# UFLS Philosophy with Increasing Subtransmission BESS Resources

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## 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

 $\circ$  Trip ~800 MW

### • 59.1 Hz

 $\circ$  Trip~900 MW

## • 58.9 Hz

 $\circ$  Trip ~1,000 MW

### • 58.7 Hz

 $\circ$  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
  - $\circ$  Trip ~1,800 MW
  - All interconnects open (1 sec time delay)

## • 57.7 Hz

 $\circ$  Trip ~2200 MW

3

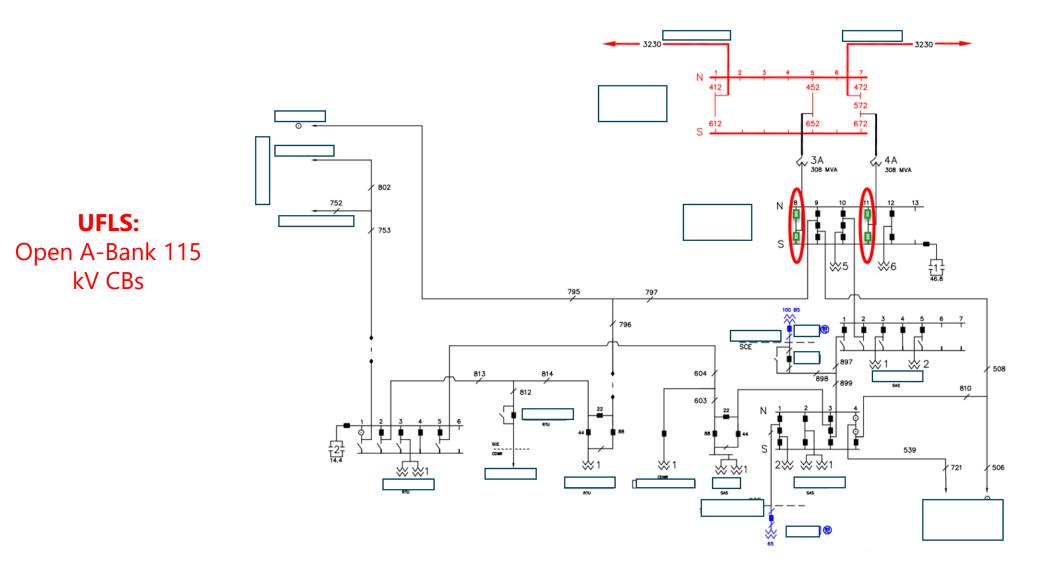
# UFLS with Subtransmission BESS

## Problem Statement:

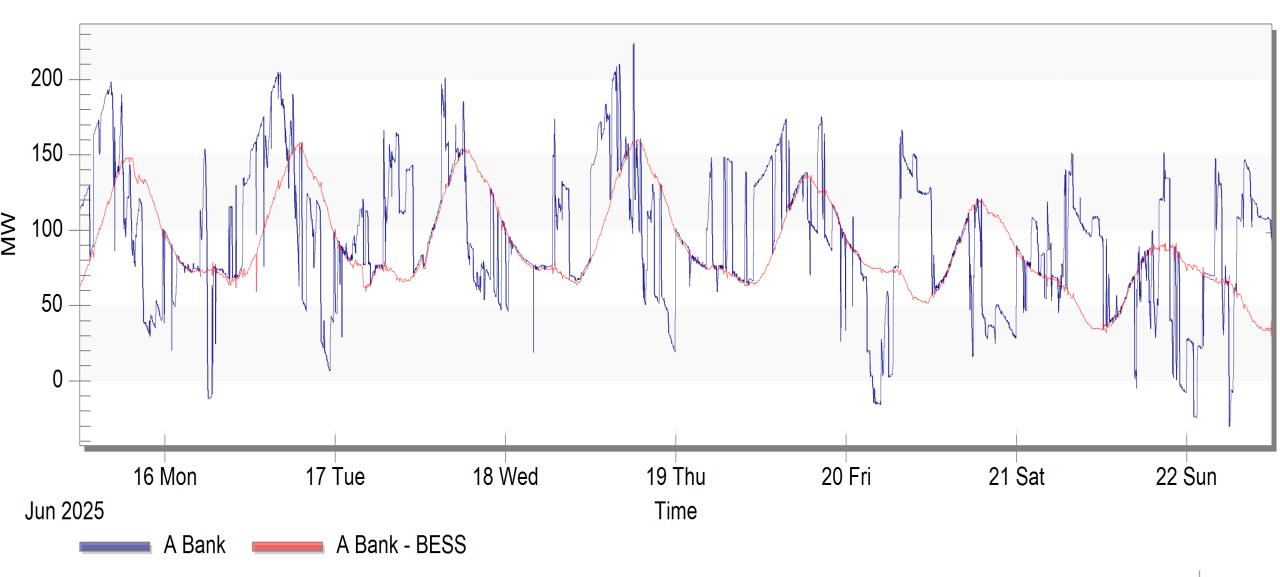
 Due to increasing subtransmission generation (including BESS), UFLS tripping blocks may deviate significantly from planned percentages, and may at times incorrectly trip net generating systems.

