# Integrated Topside Design Program

## Validated, Integrated, Physics-based Electromagnetics Radiation Toolset

**03 March 2004**

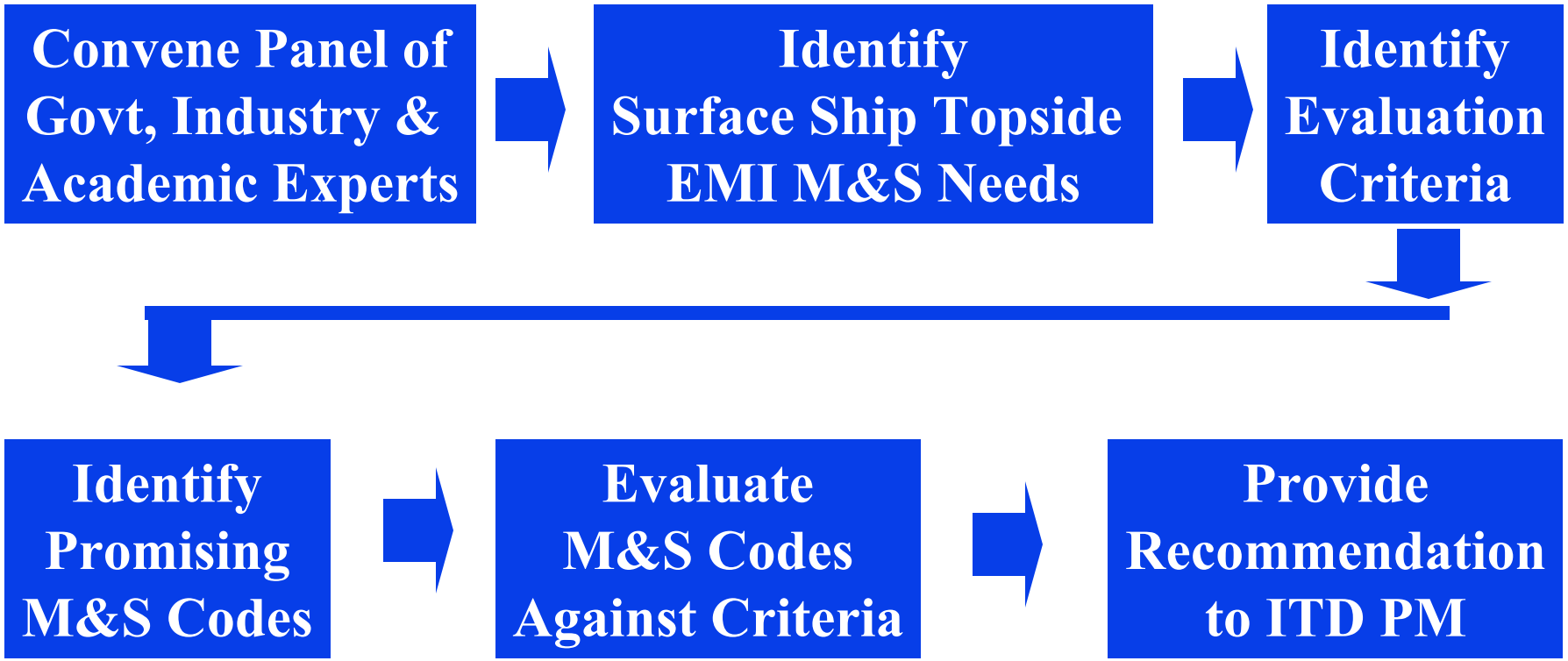
**SSC-SD 2825**

# VIPER Goals

- **Phased approach to development of topside EMI M&S tools**
  - **VIPER 1 - Advanced ship M&S needs (FY00-02/3)**
  - **VIPER 2 - In-service ship M&S needs (FY02/04)**
- **Identify, enhance, and V&V the most promising existing M&S tools**
- **Support the user community**
  - **Physics-based tools for component and system level analysis**
  - **V&V critical component of effort**
  - **User friendly graphics interfaces**
  - **Common set of tools for Navy labs and contractors**
    - **Foster intra-Navy and Navy-contractor collaboration**
    - **Facilitate peer review of analysis and analysis methods**

