UFLS Philosophy with Increasing Subtransmission BESS Resources

July 8, 2025

Current UFLS Plan

- SOB115 documents SCE's procedure for automatic/manual implementation of WECC's Off-Nominal Frequency Load Shedding Plan
- SCE's UFLS Plan sheds load in blocks based upon the degree of frequency decline
- A bank load tripping is accomplished by tripping low-side A bank CBs.

SCE Underfrequency Load Shed Plan

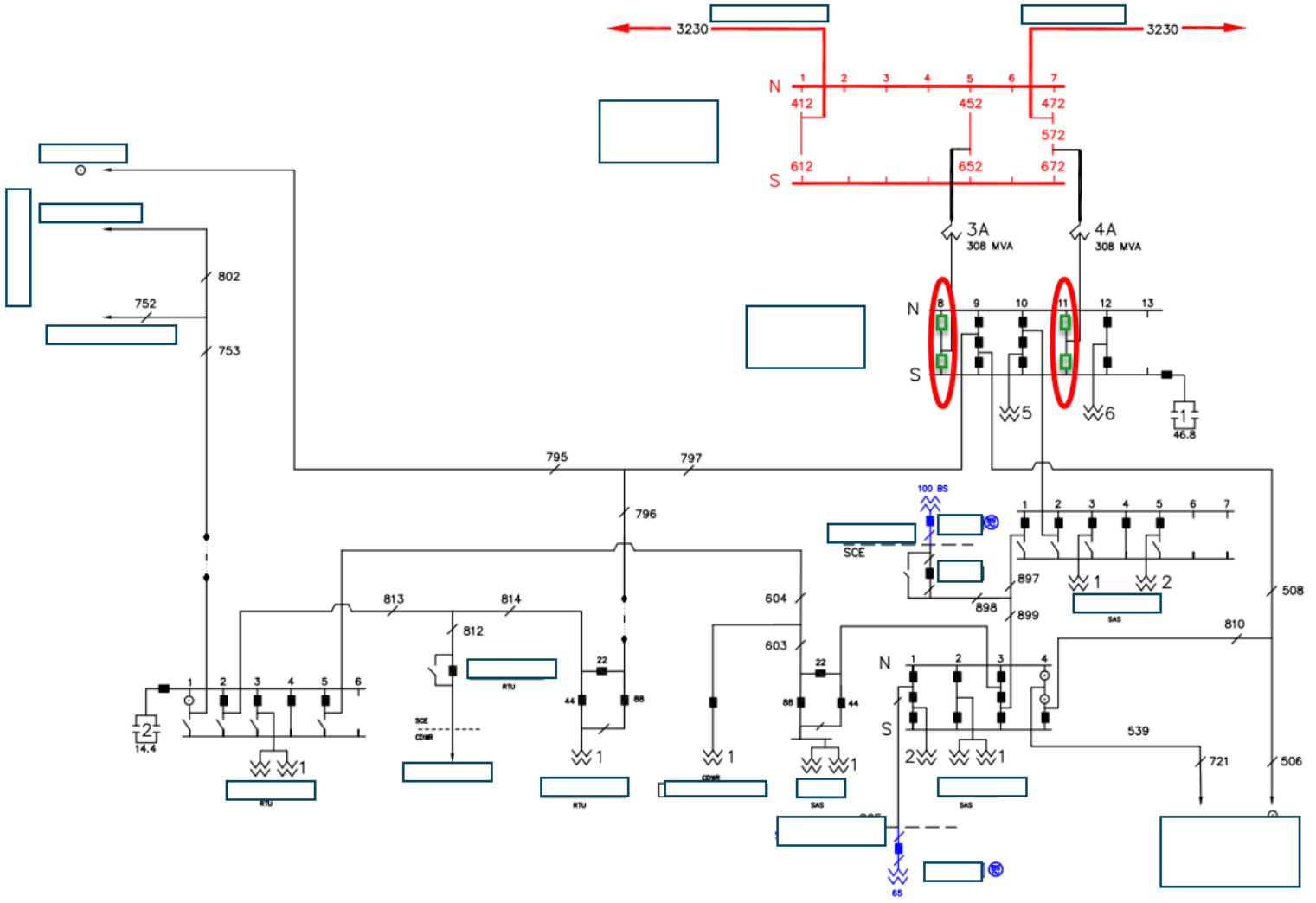
- **59.5 Hz**
  - Various generators are started
  - CAISO AGC trips off control
  - Trip ~300 MW
- **59.3 Hz**
  - Trip ~800 MW
- **59.1 Hz**
  - Trip~900 MW
- **58.9 Hz**
  - Trip ~1,000 MW
- **58.7 Hz**
  - Trip ~1,100 MW
- **58.5 Hz**
  - Trip ~1,200 MW
- **58.3 Hz**
  - Trip ~1,100 MW
- **58.1 Hz**
  - Trip ~1,900 MW
- **57.9 Hz**
  - Trip ~1,800 MW
  - All interconnects open (1 sec time delay)
- **57.7 Hz**
  - Trip ~2200 MW

