Supply Chain and Asset Traceability for Energy (SCATE)

P3476 Work Group

October 23, 2024
ICC Sub B

The problem we are solving . . .

- Products are labelled with analogue markings that require interpretation and manual transcription (or manufacturer specific barcodes that may or may not contain useful information for the customer)
- Manufacturers deliver product data in a various non-structured formats that is difficult to access when needed (PDF, excel, paper)
- Data is manually copied and transferred from one system to another
- Data is not easily available for operations, engineering, asset management and analytics

How we propose to solve it . . .

A **Digital Thread** provides traceability data that seamlessly transfers from one phase of an asset's life to the next from design to decommissioning

Unique IDs that encode attribute data and enable traceability along the entire supply chain

Smart Tags that link the physical asset to its Unique ID and Digital Thread data

Linked Data is a supporting dataset linked to an asset through its Unique ID

Supply Chain and Asset Traceability for the Electric Grid (SCATE)

#1 - Manufacturer creates unique ID and applies smart tag based on IEEE industry standard data model

#3 - Application decodes unique ID into attributes to enable real-time use cases

Unique ID: AB.98.40.1.03

Asset: Pad Mounted XFR

Manufacturer: ABC

Serial Number: 397065

KVA Rating: 50 KVA
Primary Voltage: 2400 V
Secondary Voltage: 120/240 V

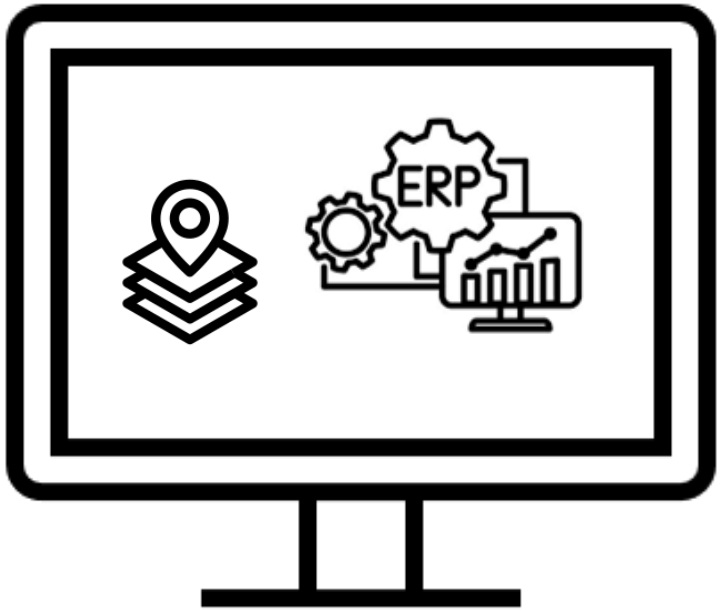
Phase: 1

Cooling Class: ONAN

BIL Rating: 60 KV

https://install.guide.com
https://MSDS.sheet.com

#4 - Asset attribute data delivered to the utility's system of record to support asset management and analytics

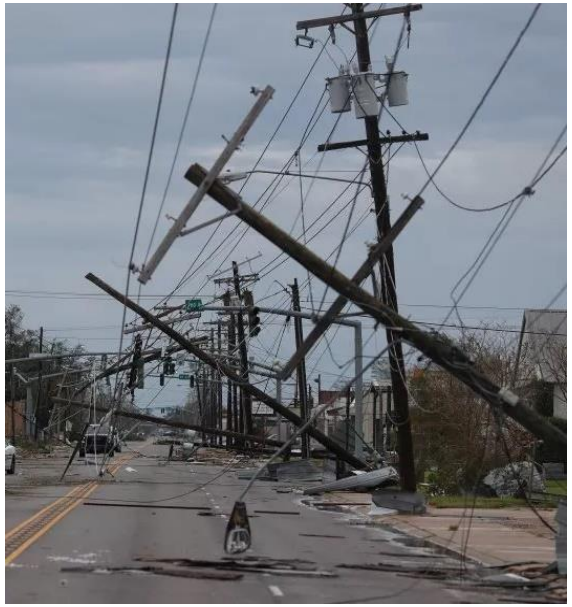


#2 - Utility workers scan smart tag in the warehouse or in the field with a mobile application

