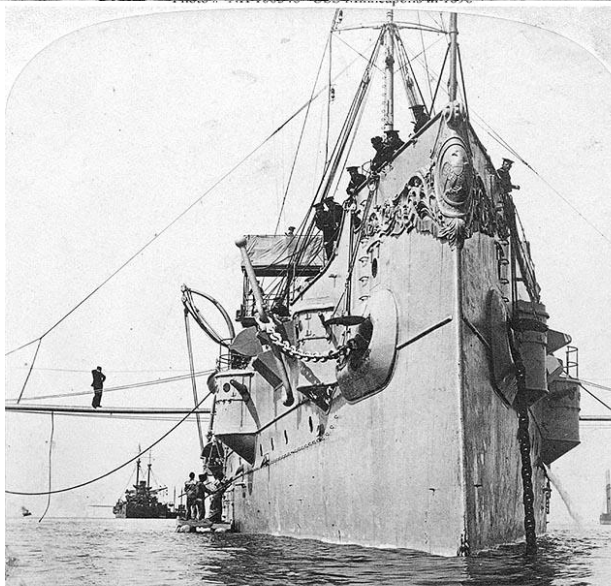
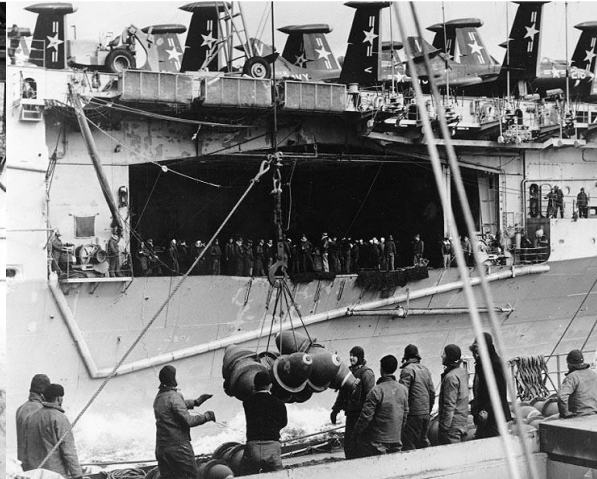


Combat Logistics Force: 1898 - Present

Photo # 80-G-13106 USS Neosho refuels USS Yorktown in heavy seas, May 1942



Photo # 80-G-439879 USS Philippine Sea takes on bombs from USS Mt. Katmai, Nov. 1950



Matt McCarton (CSC - Advanced Marine Center)

BLUF

- CLF history *is* history of entire USN. No small undertaking
- Force Structure / Operational Emphasis
 - Ship Characteristic details in back up material
- 1889 and 1898 genesis of blue water USN & CLF need
- But Pacific war 1942-45 genesis of UNREP as we know it
- Historically seven types of CLF Ships
 - AO, AE, AF, AFS, AOE, AOR, T-AKE. AO/AF usually leased/chartered
- Trend in 1950/60's toward multi-product, & SCN
 - Decrease #s offset by larger more capability ships
- Trend post-Vietnam
 - transition to MSC op control. Completed in 2004
 - Search for balance of **numbers**, **capability**, **affordability**
- Predicated on **stability**, **predictability**, **command of sea**
- Disclaimer: Based on FY08 05D1 tasker, but opinions are presenter's alone.

Overview / Primer

UNREP / CLF 101

CLF – Combat Logistics Force

UNREP – Underway Replenishment

- VERTREP – Vertical Replenishment
- CONREP – Connected Replenishment
 - RAS – Replenishment at Sea
 - FAS – Fueling at Sea

CONREP

- CLF ship (issuing ship) holds steady course/speed
- “Customer Ship” comes alongside, fires shot line to CLF
- CLF ship attaches wire to shot line. Drawn across water back to customer ship
- Secured at replenishment station
- Wire(s) placed under tension.
- Used to support fuel hoses (FAS) or pulleys, etc. (RAS)

VERTREP

- Helos for RAS



Customer Ship / Shot Line



RAS via CONREP

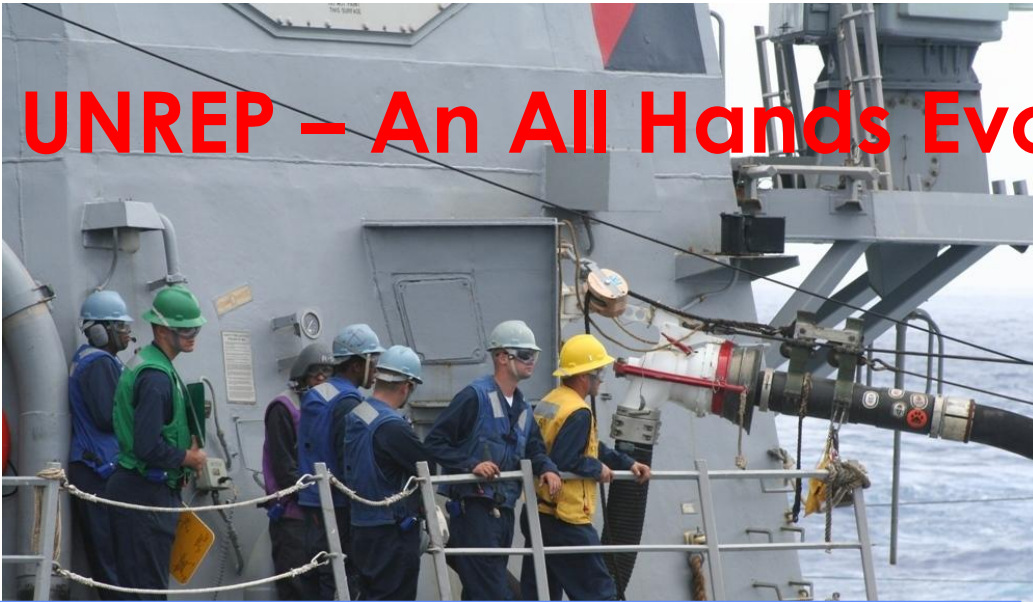


FAS via CONREP



RAS via VERTREP

UNREP – An All Hands Evolution...



...especially on smaller ships with limited CONREP/flight deck area. Larger ships, like CVN or LHA/D can use elevator/hangar to buy time.



~329 CLF Ships “Beans, Bullets, and Oil”

Vs. 1000’s of other Auxiliaries, 1889-2012

Tenders and Repair Ships

AD Destroyer Tender
AR Repair Ship
ARB Battle Damage Repair Ship
ARC Cable Repairing or Laying Ship
ARG Internal Combustion Engine Repair Ship
ARH Heavy-hull Repair Ship
ARL Landing Craft Repair Ship
ARSD Salvage Lifting Vessel
ARST Salvage Craft Tender
ARV Aircraft Repair Ship
ARVH Aircraft Repair Ship, Helicopter
AS Submarine Tender

Cargo Ships

ACS Crane Ship

AK Cargo Ship

AKD Cargo Ship Dock
AKL Light Cargo Ship
AKN Net Cargo Ship
AKR Vehicle Cargo Ship

AKS General Stores Issue Ship

AKV Aircraft Transport

Transports and Barracks Ships

AP Transport
APB Self-propelled Barracks Ship
APC Coastal Transport
APH Evacuation Transport
APM Mechanized Artillery Transport
APV Transport and Aircraft Ferry

Fleet Replenishment Ships

AE Ammunition Ship
AF Stores Ship
AFS Combat Stores Ship
AO Fleet Oiler
AOE Fast Combat Support Ship
AOR Replenishment Fleet Tanker
T-AKE Dry Cargo/Ammunition Ship

Aviation Support Ships (AV, AZ)

AV Seaplane Tender
AVB Advance Aviation Base Ship
AVD Seaplane Tender, Destroyer
AVM Guided Missile Ship
AVP Small Seaplane Tender
AVS Aviation Stores Issue Ship
AVT Auxiliary Aircraft Landing Training Ship
AZ Lighter-than-Air Aircraft Tender

Tugs, Rescue and Salvage Ships

ARS Rescue and Salvage Ship
ASR Submarine Rescue Vessel
AT Fleet Tug
ATA Auxiliary Fleet Tug
ATF Fleet Ocean Tug
ATO Fleet Tug (Old)
ATR Rescue Ocean Tug
ATS Salvage and Rescue Ship

Service Force Type (Misc.)

AB Crane Ship
AC Collier
ADG Degaussing Ship
AFD / ARD Dry Docks
AH Hospital Ship
AN Net Laying Ship
AOG Gasoline Tanker
AOT Oil Transporter
AW Distilling Ship
IX Miscellaneous Unclassified
HSV High Speed Vessel (HSV)

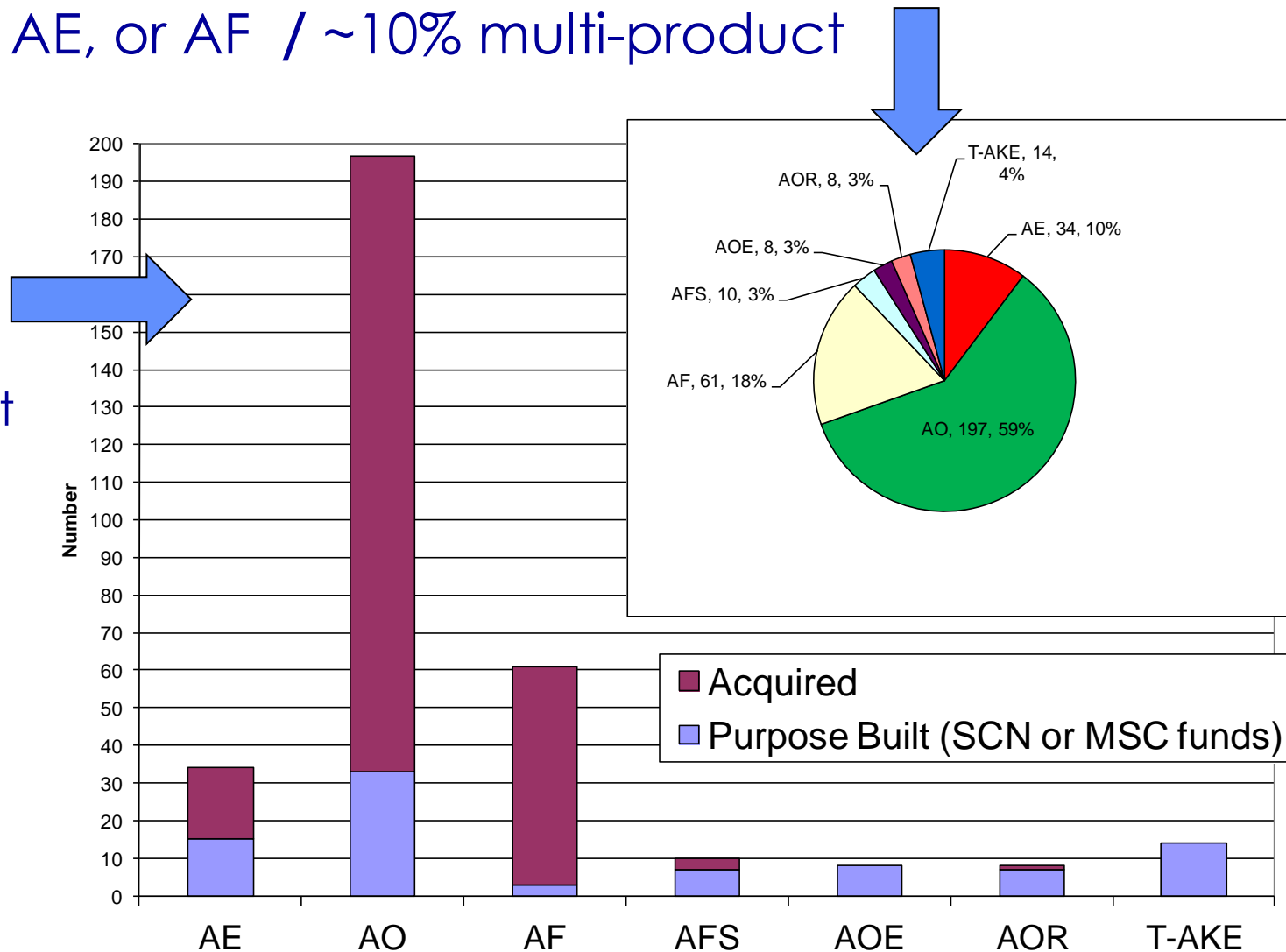
Miscellaneous

AG Miscellaneous Auxiliary
AGB Icebreaker
AGDS Deep Submergence Support Ship
AGEH Hydrofoil Research Ship
AGER Environmental Research Ship
AGF Command Ship
AGM Missile Range Instrumentation Ship
AGMR Major Communications Relay Ship
AGOR Oceanographic Research Ship
AGOS Ocean Surveillance Ship
AGP Motor Torpedo Boat Tender
AGR (YAGR) Radar Picket Ship
AGS Survey Ship
AGSC Coastal Surveying Ship
AGTR Technical Research Ship

CLF Ships, by Type & Procurement Method

- ~ 329 ships operated as CLF ships since 1900.
- ~90% AO, AE, or AF / ~10% multi-product

- 75% purchase, charter, or lease not purpose built
- Most acquisitions AO or AF for short-term needs and did not see lengthy service



Pre-World War II

Spanish American War & UNREP

- **1889 – Naval Renaissance and Birth of Modern Navy**
 - Heavy on combatants, fewer auxiliaries
- **1898- Blue water ships coming on line and war with Spain**
 - Need for UNREP for Cuba blockade
 - **Must coal in protected harbor ~30 miles away at Guantanamo because USN has no ability to safely coal at sea**
 - **Significant operational limitation**



Photo # NH 100346 Minneapolis in 1898

Texas coaling at anchor in background



Post Span-Am War Research

- Failure spurs General Board & R&D for gear and doctrine
- **UNREP gear on combatants or colliers?**
 - Not foregone conclusion
- 1904 -Prototype successfully tested on *Illinois* (BB 7)
 - Rejected by fleet. Detracts from combat mission

- **1913 -Test w/
collier *Cyclops* &
South Carolina (BB
26)**

- Slow UNREP rate
but feasible

- **Navy transitions
to oil**

- **But concept of
FAS proven**

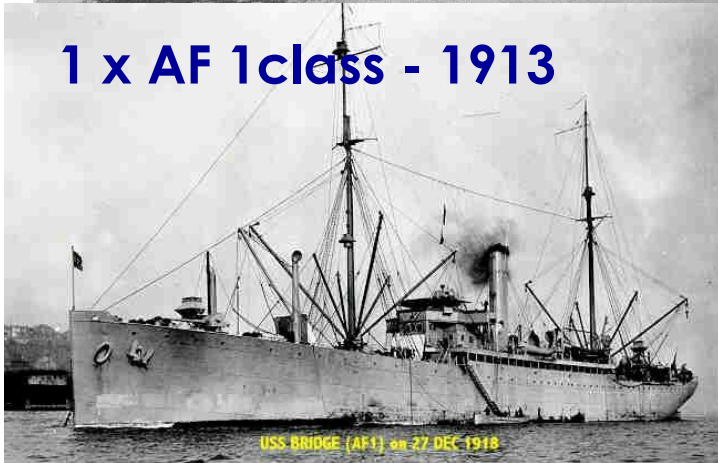


**RAS of stores / ammunition
not yet feasible**

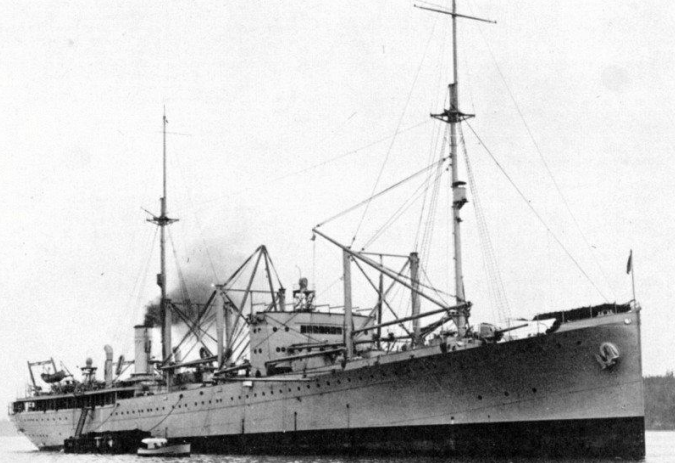
6 x AO 2 class – 1912



1 x AF 1 class - 1913



2 x AE 1 class – 1916



Force Structure - Interwar

- 9 x SCN (New Construction) CLF type ships 1912-1916
 - **No new SCN again until 1950s**
 - General Board funds combatants over AUX in time of tight budgets
 - Rationale: AUX can be STUFF.
- FAS jury-rigged between AO/DD in WWI
- 1920's growing OP AREA (Pacific) drives need for fleet logistics ships
- Early 1920's: fleet logistics matures
 - Fleet Base Force, US Fleet - tasked with defending Pacific bases & supplying ships.
 - 1925: Fleet Problem V includes FAS
- But ~ 14 CLF for ~ 180-200 warships for most of interwar Ranges-10 to 1 to 18 to 1.