UFLS with Subtransmission BESS

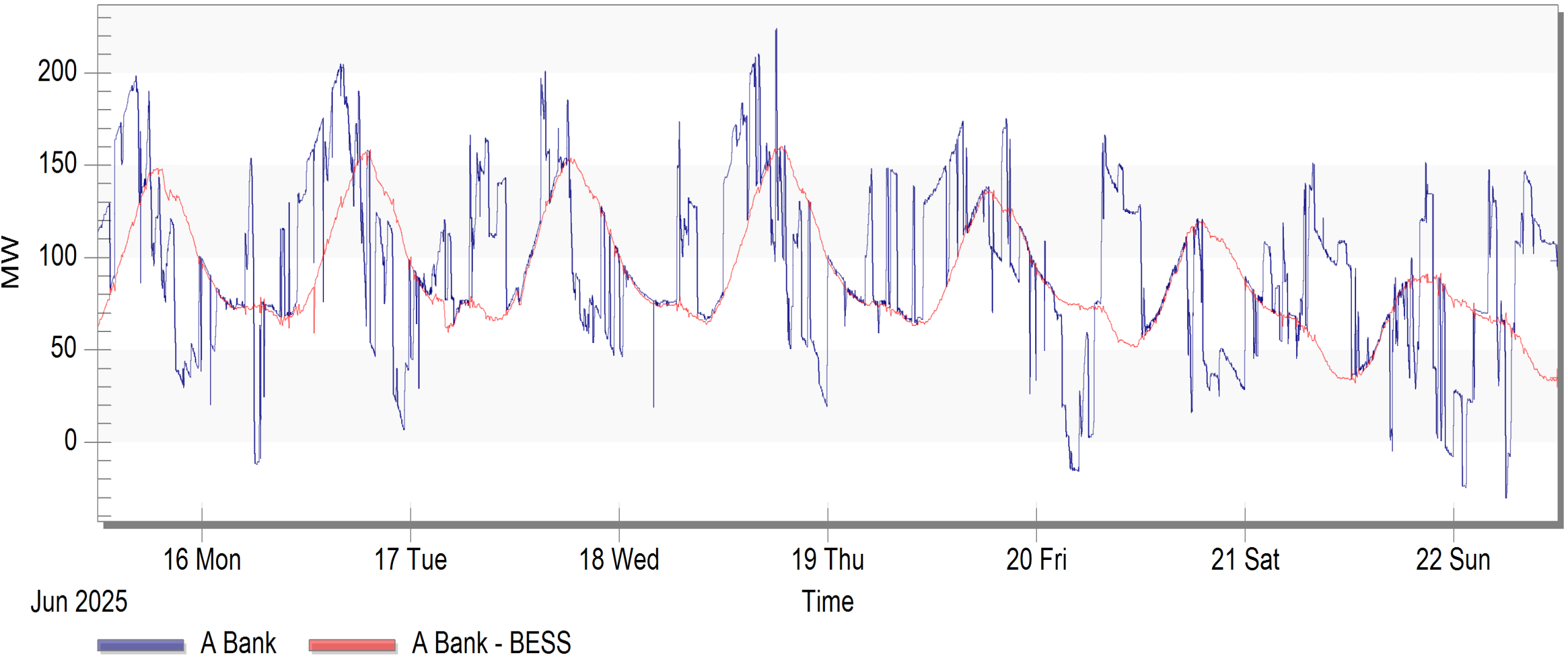
- **Problem Statement:**
  - Due to increasing subtransmission generation (including BESS), UFLS tripping blocks may deviate significantly from planned percentages, and may at times incorrectly trip net generating systems.

