

RFP calls for Oil and Gas Support

Revision 1:

Clarifies Aircraft Loading, Pg 17

The Boiler Plate: General requirements (Pages 1-10)

- Rules (Pgs 2-3)
- Units -updated from Previous years (Pg 4)
- Formatting and Files for submittal: Two documents – Exec Summary (20Pgs) + RFP (50 pgs Undergrad, 100pgs Grad)
  - Penalty for exceeding page count)
  - Exec Summary can use viewgraphs, but a narrative is called for
- Awards (pg 7)
- Schedule: Timelines for Q&A and Proposal Submittal (Pg 8)
- Evaluation Criteria (pgs 8-10)
  - Technical (40 pts)
  - Feasibility (25 pts)
  - Originality (20 pts)
  - Organization (15 pts)
- General Proposal Requirements / Guidance (Pg 10)

Bell Specific Requirements (Pg 11-22)

- Background: The Oil and Gas Industry
  - 11Billion Barrel Discovery off South American Coast
- Operating Concept - Rotorcraft Supporting “Floating Production Storage and Offloading (FPSO)

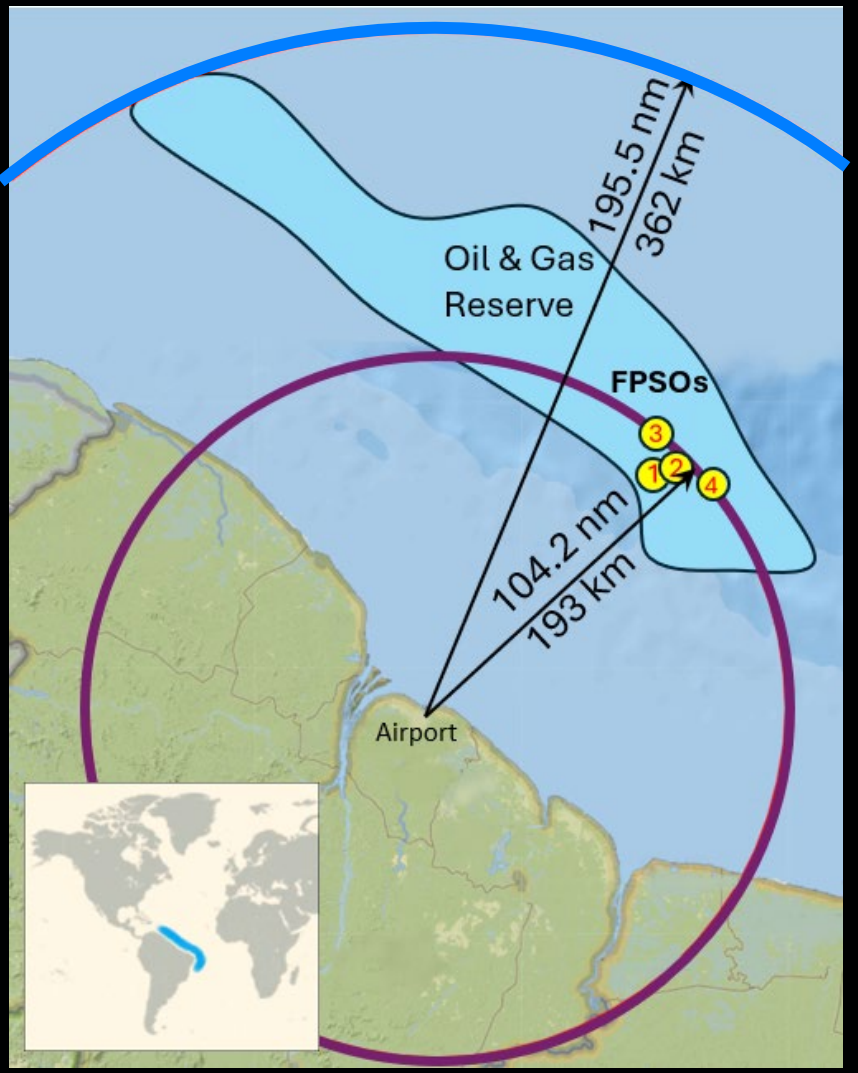


Heavy and Medium Helicopters support multiple passenger flights to/from the FSPO each day. (ExxonMobil)



