Navy Maintenance Reducing Initiatives and Ship's Material Condition Visibility

Rick Leeker

Agenda

- Program Description
- Initiative Overview
  - SEA 05N
    - Hardware
    - Model
  - SEA 04RM (ePMA)
- Summary

SEA 05N/04RM Programs

- Capital Investment for Labor – ASN (RD&A) directed program to reduce Sailor workload and improve shipboard Quality of Life.
- Common Ship – Addresses common problems applicable across multiple ship classes and equipment with an eye towards reducing Sailor workload and operating costs.
- Surface Ship Maintenance – Continuous review of ship maintenance requirements to ensure they are applicable and effective.

- **All areas endorsed by Fleet**
- **Specific technologies approved by the Cost Reduction and Effectiveness Improvement (CREI) Council**

Navy Technologies with Common Application to the Coast Guard

- Magnetic Couplings
- Mechanical Seals
- Composites
- Ventilation
- Calibration Reduction
- Tank Level Indicators
- Tank Monitoring
- Sanitary Spaces
- Durable Easy Care Tile
- Preservation Teams
- Motor testers
- Ultrasonic Tester
- Diesel Monitoring
- Ceramic Bearings
- Hand Tools
- Anti-Stain Paints
- Bilge Preservation
- Nonskid Preservation
- Water Tight Doors
- Water-jetting
- Superbolt
- Mounting Foundation Levelers
- Self Cleaning Lube/Fuel Oil Filter
- IR Cameras
- Centrifugal Oil Filters
- TOMS Oil monitoring
- Valve Tester

Fleet Feedback

Magnetic Couplings

Problem:

- Alignments are time consuming
- Poor alignment causes premature seal and bearing failure
- Leads to coupling and motor winding failures

Old Style Coupling

Solution:

Magnetic Couplings

- Eliminate precision alignments
- Coupling maintenance
- Increase bearing and seal life
- Lower starting current for electric motors

New Magnetic Coupling

Installation Status

Industry

In use throughout industry in 100s of applications:
- Mine rock crushers and conveyor belts
- Commercial marine use
- Petroleum and refinery applications

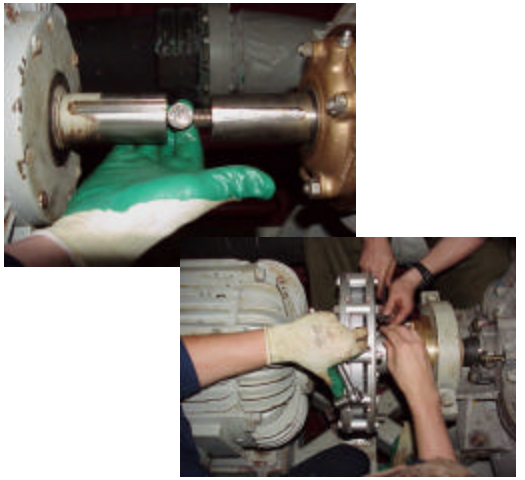
USS CARNEY (DDG-64)
Magnetic Coupling Installation
on Seawater Service Pump

Navy

Passed Shock, Vibration, and EMI Testing

Installed Couplings:

- More than 130 couplings installed
- 161 procured during FY03
- Plan to install 700+ couplings on surface combatants
- Working on CVN installations



Magnetic Couplings

USS CARNEY (DDG-64) Case Study:

- #2 seawater service pump experienced recurring leakage and premature failure of standard mechanical seals
  - Mechanical seals were failing about every 4 months
  - Documented annual expenditures for this pump for each of the two previous years had been
    - ***$27k*** *for pump due to failed mechanical seals*
    - ***230 IMA man-hours*** *and*
    - ***14 ship's force man-hours*** *for corrective maintenance*

- In April of 2001, a Chesterton 442 Split Mechanical Seal & a Rexnord Magnalink Magnetic Coupling were installed on the #2 seawater pump

- 12 May 2003 inspection of the #2 seawater service pump observed:
  - *No visual evidence of seal leakage or premature wear*
  - *The new mechanical seals have never leaked during their 2-year service period.*

USS CARNEY

Mechanical Seals

Problem:

- 85% of of installed mechanical seals fail with 6 – 12 months of installation
- Sailors currently spend 12 Sailor-days per year per pump repairing and replacing mechanical seals.

Solution:

- Use of improved Mechanical Seals allows easier replacement, better reliability and they last longer to cut maintenance costs.
- Installation of commercial off-the-shelf split, cartridge, and gas seals can increase service life to two plus years.
- Improved seals decrease installation difficulties to reduce Sailor pump maintenance burden.

Split Mechanical Seals

Benefits

- Increased reliability
- Field repairable
- Simple installation
- Future seals do not require pump disassembly
- Static shaft O-ring
  - held in a captive groove
  - easy installation and rebuilding
  - no adhesive needed

USS MONTEREY (CG-61) pump with split mechanical seal

Specifications

Temperature range: to 500 degrees F

System pressure: 25” vacuum to 400 psig

Shaft speed: 3600 rpm

Available sizes: 2.625 to 3.5 inches

Navy application: Seawater & Freshwater

Cartridge Mechanical Seals

Benefits

- Reduced installation time from 96 hours to 2 hours
- Service life increased to 2 yrs
- Fits most pumps without seal chamber modification
- Cartridge design for easy installation
- No small springs to clog
- Dynamic O-ring hang-up eliminated (cause of most seal failures)

Specifications

Temperature range: -20 °F to 500 °F

System pressure: Full vacuum to 300 psig

Shaft speed: 500 to 7,000 rpm

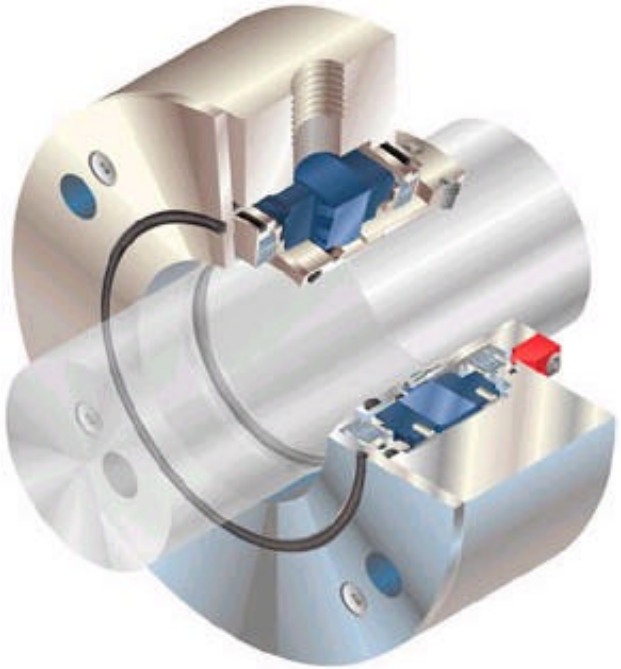
Available sizes: 1-1/8” to 3-1/2”

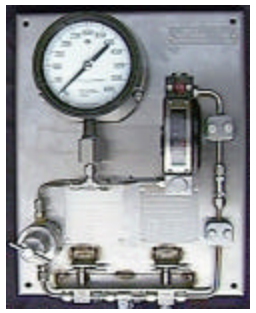
Navy application: Lube Oil Systems

Gas Mechanical Seals

Benefits

- Zero leakage without pump shaft modification
- Non-contacting seal faces provides for seal life expectancy of 3-5 years minimum
- Simple installation
- Dynamic O-ring hang-up eliminated (cause of most seal failures)
- Rides on gas seal





Specifications

Temperature range: -40 to 500 ^{o}F

System pressure: 25” vacuum to 200 psig

Shaft speed: 500 to 7,000 rpm

Available sizes: 1 to 3 inches

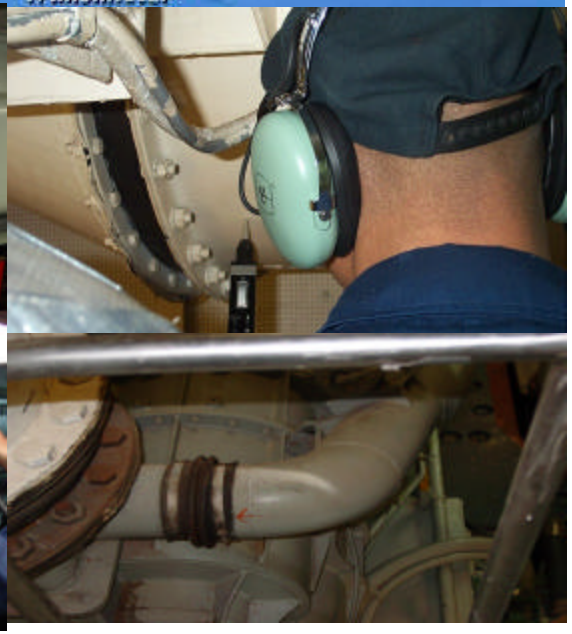
Navy application: Fuel Oil and Lube Oil

Ultrasonic Hand Held Tester

- Problem:
  - Current tools used to assess WTD integrity, Freon leaks, compartment integrity, bearing condition, and fluid leaks are subjective and inaccurate
- Solution:
  - Ultrasonic testers replace
    - chalk lines,
    - flashlights,
    - soap suds,
    - stethoscopes,
    - and electronic Freon sniffers
- Benefits
    - Eliminates false findings
    - Easy to use
    - Ventilation status does not impact ability to find leaks

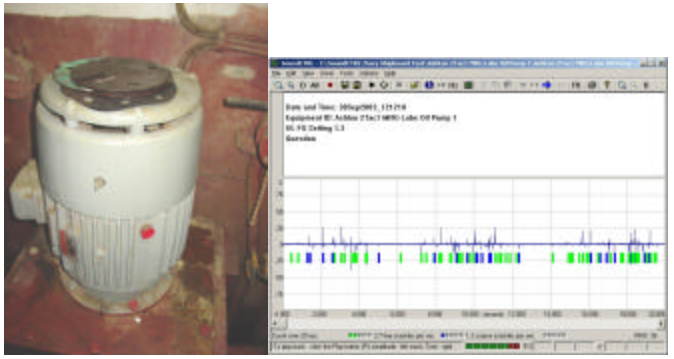
Ultrasonic Hand Held Tester

- Usage:
  - More accurate than current tools
  - Average Sailor can use with only minimal training
  - Use in high noise areas does not affect performance
  - Problems and checks can be done more efficiently (less time)
- Status:
  - NAVSEA pursuing funding to outfit Fleet
  - All Surface Ships will have 5 testers per ship
  - CVN/CV, LHA, LHD, and AS ship classes will have 10 testers per ship



Ultrasonic Hand Held Tester

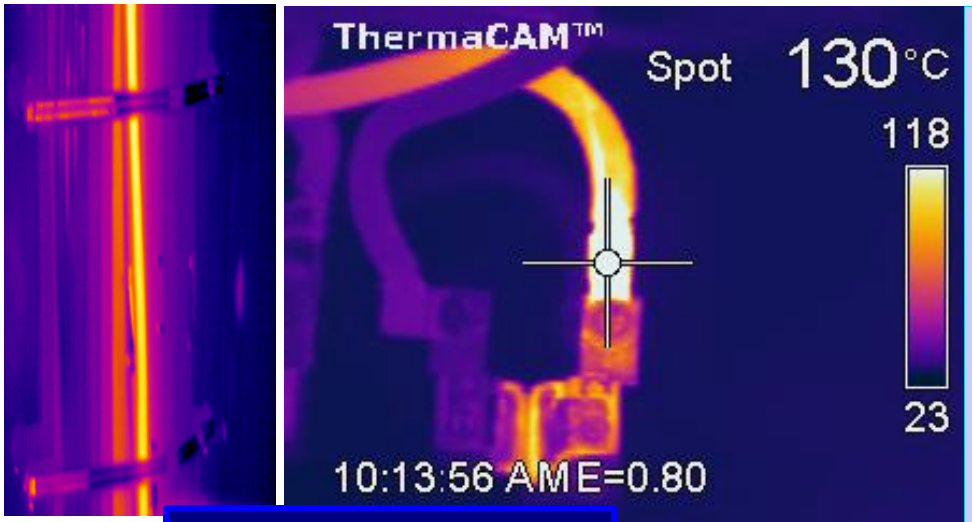
- USS ASHLAND LSD-48 Case Study
  - Electric lube oil pumps for #MRG could not provide full flow and pressure, ship was unable to isolate problem
  - Tool used by Port Engineer to identify failing pump gear train and bearings



- USS GUNSTON HALL LSD-44 Case Study:
  - SWS discharge valve
  - Tool used by Ship's Force to determine leaking valve

IR Cameras

- Problem:
  - Current maintenance strategies assess the electrical distribution system condition only once every 24 months
  - Shipboard repairs often result in self inflicted casualties



Category 4

Category 4 deficiencies are the most severe classification of electrical distribution deficiency

A typical electrical distribution IR Thermographic assessment visit results in finding 5-7 Cat 4 deficiencies

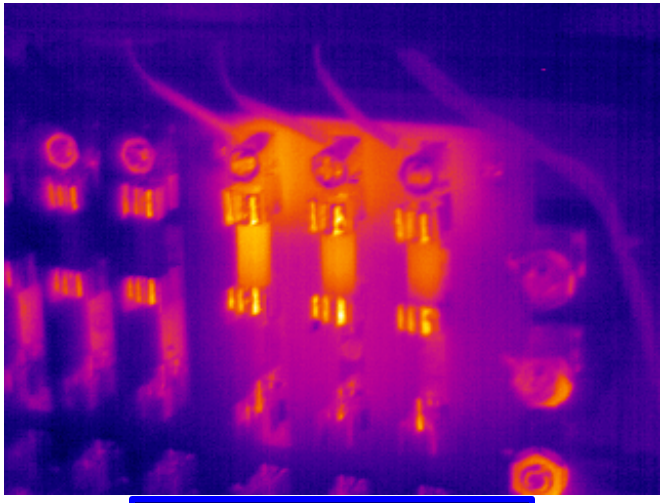
These are immediate fix and repair before further use deficiencies.

