

NAVSEA 05Z3

Electrical Systems Technical Update

Presented at the National Shipbuilding Research Program
All Panel Meeting
Electrical Technologies Panel
Charleston, SC

27 February 2025

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Engineering Manager

Electrical Systems, Protection, Safety, Distribution, Lighting and Instrumentation – Ships

SEA 05Z33

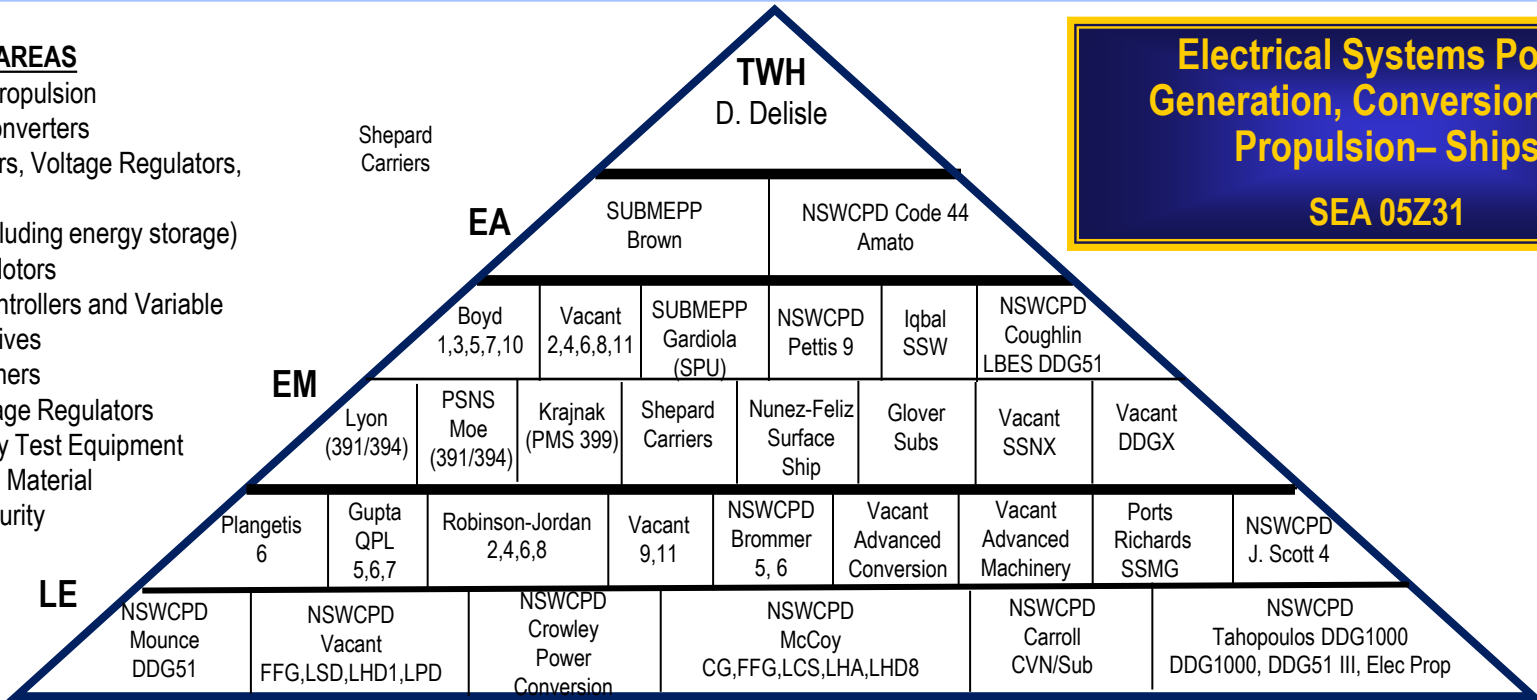
NAVAL SEA SYSTEMS COMMAND

NAVSEA 05Z Update to NSRP

- NAVSEA 05Z3 Technical Warranted Areas
- NAVSEA 05Z33 Organization and Technical Areas of Responsibility
- Summary of Standards and Specifications Projects
- NSRP Electrical Technologies Supported Projects

SPECIALTY AREAS

1. Electric Propulsion
2. Power Converters
3. Generators, Voltage Regulators, Exciters
4. UPS (excluding energy storage)
5. Electric Motors
6. Motor Controllers and Variable Speed Drives
7. Transformers
8. Line Voltage Regulators
9. Machinery Test Equipment
10. Insulating Material
11. Cybersecurity



**Electrical Systems Power,
Generation, Conversion, and
Propulsion-Ships**
SEA 05Z31

Collaborating TWHs:

