Program Executive Office
Command, Control, Communications,
Computers and Intelligence (PEO C4I)

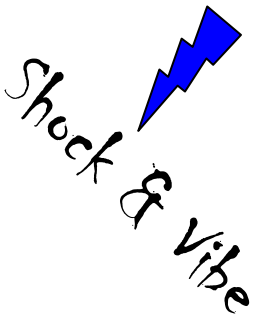
Acquisition and Fielding of Capability

12 June 2008
Kurt Fiscko
Future SATCOM Chief Engineer (PMW 170)

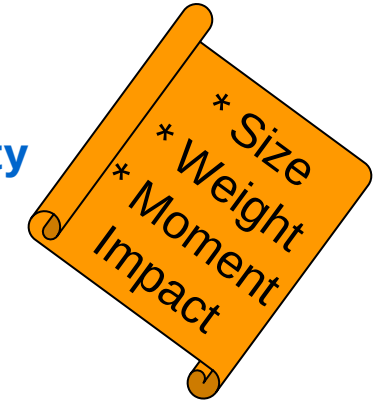
Agenda

- Ship-Unique Considerations
- Military Standards
- Antenna Examples
- Ship Motion
- Shock
- Electro-Magnetic Interference (EMI)
- Blockage
- RADAR Cross Section (RCS)
- Blast
- Green Water Loading
- The Future

Fielding Considerations

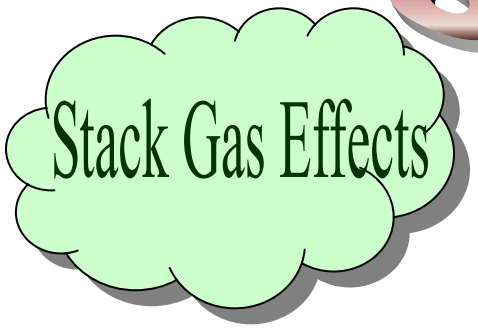


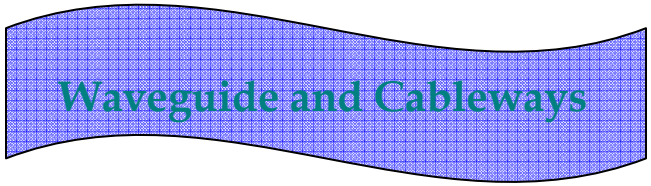
Maintenance Accessibility and Related Structures



Antenna Handover

Electromagnetic Compatibility/ Electromagnetic Interference





Impact to Existing Combat System, EW, Navigation, Aviation Systems

A Few Military Standards

• Shock & Vibration	MIL-STD 901D, MIL-STD 167
• EMI/EMC	MIL-STD 461C/E, MIL-STD 1399
• Humidity	MIL-STD 810
• Airborne Noise	MIL-STD 740
• Structure-borne Noise	MIL-STD 1474D
• HAZMAT	OPNAVINST 5100.8G
• Power/Harmonic Current	MIL-STD 1399
• Time & Frequency	MIL-STD 1399

