

Sand Bar Phase Shifting Transformer Asset Condition



VSPC Meeting
April 17, 2024

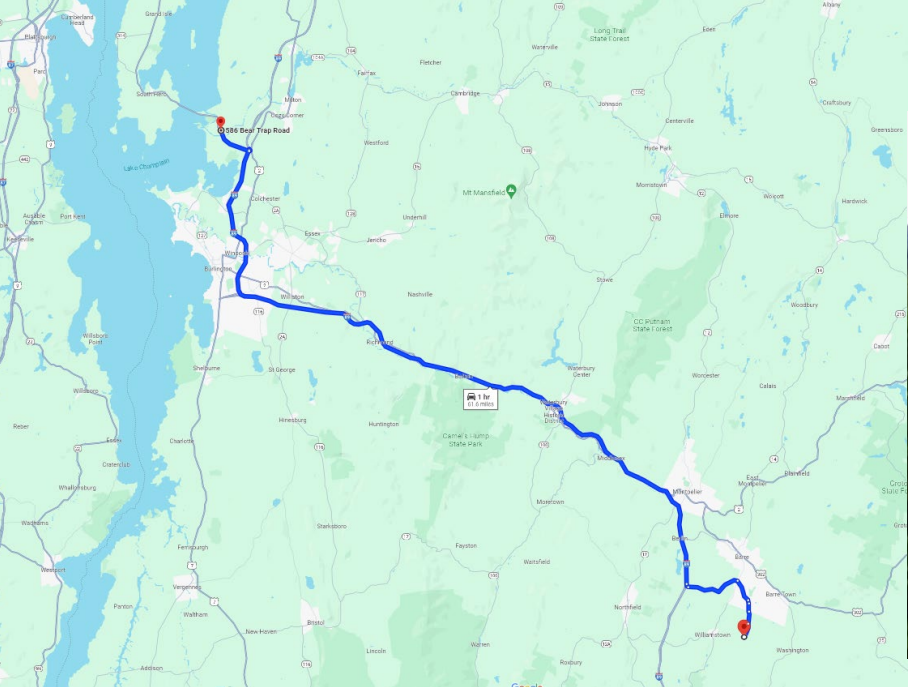
Sand Bar PST failure

- Internal fault on Feb 22, 2021
- PV20 line remained open until restoration
 - Found fault location
 - Effected on-site fix in lieu of shipping to Europe
 - Moved one Granite PST to Sand Bar in May 2021
 - 62 miles on dirt road, highway, and city streets – 12 hours
 - Limited VT roads meant significant transportation impacts (seasonal limitations, permitting, dirt roads)
 - PST placed in service at Sand Bar in July 2021
 - Repaired PST returned to Granite in Nov 2023
- Cost of repair and transportation
 - \$3.5M