**Need to optimize balance between computer throughput and modeling accuracy**

# VIPER Process




**Provide "best value" to Navy in minimum amount of time**

# VIPER Mission Statement

- **Determine the set of ITD EME problems whose solutions are within the capability of existing or near-term (e.g., 2 to 3 years) software, numerical methods, and computer resources.**
- **Identify, evaluate, and prioritize all relevant existing EM software tools for applicability to solving the ITD problem set defined above.**
- **Identify technical shortfalls where existing codes either fail or are not available to solve the ITD problem set defined above.**
- **Develop a strategic recommendation as to which of the existing codes should be validated and which of the unavailable techniques or codes should be developed in the near-term as part of the VIPER Tool Set.**

**Identify, demonstrate, and validate EM engineering tools for future ships' advanced apertures (I.e. planar arrays)**

# VIPER Evaluation Criteria

## Risk (high, medium, low)

- Performance risk
  - Technical feasibility vs. complexity of enhancements
  - V&V conducted to date vs. still required
- Schedule risk
  - Can be done now with existing codes after adaptation, if needed (< 1 year)
  - Manageable with additional co de development over short term (< 3 years)
  - Not realistically achievable in near term (> 3 years)
- Cost risk
  - <$500K
  - $500-$1000K
  - >$1000K

## Cost Drivers

- Performance
  - Enhancements to code
  - V&V of code
- Packaging
  - Improving usability (input/output)
  - Increasing portability
  - Improving computational speed

