BEFORE
THE PUBLIC UTILITIES COMMISSION OF OHIO

In the Matter of the Application for Approval of Transmission and Distribution Projects of Ohio Edison Company, The Cleveland Electric Illuminating Company, and The Toledo Edison Company	**Case Nos. 15-0372-EL-EEC** **15-0373-EL-EEC** **15-0374-EL-EEC**

APPLICATION

Pursuant to R.C. 4928.66(A)(2)(d), Ohio Edison Company, The Cleveland Electric Illuminating Company ("CEI") and The Toledo Edison Company (collectively, "Companies") request approval of the transmission and distribution ("T&D") projects listed on attached Exhibits C and D, respectively, for inclusion as part of their compliance with the Companies' 2014 energy efficiency benchmarks.[1] In support of this Application, the Companies state:

I. BACKGROUND

1. Each of the Companies is an electric distribution utility ("EDU") as that term is defined in R.C. 4928.01(A)(6).
2. 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 percent of the total annual average, and normalized kilowatt-hour sales of the

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[1] This application is similar to that filed and which the Commission approved for the 2009 T&D projects in *In re Request by Ohio Edison Company, Cleveland Electric Illuminating Company, and The Toledo Edison Company For Approval to Include Transmission and Distribution Projects In Partial Compliance With Energy Efficiency Benchmark Requirements* Case No. 09-951-EL-EEC, *et al.* and filed and approved in *In re Request by Ohio Edison Company, Cleveland Electric Illuminating Company, and The Toledo Edison Company For Approval to Include Transmission and Distribution Projects In Partial Compliance With Energy Efficiency Benchmark Requirements*, Case Nos. 10-3023-EL-EEC, *et al.* The Companies also have pending applications in Case Nos. 12-1550-EL-EEC, *et al.*, 13-1188-EL-EEC, *et al.* and 14-0862-EL-EEC, *et al.* whereby Staff has recommended that the Commission approve the T&D projects. .

[EDU] during the preceding three calendar years to customers in this state."

3. The statutory benchmark for 2014 is one percent greater than that for 2013. R.C. 4928.66(A)(1)(a).

4. R.C. 4928.66(A)(2)(d) permits a utility to include, for purposes of compliance with the aforementioned statutorily mandated energy efficiency benchmark, "transmission and distribution infrastructure improvements that reduce line losses."

5. As part of their overall compliance strategy with statutory benchmarks, the Companies intend to incorporate various T&D infrastructure improvement projects that they have completed. Projects completed during 2014 are included in this Application.

II. NATURE OF THE PROJECTS

6. Inherent in the operation of a power system is the loss of a portion of the power being transmitted due to the electrical resistance of the various elements within the power system (e.g., conductors, transformers and regulators.) The transmission of power at various voltage levels throughout the power system has different levels of losses attributable to the delivery of the power. The farther through the system the power must travel, the greater the loss component associated with the transfer. There are various system improvements that, if made, can reduce the amount of line losses, including, as examples, the re-conductoring of lines, substation improvements, the addition of capacitor banks and the replacement of regulators.

7. A typical re-conductoring project involves the replacement of existing wires with larger wires between either the transmission towers or distribution poles. Re-conductoring projects reduce line losses by lowering the resistance of the system through which energy flows, such that the power consumed to transmit that energy –

or line loss – is lowered. Re-conductoring projects are analogous to improving traffic flow on a highway by adding an extra traffic lane.

8. Substation projects typically include tying together previously unconnected transmission or distribution lines, and/or the addition or upgrade of transformers and circuits in new or existing locations. These projects generally improve efficiency, and thus reduce line losses, by providing an additional energy transformation point closer to the load center. As a result, a greater portion of the energy flows across high-voltage lines instead of lower-voltage lines. This is analogous to driving along a fast-moving interstate highway and being able to exit closer to your destination rather than driving on a slower, secondary road to reach the exit. The addition of new circuits on a distribution substation results in the transfer of load from one substation to another that is closer to the source, thus improving overall system operations. New distribution circuits are analogous to providing a new exit ramp along the highway closer to your destination.

