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NOAA Techniques Development Laboratory
Computer Program NWS TDL CP 87-1

AFOS TERMINAL AERODROME FORECAST FORMATTING

Silver Spring, Md.
July 1987

U.S. DEPARTMENT OF COMMERCE / National Oceanic and Atmospheric Administration / National Weather Service

PREFACE

The Techniques Development Laboratory's (TDL's) computer program (CP) series is a subset of TDL's technical memorandum series. The CP series documents computer programs written at TDL primarily for the Automation of Field Operations and Services (AFOS) computers.

The format for the series follows that given in the AFOS Handbook 5, Reference Handbook, Volume 6: Applications Programs, Part 1: Policy and Procedures, published by the Office of Technical Services/AFOS Operations Division.

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CP 83-1 Cross Sectional Analysis of Wind Speed and Richardson Number. Gilhousen, Kemper, and Vercelli, May 1983. (PB83 205062)
CP 83-2 Simulation of Spilled Oil Behavior in Bays and Coastal Waters. Hess, October 1983. (PB84 122597)
CP 83-3 AFOS-Era Forecast Verification. Heffernan, Newton, and Miller, October 1983. (PB84 129303)
CP 83-4 AFOS Monitoring of Terminal Forecasts. Vercelli, December 1983.
CP 83-5 Generalized Exponential Markov (GEM) Updating Procedure for AFOS. Herrmann, December 1983.
CP 84-1 AFOS Display of MDR Data on Local Map Background. Newton, July 1984.
CP 84-2 AFOS Surface Observation Decoding. Perrotti, September 1984.
CP 84-3 AFOS-Era Forecast Verification. Miller, Heffernan, and Ruth, September 1984.
CP 85-1 AFOS Monitoring of Terminal Forecasts. Vercelli and Norman, May 1985.
CP 85-2 AFOS Terminal Forecast Decoding. Vercelli, Norman, and Heffernan, October 1985.
CP 85-3 AFOS-Era Forecast Verification. Ruth, Miller, and Heffernan, October 1985.

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Assistant Administrator

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AFOS TERMINAL AERODROME FORECAST FORMATTING

James Wantz and Cynthia A. Eggers

1. INTRODUCTION

The National Weather Service (NWS) issues Terminal Aerodrome Forecasts (TAF's) for aircraft terminals serving international flights in accordance with World Meteorological Organization (WMO) requirements. Most Weather Service Forecast Offices (WSFO's) issue TAF's for at least one terminal, in addition to the Terminal Forecasts (FT's) issued for domestic aviation. This means that aviation forecasts are being prepared in two formats (FT's and TAF's) for some terminals and causes a duplication of effort by the forecaster. To assist WSFO's in preparing TAF's, an applications program has been written for the Automation of Field Operations and Services (AFOS) system, which automatically formats a guidance TAF from an FT. This program is named TAFENC (TAF encoder), and reads a data file with the following form: (cccxxx##). In this paper, ccc is the 3-letter station identifier of the issuing WSFO, xxx is the 3-letter identifier of the individual station, and ## is a two-digit number which specifies the types of forecasts issued for station xxx.

It should be stressed that the product created by TAFENC is a guidance product and not the official forecast because of assumptions (stated in the following section) that the program must make. In addition, if the 0600 GMT TAF is run off the 0100 GMT FT, the information used for the TAF is 5 hours old, and the last FT categorical forecast must be extrapolated for at least 6 hours in order for a full 24-h forecast to be produced. It is hoped, however, that the TAF encoder will significantly reduce the time spent preparing TAF's, eliminate some of the duplication effort by the forecaster, and also ensure consistency between FT's and the TAF's.

2. METHODOLOGY AND SOFTWARE STRUCTURE

Unfortunately, there is not a one-to-one correspondence between the forecast elements of the FT and the TAF (NWS, 1984; NWS, 1985; NWS, 1986), and the forecasts are not issued for the same times. Therefore, a number of assumptions are made by the program. As an example, FT's do not include the cloud types as do TAF's, and TAF's are considerably more specific in terms of cloud height and amount. Since TAFENC uses only the decoded information derived from the FT, it is necessary for TAFENC to assign a "likely" cloud type based on the FT's current weather forecast. Table 1 shows the cloud types assigned for specified weather types.

