

# As lições da experiência francesa na construção de submarinos

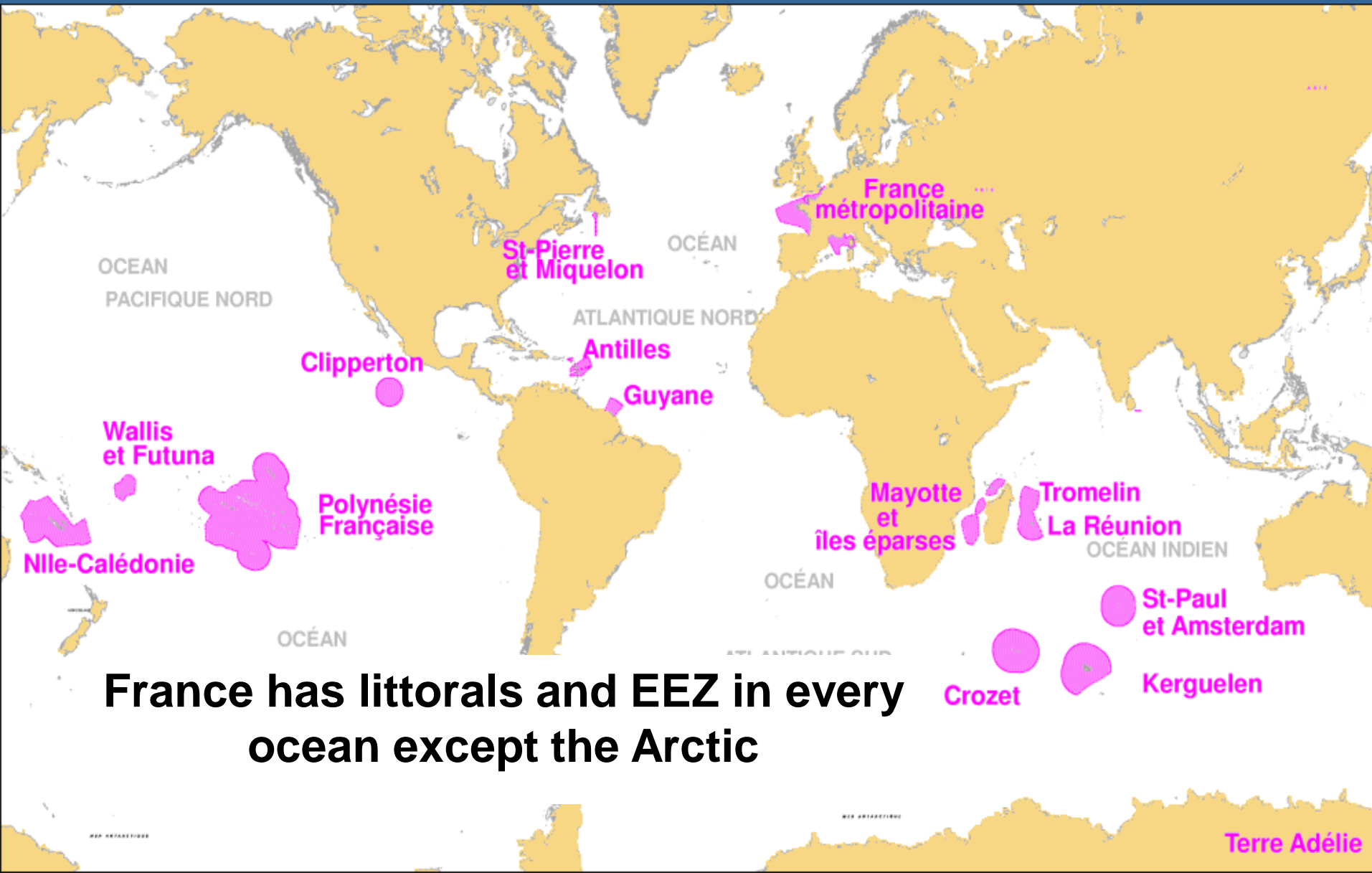


*Sao Paulo August 2012*

*Vice admiral Jean-Louis Vichot*



# France has the second world's maritime domain



**France has littorals and EEZ in every ocean except the Arctic**



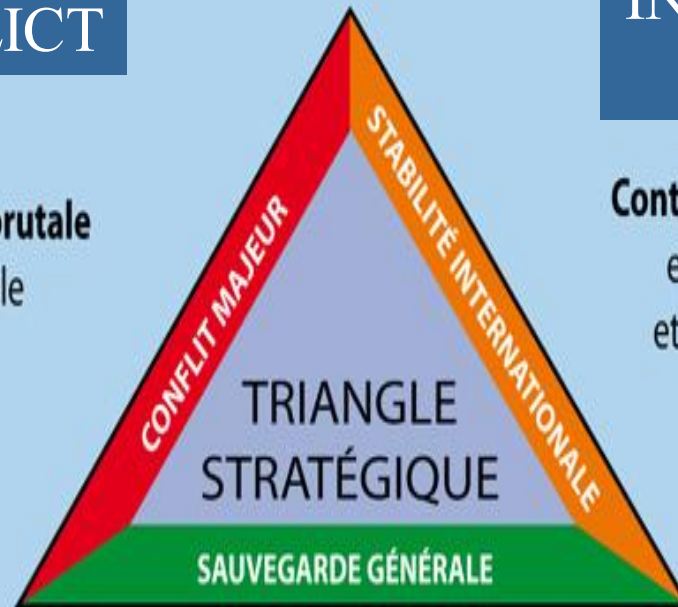
# At the same time a Navy and a Coast Guard

