A vertical image on the left side of the page showing a close-up of a white offshore wind turbine. The turbine has three blades and is mounted on a yellow and black pile foundation in the ocean. In the background, another similar turbine is visible under a blue sky.

Appendix I:

Transfer Analysis – Normal Limits & Flexibility Under Outage Conditions

Long Island Offshore Wind Export Public Policy Transmission Need Evaluation

**A Report from the New York
Independent System Operator**

DRAFT for May 16, 2023 ESPWG

Appendix I: Transfer Analysis

Transfer Limit Methodology

Transfer limit analysis calculated transfer limits with and without each project to determine the incremental impact on the amount of power that can be transferred across the LIPA Import and LIPA Export interfaces, while observing applicable reliability criteria. These transfer limits are “optimal transfers” where all generators may be dispatched anywhere between their maximum and minimum power output. These generators are dispatched independently (not proportionally) to facilitate transfers. The goal of this analysis is to mimic, to the extent possible, the energy market management system in the NYISO Control Center; however, it does not include generator bid information and instead assumes that all generators have identical bids.

Transfer limit analysis was performed under the following assumptions:

- 1) The transfer limits were evaluated using the generation summarized in Figure 1;
- 2) All NYISO Bulk Power Transmission Facilities (BPTF) lines, all 115 kV and above lines in Zones F–J, and all 138 kV and above line in Zone K were secured;
- 3) In accordance with NPCC criteria and NYSRC reliability rules, the contingency list was modified to include the project’s related contingencies;
- 4) Phase angle regulators were allowed to be at the optimized setpoints in pre-contingency conditions to facilitate transfers and their angle was fixed post-contingency;
- 5) Internal HVDC facilities were allowed to be optimally scheduled in pre-contingency conditions and this schedule was fixed post-contingency; and
- 6) The flows on all monitored lines are secured to their normal rating in pre-contingency conditions and the applicable emergency rating in post-contingency conditions.

Transfer limit analysis was based on the CY21 Annual Transmission Baseline Assessment transfer case with assumptions of Long Island offshore wind (OSW) consistent with the Policy Scenario.

Figure 1: Transfer Source and Sink Definitions

Interface	Source Zone (s)	Sink Zone (s)
LI-Export	K	ON – J
LI-Import	ON – J	K

Transfer Limit Results: Normal Transfer Limit Results

The normal all-lines-in-service transfer limits (N-1) of the LI Import and LI Export interfaces are presented in

Figure 2 and Figure 3, respectively, for the pre-project system and for the system with each project.

Figure 2: Policy Scenario: Long Island Import N-1 Normal Transfer Limits (MW)

Project	Limiting Facility	Limiting Contingency	LI Import	Delta MW
Pre-Project	Dunwoodie - Shore Road 345 kV	Sprain Brook 345 kV stuck breaker	1,665	--
T035 - LS Power	Bagatelle - Bethpage 138 kV	Ruland Road 138 kV P5 contingency	3,220	+1,555
T036 - NextEra Core 1	Locust Grove - New Bridge 138 kV	Northport 138 kV P5 contingency	3,405	+1,740
T037 - NextEra Core 2	Locust Grove - New Bridge 138 kV	Northport 138 kV P5 contingency	3,410	+1,745
T038 - NextEra Core 3	Hauppauge - Pilgrim 138 kV	Holbrook 138 kV tower contingency	3,440	+1,775
T039 - NextEra Core 4	Hauppauge - Pilgrim 138 kV	Holbrook 138 kV tower contingency	3,415	+1,750
T040 - NextEra Core5	Hauppauge - Pilgrim 138 kV	Holbrook 138 kV tower contingency	3,420	+1,755
T041 - NextEra Core 6	Hauppauge - Pilgrim 138 kV	Holbrook 138 kV tower contingency	3,460	+1,795
T042 - NextEra Core 7	Hauppauge - Pilgrim 138 kV	Holbrook 138 kV tower contingency	3,460	+1,795
T043 - NextEra Enh 1	Holbrook - Pilgrim 138 kV	Holbrook 138 kV tower contingency	3,755	+2,090
T044 - NextEra Enh 2	Holbrook - Pilgrim 138 kV	Holbrook 138 kV tower contingency	3,735	+2,070
T047 - Propel Base 1	Sprain Brook - New Shore Road 345 kV	Base Case	3,140	+1,475
T048 - Propel Base 2	Ruland Road 345 kV PAR	Base Case	3,175	+1,510
T049 - Propel Base 3	Sprain Brook - New Shore Road 345 kV	Base Case	3,140	+1,475
T051 - Propel Alt 5	Hauppauge - Pilgrim 138 kV	Holbrook 138 kV tower contingency	3,475	+1,810
T052 - Propel Alt 6	Hauppauge - Pilgrim 138 kV	Holbrook 138 kV tower contingency	3,460	+1,795
T053 - Propel Alt 7	Hauppauge - Pilgrim 138 kV	Holbrook 138 kV tower contingency	3,425	+1,760