FPSO Liza Destiny: Helideck height off the water shall be taken as 35 m, 115 ft

Notional Map and Range Rings showing FPSO locations



Mission Requirements

Mission 1 – Range Ring 1

- Carry the crew plus a full 16 passenger and baggage load to the inner range ring (193 km, 104.2 nm)
- Without taking on fuel, takeoff from the FPSO helideck with a full passenger/baggage load and return to the Airport with 16 pax + crew

Mission 2 – Range Ring 2:

- At the same maximum gross weight as Mission 1, with full fuel tanks, crew, and a “to be determined” passenger/baggage load, takeoff from the Airport and land on the FPSO.

Without taking on fuel, Return with the same number of passengers/baggage as the inbound flight.

Mission 1: Full Pax Load, Partially filled fuel tanks

Transport 16 Passengers + Baggage+ Crew to FPSO, Return without taking on fuel

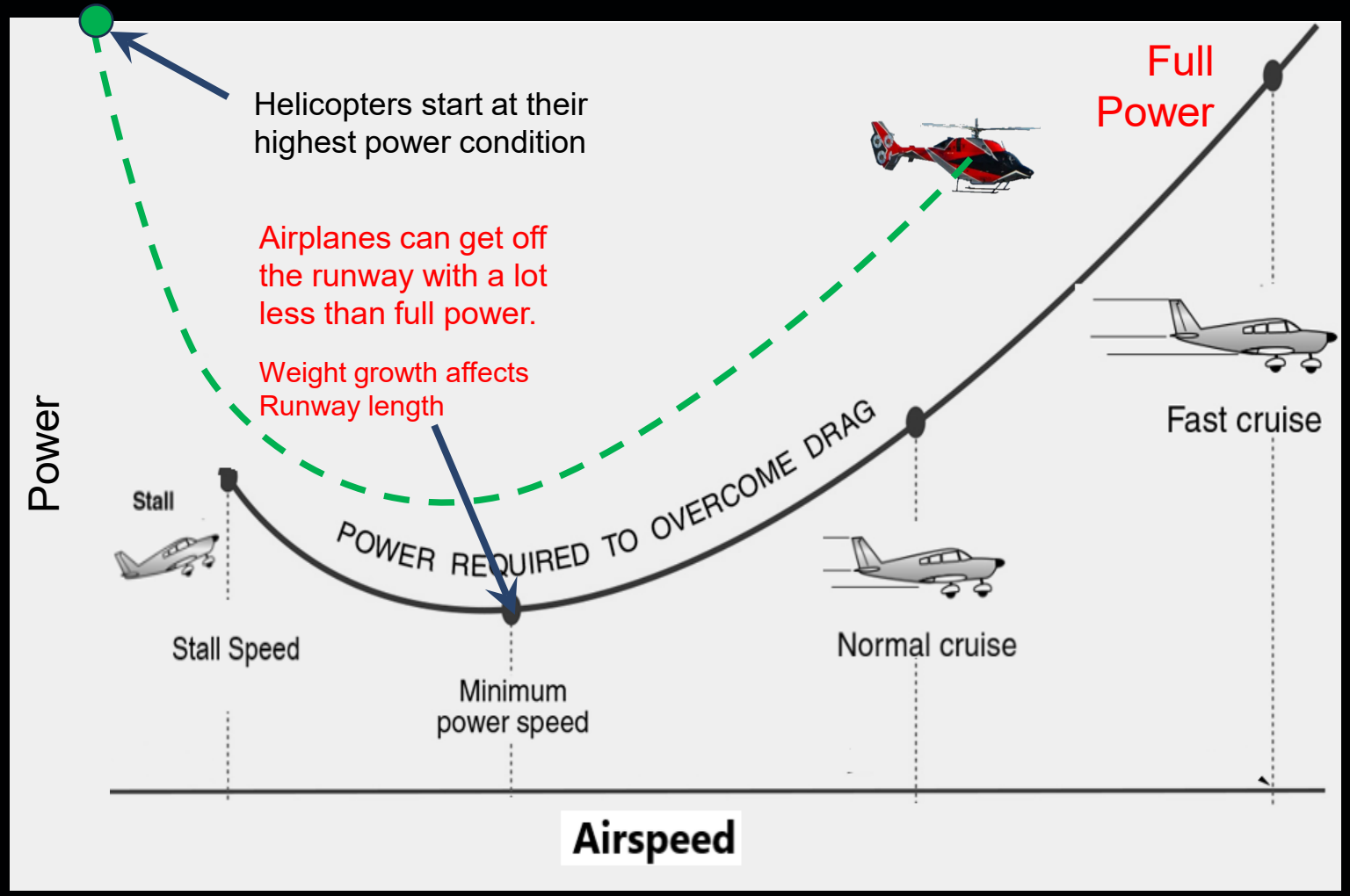
Smaller distance to inner range ring, (193 km, 104.2 nm)

