Innovations in Tankers, Air Mobility, and Expeditionary Forces Support

The views expressed in this presentation are those of the author and do not necessarily represent the views of the Air Force Research Laboratory or the Air Force

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The Air Force is now completing its fighter modernization

Where it will deploy nearly 2,000 5th generation fighters

The acquisition community is now focusing on further modernization

Starting with tankers …

The acquisition community is now focusing on further modernization

But also thinking about theater airlift,

The acquisition community is now focusing on further modernization

SOF and gunships …

The acquisition community is now focusing on further modernization

Heavy VTOL …

The acquisition community is now focusing on further modernization

UCAVs …

The acquisition community is now focusing on further modernization

Replacement bombers …

The acquisition community is now focusing on further modernization

Replacement EW aircraft …

The acquisition community is now focusing on further modernization

And replacement aeromedical evac aircraft

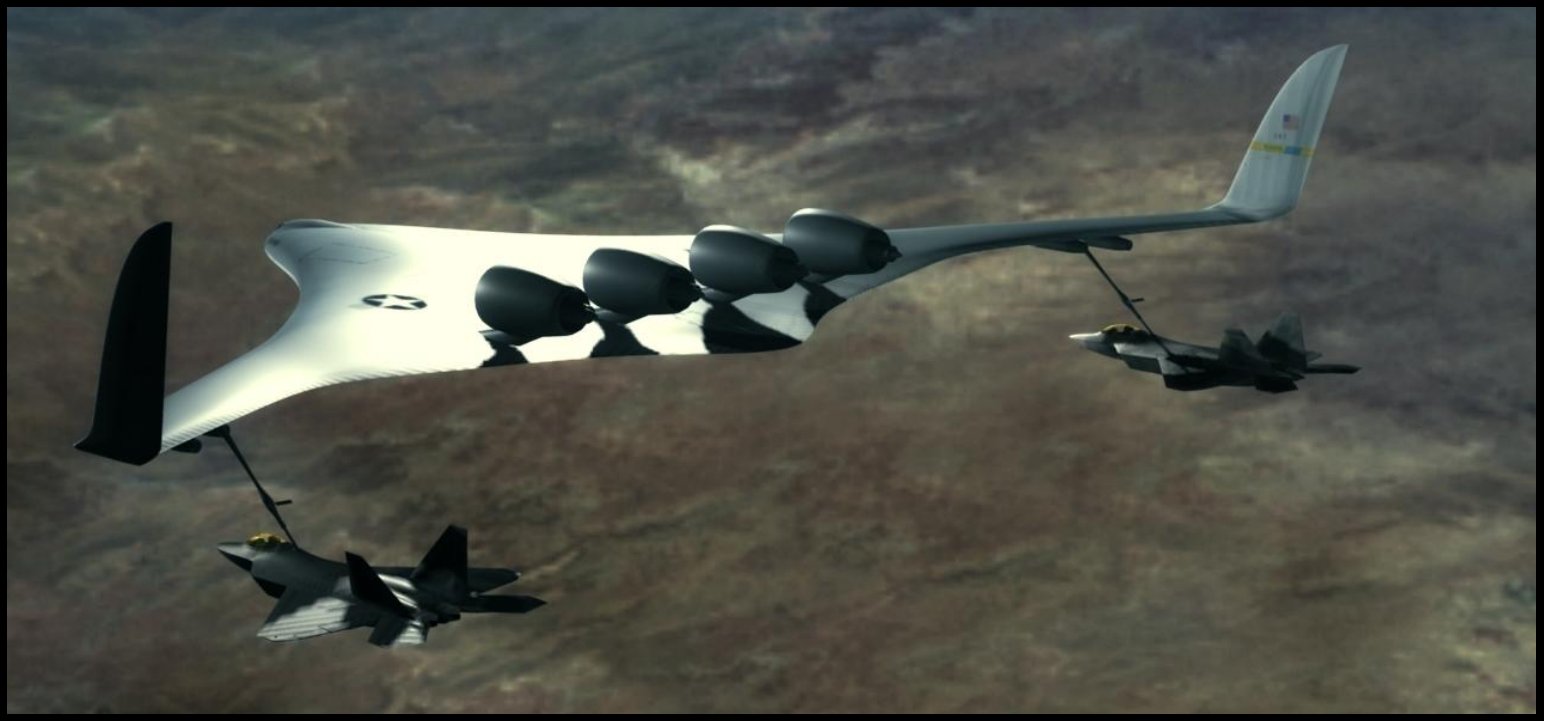
Yet, the acquisition path to modernization is not clear

- What path is affordable?
- What path provides needed global and theater mobility, air power, force deployment and sustainment, multi-mission flexibility?
- What path capitalizes on recent and on-going science and technology advances?
- What path benefits the future of the U.S. industrial base?

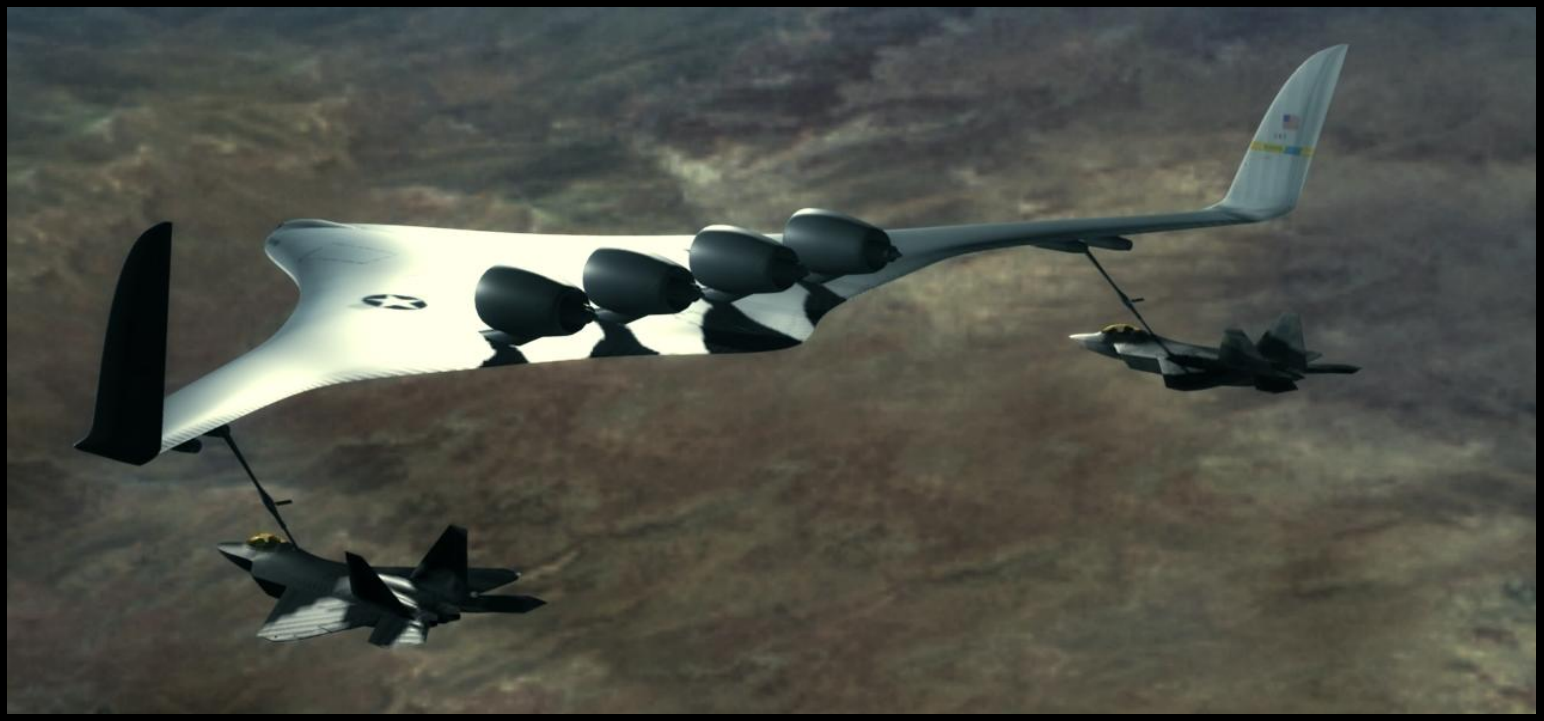
Especially important, what path will let the future Air Force execute effectively?

- Across the full spectrum of military operations
- Against a wide variety of threats including chem / bio / nuclear / energy
- With integrated command, control, communications, and mobility
- With flexibility to quickly adapt to future needs and threats
- With a “joint” solution

There is a new approach that will better address 21st century challenges



Strategic Configurable Air Transports (S-CAT)



Strategic tanker – airlifter – air power platform

Strategic Configurable Air Transports (S-CAT)

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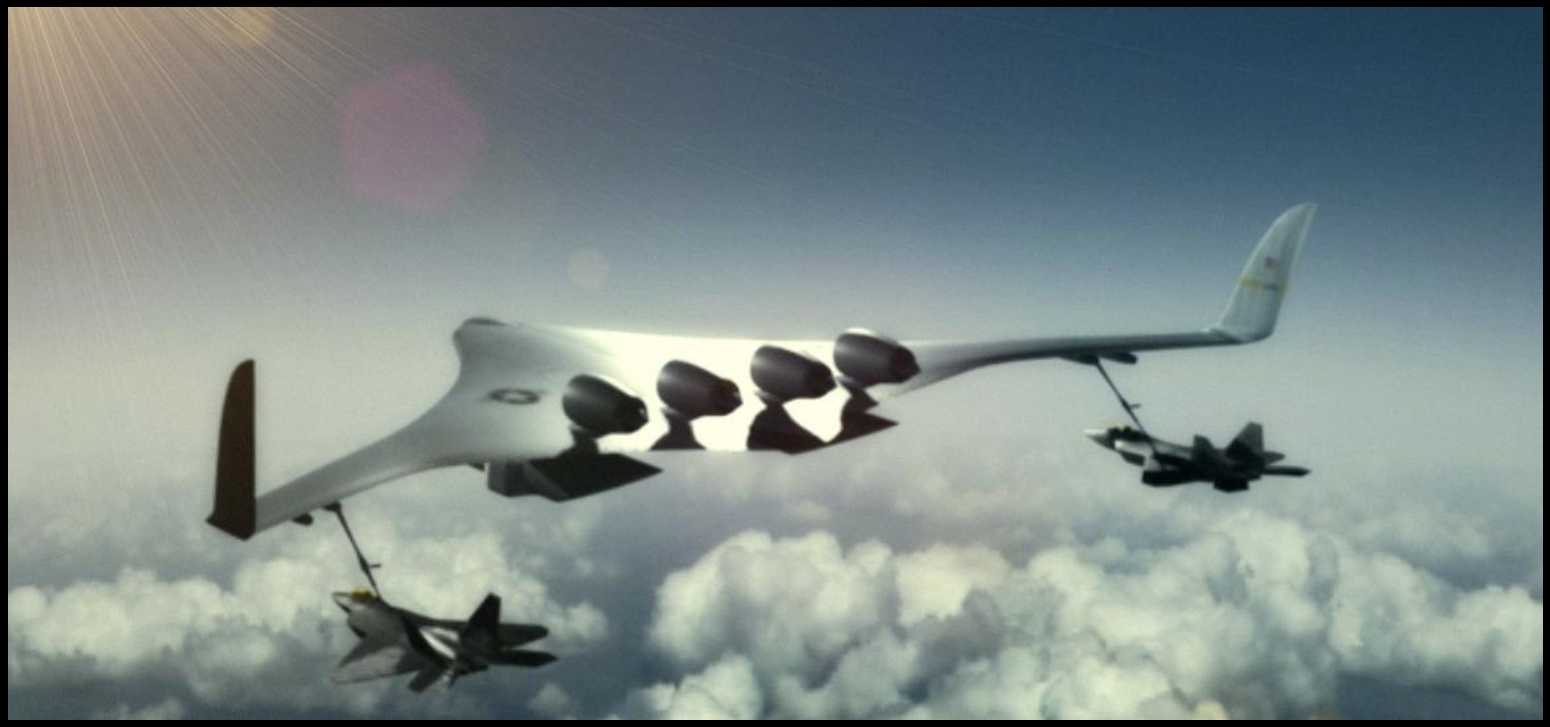

Strategic tanker – airlifter – air power platform

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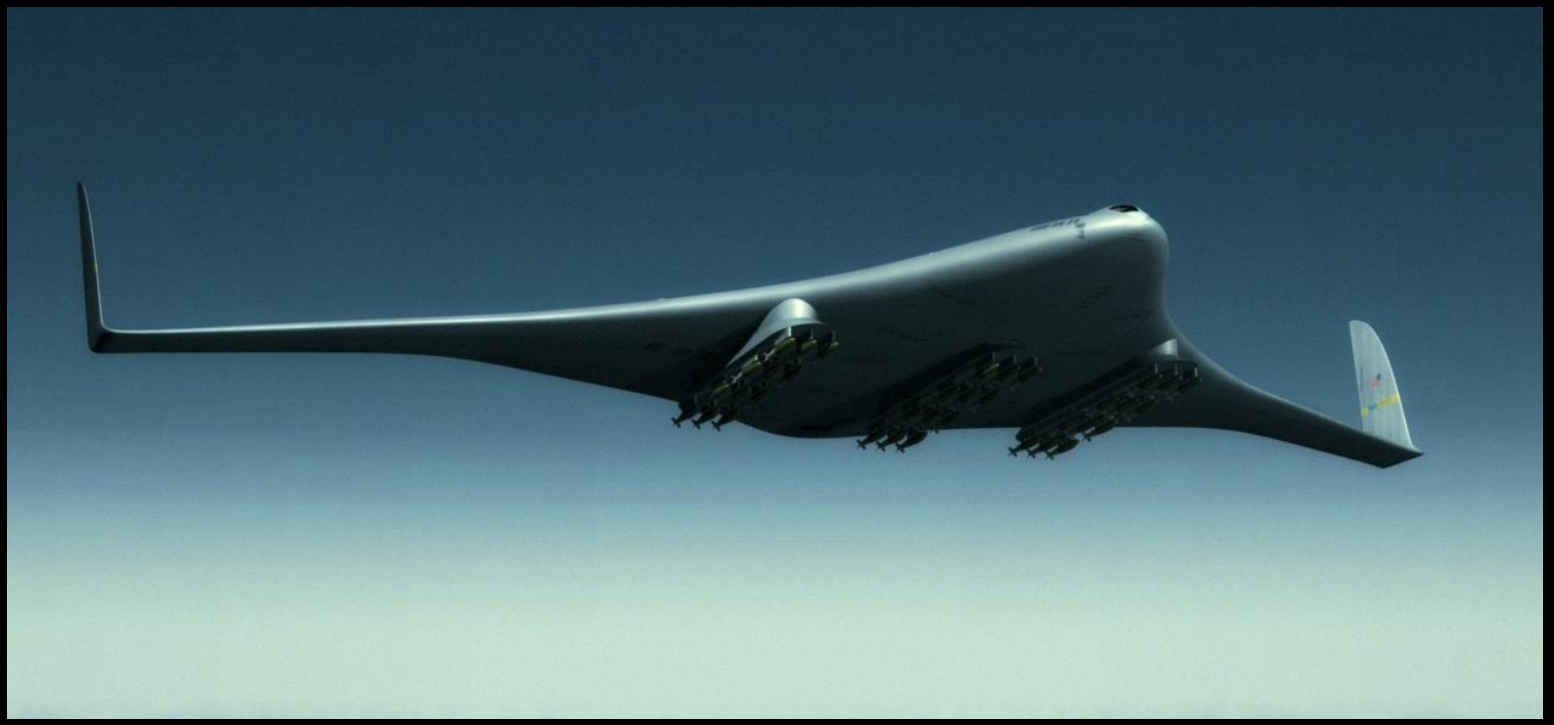

Strategic tanker – airlifter – air power platform

Theater Configurable Air Transports (T-CAT)

Theater tanker – airlifter – air power platform

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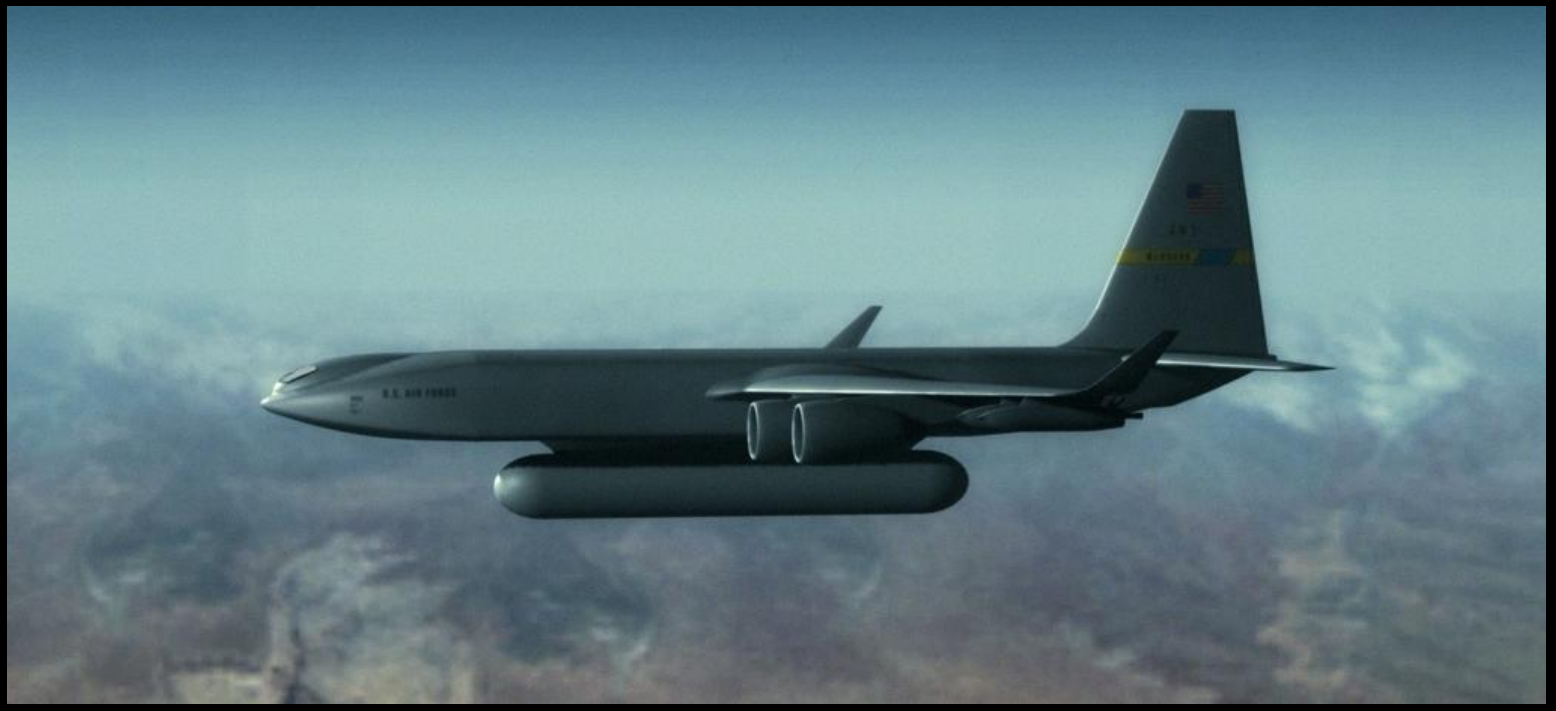
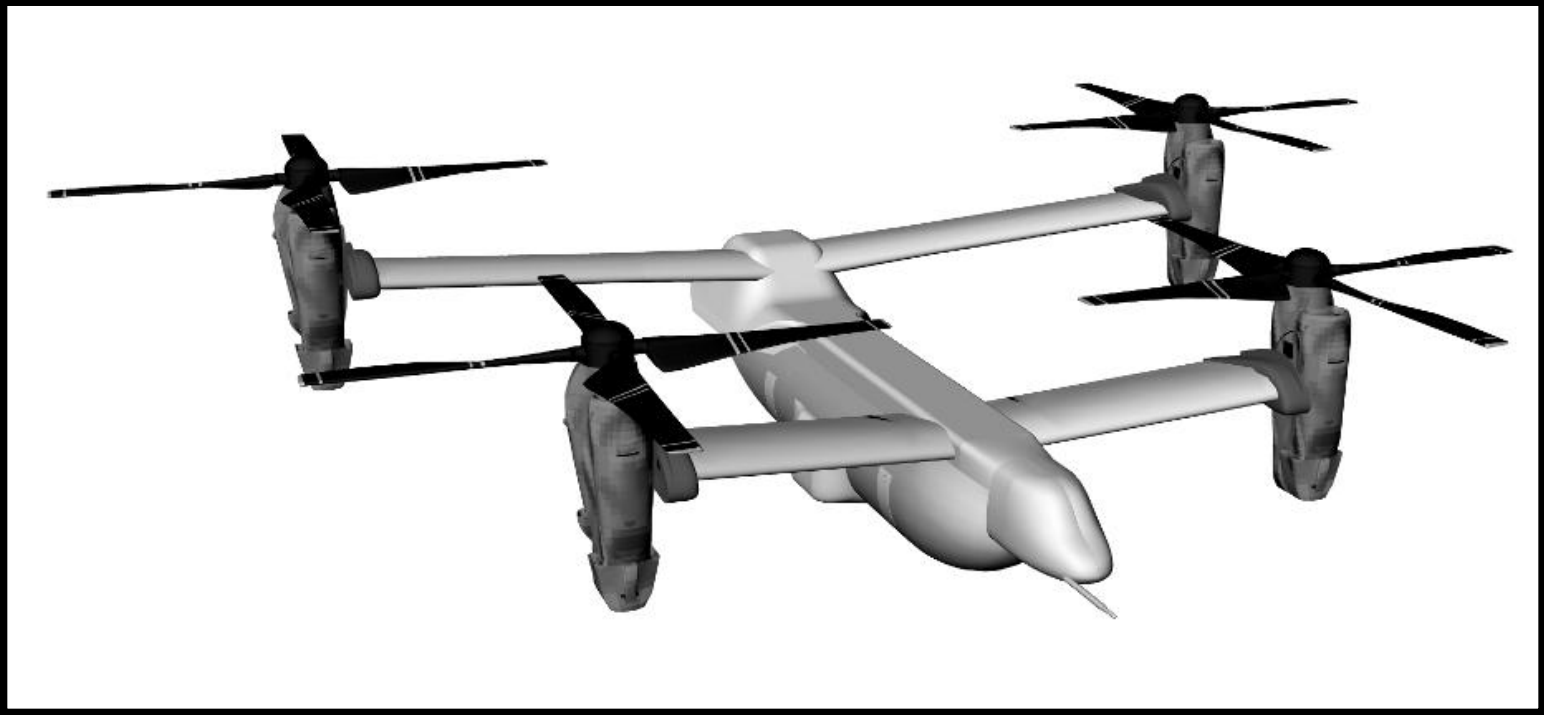
Theater tanker – airlifter – air power platform

Theater Configurable Air Transports (T-CAT)



Theater tanker – airlifter – air power platform

Tactical Vertical Configurable Air Transports (V-CAT)



Tactical airlifter – air power platform

Presentation Purpose

- Redefine “air mobility” for the 21st century in terms of the mission capabilities
- Identify a new set of integrated “air mobility” capabilities:
  - Utilizing emerging science and technology advancements
  - Enabling significantly improved operational capabilities, especially for joint operations
  - Addressing emerging 21st century challenges

Tanker History

- 816 KC-97s
- 732 KC-135s (530 in service)
- 59 KC-10s

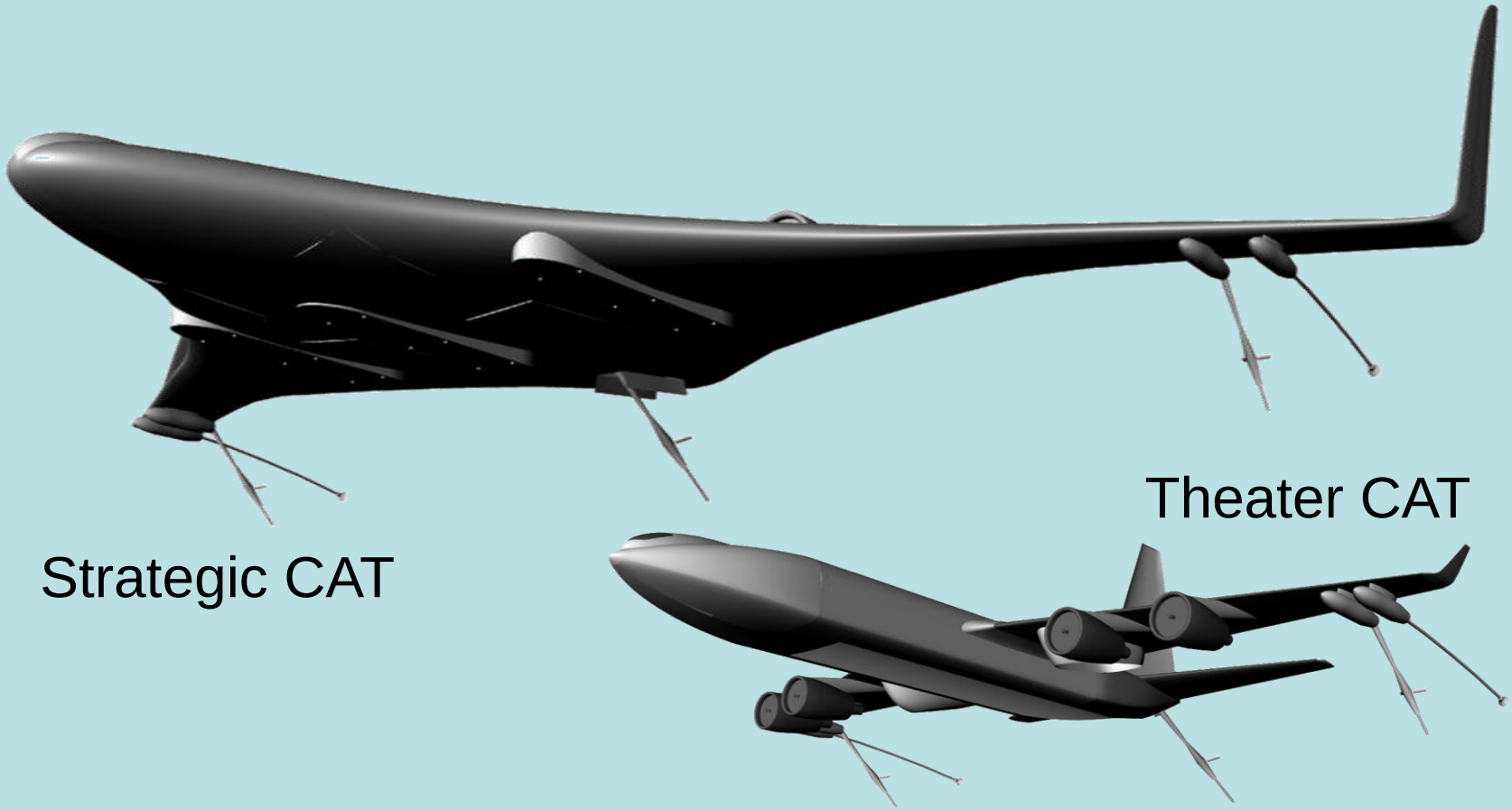
Compare Conventional and Modular Alternatives

Two views of the future of tankers

- KC-135 model
  - Primarily air-refueling
  - Commercial-derived design
  - Palletized cargo
  - Some multi-mission capability with Info Warfare
  - Specialized aircraft capabilities through permanent mods
  - Traditional levels of integration
  - Fleets of fixed capabilities

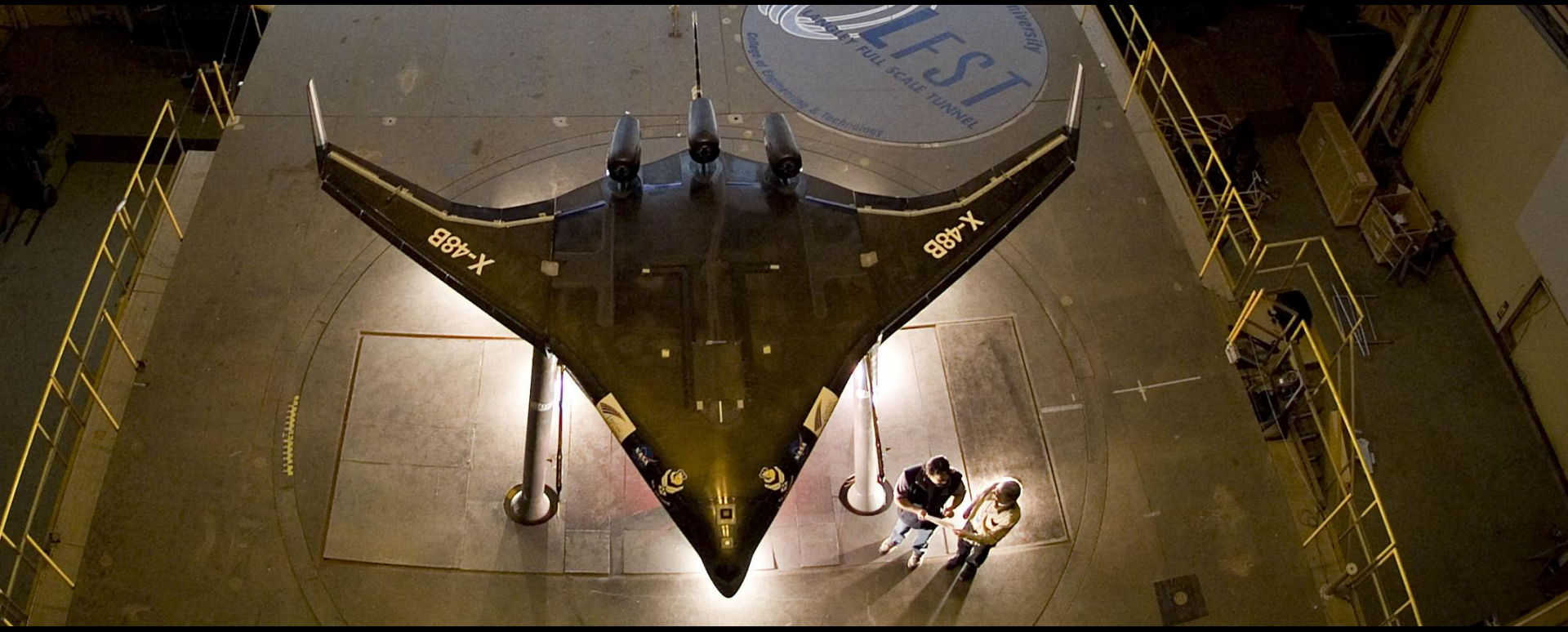
- Modular approach
  - Mixed air-refueling, cargo, air power missions
  - New designs
  - Module for carrying cargo
  - Missionized modules for flexible mission capabilities
  - Strategic – theater – tactical integration
  - Generic fleet with true multi-mission capabilities

