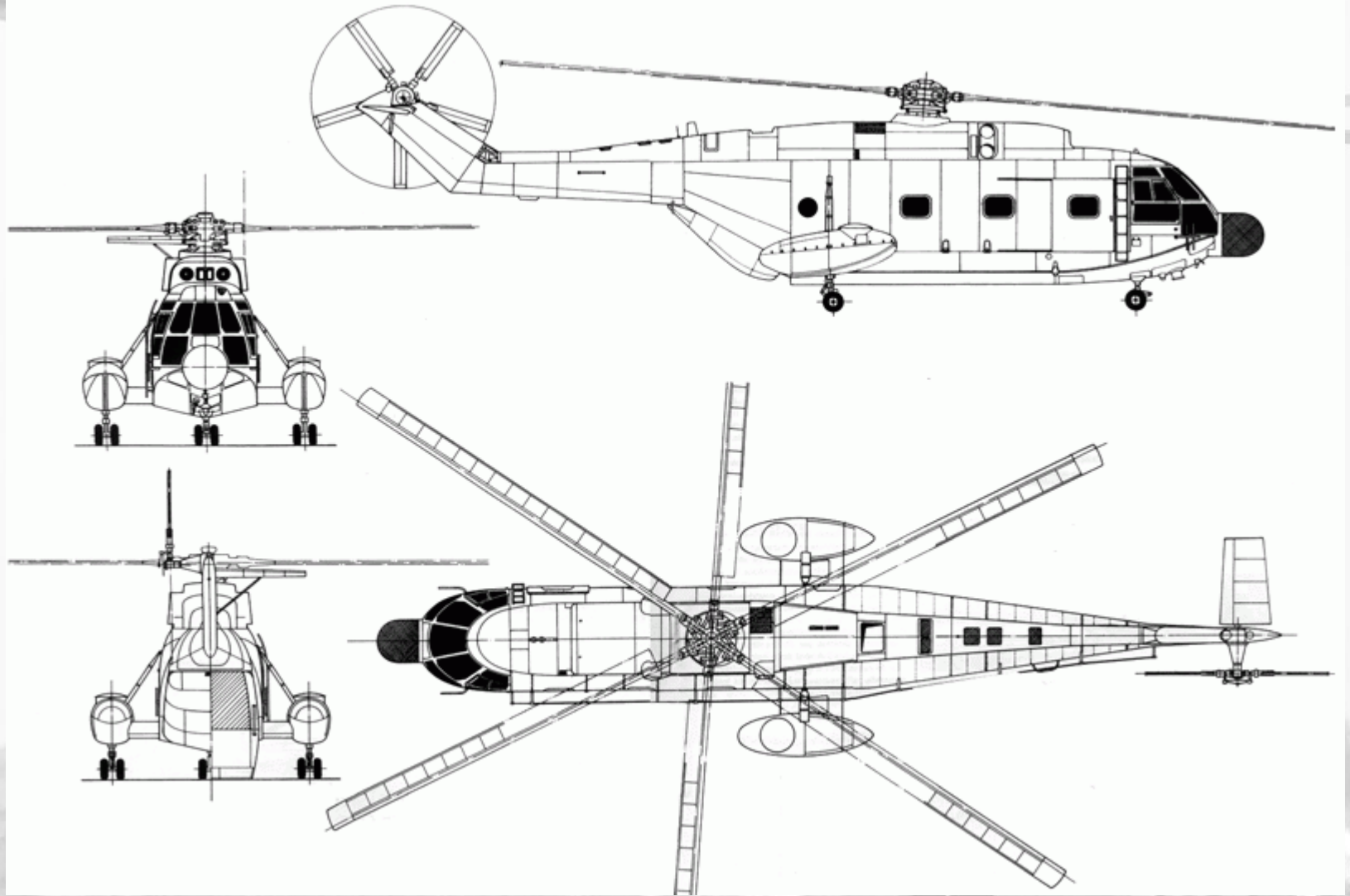


A grayscale photograph of an SA321G Super Frelon helicopter. The helicopter is shown from a front-three-quarter view, parked on a tarmac. Its main rotor blades are blurred, indicating they are in motion. The tail boom is visible on the left, and the landing gear is at the bottom. The background shows a hazy airfield with some structures and trees.

