9 – OBOE SYSTEM
9.1 – What is "Oboe"?

"Oboe" was a British aerial blind bombing system of the second world war based on radio transponder. This system was used to guide bombers to a specific target and provide cue signals to let the pilot and navigator know if they were following the pre-planned route or not.

The Oboe system consisted of a pair of radio transmitters on the ground, which sent signals which were received and retransmitted by a transponder in the aircraft. **By comparing the time each signal took to reach the aircraft, the distance between the aircraft and the station could be determined**. The Oboe operators then sent radio signals to the aircraft to bring them onto their target and properly time the release of their bombs.

The system was first used in December 1941 in short-range attacks over France where the necessary line of sight could be maintained. To attack the valuable industrial targets in the Ruhr, only the de Havilland Mosquito flew high enough to be visible to the ground stations at that distance. Such operations began in 1942, when Pathfinder squadron Mosquitos used Oboe both to mark targets for heavy bombers, as well as for direct attacks on high-value targets. In an attack on 21 December 1942, Oboe-guided bombers dropped over 50% of their bombs on the Krupp factories in Essen, an enormous improvement over previous efforts that resulted in less than 10% of bombs landing on their targets. Versions using shorter wavelengths demonstrated accuracy on the order of 15 meters (about 50 ft).

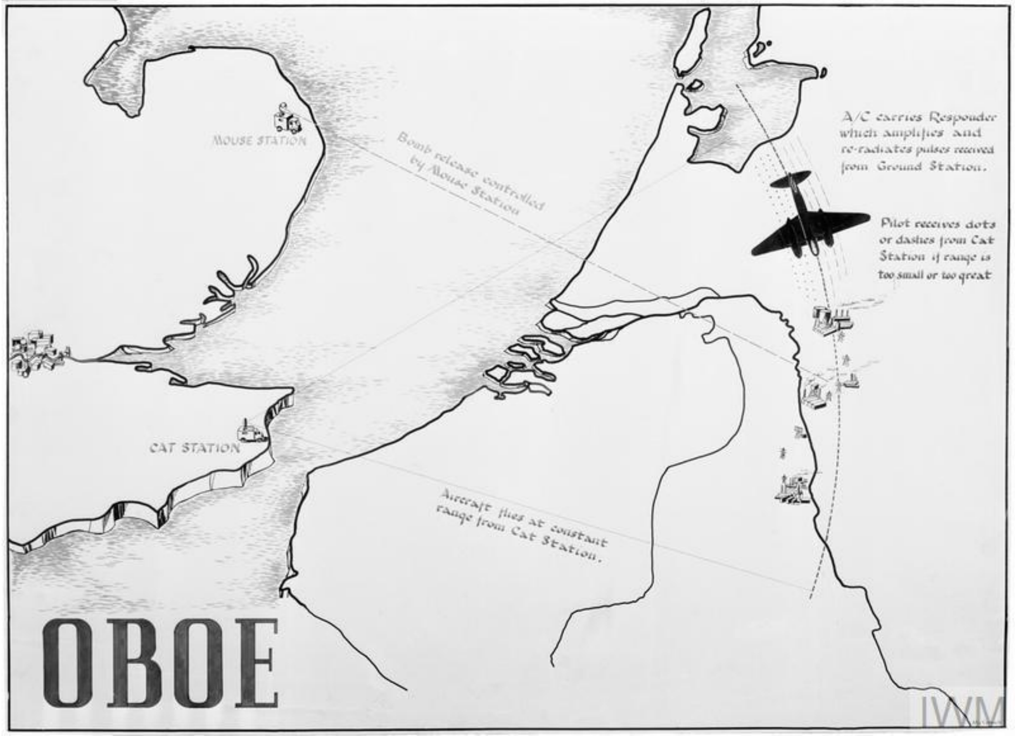
Oboe was used extensively by Pathfinder marker aircraft during the Battle of the Ruhr in 1943. In December 1943 Bomber Command began the Battle of Berlin, which was beyond the range of Oboe. For this campaign, Bomber Command was forced to rely on the H2S ground mapping radar instead, which never was able to provide the consistent accuracy of Oboe.

A later development was the Gee-H system, in which the transponder remained on the ground but the transmitter was mounted in the aircraft where the readout was made. This system allowed around 80 aircraft to be guided at the same time. Neither the H2S ground mapping radar nor Gee-H could provide the accuracy of Oboe, which demonstrated the highest average bombing accuracy of any system in the war.

Take note that the Gee-H and H2S systems were not installed in our DCS Fighter-Bomber Mosquito.

Here is a nice video about Oboe by Jake Howland:
https://youtu.be/hURdl91MCNQ

Interesting Oboe article by "Pathfinder Craig"
https://masterbombercraig.wordpress.com/bomber-command-structure/no-8-pff-group-bomber-command/pathfinder-force-pff/pathfinder-methods/oboe/




Oboe Navigation Console & Operator

9 – OBOE SYSTEM
9.1 – What is “Oboe”?

The basic concept would be to have two ground stations that would periodically send out signals on similar but separate frequencies. The aircraft carried transponders, one for each signal, which re-broadcast the signals upon reception. By timing the total round trip time from broadcast to reception and then dividing by twice the speed of light (the signal travels to the aircraft and back again) the distance to the aircraft could be determined. This was essentially identical to radar, with the exception that the transponder (transmitting at a frequency of about 200 MHz) greatly amplified the signals for the return journey, which aided accuracy by providing strong, sharply defined signal pulses.

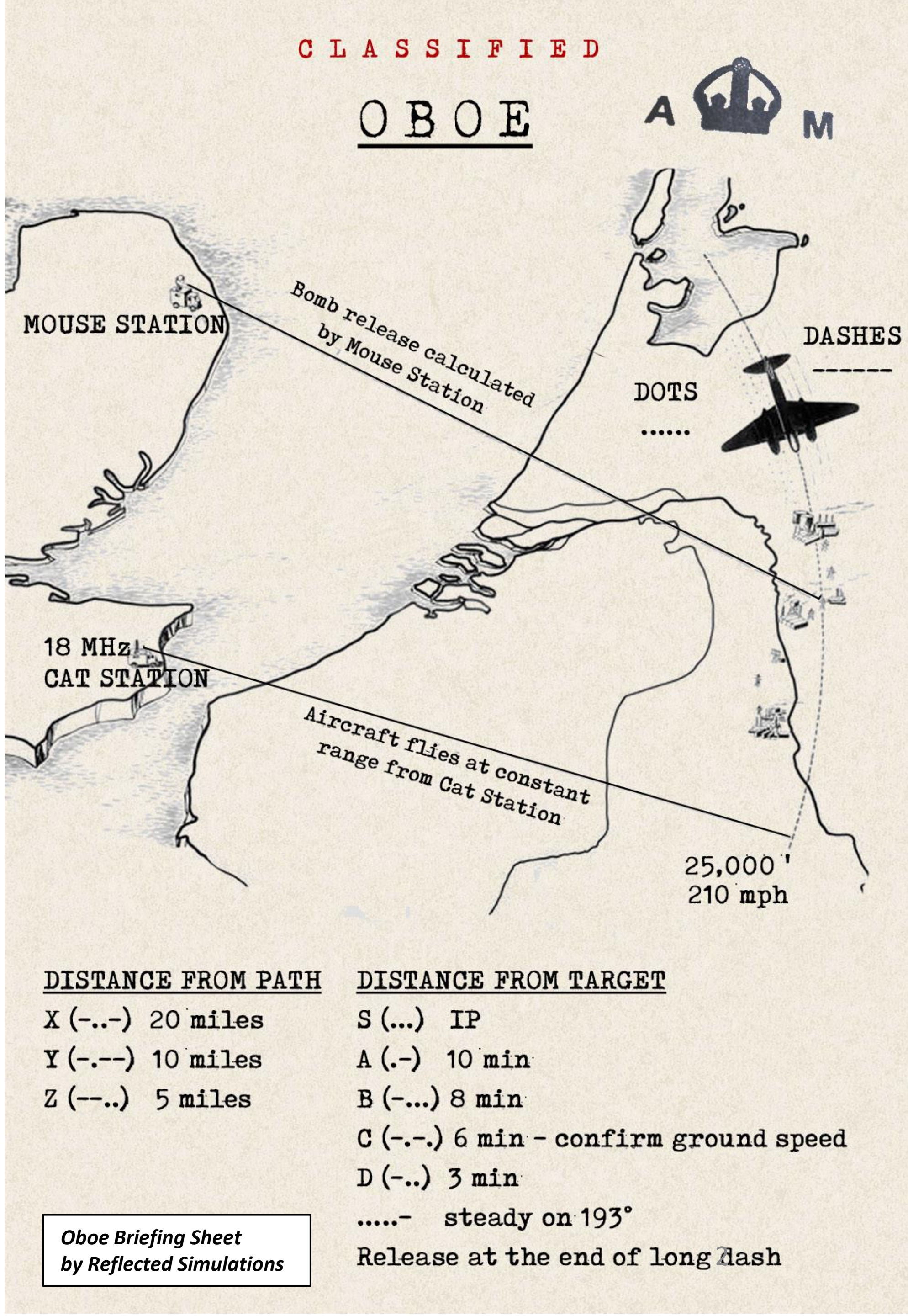
Before the mission, a path was defined that represented the arc of a circle whose radius passed through the target as measured from one of the two stations. This station was given the name "Cat". The aircraft would then use conventional navigation techniques, dead reckoning or Gee if it was equipped, to place itself some distance north or south of the target on a point near this line. They would then begin flying towards the target, at which point an operator at Cat would call out corrections to have the aircraft fly closer or further from the station until it was flying at precisely the right range to keep it on the circle

- The first station, code-named “**Cat**, continued to keep the aircraft positioned at this precise distance as it flew towards the target, causing the aircraft to fly along the pre-defined arc.
- The second station, code-named "**Mouse**", calculated the range to the target before the mission. As the Mosquito approached that predetermined range, they would first call out a "heads up" to tell the bomb aimer to begin the run, and then a second signal at the right time to drop it.

