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Issue(s): Project Design  
Witness: David Endorf, P.E.  
Sponsoring Party: Ameren Transmission  
Company of Illinois  
Type of Exhibit: Direct Testimony  
Case No.: EA-2015-0146  
Date Testimony Prepared: May 29, 2015

**MISSOURI PUBLIC SERVICE COMMISSION**

**CASE NO. EA-2015-0146**

**DIRECT TESTIMONY**

**OF**

**DAVID ENDORF, P.E.**

**ON**

**BEHALF OF**

**AMEREN TRANSMISSION COMPANY OF ILLINOIS**

St. Louis, Missouri  
May 2015

ATX/ Exhibit No. 13  
Date 1/25/16 Reporter JL  
File No. EA-2015-0146

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1                   **I. INTRODUCTION AND WITNESS QUALIFICATIONS**

2           **Q. Please state your name, business address and present position.**

3           A. My name is David Endorf, and my business address is 1901 Chouteau Avenue, St.  
4 Louis, Missouri 63103. I am employed by Ameren Services Company (“Ameren Services”) as a  
5 Principal Engineer in the Transmission Performance Management and Engineering Department.

6           **Q. Please summarize your professional experience and educational background.**

7           A. I have a Bachelor of Science degree in Civil Engineering from Valparaiso  
8 University. I have a Master of Science degree in Civil Engineering from the University of  
9 Missouri – Rolla. I am a registered Professional Engineer in Missouri and Illinois. I have  
10 transmission line experience including project design and management of both small and large  
11 projects at voltages from 138,000 volts to 345,000 volts. I currently serve as a member on the  
12 American Society of Civil Engineers Standards Committee. I am a member of both the Institute  
13 of Electrical and Electronic Engineers and the American Society of Civil Engineers.

14           **Q. What are your duties and responsibilities in your present position?**

15           A. My duties include designing transmission line projects for the operating  
16 companies to which Ameren Services provides support, including Ameren Transmission  
17 Company of Illinois (“ATXI”) and other Ameren Corporation subsidiaries such as Ameren  
18 Illinois Company and Union Electric Company, d/b/a Ameren Missouri. These duties include

1 assisting with the selection of line routes that balance cost effectiveness and environmental  
2 impacts, and ensuring line design meets National Electrical Safety Code (“NESC”) requirements.  
3 While the scope of the projects vary, each one includes the following elements: the design of the  
4 transmission structures that are to be used on the transmission line, selection of transmission  
5 hardware, development of technical drawings, materials procurement, coordinating the  
6 scheduling of outages, coordination of field surveying work and cooperation with other  
7 departments within Ameren Services (real estate, vegetation management, environmental  
8 services and other engineering groups), resolution of issues during construction, performance of  
9 the final inspection and turning the line over to operations to place in service. One of my primary  
10 responsibilities at present is to serve as an engineer for the Mark Twain Project, the subject of  
11 this Application, which means that I will be designing approximately 95 miles of new 345-kV  
12 transmission line and an approximately 2.2-mile, 161-kV connector transmission line between  
13 Ameren Missouri's existing Adair Substation and ATXI's new Zachary Substation.

## 14 II. PURPOSE AND SCOPE

15 Q. What is the purpose of your testimony?

16 A. The purpose of my testimony is to provide information regarding the design of the  
17 proposed Mark Twain transmission project.

18 Q. Are you sponsoring any schedules in support of your direct testimony?

19 A. Yes. I am sponsoring **Schedule DE-01**, a drawing of a typical tangent steel pole  
20 structure for the 345-kV transmission line. I am also sponsoring **Schedule DE-02**, a drawing of a  
21 typical tangent pole steel structure for the 161-kV transmission line, and **Schedule DE-03**, a  
22 drawing depicting the site design of the Zachary Substation.

1

### III. DESIGN CONSIDERATIONS

2

**Q. Please provide a technical description of the proposed Mark Twain Project.**

3

**A. The proposed line will be a 345-kV, overhead transmission line approximately 95**

4

miles long. The route for the primary transmission line consists of two portions, from ATXI's

5

Maywood Switching Station located near Palmyra to the new Zachary Substation near

6

Kirksville, and from the Zachary Substation north to a connection point at the Iowa state line. In

7

addition, the Project includes construction of a 2.2-mile, 161-kV transmission line from the

8

Zachary Substation, which is also to be constructed for the transmission Project, to an existing

9

substation near Adair.

