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October 27, 1989

Mr. Steve C. Tribble, Director
Division of Records and Reporting
Florida Public Service Commission
101 East Gaines Street
Tallahassee, Florida 323091

Re: Tampa Electric Company vs.
Florida Power Corporation
FPSC Docket No.: 890646-EI

Dear Mr. Tribble:

Enclosed for filing in the above docket are the original and fifteen (15) copies of Prepared Direct Testimony of Don R. Morrow; Bruce C. Kelsey; Kenneth R. BuShea, P.E.; and Graeme R. Addie, P.E.

Please acknowledge receipt and filing of the above by stamping the duplicate copy of this letter and returning same to this writer.

Thank you for your assistance in connection with this matter.

Sincerely,

Roy C. Young

cc: All Parties of Record (w/encl.)

RCY/rj

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BEFORE THE FLORIDA PUBLIC SERVICE COMMISSION

Re:	Petition of Tampa Electric Company) For Resolution of Territorial) Dispute with FPC.) ______________________________)	Docket No. 890646-EI

PREFILED DIRECT TESTIMONY OF
KENNETH R. BUSHEA, P.E.
OF
BUSHEA & ASSOCIATES, INC.
ON BEHALF OF
AGRICO CHEMICAL COMPANY

Date Submitted:

October 25, 1989

Submitted by:

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FLORIDA PUBLIC SERVICE COMMISSION

DOCKET NO. 890646-EI

PREFILED DIRECT TESTIMONY OF

KENNETH R. BUSHEA, P.E.

ON BEHALF OF AGRICO CHEMICAL COMPANY

Q. Please state your name and business address.

A. Kenneth R. BuShea, P.E. My business address is BuShea & Associates, Inc., 1003 S. Collins St., Plant City, Florida 33566.

Q. What is your occupation?

A. I am the President of BuShea & Associates, Inc., a Registered Professional Engineering Corporation in Plant City, Florida.

Q. Please state your educational background and experience.

A. I am a Registered Professional Engineer, licensed to practice in the State of Florida with a Bachelor of Science degree in Electrical Engineering from the University of Florida. I am a Past President of the Ridge Chapter of the Florida Engineering Society (F.E.S.) and a senior member of the Institute of Electrical and Electronic Engineers (IEEE).

In my work experience I have been employed by both an electric utility company and industry before entering private practice in 1978. Since graduation in 1969, I have been involved in the design, construction and energy management aspects of electrical power systems for Florida Power & Light Company, International Minerals and Chemical Company, and the Harris

Corporation. In my present position as President of BuShea & Associates, Inc., I manage and am responsible for all of the design, construction, testing, and electrical utility management for numerous projects throughout the State of Florida. (See Exhibit KRB-1.)

Q. Have you previously testified before the Florida Public Service Commission?

A. Yes. I have testified before the Florida Public Service Commission (FPSC) on seven other occasions involving such diversified topics as investor-owned utility rate requests, cogeneration needs hearings, industrial client rate relief requests, utility service requests, rule-making procedures associated with cogeneration, cooperative and municipal electric utility dockets.

Q. Do you have any specific experience in the design and control of electrical systems associated with phosphate mining operations?

A. Yes. As the former Senior Electrical Engineer for the International Minerals & Chemical Company in Bartow, Florida, I was responsible for all of the design, construction and operation of the electrical systems for five phosphate dragline mining and beneficiation plants. During the past eleven years with BuShea & Associates, Inc., I have been involved in the design, construction, and operation of numerous other dragline pumping and beneficiation facilities throughout the State of Florida. In addition, we have extensive experience in the rock and sand mining operations throughout Florida, along with over 20 years of related experience with electrical power systems since graduation from the University of Florida in 1969.

Q. What is the purpose of your testimony?

A. The purpose of my testimony is to evaluate the operational, technical, and safety aspects of running a phosphate dragline mining system and beneficiation plant from two separate electric utility sources at the same time.

Q. When examining the issue of safety in electrical systems, do professional engineers rely on any codes and standards for guidance?

