Specifications and Standards for the Electric Warship

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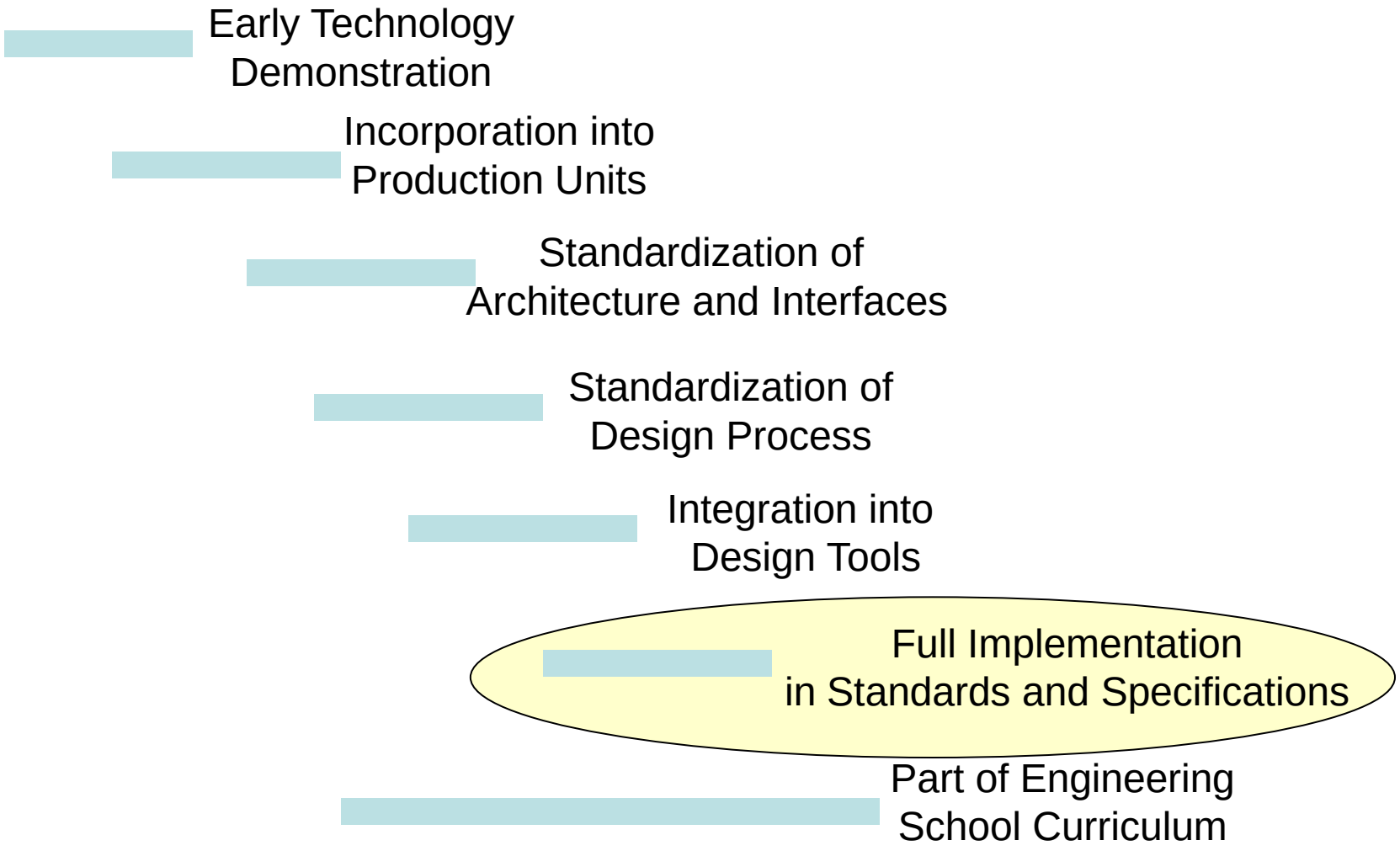
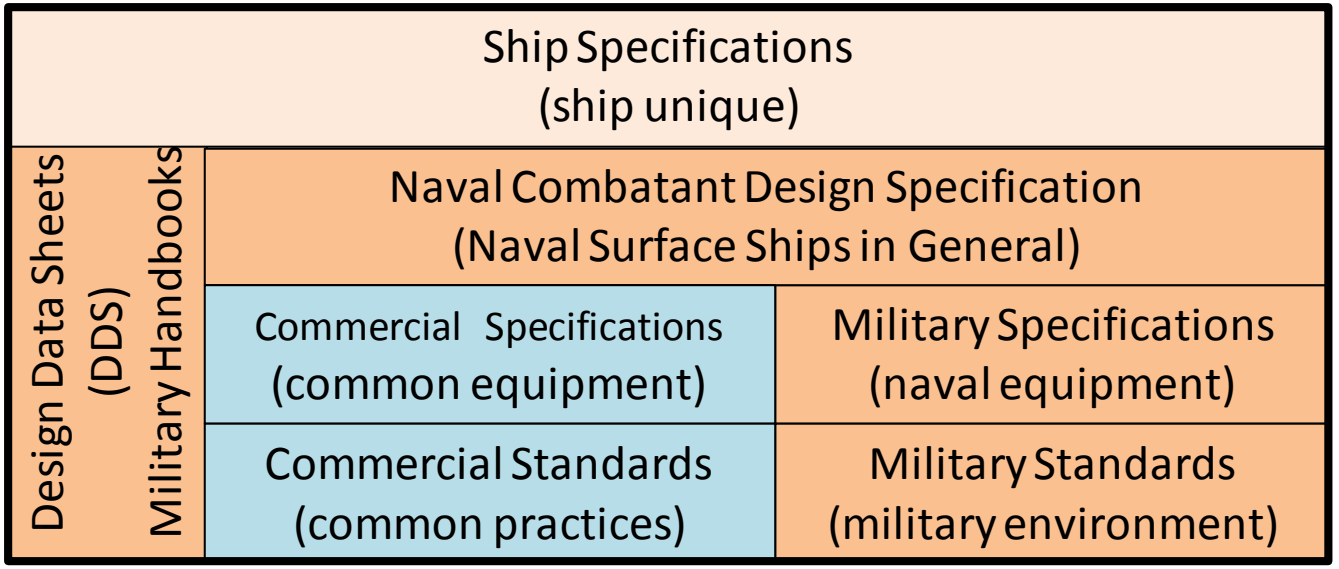
Dr. Norbert Doerry
Naval Sea Systems Command, U.S. Navy
Norbert.doerry@navy.mil
Khosrow Moniri
Naval Sea Systems Command, U.S. Navy
Khosrow.moniri@navy.mil