Using this method there was no need for the two stations to compare measurements or perform any trigonometry to determine an actual location in space, both performed simple range measurements directly off their screen and sent their separate corrections to the aircraft.

In practice, ranges were not sent by voice to the aircraft. Instead, a tone generator produced Morse code dots or dashes under the control of the operators. This was similar to the beam systems like Lorenz, which the UK aircrew were already familiar with using as a blind landing aid in the pre-war period. If the aircraft was too close to the station the operator would play the dot signal, and when they were too far, dashes. The two could be mixed so that as they approached the correct range, the dots would fill in the gaps between the dashes and form a steady tone.[4]

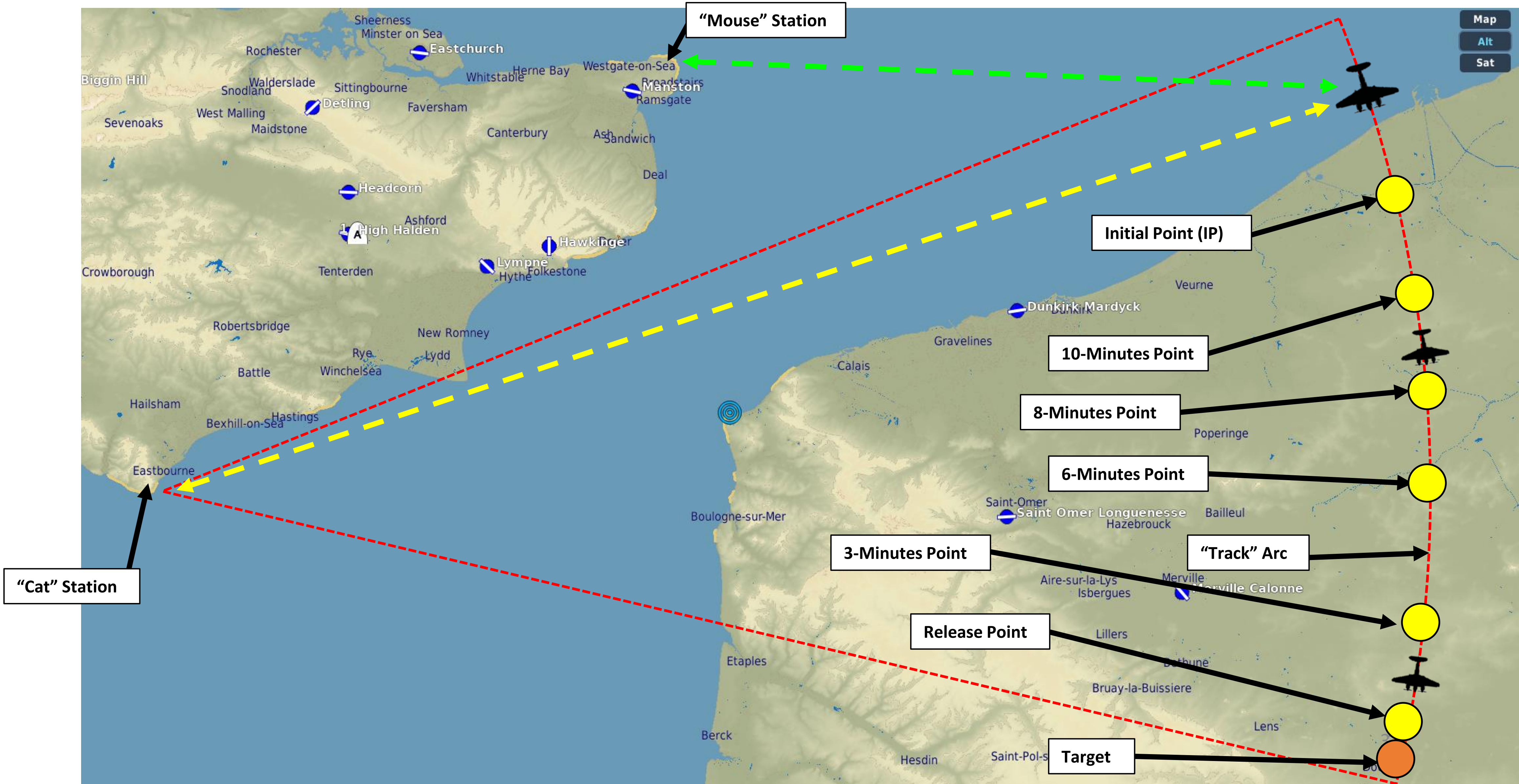
Periodically the signal would be keyed to send out a letter to indicate how far they were from the correct range, X indicating 20 miles (32 km), Y 10 miles (16 km), and Z 5 miles (8.0 km). Likewise, the Mouse station sent a series of keyed signals to indicate the approach, S to indicate the approach was starting, and then A, B, C and D as the aircraft approached.



Oboe Briefing Sheet by Reflected Simulations

9 – OBOE SYSTEM
9.1 – What is "Oboe"?

Here is an overview of the Oboe system with the Cat and Mouse Stations, including reference points.



9 – OBOE SYSTEM
9.1 – What is "Oboe"?

Oboe was first used by Short Stirling heavy bombers in December 1941, attacking Brest. In December 1942, Oboe on Mosquitos was trialed at Lutterade. Half of the Oboe units malfunctioned in some way. This was about the same time as H2S ground mapping radar was introduced. The Germans, observing the curved path of the Mosquito, called the system "Boomerang". The predictable path of the bomber was a vulnerability, compensated for by the fact that the speed and altitude of the Mosquito made it very hard to intercept. The major limitation of Oboe was that it was a line-of-sight system; the curvature of the Earth therefore allowed it to be useful for attacking the Ruhr industrial area, but not targets deeper inside Germany.

Oboe was extremely accurate. In his book "Most Secret War", British physicist R. V. Jones wrote, "As it turned out, Oboe was the most precise bombing system of the whole war. It was so accurate that we had to look into the question of the geodetic alignment of the Ordnance Survey with the Continent, which effectively hinged on triangulation across the straits of Dover." With an error radius of about 110 metres (120 yards) at a range of 400 kilometers (215 nm), Oboe was about as good as optical bombsights. Late in the war, it was used for humanitarian purposes to assist food drops to the Dutch still trapped under German occupation, as part of Operation Manna. Drop points were arranged with Dutch Resistance contacts and the food canisters were dropped within about 30 m (98 ft) of the aiming point thanks to Oboe.

It took the Germans more than a year to discover the mystery of the system. Oboe was cracked by engineer H. Widdra (who had already detected the British "Pip Squeak" (IFF, Identify-Friend-or-Foe) in 1940) at the end of August 1943 at the RF tracking station "Maibaum", located in Kettwig near Essen, while the British bombers attacked the steelworks of "Bochumer Verein".

The Germans tried to jam 1.5 metre / 200 MHz Oboe signals, though by the time they did the British had moved on to the 10 cm / 3 GHz Mk.II Oboe and were using the old transmissions as a ruse. This was discovered in July 1944 after its operator failed to properly mark a drop using the Mk.1 signals.

The Mk.III of April 1944, was more sophisticated. Four aircraft could operate on one frequency and the system could accommodate approaches other than simple radial ones.

9 – OBOE SYSTEM
9.2 – Principles Behind "Oboe"

The main principle behind Oboe are based on the physics of radio signals. If we draw a Track Line (Arc) to the target with the Cat Station as its center… how can the operator of the station know when the aircraft is crossing the Track Line? Well, if we know the speed at which the radio wave travels.

Problem: We want to know how far the aircraft is from the Cat Station.

Solution: Take the time between Cat station radio transmission and transponder response signal reception, and multiply it by the speed of the radio signal (known). This will give you the travel distance of the wave.

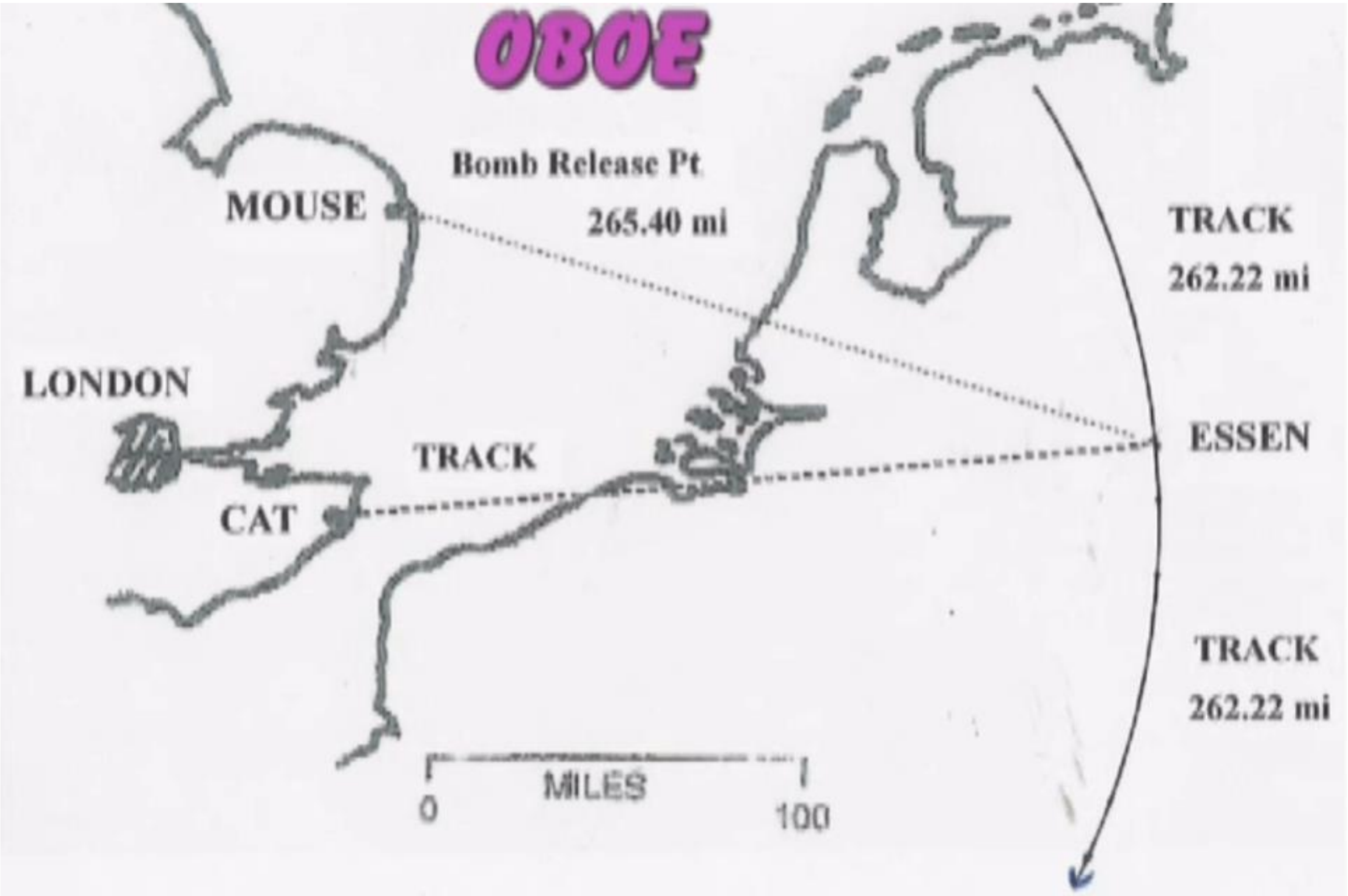
Speed of Radio Signal = 1000 ft / microseconds (uS)