#5 - Field crews access the data for future O&M, recalls, and repairs

Use Cases

- Ordering
- Intake Verification
- Inventory Management
- Mutual Assistance
- Storm Restoration
- Digital As-Builting
- Populating Systems of Record (GIS/ERP)
  - Asset Management
  - Manufacturer Recalls
  - Performance Analytics
- End-of-Life: Disposal, Refurbishment, Recycling

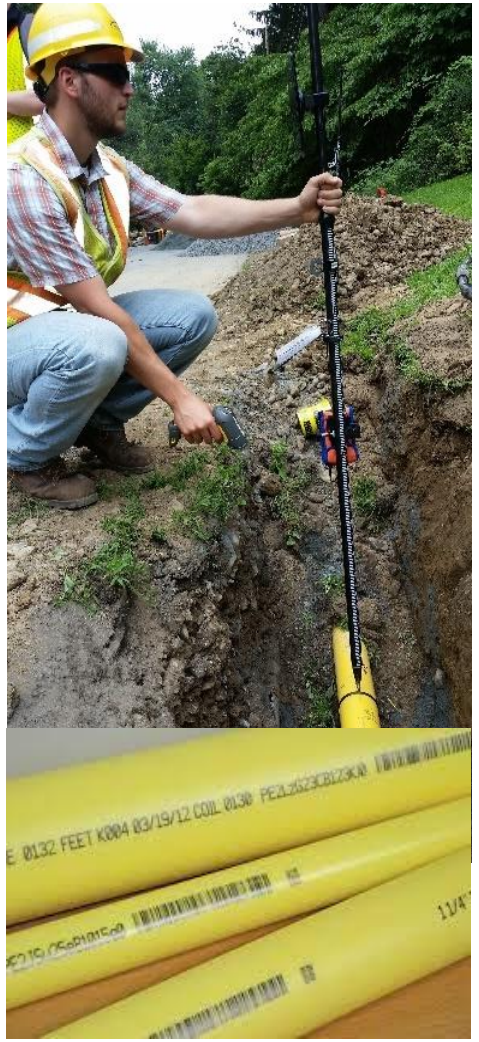


Success Stories from Natural Gas

- ASTM F2897 provides a traceability code for asset type, manufacturer, date, size, material, and lot code

- Use cases include:
  - Regulatory compliance
  - Digital as-builting
  - Material verification
  - Automated project close-out
  - Automated GIS updating

- Full industry adoption in five years



IEEE IC22-009 SCATE

- IEEE Industry Connections Program
- Funding from EPRI
- Year 1 Scope
  - Use cases
  - Asset types
  - SCATE Specification
  - Asset-specific work groups to develop data models
  - Implementation tests with manufacturers and utilities

Deliverable: SCATE Specification

- Unique IDs
- Additional Attributes
- Linked Data
- Smart Tags

IEEE IC22-009 SCATE

- Year 2 Scope
  - Implementation tests
  - Implementation guidelines
  - Sharing successes and lessons learned

