

**TECHNICAL EVALUATION
AND
PRELIMINARY DETERMINATION**

Orlando Utilities Commission
Curtis H. Stanton Energy Center Units 1 & 2

Forced Oxidation Project

Orange County

DEP File No. 0950137-014-AC



Florida Department of Environmental Protection
Division of Air Resource Management
Bureau of Air Regulation
Permitting South

September 11, 2007

1. GENERAL FACILITY DESCRIPTION

Facility Description and Location

The OUC Curtis H. Stanton Energy Center is located in Orange County, Southeast of Orlando and North of Highway 528 at 5100 South Alafaya Trail. The site is located 144 km southeast from the Chassahowitzka National Wildlife Area; the nearest Federal Prevention of Significant Deterioration (PSD) Class I Area. The UTM coordinates for this site are 483.6 km East and 3151.1 North. The location of the OUC Stanton Energy Center is shown in Figure 1.



Figure 1. OUC Curtis H. Stanton Energy Center Location and Stanton Units 1 and 2.

The OUC Stanton Energy Center presently consists of two fossil fuel-fired steam electrical generating units and a combined cycle unit. Fossil fuel-fired steam electric generating Units 1 and 2 (468 megawatts-MW each) began operation in 1987 and 1996 while Combined Cycle Unit A (640 MW) began operation in 2003. A PSD permit was recently issued for the construction of a nominal 285 MW integrated gasification combined cycle unit (Unit B) planned to be operational by 2012.

Table 1. OUC Curtis H. Stanton Energy Center SIC Codes

STANDARD INDUSTRIAL CLASSIFICATION CODES (SIC)		
Industry Group No.	49	Electric, Gas, and Sanitary Services
Industry No.	4911	Electric Services

Key Regulatory Categories

The key regulatory provisions applicable to Stanton Units 1 and 2 are:

Title I, Part C, Clean Air Act (CAA): The facility is located in an area that is designated as “attainment”, “maintenance”, or “unclassifiable” for each pollutant subject to a National Ambient Air Quality Standard. It is classified as a “fossil fuel-fired steam electric plant of more than 250 million BTU per hour of heat input”, which is one of the 28 Prevention of Significant Deterioration (PSD) Major Facility Categories with the lower PSD applicability threshold of 100 tons per year. Potential emissions of at least one regulated pollutant exceed 100 tons per year, therefore the facility is classified as a “major stationary source” of air pollution with respect to Rule 62-212.400 F.A.C., Prevention of Significant Deterioration of Air Quality.

Title I, Section 111, CAA: Units 1 and 2 are subject to Subpart Da (Standards of Performance for Electric Utility Steam Generating Units for Which Construction is Commenced After September 18, 1978) of the New Source Performance Standards in 40 CFR 60.

Title I, Section 112, CAA: The facility is a “Major Source” of hazardous air pollutants (HAP).

Title IV, CAA: The facility operates units subject to the Acid Rain provisions of the Clean Air Act.

Title V, CAA: The facility is a Title V or “Major Source of Air Pollution” in accordance with Chapter 62-213, F.A.C. because the potential emissions of at least one regulated pollutant exceed 100 tons per year (TPY). Regulated pollutants include pollutants such as carbon monoxide (CO), nitrogen oxides (NO_x), particulate matter (PM/PM₁₀), sulfur dioxide (SO₂), and volatile organic compounds (VOC).

CAIR: The facility is subject to the Clean Air Interstate Rule (CAIR) set forth in Rule 62-296.470, Florida Administrative Code (FAC).

CAMR: The facility is subject to the Clean Air Mercury Rule (CAMR) set forth in Rule 62-296.480, F.A.C.

Siting: The facility was originally certified pursuant to the power plant siting provisions of Chapter 62-17, F.A.C.

Application Processing Schedule

- 02/05/07: Received application to construct, install or improve low NO_x burners (LNBs), overfire air (OFA), forced oxidation, ash loadout system and scrubber on Units 1 and 2.
- 03/07/07: Application determined incomplete. Sent request for additional information (RAI).
- 08/09/07: Received partial responses to RAI.
- 09/04/07: Received additional responses to RAI including Best Available Control Technology (BACT) proposal for carbon monoxide (CO), revised application pages, air dispersion modeling, etc.
- 09/06/07 Separated out requests into three different projects including the present on for the forced oxidation systems.
- 09/07/07 Received additional information for forced oxidation project. Determined it is complete.
- 09/11/07 Distributed public notice package including the draft PSD permit for the forced oxidation project.