CATs' core mission is air refueling



Strategic CAT provides global-range escort for deploying fighters

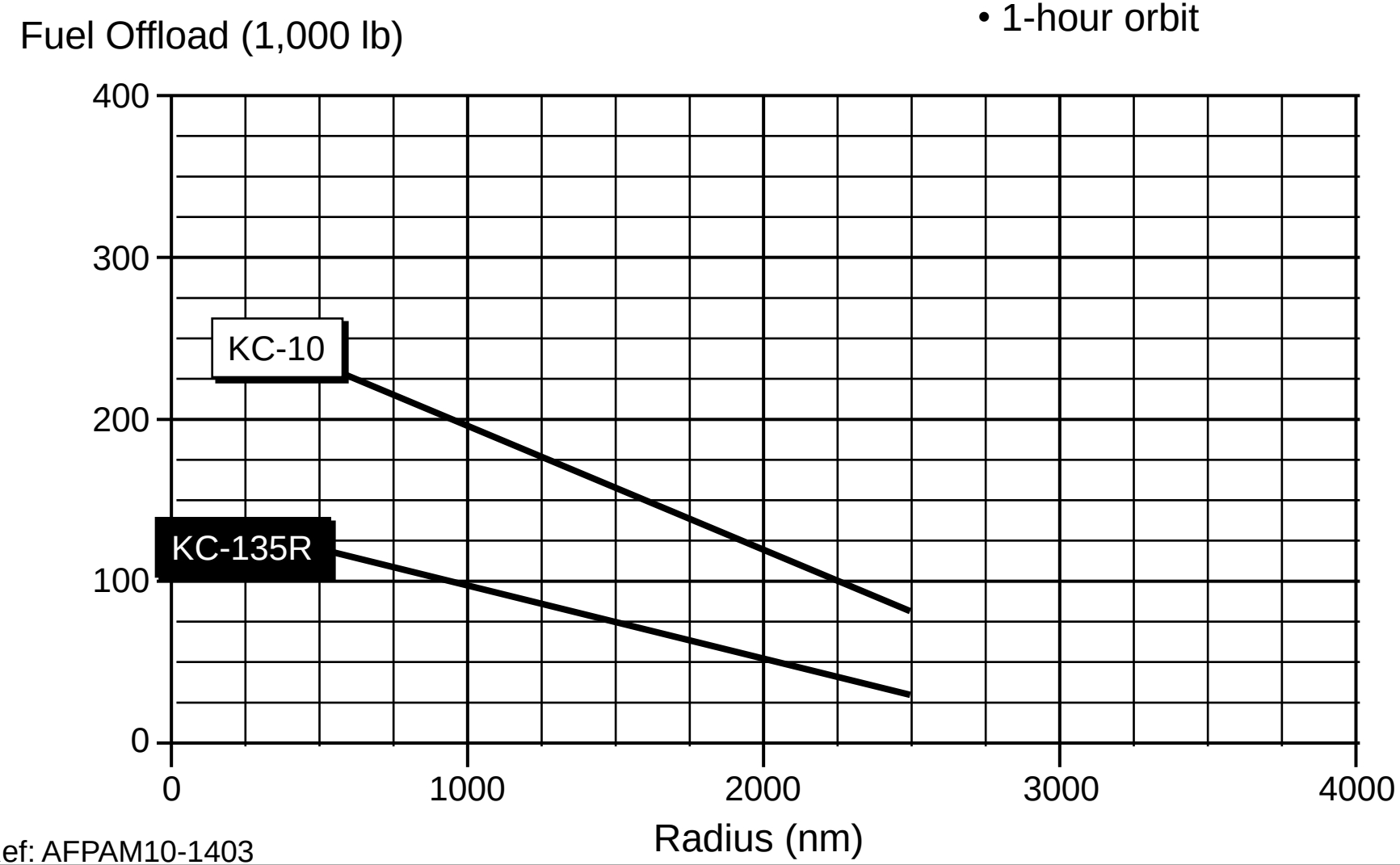
Blended Wing Body Transports



- Improved
  - Aerodynamic performance
  - Reduced structural weight fraction

Current Air Force tanker offload

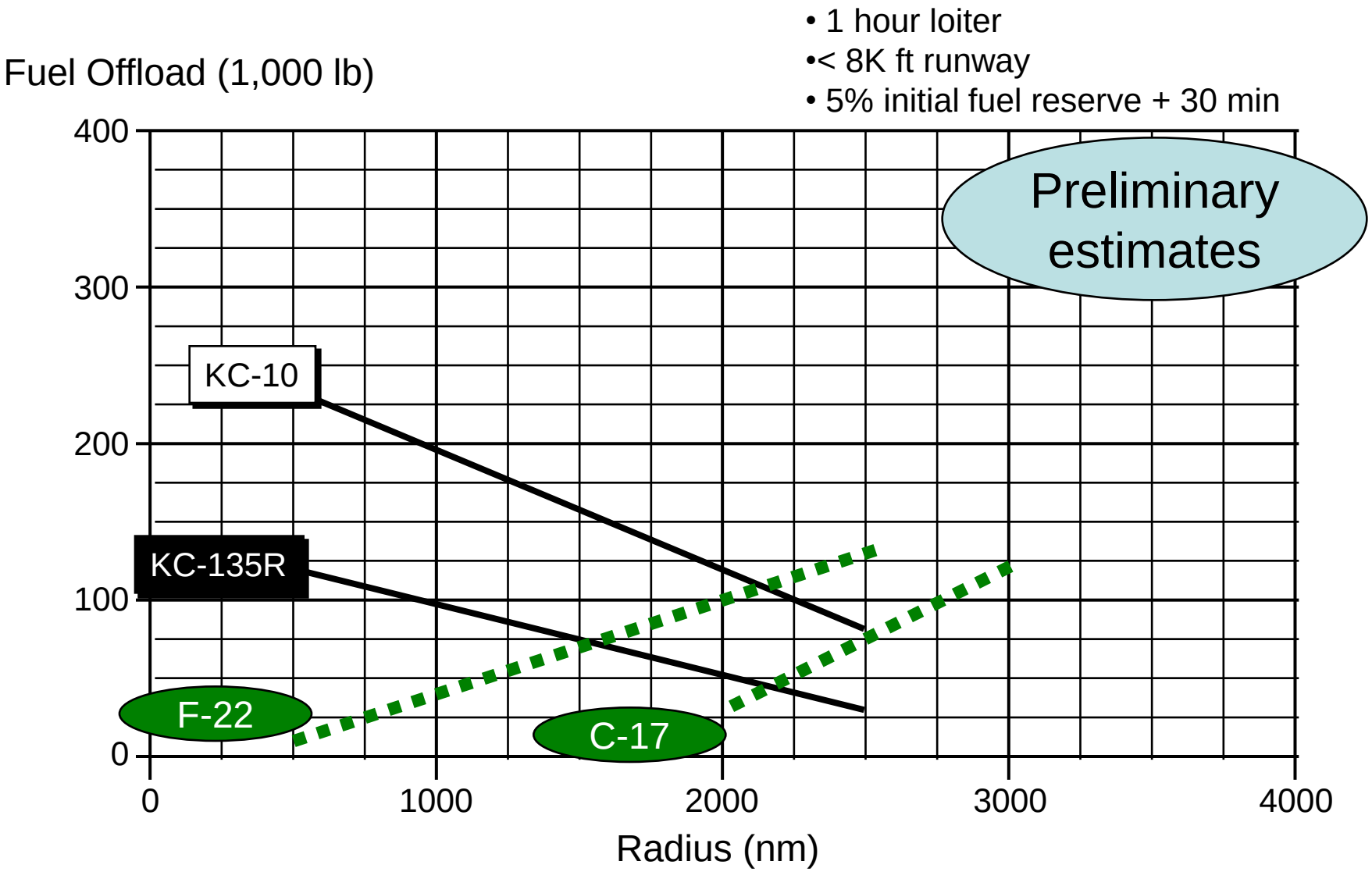
- 10,000 ft runway
- 1-hour orbit



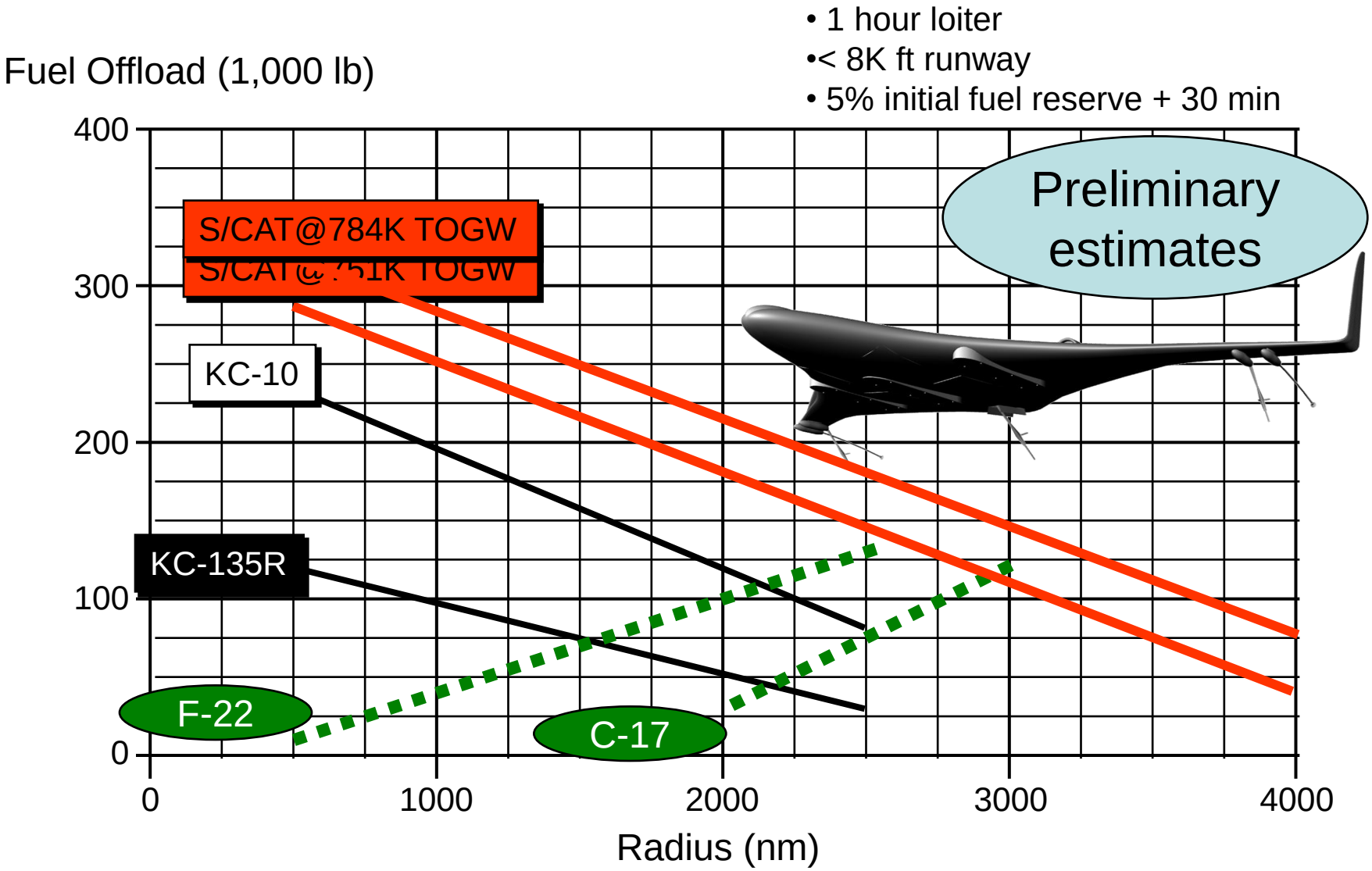
Ref: AFPAM10-1403

Strategic CAT is sized for 5,100 nm escort mission with F-22

Existing tanker offload



Strategic CAT comparison with current tankers

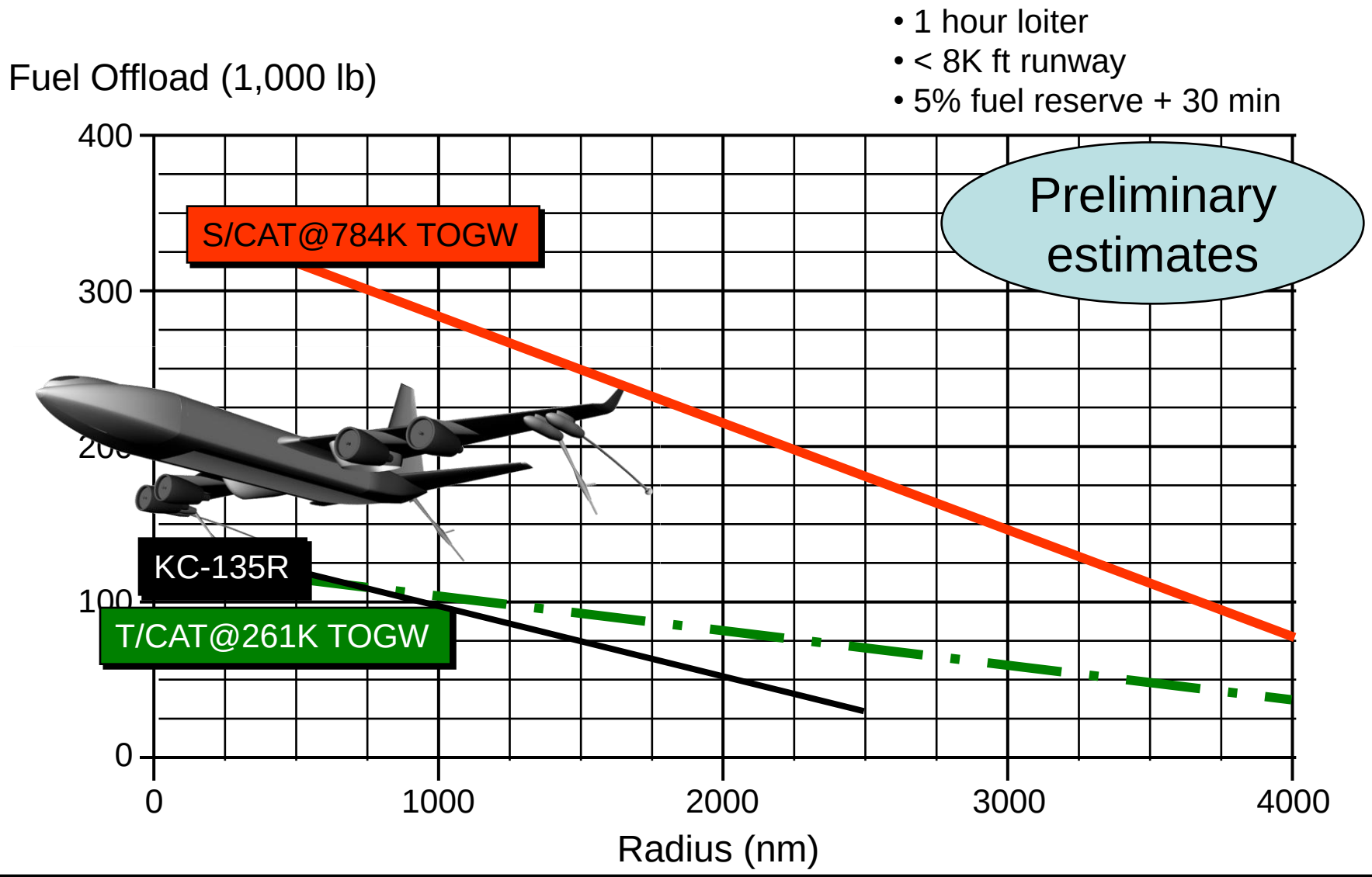


Strategic CATs have the range/offload to support global power projection

Theater CAT can provide theater air refueling support

Theater CAT comparison with current and future tankers

- 1 hour loiter
- < 8K ft runway
- 5% fuel reserve + 30 min



CAT Tankers

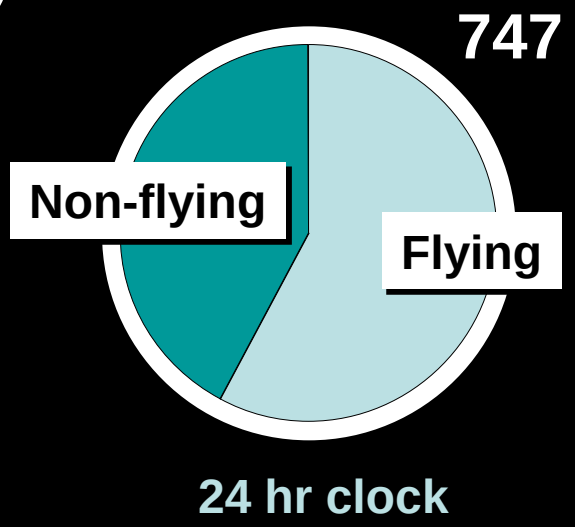
- Increase strategic offload capacity
- Provide good large/medium tanker match
  - Support global force deployment and power projection
  - Provide theater commander with dedicated tankers that can also perform other air mobility missions
- Strategic CAT uses BWB design to improve mission performance and partially offset the weight penalty of being able to carry modules
- Theater CAT could probably also be BWB

KC-135 Statistics

- KC-135E example (133 aircraft)
  - Average age of 45 years
  - Average of 20,000 hrs of projected 36,000 hr life
- Recent annual flight rate – about 450 hours/yr
  - 35 years of life left at this rate of use
  - 1.25 hours per day on average

Commercial Aircraft Utilization

- Boeing 747-400 Freighters (1995)
  - 13.85 hours per day (average)
- Boeing 767 (current)
  - 9 hours per day
- JetBlue Airbus 320 (2004)
  - 13.6 hours per day



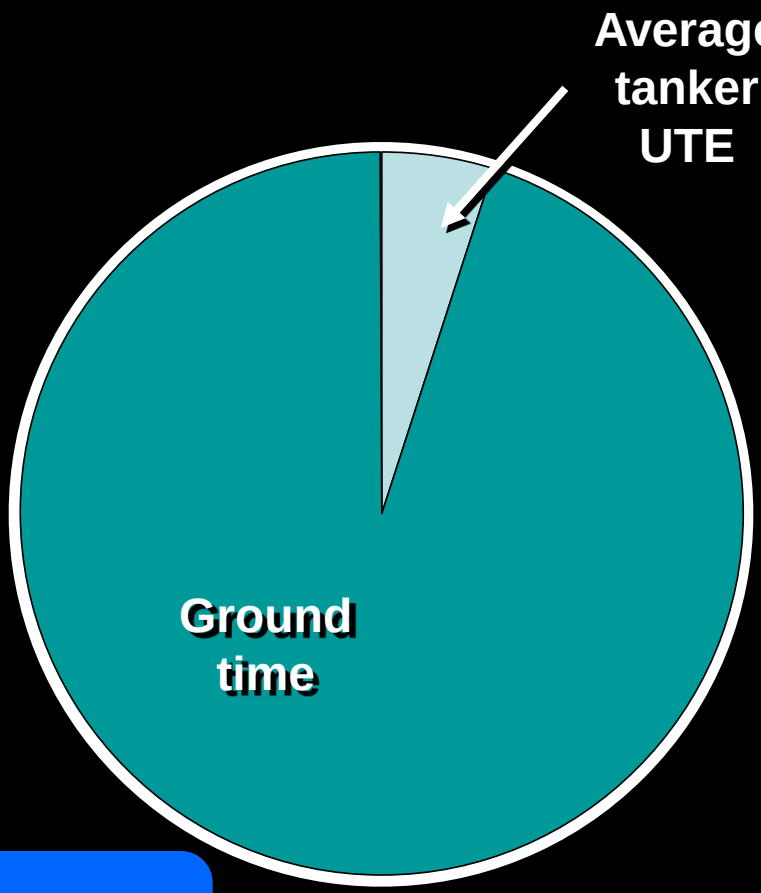
Modern aircraft are capable of high rates of sustained operations

Table 6. Aircraft Utilization.

Aircraft Type	UTE Rates[1]		Primary Mission Aircraft Inventory (PMAI)[2]				
	Surge	Contingency/Sustained	2003	2004	2005	2006	2007
C-130[1]	6.0	6.0	410	395	388	364	354
C-141	6.5	6.0	66	42	22	8	0
C-17	14.5	12.5	79	94	109	122	136
C-5A/B[5]	8.5 / 11.5	7.7/ 8.1	104	96	94	94	94
KC-10[3]	9.8	8.6	54	54	54	54	54
KC-135[3,5]	6.8	5.1	472	445	429	421	421
CRAF[4]			STAGE 1		STAGE 2	STAGE 3	
A-300	10	10	0/0		0/10	0/10	
B-747	10	10	11/6		27/20	85/61	
B-757	10	10	0/5		0/15	0/69	
B-767	10	10	0/7		0/36	0/138	
B-777	10	10	0/5		0/24	0/84	
DC-8	10	10	6/0		13/0	31/0	
DC-10	10	10	4/6		16/9	86/29	
L-1011	10	10	1/12		1/12	2/12	
MD-11	10	10	9/4		19/6	48/21	

Is this an economical utilization rate for a new tanker?

- 450 hours per year
- 30,000 hour airframe life
- Nearly 70 years of "life"



Tanker fleet is sized by contingency planning missions, not nominal usage

C-17 is currently experiencing about 1,500 hours per year per aircraft

- FY03 – 160,000 hrs
- FY04 – 156,000 hrs
- FY05 – 157,000 hrs
- Assume 100 C-17s
- Average ~1,500 hrs/year

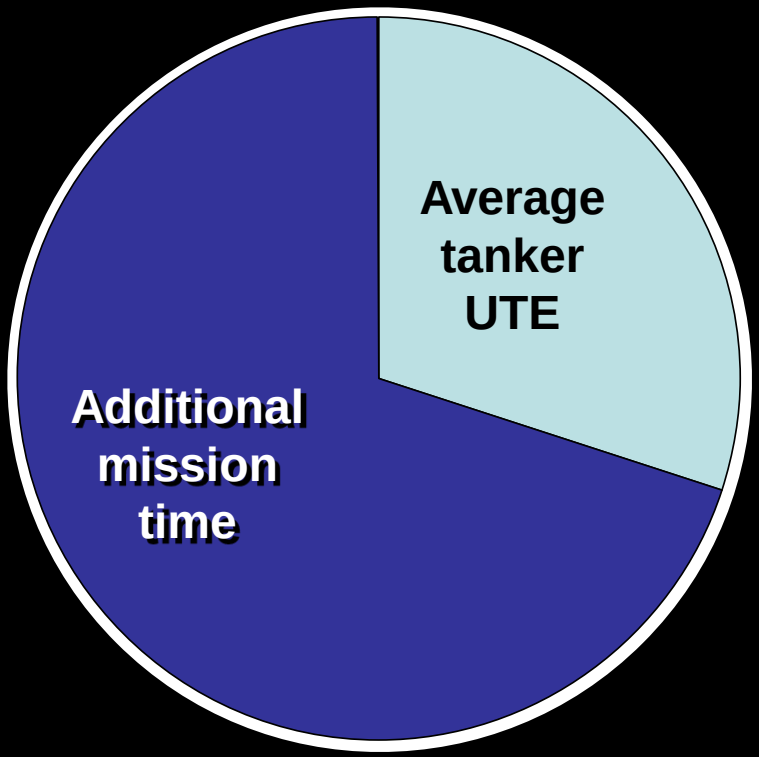
- Sustained/contingency rate = 4,600 hrs/yr
- 30,000 hr airframe life
- Replacement cycle – 20 years@1,500 hrs/yr

What would be an economical utilization rate for a new tanker?

- 30,000 hour airframe life
- 20-year replacement cycle
- 1,500 hrs/yr
  - 450 hrs/yr for tanker
  - 1,050 hrs/yr for other air mobility missions

The low nominal tanker demand provides opportunity for other mission uses

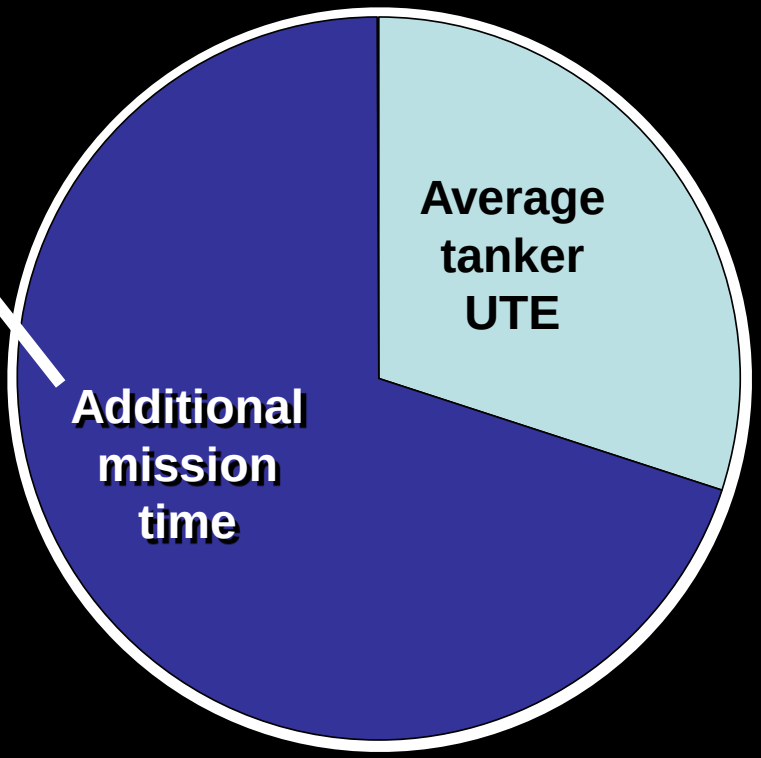
- 1,500 hrs/yr total utilization with 20-yr replacement cycle
- 450 hrs/yr utilization rate for air refueling
- 1,050 hrs/yr available for other missions



For KC-135s, the additional mission time can be used to PAX/cargo transport

- 6 pallet positions
- 13 tons (planning)
- 421 KC-135 aircraft
- 1,050 hrs/yr
- 13,650 ton-hrs/yr/aircraft
- 5.75 M ton-hrs/yr (fleet)

- 120 C-17s
- 45 tons (planning)
- 1,500 hrs/yr
- 67,500 ton-hrs/yr/aircraft
- 8.1 M ton-hrs/yr (fleet)



How many new tankers?

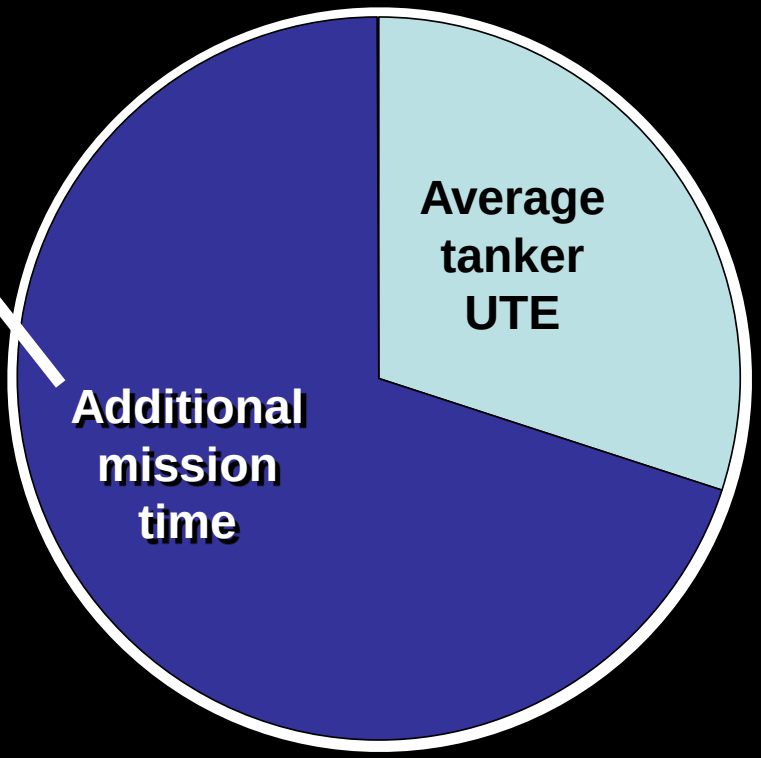
Lt. Gen. Christopher A. Kelly, the vice commander of Air Mobility Command, told a House panel in February he would prefer that the Air Force buy a mix of aircraft for the tanker mission. Kelly said a mix would offer operational benefits of flexibility. It also would offer a hedge against a problem that could ground the entire fleet. With two types, a problem that grounded one would likely not affect the other.

Kelly also lifted some of the secrecy enshrouding the Mobility Capabilities Study. He said the MCS put the new tanker requirement at "520 to 640 total aircraft inventory" and that AMC believes 520 is the "minimum requirement." The MCS said the existing tanker fleet "shows a … shortfall in all scenarios except for one."

"Charting a course for tankers," Air Force Magazine
1 June 2006

A new commercial-based tanker would provide improved airlift capabilities

- 19 pallet positions
- 58 tons (planning)
- 520 aircraft
- 1,050 hrs/yr
- 60,900 ton-hrs/yr/aircraft
- 31.7 M ton-hrs/yr (fleet)



- 180 C-17s
- 45 tons (planning)
- 1,500 hrs/yr
- 67,500 ton-hrs/yr/aircraft
- 12.2 M ton-hrs/yr (fleet)

Gavin's *Airborne Warfare*

- James M. Gavin
  - Maj Gen, USA, in WWII
    - 37 years old
    - Commanded 82nd Airborne into Normandy
  - Lt Gen, USA
    - Chief of Army R&D
  - US Ambassador to France
  - Wrote *Airborne Warfare* in 1947

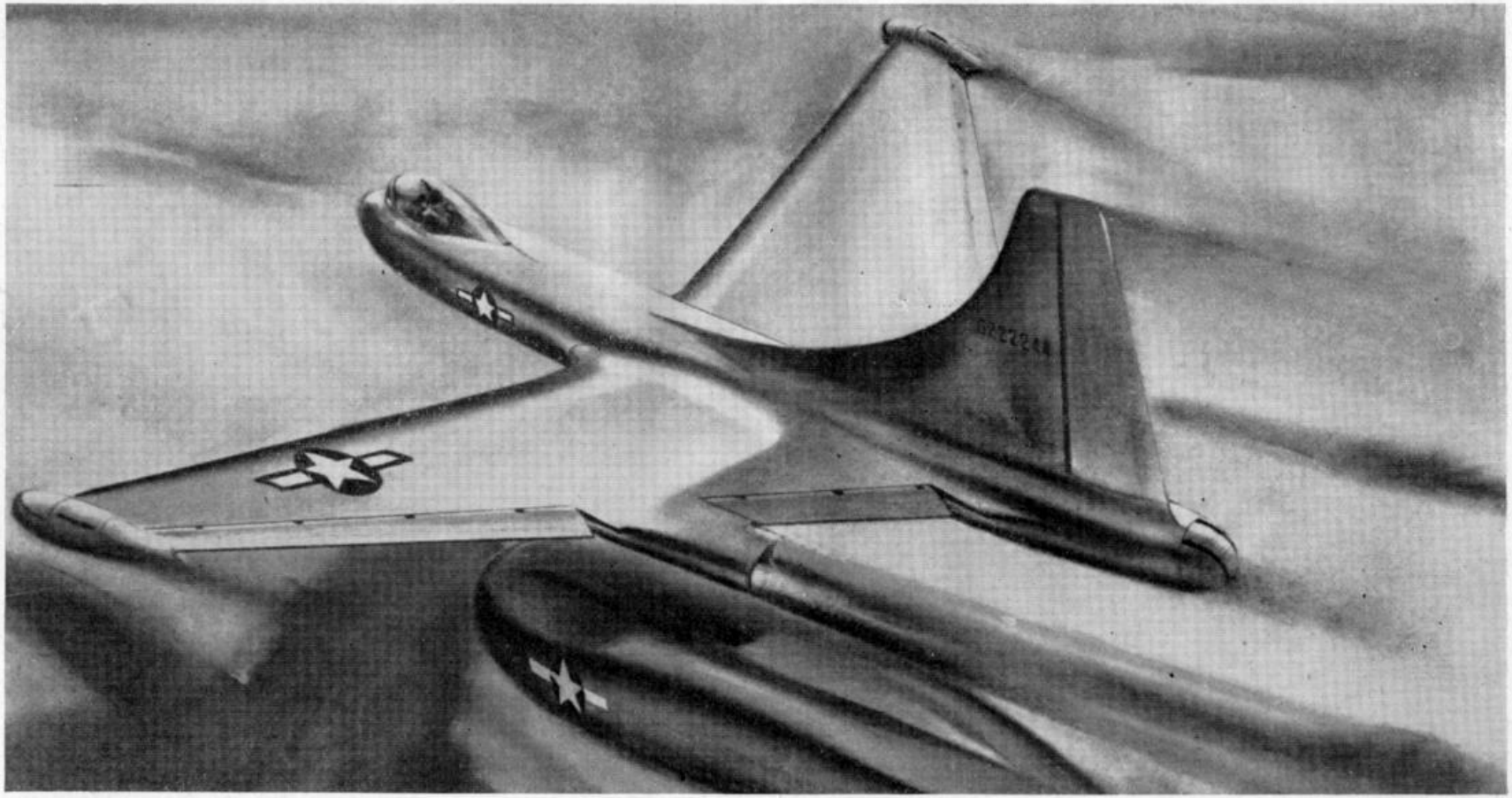


Plate 3. Airborne planners have long sought a means of rapid delivery of cargo into a combat area without the necessity of using the conventional type doors or hand-carry. The Kiwi or specialized cargo container offers a possible solution to the problem. This carrier can be dropped from the aircraft in flight near the ground and expended or used for shelter or air evacuation missions after landing. If it proves feasible there should be many types developed for specific uses. For example, assault infantry carriers, reconnaissance and ground combat vehicle carriers, repair shops, radio stations, aid stations, and shelters. The engineering problems inherent in its development are many but the multitude of uses to which this carrier could be put, in peace as well as in war, makes its development a "must."

Gavin's "ton-mile-per-day metric"

C-119s were the mainstay of airlift through the 1950s

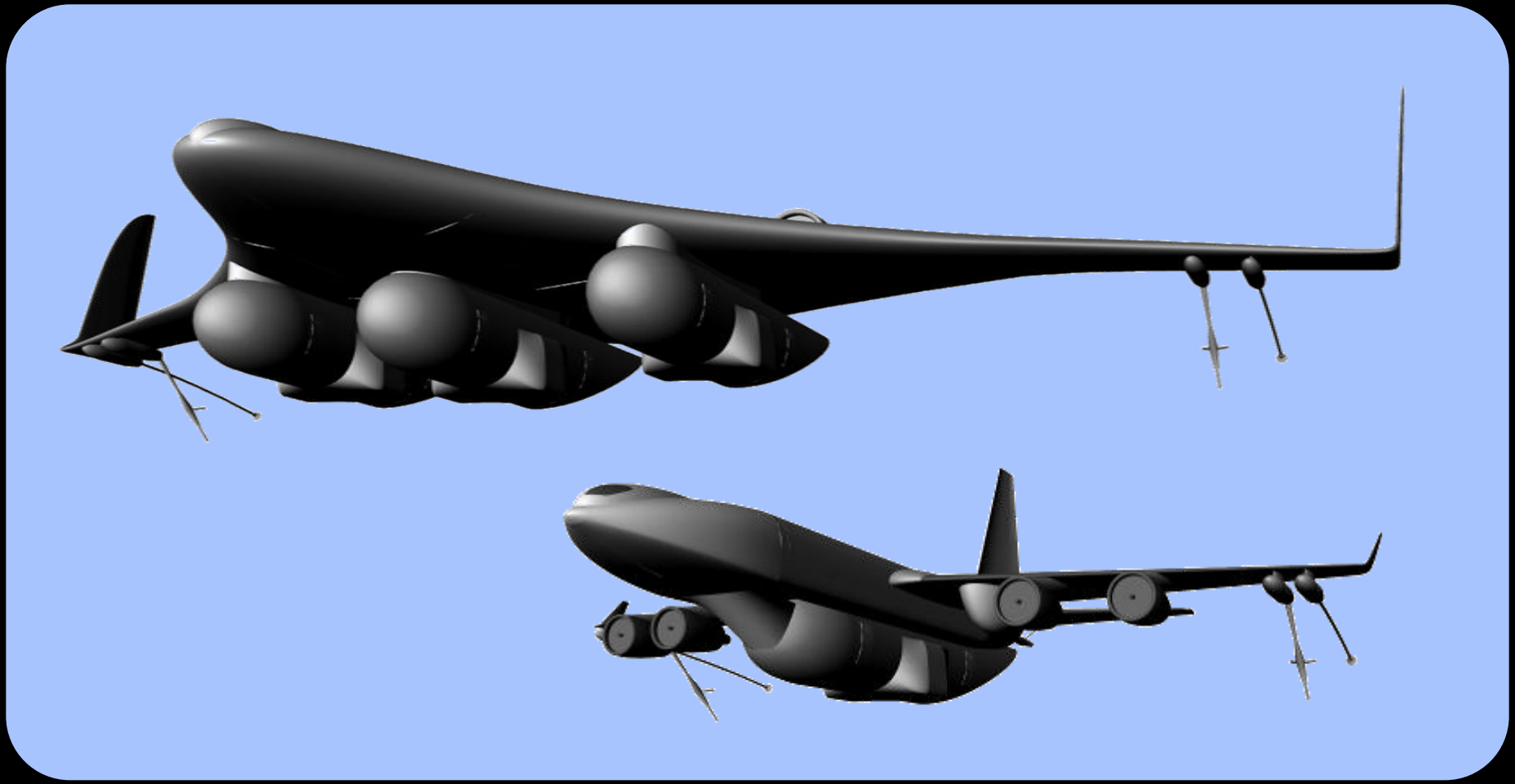
Korean War

Fairchild XC-120

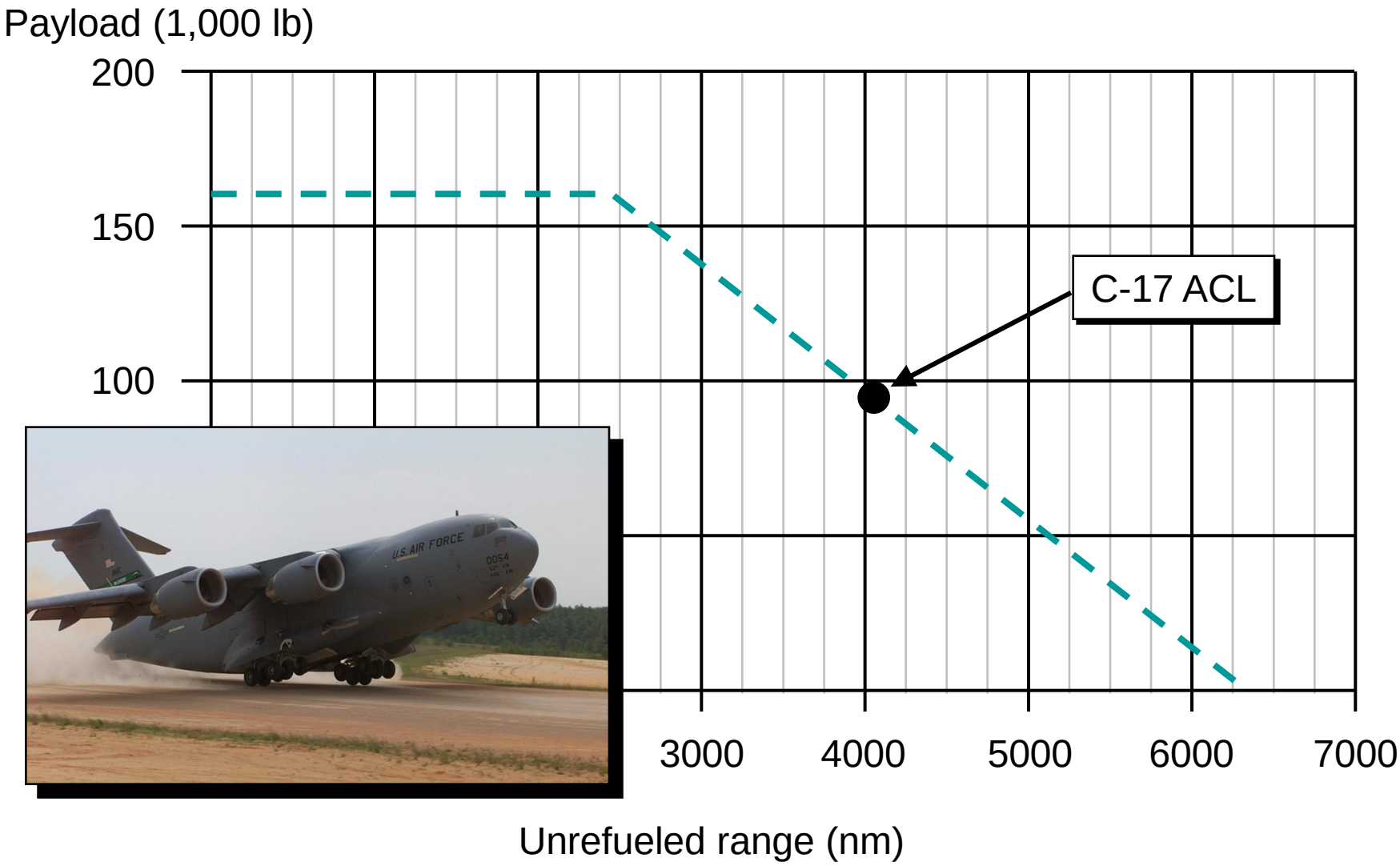
Containerization has swept the commercial shipping world

