Request for Qualifications

ARC Flash Analysis & Infrared Study for Forsyth County Facilities

Qualifications Will Be Received Until
12:00 Noon, Friday, July 21, 2017

By The City of W-S/Forsyth Co. Purchasing Department
In Room 324 City Hall Building
101 North Main Street
Winston-Salem, North Carolina

It is the policy of the County of Forsyth that an employee, officer, or agent of the County may not participate in any manner in the bidding, awarding, or administering of contracts or agreements in which they, or a member of their immediate family, their business partner, or any organization in which they serve as an officer, director, trustee, or employee, have a financial interest.

The successful Proposer must comply with all provisions of the Americans with Disabilities Act (ADA) and all rules and regulations promulgated thereunder. By submitting a proposal, the successful Proposer agrees to indemnify the County from and against all claims, suits, damages, costs, losses, and expenses in any manner arising out of, or connected with, the failure of the Company, its subcontractors, agents, successors, assigns, officers, or employees to comply with the provisions of the ADA or the rules and regulations promulgated thereunder.

Public Records
Any material submitted in response to this RFQ will become a "public record" once the Proposer's document(s) is opened and the Proposer is determined to be a participant in the solicitation process and shall be subject to public disclosure consistent with Chapter 132, North Carolina Statutes. Proposers must claim any applicable exemptions to disclosure provided by law in their response to this RFQ. Proposers must identify materials to be protected, and must state the reasons why such exclusion from public disclosure is necessary and legal. The County reserves the right to make all final determination(s) of the applicability of North Carolina General Statutes § 132-1.2, Confidential Information.

Familiarity with Laws and Ordinances
The submission of a proposal on the services requested herein shall be considered as a representation that the Proposer is familiar with all federal, state, and local laws, ordinances, rules and regulations which affect those engaged or employed in the provision of such services, or equipment used in the provision of such services, or which in any way affects the conduct of the provision of such services; and no plea of misunderstanding will be considered on account of ignorance thereof. If the Proposer discovers any provisions in the RFQ documents that are contrary to or inconsistent with any law, ordinance, or regulation, it shall be reported to the County in writing without delay

E-Verify Compliance
Per N.C.G.S. 143-133.3 "E-VERIFY. Provider shall comply with the requirements of Article 2 of Chapter 64 of the North Carolina General Statutes. Further, if the Provider utilizes a subcontractor, the Provider shall require the subcontractor to comply with the requirements of Article 2 of Chapter 64 of the North Carolina General Statutes."

Iran Divestment Act; Provider hereby certifies that it is not on the North Carolina State Treasurer's list of persons engaging in business activities in Iran, prepared pursuant to NCGS 147-86.58, nor will Provider utilize on this agreement any subcontractor on such list. This list, along with additional information about the Iran Divestment Act, is available on the Treasurer's Office site: https://www.nctreasurer.com/inside-the-department/OpenGovernment/Pages/Iran-Divestment-Act-Resources.aspx.

RFQ Response Submission
All proposals shall be returned in a sealed container or envelope containing **one original proposal (please mark document as original)** showing original signatures and seals **and two (2) copies** of the complete proposal **marked ARC Flash Hazard Analysis and Infrared Study for**

Forsyth County Facilities. Proposals must be submitted to the City/County Purchasing Department in Suite 324, City Hall Building, 101 North Main Street, Winston-Salem, NC, no later than **12:00 Noon, Friday, July 21, 2017. Late proposals will not be considered.**

The County will not be obligated for the expenses of any provider arising out of preparation and/or submittal of responses to this RFQ. Any and all proposals to this RFQ are to be prepared at the cost and expense of the respondents, with the express understanding that there may be no claims whatsoever for the reimbursement of any costs, damages, or expenses relating to this procurement from the County or any other party for any reason (including the cancellation of this RFQ).

Proposals must be made in the official name of the individual, firm, or corporation under which the business is conducted (showing official business address) and must be signed in ink by a person duly authorized to legally bind the business entity submitting the proposal.

All proposals should be complete and carefully worded and must convey all of the information requested by the County. If errors or exceptions are found in the proposal, or if the proposal fails to conform to the requirements of the RFQ, the County will be the sole judge as to whether that variance is significant enough to reject the proposal.

