Service Disruption Updates

May 9, 2025 – Operational Technology Network Disruption
May 20, 2025 – San Leandro Fault & Equipment Fire

BART Board of Directors | June 26, 2025

May 9, 2025
Operational Technology Network Disruption

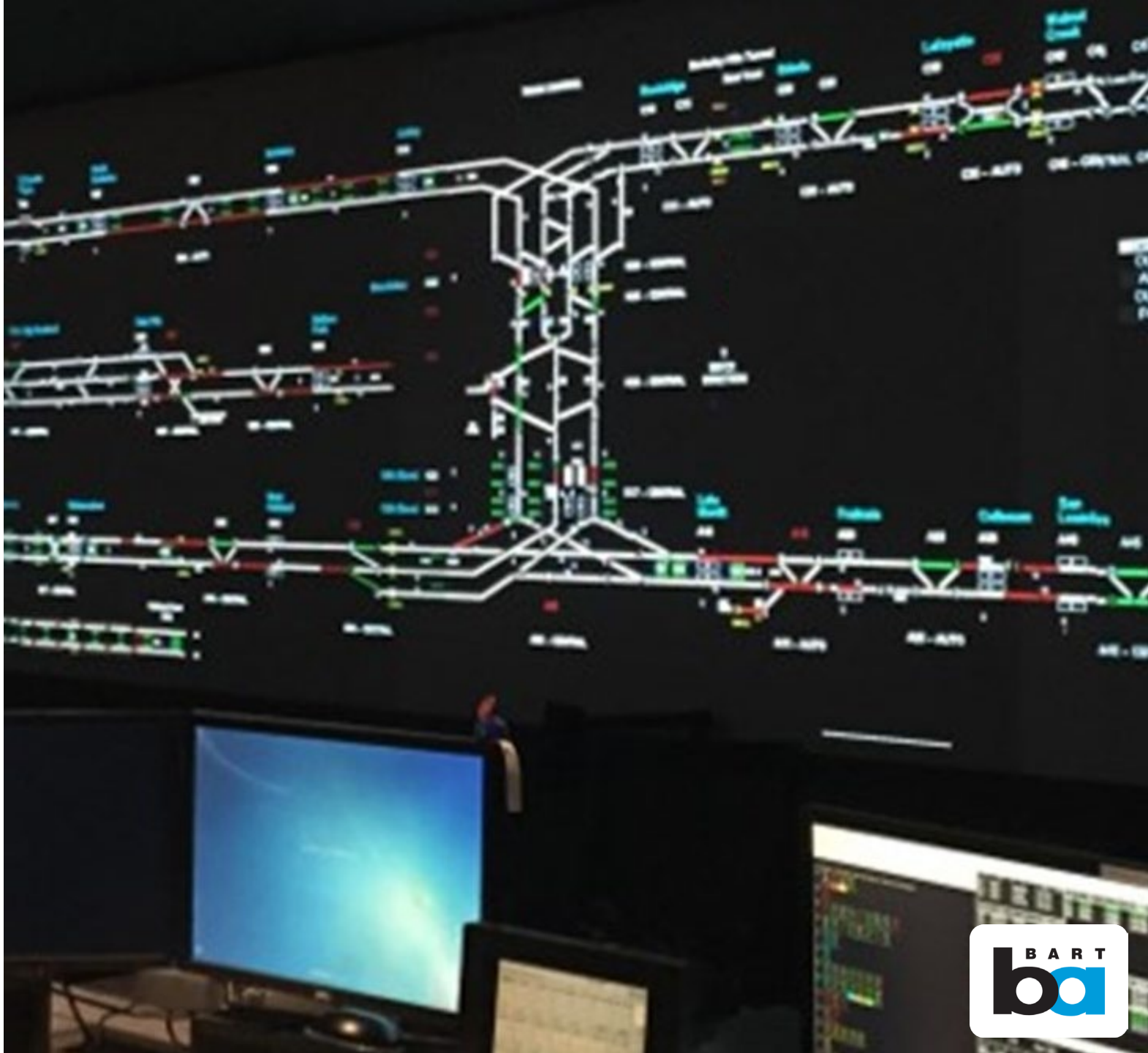
Network Disruption

Date: Friday, May 9, 2025

Time: Approximately 2:24 AM

Operational Impact:

A network looping event caused OCC to lose visibility and control of operating systems resulting in a delay to the start of revenue service



Terminology

Operations Control Center (OCC)

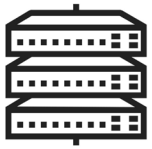
Location where BART Staff remotely monitor and manage train control, power systems, emergency communication, and field operations

BART Data Center

A secure facility that hosts core computing, storage, and network infrastructure for the District's operating technology systems

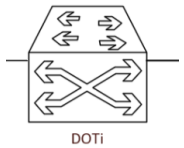
Station Network Switch

A smart device that directs network traffic between other network switches and systems



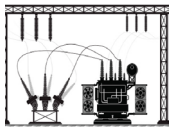
Operational Technology (OT)

The secure dedicated computer network environment specifically for operating trains and safety systems



Field Devices

Equipment such as PA speakers, CCTV cameras, radios, track switches, phones, and power breakers that support day-to-day operations located in various locations within the BART system



Supervisory Control and Data Acquisition (SCADA)

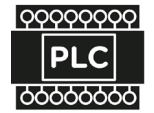
A system of software and hardware to collect data from field devices and control them remotely

Integrated Computer System (ICS)

A software which allows monitoring and control of industrial equipment such as field devices, sensors, controllers which allows OCC to manage power, ventilation, and train control systems

Programmable Logic Controller (PLC)

A small industrial computer used to automate and control devices like fans, pumps, power relays, breakers, and many other devices

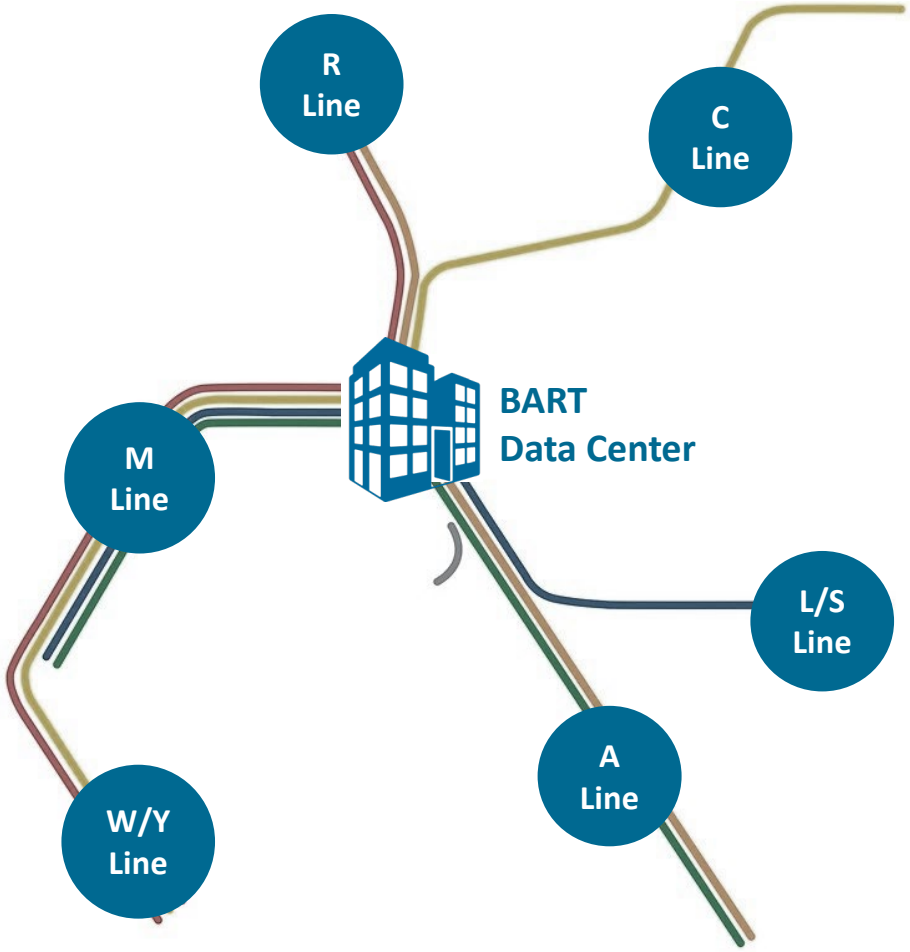


Unified Optical Network (UON)

