Department of Environmental Protection

Jeb Bush
Governor

Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, Florida 32399-2400

David B. Struhs
Secretary

March 15, 2002

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

Benjamin M.H. Borsch, P.E.
Environmental Manager, Calpine
Auburndale Power Partners L.P.
Island Center
2701 N. Rocky Point Drive, Suite 1200
Tampa, FL 33607

Re: DEP File No. 1050221-006-AC
Auburndale Cogeneration Facility

Dear Mr. Borsch:

Enclosed is one copy of the Draft air construction permit for the installation of a wet compression system on the Simple Cycle Combustion Turbine located at 1501 West Derby Avenue, Auburndale, Polk County. The Technical Evaluation and PSD Applicability Determination, the Department's Intent to Issue Air Construction Permit and the Public Notice of Intent to Issue Air Construction Permit are also included.

The Public Notice of Intent to Issue Air Construction Permit must be published one time only, as soon as possible, in the legal advertisement section of a newspaper of general circulation in the area affected, pursuant to the requirements Chapter 50, Florida Statutes. Proof of publication, i.e., newspaper affidavit, must be provided to the Department's Bureau of Air Regulation office within seven days of publication. Failure to publish the notice and provide proof of publication may result in the denial of the permit.

Please submit any written comments you wish to have considered concerning the Department's proposed action to A. A. Linero, P.E., Administrator, New Source Review Section at the above letterhead address. If you have any other questions, please contact Michael P. Halpin at 850/921-9519.

Sincerely,

C. H. Fancy, P.E., Chief,
Bureau of Air Regulation

CHF/mph

Enclosures

In the Matter of an
Application for Permit by:

Benjamin M.H. Borsch, Environmental Manager, Calpine
Auburndale Power Partners L.P.
2701 N. Rocky Point Drive, Suite 1200
Tampa, FL 33607

DEP File No. 1050221-006-AC
Auburndale Cogeneration Facility
Polk County

INTENT TO ISSUE AIR CONSTRUCTION PERMIT

The Department of Environmental Protection (Department) gives notice of its intent to issue an air construction permit (copy of Draft permit attached) for the proposed project, detailed in the application specified above and the enclosed Technical Evaluation and PSD Applicability Determination, for the reasons stated below.

The applicant, Benjamin M.H. Borsch, Environmental Manager, Calpine, applied on October 3, 2001, to the Department for an air construction permit for its Auburndale Cogeneration Facility located at 1501 West Derby Avenue, Auburndale, Polk County. The application became complete on January 22, 2002. The permit is to install a wet compression system on the existing Simple Cycle Unit at the facility.

The Department has permitting jurisdiction under the provisions of Chapter 403, Florida Statutes (F.S.), and Florida Administrative Code (F.A.C.) Chapters 62-4, 62-210, and 62-212. The above actions are not exempt from permitting procedures. The Department has determined that an air construction permit is required to install the wet compression system.

The Department intends to issue this air construction permit based on the belief that reasonable assurances have been provided to indicate that operation of these emission units will not adversely impact air quality, and the emission units will comply with all appropriate provisions of Chapters 62-4, 62-204, 62-210, 62-212, 62-296, and 62-297, F.A.C.

Pursuant to Section 403.815, F.S., and Rule 62-110.106(7)(a)1., F.A.C., you (the applicant) are required to publish at your own expense the enclosed Public Notice of Intent to Issue Air Construction Permit. The notice shall be published one time only in the legal advertisement section of a newspaper of general circulation in the area affected. Rule 62-110.106(7)(b), F.A.C., requires that the applicant cause the notice to be published as soon as possible after notification by the Department of its intended action. For the purpose of these rules, "publication in a newspaper of general circulation in the area affected" means publication in a newspaper meeting the requirements of Sections 50.011 and 50.031, F.S., in the county where the activity is to take place. If you are uncertain that a newspaper meets these requirements, please contact the Department at the address or telephone number listed below. The applicant shall provide proof of publication to the Department's Bureau of Air Regulation, at 2600 Blair Stone Road, Mail Station #5505, Tallahassee, Florida 32399-2400 (Telephone: 850/488-0114; Fax 850/ 922-6979). You must provide proof of publication within seven days of publication, pursuant to Rule 62-110.106(5), F.A.C. No permitting action for which published notice is required shall be granted until proof of publication of notice is made by furnishing a uniform affidavit in substantially the form prescribed in section 50.051, F.S. to the office of the Department issuing the permit. Failure to publish the notice and provide proof of publication may result in the denial of the permit pursuant to Rules 62-110.106(9) & (11), F.A.C.