Proposals should be prepared simply and economically. All data, materials, and documentation shall be available in a clear, concise form. The County reserves the right to reproduce proposals for internal use in the evaluation process.

Proposers are expressly forbidden from contacting any other County employee or Forsyth County elected official regarding this Request for Qualifications. Any such outside contact may result in disqualification from the request for qualification process.

Proposer Questions and Inquiries

Proposer Questions and Inquiries relative to this RFQ must be submitted **in writing only by 12:00 Noon, Friday, June 30, 2017,** to Jerry Bates, City/County Purchasing Director, 101 North Main Street, Winston-Salem, NC 27101 or e-mail: jerryjb@cityofws.org **(Email is preferred),** Fax: (336) 727-2443. The County will provide written responses to all inquiries received by this date, and responses will be made available to all recipients of this RFQ. Any oral responses made by any representative of the County may not be relied upon. Any supplements or amendments to this RFQ will be in writing and furnished to potential proposers.

PART 1 - GENERAL SCOPE OF SERVICES

Forsyth County is seeking the services of a qualified North Carolina Licensed Engineering firm to perform an arc flash analysis and infrared study for Forsyth County facilities. The successful firm shall conduct and furnish a short-circuit, electrical equipment protective device evaluation, interrupt rating analyses, time current protective device coordination and arc flash hazard analysis studies for electrical distribution equipment for Forsyth County facilities. The limits of the Study shall begin at the Utility Primary Source of Connection and end at (including but not limited to) all Three-Phase Panelboards, Switchboards, Fused Switches, Motor Starters, and Serviceable Enclosures/Equipment containing exposed live electrical parts including standby power generators and associated equipment. The Study will also include a qualitative Infrared Thermographic Survey of entire electrical distribution system.

RFQ responses should include the following information indicating how your firm is qualified to provide the services outlined in this document:

A. Letter of interest.
B. Minimum Qualifications/Experience Checklist: By including this list and checking YES, firm agrees to and will demonstrate compliance with the following requirements as well as provide appropriate documentation for verification (if applicable):
    a. PE (Electrical) on staff to review/approve data and analyses.
    b. Referenced PE shall be registered in North Carolina and have five (5) years of experience in arc flash analysis studies.
    c. Minimum of ten (10) similar studies completed in the last two (2) years
    d. Degreed electrical engineers on staff to supervise all field work
    e. Engineer s and technicians completing field work must be experienced and regularly perform electrical system testing.
C. Firm history.
D. Current project list.
E. List previous projects of similar scope.
F. Description of experience with arc flash hazard analyses.
G. Description of experience with infrared studies.
H. Resumes for staff who would be assigned to the project.
I. Consultant/contractor shall indicate compliance with Forsyth County insurance requirements as outlined in this document.
J. References.

PROJECT TIMELINE

Forsyth County General Services anticipates that a Contract will be fully executed on **July 1, 2017, the notice to proceed**. The project report is to be finished by **June 30, 2019**. Please indicate if consultant/contractor can meet this schedule and provide a proposed project timeline with your response. Timeline shall include contract award date, on-site data collection timeframe, system model development and analysis timeframe, draft report presentation and final report presentation.

PART 2 - BELOW IS FORSYTH COUNTY'S OUTLINE OF THE SCOPE OF WORK. THIS IS SUBJECT TO CHANGE BASED UPON SELECTED PROFESSIONAL ENGINEER'S EXPERTISE AND EXPERIENCE ASSOCIATED WITH ARC FLASH ANALYSIS AND INFRARED STUDY.

1.1 DESCRIPTION

A. Forsyth County General Services desires to implement an arc flash hazard program to supplement/enhance our existing electrical safety program, provide additional safety measures for our employees, and provide compliance with OSHA mandates. Forsyth County General Services desires to retain a qualified firm to assist in the development and implementation of the arc flash and electrical safety programs. Forsyth County General Services desires that the process be interactive with Forsyth County General Services employees contributing to the development/enhancement of the arc flash safety program. Forsyth County General Services desires that the successful firm will assist with the following:

1. GAP Analysis – review our existing safety program, resources, and facility conditions to determine what steps need to be taken to help comply with industry arc flash mandates and requirements.

