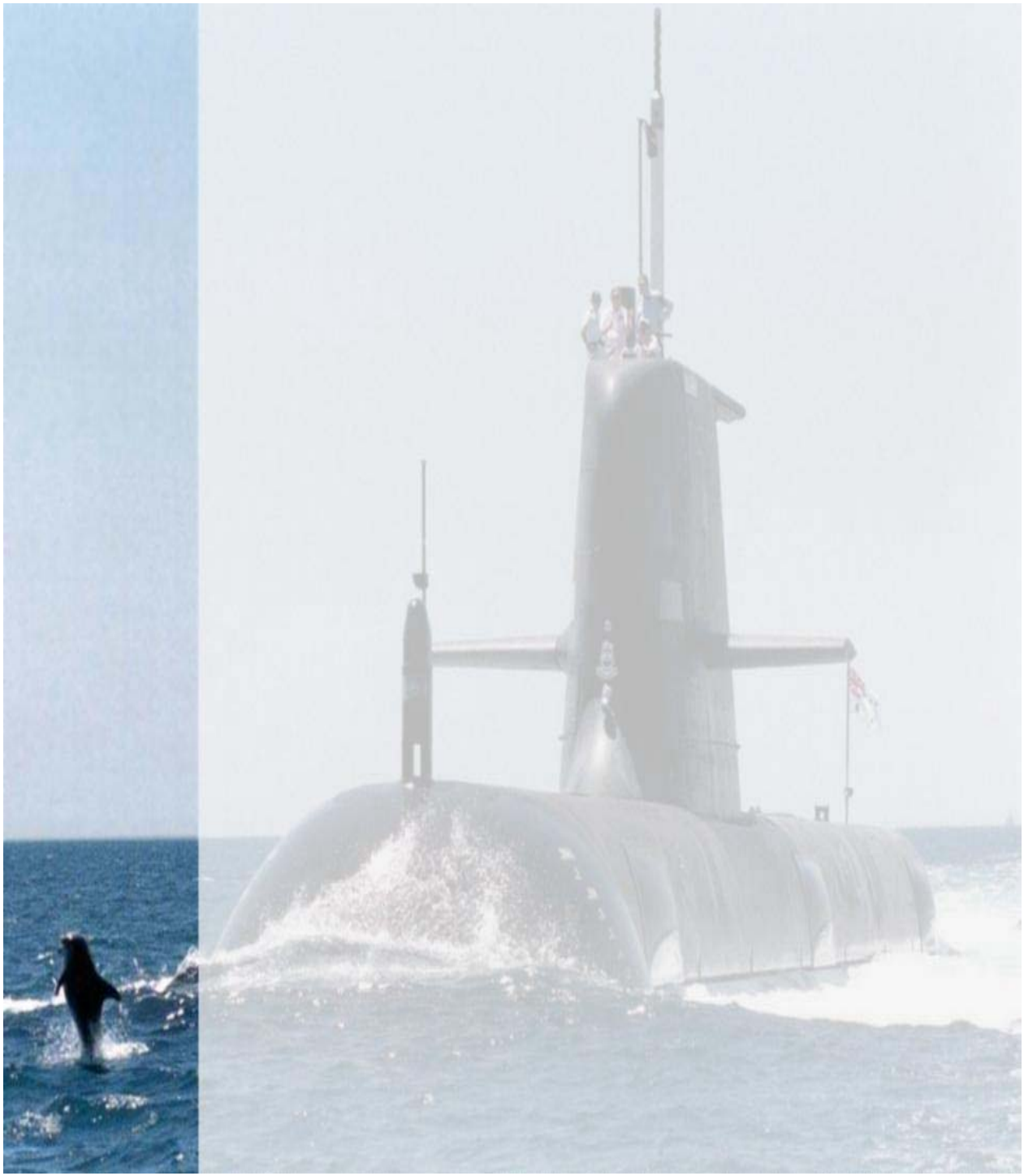
COLLINS Replacement Combat System

APB Industry Brief

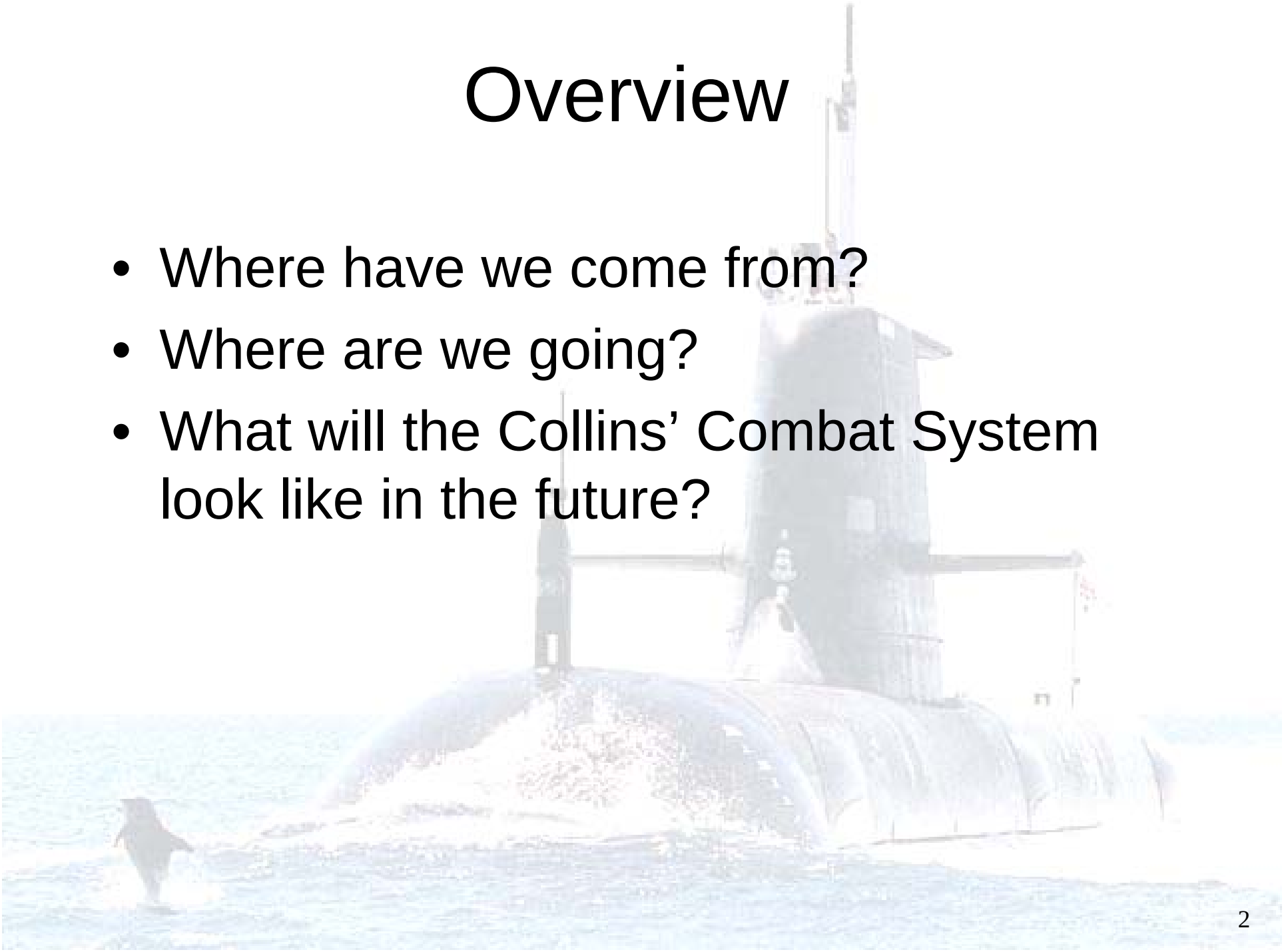
5 Sep 2003

Prepared by Edward Louis



Overview

- Where have we come from?
- Where are we going?
- What will the Collins' Combat System look like in the future?



Where have we come from?

- Oberon SFCS
  - Highly Capable for its vintage and technology
  - SWSC experience
    - System development
    - Tactical development
    - Training
    - Close synergy and feedback
  - Indigenous industry support
  - Highly skilled and innovative submarine force

Where have we come from?

- COLLINS TDHS and Integrated Sonar
  - Significant “expectation”
    - Integrated and flexible console strategy
      - Integrated sonar and tactical
      - Any function any console
    - Extensive reliance on automation
    - High levels of redundancy and failure management
  - Underwhelming “reality”
    - Technology could not deliver to expectation
      - Lower capability than desired
      - Less reliability than desired
      - Difficult to evolve to something else

Where have we come from?

- COLLINS TDHS and Integrated Sonar (Augmented)
  - Increased federation of Sonar
  - Increased federation of Engagement
  - Use of “gateways” to open system to extensive improvements in capability
    - USN
    - Australian Industry
  - Still reliant on core TDHS infrastructure for many critical functions
    - Limits to “gateway” capabilities
    - Same vulnerabilities as core systems

Where are we going?

- Government has decided on a strategic alignment with the United States of America
- RAN and USN have signed a Statement of Principles on Submarine matters
    - Cooperate in development of submarine capabilities including but not limited to the combat system
    - Given form by the signature of MOUs
    - HWT MOU already in place
- Government has agreed on a Combat System Acquisition strategy based upon ongoing joint development and collaboration with the USN
    - Delivery of core US Submarine combat system under FMS
    - Transition to an MOU for ongoing cooperative development
    - Future changes to reflect joint requirements

RCS Project Key framework

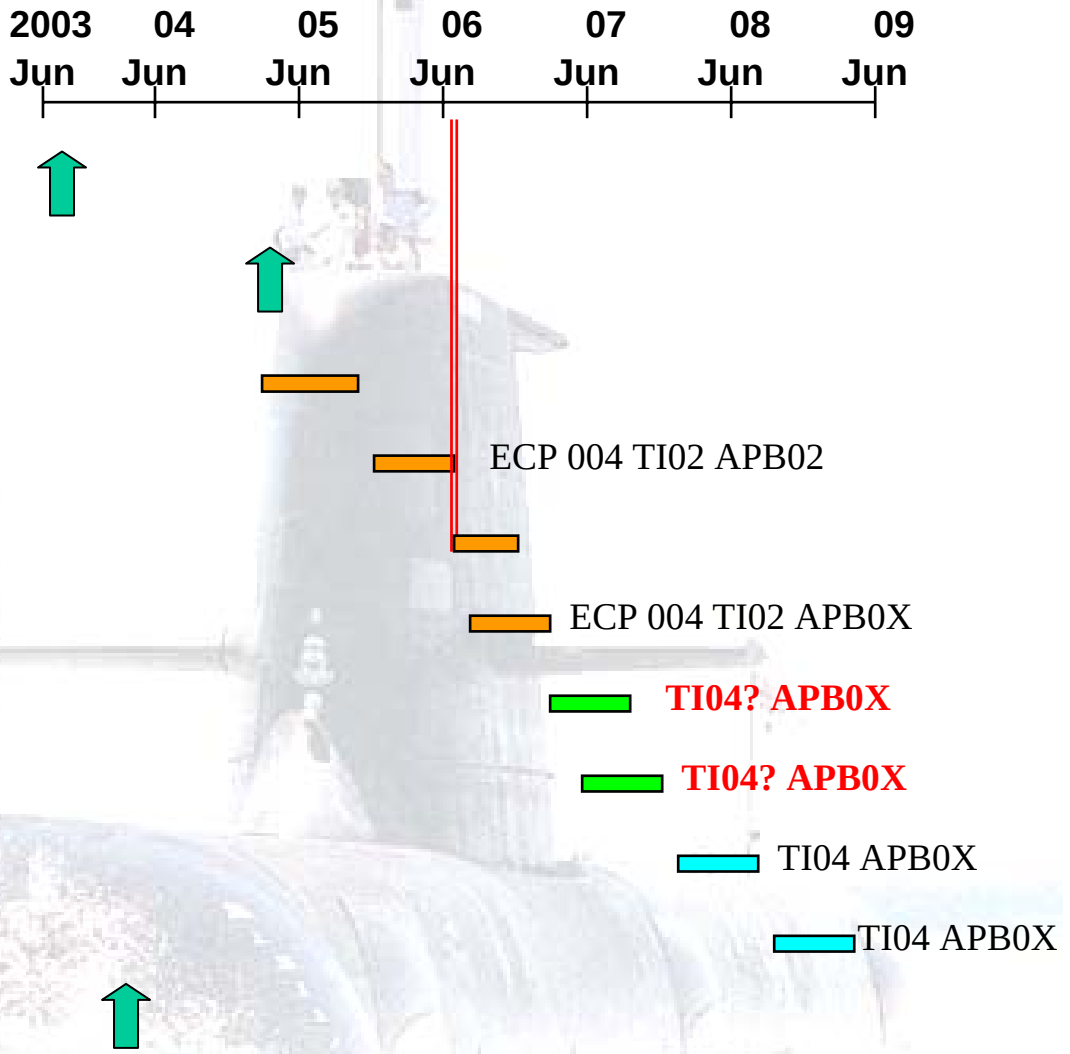
- Lowest possible risk
- At sea pedigree from USN program
- Need to roll out ASAP
- Linked to SM docking cycles
- Linked to HWT project
- Move to alignment with USN program
  - Separate TSC and WSC architecture
  - TI program (key to APB outcomes)

The initial “rollout”

- First two submarines
  - CCS Mk 2 Technical Insert 02, APB 02
  - Combined TSC and WSC
  - As per current USN system with small number of RAN critical changes
- Remaining four submarines
  - CCS Mk 2 Technical Insert 0X, APB0X
  - Split TSC and WSC
    - will include RAN requirements
    - based on COTS with rapid change cycle

