Freeport Area Master Plan Project - ERCOT Independent Review Final Recommendation

System Development
November 14, 2017

Overview

CenterPoint submitted Freeport Masterplan Project for RPG review. This is a Tier 1 project that is estimated to cost $ 246.7 million.

- Proposed for 2019 –2021
- To serve new committed loads
- Reliability Issues
  - Severe low voltages
  - Overloads
  - Difficulty of maintenance outage Scheduling
- Provide Operational Flexibility

Past RPG Presentations on Freeport Master Plan Project

- ERCOT presented the study scope in June 2017 RPG

  http://www.ercot.com/content/wcm/key_documents_lists/108872/CNP_Freeport_Masterplan_Study_Scope_-_RPG.pdf

- ERCOT presented a status update during August 2017 RPG
  http://www.ercot.com/calendar/2017/8/22/108879-RPG

- ERCOT presented last status updates during October 2017 RPG

  http://www.ercot.com/content/wcm/key_documents_lists/108888/CNPFP_EIR_StatusUpdate_RPG_10192017.pdf

Near-Term Planning -> Bridge The Gap Upgrades

- To resolve the base case violations CNP's 'Bridge The Gap Upgrades' are recommended for 2019/2022 time period.
- The list of these upgrades include ->
  1. Loop 345 kV South Texas Project (STP) – Dow-Velasco circuit 27 into the Jones Creek Substation (approximately 0.9 mile)
  2. Install 7-ohm in-line reactors at the Jones Creek Substation on 345 kV STP – Jones Creek circuits 18 and 27
  3. Install 3rd 345/138 kV 800/1000 MVA Autotransformer at the Jones Creek Substation
  4. Install 4th 138 kV Capacitor Bank (120 MVAr) at Jones Creek Substation
  5. Install 1st 138 kV Automatically Switchable Capacitor Bank (140 MVAr) at Jones Creek Substation
  6. Install 2nd 138 kV Automatically Switchable Capacitor Bank (140 MVAr) at Jones Creek Substation
- Total cost estimate for all these upgrades is $32.3M.

2020 Steady State Violations After Bridge The Gap Upgrades

- Violation summary for 2020 Study Case after including 'Bridge the Gap Upgrades' ->

Contingency Category	Branch Violations		
	Element	KV	Max. Loading (%)
P3 (G-1 + N-1)	Oasis to WA Parish Ckt 99	345	100.4

2022 Steady State Violations After Bridge The Gap Upgrades

- Violations summary for 2022 Study Case with 'Bridge the Gap Upgrades' ->

Contingency Category	Branch Violations		
	Element	KV	Max. Loading (%)
P3 (G-1 + N-1)	Oasis to WA Parish Ckt 99	345	101.7
P6-1, P6-3 (N-1-1)	Oasis to Dow Ckt 27	345	135.8
	STP to Jones Creek Ckt 27	345	109.2