2. An electrical arc flash hazard analysis, including:

   a. The development of an up-to-date electrical system one-line diagram and model to provide staff members with an accurate representation of the installed electrical system.

   b. Determination of system operating modes and conditions that can impact short circuit currents and arc flash hazard energy levels.

   c. Short circuit and equipment duty study to verify that equipment is rated to safely handle short circuit currents without creating hazardous conditions.

   d. Protective device coordination study and review to help ensure proper electrical system reliability and to determine if arc flash hazard energy levels can be reduced.

   e. Arc flash hazard analysis study to determine arc flash energy levels and Personal Protective Equipment (PPE).

   f. A copy of the power system model and database electronic file that is fully compatible with arc flash and electrical safety program implementation software.

   g. Arc flash hazard labeling.

B. An electrical arc flash hazard analysis shall be performed on Forsyth County facilities to determine incident energy, arc flash protection boundaries, and required PPE for all electrical equipment in the facility. The calculations shall comply with NFPA-70E 2015, and IEEE-1584. An integral part of NFPA-70E compliance is integrating work permits with arc flash assessment for all equipment in this facility. This section describes in detail the requirements for the study as well as integrating work permits in the system model for 70E compliance.

C. The purpose of this study is to provide a comprehensive software model of the Forsyth County General Services electrical distribution system, which will document Forsyth County General Services compliance with NFPA 70E mandates as described below. This model will serve as an integral part of an ongoing safety program by providing integral work permits and arc flash calculations in compliance with NFPA-70E:

1. **Article 205.2, 120.2(F)(1):** Updated and verified one-line diagram for all electrical distribution voltages including all sources for lock-out and tag out procedures.

2. **Article 210.3, 210.5:** Updated short circuit and equipment duty verification study showing all electrical equipment is properly rated to withstand and interrupt the available short circuit duty per ANSI Standards and NEMA/UL/NEC requirements. If underrated, supply list of underrated equipment to owner.

3. **70E (2004) Article 400.6, 410.9:** *(Removed in 70E 2009 but should be referenced for a complete specification).* Updated protective device coordination study showing the system protective devices are properly set to coordinate and clear a fault without extensive equipment damage or personnel risk.

4. **Article 130.3, 110.8(B)(1)(b):** Updated arc flash study providing maximum incident energies, arc flash boundaries, and PPE requirements for each equipment in the system. In addition, these calculations shall be integrated with 70E compliant work permits as part of initial safety program.

5. **Article 130.3(C):** Updated labeling displaying the worst-case arc hazard values for each piece of equipment in the facility.

D. The analysis shall consist of the following:

1. Field data collection by qualified personnel (as defined by NFPA 70E 2015).

2. Data entry and system one-line modeling in commercially available power system software.

3. Model verification.

4. Short Circuit and equipment verification study.

5. Protective device coordination study.

6. Arc flash hazard study.

7. Detailed report and findings of the analysis.

8. Electronic copies of the Project Report and the System Modeling File.

9. Review of a draft copy of the report and presentation of the final copy of the report in person, via teleconference, or via teleconference and web conference.

10. Hard copies of the project report.

E. The analysis and procedures shall comply with the following standards and recommended practices for power system studies.

1. NFPA-70E, 2015 Standard for Electrical Safety in the Workplace

2. IEEE-1584-2002 Guide for Performing Arc Flash Hazard Calculations

3. IEEE-242 “Buff Book” Protection and Coordination of Industrial Power Systems

4. IEEE-399 “Brown Book” Power System Analysis

5. IEEE-141 “Red Book” Electric Power Distribution for Industrial Plants

6. IEEE-551 “Violet Book” Calculating Short Circuit Currents in Industrial Power Systems

F. Perform qualitative Infrared Thermographic Survey of entire electrical distribution system consisting of, but not limited to; Electrical Switchgear, Switchboards, Panels, Disconnects, Transformers, and Automatic Transfer Switch located within electrical rooms.

1. Thermal imaging equipment shall operate in the 3-5 or 8-12 micron range and have the capability of taking direct temperature measurements along with adjustable emissivity.