SA321G Super Frelon Pilot's Manual



A SHORT HISTORY...

The super Frelon project was developed by Sud Aviation, La Courneuve, in April 1960. The configuration of the Super Frelon was first presented during a seminar in April 16, 1961.

The Super Frelon was described as an heavy helicopter with a 6 blades main rotor, a five blades antitorque rotor, a waterproof fuselage with side floats and a rear access ramp. The empty weight was a gross weight of 12 metric tons, an empty weight of 7 metric tons and an useful load of 5 metric tons.

The super Frelon is equipped with 3 Turboméca Turmo III C2 turbine engines. These engines are free turbine type.

The engine have an air intake, an axial compressor, followed by a centrifugal compressor, a ring combustion chamber , a two stages turbine tied to the compressor and a a one stage free turbine linked to main rotor.

The three turbine engine type was retained because the configuration ease the control of multi-engines. Moreover the shutdown of an engine does not modify the rotor speed variation.

Since the beginning the Super Frelon was an international cooperation project.

The main rotor was designed by Sikorsky on the base of their flying crane helicopter S-54. The S-54 main rotor diameter was however slightly greater than the Super Frelon main rotor.

A SHORT HISTORY...

**The main transmission box and the rear transmission box were built by FIAT of Italy.
The first prototype was build at Marignane in 1961 -62.**

The 01 prototype has F-ZWWE registration and its first flight occurred in December 7, 1962. This was a land version (without floats).

The flight team was composed with Jean Boulet pilot, Roland Coffignot copilot, Joseph Turchini navigation technician and Jean-Marie Besse flight engineer.

The 01 prototype ended its career at Musée de l'Air et de l'Espace at Bourget in 1974.

The second prototype, registration code F-ZWWF, was a navy version with floats. Its first flight occurred in may 28, 1963.

**Look at Daniel Liron, "Les hélicoptères français de la SNCASE à Eurocopter"
http://aerostories2.free.fr/acrobat/helico/liron/heli_france/SE3210.pdf**

Read also the paper of Jacques Cambu and Jean Perard, "Super Frelon", Aviation and Space Magazine, Vol. 2 no. 13 Myi 1963

And of course Super Frelon from Mister Kerdiles at lela press edition... a reference.



INSTALLATION

- 1/ **Unzip Super-Frelon.zip in a temporary folder**
- 2/ **Move the folder
"Super-Frelon"
into the folder
C:\Program Files\Microsoft Games\Flight Simulator 9\Aircraft**
- 3/ **Move the files of the folder
"gauges"
into the folder
C:\Program Files\Microsoft Games\Flight Simulator 9\Gauges**
- 4/ **Move the files of the folder
"Effects"
into : the folder
C:\Program Files\Microsoft Games\Flight Simulator 9\Effects**

INTRODUCTION

The SA321G Super Frelon package included 10 variants. Each one has a specific model and texture:

Super Frelon SAR 75

Super Frelon SAR 90

Super Frelon Clean 75

Super Frelon Clean 90

Super Frelon Sonar 75

Super Frelon Sonar 90

Super Frelon Commando 90

Super Frelon Sonar torpedoes 75

Super Frelon Sonar torpedoes 90

Super Frelon Exocet 90



Various models for various missions...



SAR 75



SAR 90



clean 75



clean 75



Sonar 90



Sonar 75



Commando 90



Torpille 75



Torpedo 90



Exocet 90

ANIMATIONS

Sar 75 & Sar 90

Right lateral door

MAJ+E

Rear ramp

MAJ+E+2

Plouf

MAJ+T (*) (**)

Clean 75 & Clean 90

Right lateral door

MAJ+E

Rear ramp

MAJ+E+2

Sonar 75 & Sonar 90

Right lateral door

MAJ+E

Rear ramp

MAJ+E+2

Acoustic sonar

MAJ+T (*)

Commando

Right lateral door

MAJ+E

Rear ramp

MAJ+E+2

Câble

MAJ+T (*)

Torpille 75 & Torpille 90 & Exocet 90

Right lateral door

MAJ+E

Rear ramp

MAJ+E+2

(*) Keyboard shortcut must be defined in the menu Options / controls /
Assignments

(**) French navy rescue diver

BEFORE SELECTING

It is strongly recommended to choose a default aircraft first. Then choose the Super Frelon . If you choose first the Super Frelon after starting FS2004, it may result in a shutdown of the program.