Mission 2: Same Gross Weight as above. But…

Full Fuel (for outer ranger Ring)
Partial Passenger/ Baggage load ←You will determine this once you know the fuel (weight) required.

Mission 1 sizes the cabin, Mission 2 sizes the fuel tanks

WHAT YOU SHOULD KNOW BEFORE YOU START



VERTICAL TAKEOFF IS THE HELICOPTER'S HIGHEST POWER CONDITION

Discussion Section

The Rotorcraft must be designed to land safely after a single engine failure - FAA Transport Category A Rules “Cat A”

The missions start by AVOIDING vertical take-off at the airport – Allows takeoff at the maximum gross weight and an easy CAT A runway landing

The most stringent flight condition is the CAT A takeoff profile as the helicopter leaves the FPSO helideck

- Determine which case sizes the engines (Mission 1 or Mission 2)
- The mission with the higher weight at FPSO takeoff sizes the engines/ rotor diameter. This is the only CAT A Perf calculation needed.
- The take off is a slow climb to the Take-off Decision point using 5-min AEO Takeoff Power. At the TDP, one engine fails and the remaining engine goes to 30 sec OEI power. Show that the aircraft can both land safely or continuing OEI flight to V_{TOSS} at 30 sec OEI Power.

Mission Weight Analysis: Starts with a Guess

One method: Guess a Gross weight. Use Ai but verify.

Example: MTOW=22000 lb

Calculate Payload for Mission 1 (Fuel +Crew + 16 Pax)

Human Payload: Crew=2*200=400lb plus Pax+Baggage=16*255=4080 lb

Mission 1 fuel (2*104 nm) = Some guessing and later iteration required. Assume 1000 lb/100 nm (use Ai). Don't forget fuel reserves

Calculate Takeoff Weight at FPSO factoring weight of fuel burned
Fuel Burn to the FPSO ~ 1000 lb

TOGW at FPSO = MTOW – Fuel Burned
22000 lb – 1000 lb = 21000 lb ←Assess a CAT A Takeoff at this weight (Mission 1)
Do you have enough power, enough rotor to land, continue?

Mission Weight Analysis: More Checks

Assume a reasonable empty weight fraction: Use Ai and verify numbers

EW fraction=0.56=EW/22000 ➔ EW=12320 lb

Weight analysis segment: For your design, collect the numbers:

Airframe structural weight
Seats
Baggage volume
Drive train and rotors
Engines / fuel tanks
OGP kits
Avionics
Controls and actuation…
Systems

Do the weights add up to 12320 lb?

Iterative Analysis Process:

If the iteration stage does not result in the proposed EW fraction, a larger gross weight may be needed or larger engines, or more rotor diameter.

