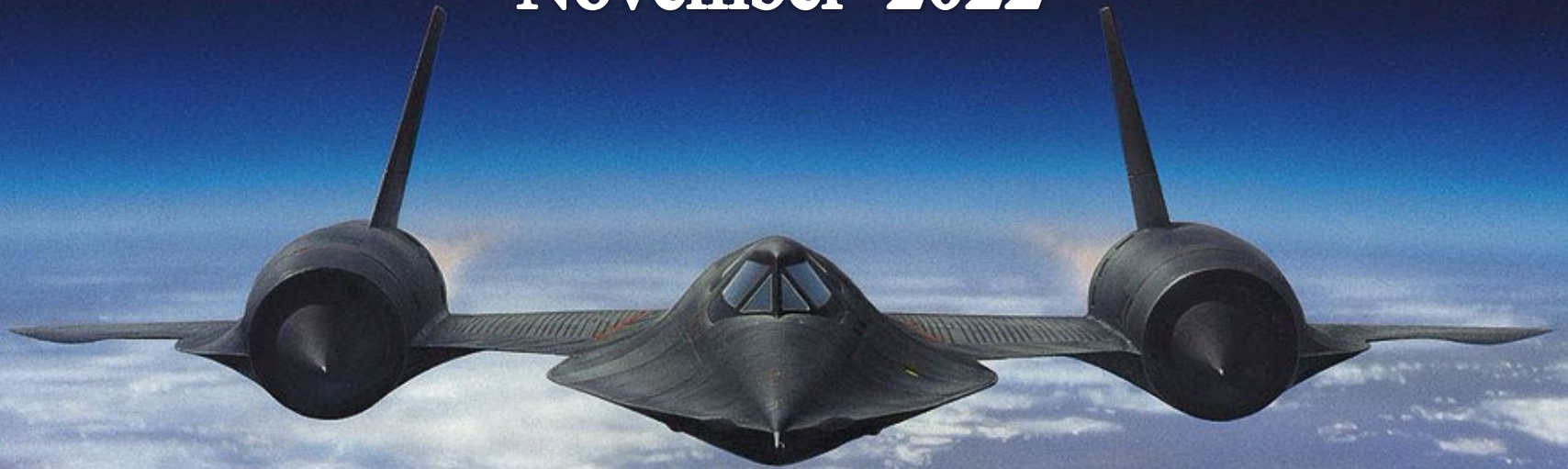


Kelly's Greatest Challenge – The Blackbirds

November 2022



Smithsonian Air & Space UHC

Amazing Achievement – Visionary Tight Leadership

Buz Carpenter
UHC Docent

- Background

- Development

- Operations

- Vignettes

- Questions

Background

DEFINITIONS: Spying & Reconnaissance

HISTORY

- Humint

- Technology

- Hot air Balloons

 - Civil War

- Aircraft

 - WWI - Caudron G4, & Spad XVI

 - WWII – Spitfire, P-38(F-5 recon Variant)

 - High altitude recon challenges – cold & moisture

COLD WAR - Soviet Union – Closed Society

- Modified current aircraft – limited Success – Great losses
- Kelly Johnson – Skunk Works
 - P-38, P-80, F-104, U-2, & finally SR-71
 - U-2 – First a/c designed & built for Reconnaissance
 - Over Flight and Political consequences - Pres Eisenhower
- SURVIVABILITY STUDY 1957 – CIA Led
 - U-2 at Risk – RADAR & SAM DEVELOPMENT
 - SPACE PROGRAMS - yet to deliver Corona Program
 - TO SURVIVE – need Speed, Altitude and Reduced Radar Signature – NEW MANNED AIRCRAFT NEEDED

Kelly Johnson – Master of the Lockheed Skunk Works



Kelly's Management Rules

Be Quick, Be Quiet, And Be On TIME

- Manager has practically complete control
- Strong , Small project offices – Military & Industry
- Keep small number of good people –limit access
- Minimum number of reports –Important work recorded thoroughly
- Monthly cost reviews –what has been spent & projected costs to conclusion of program
- Manager gets responsibility to get good vendors/subs
- Inspect as required –do not duplicate – Subs/vendors important here

Kelly's Management Rules – Part 2

- Specifications agreed to in advance of contracting
- Contractor must have Flight test authority of final product –lays basis for team growth and competency
- Funding must be timely from Government
- Mutual trust must exist between Contractor and Government with very close cooperation & liaison on a day-to-day basis.
- Access by outsiders to the project & personnel must be strictly controlled
- System of rewards must be in place to recognize this exceptional small group.

Aviation Achievements

- 1936 – Redesign Lockheed Electra
- 1937 – XP-38
- 1938 – Hudson Bomber for RAF 200 order –about 3000 built
- 1944 – P-80 First Operational US Jet Fighter – Built 143 days
- 1955 – U-2 built in 9 months under cost and operational in 20 months after contract award
- 1959 – August CIA contract to build A-12
- 1962 – April first A-12 flight in Area 51 – 32 months after contract award
- 1967-1968 – A-12s Operational
- 1968-1989 – SR-71s Operational
- 1939-1961 – 12 Aviation Patents

Kelly's Aviation & Management Awards

- 1937 Lawrence Sperry Award – Institute of Aeronautical Sciences
- 1956 Sylvanus Albert Reed Award – 2nd in 1966
- 1959 Collier Trophy for F-104 & 1964 for YF-12A
- 1963 Theodore Von Karman Award & 1964 for YF-12A
- 1964 Medal of Freedom – President Johnson
- 1966 Thomas D. White National Defense Award @ USAFA
- 1972 1st Clarence L. Johnson Award – Society of Flight Test Engineers
- 1981 Kelly Johnson Blackbird Achievement Award
- 1983 National Security Medal – President Reagan
- 1990 National Air & Space Museum Trophy for life time contributions
- 1991 National Management Association Hall of Fame

Famous Lockheed Skunk Works Logo

- Logo Started in WW II
- Kelly Johnson's development of P-80 Jet Fighter in Top Secrecy – Partition off part of Lockheed plant
- Fighter/aircraft production was 37/day -
- Based on Lil Abner character
- 972 last years was as a test asset at the Skunk Works at Palmdale, Calif



SR-71 –Push Technology

- Goal: Mach 3+, above 80,000ft, & Low RCS
- Achieved 3.3Mach+, 85,000 ft, 2200 mph, 1 Sq Meter Radar Cross Section(RCS) return
- Kelly Johnson considered this his greatest Challenge and Achievement
- A-11 Archangel - Leads to 2 fielded programs
 - A-12 Ox Cart – CIA Led
 - Single seat- primarily Imagery
 - 13 built – 5 lost
 - Was lighter & Flew Higher than SR-71
 - SR-71 Senior Crown - USAF
 - 2 Crew members & Multi-Intelligence
 - 32 built/12 lost
 - Unsurpassed technology
 - National policy – Who will do over flights?

The Family

- The A-12 was the first operational Mach3+ reconnaissance aircraft, operated by the CIA from May 1967-May 1968
- The SR-71, a derivative of the A-12, was a highly successful Mach3+ reconnaissance aircraft operated by the USAF between March 1968 – Jan 1990.
- The YF-12 prototype was a Mach3+ air-air interceptor derivative of the A-12. The program was cancelled due to operational considerations & the lack of a viable supersonic threat.
- The D-21 was a Mach 3+ reconnaissance drone, initially launched by the M-21, a modified A-12. D-21 performed four operational missions launched from a USAF B-52 between Nov 1969- Mar 1971.



SR- 71 Aircraft Characteristics

- Last major U.S. Aircraft designed with Slide rule
- America's first stealthy Aircraft
- Tremendous heat environment drives whole new technologies
 - Titanium 93% of A/C – Russian sponge source
 - Special Fuel –JP-7
 - Fleet of dedicated tankers - KC-135Qs plus on call KC-10s
 - Liquid Nitrogen Dewars for inerting fuel tanks
 - Special Hydraulic fluids – normal system 3200 psi
 - Fuel used as Coolant & Hydraulic for Engine Nozzle control

SR-71 Aircraft Statistics

Dimensions – 107 feet long, 56 feet wide, and 18 feet high

- Aircraft empty weight – 60,000 lbs
- Maximum Fuel load -80,000lbs
- Maximum weight 145,000 lbs
- Maximum takeoff weight - 140,000 lbs
- Normal takeoff weight – 105,000 lbs
- J-58 Engine 20 feet long & 4.5 feet in diameter
- Engine weight – 6,000lbs
- Two person crew – Pilot & Navigator

SR-71 WORLD FLIGHT RECORDS

July 1976 Bicentennial

Absolute Speed record -2193 mph

Absolute Sustained Altitude record – 85,069ft

Absolute 1000 Km Closed coarse record – 2092 mph

UHC SR-71 Blackbird 972 records

New York to London 1 hour & 56 minutes

London to Los Angeles 3 hours & 48 minutes

Los Angeles to Dulles 64 minutes

Coast to Coast 68 minutes

St Louis to Cincinnati 8.5 minutes

Kansas City to Dulles 26 minutes

First Operational Mission in Europe –RAF Mildenhall

SR-71 RECORD SPEED RUNS

NEW YORK - LONDON (SEPT. 1, 1974) _____

LONDON - LOS ANGELES (SEPT. 13, 1974) _____



LONDON TO LOS ANGELES

TIME 3:47:39

DISTANCE 5463 MILES (4745 NM)

AVERAGE SPEED 1438 MPH (1249 KNOTS)



NEW YORK TO LONDON

TIME 1:55:32

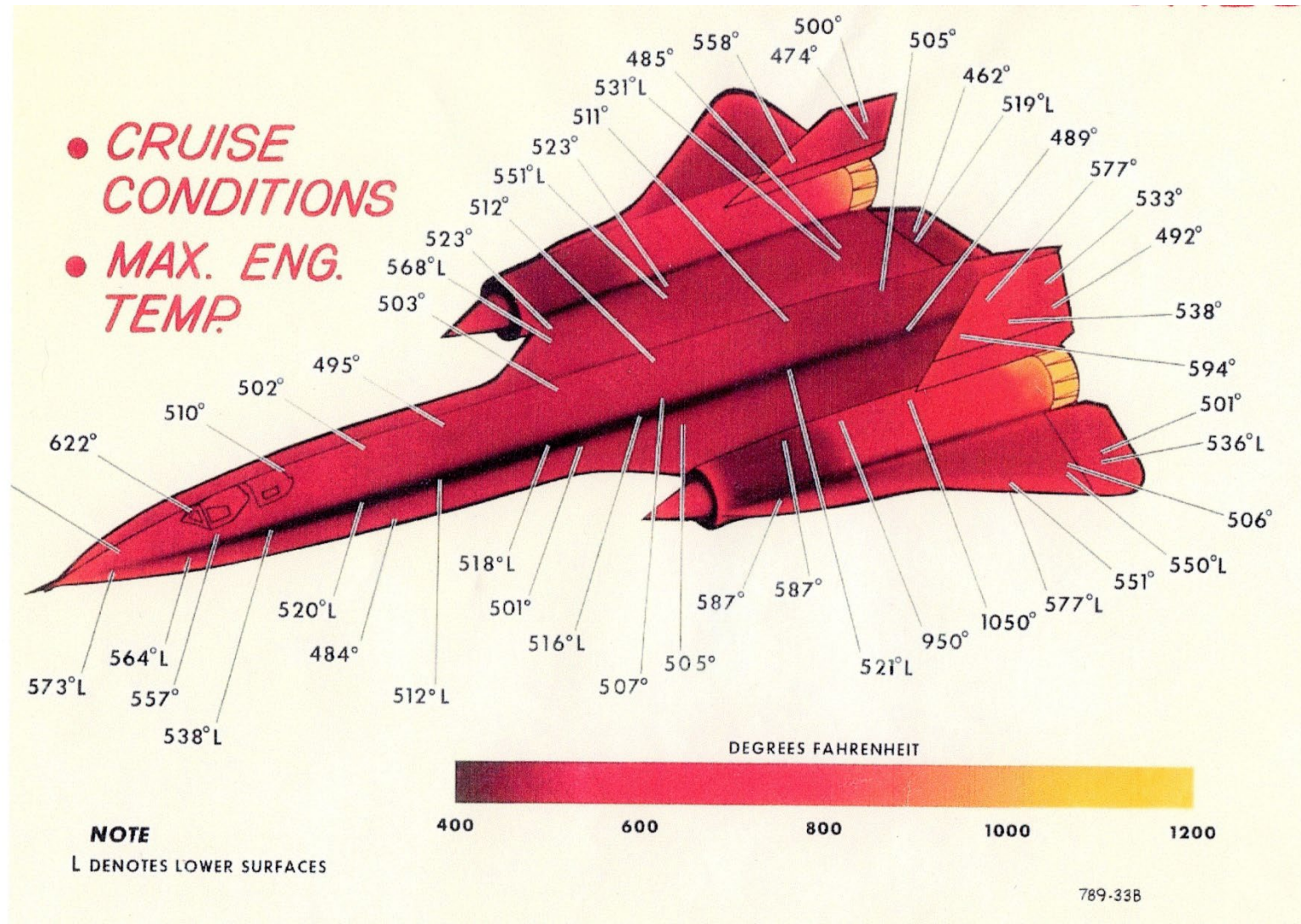
DISTANCE 3470 MILES (3014 NM)

AVERAGE SPEED 1817 MPH (1578 KNOTS)

Copyright Lockheed Martin

SR-71 Surface Temperature Profile

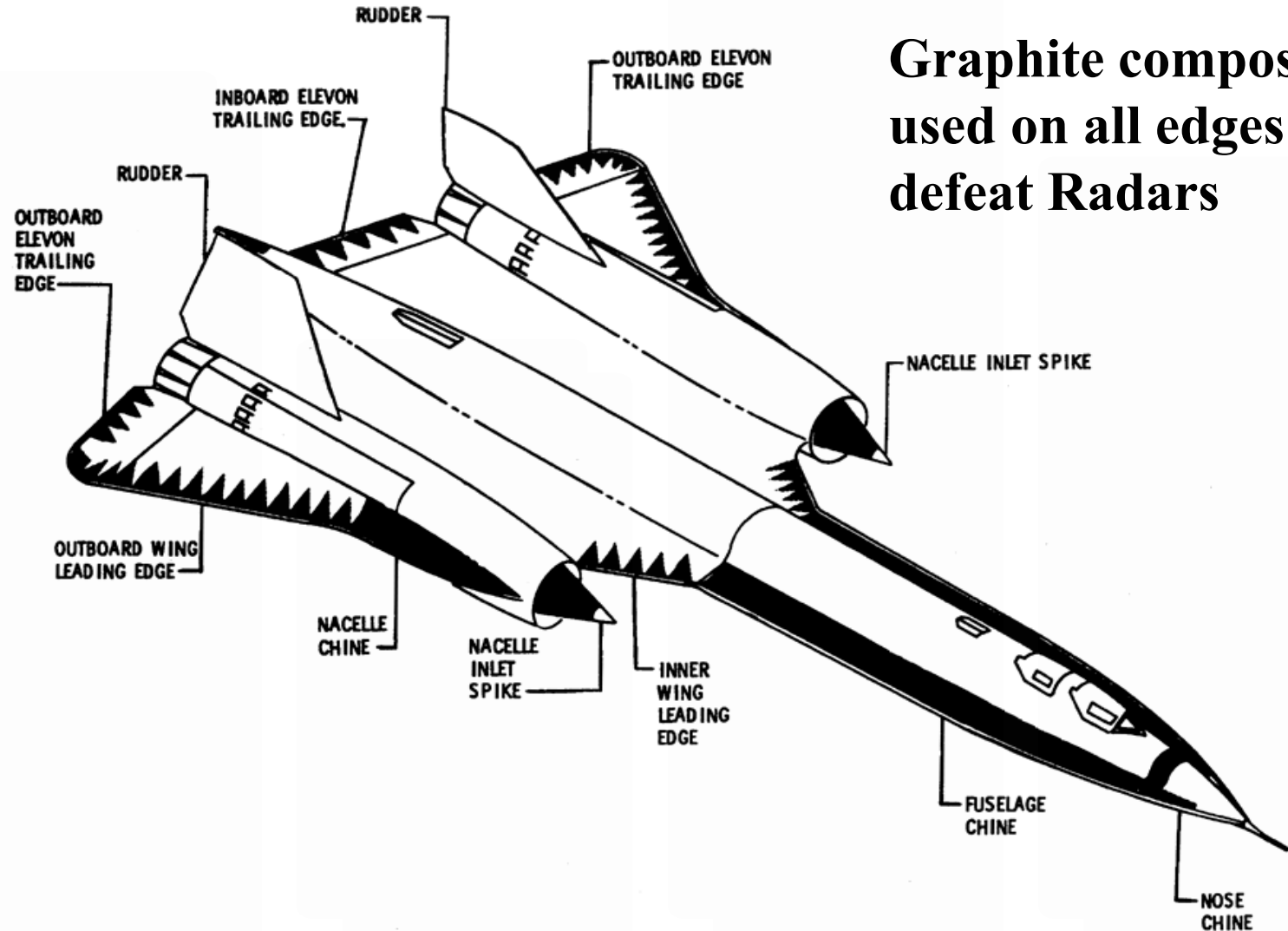
- Ave Temp around 600F
- Surface Temp Range 400-1200F
- Pilot's Pie Windows 620F
- A/C Growth L 3-4 Inches W 1-2 Inches
- J-58 Engine grows 6 inches in length and 2.5 inches in width at cruise