Figure 3: Policy Scenario: Long Island Export N-1 Normal Transfer Limits (MW)

Project	Limiting Facility	Limiting Contingency	LI Export Limit	Delta
Pre-Project	Carle Place-East Garden City 138 kV	Valley Stream 138 kV P5 contingency	375	--
T035 - LS Power	Northport-Pilgrim 138 kV	Pilgrim 138 kV stuck breaker	3,550	+3,175
T036 - NextEra Core 1	Ruland Road - Sprain Brook 345 kV	Base Case	3,265	+2,890
T037 - NextEra Core 2	Bethpage - Ruland Road 138 kV	Ruland Road - Pilgrim 138 kV tower contingency	3,685	+3,310
T038 - NextEra Core 3	Holbrook - Ronkonkoma 138 kV	Holbrook 138 kV tower contingency	3,925	+3,550
T039 - NextEra Core 4	Dunwoodie 345 kV - Northport 345 kV	Ruland Road - Sprain Brook 345 kV	3,385	+3,010
T040 - NextEra Core5	Northport 138 kV - Northport 345 kV	Ruland Road - Sprain Brook 345 kV	3,405	+3,030
T041 - NextEra Core 6	Jamaica - Valley Stream 138 kV	Dunwoodie GIS 345 kV stuck breaker	3,670	+3,295
T042 - NextEra Core 7	Jamaica - Valley Stream 138 kV	Dunwoodie GIS 345 kV stuck breaker	3,660	+3,285
T043 - NextEra Enh 1	Elwood - Northport 138 kV circuit 2	Elwood - Northport 138 kV circuit 1	4,305	+3,930
T044 - NextEra Enh 2	Elwood - Northport 138 kV circuit 2	Elwood - Northport 138 kV circuit 1	4,275	+3,900
T047 - Propel Base 1	Carle Place - East Garden City 138 kV	Shore Rd 138 kV stuck breaker	2,130	+1,755
T048 - Propel Base 2	Roselyn - East Garden City 138 kV	Shore Rd 138 kV stuck breaker	2,040	+1,665
T049 - Propel Base 3	Carle Place - East Garden City 138 kV	Shore Rd 138 kV stuck breaker	2,145	+1,770
T051 - Propel Alt 5	Carle Place - East Garden City 138 kV	Shore Rd 138 kV stuck breaker	2,640	+2,265
T052 - Propel Alt 6	Shore Road - Dunwoodie 345 kV	Base Case	3,860	+3,485
T053 - Propel Alt 7	Carle Place - East Garden City 138 kV	East Garden City 138 kV stuck breaker	2,915	+2,540

The Normal Transfer limits for the Barrett-Valley Stream Scenario (i.e., Barrett-Valley Stream paths are secured) are shown in Figures 4 and 5.