- SDM CVN
- SDM LCS 1
- SDM DDG 1000
- SDM LCS 2
- SDM FFG(X)
- SDM DDG 51
- SDM Ship to Shore
- SDM LPD 17
- SDM LX(R)
- SDM LHD/LHA/LCC

- SDM In-Service Subs
- SDM Virginia Class
- SDM Columbia Class
- Machinery In-Service 05U7

CHENG

- Submarine Struct Closure, Hull Outfitting, Escape & Waterfront CHENG
- Shipyard CHENG
- SUPSHIP CHENG

Machinery TWH

- Batteries and Battery Monitoring Systems Control Systems TWH
- Materials - Non-metallic
- Metallic Materials, Welding and Fabrication Processes for Machinery
- Non-Ferrous Metallic Materials and Fasteners, Welding and Fabrication Processes for Structures
- Arrangements – Surface Ships
- Nondestructive Testing and Evaluation

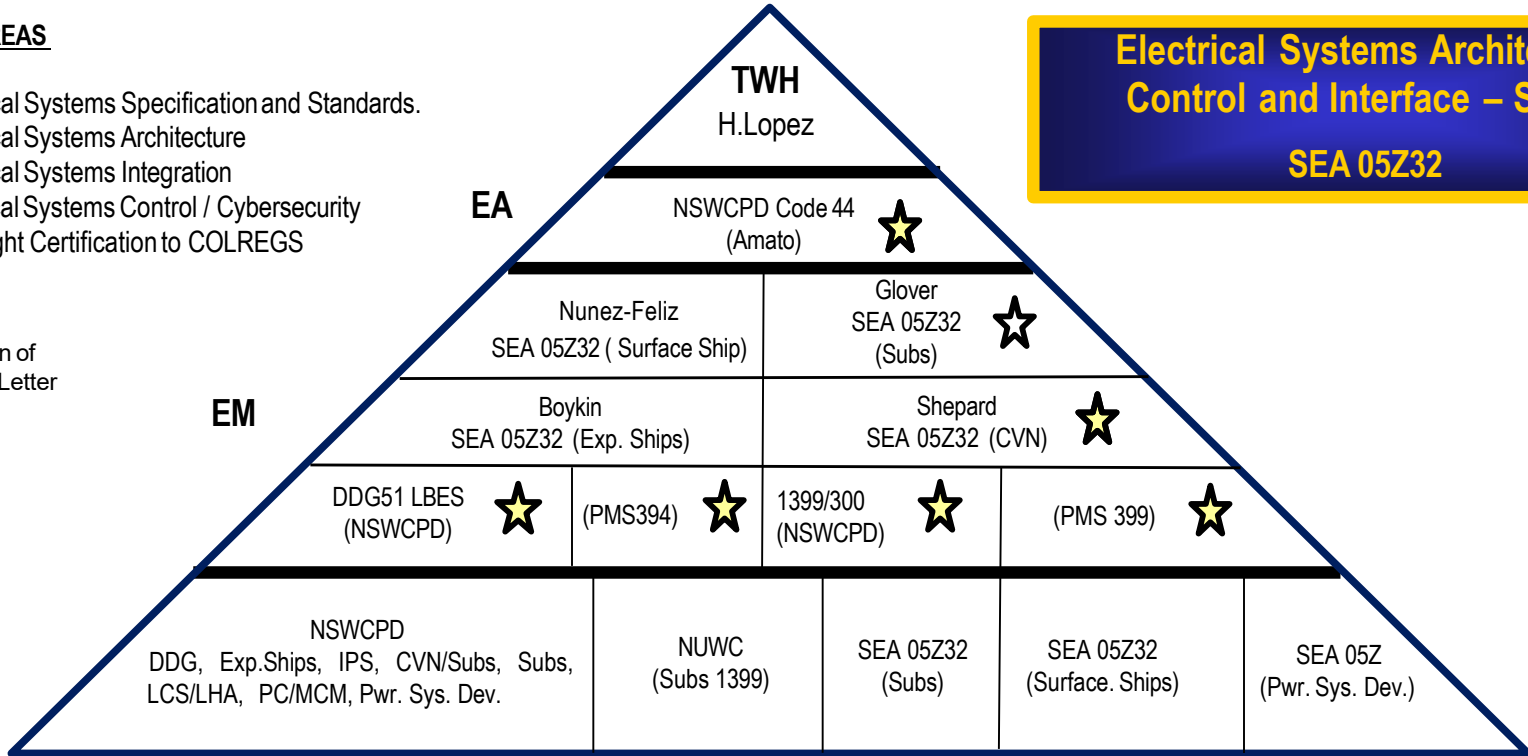
- Shock - Ships
- Signatures and Susceptibility (Underwater)
- Steam Turbines
- Gas Turbines
- Main Reduction Gear
- EMI / EMC – Ships and Submarines