Operational Concepts - Interwar

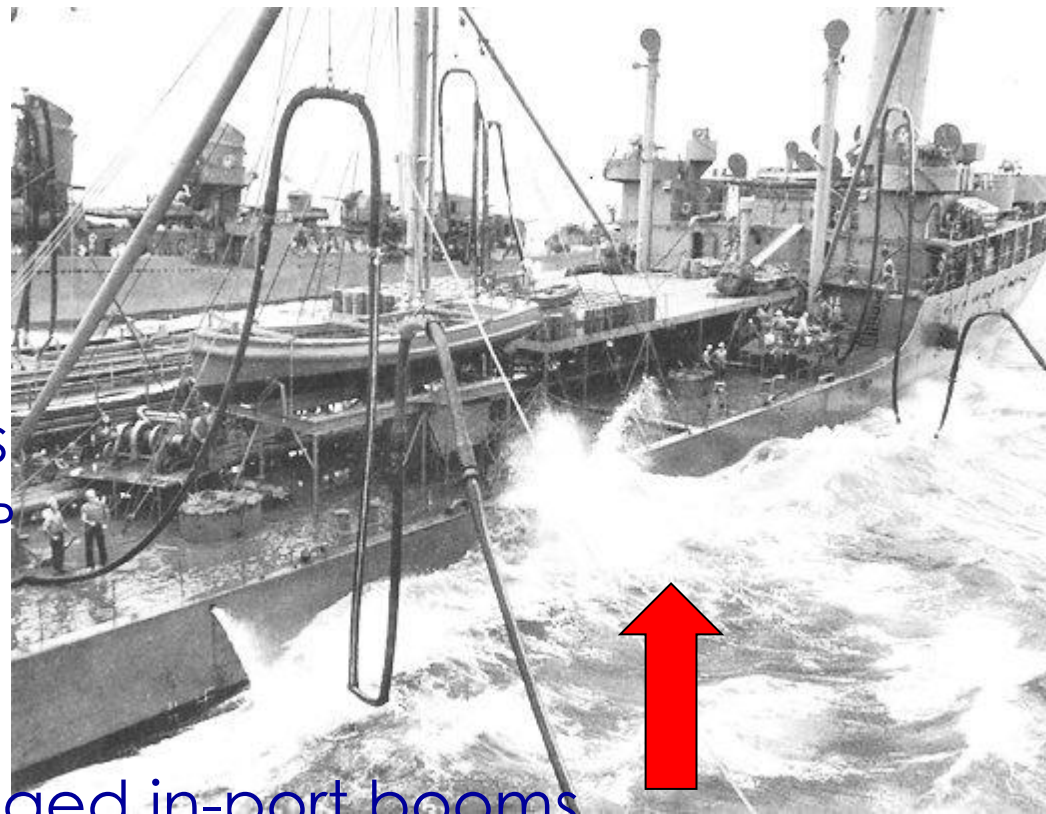
- Paucity of CLF not a big issue
- Resupply mostly at pier / protected anchorage
- 1920-30's anti-militarism, Depression, low OP tempo
- Interwar fleet maneuvers consume predictable rates of fuel and stores
- Ammunition expenditure rates low to zero
- Easier to schedule port calls to FAS (& RAS) vs. UNREP
- 2 x *Pyro* (AE 1) primarily shuttle ammo between bases

- So.....FAS not common
- Seen as a “stunt”. No need to incur risk... (until war).

World War II

War Looms

- Hitler, IJN menace
- Winter 1938-39 RADM
- Nimitz orders UNREP tests
 - Heavy cruiser proxy UNREP ship
 - DD customer ship
- UNREP Gear still jury-rigged in-port booms
- Results:
 - 10 knots better than slower
 - 12-15 knots better than 10
 - 20-25 knots feasible but maintaining ship separation difficult
 - 25+ more difficult
 - 28 knots: test stopped
 - Bad weather: 15 knot max and only into wind



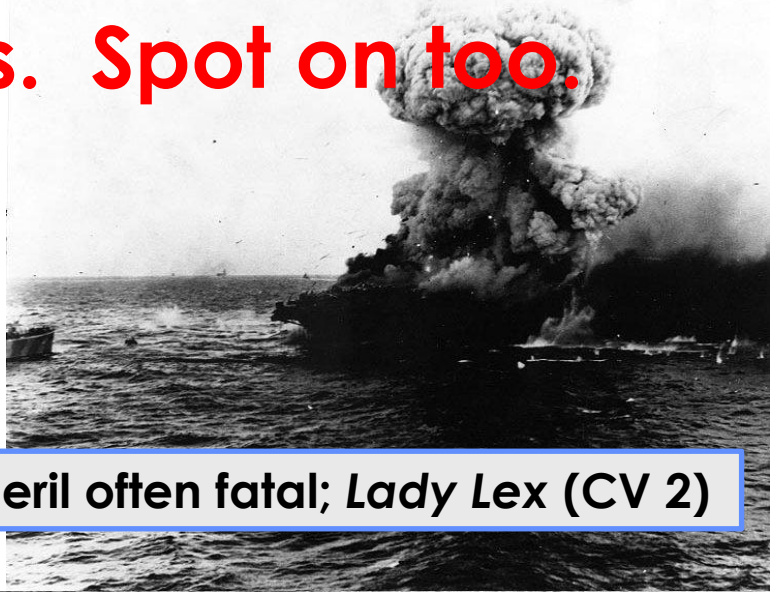
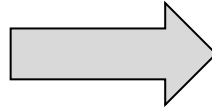
Force Structure / CONOPS – Early War

- 1939: USN purchases ~20 AO's
 - Accom for larger crew, modified to carry lube oil, grease, more masts and booms
- **Assumptions:** 1st priority in battle-**fuel** for **mobility (pre- & during battle)**. Battle tempo will not exhaust stores/ammo. Can be replenished after
- If no near bases (i.e. CentPac): advance warning of battle, fight w/ **stores/ammo** on board. Battle won't last too long & will be **climactic** (sink or win). If sunk, moot. If victorious, time to retire to base
- No purpose built CLF ships during all of WW 2.
- All ships purchased, chartered, or leased. Many others served CLF type roles on ad hoc basis (e.g. AKS / CVE)
- **Thus, no UNREP gear development**



USS Cimarron (AO 22)

Such were assumptions. Spot on too.



AO FAS of Yorktown at any peril

Climactic: Peril often fatal; Lady Lex (CV 2)

Coral Sea (MAY '42)



Midway (JUN '42)
Turnabout is fair play. Scratch 4

Photo # NH 73065 Japanese aircraft carrier Hiryu burning, morning of 5 June 1942



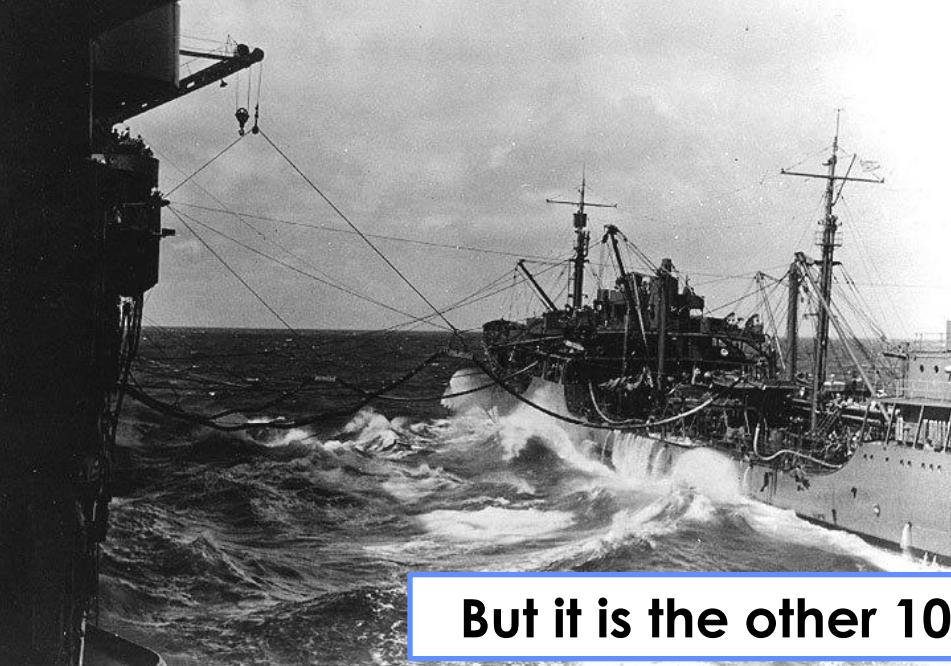
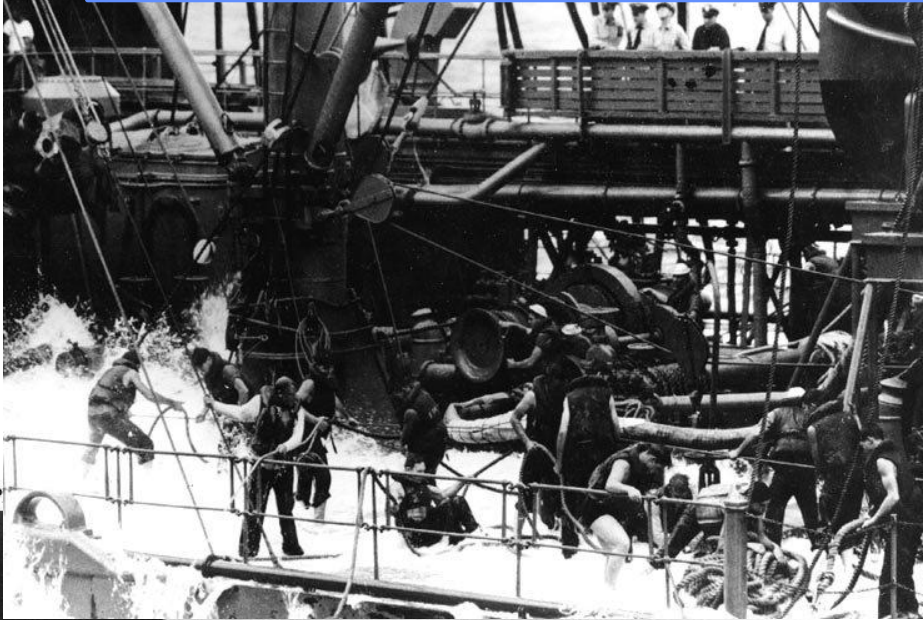
Enterprise at Santa Cruz (OCT 42)



Enterprise at Eastern Solomons (AUG '42)

Mobility/Scouting...Training/Luck

**AO FAS and RAS at protected anchorages –norm for most of war
If you think of this when you think logistics you'd be 90% correct**



But it is the other 10% that matters for CLF

Let's Back up a minute...

- Greatest naval war in history.
 - multiple theaters , scores of major campaigns & ship types, variety of CLF scenarios
 - No way to truly condense all CLF WW2 history into few slides, but here goes....

Theaters

Atlantic

Southwest Pacific

Central Pacific

Campaigns

Convoy Escort in North Atlantic, '41-'42

CV Ops in PAC DEC '41-Oct '42

invasion of North Africa, NOV '42.

Tarawa, NOV '43

CentPAC landings '44

Iwo Jima, FEB '45

Okinawa, APR '45

TF 38/58 ops near Japan, JUL-AUG ' 45

CLF Phase

1

2

3

CLF Phases & Organization - Pacific

Phase 1

- CV engage w/ IJN CV in strategic defensive
- AO's used for mobility / ad hoc RAS

Phase 2

- Amass forces for amphib assaults, fight IJN if needed
- AO for mobility, logistics bases to support landings

Phase 3

- Offensive. More amphib assaults. Seek out/ destroy IJN
- Final 2 months LSG – forerunner of CLF
 - Phase 2/3 overlap /complementary

Service Force, Pacific (SERVPAC) Service Squadrons (ServRon)

ServRon 8: Supply and distribution to the fleet of all its fuels, food, and ammunition – CONUS to rear base

ServRon 4 (new): NOV 43 to Funafuti act as afloat mobile logistics force

•ServRon 10: FEB 44 sent to Marshall Islands act as seabase
MAR 44 ServRon 10 absorbs ServRon