Delay between Cat Station Pulse Signal Emission and Reception of the Transponder Response signal of the Aircraft = 2769.04 uS

Time Requirement (One Way) = Delay / 2 = 2769.04 uS / 2 = 1384.52 uS

Total One-Way Distance between Aircraft and Cat Station (ft) =
Time Requirement x Speed of Radio Signal = 1384.42 uS x 1000 ft/uS
= 1384520 ft

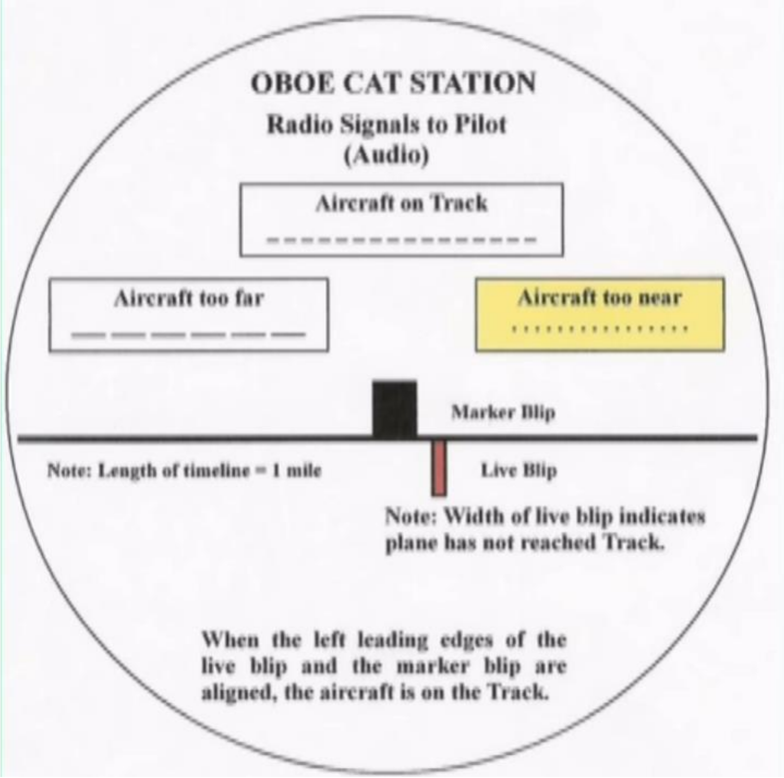
Total Distance (miles) = Total Distance (ft) / 5280 ft/mile
= 262.22 miles

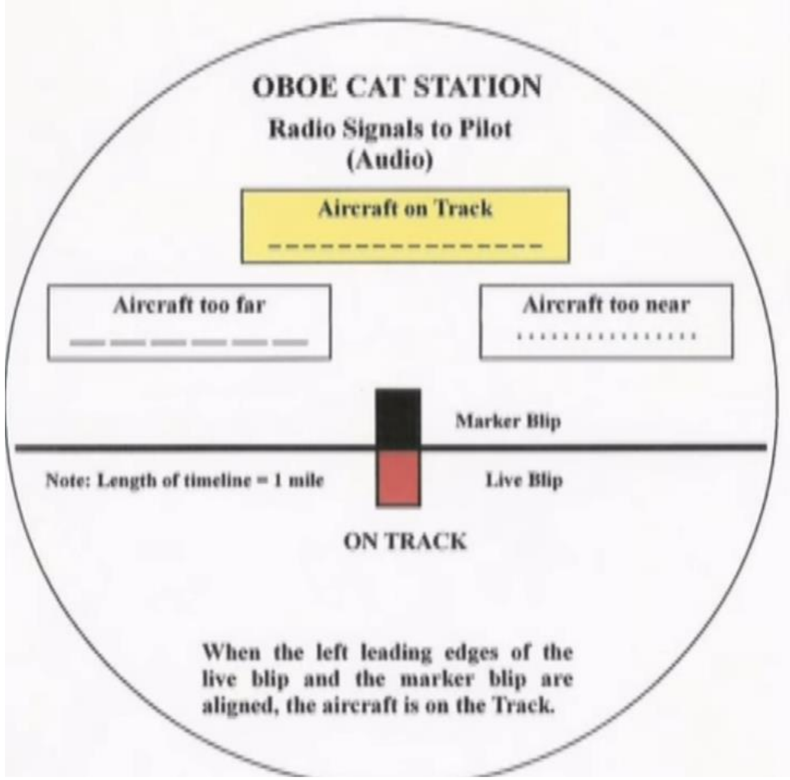


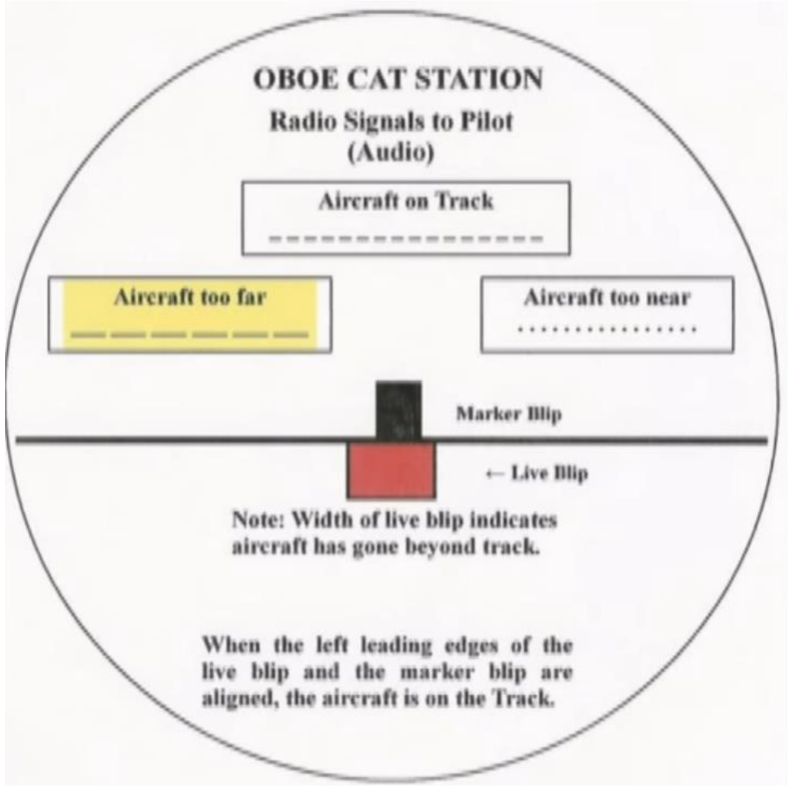
9 – OBOE SYSTEM
9.2 – Principles Behind "Oboe"

The primary role of the Cat Station is to figure out where the aircraft is in relationship to the Track Arc. The radio signals sent to the pilot and navigator indicate whether the aircraft is too near, too far, or directly on the track.

Source: **"OBOE - WWII Blind Bombing System (precursor to GEE)" by Jake Howland:**
https://youtu.be/hURdl91MCNQ



