

# Tutorial on how to create and adapt data files for PMDG FMC.

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## *Introduction*

This tutorial implies that people who read it have already created their own airport, with its own VOR, NDB, ILS approaching etc. To do this there is a lot of payware and freeware software. I personally use Airport Facilitator X to create my own airports on Flight Simulator 2004 and Instant Scenery to create my own personalized sceneries.

## *THE PMDG FMC*

The PMDG FMC works by reading some files in which are registered all the airports, all the intersection points, VORs, NDBs etc. You can usually find these files in the “Flight Simulator/FMCWP/NavData” and “Flight Simulator/PMDG/SIDSTARS” folders.

In the “Flight Simulator/FMCWP/NavData” folder you'll find the following 7 files:

wpNavRTE.txt  
wpNavFIX.txt  
wpNavAPT.txt  
wpNavAID.txt  
fmc\_ident.txt  
cycle\_info.txt  
airports.dat

These files, together with the ones which are in the “Flight Simulator/PMDG/SIDSTARS” folder complete the whole FMC database.

Let's examine them one by one.

### *The “wpNavRTE.txt” file*

This file contains the routes database. Let's look at the first 5 lines:

```
A1 001 SU 65.059922 -22.755450  
A1 002 SORPU 64.714722 -22.473333  
A1 003 RK 64.151467 -22.028844  
A1 004 BRY 48.407000 3.294778  
A1 005 LUREN 48.025833 3.913889
```

As you can see the strings are composed of the name of the airway, the number of the route waypoint and at the end there are the latitude and the longitude of the waypoint itself (expressed in decimal degrees).

If you want to create a personalized airway you just have to edit this file adding some strings. If you use real-world waypoints you don't need to do anything else, while if you want to create your own waypoints you also have to edit the “wpNavFIX.txt”

file, which contains all the route waypoints that exist in the real world. The “wpNavRTE.txt” file is in alphabetical order. In order to add strings you should remember this and add your lines in the right place.

### *The “wpNavFIX.txt” file*

As I already said, this file contains the route waypoints database. Here are the first 5 lines:

```
90W70      90W70-90.000000-170.000000
90W60      90W60-90.000000-160.000000
90W50      90W50-90.000000-150.000000
90W30      90W30-90.000000-130.000000
90W20      90W20-90.000000-120.000000
```

The file is composed in the following way: name of the route waypoint, sequence of spaces, again name of the route waypoint and in the end latitude and longitude of the point. Notice that the strings are ordered by increasing latitude in this file. If you scroll down the file you can see that the latitude increases from -90.0 up to +90.0. To add a new route waypoint you should consider this fact. Be careful: the sequence of spaces between the first name and the second one **MUST NOT** be added by pushing the TAB key but pressing the space key repeatedly. The FMC counts the number of digits to read information. If you press the TAB key you are not going to insert the correct number of spaces and your route waypoint might not appear on the FMC. (I had been stuck on this mistake for months before understanding the cause, so be careful).

### *The “wpNavAPT.txt” file*

The “wpNavAPT.txt” file is one of the most important and complex to edit. It contains all the airport information. The FMC reads the location and all the data of each runway of the 24000 airports which are in Flight Simulator from this file.

This file is ordered by increasing latitude too. Here are the first 6 lines:

```
WILKINS      YWKS09 10500093-66.687500 111.491667000.0009302366
WILKINS      YWKS27 10500273-66.688889 111.563889000.0027302533
BASE MARAMBIO  SAWB06 04134061-64.240119 -56.643156000.0006100760
BASE MARAMBIO  SAWB24 04134241-64.236550 -56.618511000.0024100760
ISLE REY JORGE-MARTIN ABSCRM11 04239106-62.187778 -58.997222000.0010600142
ISLE REY JORGE-MARTIN ABSCRM29 04239286-62.193842 -58.976075000.0028600127
```

Don't panic! It seems complicated but it isn't. I managed to understand the meaning of each number on my own, and I'm going to explain them. I'll take the first line as an example:

```
WILKINS      YWKS09 10500093-66.687500 111.491667000.0009302366
  1           2   3   4   5       6           7           8   9   10
```

I coloured the different data with different colours and I numbered them.

- 1: name of the city where the airport is
- 2: airport's ICAO code
- 3: name of the runway. (When needed, you can add L or R in the empty space)
- 4: length of the runway
- 5: true direction of the runway
- 6: latitude (in increasing order)
- 7: longitude
- 8: ILS frequency (if it is available, otherwise you have to put the zeros like in the ex.)
- 9: true direction of the ILS
- 10: altitude of the runway

If you want to create your own airport and you want to insert the runways in the FMC you should edit this file as I have just explained. Be careful: the runway latitude and longitude are not the ones measured from the centre of the runway but from the ends. The best way to know the right points is to record them directly from Flight Simulator. Take your position with you aircraft at the ends of each runway and push CTRL-Z. The latitude and the longitude will appear on the monitor with other data. Take a note and (after converting them in decimal degrees) insert the data into the file.

