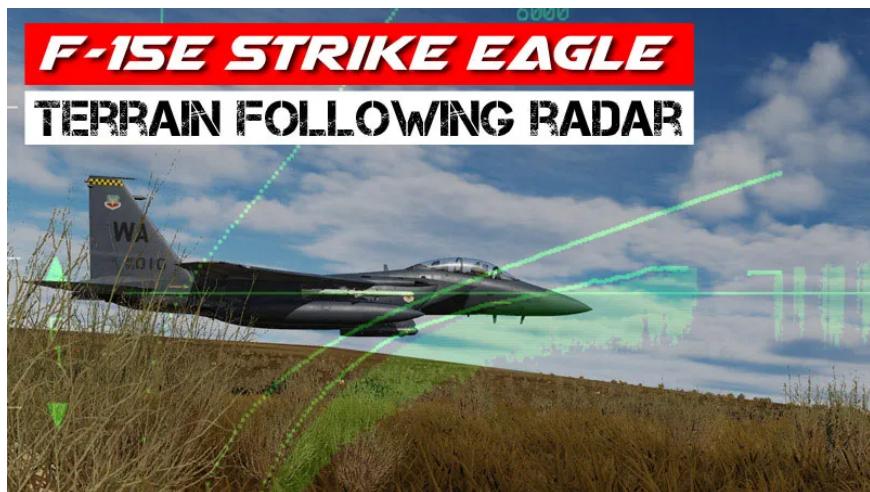


# DCS World Flying School

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## Terrain Following Radar TFR - F-15E Strike Eagle guide

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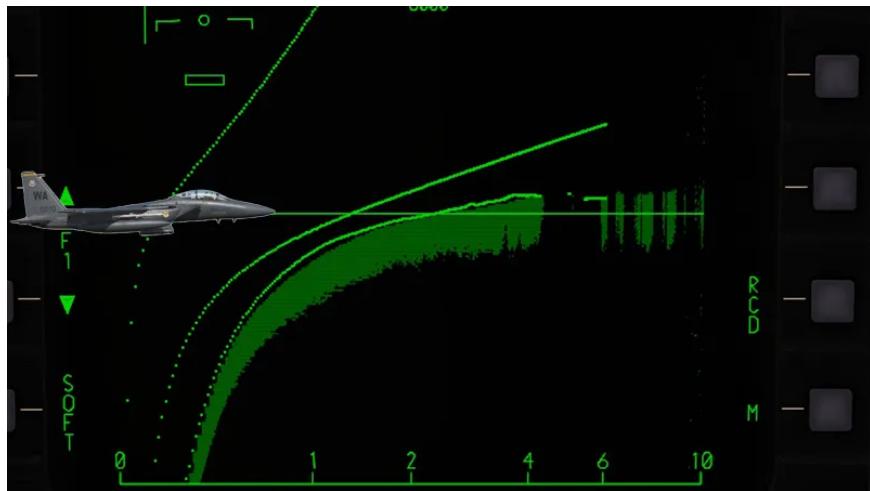
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## How does Terrain Following Radar work?

**Terrain Following Radar is a special radar that tracks the terrain in front of the aircraft.** The radar, together with the FLIR camera for night flights in the dark, is located in the AN/AAQ-13 LANTIRN NAV POD suspended navigation tank – in a separate tube from the TGP sighting tank, suspended only under the right hardpoint. It is therefore a separate system, not related to the AA and AG radar in the bow of the aircraft.

TFR allows flying at very low altitudes and avoiding all terrain obstacles, all the time telling the pilot how to fly "hugged to the ground" to maintain the set altitude. **In combination with the autopilot, the TFR can maintain the aircraft at the indicated altitude by itself, without human intervention,** regardless of the terrain.

In the event of an incorrect positioning of the aircraft and the inability to operate properly the radar or a suddenly approaching terrain obstacle, **the FLY UP emergency system is turned on, picking up the aircraft up** to the set, safe height MEA (Minimum Enroute Altitude) for a given steerpoint.