10

ATXI will construct the proposed single-circuit 345-kV transmission line using single-

11

shaft, self-supported steel poles on concrete foundations. Pole heights will range from

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approximately 90 feet to 130 feet above ground. The steel pole structures will be set on top of a

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concrete pier foundation that will be about seven to ten feet in diameter. **Schedule DE-01** shows

14

a drawing of a typical tangent steel pole structure for the 345-kV transmission line. Typical spans

15

will be approximately 850 feet. The transmission line will require a 150-foot wide easement for

16

right-of-way.

17

Each phase for the 345-kV line will be bundled Cardinal ACSS conductor. One shield

18

wire will be 7#7 AW, and the second shield wire will be a fiber optic ground wire. The structure

19

types will consist of tangents, running angles, and dead-ends. The line will be designed to meet

20

or exceed the requirements of the NESC and, accordingly, the requirements at 4 CSR 240-

21

18.010.

22

**Q. Will there be any above-ground fixtures located on agricultural land other**

23

**than support structures and conductors?**

1           A.     No.

2           **Q.     Will ATXI place any guy wires and anchors along right-of-way lines or land**  
3 **division lines?**

4           A.     No. All proposed structures will be self-supporting steel poles with concrete  
5 foundations and will not require any guy wires.

6           **Q.     Please provide a general description of the proposed Zachary Substation and**  
7 **facilities.**

8           A.     The 23-acre substation, designed by the Ameren Substation Design Team, will  
9 consist of a 345-kV and a 161-kV switchyard connected by a power transformer. The substation  
10 will include two relay control enclosures, six circuit breakers, voltage and current sensing  
11 transformers, and a shunt reactor for voltage stability. The substation yard will be fully enclosed  
12 by chain-link fencing and only accessible by authorized personnel. **Schedule DE-03** depicts the  
13 substation design for the Zachary Substation.

14          **Q.     Please provide a technical description of the proposed 161-kV transmission**  
15 **line that will connect the Zachary Substation with the Adair Substation.**

16          A.     The proposed 161-kV transmission line from the Zachary Substation to the Adair  
17 Substation will be approximately 2.2 miles long. ATXI will construct the proposed double-  
18 circuit 161-kV transmission line using single-shaft, self-supported steel poles on concrete  
19 foundations. Pole heights will range from approximately 70 to 100 feet above ground. These  
20 steel pole structures will be set on top of a concrete pier foundation that will be about seven to  
21 ten feet in diameter. **Schedule DE-02** shows a drawing of a typical tangent steel pole structure to  
22 be used for the 161-kV transmission line. Typical spans will be approximately 600 feet. The  
23 transmission line will require a 100-foot wide easement for right-of-way.

1 Each phase for the double circuit 161-kV line will be a single 1192 Grackle ACSS  
2 conductor. Both shield wires will be fiber optic ground wires. The structure types will consist of  
3 tangents, running angles, and dead-ends. The line will be designed to meet or exceed the  
4 requirements of NESC and, accordingly, the requirements at 4 CSR 240-18.010.

5 **Q. Did ATXI evaluate the conceptual design impacts of the proposed Mark**  
6 **Twain Project?**

7 **A.** Yes. ATXI retained a consultant, Burns & McDonnell Engineering, Inc. (“Burns  
8 & McDonnell”) to help develop route siting criteria, prepare a route siting analysis, and work  
9 with various stakeholders and the public to obtain their input into that process. The ATXI project  
10 team worked with Burns & McDonnell in the route selection process, which addressed land use  
11 impacts, environmental, cultural and historical resource concerns, and other routing criteria,  
12 including the engineering and constructability of the Project. The results of the route selection  
13 process are discussed in more detail in Mr. Christopher Wood’s direct testimony.

14 **IV. RIGHT-OF-WAY WIDTH**

15 **Q. You have stated that a 150-foot right-of-way easement will be required to**  
16 **construct the 345-kV portion of the Mark Twain Project transmission line. Please describe**  
17 **why a 150-foot easement is required.**

18 **A.** The 150-foot wide easement is required to provide adequate clearance from the  
19 345-kV transmission line conductors to the edge of the right-of-way for operational and  
20 maintenance purposes.