COLLINS REPLACEMENT COMBAT SYSTEM OVERVIEW SCHEDULE

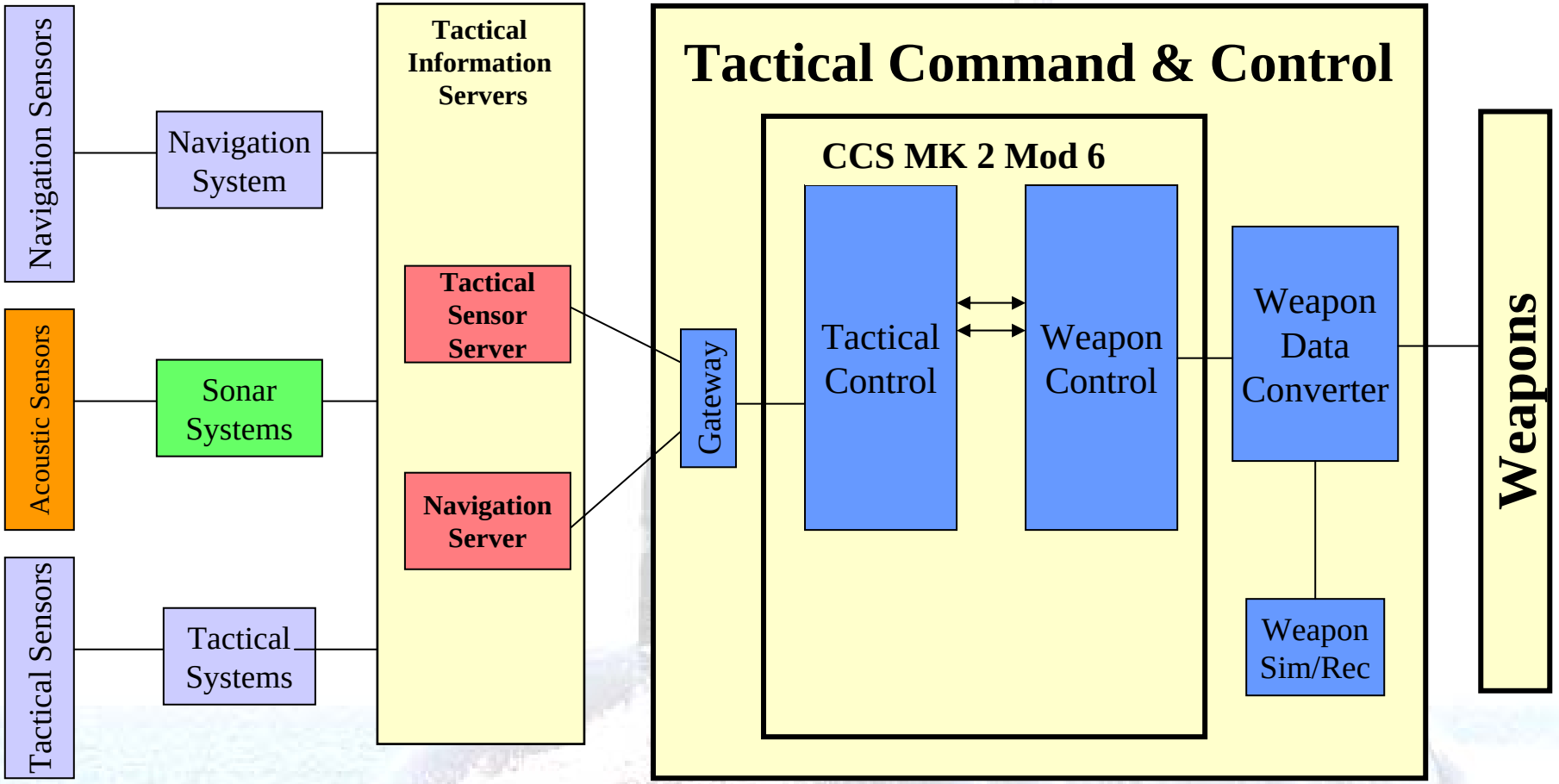
Subject to Fleet Program Changes



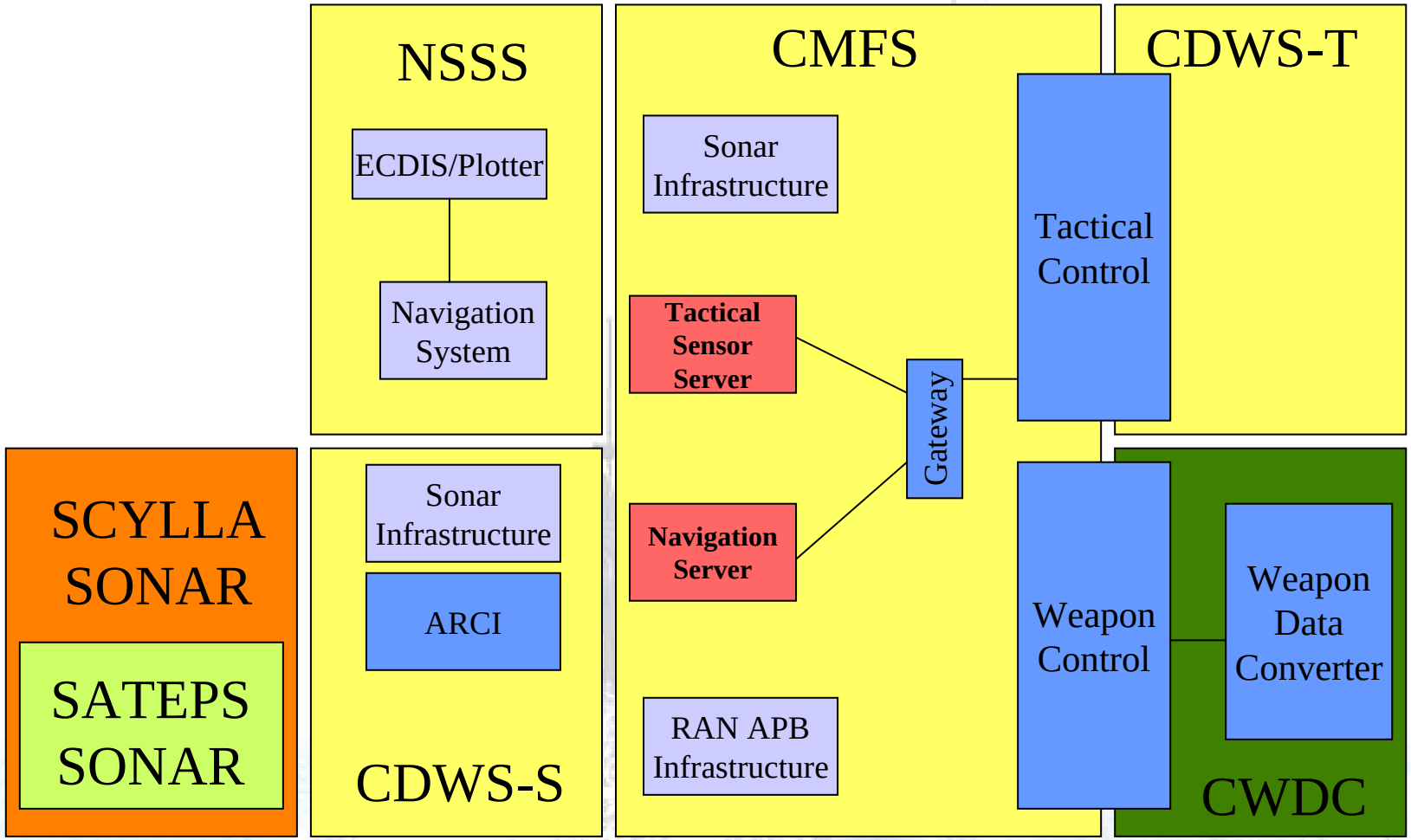
RCS

- The next presentation will provide details on the development methodology used by the US and in which we will be involved in the future
- Context will be the replacement combat system architecture
- The architecture will allow for the Collins to keep aligned to the US program, and also to trial capabilities separate to the US core system
- Future upgrades include both hardware and software changes

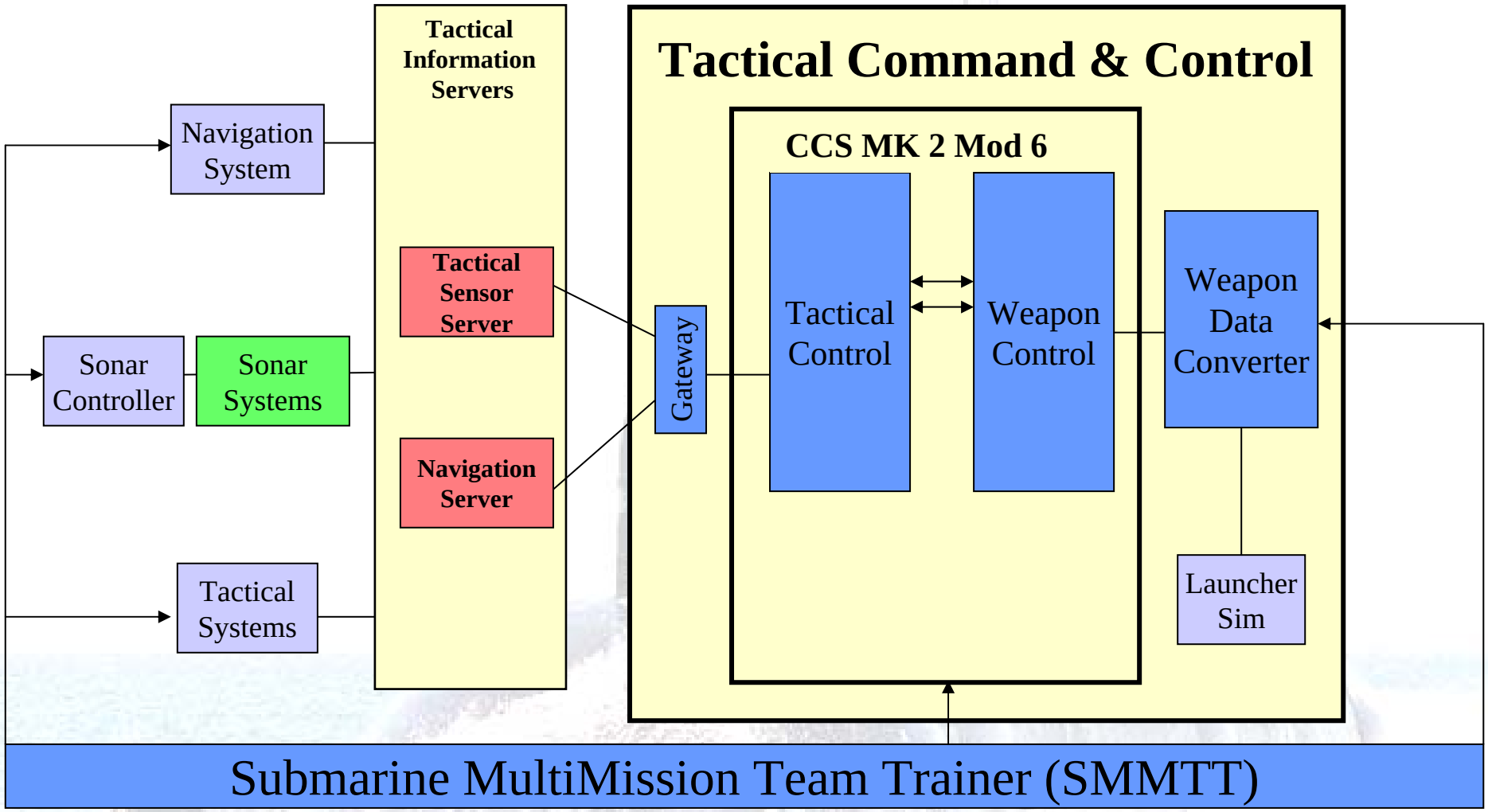
RCS MISSION SYSTEM FUNCTIONAL BASELINE



RCS MISSION SYSTEM PHYSICAL BASELINE



RCS SHORE FACILITIES FUNCTIONAL BASELINE



Advanced Processing Builds and the Replacement Combat System

What are we going to tell you?

- Who We Are
- Why We Are Here
- What an APB Is and Is Not
- How the Four Step Process Works
- How We Rapidly Transition Science & Technology (S&T) Products to Fleet Ready Products
- How We Manage This Process
- *How You Can Get Involved*

Who We Are

- CAPT David Veatch – Program Manager, Submarine Combat Systems (PMS 425)
- Victor Gavin – Assistant Program Manager Research & Development, PMS 425
- David Morel – Australia Programs, Naval Undersea Warfare Center (NUWC)
- *Vinay Krishna – Systems Engineer, Submarine Combat Systems, NUWC*
- *Dr. Robert Zarnich – Submarine Acoustic Research, Advanced Systems Technology Office (ASTO)*

Key Players in APB Process

- PMS 425 – USN Production Program Office

  Responsible for integrating APBs and producing CCS Mk2 systems

- ASTO – USN Advanced Systems & Technology Office

  Responsible for managing APB process

- ONR - Office of Naval Research

  Coordinates, executes, and promotes the science and technology programs of the United States Navy

- NUWC - Naval Undersea Warfare Center

  Navy's full-spectrum research, development, test and evaluation, engineering and fleet support center for submarines and submarine systems

Before We Get Started
Some Terms You Will See

ACP – Armaments Cooperative Project

Agreement governing USN/RAN cooperative modernization process

APB – Advanced Processing Build

Functionality improvements

STRG – Submarine Tactical Requirements Group

Group of senior Fleet officers responsible for setting modernization requirements

More Terms…

TCSG – USN Tactical Concept of Operations Support Group

Responsible for interpreting requirements and overseeing implementation

COSG – Concept of Operations Support Group

Working level group of senior enlisted operators and junior officers focused on control and display implementation

CCS MK2 - Also known by AN/BYG-1

Version that will be installed in COLLINS is CCS MK2 Mod 6 (also known as AN/BYG-1(V)8)

Indicates APB Process Change to include RAN participation

Why Are We Here?

History of Strong USN/RAN Submarine Partnership

- Submarine Statement of Principles
  - Signed by USN Chief of Naval Operations/RAN Chief of Navy 10 September 2001
- USN/RAN PCO Operations and Lungfish
- Shipyard Support
  - EB “Technology Partner” for HM&E support
- Acoustic Assistance
  - Hydro-acoustic improvements/analysis
  - Designed improved propellers
- Heavyweight Torpedo
  - Armament Cooperative Project (ACP) for CBASS since March 2003
- Combat Systems
  - CCS MK2 selected by RAN as replacement Combat System for COLLINS FMS case signed June 03
  - ACP planned for Apr 04

Statement Of Principles For Enhanced Cooperation Between USN/RAN

- Shared goal of Maximum Cooperation and Synergy on Submarine Matters
- Both Navies to assist each other in providing fully capable, sustainable, and interoperable submarine forces
- Collaborative activities will enhance ability of submarines to operate effectively in prevailing strategic circumstances
- Share training opportunities to increase mutual skills in warfare
- To facilitate participation in collaborative ventures designed to maximize the Participants advantage in sub warfare in the region
- To facilitate the exchange of data and analysis of info from test, evaluation and warfare in support of mutually determined objectives
- To maximize the mutual benefits of interoperability/synergy of equipment production and logistics support that results from increased opportunities for both Participants' industrial bases

EXCHANGE INFORMATION, SHARE LOGISTICS, AND COOPERATION IN R&D

WHAT IS AN ACP?