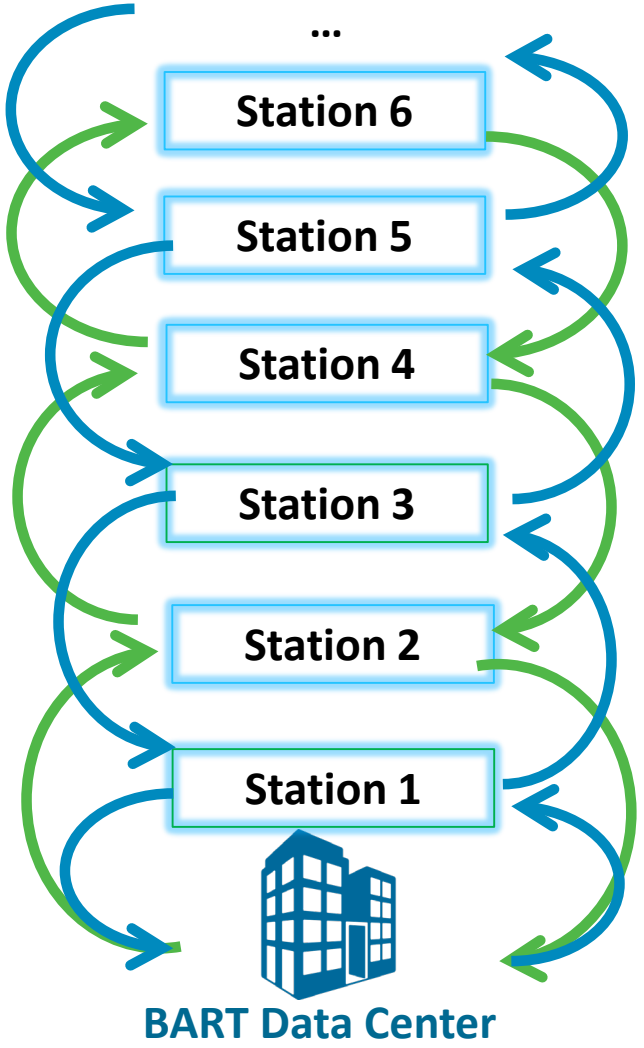
Series of fiber optic cables and network cabinets at each station (UON Chassis) that serve as the backbone of OT network