## • Analysis: UFLS under varying BESS states

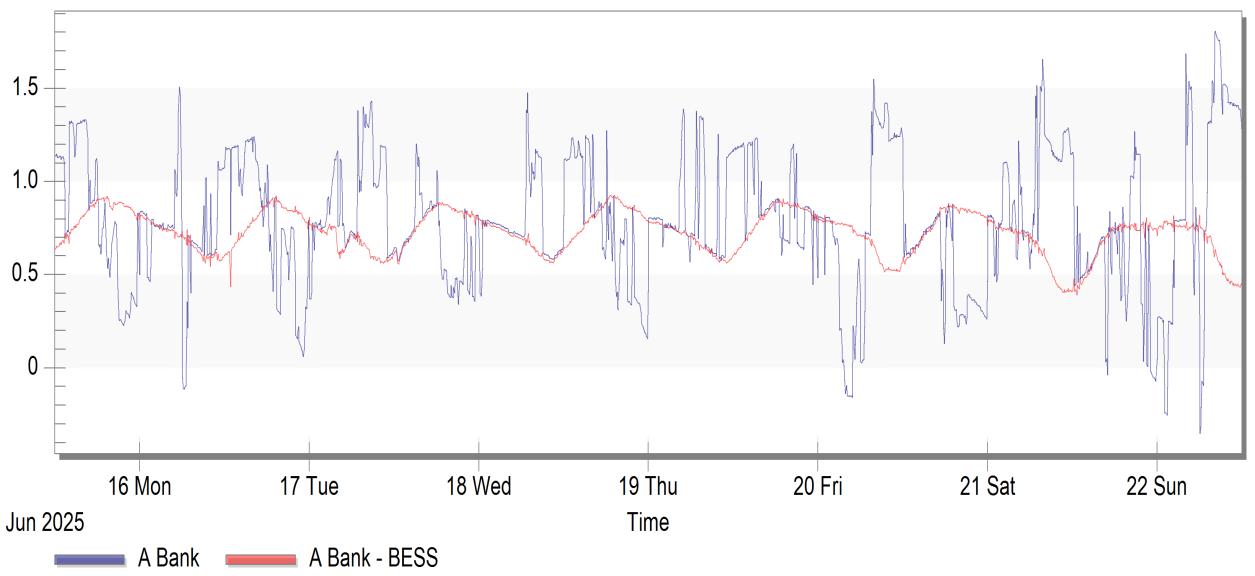
- BESS Discharging: Negative Course of Action
  - Tripping A banks while BESS is discharging will result in either:
    - Smaller than expected frequency increase **OR**
    - Further frequency decrease (depending on amount of BESS)
- **BESS Charging:** Positive Course of Action
  - Tripping A bank while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