Heat Environment During Cruise

- Blue Black paint – radiate heat away from aircraft surface and reduces surface temperature by up to 50F degrees at 3.2 Mach, Provides some Visual Protection against a black sky, & Minute Ferrite Particles in paint help Defuse Radar Energy
- Glass – Quartz laminated glass 1/2 inch thick
- Oil a solid at 32 degrees – Preheat engines to 70F before start
- Fuel used as Coolant thru Heat Exchangers for aircrew, sensors, oil & hydraulics systems
- Special Electrical wire to withstand the heat

Graphite over Asbestos Airframe Material



**Graphite composite
used on all edges to
defeat Radars**

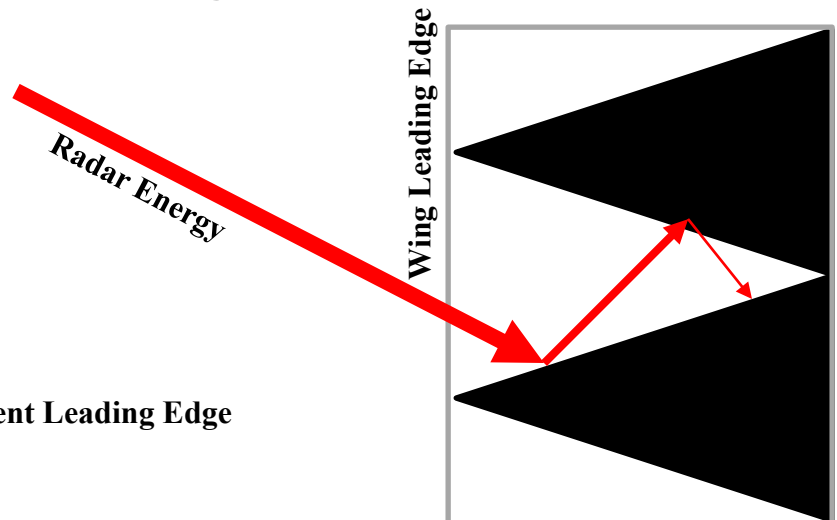
Figure 4-5. Composite-Honeycomb Areas of the SR-71

First Generation Stealth Technology

- Goal was to reduce the Radar Cross Section as low as possible
- Focus on higher radar fire control Surface to Air Missile and Air Intercept frequencies
- Achieved a nose-on RCS of about 1 Square meter
- Shaping, coatings, canted stabilizer, edge design



RF Absorbent Leading Edge



Aerodynamic Characteristics

Double Delta Wing Design

Forward Lifting Body- 35% lift @ 3.2 Mach

Fly higher Altitude and make Steeper turns – 45 deg

Cruise with nose 6 degrees up to create lifting body effect – Engines Level

Sonic Boom - Sound of Freedom

Elevons Mixer Assembly – blend pitch & roll inputs to back surfaces



Dryden Flight Research Center EC97-43933-4 Feb1997



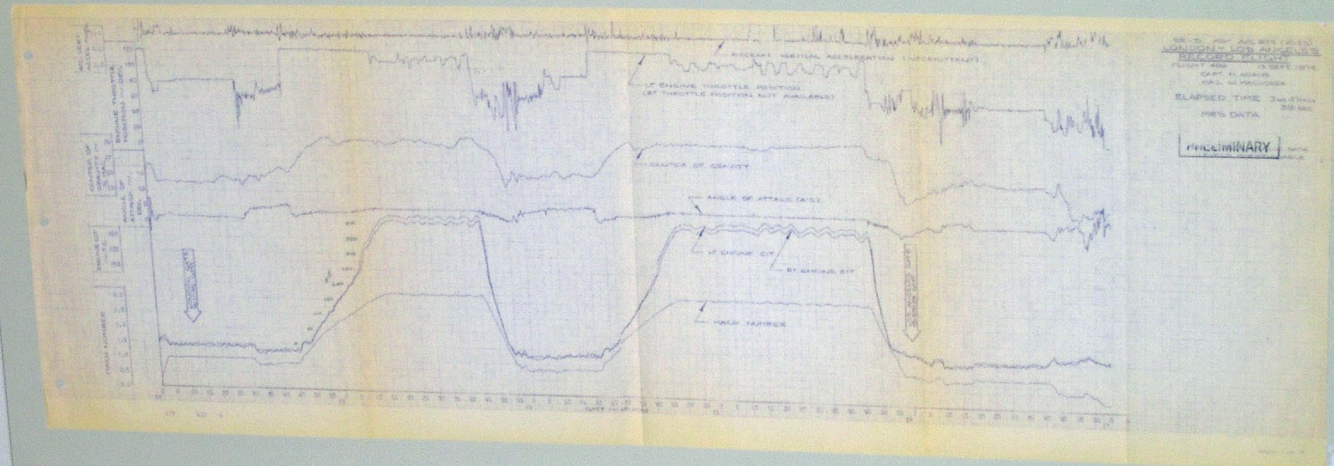
This head-on view is what the aerial tanker boom operator or "boomer" sees as NASA Dryden's SR-71A #844 approaches for refueling. (NASA/Jim Ross)



Analog SR-71 Mission Recorder System Data

- Records over 650+ Specific Flight & Sensor activities
- On when power is on aircraft
- Data points recorded at set intervals depending on system needs
- Voice recording part of system
- Key factor in achieving almost 95% maintenance operational mission success

These flight maps depict the SR-71's route flown from London to Los Angeles. The performance data sheets (below) record the airplane's historic record-setting performance on that flight.



Landing Gear & Tires

- Largest Titanium Forging on aircraft
- Tires BF Goodrich 22 ply
- Aluminum Silver coating to reduce thermal stress
- Pressure 415 PSI filled With N₂
- Good for about 15 landings
- One of the most sensitive operational parts of aircraft
- Three aircraft lost due to tire failures. 1 Max Brake Test – 950 & Max Weight Takeoff - 954 at Edwards AFB & 977 at Beale AFB. A fourth aircraft, 978, was lost on landing at Kadena AB, Japan and tire failure was a large contributor



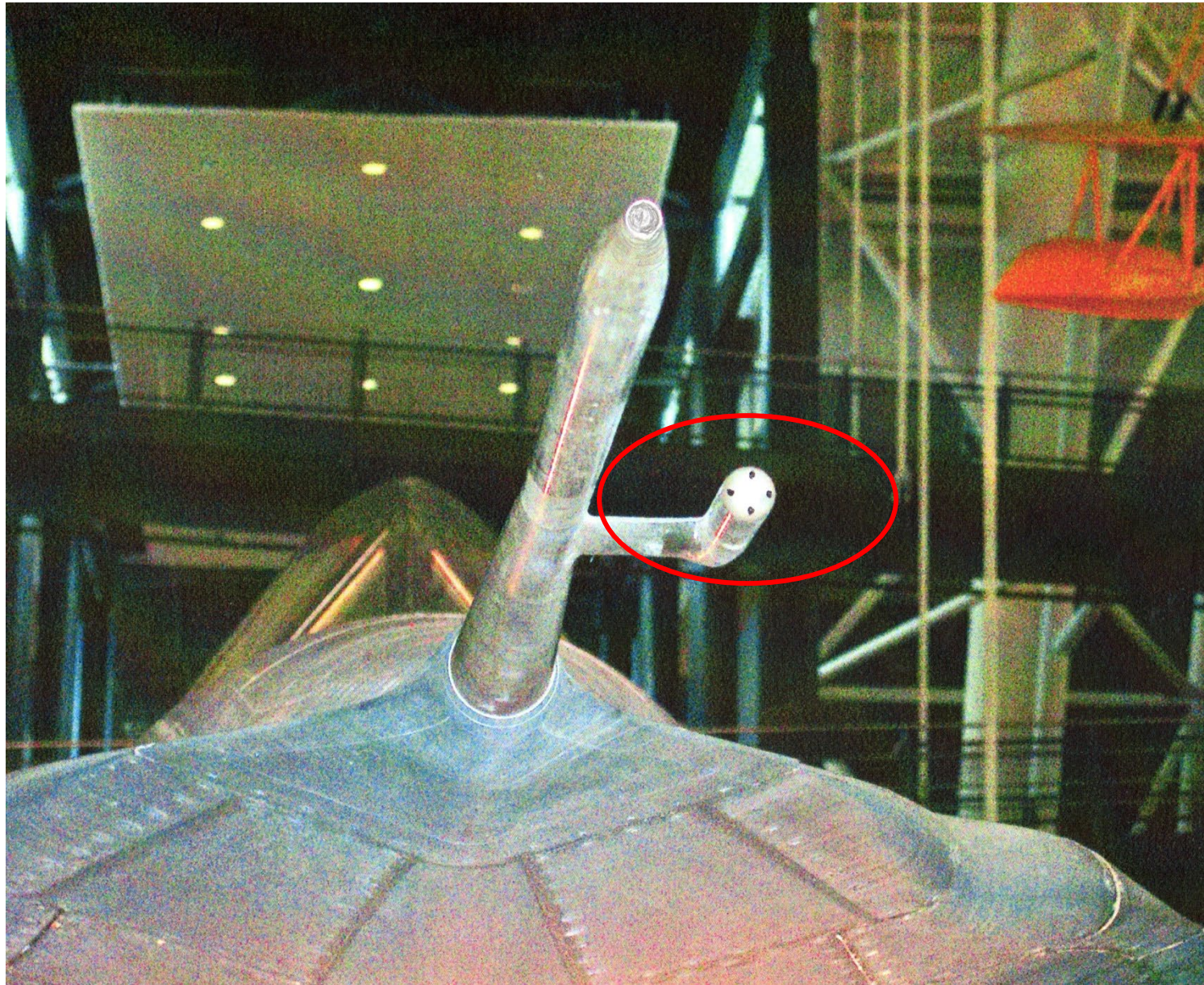
Lockheed Skunk Works SR-71 production line



SR-71 Stability Issues – Pitch & Yaw

**-A/C shows
divergent
stability in
Pitch & Yaw
axis**

**-Pitot Static
Tube Ys to
provide
Airspeed from
center shaft &
Constant Pitch
& Yaw inputs
for Stability
Augmentation
System from
side shaft**

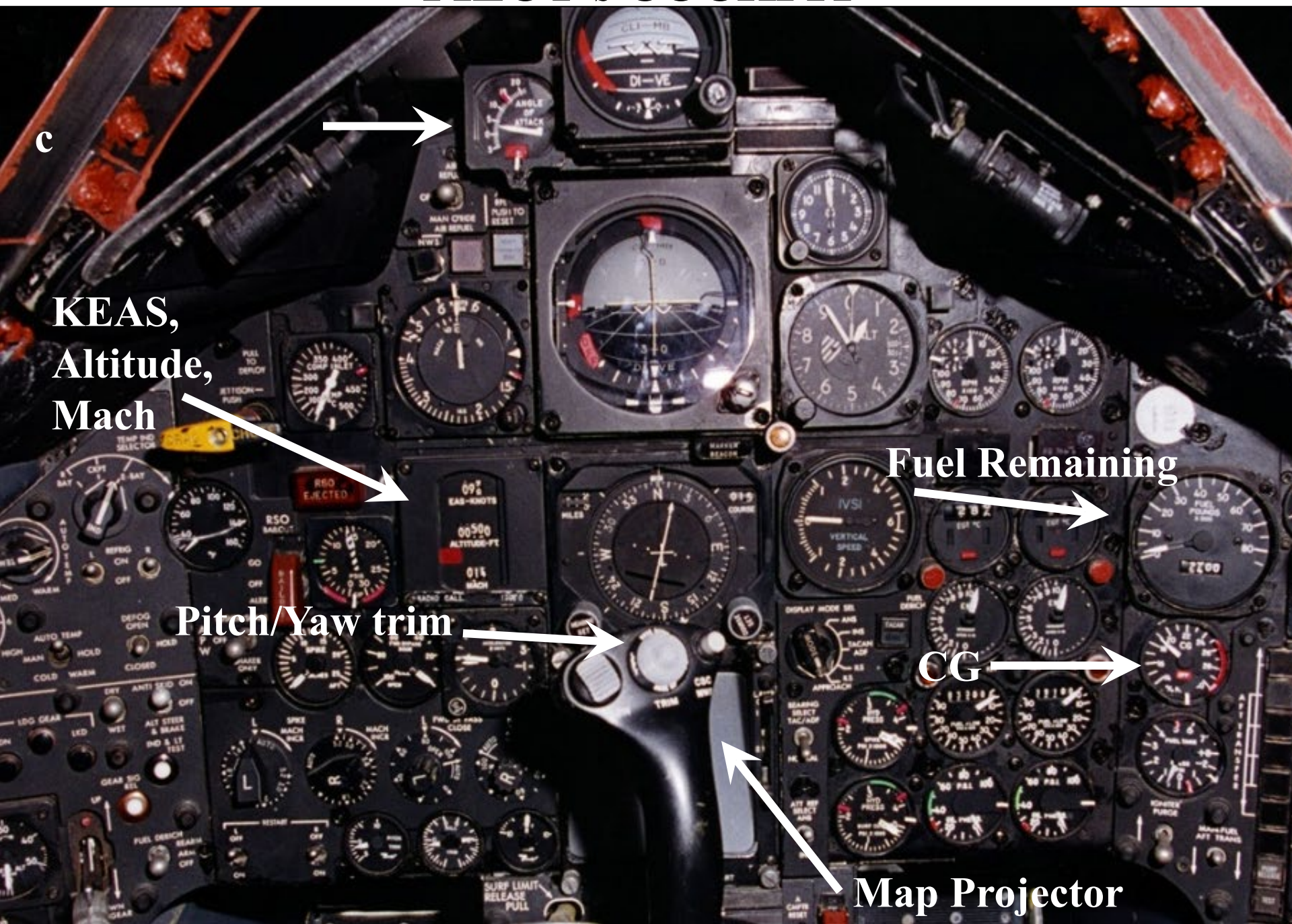


Steam Cockpit with mostly round dials & Analog displays

- Typical late 50s cockpit – Steam Round Dials
- Map projector in lower middle- great innovation- not in A-12 cockpit
- Triple display Indicator had Mach, Altitude and Knots Equivalent Airspeed(KEAS)
- Could manually adjust Engine Temp
- Laser Peripheral Vision Display