Some Navy SATCOM Antennas

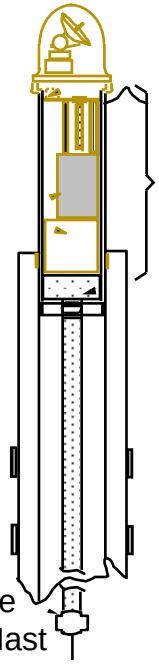
AN/SMQ-11

GPS AJ

CBSP SSV

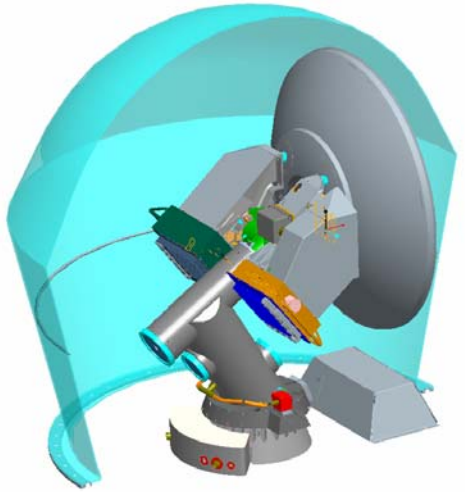
CWSP

GBS



Submarine
EHF/SHF Mast

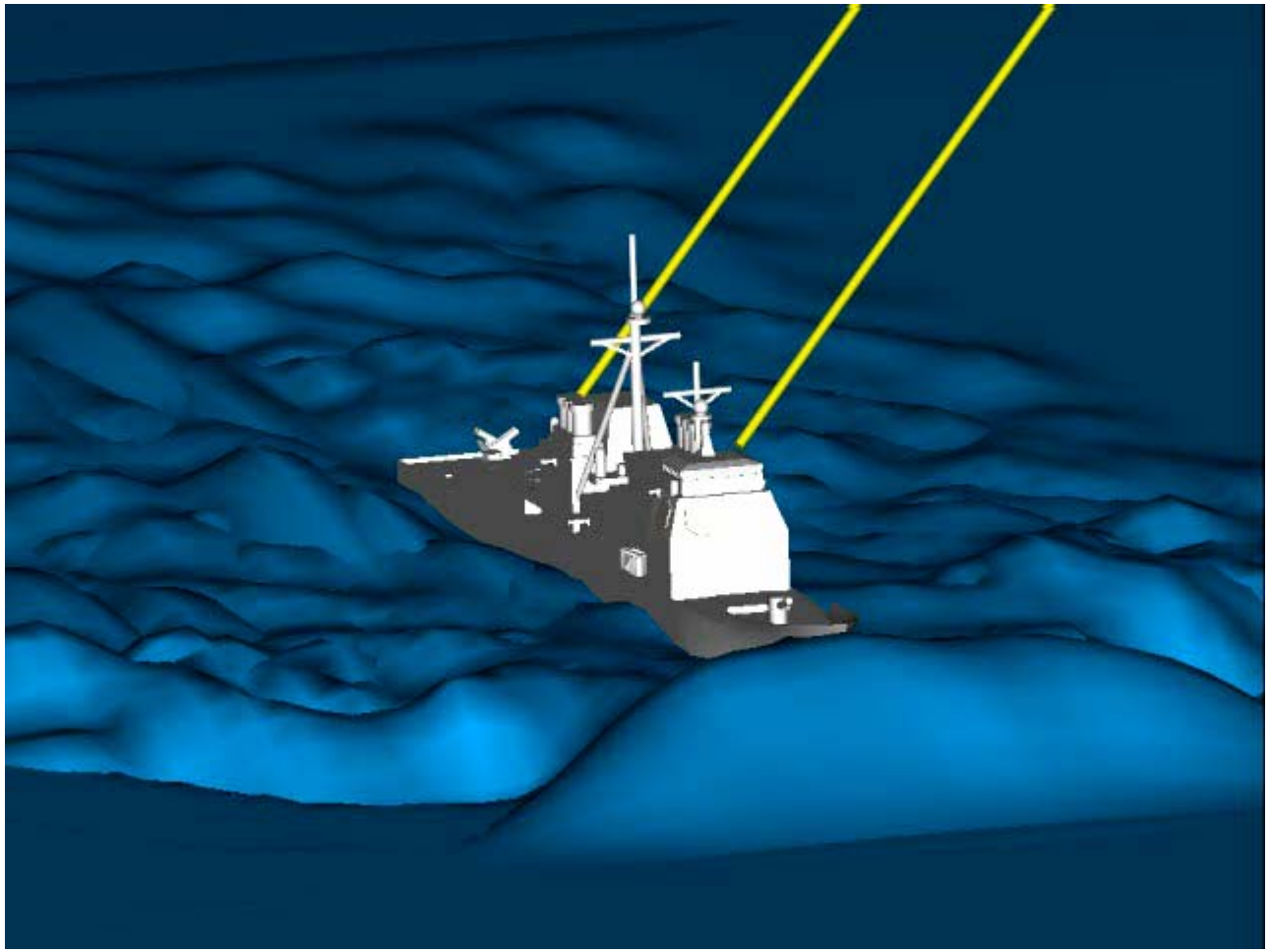
NMT Q/Ka



TV-DTS

CG Example Topside

What About Ship Motion?



