Homeland Defense Interceptor

Request for Proposal

1.0 Background

Increasing international political tensions make it likely that the United States will be attacked from the air again. This attack may involve aircraft ranging in size from large chartered or hijacked airliners to small autonomous cruise missiles. At the same time, most current Air Force and Navy fighter aircraft will reach the end of their service life by 2045. The stealthy F-22 and F-35, designed primarily for operations against large, sophisticated air defense systems and high-performance fighters, are too expensive to be bought in sufficient numbers to provide adequate force projection assets while maintaining homeland airspace sovereignty. A small, high-performance but low-cost homeland defense interceptor could fill this gap without drawing excessive funds away from offensive forces. Approximately 1000 aircraft are needed to fill this requirement.

Strict budgetary constraints dictate that this aircraft will only be built if it is extremely affordable. In order to minimize cost per aircraft, all practical measures must be taken to keep it as small and simple as possible without compromising mission performance. The program will be titled Homeland Defense Interceptor (HDI).

2.0 Requirements

2.1 Design a homeland defense interceptor, including an engine data package.

2.2 The design should be cost effective and perform two design missions. The first is a defensive counter-air (DCA) patrol mission. Attachment 1 provides specific information on this design mission. The second is a point defense interception mission. Attachment 2 provides specific information on this design mission.

2.3 An intercept/escort mission will be evaluated. Attachment 3 provides specific information.

2.4 Attachment 4 specifies minimum performance requirements.

2.5 Attachment 5 specifies weapons carriage capabilities.

2.6 Attachment 6 specifies engine design requirements.

2.7 All reports shall be submitted electronically as MSWord documents or PDF files.

3.0 Other Desired or Required Capabilities and Characteristics

3.1 Remote Pilot (required). All systems must be designed for remote pilot operation. Pilot can control the aircraft remotely if the operational concept accomplishes positive threat identification and clearly addresses all communication bandwidth issues related to that approach. An unmanned approach can remove any man/machine interfaces from the aircraft itself, but must address remotely piloted infrastructure issues in full detail.

3.2 Maintenance (required). The design must allow easy access to and removal of primary elements of all major systems. Minimize requirements for unique support equipment.

3.3 Structure (required): Design limit load factors are +7 and -3 vertical g's in the clean configuration with 50% internal fuel. The structure should withstand a dynamic pressure of 2,133 psf (M=1.2 at sea level). A factor of safety of 1.5 shall be used on all design ultimate loads. Primary structures should be designed for durability and damage tolerance. Design service life is 2,000 hours.

3.4 Fuel/Fuel Tanks (required): Primary design fuel is standard JP-8 or Jet-A (6.7 lb/gal). All fuel tanks will be self-sealing. External fuel tanks may be carried for design missions, but if carried, must be retained for the entire mission.

3.5 Stability (required): Unaugmented subsonic longitudinal static margin (S.M.) shall be no greater than 10% and no less than -10%. A digital flight control system is mandatory for designs that are statically unstable in the longitudinal axis.

3.6 Operation (required): The aircraft must operate in all weather from existing NATO runways (8,000 ft), shelters, and maintenance facilities and from austere bases without support equipment. The aircraft must be capable of all-weather interception and weapon delivery.

3.7 Cost (required). Flyaway cost per aircraft for a 1000 aircraft buy will not exceed $25 million in 2024 US dollars. All practical measures will be taken to minimize total life cycle costs.

4.0 Measures Of Merit

Designs will be evaluated on DCA and intercept mission performance (Attachments 1 and 2), escort mission radius (Attachment 3), other performance requirements (Attachment 4), weapons carriage (Attachment 5), and cost. The following measures of merit will be reported for each design mission:

4.1 Weight summary (GTOW, W_e, W_f, W/S, T/W, W_f /W) including external tanks, if used.

4.2 Aircraft geometry and systems integration (wing and control surface area, fuselage size and volume, frontal cross sectional area distribution, wetted area, inlet and diffuser, landing gear, weapons carriage, sensor and avionics locations, crew station, etc.)