SPECIALTY AREAS

1. Naval Electrical Systems Specification and Standards.
2. Naval Electrical Systems Architecture
3. Naval Electrical Systems Integration
4. Naval Electrical Systems Control / Cybersecurity
5. Navigation Light Certification to COLREGS

**Electrical Systems Architecture
Control and Interface – Ships
SEA 05Z32**

 Delegation of Authority Letter



- | | | |
|--|---|---|
| <p>Collaborating TWHs:</p> <ul style="list-style-type: none"> • SDM CVN 68/78 • SDM LCS 1/2 • SDM DDG 1000 • SDM FFG 62 • SDM DDG 51 • SDM Ship to Shore • SDM LPD 17 • SDM DDGX • SDM CG 47 | <p>Machinery TWH</p> <ul style="list-style-type: none"> • Batteries and Battery Monitoring Systems Control Systems • Arrangements – Surface Ships • Electrical System Power Generation, Conversion and Propulsion • Electrical System Protection, Safety, Distribution and Instrumentation • System Integration Manager - Future Power and Energy Storage Architectures | <ul style="list-style-type: none"> • Machinery Controls and Monitoring Systems • Signatures and Susceptibility (Underwater) • Steam Turbines • Diesel Engines • Gas Turbines • EMI / EMC – Ships and Submarines |
|--|---|---|

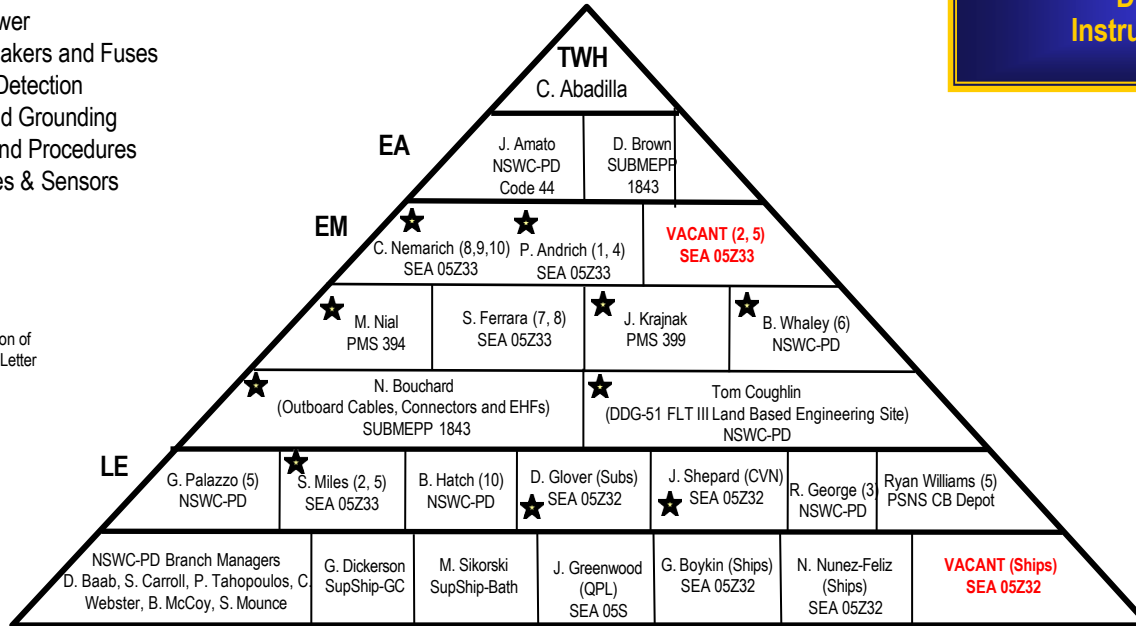
- CHENG**
- Submarine Struct Closure, Hull Outfitting, Escape & Waterfront CHENG
 - Shipyard CHENG
 - SUPSHIP CHENG
 - RMC CHENG

SPECIALTY AREAS

1. Power Distribution – Cables, Cableways & Connectors
2. Power Distribution– SWBDs, Load CTRs & Panels
3. Power Distribution– Automatic and Manual Bus Ties
4. Power Distribution– Shore Power
5. Circuit Protection – Circuit Breakers and Fuses
6. Circuit Protection – Arc Fault Detection
7. Electrical Safety – Bonding and Grounding
8. Electrical Safety – Practices and Procedures
9. Instrumentation – Meter, Gages & Sensors
10. Lighting Systems

