STATE OF INDIANA

INDIANA UTILITY REGULATORY COMMISSION

VERIFIED PETITION OF DUKE ENERGY INDIANA, INC. FOR; (1) APPROVAL OF PETITIONER'S 7-YEAR PLAN FOR ELIGIBLE TRANSMISSION, DISTRIBUTION AND STORAGE SYSTEM IMPROVEMENTS, PURSUANT TO IND. CODE § 8-1-39-10; (2) APPROVAL OF A TRANSMISSION AND DISTRIBUTION INFRASTRUCTURE IMPROVEMENT COST RATE ADJUSTMENT AND DEFERRALS, PURSUANT TO IND. CODE § 8-1-39-9; (3) APPROVAL OF CERTAIN REGULATORY ASSETS; (4) APPROVAL OF VOLUNTARY DYNAMIC PRICING RIDERS; AND (5)APPROVAL OF A NEW DEPRECIATION RATE FOR ADVANCED METERS	)	**CAUSE NO. 44720**

OUCC SETTLEMENT TESTIMONY

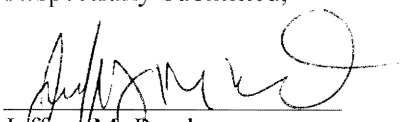
LEON A. GOLDEN – PUBLIC'S EXHIBIT NO. 1

ON BEHALF OF THE

INDIANA OFFICE OF UTILITY CONSUMER COUNSELOR

March 17, 2016

Respectfully Submitted,



Jeffrey M. Reed
Deputy Consumer Counselor

SETTLEMENT TESTIMONY OF OUCC WITNESS LEON A. GOLDEN
CAUSE NO. 44720
DUKE ENERGY INDIANA, INC.

I. INTRODUCTION

Q: Please state your name and business address.

A: My name is Leon A. Golden, and my business address is 115 West Washington Street, Suite 1500 South, Indianapolis, Indiana 46204.

Q: By whom are you employed and in what capacity?

A: I am employed by the Indiana Office of Utility Consumer Counselor ("OUCC"), as a Utility Analyst for the Resource Planning and Communications Division. My educational background and experience are detailed in Appendix A attached to this testimony.

Q: Please describe the review and analysis you conducted in order to prepare your testimony.

A: I reviewed and analyzed Petitioner's testimony, exhibits, and company workpapers. I also drafted data requests and reviewed responses to data requests issued by the OUCC and other parties in this cause. In addition, I read various articles, consulted reference materials, and attended multiple meetings with Duke Energy Indiana "DEI" or "Petitioner" personnel to discuss technical aspects of DEI's 7-Year Plan. I assisted with the settlement negotiations and reviewed the Settlement Agreement filed in this cause. My project analysis focused on the engineering reasonableness of three broad categories: 1) Distribution System

Circuit Improvements; 2) Transmission Substation Upgrades; and 3) Transmission Line Upgrades.[1]

Q: What is the purpose of your testimony?

A: My testimony supports a Commission finding that the Settlement Agreement is reasonable and serves the public interest. In particular, my testimony:

- explains how the OUCC investigated the project engineering aspects for reasonableness,
- addresses whether each project in the Plan provides a benefit to DEI's customers in the areas of either, system safety, and/or reliability, and
- supports the OUCC's recommendation that the Commission find DEI has provided sufficient engineering detail and support for the Settlement Agreement projects to be "eligible transmission, distribution, and storage system improvements" within the meaning on I.C. 8-1-39-2 for inclusion within DEI's 7-Year Plan.

OUCC Witness Mr. Ray Snyder provides settlement testimony addressing his analysis and recommendations regarding project cost detail and support.

II. DISTRIBUTION SYSTEM CIRCUIT IMPROVEMENTS

Q: Please describe your analysis of the Distribution System Circuit Improvement projects.

A: DEI system planners and engineers selected the Distribution System Circuit Improvement projects in DEI's 7-Year Plan based on many factors including, age, system conditions, and availability of grid modernization equipment. In addition, system reliability and customer benefits were a part of the planning process.[2]

Declared Circuits

Declared circuit projects address poor performing circuits (circuits

[1] My analysis of DEI's Transmission Substation Upgrades and Transmission Line Upgrades are both organized under the Transmission System Improvements section of my testimony.
[2] Petitioner's Exhibit 2, page 15, lines 2-8.

experiencing an above-average number of outages) by inspecting each pole on the declared circuit for deteriorated/damaged equipment, outdated construction, and dangerous trees or limbs that contribute to poor circuit performance.[3] DEI's original plan would double its review of circuits from the current annual average of 11 circuits to 22.[4] As a result of the Settlement Agreement, DEI now plans to review 16 circuits annually.