Wet Flue Gas Desulfurization (WFGD) Limestone Scrubbing for SO₂ Control

Stanton Units 1 and 2 utilize WFGD limestone-based scrubbers to control SO₂ emissions. The figure on the following page is a simplified flow diagram of a design from the early 1990s that reasonably represents the scrubbing principles used at OUC Stanton Units 1 and 2. Each unit's scrubber system includes three (3) 50 percent (%) capacity absorber modules, with two normally in operation and the other designated as a spare. Authority to inject dibasic acid (DBA) was given under a recently issued permit.

Limestone is ground and mixed with water in a reagent preparation area. The resultant slurry is pumped to the absorber and sprayed into the flue-gas stream. The slurry droplets absorb SO₂ from the flue gas and fall to the base of the absorber, where they are collected in a reaction tank.

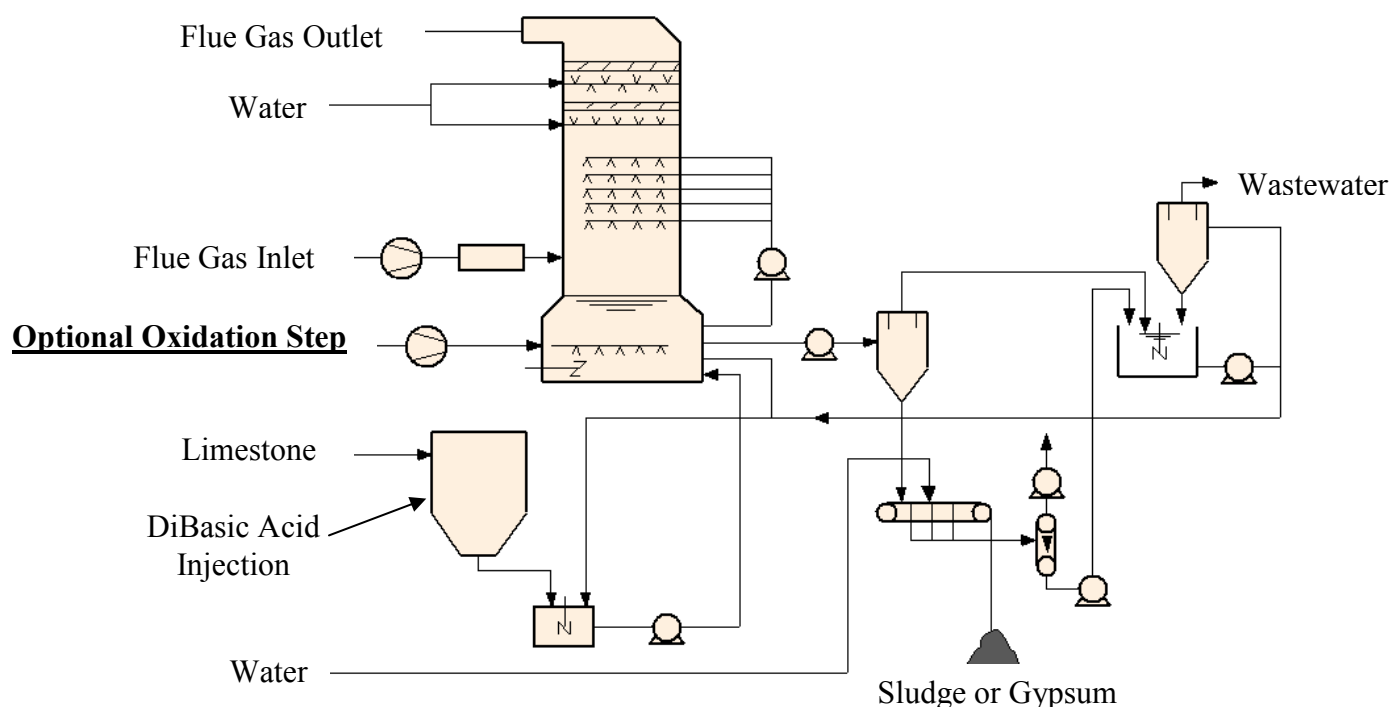
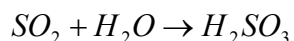


Figure 2. Flow Diagram of a WFGD Limestone Scrubber System (Soud and Takeshita, 1994).

The reactions in the absorber and tank can be represented by the following simplified description:

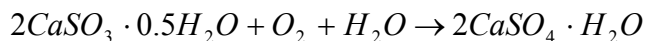
Equation 1. Sulfur dioxide and water react to form sulfurous acid.



Equation 2. Sulfurous acid reacts with limestone to form calcium sulfite ($CaSO_3 \cdot \frac{1}{2}H_2O$), carbon dioxide (CO₂) and water (H₂O).