PILOT'S COCKPIT



c

KEAS,
Altitude,
Mach

Pitch/Yaw trim

Fuel Remaining

CG

Map Projector

F-35 HOTAS, HELMET, DISPLAYS

**Hands on Throttle & Stick
Canopy Rotates Forward**



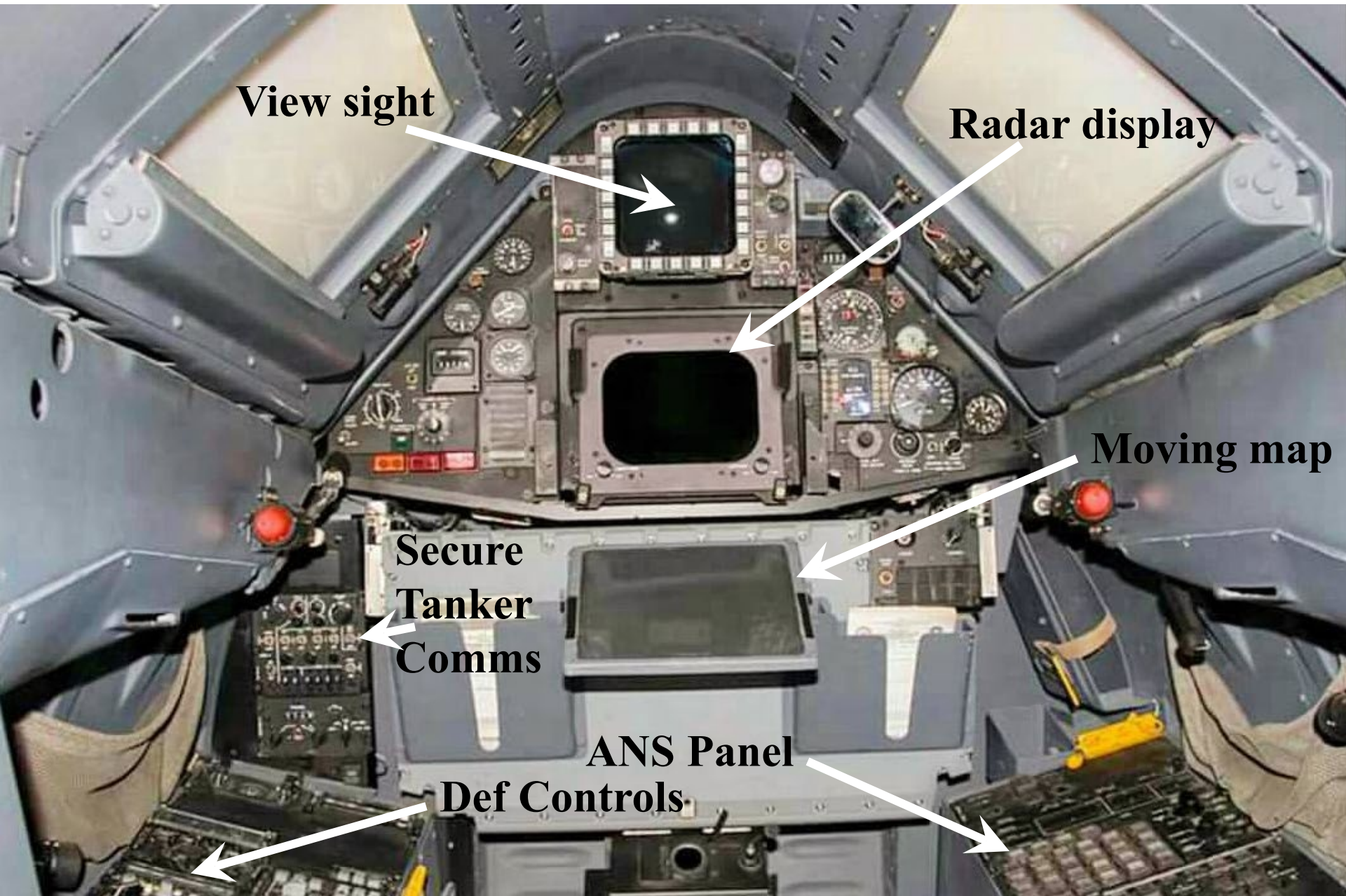
©Mike Vines/JSF Cockpit



**Helmet -Heads
up Display**

**Virtual image
Day or Night**

RSO Controls



A/C Astro Tracker & Master Computer

300+ Ft anywhere in the world traveling at 2,200 MPH – Before GPS

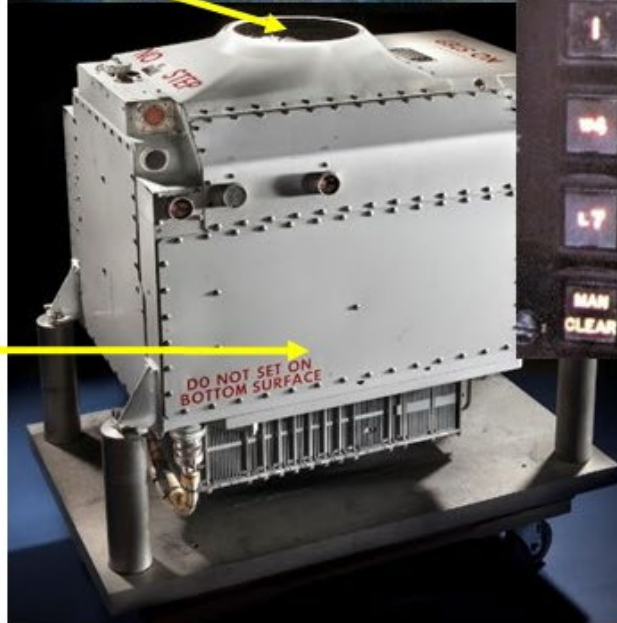
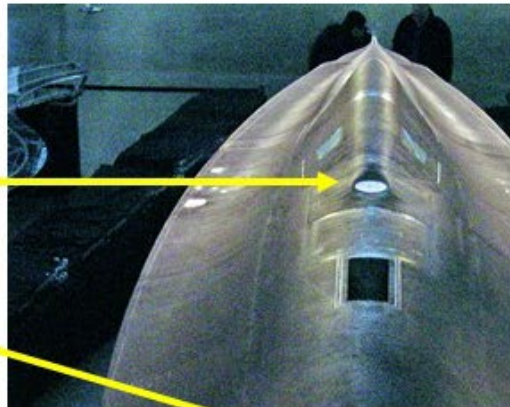
Tracker
Quartz Window

Star Tracker
Telescope

About 2 minutes
taxing in the
clear a 3-star
lock is achieved

Navigation
Computer

Geodetic Marker
in each hangar
for alignment



NAS 14-V2 Astro Tracker/Nav computer

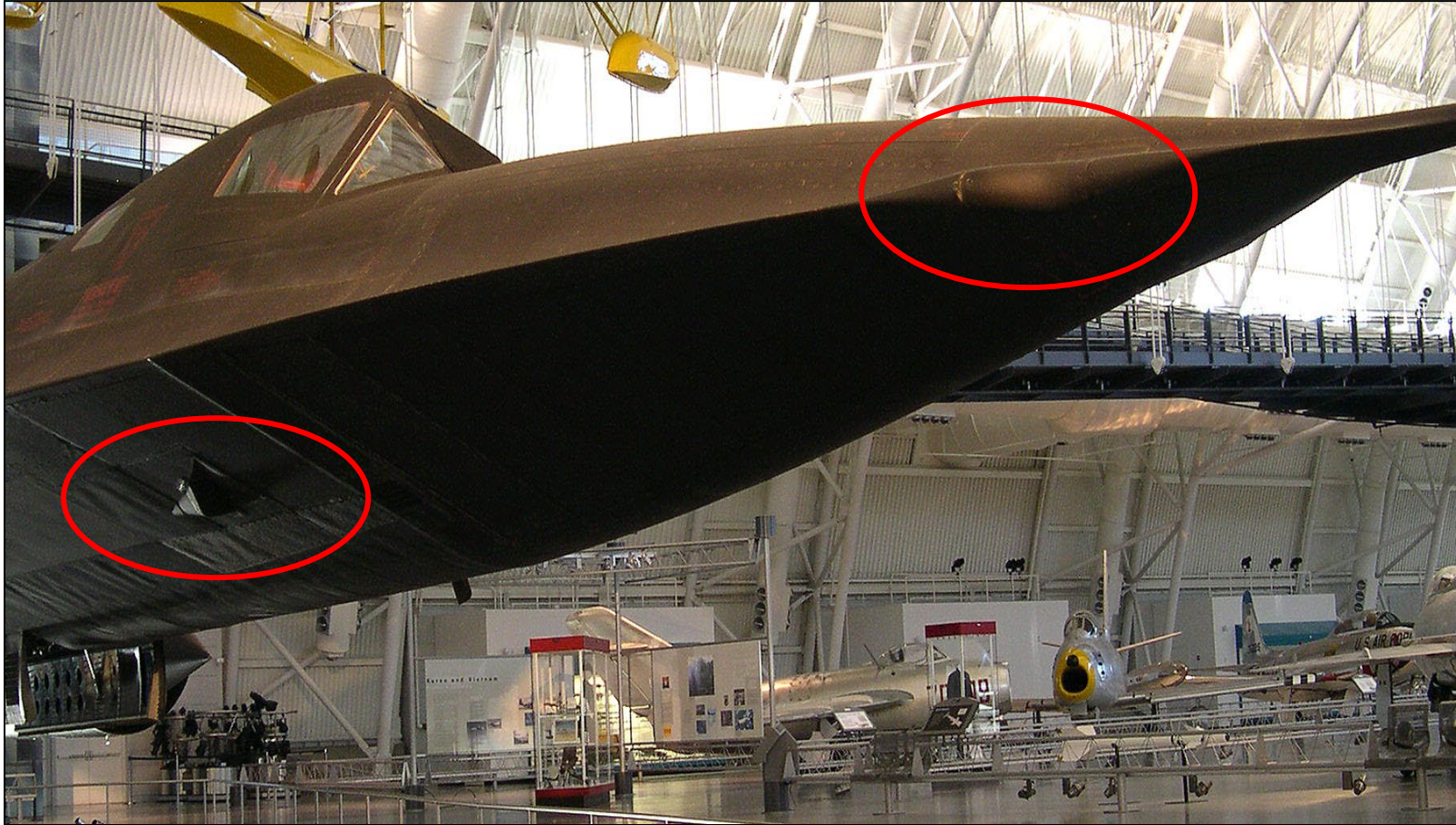


RSO NAV Panel

The Nav Computer is loaded and
checked pre-mission in the hangar
1 Hr & 45 Min to upload mission
data before engine start

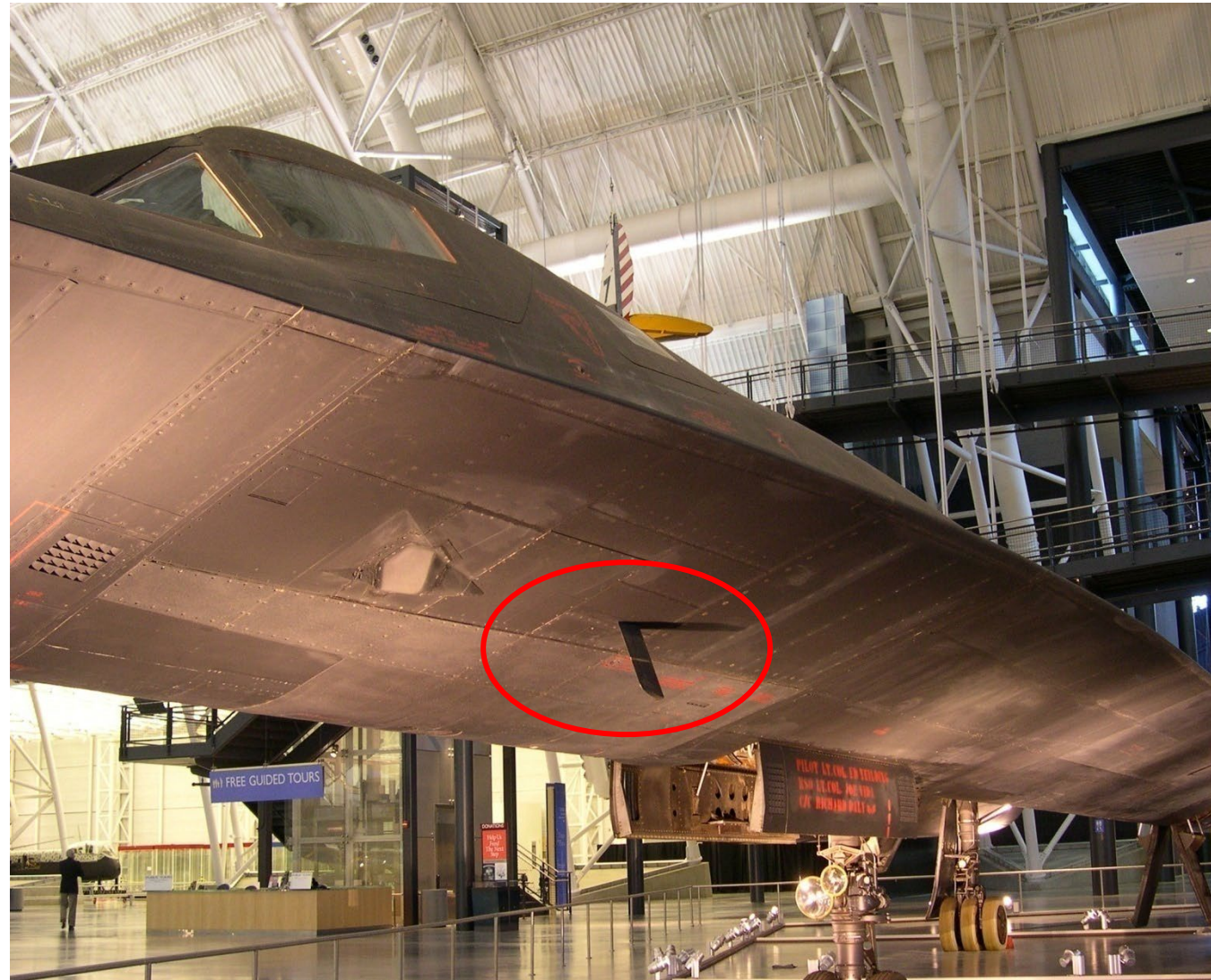
SR-71 Electronic Defensive Systems

- Powerful Electronic DEF Systems provide SAM & Air -to- Air Missile Protection
- About 100 SAMs fired at aircraft
- Numerous Fighter intercept attempts
- Nose ant Threat receiver
- Lower ant Threat Jam transmitter



PRIMARY -2 UHF COMNAV 50 Radios – Forward Antenna

- UHF Antennas – Left forward and aft right blades
- UHF Secure comm and tanker ranging info
- Fix Tanker position beyond 300nm with COMNAV 50 range & ADF bearing function present with ARA-48
- HF ARC-190 radio using nose and pitot boom as antenna



Engine Start

- Mechanical start with two Buick Wildcat engines under aircraft
- Chemical Engine Ignition – Start & A/B initiation
- TEB - Triethylborane that Ignites with air @ 3000F degrees
- Highly toxic & unstable compound
- 16 guaranteed ignition shots with counter on each throttle



copyright (c) John Freedman

Thrust 34,000 lbs

Normal Idle

RPM 3975

Bleed Bypass

**Turbojet Engine
with Afterburner**

**6 By-pass tubes
create part of the
High Mach Ram
effect**

**-Air from 4th
stage compressor
is dumped in
front of A/B
section for
cooling &
additional thrust**

**-Engine grows 6
inches length and
2.5 inches in
width at cruise**

SR-71 P & W J58 Engine



Copyright 200

J58 Engine run in full afterburner

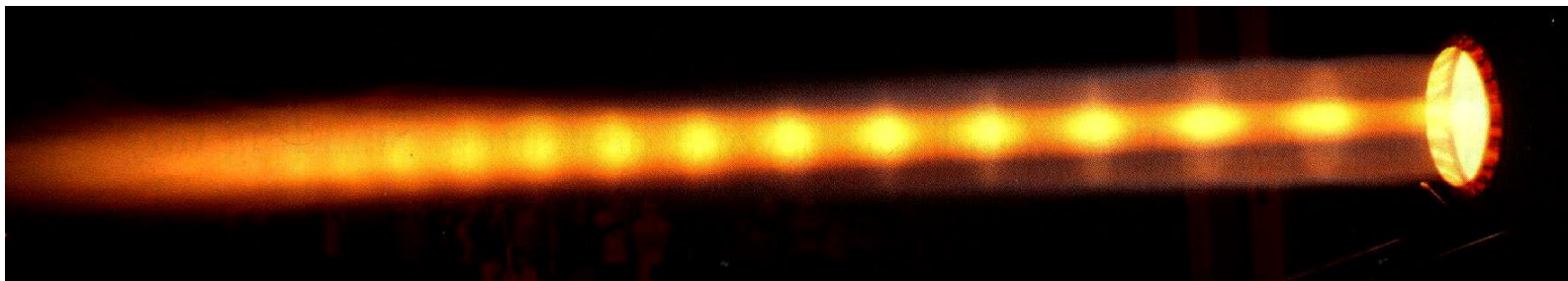
**-First Engine
capable of sustained
A/B use 1.25 – 1.75
hrs during Climb &
Cruise**