BART's Operational Network Topology

BART System

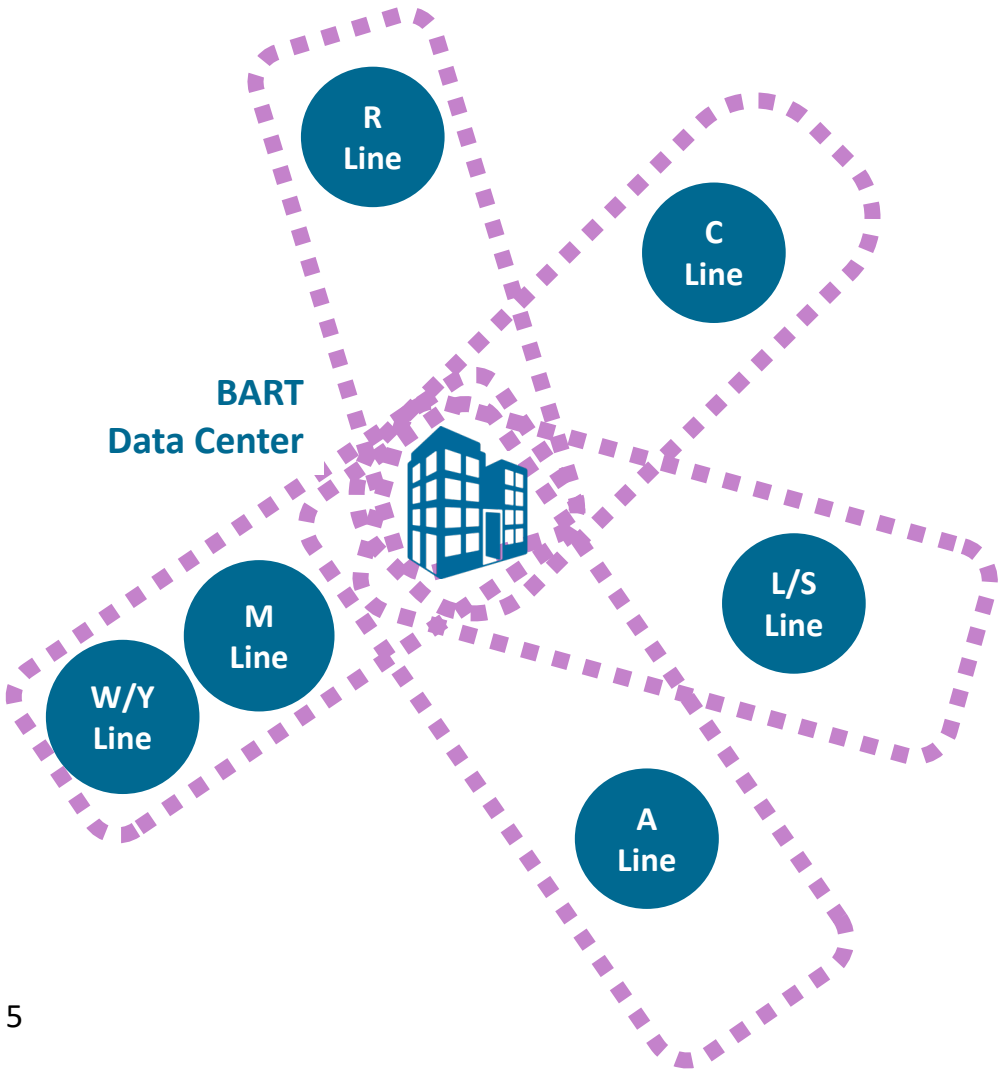


OT Network Connectivity

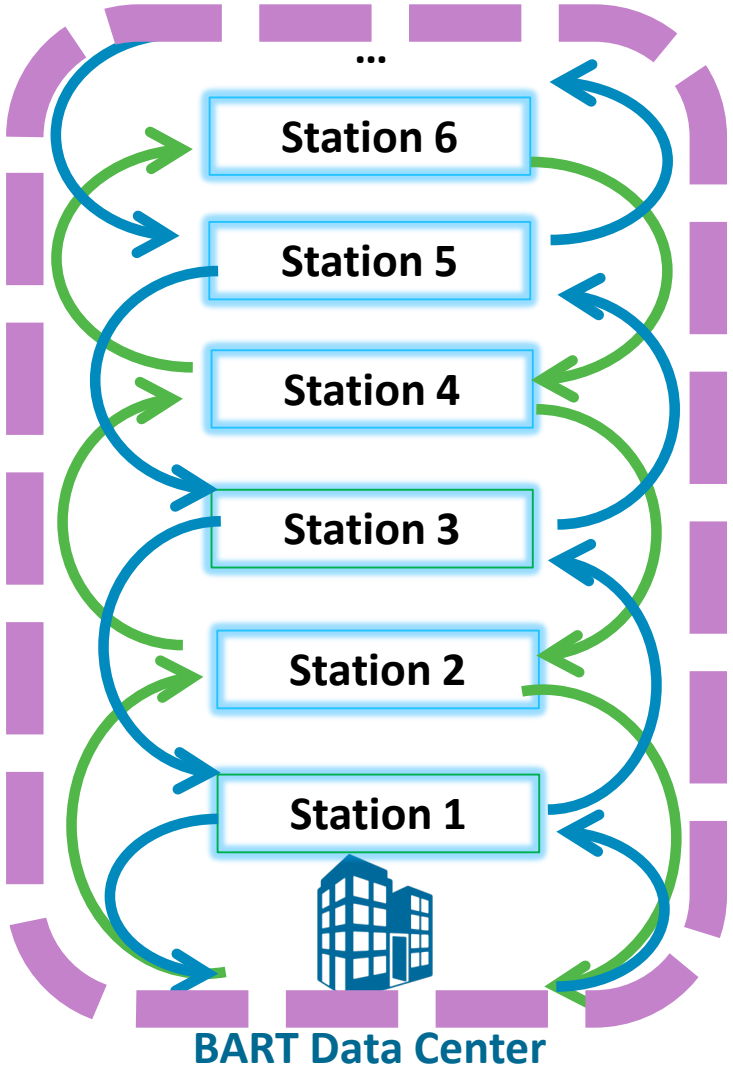


BART's Operational Network Topology

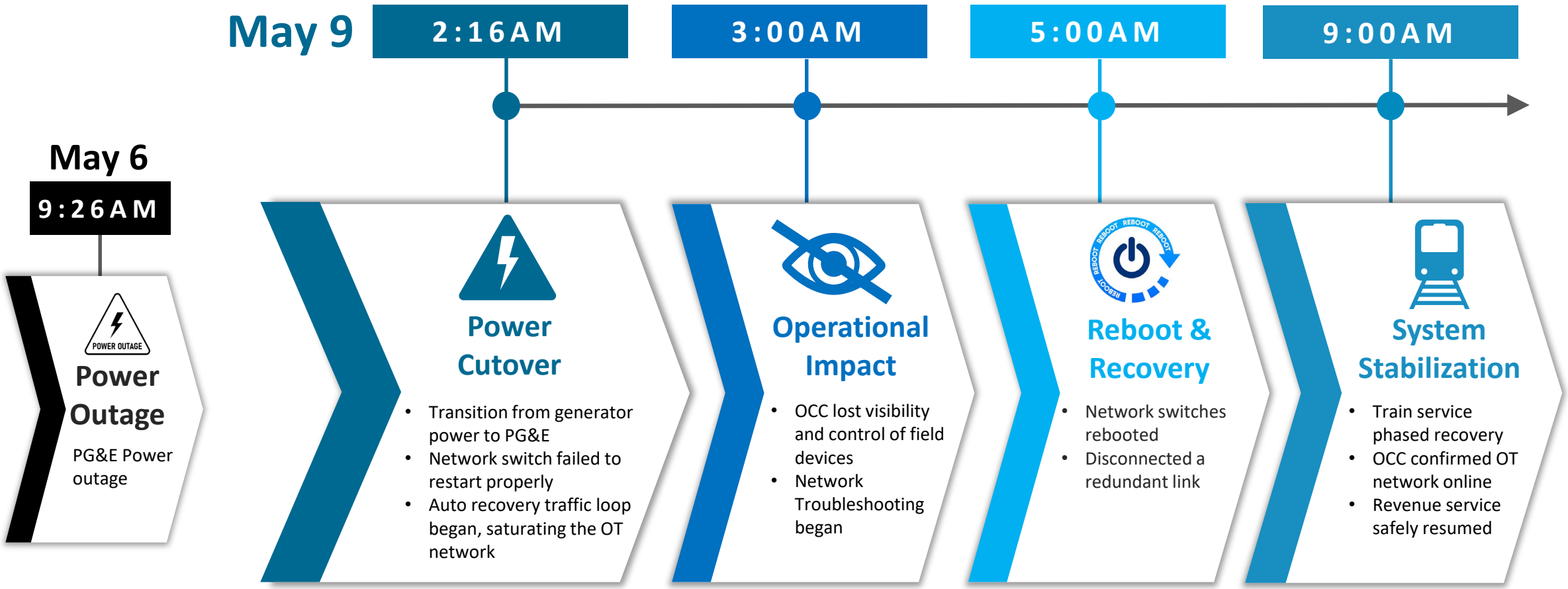
BART System



OT Network Connectivity

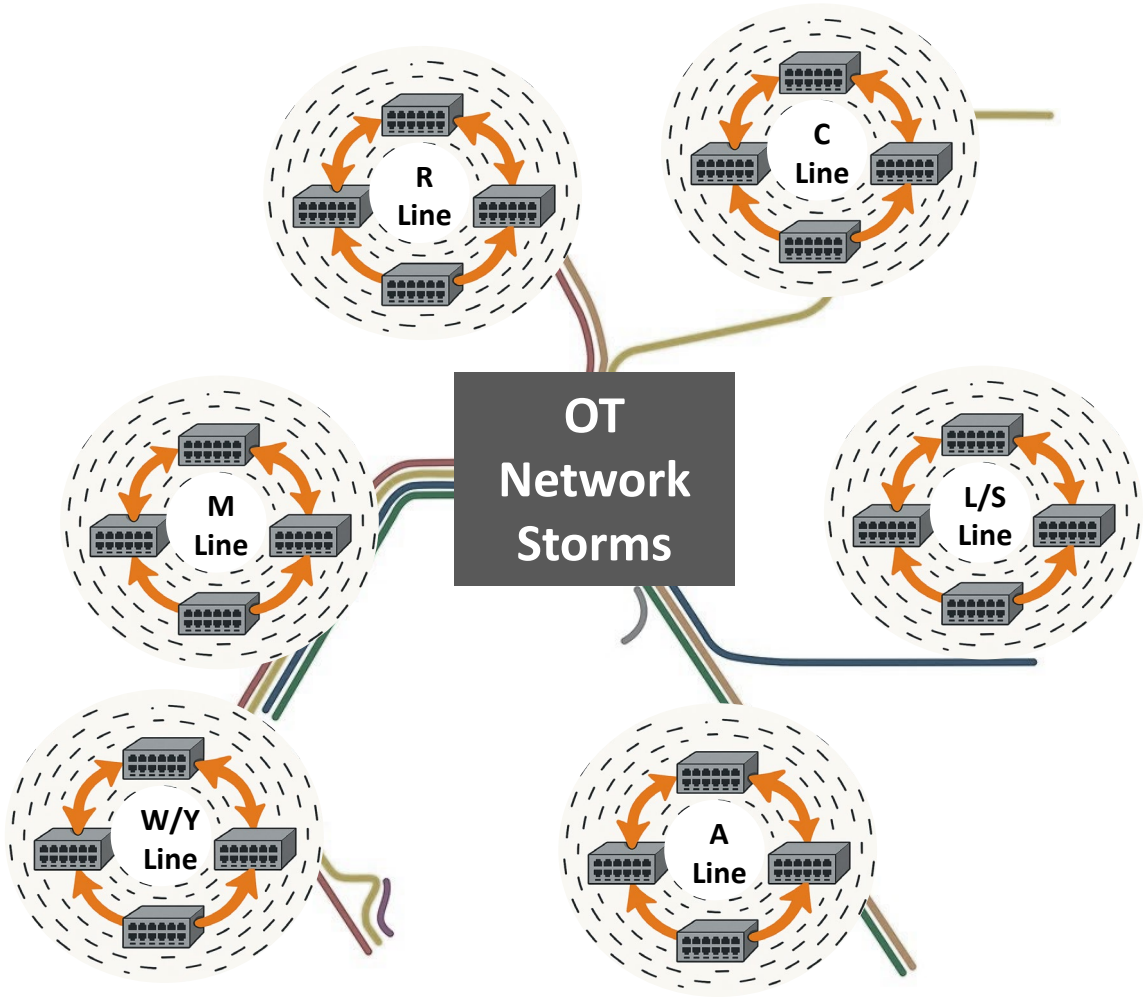


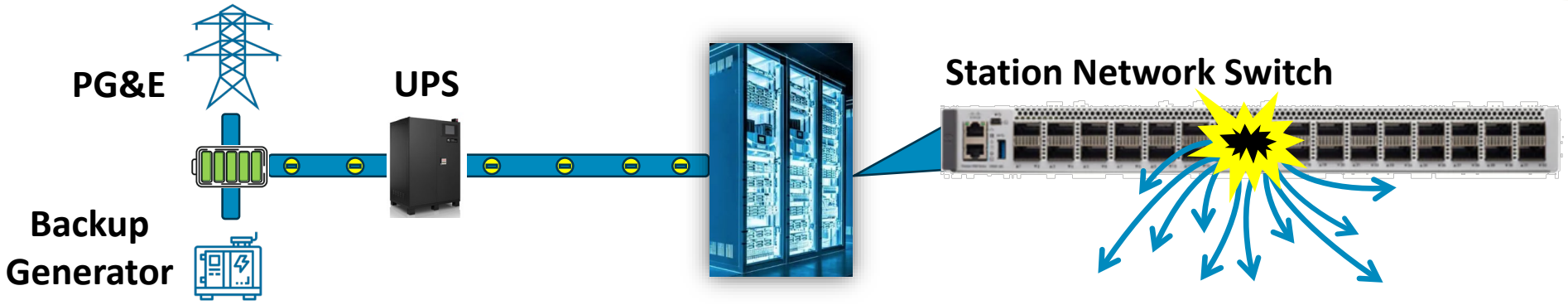
Event Timeline



Investigation Findings

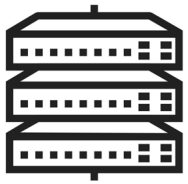
- Power transferred from generator to PG&E
- Power interruption < 1 second
- Loss of light in fiber
- Internal component failure in the network switch
- Network switch initiates an auto recovery feature creating a line-by-line network storm of data traffic





Lessons Learned

Network Architecture & Design

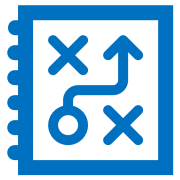


Evolve network topology to leverage available fiber infrastructure

Visibility & Monitoring

Implement technologies to provide additional monitoring and isolation of compromised devices

Planning & Coordination

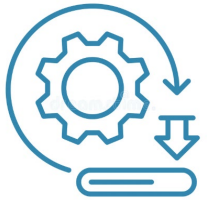


Review procedures for opportunities to enhance response time

Documentation

Explore software to better capture network topology and make available to incident responders

Spare Parts & Field Readiness



Place spare network cards in key locations for quicker response time

Key Actions & Activities

Immediate Actions

3 Months

- UON switch reconfiguration
- Forensic testing of comprised hardware
- Additional re-training on network topology

Short Term Actions

6 months

- VLAN segmentation
- Spare parts procurement
- Deploy additional routers for redundancy and flexibility

Longer Term Actions

- Develop and implement mesh topology network
- Continued hardware infrastructure updates
- Additional network monitoring software and systems