COLD START

The Super Frelon will appear with cold engines. But because of Flight Simulator limitations, the helicopter will appear with running rotors. And because of the very large inertia of the main rotor it will take several minutes to obtain completely rest rotors.

To speed up the slowdown process, we suggest you to reselect the Super Frelon. Following this second selection, the rotor will appear at rest. Then follow the engine starting procedure described in this manual.

RUNNING ROTORS

Several simmers will prefer to have running engines and rotors at the selection. For them we suggest the following modification of the panel.cfg file.

1/Save the original panel.cfg file under a new name.

2/Edit the panel.cfg file with Notepad

3/Search for [Window00]

4/Replace the line

```
gauge00=Super_Frelon_Instr!Shut_Down, 0, 767, 1, 1
```

by the line

```
//gauge00=Super_Frelon_Instr!Shut_Down, 0, 767, 1, 1
```

In other word add two // at the beginning of the line to make it a comment.

5/Save the modification

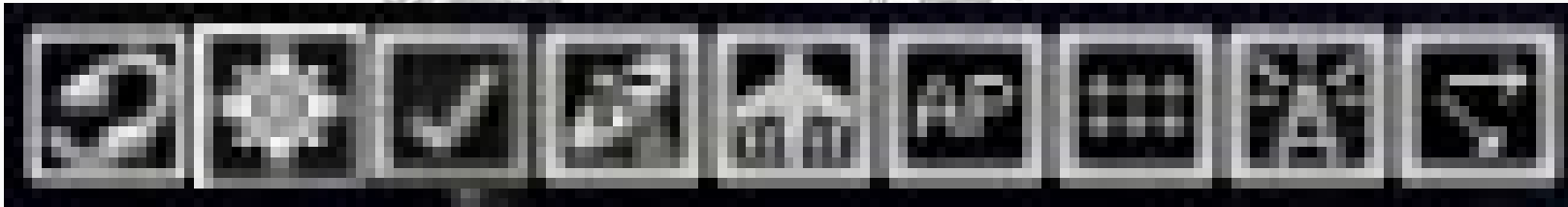
After this modification the Super Frelon will appear with running engines and rotors

SIMICONS

Never use **SHIFT + Number** to switch between the different panels, but use only the Simlcons to open/close different views simultaneously

(The Simcons close the previous view and open the new one).

Not using the Simcons will bring the superposition of several views.



The selection simicons are from left to right

Display/Hide ATC

Display/Hide Map

Display/Hide Kneeboard

Display/Hide GPS

Display/Hide Throttle engine levers

Display/Hide Autopilot

Display/Hide Engines instruments

Display/Hide Radios

Switch Main view/Landing view

PANEL

INTRODUCTION

The panel, created by Jean-Pierre Langer, is based on photos of the Super Frelon in display at Musée de l'Air et de l'Espace at Bourget airport, France and photos from a Super Frelon of the flottille 32F at Lanvéoc-Poulmic French navy base.

MAIN FEATURES

The panel has two general views : IFR and landing hereafter shown. The panel have five subpanels : GPS, Radios, Autopilot, Throttle controls and engines gauges board.



IFR view
IFR PANEL



Landing view

The IFR panel view is shown page 9, and display most of the gauges on the panel board.

LANDING BOARD

The Landing panel is identical to the IFR one, but has more outside view and the bottom last two rows instruments are not visible.

GPS

This subpanel, which displays the standard GPS-500, can be called from any panel views by clicking on the GPS SimIcon and would be closed by clicking on the same SimIcon, or by clicking on the GARMIN name at the top left corner of the GPS.