**-Rocknite ceramic
coating in A/B
section helps protect
afterburner metal
liner**

**- 13 A/B pressure
Jewels in perfectly
operating engine**

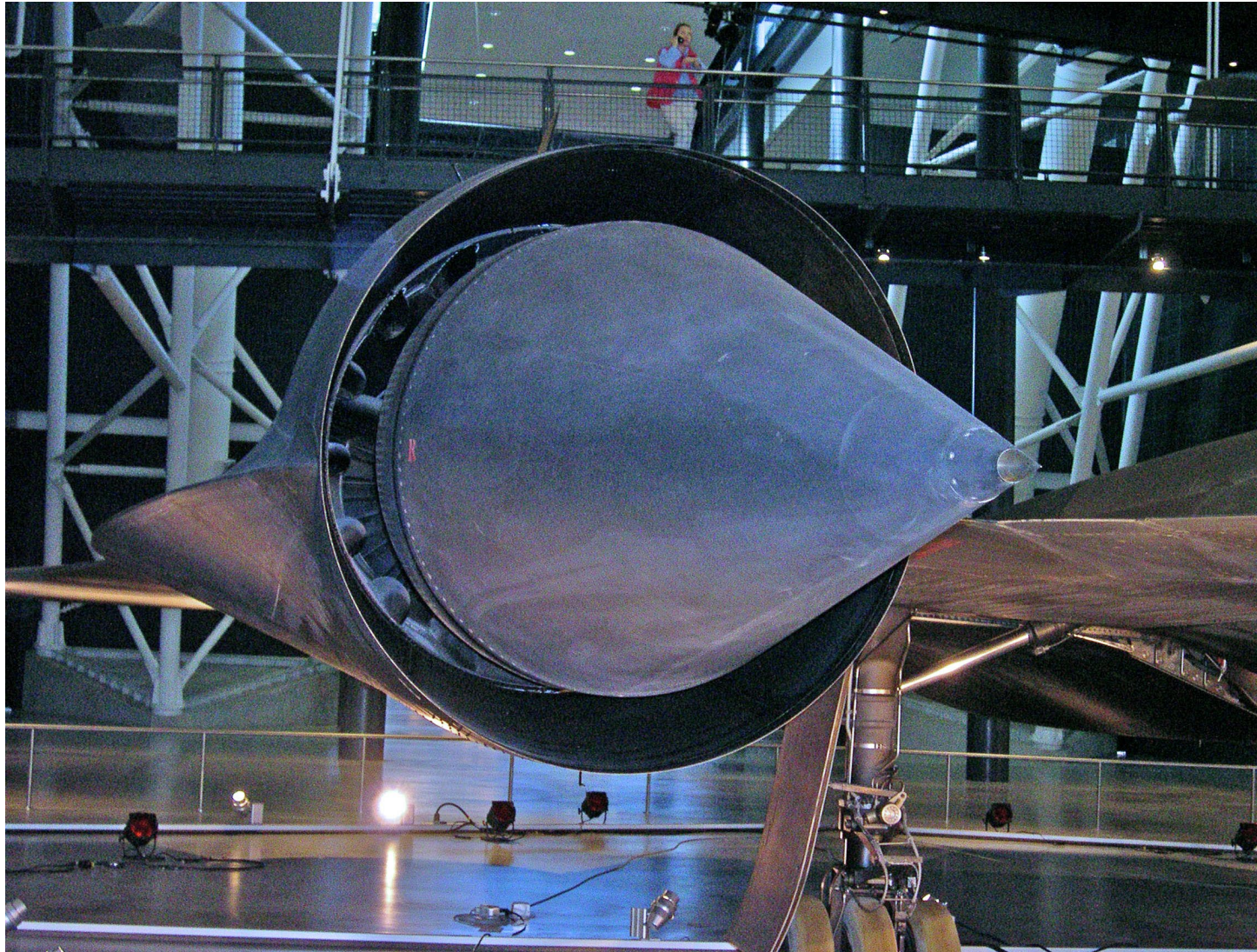
**-Core Engine Temp J
2000F**

**-Afterburner
Temp 3200F -
3400F**

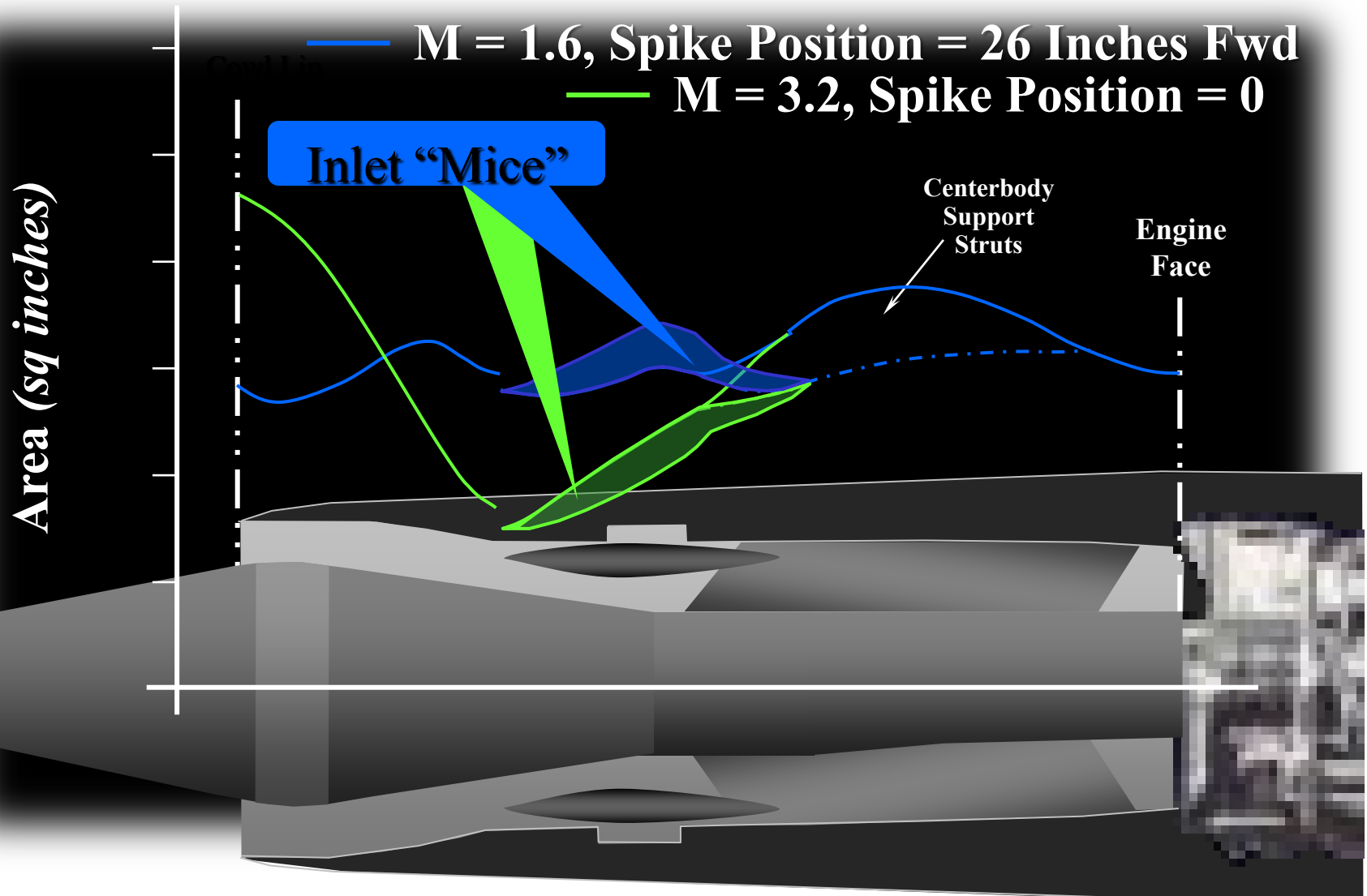


Air Inlet Spike for Controlling the Shock Waves

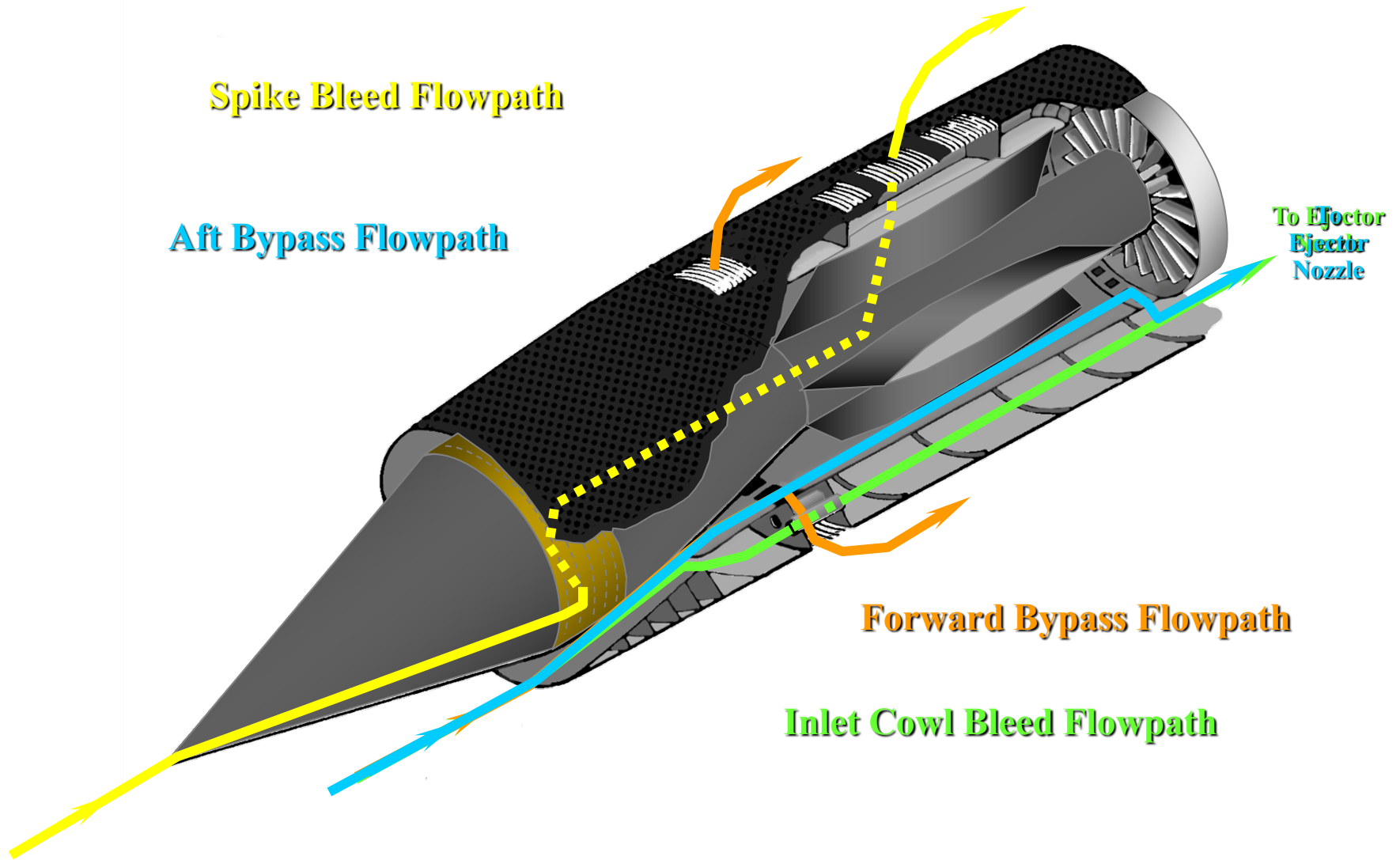
- Mechanical Spike starts moving aft at 1.6 Mach with $1 \frac{5}{8}$ inch movement for each tenth of a Mach
- Total movement at 3.2 Mach is 26 inches
- Shock wave is actually carried inside to reduce drag
- Opens inlet entry area by 112% and closes down inlet throat by 54% by 3.2 mach



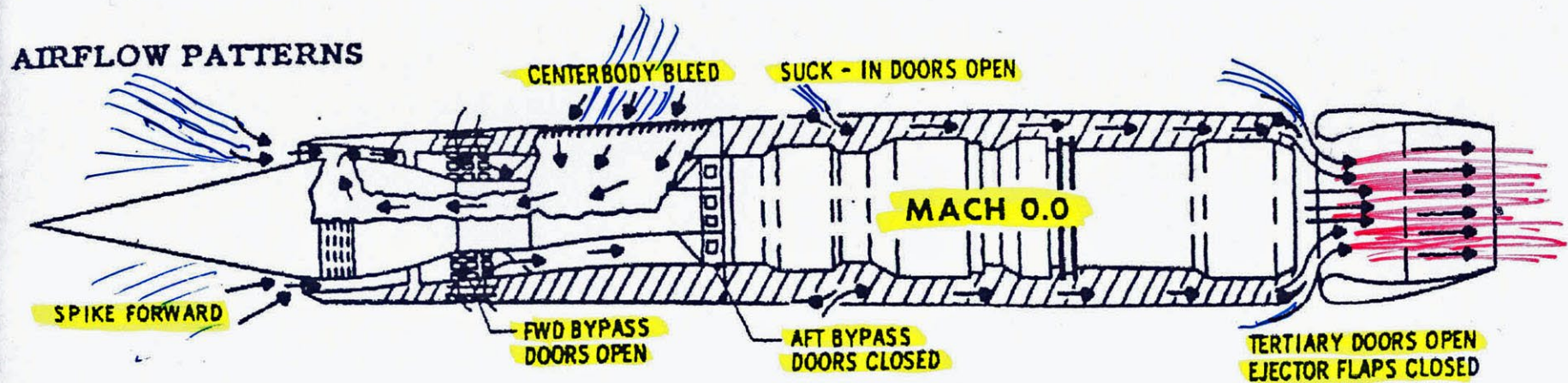
Inlet Duct Area Control



Inlet Flowpaths – Cruise Condition

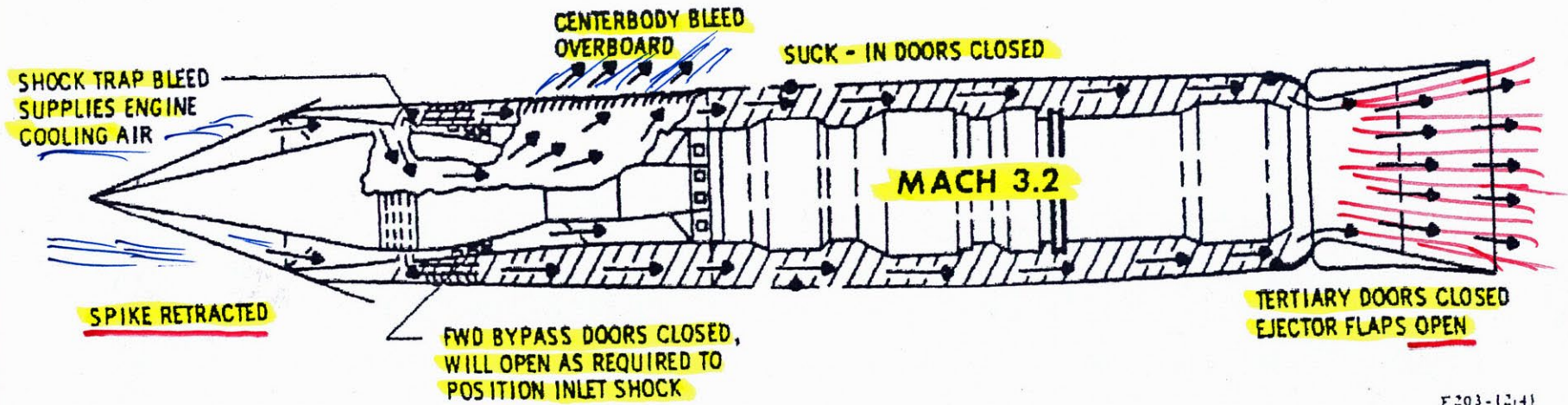


No Air Movement – Spike locked forward, most doors open to get extra air to engine. AFT Bypass doors & Ejector Flaps closed



Ambient pressure at sea level 14.7 psi

Design Top Speed -Inlets tight – Spike full aft, Aft Bypass doors closed, Forward Bypass just barely modulating, ejector flaps normally full open



F203-12141

Ram Effect Comparison –

Outside Pressure at 80,000 ft 0.4psi - at Compressor face 14-17.5 psi

2.2 Mach Thrust contributors Engine 73%, Inlet 13% & Ejectors 14% - Ram effect 27%

3.2 Mach Thrust contributors Engine 17%, Inlet 54%, & Ejectors 29% - Ram effect 83%



APPLICATION PROCESS

- Had to be a VOLUNTEER
- About 2,000 hours & 5-7 years as USAF Pilot or Navigator
- Prefer multiple aircraft experience – one high performance
- Pilot normally needed AIR REFUELING background
- Submitted PERSONNEL, FLYING, & MEDICAL records for review
- Successful Records Review brought week long evaluation at BEALE AFB, California
 - Two day modified Astronauts physical at TRAVIS AFB
 - Series of interviews with Wing Personnel
 - Pilots flew in T-38 with current SR-71 pilot for evaluations & had an assessment in the SR-71 Simulator
 - If accepted - await orders to Beale and the year long paired with navigator crew training checkout

SR-71 TRAINING - A CONSTANT

**Special Unit –
All volunteers**

**1 Year initial
training**

**Continuing
training:**

**Home: each
month - 3 SR
flights, 1**

**Simulator & up
to 8 T-38**

**Companion
trainer flights**

**Overseas - you
fly SR-71 as
required by
Operations &
Maintenance**



Defining Moments

Your first Crew picture

You are now recognized as part of the crew force – all be it still in training

- Significant milestones: First flight, First Mach 3 flight, First Crew flight, 1st 3.2 Mach Flight, 45 Degree High Bank Turns Flight, and finally Night checkout



ADDITIONAL TRAINING FOR MISSIONS

- **Special Survival & Intelligence Schools**

- WATER survival in Space suit
- Intense INTEL training because of Over Flight

Missions

- -GARY POWERS Lessons
- -COVERT COMMUNICATION Techniques
- -Experience types of Interrogations & Torture

- **FAMILY PREPARATIONS**

- - Had to Live on Base
- - Wife had a special one day course
- - What support would be available if something happened – USAF & Government
- - Typical 6 week overseas tours – multiple times a year for average of 150 days a year
- - Family support at home