TAF's are issued at standard synoptic times (i.e., 00, 06, 12, and 18 GMT), whereas FT's are issued three times per day. Table 2 shows the issuance times by time zone. Both the FT's and the TAF's are issued for 24-h periods, and the TAFENC program is designed to be run after an FT is issued. Because of the difference in the starting and ending times of the two forecasts, TAFENC makes the assumption that the weather predicted in the FT categorical outlook group will continue until the end of the TAF valid time. The FT's contain an 18-h

"specific" forecast followed by a 6-h "categorical" forecast, of which the 6-h categorical forecast is quite general and lacking in specific detail. The FT's categorical forecasts (last 6 hours) have to be translated into the specific values required by the TAF. This is accomplished according to the assumptions found in Table 3.

Table 1. Cloud types based on terminal forecasts of significant weather.

Significant Weather	Height of Clouds		
	Low	Middle	High
CONVECTIVE (thunder)	CUMULONIMBUS (CB)	ALTOSTRATUS (AS)	CIRRUS (CI)
(w/o thunder)	CUMULUS (CU)	ALTOCUMULUS (AC)	CIRRUS (CI)
STEADY PRECIP. (excluding drizzle)	NIMBOSTRATUS (NS)	ALTOCUMULUS (AC)	CIRRUS (CI)
DRIZZLE/FOG (or other obstructions to vision)	STRATUS (ST)	ALTOSTRATUS (AS)	CIRRUS (CI)

Table 2. FT product issuance times in GMT during standard (daylight) time.

Time Zones			
Eastern	Central	Mountain	Pacific
0100 (0000)	0100 (0000)	0200 (0100)	0300 (0200)
0900 (0800)	0900 (0800)	1000 (0900)	1100 (1000)
1800 (1700)	1800 (1700)	1900 (1800)	2000 (1900)

Table 3. Translation for FT categorical forecasts.

Category Type	Weather Forecast
LIFR	8/8 cloud cover at 300 ft, visibility 800 meters
IFR	8/8 cloud cover at 800 ft, visibility 3,200 meters
MVFR	8/8 cloud cover at 2,000 ft, visibility 6,400 meters
VFR (3,000 ft < ceiling $\leq$ 10,000 ft)	8/8 cloud cover at 8,000 ft, unrestricted visibility
VFR (ceiling > 10,000 ft)	8/8 cloud cover at 20,000 ft, unrestricted visibility
VFR	Sky clear

The TAF encoder consists of three main programs and 10 TAF encoder-specific subroutines. Fig. 1 shows an overview of the program. The memory requirements for TAFENC alone are approximately 60,000 bytes of memory. Because of the large memory requirements and memory restrictions within AFOS, it is necessary to run TAFENC using an overlay structure. TAFGEN requires approximately 40,000 bytes of memory and TAFBUL requires approximately 15,000 bytes of memory. A Real-time Disk Operating System (RDOS) input file called TAFSTA is used by the TAF encoder, and specifies which stations produce TAF forecasts. Also, three other RDOS files are created by the program. The first of these files, FTARR, contains the decoded FT output written by TAFENC and used by TAFGEN to generate a TAF. The second file, cccTAFxxx, contains the generated TAF guidance forecasts without the carriage return and line feed characters necessary for proper storage as a TAF bulletin. The third file, cccWRKTAF, is the finished TAF bulletin stored in the AFOS database and is deleted after the product is stored. Neither of the latter two files should ever exceed 1,800 characters in length.

Before running the TAF encoder program, it is necessary to have the files TAFENC.SV, TAFENC.OL, TAFBUL.SV, TAFGEN.SV, and TAFSTA on the master directory or linked to the master directory. This will ensure that during program execution, the TAF bulletin will be stored properly. To activate the encoder from the ADM, type: RUN:TAFENC [ENTER] or at the Dasher, type: TAFENC [RETURN]. If you have executed the program from foreground, the alarm light will flash and the message "JOB TAFENC COMPLETED: PRODUCT cccWRKTAF STORED" will appear when you press the ALARM/ALERT button on the ADM.