Deteriorated Conductor Replacement

This project addresses deteriorating and poorly performing small and medium voltage conductors[5] that can create undesirable line and field conditions.[6] These projects will result in both reduced conductor failures and fewer emergency conductor repairs.

Ground Line Pole Replacement

This is a continuation of DEI's existing distribution wood pole inspection and replacement project. Inspected on a 12-year cycle, approximately 50,000 poles are inspected annually (visual evaluation, below ground-line inspection, sound test, and test bore holes if needed), averaging 3,186 poles replaced annually.[7] Pole inspections using these criteria produce comprehensive results and can lengthen time needed between re-inspection cycles.[8]

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[3] Petitioner's Exhibit 2-C (WHF), pages 7-9
[4] *Id.*
[5] *Id.* pages 10-12.
[6] In Wisconsin, sub-standard copperweld conductors allegedly caused stray voltage conditions in farms. See Wisconsin Public Service Commission: https://psc.wi.gov/utilityInfo/electric/documents/strayVoltage/strayvol.pdf (Accessed 1/29/2016).
[7] Petitioner's Exhibit 2-C (WHF), pages 15-18.
[8] Daugherty, Gerald L. *The Realistic Expectation of an In-Place Wood Pole Inspection Program.* International Conference on Utility Line Structures. March 23-25, 1998. http://www.osmose.com/documents/realistic-expectation-of-in-place-wood-pole-inspection-program.pdf (Accessed 2/1/16).

Transformer Retrofit

This project targets a total of 37,000 Completely Self-Protected ("CSP") transformers on 4 kilovolt ("kV") and 34.5 kV circuits, and certain fused cutouts with a strong failure potential. These projects include retrofitting all 37,000 CSP transformers and reconfiguring external protective devices such as cutouts, fuses and arresters, replacing bare lead wires with covered wires, and installing animal guards over all exposed bushings.[9]

Three-Phase Primary Switch Replacement

Inline and gang-operated air break ("GOAB") switches on the distribution system perform routine switching operations, isolate faults, and/or energize/de-energize circuit sections. As GOAB switches near the end of their useful lives, they can become difficult or impossible to operate due to rust, dirt, wear and tear, and hot spots that develop at switch connections and blades. Replacing these, where possible, remedies these problems.

Hydraulic Recloser Replacements

Reclosers are an integral component of a distribution system's protection scheme in that they act somewhat as a circuit-breaker, but have the ability to automatically reclose, as prescribed, by programmed settings. Their purpose is to prevent long-term power outages by allowing momentary faults to clear. If the fault fails to clear, the recloser then locks out the faulted circuit segment to isolate the fault. Replacing older oil-filled units with new or refurbished units will

[9] Petitioner's Exhibit 2-C (WHF), pages 40-42.

enhance distribution system performance.[10]

In addition, I also examined DEI's proposed distribution system projects for:

- Limited Access Road Crossings
- Capacitor Changeouts
- Capacitor Automation
- Capacitor Oil to Vacuum Switch Replacements
- Ungrounded 34.5 kV Delta Capacitor Bank Oil Switch Replacements
- 34.5 kV Circuit Automation
- Cable Injection/Cable Replacement
- General Switchgear Replacement
- Live Front Transformer Replacements
- Surface Mount Equipment Inspections ("SMEI")
- Distribution Automation, including Self-Healing Teams, Circuit Sectionalization, Line Sensors and Recloser Controls Upgrades/Replacements
- Integrated Volt-VAR Control ("IVVC"), including End of Line Voltage Sensors, Voltage Regulator Control Replacement, and Circuit Conditioning.

In each instance, the primary focus of the project is safety, reliability, system modernization, or most often, some combination of the three. DEI's evidence explains the nature of the project, the expected benefits, and provides sufficient engineering background and support for the OUCC to conclude each project is reasonable, from an engineering standpoint, for inclusion within the 7-Year Plan.

[10] *Id.* pages 19-20. (DEI explains that after being removed from service, most units are refurbished and placed back into service.)

III. TRANSMISSION AND DISTRIBUTION SUBSTATION IMPROVEMENTS

Q: Please describe your analysis of DEI's Substation Upgrades projects.