Cat 4 deficiencies can be avoided by augmenting existing PMS and adding IR cameras as a QA tool to evaluate electrical system repairs

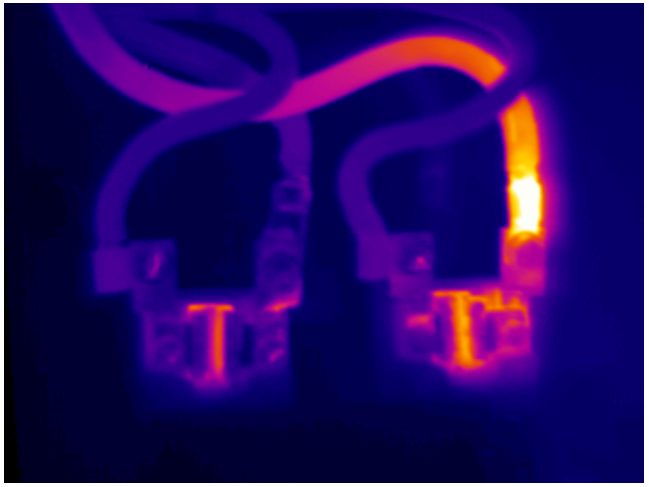
- Solution:
  - Inexpensive IR cameras for use in daily electrical distribution system maintenance and repair tasks

IR Cameras

- Benefit:
  - Based on FTSCPAC studies cost avoidance on a FY basis would be $3.6M Fleet-wide
  - Eliminates self inflicted casualties caused by improper repair techniques
  - Identify component failure, overheating and overload conditions before failure occurs
  - Eliminates guess work in determining the condition of wiring insulation for motors, controllers, power and fuse panels



Category 1



Category 4

IR Cameras

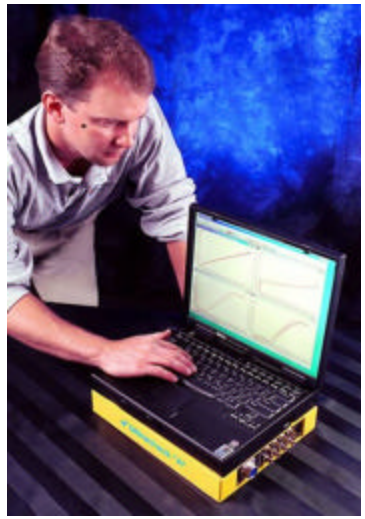
- Status
  - NAVSEA 04RM conducted shipboard testing in 2002.
  - Test results recommended IR cameras for use in conducting electrical distribution equipment PMS and use as a final QA tool for assessing repairs.
  - Two cameras were evaluated as cost effective and ready for shipboard use, and have a service life of >5yrs.
    - ISI 'Snap Shot', $8K
    - Flir model 2E, $14K
  - NAVSEA is seeking funding to outfit Fleet
    - One camera per surface ship
    - Two cameras per carrier and ships with repair departments

FLIR Model 2E

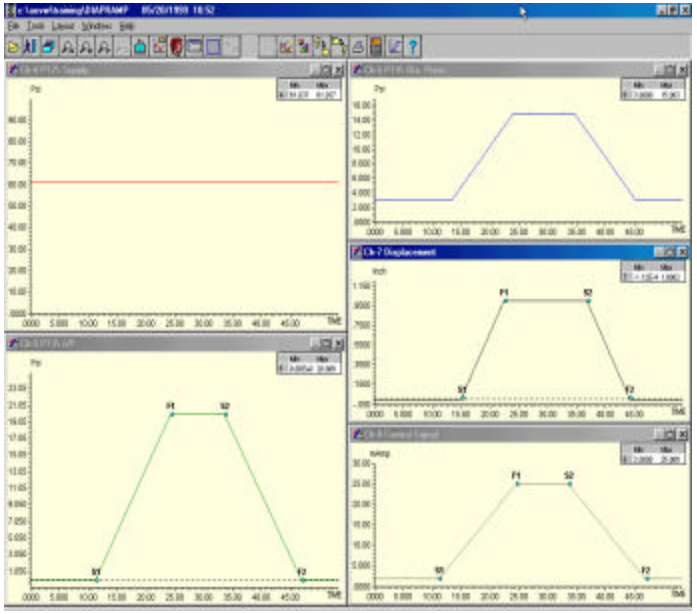
ISI 'Snap shot'

Valve Testing

- Problem:
  - Current overhaul and maintenance strategies
    - Hard time events
    - Valves are overhauled before wear out
    - Valves not needing repair are unnecessarily overhauled



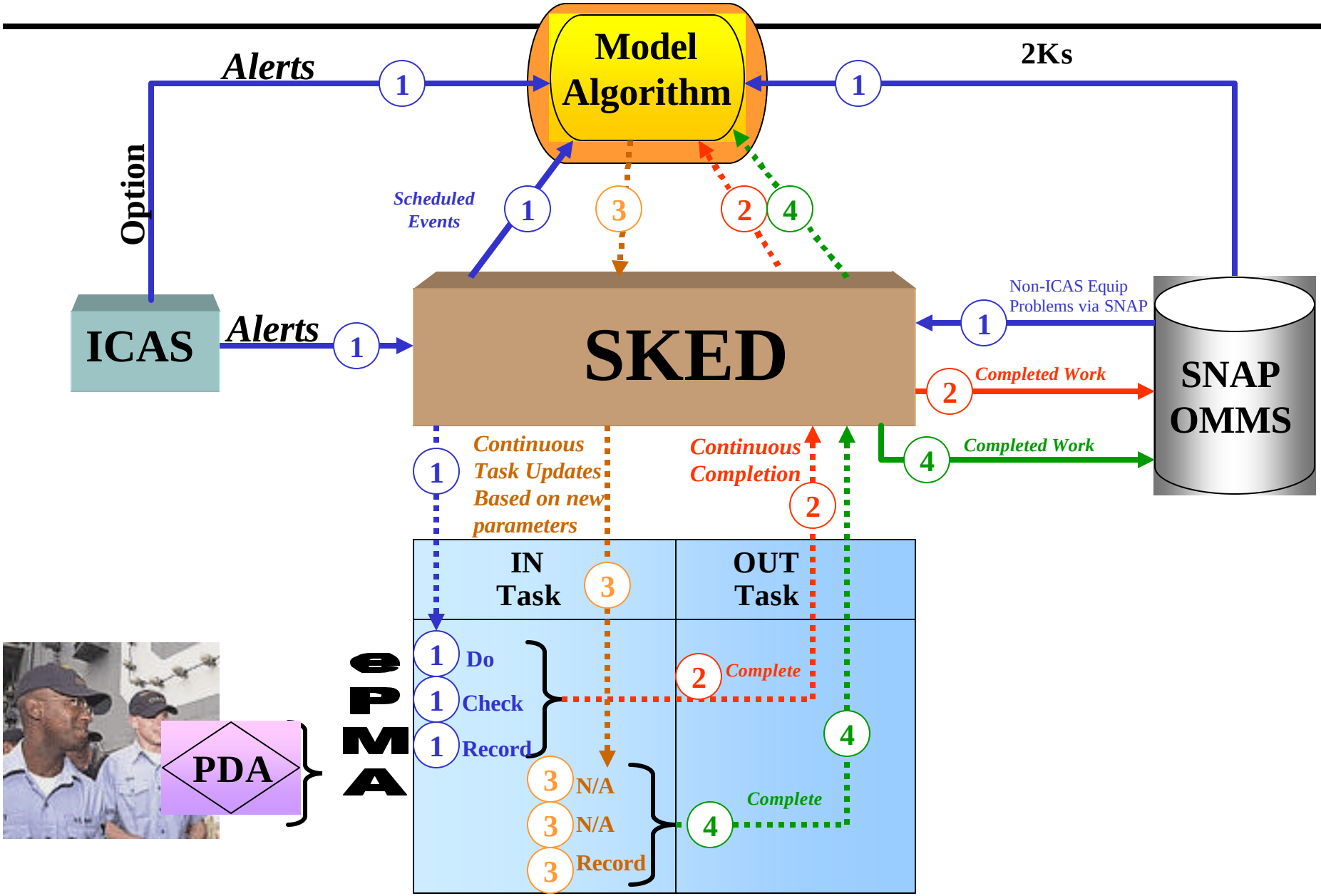
- Solution:
  - In place portable valve testers that can identify mistimed, damaged, and leaking valves
    - Motor operated
    - Air operated
    - Hydraulic operated
    - Control
    - Regulators (i.e. Leslie)
    - Check valves



Valve Testing

- Benefit
  - Replaces multi-meters, and stethoscopes for valve testing and setting
  - Valve conditions can be trended
  - Valves can be rapidly timed and set
- Status
  - NAVSEA will be conducting shipboard testing in mid summer

MCM Prototype Nr. Two – Paperless Logs



CNO Goals and Guidance

NAVOP 008/00 (DTG 191605Z JUL 00), Paragraph 4

1. Develop and implement standardized, configuration-linked assessment criteria across the Fleet using common material condition metrics and assessment procedures.
2. Incorporate methodology to support continual assessment process improvement and elimination of duplicative events.
3. Consolidate all Fleet material condition data into a single data warehouse and provide easy and timely access to all users.

Develop procedures to determine key areas to reduce sailor workload and improve Fleet material readiness.

CNO Guidance for 2004

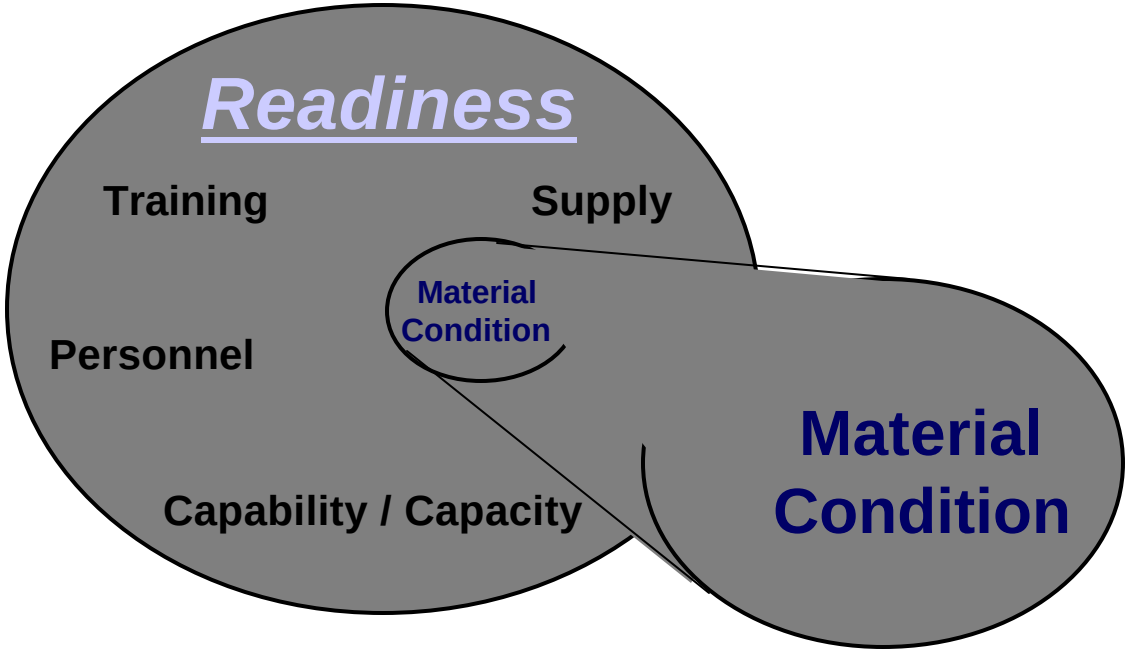
1. We must:
   - Improve our use of modeling
   - Develop and improve output metrics to better define our requirements and resource needs
2. Deliver the right readiness (Action Items for 2004)
3. We must refine our training, maintenance and interdeployment readiness processes to increase our operational availability.
4. Develop a performance measurement system within the Integrated Readiness Capabilities Assessment (IRCA) process to equate funding inputs to expected levels of readiness outputs.