3. PROCEDURES

The first program, TAFENC, reads an input RDOS file, called TAFSTA, which is used to define which FT's to process for TAF's. The stations used by TAFSTA must be designated by the user. To create this RDOS file (TAFSTA), it must be written in the following format:

cccxxx02cccxxx02...cccxxx09

The 09 is the end of file marker. TAFENC then reads FT's from the AFOS database and returns the decoded FT via the main FT decoder subroutine DCDFT (Vercelli and Leaphart, 1987). TAFENC then writes the decoded FT into an RDOS file called FTARR. Upon completion, TAFENC chains to TAFGEN. The software structure and load line for TAFENC are given in Fig. 2, and for TAFGEN in Fig. 3. TAFBUL is a main program which calls only utility subroutines. The load line is shown in Fig. 4.

TAFGEN reads in the RDOS file FTARR to obtain the decoded FT, then encodes a TAF from the FT. The newly encoded TAF is then written to the RDOS file cccTAFxxx, then TAFGEN chains to TAFBUL. TAFBUL reads cccTAFxxx, inserts carriage returns and indentations where required, then stores the output by sending it to the AFOS database as product cccWRKTAF.

4. CAUTIONS

A. Possible Program Execution Problems

When running the TAF encoder, it is permissible to run TAFENC from background by typing at the Dasher: TAFENC [ENTER]. However, when doing this, an error in FORKP will result since FORKP requires that the program be initiated from foreground. Therefore, the "product stored" message will not be displayed.

When executing TAFENC, be sure that the following files are either on or linked to the master directory: TAFSTA, TAFENC.SV, TAFENC.OL, TAFBUL.SV, and TAFGEN.SV. The program will not execute unless these files are present.

B. Program Encoding Errors

Keep in mind that the TAF encoder is only as good as the FT from which it is generated. For example, if the final group in the FT "categorical forecast" is not terminated with two periods, the FT decoder will give an error message stating that it could not find the end of the FT, and the TAF encoder will have nothing to encode.

A more subtle problem can arise when storing a work file containing FT's that was generated on a microcomputer such as the AFOS Backup Terminal (ABT) into the AFOS database. This occurs because lower case ASCII characters are often contained in the work file which was created on the PC. The lower case characters are then stored in AFOS and become part of the FT. Therefore, when the FT decoder tries to decode the FT, it encounters characters that it does not recognize. Thus, the TAF will not be produced.

Also, a TAF encoder problem may arise from a statement in the FT similar to the following: 14Z C250 OVC OCNL 250 -OVC. 20Z... The TAF encoder output generated from the above FT segment would look like this: GRADU 1314 8CI250 INTER 1420 GRADU 1920. This results because the TAF encoder does not check the thin ceiling flag set in the FT decoder, since there is no provision for thin ceilings in TAF's. Therefore, the TAF encoder assumes that the two cloud layers are redundant and does not encode the layer in the INTER group. This would normally be all right except in a situation like the one above when only clouds were forecast, and nothing is encoded in the INTER group.

Another TAF encoder limitation lies in the encoding of categorical forecasts from the FT. By their nature, categorical forecasts in the FT are very general, whereas TAF requirements are very specific. Therefore, the TAF encoder must "estimate" the forecast. Operationally, that means the forecaster will often need to modify the TAF encoder output.

Finally, as already stated, TAF's are issued at standard synoptic times, whereas FT's are issued only three times per day, depending upon location. This may cause an encoding problem as described in Section 2.

5. REFERENCES

National Weather Service, 1984: Aviation terminal forecasts. NWS Operations Manual, Chapter D-21, Manual Issuance 84-14, National Oceanic and Atmospheric Administration, U.S. Department of Commerce, 44 pp.

_____, 1985: Aviation terminal forecasts. NWS Operations Manual, Chapter D-21, Manual Issuance 85-1 (Rev. 1), National Oceanic and Atmospheric Administration, U.S. Department of Commerce, 10 pp.