**Electrical System
Protection, Safety,
Distribution and
Instrumentation – Ships
SEA 05Z33**

★ Delegation of Authority Letter



- | | | | |
|--|--|--|--|
| <p>Collaborating TWHs:</p> <ul style="list-style-type: none"> • TWH Elect. System Power Generation and Conversion • TWH Elect. System Arch. & Control • TWH Batteries & UPS • TWH Mach. Controls & Monitoring • SDM CVN 78 Class | <ul style="list-style-type: none"> • SDM CVN 68 Class • SDM LCS 1 and 2 Classes • SDM FFG • SDM DDG 51 & 1000 • SDM LPD • SDM Virginia Class • SDM Columbia Class | <ul style="list-style-type: none"> • TWH Controls & Monitoring Systems • TWH Shock - Ships • TWH EMI / EMC • TWH Metrology & Calibration • TWH Cybersecurity • TWH Material – Cathodic Protection • TWH Directed Energy Weapons | <ul style="list-style-type: none"> • TWH Shipboard Interior Communications • TWH Network Infrastructure • TWH Damage Control & Personal Protection • TWH Fire Protection Systems • TWH Coatings and Corrosion Control |
|--|--|--|--|

Naval Surface Warfare Center, Philadelphia Division (NSWCPD), Power Systems Division (Code 44) and SUBMEPP 1843 is the assigned Engineering Agent (EA) for SEA 05Z33 Warranted Technical

Area.

NSWC-PD Code 44 serves as:

- Acquisition Engineering Agent (AEA)
- In-Service Engineering Agent (ISEA)

SUBMEPP 1843 serves as:

- Acquisition Engineering Agent (AEA)
- In-Service Engineering Agent (ISEA)

Taking this...

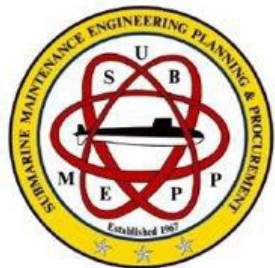


Philadelphia

and fitting it in here safely...



so this doesn't happen



Submarine EHP





Connectors

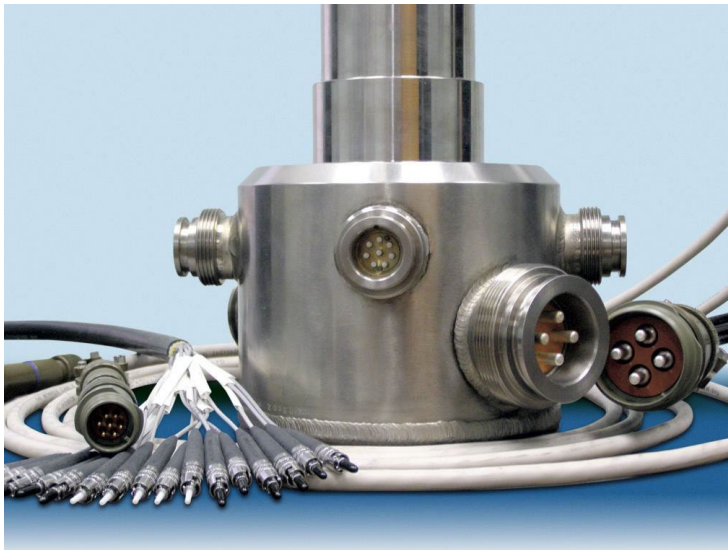


Cableways

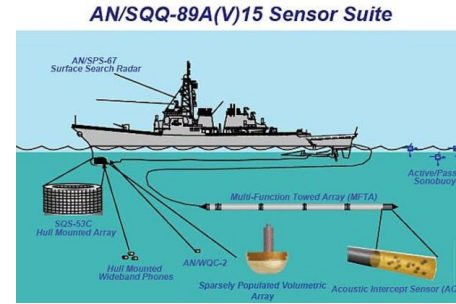


Watertight penetrations

Cables and connectors are used on every shipboard HM&E and mission system the US NAVY has. Cables, cableways, penetrators and connectors are intended to meet strenuous environmental tests minimizing the risk of fire spread, smoke generation, trans-compartmental flooding, high temp/humidity in addition to general electrical requirements.



**Submarine
Electrical Hull
Fittings**



Outboard cable application

PBOF: Pressure Balanced Oil Filled
Cabling, Connectors and Pressure Vessels

- Long Life: 2-3x PU Assemblies
- Repairable and Reconfigurable
- Crimped / Compression Fittings Available

AMETEK
SCP, INC.

Let Us Help You With Your PBOF Project!