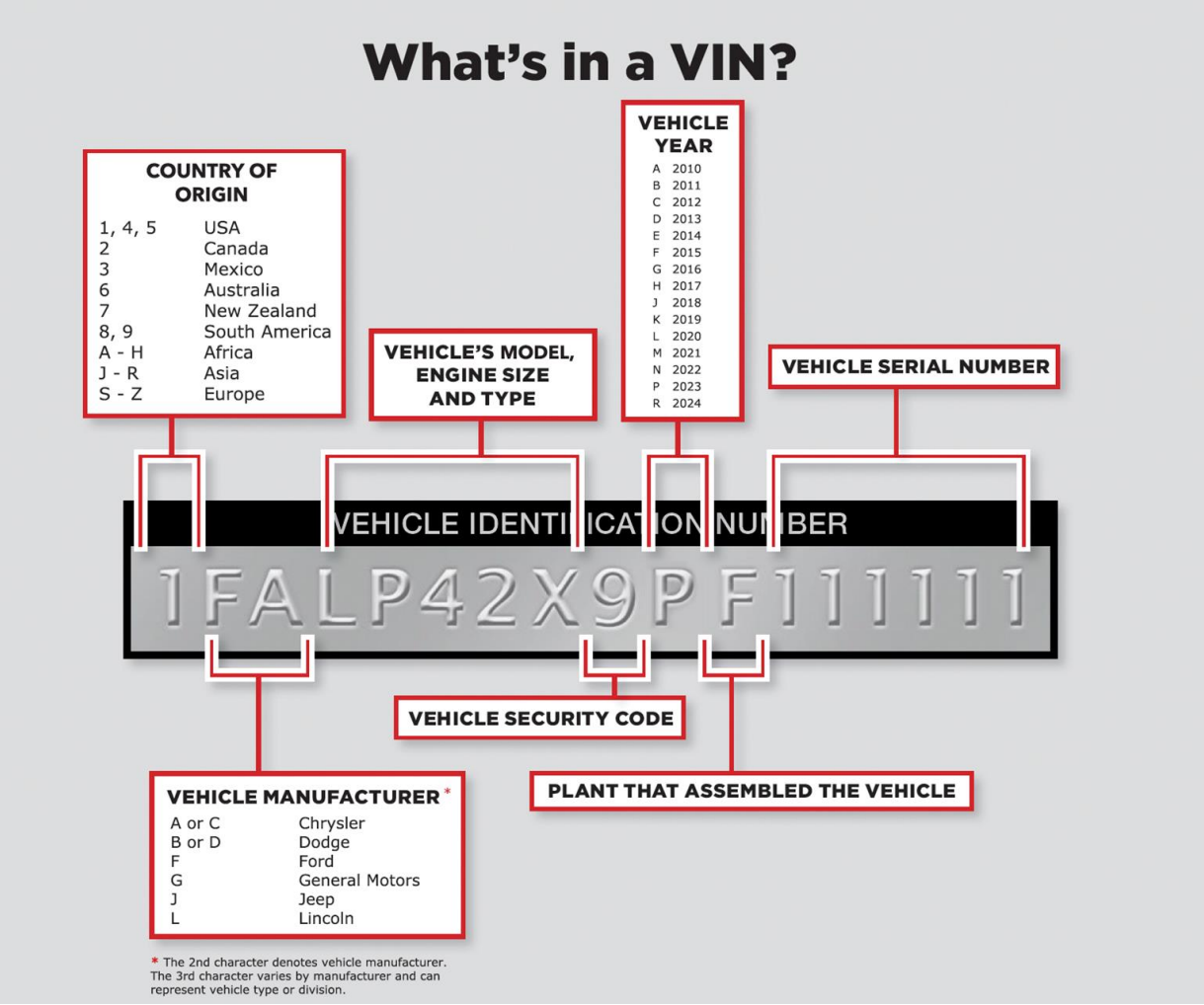
SCATE Approach

- SCATE for all energy asset types - electric grid, renewables, oil and gas, hydrogen, batteries

- SCATE Concepts
  - Based on flexible industry standards (lessons learned from ASTM F2897)
  - Based on ISO/IEC 15459 for Unique IDs
  - Based on ISO/IEC 15418 and 15434 for AIDC Tag Encoding