Sand Bar PST failure

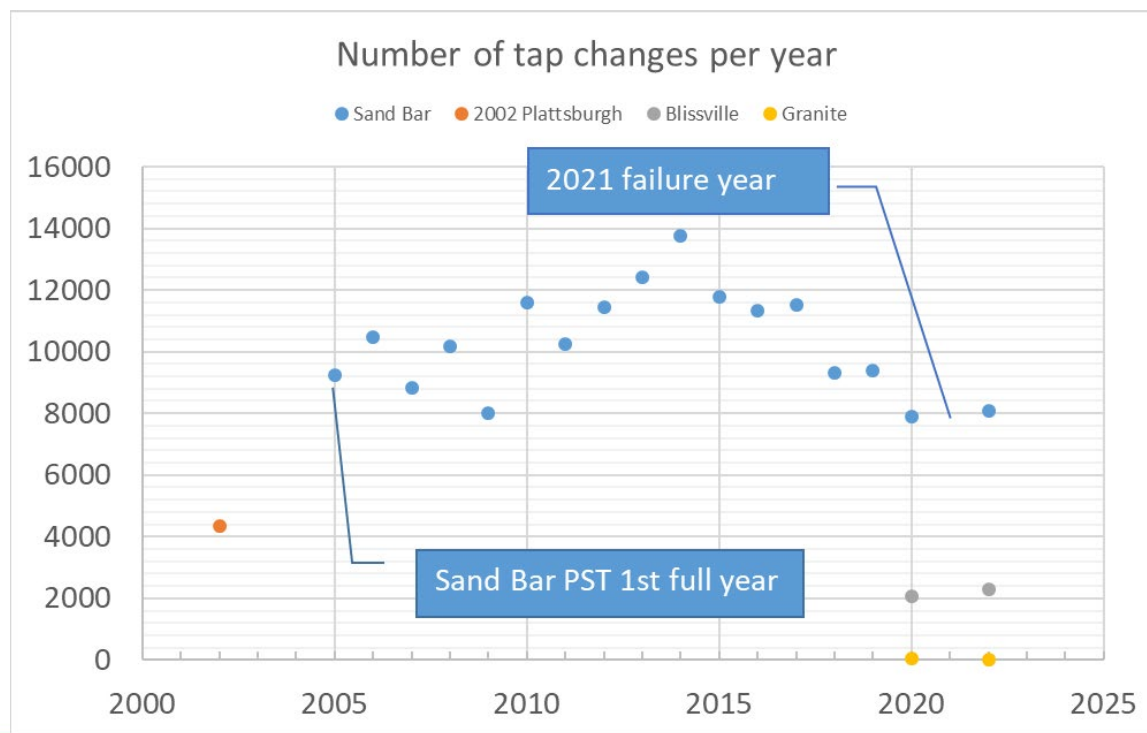


PST move from Granite to Sand Bar



A history of PV20 phase shifter failures

- Plattsburgh PAR failures after repairs
 - 2002, 2003, and 2007
- Sand Bar PST failure in 2021
 - Likely caused by excessive tap changes
 - Expect similar or increased tap changes due to future NY wind gens and recently observed Highgate cycling



Need to extend PST asset life

- Excessive tap changes even with recent operating change
 - From frequent bandwidth changes to a constant bandwidth of +/-25 MW
- **Alternative 1** – install a second PST in series
 - Reduces number of tap changes by a half (4000 or less)
 - Other benefits
 - Full redundancy – keeps PV20 line closed and flow controlled after a PST failure
 - Doubles the control range with both PSTs in service

Need to extend PST asset life

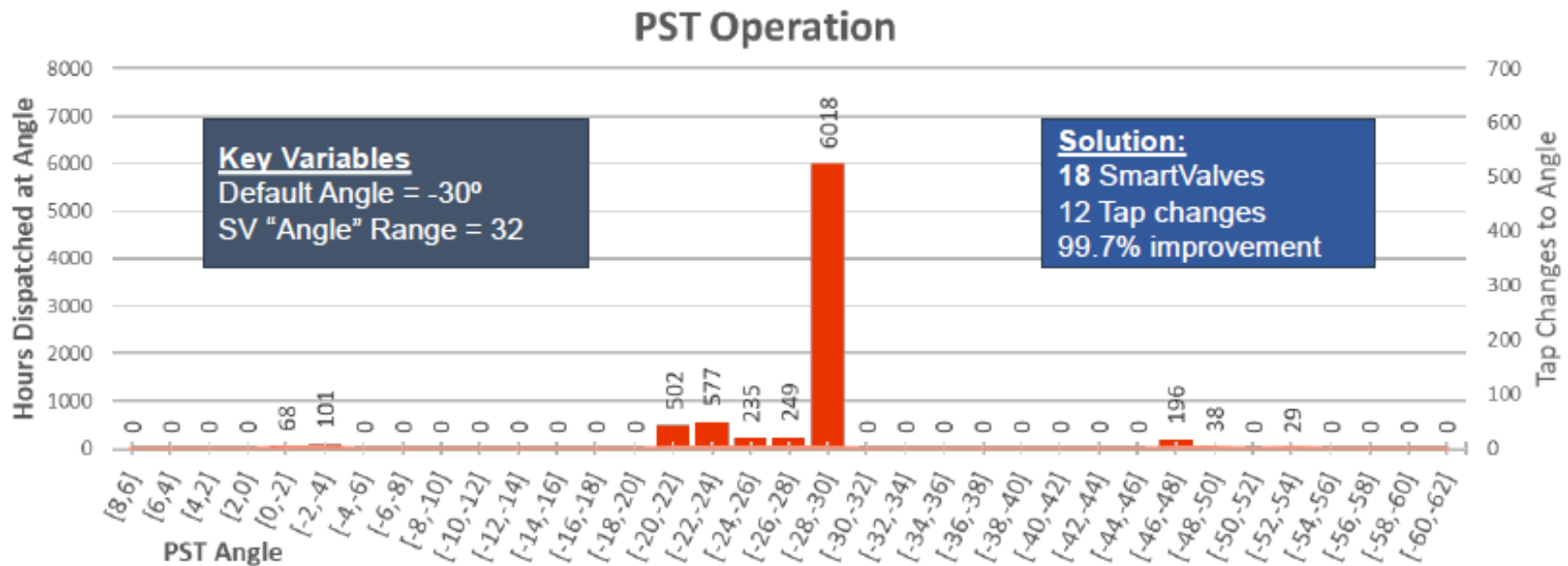
- Alternative 2A: Install full replacement SMARTVALVE™ in series
 - High-level description
 - 12 valves per phase, VSC technology
 - Footprint 179' x 65'
 - Reduces number of tap changes to nearly 0
 - Other benefits
 - Full redundancy – keeps PV20 line closed and flow controlled after a PST failure
 - Doubles the control range with the PST in service
 - More precise control → More renewable generation delivery
 - Technology diversity – modular, expandable, faster failure recovery
 - SMARTVALVE™ modules can be reapplied at 230 kV
 - Two-year materials delivery time



