ELECTRICAL AND I&C CODES AND INSPECTION

Day 6

DAY 6

Sessions:

12 Installation Standards

13 Inspection and Testing Standards

14 Operation, Maintenance and Surveillance Standards

Student Activity: Electrical Component vs. IEEE Standards Matrix

Session 12

Installation Standards

12. Installation Standards Objectives

- Identify the major installation standards
- Provide a general overview of the purpose of these standards
- Discuss how these standards relate to new reactor inspection

12. Installation Standards

- 336 - Power, instrumentation, control equipment
- 384 - Independence
- 484 - Battery installation

12. Installation Standards

- 576 - Installation, termination, and testing of Cables
- 628 - Raceways
- 665 - Grounding power systems
- 690 - Cable systems

12. Installation Standards

- 1050 - Grounding I&C systems
- 1185 - Cable installation methods
- 1210 - Cable lubrication

336 - Power, Instrumentation, Control Equipment

- Covers pre-installation, installation, inspection, and testing
- Applicable to initial construction, modification, and maintenance activities
- Does not apply to periodic testing

336 - Power, Instrumentation, Control Equipment

4. General considerations for initial construction, modification, and maintenance

5. Pre-installation constructability review

6. Installation/Construction

7. Testing

336 - Power and I&C Equipment
Clause 5. Constructability Review

- Approved-for-construction drawings
- Installation specifications and procedures
- Identification of materials and equipment
- Protective measures for storage and handling
- Examination of materials and equipment for damage
- Qualification reports and documents reviewed and approved

336 - Power and I&C Equipment
Clause 6. Installation/Construction

6.1 Equipment placement

6.2 Engineering procedures and specifications

6.3 Verification during installation

6.4 Post-installation inspections

6.5 Inspections of temporary conditions

384 - Independence

- The independence requirements of the circuits and equipment associated with Class 1E systems

- Criteria for independence that can be achieved by physical separation and electrical isolation of circuits and equipment

384 - Independence

4. General independence criteria
5. Specific separation criteria
6. Specific electrical isolation criteria

384 – Independence
Clause 4. General Independence Criteria

4.1 Required independence

4.2 Methods of achieving independence

4.3 Equipment and circuits requiring independence

4.4 Compatibility with supporting features

4.5 Associated circuits

4.6 Non-class 1E circuits -General criteria

384 – Independence
Clause 4. General Independence Criteria

4.7 Mechanical systems

4.8 Structures and equipment

4.9 Fire protection systems

4.10 Fire

4.11 Electromagnetic interference/radio frequency interference (EMI/RFI)

384 – Independence
Clause 5. Specific Separation Criteria

5.1 Cables and raceways

5.2 Standby power supply

5.3 DC system

5.4 Distribution system

5.5 Containment electrical penetrations

384 – Independence
Clause 5. Specific Separation Criteria

5.6 Control switchboards

5.7 Instrumentation cabinets

5.8 Sensors

5.9 Actuated equipment

5.10 EMI/RFI

384 – Independence
Clause 6. Specific Electrical Isolation Criteria

6.1 Power circuits

6.2 Instrumentation and control circuits

484 - Battery Installation

- This standard provides recommended design practices and procedures for storage, location, mounting, ventilation, instrumentation, pre-assembly, assembly, and charging of vented lead-acid batteries.

- Required safety practices are also included.

484 - Battery Installation

4. Safety
5. Installation Design Criteria
6. Installation Procedures
7. Records

484 - Battery Installation
Clause 4. Safety

4.1 Protective equipment

4.2 Precautions

484 - Battery Installation
Clause 5. Installation Design

5.1 Location

5.2 Mounting

5.3 Seismic

5.4 Ventilation

5.5 Instrumentation and alarms

484 - Battery Installation
Clause 6. Installation Procedures

6.1 Receiving and storage

6.2 Assembly

6.3 Freshening charge, data collection, and testing

6.4 Connection to dc system

484 - Battery Installation
Clause 7. Records

- Receiving inspection data and conditions of charge
- Initial resistance values of the intercell connections
- Individual cell specific gravities, voltage measurements, electrolyte levels and temperatures
- Acceptance test data
- Cell serial number, manufacture date, and lot number

576 - Installation, Termination, and Testing of Cables

- Provides a guide for installing, splicing, terminating, and field proof testing of cable systems
- It is not intended to be a design document.
- One of the most valuable installation standards

