Docket No. SA-516

Exhibit No. 5-A

NATIONAL TRANSPORTATION SAFETY BOARD

Washington D.C.

Meteorological Factual Report
[DCA96MA070]

by

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(11 Pages)

NATIONAL TRANSPORTATION SAFETY BOARD
Office of Aviation Safety
Washington D.C. 20594

Meteorological Factual Report
DCA96MA070

A. ACCIDENT

Location: Eight Miles South of East Moriches, New York.
Date: July 18, 1996
Time: 0031 UTC
Aircraft: B-747-131, N93119, Operated as Trans World Airlines Flight 800 (TWA Flight 800).

B. WEATHER GROUP

A Weather Group was not established.

C. SUMMARY

On July 18, 1996, about 0031 UTC (July 17, 1996 at 2031 Eastern Daylight Time), a Boeing 747-131, N93119, operated as Trans World Airlines Flight 800, crashed into the Atlantic Ocean, about 8 miles south of East Moriches, New York after taking off from John F. Kennedy International Airport (JFK), Jamaica, New York. All 230 people aboard the airplane were killed. The airplane was bound for Charles De Gaulle International Airport (CDG), Paris, France.

D. DETAILS OF INVESTIGATION

Note: in the report all times Coordinated Universal Time (UTC) based on the 24 hour clock unless noted. All heights above mean sea level (MSL) unless noted. Heights in surface weather observations above ground level (AGL). All directions with reference to true north unless noted. Z = Coordinated Universal Time. Eastern Daylight Time = Z - 4 hours. McIDAS - Man computer Interactive Data Access System. McIDAS is an interactive meteorological analysis and data management computer system. McIDAS is administered by personnel at the Space Science and Engineering Center at the University of Wisconsin at Madison. Data are accessed and analyzed on an IBM PS/2 Model 77 Computer.

Surface Weather Observations

John F. Kennedy Airport, New York (KJFK)

KJFK is located about 52 nautical miles west of the accident site.

2351Z .. Winds 220 degrees at 8 knots; visibility 10 miles; 6,000 feet scattered, ceiling 7,000 feet broken, 9,000 feet broken; temperature 27.8 degrees C; dew point 21.1 degrees C; altimeter setting 30.07 inches of Hg.; wind shift 2306Z; rain began 2318Z and ended 2329Z; precipitation 0.00 inch between 2327Z and 2351Z.

July 18, 1996 at 0051Z .. Winds 240 degrees at 9 knots; visibility 10 miles; few clouds at 10,000 feet; temperature 26.7 degrees C; dew point 20.6 degrees C; altimeter setting 30.08 inches of Hg.

Farmingdale, New York (KFRG)

KFRG is located about 35 nautical miles west of the accident site.

2345Z .. Winds 240 degrees at 5 knots; visibility 7 miles; 5,000 feet scattered; altimeter setting 30.04 inches of Hg.; 3/8 total sky cover.

July 18, 1996 at 0045Z .. Winds 250 degrees at 5 knots; visibility 7 miles; 5,000 feet scattered; altimeter setting 30.05 inches of Hg.; 3/8 total sky cover.

Islip, New York (KISP)

KISP is located about 23 nautical miles west-northwest of the accident site.

2350Z .. Winds 220 degrees at 4 knots; visibility 8 miles; skies clear; temperature 27 degrees C; dew point 23 degrees C; altimeter setting 30.05 inches of Hg.

July 18, 1996 at 0050Z .. Winds 250 degrees at 3 knots; visibility 8 miles; skies clear; temperature 25 degrees C; dew point 22 degrees C; altimeter setting 30.05 inches of Hg.

Westhampton Beach, New York (KFOK)

KFOK is located about 12 nautical miles north of the accident site.

2345Z .. Winds 240 degrees at 4 knots; visibility 4 miles; haze; 6,000 feet scattered; temperature 23 degrees C; dew point 19 degrees C; altimeter setting 30.08 inches of Hg.; total sky cover 3/8.

July 18, 1996 at 0045Z .. Winds calm; visibility 6 miles; haze; 6,000 feet scattered; temperature 22 degrees C; dew point 19 degrees C; altimeter setting 30.09 inches of Hg.; total sky cover 3/8.

Attachments 1 - 12 .. Surface Weather Observation Forms for KJFK, KFRG, KISP, and KFOK.
Attachment 13 .. Map showing surface weather observation locations.

