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ORIGINAL
FILE COPY

REPLY TO:

Tallahassee

October 27, 1989

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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
FISC Docket No.: 890646-BI

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.

- ACK
- AFA _____
- APP _____
- CAF _____
- CMH _____
- CTR ary
- EAG 1
- LEG 1
- LIN 6
- OPC ALL Parties of Record (w/encl.)
- RCH _____
- SEC /RCY/rj
- WAS _____
- OTH _____

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

Addie
DOCUMENT NUMBER 10661
10661 OCT 27 1989
PSC-RECORDS/REPORTING

Bushea
DOCUMENT NUMBER DATE

10660 OCT 27 1989

FISC-RECORDS/REPORTING

Kelsey
DOCUMENT NUMBER DATE

10659 OCT 27 1989

FISC-RECORDS/REPORTING

Morrow
DOCUMENT NUMBER DATE

10658 OCT 27 1989

FISC-RECORDS/REPORTING

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BEFORE THE FLORIDA PUBLIC SERVICE COMMISSION

RE: Tampa Electric Company Complaint

Concerning Territorial Boundaries

PREFILE TESTIMONY OF

GRAEME R. ADDIE

GIW INDUSTRIES, INC.

Q. Please state your name and address.

A. My name is Graeme Addie. My address is 416 Sheffield Circle,
Augusta, Georgia 30909.

Q. What is your occupation?

A. I am a registered professional mechanical engineer and have been
employed by GIW Industries since 1976.

Q. Briefly state your responsibilities at GIW.

A. My job title is Vice President of Engineering and Research &
Development. My responsibilities are design and development of our
company's product and the provision of technical support related to
all aspects of its application and use. In particular, as our main
product is centrifugal slurry pumps, I am responsible for all
matters relating to design, development and application of our
slurry pumps.

Q. Briefly outline your education and professional experience prior to
being employed by GIW.

A. I have a four year Degree in Mechanical Engineering from the Royal
Melbourne Institute of Technology in Melbourne, Australia. 10

DOCUMENT NUMBER-DATE

10661 OCT 27 1983

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1 Australia, I was employed by Kelly and Lewis Pumps, the largest
2 manufacturer of pumps in Australia at that time. Initially, I was
3 employed by Kelly and Lewis as a design engineer and for the last
4 five years with the company as the Chief Engineer in charge of all
5 design, testing and quality control.

6 Q. Do you have any exhibits on file with your testimony?

7 A. Yes, I do. Exhibit 1 is a memo by one of my engineers reporting the
8 results of a water hammer analysis carried out on the Fort Green
9 pipeline simulating the case of a power failure to the pumps
10 upstream of the county line and other shutdown conditions.

11 Q. What was the result of your water hammer simulation?

12 A. It showed that an upstream pump shutdown was the worst case and that
13 high pressures were generated all along the pipeline, and that those
14 pressures went as high as 8,830 psi.

15 Q. What would be the effect of these pressures on the pumps and
16 pipeline?

17 A. It would break open some if not all of the pumps in the pipeline and
18 probably burst the pipeline in several places also.

19 Q. Did you read John Rowe's testimony?

20 A. Yes.

21 Q. Did you agree with his testimony about water hammer?

22 A. No. There is, in my opinion, no technology available that could,
23 with any reasonable guarantee, prevent a water hammer in this slurry
24 system with this type of transient applied. There is technology
25 available that reduces the magnitude of water hammers which

1 presumably he is talking about. I have experience with this in both
2 water and slurry systems. The most common devices used are non
3 return valves with air tanks and compressors. These cannot be made
4 to work in slurry systems because of wear and blockage by the
5 slurry. Rupture valves cannot become blocked but need to be at
6 every place where a high pressure can occur. They also do not react
7 fast enough. Vacuum relief valves can also help but have location
8 and reliability problems also. I have recommended use of some or
9 all of these at different times and found that they help in simply
10 systems and with small transients. I don't see any of them being
11 of use in the case of a power failure here because of the magnitude
12 and extent of the pressure spikes. John Rowe suggests detecting
13 failure of the upstream pumps and shutting down all the remaining
14 pumps as a means of stopping a water hammer. I doubt if he could
15 shut the other pumps down quickly enough bearing in mind the first
16 major pressure spike of 614 psi, according to our calculation,
17 occurs within 6 seconds.

18 Q. Did you consider any other ways that water hammer could occur?

19 A. Yes. I also had my engineer run the case of electrical failure to
20 the downstream pumps and off the whole line. A downstream power
21 failure is a much less severe case, but again gave a pressure spike
22 of 309 psi at one pump which is enough to damage the pumps in the
23 worn condition. When the whole line shuts down at the same time
24 transients still occur but they are small enough as to not cause any
25 problems.