576 - Installation, Termination and Testing of Cables

4. Pulling Tensions

5. Sidewall Pressure

6. Jamming

576 - Installation, Termination and Testing of Cables

7. Recommended Bending Radii for Cables

8. Minimum Installation Temperature

12. Pulling Lubricants

576 - Installation, Termination and Testing of Cables

9. Direct Burial

10. Cable Tray Installation

11. Aerial Cable Installation

576 - Installation, Termination and Testing of Cables

13. Splicing
14. Terminating
15. Electrical Connections
16. Field Acceptance Testing

576 – Installation of Cables

Clause 4. Pulling Tensions

4.1 Maximum pulling tension on cable
4.2 Maximum pulling lengths
4.3 Small conductor cables
4.4 Pulling tension requirements in duct and conduit
4.5 Check list prior to pulling cable
4.6 Methods of gripping cables for pulling

576 – Installation of Cables
Clause 5. Sidewall Pressure

5.1 Sidewall pressure limitations

5.2 Weight correction factor calculations

576 – Installation of Cables
Clause 6. Jamming

6.1 Computation of ratio

6.2 Jam ratio

576 – Installation of Cables
Clause 7. Minimum Bending Radius

7.1 Cables without metallic shielding or armor

7.2 Cables with metallic armor

7.3 Shielded cables

7.4 Portable cables

576 – Installation of Cables
Clause 8. Installation Temperature

Table 7, Minimum Installation Temperatures

8.1 After installation

8.2 Storage prior to installation

576 – Installation of Cables
Clause 8. Table 7

Cable Insulation or Jacket Material	Minimum Insulation Temperature
PVC	-10 °C/14 °F
PPVP, CSPE, CPE	-20 °C/-4 °F
XLPE, PE, EPR	-40 °C/-40 °F

576 – Installation of Cables
Clause 12. Pulling Lubricants

- Compatibility with the cable jacket material
- Extreme conditions of temperature
- Impact on the flame resistance of the cable

576 – Installation of Cables
Clauses 9, 10, and 11

9. Direct Burial

10. Cable Tray Installation

11. Aerial Cable Installation

576 - Termination of Cables
Clause 13. Splicing

13.1 Solid dielectric insulated cable

13.2 Lead sheathed cable

576 - Termination of Cables
Clause 14. Terminating

14.1 Cable preparation

14.2 Installation of terminations

576 - Testing of Cables
Clause 15. Electrical Connections

15.1 Connector types

15.2 Contact resistance

15.3 Clamp connectors

15.4 Cable connection to bus bar

576 - Testing of Cables
Clause 15. Electrical Connections

15.5 Thermal expansion

15.6 Joint compounds for aluminum connections

15.7 Connectors for aluminum

15.8 Connection procedures

576 - Testing of Cables
Clause 16. Field Acceptance Testing

16.1 Advantages of high voltage dc acceptance testing

16.2 Installation acceptance test voltages

16.3 Interpretation of test results

576 - Testing of Cables
Clause 16. Field Testing

- IEEE Std 400 Overview
  - 400.1 Direct current (DC)
  - 400.2 Very low frequency (VLF)
  - 400.3 Partial discharge (PD)
  - 400.4 Dissipation factor (DF)
  - 400.5 Power frequency (PF)
  - 400.6 Oscillating wave (OW)

628 - Class 1E Raceways

- Provides criteria for the minimum requirements in the design, installation, and qualification of raceway systems
- Prescribes methods for the structural qualification of raceway systems

628 - Class 1E Raceways

4. Design
5. Qualification Methods
6. Installation
7. Documentation

628 - Class 1E Raceways
Clause 4. Design

4.1 General

4.2 Separation criteria

4.3 Grounding

4.4 Raceway identification

4.5 Raceway system protection

628 - Class 1E Raceways
Clause 4. Design

4.6 Environmental considerations

4.7 Materials

4.8 Metallic raceway system finishes

4.9 Raceway system requirements

4.10 Structural design criteria

628 - Class 1E Raceways
Clause 5. Qualification Methods

5.1 Analysis

5.2 Dynamic testing

5.3 Combined analysis and testing

5.4 Seismic-experience-based qualification

5.5 Acceptance criteria

628 - Class 1E Raceways
Clause 6. Installation

6.1 Packaging, shipping, receiving, storage, and handling

6.2 Installation of raceway systems

628 - Class 1E Raceways
Clause 7. Documentation

7.1 Design activities

7.2 Raceway system components

7.3 Construction activities

7.4 Document collection, storage, and maintenance

665 - Grounding Power Systems

- Generally accepted utility grounding practices for personnel safety and equipment protection
- Guide for the design of generating station grounding structures, systems, and components
- Interconnection of the station and substation grounding systems