May 20, 2025
Electrical Fault & Equipment Fire at San Leandro Station

San Leandro Station Electrical Fault & Fire

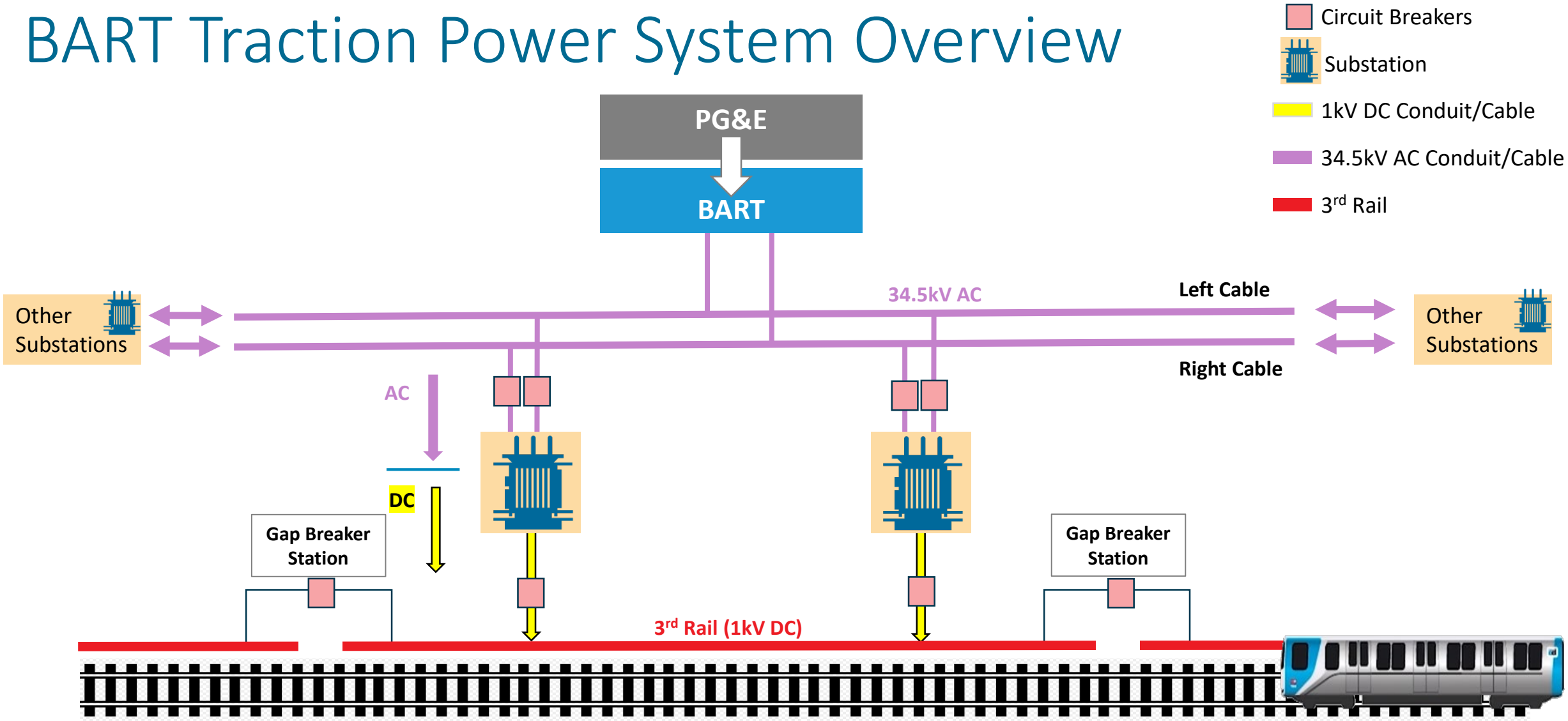
Date: Tuesday, May 20, 2025

Time: Approximately 4:55 AM

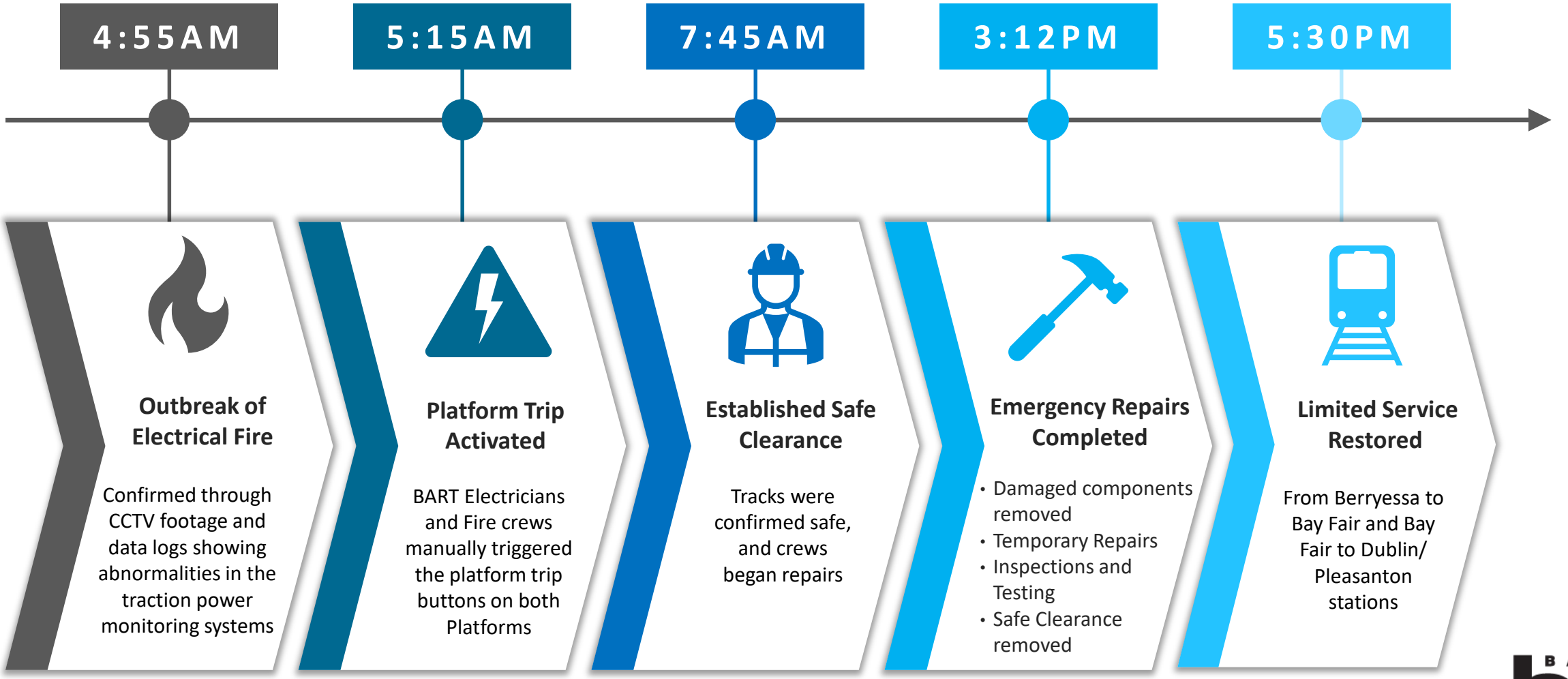
Operational Impact:

- Closure of all stations south of Lake Merritt during the morning commute
- Immediate service suspension of Green, Orange, and Blue lines

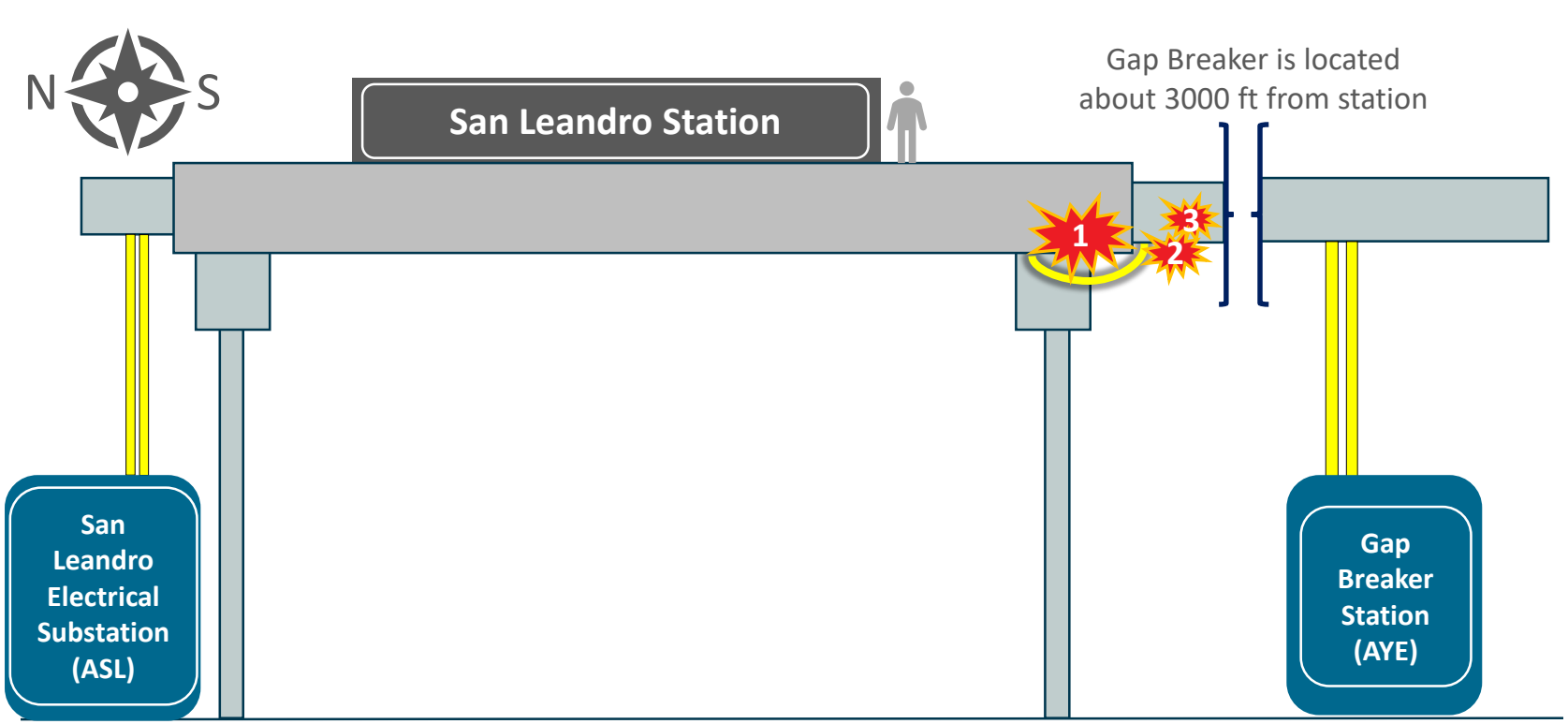
BART Traction Power System Overview

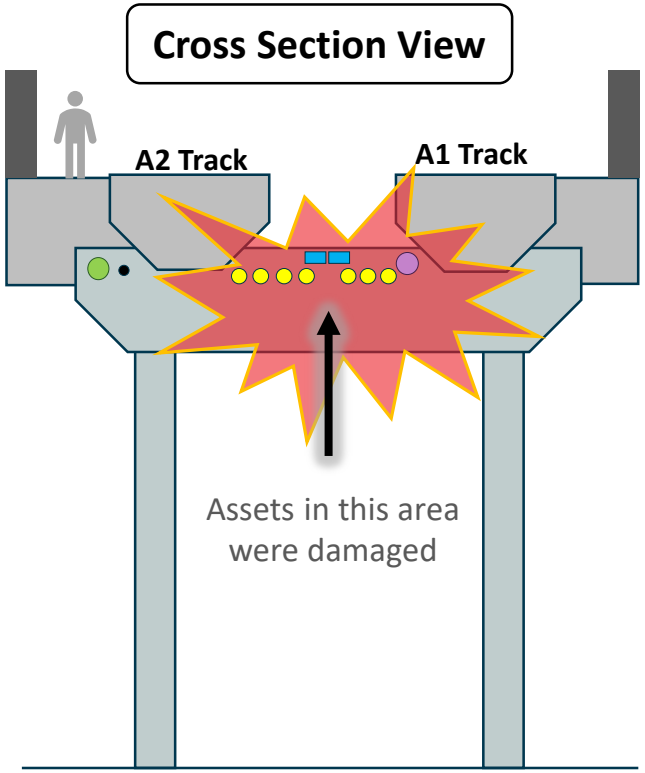


Event Timeline



Incident Description





Protection available at ASL:
- Circuit Breakers with Multifunction Protective Relays (MPR) for Overcurrent Protection
- Negative Grounding Device (NGD)
- Real Time Automatic Controller (RTAC)

Protection available at AYE:
- Circuit Breakers with Instantaneous Overcurrent

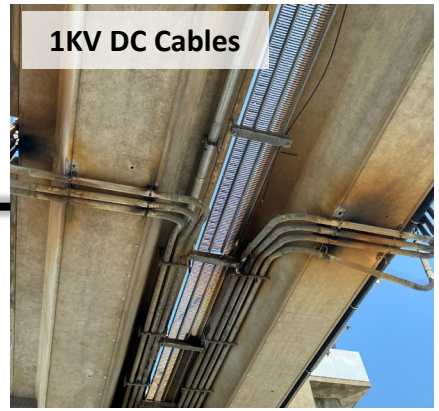
Train Control & Communication Cable Tray

