STATE OF INDIANA

INDIANA UTILITY REGULATORY COMMISSION

VERIFIED PETITION OF INDIANAPOLIS POWER & LIGHT COMPANY FOR APPROVAL OF IPL'S TDSIC PLAN FOR ELIGIBLE TRANSMISSION, DISTRIBUTION, AND STORAGE SYSTEM IMPROVEMENTS PURSUANT TO INDIANA CODE § 8-1-39-10.	)	**CAUSE NO. 45264**

Direct Testimony and Attachments of

Dennis Stephens EE

On behalf of

The City of Indianapolis

October 7, 2019

STATE OF INDIANA

INDIANA UTILITY REGULATORY COMMISSION

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I. Introduction, Qualifications, Purpose, and Preview

Q PLEASE STATE YOUR NAME AND BUSINESS ADDRESS.

A My name is Dennis Stephens. My business address is 1153 Bergen Parkway, Ste 130, Evergreen, Colorado 80439.

Q WHAT IS YOUR OCCUPATION?

A I am an independent consultant in the field of electric and gas distribution planning, asset management, and operations. I frequently work for the Wired Group, a small consultancy, as its Senior Technical Consultant.

Q ON WHOSE BEHALF ARE YOU APPEARING IN THIS PROCEEDING?

A The City of Indianapolis ("the City" or "City"). The City purchases substantial quantities of electricity from Indianapolis Power & Light ("IPL" or "Company") and is concerned about potential TDSIC rate impacts on its citizens.

Q PLEASE DESCRIBE YOUR EDUCATION, BACKGROUND, AND EXPERIENCE.

A After graduating from the University of Missouri with a bachelor's degree in Electrical Engineering, I began work for Xcel Energy (then Public Service Company of Colorado) as an electrical engineer in distribution operations. In a series of electrical engineering and management roles of increasing responsibility, I gained experience in distribution planning, operations, and asset management, and the innovative use of technology to assist with these functions. Positions I've held over the years have included Director, Electric and Gas Operations for the City and County of Denver Colorado; Director, Asset Strategy; and Director, Innovation and Smart Grid Investments.

In 2007, I was asked to lead parts of Xcel Energy's SmartGridCity™ demonstration project in Boulder, Colorado, the first of its kind at the time, covering 46,000 customers. I developed the technical foundations for the project, including the development of all concepts presented to the Xcel Energy Executive Committee for project approval, and including the negotiations with technology vendors on their contributions to the project. As Director of Utility Innovations for Xcel Energy, I also worked with many software providers, including ABB, IBM, and Siemens, helping them develop their distribution automation ideas into practical software applications of value to grid owner/operators. I retired from Xcel Energy in 2011, and now work for the Wired Group on a part-time basis. A full CV is provided as Appendix A to this testimony.

Q HAVE YOU BEEN INVOLVED WITH PRIOR PROCEEDINGS BEFORE THE INDIANA UTILITY REGULATORY COMMISSION ("IURC" OR "COMMISSION")?

A No.

Q. HAVE YOU BEEN INVOLVED IN PROCEEDINGS BEFORE OTHER REGULATORY COMMISSIONS?

A. Yes. I have testified jointly with my Wired Group colleague, Paul Alvarez, in three rate cases before the California Public Utilities Commission. I testified regarding the appropriateness of multi-billion-dollar grid modernization proposals by Southern California Edison[1] and Pacific Gas and Electric.[2] (Forward test years are employed in California rate cases.) I also testified jointly with Mr. Alvarez in two cases regarding grid modernization and distribution planning in Michigan[3] and New Hampshire.[4]

[1] California PUC A.16.09.001. May 1, 2017.
[2] California PUC A.15-09-001 and A.18.12.009. May 5, 2016 and July 30, 2019 respectively.
[3] Michigan PSC U-20147. September 11, 2019
[4] New Hampshire PUC IR15-296. September 6, 2019

Q WHAT IS THE SUBJECT MATTER OF YOUR TESTIMONY?

A In this testimony I present my perspectives on IPL's TDSIC Plan (the "Plan", or "IPL's Plan") proposed in this Cause at a high level.

Q PLEASE PROVIDE A PREVIEW OF YOUR TESTIMONY AND RECOMMENDATIONS IN THIS PROCEEDING.

A My review of IPL's testimony, TDSIC Plan, and workpapers, as well as data request responses provided in discovery, identified significant deficiencies in the methodology IPL used to develop its TDSIC Plan. For five components of its Plan, IPL used an age-based approach to select assets for prospective (in advance of demonstrated need) replacement. This is not standard industry practice. While standard industry practice provides for prospective replacement of certain types of assets based on the results of commonly-employed tests, these five Plan components were not developed in this manner. My testimony describes the deficiencies in IPL's age-based approach, as well as the manner in which the IPL approach dramatically overstates the replacements needed for public convenience and necessity. Based on this, I recommend the Commission reject the five components of the Plan IPL developed using the age-based approach to asset replacement selection, totaling $753 million in capital.

If the Commission rejects these five Plan components as I recommend, I anticipate IPL will redevelop and resubmit its Plan or components. To assist the Commission with this potential chain of events, I identify the asset types typically replaced prospectively using standard industry practices, and the commonly-employed tests which constitute standard industry practices for the identification of assets for

prospective replacement. I recommend the Commission require results from industry standard tests as justifications for prospective asset replacement.

My testimony continues with a discussion of Plan components I believe to have merit. I discuss why I believe these Plan components have merit, as well as my reservations for each. I recommend the Commission approve these Plan components with conditions I describe to address the reservations.