A. Yes. There are numerous standards for the design, operation, and maintenance of industrial electrical systems. These standards are designed to provide maximum safety to personnel as their primary objective. This is clearly demonstrated by ANSI/IEEE Standard 242-1986 (Protection and Coordination of Industrial and Commercial Power Systems). At the outset of this entire standard in Section 1.1.1. (SAFETY) are the following guidelines:

> "Prevention of human injury is the most important objective of electrical system protection... Safety has priority over service continuity, equipment damage, or economics."

Q. Are there any special safety requirements that the mining industry must comply with above the normal electrical codes and standards such as ANSI/IEEE, NEC, and NESC?

A. Yes. The mining industry is required to comply with all aspects of MSHA (Mining Safety and Health Act). This Act requires specialized grounding requirements on electrical equipment for the protection of personnel operating and maintaining the system.
Q. Has your research and experience with the design and operation of electrical systems in the phosphate mining industry uncovered any potential safety problems associated with operating dragline pumping systems from more than one source of electrical power?
A. Yes.
Q. Please explain.
A. A phosphate dragline pumping operation is an integral system that relies on a coordinated electrical design for the proper operation and protection of the personnel utilizing the equipment. To properly set all of the protective relaying on the system, the electrical design engineer must rely on available short circuit data supplied by the utility company providing power to the system. This basic short circuit data is used as the starting point for setting all of the protective relaying in the system.
Q. Are the short circuit values from each utility company the same?
A. In general, no. Each utility company will have an available short circuit value that is different from another utility company in the same service area. Since short circuit values are a function of the size of the generation equipment and it's distance from the user, the size of lines between the generator and the load, and numerous other factors, it is unlikely that the short circuit

value will be the same for any two utility companies in the same general service area.

Q. If the available short circuit value is different for each utility, would it be possible to set all of the protective relaying on the portable mining equipment the same regardless of which source it was connected to?

A. Not usually. Since the dragline pumping system consists of numerous portable stepdown substations fed from the utility grid, the protective relaying equipment must be coordinated and set based on the incoming short circuit value from that utility. The system design engineer determines these settings based on the given short circuit value and makes the appropriate adjustments in each portable substation to coordinate with the particular utility grid.

Q. If a particular portable substation setup for the short circuit value of one utility were connected to a different utility whose short circuit values were not the same, is there any possibility of personal injury or equipment damage?

A. Yes. A portable substation that is moved from one utility company having a higher or lower short circuit value than the other utility company can create safety and equipment problems.

Q. Please explain.

A If the short circuit values from one utility company is higher than another and the values of the relays are not reset, the possibility exists that the relays will trip the substation prematurely and miscoordinate with the other portable substations. On the other hand, if the short circuit value from a utility is lower, the relays may not trip when a problem occurs and personnel can be injured or equipment damaged because the substation is not removed from service immediately.

Q. You keep indicating the need for an overall coordinated electrical system design to protect personnel and equipment. Isn't that normally the job of the electric utility company?

A. Yes. Normally it is, but in the case of large industrial mining operations, the utility companies normally do not own and operate the distributions systems like they do for their residential and commercial customers.

Q. Does Agrico own any of its own distribution system?

A. Yes. Agrico owns all of it's distribution system. Agrico presently receives power from TECO and FPC at 69 KV and then distributes the power over it's own system at 34.5 KV, 13.8 KV, and 4160V. They own and operate miles of their own overhead distribution system including numerous portable stepdown substations and equipment to utilize the power.

Q. If Agrico owns and operates its own distribution system, who should be responsible for its design, coordination and the safety aspects of it's operation?

A. Agrico. While Agrico receives it's primary (69 KV) power from TECO or FPC, it must design and coordinate it's own distribution system. This responsibility includes the timing and orderly transfer of this distribution system from one utility to another and the proper internal isolation of the system should it be fed from two different utility companies during a transition period.

Q. Has Agrico ever operated mining equipment hooked up to the Tampa Electric Company grid in the Hardee County service area of FPC?

A. Yes. In 1978 Agrico began mining in the Hardee County service area of FPC while connected to the TECO grid. By doing this Agrico would maintain an orderly coordination of its electrical system to protect personnel and prevent any need to evaluate system isolation and the confusion caused by being connected to two separate utility grids.

Q. Has Agrico begun mining deeper into the Hardee County service area of Florida Power Corporation than in previous years?