An entire new architecture of shipping has been implemented world-wide

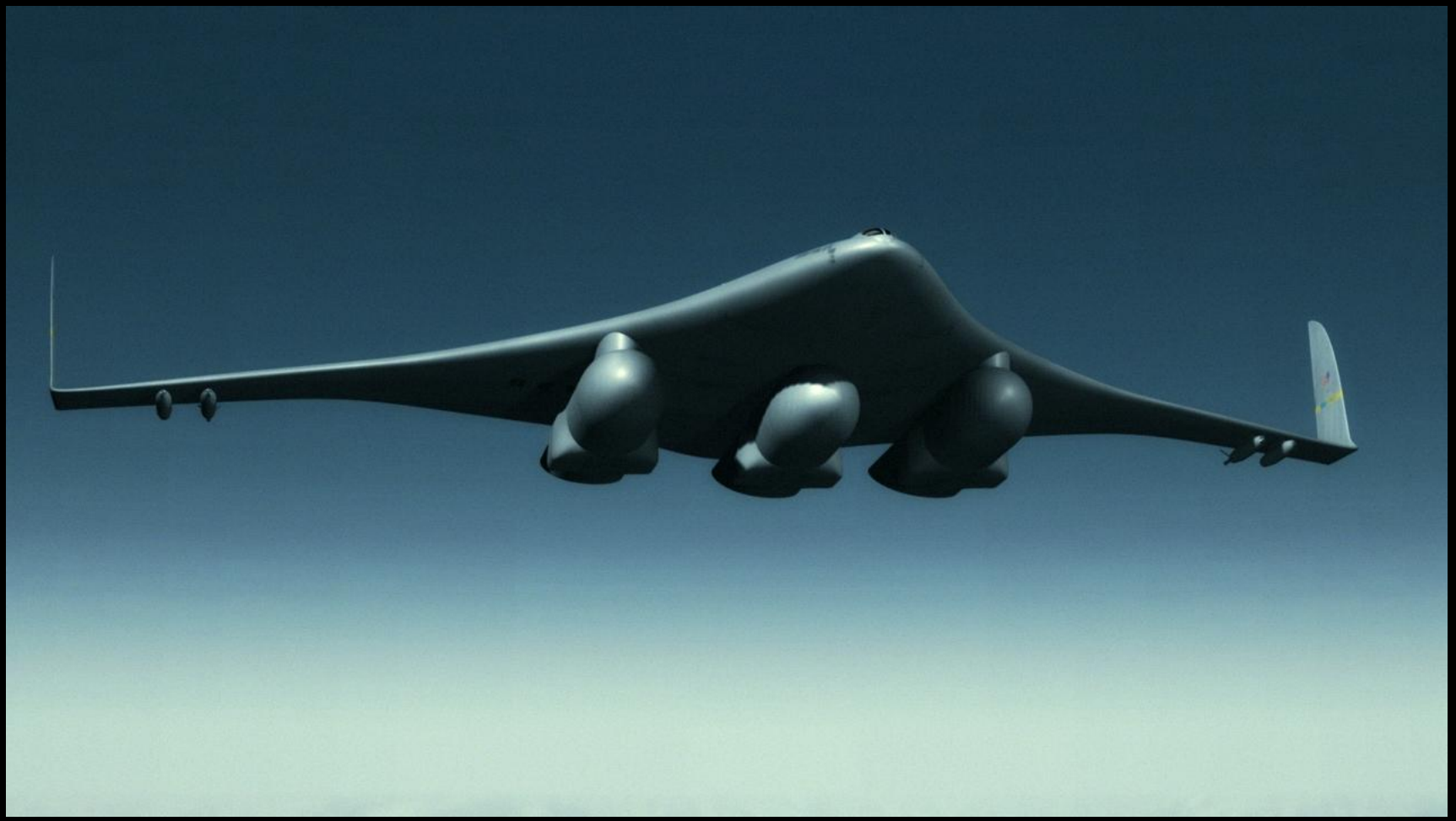
Module-Carrying Tankers



C-17 Performance

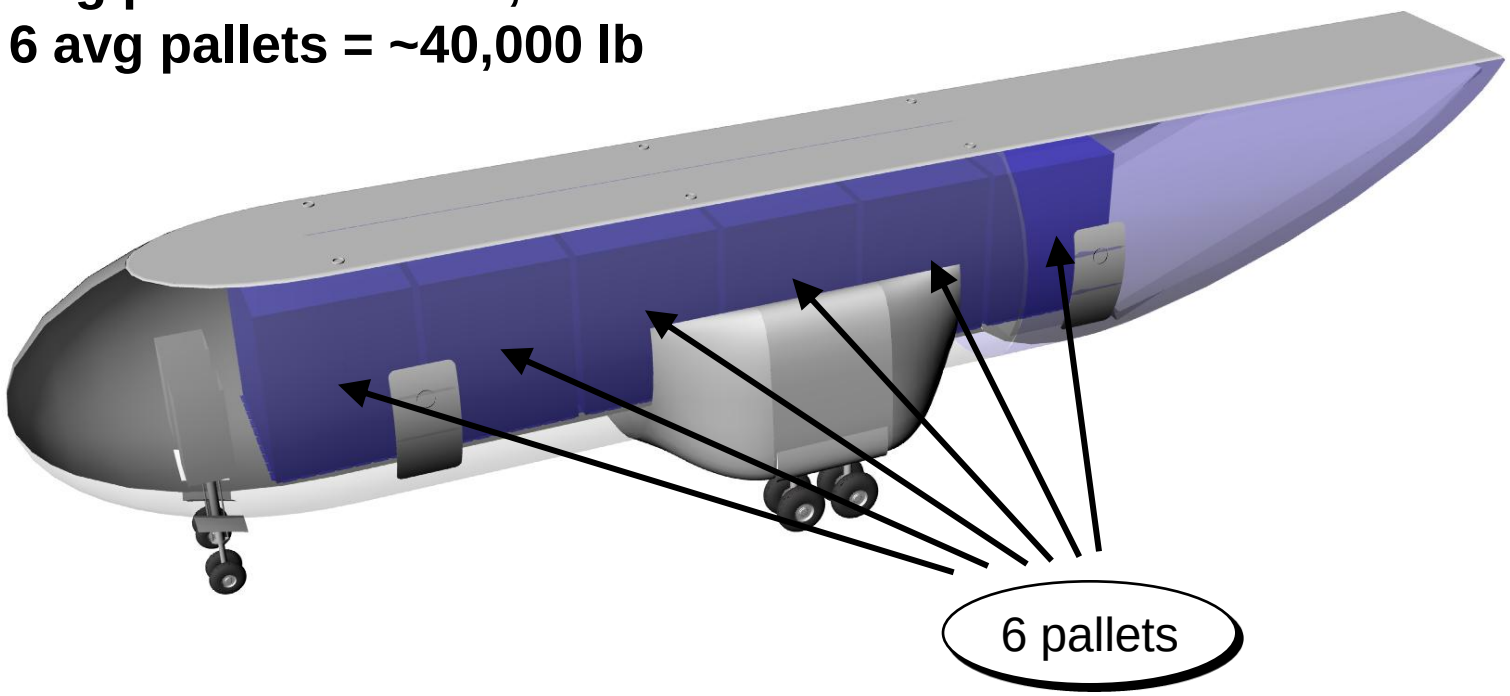


Strategic CAT with 3 Modules



Module with 463L Pallets

- **Max load = 52,600 lb**
- **Avg pallet load = ~6,700 lb**
- **6 avg pallets = ~40,000 lb**



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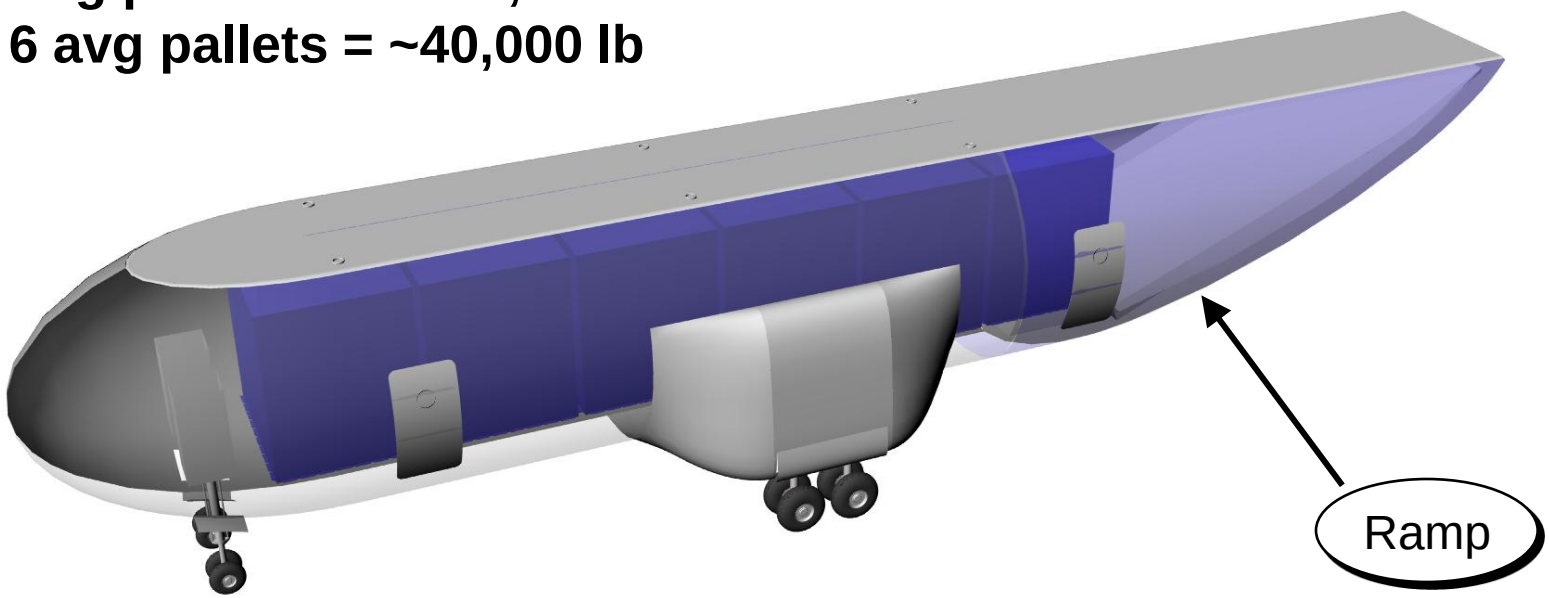

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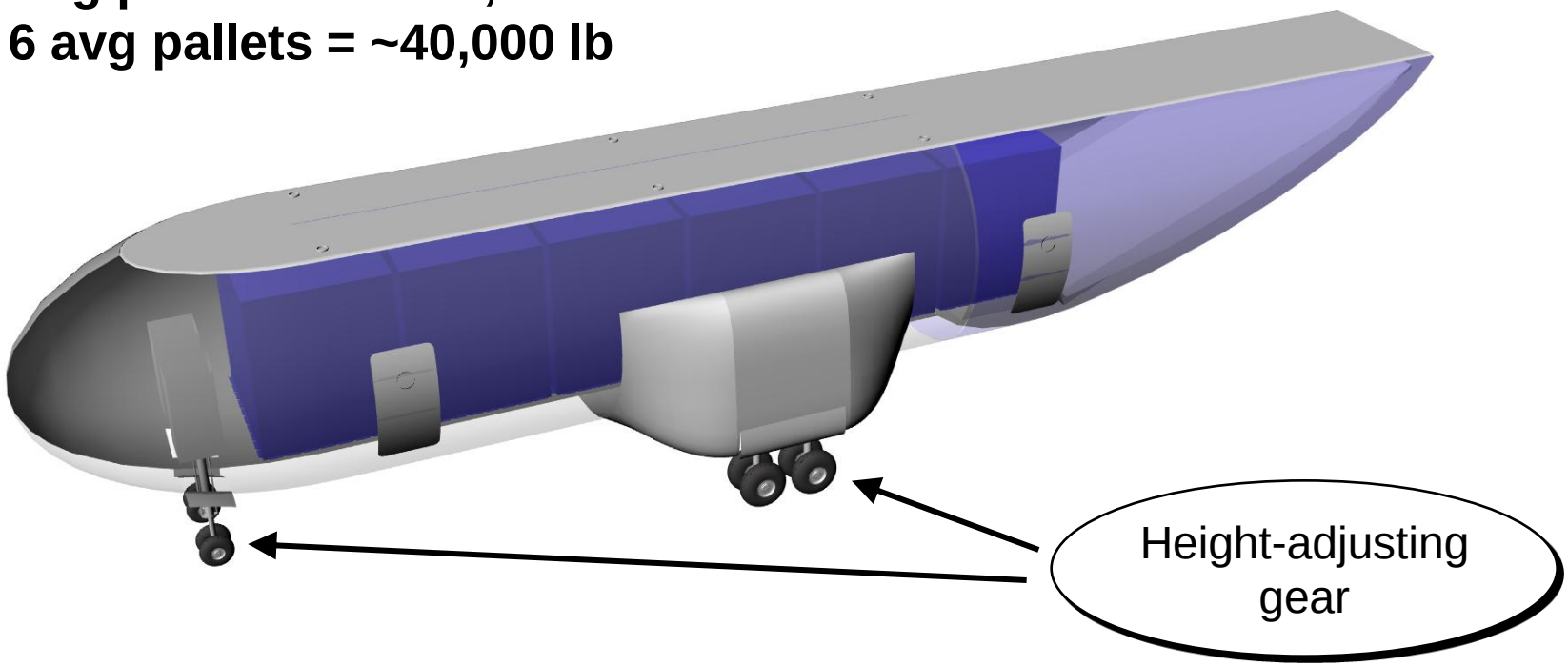

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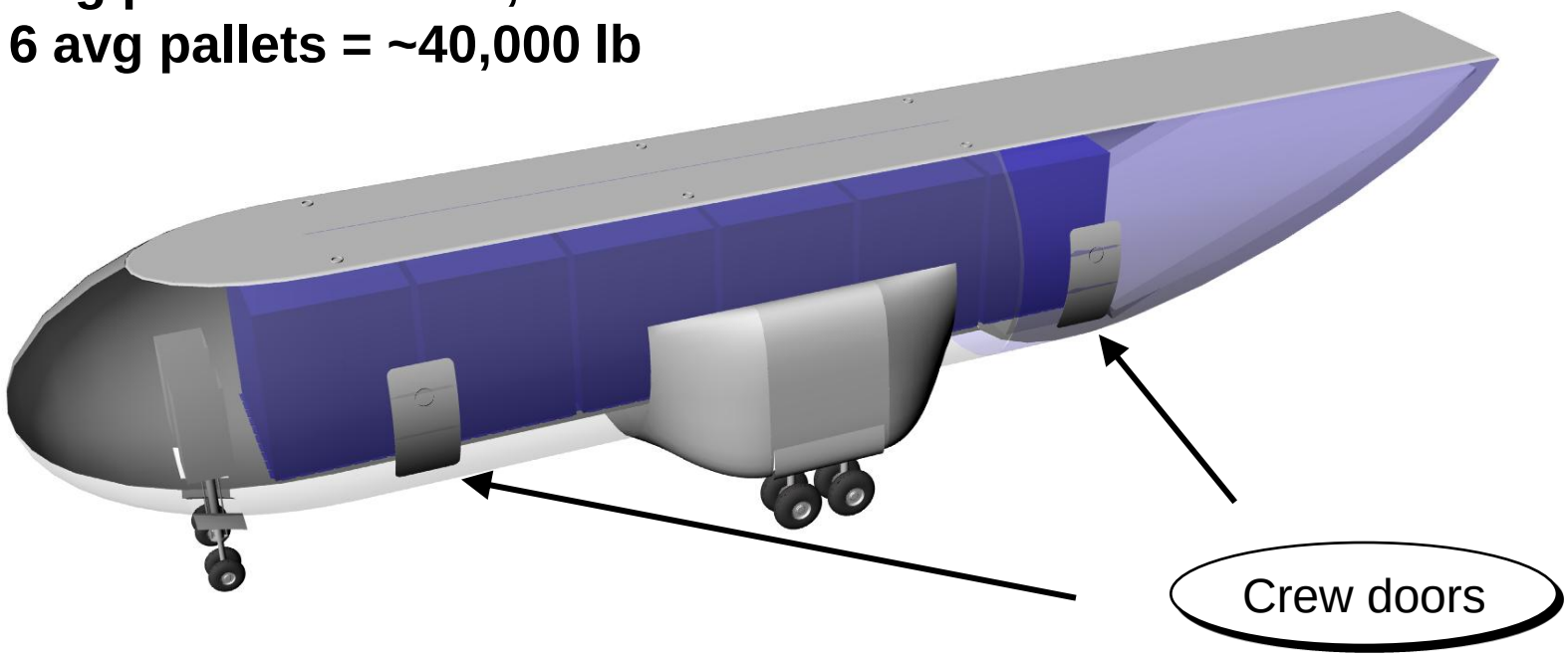

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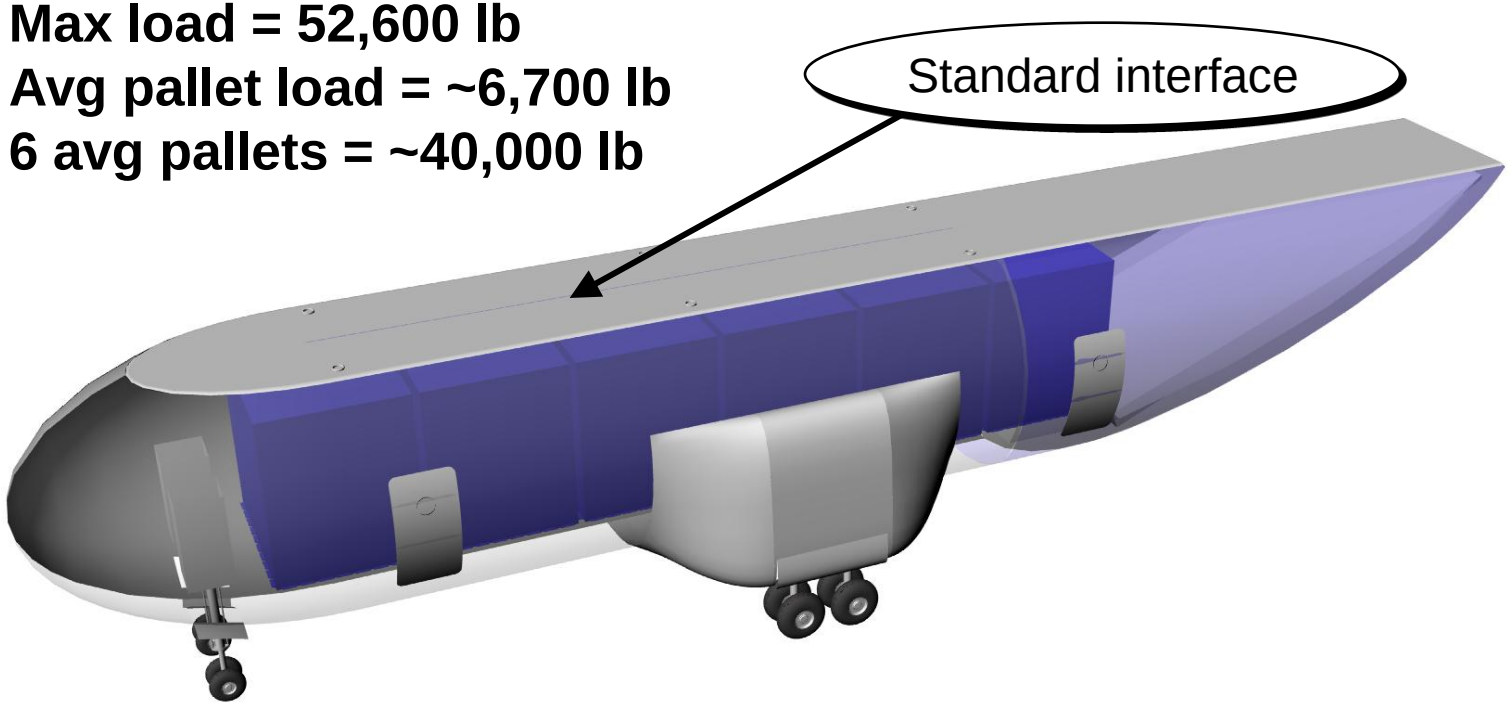
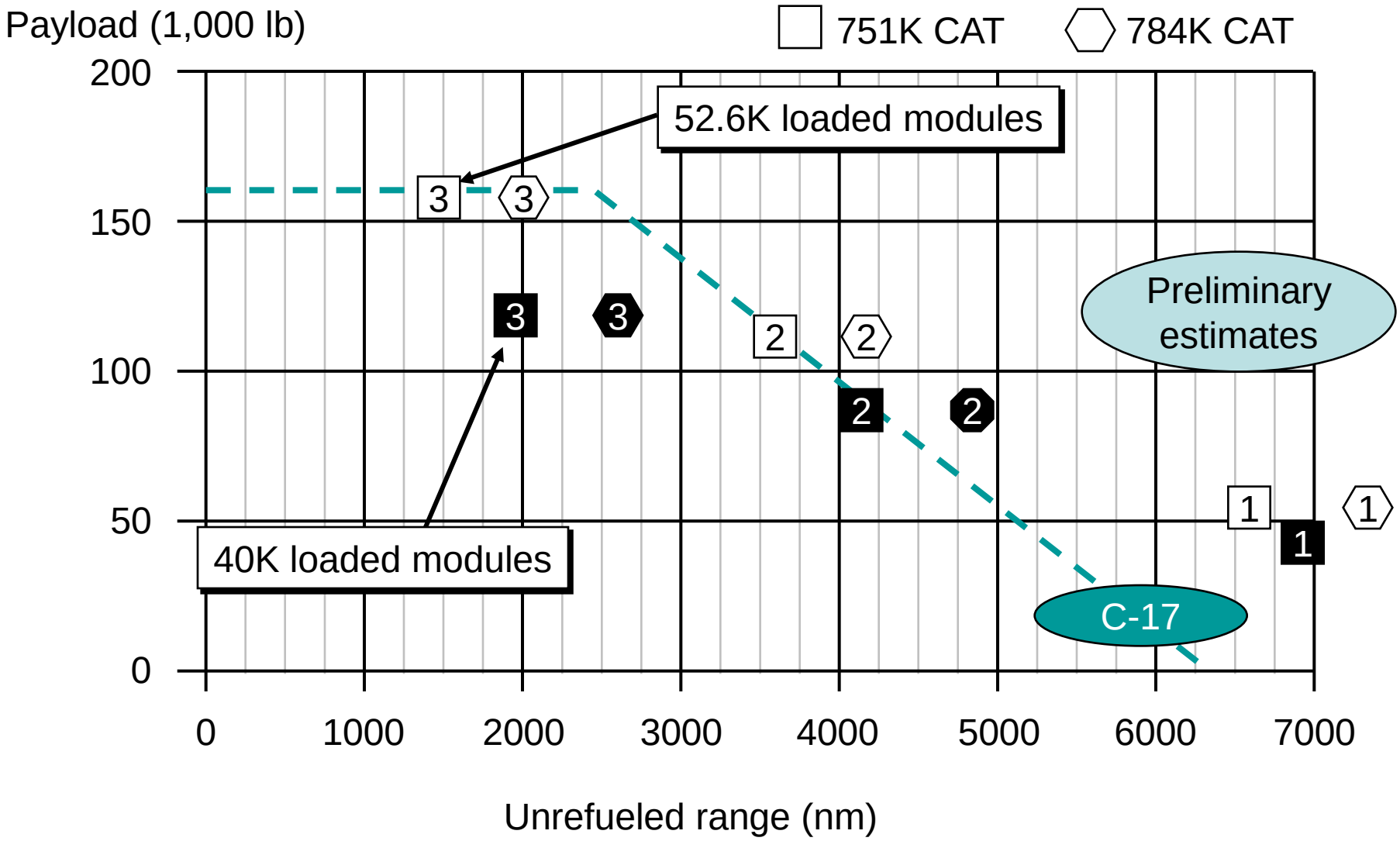


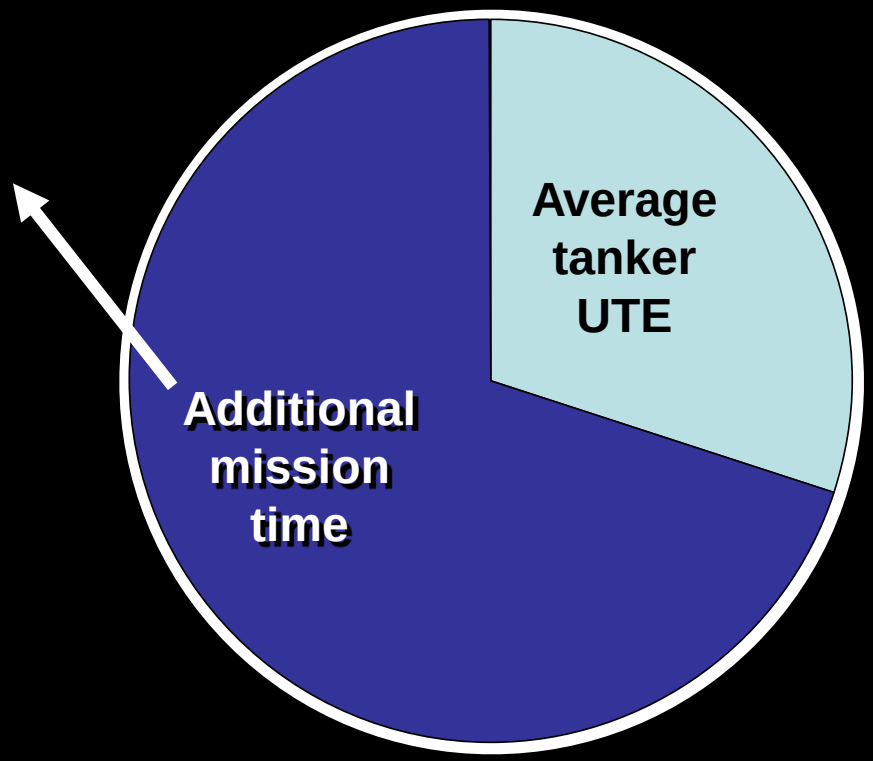
Strategic CAT performance is comparable to a C-17



A strategic CAT would also provide improved airlift capabilities

- 12 pallet positions
- 40 tons (planning)
- 520 S-CATs
- 1,050 hrs/yr
- 42,000 ton-hrs/yr/aircraft
- 21.8 M ton-hrs/yr (fleet)

- 180 C-17s
- 45 tons (planning)
- 1,500 hrs/yr
- 67,500 ton-hrs/yr/aircraft
- 12.2 M ton-hrs/yr (fleet)



Comparison

180 C-17s	520 Conventional Tankers	520 S-CATs
45 tons	58 tons	40 tons
12.2 M ton-hrs/yr	31.7 M ton-hrs/yr	21.8 M ton-hrs/yr
1X	2.6X	1.8X

AFPAM 10-1403 Ground Times

Aircraft Type	Passenger and Cargo Operations Wartime Planning Times (hrs+min)				Minimum Crew Rest Times	Aeromedical Evacuation		
						(hrs+min)		
						Reconfigure	Onload / Offload	Expedited[2]
	Onload	En route Refuel only	Offload	Expedited[2]				
C-17	3+15	2+15	3+15	1+45	16+30	4+15	2+15	1+45
C-5	4+15	3+15	4+15	2+00	17+00	-	-	-
KC-10	4+15	3+15	4+15	3+15	17+00	-	-	-
KC-135 [3]	4+15	3+15	4+15	3+15	17+00	1+30	1+30	45
B-747	3+30/5+00[1]	1+30	3+30/5+00[1]	-	-	-	-	-
B-707	3+00	1+30	3+00	-	-	-	-	-
B-767	3+00	1+30	3+00	-	-	n/a	5+00	5+00

C-17 Cargo Loading

- **On ramp cargo offloading**
- **Specialized MHE**

60,000 lb Capacity
Air Force Tunner Cargo Loader

- Holds 6 463L pallets
- C-17/C-5 transport compatible

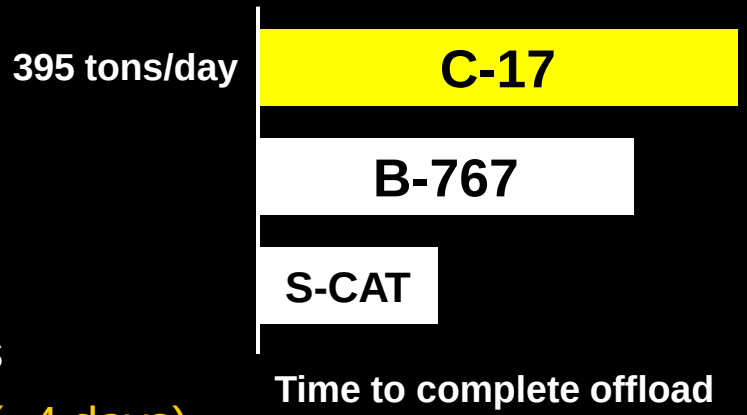
Tunner Loader can load high deck aircraft

Halvorsen 25,000 lb Loader

- Holds 3 463L pallets
- C-141 transport compatible

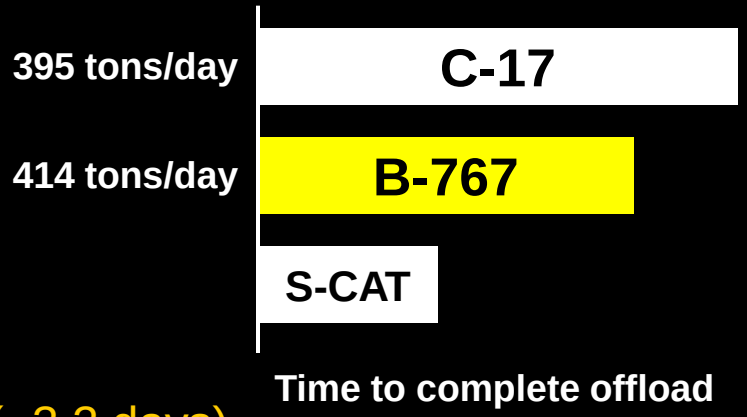
Typical C-17 mission to deploy 800 tons of relief supplies

- **18 - C-17 missions**
- Ground time = 17.75 hrs (out and return)
  - Load = 3.25 hrs
  - Refuel = 5 x 2.25 hrs = 11.25 hrs
  - Offload = 3.25 hrs
- Flight time = 2 x 19.8 hrs = 39.6 hrs
- Total mission time = 39.6 + 17.75 = 57.35 hrs
- Time to complete last cargo offload = 98 hrs (~4 days)
  - Flight and ground time for first aircraft = 19.8 hrs + 13.25 hrs = 33 hrs
  - Ground time for subsequent 17 aircraft with 85% queuing efficiency = 65 hrs.



Typical B-767 mission to deploy 800 tons of relief supplies

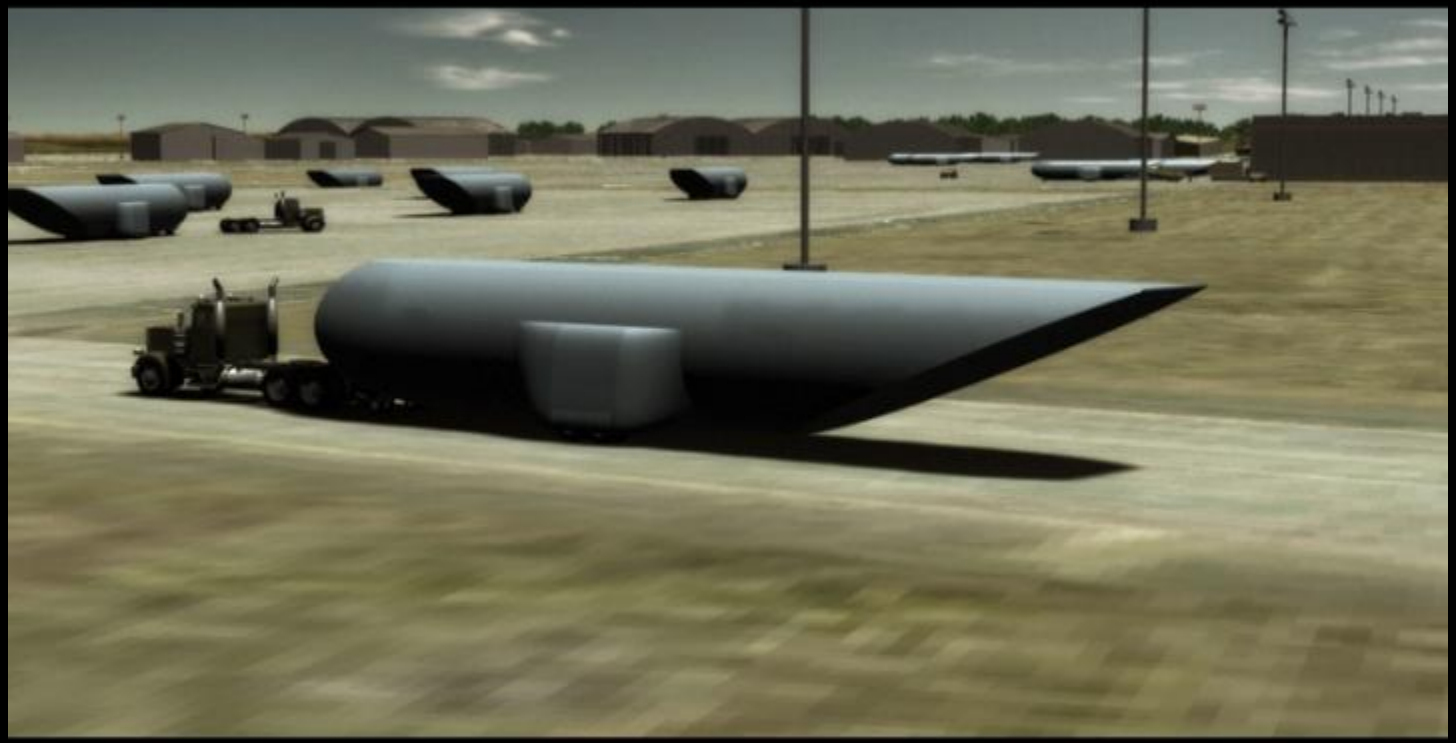
- **14 - 767 missions**
- Ground time = 13.5 hrs (out and return)
  - Load = 3 hrs
  - Refuel = 5 x 1.5 hrs = 7.5 hrs
  - Offload = 3 hrs
- Flight time = 2 x 19.8 hrs = 39.6 hrs
- Total mission time = 39.6 + 13.5 = 53.1 hrs
- Time to complete last cargo offload = 77 hrs (~3.2 days)
  - Flight and ground time for first aircraft = 19.8 hrs + 10.5 hrs = 30.3 hrs
  - Ground time for subsequent 17 aircraft with 85% queuing efficiency = 45.9 hrs.