Why Measure Material Condition?

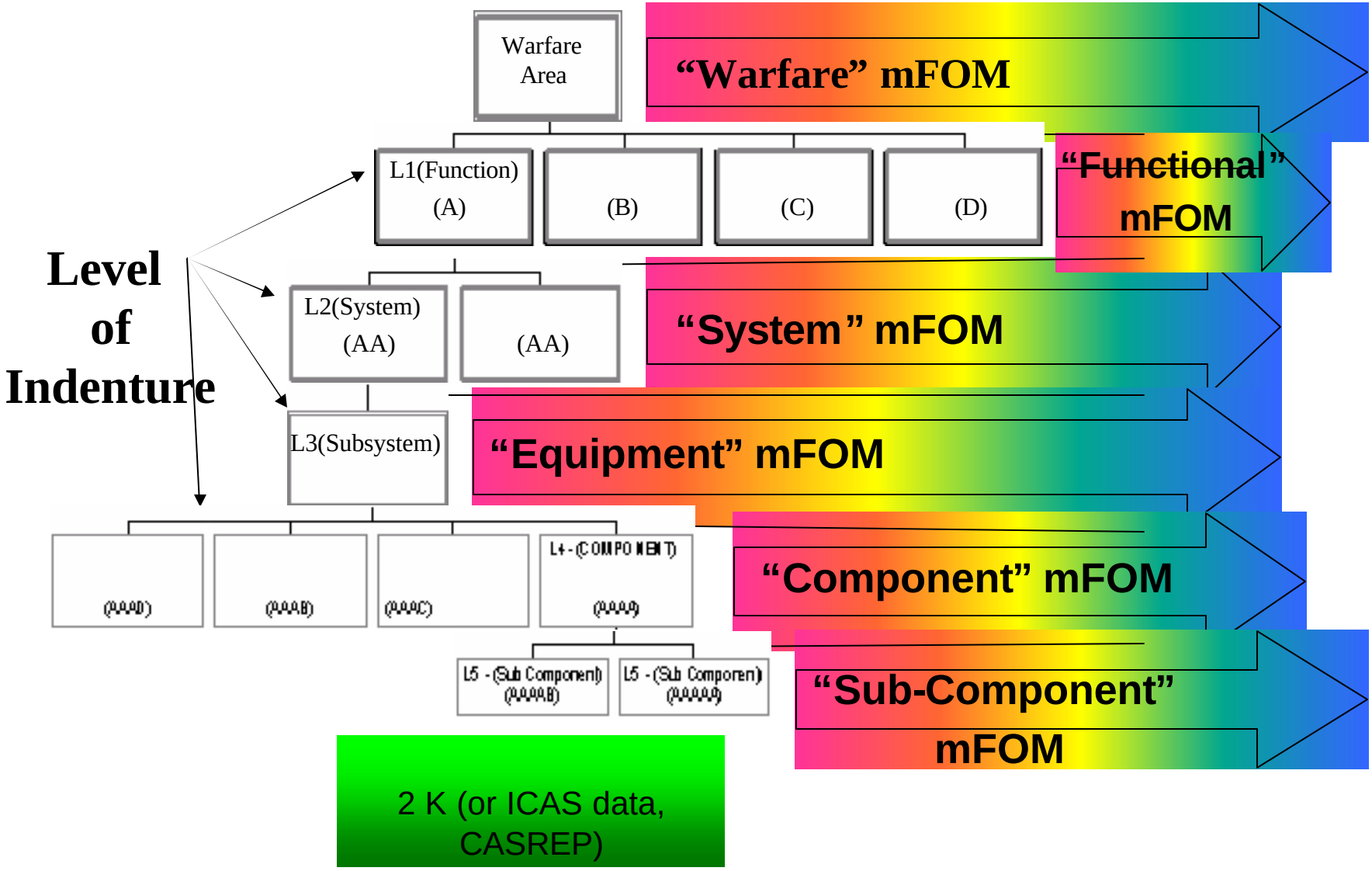
<u>Material condition</u> is a key component of Readiness

The output of the maintenance process is ships in adequate material condition; materially capable of performing their mission.

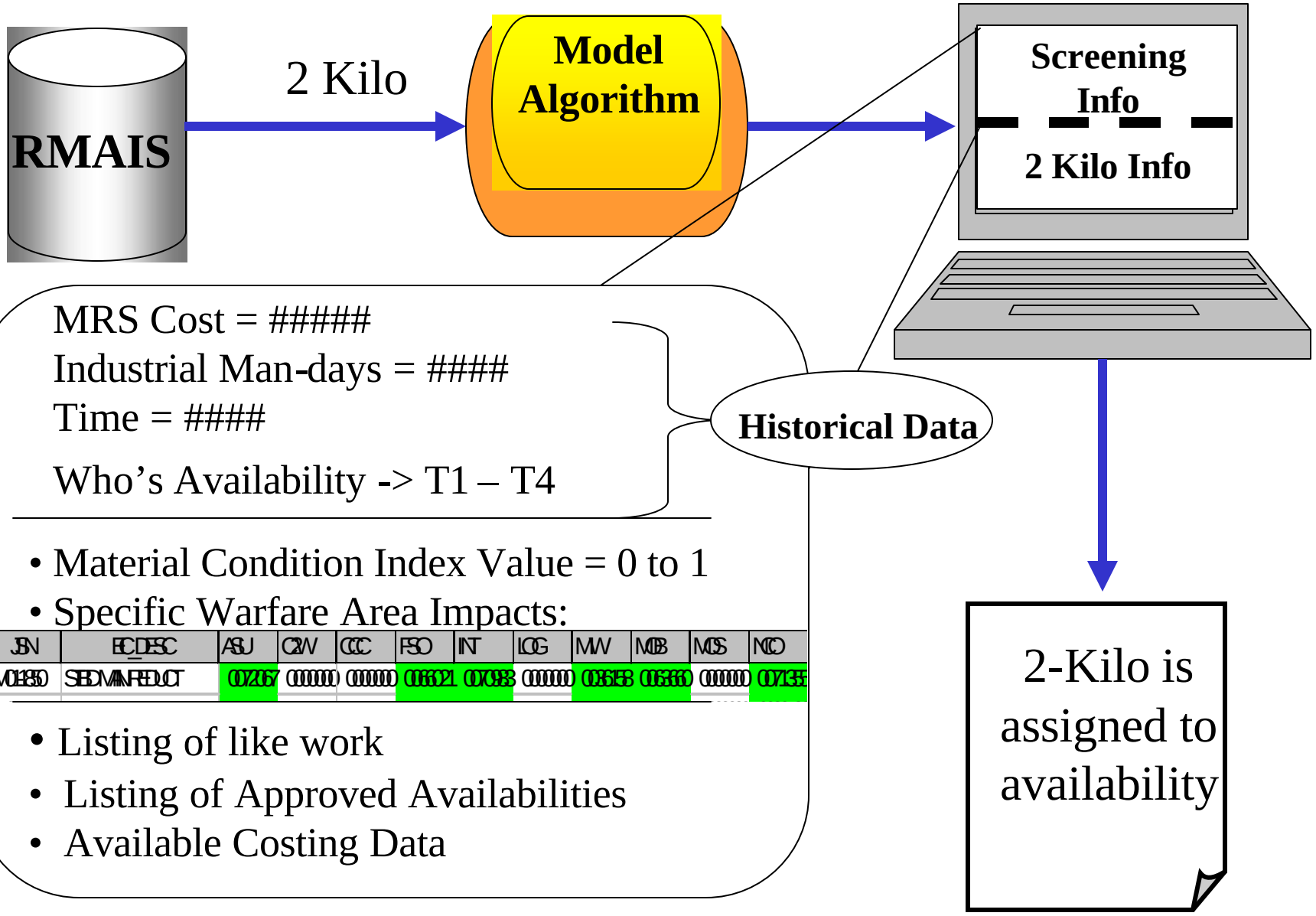
Readiness - The capability to provide well maintained, adequately supplied platforms with sufficient resources to carry out required Naval missions and functions



Material Condition Model



Screening Process Data Flow



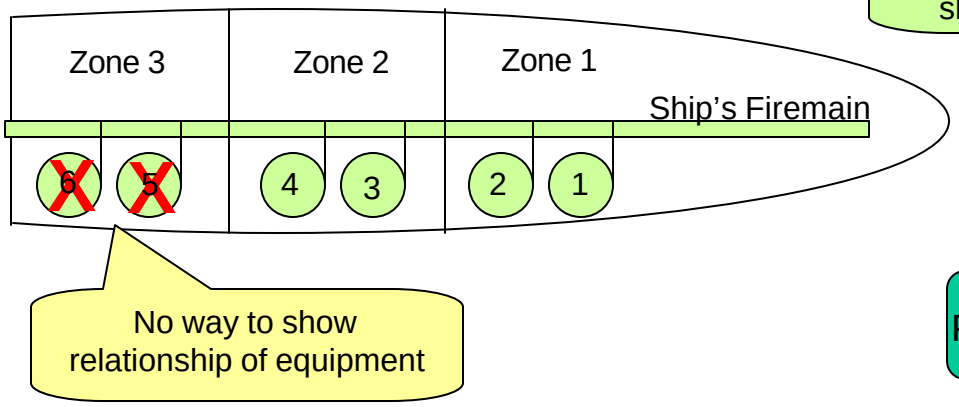
mFOM 1.0 and mFOM 2.0 Difference

Significance of Failure

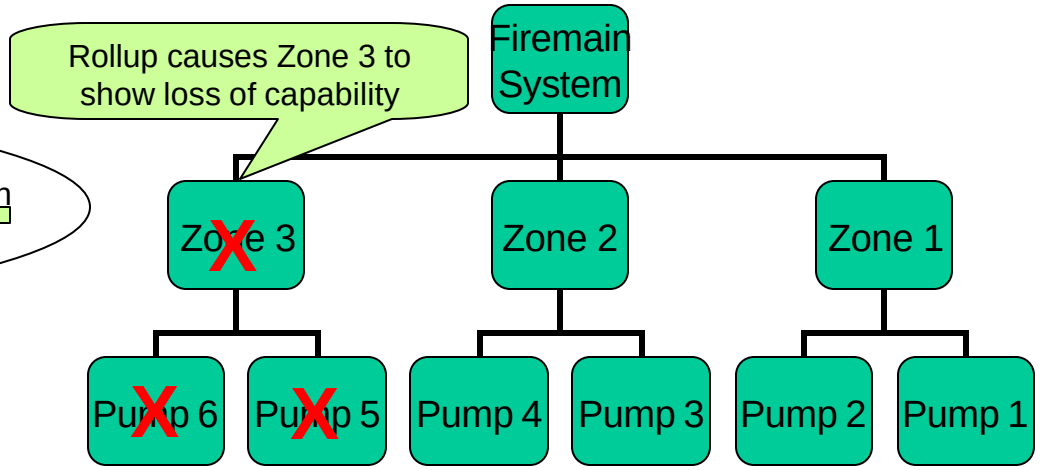
- **mFOM 1.0** requires Ship's Force to use 2K Priority and Job Status (STm) fields to show equipment relationships
  - MCC and Severity Codes are fixed
  - Outcome is subjective as Ship's Force manipulates 2 factors to show relationship

