TESTIMONY OF DR. K. R. OLEN,
SENIOR TECHNICAL ADVISOR
FLORIDA POWER & LIGHT COMPANY

BEFORE THE FLORIDA DEPARTMENT OF ENVIRONMENTAL REGULATION
CONCERNING FPL ORIMULSION TEST BURN
(PSD PERMIT AND SIP REVISION)
SEPTEMBER 6, 1990
DEBARY, FLORIDA

EXHIBIT
5-B2

Mr. Cepero has talked about the potential benefits of Orimulsion to FPL customers, namely lower electric bills because of lower fuel costs. I am here to tell you about the experience others have had in burning Orimulsion, and what FPL's plans are for the proposed Sanford Test Burn.

COMBUSTION EXPERIENCE AND EMISSIONS

As Mr. Cepero said, Orimulsion consists of a heavy hydrocarbon, commonly called bitumen, which is mixed into 28-30% water. The mixture has the consistency of thin black latex paint, and is about as easy to handle. However, unlike latex paint, Orimulsion is stable and does not have to be stirred occasionally. But how can a fuel with so much water burn, much less burn efficiently? Water is generally used to put out fires. Surprisingly, the water in Orimulsion actually promotes burning. When Orimulsion is sprayed into a flame, the water quickly turns to steam. This process helps to separate the very small suspended bitumen particles from each droplet of fuel. Ideal conditions for combustion are created when the very small bitumen particles are mixed in this manner with preheated air. The conditions are similar to those found in burning pulverized coal.

Tests carried out with different types of burners in Japan, England, and the United States have consistently demonstrated very high combustion efficiency. The combustion efficiency of

Orimulsion is slightly higher than that generally experienced with residual oil and much higher than that found for coal. Along with good combustion, Orimulsion has two less desirable properties: high fuel sulphur and ash contents.

The sulphur content of Orimulsion is similar to that of some high sulphur Eastern coals. Orimulsion's ash content is much lower than the 4 to 8% ash in a good quality coal, but still greater than the ash content of residual oil. Higher fuel sulphur and ash contents can mean higher emission rates of sulphur dioxide and dust particles, or particulate. The higher particulate emission rate will result in a higher stack opacity, or smoke density, due to an increase in the number of ash particles, which is unavoidable during the proposed Test.

Permanent conversion of a power boiler from oil-firing to Orimulsion will clearly require that expensive pollution control equipment be installed to limit sulphur dioxide and particulate emissions. One of the main objectives of the proposed FPL

Orimulsion Test Burn will be to characterize emissions such that effective and efficient environmental control systems can be designed and built, during a future conversion. Later in this presentation Mr. Kosky will talk about the emission levels that might be expected on a temporary basis during the proposed demonstration at Sanford.

UTILITY EXPERIENCE

The proposed FPL demonstration will be the first test of Orimulsion in a utility boiler in the United States. However, between September 1988 and February 1990 New Brunswick Power (Canada) burned about one million barrels of Orimulsion in its 100MW unit at the Dalhousie Generating Station. As part of their test, the Canadians evaluated an electrostatic precipitator (ESP) in an effort to control particulate emissions. Although reasonable engineering assumptions were used to design the ESP, it was found that collection efficiency was limited to only about 86%. In comparison, ESP's installed on coal and oil-fired boilers typically operate at collection efficiencies near 99%. In addition to the unexpected low collection efficiency, unacceptably high opacity was experienced whenever the precipitator's collection plates were subjected to normal on-line cleaning to remove fly ash. This is why we intend to include the evaluation of several other types of particulate control devices in our proposed Test.

For sulphur dioxide control, the Canadians evaluated an in-furnace limestone injection process. At best, they were able to control only about 30% of the sulphur dioxide with this approach. We believe that we can, and must, do better. Included in the proposed FPL test plan are two different types of sulphur dioxide removal processes. I will tell you more about these processes in a minute.

