# 16RTEP1 Proposal

SUBMITTED BY: ITC MID-ATLANTIC DEVELOPMENT LLC

March 31, 2016

# REDACTED VERSION

# TABLE OF CONTENTS

# A. EXECUTIVE SUMMARY

## 1. Name and Address

ITC Mid-Atlantic Development LLC
27175 Energy Way
Novi, MI 48377

## 2. Proposal Window and Associated Violations Addressed

ITC Mid-Atlantic Development LLC ("ITC") has proposed four 500-kV alternatives that resolve the flowgate 102 violation which is a thermal overload of the Rogers Rd to Carson 500-kV line identified as a Generator Deliverability issue in the 2016 RTEP Proposal Window 1. Two alternatives consist of a greenfield 500-kV line project and the other two alternatives consist of a greenfield 500-kV substation with an associated 230-kV line, as detailed in the sections below. The Rawlings to Steers Project ("16RTEP1-2b") also resolves some of the 230-kV Generation Deliverability issues on flowgates 68, 78, and 249 near Richmond, VA. The projects and resolved flowgates identified in 2016 RTEP Proposal Window 1 are shown in Table A1 below.

***Table A1– Flowgate Resolution***

| Project | 60 | 61 | 62 | 66 | 68 | 70 | 71 | 72 | 76 | 78 | 102 | 248 | 249 | Adverse Impact |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 16RTEP1-2b | N | N | N | N | Y | N | N | N | N | Y | Y | N | Y | NEW-1 |
| 16RTEP1-3b | N | N | N | N | N | N | N | N | N | N | Y | N | N | NEW-1 |
| 16RTEP1-4a | N | N | N | N | N | N | N | N | N | N | Y | N | N | NEW-1 |
| 16RTEP1-4c | N | N | N | N | N | N | N | N | N | N | Y | N | N | NEW-1, NEW-2 |

## 3. Violations Caused or Not Addressed by Proposal

The projects were identified primarily as options to resolve the 500-kV Generator Deliverability issue identified south of Richmond for flowgate 102. Further, the 16RTEP1-2b project was found to provide relief to various combinations of the 230-kV Generator Deliverability issues into Richmond as identified in flowgates 68, 78, and 249.

As shown in Table A1 under the Adverse Impact column, Projects 16RTEP1-2b, 16RTEP1-3b, 16RTEP1-4a and 16RTEP1-4c all cause a marginal increase to the loading on the Charles City to Lakeside 230-kV line (NEW-1) for the loss of various related contingencies, as identified as a part of the Generator Deliverability test for single contingencies. Note that in base model results, the loading on this line was already nearly at 100-percent of its rating limit; however, the branch was not identified as a flowgate generation deliverability issue by PJM. Additionally, the 16RTEP1-4c project causes the incumbent Transmission Owner (Dominion) segment of the newly created Lewis to Clubhouse 230-kV line (NEW-2) to overload. See Section D for more details regarding these violations.

# 4. Identification of Interregional Project

All proposed project options were developed to address a reliability need within the PJM footprint and are wholly contained within the boundaries of PJM member operating territories (Dominion). However, an existing interconnection will be modified that may require minor relaying modifications at the Duke Progress-owned Wake station.

# 5. Intentions to Construct/Own/Operate/Maintain

ITC Mid-Atlantic Development LLC intends to be the Designated Entity to construct, own, operate and maintain the project described in this proposed project submittal.

# 6. Description of Proposed Solution and Resolution

ITC has identified the following projects to address Generator Deliverability thermal violations identified as a part of the 2016 RTEP Proposal Window 1 (Figure 1, Table A2):

*Table A2– Summary of Proposed Solutions*

| Project | Line | Proposed Solution | Resolution |
|---|---|---|---|
| **16RTEP1-2b** | Rawlings to Steers 500-kV Line | 21.0-miles of new 500-kV single-circuit overhead line from Rawlings substation (Dominion) to a new ITC owned 500-kV Steers switchyard | • Rogers Rd – Carson 500-kV overload<br>• 230kV Richmond Area Issues |
| **16RTEP1-3b** | Rawlings to Carson 500-kV Line | 23.1-miles of new 500-kV single-circuit overhead line from Rawlings substation (Dominion) to Carson substation (Dominion) | • Rogers Rd – Carson 500-kV overload |
| **16RTEP1-4a** | 500-kV Lewis Substation and Clubhouse 230-kV Line | New ITC owned 500-kV Lewis substation and 4.0-miles of new 230-kV single-circuit overhead line from Lewis substation (ITC) to Clubhouse substation (Dominion) | • Rogers Rd – Carson 500-kV overload |
| **16RTEP1-4c** | 500-kV Lewis Substation and Clubhouse-Lakeview 230-kV Line Tap | New ITC owned 500-kV Lewis substation and 4.0-miles of new 230-kV double-circuit overhead line from Lewis substation (ITC) to tap point on Clubhouse-Lakeview 230-kV line | • Rogers Rd – Carson 500-kV overload |

# 7. Description of How the Project(s) Should be Considered

Each greenfield proposed project described above in Table A2 is an alternative to address the primary target issue on the 500-kV system and ancillary target issues on the nearby 230-kV system. It is not anticipated for PJM to combine or segment the ITC projects since there is a high degree of overlap on the resolution. However, ITC makes no prohibition on PJM scope additions, combinations, or reductions to these ITC projects. Issues identified in future 2016 RTEP Proposal Windows may make such revisions to greenfield project elements the most sensible approach.

The incumbent upgrade components of the project are not under ITC control but are critical components to the ITC proposal. Scope revisions, additions and subtractions to incumbent upgrades that are immaterial to the ITC resolution should be considered. The owner of these facilities is best capable of understanding the scope of the project and the more cost effective solution. For example an incumbent could identify a rearrangement at a substation that would increase, or decrease, scope and cost to the incumbent upgrades that would increase or decrease the overall cost of the project. This is exemplified in the 16RTEP1-2b and 16RTEP1-3b projects, which include an assumption that the incumbent substation modification scope at Rawlings would include adding sufficient breakers to create a breaker and a half configuration rather than adding only a single breaker in a ring bus configuration. The breaker and a half scope is more costly than the ring bus scope, but the breaker and a half configuration is preferred, particularly at higher voltages, according to PJM's Transmission Substation Design Standards.

In summary, an ITC greenfield solution should be evaluated independently of whether an incumbent or PJM has a better approach than ITC's to addressing the necessary upgrades to properly incorporate the ITC greenfield proposal.

# 8. High-Level Overview of Cost and Cost Commitment

The capital cost of the proposed projects in 2016 dollars, including the substation work that would be assigned to incumbent transmission owners, are shown in Table A3 below and described in detail in section E.2.

***Table A3– Summary of Total Project Costs***

| Project | Greenfield Cost in 2016 Dollars ($MM) | Incumbent Cost in 2016 Dollars ($MM) | Total Project Cost in 2016 Dollars ($MM) | Total Project Cost in 2020 ISD Dollars ($MM) |
|---|---|---|---|---|
| 16RTEP1-2b | $85.9 | $25.6 | $111.5 | $120.3 |
| 16RTEP1-3b | $74.9 | $26.3 | $101.2 | $109.3 |
| 16RTEP1-4a | $38.0 | $23.8 | $61.8 | $66.9 |
| 16RTEP1-4c | $39.8 | $20.0 | $59.8 | $64.6 |

### Cost Containment/Commitment

As described in Section E.3, ITC is proposing a binding project cost cap for all projects proposed herein. This cap on project costs would change only under certain explicitly defined, narrow exceptions based on circumstances beyond ITC's control and which would be experienced by any project owner.

# 9. Additional Benefits of Proposal

## Enhanced Reliability and Resilience

The projects submitted by ITC offer PJM a wide range of solutions to address some of the generator deliverability and common mode outage violations identified in this 2016 RTEP Proposal Window #1. Many of the facilities in and around the Richmond, VA area are heavily loaded to support the delivery of generation to load centers in Richmond, Virginia Beach-Norfolk-Newport News, and other large metropolitan areas further north. While all of the submitted ITC projects resolve one or more of the PJM identified violations, 16RTEP1-2b and 16RTEP1-3b provide a longer term solution with significant loading relief to the 500-kV facilities that serve as a delivery path of existing and proposed generation in the area south of Richmond.

Further, the existing Carson substation appears to be a critical delivery hub into Richmond with five existing 500-kV circuits and three existing 230-kV circuits. 16RTEP1-2b offers an alternate delivery path west of the Carson hub. This solution will increase the resilience of the PJM transmission network by decreasing the reliance on the Carson substation to feed power into Richmond should an outage to the substation or facilities feeding power to Carson occur. Please see Section D for more discussion and results around ITC's reliability analysis.

## Outage Flexibility for End of Life Facilities

Dominion has identified a number of facilities in the general study area that are approaching their end of life in the near term (5 years) and long term (10 years). ITC's proposed greenfield solutions will enable PJM and Dominion to more effectively handle facility outages related to the replacement and/or removal of those facilities reaching their end of life.

## Unique Qualifications

As the nation's first and largest independent transmission-only utility, ITC has unrivaled experience in the successful integration of established transmission systems and non-incumbent development projects into a unified independent transmission company. To date, ITC's Southwest Power Pool ("SPP") affiliate ITC Great Plains LLC ("ITC Great Plains" or "ITCGP") remains the only transmission owner in United States history to be built from the ground up, through the construction of greenfield transmission projects, not through the acquisition of existing transmission lines. No other utility has at its disposal ITC's resources, experience, and singular focus on transmission in general and on non-incumbent transmission development in particular, and ITC will leverage these unique characteristics to develop this greenfield project and successfully integrate it into ITC's other operations, just as ITC Great Plains' facilities have been.

ITC has successfully expanded from its origins in Southeast Michigan to include planning, construction, operation and maintenance of over 15,000-miles of transmission facilities in seven states covering three NERC regions and two RTO footprints. ITC is expanding into the PJM footprint and is actively engaged in ensuring all PJM requirements will be met when the new Covert to Segreto 345-kV line in Southwest Michigan goes into service on June 1, 2016. This will be ITC's first project energized in PJM.

Since ITC was formed in 2003, contract maintenance services have been used over its entire multistate footprint. These services have been typically performed via a specialized utility maintenance contractor but in some cases have been in partnership with local utilities to leverage their local experience and knowledge. ITC has consistently delivered best-in-class reliability metrics.

ITC operates as a utility in eight different states, and recognizes that states have varying regulatory and legal requirements. ITC has unrivaled experience in successfully navigating state regulatory processes to obtain public utility status and to obtain siting authority for greenfield transmission projects, particularly in states outside of ITC's incumbent footprint. ITC will leverage this experience in obtaining state regulatory approvals outside of its incumbent territory to successfully obtain all necessary approvals in PJM states where ITC is successful in securing projects through the PJM competitive process.

## Independent Business Model

ITC's independent transmission business model is unique and vital to its corporate identity. ITC does not own generation or distribution assets; ITC employees and directors are prohibited from owning the market securities of market participants (generation owners, load-serving entities, marketers, etc.); and there are strict restrictions on market participants owning ITC stock. Unlike some utilities that have created stand-alone transmission subsidiaries, ITC is not owned by utility companies, holding companies of utilities, or entities that buy or sell electric energy.

Because ITC is fully independent, it does not have and is not distracted by conflicting interests with generators, markets, electricity retailers and other market participants. ITC's attention and resources are focused solely on the reliable delivery of low cost energy to end users.

The independent transmission model provides numerous substantial benefits:

- **Transparency:** Throughout transmission development and operations, ITC is transparent in its planning processes, design and routing, construction, operations and maintenance

- **Operational Excellence:** Since high-voltage transmission is ITC's sole business, ITC has an unparalleled focus on reliable transmission operations, through which it delivers creative and flexible solutions to transmission needs, and drives benefits and value to transmission customers.