Aircrew Mission Responsibilities

Pilot – Aircraft Commander,
ultimately
accountable for
Aircraft & Mission
Flies A/C, Engine
Inlet control, Air
Refueling & Fuel
management

Reconnaissance
System Officer -
Navigator – had
Navigation, Sensor
Controls, Tanker
Rendezvous,
Defensive Systems
operation, Checklist
execution, & most
Radio Calls



Original Gemini Based Suit

- About same weight. Suits either White or Chocolate Brown**
- More restricted movement**
- Note stir-ups on boot heels – attach to lanyard to bring heel against ejection seat during ejection to prevent collision with cockpit**
- Rocket ejection seat one of the safest ever made. No USAF fatalities during SR-71 program**
- Seat tested from on the ground during take-off roll to 85,000ft at full speed of the aircraft**
- 8-10 minutes controlled fall from 80,000+ft to 15,000ft. Here large parachute automatically opened and 15 minutes to descend to sea level**
- Suit provided crewmember all the protection they needed from air blast**



1030 SR-71 Pressure Suit

- Required for flight above 50,000ft
- David Clark Co. created
- Suit life around 12 years and come in 12 adjustable sizes
- Suit weighs about 45 lbs
- Suit Basically four layers
 - Inner nylon layer for comfort
 - Rubber bladder for inflation & pressurization
 - Adjustable fish net shape to give the bladder its shape
 - Outer layer of Fipro, fire resistant material good to about 800 F
- You flew with the suit deflated at your 26,000 ft cockpit altitude. Only pressurized during an emergency



1030 SR-71 Pressure Suit

- Shoulder area expanded for greater cockpit flexibility
- Velcro used to loosely attach checklists
- Right valve is vent control where ventilating air came in
- Left control is pressure valve to inflate the suit for comfort or during an emergency
- Strap in center is to keep helmet from riding up with suit inflation. Could literally pull your head out of helmet without it
- Boots about 1-2 sizes larger than you normally wore
- Mae West in parachute harness that inflated automatically with water contact



SR-71 Helmet & Gloves

- Helmet weighs about 10 lbs
- Special face plate glass for pilot – distortion free and Plexi-glass for RSO
- Both have fine gold mesh heating elements to prevent fogging
- Dual O2 systems
- Water/food access port on Right hand side. Turn head to use
- Microphone in front of mouth
- Gloves are three layers Cotton surgical glove, rubber layer, and leather/fipro layer



SR-71 shoulder patch worn only by each SR-71 Pilot and Reconnaissance System Officer on the left shoulder of their pressure suits

- PRESSURE SUIT COST of \$250,000 included: Suit, Helmet, Parachute Harness, Oxygen Regulator and suit Pressure Controller



SR-71 HABU patch worn by SR-71 Pilots and Reconnaissance System Officers on their normal flight suits.

This acknowledged that you had flown an operational mission in the SR-71

HABU was the unofficial name given the aircraft by the Okinawans – In Japanese means deadly Cobra like snake



**Symbol of SR-71 team.
This patch was worn by
anyone working in some
capacity on the program.
It was truly a team with
the Pilot & RSO playing
one of the few highly
visible roles**

**-Included Aircraft
Maintenance,
Physiological Support
Division, Sensor Support,
Mission Planning, Film
& SIGINT Recorder
Processing, Intelligence,
& many other wing
personnel**



Speed Run Route from London to Los Angeles

3 Hours & 48 minutes -Average Speed – 1438 MPH

- Typical map the aircrew would have carried on flight and used as back-up reference
- Would be in computer mission planning packet for review before mission
- Not much room in cockpit to carry many materials and awkward to use in Pressure suit



PLANNING & OPERATIONS

- MISSION REVIEW – Day before with MISSION COMPUTER PLANNING GROUP
 - Critical check of Route, Assess Target Areas, Cameras on points, Fuel consumption, Any High Bank turns, Establish divert bases, Defensive Systems, any special Rules of Engagement
- Training mission – BASE OPERATIONS file canned mission & check weather
- OPERATIONAL MISSION – FULL BRIEFING
 - Mission overview
 - Weather
 - Aircraft & Tanker status
 - Intelligence update
 - Any special considerations - OPERATIONALLY and POLITICALLY

Normal Flight Day - Process

- Report 2 ½ Hours prior to Takeoff
- Short Physical
- High protein & low residue meal of Steak & Eggs
- 1:15 hour+ change into Cotton Long Johns to start suiting up process
- Suit is laid out on floor and you pull suit over yourself from the back of suit
- With help of two Physiological Support technicians – everything was command & response



Donning Process Continues

- Donning(suiting –up) process normally took 10-15 minutes to complete
- Here final adjustments are made before helmet and gloves are donned
- Three layers of glove significantly reduced your sense of feel. Had to be very careful as you moved switches, etc
- Each of us had two complete pressure suits with helmets



Pressure Suit Functional Checks

Checks

- Oxygen Sys
- Suit Pressurization
- Communication
- Inner suit seals between helmet and suit , entry zipper & glove seals for overall suit pressure integrity
- Face Heat



Inflated Suit Check

- Suit tested for pressurization and any leakage
- Held your breath and felt like the Pillsbury Doughboy
- To feel the suit at this point it felt very rigid
- Final adjustments are made to the suit and the ejection seat stir-ups are installed on boots
- Most common leak area was at the glove seals



-1030 suit bulkier but more comfortable than Gemini suits

-This “business” work suit was not for the claustrophobic

-In Pressure suit for up to 13 hours – normally more like 4-6 hours

Used slow deliberate movements so that the suit went with you and then the suit did not fight or restrict your movements

This suit was used for the Columbia Space Shuttle Test Missions



Physiological Support people Installing Pilot in Cockpit



Strapping in Flight Crew

Engine Start –Buick Wildcats

-A pair of Buick Wildcat Engines connected in tandem drive a manual drive shaft to turn over the large J58 engines from underneath the aircraft

-At 1000 rpm engine ignition is started with a shot of TEB as the Throttle is set to idle

-At around 3200 rpm the shaft senses engine acceleration and automatically disengages



Ready to Taxi

**-Engine Start
30 min prior to
Take Off**

**-Faceplates
down – 100%
O2 – 30 minute
breathing O2
reduces N2 in
blood by 50%
to reduce
possible Bends**

**-Taxi route &
length critical
to A/C tires**

**-Flight control
checks here**

**- Note JP-7
fuel on hangar
floor- Always
leaking**





NASA Dryden Flight Research Center Photo Collection
<http://www.dfrc.nasa.gov/gallery/photo/index.html>
NASA Photo: EC95-43075-4 Date: 1995

SR-71 - Taxi on Ramp with Engines

Takeoff & Climb Data

**-Take-off - one of your greatest senses of speed and power
Release brakes, select A/Bs –
always asymmetrical lights –20
seconds thru 4,500 ft and lift
off at 210 knots (~240 mph)**

**-Pass thru 20,000ft in about 2
minutes after brake release**

**-Climb/accelerate to 75,000ft+
will take another 17 minutes,
consume 1/3 of your fuel, and
roughly fly about 360 nautical
miles**

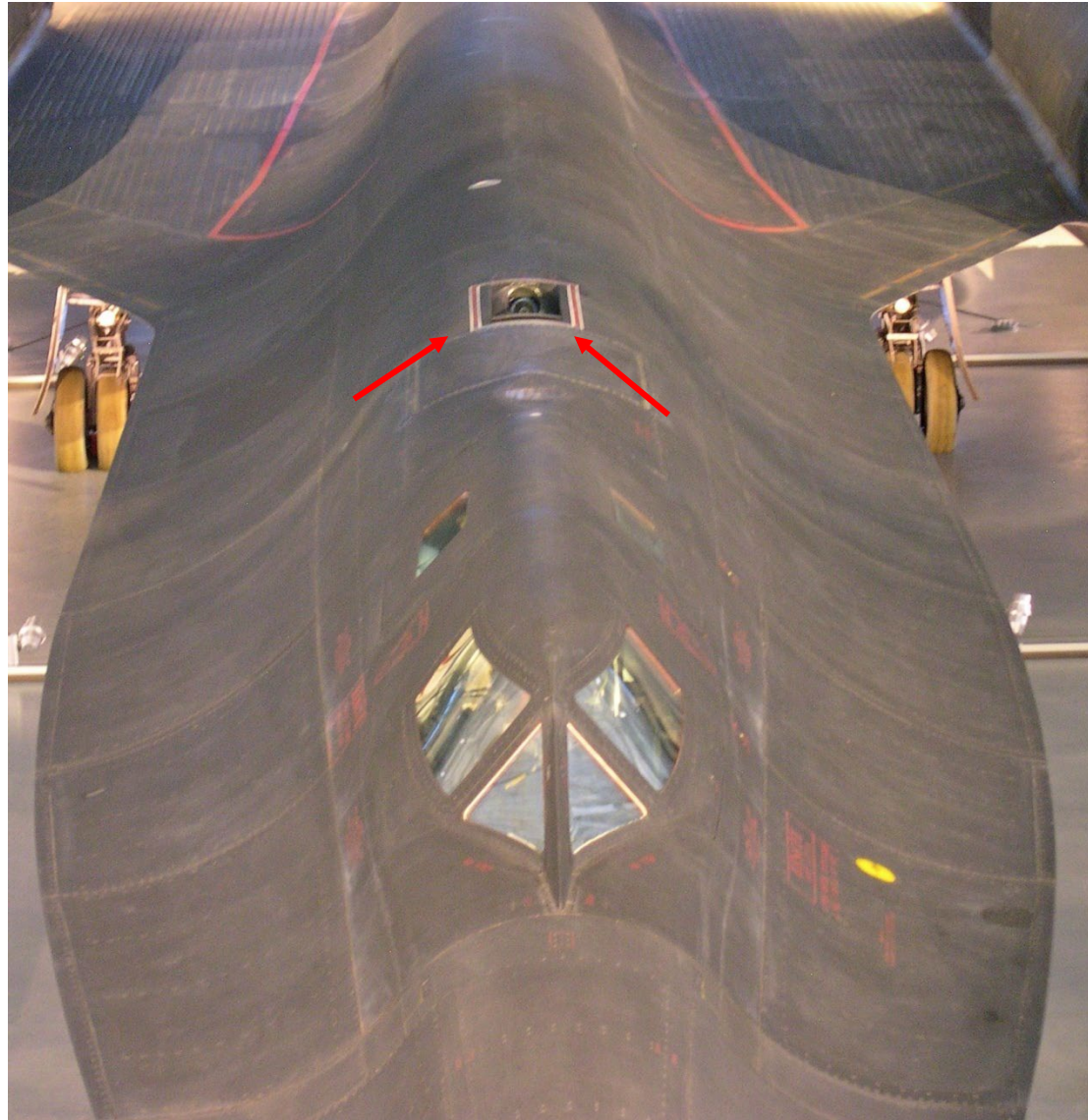
**-Level off and establish a cruise
climb profile as you burn down
fuel**

**-Hostile over flight must be
75,000ft+ & 3.15 Mach to enter
enemy airspace**



SR-71 Air Refueling Receptacle

- Air Refueling receptacle puts you well under the tanker
- Transfer about 6,000 lbs/min (1000 gals/min)
- Refueling normally 12-15 minutes
- One of the more demanding parts of the Pilot & RSO training
 - Pilot to handle the SR-71 under tanker in contact position & using A/B at higher fuel load weights
- Normally lighting an A/B while remaining in contact – timing on air refuelings was often critical
- RSO to plan and execute supersonic rendezvous with descent and guidance to hook-up
- Operational missions were normally radio silent; maintaining a listening watch



KC-135Q Tanker refueling SR-71 - 952

Tanker transfers 65 – 70,000 lbs of fuel in
12 – 15 mins Approximately 10,000 gallons



Typical Mission usually involved 1-3 Inflight Refuelings

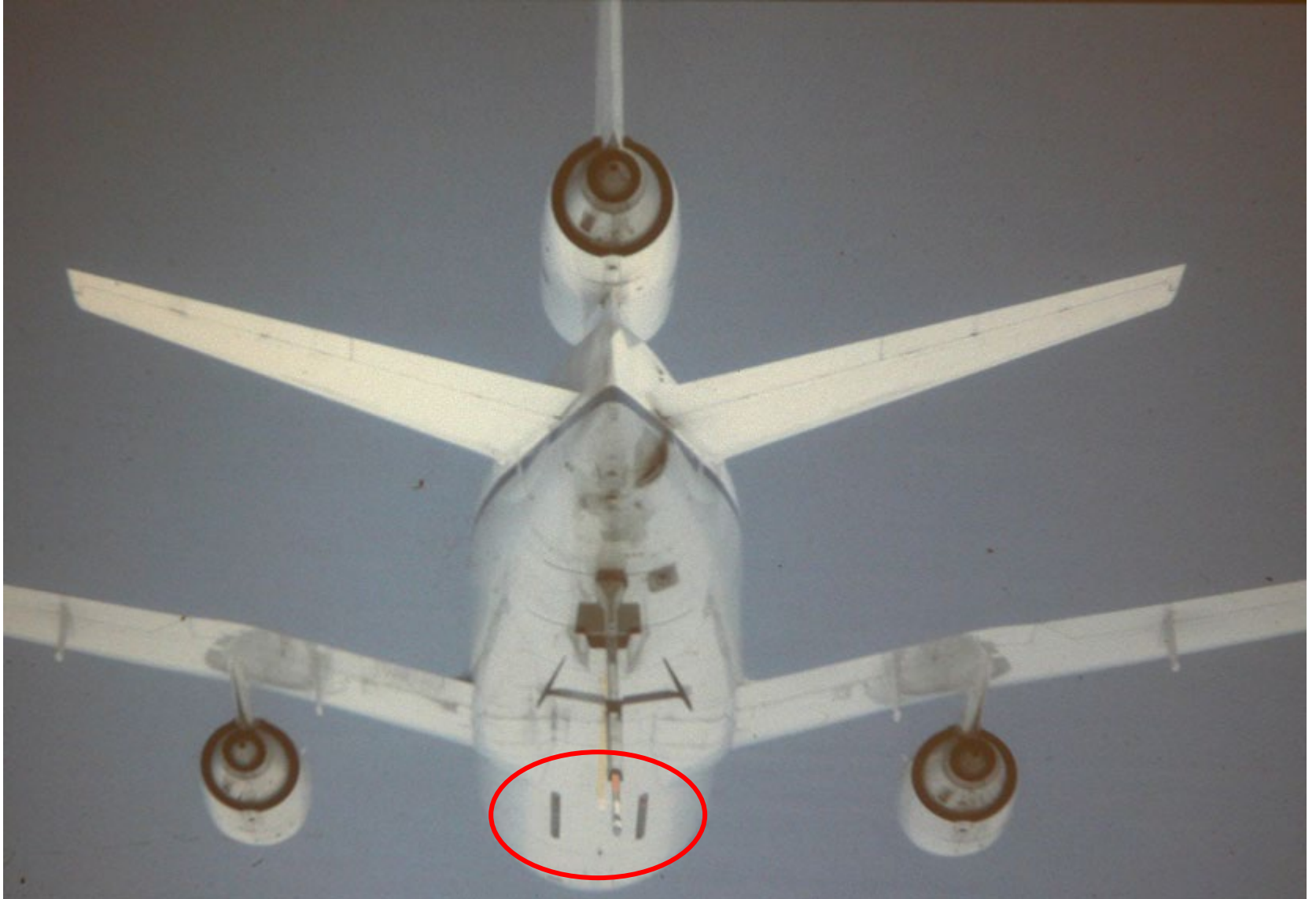
Without our TANKERS, We didn't complete our mission!