Equation 3. Most $CaSO_3 \cdot 0.5H_2O$ is further oxidized to form gypsum ($CaSO_4 \cdot 2H_2O$).



Measures to enhance and drive the reaction in equation 3 towards completeness are not practiced at OUC Stanton and salable quality gypsum is not produced. Instead, fly ash removed by the electrostatic precipitators (ESPs) prior to scrubbing is blended with scrubber sulfite/sulfate sludge and hydrated lime to solidify the material. It is then deposited in special retention areas on site, and covered with soil and vegetation.

2. PROJECT DESCRIPTION

The following descriptions are based on information provided by Black and Veatch (BV) for OUC and from Babcock & Wilcox Publication BR 1645 on forced oxidation options.

Description of Forced Oxidation for WFGD Limestone based Scrubbers

Both systems currently are operating in a *natural oxidation* mode, where approximately 75 % of the scrubber reaction products are calcium sulfate ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ also called gypsum) and the remainder is calcium sulfite ($\text{CaSO}_3 \cdot 0.5\text{H}_2\text{O}$). In state-of-the-art WFGD systems, gypsum scale is effectively controlled through the use of *forced oxidation* of the sulfite compounds to sulfate. See the optional oxidation step where forced air injection can be practiced in the above diagram.

The higher oxidation rates, usually in excess of 95 %, in combination with recycle tank suspended solids concentrations of 12-15 %, provide for controlled precipitation of the gypsum crystals. This greatly reduces scaling by forcing gypsum crystals to grow upon themselves and not form on absorber internal components. In this manner, the scaling and deposit growth on the WFGD internals can be significantly reduced resulting in greater reliability of the absorber modules and lower maintenance costs.

In the forced oxidation mode, air molecules are injected into the absorber slurry in the reaction tank. The air molecules are absorbed in the scrubbing liquor, and provide ample driving force to convert nearly all liquid phase sulfite to sulfate. Gypsum super saturation is controlled by ensuring adequate gypsum seed crystals are present in the absorber liquor.

The method chosen for the introduction of oxidation air has an influence on plant costs and system operating requirements. Air sparge grids and air lances with mechanical agitators are two different generally applied methods of introducing oxidation air into the process. The sparge grid is a multiple air header arrangement with near even spacing of bubble stations across the vessel plan area. The lance system consists of air pipes directed to a definite region in the liquid jet created by side entry mixers. Following are diagrams from Babcock & Wilcox of the two options that would be placed within the vessel indicated in Figure 2.

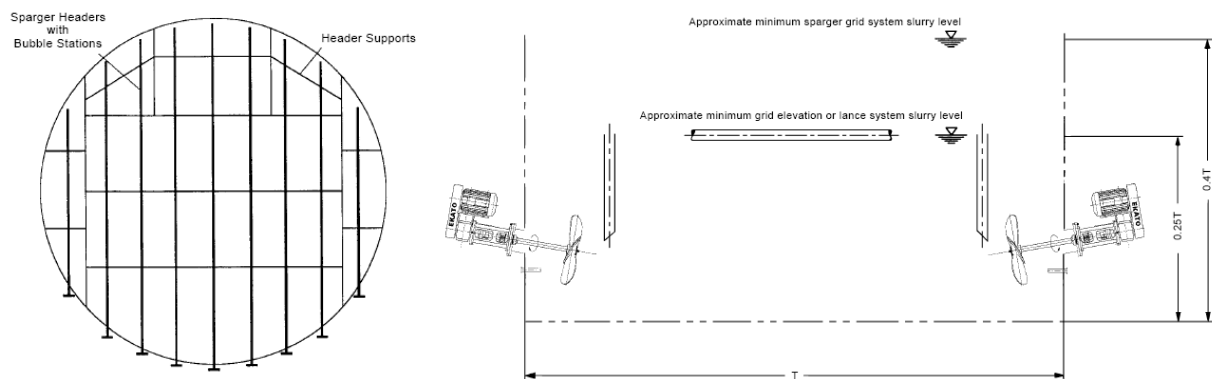


Figure 3. Top View Sparger Grid Plan. Agitator/Lance Assembly and Practical Decision Criteria.

The performance of the lance system is influenced by the energy of the fluid jet (mixer power) and the submergence depth (compressor power). The performance of the sparge grid is less dependent on the mixer power and is, to a much greater degree, influenced by submergence depth.

Description of Forced Oxidation Project at Stanton Units 1 and 2

It has been determined that the Stanton Unit 1 and Unit 2 existing absorber systems would support the addition of forced oxidation. There is adequate depth in the recycle tanks to inject air in the manner shown in the above diagrams at the proper depth (~ 22 feet below liquid level) without affecting recycle pump performance. Air injection will be accomplished by installing a fixed grid sparging system in each recycle tank.

