light company as defined by O.R.C. §4905.02 and §4905.03(A)(4), and an electric distribution utility as defined by O.R.C. §4928.01(A)(6) and is subject to the jurisdiction of the Public Utilities Commission of Ohio ("PUCO" or "Commission").
2. O.R.C §4928.66(A)(1)(a) requires an EDU, starting in 2009, to "implement energy efficiency programs that achieve energy savings equivalent to at least three-tenths of one per cent of the

total, annual average, and normalized kilowatt-hour sales of the electric distribution utility during the preceding three calendar years to customers in this state. The savings requirement, using such a three-year average, shall increase to an additional five-tenths of one per cent in 2010, seven-tenths of one per cent in 2011, eight-tenths of one per cent in 2012, nine-tenths of one per cent in 2013, one per cent from 2014 to 2018, and two per cent each year thereafter, achieving a cumulative, annual energy savings in excess of twenty-two per cent by the end of 2025."

3. O.R.C §4928.66(A)(1)(b) requires an EDU, starting in 2009, to "implement peak demand reduction programs designed to achieve a one per cent reduction in peak demand in 2009 and an additional seventy-five hundredths of one per cent reduction each year through 2018."

4. O.R.C §4928.66(A)(2)(d) permits a utility to include, for purposes of compliance with the energy efficiency and peak demand reduction benchmarks, "transmission and distribution infrastructure improvements that reduce line losses."

5. DP&L's portfolio plan has been approved in *In the Matter of the Application of The Dayton Power and Light Company for Approval of Its Electric Security Plan*, Case No. 08-1094-EL-SSO ("ESP filing") and as supplemented by the Stipulation and Recommendation filed and approved without modification by Commission Order dated April 27, 2011 in *In the matter of the Application of the Dayton Power and Light Company for a finding that DP&L has Satisfied Program Portfolio Filing Requirements*, Case No. 09-1986-EL-POR.

6. DP&L does not propose in this application to modify any of its existing energy efficiency and peak demand reduction programs. Indeed the feedback on its existing program portfolio plan which DP&L has received from members of DP&L's Energy Efficiency Collaborative has been positive. DP&L presented information on this Conversion Project to Energy Efficiency Collaborative members on August 31, 2010. By way of this Application DP&L seeks approval to supplement its program portfolio with the Conversion Project only to incorporate the results

of the Conversion Project into DP&L's program portfolio for purposes of counting against DP&L's statutory benchmarks. This Project is a distribution infrastructure improvement that reduces line losses and as such is permitted to count towards DP&L's benchmarks pursuant to O.R.C §4928.66(A)(2)(d).

7. The Conversion Project provides very real energy efficiency and peak demand reduction results. As noted above, DP&L is not seeking cost recovery for this project in this filing, but instead intends to file a separate application at a later point to propose a recovery mechanism.

8. This Project consists of the conversion of approximately 205 miles of 4 kV distribution system to 12 kV. Line losses are primarily a result of heat losses due to the electricity flowing through the wires and system equipment. The line losses in the facilities to be replaced will be reduced to approximately 1/9 of the current losses experienced. Once completed, such conversion is estimated to result in an estimated on-peak power loss reduction of 16.8 MW and annual energy savings of approximately 58,900 MWh. The voltage conversion, which started in August 2009 and is expected to be completed in September 2014, will involve the replacement of poles which are at the end of their useful life or unsuitable for the clearances required for operating at a higher voltage, as well as the replacement of insulators, cutouts, cross arms, arrestors, transformers (which are not already dual 4 kV/12 kV winding), and other associated hardware.

9. Upgrading the 4 kV distribution system to the 12 kV will have a positive impact on DP&L's distribution and transmission system. The reduction in line losses mentioned above will release the capacity on conductors, transformers, circuit breakers and other devices. The conversion will result in the increased capacity of the power lines as well as increased power flow throughout the system while providing a more efficient delivery of power to DP&L customers.