A. Yes. Presently the entire mining operation is moving south and the majority of the property north of the Polk/Hardee County line has been mined out by Agrico. As the mining moves further and further south it becomes necessary to attach Agrico's electrical system to Florida Power Corporation in their Hardee County service area and remove it from the Tampa Electric Company. As discussed above, for safety reasons, the relay design engineer prefers moving the entire mining operation to the alternate utility at one time to limit damage to electrical equipment and provide maximum protection for operating personnel.

Q. Is Agrico presently supplying any of its mining operations from Florida Power Corporation?

A. Yes. As shown on Bruce Kelsey's Exhibits BCK-1 and BCK-2, Florida Power now provides service to Agrico's mining operation at the southeastern extremities of the mine. Once the #14 dragline and mine pumping system reached a sufficient distance from the main beneficiation plant that justified use of Florida Power Corporation's service, Agrico requested a conversion to FPC's system. Agrico's attempts to uniformly transfer it's dragline mining operation to FPC have not occurred to date. This is because of the territorial agreement that exists between TECO and FPC and TECO's complaint to prevent such an orderly transfer.

Q. You have indicated that the dragline pumping system is an integral electrical setup requiring overall coordination for safety and equipment protection. How has this territorial agreement affected Agrico's need for a coordinated design?

A. Territorial agreements in general are set forth by the utility companies and approved by the Commission to limit duplication of service and provide for an orderly transition between systems. In the case of high density residential and commercial operations within or around city boundaries, this is especially critical both as a safety aspect for the public and the utility company. Since the utility companies own and operate all of the distribution equipment in these areas, they must be the responsible party for overall safety and operations of the systems. However, the issue of territorial agreements as they apply to open mining areas encompassing tens of thousands of acres and having their own distribution system has not been adequately addressed. The question of who should serve a particular large industrial customer owning it's own distribution system cannot be determined by an arbitrary line drawn somewhere through the middle of their property.

Q. What would be your criteria for determining the need to receive service from a particular utility where two potential grids exist?

A. The primary criteria should always be safety. The mining company should be given the option of determining which utility company best suits its needs from a safety and operational point of view and then the entire operation coordinated around the service from that particular utility company. Since the overall mining operations are moving in a southerly direction in Polk, Hillsborough, Hardee, and Manatee Counties, an orderly transition must occur or the commission must re-examine the concept of a territorial line as it applies to open mining operations.

Q. Is there a preferable method for transferring operations such as Agrico from one utility company to another?

A. Yes. The preferred method would be to transfer large, single blocks of the mining operation grid and dragline pumping system as a single entity based on the discussions outlined in my testimony. This presents a higher degree of safety for the mining personnel and prevents any confusion of having partial segments of an integrated electrical system operating from two different utility companies.

Q. Are there any other specific problems associated with having two utility companies serve a large industrial customer who owns it's own distribution system?

A. Yes. The concept of internal isolation must be considered carefully when dealing with a customer served from more than one particular utility grid. The customer must decide, based on his best working knowledge of his system and his primary concern for safety, at what point in his internal grid will he segregate the service from one utility to the other.

Q. Where would the customer typically make this isolation?

A. The customer would in general consider the overall operations, personnel and equipment in it's system to determine if there is a single logical point at which the system would change and effectively isolate the feeds from each utility. In a mining and beneficiation system similar to the Agrico facilities, the best available location is to segregate the mining operations from the beneficiation plant. Typically, this isolation would produce a segregated system between fixed base operations similar to the beneficiation plant and the portable mining operations.

Q. Who is the best person available to make the decision on the proper point at which to isolate the electrical system in a phosphate mining and beneficiation facility?

A. The end user, since he owns and operates his own distribution system. The owner is the ultimate responsible party for all personnel safety and is the only person who should make the decision. Since safety is the primary goal, any externally enforced edict may not consider all of the operating criteria and facts associated with the operation.

Q. When an operation similar to Agrico begins a transition from one utility service area into another, who is best suited to decide the appropriate time and logical order of transition from one utility to the other?

A. Again, it must be the end user. This party is the only one who is ultimately responsible for the safety of all personnel involved and the one best suited to make the safest decision possible. Again, externally enforced edicts that establish the point of isolation or the mixing of two utility companies within a single user distribution system invites added risk and confusion to the company's personnel. Since safety is the first order of priority in all operations of electrical systems, the end-user who owns his own distribution system is best suited to make the ultimate decision on when and where the two electrical systems will either be isolated or transfered.