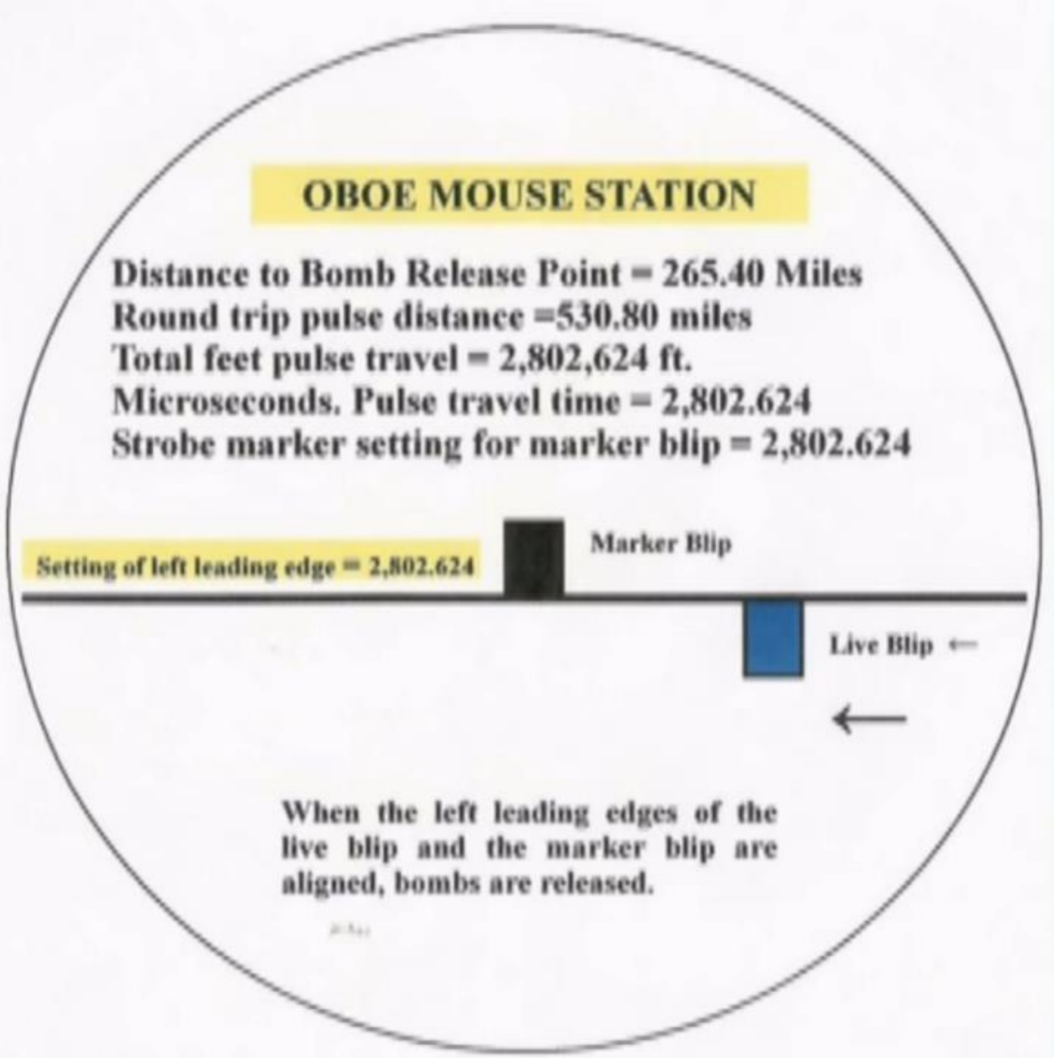




9 – OBOE SYSTEM
9.2 – Principles Behind "Oboe"

The Mouse Station operator's job is to make sure you are dropping your bombs at the right time. The Mouse Station tracks you in a similar fashion as the Cat Station, but the Morse Code signals it will send you will be different and indicate how far you are from the target. This will, of course, require you to keep following the Track Arc, meaning that you have to be on the lookout for both the Cat and the Mouse signals.

Source: **"OBOE - WWII Blind Bombing System (precursor to GEE)" by Jake Howland:**
https://youtu.be/hURdl91MCNQ



9 – OBOE SYSTEM
9.3 – Bombing Example with a Simulated “Oboe”

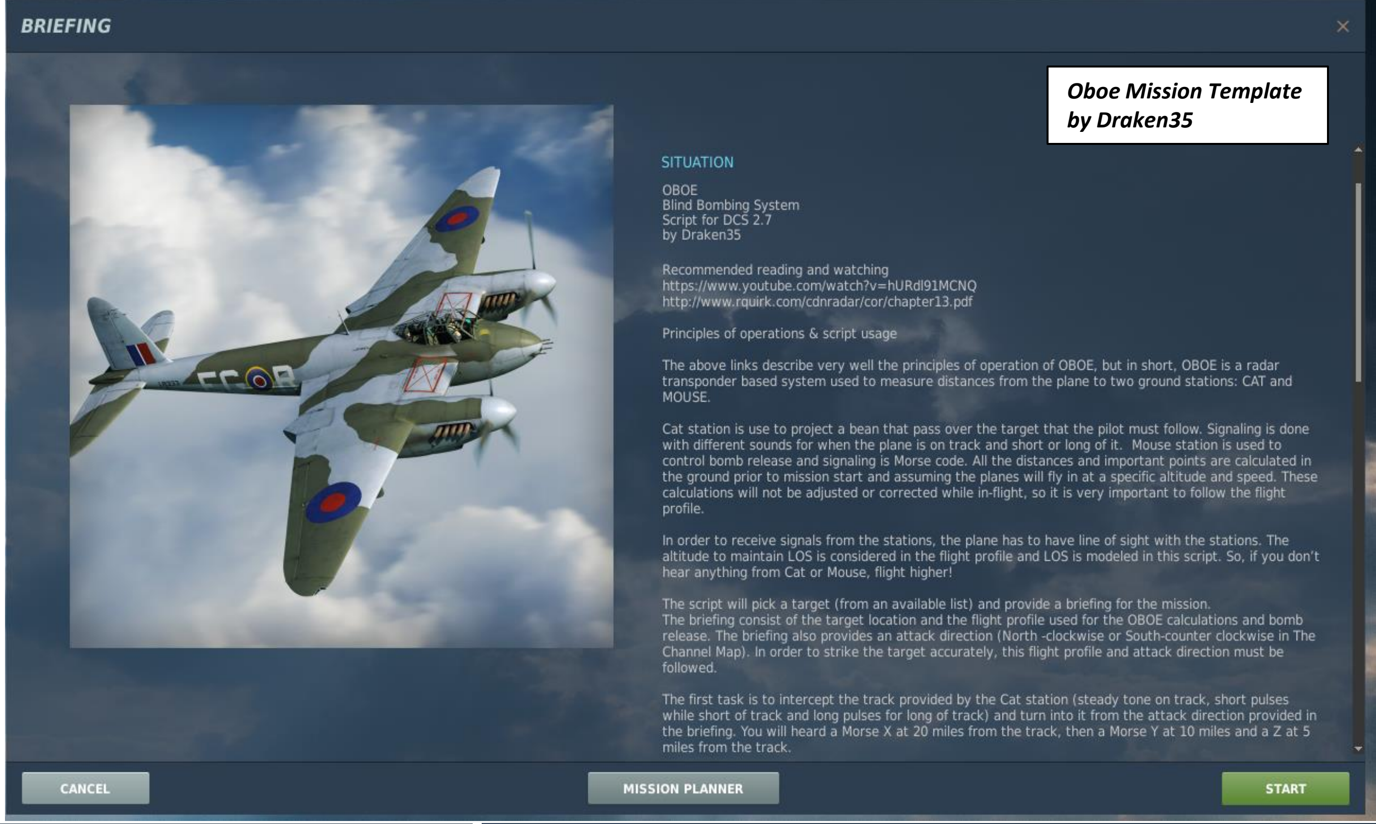
9 – OBOE SYSTEM
9.3 – Bombing Example with a Simulated "Oboe"

Here is an overview of the Mission Template we will use (by Draken35).
https://forums.eagle.ru/topic/282986-oboe-mission-script-inside/

Simplifications / Gameplay Concessions:

- Take note that the **Fighter-Bomber Mosquito variant we have in DCS is not equipped with a transponder compatible with "Oboe"**. The transponder was available for Bomber variants. As a work-around, the mission creator uses a series of scripts to simulate the transponder behavior.
- The "cat" and "mouse" station operators are simulated with mission scripts.
- In order to hear the morse code signals sent by the "cat" and "mouse" station operators, we will use the R1155 Radio Receiver with a custom frequency set to 18 MHz.
- This mission is not meant to be a perfect replication of an Oboe mission; it's merely meant to give you an idea about the general principles behind it and how the pilot and navigator would figure out where they are and when to drop their bombs.

Oboe Demonstration Video by Reflected Simulations
https://youtu.be/Vb0aa5nSbeU



Note:
The Mission Template we use for this demonstration is from Draken35. The Mission Briefing (which includes the required altitude of 25000 ft and required airspeed of 210 mph) is taken from an Oboe mission adapted by Reflected Simulations.

Follow the track and, at 10 minutes from the target, a Morse code warning will be heard: AAAA. At 8 minutes it will be BBBB. At 6 minutes, CCCC. Then, at 3 minutes away another signal will be give: DDDD. The signal for bomb release point is 5T, which is 5 dots followed by a dash. Bombs shroud be release at the end of the dash. The "OBOE: Sound 'tutorial'" in COMMS menu will provide examples of these signals.

Release heading. At the time of this writing, it is not clear to the author when the pilot should turn into the release heading but as a best guess, since it is calculated from the release point to the target, is that the pilot should start turning into the release heading when the release signal starts.

Morse Signals
A = .-
B = -...
C = -.-.
D = -..
5T = ...-
X = -..-
Y = -.--
Z = --..

Use COMMS Menu (other) to access the OBOE Functions:
"OBOE: Mission Briefing":
Shows target and flight profile information

"OBOE: toggle on/off":
Toggles the OBOE equipment On and Off.

"OBOE: reset approach" :
The script keeps track of the 10min, 3 min and release signals and they are give only once This option allows for them to be reseted and the track flown again.

"OBOE: Report results"
Reports distance and position, using a clock face of the bombs impact in relation to the target. 6 o'clock is short, 12 is long, 3 is right and 9 is left.

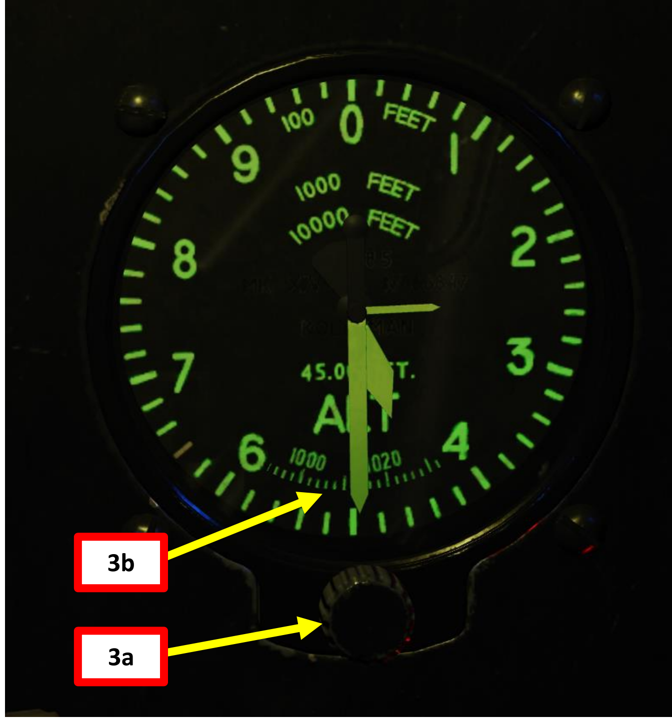
"OBOE: Settings"
Allows to change the units in which the briefing and results are given and the accuracy of the system. The more accurate, the narrower the Cat beam is and the closer you need to get to the warning points in order to receive the corresponding signals.