10. For compliance purposes, DP&L is anticipating counting the savings resulting from the line loss reductions after the physical work is complete and after the evaluation and verification analysis has been conducted. The evaluation and measurement of the savings will be derived by

DP&L's independent evaluator, The Cadmus Group, by developing pre-conversion and post-conversion models of the impacted distribution systems. In addition, The Cadmus Group has calculated a Total Resource Cost ("TRC") test score of 2.54 for the Project. See Appendix B for a more detailed description of the Cadmus's evaluation plan.

WHEREFORE, for the foregoing reasons, DP&L respectfully requests this application be approved.

Respectfully submitted,

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APPENDIX A

TRANSMISSION AND DISTRIBUTION ENERGY EFFICIENCY PROJECTS

Project Name
4 Kilovolt (kV) to 12 Kilovolt Conversion Project

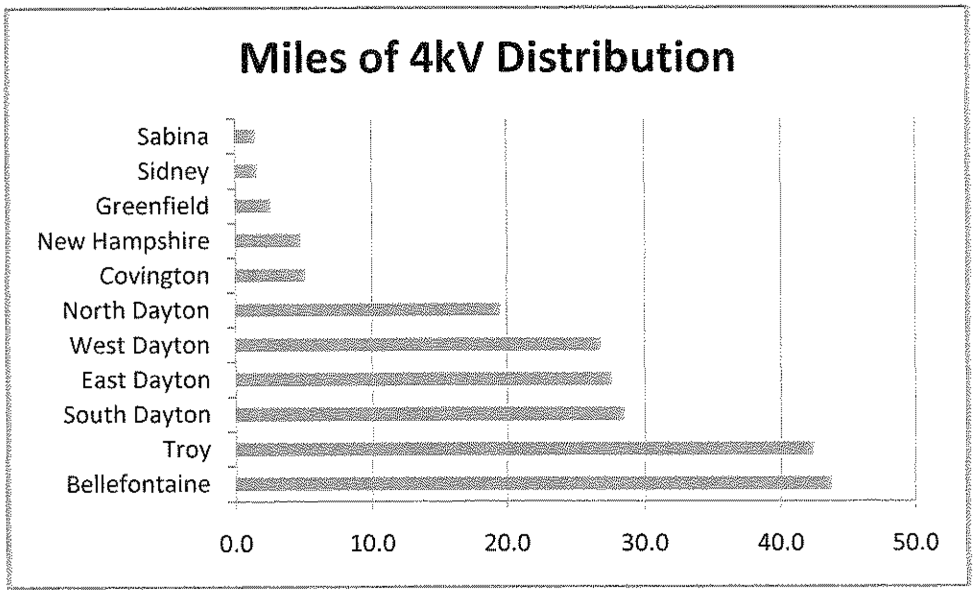
Program Objective
The program objective is to convert approximately 205 miles of 4 kV distribution system to 12 kV, thereby reducing the associated peak power losses and energy losses due to load. Power losses on a 4 kV system are nine times higher than on a 12 kV system to serve an equivalent load. The upgrade is expected to result in an estimated on-peak power loss reduction of 16.8 MW and annual energy savings of approximately 58.9 GWh.

Project Start and Completion Date
Project Start Date: August 2009
Project Completion Date: September 2014

Cumulative	2009-10 Actual	2011 Projected	2012 Projected	2013 Projected	2014 Projected
Miles completed	35.9	53.3	139.1	190.0	205.0
Poles replaced	302	624	1,632	2,232	2,400
Transformers replaced	373	463	1,210	1,655	1,780
No. Customers	5,885	8,753	22,826	31,186	33,652
% Complete	17%	26%	68%	93%	100%

Project Description
The 4 kV to 12 kV project will convert approximately 205 miles of the existing 4 kV distribution system to 12 kV. This will involve replacing poles which are at the end of their useful life or unsuitable for the clearances required for operating at a higher voltage, replacing insulators, cutouts, cross arms, arrestors, transformers (which are not already dual 4 kV/12 kV winding), and other associated hardware. During the replacement process, hardware found to be in need of replacement, including cross arms, braces and arrestors, is being replaced as well. Many of the transformers, which have been purchased over the years for the 4 kV systems, are already dual 4 kV/12 kV winding in anticipation of accommodating a potential conversion to 12 kV.

