

**PINELLAS COUNTY RESOURCE RECOVERY FACILITY  
AIR POLLUTION CONTROL RETROFIT  
"UPDATE REPORT"**

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**ABSTRACT**

The Clean Air Act Amendments promulgated by the U.S. Environmental Protection Agency (EPA) in 1990 set new emission standards for Waste-To-Energy (WTE) plants throughout the United States. Many WTE facilities, such as the Pinellas County Resource Recovery Facility (PCRRF) in St. Petersburg, Florida, have been forced to make the decision to either cease operations or retrofit their facility to meet the new emission guidelines in the year 2000. This paper is intended to provide a general overview of the project approach, implementation, current progress and completion schedule in the retrofit for the PCRRF.

**INTRODUCTION**

The PCRRF, owned by Pinellas County, is located on the 750 acre Bridgeway Acres Class I/III landfill site in mid-County. The facility consists of three (3) combustion units (boilers) having a combined rated capacity to mass-burn 3,150 tons per day of municipal solid waste (MSW) with a heating value (HHV) between 3,800 and 5000 BTU/lb. Each boiler is rated to produce 261,400 pounds per hour of 615 psig, 750°F steam. This steam supply is directed to two (2) turbine-generators which can nominally generate a total of 75 megawatts of electricity. Energy and available capacity from these two generating units are contracted for sale to the local utility, after in-plant electrical loads have been served. Wheelabrator Pinellas, Inc. currently is contracted by Pinellas County for operations and maintenance of the facility.

The existing design of each boiler utilizes a balanced draft combustion air system with an electrostatic precipitator for control of particulate emissions. With the promulgation of the new emission guidelines by the USEPA under 40 CFR Part 60 Subpart C<sub>b</sub>, HDR Engineering, Inc. (HDR) was contracted by Pinellas County to evaluate the impacts for compliance of the existing facility with the new emission guidelines. The resulting recommendation was that the electrostatic precipitator on each boiler would require replacement with a new emission control train consisting of a Spray Dry Absorber (SDA) and a Fabric Filter (FF) for Hydrogen Chloride (HCL), Sulfur Dioxide (SO<sub>2</sub>) and particulate control. To achieve compliance with Nitrogen Oxide (NO<sub>x</sub>) emission limits, a Selective Non-Catalytic Reduction (SNCR) system was recommended for each combustion unit. A Powered Activated Carbon Injection System (PACIS) was also recommended for control of mercury, lead and VOC emissions. Figure 1 illustrates a schematic diagram of the process.

**PROJECT INITIATION**

Upon initiation of this project in 1994, HDR developed and evaluated various alternative conceptual plant arrangements, with consideration for emissions compliance, operations, maintenance, tie-in outage time, installed cost and schedule duration. The conceptual design allows for the sequential staging of APC equipment installation for each unit, integrated with the demolition of the each existing Precipitator. This design arrangement required the relocation of the existing Material Recovery System (MRS). The arrangement depicted in Figure 2 was the basis for the Power Plant Site Certification Modification application.