- Armaments Cooperative Project (ACP)
  - Conceived in 1970s to foster interoperability with NATO and non-NATO major allies
- Objectives
  - Development and support of common, interoperable equipment with U.S. allies and friendly nations
  - Cost savings through cost sharing and economies of scale in jointly managed Research and Development (R&D), production, and logistics support
  - Exploitation of the best technologies available for equipping the U.S., allies and friendly nations
  - Supply the best available defense material to the U.S., allies and friendly nations in the most timely and cost-efficient manner

Proposed U.S. – Australia RCS ACP: Basic Program Tenets & Requirements

- Royal Australian Navy (RAN) upgrades COLLINS Class submarines to CCS CCS MK2 Mod 6 (ECP004)
  - Land Based unit, Two Commercial units, Two ship sets procured through FMS
  - Four ship sets procured under ACP
- CCS MK2 upgrades co-developed by USN and RAN personnel
  - Upgrades managed through Advanced Processing Build (APB) Process and Tech Insertions (TI)
  - RAN can influence common requirements and input RAN unique requirements into APB process
  - Both nations support ongoing development, configuration management, sustaining engineering efforts
- RAN-unique CCS MK2 required infrastructure delivered and installed
- Integrated Logistic Support over life of the ACP
  - Both nations fund ongoing ILS efforts
  - Parts, training, documentation, etc. covered under MOU

CCS MK2 ACP is a Means to Strengthen Both our Navies

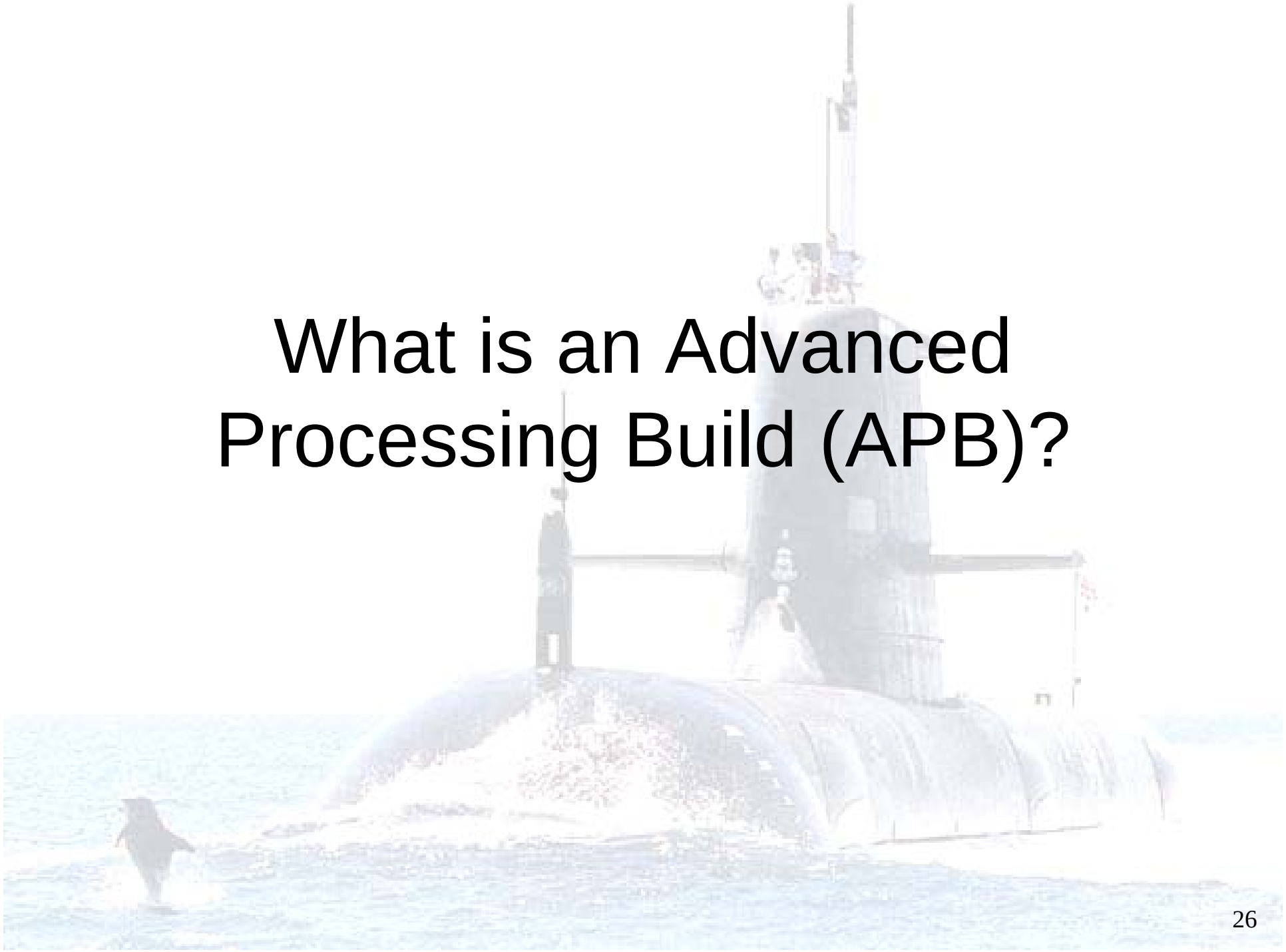
This is where you come in…

- Cooperative development of CCS MK2 upgrades being pursued
  - Integral members in APB development process
  - Members of Peer Review Integrated Product Teams (IPT)
  - Inclusion in requirements setting process
  - Cost savings for USN/RAN

- Royal Australian Navy voting members of STRG
  - RAN provides diesel-electric submarine perspective
  - Maintains fleet interoperability
  - Strengthens USN/RAN Submarine partnership

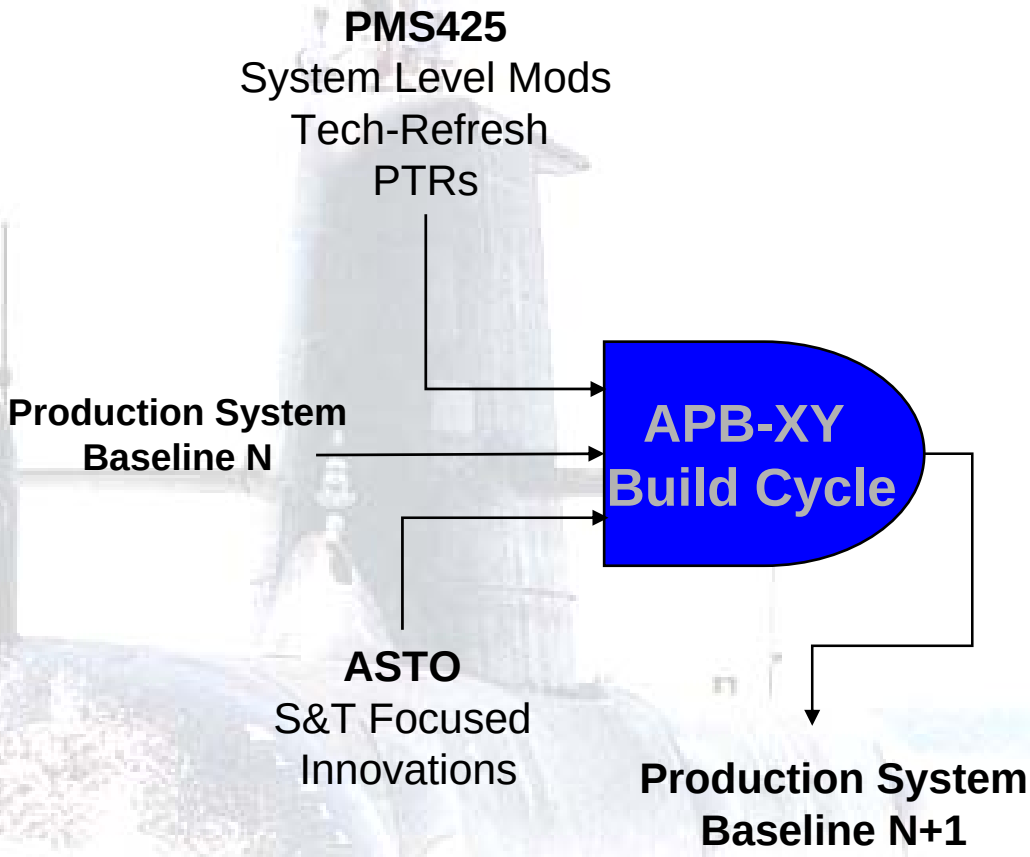
We Want to Inform and Invite Australian Industry!

What is an Advanced Processing Build (APB)?



What is an APB?

- An APB is a software product that contains new or enhanced capabilities
  - The thrust is to deliver new/improved Combat System Capability via Software
- APBs are applied as upgrades to existing baselines
  - An APB Build Cycle is a *Transform* that outputs a new production baseline
  - Production software systems are made resilient over hardware technology with Middleware and over APB Build cycles by solid software engineering practices



The Way We Do It Today – HW and SW; Separate and Open Systems

APB Process Perspectives

IS	***IS NOT***
• Open Architecture Systems using COTS Hardware Products	• Proprietary systems
• A system of integrated functionality	• Stand-alone components
• An open process that shares source material to the benefit of ALL participants	• A closed club of traditional providers

What is this Four Step Process?

Combat Systems Modernization

Technology Push

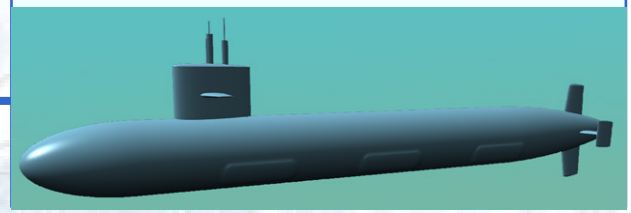
Military
IR&D
Industry
Academia
Navy Labs

Four Step APB Process

1. R&D Test
2. Stress Test
3. Lab Test
4. Sea Test

Production System

Fleet

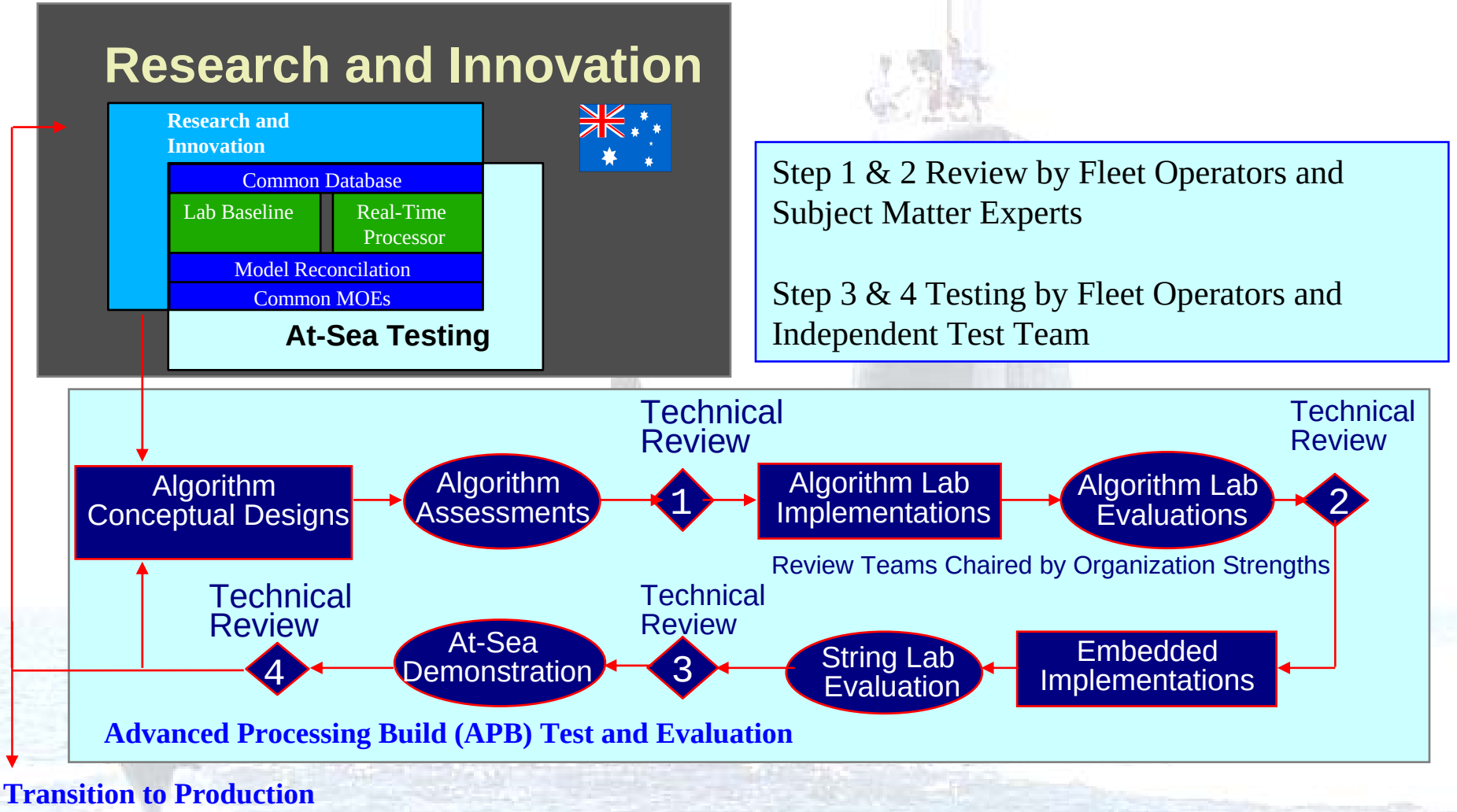


Assess Needed Improvements

Build-Test-Build

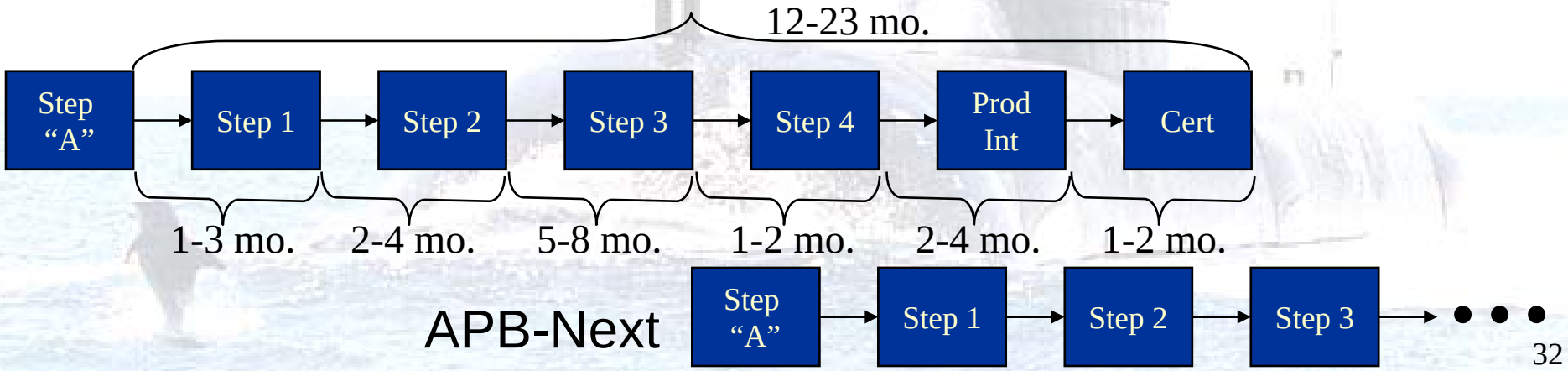
- **Faster Introduction**
- **Earlier testing**
- **Reduced risk**