- **Analysis: UFLS under varying BESS states**
  - **BESS Discharging:** Negative Course of Action
    - Tripping A banks while BESS is discharging will result in either:
      - Smaller than expected frequency increase **OR**
      - Further frequency decrease (depending on amount of BESS)
  - **BESS Charging:** Positive Course of Action
    - Tripping A bank while BESS charging will arrest frequency decline/increase frequency
    - Primary Frequency Response complicates analysis

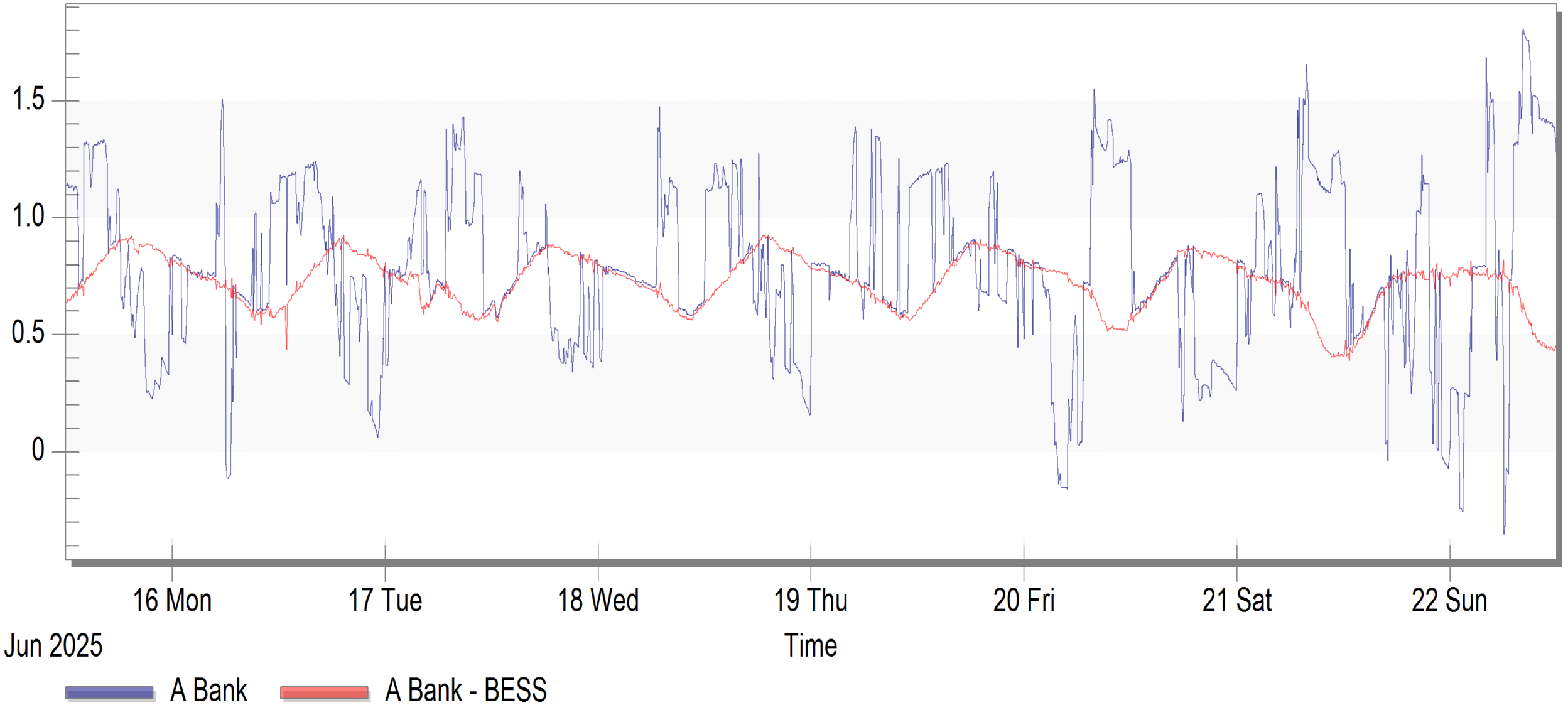
UFLS:
Open A-Bank 115 kV CBs



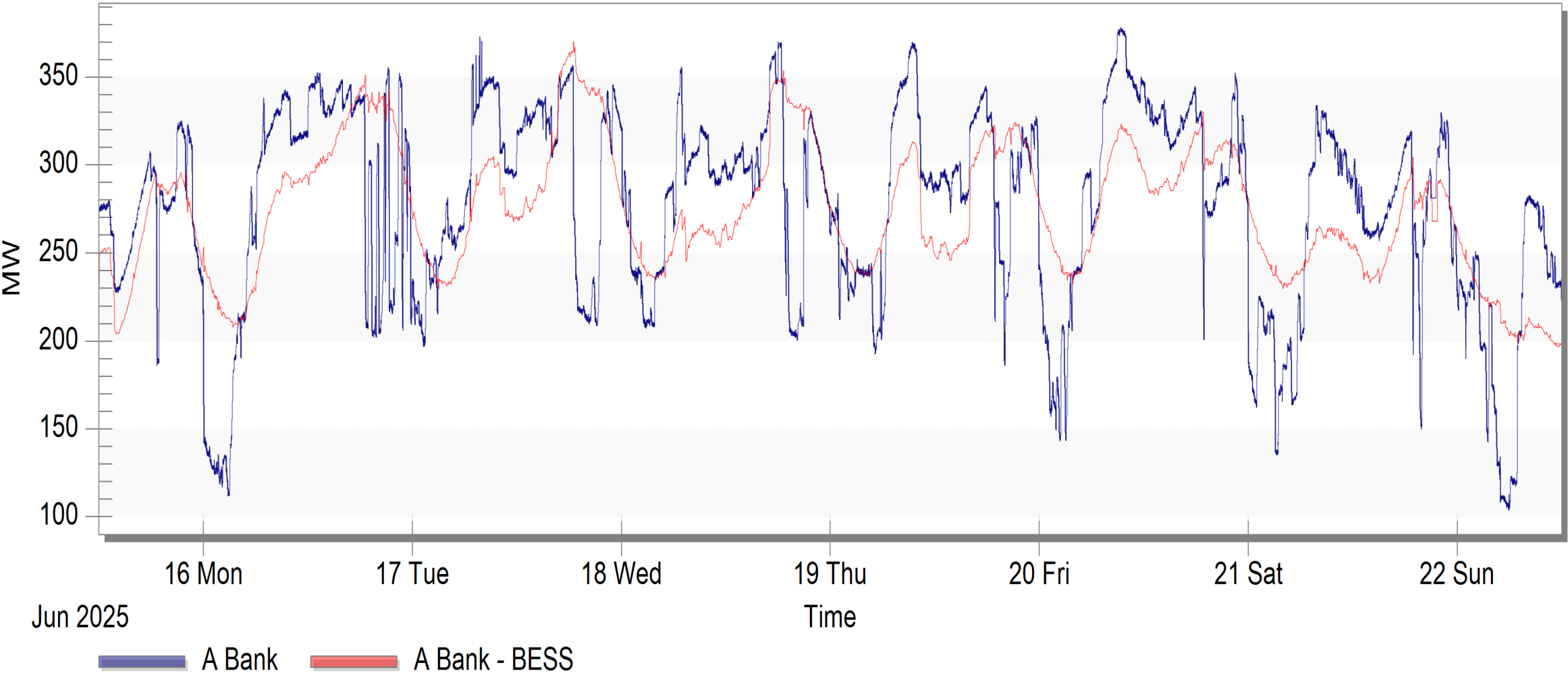
Example Station #1 (MW)



