SHIPBOARD ELECTRICAL SAFETY REQUIREMENTS

2012
Background

- There have been many recent incidents onboard our ships related to Electrical Safety
  - Voltage still present in a tagged out system
  - Tagged out circuit breakers in the “on” position
  - Live dead-ended cables
  - Live cables (thought de-energized) being cut
  - Personnel receiving an electrical shock
  - Induced Voltage from wind milling equipment
Electrical Shock

- Nationwide - 30,000 work-related non-fatal shocks/year
- Nationwide - 1,000 deaths/year
- Navy – 2 deaths (sailors) in two years (2009 & 2010)
- > 30 volts can KILL
- Body resistance can be as low as 300 ohms
- 1 mAmp - shock felt
- 10 mAmp - may cause muscle contraction – person can’t let go
- 100 mAmp - may cause ventricular fibrillation - and death if longer than 1 second
Think Safety

- Safety is everyone’s job!!!

- The information contained in this presentation is not new, it is just a refresher to remind everyone of the need for safety.

- In an industrial environment, there are numerous entities working on our ships. This increases everyone’s responsibility to monitor their surroundings.

- Electrical Safety requirements do not change in an Availability so do not “Give up the Ship”
• An understanding of both the Navy and Shipyard requirements is required to properly oversee Electrical Safety in a shipyard environment

• Naval Ships Technical Manual (NSTM) Chapter 300, Electric Plant General
  – Contains electrical safety requirements for the U.S. Navy

• Occupational Safety and Health Administration (OSHA 2268-03R)
  – Contains all the safety and health standards for the Shipyard Industry
• What is Work?

• The JFMM definition of work is on the following slide
• The Joint Fleet Maintenance Manual (JFMM) Volume 1, Chapter 1, Appendix D, defines work as follows:

Work:

a. Any action that actually or potentially changes (including disassembly for the purposes of inspection or repair) the approved configuration of any part, component or ship’s system.

b. Any action that removes or affects the ship’s ability to operate ship’s systems or components in accordance with ship’s systems/operating manuals or reactor plant manuals.

c. Any testing or inspections required to establish, maintain or reestablish certification.

d. Any design, engineering, planning or configuration management functions that involve the final review and/or approval of technical information.

Examples of work include the following:

1. Action which disassembles or removes any part, component or ship’s system.


3. Any action that removes or affects the ship’s ability to operate ship’s systems or components in accordance with ship’s systems manuals, operating manuals or reactor plant manuals, excluding tagout in accordance with the Tagout Users Manual, including but not limited to:

   (a) Component or system tests.

   (b) Intrusive inspections (such as breaking the plane of electrical panels requiring electrical safety).

   (c) Valve line ups that alter the normal system line up not governed by operating procedures.

   (d) Removing valve hand wheels, disconnecting of reach rods.
What are some examples of Electrical Equipment (work) Maintenance?

Examples from NSTM Chapter 300 are on the following slide
Examples of Electrical (work) Maintenance include:

- Testing
- Calibrating
- Taking measurements
- Troubleshooting
- Repairing
- Assembling/Disassembling equipment or associated sub-components
- Installation/Removal of equipment or associated sub-components
- Making adjustments to electrical equipment
- Cleaning and inspection of electrical equipment
• When can you work on Energized Equipment?

• Answers from NSTM Chapter 300 on the following slide
• Only work on Energized Equipment (aka: Conducting Electrical Maintenance) when:

  – Only if all means of working on electrical equipment while de-energized is exhausted should you work while equipment is energized. Then you MUST take additional precautions for work on energized gear:
    • Review requirements for work on Energized Equipment
    • Use proper PPE
    • Be trained in conducting Electrical Maintenance
    • Obtain the proper authorization
• Electrical equipment should always be considered energized until proven de-energized