Modules offer a new approach to efficient cargo transport

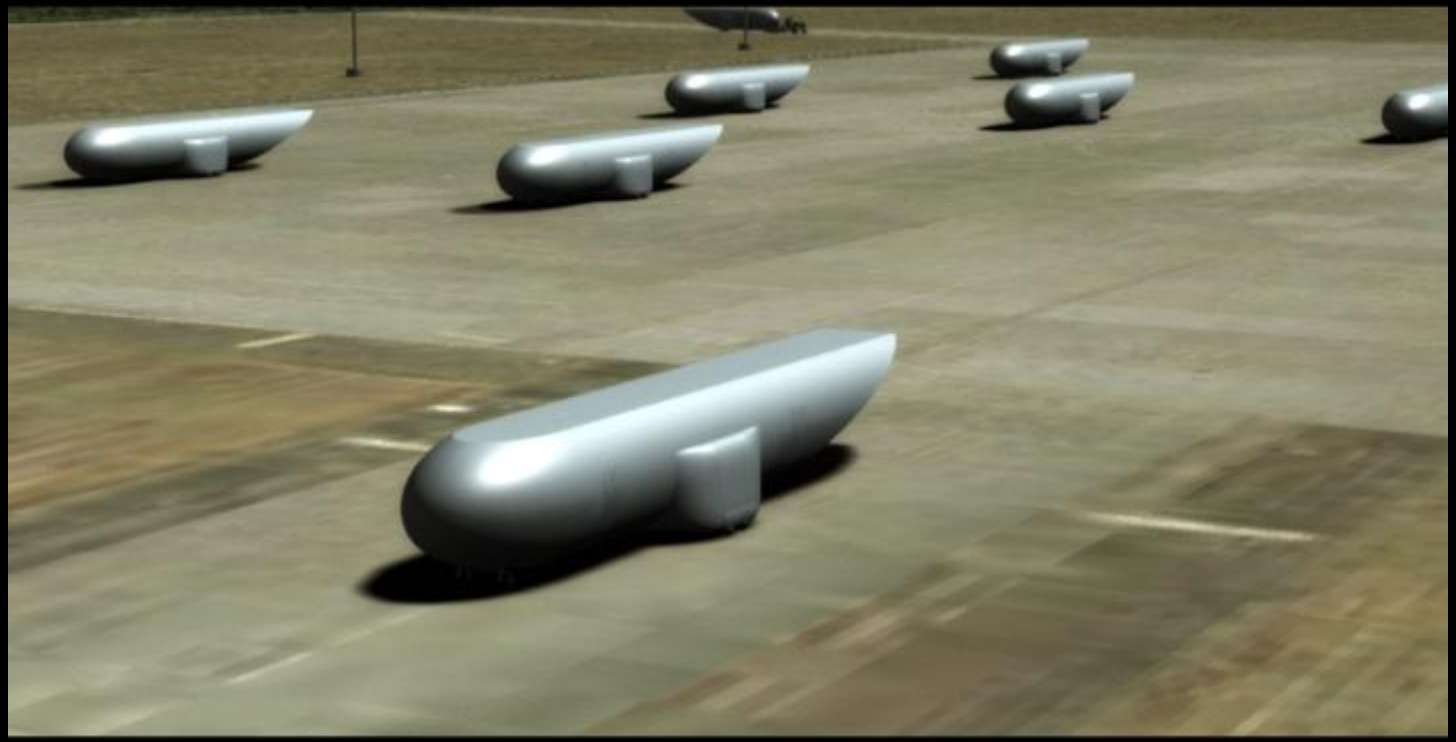
S-CAT Module Loading

Preloaded modules can be towed to ramp area for pickup

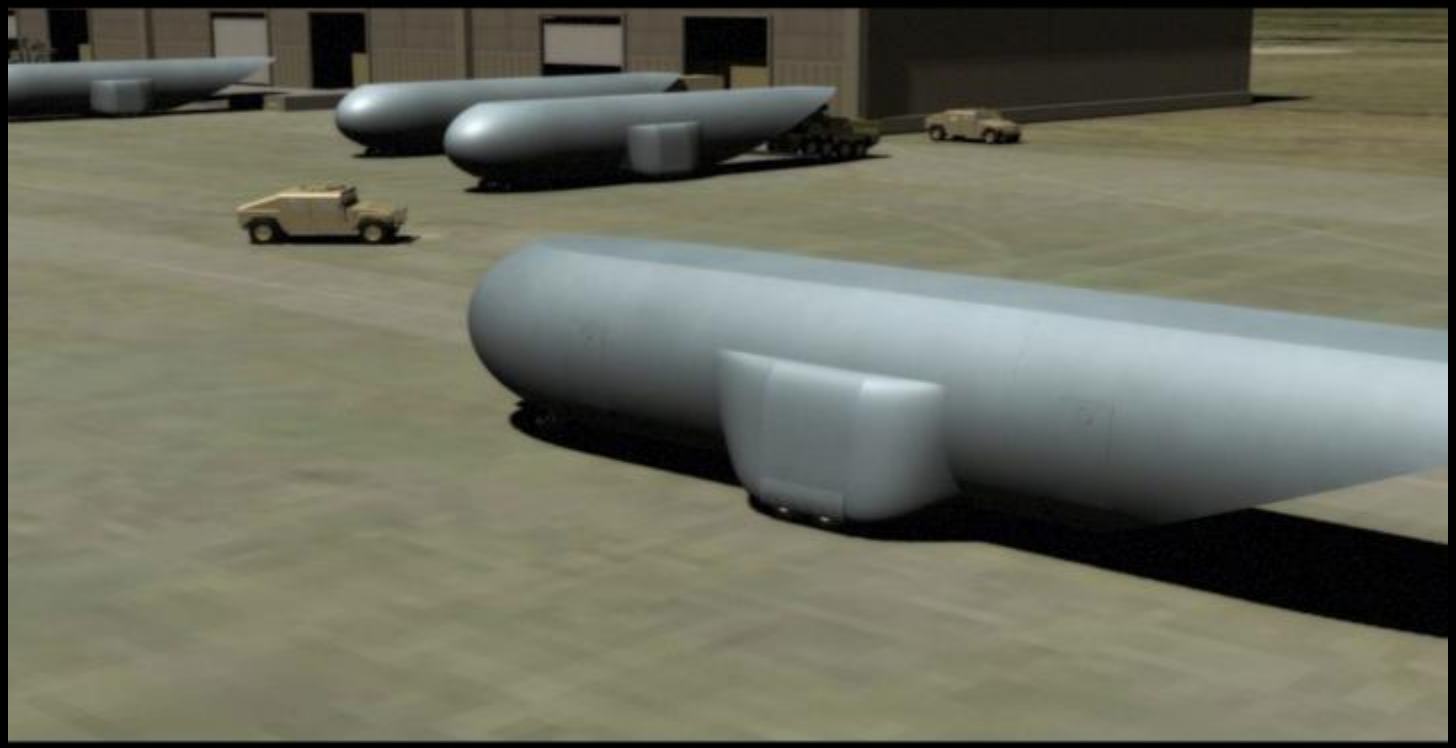


Inspected modules are readied for loading

When directed, modules move to the active ramp

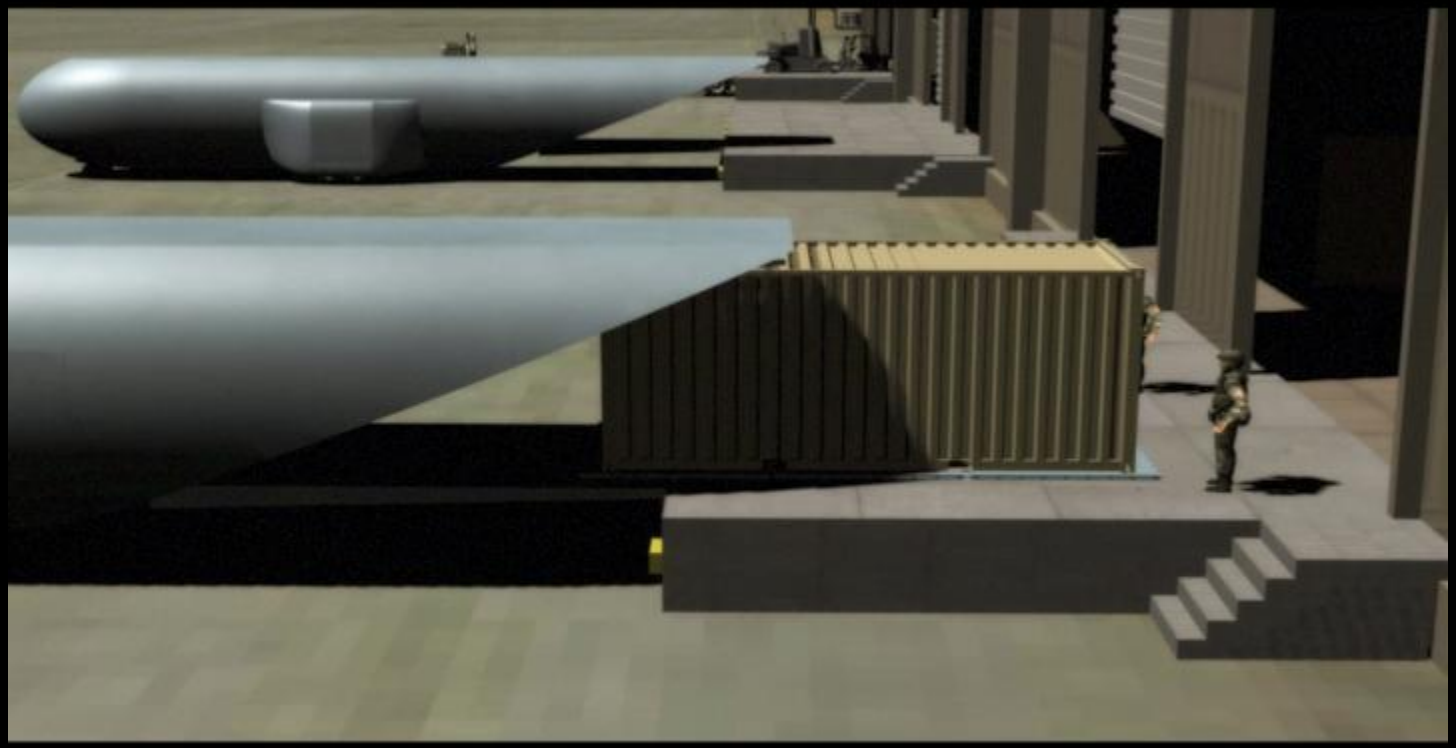


Module self-movement minimizes required personnel on active ramp

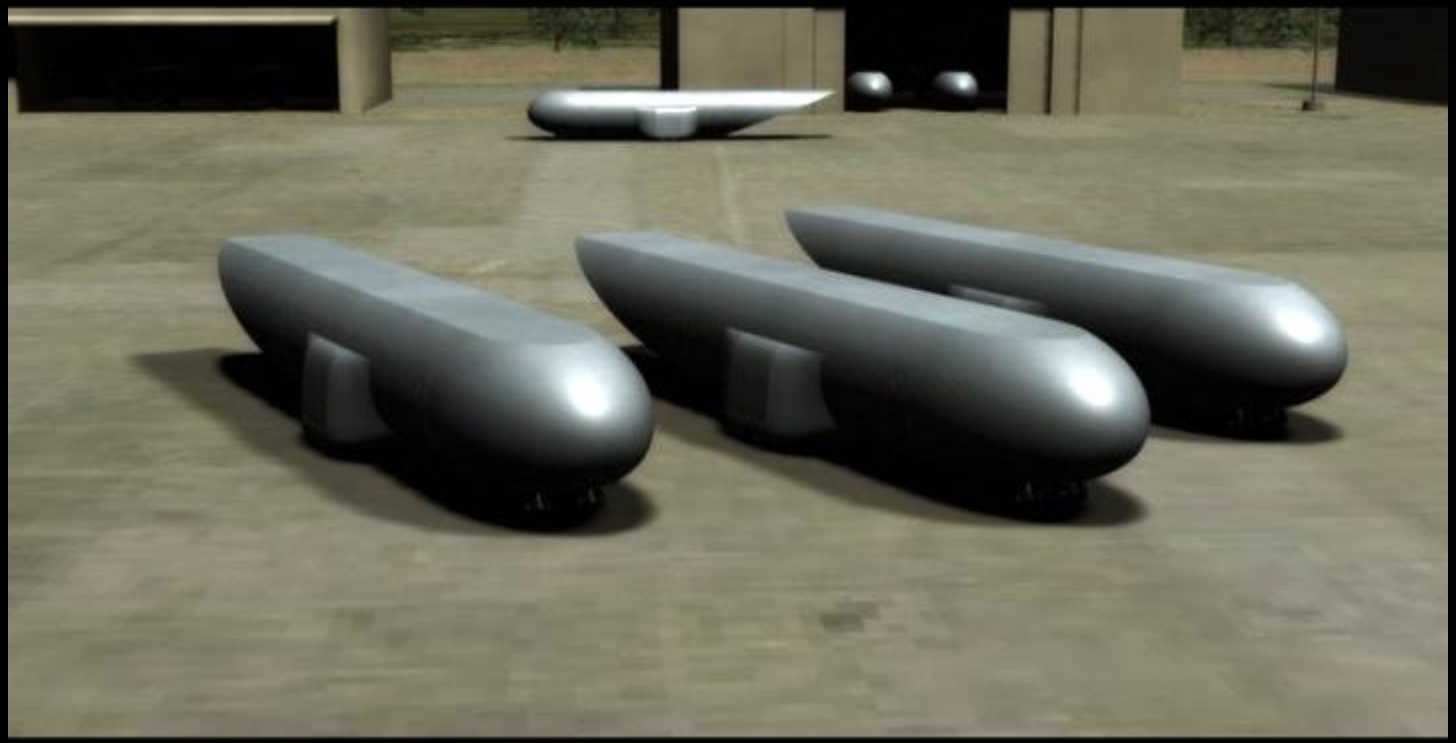


Modules are designed to enable rapid cargo loading

Modules can be raised or lowered to facilitate cargo loading without MHE



Readied modules are positioned on the active ramp for pickup



Arriving S-CATs taxi into position to pickup waiting modules

Loaded CATs quickly depart to establish global-range, high-throughput air bridges

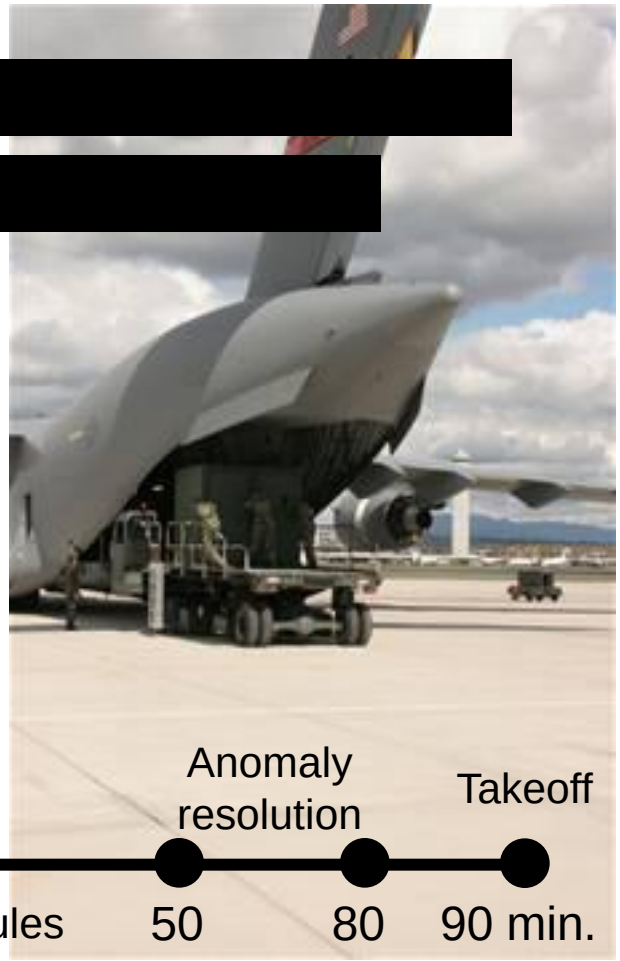
With modules, cargo aircraft turn time is dramatically reduced

C-17 Offload - 195 minutes (AFPAM 10-1403)

767 Offload – 180 minutes

C-17 Offload expedited – 105 minutes

Strategic CAT – 20 minutes



Strategic CAT

Land — Takeoff

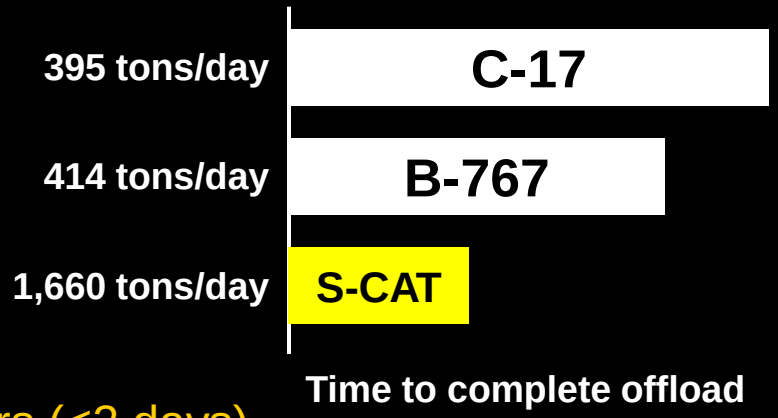
5 — Offload modules — 20 — 30 min.

Land — Anomaly resolution — Takeoff

5 — Offload modules — 20 — 30 — Load modules — 50 — 80 — 90 min.

Typical Strategic CAT mission to deploy 800 tons of relief supplies

- **20 Strategic CAT missions**
- Ground time = 9 hrs (out and return)
  - Load = 1 hrs
  - Refuel = 5 x 1.5 hrs = 7.5 hrs
  - Offload = 0.5 hrs
- Flight time = 2 x 19.8 hrs = 39.6 hrs
- Total mission time = 39.6 + 9 = 48.6 hrs
- Time to complete last cargo offload = ~37 hrs (<2 days)
  - Flight and ground time for first aircraft = 19.8 hrs + 6 hrs = 25.8 hrs
  - Ground time for subsequent 19 aircraft with 85% queuing efficiency = ~11 hrs.



Comparison of time to delivery 800 tons of relief supplies

18 C-17s	14 Conventional Tankers	20 S-CATs
395 tons/day	414 tons/day	1,660 tons/day

Modules provide secure storage for arriving supplies & equipment

Example – S-CATs being used to deliver an Army FCS brigade to Djibouti

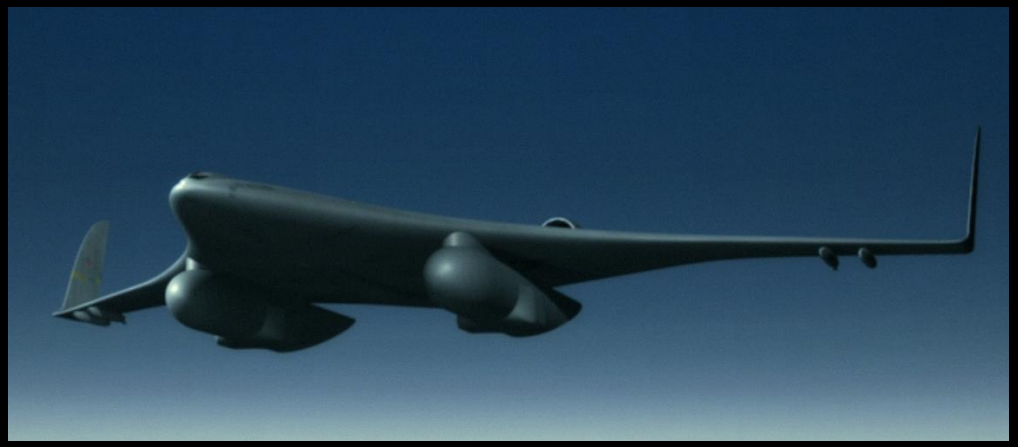
CBO estimate of 23 days for C-17s (MOG constrained – 340-380 sorties)

ASC/ENMM estimate of 5-7 days for S-CATs
(No MOG constraint~350 sorties)

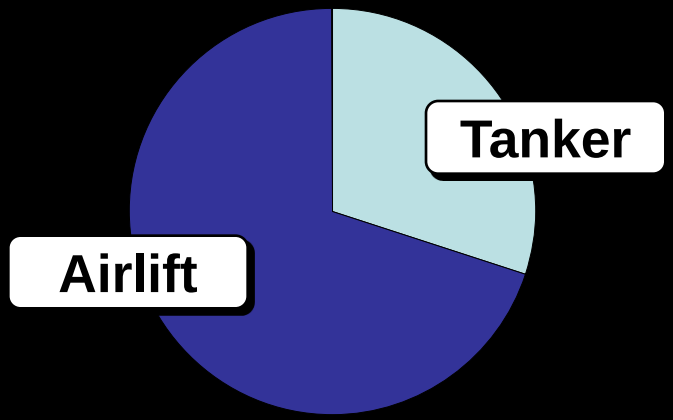
C-5s and C-17s would still be called on to move the heavy equipment

But, by using new S-CATS to transport palletized cargo and vehicles, C-5 and C-17 lives would be extended

CATs would extend C-17 and C-5 lives while providing useful multi-mission support



- C-17 current usage -1,500 hrs/yr
  - 20 year life @ 30,000 hr airframe life
- Decrease average usage by using CATs
  - Gain years of added C-17 life
  - May also provide benefit to C-5 fleet



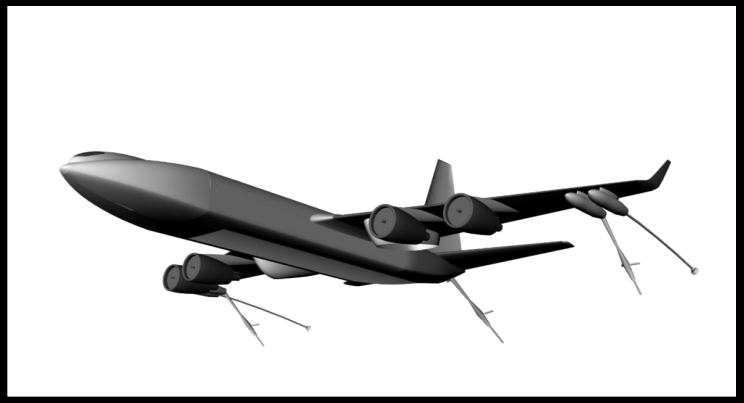
Module-carrying tankers will provide significant cargo transport utility

- Can be loaded and unloaded without specialized MHE
- Aircraft time on the ground for “unloading” the cargo is substantially reduced
  - Improved ton-mile per day per aircraft metric (per Gavin)
- MOG constraints are significantly reduced
- Enroute cargo transfer minimized

Modernizing Theater Airlift

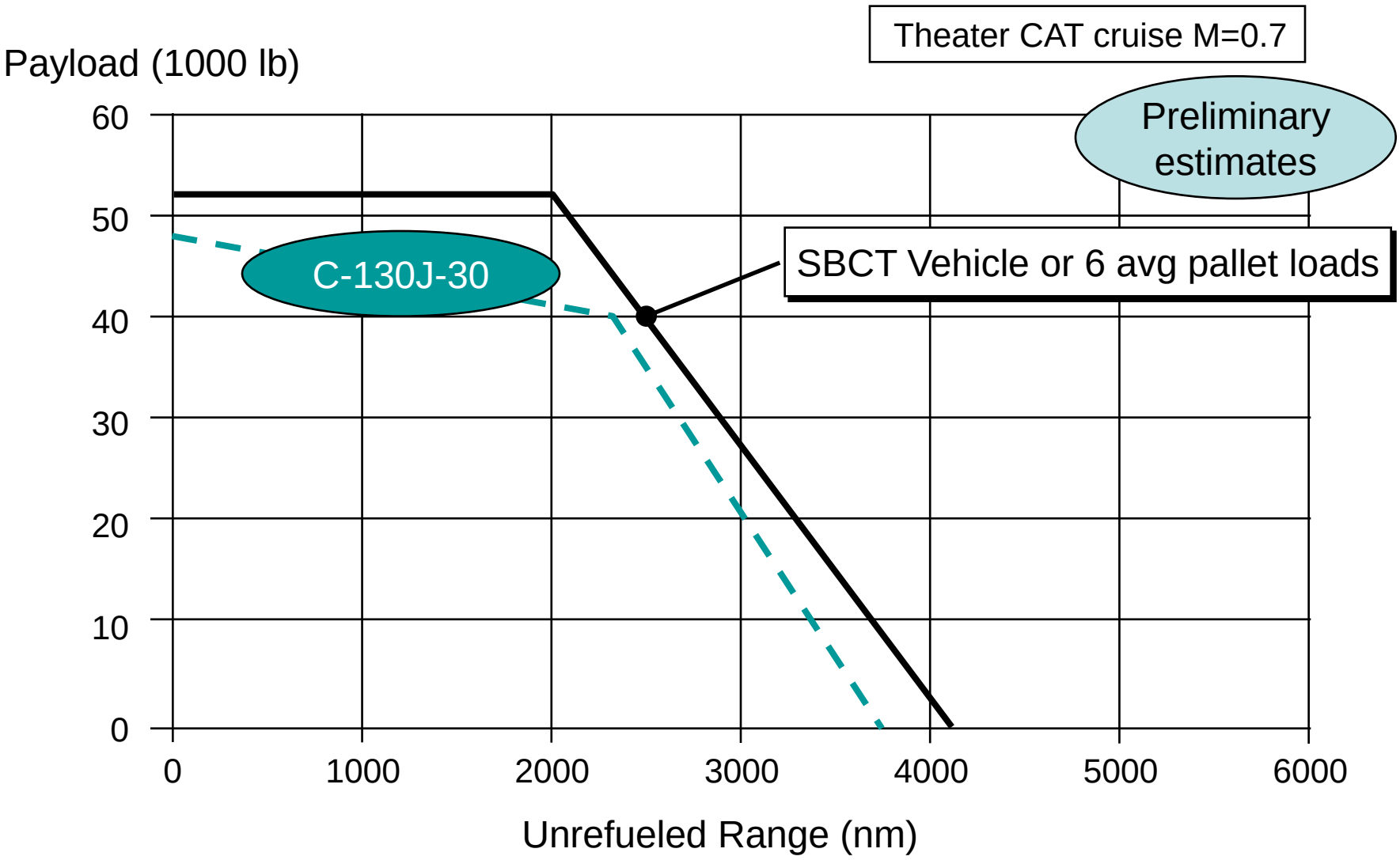
AMC-X Concept

Theater CAT (T-CAT) Concept



Could also be BWB configuration

T-CAT has moderately better range/payload than C-130



Regional bases are used to transfer modules to T-CATS

Arriving S-CATs detach modules on ramp

T-CATs rapidly pick-up modules

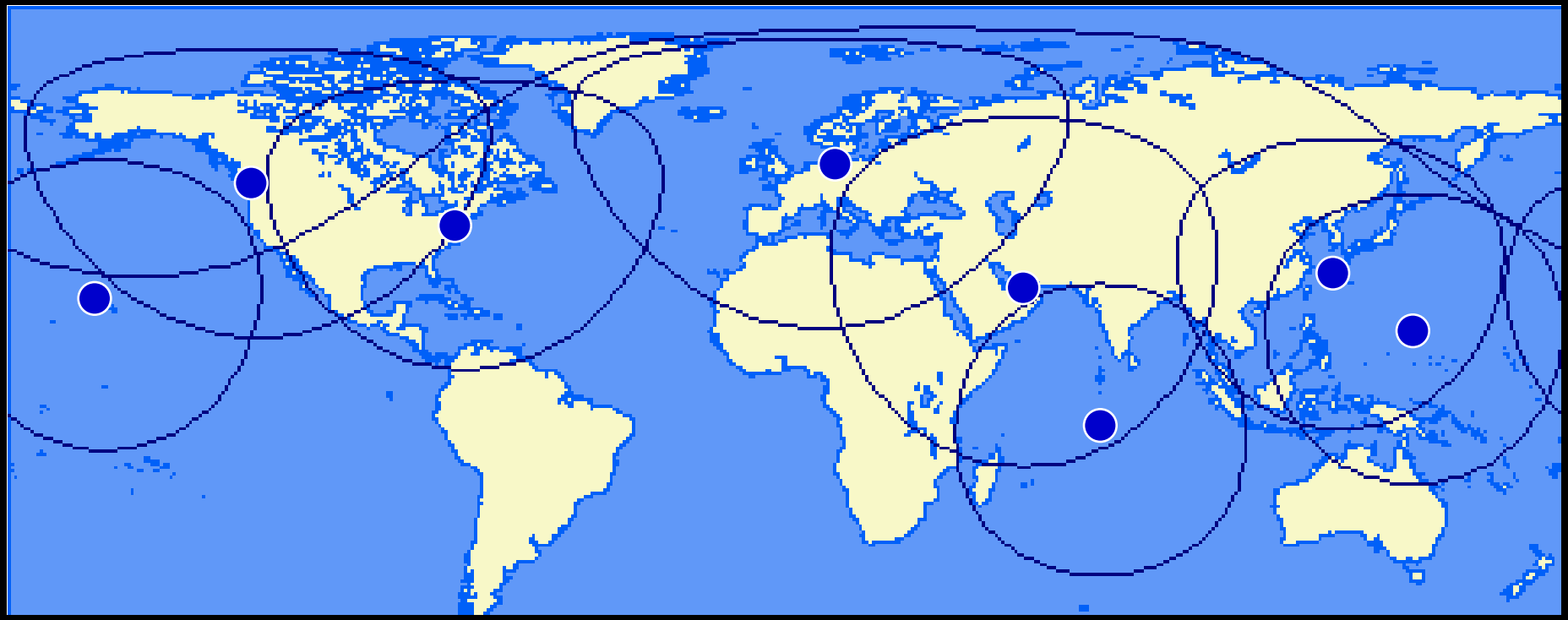
T-CATs rapidly pick-up modules

T-CATs rapidly pick-up modules

And depart for forward bases

T-CATs complement S-CATs to complete delivery of modules to forward bases

2,000 nm range



Theater CAT can deliver modules to 3,000 ft runways

T-CATs will also offer significant multi-mission capability

- Tanker
- Tanker + airlifter
- Tanker + gunship
- Tanker + bomber
- UCAV tanker + UCAV tender
- Tanker + EW platform

Theater commanders will have unprecedented flexibility in mission-configuring assigned air forces and responding quickly to changing circumstances

Modernizing Tactical Airlift

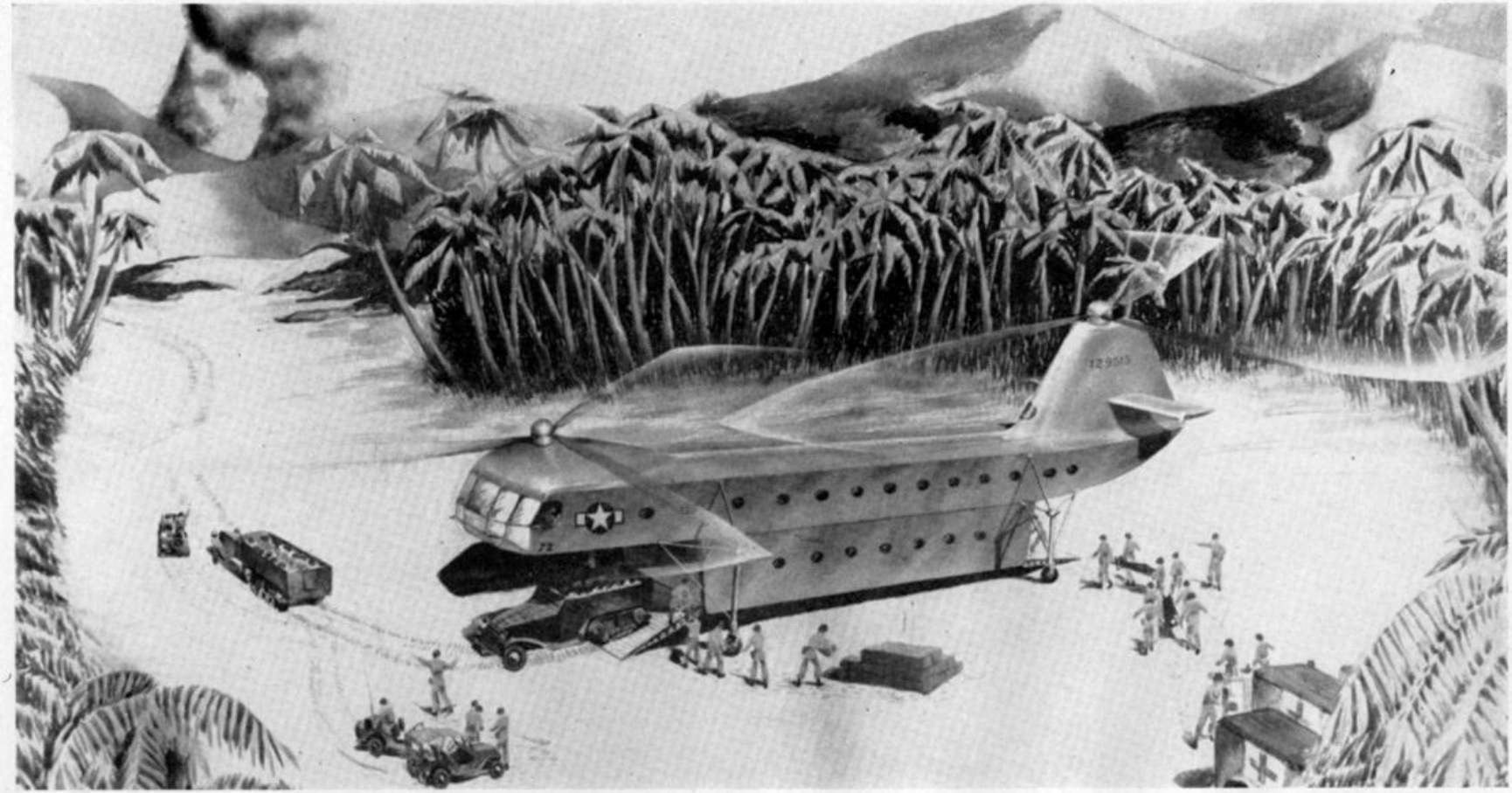
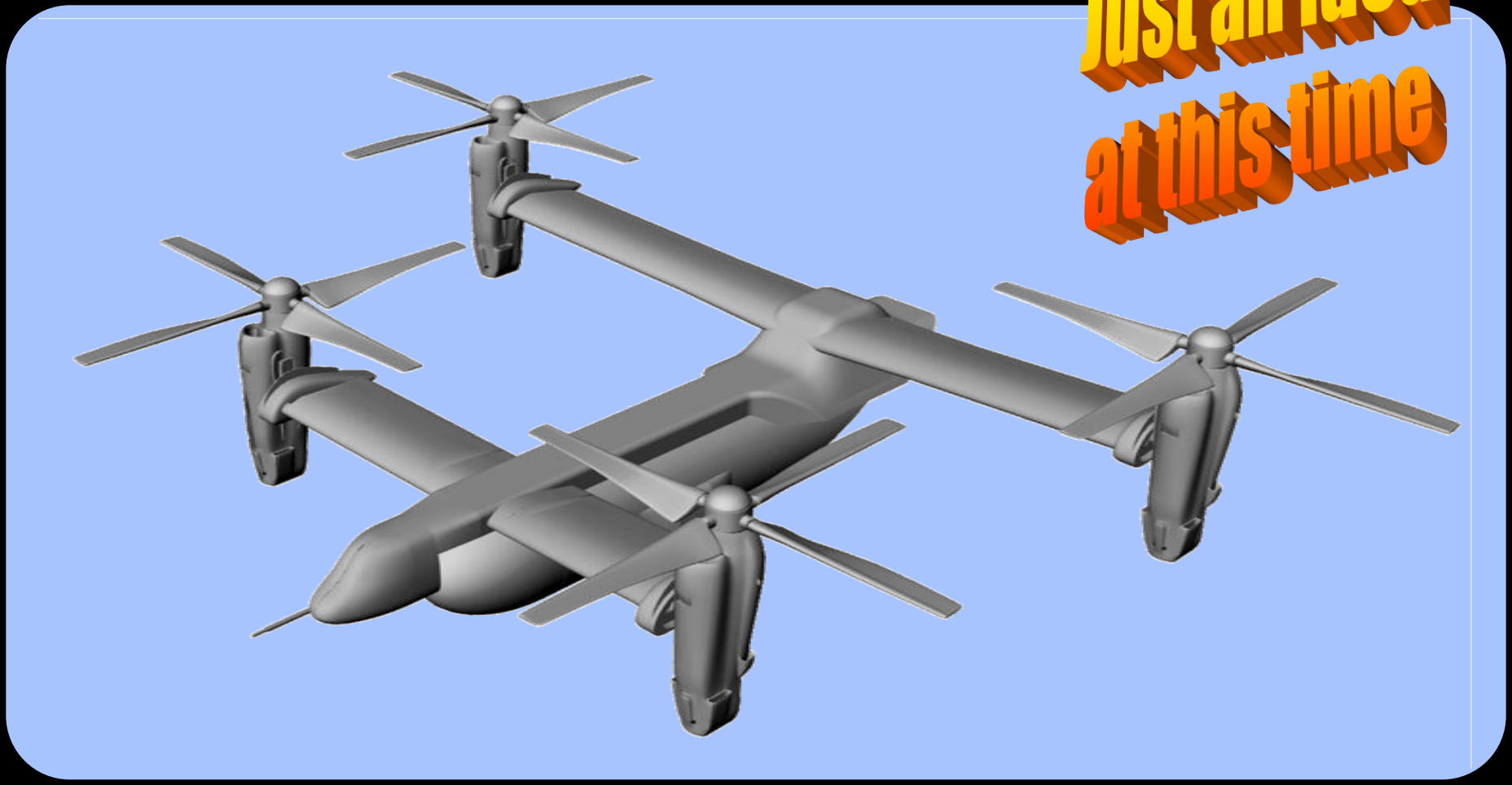