RADIOS

This subpanel, which displays some old type radios, can be called from any panel views by clicking on the Radios SimIcon and would be closed by clicking on the same SimIcon, or by clicking on the closing SimIcon on the radio subpanel.

The closing SimIcon represents an (X).

Note that all radios must first be switched ON to operate, and to let the navigation instruments display the needed information for VOR and ADF navigation instruments.

For the ADF radio, first use the On/Off switch, On the ADF radio you should first select a range of frequencies 200-410, 410-850 or 850-1750 kHz , before searching for a particular frequency value.

A left click increase or decrease the frequency by 0.5 kHz step and a right click increase or decrease the frequency by 5 kHz.





No	Identification	No	Identification	No	Identification
1	Radio altimeter	6	Airspeed	11	VOR / ILS
2	Hover indicator	7	Altimeter	12	Standby artificial horizon
3	Main rotor blades angle	8	Slip ball	13	G-meter
4	Vertical speed	9	Warning low speed rotor light	14	Chronometer
5	Artificial horizon	10	Rotor RPM		

HOVER INDICATOR

The hover indicator have two mode of operation, which can be selected using the switch located at the bottom left corner of the instrument :

- ILS** The hover indicator give the same indications than a VOR / ILS
- IVS** hover control display



ILS Mode



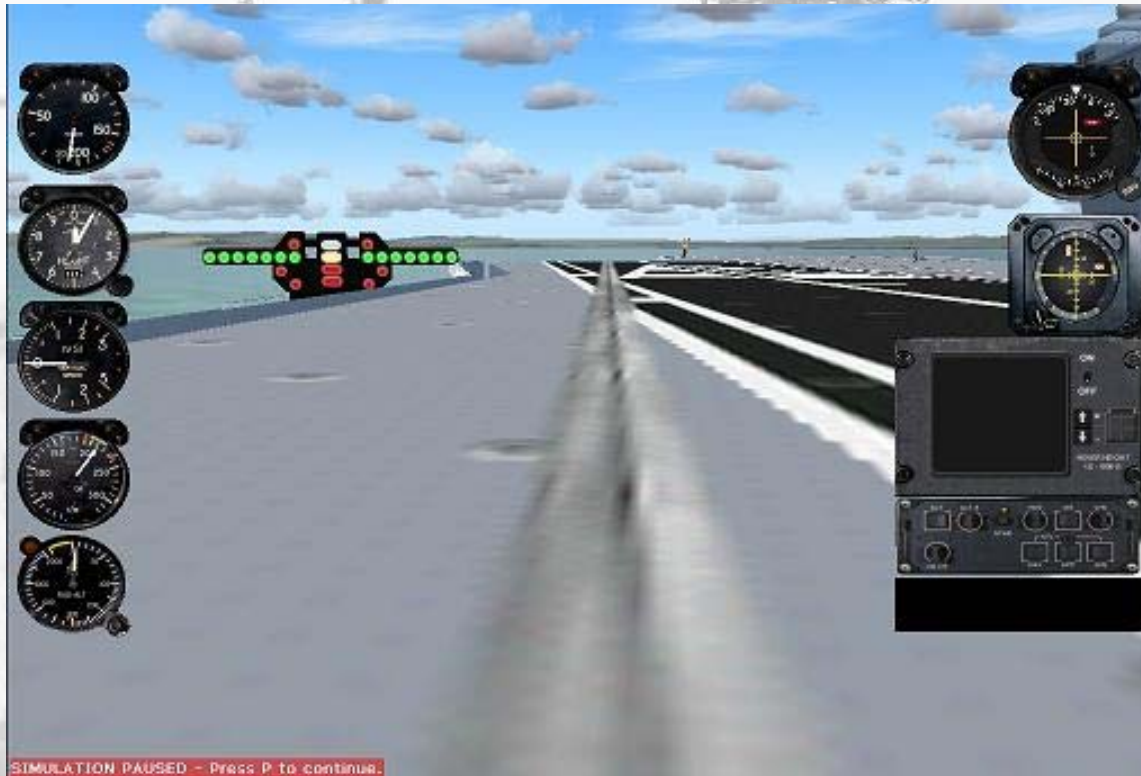
IVS Mode

In the IVS mode the hover indicator give clues to maintain an hover
The horizontal bar give an indication of the forward/backward helicopter speed
The vertical bar give an indication of the lateral helicopter speed
The hover indicator included also an airspeed indicator represented by an arrow head in the bottom right of the IVS Mode" picture
To maintain an hover, the vertical and the horizontal bars should be centred

MINIPANEL

The pilot of real helicopter would tell you. During the precision landing on an helipad, the pilot look outside and give only a glance to the instruments.