21 **Q. Is the 150-foot easement the minimum easement required?**

22 **A.** Yes. The 150-foot easement will provide adequate NESC clearances from the  
23 conductor to a building on the edge of the right-of-way (Rule 234C.1). The 150-foot easement is

1 the minimum easement that will provide the necessary clearance to trees or vegetation at the  
2 edge of the right-of-way. Maintenance of this clearance is necessary for the safe operation of the  
3 line.

4 **Q. Does ATXI have the necessary easements to construct the Mark Twain**  
5 **Project?**

6 A. Not yet. ATXI witness Douglas Brown will address the acquisition of the  
7 permanent easements. ATXI has acquired the property for the proposed Zachary Substation.

8 **Q. In addition to the permanent utility easements, will ATXI require**  
9 **construction easements to construct the Mark Twain Project transmission line?**

10 A. Generally, the permanent easement obtained by ATXI will provide sufficient area  
11 for construction of the transmission line. During the installation of the wires, the construction  
12 contractor may need to set up equipment outside the permanent right-of-way. Depending on the  
13 particular circumstances, there may be a need to obtain a temporary construction easement.

14 **Q. Does ATXI anticipate installing its transmission support structures along the**  
15 **centerline of the easement?**

16 A. Yes.

17 **Q. When the electric line parallels other electric transmission lines, will ATXI**  
18 **require a narrower easement?**

19 A. No, ATXI will still require a 150-foot easement width; however, where the  
20 transmission line parallels other facilities, ATXI will seek to acquire an overlapping easement so  
21 as to reduce the total easement width impacting a given property.

22 **Q. Will the 161-kV connector line between the Zachary Substation and the**  
23 **Adair Substation also require a 150-foot wide permanent easement?**



1           A.     No. The 161-kV line will require a 100-foot wide permanent easement. Similar to  
2 the construction of the 345-kV transmission line, the construction contractor may need to set up  
3 equipment outside the 100-foot wide right-of-way. Depending on where this might occur, there  
4 may be a need to obtain a temporary construction easement.

5                                 **V.     CONCLUSION**

6           **Q.     What is the status of the final technical design for the Mark Twain Project?**

7           A.     Now that the final route has been selected, the technical design of the Project has  
8 begun. We anticipate having a final design for the project complete by late fall 2015.

9           **Q.     Does this conclude your direct testimony?**

10          A.     Yes, it does.

BEFORE THE PUBLIC SERVICE COMMISSION  
OF THE STATE OF MISSOURI

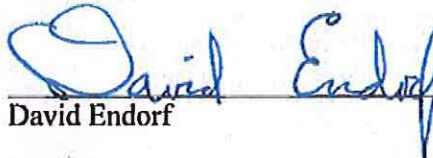
In the Matter of the Application of Ameren Transmission )  
Company of Illinois for Other Relief or, in the Alternative, )  
a Certificate of Public Convenience and Necessity )  
Authorizing it to Construct, Install, Own, Operate, ) File No. EA-2015-0146  
Maintain and Otherwise Control and Manage a )  
345,000-volt Electric Transmission Line from Palmyra, )  
Missouri, to the Iowa Border and an Associated Substation )  
Near Kirksville, Missouri. )

AFFIDAVIT OF DAVID ENDORF

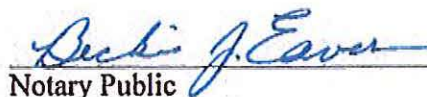
STATE OF MISSOURI )  
 ) ss  
CITY OF ST. LOUIS )

David Endorf, being first duly sworn on his oath, states:

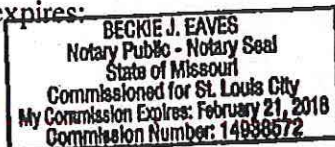
1. My name is David Endorf. I work in St. Louis, Missouri, and I am employed by Ameren Services Company.
2. Attached hereto and made a part hereof for all purposes is my Direct Testimony on behalf of Ameren Transmission Company of Illinois consisting of 7 pages, and Schedule(s) DE-01, DE-02, DE-03 all of which have been prepared in written form for introduction into evidence in the above-referenced docket.
3. I hereby swear and affirm that my answers contained in the attached testimony to the questions therein propounded are true and correct.