4.3 Mission duration, radius or range, fuel burn by mission segment for each design mission.

4.4 Take-off and landing distance for each design mission including standard day and icy runway balanced field length at sea level and 4,000 feet MSL.

4.5 Performance at maneuver weight (50% internal fuel) for design mission loadings.

4.5.1 Maximum Mach Number at 35,000 Ft.

4.5.2 1-g Maximum Thrust Specific Excess Power Envelope

4.5.3 5-g Maximum Thrust Specific Excess Power Envelope

4.5.4 Maximum Thrust Sustained Load Factor Envelope

4.5.5 Maximum Thrust Maneuvering Performance Diagrams

4.5.5.1 10,000 ft

4.5.5.2 30,000 ft

4.5.5.3 50,000 ft

4.5.6 Climb to 35,000 ft from sea level, at a distance of 4.8 nmi away in less than or equal to 1 minute

4.6 Flyaway and total life cycle costs estimates must be provided for the system. Include any support system costs and infrastructure improvement costs. Show cost trades for aircraft buys of 100, 500, and 1000 units.

4.7 A digital 3D model of the aircraft is required. This model must be full scale and accurately depict the final design including location of all major subcomponents, fuel tanks, payloads, and crew. A conceptual drawing package shall be submitted (separate from the report) using D-size (22” x 34”) format.

5.0 Government Furnished Equipment (GFE)

GFE will be used to the maximum extent possible. GFE available or being developed for this aircraft is described in Attachment 7.

Attachment 1

Defensive Counter-Air Patrol Mission

Phase	Description
1	Take-off and acceleration allowance (computed at sea level. 59º F).
	a. Fuel allowance for warm-up
	b. Fuel to accelerate to climb speed at maximum thrust (no distance credit)
2	Climb from sea level to optimum cruise altitude
3	Cruise out 300 nm at optimum speed and altitude
4	Combat air patrol 4 hours at best loiter speed and 35,000 ft
5	Dash 100 nm at maximum speed at 35,000 ft
6	Combat allowance:
	Fuel required to perform the following maneuvers at 35,000 ft with maximum thrust and fuel flow.
	a. One sustained 360º turn ($P_s = 0$) at Mach = 1.2
	b. One sustained 360º turn ($P_s = 0$) at Mach = 0.9
	After maneuvers, fire all missiles and retain gun ammunition.
7	Climb/accelerate to optimum speed and altitude
8	Cruise back 400 nm at optimum speed and altitude
9	Descend to sea level (no distance credit or fuel used)
10	Reserves: fuel for 30 minutes at sea level at speed for maximum endurance

Note: Base all performance calculations on standard day conditions with no wind.

Attachment 2

Point Defense Intercept Mission

Phase	Description
1	Take-off and acceleration allowance (computed at sea level and 59º F). a. Fuel allowance for warm-up b. Fuel to accelerate to climb speed at maximum thrust (no distance credit)
2	Climb from sea level to 35,000 ft and accelerate to maximum speed
3	Dash 200 nm at maximum speed at 35,000 ft
4	Combat allowance: Fuel required to perform the following maneuvers at 35,000 ft with maximum thrust and fuel flow. a. One sustained 360º turn ($P_s = 0$) at Mach = 1.2 b. One sustained 360º turn ($P_s = 0$) at Mach = 0.9 After maneuvers, fire all missiles and retain gun ammunition.
5	Climb/accelerate to optimum speed and altitude
6	Cruise back 200 nm at optimum speed and altitude
7	Descend to sea level (no distance credit or fuel used)
8	Reserves: fuel for 30 minutes at sea level at speed for maximum endurance

Note: Base all performance calculations on standard day conditions with no wind.