2. The thermographer must be trained and have a minimum of Level II Certification and have at a minimum of five (5) years field experience. They must also have a thorough understanding of electrical systems.

3. Reports to include not only temperature related concerns but also any other code related findings with related pictures used to reference all noted problems found. Report shall include a data log of all equipment inspected with time, date, location, electrical equipment identification reference & high temperature along with rise and current readings were applicable along with a description of problem and possible corrective action. Thermographic image of all anomalies discovered including a candid image.

1.2 DATA COLLECTION

A. Field data collection shall be performed by a qualified (as defined by NFPA 70E – 2015) consultant/contractor to ensure accurate equipment modeling.

B. Consultant/contractor field personnel shall have up-to-date training in electrical safety and shall supply and utilize their own Personal Protective Equipment for electrical shock hazards and arc flash hazards. Consultant/contractor shall provide an Energized Work Permit for all field work where live parts are exposed. Forsyth County General Services personnel shall not be responsible for reviewing or evaluating successful consultant/contractors safety program for suitability. Attach information describing your safety training and program.

C. Forsyth County General Services personnel have provided an estimate of the number of substations, panels, motor control centers, motor control panels and electrical equipment in Exhibit A. A calculated point is defined as greater than or equal to one hundred (100) amps. A point less than one hundred (100) amps was not calculated as a point. Forsyth County General Services estimates a +/- 10% difference in total calculated points. All available electrical drawings for Forsyth County facilities are available on the link:

https://drive.google.com/drive/folders/0B7vxY_fidgXeaE1hbTZ1aDRpQWs?usp=sharing

D. Equipment shall be visually inspected to collect the necessary nameplate data used in the analysis. Consultant/contractor is responsible for visual verification of this data, including transformers, switchgear and breakers, relays, direct-acting trip units, etc. Data that may not be readily accessible or may not have nameplate data such as conductors, busway, etc. can be taken from drawings.

E. Plant/facility shall provide qualified personnel to show contractor/consultant equipment location and to open all equipment doors, locks, etc. necessary to collect nameplate data.

F. Where equipment data is available from the plant/facility on updated drawings or in database format, consultant/contractor may use this data in building the model, but shall field verify information when necessary.

G. Data collection shall include the step down transformer from the utility service (including primary relaying) down through each 480 volt panel and 120 volt to ground panel for all systems served by transformers rated greater than 125kVA as per IEEE-1584-2002.

H. Consultant/contractor shall obtain from the utility the minimum, normal, and maximum operating service voltage levels, three-phase short circuit MVA and X/R ratio, as well as line-to-ground short circuit MVA and X/R ratio at the point of connection as shown on the drawings.

I. Consultant/contractor staff shall have an internal safety program and up-to-date electrical safety training that includes arc flash hazards. Consultant/contractor shall comply with all of the consultant/contractor safety program requirements and the plant/facility safety regulations during field data collection. Forsyth County shall not be responsible for development of consultant/contractor safety program or safety procedures utilized during the data gathering process. A minimum of #2 PPE rated 8 cal/cm^2 shall be worn by field data collection personnel at all times when exposed to energized electrical equipment.

1.3 SYSTEM MODELING

A. The system model shall be developed using a commercially available, fully integrated software package that meets the performance specifications developed in this Section. To ensure compliance with NFPA-70E 2015, ANSI, and IEEE Standards, and OSHA mandates, no exceptions or substitutions to the performance specification are allowed.

B. The system model shall be laid out in one drawing/view and in a manner that provides for easy viewing of all analysis results. The one drawing/view requirement ensures that problem areas found and highlighted by the program are easily seen and not hidden or buried in multiple drawings, eliminating potential human errors where multiple drawing verification is required.

C. All one-line symbols shall be spaced properly to facilitate viewing results on the one-line.

D. Equipment names used in the modeling software shall be identical to the equipment and naming convention shown on the existing facility drawings and equipment unless conflicts exist. Consultant/contractor shall bring all naming convention conflicts or deficiencies to the attention of Forsyth County General Services staff members for clarification.