## Data Rights

- Source code
- Executable code
- Availability to Navy contractors

**Configuration & Maintenance?**

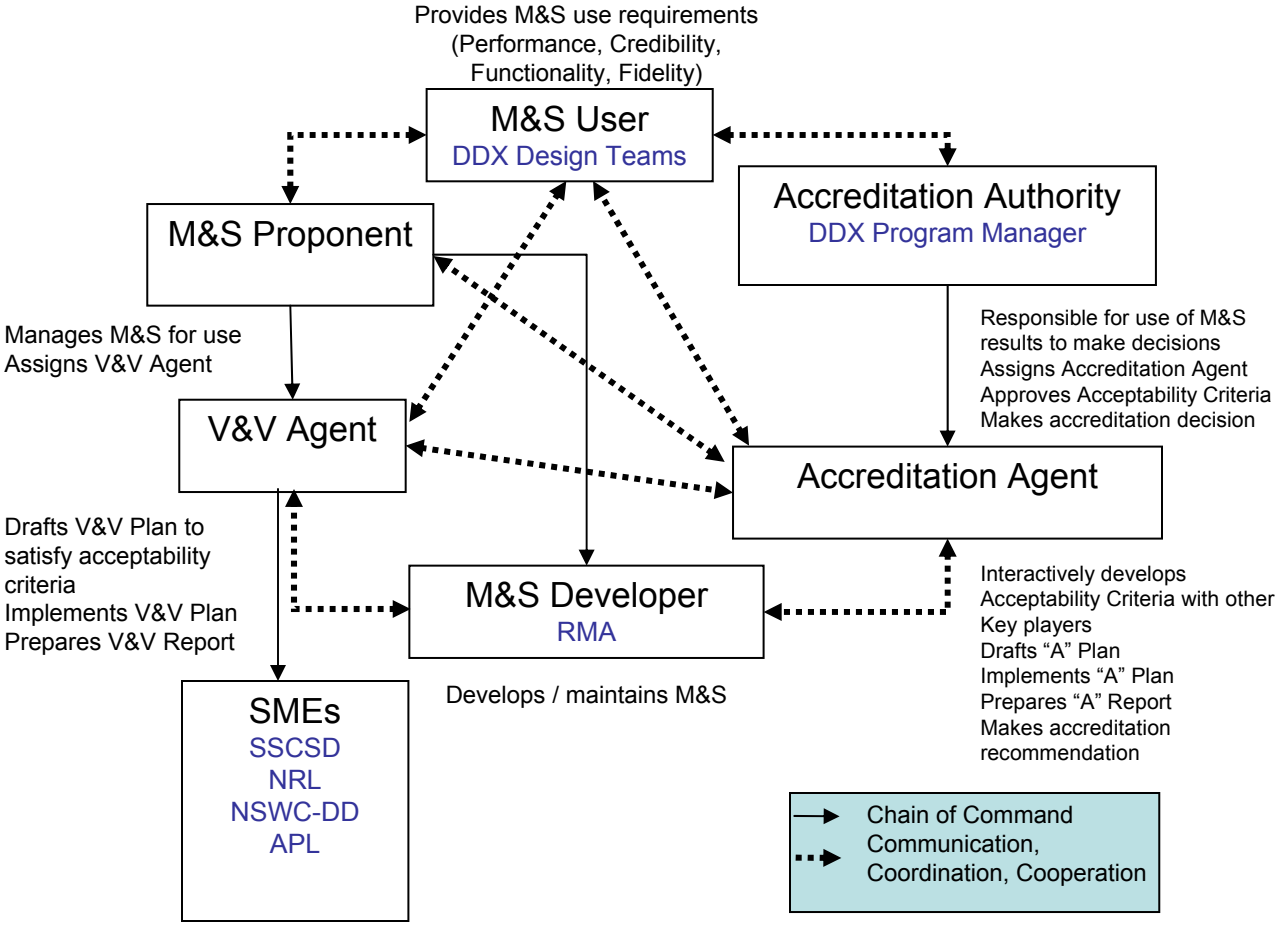
## Growth Potential & Scalability

- Scalability to high/low band
  - Risk (high, medium, low)
  - Estimated cost of effort
- Scalability to future functionality
  - Risk (high, medium, low)
  - Estimated cost of effort
- Integration potential with other EM codes