The Department will issue the final permit with the attached conditions unless a response received in accordance with the following procedures results in a different decision or significant change of terms or conditions.

The Department will accept written comments concerning the proposed permit issuance action for a period of 14 (fourteen) days from the date of publication of Public Notice of Intent to Issue Air Permit. Written comments should be provided to the Department's Bureau of Air Regulation at 2600 Blair Stone Road, Mail Station #5505, Tallahassee, FL 32399-2400. Any written comments filed shall be made available for public inspection. If written comments received result in a significant change in the proposed agency action, the Department shall revise the proposed permit and require, if applicable, another Public Notice.

The Department will issue the permit with the attached conditions unless a timely petition for an administrative hearing is filed pursuant to sections 120.569 and 120.57 F.S., before the deadline for filing a petition. The procedures for petitioning for a hearing are set forth below.

A person whose substantial interests are affected by the proposed permitting decision may petition for an administrative proceeding (hearing) under sections 120.569 and 120.57 of the Florida Statutes. The petition must contain the information set forth below and must be filed (received) in the Office of General Counsel of the Department at 3900 Commonwealth Boulevard, Mail Station #35, Tallahassee, Florida, 32399-3000. Petitions filed by the permit applicant or any of the parties listed below must be filed within fourteen days of receipt of this notice of intent. Petitions filed by any persons other than those entitled to written notice under section 120.60(3) of the Florida Statutes must be filed within fourteen days of publication of the public notice or within fourteen days of receipt of this notice of intent, whichever occurs first. Under section 120.60(3), however, any person who asked the Department for notice of agency action may file a petition within fourteen days of receipt of that notice, regardless of the date of publication. A petitioner shall mail a copy of the petition to the applicant at the address indicated above at the time of filing. The failure of any person to file a petition within the appropriate time period shall constitute a waiver of that person's right to request an administrative determination (hearing) under sections 120.569 and 120.57 F.S., or to intervene in this proceeding and participate as a party to it. Any subsequent intervention will be only at the approval of the presiding officer upon the filing of a motion in compliance with Rule 28-106.205 of the Florida Administrative Code.

A petition that disputes the material facts on which the Department's action is based must contain the following information: (a) The name and address of each agency affected and each agency's file or identification number, if known; (b) The name, address, and telephone number of the petitioner, the name, address, and telephone number of the petitioner's representative, if any, which shall be the address for service purposes during the course of the proceeding; and an explanation of how the petitioner's substantial interests will be affected by the agency determination; (c) A statement of how and when petitioner received notice of the agency action or proposed action; (d) A statement of all disputed issues of material fact. If there are none, the petition must so indicate; (e) A concise statement of the ultimate facts alleged, including the specific facts the petitioner contends warrant reversal or modification of the agency's proposed action; (f) A statement of the specific rules or statutes the petitioner contends require reversal or modification of the agency's proposed action; and (g) A statement of the relief sought by the petitioner, stating precisely the action petitioner wishes the agency to take with respect to the agency's proposed action.

A petition that does not dispute the material facts upon which the Department's action is based shall state that no such facts are in dispute and otherwise shall contain the same information as set forth above, as required by Rule 28-106.301.

Because the administrative hearing process is designed to formulate final agency action, the filing of a petition means that the Department's final action may be different from the position taken by it in this notice. Persons whose substantial interests will be affected by any such final decision of the Department on the application have the right to petition to become a party to the proceeding, in accordance with the requirements set forth above.

Mediation is not available in this proceeding.

In addition to the above, a person subject to regulation has a right to apply for a variance from or waiver of the requirements of particular rules, on certain conditions, under Section 120.542 F.S. The relief provided by this state statute applies only to state rules, not statutes, and not to any federal regulatory requirements. Applying for a variance or waiver does not substitute or extend the time for filing a petition for an administrative hearing or exercising any other right that a person may have in relation to the action proposed in this notice of intent.

The application for a variance or waiver is made by filing a petition with the Office of General Counsel of the Department, 3900 Commonwealth Boulevard, Mail Station #35, Tallahassee, Florida 32399-3000. The petition

must specify the following information: (a) The name, address, and telephone number of the petitioner; (b) The name, address, and telephone number of the attorney or qualified representative of the petitioner, if any; (c) Each rule or portion of a rule from which a variance or waiver is requested; (d) The citation to the statute underlying (implemented by) the rule identified in (c) above; (e) The type of action requested; (f) The specific facts that would justify a variance or waiver for the petitioner; (g) The reason why the variance or waiver would serve the purposes of the underlying statute (implemented by the rule); and (h) A statement whether the variance or waiver is permanent or temporary and, if temporary, a statement of the dates showing the duration of the variance or waiver requested.