Figure 4: Barrett-Valley Stream Scenario: Long Island Import N-1 Normal Transfer Limits (MW)

Project	Limiting Facility	Limiting Contingency	LI Import Limit	Delta
Pre-Project	Dunwoodie – Shore Rd 345 kV	Sprain Brook stuck breaker	1,665	--
T035 – LS Power	Barrett-Valley Steam 138 kV	Ruland Rd P5 contingency	2,720	+1,055
T036 – NextEra Core 1	Locust Grove – Newbridge 138 kV	Northport P5 contingency	3,400	+1,735
T040 – NextEra Core 5	Hauppauge – Pilgrim 138 kV	Holbrook – Ruland Rd 138 kV tower contingency	3,420	+1,755
T048 – Propel Base 2	Barrett-Valley Steam 138 kV	Barrett stuck breaker	2,910	+1,245
T049 – Propel Base 3	New Shore Rd – Sprain Brook 345 kV	Base Case	3,140	+1,475
T051 – Propel Alt 5	Hauppauge – Pilgrim 138 kV	Holbrook-Ruland Rd 138 kV tower contingency	3,465	+1,800
T052 – Propel Alt 6	Hauppauge – Pilgrim 138 kV	Holbrook – Ruland Rd 138 kV tower contingency	3,460	+1,795

Figure 5: Barrett-Valley Stream Scenario: Long Island Export N-1 Normal Transfer Limits (MW)

Project	Limiting Facility	Limiting Contingency	LI Export Limit	Delta
Pre-Project	Carle Place – East Garden City 138 kV	Valley Stream P5 contingency	320	--
T035 – LS Power	Valley Stream – East Garden City 138 kV	Ruland Rd P5 contingency	3,350	+3,030
T036 – NextEra Core 1	Sprain Brook – Ruland 345 kV	Base Case	3,055	+2,735
T040 – NextEra Core 5	Northport 138/345 kV	Ruland – Sprain Brook 345 kV	3,095	+2,775
T048 – Propel Base 2	Valley Stream – East Garden City 138 kV	Shore Rd P5 contingency	1,795	+1,475
T049 – Propel Base 3	Carle Place – East Garden City 138 kV	Shore Rd stuck breaker	2,145	+1,825
T051 – Propel Alt 5	Carle Place – East Garden City 138 kV	Shore Rd stuck breaker	2,625	+2,305
T052 – Propel Alt 6	Eastern Queens – Dunwoodie 345 kV	Base Case	3,850	+3,530

Transfer Limit Results: Flexibility Under Outage Conditions

This analysis focused on transfer limits under the worst one single element and two single element maintenance conditions in order to evaluate the flexibility of each project given normal operations when all lines are not in service. When reviewing these transfer limits, larger import and export limits are preferable. Adding the import and export limits gives another useful indication of the operating range under outage conditions, which would give NYISO more operational flexibility.

The outage import and export transfer limits for the Policy Scenario are shown in Figures 6 and 7, respectively, and the range is shown in Figure 8. The same analysis was run for the top-tier projects on the Barrett-Valley Stream Scenario. Figures 9 and 10 show the import and export transfer limits, respectively, for the Barrett-Valley Stream Scenario and the range is shown in Figure 11.

Figure 6: Policy Scenario: Long Island Import Transfer Limit Under Single and Double Maintenance Conditions (MW)