## MAJOR CONFLICT

**Faire face à une aggravation brutale  
de la situation internationale**

## INTERNATIONAL STABILITY

**Contribuer à la stabilité internationale  
en agissant sur les foyers de crise  
et en prévenant leur embrasement**

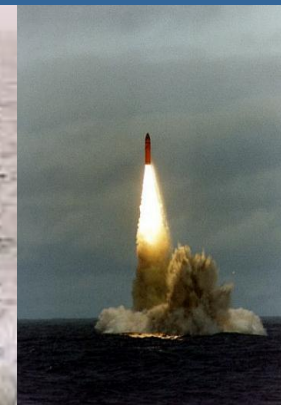


**Assurer la protection des concitoyens  
et des intérêts nationaux  
contre les menaces et risques effectifs et immédiats**

## DAY TO DAY SECURITY



# NAVY MISSIONS: deterrence



4 SSBN WITH 16 SLBM EACH - 75 % of French deterrence  
At least one SSBN at sea every day of the year



# NAVY MISSIONS: knowledge and anticipation



**FRENCH NAVY : EVERY DAY 30 SHIPS AND 8 AIRCRAFT DEPLOYED**  
**EVERY YEAR 730 PORT VISITS ON THE WORLD LITTORALS**



# DEPLOYMENT of SSN PERLE

12 janvier - 11 juin 2001

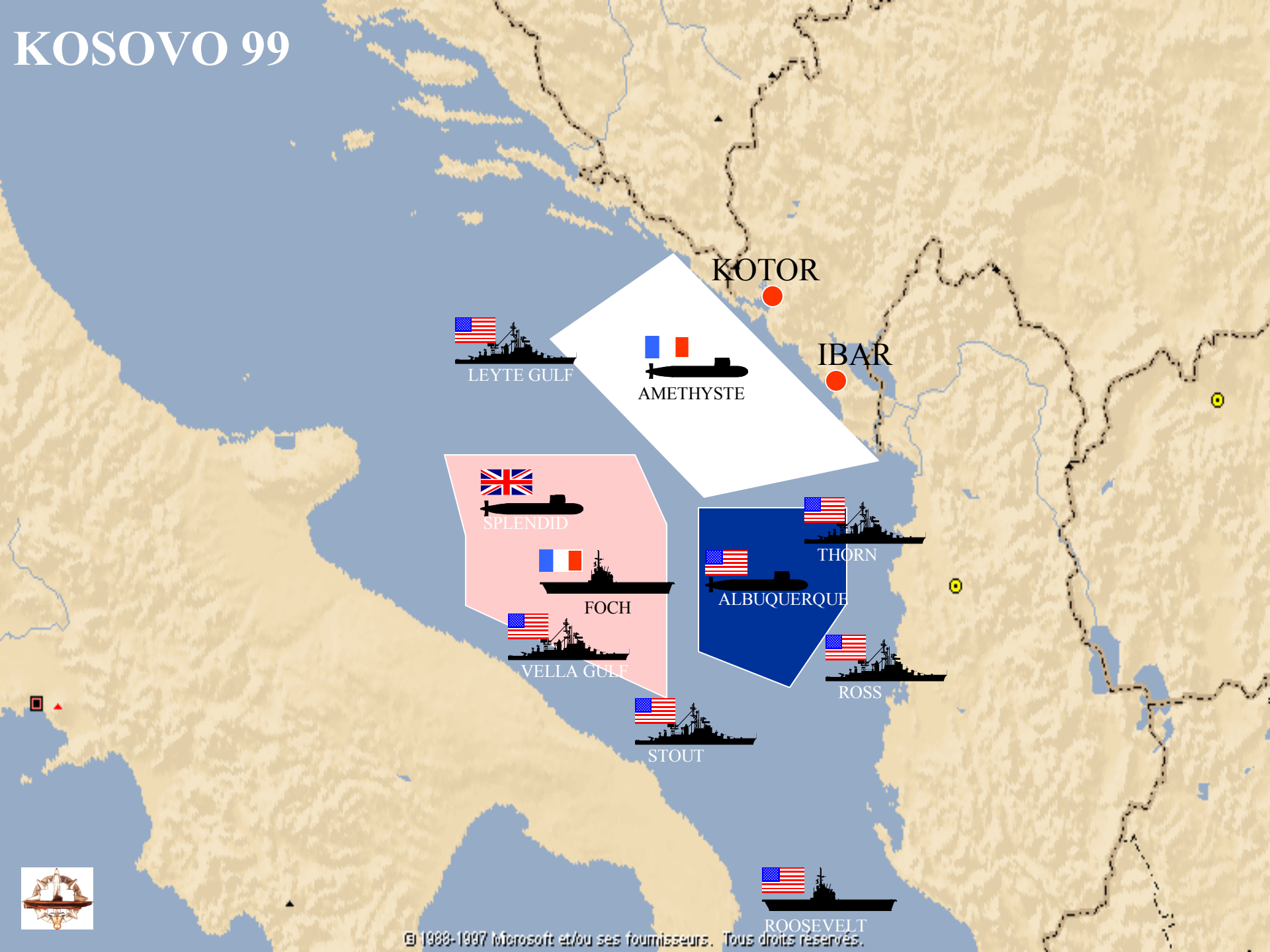




# NAVY MISSIONS : Projection



# KOSOVO 99



KOTOR

IBAR



LEYTE GULF



AMETHYSTE



SPLendid



FOCH



VELLA GULF



STOUT



THORN



ALBUQUERQUE



ROSS



ROOSEVELT







# NAVY MISSIONS : protection







# French submarines : an old story

- 1887: first French submarine: the Gymnote.
- 1954: first attempt to build two SSN (Cold War)
- 1958: the project fails : the power plant does not fit into the designed hull.
- 1959: new attempt with a PWR type power plant.
- 1962: decision to build an SSBN.
- 1964: the ashore prototype is operational.
- 1967: “Le Redoutable” is launched.