Why Shock Test?

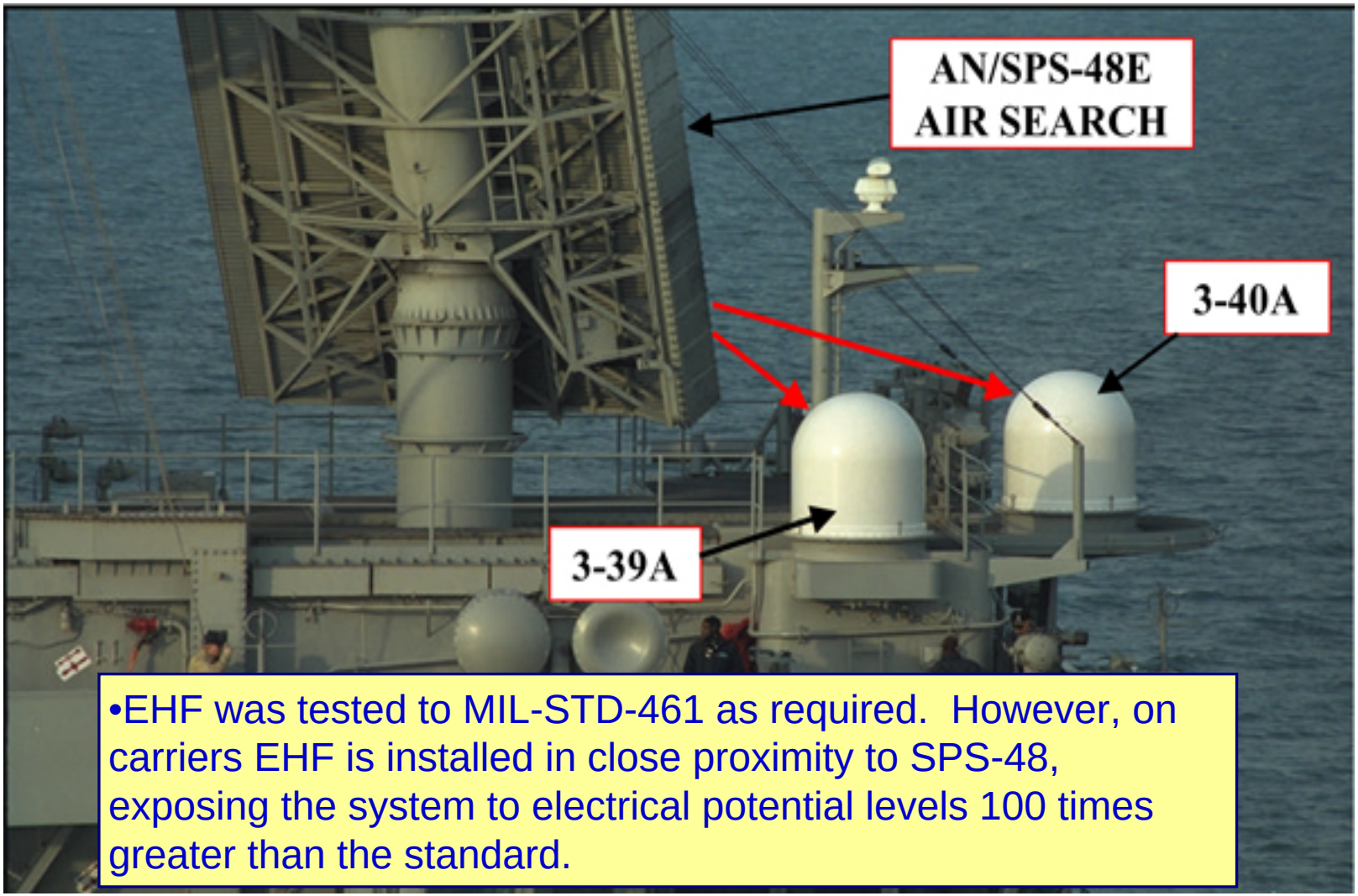
USS Cole
10/12/2000

Barge Shock Test

Passing Navy Shock Tests is NOT Easy

At least we know why this one didn't pass the first time!