Attachment 3

Intercept/Escort Mission

Phase	Description
1	Take-off and acceleration allowance (computed at sea level and 59º F). a. Fuel allowance for warm-up b. Fuel to accelerate to climb speed at maximum thrust (no distance credit)
2	Climb from sea level to 35,000 ft and accelerate to maximum speed
3	Dash out at maximum speed at 35,000 ft
4	Escort for 300 nm at minimum practical airspeed. Retain all weapons.
5	Climb/accelerate to optimum speed and altitude
6	Cruise back at optimum speed and altitude
7	Descend to sea level (no distance credit or fuel used)
8	Reserves: fuel for 30 minutes at sea level at speed for maximum endurance

Note: Base all performance calculations on standard day conditions with no wind.

Attachment 4

Minimum Performance Requirements/Constraints

Criteria	Requirement
Mission Performance	
Intercept Mission Radius	200 nm
DCA Mission CAP endurance at 300 nm radius	4 hrs
Performance at Maneuver Weight (50% Internal Fuel)	
• Maximum Mach Number at 35,000 ft	Mach 1.6
• 1-g Specific Excess Power– Military Thrust	
• 0.9M/Sea Level	200 ft/sec
• 0.9M/15,000 ft	50 ft/sec
• 1-g Specific Excess Power– Maximum Thrust	
• 0.9M/Sea Level	700 ft/sec
• 0.9M/15,000 ft	400 ft/sec
• 5-g Specific Excess Power– Maximum Thrust	
• 0.9M/Sea Level	300 ft/sec
• 0.9M/15,000 ft	50 ft/sec
• Sustained Load Factor– Maximum Thrust	
• 0.9M/15,000 ft	5.0 g's
• Maximum Instantaneous Turn Rate at 35,000 ft	18.0 deg/s

Attachment 5

Required Maximum Weapons Carriage Capability

Air-to-Air Loading

- Trade the number of AIM-120
- Trade internal and external carriage

Attachment 6

Engine Cycle Requirements

1. The engine must provide adequate installed thrust for all portions of the design missions. The engine data package must include all parameters necessary to completely describe the engine cycle and geometry.

2. Aircraft System Requirements:

   a. Electrical and hydraulic systems require 50kw of power.

   b. Environmental control systems and the avionics liquid cooling system require 2% of engine mass flow.

3. It is highly desirable that the engine utilized is a non-developmental item (NDI). A derivative of the engine should currently be in production or forecast to be in production by 2027.

Attachment 7

Government Furnished Equipment

Item	Volume, ft^3	Weight, lb	Cost, K$ (2005)
<u>Avionics</u>			
• Base Suite			
- ICNIA[1]	3.0	100	200
- 3 x MFDs	1.5	20	60
- Head-Up Display	1.6	35	20
- Data bus	0.5	10	10
• ECM Equipment			
- INEWS[2]	3.0	100	500
<u>Flight and Propulsion Control System</u>			
Vehicle Management System	1.0	50	200
<u>Fire Control Systems</u>			
• IRSTS[3]	2.0	50	300
• Active Array Radar	6.0	450	1000
<u>Systems and Equipment</u>			
• Electrical System(2 engines)	4.0	300	50
	(subtract 80 lb, 1 ft^3 and $10k if one engine is used)		
• Auxiliary Power Unit (APU)	2.0	100	50
• Ejection Seat	8.0	160	100
• OBOGS[4]	1.0	35	10
• OBIGGS[5]	1.0	35	10
<u>Air-to-Air Weapons</u>			

AIM - 120 AMRAAM

Launch weight:	327 lb
Length:	12 ft
Max span:	2.1 ft
Body diameter:	0.6 ft

M61A1 20 mm Cannon

Cannon weight:	275 lb
Length:	74 in
Max diameter:	10 in
Ammunition feed system (500 rounds) weight:	300 lb
Ammunition drum length:	25 in
Diameter: 25 in	
Ammunition (20 mm)	0.58 each
Returned casings	0.26 each

[1] Integrated Communication, Navigation, and Identification Avionics

[2] Integrated Electronic Warfare System

[3] Infrared Search and Track System with laser ranging

[4] Onboard Oxygen Generation System

[5] On-Board Inert Gas Generation System