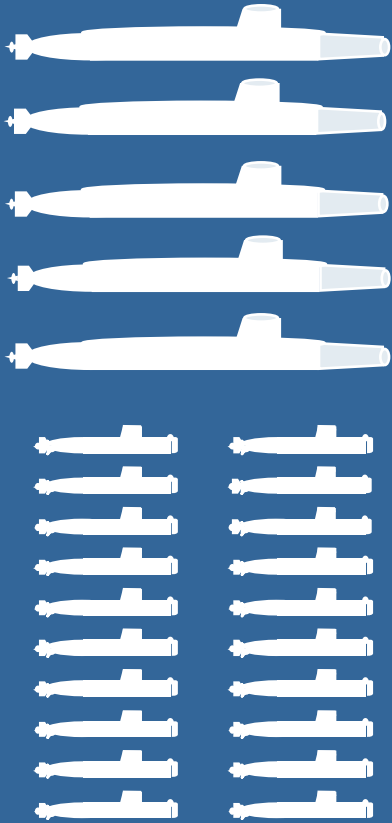


# French submarines : an old story

- 1969: “Le Redoutable” is commissioned.
- 1972: “Le Redoutable” sails for her first patrol.
- 1996: the ship is decommissioned.
- In between, three types of submarines have been built: SSK Agosta, SSN Rubis, SSBN Le Triomphant. SSK of Daphné and Agosta class have been exported.
- An export SSK has also been built and sold in many variants: the Scorpene.

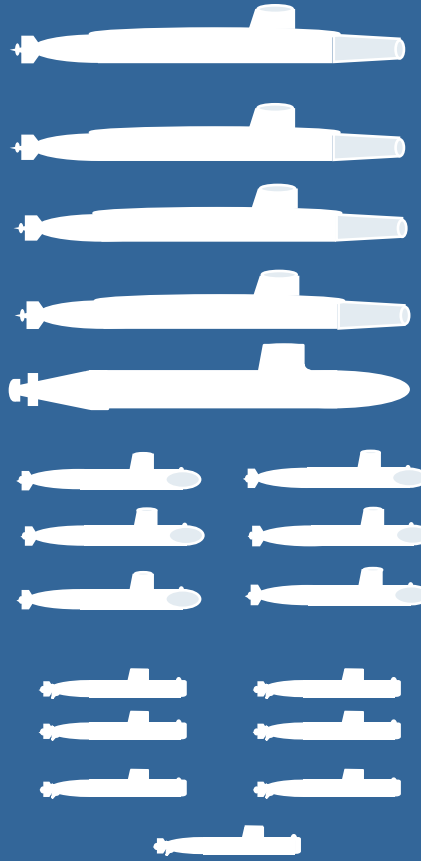


# French submarines : an old story



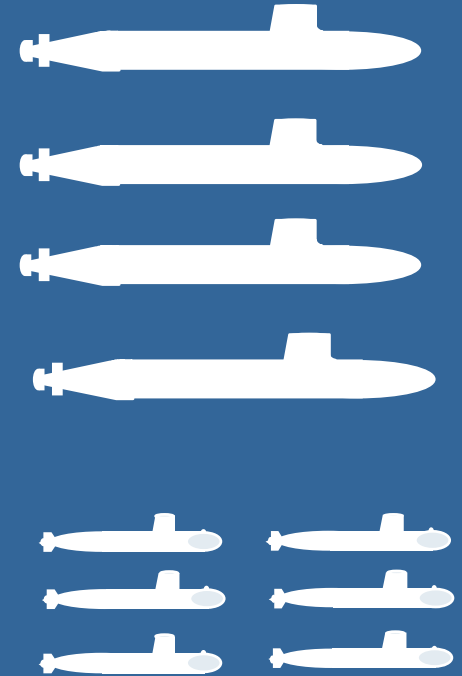
**1980**

**5 SSBN  
20 SSK**



**1996**

**5 SSBN  
6 SSN  
7 SSK**



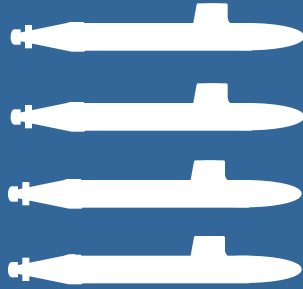
**2001  
(present)**

**4 SSBN  
6 SSN**



# French submarines : bases

**ESNLE**



**SSBN**

**Full command**

**SSN**

**Maintenance, training  
and qualification**

**• ALFOST**

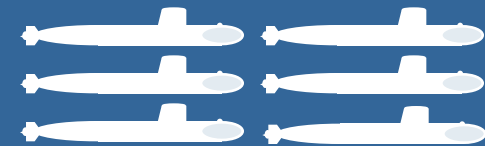


*Ste-Assise*



*Rosnay*

**ESNA**





# The submarine: a very complex system

- A submarine is similar to an airship which flies at low altitude with no visibility.
- The nuclear propulsion is the only way to get a real submarine, one that can achieve long patrols submerged, and still be able to sail at high speeds
- A submarine is a deadly anti surface and anti submarine weapon. She can strike ashore.