A major objective of the proposed FPL test is, in addition to evaluating emission control systems, to establish boiler performance and efficiency. The Canadians, unfortunately, experienced about a 10% loss in generating capacity while burning Orimulsion, due to design and operating limitations of their boiler. Initially, this was of a great concern to us since our test boiler is four times larger than the Canadian unit. Upon closer comparison of the two boilers, we now believe that we will not encounter the problems experienced in Dalhousie, because of important differences in boiler design and operating flexibility. Of course, the cost of such losses in capacity, if they were to occur, and those associated with the installation of environmental control systems, would somewhat offset the potential economic benefits of Orimulsion as an alternate boiler fuel. At present, despite possible generating capacity losses, the Canadians are studying the overall economics of converting one or more utility boilers to Orimulsion.

During the summer of 1989, a second Orimulsion demonstration was carried out by PowerGen (England) in a 500MW boiler at its Ince B power station. In total, only about 250,000 barrels of Orimulsion were burned. Based on the test results, the British signed a 5-year contract for one million metric tons of Orimulsion per year, or about 6 million barrels per year. An ESP to control particulate emissions is currently being designed for the conversion of the Ince B, Unit #5 boiler. The basis for the design will take advantage of the Canadian experience in attempting to collect and contain Orimulsion fly ash with an ESP.

The British have a unique situation that allowed them to decide to convert the Ince B boiler from residual oil to Orimulsion, after a relatively short test burn. Firstly, the economics for conversion were very much favored by the decision not to install scrubbers to control sulphur dioxide emissions. Secondly, it should be appreciated that oil-fired boilers in England are mainly peaking units. That is, the oil-fired boilers are operated only when the demand for electric power is greater than the combined generating capacity of the nuclear and coal-fired plants. Under these conditions, the boiler performance of each converted unit is not as critical as it would be for FPL, which is considerably more dependent on oil.

FPL's PROPOSED SANFORD TEST BURN

FPL's proposed Sanford Orimulsion Test Burn is designed to characterize emissions as well as collect boiler performance information. Boiler engineers, guided with these performance data, will access boiler capacity and efficiency, and will determine if any boiler modifications are required to convert to Orimulsion. These data will also be used to predict the performance of other FPL boilers if fired on Orimulsion. The Test Burn is tentatively scheduled to start in early December 1990 and to continue until May 1991. Current estimates suggest that about 2 million barrels of Orimulsion will be burned during that period.

Unlike the Canadian and British test burns, FPL's program will include the evaluation of several pilot-scale environmental control systems. Present plans (see schematic diagram) call for the construction of two slipstreams, one on either side of the test boiler. Through involvement of the Electric Power Research Institute (EPRI) in the test burn, two different types of fabric filter (baghouse) systems are to be evaluated for particulate control. Of the two systems, the High Volume/Low Pressure Pulse Jet is preferred over the conventional Reverse Air system, or even an ESP, because it is more compact and can more easily fit into the limited space available at an existing oil-fired power plant.

In addition to the pilot-scale baghouses, two emerging flue gas desulphurization processes are to be evaluated. The first is a lime spray dryer, a type of scrubber in which a slurry of slaked lime is sprayed into the flue gas to react with and remove the sulphur dioxide. The dry, harmless solid product from the process is generally mixed with some water and disposed of in a landfill. Florida Institute of Technology in Melbourne is currently conducting an FPL-sponsored research project to determine how to best stabilize spray dryer waste produced from flue gas containing Orimulsion fly ash. Lime spray dryers have had limited commercial application to remove sulphur dioxide from low-sulphur coal and municipal waste flue gases. The results from recent EPRI-sponsored studies suggest that the reasonably compact spray dryer systems could also be used to efficiently desulphurize flue gases with higher sulphur dioxide concentrations.