- **mFOM 2.0** takes into account equipment relationship based on model structure with weights and criticalities supplied by *Warfighters (COs, XOs, Dept Heads, etc)* and Technical Experts (ISEAs)
  - Outcome is objective and repeatable across multiple ships and classes

Firemain Example



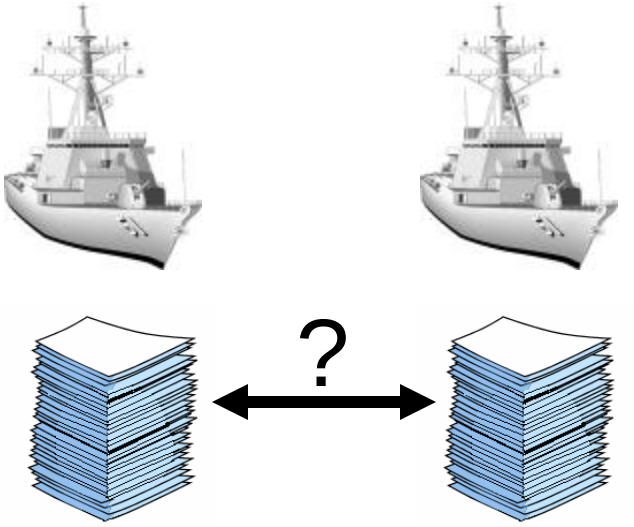
mFOM 2.0 Representation of Firemain System



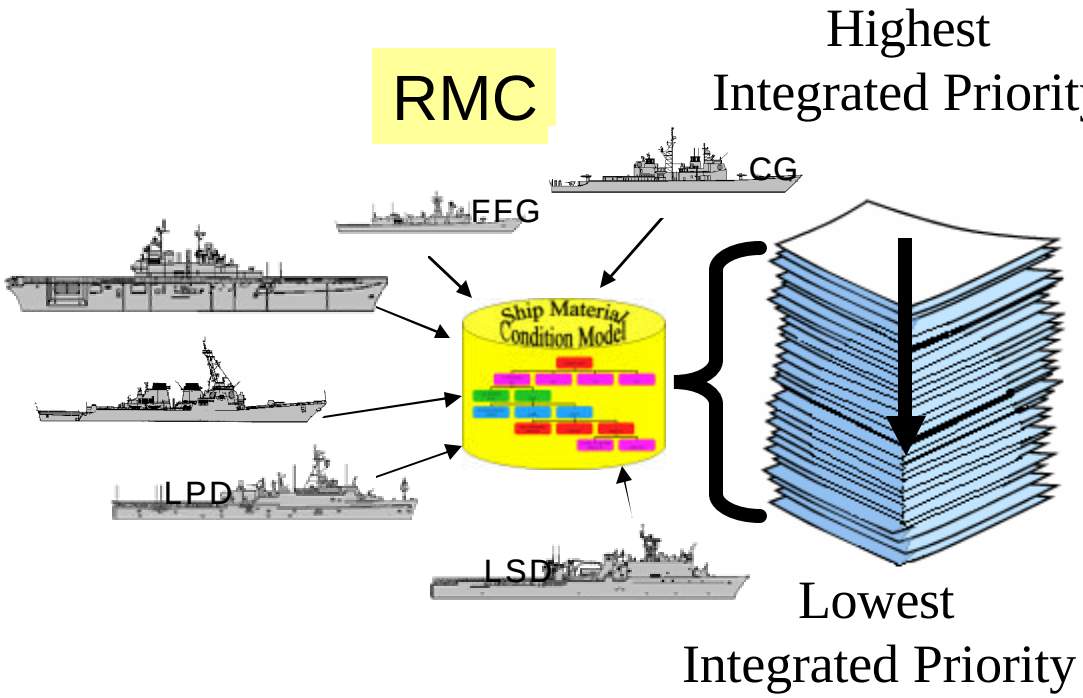
mFOM 1.0 and mFOM 2.0 Difference

Integration of Work at the RMC

- **mFOM 1.0** 2K Priority at RMC is a straight combined grouping not an integrated priority.
  - –Does not allow ability to prioritize between ships of the same class or across classes
  - –Results may vary



- **mFOM 2.0** with model structure provides priority between various ships and is warfare based.
  - –Allows ability to tie funding to material readiness
  - –Consistency of process



War Fighting Reporting

- These ***CASREPs*** open on 06/30/02:

L2	L3	L4	L5	LLI	CAS_DATE
DC	DC EQUIP	CLOSURES	ZONE 4	ZONE 4	03/08/02
PROP	MP 1	1 PROP-SHAFT		SEAL	05/01/02
MINE SWEEPING	ENGAGE	AN/SLQ-38		MECH SWEEP	05/16/02
MINE HUNTING	ENGAGE	AN/SLQ-48		AN/SLQ-48	06/27/02
AUX	REVERSE OSMOSIS			REVERSE OSMOSIS	06/30/02

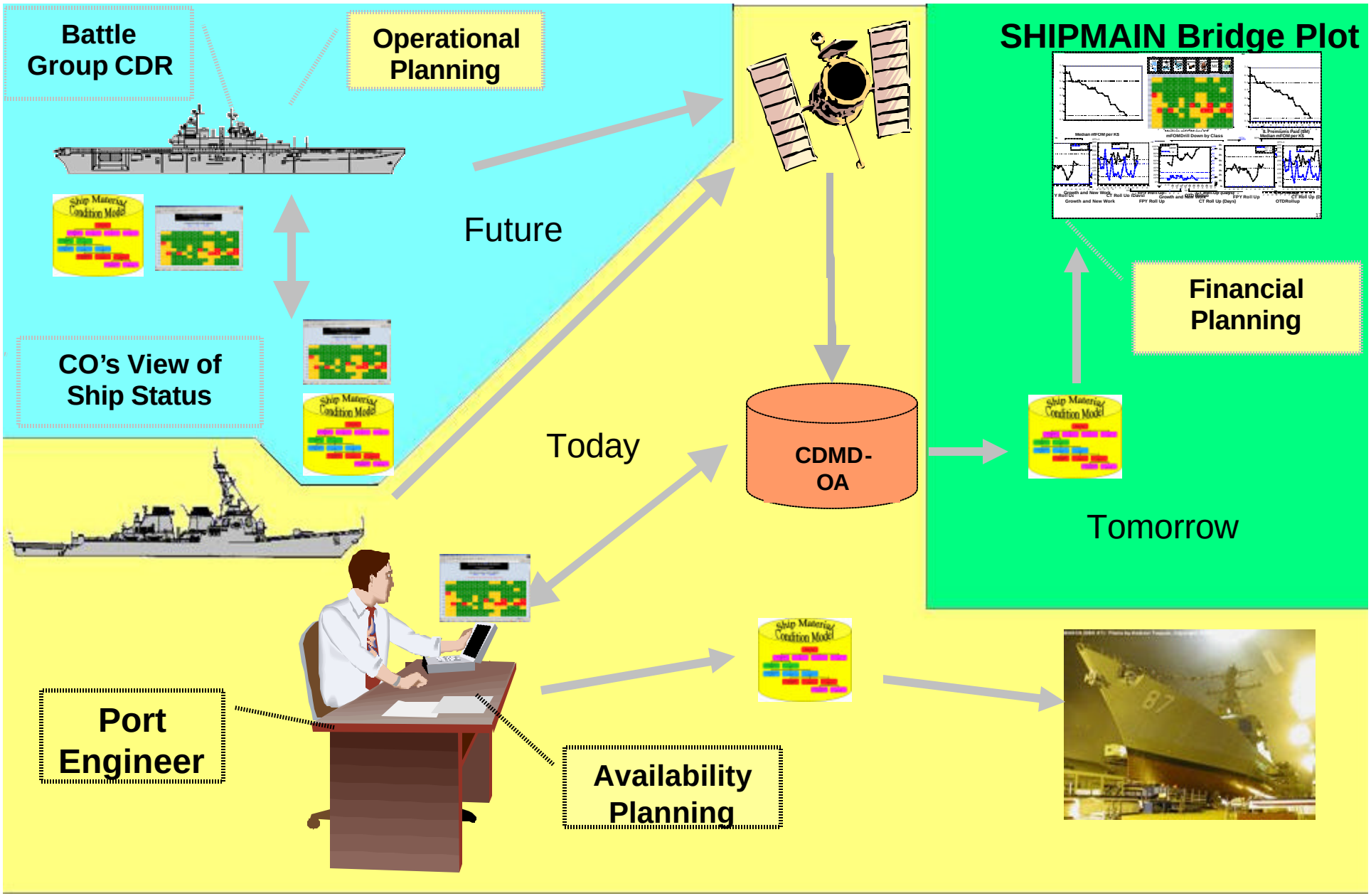
- Impact these *Mission Areas:*

L1	L2	L3	L4	L5	LLI	CAS_DATE
MOB	DC	DC EQUIP	CLOSURES	ZONE 4	ZONE 4	03/08/02
ASU	PROP	MP 1	1 PROP-SHAFT		SEAL	05/01/02
CCC	PROP	MP 1	1 PROP-SHAFT		SEAL	05/01/02
FSO	PROP	MP 1	1 PROP-SHAFT		SEAL	05/01/02
INT	PROP	MP 1	1 PROP-SHAFT		SEAL	05/01/02
MIW	PROP	MP 1	1 PROP-SHAFT		SEAL	05/01/02
MOB	PROP	MP 1	1 PROP-SHAFT		SEAL	05/01/02
NCO	PROP	MP 1	1 PROP-SHAFT		SEAL	05/01/02
MIW	MINE SWEEPING	ENGAGE	AN/SLQ-38		MECH SWEEP	05/16/02
CCC	MINE HUNTING	ENGAGE	AN/SLQ-48		AN/SLQ-48	06/27/02
MIW	MINE HUNTING	ENGAGE	AN/SLQ-48		AN/SLQ-48	06/27/02
LOG	AUX	REVERSE OSMOSIS			REVERSE OSMOSIS	06/30/02
MOB	AUX	REVERSE OSMOSIS			REVERSE OSMOSIS	06/30/02

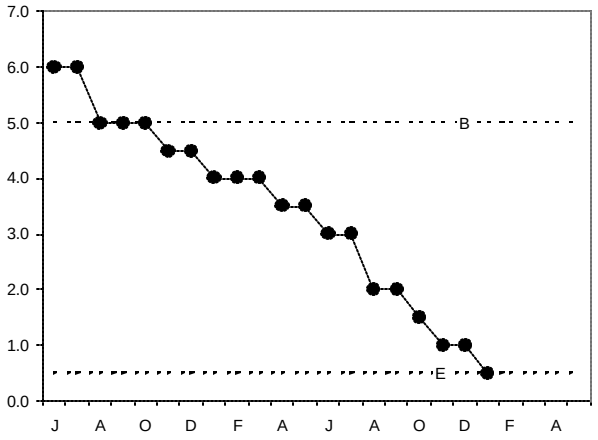
- Leading to these metrics:

ASU	*C2W*	*CCC*	*FSO*	*INT*	*LOG*	*MIW*	*MOB*	*MOS*	*NCO*
0.00	1.00	0.75	0.00	0.00	0.25	0.00	0.00	1.00	0.00

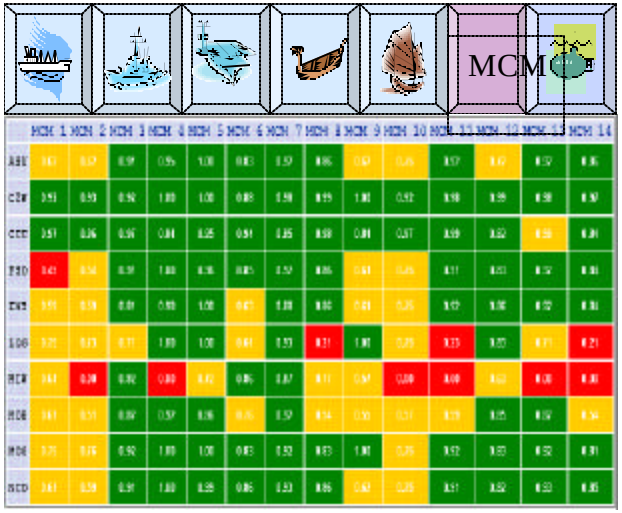
Concept of Model Use



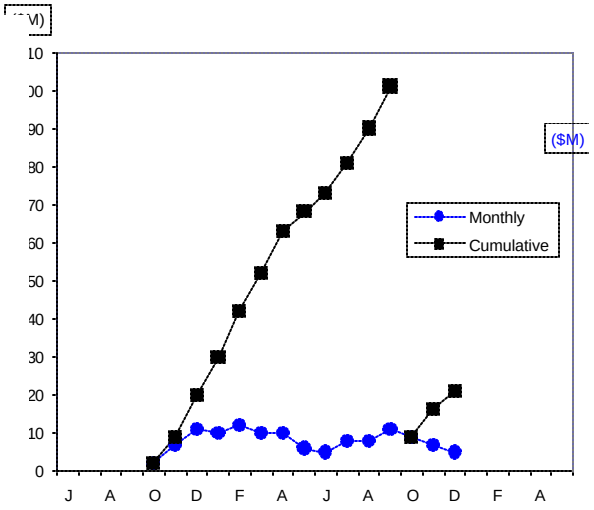
Possible SHIPMAIN Bridge Plot



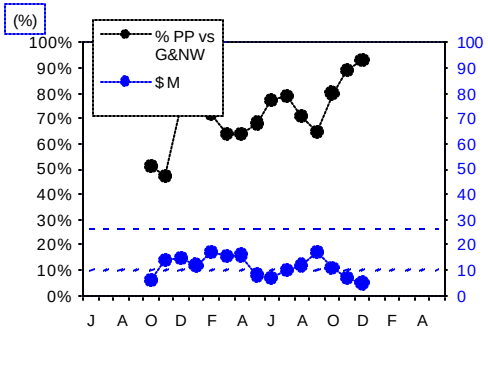
Median mFOM per K$



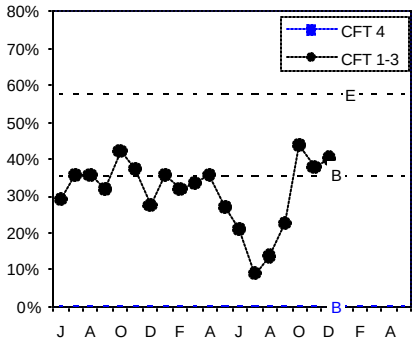
mFOM Drill Down by Class



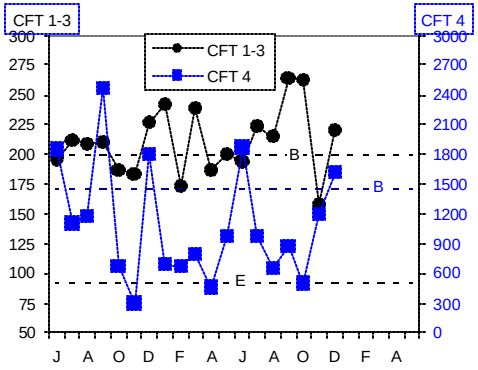
8. Premiums Paid ($M)



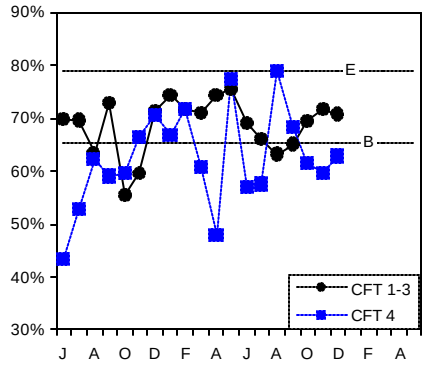
Growth and New Work



FPY Roll Up



CT Roll Up (Days)



OTD Rollup

RIMS - Microsoft Internet Explorer provided by AMS

File Edit View Favorites Tools Help

Back Search Favorites Media

Address http://ww2.rims.corona.navy.mil/rollup/3MMCM.cfm Go Links

MATERIAL READINESS ASSESSMENT

Naval Surface Warfare Center
Corona Division

MCM MISSION AREA MODEL WEBSITE

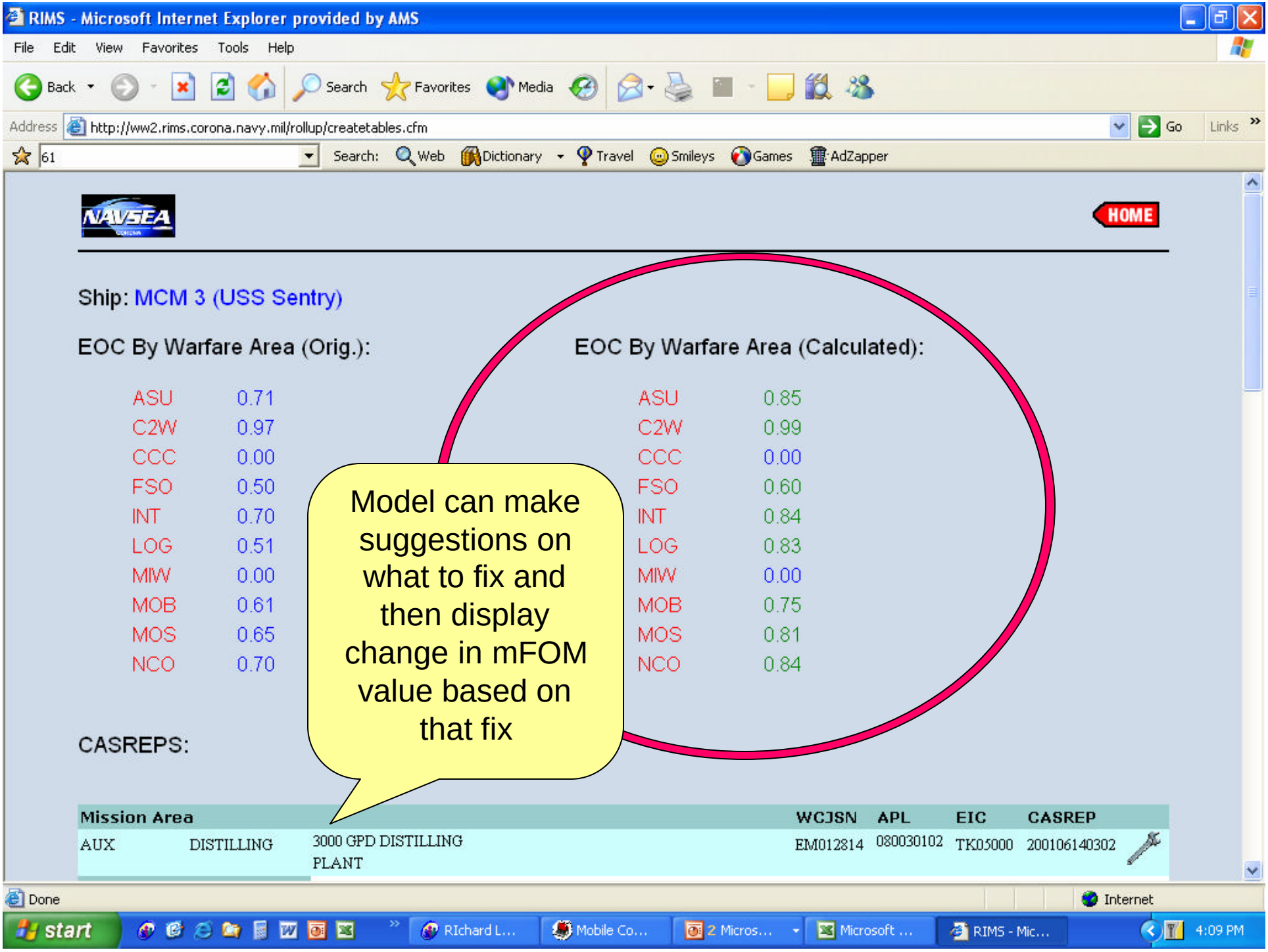
(3M Data)

Purpose | FAQ | The Model

** Cells link to Warfare Area Data*

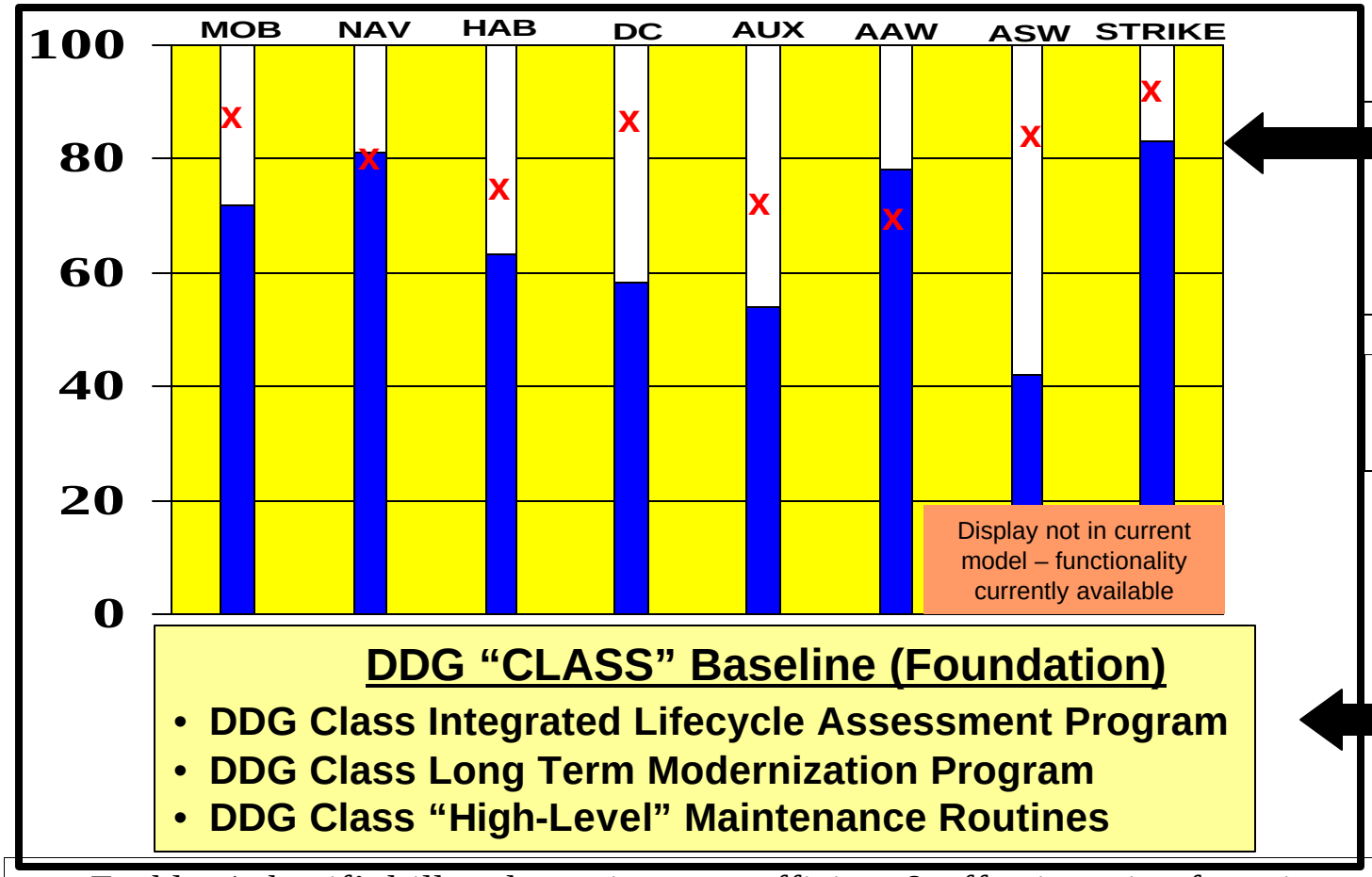
Re-Color		MCM 1	MCM 2	MCM 3	MCM 4	MCM 5	MCM 6	MCM 7	MCM 8	MCM 9	MCM 10	MCM 11	MCM 12	MCM 13	MCM 14
0.70	ASU	0.00	0.00	0.71	0.77	0.92	0.76	0.54	0.65	0.00	0.00	0.60	0.54	0.58	0.00
0.80	C2W	1.00	0.88	0.97	1.00	1.00	0.80	1.00	0.60	0.93	0.96	0.81	0.97	0.99	0.96
0.80	CCC	0.00	0.64	0.00	0.00	0.89	0.82	0.99	0.00	0.64	0.97	0.00	0.66	0.00	0.00
0.50	FSO	0.00	0.00	0.50	0.69	0.67	0.75	0.51	0.72	0.00	0.00	0.61	0.55	0.56	0.00
0.80	INT	0.00	0.00	0.70	0.86	0.92	0.71	0.52	0.59	0.00	0.00	0.59	0.53	0.58	0.00
0.80	LOG	1.00	0.00	0.51	0.83	0.93	0.59	0.83	0.18	0.00	0.00	0.75	0.66	0.62	0.00
0.80	MIW	0.00	0.00	0.00	0.59	0.85	0.72	0.52	0.00	0.00	0.00	0.00	0.47	0.00	0.00
0.80	MOB	0.00	0.00	0.61	0.78	0.78	0.68	0.52	0.47	0.00	0.00	0.59	0.45	0.52	0.00
0.80	MOS	1.00	0.00	0.65	0.83	0.92	0.73	0.83	0.71	0.00	0.00	0.92	0.61	0.81	0.00