9. Typical transmission capacitor bank projects include the addition or expansion of large capacitor banks at a substation location. These projects involve reducing line losses by placing reactive sources at, or near, a load center. By doing so, a portion of the reactive load no longer travels across the entire transmission system, over which line losses occur. Typical distribution capacitor bank projects include the addition of capacitor banks, or a series of banks, in parallel at a substation location or on distribution poles along the circuit. These projects involve reducing line losses by placing reactive sources at or near a load center. The addition or upgrade of transmission and distribution capacitor banks can be compared to smoothing out the hills and valleys along a highway for more efficient travel.

10. A typical distribution voltage regulation project involves the replacement of existing equipment with larger and/or more efficient equipment. These projects improve the energy efficiency of the distribution system by reducing the losses and heating associated with smaller equipment. As a result of the upgrades, the distribution system transfers electricity more efficiently to the customer. This is similar to the re-conductoring projects discussed above and is also analogous to improving traffic flow on a highway by adding an extra lane.

11. The Companies have made some of the aforementioned types of improvements on their T&D systems during 2014. Transmission and distribution-related projects are listed on attached Exhibits C and D, respectively. As indicated on attached Exhibit A, the completion of these projects results in a total annual contribution to energy efficiency savings in 2014 of 73,453 Megawatt hours ("MWhs") for the Companies generally, and more specifically, 48,970 MWhs for Ohio Edison Company; 12,793 MWhs for CEI; and 11,690 MWhs for The Toledo Edison Company. These annualized savings are based on models which are discussed in attached Exhibit B and which are consistent with those commonly used in the industry and/or by the North American Electric Reliability Council (NERC).

12. Attached in support of this Application are the following exhibits:

Exhibit A:	A summary of Loss Reductions by Company, along with the allocation factors used to allocate transmission loss reductions among the Companies.[2]
Exhibit B:	A description of the methodology used to determine the Loss Factors for both transmission and distribution projects.

[2] Because losses occur at various points on the transmission system and the transmission system encompasses all three of the Companies' respective service territories, the loss reductions were allocated based on their individual line miles as a percent of the total FirstEnergy system line miles.

Exhibit C: List of Transmission Projects included for consideration

Exhibit D: List of Distribution Projects included for consideration (three pages)

III. CONCLUSION

13. Based upon the foregoing, the Companies respectfully request that the Commission approve the energy savings set forth on attached Exhibit A for each of the Companies as part of their respective energy efficiency compliance with their 2014 energy efficiency benchmark requirements.

Respectfully submitted,

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Summary of Energy Savings from Transmission and Distribution Projects

Exhibit A

Projects placed in service 2014 (a)
Case No.

	(in MWhs)			
	OE	**CEI**	**TE**	**Total**
Transmission System Annualized Energy Savings (b)	44,825	12,659	11,690	69,174
Distribution System Annualized Energy Savings	4,145	134	0	4,279
Total Annualized Energy Savings	**48,970**	**12,793**	**11,690**	***73,453***

(a) For Transmission project listing, see Exhibit C; for Distribution project listing, see Exhibit D

(b) Allocation of transmission energy savings is based on transmission line miles within each operating company compared to total FirstEnergy (Ohio) transmission line miles

	OE	**CEI**	**TE**
Loss Allocation %	64.80%	18.30%	16.90%

Exhibit B

Methodology for Determination of Energy Efficiency Savings on the Transmission and Distribution Systems

The calculation of energy efficiency savings associated with Transmission and Distribution infrastructure improvement projects is performed by modeling and documenting the pre-project and post-project electrical system parameters in a load flow analysis tool. The load flow analysis tool contains data base models that reflect the current and/or historic parameters of the electrical system. These tools are used to model the electrical grid at various system conditions and provide the electrical load flows resulting from those conditions. The measurement of the load flows throughout the electrical system, both before and after the improvements, allows for the calculation of the reduction in total losses in the system associated with the improvement projects.

DETERMINATION OF LINE LOSSES – GENERAL

For both the transmission and distribution systems, the loss factor is the ratio of the total system losses associated with supply to a specific voltage class, to the total system load connected to that voltage class. Ohio Edison Company, The Cleveland Electric Illuminating Company and The Toledo Edison Company (collectively, "Companies") use various modeling and analytic software tools to determine, among other things, line losses on various parts of the transmission and distribution systems. Transmission losses were determined by using PSLF (Positive Sequence Load Flow) software, a General Electric software product. Information on this software package can be found at http://www.gepower.com/prod_serv/products/utility_software/en/ge_pslf/index.htm, which is incorporated herein by reference. Distribution losses were determined through the use of Milsoft – Windmill. Background information on this software tool can be found at https://milsoft.com/smart-grid/windmill/analysis-funcitons, which is also incorporated herein by reference. The Companies determined the reduction in line losses on both the transmission and distribution systems by modeling both before and after scenarios, with the former representing conditions on the system prior to the identified project being implemented, and the latter representing conditions on the system after the project was complete.