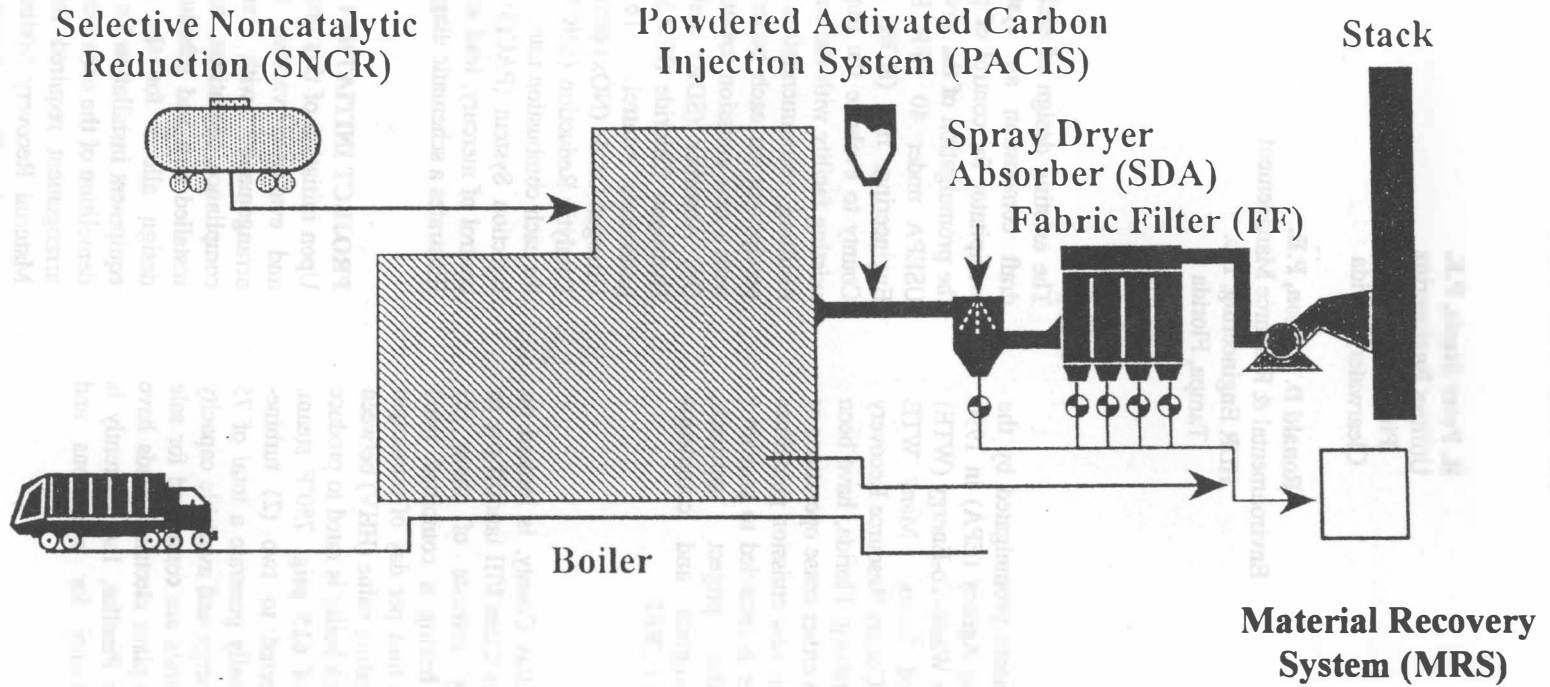


Figure 1 - APC SYSTEM SCHEMATIC

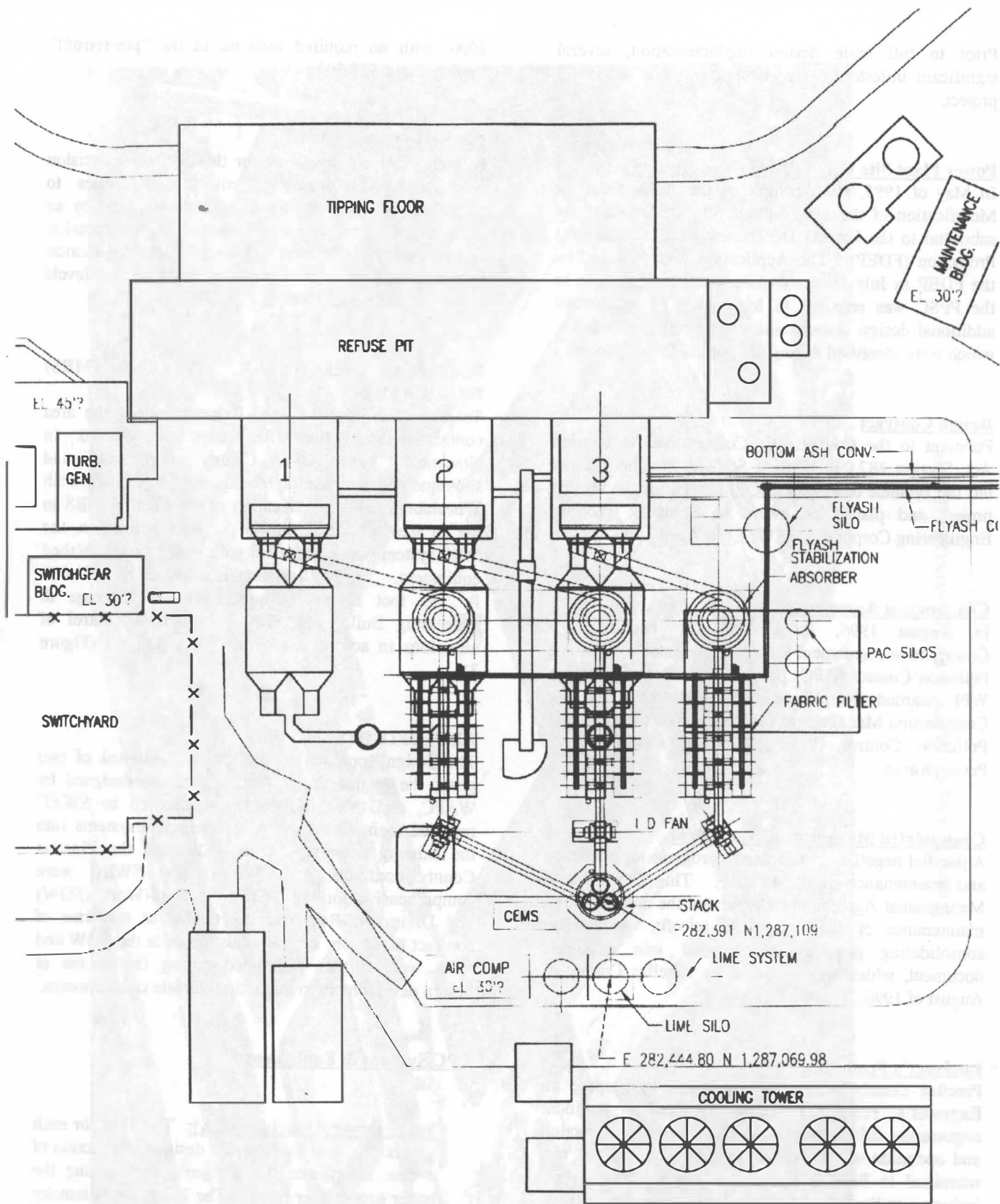


Figure 2 – APC EQUIPMENT INSTALLATION SEQUENCE

Prior to full scale design implementation, several significant milestones were necessary for a successful project.

#### **Power Plant Site Certification (Modification)**

In May of 1995, HDR completed the Application for Modification of the Power Plant Site Certification for submittal to the Florida Department of Environmental Protection (FDEP). The Application was approved by the FDEP in July 1996. A subsequent modification to the PPSC was required in May 1998 to incorporate additional design features and minor emission sources, which were identified during the project design process.

#### **Design Contract**

Pursuant to the Consultant's Competitive Negotiation Act, Section 287.055, Florida Statutes, Pinellas County bid the Balance of Project (BOP) design for the retrofit project and placed an award to Stone & Webster Engineering Corporation (SWEC) in April 1996.

#### **Construction Agreement**

In August 1996, Pinellas County negotiated a Construction Agreement with Wheelabrator for the Air Pollution Control (APC) portion of the retrofit project. WPI awarded the primary APC equipment and the Construction Management contract to Wheelabrator Air Pollution Control (WAPC), located in Pittsburgh, Pennsylvania.

#### **Consolidated Management Agreement**

A parallel negotiation was also in progress for operation and maintenance of the PCRRF. This Consolidated Management Agreement incorporated the operation and maintenance of the new APC retrofit, as well as consolidating previous amendments into a single document, which was approved by Pinellas County in August of 1996.

#### **Engineer's Feasibility Report**

Pinellas County contracted with HDR to prepare an Engineer's Feasibility Report containing pertinent engineering information on the feasibility, construction and operation of the retrofit project. This report was submitted to Pinellas County in August of 1996 for inclusion to the Official Statement to issue Series 1996 Bonds for project financing. The total debt service of \$83,250,000 for this project will be retired in the year of

2006, with no required increase in the "pre-retrofit" tipping fee of \$37.50/ton.

#### **Partnering**

Although not a prerequisite for this project, a decision was jointly entertained by all project parties to participate in a project Partnering session. Lead by an independent professional "facilitator", this session emphasized the "teamed approach" with interaction between key project team members from various levels within each organization.