The following bar chart displays the number of miles of converted line, broken down by community.



Project Justification as an Allowable Efficiency Activity

In the discussion of Ohio's energy efficiency and demand benchmarks, Ohio Revised Code Section 4928.66(A)(2)(d) provides, in part, "Programs implemented by a utility may include demand-response programs, customer-sited programs, and **transmission and distribution infrastructure improvements that reduce line losses.**"

The 4 kV to 12 kV conversion is a distribution infrastructure improvement project that reduces line losses, and as such satisfies this statutory provision.

T&D System Impact

The 4 kV to 12 kV conversion program increases capacity of the power lines in the DP&L territory. These increases to capacity allow more power to flow throughout the system, thereby increasing DP&L's ability to meet customer demand. The conversion replaces a 4 kV distribution system to provide a more efficient delivery of power to DP&L customers.

Power losses on a 4 kV system are nine times higher than on a 12 kV system to serve an equivalent load. This relationship can be demonstrated with the following formulas:

$$\text{Power (in VA)} = V \times I$$

and

$$\text{Line Losses (in Watts)} = I^2 \times R$$

Where: I = current (amperes)
R = resistance (ohms)
V = voltage

Therefore, by keeping power constant and upgrading the existing 4 kV distribution system to 12 kV, the line current is reduced by 1/3 and associated peak power losses and total energy losses can be reduced to 1/9.

A more detailed analysis of the reduction in line loss due to an increase in voltage can be found in the evaluation plan developed by The Cadmus Group, attached as Appendix B.

T&D System Reinforcement (if any)

The reduction of line loss on the distribution system has a positive impact on the distribution and transmission system. First, a reduction in line loss releases capacity on conductors, transformers, circuit breakers and other devices that are a part of the distribution system. Additional reliability benefits will be realized by pole, transformer, insulator and hardware replacements, and standardizing to the rest of DP&L's 12 kV distribution system.

T&D Reliability, Market and System Losses Enhancement

The 4 kV to 12 kV conversion will result in a strengthened distribution system. As part of the conversion, approximately 2,400 poles and 1,780 transformers are being replaced.

T&D Energy & Demand Baselines and Expected Savings

An initial estimate of the energy and demand savings for the 4 kV to 12 kV conversion were calculated in the following manner:

1. Extracting the miles of 4 kV circuit single- and three-phase from the mapping system.
2. Determining the distribution of wire type on the system (#6 Cu, #4 Cu, #2 Cu, 2/0 Cu, 4/0 Cu, 1/0 AAAC and 4/0 ACSR).
3. Calculating the 4 kV and 12 kV losses. DP&L does not have distribution modeling software, so reasonable assumptions had to be made, including:
    - The 3 phase line has 1 MW on peak and the single phase line has 0.5 MW on peak.
    - 0.4 load loss factor.

The initial savings estimates from 2009-2010 and projections for 2011- 2014 are presented below.

	2009-10		2011		2012		2013		2014	
	Energy (MWh)	Demand (MW)	Energy (MWh)	Demand (MW)	Energy (MWh)	Demand (MW)	Energy (MWh)	Demand (MW)	Energy (MWh)	Demand (MW)
Baseline	11,587	3.3	17,231	4.9	44,935	12.8	61,391	17.5	66,247	18.9
Expected	1,287	0.4	1,915	0.6	4,993	1.4	6,821	1.9	7,361	2.1
Savings	**10,299**	**2.9**	**15,316**	**4.3**	**39,942**	**11.4**	**54,570**	**15.6**	**58,886**	**16.8**

It should be noted that the savings values above are initial estimates only. DP&L will not be "counting" these estimates toward its energy efficiency benchmarks. Instead, a more detailed savings analysis will be conducted through the evaluation and verification process as presented in Appendix B. Once this evaluation is completed, DP&L will claim the savings values, as determined by the evaluation, toward its energy efficiency benchmarks.

Economic Benefit from the Energy and Demand Savings

The Cadmus Group, the independent evaluator contracted by DP&L, calculated a Total Resource Cost test score of 2.54 for the project. The TRC test is a valuation of the project's total resource benefits (measured by the electric avoided costs) compared to the total costs of acquiring the savings.