## Essential buttons

Virtually all buttons are located on the left console or around the MFD monitor. The only necessary button on the stick is:

- **Paddle Switch** - holding it temporarily disables the radar, especially when the Fly Up function is running

## Other navigation entries

- Basics of INS / GPS navigation – EGI
- Editing, creating navigation points and routes
- autopilot

## Restrictions on the use of TFR

**Terrain Following Radar** can only work if certain conditions are met. Otherwise, it will either fail to turn on or the radar will think that the pilot is incapable of operating and will activate the Fly Up function to

bring the plane to a safe altitude.

### **For the TFR to work properly, the aircraft:**

- must fly faster than 400 knots and slower than Mach 0.97 - otherwise the radar will not start working
- can't dive down more than 15 degrees - otherwise Fly Up will turn on after 3 seconds
- tilting to the side must not exceed 60 degrees - otherwise Fly Up will turn on after 2 seconds
- acceleration in the turn must not exceed 2.2 degrees per second - otherwise Fly Up will turn on after 2 seconds
- the angular speed of the turn must not exceed 5.5 degrees - otherwise Fly Up will turn on after 2 seconds

## **Fly Up – how to turn off?**

The **FLY UP** function, i.e. the lifting of the plane up to a safe height, is armed by default - enabled. It can be turned off, for example, to avoid accidentally exceeding any heights in the event of a threat of detection by an enemy radar. Then it is absolutely important to remember to monitor all warning messages of the system.

The Fly Up system is armed with a hidden switch on the left wall of the cockpit, after revealing the red cover.



## Message about too low height - how to turn it off?

If you are annoyed by Betty's constant voice message, press the LAW button on the UFC console until will show OFF (Low Altitude Warning).



## Turning on TFR

1.

Make sure that the AN/AAQ-13 LANTIRN NAV POD navigation tank is installed before taking off.



2.

On the left console, set the TF RDR switch to the ON position. Set the RDR ALT radar altimeter switch to ON.



3.

Display the TFR screen on the MFD monitor. From the M main menu, select TF.



# TFR screen description

The TFR radar screen displays an E-Scope image, which is a side view as opposed to the top view in the main radar. The position of the plane is the extreme left side, from which an image with a graduation from 0 to 10 miles of tracked terrain in front of the plane comes out - this scale cannot be changed.



1. **Raw Video** - actual view of the terrain detected by the radar
2. **Synthetic Video** - the image of the terrain that the TFR system predicts is in front of the aircraft and determines the flight profile according to it - is an additional protection and should coincide as much as possible with Raw Video. If these two images are very different from each other, it means that the TFR is not working properly
3. **Zero Command Line** - a line of the current and expected position of the aircraft relative to the set cough altitude with TFR. It should coincide with the Synthetic Video line - then the plane flies at a fixed altitude. A position below or above means that the height of the aircraft is different from the set.
4. **Aircraft Flight Vector Line** - position of the flight

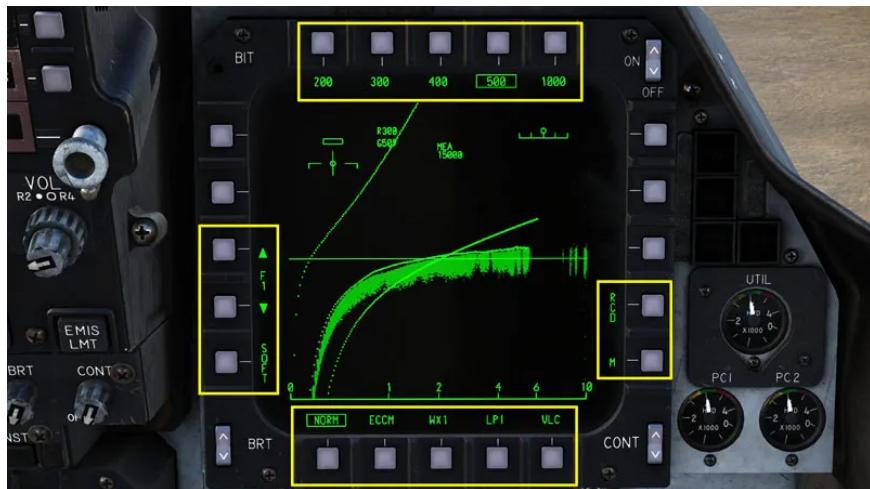
direction vector on the HUD relative to the tracked terrain (side view)