#### **MATERIAL RECOVERY SYSTEM (MRS) RELOCATION**

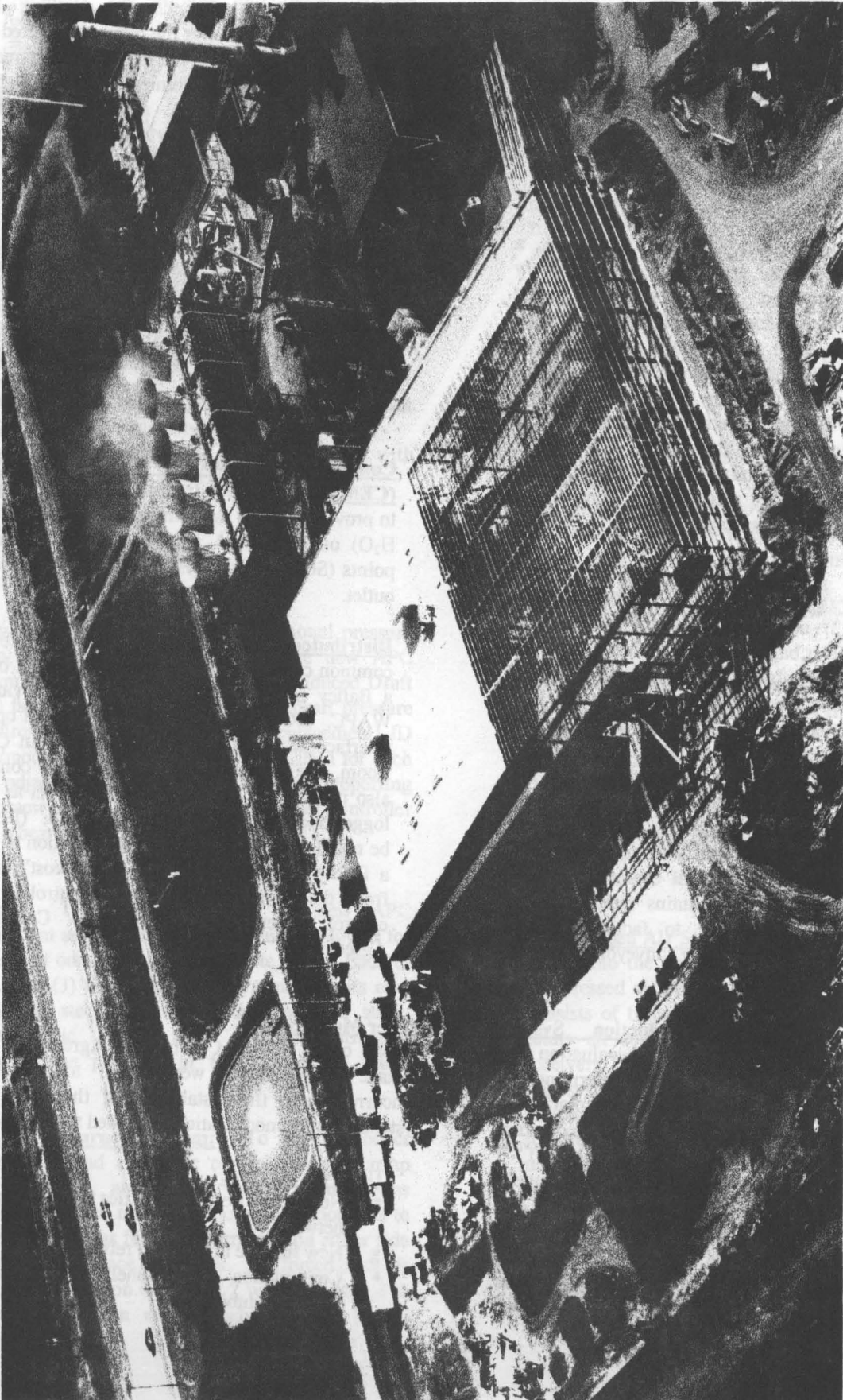
To make room for the APC Retrofit Project, the area containing the existing MRS needed to be vacated. In November 1995, the County negotiated and subsequently amended the Management Agreement with Wheelabrator for the relocation of the existing MRS to the an area north of Unit No. 3. At this location, the MRS system was re-installed with new and refurbished equipment. The MRS system is enclosed in a 70,000 ft.<sup>2</sup>, 55 foot high pre-engineered Ash Storage & Processing Building (ASPB) to maintain control of emissions in accordance with EPA guidelines (Figure 3).

#### **RETROFIT DESIGN**

The design approach to the project consisted of two parts; the "stand alone" APC systems as designed by WAPC, and those BOP systems designed by SWEC required to integrate the APC equipment/systems into the existing operating plant. Although the Pinellas County contracts with WAPC and SWEC were comprehensive for the known Scope-of-Work (SOW) and Division-of-Responsibility (DOR) at the time of contract execution, several adjustments in the SOW and DOR were further negotiated during the course of design development to maintain schedule commitments.

#### **APC Systems & Equipment**

**Spray Dryer Absorber (SDA):** The SDA for each unit is of a dual fluid nozzle design for injection of a lime slurry into the gas path after exiting the boiler economizer outlet. The height and diameter of each single SDA vessel allows for proper slurry injection, absorption and residence time to achieve



**Figure 3 - ASH STORAGE & PROCESSING BUILDING**



drying of the gas before exiting the SDA. Ash residue which settles out of the gas path within the SDA vessel is collected in a bottom hopper for combination with other ash collection streams (e.g. from other SDA vessels and Fabric Filters). A supplemental electric resistance contact heating system maintains temperature in the SDA collection hopper to facilitate proper discharge flow.

To provide a lime slurry supply to each SDA, a common lime slurry preparation and delivery system was provided. This system consists primarily of two redundant lime slakers which receive site collected waste water and/or tertiary water, and dry lime from a single storage silo for mixing to create a lime slurry mixture. The slurry is then passed through grit screens before entering a final slurry storage tank that each SDA uses as its slurry supply. Proper mixing of the storage tank slurry is achieved by recirculation pumping to maintain the lime in suspension.

