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BUREAU OF AIR REGULATION

September 25, 2002

Mr. Scott Sheplak  
Bureau of Air Regulation – Title V Section  
Florida Department of Environmental Protection  
2600 Blair Stone Road  
Tallahassee, FL 32399

Dear Mr. Sheplak:

Re: Redesign of Bartow Unit 1 Electrostatic Precipitator

Florida Power is requesting DEP's approval of a redesign of the Bartow Unit 1 electrostatic precipitator (ESP). As you know, the ESP was originally designed to control particulate emissions and opacity from a fuel that was a mixture of 50% coal and 50% oil. The unit no longer burns this fuel, nor is it permitted to use it. Unit 1 burns #6 fuel oil, a fuel for which the ESP was not designed.

Florida Power proposes to redesign the ESP to one that is better suited to controlling emissions from #6 oil fuel. The attached report by BHA, which is a firm that specializes in ESP design, describes the new design, which will use more durable rigid discharge electrodes rather than wires. The BHA report also discusses the results of a study of the efficiency of the revised design in comparison with the current ESP, as it controlled the original coal/oil mixture and in comparison with the performance on the current fuel. In both cases, the performance of the revised design is expected to equal or exceed the current ESP. An additional benefit associated with the revised design is that it will be more durable and less maintenance-intensive.

Also enclosed in this submittal are completed Responsible Official and Professional Engineer certification forms. Originally, this work was scheduled to be completed during the spring 2003 outage. However, an opportunity to complete the work during the next eight weeks has surfaced, so your prompt review and approval would be much appreciated. Thank you for your consideration of this request, and feel free to contact Mike Kennedy at (727) 826-4334 if you have any questions.

*I, the undersigned, am the responsible official as defined in Chapter 62-210.200, F.A.C., of the Title V source for which this document is being submitted. I hereby certify, based on the information and belief formed after reasonable inquiry, that the statements made and data contained in this document are true, accurate, and complete.*

Sincerely,

A handwritten signature in black ink, appearing to read "Brenda Brickhouse". The signature is fluid and cursive, with a long horizontal stroke at the end.

Brenda Brickhouse  
Plant Manager/Responsible Official  
Bartow Plant

Enclosure

# Harris Group Inc.

September 26, 2002

BHA Group, Inc.  
8800 East 63<sup>rd</sup> Street  
Kansas City, Missouri 64133

Attention: Mr. Bob Taylor, Vice president - Engineering

Subject: **Engineering Review of BHA Report to Florida Power Corporation  
Bartow Station Unit 1 ESP Rebuild Performance Review  
Harris Group Inc. Ref. Number 65080.00**

Dear Mr. Taylor:

Attached is BHA Report to Florida Power Corporation dated August 26, 2002. We have reviewed this report and find it consistent with the earlier version.

Upon review of the above documentation HGI concludes that the methodology and approach taken by BHA to analyze the performance of Bartow Unit 1 ESP following a modification is reasonable, and in accordance with proven industry standards. HGI believes it is reasonable to expect that the predicted performance of the ESP after the rebuild, with Unit 1 firing only the fuel oil used in the BHA analysis, can be achieved.

The professional review conducted by HGI does not constitute any guarantee of performance as predicted by BHA. It is understood by HGI that the documents provided by BHA are not intended or issued for construction purposes.

Should there be any questions concerning the intent of this letter, please do not hesitate to contact me directly.

Sincerely,



Carlos Rollan, P.E.

cc: **Mr. Michael Kennedy, FPC  
Tom Davis  
Project File**



Communications:  
P.O. Box 58090  
Jacksonville, FL 32241-8090  
(904) 739-1115  
Fax (904) 739-1117  
[www.harrisgroup.com](http://www.harrisgroup.com)

Office:  
Corporate Plaza (Bldg. #3)  
8659 Baypine Road  
Jacksonville, FL 32256



**Florida Power  
Bartow Station Unit 1  
ESP Rebuild Performance Review**



August 26, 2002

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We have reviewed expected performance of the Buell "BAB" model electrostatic precipitator utilized to collect particulate from the Unit 1 oil fired boiler. The intent of this review is to compare expected emission levels of the Unit 1 electrostatic precipitator when rebuilt with two mechanical fields, using the original process design values.

### **Summary**

When burning #6 Fuel Oil as compared to the original design fuel, the following comparisons can be made:

- The dust loading at the inlet to the Unit 1 electrostatic precipitator is about 1/60<sup>th</sup> of the original design value using 50% COM.

If two of the original fields in the existing electrostatic precipitator are rebuilt, emissions will be lower than the original design values.

Mass emissions and opacity from the electrostatic precipitator when rebuilt with two fields will be lower than current emissions and opacity values.