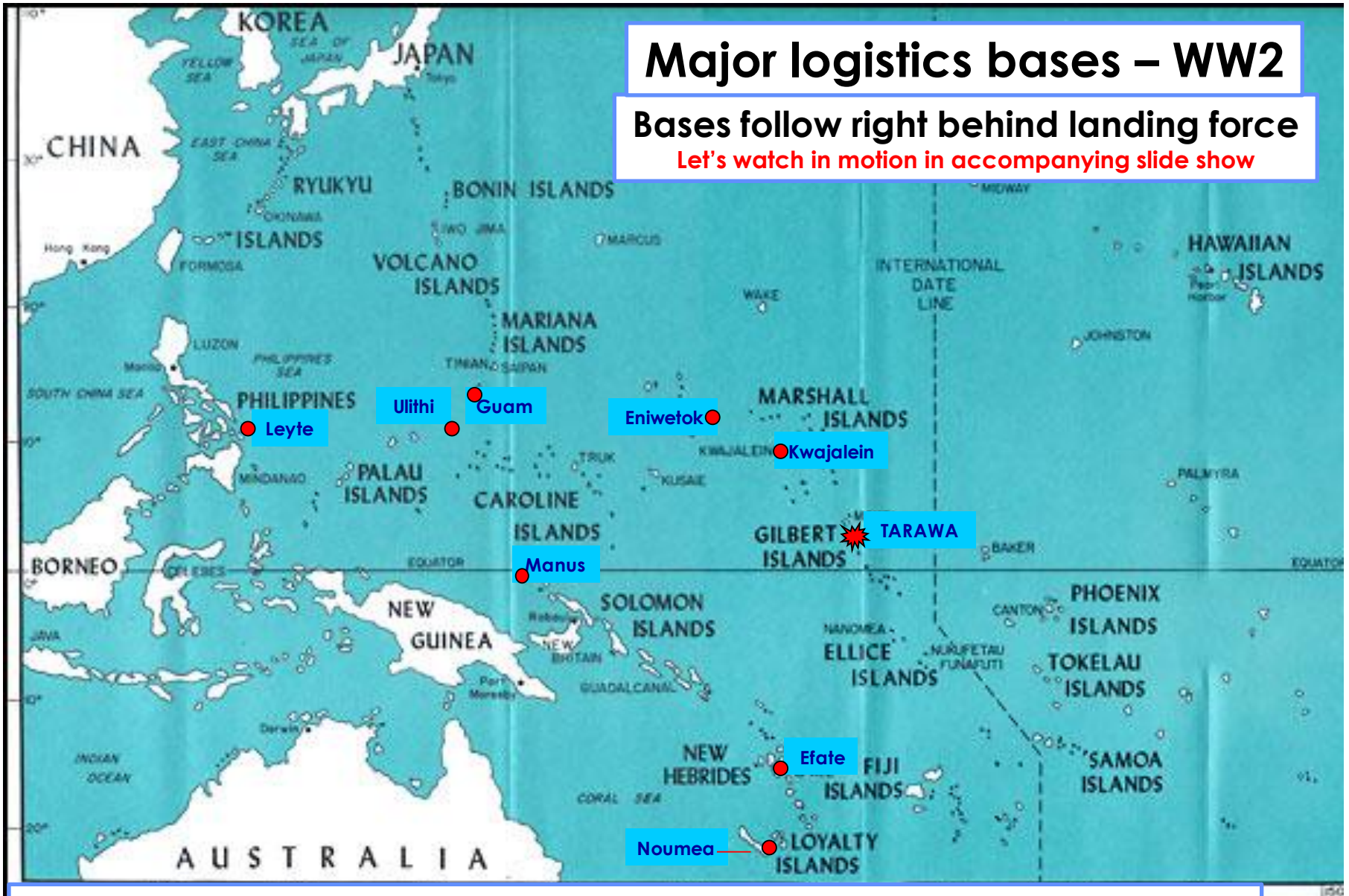
•ServRon 12: MAR 44. Harbor/base improvement. Sign of more ships

ServRon 6: aka Logistics Support Group (LSG), JAN 45 Act as CLF force for Fast Carrier TF to bomb Japan continually. Jury rig RAS. Sign of massive #'s of auxiliaries

Major logistics bases – WW2

Bases follow right behind landing force

Let's watch in motion in accompanying slide show



Vast majority of replenishment comes at protected anchorages

MAR 44-SEP 45 - Fast Carrier TF never again retire as unit to Pearl Harbor

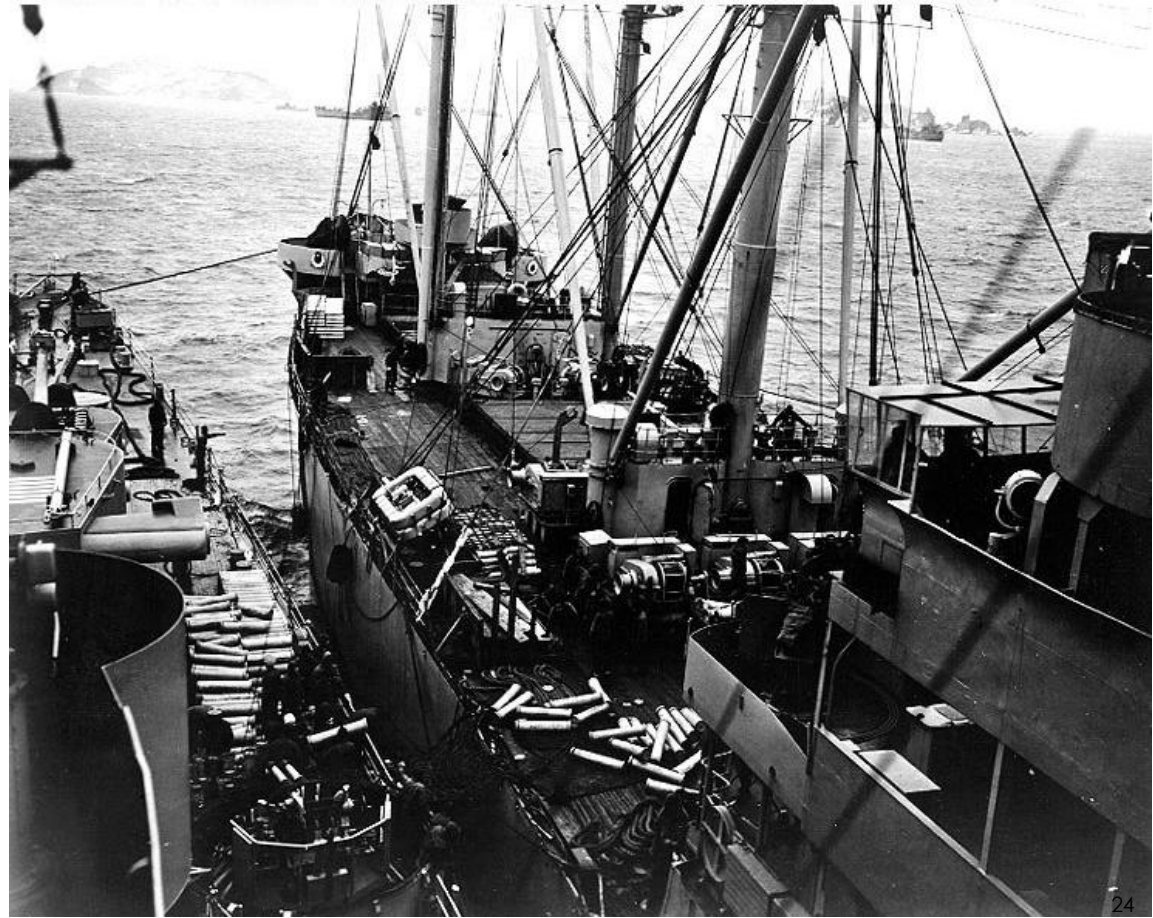
Mind Numbing Stats Make it All Possible

| <u>Date</u> | <u>Number of Ships</u> |
|-------------|--|
| • SEP 43 | 324 |
| • MAR 44 | 990 |
| • FEB 45 | 1432 |
| • AUG 45 | 2,930 |
| | • ServRon 2: 1,081 |
| | • SR 6: 107 |
| | • SR 8: 727 |
| | • SR 10: 609 |
| | • SR 12 – 39 |
| | • Service Force 7 th Fleet: 367 |
| | • Utility Wing: 305 planes |

- **Service Force, Pacific personnel: 30,369 officers / 425,945 enlisted**
- **1/6 of the USN at peak**

Korean War

- Massive demobilization after WW 2. Korean War starts w/more CLF than 1941, but none in theater,
- Scramble CLF while clinging to Pusan perimeter
 - sustained air strikes from CV in Sea of Japan.
 - Relentless OPTEMPO quickly consumes ordnance
 - CV must return to Japan often
- CLF needed to maximize CV time on station
- CLF/UNREP ops resurrected for Korea using same jury-rigged UNREP gear



UNREP of Ammunition from AE

- By Fall 1950 Crisis averted. CV can stay on station
- At cost of CLF worked hard / unsafe
 - Ammo often pre-staged on AE weather deck day before
 - Night UNREP to maximize CV time on target
 - AE / CV average transfer of 125 tons ammo per hour

Photo # 80-G-439879 USS Philippine Sea takes on bombs from USS Mt. Katmai, Nov. 1950



Photo # 80-G-420962 Moving bombs aboard USS Philippine Sea, October 1950



UNREP of Stores from AF

- Booms frequently failed. Transfer wire ropes often “tightlined” when CLF ship and customer rolled apart. No compensating system to relieve tension on transfer wire ropes was then available
- UNREP must become more efficient and specialized
- major reassessment of CLF and UNREP in 1952 (more on this later)

Photo # 80-G-424637 USS Graffias replenishes USS Missouri, Dec. 1950

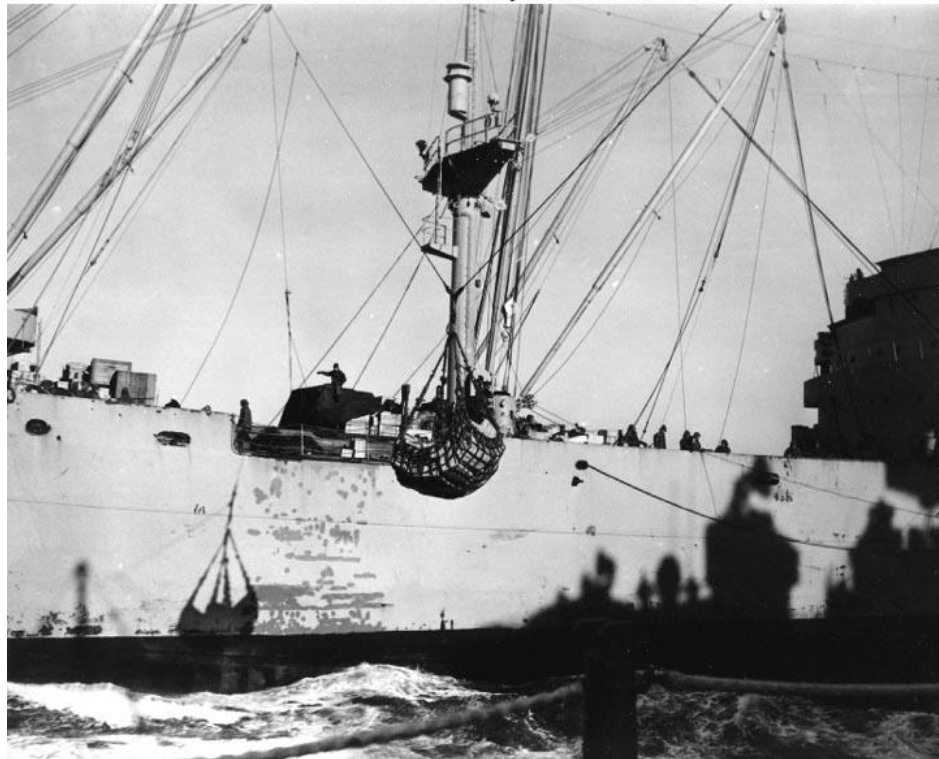


Photo # 80-G-424636 Underway replenishment on USS Missouri, December 1950

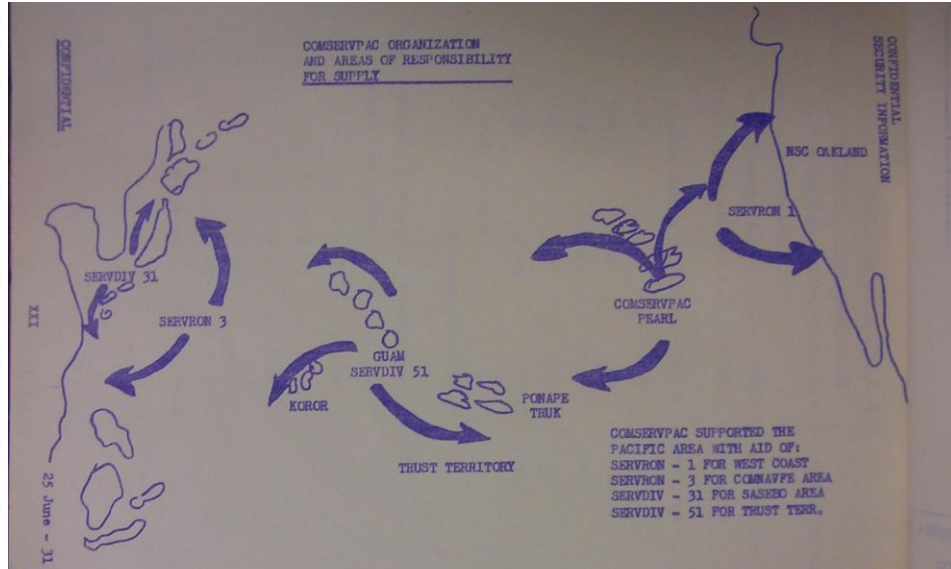
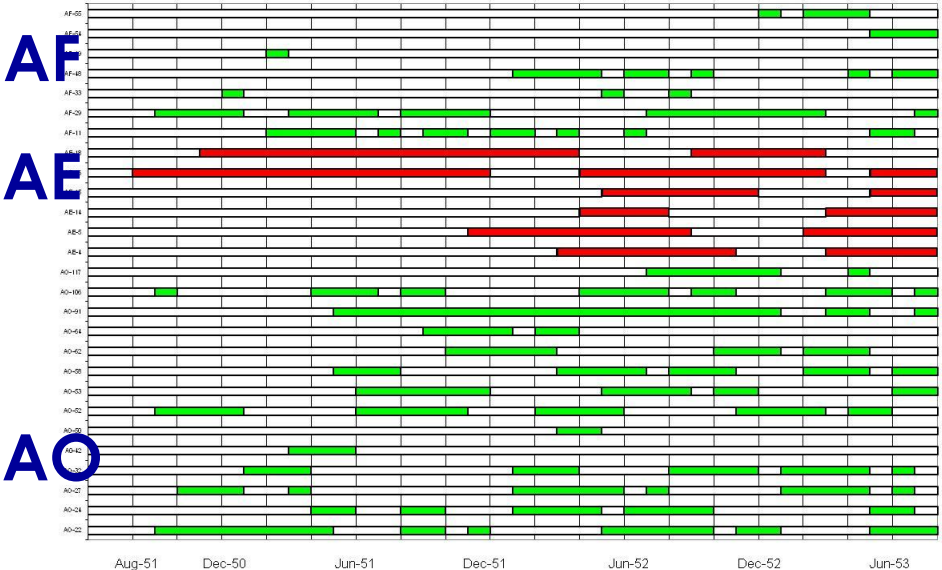


Deficiencies

- UNREP OPS inadequacies in reliability / efficiency.
 - existed in World War II, but tolerated because of urgency
 - overcome by massive combined size /capability of the naval task forces operating in 1944-45
- Reconstitute Service Squadrons
 - ServRon 3 JUL 1950.
 - provide logistic support to Seventh Fleet
 - Service Division 31 (ServDiv 31)
 - logistic support to all ships in Far East except Seventh Fleet
 - Just like Vietnam CV ops and NGFS ops don't stop other Cold War commitments
- SERVPAC supports 128 ships in JUN 1950
- NOV 1950, SERVPAC supports 546 ships

Korea after Initial Crisis Passes

- TF 77 (3 CV's) replenished every 4days
 - ~150K gallons AVGAS / 300K gallons NSFO / 250 tons ammo each CV
 - UNREP'd by 2 x AO, 1-2 x AE and, as needed AF /other Aux.
- Coordinated ship movements allowed combatants to leave station and rendezvous with CLF ships and systematically receive their products in turn (the "chainsaw" method).
 - usually done leeward of near island, weather more favorable