**Fabric Filter (FF):** Each FF unit consists of a total of twelve (12) modules, containing an array of woven glass fiber bags. The gas path from the exit of the SDA is manifolded into the bottom of each of the FF modules, the gas exits each module in a plenum area above the top of the bag array, and the gas from all modules is manifolded together to a single discharge duct to an Induced Draft (ID) fan. Shake/deflate systems (deflation fans), common for each set of FF modules, is cycled to release collected particulates into the bottom collection hopper of each module. A supplemental electric resistance contact heating system maintains temperature in each FF collection hopper to facilitate proper discharge flow into a collecting conveyor system.

#### **Selective Non-Catalytic Reduction System**

**(SNCR):** A temperature profile and evaluation was conducted on one of the boilers to determine the optimum location for each set of nozzle platforms. This information was used to design and construct the SNCR system. A SNCR system (NO<sub>x</sub>OUT™) consists of three major elements; (1) a common circulation module to supply a heated reagent; (2) a metering module for each boiler; and (3) a distribution panels on two opposite sides of each boiler. A storage tank supplies urea to the circulation module, which provides a continuous

circulation of the heated reagent through heat traced piping to all three boiler metering modules. Each metering module supplies the required metered flow to the distribution panels for injection of the reagent into the boiler with atomizing air through 24 nozzles per boiler. A supplemental electric resistance contact heating system is provided on all supply and recirculation return lines to/from the common circulation module.

#### **Powdered Activated Carbon Injection System**

**(PACIS):** The PACIS system pneumatically conveys activated carbon from a storage silo into the inlet gas stream of the SDA. This system is equipped with its own air blowers feeder/eductors for this purpose.

#### **Continuous Emissions Monitoring System**

**(CEMS):** One (1) extractive CEMS was supplied to provide four (4) sampling points (SO<sub>2</sub>, CO, O<sub>2</sub> & H<sub>2</sub>O) on each SDA inlet and five (5) sampling points (SO<sub>2</sub>, O<sub>2</sub>, NO<sub>x</sub>, H<sub>2</sub>O & Opacity) at each FF outlet.

#### **Distributed Control System (DCS):**

To provide a common control of the APC systems for all boilers, a Bailey Infi 90™ DCS system was provided by WAPC. DCS control consoles for normal operator interface are located in the existing Main Control Room, one for each unit. A fourth DCS console is also installed in the Main Control Room as a data logger operator interface for the CEMS. (It should be noted that the WAPC recommendation to utilize a DCS system approach was a “no cost” upgrade from the Programmable Logic Controller (PLC) control system specified in the Construction Agreement.)

#### **Boiler Modifications**

As part of the Retrofit Construction Agreement, several furnace modifications were made to the boilers, concurrent with the installation of the APC retrofit systems. Major modifications included the following:

##### **Unit Nos. 1 and 2:**

- New overfire air nozzles and distribution network
- New furnace arches and refractory
- Continuation of Inconel 625 overlay on waterwall tubing

- Auxiliary gas burners and burner control system
- Balancing of underfire and overfire air systems

**Unit No. 3:**

- Continuation of inconel 625 overlay on waterwall tubing
- Auxiliary gas burners and burner control system

Under a separate negotiation through the Management Agreement, the County opted for modifications to the ram ash expellers and the riddlings systems, two of the major causes for forced outages over the past few years. The modifications included the following:

- Replacement of the ram ash expellers on all three units with a larger capacity model
- Replacement of the dry type riddlings systems with a submerged type wet application

**BOP Systems & Equipment**

**Induced Draft Fan:** With the additional pressure drop of the draft system through the new APC equipment train, the existing 500 hp Induced Draft (ID) fans could not support the total draft pressure requirements. Therefore, a new (replacement) ID Fan/motor, rated at 1000 hp, was installed for each unit adjacent to the new common stack. Supporting each new ID fan was a new inlet damper controller and a bearing lube oil cooling system.

**Stack:** The arrangement of the new APC equipment serving all three boiler units allowed for the use of one (1) 165 foot concrete stack. Each of the three (3) boiler unit draft systems has its own dedicated steel flue within the common stack. Photoelectric strobe type aircraft obstruction lighting was provided at the top of the stack.

**Auxiliary Burner System:** To provide better combustion and emissions control during startup and shutdown, an auxiliary burner system was installed on each unit. Each boiler was modified to accept two (2) gas fueled burners, one on either side of the boiler furnace tube walls. The forced draft air system ductwork on Units 1 & 2 will be modified to supply combustion air to each auxiliary burner

location. A supplemental air fan was installed with each of the two (2) auxiliary burners on Unit #3 to satisfy combustion air requirements. A new underground natural gas line was installed by the local gas utility.