5. **Obstacle Warning Line** - terrain obstacle line. The closer it gets to the Synthetic Video line, the more likely it is that the Fly Up system will turn on or the plane will hit the ground



1. **Manual Pitch Command Box** - TFR indicator showing where to control and maintain the flight direction vector so that the aircraft tracks the terrain according to TFR indications
2. **TF Steering Commands** - horizon line, flight direction vector and direction to the current steering point - symbols from the HUD repeated on the TFR screen
3. **Rxxx, Gxxx** - current radar altitude and Ground speed
4. **MEA** - Minimum Enroute Altitude - the minimum altitude at which the aircraft is safe from all terrain obstacles. Set separately for each steerpoint, it defaults to 15000 feet
5. **Raw Video Antenna Position** - shows where the radar antenna is currently scanning the terrain to the sides of the flight direction

# TFR options and settings



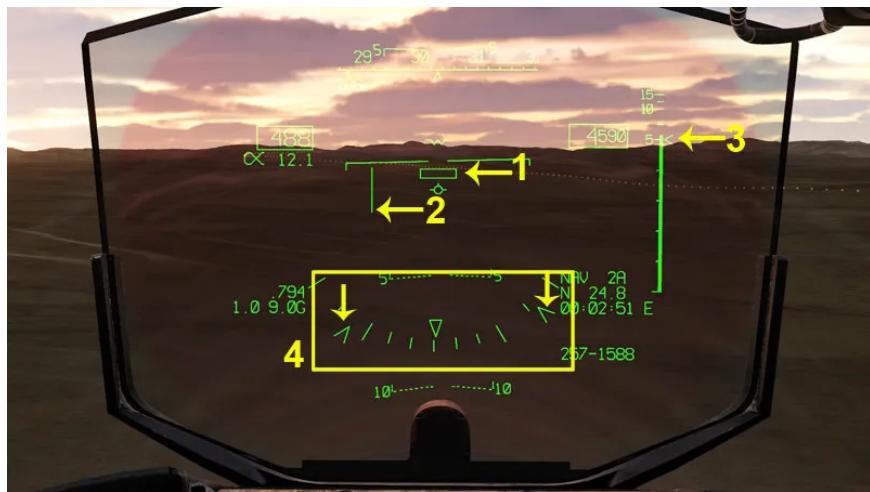
- **100, 200, 300, 400, 500, 1000** - radar altitude in feet, which the aircraft is to maintain over the tracked terrain
- **RCD / M** - screen image recording, display of the main monitor menu
- **NORM** - normal TFR mode
- **ECCM** - a mode that allows your enemy radar jammer (Jammer) to operate
- **WX1** - mode of operation in worse weather, e.g. light rain
- **WX2** - mode of operation in very bad weather, e.g. downpour (available heights: 500/1000)
- **LPI** (Low Probability of Intercept) - mode to minimize detection by enemy radar, limits the scan to 1 bar for 2.5 seconds compared to 8 bar for 2.5 seconds in other modes
- **VLC** (Very Low Clearance) - very low altitude flight mode, enables the flight option at 100 feet and increases the scanning to 2 bar for 0.5 seconds. Used with relatively gentle terrain slopes
- **SOFT/HARD** - "sharp driving", regulates the value of negative overload when tracking the terrain. SOFT is a gentle dive up to -0.45g. HARD -

stronger up to -0.9g. In the case of climbing, the value is always +2g. Negative g is much more unpleasant and uncomfortable for the pilot's body. With manual piloting, it determines the position of the Manual Pitch Box, with autopilot it affects the suddenness of lowering the position, e.g. after passing the top of the hill

- **F1-F8** - radar frequency - in the case of flying several aircraft in the key, it is worth setting a different one for each machine to avoid interference

## Description of TFR symbols on HUD

HUD displays some of the symbols from the TFR screen



1. **Pitch Command Box** - an indicator of the set height above the tracked terrain, suggests where to place the flight direction vector to fly according to radar indications all the time
2. **Vertical Steering Bar** - direction to the active steering point - the line should cross the flight direction vector

