Golder Associates Inc.

6241 NW 23rd Street, Suite 500
Gainesville, FL 32653-1500
Telephone (352) 336-5600
Fax (352) 336-6603

Golder Associates

November 3, 2004

043-7639

Florida Power & Light Company
Environmental Services Department
700 Universe Blvd.
Juno Beach, Florida 33408

Attention: Mr. Harris M. Rosen, Esq., Senior Attorney

RE: Blythe Energy Project
Evaluation of Plume Interaction and Flight landings

Dear Harris:

At your request, Golder Associates performed an evaluation to determine the potential interaction of the plume from the Blythe Energy Project with aircraft landings at the Blythe Airport. The Blythe plant consists of a 2-on-1 combined cycle facility using Siemens-Westinghouse "F" Class combustion turbines with associated heat recovery steam generators (HRSGs). The facility is located about 1 mile west of the Blythe Airport. During the operation of the facility, aircraft pilots operating out of the Blythe Airport have commented on turbulence allegedly created by the mechanical draft cooling tower. The evaluation of plume interaction and aircraft landings will focus on four aspects of potential plume interactions. First, an evaluation was conducted to determine the potential for the cooling tower and HRSG plumes to intersect aircraft making an approach to the Blythe Airport. Second, the frequency for potential plume intersection with aircraft approaches was determined. Third, an evaluation of the forces on small aircraft was made for both a plume intersecting a landing aircraft and under normal atmospheric conditions. Finally, an evaluation was conducted of potential mitigation measures.

PLUME INTERACTION

Introduction--Aircraft approaching Blythe airport runway 26 have the potential of crossing the plumes of either the HRSG or cooling tower stacks during a standard 3 degree glide path approach. At the standard glide approach, aircraft would be from about 300 to 500 feet above the ground surface near the Blythe Energy Project. The relative locations of the HRSG and cooling tower stacks with respect to the east end of runway 26 are shown in Table 1. The closest HRSG and cooling tower stack are located approximately 5,937, and 5,663 feet from the end of runway 26, respectively.

The terrain in the area surrounding the Blythe Airport consists of mountains to the west and northwest with flat to rolling terrain to the east. The elevation of Runway 26 is 393.5 feet. The elevation of the Blythe Energy Project is 328 feet. The change in elevation from the Blythe Energy Project to the airport is 65 feet. The city of Blythe is located approximately 5.5 miles east of the airport.

Plume Analysis Methodology--A plume analysis was performed to investigate the potential for the plume to intersect aircraft approaches generated from rising plumes from the Blythe Energy Project's HRSG and cooling tower stacks. Characteristics of each plume were calculated under varying weather conditions and compared to a standard 3 degree approach to Runway 26. Aircraft would generally land on Runway 26 when the wind direction is from the west. The plume path for both the HRSG and cooling tower was determined for three wind speeds and three atmospheric stabilities. The four wind speeds evaluated were 1-, 2-, 4-, and 8- meters/second (m/s) and the three atmospheric stabilities were unstable (A/B), slightly unstable (C) and neutral (D). The runway and Blythe Energy Project elevation difference were taken into account in these analyses. The plume calculations were conducted using the plume rise and stability algorithms incorporated into the EPA approved Industrial Source Complex Short-Term, Version 3 (ISCST3)

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dispersion model. This is the same dispersion model used to determine the air quality impacts of the facility as approved by the State of California. The HRSG and cooling tower stack parameters used in these analyses are listed in Table 2. The information on Table 2 indicates that the flow rate of the HRSG stacks are about 650,000 cubic feet per minute (cfm) while the flow rate of each cooling tower cell is 1.3 million cfm. It should be noted that other features or equipment located at the Blythe Energy Project site (e.g., other mechanical equipment and ponds) would have an insignificant influence compared to the HRSG exhausts and cooling tower cells.

The building structures that have the potential to create downwash of the stack plumes are the HRSG and the cooling tower structures. The dimensions of these structures are 52 x 137 feet and 46 x 521 feet, for the HRSG and cooling tower, respectively. Downwash occurs as a result from wind moving over buildings and structures causing wake vortices. When a stack is in the influence zone of a buildings downwash, the result is lower plume rise. Because the intersection of the plane path with either the HRSG or the cooling tower stack plumes is estimated to only occur at low wind speeds, downwash effects are considered insignificant and not included in the analysis. Regardless of the wind speed, analyses without downwash will produce a higher plume height and a lower intersection altitude and would therefore be considered a conservative estimate.

Plume Analysis Results--Figures 1 though 12 present the plume height, potential airplane height, ambient temperature and plume temperature, as a function of downwind distance for the various meteorological conditions evaluated. Figures 1 through 6 present the results of the HRSG plume and Figures 7 through 12 present the results for the cooling tower plume. The results indicate that intersection of the plane with either of the HRSG or cooling tower plumes would primarily occur at low wind speeds, 1 and 2 m/s and unstable atmospheric conditions. At the point of intersection the plume temperature is nearly equivalent to ambient conditions, thus the upward velocities are result of the momentum of the plume rather than thermal buoyancy. At low wind speeds, the analysis indicates that a plane has the potential to intersect the HRSG or cooling tower plumes at an altitude of approximately 400 feet. Interaction of the plume and a landing airplane at higher altitudes is possible under lower wind speed conditions. At the point of potential intersection of a plume and landing aircraft, the plume's temperature is almost ambient and upward velocity is estimated to be 5 and 7 feet per second for the cooling tower and HRSG plumes, respectively.

The dimensions of the HRSG and cooling tower cell plumes at an altitude that would potentially intersect an aircraft landing at the Blythe Airport would range from 28 to 72 meters in diameter. At these dimensions, the travel time through a plume by an intersecting aircraft would range from 1 to 2 seconds based on an air speed of 70 miles/hour. The cooling tower has eight cells that could combine in an elongated plume that would be about 130 meters in length. The travel time for an aircraft traveling through the full length of all the cooling tower cells would be about 5 seconds. However, this would require a perfect alignment of the plane's approach and the elongated portion of the cooling tower plume. The HRSG and cooling tower plumes would also not be combined at the heights of potential intersection with aircraft landings. The HRSG and cooling tower are located perpendicular to Runway 26 at the Blythe Airport and the lateral widths of the plumes in this direction are small relative to their relative locations. For example, plume diameters are in the range of 28 to 72 meters while the distances between the HRSG exhaust and cooling tower cell locations are about 140 meters.

FREQUENCY OF METEOROLOGICAL CONDITIONS

Five years of meteorological data from the Blythe Airport were evaluated to determine the frequency of meteorological conditions that occur during which potential plume interaction could occur. These data were evaluated for both wind speed and direction. As noted in the plume analysis, the potential interaction between the Blythe Energy Project plumes and a landing aircraft would occur during lower wind speeds, 2 m/s or less. These winds speeds are consistent with the conditions under which pilots have noted turbulence. Based on the available data, wind speeds of 2 m/s and less occur about 17.2 percent of the time with 7.7 percent reported as calms and 9.5 percent reported as winds from 0.5 to 2.1 m/s.

An approaching aircraft to the Blythe Airport would generally fly over the Blythe Energy Project when the winds are from the west. Winds from a westerly direction are less frequent than winds from either the southerly or northerly directions as shown on Figure 13. West winds, or wind from a direction of 270 degrees, over a 22.5 degrees sector and 0.5 to 2 m/s range occur about 0.44 percent of the time. This is about 39 hours per year. West winds covering a 67.5 degree sector and centered on 270 degrees occur about 1.5 percent of the time or about 127.9 hours per year. During other times, the reported wind directions at the Blythe Airport would suggest that other runways other than runway 26 would be used. In these cases, while aircraft could fly over the Blythe Energy Project, they would be at much higher altitudes where interaction with the plumes is less likely due to the lower plume rise.

Aircraft operations are reported to be about 34 operations per day (www.FltPlan.com). The limited number of flights along with the low frequency of winds from a westerly direction and pilot selection of final approach suggest a low frequency of occurrence for plumes from the Blythe Energy Project impacting landing aircraft.

ATMOSPHERIC AND PLUME TURBULENCE

Turbulence is an irregular movement of air resulting from eddies and vertical currents. It is naturally occurring weather phenomena and can be highly variable. Turbulence can be categorized as four types depending on how they are created as described below:

- Mechanical turbulence – Mechanical turbulence is produced when air passes over the ground, particularly irregular ground, and man made objects.
- Thermal turbulence – Thermal turbulence is a result of ground heating. Radiant energy from the sun heats the ground and the heating causes convective currents of different magnitudes.
- Frontal turbulence – Produced along the interface of moving air masses. As warmer air is forced up and over cooler air, friction between the two air masses creates a zone of turbulence.
- Wind shear – Caused by changing weather systems. A shift in wind direction or velocity at altitude can produce significant turbulence.