665 - Grounding Power Systems

4. Design Objectives

5. Detailed Design Considerations

665 - Grounding Power Systems
Clause 4. Design Objectives

4.1 Neutral ground, equipment ground, and safety ground

4.2 Station grounding system

4.3 Preventing the transfer of high ground voltages

4.4 Design objectives

665 - Grounding Power Systems
Clause 5. Detailed Design

5.1 Grounding principles

5.2 Ground grid design

5.3 Generator and isolated phase bus grounding

5.4 Grounding of buildings, fences, and structures

665 - Grounding Power Systems
Clause 5. Detailed Design

5.5 Grounding of station auxiliaries

5.6 Lightning protection for structures

5.7 Grounding of buried structures

5.8 Sizing of grounding conductors

665 - Grounding Power Systems
Informative Annexes

A Determination of the *k* factor

B Corrosion

C Division of current for small interior grids

690 - Cable Systems

- Design and installation of safety-related electrical cable systems
- Includes associated circuits

690 - Cable Systems

4. Cable, Field Splice, and Connection Qualification
5. Conductor Sizing
6. Electrical Segregation
7. Separation and Identification
8. Shielding and Shield Grounding
9. Cable-Penetration Fire Stops, Fire Breaks, and System Enclosures

690 - Cable Systems

10. Fire-Detection Systems
11. Fire-Extinguishing Systems
12. Handling and Installation
13. Acceptance Testing of Installed Cables
14. Documentation

690 - Cable Systems
Clause 5. Conductor Sizing

- The minimum ambient temperatures used in calculating cable ampacities shall be 30°C for buried installations and 40°C for exposed installations.
- Conductor size shall be selected for normal, emergency overload, and short-circuit current without exceeding rated temperature of the insulation at the maximum ambient temperature.
- Conductor size shall be selected for the limiting raceway condition.
- Conductor size shall consider voltage drop, shield current, and mechanical strength.
- Cable ampacity shall consider appropriate de-ratings due to installation conditions.

690 - Cable Systems
Clause 6. Electrical Segregation

6.1 Cable Classifications

6.2 Requirements

690 - Cable Systems
Clause 7. Separation and Identification

- Clause 7 Invokes IEEE Std 384 for the Separation and Identification Requirements

690 - Cable Systems
Clause 8. Shielding and Shield Grounding

8.1 Medium-voltage power cable

8.2 Instrumentation cable

690 - Cable Systems Clause 9. Cable-Penetration Fire Stops and Fire Breaks

9.1 General requirements

9.2 Cable-penetration fire stop requirements

9.3 Cable tray fire break requirements

9.4 Cable-system enclosure requirements

690 - Cable Systems Clauses 10 and 11

10. Fire-Detection Systems

11. Fire-Extinguishing Systems

690 - Cable Systems
Clause 12. Handling and Installation

12.1 General requirements

12.2 Storage requirements

12.3 Cable-installation requirements

12.4 Raceway - cable-fill requirements

12.5 Requirements for supporting cables in vertical runs

690 - Cable Systems Clauses 13 and 14

13. Acceptance Testing of Installed Cables

14. Documentation

1050 - Grounding I&C Systems

- Suitable level of protection for personnel and equipment, and
- Suitable electric noise immunity for signal ground references in generating stations

1050 - Grounding I&C Systems

4. Electrical Noise Minimization
5. I&C System Grounding
6. Signal Cable Shield Grounding
7. Testing

1050 - Grounding I&C Systems

Clause 4. Electrical Noise Minimization

4.1 Typical noise sources and their characteristics

4.2 Noise-coupling methods

4.3 Techniques for electrical noise minimization

1050 - Grounding I&C Systems
Clause 5. I&C System Grounding

5.1 Grounding philosophy
5.2 Types of signal ground systems
5.3 Separation criteria for circuits
5.4 I&C system power considerations
5.5 Surge protection considerations
5.6 Other grounding considerations
5.7 Generating station EMI environment

