

# Sandbar Phase Shifting Transformer Incident



Operating Committee  
March 18, 2021

# Background

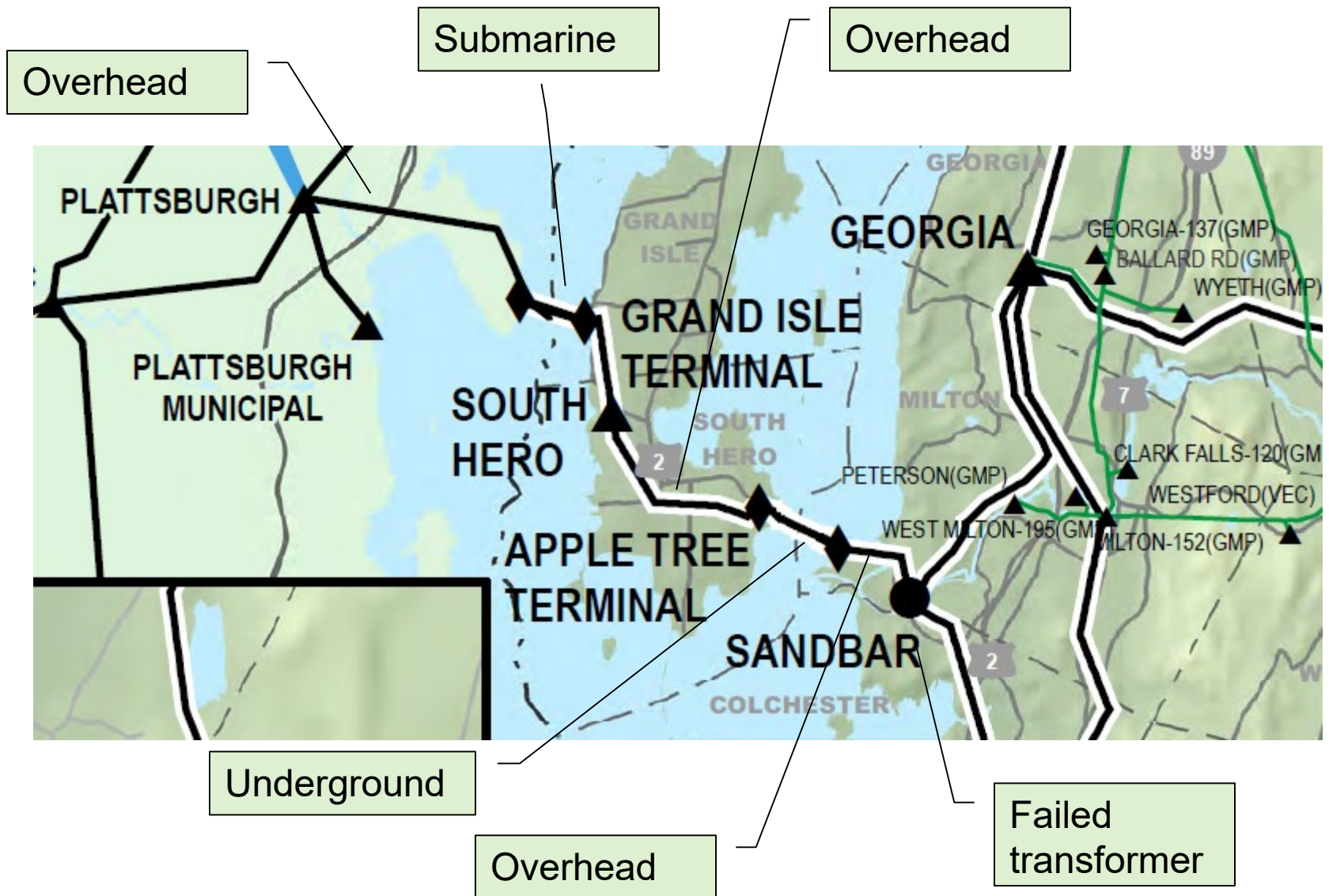
- What is a PST?
  - Phase Shifting Transformer is a complex device used to change the voltage angle on a line to either increase or decrease flows
  - Expensive and fairly unique
  - Due to the geography of VT, VELCO has 4 PST's
  - Approximate replacement cost is up to \$6M each
  - Sandbar (PV-20) PST was installed in 2004
- Where does VELCO have them
  - Sandbar (NY/VT) line
  - Blissville (NY/VT) line
  - Granite (2 PST's on NH/VT) 230kV line