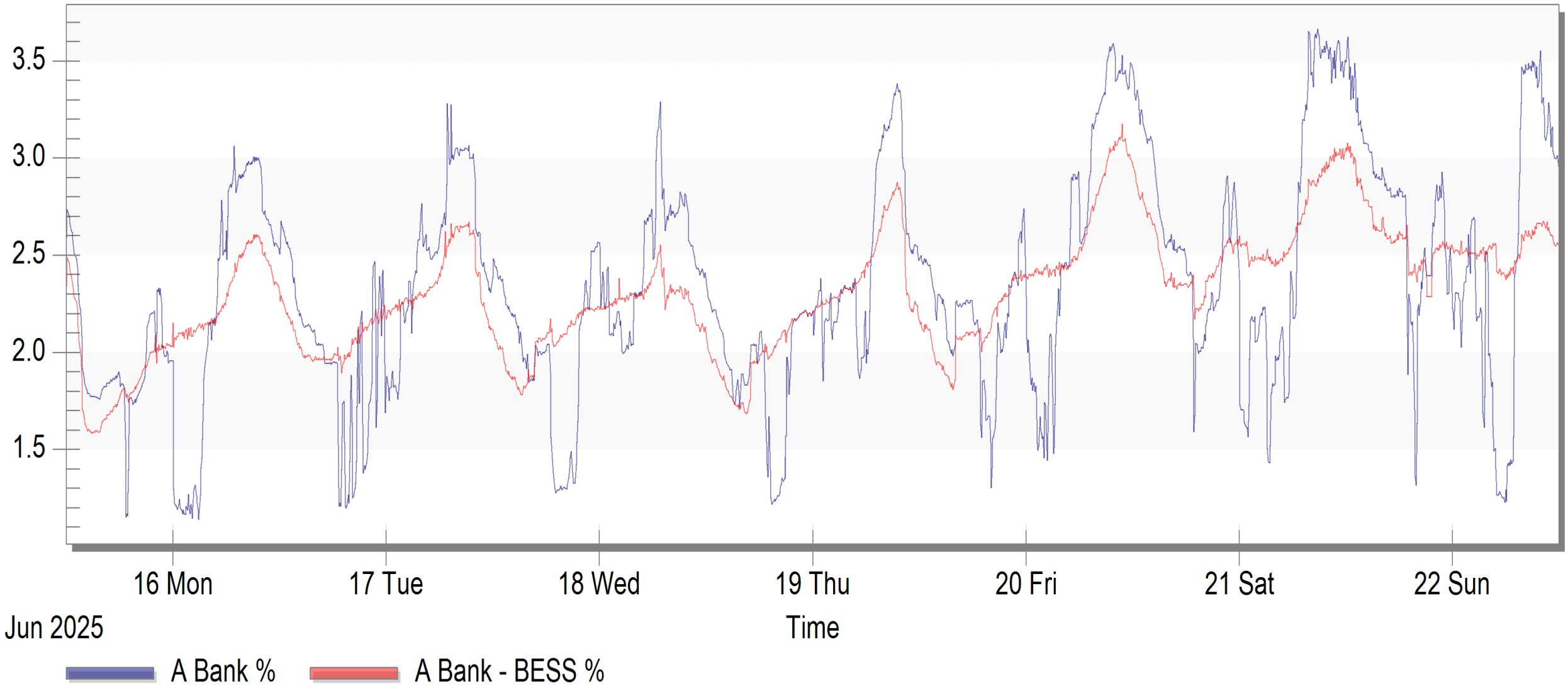
Example Station #1 (Percent of total load)