1 Q. In general, then how do you feel about the use of electric power
2 supply from two power companies?

3 A. I feel convinced that a dual power supply would significantly
4 increase the likelihood and frequency of damage to the pumps and
5 pipeline due to water hammer.

Oct. 25, 1989

MEMO TO: Graeme Addie

FROM: George Cain

SUBJECT: Agrico power failure problem

After receiving the measurements for calculating the moment of inertia for the motors used in the Agrico pipeline system, I restarted my analysis. I calculated the moment of inertia for the motor and changed my input data appropriately and began running each of the three cases we had discussed.

CASE #1: Six pump system in which the power source for the first four pumps fail.

CASE #2: Six pump system in which all pumps are shutdown at the same instant.

CASE #3: Six pumps system in which the power source for the last two pumps fail.

In CASE #1 the water hammer effect was extreme. The maximum pressure reached in pump #5 during the first sixty seconds after power failure was 1627 psi; the maximum pressure reached in pump #6 was 4052 psi. A plot of the discharge pressure vs time for pump #6 for the first sixty seconds after power failure is attached to this memo; this same type of pressure oscillation occurred in pump #5. I believe the pumps are rated only at 600 psi. The highest pressure spike occurred 489 feet after pump #5 in pipeline five, station two; the pressure reached was 8830 psi. This pressure is so extreme that it is probable that the pipe would burst. Of course, this is assuming that no other failures have occurred already to relieve pressure in the system. Such a pressure relieving failure would occur in pump #5 or #6. This particular power failure scenario would be most costly and should be avoided.

In CASE #2 the water hammer effect is much lower. The highest pressure reached in the pumps after shutdown occurred at the discharge of pump #6; the pressure reached was 160 psi. This pressure is well below the limit that the pumps can withstand for most circumstances. The highest pressure spike occurred 488 feet after pump #6 in pipeline six, station two; the pressure reached was 1959 psi. A 19" pipe can handle up to about 3000 psi in new condition so this pressure shouldn't pose any great hazard for the pipe under the condition that the pipe is new. This scenario will be harmless under most circumstances.

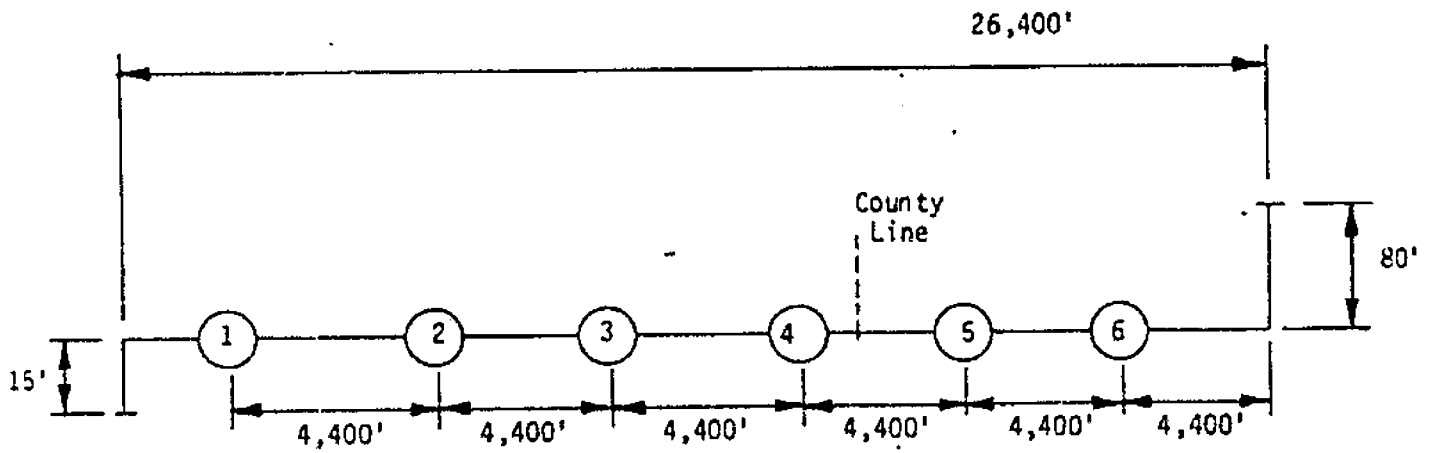
In CASE #3 the water hammer effect could pose danger. The highest pressure reached in the pumps after shutdown occurred at the discharge of pump #4; the pressure reached was 309 psi. This pressure is safe only if the pumps are in good condition; with wear of the pumps, this pressure could become dangerous. The highest pressure spike occurred about 488 ft after pump #6; the pressure was 1961 psi. This scenario will be safe under good conditions.