1050 - Grounding I&C Systems
Clause 6. Signal Cable Shield Grounding

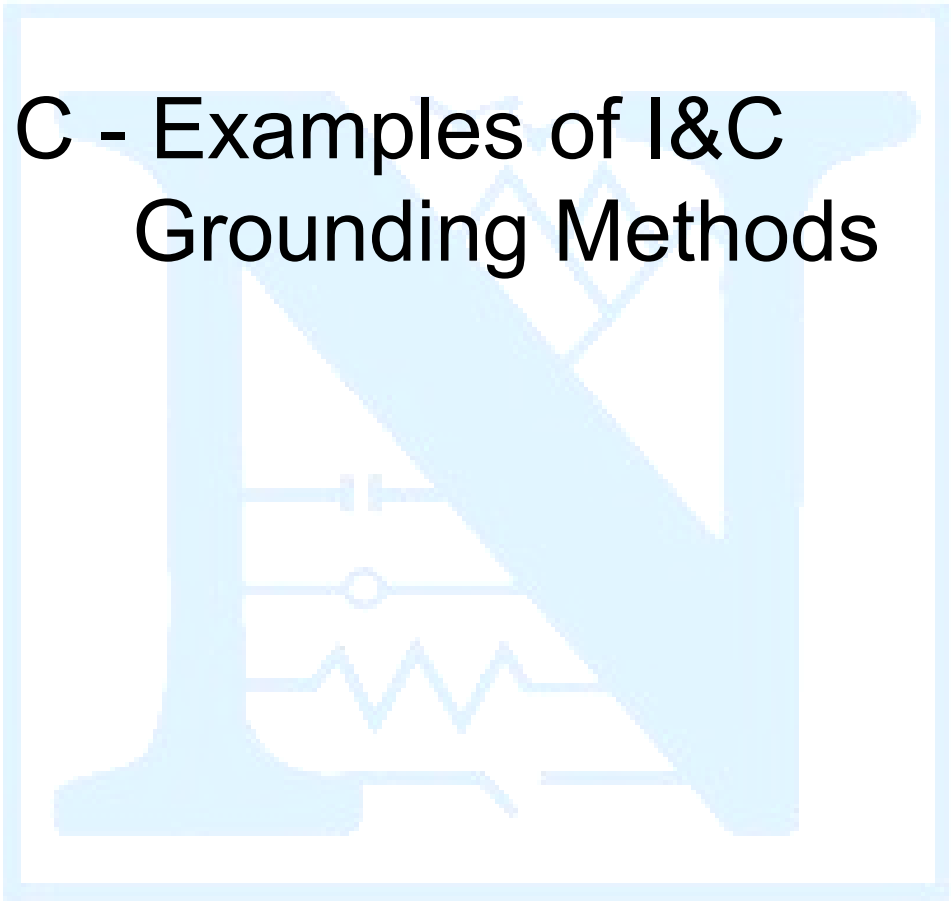
6.1 Cable shield requirements
6.2 Analysis of shield grounding practices
6.3 Other cable shielding considerations
6.4 Comparison of shielding effectiveness
6.5 Common practices in shielding cables for distributed control and PLC circuits
6.6 Central distribution frame grounding

1050 - Grounding I&C Systems
Clause 7. Testing

7.1 General
7.2 Sources of conductive ground loops
7.3 Ground loop prevention and detection
7.4 Testing for ground loops
7.5 Signal ground system integrity
7.6 Maintenance of the signal ground

1050 - Grounding I&C Systems

Annex C - Examples of I&C Grounding Methods



1185 - Cable Installation Methods

- The purpose of this recommended practice is to avoid potential wire or cable damage during the installation and testing process.

1185 - Cable Installation Methods

4. Conduit-Cable Pulling Charts
5. Cable Pulling Attachment Methods
6. Pull Rope Selection
7. Lubrication Techniques
8. Tension Limiting Methods
9. Cable Pullbys
10. Pullbacks

1185 - Cable Installation Methods
Clause 4. Conduit-Cable Pulling

4.1 General
4.2 Cable types and raceway configurations
4.3 Use of conduit-cable pulling charts
4.4 Bend correction adjustment
4.5 Examples
4.6 Methodology
4.7 Pulling tension

1185 - Cable Installation Methods
Clause 5. Cable Pull Attachments

5.1 General
5.2 Basket-type pulling grips
5.3 Compression-type pulling eyes
5.4 Wedge-type pulling eyes
5.5 Mare's tails
5.6 Swivels