- **Reliability:** Without other activities or lines of business that can become distractions, ITC is completely focused on the reliability of transmission systems.

- **Infrastructure Investment:** Since ITC does not have other capital-intensive businesses such as generation or distribution, there are no internal conflicts for capital that can lead to deferring needed transmission investments.

- **High Quality Credit:** ITC's unique business model and long-term record of achievements in financial management, project development, construction and operations have resulted in investment-grade credit ratings, which ITC is committed to retaining. Higher credit quality enables consistent and predictable access to capital, even during challenging economic times, and results in lower borrowing costs to be borne by transmission customers.

- **Public Policy Alignment:** ITC's independence does not favor any specific type of generation, but ITC's focus on transmission efficiency and flexibility results in a more robust transmission system that can be a strong facilitator of various public policies.

- **Facilitate Generator Interconnections:** Since ITC does not own generation that may be impacted by new generation or transmission facilities, generators will be treated fairly throughout the interconnection process.

- **Customer Focus:** ITC's independence from all electricity generators, buyers and sellers allows planned improvements to the electric transmission grid for the broadest public benefit including seams and regional projects.

FERC has also recognized the benefits of an independent transmission company. ITC's superior record of investment in reliability and economic infrastructure to facilitate energy markets has been recognized in federal policies aimed at perpetuating and replicating ITC's independent model. Benefits cited by FERC include:

1. Improved asset management including improvements in the reliability of the systems ITC owns;;
2. Improved access to capital markets, given a more focused business model than that of vertically-integrated utilities;
3. Development of innovative services; and
4. Additional independence from market participants

In summary, ITC offers the following benefits to PJM:

- **Vast Resources** – Because ITC is the largest independent transmission owner in the country, it has the resources needed to undertake all sizes and complexities of projects;
- **Experience in the PJM Region** – Existing connections and the Covert-Sergreto project means ITC will have a reduced or very minimal learning curve, so we can hit the ground running in PJM earlier than other non-incumbent owners;
- **Experience Operating Infrastructure in Different Regions** – ITC has owned, operated and maintained more than 15,600 miles of transmission lines in seven states, serving a combined peak-load of more than 26,000 MW, and is the sole transmission-owning utility to successfully form a new non-incumbent transmission-owning affiliate from scratch;
- **Experience participating in Multiple Regional Processes** – ITC is a transmission-owning member in both the Midcontinent Independent System Operator ("MISO") and the SPP Regional Transmission Organizations ("RTO") and actively participates in both the planning and operations process of both RTOs;
- **Scalable Resources** – ITC can match its expertise based on the needs of its customers because of its close working relationships with industry-leading consultants and contracting firms.

# B. COMPANY EVALUATION INFORMATION

## 1. Name and Address of Primary and Secondary Contact


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## 2. Pre-Qualification Submittal Identification Number

ITC affirms that the information included in its pre-qualification application dated March 2014 and posted on the PJM website reflects the company's present qualifications.

## 3. Technical & Engineering Qualifications

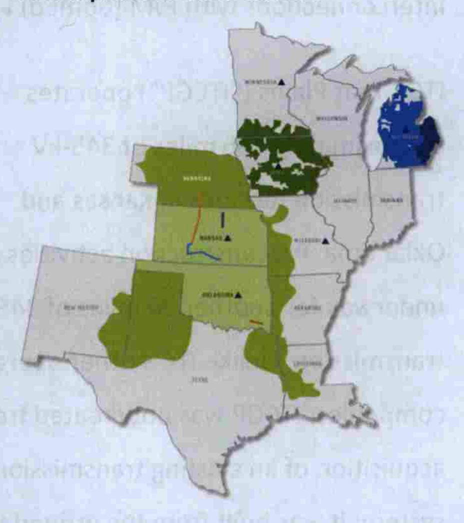
ITC Mid-Atlantic Development LLC is a wholly-owned subsidiary of ITC Grid Development, LLC, which is itself a wholly-owned subsidiary of ITC Holdings Corp. ITC Mid-Atlantic was formed to develop, construct, own, operate, maintain and finance transmission facilities in PJM. As a wholly-owned subsidiary of ITC Grid Development, LLC, ITC Mid-Atlantic has full access to the resources, capabilities, and expertise of ITC Holdings Corp. and its affiliates.

ITC is the nation's first, largest and only publicly-traded independent transmission company. Since its founding in 2003, ITC has invested over $5.8 billion in the electric transmission grid to improve reliability, expand non-discriminatory access to markets, lower the overall cost of delivered energy and allow new generating resources to interconnect to its transmission systems regardless of ownership. In its first 10 years, ITC successfully acquired and integrated three transmission businesses. In addition, ITC established a new subsidiary company, ITC Great Plains, a new pioneering transmission-only utility that was created from the ground-up. ITC Great Plains has identified and facilitated critical regional transmission infrastructure in the SPP footprint, and has constructed a portfolio of actionable transmission development projects by partnering with local utilities and electric cooperatives.

## a. Operating Companies

A brief summary of the existing operating companies provides a high-level context of ITC and its capabilities to develop and own transmission projects (approvals, siting, engineering, construction, operations and maintenance).

**ITC Companies in MISO and SPP**



ITC has four operating companies that own, operate and maintain transmission assets of multiple voltage levels in diverse geographies and conditions: International Transmission Company, d/b/a; ITC*Transmission*; Michigan Electric Transmission Company, LLC; ITC Midwest LLC; and ITC Great Plains, LLC (see Table B1).

ITC*Transmission* ("ITCT"), the operating company in Southeast Michigan is comprised of approximately 3,000 circuit miles of transmission assets formerly owned by DTE Electric and its parent company DTE Energy. ITCT has invested over $1.9 billion to upgrade and expand this system. ITCT serves the densely populated Detroit metropolitan area and its concentration of automotive and other manufacturing and supplier facilities in the region. ITCT's transmission system includes predominantly 120-kV and 345-kV facilities. ITCT also owns and operates some 230-kV facilities, as well as underground transmission facilities operated at 120-kV and 345-kV. ITCT has existing transmission interconnections with the IESO (HydroOne) and PJM (ATSI).

The Michigan Electric Transmission Company ("METC") transmission system serves much of the remainder of Michigan's Lower Peninsula and is made up of the transmission assets formerly owned by Consumers Energy and its parent company CMS Energy. METC's transmission system has approximately 5,600 circuit miles of 138-kV and 345-kV facilities. Over $1.3 billion has been invested in the METC system to strengthen the transmission network. METC also has existing interconnections with PJM (AEP).

ITC Midwest ("ITCMW") serves most of Iowa and parts of Minnesota, Illinois and Missouri with approximately 6,600 circuit miles of transmission assets formerly owned by Interstate Power and Light Company and its parent company Alliant Energy. ITC has invested over $2.1 billion into the ITCMW system since acquiring the assets in late 2007. The ITCMW footprint is predominantly rural and includes 34.5-kV, 69-kV, 115-kV, 161-kV and 345-kV facilities. ITCMW has existing interconnections with PJM (ComEd) as well.

ITC Great Plains ("ITCGP") operates approximately 436 miles of 345-kV transmission facilities in Kansas and Oklahoma. Preconstruction activities are underway for another 30 miles of 345-kV transmission. Unlike ITC's other operating companies, ITCGP was not created from the acquisition of an existing transmission system; it was built from the ground up by establishing a presence in a new region, acquiring discrete transmission assets and acquiring the rights to construct, own and operate specific facilities through co-development agreements with utilities in Kansas and Oklahoma.

***Table B1 – ITC Line Miles by Voltage***

| Voltage | ITC Line miles |
|---|---|
| **<100-kV** | 4,406 |
| **100-kV – 230-kV** | 7,073 |
| **345-kV** | 4,067 |
| **Total** | 15,682 |

ITC is also expanding into PJM and is actively engaged in ensuring all PJM requirements will be met when the new Covert to Segreto 345-kV line in Southwest Michigan goes into service on June 1, 2016. This is expected to be ITC's first project energized in PJM.

In summary, ITC offers the following benefits to PJM:

- Largest independent transmission owner in the country: *resources needed to undertake complex projects*
- Experience in the PJM region through existing connections and the Covert-Segreto project: *reduces learning curve and enables ITC to hit the ground running on day one*
- Experience owning, operating and maintaining more than 15,600-miles of transmission line in seven states serving a combined peak load of more than 23,000 megawatts (MW): *processes in place to operate infrastructure in many different regions*
- Transmission-owning member of both Midcontinent Independent System Operator (MISO) and Southwest Power Pool (SPP) Regional Transmission Organizations (RTOs): *experience participating in multiple regional processes*
- Close working relationships with industry-leading consulting firms: *ability to scale up and down resources to match expertise with PJM's needs*

## b. ITC Engineering

ITC's in-house engineering staff totals nearly 301 engineering employees across the Design, Project Management, Operations and Planning departments. These resources include: 149 engineers (over 600 total years of experience) in project development functions such as detailed design for high-voltage electrical infrastructure and 10 project management engineers (over 300 total years of experience). ITC has also developed close working relationships with industry-leading consulting firms that have considerable experience working hand-in-hand with ITC on detailed engineering and design packages. These consultants act as an extension of ITC and often have teams solely dedicated to ITC projects. This arrangement enables ITC to scale resources up and down to match expertise with the present transmission development needs.

All design packages are reviewed, finalized, and approved for construction by ITC internal engineering staff. ITC will continue to use its internal expertise in both substation design engineering and transmission line design engineering in coordination with its consulting firms to develop future projects.

Through the detailed design process, ITC strives to create efficiency and optimize system performance and functionality. This effort has resulted in standardization of substation layouts, protective relay and control panels, control center design, substation equipment, and line structures. This standardization method streamlines design, creates efficiencies during maintenance practices, and optimizes required inventories due to the use of interchangeable parts.

To ensure ITC's expectations are achieved, certain policies, practices, processes, and field manuals have been developed. These include but are not limited to:

[redacted]

ITC's design and construction standards meet or exceed National Electric Safety Code ("NESC") requirements. ITC has committed to constructing transmission to a NESC Grade B standard or above. It is the objective of ITC to maintain best-in-class construction standards and techniques to provide a reliable and efficient transmission system.

## c. Operations & Maintenance

ITC has extensive experience conducting preventative and predictive maintenance on the 15,000+ circuit-miles of existing transmission lines on its system, and has consistently achieved best-in-class results in numerous reliability and safety metrics. The ultimate goals of ITC's maintenance program are to achieve compliance with all applicable North American Electric Reliability Corporation (NERC) Mandatory Reliability Standards, and to maintain its system in accordance with Good Utility Practice. To achieve these ultimate goals, ITC conducts a comprehensive maintenance program that focuses on five distinct areas: preventive, reactive, facilities, vegetation, and vehicular maintenance. For each category of preventative maintenance, ITC's program is conducted based on four principles:

1. [redacted]
2. 
3. 
4. 

ITC also supports its preventative and predictive maintenance program through efficient and reliable system designs, which ensure that ITC's system is expanded in a manner which is compatible with ITC's maintenance practices and reliability and safety goals. ITC also supports its maintenance program through capital improvements. The systematic upgrading of aging and/or obsolete equipment, such as circuit breakers, switches, relays, surge arrestors, transmission line structures, security infrastructure and other equipment, on a recurring basis obviates can significantly obviate the need for maintenance by replacing unreliable or maintenance-intensive equipment with state-of-the-art equipment that is more dependable and easier to maintain.