In order to model these various scenarios, three critical values had to be determined: (i) Peak-Load Coincident Factor; (ii) Load Factor; and (iii) Loss Factor. The Peak-Load Coincident Factor is defined as the portion of a demand that contributes to the peak load. The Load Factor is defined as the average demand for a time period divided by the maximum demand for the same time period. And the Loss Factor is defined as the average losses for a time period divided by the maximum losses for the same time period. System losses are comprised of two major components that can generally be characterized as (i) no-load losses; and (ii) load losses. The no-load losses never vary. Load losses, on the other hand, vary with the amount of current being carried in the system. The more current that flows over a wire, the hotter the wire gets, expelling energy. This relationship of lost energy varies with the square of the current; so if the current is doubled, the losses increase by a factor of four. Similarly, if the current is reduced to half of its original value, the losses decrease by a factor of four. The method for determining these values for both the transmission and distribution systems is set forth below.

TRANSMISSION SYSTEM

When studying transmission system losses, it is necessary to determine the total energy consumed by losses over a given period of time, such as one year. It is not practical to perform an hour-by-hour evaluation of the losses. Therefore, the FE Companies, following an IEEE methodology, converted the losses evaluated at the peak hour into an average number that can be multiplied by the hours in a year to determine an annual loss factor. For a detailed discussion of the conversion methodology used, *see* "*The Equivalent Hours Loss Factor Revisited*", Stone & Webster Management Consultants, (1988), which is incorporated herein by reference.

In order to determine the loss factor, the system load factor first needed to be calculated. Applying the IEEE methodology described above, the FE Companies obtained hourly load data through their energy management system. The system load factor is essentially the average load on the line over the period of time considered, which in this case was one year. It is determined by normalizing all the hourly load values so that the highest value (system peak hour) is 1.000, with all other hours being assigned values less than one. The normalized values were then summed and divided by the number of values used. This approach provides a way to convert the peak hour load for a year into a yearly total energy quantity.

The system loss factor calculation is then done by performing the same calculations as described above, except that the normalized values are squared before summing. This allows the user to evaluate the losses at the peak hour and still use the factor to obtain an energy value for the entire year.

DISTRIBUTION SYSTEM

The Peak-Load Coincident Factor was determined by first selecting a set of circuits to sample; and second, determining the top-five peak load periods for the overall distribution system. Using this information, the Companies determined the demand at each of the peak load periods as a percentage of the load's peak demand, taking the average of the results. For purposes of this calculation, the Companies studied a sample set of 98 Ohio distribution circuits, calculating the peak load coincidence factors at the operating company level based on the top-five peak load times.

The Load Factor was determined by using the same sample of 98 circuits and averaging the individual circuit load factors, using each circuit's average load as a weighting factor.

The Loss Factor was calculated by averaging the loss factor on each of the sample circuits, which was determined through the use of the following standard formula: (0.15 * Load Factor) + (0.85 * (Load Factor)^2) [David Farmer, *Distribution Planning*, Synergetic Design, Engineering Consultants, p. 26 (2008).]

Capacitor additions are calculated in two methods. For substation located (single location) capacitor banks, the same calculation applicable for distribution projects is applicable. For the distributed line capacitor additions, the line losses are determined through a different process. Distribution line capacitors reduce load losses by reducing the reactive portion of the current flow in the distribution lines and station power transformers. The Companies sampled 48 of their 161 existing capacitor banks and found that loss savings benefits ranged from a negligible change to as much as 8 kW/100 kVAR. Taking the average of all of the circuits studied, results in a 2.0 kW per 100 kVAR of capacitor additions at circuit peak load.

FE-Ohio Transmission Level Projects

Exhibit C

Based on new transmission facilities placed in service 2014.