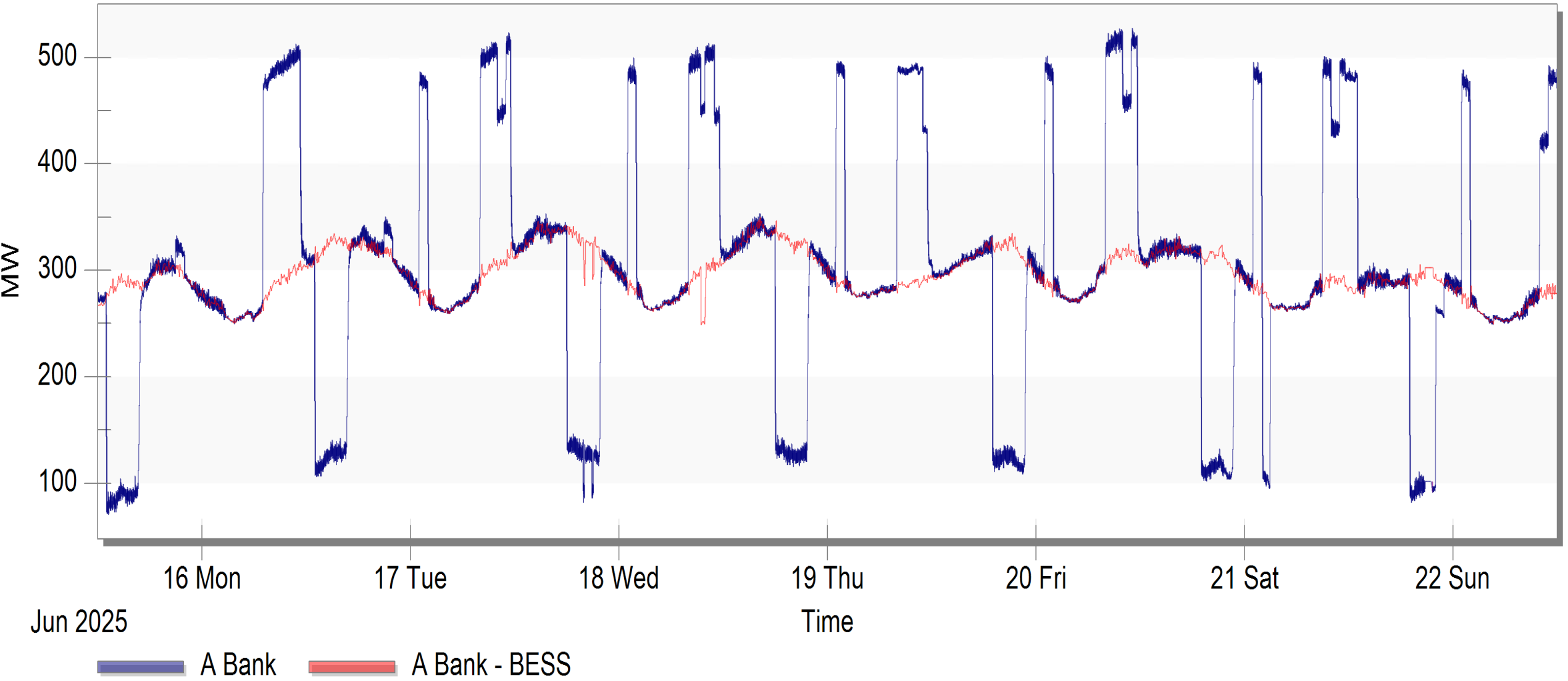
Example Station #2 (MW)