Internet


RIMS - Microsoft Internet Explorer provided by AMS
File Edit View Favorites Tools Help
Back Search Favorites Media
Address http://ww2.rims.corona.navy.mil/rollup/createtables.cfm
Go Links
61 Search: Web Dictionary Travel Smileys Games AdZapper
NAVSEA
HOME
Ship: MCM 3 (USS Sentry)
EOC By Warfare Area (Orig.):
ASU 0.71
C2W 0.97
CCC 0.00
FSO 0.50
INT 0.70
LOG 0.51
MIW 0.00
MOB 0.61
MOS 0.65
NCO 0.70
EOC By Warfare Area (Calculated):
ASU 0.85
C2W 0.99
CCC 0.00
FSO 0.60
INT 0.84
LOG 0.83
MIW 0.00
MOB 0.75
MOS 0.81
NCO 0.84
Model can make suggestions on what to fix and then display change in mFOM value based on that fix
CASREPS:
Mission Area
WCJSN APL EIC CASREP
AUX DISTILLING 3000 GPD DISTILLING PLANT
EM012814 080030102 TK05000 200106140302
Done
Internet
start
RIchard L...
Mobile Co...
2 Micros...
Microsoft ...
RIMS - Mic...
4:09 PM

The End in Mind

Link Material Condition to Readiness



SHORT TERM (x)
mFOM Requirements based on upcoming mission

Current mFOM Status

DDG "CLASS" Baseline (Foundation)

- **DDG Class Integrated Lifecycle Assessment Program**
- **DDG Class Long Term Modernization Program**
- **DDG Class "High-Level" Maintenance Routines**

LONG TERM Requirements

- Enables 'what if' drill to determine most efficient & effective mix of repairs and/or mods to meet objective readiness requirements
- Tycoms establish the short term requirements, maintenance community can state what work is required to get there and how much it will cost
- Short term requirements link to specific equipment and numbers of equipment availability based on upcoming mission type (i.e. 3 of 4 main engines etc. for drug ops)

SBIRs

- Smart Machinery Space
  - Wireless sensors monitor spaces to reduce watchstander time
- Bearing Remaining Useful Life
  - Wireless sensors monitor bearing trends to predict remaining useful life
  - Power harvesting sensors

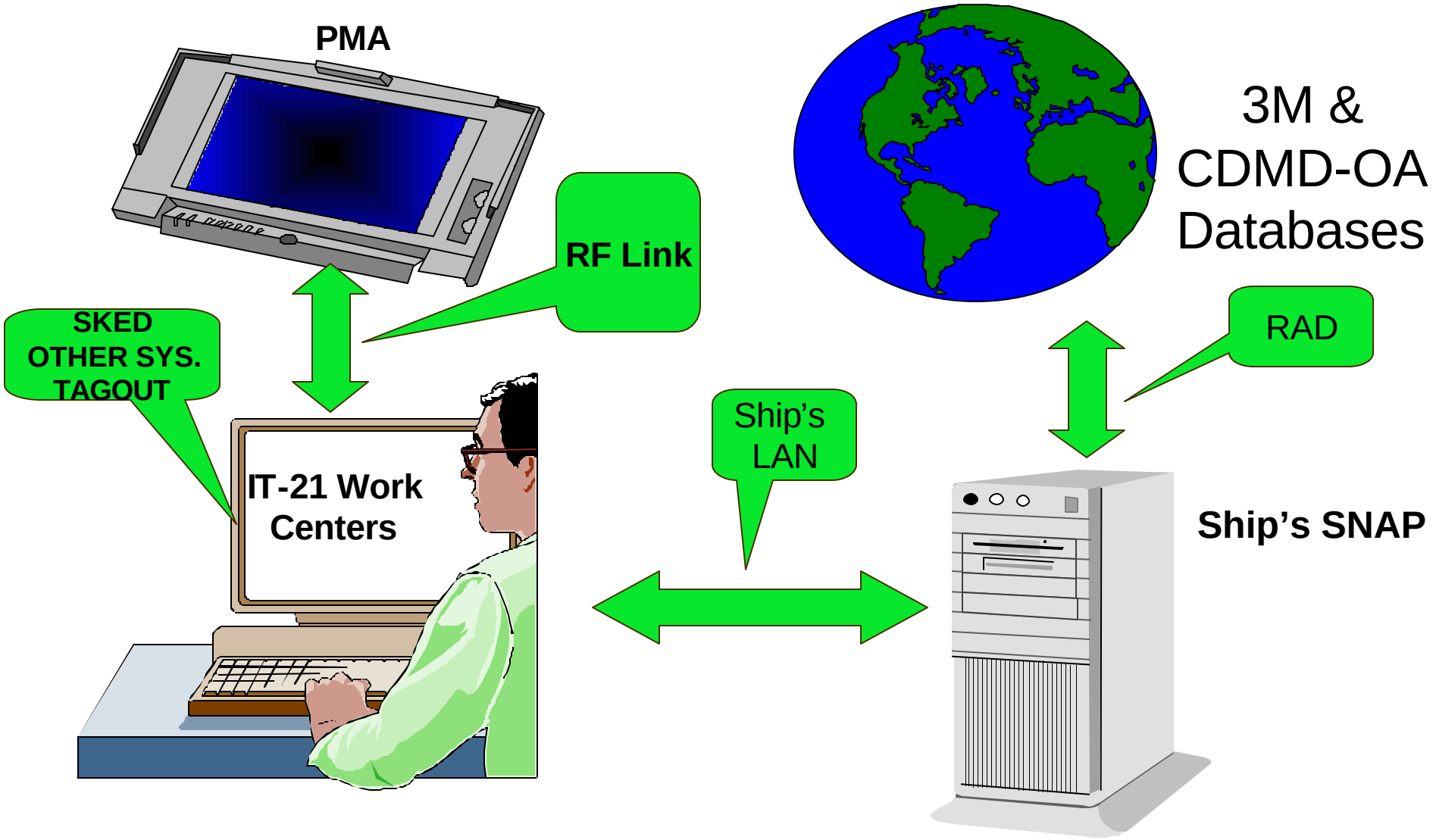
Portable Maintenance Assistant (PMA)

- Program Description - Application of Mobile Computing for reducing shipboard workload. It provides Paperless PMS management, paperless e-Logs, paperless data collection, ready access to IETMs and logistics data at the Point of work, diagnostic and troubleshooting capability, generate electronic work items (4790/2K & CK) at the Point of Work, wireless communication interface to shipboard OMMS-NG / SKED / ICAS, Paperless e-feedback reports

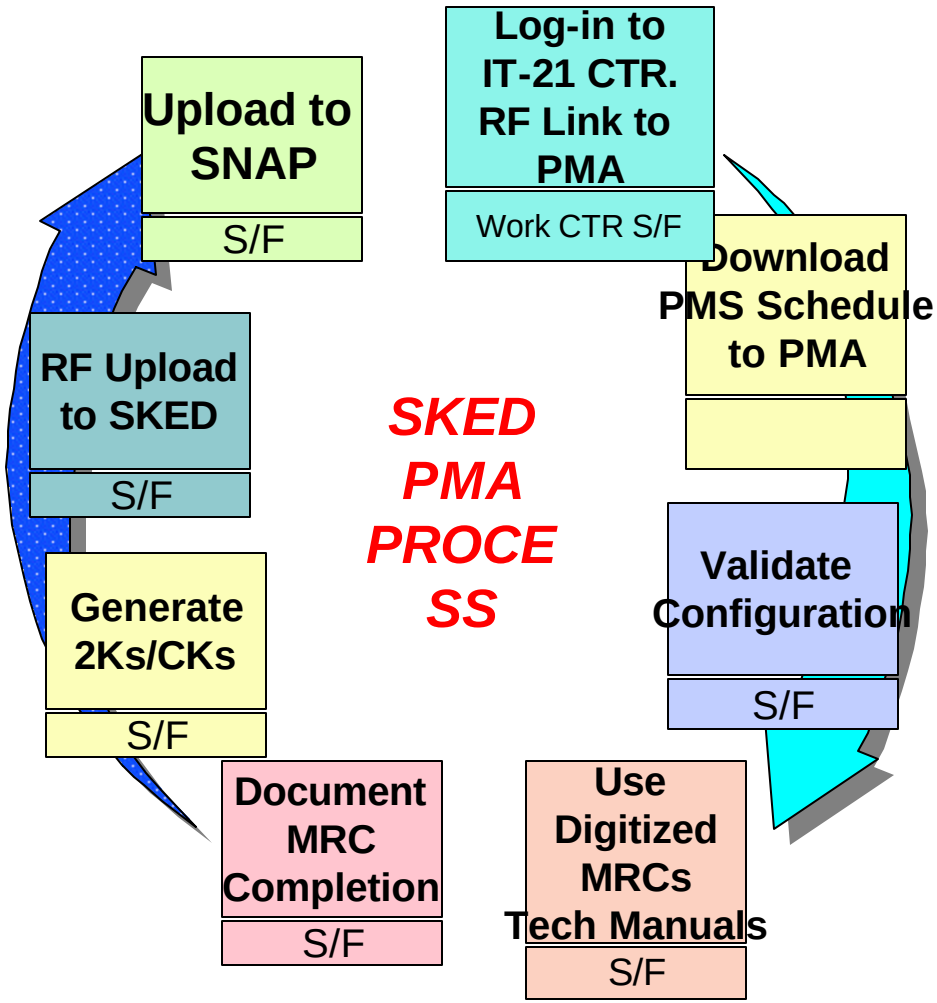
- The entire business process utilizes existing and near term infrastructure and Navy Technical and Logistics products to optimize the Life Cycle Cost

- Deployment Status: - Prototype ready for demonstration and customer feedback. A networked workstation and a PMA is being tailored for a shipboard demo

PMA Information Flow



PMA Overview



Objectives

- Workload Reduction
- Maintenance Mentoring / Tailored EPSS
- Paperless PMS

Benefits

- Reduce data collection workload
- Facilitates paperless work site
- Quality 2K generation
- Eliminates filing and re-filling of paper MRCs in work center
- Interactive MRCs - video and audio
- Facilitates performance based training for maintenance generalist
- Allows tailoring of MRCs to account for differences in equipment configuration
- Eliminate confusion due to "line out" on MIPs and MRCs
- Paperless feedback generation at the point of work

PMA Benefits Overview

- Maintenance Mentoring
- Generate/Edit/View e-2 Kilos
- PMS “to do" list on PMAs
- Generate/Edit/View e-4790 CKs
- Generate/Edit E-log entries
- Switch between SRF screen, associated MRC comments screens, and pre-filled 2K screen.
- Standard statements based on dominant failure modes (RCM), filtered by SWAB for Block 35, User Editable
- IETMs on PMAs
- Spell Checker for block 35
- External connectivity
- Select Origin codes
- Generate POC list
- Review MRC cards
- View/Edit/Print Visit Summary Report
- View/Edit/Print PMS summary status
- Streamlined SNAP and up-line reporting
- Validation of configuration data at the point of work
- Improve accuracy of configuration information by CK generation at

PMA Benefits Overview Contd.

- Collect usage information
  - GPETE - reduce calibration
  - Parts usage- more efficient loadout, COSAL validation
  - Consumables- more efficient loadout, COSAL validation
  - HAZMAT - reduce stowage and loadout
- Error reduction, eliminates transposing of information, data capture one time
- Feedback generation at point of work
- Sketchpad for Sailor to provide additional information he can't otherwise enter
- Recording and reporting of "as found" conditions
- Alternate views of information based upon viewing medium
- Onboard vibration analysis capability at the point of work
- Onboard thermal analysis capability at the point of work
- Other analysis tools available onboard at the point of work
- Allow hyperlinks to other media (video, pictures, procedures, how to's, etc.)

Summary

- USN has invested considerable research into new technologies that will eliminate much of what Sailors do for routine maintenance
  - One technologies does not necessarily solve all problems
  - It must be applicable and effective
  - New technologies should undergo a trial period with a definitive test plan that specifies what success is
- Model usage can provide real time visibility into ship's material condition
- ePMA testing is continuing on DDG-51 platforms
- These efforts can be leveraged for new construction efforts and for legacy platforms.