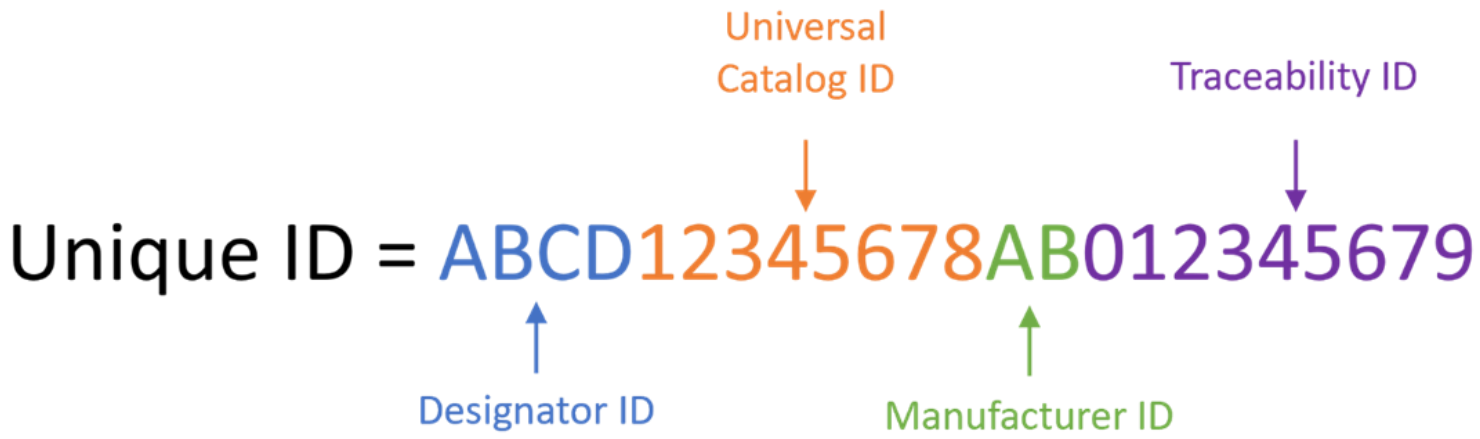
- Advantages (and disadvantages)
  - Non-proprietary – vendor neutral system, no specific software required
  - Decentralized – manufacturers generate unique IDs based on the SCATE Specification, no central registration system (but no central oversight)
  - Offline – internet connectivity not required for decoding and attribute look-up
  - Defined domain values – standardized encoding and decoding (but requires maintenance of data models)