### **Background**

The objective of this review is to determine if it is reasonable to expect emissions and opacity from a rebuild covering two mechanical fields of the existing casing to be equal to or less than current measured values.

In addition, the review will determine if the emissions resulting from rebuilding two of the three mechanical fields will result in emissions equal to or lower than the original design values.

### **Fuel Discussion**

When originally designed, the Unit 1 ESP was intended to burn a blend of coal and oil fuels. The original vendor designed the Unit 1 electrostatic precipitator to achieve emission guarantees based fuel comprised of 50% coal and 50% #6 Fuel Oil. This fuel was characterized as 50% COM (50% coal oil / mixture).

Presently, Bartow Station does not burn a blended fuel. Number 6 Fuel Oil constitutes 100% of the boiler heat input. The following table presents a comparison of the critical fuel characteristics for both the original design 50% COM blend and current fuel.

<b>Comparison of Fuel Sources</b>		
	<b>Original 50% COM</b>	<b>Current #6 Fuel Oil</b>
<b>Constituent</b>	<b>Percent by weight</b>	<b>Percent by weight</b>
Heating value, BTU/lb.	14,750	17,678
Ash content, %	6.05	0.1

The values shown above reflect the original design fuel and the fuel presently burned in Unit 1 Bartow Station. As seen from the table, the ash content of the Fuel Oil is significantly lower than the original value used for the precipitator design. A more relevant comparison would utilize the ash content relative to the heating value of the fuel. This is a better indication of the amount of ash created during the combustion process. The following table reflects the ash content value of each fuel:

<b>Comparison of Fuel Ash Content</b>		
	<b>Original 50% COM</b>	<b>Current #6 Fuel Oil</b>
Ash content of fuel, lb/mmBTU	4.4	0.057
Conversion of ash to flyash, %	80	100
Flyash at inlet to ESP, lb/mmBTU	3.53	0.057

The ash content of the fuel is obtained by dividing the pounds of ash per pound of fuel by the corresponding heating value per pound of fuel. When calculated in this manner, the ash content represents 100 percent of the ash contained in the fuel.

In a pulverized coal fired boiler, approximately 70% to 80% of the ash contained in the coal enters the electrostatic precipitator as flyash. The balance of the ash exits the boiler as bottom ash. To arrive at the expected inlet dust loading for the original design, we utilized a conversion ratio of 80% ash to flyash.

A higher percentage of ash converts to flyash when burning #6 Fuel Oil. As a result, we utilized a conversion ratio of 100% ash to flyash for #6 Fuel Oil.

As seen in the table, the original design utilized dust loading at the inlet to the electrostatic precipitator about 60 times greater than presently experienced while burning #6 Fuel Oil. Emissions from an electrostatic precipitator are proportional to the amount of dust present at the inlet.

The process conditions utilized for the original electrostatic precipitator design are shown in the table below. Recent stack test data indicates that they are still valid for current operation.

<b>Unit 1 ESP Inlet Design Conditions</b>		
<b>Description</b>	<b>Value</b>	<b>Units</b>
Gas volume, actual	488,000	Actual ft <sup>3</sup> /min
Gas volume, standard	308,830	Dry standard ft <sup>3</sup> /min
Gas temperature	250 to 320	°F

Gas pressure	-2 to -4	Inches w.c.
Gas moisture content	6 to 8	% by volume

Applying these process conditions to the dust loading shown in the previous table, produces the data shown in the following table:

Comparison of Inlet Dust Loading		
	Original 50% COM	Current #6 Fuel Oil
Boiler heat input, mm BTU/hr	1,220	1,220
Inlet loading, gr./acf	1.03	0.016
Inlet loading, gr./ dscf	<b>1.63</b>	<b>0.025</b>

The inlet loading values were obtained by dividing the mass flow rate of ash by the gas volume in which it is suspended. Emission levels expected from the precipitator are a function of the inlet dust loading data provided above and the precipitator configuration. When rebuilt as proposed using two mechanical fields with one field left vacant, the Unit 1 electrostatic precipitator will have the following configuration:

Unit 1 - Two Mechanical Field Upgrade		
Description	Value	Units
Number of casings	1	Each
Number of chambers per casing	2	Each
Gas passage width	11	Inches
Number of passages per chamber	30	Each
Number of mechanical fields	2	Each
Field 1	Vacant	Feet
Field 2	9 wide by 36.79 tall	Feet
Field 3	12 wide by 36.79 tall	Feet
Number of energized fields	5 per casing	Each
Field 1	45 kV, 240A, 45kV,1800 ma	
Current density	136 $\mu$ A/ft. <sup>2</sup> over two bus sections	
Field 2	45 kV, 240A, 45kV,1800 ma	
Current density	136 $\mu$ A/ft. <sup>2</sup> over two bus sections	
Field 3	45 kV, 240A, 45kV,1800 ma	
Current density	68 $\mu$ A/ft. <sup>2</sup> over four bus sections	
Field 4	45 kV, 240A, 45kV,1800 ma	
Current density	68 $\mu$ A/ft. <sup>2</sup> over four bus sections	
Field 5	45 kV, 240A, 45kV,1800 ma	
Current density	136 $\mu$ A/ft. <sup>2</sup> over two bus sections	