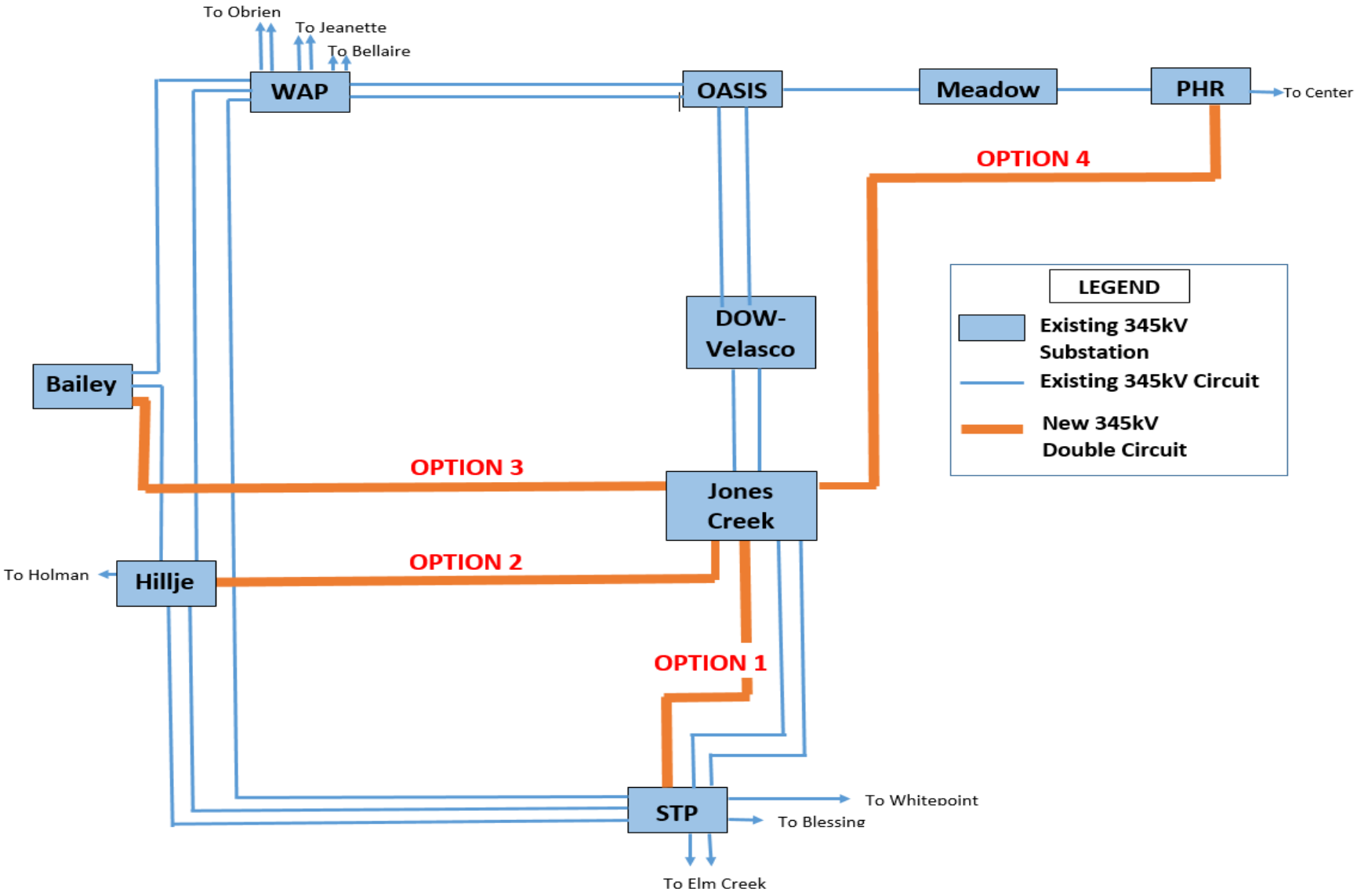
Options Studied

- **Option – 1**: New Double Circuit 345kV line from STP to Jones Creek (50.4 miles);
- **Option – 2**: New Double Circuit 345kV line from Hillje to Jones Creek (62.4 miles);
- **Option – 3**: New Double Circuit 345kV line from Bailey to Jones Creek (48 miles);