EHF EMI on Carriers Example



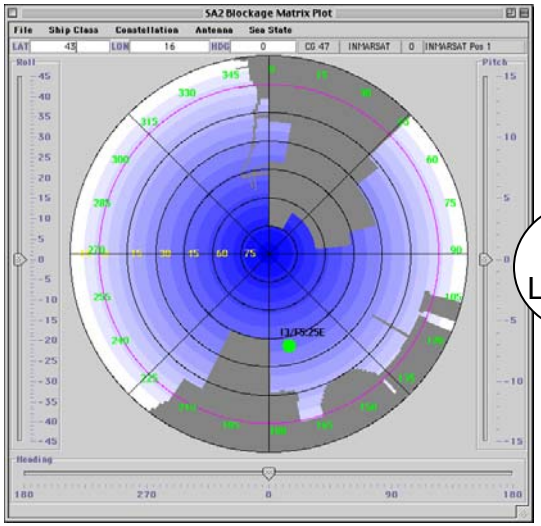
•EHF was tested to MIL-STD-461 as required. However, on carriers EHF is installed in close proximity to SPS-48, exposing the system to electrical potential levels 100 times greater than the standard.

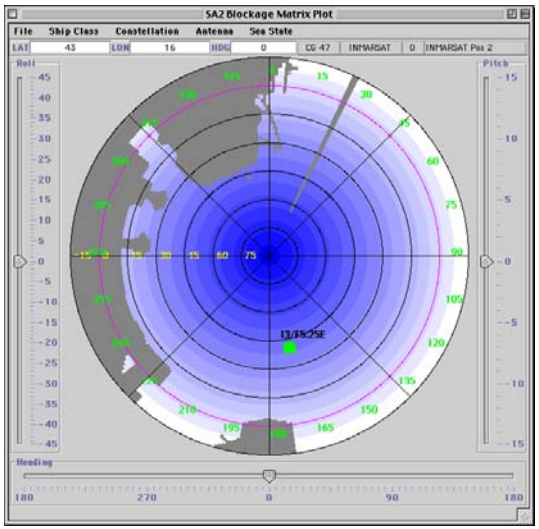
Superstructure Antenna Blockage

- Most Critical SATCOM Systems Use Two Topside Antennas To Provide An Unobstructed View Of The Entire Sky Or A Single Antenna Mounted At The Top Of The Mast
  - For Dual Antenna Installations Handover From One Antenna To The Other Occurs As The Active Antenna Goes Into A Blockage Zone
- Lower Priority SATCOM Systems Are Sometimes Forced To "Make Do" With A Single Antenna Location In A Poor (Partially Blocked) Location