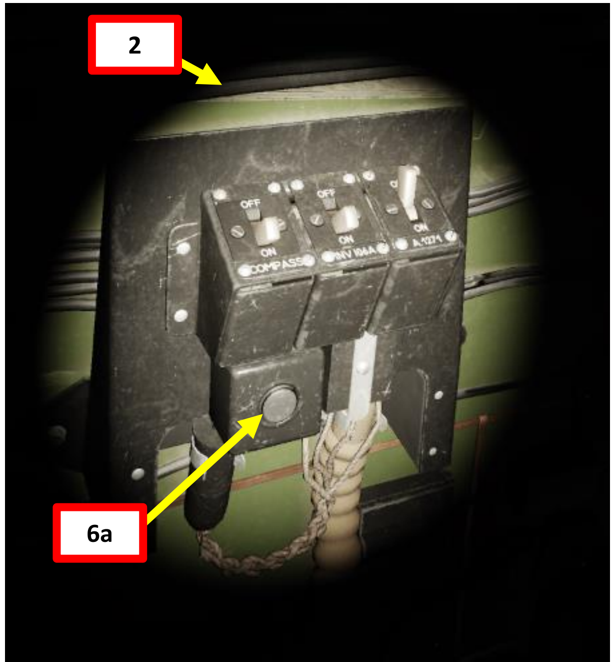
"OBOE: Sound 'tutorial'" (Cat & Mouse)
Gives you the option to listen to all the sounds used by the script.

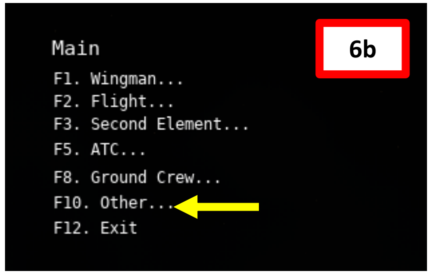
Mission editor:
In case you want to open the missions in the ME, the scripts and sounds are included in the respective folders. Just make sure to copy them to the places you normally use for those types of files.

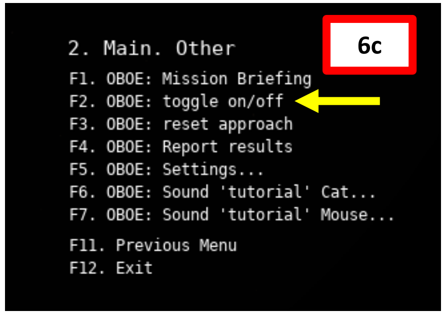
9 – OBOE SYSTEM
9.3 – Bombing Example with a Simulated "Oboe"

1. Adjust cockpit lighting as required.
2. Use flashlight if needed ("LALT+L").
3. Scroll mousewheel on the "Altimeter Barometric Pressure Setting" knob to set a standard barometric pressure of 1013.2 mBar. This is very important since barometric pressure settings are standardized at high altitudes, and this will affect your altimeter reading.
4. Fly the aircraft at an altitude of 25000 ft (as per briefing).
5. Fly the aircraft at an airspeed of 210 mph (as per briefing).
6. Turn on the Oboe scripts
   a) Use the Radio Push-to-Talk Button ("RALT+\")
   b) Press "F10" to select the "Other" option
   c) Press "F2" to toggle the Oboe ON
7. Operators on the Cat and Mouse stations will then send radio signals to you, and the transponder simulated by the script will then send back a response signal. From this information, the station operators will then be able to pinpoint your location based ON:
   - Your altitude (as briefed, which should be 25000 ft)
   - Your airspeed (as briefed, which should be 210 mph)



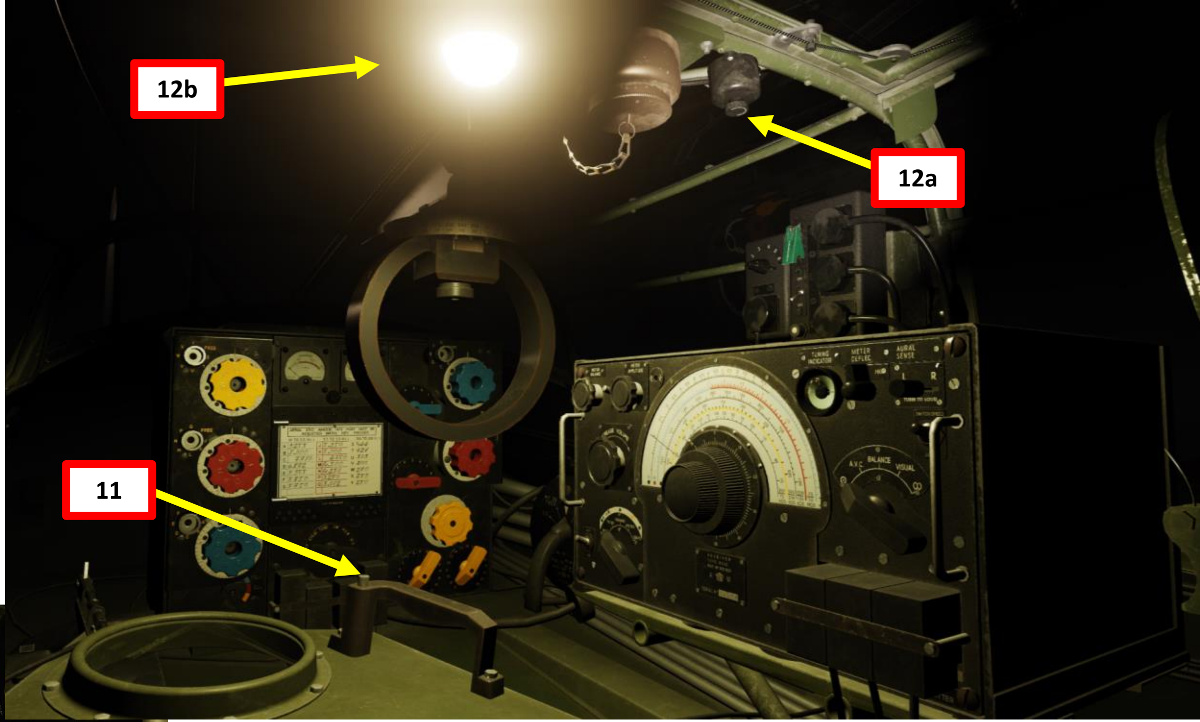


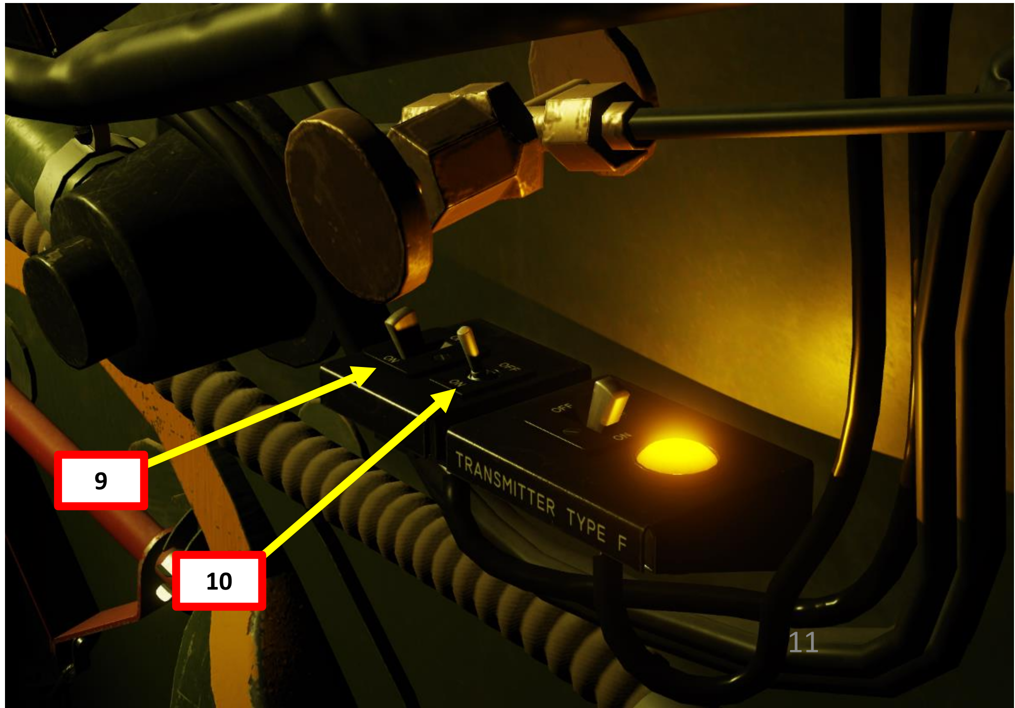




9 – OBOE SYSTEM
9.3 – Bombing Example with a Simulated "Oboe"