_____, 1986: International aviation aerodrome forecasts. NWS Operations Manual, Chapter D-37, Manual Issuance 86-3, National Oceanic and Atmospheric Administration, U.S. Department of Commerce, 36 pp.

Vercelli, D. J. and M. Leaphart, 1987: AFOS terminal forecast decoding. NOAA Techniques Development Laboratory Computer Program NWS TDL CP 87- , National Weather Service, NOAA, U.S. Department of Commerce, (in preparation).

6. PROGRAM INFORMATION AND PROCEDURES FOR INSTALLATION AND EXECUTION

AFOS TERMINAL AERODROME FORECAST FORMATTING

PART A: PROGRAM INFORMATION and INSTALLATION PROCEDURE

PROGRAM NAME: TAFENC

AAL ID: DBC077
Revision No.: 01.10

PURPOSE: Encode TAF forecasts from official FT forecasts. The Program is designed to run off the output of the FT decoder program (DCDFT).

PROGRAM INFORMATION:

Development Programmer:

Jim Wantz

Location: Techniques Development Laboratory

Phone: FTS 427-7639

Maintenance Programmer:

Jim Wantz

Location: Techniques Development Laboratory

Phone: FTS 427-7639

Language: FORTRAN IV/Rev. 5.20

Type: Standard

Save file creation date: May 28, 1987

Running time: 15 seconds/forecast

Disk space: Program files - 260 RDOS blocks
Data files - 8 RDOS block

PROGRAM REQUIREMENTS

Program files:

NAME

TAFENC.SV
TAFENC.OL
TAFBUL.SV
TAFGEN.SV

Data Files:

NAME	Disk location	Read/Write	Comments
TAFSTA	Master Directory	R	ID's of stations to be placed in TAF bulletin
cccTAFxxx	Master Directory	R/W	TAF bulletin without carriage return-line feed (CRLF)
cccWRKTAF	Master Directory	W	Bulletin with CRLF stored in data base
FTARR	Master Directory	R/W	Decoded FT output

AFOS Product:

ID	ACTION	COMMENTS
cccWRKTAF	Stored	TAF bulletin derived from program TAFBUL

LOAD LINES

RLDR TAFENC DCDFT CLD COUNT SSEARCH IUANDEC NXTWRD DCDGRP BLNKPH WXCHKR CHKR3 CHKR2 CHKR1 DUBWX CKEY GETPRD EROR POUT [FTCOMP FINDSCL FINDKSCL DFTYPE DDSHEH AMD CKDLAU CKDLDA CKAUTOB CKDLPER FINDGRPS POSFIND, CATPHR CATDCD CATCW FRONTAL PHRCLD DRVWW VSBLTY VBWXWD SPWCHKR TQCHKR SPWIND NEWPWD NEWWXP WXWD VCNTY REMARKS OCNL CDVSSPWX WNDTQ CPYPRV CHC OBWX SLGTCHC LLWS WIND COMPCAT] BG.LB UTIL.LB FORT.LB SYS.LB AFOSE.LB

RLDR TAFGEN TAFHDR TAFCAT TAFTIM TAFREM TAFTMR TAFVIS TAFWND TAFWEA TWXNIL TAFCLD BREAD TOP.LB UTIL.LB FORT.LB AFOSE.LB

RLDR TAFBUL BREAD BG.LB UTIL.LB TOP.LB FORT.LB SYS.LB

PROGRAM INSTALLATION

1. List the contents of the supplied floppy disk and make sure the following files are present: TAFENC.SV, TAFENC.OL, TAFBUL.SV, TAFGEN.SV, and TAFINSTALL.MC.

2. TAFSTA must be created by the user. See the procedures section.

3. If all the above files are there, type at the ADM: RUN:DP#: TAFINSTALL (where # refers to the floppy drive number) and hit [ENTER], or type in at the Dasher: DIR DP#[RETURN]. Then type: TAFINSTALL [RETURN].