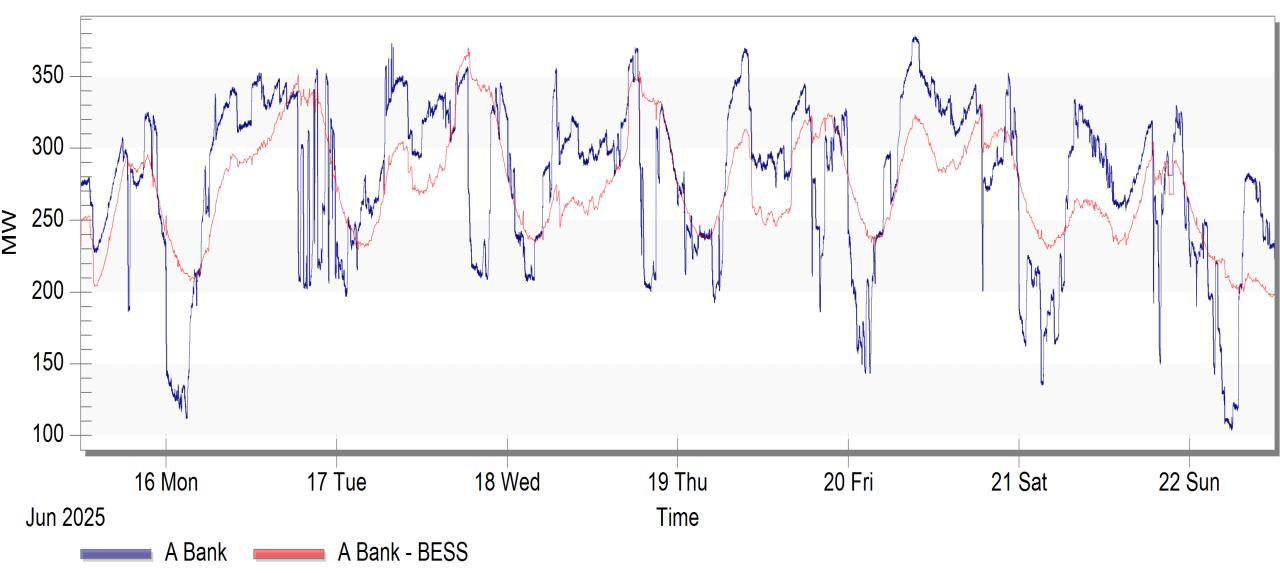
## Example Station #1 (MW)