VINs for the Electric Grid

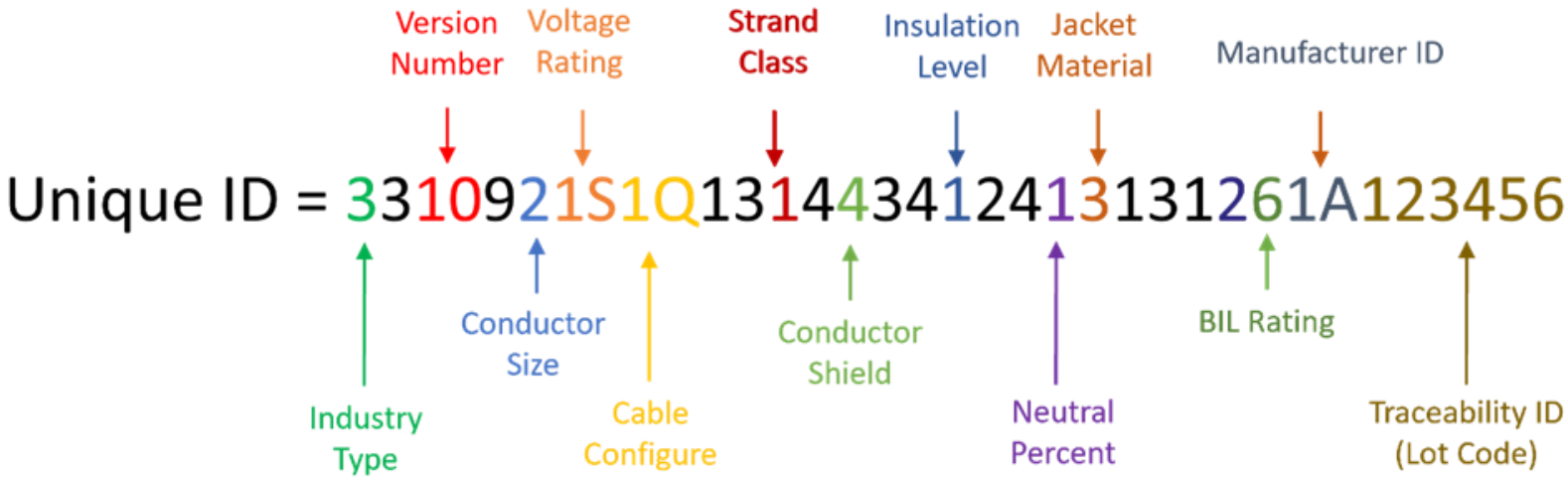


SCATE Unique ID Structure

- **Designator ID** - specifies the model based on industry, asset type and version number
- **Universal Catalog ID** - defines the product at the catalog level
- **Manufacturer ID** - ID assigned to the primary manufacturer
- **Traceability ID** - ID assigned by the manufacturer to uniquely identify an individual product (serial number) or group of products manufactured under the same process (batch, lot, heat code)



Unique ID - Underground Cable Example



SCATE Smart Tag Structure

- AIDC (Smart Tag) Syntax – ISO/IEC 15434
- Data Identifiers - ISO/IEC 15418

- (DI)string^(DI)string^(DI)string

- Structure:
  (S1)DesignatorID(S2)CatalogID(S3)ManufacturerID(D5)BatchCode(F5)PONumber(HB)TestReport

- Example:
  (S1)1102^(S2)1145564T3^(S3)79^(D5)123456AB^(F5)AA1234^(HB)http://digitaltestreport.com

- Decoded:
  Medium Voltage Cable, 1/0 AWG, 15 KV, CU, Class B, Semi-conducting PE, Concentric Neutral, TRXLPE, ACME, 3732019, PO Number 589945, Test Report at http://digitaltestreport.com

Smart Tag - Underground Cable Example

Unique ID: 3310921S1Q13144341241313126.1A.123456
Asset: Medium Voltage Underground Distribution Cable
Conductor Size: 1/0 AWG
Rating: 15 kV
Neutral: Concentric Neutral
Manufacturer: ACME
Batch Code: 3732019
CatID - Manufacturer: 490789
CatID - Customer: 432433
Customer PO Number: 589945

Unique ID Attributes

Conductor Size: 1/0 AWG
Rating: 15 kV
Configuration: Single
Conductor Material: CU
Conductor Stranding - Class B
Conductor Type - Concent Comp
Conductor Shield: Semi-cond PE
Insulation Level: 100%
Neutral: Concentric Neutral
Insulation: TRXLPE
Jacket Material: LLDPE
Manufacturer: ACME
Batch Code: 3732019