Plate 9. The Piasecki helicopter offers interesting possibilities in the airborne field. Here one is being used in support of an airborne attack in a country with limited landing area. Immediately upon landing its combat cargo is discharged and its evacuation cargo loaded. It should take off promptly and not remain in the airhead any longer than necessary. *(Photo courtesy Piasecki Helicopter Corporation.)*

VTOL CAT



VTOL-CATs will offer significant multi-mission capability

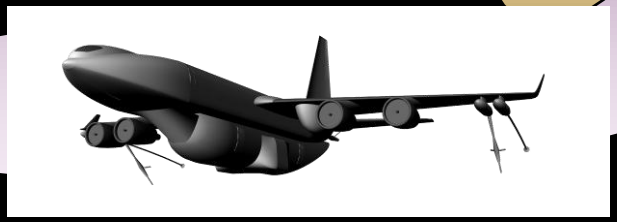
- Airlifter
- Gunship
- Bomber
- EW
- ISR
- CSAR
- SOF support
- HUMRO
- Heavy material handling

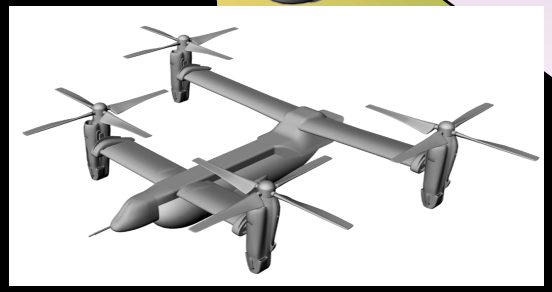
Theater commanders will have unprecedented flexibility in mission-configuring assigned air forces and responding quickly to changing circumstances

Concept of Operations

Modules owned
by using Service/Agency/Allies

SEAMLESS DIRECT DELIVERY



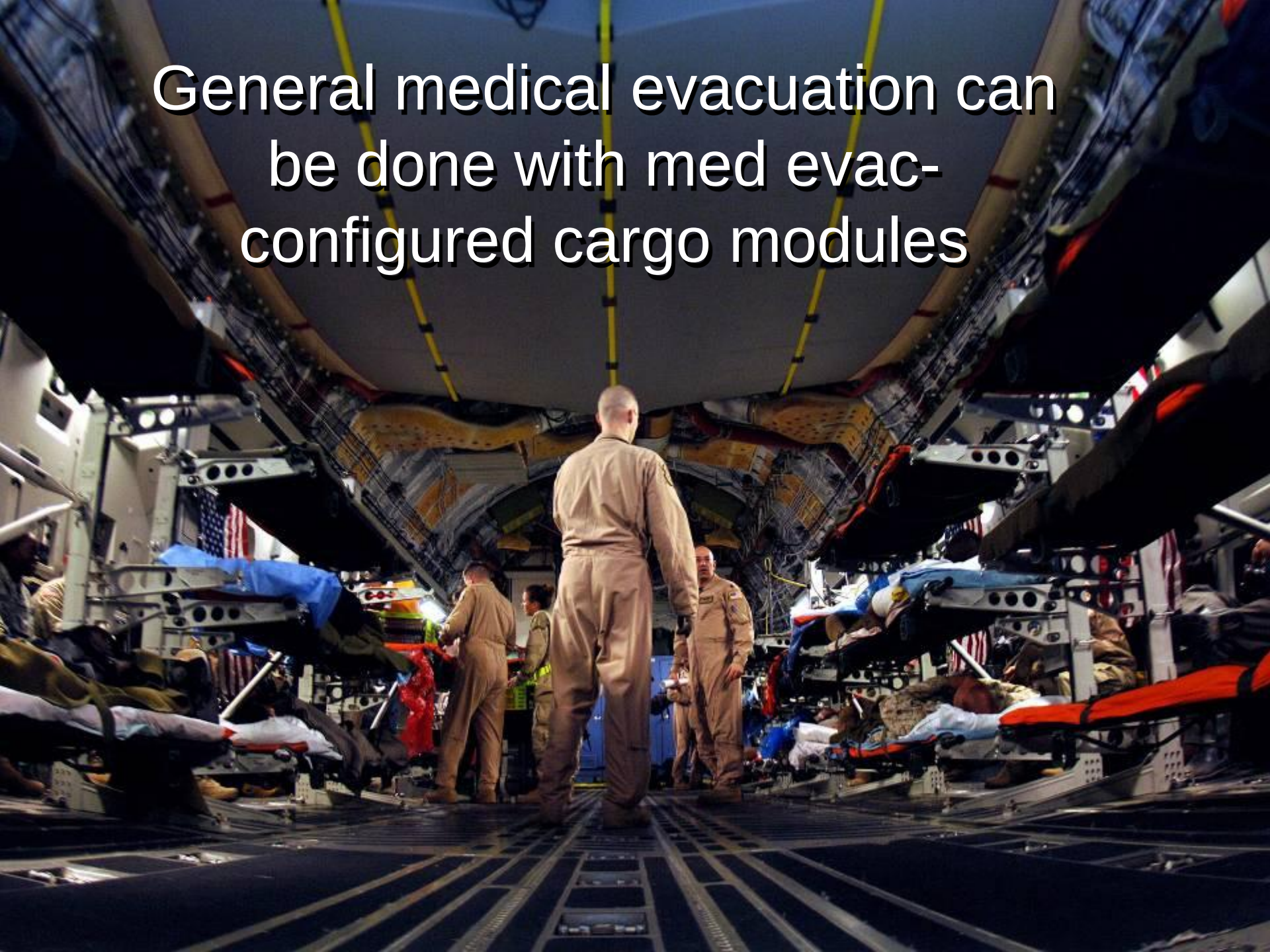


Prepositioned
modules

- Strategic, Theater & Tactical Deployability
- Direct module delivery – load/unload once
- Ground & airborne missionized modules

Expanding Airlift Multi-Mission Capabilities

Modules enable unique airlift and HUMRO missions to be readily undertaken


General medical evacuation can be done with med evac-configured cargo modules

Special medical evacuation can be done with special med-evac modules

- Critical care patients
- Chem-bio-nuc-exposed patients

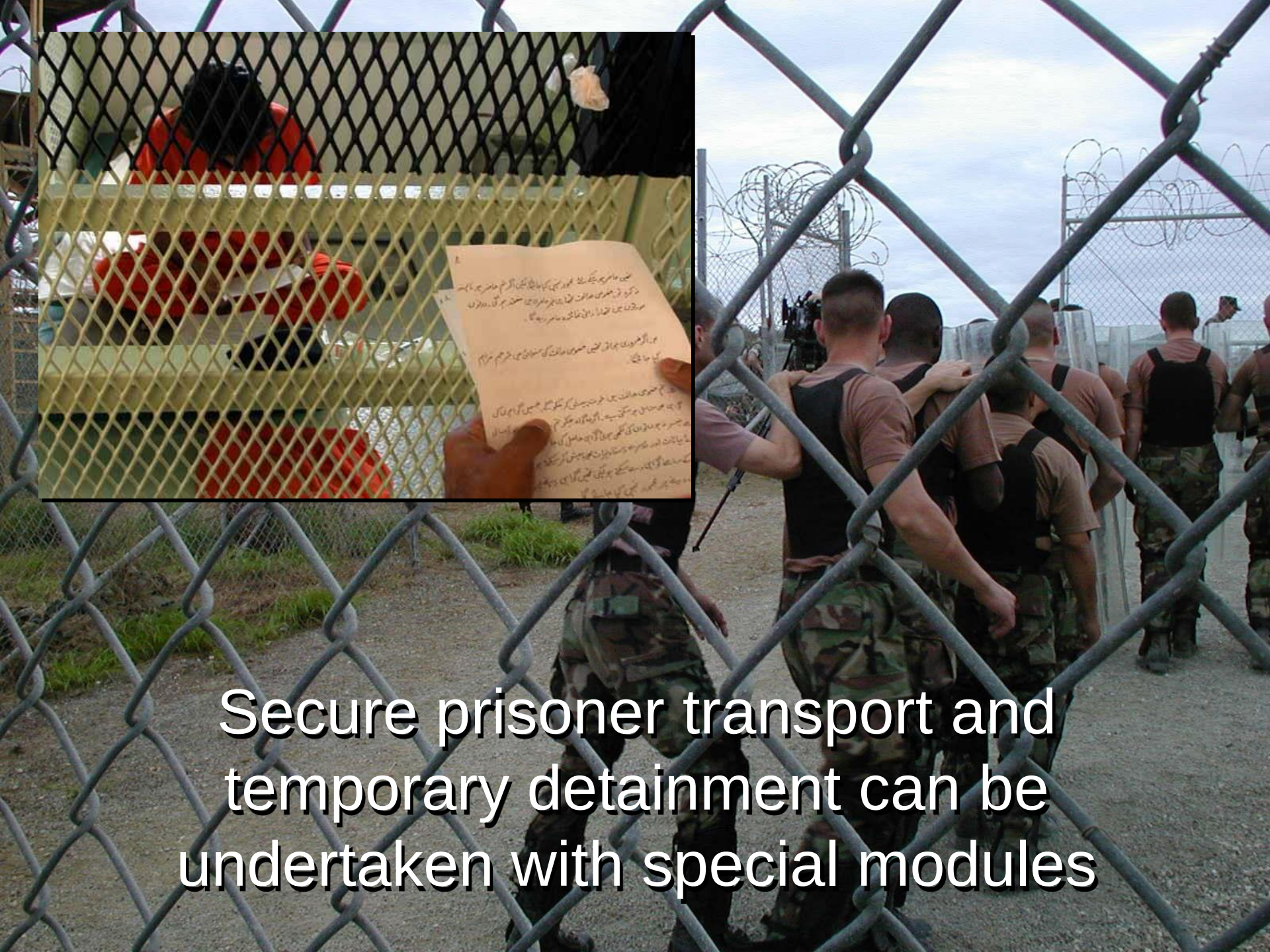
By having the module always available, realistic training and exercises can be undertaken at any time to keep troops fully prepared

The entire module can be decontaminated, if needed


Hospital modules can be used for air-mobile emergency medical facilities

VIP transport can use VIP modules

- Special protection
- Added communications
- Integrated ground mobility capabilities



Secure prisoner transport and temporary detainment can be undertaken with special modules

HUMRO equipment and supplies can be preloaded and prepositioned for rapid transport

Allies and cooperative organizations (e.g., Red Cross) can own, equip, and staff modules

Air national guard units can use special modules to aid forest and urban fire fighting

Modules will add substantial new flexibility in meeting unique airlift and HUMRO missions

- No dedicated aircraft
- Prepositioning of modules for rapid response
- Special modules (e.g., contaminated patient transport) for training and exercises
- Allied countries and humanitarian organizations can provide their own modules
- New unique mission capabilities can be readily added

Airborne Mission Modernization

Module-carrying strategic and theater tankers can be used to modernize most airborne missions

Many existing dedicated airborne missions can be moved to missionized modules

With CATs, the need for most permanent mission-configured aircraft will go away

- Missions that can transition to modules
  - Bomber
  - EW / IW / specialized surveillance
  - AWACS / JSTARS
  - Electronic jammers
  - VIP transport and support
  - MedEvac
  - Airborne test support
  - Gunship

Air Force is interested in a new bomber by 2018

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OF INTEREST

YOUR AIR FORCE IN ACTION

EXTRA

Air Force to step up new bomber search in next budget

BY: REBECCA CHRISTIE, DOW JONES NEWSWIRES*
06/29/2006

WASHINGTON (Dow Jones) -- The U.S. Air Force's search for a new bomber will step up in coming months, in hopes of meeting the 2018 goal set by a defense strategy report.

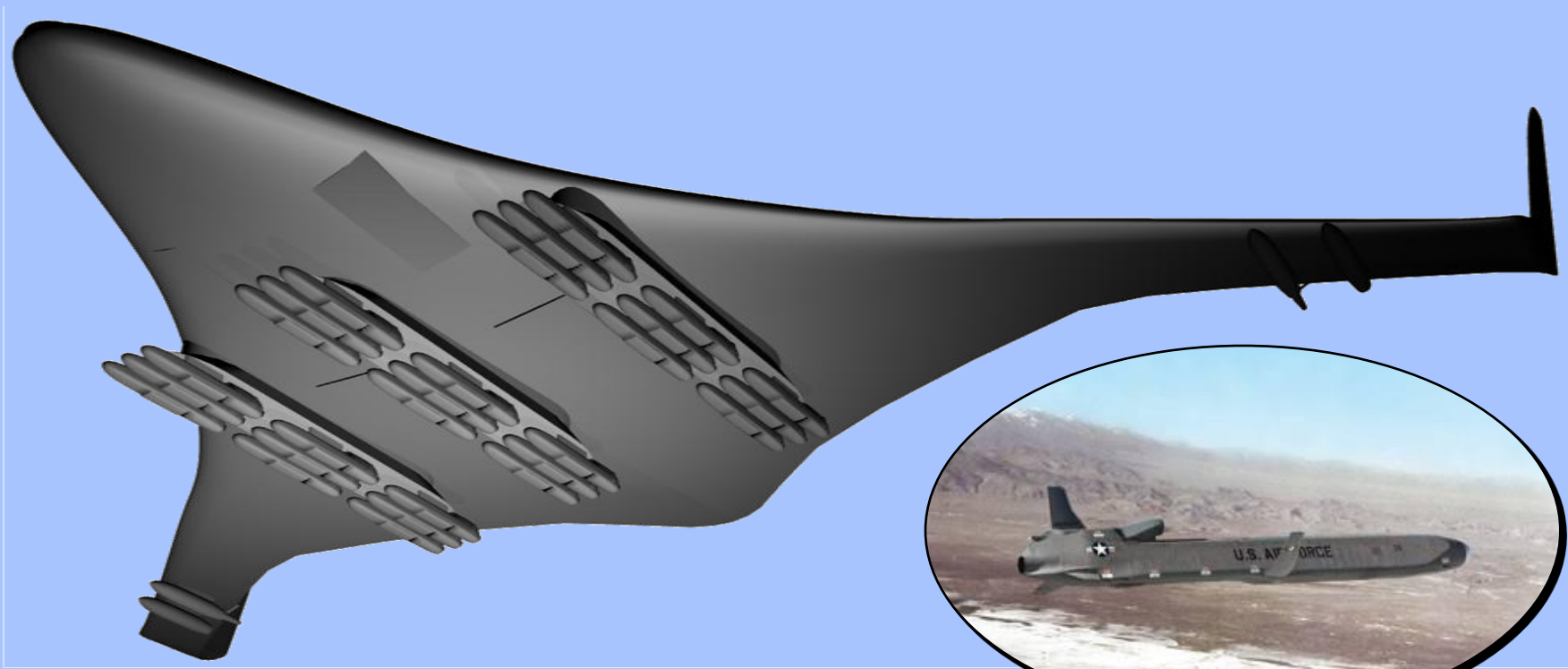
Air Force Secretary Michael Wynne told Dow Jones Newswires that the Pentagon needs to "get on with the getting on" of a new bomber program. Unless the service starts soon, it won't get its new plane by even 2020, he said in a recent interview.

CATs can perform
many airpower missions

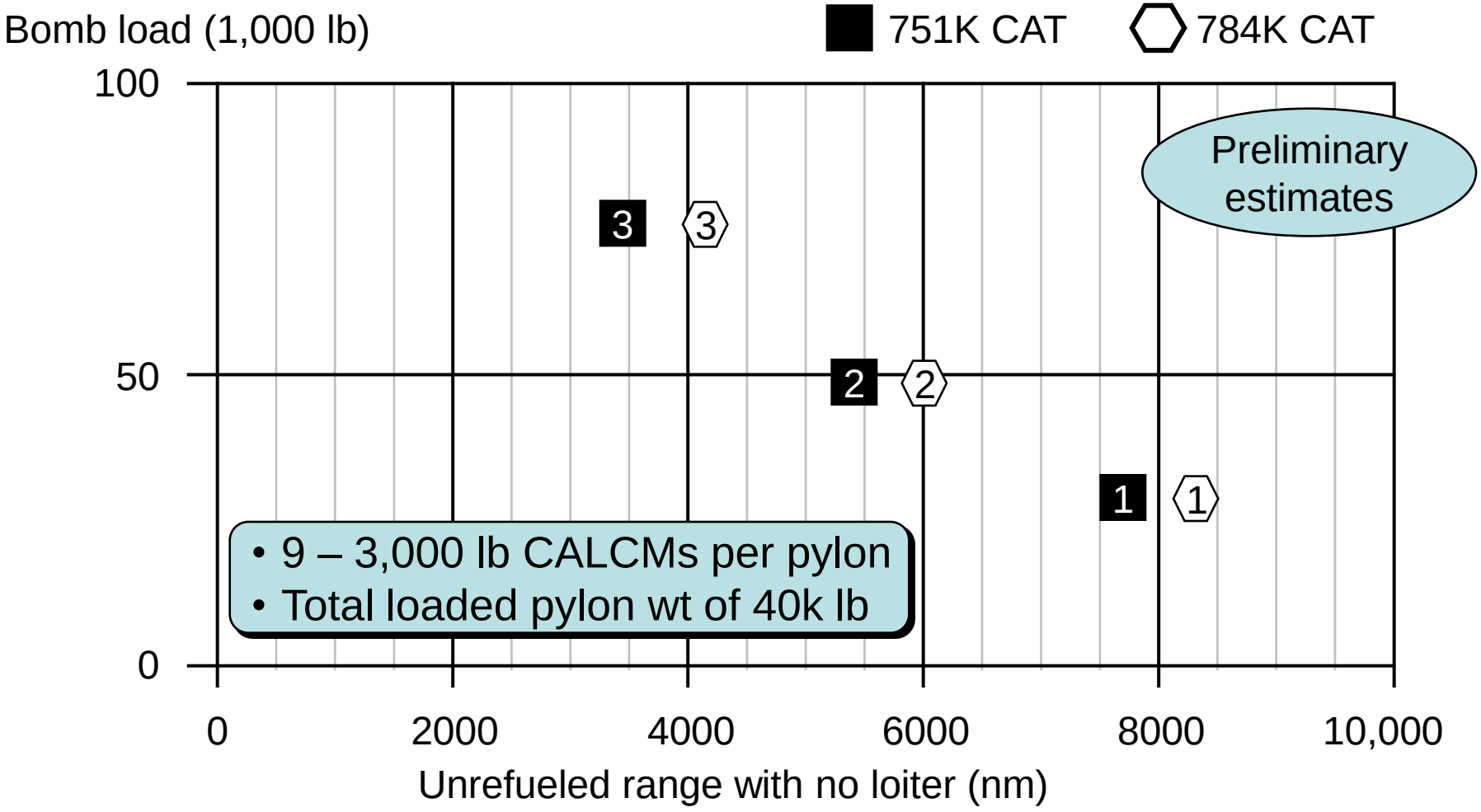
Using modules reduces mission preparation timeline

Air force photo caption: Weapons loaders work through the night loading cruise missiles onto B-52H.

CATs can provide airpower capabilities



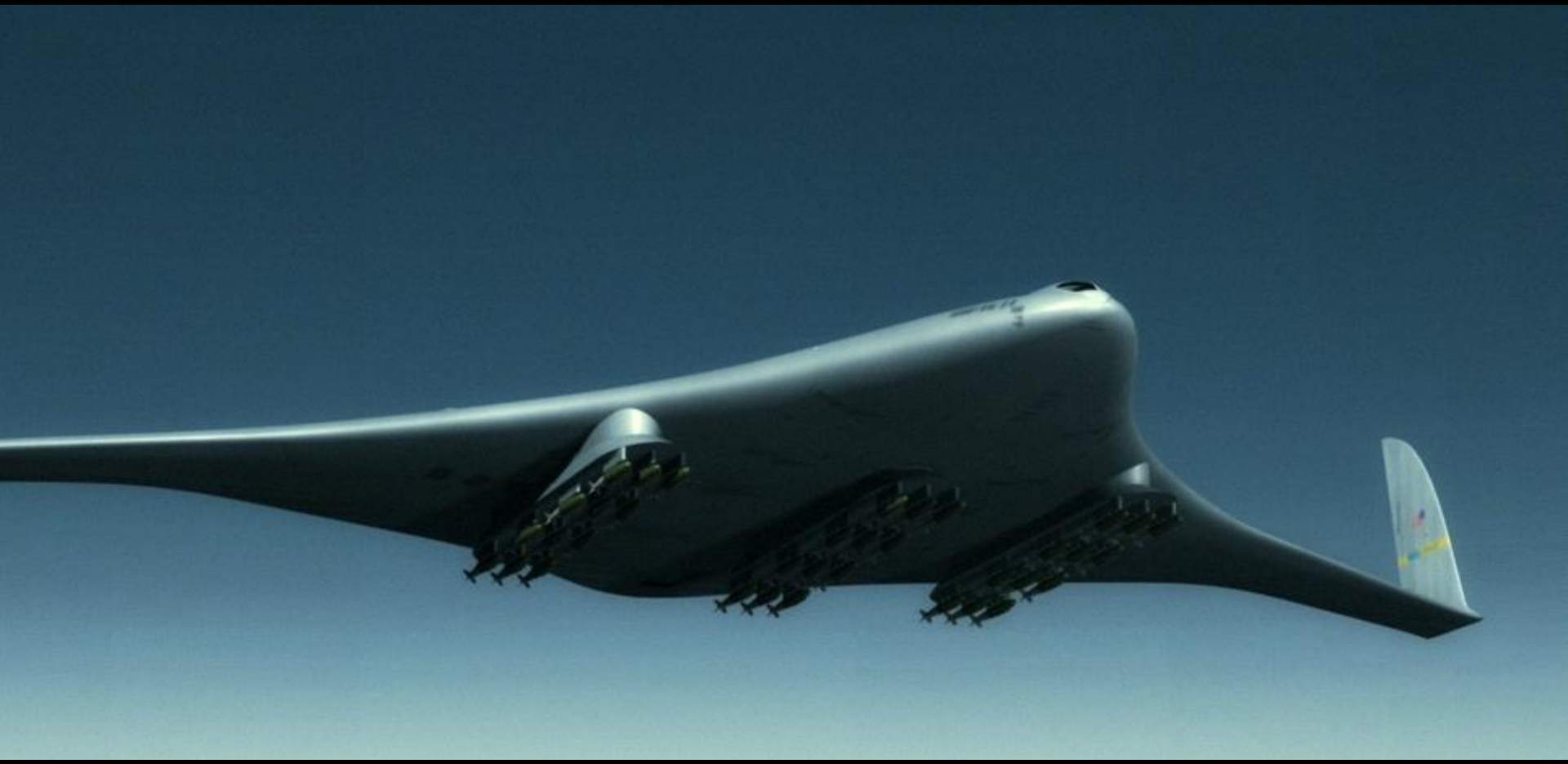
Strategic CAT can carry three weapon pylons



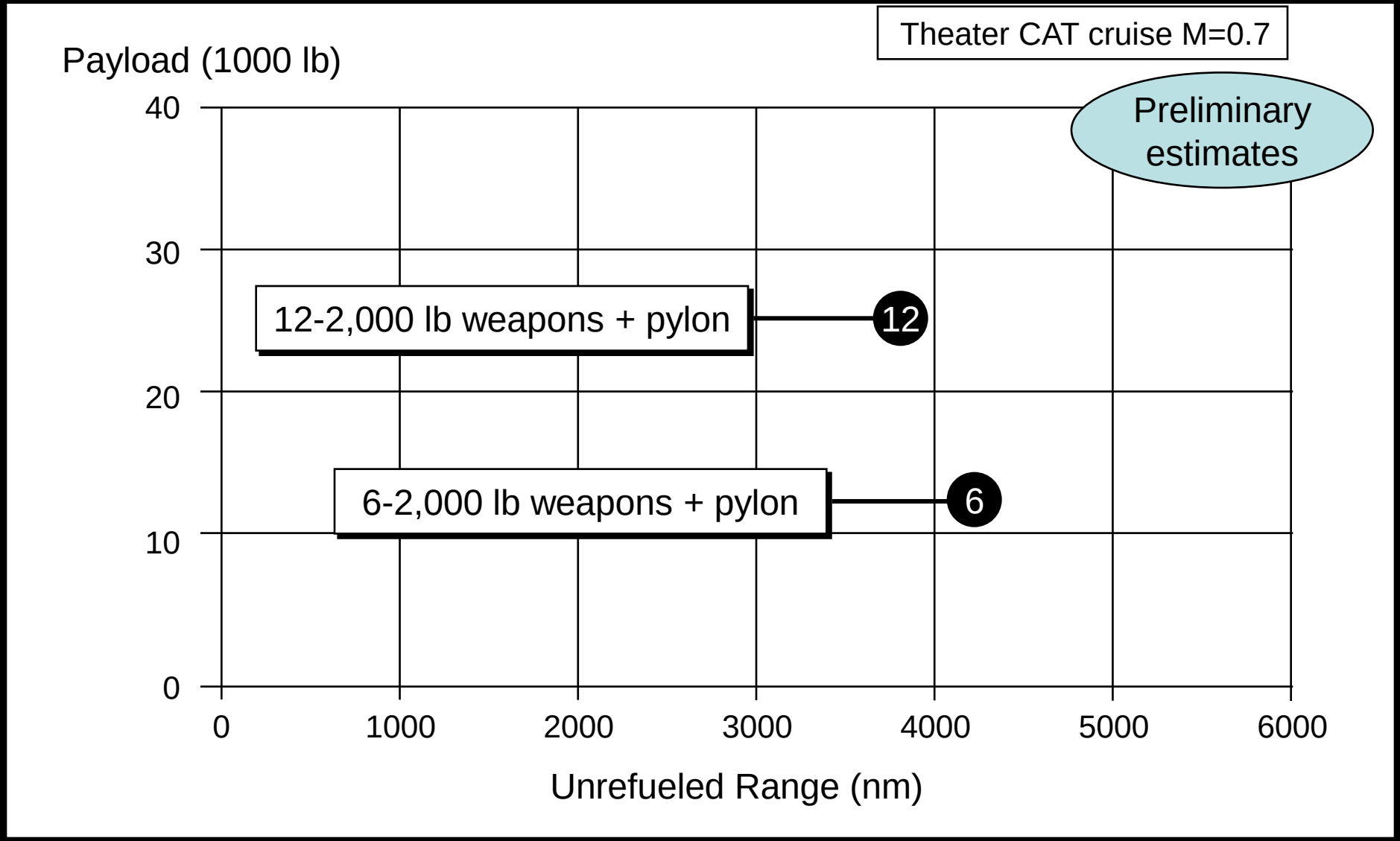
Theater CATs can also perform airpower missions

Same weapon pylons can be used on strategic and theater CATs

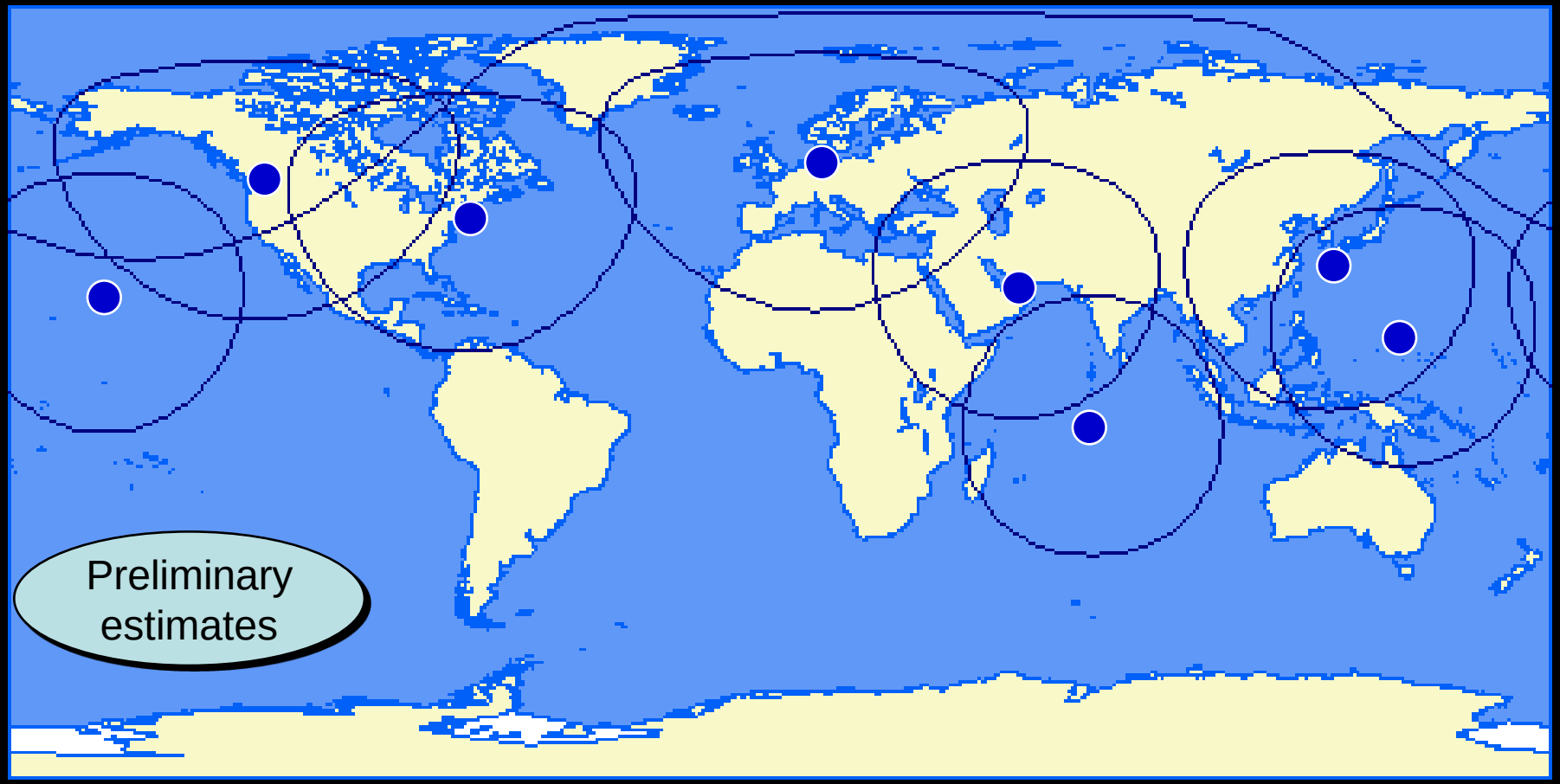
Same weapon pylons can be used on strategic and theater CATs