Pax Americana and the New Normal

- Comparatively smaller navy and fewer CLF ships
- Start of move toward **QUALITY** (efficiency /technological superiority) to overcome **QUANTITY**
- Korea set pattern: Command of sea meant (1) CLF numbers, (2) on-station time, (3) UNREP rates are limiting factors in keeping warships on station
- Significant contributing factor in USN's ability to project power from sea since 1945.
 - One of most consistently successful aspects of USN OPS since WW 2
- AE and AF UNREP common now. Hard to remember prior novelty



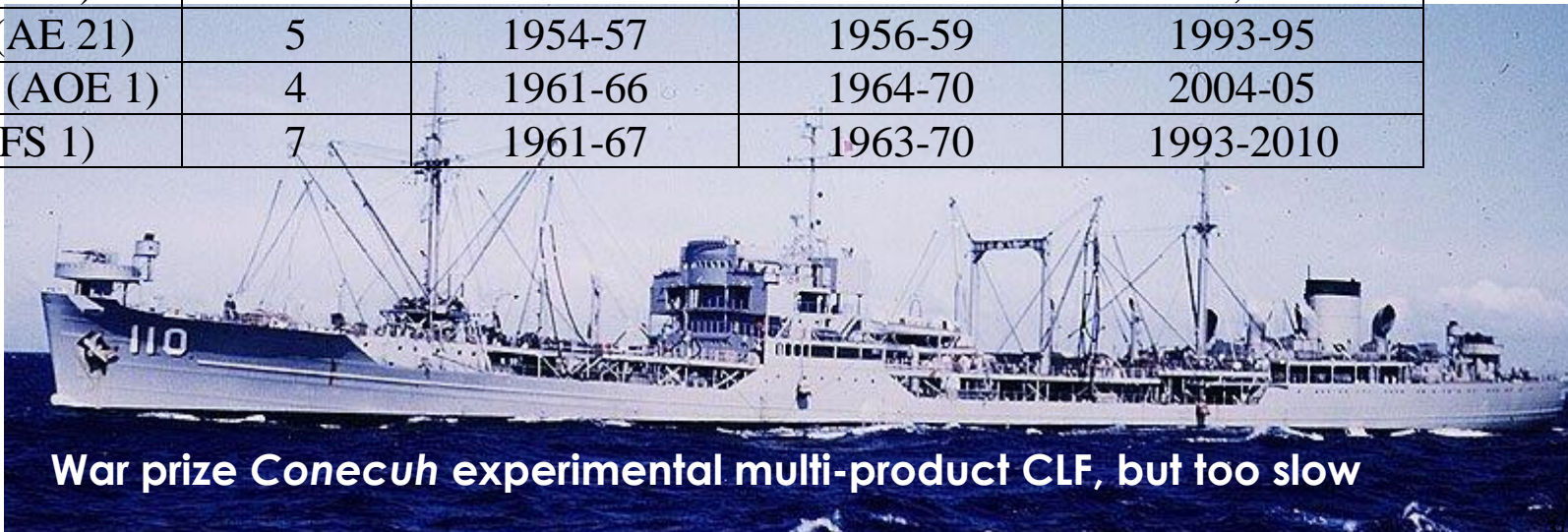
“what can haze gray do for you?”

CLF Renaissance

New Ships

- Recognition of Cold War duties & CLF shortcomings
- CNO convenes CLF conference, San Fran, SEP 1952
 - ultimately led to 15 years' worth (1953-1967) of sustained procurement of purpose-built CLF ships
 - Military Sea Transportation Service (MSTS) also created. Many AO's placed in MSTS to support worldwide mobility

| Class | # of Ships | FY Authorized | Commissioned | Decommissioned |
|---------------------------|------------|---------------|--------------|----------------|
| <i>Conecuh</i> (AOR 110) | 1 | n/a& | 1952 | 1956 |
| <i>Neosho</i> (AO 143) | 6 | 1953* | 1954-56 | 1991-92 |
| <i>Rigel</i> (AF 58) | 2 | 1953 | 1955 | 1977, 1994 |
| <i>Suribachi</i> (AE 21) | 5 | 1954-57 | 1956-59 | 1993-95 |
| <i>Sacramento</i> (AOE 1) | 4 | 1961-66 | 1964-70 | 2004-05 |
| <i>Mars</i> (AFS 1) | 7 | 1961-67 | 1963-70 | 1993-2010 |



War prize *Conecuh* experimental multi-product CLF, but too slow

- AO/AF/AE – all larger, faster than predecessors
- Neosho (AO 143) – 1st SCN CLF since WWI
 - 150 ft. longer
 - 180k barrel vice 140k
- AF (58)
 - holds & pre-staging areas refrigerated

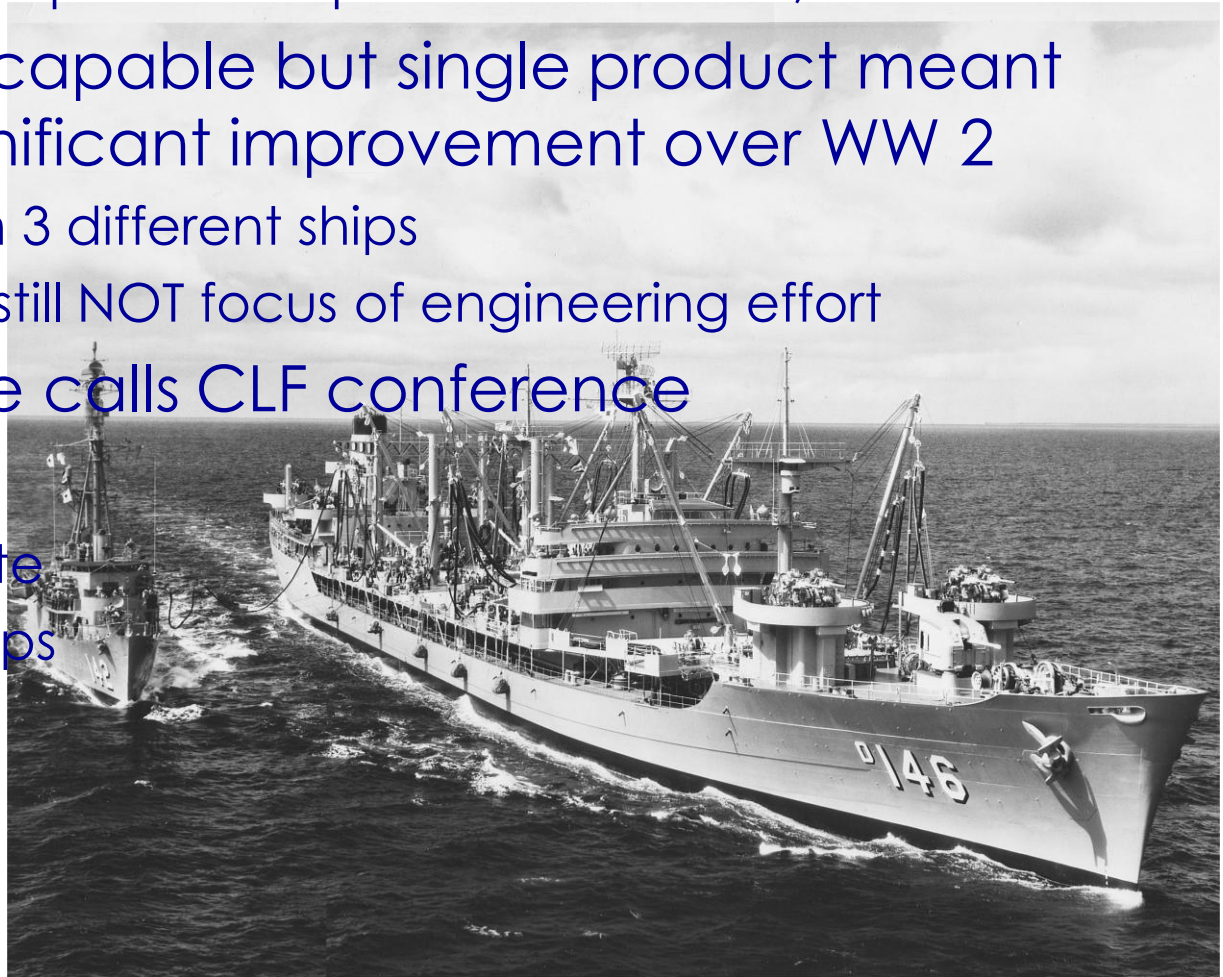


AE (21) - 5 holds, 3 fitted for palletized ammo. Each hold 2 cargo elevators. Battery-powered forklifts



Multi-Product Concept

- Stalwarts of the Cold War
 - In 13 years (1955-1967) Neosho (AO 143) transferred over 640 million gallons petroleum products in over 2,500 UNREPs
- New ships were capable but single product meant they weren't significant improvement over WW 2
 - Must UNREP from 3 different ships
 - Transfer systems still NOT focus of engineering effort
- 1957: CNO Burke calls CLF conference
- Two fixes
 - Speed UNREP rate
 - Multi-product ships



4 x Sacramento (AOE 1) Class

- ADM Burke's staff determines fuel, stores, and ammo needs to support wartime CVBG
 - Analysis shows multi-product ship should carry all 3 products & be large enough for speed to operate w/ CV
 - Result: **Fast Combat Support Ship (AOE)**
- Large, expensive on per ship cost basis but cheaper in aggregate than 3 ships it functionally replaced.
 - Only stores capability less than combined carrying capability of AO, AE, and AFS.
- largest (793 feet long) most capable AUX ever built
 - Fuel capacity of an AO. Ammo capacity of an AE. Partial refer capacity of an AF
 - 26 knots
 - Based on North Carolina (BB 55) hull
 - Ability to hold steady course even in Sea State 5 & night

- *Sacramento* originally equipped with first Fast Automated Shuttle Transfer (FAST) system
 - prone to equipment malfunctions.
 - Standard Tensioned Replenishment Alongside Method (STREAM) system later installed
- NOV '64: maiden deployment, 175-day WestPac Provide in-port services in Japan & UNREP ships in South China Sea for 4 months
 - Served 294 ships, transferred 35 million gal. fuel, 1,191 short tons provisions, and 670 tons of ammo



Mars (AFS 1) Class

- Second multi-product CLF ship
- Combined capabilities of AF, AKS and ARV
 - General Stores Issue Ship (AKS): spare parts, housekeeping items and multitude miscellaneous items
 - Aircraft Repair Ship (ARV): aircraft engines / aviation-parts.
- AKS /ARV didn't carry vital CLF type cargo

AFS concept
recognition that
USN continuous
forward posture
required
logistical
efficiencies

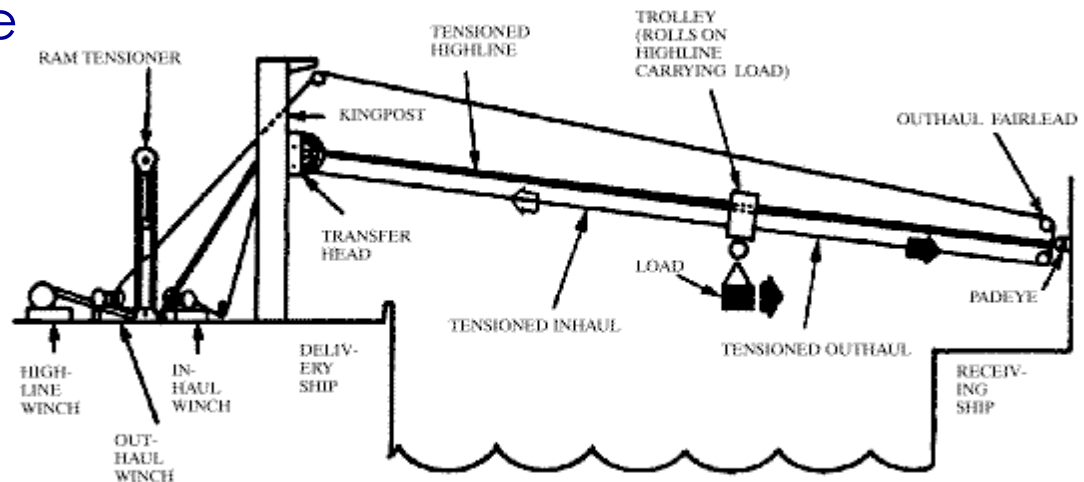
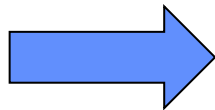


Single-product still introduced /operated. Envisioned as shuttle ships, material consolidated on AOE's for final delivery

UNREP Gear

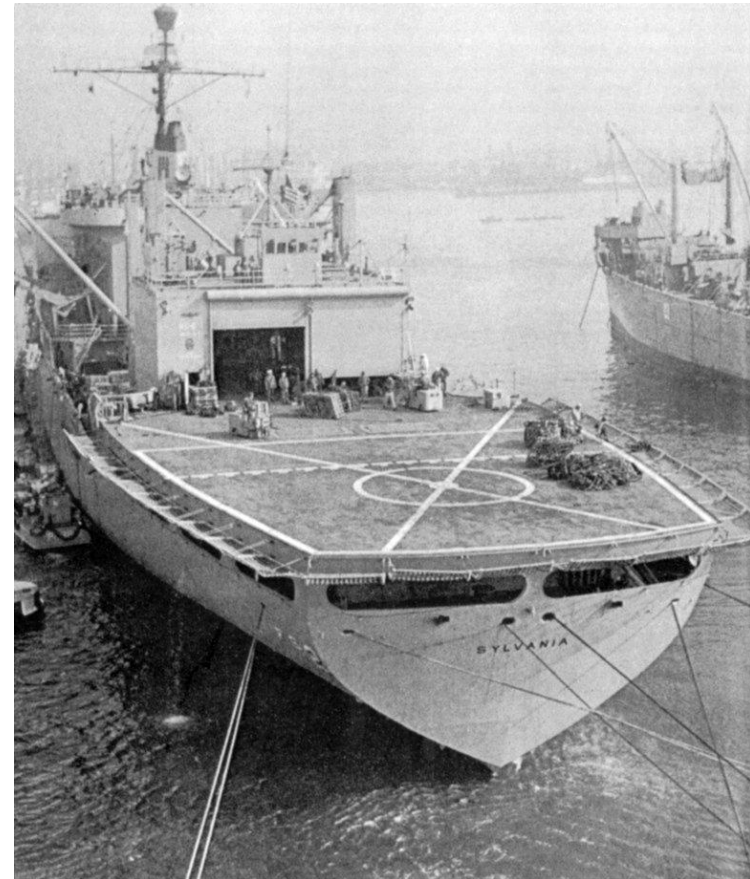
- Counterweight-tensioned spanwire systems
 - Fix problem with wire ropes parting
 - Back fit on all AO's
 - Later put on AE's w/ less success, replaced w/ hydraulic ram tensioner
- Double hose rig
 - Increase fuel rates
- Fast Automated Shuttle Transfer (FAST)
 - Speed up rates and handle delicate Surface-to-Air missiles
 - High breakdown rate

- STREAM



VERTREP

- Late 1950's: helicopters seen as method to increase UNREP rates
- New construction and back fit