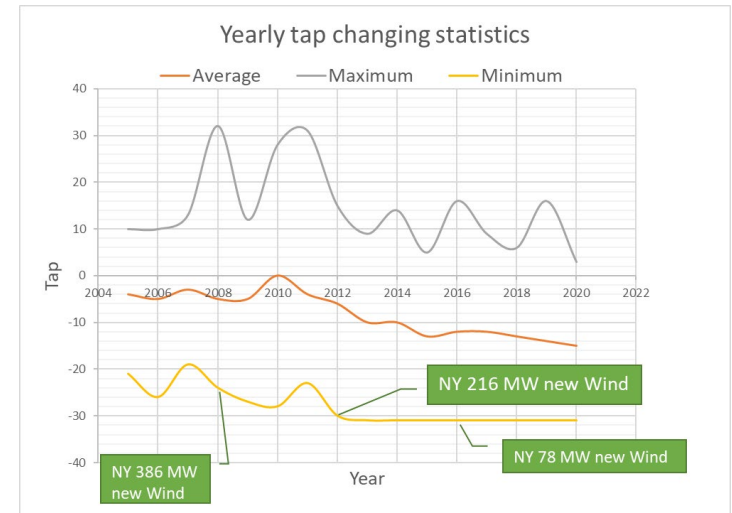
Need to extend PST asset life

- Alternative 2B Install a half replacement SMARTVALVE™ in series (preferred)
 - High-level description
 - 6 valves per phase, VSC technology
 - Footprint 82' x 65'
 - Reduces number of tap changes to nearly 0
 - Other benefits
 - 50% redundancy – keeps line closed and flow controlled after a PST failure
 - Increases the control range by 50% with the PST in service
 - More precise control → More renewable generation delivery
 - Technology diversity – modular, expandable, faster failure recovery
 - SMARTVALVE™ modules can be reapplied at 230 kV
 - Two-year materials delivery time

PST tap changes reduced with Alt 2B



- The PST stays at -30 degrees (at -15 tap step)
- The smart valve moves ± 32 degrees on either side of the PST setting
- The PST is adjusted only when the smart valve is at max or min angle