Frontal turbulence and wind shear are primarily a result of large scale weather systems. As mentioned previously, pilots landing at the Blythe Airport have report turbulence while flying near the Blythe Energy Project during clear and calm conditions. However, an aircraft approaching to land is at a close proximity to the ground and may therefore, experience mechanical or thermal turbulence. For the Blythe Airport, the possibility of mechanical turbulence can be ruled out as a runway is situated without any nearby large structures. Also, an aircraft in its approach path is usually at an altitude beyond the mechanical turbulence zones for any buildings that are close to the airport. The thermal turbulence however, is a very common phenomenon that occurs during the daytime in the warmer months of late spring, summer and early fall, when ground heating creates unstable convective conditions of atmosphere. Unstable atmosphere occurs when the sensible heat flux is positive due to surface temperature being greater than air temperature. Because of higher temperature air near the surface heats up and starts to rise because of lower density, as a result creates thermal turbulence.

Thermal turbulence can be quite common and severe in a desert environment where surface rapidly heats up the surrounding air. Small aircraft operating close to the ground and at low airspeeds would be more influenced by this effect. To contrast the velocities calculated from the plumes, the velocity of upward moving air was determined based on the heat flux of an unstable atmosphere. An unstable atmospheric occurs during the daytime when the ground is heated by the sun causing a temperature gradient at the surface and aloft. This gradient causes air to rise, causing turbulence. Two pilots reported turbulence on May 4, 2004. Unstable meteorological conditions occurred during May 4, 2004 during the mid-morning to afternoon.

The calculated upward velocity of an unstable atmosphere was calculated to be 2.3 meters/second or 7.5 feet per second. This within the range of the upward velocities determined for the plumes.

In reality a complex array of things are possible such as wind gusts which will significantly increase the load factor. An upward force on the wing can change the angle of attack of the wing, which may have an effect on airplane handling. If the airplane travels from one convective flow to another such as a plume of hot gases from a stack with lower density and higher velocity, it may also experience different forces. None the less, the potential forces exerted by plumes from the Blythe Energy Project are of the same magnitude that occurs naturally in the atmosphere during unstable conditions.

MITIGATION

The potential for mitigating the potential effects of the HRSG and cooling tower plumes were evaluated in light of their location and physical properties. Based on the location of the Blythe Energy Project and the Blythe Airport, not with standing economic issues, the relocation of any facilities would not result in any benefit. The approach to runway 26 would cover a wind range of potential wind directions from the west that could ultimately bring an aircraft over any location on the Blythe Energy Project's site. Moving the cooling tower to another location on the Blythe Energy Project site would not result in any benefit since aircraft landing on runway 26 could travel any portion of the site as evidenced from the meteorological data. The frequencies of wind directions centered on 247, 270, 292.5 degrees and over 22.5 degree sectors are 0.63 percent, 0.44 percent and 0.39 percent, respectively. These frequencies, albeit very low, are similar and would not result in aircraft going over one portion of the site substantially more frequently than another. Moreover, the HRSG and cooling tower plumes have similar effects in plume height, dimensions and temperature and are located in different areas of the plant site.

Reducing the velocity of either the cooling tower or HRSG exhaust would reduce the momentum of the plumes. This would affect plume rise as well as the velocity of the plume at the heights where potential plume interaction with aircraft could occur. Lowering the velocity of the plume would reduce its potential force. However, at elevations where plume interaction with aircraft could occur, the velocities are low and the calculated forces small. In addition, reducing velocity would reduce atmospheric dispersion and have unwanted effects on the air quality impacts of the facility.

CONCLUSIONS

The results of our analysis suggest the following:

- Intersection of the HRSG or cooling towers with aircraft approaching the Blythe Airport is possible under light wind speeds and unstable conditions.
- The plume rise from the HRSG stacks and cooling tower are similar.
- If a plume were to intersect the path of an airplane, the plume temperature would be similar to the ambient conditions and upward velocity of the plume is low.
- Based on the diameters of the HRSG and cooling tower plumes, the travel time for an aircraft intersecting a plume would range for 1 to a maximum of 5 seconds.
- The probability of occurrence of meteorological conditions that would potentially result in the intersection of plumes from the Blythe Energy Project and landing aircraft is very low.
- The vertical velocity of the HRSG and cooling plumes was determined to be similar to normally occurring atmospheric conditions. Such conditions are frequent during surface heating that occurs during the mid-morning hours when low winds speeds are present.
- Based on the location and orientation Blythe Airport relative to the Blythe Energy Project, moving the cooling tower to another location on the site would not result in any mitigation of potential plume interaction.
- Reducing the velocity of the plumes would reduce the plume rise and potential forces exerted on low flying aircraft. However, such reductions would result in unwanted environmental impacts (i.e., increase in air impacts) due to a reduction in plume dispersion.

Please call if you have any questions.

Sincerely,

GOLDER ASSOCIATES INC.

Kennard F. Kosky, P.E.
Principal

KFK

cc: Mr. Rich Piper

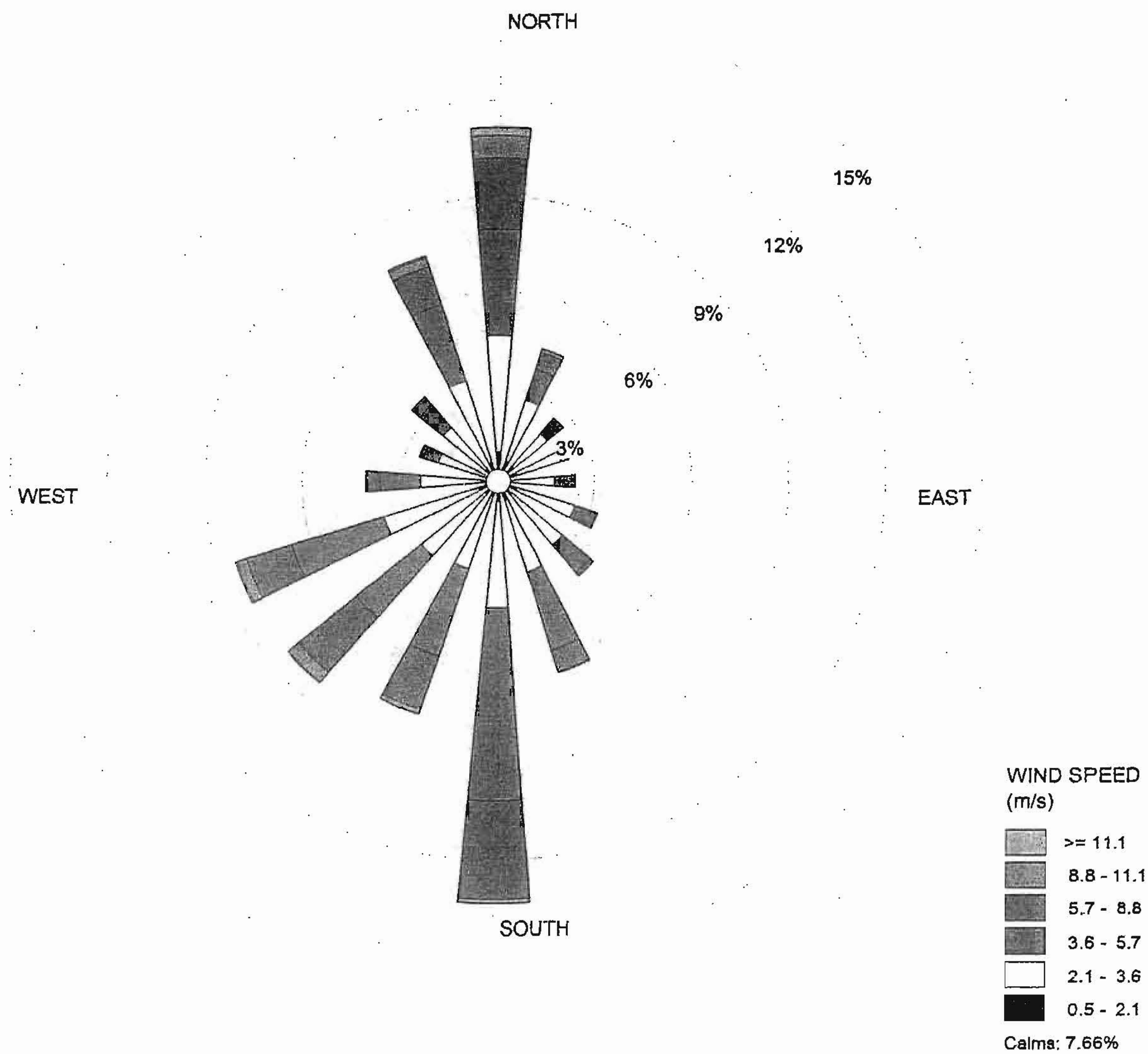
Blythe Plume Interaction Report.doc

WIND ROSE PLOT:

Figure 13. Blythe Riverside County Airport, 1995-1999

DISPLAY:

Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	1995-1999 **Jan 1 - Dec 31** **00:00 - 23:00**	**Blythe Energy Project**	
		MODELER: **S. Marks**	
	CALM WINDS: **7.66%**	TOTAL COUNT: **37171 hrs.**	
	AVG. WIND SPEED: **3.61 m/s**	DATE: **10/26/2004**	PROJECT NO.: **043-7639**

WRPLOT View - Lakes Environmental Software

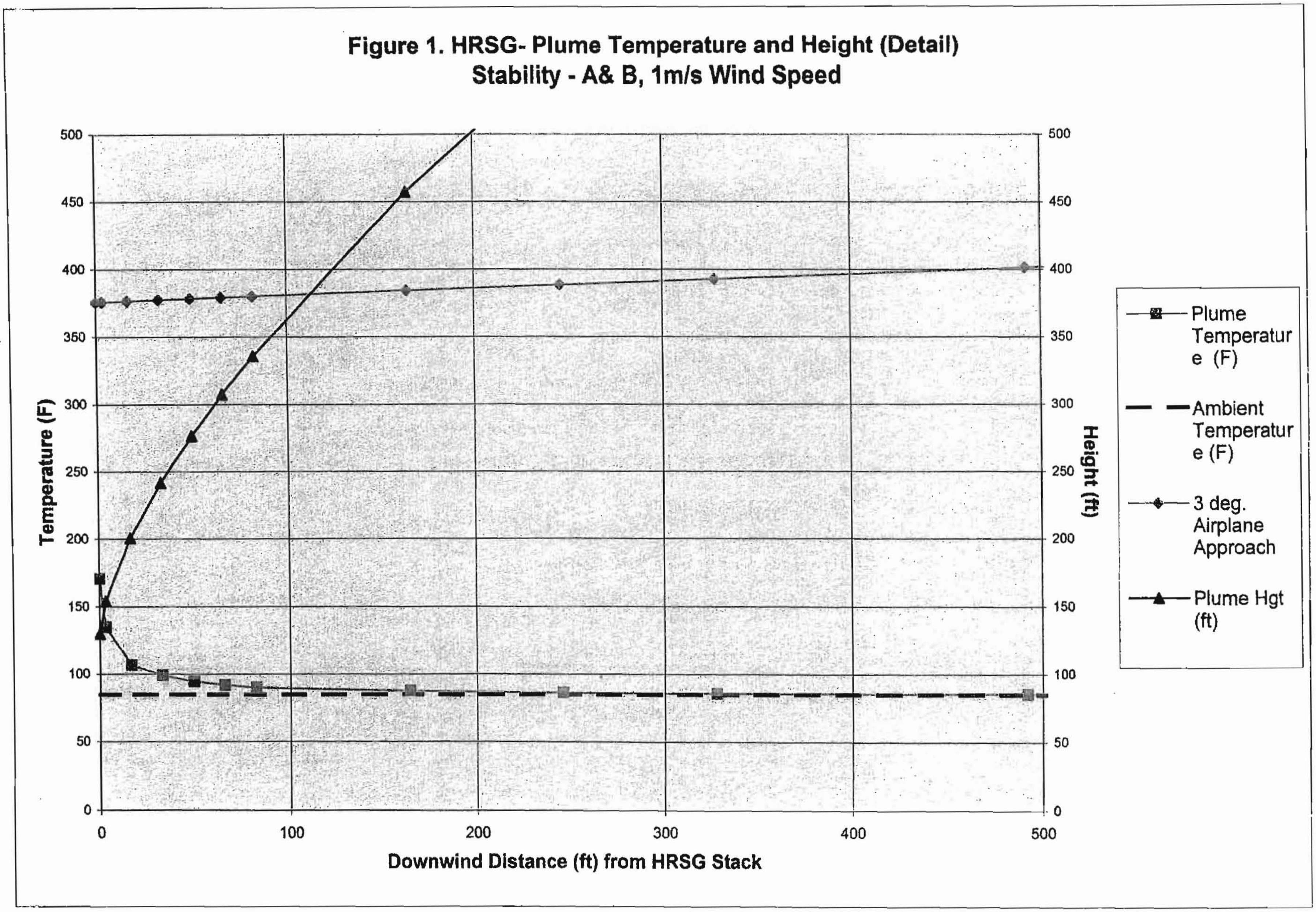


Figure 1. HRSG- Plume Temperature and Height (Detail)
Stability - A& B, 1m/s Wind Speed
500
450
400
350
300
250
200
150
100
50
0
Temperature (F)
Height (ft)
0
100
200
300
400
500
Downwind Distance (ft) from HRSG Stack
Plume Temperature (F)
Ambient Temperature (F)
3 deg. Airplane Approach
Plume Hgt (ft)