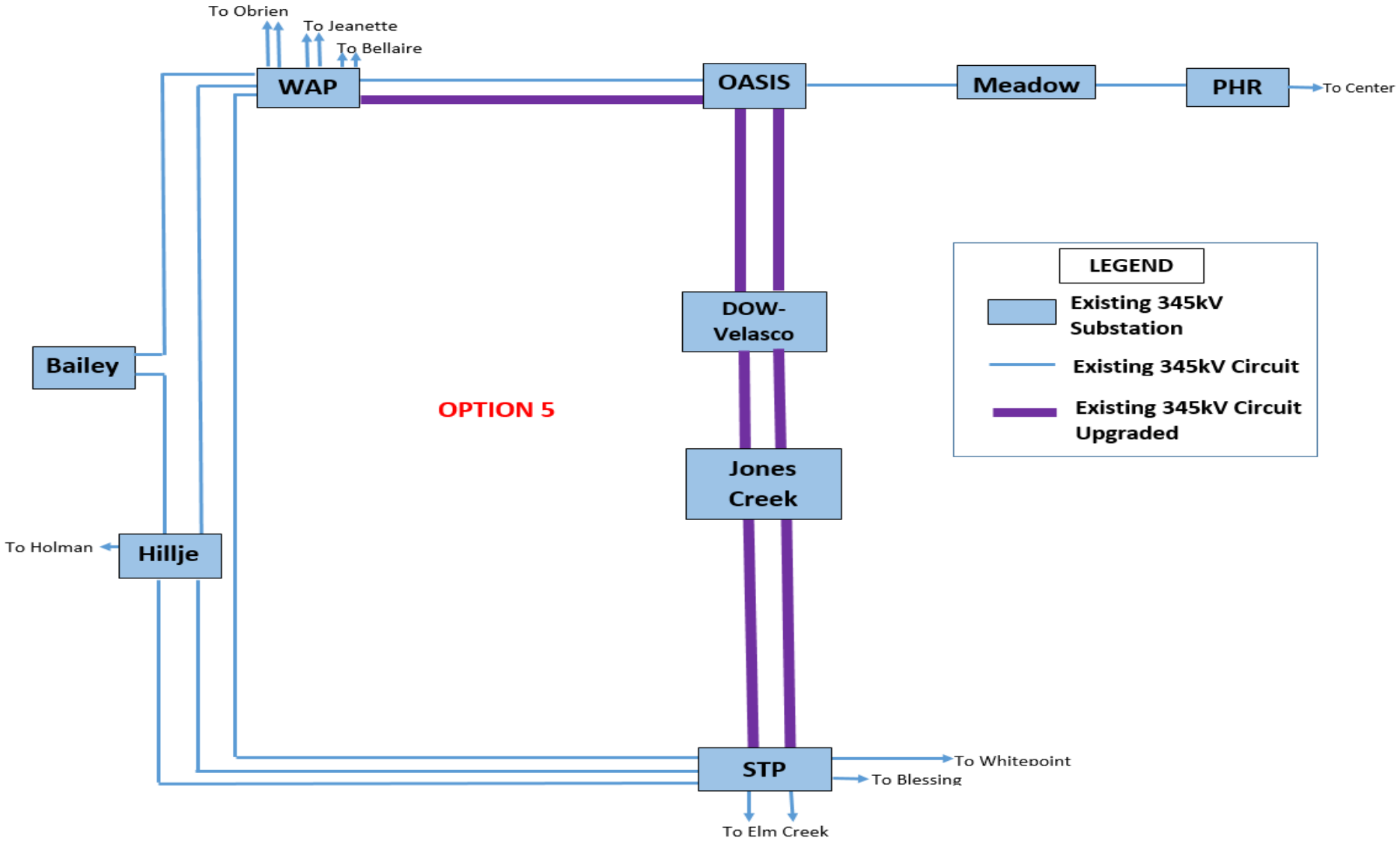
Options 1-3 have a common upgrade of DOW to Jones Creek 345kV Circuits 18 & 27 (3 miles)

- **Option – 4**: New Double Circuit 345kV line from PHR to Jones Creek (60 miles)
- **Option – 5**: Existing System Upgrade
  - Oasis to WAP 345kV Circuit 99
  - DOW to Oasis 345kV Circuits 18 & 27
  - DOW to Jones Creek 345kV Circuits 18 & 27
  - STP to Jones Creek 345kV Circuits 18 & 27

New Line Options



Option – 5 (Line Upgrades)



Overview of further results

- Transfer Analysis
- High Load Sensitivity
- Dynamics Analysis
- Economics Analysis
- PG Section 3.1.3 (4) - Generation Addition and Load Scaling Sensitivity