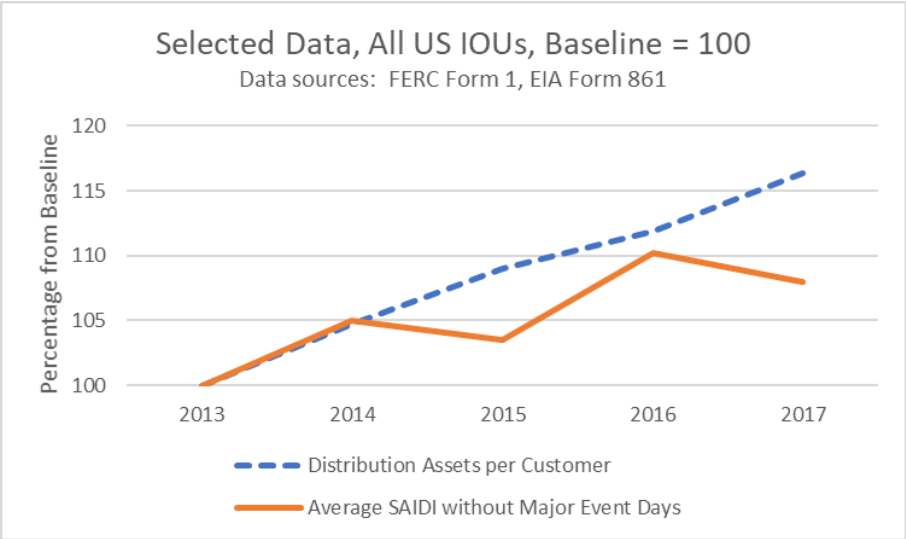
My testimony concludes by identifying Plan components for which no standard industry practice exists, and/or for which no favorable benefit-cost analysis is available. I summarize my recommendations in the table below.

City Recommendations

TDSIC Program Component	**$ in Millions**
Reject; Reconsider Future Proposals Based on Standard Industry Practice	
Circuit Rebuilds	298.7
Substation Assets Replacement	248.1
XLPE Cable Replacement	86.2
4kV Conversion	92.0
Remote End – Breaker Relay/Upgrades	28.0
TOTAL	**753.0**
Approve with Conditions	
Distribution Automation	109.0
CBD Secondary Network Upgrades	39.0
Pole Replacements	24.2
Steel Tower Life Extension	4.2
TOTAL	**176.4**
Reject	
Tap Reliability Improvement Projects	76.5
Static Wire Performance Improvement	62.1
Substation Design Upgrades	94.5
Meter Replacement (See City witness Alvarez testimony)	55.9
TOTAL	**289.0**

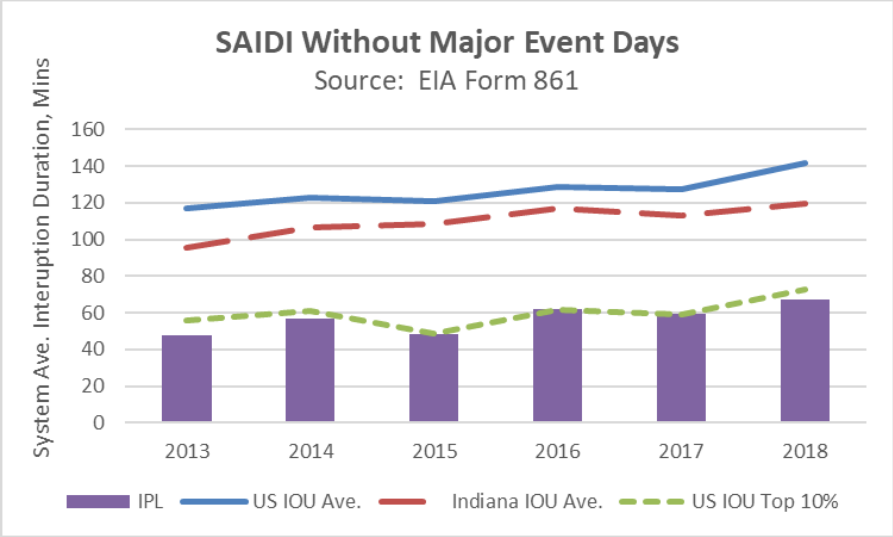
Q. BEFORE YOU BEGIN, CAN YOU PROVIDE YOUR PERSPECTIVE ON DISTRIBUTION PLANNING AND GRID MODERNIZATION ACROSS THE US?

A. As an electrical engineer with 35 years' experience maintaining grid reliability, I appreciate that periodic investments in grid assets are required. As a grid engineer with experience in California and Colorado – states with relatively high adoptions of distributed solar generation and electric vehicles – I appreciate that investments may be needed to accommodate these technologies at points on the grid as conditions dictate. But I am concerned that the current wave of grid investment is being driven more by earnings growth commitments to shareholders, and an absence of investment opportunities in generation, than by any immediate needs in transmission and distribution. I have seen IOUs propose investments indiscriminately across their grids, rather than surgically based on standard industry evaluation practices on an as-needed basis. The use of "blanket" approaches in anticipation of problems which have not yet materialized, or in place of objectively test and inspection results, invariably results in investments in assets which turn out not to have been necessary. These investments are in addition to those which are legitimately necessary, with the net result being an overall increase in distribution rate base with little impact on reliability. To illustrate, I compare recent increases in US IOU distribution rate bases with recent IOU reliability performance in the chart below. In the last five years, despite a 16% increase in distribution rate base nationwide, reliability performance has deteriorated 8%.



Rather than grand, distinct grid modernization plans, I advocate the use of standard industry practices which have proven their worth in distribution grid planning over the past 100 years. They have become standards for a reason; in their absence, investor-owned utilities' capital bias encourages them to replace assets unnecessarily.

I believe IPL's historical performance illustrates the value of compliance with standard industry practices. IPL rates are reasonable and IPL reliability performance is exceptionally good. In each and every year since the Department of Energy started collecting reliability data from US IOUs, IPL has performed in the top 10% (see the chart below, as well as the chart in Appendix B). If IPL has been delivering safe, exceptionally reliable service at reasonable rates through compliance with standard industry practices, I see no rationale for departing from standard industry practices in IPL's TDSIC Plan.