**Ash Handling and Treatment System:** A new ash conveying system was installed to direct fly ash to a treatment system before combining with the bottom ash disposal stream to the MRS. Each APC train is provided with its own ash collection and conveying system, which discharge into a common transfer conveyor for transport to a common WES-Phix™ ash treatment system in the Fly Ash Conditioning Building.

As a result of planned boiler modifications, a separate common ash collection and conveying system has also been provided for the superheater and economizer ash hoppers. This ash stream enters the fly ash conveying stream from the SDA/FF just prior to entering the Fly Ash Conditioning Building for treatment.

During the transition between the final “tie-in” of APC systems for Phases I, II and III of the project, the existing ash conveying system from Precipitator bottom hoppers is being temporarily relocated and reconfigured to accommodate each. As part of this temporary conveyor rearrangement, the existing WES-Phix™ ash treatment system is also being relocated.

**Compressed Air System:** For injection of the lime slurry into the gas path in each SDA, a common compressed air system was provided. This system consists of three (3) fifty percent capacity 800 hp rotary air compressors and two (2) redundant air receivers. A portion of the air supply provided by this system passes through an air dryer to serve various other miscellaneous instrument requirements for the APC system, thereby placing no additional demands on the existing plant air supply system.

**Waste Water Collection System:** During design development of the project, the method for handling and management of site generated storm/waste

water was re-evaluated. To optimize the collection and disposal of waste water collected in plant open floor drain systems, a large Contact Water Sump was installed with adequate volume to allow for ash settlement and water capacity. A pair of sump pumps provide for nominal expected discharge pumping rates, and a second pair of larger sump pumps provide backup capacity to handle rainfall events and discharges from scheduled boiler water wash operations. Water from the Contact Water Sump is pumped to a 250,000 gallon Contact Water Storage Tank, which is then recycled as a normal makeup water supply to the SDA lime slurry system and the boiler ash dischargers.

**Electrical Distribution System:** With the increase in size of the three (3) ID Fans from 500 hp to 1000 hp, the addition of three (3) new 800 hp Air Compressors and other miscellaneous APC and BOP loads, the existing capacity of the plant electrical auxiliary system was deemed inadequate. To provide for the approximate 25 percent increase in auxiliary system capacity, one 4160 volt transformer was replaced with a larger unit and a new 480 V transformer was added. This increase in electrical auxiliary system capacity is not unusual for such APC retrofit projects.

**DCS Controls System Extension:** In a similar manner to the APC control system upgrade, controls for BOP systems, such as ash handling, were integrated as an "add on" extension to the APC DCS system. Strategically located remote I/O cabinets were included to "close couple" BOP electrical load control requirements. As the existing plant is of a conventional pneumatic control design, only those systems affected by the retrofit project have been presently included in the DCS control scheme for economical reasons.

## **CONSTRUCTION**

The overall sequence of construction is divided into four (4) phases, which began in July 1997 and is scheduled for completion in November 2000. This approach permits the continuous operation of the existing facility, with a minimal outage period for "tie-in" of each new APC system. At its peak, 150 craft personnel were involved in construction on any day. A safety incentive program, which was implemented in conjunction with Pinellas County's "wrap-up" insurance covering the

majority of the contractors, has resulted in exemplary results for safety performance.

### **Phase I**

Following the relocation of the MRS system, demolition of the retired MRS equipment foundations were required to begin new construction. This first phase of the project included the construction of the new APC system for boiler No. 3 and common support systems. The new SDA and FF for Unit No. 3 were constructed along the north side of the existing Unit No. 3 Precipitator.

Immediately to the north of this APC train, the MCC/Compressor Building, Lime Preparation Building, PACIS Storage Silo and Contact Water Storage Tank were constructed concurrently with the Unit No. 3 APC systems. Also during this period, other systems, such as the SNCR and Fly Ash Conditioning Building, were constructed in other areas of the plant.

Construction was completed for tie-in by mid-August, 1998. During the six (6) week outage of the Unit No. 3 boiler, new Ram Ash Expellers, Riddlings Collection/Transfer Conveyors and Auxiliary Gas Burners were installed. Unit No. 3 resumed operation with the retrofitted APC system on September 24, 1998.

### **Phase II**

Immediately after the tie-in and test of the new APC systems, demolition began on the Unit No. 3 Precipitator and Stack. When Unit No. 3 resumed operation, the Unit No. 3 Precipitator, its foundations, and the Unit No. 3 Stack had been removed. Figure 4 depicts the project condition at this time.