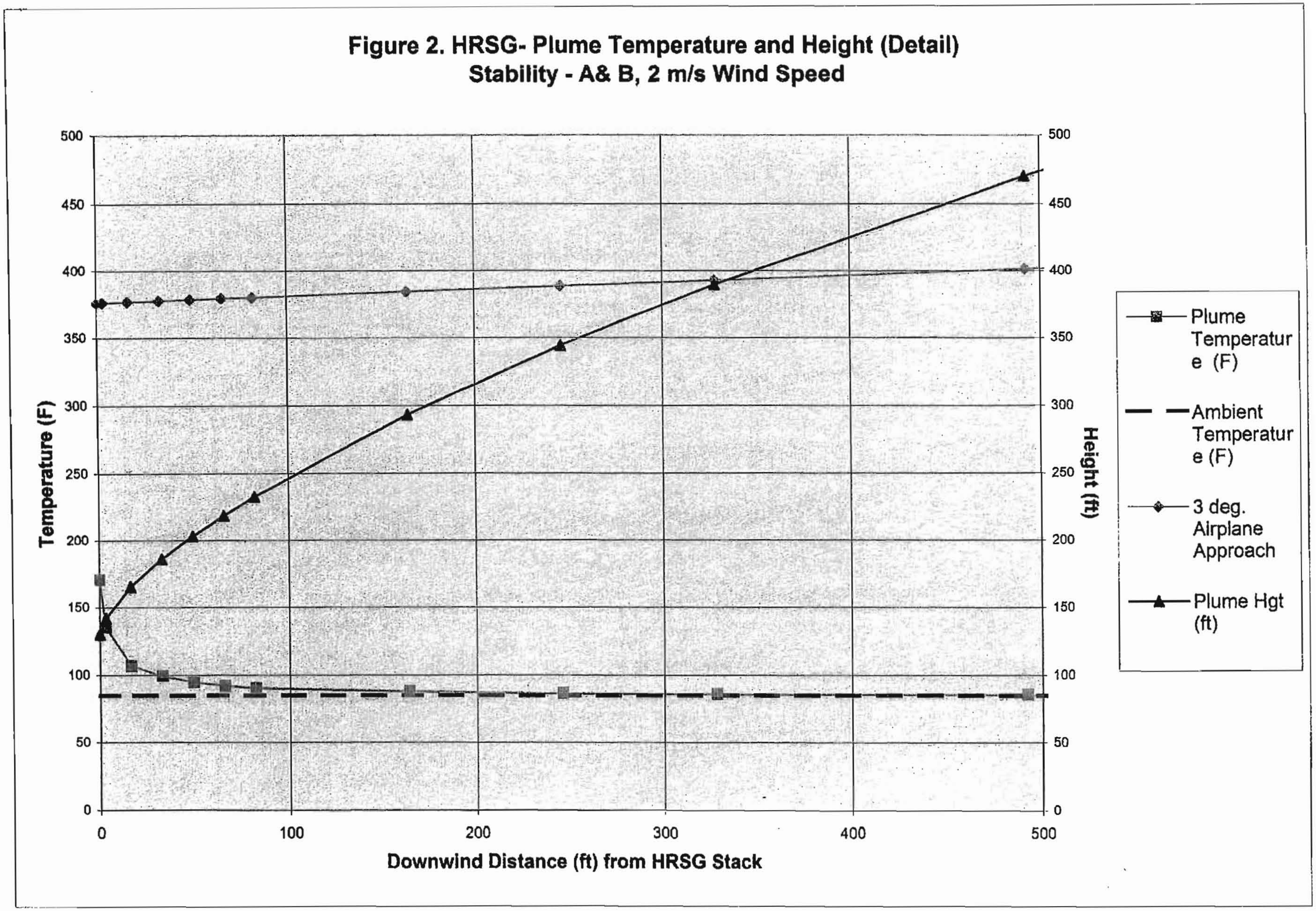


Figure 2. HRSG- Plume Temperature and Height (Detail)
Stability - A& B, 2 m/s Wind Speed
Temperature (F)
Height (ft)
Downwind Distance (ft) from HRSG Stack
0
50
100
150
200
250
300
350
400
450
500
0
100
200
300
400
500
Plume Temperatur e (F)
Ambient Temperatur e (F)
3 deg. Airplane Approach
Plume Hgt (ft)

Figure 3. HRSG- Plume Temperature and Height (Detail)
Stability - A & B, 4m/s Wind Speed

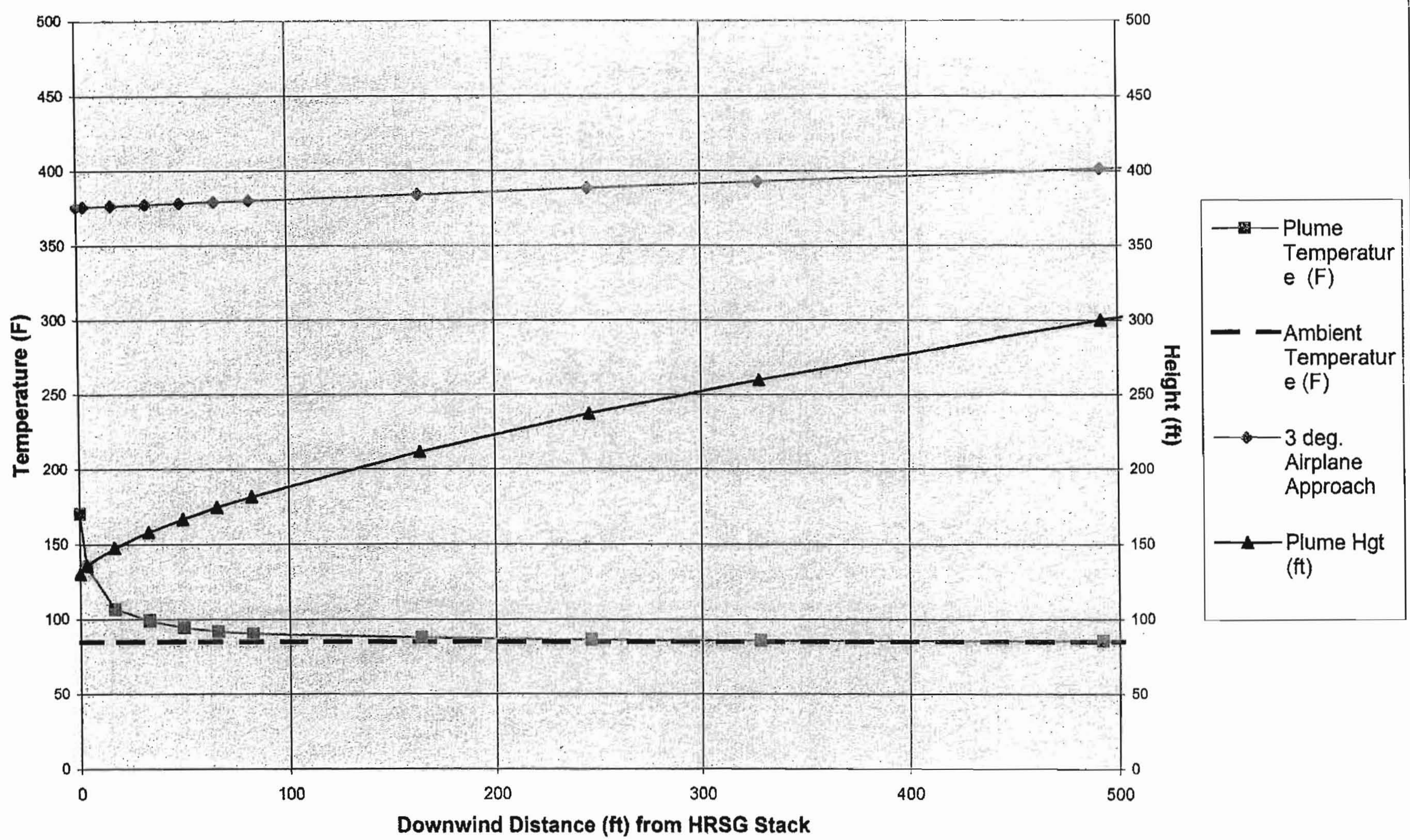


Figure 4. HRSG- Plume Temperature and Height (Detail)
Stability - C, 4m/s Wind Speed