II. IPL Methodology to Justify Prospective Asset Replacement Is Flawed, Overstating the Need for Investment

Q. MUCH OF IPL'S TDSIC PLAN INVOLVES PROSPECTIVE ASSET REPLACEMENT. IS THE PROSPECTIVE REPLACEMENT OF ASSETS A STANDARD INDUSTRY PRACTICE?

A. It depends. For most assets, standard industry practice is to replace assets only as they fail. This is particularly true for distribution assets, as equipment failures are a minority of outage causes, and the number of customers impacted by any single equipment failure is relatively small. There are exceptions for high-consequence assets, such as assets in substations which serve thousands of customers, or utility poles (which present a public safety issue when they fail). For these exceptions, equipment testing and inspections are used to identify assets which should be prospectively replaced. I will return to the topics of equipment testing and inspections specific to certain asset types later in my testimony.

Q. DID IPL PROVIDE EQUIPMENT TEST RESULTS FOR THE ASSETS IT HAS IDENTIFIED FOR REPLACEMENT IN ITS TDSIC PLAN?

A. No. IPL's TDSIC Plan identifies assets for prospective asset replacement through an age-based approach to asset failure prediction. IPL hired Burns and McDonnell, an engineering firm, to identify the assets which, if replaced, will reduce failure risk by the greatest amount.[5] The identification of assets at greatest risk of failure answers a question much different from the question customers have, and to which the TDSIC legislation demands an answer,[6] which is, "What amount of prospective asset replacement will deliver incremental benefits in excess of customer costs?" This latter question has largely already been answered, and is already reflected in the standard industry practices I describe above. The answer, according to standard industry practice, is that prospective replacement is cost-effective for specific high-consequence assets identified through testing and inspection. Other prospective asset replacements are not supported by standard industry practice or by research.

Q. HOW MUCH OF IPL'S TDSIC PLAN INVOLVES THE PROSPECTIVE REPLACEMENT OF ASSETS IDENTIFIED BY BURNS AND MCDONNELL'S AGE-BASED APPROACH TO FAILURE PREDICTION?

A. The majority of TDSIC Plan Capital (62%) involves the prospective replacement of assets identified by Burns and McDonnell's age-based approach to failure prediction.[7]

[5] IURC Cause No. 45264. IPL Attachment BJB-2 (Public). Appendix 8.3, page 17.
[6] Indiana Code 8-1-39-10(b)(3), which states that the Commission must determine "whether the estimated costs of the eligible improvements included in the plan are justified by incremental benefits attributable to the plan."
[7] IURC Cause No. 45624. IPL Attachment BJB-2. Page 12, Table 2.1.

IPL TDSIC Plan Component	Proposed Capital Amount (in millions)
Circuit Rebuilds	$298.7
Substation Asset Replacement	248.1
XLPE Cable Replacement	86.2
4kV Conversion (substations and circuits)	92.0
Remote End – Break Relay/Upgrades	28.0
Total	**$753.0**

Q PLEASE SUMMARIZE THE BURNS AND MCDONNELL AGE-BASED APROACH TO FAILURE PREDICTION.

A. The Burns and McDonnell age-based approach to failure prediction is based on "survivor curves" specific to various asset types. Survivor curves assume a relationship between age and asset failure rates. By locating an asset on the curve based on the asset's age, the curve estimates the likelihood that an asset will fail over a specific period of time, in this case the seven-year timeframe of IPL's TDSIC Plan.

Q. THIS SOUNDS LOGICAL. WHY DO YOU BELIEVE THE BURNS AND MCDONNELL AGE-BASED APPROACH TO IDENTIFING ASSETS FOR PROSPECTIVE REPLACEMENT IS FLAWED?

A There are two significant reasons why the Burns and McDonnell age-based approach to identifying assets for prospective replacement is flawed, and why age-based approaches to identifying assets for prospective replacement are not standard industry practice. These include: 1) asset age is not an accurate predictor of failure; 2) Burns and McDonnell did not use actual historical asset failure rates to develop the survivor curves used to predict asset "likelihood of failure" during the TDSIC time frame. Instead of using actual historical asset failure rates – the best predictor of future asset failure -- the Burns and McDonnell survivor curves are based 100% on assumptions.

Q. BUT ISN'T THE USE OF SURVIVOR CURVES, AND ASSOCIATED LIKELIHOODS OF FAILURE, A STANDARD INDUSTRY PRACTICE?

A. The use of survivor curves and associated likelihoods of failure is standard industry *accounting* practice. They are commonly used to determine appropriate depreciation rates, typically in rate cases, as IPL witness De Stigter testifies.[8] To my knowledge, age-based failure predictions are not used by any utility, other than those in Indiana, to determine when assets should be replaced, or to prioritize assets for replacement. The estimated useful life estimates equipment manufacturers provide, and which are a significant input into survivor curves, are designed primarily to satisfy utilities' needs for depreciation rate justification, not as a guide to how long any individual asset will operate before failing. Accountants turn to engineering firms to help them determine appropriate depreciation rates for technical equipment. This is how firms like Burns and McDonnell, and IPL's 'second opinion' consultant Black and Veatch, began developing survivor curves and estimating likelihoods of failure.

Q. WHY IS ASSET AGE A POOR PREDICTOR OF ASSET FAILURE?

A. In my experience, assets fail in an inconsistent manner. For example, an asset that is 30 years old can easily last another 30 years, and an asset that is 10 years old can fail tomorrow. The amount of time an asset can be utilized is not based on the age of the asset, but rather on the objectively determined condition of the asset. The types of assets IPL proposes to replace using age-based failure prediction are typically replaced under standard utility practice only when the results of tests (chemical or electrical) or formal inspections (of utility poles, for example) indicate prospective replacement is justified. If you look at any utility's records you will find many assets in use that are

[8] IURC Cause No. 45264. Direct testimony of IPL witness De Stigter. Page 8 at 18.

much, much older than their useful lives as estimated at installation. A long time ago, when utilities installed wood poles, they would also put a date nail in the pole. So, for a pole installed in 1929 the date nail would have a "29" on the head of the nail. My utility career began in 1976, and I remember seeing date nails as old as 1919.