Additional Attributes

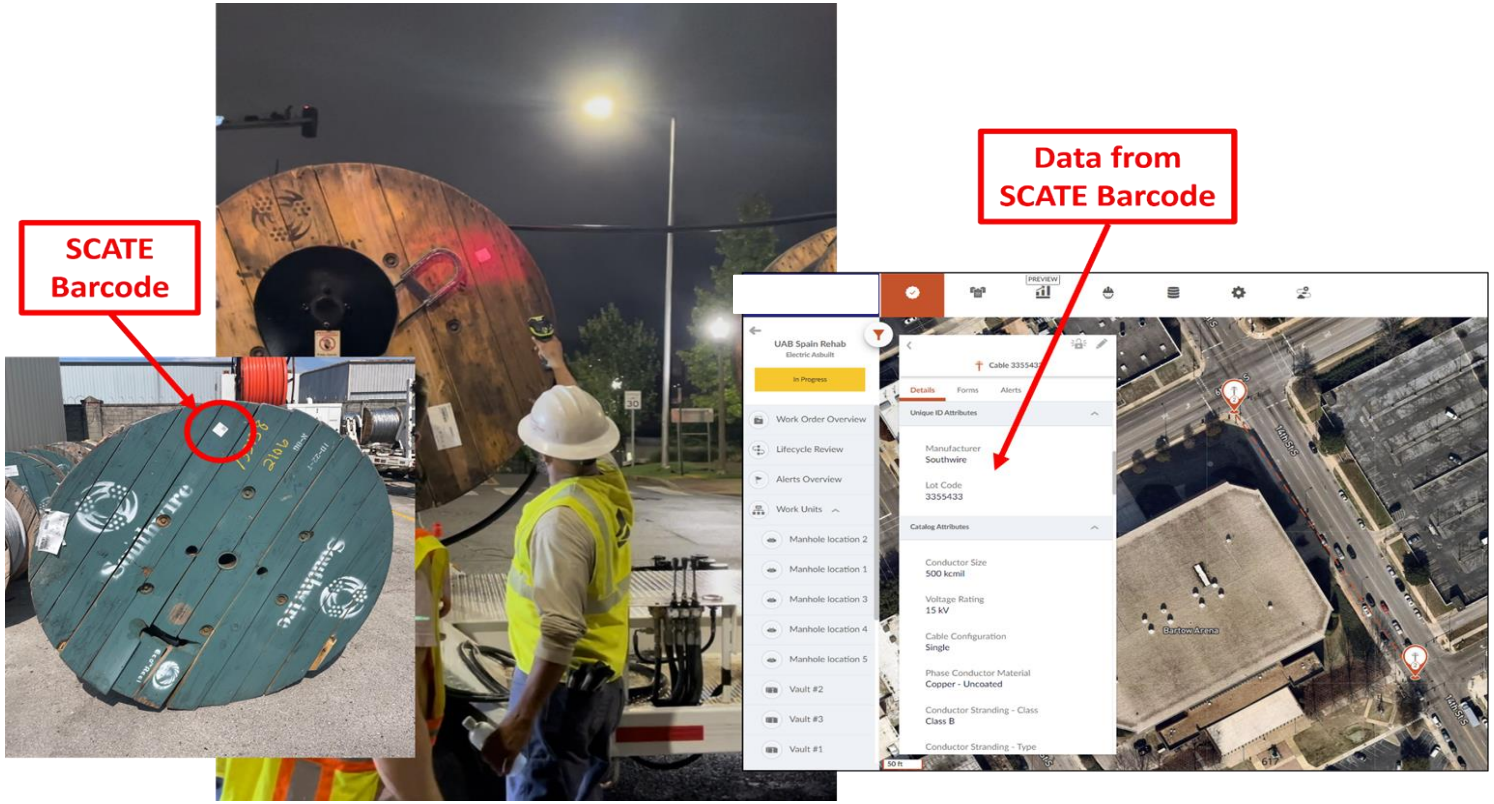
CatID - Manufacturer: 490789
CatID - Customer: 432433
Customer PO Number: 589945
Date of Manufacture: 9/8/2023
Country of Origin: USA
Reel ID: 3-744
Diameter: 1.060 inch
Conductor Strand Count: 19

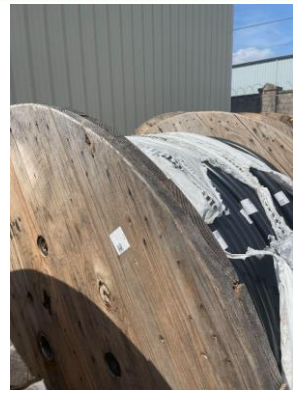
Linked Data

https://installation.guide.com
https://digitaltestreport.com
https://disposal.guide.com

Implementation Tests - Alabama Power

- Network Underground System
- Network Transformer, Network Protector, Cable, HBODY Splices