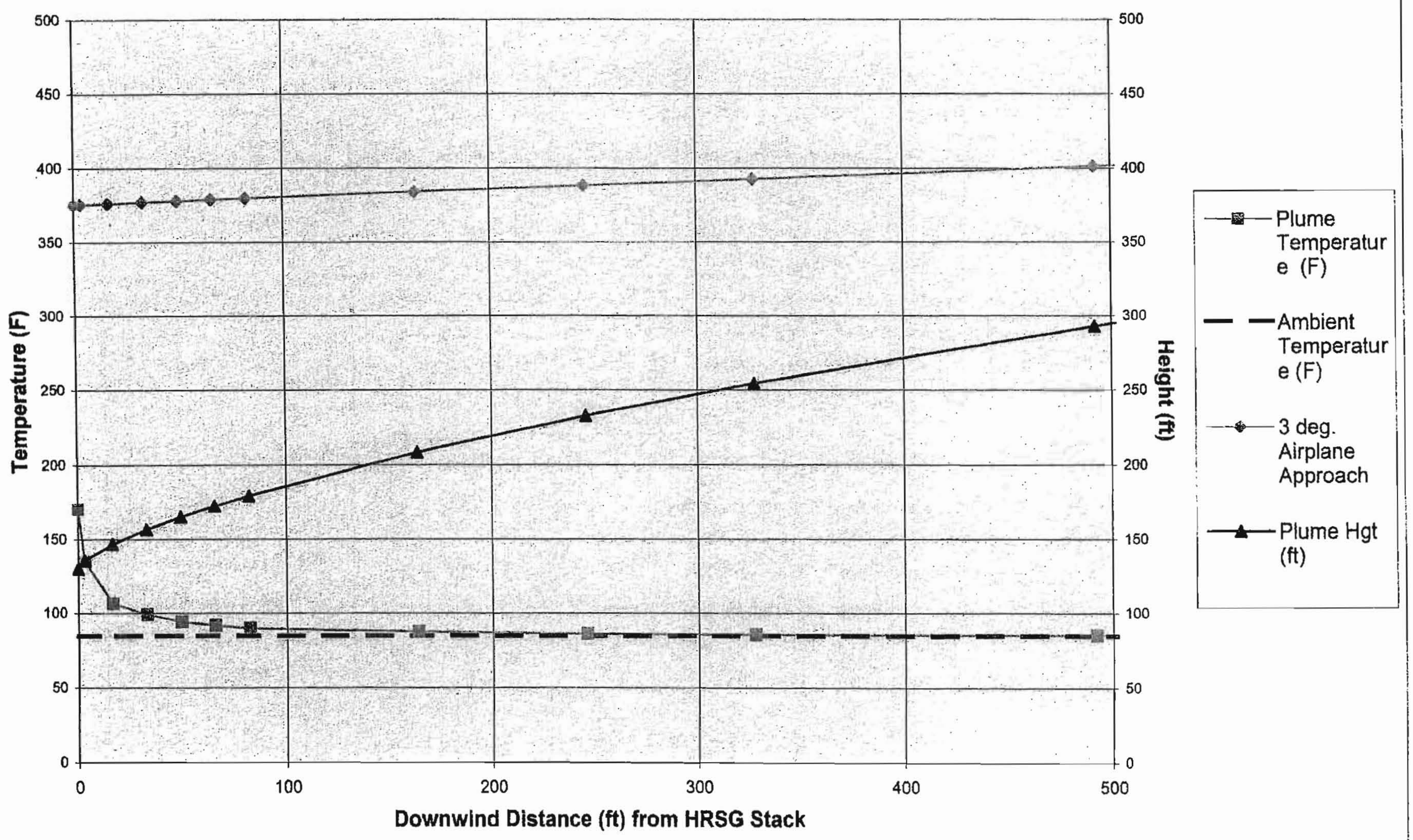
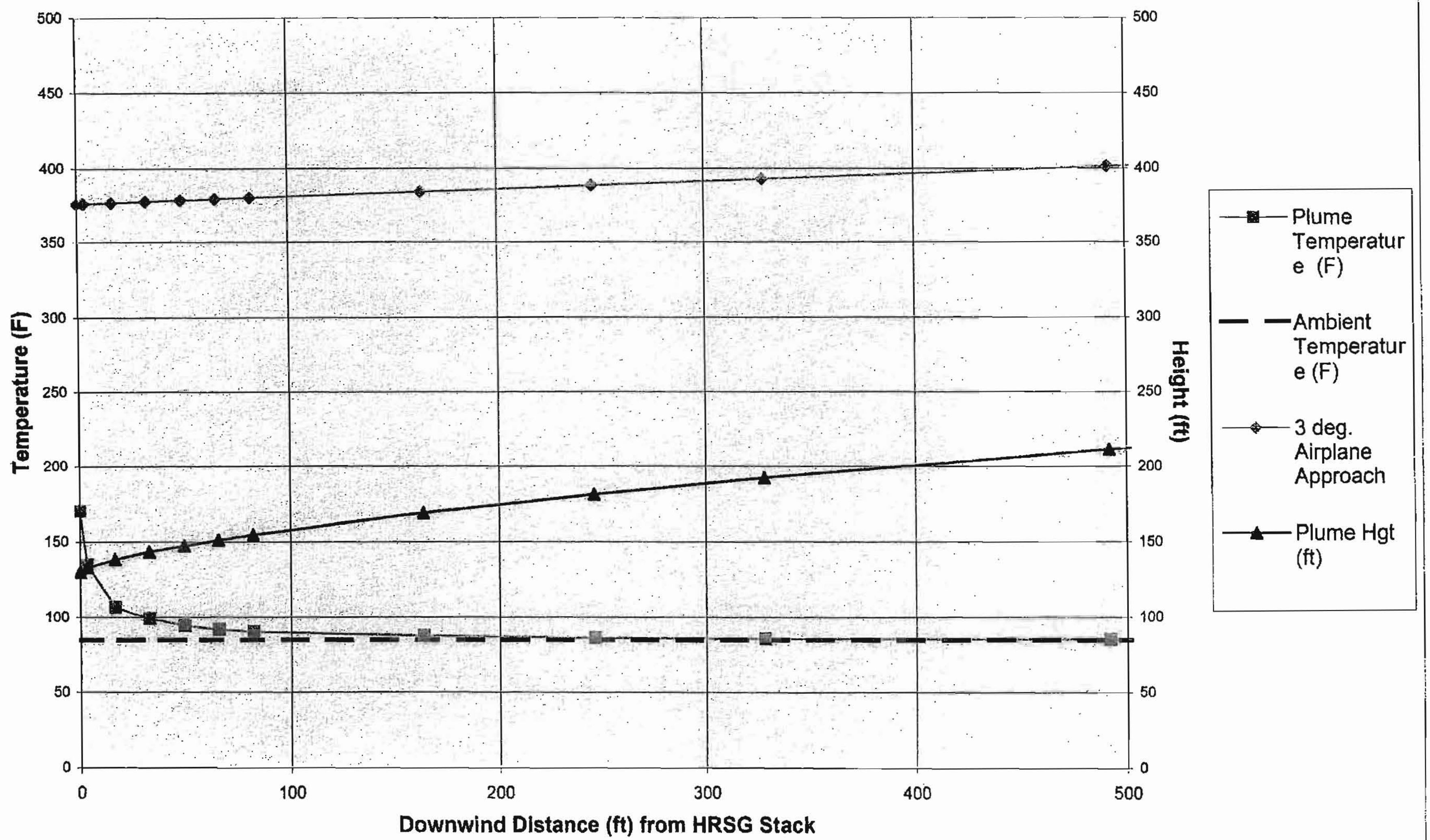


Figure 5. HRSG- Plume Temperature and Height (Detail)
Stability - C, 8 m/s Wind Speed



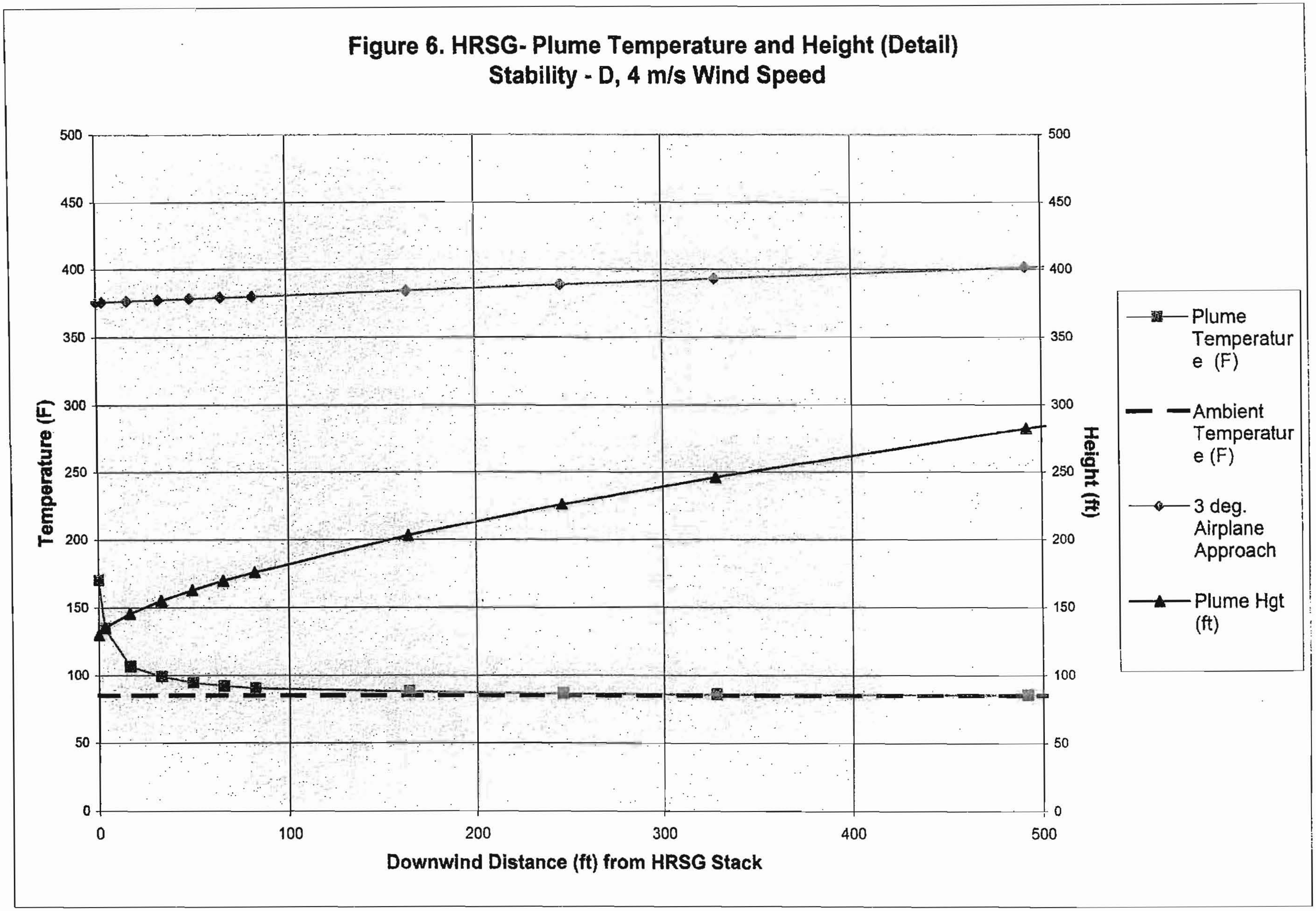


Figure 6. HRSG- Plume Temperature and Height (Detail)
Stability - D, 4 m/s Wind Speed
Temperature (F)
Height (ft)
Downwind Distance (ft) from HRSG Stack
Plume Temperature (F)
Ambient Temperature (F)
3 deg. Airplane Approach
Plume Hgt (ft)
0
50
100
150
200
250
300
350
400
450
500