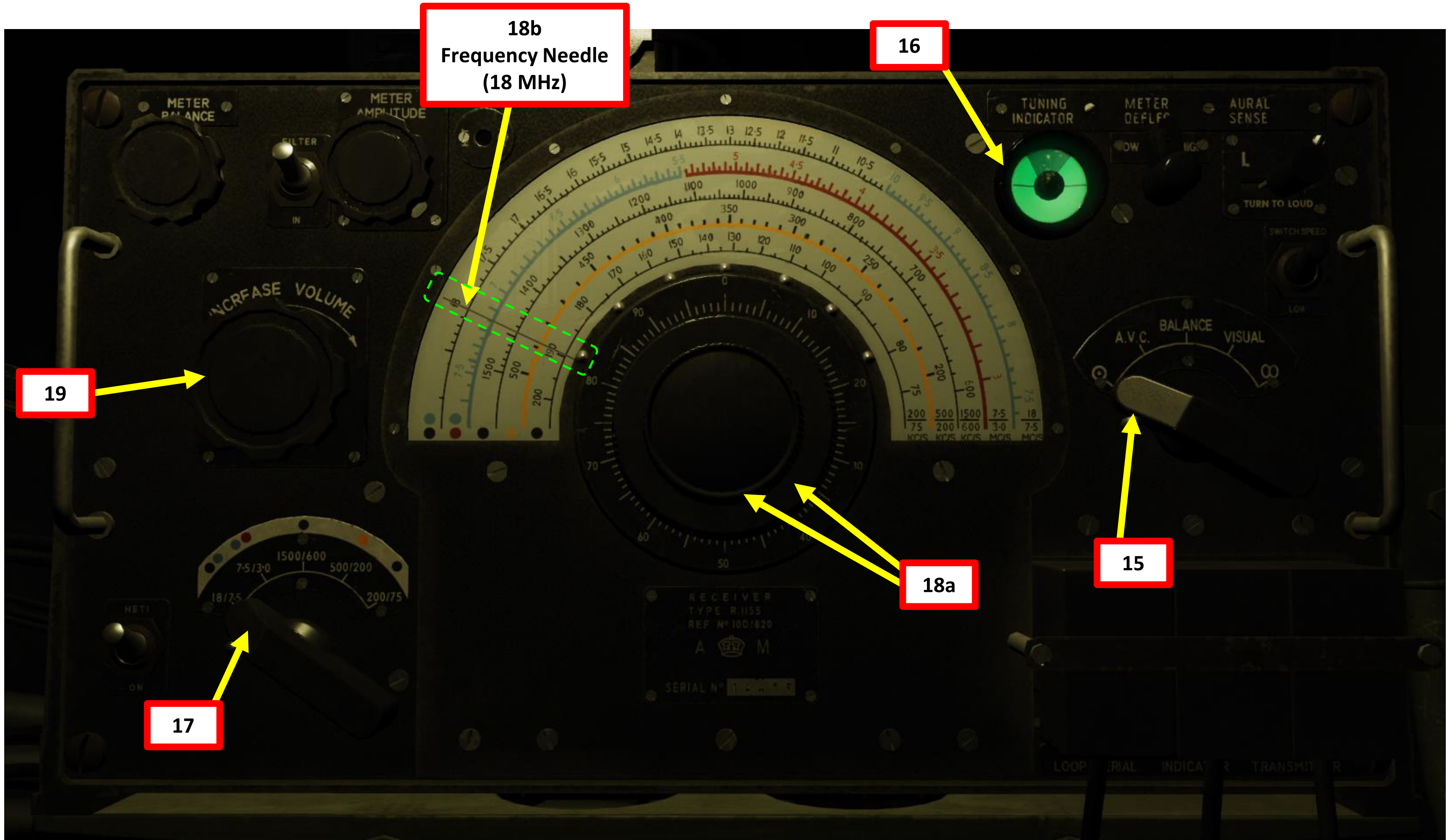
8. Select the Navigator Seat by pressing "2".
9. Set T1154 Radio Transmitter Low Voltage Power Switch – ON (LEFT)
10. Set T1154 Radio Transmitter High Voltage Power Switch – ON (LEFT)
11. Lower the armored headrest of the navigator seat to access the radio compartment by clicking on the headrest handle.
12. Turn on the Dome Light
13. Set T1154 Radio Transmitter Set Tuning Control knob to STD-BI (Standby) position.
14. Set Aerial (Antenna) Mode Selector – NORMAL





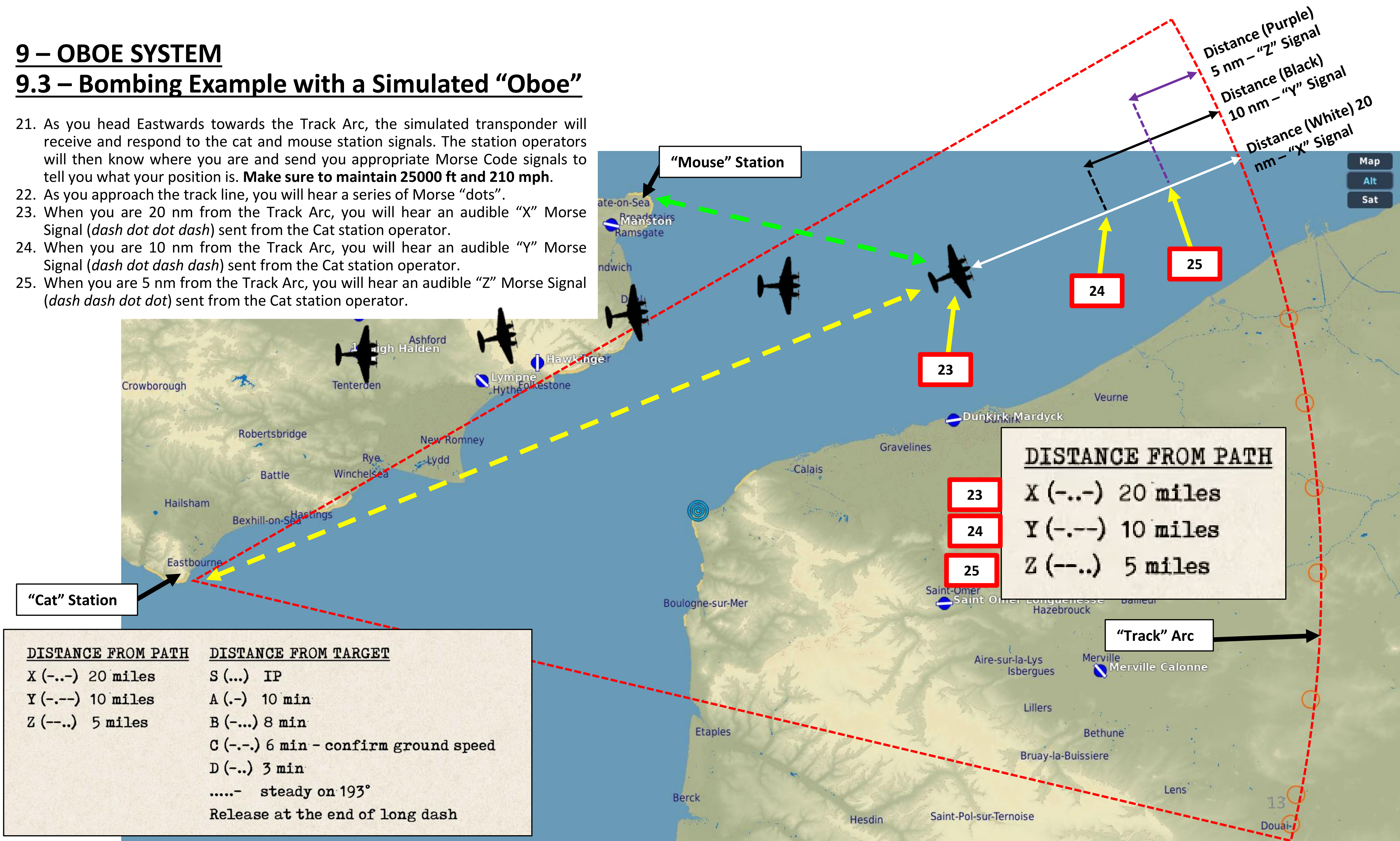
9 – OBOE SYSTEM
9.3 – Bombing Example with a Simulated "Oboe"

15. Set R1155 Radio Receiver Set Master Selector Switch – Omni (O)
16. Confirm that the Tuning Indicator Light illuminates
17. Set the R1155 Radio Receiver Set Frequency Range Switch to the appropriate frequency range ("18/7.5" for frequency 18 MHz).
18. Use tuning knobs to set radio frequency needle to the appropriate frequency (18 MHz). Since we use the 18/7.5 frequency range, we use the outermost band.
    - Use the outer tuning knob for coarse tuning (big needle movements) and the inner tuning knob for fine tuning (small needle movements).
19. Adjust Volume Control.
20. You should now be hearing a radio morse code signal which is made of a series of "dots". This means that we have not reached the track arc yet, which is normal.