ITC's maintenance program has consistently achieved measureable safety and reliability results which far exceed industry averages with respect to compliance with NERC Mandatory Reliability Standards and outage prevention. ITC also has a peerless safety record – in the 2014 Edison Electric

Institute Annual Safety Survey (the most recent year in which data is available), ITC's lost work day incident rate and recordable safety incident rate were both in the top decile of all US transmission owners:

*Table B2 – Lost Work Day Case Incident Rate*

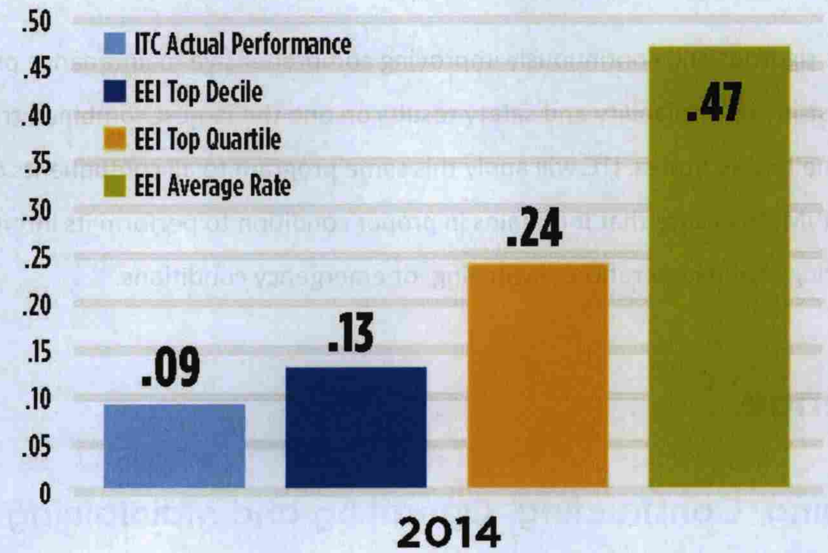
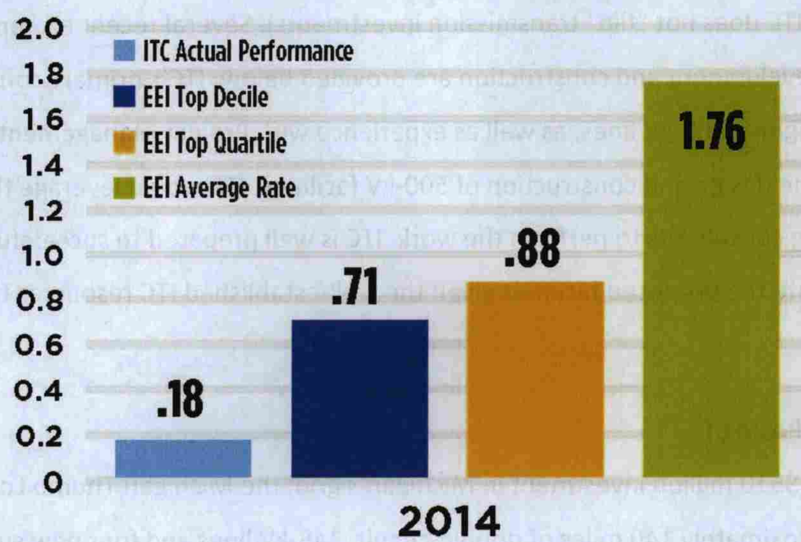



*Table B3 – Recordable Incident Rate*



In support of ITC's maintenance program, ITC's Capital Improvement program has also consistently replaced or upgraded aging components in a manner which eliminates maintenance needs. For example, ITC's replacement of circuit breakers in the ITC*Transmission* and Michigan Electric Transmission Company systems has decreased the average age of circuit breakers on those systems by more than 11 years since ITC acquired those system.

In sum, ITC's rigorous and continuously improving comprehensive maintenance program has achieved best-in-class reliability and safety results on one the largest combined transmission systems in the United States. ITC will apply this same program to all components of the project selected by PJM, to ensure that it remains in proper condition to perform its intended function, whether during routine operations, switching, or emergency conditions.

# 4. Experience

## a. Developing, Constructing, Operating and Maintaining

ITC has significant experience developing, constructing, operating and maintaining transmission facilities to help improve reliability, reduce congestion, improve system efficiency, and interconnect new generation to load all leading to lowering the overall costs of delivered energy to ITC's customers. ITC's history demonstrates that it does this with the intent of holding those assets over the long-term (ITC does not "flip" transmission investments). Several recent examples of transmission development and construction are provided below. ITC's primary consultants have experience designing 500-kV lines, as well as experience with Project Management at those voltages. For the design and construction of 500-kV facilities, ITC would leverage the expertise of industry-leading consultants to perform the work. ITC is well prepared to successfully construct, own, and operate the proposed facilities given the well-established ITC resources for similar facilities.

### Thumb Loop Project

Representing a $510 million investment in Michigan's grid, the Michigan Thumb Loop project consists of approximately 140 miles of double-circuit, 345-kV lines and four new substations. ITC has led the planning, construction and development phases, working with skilled labor, engineering and project management organizations to manage project resources. The Michigan Thumb Loop project was the first of MISO's Multi-Value Projects (MVPs) to be approved and will serve as the backbone of a system designed to meet requirements set by Michigan's Wind Energy Resource Zone Board. The Thumb Loop project will also provide additional power delivery capacity for future economic development thereby helping existing businesses grow and also attract new businesses, jobs and investment to the region.

Despite its size and complexity, ITC completed this project on time and on budget – a testament to the company's project management and construction team abilities. Each Phase of the project was completed on schedule – Phase 1 of the project was placed in-service in September 2013, while Phase 2 entered into service in May, 2014, with the remainder of the project completed and put in-service in May, 2015. In total, the Thumb Loop project includes nearly 800 structures consisting of both tubular steel poles and lattice steel towers. Additional lines and facilities are being added as wind generators go into service and connect to the system to fulfill the requirements of the State of Michigan's Renewable Portfolio Standard. The Thumb Loop project is a prime example of ITC's efforts to improve the national electric transmission system, create access to competitive energy markets and foster growth for local and regional economies – all for the benefit of customers.

## KETA Project

The KETA Project is a 227 mile, 345-kV project which runs from Spearville, Kansas, in the southwestern part of Kansas; north to the Post Rock substation just outside of Hays, Kansas; and then north to Axtell, Nebraska. The Kansas Electric Transmission Authority (KETA) identified this particular project in 2007 through its initiatives to bring significant economic and reliability benefits to Kansas and the regional transmission grid. KETA is an organization that was created in 2005 by the Kansas Electric Transmission Authority Act (HB 2263) and is intended to promote and facilitate the expansion of Kansas transmission infrastructure for the betterment of the Kansas economy. ITCGP worked with the incumbent electric cooperatives to acquire the rights to build the Kansas portion of this 345-kV project, from Spearville to the Kansas/Nebraska state line. ITC placed its portion of the KETA (Spearville-Axtell) transmission project into service in 2012, five months ahead of schedule and at a cost significantly below the budgeted amount, which demonstrates ITC's focus and commitment to cost containment and operational excellence.

## V-Plan

In cooperation with Sunflower Electric Power Corporation and Mid-Kansas Electric Company, ITC has constructed two segments of the V-Plan project, totaling approximately 122 miles of double-circuit 345-kV line. The high-voltage transmission line is designed to connect eastern and western Kansas to improve electric reliability and enable energy developers to tap into the transmission grid. The project was placed in-service on schedule in December 2014.

## Au Sable Circuit

This 110 mile, 138-kV line from Zilwaukee to Mio, Michigan, is important to electric reliability in northeastern Michigan. In June 2014, ITC completed rebuilding and upgrading this line from single-circuit 138kV to future double-circuit 230-kV design and construction standards. This will increase its capacity and reliability, provide increased lightning protection and facilitate potential future 230-kV expansion in northern Michigan. The project is the result of ITC's rigorous planning process that is designed to anticipate future customer needs and provide the grid flexibility to meet those needs in an efficient and cost-effective manner.

## Multi-Value Projects (MVPs)

ITC is advancing its portions of four Multi-Value Projects (MVPs) in Iowa, Minnesota and Wisconsin. Following approval of these projects by MISO in late 2011, ITC has focused on siting preparations and worked with other utilities to finalize ownership levels of the projects in support of our targeted in-service dates. In 2014, two 345-kV line sections received Iowa regulatory approval and easements have been secured. Also in 2014, regulatory hearings were completed toward the Certificate of Need and Route Permit in Minnesota. These projects are part of MISO's MVP portfolio and are anticipated to provide broad regional benefits while also supporting approved state and federal energy policy mandates in the MISO region. Anticipated in-service dates of the projects range from 2015 to 2020.

ITC will build portions of the following projects:

- MVP 3 – a joint project with MidAmerican Energy Company of about 70 miles in Minnesota and about 145 miles in Iowa, of which ITC will construct approximately 100 miles of new 345-kV line.
- MVP 4 – a joint project with MidAmerican Energy Company of approximately 190 miles in Iowa, of which ITC will construct approximately 118 miles of new 345-kV line.
- MVP 5 – a joint project with American Transmission Company (ATC) of approximately 125 miles of 345-kV line in Wisconsin and Iowa.
- MVP 7 – a joint project with MidAmerican of approximately 90 miles of 345-kV line in Iowa and Missouri.

## b. Standardized Construction Practices

ITC has an exceptionally strong record of adhering to standardized construction, maintenance, and operating procedures, which have driven ITC's ability to safely and reliably complete numerous transmission projects on time and within their original budget. ITC's operations and maintenance practices are equally strong with similar records of achievement. ITC has standard construction specification documents to which its construction teams adhere.

## c. Emergency Response & Restoration Capability

ITC has a strong track record of mobilizing quickly and effectively to resolve forced outages. Weather events often strike the ITC system with little or no warning, requiring an immediate response. ITC employees and contractors excel at prioritizing and focusing organized efforts on safely and quickly restoring the transmission system to ensure grid reliability and prompt restoration of service to customers.

One example of ITC's capability for emergency response and restoration of damaged equipment our response to the July 2011 Midwest Derecho storm. In the early morning hours of July 11, 2011, a storm, with winds of more than 100 miles per hour swept through central Iowa, with peak winds estimated to be in the range of 130 miles per hour, equal to a Category 3 hurricane. At its peak, Interstate Power and Light, the electric utility providing retail service to many customers in the area, estimated that more than 45,000 of its retail customers across four counties lost power. Thousands more customers who were served by electric cooperatives and municipal utilities were also impacted. The National Oceanic and Atmospheric Administration said the storm was the most widespread and damaging wind event to affect central and east central Iowa since 1998. The storm knocked out nine 161-kV lines, two 69-kV lines and twenty 34.5-kV lines across the ITCMW system and affected approximately 60 substations. More than 300 poles required replacement.

Within 72 hours, ITCMW restored transmission service to all customers and customer substations that could take service, pending the repairs of their distribution systems. Once all customer connections were re-established, crews began working to provide backup feeds to those substations. The secondary feeds were critical to serve the returning load as distribution customers were returned to service.

*Many other examples of ITC's timely remedying of facility failures due to weather or other events are available upon request.*

## d. Regional Experience

ITC has experience working with PJM through its multiple existing system interconnections and is familiar with its functions and history. Three of ITC's four operating companies have interconnections with PJM transmission owners.

ITC maintains a strong track record of providing crews to support PJM during extreme weather and other emergency events. Our extensive experience with other RTOs, combined with our experience in PJM, offers tangible benefits in the form of our independence and history as an owner, operator and developer of transmission throughout the country.

As an example of this, ITC resources have supported utilities in PJM in emergency situations, including deployment of 167 personnel to New Jersey and eastern Pennsylvania in response to Hurricane Sandy. These resources came from Michigan, Iowa and Minnesota. ITC resources have also supported PJM member Commonwealth Edison during emergency situations.

Outside of PJM, ITC has extensive experience in a wide range of activities with multiple RTOs including transmission project development, advocacy, and participation in Federal Energy Regulatory Commission ("FERC") Order No. 890 Compliant stakeholder planning processes. ITC has MISO transmission assets in Michigan, Iowa, Minnesota, Illinois and Missouri. ITC also has SPP operational transmission assets in Oklahoma and Kansas.