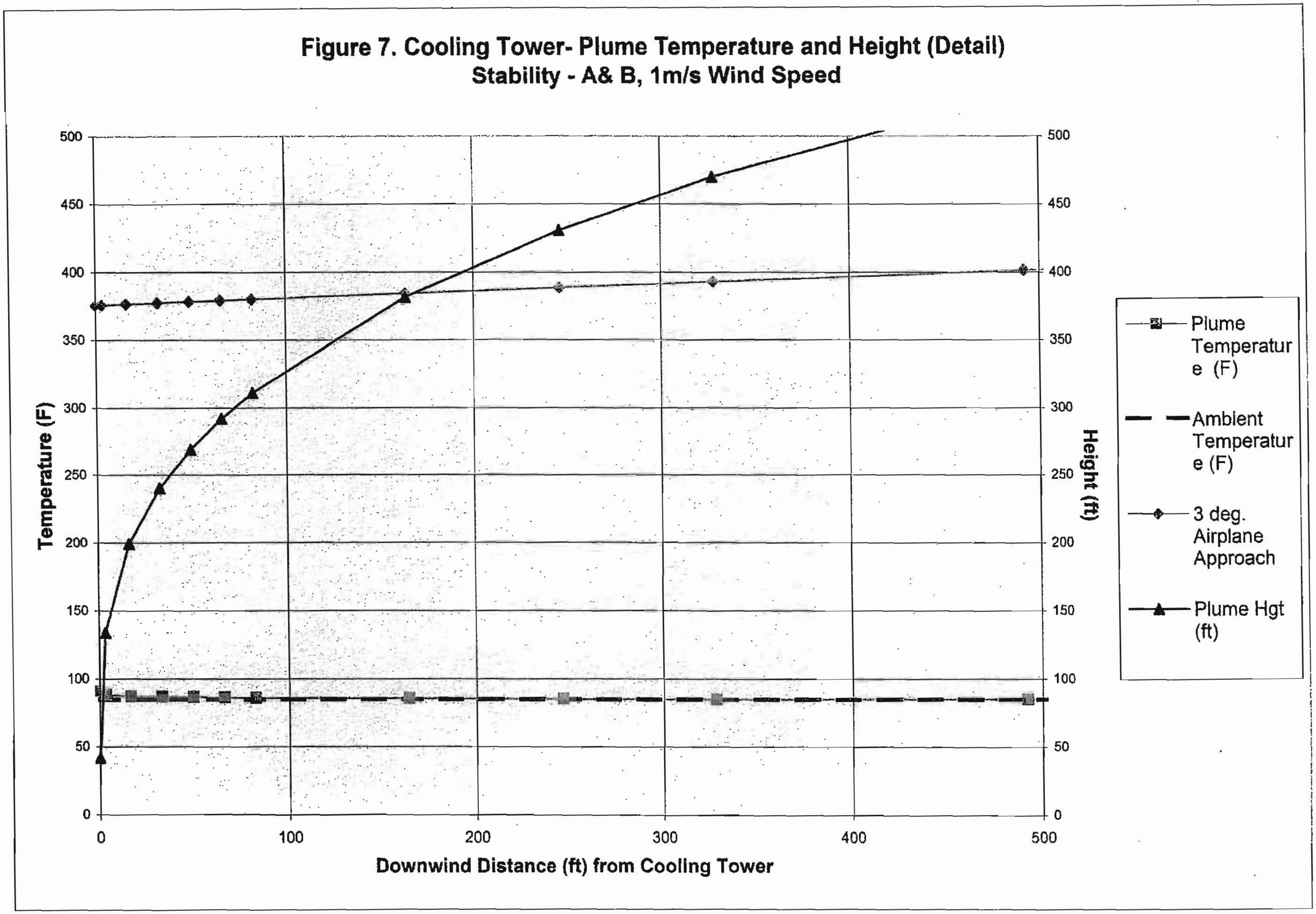


Figure 7. Cooling Tower- Plume Temperature and Height (Detail)
Stability - A& B, 1m/s Wind Speed
Temperature (F)
Height (ft)
Downwind Distance (ft) from Cooling Tower
0
50
100
150
200
250
300
350
400
450
500
0
100
200
300
400
500
Plume Temperature (F)
Ambient Temperature (F)
3 deg. Airplane Approach
Plume Hgt (ft)