## Example Station #1 (Percent of total load)

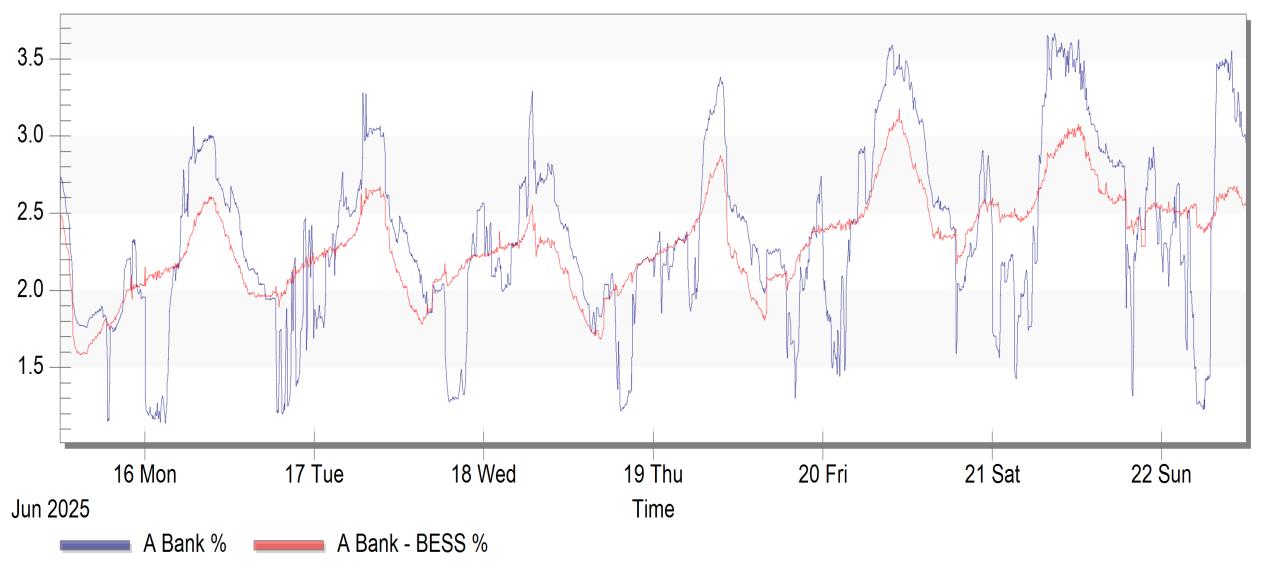


## Example Station #2 (MW)

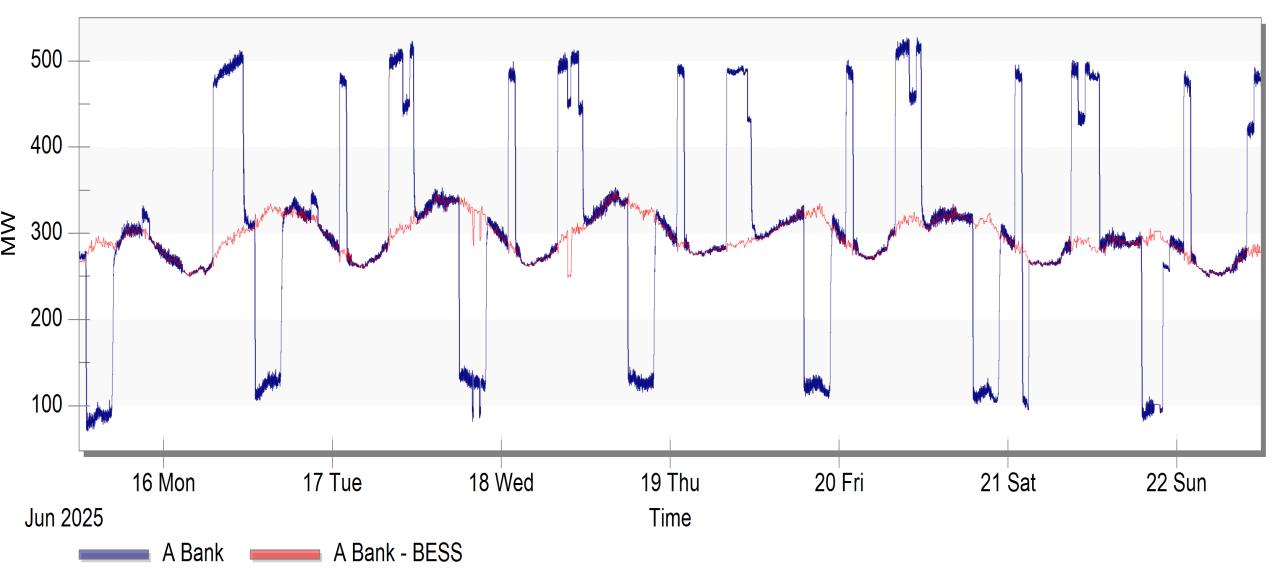


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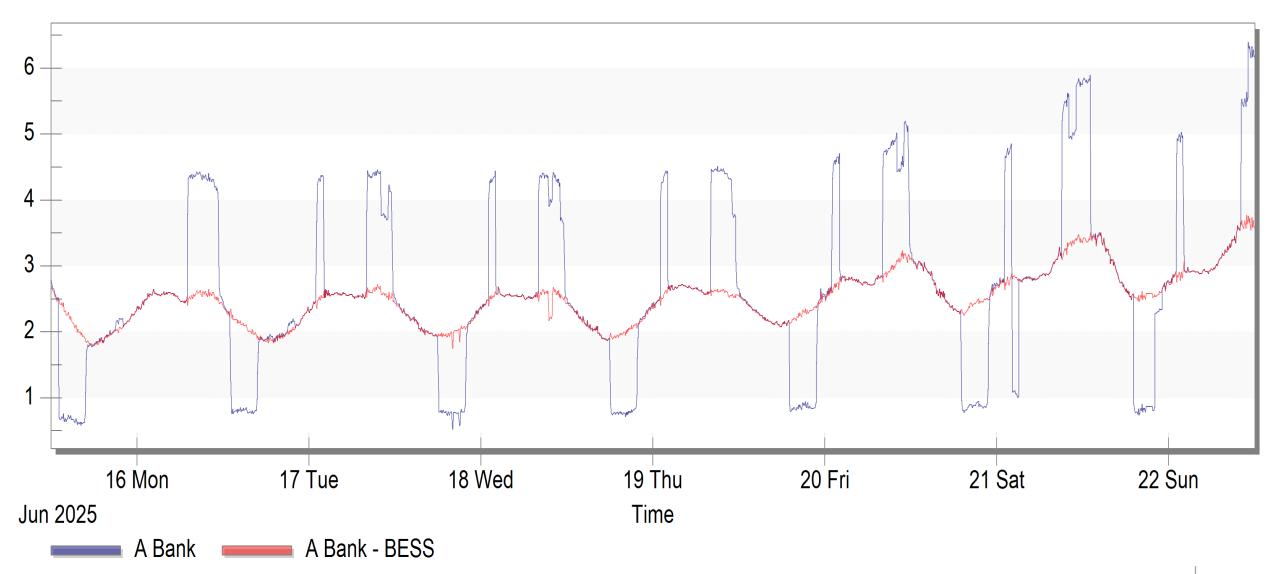
## Example Station #2 (Percent of total load)



## 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.

AUTOMATIC LOAD SHEDDING ACTUALS									
HELP	ALH DIG								
SYSTEM FREQUENCY FREEZE FLAG	RST								
HLUFLS FRZ FLAG PAGER MESSAGE:	RST Normal						RLY	SHED	ACTL
TAGEN HEBBAGE					58.7				
59.5	RLY	SHED	ACTL				SEL	+217	+217
39.3	SEL	+264	+264				SEL	+172	+172
	SEL	+204	+204				SEL	+177	+177
59.3					ACCUM	+1557	BLK TOT	+566	5.9 %
19.3	SFF	+538	+538			16.2 %			
	SEE	-8	-8		58.5		SEL	+70	+68
	SFF	+69	+69				SFF	+161	+161
	SEL	+217	+218				SEL	+111	+111
							SEL	+254	+254
59.1					ACCUM	+2153 22.4 %	BLK TOT	+595	6.2 %
	SEL	+122	+122						
	SEL	+148	+148		58,3				
	F60	+230	+230				SEL	+140 +278	+140 +279