Back Ups

METRICS
Common Ship Tracking Database

INITIATIVE: Watertight Doors

Sub Part
Hinges : Doors

Ship
LHA 0002 : SAIPAN

Installation Type
NAVSEA Installation

Notes

Installation Date: 03/01/2001

Number of Units Installed: 50

Multiply By Units ☑ *Proposed* ☐

SAILOR MANYEAR SAVINGS

Case 1: Rate Savings
Calculation Performed --> (MY Savings Rate Per Year/365)x(Current Date - Install Date)

Service Life: (Leave blank if indefinite) —

MY Savings Per Year: 0.03

Case 2: One Time Savings
Calculation Performed --> MY Savings Recognized When Date Has Arrived

Date Savings To Be Recognized: —

Man Years Saved: 0

TOTAL MAN YEARS SAVED: 1.7

DOLLAR SAVINGS

Case 1: Rate Savings
Calculation Performed --> (Cost Avoidance Rate/365)x(Current Date - Install Date)

Service Life: (Leave blank if indefinite) —

Cost Avoidance Rate Per Year: 0.76 **(k$)**

Case 2: One Time Savings
Calculation Performed --> Savings will be taken when date has arrived

Date of Cost Avoidance: —

One Time Cost Avoidance: 0 **(k$)**

Case 3: Multi Year Savings (Enter End Date and Total Cost Avoidance)
Calculation Performed --> Total Cost Avoidance/(End Date - Installation Date)

End Date: —

Total Cost Avoidance: 0 **(k$)**

TOTAL COST SAVED: 43.5 **(k$)**

Save Ship *for Watertight Doors.*

Create New Installation of Initiative *Add a ship with the Watertight Doors initiative installed.*

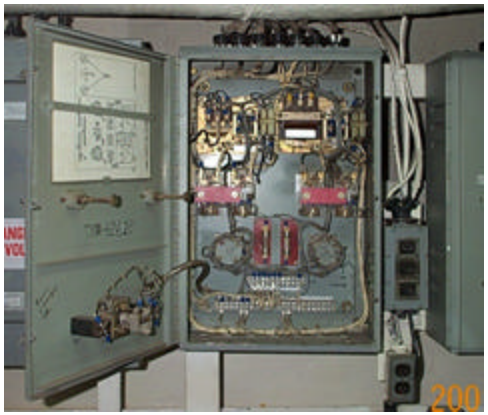
View Installations *Go back to the view showing all the ships with the Watertight Doors initiative installed.*

Portable Motor Testers

- Problem:
  - Motor overhauls are time directed tasks based on projected hours (40,000 hrs).
  - Dominate motor failure modes:
    - Shorted windings (turn to turn)
    - Bearing, causing collateral damage to windings and stator

- Solution:
  - Inexpensive portable motor tester that analyzes motor health and bearings:
    - Determines bearing condition and remaining service life until failure
    - Determines optimum overhaul cycle for motors and determine motor service life remaining

- Benefit:
  - In place motor assessment at the controller (motor running or off)
  - Assesses material condition of controller and motor in one test
  - Eliminate premature overhaul costs of good motors
- Status:
  - NAVSEA 04RM will be conducting a shipboard test of three motor testers in March 2004 to determine:
    - Applicability and effectiveness of conducting in place motor testing
    - Determine whether high voltage or low voltage testing offers the most benefit with least risk in assessing motor health
    - Determine whether motor testing tools are best suited for shipboard maintenance tasks or better suited for assessment team use



Ship Availability Planning Tool

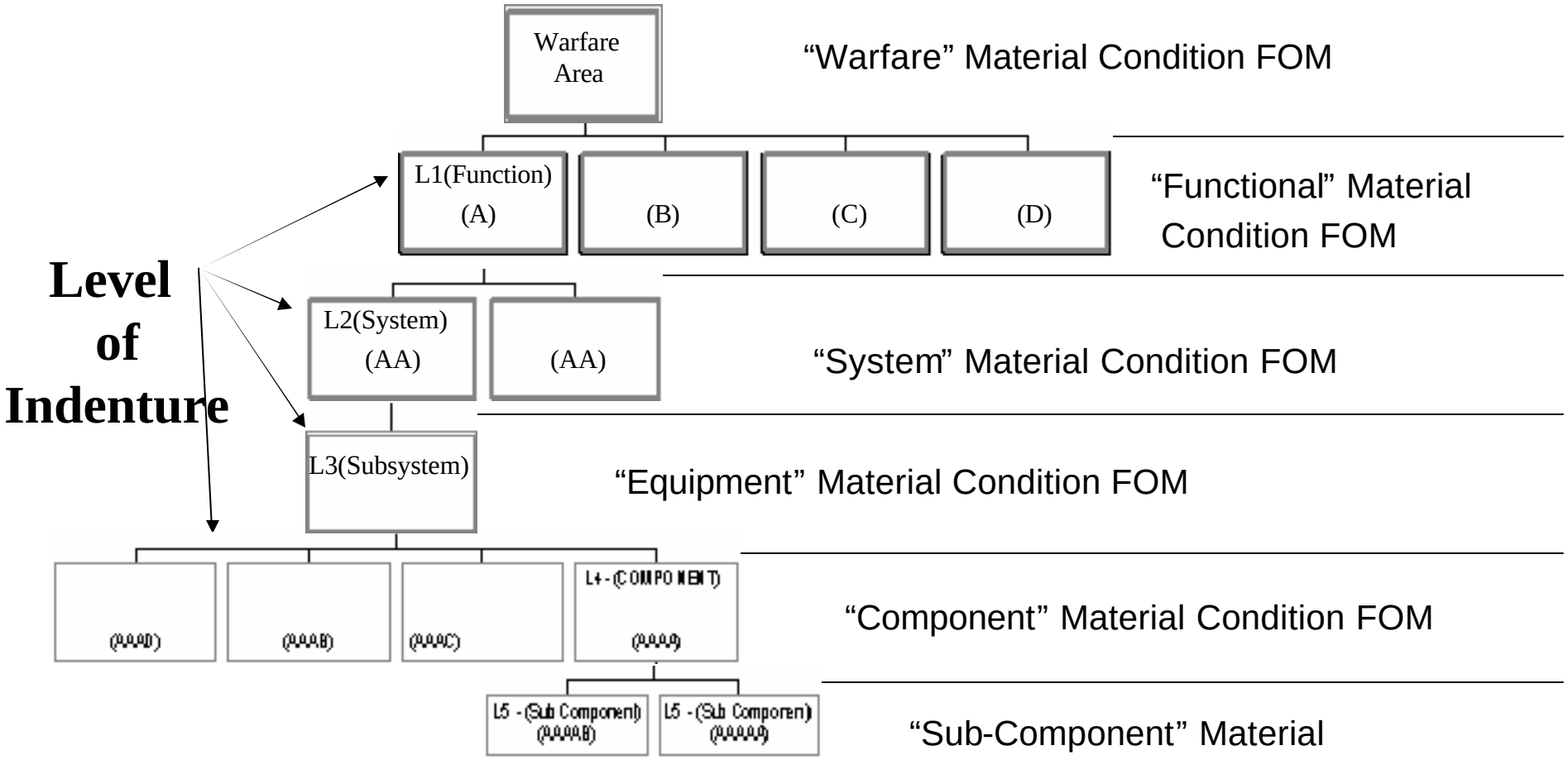
With all the work candidates loaded, mFOM 2.0 displays the Warfare FOM Values:

ASU	C2W	CCC	FSO	INT	LOG	MIW	MOB	MOS	NCO
0.71	0.98	0.75	0.64	0.68	0.88	0.65	0.58	0.85	0.69

The Model lists the impact that a work item has on each warfare area:

JSN	EIC_DESC	ASU	C2W	CCC	FSO	INT	LOG	MIW	MOB	MOS	NCO
EM01-1850	STBD MAIN REDUCT	0.072067	0.000000	0.000000	0.066021	0.070983	0.000000	0.036158	0.063660	0.000000	0.071355
EM01-1891	MN PRPLN DENG 1B	0.027673	0.000000	0.000000	0.024553	0.026646	0.000000	0.022506	0.023897	0.000000	0.026786
EM01-1985	RDCN GEAR STBY P	0.018977	0.000000	0.000000	0.022857	0.024488	0.000000	0.023369	0.021962	0.000000	0.024617
EM02-1294	SW SPLX STRAINER	0.010844	0.000000	0.000000	0.013061	0.013993	0.000000	0.013354	0.012549	0.000000	0.014067
EA01-0787	REFRIGERATION CO	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.012488	0.000000	0.000000
EA01-0790	NR 2 ASW PUMP	0.008133	0.000702	0.001303	0.009796	0.010495	0.048145	0.010016	0.009412	0.045833	0.010550
EA01-0734	REFER NO.2 COND	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.006244	0.000000	0.000000
OA01-0857	SHIPS DISTANCE I	0.007736	0.000000	0.000000	0.011658	0.000000	0.000000	0.004700	0.005492	0.000000	0.000000
EM02-1344	MEDIUM PRESSURE	0.002711	0.002105	0.000434	0.003265	0.003498	0.016575	0.003339	0.003137	0.016000	0.003517

Model Hierarchal Structure



One or more EOC's from 2Ks, CASREPs, assessments, ICAS data, PMS can all contribute to FOM

Ship Availability Planning Tool

The Port Engineer can use mFOM 2.0 to see what jobs will have the most impact on the mission assigned to the ship.

Mine Warfare

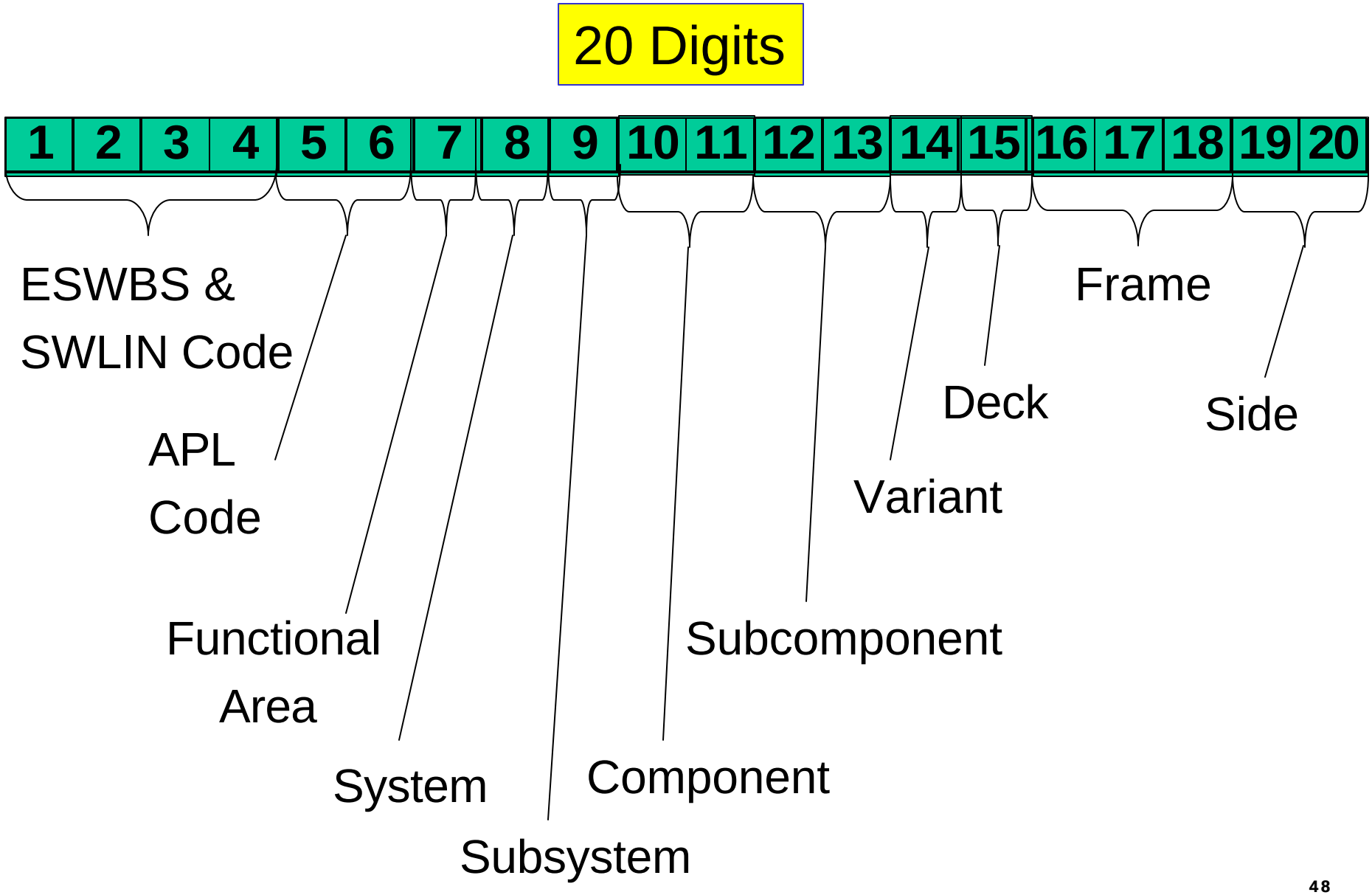
JSN	EIC_DESC	MIW
EM01-1850	STBD MAIN REDUCT	0.036158
EM01-1793	MN PRPLN DENG 1B	0.022506
EM01-1985	RDCN GEAR STBY P	0.023369
EM02-1294	SW SPLX STRAINER	0.013354
EA01-0790	NR 2 ASW PUMP	0.010016
OA0-10857	UWTR LOG	0.004700
EM02-1344	MP AIR COMP NO 2	0.003339
EE01-2274	OUTSIDE ELECTRIC	0.000406
EM02-1296	1A SSDG	0.000355
EM02-1295	1B SSDG	0.000237
EE01-R026	400HZ MOTOR GENE	0.000119
EA01-0796	STEERING GEAR RO	0.000107
OA01-0845	TB-30C/SQQ-32(V)	0.022616
OA01-0763	VEH HDLG SYS SLQ	0.008481
DA01-0677	AEL MECH MS EQPT	0.007068
DA01-0678	AEL MECH MS EQPT	0.007068