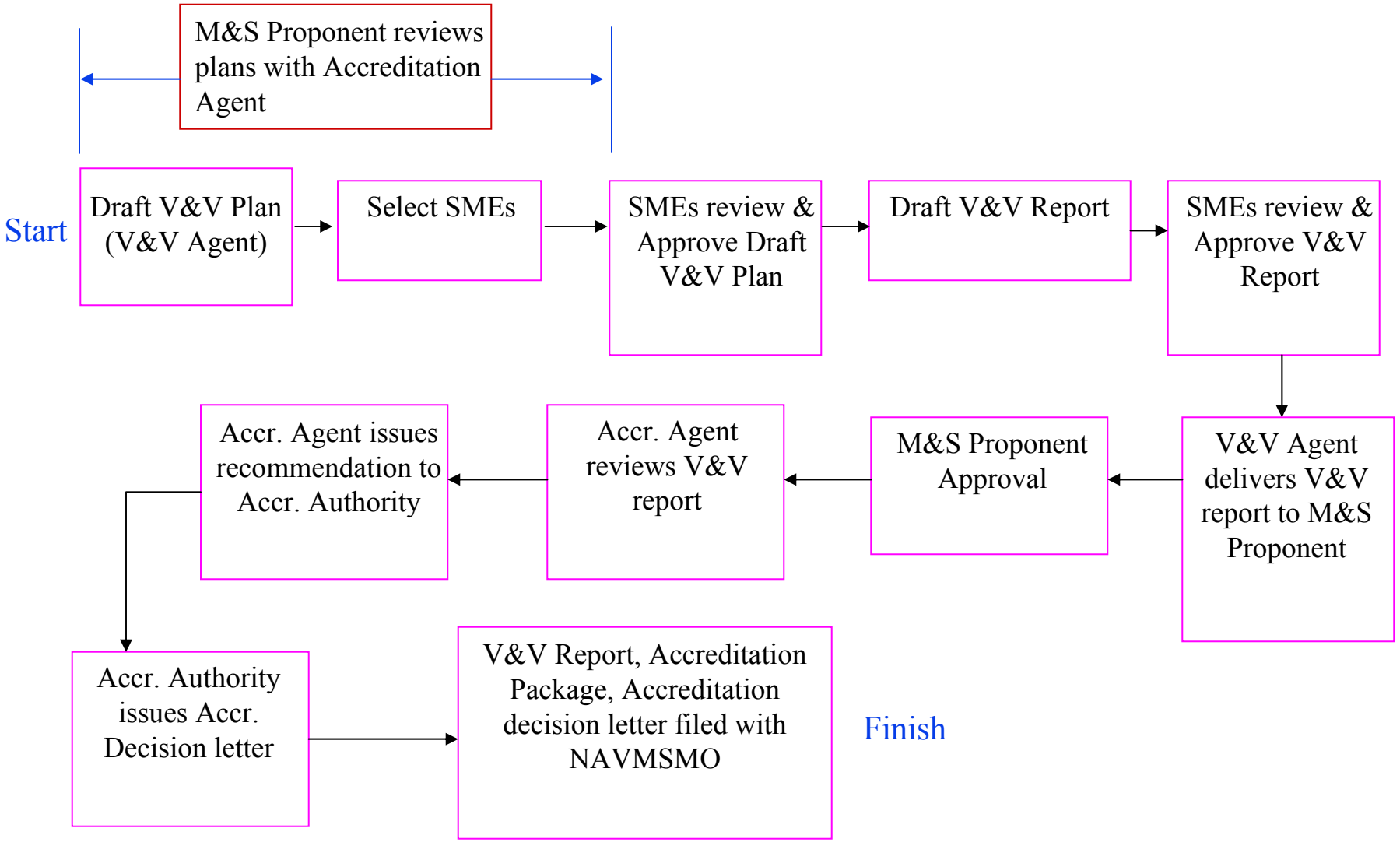
## Computing Efficiency

- Usability
  - Compatibility with CAD software
    - Geometric meshing requirements
    - Setup time requirements
  - Input evaluation/quality control capability
  - Post processing/visualization capability
- Portability
  - Platforms (PC, NT, Unix, supercomputers)
- Computational speed
  - Memory requirements
  - I/O requirements (size, speed)
  - Execution time
    - Iterative
    - Direct
  - Potential for parallelization
    - Expected performance payoff
    - Estimated cost of effort

# VV&A Responsibility



# VV&A Process Outline



# V&V Testing

Test Cases selected from

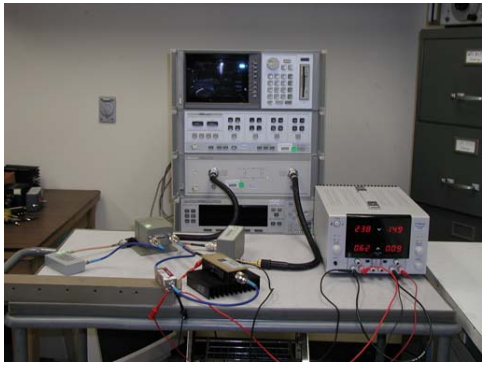
- Open literature
- Navy data

Numerical Predictions compared with

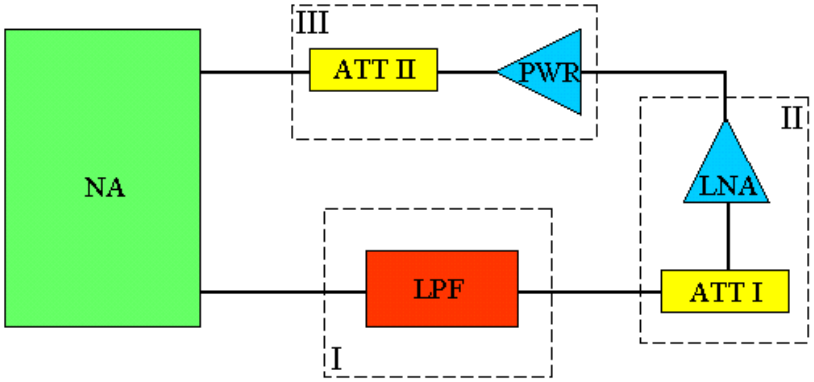
- Measured data
- Alternative simulations