A	B	C	D	E
Project Name	**Pri kV**	**In Service Date**	**Peak Loss Reduction MW**	**Annualized Loss Reduction MWhs**
Bayshore #2 345/138kV 448MVA Transformer Addition	345/138	5/24/2014	0.7	1,968
Boardman #2 138/69kV Transformer Replacement	138/69	5/31/2014	0.5	1,406
Juniper #3 345/138kV 280MVA Transformer Replacement	345/138	12/31/2014	1.2	3,374
Hanna 345kV Loop Project (Sectionalize Chamberlin-Mansfield 345kV Line)	345	5/26/2014	3.6	10,123
Hayes 345/138kV Substation + Davis Besse-Beaver 345kV Line	345/138	5/29/2014	11.2	31,494
Tangy-London 138kV Line	138	12/31/2014	1.5	4,218
Johnson #7 138/69kV Transformer Replacement	138/69	7/14/2014	0.4	1,125
Galion #4 345/138kV 448MVA Transformer Replacement	345/138	12/31/2014	0.2	562
Harding #2 345/138kV Transformer Addition	345/138	12/31/2014	5	14,060
East Springfield-London #2 138kV Line	138	12/31/2014	0.3	844
Total Loss Reductions - FE Transmission Projects			24.6	69,174

total PDR for T&D		
	OE	17.46
	CE	4.51
	TE	4.16

Column Description

- **A** Project description
- **B** Primary voltage
- **C** Date project was put into service
- **D** MW Loss Reduction - system modeled before and after project using PSLF software. For a description of the software, see http://www.gepower.com/prod_serv/products/utility_software/en/ge_pslf/index.htm
- **E** Calculation of MWhs
  Formula: MW Loss Reduction x Average Loss Factor x 8760

Ohio Edison Distribution Level Projects

Based on new distribution facilities placed in service 2014.

Exhibit D
(1 of 3)

A	B	C	D
Project Name	**In Service Date**	**Peak Loss Reduction MW**	**Annualized Loss Reduction MWhs**
Lowelville D80 2.4kV to T320 22.86kV conversion	3/26/2014	0.0545	149
Lisbon W154 Reconductor	2/26/2014	0.0485	133
NEOMED/Campbellsport-New Milford Reconductor	9/1/2014	0.701	1,916
Ira Retirement, Bath Modsub	10/15/2014	0.7125	1,947
Total Loss Reductions - OE Distribution Projects		1.517	4,145

Column Description

A Project description

B Date project was put into service

C MW Loss Reduction - Losses Before minus Losses After modeled in Millsoft engineering software. For a description, see https://milsoft.com/smart-grid/windmill/analysis-funcitons
(a) For capacitors, loss reductions were based on a 2kW loss per 100 kVAR

D Calculation of MWhs
Formula: MW Loss Reduction x Average Loss Factor x 8760
Loss Factor = 31.2%

Toledo Edison Distribution Level Projects

Based on new distribution facilities placed in service 2014.

A	B	C	D
Project Name	**In Service Date**	**Peak Loss Reduction MW**	**Annualized Loss Reduction MWhs**
Total Loss Reductions - TE Distribution Projects		0.000	-

Column Description

A Project description

B Date project was put into service

C MW Loss Reduction - Losses Before minus Losses After modeled in Millsoft engineering software. For a description, see https://milsoft.com/smart-grid/windmill/analysis-funcitons

(a) For capacitors, loss reductions were based on a 2kW loss per 100 kVAR

CEI Distribution Level Projects

Based on new distribution facilities placed in service 2014.

Exhibit D
(3 of 3)

A	B	C	D
Project Name	**In Service Date**	**Peak Loss Reduction MW**	**Annualized Loss Reduction MWhs**
SE Lorenzo Substation	5/14/2014	0.042	114.79104
SE Nash Feeder Exit Upgrades 2 & 5-NS	6/1/2014	0.007	19
			-
Total Loss Reductions - CEI Distribution Projects		0.007	134

Column Description

A Project description

B Date project was put into service

C MW Loss Reduction - Losses Before minus Losses After modeled in Millsoft engineering software. For a description, see https://milsoft.com/smart-grid/windmill/analysis-funcitons

(a) For capacitors, loss reductions were based on a 2kW loss per 100 kVAR

D Calculation of MWhs

Formula: MW Loss Reduction x Average Loss Factor x 8760

Loss Factor = 31.2%