To help you during the helipad landing, you can use the MINIPANEL view



One can access the MINIPANEL view by using the shortcut key W,
By using the shortcut key W again one will obtain a view without instrument.
A third use of shortcut key W will bring back the instrument panel

AUTOMATIC HOVER

INTRODUCTION

The automatic hover command board is located on the upper part of the autopilot subpanel.



<i>N o</i>	<i>Identification</i>	<i>N o</i>	<i>Identification</i>
1	On/Off switch	6	Vertical scale
2	Activation button	7	Hoer height display
3	Buttons to change hover height	8	Heading
4	Display panel	9	Ground speed
5	Horizontal scale		
10	Altitude hold mode on/off	15	Vertical speed hold mode On/Off
11	Reference altitude change	16	Cruise height
12	Autopilot On/Off	17	NAV mode On/Off
13	Heading change	18	Approach mode On/Off
14	Air speed hold mode On/Off	19	Glide slope mode On/Off

HOW TO USE AUTOMATIC HOVER ?

- 1/ Click on switch 1 (ON) This will light on the display
- 2/ Click on the protective cover of the square button 2
- 3/ To activate the automatic hover, click on the pad of button 2.
The message HVR will appear
The default hover height is set to 10 feet above the ground,
(see display 7)
- 4/ After activation and a transition period, the helicopter will reach 10 feet above the initial point.
- 5/ If you click on a vertical up arrow (+) the helicopter will climb
- 6/ If you click on a vertical down arrow (-) the helicopter will descent
The left display have a centre cross hairs (4), an horizontal scale at the bottom (5)
- 9/ If you click on the vertical cross hair, above de centre point, the helicopter will go forward
- 10/ If you click on the vertical cross hair, below de centre point, the helicopter will go backward
- 11/ If you click on the horizontal cross hair, at right of de centre point, the helicopter will go to right
- 12/ If you click on the horizontal cross hair, at left of de centre point, the helicopter will go to left
- 13/ If you click on the vertical scale at the bottom, left or right ends, the helicopter will rotate to left (contraclockwise) or right (clockwise)
- 14/ When the helicopter is in cruise flight and you want to transition to an hover, you should do it manually by reducing airspeed lower than 40 kts, before activating the automatic hover
- 15/ We suggest to place the helicopter in hover at some distance of the hover point.
Then using the controls described above, move the helicopter over the hover point.

AUTOPILOT

INTRODUCTION

The autopilot control board is located in the lower part of the autopilot subpanel.

LIMITS OF USE OF THE AUTOPILOT

The autopilot will work only if the following conditions are met.

The helicopter must have an airspeed greater than 40 knots

The helicopter must be at least 200 feet above the ground.

The parking brakes must be off



EXAMPLE OF AUTOPILOT USE

- 1/ On the ground, enter the heading with the OBS at the bottom right of VOR/ILS (11) on the main panel
- 2/ Click three times on the right side of the knob (15) to enter a reference vertical speed of 300 feet/minutes
- 3/ When you reach an airspeed greater 40 kts and an altitude greater than 200 feet above the ground, activate the autopilot with the switch (12)
- 4/ Click on the centre of the knob (15) to activate the vertical speed hold mode.
- 5/ Click on the centre of the knob (13) to activate the heading hold mode
- 6/ When you are near the wanted altitude, click on the centre of the knob (10) to activate the altitude hold mode. This will deactivate the vertical speed hold mode
- 7/ If you click on the knob (14) you will activate the airspeed hold mode . This will deactivate the altitude hold mode
- 8/ If you click on the knob (17) you will activate the NAV mode to follow the chosen course
- 9/ If you click on the knob (18) you will activate the approach mode on an ILS runway. However when the helicopter will reach 200 feet above the ground, the mode will be deactivated , and you will have to complete the landing manually
- 10/ If you click on the knob (19) you will activate the glide slope mode on an ILS approach.
- 11/ When you click on the left or right side of the circle around the knob (11) you will decrease or increase the reference altitude
- 12/ If you click on the centre of the knob (16) you will activate height above ground hold mode. When you click on the left or right side of the circle around the knob (16) you will decrease or increase the reference height
- 12/ The round knob (11, 13, 15) have a circle around them When you click on the left or right side of the circle you will decrease or increase the reference values.
- 13/ If you click on the centre of the knobs 13 or 15 you will activate the corresponding modes.
- 13/ The square buttons are switches