Q. WHY DOES THE FAILURE TO INCORPORATE HISTORICAL FAILURE RATES INTO SURVIVOR CURVE DEVELOPMENT CONSTITUTE A FLAW?

A. For any given type of asset, there is no better guide to future failure rates than actual historical failure rates. Historical failure rates are known and measurable; it is why equipment manufacturers, from Boeing and General Motors to Apple and General Electric, use historical failure rates to improve production processes over time. It is also why neither the IEC Standard 31010 regarding risk assessment techniques (endorsed by ISO),[9] nor ISO Standard 55000 for risk management,[10] which IPL witness De Stigter cites as the basis for the Burns and McDonnell risk model,[11] make any mention of survivor curves at all, let alone survivor curves based entirely on assumptions. There are only two situations in which I can imagine an age-based failure prediction tool which doesn't utilize historical rates of failure might be helpful to a utility. These are 1) If the historical rates of failure are too low to justify the amount of capital a utility wants to invest; or 2) if the rates of failure are so low as to constitute an insufficient experience base for modeling, as Burns and McDonnell asserts in its Asset Risk and Investment Assessment Report.[12] In the case of the former, the failure to include historical failure rates is misleading; in the case of the latter, the need to

[9] International Electrotechnical Commission Standard 31010, "Risk Assessment Techniques". June, 2019

[10] International Standards Organization International Standard 31000, "Risk Management -- Guidelines". February, 2018.

[11] IURC Cause No. 45264. Direct testimony of IPL witness De Stigter. Page 4 at line 6.

[12] IURC Cause No. 45264. IPL Attachment BJB-2 (Public), Appendix 8.3, Section 2.2.1, p. 18.

prospectively replace assets for which need has not been proven through testing does not exist.

Q. WHAT IS THE NET RESULT OF THE FLAWS IN THE BURNS AND MCDONNELL AGE-BASED FAILURE PREDICTION APPROACH?

A. The net result is that the age-based failure prediction approach identifies many more assets for prospective replacement than standard industry practice, based on the results of asset testing and inspections would deliver.

Q. GIVEN YOUR CONCLUSION, WHAT DO YOU RECOMMEND TO THE COMMISSION?

A. I recommend that the Commission reject all five components of IPL's Plan in which assets are selected for replacement through age-based failure predictions, including Circuit rebuilds, Substation Asset Replacement, XLPE Cable Replacement, 4kW conversion, and Remote End – Breaker Relay/Upgrades.

Q. YOU TESTIFY THAT IPL'S METHOD OF IDENTIFYING ASSETS FOR PROSPECTIVE REPLACEMENT LEADS TO EXCESS INVESTMENT. DOES THIS IMPLY THAT SOME AMOUNT OF PROSPECTIVE REPLACEMENT IS WARRANTED?

A. Yes. Using standard industry practices, the prospective replacement of some assets does deliver benefits in excess of customer costs; that is how such practices have become standard in the industry. These include substation asset replacement; XLPE Cable Replacement; 4kV Conversion; Circuit Rebuilds; and Remote End – Breaker Relay/Upgrades. I would like to describe each, the applicable standard industry

practices, and the documentation the Commission should seek to justify inclusion of any amounts IPL might request in a future TDSIC application.

Q. DESCRIBE STANDARD INDUSTRY PRACTICES REGARDING SUBSTATION ASSET REPLACEMENT.

A Substation equipment does warrant additional consideration that distribution equipment does not, due to the large numbers of customers served by substations and the associated higher consequences of equipment failure. While a distribution equipment failure might impact hundreds of customers, a substation asset failure usually impacts thousands. For this reason standard industry practices have evolved to reduce the failure incidence of two types of substation assets, transformers and circuit breakers.

Transformers convert high voltage electricity on the transmission grid into medium voltage electricity for distribution. As transformers approach failure, changes in the transformer oil mark the impending failure. Chemical analysis of transformer oils can detect these changes, and indicate that a transformer should be replaced. IPL should be allowed to include the prospective replacement of any substation transformers exhibiting the telltale signs of impending failure as documented by chemical analysis of transformer oil.

Q. COULDN'T THE SAME OIL TESTING PROCESS BE USED FOR DISTRIBUTION TRANSFORMERS?

A. Yes, it could. However, the cost of collecting and testing oil samples from transformers is not inconsequential. Whereas IPL probably has scores of substation transformers,

it probably has thousands, and perhaps tens of thousands, of distribution transformers. As distribution transformer failure is a fairly rare occurrence, and given that each individual distribution transformer failure impacts so few customers, testing the oil of distribution transformers simply doesn't deliver the level of reliability benefit required to exceed testing costs. This is precisely why standard industry practice for distribution assets is "run to failure". IPL has had good reliability results following this practice.

Q. WHAT ARE THE STANDARD INDUSTRY PRACTICES REGARDING SUBSTATION CIRCUIT BREAKERS?

A. Like transformer oils, circuit breakers can be tested. Circuit breakers are tested electrically, not chemically, by creating the conditions under which the circuit breaker would be expected to operate (or "trip" just like a residential circuit breaker). Circuit breakers which do not operate under test conditions should be prospectively replaced, as they are also likely to fail to operate in actual operation. All utilities maintain a periodic substation circuit breaker testing program; IPL could increase the frequency of substation circuit breaker testing as part of its TDSIC Plan.