4. The TAFINSTALL macro will move the program files onto your master directory. If the "FILE SPACE EXHAUSTED" error prints during the execution of TAFINSTALL, it will be necessary to delete or move some files before running TAFINSTALL.MC again.

AFOS TERMINAL AERODROME FORECAST FORMATTING

PART B: PROGRAM EXECUTION and ERROR CONDITIONS

PROGRAM NAME: TAFENC

AAL ID: DBC077
Revision No.: 01.10

PROGRAM EXECUTION

1. Add the product cccWRKTAF to your wish list or database. The ccc represents your WSFO ID.

2. From the ADM type: RUN:TAFENC [ENTER].

3. When the program has completed, the alarm/alert light at your console should flash. Pressing the alarm/alert button displays the message "JOB TAFENC COMPLETED: PRODUCT cccWRKTAF STORED."

4. In order to display the product just created, type: cccWRKTAF [ENTER].

ERROR CONDITIONS

ON THE DASHER:

1.	OPEN ERROR FILE: TAFSTA!	TAFSTA file is missing
2.	CHAINING ERROR:	TAFBUL.SV is missing
3.	INVALID WEATHER GROUP FOUND!	FT decoding error
4.	FROM TAFWND: BAD WIND DIRECTION SUPPLIED.	FT decoding error
5.	AN ILLEGAL VALUE FOR CLOUD HEIGHTS FOUND.	FT decoding error
6.	CATEG. PHRASE TYPE EXPECTED	FT decoding error
7.	WARNING: THIS BULLETIN EXCEEDS 1,800 CHARACTERS.	TAF bulletin is longer than the 1,800 characters permitted by international agreement. Any information after 1,800 characters will be lost.

In case the output from this program is faulty, it is possible to run the program with a /P switch. This switch enables the printing of diagnostic messages from various subroutines within the FT decoder portion of the program. The diagnostics will be typed on the Dasher. The general form of the command would be RUN:TAFENC #/P, where # symbolizes the diagnostics number. The diagnostics number will determine what messages are printed from the FT decoder (Vercelli and Leaphart, 1987) subroutines.