The 4 Step APB Process



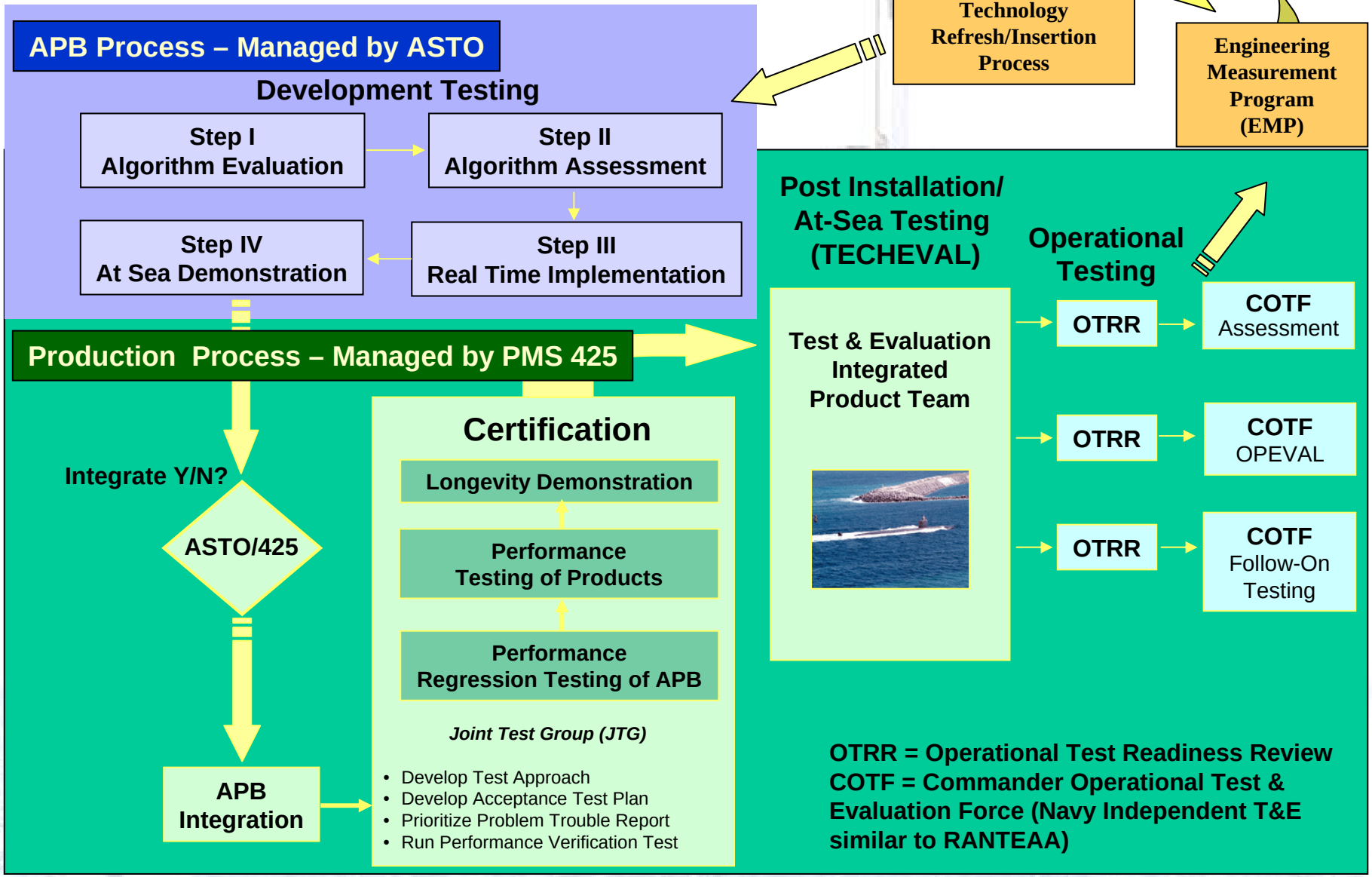
APB Product Expectations

- An APB Product is ***not*** a Deliverable Production System
- Sea Test configuration may have elements intended for production, and/or elements for evaluation
  - These may not be in the next year's production release
  - The may also be missing components - To be fielded with Production
- Sea test is an Engineering Design & Manufacturing level product, will not have logistic support, training, planned maintenance.
  - Typically Requires Temporary Alteration (TEMPALT) equipment
  - Typically Uses Code Not Intended for Production
  - Production Integration Adds Significant Value



From S&T to Production…

Development & Certification Process



How Do We Manage this Process?

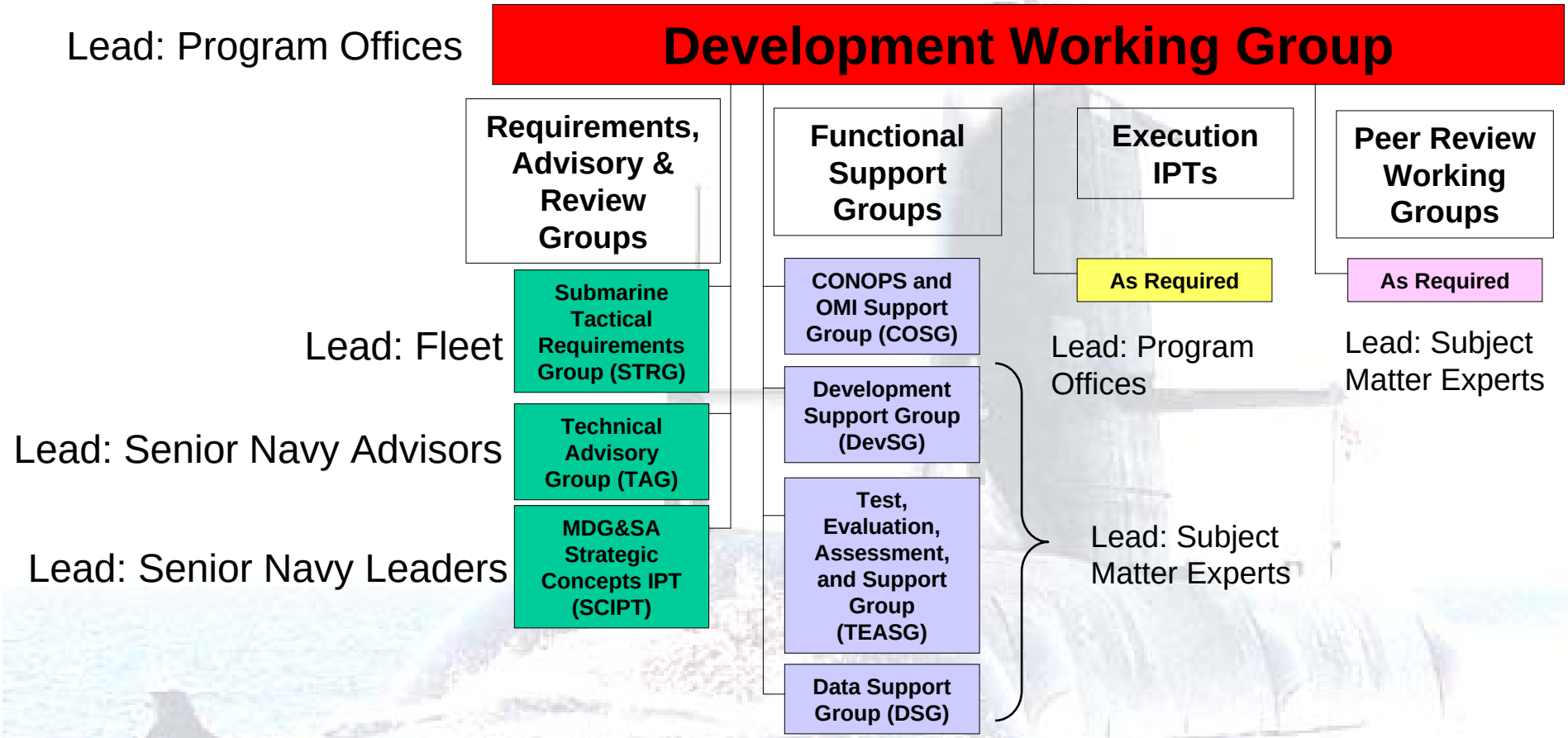
Managing Combat System Modernization

- Fleet Input via the Submarine Tactical Requirements Group (STRG) Define and Approve the Requirements

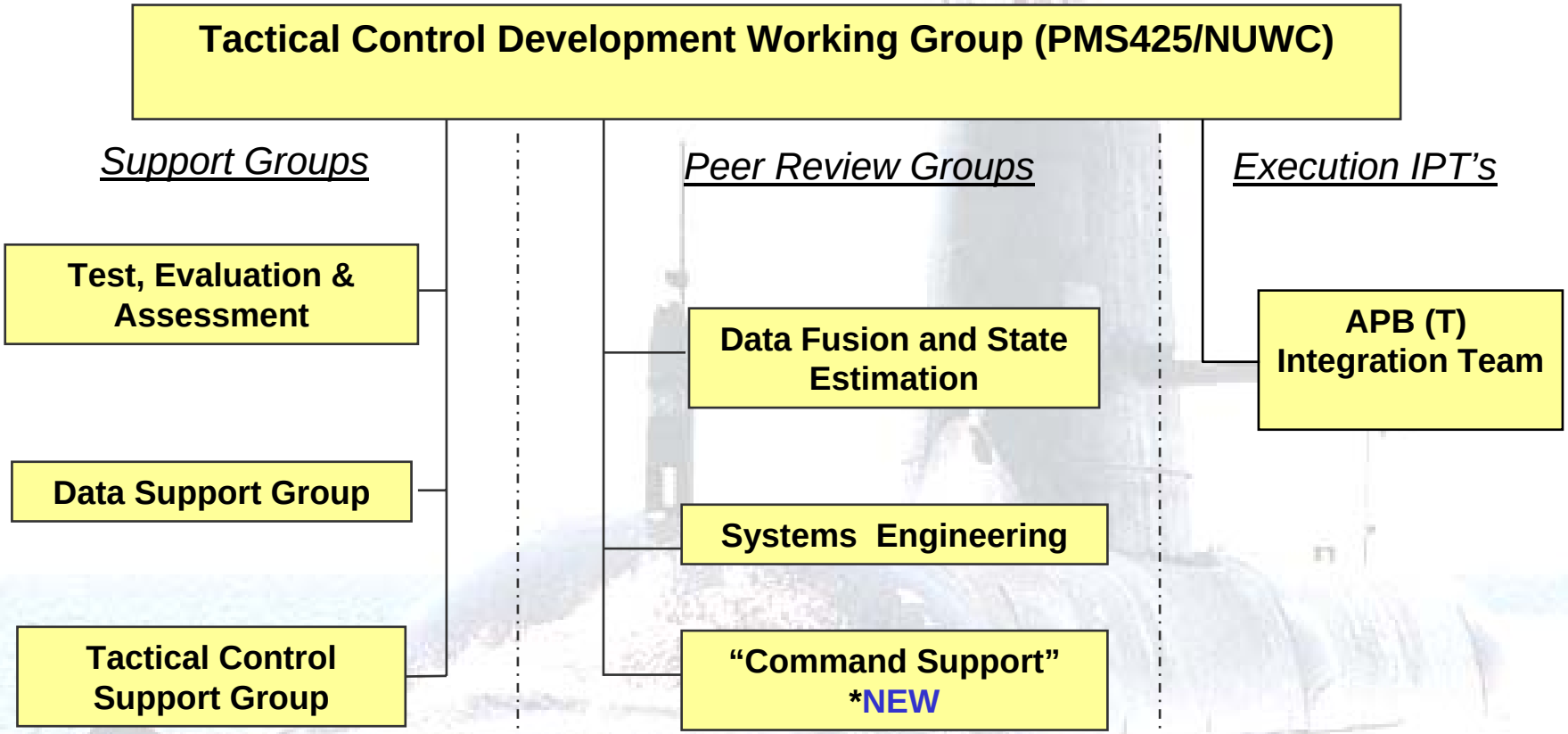
- PEO SUB / ASTO/ RAN jointly budget for APB development, test and fielding under USN/RAN ACP
- Focused contract actions
  - Consistent funding and focused contracting creates team stability and identifies common goals
- Incentives to Developers through
  - Return Business - Tech Base Maintained/Updated by Innovators