E. Forsyth County General Services may have multiple operating conditions, including, but not limited to, generation on/off, shutdown, bus-ties, start-up, emergency operation, etc. Consultant/contractor shall discuss facility operation with designated Forsyth County General Services staff to determine the possible operating modes of the system. Each of the operating modes shall be documented and modeled in the software in order to determine the worst-case arc flash hazard and associated parameters for the electrical equipment. Consultant/contractor shall assume that up to four (4) operating modes are possible.

F. The software shall model each operating mode in a manner such that each mode is a scenario or change case from the base case. Each scenario shall be a simple differential algorithm storing only the difference from the base case and the scenario. Modifications to the base case model shall automatically update all scenarios to eliminate the necessity to store complete databases for each condition, providing for a manageable file size that can be Emailed and eliminating the associated time, man hours, and errors with updating each database individually.

G. Project files created by the software shall be single files and not project directories containing multiple files. The file shall be self-contained and have all necessary information to describe the one-line, system data, settings, and analysis information.

Files shall be easily transferable to any site via Email or disk and operable with no setting changes to the database file to eliminate the maintenance and administrative problems associated with multi-file project directories, and to provide an easy method to transfer the file for engineering review.

H. The software shall accurately model daisy-chained MCC's, panels, and sub-transformers without the use of intermediate buses, nodes or fake impedances.

I. Lumped motor groups for MCC's shall be modeled per IEEE standards using groups >50 Hp, and <50 Hp. Where motor list data is not available, single lumped groups may be modeled per IEEE-141 "Red Book".

J. Medium voltage motors greater than 1.0 kV shall be modeled individually on their respective buses including all protective phase and ground overcurrent relays and fuses. This model will provide individual work permits for each starter/motor on the one-line.

K. All low voltage power circuit breaker (LVPCB), insulated case (ICCB), molded case (MCCB) and fuse data shall be modeled based on the actual nameplate data including manufacturer, type, style, trip device, and actual settings. Generic substitutions or assumptions shall not be allowed unless data cannot be field verified. All assumptions shall be documented in the report.

L. All relay data shall be modeled based on the actual nameplate data including manufacturer, type, style, trip device, and actual settings. Generic substitutions or assumptions shall not be allowed unless data cannot be field verified. All assumptions shall be documented in the report.

M. All overcurrent relay types for the distribution system shall be modeled on the one-line diagram (and database) including phase and ground overcurrent, differential, residual, ground neutral, etc. to establish a complete and detailed system model where protective device data can be easily modified and updated by the facility and all data is available for a comprehensive protective device coordination study if required in the future.

N. Relay models shall depict the actual connection requirements. Programs using generic CT and overcurrent symbols as shown are not acceptable since they do not depict the actual protective system and can lead to confusion in determining arc flash results and proper protective device modeling.

O. Multi-function relays shall have all their overcurrent devices modeled in a single device and shall be able to accept multiple CT's.

P. All equipment modeling must have a corresponding one-line diagram symbol. This means that there can be no hidden database models. The purpose is for the facility to easily see all equipment, its associated data, to be able to link documents to the equipment as a data repository, etc. and to see problems right on the one-line.

Q. All system modeling shall conform to accepted modeling practices as outlined in IEEE-399 "Brown Book". Contractor/consultant may provide more advanced modeling techniques where compliance with the specification is maintained.

1.4 MODEL VERIFICATION

The system model shall be verified by reviewing the results of short circuit current flows for all buses/equipment in the system. The results shall be viewed on each branch and total flow into a bus/equipment on the system one-line diagram. The purpose is to visually spot check all substations with recognized industry benchmarks as to the expected amount of short circuit current, and correct any problem areas.

1.5 SHORT CIRCUIT STUDY

A. A short circuit study shall be performed to verify all equipment duties in the system. The calculations shall comply with ANSI C37.010, C37.13, C37.5, IEEE-141, and

IEEE-399. The short circuit study shall verify the system electrical equipment is properly rated to withstand and interrupt the expected bolted and arcing faults in the system. Improperly rated and applied equipment may not protect personnel against arc flash hazards even if properly applied PPE is used. The software program must comply with the above standards in order to properly verify equipment installed in North America. No substitutions will be allowed.