# French SSN Rubis : the design

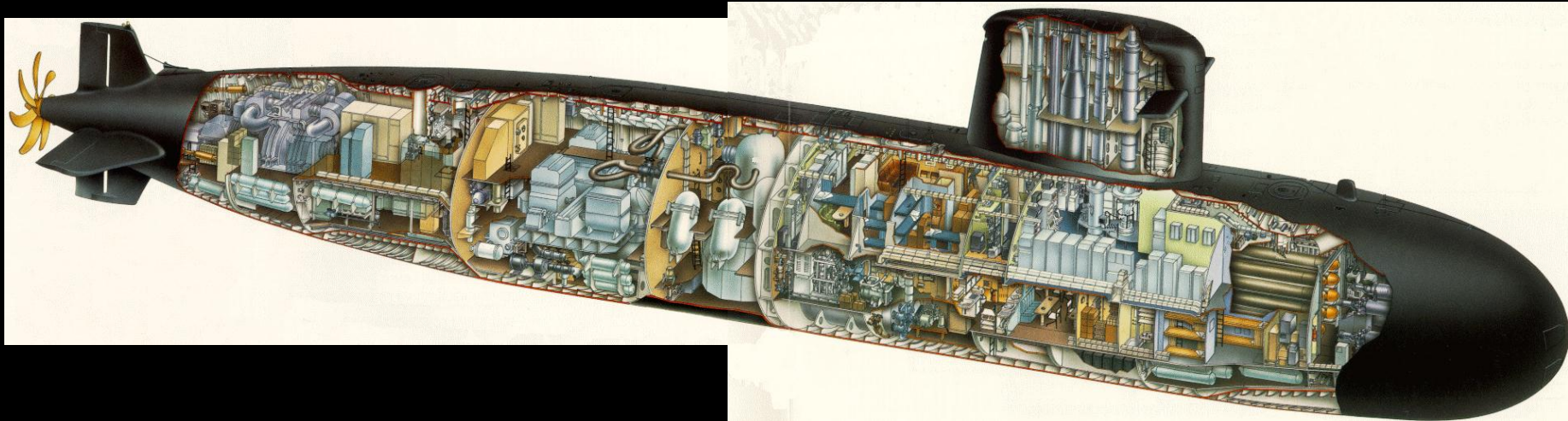
Propulsion

Production of  
electricity

Power  
Plant

Operations and  
navigation control  
systems – living  
quarters

Weapons



**Displacement (Geneva) : 2600 t**

**Crew : 72**

**Speed : 20+ kt**

**Depth : 300 m**





# French submarines : challenges

- Nuclear propulsion: powerful, compact, reliable, sealed (\*).
- An efficient and reliable steering gear, able to control the ship at high speeds or in shallow waters. Need to know precisely the hydrodynamics of the submarine.
- Stabilization at low speed to operate divers or fire SLBM.
- Very accurate navigation systems (\*).



# French submarines : lessons learned

- A dedicated organization: Coelacanthe, created in 1962, led by an executive committee where all organisms involved are represented at the highest level.
- This executive committee is chaired by the head of the Defence procurement agency.
- Two working groups prepare the decisions, one technical, one operational.



# Nuclear propulsion : lessons learned

- An ashore prototype was completed in the South of France.
- Everything had to be defined :
  - integrating the whole system in a submarine hull
  - designing the steel of the reactor vessel,
  - welding the different high pressure circuits to make them watertight,
  - elaborating appropriate concepts and procedures to achieve full reliability and safety,
- Five years needed.



# Nuclear propulsion : lessons learned

- This operation was realised by a special organisation which was in charge of the whole process.
- The first core were able to deliver more than 4000 hours at maximum speed, to be increased to more than 10 000 in 1991.
- Cost of the shore prototype was 1250 MF 1991 three times the price of the “Le Redoutable” engine room.



# Nuclear propulsion : lessons learned

- This process has been used for the next generation of power plants, but it lasted longer due to the new safety regulations which forbade any overlap between the different design phases.
- A shore prototype is still used for experimentation by the designers and for the education of Navy personnel who stand watch at this installation, and realize there their first real divergence.