ITC has been a member of MISO since the company's inception in 2003. ITC is one of the largest transmission owners in MISO and is actively involved in a wide range of activities, committees, and working groups. ITC has a valuable working relationship with MISO management and staff and have proven to be a contributing and collaborative member. ITC played a key leadership role in advocating regional transmission projects, which resulted in MISO's MVPs – a set of 17 regional projects valued at $5.2 billion.

ITCGP has been a member of the SPP since 2007. As an SPP transmission owner, ITC has strong working relationships with SPP management and staff. Since 2007, through its leadership positions on various task forces and working groups, ITCGP has been a consistent participant in the SPP planning process, advocating for specific large-scale regional projects. Participation and advocacy in these groups resulted in SPP's approval of approximately $500 million of transmission expansion projects that are in varying stages of development or operation by ITCGP.

ITC is also expanding into the PJM footprint and actively engaged in ensuring all PJM requirements will be met when the new Covert to Segreto 345-kV line in Southwest Michigan goes into service on June 1, 2016. This will be ITC's first project energized in PJM.

## e. Acquiring Right-of-Way and Permitting

ITC has extensive experience acquiring rights-of-way ("ROW") in the eastern interconnection. ITC's primary land acquisition firm which ITC would likely retain to work on this project has extensive experience working on ROW acquisition projects in the region of PJM where this project is proposed. ITC will acquire ROW in PJM in the same manner that has generated success by obtaining broad stakeholder support in routing, siting, and permitting. The siting process begins with a routing study that considers multiple stakeholders broadly and carefully. As a project advances, ITC begins ROW acquisition, working extensively and collaboratively with landowners to secure land rights on a voluntary basis. ROW is generally secured voluntarily and ITC makes every effort to work with landowners. However, even when ITC has filed condemnation actions, the company continues to work with the landowners and is often able to reach mutually acceptable resolution outside of the judicial forum.

Transmission development requires a wide variety of permits ranging from road crossing permits to Department of Natural Resources and U. S. Army Corps of Engineer permits. Since 2009, ITC has obtained more than 1,500 permits. ITC has a well-established permitting process involving a cross-functional team led by a Design Engineering group that also includes Project Engineering, Environmental, Legal, and Local Governmental and Community Affairs groups. This team works closely with consulting firms to identify required permits for the project and provide the information needed for filing permit applications. ITC has effectively leveraged a variety of local, regional, and national firms to successfully acquire the required permits, including [redacted]. A few examples of ITC's siting and permitting experience are cited below.

As part of ITC's environmental management system and in line with ITC's best-in-class approach to conducting business, ITC is committed to considering environmental impacts in its decision-making process when planning infrastructure improvement projects. Transmission line projects can span many miles and occasionally cross environmentally sensitive areas. ITC's project teams understand this and include environmental assessments for wetlands, threatened and endangered species and other sensitive habitats as part of the planning process.

## Examples:

*KETA project*: A 174 mile, single-circuit, 345-kV line on new ROW in Kansas. ITC performed a routing study and worked with the state siting authority to secure route approval. ITC secured 10 Department of Transportation ("DOT") permits and 15 Department of Environmental Quality ("DEQ") permits for the project. ITC also worked with the U.S. Fish and Wildlife Service and the Kansas Department of Wildlife, Parks and Tourism on whooping crane protection and lesser prairie chicken habitat protection and remediation.

*Salem-Hazleton project*: An 81 mile, single-circuit, 345-kV line on mostly new ROW in Iowa. ITC was able to successfully negotiate co-locating approximately 20 miles of the new line jointly with another transmission company's facility. ITC worked through the Iowa Utilities Board siting process. ITC secured six Iowa DOT permits, one DEQ permit, 124 road crossing permits, two Department of Natural Resources permits or letters of no effect, three Federal Aviation Administration permits, three county floodplain permits and two Army Corp of Engineers permits or letters of no effect.

*Thumb Loop project*: A 140 mile, double-circuit, 345-kV line in Michigan. ITC actively participated in the Michigan Public Service Commission ("MPSC"), which approved the preferred route. Phase 1 of the project was energized in September 2013. Phase 2 was placed in-service in May 2014. The final phase of the project was placed into service in May 2015. To date, ITC has obtained 16 Michigan DOT permits, 20 DEQ permits, six soil erosion permits, 175 county road crossing permits and 60 drain commission permits.

*V-Plan project*: A 122 mile, double-circuit, 345-kV line under construction in Kansas with a projected in-service date of December 2014. ITC obtained siting approval from the Kansas Corporation Commission and to date has obtained nine Kansas DOT and five DEQ permits. ITC worked with environmental stakeholders to find alternative routes to minimize impact to landowners and to lesser prairie chicken habitat and to help facilitate further wind farm development.

# 5. Financing Plan and Financial Statements

[redacted]

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[redacted]

[redacted]

## 6. Commitment to execute Consolidated Transmission Owner Agreement

If ITC Mid-Atlantic LLC is the successful bidder of a project and becomes a Designated Entity, ITC Mid-Atlantic Development LLC commits to execute the PJM Interconnection Consolidated Transmission Owners Agreement.

# C. CONSTRUCTABILITY INFORMATION

## 1. Scope and Detailed Breakdown of Project Elements

ITC has identified the Rawlings to Steers 500-kV line (16RTEP1-2b), Rawlings to Carson #2 500-kV line (16RTEP1-3b), Lewis 500-kV Substation and 230-kV line to Clubhouse (16RTEP1-4a), and Lewis 500-kV Substation and Clubhouse-Lakeview 230-kV line tap (16RTEP1-4c) projects to address Generator Deliverability thermal violations identified as a part of the 2016 RTEP Proposal Window 1. A high level summary of each of these projects is provided in Table C1 below.

***Table C1 – Project Scope Summaries***

| Project | Line | Project Scope |
|---|---|---|
| 16RTEP1-2b | Rawlings to Steers 500-kV Line | • 21-miles of new 500-kV single-circuit overhead line from Rawlings substation (Dominion) to a new 500-kV Steers switchyard (ITC)<br>• Modifications at the Rawlings 500-kV Substation (Dominion)<br>• Greenfield ring bus Steers Switchyard (ITC)<br>• Reconductor 11.03-miles of the Charles City-Lakeside 230-kV line (Dominion) |
| 16RTEP1-3b | Rawlings to Carson 500-kV Line | • 21-miles of new 500-kV single-circuit overhead line from Rawlings substation (Dominion) to Carson substation (Dominion)<br>• Modifications at the Rawlings and Carson 500-kV Substations (Dominion)<br>• Reconductor 11.03-miles of the Charles City-Lakeside 230-kV line (Dominion) |
| 16RTEP1-4a | 500-kV Lewis substation and Lewis to Clubhouse 230-kV Line | • New 500/230-kV Lewis substation and 4-miles of new 230-kV single-circuit overhead line from Lewis substation (ITC) to Clubhouse substation (Dominion)<br>• Modifications at the Clubhouse 230-kV Substation (Dominion)<br>• Greenfield ring bus 500-kV Lewis Substation (ITC)<br>• Reconductor 11.03-miles of the Charles City-Lakeside 230-kV line (Dominion) |

| | | |
|---|---|---|
| 16RTEP1-4c | 500-kV Lewis substation and Lewis to Clubhouse-Lakeview Tap 230-kV Line | • New 500/230-kV Lewis substation and 4-miles of new 230-kV double-circuit overhead line from Lewis substation (ITC) to Clubhouse-Lakeview 230-kV line tap point (Dominion)<br>• Greenfield ring bus 500-kV Lewis Substation (ITC)<br>• Reconductor 11.03-miles of the Charles City-Lakeside 230-kV line (Dominion)<br>• Reconductor 0.5-miles of the Clubhouse-Lewis Tap 230-kV line (Dominion) |

Any of these projects would be a highly beneficial addition to the PJM system 500-kV backbone upon which the entire PJM interconnection system heavily depends for reliability and security as well as market efficiency. Due to this vital nature, the benefit of reusing or co-locating new transmission adjacent to existing right-of-way should be weighed against the benefit provided by using new right-of-way that provides locational diversity. Such diversity would improve resiliency, security and potentially mitigate or reduce the occurrence of catastrophic and widespread outages.

[redacted]

[redacted]

For each project detailed below, the proposed configuration provides unique advantages with respect to constructability, cost and schedule and every project would enable the realization of benefits from ITC's standard processes, vendor alliances and other partnerships described in Section B above.

## a. 16RTEP1-2b: Rawlings to Steers 500-kV Transmission Line Project


The Rawlings to Steers 500-kV line is a streamlined solution to address the Generator Deliverability thermal violations identified as a part of the 2016 RTEP Proposal Window 1. This project, referred to as 16RTEP1-2b, consists of constructing approximately 21.0-miles of new 500-kV single-circuit overhead line from the proposed Rawlings substation (Dominion) to a new ITC owned Steers switchyard.

### Greenfield Switchyard Details

The project includes a greenfield substation, named Steers, that loops in the Carson-Midlothian 500-kV line. The assumed scope of work required at Steers is shown below.

*Steers Substation (New Greenfield)*
*Conceptual One Line Diagram: Figure 7, Appendix A*
*Conceptual Arrangement Plan: Figure 9, Appendix A*

- The 500-kV switchyard would be a three position ring bus, in a two-bay breaker and a half configuration.
- The existing Carson-Midlothian line would be looped in on the northeast and northwest sides of the new switchyard at approximately 6.9 Transmission line miles from Carson station.
- The new proposed Rawlings – Steers line would enter from the southwest side of the station.
- The demarcation points would be the first structure within the substation fence.

Possible substation locations including a location in which ITC has land option agreements are shown in Figure 6 of Appendix A.

*Relaying*

The new substation relaying would consist of primary and secondary line relays for each 500-kV line, breaker control & breaker failure relays for each 500-kV breaker, an RTU & communications panel, a DFR panel and revenue meters for the new proposed Rawlings – Steers line. Line relay upgrades would also be required at the remote ends of the line (Carson & Midlothian).

ITC has developed standard relay system designs to protect its equipment and has long standing working relationships with its control panel vendors. Standard design packages are available for line relaying with power line carrier, line relaying using current differential, transformer differential, bus differential and breaker control panels. All design packages are redundant protection schemes. The use of pilot protection and direct transfer trip is determined by system stability studies and fault analysis.

ITC typically uses [redacted] relays that have established industry track records. ITC makes use of the advanced communication technologies available on these relays for system protection, operation, control and metering. ITC's use of standard relay panel designs allows for quick deployment and installation in the field and quick replacement and restoration in the event of a failure. It is assumed that ITC would coordinate the line relaying design with the existing substation owners and that OPGW would be installed and used for line differential relaying.

### *Substation Land*

ITC has investigated land options and identified multiple feasible site options. A single site alternative was used to develop cost-estimates. [redacted] The switchyard would be approximately 5-acres in size. ITC has secured an option with an existing landowner to obtain the rights/easements to the property in order to construct the Steers substation on property near these coordinates.

## Greenfield Transmission Line Details

The project will use all-overhead construction with primarily lattice steel towers and triple bundled 954-kcmil ACSR conductor. [redacted] Table C1a below shows the proposed project terminal points.

### *Table C1a – Terminal Points*

| | Beginning Station (Existing) | Ending Station (New) |
|---|---|---|
| **Station Name** | Rawlings | Steers |
| **Owner** | Dominion | ITC |
| **Voltage** | 500-kV | 500-kV |
| **State** | Virginia | Virginia |
| **County** | Brunswick | Dinwiddie |
| **Coordinates** | [redacted] | |

## Route and Geographic Description

For the development of this proposal, a high-level study was conducted to identify a route representative of what could reasonably be expected for a project of this type in this area. [redacted]

Portions of three cities are located within the study area (Table C2a). The largest of these cities is Sutherland, Virginia.