B. The equipment duty verification shall determine both the line side and load side fault current through each equipment and use the highest current to verify equipment ratings. Standard bus faults are not acceptable for protective devices in that they do not accurately model the current through the device and consequently they provide erroneous results. For solidly grounded systems, both three-phase and single-line-to-ground faults should be modeled. For other grounding configurations only a three-phase fault is required.

C. Equipment duty results shall be graphically displayed on the electrical one-line as well as tabular report format.

D. The results of the equipment duty verification tabular format report shall provide the following data:

1. Equipment name and kV
2. Manufacture, type, style, and ratings of the device
3. Actual line or load side currents through the device and percent over/under duty
4. Flag for the device showing VIOLATION or WARNING level for visual identification

E. A report of all problem areas shall be provided.

1.6 PROTECTIVE DEVICE COORDINATION REVIEW OR STUDY

A. A PDC study shall be performed in order to determine if the system protection characteristics are sufficient to provide reliable power to the facility. The PDC study will also determine if the existing settings entered in the software will provide proper personnel protection in the arc flash portion of this study. For facilities where the main distribution is low voltage (under 600 volts) and only instantaneous breakers or fuses are used, this section may not apply.

B. The PDC study shall consist of selecting major system feeders and plotting the time-current curves (TCC's) to verify proper selective operation of the protective devices. The study should also determine if the settings can be enhanced to provide increased personnel/equipment protection without sacrificing selective coordination. The consultant /contractor shall determine in conjunction with Forsyth County General Services staff the systems to be studied. It is expected that the protective device coordination include all substation equipment and major feeders designated by Forsyth County General Services to be included in this study.

C. The consultant/contractor shall notify Forsyth County General Services staff of any potential problems in the protective device settings that affect either selective operation and reliability or personnel protection and shall provide recommendations for changes to the settings in writing. Forsyth County General Services personnel may then opt to continue with the study using existing settings or to extend the contract for a complete PDC study to correct the settings before continuing on with the arc flash study.

D. As specified in the data collection and modeling sections, all PDC data shall be modeled on the one-line diagram and in the equipment database.

E. The consultant/contractor shall contact the serving utility and obtain protective device settings for all service entrance overcurrent devices in series with the facility and affecting coordination with facilities distribution system.

F. **TCC Specifics:** The TCC's shall graphically illustrate on log-log paper that adequate time separation exists between series devices. The specific time-current characteristics of each protective device shall be plotted in such a manner that sufficient upstream devices will be clearly depicted on one sheet to prove selective coordination.

1. TCC's shall include a system one-line diagram and protective device coordination curves for each device in the selected area. The TCC shall be printed in color on 8 ½ x 11" paper – full size portrait mode, using a log-log scale. The one-line diagram shall be part of the TCC and include all protective devices, equipment names, and short circuit currents calculated from the main one-line. The purpose of this requirement is to provide all necessary information on one sheet, in a format easily readable and standard to the industry.

2. For low voltage systems, TCC's shall be developed for both phase and ground protective devices. One phase and one ground TCC should be developed for each unit substation. The TCC should show the largest feeder/motor protective device in the MCC or panel up through the switchgear/switchboard feeder breaker, transformer secondary main, unit substation primary fuse, and medium voltage feeder breaker. For secondary switchboards serving large loads or a wide variety of loads that may affect upstream coordination, additional TCC's may be required.

3. For medium voltage systems, TCC's shall be developed for both phase and ground protective devices. The TCC should show the largest feeder/motor protective device in the lineup up through the switchgear/transformer secondary main, unit substation primary fuse, and medium voltage feeder breaker.

4. The following specific information shall also be shown on the coordination curves:

   a. Device identification.

   b. Transformer three-phase and single-line-to-ground ANSI damage curves.

   c. Minimum melting, and clearing curves for fuses, and if available the no-damage curve.

   d. Typical time separations for curves:

      Consultant/contractor shall discuss the advantages and disadvantages of various time separation settings between device curves with Forsyth County General Services personnel to help determine how the system settings shall be optimized for selectivity and arc flash hazard reduction.

G. A setting table shall be developed to summarize the settings selected/existing for the protective devices. The table shall include the following:

1. Device identification.

2. For low voltage breakers, the circuit breaker manufacturer, type, and style, sensor rating, long-time, short-time, instantaneous settings, and time bands. For breakers with ground fault capability, the pickup and time delay.