Benefits counted in the TRC include the full value of time and seasonally differentiated generation, transmission and distribution, and capacity costs. Cadmus utilized the estimated energy and demand savings in the previous tables to calculate the benefits utilized in the TRC. A measure life of 30 years was also assumed. Capital costs of the project were provided by DP&L.

Project Budget

DP&L is not requesting recovery of the costs of this project through the energy efficiency rider. The total capital cost of the project is estimated at $19,663,000.

Evaluations, Measurement and Verification Plan

The Cadmus Group, DP&L's independent evaluator, has developed an evaluations plan for the project. It is attached as Appendix B.

Ongoing Reporting

DP&L will report on project progress and savings through the annual Energy Efficiency and Demand Reduction/Response Portfolio Status Report.

DP&L will claim savings from the 4 kV to 12 kV conversion after the physical work is complete and after the evaluation and verification analysis has been conducted. For instance, 2009 through 2011 savings will be claimed once the 2012 evaluation analysis is finalized. In this example, the 2009 through 2011 conversion savings will be reported and claimed on DP&L's 2012 Energy Efficiency and Demand Reduction/Response Portfolio Status Report filed in 2013. An update will be provided in each successive Status Report for work completed the previous year.

Appendix B – Evaluation Plan

THE CADMUS GROUP, INC.

Distribution Voltage Conversion Project

December 2011

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Introduction

The plan outlined in this report specifies Cadmus' evaluation methodology for the Dayton Power and Light (DP&L) 4 kilovolt (kV) to 12 kV conversion project. As with the evaluation of any complex project such as this, the evaluation plan may need to be adjusted as we progress through the evaluation due to issues such as data availability and the viability of our initial metering strategy. As any major adjustments to the plan are made, Cadmus and DP&L will inform the statewide evaluator.

Program Overview

DP&L's conversion project will convert approximately 205 miles of the existing 4 kV distribution system to a 12 kV system. Described more fully in the Program Evaluation Logic section, the conversion will result in reduced system line losses, which will translate into energy savings on the DP&L distribution system.

As many components of the distribution system are upgraded, the conversion project will likely lead to improvements in reliability as well as energy savings. The conversion will include replacing poles that are at the end of their useful life or unsuitable for the clearances required for operating at a higher voltage. It will also replace some hardware such as insulators, cutouts, cross arms, braces, arrestors, and transformers (those which are not already dual 4 kV/12 kV windings[1]).

The voltage conversion project began in 2009 and will be complete in 2014. Table 1 details the current and forecasted progress of the project.

Table 1. Project Summary

Cumulative	2009-10 Actual	2011 Actual	2012 Projected	2013 Projected	2014 Projected
Miles completed	35.9	53.3	139.1	190.0	205.0
Poles replaced	302	624	1,632	2,232	2,400
Transformers replaced	373	463	1,210	1,655	1,780
No. customers	5,885	8,753	22,826	31,186	33,652
% complete	17%	26%	68%	93%	100%

In the discussion of Ohio's energy-efficiency and demand benchmarks, Ohio Revised Code Section 4928.66(A)(2)(d) provides in part, "*Programs implemented by a utility may include demand-response programs, customer-sited programs, and* ***transmission and distribution infrastructure improvements that reduce line losses.***"

The 4 kV to 12 kV conversion is a distribution infrastructure improvement project that reduces line losses, and as such satisfies this statutory provision.

Program Evaluation Logic

Converting the 4kV distribution system to a 12kV distribution system will increase the operating voltage of the system. Because the customer-facing electric distribution system will remain the

[1] Many of the system transformers have dual 4 kV/12 kV windings and will not require replacement.

same, the power of the system, typically referred to as demand, will remain the same. Per Ohm's law:

$$\text{Power} = V \times I$$

Where:

V	=	voltage (volts)
I	=	current (amperes)

Therefore, if the power remains constant and voltage is increased by a factor of three, current will decrease by a factor of three.