The Department will grant a variance or waiver when the petition demonstrates both that the application of the rule would create a substantial hardship or violate principles of fairness, as each of those terms is defined in Section 120.542(2) F.S., and that the purpose of the underlying statute will be or has been achieved by other means by the petitioner.

Persons subject to regulation pursuant to any federally delegated or approved air program should be aware that Florida is specifically not authorized to issue variances or waivers from any requirements of any such federally delegated or approved program. The requirements of the program remain fully enforceable by the Administrator of the EPA and by any person under the Clean Air Act unless and until the Administrator separately approves any variance or waiver in accordance with the procedures of the federal program.

Executed in Tallahassee, Florida.

C. H. Fancy, P.E., Chief
Bureau of Air Regulation

CERTIFICATE OF SERVICE

The undersigned duly designated deputy agency clerk hereby certifies that this Intent to Issue Air Construction Permit (including the Public Notice of Intent to Issue Air Construction Permit, Technical Evaluation and PSD Applicability Determination, and the Draft permit) was sent by certified mail (*) and copies were mailed by U.S. Mail before the close of business on 3/18/02 to the person(s) listed:

Mr. Benjamin Borsch, Environmental Manager, Calpine *
Mr. Bill Thomas, SWD-DEP
Mr. Gregg Worley, EPA
Mr. John Bunyak, NPS

Clerk Stamp

FILING AND ACKNOWLEDGMENT FILED, on this date, pursuant to §120.52, Florida Statutes, with the designated Department Clerk, receipt of which is hereby acknowledged.

Victoria Gibson (Clerk) March 18, 2002 (Date)

PUBLIC NOTICE OF INTENT TO ISSUE AIR CONSTRUCTION PERMIT

STATE OF FLORIDA
DEPARTMENT OF ENVIRONMENTAL PROTECTION

DEP File No. 1050221-006-AC

Auburndale Cogeneration Facility
Auburndale, Polk County

The Department of Environmental Protection (Department) gives notice of its intent to issue an air construction permit to Calpine, for the Auburndale Cogeneration Facility located at 1501 West Derby Avenue, Auburndale, Polk County. The permit is to install a wet compression system on the existing Simple Cycle Gas Turbine at the facility. A Best Available Control Technology (BACT) determination was not required pursuant to Rule 62-212.400, F.A.C. and 40 CFR 52.21, Prevention of Significant Deterioration (PSD). The applicant's mailing address is: Calpine Eastern Corporation, Island Center, 2701 N. Rocky Point Drive, Suite 1200, Tampa FL 33607.

A PSD Applicability Determination was made and emissions of regulated pollutants will not increase above the de minimis thresholds established for PSD Review. There will be no change to hours of operation or fuel types as a result of this modification, although fuel throughput is expected to increase.

Total increases in the emissions of PSD pollutants as a result of this project are as follows:

Pollutant	Emission Factor (lbs/MMBtu)	Increased Annual lbs	Increased TPY	PSD Significant Emission Rate	Review Required
PM_{10}	0.002	1380	0.7	15	No
SO_2	0.003	2070	1.0	40	No
NO_X	0.099	68326	34	40	No
CO	0.023	15874	7.9	100	No

An air quality impact analysis was not conducted, nor required. The Department will issue the Final Permit with the attached conditions unless a response received in accordance with the following procedures results in a different decision or significant change of terms or conditions.

The Department will accept written comments concerning the proposed permit issuance action for a period of 14 (fourteen) days from the date of publication of this Public Notice of Intent to Issue Air Construction Permit. Written comments should be provided to the Department's Bureau of Air Regulation at 2600 Blair Stone Road, Mail Station #5505, Tallahassee, FL 32399-2400. Any written comments filed shall be made available for public inspection. If written comments received result in a significant change in the proposed agency action, the Department shall revise the proposed permit and require, if applicable, another Public Notice.

The Department will issue the permit with the attached conditions unless a timely petition for an administrative hearing is filed pursuant to sections 120.569 and 120.57 F.S., before the deadline for filing a petition. The procedures for petitioning for a hearing are set forth below. Mediation is not available in this proceeding.