3. Fuse manufacturer, type, style, and rating.

4. Protective relay manufacturer, type, style, function (51, 50, 67, etc.) pickup, current multiplier, time dial, and delay. For multi-function units, list all devices being used. Include the CT and/or PT ratios for each function.

H. The software shall provide complete integration of the one-line, database, short circuit, protective device coordination and arc flash analysis functions to provide accurate calculations and avoid errors and inefficiencies associated with multiple data entry programs. Programs using separate PDC or TCC plotting packages are not allowed. Complete PDC integration is defined as the following:

1. TCC's shall be developed by simply selecting (highlighting) with the mouse the one-line area to be coordinated. The TCC shall automatically be plotted for the selected area including all short circuit levels. The TCC plot shall automatically include the selected one-line area in a drag and drop window on the TCC showing all one-line attributes without user additions required. These attributes shall automatically include all short circuit currents and voltages displayed on the main one-line, equipment names, etc. and update automatically without additional user input.

   Programs requiring the user to build a separate TCC one-line are not integral with system short circuit calculations and do not automatically update as the system one-line changes, requiring additional man-hours for one-line development and are consequently prone to errors as the system changes. These types of programs shall not be considered for the study.

2. The software model shall allow each protective device to model momentary (1/2 cycle), interrupting (1-4 cycle), and 30 cycle short circuit currents simultaneously depending on the characteristics of the device.

3. The software shall model remote voltages and currents for any single fault and display them on the TCC showing all trip cutoffs based on the remote currents. The purpose is to accurately model and verify backup relaying to ensure selective operation under all fault conditions. PDC programs that perform only batch faults, or fail to model remote voltages and currents for all fault types shall not be considered.

4. The software shall model and display time difference calculations for any selected pair of protective devices. The difference calculator shall include bracketing bars with the calculated difference to clearly show the selective time between the devices. The calculated time shall update dynamically for instant visual setting as the devices are dragged (settings modified). In addition, Windows tool tips shall clearly show the time difference and the protective device settings for all devices as they are dynamically changed or set to allow the user to accurately determine the proper setting between devices in the most efficient manner, reducing coordination time and providing more accurate results.

5. The software model shall provide for WYSIWYG drag and drop modeling of all protective devices and provide for tool tips and notes to display all settings dynamically. The purpose is to provide accurate adjustments and settings in the most time efficient and accurate manner.

6. TCC's shall have the ability to display short circuit currents and arc flash hazard results within the fully integrated system one-line in the PDC focus. Short circuit currents are available at any equipment with a single mouse click. Short circuit currents and arc flash hazard values shall change on the fly as the protective device settings change, allowing the user to instantly see the results of PDC changes and the associated impact to short circuit currents and arc flash hazard values.

7. The software model shall provide a detailed library for the most common protective devices available in North America. The library shall be user definable.

1.7 ARC FLASH STUDY

A. A detailed arc flash study shall be performed to determine potential arc flash incident energies, arc flash boundaries, shock hazard boundaries and proper personal protective equipment (PPE) for all energized electrical system equipment tasks for the electrical system studied. The calculations shall comply with NFPA-70E 2015, and IEEE-1584. Bolted short circuit calculations used in the above standards shall comply with ANSI C37.010, C37.13, C37.5, IEEE-141, and IEEE-399. The purpose of this study is to determine arc flash hazards in conformance with NFPA-70E and Forsyth County General Services ongoing safety program, and to provide a comprehensive software model of the electrical distribution system, which provides integral work permits and arc flash calculations in compliance with NFPA 70E Article 130.1(A)(2) for all equipment in the facility. The software program used in this study shall comply with the above standards. No substitutions in calculation methods will be allowed.

B. Each mode of operation shall include a detailed write-up indicating areas where incident energy calculations and PPE requirements are higher than calculated in the normal operating mode.

C. Consultant/contractor shall provide a detailed arc flash analysis report including as a minimum:

1. Introduction.

2. Methodology.

3. Information Sources.

4. Key Assumptions.

5. Arc Flash Energy and other consideration for various System Modes of Operation (maintenance mode, bus-tie, co-gen on/off, etc.).