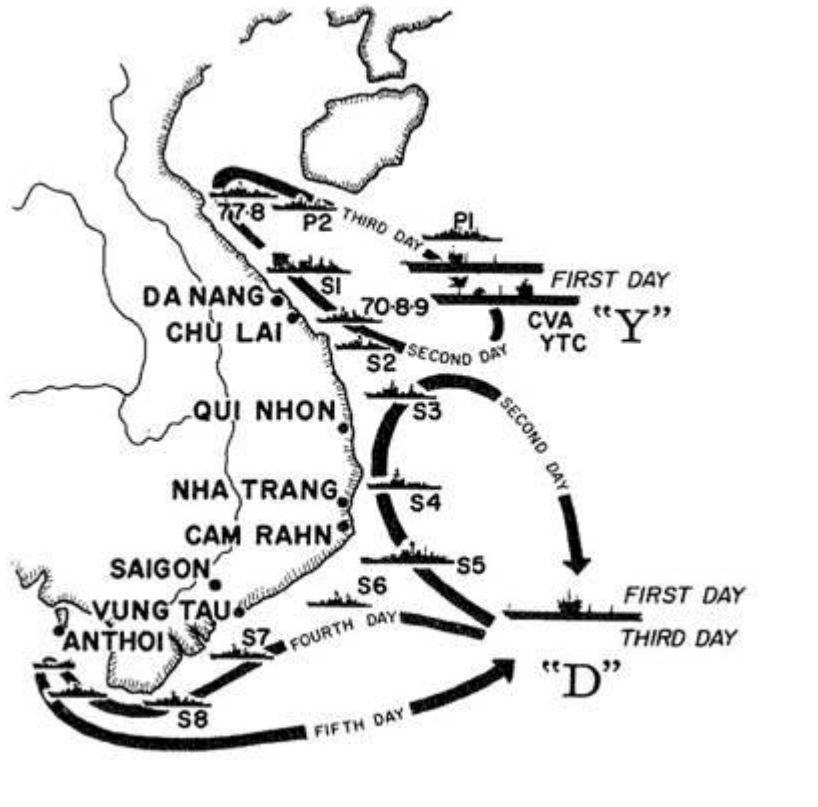
Vietnam

Photo # USN 1142142 USS Hornet replenishes from USS Sacramento, June 1967

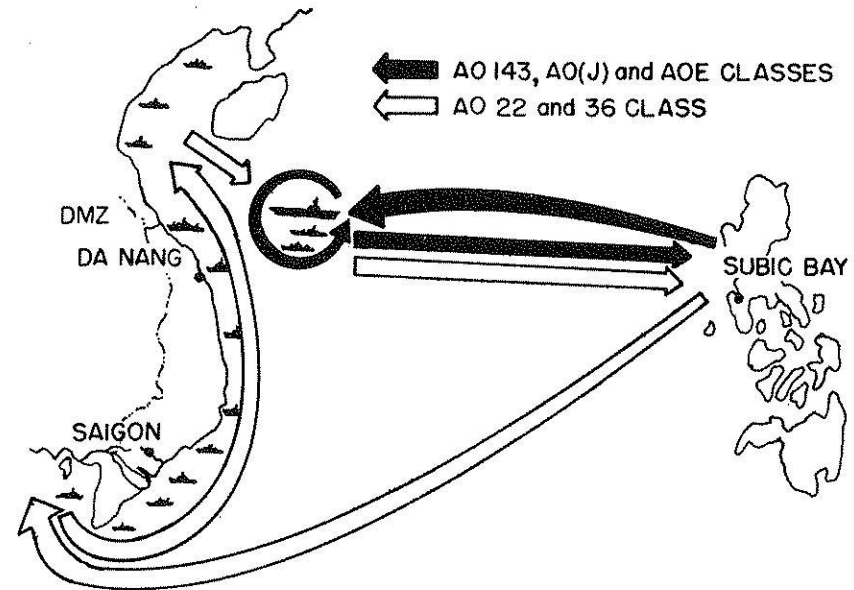


More of the Same.....

- Continuation of Korean War model
 - Command of sea
- Increasingly capable aircraft and CV/CVNs
- CLF op cycle become highly systematic
- **At least two CV off of Southeast Asia for over 12 years!**



UNREP cycles 1965 to mid-1966



UNREP Cycles after June 1967

...but even greater challenges and accomplishments

- Large numbers of ground forces, few big ports besides Saigon and later Cam Ranh Bay
- Korea: major ship repair facilities/warehouses in Sasebo, 150 miles
- Vietnam: nearest major supply /repair yard in Subic Bay, 850 miles
- Much greater rate of expenditure of ammo, supplies
- Record UNREP rates continually made and then broken
- Most sustained CLF/UNREP operations in USN history
 - 21,000 items for UNREP vs. 100 in WW 2
 - CVN 65 peak month 4,478 tons ammo vs. CV 6's 2,000 tons entire WW2
- Highly successful use of multi-product AOE's to sustain CV ops

% of supplies UNREP'd (CONREP/VERTREP) in typical year in Vietnam (FY67)

| | |
|-------------------|----------|
| Ship fuel | 70% |
| Jet fuel | 95% |
| Aviation Gasoline | Over 99% |
| Ammunition | 95% |
| Provisions | 97% |
| Stores | 70% |

Monthly UNREP comparison, Okinawa vs. Vietnam

| | Peak of Okinawa Campaign (April 1945) | Vietnam - FY67 |
|---------------------------------------|--|-----------------------|
| Ammunition (Short tons) | 7,000 | 15,000 |
| Aviation fuel (barrels) | 221,000 | 450,000 |
| Provisions (tons) | 2,800 | 2,699 |
| Mail (pounds) | 1,005,000 | 3,400,000 |
| Stores line items available for UNREP | 100 | 21,215 |

Far fewer CLF ships involved in Vietnam in a given month than at Okinawa

- AVG of 10 ships in theater at all times 1965-73
- Greater use of helicopters
 - 2/3 of AFS replenishments by helo
- AE's always in short supply.
 - AE crews break backs to keep ground troops supplied with ammo & jury rig risky multi-product capability. Ordered to slow down for safety. LANT AE's often in-chopped
 - 8 AE 26 class SCN 1965-68. Bucks trends for multi-product



Vietnam War CLF Use

AOR

AOE

AFS

AF

AE

AO



AOR

- 1965: AOR -austere AOE for Essex CVS
 - 2/3 speed of AOE based on cost-benefit analysis
 - Small % of AOE's ammo capacity because of lower expenditure rates of ASW task groups
 - ASW roles soon goes away. AOR used in Vietnam. Shortcomings tolerated because of war emergency
 - Late 1970's Persian Gulf / Indian Ocean ops reveal flaws



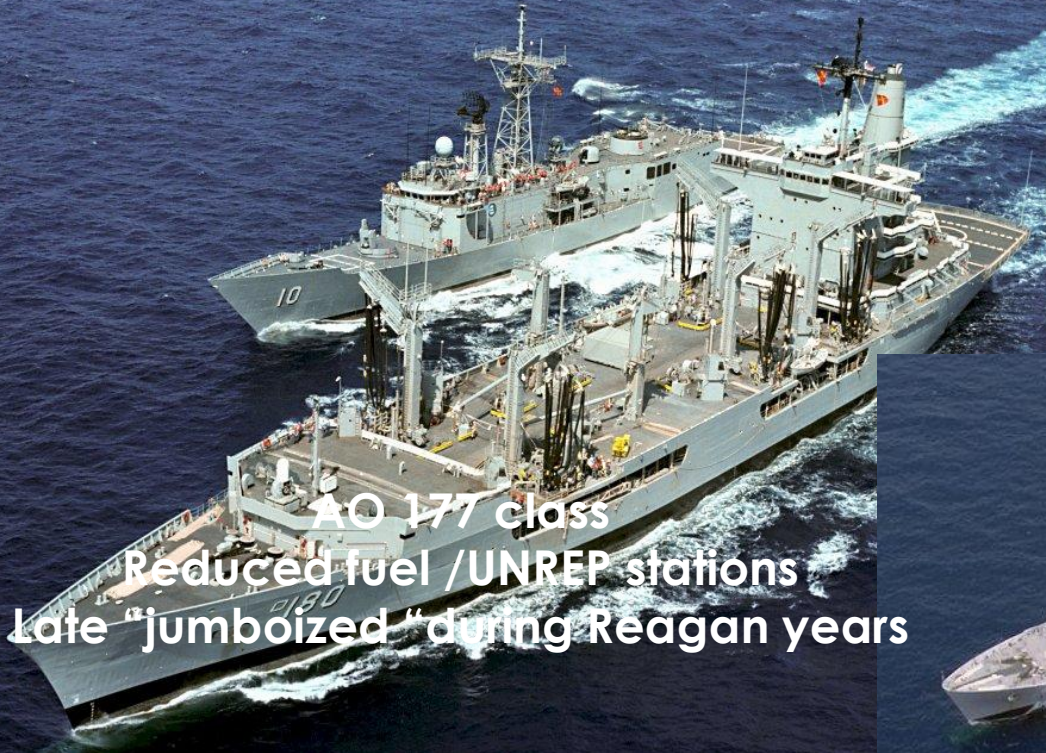
Post-Vietnam & Post Cold War

Post Vietnam

- Post war Budget Crunch / WW2 Bloc Obsolescence
 - 1969-73: 50 CLF ships decommissioned
 - Unintended consequence of AOE/AFS is shortage of ships.
- Search for immediate cost savings
 - (1) cancel deployments & use on station ships, (2) use helos instead, (3) reduce shore side support orgs
- Longer term Solutions
 - transfer of CLF to MSC
 - Backfit UNREP gear on CLF ships to transfer multiple products (“**mini-multi-product**” concept) vs more AOE/AFS
 - Outfit commercial ships with UNREP gear for shuttle ships use during contingencies
- Austere designs and **foreign purchases**
 - AO 177, AOE 6, **T-AFS 8**

Search for Flexibility / affordability: Largely the CLF world we still live in.

Austere Designs



AO 177 class
Reduced fuel /UNREP stations
Late "jumboized" during Reagan years



AOE 6 class
Delete 1 cargo hold and 1 UNREP station



AFS 8 class. Purchase from UK
Direct transfer to MSC

While we are on ships and MSC....Designed for MSC



**T-AO 187 class
1st SCN CLF designed for MSC crew/ops**

**T-AKE 1 class
replace AE/AFS**



5th Fleet Operations

- Quarterly 30-day deployments of CV/CVN to Indian Ocean / Persian Gulf starting in mid 1970s
 - Show the flag requires only AO. AE and AF not necessary. Mail flown in
- 1979. Longer Presence in region taxes CLF system
 - Nearest **reliable** port was Diego Garcia – 2,000 miles from Persian Gulf, but not a well developed base
 - Subic 5,000 miles away. Difficult environment (sand)
- Severe shortage of CLF
 - AO/AF high demand. AE not
 - AOR found wanting
 - Commercial augmentation
- 1980's – “Airheads” established in theater



AFS 4, Indian Ocean, 1980

Desert Shield / Storm & OEF/OIF

- 1980's Experience pays off
 - Established supply bases in Persian Gulf by 1990
 - Augmented by intra-theater helo/C-9 flight ops
- 20+ CLF ships at peak (~40% of entire USN inventory)
- Doctrine
 - Other CLF ships shuttle products to T-AOE, which operate organically as station ships with battle force.
 - Not strictly followed
- Flexible operating profiles. Whatever works
 - Delivery boy vs "gas station" (like "chainsaw" in Korea)
 - During Desert Shield/Storm and Enduring Freedom (OEF), all CLF types used as both station ships and shuttle ships.

Where are we now?

- MSC
 - As noted, MSC complete in 2004
 - T-AFS gone in 2010. 1 x AE left, soon will go
 - T-AOE 6, T-AO 187, T-AKE 1, T-AO(X) in works
 - significant cost reduction by reduced manning
 - Weapons removed, reduces maintenance
 - Crews more experienced, especially Air DET
- Increased time on station
- Common use of T-AO: FAS ships coming out of port due to difficulty fueling in port. At major US bases, 1 T-AO dedicated FAS ships leaving harbor
- 9/11 has meant little/no reduction in op tempo



Conclusions

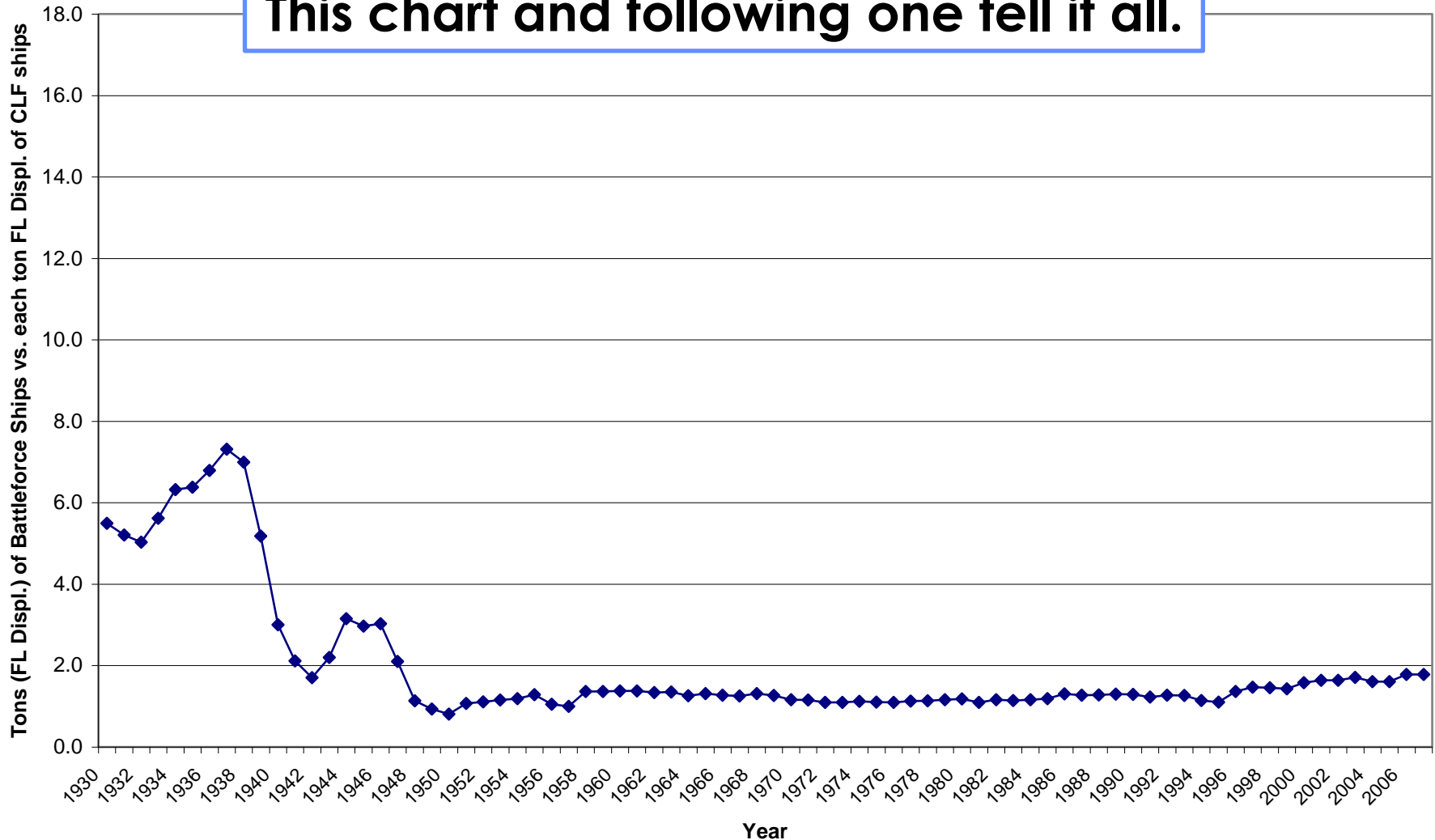
- Inherently flexible, adaptable
- A tale of two “~half centuries”
- 1889-1944 – little to no UNREP/CLF
- Command of Sea assured since 1945
- Significant continuity in force structure since 1950s
- Primary inhibitor to efficient UNREP since 1945
 - number of CLF ships, distance from op areas to bases, transfer rates