Theater CAT with 1 weapons module has intermediate bomber performance

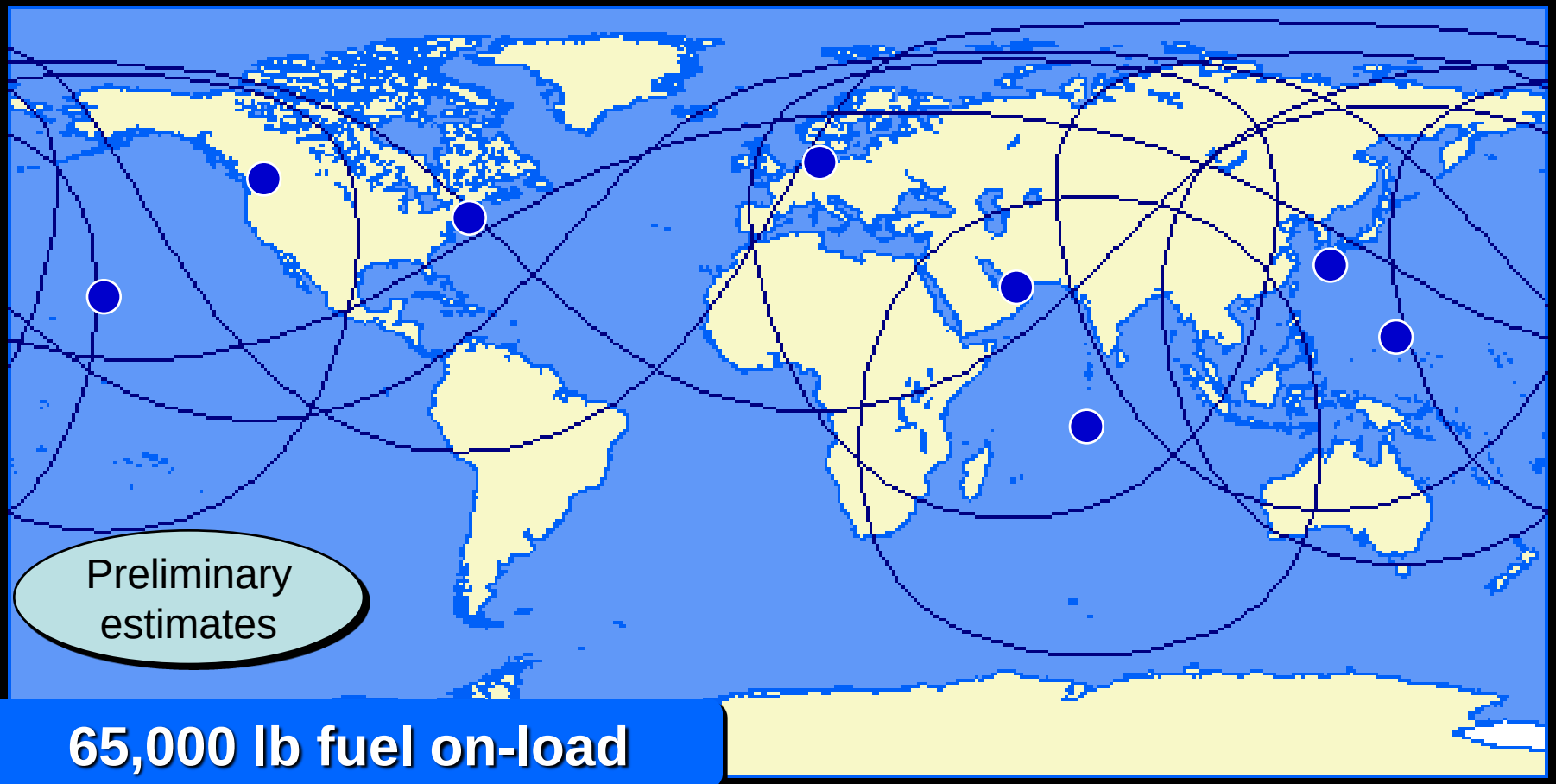


Theater CAT with 1 weapons module has intermediate bomber performance



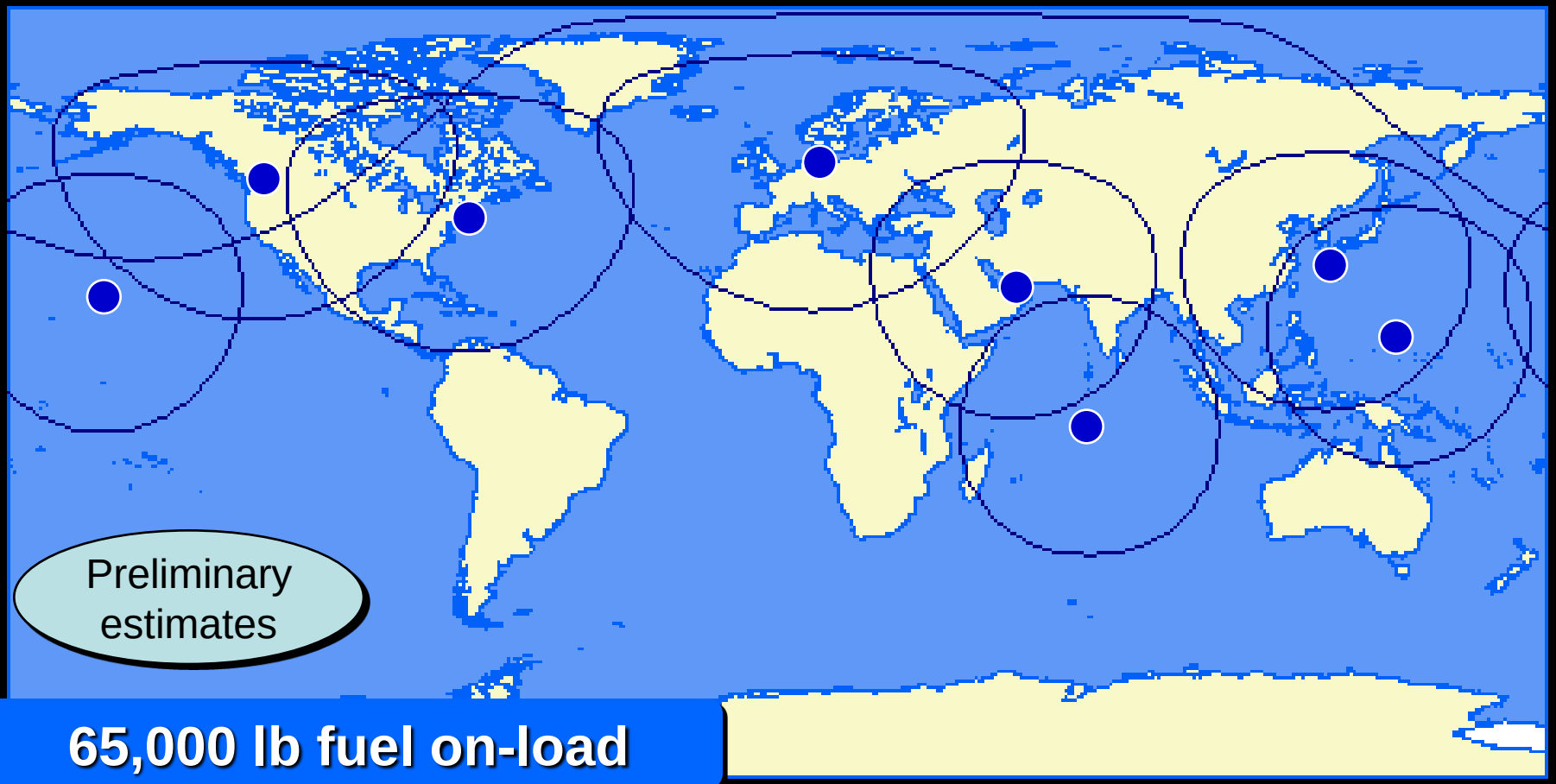
1,800 nm mission radius with 24,000 lb of munitions

With air refueling T-CATs can significantly extend the mission radius



3,200 nm mission radius with 24,000 lb of munitions

Or mission endurance



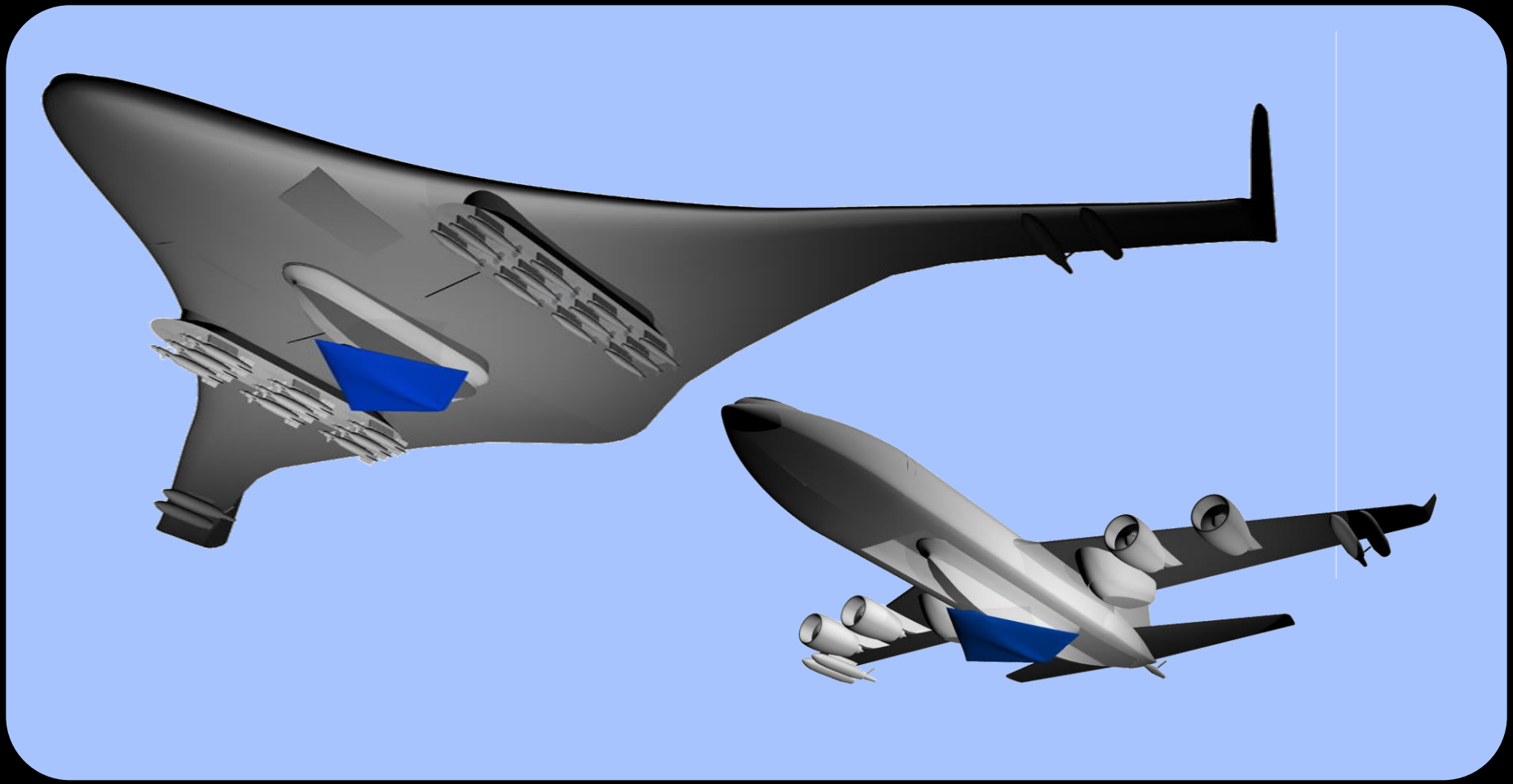
65,000 lb fuel on-load

15 hr mission endurance at 1,800 nm
with 24,000 lb of munitions

Unmanned aircraft operations in the battlespace is increasing in importance

Having UCAVs forward early is a significant advantage where response time is critical

CATs provide a way to “air base” UCAVs to provide persistent forward presence



Providing dedicated EW platforms has become cost prohibitive

CATs provide a new means to use EW in battlespaces where it makes sense

S-CATs would enable EW to be combined with other airborne missions

Modernizing through missionized modules will have several advantages

- Multi-mission use adds to economic return on investment in new strategic and theater aircraft
  - Avoids need to add unique new airframes to modernize airborne missions
- Provides a common cockpit and pilot training environment
  - Reduces number of different aircraft to train for
- Common logistics support
  - Simplifies depot structure
  - Strengthens vendor/supplier base

Modernizing through missionized modules will have several advantages

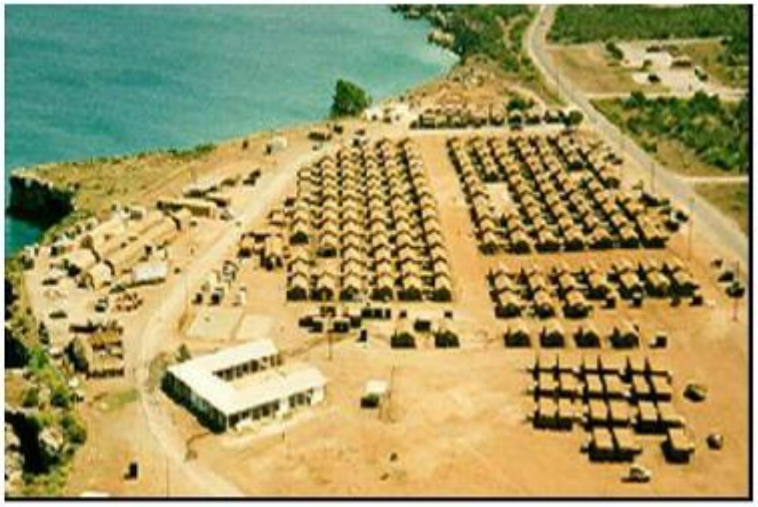
- Eases the transition of missions from older dedicated platforms to new modular platforms to maintain desired level of capabilities
  - Existing electronics can be moved to modules if airframe life is the issue
  - May enable earlier transition
- Enables new missions to be readily added to fleet
  - Shortens development and deployment time and cost by avoiding the need to compete, acquire, and support different airframes
- Long production runs
  - Enables total available fleet size to be adjusted over the next 20-30 years
  - May support multi-year funding

Improving Support for Forward-based Forces

Module-carrying strategic and theater tankers can be used to modernize BEAR base construction and support

Expeditionary forces need rapidly established forward bases

Examples of traditional BEAR facilities



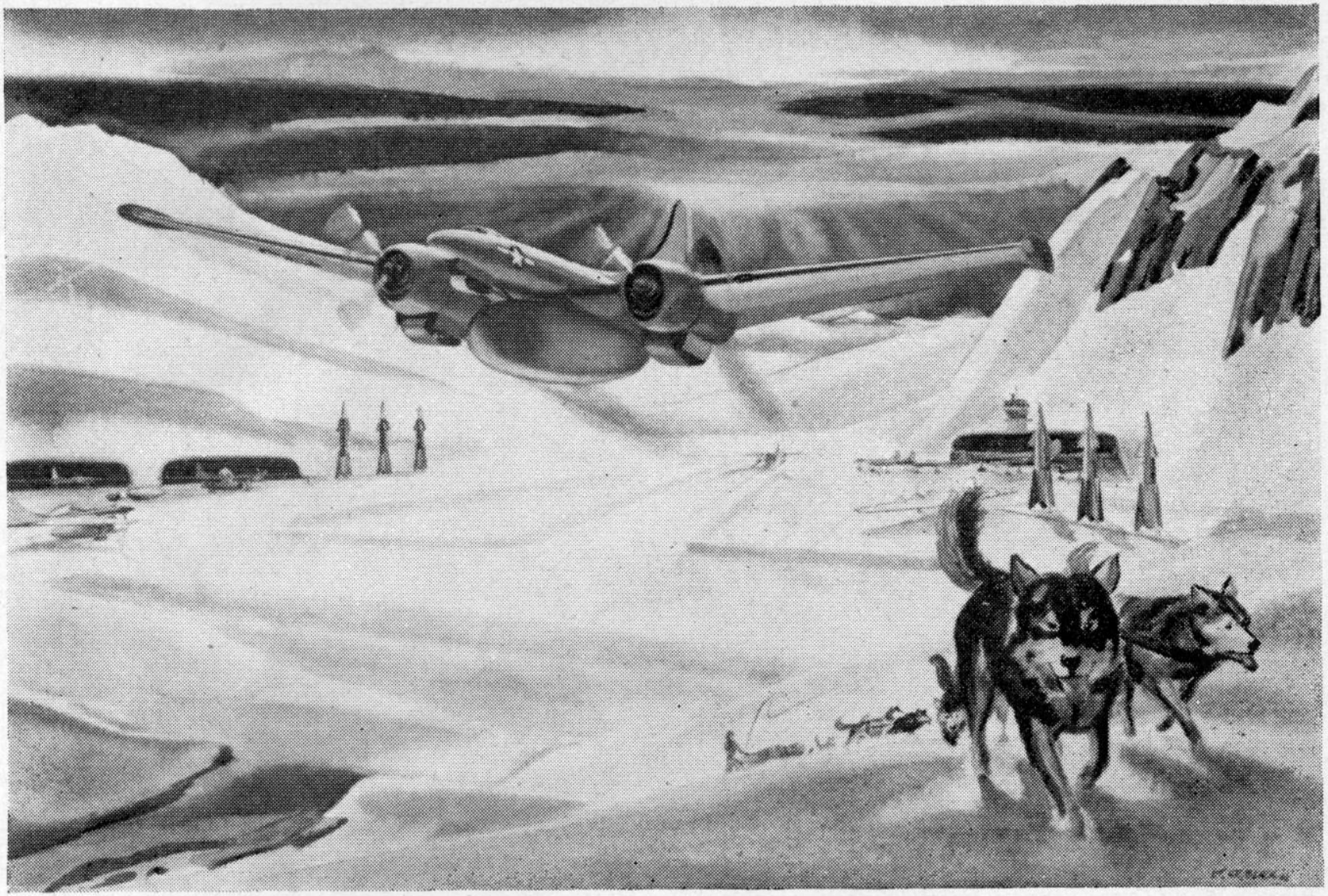


Plate 5. Isolated bases can be supplied by cargo carriers with little difficulty. They can provide the initial assault forces and then follow up with the ammunition, rations, and other supplies needed to maintain their combat effectiveness. They can evacuate the wounded to interior bases and finally, if necessary, they can evacuate the entire base and move to another area if the tactical or strategical situation requires it.

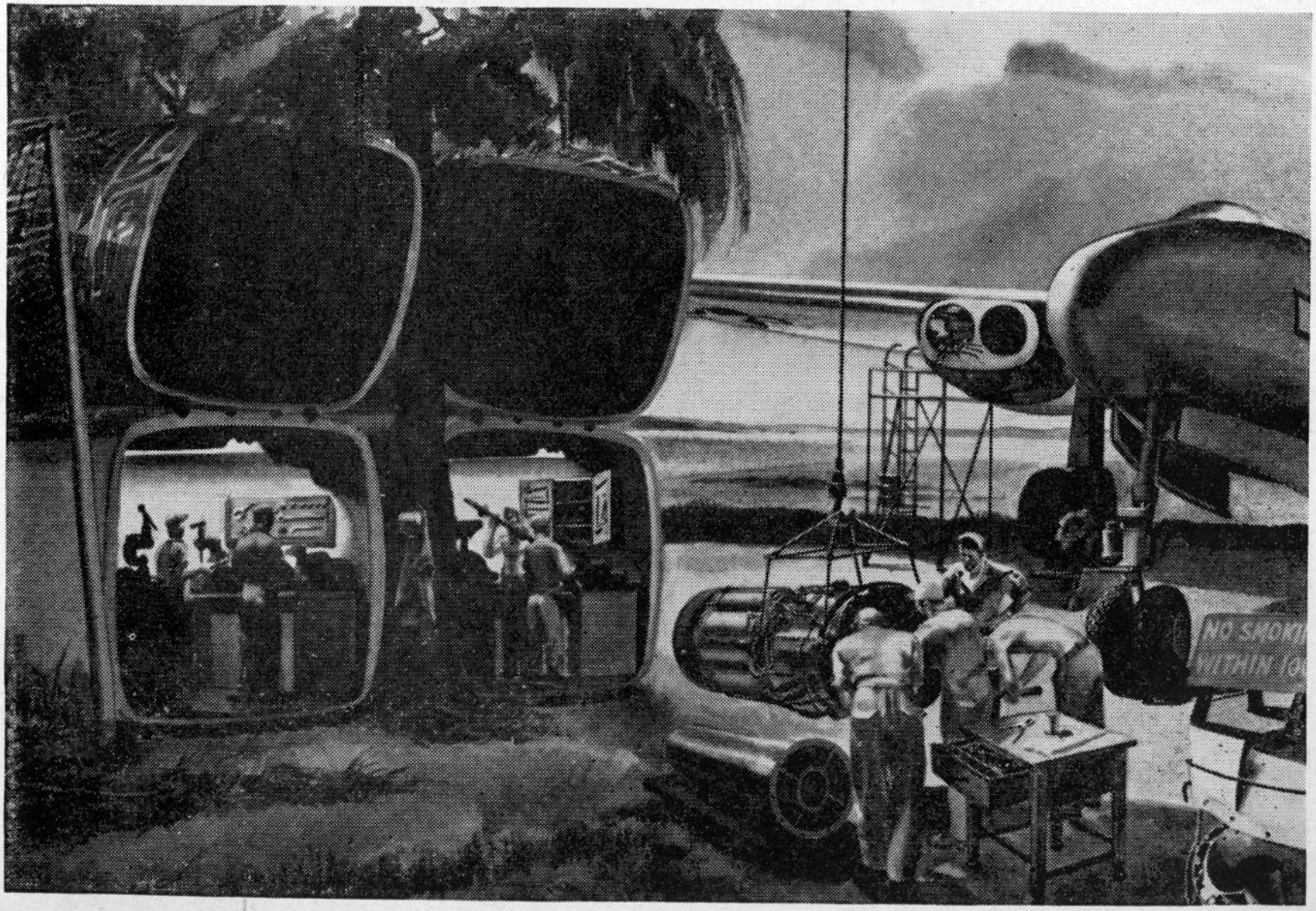
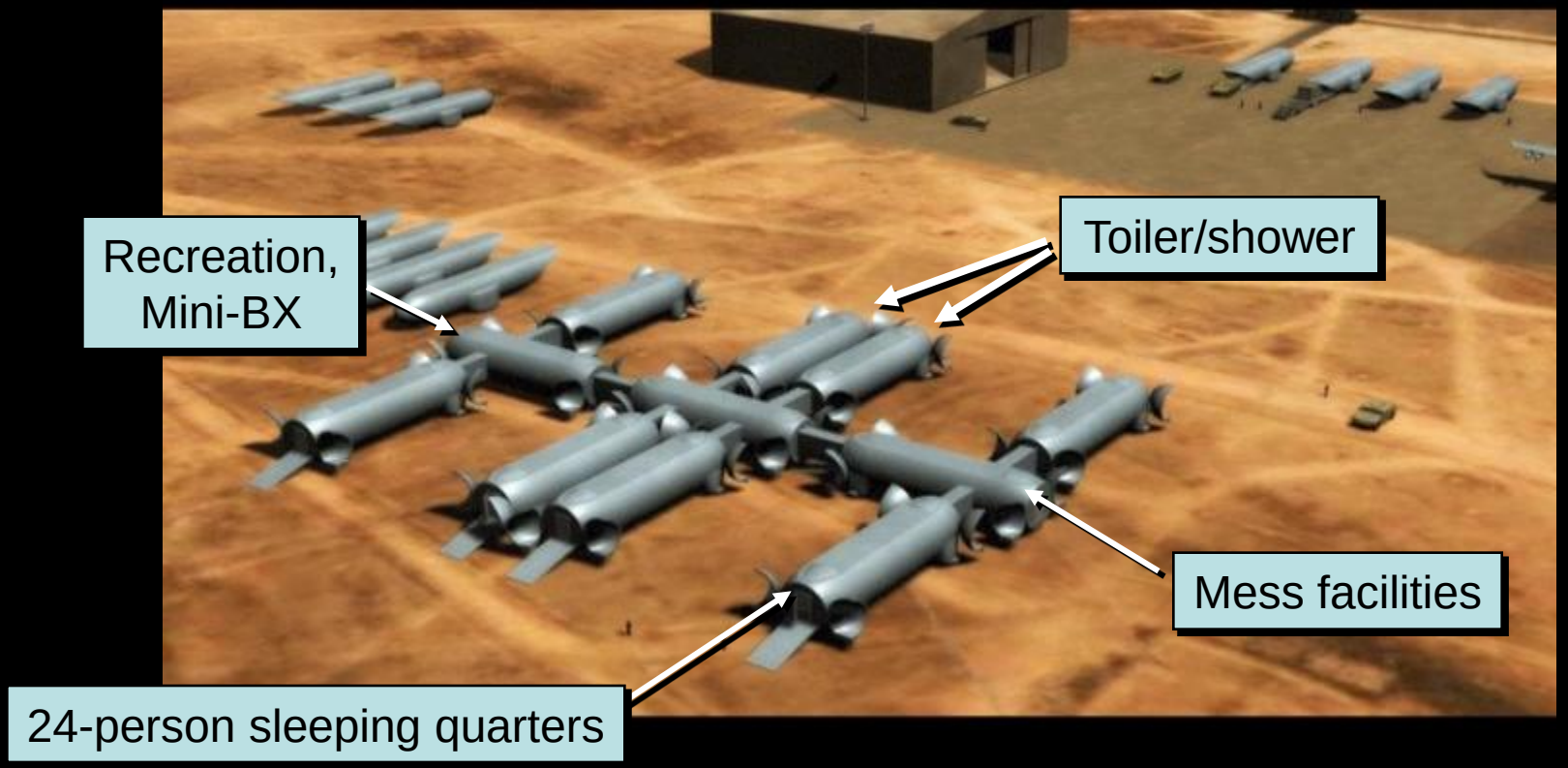


Plate 6. The cargo compartment makes possible specialized uses. Repair shops, radio stations, radar stations, and aid stations all can be flown in ready to operate. As the scene of activity shifts they can be flown from one area to another and be ready for use immediately upon landing.

Modules will take the place of erectable personnel and support facilities

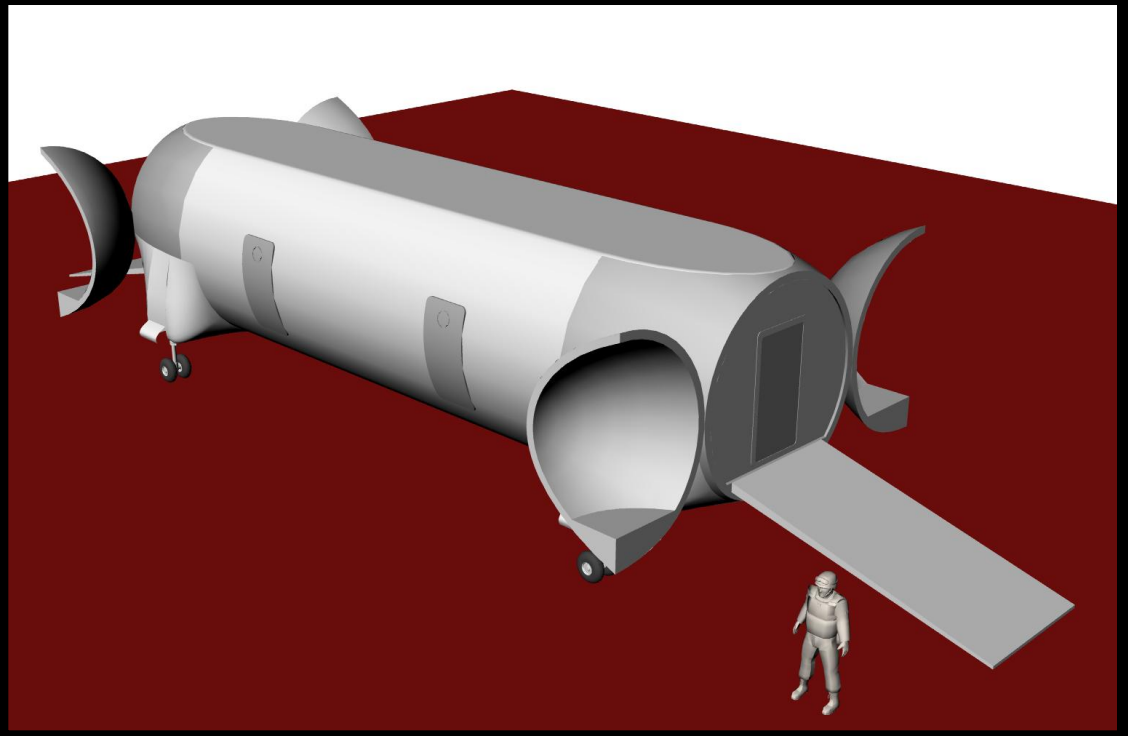
2-3 modules delivered by T-CATs each hour
24-36 modules per day

Examples include crew quarters, command facilities, hospital, mess facilities, etc.

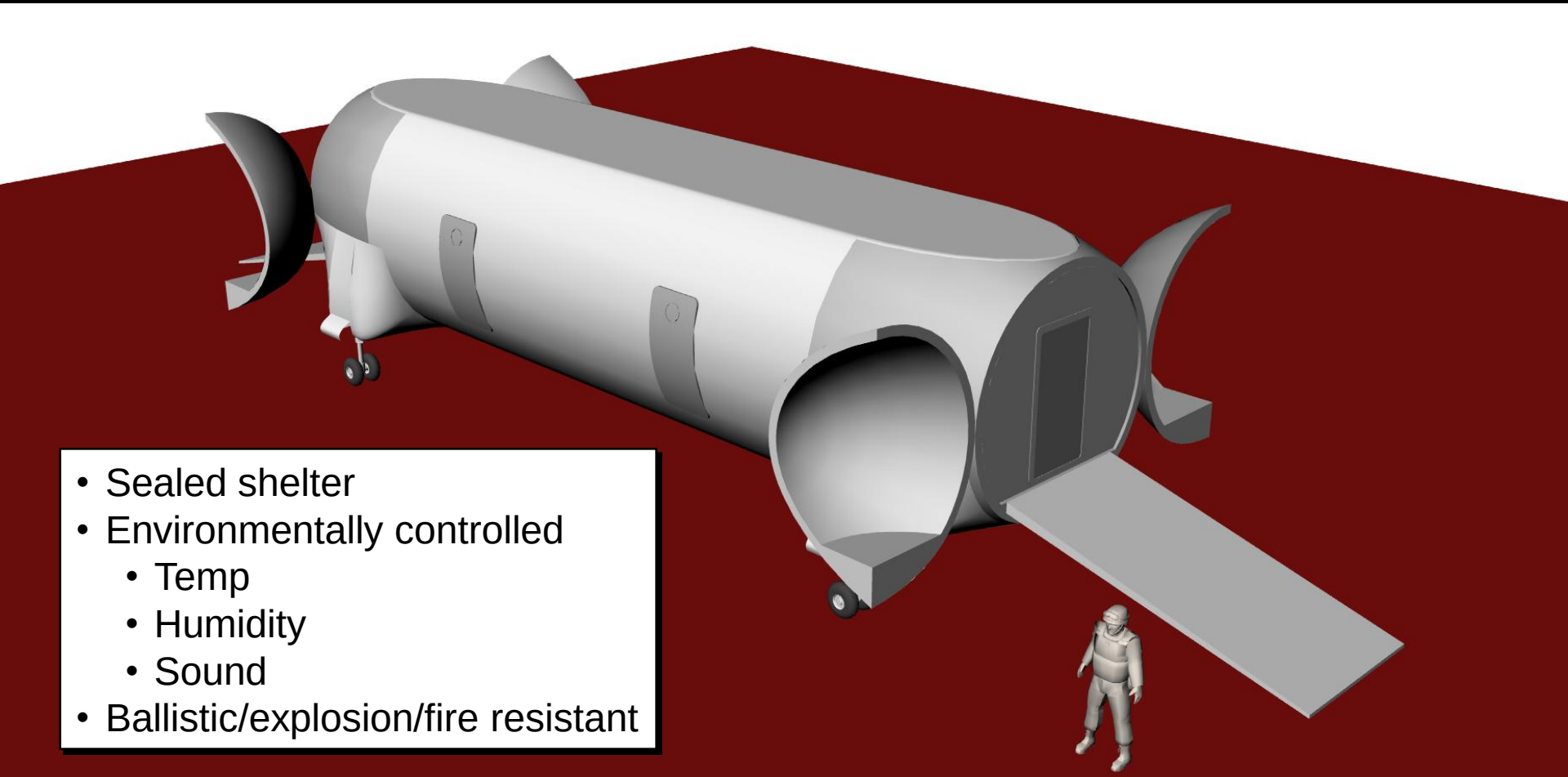


Facilities for about 150 people

Self-contained modules require minimum on-site preparation and construction

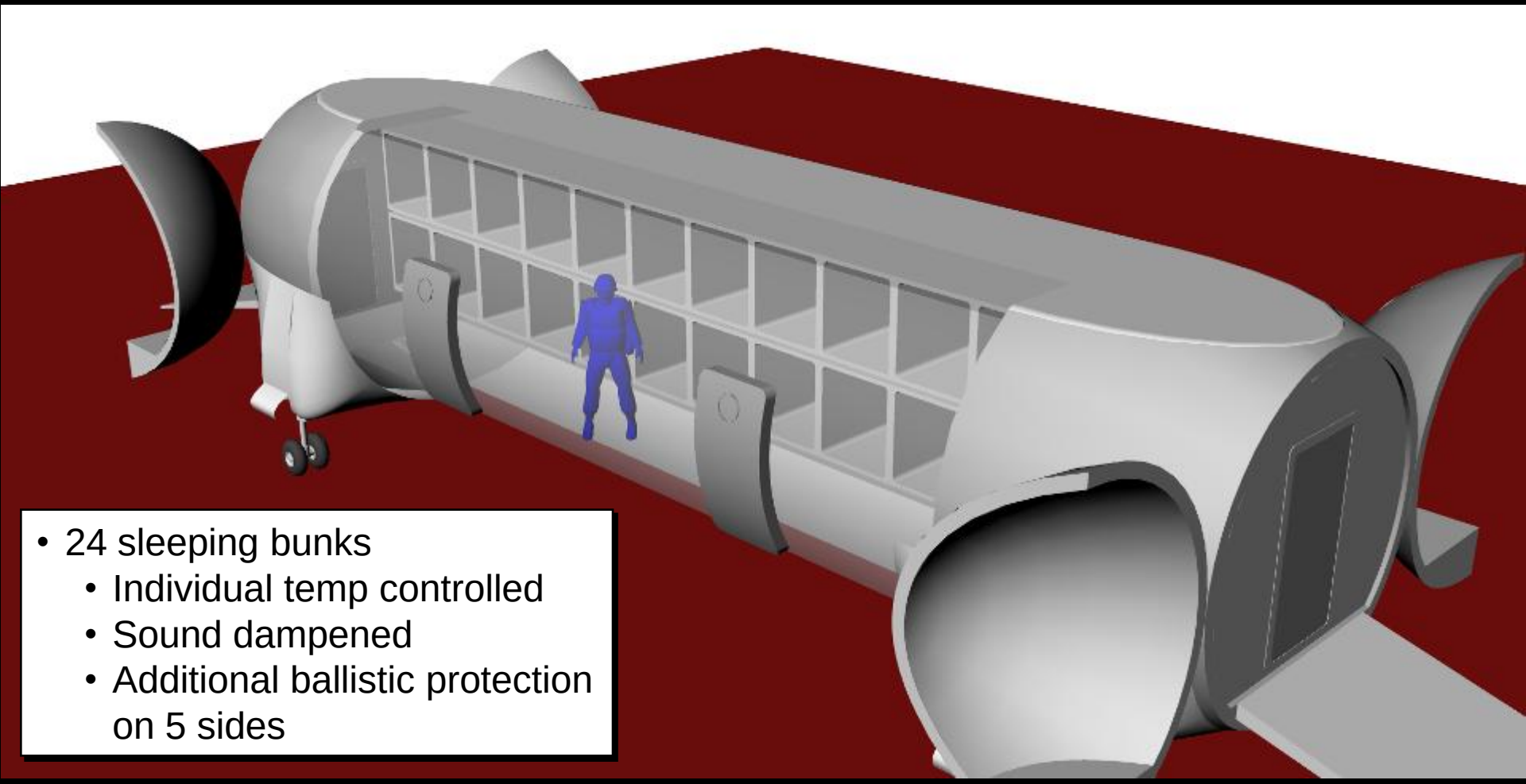


Modules can provide increased chem-bio and small arms protection



- Sealed shelter
- Environmentally controlled
  - Temp
  - Humidity
  - Sound
- Ballistic/explosion/fire resistant

Sleep modules will provide initial deployed forces with secure sleeping quarters



- 24 sleeping bunks
  - Individual temp controlled
  - Sound dampened
  - Additional ballistic protection on 5 sides

Complex support capabilities can be provided in self-contained modules

10 modules / day will deliver 200 tons of supplies

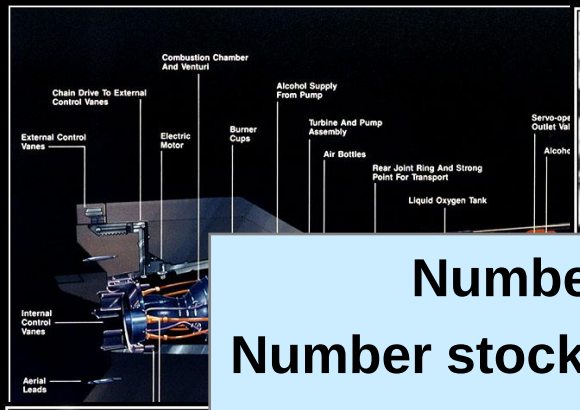
Emerging 21st Century Warfighting Mobility Challenges

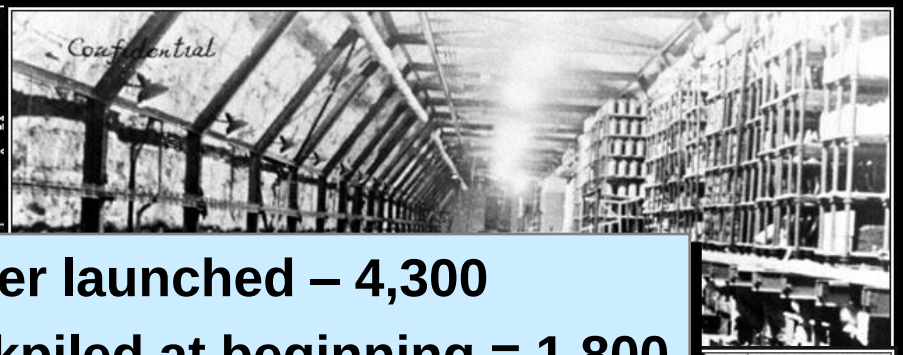
Will the 20th century model of air mobility suffice for the 21st century, or will Gavin's thoughts for expanded air mobility capabilities be needed?