# Sandbar Phase Shifting Transformer





# PV20 line description



# PV20 line operation and planning framework

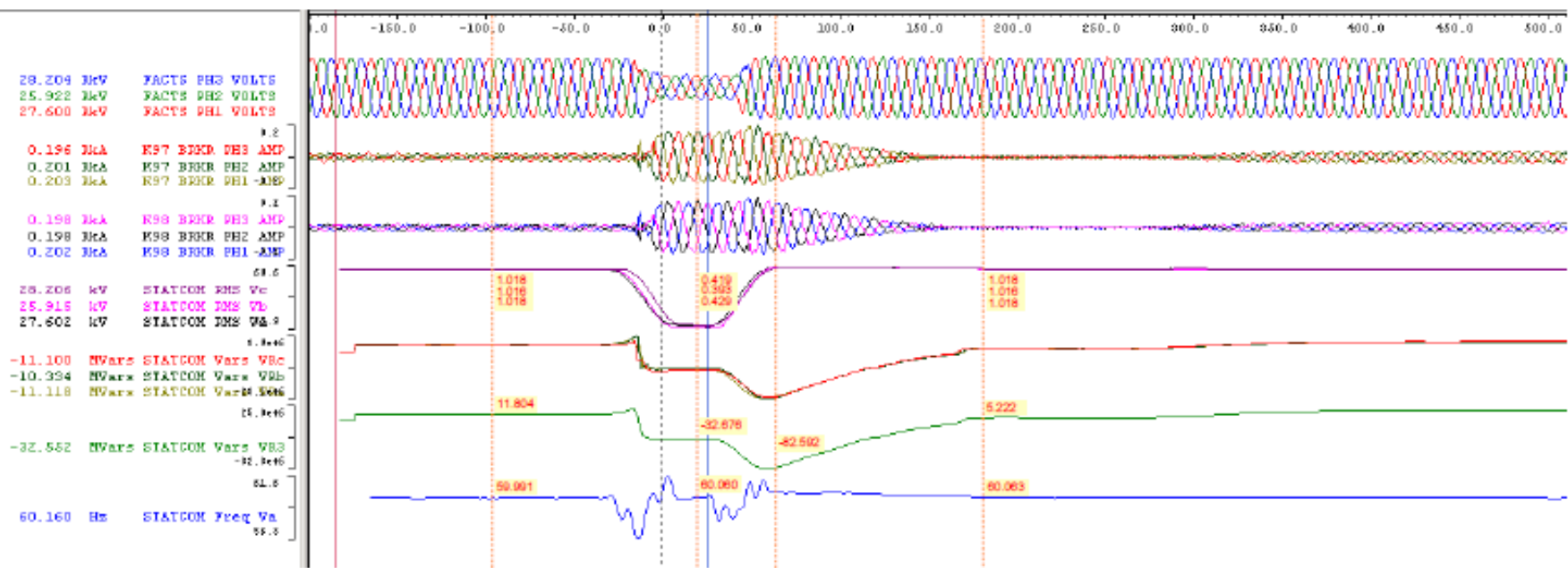
- Operated at 115,000 volts
- Owned by NYPA and VELCO
- Operated by NYISO, ISO-NE, NYPA and VELCO
- Tie line between two operating regions
- New England Pool Transmission Facility
  - Under ISO-NE's planning authority
  - Regional funding requires ISO-NE approval
    - ISO-NE determines that the upgrade is needed and is the most cost-effective solution for the region

# Failure Sequence

- PST tripped off at 4:41 on February 22
- Unit was removed from service in 3.5 cycles (1 cycle is 1/60 of a second)
- Some VEC load was dropped out of South Hero substation while line work was being performed on the New York side of the PV20
- The fault in the PST was a significant short circuit lowering voltage throughout Northern VT for 3.5 cycles (see next slide)

115 kV Network - Voltage Dip Impact  
of PST Fault 2/22/2021





11.804 - (-32.676) = 44.48 MVAR change (while under low voltage)  
 32.676 / 0.414 pu (ignoring filters V-q) = 78.927 MVAR (if not in under voltage) compared with post  
 recovery 82.592 MVAR. 11.804 + 82.592 = 94.4 MVAR change (compensating for undervoltage)