In conclusion, CASE #2 is acceptable under almost all conditions; CASE #1 will cause catastrophic failure; CASE #3 will be safe under only the condition that the pipes and pumps are not too worn.

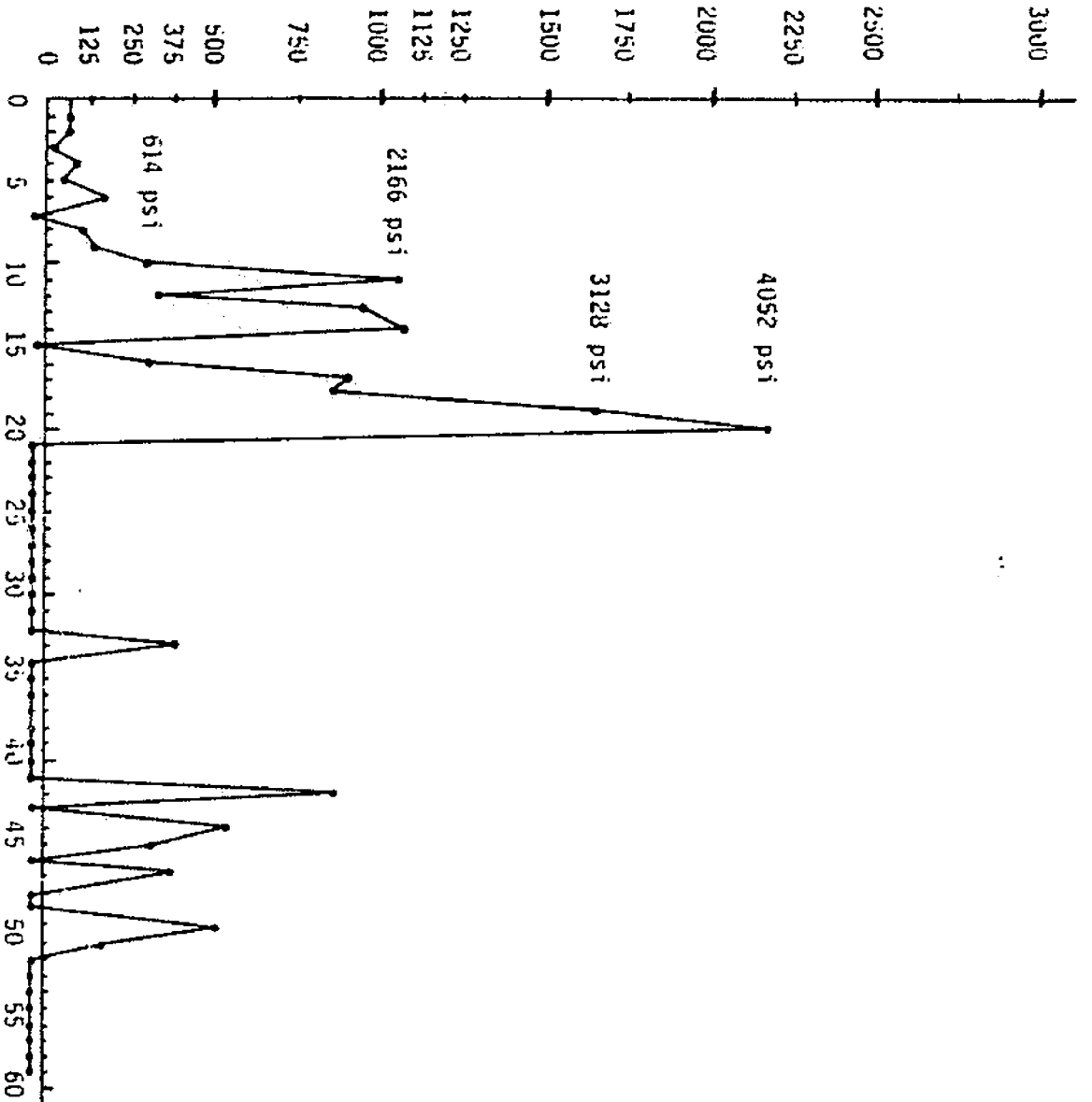
AGRICO PIPELINE SYSTEM

Six 18/18WBC 46 Pumps
POWER FAILURE: Pumps 1, 2, 3, 4
4400 feet between pumps

FLOW →



(METERS OF SLURRY)



Agrico six pump system
discharge pressure vs time for pump #6 (pipeline6 station 1)
first 60 seconds after power failure of first 4 pumps
(1.39 psi/meter slurry)

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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