In the second desulphurization process planned for evaluation, the flue gas sulphur dioxide will be reacted with a salt solution in a high efficiency scrubber. The original salt solution will be regenerated using the SOXAL Process, then recycled for use in the scrubber again. The SOXAL Process not only regenerates the original salt solution, but also concentrates the sulphur dioxide gas so it can be sold as a "byproduct" chemical. Concentrated sulphur dioxide could be used to produce sulphuric acid for use by the Florida phosphate industry for the manufacture of fertilizer. The Florida phosphate industry has the greatest demand for sulphuric acid in the United States. To meet present demand, concentrated sulphuric acid is being shipped in railroad tanker cars from outside the State of Florida. A permanent conversion of a power boiler to Orimulsion, that would include a flue gas desulphurization process like the SOXAL Process, could benefit both our customers and one of Florida's major industries.

During the Orimulsion Test Burn, the small amount of sulphur dioxide concentrated in the pilot scale SOXAL module would be vented back into the flue gas. The fly ash collected in the fabric filter test units would be sold as an ore, from which vanadium could be recovered. Vanadium is a metallic element. One of its chief uses is as an alloy addition to tool steels. Solid waste from the lime spray dryer would be stabilized, per the guidelines being developed by FIT, and shipped to a DER approved landfill.

The Sanford Plant is the ideal site to carry out the proposed Orimulsion Test Burn. I say this because, first and foremost, the Sanford personnel are, unquestionably, FPL's most experienced people in evaluating alternate fuels. In addition, the design and size of the boilers at Sanford are representative of about 6800MW (about 80%), of FPL's residual oil capacity. Data collected on the Sanford units would enable engineers to confidently predict the Orimulsion-fired performance of 12 other FPL boilers. Also, the Sanford Plant has ample fuel tanks to store both Orimulsion and residual oil during the proposed Test. Should a need arise to switch to oil, due to unforeseen circumstances during the Test, this could most easily be accomplished at Sanford. Finally, the Sanford Plant is located in a more independent position that other plants in the FPL system, which are nearer to major electrical load centers.

I should now like to introduce Mr. Tom Wright, General Manager Power Resources and immediate past manager of the Sanford Plant. Mr. Wright will discuss the changes that will be made to the plant site for the Orimulsion Test Burn.

TESTIMONY OF T. D. WRIGHT,
GENERAL MANAGER POWER RESOURCES
FLORIDA POWER & LIGHT COMPANY

BEFORE THE FLORIDA DEPARTMENT OF ENVIRONMENTAL REGULATION
CONCERNING FPL ORIMULSION TEST BURN
(PSD PERMIT AND SIP REVISION)
SEPTEMBER 6, 1990
DEBARY, FLORIDA

EXHIBIT
5-C2

Mr. Cepero and Mr. Olen have discussed the reasons for this project and the testing required. What I will share with you is how we will implement the project at the Sanford Plant.

To do this I intend to cover four areas:

(A) Site Arrangement

(B) Plant Operations

(C) Fuel Handling

(D) Air Pollution Control Equipment

First: Site Arrangement: This aerial photograph (slide 1) was taken a few years ago but gives you a very good perspective of the present plant layout. I would like to point out some of the key components or equipment involved in the proposed test.

The test will only be done on unit number 4 which is the one in the center on this slide. At the bottom of the picture you see our intake canal off the St. Johns River. This is the area where the Orimulsion will be received on the plant site. It is expected that the pumps and piping presently used for oil will also handle the Orimulsion. The two large tanks in this area are fuel oil storage tanks and will continue to be used to supply oil to the other units. The pipeline running from the unloading area to the tanks at the top of the picture will be used for transfer of the Orimulsion fuel; and, of course, these tanks will be used for on-site storage of this new fuel. The availability of these tanks is one of the features of the Sanford Plant that makes the testing here attractive, as Ken Olen has mentioned. One more point I would like to make about this picture is the coal pile at the very top. This was taken in the early 80's during the COM testing. Unlike coal, the Orimulsion fuel will all be contained within the existing tanks and there is no need for additional or open storage.