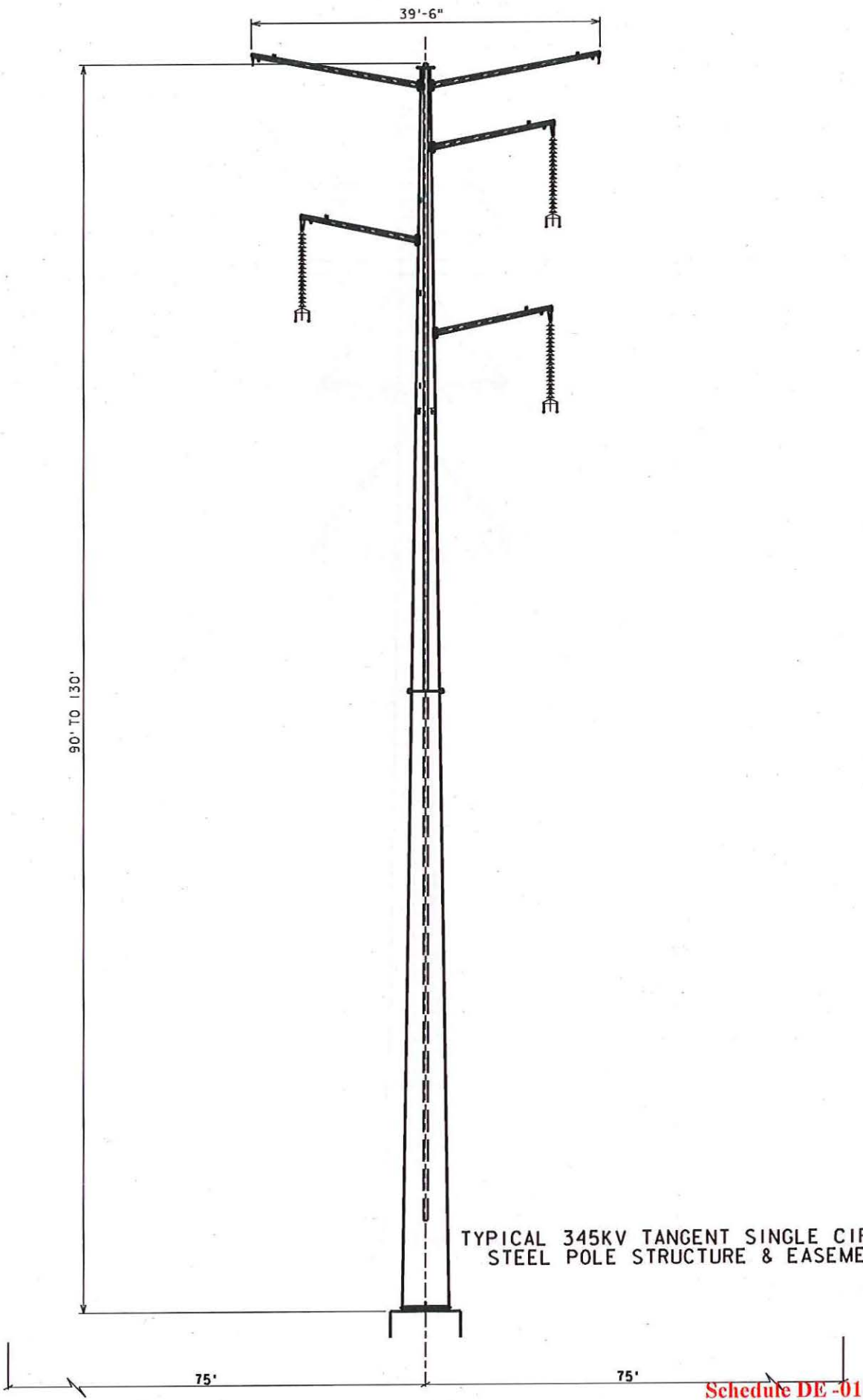
  
\_\_\_\_\_  
David Endorf

Subscribed and sworn to before me this 26<sup>th</sup> day of May, 2015.