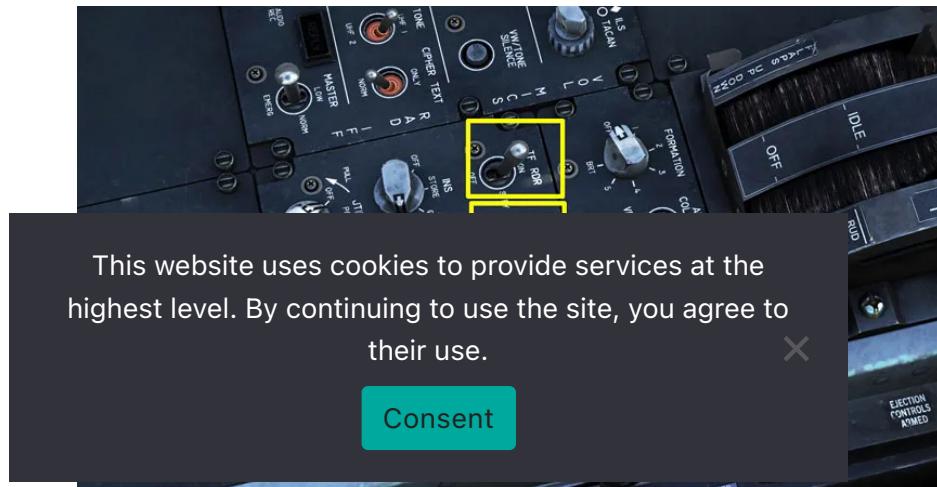
3. radar altimeter and **Set Clearance Caret** - height indicator set to TFR
4. **Turn Scale / Limits** - the degree of tilt of the Bank Limits aircraft with dynamically changing limits. The aircraft cannot overstep two large groots 45 degrees on the left and 60 degrees on the right - the difference is due to the installation of the NAV POD tank on the right hardpoint

The warning messages described below are also displayed on the HUD.



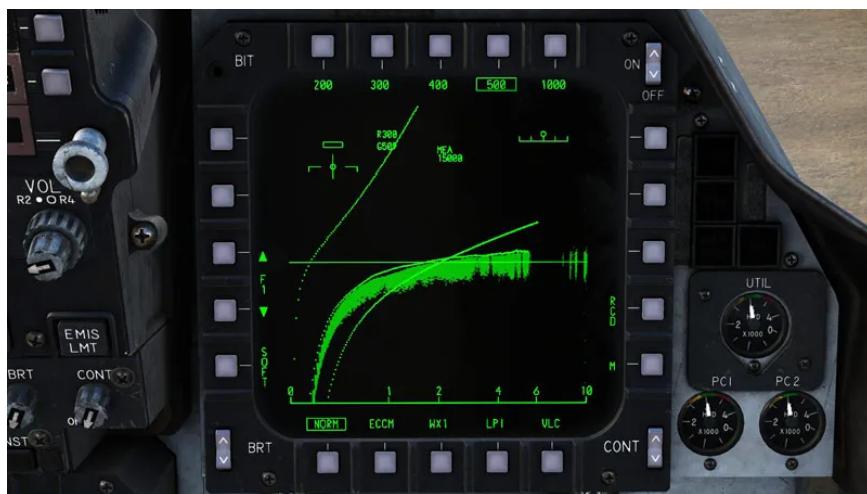
1.

Make sure TF RDR and RDR ALT are enabled – ON position.



2.

Display the TFR screen on one of the monitors.



3.

Select the mode of operation and the altitude at which you want to fly.



4.

Accelerate to speeds above 400 knots, but do not exceed 0.97 Macha.



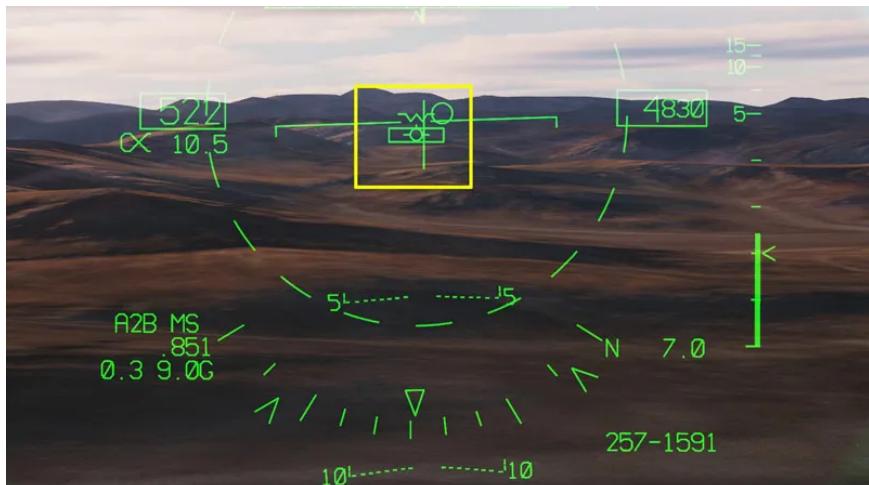
5.