Normally Multiple Tankers for Air Refueling

- Multiple tankers for practice
- Overseas many times distant A/R tracks too far for single tanker to cover SR-71 fuel off-load
- Extra tanker in case of Tanker abort because of equipment malfunction during refueling
- California to Northern Coast of Russia & Back – tapped 15 tankers during 5 air refuelings on a 10.4 hour mission off-loading 72,000 gals plus – covering 15,000 miles

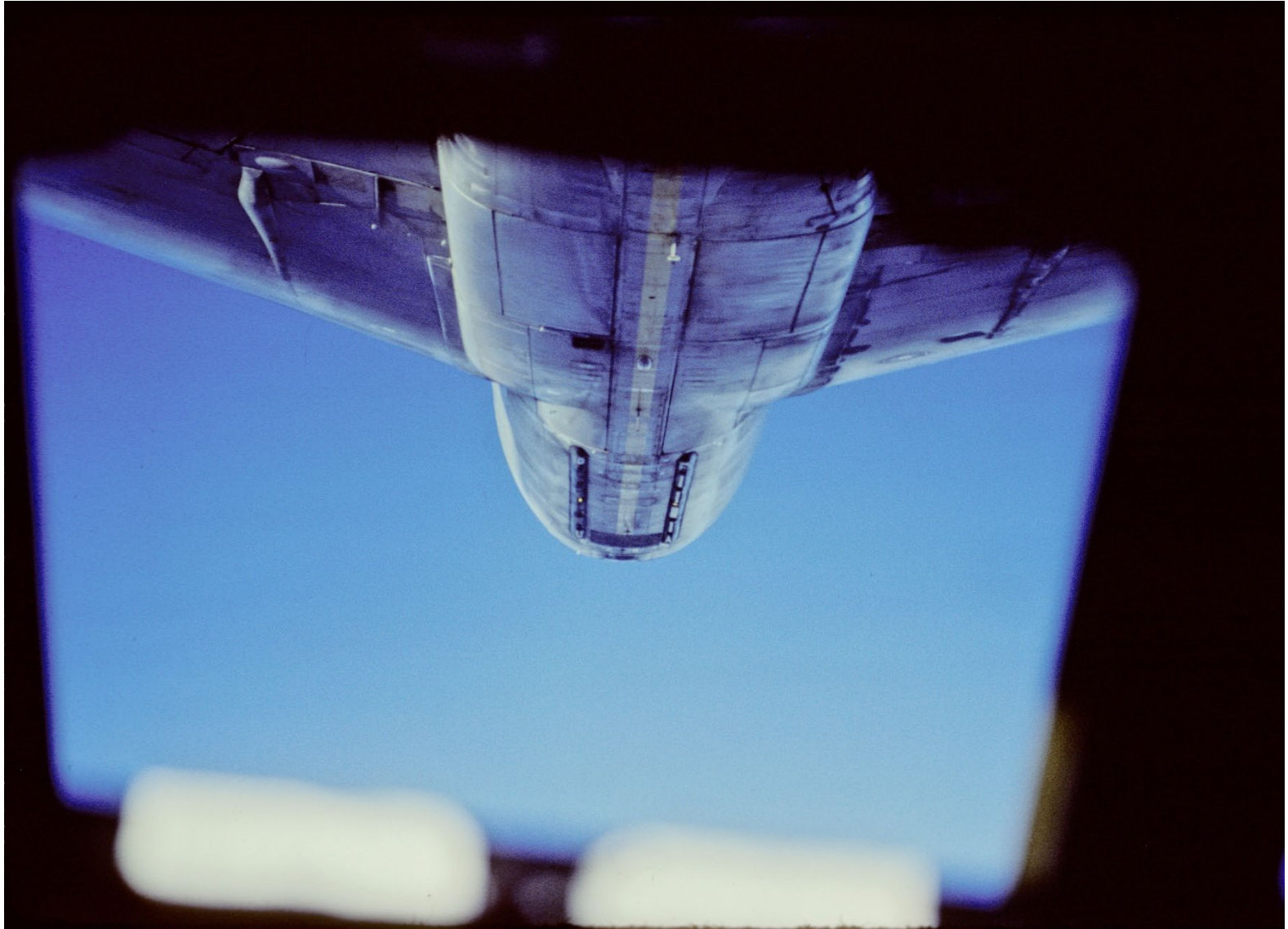


Approaching tanker to position yourself in contact position



Note director lights on belly of Tanker aircraft – Boomer in window

SR-71 refueling from KC-135 Q – SR-71 Cockpit View



SR-71 Refueling in the Contact Position



**SR-71 B-Model
completing
refueling over
El Paso, Texas**

**B- Model SR-
71 Trainer
aircraft had
dual controls in
the front and
back seats for
initial &
continuation
pilot training,
check rides, and
VIP orientation
flights**

**Note fuel
leaking from
wing tanks &
around
refueling
receptacle rear
of cockpit for
Instructor Pilot**



SR-71 View from 80,000ft +

**-Curvature of
earth**

**-See almost
350 miles**

**-Black sky
over head as
most of air is
below you
(97%)**

**-16 miles up
with no real
sense of speed**

**-Quiet because
you are in
Space suit and
Supersonic -
noise is behind
you**



Descent planning – Slow and cool down aircraft

- Start down
220+nm back and
it will take 10
minutes to 25,000ft
- Carefully come
out of A/B
- Narrow speed &
altitude profile to
maintain during
descent to assure
A/C cooling and
prevent engine
compressor stalls
- Figure every two
hours and 2800nm
(~3200 Statue
miles) it's time to
refuel or land



SR-71 Sensor Combinations

- Multiple sensor combinations
 - Noses- Training, Synthetic Aperture Radar, & Optical Bar Camera
 - Side bays -Technical Objective Pointing Cameras, Electromagnetic (ELINT) Reconnaissance System (EMR), mission recorders, Radar recorders, etc
 - Center bay -Terrain Camera



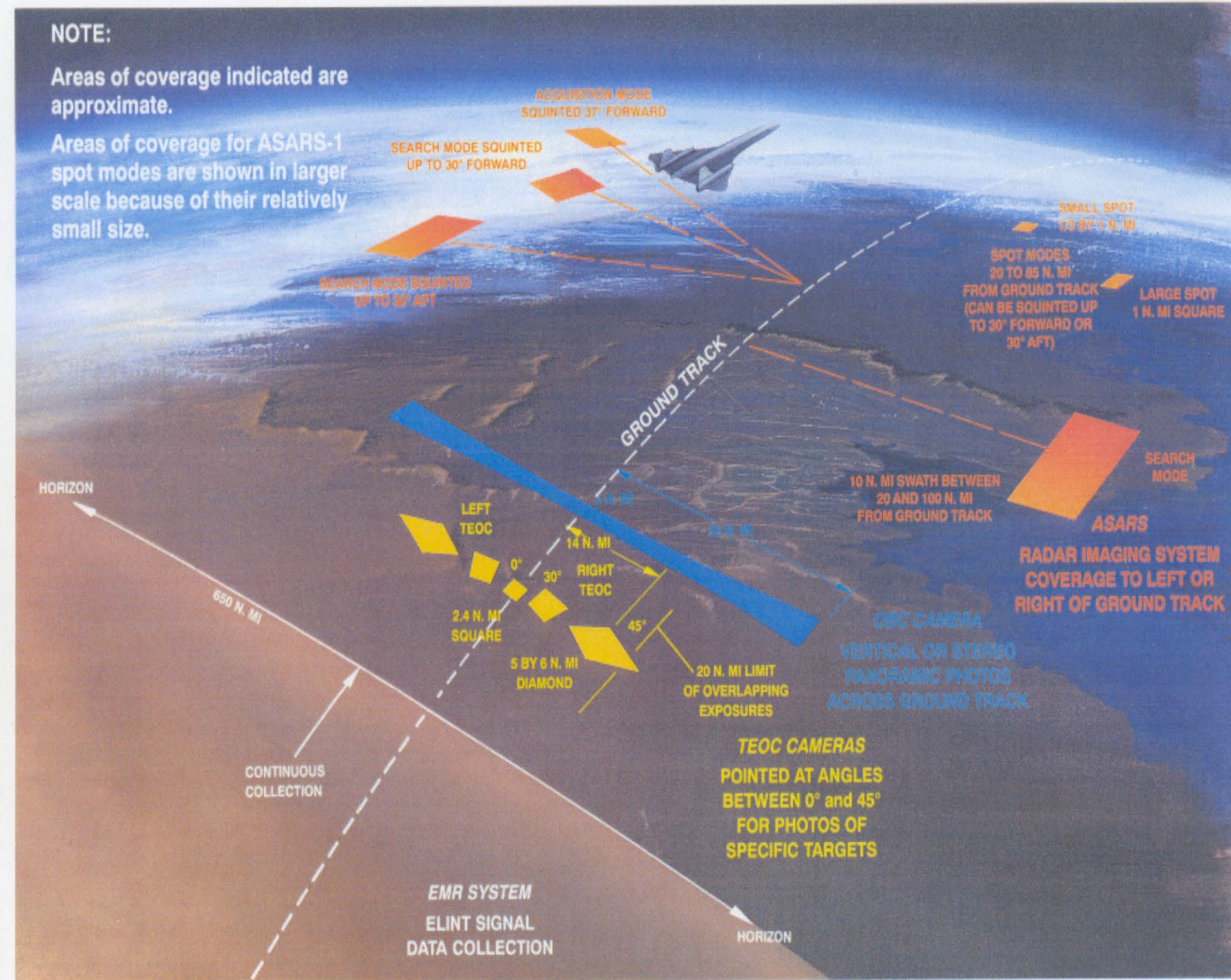
-Nose – Optical Bar Camera (OBC) – film 100,000sq miles/hr, film image 72 miles wide, & film length 10,500ft OR Synthetic Aperture Radar (SAR) with 12” res in spot mode 25-85 NM either side. Can do 10 nautical wide swaths either side of aircraft at 20-100 nm with 10ft res – Technical Objective

Cameras- Mounted both sides of Chine controlled by computer – 100s of targets/mission with 2 to 4+ inch res possible – out to 20 nm on side mounted

- Electromagnetic Recon Sys - Electronic horizon 325nm+ Greatest ELINT gatherer of its time

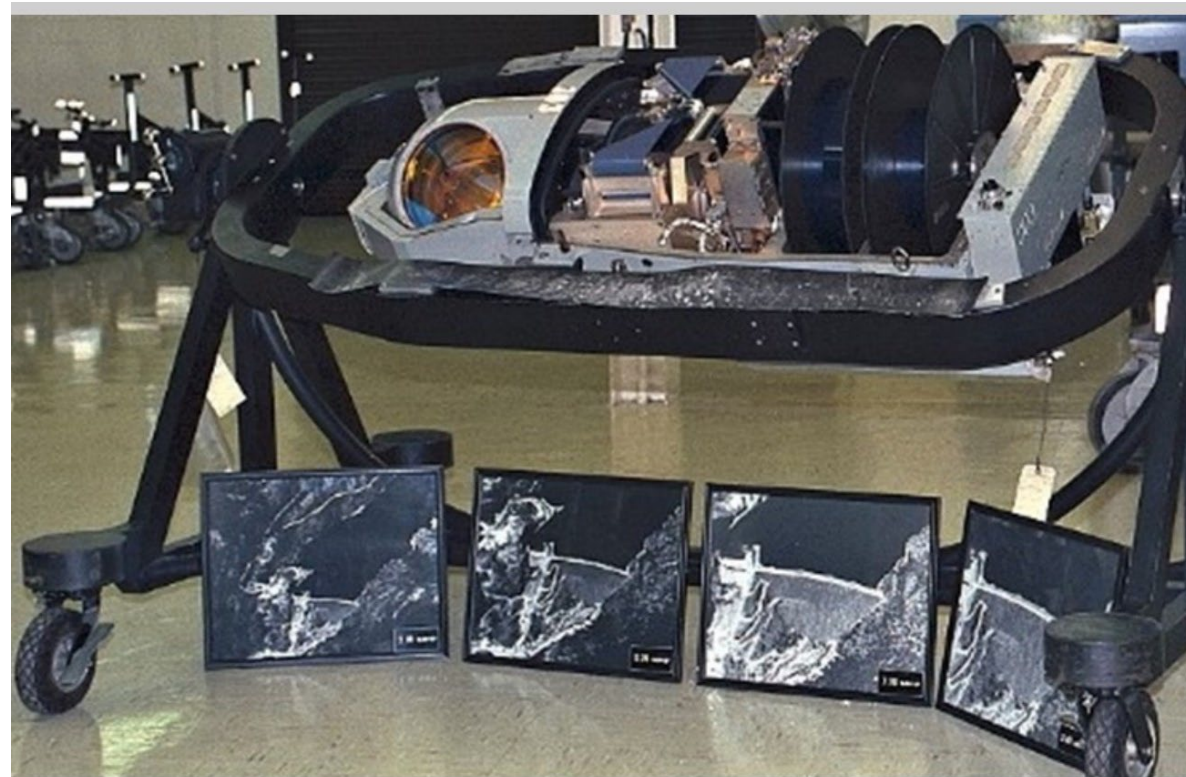
SR- Used as stimulating aircraft of enemy on Coordinated Missions

Sensor Data Collection (Terrain Coverage at 80,000 Feet)

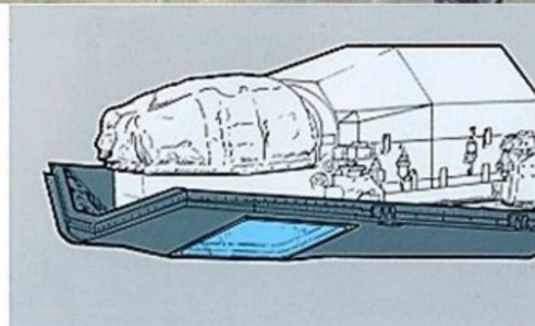


Toughest Missions -Not over flights because political risk already taken , but right on the border @ Mach 3+ flights with no over flight authority – even in the case of an emergency. Very strict Rules of Engagement

Optical Bar Camera - OBC



Optical BAR Camera (OBC)

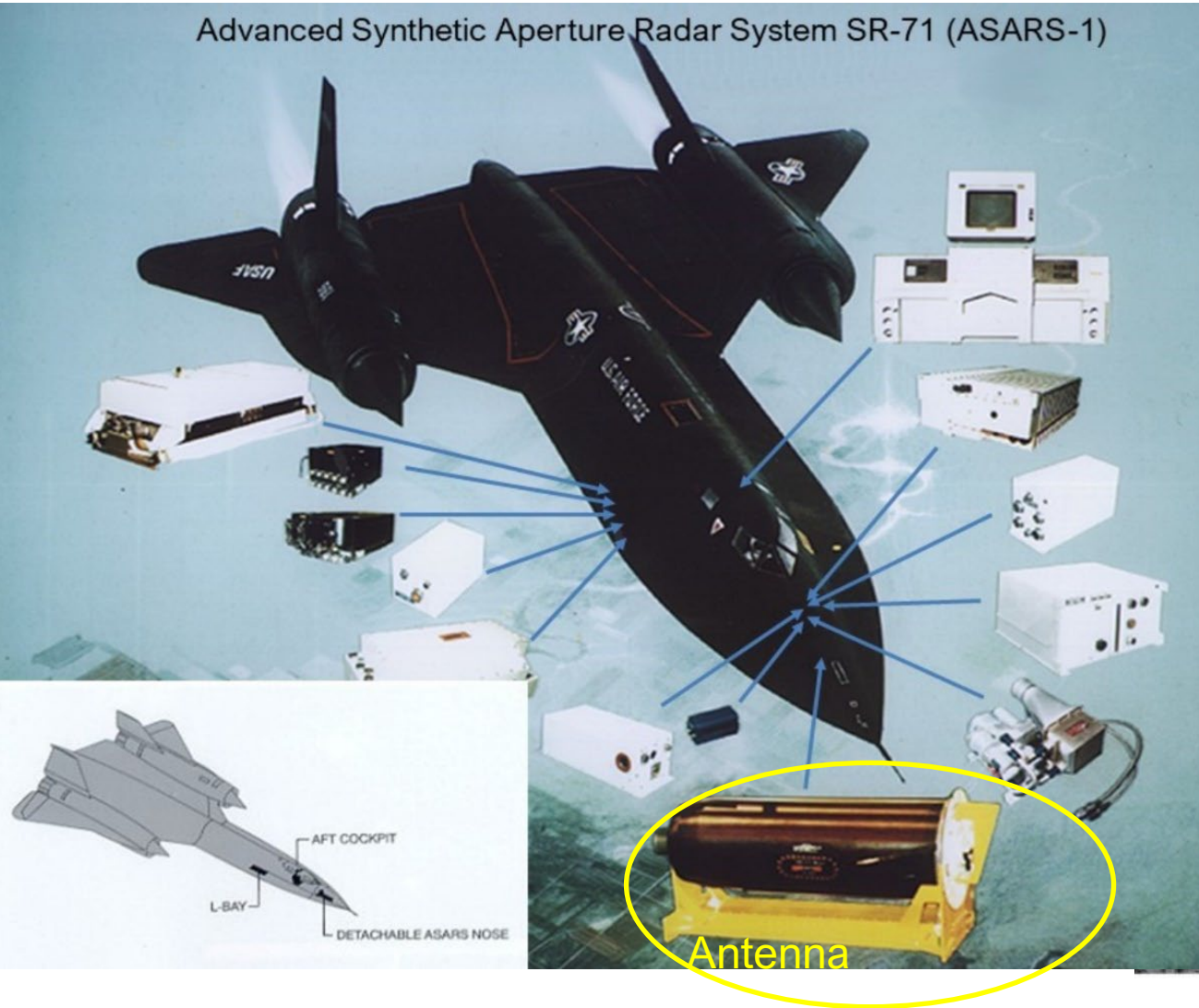


Camera Mounted on Nose Hatch Door



ASARS-1 Radar

Advanced Synthetic Aperture Radar System SR-71 (ASARS-1)



Technical Objective Camera - TEOC

Film – 1500 ft long & 9.5 inches wide – About 1800+ images

Resolution possible 4-6 inches, NADAR out to about 20 nm



-SR-71 TEOC

**picture of
Seattle**

**Kingdom from
80,000ft +**

**-Black & White
film used most
of the time as a
single emulsion
thickness gives
the best picture
resolution – 4 to
6 inches possible**