Second: Plant Operations: As I'm sure you're all aware, an electrical power generating plant is nothing more than an energy conversion plant. We convert the chemical energy of the fuel into heat energy. The heat energy is then converted to mechanical energy, which in turn is converted to electrical energy. In a modern fossil power station, these changes take place in three major components: the boiler, the turbine and the generator.

The boiler is the component where the chemical energy of the fuel is converted to the heat energy to produce steam used to drive the turbine. This is the only component affected by the Orimulsion project.

The slide shown here is a cross section of a typical boiler. In the furnace section, the fuel is mixed with combustion air and burned. The air is supplied by draft fans and the fuel is injected through the burner guns. The chemical energy of the fuel is released as heat in the boiler. The radiant heat is transferred in the furnace. The rest is carried within the combustion gases to the convection sections of the boiler where the remaining heat is absorbed.

The combustion gases continue out through the dust collectors, where particulate matter is removed, and finally through the fans and out the stack.

The boiler manufacturer has indicated that the boiler is capable of burning Orimulsion with no major changes.

This brings me to the third point:

<u>Fuel Handling:</u> As has been mentioned, the Orimulsion fuel is liquid and can be handled very similarly to the oil we currently burn. Fortunately, therefore, the systems we use to deliver the fuel to the burners in the furnace do not require much change. In fact, for the most part, we are reducing the amount of equipment used.

Two simple, but important changes to the fuel systems will have to be made. One relates to the temperature required for combustion and the other to the method used to break the fuel into tiny particles for combustion. We refer to this as atomization.

First - <u>Temperature:</u> Oil requires preheating with fuel oil heaters to approximately 200-250°F to achieve optimum combustion temperature; whereas Orimulsion can be burned at 90°F fuel temperature when combined with steam atomization, thereby eliminating the need for fuel oil heaters.

Second - <u>Atomization:</u> With oil we use a mechanical atomization. This is accomplished by using pumps to generate a high differential pressure at the burner tip. With Orimulsion we use a steam atomization method. This method injects steam into the fuel as it enters the furnace through the burner tip. The steam causes the fuel to be sprayed into the furnace in a fine mist resulting in complete combustion. Again, this allows for the elimination of the booster pumps.

All in all, while the handling of this fuel and delivery to the furnace for combustion is a little different than oil, for the most part it is actually a simpler process in terms of equipment.