### *The “wpNavAID.txt” file*

The “wpNavAID.txt” file contains all the VORs, DMEs, NDBs, ILSs etc. As usual, here are the first 5 lines:

```
MCMURDO STATION      NGD VOR -77.865000 167.180000114.30H
GABRIEL VIDELA      GGV NDB -64.800000 -62.800000395.00N
BASE MARAMBIO       MBI NDB -64.255556 -56.647222345.00N
MARAMBIO            MBI VORD-64.234722 -56.620000117.90H
ISLA REY JORGE      IRJ NDB -62.199444 -58.961389360.00N
```

Again, the lines are ordered by increasing latitude and they are composed in this way: name of the station, sequence of spaces, ident of the station, type of station, latitude and longitude, frequency and category of the station (which can be H “High”, L “Low”, T “Terminal” and N “NDB”). To create personalized stations you have to edit the file like the previous ones paying attention to the structure of the file, as usual.

### *The “fmc-ident.txt” and “cycle\_info.txt” files*

These files contain the strings you can see on the main page of the FMC and they have all the update information of the AIRACs and their expiry dates. We don't need to modify them.

### *The “airports.dat” file*

This file contains all the airports of Flight Simulator known by the FMC. Even if I'm

explaining this file as the last one, it is the first that you must edit because you can't see the changes you have done in the previous files if you don't tell the FMC where your airport is in advance. To open this file you have to click on it with the right key of the mouse in order to select "Open with.. ->Note Book". Here are the first 5 lines:

```
YWKS-66.686667 111.521667  
SAWB-64.244944 -56.630833  
SCRM-62.190833 -58.986667  
SCGZ-54.931072 -67.626261  
SAWH-54.843334 -68.295556
```

As you can see it is very easy and intuitive: Airport ICAO code, latitude and longitude. As usual, be careful about the increasing latitude.

If everything has been done correctly you should be able to insert your airport, see it, and select all the runways in your FMC. There is no point in proceeding with the sids and stars creation if you are unable to see all the runways on the FMC. Make sure that everything is correct, that the runways coincide with where they really are and that all the data are correct. If everything is perfect you can proceed with the sids and stars creation.

### *Creation of terminal procedures*

The previous files already existed and you only had to edit it while the file that contains the terminal procedures must be created from scratch. To do this, create an empty file with ".txt" extension whose name corresponds with the airport ICAO code. For example "LIRP.txt".

Here is how a SIDSTARS file is usually structured :

- 1: copyright information, procedures names etc..
- 2: list of the waypoints
- 3: list of the runways
- 4: list of the sids
- 5: list of the stars
- 6: list of the approaches
- 7: list of the gates

**STEP 1:** You can write whatever you want at the beginning of the file provided that each string you use is preceded by two consecutive slashes "//". What you write after the slashes will only be part of the text file and won't be read by the FMC. The first line that the FMC must read is the list of the waypoints, so all the previous lines must be followed by the two slashes.

**STEP 2:** Write "FIXES" and begin to write the waypoints list which you will use in your sids and stars in this way:

```
FIX BELEL LATLON N 43 33.19998 E 9 46.09998
```

The structure is “FIX”, name of the point, “LATLON”, “N” or “S”, latitude, “E” or “W”, longitude. Be careful: in these files the latitude and the longitude are expressed in degrees and decimal minutes. There are a lot of sites that help you to convert the latitude and longitude in the three possible formats. Here is one of them:

<http://maps2.nris.mt.gov/topofinder1/LatLong.asp>

The structure I have just explained concerns all the waypoints reported in the previous text files. If you want to create transition waypoints that are not in the text files but only in the terminal procedures files you should use the word “COLOCATED”. Here is an example:

```
FIX C163 COLOCATED PIS 163 28
```

The C163 waypoint will be automatically located at 28 miles, heading 163, from the PIS waypoint. So, to create an imaginary waypoint which is not in the database, you have to specify where you want the waypoint to be in relation to another waypoint (which is in the database). After this string you can create a chain of imaginary waypoints. For example:

```
FIX C163 COLOCATED PIS 163 28  
FIX C164 COLOCATED C163 122 10  
FIX C165 COLOCATED C164 156 20
```

The chain works on condition that the first “loop” contains a waypoint which is in the database.

When you have finished inserting the waypoints you will write “ENDFIXES” and proceed with the next step.