# Sea trials: lessons learned

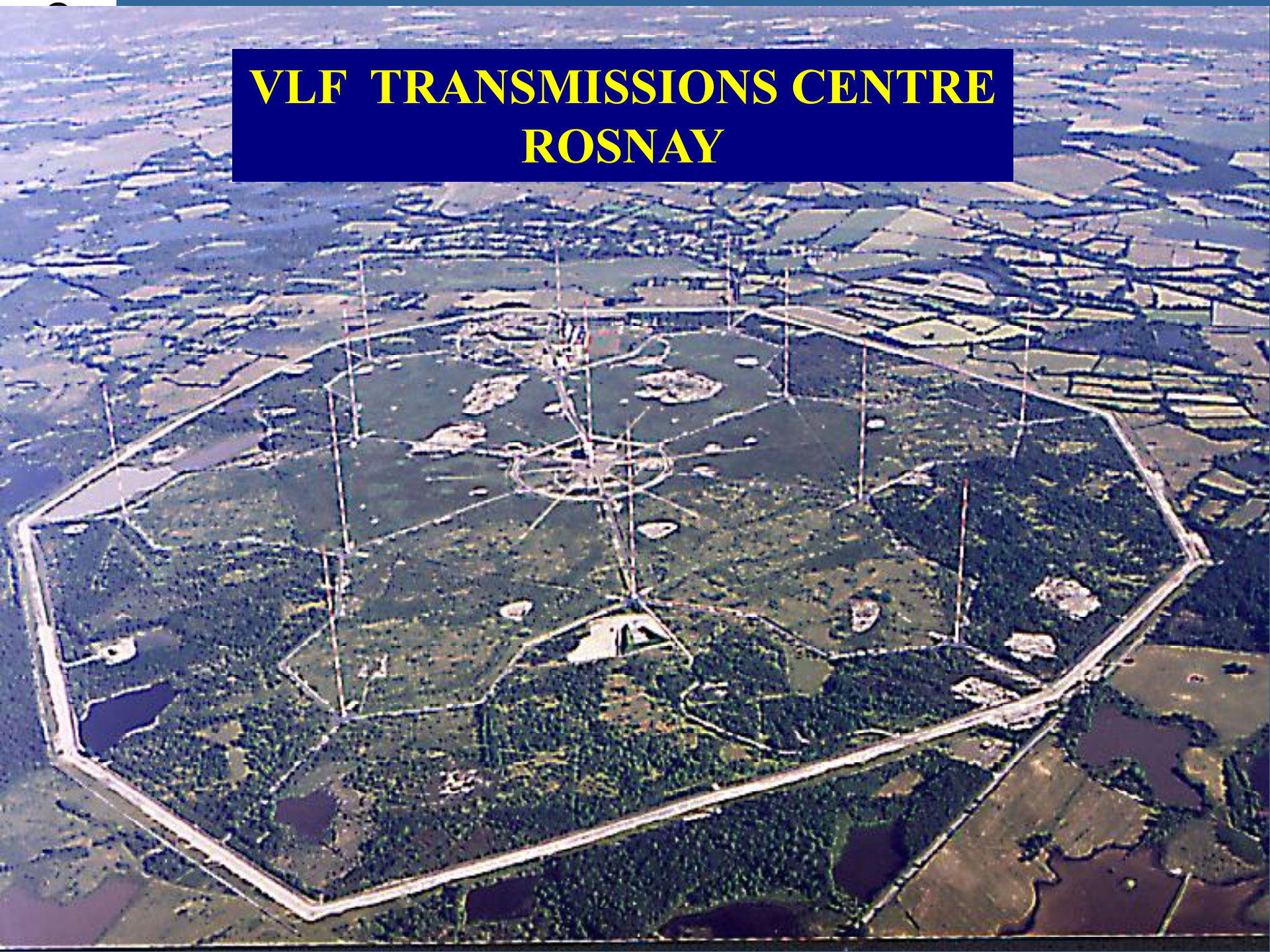
- “Le Redoutable” was launched the 29<sup>th</sup> of March 1967, commissioned for trials the 26<sup>th</sup> of April 1968, produced its first nuclear electric power in March 1969. Static dive the 25<sup>th</sup> of June, first real dive the 2<sup>nd</sup> of July.
- Tests were made to check the submarine reactions when sailing submerged.
- The submarine was then examined in depth, had a new period of tests (SLBM) and started its first patrol the 20<sup>th</sup> of January 1972.



# The organization: lessons learned

- The submarine command was created in 1972.
- This organization was particular due to its nuclear deterrence mission.
- Two major realizations:
  - The transmissions network (VLF)
  - The submarine base:
    - Shore training facilities (simulators: propulsion, combat system, steering system).
    - Shore maintenance and support facilities.