Upper Air Data

Upton, New York 0000Z July 18, 1996 [72501]

Upton is located about 15 nautical miles northwest of the accident site.

LEVEL...Height Millibars
TEMP...Temperature Degrees C
DEW PT...Dew Point Temperature Degrees C
DIR...Wind Direction Degrees True
SPEED...Wind Speed Meters per Second
HEIGHT...Height Meters Above Mean Sea Level

STATION:72501 DAY/TIME:96200 000000 LAT/LONG:408500 728500

LEVEL	TEMP	DEW PT	DIR	SPEED	HEIGHT
1015.0	27.8	20.8	240.0	2.5	20.0
1000.0	27.2	18.2	255.0	4.6	152.3
982.9	26.1	16.9	270.0	6.6	304.0
949.4	23.9	14.2	280.0	7.7	609.0
925.0	22.2	12.2	285.0	8.7	837.5
916.8	21.5	11.9	285.0	9.2	914.0
884.9	18.6	10.7	290.0	9.7	1219.0
850.0	15.4	9.4	305.0	10.2	1564.9
823.8	13.5	8.0	310.0	10.8	1829.0
794.5	11.3	6.3	315.0	9.7	2134.0
793.0	11.2	6.2	315.3	9.6	2150.4
766.0	10.3	-1.4	320.0	8.2	2439.0
757.0	10.0	-4.0	323.3	7.7	2538.0
748.0	9.2	1.2	326.5	7.2	2637.3
738.5	8.4	1.7	330.0	6.6	2743.0
723.0	7.2	2.4	332.9	6.3	2918.6
711.7	6.3	0.9	335.0	6.1	3048.0
700.0	5.4	-0.6	325.0	6.1	3184.2

699.0	5.4	-0.6	324.7	6.1	3196.0
686.0	5.2	-12.8	320.1	6.1	3349.5
685.7	5.2	-12.9	320.0	6.1	3353.0
676.0	4.4	-16.6	310.5	6.9	3469.2
660.4	3.3	-17.0	295.0	8.2	3658.0
636.0	1.5	-17.6	290.0	8.7	3963.0
634.0	1.4	-17.6	290.8	8.8	3988.5
612.3	0.8	-20.4	300.0	9.7	4268.0
586.0	0.0	-24.0	302.9	10.9	4620.7
567.3	-1.9	-23.0	305.0	11.8	4878.0
545.9	-4.2	-21.8	315.0	15.9	5182.0
530.0	-5.9	-20.9	315.0	17.1	5416.5
500.0	-9.3	-28.3	315.0	19.5	5870.1
485.5	-10.4	-30.2	310.0	20.0	6097.0
466.6	-11.8	-32.7	305.0	20.5	6402.0
465.0	-11.9	-32.9	304.8	20.5	6428.6
400.0	-22.5	-35.5	295.0	20.5	7558.2
396.5	-23.0	-36.0	295.0	20.5	7621.0
363.9	-27.9	-40.6	295.0	20.5	8231.0
319.9	-35.2	-47.5	305.0	20.0	9146.0
306.5	-37.7	-49.8	315.0	19.0	9451.0
300.0	-38.9	-50.9	315.0	19.0	9602.3
286.0	-41.9	-51.9	300.8	18.6	9928.2
280.4	-42.7	-52.9	295.0	18.5	10060.0
256.0	-46.5	-57.3	280.0	21.0	10670.0
250.0	-47.5	-58.5	280.0	21.6	10828.8
200.0	-58.1	-67.1	310.0	24.6	12269.6
182.0	-56.5	-65.5	313.6	29.0	12866.1
175.1	-57.2	-66.2	315.0	30.8	13109.0
151.4	-59.9	-68.9	300.0	25.7	14024.0
150.0	-60.1	-69.1	300.0	25.7	14083.4
133.0	-61.9	-70.9	312.9	23.4	14831.2
124.5	-60.8	-69.8	320.0	22.1	15243.0
118.5	-59.9	-68.9	320.0	20.0	15548.0
117.0	-59.7	-68.7	318.7	19.3	15628.7
102.3	-61.8	-70.8	305.0	12.3	16463.0
100.0	-62.1	-71.1	305.0	11.3	16605.1
93.3	-62.5	-71.5			17033.6
25.9	-49.7	-62.7			25184.4
24.7	-49.7	-62.7			25495.0

PARCEL: DEW PT.= 288.7 POT. TEMP= 301.1 EQUIV.POT.TEMP= 334.9 MIX= 12.3
PRECIP.WATER= 30.4 CONV.TEMP= 30.9 FCST MAX= 0.0 LIFTED INDEX= -0.6
TOTALS= 43.4 EQUIL.PRES.= 253.8 K-INDEX= 28.1 SWEAT INDEX=190.4

Attachments 14 - 15 ... Upper Air Data from Upton, New York, July 18, 1996 at 0000Z.