# Electronics Design Tool V&V - RF Cascade Network

**Cascade Experiment**



**Cascade Schematic**



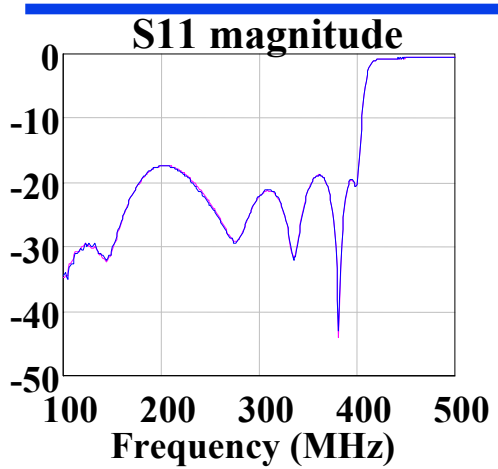

**Component I Low Pass Filter**

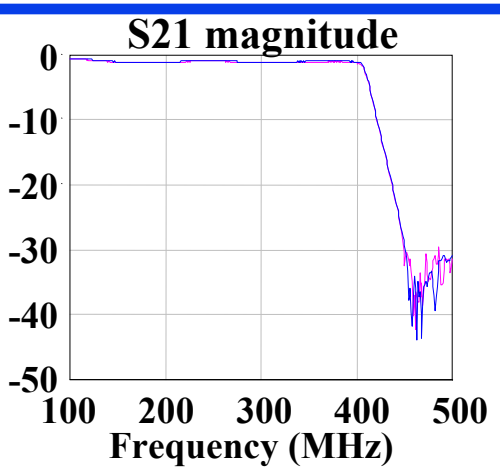
**Component II LNA/Attenuator**

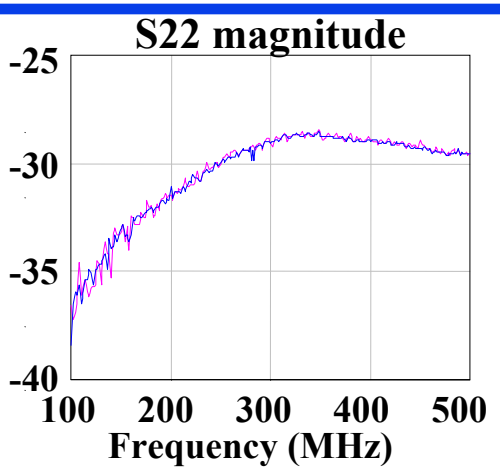
| | | |
|---|---|---|
| NA | HP 8510C | S/N PB47749 |
| LPF | Coaxial Dynamics 2150 | P/N 08-00924-001 |
| ATT I | HP 354A @ 50 dB | S/N 01449 |
| ATT II | HP 355D @ 30 dB | |
| LNA | Miteq AU-3A-0150 | S/N 478491 |
| PWR | Mini-Circuits ZHL-1-2W-N | S/N D101397-14 |