1185 - Cable Installation Methods
Clause 6. Pull Rope Selection

6.1 General

6.2 Guidelines for pull rope selection

6.3 Precautions

1185 - Cable Installation Methods
Clause 7. Lubrication Techniques

7.1 When to use lubricant

7.2 Lubricant quantity

7.3 Methods of lubricating conduit systems

7.4 Cable jacket lubrication

7.5 Lubrication procedure

7.6 Clean up and safety

1185 - Cable Installation Methods
Clause 8. Tension Limiting Methods

8.2 Limiting size of pulling crew

8.3 Dynamometer

8.4 Break link

1185 - Cable Installation Methods
Clause 9. Cable Pullbys

9.1 General

9.2 Conditions for potentially successful pullbys

9.3 Installation practices

9.4 Post-pullby testing

1185 - Cable Installation Methods

Clause 10. Pullbacks

10.1 General

10.2 Cable inspection

10.3 Installation practices

1185 - Cable Installation Methods
Normative Annexes

A. Examples - Use of conduit-cable pulling charts

B. Methodology - Conduit-cable pulling charts

C. Bend correction factor - Conduit-cable pulling charts

1210 - Compatibility of Cable-Pulling Lubricants with Cable

- Cable-pulling lubricants are used to lower the friction on cable.
- Lubricants should not negatively interact with the cables they lubricate.

1210 - Compatibility of Cable-Pulling Lubricants with Cable

3. Physical property effects

4. Electrical property effects

5. Testing and test methods

1210 - Pulling Lubricants
Clause 3. Physical Property Effects

3.1 General

3.2 Lubricant on cable jacket

1210 - Pulling Lubricants
Clause 4. Electrical Property Effects

4.2 Semiconducting jackets and shields

4.3 Stability of lubricant on semiconductors

4.4 Final high-temperature volume resistivity test

4.5 Lubricant on thermoplastic insulation

4.6 Lubricant on thermoset insulation

1210 - Pulling Lubricants
Clause 5. Test Methods

5.2	Jacket test specimens for the immersion/physical property tests
5.3	Tensile strength and elongation test
5.4	Heated lubricant immersion method
5.5	Heated water/air immersion method
5.6	Environmental stress cracking test
5.7	Volume resistivity test procedure for lubricants on semiconducting jackets/shields
5.8	Dielectric voltage withstand test in water

12. Installation Standards Objectives Review

- Identified the major installation standards
- Provided a general overview of the purpose of these standards
- Discussed how these standards relate to new reactor inspection by identifying and discussing their major clauses

12. Installation Standards Out of Scope

- 381 - Class IE Modules OOS
- 634 - Cable Penetration Fire Stops OOS
- 1120 - Guide to Considerations for Submarine Cable Installation OOS

Session 13

Inspection and Testing Standards

13. Inspection and Testing Objectives

- Identify the major inspection and testing standards
- Provide a general overview of the purpose of these standards
- Discuss how these standards relate to new reactor inspection

13. Inspection and Testing Standards

- 336 - Guide for Installation, Inspection, and Testing for Class 1E Power, Instrumentation, and Control Equipment

- 1050 - I&C Grounding (Testing)

13. Inspection and Testing Standards

- 387 - Diesels
- 450 - Batteries (Testing)
- 944 - UPS
- 1458 - Molded Case Circuit Breakers

13. Inspection and Testing Standards

- 48 - Initial Testing of MV Cable Terminations
- 400 Field Testing of Shielded Power Cables
- 576 Installation, Terminating and Testing of Power Cables
- 690 Cable Systems (Testing)
- 1185 Cable Pullbys (Testing)

336 - Power, Instrumentation, Control Equipment

- Pre-installation, installation, inspection, and testing of Class 1E power, instrumentation, and control equipment and systems

- Applicable to initial construction, modification and maintenance activities

336 - Power, Instrumentation, Control Equipment

4. General Considerations for Initial Construction, Modification, and Maintenance
5. Pre-Installation Constructability Review
6. Installation/Construction
7. Testing

336 - Power, Instrumentation, Control Equipment Clause 7. Testing

- 7.1 General
- 7.2 Material source testing

336 - Power, Instrumentation, Control Equipment Clause 7. Testing

7.3 Electrical Tests

- Correct wiring
- EMI/RFI compatibility
- Functional tests
- Insulation resistance.
- Dielectric strength

336 - Power, Instrumentation, Control Equipment Clause 7. Testing

7.4 Physical and Chemical Tests

- Chemical analysis of fluids
- Radiation Testing

336 - Power, Instrumentation, Control Equipment Clause 7. Testing

7.5 Mechanical Tests

- Flow and pressure tests on instrument connections
- Flow tests on required ventilation and cooling components

336 - Power, Instrumentation, Control Equipment Clause 7. Testing

7.6 Equipment functional tests

7.7 System tests

7.8 Post-modification/ maintenance testing

1050 - I&C Grounding (Testing)