Control so that the flight direction vector is always in the middle of the Pitch Command Box.



6.

If you are heading to the steerpoint, there should also be a vertical vertical Steering Bar in the middle of the vector.



7.

For various reasons, the FLY UP mode may be turned on during the flight - usually if you are flying alone and do not comply with the parameters of a safe flight or the parameters of proper operation of the radar. To quickly turn off FLY UP and return to terrain tracking, press the Paddle Switch button on the stick. If you previously turned off Fly Up on the cockpit wall, you will only see the inscription on the HUD, the radar will not take over the helm.



8.

The inscription UNARMED will appear, and the plane will be able to fly. Holding the Paddle Switch, align the flight to the parameters required by the TFR.



9.

Bring the plane back to the terrain tracking parameters, to the correct altitude, speed, equalize the flight and release the Paddle Switch.



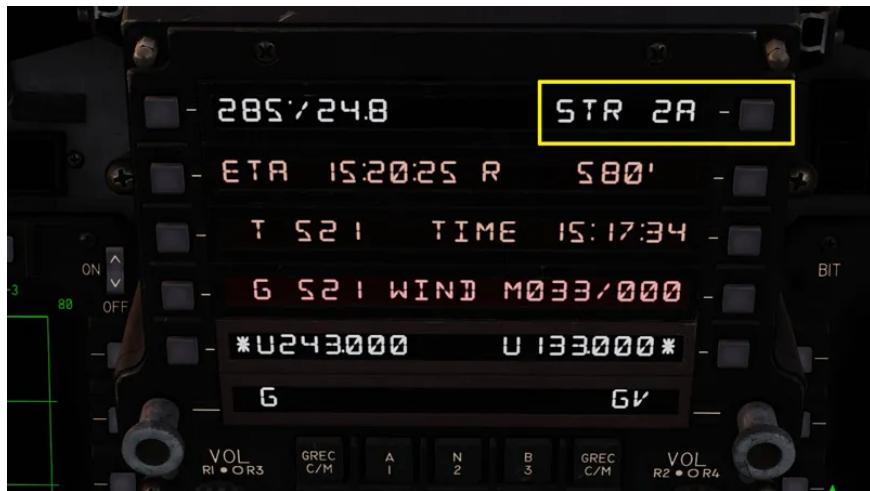
10.

To fly according to TFR indications, you do not need to use HUD. In emergency situations, you can also rely on symbols on the TFR screen, although this is much less readable and convenient.



11.

The MEA height that the FLY UP function aims to can be changed by clicking on the steerpoint menu. Exceptionally, this option can be edited even if the steerpoint is active.



12.

Type the safe height in the feet on the keyboard and click the MEA button.



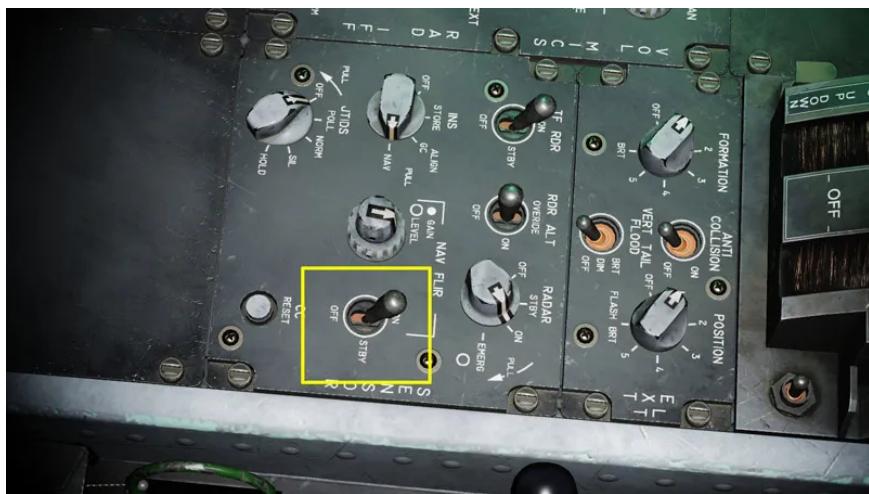
13.