Q. From a safety standpoint, does the present territorial line through the middle of Agrico's property seem logical or appropriate?

A. No. This territorial line through the middle of Agrico's property invites confusion for the operating personnel and a potential miscoordination of the electrical protection for the system. Since Agrico operates it's mines off of interruptible rates from both utilities, various portions of the system can be interrupted and re-energized by each utility at different times. This invites increased safety risk to personnel. Receiving interruptible power from two separate utility sources at the same time can only be done safely if the owner of the mining operation has full control over the points in his distribution grid to isolate the system and the timing of a transfer from one utility company to another during any transitional period. The location of an arbitrary territorial line between utility companies should not be considered when the company owns it's own distribution system and must cross the territorial line.

Q. Please summarize your testimony and provide us with your recommendation.

A. As I have indicated in my analysis, one of the primary and first criteria to be considered in this type of arrangement is safety. My testimony indicates that the end user who owns his own distribution system is the ultimate party responsible for the safety of the personnel operating this electrical system. Since they are the ultimate party responsible for the personnel utilizing all of the mining equipment, they should be the one properly chosen to make decisions regarding isolation and transfer from one utility grid to another. Since an arbitrary line has been drawn by the utility companies through Agrico's property without their concurrence, the end user must be the person to decide which utility company can provide the safest service to their system. The end user who owns his own distribution system must also decide the proper time to switch from one utility company to the other to protect the overall safety of all of its personnel. Unlike the typical residential and commercial services evaluated in most territorial agreements, the end user of a large industrial mining operation who owns their own distribution system must be ultimately responsible for its coordination, isolation, operation, and overall safety.

Q. Does that conclude your testimony?

A. Yes.

RECENT COGENERATION PROJECT WORK

I. FARMLAND INDUSTRIES, INC. - SYSTEM DESIGN & SPECIFICATIONS - SEPTEMBER, 1988 TO PRESENT:

A. Prepare a complete turnkey bid specification (approximately 400 pages) with interconnect and relaying one-line diagrams for 35 MW cogeneration project, including new 2000 TPD Sulfuric Acid Plant.

B. Interconnection negotiation with Tampa Electric Company.

C. Complete site investigation to determine feasibility and practical application of cogeneration including utility interconnection, plant load analysis and preliminary system design.

II. HARRIS CORPORATION, INC. - COGENERATION PROPOSAL EVALUATIONS - AUGUST, 1988 TO PRESENT:

A. Prepare complete evaluation of alternate proposal from Thermo Electron and Florida Power & Light Company on feasibility of cogeneration at the Melbourne, Florida facilities.

B. Prepare Owner's independent site evaluation of facilities to evaluate proposal.

C. Review proposals for 27 MW Combined Cycle Gas Turbine Cogeneration Project vs. Interruptible Rates with Diesel Generation back-up.

III. GARDINIER, INC. - SYSTEM DESIGN STUDIES - JULY, 1984 TO PRESENT:

A. Cogeneration Electrical Feasibility Study.
B. Substation Bus-Tie Short Circuit Analysis.
C. Generator/Interruptible Power Study.
D. Owner's Representative for 35 MW Project Construction.
E. Plant Start-Up Electrical Engineer for Owner.

IV. GENERAL ELECTRIC COMPANY - COGENERATION SUBSTATION DESIGN - SEPTEMBER, 1988 TO PRESENT:

A. Detail Electrical Engineering Design on modifications to Gardinier, Inc. Cogeneration Substation including new 7,500 KVA 69 KV - 4160V Transformer and Breakers.
B. Relocation of 1200 KVAR capacitor bank.
C. Shutdown and interconnect procedures for tie-in to existing substation.

V. <u>ROYSTER COMPANY/W.R. GRACE - TECO INTERCONNECTION STUDY - JULY, 1984 TO JANUARY, 1986</u>:

A. Feasibility study of alternate connection to Tampa Electric Company other than dedicated service.

B. Design & recommendation of transfer trip scheme and circuit switcher in lieu of oil circuit breakers and dedicated line at significant cost reductions.