Another standard industry practice for substation circuit breakers is to monitor the number of times each operates (trips). Manufacturers specify the expected number of operations for which a circuit breaker is rated. When the specified number of operations is reached, substation circuit breakers should be tested. However, given the rarity of substation circuit breaker operations, circuit breaker test failure is much more common than exceeding operation count ratings. IPL should be allowed to include in its TDSIC Plan the prospective replacement of substation circuit breakers which fail testing procedures or exceed operation count ratings.

Q DESCRIBE STANDARD INDUSTRY PRACTICES OR PROSPECTIVE REPLACEMENT OF XLPE CABLE.

A Most utilities use a simple rule of thumb to identify underground cables for prospective replacement. In my experience, "three strikes and you're out" is a common rule of thumb, meaning that any segment of underground cable which incurs three failures should be replaced in its entirety. When asked for its underground cable replacement policy in discovery, IPL responded only that its policies "are within industry norms."[13] IPL should be allowed to include in its TDSIC plan the replacement of any XLPE cable segment once it experiences three failures.

Q. DESCRIBE STANDARD INDUSTRY PRACTICES FOR 4kV CONVERSION

A. 4kV substations and circuits command more than their fair share of management attention. However, the inconveniences associated with 4kV circuit management and operation do not rise to a level of incremental cost which comes anywhere close to the cost to replace such circuits. Nor, in my experience, are 4kV circuits any less reliable than other circuits, all else being equal. I have personally completed analyses to justify the cost-effectiveness of 4kV replacement, and always reach the same conclusion: not cost-effective.

On the other hand, as with 13kV circuits, load growth on 4kV circuits sometimes dictates that circuit capacity be increased. In these instances, rather than upgrade the capacity of a 4kV circuit, it makes good economic sense to simply convert such 4kV circuits to a 13kV circuit. Conversion to 13kV represents the least expensive means to

[13] IURC Cause No. 45624. IPL response to City DR 3-30(b).

increase the capacity of a 4kV circuit. This has become the standard industry practice for 4kV circuit conversion: as capacity is reached, convert to 13kV. IPL should be allowed to include in its TDSIC Plan only those 4kV circuit conversions for which capacity increases are required. By following this practice, IPL will likely eliminate all 4kV circuits over the course of a few decades. But there is no justification for eliminating all 4kV circuits in the next seven years (the period covered by IPL's TDSIC Plan) for circuits that are not overloaded.

Q. DESCRIBE STANDARD INDUSTRY PRACTICES FOR CIRCUIT REBUILDS

A. There is no standard industry practice for rebuilding circuits. Like 4kV conversion, the only reason to rebuild a circuit is to increase the capacity as needed to accommodate load growth. IPL should be allowed to include in its TDSIC Plan only those circuit capacity upgrades shown to be necessary by load growth forecasts.

Q. DESCRIBE STANDARD INDUSTRY PRACTICES FOR REMOTE END – BREAKER RELAY/UPGRADES

A. IPL should be allowed to include Remote End – Breaker Relay/Upgrades in its TDSIC Plan using standard industry practices for relays. That is, those devices which fail relay testing should be authorized for replacement and included in IPL's TDSIC Plan.

III. Some IPL TDSIC Plan Components Have Merit, and Warrant Approval With Conditions

Q YOU TESTIFY THAT IPL'S USE OF AGE-BASED FAILURE PREDICTION INVALIDATES MANY PLAN COMPONENTS. DO OTHER PLAN COMPONENTS HAVE VALUE?

A While I believe several TDSIC Plan components have potential to deliver value in excess of customer costs, none should be approved without conditions. I believe those which warrant approval with conditions, in rough order of benefits relative to cost, include distribution automation capabilities; pole replacements; steel tower life extensions, and central business district secondary network upgrades.

Q. PLEASE DISCUSS WHY DISTRIBUTION AUTOMATION WARRANTS APPROVAL WITH CONDITIONS.

A. In my experience, and in research, distribution automation can offer good potential value relative to cost, and should be approved by the Commission with conditions. Distribution automation is an umbrella term that means many different things to many different people and utilities. IPL's approach to distribution automation includes some of the more valuable capabilities incorporated by the term, including Fault Location, Isolation, and Service Restoration (FLISR), and Integrated Volt-VAr Control (IVVC) for conservation voltage reduction (CVR). While I believe IPL overestimated distribution automation benefits in its business case, I agree that the benefits of these two distribution automation capabilities can outweigh their costs, if carefully implemented and operated. The conditions I recommend the Commission attach to any distribution automation it elects to approve relate to implementation and operation concerns.

Q. WHAT CONDITIONS WOULD YOU ATTACH TO COMMISSION APPROVAL OF IPL'S DISTRIBUTION AUTOMATION PLAN?

A. My distribution automation recommendations include one condition that I believe to be essential, and one condition which is more appropriately described as cautionary. The essential condition is annual performance reporting on IVVC for CVR, while the

cautionary advice relates to the new central control system which IPL proposes as part of distribution automation.

Q. PLEASE DESCRIBE YOUR RECOMMENDED PERFORMANCE REPORTING CONDITION ON IVVC FOR CVR.

A. According to research, the implementation of integrated volt-VAr control (IVVC) for the purposes of conservation-related voltage reduction (CVR) is one of the more cost-effective grid modernization actions any utility can take. Customers experience reductions in electricity use without any required actions or changes in behavior. Of course, from a utility's perspective, reductions in electricity use represent a reduction in electric sales volumes, and therefore reductions in revenues and profits. As a result of this utility bias against CVR, I recommend any IVVC investment proposal be approved with a required and comprehensive performance reporting program.

A comprehensive CVR performance reporting program should involve the establishment of average annual voltage baselines for each circuit on which the IVVC capability will be installed. Then, at least annually thereafter, a utility implementing IVVC should be required to report average annual voltage for each circuit, thereby documenting reductions from the baseline and continuous improvement over time. Similar reporting processes could, and perhaps should, be required for power factor (the "VAr" in Integrated Volt-VAr Control), though the potential impact on energy use from power factor improvement is much smaller than the potential impact from CVR.