A person whose substantial interests are affected by the proposed permitting decision may petition for an administrative proceeding (hearing) under sections 120.569 and 120.57 of the Florida Statutes. The petition must contain the information set forth below and must be filed (received) in the Office of General Counsel of the Department at 3900 Commonwealth Boulevard, Mail Station #35, Tallahassee, Florida, 32399-3000. Petitions filed by the permit applicant or any of the parties listed below must be filed within fourteen days of receipt of this notice of intent. Petitions filed by any persons other than those entitled to written notice under section 120.60(3) of the Florida Statutes must be filed within fourteen days of publication of the public notice or within fourteen days of receipt of this notice of intent, whichever occurs first. Under section 120.60(3), however, any person who asked the Department for notice of agency action may file a petition within fourteen days of receipt of that notice, regardless of the date of publication. A petitioner shall mail a copy of the petition to the applicant at the address

indicated above at the time of filing. The failure of any person to file a petition within the appropriate time period shall constitute a waiver of that person's right to request an administrative determination (hearing) under sections 120.569 and 120.57 F.S., or to intervene in this proceeding and participate as a party to it. Any subsequent intervention will be only at the approval of the presiding officer upon the filing of a motion in compliance with Rule 28-106.205 of the Florida Administrative Code.

A petition that disputes the material facts on which the Department's action is based must contain the following information: (a) The name and address of each agency affected and each agency's file or identification number, if known; (b) The name, address, and telephone number of the petitioner, the name, address, and telephone number of the petitioner's representative, if any, which shall be the address for service purposes during the course of the proceeding; and an explanation of how the petitioner's substantial interests will be affected by the agency determination; (c) A statement of how and when petitioner received notice of the agency action or proposed action; (d) A statement of all disputed issues of material fact. If there are none, the petition must so indicate; (e) A concise statement of the ultimate facts alleged, including the specific facts the petitioner contends warrant reversal or modification of the agency's proposed action; (f) A statement of the specific rules or statutes the petitioner contends require reversal or modification of the agency's proposed action; and (g) A statement of the relief sought by the petitioner, stating precisely the action petitioner wishes the agency to take with respect to the agency's proposed action.

A petition that does not dispute the material facts upon which the Department's action is based shall state that no such facts are in dispute and otherwise shall contain the same information as set forth above, as required by rule 28-106.301

Because the administrative hearing process is designed to formulate final agency action, the filing of a petition means that the Department's final action may be different from the position taken by it in this notice. Persons whose substantial interests will be affected by any such final decision of the Department on the application have the right to petition to become a party to the proceeding, in accordance with the requirements set forth above.

A complete project file is available for public inspection during normal business hours, 8:00 a.m. to 5:00 p.m., Monday through Friday, except legal holidays, at:

Dept. of Environmental Protection
Bureau of Air Regulation
Suite 4, 111 S. Magnolia Drive
Tallahassee, Florida, 32301
Telephone: 850/488-0114
Fax: 850/922-6979

Dept. of Environmental Protection
Southwest District
3804 Coconut Palm Drive
Tampa, Florida 33619-8218
Telephone: 813/744-6100
Fax: 813/744-6084

The complete project file includes the application, technical evaluations, Draft permit, and the information submitted by the responsible official, exclusive of confidential records under Section 403.111, F.S. Interested persons may contact the Administrator, New Source Review Section, at 111 South Magnolia Drive, Suite 4, Tallahassee, Florida 32301, or call 850/488-0114, for additional information. The Technical Evaluation and PSD Applicability Determination as well as the Draft Permit may be viewed at http://www.dep.state.fl.us/air/permitting/construct.htm

NOTICE TO BE PUBLISHED IN THE NEWSPAPER

April XX, 2002

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

Benjamin M.H. Borsch, P.E.
Environmental Manager, Calpine
Auburndale Power Partners L.P.
Island Center
2701 N. Rocky Point Drive, Suite 1200
Tampa, FL 33607

Re: DEP File No. 1050221-006-AC
Wet Compression Project
Auburndale Cogeneration Facility

Dear Mr. Borsch:

The Department reviewed your request to modify the PSD Permit to authorize the installation of a wet compression system on the simple cycle unit at the subject facility (EU-006). The request is acceptable as detailed in the Department's Technical Evaluation and PSD Applicability Determination.