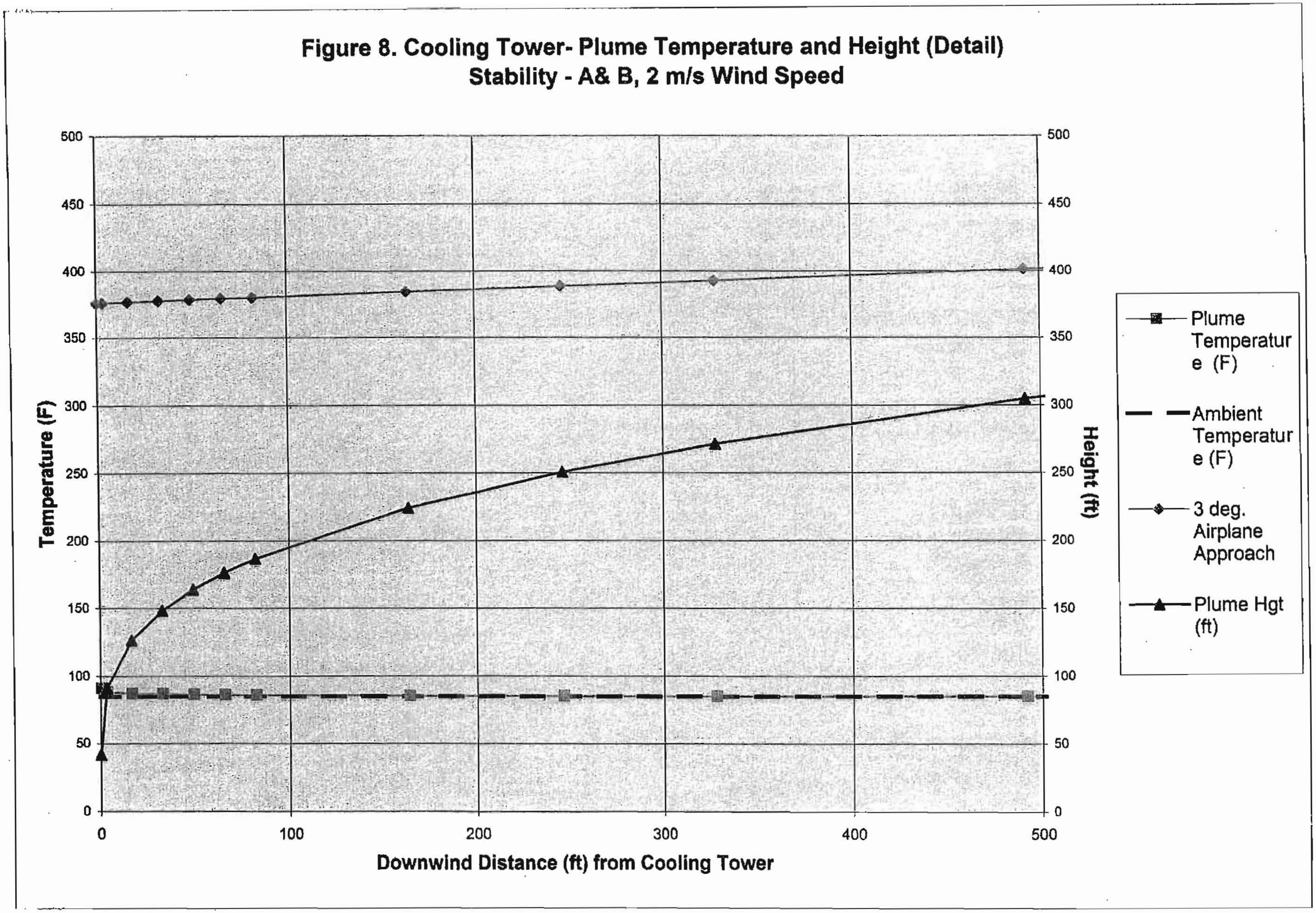
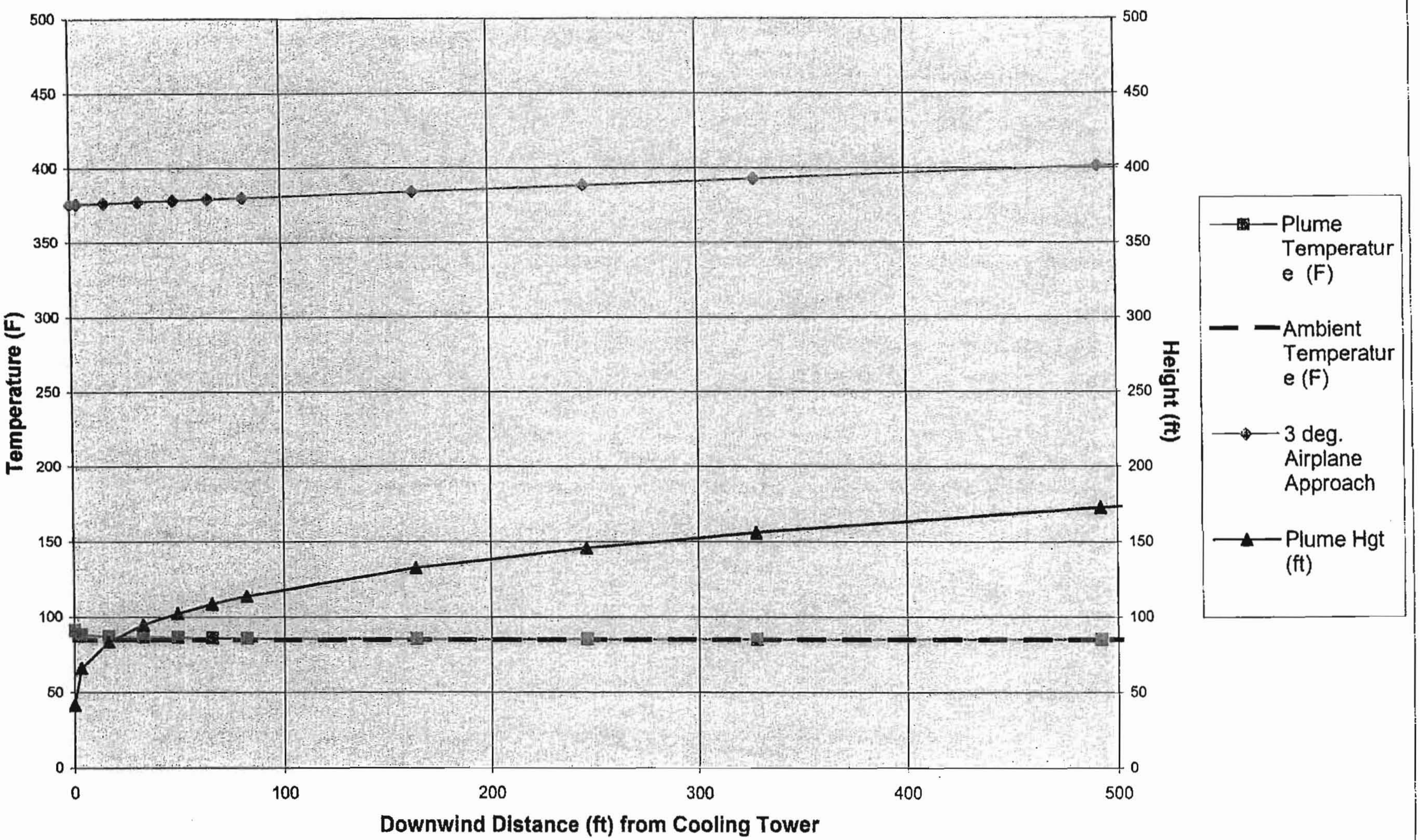


Figure 8. Cooling Tower- Plume Temperature and Height (Detail)
Stability - A& B, 2 m/s Wind Speed
Temperature (F)
Height (ft)
Downwind Distance (ft) from Cooling Tower
0
50
100
150
200
250
300
350
400
450
500
Plume Temperatur e (F)
Ambient Temperatur e (F)
3 deg. Airplane Approach
Plume Hgt (ft)

Figure 9. Cooling Tower- Plume Temperature and Height (Detail)
Stability - A & B, 4m/s Wind Speed



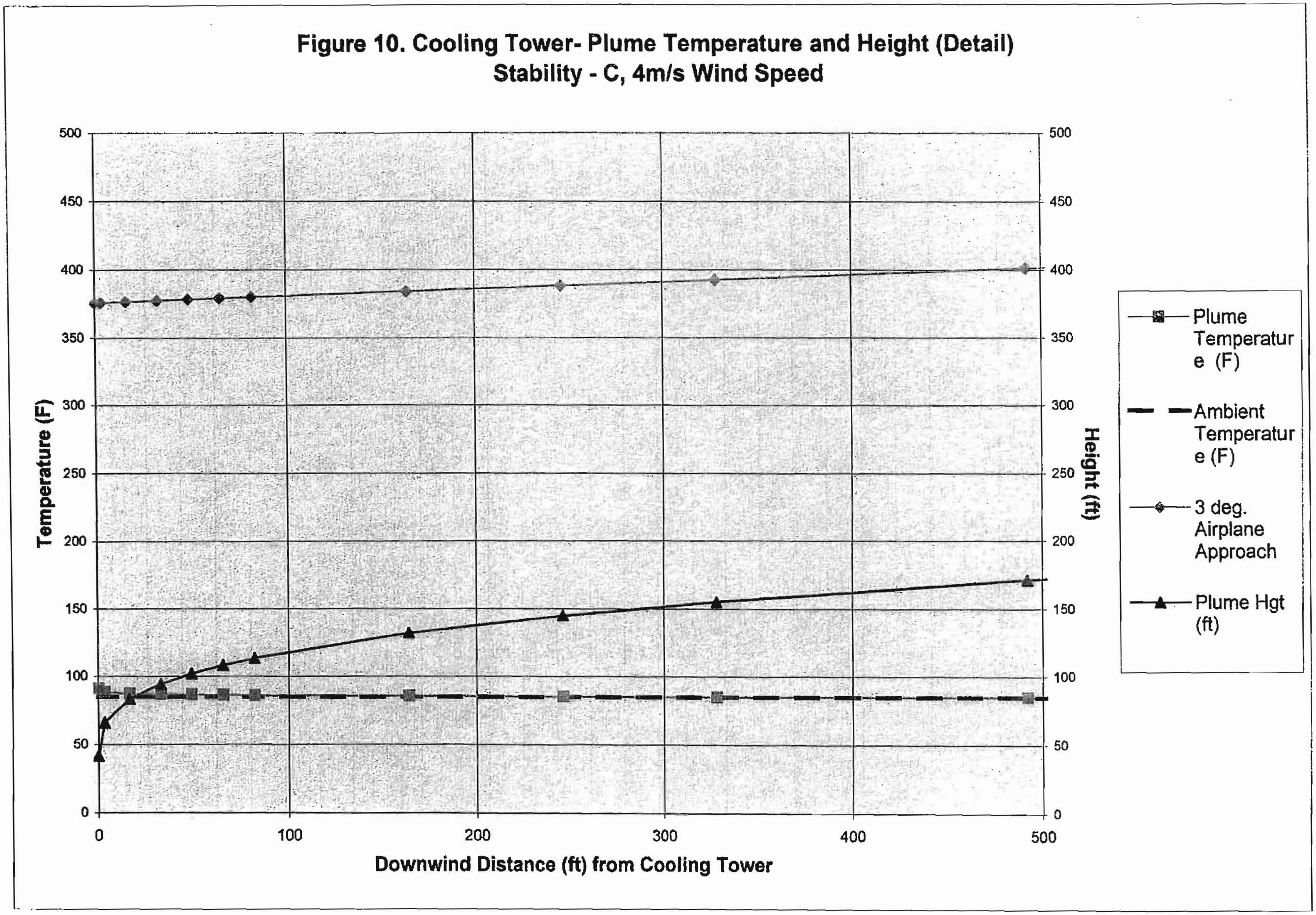
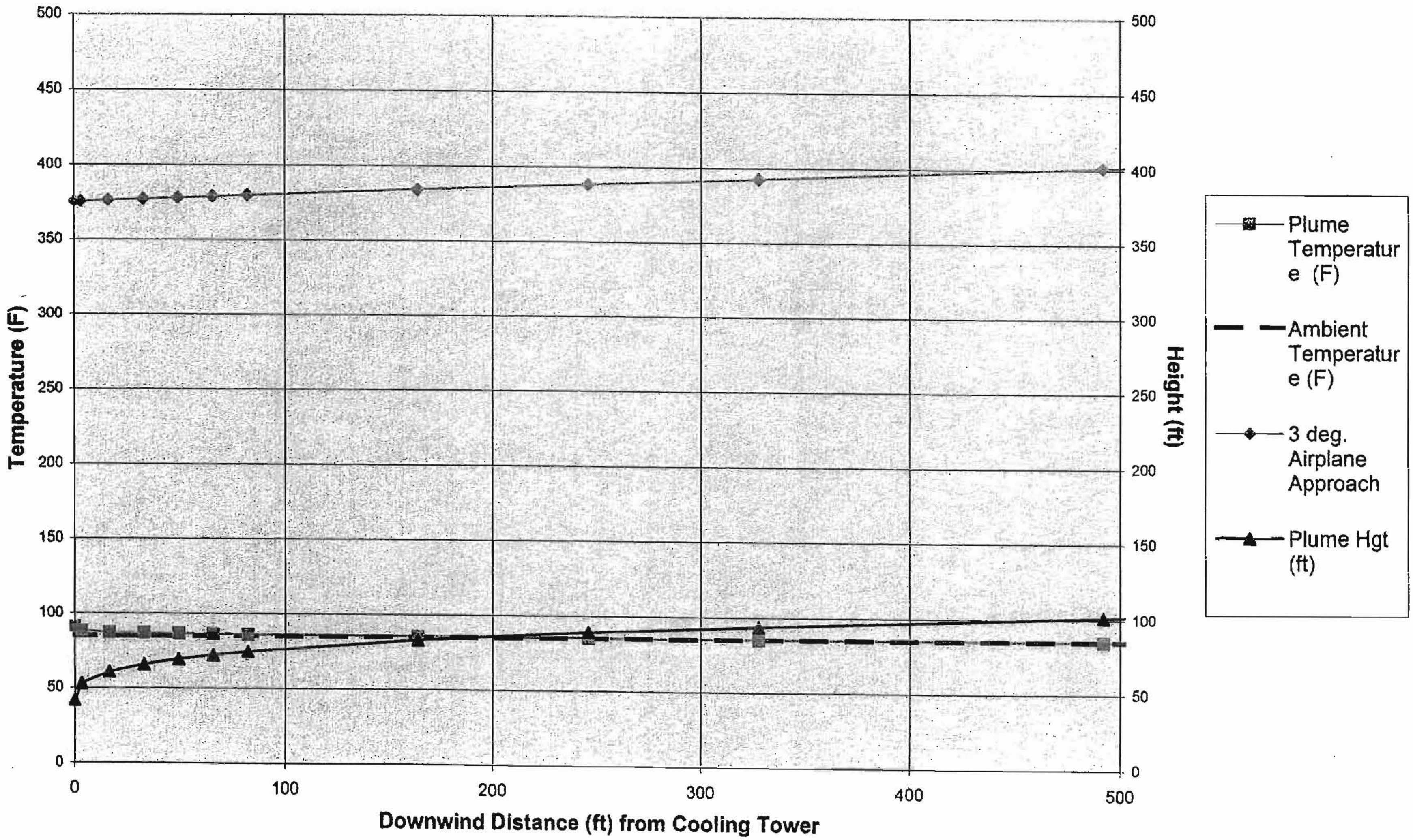