TFR is mainly useful at night, in combination with the NAV FLIR infrared camera.



14.

To enable NAV FLIR on the HUD, set the switch to ON...



15.

...and the BRT and CONT contrast brightness knobs on the UFC console. Detailed NAV FLIR support is described in a separate entry.



## Automatic TFR mode with autopilot

The TFR radar can automatically track terrain and control the tilt control of the aircraft's PITCH, keeping the radar altitude set between 100 and 1000 feet. The basic TF COUPLE mode is used for this. When combining TFR radar with autopilot modes, the aircraft can fly alone from steerpoint to steerpoint, avoiding terrain obstacles and maintaining low altitude.

### TF Couple Mode

1.

With the TF radar turned on and in the parameters that allow it to work, set the TF switch on the left to the COUPLE position.



2.

The aircraft will maintain the altitude set and avoid obstacles. The radar only takes over the control of the tilt of the PITCH front / rear stick. You can still use it by sliding the ROLL sideways and changing the course of the flight, as long as you do not exceed the Bank Angle limits set by the two grottoes on the scale. Note that in automatic modes, the Pitch Command Box rectangle disappears and a horizontal line appears instead.



## TFR + Autopilot

1.

Enable NAV navigation mode and A/P autopilot. In the default mode, the aircraft will maintain the current

course in Heading Mode HDG combined with TF.



2.

Press the button next to STR MODE-NAV. The autopilot will switch to A/P NAV/TF mode and will be guided to subsequent steerpoints while maintaining a low altitude.



3.

On the HUD, two lines, one of maintaining the correct altitude, the other of steering to the steering point, will cross on the flight direction vector.



## TFR messages on HUD



During a flight with a TF radar on the HUD, various information or warning messages may appear.

### Warnings:

They require immediate pilot response, they are displayed above the flight direction vector.

- **FLY UP** - a sharp rise of the aircraft up to a safe altitude in the event of a danger of collision with the ground or failure to meet the operating conditions of the radar
- **UNARMED** - Fly Up mode cannot turn on, usually when holding the Paddle Switch button

disconnecting the TFR

- **NO ATF** (No Auto Terrain Following) - no automatic control when tracking the terrain despite the TF COUPLE enabled, usually exceeding the limits of ATF operation
- **TF FAIL** - the terrain tracking radar is damaged / not working
- **OBSTACLE / G-LIMIT** - an obstacle has been detected, the bypass of which requires exceeding 2g
- **TF LOW** - the plane went below 75% of the designated altitude

### Information:

They appear below the flight direction vector. The exception is the "Obst" on the left or right side, depending on where the terrain obstacle is. Some, required for the correct operation of the radar, require a reaction within 2-3 seconds, otherwise the FLY UP system will turn on.

- **OBST** (Obstacle) – during the turn, an obstacle was detected on the left or right side. OBST exceptionally shows itself together with other warnings.
- **N-F LOS** - the field of view of the FLIR camera goes beyond the limits
- **ROLL** - the rotation of the aircraft around its own ROLL axis exceeds the limit of 60 degrees
- **TURN RATE** - the angular speed of the turn exceeds the limit of the active mode
- **TURN ACCEL** - acceleration in turn exceeds the limit of active mode
- **DIVE ANGLE** - the angle of diving reached -15 degrees or more
- **INS LIMIT** - the radar antenna cannot work within

its limits: by low Ground speed below 360 who or directing the NAV POD tank outside the tracked area as a result of maneuvering the aircraft

- **AIRSPEED** - speed below 370 KCAS or above 0.97 Mach
- **NO TERRAIN** - the radar does not see the terrain either by too high altitude, elevation angle or terrain type
- **ECCM** - radar jamming can affect the work of TFR
- **N-F BRST** - Nav Flir camera is turned on on HUD in boresight mode



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