**Logistics are fundamental. Story of
CLF/UNREP is the story of the USN**

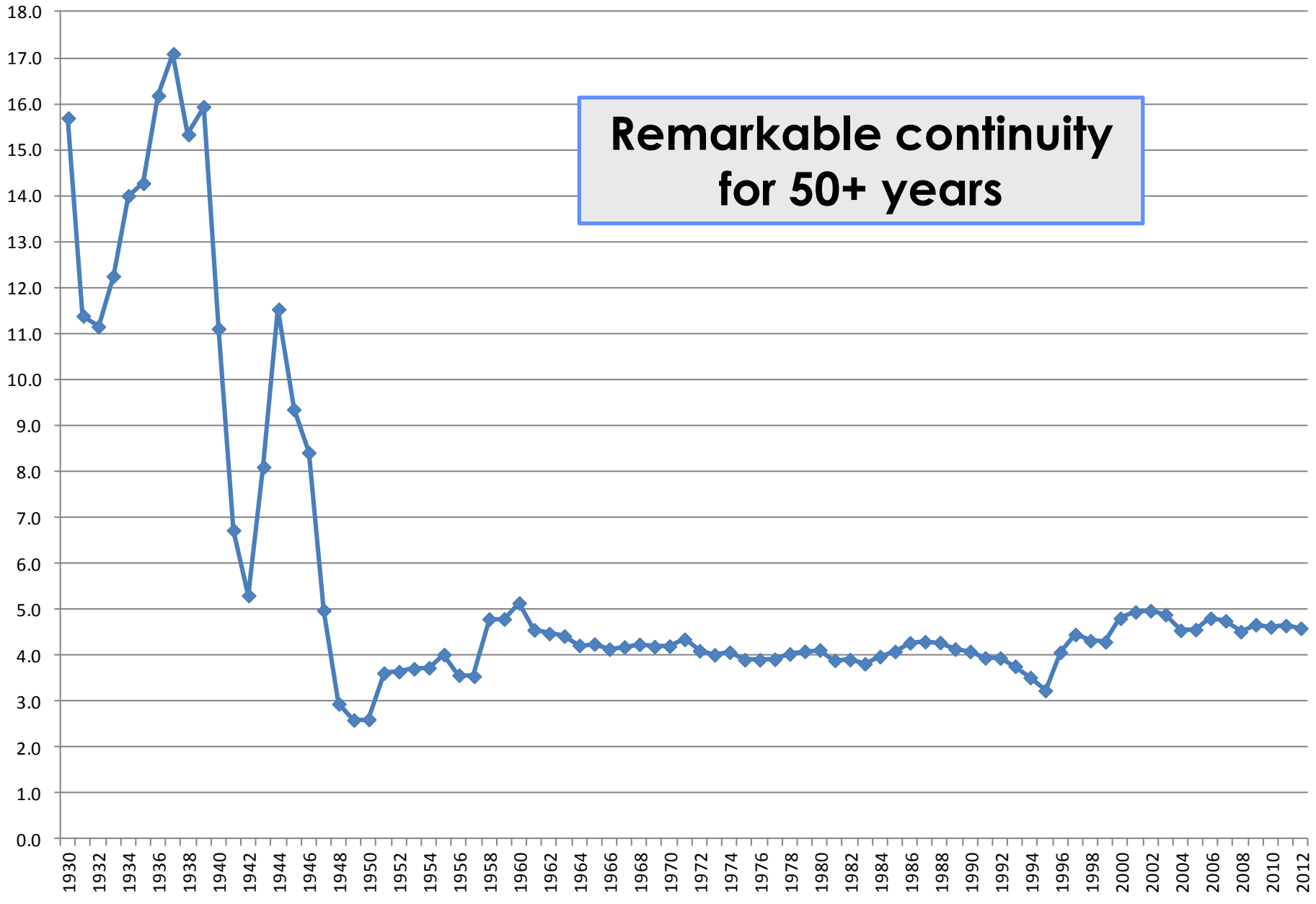
Displ. of Combatants/Amphibs for each CLF – 1930-2008

This chart and following one tell it all.



Note: Battleforce ships (Aircraft Carriers, Battleships, Cruisers, Destroyers, Frigates and Escort Carriers).
CLF ships (AE, AF, AO, AFS, AOE, AOR, T-AKE)

No. of Combatants/Amphibs for each CLF – 1930-2012



**Remarkable continuity
for 50+ years**

Questions?

For want of a nail the shoe was lost.
For want of a shoe the horse was lost.
For want of a horse the rider was lost.
For want of a rider the battle was lost.
For want of a battle the kingdom was lost.
And all for the want of a horseshoe nail

- Underway replenishment was the U.S. Navy's secret weapon of World War II.

~ *Fleet Admiral Chester Nimitz* ~

If you read no other book on WW 2...

- *Beans, Bullets and Black Oil* by ADM Worrell Carter

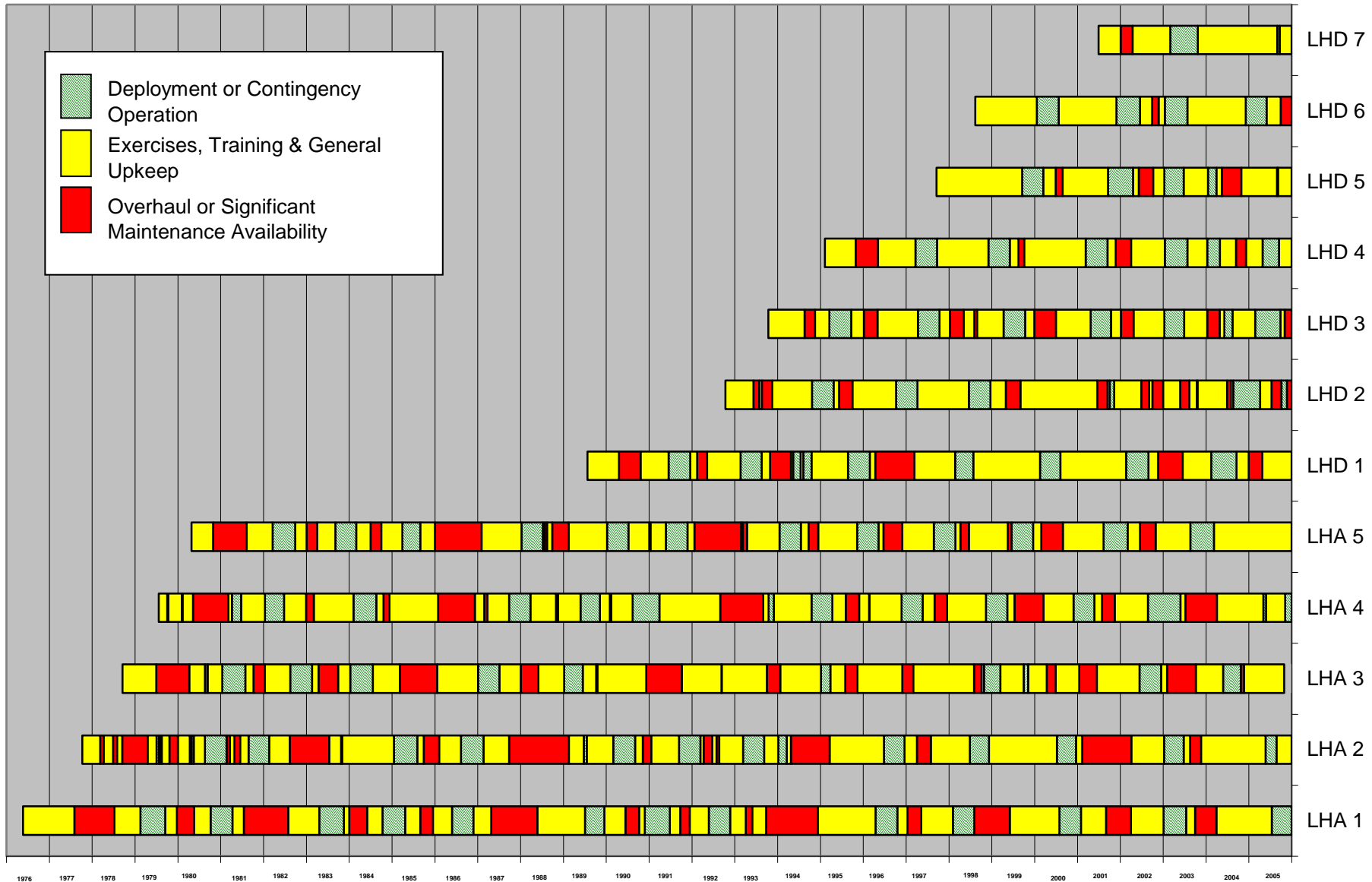
Epilogue: Black Swans & Fragile vs. Anti-Fragile

CLF Losses

- **5 x AO - enemy action in WW 2**
- **1 x AE - explosion, unknown cause, Manus, NOV 44**
- **No other combat losses of any CLF type...ever**
 - Reflection of AF/AE not UNREPIing before 1945 & command of sea since AOE, AOR, AFS, AKE have been around

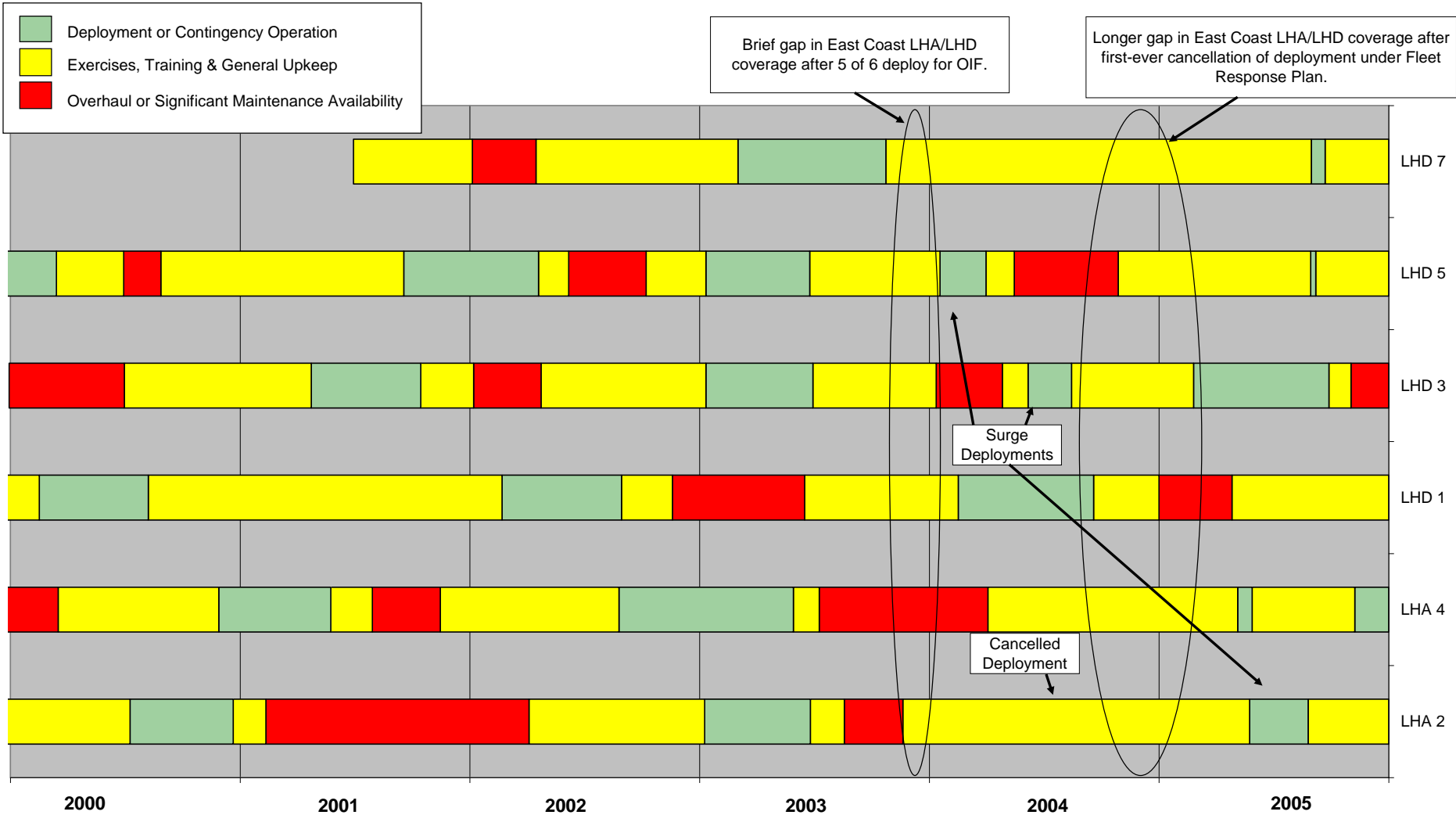
As noted, history of CLF since 1945 is one of stability. Force structure and ops predicated on it. Will it always be so?

Fragile or Anti-fragile? LHA / LHD – Usage 1976-2005



A total of 76,720 days in service are plotted

Black Swan, Fragile or Anti-Fragile? East Coast LHA/LHD Usage – 2000-05



Future CONOPS?

- **Time to react seemingly keeps compressing**
 - Response to Korea 1950 vs. LHA 7 Lebanon NEO, 2006
- **Tight Budgets, Focus back to Pacific, Uncertain Enemy**
- **Force Multipliers?: Heavy UNREP, High Capacity Alongside Sea Base Sustainment (HiCASS)**

- Leverage commercial shipping to augment CLF ships during crisis to enable Sea Base, STOM, OMFTS, Expeditionary Maneuver Warfare

Elements of interwar period. SCN for combatants vs. CLF during fiscal austerity



Future Force Structure?

- **Reduced USN totals, reduced CLF?**
- **Changing ratio of CLF to USN?**
 - No evidence so far (see last graph)
- **Continued MSC Operation?**
- **Changes in force structure of “Customer Ships”**
 - Changing mix of MEB lift vs. MPF follow on?
 - MLP
 - LCS
- **No way to be certain. But past force changes have been met by changes in CLF structure.**
 - Food for thought.