Critical Operating Parameters		
Total collecting plate area	92,711	Ft. <sup>2</sup> (Actual 11" GP spacing)
Total collecting plate area	114,343	Ft. <sup>2</sup> (9" GP spacing equiv.)
Treatment length	21	Ft.
Aspect ratio	0.57	

Specific collecting area, SCA	190	Ft. <sup>2</sup> /1000 ACFM (11" basis)
Gas velocity	4.0	Ft./sec.
Treatment time	5.2	Sec.

### Results of Evaluation

The expected emission levels from the Unit 1 electrostatic precipitator rebuilt with two mechanical fields were estimated using industry accepted predictive computer models. The model results are shown in the following table. In addition, the original guaranteed emission levels are listed for comparison.

Comparison of Design Versus Expected Emission Levels		
	Original guarantee 50% COM	Estimated for #6 Fuel Oil
Outlet dust loading, gr./acf	0.02	0.004 to 0.0047
Opacity, %	No guarantee	4 to 6

As shown in the table, there was no opacity guarantee provided with the original design. In terms of mass emissions, the expected emission levels using #6 Fuel Oil are less than those expected from the original design. Another important comparison occurs between expected performance of the Unit 1 electrostatic precipitator and recent stack test data.

Comparison of Current Versus Expected Emission Levels		
	August 2001 Stack Test	Estimated for #6 Fuel Oil
Outlet dust loading, gr./acf	N/A	0.004 to 0.005
Outlet dust loading, gr./dscf	0.0140 to 0.02	0.006 to 0.007
Opacity, %	6.7 to 8.1	4 to 6

The tables show that the Unit 1 electrostatic precipitator when rebuilt with two mechanical fields and experiencing the design inlet process conditions will provide emissions lower than the current values measured during stack testing. The expected opacity values are also lower than those recorded during the mass emission testing.

### Rebuild Approach

The proposed rebuild would occur in the second and third mechanical fields. The first mechanical field would be left vacant. The intent is to use the vacant first field as an expansion chamber ensuring uniform gas flow into the rebuilt second and third fields. A new perforated plate will be provided at the inlet to the second field.

The expected performance is based on a rebuild utilizing rigid discharge electrodes. It will be necessary to increase the gas passage width to eleven inches to accommodate the rigid electrodes. The key to increasing gas passage width and maintaining performance is to have transformer rectifiers that allow secondary voltage levels to increase to the new levels required by a rigid electrode.

The rebuild proposed is based on utilizing the ESP-3 collecting panel in our modular

Buell rebuild configuration. The existing roof box beams will be reused in the proposed rebuild. The internal pivot points supporting the existing collecting plate frames will be reused as well. Rapping density will be decreased to provide more uniform plate cleaning. Collecting plate rapping will utilize EGR rappers.

## Summary

Rebuilding two of the three mechanical contained in the Unit 1 electrostatic precipitator will provide emissions and opacity that are equal to or better than the original design values. In addition, the expected emission and visible emission values are lower than those recorded during the August 2001 stack test. Another benefit of the two-field rebuild is that reliability and availability will be greatly improved compared to the existing precipitator.

We look forward to further discussions concerning this work and appreciate this opportunity to support you. If you should have any questions or comments, please feel free to contact us at 800-821-2222.

Sincerely,

BHA GROUP, INC.

Bob Taylor  
Vice President-Engineering

D-022E2A1-1.7

REVIEWED BY: CARLOS ROLLAN, P.E.  
September 25, 2002  
FLORIDA PE 23022





**4. Professional Engineer Statement:**

*I, the undersigned, hereby certify, except as particularly noted herein\*, that:*

*(1) To the best of my knowledge, there is reasonable assurance that the air pollutant emissions unit(s) and the air pollution control equipment described in this Application for Air Permit, when properly operated and maintained, will comply with all applicable standards for control of air pollutant emissions found in the Florida Statutes and rules of the Department of Environmental Protection; and*

*(2) To the best of my knowledge, any emission estimates reported or relied on in this application are true, accurate, and complete and are either based upon reasonable techniques available for calculating emissions or, for emission estimates of hazardous air pollutants not regulated for an emissions unit addressed in this application, based solely upon the materials, information and calculations submitted with this application.*