*Table C2a – Major Cities within the Study Area*

| City | County | Population |
|---|---|---|
| [redacted] | | |

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

### *Public Opposition*

Overhead electric transmission line projects can be some of the most controversial projects in the United States. They typically involve the crossing of private property, the clearing of vegetation and the construction of large structures that are visible to the public. Often they cross multiple jurisdictions and political boundaries with competing interests. The risk for public opposition is always there, but the outcomes can be greatly mitigated by engaging and involving the full range of project stakeholders early, often and throughout the life of the project.

## Physical Characteristics

The electrical and physical characteristics for the proposed line are shown in Table C7a below. A typical 500-kV overhead transmission structure cross-section is included as Figure 2 of Appendix A.

*Table C7a – Line Characteristics*

| | Overhead Line – 21.0-miles |
|---|---|
| **Construction** | [redacted] See Figure 2, Appendix A |
| **Nominal Voltage Rating** | 500-kV |
| **AC or DC** | AC |
| **Summer Normal Rating** | [redacted] MVA |
| **Summer Emergency Rating** | [redacted] MVA |
| **Grounding Design (for underground circuits)** | N/A |
| **Configuration** | [redacted] |
| **Phase Conductor Type** | |
| **Shield Wire Conductor Type (for overhead circuits)** | |

## Facilities to be Constructed by Others

The proposed project requires the addition of new breakers and associated equipment at the existing Rawlings substation to accommodate the termination of the proposed line. The assumed scope of work required at each station is shown below; however, the final scope of work is subject to change and would be determined by the existing transmission owner in coordination with ITC.

Any proposed upgrades to existing TO-owned substations meet the publicly posted criteria on the PJM website and are subject to modification by the TO if necessary. If the proposed upgrades are deemed infeasible, with a PJM scope change, ITC could construct new greenfield facilities to minimize the impact to the existing TO facilities and to accommodate the project.

### *Rawlings Substation*

*Conceptual One Line Diagram: Figure 7, Appendix A*

*Conceptual Arrangement Plan: Figure 8, Appendix A*

- Add three 500-kV SF6 gas circuit breakers and associated switches to create a fully built out, two bay, breaker and a half configuration. Alternatively, a lower cost option may be to add only a single 500-kV SF6 gas circuit breaker and associated switches to expand the three position ring to four positions.
- Add new line entrance structures (A-frame or H-frame) to existing bay to accommodate the new Rawlings – Steers line.
- The proposed line to Steers would likely enter from the northeast side of the station.
- Move position of existing Rawlings – Carson line to accommodate proposed line to Steers and re-terminate.
- It is assumed the existing fence should not need to be expanded.
- The demarcation point on the Rawlings – Steers line would be the first structure within the substation fence.
- Install line, breaker & bus relays to protect the proposed line and the bus given the new configuration
- Install metering CTs and metering equipment for the proposed Rawlings – Steers line.

### *Relaying*

The proposed substation expansion relaying at Rawlings would consist of primary and secondary line protection relays, breaker failure and control relays, primary and secondary bus differential relaying and minor modifications to the existing line relaying schemes. It is assumed that ITC would coordinate the line relaying design with the existing substation owners and that OPGW would be installed and used for line differential relaying.

### *Substation Land*

The scope of work at Rawlings does not require expansion of the existing substation footprint. No additional land should be needed.

### *Transmission Line & Substation Outages*

- [redacted]

Note: Additional constructability outages may be required upon detailed construction planning.

## Total Cost of Project and Major Components

Table C8a provides a summary of major component costs for the project, in 2016 dollars. Section E.2 discusses the costs associated with this project in further detail.

### *Table C8a – 16RTEP1-2b Project Costs*

| Components | COST ($MM) |
|---|---|
| **Transmission Line Components** | |
| [redacted] | |
| **Substation Components** | |
| **GRAND TOTAL (2016 dollars)** | **$111.5** |

## b. 16RTEP1-3b: Rawlings to Carson #2 500-kV Line Project


The Rawlings to Carson #2 500-kV line is a streamlined solution to address Generator Deliverability thermal violations identified as a part of the 2016 RTEP Proposal Window 1. The project alleviates the overloads seen on the Rogers Rd – Carson 500-kV line as reported by PJM for the Generator Deliverability test. This project, referred to as 16RTEP1-3b, consists of constructing approximately 23.1-miles of new 500-kV single-circuit overhead line from Rawlings substation (Dominion) to Carson substation (Dominion).

### Greenfield Transmission Line Details

The project will use all-overhead construction with primarily lattice steel towers and triple bundled 954-kcmil ACSR conductor. ITC benefits from supplier alliances and recent construction experience with this conductor. Table C1b below shows the proposed project terminal points.

### *Table C1b – Terminal Points*

| | Beginning Station (Existing) | Ending Station (Existing) |
|---|---|---|
| **Station Name** | Rawlings | Carson |
| **Owner** | Dominion | Dominion |
| **Voltage** | 500-kV | 500-kV |
| **State** | Virginia | Virginia |
| **County** | Brunswick | Dinwiddie |
| **Coordinates** | [redacted] | |

## Route and Geographic Description

For the development of this proposal, a high-level study was conducted to identify a route representative of what could reasonably be expected for a project of this type in this area. [redacted]

Portions of six cities are located within the study area (Table C2b). The largest of these cities is DeWitt, Virginia.

***Table C2b – Major Cities within the Study Area***

| City | County | Population |
|---|---|---|
| [redacted] | | |

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

*Public Opposition*

Overhead electric transmission line projects can be some of the most controversial projects in the United States. They typically involve the crossing of private property, the clearing of vegetation and the construction of large structures that are visible to the public. Often they cross multiple jurisdictions and political boundaries with competing interests. The risk for public opposition is always there, but the outcomes can be greatly mitigated by engaging and involving the full range of project stakeholders early, often and throughout the life of the project.

## Physical Characteristics

The electrical and physical characteristics for the proposed line are shown in Table C6b below. A typical 500-kV overhead transmission structure cross-section is included as Figure 2 of Appendix A.

***Table C6b – Line Characteristics***

| | Overhead Line – 23.1-miles |
|---|---|
| **Construction** | [redacted] |
| **Nominal Voltage Rating** | 500-kV |
| **AC or DC** | AC |

| | |
|---|---|
| **Summer Normal Rating** | [redacted] MVA |
| **Summer Emergency Rating** | [redacted] MVA |
| **Grounding Design (for underground circuits)** | N/A |
| **Configuration** | [redacted] |
| **Phase Conductor Type** | |
| **Shield Wire Conductor Type (for overhead circuits)** | |

## Facilities to be Constructed by Others

The proposed project requires the addition of new breakers and associated equipment at the existing Rawlings substation to accommodate the termination of the proposed line. The assumed scope of work required at each station is shown below; however, the final scope of work is subject to change and would be determined by the existing transmission owner in coordination with ITC.

Any proposed upgrades to existing TO-owned substations meet the publicly posted criteria on the PJM website and are subject to modification by the TO if necessary. If the proposed upgrades are deemed infeasible, with a PJM scope change, ITC could construct new greenfield facilities to minimize the impact to the existing TO facilities and to accommodate the project.

### *Transmission Line Modifications*

The proposed line would cross the existing 500-kV Rawlings to Carson line. If required, modifications to the existing line facilities would be performed by the existing transmission owner.

### *Rawlings Substation*

*Conceptual One Line Diagram: Figure 13, Appendix A*

*Conceptual Arrangement Plan: Figure 14, Appendix A*

- Add three 500-kV SF6 gas circuit breakers and associated switches to create a fully built out, two bay, breaker and a half configuration. Alternatively, a lower cost option may be to add only a single 500-kV SF6 gas circuit breaker and associated switches to expand the three position ring to four positions.
- Add new line entrance structures (A-frame or H-frame) to existing bay to accommodate new Carson – Rawlings #2 line.
- The proposed Carson – Rawlings #2 line would likely enter from the east side of the station.
- It is assumed the existing fence should not need to be expanded.

- The demarcation point for the Carson – Rawlings #2 line would be the first structure within the substation fence.
- Install line, breaker & bus relays to protect the proposed line and the bus given the new configuration. If the Rawlings substation were kept as a ring, new bus relaying would not be needed.
- Install metering CTs and metering equipment for the proposed Carson – Rawlings #2 line.

### *Carson Substation*

*Conceptual One Line Diagram: Figure 13, Appendix A*

*Conceptual Arrangement Plan: Figure 15, Appendix A*

- Add one 500-kV SF6 gas circuit breaker and associated disconnect switches to create a fully built out breaker and a half configuration.
- No new line entrances would be required. The Carson-Midlothian line would be reterminated to the bay with the added breaker. The new Carson – Rawlings #2 line would then be terminated in the previous position of the Carson-Midlothian line.
- The proposed Carson – Rawlings #2 line would enter from the west side of the station.
- The existing fence should not need to be expanded.
- The demarcation point for the Carson – Rawlings #2 line would be the first structure within the substation fence.
- Install two new line relays and breaker relay to protect the reterminated Carson – Midlothian line and new proposed Carson – Rawlings #2 line.
- Install metering CTs and metering equipment for the proposed Carson – Rawlings #2 line.

Available planning data indicates that significant line termination modifications are under development at Carson substation. Based on this data, the following one line diagrams depict the existing, intermediate and proposed equipment arrangements at Carson substation.

[redacted]

[redacted]

It should be noted that in order to accommodate the re-termination of the Carson-Midlothian line and the addition of the new Carson – Rawlings #2 line, this work will likely require replacing up to two transmission structures currently utilized by the Carson-Midlothian line. Replacing these structures and modifying their location will allow the new Rawlings-Carson #2 line to be brought into the west side of the substation. It is also worth noting that at least one 500-kV line crossing of the Rawlings-Carson #1 line will be required.

### *Relaying*

The proposed relaying would consist of primary and secondary line protection relays, breaker control relays, breaker failure relays, primary and secondary bus differential relaying and minor modification to the existing line & bus relaying schemes. It is assumed that the existing substation owners would be responsible for the line relaying design and that OPGW would be installed and used for line differential relaying.

### *Substation Land*

The scope of work at Rawlings and Carson do not require expansion of the existing substation footprints. No additional land should be needed.

*Transmission Line & Substation Outages*

- [redacted]
- [redacted]
- [redacted]
- [redacted]
- [redacted]

Note: Additional constructability outages may be required upon detailed construction planning.

### Total Cost of Project and Major Components

Table C7b below provides a summary of major component costs for the project, in 2016 dollars. Section E.2 discusses the costs associated with this project in further detail.

*Table C7b – 16RTEP1-3b Project Costs*

| Components | COST ($MM) |
|---|---|
| **Transmission Line Components** | |
| [redacted] | |
| **Substation Components** | [redacted] |
| **GRAND TOTAL (2016 dollars)** | $101.3 |

## c. 16RTEP1-4a: Lewis 500-kV Substation 230-kV Transmission Line to Clubhouse Project


The Lewis 500-kV substation and 230-kV line to Clubhouse is a streamlined solution to address the Generator Deliverability thermal violations identified as a part of the 2016 RTEP Proposal Window 1. This project, referred to as 16RTEP1-4a, consists of constructing a new ITC owned Lewis 500-kV substation and approximately 4.0-miles of new 230-kV single-circuit overhead line from the Lewis substation (ITC) to the Clubhouse substation (Dominion).

## Greenfield Substation Details

The project includes a greenfield substation, named Lewis, that loops in the Brunswick-Wake 500-kV line. The assumed scope of work required at Lewis is shown below.

### *Lewis Substation (New Greenfield)*

*Conceptual One Line Diagram: Figure 20, Appendix A*

*Conceptual Arrangement Plan: Figure 21, Appendix A*

- The 500/230-kV substation would include three 500-kV breakers in a ring bus, a 500/230-kV transformer, and a single 230-kV breaker.
- The existing 500-kV Brunswick-Wake line would be looped in on the north and south sides of the new substation.
- The new proposed 230-kV Lewis – Clubhouse line would enter from the northeast side of the station.
- The demarcation points would be the first structure within the substation fence.