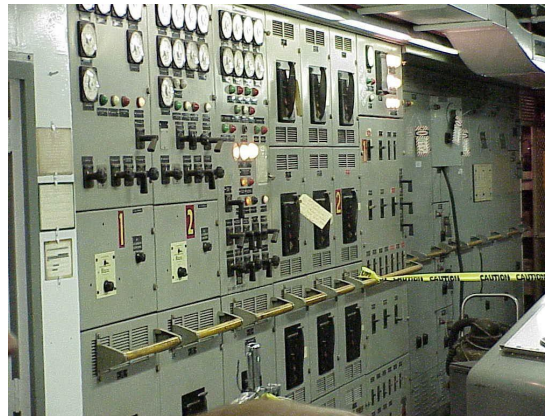


PCOF Cables

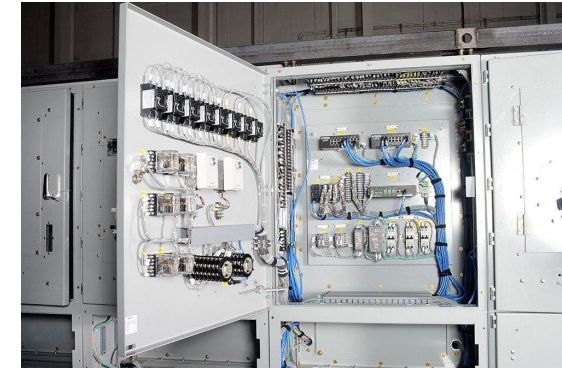
All SUBSAFE EHF components supporting HM&E and undersea warfare systems have a high degree of technical pedigree spanning ND drawing controls, levelized material and OQE unique to each part that requires variance, culminating in SUBSAFE qualification. Outboard cables require significant design features to maintain performance under subsea and highly pressurized environments.



**Main Distribution
Switchboard**



**Main Distribution
Switchboard**



**Switchboard Control
Section**

Switchboards, load centers and power panels are means of distributing available power generation throughout a ship.



Mechanical ABT



Static ABT

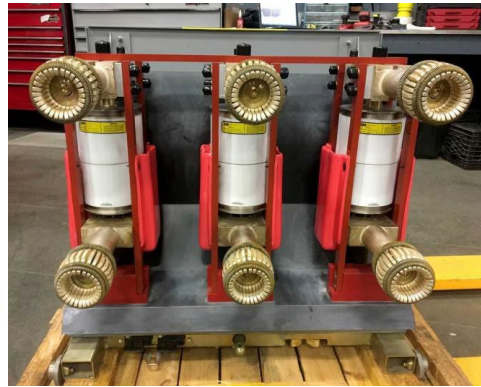


MBT

Bus transfer devices provide means of sourcing vital power to critical ship and mission systems in case of loss of bus. Depending on the technology applied, the speed of transfer is the key performance difference.



Vacuum Circuit Breaker



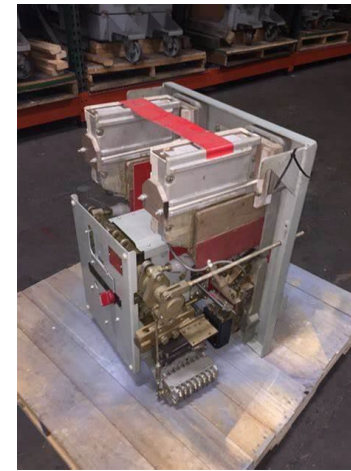
Air Circuit Breaker



Fuses



Molded Case Circuit Breaker

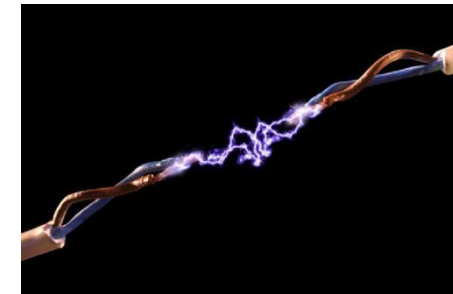
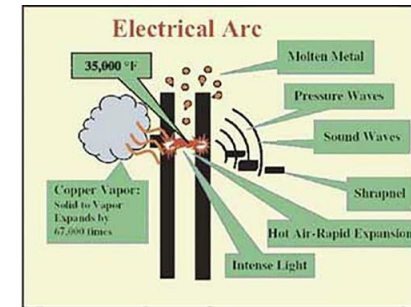


Devices that protect cables, buss bar and similar interconnects from catching fire/exploding when there is a circuit failure/fault. Different interrupting methods are utilized to balance component sizing to performance relative to fault energy levels. High endurance cycles and thermal capacity due to unique NAVY operations.

Arc Fault Protection Systems



DRS manufactured ADACS



Arcing Event

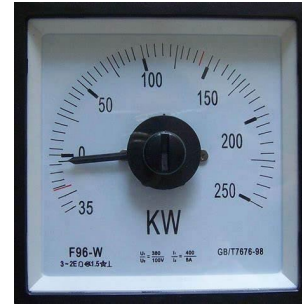
Systems designed to protect against high resistance faults outside the capability of circuit breakers and fuses. Rather than current measurement as the primary means of detection; UV light, pressure and particulate detectors are utilized to validate an arcing fault.