# VLF TRANSMISSIONS CENTRE ROSNAY





# L' ILE LONGUE

**SSBN maintenance:  
Naval yard**

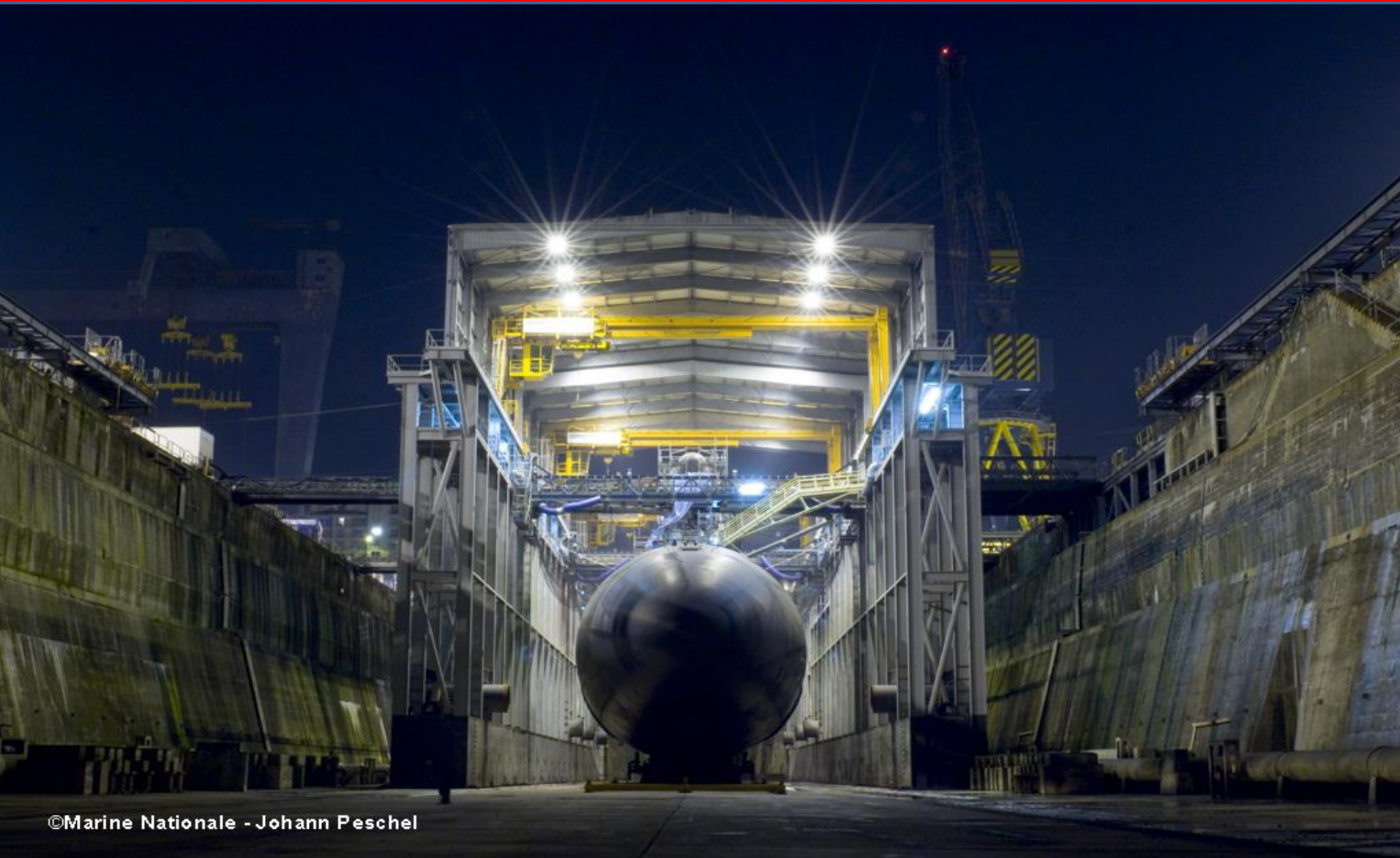
**SLBM maintenance:**

**Housing**





# SSBN in dry dock





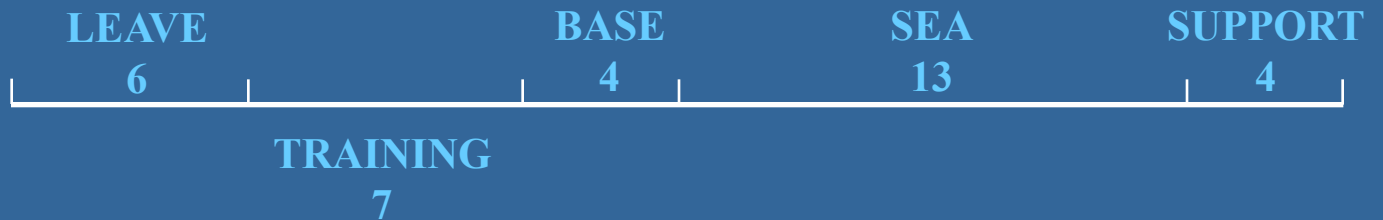
# Navy personnel : lessons learned

- Need for a better scientific training of all Navy personnel.
- An all volunteer force of 3200 people :
  - submariners: extra pay, better life, better retirement pay.
  - nuclear personnel: extra pay, better education, better promotions.
- Increase in the number of submariners: 2/3, 1/3.
- A culture of safety: “if it is not written, it is forbidden”.