Q. WHAT IS YOUR CAUTIONARY ADVICE FOR THE CENTRAL CONTOL SYSTEM?

A. IPL's distribution automation program includes a significant budget to install a central distribution control system. Such systems are typically called advanced distribution management systems, or "ADMS". ADMS generally involves the integration of various software capabilities into a single application for the convenience of grid operators in distribution control centers. The integration of some systems, such as an outage management system as IPL proposes, makes intuitive sense. However, my concern is that software integration for the sake of integration can be expensive, and cost-ineffective.

Most of the value of distribution management (central control) software comes not from their integration via ADMS, but from their component parts. In IPL's case, these valuable component parts include FLISR and IVVC. These components can be implemented individually; it is not essential to install them as part of an ADMS. I have observed utilities taking the automation potential of ADMS investments to an extreme, using such potential as justification to spend hundreds of millions of dollars on ADMS. I have also observed utilities prioritizing integration over the implementation of the components parts, such as IVVC for CVR. I was unable to determine from discovery to date if any of these situations apply to IPL. But the takeaway is that IPL should prioritize the valuable components of central control software over integration for integration's sake, and be careful not to pursue the "rabbit trail" of over-hyped automation potential.

Q. DESCRIBE WHY IPL'S POLE REPLACEMENT PROPOSAL WARRANTS APPROVAL, AND ANY ASSOCIATED CONDITIONS YOU WOULD ATTACH.

A. Pole inspection processes are well-established, and IPL has well-developed policies. As IPL's Plan only eliminates the distinction between two categories of inspection failure, I recommend IPL's pole replacement proposal should be approved, under the condition that inspection failure documentation be provided for replaced poles. Another Pole Replacement condition relates to the City's recent Agreement with IPL on street lights. Poles replaced in accordance with the City's street light Agreement with IPL should be excluded from the TDSIC Plan.

Q. DESCRIBE WHY IPL'S STEEL TOWER LIFE EXTENSION PROPOSAL WARRANTS APPROVAL, AND ANY ASSOCIATED CONDITIONS YOU'D ATTACH.

A. As far as I know, there are no standard industry practices for steel tower life extension efforts. IPL should design a formal inspection routine, similar to that used in pole inspections, to identify towers for which life extension efforts are required. IPL should be allowed to include life extension efforts for steel towers which fail inspection as part of its TDSIC Plan, under the condition that inspection failure documentation be provided for towers identified for life extension efforts.

Q. DESCRIBE WHY CBD SECONDARY NETWORK UPGRADES WARRANT APPROVAL, AND ANY ASSOCIATED CONDITIONS YOU WOULD ATTACH.

A. I know of no standard industry practices which apply specifically to underground vault and facility upgrades. The capabilities IPL proposes in its Plan for underground central business district facilities could have merit owing to employee and public safety, limitations of equipment-damage, and benefits to non-IPL utilities. However, IPL

includes no benefit-cost analysis of its CBD network investment in its TDSIC Plan. If IPL can develop and provide a thorough and substantiated analysis which indicates benefits in excess of costs for central business district upgrades, I believe the proposed capabilities should be approved for inclusion in IPL's TDSIC Plan.

IV. Other Plan Components Are Unlikely To Ever Deliver Benefits In Excess Of Costs To Customers

Q THERE ARE SOME COMPONENTS OF IPL'S PROPOSED TDSIC PLAN YOU HAVE NOT YET ADDRESSED. WHAT DO YOU RECOMMEND FOR THESE?

A I have not yet addressed the Tap Reliability Improvement Projects, Meter Replacement, Static Wire Performance Improvement, and Substation Design Upgrade components of IPL's Plan. While City witness Alvarez's testimony discusses his recommendation to reject IPL's Meter Replacement proposal, I will discuss the reasons I believe the other proposals should be rejected presently.

Q. WHY DO YOU BELIEVE IPL'S TAP RELIABILITY IMPROVEMENT PROJECTS PROPOSAL SHOULD BE REJECTED?

A. As I have testified, there is no industry practice for prospective replacement of distribution assets. This means that no distribution asset should be prospectively replaced without a favorable benefit-cost analysis. IPL's tap reliability improvement project proposal consists only of annual capital budgets, and provides no specific projects for evaluation. While IPL provides an analysis indicating benefits in excess of costs for tap reliability projects overall, witness Alvarez testifies the reliability improvement projections on which benefit estimates are based cannot be validated without specific project proposals to examine. As such, IPL's reliability improvement

projections are simply assumptions without support. Further, Mr. Alvarez testifies that the operating expense savings IPL estimates from tap reliability improvement projects are not backed by any headcount reductions. I concur with Mr. Alvarez's assessment that the benefits IPL projects from tap reliability improvements cannot be validated. This, in combination with the fact that there are no standard industry precedents for prospective distribution asset replacement, leads me to recommend that the tap reliability improvement projects proposal be rejected.

Q. WHAT ABOUT IPL'S PROPOSALS FOR STATIC WIRE PERFORMANCE AND SUBSTATION DESIGN UPGRADES?

A. IPL's proposals for Static Wire Performance and Substation Design Upgrades suffer from two deficiencies. Not only does IPL provide no benefit-cost analysis for these proposed programs, there is no standard industry practice or precedent for them. As a result, I recommend the Commission reject IPL's Static Wire Performance and Substation Design Upgrade proposals.

V. Summary and Recommendations

Q PLEASE SUMMARIZE YOUR TESTIMONY

A I began my testimony by making general observations on the state of US grid modernization, providing evidence that recent increases in grid investment have not delivered reliability benefits to customers in aggregate. I also provided data on IPL's reliability performance, finding it to be exceptionally good relative to other utilities, and calling into question the need for IPL's TDSIC Plan for public convenience and necessity.