The APC systems for Unit No. 2 are currently being constructed directly over the existing footprint of the removed Unit No. 3 Precipitator. The schedule for beginning the outage on Unit No. 2 is in mid-June 1999. Due to an opportunity to install the new Ram Ash Expellers and Riddlings Collection/Transfer Conveyors during a scheduled outage on Unit No. 2 in November/December 1998, the tie-in outage for the APC system is expected to be reduced to 4-5 weeks.

### **Phase III**

The planned demolition of Unit No. 2 Precipitator and construction of the new Unit No. 1 APC System will follow the construction activities of Phase II. Likewise,



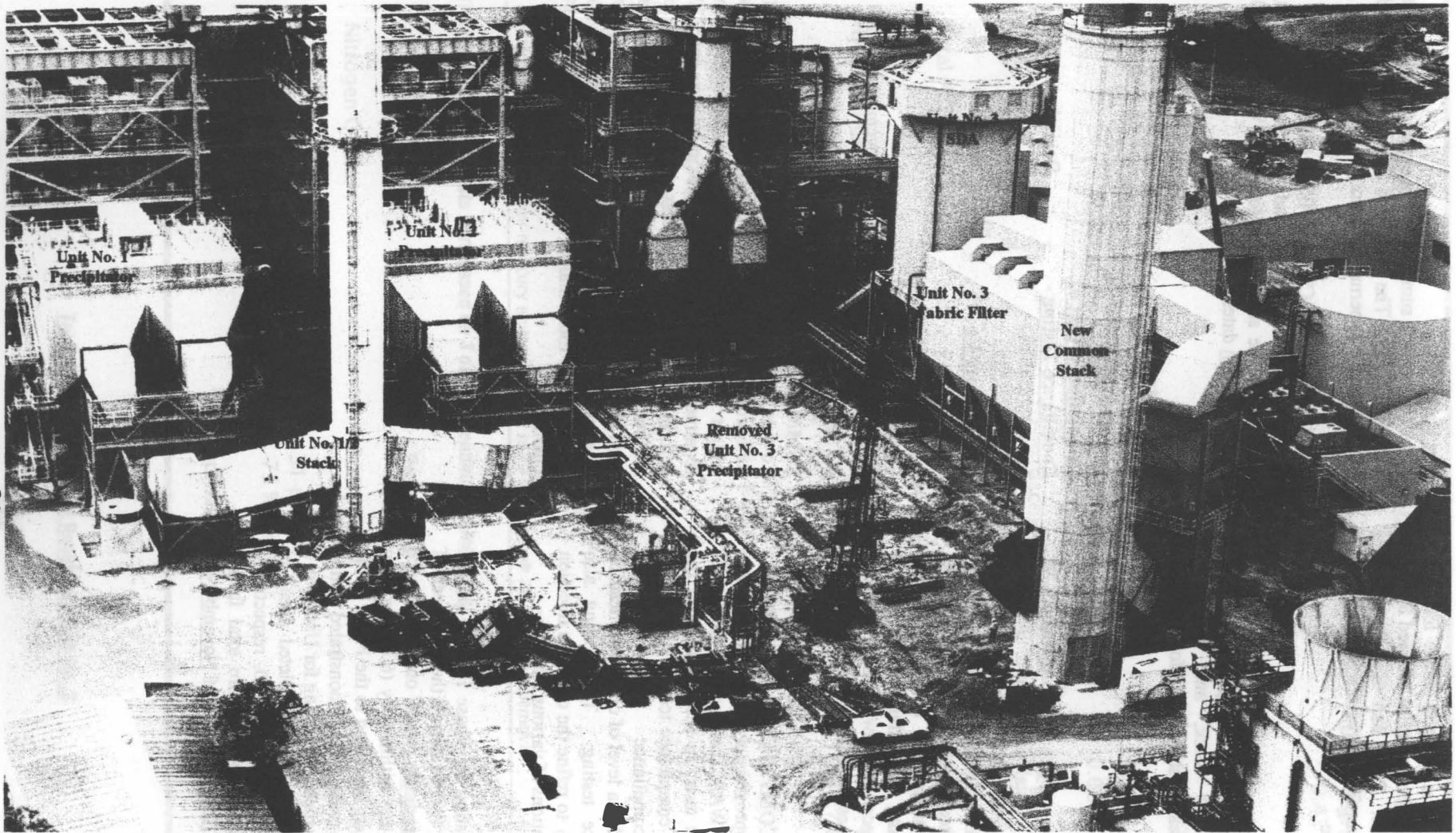


Figure 4 - PINELLAS COUNTY APC RETROFIT PROJECT (September 22, 1998)

opportunistic scheduling of a planned outage for Unit No. 1 boiler at the end of February 1999, allowed for the installation of the new Ram Ash Expellers and Riddlings Collection/Transfer Conveyors eleven (11) months ahead of schedule.