Project	Import (MW)				
	All Lines In	Worst 1st Contingency (N1)		Worst 1st Contingency (N2)	
Pre-Project	1,665	NEPTUNE	1,005	SPRNBK - EGC 345 Y49_NEPTUNE	390
T035 - LSPower	3,220	138-563	2,740	138-563_NNC-3C	2,540
T036 - NextEra Core1	3,405	NEET_RUL-SBR_345	3,055	NEET_EGC-DUN_345_NEET_RUL-SBR_345	2,400
T037 - NextEra Core 2	3,410	NEET_RUL-SBR_345	3,035	NEWBRGE 345/138 Bank #1_NEET_RUL-SBR_345	2,535
T038 - NextEra Core 3	3,440	138-882	3,330	138-882_PILGRIM 138/69 Bank #4	3,035
T039 - NextEra Core 4	3,415	138-679	3,155	138-367_138-679	3,060
T040 - NextEra Core 5	3,420	138-679	3,105	138-367_138-679	3,035
T041 - NextEra Core 6	3,460	138-882	3,355	138-882_PILGRIM 138/69 Bank #4	3,000
T042 - NextEra Core 7	3,460	138-882	3,350	138-882_PILGRIM 138/69 Bank #4	3,005
T043 - NextEra Enh 1	3,755	138-871	3,450	138-871_69-670	3,280
T044 - NextEra Enh 2	3,735	138-871	3,430	138-871_69-670	3,275
T047 - Propel Base 1	3,140	SHR-SPRBK LINK	2,310	EGC-TREMONT LINK_SHR-SPRBK LINK	1,635
T048 - Propel Base 2	3,175	Y51-Barrett-Tremont345	2,455	Y51-Barrett-Tremont345_Y53-Ruland-SPRAINBROOK	1,660
T049 - Propel Base 3	3,140	SHR-SPRBK LINK	2,325	EGC-TREMONT LINK_SHR-SPRBK LINK	1,610
T051 - Propel Alt 5	3,475	EGC-TREMONT LINK	3,145	Y49_EGC-TREMONT LINK	2,320
T052 - Propel Alt 6	3,460	NEW SYO-SHR	3,255	138-563_NEW SYO-SHR	2,815
T053 - Propel Alt 7	3,425	138-882	3,340	138-882_69-670	3,150

Figure 7: Policy Scenario: Long Island Export Transfer Limit Under Single and Double Maintenance Conditions (MW)

Project	Export (MW)				
	All Lines In	Worst 1st Contingency (N1)		Worst 1st Contingency (N2)	
Pre-Project	375	SPRNBK - EGC 345 Y49	-415	SPRNBK - EGC 345 Y49_138-362	-650
T035 - LSPower	3,550	NTHGATE - STHGATE HVDC 1/2/3	2,565	NTHGATE - STHGATE HVDC 2_NTHGATE - STHGATE HVDC 3	1,355
T036 - NextEra Core 1	3,265	NEET_EGC-DUN_345	2,440	NEET_EGC-SBR_345_NEET_EGC-DUN_345	1,540
T037 - NextEra Core 2	3,685	SPRNBK - EGC 345 Y49	2,540	SPRNBK - EGC 345 Y49_NEET_RUL-SBR_345	1,725
T038 - NextEra Core 3	3,925	SPRNBK - EGC 345 Y49	2,775	SPRNBK - EGC 345 Y49_NEET_NPT_TB1	2,385
T039 - NextEra Core 4	3,385	NEET_DUN-NPT_345	2,395	NEET_EGC-SBR_345_NEET_DUN-NPT_345	1,510
T040 - NextEra Core 5	3,405	NEET_DUN-NPT_345	2,425	NEET_EGC-SBR_345_NEET_DUN-NPT_345	1,530
T041 - NextEra Core 6	3,670	NEET_NPT-SPR_HVDC	2,510	NEET_EGC-DUN_345_NEET_NPT-SPR_HVDC	1,530
T042 - NextEra Core 7	3,660	NEET_NPT-SPR_HVDC	2,500	NEET_EGC-DUN_345_NEET_NPT-SPR_HVDC	1,535
T043 - NextEra Enh 1	4,305	SPRNBK - EGC 345 Y49	3,160	SPRNBK - EGC 345 Y49_NEET_NPT-SPR_HVDC	2,510
T044 - NextEra Enh 2	4,275	SPRNBK - EGC 345 Y49	3,130	SPRNBK - EGC 345 Y49_NEET_NPT-SPR_HVDC	2,465
T047 - Propel Base 1	2,130	SHR-SPRBK LINK	1,300	Y49_SHR-SPRBK LINK	625
T048 - Propel Base 2	2,040	SPRNBK - EGC 345 Y49	1,270	SPRNBK - EGC 345 Y49_Y53-Ruland-SPRAINBROOK	510
T049 - Propel Base 3	2,145	SHR-SPRBK LINK	1,310	Y49_SHR-SPRBK LINK	660
T051 - Propel Alt 5	2,640	EGC-TREMONT LINK	1,930	Y49_EGC-TREMONT LINK	1,190
T052 - Propel Alt 6	3,860	SHR-SPRBK LINK2	3,135	Y49_SHR-SPRBK LINK2	2,400
T053 - Propel Alt 7	2,915	NORTHPORT-SPRAINBROOK-HVDC	1,725	Y49_NORTHPORT-SPRAINBROOK-HVDC	905