Intel

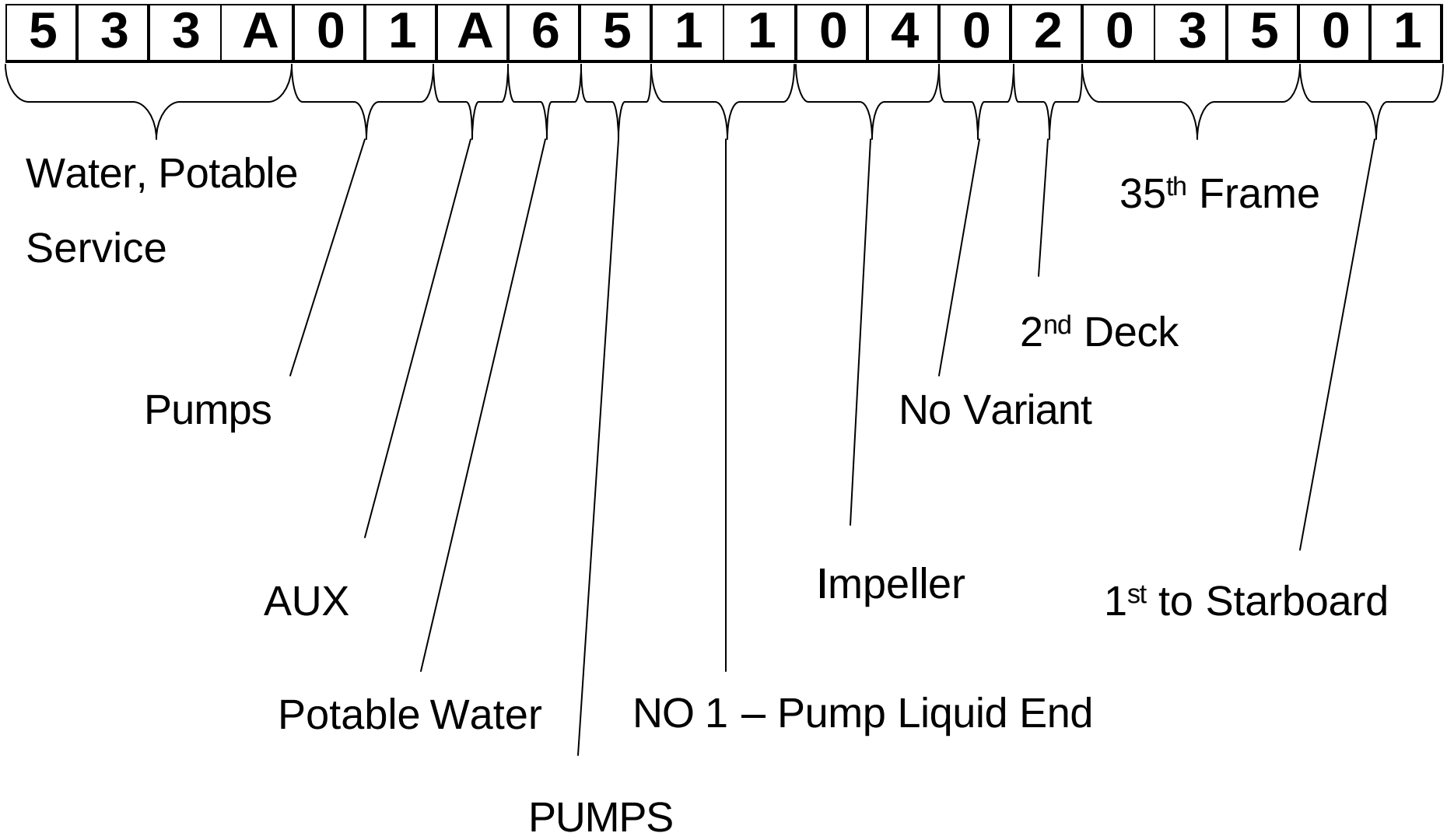
JSN	EIC_DESC	INT
EM01-1850	STBD MAIN REDUCT	0.070983
EM01-1793	MN PRPLN DENG 1B	0.026646
EM01-1985	RDCN GEAR STBY P	0.024488
EM02-1294	SW SPLX STRAINER	0.013993
EA01-0790	NR 2 ASW PUMP	0.010495
EA01-0796	STEERING GEAR RO	0.008813
EE01-2274	OUTSIDE ELECTRIC	0.004203
EM02-1296	1A SSDG	0.003966
EM02-1344	MP AIR COMP NO 2	0.003498
EM02-1295	1B SSDG	0.002644
EE01-R026	400HZ MOTOR GENE	0.001322

- Some items are the same on the lists since the item impacts both mission areas
- Items move up and down on each list based on importance to each warfare area
- Some items are important to some mission areas, but not others

Functional Index Number FIN



Functional Index Number FIN



Functional Index Number FIN

Positions

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20

ESWBS & SWLIN Code

53300	POTABLE WATER	533	Z
53310	**WATER, POTABLE SERVICE**	**533**	**A**
53320	DISTILLED WATER SERVICE	533	B

Common Configuration Item: 01 - Pumps

Functional Area: A = AUX

System: Potable Water

Subsystem: PUMPS

Component: NO 1 – Pump Liquid End

Subcomponent: Impeller

Variant: No Variant

Deck: 2nd Deck

Frame: 35th Frame

Side: 1st to Starboard

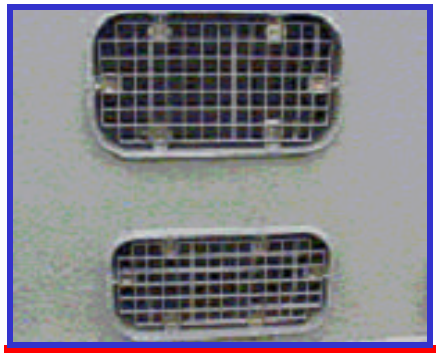
5	3	3	A	0	1	A	6	5	1	1	0	4	0	2	0	3	5	0	1

Values

Composite Materials

Problem:

- Shipboard metal materials corrode & require frequent maintenance painting and repair
- Fleet-wide, sailors spend 15,400 man-days per year maintaining these items



Composite vent screen

Solution:

- Replace metal materials with composite components extending the service life from 5 to 20 years.

Composite deck grating

Composite Materials

Benefits:

- Composite materials never require painting.
- Composite materials provide a strong, lightweight and comparatively priced alternative to standard metal products for a variety of applications:
  - Pumps and valves
  - Grating and screens
  - Topside electrical boxes
  - Ladders, vent ducts and fans

Composite boxes

Composite boxes

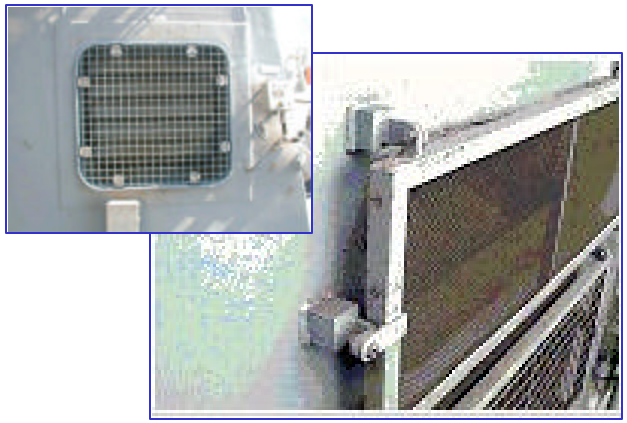
USS LEYTE GULF
Composite Pump

Composite Materials

Case Study:

- Installation of composite material on CVN catwalks has resulted in cost avoidance of:
  - $1.9M USS ABRAHAM LINCOLN (CVN-72)
  - $1.9M USS THEODORE ROOSEVELT (CVN-71)
  - 4 ships completed to date

- Installation of composite vent screens resulted in cost avoidance of:
  - $2.7M USS ABRAHAM LINCOLN (CVN-72)
  - $599K USS STOUT (DDG-55)
  - 13 ships have composite vent screens

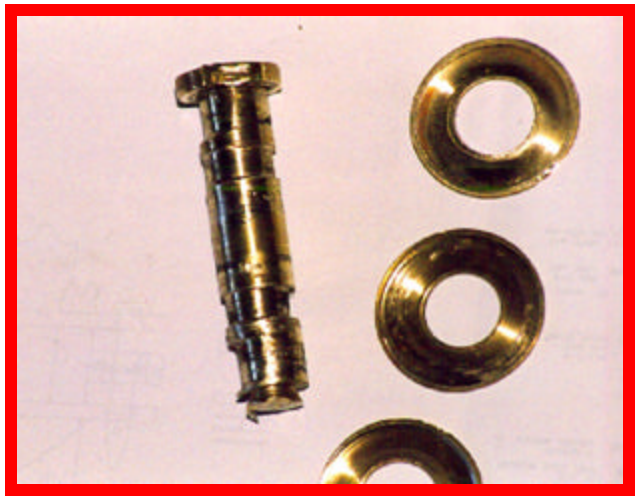


Composite vent screen

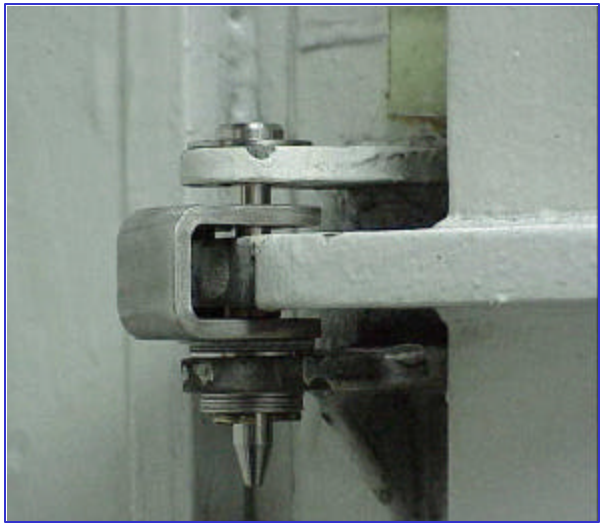
- Composite decks & grates now available via supply system

Watertight Doors

- Problem:
  - **Watertight doors require frequent maintenance.**
  - **Fleet-wide, sailors spend over 590 man-years/year maintaining watertight doors.**
- Solution:
  - **Redesign door hinge pins, bushings, and hinge yokes to eliminate premature hinge failures**
  - **Redesign door dogs to incorporate more resistant materials to extend life of dog bushings.**
  - **Projected sailor workload reduction is 350 myr/yr**
  - **Projected cost avoidance is $100 M**



Hinge Pins and Bushings Currently in Use



Redesigned Hinge Pins and Bushings