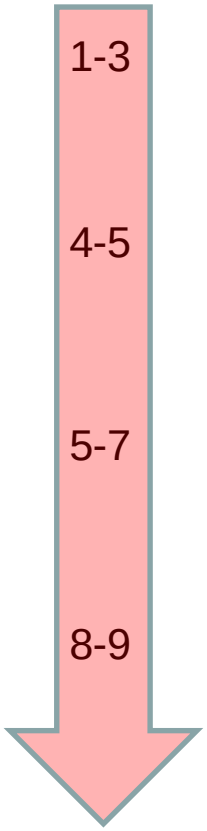
Institutionalizing Technology



Technical Documentation Relationships



Technical Maturation & Product Development



Basic and Applied Research	**Spec Concept**	**Design/ build/ test to understand technology**	**Small concept demo**
Advanced Technology Development	**Develop Draft Spec or Standard**	**Design/ build/ test to mitigate high risks**	**ADM**
Transition & Product Line Development	**Validate Draft Spec or Standard**	**Design/ build/ test to mitigate known risks**	**EDM Product Line**
Production	**Implement Spec or Standard (revise with lessons learned)**	**Tactical hardware Design/ build/ test**	**Deployed hardware**

Science & Technology

System Development

Product Development

Ongoing Specification Efforts

- MIL-DTL-XXXX Switchgear, Power, Medium Voltage, Naval Shipboard
- MIL-DTL-XXXX Circuit Breakers, VCB, Electric Power, Vacuum Medium Voltage, Draw-out Removable Construction, Without Internal Overcurrent Protection.
- MIL-PRF-XXX, Protective Relays and Attachments for Use with Medium Voltage Vacuum Circuit Breakers.
- MIL-DTL-917, (NAVY) Electric Power Equipment Basic Requirements is being modified to update referenced specifications and standards as well as incorporate changes to preserve military performance while enabling reductions in total ownership costs.
- MIL-STD-1399 section 300B amendment to include: high resistance grounding for 450 VAC Type 1 power,. L-G voltage requirements, and power interruption requirements associated with QOS and survivability.
- MIL-DTL-2212, Contactors and Controllers, Electric Motor AC or DC and Associated Switching Devices
- MIL-DTL-3124, Generator, Alternating Current, 60 Hertz (Naval Shipboard Use)
- MIL-DTL-16036, Switchgear, Power, Low Voltage, Naval Shipboard
- MIL-T-15108, update to include medium voltage transformers and 3 phase distribution transformers
- MIL-DTL-16377, Fixtures, Lighting, and Associated Parts, Shipboard use, General Specification for.
- MIL-DTL-17361, Circuit Breaker Types AQB,NQB, Air, Electric, Low Voltage, Insulated Housing (Shipboard Use), General Specification for.
- MIL-DTL-17587, Circuit Breakers, ACB, Low Voltage, Electric Power, Air, Removable Construction, General Specification for,
- MIL-DTL-17588, Breakers (Automatic -ALB-1) and Switch, Toggle (Circuit Breaker, Non-Automatic- NLB-1) Air, Insulated Housing, 125 Volts and Below A.C.
- MIL-DTL-24643, Cables, Electric, Low Smoke Halogen-Free, for shipboard Use, General Specification for.
- MIL-DTL-24765, Power Supply, Uninterruptible, Static (Naval Shipboard),
- MIL-PRF-32150 Static Automatic Bus Transfer Switch (SABT) on Surface and Submarine Naval Vessels
- MIL-PRF-32168 Variable Speed Drive System for Induction and Synchronous Machines. Incorporating affordability initiatives.
- MIL-PRF-32272 Integrated Power Node Center (IPNC): general update

Ongoing Standards Efforts

- MIL-STD-X628, Design Criteria Standard for the Architecture of Machinery Control Systems
- MIL-STD-2037, Procedure to Obtain Certification for Electric Motor Sealed Insulation Systems, being reviewed for cancelation.
- IEEE P45 Recommended Practices for Electrical Installations Shipboard
- IEEE P45.1 Recommended Practice for Electrical Installations on Shipboard - Design
- IEEE P45.3 Recommended Practice for Shipboard Electrical Installations - Systems Engineering
- IEEE P2030.4 Guide for Control and Automation Installations Applied to the Electric Power Infrastructure
- IEEE P1580.1 Recommended Practice for Marine Insulated Bus Pipe (IBP) for Use on Shipboard and Fixed or Floating Platforms
- OPNAVINST 9300.yy Electrical Power Quality Requirements Program within the Department of the Navy.
- NAVSEAINST 9304.1 Shipboard Electrical Cable and Cableway Inspection and Reporting Procedures.