ACCUM +500	BLK TOT	+500	5.2	%			BE1 SEL	+278 +89	+279 +89
5.2	%						SEL	+107	+107
58.9					ACCUM	+2767	BLK TOT	+614	6.4 %
50.9	۶FR	+117	+117			28.7 %			
	SER	+11/	+11/		58.1				
	SEL	-208	-208				SEL	+91	+91
	SEL	+132	+132				SEL	+183	+183
	SEL SEL	+171 +185	+171 +185				SEL	+264	+264
	SEL	+103	+10]				SEL	+225	+225
							EL	+150	+75
ACCUM +992	BLK TOT	+492	5.1	%			SEL	+180	+180
10.3	%						SEL	-64	-64
					ACCUM	+3645 37.9 %	BLK TOT	+878	9.1 %
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## 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
  - $\circ\,$  (This is likely not sustainable for ever)
- 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?
  - $\,\circ\,$  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:

- o Should SCE install our own UFLS relay?
- Do we require a BESS owned/operated relay?

## **Modified UFLS Scheme:**

#### • 59.5 Hz

- Start Generators
- o BESS units trip (ONLY if charging)
- $\circ$  Trip ~300 MW

## • 59.3 Hz

- Trip ~800 MW
- **59.1 Hz** • Trip ~900 MW