1kV DC Conduit/Cable

34.5kV AC **Right** Conduit/Cable

34.5 kV AC **Left** Conduit/Cable

Incident Description



Coliseum Station — N — S — Bay Fair Station

Platform 2

A2 Track

A1 Track

Platform 1

1

2

3

- Train Control & Communication Cable Tray
- 1kV DC Conduit/Cable
- 34.5kV AC Conduit/Cable
- 3rd Rail
- Initial Fires
- Areas Impacted by Fire

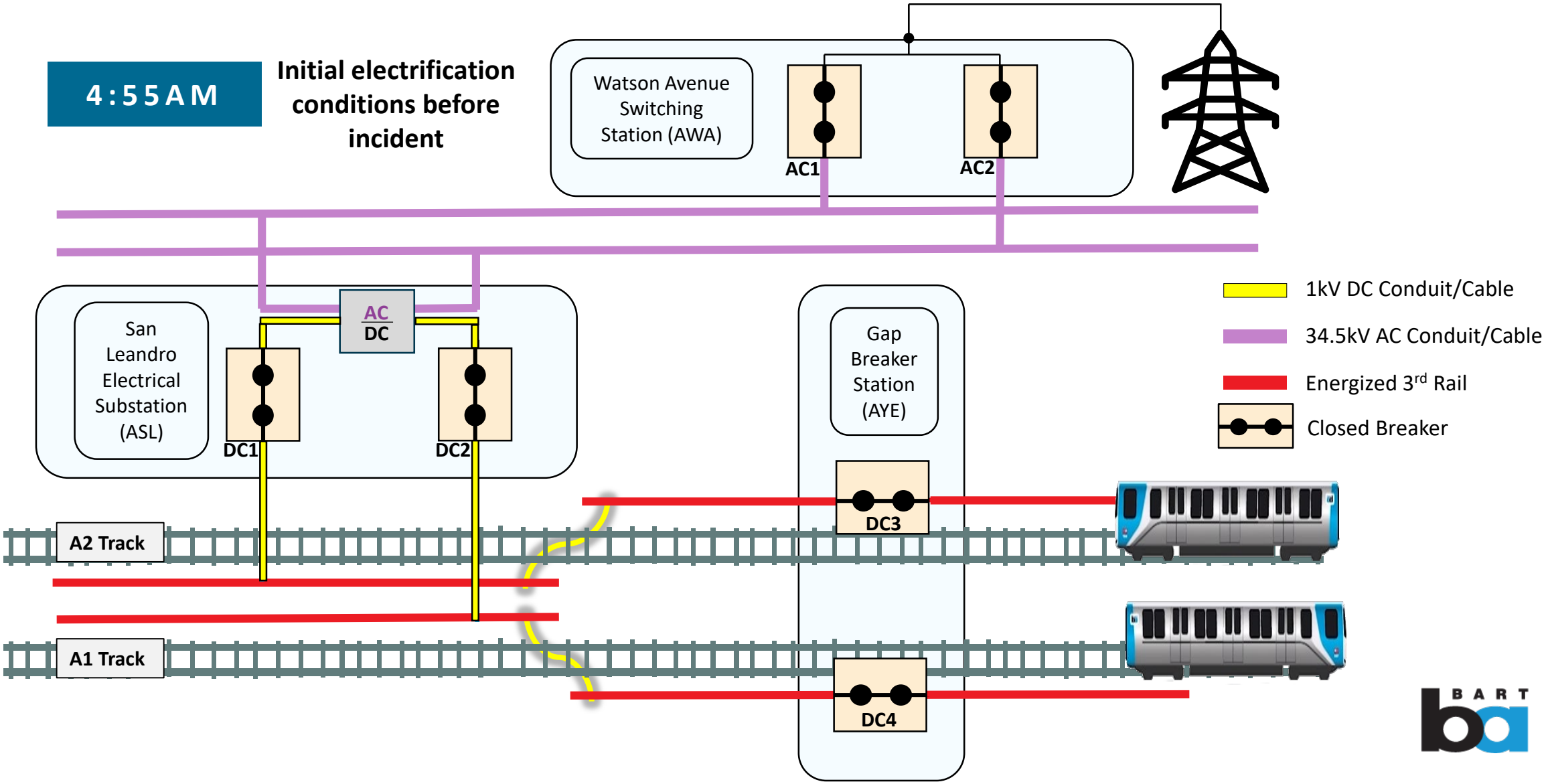
Train Control & Communication Cable Tray