# PST at factory before tanking



# Electrical tracking across the wood supports

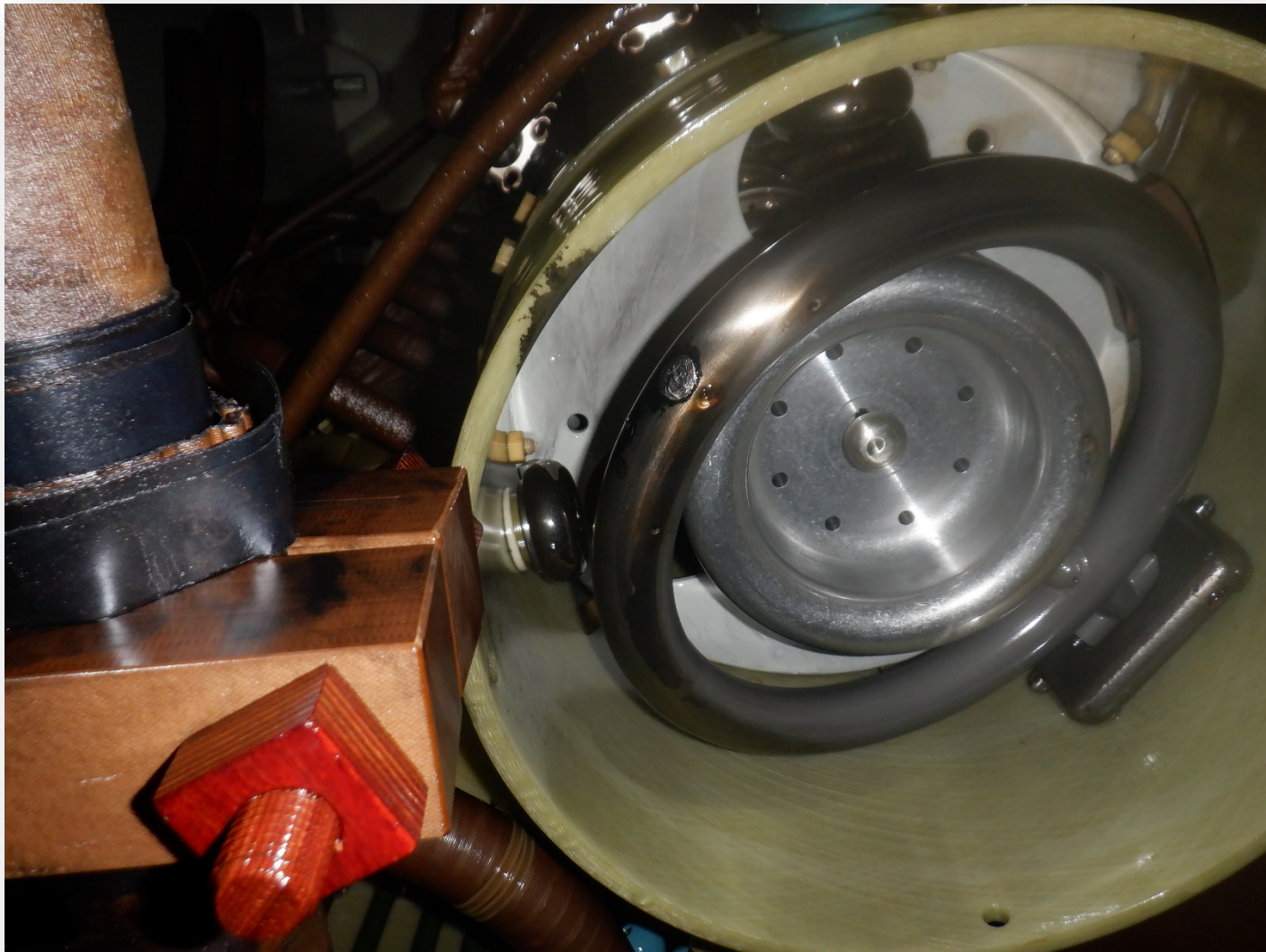




# Fault between the two phases



# Electrical fault flashed to corona ring





# Fault pressure shifted bushing





# 1970's GE PV20 Circuit Breaker



# Next Steps

- Sandbar PST to be taken apart and moved off foundation
- Granite PST Unit
  - Mineral Oil to be emptied week of March 15
  - Inspection of unit March 22
  - If ok, re-location contract to be awarded
  - Move schedule being developed
- A repair scope for the Sandbar Unit developed
  - Unit to be shipped back to Netherlands
  - Discussions on who pays and how much
    - Insurance coverage review