Annual Installments on Fleet Requirements
One process - _One_ product

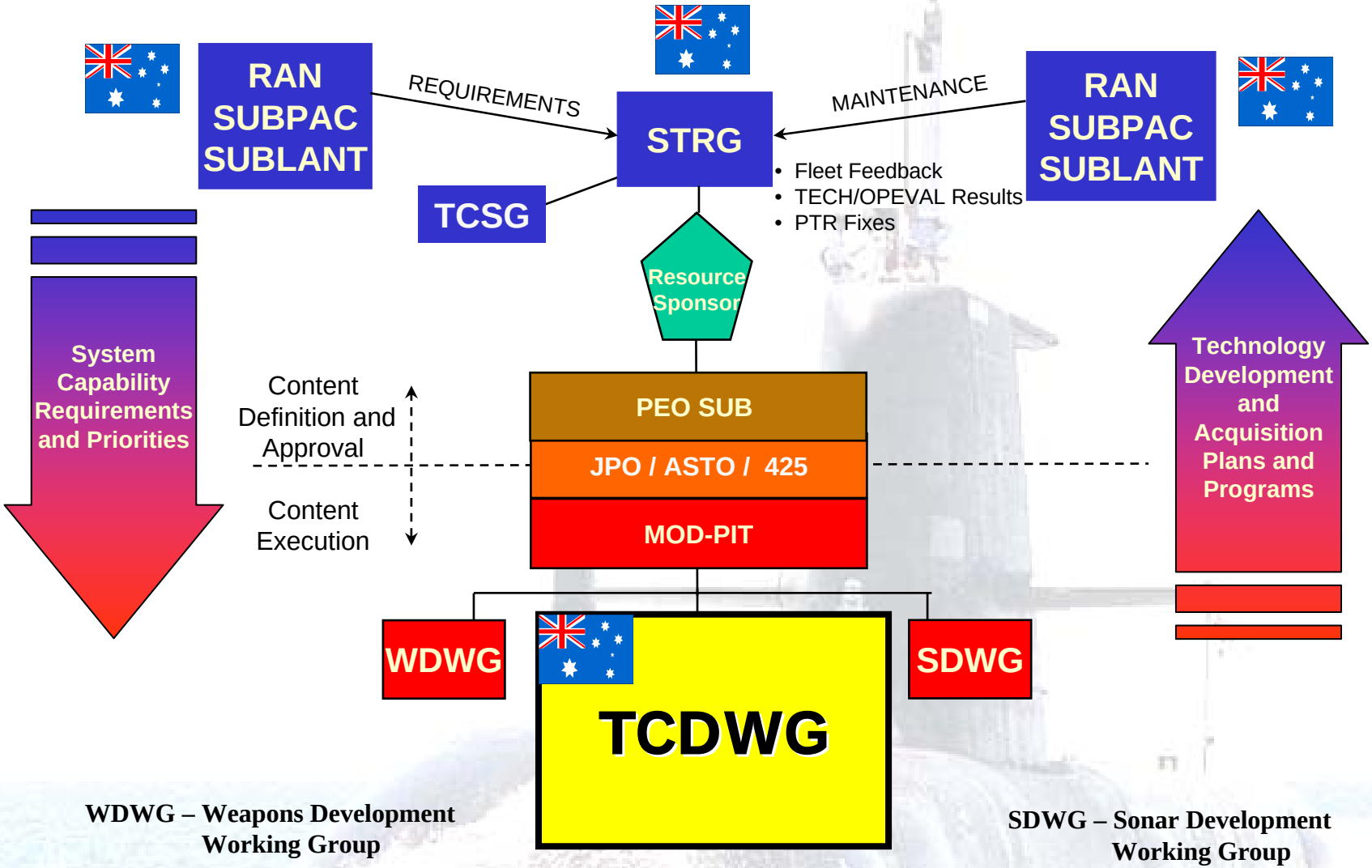
General Working Modernization Organization



Tactical Control Development Working Group (TCDWG)



Requirements and Planning



WDWG – Weapons Development Working Group

SDWG – Sonar Development Working Group

STRG + Test Results + FLEET Feedback + Maintenance = APB Content

Australia's Role in the Modernisation Process

Australia's Role in the Modernisation Process

- RAN Requirements Input
- RAN Operational System Feedback
- RAN Operational Employment/Tactical Feedback
- Australian Industry Proposals for enhancement of CCS Mk-2
- Australian R&D activities for enhancement of CCS Mk-2

RAN Requirement Input Cycle for CCS Mk-2

USN tactical requirements

2

STRG
(SM Tactical Requirements Group)

RAN Representative

USN & RAN prioritised tactical requirements

US$

AU$

RAN-prioritised tactical requirements

3

APB-XY Build Cycle

1

RAN Operational Requirements Development Process

Input from:
- Operations Analysis
- Exercises & Training Assessments
- Future War-fighting Concepts
- Strategic Assessments

4

Up-date to CCS Mk-2

5

CoA on TCDWG

Aust. in Peer Review Groups

Aust. in Execution IPTs (JPO)

RAN variant

(CCS Mk-2 Mod.6)

USN variants

(CCS Mk-2 Mod.1-5)

RAN Operational System Feedback for A/N BYG-1

Production Baseline Issues

1 **CS Issues Mgt Process:** DSMS(SSG)

2a **CCS Problem Assessment Board:**

USN operational CCS Mk-2 system Issues

- defects
- deficiencies
- proposals

Non-Production Baseline & COLLINS-Specific Issues

Production Baseline Engineering Changes

2b **RAN System Enhancement Processes**

Input from:
- **SM FEG**
- **Maritime Development**
- Operations Analysis
- Exercises & Training Assessments
- Future War-fighting Concepts
- Strategic Assessments

Common Baseline & RAN-Specific Engineering Change Proposals

3 **APB-XY Build Cycle**

4 Up-date to CCS Mk-2

5

RAN variant

(CCS Mk-2 Mod.6)

USN variants

(CCS Mk-2 Mod.1-5)

CoA on TCDWG

Aust. in Peer Review Groups

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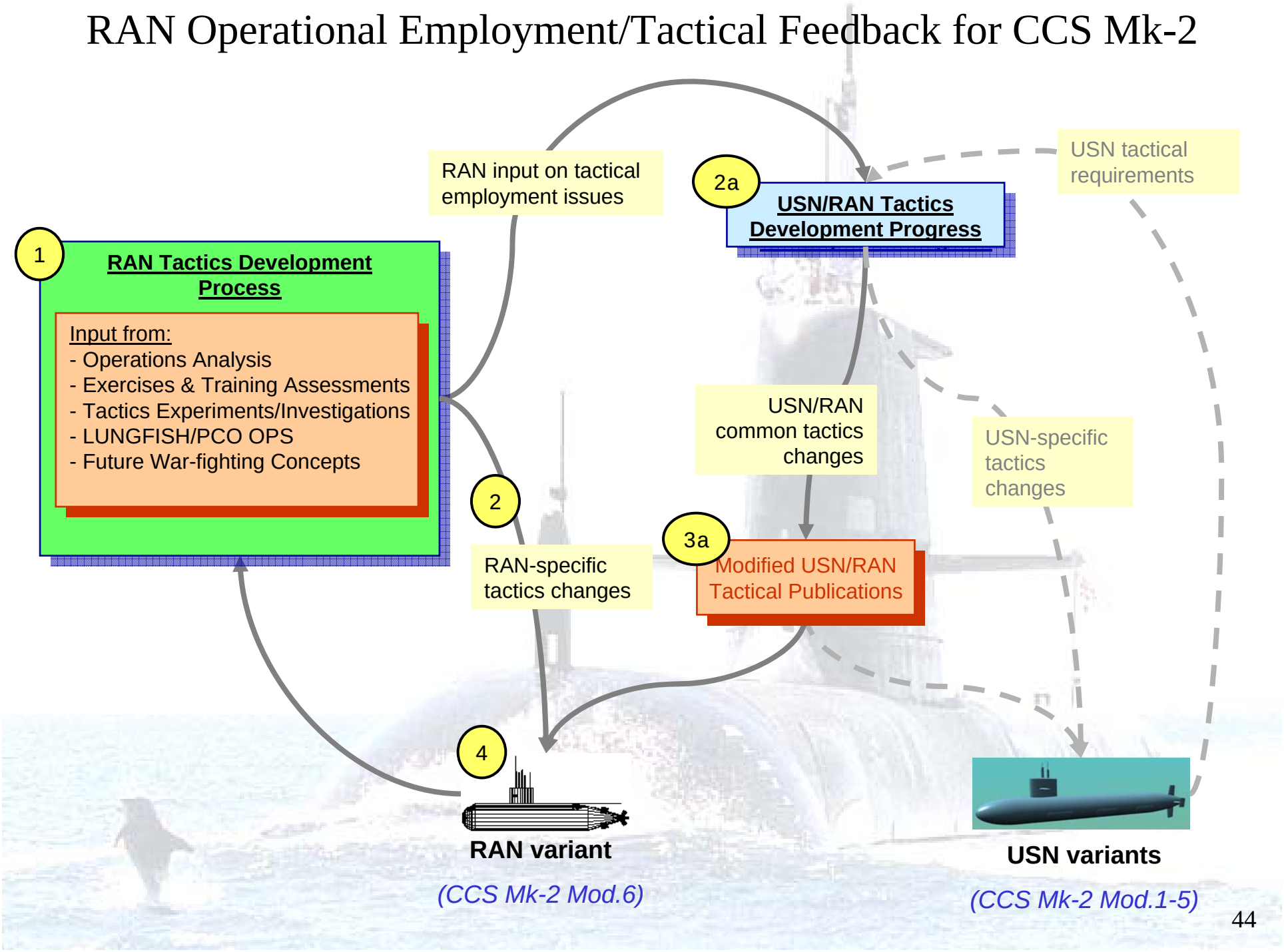
RAN Operational Employment/Tactical Feedback for CCS Mk-2



Australian Industry Proposals for enhancement of CCS Mk-2

Industry Proposals:

Solicited Proposals:

Unsolicited Proposals :

BAA Responses – ONR

Potential COLLINS CS enhancement proposals

ONR Gateway

CCS Problem Assessment Board:

Production Baseline Issues

CS Issues Mgt Process:
DSMS(SSG)

3

APB-XY Build Cycle

Non-Production Baseline & COLLINS-Specific Issues

RAN System Enhancement Processes

Input from:
- **SM FEG**
- **Maritime Development**
- Operations Analysis
- Exercises & Training Assessments
- Future War-fighting Concepts
- Strategic Assessments

Common Baseline & RAN-Specific Change Proposals

4

Up-date to CCS Mk-2

5

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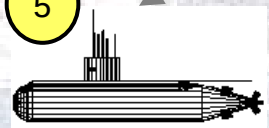


RAN variant

(CCS Mk-2 Mod.6)

USN variants

(CCS Mk-2 Mod.1-5)

Australian R&D activities for enhancement of CCS Mk-2

APB Process – Managed by ASTO

- **Step I** Algorithm Evaluation
- **Step II** Algorithm Assessment
- **Step III** Real Time Implementation
- **Step IV** At Sea Demonstration

RAN System Enhancement Processes

Input from:

- **SM FEG**
- **Maritime Development**
- **R&D Programs**
- **Industry Sector Plans**

- Industry Study Programs
- Focused Research Programs
- CS/SS related CTDs
- GOANNA Prototype Programs
- Major Capability Acquisition

R&D & Industry Support in an ACP Context

Aim: ***Compatible & Complementary R&D***

Expect to see Australian Involvement in:

- Peer Review Groups
- Data Support Group
- Industry Study Programs
- Focused Research Programs
- CS-related CTDs
- Prototype system component developments

What Did We Just Tell You?

- Requirements are Fleet Driven
- The Process is Supported with Fleet Involvement at Each Step
- Innovative Application of S&T Products Applied Through the “APB” Process
  - The Process is Open
  - The Process is Merit Based
  - Rapid Build-Test-Build Methodology
  - ASTO Lead for Innovation
  - Project Office Lead for Production
- The Commonwealth of Australia will Participate at ALL Levels 

How Can You Get Involved?

Open and Competitive Process

APB acquisition process is open and competitive

- Broad-based Agency Announcements (BAA) used for solicitation of APB Candidate technologies
  - Candidate technologies **evaluated by multi-disciplinary independent Peer Review Groups** consisting of submarine operators, headquarters and field activity technical specialists, and academia and industry experts

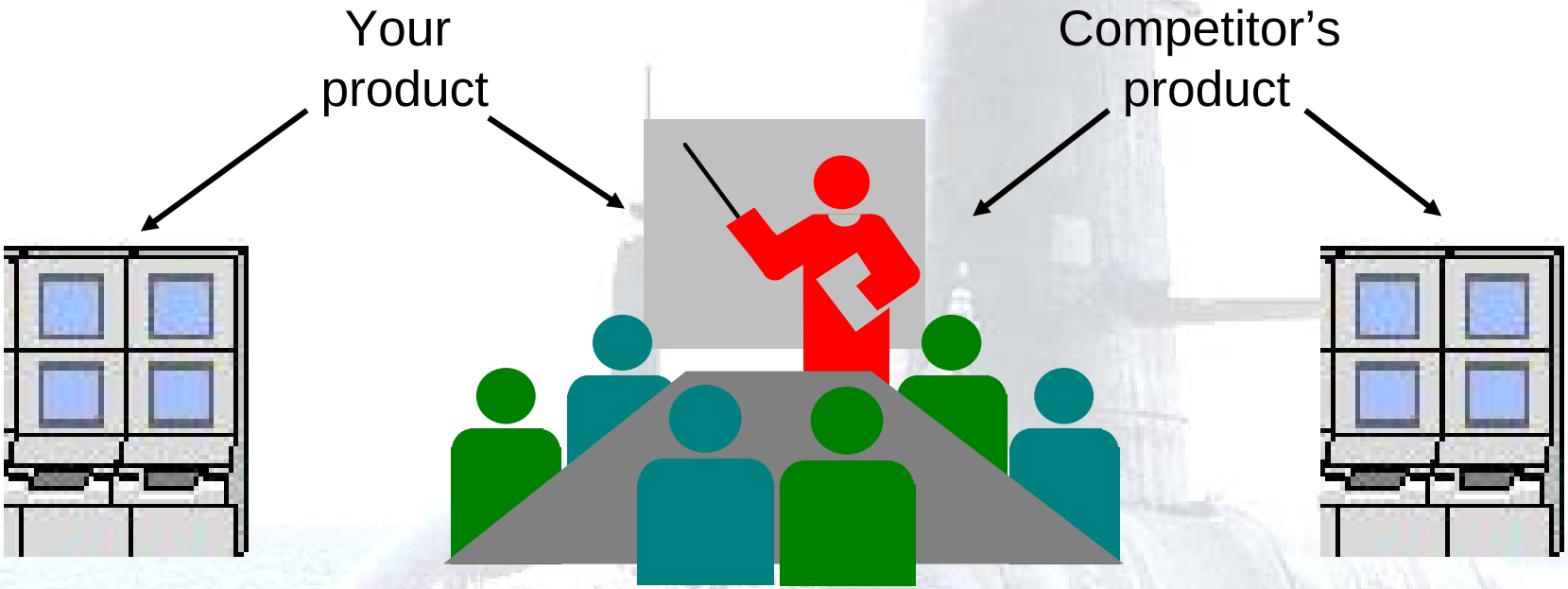
Australian Industry Welcome to Participate

Business Issues You Need to be Aware of

- U.S. Security Clearance required
- Data Rights – Bi-lateral and International Respect for Protection
  - We Require Non-Disclosure Agreements
  - We Require You to Share and Share Alike
  - ***… Full disclosure !***
- We generally buy software components and their support, ***NOT***, new add-on boxes
- We expect you to come prepared for Evaluation and to Even-handedly Evaluate others
- We are Fickle (Good News and Bad News)
  - If someone else has a better performer we'll dump you and "*Be on it like a Hobo on a Ham Sandwich"*!

If successful, you could be here…

It's Step 2 and the room is full of technical experts, your competitors and you ~ reviewing each others algorithms and performance against data you have never processed prior to the blind test !!!