Permit 1050221-004-AC (Specific Condition 6.) is hereby modified as follows:

6. Allowable Operation: The combustion turbine shall utilize no more than 2,227,400 MMBtu of natural gas during any consecutive 12-month period. The use of wet compression as an alternate means of evaporative cooling is authorized for up to 7000 hours during natural gas firing (only) for any consecutive 12-month period. The permittee shall install, calibrate, operate and maintain a monitoring system to measure and accumulate the amount and heat inputs of natural gas as well as fuel oil fired and the hours of operation. [Rule 62-210.200, F.A.C. (Definitions - PTE), PSD Avoidance]

A copy of this letter shall be filed with the referenced permit and shall become part of the permit. This permit modification is issued pursuant to Chapter 403, Florida Statutes. Any party to this order (permit modification) has the right to seek judicial review of it under Section 120.68, F.S., by the filing of a Notice of Appeal under Rule 9.110 of the Florida Rules of Appellate Procedure with the Clerk of the Department of Environmental Protection in the Office of General Counsel, Mail Station 35, 3900 Commonwealth Boulevard, Tallahassee, Florida, 32399-3000, and by filing a copy of the Notice of Appeal accompanied by the applicable filing fees with the appropriate District Court of Appeal. The Notice of Appeal must be filed within (thirty) days after this Notice is filed with the Clerk of the Department.

Executed in Tallahassee, Florida.

Sincerely,

Howard L. Rhodes, Director
Division of Air Resources
Management

HLR/mph

TECHNICAL EVALUATION

AND

PSD APPLICABILITY DETERMINATION

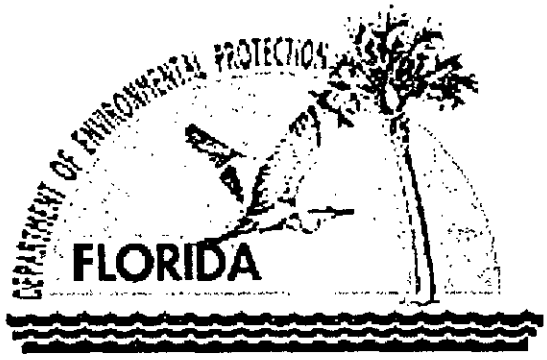
Auburndale Power Partners LP - Calpine

Wet Compression Modification

Simple Cycle Unit EU-006

Polk County

1050221-006-AC



Department of Environmental Protection
Division of Air Resources Management
Bureau of Air Regulation
New Source Review Section

March 13, 2002

1. GENERAL INFORMATION

1.1 APPLICANT NAME AND ADDRESS

Auburndale Power Partners L.P.
Auburndale Unit 1
1501 West Derby Avenue
Auburndale, Florida 33823-4079

Authorized Representative: Benjamin M.H. Borsch, P.E. Environmental Manager, Calpine

1.2 REVIEWING AND PROCESS SCHEDULE

February 22, 2002	Received Permit Application
March 1, 2002	Request For Additional Information
March 11, 2002	Application complete

2. FACILITY INFORMATION

2.1 FACILITY LOCATION

The facility is located in Auburndale, Polk County. The UTM coordinates are Zone 17; 420.8 km E; 3103.2 km N. This site is approximately 95 kilometers from Chassahowitzka Wildlife Refuge, a Class I PSD Area.

2.2 STANDARD INDUSTRIAL CLASSIFICATION CODES (SIC)

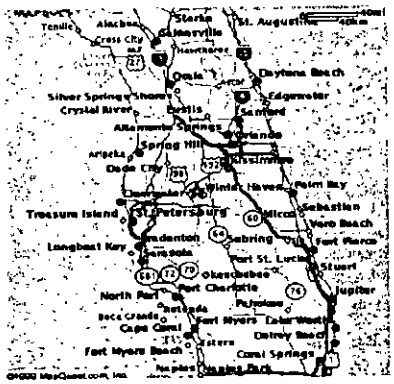
Industry Group No.	49	Electric, Gas and Sanitary Services
Industry No.	4911	Electric Services

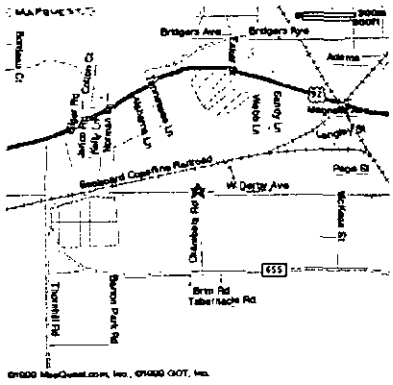
2.3 FACILITY CATEGORY

The existing facility is a cogeneration plant consisting of a combined cycle combustion turbine cogeneration system rated at 156 total megawatts (MW) output and a simple cycle peaking unit, rated at 104 MW nominally. The simple cycle unit consists of one Siemens Westinghouse D5A combustion turbine (CT), which is under construction. The facility utilizes pipeline natural gas as its primary fuel source and low sulfur (0.05 % by weight) distillate fuel oil as a backup fuel source. Also located at this facility are two distillate fuel oil storage tanks, and miscellaneous unregulated/insignificant emissions units and/or activities.