NORMAL PROCEDURES

STARTING ENGINES PROCEDURE

In the procedure the expression "**push forward the lever**" translate visually as a downward displacement of the lever on the panel view.



- 1/ Open the throttle subpanel
- 2/ Open the engines instrument subpanel
- 3/ On the throttles subpanel push forward the yellow & black lever (fuel intercom lever)
- 4/ Push forward the red fuel emergency cut off lever of the turbine 1 (left red lever)



- 5/ On the engines instruments subpanel, click on the fuel pump switch of turbine 1. The fuel pump light will goes ON

When the pointer of the mouse is over a gauge, an help pop up window give the name and the status or value reading of the gauge.

6/ With a right mouse button, click on the red protection cap of the starter of turbine 1. This action will open the protection cap, The starter protection caps are located at bottom centre of the subpanel. The starter of turbine 1 is the left one. Then click and maintain the mouse button push on the switch, until the engine is started. Initially the RPM increase slowly, then the RPM increase more rapidly. When the engine RPM reach at least 13000 RPM, you can release the push on the mouse button.

7/ Close the protection cap with a right mouse button click

8/ Wait until the engine 1 reach 20000 RPM. Then repeat the steps 3 to 8 for the turbine 2 and after for the turbine 3.



9/ Push forward the left black throttle lever of turbine 1. Then push forward the centre black throttle lever of turbine 2. Finally push forward the right black throttle lever of turbine 3.

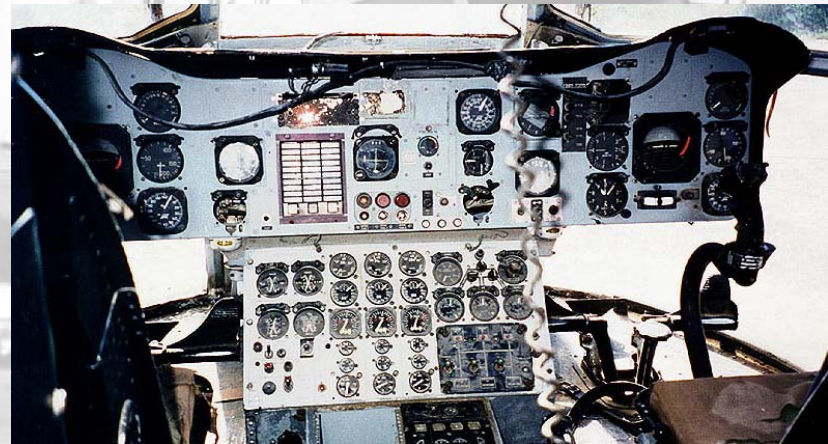
10/ Watch the increase of rotor RPM and increase slightly the collective pitch control (throttle on your joystick). If the rotor RPM decrease, decrease slightly the collective pitch control until the rotor RPM increase again. At 30 RPM value, the minimum rotor speed warning light will flash. The warning light will go off when the main rotor will reach its nominal value of 210 RPM (on the green arc on the main rotor RPM dial face).

11/ Now you can close both subpanels and prepare for take off.

TAKE OFF WITH AUTOMATIC HOVER

1/ Activate the automatic hover as described previously

2/ Choose an 45 feet hover height.