**STEP 3:** Write “RNWS” and begin to write all the runways of your airport; it does not matter if they are closed for landing or take off, they must appear on the FMC anyway, so write each of them, in this way:

```
RNW 04L  
RNW 04R  
RNW 22L  
RNW 22R
```

When you have finished, write “ENDRNWS” and proceed to the next step.

**STEP 4:** Here is the most complex part of the tutorial: the writing of the sids. As all of you will know, the sids are procedures that take into consideration a lot of factors such as the sorting of the traffic, the zones in which it is forbidden to fly etc, and they help the aircraft to fix the first route waypoint of the airway on which they are going to fly. The sids can be written as you like provided that you respect the structure and the commands of the file. I'll try to explain the most common commands. First of all

write “SIDS”. Each sid can contain different procedures depending on which runway the aircraft is going to use for take off, so for the same sid you may write different procedures for different runways.

Here is an example:

SID BELE6A

RNW 04L TRK 035 UNTIL 407 FIX OVERFLY D033C AT OR ABOVE 700 HDG 264 UNTIL 3000 SPEED 230 TRK 195 INTERCEPT RADIAL 254 TO FIX D254T FIX D254T AT OR ABOVE 4000 FIX BELEL AT OR ABOVE 9000

In this document I cannot write the file in the correct way because the whole procedure must be written in one line; there must be a string for each sid you create.

As you can see you have to begin writing “SID” and the name of the procedure (“BELE6A in this case). Then you have to start a new line and write the procedure. Obviously you will begin from the runway (RNW 04L).

The first command you find is “TRK”, which means TRACK. The sid means that you will take off from runway 04L and you will follow heading 035 (the real direction of the runway) UNTIL 407. “407” is the altitude expressed in feet. The aircraft will follow the runway heading up to 407 feet. Then it will fix the waypoint (FIX) “D033C”. Be careful. To make the FMC understand that it must get to a waypoint there are two different ways: FIX “name of the waypoint” and FIX OVERFLY “name of the waypoint”. In the first case the aircraft will not pass through the waypoint but it will begin to execute the next step (which can be a turn or the intercepting of a radial) a couple of miles before catching the waypoint itself. The FMC gets to the waypoint but it does not make the aircraft pass through it. On the contrary, in the second case the aircraft will pass through the waypoint (OVERFLY) then the FMC will proceed to the next step. So if the next step is a turn, the aircraft will turn ONLY AFTER having overflown the previous waypoint.

Let's resume reading the sid: at 407 feet the aircraft will proceed to waypoint D033C until it flies over it, then the aircraft will be at or above 700 feet. The command “AT OR ABOVE” can be inserted after a waypoint when you want the aircraft to fix it at a chosen altitude. In this case the altitude is 700 feet. You can also write “AT” only; in this case the aircraft will pass through waypoint D033C at 700 feet, no more no less. After passing the waypoint the aircraft will turn (HDG) to heading 264 until getting to 3000 feet and at that waypoint the SPEED will be 230 knots. Then it will be following heading 195 until intercepting radial (INTERCEPT RADIAL) 254 TO FIX the waypoint D254T. It will get to waypoint D254T at the altitude of 4000 feet or above and then it will get to waypoint BELEL at the altitude of 9000 or above.

To recapitulate the commands we have used are:

TRK (heading)	to follow a direction
UNTIL (altitude)	until reaching an altitude
FIX (name of the waypoint)	to get to a waypoint
FIX OVERFLY (name of the waypoint)	to get to and pass through a waypoint

AT (altitude)	to reach an altitude
AT OR ABOVE (altitude)	to get to or above an altitude
HDG (heading)	to turn to a direction
SPEED (speed)	to reach a speed
*INTERCEPT RADIAL (radial direction)	to intercept a radial->
TO FIX (name of the waypoint)	->to fix a waypoint

\*INTERCEPT RADIAL → TO FIX is an indivisible command because of the connection between the radial with a waypoint.

Example of other commands:

```
TRK 110 UNTIL 9.0 FROM FIX BCU TURN RIGHT DIRECT FIX D134H
```

In this sid the FMC will follow route 110 up to 9.0 miles from waypoint BCU then it will turn right and proceed directly to waypoint D134H

In this case UNTIL refers to a distance:

UNTIL (distance) FROM FIX (name of the waypoint)	until xxx miles from the waypoint
TURN RIGHT DIRECT (name of the waypoint)	turn right direct to a waypoint
TURN LEFT DIRECT (name of the waypoint)	turn left direct to a waypoint

If you open FS at the same time as you are editing your procedures you can immediately see the result. You just have to update the file inserting the ICAO code of the airport in the FMC every time you want to use your procedures. If you are afraid of making some mistakes don't worry about it. The FMC will let you know where mistakes are and you will be able to correct them.