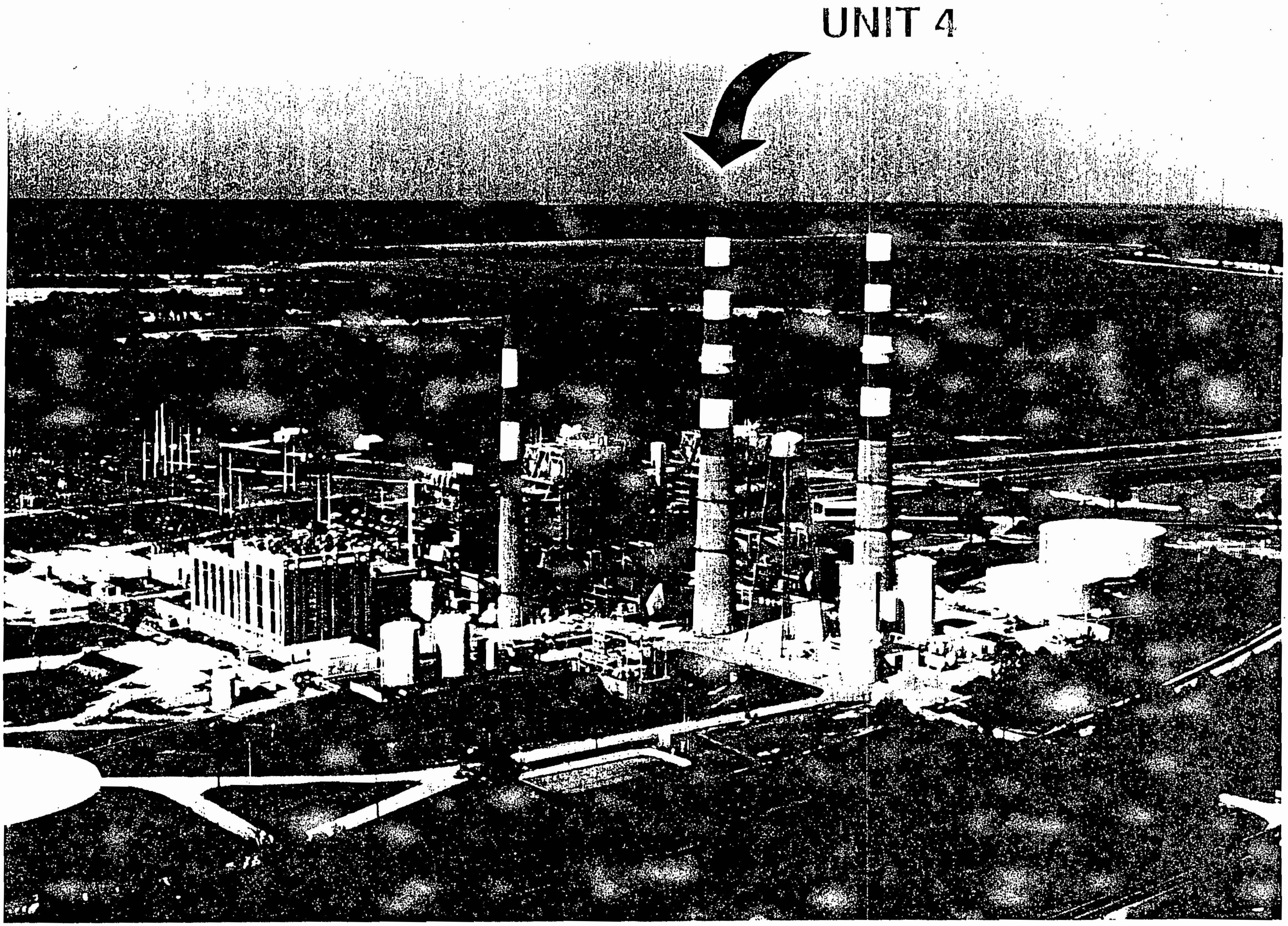
The fourth item is Air Pollution Control Equipment: Mr. Olen has already described the testing we intend to perform and I will not bore you with any more details. However, I would like to briefly discuss the expected effect on plant operations.

I have a few slides here that will give you some feel for the physical size of this equipment. These pictures are representative of what I expect to see during this test.

The first two slides show particulate collection devices. They are the two different types collection devices mentioned in Dr. Olen's presentation. The next slide shows what appears to be a temporary office trailer. In fact, it houses the regenerative sulfur dioxide removal equipment mentioned previously. My point here is to give you a feel for the portable nature of this equipment. The last slide I have is of a typical scrubber. This is the device where the reagent is exposed to the exhaust gases. Please keep in mind, these are only used to give you an idea of what we expect to have on site. The actual equipment used during the Orimulsion testing will be somewhat different but, in general terms, connect to the boiler in a similar fashion.