Electrical or technical line losses[2] are primarily a result of heat losses due to electricity flowing through the wires and system equipment. Line losses can be calculated using the following equation.

$$\text{Line Loss (in Watts)} = I^2 \times R$$

Where:

R	=	resistance of the cable or wire (ohms)

Where resistance and power is unchanged, the line losses on the system will be reduced by the square of the reduction in amperage. Thus, for a factor of three increase in voltage, the line losses will be reduced by a factor of nine.

This is more readily shown by rearranging the above equations to the following equation:

$$\text{Line Loss} = (\text{Power}/V)^2 \times R$$

Plugging in a one for Power and R since they remain constant and a three for the three factor increase in voltage results in:

$$\text{Line Loss} = (1/3)^2 \times 1$$

$$\text{Line loss} = 1/9$$

Some conductors will likely be replaced with slightly lower resistance conductors, leading to additional savings. However, the impacts of those changes will be minor compared to the effects of lowering the system amperage. Where replacement cable data is available, Cadmus will account for changes in system resistance.

Cadmus will derive the actual project savings using actual demand, voltage, amperage, and resistance values.

[2] Other types of line losses include unmetered accounts and theft.

Evaluation Methods

In order to validate the voltage conversion savings, Cadmus will use the approaches described in the subsections below.

Engineering Model

Cadmus will develop pre-conversion and post-conversion models of the impacted distribution systems. An impacted circuit either has had or will have customers added or removed due to the conversion process. The pre-conversion model will include a sample of impacted circuits in the pre-conversion 4 kV state. The post-conversion model will include the sample of impacted circuits in their post-conversion 12 kV state.

As the voltage conversion implementation entails not only a change in system voltage, but also a change in the actual circuit paths, the pre and post models will not be identical. The 12 kV conversion process will involve transferring those customers on 4 kV circuits to existing 12 kV circuits. Thus, a number of 12 kV circuits will gain customers, while the 4 kV circuits will lose customers and be taken out of service. The 12 kV circuits will be comprised of impacted and non-impacted customers. The model will identify line loss savings for the impacted customers by comparing the total line loss differences between each model.

The models will be comprised of the following variables:

- Customer count and circuit configuration of each impacted circuit for each phase of the voltage conversion.
- Data describing each transformer on each impacted circuit.
- The length, type, and arrangement[3] of the conductor for each impacted circuit.
- Hourly substation level demand, amperage, voltage and VAR of impacted circuits.

Additionally, the model will require voltage conversion dates for each segment of the conversion.

Distribution Line Metering

Cadmus will study the distribution system layout to identify key places on the system which, if metered, would provide valuable insight input to refine the engineering model. Ideal places for this would likely be conductors that will remain the same with the customers and conductors down line after being converted to 12 kV.

By strategically metering impacted circuits and combining that data with substation metered demand, amperage, voltage, and VAR, Cadmus will be able to evaluate the impacts of the voltage conversion at a more granular level. We could then extrapolate the findings of the strategic sample to the entire impacted distribution system. The associated model will be comprised of the following variables:

- Hourly line metering data for strategic locations.
- Data describing each transformer on each impacted circuit.

[3] Arrangement refers to circuit configuration wye, delta, single phase, poly phase, etc.

- The length, type, and arrangement of conductors per impacted circuit.
- The hourly substation level demand, amperage, voltage, and VAR of impacted circuits.

Evaluation Objectives

The evaluation goal is to provide estimates of the voltage conversion's energy savings and economic impact. The objectives for this include the following:

- Identify and document the pre- and post-configurations.
- Develop data structures for recording and transferring key program data.
- Format data for evaluation.
- Develop and evaluate engineering models.
- Develop a line metering strategy and evaluate results.
- Synthesize the results of the various evaluation methods.
- Develop per unit savings values.
- Determine the economic value of energy savings.