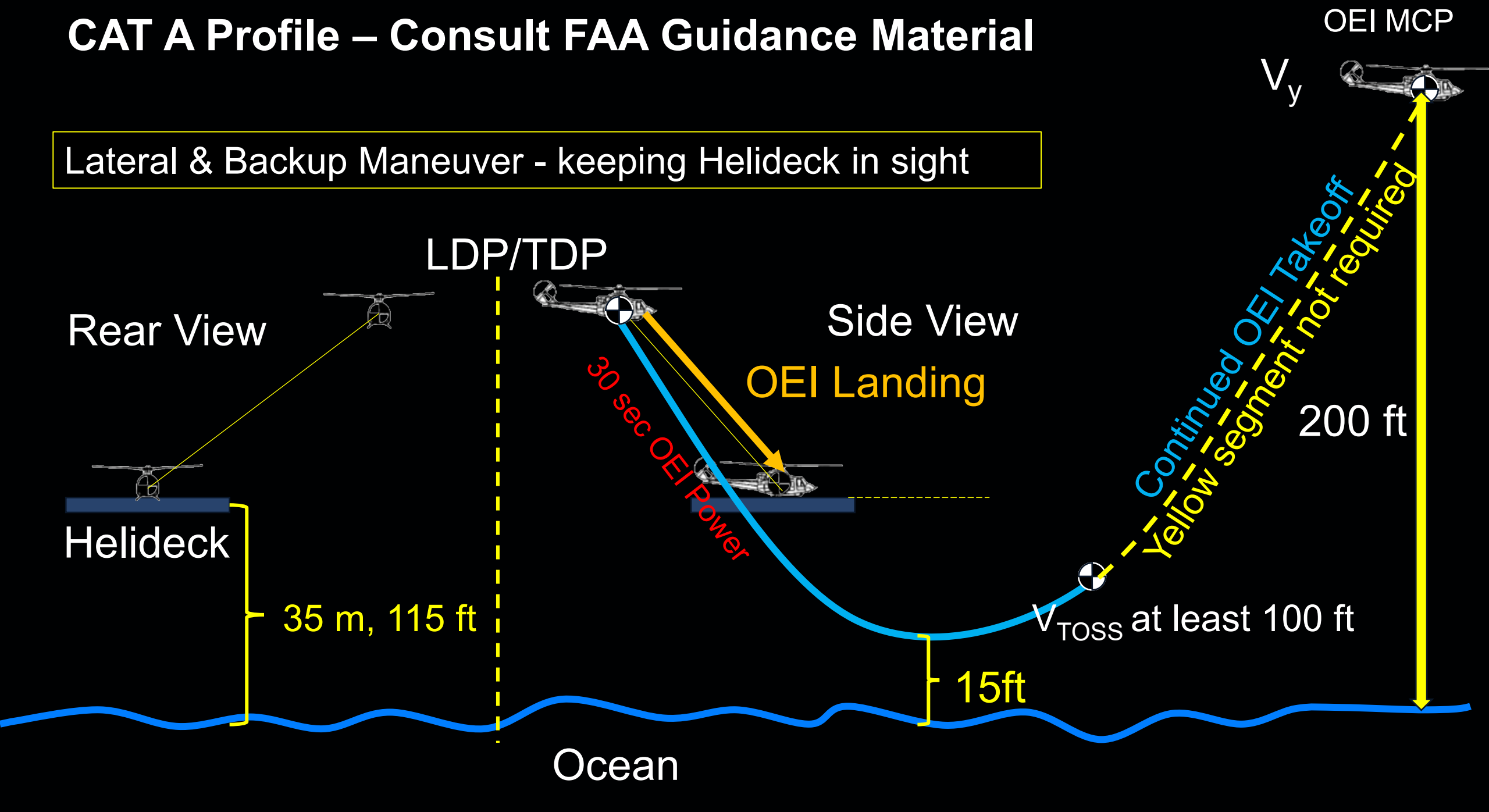
At the same time, the CAT A Takeoff at the FPSO must be feasible. Show a flight profile that can land at 3 ft/s sink rate and stop on the helideck. Show that a continued takeoff is also possible. Rotor sizing, 30 sec OEI power, and rotor inertia will factor into these calculations

Eventually, you need to use your selected engine fuel flow in the calc. The entire final design needs to converge on the weight and performance

Hint: I think the Mission 1 weight at the FPSO is higher than Mission 2's. So, confirm this in your proposal and you'll only need to work the CAT A Profile for Mission 1

CAT A Profile – Consult FAA Guidance Material

Lateral & Backup Maneuver - keeping Helideck in sight



CAT A Calculation: Use Energy Analysis* and Speed-Power chart slide 7

- For each Iteration's Estimated Weight at FPSO Takeoff, set a TDP height (you can vary it)
- At the TDP, assume hover power is required
- Fail one engine and bring the second engine to 30 sec power rating
- Gain Forward speed – less power required