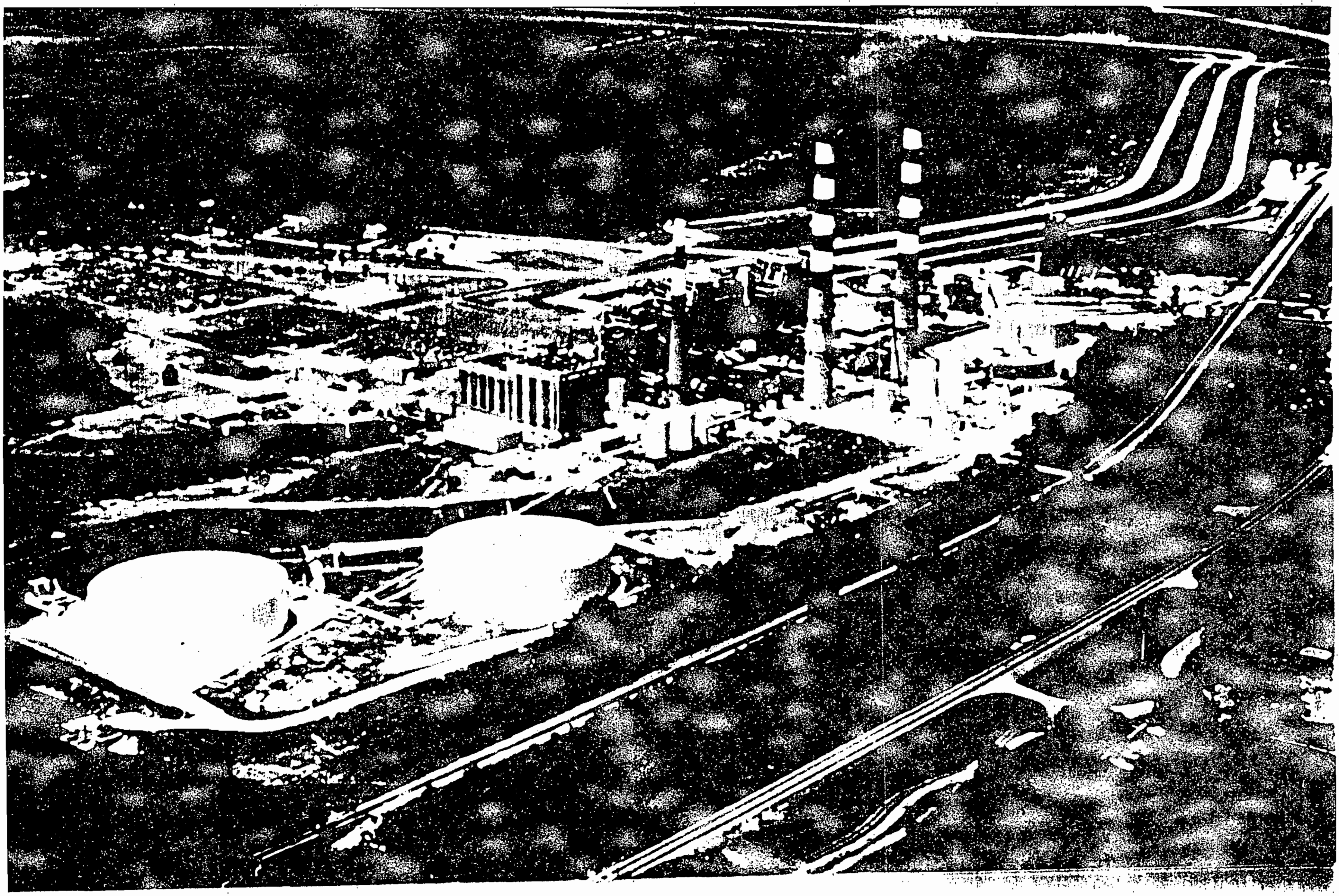
In summary, the handling of the Orimulsion fuel is very similar to the oil currently being burned. The physical plant changes that will be observed during the test are minimal and are primarily related to the combustion gas cleaning equipment used for testing. Probably the most obvious difference for anyone outside the plant will be the stack plume, which we anticipate to be somewhat denser during the test.