Figure 8: Policy Scenario: Operability Ranges Under Maintenance Conditions (MW)

Project	No Outages	One Outage	Two Outages
Pre-Project	2,040	590	0
T035 - LSPower	6,770	5,305	3,895
T036 - NextEra Core 1	6,670	5,495	3,940
T037 - NextEra Core 2	7,095	5,575	4,260
T038 - NextEra Core 3	7,365	6,105	5,420
T039 - NextEra Core 4	6,800	5,550	4,570
T040 - NextEra Core 5	6,825	5,530	4,565
T041 - NextEra Core 6	7,130	5,865	4,530
T042 - NextEra Core 7	7,120	5,850	4,540
T043 - NextEra Enh 1	8,060	6,610	5,790
T044 - NextEra Enh 2	8,010	6,560	5,740
T047 - Propel Base 1	5,270	3,610	2,260
T048 - Propel Base 2	5,215	3,725	2,170
T049 - Propel Base 3	5,285	3,635	2,270
T051 - Propel Alt 5	6,115	5,075	3,510
T052 - Propel Alt 6	7,320	6,390	5,215
T053 - Propel Alt 7	6,340	5,065	4,055

Figure 9: Policy Scenario: Operability Ranges Visualized Under Maintenance Conditions

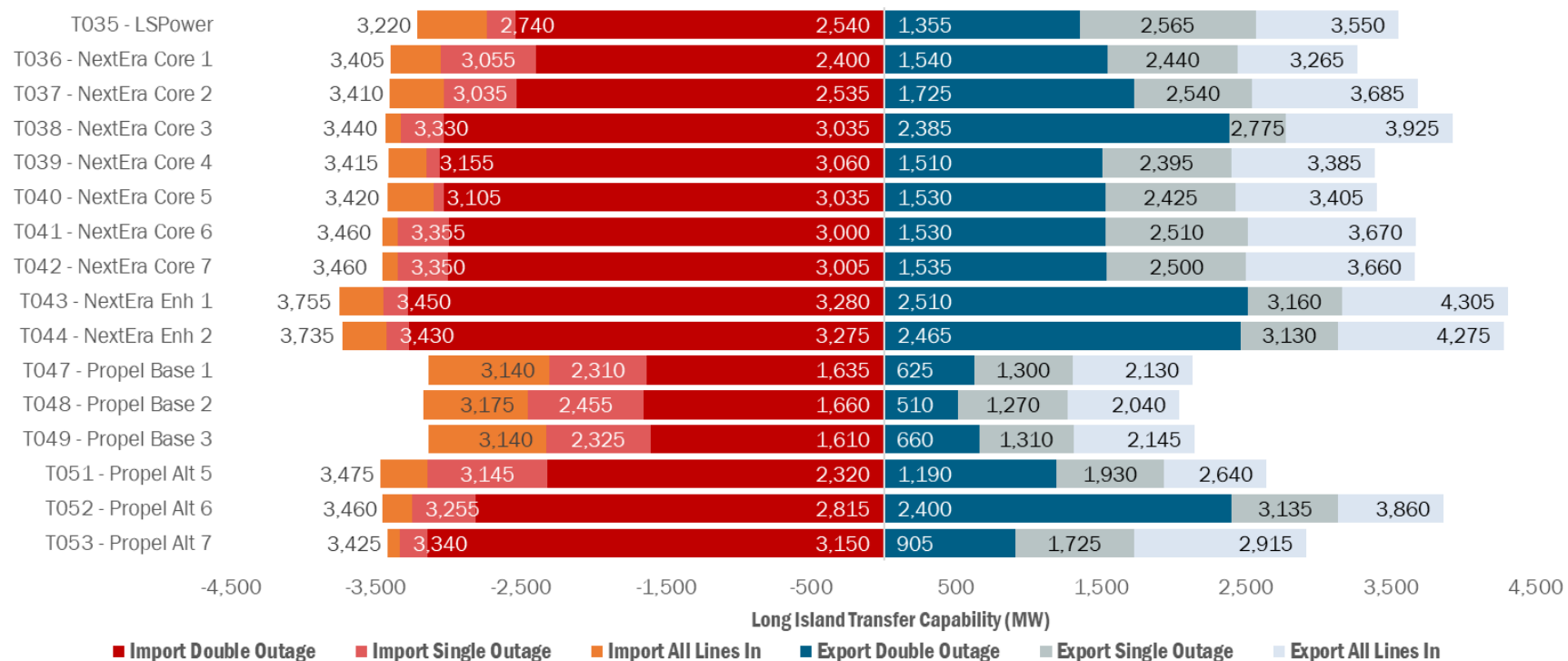


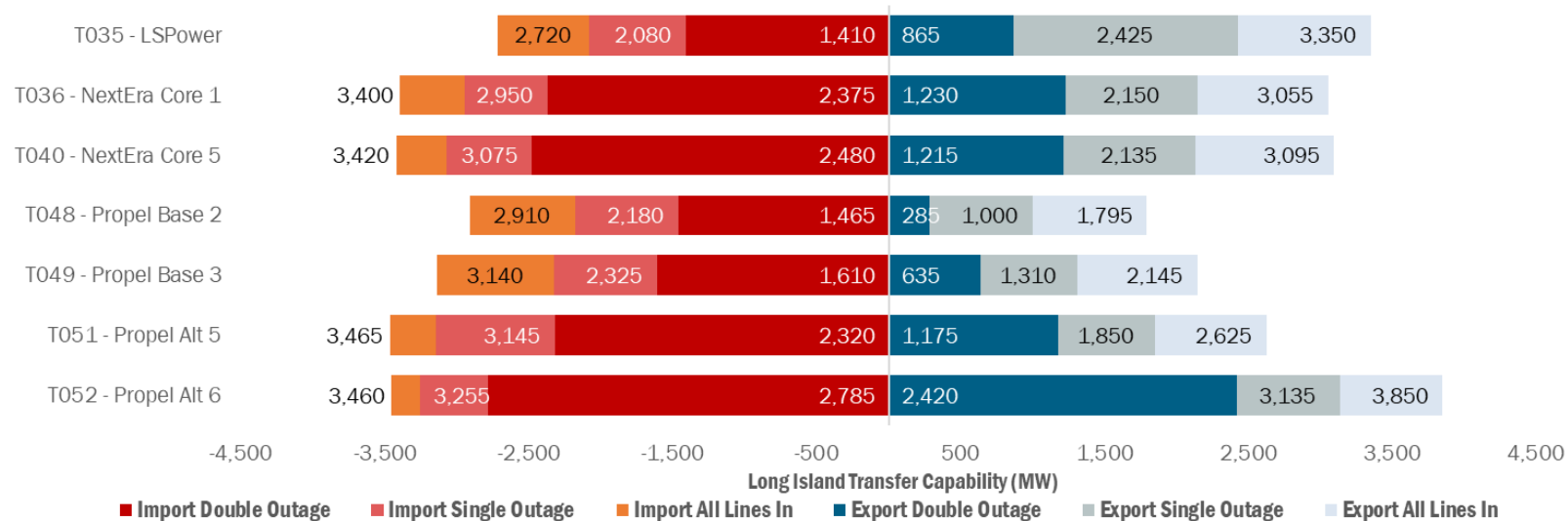
Figure 10: Policy + Barrett-VS Scenario: Long Island Import Transfer Limit Under Single and Double Maintenance Conditions (MW)