The math:

(Altitude loss) ·(Weight)= Energy

(Downward Velocity) ·(Weight) = Power available

- Use energy principle and the 30 sec OEI Power to:
- - Land on the helideck (Gain Forward speed but arrest with flare)
- - Continue the flight on one engine (30 sec OEI power to V_{Toss}) ←Terminate analysis here
- - The aircraft achieves the 3 ft/s sink rate on landing by flaring and pulling collective, reducing RPM down to ~70-75% at touchdown. As seen in the video a critical piece of the puzzle for this maneuver is using the stored energy in the rotor's inertia to cushion the landing.
- Converge on Solution

* The energy analysis does not need to consider the lateral portion of the maneuver – only the fore/aft & vertical energy components

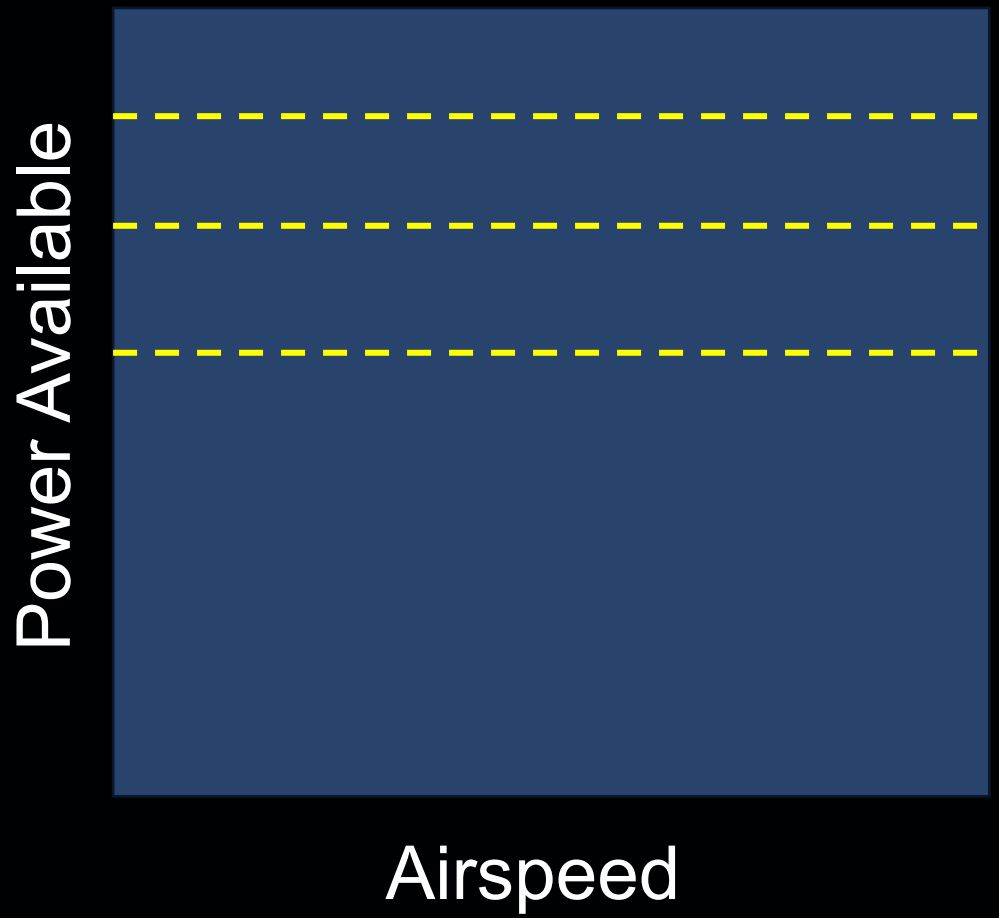
Hint: The analysis does not need to be perfect

It just needs to be reasonable physics

Judges love simplicity with a good explanation that shows your thought process

In real life, all assumptions are resolved in Flight Test!