A: The Transmission Substation projects in DEI's 7-Year Plan are primarily focused on replacing obsolete equipment and addressing system reliability issues. DEI originally proposed 323 specific projects at 280 T&D Substations.[11] As a result of the Settlement Agreement, DEI's plan now contains 306 projects at 274 Substations, including:

Remote Monitoring & Control of Substation Devices

Remote Terminal Units ("RTUs"), support DEI's Supervisory Control and Data Acquisition ("SCADA") systems. Historically, SCADA systems were installed primarily at larger and more critical substations. This project will allow DEI system operators the ability to monitor and control substation devices at other substations.[12]

Transmission Relay Upgrades – Tiers I & II

Projects include upgrading and/or replacing outdated, poor performing, and troublesome electro-mechanical and first-generation microprocessor relays with new microprocessor-based models.[13] Electromechanical relays have operational limitations such as slow speed of operation, degradation over time, bulky size, and they impose high burdens on current transformers. New microprocessor-based relays contain upgrades such as characteristic and behavioral programmable capabilities and multi-functionality. DEI proposes

[11] Petitioner's Exhibit 3, page 13, lines 5-8.
[12] Petitioner's Exhibit 3-B (DEB), pages 3-5.
[13] *Id.* pages 6-9.

upgrading and/or replacing outdated, poor performance type, and troublesome relays to reduce the risk of outages, incorrect operation, and failures.[14]

Circuit Breaker Replacement

DEI estimates replacing outdated transmission and distribution oil circuit breakers ("OCBs") and high volume Sulfur Hexafluoride gas circuit breakers ("GCBs") plus outdated relays will save $65,000 to $75,000 per breaker.[15] DEI plans to replace 230 transmission voltage OCBs, 213 distribution voltage OCBs, and 2 GCBs.

Substation Transformer Replacements

The Plan originally identified six distribution transformers, thirty-two transmission-distribution transformers, and two transmission-transmission transformers as having known conditions associated with a high risk for premature failure.[16] As a result of the Settlement Agreement, the Plan will now address four distribution transformers, twenty-five transmission-distribution transformers, and one transmission-transmission transformer. Over time, insulating paper inside the transformer windings breaks down and can lead to catastrophic failure. These projects will provide safety and system reliability benefits.

Bushing Replacement

Porcelain style General Electric ("GE") Type "U" bushings, as well as, the Westinghouse Types "S" and "OS" transformer bushings have documented high

[14] *Id.*
[15] *Id.* Page 12.
[16] *Id.* pages 13-15.

failure rates.[17] The condenser design of these transformer bushing types is susceptible to electrical stresses and partial discharge issues inside the transformer bushings.[18] The long-term effect of the partial discharges is an increase in the insulation system's dielectric losses that result in a rise of the bushing's power factor.[19] These projects will provide benefits to system safety and reliability.

In addition, I also analyzed other proposed Transmission and Distribution Substation projects, including:

- Load Tap Changer ("LTC") Replacements and Upgrades
- Remote Monitoring of Transmission Auto Throw-Over ("ATO") Schemes
- Add Remote Monitoring & Control to Substation Line Switches
- Eliminate High-Speed Grounding Switches
- Reconfigure Transmission Bus from Straight Bus to Ring Bus

Q: Please describe your analysis of DEI's Transmission Line Upgrade projects.

A: DEI's Transmission Line Upgrade projects are primarily focused on replacing obsolete equipment and addressing system reliability issues. DEI originally identified 144 specific projects on 81 Transmission Lines in its 7-Year Plan.[20] As a result of the Settlement Agreement, the Plan now contains 124 specific projects on 77 Transmission Lines including:

[17] *Id.* pages 16-17.
[18] *See* ABB Contact. *Type "U" Bushings...So What's the Concern About"?* Article. ABB Power T&D Company, Inc. Special No. 1, March 1988, Alamo, TN.
[19] *Id.* ABB Contact, Special No. 1, March 1988.
[20] Petitioner's Exhibit 3, page 13, lines 5-8.

Transmission Pole Replacements

Similar to DEI's inspection-based distribution pole replacement project, but these projects replace wood transmission poles with steel poles, which are typically lighter, have longer service lives, and require less maintenance.[21] The project accelerates inspections for DEI's approximately 80,000 wood transmission poles from eight year intervals to five, and estimates it will replace approximately 384 poles each year (2,688 poles over the 7-Year Plan).[22] These projects will benefit system reliability by reducing outages attributable to pole failures.