U.S. forces must be prepared for

- Anti-access political denial
- Accurate, longer-range missile threats
- SOF / persistent non-conventional attack
- Chem / bio / nuclear threats
- Greater distances from CONUS
- Less indications and warnings of hostilities
- High tempo warfare

V-2's from WW II provide insight into the potential missile threat





Number launched – 4,300

Number stockpiled at beginning = 1,800

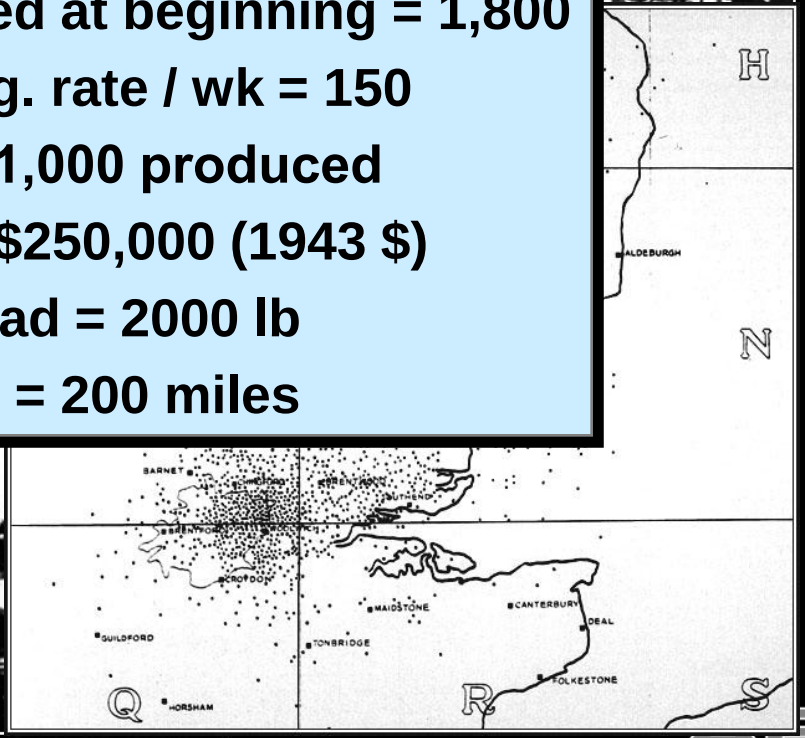
Launch avg. rate / wk = 150

Oct '44 = 1,000 produced

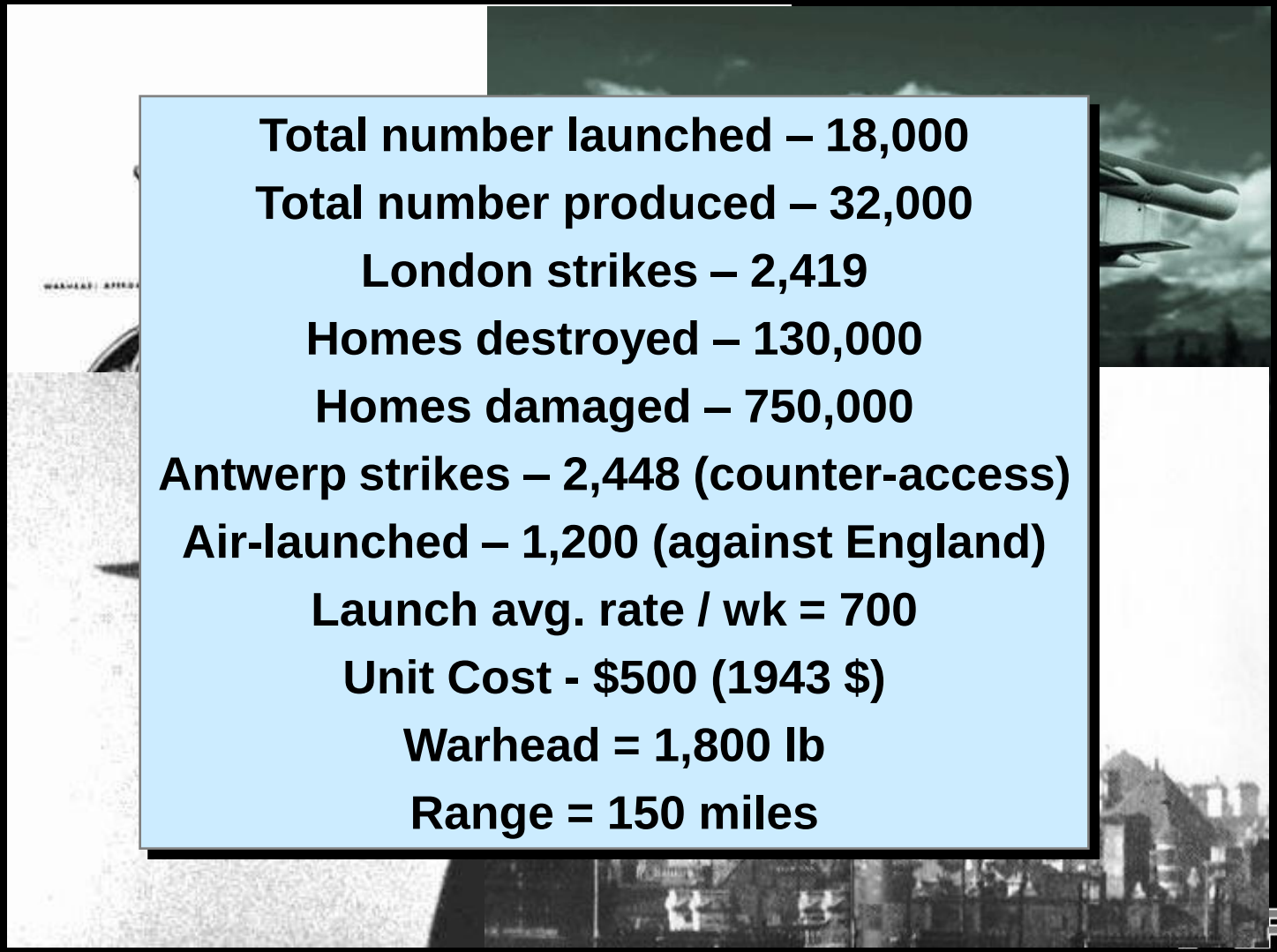
Unit Cost - $250,000 (1943 $)

Warhead = 2000 lb

Range = 200 miles



V-1's also provide historical guidance on the potential threat



Total number launched – 18,000

Total number produced – 32,000

London strikes – 2,419

Homes destroyed – 130,000

Homes damaged – 750,000

Antwerp strikes – 2,448 (counter-access)

Air-launched – 1,200 (against England)

Launch avg. rate / wk = 700

Unit Cost - $500 (1943 $)

Warhead = 1,800 lb

Range = 150 miles

U.S. forces must be able to

- Globally project persistent air power within hours and maintain for days
- Deploy initial rapid response ground and theater air forces within days
- Sustain deployed forces

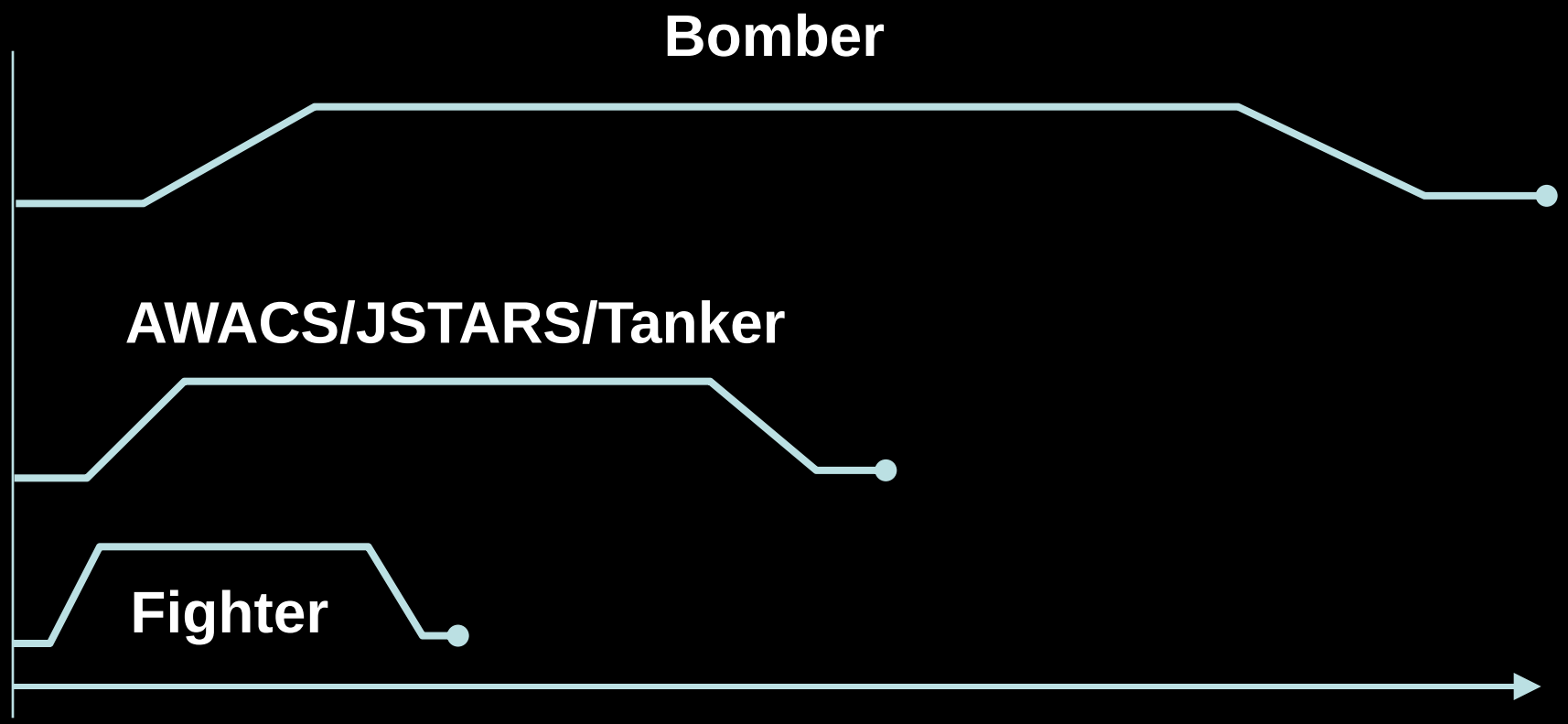
How can we exploit improved air mobility S&T to:

- Reduce vulnerabilities?
- Increase global coverage from fewer bases?
- Increase deterrence?
- Enable a rapid and persistent response to aggression?
- Enhance forward-based land and air forces?

Enhanced air mobility is a potent counter to these challenges

- Air power still has the ability to operate effectively outside the range of threats
  - Advantage of altitude, speed, range, and visibility
- Air power forces can patrol “at risk” areas to deter aggression and provide very rapid initial response
  - Air mobility can provide “persistent air bases” from which to operate
- New air mobility systems can do a better job at deploying, sustaining, protecting, and supporting forward-based air and land forces

Why are air power mission durations still thought of in terms of hours?



We designed military aircraft for a different technology / operational environment

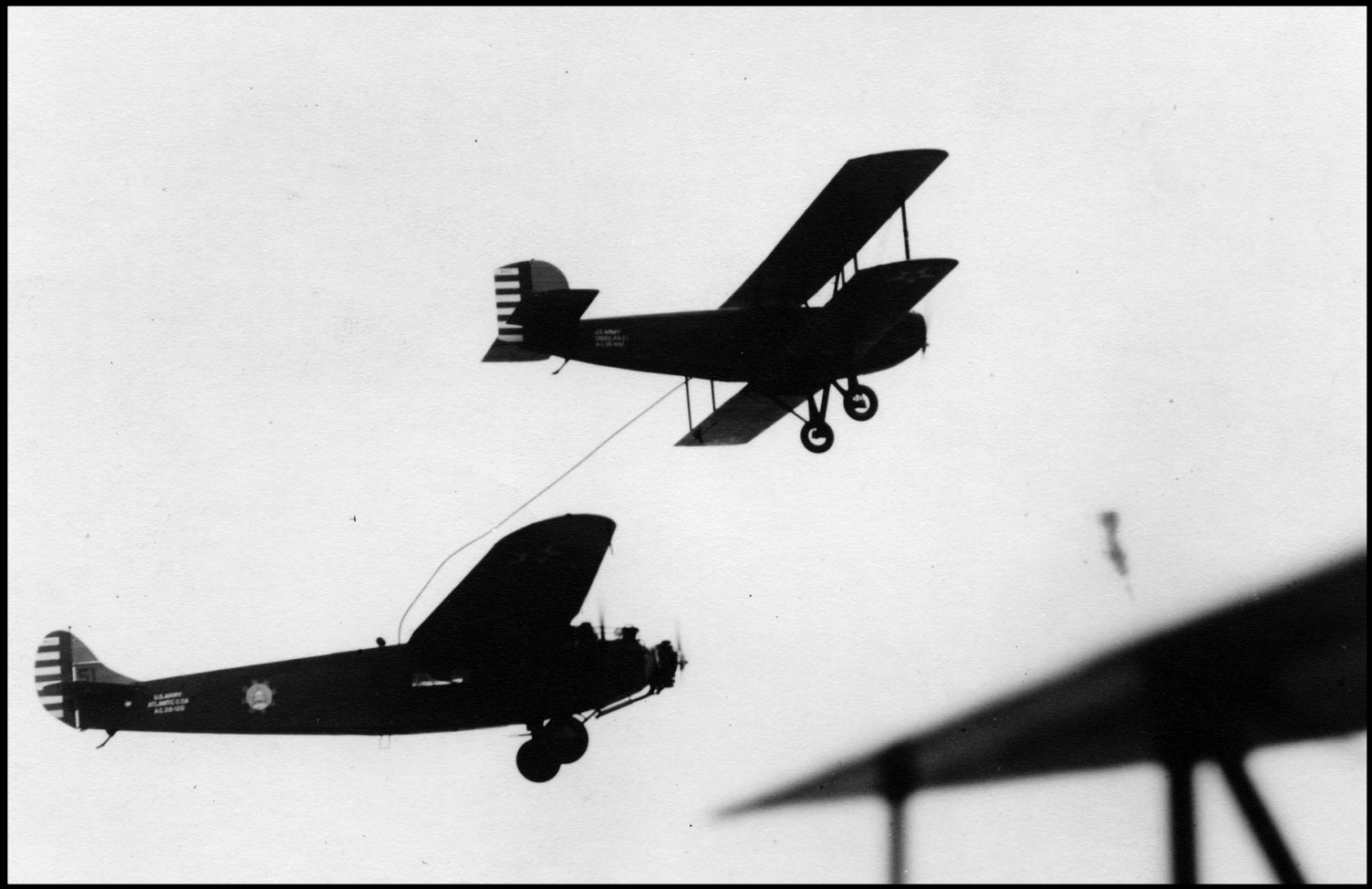
- Maneuverability used to be important
  - Needed fighters, but they had limited fuel
- Wasn't any reason to loiter
  - Bomb accuracy used to be poor
  - Drop all at one time or in short time, then go home
- Cockpit environment could be tough on pilots because missions were not long
- Aircraft needed frequent maintenance

We need to better exploit today's aircraft technology capabilities

- Reduce vulnerability /enhance survivability
  - Use active/passive defenses
- Precision weapons make bomb load last longer
- Improve cokpit environment
- Exploit increased MTBF

1923 – 4 days aloft

1929 – 6 days aloft



Further Endurance Records

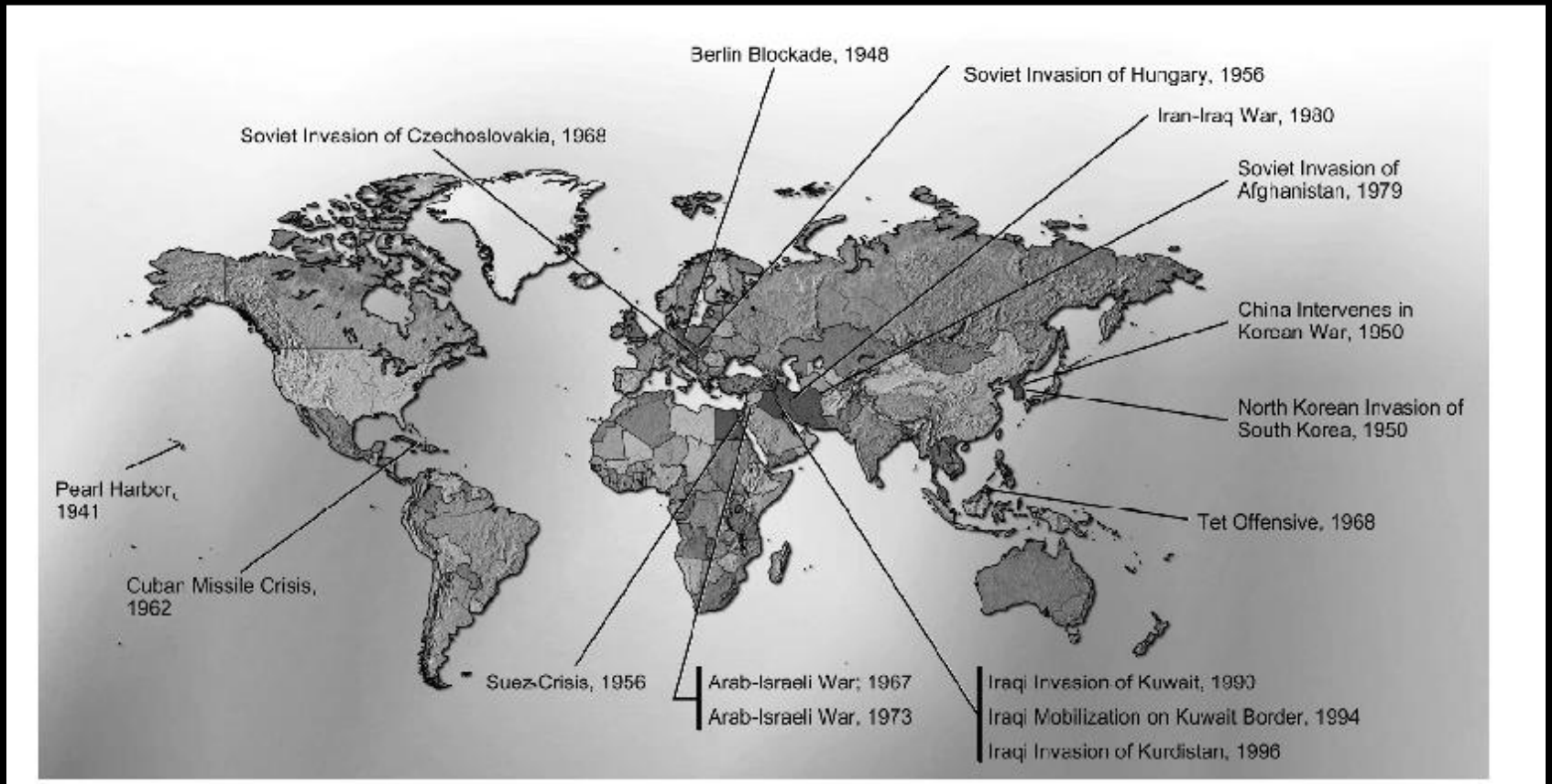
- 1929 – 7 days
- 1929 – 10 days (single engine)
- 1929 – 18 days (single engine)
- 1935 – 27 days (single engine)

At 500 mph, a jet aircraft covers 12,000 miles every 24 hours

Pulling the Pieces Together

Module-carrying tankers provide a new means of early, persistent air power projection and rapid deployment of expeditionary forces

Actionable warning time may be short or not occur

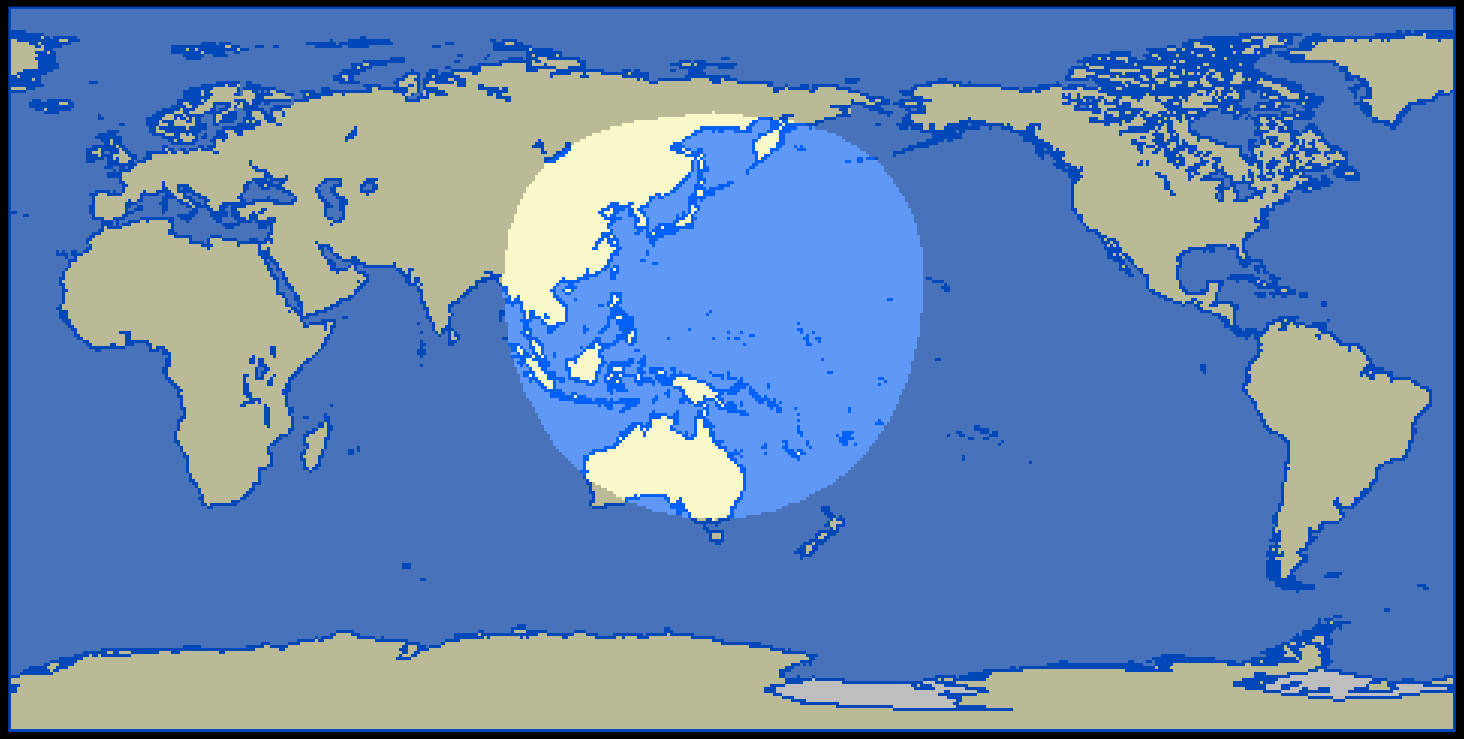


[4] Ochmanek, David, and Zalmay Khalilzad, "Rethinking U.S. Defense Planning", *Survival*, vol. 39, no. 1, Spring 1997, p. 43.

Design CAT tankers for extended duration missions of 3-5 days

Use groups of CAT tankers with air power modules for form “air battle groups” operating from key worldwide bases

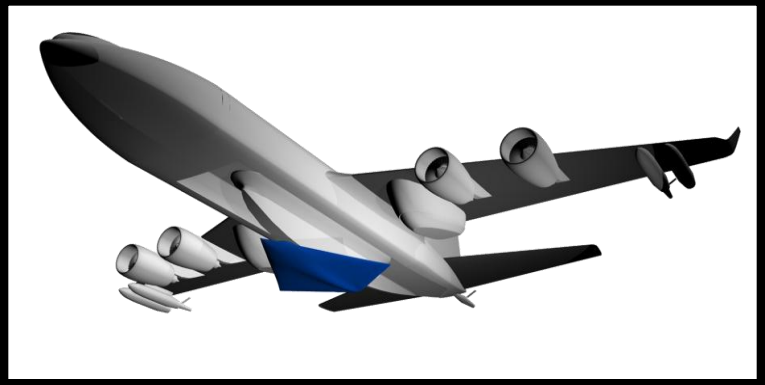
3,000 nm radius from Guam



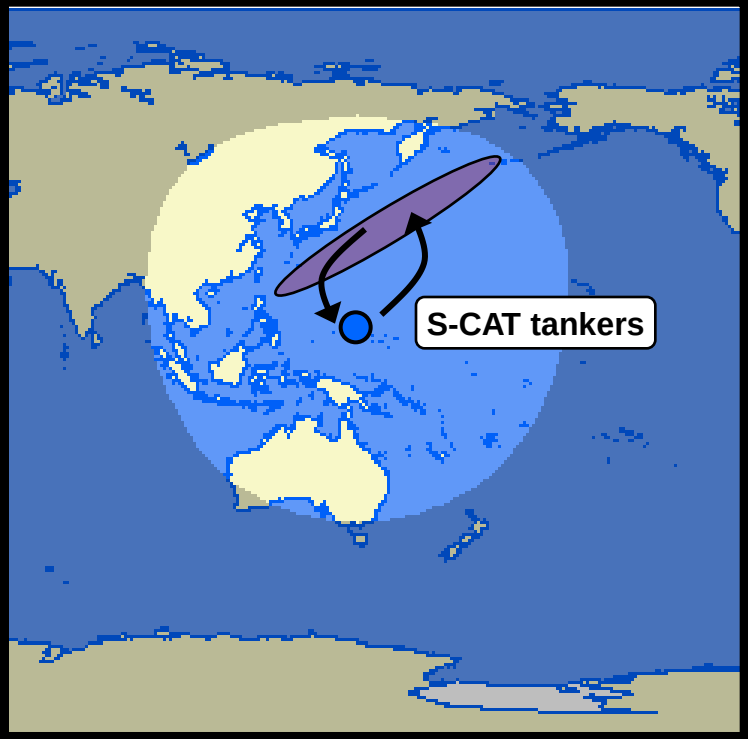
Example patrol area for a CAT air battle group operating from Guam

Notional Air Battle Group

- 8 T-CATs with these modules
  - 2 UCAV tenders for penetrating surveillance / rapid strike
  - 2 airborne lasers for missile/self defense
  - 2 AWACS/JSTARS
  - 2 EW platforms
- 2 S-CATs for fighter escort tankers
- 2 S-CATs with bomber/ ECM modules
  - 18 cruise missiles
  - 24 JDAMs
- F/A-22s for CAP/attack



Mission Objectives

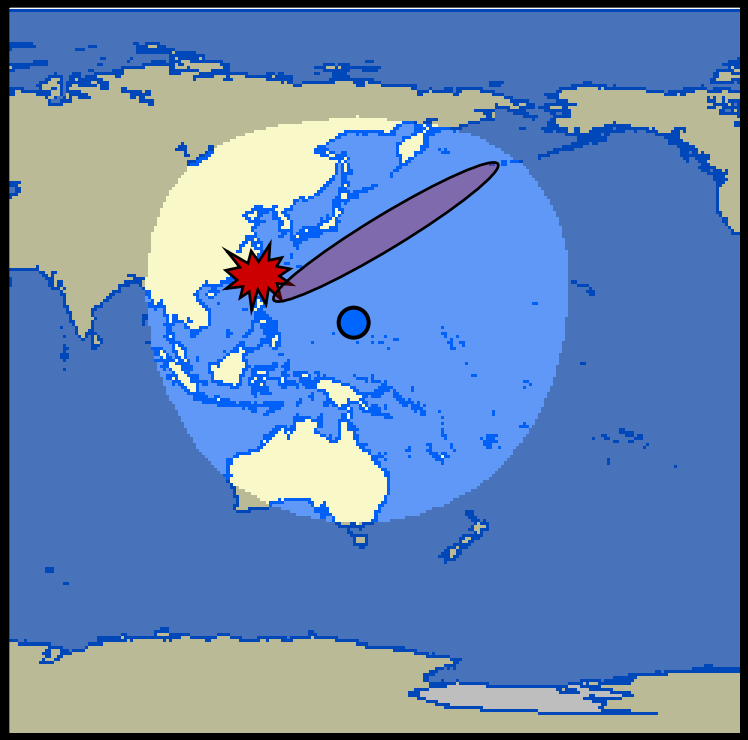


Air Battle Group patrol zone

Notional

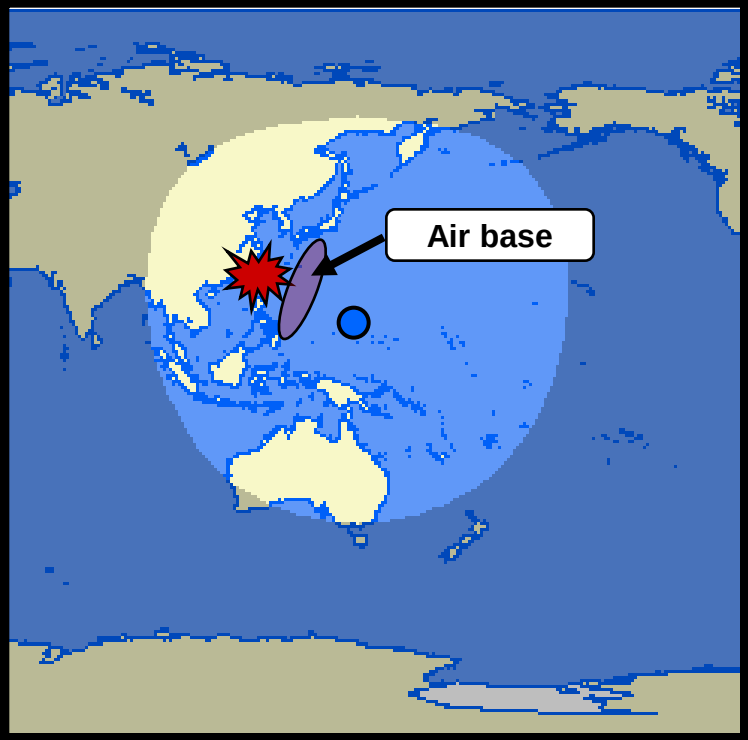
- Provide airborne protection against surprise attack
- Patrol designated area for 3-4 days using air refueling
- Use covertness of airborne movement to deny targeting
- Engage hostile forces within hours

Trouble in the Pacific



- Hostilities breakout without clear I&W
- U.S. national interests judged to be at risk
- CAT battle group directed to reposition to protect U.S. national interests

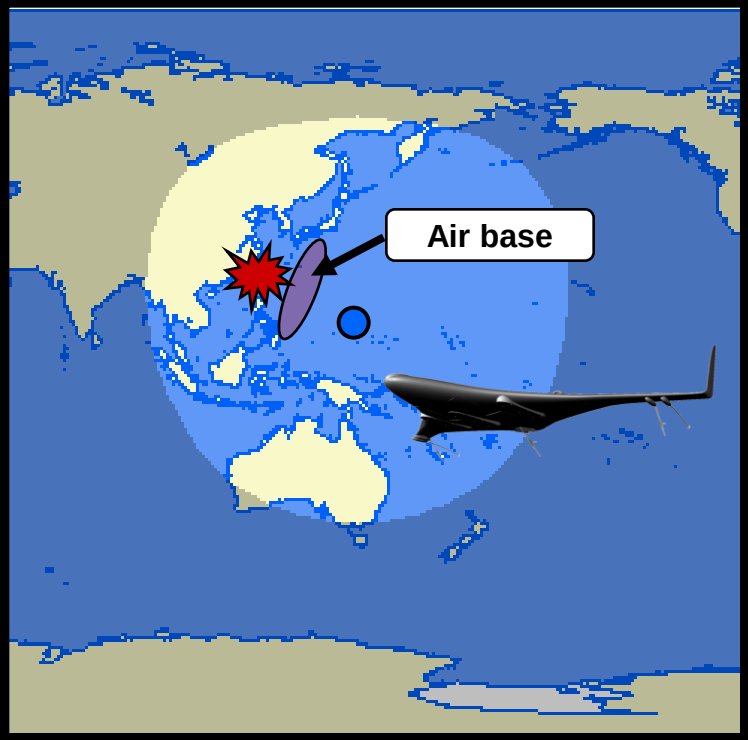
Within hours, “air base” established



Air Battle Group
establishes “air base”

- CAT Air Battle Group quickly repositions patrol zone
- CAT IW and UAVs deployed to augment surveillance
- CAT ABL located to provide BMD
- At-sea Navy forces directed to reposition

“On alert” air refueling activated



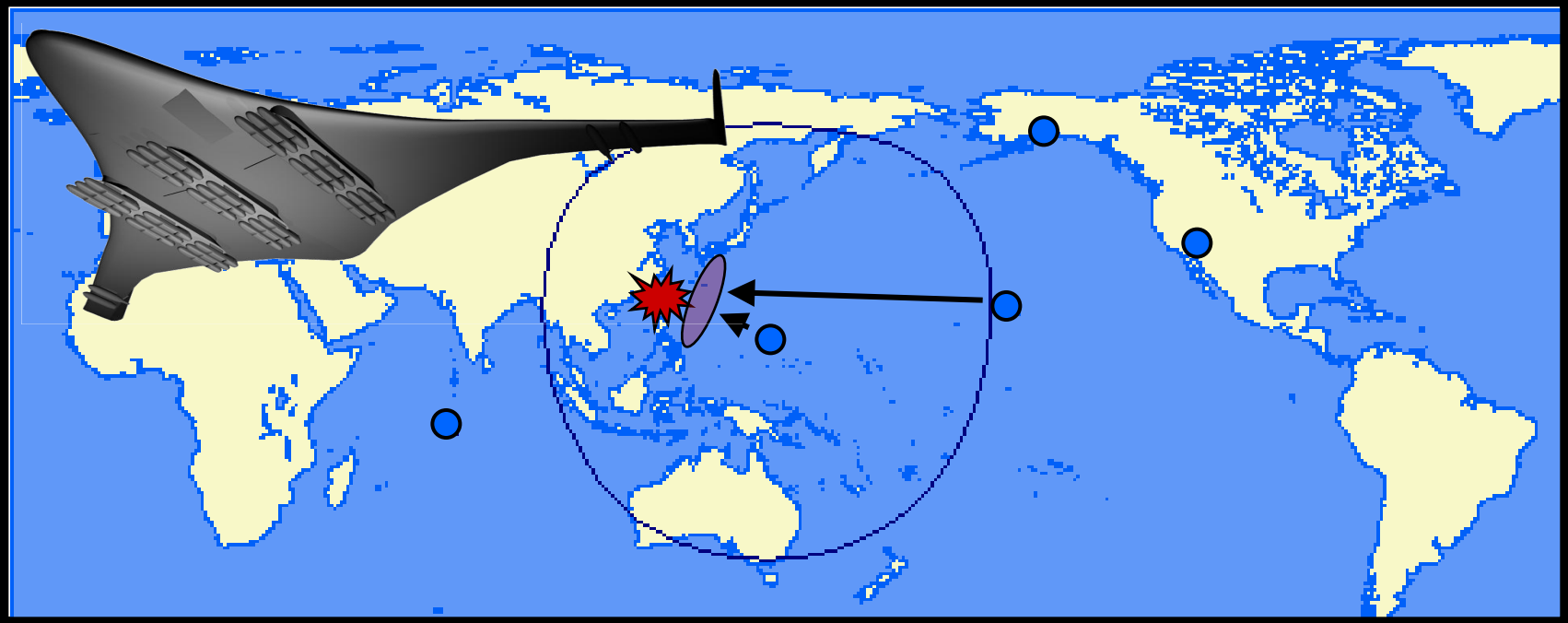
Air Battle Group establishes “air base”