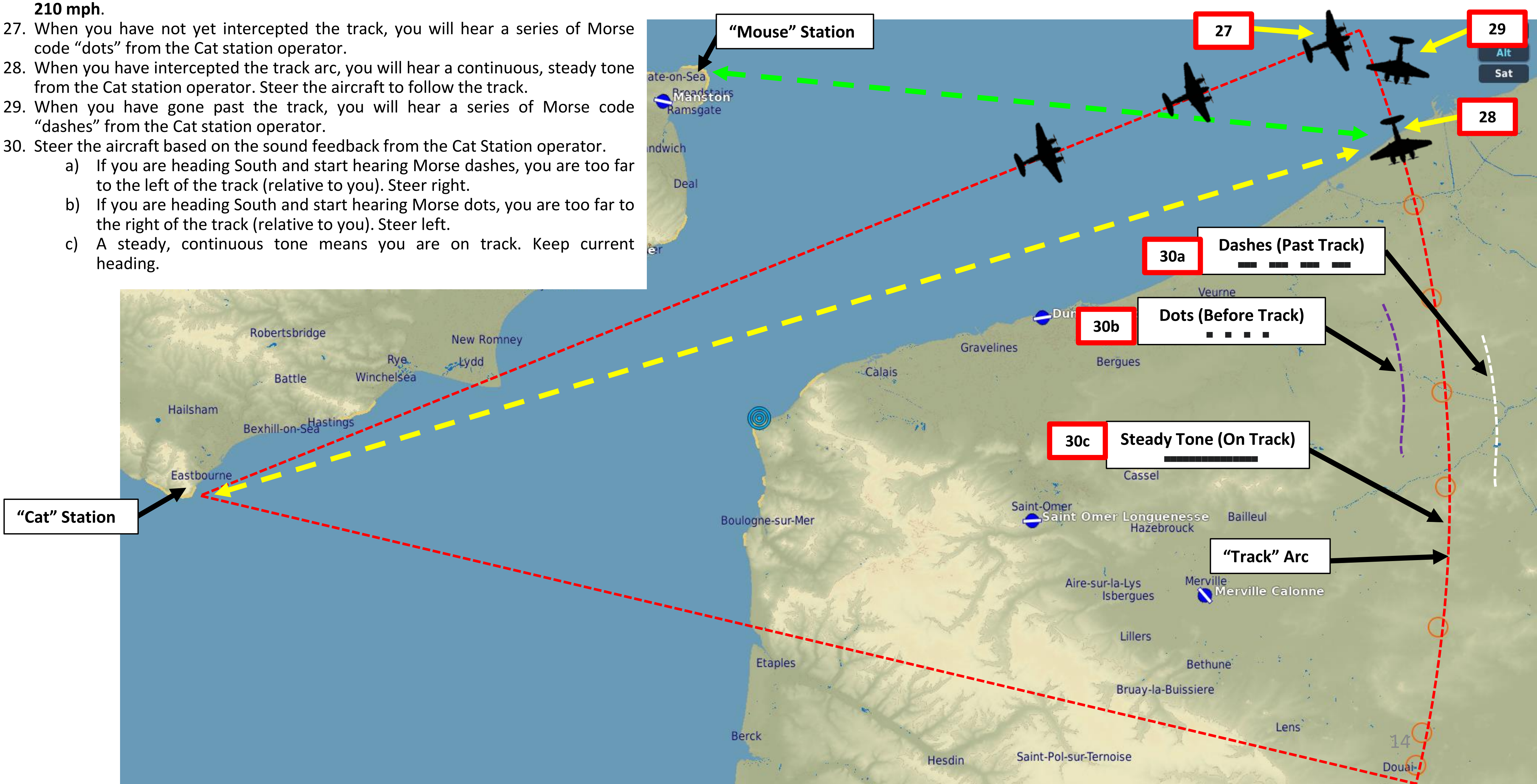
9 – OBOE SYSTEM
9.3 – Bombing Example with a Simulated "Oboe"

21. As you head Eastwards towards the Track Arc, the simulated transponder will receive and respond to the cat and mouse station signals. The station operators will then know where you are and send you appropriate Morse Code signals to tell you what your position is. **Make sure to maintain 25000 ft and 210 mph**.
22. As you approach the track line, you will hear a series of Morse "dots".
23. When you are 20 nm from the Track Arc, you will hear an audible "X" Morse Signal (*dash dot dot dash*) sent from the Cat station operator.
24. When you are 10 nm from the Track Arc, you will hear an audible "Y" Morse Signal (*dash dot dash dash*) sent from the Cat station operator.
25. When you are 5 nm from the Track Arc, you will hear an audible "Z" Morse Signal (*dash dash dot dot*) sent from the Cat station operator.



9 – OBOE SYSTEM
9.3 – Bombing Example with a Simulated "Oboe"

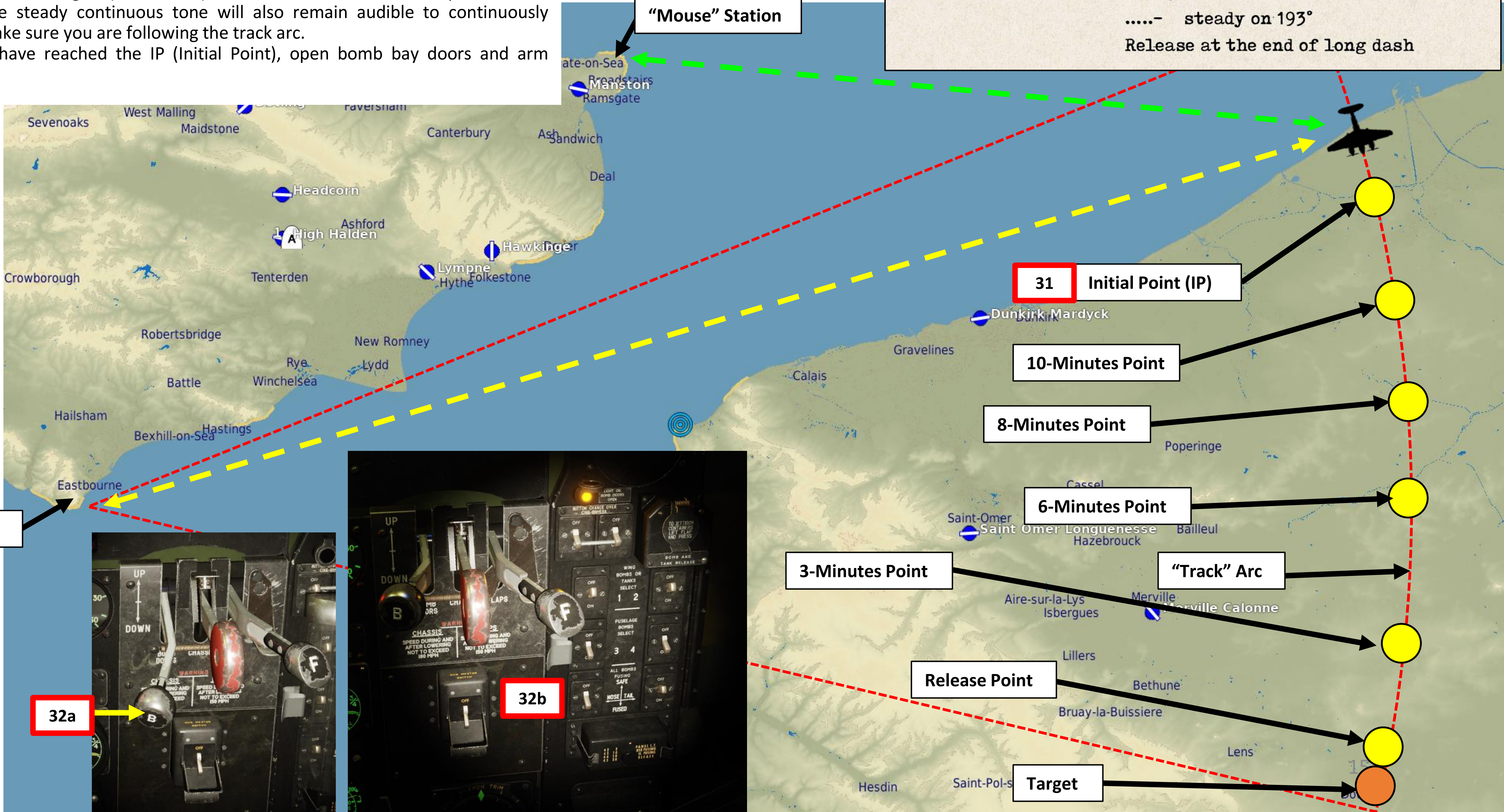
26. Now, we have to intercept the Track Arc. **Make sure to maintain 25000 ft and 210 mph**.
27. When you have not yet intercepted the track, you will hear a series of Morse code "dots" from the Cat station operator.
28. When you have intercepted the track arc, you will hear a continuous, steady tone from the Cat station operator. Steer the aircraft to follow the track.
29. When you have gone past the track, you will hear a series of Morse code "dashes" from the Cat station operator.
30. Steer the aircraft based on the sound feedback from the Cat Station operator.
    a) If you are heading South and start hearing Morse dashes, you are too far to the left of the track (relative to you). Steer right.
    b) If you are heading South and start hearing Morse dots, you are too far to the right of the track (relative to you). Steer left.
    c) A steady, continuous tone means you are on track. Keep current heading.



9 – OBOE SYSTEM
9.3 – Bombing Example with a Simulated "Oboe"

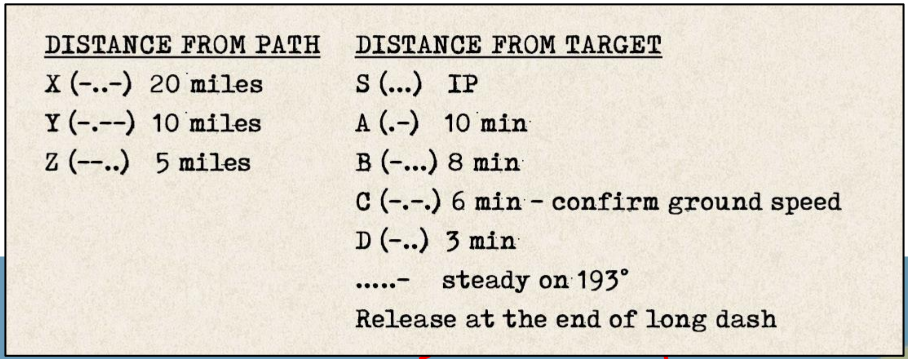
31. When you are over the Initial Point (which is on the Track Arc), you will hear an audible "S" Morse Signal (*dot dot dot*) sent from the Mouse station operator.
    - The steady continuous tone will also remain audible to continuously make sure you are following the track arc.
32. Once you have reached the IP (Initial Point), open bomb bay doors and arm bombs.