Antenna Handover & Coverage DDG/WSC-6(V)9 Example

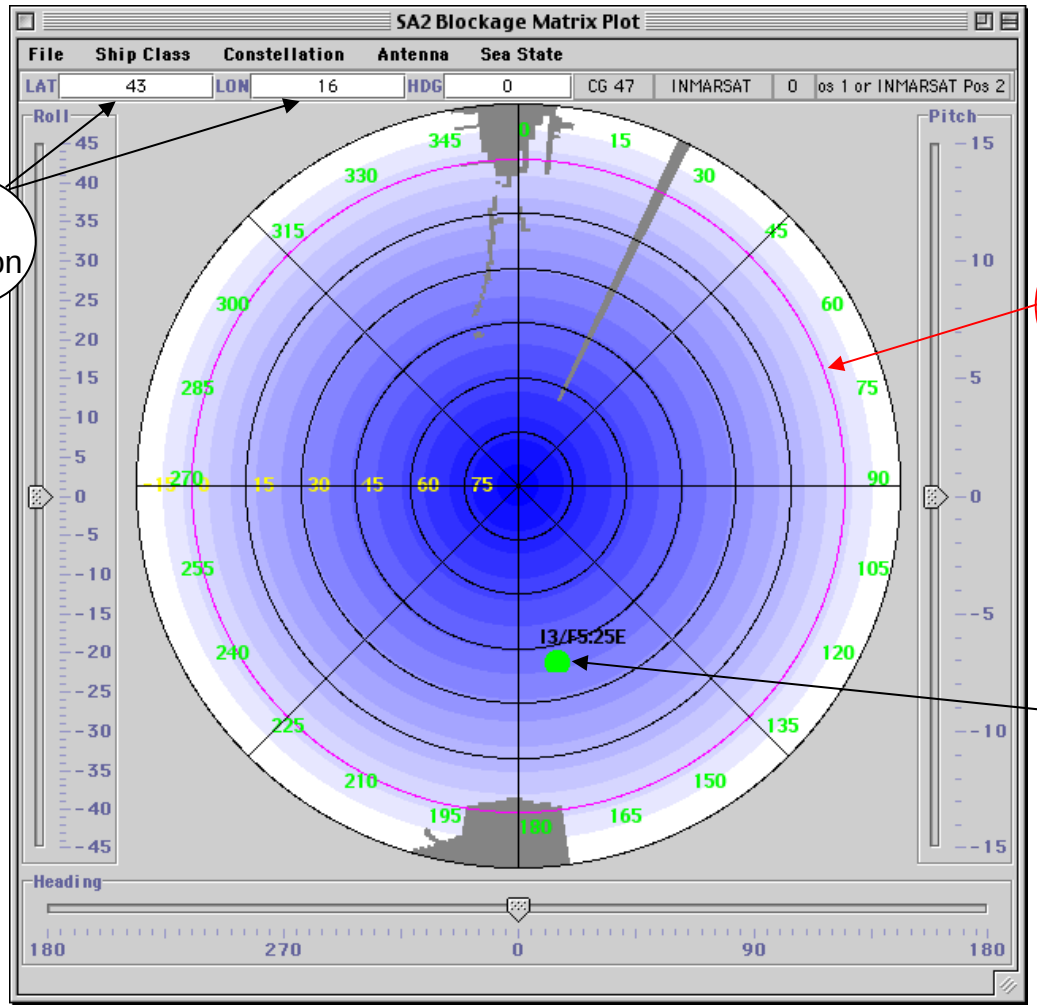
Antenna 1





Antenna 2

Sky View looking straight up from antenna location



Ship Location

0 Deg. Elevation Ring

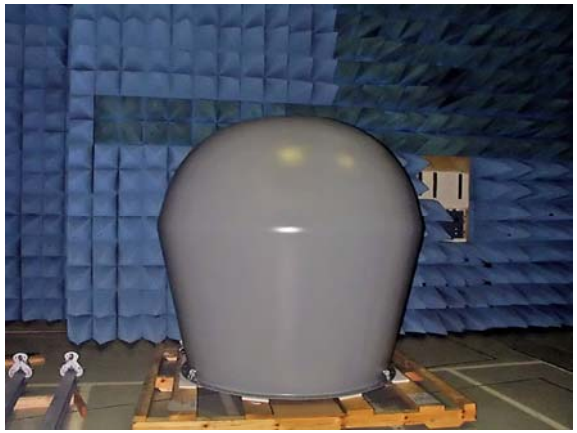
Satellite Location

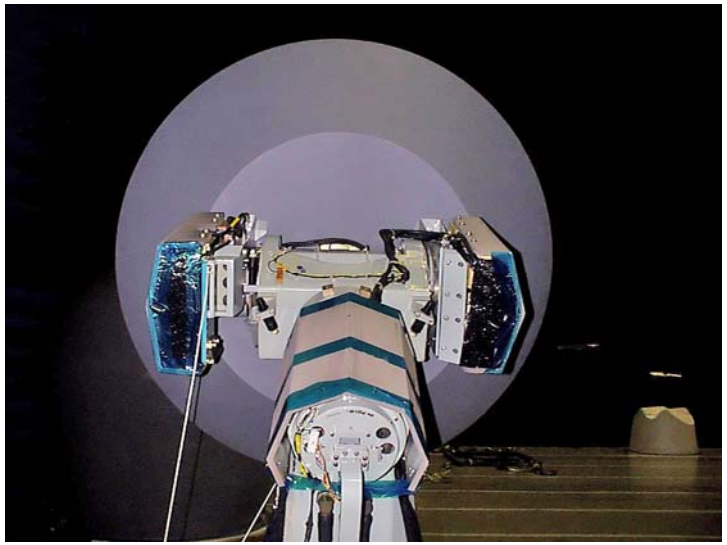
Coverage with both antennas combined (Handover)

Why RADAR Cross Section (RCS) Reduction?