Crossarm Replacements

DEI states "[s]ince most crossarms are of the same vintage as the poles on which they are mounted, we estimate that most identified defective crossarms will be addressed within the pole replacement program described previously."[23]

Static Wire Replacements

Static wire acts as a lightning rod to protect the transmission lines. DEI explains that as the zinc galvanized coating on the wire degrades, it exposes the steel wire beneath, promoting rust. Static wire is prone to breaking where it is attached to the pole. DEI states transmission system outages attributable to breaking static wires have averaged nearly 70 annually over the past four years.[24] Replacement of worn static wire will benefit transmission system reliability.

[21] Petitioner's Exhibit 3-C (DEB), pages 4-8.
[22] *Id.* page 7.
[23] *Id.* page 10.
[24] *Id.* page 13.

69 kV Line Rebuilds

Many of DEI's 69 kV transmission circuits have been in service for 50 years or longer. DEI explains that approximately 75% of lines inspected had more than two deteriorating sets of assets; the remaining 25% had one or two issues. 55% of the worst performing lines were found to need at least a partial rebuild.[25] Rebuilding selected 69 kV transmission lines or line sections will benefit system safety and reliability, and reduce outages due to equipment failure.

Other Transmission Line Upgrade projects I reviewed include:

- Galloping Conductor Mitigation
- Aluminum H-Structure Replacement
- Transmission Line Switch Replacement
- Transmission Line Switch Motor Mechanisms & SCADA

As was the case on the Distribution side, my analysis of each Transmission Substation and Transmission Line Upgrade project illustrates how the project will improve safety, reliability, system modernization, or most often, some combination of the three. DEI's evidence explains the nature of the project, the expected benefits, and provides sufficient engineering background and support for the OUCC to conclude each project is reasonable from an engineering standpoint.

The benefits of these projects, when considered in conjunction with the annual TDSIC cost caps, total 7-Year plan cost cap, the cost reductions for both transmission and distribution customers and all other terms of the Settlement Agreement, form a fair and balanced compromise. The Settlement Agreement

[25] *Id.* page 16.

promotes the ongoing improvement of DEI's infrastructure at a reasonable cost. The public interest is served by fairly balancing both customers' and the utility's interests in this Settlement Agreement.

IV. RECOMMENDATIONS

Q: Please summarize the OUCC's recommendations.

A: The OUCC recommends the Commission approve the Settlement Agreement in its entirety.

Q: Does this conclude your testimony?

A: Yes.

APPENDIX A

Q: Please describe your educational background and experience.

A: I graduated from Purdue University School of Engineering and Technology - Indianapolis in 2011, with a Bachelor of Science degree in Mechanical Engineering. In October of 2011, I passed the Fundamentals of Engineering exam administered by the Indiana Professional Licensing Agency.

I worked as a civil engineering technician from 2005-2008, performing materials testing in field and laboratory settings, conducting analysis of mechanical properties of soils, and working in accordance with a variety of testing standards. From 2009-2014, I worked as a engineer co-op and project engineer in the electric utility industry in a number of different areas, including; Customer Projects, Substation Relaying and Protection, Standards and Code Compliance, and distributed generation interconnections.

I have participated in several IEEE technical workshops, including; Smart Grid Cyber-Security, Smart Distribution Systems, and Wind Farm Collector System Design workshops. I have attended New Mexico State University – Center for Public Utilities' Basic Regulatory Training for the Electric Industry in New Mexico.

Q: Have you previously testified before this Commission?

A: Yes. I have testified in consolidated electric base rate case and Commission investigation (Cause Nos. 44576/44602), Transmission, Distribution, and Storage System Improvement Charge ("TDSIC") case (Cause No. 44430), a base rate case (Cause No. 44684), a solar distributed generation tracker case (Cause No. 44511

SPR-1), and a Certificate of Public Convenience and Necessity ("CPCN") case (Cause No. 44739).

AFFIRMATION

I affirm, under the penalties for perjury, that the foregoing representations are true.

By: Leon A. Golden
Indiana Office of
Utility Consumer Counselor

3-17-2016
Date:

CERTIFICATE OF SERVICE

This is to certify that a copy of the foregoing ***Office of Utility Consumer Counselor Filing Settlement Testimony of Leon A. Golden*** has been served upon the following parties of record in the captioned proceeding by electronic mail on March 17, 2016.

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