DISTANCE FROM PATH		DISTANCE FROM TARGET	
X (-..-)	20 miles	S (...)	IP
Y (-.--)	10 miles	A (.-)	10 min
Z (--..)	5 miles	B (-...)	8 min
		C (-.-.)	6 min - confirm ground speed
		D (-..)	3 min
		.....-	steady on 193°
		Release at the end of long dash	

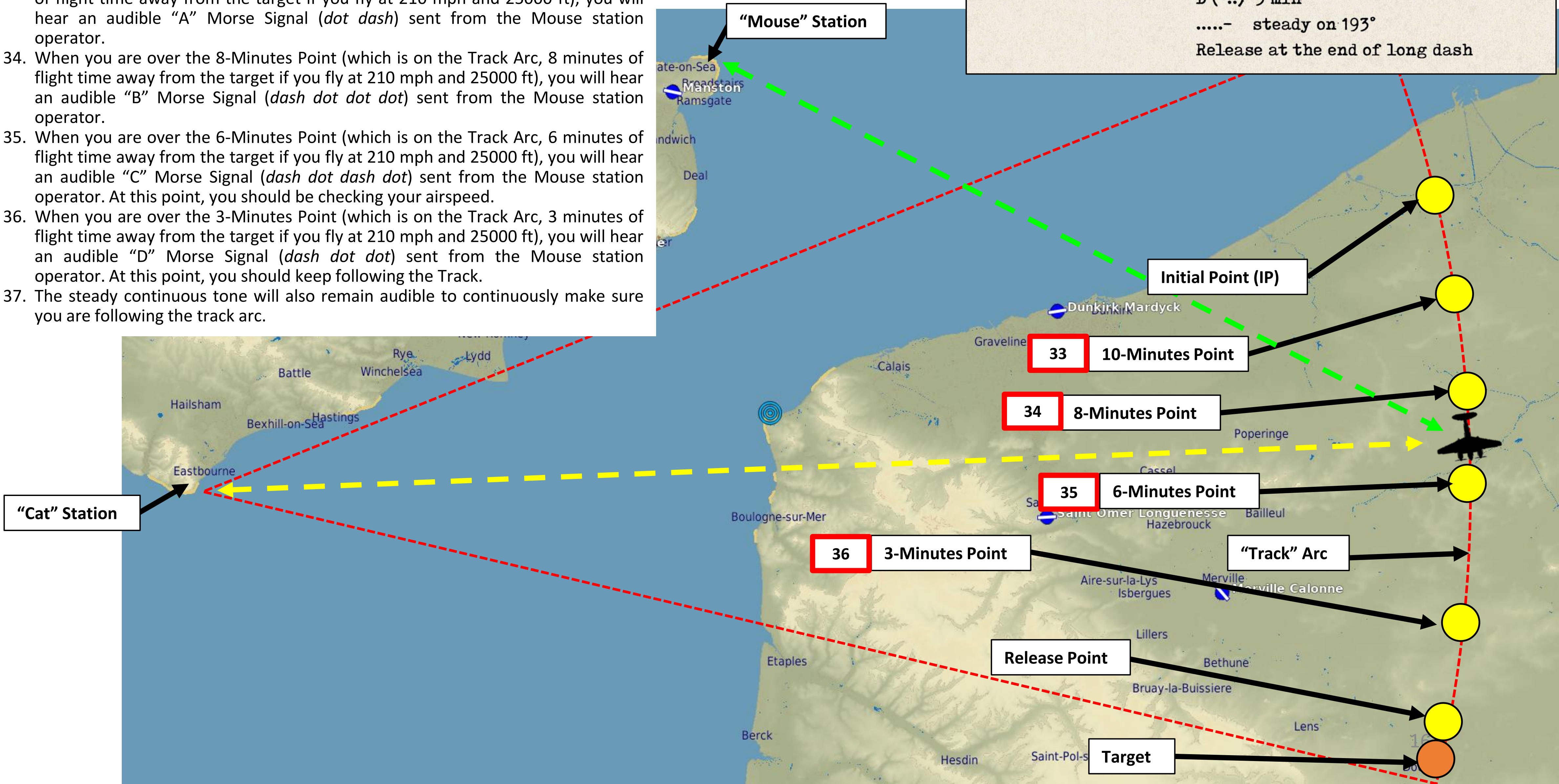


9 – OBOE SYSTEM
9.3 – Bombing Example with a Simulated "Oboe"

33. When you are over the 10-Minutes Point (which is on the Track Arc, 10 minutes of flight time away from the target if you fly at 210 mph and 25000 ft), you will hear an audible "A" Morse Signal (*dot dash*) sent from the Mouse station operator.
34. When you are over the 8-Minutes Point (which is on the Track Arc, 8 minutes of flight time away from the target if you fly at 210 mph and 25000 ft), you will hear an audible "B" Morse Signal (*dash dot dot dot*) sent from the Mouse station operator.
35. When you are over the 6-Minutes Point (which is on the Track Arc, 6 minutes of flight time away from the target if you fly at 210 mph and 25000 ft), you will hear an audible "C" Morse Signal (*dash dot dash dot*) sent from the Mouse station operator. At this point, you should be checking your airspeed.
36. When you are over the 3-Minutes Point (which is on the Track Arc, 3 minutes of flight time away from the target if you fly at 210 mph and 25000 ft), you will hear an audible "D" Morse Signal (*dash dot dot*) sent from the Mouse station operator. At this point, you should keep following the Track.
37. The steady continuous tone will also remain audible to continuously make sure you are following the track arc.


DISTANCE FROM PATH
X (-..-) 20 miles
Y (-.--) 10 miles
Z (--..) 5 miles

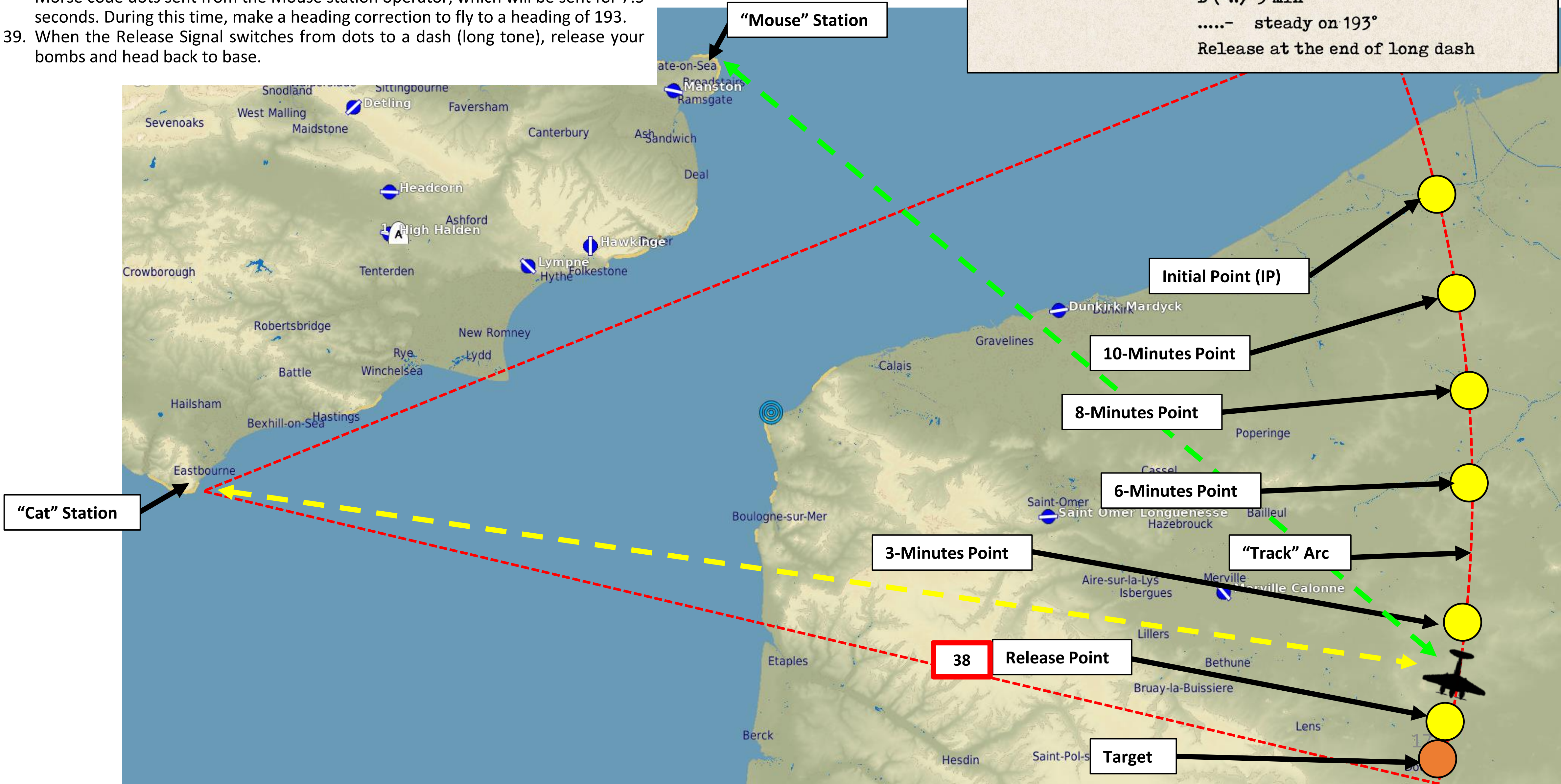
DISTANCE FROM TARGET
S (...) IP
A (.-) 10 min
B (-...) 8 min
C (-.-.) 6 min - confirm ground speed
D (-..) 3 min
.....- steady on 193°
Release at the end of long dash



9 – OBOE SYSTEM
9.3 – Bombing Example with a Simulated "Oboe"

38. When you are over the Release Point, you will hear the Release Signal, a series of Morse code dots sent from the Mouse station operator, which will be sent for 7.5 seconds. During this time, make a heading correction to fly to a heading of 193.
39. When the Release Signal switches from dots to a dash (long tone), release your bombs and head back to base.

DISTANCE FROM PATH	DISTANCE FROM TARGET
X (-..-) 20 miles	S (...) IP
Y (-.--) 10 miles	A (.-) 10 min
Z (--..) 5 miles	B (-...) 8 min
	C (-.-.) 6 min - confirm ground speed
	D (-..) 3 min
	.....- steady on 193°
	Release at the end of long dash



9 – OBOE SYSTEM
9.3 – Bombing Example with a Simulated "Oboe"