This facility is classified as a Major or Title V Source of air pollution because emissions of at least one regulated air pollutant, such as particulate matter (PM/PM_{10}), sulfur dioxide (SO_2), nitrogen oxides (NO_X), carbon monoxide (CO), or volatile organic compounds (VOC) exceeds 100 tons per year (TPY).

This facility is within an industry included in the list of the 28 Major Facility Categories per Table 62-212.400-1, F.A.C. Because emissions are greater than 100 TPY for at least one criteria pollutant, the facility is also a Major Facility with respect to Rule 62-212.400, Prevention of Significant Deterioration (PSD). Based upon the Title V application, the facility is not a major source of hazardous air pollutants (HAPs).





3. DESCRIPTION

This project addresses the following emissions unit, which is under construction:

Emissions Unit No.	Emissions Unit Description
006	Westinghouse 501D5A combustion turbine (CT) configured for simple cycle operation, 1369 MMBtu/hr for natural gas and 1412 MMBtu/hr for number 2 fuel oil (0.05% S) at ISO conditions [LHV]. Evaporative cooling is authorized.

3.1 PROJECT DESCRIPTION

The applicant proposes to install a wet compression system for use at temperatures above 60 degrees F. This system is proposed for use while firing natural gas (only). The Department has made prior Determinations for the application of inlet foggers (and alternate means of evaporative cooling), typically finding that those applications result in de minimis increases in PSD pollutants. Recently, the Department evaluated the PSD applicability of a wet compression system for the combined cycle unit (EU-001) at this same facility, finding that a PSD review was not triggered. Notwithstanding the fact that EU-006 is currently permitted for evaporative cooling, the Department will review the PSD applicability of wet compression in a fashion similar to that which was recently done for EU-001.

According to publicly available data, wet compression has the ability to increase fuel flow by as much as 13.8% on a 90 degree F day, at 60% R.H. and sea level.

Typical wet compression performance (W501D5A gas turbine)

	Dry	Wet compression	Change
GT power (MW)	106	122	+15%
GT heat rate (Btu/kWh)	10240	10120	-1.2%
GT fuel flow (lb/h)	50425	57360	+13.8%
ST power (MW)	49	51	+4%
CC power (MW)	151	169	+12%
CC heat rate (Btu/kWh)	7190	7310	+1.7%

Much of the following was obtained from an article entitled "*Wet compression extended to V-series machines*" in **Modern Power Systems**, September 21, 2001.

3.2 WET COMPRESSION

In recent years there has been growing interest in ways of boosting the output of existing gas turbines by conditioning the air input to the compressor. There are two main categories of such technology. The first involves the introduction of water and cooling of the air through the enthalpy of evaporation of the water. In this category are wet compression, inlet fogging and evaporative cooling. The second category involves use of a heat exchanger to reduce air inlet temperature, without addition of water. In this category, which results in a lowering of inlet air humidity rather than an increase, are inlet chilling and refrigeration.

Wet compression was developed in the early 1990s by Dow Chemicals, which holds the patent. Siemens Westinghouse has applied it commercially to around 20 installations, all of them Westinghouse W501 type gas turbines. The initial installation has operated for over 25000 hours on a W501A machine, since 1995. The first

installation on a W501D5A (DLN) turbine was in 1997, while 1999 saw the first installation on W501D5 and W501D5A machines. Recently, tests of the wet compression technology have been carried out on a Siemens type V84.3A2 gas turbine at the Siemens test bed in Berlin. A prototype application of the technology on a V84.2 machine is planned for the spring of 2002 at a US plant. Subsequently, the technology will be tested on a V94.2 gas turbine, also slated for 2002.

Siemens Westinghouse believes that wet compression is the most cost effective of the common techniques for augmenting gas turbine output. It reportedly can increase gas turbine power output by 10-15 percent and raise efficiency by 1-2 percent. When fitted on engines with conventional combustion systems, NO_X emissions have been reduced by 20-40 percent. In terms of CO_2, wet compression increases fuel consumption, but the increase in power is greater, resulting in less CO_2 emissions per unit of power generated. As mentioned below, another advantage of wet compression is that it allows power to be increased and maintained independent of ambient temperatures and relative humidity – it even works with relative humidity of 100 percent. It can also be used in conjunction with evaporative cooling.