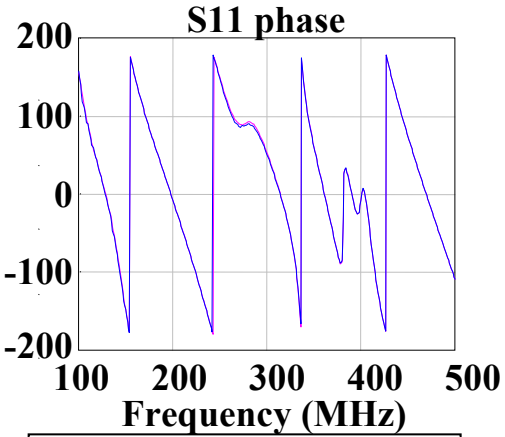
**Component III Power Amp/ Attenuator**

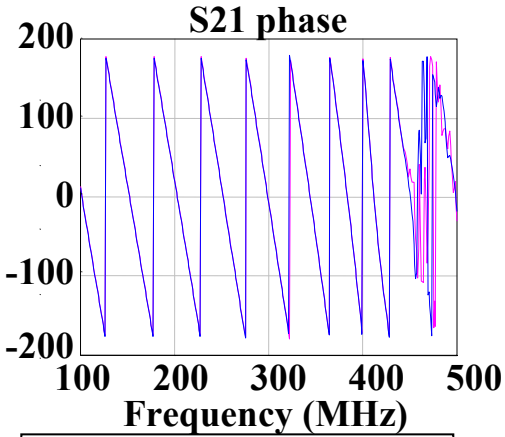
# RF Cascade Network S-Parameters

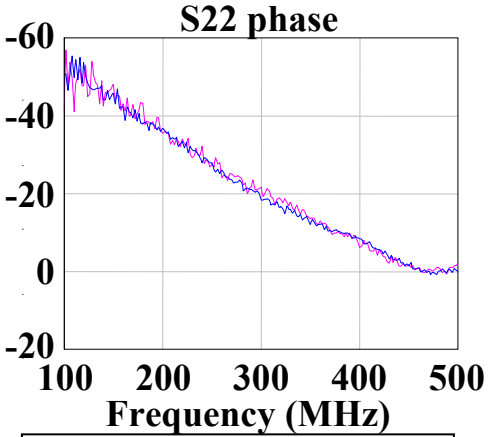