*If the purpose of this application is to obtain a Title V source air operation permit (check here [    ], if so), I further certify that each emissions unit described in this Application for Air Permit, when properly operated and maintained, will comply with the applicable requirements identified in this application to which the unit is subject, except those emissions units for which a compliance schedule is submitted with this application.*

*If the purpose of this application is to obtain an air construction permit for one or more proposed new or modified emissions units (check here [    ], if so), I further certify that the engineering features of each such emissions unit described in this application have been designed or examined by me or individuals under my direct supervision and found to be in conformity with sound engineering principles applicable to the control of emissions of the air pollutants characterized in this application.*

*If the purpose of this application is to obtain an initial air operation permit or operation permit revision for one or more newly constructed or modified emissions units (check here [    ], if so), I further certify that, with the exception of any changes detailed as part of this application, each such emissions unit has been constructed or modified in substantial accordance with the information given in the corresponding application for air construction permit and with all provisions contained in such permit.*

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Date

(seal)

\* Attach any exception to certification statement.

**Owner/Authorized Representative or Responsible Official**

1. Name and Title of Owner/Authorized Representative or Responsible Official: Brenda Brickhouse
2. Owner/Authorized Representative or Responsible Official Mailing Address: Organization/Firm: Florida Power, Bartow Plant Street Address: P.O. Box 14042 City: St. Petersburg State: FL Zip Code: 33733
3. Owner/Authorized Representative or Responsible Official Telephone Numbers: Telephone: (727 ) 827 - 6105 Fax: (727 ) 827 - 6102
4. Owner/Authorized Representative or Responsible Official Statement: <i>I, the undersigned, am the owner or authorized representative*(check here [ ], if so) or the responsible official (check here [X ], if so) of the Title V source addressed in this application, whichever is applicable. I hereby certify, based on information and belief formed after reasonable inquiry, that the statements made in this application are true, accurate and complete and that, to the best of my knowledge, any estimates of emissions reported in this application are based upon reasonable techniques for calculating emissions. The air pollutant emissions units and air pollution control equipment described in this application will be operated and maintained so as to comply with all applicable standards for control of air pollutant emissions found in the statutes of the State of Florida and rules of the Department of Environmental Protection and revisions thereof. I understand that a permit, if granted by the Department, cannot be transferred without authorization from the Department, and I will promptly notify the Department upon sale or legal transfer of any permitted emissions unit.</i>  _____ Signature Date

\* Attach letter of authorization if not currently on file.

**Professional Engineer Certification**

1. Professional Engineer Name: CARLOS ROLLAN Registration Number: 23022
2. Professional Engineer Mailing Address: Organization/Firm: HARRIS GROUP INC Street Address: 8659 BAYPINE ROAD City: JACKSONVILLE State: FL Zip Code: 32256
3. Professional Engineer Telephone Numbers: Telephone: (904) 739 - 1115 Fax: (904) 739 - 1117

4. Professional Engineer Statement:

*I, the undersigned, hereby certify, except as particularly noted herein\*, that:*

*(1) To the best of my knowledge, there is reasonable assurance that the air pollutant emissions unit(s) and the air pollution control equipment described in this Application for Air Permit, when properly operated and maintained, will comply with all applicable standards for control of air pollutant emissions found in the Florida Statutes and rules of the Department of Environmental Protection; and*

*(2) To the best of my knowledge, any emission estimates reported or relied on in this application are true, accurate, and complete and are either based upon reasonable techniques available for calculating emissions or, for emission estimates of hazardous air pollutants not regulated for an emissions unit addressed in this application, based solely upon the materials, information and calculations submitted with this application.*

*If the purpose of this application is to obtain a Title V source air operation permit (check here [ ], if so), I further certify that each emissions unit described in this Application for Air Permit, when properly operated and maintained, will comply with the applicable requirements identified in this application to which the unit is subject, except those emissions units for which a compliance schedule is submitted with this application.*

*If the purpose of this application is to obtain an air construction permit for one or more proposed new or modified emissions units (check here [ ], if so), I further certify that the engineering features of each such emissions unit described in this application have been designed or examined by me or individuals under my direct supervision and found to be in conformity with sound engineering principles applicable to the control of emissions of the air pollutants characterized in this application.*

*If the purpose of this application is to obtain an initial air operation permit or operation permit revision for one or more newly constructed or modified emissions units (check here [ ], if so), I further certify that, with the exception of any changes detailed as part of this application, each such emissions unit has been constructed or modified in substantial accordance with the information given in the corresponding application for air construction permit and with all provisions contained in such permit.*

Signature

Date

(seal)

\* Attach any exception to certification statement.