Wet compression can have advantages over direct combustor water injection for NO_X control and power enhancement. In the case of water injection, heat rate is increased (due to vaporization of the water), whereas wet compression improves heat rate while at the same time intercooling the compressor. It should however be noted that in a combined cycle application, wet compression increases heat rate. This is because, with wet compression, gas turbine fuel consumption increases in line with the power increase, but turbine exhaust energy increases to a lesser extent.

The thermodynamics of wet compression is relatively straightforward. The compressor inlet air is over-saturated, with the double effect of cooling at the compressor inlet (dependent on ambient conditions) and intercooling, i.e. cooling inside the compressor (which is independent of ambient conditions). Thermodynamics dictates that an isothermal compression will consume less work than an adiabatic compression. Once the over-saturated air is inside the compressor, the evaporation of the remaining droplets provides intercooling and thus moves the compression in the direction of an isothermal process. As an additional effect the overall increase in the mass flow increases the power output from the turbine.

Wet compression technology does not suit all turbines because the intercooling effect will change the operating gaps in the compressor. Droplet sizes must be carefully controlled to minimize erosion of the compressor blades. Also, wet compression causes the pressure ratios inside the gas turbine to vary, which results in changes to the cooling air management requirements. These and other effects are influencing the commercialization of wet compression technology.

A wet compression system includes fitting of the spray atomization system and spray nozzle rack, modifications to the plant control system (e.g. to adjust firing temperature as a function of the quantity of water being injected), installation of high pressure pumps, application of protective coatings to the inlet ducts, and installation of water traps in first compressor bleed lines. The injection of water changes the work distribution of the compressor and requires changes to turbine cooling circuits and usually installation of an automated flow control system. Since its introduction some six years ago the technology has evolved in a number of ways, including improved nozzle design and reduced average droplet size.

Tests on the V84.3A2 turbine at the Siemens test facility in Berlin have aimed to gather basic thermodynamic data for the Siemens V series machines. The tests were conducted for fuel oil and fuel gas premix modes with low NO_X combustors. The V84.3A2 had test instrumentation to monitor the following: vibration and natural frequency of the compressor blades; compressor blade tip clearances; compressor casing temperature distribution and deformation; pressures and temperatures in bleeds; and thermodynamic values. With an injected water temperature of less than 30°C, ambient conditions of 22 to 23.3°C, 1004 mbar, and 60 percent relative humidity, the wet compression gave a power gain in the range 10-15 percent. The tests demonstrated successful application of the technology to the V series.

3.3 ALTERNATIVES TO WET COMPRESSION

Evaporative cooling is a widely used technology for boosting gas turbine output, particularly in dry and hot climates. Unlike wet compression, where water is sprayed into the compressor inlet, evaporative cooling uses a stationary water saturated medium, over which the inlet air is passed. Because the residence time is short, evaporative cooling does not allow the air to become fully saturated, achieving humidity levels in the range 85-95 percent. Typically the hardware for evaporative cooling is installed in the inlet filter house, well upstream of the compressor inlet. In contrast the spray rack for wet compression is installed close to the compressor inlet.

Like wet compression, inlet fogging/misting involve the direct spraying of water into the inlet air, with the possibility of achieving 100 percent humidity. However, like evaporative cooling the fogging/misting is done close to the filter house and as far away as possible from the compressor inlet. This is to allow maximum time for the drops to evaporate before entering the turbine. The disadvantage of being so far from the inlet is that a large amount of ductwork gets wet, which can cause corrosion, and contaminants on the ductwork can get washed into the turbine.

Recently, turbine inlet chilling has been applied in particular market niches. The chilling can be done with absorption refrigeration, electric chillers or even ice. In some cases non-peak electricity can be used to make ice or chilled water, which can then be used to boost output during peak times, when electricity prices are high. However, according to recent figures presented by Siemens Westinghouse (Power Gen conference, Brussels, May 2001) these refrigeration and storage systems can be expensive and installation may take up a large amount of space.

Wet compression can also be used in addition to evaporative cooling, with consequent benefits; wet compression allows a gas turbine to maintain output with increasing ambient temperatures. Siemens Westinghouse argues that power gains from wet compression are more reliable than those from evaporative cooling and inlet fogging because they are not dependent on the relative ambient air humidity.

4. PROJECT EMISSIONS

4.1 MAXIMUM HEAT INPUT INCREASE

The only logical impact to emissions resulting from the installation of the wet compression system is related to the increased heat input (rather than increases in hours of operation), which will be achieved at temperatures greater than 60 degrees F. The chart below represents a monthly table of average temperatures for Tampa, Florida based upon National Weather Service data. It additionally shows the correlating heat input (HHV), as well as the expected heat input during wet compression, both based upon the submitted data.