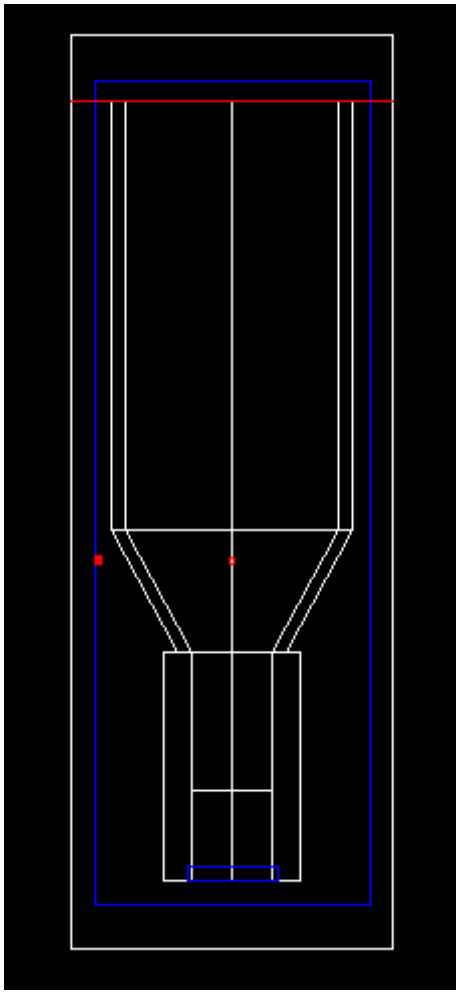



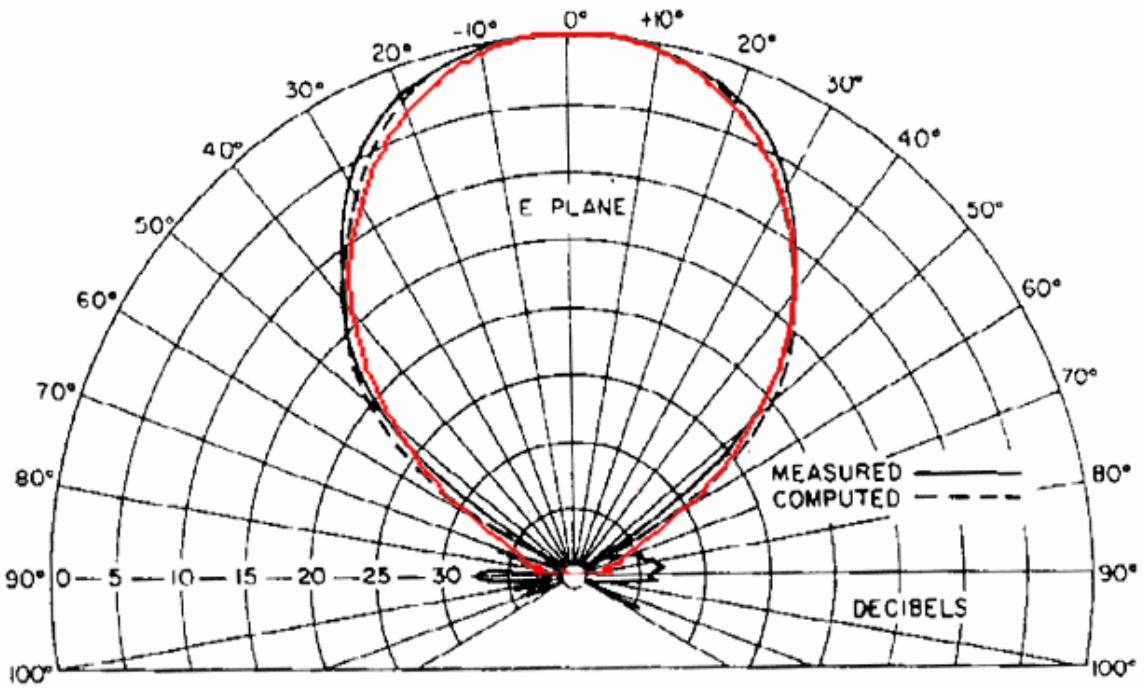



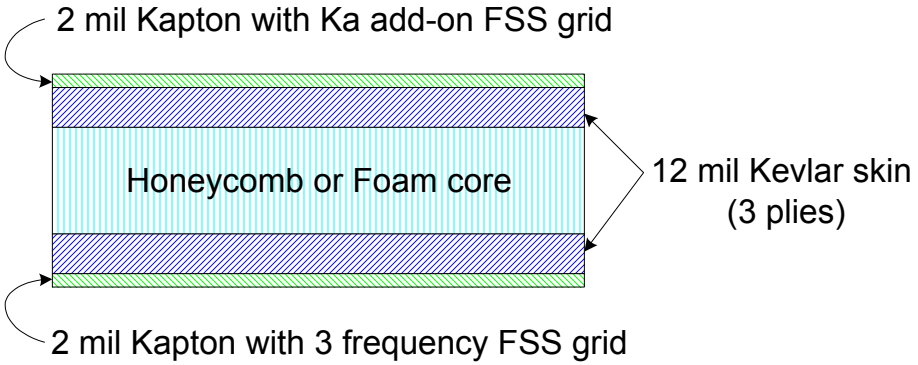
# Circular Horn Antenna (11 GHz)