VI. <u>ROYSTER COMPANY - 22 MW SULFURIC ACID - WASTE STEAM COGENERATION PROJECT - DECEMBER, 1982 TO APRIL, 1986</u>:

A. Prepare complete turnkey bid specification (approximately 250 pages) and preliminary one-line generator and relay protection scheme drawings for new 22 MW <u>POWER</u> (Process Optimization With Energy Recovery) project.

B. Prepare all electrical specifications for the upgrading of the existing 1400 STPD sulfuric acid plant including total waste steam recovery for new 22 MW cogeneration project.

C. Handle all interconnection negotations for new 22 MW cogeneration project with the Tampa Electric Company.

D. Work with legal counsel and economic advisors on buy all/sell all or net billing analysis, bid invitations and all engineering interface to the project.

VII. <u>TIMBER ENERGIES, INC. - TWO WOOD-FIRED SMALL POWER PRODUCTION FACILITIES - (5 & 15 MW) - FEBRUARY, 1985 TO OCTOBER, 1985</u>:

A. Industrial Revenue Bond Approval Engineer.

B. Design five mile, 69 KV interconnection line.

C. Turn-key bid Specs - Powerline, Wood Fuel Production Plant.

D. Permitting - D.O.T., EPA, D.E.R.

E. Used Turbine Research, Selection and Turn-key Bid Spec.

VIII. <u>FLORIDA CRUSHED STONE COMPANY - 125 MW COGRNERATION PROJECT - JULY, 1982 TO PRESENT - LARGEST COGENERATION PROJECT IN FLORIDA</u>:

A. Prepare all documents to qualify facility with the Federal Energy Regulatory Commission.

B. Full Responsibility for total interface to Florida Power Corporation including:

   1. Cogeneration contract for purchase and sale of cogenerated energy.

   2. Analysis and recommendations for interconnection to FPC grid.

C. Professional revenue opinion for banking and finance companies.

D. Interface to Florida Public Service Commission on avoided cost and capacity payments for generated power and energy.

E. Florida Crushed Stone interface representative with power plant design engineers, Laramoore, Douglas & Popham.

F. Power billing analysis for comparative buy-all/sell-all or net sales agreement.

G. Engineering interface with legal departments on power plant permitting.

IX. UNITED SERVICES, INC. - 6 MW WOOD-FIRED SMALL POWER PRODUCTION FACILITY - JANUARY, 1982:

A. Complete project scope of work.

B. All regulatory requirements and utility interface estimates.

C. Complete feasibility and engineering study and capital budget estimate.

D. Planned operations and maintenance program.

E. Complete economic analysis including payback, revenue requirements, and capital investment requirements.

F. Complete equipment availability and feasibility analysis.

G. Preliminary site plan, one-line electrical drawings, steam cycle and gas cycle diagrams.

H. Wood gasification analysis.

I. Steam generation vs. gasifier/engine analysis.

J. Wood fuel resources appraisal.

X. INTERNATIONAL MINERALS & CHEMICALS, INC. - 60 MW SULFURIC ACID COGENERATION PROJECT - FEBRUARY, 1982 TO MARCH, 1984:

A. Public Service Commission Cogeneration Rate Analysis.

B. Utility interconnection cost and feasibility analysis.

C. Interconnection negotiation with Tampa Electric Company.

XI. GENERAL COGENERATION WORK:

A. Work with the Florida Cogeneration Group consisting of seven large industrial potential or existing cogenerators or small power producers on Florida Public Service Commission rate dockets pertaining to rules and regulations for all qualified facilities (approximately 400 MW: Royster, U.S. Sugar, IMC, Florida Crushed Stone Co., U.S.S. Agrichemicals, Occidental Chemical Company, W.R. Grace).

B. Testify before the Florida Public Service Commission in matters relating to cogenerators.

C. Work before the Federal Energy Regulatory Commission; Washington, D.C. on qualifying cogeneration and small power production facilities.