Attachment 16 .. Plot of temperature data from Upton, New York.

Attachment 17 .. Skew T Log P plot of Upton, New York upper air data.

Lightning Data

On November 26, 1996 an individual with the National Oceanic and Atmospheric Administration (NOAA) in Norman, Oklahoma was interviewed by phone. The following is a summary of the interview:

Clear air lightning can occur in clear air in the vicinity of a thunderstorm i.e. within a few kilometers of a thunderstorm. Clear air lightning probably does not occur in totally clear air. Some convection in the vicinity is needed.

Cloud to ground lightning data from the National Lightning Detection Network (NLDN) prepared by Global Atmospherics Inc. [see Report to Vice Chairman Francis 10/23/96] showed that the closest cloud to ground lightning stroke for the time period 0020 to 0035Z was located in East-Central North Carolina, about 361 miles from the accident site. The NLDN does not detect cloud to cloud or intra-cloud (within cloud) lightning strokes. Detection efficiencies off the coast probably drop to 60% (sensors are land based although the sensors have a very long range capability - 1,000's of kilometers).

Attachments 18 - 28 .. Report provided to NTSB Vice Chairman Francis.

An Optical Transient Detector (OTD), a space based sensor developed at NASA's Marshall Space Flight Center (MSFC), can detect the full spectrum of lightning flashes, including cloud to ground, cloud to cloud, and intra-cloud. The OTD is on a satellite which is in a near polar orbit. According to an individual from the MSFC, phone contact 12/5/96, the satellite was over New Guinea at the time of the TWA 800 accident. Therefore, no data pertinent to the accident was available.

Attachment 29 .. Information on OTD.

A Senior Engineer with Sandia National Laboratories in Albuquerque, New Mexico reviewed lightning detection data from the National Lightning Detection Network [NLDN] and from the Niagra Mohawk Power Company lightning detection sensor array in Western New York State. He noted on January 21, 1997 in a phone conversation that there is no convincing evidence of electrical activity at the time and in the area of the accident based on these data. Although data from the Wallops Island, Virginia NLDN sensor [LPATS sensor] showed an electrical transient about the time of the accident, this transient was not verified by the data from the Mohawk Power Company. The Wallops Island sensor's area of detection includes the accident site. The exact location of the electrical transient is unknown. This electrical transient needed to be detected by more sensors to determine its exact location. The Wallops Island sensor will detect cloud to cloud and intra-cloud lightning.

Satellite Data

Geostationary Operational Environmental Data (GOES) 8 data were reviewed on McIDAS. GOES 8 visible images for 2332Z and 2345Z showed clouds with some vertical development about 20 nautical miles northeast of the accident site. Clouds were also evident about 30 nautical miles to the southwest. GOES 8 infrared images [Band = 4 .. long wave infrared] for 0015Z and 0045Z showed radiative temperatures colder than 0 degrees C about 30 nautical miles northeast and about 30 nautical miles southwest of the accident site. Using upper air data from Upton, New York for 7/18/0000Z indicated a temperature of about 0 degrees C would correspond to a cloud height of about 15,200 feet.

Within about a 10 nautical mile radius of the accident site the following radiative temperatures were indicated (GOES 8; Band=4; 1 kilometer [blow up] resolution) (McIDAS command: IMGPROBE STAT TEMP BOX):

Radiative Temperatures in degrees Kelvin (K).
Std Dev .. Standard Deviation degrees Kelvin.

0015Z .. Minimum 288.0 K Maximum 292.0 K Mean 290.2 K Std Dev 0.679
0045Z .. Minimum 286.5 K Maximum 292.5 K Mean 290.1 K Std Dev 0.752

These radiative temperature data indicate that cloud tops in this area were below about 6,000 feet [Upton, New York, July 18/ 0000Z, Upper Air Data].