Back up Material

CONREP Stations Differ by Ship



ASL Data

| Ship Type, Excluding Active Ships | Average ASL |
|-----------------------------------|-------------|
| AO | 16.1 |
| AF | 11.2 |
| AE | 21.7 |
| AFS | 31.5 |
| AOE | 37.5 |
| AOR | 23.1 |
| Post-1946 Cruisers | 26.3 |
| Post-1946 Destroyers | 25.6 |
| Post-1946 Frigates | 19.8 |
| Amphibious Ships | 23.9 |

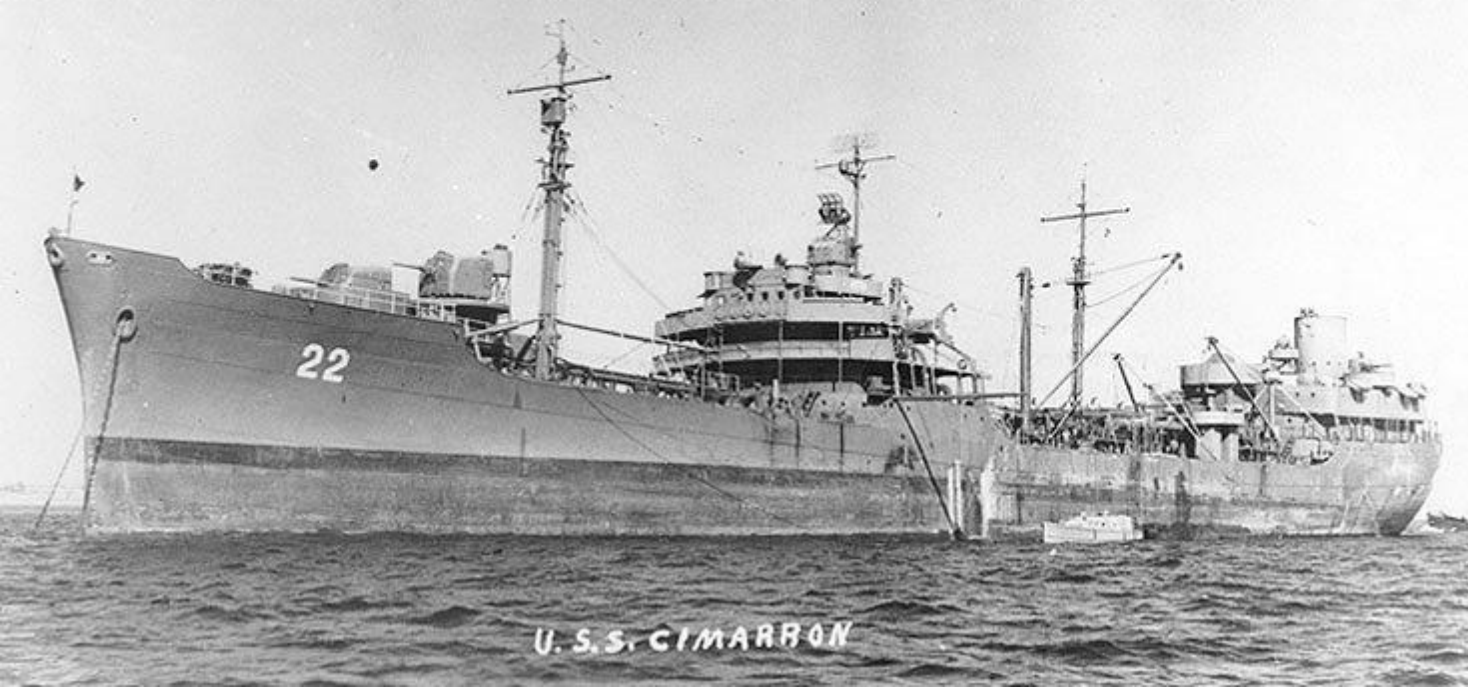
| Post-1953 CLF Ship Classes | Average ASL |
|----------------------------|-------------|
| AO 143 | 36.8 |
| AF 58 | 30.1 |
| AE 21 | 36.3 |
| AOE 1 | 37.5 |
| AFS 1 | 33.8 |
| AOR 1 | 23.1 |
| AE 26 | 35.2 |
| AO 177 | 17.3 |
| AFS 8 | 25.4* |
| T-AO 187 | 15.4 |
| AOE 6 | 12.4 |
| T-AKE 1 | 1 |

*The three AFS 8 served approximately 15 years in the Royal Navy before being purchased by the U.S. Navy in 1981-1983. If their previous service is counted, the average ASL of the AFS 8 class is currently 40.0 years.

Shaded ship classes contain all or some ships in active service. If the 2009 CNO 30-year Shipbuilding Plan and Ship Inventory is followed the active ships will achieve the following average ASL: AFS 1 – 33.9 years; AE 26 – 36.2 years; AFS 8 – 25.6 years in USN service and 40.2 years in RN/USN service.; T-AO 187 – 34.6 years; AOE 6 8.9 years.

SHIP CHARACTERISTIC DATA

| | <i>Maumee (AO 2)</i> | <i>Bridge (AF 1)</i> | <i>Pyro (AE 1)</i> |
|---------------------|---------------------------|----------------------|---------------------------|
| Displacement (tons) | 5,723 (lt) 14,800 (fl) | 5,207 | 7,025 (lt) 10,600 (fl) |
| Length (ft.) | 475 | 422 | 482 |
| Beam (ft.) | 56 | 55 | 60 |
| Draft (ft.) | 26 | 20 | 20 |
| Speed (knots) | 14 | 14 | 13 |
| Complement | 475 | 212 | 289 |



Typical WW 2 AO's

| | <i>Cimarron (AO 22)</i> | <i>Kennebec (AO 36)</i> | <i>Mattaponi (AO 41)</i> | <i>Suamico (AO 49)</i> |
|-------------------------------|--|---|--|---|
| Maritime Commission hull type | T3-S2-A1 tanker | T2-SO tanker | T2-A-MC-K tanker | T2-SE-A1 tanker |
| Displacement (tons) | 24,000 (fl) | 6,013 (lt) 21,077 (fl) | 6,809 (lt) 21,450 (fl) | 5,782 (lt) 21,880 (fl) |
| Length (ft.) | 553 | 501 | 520 | 523.5 |
| Beam | 75 | 68 | 68 | 68 |
| Draft (mean) | 32 | 30 | 30,5 | 30 |
| Speed (knots) | 18 | 16.5 | 17 | 15.5 |
| Complement | 304 | 214 | 242 | 251 |
| Propulsion | geared turbines twin screws 30,400hp | geared turbine single screw 12,000hp | geared turbine single screw 12,800hp | turbo-electric single screw 8,000hp |
| Armament (typical) | 4 x 5"/38 DP 8 x 40mm (4 twin) AA 8 x 20mm (4 twin) AA | 1 x 5"/38 DP 4 x 3"/50 (single) DP 8 x 40mm (4 twin) AA 8 x 20mm (4 twin) AA | | |
| UNREP systems | "Maumee jury-rig" | | | |
| Cargo capacity (bbls) | 146,000 | 134,000 | 135,000 | 140,000 |

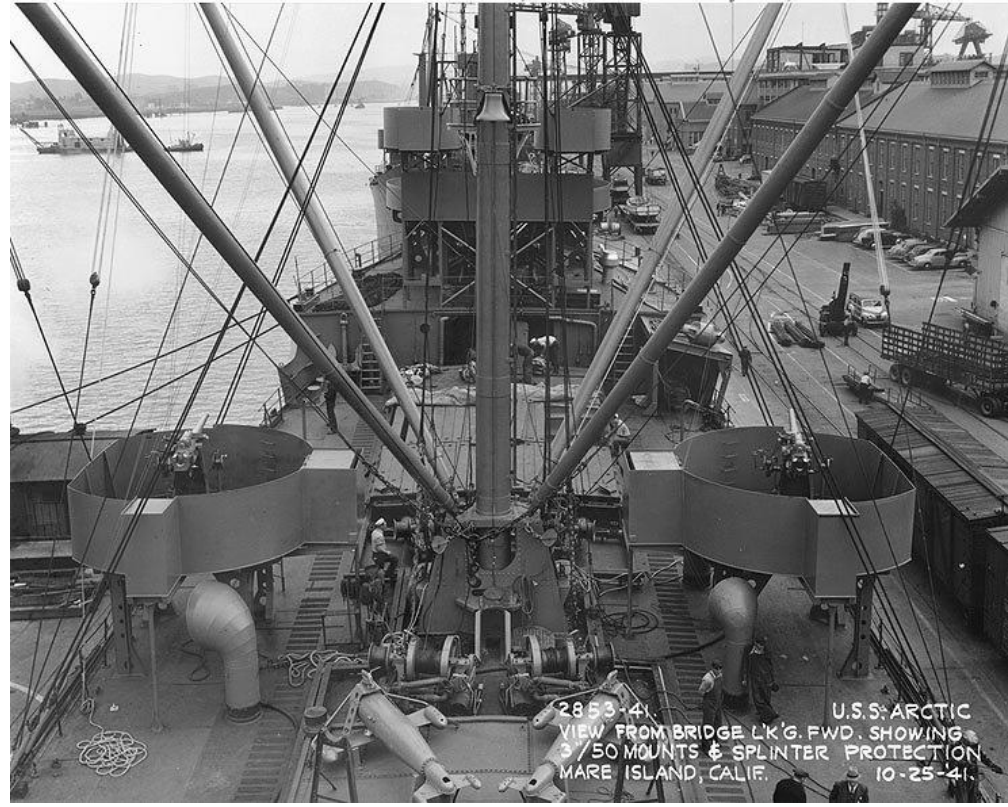
Typical WW 2 AE's

| | <i>Lassen (AE 3)</i> | <i>Mount Hood (AE 11)</i> |
|-------------------------------|---|---|
| Maritime Commission hull type | C2 Cargo | C2-S-AJ1 |
| Displacement | 6,350 tons (lt) 13,855 tons (fl) | 13,910 tons (fl) |
| Length | 459 feet | 459 feet |
| Beam | 63 feet | 63 feet |
| Draft (mean) | 25.9 feet | 28.25 feet |
| Speed | 16 knots | 16 knots |
| Crew | 280 | 318 |
| Propulsion | Diesel single shaft 6,000hp | geared turbine, single propeller, 6,000shp |
| Armament (typical) | 1 x 5"/38 DP 4 x 3"/50 DP 4 x 40mm AA(2 twin) 16 x 20mm AA(8 twin) | 1 x 5"/38 DP 4 x 3"/50 DP 4 x 40mm AA (2 twin) 10 x 20mm AA (single) |
| UNREP systems | | |
| Cargo capacity | 5,000 DWT | 7,700 DWT |