Pulse Radar TLI



Ultrasonic flowmeters



Electrical Meters



Salinity Cell



Pressure Transducer



Thermal Imaging

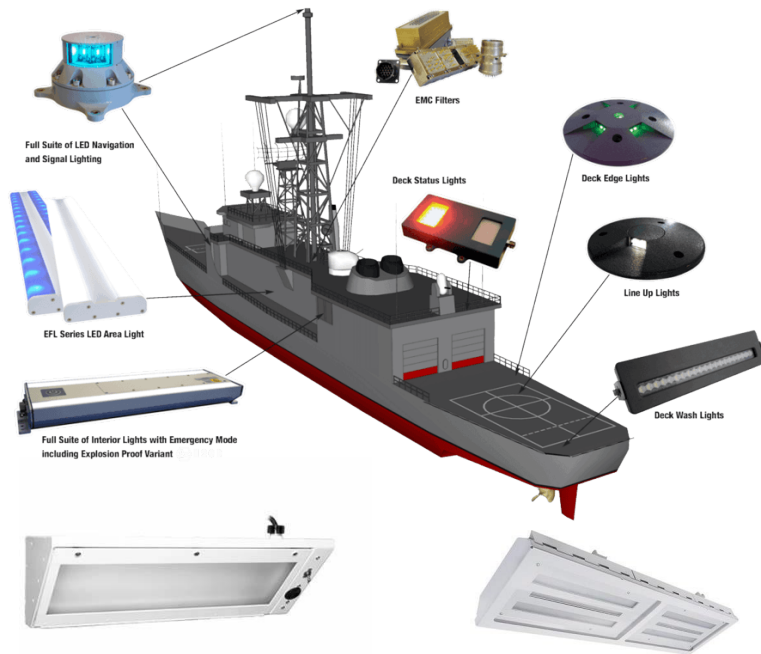


Pressure Switch



Thermocouple

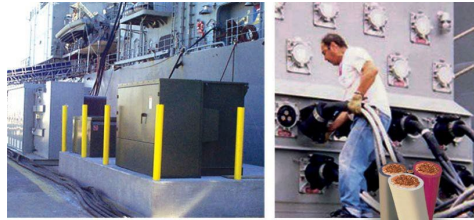
Detection and measuring devices used in nearly every application.



Every system needs lights!



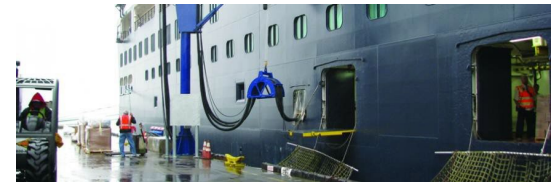
Medium Voltage Shore Power Connector



Shore Power Example

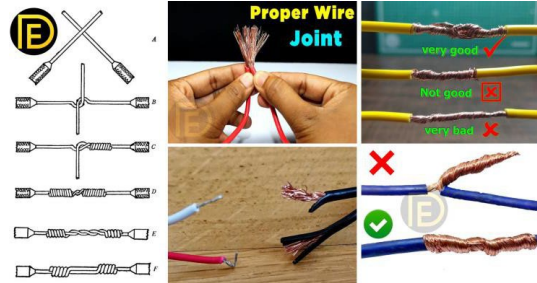
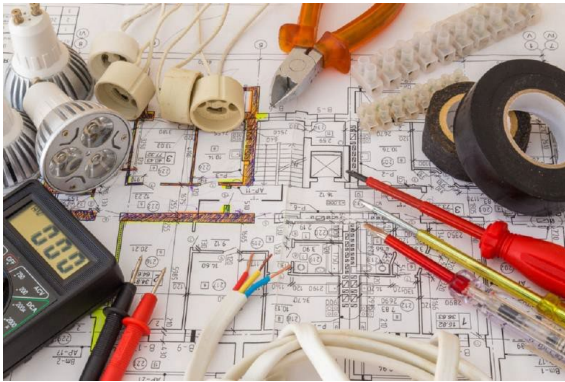


Submarine Shore Power Connector



Shore Power Commercial Example

Components that interface with pier-side US and allied infrastructure. Primary technical liaison between NAVSEA and NAVFAC.



MIL-STD-2003 provides detailed guidance, through all lessons learned from industry and NAVY experience, on how to perform electrical installations/repairs on NAVY ships.

Inconsistent purchasing models due to NAVY budget constraints over the last 30+ years have led to supplier challenges.