If you want to create a sid transition you just have to insert the data as in the example:

```
SID SID3
RNW 05 TRK 054 UNTIL 8684 FIX CUV AT OR ABOVE 10000
TRANSITION CANAR FIX D008E AT OR ABOVE 12000 FIX D008J AT OR ABOVE 14000 FIX CANAR AT OR
ABOVE 25000
TRANSITION PIRCA FIX D013E AT OR ABOVE 12000 FIX D013J AT OR ABOVE 14000 FIX PIRCA AT OR
ABOVE 18000
```

Write the sid and then start a new line, write “TRANSITION” and the name of the transition itself, then write the procedure. (The name of the transition should be the one of the last waypoint of the transition itself; the same applies to the name of the sid)

When you have finished writing your sids write “ENDSIDS”

**STEP 5:** Write “STARS”. The writing of the stars is done with the same commands you used to write sids. Only the initial syntax is different:

STAR BELE1L FIX BELEL TRK 074 UNTIL 19.0 FROM FIX PIS  
STAR BERO2L FIX BEROK FIX OLKIS TRK 175 UNTIL 9.0 FROM FIX PIS FIX PIS FIX PISNB FIX JESSY

The names of the sids are written in a separate line: you have to write “SID” and the name of the sid itself, then start a new line, while the stars are written in one string. Stars are procedures that do not refer to any particular runway but usually end at a waypoint that is near the arrival airport, from which the aircraft is sorted to a runway approach. For this reason stars occupy only a string, unlike the sids which occupy more than one line.

If you want to write one or a few transitions you will have to use a separate string for each transition:

STAR DANEI2.ALL FIX DANEI HDG 253 VECTORS  
TRANSITION APE FIX APE FIX COOJO

In the sids the transition extends the procedure in its final part while in the stars the extended part is obviously the initial one. To put it more clearly, the star with the transition begins from a waypoint farther from the airport so the name of the star will not be the final waypoint any more as we have seen talking about sids, but the initial one.

If you want to specify for which runway a star is available you have to add a string composed as in the example:

RNW 02 RNW 14 RNW 20 RNW 32

It must be written immediately under the procedure.

When you have finished writing the stars write “ENDSTARS”

**STEP 6:** The approaching procedures also use the same commands as the previous ones. Write “APPROACHES” and write the procedure. The final approach contains the final waypoints of the route before the landing runway. After the runway a HOLD procedure might be inserted which can be used in case of missed approach.

Here is an example of an approach procedure:

APPROACH VORD04L FIX CD04L 2000 FIX FD04L 1500 FIX OVERFLY MD04L 284 RNW 04L FIX OVERFLY  
PIS AT OR ABOVE 406 HOLD AT FIX D309L LEFT TURN INBOUNDCOURSE 309 ALT 2000 LEGTIME 1

As you can see, you have to write “APPROACH” followed by the name (VORD04L in this case) and begin writing the procedure. At a certain point you will see the runway (RNW 04L) that will be the final waypoint in case of landing. In the case of missed approach, the procedure continues after the landing runway up to a holding waypoint which is inserted in this way:

HOLD AT FIX (name of the waypoint)

then:           LEFT TURN           Holding circuit with left turns  
                  RIGHT TURN        Holding circuit with right turns

INBOUNDCOURSE (heading)       Direction of the holding circuit

ALT (altitude)                    Altitude of the holding circuit

LEGTIME (number of minutes)    Length of the holding circuit

If you want to insert a speed limit you will write “SPEED” immediately before writing “HOLD” in the procedure.

When you have finished writing the approaches write “ENDAPPROACHES”

**STEP 7:** The gates may not be inserted in the file, but however they are an extra adding that might be useful and they are very easy to create.

Write “GATES” and then proceed creating as in the example:

```
GATE 0 N 43 40.965 E 10 23.73168  
GATE 10 N 43 41.69334 E 10 23.79516  
GATE 11 N 43 41.69868 E 10 23.79564  
GATE 12 N 43 41.72748 E 10 23.80266
```

As you can see, you have to write “GATE”, the name of the gate, the latitude and the longitude (degrees and decimal minutes as usual).

When you have finished adding the gates write “ENDGATES”.

At this point the whole file is completed. I suggest opening the “PMDG/SIDSTARS” folder to look at some of the biggest airport files so that you can realize how the files are structured, and if there is something you did not understand you can have a look at the files written by PMDG programmers, who certainly know a lot of things better than I. For any questions or mistake notifications I am leaving my private e-mail address which is: [luket87@hotmail.it](mailto:luket87@hotmail.it)

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