AUTOMATIC HOVER DISACTIVATION & TRANSITION TO HORIZONTAL FLIGHT

- 1/ If the automatic hover have been activated on ground, we must deactivate it before starting the transition to horizontal flight
- 2/ Increase the collective pitch control to it maximal limit 2/Click on the square button to deactivate the automatic hover
- 4/ Click the switch (1) OFF
- 5/ Adjust the collective pitch control to maintain your altitude or the vertical speed

CLIMB

- 1/ Increase the collective pitch control as required
- 2/ Counter the torque effect with the control pedals (rudder)
- 3/ Adjust the pitch angle of the helicopter using the cyclic pitch control

CRUISE

- 1/ Check the airspeed.. If greater than wanted, put stick backward and simultaneously reduce the collective pitch control to maintain the altitude
- 2/ If the airspeed is lower than wanted, push the stick and s simultaneously increase the collective pitch control to maintain altitude
- 3/ If the altitude is greater than wanted, decrease the collective pitch control
- 4/ If the altitude is lower than wanted, increase the collective pitch control

TRANSITION TO HOVER

- 1/ Increase the helicopter pitch angle to reduce the airspeed
- 2/ Simultaneously decrease the collective pitch control to hold altitude
- 3/ When the airspeed is lower than 20 kts, put ON the automatic hover switch (1)
- 4/ Click on the protection cover to uncover the activation pad
- 5/ Click on the activation pad. The HVR will light on.

To move the helicopter in hover see the automatic hover procedure described previously

LANDING USING AUTOMATIC HOVER

- 1/ Reduce the hover height to its minimal value (10 feet)
- 2/ Put the collective pitch control at middle course
- 3/ Deactivate the automatic hover
- 4/ Adjust the collective pitch control to obtain the wanted vertical speed

MANUAL LANDING

- 1/ Adjust the collective pitch control to obtain the wanted vertical speed
- 2/ Adjust the heading with the control pedals
- 3/ Hold airspeed by increasing the helicopter pitch angle or reduce the airspeed by decreasing the helicopter angle to increase airspeed
- 4/ Watch the visual clues to land on the helipad

SHUTDOWN ENGINES PROCEDURE

- 1/ Open the engine control subpanel
- 2/ Click on the red fuel cut off lever of turbine 3
- 3/ Click on the red fuel cut off lever of turbine 2
- 4/ Click on the red fuel cut off lever of turbine 1
- 5/ Click on the yellow – black lever

After the shutdown of the three engine, the main rotor will take at least 3 minutes to slow down. To shorten the process increase the collective pitch control, this will increase the pitch blade angle and increase the drag so to slowdown the rotor speed

Rescue Mission : Lost tanker in Ouessant's Rail...



A TYPICAL MISSION STORY

The flight crew members have taken place aboard the Super Frelon for an evacuation training mission with our courageous Plouf (French navy rescue diver)

Super Frelon : “Lanvéoc Ground, from Black Belligou for engines start”.

“Clear for engines start. Call when ready to move”

In cockpit the flight crew members have start the long checklist procedure. Then come the moment to start the first engine

“Fire security in place

Rotor brake released

Ready for the number one..

Ventilation on, three,.. two ... unity. Top start sequence.

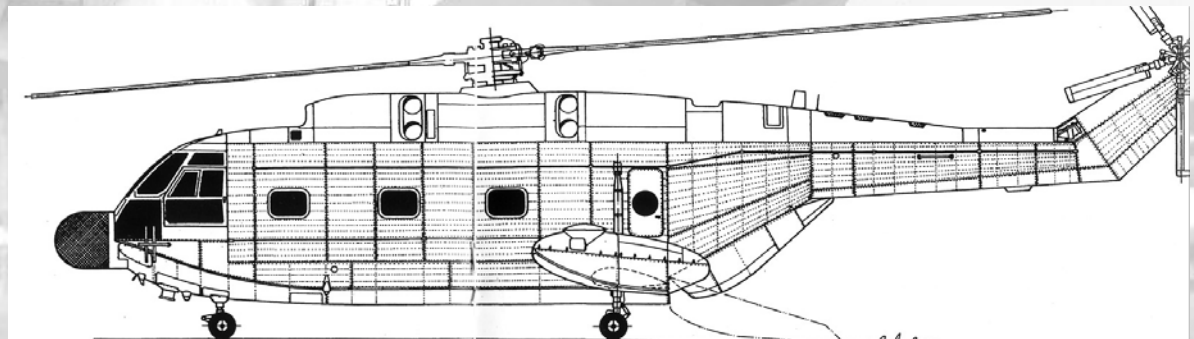
The yellow... T4 increase...the pressure take off...the yellow warning light off...