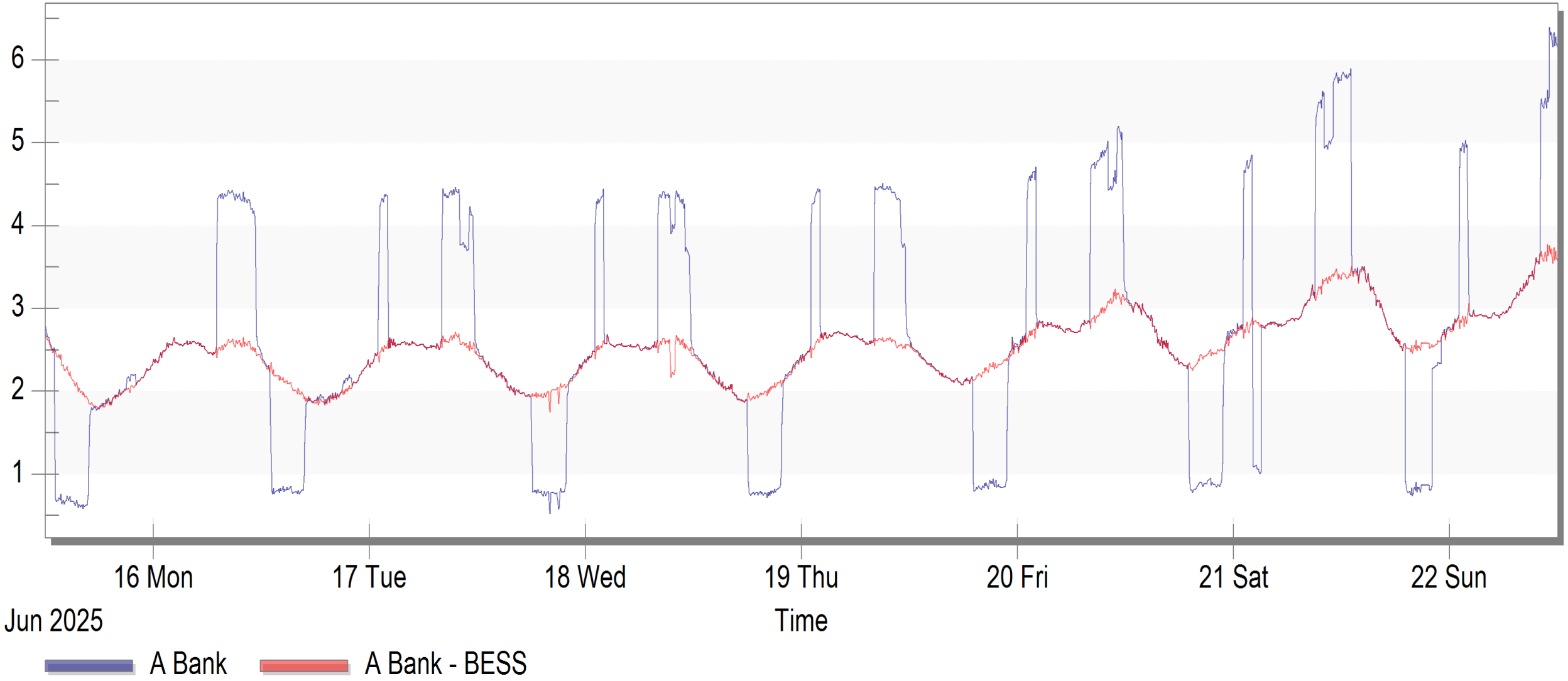
Example Station #2 (Percent of total load)



Example Station #3 (MW)