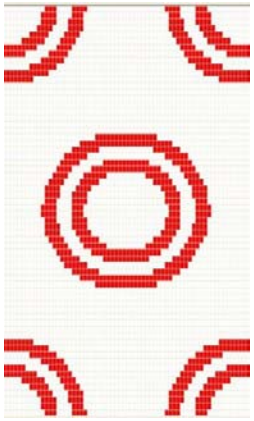


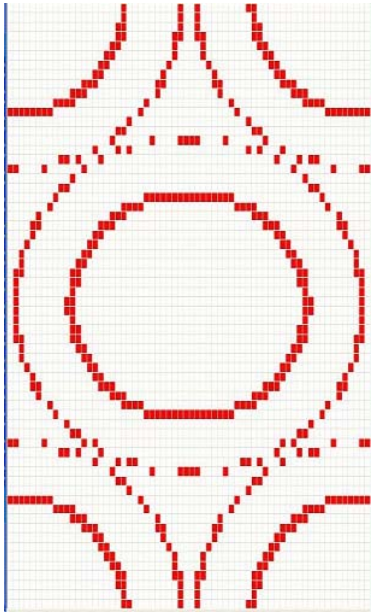


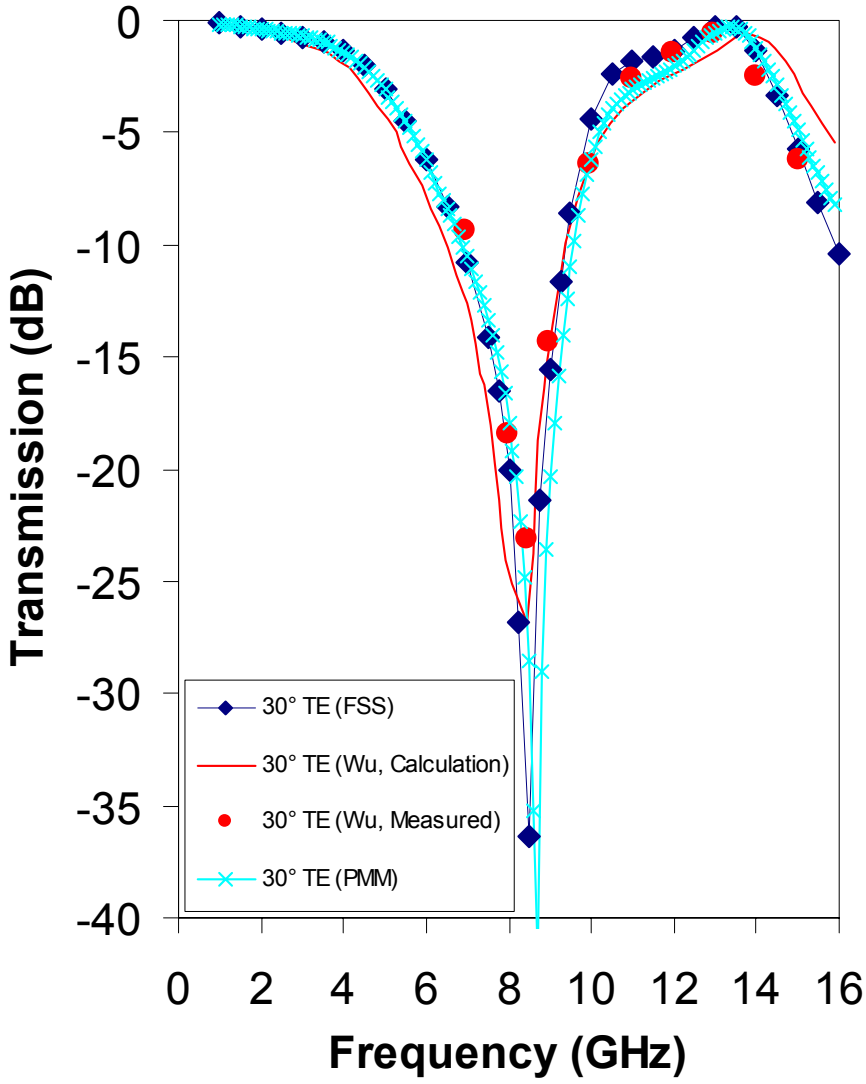

R. H. Turrin, IEEE AP-15, pp. 307-308 (1967)

# S/X/Ku/Ka FSS (Dual Double Ring)







# Conclusion

- Process can be time consuming
- Important to incorporate V&V planning process in the development plan
- Early consultation with NAVMSMO!