The exact location of the new substation would be determined by optimizing the final route of the transmission line combined with the ideal location for a new substation. Possible substation locations are shown in Figure 19 of Appendix A.

### *Relaying*

The new substation relaying would consist of primary and secondary line relays for each line, breaker control & breaker failure relays for each breaker, primary and secondary relays for the transformer, an RTU & communications panel, a DFR panel and revenue meters for the new proposed Lewis – Clubhouse 230-kV line. Line relay upgrades would also be required at the remote ends of the 500-kV line (Brunswick & Wake).

ITC has developed standard relay system designs to protect its equipment and has long standing working relationships with its control panel vendors. Standard design packages are available for line relaying with power line carrier, line relaying using current differential, transformer differential, bus differential and breaker control panels. All design packages are redundant protection schemes. The use of pilot protection and direct transfer trip is determined by system stability studies and fault analysis.

ITC typically uses [redacted] relays that have established industry track records. ITC makes use of the advanced communication technologies available on these relays for system protection, operation, control and metering. ITC's use of standard relay panel designs allows for quick deployment and installation in the field and quick replacement and restoration in the event of a failure. It is assumed that ITC would coordinate the line relaying design with the existing substation owners and that OPGW would be installed and used for line differential relaying.

## Greenfield Transmission Line Details

The project will use all-overhead construction with primarily steel poles and 954-kcmil ACSR conductor. ITC benefits from supplier alliances and recent construction experience with this conductor. Table C1c below shows the proposed project terminal points.

*Table C1c – Terminal Points*

| | Beginning Station (New) | Ending Station (Existing) |
|---|---|---|
| **Station Name** | Lewis | Clubhouse |
| **Owner** | ITC | Dominion |
| **Voltage** | 500-kV | 230-kV |
| **State** | Virginia | Virginia |
| **County** | Brunswick | Greensville |
| **Coordinates** | [redacted] | |

## Route and Geographic Description

For the development of this proposal, a high-level study was conducted to identify a route representative of what could reasonably be expected for a project of this type in this area. [redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

*Public Opposition*

Overhead electric transmission line projects can be some of the most controversial projects in the United States. They typically involve the crossing of private property, the clearing of vegetation and the construction of large structures that are visible to the public. Often they cross multiple jurisdictions and political boundaries with competing interests. The risk for public opposition is always there, but the outcomes can be greatly mitigated by engaging and involving the full range of project stakeholders early, often and throughout the life of the project.

## Physical Characteristics

The electrical and physical characteristics for the proposed line are shown in Table C4c below. A typical 230-kV single circuit overhead transmission structure cross-section is included as Figure 3 of Appendix A.

*Table C4c – Line Characteristics*

| | Overhead Line – 4.0-miles |
|---|---|
| **Construction** | [redacted] |
| **Nominal Voltage Rating** | 230-kV |
| **AC or DC** | AC |
| **Summer Normal Rating** | [redacted] MVA |

| | |
|---|---|
| **Summer Emergency Rating** | [redacted] MVA |
| **Grounding Design (for underground circuits)** | N/A |
| **Configuration** | [redacted] |
| **Phase Conductor Type** | |
| **Shield Wire Conductor Type (for overhead circuits)** | |

## Facilities to be Constructed by Others

The proposed project requires the expansion of the Clubhouse substation to accommodate the termination of the proposed line and reconfiguring the physical layout of the substation. The assumed scope of work required at each station is shown below; however, the final scope of work is subject to change and would be determined by the existing transmission owner in coordination with ITC.

Any proposed upgrades to existing TO-owned substations meet the publicly posted criteria on the PJM website and are subject to modification by the TO if necessary. If the proposed upgrades are deemed infeasible, or the required outages too detrimental to the reliable and efficient operation of the transmission grid, ITC has proposed three alternative project ideas that avoid this condition.

### *Clubhouse Substation*

*Conceptual One Line Diagram: Figure 20, Appendix A*

*Conceptual Arrangement Plan: Figure 22, Appendix A*

- Add three 230-kV breakers and associated switches to create a new four breaker ring bus.
- Add a new line entrance structure (A-frame or H-frame) to the new ring position to accommodate the new Lewis – Clubhouse line.
- The proposed line to Lewis would likely enter from the northwest side of the station.
- It is assumed the existing fence on the west and south sides of the station could be expanded should more space be needed to accommodate the additional equipment.
- It is assumed that the existing building towards the west side of the station contains no critical equipment and will be removed.
- Add a new control center for the new 230kV relaying if space is not available in the existing control center.
- The demarcation point on the Lewis – Clubhouse line would be the first structure within the substation fence.

- Install line and breaker relays to protect the proposed line and breakers in accordance with the proposed configuration.
- Install metering CTs and metering equipment for the proposed Lewis – Clubhouse line.

***Relaying***

The proposed substation expansion relaying at Clubhouse would consist of primary and secondary line protection relays, breaker control relays, breaker failure relays and minor modifications to the existing line relaying schemes. It is assumed that ITC would coordinate the line relaying design with the existing substation owners and that OPGW would be installed and used for line differential relaying.

***Substation Land***

The scope of work at Clubhouse may require expansion of the existing substation footprint. Land to the west and south of the existing substation footprint may be acquired should additional land be needed.

***Transmission Line & Substation Outages***

[redacted]

Note: Additional constructability outages may be required upon detailed construction planning.

## Total Cost of Project and Major Components

Table C5c provides a summary of major component costs for the project, in 2016 dollars. Section E.2 discusses the costs associated with this project in further detail.

*Table C5c – 16RTEP1-4a Project Costs*

| Components | COST ($MM) |
|---|---|
| **Transmission Line Components** | |
| [redacted] | |
| **Substation Components** | |
| [redacted] | |
| **GRAND TOTAL (2016 dollars)** | **$61.8** |

## d. 16RTEP1-4c: Lewis 500-kV Substation and Lewis to Clubhouse-Lakeview Tap 230-kV Transmission Line Project


The Lewis 500-kV substation and 230-kV Clubhouse-Lakeview line tap is a streamlined solution to address the Generator Deliverability thermal violations identified as a part of the 2016 RTEP Proposal Window 1. This project, referred to as 16RTEP1-4c, consists of constructing a new ITC owned Lewis 500-kV substation and approximately 4.0-miles of new 230-kV double-circuit overhead line from Lewis substation (ITC) to a tap point on the Clubhouse to Lakeview 230-kV line (Dominion).

### Greenfield Substation Details

The project includes a greenfield substation, named Lewis, that loops in the Brunswick-Wake 500-kV line and the Clubhouse-Lakeview 230-kV line. The assumed scope of work required at Lewis is shown below.

***Lewis Substation (New Greenfield)***

*Conceptual One Line Diagram: Figure 27, Appendix A*

*Conceptual Arrangement Plan: Figure 28, Appendix A*

- The 500/230-kV substation would include three 500-kV breakers in a ring bus, a 500/230-kV transformer, and three 230-kV breakers in a ring bus.
- The existing 500-kV Brunswick-Wake line would be looped in on the north and south sides of the new substation.

- The new proposed double circuit 230-kV Lewis – Clubhouse-Lakeview Tap line would enter from the northeast side of the station.
- The demarcation points would be the first structure within the substation fence.

The exact location of the new substation would be determined by optimizing the final route of the transmission line combined with the ideal location for a new substation. Possible substation locations are shown in Figure 26 of Appendix A.

### *Relaying*

The new substation relaying would consist of primary and secondary line relays for each line, breaker control & breaker failure relays for each breaker, primary and secondary relays for the transformer, an RTU & communications panel, a DFR panel and revenue meters for the new proposed Lewis – Clubhouse-Lakeview Tap line. Line relay upgrades would also be required at the remote ends of the lines (Brunswick, Wake, Clubhouse and Lakeview).

ITC has developed standard relay system designs to protect its equipment and has long standing working relationships with its control panel vendors. Standard design packages are available for line relaying with power line carrier, line relaying using current differential, transformer differential, bus differential and breaker control panels. All design packages are redundant protection schemes. The use of pilot protection and direct transfer trip is determined by system stability studies and fault analysis.

ITC typically uses [redacted] relays that have established industry track records. ITC makes use of the advanced communication technologies available on these relays for system protection, operation, control and metering. ITC's use of standard relay panel designs allows for quick deployment and installation in the field and quick replacement and restoration in the event of a failure. It is assumed that ITC would coordinate the line relaying design with the existing substation owners and that OPGW would be installed and used for line differential relaying.

## Greenfield Transmission Line Details

The project will use all-overhead construction with primarily steel poles and 954-kcmil ACSR conductor. ITC benefits from supplier alliances and recent construction experience with this conductor. Table C1d below shows the proposed project terminal points.

*Table C1d – Terminal Points*

| | Beginning Station (New) | Ending Station (New) |
|---|---|---|

| Station Name | Lewis | Clubhouse-Lakeview Tap |
| --- | --- | --- |
| Owner | ITC | Dominion |
| Voltage | 500-kV | 230-kV |
| State | Virginia | Virginia |
| County | Brunswick | Greensville |
| Coordinates | [redacted] | |

## Route and Geographic Description

For the development of this proposal, a high-level study was conducted to identify a route representative of what could reasonably be expected for a project of this type in this area. [redacted]

[redacted]

There are no major cities located within the study area.

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

### *Public Opposition*

Overhead electric transmission line projects can be some of the most controversial projects in the United States. They typically involve the crossing of private property, the clearing of vegetation, and the construction of large structures that are visible to the public. Often they cross multiple jurisdictions and political boundaries with competing interests. The risk for public opposition is always there, but the outcomes can be greatly mitigated by engaging and involving the full range of project stakeholders early, often and throughout the life of the project.

## Physical Characteristics

The electrical and physical characteristics for the proposed line are shown in Table C4d below. A typical 230-kV double-circuit overhead transmission structure cross-section is included as Figure 4 of Appendix A.

*Table C4d – Line Characteristics*

| | Overhead Line – 4.0-miles |
|---|---|
| **Construction** | [redacted] |
| **Nominal Voltage Rating** | 230-kV |
| **AC or DC** | AC |
| **Summer Normal Rating** | [redacted] MVA |
| **Summer Emergency Rating** | [redacted] MVA |
| **Grounding Design (for underground circuits)** | N/A |
| **Configuration** | [redacted] |
| **Phase Conductor Type** | |
| **Shield Wire Conductor Type (for overhead circuits)** | |

## Facilities to be Constructed by Others

The proposed project requires a cut in of the existing Clubhouse-Lakeview 230-kV circuit to bring a new double circuit 230-kV line to the proposed Lewis substation. The assumed scope of work required is shown below; however, the final scope of work is subject to change and would be determined by the existing transmission owner in coordination with ITC.

Any proposed upgrades to existing TO-owned assets meet the publicly posted criteria on the PJM website and are subject to modification by the TO if necessary. If the proposed upgrades are deemed infeasible, with a PJM scope change, ITC could construct new greenfield facilities to minimize the impact to the existing TO facilities and to accommodate the project.

### *Clubhouse-Lakeview Tap*

*Conceptual One Line Diagram: Figure 27, Appendix A*

- Cut a new double-circuit 230-kV line into the existing Clubhouse-Lakeview line.

The exact location of the cut-in would be determined by optimizing the final route of the transmission line combined with the ideal location for the new Lewis substation.

### *Relaying*

The relaying at both ends of the existing Clubhouse-Lakeview line would be modified to protect the new line segments from Clubhouse to Lewis and from Lakeview to Lewis, and would be upgraded as necessary to accommodate relaying schemes at the new Lewis substation. It is assumed that ITC would coordinate the line relaying design with the existing substation owners.

### *Land*

The scope of work for the line cut-in would not require additional land outside of existing or new transmission line right-of-way.