CAT A Calculation: Use Energy Analysis

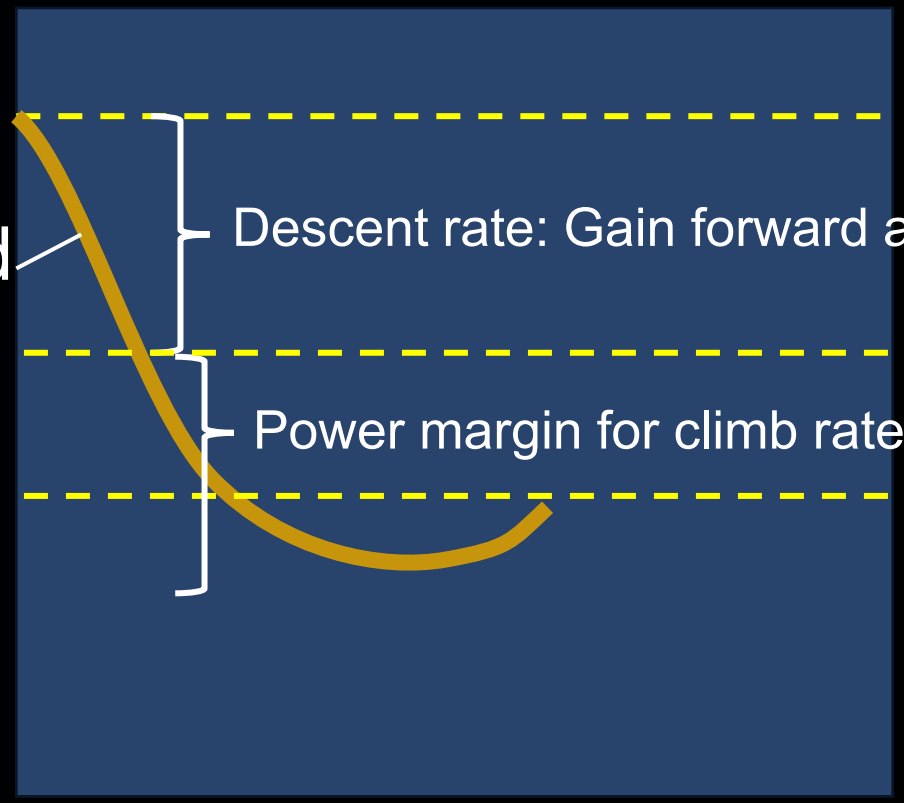


5-min Takeoff Power – All Engines

Max Continuous Power – All Engines

30 Sec Power – 137% MCP, One Engine

CAT A Calculation: Use Energy Analysis



You must solve the Cat A Helipad Landing Problem
and the Cat A Continued Takeoff Problem
for the Helicopter's Weight at the FPSO

For the continued takeoff
Take advantage of the Helideck's "Height off the water" (35 m, 115 ft)

The helicopter is allowed to dive below the helideck but must not get within 15 ft of the waterline

An optimal design achieves the lowest Max Gross Weight
for the starting the mission at the airport… Weight=Cost

Design Iteration

Getting the weight of the helicopter at the FPSO is an iterative process

- Estimate a approximate Max Gross Weight for the design.
- See how much fuel you need for that design to do the Missions
- See what the weight is for the return takeoff at the FPSO
- With both engines, get to a Take Off Decision Point
- Fail one engine, Set the remaining engine(s) to 30 sec OEI Power
- Rejected takeoff: Show that you can land at 3 ft/s and not run off the helideck
- Continued Takeoff: Show a that you can Continue the flight on one engine using 30 sec OEI power and attain V_{TOSS}
- If CAT A does not work, adjust TDP and/or iterate on power, fuel flow, rotor diameter, rotor inertia, gross weight

Outbound Mission: It's all about fuel burn and weight

Both mission profiles shall assume ISA+15°C conditions for all mission segments as identified below:

1. Onshore runway (Category A) "rolling" take-off at sea level
   - For purposes of weight calculation, fuel burn for the take-off shall assume AEO Take-Off Power for 1 minute. (See Powerplant detail in the DDN section for powerplant rating structure)
2. Climb at Max Continuous Power (MCP) at best climb speed to 1830 m, (6000 ft)
3. Cruise at 1830 m, (6000 ft) altitude, at long range cruise speed (V_{LRC})
4. Descent at 222 km/h True Air Speed, (120 KTAS) and 152 meters/min (500 ft/min) to sea level
5. Offshore elevated heliport landing (Category A) at sea level
   - For purposes of weight calculation, fuel burn for the landing shall assume AEO Take-Off Power for 1 minute
6. 15 min at 10% MCP AEO to determine fuel consumption during loading and unloading of passengers at the FPSO

Here, you are just calculating fuel burn (weight) – Cat A design work is complete (though some iteration on mission was required for that)

Again, just calculate the fuel weight based on the design that meets CAT A Takeoff at the FPSO

Return Mission

7. Offshore elevated helipad takeoff (Category A) at sea level
   - For purposes of weight calculation, fuel burn for the take-off shall assume AEO Take Off Power for 1 minute.

Weight of burned fuel

8. Climb at MCP at best climb speed to 1,830 meters, (6000 ft)

9. Cruise at 1,830 meters, (6000 ft) at V_{LRC}

10. Descent at 222 km/h True Air Speed, (120 KTAS) and 152 meters/min, (500 ft/min) to sea level

11. Vertical landing at the Airport (Category A) at sea level
    - For purposes of weight calculation, fuel burn for the landing shall assume AEO Take Off Power for 1 minute

just weight

12. At the end of the mission, there shall be a reserve fuel weight to fly the following profile: First, cruise at 915 m (3,000 ft) at best range speed (V_{BR}) for 50 km (27 nm) to an alternate airport and then cruise at 915 m (3000 ft) altitude at best endurance speed (V_{BE}) for 30-minutes.

This is reserve fuel weight you carry but never use

Design Decision Notifications (DDNs) – Pg 17

DDNs give an account of your decision-making process and these count heavily in your Technical Score, Organizational Score, Feasibility Score, and Originality Score

We give so much importance to them that each team must identify (on the signature page) a DDN Communication Specialist!

DDNs are “preliminary design” artifacts. We do not expect you to provide a detail design of these items. Keep it simple - diagrams and useful descriptions about what you would do if you had to design that element. 1-2 pages each

Design Decision Notifications (DDNs) – Pg 17

You only have 6 DDNs to put forward

The OEMs will have about 50 critical DDNs to kick-off a Preliminary Design Effort for major systems

OEMs facilitate good DDN “decision making” in a High Communication environment (Close Reading of this RFP section is highly recommended for all team members)

Everyone on the team should know the what and why of each DDN and proceed accordingly. DDNs require cross-team assessments to finalize.

When you finish the design:
Consolidate the “Final Design” Information in Table XX (Pg 21)

Table XX: Final Configuration Parameters				
1	Maximum Gross Weight	kg	Lb	
2	Empty weight	kg	Lb	
3	Maximum Fuel Capacity (Usable)	kg	lb	
4	Total Passenger weight Fully Occupied, including baggage* for Minimum Radius Mission (@ 115.6 kg 255 lb each)	kg	lb	
5	Total Passenger weight including baggage* (@ 115.6 kg 255 lb each) for Max Range Mission	kg	lb	
6	Installed Power (MCP) at SL ISA+15°C	kW	HP	
7	Number of Engines	#		
8	5-min TOP rating at SL, ISA+15°C (installed)	kW	HP	
9	30 sec OEI power at SL, ISA+15°C (installed)	kW	HP	
10	Rotor Diameters	Rotor 1	Rotor 2	…
		m, Ft	m, Ft	…
11	Number of Blades per rotor	Rotor 1	Rotor 2	…
		#	#	…
12	Blade Moment of Inertia: $I = \int_0^R m\, r^2 dr$, m=mass/length	kg-M^2	Slug-Ft^2	
13	Ideal hover power required, MTOW Sea Level, ISA+15°C	kW	HP	

Best Wishes for a 2027 Win!

Ask Questions! There will be a Q&A

1.3 Schedule

Schedule milestones and deadline dates for submission are as follows:

Milestone	Date
VFS Issues the RFP	August 2025
Bell Responses to Team First Round RFIs	November 20, 2026
Teams Submit Second Round Request for Information (RFI)*	NLT February 1, 2027