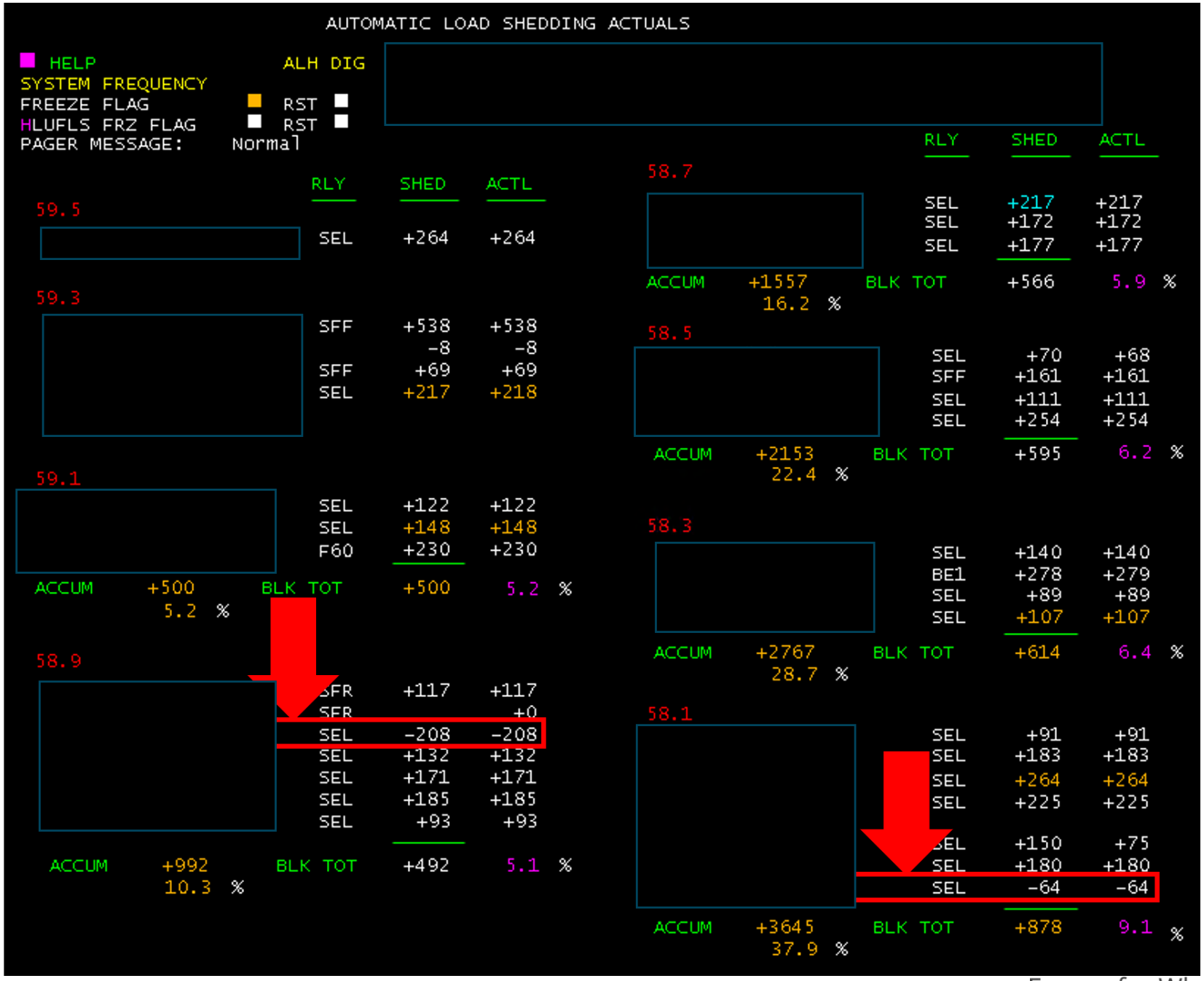


Example Station #3 (Percent of total load)



If UFLS were triggered at this point in time, two exporting stations would be tripped.

Tripping exporting A bank systems will increase frequency decline.



Moving Forward

"The Ask":

If we all agree that SCE's UFLS program should consider the impact of subtransmission connected resources, then **how should we adjust our UFLS program to align with the needs of our changing system, and who should lead this effort?**

Ideas:

- Exclude systems with high penetrations of BESS from the UFLS program, or move these systems to lower frequency blocks
  - (This is likely not sustainable forever)
- Trip highly variable loads (BESS) separately and at higher frequency thresholds so that they don't impact the main tripping block(s)
- Trip load at lower voltage levels (i.e. at the B bank level)
- UFLS CRAS?
- Other?
  - How are other similarly situated utilities handling this situation?

Expanding on Tripping BESS Loads separately:

- **Solution:**
  - Modify UFLS Scheme and add relays to trip BESS units prior to SCE load
  - Begin tripping BESS units when system frequency declines to 59.5 Hz (only if they are charging)
- **Considerations:**
  - UFLS relays must consider flow directionality and only trip BESS units if charging
  - Primary Frequency Response of BESS units
- **Questions to Consider:**
  - Should SCE install our own UFLS relay?
  - Do we require a BESS owned/operated relay?

Modified UFLS Scheme:

- **59.5 Hz**
  - Start Generators
  - BESS units trip (ONLY if charging)
  - Trip ~300 MW
- **59.3 Hz**
  - Trip ~800 MW
- **59.1 Hz**
  - Trip ~900 MW