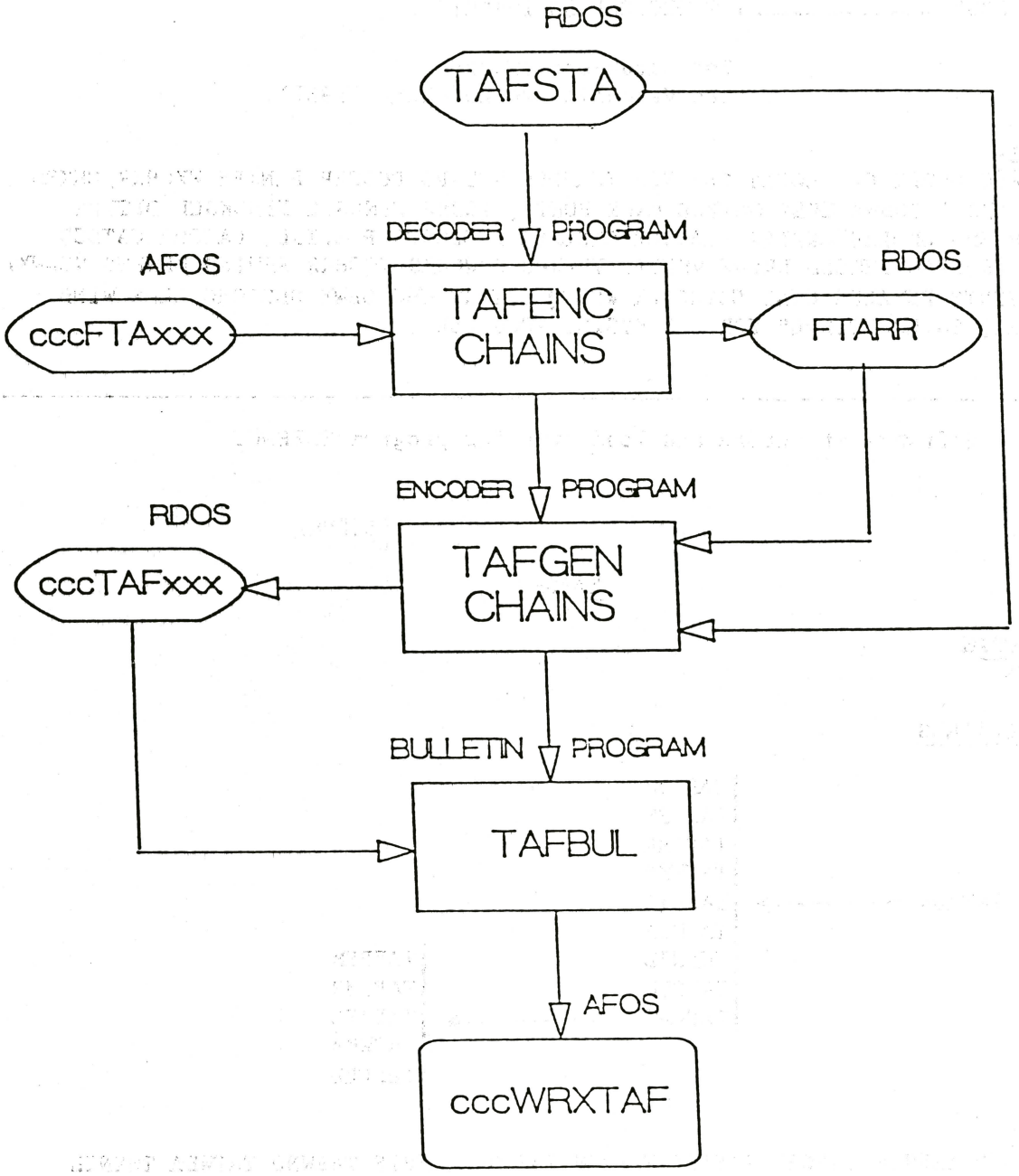

Figure 1. Overview of the TAF Formatting Program.

TAFENC

MAIN PROGRAM
TAFENC

SUBROUTINE
DCDFT ——— |FT DECODER SOFTWARE|

For structure diagram,
see Vercelli and Leaphart (1987).

LOAD LINES
RLDR TAFENC DCDFT CLD COUNT SSEARCH IUANDEC NXTWRD DCDGRP BLNKPH WXCHKR CHKR3 CHKR2 CHKR1 DUBWX CKEY GETPRD EROR POUT [FTCOMP FINDSCL FINDKSCL DFTYPE DDSHEH AMD CKDLAU CKDLDA CKAUTOB CKDLPER FINDGRPS POSFIND, CATPHR CATDCD CATCW FRONTAL PHRCLD DRVWW VSBLTY VBWXWD SPWCHKR TQCHKR SPWIND NEWPWD NEWWXP WXWD VCNTY REMARKS OCNL CDVSSPWX WNDTQ CPYPRV CHC OBWX SLGTCHC LLWS WIND COMPCAT] BG.LB UTIL.LB FORT.LB SYS.LB AFOSE.LB

Figure 2. Software structure and load line for program TAFENC.

TAFGEN

MAIN PROGRAM
TAFGEN

SUBROUTINES

TAFHDR → TAFTIM, TAFREM, TAFTMR, TAFWMD, TAFVIS, TAFWEA, TWXNIL, TAFCLD, TAFCAT → TAFREM, TAFTMR, TAFVIS, TAFWEA, TAFCLD

LOAD LINE
RLDR TAFGEN TAFHDR TAFCAT TAFTIM TAFREM TAFTMR TAFVIS TAFWND TAFWEA TWXNIL TAFCLD BREAD TOP.LB UTIL.LB FORT.LB AFOSE.LB

Figure 3. Software structure and load line for program TAFGEN.

TAFBUL

MAIN PROGRAM
TAFBUL

SUBROUTINES
BREAD

LOAD LINE
RLDR TAFBUL BREAD BG.LB UTIL.LB TOP.LB FORT.LB SYS.LB

Figure 4. Software structure and load line for program TAFBUL.