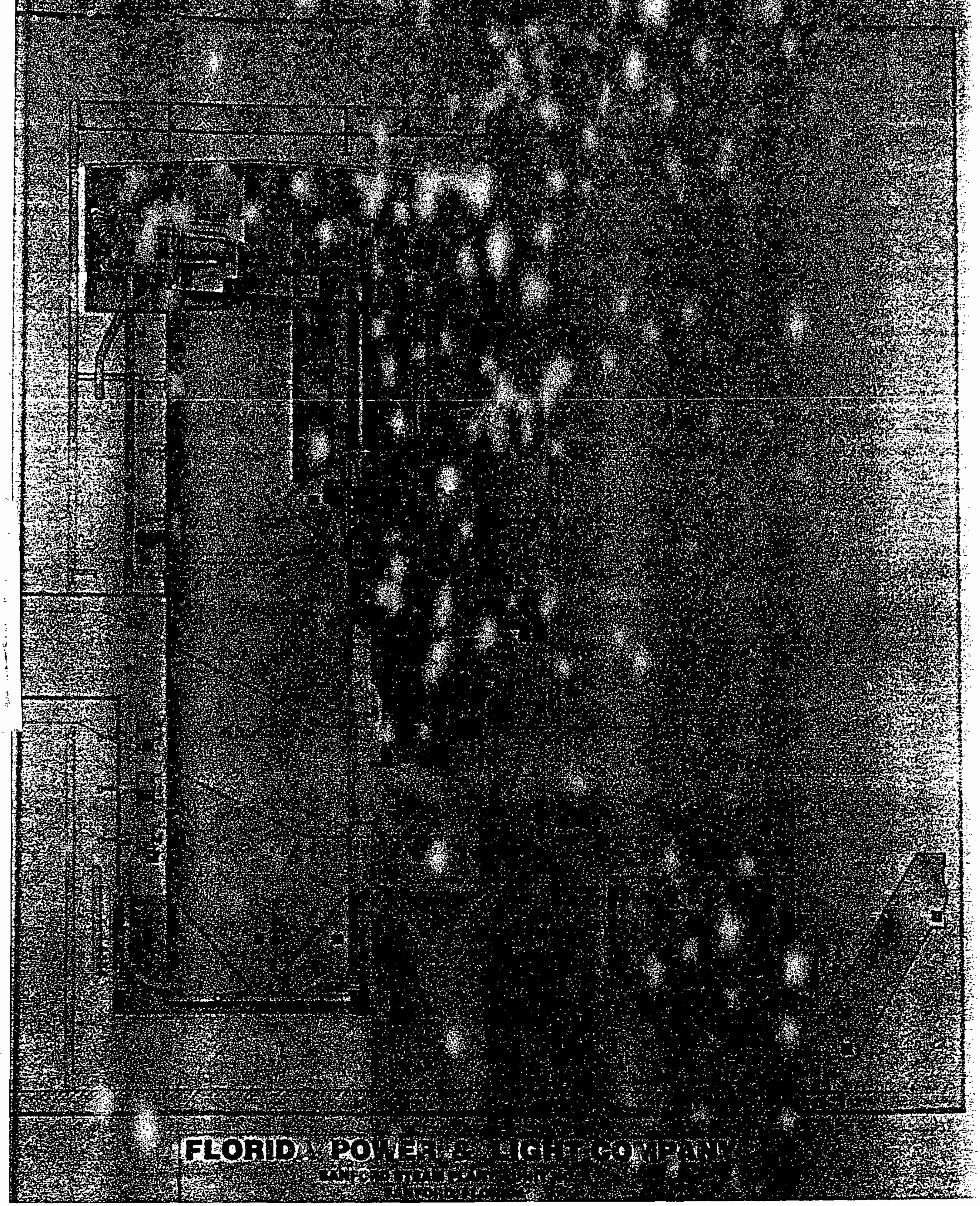
I certainly appreciate the opportunity to share this with you. Now, I would like to introduce Mr. Ken Kosky who will discuss the environmental evaluation.