VSAT Transfer analysis – Voltage Stability

Options	Description	Base load level (MW)	Maximum transfer (MW)	Margin (MW)
1	STP-JC	20451	22691	2240
2	HILLJE-JC		22611	2160
3	BAILEY-JC		22531	2080
4	PHR-JC		22011	1560
5	Only line upgrades		20811	360

Source Weather Zones	East, West, South Central, South
Sink Weather Zone	Coast
Monitored Buses	Freeport area and south side of Houston
Study base case source	2023 Summer peak case from LT 2023 SP dynamics data set
Contingencies studied	All 345 kV Branch, Generation outages and 345 kV Double circuit outages in Coast weather zone

High Load Sensitivity (P1, P2-1, P7)

Uncommitted load of 657MW is added to the Freeport Area

- Unsolved Contingency

Contingency	Option 1	Option 2	Option 3	Option 4	Option 5
STP to Jones Creek Ckts 18 and 27 (P7)	-	-	-	-	Unsolved Contingency

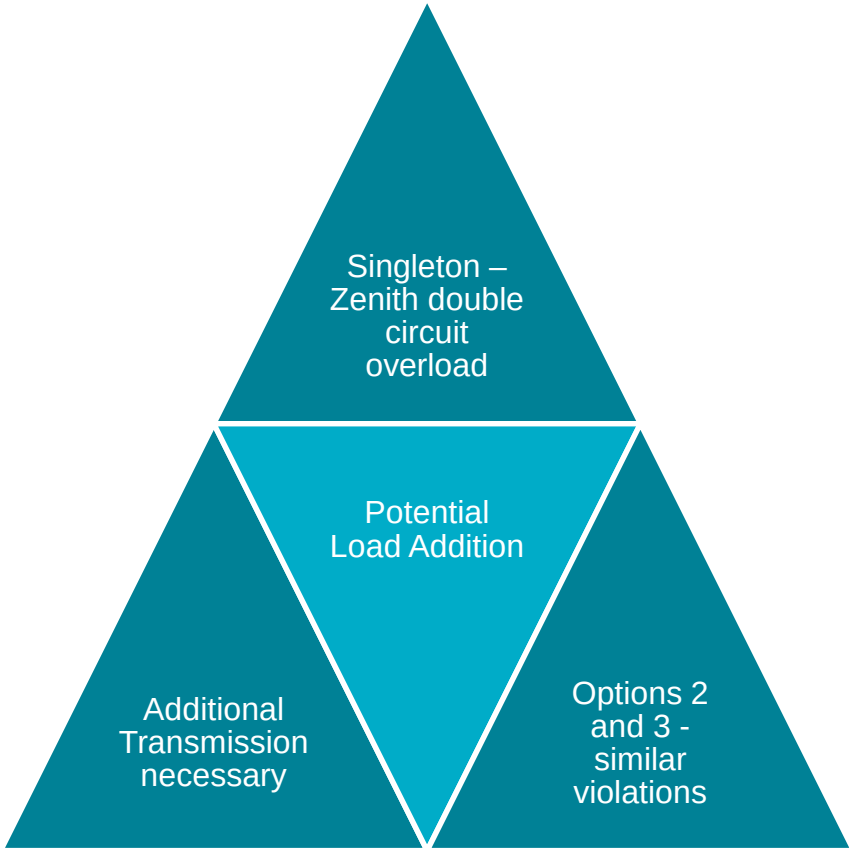
- 345kV Branch Violations, in %

Element	Option 1	Option 2	Option 3	Option 4	Option 5
WAP to OASIS Ckt 99	-	-	-	106.2	-

High Load Sensitivity (G-1 + N-1; X-1 + N-1)

Contingency	345kV Bus Violations			345kV Branch Violations		
	Option 1	Option 2	Option 3	Option 1	Option 2	Option 3
G-1 + N-1	None	None	None	None	None	Singleton to Zenith Double Circuit (100.5%)
X-1 + N-1	None	None	None	None	Singleton to Zenith Double Circuit (101.5%)	Singleton to Zenith Double Circuit (101.3%)