Attachments 30 and 31 .. GOES visible images; 2332Z and 2345Z; 1 kilometer resolution; images are contrast stretched; cross box = approximate accident location.

Attachments 32 and 33 .. GOES long wave infrared images (Band = 4); 0015Z and 0045Z; 1 kilometer (blow up) resolution; cross box = approximate accident location; images are color enhanced using the following Table:

Color Enhancement Table

Segment #	Temperature (degrees C)	(degrees K)
1	39.3 to 30.3	312.5 to 303.5
2	29.8 to 20.3	303.0 to 293.5
3	19.8 to 10.3	293.0 to 283.5
4	9.8 to -0.2	283.0 to 273.0
5	-0.7 to -2.7	272.5 to 270.5
6	-3.2 to -15.2	270.0 to 258.0
7	-15.7 to -31.2	257.5 to 242.0
8	-32.2 to -41.2	241.0 to 232.0

9	-42.2 to -52.2	231.0 to 221.0
10	-53.2 to -58.2	220.0 to 215.0
11	-59.2 to -62.2	214.0 to 211.0
12	-63.2 to -80.2	210.0 to 193.0
13	-81.2 to -109.2	192.0 to 164.0

Doppler Weather Radar Data

An Archive Level II doppler weather radar tape from the Taunton, Massachusetts (KBOX) and Mt Holly, New Jersey (KDIX) WSR-88D doppler weather radars were obtained from the National Climatic Data Center in Asheville, North Carolina. The data on the tape were reviewed on a Hewlett Packard X-Station using Motif Interactive Radar Analysis Software (Motif-IRAS).

> Reference : Priegnitz, D.L., 1995 : IRAS: Software to display and analyze WSR-88D radar data, Eleventh International Conference on Interactive Information and Processing for Meteorology, Oceanography, and Hydrology, Boston, American Meteorological Society, 197-199.

The data from KBOX (.5 degree elevation angle) for 0027:35Z and 0033:25Z indicated weather echoes about 50 to 55 kilometers to the north and to the northeast of the accident site.

The data from KDIX (.5 degree elevation angle) for 0026:49Z and 0036:30Z indicated weather echoes about 50 to 55 kilometers to the north and to the northeast of the accident site.

Attachments 34 and 35 .. WSR-88D Doppler Weather Radar Images from KBOX; 0027:35Z and 0033:25Z; .5 degree elevation angle; polar grid centered at the approximate accident location; range rings in kilometers; weather radar reflectivities (dBZ) indicated by color bar at bottom; the radar echo near the grid center is from the result of the explosion. The beam center is at about 12,700 feet. The beam width is about 10,400 feet. The radar echo at 0033:25Z covered approximately a 12.3 nautical miles square area.

Attachments 36 and 37 .. WSR-88D Doppler Weather Radar Images from KDIX; 0026:49Z and 0036:30Z; .5 degree elevation angle; polar grid centered at the approximate accident location; range rings in kilometers; weather radar reflectivities (dBZ) indicated by color bar at bottom; the radar echo near the grid center is from the result of the explosion. The beam center is at about 10,700 feet. The beam width is

about 9,300 feet. The radar echo at 0036:30Z covered approximately a 15.8 nautical miles square area.

Attachments 38 - 42 .. Excerpts from: Radar Observations of a Major Industrial Fire.

VIP/DBZ Conversion Table

NWS VIP ... National Weather Service Video Integrator and Processor Level.
WSR-88D LVL ... WSR-88D Doppler Weather Radar Level.
PREC MODE dBZ ... Precipitation Mode dBZ.
RAINFALL .. Rainfall in inches per hour.

NWS VIP	WSR-88D LVL	PREC MODE DBZ	RAINFALL
0	0 1 2	<5 5 to 9 10 to 14	
1 Very Light	3 4 5	15 to 19 20 to 24 25 to 29	.01 in/hr .02 in/hr .04 in/hr
2 Light to Moderate	6 7	30 to 34 35 to 39	.09 in/hr .21 in/hr
3 Strong	8	40 to 44	.48 in/hr
4 Very Strong	9	45 to 49	1.10 in/hr
5 Intense	10	50 to 54	2.49 in/hr
6 Extreme	11 12 13 14 15	55 to 59 60 to 64 65 to 69 70 to 74 GTE 75	>5.67 in/hr

Astronomical Data

Latitude 40 degrees 40 minutes north .. Longitude 72 degrees 38 minutes west
[Approximate Accident Site]
July 17, 1996

Eastern Daylight Time (EDT) = Z - 4 Hours.