• When conducting voltage verification:
  – Ensure test gear is properly rated and in good working order
  – Use all required personal protective equipment (PPE)
  – Consider the possibility of alternate sources of power
  – Stray voltage may be present (Voltage present after isolation)
    • Capacitive Coupling – energized and de-energized wiring in close proximity, capacitive effect may cause voltage in de-energized wire
    • Inductive Means – energized and de-energized wiring in close proximity, transformer action may cause voltage in de-energized wire or wind milling motor may cause voltage in de-energized wire

• Retest equipment often to ensure electrical isolation especially after long period of no work, changed work boundaries, and change in scope of job
• Do not allow for the removal and installation of fuses to seem like common practice.
• The removal and installation of fuses is an inherently dangerous event.
• When removing or installing fuses:
  – Always use proper PPE
  – Always conduct voltage verification requirements
  – Should normally be removed and installed while de-energized
  – When fuse is removed the fuse holder and clips may be energized
  – If a replacement fuse opens (blows) investigate the cause prior to replacing again
  – Don’t re-energize panel after fuse installation until covers are installed
• General considerations when removing circuit breakers
  – Use proper PPE and conduct voltage verification
  – Enclosure should be de-energized
  – Control circuit shall be de-energized
  – Motor operators shall be removed
  – If can’t de-energize enclosure, treat as work on energized gear
  – If energized set up electrical safety boundary
  – Ensure breaker is in open position with springs discharged prior to racking out
  – Be fully racked-out prior to work on C/B
  – Once racked-out put rubber mat between C/B and enclosure to minimize access
  – Presents both electrical and mechanical hazards
• What are the requirements for conducting a Visual Inspection on Energized Gear?

• Answers from NSTM Chapter 300 on the following slide
• Visual Inspection of Energized Gear
  – Remove metal and loose clothing and use required PPE
  – Maintain a minimum two foot safety boundary, may be a person
  – No uninsulated tools inside the 2 foot electrical safety boundary
  – Must inform the watchstanding supervisor/officer in all cases
  – No contact with energized circuits is permitted during visual inspections
  – Do not cross the electrical plane
    • Imaginary boundary across the front of the enclosure (Extends on an arc even with the swing of the door if energized components are mounted on the door)
  – Not allowed $\geq 1000$ volts unless approved by NAVSEA
  – Commanding Officer’s permission required unless:
    • Part of routine PMS, Inspection or tag-out verification
  – Thermal camera may go inside the boundary
Availability Concerns

- The large amount of ongoing work by different entities onboard ship during an availability increases the odds of electrical safety infractions.

- Personnel not accustomed to work in an industrial environment may not be familiar with the type of electrical safety infractions during an availability.

- The large amount of tags hung and cleared during an availability increases the possibility of an incorrect tagout.
**Specific Concerns**

- Improper tagouts could cause equipment to not be fully de-energized
  - Tags hung on the wrong breaker/fuse panel
  - Incorrectly labeled tags or equipment
  - Improperly performed tagout audits
- Dead-ended cables may not always be treated as energized
  - If not properly tested, could lead to electrical shock
- Unauthorized electrical gear onboard ship
  - Many types of gear are not suitable for shipboard use and could be an electrical shock hazard
  - Unauthorized equipment could cause grounds in the ships electrical distribution system
Specific Concerns

• Dirt in debris in electrical enclosures
  – Dirt and debris in electrical enclosure could become a fire hazard

• Damaged or Wetted equipment
  – Electric/electronic equipment can be a shock hazard due to becoming damaged, dirty, or wetted in an industrial environment

• Damaged electrical cables/cords
  – Cables/cords are often damaged in an industrial environment causing an electrical shock hazard
Maintaining Standards

- Electrical Safety is everyone's responsibility

- Anyone discovering a problem/discrepancy should promptly notify the required personnel

- Conducting a safety walk-through is only the first step, problems discovered must be reported, documented, corrected, training held if needed, and follow up to ensure the same problem does not reappear
Questions?