D. Economic studies on buy-all/sell-all or net sales analysis for cogenerators.

OTHER RECENT CAPITAL PROJECTS

I. TURKS AND CAICOS UTILITIES, LTD. - SYSTEM ENGINEERING JUNE, 1985 TO PRESENT:

A. Complete Rate Design Study.

B. Complete One-Line Diagram preparation.

C. Prepare complete Caribbean Development Bank million dollar loan application.

II. HONEYWELL, INC. - FIRE ALARM SYSTEM INVESTIGATION APRIL, 1986 TO PRESENT:

A. Investigation of Fire Alarm System Electrical Failures.

B. Expert Witness Preparation and Strategy Recommendations.

III. NORANDA MINING COMPANY - COMPLETE MINE ELECTRICAL EQUIPMENT DESIGN AND SPECIFICATIONS - JUNE, 1981 - APRIL, 1984:

A. Prepare a complete project capital estimate for all electrical equipment associated with the startup of a new phosphate mining complex near Plant City, Florida.

B. Prepare all detail equipment specifications including detail design drawings.

C. Assist Noranda in bid evaluations and equipment selection of all electrical equipment for the mine.

D. Redesign and prepare all bid specifications for the revamping of the plant 5000 KVA main substation.

E. Provide negotiation and interface service with the Tampa Electric Company on interruptible rates and a new 5000 KVA mine substation.

F. Provide on-going project management for the installation of all mining electrical equipment, including a Page Dragline.

IV. <u>FLORIDA MINING & MATERIALS CO. - TURN-KEY ELECTRICAL BIDDERS SPECIFICATION - BABCOCK AGGREGATES MINE - JANUARY, 1982:</u>

A. Prepare a complete turn-key electrical bidders specification for new 600 ton per hour nominal limestone rock mine.

1. Complete scope of work.

2. Including main substation, motor control center, underground feeder banks, switchgear, motors, power factor correction capacitors, variable speed drives, sequence panels, field control panels, instrumentation, lighting, conduit, cable trays and cable messengers, wiring and wiring methods, and compliance to all codes.

B. Complete division of responsibility for contract approval program.

C. Material and workmanship requirements.

D. Preliminary motor lists, plot plans and one-line electrical drawings.

E. Complete capital budget estimate.

V. <u>OCCIDENTAL CHEMICAL COMPANY - KW/KWH METERING -JUNE, 1981:</u>

A. Prepare a complete preliminary engineering report for the installation of approximately 50 KW/KWH metering devices at the Occidental facilities in White Springs, Florida.

B. Prepare detailed equipment specifications for the purchase of all KW/KWH metering equipment.

C. Prepare complete contractor installation specifications for the project.

D. Prepare complete set of installation drawings for all plant and mine substation and transformation points on KW/KWH metering.

VI. <u>GARDINIER, INC. - FORT MEADE MINE ELECTRICAL DESIGN - MAY, 1980 - MARCH, 1982:</u>

A. Provide detailed capital estimate for installation of five new 1250 HP matrix and pit pump controllers and motors.

B. Provide detailed equipment specifications for the installation of mine electrical equipment including portable substations, matrix controllers, motors, and power factor equipment.

C. Provide detailed equipment specifications for the purchase of a new motor control center at the Beneficiation Plant.

D. Provide a detailed contractor bid specification for all electrical work associated with the Beneficiation Plant expansion and the mine equipment.

E. Provide on-going power billing analysis and interface to Florida Power Corporation on revisions necessary for the plant and mine expansion.

F. Provide on-going project management for the installation of all electrical equipment in the Beneficiation Plant and Mine.

VII. HARTFORD INSURANCE - INDUSTRIAL EQUIPMENT FAILURE INVESTIGATION SEPTEMBER, 1982 TO DECEMBER, 1982:

A. Investigate failure of 800 feet of conduit.

B. Expert Witness Preparations and Analysis Report.

BEFORE THE FLORIDA PUBLIC SERVICE COMMISSION

TAMPA ELECTRIC COMPANY, Complainant, vs. FLORIDA POWER CORPORATION, Respondent.	)	DOCKET NO. 890646-EI

CERTIFICATE OF SERVICE

I HEREBY CERTIFY that a true copy of the foregoing Prepared Direct Testimony of Don R. Morrow; Bruce C. Kelsey; Kenneth R. BuShea, P.E.; and Graeme R. Addie, P.E. has been furnished by U.S. Mail to the following parties of record, this 27th day of October, 1989:

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