More variability expected

Project Name	Date of IR	SP (MW)	Type/ Fuel	County	Zone	Stations	Last Updated Date	Availability of Studies	Proposed COD
Bull Run II Wind	12/15/2015	449	W	Clinton	D	10	11/30/2022	FES, SRIS, FS	12-2026
North Side Solar	3/27/2017	180	S	St. Lawrence	D	11	9/30/2022	FES, SRIS, FS	12-2024
Bull Run Solar Energy Center	1/26/2018	125	S	Clinton	D	9	5/31/2023	SRIS	06-2027
North Country Wind	6/3/2019	298.2	W	Franklin	D	9	4/30/2023	FES, SRIS	12-2026
Brookside Solar	6/10/2019	100.0	S	Franklin	D	9	4/30/2023	SRIS	07-2026
Bangor Solar	10/26/2020	106.9	S	Franklin	D	P	12/31/2023	FES	12-2026
Northline Energy Center	5/20/2021	200	ES	Clinton	D	5P	12/31/2023		12-2028
NY125A - Fort Covington Solar	5/20/2021	250	S	Franklin	D	9	4/30/2023	SRIS	12-2026
NY125B - Two Rivers Solar	5/20/2021	200	S	St-Lawrence	D	9	4/30/2023	SRIS	12-2025
Roosevelt Solar LLC	6/25/2021	19.9	CR	St. Lawrence	D	9	3/31/2023	SIS	12-2025
North Foothills	9/13/2022	100	S	FRANKLIN	D	P	12/31/2023		12-2026
Golden Knight Solar	6/13/2023	140	S	St. Lawrence	D	P	12/31/2023		09-2028
Jericho Solar	9/11/2023	100	S	Franklin	D	1	11/30/2023		10-2027
Lake City Storage	10/25/2023	120	ES	Clinton	D	1	11/30/2023		12-2027
Marble River Storage	10/25/2023	160	ES	Clinton	D	1	11/30/2023		12-2027
North Farm Solar LLC	11/14/2023	19.9	S	Clinton	D	1	12/31/2023		03-2025
Malone Energy Storage	11/15/2023	80	ES	Franklin	D	1	11/30/2023		12-2027

- Future/proposed Generation projects in NYISO queue
 - Wind: 750 MW; Solar PV: 1,300 MW; Storage: 560 MW
- Should cause taps to be more variable and more negative on average (pushing more against NY-VT flows)

Comparison of alternatives

	Alternative #1: Series PST	Alternative #2A: Full PST replacement SmartValve	Alternative #2B: PST augmentation SmartValve (Preferred)
PST life extension	Yes, but not nearly as much as the smart valve options	Yes	Yes
Recovery following PST failure	Restore current imprecise control	Retains fast, precise and full control (+/-64 deg)	Retains fast, precise and half control (+/-32 deg)
Recovery following smart valve failure	N/A	Restore current imprecise control	Restore current imprecise control
Longevity	Portable, but difficult Cannot be used at 230 kV	Easily portable Usable at 230 kV	Easily portable Usable at 230 kV
Delivery timing	4 to 5 years	1 to 2 years	1 to 2 years
Estimated In Service date	Q2 2029	Q2 2027	Q2 2027
Cost estimate with 50% contingency	\$56.2M PTF (+50%/-25% accuracy)	\$66.3M PTF (+50%/-25% accuracy)	\$47.7M* PTF (+50%/-25% accuracy)
Grid-enhancing Technology	No	Yes	Yes
Expected DOE funding support	No	No	Yes – *\$13.8M which drops cost to \$33.9M

Benefit Summary

- Extends the life of the Sandbar PST
- Retains fast, precise and half control (+/-32 deg) of flow with PST out of service.
- Easily portable, Usable at 230 kV
- \$47.7M* PTF (+50%/-25% accuracy)
- Utilizes Grid Enhancing Technology
- DOE Grant Awarded – \$13.8M which drops cost to \$33.9M*
 - Partnership with EPRI (Prime), VELCO (Recipient) and Smart Wires (sub-recipient).

Project Time Line

- February 2024 – Successful ISO Planning Advisory Committee (PAC) presentation.
- Summer 2024 – Prepare for Regulatory Approval.
- March 2025 – 248 Certificate of Public Good (CPG) Application Submittal.
- May 2026 – Start Site Construction.
- March 2027 – Testing and Commissioning.

Thank you!