The APB Process in not for the Faint of Heart

The Front Door to APB's www.onr.navy.mil/02/BAA/

ONR's Long Range BAA

- An APB is an integrated set of Ready for Operational use capabilities
- The APB process transforms S&T products that are Operationally Meaningful into products that are Operationally Useful
- ONR is our primary source of Operationally Meaningful products
- ONR's role in the APB Process is to solicit, vet and mature S&T tools, concepts and techniques

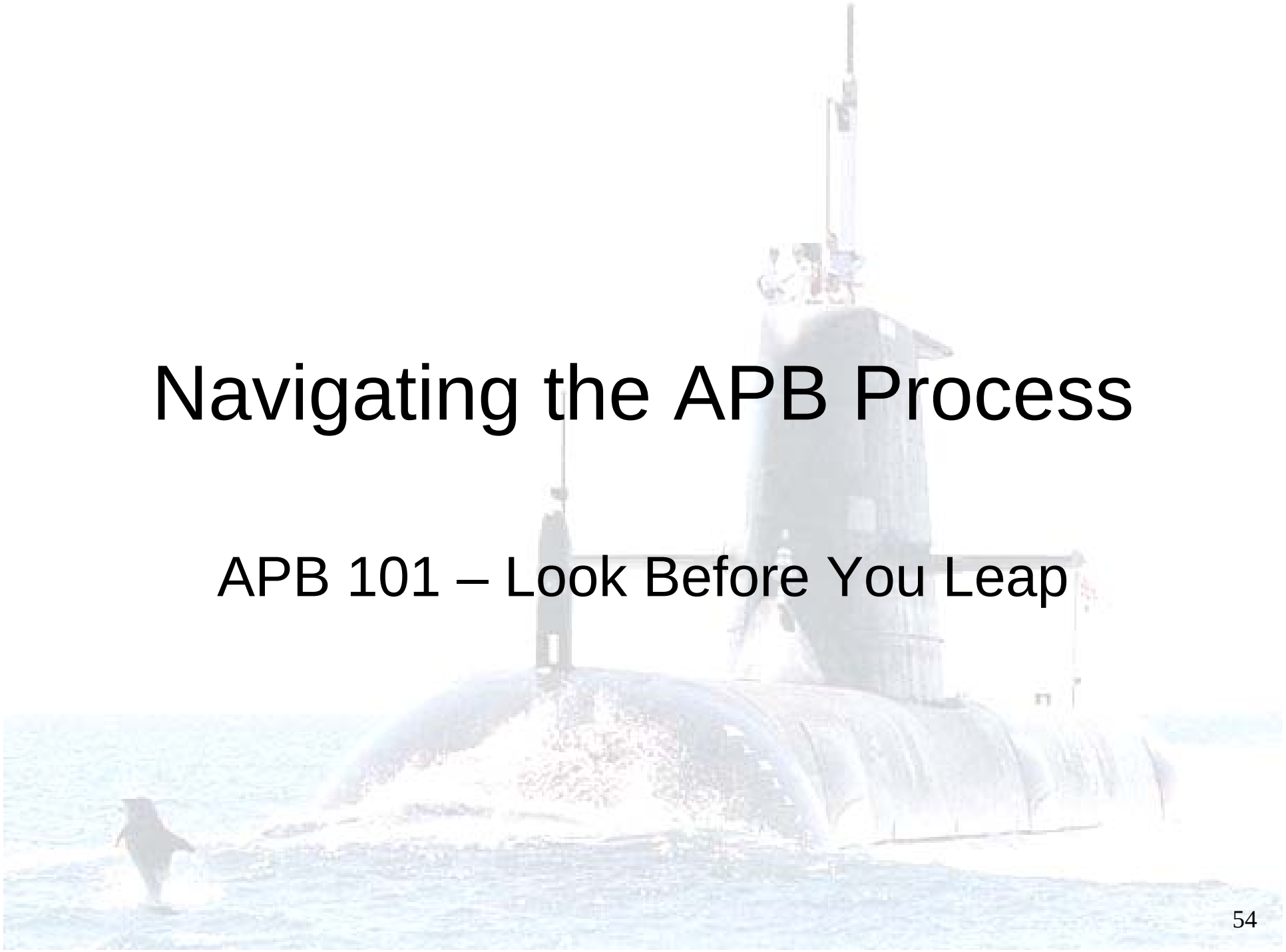
Current US Approach – ONR vets S&T

The Front Door to APB's

ONR – ASTO Relationship

- The APB-ONR relationship is well established and has experienced significant success in Acoustics
- ASTO and ONR cooperate on, and have transition agreements on, Advanced USW technologies
- ASTO provides supplemental funding for specific promising ONR technologies
- ONR BAA solicitations are produced in cooperation with ASTO
- ONR participates on APB Advisory and Working Groups

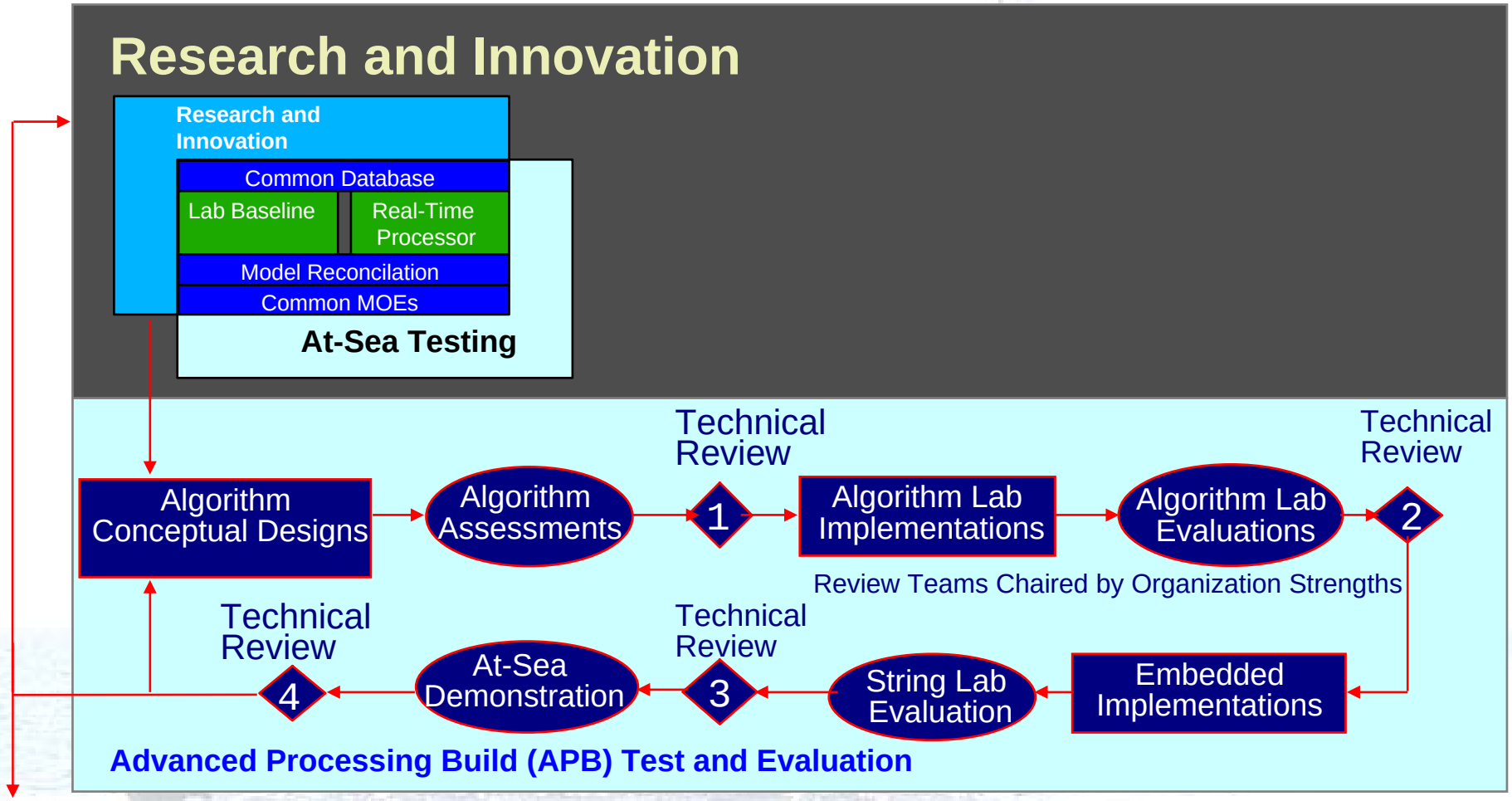
ONR/ASTO - Partners in Soliciting Research



Navigating the APB Process

APB 101 – Look Before You Leap

Navigating the APB Process



S&T to APB
Transition Criteria

Transition Readiness Is Based on the Peer Group's Step 1 Quantitative and Qualitative Assessment in the Following Areas:

- **Utility - The goal is relevant to APB functional objectives, STRG letter, …**
- **Risk - Tuning requirements, critical path items such as new algorithms, specific input data, integration difficulty, …**
- **Maturity - Use of sea data in development, independent testing prior to DFWG, metrics definition, …**
- **Operator Interface - Concept for review by TCSG**
- **Sizing/Timing - Clear definition of processing requirements for target hardware**

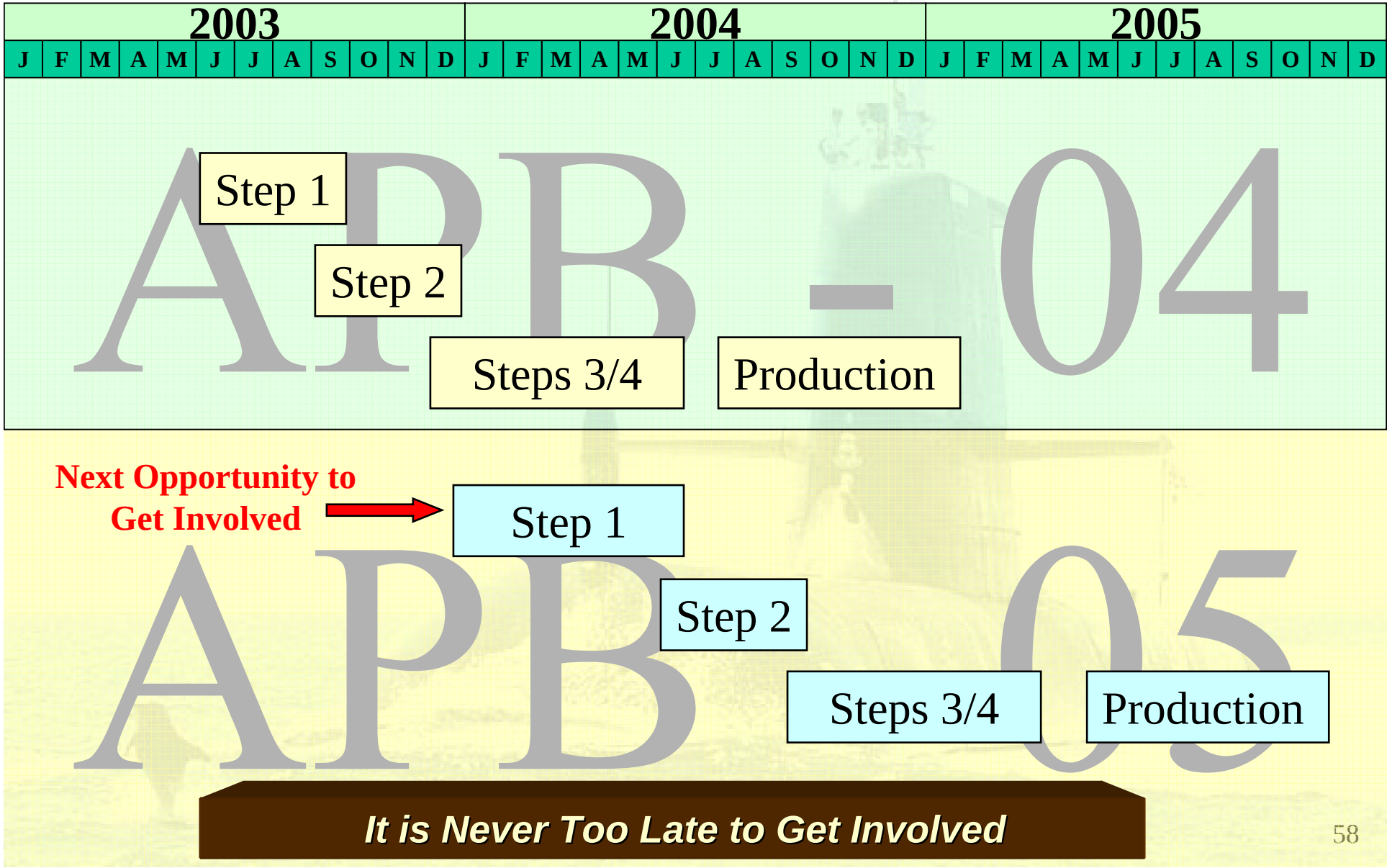
- and -

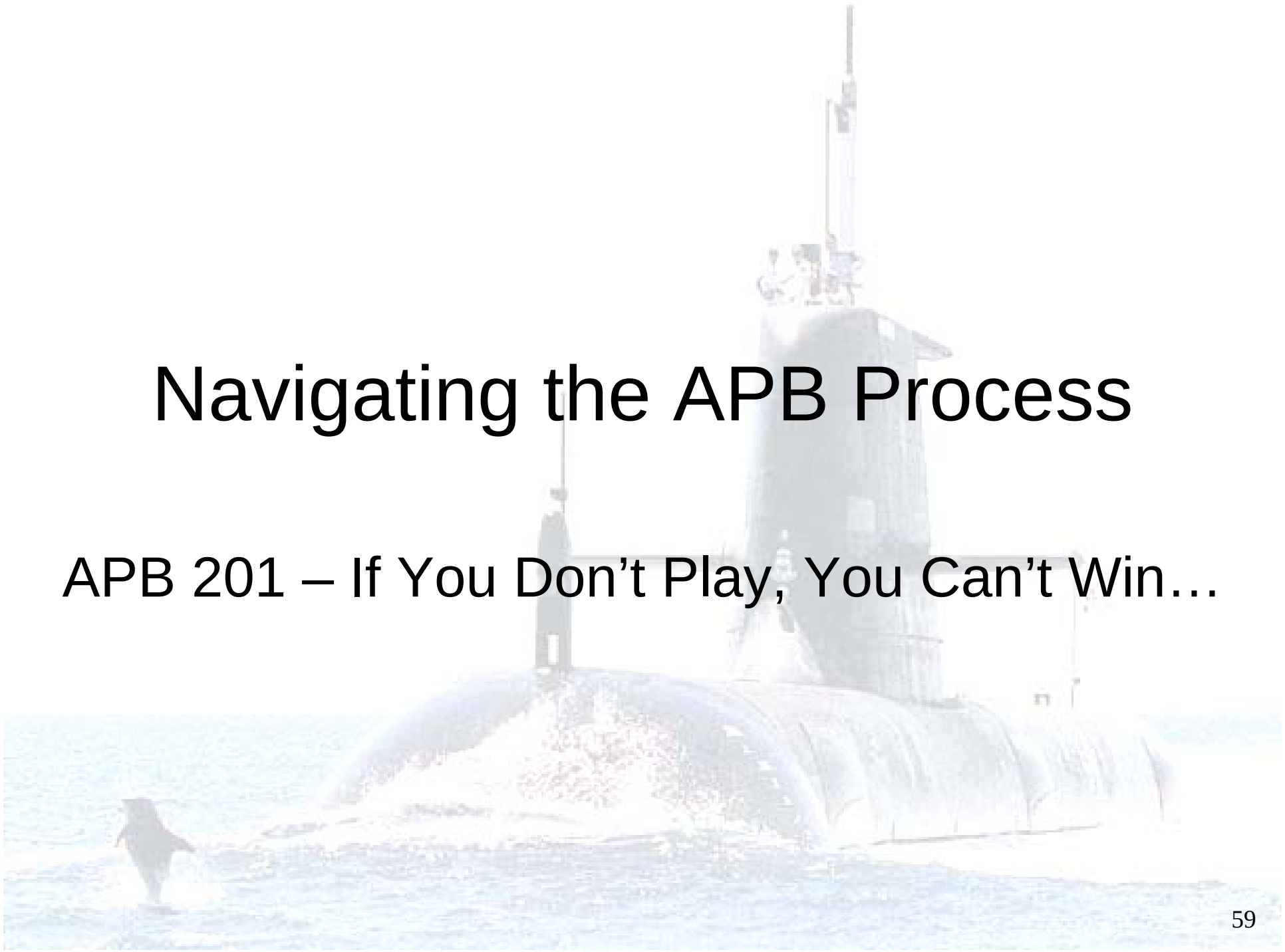
Step 2 Analysis with Quantitative Performance Metrics in Open and Closed Testing (data permitting) and comparison to current Fleet baseline performance where applicable.