Project	Import Limits (MW)		
	No Outages	One Outage	Two Outages
T035 - LSPower	2,720	2,080	1,410
T036 - NextEra Core 1	3,400	2,950	2,375
T040 - NextEra Core 5	3,420	3,075	2,480
T048 - Propel Base 2	2,910	2,180	1,465
T049 - Propel Base 3	3,140	2,325	1,610
T051 - Propel Alt 5	3,465	3,145	2,320
T052 - Propel Alt 6	3,460	3,255	2,785

Figure 11: Policy + Barrett-VS Scenario: Long Island Export Transfer Limit Under Single and Double Maintenance Conditions (MW)

Project	Export Limits (MW)		
	No Outages	One Outage	Two Outages
T035 - LSPower	3,350	2,425	865
T036 - NextEra Core 1	3,055	2,150	1,230
T040 - NextEra Core 5	3,095	2,135	1,215
T048 - Propel Base 2	1,795	1,000	285
T049 - Propel Base 3	2,145	1,310	635
T051 - Propel Alt 5	2,625	1,850	1,175
T052 - Propel Alt 6	3,850	3,135	2,420

Figure 12: Policy + Barrett-VS Scenario: Operability Ranges Visualized Under Maintenance Conditions



In order to explore each project's ability to accommodate net-load variability in Long Island, the NYISO performed a sensitivity analysis to assess the impact of an increase in transmission constraint margin. For the transmission constraint margin sensitivity, the operations flexibility range methodology uses the same assumptions as the Barrett-Valley Stream Scenario except it assumes that all Long Island/NYCA tie lines evenly split a 600 MW transmission constraint margin across all 345 kV AC lines from Zone K to the rest of the NYCA. The NYISO employed this sensitivity to further evaluate and distinguish among the top-tier projects. The outage import and export transfer limits for the transmission constraint margin sensitivity are shown in Figures 13 and 14, respectively. This analysis did not account for re-allocating the transmission constraint margin to account for the outage(s).

Figure 13: Transmission Constraint Margin Sensitivity: Long Island Import Transfer Limit Under Single and Double Maintenance Conditions (MW)

Project	Import Limits (MW)		
	No Outages	One Outage	Two Outages
T035 - LS Power	2,200	1,770	1,410
T036 - NextEra Core 1	3,350	2,920	2,105
T040 - NextEra Core 5	3,410	2,910	2,095
T048 - Propel Base 2	2,530	1,900	1,315
T049 - Propel Base 3	2,775	2,015	1,415
T051 - Propel Alt 5	3,465	2,900	2,120
T052 - Propel Alt 6	3,460	3,255	2,785

Figure 14: Transmission Constraint Margin Sensitivity: Long Island Export Transfer Limit Under Single and Double Maintenance Conditions (MW)

Project	Export Limits (MW)		
	No Outages	One Outage	Two Outages
T035 - LS Power	3,050	2,135	615
T036 - NextEra Core 1	2,650	1,835	1,065
T040 - NextEra Core 5	2,815	1,825	1,050
T048 - Propel Base 2	1,570	910	275
T049 - Propel Base 3	1,910	1,115	500
T051 - Propel Alt 5	2,500	1,795	1,170
T052 - Propel Alt 6	3,655	2,950	2,240