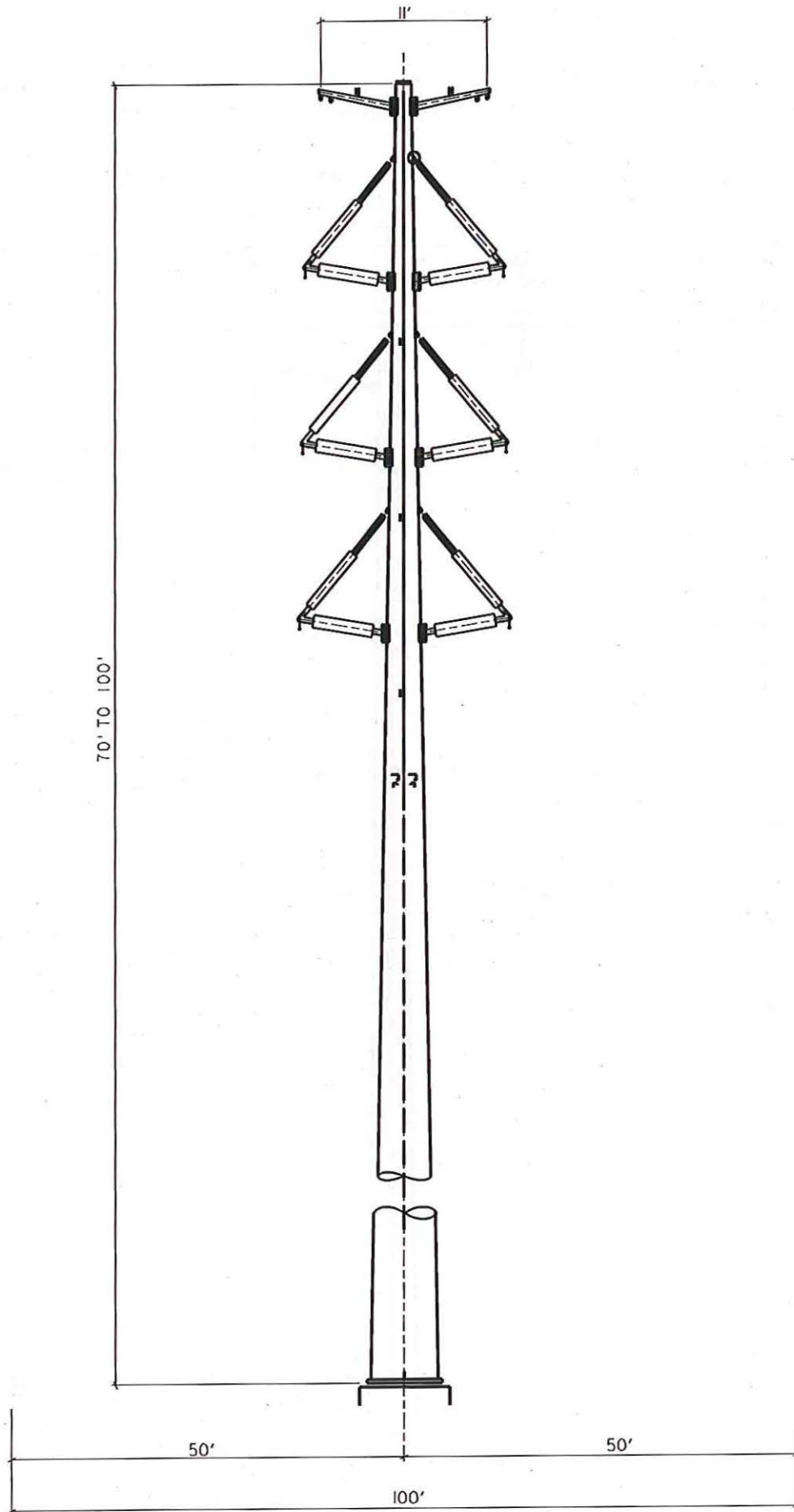
  
\_\_\_\_\_  
Notary Public

My commission expires:



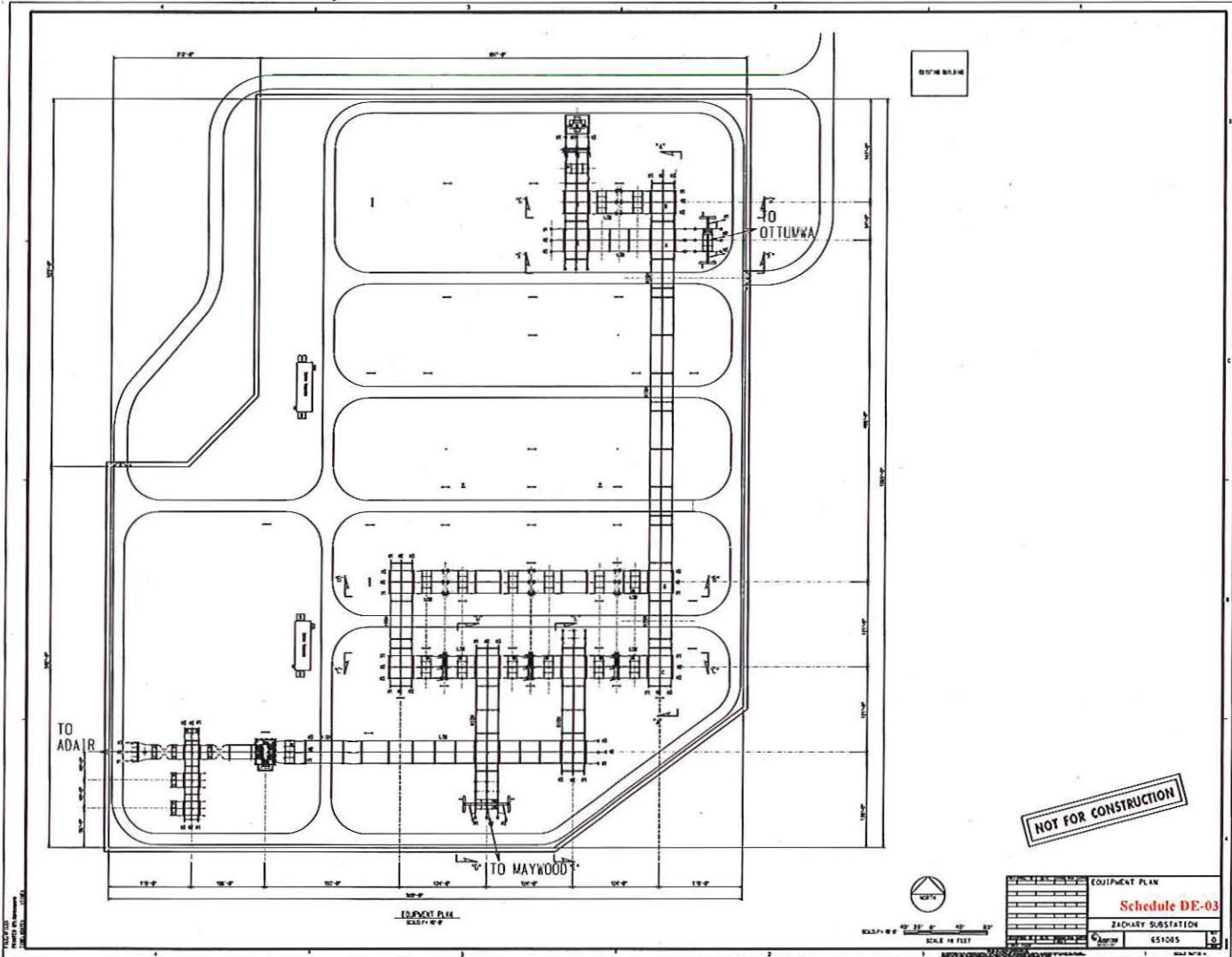


TYPICAL 345KV TANGENT SINGLE CIRCUIT  
STEEL POLE STRUCTURE & EASEMENT



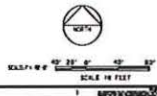
TYPICAL 161KV TANGENT DOUBLE CIRCUIT  
STEEL POLE STRUCTURE & EASEMENT

Schedule DE-02



BY THE WAY

NOT FOR CONSTRUCTION



EQUIPMENT PLAN	
Schedule DE-03	
ZACHARY SUBSTATION	
DATE	5/1/05
BY	SS1085
CHKD	
APP'D	
DATE	

EQUIPMENT PLAN  
SCALE IN FEET

PROJECT NO. 05-000000  
SHEET NO. 001