- Electrical cabling supplier capability is imbalanced and manufacturers are backlogged
- Circuit breaker supply chain is diminished to 2 OEMs with imbalanced revenue generation
- Analog metering suppliers down to single sources
- SABB OEM lead times and costs skyrocketing due to imbalanced supplier capability

Current Status:

- Advocated and continuing to advocate CAP-EX and better buying for suppliers through defense industrial base funding initiated by 2020 CARES Act
- Updated over 200 of ~750 Z33 owned specifications and manuals since 2020
- Actively revising specifications that inhibit/discourage supplier growth and sustainment
- Partnering with PEOs to advocate for supplier investments

MIL-STD-108 Standard for Electrical Enclosures Update

Definitions Basic Requirements Enclosures for Electric and Electronic Equipment

- Last updated in 1985 but no significant changes since 1966
- ✓ Updated all references e.g. IEC 60947-1
- ✓ Aligned with MIL-DTL-2036
- ✓ Added reference to Composite Enclosures Drawing
- ✓ Included a cross-reference table for enclosure rating definitions comparison to IP and NEMA
- ✓ Final SRB adjudicated.
Publication is expected in 2025.

MIL-DTL-15103 Salinity Indicating Equipment

- ✓ Updated all references
- ✓ Updated all Test Methods and Procedures (extensive)
SRB Comments being adjudicated
Publication expected 2025

Stainless Steel Cells and Valve Assembly qualified and listed on QPL-15103
Brass Cells and Bronze Valve Assembly completed Qualification testing
QPL-15103 listing pending approval

MIL-DTL-24640 Cables Lightweight Low Smoke
Review in progress

MIL-HDBK-299 Electrical Cable Comparison Handbook – October 1991
Cable Data Pertaining to Electric Shipboard Cable

- Complete.
- NAVSEA 08 final review
- **Publication expected 2025**

NSTM 300 (S9086-KC-STM-010-300) Naval Ship's Technical Manual Chapter 300 Electric Plan, General

NSTM 320 (S9086-KY-STM-010/320 Rev 8) Electric Power Distribution Systems

MIL-STD-1399-300-3 Low Voltage DC Interface (SEA 05Z32 spec)

- **Publication Expected Mid - 2025**

MIL-I-3064 Insulation, Electrical, Plastic Sealer

- ✓ Extensive update of Qualification Test Requirements completed
- ✓ Incorporated tailored requirements from MIL-STD-3020 FIRE RESISTANCE OF US NAVAL SURFACE SHIPS
- ✓ SRB Comments received and in process of review and adjudication
- Publication expected mid 2025

MIL-DTL-24705 B (and 3 Slant Sheets -1, 3, 4) Penetrators, Multiple Cable, for Electric Cables, General Specification

- Update of Qualification Test Requirements in progress
- Incorporating tailored requirements from MIL-STD-3020 FIRE RESISTANCE OF US NAVAL SURFACE SHIPS
- Publication expected 2025

MIL-DTL-19166 Insulation Tape, Electrical, High-Temperature, Glass Fiber, Pressure-Sensitive

- Update of Qualification Flammability Test Requirements in progress

MIL-I-24391 Insulation tape, electrical, plastic pressure sensitive

- Update of Qualification Flammability Test Requirements in progress

MIL-I-3505 Insulation Sheet and Tape, Electrical, Coil and Slot, High Temperature

- Update of Qualification Flammability Test Requirements in progress

S9320-AM-PRO-020/MLDG, Rev 3

Underwater Cable Assembly and Encapsulated Components, Fabrication, Repair, and Installation Manual, Volume II: Molding and Inspection Procedures

NAVSEAINST 9304.1E

Shipboard Cable and Cableway Inspection and Reporting Procedures

MIL-DTL-917 (NEW)

Detail Specification Electric Power Equipment, Basic Requirements For

- Review of References in progress

MIL-PRF-17773 Switch, Bus Transfer, Electric Power, Automatic

UL 2831, Rev. 1

US Naval COTS 3-Pole, Rated V_{max} 4.76, 8.25, & 15kV, AC, VCBs, Drawout Type, Without Internal OC Protection, & Accessories/Components for Use on Non-Nuclear Naval Combatant Ships

MIL-DTL-XX663 - Switchgear, Power, Shock-Mounted, Low Voltage, Naval Shipboard

MIL-DTL-17361H - Circuit Breaker Types AQB/NQB, Air, Electric, Low Voltage, Insulated Housing (Shipboard Use), General Specification for

MIL-DTL-32772 PUBLISHED 31 July 2024

SWITCHGEAR, POWER, SHOCK-MOUNTED, LOW VOLTAGE, NAVAL SHIPBOARD

MIL-DTL-17587D and /3A, 5A, and 6A –

Circuit Breakers, ACB, Low Voltage, Electric Power, Air, Removable Construction, General Specification for

MIL-DTL-17588F –

Breakers (Automatic - ALB-1) and Switch, Toggle (Circuit Breaker, Non-Automatic - NLB-1) Air, Insulated Housing, 125 Volts and Below AC and DC (Naval Shipboard Use)

MIL-DTL-32485 Amendment *NEW*

MIL-DTL-32485/1 - MSVCB-4.76KV-1200 MSVCB-4.76KV-1600

MIL-DTL-16036N –

Part 1 (Amendment); Part 2 (Revision) Switchgear, Power, LV, Naval Shipboard

SEA 05Z31 Specifications

MIL-R-2729 Regulator-Exciter Systems, Voltage, A.C. General

- SEA 08 Review

MIL-DTL-17059 Motor, 60 Cycle, Alternating Current, Fractional H.P.