13000 RPM..

engine ignition...

hydraulic pump ON...

Ready for the two”...





Then the two other turbines are started...

“Lanvéoc Ground, from Black Belligou, ready to move”

“Black Belligou enter 4600 on the transponder and, pass to Tower control”.

“4600...”

The pilots look at left and right. ...clear on left...clear on right. The helicopter start taxi on the tarmac and arrive to the runway assigned

“Lanvéoc Tower from Black Belligou ready to align”

“Black Belligou, align on runway 24. call when ready for take off”.

The flight mechanic (“mecbo” in the French navy) do the last points check :engine parameters, main transmission box and hydraulic parameters are OK. We can go

“Lanvéoc from Black Belligou we are ready for take off.”

“Roger, Take off and call in transverse delta”

The pilot pull the collective pitch control, 32600 RPM,. Vertical climb at 70 feet above ground. Then the pilot push the stick forward and the helicopter take an 10 degree nose down position to achieve a 70 kts airspeed.

At 85 kts, the flight mechanic activate a switch to change the main rotor reference speed value 207 to 212 rpm, in order to optimize the main rotor operating condition.

The cruise airspeed is now 120 kts,



Lanvéoc Approach from Black Belligou, we cross the sea coastal line

Roger, call when the mission is completed

The helicopter is now in sight of the French navy tugboat Malabar.

Malabar, Malabar, from Black Belligou for contact uniform.

Black Belligou from Malabar, Loud and clear.

Malabar from Black Belligou, we arrive in sight of the ship and we request a evacuation simulation on you rear desk

Black Belligou from Malabar, authorization granted

Malabar from Black Belligou, we are vertical of the ship in one minute.

Black Belligou from Malabar, course avia 278, 8 kts, pitch 3, roll 5

Roger, what is the wind on the desk?

19 kts, authorize to start the exercise

On a clear and calm day, one stabilize the helicopter manually. When the weather is bad, the autopilot 4- axes is activates. The helicopter is put in the wind direction.

The flight mechanic guide the pilot... The door is opened. The Plouf is outside

5 meters forward, 2 meters left ...

In hover the Super Frelon burns 1000 kgs/hr as compared to 300 kgs/hrr in cruise flight.

AUTHORS

Project Manager :

Benoît Dubé

Model Masters and textures

Pierre Marchadier

Panel, subpanels & gauges

Jean-Pierre Langer

Antty Pankonen

Arne Bartels

autopilot gauge

Automatic hover gauges

Flight dynamic

Benoît Dubé

dube_benoit_m@yahoo.fr

Documentation

Benoît Dubé

Jean-Pierre Langer

Pierre Marchadier

Rescue Tanker Scenery :

Project managers : Yannick Mille (fsfrance)
Sébastien Petiteau (Fsfrance Brest ;-)

Model : Pierre Marchadier

HELP & SUPPORT :

For help and support please use :

- the **Gmax Academy** forum <http://forum.gmax-ac.fr/index.php>
- the **Francesim** forum <http://www.francesim.info/forumfs/>
- the **Hovercontrol** message forums

ACKNOWLEDGMENTS :

We would like to thank all those who have shown interest about the Super Frelon project, in their post on Francesim, FsFrance and the Gmax AC fora.

These messages were numerous and the interest have not fade out during the long creation process. Sorry for this long delay.

These messages were a strong motivation to us to overcome the development problems.

We would like also to specially thank Lanvéoc, Blackhawk, Belligou Charlie, Jean-Marie (jjmsl) who have generously given data about the real Super Frelon.

We would like to greatly thank Olivier Mabilie, Real Super Frelon pilot, for his help during the project.

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