I then provide evidence for my claim that the methodology IPL employs to justify prospective asset investment overstates the need for such investments. These include the facts that 1) The use of age-based failure predictions to justify prospective asset replacements is not standard industry practice; 2) Asset age is a poor predictor of asset failure; and 3) IPLs future asset failure rate assumptions, which it calls survivor curves, have no basis in historical asset failure rates. The survivor curves, and associated failure rate predictions, are therefore based entirely on assumptions. I recommend the Commission reject all five components of IPL's Plan which were developed using age-based failure predictions, totaling $753 million. In the event the Commission rejects IPL's Plan as recommended, I provide guidance for future reconsideration. Using standard industry practices, I believe IPL could legitimately justify a portion of each of the five components for TDSIC Plan inclusion, though at dramatically reduced deployment extents and dollar amounts.

My testimony then turns to the positive features of IPL's Plan. I recommend that the Commission approve the distribution automation components of the Plan, as long as performance reporting for conservation voltage reduction is mandated, and caveats regarding central control software are monitored. Similarly, I provide recommendations for approval and associated conditions for Pole Replacements, Steel Tower Life Extensions, and central business district secondary network upgrades. TDSIC Plan capital amounts for components for which I recommend approval, conditionally total $176.4 million.

Finally, I recommend that other parts of the Plan be rejected entirely based on either a lack of cost-effectiveness or standard industry practice. These include Tap

Reliability Improvement Projects, Meter Replacement (based on City witness Alvarez's testimony), Static Wire Performance Improvement, and Substation Design Upgrades. Capital amounts for these components of IPL's TDSIC Plan total $289 million.

Q DOES THIS CONCLUDE YOUR DIRECT TESTIMONY?

A Yes, it does.

Appendix A – Curriculum Vitae of Dennis Stephens EE

Profile

Mr. Stephens has over 35 years' experience in electric distribution grid planning, design, operations management, asset management, and the innovative use of technology to assist with these functions. He spent his entire career at Xcel Energy subsidiary Public Service Company of Colorado, an electric (and gas) distribution business serving over 1.2 million customers. In a series of electrical engineering and management roles of increasing responsibility, Mr. Stephens served as Director, Electric and Gas Operations for the City and County of Denver; Director, Asset Strategy; and Director, Innovation and Smart Grid Investments (for all of Xcel Energy's 8-state service territory). Mr. Stephens retired from Xcel Energy in 2011, and now works for the Wired Group on a part-time basis.

Noteworthy Projects

Smart Grid Solutions Development, 2010. Worked with several large solution providers to develop and implement technical distribution grid solutions and innovations, including IBM, ABB, and Siemens**.**

DER Integration Strategy and Roadmap Development, 2009. Established DER integration strategy and road-maps for Xcel Energy, including technology and capability roadmap for high DER penetration geographies in Boulder, Colorado.

SmartGridCity™ Project Development, 2008. Developed the technical foundations for the SmartGridCity project in Boulder, Colorado (46,000 customers).

Distribution Automation Design, 2007. Worked with ABB Corporation to design software to identify and locate failures in underground cable. The ABB Smart Analyzer™ was programmed with three traps to capture detailed information using Oscillography/Digital Fault Records (O/DFR).

Utility Innovations Program Development, 2006. Led the development of Xcel Energy's Utility Innovations program, for which Mr. Stephens' team receive a national Edison Award.

Distribution Asset Optimization Process, 2005. Taking advantage of SPL's Centricity Outage Management Program and Itron's Real Time Performance Management system

(RTPM), developed a Distribution Asset Optimization process by mining AMI meter data and asset utilization information in the development of an enhanced asset loading forecasting process. The process took advantage of the systems' abilities to forecast sudden changes in usage patterns to take prospective mediation of equipment overloading.

Distribution Asset Optimization Software Development, 2004. Worked with Itron on the development of a Distribution Asset Optimization software program.

Fixed AMI Communications Network Development, 2003. Worked with Itron to pilot one of the first applications of a fixed wireless radio network to collect data from customer meters.

Electric Asset Management Strategy Development, 2002. Developed Xcel Energy's Electric Distribution Asset Management Strategy

Automated Switching System Deployment, 2001. Worked with S&C Electric Corporation on to deploy its Intelliteam™ devices on Xcel Energy's distribution grid to reduce the number of customers impacted by an outage by isolate faults through automated switching routines.

Regulatory Appearances

Michigan PSC Investigation into Distribution Planning. Joint testimony with Paul Alvarez in U-20147 on behalf of ABATE, a business customer advocacy group. Proposed a transparent distribution planning process featuring stakeholder engagement.

New Hampshire PUC Investigation into Grid Modernization (and Distribution Planning). Joint testimony with Paul Alvarez in IR15-296 on behalf of the Consumer Advocate. Proposed a transparent distribution planning process featuring stakeholder engagement.

California PUC Pacific Gas & Electric Rate Case. Joint testimony with Paul Alvarez in A.18-12-009 on behalf of The Utility Reform Network, a consumer advocate. Provided recommendations on the IOU's $936 million grid modernization plan.

California PUC Southern California Edison Rate Case. Joint testimony with Paul Alvarez in A.16-09-001 on behalf of The Utility Reform Network, a consumer advocate. Provided recommendations on the IOU's $1.275 billion grid modernization proposal

California PUC Pacific Gas & Electric Rate Case. Joint testimony with Paul Alvarez in A.15-09-001 on behalf of The Utility Reform Network, a consumer advocate. Provided recommendations on the IOU's $100 million distributed energy resource accommodation proposal.