- S-CATs, T-CATs and KC-10s on alert at Guam and Hawaii launched to provide increased air refueling support to CAT Air Battle Group
- F-22s at Guam launched to augment Air Battle Group defense
  - Use super-cruise and tanker bridge to quickly join up

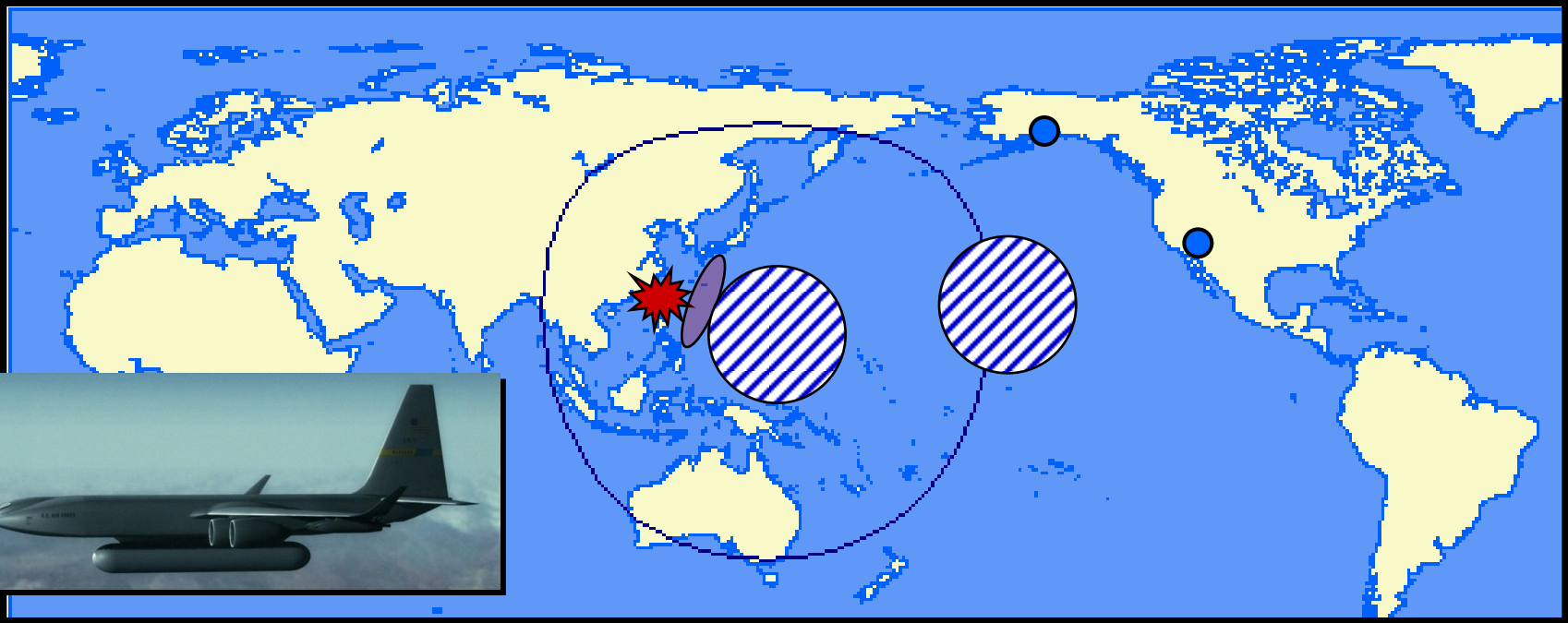
CATs are redirected to Pacific Theater and Western CONUS

Ten percent of the CAT fleet – 50 aircraft - could be relocated to Guam, Hawaii, Diego Garcia, Alaska, and western CONUS within 24 hours

S-CATs arriving at Guam and Hawaii quickly arm for combat using pre-loaded modules weapon modules

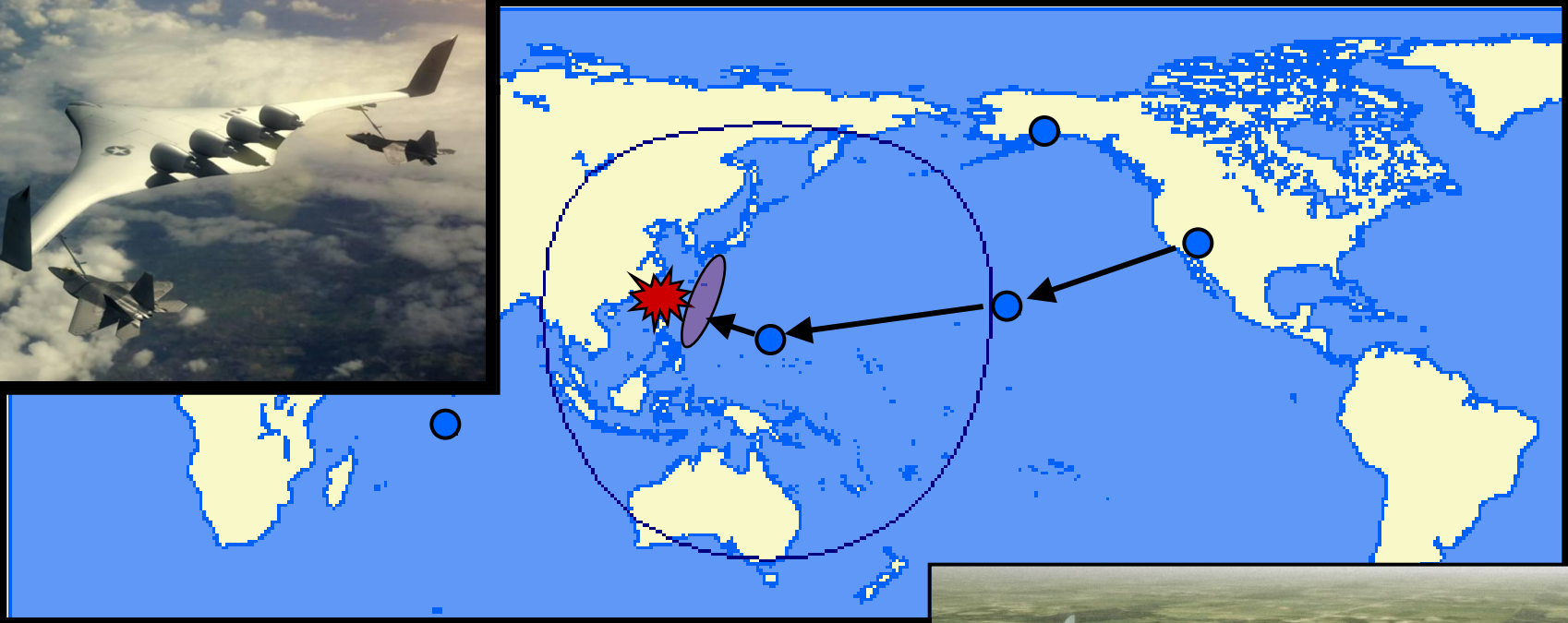


T-CATs provide airborne surveillance and protection of Guam and Hawaii



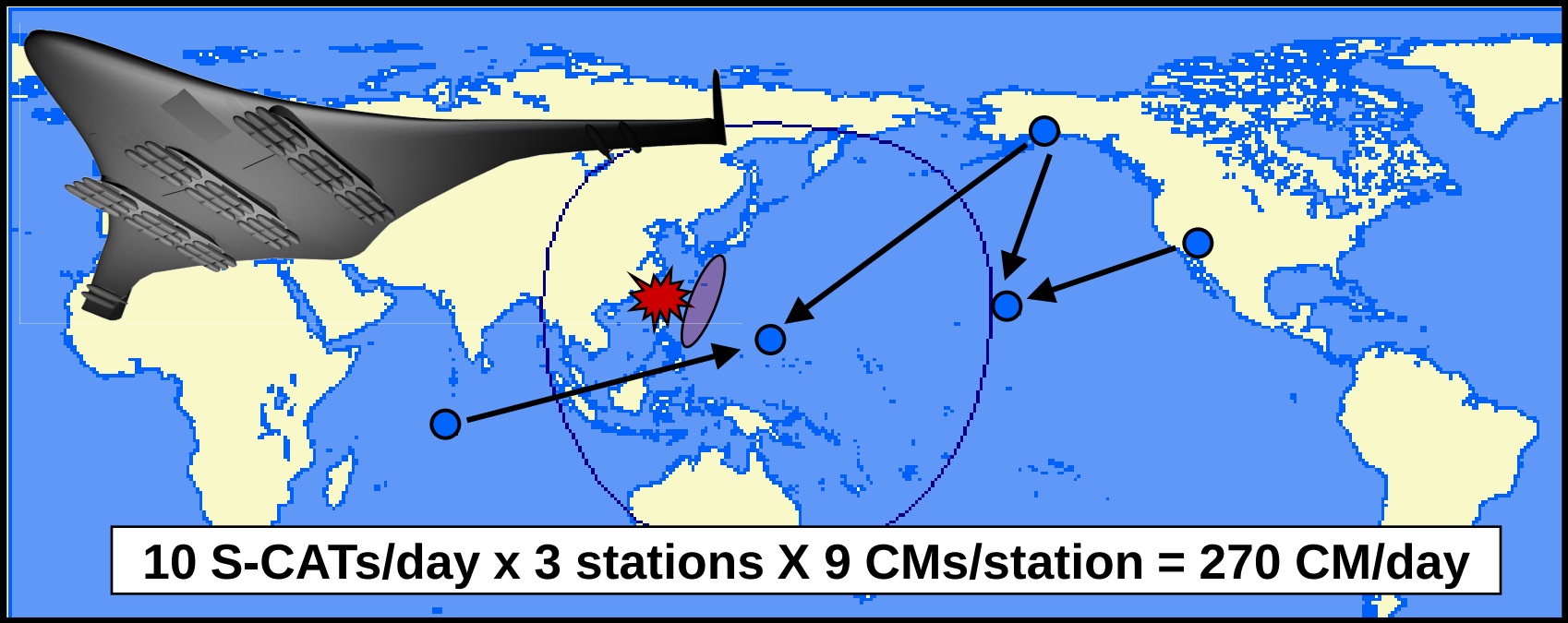
Prepositioned surveillance and ABL modules are used for self-protection

S-CATs escort F/A-22s from Hawaii and CONUS



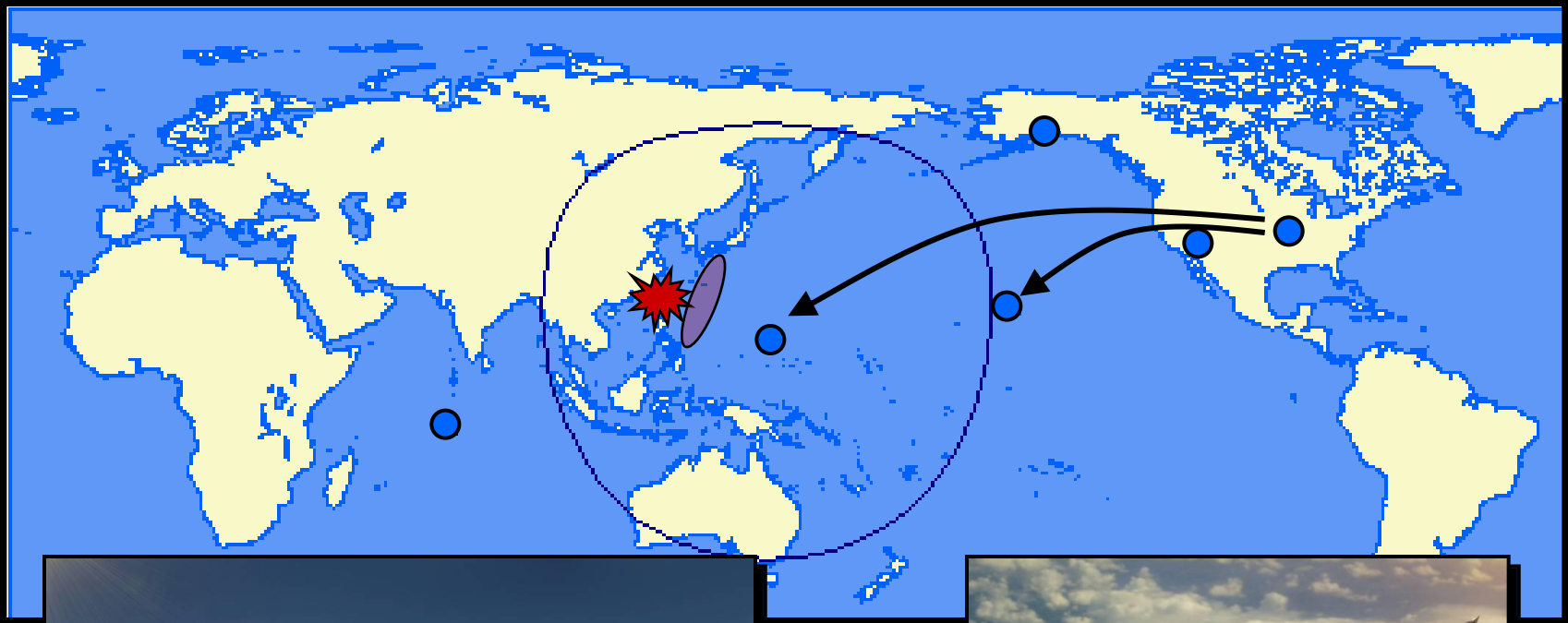
S-CATs transfer AEF support modules for aircraft maintenance, housing, and spares to support relocating F/A-22s and personnel

Airbridge of S-CATs transport air power modules to Guam and Hawaii

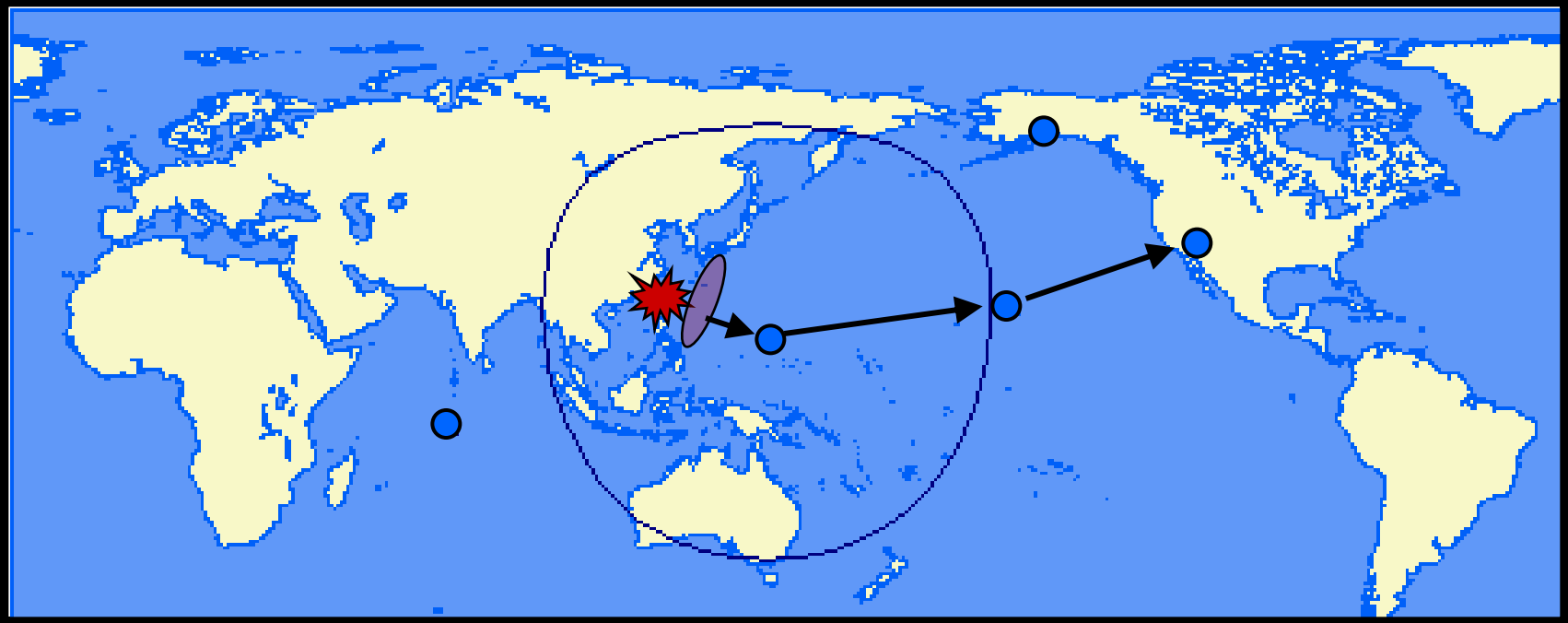


S-CATs tankers relocating to Guam and Hickam pickup air power modules en route

S-CATs air refuel B-2s and F-35s deploying to Guam and Hawaii

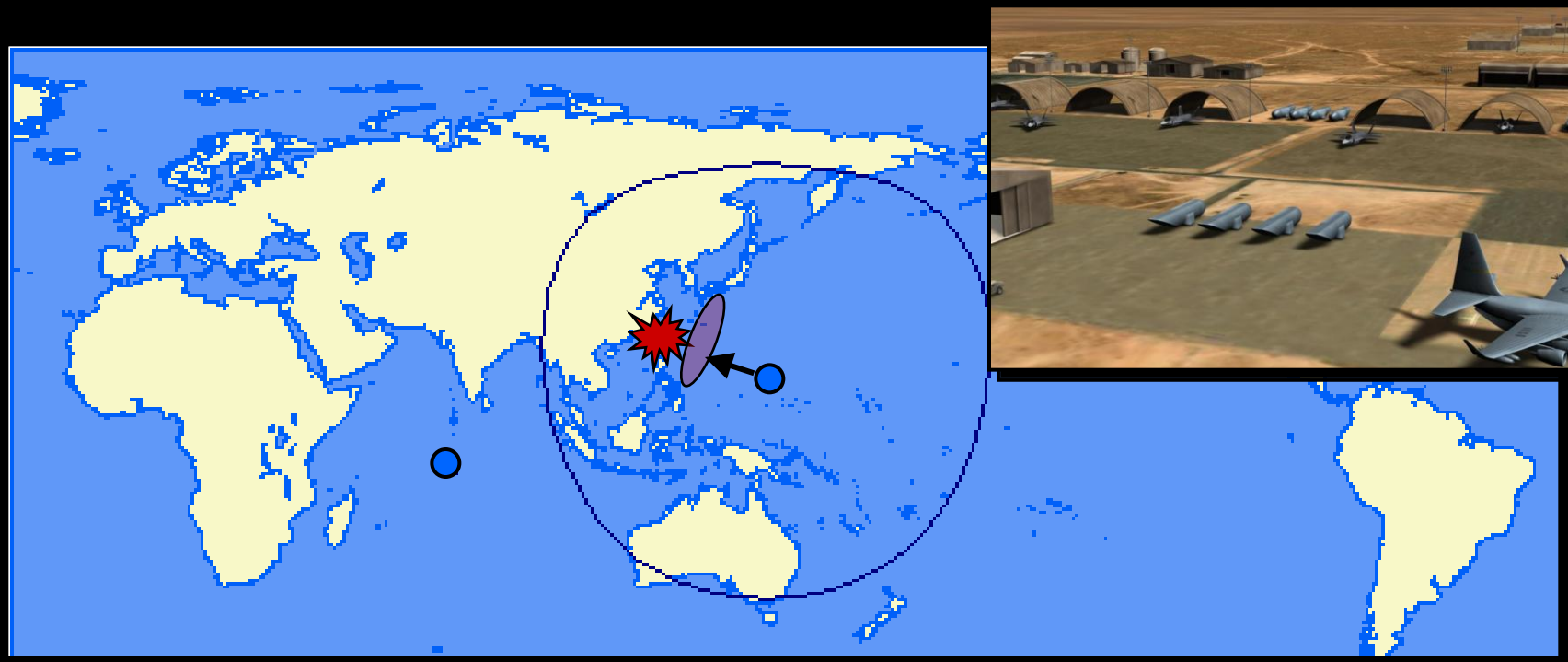


S-CATs escorting fighters and bombers return empty weapons modules



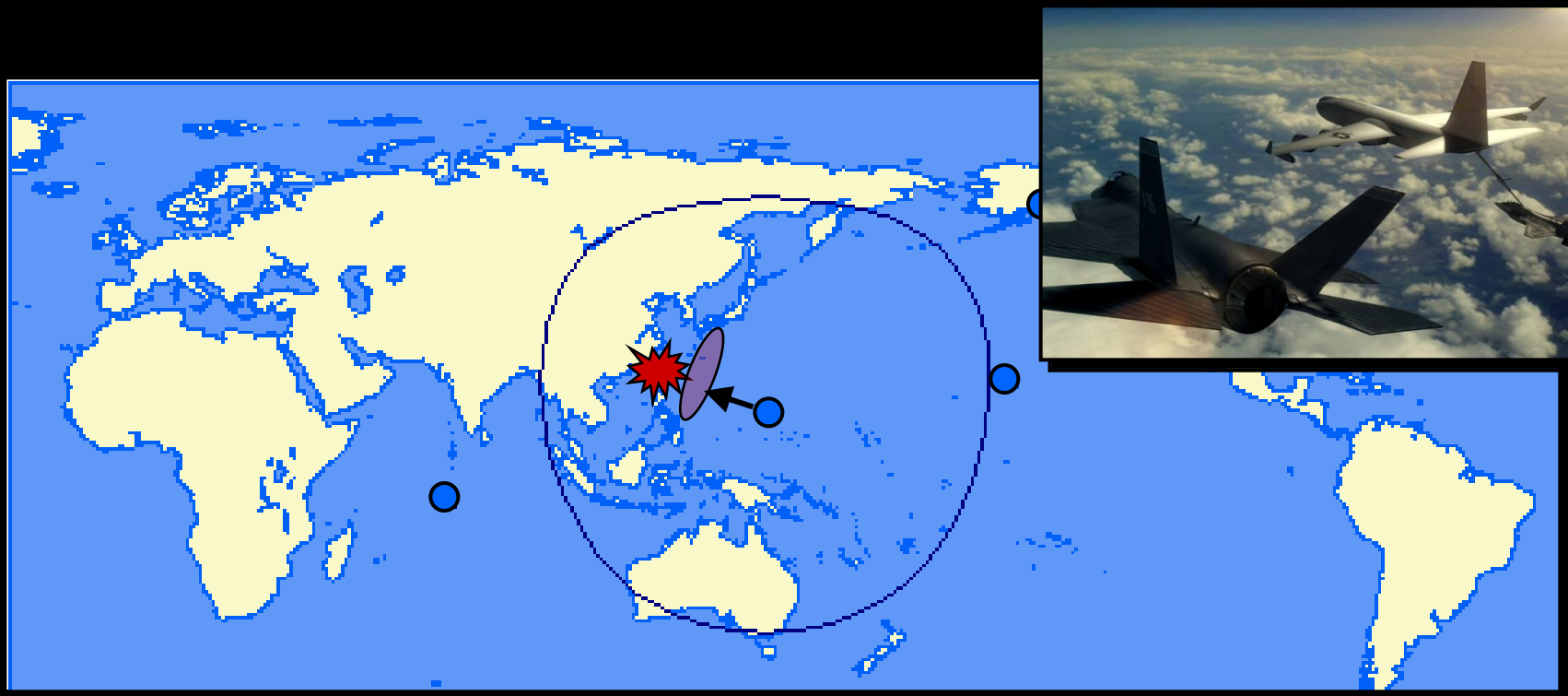
Reloaded weapons modules will reenter westward flow of airpower and resupply modules

T-CATs move AEF BEAR base modules forward to support F-35s



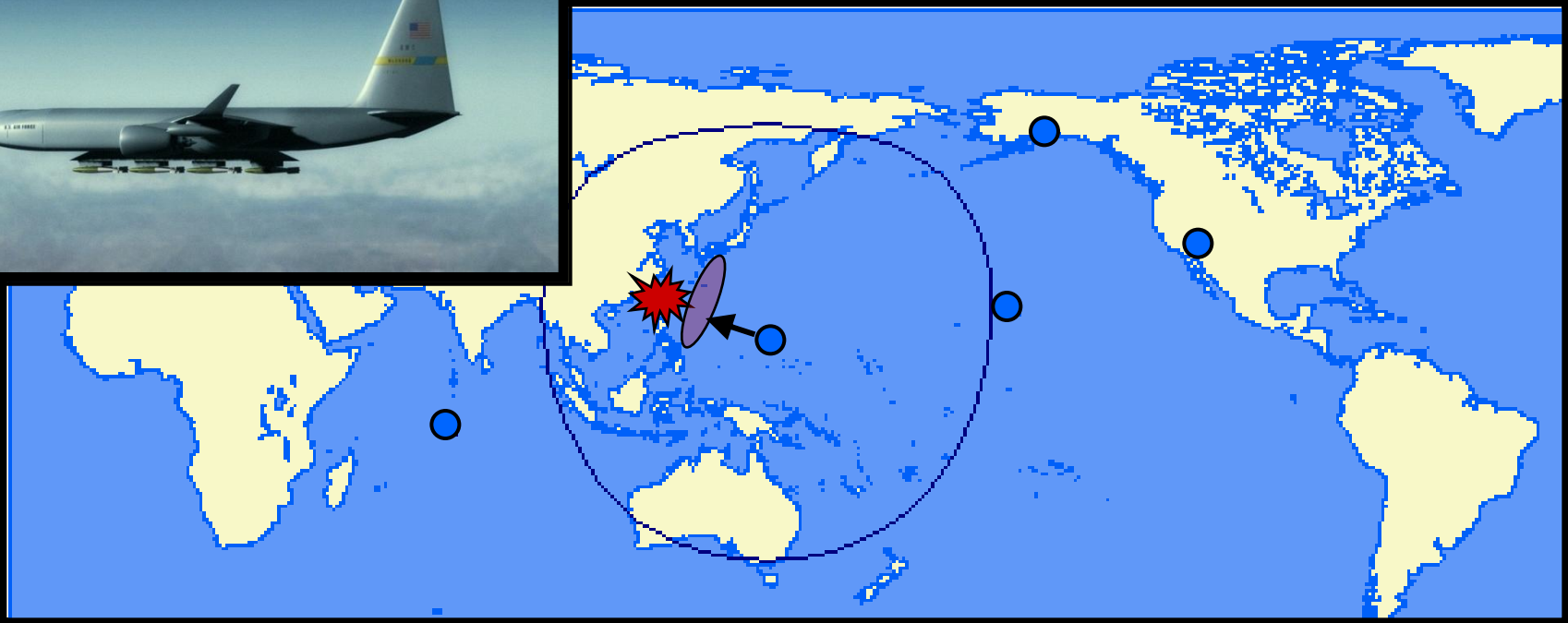
BEAR base modules include housing, flight ops, maintenance, spares, munitions, fuel, water, security, etc.

T-CATs escort F-35s to AEF bases



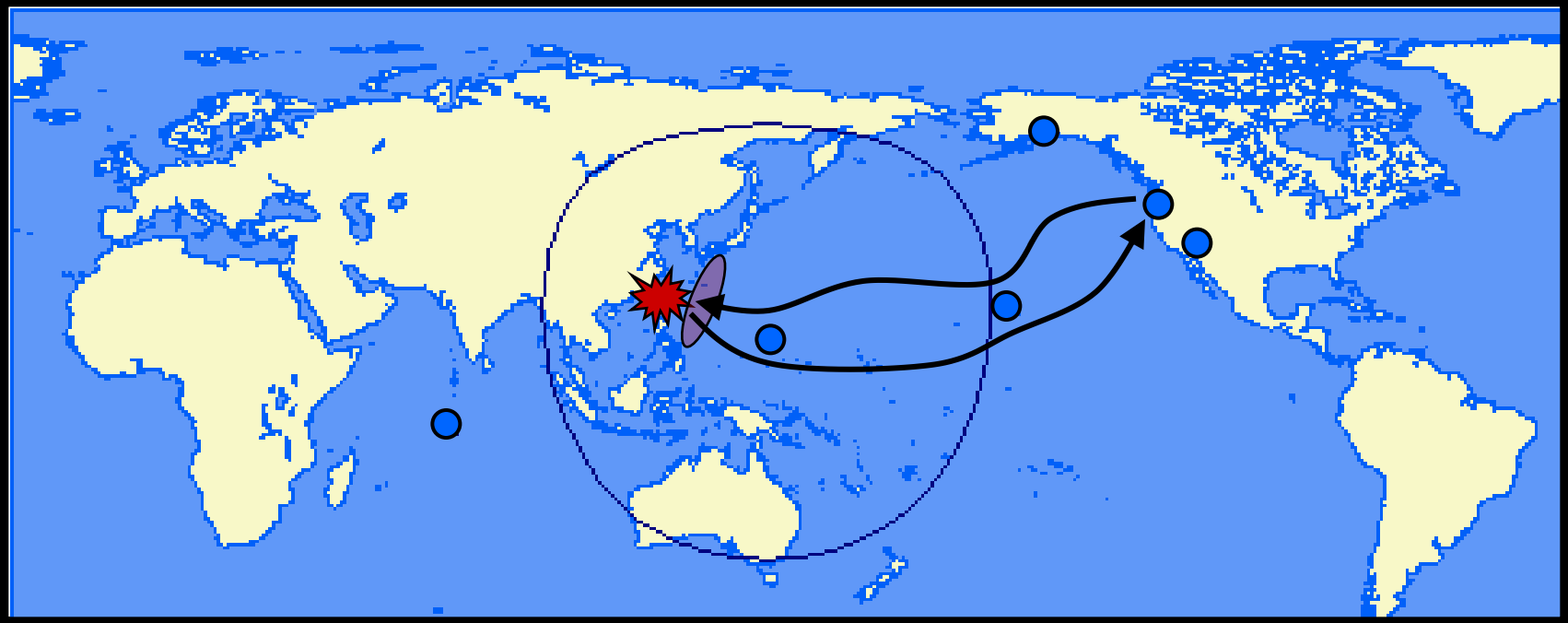
Depending on the range, T-CATs can both transport modules and refuel F-35s

T-CATs relocate to AEF bases to provide dedicated multi-mission support



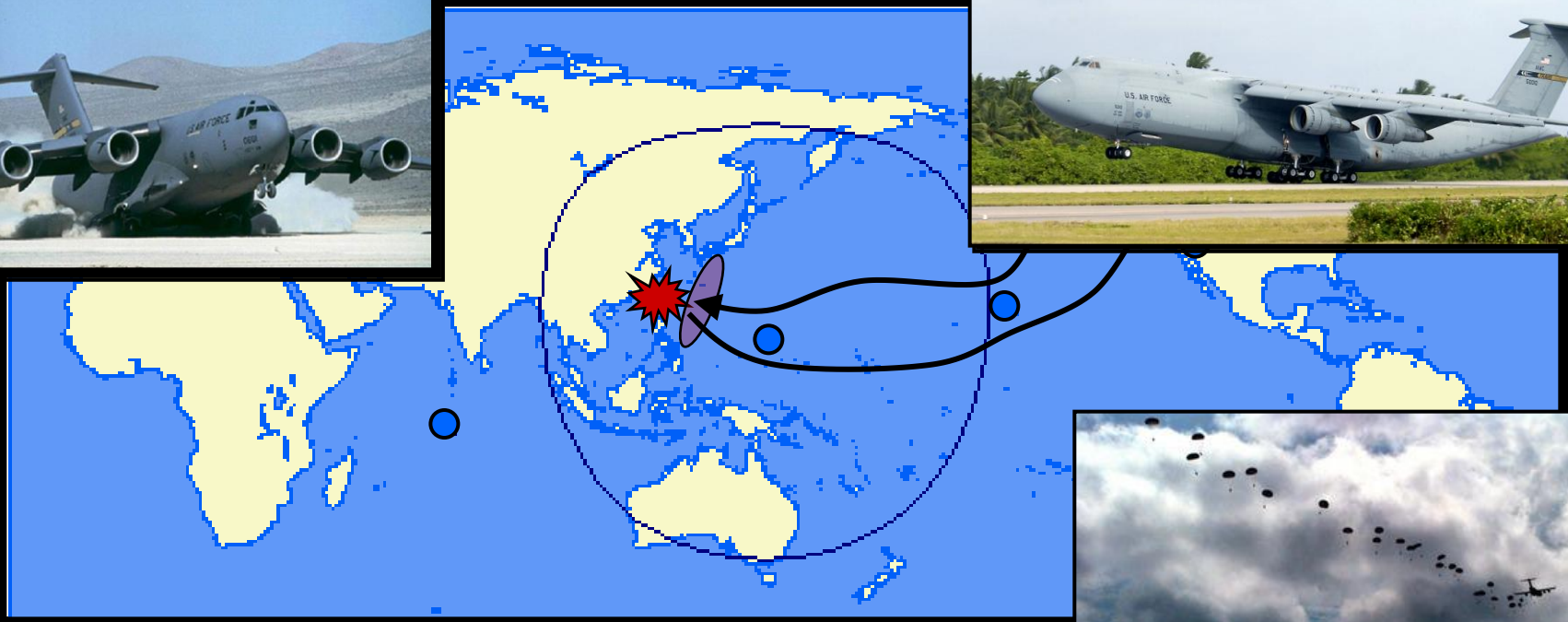
T-CATs can provide the persistent loiter needed to provide prompt tactical response to support U.S./allied ground forces

On-alert Army Air Mobile Brigade is air deployed forward to reinforce allied ground forces



200 S-CATs tasked to air bridge 18,000 tons of materiel and 3,000 personnel forward within 4 days

C-5s and C-17s augment air bridge with heavy materiel movement



C-17s assigned to theater commander to provide tactical airlift of Army forces on the battlefield

Enhanced air mobility would enable “Trouble in the Pacific” to be responded to rapidly

- Initial significant, persistent air power response with hours
- Reinforced air power within 6-12 hours
- Initial AEF deployed within 24-48 hours
- Initial ground forces within 4-6 days

Enhanced air mobility changes the OODA loop for warfare

- Respond with air power
  - Quicker
  - More fully
  - Safer
- Reduce reliance upon allies during initial phase of operations
- Engage with both air and land expeditionary military power days to weeks faster
- Avoid
  - Many threats, especially non-standard warfare (IED)
  - Mitigate anti-access
- Improve safety of in-theater forces
- Have virtually world-wide applicability

In summary, module-carrying tankers can enable a revolution in air mobility

- Provide strategic and tactical air refueling
- Augment C-17 and C-5 with effective cargo carrying capabilities with improved throughput
- Provide an airborne platform for transitioning current and adding new air power missions
- Enhance AEF deployment and sustainment
- Increase the speed of Army air mobile brigade deployment and sustainment
- Improve HUMRO support
- Strengthen the U.S. industrial base with a new generation of air transport technologies

Questions