1kV DC Conduit and Cables

Sequence of Events

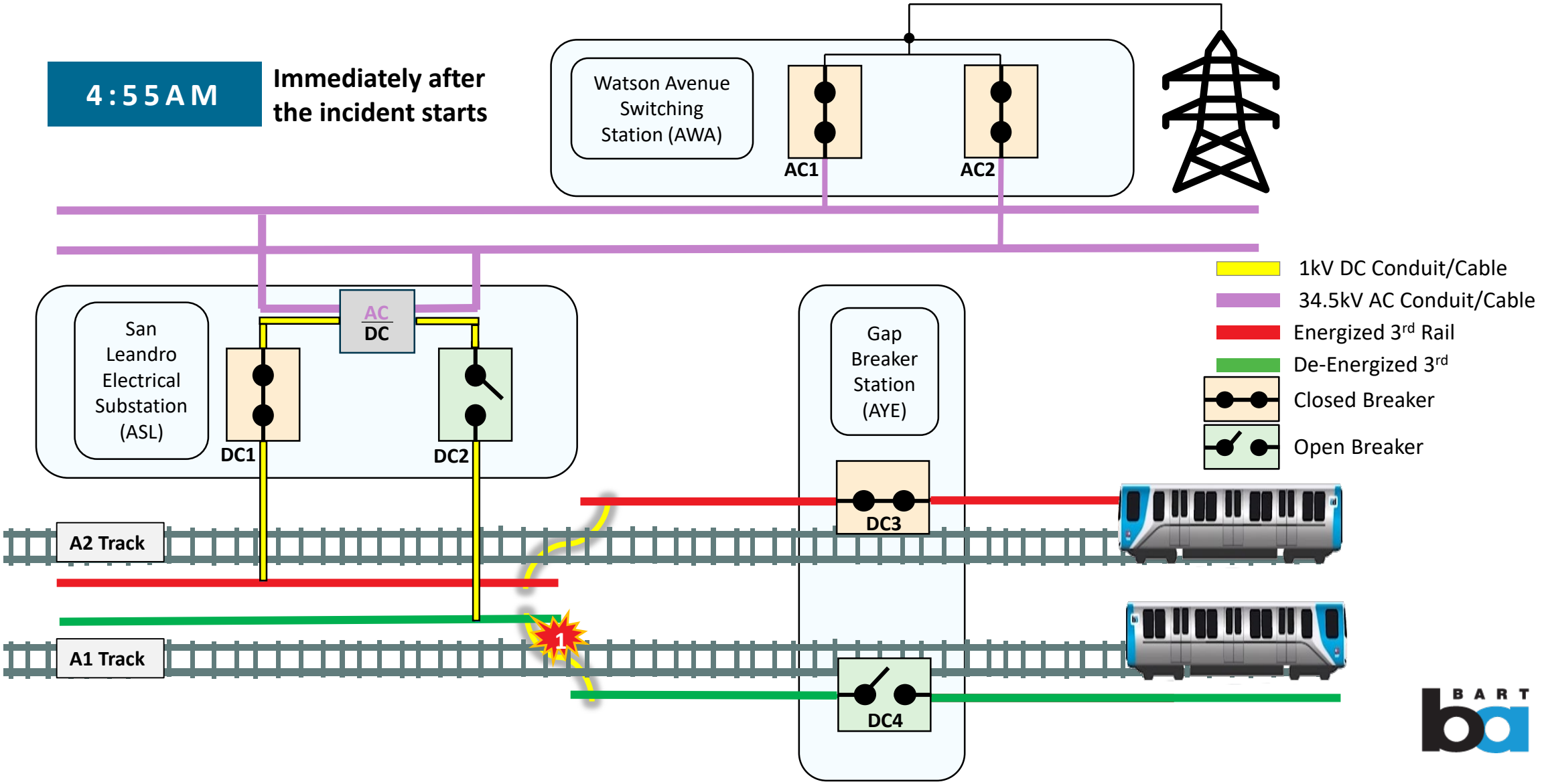
4:55AM

Initial electrification conditions before incident



Sequence of Events

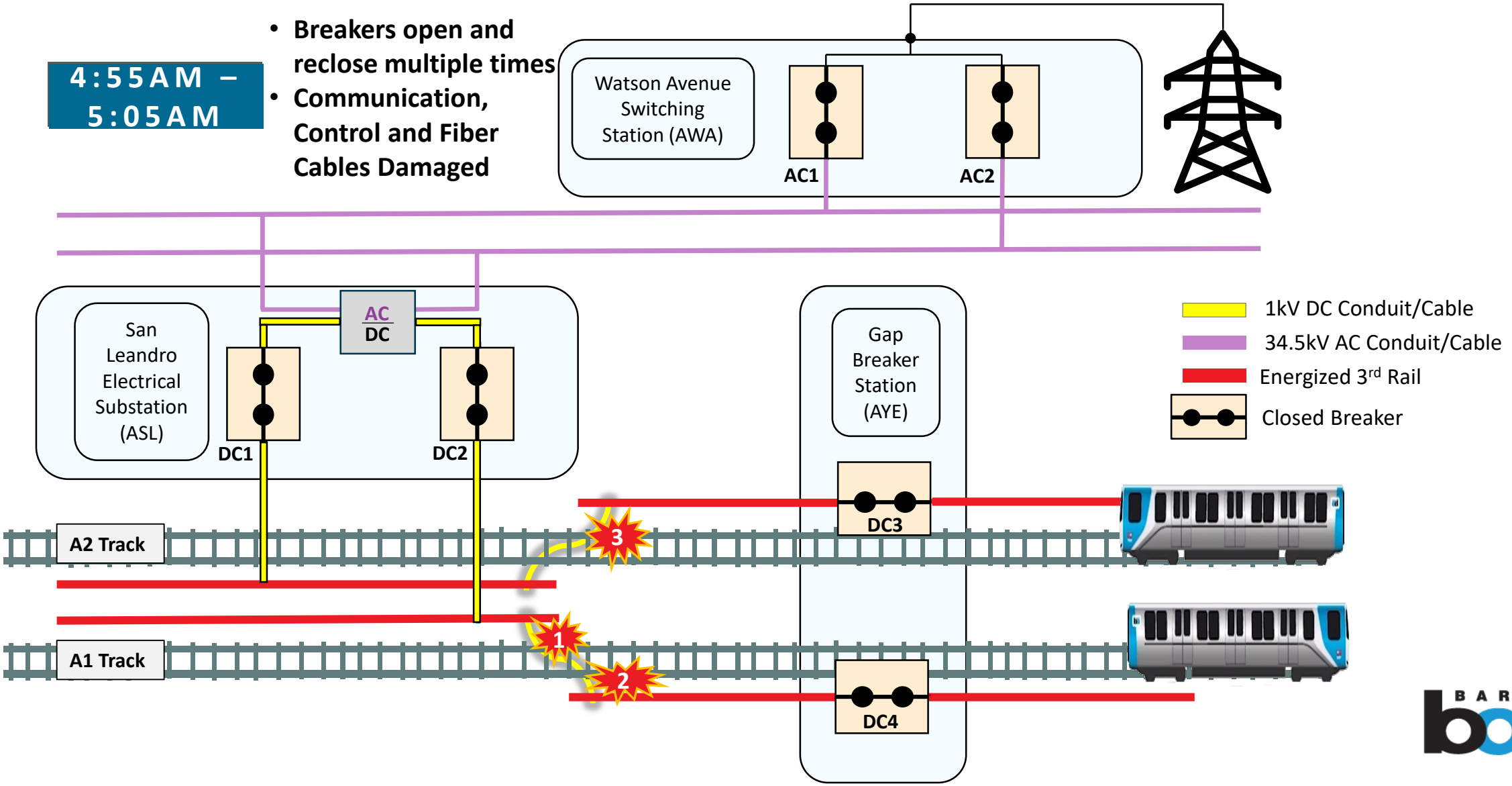
4:55AM **Immediately after the incident starts**



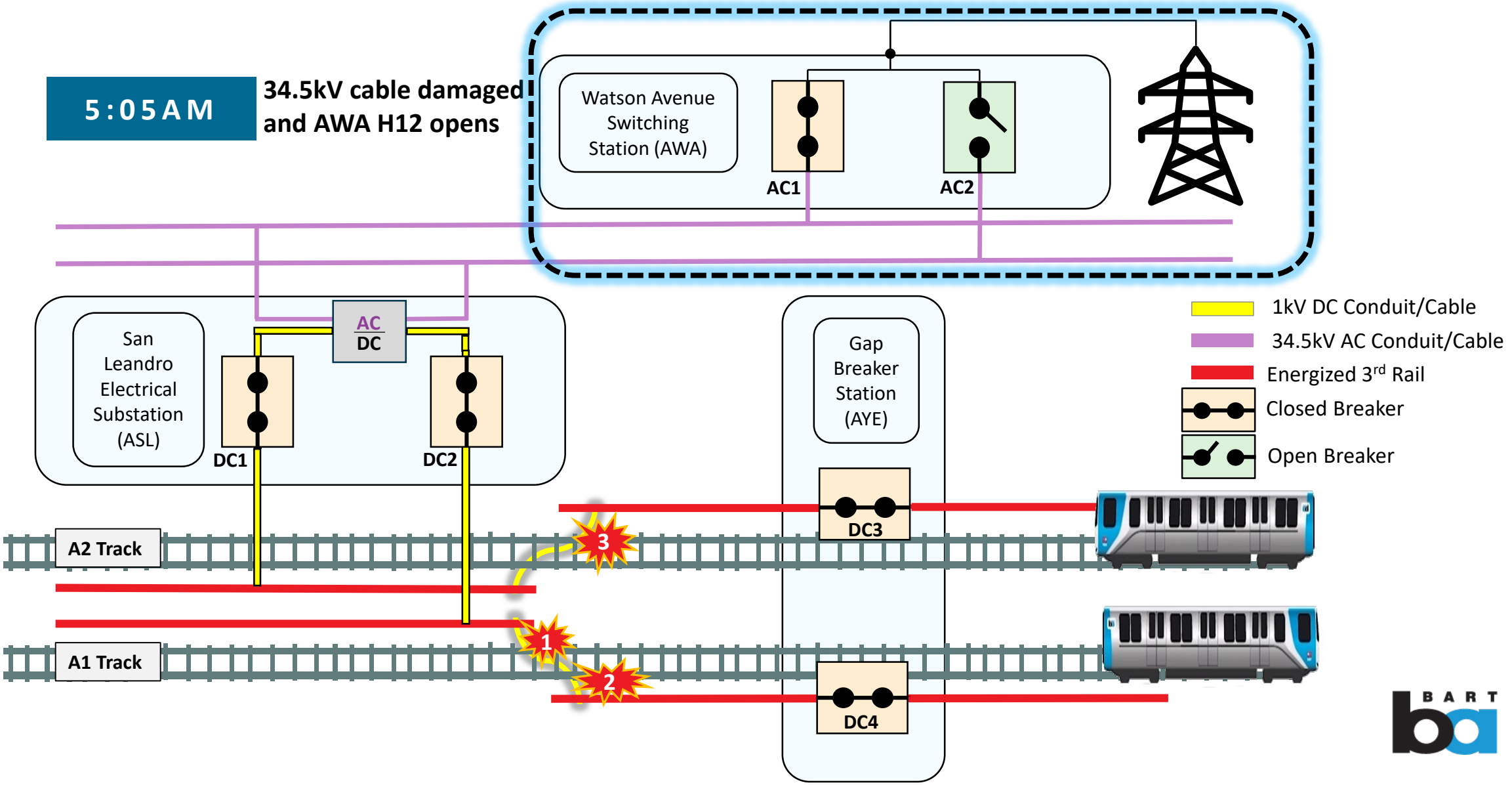
Sequence of Events

4:55AM – 5:05AM

- **Breakers open and reclose multiple times**
- **Communication, Control and Fiber Cables Damaged**