- I&C equipment grounding methods for
  - Protection for personnel and equipment
  - Noise immunity for signal ground

1050 - I&C Grounding (Testing)

4. Design considerations for electrical noise minimization
5. I&C system grounding
6. Signal cable shield grounding
7. Testing

1050 - Grounding I&C Systems
Clause 7. Testing

7.1 General

7.2 Sources of conductive ground loops

7.3 Ground loop prevention and detection

7.4 Testing for ground loops

7.5 Signal ground system integrity

7.6 Maintenance of the signal ground

387 - Diesel Generators

- Application and testing of diesel-generator units
- Covers site testing

387 - Diesel Generators Testing

- Factory
- Qualification
- Site Acceptance
- Periodic Surveillance

387 - Diesel Generators
Clause 7. Site Testing

7.1	Testing
7.2	Site acceptance testing
7.3	Pre-operational testing
7.4	Periodic testing
7.5	Test descriptions
7.6	Records

944 – Application and Testing of UPS

- Application and performance requirements for a UPS system
- Requirements for design, procurement, and testing

944 – Application and Testing of UPS

4. Service Conditions
5. Design Application Requirements
6. Procurement Document Requirements
7. Testing Requirements

944 – Application and Testing of UPS
Clause 7. Testing

7.1 General

7.2 Functional Unit Tests

7.3 UPS Tests

7.4 Test Specifications

1458 – Molded Case Circuit Breakers

3. MCCB Basics
4. MCCB Safety Considerations
5. Selection of MCCBs
6. Estimated Available Fault Current
7. Simplified Method to Calculate Fault Current
8. Field Testing of MCCBs

1458 – MCCBs Clause 8. Field Testing

8.1 Rated current hold in test

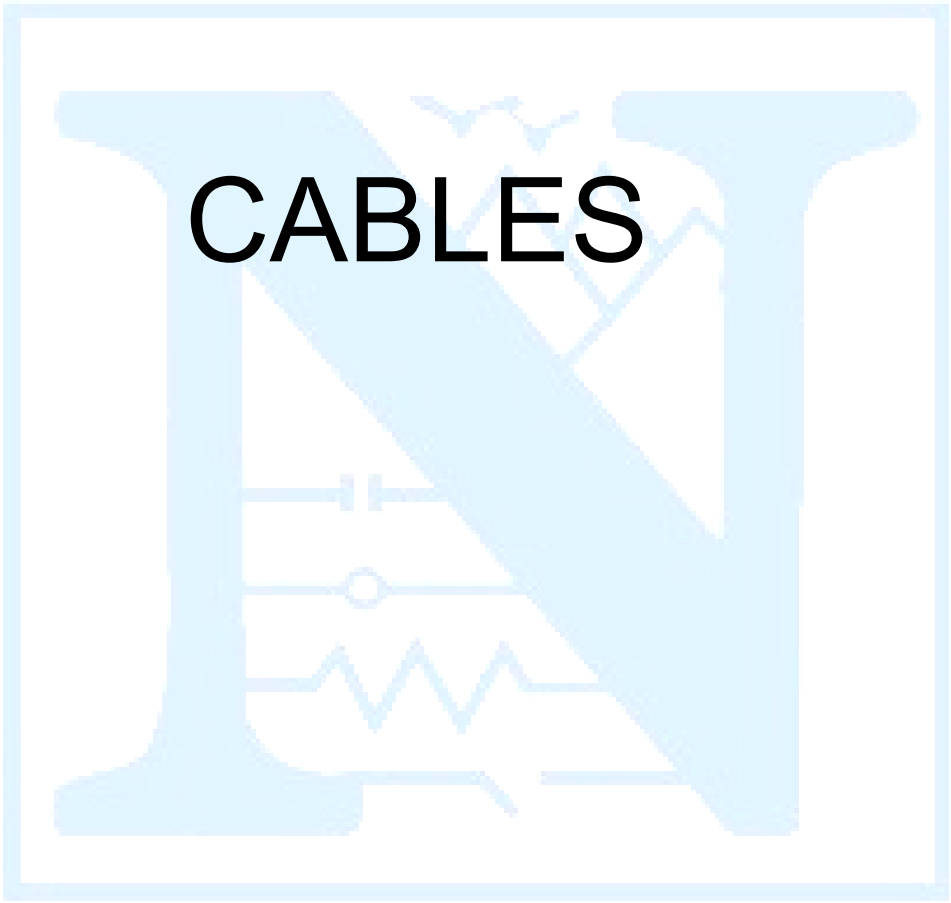
8.2 Exposed face and lug temperature

8.3 Mechanical operation tests

8.4 Insulation resistance test

8.5 Individual pole resistance test

CABLES



48 - Initial Testing of MV Cable Terminations

- Indoor and outdoor AC cable terminations
- Laminated insulation rated 2.5 kV through 765 kV
- Extruded insulation rated 2.5 kV through 500 kV