Month	Normal Daily Temperature	Hours in Month	HHV Heat Input Normal Temperature	HHV Heat input wet compression	Increased Heat Input	Heat Input Increase MMBtu[1]
January	59.9	744	1448	N/A	N/A	N/A
February	61.5	672	1444	1503	59	39648
March	66.6	744	1433	1518	85	63240
April	71.3	720	1422	1531	109	78480
May	77.4	744	1408	1537	129	95976
June	81.3	720	1400	1529	129	92880
July	82.4	744	1397	1527	130	96720
August	82.4	744	1397	1527	130	96720
September	80.9	720	1401	1530	129	92880
October	74.8	744	1414	1542	128	95232
November	67.5	720	1431	1521	90	64800
December	62.2	744	1443	1505	62	46128
ANNUAL			AVG = 1420			862,704

[1] Based upon continuous gas firing

4.2 MAXIMUM POTENTIAL TO EMIT (PTE)

In order to determine whether the increased annual heat input will trigger a PSD Review, the following emission factors were utilized. These are calculated based upon the original BACT determined Ton Per Year (TPY) emissions and an average (HHV) heat input of 1420 MMBtu/hour (from above). Additionally, an annual increase in heat input of 862,704 MMBtu was assumed (from above).

Pollutant	Emission Factor (lbs/MMBtu)	Increased Annual lbs	Increased TPY	PSD Significant Emission Rate	Review Required
PM_{10}	0.002	1725	0.9	15	No
SO_2	0.003	2588	1.3	40	No
NO_X	0.099	85408	42.7	40	Yes*
CO	0.023	19842	9.9	100	No

As shown in the above table, potential increases in emissions of regulated pollutants (other than NO_X) are well below the PSD thresholds; hence a PSD Review is not required of PM_{10}, SO_2 and CO. Of note, this facility recently underwent a PSD Review related to the installation of a new peaking unit, and that review established an annual emission limit of 115 TPY of NO_X for this Emission Unit, to be complied with via CEMS on a 12-month rolling average. Only as a means to embolden that requirement, and in order to further ensure that a PSD Review is not required, the Department will limit the annual hours allowed for wet compression on EU-006. This means that the annual increase in heat input cannot exceed 808,081 MMBtu (exactly 40 TPY based upon a 0.99 lb/MMBtu NO_X emission rate). In order to determine the necessary number of hours of operation to be reduced, the months of February and then December will be utilized as the baseline months. Since the increased hourly heat input increase during wet compression is the lowest during these months, this will ensure that the hours reduced are maximized. Applying this rationale eliminates all of the 672 February hours plus 242 hours during December. Since no wet compression use has been anticipated during the 744 hours of January, the annual maximum hours of use that can be permitted without triggering a PSD review is 8760 – (744+ 672 + 242) or 7072 hours annually.
Accordingly, the Department will limit the hours of use of wet compression on EU-006 to 7000 hours per 12-month rolling period.

5.0 CONCLUSION

Based on the foregoing technical evaluation of the application, additional information submitted by the applicant and other available information, the Department has made a preliminary determination that the proposed project will not trigger a PSD Review. This conclusion is consistent with prior Determinations made for the installation of foggers as well as wet compression. However, a similar review should be undertaken for combustion turbines representative of F classes and above.

Michael P. Halpin, P.E. Review Engineer
Department of Environmental Protection, Bureau of Air Regulation
2600 Blair Stone Road
Tallahassee, Florida
32399-2400

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1. Article Addressed to:

Benjamin M.H. Borsch, P.E.
Environmental Manager, Calpine
Auburndale Power Partners L.P.
Island Center
2701 N. Rocky Pt. Dr., Suite 1200
Tampa, FL 33607

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Memorandum

Florida Department of
Environmental Protection

3/18 OK to mail

TO: C.H. Fancy

THRU: Al Linero

FROM: M. P. Halpin

DATE: March 15, 2002

SUBJECT: Auburndale Power Partners L.P.

Attached for approval and signature is a construction permit for a minor modification at the Auburndale Cogeneration Facility, located in Auburndale, Polk County. The permit is to install one wet compression system on the Simple Cycle Unit at the existing facility. The wet compression system is similar to the application of foggers.

A Determination was made that the project is not subject to a PSD review or a BACT Determination. Modeling was not required, as the emission increases from this project are insignificant. Of note, based upon prior permitting actions, this unit has an annual NO_X emission cap of 115 TPY.

I recommend your approval and signature. Day 90 is May 10th.

Attachments

/mph