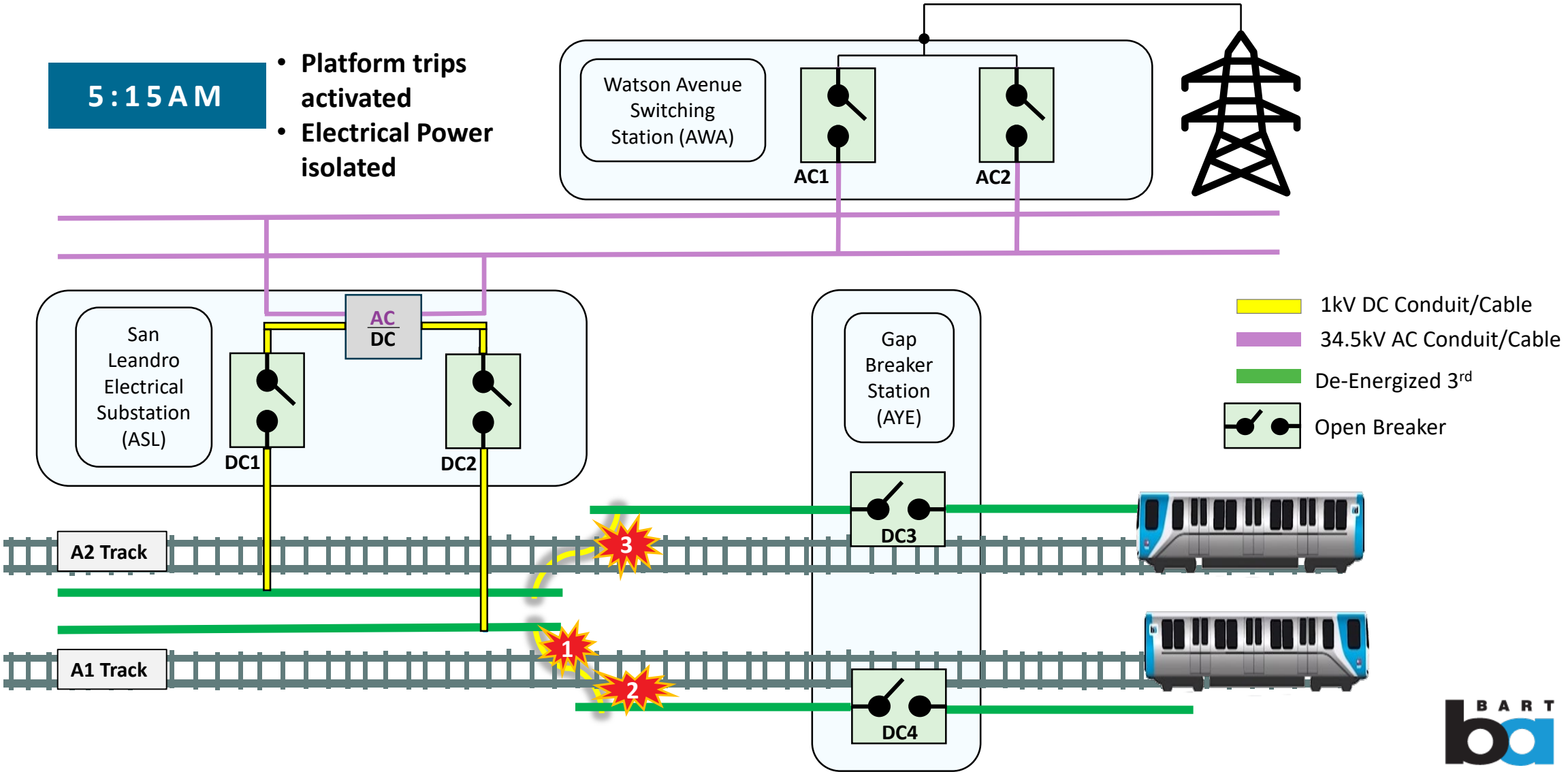
Sequence of Events



Sequence of Events

5:15AM

- **Platform trips activated**
- **Electrical Power isolated**



List of Damaged Equipment

Train Control

- MUX Boxes & Cards
- Two VTC Boxes
- Three Lightening Arrestor Boards
- 140 Lightening Arrestors for A and B MUX
- 70 (3 ½ Amp) Fuses
- A-MUX & B-MUX Cables (2200 ft each)
- Two Full Transmitter Loops
- Two Dual Receiver Coils
- Two Sun Shields
- Four (5 Amp) Fuses
- Two NSMUX WMD Board
- MUX 220VAC 30amp Breaker
- One Cab 33-1A Switch 480VAC 30amp Breaker
- Switch Signal cable 3000 ft (9C#14)
- Switch Power cable 3000 ft (3C#4)
- 10 SPSC Lightning Arrestors
- One SPSC 480VAC Transformer (7kVA 480VAC to 120VAC)
- One SPSC 480VAC 30amp Breaker
- Program Stop Cover Board Antenna 360 ft
- IDTX Cover Board Antenna 360 ft
- IDRX Cover Board Antenna 360 ft

Communications

- 96 strand sm fiber (48 strand SM fiber for A line)
- 96 strand sm fiber (48 strand SM fiber for L line)
- Commercial fiber 288SM fiber (of which 96SM are allocated to BART for the S-Line)
- 24 strand SM fiber for AYE
- 24 strand SM fiber for AWA
- 25 pair copper cabling for AWA
- 25 pair copper cabling for AYE
- 25 pair copper "A" Cable south
- 25 pair copper "B" Cable south
- Commercial fiber 48, 156 and 216 strand fiber cables

Traction Power

- 3,600 ft 34.5kV cable and conduit
- 9,600 ft of 1kV cable and conduit
- 32 Rosettes
- 96 Whips (36”)
- Coverboards

Key Investigation Findings & Lessons Learned

Initiating Cause: A low level Electrical fault (line to ground) in the 1kV DC power cable system

Initial fault (low level currents) turned into arcing fault and fire

Fire and arc blasts caused damage to nearby 34.5kV cables, Train Control and Communications equipment propagating into additional faults and fires

Electrical Protection Systems activated but did not isolate the fault due to initial low level fault currents and its design to preserve continuity of service

Remote control ability from OCC was lost due to damaged to Train Control and Communications equipment

Key Investigation Findings & Lessons Learned

Risks

- Similar Power System design and electrical protection schemes Systemwide
- Long satisfactory operating experience and performance
- Nature of fault event and impacts are extremely rare
- **Likelihood of similar repeat events are very low**

Design

- **Balance Continuity of Service and Equipment Protection** (Key Design Criteria)
- Multiple Layers of Protection
- Electrical Protection Schemes with features to reduce nuisance trips
- Ungrounded DC Power System

Equipment, Programs, Processes

- Continue renewal and modernization of legacy equipment
- Optimize Preventative and Predictive Maintenance Programs and Processes
- Improve physical layout / separation of power and communication assets where feasible

Actions in Progress

Short Term Action Plans

- ❑ Infrastructure Repairs & Replacement
- ❑ Install and adjust Protective Equipment Settings where needed
- ❑ Review Inspection and Maintenance Program, and Electrical Protection Schemes for enhancements

Long Term Action Plans

- ❑ Complete replacement of damaged assets
- ❑ Assess Power System Protection & Detection Improvement Opportunities
- ❑ Assess innovative tools and life cycle management improvement opportunities

Thank You