Figure 10. Cooling Tower- Plume Temperature and Height (Detail)
Stability - C, 4m/s Wind Speed
Temperature (F)
Height (ft)
Downwind Distance (ft) from Cooling Tower
0
50
100
150
200
250
300
350
400
450
500
Plume Temperature (F)
Ambient Temperature (F)
3 deg. Airplane Approach
Plume Hgt (ft)

Figure 11. Cooling Tower- Plume Temperature and Height (Detail)
Stability - C, 8 m/s Wind Speed



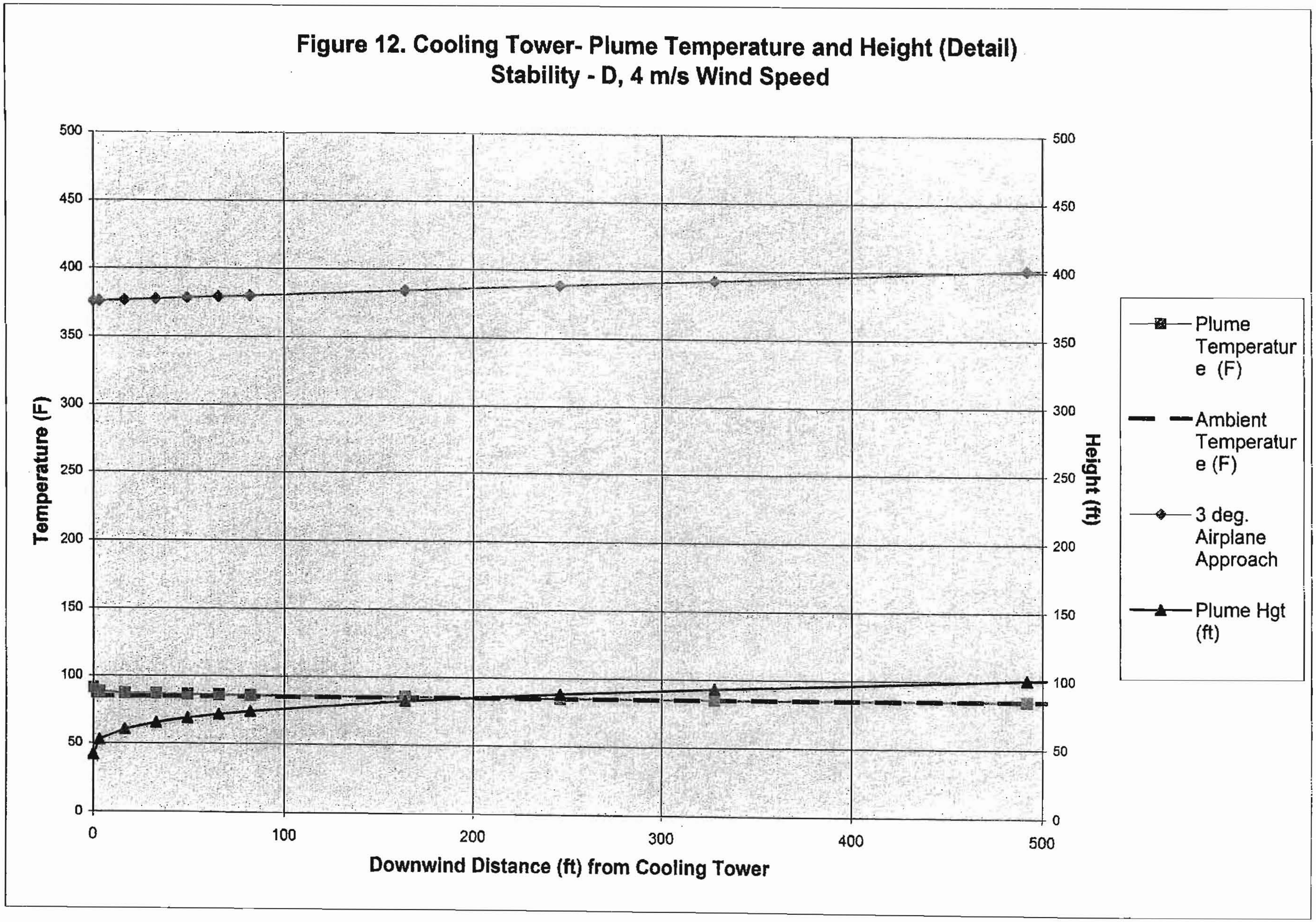


Figure 12. Cooling Tower- Plume Temperature and Height (Detail)
Stability - D, 4 m/s Wind Speed
Temperature (F)
Height (ft)
Downwind Distance (ft) from Cooling Tower
Plume Temperature (F)
Ambient Temperature (F)
3 deg. Airplane Approach
Plume Hgt (ft)