### *Transmission Line & Substation Outages*

- [redacted]

Note: Additional constructability outages may be required upon detailed construction planning.

## Total Cost of Project and Major Components

Table C5d provides a summary of major component costs for the project, in 2016 dollars. Section E.2 discusses the costs associated with this project in further detail.

*Table C5d – 16RTEP1-4c Project Costs*

| Components | COST ($MM) |
| --- | --- |
| **Transmission Line Components** | |
| [redacted] | [redacted] |
| **Substation Components** | [redacted] |
| [redacted] | [redacted] |
| **GRAND TOTAL (2016 dollars)** | **$59.8** |

## 2. Regional and Interregional Requirements

All proposed project options are wholly contained within the boundaries of PJM's operating territory and, more specifically, within Dominion's existing territory. There are no proposed direct interconnections with any other PJM TO or neighboring ISO/RTO operating regions; however, an existing interconnection will be modified that may require minor relaying modifications at the Duke Progress-owned Wake station. For these reasons, ITC notes that these projects are not considered to be interregional in nature and ITC will not be seeking interregional cost allocation.

# D. ANALYTICAL ASSESSMENT

## 1. Equipment Parameters and Assumptions

[redacted]

[redacted]

# 2. Model Data

On March 17, 2016 ITC submitted all the modeling data to PJM for each of the proposals. The information below is a summary of the information that was previously provided.

### Rawlings to Steers 500-kV Line

The transmission line characteristics used for modeling the new 16RTEP1-2b 500-kV line is shown in Table D1 below.

*Table D1 – 16RTEP1-2b Model Data*

| From | | To | | CKT | R (p.u.) | X (p.u.) | B (p.u.) | Rate A (MVA) | Rate B (MVA) | Length (miles) |
|---|---|---|---|---|---|---|---|---|---|---|
| 314936 | 8RAWLINGS | 999991 | NEWSWYD | 1 | [redacted] | | | | | 21 |

### Rawlings to Carson #2 500-kV Line

The transmission line characteristics used for modeling the new 16RTEP1-3b 500-kV line is shown in Table D2 below.

*Table D2 – 16RTEP1-3b Model Data*

| From | | To | | CKT | R (p.u.) | X (p.u.) | B (p.u.) | Rate A (MVA) | Rate B (MVA) | Length (miles) |
|---|---|---|---|---|---|---|---|---|---|---|
| 314936 | 8RAWLINGS | 314902 | 8CARSON | 2 | [redacted] | | | | | 23.1 |

### Lewis 500-kV Substation and 230-kV Line to Clubhouse

The transmission line characteristics used for modeling the new 16RTEP1-4a 230-kV line is shown in Table D3 below.

*Table D3 – 16RTEP1-4a Model Data*

| From | | To | | CKT | R (p.u.) | X (p.u.) | B (p.u.) | Rate A (MVA) | Rate B (MVA) | Length (miles) |
|---|---|---|---|---|---|---|---|---|---|---|
| 314563 | 6CLUBHSE | 888890 | CLUBHSTP | 1 | [redacted] | | | | | 4.0 |

### Lewis 500/230-kV Substation and 230-kV Lines

The transmission line characteristics used for modeling the new 16RTEP1-4c 230-kV lines are shown in Table D4 below.

*Table D4 – 16RTEP1-4c Model Data*

| From | | To | | CKT | R (p.u.) | X (p.u.) | B (p.u.) | Rate A (MVA) | Rate B (MVA) | Length (miles) |
|---|---|---|---|---|---|---|---|---|---|---|
| 314563 | 6CLUBHSE | 700002 | NewTap230 | 1 | [redacted] | | | | | 4.5 |
| 314583 | 6LAKEVEW | 700002 | NewTap230 | 1 | | | | | | 21.4 |

## Reconductor Charles City to Lakeside 230kV Line

In the event that the reconductor of the Charles City to Lakeside 230kV line is the required solution to the marginal overloading caused by the project the detail is provided below. This mitigation was included in the project idev and cases with label of Mitigation in the file name. The transmission line characteristics used for modeling the upgraded line is shown in Table D5 below.

*Table D5 – Reconductor Charles City to Lakeside 230kV Model Data*

| From | | To | | CKT | R (p.u.) | X (p.u.) | B (p.u.) | Rate A (MVA) | Rate B (MVA) |
|---|---|---|---|---|---|---|---|---|---|
| 314225 | 6CHARCTY | 314227 | 6LAKESD | 1 | [redacted] | | | | |

## Reconductor Lewis to Clubhouse 230kV Line

In the event that the reconductor of the Lewis to Clubhouse 230kV line is the required solution to the marginal overloading caused by the project the detail is provided below. This mitigation was included in the project idev and cases with label of Mitigation in the file name. The transmission line characteristics used for modeling the upgraded line is shown in Table D6 below.

*Table D6 – Reconductor Lewis to Clubhouse 230kV Model Data*

| From | | To | | CKT | R (p.u.) | X (p.u.) | B (p.u.) | Rate A (MVA) | Rate B (MVA) |
|---|---|---|---|---|---|---|---|---|---|
| 314563 | 6CLUBHSE | 700002 | NewTap 230 | 1 | [redacted] | | | | |

# 3. Detailed Analysis Report on Proposed Solutions

The projects are proposed to address Generator Deliverability thermal violations identified as a part of the 2016 RTEP Proposal Window 1. Generator Deliverability analysis was performed using the PowerGEM TARA software package V850. The results of the simulation with the project included were compared against the base case simulation without the project to determine the effectiveness of the projects in resolving the identified Generator Deliverability thermal violations. Although ITC could not identically replicate the PJM calculations the % change between the ITC base and project case was used as the expected % change on the initial PJM base case loading and thus show the effectiveness of the ITC proposals.

### Rawlings to Steers 500-kV Line

Project 16RTEP1-2b was shown to be effective in resolving the PJM identified flowgates as shown below in Table D7.

***Table D7 – 16RTEP1-2b Identified Flowgates***

| FG # | Analysis Type | Facility | Outage Type | % Loading | | % Change |
|---|---|---|---|---|---|---|
| | | | | Without Project | With Project | |
| 68 | GD | [redacted] | | | | |
| 78 | GD | | | | | |
| 102 | GD | | | | | |
| 249 | GD | | | | | |

The project alleviates the overloads seen on the Rogers Rd – Carson 500-kV line as reported by PJM for the Generator Deliverability test. This project does not address the following nearby violations summarized in Table D8 below.

*Table D8 – 16RTEP1-2b Violations Not Addressed*

| FG # | Analysis Type | Facility | Outage Type | % Loading | | % Change |
|---|---|---|---|---|---|---|
| | | | | Without Project | With Project | |
| 60 | GD | [redacted] | | | | |
| 61 | GD | [redacted] | | | | |
| 62 | GD | [redacted] | | | | |
| 66 | GD | [redacted] | | | | |
| 70 | GD | [redacted] | | | | |
| 71 | GD | [redacted] | | | | |
| 72 | GD | [redacted] | | | | |
| 76 | GD | [redacted] | | | | |
| 248 | GD | [redacted] | | | | |

## Rawlings to Carson #2 500-kV Line

Project 16RTEP1-3b was shown to be effective in resolving the PJM identified flowgates as shown below in Table D9.

*Table D9 – 16RTEP1-3b Identified Flowgates*

| FG # | Analysis Type | Facility | Outage Type | % Loading | | % Change |
|---|---|---|---|---|---|---|
| | | | | Without Project | With Project | |
| 102 | GD | [redacted] | | | | |

The project alleviates the overloads seen on the Rogers Rd – Carson 500-kV line as reported by PJM for the Generator Deliverability test. This project does not address the following nearby violations summarized in Table D10 below.

*Table D10 – 16RTEP1-2b Violations Not Addressed*

| FG # | Analysis Type | Facility | Outage Type | % Loading | | % Change |
|---|---|---|---|---|---|---|
| | | | | Without Project | With Project | |
| 60 | GD | [redacted] | | | | |
| 61 | GD | [redacted] | | | | |
| 62 | GD | [redacted] | | | | |
| 66 | GD | [redacted] | | | | |
| 68 | GD | [redacted] | | | | |
| 70 | GD | [redacted] | | | | |
| 71 | GD | [redacted] | | | | |
| 72 | GD | [redacted] | | | | |
| 76 | GD | [redacted] | | | | |
| 78 | GD | [redacted] | | | | |
| 248 | GD | [redacted] | | | | |
| 249 | GD | [redacted] | | | | |

## Lewis 500-kV Substation and 230-kV Line to Clubhouse

Project 16RTEP1-4a was shown to be effective in resolving the PJM identified flowgates as shown below in Table D11.

*Table D11 – 16RTEP1-4a Identified Flowgates*

| FG # | Analysis Type | Facility | Outage Type | % Loading | | % Change |
|---|---|---|---|---|---|---|
| | | | | Without Project | With Project | |
| 102 | GD | [redacted] | | | | |

The project alleviates the overloads seen on the Rogers Rd – Carson 500-kV line as reported by PJM for the Generator Deliverability test. This project does not address the following nearby violations summarized in Table D12 below.

***Table D12 – 16RTEP1-4a Violations Not Addressed***

| FG # | Analysis Type | Facility | Outage Type | % Loading | | % Change |
|---|---|---|---|---|---|---|
| | | | | Without Project | With Project | |
| 60 | GD | [redacted] | | | | |
| 61 | GD | [redacted] | | | | |
| 62 | GD | [redacted] | | | | |
| 66 | GD | [redacted] | | | | |
| 68 | GD | [redacted] | | | | |
| 70 | GD | [redacted] | | | | |
| 71 | GD | [redacted] | | | | |
| 72 | GD | [redacted] | | | | |
| 76 | GD | [redacted] | | | | |
| 78 | GD | [redacted] | | | | |
| 248 | GD | [redacted] | | | | |
| 249 | GD | [redacted] | | | | |

## Lewis 500/230-kV Substation and 230-kV Lines

Project 16RTEP1-4c was shown to be effective in resolving the PJM identified flowgates as shown below in Table D13.

*Table D13 – 16RTEP1-4c Identified Flowgates*

| FG # | Analysis Type | Facility | Outage Type | % Loading | | % Change |
|---|---|---|---|---|---|---|
| | | | | Without Project | With Project | |
| 102 | GD | [redacted] | | | | |

The project alleviates the overloads seen on the Rogers Rd – Carson 500-kV line as reported by PJM for the Generator Deliverability test. This project does not address the following nearby violations summarized in Table D14 below.

*Table D14 – 16RTEP1-4c Violations Not Addressed*

| FG # | Analysis Type | Facility | Outage Type | % Loading | | % Change |
|---|---|---|---|---|---|---|
| | | | | Without Project | With Project | |
| 60 | GD | [redacted] | | | | |
| 61 | GD | | | | | |
| 62 | GD | | | | | |
| 66 | GD | | | | | |
| 68 | GD | | | | | |
| 70 | GD | | | | | |
| 71 | GD | | | | | |
| 72 | GD | | | | | |
| 76 | GD | | | | | |
| 78 | GD | | | | | |
| 248 | GD | | | | | |
| 249 | GD | | | | | |

# 4. Additional Supporting Documentation

In addition to testing the project's effectiveness in alleviating the identified Generator Deliverability thermal violations, N-1, N-1-1 and Extreme Event reliability analysis was performed. These reliability analyses were performed using the posted data for PJM's 2016 RTEP Proposal Window 1. These analyses were performed using the posted case (base summer peak) and the modified base cases with the inclusion of the project. [redacted] were used for simulation. The raw results files can be made available upon PJM request.