USS Shasta (AE 6), Lassen Class

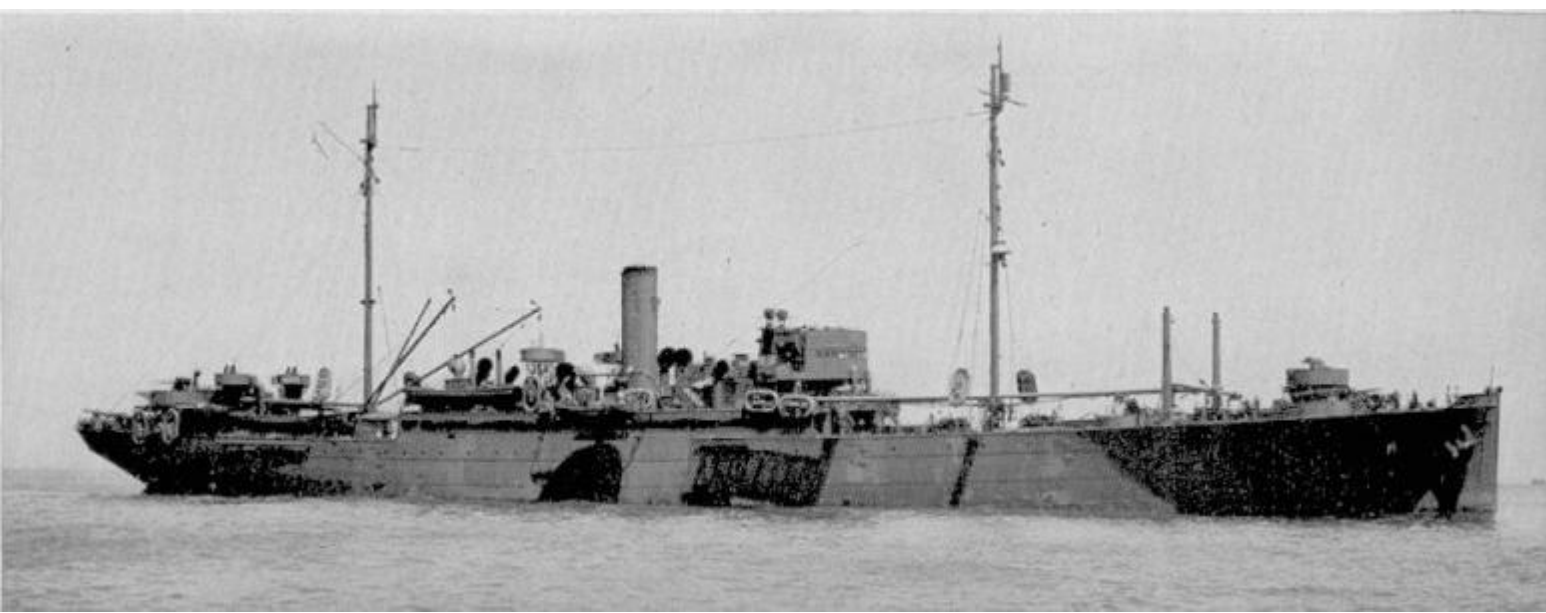


Photo # 19-N-25856 On board USS Arctic, at the Mare Island Navy Yard, Oct. 1941

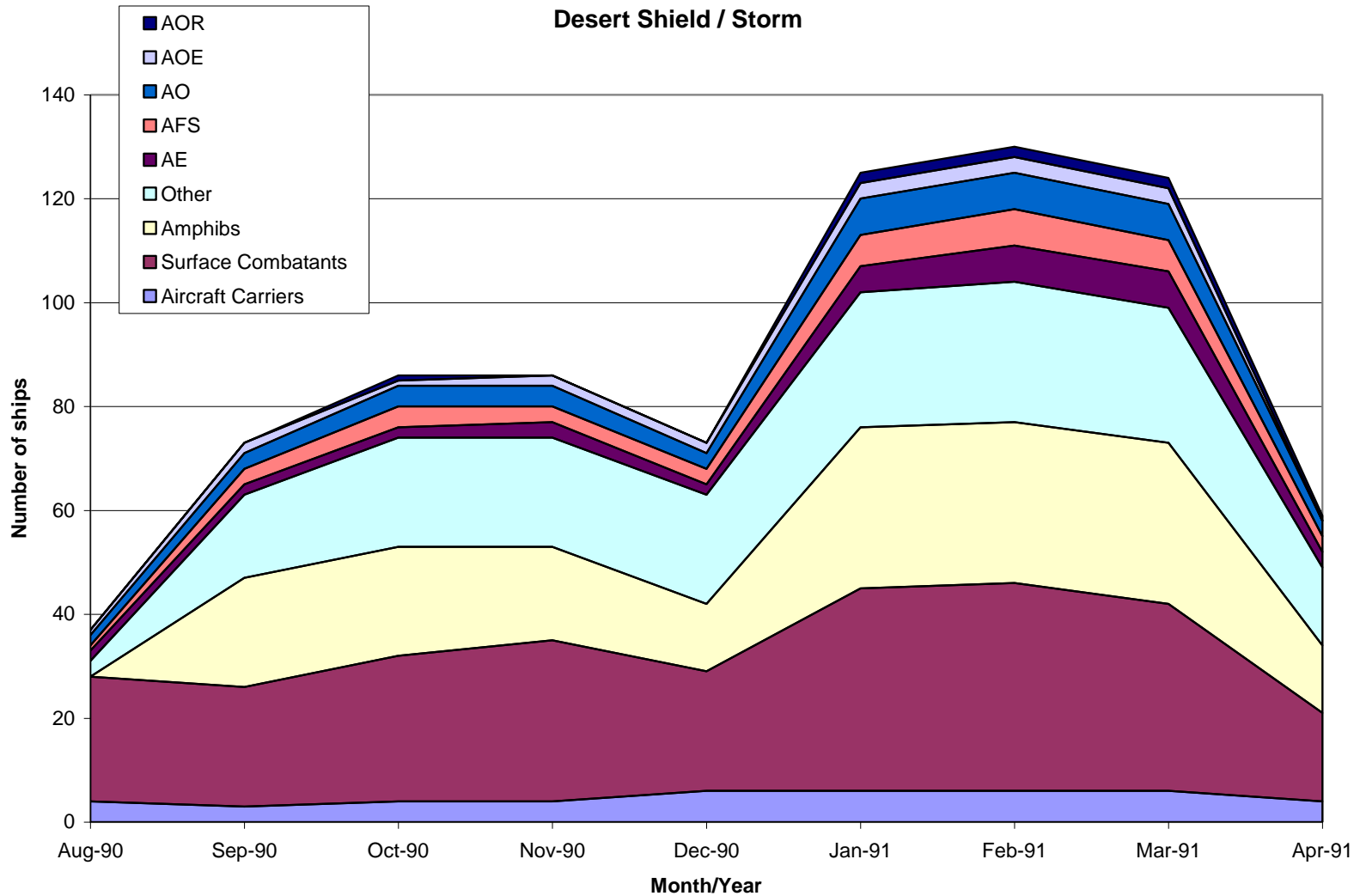


2863-41 U.S.S. ARCTIC
 VIEW FROM BRIDGE LK'G. FWD. SHOWING
 3"/50 MOUNTS & SPLINTER PROTECTION
 MARE ISLAND, CALIF. 10-25-41.

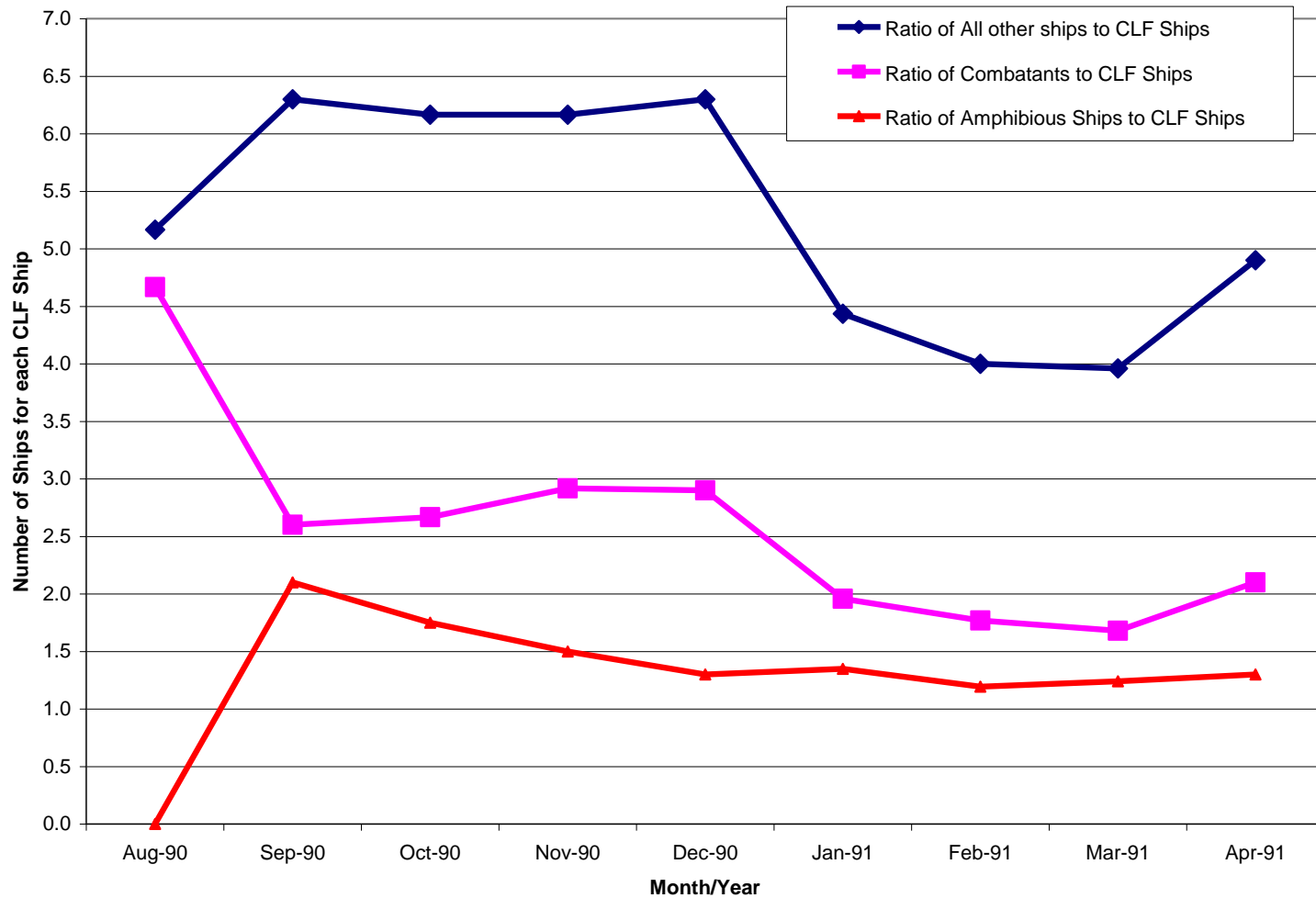
| <i>Bridge (AF 1)</i> | <i>Arctic (AF 7)</i> | <i>Mizar (AF 12)</i> |
|--|---|---|
| 5207(fl) | 6,100 (lt) | 6,982 (lt) |
| 9,500 in 1945 | 12,600 (fl) | 11,880 (fl) |
| 422'11feet | 415.5 | 447.7 |
| 55'3"feet | 53 | 60 |
| 20'8"feet | 26.5 | 25 |
| 14 | 11 | 18 (max) |
| 212 (282 in 1945) | 211 | 238 |
| | single geared turbine single shaft 2,800shp | Turbo-electric twin screws 11,000 shp |
| 4 x 5"/51s, 1 x 3" AA four x 1.1" (quad) mount forward 75-mm (single) Oerlikons AA 1945 - 1 x 40-mm (twin) Bofors (replaced 1.1" mount) 38 DP (replaced 2 x 5"/51s) | 1 x 5"/51 4 x 3"/50 DP 8 x 20mm (single) | 1 x 5"/38 DP 4 x 3"/50 |
| | 5,260 DWT | 2,615 DWT |



Desert Shield/Storm CLF Use

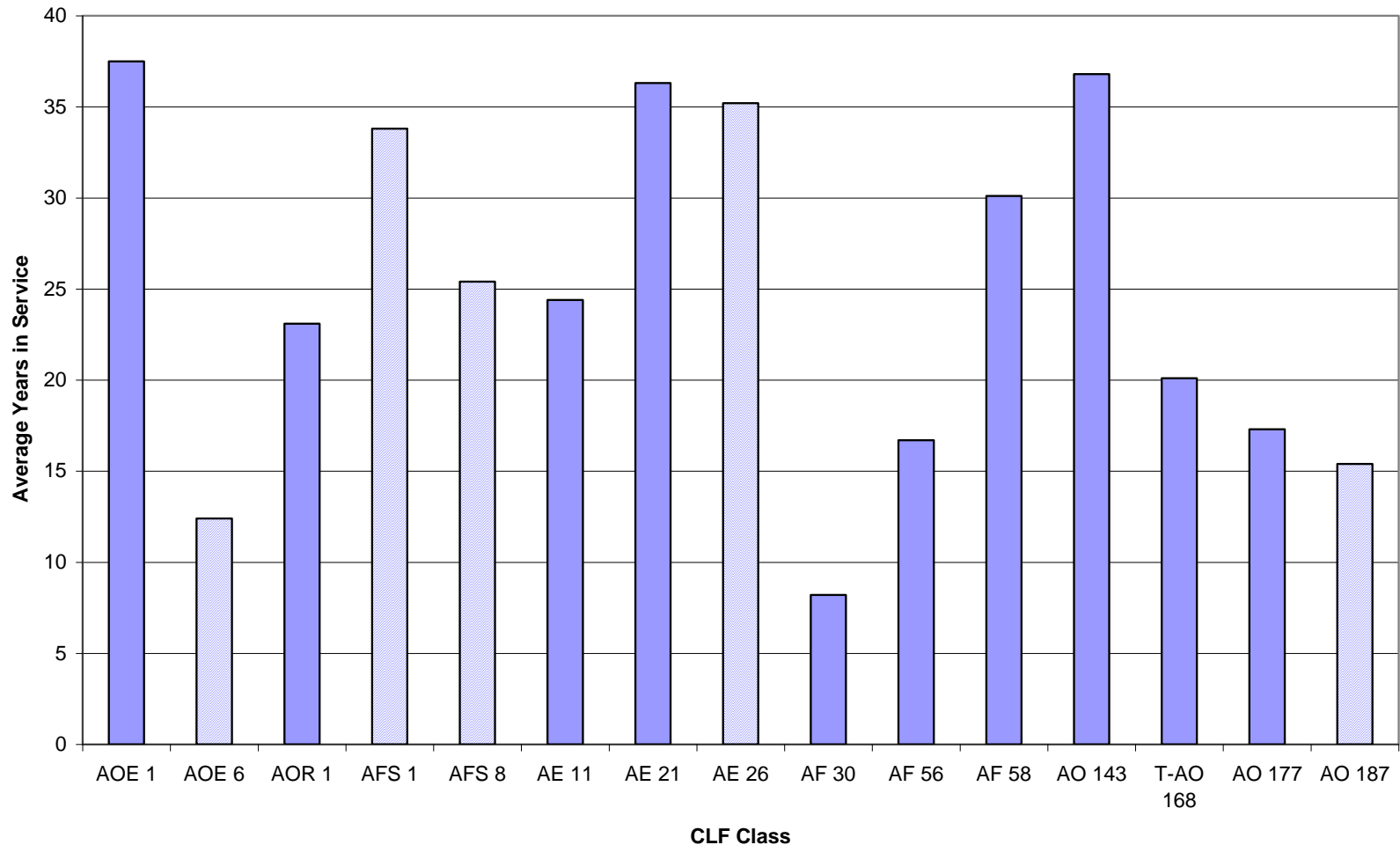


Desert Shield/Storm CLF Use



Findings – Service Life Analysis

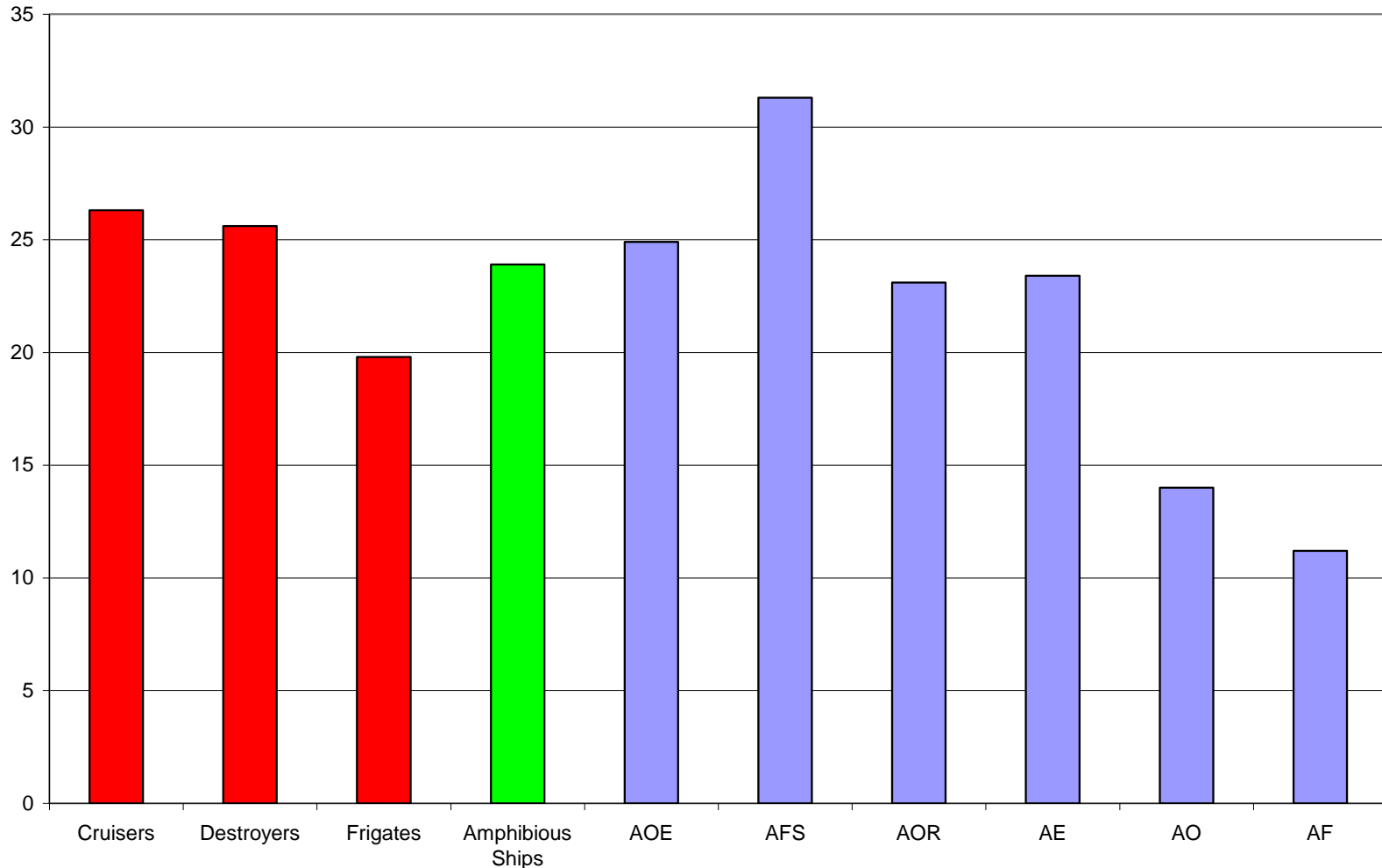
Average ASL, By Select CLF Ship Class



Classes with active MSC ships shown with hash marks. Average ASL is for all ships in class.

Findings – Service Life Analysis

Average ASL, By Type



Counts only post-1946 surface combatants