# Activity cycle : lessons learned

**RED  
CREW**



**SNA**

**BASE**

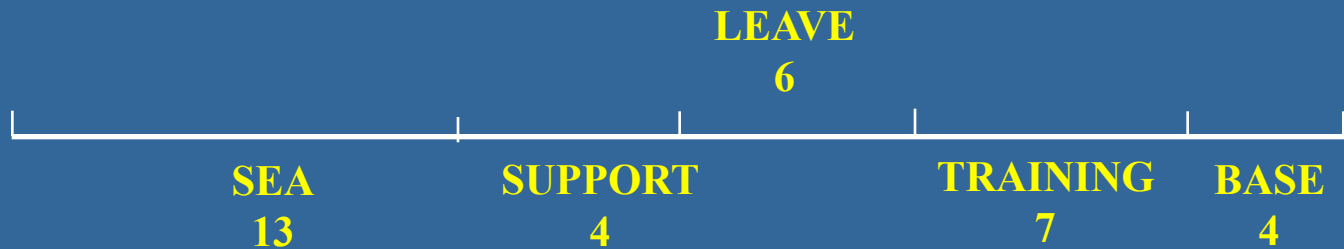
**SEA**

**BASE**

**SEA**

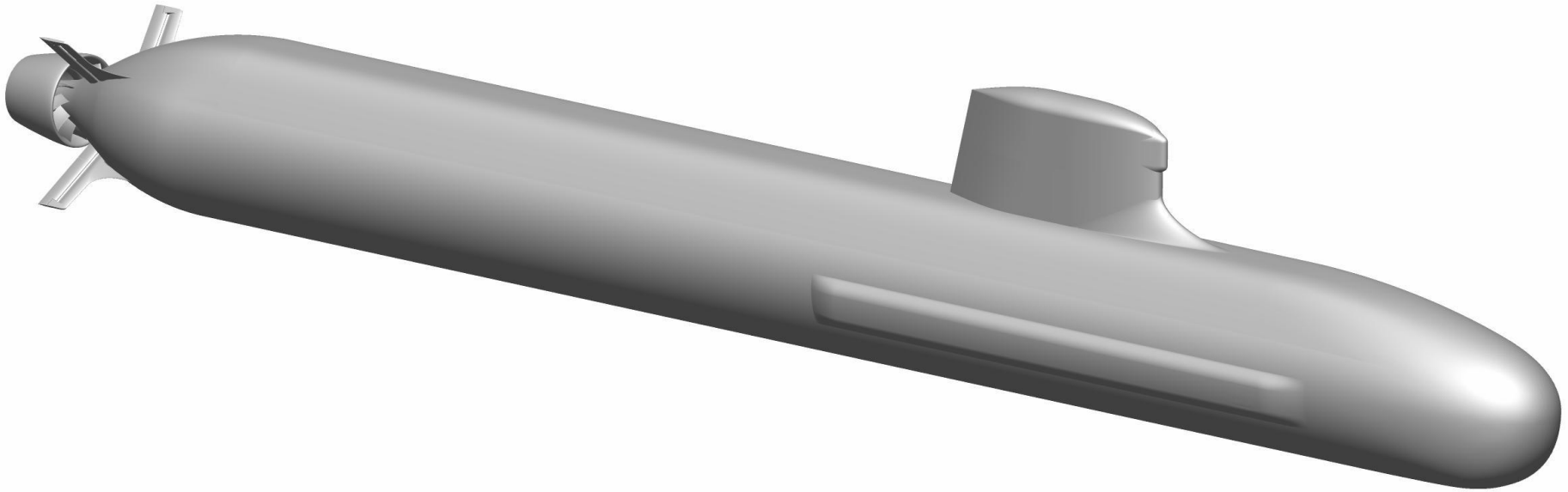
**BASE**

**BLUE  
CREW**





# FRENCH NAVY NEW ASSET: BARRACUDA



- *4 600 t*
- *Acoustic stealth*
- *Crew : 60*
- *20 weapons*

- *6 to be 2017 - 2027*
- *Difficult transition with SSN Rubis class*



# French submarines : lessons learned

- Submarine construction presents many challenges which interact:
  - Size of the hull.
  - Propulsion.
  - Auxiliaries.
  - Sensors and weapons – combat system.
- Personnel is a permanent problem.
- A dedicated organisation is needed.



# Questions ?





# Evolution of Submarine technology: Air Independent Propulsion

For the RDR-1500B search radar on the Venezuelan Navy CASA 212 S43 maritime patrol aircraft, for three different exposed periscope heights of .5, .6, .7 meters, respectively, exposed a total of 6 hours per day, in sea-state 1, in a search area of 60 x 60 nm, aircraft altitude of 500 feet, and search speed of 180 knots, figure 5 shows the resulting cumulative detection probability as a function of search time.

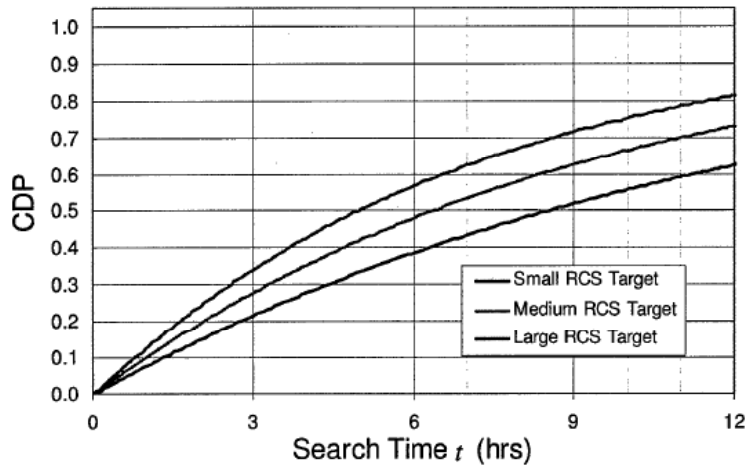


Figure 5. Example: Cumulative Detection Probability as a function of search time

## SSK with fuel cells

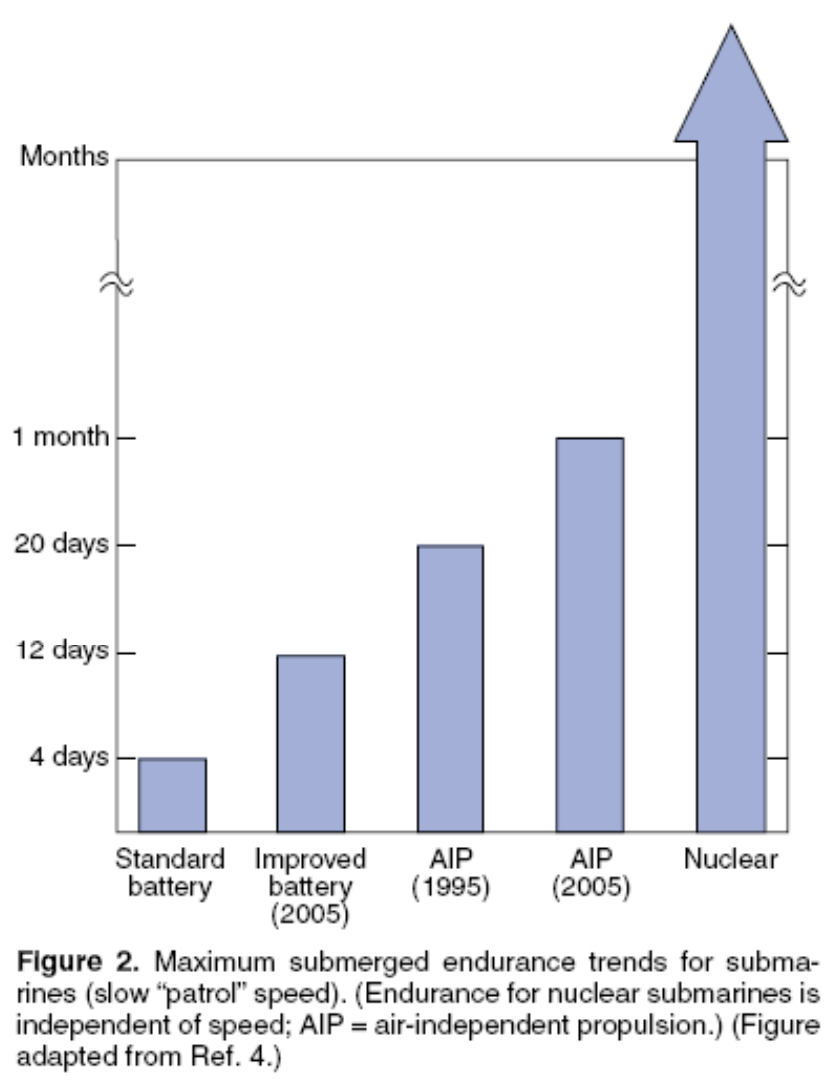
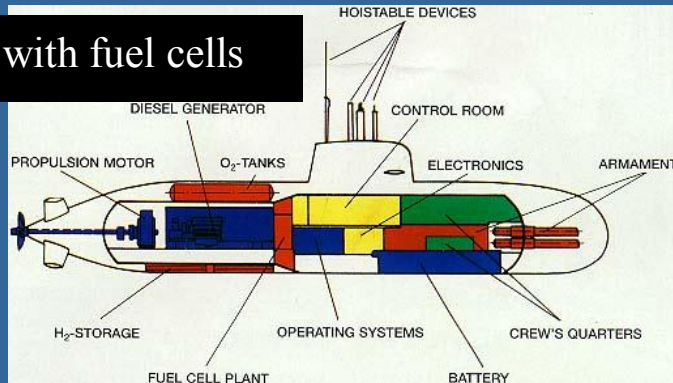