48 - Initial Testing of MV Cable Terminations

4. Service Conditions
5. Rating
6. Product Markings
7. Test Requirements
8. Test Procedures
9. Application Guide
10. Suggested Environmental Tests

48 - Initial Testing of MV Cable Terminations
Clause 7. Test Requirements

7.1 Design tests

7.2 Routine tests

7.3 Installed field tests

48 - Initial Testing of MV Cable Terminations
Clause 8. Test Procedures

8.1 Preparation of test specimen
8.2 Standard test conditions
8.3 Correction factors
8.4 Design tests
8.5 Routine tests
8.6 Dielectric field tests

400 - Field Testing of Shielded Power Cables

- This guide lists various field test methods
  - presently available
  - under development
- Field tests on insulated, shielded power cable systems rated 5 kV through 500 kV
- Consider the performance of the entire cable system, including joints, terminations, and associated equipment

400 - Field Testing of Shielded Power Cables

400.1 DC High Potential

400.2 Very Low Frequency

400.3 Partial Discharge

576 - Installation, Terminating and Testing of Power Cables

- A guide for installing, splicing, terminating, and field proof testing of cable systems in industrial and commercial applications is provided.

576 - Installation, Terminating, and Testing of Power Cables

Clause 16. Field Acceptance Testing

16.1 Advantages of high voltage dc acceptance testing

16.2 Installation acceptance test voltages

16.3 Interpretation of test results

690 Cable Systems (Testing)

- Design and installation of safety related electrical cable systems

690 - Cable Systems Clause 13

Acceptance Testing of Installed Cables

- Medium voltage power cables should be hi-pot tested prior to equipment connection.
- VLF can be performed in lieu of high-potential testing if trending of service aged cables is desired.
- Low-voltage cables shall be either IR tested prior to connecting cables.

1185 - Cable Installation Methods
Sub Clause 9.4 Post-Pullby Testing

- Test Per IEEE 690 on both
  - Initial Cables
  - Recently Pulled Cables

13. Inspection and Testing Objectives Review

- Identified the major Inspection and Testing Standards
- Provided a General Overview of the Purpose of these Standards
- Discussed how these Standards relate to New Reactor Inspection by identifying and discussing their major Clauses.

13. Inspection and Testing Standards Out of Scope

- 415 - Preoperational Testing Program - Class 1E Systems OOS

Session 14

Operation, Maintenance, and Surveillance Standards

14. Operation, Maintenance and Surveillance Standards Objectives

- Identify the major operation, maintenance and surveillance standards
- Provide a general overview of the purpose of these standards
- Discuss how these standards relate to new reactor inspection by identifying and discussing their major clauses

14. Operation, Maintenance and Surveillance Standards

- 400 - Cables
- 450 - Batteries
- 498 - Measuring and Test Equipment

14. Operation, Maintenance and Surveillance Standards

- 749/387 - Diesels
- 934 - Replacement Parts
- 1205 - Assessing Aging Effects

400 – Cables

- This guide lists the various field test methods that are presently available or under development to perform field tests on insulated, shielded power cable systems rated 5 kV through 500 kV.

- Consideration should be given to the performance of the entire cable system, including joints, terminations, and associated equipment.

450 - Batteries

- Provides maintenance, test schedules, and testing procedures
- Guidance to determine when batteries should be replaced

450 - Batteries

4. Safety
5. Maintenance
6. Test Schedule
7. Procedure for Battery Tests
8. Battery Replacement Criteria

450 - Batteries Clause 5. Maintenance

5.1 General

5.2 Inspections

5.3 Corrective actions

5.4 State of charge

450 - Batteries Clause 6. Test Schedule

6.1 Acceptance

6.2 Performance

6.3 Service

6.4 Modified performance test

498 - Measuring and Test Equipment

- Provides requirements for a calibration program to control and verify the accuracy of MT&E to ensure:
  - safety systems of a nuclear facility are in conformance with prescribed technical requirements, and
  - data provided by testing, inspection, or maintenance are valid.