High Load Sensitivity Summary



Dynamics Analysis Results – Base case with BTG Upgrades

Case	Topological Changes	Contingency Category					
		P1	P2	P3	P4, P5	P6	P7
LT2023 SP	BTG Upgrades + DOW 4th Auto	Stable	Stable	Stable	Stable	Stable	Stable

Dynamics Analysis Results – Option 2 or 3

Case	Topological Changes	Contingency Category					
		P1	P2	P3	P4, P5	P6	P7
LT2023 SP	BTG Upgrades + DOW 4th Auto + Option 2 or 3	Stable	Stable	Stable	Stable	Stable	Stable

Economic Analysis

- 2023 RTP Economic case was used to run the Economic Analysis in UPLAN
- No load or generation changes were made to the base case
- The production cost savings of Option 2 and 3 are very similar

Sensitivity Analysis – PG Section 3.1.3 (4)(a) Generation

- Generation Sensitivity study to meet PG Section 3.1.3 (4)(a)
- 2017 August Generation Interconnection Report
- The additional generation does not resolve any of the base case violations for 2022
- Generation sensitivity analysis does not have an impact on the project need

GINR Number	Project Name	MW	Fuel	County
15INR0023	Indeck Wharton	654	Gas	Wharton
16INR0044	Halyard Wharton	419	Gas	Wharton
16INR0074	Chocolate Bayou W	150	Wind	Brazoria
17INR0022	MIRAGE (NET Power LA Porte)	11	Gas	Harris

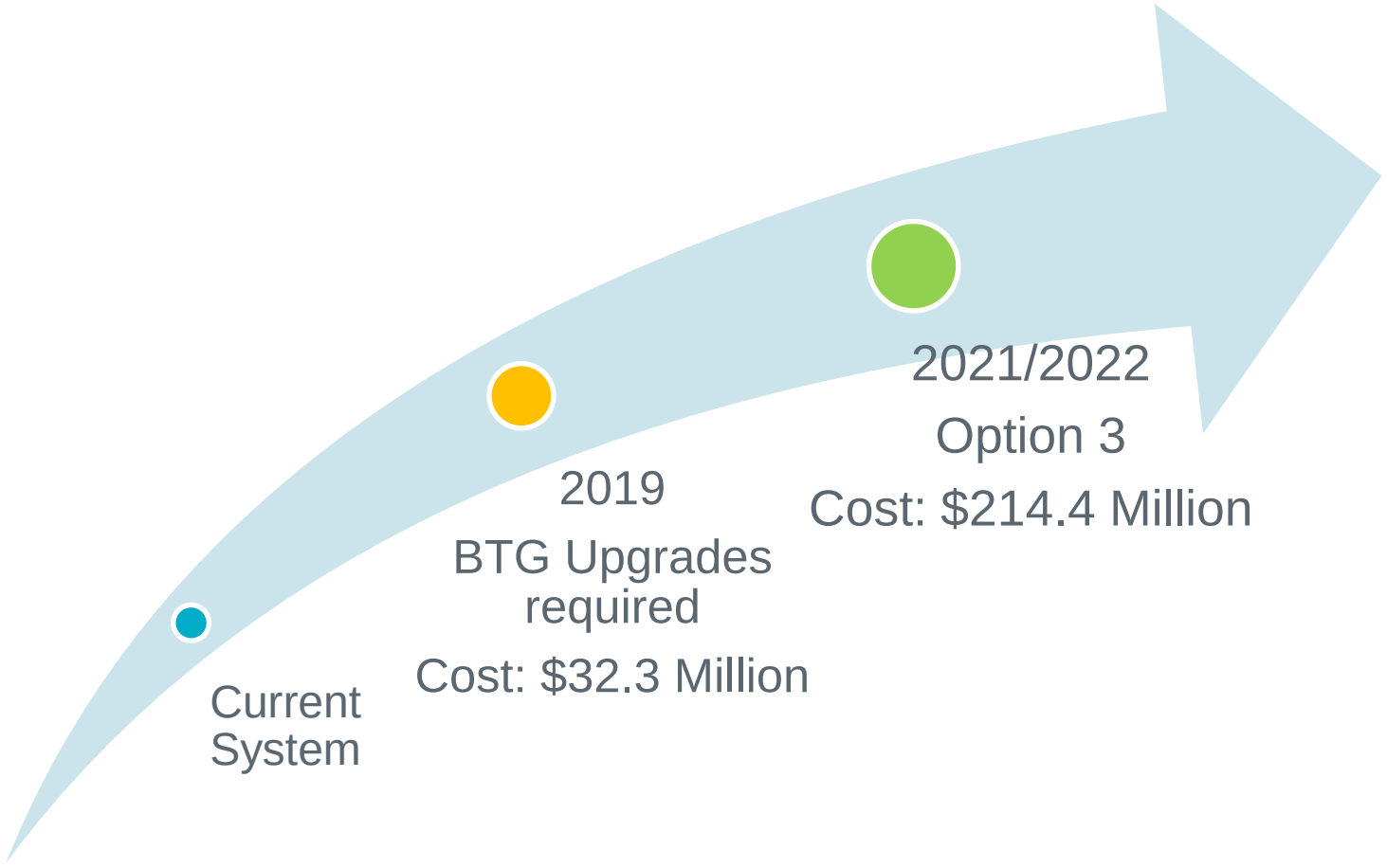
Sensitivity Analysis – PG Section 3.1.3 (4)(b) Load Scaling