**-Processing time
was 1 to 3 hours
depending on
the type of film**

**–Color or Black
& White**



SR-71 Operations





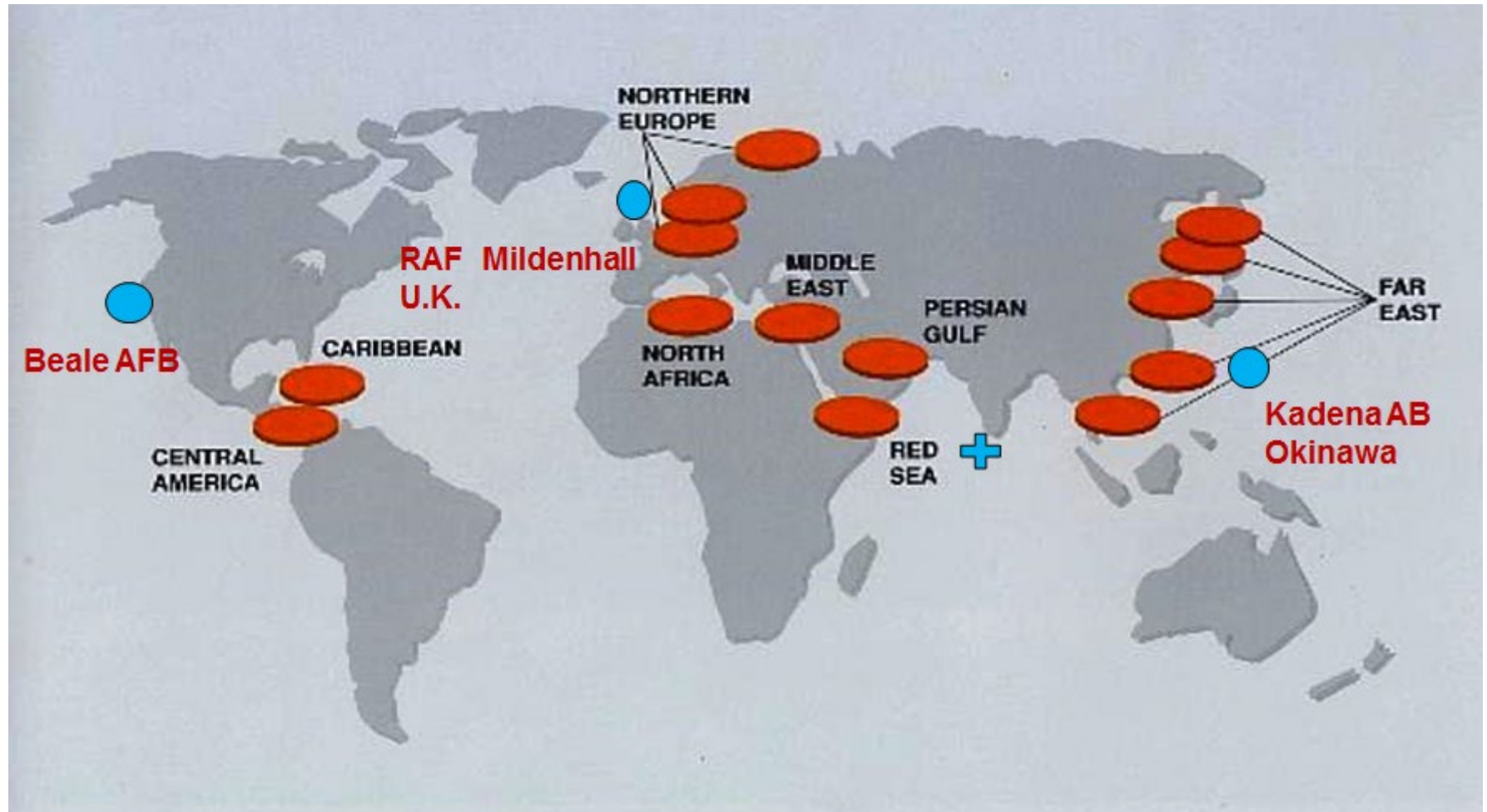
Cold War “Themes”

- Strategic Reconnaissance
- Diplomatic / Territorial
- Stimulate the Environment
- “In Your Face”
- Support Strategic/Tactical Operations

Operating Locations

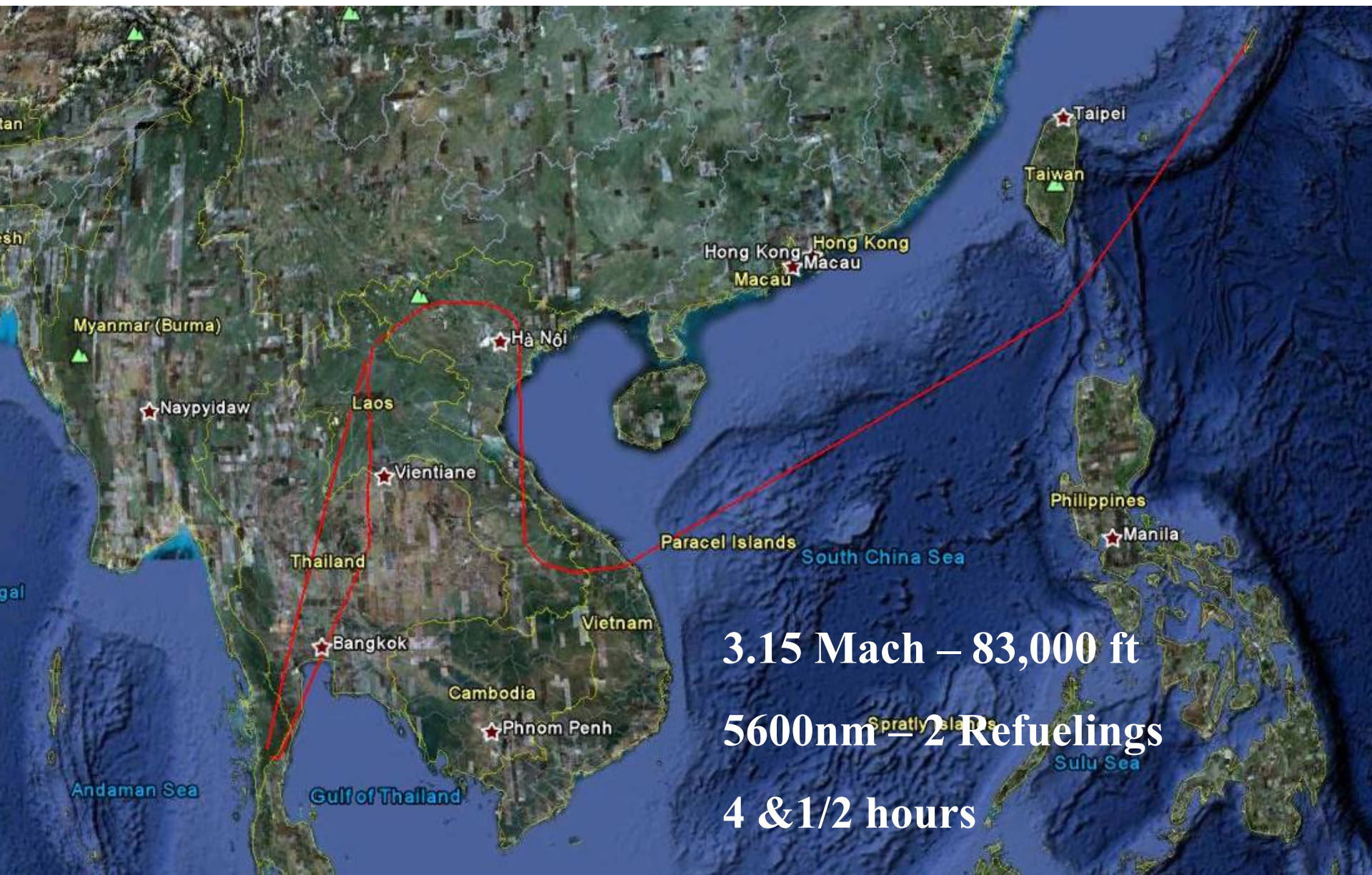
- Beale AFB, CA (Home Base)
 - Cuba, Nicaragua, Panama, USSR
 - Kadena AB, Japan
 - North Korea, North Viet Nam, China, Eastern USSR, Middle East,
 - Mildenhall AB. UK
 - USSR, East Germany, Baltic, Libya, Middle East
 - Eielson AFB, AK
 - USSR
 - Seymour Johnson AFB, NC
 - Arab/Israeli 1973 war
- Diago Garcia, Indian Ocean
- Middle East, Far East