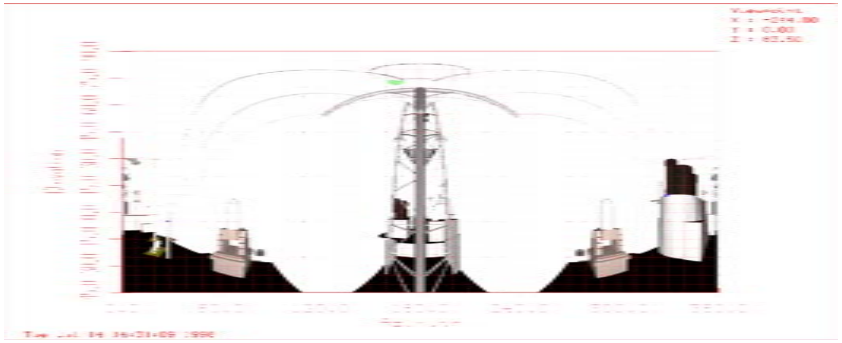
- Ships Are Vulnerable To RADAR Guided Missiles
- Most Newer Navy Ships Have Been Designed To Mitigate The Vulnerability Via A Low RCS Design
  - Antennas For These Ships Are Also Required To Provide A Low RCS
- PMW/A-170 Works Very Closely With Ship Program Managers And NAVSEA To Meet Antenna RCS Requirements
  - Participated In Several RCS Summits
  - Provided RCS Compliant EHF, GBS, and SHF Antennas
  - Currently Working With The Zumwalt Program To Meet Extremely Stringent RCS Goals For That Ship Class

RCS Treatment & Testing

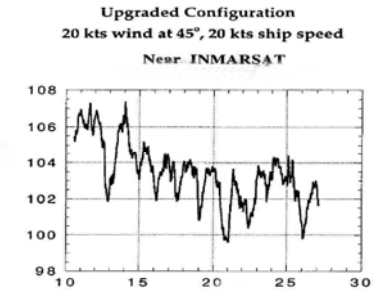




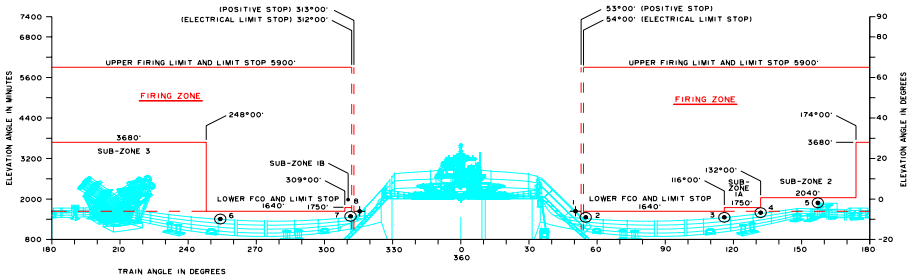
Studies and Analysis

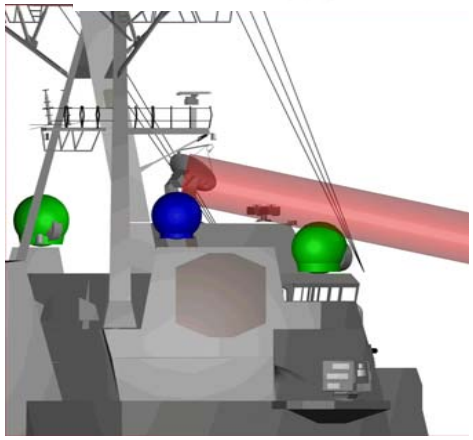


Antenna Performance Assessments (LM-GES)



Stack Gas Flow analysis (NRL)