- Load Scaling Sensitivity study to meet PG Section 3.1.3 (4)(b)
- Five 345 kV thermal violations in the study
- PTDFs calculated with Coast weather zone as sink and each of the other weather zones as source
- The RTP case load scaling did not have an impact on the project need

Summary of Results

Option #	Option 1	Option 2	Option 3	Option 4	Option 5
Description	STP-JC	HILLJE-JC	BAILEY-JC	PHR-JC	Only line upgrades
Extreme Contingency Limitation	Yes	No	No	Yes	Yes
Voltage Stability Transfer Limit (MW)	2240	2160	2080	1560	360
Dynamic Stability Issues	--	No	No	--	--
Projected Load for 2022 issues	No	No	No	No	No
Projected Load for 2022 + High Load	None	P6	P3/P6	--	--
New ROW Distance (miles)	50.4	62.4	48	60	--
Estimated Cost (Million $)	223.2	**272.5**	**214.4**	220	281.8

Final Recommendation



Final Recommendation - Description

- ‘Bridge the Gap Upgrades’ are required to meet the reliability needs. Cost estimate: $32,340,000:
  - Loop 345 kV South Texas Project (STP) – Dow-Velasco circuit 27 into the Jones Creek Substation (approximately 0.9 mile)
  - Install 7-ohm in-line reactors at the Jones Creek Substation on 345 kV STP – Jones Creek circuits 18 and 27
  - Install 3rd 345/138 kV 800/1000 MVA Autotransformer at the Jones Creek Substation
  - Install 4th 138 kV Capacitor Bank (120 MVAr) at Jones Creek Substation
  - Install 1st 138 kV Automatically Switchable Capacitor Bank (140 MVAr) at Jones Creek Substation
  - Install 2nd 138 kV Automatically Switchable Capacitor Bank (140 MVAr) at Jones Creek Substation

- Option 3 meets the reliability criteria in the most cost effective manner. Option 3 has a cost estimate of $214,400,000 and is described as follows:
  - Construct a new approximately 48 mile 345 kV double circuit transmission line from Bailey Substation to Jones Creek Substation (2988 MVA emergency rating)
  - Upgrade 345 kV Dow-Velasco to Jones Creek circuits 18 and 27 which is approximately 3 miles (minimum 1700 MVA emergency rating)

For any questions please email Ajay Pappu (Venkata.Pappu@ercot.com)