Step 1 Survey Criteria

	Green Star ★	Yellow Circle ●	Red Stop Sign ⯃
Utility	**High**	**Medium**	**Low**
Risk	**Low**	**Medium**	**High, expect surprises**
Maturity	**Stable and independently tested**	**Developer-only testing**	**No testing with sea data**
Operator Interface	**Well defined**	**Questions**	**Not defined**
Sizing/Timing	**Available**	**In progress**	**Not available**
Proceed to Step 2	**Yes**	**Conditionally**	**Defer with feedback**

APB Major Activity Schedule





Navigating the APB Process

APB 201 – If You Don’t Play, You Can’t Win…

S&T Transition Pathway

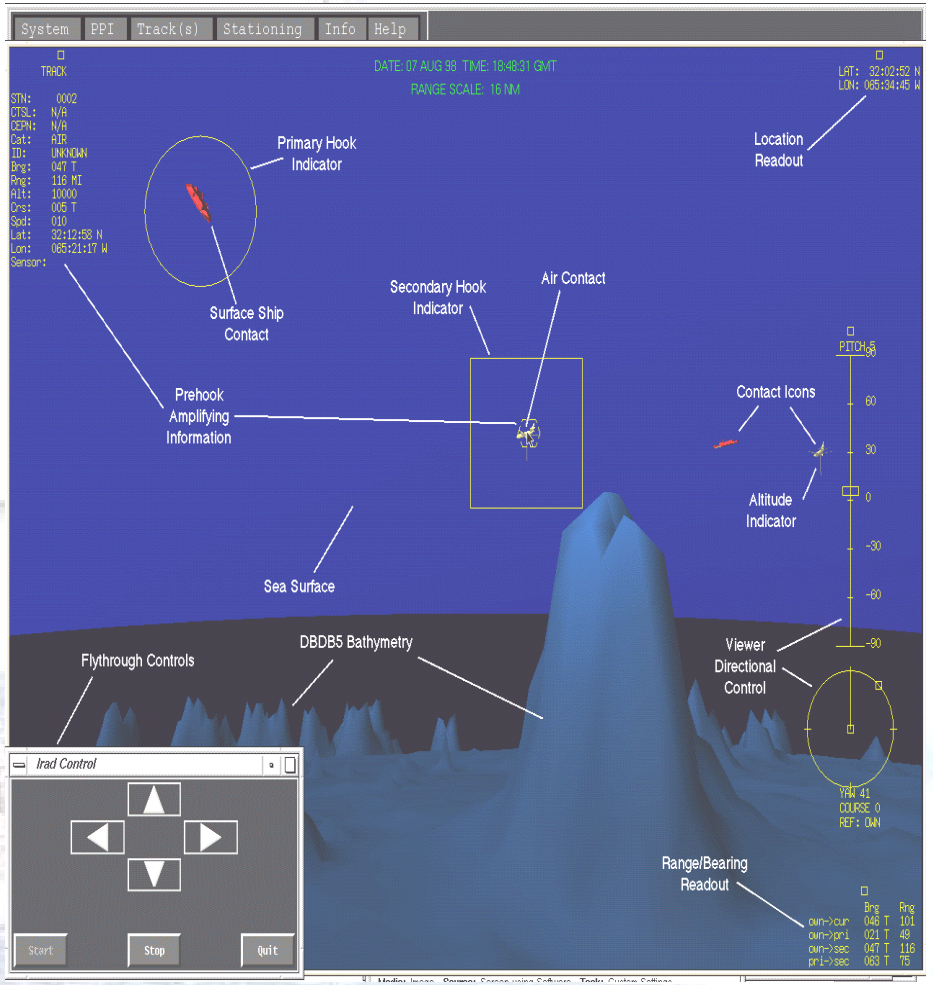
- Preparation for Step 1 (Introductory Brief to ASTO Working Groups):
  - Fleet Requirements
  - Use of APB Data Sets in Algorithm Development and Testing
  - Use of ASTO Metrics in Development and Testing
  - Focus on Algorithms, not Step 3 (End-to-End Lab Testing) and Step 4 (At-Sea Testing)
  - Focus on Transition Product Instead of Publication
  - Call an ASTO Working Group to Set Up the Brief

- Transition Success:
  - Pass Step 2 Closed Testing (Recommendation for Transition to Step 3)
  - Algorithm is Incorporated Into APB Baseline for Step 3 (Lab) and Step 4 (At-Sea)Testing

- ONR Participation in Step 2 (ASTO Algorithm Testing)
  - Closed Data Set Testing
  - Peer Review
  - ASTO Metrics
  - ONI Data

What's Needed: Tactical Control and Situational Awareness

- ***Help From S&T Needed In:***
- **Data Fusion**
  - **Includes state estimation and association improvements**
  - **Includes expanded sensor coverage for All Source Data**
- **Command Decision Aids**
  - **High Density Contact Management**
  - **Integrated Vulnerability Management**
  - **Route planning**
  - **Engagement planning and execution Engagement Recommendations**
- **Renderings That Communicate the Scene Including the *Uncertainty***
- **Navigational Support**
- **Decision Aid Bell Ringers and Tools**



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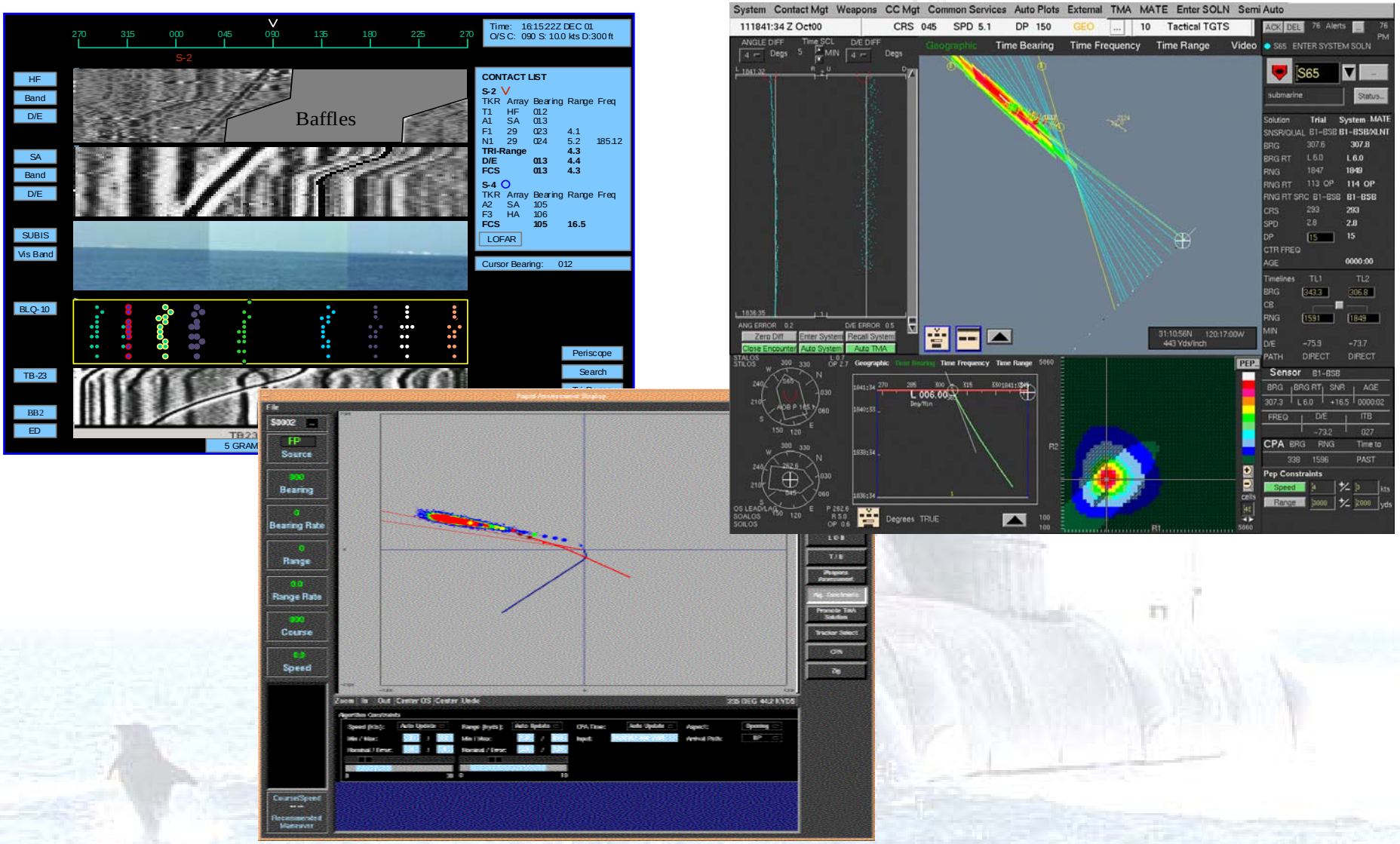
Baffles
CONTACT LIST
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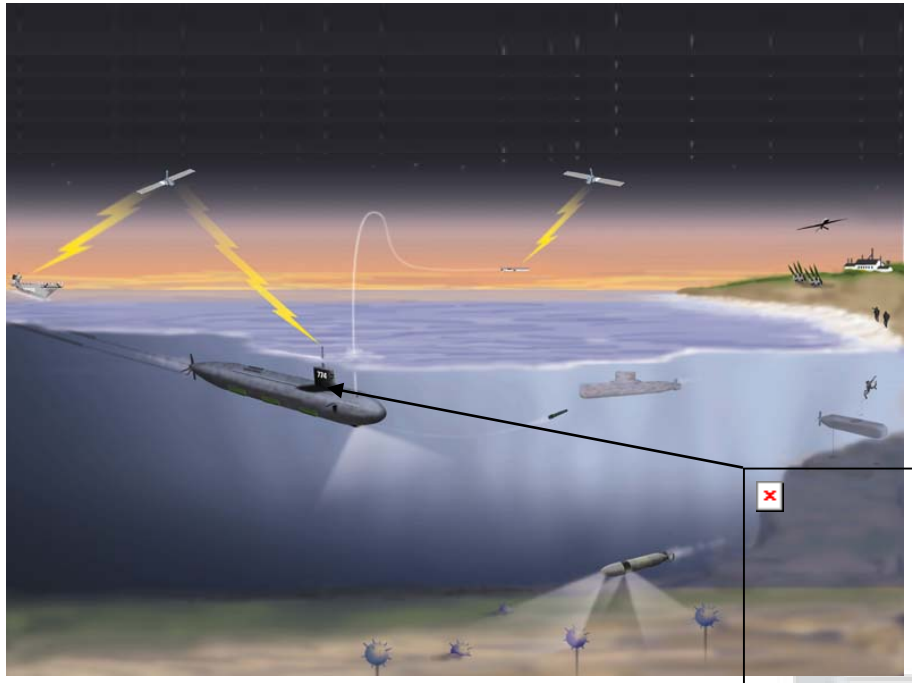
Course
Speed



... to This

Combat Systems Modernization being built on…

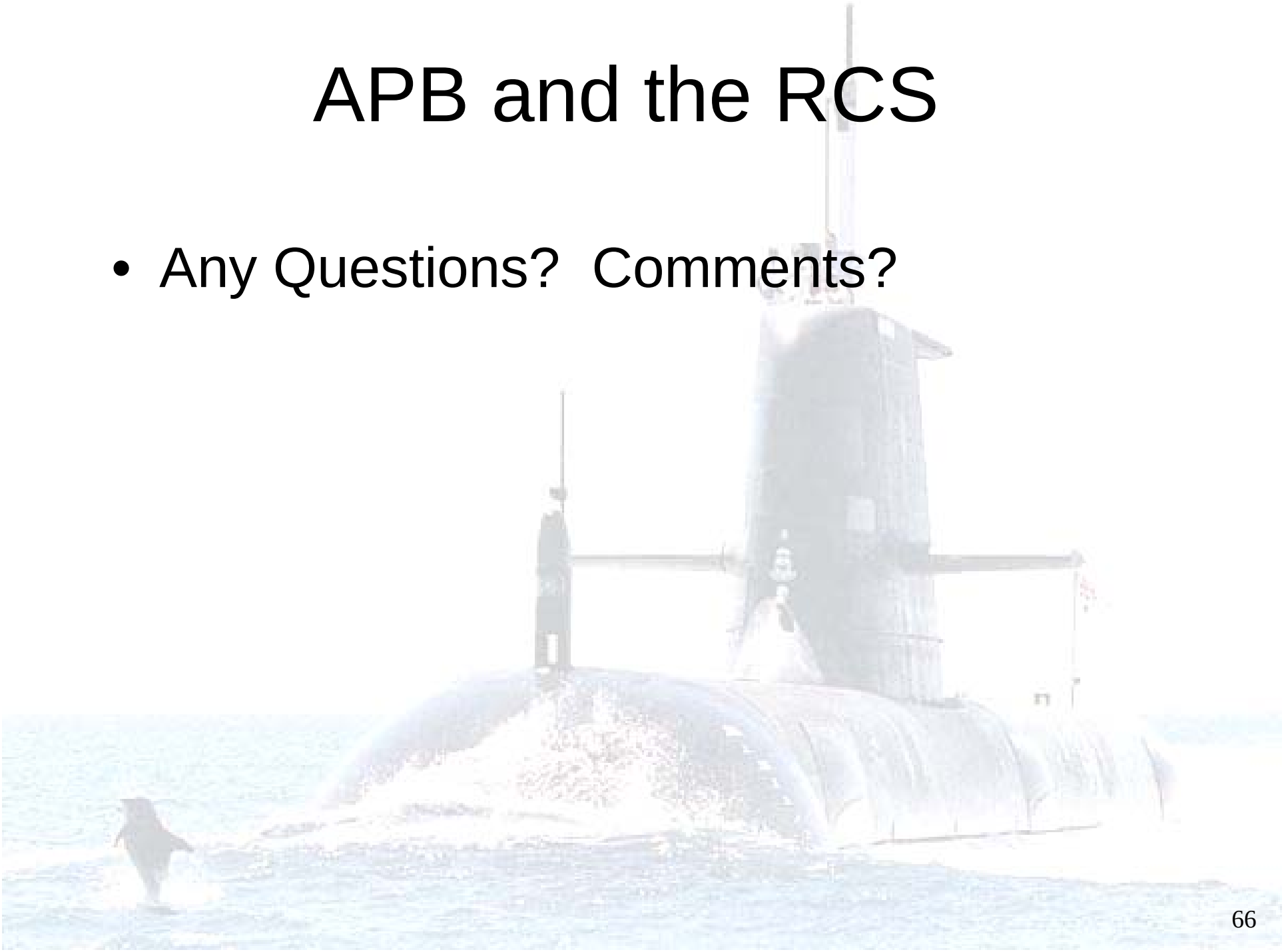
- Rapid Turn Around of Requirements
- Strong Operational Involvement
- Open Architectures
- Annual Capability Insertion
- Information Age Business Practices
- State of the Practice Information Technology
- State of the Art Science and Technology

We ain't doing it the way we used to!!