Major Cold War Theaters of Operation



Blue - Base of operation
Red - Intelligence hot spots

Kadena AB Japan to Hanoi



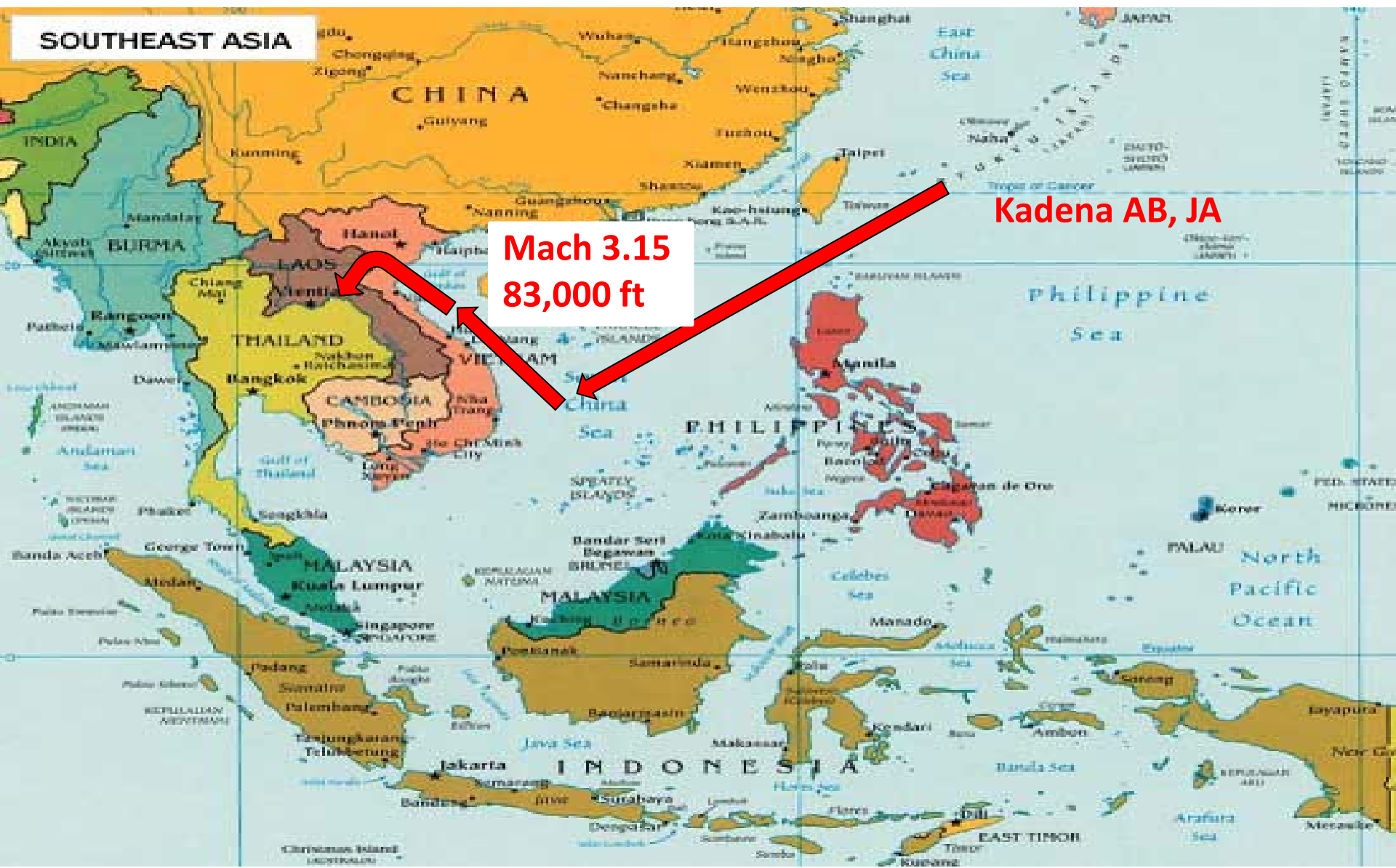
3.15 Mach – 83,000 ft

5600nm – 2 Refuelings

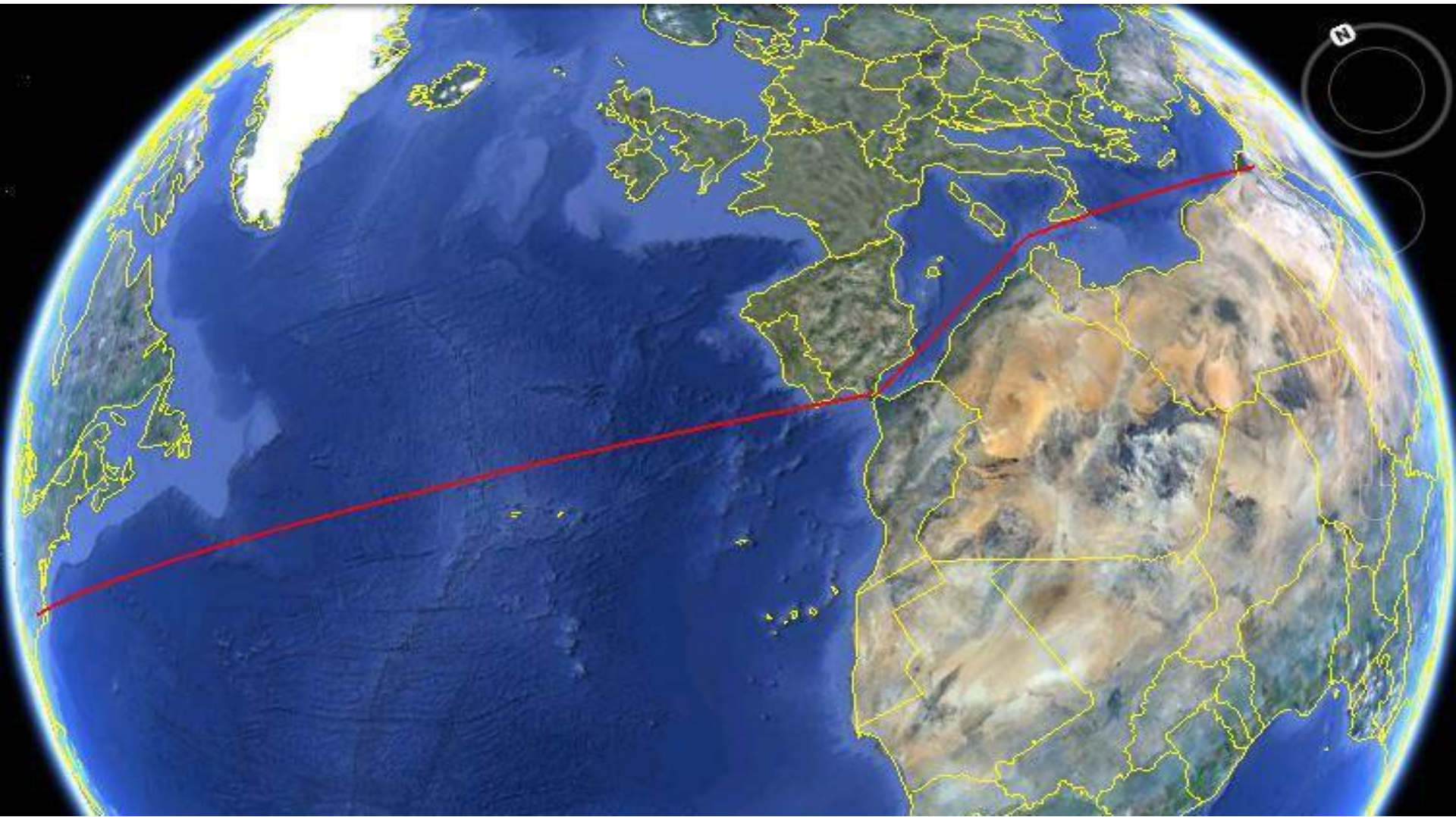
4 & 1/2 hours

War in Vietnam

Enemy SAM & Troop Movements



1973 Arab-Israeli War



**Missions: 10.5 – 11.4 hours, up to 6 refuelings, & up to 15,000 Miles
Enroute Flown at 3.00 Mach**

Israel / Egypt – Sinai 1973/74 War



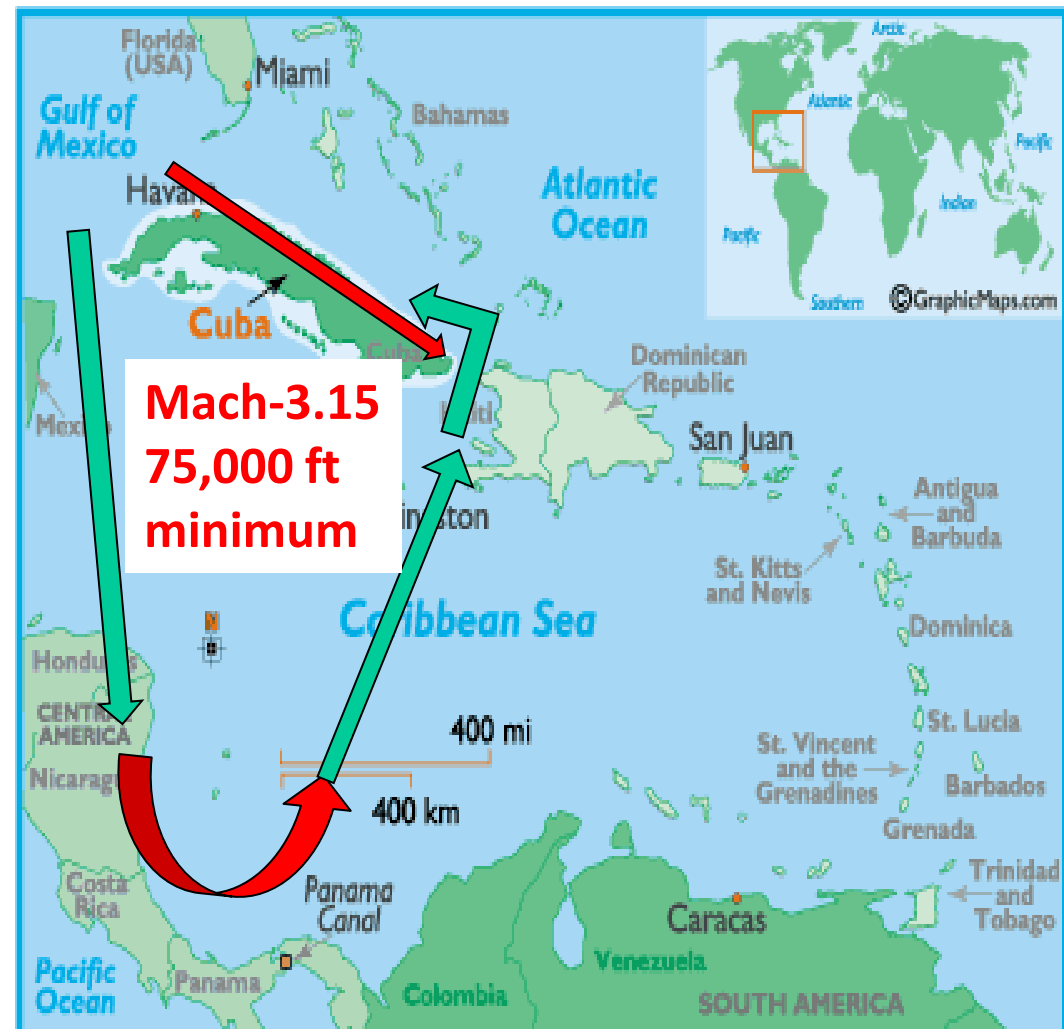
Petropavlovsk – Vladivostok

Soviet Naval Movements

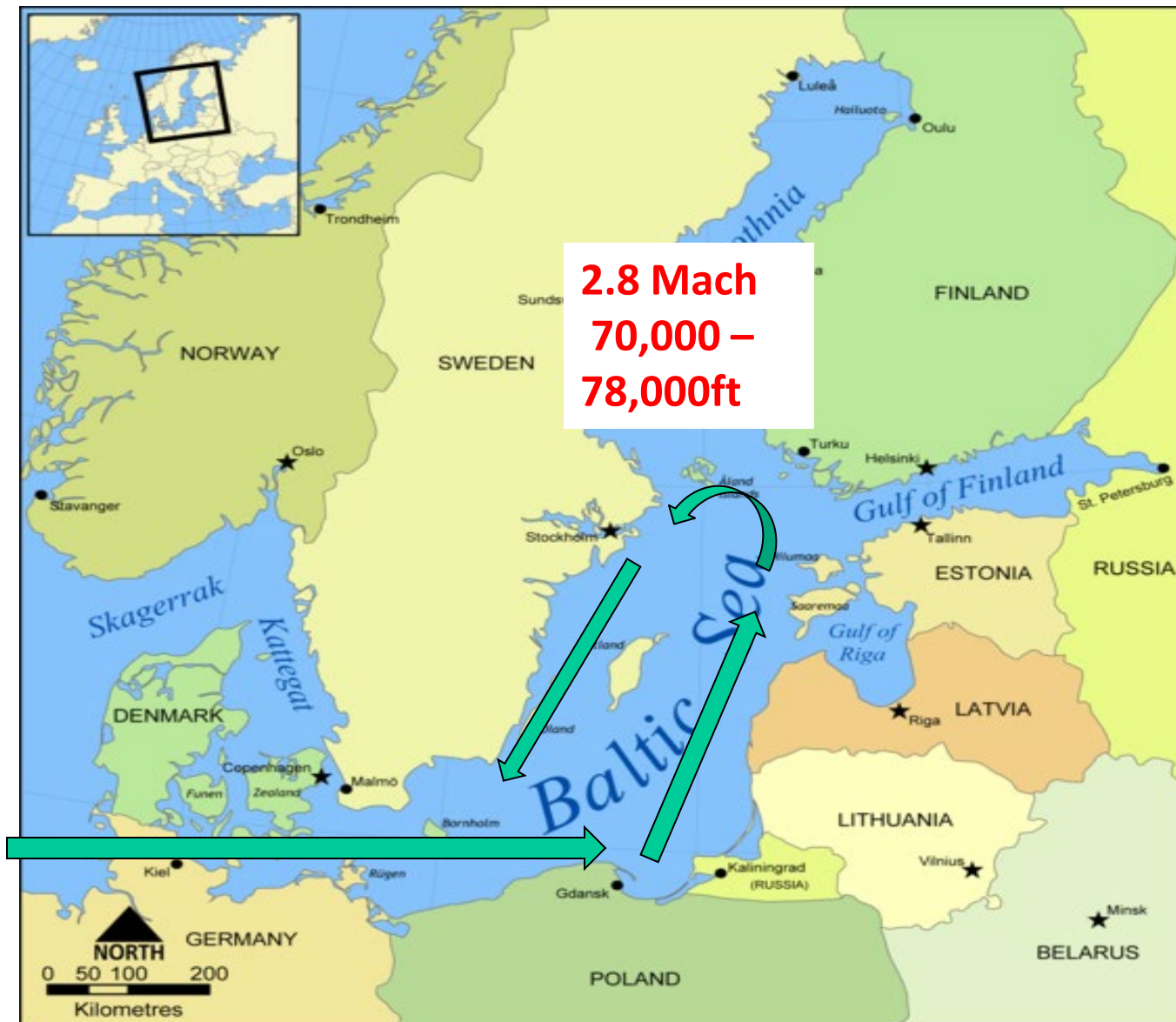


Cuba / Nicaragua

Missile & Aircraft Deployment & “Politics”

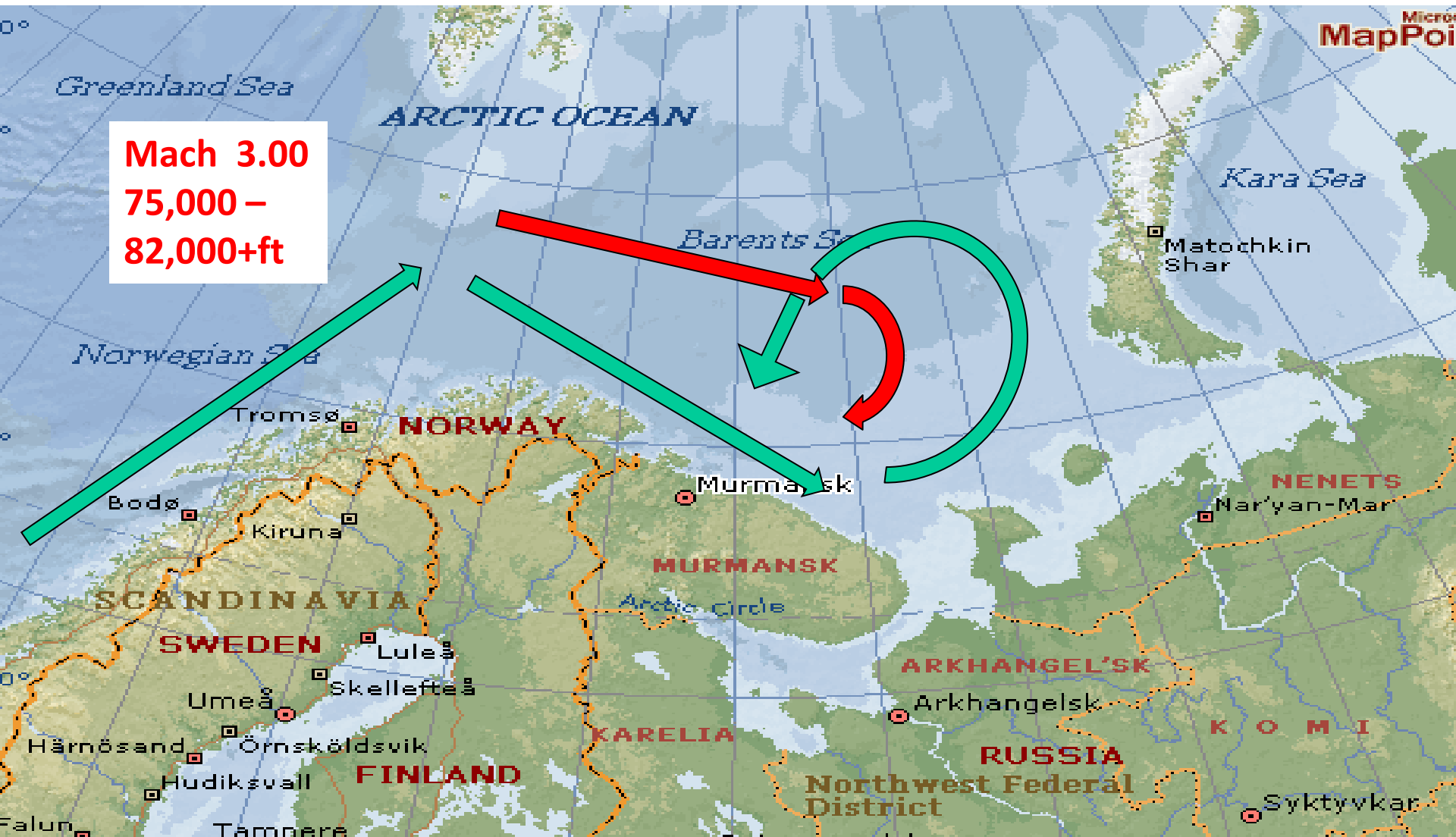


Warsaw Pact Missions – Baltic Troop Rotations and Placement



Murmansk

USSR Ballistic Missile fleet



Libya April 1986

Post Strike Reconnaissance



SR-71 Approach & Landing

- Land with normally less than 10,000lbs fuel

- Approach A/S 175 knots + fuel

- Land 155 knots + Fuel (~ 175+ MPH)

- Crosswind landing critical on tires

- Deploy drag chute on landing
 - jettison by 55 knots

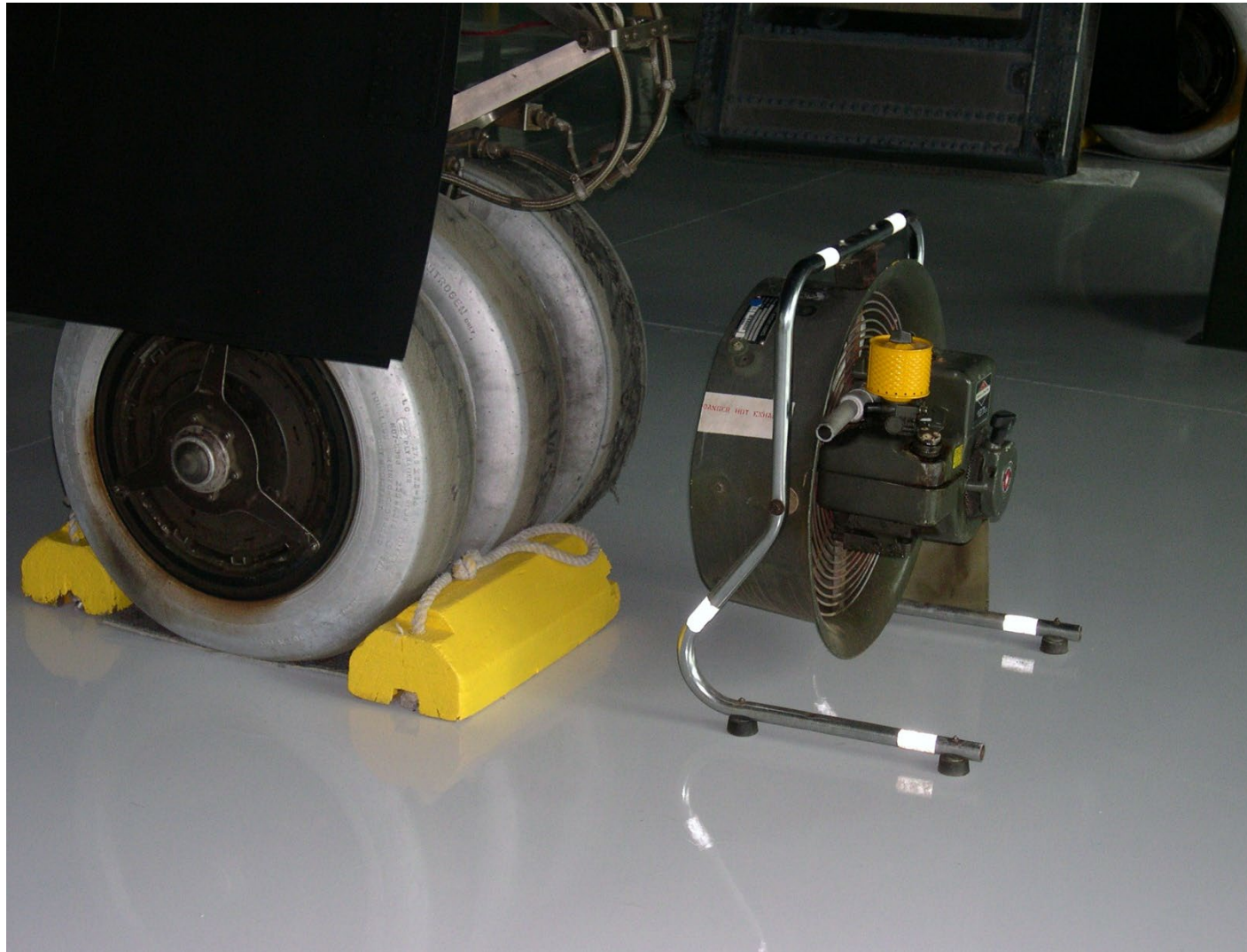
- Roll-out 4-5,000 ft on 10,000ft runway



After Taxing & Parking in SR-71 Shelter

As Engines are shut down cooling air is applied to the hot aircraft brakes

The brakes were actually undersized for the aircraft's weight to save on weight – creating a critical aircraft operating factor



DEF H download after Engine shut down

-Here a DEF H Defensive System is downloaded from a side bay onto a dolly which will then be wheeled into maintenance. The Side optical TEOC cameras were downloaded this same way – Most Efficient

-Aircraft optical sensor systems were complete units which included the Quartz optical glass window & would be installed into a side bay or with the panoramic camera being installed as one of the interchangeable noses.

-Aircraft nose had three configurations, training as you see at the UHC, SAR radar which externally looks the same or optical which had large glass windows in the center bottom of the nose



Initial Dark Room film assessment - preprocessing

- All film had to be inspected in the Dark room by hand to detect torn or broken film
- Color film had to be done in pitch black conditions
- Film cut into 500 ft lengths with headers and tails spliced on for processing This insured speedy processing and if there were an accident only a limited amount of film might be effected



Patch of the 9th Strategic Reconnaissance Wing



Wing For SR-71s and KC-135Qs. Later gained U-2s which they are still flying today. The USAF's Global Hawk, Unmanned Aerial Vehicle, is assigned with them at Beale AFB - Home of High Altitude Recon for USAF

FIRST STRATEGIC RECONNAISSANCE SQUADRON



The Only SR-71 Squadron. It's lineage went back to the first US Military Aero Squadron in the Army Signal Corp formed in 1913

FAREWELL – Last Shot of SR Fleet before being dispersed



Lockheed Martin Photo

Why Retirement? ... Cold War over -Threat diminished, Too Costly -\$85,000/hour, & Never had a Real Time Data Link to bring the information immediately to the Decision Maker