6. Arc Energy at 100% and reduced currents.

7. IEEE 1584-2002 Considerations.

8. Explanation of Data in Arc Flash Hazard Report Tables.

9. NFPA 70E Information.

   a. Shock Hazards with covers removed.

   b. Shock Hazard Approach Boundaries.

      1) Limited Approach Boundary.

      2) Restricted Approach Boundary.

c. Arc Flash Hazard Boundaries.

10. Results of Arc flash Hazard Analysis for high voltage, medium voltage and low voltage systems, including:

    a. Working distances.

    b. Energy Levels.

11. Arc Flash Hazard Report.

    a. 5 Hard Copies.

    b. 1 Electronic Copy in PDF format.

12. Electronic file for Power System Modeling Software as developed and utilized for this analysis.

13. Contractor shall print labels for Forsyth County General Services for all equipment in the system from the project study file. Assume three (3) labels per equipment/bus using 4" x 6" labels or one (1) 6" x 8" label per equipment bus. The labels shall be UV resistant vinyl labels (white with orange warning strip and black letters) conforming to ANSI-Z535.

14. Arc flash calculations shall be performed with enhanced IEEE-1584 equations, which eliminate voltage discontinuities and the non-conservative/average results of the standard equations. The purpose of this requirement is to ensure that the calculated incident energies are closer to actual test results insuring a conservative calculation minimizing personnel risk.

15. Arc flash calculations shall be based on the fastest clearing upstream protective device protecting the equipment for single sources and the slowest upstream protective device for multiple sources. The calculations shall automatically compare all series and parallel upstream protective devices in the system to determine the fastest series device or a conservative parallel clearing time. The algorithm shall incorporate a traversing routine that can search back an unlimited number of buses/nodes and consider all series and parallel branches in the comparison to ensure accurate answers and to prevent hazards associated with incorrect results. Software shall not have trace back limits (5-10 buses) that can provide incorrect answers for low voltage faults that require high voltage protective device clearing to prevent potential errors.

16. The arc flash calculations shall include four (4) calculation options to ensure that the software provides the flexibility required to meet any system configuration or training requirement that may be considered. Each calculation option shall comply with the graphic and spreadsheet display requirements of this section. Each option is more specifically described below.

    a. The detailed option shall provide the let-through energy for each protective device in the system or on selected equipment. This is the energy on the load side of the protective device. The equipment shall be highlighted when the let-through energy exceeds a user defined threshold-clothing limit.

b. Worst-case including main protective device. This option shall provide the worst-case arc-hazard energy for the equipment based on the let-through energy of the equipment's main protective device. If the equipment is not equipped with a main device, the program must traverse back the entire system to determine the fastest series upstream protective device. The equipment shall be highlighted when the let-through energy exceeds a user defined threshold-clothing limit.

1.8 REPORTING AND ANALYSIS SUMMARY

Provide a detailed written report that includes the following:

A. Executive Summary: The executive summary shall be brief 1-2 pages maximum and cover at an executive level the findings of the study, recommendations, and requirements for maintaining NFPA-70E compliance.

B. Scope of studies performed: The scope shall provide details of what actions were intended to be performed for each aspect of the study, including short circuit, protective device coordination, and arc flash.

C. Description of system and explanation of bus and branch numbering system.

D. Modes of operation studied: Each scenario/plant operating condition shall be thoroughly documented.

E. Detailed report and results of short circuit, coordination, and arc flash studies including:

1. Recommendations and additions to equipment rating and/or PDC characteristics.

2. Recommendations to reduce arc flash hazards for equipment with incident energies over 40 cal/cm^2.

F. Prioritized recommendations for all studies.

G. Action list and check off column for all recommendations.

H. Infrared study including photographs of all panels with list of concerns and associated pictures.

1.9 SUBMITTALS

A. Five (5) printed copies (hardcopies) of the completed study report shall be provided and one (1) electronic copy in PDF format.

B. Labels placed on equipment as described above in Section 1.7 C-13.

1.10 QUALITY ASSURANCE

A. The studies shall be in conformance with the NFPA and ANSI Standards, and IEEE recommended practices detailed in this section. No substitutions in study methods or software conformance will be allowed.