We Value our partnership with the Commonwealth of Australia and look forward to the full participation of Australian Industry and the Royal Australian Navy in the Combat System Modernization Process

APB and the RCS

- Any Questions? Comments?



Back-up

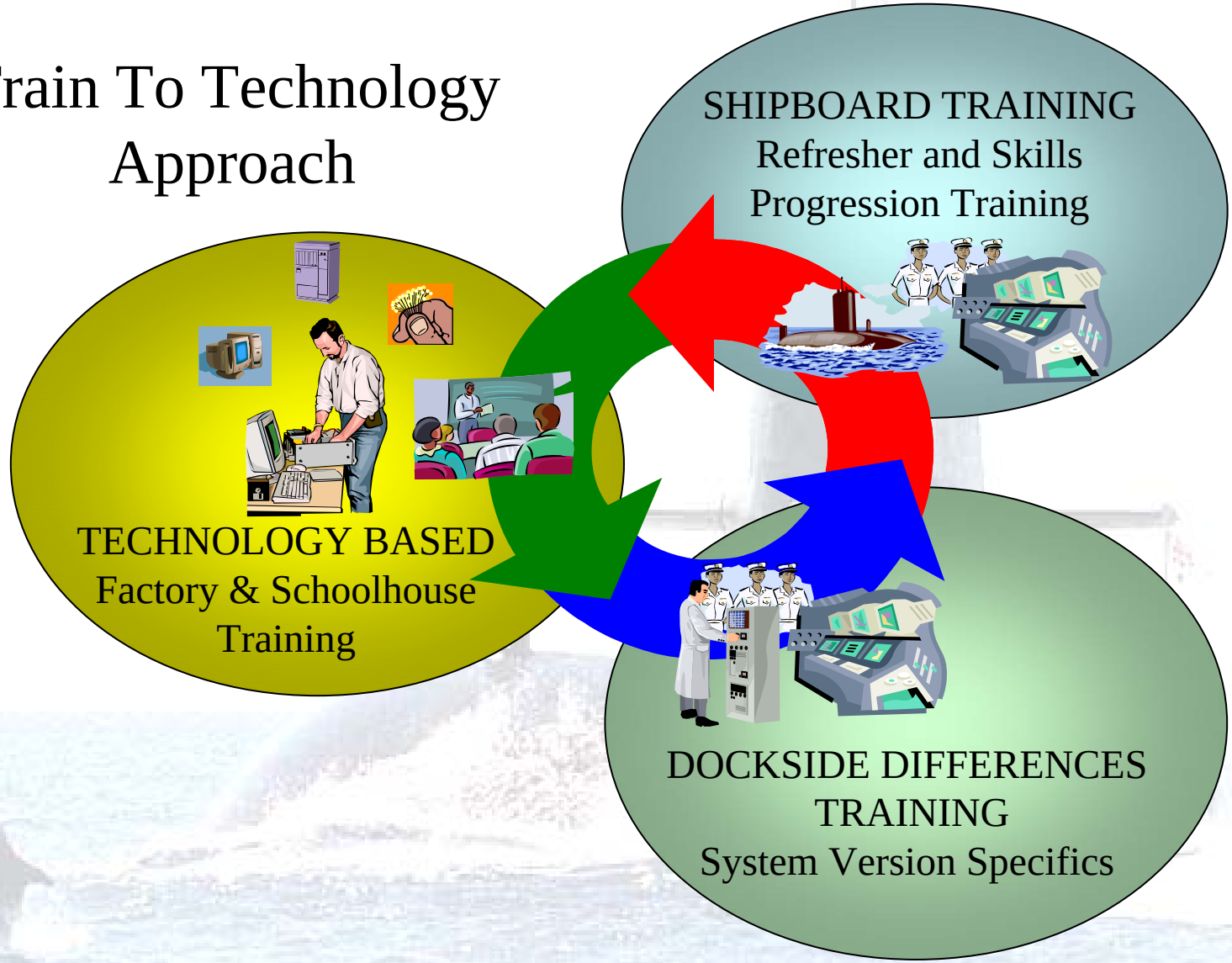
Step 1 Survey Results

(Algorithms grouped by developer)

Developer	Technology	Developer judgment to defer to APB-03, as presented to DFWG	Step 1 Survey Summary						Can do Step 2		Can't do Step 2		
			Utility	Risk	Maturity	Sizing/Timing	Operator Interface	Proceed to Step 2	Data/interfaces are available to conduct Step 2 on schedule	Data/interfaces may be available to conduct Step 2 past due	Existing capabilities in the combat system. Need APB-02 data collection to establish performance baseline	Algorithms that add new functionality to the combat system, have no competitor, and need a performance baseline. Put in APB-02 with OFF/ON switch at display. Collect required data to establish performance before turning on for use after Step 4.	Maybe a good technology, has competitors, need data to test for Step 2. Data collection requirements will be forwarded to TEASG.
NUWC	ASCM/CTIMS										×	×	
NUWC	High Contact Density												
NUWC	TMAI Baseline Capability		Superceded by ECP04										
NUWC	CETB, adding TA improvements								×				
NUWC	Voice Recog	To be reviewed at May DFWG											
LM	ATSEAK, adding TA, HA, HF improvements								×				
Metron	Nodestar, adding periscope & radar data												×
Metron	MultiStar	×											×
Metron	Maneuver Recommendations	×											×
Metron	Likelihood Trackers	×											×
ORINCON	ALFP, adding periscope, radar, and ACF data								×	×			×
ORINCON	ALFP High Contact Density Management	To be reviewed at May DFWG											
ORINCON	MultiStar	×											×
ORINCON	Periscope Imagery	×											×
JHU/APL	Integrated Vulnerability Management											×	
JHU/APL	Option Reduction	×											
JHU/APL	Periscope Imagery	×											
Raytheon	Chi Squared	×											
Raytheon	ECP-04 MT Mate CC Baseline												×
Raytheon	Auto Cse PEP	×											
Raytheon	Parallel Kalman	×											
Raytheon	Voice Recog												×
Raytheon	Auto Stadimeter	×											
Raytheon	Ferret												×
Raytheon	Image Tracker												×
Raytheon	Observation Association	×											

Integrated Logistics Support

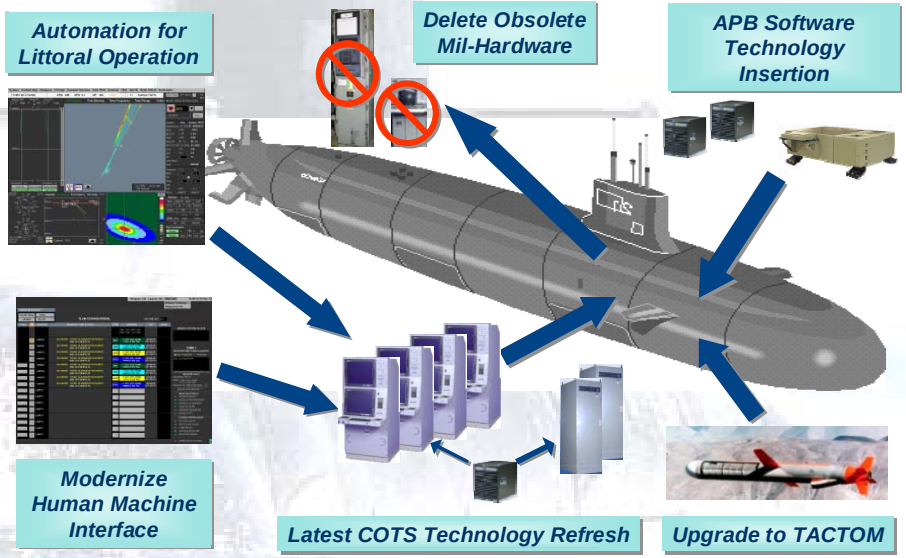
Train To Technology Approach



CCS Development Today

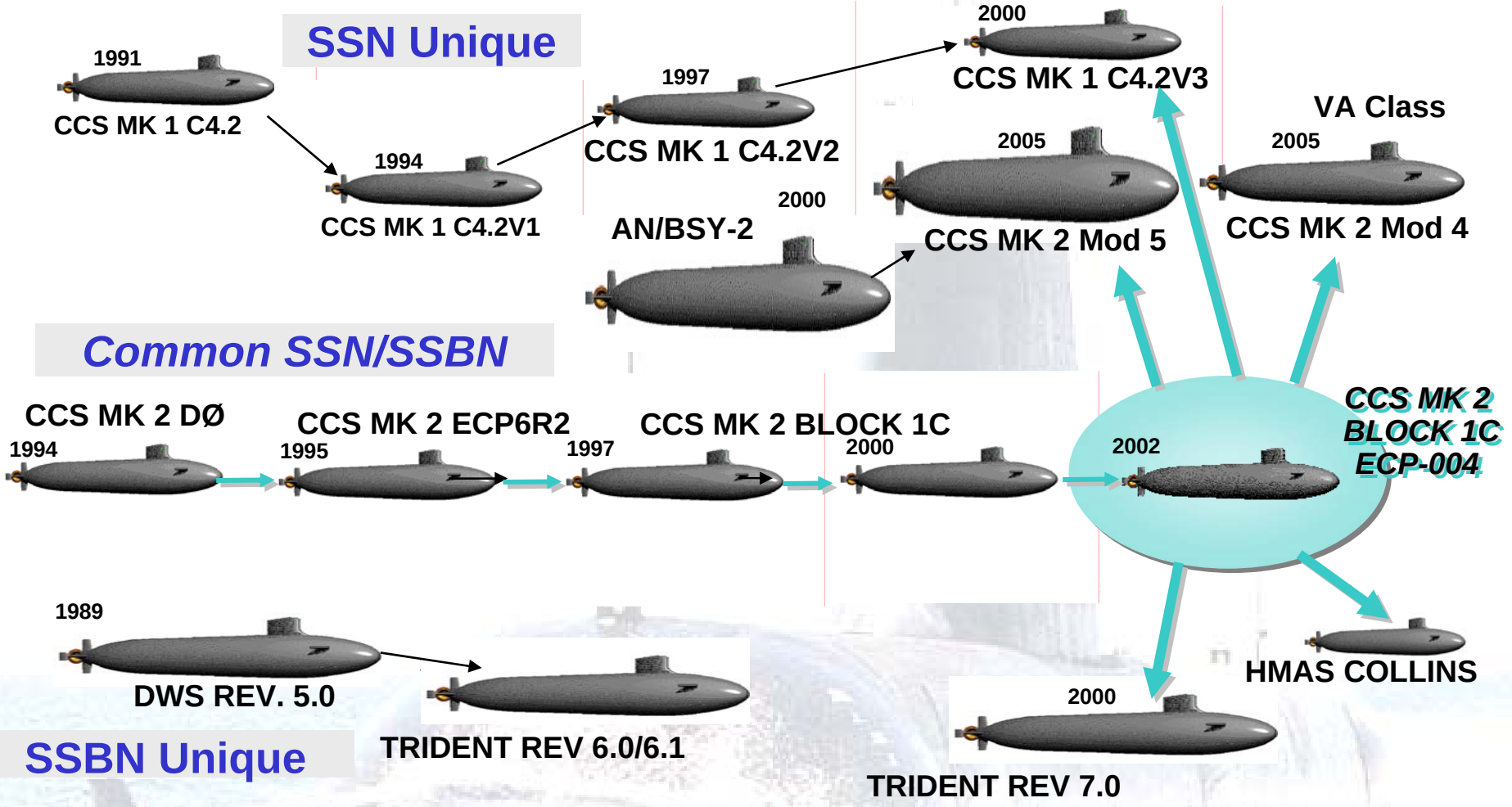
- CCS MK2 Block 1C *(and follow-on Maintenance Build)*
  - 1st success at COTS in CCS
  - Driven by ATWCS -- Navy Standard Tomahawk
  - Implemented advanced Open Systems Architecture
  - Tactical improvements incorporated
    - Improved strike capability; improved TMA Accuracy/Operability
    - Enhanced Torpedo Pre / Post Launch Operability
    - Sonar Back Track Capability

- **CCS MK2 Block 1C ECP-004**
  - **Eliminate Mil-Spec Computers**
  - **Driven by TTWCS**
  - **Tactical Control (TC) and Weapons Control (WC) in separate servers**
  - **TTWCS & TACTOM launch capability**
  - **Fleet requested enhancements**
    - **Close Aboard, Mate, Periscope Video, Contact Mgmt, HMI**
  - **Multi-Function Server and ECDWS**
  - **APB Process Introduction**



CCS MK2 Block 1C ECP-004

CCS MK2 History



Developing A Single CCS For All US and Australian Submarines