Figure 2. Maximum submerged endurance trends for submarines (slow "patrol" speed). (Endurance for nuclear submarines is independent of speed; AIP = air-independent propulsion.) (Figure adapted from Ref. 4.)



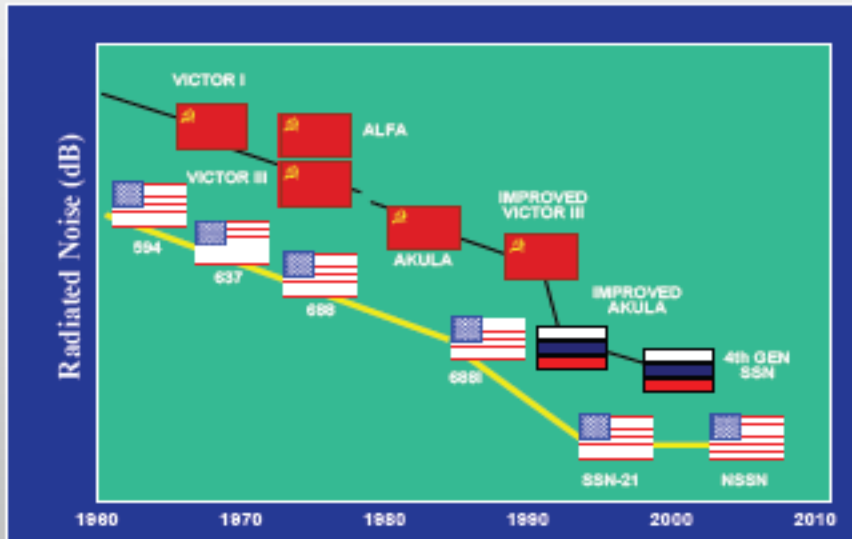


# Submarine technology: radiated noise

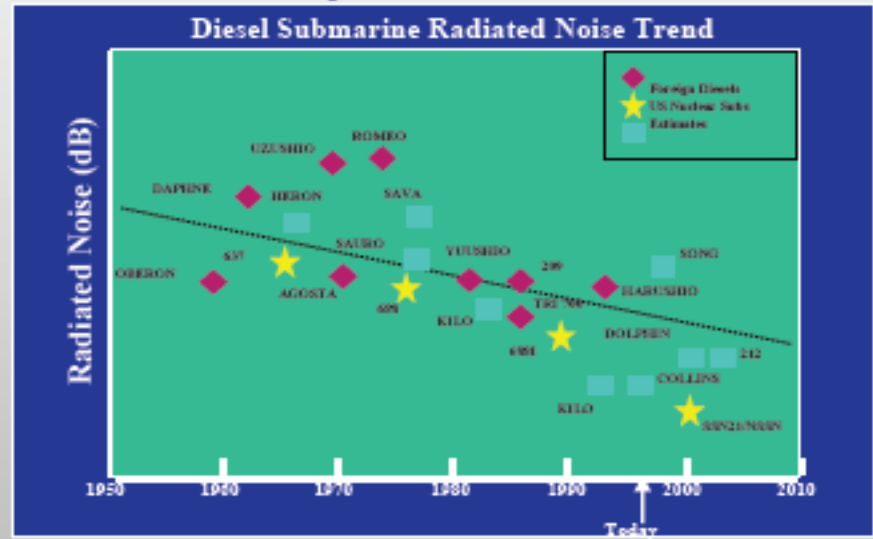
- Propellers
- Electric drive
- Active acoustic/vibration control

## Worldwide Submarine Challenges -

### FSU/US Nuclear Stealth

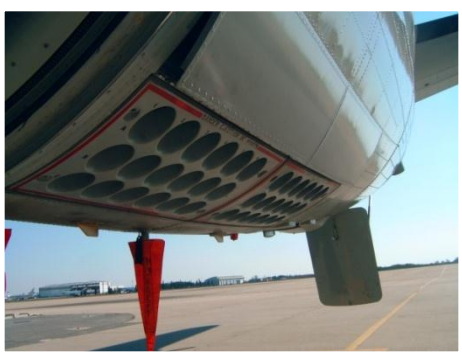


### Rest of the World Diesels





# ASW: need for MPA





# ASW : the frigate



- May deal with multiple threats
- In different and evolving situations

- Environment
- Politics
- In front of unknown subs

Need for multiple means, in a coalition ?

- Before
  - Information gathering
  - Intelligence
  - Basing rights or port visits



# FREMM Aquitaine

Displacement	6000 t class
Dimensions	142 m x 20 m
Range (15 knots)	6000 NM
Autonomy	5-week without RAS
Maximal speed	27 knots
Aviation facilities	12 t class helo and UAVs
Crew	108