#### Phase IV

Demolition of the Unit No. 1 Precipitator and the common Unit 1 and 2 Stack, and final site paving/landscaping, which constitute the efforts to close out the project.

#### **PROJECT COST**

The overall cost for the project is approximately 91 million dollars. Of this total expenditure, 9 million dollars was required for relocation of the MRS system, including installation of the ASPB. Seventy-six (76) million dollars is budgeted for the new APC and BOP systems, including lower furnace modifications and construction management. The balance of the project cost covers engineering services, new gas utility service, loss-of-generation revenues, permitting and insurance.

#### **ENVIRONMENTAL COMPLIANCE TESTING**

In late October 1998, approximately one (1) month after start-up of Unit No. 3, WAPC conducted a full set of "preliminary" emissions tests, in accordance with the protocol established for compliance testing. These test results confirmed compliance with regulatory requirements and provided a level of confidence leading into formal compliance testing. This testing also provided the opportunity to refine the optimum injection quantities and concentrations of various reagents.

Formal Compliance Testing for Phase I of the project was completed in four (4) days during the first week of December 1998. The final report on Compliance Testing of Unit No. 3, due within sixty (60) days from completion of testing, was submitted to the FDEP at the end of January 1999. Based on the demonstrated testing period for Unit No. 3, compliance testing for Units No. 2 and No. 1 are anticipated to be completed ahead of schedule; September 1999 and July 2000, respectively. This schedule should comfortably insure total facility compliance by the regulatory deadline of November 16, 2000.

#### Test Results

Table 1 provides a summary of the emissions test results for Unit No. 3. The retrofitted facility demonstrated full compliance to permit conditions.

#### **CURRENT PROJECT STATUS & COMPLETION**

As a final summary of outstanding project milestones, following is the schedule of remaining activities with their late finish dates:

Unit #2 Start-Up - July 1999

Completion of Unit #2  
Compliance Testing - December 1999

Unit #1 Start-Up - May 2000

Completion of Unit #1  
Compliance Testing - November 16, 2000

#### **SUMMARY**

To-date, the APC retrofit of the Pinellas County Resource Recovery Facility is on schedule, within budget and has met all regulatory emissions requirements. The project is approximately seventy (70) percent complete. The success of this project can be attributed to many factors, but the one key element has been proper planning and foresight by the Project Team. The team's dedication and positive attitude will serve as model for all those that have chosen to "meet the APC challenge".

<u>Pollutant</u>	<u>Permit Limit</u>	<u>Test Result</u>
Particulate	0.012 gr/dscf @ 7% O <sub>2</sub> 14.4 lb/hour	0.0006 gr/dscf @ 7% O <sub>2</sub> 0.47 lb/hour
Opacity (Visual Emissions)	10%	0%
Cadmium	40 ug/dscm 0.021 lb/hr	0.748 ug/dscm 0.00028 lb/hour
Lead	490 ug/dscm 0.257 lb/hr	3.53 ug/dscm 0.000135 lb/hour
Mercury	70 ug/dscm @ 7% O <sub>2</sub> or 85 % removal	53.2 ug/dscm @ 7% O <sub>2</sub> 70.3% removal <sup>1</sup>
Total PCDDs/PCDFs	30 ng/dscm @ 7% O <sub>2</sub> .000016 lb/hr	16.4 ng/dscm @ 7% O <sub>2</sub> 0.00000625 lb/hour
Hydrogen Chloride	31 ppmdv or 95 % removal	24.9 ppmdv 96.7% removal
Ash Handling System Fugitive Emissions	Less than 5% of Obsv. time	0%
FA Cond. Bldg. Wet Scrubber Visual Emissions	5%	0%
MRS Wet Scrubber Visual Emissions	5%	0%

Note 1 Shaded area for mercury emissions limit is 70 ug/dscm @ 7% O<sub>2</sub> or 80 % removal

*(The following test results were based on 3 days of continuous emissions)*

<u>Pollutant</u>	<u>Permit Limit</u>	<u>Average Test Result</u>
Nitrogen Oxides	205 ppmdv	171.55 ppmdv
Sulfur Dioxide	31 ppmdv or 75 % removal	3.4 ppmdv 97.73% removal
Carbon Monoxide	100 ppmdv @ 7% O <sub>2</sub>	32.7 ppmdv @ 7% O <sub>2</sub>

**Table 1 - Emissions Test Results for Unit No. 3**