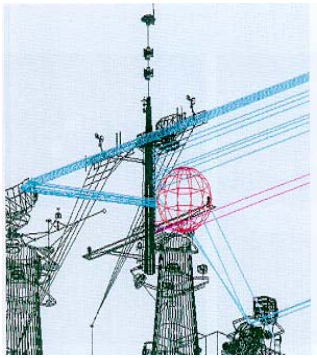


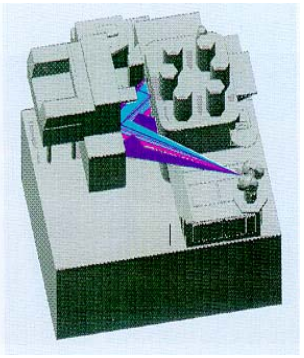


3D CAD Modeling (LM-GES)

Brass Model Studies (SSC-SD)

RCS Modeling (NSWC-CD, NRL)





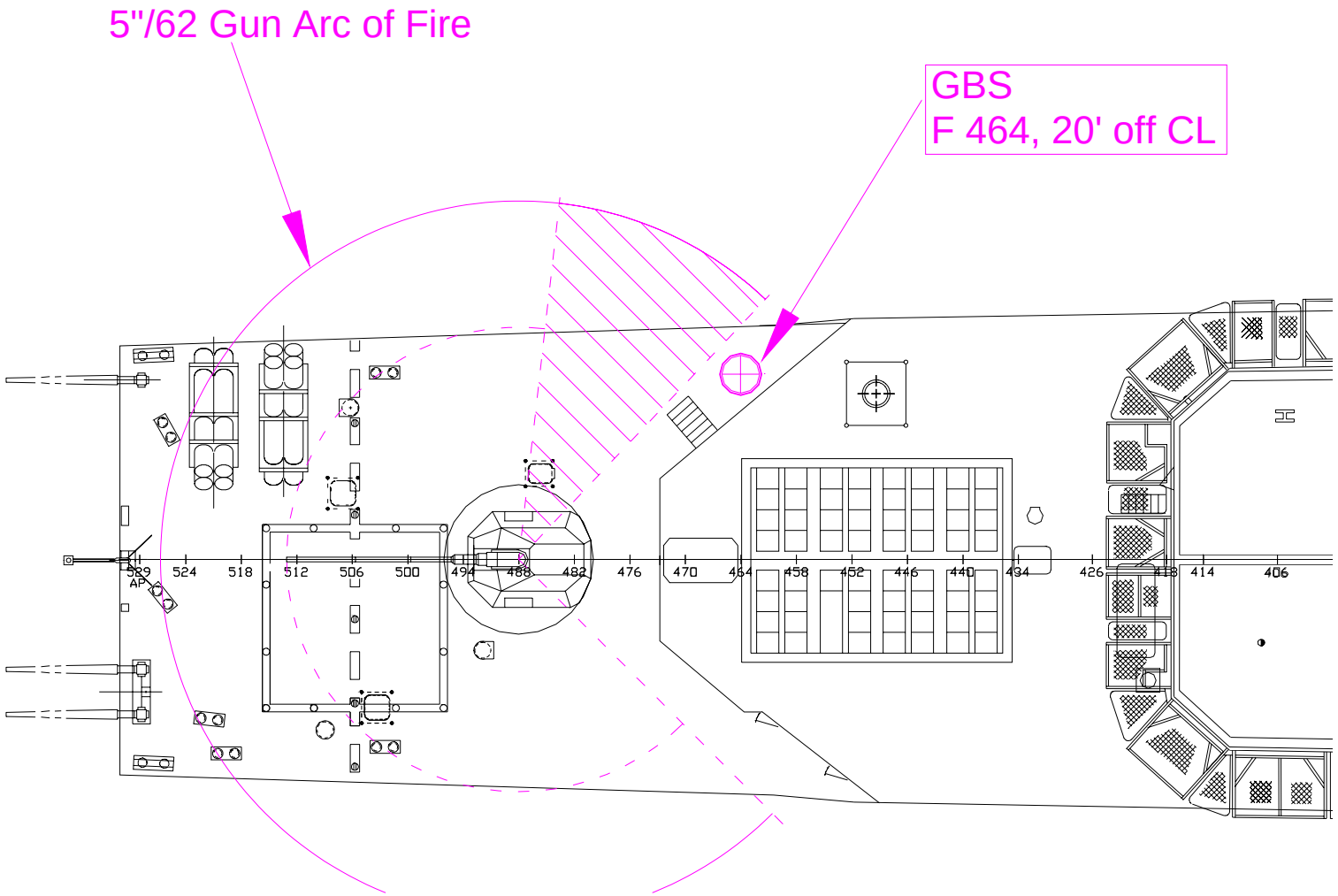
Missile/Gun Blast, Aircraft Exhaust Plume - Analysis