749 - Diesels

- Withdrawn in 1991
- This standard addressed the periodic testing of diesel-generator units applied as standby power supplies in nuclear power generating stations.
- See IEEE Std 387

387 – Diesels
Sub Clause 7.4 Periodic testing

- Periodic tests shall consist of:
  - Availability tests
  - System operation tests
  - Independence verification tests

387 – Diesels
Sub Clause 7.5 Test Descriptions

7.5.1 Slow-start test

7.5.2 Load-run test

7.5.3 Fast-start test

7.5.4 Loss-of-offsite power (LOOP) test

7.5.5 Safety injection actuation signal (SIAS) test

387 – Diesels
Sub Clause 7.5 Test Descriptions

7.5.6 Combined SIAS and LOOP test

7.5.7 Largest-load rejection test

7.5.8 Design-load rejection test

7.5.9 Endurance and load test

7.5.10 Hot restart test

387 – Diesels
Sub Clause 7.5 Test Descriptions

7.5.11 Synchronizing test

7.5.12 Protective-trip bypass test

7.5.13 Test mode override test

7.5.14 Independence test

934 - Replacement Parts

- Requirements for the selection and utilization of replacement parts for Class 1E equipment
- Selection, categories, and replacement of parts are covered.
- The requirements ensure that replacement parts will not degrade safety.

934 - Replacement Parts

1. Introduction
2. Selection of Parts
3. Categories of Parts
4. Replacement of Parts
5. Nonconforming Conditions
6. Quality Assurance Records

1205 - Assessing Aging Effects

- Guidelines for assessing, monitoring, and mitigating aging degradation effects

- Informative Annexes on:
  - aging mechanisms
  - environmental monitoring
  - condition monitoring
  - aging program essential attributes
  - example assessments

1205 - Assessing Aging Effects
Clause 7. Monitoring and Mitigating Aging Degradation

7.1 Maintenance

7.2 Replacement

7.3 Refurbishment

7.4 Redesign of equipment

7.5 Adjustments in operating environments and practices to reduce stresses

1205 - Assessing Aging Effects
Clause 7. Monitoring and Mitigating Aging Degradation

7.6 Environmental and operational stress monitoring

7.7 Inspection

7.8 Surveillance

7.9 Trending

1205 - Assessing Aging Effects Informative Annexes

A. Aging effect tables
B. Monitoring of environments
C. Condition monitoring
D. Equipment and system examples
E. Aging management program attributes

14. Operation, Maintenance and Surveillance Standards Objectives Review

- Identified the major operation, maintenance, and surveillance standards
- Provided a general overview of the purpose of these standards
- Discussed how these standards relate to new reactor inspection by identifying and discussing their major clauses

Student Activity

Electrical Components
vs.
IEEE Standards Matrix

Electrical Components vs. IEEE Power Supplies Standards

- Diesel Generators
  - 387 - Diesel Generators
  - 749 – Diesels (W)
- Batteries
  - 450 - Batteries (Testing)
  - 484 - Lead-Acid Batteries
  - 485 - Sizing Large Lead Acid Batteries
  - 535 - Batteries

Electrical Components vs. IEEE Cable Standards

- 48 - Initial Testing of MV Cable Terminations
- 383 - Cable Qualification
- 400 - Cable Testing
- 572 - Connection Assemblies
- 576 - Installation, Termination, and Testing of Power Cable

Electrical Components vs. IEEE Cable Standards

- 628 - Raceways
- 634 - Cable Penetration Fire Stops
- 690 - Cable Systems
- 835 - Power Cable Ampacity Tables
- 848 - Ampacity Derating of Fire-Protected Cables

Electrical Components vs. IEEE Cable Standards

- 1120 - Submarine Cable Installation
- 1143 - Low Voltage Cable Shielding
- 1185 - Cable Installation Methods
- 1202 - Flame Tests for Cables
- 1210 - Cable Lubricant Compatibility

Electrical Components vs. IEEE Power Electronics Stds

- 650 - Battery Chargers and Inverters
- 944 - Testing UPS

Electrical Components vs. IEEE Motor Standards

- 334 - Continuous Duty Motors
- 382 - Value Actuators
- 1290 - MOV Application, Control, Protection and Testing
- 1349 - Hazardous Duty Motors

Electrical Components vs. IEEE Protective Device Stds

- 649 - Motor Control Centers
- 741 - Protection of Class 1E Power Systems
- 946 - DC Auxiliary Power
- 1375 - Protection of DC Systems
- 1458 - Molded Case Circuit Breakers
- 1590 - Molded Case Circuit Breakers
- C62.23 - Surge Protection