Altitude 0 feet .. Time 2031 EDT
Altitude of Sun -2.9 degrees
True Bearing to Sun 301.0 degrees
Altitude of Moon 7.2 degrees
True Bearing to Moon 277.6 degrees
Percent illumination of Moon 5 %
Sunset 2019 EDT
End Civil Twilight 2051 EDT

Altitude 10,000 feet .. Time 2031 EDT
Altitude of Sun -1.2 degrees
True Bearing to Sun 301.0 degrees
Altitude of Moon 8.8 degrees
True Bearing to Moon 277.6 degrees
Percent illumination of Moon 5 %
Sunset 2028 EDT
End Civil Twilight 2101 EDT

Altitude 15,000 feet .. Time 2031 EDT
Altitude of Sun -0.9 degrees
True Bearing to Sun 301.0 degrees
Altitude of Moon 9.1 degrees
True Bearing to Moon 277.6 degrees
Percent illumination of Moon 5 %
Sunset 2031 EDT
End Civil Twilight 2103 EDT

Trip Report: Sandia National Laboratories

On February 19, 1997 starting at 0900 Mountain Standard Time (MST) a meeting was held at Sandia National Laboratories in Albuquerque, New Mexico to discuss the theory that a bubble of methane gas ("gas bubble") released from the sea bed resulted in an electrical discharge and gas detonation at TWA 800. Other topics related to the TWA 800 investigation were also discussed. In attendance were three individuals from Sandia Laboratories and a meteorologist from JWR, Inc. The meeting was adjourned at 1700 MST.

The "gas bubble" scenario is as follows:

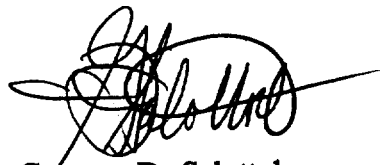
Methane gas is emitted from the sea floor and bubbles to the sea surface. This volume of gas rises from the sea surface into the atmosphere. This volume of gas can be viewed as being spherical with a diameter of about 80 feet. However, the diameter of is probably considerably larger. Since methane gas is lighter than air the gas volume now rises and mixes in the atmosphere as it ascends. The rate of rise is 2,000 to 4,000 feet per minute. As the gas reaches altitudes above 13,000 feet it interacts with the atmospheric electric field. Things now are set up for a lightning strike. The plane flies into this region and a electric discharge occurs at the airplane. The propagation point of the electric current is at the head of a fireball maybe 20 feet in diameter that propagates at 2 to 3 kilometers per second (supersonic) from the source region above. It looks like a meteor streaking across the sky. The energy contained in the electric discharge is greater than that contained in a typical lightning strike. Since there is not one attachment point as with lightning generated by a thunderstorm- electric energy is contained in the 20 feet fireball- it will not leave evidence like other lightning strikes. However, a massive amount of electric current will move through the airplane. Evidence of electrical transients should be looked for in the Flight Data Recorder or the Cockpit Voice Recorder data, or on airplane systems or structure. Detonation of the methane gas also occurs resulting in a shock wave.

An acoustic expert in the area of explosions who was at the meeting noted that the sound of the explosion as noted in witness accounts is not consistent with an explosion only of the center fuel tank. The data he has analyzed indicates that the explosive force, as determined by witness accounts, is equivalent to about 1 ton of TNT. This is many times more than what would be expected in only a center fuel tank explosion. An explosion external to the airplane is theorized. The "gas bubble" theory produces such an external explosion.

Aircraft Condensation Trails (Contrails)

Using upper air data from Upton, New York for July 18 at 0000Z (See **Attachment** 43) and information contained in the Air Weather Service publication "New Techniques for Contrail Forecasting" it was estimated that contrails would have occurred from about Flight Level 330 to above Flight Level 450. Contrail occurrence (obtained from nomograms) varied from "yes" to "probable." Three nomograms were used: 1) the non-bypass engine contrail algorithm; 2) the low-bypass engine contrail algorithm; and 3) the high bypass engine contrail algorithm (See **Attachments** 44 - 46).

> Reference: New Techniques for Contrail Forecasting; Air Weather Service; August 1993; Captain Jeffrey L. Peters; AWS/TR--93/001.



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