Overall Approach to Evaluation Plan

Cadmus' evaluation will include the following:

- **Identify and document the pre- and post-configurations.** Cadmus will identify circuits that are impacted by the voltage conversion. Next, we will clearly identify the pre- and post-circuit configurations by developing per-transformer and customer models for a sample of impacted circuits. The pre- and post-configurations will serve as a guide for future evaluation activities.
- **Develop data structures for recording and transferring key program data.** Cadmus will work with DP&L to identify the exact data requirements and develop a strategy for program data transfer to Cadmus for evaluation.
- **Format data for evaluation.** Cadmus will convert the data we receive from DP&L into a format that will enable evaluation.
- **Develop and evaluate engineering models.** Cadmus will develop engineering models that specify circuit configurations, evaluation formulas, and line losses for both the pre- and post-voltage conversion systems.
- **Develop a line metering strategy and evaluate results.** Cadmus will work with DP&L to identify a line metering strategy. We will then evaluate the collected data to quantify line loss estimates.
- **Synthesize the results of the various evaluation methods.** Cadmus will synthesize results from the two evaluation methods to develop a final estimate of the voltage conversion energy savings.

- **Develop per unit savings values.** Cadmus will derive per unit savings estimates to apply to future work. The unit basis will depend on the results of the engineering and line metering evaluations, but will likely be some combination of length of line, number of customers, and number of transformers.
- **Determine the economic value of energy savings.** Cadmus will calculate the economic benefit of the energy savings and the total resource cost value.
- **Update annual savings and economic value estimates.** Cadmus will update program savings by applying per unit savings values to actual conversion construction results.

Summary of Evaluation Tasks

A summary of tasks is provided in Table 2.

Table 2. Summary of Evaluation Tasks

Evaluation Task	Details
Task 1. Specify Pre- and Post-Configurations	Develop clear definitions of the program
Task 2. Develop Data Structures	Determine data obtainment and transfer mechanisms
Task 3. Format Data	Transform raw data into an evaluable form
Task 4. Engineering Models	Develop models of circuit characteristics
Task 5. Line Metering	Develop empirical data collection methodology and evaluate the results
Task 6 Synthesize Results	Synthesize the results of each evaluation method
Task 7 Develop per Unit Savings Values	Derive per unit savings estimates
Task 8 Determine Economic Value	Estimate a monetary value to the program savings
Task 9 Update Annual Savings Estimates	Apply per unit savings values to actual project construction data

The Cadmus team will complete the evaluation tasks on the following schedule:

Table 3. Evaluation Timing

Task	Timeframe
Task 1 Specify Pre and Post Configurations	Early Year 1 and Annually
Task 2 Develop Data Structures	Early Year 1
Task 3 Format Data	Early Year 1
Task 4 Engineering Models	Early Year 1
Task 5 Line Metering	TBD
Task 6 Synthesize Results	Year 1
Task 7. Develop per Unit Savings Values	Year 1
Task 8. Determine Economic Value	Year 1
Task 9. Annual Update	Annually

The voltage conversion project will incrementally convert a percentage of existing 4 kV line to 12 kV line each year through 2014, making it necessary for Cadmus to update the evaluation annually.

Evaluation Deliverables

Cadmus will produce the following deliverables:

- ***Pre-Post Configurations.*** A memo specifying the pre- and post-circuit configurations. The initial memo will specify the total program circuit configurations by year. Subsequent memos will update the original to reflect actual field construction results.
- ***Data Structures.*** A memo detailing the exact data requirements, data collection periods, transfer methods, and transfer frequencies.
- ***Evaluation Results.*** An annual report detailing the findings of each evaluation method, as well as the final triangulated program savings and economic value.

We will prepare the draft evaluation reports in accordance with the highest quality standards. It will include the following components:

- ***Executive summary,*** highlighting the major findings and conclusions of the evaluation.
- ***Introduction,*** explaining the background of the program and its goals and specific objectives, implementation, and operational processes.
- ***Methodology,*** explaining in detail the methodologies we used for various components of the evaluation.
- ***Results and conclusions,*** including data and material reviews and analysis and survey results.
- ***Recommendations*** for improvements and resulting implications.

Table 4 outlines the timelines for each deliverable.

Table 4. Evaluation Deliverables

Deliverable	Deadline
Pre-Post Configurations Memo	Early Year 1
Pre-Post Configurations Update	Annually
Data Structure Memo	Early Year 1
Savings Report	Year 1
Savings Report Update	Annually