The following information is based on preliminary design of the forced oxidation systems. The oxidation air system will consist of centrifugal air blowers with air piped to each reaction tank and distributed inside the tanks with air spargers. Each unit will have a dedicated 100 % capacity oxidation air blower. The units will share a spare 100 % capacity blower. The oxidation air will be saturated with service water. The forced oxidation system will consist of the following:

- Three 100 % capacity centrifugal air blowers;
- Air piping and valves;
- Reaction tank air spargers;
- Saturation water piping;
- Foundations;
- Blower building;
- Electrical components; and
- Controls

None of the above equipment is a source of air emissions. The purpose of the forced oxidation systems is to improve scrubber reliability and reduce scrubber module maintenance. Note that each existing scrubber system includes a spare module that is used when scrubber module maintenance is required.

The use of a forced oxidation system will result in increased formation of $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ and less formation of $\text{CaSO}_3 \cdot 0.5\text{H}_2\text{O}$ as a scrubber byproduct.

It is estimated that in the existing natural oxidation WFGD systems approximately 75 % of the SO_2 reaction product is $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$, while in a forced oxidation system approximately 98 % of the SO_2 reaction product is expected to be $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$, with the remainder in both cases being $\text{CaSO}_3 \cdot 0.5\text{H}_2\text{O}$.

With a constant coal sulfur content, due to the higher molecular weight of the $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ byproduct, one could expect approximately a 7.4 % increase in the quantity of scrubber byproduct produced on a dry solids basis. However, because calcium sulfate is easier to dewater, the use of a forced oxidation system allows for production of a higher percent solids scrubber

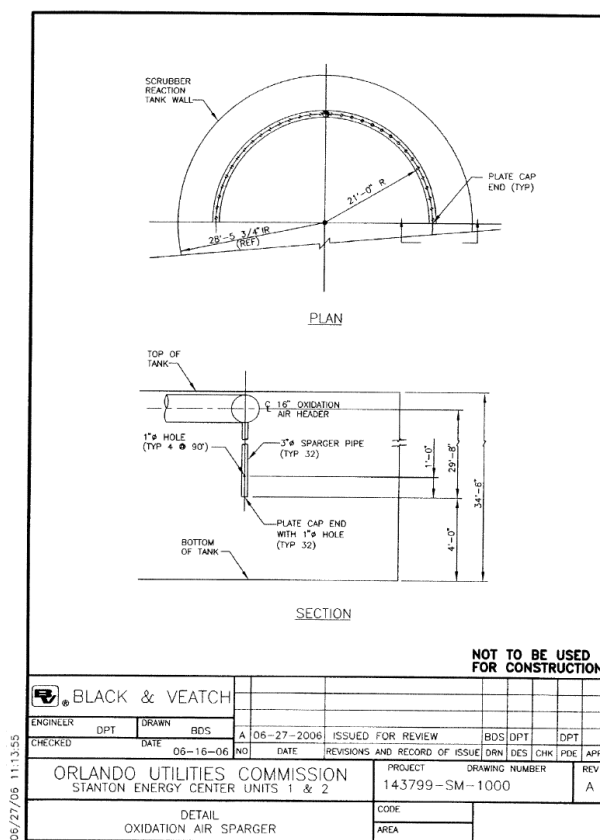


Figure 4. Details of Planned Air Spargers

byproduct. Therefore, with the same fuel sulfur content, there is expected to be no increase in total scrubber byproduct production and therefore no change in any fugitive emissions associated with byproduct materials handled.

3.0 CONCLUSION

Because there are no expected increases of any regulated pollutant, the project is not a modification as described in 62-210.200 (Definitions), F.A.C. and therefore not subject to PSD review. However, a permit is still required in accordance with paragraph 62-210.300 that states:

*“Unless exempted from permitting pursuant to paragraph 62-210.300(3)(a) or (b), F.A.C., or Rule 62-4.040, F.A.C., or unless specifically authorized by provision of Rule 62-210.300(4), F.A.C., or Rule 62-213.300, F.A.C., the owner or operator of any facility or emissions unit which emits or can reasonably be expected to emit any air pollutant shall obtain an appropriate permit from the Department prior to beginning construction, reconstruction pursuant to 40 CFR 60.15 or 63.2, modification, **or the addition of pollution control equipment**; etc.”*

The Department will issue a permit authorizing the installation of the forced oxidation systems on Stanton Units 1 and 2. The Department’s determination is strictly limited to this specific case and should not be used as a precedent for other cases, or lead to unintended consequences construed from the language contained in this determination. Ultimately, it is the Department that interprets its own regulations and opinions.