Bus, failed breaker, single and tower contingencies were evaluated for the N-1 analysis. All Single contingencies in the Dominion area were considered for the N-1-1 analysis. The Carson 500/230-kV substation was taken out of service for the Extreme Event reliability analysis. Carson was chosen to be studied because it could be considered a critical hub to deliver generation south of Richmond due to the number of 500-kV and 230-kV facilities served from Carson and its position relative to the load centers at Richmond and other nearby vital load centers such as Baltimore/Washington D.C.

The entire PJM footprint was monitored for thermal and voltage impacts. Any facility that became overloaded with the addition of the project and showed greater than 2% difference between the base case and the project case was considered an adverse impact. As ITC could not identically replicate the PJM N-1-1 methodology which includes system re-dispatch and topology modification, the N-1-1 results depict a more conservative review of the system's resiliency under those contingency conditions.

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

### Charles City to Lakeside 230-kV Line Upgrade

As indicated above, the Charles City to Lakeside 230-kV line is marginally overloaded for the outage of the Steers to Midlothian 500-kV line, the Carson to Midlothian 500-kV line or the Chesterfield to Basin 230-kV line, for all projects. The worst loadings on the Charles City to Lakeside 230-kV line are for the loss of the Carson to Midlothian 500-kV line and are shown below in Table D19. The loading without the project is derived from the corresponding outage of the Carson to Midlothian 500-kV line before it is tapped into the new Steers switchyard.

*Table D19 – Charles City to Lakeside 230-kV Line Loadings*

| Project | FG # | Analysis Type | Facility | Outage Type | % Loading | | % Change |
|---|---|---|---|---|---|---|---|
| | | | | | Without Project | With Project | |
| 16RTEP1-2b | NEW | GD | [redacted] | | | | |
| 16RTEP1-3b | NEW | GD | | | | | |
| 16RTEP1-4a | NEW | GD | | | | | |
| 16RTEP1-4c | NEW | GD | | | | | |

In order to alleviate the newly identified overload, it is assumed that the incumbent transmission owner will upgrade the Charles City to Lakeside 230-kV line with [redacted] conductor, or equivalent, to achieve ratings of at least [redacted] MVA. It should be noted that these issues highlight a stressed part of the system that will need to be upgraded in the very near future regardless of the project.

### Lewis to Clubhouse 230-kV Line Upgrade

As indicated above, the Lewis to Clubhouse 230-kV line is marginally overloaded for the outage of the Carson to Rawlings 500-kV line or the Carson to Rogers Rd 500-kV line, for 16RTEP1-4c. In order to alleviate the newly identified overload, it is assumed that the incumbent transmission owner will upgrade the transmission owner owned section of the Lewis to Clubhouse 230 kV line (formerly Clubhouse to Lakeview 230-kV line) with [redacted] conductor, or equivalent, to achieve ratings of at least [redacted] MVA for the approximately 0.5 mile section.

# 5. Additional Benefits

## 16RTEP1-2b and 16RTEP1-3b Reliability Benefits

The 16RTEP1-2b and 16RTEP1-3b projects propose new 500-kV lines in the Dominion area which has recently identified a large number of transmission lines to be at their end-of-life. Of the 106 transmission lines identified, 54 are 230-kV and 25 are 500-kV lines. These new projects will increase the operating flexibility of the system to allow for these lines to be taken out of service as necessary for removal or replacement.

## Economic Benefits

The economic benefits of each project were analyzed using PROMOD models released during the 2014 Long Term Market Efficiency window. The analysis was conducted for years 2015, 2019, 2022 and 2025 and analysis shows that implementing each of the 16RTEP1-2b and 16RTEP1-3b projects would realize APC and NLP economic benefits that could substantially offset the cost of the project shown in Table D20 below.

***Table D20 – Economic Benefits***

| Project | NLP ($MM) | APC ($MM) | Benefits ($MM, 2020) | Net Project Cost ($MM, 2020) |
|---|---|---|---|---|
| **15RTEP1-2b** | $77.8 | $14.9 | $46.4 | $120.3 |
| **15RTEP1-3b** | $114.9 | $10.8 | $62.9 | $109.3 |

Note: Escalation factor 2.5%

# 6. Proposal Template Spreadsheet

The following proposal template spreadsheets can be located in Appendix B:

- RTEP Proposal Template 2016 – 16RTEP1-2b
- RTEP Proposal Template 2016 – 16RTEP1-3b
- RTEP Proposal Template 2016 – 16RTEP1-4a
- RTEP Proposal Template 2016 – 16RTEP1-4c

# E. COST

## 1. Cost-estimates

The capital cost of the proposed projects, including the scope that would be assigned to incumbent transmission owners, are shown in Table E1 below. Project totals are shown in both current year (2016) dollars as well as In-Service Date (ISD) dollars (2020) which have been escalated at a rate of 2.5% per year per the standard PJM escalation rate. This is based on Consumer Pricing Index (CPI) projections.

*Table E1 – Total Project Costs*

| Project | Greenfield ITC Cost in 2016 Dollars ($MM) | Incumbent Cost in 2016 Dollars ($MM) | Total Project Cost in 2016 Dollars ($MM) | Total Project Cost in 2020 ISD Dollars ($MM) |
|---|---|---|---|---|
| 16RTEP1-2b | $85.9 | $25.6 | $111.5 | $120.3 |
| 16RTEP1-3b | $74.9 | $26.3 | $101.2 | $109.3 |
| 16RTEP1-4a | $38.0 | $23.8 | $61.8 | $66.9 |
| 16RTEP1-4c | $39.8 | $20.0 | $59.8 | $64.6 |

Yearly cash flows for each of the proposed projects are shown in Tables E2 – E5 below.

*Table E2 – 16RTEP1-2b Yearly Cash Flow (2020 ISD Dollars )*

| | 2016 | 2017 | 2018 | 2019 | 2020 | Total |
|---|---|---|---|---|---|---|
| ITC T-Line Costs | [redacted] | | | | | |
| ITC Switchyard Costs | | | | | | |
| Incumbent TO Costs | | | | | | |

*Table E3 – 16RTEP1-3b Yearly Cash Flow (2020 ISD Dollars)*

| | 2016 | 2017 | 2018 | 2019 | 2020 | Total |
|---|---|---|---|---|---|---|
| ITC T-Line Costs | [redacted] | | | | | |
| Incumbent TO Costs | | | | | | |

*Table E4 – 16RTEP1-4a Yearly Cash Flow (2020 ISD Dollars)*

| | 2016 | 2017 | 2018 | 2019 | 2020 | Total |
|---|---|---|---|---|---|---|
| ITC T-Line Costs | [redacted] | | | | | |
| ITC Switchyard Costs | | | | | | |
| Incumbent TO Costs | | | | | | |

*Table E5 – 16RTEP1-4c Yearly Cash Flow (2020 ISD Dollars)*

| | 2016 | 2017 | 2018 | 2019 | 2020 | Total |
|---|---|---|---|---|---|---|
| ITC T-Line Costs | [redacted] | | | | | |
| ITC Switchyard Costs | | | | | | |
| Incumbent TO Costs | | | | | | |

## 2. Detailed Breakdown of Cost Elements

Breakdown of costs for each of the proposed projects are shown in Tables E6 – E9 below.

***= Incumbent Costs**

*Table E6 – 16RTEP1-2b Project Costs*

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

*Tabl*[redacted]

[redacted]

**Planned Return on Equity (ROE), including any incentive adders the proposing entity intends to seek**

[redacted]

[redacted]

**Estimated monthly AFUDC for each Project**

[redacted]

**Detailed breakdown of annual operation and maintenance (O&M) costs**

[redacted]

# 3. Cost Commitment

[redacted]

[redacted]

# F. SCHEDULE

## 1. Detailed Conceptual Schedule

The schedule below would apply to each of the projects.

[redacted]

# G. OPERATIONS/MAINTENANCE

## 1. Overview of Plans for Operations and Maintenance

### Operational Plan Including Intentions for Control Center

ITC incorporated new service territories into its existing operations and control center as the company has grown. This is both a result of existing systems and organic growth of ITCGP and other operations.

ITC has navigated the interconnection process with various PJM Transmission Owners related to our multiple system interconnections. As noted in the response to question B.1, three of four ITC operating companies have interconnections with PJM transmission owners.

ITC will operate the new transmission facilities from its primary control center, from which ITC operates 15,000-miles of transmission lines and associated facilities in three NERC regions (Midwest Reliability Organization, RF and SPP) as well as in two ISO/RTO footprints (MISO and SPP). In anticipation of continued growth, the control center was designed with flexibility to allow additional capacity as ITC's system expands into new ISO/RTO footprints.

All ITC system operators and key management staff are NERC-certified at the Reliability Coordinator level and maintain this certification through a comprehensive ongoing training program. ITC also has a redundant and independent backup control center capable of operating all of ITC's transmission facilities, including all future assets. The ITC control center facilities provide all required telemetry on existing facilities to the MISO and SPP RTOs and we would develop similar links for any projects secured in PJM. ITC will become a PJM Member in conjunction with the future Covert to Segreto 345-kV line and is in the process of ensuring all requirements of the PJM manuals are met before the scheduled in-service date of June 1, 2016, including the PJM telemetry requirements identified in Attachment A of Manual 01 and the operator certification requirements in Manual 40. Many of the requirements covered in the manuals are similar to those ITC already meets for other RTO footprints.

### Maintenance Plan/Contracts

ITC has a comprehensive program and established procedures for substation maintenance on its existing systems that includes routine inspection of equipment in substations and control houses. Items identified for follow-up maintenance or repair are monitored and documented in a computerized maintenance management system. The program also includes cyclical and predictive maintenance intervals on major substation equipment including, but not limited to, circuit breakers, switches, transformers, relay and protective systems, distributed control systems and capacitor banks.

A similar comprehensive program exists for transmission line maintenance. It includes annual aerial inspections and cyclical ground line inspections and wood pole/steel tower maintenance. Items identified for follow up maintenance or repair are monitored and documented in a computerized maintenance management system. ITC's vegetation management policy is to actively manage, through removal, pruning, mowing and/or herbicides applications, the vegetation that grows within the electric transmission line easement area or right-of-way in order to ensure safety, reliability and, in the case of 200-kV and above facilities, meet mandatory reliability requirements established by NERC and approved by FERC on March 16, 2007. It is ITC's corporate goal to have zero outages as a result of vegetation interference.

ITC uses modern high-speed networked Supervisory Control and Data Acquisition ("SCADA") equipment health monitoring on key ITC assets such as transformers, circuit breakers and protective relaying. Alarming on these systems monitored 24-7 by the ITC central operations control room. When under active alarm, corrective action is initiated including dispatch of appropriate field maintenance resources.

ITC has a philosophy of maintaining minimum spare stock of substation and line equipment (including key assets such as circuit breakers and transformers). By analyzing past storm related damage and the associated material needed to respond, ITC has proactively staged emergency spare material along with general maintenance material at ITC warehouses. These warehouses are strategically located throughout the company's footprint to supply spare material 24-7 in emergencies. These strategic materials are replenished as needed.

In various geographic regions, ITC has addressed operations and maintenance staffing in a variety of ways, including service agreements with existing transmission-owning entities and establishing an O&M staff. For example, in Kansas, Sunflower Cooperative and Midwest Energy provided maintenance service for ITCGP's assets in Kansas. Following the philosophy of identifying strategic response material, certain materials and items are staged at maintenance partner locations for potential emergency needs.

Based on past experience, ITC has the flexibility to handle this important function in the optimal and most cost-effective manner.

# H. APPENDIX A – SUPPORTING FIGURES

# I. APPENDIX B – SUPPORTING DATA

RTEP Proposal Template 2016 – 16RTEP1-2b

RTEP Proposal Template 2016 – 16RTEP1-3b

RTEP Proposal Template 2016 – 16RTEP1-4a

RTEP Proposal Template 2016 – 16RTEP1-4c

# J. APPENDIX C – FINANCIAL STATEMENTS

ITCH 2013 Annual Financial Statement

ITCH 2014 Annual Financial Statement

ITCH 2015 Annual Financial Statement