- Update in Progress

MIL-DTL- 17060 Motors, Alternating Current, Integral-Horsepower

- Update in Progress

MIL-PRF-XXX733 Multi-layer, Multi-Conductor Laminated Electrical Bus, AC / DC

- SEA 08 Review

MIL-DTL-3124 Generator, Alternating Current, 60-Hertz

- Expected to start March 2025

SEA 05Z31 Specifications (continued)

MIL-DTL-15108 Transformers, Power Step Down, Single Phase, 60 Hz, 1 KVA, Dry Type

MIL-R-23098 Regulator, Line Voltage, Single Phase, 400 Hz AC

MIL-I-24092 Insulating Varnishes & Solventless Resins For Application By Dip Process

11 Slant Sheets

- CANCELLATION

MIL-T-17221 Transformers, Power, Distribution, Single Phase, 400 HZ, 220 Deg. C, Dry (Air Cool)

New Start

MIL-I-24718 & Slant Sheets - Insulating Resins, Solventless, Vacuum-pressure-impregnating

New Start

Instrumentation

- **MIL-DTL-16034 - and /1-18** Meters, Electrical Indicating (Switchboard and Portable Types)
Recommend cancelling portable meter slant sheets and 6" Switchboard Meters
- **MIL-V-23151** - Voltmeter, Expanded Scale Switchboard Type
Status Pending
- **MIL-M-19261** - Meter, Power Factor 4-1/2 Inch, Switchboard Type
Recommend combining with MIL-DTL-16034
- **MIL-W-19088** - Wattmeter, Switchboard Type, 4-1/2 INCH
Recommend combining with MIL-DTL-16034
- **MIL-S-16104** - Synchroscope
Recommend updating existing spec
- **MIL-M-23167** - Frequency Meter, Expanded Scale Switchboard Type
Recommend combining with MIL-DTL-16034
- **MIL-M-16125** - Frequency Meters, Electrical (Portable)
May be cancelled
- **MIL-I-16103** - Phase Sequence, Indicator, Switchboard and Panel
Status Pending



Lighting

- **16377/60B** Incandescent Floodlights 150W Sym 316 & 317 **25-Jan-2022**
Develop detailed requirements for dimmable SSL floodlights compatible with existing shipboard lighting distribution architecture. Address topside night time operation minimum illumination requirements.
 - **16377/61A** Incandesced & SSLFloodlights 300W Sym 303.2 303.3 303.4 303.2SSL 303.3SSL 303.4SSL **02-Nov-2021** – Action needed to add electrical ground check test for Type III (SSL) fixture.
 - **16377/86B** Lamp SSL for use as Replacement for Commercial Fluorescent Lamp **Published 02-Nov-2021** – Action needed to address electrical safety tests needed for LED replacement tubes.

DOD-HDBK-289 (will become MIL-STD-x743)

New

- **MIL-L-24282 SYM 106.1** Light Signal Multi-Purpose
- **MIL-P-24174 (will become MIL-DTL-24174) and /2 and /5**
Control, Navigation Lights, General Specification for
- **MIL-P-24175 (will become MIL-DTL-24175) 5 slant sheets**
Panels Power Supply and Control for Navigation Lighting

- **DOD-HDK-289 Shipboard Lighting**
- **Distributed Temperature Sensor for Electrical Switchboards *NEW RA Project***
- **MIL-DTL-24643/ 87 15KV cable**
- **Shore Power Cable Conector Test Set**

MFPT ANNUAL CONFERENCE

*Diagnostics, Prognostics, and Failure Prevention
Where Theory Meets Practice*

Network, exchange knowledge, and collaborate with professionals interested in machinery failure prevention technology.

Join us for MFPT 2025
Sheraton Oceanfront Hotel. Virginia Beach, Virginia
Tuesday, May 20, and Wednesday May 21, 2025

FAILURE PREVENTION TECHNOLOGY
Data Management and Artificial Intelligence
Diagnostics and Prognostics
Human Performance Monitoring
Failure Analysis
Sensors Technology
Signal Analysis
Lubrication Sensing and Analysis
Systems Engineering

MFPT 2025 Conference Website (registration and hotel)

<https://asnt.eventsair.com/mfpt-2025-annual-meeting25>