Ongoing Handbook and Design Data Sheet efforts

- NSTM Chapter 300, Electric Plant – General: revision.
- NAVSEA T9300-AF-PRO-020 Design Practices and Criteria Manual for Electrical Systems is being updated to reflect new technologies. Manual will reference DDS or Handbooks and provide tailoring guidance for commercial and military specifications and standards.
- DDS 320-2 Electrical System Interface - Voltage and Current Harmonic Calculations

Candidates for future work

- **System Design and Engineering**
  - new MIL-STD-1399 section for MVDC needed.
  - new MIL-STD-1399 section for LVDC needed. DDG1000 and DDG51 specification efforts should be leveraged
  - New Standard (either military or commercial) for MVDC protection systems needed,
  - New Design Data Sheets for stability analysis and module criteria allocation for each architecture with large power conversion components.
  - MIL-STD-2003A(SH) Electric Plant Installation Standard Methods for Surface Ships and Submarines requires updating to address MVDC.

Candidates for future work (continued)

- **Power Generation**
  - MIL-R-2729D Military Specification: Regulator-Exciter Systems, Voltage, A.C. General, Naval Shipboard Use. General update to ensure applicability to MVAC and MVDC systems. Alternately create a new specification that heavily leverages commercial standards.
  - MIL-G-21296B Generator Set, Diesel Engine, Direct and Alternating Current (Naval Shipboard Use) Consider a general update including incorporation of electronic governors, and allowance for magnetic bearings. Cover requirements for MVAC. Alternately create a new specification that heavily leverages commercial standards.
  - MIL-G-22077C: Generator Sets, Gas Turbine, Direct and Alternating Current, Naval Shipboard Use. Consider an update to cover Gas Turbine Generator Sets above 3,500 kW. Cover requirements for twin spool gas turbines. Cover requirements for MVAC. Alternately create a new specification that heavily leverages commercial standards.
  - MIL-M-24350B Monitors, Reverse Power and Power-Sensing, Electrical Power (Naval Shipboard Use) Review for possible update for MVAC and MVDC. Alternately create a new specification that heavily leverages commercial standards.
  - New Specification (either commercial or military) for Fuel Cell power generation needed.
  - Modifications to existing specifications needed to support MVDC architectures
  - New Standard (either commercial or military) for MVDC voltage regulation and power sharing

Candidates for future work (continued)

- **Energy Storage**
  - New Performance Specification (either commercial or military) for Energy Storage
- **Power Distribution**
  - Update MIL-PRF-17773C Switches, Bus Transfer, Electric Power, Automatic and Manual to include functionality for a controllable bus transfer. Alternately create a new specification that heavily leverages commercial standards.
  - Update MIL-DTL-24643C Cables, Electric, Low Smoke Halogen-Free, for Shipboard use, General Specification for. Include Medium Voltage cables up to 20 kV and cables for propulsion motors with high harmonic currents.
  - New standard (either commercial or military) for MV shore power connections is needed.

Candidates for future work (continued)

- **Power Conversion**
  - Extend MIL-PRF-32272 Integrated Power Node Center (IPNC) to include medium voltage input and higher power levels. Leverage ongoing medium voltage power conversion equipment developments.
- **Propulsion Motors and Drives**
  - New specification (either commercial or military) for Propulsion Motor and Drives needed. Likely will invoke IEEE Std 1566-2005, IEEE Standards for Performance of Adjustable Speed AC Drives Rated 375 kW and Larger.
  - New specification (either commercial or military) for forward retractable propulsion units needed.
  - New specification (either commercial or military) for podded propulsion units needed.
- **Power Control**
  - New specification for Power Control Modules needed.
  - New section of MIL-STD-1399 for machinery control system interface to loads needed.
  - New Handbook for describing the architecture and integration method for Power Control needed.

Industry Role

- Participate in commercial specification and standard efforts
  - IEEE P45 series
  - IEEE P2030.4
- Participate in Government Industry Review (GIR) of military specifications and standards
- Suggest improvements to military specifications and standards

Conclusion

- Specifications and Standards are critical to the institutionalization of technologies for the electric warship
- The electric warship will employ both commercial and military specifications and standards
- There are many ongoing projects to update the technical architecture for the electric warship
- Much work still remains
- You can help