TV-DTS Antenna's Close Encounter with AC Exhaust Plume

Gun Blast

Missile Launch

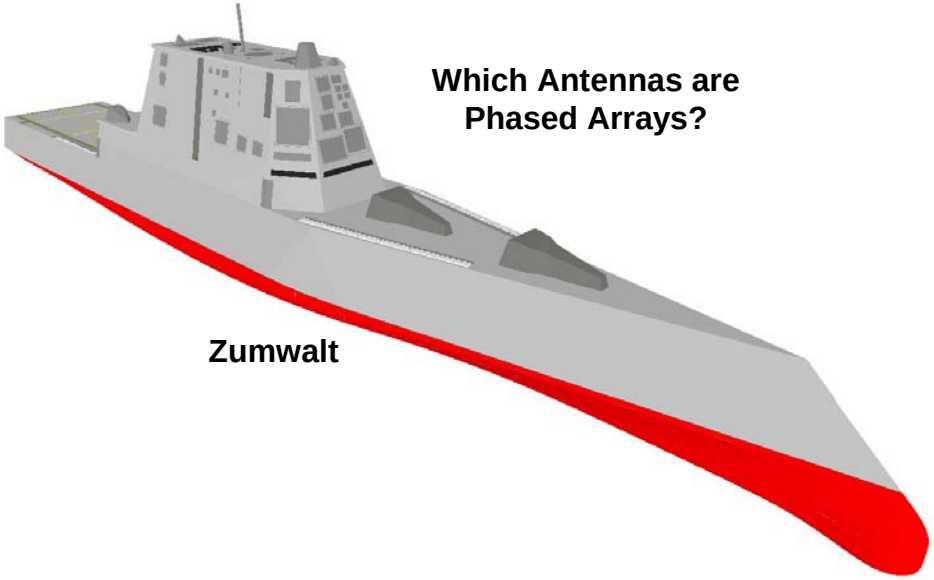
Gun Blast Analysis - GBS Example



Green Water Loading - Analysis

Analysis must made to ensure antennas are located to survive wave slap / green water loading

Future SATCOM



- Multi-beam, Multi Frequency.
- Phased Array?
- Cryogenically Cooled, all Digital?
- Higher Capacity, Smaller Size???
- QAM?

Phased Array's

- Are Phased Arrays (PA) The Answer?
  - Great For Low RCS
  - Great For Multi-beam Requirements
  - Relatively Easy To Implement In New Construction, But Very Difficult To Install On In-service Ships
  - Very High Cost. Cost Comparison Of Dual Band X/Ka Antenna.
    - Parabolic Dish System Procurement And Installation $5.7m. Assumes Dual Antennas With Handover To Meet Coverage Requirements.
    - Phased Array System Procurement And Installation $35.2m. The Assumed Per Element Cost For This Comparison Was $100 (Probably Low).
  - Current PA Antennas Are Heavier And Use Significantly More Power Than Parabolic Antennas Of Equivalent Performance
- Today's Answer Is NO, Unless RCS Requirements Cannot Be Met With Conventional Parabolic Dish Antenna Technology Or The Number Of Simultaneous Beams Rule Out Conventional Parabolic Dish Antennas

Summary

- Navy Environmental Requirements are Tough
- Navy Communications Requirements are Tough
- Topside Real Estate is at a Premium
- We Continue to Push the Envelope for Better Performance and Lower Cost

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