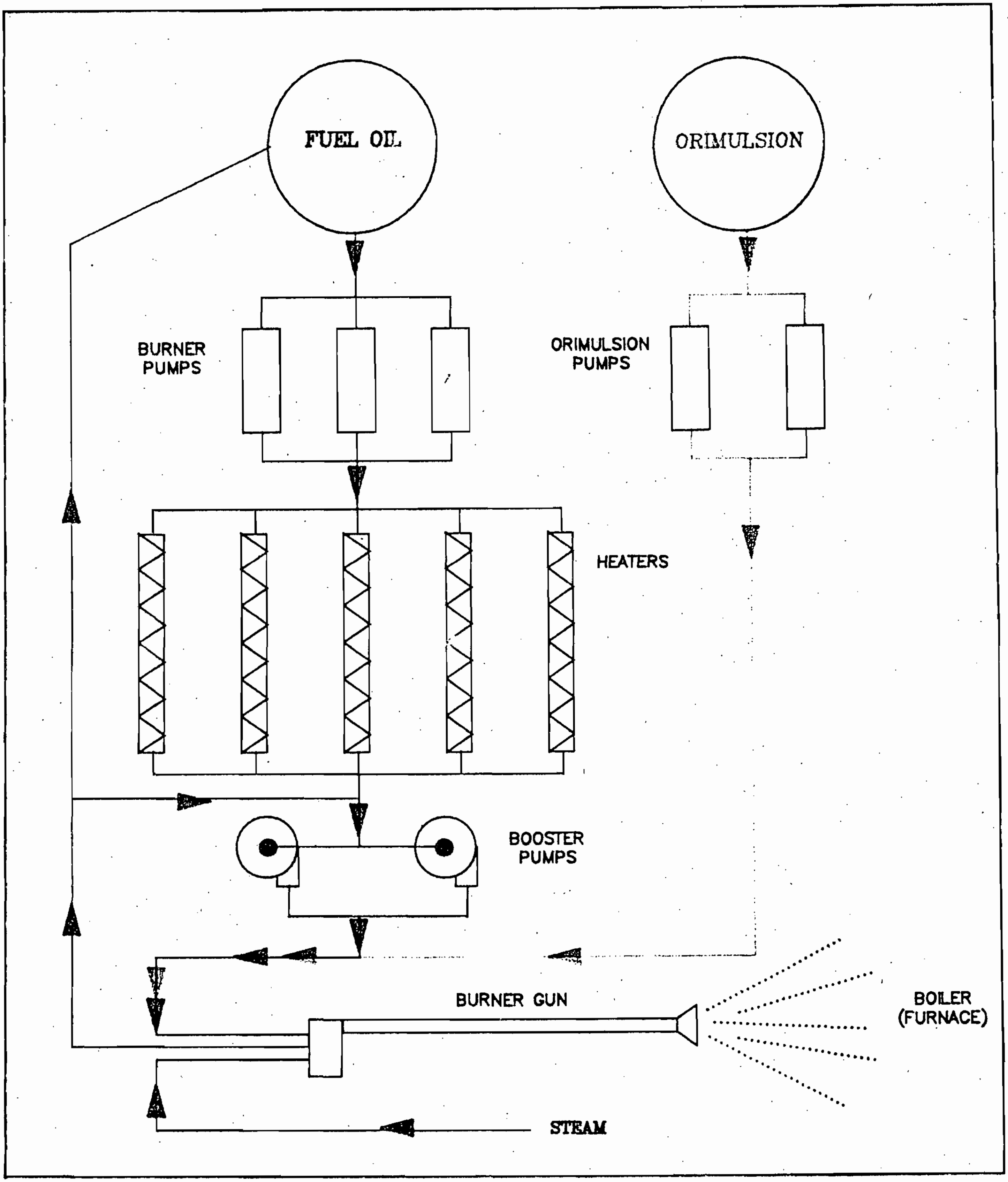


(SANFORD PLANT)

BEST AVAILABLE COPY




FLORIDA POWER & LIGHT COMPANY


FUEL OIL
ORIMULSION
BURNER PUMPS
ORIMULSION PUMPS
HEATERS
BOOSTER PUMPS
BURNER GUN
BOILER (FURNACE)
STEAM