Notable Publications and Presentations

The Rush to Modernize: An Editorial on Distribution Planning and Performance Measurement. With Paul Alvarez and Sean Ericson. Public Utilities Fortnightly. July 8, 2019. Pages 116+

Modernizing the Grid in the Public Interest: Getting a Smarter Grid at the Least Cost for South Carolina Customers. Whitepaper co-authored with Paul Alvarez for GridLab. January 31, 2019

Modernizing the Grid in the Public Interest: A Guide for Virginia Stakeholders. Whitepaper co-authored with Paul Alvarez for GridLab. October 5, 2018.
DistribuTECH 2010, Tampa, Florida. "Realizing the Benefits of DER, DG and DR in the Context of Smart Grid"

OSI 2008 User's Conference, Denver, Colorado; DistribuTECH 2007, San Diego, California. "Smart Grid City: A blueprint for a connected, intelligent grid community"

ABB 2007 World Conference, Jacksonville, Florida. "Use of Distribution Automation Systems to identify Underground Cable Failure"

North American T&D Conference 2005, Toronto, Canada; Itron 2005 User Conference, Boca Raton, Florida. "Xcel Energy Utility Innovations and Distribution Asset Optimization"

DistribuTECH 2005, San Diego, California. "How Advanced Metering Technology is Driving Innovation at Xcel Energy"

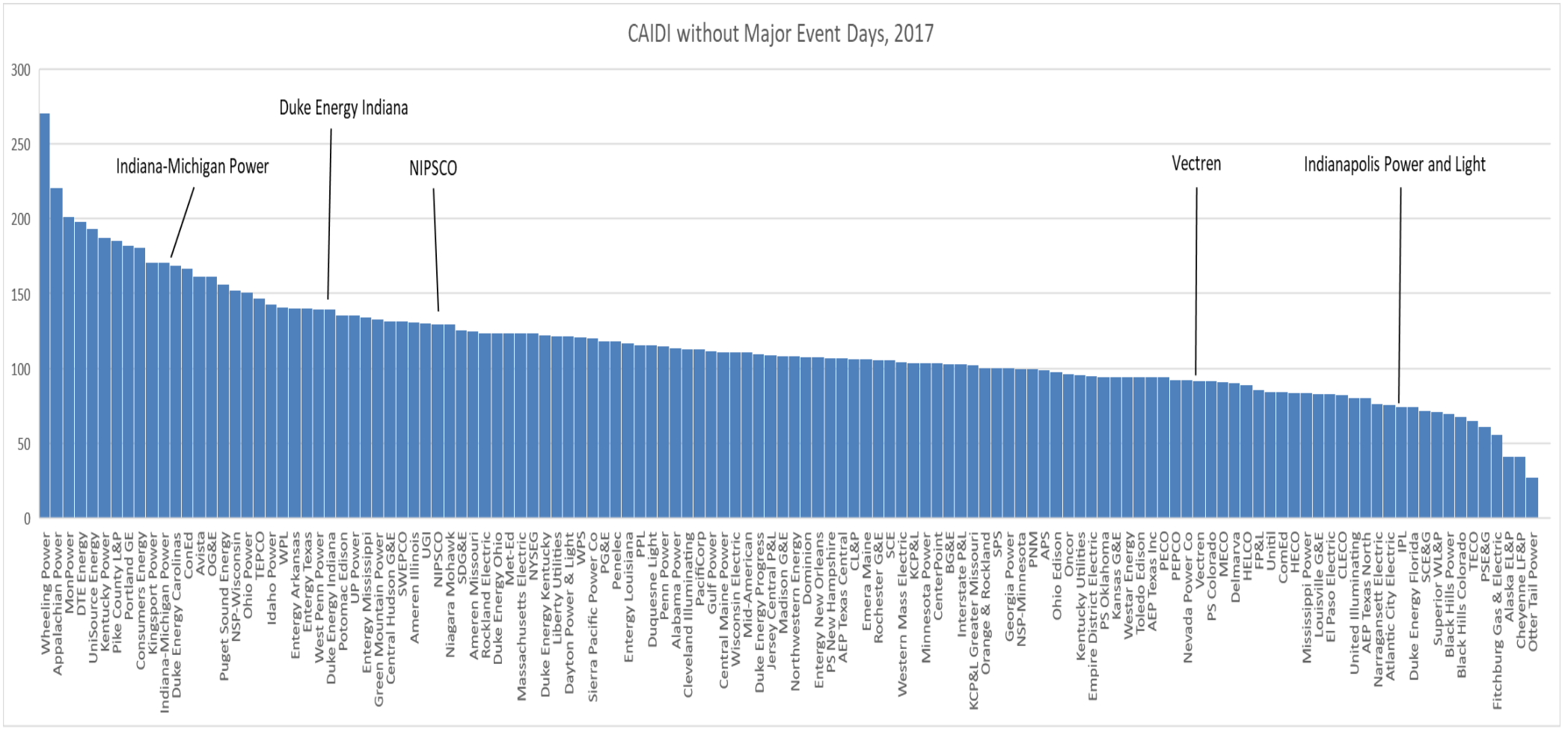
Education

Bachelor of Science Degree in Electrical Engineering, 1975, University of Missouri at Rolla.

Awards

National Edison Award for Utility Innovations, 2006.

Appendix B – Indianapolis Power & Light Relative Reliability Performance



STATE OF INDIANA

INDIANA UTILITY REGULATORY COMMISSION

VERIFIED PETITION OF INDIANAPOLIS POWER & LIGHT COMPANY FOR APPROVAL OF IPL'S TDSIC PLAN FOR ELIGIBLE TRANSMISSION, DISTRIBUTION, AND STORAGE SYSTEM IMPROVEMENTS PURSUANT TO IND. CODE § 8-1-39-10	))))))	CAUSE NO. 45264

VERIFICATION

I, Dennis Stephens EE, a Consultant of Wired Group, affirm under penalties of perjury that the foregoing representations are true and correct to the best of my knowledge, information and belief.

Dennis Stephens EE
10/7/19