Implementation Tests - National Grid

- Pole Mount Transformers
- Street Light Luminaires

IEEE P3476 Work Group

- Scope
  - Convert the SCATE Specification into a standard
  - Develop unique ID data models for each asset type

- Asset-specific subwork groups to develop the data models
  - Soliciting participation in Connector work group

Asset Types

- Energy Transformation Devices
- Interrupting Devices
- Switching Devices
- Relays
- Connectors
- Insulators
- Hardware
- Structures and Supports
- Conductors
- Surge Protection Devices
- Controls
- Communication Devices
- Measurement and Sensor Devices

Asset Subtypes - Connectors

- Connectors
  - Permanent Connectors
    - Cold shrink, heat shrink, pre-molded
  - Separable Connectors
    - Deadbreak, multi-point separable insulated, disconnectable joint
    - Loadbreak
    - Grounding Separable Insulated Connector
    - Tap Connectors
    - Splice Connector
    - Deadend Connectors
  - Terminations
    - Cold shrink, heat shrink, pre-molded

SCATE Splice Data Model

Universal Catalog ID	Reference Standard
Cable Joint Catergory	IEEE 404 3.1
Splice Type	IEEE 404 3.2
Component Type	IEEE 404 3.2
Voltage Class	IEEE 404 5.1
Maximum Phase-to-Phase Voltage Rating	IEEE 404 6.1.e
Maximum Phase-to-Ground Voltage Rating	IEEE 404 6.1.e
BIL Rating	IEEE 404 5.2
Continious Current Rating	
Temperature - Minimum	
Temperature - Maximum	
Insulation Material	
Applicable Conductor Materials	
Number of Conductors	
Conductor Size - Minimum	IEEE 404 6.1.f
Conductor Size - Maximum	IEEE 404 6.1.f
Conductor Construction Type	
Applicable Shield Type	IEEE 404 6.2
Cable Insulation Diameter - Minimum	
Cable Insulation Diameter - Maximum	
Connector Included	
Connector Type	
Applicable Connector Materials	
Minimum Connector Diameter	
Maximum Connector Diameter	
Maximum Connector Length	
Submersible	
Capacitive Test Point Included	
Shelf Life	
Manufacturer ID	**IEEE Standards Reference**
Manufacturer	IEEE 404 6.1.a
Traceability ID	**IEEE Standards Reference**
Traceability Code	
Date of Manufacture	IEEE 404 6.1.c

Splice (2151)												
Cable Joint Catergory	Splice Type	Component Type	Voltage Class	Maximum Phase-to-Phase	Maximum Phase-to-Ground Voltage Rating	BIL Rating	Continious Current Rating	Temperature - Minimum	Temperature - Maximum	Insulation Material	Applicable Conductor Materials	Number of Conductors
Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Other	Other	Other	Other	Other	Other	Other	Other	Other	Other	Other	Other	Other
Extruded	Cold Shrink	Single (inline)	5 kV	24 V	24 V	Permanently Grounded	1 A	-70 C	-70 C	Silicon	Aluminum	1-1
Laminated	Heat Shrink	Branch T	8 kV	48 V	48 V	30 kV	2 A	-69 C	-69 C	EPDM	Copper	2-1
Transition	Premolded	Branch Y	15 kV	60 V	60 V	45 kV	3 A	-68 C	-68 C		AL & CU	3-1
	Tape		25 kV	110 V	110 V	60 kV	4 A	-67 C	-67 C			
	Crimp		28 kV	120 K	120 K	75 kV	5 A	-66 C	-66 C			
	Filled (Resin)		35 V	125 V	125 V	95 kV	10 A	-65 C	-65 C			
	Shearbolt		46 kV	220 V	220 V	110k kV	15 A	-64 C	-64 C			

Connector Challenges

- Physical tag requirements - adhesion, durability, size, location
- Reel vs cable marking

Questions and Discussion